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Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System

Volume 1

Moab UMTRA Project

Revision 4
April 2008

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Work Performed by the Technical Assistance Contractor Under DOE Contract No. DE-AC30-07CC60012 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

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Operations, Maintenance, and
Performance Monitoring Plan for the
Interim Action Ground Water Treatment System
Moab, Utah

MOAB UMTRA Project

Contract Number DE-AC30-07CC60012

Revision # 4

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4	April 2008	Revision 4 of DOE-EM/GJ1220, *Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System*, under Contract DE-AC30-07CC60012 supersedes and replaces sections 1 through 7 of DOE-EM/GJ220 Revision 3, dated February 2007.

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Attachments

To view the Attachments electronically please access the entire document at http://www.gjem.energy.gov/moab/.

To request a hard copy of the Attachments please send an email to: moabcomments@gjem.energy.gov or call 1–800–637–4575.

Attachment 1. Construction Drawings for Configuration 1 Wells
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Acronyms and Abbreviations

Atlas	Atlas Minerals Corporation
bgs	Below Ground Surface
cfs	Cubic Feet per Second
COC	Constituent of Concern
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
ESL	Environmental Science Laboratory
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
gals	Gallons
gpm	Gallons per Minute
HASP	Health and Safety Plan
HDPE	High-density Polyethylene
hp	Horsepower
HSP	Health and Safety Plan
IWP	Integrated Work Plan
µS/cm	Microsiemens per Centimeter
mg/L	Milligram(s) per Liter
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Unit
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
RCT	Radiological Control Technician
TDS	Total Dissolved Solid
TOC	Top of Casing
UMTRA	Uranium Mill Tailings Remedial Action

End of current text

1.0 Introduction and Background

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site near Moab, Utah (Moab site), is a former uranium-ore processing facility located approximately three miles northwest of the city of Moab in Grand County, Utah (Figure 1–1). The plant was constructed in 1956 by the Uranium Reduction Company, which operated the mill until 1962 when the assets were sold to the Atlas Minerals Corporation (Atlas). Operations continued under Atlas until 1984. When the processing operations ceased in 1984, the mill had accumulated an estimated 16 million cubic yards of uranium-mill tailings in an unlined impoundment in the floodplain of the Colorado River. The tailings pile covers approximately 130 acres, is about 0.5 mile in diameter, averages approximately 94 feet in height above ground surface, and is located about 750 feet west of the Colorado River. Atlas placed an interim cover over the tailings pile as part of decommissioning activities between 1988 and 1995. In October 2001, the title of the property and responsibility for remediation of the tailings pile and contaminated ground water beneath the site were transferred to the U.S. Department of Energy (DOE).

It has been known for years and indicated by a number of investigations, including one completed by DOE (DOE 2003a), that contaminants have leached from the tailings pile into the ground water. Several site-related contaminants have been identified, but the most pervasive and highest-concentration constituent is ammonia. DOE's studies have identified two plumes of ammonia associated with the site: a deep plume beneath the tailings pile and a shallower plume emanating from the toe of the tailings pile to the Colorado River. Ground water from the shallow plume has been demonstrated to discharge to the Colorado River and to have a localized impact on surface-water quality. Degradation of surface-water quality is of concern because of potential effects on aquatic species in the area, particularly endangered fish.

DOE has been operating an interim action to evaluate two scenarios for treating contaminated ground water and protecting the endangered fish habitat in backwater areas of the river adjacent to the site. One method is to extract contaminated ground water from a series of wells installed in the shallow plume and pump it to an evaporation pond on top of the tailings pile. The other method is to pump diverted Colorado River water into a storage pond, allow time for settlement of fines, and then, after sediment filtration, inject this water into a series of wells installed into the alluvial aquifer and/or an infiltration trench.

A brief description of the ground-water treatment system is provided below. Figure 1–2 shows the locations of existing well-field configurations, infiltration trench, and the Baseline Area, as well as observation wells and river piezometers.

DOE constructed an interim pump and treat system in 2003 to extract contaminated ground water before it discharges into the backwater areas. The initial pump and treat system consisted of a series of 10 ground-water extraction wells and an evaporation pond. Ground water is extracted at the well field located along the west bank of the Colorado River and piped to an evaporation pond constructed on top of the tailings pile for treatment. The initial portion of the well field was constructed in 2003 and is referred to as Configuration 1.

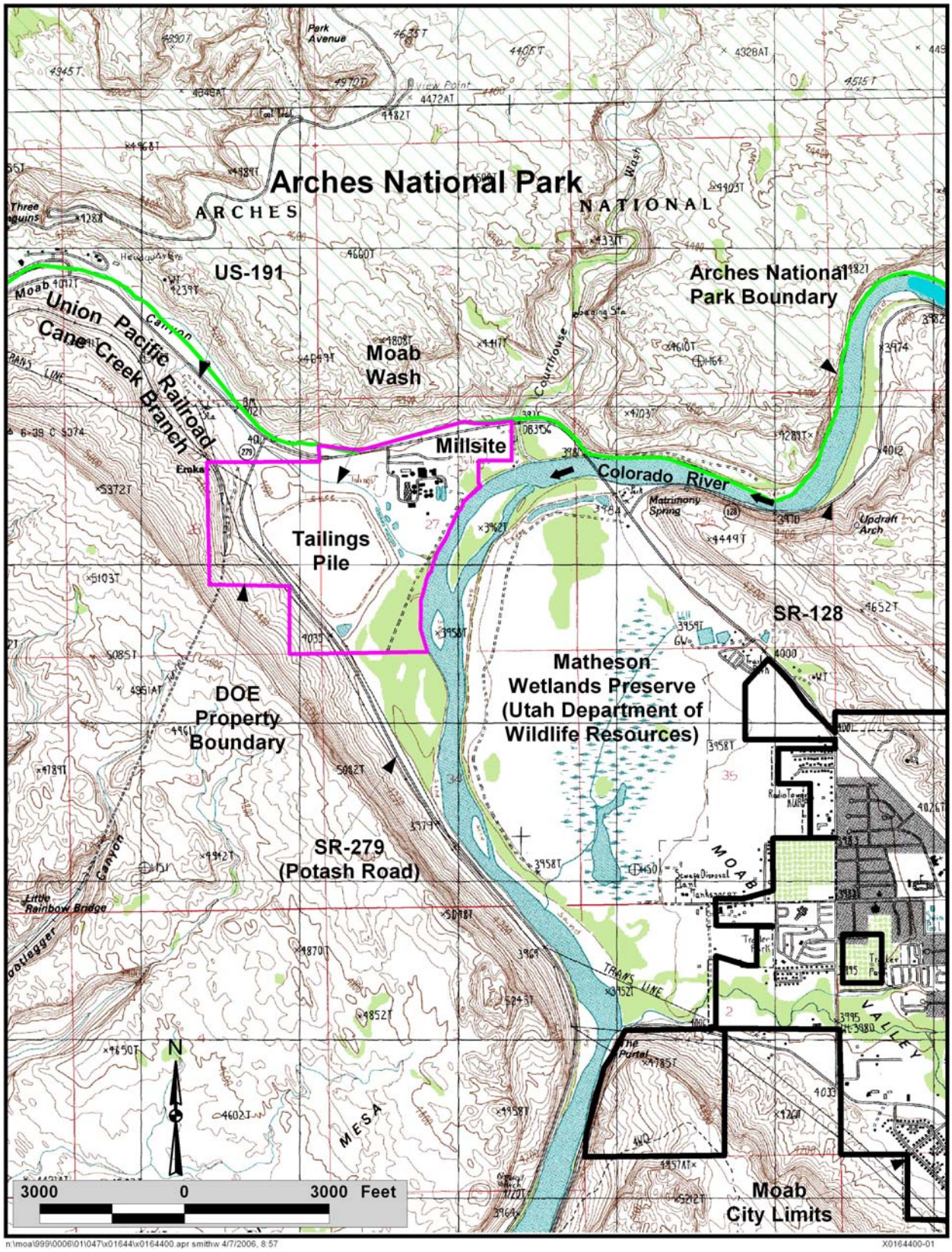


Figure 1–1. Location Map of the Moab Site and Surrounding Area

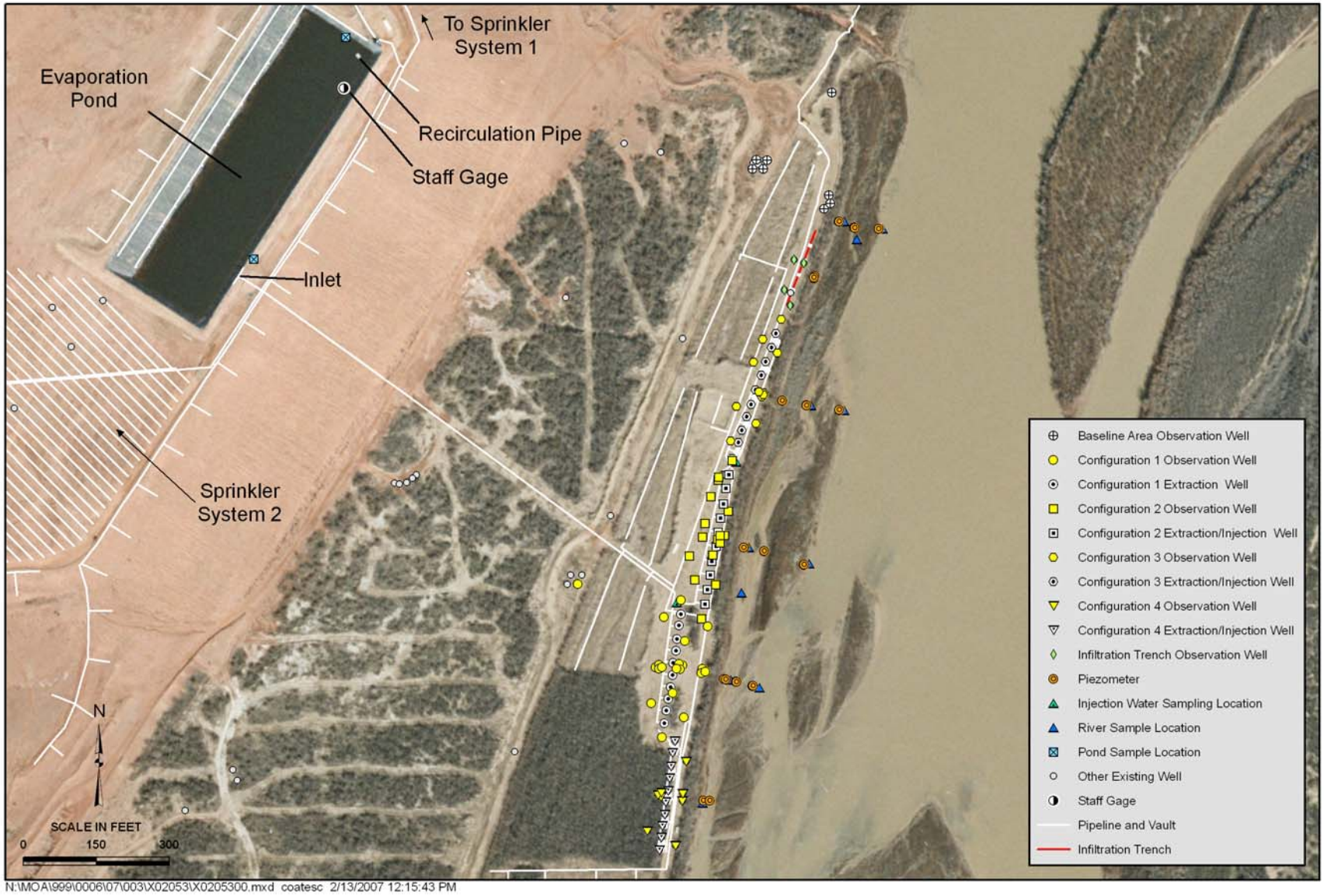


Figure 1–2. Locations of Existing Configurations 1, 2, 3, and 4, the Infiltration Trench and the Baseline Area

The interim-action well field and the treatment system were expanded in 2004. The well field was expanded by the addition of 10 dual-purpose extraction and/or fresh-water injection wells that are referred to as Configuration 2. The treatment system was expanded in 2004 and again in early 2005 by construction of a sprinkler system over 17 acres and 11 acres, respectively, on top of the tailings pile to provide additional evaporative capacity.

In late fiscal year (FY) 2005, the interim-action well field and the treatment system were expanded again. The well field was expanded by the addition of 10 dual-purpose extraction and/or fresh-water injection wells, referred to as Configuration 3. The treatment system was expanded in late 2005 and early 2006 with the installation of sprinklers along several sections of the tailings-pile crest line.

In FY 2006, the interim-action well field was expanded with another 10 dual-purpose extraction and/or fresh-water injection wells, referred to as Configuration 4. In addition, an infiltration trench was excavated to a depth of approximately 10 feet. This trench contained an approximately 150-foot length of perforated pipe and was lined with gravel. Figure 1–2 shows the location of the various configurations of the well field.

An additional area adjacent to the pile, the Baseline Area, has also been monitored. This area is outside the influence of the interim-action well field and is intended to provide data regarding natural variation of the ground-water and surface-water systems in response to changes in river stage. Several performance assessments of the extraction and injection portions of the interim actions to date have been prepared (DOE 2005a, 2005b, 2005c, 2009a). The results of those assessments will help guide the implementation of the final remedial-action system for ground water.

The current ground-water treatment system was built using a phased approach as data collected from the system was evaluated and showed the need to expand ground-water treatment at the site. Although the system consists of four well configurations, an infiltration trench, an evaporation pond, and sprinkler system, it is operated and evaluated as one entity to optimize its performance. The objectives of the ground water interim action are to:

- Protect aquatic species by reducing ammonia-contaminated ground water from discharging to backwater areas that may potentially be suitable habitat for threatened and endangered aquatic species.
- Provide performance data for use in selecting and designing a final ground-water remedy.

1.1 Background

Ground water remediation at the Moab site is aimed mostly at improving surface-water quality, particularly in areas that are potential habitat for endangered fish. Therefore, the most important processes to understand are those that relate to ground-water and surface-water interactions, such as those occurring in the hyporheic zone that underlies the river. The activities associated with the interim-action expansion are focused on improving the understanding of those interactions and on identifying ways in which the interim action can reduce ammonia concentrations in surface water.

A simple cross-section showing important features of the conceptual site model in the area where ground water is presumed to discharge to the Colorado River is shown in Figure 1–3. This figure represents baseline site conditions in the absence of active ground-water remediation.

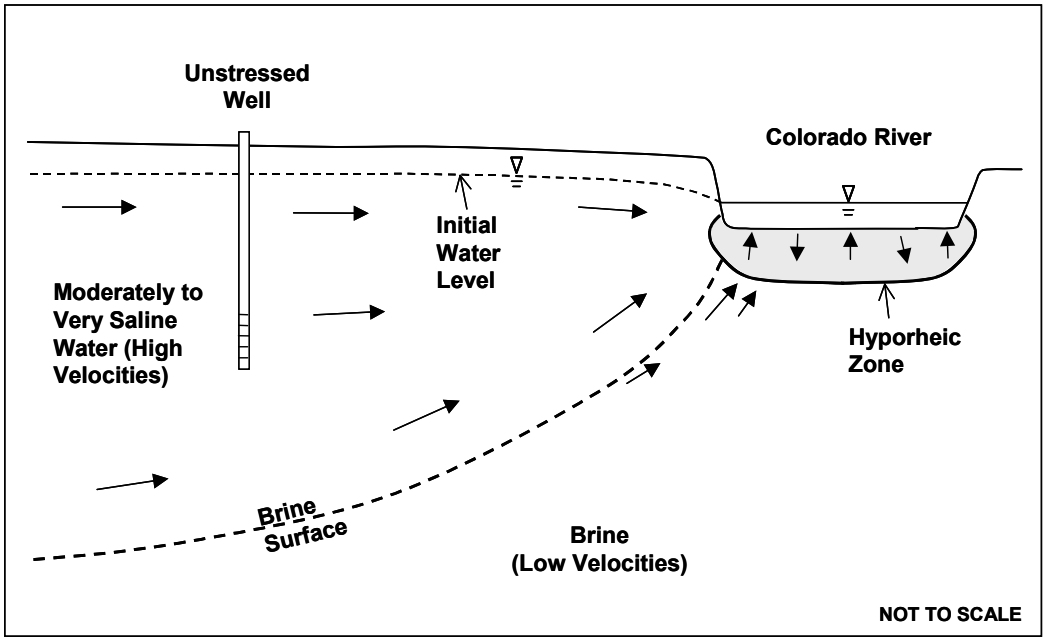


Figure 1–3. Site Conceptual Model Showing Ground Water Discharge to the Colorado River

Characterization at the site has identified two different water types in the alluvial aquifer near the river based on total dissolved solid (TDS) concentrations (DOE 2003a). The first is a relatively thin layer of water with a moderate to high salinity (TDS < 35,000 milligrams per liter [mg/L]), which overlies a deeper, thicker layer of brine (TDS > 35,000 mg/L). The boundary between the two layers, the "brine surface", is relatively sharp and is found at progressively shallower depths from the vicinity of the tailings pile toward the Colorado River. Based on shallow test-pit sampling adjacent to the river at the north end of the pile, in which all ground-water samples had concentrations of < 35,000 mg/L TDS, it is assumed that the brine surface intersects the river bottom in this area at a short distance from the river's west shore. The brine surface also generally rises closer to ground surface toward the south end of the pile and is essentially at the surface south of the southernmost extent of the pile. A seep that was observed in January 2003 during a very low stage of the river (1,820 cubic feet per second [cfs]) indicated the intersection of the brine surface with the steep bank of the river. The seep sample had a TDS concentration of > 40,000 mg/L, as estimated from specific conductance data.

The relatively sharp transition from very saline water to brine is believed to be an important feature in the alluvial aquifer for a number of reasons. It appears that the highest concentrations of ammonia—the primary constituent of concern (COC) at the site—are associated with the brine surface (DOE 2003a). Limited sampling of ground water near the river indicates increasing concentrations of ammonia from the water table to a short distance below the brine surface, and decreasing concentrations with continued depth. Because water density increases with increasing salinity, the brine surface tends to act as a barrier to flow from above; there is apparently little flow across the brine surface at locations away from the river. As a result, the two aquifer layers located above and below the brine surface tend to represent two distinct sources of ammonia discharge to the river.

Also, as a result of density differences, any active remediation that results in drawdown of the surface of the upper layer could cause upconing of the brine layer and a potential shift in the location of the brine surface. Pumping of the aquifer could therefore bring the brine closer to ground surface and affect phreatophyte vegetation. Pumping can also alter where the brine discharges to the river. One study of vegetation in the Matheson Wetlands Preserve across the river from the Moab Site attributed mortality of cottonwood trees in the preserve, in part, to increases of natural salinity in the ground water (Bellagamba 1997). It has also been hypothesized that pumping of the aquifer could cause higher concentrations of ammonia to discharge to the river at sensitive locations by raising the brine surface. Therefore, it is important to understand how the alluvial system will likely respond to the application of stresses during remedial action, particularly those associated with the interim action.

Limited data were obtained during operation of Configurations 1 and 2 in 2004 regarding response of the brine interface to extraction and injection. Additional data were collected in 2005 and 2006 for the well-field remediation wells, observation wells, and the riverbed piezometers/well points to further this objective. Some well points continue to yield insufficient water quantities for sampling purposes, and some wells that are installed at depths periodically at or below the brine surface reflect erratic concentrations of COCs.

1.2 Purpose and Objective

The purpose of this document is to specify the operating- and performance-monitoring procedures for the interim-action treatment system. This plan includes the following corresponding objectives listed in the procedures below.

Operating Procedures

The objectives of these procedures are to provide for (1) safe conduct of operations, (2) inspections, and (3) maintenance activities for both the well field and treatment system.

Performance-monitoring Procedures

The objectives of the performance monitoring is to provide necessary hydraulic and chemical data to (1) optimize the extraction, fresh-water injection, and treatment system, (2) evaluate the effectiveness in reducing ammonia concentrations discharging to the surface water by either extraction of contaminated ground water or injection of fresh water into the aquifer, (3) minimize the upconing of the salt-water interface in response to pumping the aquifer, and (4) develop and design a final ground-water remedy.

2.0 Operation Structure and Responsibilities

The Contractor is responsible to DOE for the operation and maintenance of the ground water interim-action treatment system at Moab. To accomplish this, the Contractor has assigned personnel at the Moab site to carry out the day-to-day operational activities. The names, organizational relationship, contact numbers, and reporting relationships for Contractor personnel critical to the operations and maintenance activities of the interim action are identified in Table 2–1 and described below.

Table 2–1. Selected Contractor Personnel Critical to Operations and Maintenance Activities of the Ground Water Interim Action Treatment System

Position	Location
TAC Senior Program Manager	Grand Junction
Site Manager	Moab
Ground Water Manager	Grand Junction
Project Hydrogeologist	Moab
Well Field Operator	Moab
TAC Safety/QA Manager	Grand Junction
Site Safety Coordinator	Moab
Quality Assurance	Moab

2.1 Senior Program Manager

The Moab Senior Program Manager is responsible for overall Moab program coordination and interaction with DOE. The Senior Program Manager has overall Contractor responsibility to implement the selected remedial actions.

2.2 Project Hydrogeologist

The Project Hydrogeologist is the Contractor representative that is responsible for implementation of field-data collection for performance monitoring of the interim-action treatment system. The Project Hydrogeologist is also responsible for data collection for site-wide ground-water monitoring and coordination of reporting efforts with the Ground Water Manager. The Project Hydrogeologist reports directly to the Ground Water Manager, but also coordinates activities with the Site Manager. The Project Hydrogeologist is located onsite and is responsible for oversight of the day-to-day operation, inspection, maintenance, and record keeping for the interim action. The Project Hydrogeologist is the focal point for coordination of all site activities and works closely with the Moab Site Safety Coordinator to ensure implementation of health and safety requirements. The Project Hydrogeologist will direct site personnel as necessary to assist the Well Field Operator to carry out specific tasks as specified in the following procedures. In the case of a power failure or severe storm event (electrical outage, wind or dust storm, storm causing flooding), the Project Hydrogeologist will conduct an immediate inspection. The Project Hydrogeologist will direct personnel to perform maintenance operations for the evaporative-treatment system. This includes the sprinkler system and the pumps associated with the evaporation pond. The Project Hydrogeologist is also responsible for emergency response as described in the Health and Safety Plan (HASP) (DOE-EM/GJ1038-2007).

2.3 Ground Water Manager

The Ground Water Manager reports directly to the TAC Senior Program Manager. The Ground Water Manager is responsible for the management, operation, and overall direction of the ground-water interim action. The Ground Water Manager develops and manages cost and schedules for the interim action, is the first contact and line of authority for all communications regarding operation of the interim action, and has approval authority for maintenance and field changes with technical direction provided by the Site Manager. The Site Manager reports directly to the Ground Water Manager on all aspects of the remediation system.

2.4 Ground Water System Operator

The Ground-Water System Operator is responsible for conducting periodic and routine inspections of the remediation system along with maintenance and minor repairs of the system, when necessary. The Ground-Water System Operator reports directly to the Ground Water Manager. The Ground-Water System Operator is responsible for documenting operating conditions of the system, such as flow rates, pressures, and water-quality field measurements, and maintaining an inventory of materials and supplies. The Ground-Water System Operator may also be required to conduct additional work to direct, monitor, document, and report on repair and maintenance work performed by site personnel or subcontractors that will occasionally be necessary to keep the remediation system operating correctly.

2.5 Site Safety Coordinator

The Site Safety Coordinator reports directly to the Contractor Health and Safety Manager. The Site Safety Coordinator is the primary health and safety point-of-contact for site interim-action activities, is responsible for implementing the Moab HSP, verifies compliance with health and safety requirements, and performs routine health and safety oversight of subcontractors that may occasionally work on the interim-action system.

2.6 Radiation Protection Lead

The Moab Radiation Protection Lead is the Contractor representative responsible for all site radiation health and safety issues and, together with the Site Safety Coordinator, will provide health- and safety-related technical direction to the Ground Water Manager, the Site Manager, and the Well Field Operator.

2.7 Environmental Compliance Lead

The Environmental Compliance Lead is the Contractor representative responsible for all environmental compliance issues and will provide environmental compliance-related technical direction to the Ground Water Manager, Site Manager, and the Well Field Operator and will notify the TAC Senior Program Manager in the event of a spill.

2.8 Quality Assurance Manager

The Quality Assurance Manager is the Contractor representative responsible for all quality-assurance issues and will provide quality assurance-related technical support to the Ground Water Manager, the Site Manager, and the Well Field Operator.

End of current text

3.0 Ground Water Treatment System

The focus of the interim action is to reduce discharge of contaminated ground water to potentially sensitive surface-water areas through mass removal of ammonia from the aquifer and by manipulation of ground-water flow gradients. This is accomplished by extracting contaminated ground water from or injecting diverted Colorado River water into the well field (Configurations 1, 2, 3, and 4) located between the toe of the tailings pile and the Colorado River. This is an area where the highest ammonia concentrations have been observed in the shallow basin-fill aquifer.

Extracted ground water is transmitted in an above-ground pipeline from the well field to a lined evaporation pond located on top of the tailings pile. The evaporation pond is designed to treat contaminated ground water by evaporation at an average annual rate of 15 gallons per minute (gpm). Additional treatment capacity is provided by (1) 28.4 acres covered by sprinklers that spray water from the pond over the top of the tailings pile for eventual evaporation, and (2) sprinklers that spray along 9.6 acres of the crest line of the tailings pile. In addition to ground-water treatment, the sprinkler systems provide dust control for the tailings pile. The main ground-water transmission line from the well-field area to the pond is designed to accommodate up to a total of 200 gpm.

Configuration 1 wells are for extraction only, while Configuration 2, 3, and 4 wells are dual-purpose and can operate as extraction wells or as fresh-water injection wells. The objective of fresh-water injection is to create a fresh-water mound that provides a hydraulic barrier between the ammonia plume and the river. The infiltration trench also is used for fresh-water injection along a stretch adjacent to the north end of the well field. Fresh water discharging to the near-shore backwater areas provides dilution of ammonia concentrations and thereby improves the quality of the surface water in these areas.

Details of the well field and the treatment system, including drawings and specifications, are documented in the *Moab Project Site Ground Water Interim Action Remediation Construction Specifications* (DOE 2003b) for Configuration 1. Drawings for Configuration 1 are also included as Attachment 1. Configuration 2, 3, and 4 drawings are included as Attachments 2, 3, and 4, respectively. Attachment 4 also includes drawings for the infiltration trench. Attachment 5 contains the construction details for the sprinkler system. The location of the well field, piping, and the evaporation pond is shown on Figure 3–1.

3.1 Well Field Design

This section describes the objectives for the different portions of the existing well-field system and outlines tasks associated with continued data collection and reporting. As shown on Figure 1–2, there are numerous observation wells and well points located adjacent to the existing configurations of remediation wells. There are several purposes associated with the different areas. The purpose of Baseline-Area characterization is to continue to evaluate the effects of the well-field system operation. The Baseline Area has been established to monitor the ground-water chemistry and water-level elevation changes that are not under the influence of remediation activities associated with the well field or the infiltration trench.

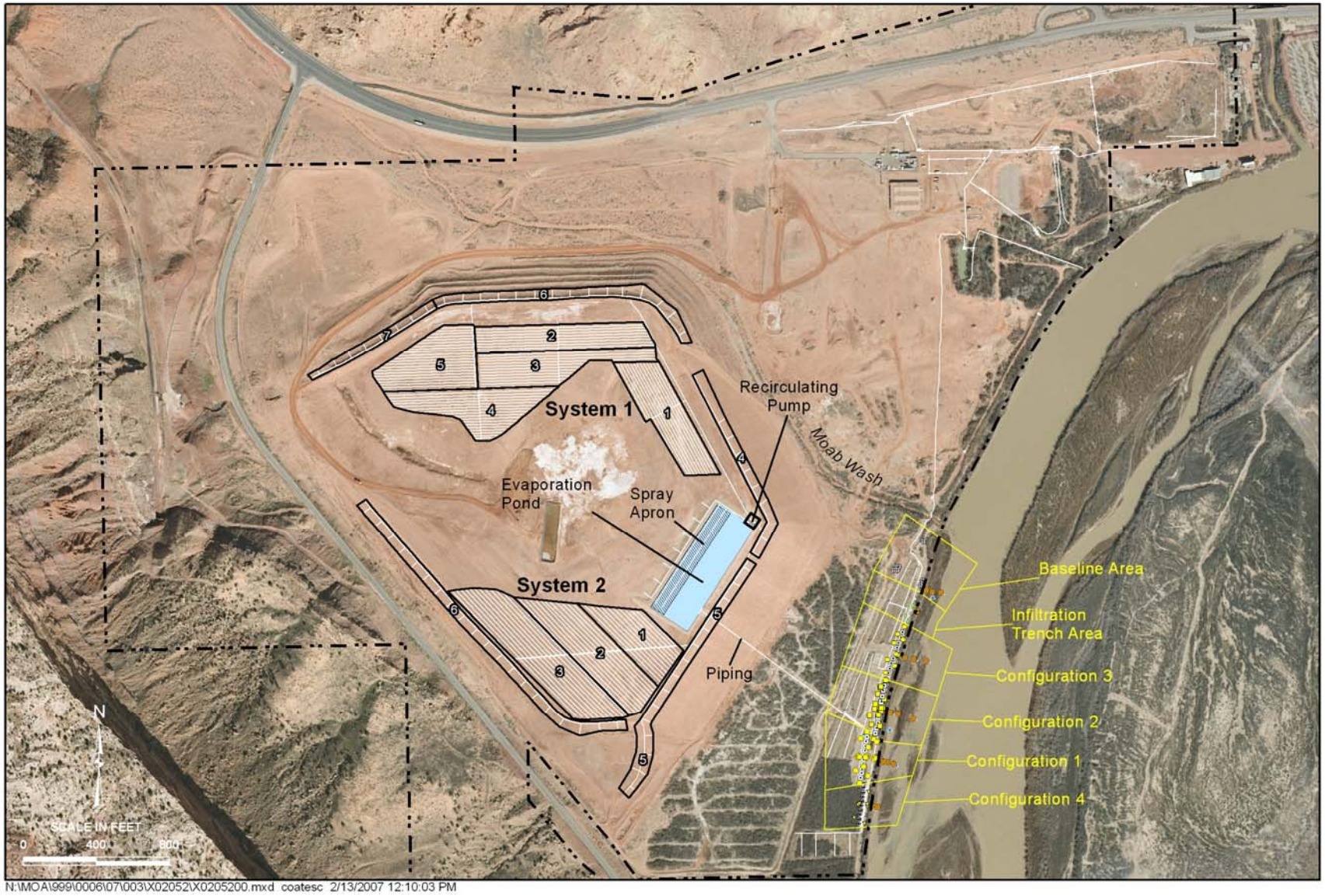
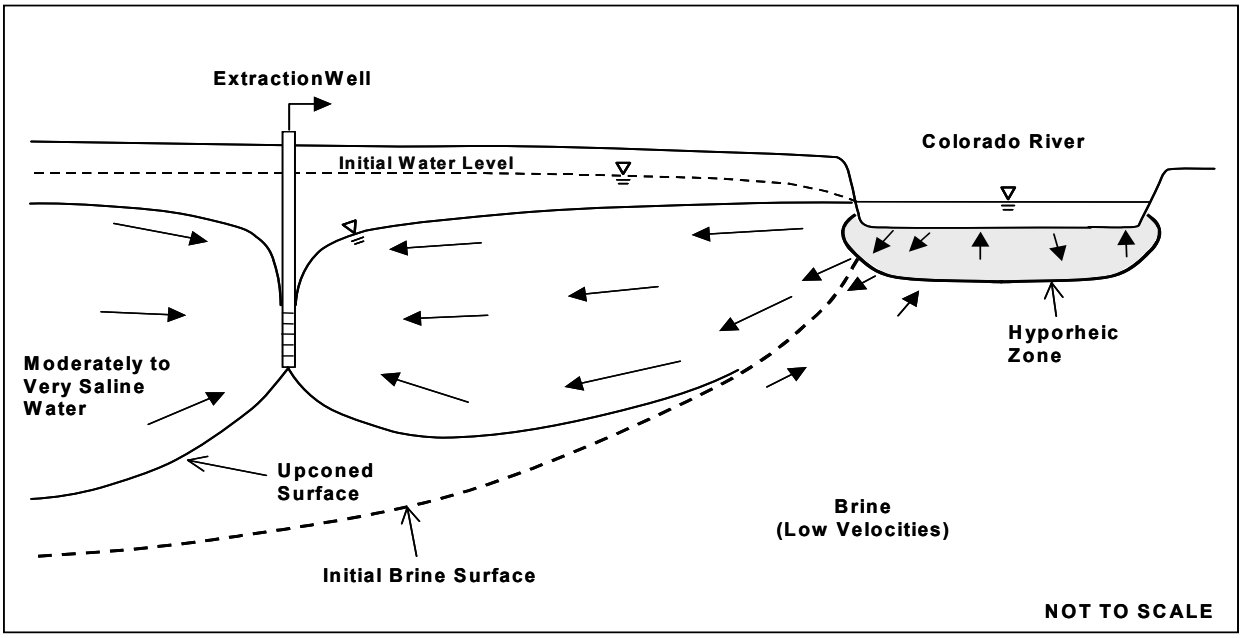


Figure 3–1. Treatment System Components

The primary purpose of operating any of the well-field configurations in extraction mode is to intercept ammonia in high-concentration areas, thereby reducing mass loading to the river. Results of system operation and monitoring indicate that extraction can pull river water into the aquifer and reverse the ground-water flow gradient, at least locally. Figure 3–2 shows this reversal conceptually. This reversal should result in reduced discharge of ammonia to near-shore areas. However, it is not clear how ground-water extraction affects the brine surface below the river and locations of ammonia discharge to the river.

Figure 3–2. General Effects of Operating Remediation Wells for the Purpose of Contaminant Mass Removal



The purpose of operating Configurations 2, 3, or 4 in injection mode is to determine the feasibility of and capacity for diluting ammonia concentrations in the backwater habitat via injection of fresh water into the aquifer close to the Colorado River. A conceptual depiction of the effects of operating remediation wells for fresh-water injection is shown in Figure 3–3. Mounding of fresh water at the injection well(s) helps provide a hydraulic barrier between the ammonia plume and the river near its western shore. At this time, the purpose of the infiltration trench is to obtain operational performance data regarding flow rates and associated ground-water mounding.

Configuration 1

The primary purpose of operating Configuration 1 is to intercept ammonia in high-concentration areas, thereby reducing mass loading to the River. Figure 3–4 shows the existing wells and piezometers associated with Configuration 1. Results of system operation and monitoring indicate that extraction can pull river water into the aquifer and reverse the ground-water flow gradient at least locally. Figure 3–2 shows this reversal conceptually. This reversal should result in reduced discharge of ammonia to near-shore areas.

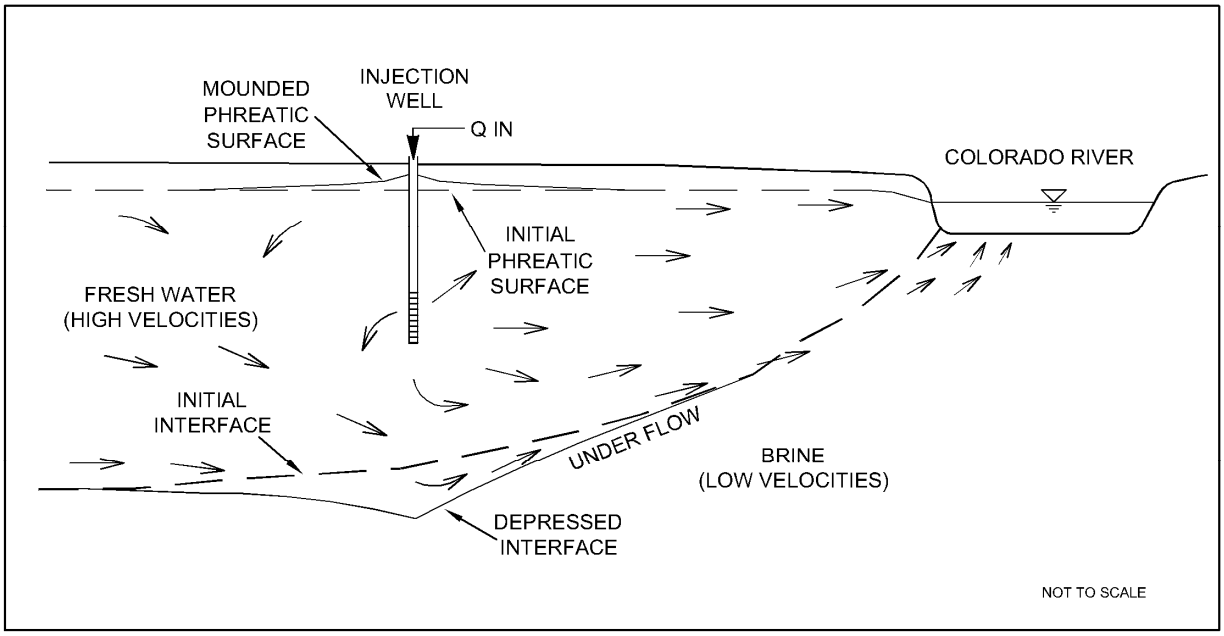


Figure 3–3. General Effects of Fresh Water Injection via Remediation Wells

Configuration 1 was constructed in 2003 and modified in 2005 with the addition of one observation well and five piezometers. Configuration 1 currently consists of a total of 10 pumping wells, 20 observation wells, and nine shallow Solinst drive-point well points (Figure 3–4). The pumping wells are located within an area approximately 75 feet wide by 250 feet long and are evenly spaced approximately every 25 feet along an axis parallel to and approximately 100 feet from the west bank of the Colorado River. The observation wells are nested in the center of the configuration approximately 15 to 20 feet on either side of the axis and at both ends. The nine well points are nested in groups of three and located in the riverbed along a line that is perpendicular to the shoreline and through the center of the configuration.

Configuration 2

The objectives of Configuration 2 when in extraction mode are the same as those for Configuration 1 and conceptually as shown in Figure 3–2.

The purpose of continued operation of Configuration 2 is to determine the feasibility and capacity of diluting ammonia concentrations in the backwater habitat via injection of fresh water into the aquifer close to the Colorado River. Figure 3–4 shows the existing wells and well points associated with Configuration 2. A conceptual depiction of the effects of operating Configuration 2 for fresh-water injection is shown in Figure 3–3. Mounding of fresh water at the injection well(s) helps provide a hydraulic barrier between the ammonia plume and the river near its western shore.

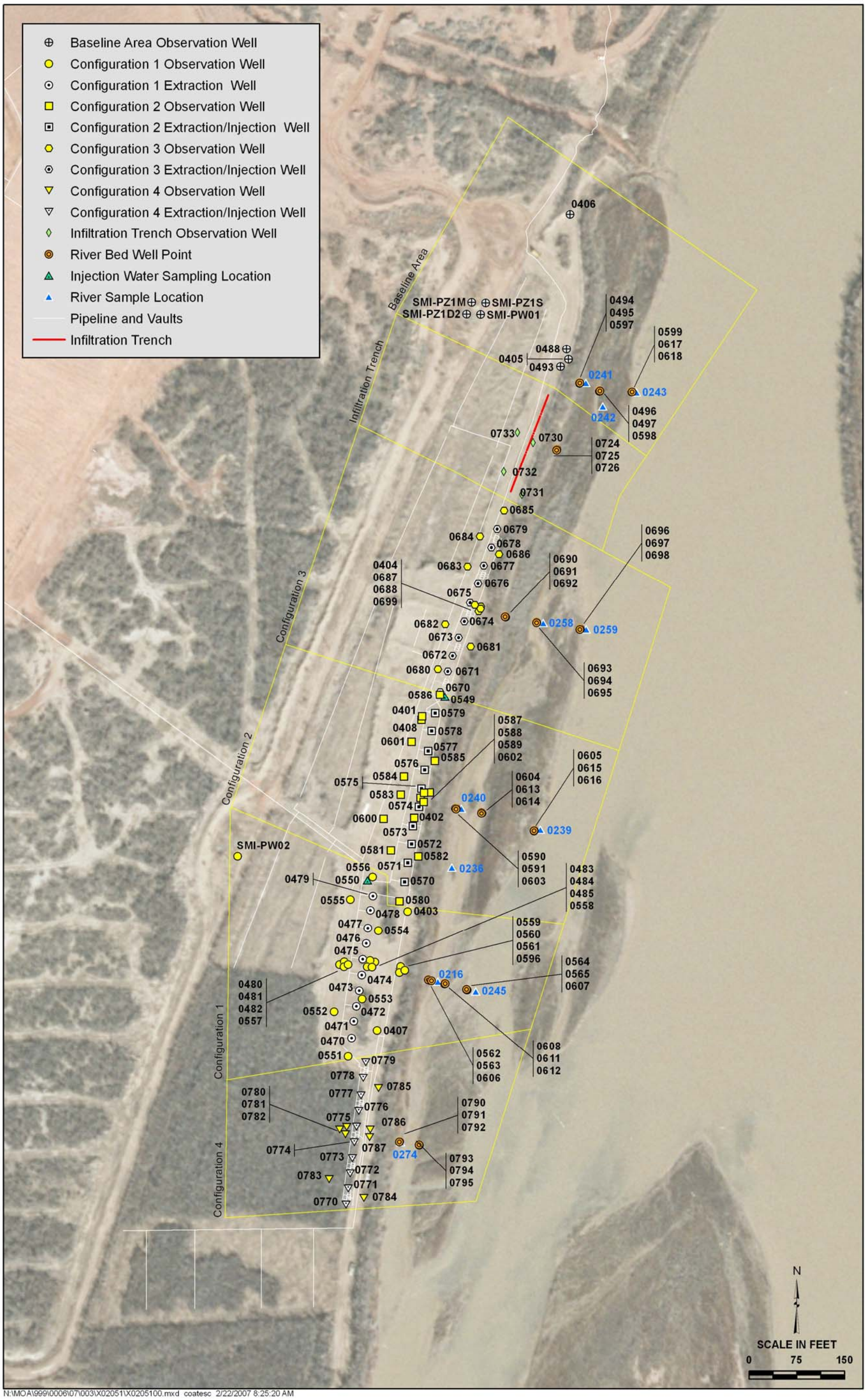


Figure 3–4. Existing Well Locations for Interim Action Well Field, Infiltration Trench, and Baseline Area

Injection of fresh water (diverted Colorado River water) into areas near the river has been demonstrated to depress the brine surface and possibly moves ground-water discharge of the ammonia plume farther toward the east than occurs under baseline conditions. The diverted Colorado River water discharging to the near-shore backwater areas provides dilution of ammonia concentrations and thereby improves the local surface-water quality. Results of ongoing system operation and monitoring indicate that injection can dilute concentrations of ammonia at least locally.

Configuration 2 was constructed in 2004 and modified in 2005 with the addition of three observation wells and five piezometers. Configuration 2 currently consists of a total of 10 dual-purpose extraction or injection wells, 16 observation wells, and nine shallow Solinst drive-point well points (Figure 3–4). The wells are located within an area approximately 75 feet wide by 300 feet long and are evenly spaced approximately every 30 feet along an axis parallel to and approximately 50 feet from the west bank of the Colorado River. The observation wells are nested in the center of the configuration approximately 15 to 20 feet on either side of the axis and at both ends. The nine well points are nested in groups of three and located in the riverbed along a line that is perpendicular to the shoreline and through the center of the configuration.

Configuration 3

The objectives of Configuration 3 when in extraction mode are the same as those for Configuration 1. The objectives of Configuration 3 when in injection mode are the same as those for Configuration 2. Figure 3–4 shows the existing wells and well points associated with Configuration 3. Based on operational experience of Configurations 1 and 2, different depths, screen lengths, and well construction details were used to improve efficiency of the system for Configuration 3. Conceptually, the system acts in a similar manner to both Configuration 1 (Figure 3–2) and Configuration 2 (Figure 3–3).

Configuration 3 was constructed in 2005 and consists of a total of 10 dual-purpose extraction or injection wells, 11 observation wells, and nine shallow Solinst drive-point well points (Figure 3–4). The wells are located within an area approximately 75 feet wide by 300 feet long and are evenly spaced approximately every 30 feet along an axis parallel to and approximately 50 feet from the west bank of the Colorado River. The observation wells are nested in the center of the configuration approximately 15 to 20 feet on either side of the axis and at both ends. The nine well points are nested in groups of three and located in the riverbed along a line that is perpendicular to the shoreline and through the center of the configuration.

Each individual well is equipped with a submersible pump with an operating range rated between 1 to 10 gpm. The pumps are equipped with thermal-overload protection and are designed to cycle every 15 minutes if the ground-water level in the well decreases below the pump intake.

Configuration 4

The objectives of Configuration 4 when in extraction mode are the same as those for Configuration 1. The objectives of Configuration 4 when in injection mode are the same as those mentioned for Configuration 2. Figure 3–4 shows the existing wells and well points associated with Configuration 4.

As was conducted for Configuration 3 based on operational experience of Configurations 1 and 2, different depths, screen lengths. and well-construction details were used to improve efficiency of the system for Configuration 4. Conceptually, the system acts in a similar manner to both Configuration 1 (Figure 3–2) and Configuration 2 (Figure 3–3).

Configuration 4 was constructed in 2006 and consists of a total of 10 dual-purpose extraction or injection wells, eight observation wells, and six shallow Solinst drive-point well points (Figure 3–4). The wells are located within an area approximately 75 feet wide by 300 feet long and are evenly spaced approximately every 30 feet along an axis parallel to and approximately 75 feet from the west bank of the Colorado River. The observation wells are nested in the center of the configuration approximately 15 to 20 feet on either side of the axis and at both ends. The six well points are nested in groups of three and located in the riverbed along a line that is perpendicular to the shoreline and through the center of the configuration.

Each individual well is equipped with a submersible pump with an operating range rated between 1 to 10 gpm. The pumps are equipped with thermal-overload protection and are designed to cycle every 15 minutes if the ground-water level in the well decreases below the pump intake.

Contaminated ground water withdrawn from pumping wells is piped to their respective collection manifold and then discharged to an evaporation pond located on top of the tailings pile. Flow rate, pressure, and cumulative volume are monitored at each well and at the collection manifolds. Valves and sampling ports are available at each well for sample collection. When remediation wells are operated in the injection mode, fresh water is pumped from an onsite storage pond and piped to each well. Flow rate and cumulative volume are monitored at each well and at the fresh-water storage pond. The same valves and sampling ports used for the extraction mode are also available for sample collection during the injection mode.

Infiltration Trench

The objectives of the infiltration trench are similar to those mentioned for Configuration 2 when operated in injection mode. At this time, the primary purpose of the trench is to obtain operational data on the amounts and flow rate of water that can be injected (infiltrated) into a subsurface trench. This data will be compared to the well configurations that are operated in injection mode.

The infiltration trench was installed in August and September 2006 and consists of approximately 160 linear feet of 4-inch polyvinyl chloride (PVC) that is buried at a depth of about 10 feet. The PVC pipe is surrounded by gravel, and a filter fabric covers the top of the gravel to help reduce silt accumulation in the gravel pack from the overlying native backfill. The infiltration trench is located parallel to and approximately 50 feet from the west bank of the Colorado River. Four observation wells are located adjacent to the trench, and three riverbed well points are also in place downgradient (to the southeast) off the middle of the trench.

Baseline Area

The Baseline Area is located upstream of the well-field configurations and the infiltration trench, as shown on Figure 1–2. Sampling will occur to better understand the characteristics and

processes in the hyporheic zone shown on Figure 3–5 (e.g., location of the brine surface, flow paths and hydraulic gradients, ammonia concentrations).

Sampling of the Baseline Area wells in 2004 was limited and did not provide adequate data to separate natural system variability (largely as a result of fluctuations in river stage) from changes caused by operation of the active remediation systems. Monitoring of the Baseline Area since 2005 has occurred more frequently, generally monthly, to provide this needed information.

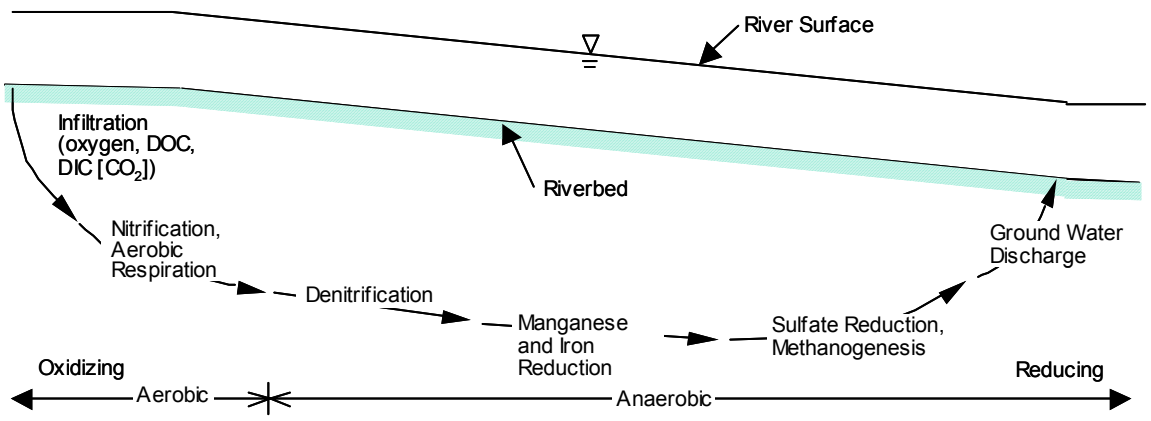


Figure 3–5. Microbially Mediated Processes in the Hyporheic Zone

3.1.1 Well Installation and Construction

In general, the subsurface in the vicinity of the well field consists of sandy silt and silty sand deposits in the uppermost 10 feet below ground surface (bgs), which is underlain by 6 feet of fine to coarse-grained sand. At a depth of approximately 16 feet bgs, a gravelly sand unit is present with thin interbedded clayey, gravelly sand units. Beginning at 29 feet bgs, the lithology consists primarily of gravelly sand. The deepest depth drilled during recent investigations at the well field was 65 feet. Lithologic logs and well-completion information for each well are presented in Appendix A (Well Boring and Construction Logs).

3.1.1.1 Baseline Area

The Baseline Area is located just to the south of the confluence of Moab Wash and the Colorado River (Figure 1–2) and is utilized as the background area for well-field performance assessment. This area is comprised of observation wells and riverbed well points installed during various times since 2000. The four SMI wells, which are screened over various depths, were installed in October 2000 using ODEX/air rotary drilling equipment. Wells 0405 and 0406 were installed with a Geoprobe rig in December 2001, and wells 0488 and 0493 were installed using an air-percussion drilling method in July 2004. The nine riverbed piezometers were initially installed in August 2004 and upgraded to well points in September 2006. These stainless steel well points consist of a 1-foot screened section and were installed using a direct push method in the same borehole as the original piezometer. Well-construction information for the Baseline Area is summarized in Table 3–1, and the logs are included in Appendix A.

Table 3–1. Summary of Well Construction Information for the Baseline Area

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0405	Observation / Shallow	1	3,966.40	15.1 – 20.0	20.3
0406	Observation / Shallow	1	3,967.90	13.2 – 18.0	18.3
0488	Observation / Deep	6	3,966.82	25.0 – 40.0	40.3
0493	Observation / Deep	6	3,966.08	45.0 – 55.0	55.3
SMI-PW01	Observation / Deep	4	3,966.40	20.1 – 60.1	60.2
SMI-PZ1D2	Observation / Deep	2	3,966.40	69.8 – 74.8	75.0
SMI-PZ1M	Observation / Deep	2	3,966.30	55.5 – 60.5	60.8
SMI-PZ1S	Observation / Shallow	2	3,966.70	13.9 – 18.9	19.1
0494	Riverbed Well Point	1	3,957.41	2.4 – 3.4	3.4
0495	Riverbed Well Point	1	3,957.41	4.6 – 5.6	5.6
0597	Riverbed Well Point	1	3,957.41	9.3 – 10.3	10.3
0496	Riverbed Well Point	1	3,955.62	2.2 – 3.2	3.2
0497	Riverbed Well Point	1	3,955.62	4.0 – 4.9	4.9
0598	Riverbed Well Point	1	3,955.62	9.1 – 10.1	10.1
0617	Riverbed Well Point	1	3,954.24	1.7 – 2.7	2.7
0618	Riverbed Well Point	1	3,954.24	5.3 – 6.3	6.3
0599	Riverbed Well Point	1	3,954.24	9.4 – 10.4	10.4

msl = mean sea level
bgs = below ground surface

3.1.1.2 Configuration 1

Configuration 1 extraction wells are installed to depths that range from approximately 21 to 25 feet bgs. Eight of the wells are screened between 10 and 20 feet bgs, and two are screened between 9 and 24 feet bgs. The 10 Configuration 1 extraction wells (0470 through 0479) and the six observation wells (0480 through 0485) shown in Figure 3–4 were installed in June 2003 using an air-hammer percussion method. An additional 11 observation wells (0551 through 0561) were installed in July 2004 using the same drilling method. Observation wells 0403 and 0407 were installed in December 2001, and four piezometers (0562 through 0565) were installed in August 2004 using a direct-push method. An additional observation well (0596) was installed in June 2005, and five piezometers (0606, 0607, 0608, 0611, and 0612) were installed in September 2005 using a direct-push method. The original open-ended piezometers were replaced in September 2006 with stainless steel, drive-point well points manufactured by Solinst. These well points have a 1-foot screened section, and they were also installed using a direct-push method in the same borehole as the original. Well-construction information for Configuration 1 is summarized in Table 3–2, and the logs are included in Appendix A.

Table 3–2. Summary of Well Construction Information for Configuration 1

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0403	Observation / Shallow	1	3,966.90	13.3 – 18.2	18.4
0407	Observation / Shallow	1	3,967.20	13.3 – 18.3	18.5
0470	Extraction / Shallow	4	3,966.56	10.3 – 19.7	21.3
0471	Extraction / Shallow	4	3,966.59	10.3 – 19.7	21.3
0472	Extraction / Shallow	4	3,966.62	10.3 – 19.7	21.3
0473	Extraction / Shallow	4	3,966.67	10.3 – 19.7	21.3
0474	Extraction / Shallow	4	3,967.02	10.3 – 19.7	21.3
0475	Extraction / Shallow	4	3,967.13	10.3 – 19.7	21.3
0476	Extraction / Shallow	4	3,967.38	10.3 – 19.7	21.3
0477	Extraction / Shallow	4	3,967.30	10.3 – 19.7	21.3
0478	Extraction / Shallow	4	3,966.82	9.6 – 23.9	25.5
0479	Extraction / Shallow	4	3,966.60	9.3 – 23.6	25.2
0480	Observation / Shallow	4	3,966.94	15.5 – 19.8	20.3
0481	Observation / Intermediate	4	3,967.01	25.4 – 29.7	31.3
0482	Observation / Deep	4	3,967.03	55.4 – 59.7	61.3
0483	Observation / Shallow	4	3,967.00	15.5 – 19.8	20.3
0484	Observation / Intermediate	4	3,967.19	25.5 – 29.8	30.3
0485	Observation / Deep	4	3,966.99	55.6 – 59.9	60.4
0551	Observation / Shallow	1	3,966.65	10.3 – 20.3	20.6
0552	Observation / Shallow	1	3,966.33	10.2 – 20.2	20.4
0553	Observation / Shallow	1	3,966.87	10.6 – 20.5	20.8
0554	Observation / Shallow	1	3,967.63	10.4 – 20.4	20.6
0555	Observation / Shallow	1	3,967.32	10.2 – 20.1	20.4
0556	Observation / Shallow	1	3,966.69	10.2 – 20.1	20.4
0557	Observation / Intermediate	6	3,967.01	35.0 – 45.0	45.9
0558	Observation / Intermediate	6	3,966.85	35.0 – 45.0	45.1
0559	Observation / Shallow	1	3,967.84	10.5 – 20.5	20.7
0560	Observation / Intermediate	6	3,966.95	30.0 – 40.0	40.4
0561	Observation / Deep	6	3,966.46	45.2 – 55.2	55.3
0562	Riverbed Well Point	1	3,953.82	1.3 – 2.3	2.3
0563	Riverbed Well Point	1	3,953.82	4.6 – 5.6	5.6
0564	Riverbed Well Point	1	3,953.50	1.2 – 2.2	2.2
0565	Riverbed Well Point	1	3,953.50	4.0 – 5.0	5.0
0596	Observation/Shallow	1	3.966.91	15.3 –25.3	25.5
0606	Riverbed Well Point	1	3.953.82	9.3 – 10.3	10.3
0607	Riverbed Well Point	1	3,953.50	9.6 – 10.6	10.6
0608	Riverbed Well Point	1	3,954.57	8.9 – 9.9	9.9
0611	Riverbed Well Point	1	3,954.57	2.2 – 3.2	3.2
0612	Riverbed Well Point	1	3,954.57	4.3 – 5.3	5.3

3.1.1.3 Configuration 2

Configuration 2 consists of alternating shallow and deep dual-purpose wells. The shallow wells are screened at depths between 15 to 30 feet bgs. The deep wells are screened at depths between 25 to 40 feet bgs. The 10 Configuration 2 wells (0570 through 0579) and the 10 observation wells (0580 through 0589) shown Figure 3–4 were installed in July 2004 using an air-hammer percussion method. Observation wells 0401, 0402, and 0408 were installed in December 2001. Four piezometers (0590 through 0593) were installed in August 2004 using a direct-push method. In June 2005, three observation wells (0600, 0601, and 0602) were installed, and in September 2005, five piezometers (0603, 0604, 0605, 0615 and 0616) were installed using a direct-push method. In addition, two piezometers (0592 and 0593) were abandoned as a result of silting and replaced with 0613 and 0614, respectively. The original open-ended piezometers were replaced in September 2006 with stainless steel, drive-point piezometers manufactured by Solinst. These well points have a one-foot screened section, and they were also installed using a direct-push method in the same borehole as the original. Well construction information for Configuration 2 wells is summarized in Table 3–3, and the logs are included in Appendix A.

3.1.1.4 Configuration 3

Configuration 3 consists of 10 dual-purpose wells. The wells are screened at depths between 15 to 45 feet bgs. The 10 Configuration 3 wells (0670 through 0679) and the 10 observation wells (0680 through 0689) shown in Figure 3–4 were installed in June and August 2005. Deep wells were installed using an air-hammer percussion method, while shallow observation wells were installed using a direct-push method. Nine piezometers (0690 through 0698) were installed in September 2005 using a direct-push method. The original open-ended well points were replaced in September 2006 with stainless steel, drive-point piezometers manufactured by Solinst. These well points have a 1-foot screened section, and they were also installed using a direct-push method in the same borehole as the original. Well-construction information for Configuration 3 wells is summarized in Table 3–4, and the logs are included in Appendix A.

3.1.1.5 Configuration 4

Configuration 4 consists of 10 dual-purpose wells. The wells are screened at depths between approximately 15 to 35 feet bgs. The 10 Configuration 4 remediation wells (0770 through 0779) and the eight observation wells (0780 through 0787) shown in Figure 3–4 were installed in May and August 2006. Deeper wells were installed using an air-rotary, casing-hammer method while shallow observation wells were installed using a direct-push method. Six well points (0790 through 0795) were installed in September 2006 using a direct-push method. They consist of a stainless-steel drive point manufactured by Solinst along with a steel riser. These well points have a 1-ft screened section. Well-construction information for Configuration 4 wells is summarized in Table 3–5, and the logs are included in Appendix A.

Table 3–3. Summary of Well Construction Information for Configuration 2

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0401	Observation / Shallow	1	3,967.70	13.0 – 17.9	18.9
0402	Observation / Shallow	1	3,967.70	13.4 – 18.3	18.5
0408	Observation / Shallow	1	3,967.80	23.0 − 7.9	28.0
0570	Dual Purpose / Shallow	6	3,967.52	15.0 – 30.0	31.3
0571	Dual Purpose / Deep	6	3,967.01	25.0 − 40.0	41.3
0572	Dual Purpose / Shallow	6	3,967.01	15.0 − 30.0	31.3
0573	Dual Purpose / Deep	6	3,967.70	25.0 − 40.0	41.3
0574	Dual Purpose / Shallow	6	3,967.30	15.0 − 30.0	31.3
0575	Dual Purpose / Deep	6	3,967.30	25.0 − 40.0	41.3
0576	Dual Purpose / Shallow	6	3,967.17	15.0 − 30.0	31.3
0577	Dual Purpose / Deep	6	3,967.59	25.0 − 40.0	41.3
0578	Dual Purpose / Shallow	6	3,967.80	15.0 − 30.0	31.3
0579	Dual Purpose / Deep	6	3,967.21	25.0 − 40.0	41.3
0580	Observation / Shallow	1	3,967.52	10.2 − 20.2	20.4
0581	Observation / Shallow	1	3,967.01	10.3 − 20.3	20.5
0582	Observation / Shallow	1	3,967.67	9.8 − 19.7	20.0
0583	Observation / Shallow	1	3,967.53	8.9 − 18.8	19.1
0584	Observation / Shallow	1	3,967.17	10.3 − 20.2	20.5
0585	Observation / Shallow	1	3,967.59	10.4 − 20.3	20.6
0586	Observation / Shallow	1	3,967.21	10.0 − 19.9	20.2
0587	Observation / Shallow	1	3,967.30	10.0 − 19.6	20.2
0588	Observation / Intermediate	6	3,967.22	24.8 − 34.8	35.0
0589	Observation / Deep	6	3,966.98	42.7 − 52.7	53.0
0590	Riverbed Well Point	1	3,953.82	1.0 – 2.0	2.0
0591	Riverbed Well Point	1	3,953.82	3.9 – 4.9	4.9
0592	Abandoned Piezometer	1	3,953.46	na	2.1
0593	Abandoned Piezometer	1	3,953.53	na	4.1
0600	Observation / Shallow	1	3,966.88	19.5 − 29.5	29.7
0601	Observation / Shallow	1	3,967.09	19. 6 − 29.5	29.7
0602	Observation / Shallow	1	3,967.57	9.5 − 19.5	19.7
0603	Riverbed Well Point	1	3,953.82	9.2 – 10.2	10.2
0604	Riverbed Well Point	1	3,955.59	7.3 – 8.3	7.8
0605	Riverbed Well Point	1	3,954.96	9.4 – 10.4	10.4
0613	Riverbed Well Point (replaces 0592)	1	3.955.59	1.2 – 2.2	2.2
0614	Riverbed Well Point (replaces 0593)	1	3.955.59	5.1 – 6.1	6.1
0615	Riverbed Well Point	1	3,954.96	1.4 – 2.4	2.4
0616	Riverbed Well Point	1	3,954.96	5.3 – 6.3	6.3

na = not applicable

Table 3–4. Summary of Well Construction Information for Configuration 3

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0670	Dual Purpose / Deep	6	3,967.05	15.7 − 45.9	46.3
0671	Dual Purpose / Deep	6	3,967.31	14.4 − 44.4	44.8
0672	Dual Purpose / Deep	6	3,967.27	15.0 − 45.0	45.4
0673	Dual Purpose / Deep	6	3,967.19	16.3 − 46.3	46.7
0674	Dual Purpose / Deep	6	3,967.11	15.1 − 45.1	45.5
0675	Dual Purpose / Deep	6	3,966.99	16.0 − 46.0	46.4
0676	Dual Purpose / Deep	6	3,967.27	15.9 − 45.9	46.3
0677	Dual Purpose / Deep	6	3,967.17	15.2 − 45.2	45.6
0678	Dual Purpose / Deep	6	3,967.11	16.3 – 46.3	46.6
0679	Dual Purpose / Deep	6	3,967.03	15.0 − 45.0	45.4
0680	Observation / Shallow	1	3,967.75	9.9 − 19.8	20.0
0681	Observation / Shallow	1	3,967.65	10.2 − 20.2	20.4
0682	Observation / Shallow	1	3,968.25	19.6 − 29.5	29.7
0683	Observation / Shallow	1	3,967.76	21.2 − 31.2	31.4
0684	Observation / Shallow	1	3,968.48	11.3 − 21.3	21.5
0685	Observation / Shallow	1	3,967.11	20.0 − 30.0	30.2
0686	Observation / Shallow	1	3,967.08	10.0 − 20.0	20.2
0687	Observation / Shallow	1	3,966.74	20.0 − 30.0	30.2
0688	Observation / Deep	6	3,966.57	30.6 − 40.6	41.0
0689	Observation / Deep	6	3,966.62	46.0 − 56.0	56.4
0690	Riverbed Well Point	1	3,957.15	3.3 – 4.3	4.3
0691	Riverbed Well Point	1	3,957.15	6.5 – 7.5	7.5
0692	Riverbed Well Point	1	3,957.15	9.7 – 10.1	10.1
0693	Riverbed Well Point	1	3,955.36	2.0 – 3.0	3.0
0694	Riverbed Well Point	1	3,955.36	4.3 – 5.3	5.3
0695	Riverbed Well Point	1	3,955.36	9.3 – 10.3	10.3
0696	Riverbed Well Point	1	3,954.50	1.3 – 2.3	2.3
0697	Riverbed Well Point	1	3,954.50	4.3 – 5.3	5.3
0698	Riverbed Well Point	1	3,954.50	9.9 – 10.3	10.3

Table 3–5. Summary of Well Construction Information for Configuration 4

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0770	Dual Purpose / Deep	6	3,968.86	14.9 – 34.8	35.2
0771	Dual Purpose / Deep	6	3,969.04	15.0 – 34.9	35.3
0772	Dual Purpose / Deep	6	3,969.21	15.2 – 35.1	35.5
0773	Dual Purpose / Deep	6	3,969.15	15.2 – 35.1	35.5
0774	Dual Purpose / Deep	6	3,968.77	15.5 – 35.4	35.8
0775	Dual Purpose / Deep	6	3,969.18	15.1 – 35.0	35.4
0776	Dual Purpose / Deep	6	3,968.97	15.2 – 35.1	35.5
0777	Dual Purpose / Deep	6	3,968.76	15.3 – 35.2	35.6
0778	Dual Purpose / Deep	6	3,968.93	15.1 – 35.0	35.4
0779	Dual Purpose / Deep	6	3,968.34	15.7 – 35.6	36.0
0780	Observation / Shallow	6	3,968.45	20.3 –30.1	30.5
0781	Observation / Deep	6	3,968.56	44.8 – 54.5	55.0
0782	Observation / Deep	6	3,968.46	31.0 – 40.8	41.2
0783	Observation / Shallow	2	3,968.82	8.6 – 18.6	19.1
0784	Observation / Shallow	2	3,968.73	9.4 – 19.4	19.9
0785	Observation / Shallow	2	3,969.24	9.6 – 19.6	20.1
0786	Observation / Shallow	6	3,968.14	20.5 – 30.3	30.7
0787	Observation / Deep	6	3,968.43	35.4 – 45.2	45.7
0790	Riverbed Well Point	1	3,953.91	2.0 – 3.0	3.0
0791	Riverbed Well Point	1	3,953.91	4.3 – 5.3	5.3
0792	Riverbed Well Point	1	3,953.91	9.3 – 10.3	10.3
0793	Riverbed Well Point	1	3,952.69	2.0 – 3.0	3.0
0794	Riverbed Well Point	1	3,952.69	4.3 – 5.3	5.3
0795	Riverbed Well Point	1	3,952.69	9.3 – 10.3	10.3

3.1.1.6 Infiltration Trench

The four observation wells (0730 through 0733) used to monitor the fresh-water mounding adjacent to the infiltration trench were installed using the Geoporobe in late May and early June 2006 and September 2006. The three riverbed well points (similar to well points installed for Configurations 1, 2, 3, and 4) were installed in November 2006. Table 3–6 summarizes the well construction information, and Appendix A contains the logs.

Table 3–6. Summary of Well Construction Information for the Infiltration Trench

Well	Well Type/ Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0730	Observation / Shallow	2	3,965.90	8.6 – 18.6	19.1
0731	Observation / Shallow	2	3,966.95	9.4 – 19.4	19.9
0732	Observation / Shallow	2	3,967.02	9.6 – 19.6	20.1
0733	Observation / Shallow	2	3,966.31	20.5 – 30.3	30.7
0724	Riverbed Wellpoint	1	3,957.50	2.4 – 3.4	3.4
0725	Riverbed Wellpoint	1	3,957.50	4.6 – 5.6	5.6
0726	Riverbed Wellpoint	1	3,957.50	9.8 – 10.5	10.5

3.1.2 Well Development

Wells were developed using standard surge and bail techniques. Development continued until the turbidity of the discharge water dropped below 10 nephelometric turbidity unit (NTU)s. On average, more than two hours was spent developing each well. The turbidity of the discharge water from some wells dropped quickly below the 10-NTU limit, which meant that limited time was required to develop those wells. Development records for each well are contained in Appendix B (Well Development Records).

3.1.3 Hydraulic Tests

3.1.3.1 Configuration 1

Step-tests were conducted at each of the Configuration 1 extraction wells after they were developed to collect hydraulic properties of the aquifer prior to operating the wells. Plots of the results obtained from the step-tests are presented in Appendix C (Step-test Plots). Pumping rates, drawdown, and calculated specific capacity for each step-test performed are presented in Table 3–7.

Specific capacities at Configuration 1 during the 3-gpm step (first step) range from 3.75 gpm/foot (wells 0476, 0478, and 0479) to 5.0 gpm/foot (wells 0470, 0473, and 0474). Comparable specific capacities for the 10-gpm step (second step) range from 2.94 gpm/foot (well 0478) to 6.25 gpm/foot (well 0470). Specific capacities during the third step had pumping rates in the 11- to 20-gpm range from 1.95 gpm/foot (well 0478) to 5.56 gpm/foot (well 0474).

3.1.3.2 Configuration 2

Step-tests were conducted at all of the Configuration 2 wells after development. These tests were designed to collect hydraulic properties of the aquifer from different vertical intervals by first simultaneously pumping all the shallow wells, then the deep wells, and then both shallow and deep wells combined. Plots of the results obtained from the tests are presented in Appendix C (Step-test Plots). Pumping rates, drawdown, and calculated specific capacity for each test performed are presented in Table 3–8.

Table 3–7. Pumping Rates, Drawdowns, and Calculated Specific Capacities for Configuration 1 Wells

Well	1st Step			2nd Step			3rd Step		
	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)
0470	3	0.6	5.00	10	1.6	6.25	20	4.8	4.17
0471	3	0.7	4.29	10	2.1	4.76	15.5	4.7	3.30
0472	3	0.7	4.29	10	2.1	4.76	15.5	4.1	3.78
0473	3	0.6	5.00	10	2.3	4.35	14	5.8	2.41
0474	3	0.6	5.00	10	1.5	6.67	15	2.7	5.56
0475	3	0.7	4.29	10	2.6	3.85	12.5	4.8	2.60
0476	3	0.8	3.75	10	3.3	3.03	11	4.8	2.29
0477	3	0.7	4.29	10	2.5	4.00	12	4.5	2.67
0478	3	0.8	3.75	10	3.4	2.94	12.5	6.4	1.95
0479	3	0.8	3.75	10	2.9	3.45	12	5.8	2.07

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

Table 3–8. Pumping Rates, Drawdown, and Calculated Specific Capacities for Configuration 2 Wells

Well	Shallow Test			Deep Test			Combination Test		
	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)
0570	1.85	12.3	0.25				1.05	13.2	0.08
0571				3.42	20.8	0.16	2.13	22.6	0.09
0572	2.23	13.1	0.17				0.84	12.9	0.07
0573				3.66	15.3	0.24	1.84	23.2	0.08
0574	1.50	13.8	0.11				0.64	14.1	0.05
0575				3.77	15.4	0.24	1.40	20.3	0.07
0576	1.34	11.4	0.12				0.83	13.5	0.06
0577				–	–	–	4.97	21.9	0.23
0578	1.27	14.3	0.09				0.43	14.8	0.03
0579				9.38	11.26	0.83	8.84	19.7	0.45

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

The deep wells produce the highest pumping rates because of the greater amount of saturated thickness available for drawdown. The shallow test was conducted over an eight-day period between September 14, 2004, and September 22, 2004. During this test, the pumping rates ranged from a minimum of 1.3 gpm to a maximum of 2.2 gpm. The deep test was conducted over a six-day period between September 8, 2004, and September 13, 2004. Pumping rates ranged from a minimum of 3.4 gpm to a maximum of 9.4 gpm. The lowest pumping rates were observed when both the shallow wells and the deep wells were operated in combination. During this test the pumping rates ranged from 0.4 gpm to 8.8 gpm.

3.1.3.3 Configuration 3

Step-tests were conducted at selected remediation wells in Configuration 3 (the plots are included in Appendix C). These tests were designed to estimate the well field hydraulic properties of the aquifer prior to the startup of long-term ground-water extraction. Mechanical problems did not allow for the completion of the tests for the first step at wells 0670, 0673, and 0675.

Specific capacities at Configuration 3 during the 5-gpm step (first step) range from 10 gpm/foot (well 0677) to 16.7 gpm/foot (well 0679). During the second step, in which more tests were completed, specific capacities range from 7.5 to 25 gpm/foot (wells 0673 and 0670, respectively). Comparable specific capacities were measured during the third step, with a range from 7.4 to 17.9 gpm/foot (again wells 0673 and 0670, respectively). Pumping rates, measured drawdown, and the calculated specific capacity for each test performed are presented in Table 3–9.

Table 3–9. Pumping Rates, Measured Drawdown, and Calculated Specific Capacities for Configuration 3 Remediation Wells

Well	1st Step			2nd Step			3rd Step		
	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)
0670	na	na	na	10	0.4	25.0	25	1.4	17.9
0673	na	na	na	15	2.0	7.5	25	3.4	7.4
0675	na	na	na	10	1.0	10.0	20	2.5	8.0
0677	5	0.5	10.0	10	0.6	16.7	20	1.5	13.3
0679	5	0.3	16.7	10	1.3	7.7	20	1.6	12.5

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

3.1.3.4 Configuration 4

Step-tests were conducted at selected wells in Configuration 4 (Appendix C). As with the other well field configurations, these tests following development were designed to collect hydraulic properties of the aquifer prior to operating the wells. Unlike other step tests conducted at the well field, these tests were completed after all piping, pumps, and flow meters were installed.

The well 778 step-test had to be completed while adjacent well 779 was pumping at a rate of approximately 6 gpm. All other tests were conducted with no adjacent wells actively pumping. As a result, the specific capacity results for 778 are considerably lower compared to the other results obtained from other tests. The pump/control box for the pump installed in well 779 was not operating properly during the test, and the results may not be representative.

Excluding the 778 and 779 test data, the specific capacities of the remediation wells tested at Configuration 4 during the 3-gpm step (first step) range from 12.0 gpm/foot (wells 0772 and 0776) to 17.6 gpm/foot (well 0770). Comparable specific capacities for the 5-gpm step (second step) range from 11.4 gpm/foot (well 0772) to 18.5 gpm/foot (well 0770). Specific capacities during the third step that had a pumping rate of 10 gpm range from 11.5 gpm/foot (well 0772) to 17.2 gpm/foot (well 0770). Pumping rates, drawdown, and calculated specific capacity for each test performed are presented in Table 3–10.

Table 3–10. Pumping Rates, Drawdown, and Calculated Specific Capacities for Configuration 4 Remediation Wells

Well	1st Step			2nd Step			3rd Step		
	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)
0770	3	0.17	17.6	5	0.27	18.5	10	0.58	17.2
0771	3	0.18	16.7	5	0.31	16.1	10	0.68	14.7
0772	3	0.25	12.0	5	0.44	11.4	10	0.87	11.5
0773	3	0.21	14.3	5	0.34	14.7	10	0.68	14.7
0776	3	0.25	12.0	5	0.4	12.5	10	0.81	12.3
0778	3	0.64	4.7	5	1.13	4.4	8	1.87	4.3
0779	3	0.34	8.8	5	0.53	9.4	6	0.63	9.5

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

3.1.4 Initial Well Field Parameters and Analytical Results

3.1.4.1 Configuration 1

The initial well development data that can be used to evaluate the interim action's effectiveness in reducing ammonia concentrations in the backwater areas was collected prior to operating the system. Two rounds of sampling and analysis were conducted at Configuration 1 to establish baseline physical and geochemical characteristics of the ground water.

The first round consisted of collecting ground-water samples from the 10 extraction wells and from the six observation wells. A total of three to six samples were collected from each well at approximately every 2 feet in depth across the saturated portion of the screen interval using a peristaltic pump. Field measurements were performed for temperature, specific conductance, and pH with an YSI 6920 monitoring instrument to profile vertical changes in water quality. Measurements were recorded after the intake line was purged to ensure the sample was representative and after the field parameters stabilized. Field parameters for the vertical profile sampling from the extraction and observation wells are presented in Table 3–11 and Table 3–12, respectively.

Ground-water samples collected using a peristaltic pump from the observations wells at the approximate mid-point of the saturated portion of the screen interval were filtered and submitted to the Environmental Science Laboratory (ESL) in Grand Junction, Colorado, for determination of density, TDS, total ammonia as nitrogen, chloride, nitrate, sulfate, and uranium. These laboratory results are presented in Table 3–13. All the data from this first sampling round was collected July 1, 2003, after the wells were fully developed, but prior to performing the aquifer step-tests.

Table 3–11. Vertical Profile Field Parameter Measurement Results for Extraction Wells in Configuration 1

Well	Sample Date	Static WL Below TOC (ft)	Screen Interval (ft bgs)	Sample Depth (ft bgs)	Temperature (˚C)	Specific Conductance (µS/cm)	pH
0470	7/1/03	12.78	10.3 – 19.7	13.5	15.8	20,740	6.9
				15	15.7	24,630	6.88
				17	15.7	29,010	6.91
				19	15.7	33,800	6.94
0471	7/1/03	12.90	10.3 – 19.7	13.5	15.7	19,130	6.81
				15	15.9	24,210	6.89
				17	15.8	29,740	6.95
				19	15.6	30,660	6.97
0472	7/1/03	12.91	10.3 – 19.7	13.5	15.8	20,240	6.8
				15	15.7	22,910	6.87
				17	15.6	25,640	6.89
				19	15.6	26,280	6.89
0473	7/1/03	12.92	10.3 – 19.7	13.5	16.1	17,650	6.73
				15	15.8	25,080	6.84
				17	15.9	28,490	6.83
				19	15.7	29,340	6.86
0474	7/1/03	13.24	10.3 – 19.7	13.5	16	18,010	6.73
				15	15.9	25,560	6.88
				17	15.8	29,140	6.91
				19	15.6	30,960	6.88
0475	7/1/03	13.31	10.3 – 19.7	13.5	16.1	21,430	6.8
				15	16	28,030	6.8
				17	15.8	30,190	6.88
				19	15.7	33,580	6.87
0476	7/1/03	13.4	10.3 – 19.7	14	16.2	21,450	6.75
				15	16.2	27,100	6.74
				17	15.9	33,940	6.81
				19	16	37,260	6.89
0477	7/1/03	13.22	10.3 – 19.7	13.5	16.6	19,640	6.74
				15	16.4	23,720	6.79
				17	16.1	29,250	6.81
				19	16.3	40,320	6.79
0478	7/1/03	13.34	9.6 – 23.9	13.5	16	18,630	6.82
				15.5	15.8	21,610	6.87
				17.5	16.4	25,440	6.93
				19.5	16.3	31,370	6.91
				21.5	16.1	31,520	6.89
				23.3	15.8	31,590	6.9
0479	7/1/03	12.91	9.3 – 23.6	13.5	17.2	19,370	6.97
				15.5	16	19,800	6.83
				17.5	15.8	21,650	6.86
				19.5	15.7	25,580	6.91
				21.5	15.6	27,660	6.93
				23.5	15.5	28,020	6.93

Static WL = Static Water Level below top of casing (TOC) measured on 7/1/2003. TOC elevation is 2-ft above ground level; ft bgs = feet below ground surface.

Table 3–12. Vertical Profile Field Parameter Results for Observation Wells in Configuration 1

Well	Sample Date	Static WL Below TOC (ft)	Screen Interval (ft bgs)	Sample Depth (ft bgs)	Temperature (°C)	Specific Conductance (µS/cm)	pH
0480	7/1/03	14.68	15.5 – 19.8	16	15.9	32,930	7.07
				17.5	15.4	33,970	7.09
				19	15.5	34,110	7.08
0481	7/1/03	14.62	25.4 – 29.7	26	18.5	34,750	7.01
				27.5	17.6	34,750	7
				29	17.2	34,780	7.01
0482	7/1/03	15.73	55.4 – 59.7	56	16.6	110,100	6.92
				57.5	16.5	110,500	6.9
				59	16.4	110,200	6.9
0483	7/1/03	15.06	15.5 – 19.8	16	16.1	25,530	7.04
				17.5	15.9	28,060	6.98
				19	15.8	30,660	6.96
0484	7/1/03	15.22	25.5 – 29.8	26	16.9	35,230	7.06
				27.5	16.8	35,360	7.05
				29	16.6	35,650	7.04
0485	7/1/03	15.34	55.6 – 59.9	56	16.1	110,400	6.91
				57.5	16	110,700	6.91
				59	16.1	111,400	6.92

Static WL = Static Water Level below top of casing (TOC) measured on 7/1/2003. TOC elevation is approximately equal to ground level;
ft bgs = feet below ground surface.

Table 3–13. Initial Sampling Laboratory Results for the Observation Wells in Configuration 1

Well	Sample Date	Sample Depth (ft bgs)	Density (g/cm^3)	TDS (mg/L)	NH_3-N (mg/L)	Cl (mg/L)	NO_3 (mg/L)	SO_4 (mg/L)	U (mg/L)
0480	7/1/03	17.5	1.0157	22,503	1,100	6,224	115	10,594	4.854
0481	7/1/03	27.5	1.0169	25,978	900	8,165	99	10,955	2.850
0482	7/1/03	57.5	1.0556	85,250	800	47,023	<100	7,224	0.674
0483	7/1/03	17.5	1.0124	20,194	800	4,979	262	10,017	4.211
0484	7/1/03	27.5	1.0173	26,038	900	8,139	106	11,085	4.300
0485	7/1/03	57.5	1.0572	86,260	500	46,987	<100	6,981	0.612

ft bgs = feet below ground surface; TDS = total dissolved solids; NH_3 = Total Ammonia as Nitrogen; Cl = Chloride; NO_3 = Nitrate; SO_4 = Sulfate, g/cm^3 = gallons per cubic centimeter; µS/cm = microsiemens per centimeter; mg/L = milligrams per liter.

Vertical profile data presented in Table 3–11 and Table 3–12 indicate that specific conductance increases with increasing depth at each well location. This trend was expected based on previous investigations completed at the site (DOE 2003a). In general, the specific conductance of the ground water collected from most of the extraction wells ranges from approximately 18,000 microsiemens per centimeter (µS/cm) (at the top of the saturated zone) to 33,000 µS/cm (at a depth of about 19 feet bgs), though a few wells exceed the high end of this range.

For example, the specific conductance of the ground water contained within well 0476 increased from 33,940 µS/cm at a depth of 17 feet bgs to 37,260 µS/cm at 19 feet bgs. Well 0477 showed a similar result (29,250 to 40,320 µS/cm over the same depths). Both of these wells are located at the northern portion of Configuration 1, suggesting the brine interface is at a slightly higher elevation than at the southern end.

Ammonia concentrations measured in samples collected from the observation wells range from 500 mg/L to 1,100 mg/L near the center of the configuration as evidenced by the data presented in Table 3–13. The highest ammonia concentrations are from the water samples collected at 17.5 feet bgs. Concentrations also appear to be relatively higher for the upgradient (west) observation wells (0480, 0481, and 0482) than for the downgradient wells (0483, 0484, and 0485).

The second round of sampling and analysis was conducted July 2 and July 3, 2003, during the aquifer step-tests (Section 3.1.3). All ground-water samples were collected during these step-drawdown tests using a suction-lift pump with the intake set at 18 feet bgs. Ground-water samples were collected from the extraction-well discharge at the beginning and end of each test, and field measurements were performed for temperature, specific conductance, and pH with an YSI 6920 instrument. These field-parameter measurement results are presented in Table 3–14. The ground-water sample collected from each extraction well at the end of the three-gpm step (first step) was filtered and submitted to the ESL in Grand Junction, Colorado, for determination of density, TDS, total ammonia as nitrogen, chloride, nitrate, sulfate, and uranium. These laboratory results are presented in Table 3–15.

Results presented in Table 3–14 indicate that a measurable increase in specific conductance typically resulted from an increase in pumping rate, although the percentage of increase was relatively minor. On average, the specific conductance increased approximately 3,000 µS/cm from the beginning of the first step to near the end of the third step, which represents an approximate 10 percent increase. These short-term tests, while they cannot be used to predict long-term response to pumping the aquifer, do suggest minimal brine upconing may occur at increased pump rates for which the system was designed (1 to seven gpm).

3.1.4.2 Configuration 2

Initial Configuration 2 data were collected in August 2004 after the remediation wells (dual purpose extraction or injection) were developed. Ground water samples were collected from each remediation well from three different depths (16, 23, and 29 feet bgs from shallow wells 0570, 0572, 0574, 0576, and 0578; and 26, 33, 39 feet bgs from deep wells 0571, 0573, 0575, 0577, and 0579). Ground water samples from observation wells 0588 and 0589 were collected at two depths (26 and 34 feet bgs and 44 and 52 feet bgs, respectively).

Similar to the sampling associated with Configuration 1, these samples were collected using micropurge techniques using a peristaltic pump and downhole tubing. Field parameters were measured using a YSI 6920 instrument, and the samples were submitted to Paragon Analytical Laboratory for ammonia, chloride, sulfate, TDS, and uranium analysis. A partial summary of the analytical results (field parameters and ammonia, TDS, and uranium concentrations) is presented Table 3–16.

Table 3–14. Results of Baseline Field Parameter Measurements on Samples Collected from Configuration 1 Extraction Wells During the Aquifer Step-Tests

Well	Test Date	Static WL (ft bgs)	1st Step[h]						2nd Step[i]						3rd Step					
			Beginning of Step			End of Step			Beginning of Step			End of Step			Beginning of Step			End of Step		
			T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH
0470[a]	7/2/03	12.83	18.5	26,320	6.86	17.8	27,140	6.75	15.8	27,060	6.76	15.8	27,450	6.75	15.4	29,970	6.76	15.4	29,330	6.76
0471[b]	7/2/03	13.08	18.4	27,930	6.81	18.2	28,270	6.79	16.1	29,160	6.79	16.2	29,180	6.72	15.7	31,290	6.74	15.7	30,700	6.63
0472[b]	7/2/03	13.19	18.2	23,690	6.67	18	24,110	6.66	16.2	24,960	6.67	16.2	25,160	6.59	15.8	26,820	6.57	15.8	26,360	6.54
0473[c]	7/2/03	13.12	20.2	24,770	6.5	18.6	24,710	6.51	15.9	25,860	6.44	15.9	25,620	6.43	15.5	27,250	6.46	15.5	27,070	6.45
0474[d]	7/2/03	13.45	16.8	25,260	6.61	16.8	25,420	6.66	15.5	25,390	6.71	15.5	25,470	6.74	15.2	26,220	6.77	15.2	26,120	6.78
0475[e]	7/3/03	13.5	17.33	25,010	6.77	17.5	24,990	6.77	15.6	26,920	6.8	15.8	26,480	6.8	na	na	na	15.7	26,970	6.8
0476[f]	7/3/03	13.66	17.5	25,110	6.76	17.9	25,200	6.74	15.9	26,770	6.77	16.1	26,360	6.77	16.2	26,430	6.81	na	na	na
0477[g]	7/3/03	13.46	18	25,220	6.73	18.9	25,240	6.77	16.1	26,620	6.72	16.2	26,680	6.65	15.9	27,930	6.7	16	27,260	6.63
0478[e]	7/3/03	12.84	18.6	22,510	6.72	18.5	23,040	6.68	16.2	24,500	6.68	16.2	24,380	6.68	15.9	25,110	6.69	16	25,170	6.7
0479[g]	7/3/03	12.67	18.2	21,350	6.69	17.9	22,280	6.65	16.1	23,460	6.63	16.1	23,770	6.64	15.9	24,640	6.65	16.1	24,340	6.68

[a]3rd step completed at 20 gpm
[b]3rd step completed at 15.5 gpm
[c]3rd step completed at 14 gpm
[d]3rd step completed at 15 gpm
[e]3rd step completed at 12.5 gpm
[f]3rd step completed at 11 gpm
[g]3rd step completed at 12 gpm
[h]1st step conducted at 3 gpm
[i]2nd step conducted at 10 gpm
T = Temperature; SC = Specific Conductance; beginning of step data collected within first 5 min of step; end of step data collected within last 5 min of step; na = data not available

Table 3–15. Results of Initial Laboratory Analysis on Samples Collected from Configuration 1 Extraction Wells at the End of the 3 gpm Aquifer Step-Test

Well	Sample Date	Density (g/cm3)	TDS (mg/L)	NH_3-N (mg/L)	Cl (mg/L)	NO_3 (mg/L)	SO_4 (mg/L)	U (mg/L)
0470	7/2/2003	1.0149	20,387	1,000	5,357	195	10,023	3.741
0471	7/2/2003	1.0142	21,061	950	5,902	145	10,038	3.360
0472	7/2/2003	1.0125	18,434	850	4,403	166	9,461	3.503
0473	7/2/2003	1.0131	18,856	700	4,507	184	9,721	4.163
0474	7/2/2003	1.0124	19,372	850	4,774	164	9,832	4.086
0475	7/3/2003	1.0134	19,471	800	4,822	182	9,975	3.868
0476	7/3/2003	1.0139	19,203	1,050	4,755	125	9,865	3.595
0477	7/3/2003	1.0142	20,168	700	4,821	90	10,062	4.484
0478	7/3/2003	1.0132	18,226	650	3,669	116	9,872	3.917
0479	7/3/2003	1.0134	17,640	700	3,424	110	9,797	5.229

Note: The pump intake was set at a depth of 18 ft bgs at each location.
TDS = total dissolved solids; NH_3 = Total Ammonia as Nitrogen; Cl = Chloride;
NO_3 = Nitrate; SO_4 = Sulfate; U = Uranium; g/cm^3 = grams per cubic centimeter; mg/L = milligrams per liter.

Table 3–16. Summary of Configuration 2 Remediation Wells and Observation Wells 0588 and 0589 Field Parameter Data and Initial Concentration of Ammonia, TDS, and Uranium

Location	Date	Depth to Water (ft btoc)	Sample Depth (ft bgs)	Field Parameters			Analytical Results		
				Temp (°C)	Spec Cond (µS/cm)	pH	NH_3-N (mg/L)	TDS (mg/L)	U (mg/L)
0570	8/18/2004	15.36	16	17.44	19,230	6.71	510	15,000	2.7
			23	16.86	69,877	6.7	1,700	55,000	1.9
			29	16.55	75,061	6.75	1,700	56,000	1.9
0571	8/17/2004	14.97	26	19.78	75,769	6.7	1,700	52,000	1.7
			33	17.3	82,740	6.67	1,600	57,000	1.7
			39	17.37	88,435	6.6	1,600	61,000	1.8
0572	8/17/2004	15.16	16	18.88	39,744	6.7	970	29,000	2.5
			23	17.83	55,360	6.69	1,200	43,000	2.2
			29	17.46	62,420	6.67	1,200	48,000	2.3
0573	8/17/2004	15.15	26	19.38	55,630	6.69	1,000	40,000	2.6
			33	18.18	63,666	6.7	1,100	46,000	2.3
			39	17.26	66,592	6.66	1,200	53,000	2.1
0574	8/18/2004	14.76	16	18.22	26,630	6.69	710	21,000	2.3
			23	18.38	56,030	6.81	1,000	40,000	2.5
			29	18.26	58,430	6.78	1,100	41,000	2.6
0575	8/18/2004	15.10	26	19.51	55,006	6.77	1,200	39,000	2.5
			33	18.33	56,086	6.76	1,100	42,000	2.3
			39	17.64	63,816	6.72	1,200	48,000	2.3
0576	8/6/2004	14.28	16	16.9	18,470	6.76	520	14,000	2.1
			23	17.2	40,058	6.86	1,300	29,000	2.8
			29	17.4	49,312	6.83	1,300	35,000	2.8
0577	8/5/2004	14.50	26	23.1	31,608	6.88	1,200	24,000	3.1
			33	22.4	41,282	6.84	1,200	29,000	2.8
			39	19.8	56,044	6.81	960	37,000	2.5
0578	8/5/2004	14.65	16	23.8	24,024	6.82	840	19,000	2.6
			23	23.1	27,880	6.84	1,000	21,000	3
			29	22.6	29,929	6.85	1,100	23,000	3.2
0579	8/5/2004	14.12	26	18.9	21,502	6.79	620	17,000	2.4
			33	18.7	22,970	6.81	700	17,000	2.4
			39	19.5	28,791	6.86	1,100	23,000	3.1
0588	8/18/04	16.46	26	18.20	53,910	6.75	1,200	40,000	2.8
			34	18.54	57,740	6.75	1,100	43,000	2.6
0589	8/18/04	16.62	44	20.82	75,649	6.73	1,400	59,000	0.001
			52	19.93	88,481	6.67	1,300	71,000	0.001

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

The vertical profile data indicate the ammonia and TDS concentrations increase with increasing depth, as expected based on previous investigations (DOE 2003a). The TDS concentrations for the shallow wells ranged from 14,000 mg/L (well 0576 from 16 feet bgs) to 56,000 mg/L (well 0570 from 29 feet bgs). TDS concentrations for the deep wells ranged from 17,000 mg/L (well 0579 from 26 feet bgs) to 61,000 mg/L (well 0571 from 39 feet bgs).

Ammonia concentrations from shallow wells ranged from 510 mg/L (well 0570 from 16 feet bgs) to 1,700 mg/L (well 0570 from 23 and 29 feet bgs), while the deeper wells the ammonia concentrations ranged from 620 mg/L (well 0579 from 26 feet bgs) to 1,700 mg/L (well 0571 also from 26 feet bgs).

Uranium concentrations do not appear to follow any general trend, with concentrations increasing with increasing depth at some locations (wells 0574, 0576, 0578, and 0579), decreasing with increasing depth at other locations (wells 0570, 0573, and 0577), and not significantly changing with depth (wells 0571, 0572, and 0575). Uranium concentrations from shallow wells ranged from 1.9 mg/L (well 0570 from 23 and 29 feet bgs) to 3.2 mg/L (well 0578 from 29 feet bgs), and concentrations in the deeper wells ranged from 1.7 mg/L (well 0571 from 26 and 33 feet bgs) to 3.1 mg/L (well 0577 from 26 feet bgs and well 0579 from 39 feet bgs).

Ammonia, TDS, and uranium concentrations from observation well 0588 are comparable to concentrations detected in adjacent remediation well 0575, which is screened over approximately the same interval as observation well 0588. Samples collected from well 0589, which is screened over a deeper interval (approximately 43 to 53 feet bgs) compared to the remediation wells, had significantly different TDS and uranium concentrations. As expected based on previous investigations (DOE 2003a), TDS concentrations were elevated with the increasing depth. These concentrations are typical for wells that are completed within the underlying brine unit. The same is true for the uranium concentrations, which are typically lower within the brine unit compared to more shallow depths.

3.1.4.3 Configuration 3

Initial Configuration 3 data were collected in August 2005 after the remediation wells (dual-purpose extraction or injection) were developed. Ground-water samples were collected from each well from three different depths (16, 30, and 44 feet bgs from wells 0670 through 0679). Ground-water samples were collected from observation wells 0688 and 0689 also from different depths (31 and 39 feet bgs and 46 and 54 feet bgs, respectively).

Similar to the sampling associated with Configurations 1 and 2, these samples were collected using micropurge techniques using a peristaltic pump and downhole tubing. Field parameters were measured using a YSI 6920, and the samples were submitted to Paragon Analytical Laboratory for ammonia, chloride, sulfate, TDS, and uranium analysis. A partial summary of the analytical results (field parameters and ammonia, TDS, and uranium concentrations) is presented in Table 3–17.

The vertical profile data indicate the ammonia and TDS concentrations increase with depth, as expected based on previous investigations (DOE 2003a). The TDS concentrations for the Configuration 3 wells ranged from 3,900 mg/L (well 0670 from 16 feet bgs) to 25,000 mg/L (wells 0676 and 0678 from 44 feet bgs).

Ammonia concentrations ranged from 19 mg/L (wells 0674 and 0678 from 16 feet bgs) to 980 mg/L (well 0674 from 44 feet bgs).

Uranium concentrations appear to follow a general trend, with concentrations increasing with depth, but within a fairly narrow range of values. Uranium concentrations ranged from 0.42 mg/L to 4.2 mg/L (from 16 feet bgs), and concentrations from 2.4 mg/L to 4.6 mg/L (from 44 fteet bgs).

Ammonia, TDS, and uranium concentrations from observation wells 688 and 689 are comparable to concentrations detected in adjacent remediation wells, which is screened over approximately the same interval as observation well 0688. The highest uranium concentration (4.9 mg/L) was found in deep observation well 0689 at 54 feet bgs. As expected based on previous investigations (DOE 2003a), TDS concentrations were elevated with increasing depth. These concentrations are typical for wells that are completed within the underlying brine unit. The same is true for the uranium concentrations, which are typically lower within the brine compared to more shallow depths.

3.1.4.4 Configuration 4

Initial Configuration 4 data were collected in late August 2006 after the remediation wells (dual-purpose extraction or injection) were developed. Ground-water samples were collected from each well from two different depths (15 and 32 feet bgs from wells 0770 through 0779). Ground-water samples were also collected from observation wells 0780, 0781, 0782, 0784, 0785, 0786, and 0787 from different depths as presented in Table 3-18. Similar to the baseline sampling associated with Configurations 1, 2, and 3, these samples were collected using micropurge techniques using a peristaltic pump and downhole tubing. Field parameters were measured using a YSI 6920, and the samples were submitted to Paragon Analytical Laboratory for ammonia, chloride, sulfate, TDS, and uranium analysis.
A partial summary of the analytical results (field parameters and ammonia, TDS, and uranium concentrations) is also presented in Table 3–18.

Table 3–17. Summary of Configuration 3 Remediation Wells and Observation Wells 0688 and 0689 Field Parameter Data and Initial Concentrations of Ammonia, TDS, and Uranium

Location	Date	Depth to Water (ft btoc)	Sample Depth (ft bgs)	Field Parameters			Analytical Results		
				Temp (°C)	Spec Cond (µS/cm)	pH	NH_3-N (mg/L)	TDS (mg/L)	U (mg/L)
0670	8/09/2005	15.22	16	24.53	3,896	7.09	90	3,900	0.42
			30	22.28	18,347	6.67	410	14,000	2.5
			44	21.20	18,268	6.67	400	15,000	2.4
0671	8/09/2005	15.31	16	24.65	13,933	6.79	180	11,000	2.7
			30	25.72	14,954	6.74	180	13,000	2.9
			44	22.30	16,138	6.76	230	13,000	2.8
0672	8/09/2005	15.22	16	24.24	8,256	6.88	56	7,400	2.2
			30	22.73	19,142	6.74	710	15,000	2.5
			44	22.12	23,561	6.79	960	18,000	2.8
0673	8/09/2005	15.10	16	22.68	11,348	6.68	84	10,000	1.9
			30	22.01	18,951	6.66	400	15,000	2.6
			44	20.22	18,919	6.66	350	15,000	2.8
0674	8/10/2005	14.93	16	18.42	15,033	6.66	19	14,000	2.8
			30	17.40	18,031	6.70	210	17,000	3.4
			44	17.28	23,591	6.85	980	19,000	2.9
0675	8/10/2005	13.94	16	18.61	20,940	6.64	100	20,000	4.2
			30	17.95	25,644	6.66	340	23,000	5.3
			44	18.05	25,681	6.66	330	23,000	4.9
0676	8/10/2005	14.48	16	19.42	15,091	6.69	36	15,000	3.2
			30	19.30	26,500	6.67	260	24,000	4.6
			44	19.04	26,420	6.67	250	25,000	4.6
0677	8/10/2005	14.67	16	19.27	22,720	6.69	27	22,000	4.0
			30	18.76	26,590	6.69	430	24,000	4.2
			44	18.11	26,503	6.69	410	24,000	4.1
0678	8/10/2005	13.92	16	20.55	11,311	6.73	19	12,000	2.2
			30	19.64	23,810	6.76	650	19,000	3.2
			44	19.80	26,533	6.69	430	25,000	4.3
0679	8/10/2005	14.61	16	24.60	16,744	6.71	34	15,000	3.2
			30	19.71	24,930	6.73	610	22,000	3.7
			44	19.96	26,537	6.68	420	24,000	4.2
0688	8/10/2005	14.28	31	18.72	19,543	6.74	490	17,000	2.7
			39	18.75	23,685	6.71	540	20,000	4.1
0689	8/10/2005	14.37	46	18.08	24,788	6.68	420	23,000	4.7
			54	17.59	25,107	6.68	420	23,000	4.9

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

Table 3–18. Summary of Configuration 4 Remediation and Observation Well Field Parameter Data and Initial Concentrations of Ammonia, TDS, and Uranium

Location	Date	Depth to Water (ft btoc)	Sample Depth (ft bgs)	Field Parameters			Analytical Results		
				Temp (°C)	Spec Cond (µS/cm)	pH	NH_3-N (mg/L)	TDS (mg/L)	U (mg/L)
0770	8/28/06	16.73	15	18.54	14,520	7.26	170	12,000	1.7
			32	18.22	47,250	6.67	1,200	35,000	2.5
0771	8/28/06	16.94	15	20.86	15,070	7.25	270	13,000	2.3
			32	18.69	39,430	6.69	950	30,000	2.9
0772	8/28/06	17.10	15	24.18	21,600	7.2	460	21,000	3.1
			32	19.32	44,730	6.72	960	34,000	2.6
0773	8/28/06	16.85	15	23.41	25,940	7.29	650	21,000	2.5
			32	17.9	48,790	6.7	980	36,000	2.6
0774	8/28/06	16.58	15	22.17	25,330	7.29	640	21,000	3.0
			32	19.28	43,090	6.71	700	30,000	2.6
0775	8/28/06	17.10	15	22.28	25,700	7.3	690	21,000	3.2
			32	17.38	30,920	6.73	690	23,000	3.2
0776	8/29/06	16.75	15	15.12	26,400	6.92	670	21,000	2.7
			32	16.3	61,600	6.67	1,300	46,000	2.4
0777	8/29/06	16.59	15	21.29	27,660	6.78	810	21,000	2.6
			32	20.45	73,350	6.73	1,200	59,000	1.8
0778	8/29/06	16.69	15	21.79	24,550	6.89	650	18,000	1.9
			32	19.85	60,770	7.05	840	45,000	1.6
0779	8/29/06	16.24	15	22.91	26,950	6.81	690	19,000	2.2
			32	22.46	75,530	6.72	1,000	57,000	1.4
0780	8/31/06	16.24	21	17.24	24,650	6.84	590	21,000	3.1
			28	16.43	24,990	6.84	620	22,000	3.1
0781	8/30/06	16.37	46	21.28	90,510	6.64	420	74,000	1.3
			53	18.32	104,500	6.67	100	86,000	0.5
0782	8/30/06	16.07	31	20.93	32,100	6.77	750	26,000	2.9
			38	19.99	89,260	6.71	420	73,000	1.1
0783	11/02/06	14.50	13	16.83	16,160	6.89	250	14,000	2.6
0784	8/31/06	16.60	18	18.7	24,240	6.8	390	22,000	3.2
0785	8/31/06	16.51	18	17.51	8,893	7.38	160	5,900	0.6
0786	8/31/06	15.97	21	17.51	24,340	6.86	NA	NA	NA
			28	16.84	25,190	6.83	590	22,000	3.2
0787	8/31/06	16.35	36	17.1	91,230	6.76	NA	NA	NA
			43	16.6	96,190	6.73	190	77,000	0.7

Note: NA = Not Applicable
Well 782 was not installed until September 2006, and not sampled for the first time until November 2006.

The vertical profile data indicate the remediation well ammonia and TDS concentrations increase with depth, as expected based on previous investigations (DOE 2003a). The TDS concentrations for the Configuration 4 remediation wells ranged from 12,000 mg/L (well 0770 from 15 feet bgs) to 59,000 mg/L (well 0777 from 32 feet bgs). Ammonia concentrations for the same wells ranged from 170 mg/L (wells 0770 from 15 feet bgs) to 1,300 mg/L (well 0776 from 32 feet bgs).

Uranium concentrations appear to follow a general trend, with concentrations increasing with depth, but within a fairly narrow range of values. Uranium concentrations ranged from 1.7 to 3.2 mg/L for samples collected from 15 feet bgs and ranged from 1.4 to 3.2 mg/L for samples collected from 32 feet bgs.

Ammonia, TDS, and uranium concentrations in the observation wells are comparable to concentrations detected in observation wells screened over similar intervals in the vicinity of Configuration 1. The highest uranium concentration (3.2 mg/L) was found in observation wells 0784 and 0786 at 18 and 28 feet bgs, respectively. As expected based on previous investigations (DOE 2003a), TDS concentrations were elevated with increasing depth, and the depth to the brine-fresh water interface was entered at a more shallow depth as expected (DOE 2003a). As expected, the uranium and ammonia concentrations in wells completed within the brine unit had lower concentrations compared to wells completed in more shallow depths.

3.2 Evaporation Pond Design

The evaporation pond is designed to evaporate water from the well field at an average rate of 15 gpm for five years. Ground water extracted from the well field is piped to a lined evaporation pond located on top of the tailings pile. The current sprinkler-system configuration of the evaporation pond is shown in Figure 3–1, and the construction drawings are presented in Attachment 5. Contaminated ground-water discharges to the evaporation pond on the east side of the pond through a perforated pipe to enhance evaporation as the water enters the pond. Ground water collected in the pond is recirculated and allowed to flow down the black liner apron on the west slope of the pond to enhance the solar evaporation. A 10-horsepower (hp) centrifugal pump located at the north end of the pond is used to recirculate and spray the pond water down the evaporation apron. The recirculating rate is measured with a flow meter at the centrifugal pump. The treatment capacity was expanded in 2004 and again in 2005 and early 2006 by enhancing the evaporation rate through a sprinkler system. The sprinkler system is located outside the pond on top of the tailings pile. System 1 (Zones 1 through 7) was constructed in 2004 and System 2 (Zones 1 through 6) was constructed in early 2005. Since its initial construction, two crest-line sprinkler stations have been incorporated into System 1 and three crest-line sprinkler stations into System 2. The crest-line stations provide dust control in addition to ground-water treatment (evaporation). Appropriate modifications to operating procedures are outlined in this section to incorporate the sprinkler system.

3.2.1 Piping

The pipelines for the interim action are grouped into three different systems consisting of (1) well-field piping, (2) the main transmission piping from the well field to the pond, and (3) piping for the spray-evaporation apron. Design characteristics for each piping system are described in the following sections.

3.2.1.1 Well Field Piping

- Each Configuration 1 (Attachment 1) well discharges into a 1¼-inch-diameter Schedule 80 PVC pipe which is designed to accept a flow of 18 gpm at 5 feet-per-second velocity. This pipe connects to the well-field header pipe.
- The Configuration 1 well-field header pipe is a 2½-inch-diameter Class 160 PVC pipe that runs parallel to the wells and collects water from each well. The well-field header pipe is designed to accept a flow of 85 gpm at 5 feet-per-second velocity.
- Configurations 2, 3, and 4 (Attachments 2, 3, and 4, respectively) are designed for both fresh-water injection and ground-water extraction. Each well is connected to a vault with a 1-inch-diameter Schedule 80 PVC pipe for fresh-water injection and a 1½-inch-diameter Schedule 80 PVC pipe for ground-water extraction. The pipe entering the vault for fresh-water injection is a 1½-inch-diameter Schedule 80 PVC coming off a 4-inch-diameter raw-water line from the fresh-water pond. Similar 1½-inch-diameter pipe exits the vault for ground-water extraction and connects to the 4-inch diameter Class 160 PVC extraction pipeline.
- At the end of the well-field header pipe, downstream of the last well pipe tie-in, a magnetic flow meter is located which measures instantaneous and cumulative flow from the well field. This meter is referred to as the Badger totalizer.
- The well-field header pipe ties into the main ground-water transmission line downstream of the flow meter.
- All well-field piping is buried 2½ feet below grade to protect it from freezing.

3.2.1.2 Main Ground Water Transmission Line

- The main transmission line consists of a 4-inch-diameter Class 160 PVC pipe that is designed to allow flow of 200 gpm at 5 feet-per-second velocity. The greater flow for the main transmission line as compared to the well-field piping is designed to be flexible to allow for a future expansion of the well field of up to an additional 70 gpm.
- The transmission piping is covered by 2½ feet of native backfill from the well field to the foot of the tailings pile. The transmission piping that is located on the slope of the tailings pile is uncovered on grade and held in place by steel stakes at 20 feet on center.
- The pipe runs up the south side of the tailings pile to the top of pond berm and tees into a 4-inch-diameter perforated discharge pipe that runs the length of the pond on the east side of the transmission pipe. The discharge pipe is perforated with ½-inch-diameter holes at 1-foot intervals that allows the ground water to discharge and spread across the slope of the pond, providing additional heating and evaporation from the pond liner.
- Combination air-release and vacuum valves are located at high points on the transmission line to prevent cavitation.

- Drains are located at low points on the transmission line to allow draining for winter shutdowns or repairs if necessary.

3.2.1.3 Apron Spray Piping System

- The recirculation pump piping discharges into the spray system piping.
- Directly downstream of where the 3-inch pipe for the flow meter expands to 6-inch diameter PVC, a drain valve and flow-control valve are located. The drain valve allows the entire spray system to be drained while the flow-control valve controls flow to the apron-spray system.
- The spray-system supply line runs along the pond edge to the end of the apron where it elbows and runs parallel along the top edge of the apron.
- Six spray bars are evenly spaced along the top edge of the apron and tee off of the supply line.
- Each spray bar is a 2-inch diameter Schedule 40 PVC with ½-inch diameter holes drilled at on1e-foot intervals.
- Each spray bar has bolted blind flanges at the ends to allow ease in removal for pipe access for cleaning.
- The spray bars are connected to the supply line with a 2-inch-diameter Schedule 40 PVC pipe with a 2-inch butterfly valve on it. The valve allows flow control to each spray bar since optimal operation is to have each spray bar discharge the same amount of water.
- The entire spray-system supply line and spray bars are located above ground, resting directly on grade and supported in place by metal stakes.
- Two-inch gate valves are located on the supply line at each of the six spray-bar locations. These gate valves will provide hose hookups for future spraying of the apron to clean up anticipated residue build up.

3.2.2 Evaporation Pond Construction and Capacity

The evaporation pond is constructed by a combined excavation and berm construction using a cut-and-fill method. All earthen material used in the pond construction was obtained from existing material from the top of the pile. The dimension of the pond bottom is 12 feet wide by 615 feet long and is 11.6 feet below the top of the pond berm. The apron slopes six percent from the bottom of the pond to the top of the berm. The other three sides slope up from the bottom at a ratio of three horizontal to one vertical to the top of the berm.

The northwest and northeast berms are 12-feet wide to allow placement and access to the spray-system piping while the remaining berms are 8 feet wide. The top east corner of the berm is widened to 50 feet wide by 80 feet long to provide a location for the recirculation pump and pond access. The outside slopes of the pond are at a ratio of three horizontal to one vertical and tie into the existing grade.

The entire inside of the evaporation pond and the interior side slopes are covered with a black 40-mil high-density polyethylene (HDPE) liner that adsorbs solar radiation and thus increases the evaporation rate. The pond liner is held in place by 50-pound sand bags while the side slopes are held down by sand-filled 6-inch-diameter ballast tubes. Sand bags and ballast tubes are constructed from 45-mil scrim-reinforced polypropylene.

The capacity of the pond is a function of water depth. Water depth, elevation, surface area, volume, and freeboard are summarized in Table 3–19. The capacity of the evaporation pond with 2 feet of freeboard is approximately 5,000,000 gallons at a water depth of 9.6 feet. The pond volume and surface area as a function of water depth are shown in Figure 3–6 and Figure 3–7, respectively.

Table 3–19. Pond Elevation, Surface Area, Volume, and Freeboard as a Function of Depth

Depth (ft)	Elevation (ft)	Surface Area (acre)	Cumulative Volume (gals)	Freeboard (ft)
0.00	4,048.4	0.0	0.0	
0.50	4,048.9	0.3	38,981	
1.00	4,049.4	0.5	101,189	
1.50	4,049.9	0.6	186,826	
2.00	4,050.4	0.7	295,892	
2.50	4,050.9	0.9	429,195	
3.00	4,051.4	1.0	586,735	
3.50	4,051.9	1.2	767,905	
4.00	4,052.4	1.3	972,909	
4.50	4,052.9	1.5	1,201,543	
5.00	4,053.4	1.6	1,454,011	
5.50	4,053.9	1.8	1,732,331	
6.00	4,054.4	2.0	2,037,312	
6.50	4,054.9	2.1	2,367,943	
7.00	4,055.4	2.3	2,724,024	
7.50	4,055.9	2.4	3,105,755	
8.00	4,056.4	2.6	3,514,954	
8.50	4,056.9	2.8	3,952,026	3
9.00	4,057.4	2.9	4,417,980	
9.60	4,058.0	3.1	5,015,015	2
10.00	4,058.4	3.3	5,435,323	
10.60	4,059.0	3.5	6,098,606	1

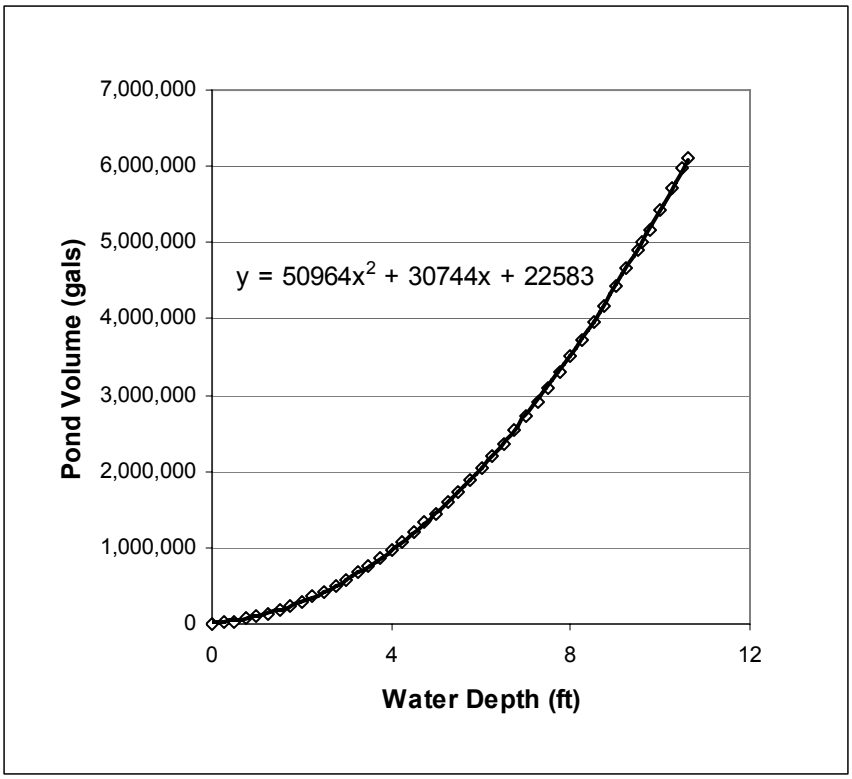


Figure 3–6. Volume of the Evaporation Pond as a Function of Water Depth

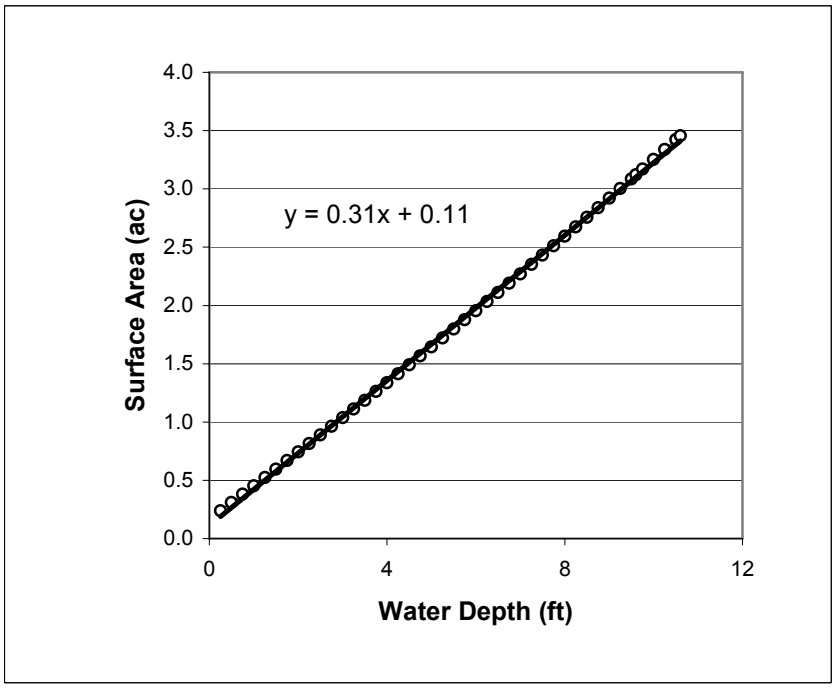


Figure 3–7. Surface Area of the Evaporation Pond as a Function of Water Depth

3.2.3 Recirculating Pump

The recirculating pump supplies water to the apron spray-piping system. The recirculation pump consists of a 10-hp, three-phase electric-motor centrifugal pump mounted on a steel skid. Electric pump controls are also mounted on the steel skid.

The recirculation pump suction line is mounted on a buoy that allows the pump intake to be fixed at a depth of approximately 1 foot from the bottom of the buoy. The buoy is constructed of eight-inch diameter Schedule 40 PVC banded together with galvanized metal strapping. A 4-inch diameter aluminum foot valve attached to the suction intake maintains water and prime in the pump. A 24-inch-diameter intake cage constructed of perforated HDPE with an HDPE solid bottom allows the cage to rest directly on the pond bottom when the pond water level is 2 feet or less in depth. The perforations allow water inflow, but keep large matter away from the suction intake.

The suction line is connected to the recirculation pump by a 4-inch-diameter rubber water-suction hose, which is designed to be flexible as the pond water levels rise and drop. The recirculation pump discharges into a 3-inch black rubber discharge hose, which is connected to the recirculation piping. All connections to the pump and to the suction end buoy are equipped with cam-lock quick disconnects to allow ease in removal and replacement for maintenance.

The discharge hose connects to a 3-inch-diameter Schedule 80 PVC pipe that has a 3-inch magnetic flow meter and pressure gauge located on it. The meter measures instantaneous flow rate and cumulative volume from the pump while the pressure gauge measures water pressure. These are used to control flow through the system and to monitor pump performance. Downstream of the flow meter, the piping expands to the 6-inch-diameter Schedule 40 PVC spray system drip line.

3.2.4 Submersible Pump

The 3-inch, 5-hp submersible pump (15-gpm capacity) is attached to the back of the barge, with a 3-inch black flex hose connected to the pump. The black flex hose is connected to Schedule 40 PVC by a cam lock. Ten feet down line is a pressure gauge, and 180 feet further down the line there is a 3-inch tee. After the tee, there is a gate valve, with one line running west and the other running north. The line running west operates sprinklers inside the evaporation pond, while the line running north operates the apron sprinklers.

3.3 Sprinkler System Design

The sprinkler system is designed to evaporate water applied to the surface of the tailings pile in order to increase the quantity of ground water that can be treated. The sprinkler systems consist of microspray-sprinkler nozzles, flow-regulated mini-sprinklers, and NETAFIM SuperNet Jr. sprinklers to achieve the application. The crest-line stations are fitted with Rain Bird® radial sprinkler heads designed for use on domestic lawns. Water from the pond is pumped through the radial sprinkler heads at increased pressure to cause the water to atomiz,e thus promoting evaporation. Ground water stored in the evaporation pond is delivered to the sprinklers through a class 200 PVC pipeline to 13 separate zones, totaling an area of approximately 38 acres. Two 460-volt, three-phase, 15-hp, variable speed, steel centrifugal pumps supply the water.

The pumps are controlled to apply water up to 200 gpm at 60 pounds per square inch (psi). As-built and design drawings for the sprinkler system are provided in Attachment 5.

Criteria used in the design are that applied water (1) shall not percolate into the tailings, (2) shall not pond on the surface of the tailings, and (3) shall not run off from the surface of the tailings. These criteria can be achieved if the rate of water applied and the application time are computed to conform with seasonal evaporation, that is, a higher application rate and application time in summer months when it is normally hot and dry. The quantity of water that can be applied to achieve these criteria is detailed in the calculation set X0064900, *Land Applied Evaporation System, Allowable Application Rates* (Attachment 6).

3.4 Fresh Water Storage Pond

The fresh-water storage pond is under control of the RAC, but is included in this discussion as it is associated with the system responsible for providing fresh water to the well field for injection purposes. The fresh-water storage pond located within the Controlled Area is designed to store water diverted from the Colorado River to be used for dust control, irrigation, and fresh-water injection purposes. Water is pumped from the river using 20-hp pumps (located at the original mill-site pump house, which is approximately 1,600 feet upstream from Moab Wash) at flow rates ranging from 0 to 2,000 gpm to the pond. Sediments reaching the pond from the river-pumping operation either drop out because of their own weight or are filtered out through a turbidity barrier between the inlet and outlet of the pond. Water from the pond is then transferred to the point of use via two pumps, one 5- and one 3-hp pump. Combined flows from both pumps provide up to 250 gpm for injection to the Infiltration Trench and Configuration 2 fresh-water injection wells and irrigation of plots C3, C4, C5, C6, and the Tree Area.

As site activities increased from 2002 through 2005, there was an increased demand on the water diverted off the river. The original pond capacity did not meet all site requirements and, as a result, in 2006 a new, larger-capacity pond was constructed to the northeast of the old pond. The design drawings for this new pond are included in Attachment 2.

3.5 Telemetry System

Configurations 1, 3, and 4 are fitted with equipment designed to collect ground-water elevation data (feet below top of casing), instantaneous flow data (gpm), and total-volume pumped data (gal), and transmit this information to the following website address: https://10.5.1.137/vdv/vv_frame.php, where Vista Data Vision is used to display the data graphically and allow for data downloads in an easy-to-use format.

Ground-water elevations in each extraction well are measured using pressure transducers (In Situ PDX-261) connected to a data logger (Campbell Scientific CR-1000) programmed to collect the data on an hourly basis. The flow meters (Great Plains, Inc.) have been modified to transmit a 4- to 20-milliamp signal to the data logger as well in order to collect the instantaneous flow rate and total gallons removed by the well.

The controls for the Configuration 1 telemetry system are located in the extraction well 475 vault. A picture of this system is provided in Figure 3–8. The controls for the Configuration 3 and 4 systems are located in the 674 and 675 vault and 774 and 775 vault, respectively.

Figure 3–9 shows the controls for the Configuration 3 system, which is identical to the Configuration 4 system. Each system is connected to the power supply provided in each vault. The systems also are connected to solar panels (Configurations 1 and 3) or marine batteries (Configuration 3, located outside the vault) to be used as backup power supplies. Detailed telemetry equipment information is located in Appendix D.

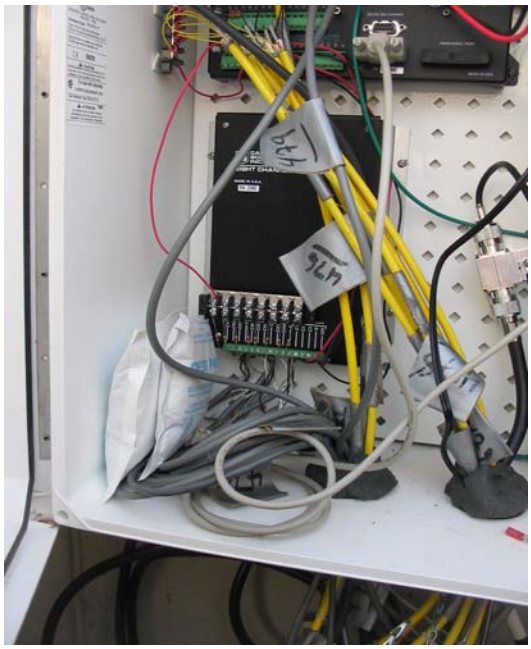


Figure 3–8. Configuration 1 Telemetry System Controls

Figure 3–9. Configuration 3 Telemetry System Controls

4.0 Operation Requirements

4.1 Inspection Days

Routine inspections shall be conducted two times each week (usually Monday and Thursday). As the system becomes more reliable, routine inspections may be conducted less frequently, as established by the Ground Water Manager. Conversely, inspections may be required more frequently depending on the specific objectives of a particular hydrologic test that may be performed as part of an observational approach to optimize the system design and effectiveness.

If a holiday occurs on a Monday, the routine inspection shall take place on the first business day after the holiday. If a holiday occurs on a Thursday, the routine inspection shall take place on the first business day prior to the holiday. Inclement weather conditions, such as heavy rain or snow, may infrequently delay an inspection. If weather conditions deteriorate to the point that fieldwork is neither safe nor practical during a scheduled inspection, the inspection shall be conducted on the first following unaffected business day.

4.2 Evaporation Pond Levels

Utah Water Quality rules require wastewater-disposal ponds to maintain a minimum freeboard to prevent overtopping and related spills or dike failure (see UAC R317-3-10.3(C)). A 3-foot freeboard is required for disposal ponds that manage more than 35 gpm. A 2-foot freeboard is required for ponds that manage less than 35 gpm. The evaporation pond is designated as a less than 35 gpm pond. During peak operations, more than 35 gpm will be pumped into the evaporation pond, an during winter months, less than 35 gpm will be added. To comply with these requirements, a minimum freeboard of 3 feet will be maintained throughout the year.

4.3 Treatment Rates

The current well field (Configurations 1 through 4 combined) is designed to extract contaminated ground water at a rate of up to 200 gpm with higher rates in the summer during periods of greater evaporation capacity. During the winter of 2007, all of the configurations, with the exception of Configuration 1, were turned off in the winter. It is expected that Configuration 1 will continue to run during the winter months. The remaining remediation wells should be turned off when the pond reaches a water depth of approximately 8 feet during periods of minimal to no evaporation. During operations in 2006, the well field was operated at maximum rates up to approximately 105 gpm before shutting the system off in mid-December when the pond level reached a depth of approximately 8.2 feet.

The two sprinkler systems consist of 13 zones with seven zones in System 1 and six zones in System 2. Prior to 2005, the System 1 zones were referred to as A through E, and System 2 zones were referred to as F through H. Modifications and additions to the sprinkler system led to revising the nomenclature of these systems. Table 4–1 presents the former and current names (to be used as a cross-reference) of these zones, along with the size of each zone (in acres), approximate operating flows (gpm), and application rates (gpm/acre). The sprinkler pump generally operates at flow rates between 100 gpm and 140 gpm. A flow rate of 100 gpm results in an average application rate of approximately 30 gpm/acre, depending on the number of stations in use.

Table 4–1. Sprinkler System Operating Parameter

System 1				
Former Zone Number	**Current Zone Number**	**Size (Acres)**	**Operating Flows (gpm)**	**Application Rate (gpm/acre)**
A	1	3.3	100	29
B	2	3.2	100	32
C	3	3.1	100	29
D	4	3.4	100	33
E	5	3.5	100	31
Crestline 1	6	2.1	100	29
Crestline 2	7	1.0	100	55
Subtotal System 1		19.6		
System 2				
F	1	2.5	100	29
G	2	4.1	100	29
H	3	5.3	100	29
Crestline I	4	1.5	100	43
Crestline J	5	2.3	100	13
Crestline K	6	2.7	100	20
Subtotal System 2		18.4		
Total		38		

4.4 Personnel and Equipment

The Well Field Operator is required to conduct each inspection and perform miscellaneous minor repairs. Major repairs to the system will be made by subcontractors who will furnish their own appropriate equipment and tools. The Well Field Operator will be supplied with a cellular telephone or a two-way radio for safety and emergency. Equipment and material cutsheets are provided in Appendix D.

4.5 Environmental Compliance

Extraction well and spray pumps require periodic repair or replacement. When the Well Field Operator removes a pump from an extraction well or the spray pump from the evaporation pond, the Moab Site Safety Coordinator shall perform a radiological survey (both interior and exterior, as appropriate) and document the free release of the pump prior to release from the site. A survey should also be conducted on associated sprinkler piping that contains accumulated sediment or precipitate.

Low volumes of wastewater will be generated from sampling and well-maintenance activities in the well field. Low volumes of purge water from sampling and well maintenance will be managed by spreading this water evenly on the ground surface in a circle around the well. If 30 gallons or less of purge water are generated, the water will be dispersed in a circle with a radius of at least 2 feet. If more than 30 gallons of purge water are generated, the water will be dispersed in a circle with a radius of at least 15 feet. This will prevent ground-water contaminants from accumulating to unacceptable levels in soils that are not contaminated.

Aquifer testing generates relatively large volumes of wastewater. Ground-water effluent from aquifer-testing activities at the extraction well field will be managed by piping the ground water to a controlled area on the site and then discharging the ground water on the surface to areas that are already surface contaminated. Wastewater will not be dispersed onto surface areas that will enable the water to flow into Moab Wash or the Colorado River. Refer to the HASP (DOE-EM/GJ1038-2007) for additional information on environmental compliance, waste management, and emergency response. Aquifer testing of Configuration 4 remediation wells conducted in 2006 was performed after the wells had been connected to the treatment system. This enabled the ground water to be pumped directly to the evaporation pond, eliminating water-disposal issues at the well field. Future aquifer pump tests should be handled in a similar manner when possible.

4.6 Health and Safety

The HASP has been prepared for the Moab Project in accordance with the requirements of 29 Code of Federal Regulations 1910.120. All operations, inspections, maintenance, and monitoring for the ground-water interim action will be performed according to the site-specific health and safety requirements developed for this task. Refer to the HASP (DOE-EM/GJ1038-2007) and task-specific Integrated Work Plans (IWP) for additional information on health and safety and emergency response.

4.7 Quality Assurance

All personnel who will conduct operations, monitoring, and maintenance of the ground-water remediation system are required to read and understand these procedures and sign a copy of the "Statement of Understanding" (Appendix E) of these procedures.

4.8 Training

Operations, maintenance, and performance-monitoring training will be performed on site by competent, qualified individuals familiar with these procedures in accordance with Occupational Safety and Health Administration requirements to perform the work. Additional training, such as site-safety briefings, job-safety hazards, and hazard-communication briefings are specified in the Moab HASP.

End of current text

5.0 Operating and Maintenance Procedures

The purpose of this section is to establish the procedures for operating the pumps and spray system that comprise the ground-water interim-action system at the Moab site. These procedures, when carried out correctly, prevent accidents and injuries, ensure proper operation, and provide a method for keeping records of the operating conditions. Site personnel will inspect and ensure the system is functioning correctly and that appropriate maintenance and repairs are made.

5.1 General

The pumps for the well field and spray system for the evaporation pond operate continuously. If an extraction pump is not operating and the well is not in a recovery mode between pumping cycles, there is a problem with the system, and it should be shutdown according to the procedure in Section 5.2.1.3. The trained Well Field Operator is authorized to shutdown and/or start pumps or systems to perform routine pump-filter change-out according to Section 5.2.1.2. The Well Field Operator is also authorized to shutdown and/or start pumps or systems if the Site Manager has directed maintenance or repair work, or an emergency requires a shutdown. The Ground Water Manager will direct all other start-ups, shutdowns, or changes in operating conditions based on specific project objectives.

5.1.1 Emergency Shutdown

Emergency shutdowns require immediate notification according to the Moab HASP. Examples of emergencies are accidents, vandalism, severe weather damage, or system component failures. If there is any question or doubt about whether to initiate a shutdown or the procedure to effect a shutdown of the entire system or an individual pump or system, contact the Ground Water Manager or the Site Manager at the telephone numbers provided for selected Contractor personnel in Table 2–1.

5.1.2 Contingency for Well Field Flooding

Estimated Colorado River Flows for the Cisco, Utah gaging station (based on upstream flows and weather systems impacting the Colorado River basin) will be monitored via the National Oceanic & Atmospheric Administration (NOAA) website (http://www.cbrfc.noaa.gov/river/station/flowplot/flowplot.cgi?CLRU1) on a daily basis starting in April (the earliest peak runoff in the 90 year recorded history for the site occurred in late April). In addition, the NOAA Western Water Supply Forecast site, that provides a long-term seasonal runoff volume forecast, will also be closely monitored (http://www.cbrfc.noaa.gov/westernwater/map.php?map=wsup).

During the 2005 spring runoff the river stage peaked at a flow of 40,200 cubic feet per second (cfs). At this flow, water just started reaching the top of the bank elevation just downstream (to the south, in the vicinity of well TP-17). As a result, forecasted flows greater than 40,000 cfs need to be taken as a serious threat to the equipment associated with the operations of the Interim Action Well Field.

Our flood event planning will be focused to insure all vital equipment will be removed prior to the flow exceeding 40,000 cfs, using flows of 15,000 and 25,000 cfs (as discussed below) as action levels for instigating the plan. This plan is also designed to take into account should these action level flows occur over the weekend. RAC crews will support the TAC activities as well as move equipment and material stored in areas prone to flooding to higher ground.

Historical data collected from the gaging station reveals that during the 1983 and 1984 runoffs, both of which exceeded 60,000 cfs, it took 6 days for the river flow to increase from approximately 15,000 to 25,000 cfs. In another 2 to 3 days the flows exceeded 40,000 cfs.

Incorporating this historical data into the plan, should the forecast indicate flows would exceed 40,000 cfs, the following actions need to be taken once the flow reaches approximately 15,000 cfs:

- Shut down all fresh water injection into the well field.
- Reinforce the river bank berm with additional fill material in low elevation areas. Install a berm across the access to Moab Wash (in the vicinity of Well 0406) to prevent water contained in Moab Wash from reaching the well field. Also add fill material across the southern end of the well field road, to the south of well 0492 to prevent water from backing into the well field from the south.
- Verify all riverbed well point and observation well caps have been installed (the riverbed well points will be capped in early April regardless of peak flow river stage).
- Anchor shed housing sand filter and prepare sand bags for placing around sand filter shed. Remove any equipment stored in the ground water shed.
- Notify electrical subcontractor of the possibility the power will have to be disconnected from the trailer. Notify subcontractor managing port-a-john to have it removed from the well field.
- Notify the RAC concerning the possibility of having to relocate the well field trailer and equipment storage shed out of the well field.
- Site security will be forewarned to notify management of any flooding during off hours, and site security along with site personnel will be cautioned to stay away from flood prone areas.

Once the flow exceeds 25,000 cfs and is expected to exceed 40,000 cfs, the following tasks need to be completed:

- Shut down all power to the well field.
- Measure water levels at each location equipped with a data logger/pressure transducer. Label, download, and remove each data logger/pressure transducer. Remove the CR1000 data loggers, multiplexers, radios, power converters, and solar panels from the vaults containing the telemetry equipment in Configurations 1, 3, and 4.
- Record all individual extraction/injection well flow meter values. Label and remove each well head flow meters. Remove Configuration 1, 3, and 4 Badger meter displays. Remove the Grunfos CU300 control boxes associated with each submersible pump.

- Place sand bags around sand filter shed, remove all equipment off the floor of the shed.
- Remove the well field storage shed.
- Remove all Initial Action piping from the well field.
- Place sandbags around the around the Configuration 1, 3, and 4 transformers. Also place sandbags at the top of pathways to the riverbed off the top of the bank.
- Shut down the well field access road across Moab Wash. All access will have to be through the alternative route.

The well field trailer floor is 2.5 ft above the ground surface in the vicinity of Configuration 2. Due the complexity of removing this equipment from the well field, special circumstances are to be applied to this task. The trailer will only be removed from the well field once the river flow reaches 30,000 cfs with a predicted peak of greater than 45,000 cfs.

5.2 Well Field Procedures

5.2.1 Extraction System

5.2.1.1 Startup

Batteries in the digital flow meters will be changed if needed. The extraction-well pumps should then be started against a slight head. The discharge valve should be one-third closed. The main power switch at the power pole is switched on. For Configuration 1, the breaker box in the electrical panel board should be opened to ensure all the required breakers are in the on position. Individual pumps can then be switched on at the switch panel. Each pump switch is labeled with the well number in which the pump is installed (i.e., wells 0470 to 0479).

For Configuration 2, an individual breaker box is located adjacent to each well vault (i.e., wells 0570 to 0579). As each pump is switched on, its pressure gauge and flow-meter readings are monitored. The CU 300 adjusts to allow the maximum flow that provides steady operation. Typically, the pressure at each well is approximately 100 psi to 140 psi. The flow rate is adjusted between 1 and 7 gpm depending upon specific operating requirements provided by the Ground Water Manager at the time. Steady operation is indicated if the pump runs quietly without surging or cutting out. Once each pump operation steadies down, the flow rate and pressure should be recorded on the worksheet provided in Appendix F.

Configurations 3 and 4 are similar to Configuration 2, with the exception of the breaker box design. Since the piping and pump controls are located in vaults located between Configurations 3 and 4 extraction wells, one breaker box controls the electrical supply to two wells.

5.2.1.2 Normal Operation

At any time the wells are shutdown (e.g., pump failure, maintenance, cleaning) the downtime and start-up time and flow rates will be recorded on the Well Field Data Worksheets.

The pumps will normally run continuously without any adjustment required. However, if there are signs of surging, the discharge valve may need to be closed more. If the flow rate falls off, the discharge valve should be opened until surging occurs, at which point it should be closed slightly until steady operation is achieved. If the pump shuts down, wait until it restarts automatically after 15 minutes, and then adjust the discharge valve to obtain steady operation.

If the flow drops off more than 1 gpm and opening the discharge valve does not improve it, then the filter is most likely blocked and needs to be cleared.

CAUTION! Pressure should be released slowly. WEAR A FACE SHIELD.

The valve on top of the filter should be opened slowly and sediment flushed out. Avoid getting sprayed in the face. If after flushing the filter the flow does not recover, then the filter needs cleaning. Once a month, shut off the flow by closing valve G, remove the filter, then brush, rinse, and replace it.

Flow Meter Check

The digital flow meters will be checked by comparison against a calibrated rotometer.

- Use the series F-44376 rotometer for flows between 0.2 and 2 gpm.
- Use the series F-44750 rotometer for flow rates greater than 2 gpm and less than 10 gpm.

Perform the check for each Configuration 1 well (0470 to 0479) by following the steps below:

1. Connect a short length of tubing to the inlet side of the appropriate rotometer and then to the calibration valve.
2. Secure the rotometer in a vertical position.
3. Connect the outlet side of the rotometer with a longer piece of tubing and place the discharge end outside the well vault.
4. Orient and secure the discharge end of the tubing away from the working area.
5. Open the calibration valve and close the throttle valve .
6. Adjust the calibration valve to achieve a steady flow rate as indicated on the rotometer.
7. Record the flow reading from the rotometer and the digital flow meter on the worksheet provided in Appendix F.
8. Repeat the process using the appropriate rotometer for each well.

The same procedure can be applied to Configurations 2, 3, and 4.

Cleaning the Filter

The pump must be shut down and the discharge valve closed. The filter relief valve is opened to relieve the residual pressure. The filter housing can then be unscrewed and the filter removed for cleaning. After cleaning and replacing the filter, the pump should be started up according to Section 5.2.1.1.

Pump Failure

If a pump shuts down and fails to restart after 15 minutes, the breaker should be checked. Contact the Ground Water Manager and Health and Safety for further instruction.

5.2.1.3 Shut Down

The pumps can be shut down by switching them off at the switch panel. The discharge valve should be closed as a precaution in case the check valve at the header bypasses. If the main header leading to the pond is shutdown during freezing conditions, it should be drained at the valve just downstream from the totalizer (Badger meter) and at the low point on the line before it goes up the side of the tailings pile. Also, the individual well-pump discharge lines should be drained during freezing conditions.

5.2.2 Injection System

5.2.2.1 Startup

Configuration 2

The following steps are required to change Configuration 2 from extraction mode to injection mode. In the extraction mode, valves D and G are closed, valve C is open, and valve E is adjusted to control the discharge rate at each individual well (Attachment 2, Plate 7). To change from extraction to injection mode:

1. Turn off all extraction pumps.
2. Attach one end of a hose to the hydrant (located near observation well 0586) and run the other end of the hose to an irrigated plot area away from the river to prevent erosion in a working area.
3. Open the valve on the hydrant.
4. Adjust valves at individual wells.
    - Close valve C.
    - Close valve D.
    - Close valve E.
    - Open valve F (sampling port near flow meter).
    - Close valve G.
5. At the fresh water pond (Attachment 2, Plate 4)
    - Open the butterfly valve all the way.
    - Turn on pump(s) (only one pump is needed for flows <100 gpm).
    - Make sure excess flow runs back into the pond by adjusting the pressure relief valve at the pump's discharge.

- Adjust the flow with the butterfly valve and reading the flow meter at pond, so that flow from pond is slightly higher than required.
- Check flow is running down to hydrant.

6. Back to the individual wells.
   - Open valve D.
   - Close the valve on the hydrant.
   - Make sure flow is running through the sampling port F at each well.
   - Open valve G halfway; close valve F.
   - Adjust valve G to obtain required flow at each individual well.
   - Adjust butterfly valve at pond if more flow is required.

Configuration 3

The following steps are required to start fresh-water injection for Configuration 3 wells. Figure 5–1 is a close-up of the piping and valves for one-half of the Configuration 3 vaults. Refer to this figure when following the procedures.

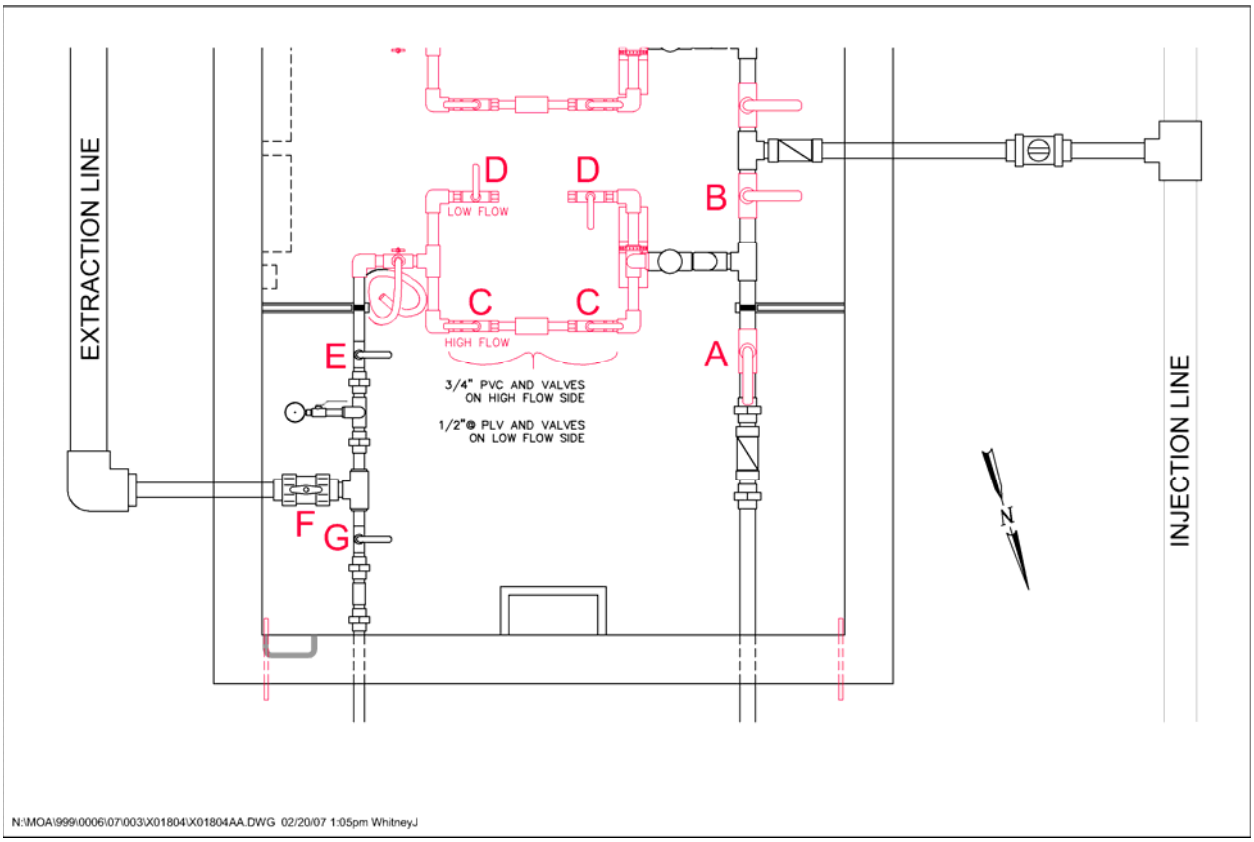


Figure 5–1. Pipe and Valve Layout for Configuration 3

The following procedure assumes the fresh-water pumps are already operating. Prior to injection, make sure all extraction pumps are shut down.

To start fresh water injection:

- Close valve A.
- Open valve B.
- Close C valves (one on each side of the extraction mode flow meter).
- Open D valves (on both sides of the injection mode flow meter).
- Open valve E.
- Close valve F.
- Open valve G.

This procedure will have to be completed on each side of the vault, for each well.

To switch from fresh-water injection to ground-water extraction:

- Close valve B.
- Open valve A.
- Open C valves (one on each side of the extraction mode flow meter).
- Close D valves (on both sides of the injection mode flow meter).
- Open valve E.
- Open valve F.
- Close valve G.
- Start extraction pump.

The pipe and valve layout for Configuration 4 is presented in Figure 5–2. The same procedure as described for switching Configuration 3 from ground-water extraction to fresh-water injection can be applied to Configuration 4 using Figure 5–2.

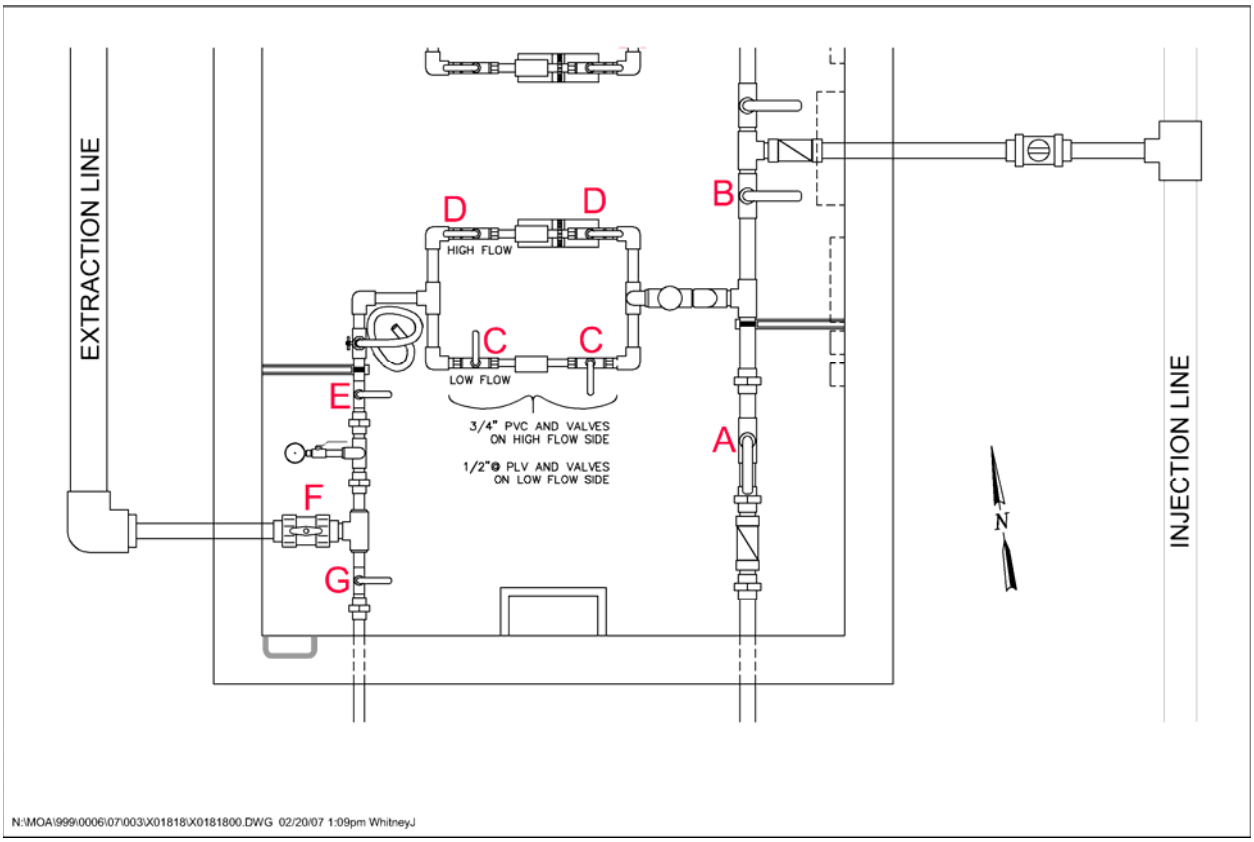


Figure 5–2. Pipe and Valve Layout for Configuration 4

5.2.2.2 Normal Operation

Injection water is piped from the fresh-water pond to Configurations 2, 3, or 4 using a 10-hp centrifugal pump that is capable of flows up to 100 gpm. A 3-hp pump is also available for increased flow. Each pump is equipped with a filter consisting of a spin plate and filter cartridge that needs to be sized according to the anticipated flow and the size of the suspended particles to be removed.

The particle filters are color-coded as follows:

Gold = 30 mesh	Blue = 100 mesh	Red = 200 mesh
Yellow = 50 mesh	Black = 150 mesh	

The spin plates are rated based on the number of holes; flow range is based on the number of holes plugged. The filter size is 4 inches.

Fully-opened spin plate rated at 284 to 365 gpm
1 hole plugged rated at 228 to 290 gpm
2 holes plugged rated at 182 to 232 gpm
3 holes plugged rated at 130 to 163 gpm

Agricultural Products, Inc. does not advise plugging more than 3 holes in the spin plates. To achieve lower gpm, use a smaller filter. The injection pumps will normally run continuously without any adjustment required. Any time the injection pumps or wells are shutdown (e.g., pump failure, maintenance, cleaning), the downtime, start-up time, and flow rates will be recorded on the Well Field Data Worksheets.

Batteries in the digital flow meters at each injection well will be changed as needed. Flow rates need to be decreased if the water level in the well rises higher than 2 feet below the top of the casing. In this case, reduce the flow rate and record the changes in flow and depth to water on the Well Field Data Worksheet.

Cleaning the Filter

Each injection pump is equipped with a spin-clean filter designed to flush continually at approximately 4 gpm. Periodic maintenance is required. Once a week, open the flush valve all the way to clean the filter. Once a month, shut down the pump, remove the filter, then brush, rinse, and replace it.

Each well is equipped with a T-filter and a 60-mesh cartridge. Each cartridge will be flushed at each well once a week using the relief valve.

CAUTION! Pressure should be released slowly. WEAR A FACE SHIELD.

The valve on top of the filter should be opened slowly and the sediment flushed out. Avoid getting sprayed in the face. If after flushing the filter the flow does not recover, then the filter needs cleaning. Once a month, shut off the flow by closing valve G, remove the filter, then brush, rinse, and replace it.

Pump Failure

If an injection pump shuts down and fails to restart after 15 minutes, the breaker should be checked. If the breaker is still in the on position or if it shuts off again immediately, the breaker should be switched permanently off and the Site Manager informed.

5.2.2.3 Shut Down

The injection pumps can be shut down by switching them off at the switch panel. If the pumps are shutdown during freezing conditions, they should be drained. Also, the individual injection line at each well should be drained during freezing conditions.

5.2.3 Well Development

Extraction or injection wells may lose efficiency after a period of time. Increased drawdown, frequent dry-pumping conditions, or decreased injection rates are indications that a well may need to be redeveloped. When the Configuration 1 extraction wells were first installed, less than 1 foot of drawdown was measured while pumping 3 gpm at each location. After five months of pumping, the majority of the extraction wells were experiencing more than 2 feet of drawdown with a pumping rate of 2 gpm.

While there was a significant drop in the river stage (which controls the saturated thickness) that may explain some of the reduced well performance, the increase in drawdown is largely a result of a decrease in well efficiency.

In order to increase and maintain well efficiency, additional well development will be required. Prior to the startup of the extraction-well field after the winter shutdown, each extraction well will be developed using surging, high-velocity jetting, or air-lift development techniques. During development, chemicals specially designed to increase well efficiency may be used to control mineral buildup on the screen (acids), reduce biological growth inside the well sumps (bioacid dispersants), and remove clay from the sand pack (clay dispersants). Well performance will dictate when additional well development is necessary.

5.3 Treatment System Procedures

5.3.1 Evaporation Pond Spray Pump

5.3.1.1 Startup

There must be at least 2 feet of water in the pond before startup of the spray system.

Open all the 2-inch spray-header valves and close the drain valves. The spray pump must be primed before attempting to start it. Removing the 1-inch plug on top of the pump and adding water until the pump and suction pipe are full can accomplish this. The discharge valve should be three-fourths closed. Holding the start button in and turning the switch to manual will start the pump. Once the pump starts pumping, the discharge valve can be slowly opened until the pressure gauge reads 10 psi. The individual spray-header valves should then be adjusted so that all the sprays are operating. The header valves nearest the pump would be partly closed while the valves furthest away would be wide open. By adequate adjustment, an even flow of water emanating from the sprays can be achieved thus enhancing the evaporation rate.

5.3.1.2 Normal Operation

Adjustments to the amount of water being pumped should only be made if the pond level is getting too low or too high. If the water level in the pond decreases to less than 2 feet in depth, then the recirculating spray pump will cavitate as a result of the increased suction. Thus, the spray pump should be turned off until the pond level rises to operating levels. To maintain the water level above the 2-foot depth, the flow rate from the well field may need to be increased or the spray-pump rate decreased.

If the influent rate of contaminated ground water from the well field is greater than the evaporation rate, then the pond could overfill its capacity or exceed the minimum freeboard (Section 4.2). Thus, the flow rate from the well field should be reduced. Alternatively, it may be possible to lower the water level in the pond by increasing the spray pump rate. In all cases, a minimum of 3 feet of freeboard is required when the system is operating at greater than 35 gpm from the well field, and a minimum of 2 feet of freeboard is required when the system is operating at less than 35 gpm from the well field.

5.3.1.3 Shut Down

Turning off the spray water-recirculation pump shuts down the spray system. If this occurs during freezing conditions, the pump and lines should be drained. This is accomplished by opening all the drain valves.

5.3.2 Sprinkler System

5.3.2.1 Startup

The pump is designed to run automatically when the main header pressure is above a set value and to shut off when the header reaches a set pressure. Thus, when the timer opens the zone solenoid-operated valves, the pump will automatically start. The pump is kept primed by a foot valve at the intake of the suction pipe. When the pump is started for the first time or after a long shut down, it will require priming using the hand pump attached to the pump for this purpose. Once the pump is primed, it is started on manual with the speed control set for slow (turn anticlockwise). The pressure is then increased until it is above 60 psi. At this point, the switch should be turned to "off." Once the pump has stopped turning (about 20 seconds) and the pressure remains above 60 psi, the switch may be turned to "Auto." The pump will not automatically run as long as the pressure in the discharge header is above the set low-pressure value (12 psi) and the pressure falls below 60 psi, such as when the sprinkler timer opens a zone solenoid valve. The pump strainer drain valves should be cracked open so that there is about fo4ur gpm flowing to drain. This will help keep the strainers from plugging. Once the pump operation steadies down, the flow rate and pressure should be recorded on the worksheet provided in Appendix F.

5.3.2.2 Normal Operation

The pump will normally run continuously without adjustment as controlled by the timer. If the flow drops off more than 200 gpm, then one of the two strainers on the pump-discharge line has started to plug. The other strainer should be put into service and the plugged strainer should be back flushed into the pond via its drain valve.

5.3.2.3 Shut Down

Switching it off at the main breaker or at the switch panel will shut down the pump. If the pump is shutdown during freezing conditions, the system should be drained and winterized.

5.4 Winterization

Until the winter of 2007, the ground-water extraction system had historically been shut down over the winter months because the extraction wells and sprinkler system were not designed to withstand freezing temperatures. Chemical data collected from Configuration 1 downgradient-observation wells and well points over the past two years, however, has suggested that shutting down the system results in increased ammonia and uranium concentrations in ground water adjacent to potential fish-habitat areas.

To limit the migration of ground water with elevated-contaminant concentrations toward the Colorado River, Configuration 1 wells (wells 470 through 479) should operate throughout most of the winter. Configuration 2, 3, and 4 wells will be winterized as normal along with the infiltration trench. The winter period of operation is approximately from November to March.

5.4.1 Winter Operations

The following winterization activities need to be addressed prior to November to limit equipment damages:

- The evaporation-pond level must be lowered as much as possible prior to the shutdown of the sprinkler system. The sprinkler system was designed to be temporary (all piping is located above ground), and it cannot be run over the winter. A similar drop in the water level (to a 3-foot depth) will be necessary to provide adequate storage for running Configuration 1 wells without the ability to remove water from the pond via the sprinkler system. Historically, the sprinkler system has been shut down in mid-November and restarted in mid-March. Operation of Configuration 1 wells at an average of 20 gpm over four months will generate a total of 3.5 million gallons. Based on the pond-capacity estimate and taking no evaporation into account, there is 2.9 million gallons of storage available when raising the pond level from 3 to 8 feet. As a result, as the volume reaches the 7-foot mark, flows may have to be decreased.

- As a result of the continued ground-water extraction over the winter, the volume stored in the pond by the spring is expected to be near capacity. Startup of the sprinkler system in March will assist in lowering the pond level.

- The discharge point into the evaporation pond from the well field needs to be changed prior to December. Typically, during the summer the extracted ground water is discharged from a perforated pipe that runs parallel to the northwest side of the pond. Discharging water into the pond through this pipe disperses the water along the length of the pipe. The concern is that these small-diameter orifices (approximately ¼-inch diameters) in the perforated pipe may freeze up and eventually restrict flow into the pond. To remedy this problem, the perforated pipe will be temporarily disconnected from the main 4-inch diameter discharge line, and the extracted ground water will be discharged directly into the pond from a 4-inch-diameter extension. In the spring, the perforated pipe will be reattached.

- Each vault will be equipped with heat tape plugged directly into the power supply located within the vault.

- The infiltration trench will be shut down by November 15 to avoid damage to the fresh-water storage-pond pump that delivers fresh water to the trench. The pump and sand filter need to be completely drained before being exposed to freezing temperatures.

5.5 Safety

Personnel should be aware that the system starts up automatically. Therefore, if personnel are working inside the sprinkler zones when the pump is not operating, then Lock Out/Tag Out procedures must be followed. The sprinkler pump is supplied by 440-volt, 3-phase current.

When the pump is operating and personnel need to work inside the sprinkler zones or have to approach within si6x feet of the sprinklers to perform repairs or adjustments, then personnel should wear rain gear and a face shield. Also, prior to entering an active sprinkler zone, personnel must consult with the Site Safety Coordinator to review the IWP for compliance with the technical basis document regarding work limitations and exposure.

End of current text

6.0 Performance Monitoring and Record Keeping

Monitoring data collected during operations of the interim action will be used to evaluate the performance of the system. Flow rates, application time, and soil-moisture observations will be performed at the sprinkler system. Water-level and water-quality measurements will be performed at the evaporation pond, the well field, the fresh-water pond, and at river-water locations. Ten extraction wells, 19 observation wells, nine well points, and two river-water locations are available for performance monitoring in Configuration 1. Ten extraction/injection wells, 13 observation wells, nine well points, one fresh-water injection location, and three river-water locations are available for performance monitoring in Configuration 2. Ten extraction/injection wells, 10 observation wells, nine well points, and two river-water locations are available for performance monitoring in Configuration 3. Ten extraction/injection wells, eight observation wells, six well points, and one river-water location are available for performance in Configuration 4. Four observation wells and three well points are also available for performance monitoring of the infiltration trench. Flow rates, cumulative volumes, and pressures will be recorded for the remediation wells.

Baseline Area monitoring will continue to be used to refine the understanding of the unstressed ground-water system. In particular, the water-quality monitoring network is designed to determine vertical and horizontal distributions of ammonia and TDS concentrations and to determine the significance of the brine surface with respect to ammonia distribution. The alluvial system in the Baseline Area has shown significant natural variability related to changes in river stage. The data collected from the Baseline Area will continue to be used, during evaluation of the well field, to distinguish natural variations in flow processes and water chemistry from the effects of system operation.

The monitoring network for Configurations 1, 3, and 4 (when used in extraction mode) will be used to monitor changes, if any, in the distribution of ammonia and TDS concentrations during continued ground-water extraction. It will also be used to monitor: (1) changes in ground-water flow paths above and below the brine surface during pumping, and (2) the extent of the cone of depression maintained by the extraction wells.

The monitoring network for Configurations 2, 3, and 4 (when used in injection mode) will be used to determine if these wells are effective in reducing contaminant concentrations in Colorado River backwater areas. An apparent reduction was observed in 2005 during operation of Configuration 2. Another ongoing objective will be to evaluate how injection affects the position of the brine surface beneath the river and discharge of ammonia to surface water.

The Well Field Operator is responsible for completing the interim-action worksheets (Appendix F) of these procedures as a record of inspection, maintenance, sampling, and operations of the treatment system. These worksheets shall be faxed on the day it is completed to the Contractor to the attention of Kym Bevan at fax number (970) 257-2174, office telephone number (970) 257-2100.

A schedule for monitoring the operating parameters of the interim action is summarized in Table 6–1. A schedule for sampling and analysis of water samples collected from wells at the surface-water locations and from the evaporation pond is summarized in Table 6–2. The schedules presented in Table 6–1 and Table 6–2 will be reevaluated after data history is established. Descriptions of the data-collection requirements for each parameter are provided in the sections below.

6.1 Sprinkler System

The sprinkler system should be checked daily to ensure it is operating properly. Operating parameters including the start time (hh:mm), operating duration (minutes), and operating schedule (days per week) will be recorded on the Evaporation Pond and Sprinkler System Field Data Worksheet (Appendix F). The Well Field Operator will also record on the worksheet descriptions of visual observations performed weekly to monitor the design criteria presented in Section 3.3. That is, applied water shall not 1) percolate into the tailings, 2) pond on the surface of the tailings, or 3) run off from the surface of the tailings. Since the beginning in FY 2007, the operations and maintenance of the sprinkler system and the evaporation pond will be conducted by personnel affiliated with the Site Construction and Operations, not the Ground Water personnel. However, completed data worksheets still will be reviewed by the Well Field Operator and submitted twice weekly to the Grand Junction office along with the other data worksheets for the system.

6.2 Water Levels

One objective of the interim action is to manipulate the ground-water gradient to minimize the discharge of contaminated water to the river. The hydraulic effect of this will be verified by measuring water depths at all the (1) extraction wells, (2) injection wells, and (3) at selected existing observation wells. The depth of water in the evaporation pond will be monitored to evaluate the evaporation rate and to monitor the freeboard. Water-level measurements generally will be collected according to the schedule provided in Table 6–1; however, see Section 6.5 and associated tables for additional schedule input.

Depth-to-ground water for the wells are measured manually with a water-level meter from the top of casing. Total depth of the water in the evaporation pond is measured directly from a scale on the staff gauge. Additional requirements for specific locations requiring water-depth measurements are listed in Table 6–3. Locations are shown in Figure 3–4. A worksheet to record the water levels is provided in Appendix F. Water levels measured for the wells will be recorded to the nearest 0.01 foot. Water levels measured at the staff gauge will be recorded to the nearest 0.25 foot.

Table 6–1. Interim Action Data Collection Schedule for Operating Parameters

Location	Pre-startup				Startup				Normal Operations			
	Water Level	Flow Rate	Volume	Pressure	Water Level	Flow Rate	Volume	Pressure	Water Level[a]	Flow Rate	Volume	Pressure
Extraction Wells	One time event	NA	NA	NA	One time event	One time event	One time event	One time event	Once per week	Twice per week	Twice per week	Twice per week
Injection Wells	One time event	NA	NA	NA	One time event	One time event	One time event	NA	Once per week	Twice per week	Twice per week	NA
Evaporation Pond	One time event	NA	NA	NA	One time event	One time event	NA	One time event	Twice per week	Twice per week	NA	Twice per week
Fresh Water Pond	NA	NA	NA	NA	NA	NA	NA	NA	NA	Twice per week	Twice per week	Twice per week
Infiltration Trench	One time event	NA	NA	NA	One time event	One time event	One time event	NA	Once per week	Twice per week	Twice per week	NA

NA; not applicable
[a] Telemetry was installed at Configurations 1 and 3 in 2006 and at Configuration 4 in 2007; water level information for the extraction wells will then be recorded remotely.

Table 6–2. Interim Action Data Collection Schedule for Water Sampling and Analysis

Location	Pre-startup		Startup		Normal Operations	
	Field Parameters	Laboratory Analysis	Field Parameters	Laboratory Analysis	Field Parameters	Laboratory Analysis
Extraction Wells	One time event	One time event	One time event	One time event	NA	Monthly
Injection Wells	One time event	One time event	NA	NA	NA	NA
Observation Wells	One time event	One time event	One time event	One time event	NA	Monthly
Well Point	One time event	One time event	One time event	One time event	NA	Monthly
River	One time event	One time event	One time event	One time event	NA	Monthly
Evaporation Pond	One time event	One time event	One time event	One time event	NA	Monthly
Fresh Water Pond	NA	NA	NA	NA	NA	Monthly
Infiltration Trench	NA	NA	NA	NA	a	a

NA – not applicable
a – field parameters and laboratory analyses may be performed for observation wells after trench system flow rate and volume assessment is conducted.

Table 6–3. Water Level Measurement Locations and Requirements

Type	Location ID	Purpose	Frequency
Extraction or Injection well	0470-0479 0570-0579 0670-0679 0770-0779	Monitor drawdown or mounding.	Before extraction pump or injection system is turned on. Also, when flow rates are changed.
Observation well	0403, 0407, 0480-0485, 0551-0561,0401, 0402, 0408, 0580-0589, 0596 0600, 0601, 0602, 0680-0689, 0730-0733, 0780-0787	Monitor zone of influence.	Before extraction pumps or injection system is turned on and then weekly. Also, when flow rates are changed.
Well point	Field determination	Monitor zone of influence.	Before extraction pumps or injection system is turned on and monthly/quarterly thereafter in conjunction with sampling events.
Evaporation pond	Staff gauge	Monitor pond volume and freeboard.	Before well field pumps or injection system is turned on and two times a week. When flow rates are changed.

6.3 Flow, Volume, and Pressure Measurements

Flow rate, volume, and pressure measurements to monitor the performance of the well field will be recorded manually according to the schedule in Table 6–1. Measurements in the well field will be collected at digital flow meters installed at each individual well and at the totalizer (Badger meter) that measures combined effluent from all the extraction wells or flow to the injection wells. Flow rate and pressure measurements will be collected at the evaporation pond recirculating spray pump and at the fresh-water pond pump. Worksheets to record the measurements are provided in Appendix F. Measurement locations referenced in Appendix F are illustrated in Figure 3–4.

6.4 Field Parameters

During the winter months, water temperature must be recorded on the inlet pipe leading into the evaporation pond. Keeping a record of the water temperature in the pipe will help to eliminate the risk of the water freezing within the pipe. Field measurements of temperature, specific conductance, and pH may be performed on specific wells under direction from the Ground Water Manager. A worksheet to record the calibration of the YSI probe used to perform the measurements is provided in Appendix F.

6.5 Laboratory Sampling and Analysis

Data collected through this sampling will improve the understanding of ground-water and surface-water interactions and help locate the intersection of the brine surface with the riverbed under background flow conditions for the Baseline Area wells and under active-remediation conditions for wells at Configurations 1 through 4. Sample collection will continue from the monitor well and well-point locations for chemical parameters and hydraulic and chemical performance data. Measurements will include water levels, field parameters, and laboratory analysis. Sampling of the well points will be conducted as river conditions permit. Except during near-bank, full-flow conditions, the shoreline well points are accessible year-round.

A surface-water sample will be collected (when present) near the base of each well point cluster location to compare local surface water chemistry with underlying ground water chemistry and to monitor the integrity of the well point completion.

Sampling procedures and analytical requirements for the samples are provided in Section 6.5.1. Sampling frequency requirements are summarized in Table 6–4 through Table 6–9. These frequencies will be integrated into the performance sampling events beginning in FY 2007. Interim Action Sampling and Analysis Worksheets are presented in Appendix G.

Table 6–4. Monitoring Requirements for the Baseline Area

Configuration	Type	Locations	Months Sampled
Baseline	Observation Wells	0405, 0488, 0495	January, March, April, June, July, September, October, December
		SMI-PZ1M, SMI-PZ1D, SMI-PZ1S, SMI-PW01	February, May, August, November
	Well Points	0494, 0495, 0597	April, August, December
		0494, 0495, 0597, 0496, 0497, 0598, 0617, 0618, 0599	February, June, October
	Surface Water	0241, 0242, 0243	February, April, June, August, October, December

Table 6–5. Sampling Frequency Requirements for Configuration 1

Configuration	Type	Locations	Months Sampled
Configuration 1	Extraction Wells	0471, 0473, 0475, 0477, 0479, SMI-PW02	January, March, May, July, September, November
		0470, 0472, 0474, 0476, 0478, SMI-PW02	February, April, June, August, October, December
	Observation Wells	0403, 0407, 0481, 0485, 0555, 0558, 0560	January, April, July, October
		0403, 0407, 0482, 0483, 0552, 0559	February, May, August, November
		0403, 0407, 0480, 0484, 0557, 0561, 0596	March, June, September, December
	Well Points	0562, 0563, 0606	April, August, December
		0562, 0563, 0606, 0608, 0611, 0612, 0564, 0565, 0607	February, June, October
	Surface Water	0216, 0245	February, April, June, August, October, December
	Evaporation Pond Inlet/Outlet	0547	January- December
		0548	March-November (or until sprinklers are down for the winter)

Table 6–6. Sampling Frequency Requirements for Configuration 2

Configuration	Type	Locations	Months Sampled
Configuration 2	Remediation Wells	0571, 0573, 0575, 0577, 0579	February, April, June, August, October
		0570, 0572, 0574, 0576, 0578	March, May, July, September
	Observation Wells	0408, 0581, 0585, 0589	January, April, July, October
		0582, 0583, 0586, 0588	February, May, August, November
		0401, 0584, 0587, 0600	March, June, September, December
	Well Points	0590, 0591, 0603	April, August, December
		0590, 0591, 0603, 0604, 0613, 0614, 0605, 0615, 0616	February, June, October
	Surface Water	0240, 0236, 0239	February, April, June, August, October, December

Table 6–7. Sampling Frequency Requirements for Configuration 3

Configuration	Type	Locations	Months Sampled
Configuration 3	Remediation Wells	0671, 0673, 0675, 0677, 0679	January, March, May, July, September, November
		0670, 0672. 0674, 0676, 0678	February, April, June, August, October, December
	Observation Wells	0688, 0689, 0680, 0681, 0684	January, April, July, October
		0682, 0688, 0689, 0404, 0685	February, May, August, November
		0683, 0687, 0688, 0689, 0686	March, June, September, December
	Well Points	0690, 0691, 0692	April, August, December
		0690, 0691, 0692, 0693, 0694, 0695, 0696, 0697, 0698	February, June, October
	Surface Water	0257, 0258, 0259	February, April, June, August, October, December

Table 6–8. Sampling Frequency Requirements for Configuration 4

Configuration	Type	Locations	Months Sampled
Configuration 4	Extraction wells	0770, 0772, 0774. 0776, 0778	March, May, July, September
		0771, 0773, 0775, 0777, 0779	April, June, August, October
	Observation Wells	0781, 0782, 0786, 0787	January, March, May, July, September, November
		0780, 0783, 0784, 0785	February, April, June, August, October, December
	Well Points	0790, 0791, 0792	April, August, December
		0790, 0791, 0792, 0793, 0794, 0795	February, June, October
	Surface Water	0274	February, April, June, August, October, December

Table 6–9. Sampling Frequency Requirements for Infiltration Trench

Configuration	Type	Locations	Months Sampled
Infiltration Trench	Observation Wells	0730, 0732	January, March, May, July, September, November
		0731, 0733	February, April, June, August, October
	Well Points	0724, 0725, 0726	February, April, June, August, October, December

Water samples will be submitted to a commercial laboratory for analyses of the constituents listed in Table 6–10. Not all of the wells are sampled for selenium and copper, see Table 6-11 for a complete list of wells that require these analyses. More extensive sampling may also be conducted on an as-needed basis at selected locations in the system or at new monitoring locations established at a later date to monitor the effectiveness of the interim action. All constituents could be analyzed, but given the low volume of ground water that is available from some well points, not all may be included during each sampling event. The well points selected for analysis may not be the same for each sampling event. Well points will be selected for sampling on the basis of river conditions and analytical results of previous sampling events.

Table 6–10. Analytes and Methods for Ground Water and Evaporation Pond Samples

Analyte	Sample Container	Preservation	EPA Method	Detection Limit	Line Item Code (LIC)
Ammonia-N	125 mL poly	H_2SO_4, pH < 2	350.3	0.1 mg/L	WCH-A-005
Chloride	500 mL poly	Cool, 4 °C	9056	0.5 mg/L	MIS-A-039
Bromide			9056	0.5 mg/L	MIS-A-038
Sulfate			9056	0.5 mg/L	MIS-A-044
TDS	125 mL poly	Cool, 4 °C	160.1	10 mg/L	WCH-A-033
Copper	500 mL poly	HNO_3, pH < 2	SW-846 6010	25 μg/L	MET-A-020
Selenium			SW-846 6020	0.1 μg/L	TAC-14
Manganese			SW-846 6010	5 μg/L	TAC-17
Uranium			SW-846 6020	0.1 μg/L	TAC-1

Table 6–11. Sample Locations That Should Include the Analytes Copper and Selenium

Location	Copper	Selenium
0405, 0412, 0413, 0414, 0437, 0439, 0440, 0442, 0456, 0495, 0496, 0597, 0598, 0599, 0604, 0605, 0606, 0617, 0618, 0676, 0683, 0691, 0693, 0695, 0696, 0697, 0725, 0726, 0792, CR3, MW-1-R, SMI-PZ3S, TP-03, TP-09, TP-17, TP-18, TP-19		X
0537, PW-11, PW-OB-A	X	X
0561, 0571, 0572, 0575, 0576, 0579, 0778, 0785, 0787	X	

6.5.1 Sampling Procedures

Water sampling will be performed in accordance with the *Ground Water and Surface Water Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (DOE 2006b) and the *Environmental Procedures Catalog* (STO 6). Deviations from these procedures will be noted in a field-variance log with an explanation and a description of its possible impacts on data quality. The following specific procedures from the *Environmental Procedures Catalog* (STO 6) will be used for water sampling:

- GT-1(P) *Standard Practice for Field Documentation Processes*
- GT-2(P) *Standard Practice for Sample Labeling*
- GT-3(P) *Standard Practice for Chain-of-Sample-Custody and Physical Security of Samples*
- LQ-2(T) *Standard Test Method for the Measurement of Water Levels in Ground Water Monitoring Wells*
- LQ-3(P) *Standard Practice for Purging Monitoring Wells*
- LQ-4(T) *Standard Test Method for the Field Measurement of pH*
- LQ-5(T) *Standard Test Method for the Field Measurement of Specific Conductance*
- LQ-6(T) *Standard Test Method for the Field Measurement of the Oxidation-Reduction Potential (Eh)*
- LQ-7(T) *Standard Test Method for the Field Measurement of Alkalinity*
- LQ-8(T) *Standard Test Method for the Field Measurement of Temperature*

- LQ-9(T) *Standard Test Method for the Field Measurement of Dissolved Oxygen*
- LQ-10(P) *Standard Practice for the Use of a Flow Cell for Field Measurements*
- LQ-11(P) *Standard Practice for the Sampling of Liquids*
- LQ-12(P) *Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples*
- LQ-19(P) *Standard Practice for the Inspection and Maintenance of Ground Water Monitoring Wells*
- LQ-24(T) *Standard Test Method for Turbidity in Water*

6.5.2 Sample Quality Assurance and Control

The objective of sample quality assurance and control measures is to provide systematic control of the tasks so as to maximize accuracy, precision, comparability, and completeness. All procedures will be checked for accuracy through internal laboratory quality control checks such as the analysis of blind duplicates, splits, and known standards. A minimum of 10 percent of the samples submitted for laboratory analysis will be field quality-control samples. Field quality-control samples may include equipment rinsate blanks, check samples, trip blanks, and duplicates. These samples will be submitted for the same analyses as the other field samples. Analytical methods to be used for the water samples are summarized in Table 6–10. Sample preservation will consist of storing the samples in a cooler with ice during field sampling, sample packaging, and shipping.

To maintain evidence of authenticity, the samples collected must be properly identified and easily discernible from other like samples. A label will be attached to the sample container specifying the sample identification number, location, date collected, time collected, and the sampler's name.

Water samples will be kept under custody from the time of collection to the time of analysis. Chain-of-custody records will be used to list all transfers in the possession of the samples. The chain-of-custody form will show that the sample was in constant custody between collection and analysis. While the samples are in shipment to the analytical laboratory, custody seals will be placed over the cooler opening to ensure that the integrity of the samples has not been compromised. The receiving laboratory must examine the seals on arrival and document that the seals are intact. Upon opening the container, the receiving laboratory will note the condition of the sample container (e.g., broken bottles, leaking bottles).

All sample shipments will be made in compliance with Department of Transportation regulations (49 CFR 171-179) governing shipment of hazardous materials and substances. These regulations govern the packaging, documentation, and shipping of hazardous material, substances, and waste. Special care will be taken to ensure the integrity of the sample through proper packaging and shipping.

To determine the proper identification of a hazardous sample, field personnel will review field measurement data and field notes for relevant information concerning the sample material in a container. This information will include field radiological scans and any other information that might be useful in classifying the sample for shipment. If a sample is known or suspected to contain a specific hazardous material, the sampler will note its presence on the sample label. This information is important to the receiving laboratory to determine the proper handling of the sample prior to its analysis.

6.5.3 Record Keeping

- All sampling field books
- Weekly readings
- Refer to EM Moab Site File Plan

7.0 References

Bellagamba, S., 1997. *A study to determine the relationship between salt concentrations and mortality of cottonwood trees* (*Populus Fremontii*) *located in the Scott M. Matheson wetlands preserve*, Nature Conservancy of Utah.

DOE (U.S. Department of Energy), 2003a. *Site Observational Work Plan for the Moab, Utah, Site,* GJO-2003-424-TAC, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2003b. *Moab Project Site Ground Water Interim Action Remediation Construction Specifications,* prepared for the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2005a. *Fall 2004 Performance Assessment of Interim Action Pumping at the Moab, Utah, Project Site.* Prepared for U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ769-2004.

DOE (U.S. Department of Energy), 2005b. Performance of the Ground Water Interim Action Injection System at the Configuration 2 Well Field. Calculation No. Moab-04-2005-03-00, prepared for U.S. Department of Energy, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2005c. *Performance of the Ground Water Interim Action Injection System at the Configuration 2 Well Field, October 2004-October 2005*. Calculation No. MOA-01-12-2005-2-03-00, prepared for U.S. Department of Energy, Grand Junction, Colorado.

DOE (U.S. Department of Energy). *Moab Project Site Health and Safety Plan,* DOE-EM/GJ1038-2007, prepared for the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2006b. *Ground Water and Surface Water Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*, Rev. 8, DOE-LM/GJ1112-2006, U.S. Department of Energy, Grand Junction, Colorado, February.

DOE (U.S. Department of Energy), 2007. *Fall 2006 Performance Assessment of the Ground Water Interim Action Well Fields at the Moab Utah, Project Site*, DOE-EM/GJ1478-2007, prepared for U.S. Department of Energy, Grand Junction, Colorado, June.

STO 6. *Environmental Procedures Catalog*, U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

Appendix A

Well Boring and Construction Logs

Baseline Area

Well Boring and Construction Logs

MONITORING WELL COMPLETION LOG MOA01-0405

PROJECT	MOAB	**NORTH COORD. (FT)**	6664404.03	**DATE DRILLED**	12/04/2001
LOCATION	,	**EAST COORD. (FT)**	2186330.59	**SURFACE ELEV. (FT NGVD)**	3966.40
SITE	MOAB	**HOLE DEPTH (FT)**	21.00	**TOP OF CASING (FT)**	3968.47
WELL NUMBER	0405	**WELL DEPTH (FT)**	20.29	**MEAS. PT. ELEV. (FT)**	3968.47
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-2.07	to	15.12
WELL SCREEN:	1 in. Slotted PVC	15.12	to	20.04
SUMP/END CAP:	1 in. PVC Sch 40	20.04	to	20.29
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	11.0
UPPER PACK:	20-40 Silica Sand	11.0	to	12.0
LOWER PACK:	10-20 Silica Sand	12.0	to	13.2

DRILLING METHOD GEOPROBE
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 12/04/2001
WATER LEVEL (FT BTOC) 14.44 on 12/04/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965		0-3.5 ft.				0-6.5 ft. SILTY SAND (SM); light brown to brown, fine to very fine silty sand, some calcite and organics present (roots), dry.
5			3.5-6.5 ft.		Bentonite Pellets		
	3960		6.5-9.5 ft		PVC Sch 40		6.5-10.0 ft. CLAYEY SILT (CL-ML); brown to light brown, mixed with fine sand, slightly plastic. Color change at 9.0 ft (Red sand).
10			9.5-12.5 ft.		20-40 Silica Sand		10.0-12.5 ft. SAND (SW); Brick red to brown fine grained sand, well sorted (sand grading).
	3955		12.5-15.5 ft.		10-20 Silica Sand		12.5-14.5 ft. GRAVELLY SAND (SP-GP); brown to reddish brown, fine to coarse grained sand mixed with pebbles-gravel mix, wet.
15							14.5-17.0 ft. SAND (SW); fine to medium grained sand, occasional pebbles.
	3950		15.5-18.5 ft.		0.010" Slotted PVC		17-21.0 ft GRAVELLY SAND (SP-GP); abundant pebble/gravel mix, rounded. Medium to fine sand, wet.
20					Slough		
	3945						Total Depth 21.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0406

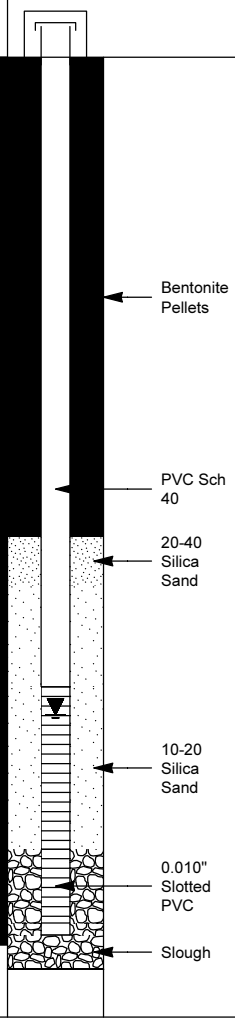
PROJECT	MOAB	**NORTH COORD. (FT)**	6664631.46	**DATE DRILLED**	12/05/2001
LOCATION	,	**EAST COORD. (FT)**	2186333.38	**SURFACE ELEV. (FT NGVD)**	3967.90
SITE	MOAB	**HOLE DEPTH (FT)**	19.00	**TOP OF CASING (FT)**	3969.91
WELL NUMBER	0406	**WELL DEPTH (FT)**	18.29	**MEAS. PT. ELEV. (FT)**	3969.91
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-2.01	to	13.12
WELL SCREEN:	1 in. Slotted PVC	13.12	to	18.04
SUMP/END CAP:	1 in. PVC Sch 40	18.04	to	18.29
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	11.0
LOWER PACK:	10-20 Silica Sand	11.0	to	16.5

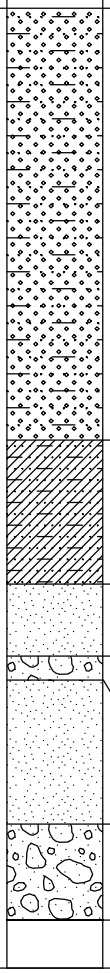
DRILLING METHOD GEOPROBE
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 12/05/2001
WATER LEVEL (FT BTOC) 15.71 on 12/05/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT
	3965		0-3.5 ft.	
5			3.5-6.5 ft.	
	3960		6.5-9.5 ft	
10			9.5-12.5 ft.	
	3955		12.5-15.5 ft.	
15			15.5-18.5 ft.	
	3950			

WELL DIAGRAM



GRAPHIC LOG



LITHOLOGIC DESCRIPTION

0-9.0 ft. SILTY SAND (SM); light brown to brown fine sand, well sorted, dry. Grades to a Very fine sand at depth and becomes moist.

9.0-12.0 ft. SILTY CLAY (CL-ML); reddish brown , low plasticity, organics and iron staining. Becomes moderate plasticity moist to wet with color changing to brick red near 12.0 ft.

12.0-13.5 ft. SAND (SP); brown to brick red with some silt and clay. Iron staining.

13.5-14.0 ft. SANDY GRAVEL (GP-SP); abundant pebbles and cobbles size material mixed with fine grained sand, moist to wet.

14.0-17.0 ft. SAND (SP); well sorted sand, wet.

17.0-19.0 ft. SANDY GRAVEL (GW-SW); medium to coarse grained sand mixed with gravel to cobble sized material, poorly sorted.

Total Depth 19.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0488

PROJECT	MOAB	**WELL NUMBER**	0488	**DATE DRILLED**	07/29/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664420.38	**SURFACE ELEV. (FT NGVD)**	3966.82
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186328.02	**TOP OF CASING (FT)**	3968.48
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	50.00	**MEAS. PT. ELEV. (FT)**	3968.48
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	40.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.66	to	25.0
WELL SCREEN:	6 in. Machine Slotted PVC	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	40.3
GROUT:	Grout	0.0	to	15.0
SEAL:	Bentonite Chips	15.0	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	50.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965, 3960, 3955, 3950, 3945				Grout; PVC Sch 40; Bentonite Chips; 30-70 Silica Sand; 16-40 Silica Sand		0-10.0 ft. SILTY SAND (SM); mostly very fine grained sand (80%) and silt (~20%), brown (7.5YR 5/4), dry, slightly damp below 5.0 ft.
5, 10							10.0-15.0 ft. SAND (SW): well sorted, mostly fine to medium grained sand, damp, ~10% pebbles and cobbles up to 4.0" in diameter, brown (7.5YR 5/4).
15, 20							15.0-25.0 ft. GRAVELLY SAND (SW-GW); moist to wet, ~60% sand, very fine to medium grained, ~40% pebbles and cobbles up to 4.0 " in diameter, matrix sand is brown (7.5YR 4/3). 20.0-25.0 ft. more sand (~70%).

MONITORING WELL COMPLETION LOG MOA01-0488

PROJECT MOAB **WELL NUMBER** 0488
SITE Moab Disposal Site **DATES DRILLED** 07/29/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						25.0-35.0 ft. SANDY GRAVEL (GW-SW); ~60% subrounded to well rounded gravel and cobbles (up to 5.0" in diameter), and fine to medium grained sand (~40%) matrix, wet, brown (7.5YR 4/3).
30							30.0-35.0 ft. sightly less sand (30-35%).
	3935				0.010" Slotted PVC		
35					0.010" Slotted PVC		35.0-50.0 ft. GRAVELLY SAND (SP-GP); mostly fine grained sand (60%), dark grayish brown (10YR 4/2), pebbles and cobbles (~40%) up to 3.0" in diameter. Sand is runny-water saturated.
	3930						
40					End Cap		40.0-45.0 ft. larger amount of sand (70%), very runny-water saturated.
	3925						
45							
	3920						
50							Total Depth 50.0 ft.
	3915						
55							
	3910						

MONITORING WELL COMPLETION LOG MOA01-0493

PROJECT	MOAB	**WELL NUMBER**	0493	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664391.83	**SURFACE ELEV. (FT NGVD)**	3966.08
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186318.49	**TOP OF CASING (FT)**	3967.94
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	60.00	**MEAS. PT. ELEV. (FT)**	3967.94
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	55.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.86	to	45.0
WELL SCREEN:	6 in. Machine Slotted PVC	45.0	to	55.0
SUMP/END CAP:	6 in. PVC Sch 40	55.0	to	55.3
GROUT:	Grout	0.0	to	35.0
SEAL:	Bentonite Chips	35.0	to	40.0
UPPER PACK:	30-70 Silica Sand	40.0	to	43.0
LOWER PACK:	16-40 Silica Sand	43.0	to	60.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SILTY SAND (SM); mostly very fine grained sand (~80%) and ~20% silt, light brown (7.5YR 6/3), dry.
5	3960						
10	3955						10.0-17.0 ft. No Recovery.
15	3950						
					Grout		17.0-25.0 ft. GRAVELLY SAND (SW-GW); sand(~60%), very fine to medium grained, ~40% pebbles and cobbles up to 3.0" in diameter, matix sand is brown (7.5YR 4/3), moist to wet.

MONITORING WELL COMPLETION LOG MOA01-0493

PROJECT MOAB **WELL NUMBER** 0493
SITE Moab Disposal Site **DATES DRILLED** 07/28/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945						20.0-25.0 ft. more sand (70%).
25	3940						25.0-35.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded gravel and cobbles (up to 6.0" in diameter) and fine to medium grained sand (~40%) matrix, wet, brown (7.5YR 4/3).
30	3935				PVC Sch 40		30.0-35.0 ft. slightly less sand (~35%), brown (7.5YR 4/2), wet.
35	3930				Bentonite Chips		35.0-40.0 ft. GRAVELLY SAND (SP-GP); mostly fine grained sand (~60%), dark grayish brown (10YR 4/2), pebbles and cobbles (40%) up to 3.0" in diameter. Sand is runny-water saturated.
40	3925				30-70 Silica Sand 16-40 Silica Sand		40.0-45.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded pebbles and cobbles (up to 4.0" in diameter) and fine to medium grained sand (~25%), wet, brown (7.5YR 4/2).
45							45.0-50.0 ft. GRAVELLY SAND (SW-GW); approximately equal

MONITORING WELL COMPLETION LOG MOA01-0493

PROJECT MOAB **WELL NUMBER** 0493
SITE Moab Disposal Site **DATES DRILLED** 07/28/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3920						amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 4.0" in diameter). Matrix sandy material is dark grayish brown (10YR 4/2), wet.
50					0.010" Slotted PVC		50.0-60.0 ft. SANDY GRAVEL (GW-SW); mostly (80%) pebbles and cobbles up to 3.0" in diameter. Little sand (20% or less), wet.
	3915						
55					End Cap		
	3910						
60							Total Depth 60.0 ft.
	3905						
65							
	3900						
70							

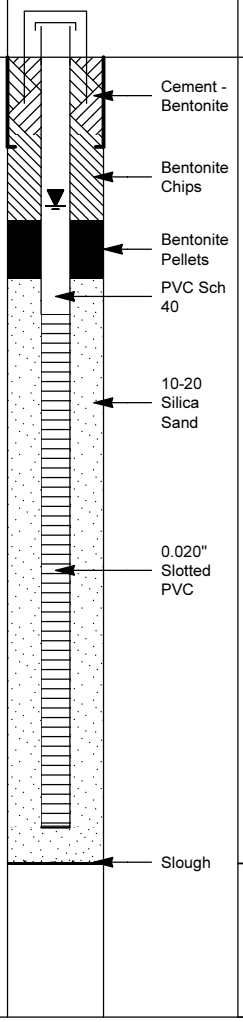
MONITORING WELL COMPLETION LOG MOA01-SMI-PW01

PROJECT	MOAB	**NORTH COORD. (FT)**	6664474.71	**DATE DRILLED**	10/26/2000 to 10/27/2000
LOCATION	,	**EAST COORD. (FT)**	2186192.88	**SURFACE ELEV. (FT NGVD)**	3966.40
SITE	MOAB	**HOLE DEPTH (FT)**	63.00	**TOP OF CASING (FT)**	3968.45
WELL NUMBER	SMI-PW01	**WELL DEPTH (FT)**	60.21	**MEAS. PT. ELEV. (FT)**	3968.45
				SLOT SIZE (IN)	0.020
				BIT SIZE(S) (IN)	10.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	8 in. Steel	-2.6	to	7.0
BLANK CASING:	4 in. PVC Sch 40	-2.05	to	20.09
WELL SCREEN:	4 in. PVC Sch 40	20.09	to	60.09
SUMP/END CAP:	4 in. PVC Sch 40	60.09	to	60.21
SURFACE SEAL:	Cement - Bentonite	0.0	to	6.0
GROUT:	Bentonite Chips	6.0	to	12.7
SEAL:	Bentonite Pellets	12.7	to	17.3
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	17.3	to	62.8

DRILLING METHOD ODEX/AIR ROTARY
SAMPLING METHOD
DATE DEVELOPED 10/27/2000
WATER LEVEL (FT BGS) 11.63 on 11/05/2000
LOGGED BY Muller, E
REMARKS No soil samples taken. No Lithology given (See Borehole log # SMI-PZ1D2 for lithology, which is considered LOG FOR SMI 1 site).

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
10, 20, 30, 40, 50, 60, 70	3960, 3950, 3940, 3930, 3920, 3910, 3900						



Total Depth 63.0 ft.

MONITORING WELL COMPLETION LOG MOA01-SMI-PZ1D2

PROJECT	MOAB	**NORTH COORD. (FT)**	6664475.11	**DATE DRILLED**	10/25/2000 to 10/26/2000
LOCATION	,	**EAST COORD. (FT)**	2186170.77	**SURFACE ELEV. (FT NGVD)**	3966.40
SITE	MOAB	**HOLE DEPTH (FT)**	83.00	**TOP OF CASING (FT)**	3968.26
WELL NUMBER	SMI-PZ1D2	**WELL DEPTH (FT)**	75.03	**MEAS. PT. ELEV. (FT)**	3968.26
				SLOT SIZE (IN)	0.020
				BIT SIZE(S) (IN)	10.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	6 in. Steel	-2.5	to	10.0
BLANK CASING:	2 in. PVC Sch 40	-1.86	to	69.75
WELL SCREEN:	2 in. PVC Sch 40	69.75	to	74.75
SUMP/END CAP:	2 in. PVC Sch 40	74.75	to	75.03
SURFACE SEAL:	Cement - Bentonite	0.0	to	5.0
GROUT:	Bentonite Chips	5.0	to	63.0
SEAL:	Bentonite Pellets	63.0	to	68.1
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	68.1	to	75.03

DRILLING METHOD ODEX/AIR ROTARY
SAMPLING METHOD CONT. CORE/SPLIT SP00N
DATE DEVELOPED 10/26/2000
WATER LEVEL (FT BGS) 12.32 on 11/18/2000
LOGGED BY Muller, E
REMARKS Borehole log is representative for SITE 1, which also represents log for well SMI-PW01, SMI-PZ1M, SMI-PZ1S.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965		0-5.0 ft.		Cement - Bentonite		0-8.0 ft. CLAYEY SAND (SC-SM); very fine to medium grained sand, subrounded to rounded to rounded, 85% quartz, 10% fine crystalline lithic fragments, 5% mica flakes. Interval contains regularly spaced layers of friable silty sand interbedded with slightly cohesive clayey sand. Interval dry to slightly moist. Roots and wood chips found throughout. Red (2.5YR 4/6).
5	3960		5.0-10.0 ft.				8.0-13.0 ft. CLAY (CL); medium plasticity, very fine to medium grained sand, subrounded to rounded, 90% quartz, 10% lithic fragments. Interval cohesive, slightly moist. Reddish brown (5YR 3/3).
10	3955		10.0-15.0 ft.				13.0-18.0 ft. SANDY GRAVEL (GP-SP); 70% gravel and 30% sand. Fine to coarse gravel, angular to subrounded various finely crystalline lithic types. Medium to coarse grained sand, subrounded to rounded, 60% quartz, 40% lithic fragments, wet, dark reddish brown (5YR 3/3).
15	3950		15.0-20.0 ft.				18.0-23.0 ft. GRAVELLY SAND (SP-GP); 70% sand, 25% gravel, and 5% silt and clay. Fine to coarse grained sand, subrounded to rounded, 60% quartz, 40% lithic fragments. Fine to coarse gravel, angular to subrounded, various finely crystalline types, wet, dark reddish brown (5YR 3/3).
20	3945		20.0-25.0 ft.				23.0-33.0 ft. CLAYEY, GRAVELLY SAND (SP-SC); 50% sand, 30% gravel, 20% clay. Fine to coarse grained sand, subrounded to rounded, 80% quartz, 20% lithic fragments. Fine to coarse gravel, subrounded to rounded, various fine crystalline lithic types, interval slightly cohesive, wet brown (7.5YR 4/3).
25	3940		25.0-30.0 ft.				
30	3935		30.0-35.0 ft.		Bentonite Chips		33.0-67.0 ft. SANDY GRAVEL (GP-SP); 60% gravel, 35% sand, 5% fines. Fine to coarse gravel, subrounded to rounded, various finely crystalline lithic types. Medium to coarse grained sand, subrounded to rounded, 80% quartz, 20% lithic fragments, wet, grayish brown.
35	3930		35.0-40.0 ft.				

mactec-ers **U.S. DEPARTMENT OF ENERGY**
GRAND JUNCTION OFFICE, COLORADO

MONITORING WELL COMPLETION LOG MOA01-SMI-PZ1D2

PROJECT MOAB **WELL NUMBER** SMI-PZ1D2
SITE MOAB **DATES DRILLED** 10/25/2000 to 10/26/2000

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
45	3925		40.0-45.0 ft.				
50	3920		45.0-50.0 ft.		PVC Sch 40		
55	3915		50.0-55.0 ft.				
60	3910		55.0-60.0 ft.				
65	3905		60.0-65.0 ft.		Bentonite Pellets		
70	3900		65.0-70.0 ft.		10-20 Silica Sand 0.020" Slotted PVC		67.0-82.0 ft. GRAVELLY SAND (SP-GP); 75% sand, 25% gravel, and 1% fines. Medium to coarse grained sand, subrounded to rounded, 80% quartz, 20% lithic fragments. Fine to coarse gravel, subangular to subrounded, various lithic types, wet, grayish brown.
75	3895		70.0-75.0 ft.				
80	3890		75.0-80.0 ft.		Slough		
85	3885		80.0-83.0 ft.				
90	3880						Total Depth 83.0 ft.

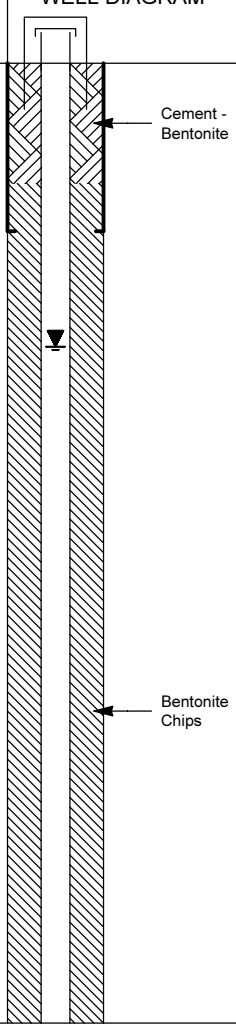
MONITORING WELL COMPLETION LOG MOA01-SMI-PZ1M

PROJECT	MOAB	**NORTH COORD. (FT)**	6664493.60	**DATE DRILLED**	10/28/2000
LOCATION	,	**EAST COORD. (FT)**	2186178.71	**SURFACE ELEV. (FT NGVD)**	3966.30
SITE	MOAB	**HOLE DEPTH (FT)**	64.00	**TOP OF CASING (FT)**	3968.29
WELL NUMBER	SMI-PZ1M	**WELL DEPTH (FT)**	60.80	**MEAS. PT. ELEV. (FT)**	3968.29
				SLOT SIZE (IN)	0.020
				BIT SIZE(S) (IN)	10.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	6 in. Steel	-2.4	to	7.0
BLANK CASING:	2 in. PVC Sch 40	-1.99	to	55.53
WELL SCREEN:	2 in. PVC Sch 40	55.53	to	60.53
SUMP/END CAP:	2 in. PVC Sch 40	60.53	to	60.8
SURFACE SEAL:	Cement - Bentonite	0.0	to	5.0
GROUT:	Bentonite Chips	5.0	to	49.0
SEAL:	Bentonite Pellets	49.0	to	52.3
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	52.3	to	60.8

DRILLING METHOD HOLLOW STEM AUGER
SAMPLING METHOD
DATE DEVELOPED 10/28/2000
WATER LEVEL (FT BGS) 11.81 on 11/18/2000
LOGGED BY Muller, E
REMARKS No soil samples taken. No Lithology given (See Borehole log # SMI-PZ1D2 for lithology, which is considered LOG for SMI 1 site).

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						
5	3960						
10	3955						
15	3950						
20	3945						
25	3940						
30	3935						
35	3930						



MONITORING WELL COMPLETION LOG MOA01-SMI-PZ1M

PROJECT MOAB **WELL NUMBER** SMI-PZ1M
SITE MOAB **DATES DRILLED** 10/28/2000

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
45	3925						
	3920						
50					Bentonite Pellets		
	3915						
55					PVC Sch 40 10-20 Silica Sand 0.020" Slotted PVC		
	3910						
60							
	3905				Slough		
65							Total Depth 64.0 ft.
	3900						
70							
	3895						
75							
	3890						
80							
	3885						
85							
	3880						
90							

MONITORING WELL COMPLETION LOG MOA01-SMI-PZ1S

PROJECT MOAB
LOCATION ,
SITE MOAB
WELL NUMBER SMI-PZ1S

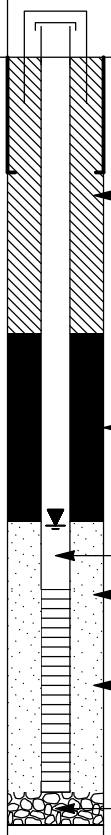
NORTH COORD. (FT) 6664492.79
EAST COORD. (FT) 2186200.77
HOLE DEPTH (FT) 20.00
WELL DEPTH (FT) 19.14

DATE DRILLED 09/26/2000 to 09/27/2000
SURFACE ELEV. (FT NGVD) 3966.70
TOP OF CASING (FT) 3969.13
MEAS. PT. ELEV. (FT) 3969.13
SLOT SIZE (IN) 0.020
BIT SIZE(S) (IN) 10.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	6 in. Steel	-2.7	to	3.0
BLANK CASING:	2 in. PVC Sch 40	-2.43	to	13.86
WELL SCREEN:	2 in. PVC Sch 40	13.86	to	18.86
SUMP/END CAP:	2 in. PVC Sch 40	18.86	to	19.14
SURFACE SEAL:				
GROUT:	Cement - Bentonite	0.0	to	7.2
SEAL:	Bentonite Pellets	7.2	to	12.1
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	12.1	to	19.14

DRILLING METHOD HOLLOW STEM AUGER
SAMPLING METHOD
DATE DEVELOPED 09/27/2000
WATER LEVEL (FT BGS) 12.2 on 11/18/2000
LOGGED BY Muller, E
REMARKS No soil samples taken. No Lithology given (See Borehole log # SMI-PZ1D2 for lithology, which is considered LOG for SMI 1 site).

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						
5					Grout		
	3960						
10					Bentonite Pellets		
	3955						
15					PVC Sch 40 10-20 Silica Sand 0.020" Slotted PVC		
	3950						
20					Slough		Total Depth 20.0 ft.
	3945						



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Configuration 1

Well Boring and Construction Logs

MONITORING WELL COMPLETION LOG MOA01-0403

PROJECT	MOAB	**NORTH COORD. (FT)**	6663534.54	**DATE DRILLED**	12/04/2001
LOCATION	,	**EAST COORD. (FT)**	2186078.28	**SURFACE ELEV. (FT NGVD)**	3966.90
SITE	MOAB	**HOLE DEPTH (FT)**	19.00	**TOP OF CASING (FT)**	3968.95
WELL NUMBER	0403	**WELL DEPTH (FT)**	18.50	**MEAS. PT. ELEV. (FT)**	3968.95
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-2.05	to	13.26
WELL SCREEN:	1 in. Slotted PVC	13.26	to	18.18
SUMP/END CAP:	1 in. PVC Sch 40	18.18	to	18.43
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	10.75
UPPER PACK:	20-40 Silica Sand	10.75	to	11.75
LOWER PACK:	10-20 Silica Sand	11.75	to	14.2

DRILLING METHOD GEOPROBE
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 12/04/2001
WATER LEVEL (FT BTOC) 16.0 on 12/04/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965		0-3.5 ft.				0-9.0 ft. SILTY SAND (SM); light brown, brown fine sand and silt, moist but become drier at depth, well sorted organics at 3.5 ft. Some iron staining.
5			3.5-6.5 ft.		Bentonite Pellets		
	3960		6.5-9.5 ft		PVC Sch 40		
10							9.0-10.5 ft. SAND (SP); reddish brown to brick red with some silt, light brown medium grained sand, moist.
	3955		9.5-12.5 ft.		20-40 Silica Sand		10.5-19.0 ft. GRAVELLY SAND (SW-GW); fine to medium sand, poorly sorted, some coarse, small pebbles grading to coarse sand and gravels at depth. Becomes wet at depth and color of sand is brick red.
			12.5-15.5 ft.		10-20 Silica Sand		
15					0.010" Slotted PVC		
	3950		15.5-18.5 ft.		Slough		
							Total Depth 19.0 ft.

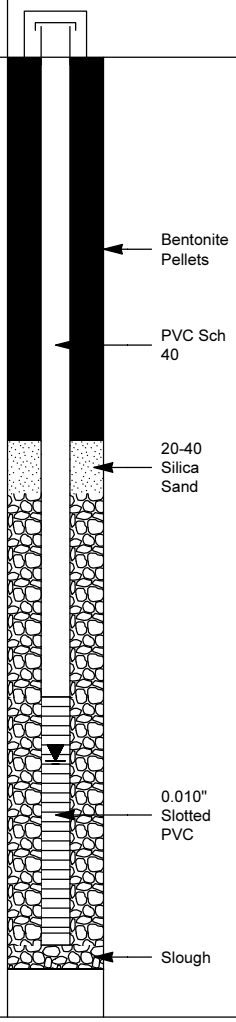
MONITORING WELL COMPLETION LOG MOA01-0407

PROJECT	MOAB	**NORTH COORD. (FT)**	6663347.51	**DATE DRILLED**	12/06/2001
LOCATION	,	**EAST COORD. (FT)**	2186030.11	**SURFACE ELEV. (FT NGVD)**	3967.20
SITE	MOAB	**HOLE DEPTH (FT)**	19.00	**TOP OF CASING (FT)**	3969.09
WELL NUMBER	0407	**WELL DEPTH (FT)**	18.50	**MEAS. PT. ELEV. (FT)**	3969.09
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.89	to	13.33
WELL SCREEN:	1 in. Slotted PVC	13.33	to	18.25
SUMP/END CAP:	1 in. PVC Sch 40	18.25	to	18.5
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	8.0
UPPER PACK:				
LOWER PACK:	20-40 Silica Sand	8.0	to	9.1

DRILLING METHOD GEOPROBE
SAMPLING METHOD
DATE DEVELOPED 12/06/2001
WATER LEVEL (FT BTOC) 16.55 on 12/06/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							No Samples taken.
	3965						
5					Bentonite Pellets		
					PVC Sch 40		
	3960						
					20-40 Silica Sand		
10							
	3955						
15					0.010" Slotted PVC		
	3950						
					Slough		
							Total Depth 19.0 ft.



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MONITORING WELL COMPLETION LOG MOA01-0470

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0470

NORTH COORD. (FT) 6663337.05
EAST COORD. (FT) 2185988.21
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/25/2003
SURFACE ELEV. (FT NGVD) 3966.56
TOP OF CASING (FT) 3966.41
MEAS. PT. ELEV. (FT) 3966.41
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	0.15	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/25/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.
5	3960				PVC Sch 40		4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.
10	3955				16-40 Silica Sand		12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.
15					0.010" Slotted PVC		13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.
20	3950				Sump/End Cap		16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.
	3945						21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.
							Total Depth 22.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0471

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0471

NORTH COORD. (FT) 6663361.48
EAST COORD. (FT) 2185991.55
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/25/2003
SURFACE ELEV. (FT NGVD) 3966.59
TOP OF CASING (FT) 3966.62
MEAS. PT. ELEV. (FT) 3966.62
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.03	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/25/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.
5	3960				PVC Sch 40		4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.
10	3955				16-40 Silica Sand		12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.
15					0.010" Slotted PVC		13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.
	3950						16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.
20					Sump/End Cap		
	3945						21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.
							Total Depth 22.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0472

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0472

NORTH COORD. (FT) 6663386.00
EAST COORD. (FT) 2185995.11
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3966.62
TOP OF CASING (FT) 3966.68
MEAS. PT. ELEV. (FT) 3966.68
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.06	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/24/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-4.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), 40% sand, fine grained, 60% silt/clay, moist.
5	3960				PVC Sch 40		4.0-10.0 ft. SILTY SAND (SM); dark reddish brown (5YR 3/4), 40% silt, ~50% fine sand, ~10 % clay (stiff), slightly mottled, moist.
10	3955				16-40 Silica Sand		10.0-16.0 ft. SAND (SP); reddish brown (5YR 4/4), fine to coarse grained with sand, ~10% fine gravel, subrounded to rounded, wet.
15	3950				0.010" Slotted PVC		16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% fine to coarse gravel/cobbles, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.
20	3945				Sump/End Cap		21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.

Total Depth 22.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0473

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0473

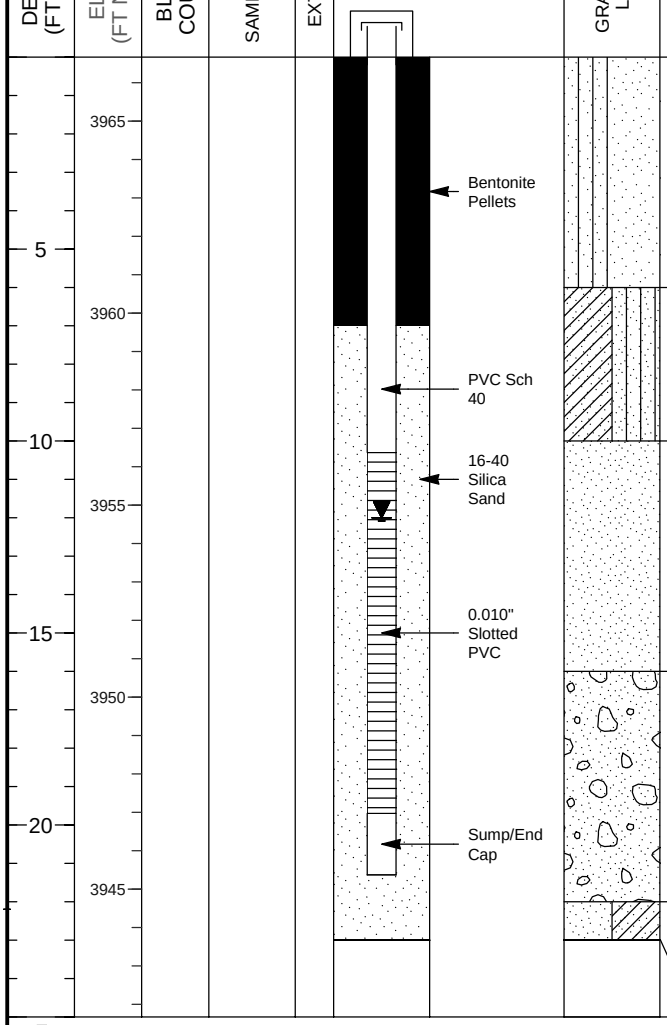
NORTH COORD. (FT) 6663411.34
EAST COORD. (FT) 2185999.02
HOLE DEPTH (FT) 23.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3966.67
TOP OF CASING (FT) 3966.74
MEAS. PT. ELEV. (FT) 3966.74
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.07	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	23.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/24/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.
							6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.
							10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.
							16.0-22.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.
							22.0-23.0 ft. CLAYEY GRAVELLY SAND (SP-SC); brown (7.5YR 4/4), 60% fine to medium sand, 20% silt/clay, 20% gravel subangular to subrounded, wet.
							Total Depth 23.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0474

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0474

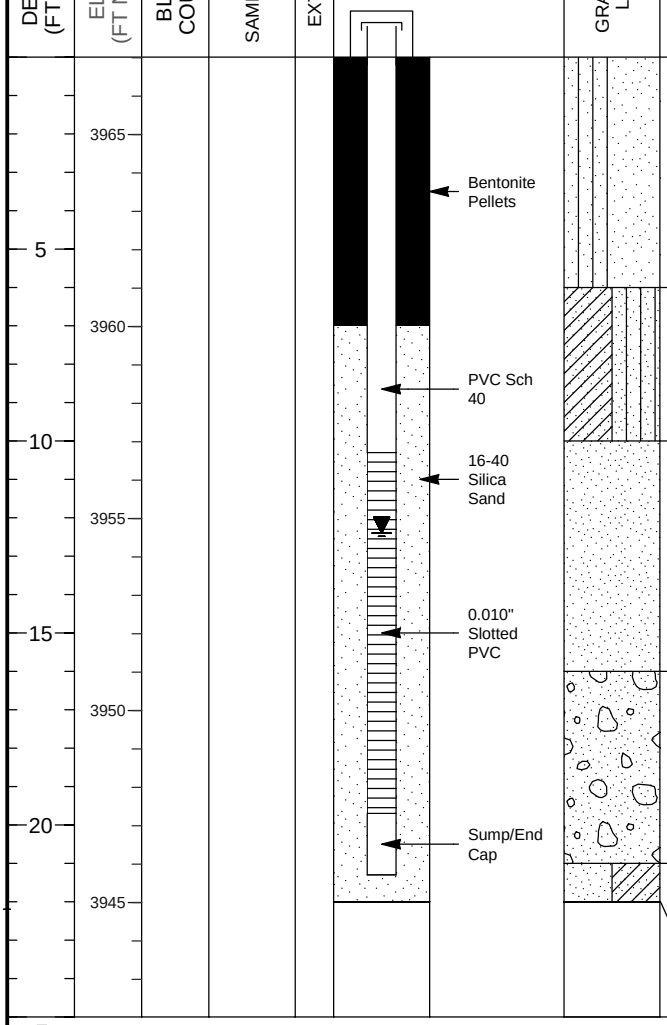
NORTH COORD. (FT) 6663435.71
EAST COORD. (FT) 2186002.61
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3967.02
TOP OF CASING (FT) 3967.10
MEAS. PT. ELEV. (FT) 3967.10
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.08	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.4 on 06/24/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.
							6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.
							10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.
							16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.
							21.0-22.0 ft. CLAYEY GRAVELLY SAND (SP-SC); brown (7.5YR 4/4), 60% fine to medium sand, 20% silt/clay, 20% gravel subangular to subrounded, wet.
							Total Depth 22.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0475

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0475

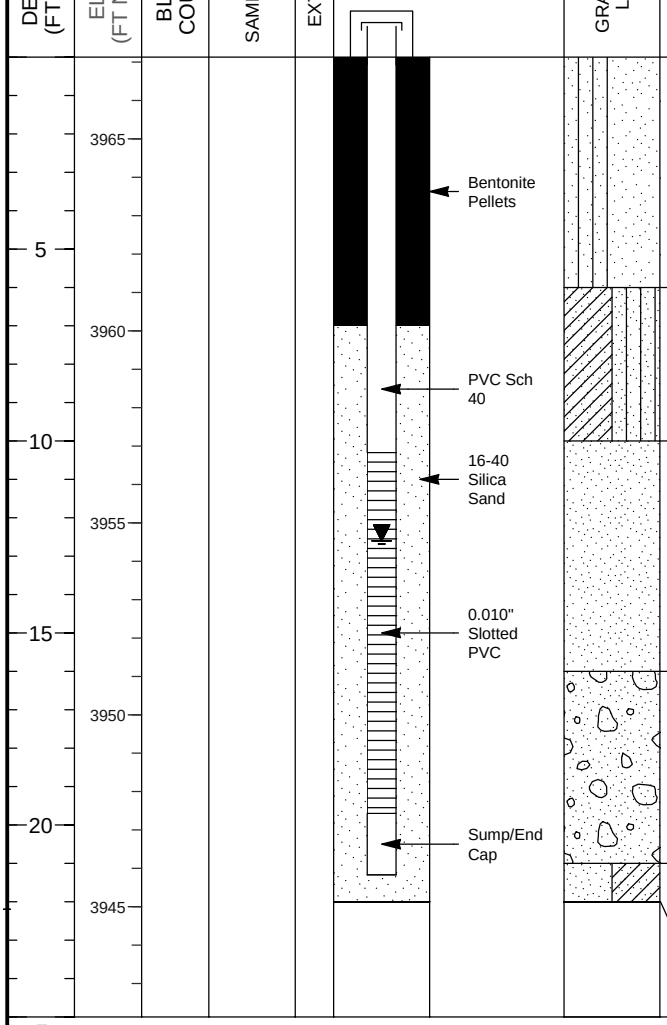
NORTH COORD. (FT) 6663460.70
EAST COORD. (FT) 2186005.78
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3967.13
TOP OF CASING (FT) 3967.32
MEAS. PT. ELEV. (FT) 3967.32
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.19	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.6 on 06/24/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.
							6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.
							10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.
							16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.
							21.0-22.0 ft. CLAYEY GRAVELLY SAND (SP-SC); brown (7.5YR 4/4), 60% fine to medium sand, 20% silt/clay, 20% gravel subangular to subrounded, wet.
							Total Depth 22.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0476

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0476

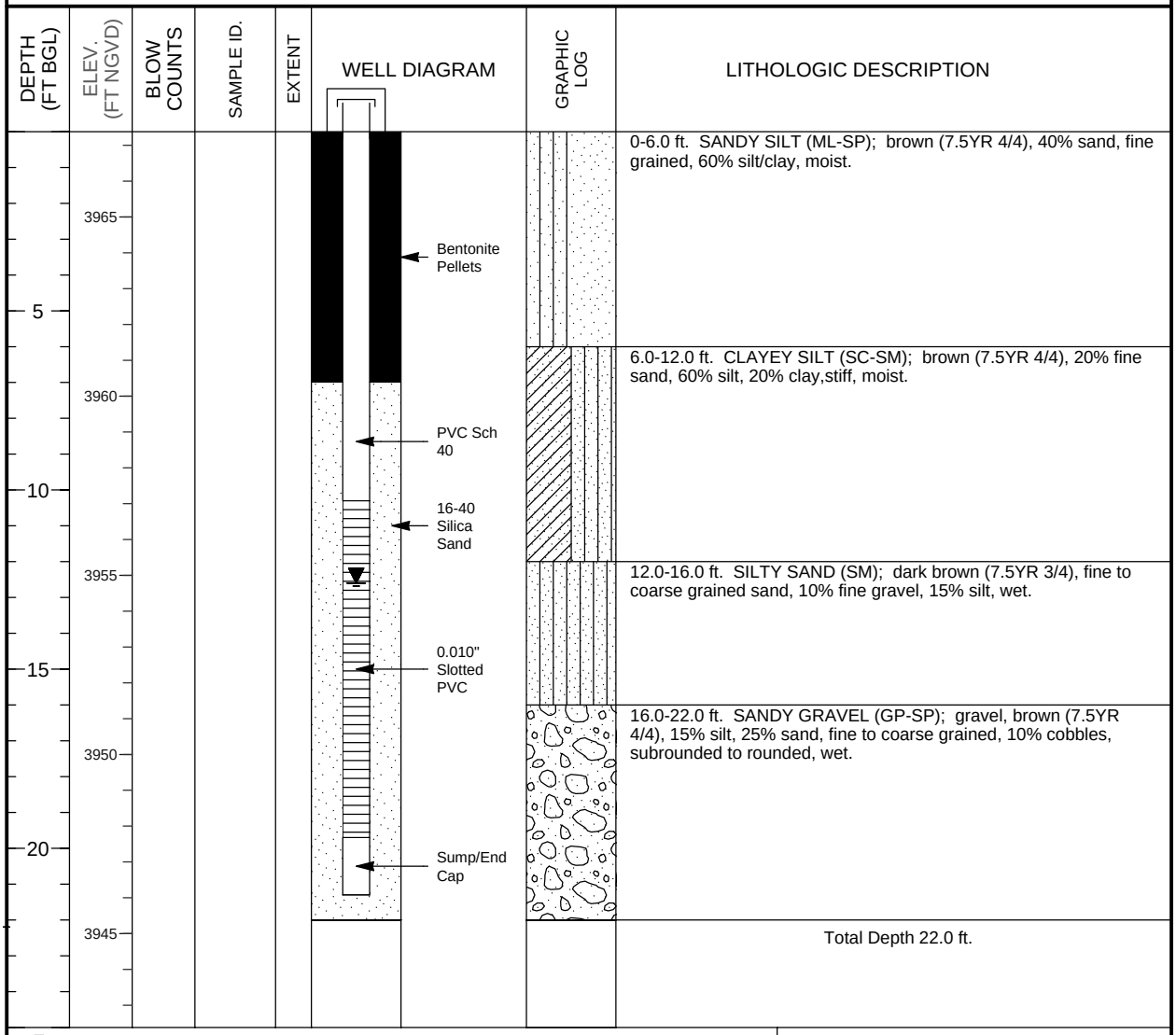
NORTH COORD. (FT) 6663485.25
EAST COORD. (FT) 2186009.58
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/23/2003
SURFACE ELEV. (FT NGVD) 3967.38
TOP OF CASING (FT) 3967.46
MEAS. PT. ELEV. (FT) 3967.46
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.08	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.6 on 06/23/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-6.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), 40% sand, fine grained, 60% silt/clay, moist.
							6.0-12.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% fine sand, 60% silt, 20% clay,stiff, moist.
							12.0-16.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/4), fine to coarse grained sand, 10% fine gravel, 15% silt, wet.
							16.0-22.0 ft. SANDY GRAVEL (GP-SP); gravel, brown (7.5YR 4/4), 15% silt, 25% sand, fine to coarse grained, 10% cobbles, subrounded to rounded, wet.
							Total Depth 22.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0477

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0477

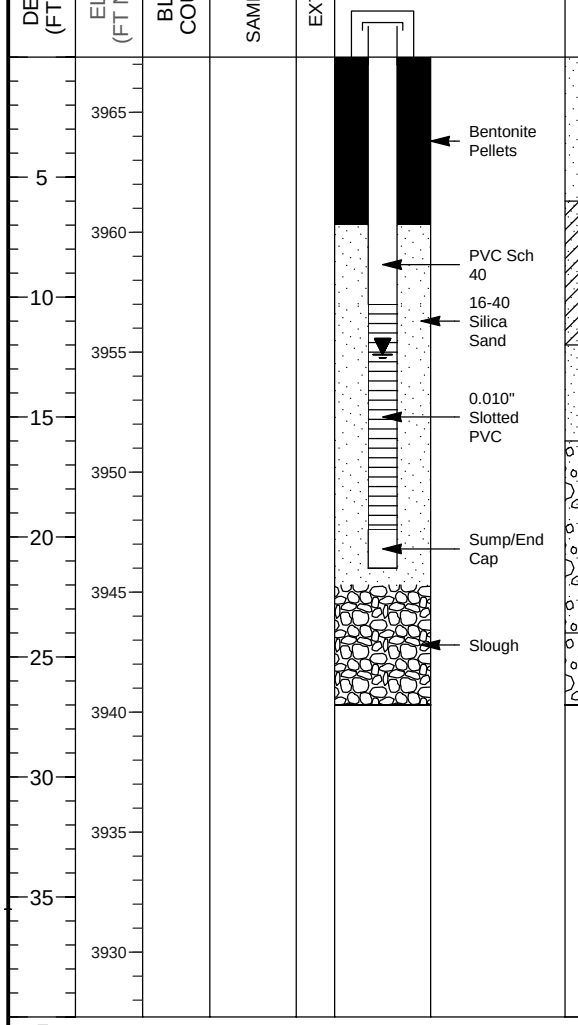
NORTH COORD. (FT) 6663510.11
EAST COORD. (FT) 2186012.49
HOLE DEPTH (FT) 27.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/23/2003
SURFACE ELEV. (FT NGVD) 3967.30
TOP OF CASING (FT) 3967.30
MEAS. PT. ELEV. (FT) 3967.30
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	0.0	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 12.4 on 06/23/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-6.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), 40% sand, fine grained, 60% silt/clay, moist.
							6.0-12.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% fine sand, 60% silt, 20% clay,stiff, moist.
							12.0-16.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/4), fine to coarse grained sand, 10% fine gravel, 15% silt, wet.
							16.0-24.0 ft. SANDY GRAVEL (GP-SP); gravel, brown (7.5YR 4/4), 15% silt, 25% sand, fine to coarse grained, 10% cobbles, subrounded to rounded, wet.
							24.0-27.0 ft. SILTY GRAVEL (GM); dark reddish brown (5YR 3/4), 20% fine grained sand, 30% silt/clay, 50% gravel/cobbles, gravel rounded to subrounded.
							Total Depth 27.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0478

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0478

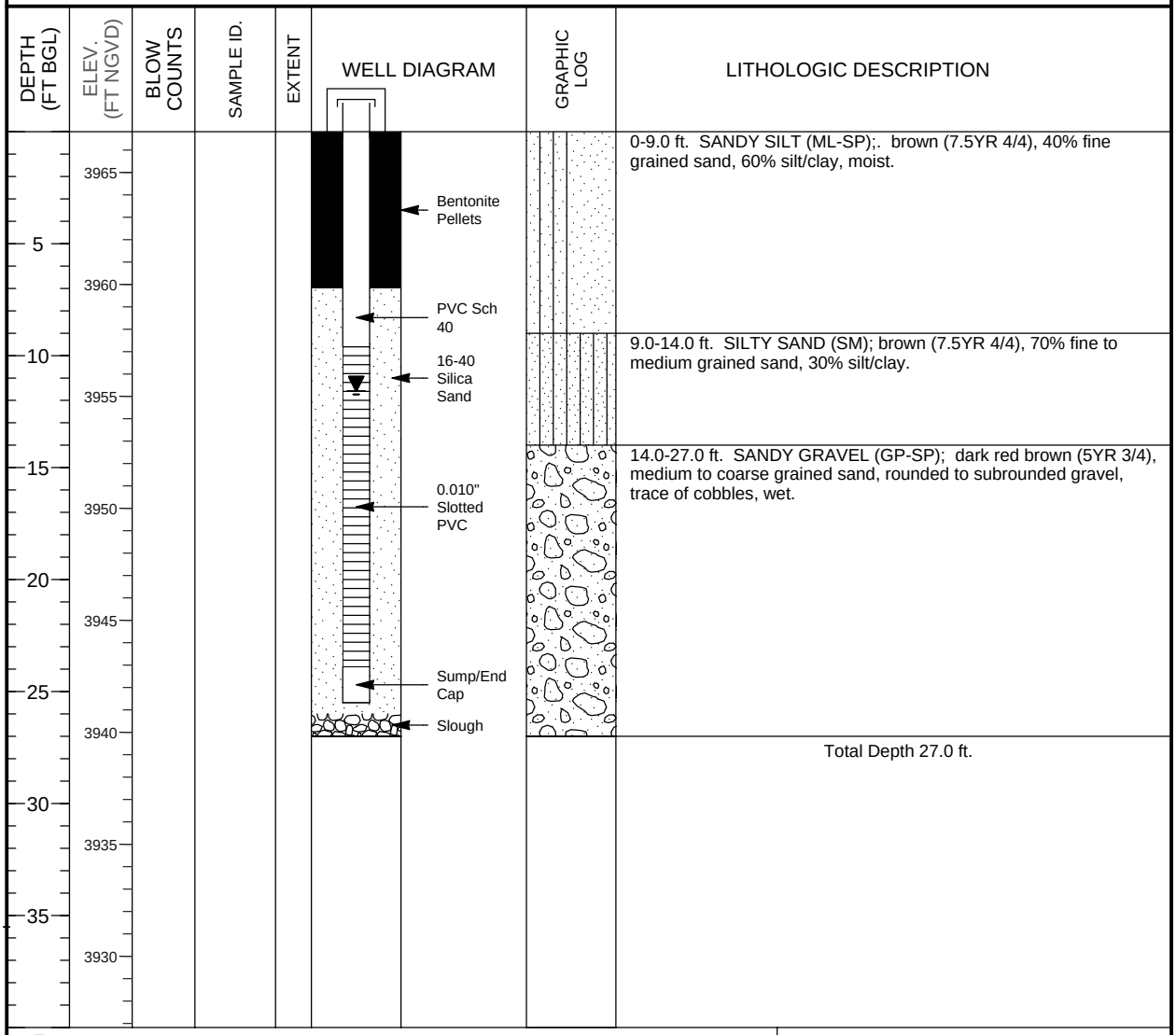
NORTH COORD. (FT) 6663535.08
EAST COORD. (FT) 2186015.76
HOLE DEPTH (FT) 27.00
WELL DEPTH (FT) 25.50

DATE DRILLED 06/21/2003 to 06/23/2003
SURFACE ELEV. (FT NGVD) 3966.82
TOP OF CASING (FT) 3967.43
MEAS. PT. ELEV. (FT) 3967.43
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.61	to	9.6
WELL SCREEN:	4 in. 0.01 Slotted PVC	9.6	to	23.9
SUMP/END CAP:	4 in. PVC Sch 40	23.9	to	25.5
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	26.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 11.6 on 06/21/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-9.0 ft. SANDY SILT (ML-SP);. brown (7.5YR 4/4), 40% fine grained sand, 60% silt/clay, moist.
							9.0-14.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), 70% fine to medium grained sand, 30% silt/clay.
							14.0-27.0 ft. SANDY GRAVEL (GP-SP); dark red brown (5YR 3/4), medium to coarse grained sand, rounded to subrounded gravel, trace of cobbles, wet.
							Total Depth 27.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0479

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0479

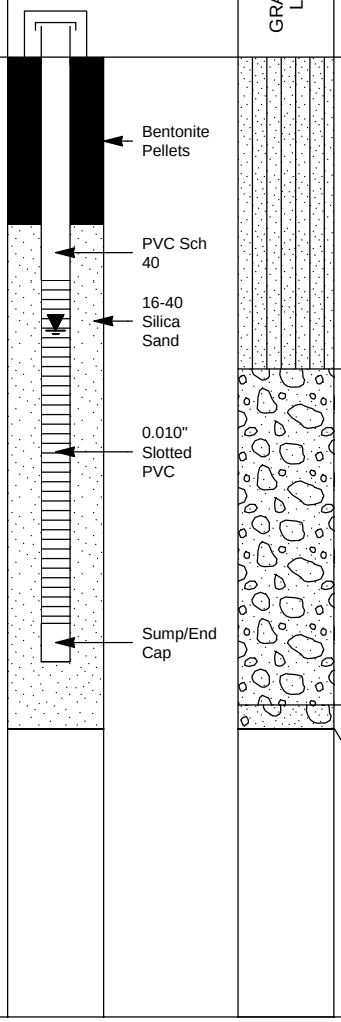
NORTH COORD. (FT) 6663559.47
EAST COORD. (FT) 2186019.45
HOLE DEPTH (FT) 28.00
WELL DEPTH (FT) 25.20

DATE DRILLED 06/21/2003
SURFACE ELEV. (FT NGVD) 3966.60
TOP OF CASING (FT) 3967.13
MEAS. PT. ELEV. (FT) 3967.13
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.53	to	9.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	9.3	to	23.6
SUMP/END CAP:	4 in. PVC Sch 40	23.6	to	25.2
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	26.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 11.4 on 06/21/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-13.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), 80% fine to medium grained sand, 20% silt/clay, moist.
							9.0-13.0 ft. color changes to reddish brown (5YR 4/4), sand is more coarse, and less silt/clay (10%).
							13.0-27.0 ft. SANDY GRAVEL (GP-SP); dark reddish brown (5YR 3/4), medium to coarse grained sand, subrounded to rounded gravel, trace of silt and cobbles, wet.
							27.0-28.0 ft. GRAVELLY SAND (SP-GP); dark red brown (5YR 3/4), slightly finer grained sand. No clay.
							Total Depth 28.0 ft.



DEPTH (FT BGL): 5, 10, 15, 20, 25, 30, 35
ELEV. (FT NGVD): 3965, 3960, 3955, 3950, 3945, 3940, 3935, 3930

MONITORING WELL COMPLETION LOG MOA01-0480

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0480

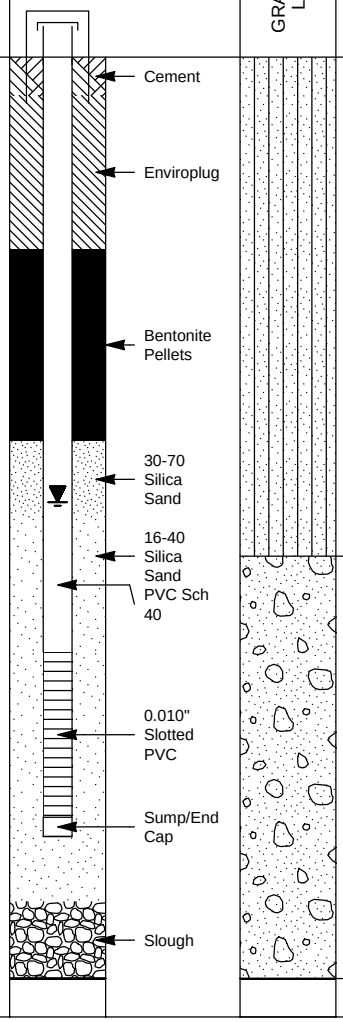
NORTH COORD. (FT) 6663451.03
EAST COORD. (FT) 2185984.93
HOLE DEPTH (FT) 24.00
WELL DEPTH (FT) 20.30

DATE DRILLED 06/21/2003
SURFACE ELEV. (FT NGVD) 3966.94
TOP OF CASING (FT) 3968.65
MEAS. PT. ELEV. (FT) 3968.65
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.71	to	15.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	15.5	to	19.8
SUMP/END CAP:	4 in. PVC Sch 40	19.8	to	20.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	12.0
LOWER PACK:	16-40 Silica Sand	12.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 11.6 on 06/21/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.
							13.0-24 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet @16.0 ft. sand becomes coarse.
							Total Depth 24.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0481

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0481

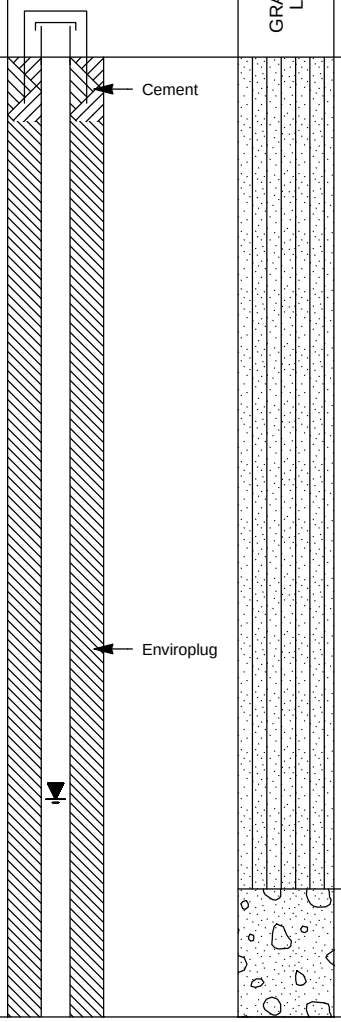
NORTH COORD. (FT) 6663447.46
EAST COORD. (FT) 2185978.30
HOLE DEPTH (FT) 33.40
WELL DEPTH (FT) 31.30

DATE DRILLED 06/20/2003
SURFACE ELEV. (FT NGVD) 3967.01
TOP OF CASING (FT) 3968.83
MEAS. PT. ELEV. (FT) 3968.83
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.82	to	25.4
WELL SCREEN:	4 in. 0.01 Slotted PVC	25.4	to	29.7
SUMP/END CAP:	4 in. PVC Sch 40	29.7	to	31.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	17.5
SEAL:	Bentonite Pellets	17.5	to	18.0
UPPER PACK:	30-70 Silica Sand	18.0	to	22.0
LOWER PACK:	16-40 Silica Sand	22.0	to	31.3

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 11.6 on 06/20/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.
	3965						
5							
	3960						
10							
	3955						
							13.0-25 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet



MONITORING WELL COMPLETION LOG MOA01-0481

PROJECT MOAB **WELL NUMBER** 0481
SITE MOAB **DATES DRILLED** 06/20/2003

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							@16.0 ft. sand becomes coarse.
	3950				Bentonite Pellets		
					30-70 Silica Sand		
20							
	3945						
					PVC Sch 40		
25					16-40 Silica Sand		25.0-29.0 ft. CLAYEY GRAVELLY SAND (SP-SC); gray brown (10YR 5/2), 50% medium to coarse grained sand (rounded), 25% clay, 15% rounded to subrounded gravel, wet.
	3940				0.010" Slotted PVC		
							29.0-33.4 ft. GRAVELLY SAND (SP-GP); grayish brown (10YR 5/2), 70% medium to coarse grained sand, 20% fine rounded to well rounded gravel, 10% rounded cobbles, wet.
30					Sump/End Cap		
	3935				Slough		
							Total Depth 33.4 ft.

MONITORING WELL COMPLETION LOG MOA01-0482

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0482

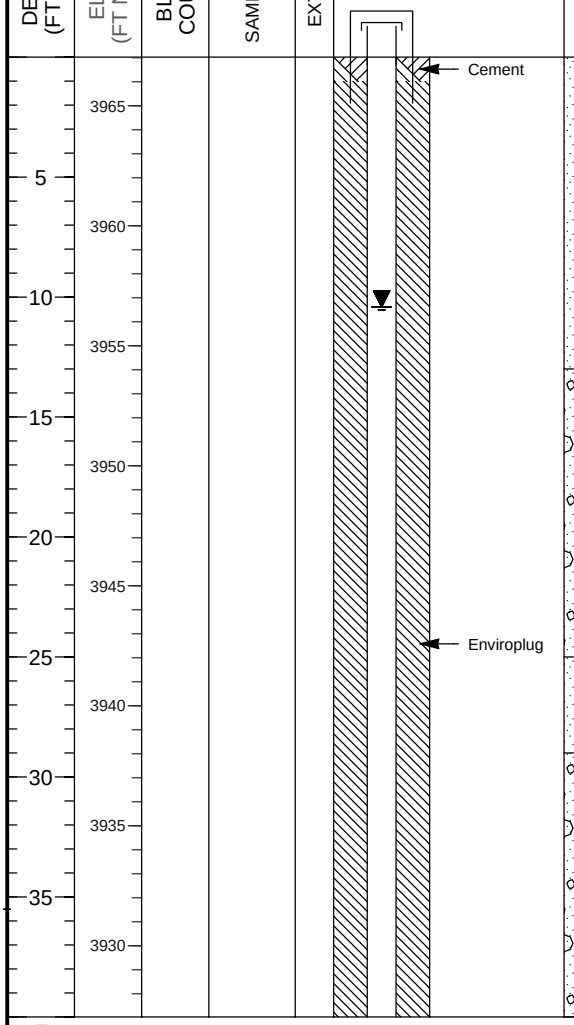
NORTH COORD. (FT) 6663455.70
EAST COORD. (FT) 2185978.84
HOLE DEPTH (FT) 64.00
WELL DEPTH (FT) 61.30

DATE DRILLED 06/19/2003
SURFACE ELEV. (FT NGVD) 3967.03
TOP OF CASING (FT) 3968.70
MEAS. PT. ELEV. (FT) 3968.70
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.67	to	55.4
WELL SCREEN:	4 in. 0.01 Slotted PVC	55.4	to	59.7
SUMP/END CAP:	4 in. PVC Sch 40	59.7	to	61.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	47.9
SEAL:	Bentonite Pellets	47.9	to	48.0
UPPER PACK:	30-70 Silica Sand	48.0	to	52.0
LOWER PACK:	16-40 Silica Sand	52.0	to	64.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 10.4 on 06/20/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.
							13.0-25 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet @16.0 ft. sand becomes coarse.
							25.0-29.0 ft. CLAYEY GRAVELLY SAND (SP-SC); gray brown (10YR 5/2), 50% medium to coarse grained sand (rounded), 25% clay, 15% rounded to subrounded gravel, wet.
							29.0-64.0 ft. GRAVELLY SAND (SP-GP); grayish brown (10YR 5/2), 70% medium to coarse grained sand, 20% fine rounded to well rounded gravel, 10% rounded cobbles, wet.



MONITORING WELL COMPLETION LOG MOA01-0482

PROJECT MOAB **WELL NUMBER** 0482
SITE MOAB **DATES DRILLED** 06/19/2003

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3925						@ 40.0 ft. slightly coarser grains, fine crystalline lithic types (up to 6.0" to 8.0" in diameter).
45							
	3920				Bentonite Pellets		
50					30-70 Silica Sand		
	3915				16-40 Silica Sand		
55					PVC Sch 40		
	3910				0.010" Slotted PVC		
60					Sump/End Cap		
	3905						
65							Total Depth 64.0 ft.
	3900						
70							
	3895						
75							
	3890						
80							
	3885						
85							
	3880						
90							

MONITORING WELL COMPLETION LOG MOA01-0483

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0483

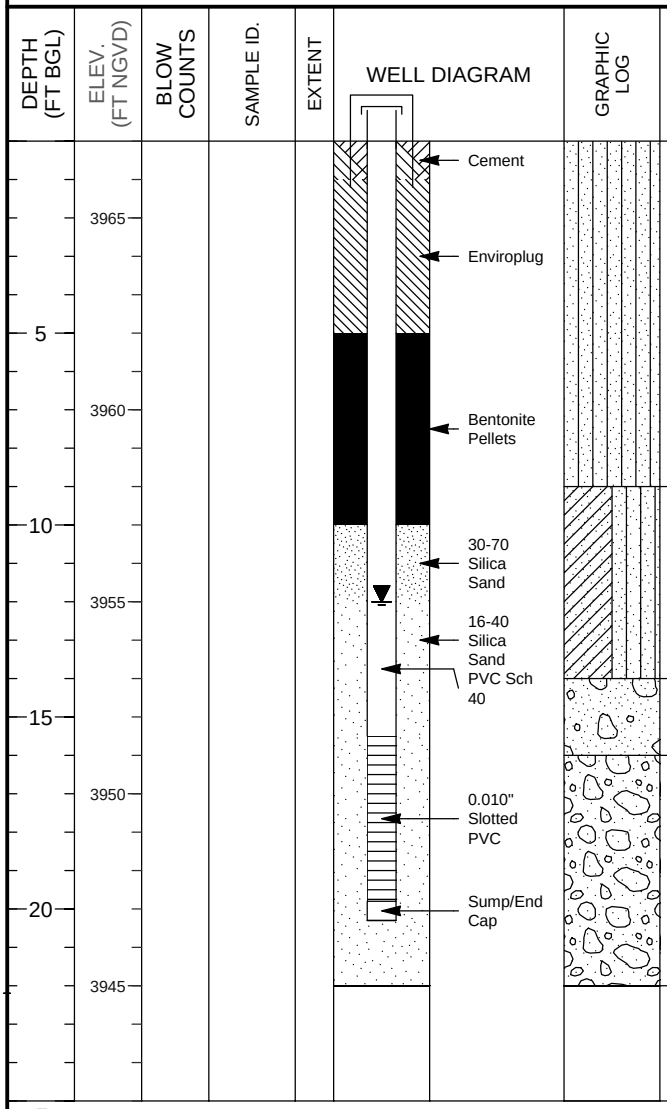
NORTH COORD. (FT) 6663447.82
EAST COORD. (FT) 2186014.93
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 20.30

DATE DRILLED 06/23/2003
SURFACE ELEV. (FT NGVD) 3967.00
TOP OF CASING (FT) 3968.90
MEAS. PT. ELEV. (FT) 3968.90
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.9	to	15.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	15.5	to	19.8
SUMP/END CAP:	4 in. PVC Sch 40	19.8	to	20.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	12.0
LOWER PACK:	16-40 Silica Sand	12.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/23/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-9.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), fine grained sand, 40% silt/clay, moist.
							9.0-14.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4); 20% fine grained sand, 60% silt, 20% clay, stiff, slightly mottled, moist.
							14.0-16.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4); fine to coarse grained sand, fine gravel, subrounded to rounded, 10% silt, moist.
							16.0-22.0 ft. SANDY GRAVEL (GP-SP); brown (7.5YR 4/4), medium to coarse grained sand, subangular to subrounded gravel, cobbles, wet.
							Total Depth 22.0 ft.



Stoller–GJO **U.S. DEPARTMENT OF ENERGY**
GRAND JUNCTION OFFICE, COLORADO

MONITORING WELL COMPLETION LOG MOA01-0484

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0484

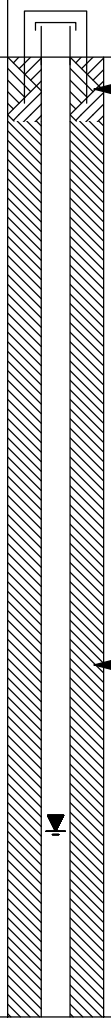
NORTH COORD. (FT) 6663457.71
EAST COORD. (FT) 2186019.38
HOLE DEPTH (FT) 32.00
WELL DEPTH (FT) 30.30

DATE DRILLED 06/22/2003
SURFACE ELEV. (FT NGVD) 3967.19
TOP OF CASING (FT) 3969.19
MEAS. PT. ELEV. (FT) 3969.19
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-2.0	to	25.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	25.5	to	29.8
SUMP/END CAP:	4 in. PVC Sch 40	29.8	to	30.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	18.0
SEAL:	Bentonite Pellets	18.0	to	18.5
UPPER PACK:	30-70 Silica Sand	18.5	to	22.0
LOWER PACK:	16-40 Silica Sand	22.0	to	32.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.1 on 06/23/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-9.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), fine grained sand, 40% silt/clay, moist.
	3965						
5							
	3960						
							9.0-14.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4); 20% fine grained sand, 60% silt, 20% clay, stiff, slightly mottled, moist.
10							
	3955						
							14.0-16.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4); fine to coarse grained sand, fine gravel, subrounded to rounded, 10%



MONITORING WELL COMPLETION LOG MOA01-0484

PROJECT MOAB **WELL NUMBER** 0484
SITE MOAB **DATES DRILLED** 06/22/2003

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							silt, moist.
							16.0-29.0 ft. SANDY GRAVEL (GP-SP); brown (7.5YR 4/4), medium to coarse grained sand, subangular to subrounded gravel, cobbles, wet.
	3950						
20					Bentonite Pellets		
					30-70 Silica Sand		
	3945						
					16-40 Silica Sand		
					PVC Sch 40		
25							
	3940				0.010" Slotted PVC		
							29.0-32.0 ft. SILTY GRAVEL (GM); dark reddish brown (5YR 3/4), 20% fine sand, subangular to subrounded gravel, minor clastic cobbles, rounded wet.
30					Sump/End Cap		
	3935						Total Depth 32.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0485

PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0485

NORTH COORD. (FT) 6663446.91
EAST COORD. (FT) 2186022.10
HOLE DEPTH (FT) 63.00
WELL DEPTH (FT) 60.40

DATE DRILLED 06/22/2003
SURFACE ELEV. (FT NGVD) 3966.99
TOP OF CASING (FT) 3968.81
MEAS. PT. ELEV. (FT) 3968.81
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.82	to	55.6
WELL SCREEN:	4 in. 0.01 Slotted PVC	55.6	to	59.9
SUMP/END CAP:	4 in. PVC Sch 40	59.9	to	60.4
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	0.0	to	47.7
SEAL:				
UPPER PACK:	30-70 Silica Sand	47.7	to	52.0
LOWER PACK:	16-40 Silica Sand	52.0	to	63.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 10.5 on 06/22/2003
LOGGED BY Pill, K.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Cement		0-9.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), fine grained sand, 40% silt/clay, moist.
5	3960						
10	3955						9.0-14.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4); 20% fine grained sand, 60% silt, 20% clay, stiff, slightly mottled, moist.
15	3950						14.0-16.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4); fine to coarse grained sand, fine gravel, subrounded to rounded, 10% silt, moist. @15.0 ft. pine cone wood fragments at 15.0 ft.
20	3945						16.0-24.0 ft. SANDY GRAVEL (GP-SP); brown (7.5YR 4/4), medium to coarse grained sand, subangular to subrounded gravel, cobbles, wet.
25	3940				Enviroplug		24.0-29.0 ft. SILTY GRAVEL (GM); yellowish red (5YR 4/6), 25% fine to medium grained sand, 30% silt/clay, subrounded to rounded gravel and cobbles, clastic, wet.
30	3935						29.0-63.0 ft. SANDY GRAVEL (GP-SP); reddish brown (5YR 4/4), medium to coarse grained sand, fine to coarse gravel, 20% subrounded to rounded cobbles, clastic, wet.
35	3930						36.0-63.0 ft. color changes to dark gray (10YR 4/1), 30% medium to coarse grained sand, fine to coarse and subangular to rounded gravel 10% clastic cobbles (up to 8.0" in diameter), well rounded, wet.

MONITORING WELL COMPLETION LOG MOA01-0485

PROJECT MOAB **WELL NUMBER** 0485
SITE MOAB **DATES DRILLED** 06/22/2003

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
45	3925						
	3920						
50					30-70 Silica Sand		
	3915				16-40 Silica Sand		@53.0 ft. no cobbles, slightly finer grained.
55					PVC Sch 40		
	3910				0.010" Slotted PVC		
60					Sump/End Cap		
	3905						
							Total Depth 63.0 ft.
65							
	3900						
70							
	3895						
75							
	3890						
80							
	3885						
85							
	3880						
90							

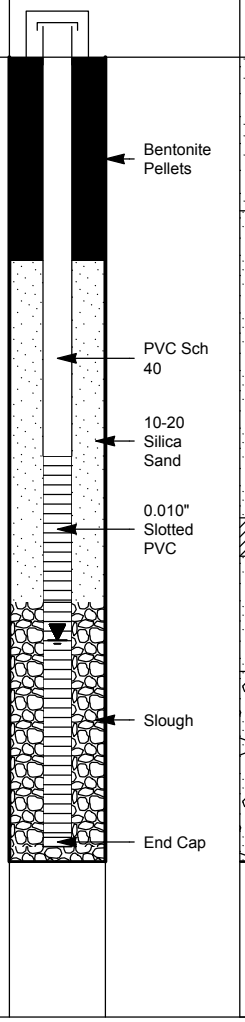
MONITORING WELL COMPLETION LOG MOA01-0551

PROJECT	MOAB	**WELL NUMBER**	0551	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663306.89	**SURFACE ELEV. (FT NGVD)**	3966.65
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2185984.62	**TOP OF CASING (FT)**	3968.67
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.95	**MEAS. PT. ELEV. (FT)**	3968.67
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.56	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.21	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	4 in. PVC Sch 40	-2.05	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.02	to	10.39
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.39	to	20.32
SUMP/END CAP:	1 in. PVC Sch 40	20.32	to	20.56
SEAL:	Bentonite Pellets	0.0	to	5.3
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.3	to	14.2

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0470 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.
5	3960				PVC Sch 40		4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.
10	3955				10-20 Silica Sand; 0.010" Slotted PVC		12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.
15							13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.
20	3950				Slough; End Cap		16.0-20.95 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.
	3945						Total Depth 20.95 ft.



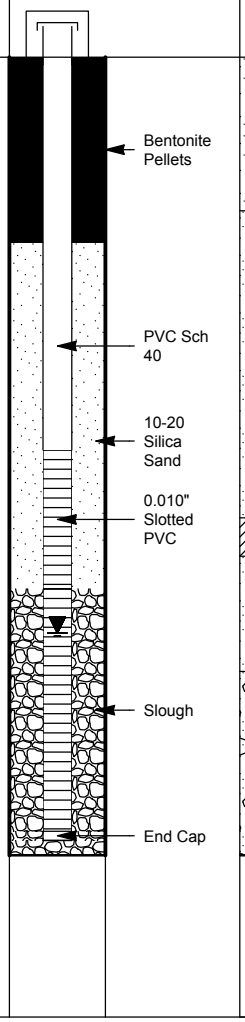
MONITORING WELL COMPLETION LOG MOA01-0552

PROJECT	MOAB	**WELL NUMBER**	0552	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663376.94	**SURFACE ELEV. (FT NGVD)**	3966.33
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2185963.03	**TOP OF CASING (FT)**	3968.40
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.79	**MEAS. PT. ELEV. (FT)**	3968.40
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.40	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.07	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-1.93	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.07	to	10.23
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.23	to	20.16
SUMP/END CAP:	1 in. PVC Sch 40	20.16	to	20.4
SEAL:	Bentonite Pellets	0.0	to	4.82
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.82	to	13.85

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0471 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.
5	3960				PVC Sch 40		4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.
10	3955				10-20 Silica Sand; 0.010" Slotted PVC		12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.
15							13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.
	3950				Slough		16.0-20.79 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.
20					End Cap		
	3945						Total Depth 20.79 ft.



MONITORING WELL COMPLETION LOG MOA01-0553

PROJECT	MOAB	**WELL NUMBER**	0553	**DATE DRILLED**	07/29/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663397.34	**SURFACE ELEV. (FT NGVD)**	3966.87
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186006.67	**TOP OF CASING (FT)**	3968.88
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	21.14	**MEAS. PT. ELEV. (FT)**	3968.88
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.75	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.72	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-1.89	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.01	to	10.58
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.58	to	20.51
SUMP/END CAP:	1 in. PVC Sch 40	20.51	to	20.75
SEAL:	Bentonite Pellets	0.0	to	5.0
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.0	to	14.2

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0473 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.
5							
	3960				PVC Sch 40		6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.
10					10-20 Silica Sand		10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.
	3955				0.010" Slotted PVC		
15							
	3950				Slough		16.0-21.14 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.
20					End Cap		
	3945						Total Depth 21.14 ft.

MONITORING WELL COMPLETION LOG MOA01-0554

PROJECT	MOAB	**WELL NUMBER**	0554	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663504.70	**SURFACE ELEV. (FT NGVD)**	3967.63
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186032.15	**TOP OF CASING (FT)**	3969.34
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.96	**MEAS. PT. ELEV. (FT)**	3969.34
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.57	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.58	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-1.87	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.71	to	10.4
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.4	to	20.33
SUMP/END CAP:	1 in. PVC Sch 40	20.33	to	20.57
SEAL:	Bentonite Pellets	0.0	to	4.9
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.9	to	13.9

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0477 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-6.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), 40% sand, fine grained, 60% silt/clay, moist.
5							
	3960				PVC Sch 40		6.0-12.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% fine sand, 60% silt, 20% clay,stiff, moist.
10					10-20 Silica Sand		
	3955				0.010" Slotted PVC		12.0-16.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/4), fine to coarse grained sand, 10% fine gravel, 15% silt, wet.
15							
	3950				Slough		16.0-20.96 ft. SANDY GRAVEL (GP-SP); gravel, brown (7.5YR 4/4), 15% silt, 25% sand, fine to coarse grained, 10% cobbles, subrounded to rounded, wet.
20					End Cap		
							Total Depth 20.96 ft.
	3945						

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GRAND JUNCTION OFFICE, COLORADO

MONITORING WELL COMPLETION LOG MOA01-0555

PROJECT	MOAB	**WELL NUMBER**	0555	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663553.79	**SURFACE ELEV. (FT NGVD)**	3967.32
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2185988.55	**TOP OF CASING (FT)**	3969.31
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.76	**MEAS. PT. ELEV. (FT)**	3969.31
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.37	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.1	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.07	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.99	to	10.2
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.2	to	20.13
SUMP/END CAP:	1 in. PVC Sch 40	20.13	to	20.37
SEAL:	Bentonite Pellets	0.0	to	5.1
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.1	to	13.95

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0478 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-9.0 ft. SANDY SILT (ML-SP);. brown (7.5YR 4/4), 40% fine grained sand, 60% silt/clay, moist.
5							
	3960				PVC Sch 40		
10					10-20 Silica Sand		9.0-14.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), 70% fine to medium grained sand, 30% silt/clay.
	3955				0.010" Slotted PVC		
15							14.0-20.76 ft. SANDY GRAVEL (GP-SP); dark red brown (5YR 3/4), medium to coarse grained sand, rounded to subrounded gravel, trace of cobbles, wet.
	3950				Slough		
20					End Cap		
							Total Depth 20.76 ft.
	3945						

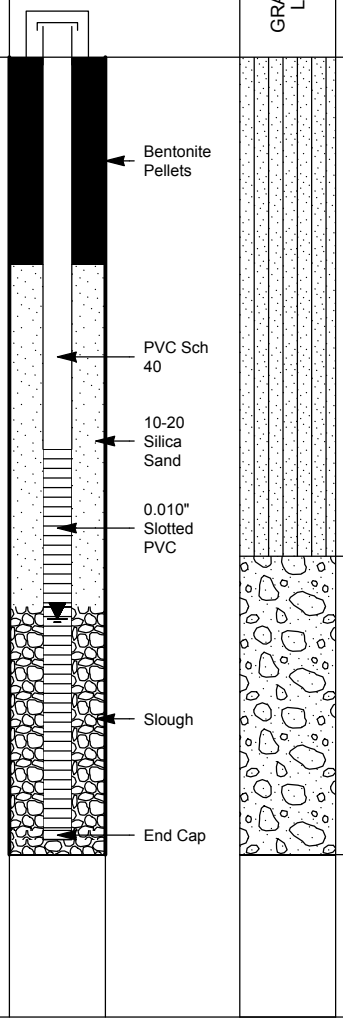
MONITORING WELL COMPLETION LOG MOA01-0556

PROJECT	MOAB	**WELL NUMBER**	0556	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663589.24	**SURFACE ELEV. (FT NGVD)**	3966.69
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186023.54	**TOP OF CASING (FT)**	3968.61
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.77	**MEAS. PT. ELEV. (FT)**	3968.61
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.38	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.55	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.21	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.92	to	10.21
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.21	to	20.14
SUMP/END CAP:	1 in. PVC Sch 40	20.14	to	20.38
SEAL:	Bentonite Pellets	0.0	to	5.41
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.41	to	14.32

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0479 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-13.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), 80% fine to medium grained sand, 20% silt/clay, moist.
5							
	3960				PVC Sch 40		
10					10-20 Silica Sand		9.0-13.0 ft. color changes to reddish brown (5YR 4/4), sand is more coarse, and less silt/clay (10%).
	3955				0.010" Slotted PVC		
15							13.0-20.77 ft. SANDY GRAVEL (GP-SP); dark reddish brown (5YR 3/4), medium to coarse grained sand, subrounded to rounded gravel, trace of silt and cobbles, wet.
	3950				Slough		
20					End Cap		
	3945						Total Depth 20.77 ft.



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MONITORING WELL COMPLETION LOG MOA01-0557

PROJECT	MOAB	**WELL NUMBER**	0557	**DATE DRILLED**	07/17/2004 to 07/18/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663451.18	**SURFACE ELEV. (FT NGVD)**	3967.01
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2185971.51	**TOP OF CASING (FT)**	3968.85
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	50.00	**MEAS. PT. ELEV. (FT)**	3968.85
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	45.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.84	to	35.0
WELL SCREEN:	6 in. Machine Slotted PVC	35.0	to	45.0
SUMP/END CAP:	6 in. PVC Sch 40	45.0	to	45.3
GROUT:	Grout	0.0	to	25.0
SEAL:	Bentonite Chips	25.0	to	29.5
UPPER PACK:	30-70 Silica Sand	29.5	to	32.5
LOWER PACK:	16-40 Silica Sand	32.5	to	50.0

DRILLER Kern, T
LOGGED BY Karp, K.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); very fine sand (ML), dark yellowish brown (10YR 4/4), dry, calcareous.
5	3960						
10	3955				Grout		10.0-15.0 ft. SILTY SAND (SM); subrounded to angular, 50% silt, 50% fine sand, poorly sorted, light brown (7.5YR 6/4), moist.
15	3950						15.0-20.0 ft. SAND (SP); fine to medium grained, subrounded to angular, wet, trace clay, trace of subrounded pebbles up to 1.0" in diameter, brown (7.5YR 4/4).
20			20 ft.		PVC Sch 40		@20.0 ft. large root fragment.
	3945						20.0-50.0 ft. SANDY GRAVEL (GW-SW); subrounded pebbles and cobbles (80%) up to 3.0" in diameter. Fine to medium grained sand matrix (20%).

MONITORING WELL COMPLETION LOG MOA01-0557

PROJECT MOAB **WELL NUMBER** 0557
SITE Moab Disposal Site **DATES DRILLED** 07/17/2004 to 07/18/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940				Bentonite Chips		25.0-30.0 ft. larger cobbles up to 6.0" in diameter.
30					30-70 Silica Sand		30.0-35.0 ft. poorly sorted gravel, mostly pebbles and cobbles up to 6.0" in diameter.
	3935				16-40 Silica Sand		
35							35.0-40.0 ft. less pebbles and cobbles (70%) and more medium sand (30%).
	3930						
40					0.010" Slotted PVC		40.0-45.0 ft. poorly sorted gravel, mostly pebbles and cobbles up to 6.0" in diameter.
	3925						
45					End Cap		45.0-50.0 ft. less pebbles and cobbles (70%) and more medium sand (30%).
	3920						
50							Total Depth 50.0 ft.
	3915						
55							

MONITORING WELL COMPLETION LOG MOA01-0558

PROJECT	MOAB	**WELL NUMBER**	0558	**DATE DRILLED**	07/17/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663455.01	**SURFACE ELEV. (FT NGVD)**	3966.85
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186026.70	**TOP OF CASING (FT)**	3968.79
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	50.00	**MEAS. PT. ELEV. (FT)**	3968.79
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	45.00	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.94	to	35.0
WELL SCREEN:	6 in. Machine Slotted PVC	35.0	to	45.0
SUMP/END CAP:	6 in. PVC Sch 40	45.0	to	45.3
GROUT:	Grout	0.0	to	24.5
SEAL:	Bentonite Chips	24.5	to	29.5
UPPER PACK:	30-70 Silica Sand	29.5	to	32.5
LOWER PACK:	16-40 Silica Sand	32.5	to	50.0

DRILLER Kern, T
LOGGED BY Karp, K.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); very fine sand, brown (7.5YR 5/4), dry, calcareous.
5	3960						5.0-10.0 ft. slightly damp, calcareous, trace of clay.
10	3955				Grout		10.0-15.0 ft. SAND (SW); moslty medium grained, subrounded to angular, and trace of pebbles up to 1/2" in diameter, poorly sorted, light reddish brown (2.5YR 6/4), damp.
15	3950						15.0-24.0 ft. SANDY GRAVEL (GW-SW); cobbles up to 6.0" in diameter, mostly gravel, damp, brown (7.5YR 5/4).
20	3945				PVC Sch 40		24.0-25.0 ft. SILT (ML), reddish brown (7.5YR 4/4), well sorted,

MONITORING WELL COMPLETION LOG MOA01-0558

PROJECT MOAB **WELL NUMBER** 0558
SITE Moab Disposal Site **DATES DRILLED** 07/17/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							calcareous, subrounded, wet.
							25.0-50.0 ft. SANDY GRAVEL (GW-SW); cobbles up to 3.0" long axis, brown (7.3YR 5/4).
	3940				Bentonite Chips		
30							30.0-40.0 ft. 80% gravel, slightly more sand, mostly medium grained.
					30-70 Silica Sand		
	3935						
					16-40 Silica Sand		
35							
	3930						
					0.010" Slotted PVC		
40							
	3925						
45					End Cap		
	3920						
50							Total Depth 50.0 ft.
	3915						
55							

MONITORING WELL COMPLETION LOG MOA01-0559

PROJECT	MOAB	**WELL NUMBER**	0559	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663441.98	**SURFACE ELEV. (FT NGVD)**	3967.84
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186073.67	**TOP OF CASING (FT)**	3969.92
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	21.08	**MEAS. PT. ELEV. (FT)**	3969.92
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.69	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	18.2	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-1.91	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.08	to	10.52
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.52	to	20.45
SUMP/END CAP:	1 in. PVC Sch 40	20.45	to	20.69
SEAL:	Bentonite Pellets	0.0	to	5.0
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.0	to	14.2

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0560 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 5/3), dry, mostly silt (80%), some very fine grained sand, calcareous, well rounded, trace mica.
	3965				Bentonite Pellets		
5							5.0-10.0 ft. slightly damp, with trace clay, some mottling. Very fine grained sand increasing, calcareous.
	3960				PVC Sch 40		
10					10-20 Silica Sand		10.0-15.0 ft. SAND (SP); fine to medium grained, damp, reddish brown (5YR 5/4), pebbles up to 3.0" in diameter, calcareous.
	3955				0.010" Slotted PVC		
15							15.0-20.0 ft. GRAVELLY SAND (SP-GP); sand (80%) is medium to fine grained, well to subrounded, cobbles (20%) up to 3.0" in diameter axis, calcareous, moist, brown (7.5YR 4/4).
	3950				Slough		
20					End Cap		20.0-21.08 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded gravel and cobbles (up to 6.0" in diameter), fine to medium grained sand matrix (~25%), wet, calcareous, brown (7.5YR 4/3).
	3945						Total Depth 21.08 ft.

MONITORING WELL COMPLETION LOG MOA01-0560

PROJECT	MOAB	**WELL NUMBER**	0560	**DATE DRILLED**	07/16/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663438.74	**SURFACE ELEV. (FT NGVD)**	3966.95
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186065.27	**TOP OF CASING (FT)**	3968.77
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3968.77
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	40.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.82	to	30.0
WELL SCREEN:	6 in. Machine Slotted PVC	30.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	40.3
GROUT:	Grout	0.0	to	20.0
SEAL:	Bentonite Chips	20.0	to	25.0
UPPER PACK:	30-70 Silica Sand	25.0	to	28.0
LOWER PACK:	16-40 Silica Sand	28.0	to	45.0

DRILLER Kern, T
LOGGED BY Karp, K.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 5/3), dry, mostly silt (80%), some very fine grained sand, calcareous, well rounded, trace mica.
5	3960						5.0-10.0 ft. slightly damp, with trace clay, some mottling. Very fine grained sand increasing, calcareous.
10	3955				Grout		10.0-15.0 ft. SAND (SP); fine to medium grained, damp, reddish brown (5YR 5/4), pebbles up to 3.0" in diameter, calcareous.
15	3950				PVC Sch 40		15.0-20.0 ft. GRAVELLY SAND (SP-GP); sand (80%) is medium to fine grained, well to subrounded, cobbles (20%) up to 3.0" in diameter axis, calcareous, moist, brown (7.5YR 4/4).
20	3945				Bentonite Chips		20.0-35.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded gravel and cobbles (up to 6.0" in diameter), fine to medium grained sand matrix (~25%), wet, calcareous, brown (7.5YR 4/3).

MONITORING WELL COMPLETION LOG MOA01-0560

PROJECT MOAB **WELL NUMBER** 0560
SITE Moab Disposal Site **DATES DRILLED** 07/16/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940				30-70 Silica Sand; 16-40 Silica Sand		25.0-30.0 ft. more sand, medium grained (30-40%).
30	3935						30.0-35.0 ft. less sandy matrix (20%), gravel and cobbles (80%), calcareous, color change to dark grayish brown (2.5Y 4/2), wet, light gray when dry (10YR 7/1).
35	3930				0.010" Slotted PVC		35.0-45.0 ft. No recovery.
40	3925				End Cap		
45	3920						Total Depth 45.0 ft.
50	3915						
55							

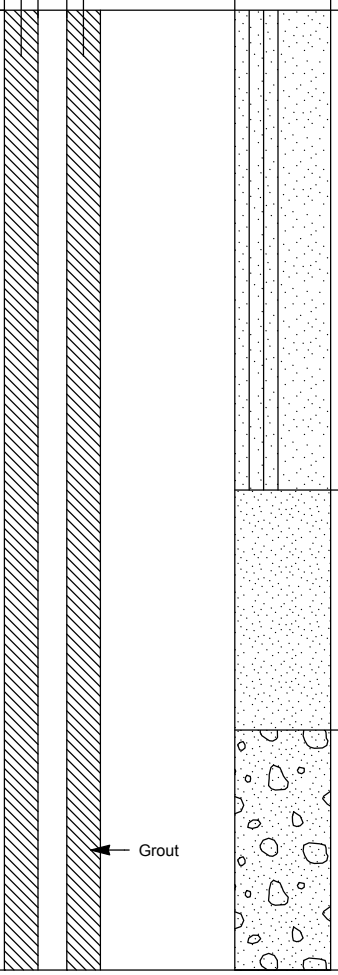
MONITORING WELL COMPLETION LOG MOA01-0561

PROJECT	MOAB	**WELL NUMBER**	0561	**DATE DRILLED**	07/15/2004 to 07/16/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663448.20	**SURFACE ELEV. (FT NGVD)**	3966.46
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186067.44	**TOP OF CASING (FT)**	3968.56
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	60.00	**MEAS. PT. ELEV. (FT)**	3968.56
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	55.50	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-2.1	to	45.2
WELL SCREEN:	6 in. Machine Slotted PVC	45.2	to	55.2
SUMP/END CAP:	6 in. PVC Sch 40	55.2	to	55.5
GROUT:	Grout	0.0	to	35.0
SEAL:	Bentonite Chips	35.0	to	40.0
UPPER PACK:	30-70 Silica Sand	40.0	to	43.0
LOWER PACK:	16-40 Silica Sand	43.0	to	60.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 5/3), dry, mostly silt with some very fine grained sand, calcareous.
5	3960						5.0-10.0 ft. slightly damp, with trace clay, some mottling, very fine grained sand increasing, calcareous.
10	3955						10.0-15.0 ft. SAND (SP); fine to medium grained sand, damp, reddish brown (5YR 5/4), trace pebbles up to 1/2" in diameter, calcareous.
15	3950				Grout		15.0-20.0 ft. GRAVELLY SAND (SP-GP); sand is medium to fine grained (80%), well to subrounded pebbles and cobbles up to 3.0" in diameter (~20%), calcareous, moist, brown (7.5YR 4/4).



MONITORING WELL COMPLETION LOG MOA01-0561

PROJECT MOAB **WELL NUMBER** 0561
SITE Moab Disposal Site **DATES DRILLED** 07/15/2004 to 07/16/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945						20.0-35.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded gravel and cobbles (up to 6.0" in diameter), and fine to medium grained sand matrix (~25%), wet, calcareous, brown (7.5YR 4/3).
25							25.0-30.0 ft. more sand, mainly medium grained (30-40%).
	3940						
30					PVC Sch 40		30.0-35.0 ft. less sandy matrix, ~80% gravel and cobbles, calcareous.
	3935						
35							35.0-40.0 ft. GRAVELLY SAND (SP-GP); mostly fine grained sand, brown (7.5YR 4/2), sand (~ 60%), pebbles and cobbles (~40%) up to 3.0" in diameter. Water in this interval.
	3930				Bentonite Chips		
40							40.0-50.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded pebbles and cobbles (up to 5.0" in diameter) and fine to medium grained sand matrix (~30%), wet, calcareous, brown (7.5YR 5/2).
	3925				30-70 Silica Sand		
					16-40 Silica Sand		
45							

MONITORING WELL COMPLETION LOG MOA01-0561

PROJECT MOAB **WELL NUMBER** 0561
SITE Moab Disposal Site **DATES DRILLED** 07/15/2004 to 07/16/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3920						
50					0.010" Slotted PVC		50.0-55.0 ft. GRAVELLY SAND (SP-GP); mostly fine to medium grained sand (~80%), calcareous, dark gray (7.5YR 4/1) to gray (7.5YR 5/1). "Salt and Pepper" sand. About 20% pebbles up to 2.0" in diameter.
	3915						
55					End Cap		55.0-60.0 ft. SANDY GRAVEL (GW-SW); about 60% subrounded to well rounded pebbles and cobbles to 3.0" in diameter. Sand matrix (~40%), is mostly fine to medium grained sand (salt and pepper), brown (7.5YR 4/2 to 7.5YR 5/2).
	3910						
60							Total Depth 60.0 ft.
	3905						
65							
	3900						
70							

Configuration 2

Well Boring and Construction Logs

MONITORING WELL COMPLETION LOG MOA01-0401

PROJECT	MOAB	**NORTH COORD. (FT)**	6663841.69	**DATE DRILLED**	12/03/2001
LOCATION	,	**EAST COORD. (FT)**	2186100.72	**SURFACE ELEV. (FT NGVD)**	3967.70
SITE	MOAB	**HOLE DEPTH (FT)**	19.00	**TOP OF CASING (FT)**	3969.60
WELL NUMBER	0401	**WELL DEPTH (FT)**	18.16	**MEAS. PT. ELEV. (FT)**	3969.60
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.9	to	13.0
WELL SCREEN:	1 in. Slotted PVC	13.0	to	17.9
SUMP/END CAP:	1 in. PVC Sch 40	17.9	to	18.16
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	11.2
UPPER PACK:	20-40 Silica Sand	11.2	to	12.3
LOWER PACK:	10-20 Silica Sand	12.3	to	14.0

DRILLING METHOD GEOPROBE
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 12/04/2001
WATER LEVEL (FT BTOC) 15.78 on 12/03/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
			0-3.5 ft.				0-5.0 ft. SAND (SP); brown to tan, fine sand to silt. Trace of black organics at 3.5 ft. Dry to moist.
	3965						
5			3.5-6.5 ft.		Bentonite Pellets		5.0-10.0 ft. SILTY CLAY (CL-ML); low plasticity, organics (roots), color change to pinkish brown, some fine sand, moist to dry.
	3960		6.5-9.5 ft		PVC Sch 40		
10			9.5-12.5 ft.		20-40 Silica Sand		10.0-14.5 ft. SAND (SP); well sorted, light brown to tan, fine to medium sand, organics on last foot (wood fragments), dry to damp.
	3955		12.5-15.5 ft.		10-20 Silica Sand		
15					0.010" Slotted PVC		14.5-19.0 ft. GRAVELLY SAND (SP-GP); sand becomes medium to coarse grained, mixture of pebbles, cobbles and gravel, moist to wet. Sandy material changes color to dark brick red at 16.0 to 17.0 ft.
	3950		15.5-19 ft.		Slough		
							Total Depth 19.0 ft.

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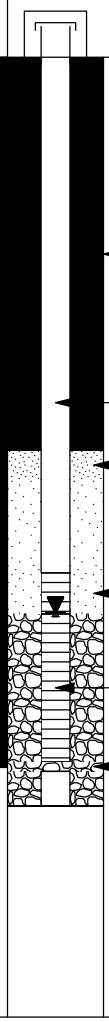
MONITORING WELL COMPLETION LOG MOA01-0402

PROJECT	MOAB	**NORTH COORD. (FT)**	6663681.81	**DATE DRILLED**	12/03/2001 to 12/04/2001
LOCATION	,	**EAST COORD. (FT)**	2186088.56	**SURFACE ELEV. (FT NGVD)**	3967.70
SITE	MOAB	**HOLE DEPTH (FT)**	19.50	**TOP OF CASING (FT)**	3968.63
WELL NUMBER	0402	**WELL DEPTH (FT)**	18.60	**MEAS. PT. ELEV. (FT)**	3968.63
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.0

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-0.93	to	13.43
WELL SCREEN:	1 in. Slotted PVC	13.43	to	18.35
SUMP/END CAP:	1 in. PVC Sch 40	18.35	to	18.6
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	10.25
UPPER PACK:	20-40 Silica Sand	10.25	to	11.0
LOWER PACK:	10-20 Silica Sand	11.0	to	14.5

DRILLING METHOD GEOPROBE
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 12/04/2001
WATER LEVEL (FT BTOC) 15.41 on 12/04/2001
LOGGED BY Hopping, B.
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965		0-3.5 ft.				0-5.0 ft. SILTY SAND (SM); light brown to brown, fine sand to silt. Abundant organics (roots) at 3.0 ft. Dry to moist.
5			3.5-6.5 ft.		Bentonite Pellets		5.0-7.5 ft. SAND WITH SILT (SP-SM); light brown to brown, fine grained sand with some silt, dry. Caliche layering at 5 ft.
	3960		6.5-9.5 ft		PVC Sch 40		7.5-9.0 ft. SILT (ML); silt mixed with organics of some calcite.
10			9.5-12.5 ft.		20-40 Silica Sand		9.0-14 ft. SAND (SP); light brown fine to medium sand, dry.
	3955		12.5-15.5 ft.		10-20 Silica Sand		14-16.5 ft. SAND (SW); medium brown sand mixed with few pebbles, wet @15.0 ft.
15			15.5-18.5 ft.		0.010" Slotted PVC		16.5-19.5 ft. GRAVELLY SAND (SP); reddish brown sand mixed with well rounded pebbles gravel, wet.
	3950				Slough		
20							Total Depth 19.5 ft.
	3945						



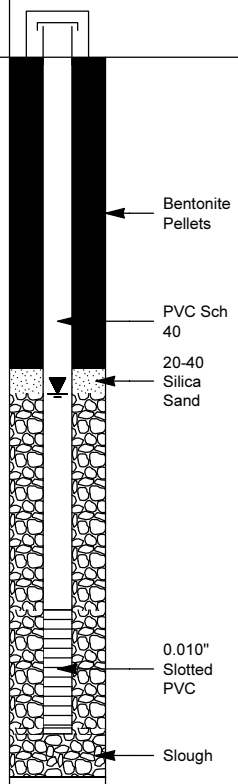
MONITORING WELL COMPLETION LOG MOA01-0408

PROJECT	MOAB	**NORTH COORD. (FT)**	6663836.19	**DATE DRILLED**	12/05/2001
LOCATION	,	**EAST COORD. (FT)**	2186099.60	**SURFACE ELEV. (FT NGVD)**	3967.80
SITE	MOAB	**HOLE DEPTH (FT)**	30.00	**TOP OF CASING (FT)**	3969.17
WELL NUMBER	0408	**WELL DEPTH (FT)**	28.20	**MEAS. PT. ELEV. (FT)**	3969.17
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.37	to	23.03
WELL SCREEN:	1 in. Slotted PVC	23.03	to	27.95
SUMP/END CAP:	1 in. PVC Sch 40	27.95	to	28.2
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	13.0
UPPER PACK:				
LOWER PACK:	20-40 Silica Sand	13.0	to	14.0

DRILLING METHOD GEOPROBE
SAMPLING METHOD
DATE DEVELOPED 12/05/2001
WATER LEVEL (FT BTOC) 15.4 on 12/05/2001
LOGGED BY Hopping, B.
REMARKS Bottom 1.05 ft. filled with fines (material installed). Actual TD will change after well development.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							No Samples taken.
							Total Depth 30.0 ft.



5 10 15 20 25 30 35

3965 3960 3955 3950 3945 3940 3935 3930

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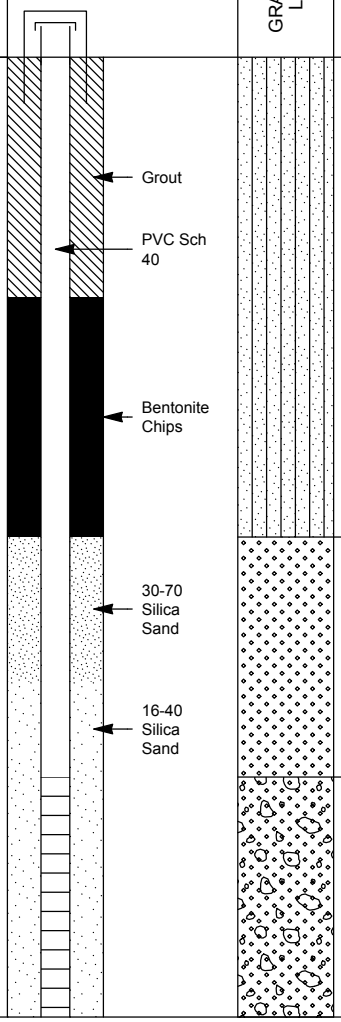
MONITORING WELL COMPLETION LOG MOA01-0570

PROJECT	MOAB	**WELL NUMBER**	0570	**DATE DRILLED**	07/28/2004 to 07/29/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663580.95	**SURFACE ELEV. (FT NGVD)**	3967.52
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186073.15	**TOP OF CASING (FT)**	3965.22
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	35.00	**MEAS. PT. ELEV. (FT)**	3965.22
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	31.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.3	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	15.0	to	30.0
SUMP/END CAP:	6 in. PVC Sch 40	30.0	to	31.3
GROUT:	Grout	0.0	to	5.0
SEAL:	Bentonite Chips	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	13.0
LOWER PACK:	16-40 Silica Sand	13.0	to	35.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%), and ~20% silt, brown (7.5YR 5/4).
	3965				Grout; PVC Sch 40		
5							5.0-10.0 ft. sightly damp, brown (7.5YR 5/3).
	3960				Bentonite Chips		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/4), trace small pebbles up to 1/4" in diameter.
	3955				30-70 Silica Sand; 16-40 Silica Sand		
15							15.0-25.0 ft. GRAVELLY SAND (SW-GW); moist to wet, ~80% sand, very fine grained to medium grained, ~20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4).
	3950						



MONITORING WELL COMPLETION LOG MOA01-0570

PROJECT MOAB **WELL NUMBER** 0570
SITE Moab Disposal Site **DATES DRILLED** 07/28/2004 to 07/29/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945				PVC Vee Wire Wrap		20.0-25.0 ft. approximately equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet.
25					Lower 5.0 ft. of screen is SS Vee Wire Wrapped.		25.0-35.0 ft. SANDY GRAVEL (GW-SW); approximately 70% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/2), wet.
	3940						
30					Sump/End Cap		30.0-35.0 ft. slightly more sand, fine to very fine grained (~35-40%). Runny sand begins at approximately 34.0 ft. Sand is dark grayish brown (10YR 4/2). Calcareous throughout hole.
	3935						
35							Total Depth 35.0 ft.
	3930						
40							
	3925						
45							

MONITORING WELL COMPLETION LOG MOA01-0571

PROJECT	MOAB	**WELL NUMBER**	0571	**DATE DRILLED**	07/27/2004 to 07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663611.00	**SURFACE ELEV. (FT NGVD)**	3967.01
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186078.14	**TOP OF CASING (FT)**	3964.89
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3964.89
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	41.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.12	to	25.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	41.3
GROUT:	Grout	0.0	to	15.0
SEAL:	Bentonite Chips	15.0	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	45.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (~80%) and ~20% silt, brown (7.5YR 5/4).
5							5.0-10.0 ft. trace clay that has white (caliche) mottles, brown (7.5YR 5/3), slightly damp.
	3960				Grout		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/4), trace pebbles up to 1/2" in diameter, trace burned woody material.
	3955				PVC Sch 40		
15							15.0-20.0 ft. GRAVELLY SAND (SW-GW); moist to wet, ~80% sand, very fine to medium grained, ~20% pebbles and cobbles up to 4.0" in diameter, matrix sand is brown (7.5YR 4/4).
	3950				Bentonite Chips		
20							20.0-25.0 ft. approximately equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet.
	3945				30-70 Silica Sand 16-40 Silica Sand		

MONITORING WELL COMPLETION LOG MOA01-0571

PROJECT MOAB **WELL NUMBER** 0571
SITE Moab Disposal Site **DATES DRILLED** 07/27/2004 to 07/28/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						25.0-45.0 ft. SANDY GRAVEL (GW-SW); 70% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/2), wet.
30							30.0-35.0 ft. more sand (35-40%), mostly fine to medium grained, dark grayish brown (10YR 4/2), wet.
	3935				PVC Vee Wire Wrap		
35							35.0-40.0 ft. sand becoming mostly fine grained and runny-water saturated.
	3930						
40					Sump/End Cap		40.0-45.0 ft. more runny-sand (very fine to fine grained) and cobbles up to 6.0" in diameter, matrix is dark grayish brown (10YR 4/2). Calcareous throughout hole.
	3925						
45							Total Depth 45.0 ft.
	3920						
50							
	3915						
55							

MONITORING WELL COMPLETION LOG MOA01-0572

PROJECT	MOAB	**WELL NUMBER**	0572	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663640.46	**SURFACE ELEV. (FT NGVD)**	3967.01
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186084.14	**TOP OF CASING (FT)**	3965.14
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	35.00	**MEAS. PT. ELEV. (FT)**	3965.14
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	31.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	1.87	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	15.0	to	30.0
SUMP/END CAP:	6 in. PVC Sch 40	30.0	to	31.3
GROUT:	Grout	0.0	to	5.0
SEAL:	Bentonite Chips	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	13.0
LOWER PACK:	16-40 Silica Sand	13.0	to	35.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%) and ~20% silt, brown (7.5YR 5/4).
5	3960				Bentonite Chips		5.0-10.0 ft. trace clay that has white (caliche) mottles, brown (7.5YR 5/3), slightly damp.
10	3955				30-70 Silica Sand; 16-40 Silica Sand		10.0-15.0 ft. SAND (SW); mostly fine to medium grained sand, damp, brown (7.5YR 5/4), trace pebbles up to 1/2" in diameter, trace burned woody material.
15	3950						15.0-25.0 ft. GRAVELLY SAND (SW-GW); moist to wet, 80-85% sand, very fine to medium grained. Pebbles (~15%) up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4), some clay/silt (~5%).

MONITORING WELL COMPLETION LOG MOA01-0572

PROJECT MOAB **WELL NUMBER** 0572
SITE Moab Disposal Site **DATES DRILLED** 07/27/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945				PVC Vee Wire Wrap		20.0-25.0 ft. gravelly sand to sandy gravel. Equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet
25							25.0-35.0 ft. SANDY GRAVEL (GW-SW); ~70% gravel and cobbles up to 4.0" in diameter, matrix sandy material is fine grained to medium grained sand and brown (7.5YR 4/3), wet.
	3940						
30					Sump/End Cap		30.0-35.0 ft. more sand, very fine to fine grained, which becomes runny-water saturated near 35.0 ft, dark grayish brown (10YR 4/2). Calcareous throughout hole depth.
	3935						
35							Total Depth 35.0 ft.
	3930						
40							
	3925						
45							

MONITORING WELL COMPLETION LOG MOA01-0573

PROJECT	MOAB	**WELL NUMBER**	0573	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663668.84	**SURFACE ELEV. (FT NGVD)**	3967.70
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186086.40	**TOP OF CASING (FT)**	3965.15
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3965.15
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	41.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.55	to	25.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	41.3
GROUT:	Grout	0.0	to	15.0
SEAL:	Bentonite Chips	15.0	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	45.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%) and 20% silt, brown (7.5YR 5/4), dry.
5							5.0-10.0 ft. trace of clay with mottles (white), brown (7.5YR 5/3), slightly damp.
	3960				Grout		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained sand, damp, brown (7.5YR 5/3), trace pebbles up to 1/2" in diameter.
	3955				PVC Sch 40		
15							15.0-25.0 ft. GRAVELLY SAND (SW-GW): moist, 80-85% sand, very fine to medium grained, ~15-20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4).
	3950		17.0 ft.		Bentonite Chips		@~17.0 ft. woody material, slightly carbonized.
20							20.0-25.0 ft. increase in amount of pebbles up to 2.0" in diameter (~25-30%), wet, brown (7.5YR 4/3).
	3945				30-70 Silica Sand 16-40 Silica Sand		

MONITORING WELL COMPLETION LOG MOA01-0573

PROJECT MOAB **WELL NUMBER** 0573
SITE Moab Disposal Site **DATES DRILLED** 07/27/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						25.0-45.0 ft. SANDY GRAVEL (GW-SW); approximately 65% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/3), wet.
30							30.0-35.0 ft. more sand, very fine to fine grained, becomes runny-water saturated at 35.0 ft, dark grayish brown sandy matrix (10YR 4/2).
	3935				PVC Vee Wire Wrap		
35							35.0-40.0 ft. less runny sand and more (~70%) large cobbles (up to 6.0" in diameter). Sandy matrix is dark grayish brown (10YR 4/2). Calcareous throughout hole depth.
	3930						
40					Sump/End Cap		40.0-45.0 ft. large cobbles (up to 6.0" in diameter).
	3925						
45							Total Depth 45.0 ft.
	3920						
50							
	3915						
55							

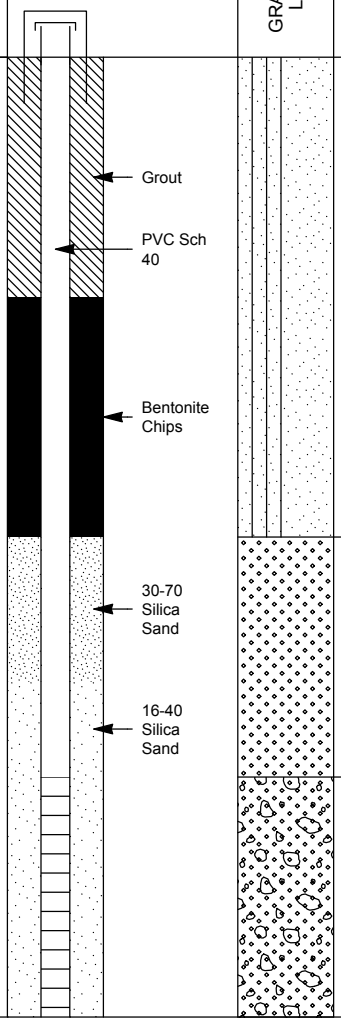
MONITORING WELL COMPLETION LOG MOA01-0574

PROJECT	MOAB	**WELL NUMBER**	0574	**DATE DRILLED**	07/26/2004 to 07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663699.41	**SURFACE ELEV. (FT NGVD)**	3967.30
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186095.79	**TOP OF CASING (FT)**	3965.12
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	35.00	**MEAS. PT. ELEV. (FT)**	3965.12
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	31.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.18	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	15.0	to	30.0
SUMP/END CAP:	6 in. PVC Sch 40	30.0	to	31.3
GROUT:	Grout	0.0	to	5.0
SEAL:	Bentonite Chips	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	13.0
LOWER PACK:	16-40 Silica Sand	13.0	to	35.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-10.0 ft. SANDY SILT (ML-SP); dry, mostly silt (80%) and ~20% very fine grained sand, pale brown (10YR 6/3).
5							5.0-10.0 ft. trace clay with mottles (white), brown (7.5YR 5/3), slightly damp.
	3960				Bentonite Chips		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/3), trace pebbles up to 1/2" in diameter.
	3955				30-70 Silica Sand; 16-40 Silica Sand		
15							15.0-25.0 ft. GRAVELLY SAND (SW-GW); moist, 80% sand, very fine to medium grained, 20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/3).
	3950						



MONITORING WELL COMPLETION LOG MOA01-0574

PROJECT MOAB **WELL NUMBER** 0574
SITE Moab Disposal Site **DATES DRILLED** 07/26/2004 to 07/27/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945				PVC Vee Wire Wrap		20.0-25.0 ft. increasing amount of pebbles (25-30%), wet.
25							25.0-35.0 ft. SANDY GRAVEL (GW-SW), approximately 60-65% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/2), wet.
	3940						
30					Sump/End Cap		30.0-35.0 ft. slightly more sand (40%), wet.
	3935						
35							Total Depth 35.0 ft.
	3930						
40							
	3925						
45							

MONITORING WELL COMPLETION LOG MOA01-0575

PROJECT	MOAB	**WELL NUMBER**	0575	**DATE DRILLED**	07/26/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663728.34	**SURFACE ELEV. (FT NGVD)**	3967.30
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186099.71	**TOP OF CASING (FT)**	3965.01
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3965.01
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	41.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.29	to	25.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	41.3
GROUT:	Grout	0.0	to	15.0
SEAL:	Bentonite Chips	15.0	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	45.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-5.0 ft. SILTY SAND (SM); approximately 80% very fine grained sand with 20% silt, pale brown (10YR 6/3), dry.
5	3960				Grout		5.0-10.0 ft. SANDY SILT (ML-SP); slightly damp, mostly silt (80%) and ~20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				PVC Sch 40		10.0-15.0 ft. SAND (SW); fine to medium grained, damp, brown (7.5YR 5/3).
15	3950				Bentonite Chips		15.0-20.0 ft. GRAVELLY SAND (SW-GW); moist, ~80% sand, very fine to medium grained, ~20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/3).
20	3945				30-70 Silica Sand; 16-40 Silica Sand		20.0-45.0 ft. SANDY GRAVEL (GW-SW); ~60% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/3), wet.

MONITORING WELL COMPLETION LOG MOA01-0575

PROJECT MOAB **WELL NUMBER** 0575
SITE Moab Disposal Site **DATES DRILLED** 07/26/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						25.0-30.0 ft. gravel increases to ~75%, matrix sand is brown (7.5YR 4/2).
30							30.0-35.0 ft. gravel increases to 80%, well rounded gravel and cobbles (up to 6.0" in diameter), ~20% fine grained sand matrix, brown (7.5YR 4/2), wet.
	3935				PVC Vee Wire Wrap		
35							35.0-40.0 ft. more sand (~25%), which is runny-water saturated.
	3930						
40					Sump/End Cap		40.0-45.0 ft. less sand (15-20%) and less runny.
	3925						
45							Total Depth 45.0 ft.
	3920						
50							
	3915						
55							

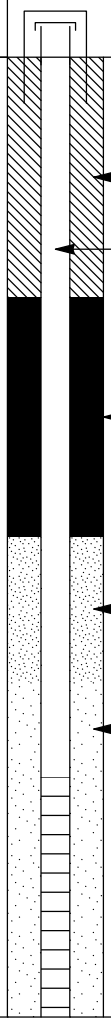
MONITORING WELL COMPLETION LOG MOA01-0576

PROJECT	MOAB	**WELL NUMBER**	0576	**DATE DRILLED**	07/26/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663757.65	**SURFACE ELEV. (FT NGVD)**	3967.17
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186105.08	**TOP OF CASING (FT)**	3965.15
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	35.00	**MEAS. PT. ELEV. (FT)**	3965.15
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	31.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.02	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	15.0	to	30.0
SUMP/END CAP:	6 in. PVC Sch 40	30.0	to	31.3
GROUT:	Grout	0.0	to	5.0
SEAL:	Bentonite Chips	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	13.0
LOWER PACK:	16-40 Silica Sand	13.0	to	35.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SILTY SAND (SM); dry, ~80% very fine grained sand with ~20% silt, brown (7.5YR 4/2).
5	3960				Bentonite Chips		5.0-10.0 ft. SANDY SILT (ML-SP); dry, ~80% silt, and ~20% very fine grained sand, brown (7.5YR 5/4), trace clay.
10	3955				30-70 Silica Sand; 16-40 Silica Sand		10.0-15.0 ft. SAND (SP); mostly very fine grained sand, damp, trace of pebbles and cobbles up to 2.0" in diameter, brown (7.5YR 4/4).
15	3950						15.0-35.0 ft. GRAVELLY SAND (SW-GW); damp to moist, ~60% sand, very fine to medium grained, ~40% pebbles and cobbles up to 3.0" in diameter, matrix sand is brown (7.5YR 4/4).

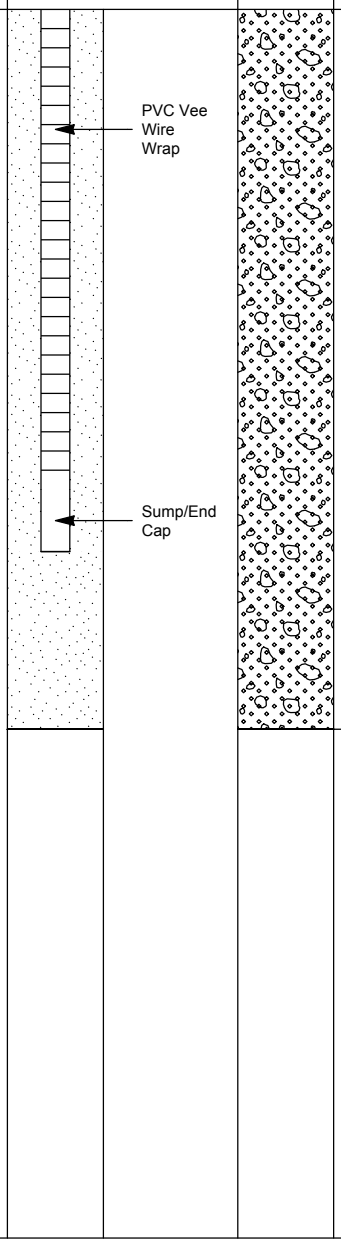


MONITORING WELL COMPLETION LOG MOA01-0576

PROJECT MOAB **WELL NUMBER** 0576
SITE Moab Disposal Site **DATES DRILLED** 07/26/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3945				PVC Vee Wire Wrap		20.0-30.0 ft. approximately equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet, calcareous throughout hole depth.
25							
	3940						
30					Sump/End Cap		30.0-35.0 ft. more sand and more water in sample.
	3935						
35							Total Depth 35.0 ft.
	3930						
40							
	3925						
45							



MONITORING WELL COMPLETION LOG MOA01-0577

PROJECT	MOAB	**WELL NUMBER**	0577	**DATE DRILLED**	07/19/2004 to 07/20/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663787.03	**SURFACE ELEV. (FT NGVD)**	3967.59
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186110.53	**TOP OF CASING (FT)**	3965.10
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3965.10
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	41.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.49	to	25.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	41.3
GROUT:	Grout	0.0	to	15.0
SEAL:	Bentonite Chips	15.0	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	45.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-5.0 ft. SILTY SAND (SM); damp, mostly very fine grained sand (80%), 20% silt, brown (7.5YR 4/2).
5	3960				Grout		5.0-10.0 ft. SANDY SILT (ML-SP); dry, 80% silt, and 20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				PVC Sch 40		10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/3), trace pebbles (1/2" in diameter).
15	3950		15.0-20.0 ft.		Bentonite Chips		15.0-30.0 ft. GRAVELLY SAND (SW-GW); damp to moist, 75-80% very fine to medium grained sand, 20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 5/3). @15.0-20.0 ft. sample of small seed pod (1/2" in diameter), partially carbonized (?), possibly a Russian Olive.
20	3945				30-70 Silica Sand 16-40 Silica Sand		20.0-30.0 ft. equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet, calcareous throughout hole depth.

MONITORING WELL COMPLETION LOG MOA01-0577

PROJECT MOAB **WELL NUMBER** 0577
SITE Moab Disposal Site **DATES DRILLED** 07/19/2004 to 07/20/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						
30							30.0-45.0 ft. SANDY GRAVEL (GW-SW), mostly (80%) well rounded gravel and cobbles (up to 6.0" in diameter), approximately 20% fine to medium grained sand matrix, brown (7.5YR 4/2), wet.
	3935				PVC Vee Wire Wrap		
35							
	3930						
40					Sump/End Cap		40.0-45.0 ft. greater amount of very fine grained sand (30%), wet and runny, sand matrix is dark grayish brown (10YR 4/2).
	3925						
45							Total Depth 45.0 ft.
	3920						
50							
	3915						
55							

MONITORING WELL COMPLETION LOG MOA01-0578

PROJECT	MOAB	**WELL NUMBER**	0578	**DATE DRILLED**	07/18/2004 to 07/19/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663818.80	**SURFACE ELEV. (FT NGVD)**	3967.80
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186115.88	**TOP OF CASING (FT)**	3965.08
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	35.00	**MEAS. PT. ELEV. (FT)**	3965.08
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	31.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.72	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	15.0	to	30.0
SUMP/END CAP:	6 in. PVC Sch 40	30.0	to	31.3
GROUT:	Grout	0.0	to	5.0
SEAL:	Bentonite Chips	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	13.0
LOWER PACK:	16-40 Silica Sand	13.0	to	35.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SILTY SAND (SM); brown (10YR 5/3), 80% very fine sand, 20% silt, dry.
5	3960				Bentonite Chips		5.0-10.0 ft. SANDY SILT (ML-SP); brown (10YR 4/3), 80% silt, 20% very fine sand, slightly moist.
10			10.0 ft.		30-70 Silica Sand		@10.0 ft. small piece of wood about 3.0" x 1/4". 10.0-15.0 ft. SAND (SW); brown (7.5YR 5/4), 80% fine sand, 10% silt, 10% medium sand including trace amount of 1/4" to 1/2" pebbles, slightly moist. Piece of wood fragment about 9.0" x 1.5".
	3955				16-40 Silica Sand		
15			15.0 ft.				@15.0 ft. wood fragment about 9.0" x 1.5". 15.0-35.0 ft. GRAVELLY SAND (SW-GW); brown (7.5YR 4/3), 20% gravel up to 2.0" in diameter, 80% matrix of mostly very fine to medium grained sand.
	3950						

MONITORING WELL COMPLETION LOG MOA01-0578

PROJECT MOAB **WELL NUMBER** 0578
SITE Moab Disposal Site **DATES DRILLED** 07/18/2004 to 07/19/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
			22.0 ft.		PVC Vee Wire Wrap; Sump/End Cap		20.0-35.0 ft. wet, approximately equal amounts of sand (medium to fine grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3). Calcareous throughout hole depth. @22.0 ft. soft unburned wood fragments.
25	3945						
30	3940						
35	3935						Total Depth 35.0 ft.
40	3930						
45	3925						

MONITORING WELL COMPLETION LOG MOA01-0579

PROJECT	MOAB	**WELL NUMBER**	0579	**DATE DRILLED**	07/12/2004 to 07/18/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663846.60	**SURFACE ELEV. (FT NGVD)**	3967.21
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186121.18	**TOP OF CASING (FT)**	3965.11
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3965.11
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	41.30	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	2.1	to	25.0
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	25.0	to	40.0
SUMP/END CAP:	6 in. PVC Sch 40	40.0	to	41.3
GROUT:	Grout	0.0	to	14.5
SEAL:	Bentonite Chips	14.5	to	19.5
UPPER PACK:	30-70 Silica Sand	19.5	to	22.5
LOWER PACK:	16-40 Silica Sand	22.5	to	45.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS Extraction Well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), slightly damp, mostly silt and very fine grained sand, trace clay.
5							
	3960				Grout		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 4/4).
	3955				PVC Sch 40		
15							15.0-20.0 ft. GRAVELLY SAND (SP-GP); damp to moist, brown (7.5YR 4/4), sand (75%) and gravel (25%) up to 3.0" in diameter.
	3950				Bentonite Chips		
20							20.0-25.0 ft. SANDY GRAVEL (GW-SW); mostly well rounded gravel of 1.0" to 4.0" in diameter (70%), and fine to medium grained sand (30%), wet, brown.
					30-70 Silica Sand		
	3945						
					16-40 Silica Sand		

MONITORING WELL COMPLETION LOG MOA01-0579

PROJECT MOAB **WELL NUMBER** 0579
SITE Moab Disposal Site **DATES DRILLED** 07/12/2004 to 07/18/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						25.0-45.0 ft. GRAVELLY SAND (SP-GP); mostly fine to medium grained sand (60%), and well-rounded cobbles 1.0" to 3.0" in diameter (40%), brown (7.5YR 4/2).
30							
	3935				PVC Vee Wire Wrap		@33.0 ft. becomes more sandy and fewer cobbles.
35							
	3930						@38.0 ft. More sand (80%) and cobbles (20%) up to 2.0" in diameter, brown (7.5YR 4/2).
40					Sump/End Cap		
	3925						
45							Total Depth 45.0 ft.
	3920						
50							
	3915						
55							

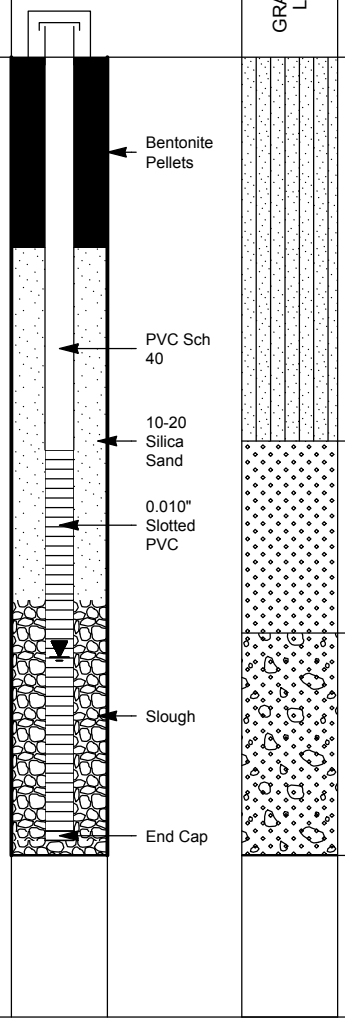
MONITORING WELL COMPLETION LOG MOA01-0580

PROJECT	MOAB	**WELL NUMBER**	0580	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663550.52	**SURFACE ELEV. (FT NGVD)**	3967.52
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186065.17	**TOP OF CASING (FT)**	3969.32
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.79	**MEAS. PT. ELEV. (FT)**	3969.32
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.40	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.43	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.14	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.8	to	10.23
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.23	to	20.16
SUMP/END CAP:	1 in. PVC Sch 40	20.16	to	20.4
SEAL:	Bentonite Pellets	0.0	to	4.95
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.95	to	14.15

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0570 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%), and ~20% silt, brown (7.5YR 5/4).
5							5.0-10.0 ft. sightly damp, brown (7.5YR 5/3).
	3960				PVC Sch 40		
10					10-20 Silica Sand		10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/4), trace small pebbles up to 1/4" in diameter.
	3955				0.010" Slotted PVC		
15							15.0-20.79 ft. GRAVELLY SAND (SW-GW); moist to wet, ~80% sand, very fine grained to medium grained, ~20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4).
	3950				Slough		
20					End Cap		
							Total Depth 20.79 ft.
	3945						



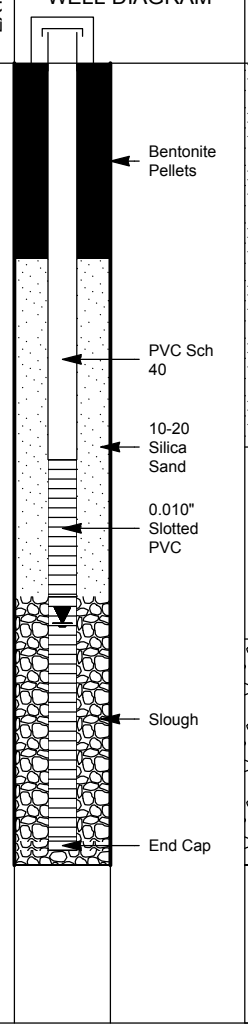
MONITORING WELL COMPLETION LOG MOA01-0581

PROJECT	MOAB	**WELL NUMBER**	0581	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663630.59	**SURFACE ELEV. (FT NGVD)**	3967.01
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186051.86	**TOP OF CASING (FT)**	3969.02
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.89	**MEAS. PT. ELEV. (FT)**	3969.02
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.50	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.6	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.09	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.01	to	10.33
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.33	to	20.26
SUMP/END CAP:	1 in. PVC Sch 40	20.26	to	20.5
SEAL:	Bentonite Pellets	0.0	to	5.1
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.1	to	13.9

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0571 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (~80%) and ~20% silt, brown (7.5YR 5/4).
5	3960				PVC Sch 40		5.0-10.0 ft. trace clay that has white (caliche) mottles, brown (7.5YR 5/3), slightly damp.
10	3955				10-20 Silica Sand; 0.010" Slotted PVC		10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/4), trace pebbles up to 1/2" in diameter, trace burned woody material.
15	3950				Slough		15.0-20.89 ft. GRAVELLY SAND (SW-GW); moist to wet, ~80% sand, very fine to medium grained, ~20% pebbles and cobbles up to 4.0" in diameter, matrix sand is brown (7.5YR 4/4).
20	3945				End Cap		Total Depth 20.89 ft.



Stoller

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GRAND JUNCTION OFFICE, COLORADO

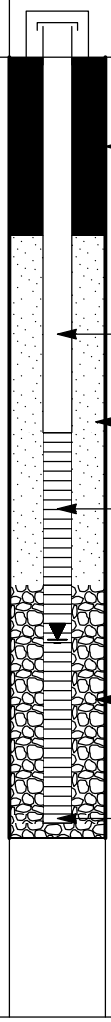
MONITORING WELL COMPLETION LOG MOA01-0582

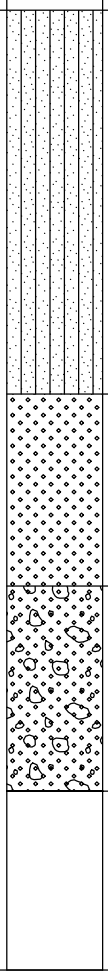
PROJECT	MOAB	**WELL NUMBER**	0582	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663621.04	**SURFACE ELEV. (FT NGVD)**	3967.67
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186094.78	**TOP OF CASING (FT)**	3969.65
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.34	**MEAS. PT. ELEV. (FT)**	3969.65
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.95	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	17.15	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.06	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.98	to	9.78
WELL SCREEN:	1 in. 0.01 Slotted PVC	9.78	to	19.71
SUMP/END CAP:	1 in. PVC Sch 40	19.71	to	19.95
SEAL:	Bentonite Pellets	0.0	to	4.65
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.65	to	13.75

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0572 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%) and ~20% silt, brown (7.5YR 5/4).
5							5.0-10.0 ft. trace clay that has white (caliche) mottles, brown (7.5YR 5/3), slightly damp.
	3960				PVC Sch 40		
					10-20 Silica Sand		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained sand, damp, brown (7.5YR 5/4), trace pebbles up to 1/2" in diameter, trace burned woody material.
					0.010" Slotted PVC		
	3955						
15							15.0-20.34 ft. GRAVELLY SAND (SW-GW); moist to wet, 80-85% sand, very fine to medium grained. Pebbles (~15%) up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4), some clay/silt (~5%).
					Slough		
	3950						
20					End Cap		
							Total Depth 20.34 ft.
	3945						





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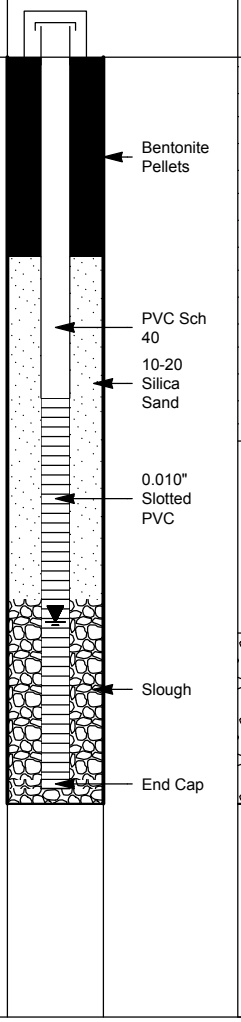
MONITORING WELL COMPLETION LOG MOA01-0583

PROJECT	MOAB	**WELL NUMBER**	0583	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663718.85	**SURFACE ELEV. (FT NGVD)**	3967.53
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186067.22	**TOP OF CASING (FT)**	3969.64
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	19.44	**MEAS. PT. ELEV. (FT)**	3969.64
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.05	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.82	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.39	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-2.11	to	8.88
WELL SCREEN:	1 in. 0.01 Slotted PVC	8.88	to	18.81
SUMP/END CAP:	1 in. PVC Sch 40	18.81	to	19.05
SEAL:	Bentonite Pellets	0.0	to	5.2
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.2	to	14.12

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0574 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dry, mostly silt (80%) and ~20% very fine grained sand, pale brown (10YR 6/3).
5	3965, 3960						5.0-10.0 ft. trace clay with mottles (white), brown (7.5YR 5/3), slightly damp.
10	3955						10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/3), trace pebbles up to 1/2" in diameter.
15	3950						15.0-19.44 ft. GRAVELLY SAND (SW-GW); moist, 80% sand, very fine to medium grained, 20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/3).
20	3945						Total Depth 19.44 ft.



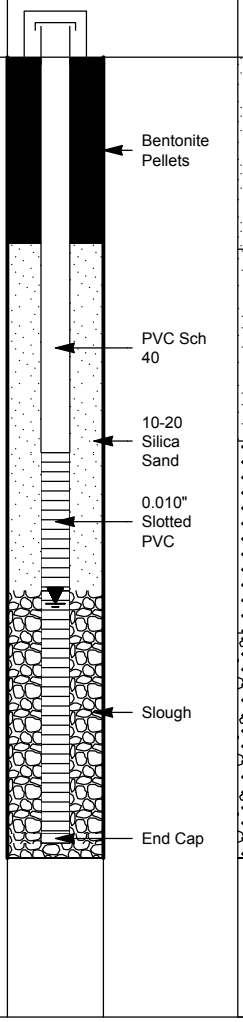
MONITORING WELL COMPLETION LOG MOA01-0584

PROJECT	MOAB	**WELL NUMBER**	0584	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663747.08	**SURFACE ELEV. (FT NGVD)**	3967.17
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186072.43	**TOP OF CASING (FT)**	3969.13
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.86	**MEAS. PT. ELEV. (FT)**	3969.13
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.47	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.19	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.41	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.96	to	10.3
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.3	to	20.23
SUMP/END CAP:	1 in. PVC Sch 40	20.23	to	20.47
SEAL:	Bentonite Pellets	0.0	to	4.85
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.85	to	13.9

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0575 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-5.0 ft. SILTY SAND (SM); approximately 80% very fine grained sand with 20% silt, pale brown (10YR 6/3), dry.
5	3960				PVC Sch 40		5.0-10.0 ft. SANDY SILT (ML-SP); slightly damp, mostly silt (80%) and ~20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				10-20 Silica Sand; 0.010" Slotted PVC		10.0-15.0 ft. SAND (SW); fine to medium grained, damp, brown (7.5YR 5/3).
15	3950				Slough		15.0-20.86 ft. GRAVELLY SAND (SW-GW); moist, ~80% sand, very fine to medium grained, ~20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/3).
20	3945				End Cap		Total Depth 20.86 ft.



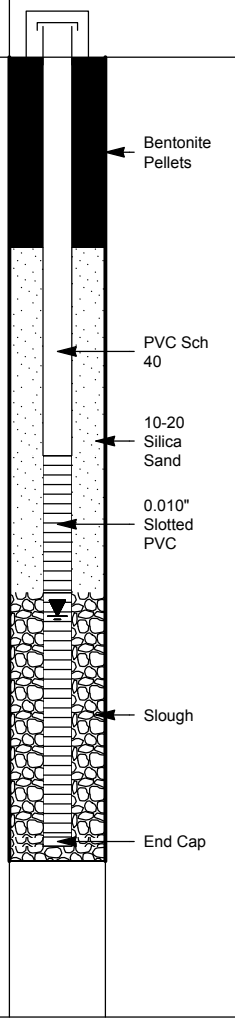
MONITORING WELL COMPLETION LOG MOA01-0585

PROJECT	MOAB	**WELL NUMBER**	0585	**DATE DRILLED**	07/29/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663771.73	**SURFACE ELEV. (FT NGVD)**	3967.59
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186121.01	**TOP OF CASING (FT)**	3969.36
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.94	**MEAS. PT. ELEV. (FT)**	3969.36
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.55	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.33	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-1.86	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.77	to	10.38
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.38	to	20.31
SUMP/END CAP:	1 in. PVC Sch 40	20.31	to	20.55
SEAL:	Bentonite Pellets	0.0	to	4.95
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.95	to	13.95

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0577 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-5.0 ft. SILTY SAND (SM); damp, mostly very fine grained sand (80%), 20% silt, brown (7.5YR 4/2).
5	3960				PVC Sch 40		5.0-10.0 ft. SANDY SILT (ML-SP); dry, 80% silt, and 20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				10-20 Silica Sand; 0.010" Slotted PVC		10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/3), trace pebbles (1/2" in diameter).
15	3950				Slough		15.0-20.94 ft. GRAVELLY SAND (SW-GW); damp to moist, 75-80% very fine to medium grained sand, 20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 5/3).
20	3945				End Cap		Total Depth 20.94 ft.



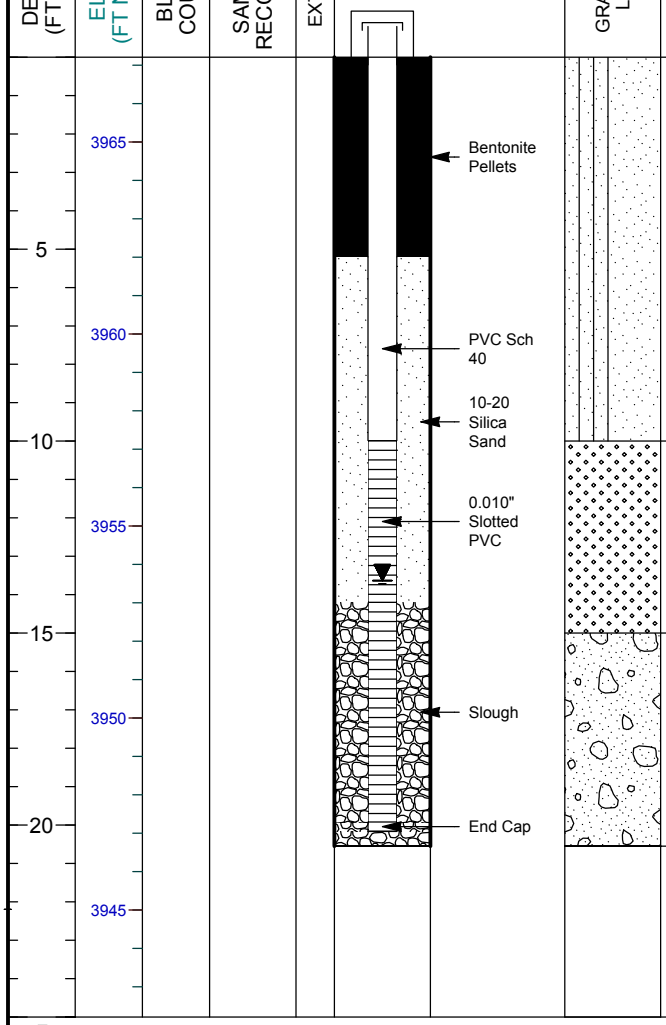
MONITORING WELL COMPLETION LOG MOA01-0586

PROJECT	MOAB	**WELL NUMBER**	0586	**DATE DRILLED**	07/27/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663875.81	**SURFACE ELEV. (FT NGVD)**	3967.21
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186128.79	**TOP OF CASING (FT)**	3969.20
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.55	**MEAS. PT. ELEV. (FT)**	3969.20
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.16	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	15.62	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.25	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.99	to	9.99
WELL SCREEN:	1 in. 0.01 Slotted PVC	9.99	to	19.92
SUMP/END CAP:	1 in. PVC Sch 40	19.92	to	20.16
SEAL:	Bentonite Pellets	0.0	to	5.2
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	5.2	to	14.2

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0579 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), slightly damp, mostly silt and very fine grained sand, trace clay.
							10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 4/4).
							15.0-20.55 ft. GRAVELLY SAND (SP-GP); damp to moist, brown (7.5YR 4/4), sand (75%) and gravel (25%) up to 3.0" in diameter.
							Total Depth 20.55 ft.



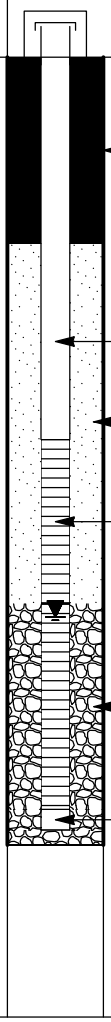
MONITORING WELL COMPLETION LOG MOA01-0587

PROJECT	MOAB	**WELL NUMBER**	0587	**DATE DRILLED**	07/28/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663713.83	**SURFACE ELEV. (FT NGVD)**	3967.30
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186098.18	**TOP OF CASING (FT)**	3968.89
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.52	**MEAS. PT. ELEV. (FT)**	3968.89
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.13	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.17	**BIT SIZE(S) (IN)**	2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:	4 in. PVC Sch 40	-2.15	to	0.0
BLANK CASING:	1 in. PVC Sch 40	-1.59	to	9.96
WELL SCREEN:	1 in. 0.01 Slotted PVC	9.96	to	19.59
SUMP/END CAP:	1 in. PVC Sch 40	19.59	to	20.13
SEAL:	Bentonite Pellets	0.0	to	4.85
UPPER PACK:				
LOWER PACK:	10-20 Silica Sand	4.85	to	14.24

DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/13/2004
REMARKS Lithology from well 0575 was used for the lithology description for this well.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Pellets		0-5.0 ft. SILTY SAND (SM); approximately 80% very fine grained sand with 20% silt, pale brown (10YR 6/3), dry.
5	3960				PVC Sch 40; 10-20 Silica Sand		5.0-10.0 ft. SANDY SILT (ML-SP); slightly damp, mostly silt (80%) and ~20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				0.010" Slotted PVC		10.0-15.0 ft. SAND (SW); fine to medium grained, damp, brown (7.5YR 5/3).
15	3950				Slough		15.0-20.0 ft. GRAVELLY SAND (SW-GW); moist, ~80% sand, very fine to medium grained, ~20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/3).
20	3945				End Cap		20.0-20.52 ft. SANDY GRAVEL (GW-SW); ~60% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/3), wet. Total Depth 20.52 ft.



MONITORING WELL COMPLETION LOG MOA01-0588

PROJECT	MOAB	**WELL NUMBER**	0588	**DATE DRILLED**	07/13/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663720.93	**SURFACE ELEV. (FT NGVD)**	3967.22
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186105.00	**TOP OF CASING (FT)**	3969.04
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	40.00	**MEAS. PT. ELEV. (FT)**	3969.04
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	35.10	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.82	to	24.8
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	24.8	to	34.8
SUMP/END CAP:	6 in. PVC Sch 40	34.8	to	35.1
GROUT:	Grout	0.0	to	14.5
SEAL:	Bentonite Chips	14.5	to	20.0
UPPER PACK:	30-70 Silica Sand	20.0	to	23.0
LOWER PACK:	16-40 Silica Sand	23.0	to	40.0

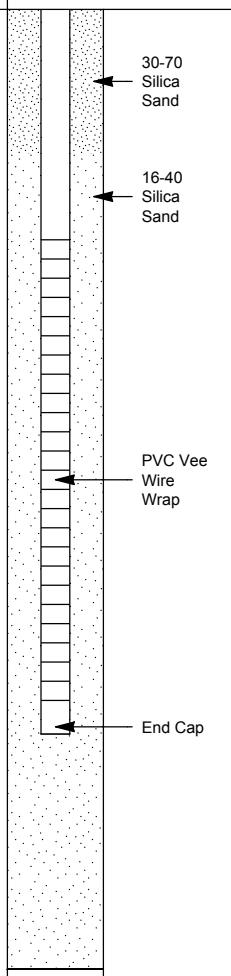
DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), dry, mostly silt and very fine grained sand.
5							
	3960				Grout		6.0-10.0 ft. sand increases, very fine grained, mottling with white caliche, trace clay, trace small pebbles.
10							10.0-13.0 ft. SAND (SP); mostly medium grained sand, with <5% clay, brown (7.5YR 4/4), trace pebbles.
	3955				PVC Sch 40		
15							13.0-40.0 ft. SANDY GRAVEL (GW-SW); damp, mostly (65%) well-rounded gravel up to 3.0" in diameter and fine to medium grained sand (30%), trace of clay or very fine grained sand, brown (7.5YR 4/4).
	3950				Bentonite Chips		

MONITORING WELL COMPLETION LOG MOA01-0588

PROJECT MOAB **WELL NUMBER** 0588
SITE Moab Disposal Site **DATES DRILLED** 07/13/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							20.0-25.0 ft. fine to medium grained sand increases to 40%, wet. 25.0-40.0 ft. sand decreases to 25% and cobble size increases to up to 5.0" in diameter.
							Total Depth 40.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0589

PROJECT	MOAB	**WELL NUMBER**	0589	**DATE DRILLED**	07/14/2004
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663707.15	**SURFACE ELEV. (FT NGVD)**	3966.98
SITE	Moab Disposal Site	**EAST COORD. (FT)**	2186103.42	**TOP OF CASING (FT)**	3968.87
DRILLING METHOD	AIR PERCUSSION	**HOLE DEPTH (FT)**	55.00	**MEAS. PT. ELEV. (FT)**	3968.87
DRILL COMPANY	Layne Christensen Co	**WELL DEPTH (FT)**	53.00	**SLOT SIZE (IN)**	0.010
RIG TYPE	AP 1000	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	12.5

	WELL INSTALLATION	INTERVAL (FT)		
BLANK CASING:	6 in. PVC Sch 40	-1.89	to	42.7
WELL SCREEN:	6 in. PVC Vee Wire Wrapped	42.7	to	52.7
SUMP/END CAP:	6 in. PVC Sch 40	52.7	to	53.0
GROUT:	Grout	0.0	to	33.0
SEAL:	Bentonite Chips	33.0	to	37.5
UPPER PACK:	30-70 Silica Sand	37.5	to	41.0
LOWER PACK:	16-40 Silica Sand	41.0	to	55.0

DRILLER Kern, T
LOGGED BY Goodknight, C.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 5/4), dry, mostly silt with some very fine grained sand, calcareous.
5	3960						5.0-10.0 ft. slightly damp, trace clay, some mottling, increase of very fine grained sand, calcareous.
10	3955						10.0-15.0 ft. SAND (SP); fine to medium grained sand, damp to moist, reddish brown (5YR 5/4), trace pebbles up to 1/2" in diameter, calcareous.
15	3950				Grout		15.0-55.0 ft. SANDY GRAVEL (GW-SW); mostly well to subrounded gravel and cobbles up to 6.0" in diameter and fine to medium grained sand matrix (20-30%), reddish brown (7.5YR 4/4), wet, calcareous.
20	3945						20.0-30.0 ft. assumed to be sandy gravel, as above. Large igneous cobble (6.0" in diameter) plugged bit during advance through this interval. Saved pieces of this cobble.

MONITORING WELL COMPLETION LOG MOA01-0589

PROJECT MOAB **WELL NUMBER** 0589
SITE Moab Disposal Site **DATES DRILLED** 07/14/2004

Continued from Previous Page

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE RECOVERY	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3940						
30					PVC Sch 40		30.0-35.0 ft. mostly well rounded pebbles and cobbles (1.0-2.0" in diameter) and fine to medium grained sand (20-30%), color of sandy matrix is brown (7.5YR 4/2).
	3935						
35					Bentonite Chips		35.0-40.0 ft. slightly more fine grained sand (30-40%) and cobbles up to 4.0" in diameter, calcareous.
	3930						
					30-70 Silica Sand		
40							40.0-45.0 ft. less sand (25%), and more pebbles/cobbles. Color of matrix is dark reddish gray (5YR 4/2), calcareous.
	3925				16-40 Silica Sand		
45							45.0-50.0 ft. cobbles up to 6.0" in diameter.
	3920				PVC Vee Wire Wrap		
50							50.0-55.0 ft. more sand (35%), medium to fine grained sand, matrix is brown (7.5YR 4/2). Cobbles up to 4.0" in diameter, calcareous.
	3915				End Cap		
55							Total Depth 55.0 ft.

Configuration 3

Well Boring and Construction Logs

MONITORING WELL COMPLETION LOG MOA01-0596

PROJECT	MOAB	**WELL NUMBER**	MOA01-0596	**DATE DRILLED**	06/22/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663443.17	**SURFACE ELEV. (FT NGVD)**	3966.91
SITE	Moab Site	**EAST COORD. (FT)**	2186066.24	**TOP OF CASING (FT)**	3968.76
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	26.00	**MEAS. PT. ELEV. (FT)**	3968.76
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	25.47	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	11.46	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.85	to	15.3
WELL SCREEN:	1 in. 0.01 Slotted PVC	15.3	to	25.27
SUMP/END CAP:	1 in. PVC Sch 40	25.27	to	25.47
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.5
UPPER PACK:	10-20 Silica Sand	5.5	to	10.0
LOWER PACK:	Slough	10.0	to	26.05

WATER LEVEL DATE 06/29/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 06/29/2005
REMARKS Lithology description from well location # MOA01-0560.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 5/3), dry, mostly silt (80%), some very fine grained sand, calcareous, well rounded, trace mica.
5							5.0-10.0 ft. slightly damp, with trace clay, some mottling. Very fine grained sand increasing, calcareous.
	3960				10-20 Silica Sand		
10							10.0-15.0 ft. SAND (SP); fine to medium grained, damp, reddish brown (5YR 5/4), pebbles up to 3.0" in diameter, calcareous.
	3955				PVC Sch 40		
15							15.0-20.0 ft. GRAVELLY SAND (SP-GP); sand (80%) is medium to fine grained, well to subrounded, cobbles (20%) up to 3.0" in diameter axis, calcareous, moist, brown (7.5YR 4/4).
	3950				Slough		
20					0.010 Slotted PVC		20.0-26.0 ft. SANDY GRAVEL (GW-SW); mostly subrounded to well rounded gravel and cobbles (up to 6.0" in diameter), fine to medium grained sand matrix (~25%), wet, calcareous, brown (7.5YR 4/3).
	3945						
25					End Cap		
	3940						Total Depth 26.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0600

PROJECT	MOAB	**WELL NUMBER**	MOA01-0600	**DATE DRILLED**	06/21/2005 to 06/23/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663679.90	**SURFACE ELEV. (FT NGVD)**	3966.88
SITE	Moab Site	**EAST COORD. (FT)**	2186040.24	**TOP OF CASING (FT)**	3968.77
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	30.50	**MEAS. PT. ELEV. (FT)**	3968.77
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	29.70	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	11.08	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.89	to	19.53
WELL SCREEN:	1 in. 0.01 Slotted PVC	19.53	to	29.5
SUMP/END CAP:	1 in. PVC Sch 40	29.5	to	29.7
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	6.0
UPPER PACK:	10-20 Silica Sand	6.0	to	9.5
LOWER PACK:	Slough	9.5	to	30.5

WATER LEVEL DATE 06/23/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 06/23/2005
REMARKS Lithology description from well location # MOA01-0573.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-10.0 ft. SILTY SAND (SM); dry, mostly very fine grained sand (80%) and 20% silt, brown (7.5YR 5/4), dry.
5							5.0-10.0 ft. trace of clay with mottles (white), brown (7.5YR 5/3), slightly damp.
	3960				10-20 Silica Sand		
10							10.0-15.0 ft. SAND (SW); mostly fine to medium grained sand, damp, brown (7.5YR 5/3), trace pebbles up to 1/2" in diameter.
	3955				PVC Sch 40		
15							15.0-25.0 ft. GRAVELLY SAND (SW-GW): moist, 80-85% sand, very fine to medium grained, ~15-20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 4/4).
	3950				Slough		
20							20.0-25.0 ft. increase in amount of pebbles up to 2.0" in diameter (~25-30%), wet, brown (7.5YR 4/3).
	3945						
25					0.010 Slotted PVC		25.0-30.5 ft. SANDY GRAVEL (GW-SW); approximately 65% gravel and cobbles up to 3.0" in diameter, matrix sandy material is fine to medium grained and brown (7.5YR 4/3), wet.
	3940						
30					End Cap		Total Depth 30.5 ft.
	3935						

MONITORING WELL COMPLETION LOG MOA01-0601

PROJECT	MOAB	**WELL NUMBER**	MOA01-0601	**DATE DRILLED**	06/22/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663801.57	**SURFACE ELEV. (FT NGVD)**	3967.09
SITE	Moab Site	**EAST COORD. (FT)**	2186084.28	**TOP OF CASING (FT)**	3968.73
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	30.50	**MEAS. PT. ELEV. (FT)**	3968.73
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	29.73	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	10.8	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.64	to	19.56
WELL SCREEN:	1 in. 0.01 Slotted PVC	19.56	to	29.53
SUMP/END CAP:	1 in. PVC Sch 40	29.53	to	29.73
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	6.0
UPPER PACK:	10-20 Silica Sand	6.0	to	10.0
LOWER PACK:	Slough	10.0	to	30.5

WATER LEVEL DATE 06/22/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 06/22/2005
REMARKS Lithology description from well location # MOA01-0577.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-5.0 ft. SILTY SAND (SM); damp, mostly very fine grained sand (80%), 20% silt, brown (7.5YR 4/2).
5	3960				10-20 Silica Sand		5.0-10.0 ft. SANDY SILT (ML-SP); dry, 80% silt, and 20% very fine grained sand, brown (7.5YR 5/3), trace clay with mottles (white).
10	3955				PVC Sch 40		10.0-15.0 ft. SAND (SW); mostly fine to medium grained, damp, brown (7.5YR 5/3), trace pebbles (1/2" in diameter).
15	3950				Slough		15.0-30.5 ft. GRAVELLY SAND (SW-GW); damp to moist, 75-80% very fine to medium grained sand, 20% pebbles up to 2.0" in diameter, matrix sand is brown (7.5YR 5/3).
20	3945						20.0-30.0 ft. equal amounts of sand (fine to medium grained) and gravel (pebbles and cobbles up to 3.0" in diameter), matrix sandy material is brown (7.5YR 4/3), wet, calcareous throughout hole depth.
25	3940				0.010 Slotted PVC		
30	3935				End Cap		Total Depth 30.5 ft.

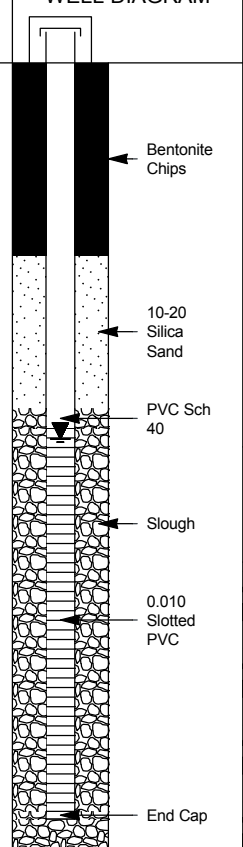
MONITORING WELL COMPLETION LOG MOA01-0602

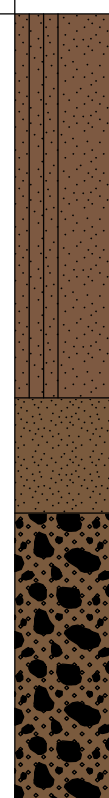
PROJECT	MOAB	**WELL NUMBER**	MOA01-0602	**DATE DRILLED**	06/20/2005 to 06/22/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663721.92	**SURFACE ELEV. (FT NGVD)**	3967.57
SITE	Moab Site	**EAST COORD. (FT)**	2186112.88	**TOP OF CASING (FT)**	3969.40
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.50	**MEAS. PT. ELEV. (FT)**	3969.40
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.69	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	11.62	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.83	to	9.52
WELL SCREEN:	1 in. 0.01 Slotted PVC	9.52	to	19.49
SUMP/END CAP:	1 in. PVC Sch 40	19.49	to	19.69
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	9.0
LOWER PACK:	Slough	9.0	to	20.5

WATER LEVEL DATE 06/23/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 06/22/2005
REMARKS Lithology description from well location # MOA01-0588.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-10.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), dry, mostly silt and very fine grained sand.
5	3960				10-20 Silica Sand; PVC Sch 40		6.0-10.0 ft. sand increases, very fine grained, mottling with white caliche, trace clay, trace small pebbles.
10	3955				Slough		10.0-13.0 ft. SAND (SP); mostly medium grained sand, with <5% clay, brown (7.5YR 4/4), trace pebbles.
15	3950				0.010 Slotted PVC		13.0-20.5 ft. SANDY GRAVEL (GW-SW); damp, mostly (65%) well-rounded gravel up to 3.0" in diameter and fine to medium grained sand (30%), trace of clay or very fine grained sand, brown (7.5YR 4/4).
20	3945				End Cap		Total Depth 20.5 ft.





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GRAND JUNCTION, COLORADO

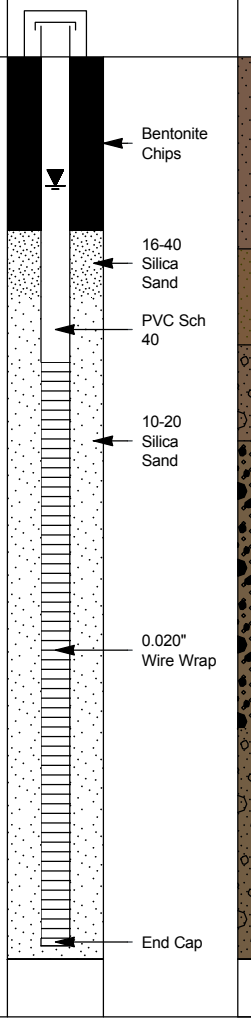
MONITORING WELL COMPLETION LOG MOA01-0670

PROJECT	MOAB	**WELL NUMBER**	MOA01-0670	**DATE DRILLED**	06/25/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663880.22	**SURFACE ELEV. (FT NGVD)**	3967.05
SITE	Moab Site	**EAST COORD. (FT)**	2186129.16	**TOP OF CASING (FT)**	3969.54
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.54
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	46.30	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BTOC)**	9.2	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.49	to	15.9
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.9	to	45.9
SUMP/END CAP:	6 in. PVC Sch 40	45.9	to	46.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.0
UPPER PACK:	16-40 Silica Sand	9.0	to	12.5
LOWER PACK:	10-20 Silica Sand	12.5	to	47.0

WATER LEVEL DATE 06/22/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/3), ~70% silt, 30% very fine grained sand, trace of clay, damp.
10	3960						10.0-15.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), ~30% silt, 70% very fine to medium grained sand, wet.
	3950						15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~60% fine to coarse grained sand, ~40% gravel (up to 2.0" in diameter), subangular to subrounded, wet.
20							20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 3.0" in diameter), wet.
	3940						
30							
	3930						Transition between sandy gravel and gravelly sand.
40							
	3920						Total Depth 47.0 ft.



MONITORING WELL COMPLETION LOG MOA01-0671

PROJECT	MOAB	**WELL NUMBER**	MOA01-0671	**DATE DRILLED**	06/27/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663912.57	**SURFACE ELEV. (FT NGVD)**	3967.31
SITE	Moab Site	**EAST COORD. (FT)**	2186141.40	**TOP OF CASING (FT)**	3969.50
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	46.00	**MEAS. PT. ELEV. (FT)**	3969.50
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	44.80	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BTOC)**	9.7	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.19	to	14.4
WELL SCREEN:	6 in. 0.020 Wire Wrap	14.4	to	44.4
SUMP/END CAP:	6 in. PVC Sch 40	44.4	to	44.8
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	10.2
UPPER PACK:	16-40 Silica Sand	10.2	to	13.2
LOWER PACK:	10-20 Silica Sand	13.2	to	46.0

WATER LEVEL DATE 06/22/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dark reddish brown (5YR 3/3), ~60% silt, 40% very fine to medium grained sand, trace of clay, damp.
	3960				Bentonite Chips; PVC Sch 40		@8.0 ft. hit water.
10					16-40 Silica Sand		10.0-15.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), ~40% silt, 60% very fine to medium grained sand, wet.
	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (10YR 4/3), ~30% subangular to rounded gravel (up to 3.0" in diameter), medium to coarse grained sand, wet. Lost fines in water.
20							20.0-46.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 3.0" in diameter), wet. ~30% gravel and 40% sand.
	3940				0.020" Wire Wrap		
30							Transition between sandy gravel and gravelly sand.
	3930						
40							
					End Cap		
	3920						Total Depth 46.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0672

PROJECT	MOAB	**WELL NUMBER**	MOA01-0672	**DATE DRILLED**	06/27/2005 to 06/28/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663937.33	**SURFACE ELEV. (FT NGVD)**	3967.27
SITE	Moab Site	**EAST COORD. (FT)**	2186148.95	**TOP OF CASING (FT)**	3969.57
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.57
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	45.40	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	9.4	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.3	to	15.0
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.0	to	45.0
SUMP/END CAP:	6 in. PVC Sch 40	45.0	to	45.4
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.7
UPPER PACK:	16-40 Silica Sand	9.7	to	12.8
LOWER PACK:	10-20 Silica Sand	12.8	to	47.0

WATER LEVEL DATE 06/28/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dark reddish brown (5YR 3/3), ~60% silt, 40% very fine to medium grained sand, trace of clay, damp.
	3960				Bentonite Chips		
10					16-40 Silica Sand; PVC Sch 40		@9.0 ft. hit water. 10.0-15.0 ft. SILTY SAND (SM); brown (10YR4/3), ~40% silt, 60% very fine to medium grained sand, wet.
	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (10YR 4/3), ~30% subangular to rounded gravel (up to 3.0" in diameter), medium to coarse grained sand, wet. Lost fines in water.
20							20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 3.0" in diameter), wet. ~60% gravel and 40% sand.
	3940						
30					0.020" Wire Wrap		
							Transition between sandy gravel and gravelly sand.
	3930						
40							
					End Cap		
	3920						Total Depth 47.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0673

PROJECT	MOAB	**WELL NUMBER**	MOA01-0673	**DATE DRILLED**	06/28/2005 to 06/29/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663965.85	**SURFACE ELEV. (FT NGVD)**	3967.19
SITE	Moab Site	**EAST COORD. (FT)**	2186158.52	**TOP OF CASING (FT)**	3969.44
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.44
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	46.70	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	9.9	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.25	to	16.3
WELL SCREEN:	6 in. 0.020 Wire Wrap	16.3	to	46.3
SUMP/END CAP:	6 in. PVC Sch 40	46.3	to	46.7
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.2
UPPER PACK:	16-40 Silica Sand	9.2	to	13.1
LOWER PACK:	10-20 Silica Sand	13.1	to	47.0

WATER LEVEL DATE 06/30/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), ~60% silt, 40% very fine to medium grained sand, trace of clay, damp.
	3960				Bentonite Chips		
10					16-40 Silica Sand		@9.0 ft. hit water. 10.0-15.0 ft. SILTY SAND (SM); dark yellow brown (10YR 4/4), ~30% silt, 70% very fine to medium grained sand, wet.
					PVC Sch 40		
	3950						15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~60% fine to coarse grained sand, ~40% subangular to rounded gravel (up to 1.0" in diameter).
20					10-20 Silica Sand		20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 1.5" in diameter), wet.
	3940						
30					0.020" Wire Wrap		
	3930						Transition between sandy gravel and gravelly sand.
40							
	3920				End Cap		Total Depth 47.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0674

PROJECT	MOAB	**WELL NUMBER**	MOA01-0674	**DATE DRILLED**	06/29/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663991.15	**SURFACE ELEV. (FT NGVD)**	3967.11
SITE	Moab Site	**EAST COORD. (FT)**	2186167.51	**TOP OF CASING (FT)**	3969.49
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.49
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	45.50	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	9.5	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.38	to	15.1
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.1	to	45.1
SUMP/END CAP:	6 in. PVC Sch 40	45.1	to	45.5
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.5
UPPER PACK:	16-40 Silica Sand	9.5	to	12.6
LOWER PACK:	10-20 Silica Sand	12.6	to	47.0

WATER LEVEL DATE 06/30/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), ~60% silt, 40% very fine grained sand, trace of clay, damp.
	3960				Bentonite Chips		
10					16-40 Silica Sand; PVC Sch 40		@9.0 ft. hit water. 10.0-15.0 ft. SILTY SAND (SM); dark yellow brown (10YR 4/4), ~30% silt, 70% very fine to medium grained sand, wet.
	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~60% fine to coarse grained sand, ~40% subangular to rounded gravel (up to 1.0" in diameter), wet.
20							20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 1.5" in diameter), wet.
	3940				0.020" Wire Wrap		
30							Transition between sandy gravel and gravelly sand.
	3930						
40							
					End Cap		
	3920						Total Depth 47.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0675

PROJECT	MOAB	**WELL NUMBER**	MOA01-0675	**DATE DRILLED**	06/29/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664020.51	**SURFACE ELEV. (FT NGVD)**	3966.99
SITE	Moab Site	**EAST COORD. (FT)**	2186176.56	**TOP OF CASING (FT)**	3969.64
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.64
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	46.40	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	9.1	**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.65	to	16.0
WELL SCREEN:	6 in. 0.020 Wire Wrap	16.0	to	46.0
SUMP/END CAP:	6 in. PVC Sch 40	46.0	to	46.4
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.8
UPPER PACK:	16-40 Silica Sand	9.8	to	13.1
LOWER PACK:	10-20 Silica Sand	13.1	to	47.0

WATER LEVEL DATE 06/30/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dark brown (7.5YR 3/3), ~60% silt, 40% very fine grained sand, trace of clay, damp.
	3960				Bentonite Chips		
10					16-40 Silica Sand		@9.0 ft. hit water. 10.0-15.0 ft. CLAYEY SILT (CL-SM); dark brown (7YR 3/3), ~60% silt, ~10% very fine grained sand, 30% clay, wet.
					PVC Sch 40		
	3950						15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~40% subangular to rounded gravel (up to 1.0" in diameter), 60% fine to coarse grained sand, wet.
20					10-20 Silica Sand		20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 2.0" in diameter), wet. Sand is medium to coarse grained.
	3940						
30					0.020" Wire Wrap		
							Transition between sandy gravel and gravelly sand.
	3930						
40							
	3920				End Cap		Total Depth 47.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0676

PROJECT	MOAB	**WELL NUMBER**	MOA01-0676	**DATE DRILLED**	06/29/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664050.78	**SURFACE ELEV. (FT NGVD)**	3967.27
SITE	Moab Site	**EAST COORD. (FT)**	2186188.85	**TOP OF CASING (FT)**	3969.69
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.69
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	46.30	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**		**BIT SIZE(S) (IN)**	10.75 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.42	to	15.9
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.9	to	45.9
SUMP/END CAP:	6 in. PVC Sch 40	45.9	to	46.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.0
UPPER PACK:	16-40 Silica Sand	9.0	to	12.0
LOWER PACK:	10-20 Silica Sand	12.0	to	47.0

WATER LEVEL DATE
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dark brown (7.5YR 3/3), ~60% silt, 40% very fine grained sand, trace of clay, damp.
	3960				Bentonite Chips		
10					16-40 Silica Sand		@9.0 ft. hit water.
							10.0-15.0 ft. SILTY SAND (SM); dark yellow brown (10YR 3/4), ~40% silt, ~50% very fine to fine grained sand, 10% clay, wet.
					PVC Sch 40		
							15.0-20.0 ft. GRAVELLY SAND (SP-GP); dark yellow brown (10YR 3/4), ~35% subangular to rounded gravel (up to 1.0" in diameter), 60% fine to coarse grained sand, wet.
	3950						
20					10-20 Silica Sand		20.0-47.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 2.0" in diameter), wet.
	3940						
30					0.020" Wire Wrap		
							Transition between sandy gravel and gravelly sand.
	3930						
40							
					End Cap		
	3920						Total Depth 47.0 ft.

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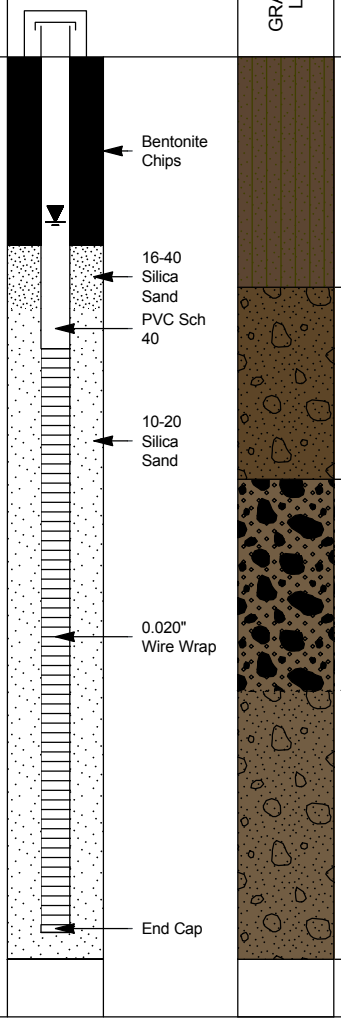
MONITORING WELL COMPLETION LOG MOA01-0677

PROJECT	MOAB	**WELL NUMBER**	MOA01-0677	**DATE DRILLED**	06/24/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664078.97	**SURFACE ELEV. (FT NGVD)**	3967.17
SITE	Moab Site	**EAST COORD. (FT)**	2186198.08	**TOP OF CASING (FT)**	3969.61
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3969.61
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	45.60	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	8.6	**BIT SIZE(S) (IN)**	10.87 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.44	to	15.2
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.2	to	45.2
SUMP/END CAP:	6 in. PVC Sch 40	45.2	to	45.6
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.8
UPPER PACK:	16-40 Silica Sand	9.8	to	13.1
LOWER PACK:	10-20 Silica Sand	13.1	to	47.0

WATER LEVEL DATE 06/25/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-12.0 ft. SILTY SAND (SM); loose, moist ~80% sand, matix is brown, wet.
							12.0-22.0 ft. GRAVELLY SAND (SP-GP); dark yellow brown (10YR 3/4), loose, saturated, ~70% sand.
							22.0-33.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 2.0" in diameter), wet. ~30% sand and 70% gravel.
							Transition between sandy gravel and gravelly sand.
							Total Depth 47.0 ft.



10 20 30 40

3960 3950 3940 3930 3920

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GRAND JUNCTION, COLORADO

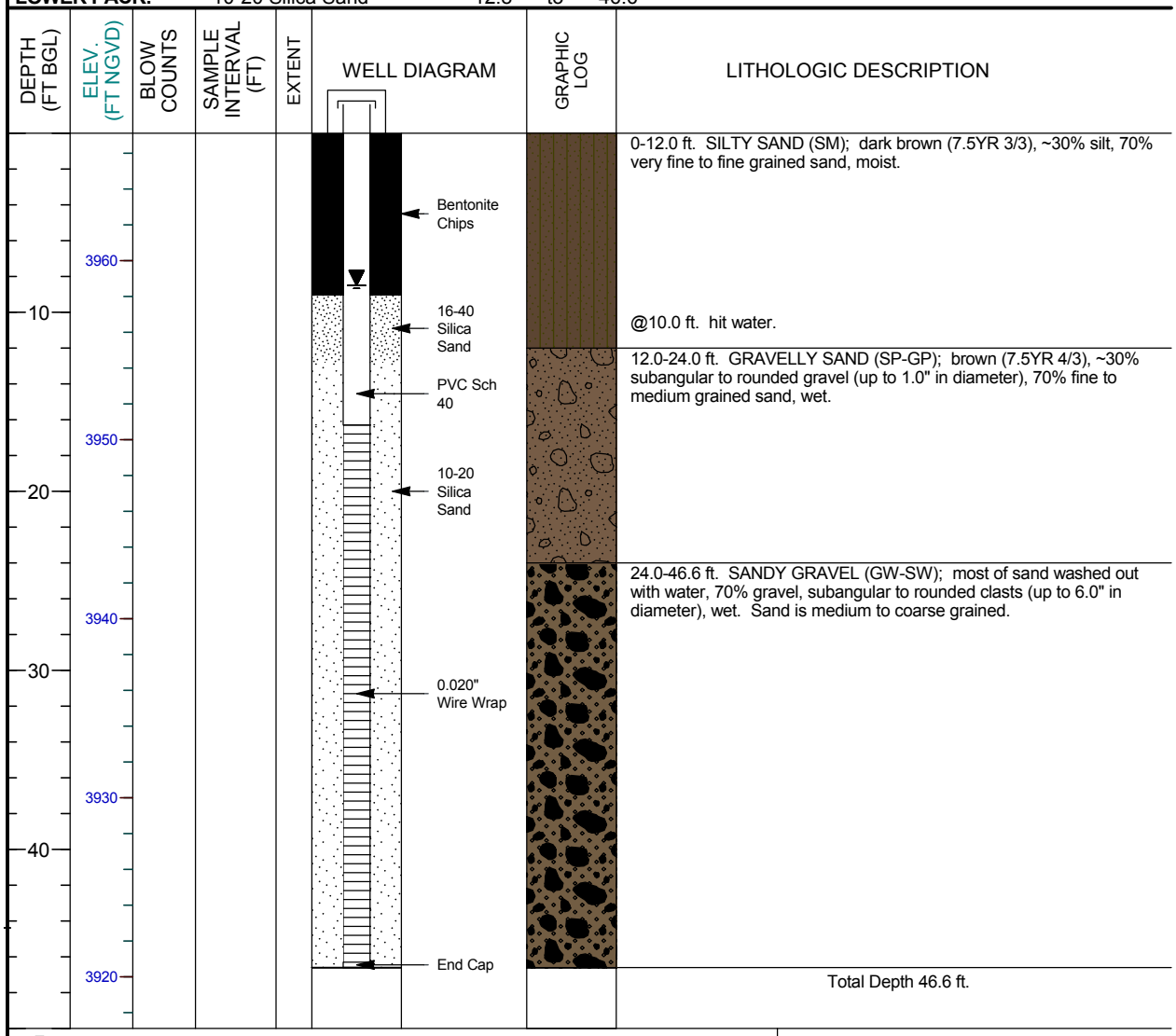
MONITORING WELL COMPLETION LOG MOA01-0678

PROJECT	MOAB	**WELL NUMBER**	MOA01-0678	**DATE DRILLED**	06/23/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664107.77	**SURFACE ELEV. (FT NGVD)**	3967.11
SITE	Moab Site	**EAST COORD. (FT)**	2186209.93	**TOP OF CASING (FT)**	3969.65
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	46.60	**MEAS. PT. ELEV. (FT)**	3969.65
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	46.60	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	8.5	**BIT SIZE(S) (IN)**	10.87 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.54	to	16.3
WELL SCREEN:	6 in. 0.020 Wire Wrap	16.3	to	46.3
SUMP/END CAP:	6 in. PVC Sch 40	46.3	to	46.6
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.0
UPPER PACK:	16-40 Silica Sand	9.0	to	12.8
LOWER PACK:	10-20 Silica Sand	12.8	to	46.6

WATER LEVEL DATE 06/25/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-12.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/3), ~30% silt, 70% very fine to fine grained sand, moist.
	3960				Bentonite Chips		
10					16-40 Silica Sand		@10.0 ft. hit water.
					PVC Sch 40		12.0-24.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~30% subangular to rounded gravel (up to 1.0" in diameter), 70% fine to medium grained sand, wet.
	3950						
20					10-20 Silica Sand		
	3940						24.0-46.6 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, 70% gravel, subangular to rounded clasts (up to 6.0" in diameter), wet. Sand is medium to coarse grained.
30					0.020" Wire Wrap		
	3930						
40							
	3920				End Cap		Total Depth 46.6 ft.



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GRAND JUNCTION, COLORADO

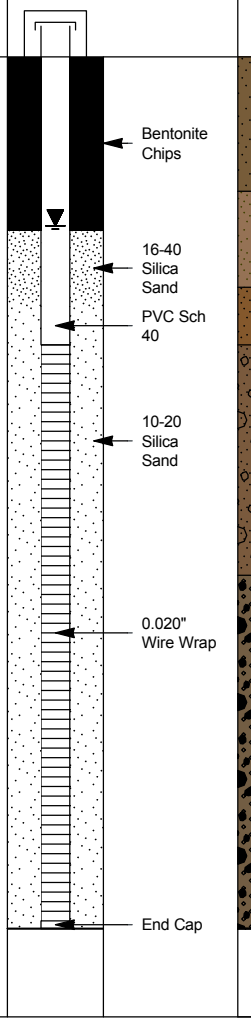
MONITORING WELL COMPLETION LOG MOA01-0679

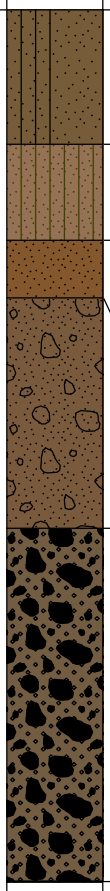
PROJECT	MOAB	**WELL NUMBER**	MOA01-0679	**DATE DRILLED**	06/21/2005 to 06/23/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664136.53	**SURFACE ELEV. (FT NGVD)**	3967.03
SITE	Moab Site	**EAST COORD. (FT)**	2186218.80	**TOP OF CASING (FT)**	3969.59
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	45.40	**MEAS. PT. ELEV. (FT)**	3969.59
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	45.40	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	8.8	**BIT SIZE(S) (IN)**	10.87 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.56	to	15.0
WELL SCREEN:	6 in. 0.020 Wire Wrap	15.0	to	45.0
SUMP/END CAP:	6 in. PVC Sch 40	45.0	to	45.4
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	9.0
UPPER PACK:	16-40 Silica Sand	9.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	45.4

WATER LEVEL DATE 06/25/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-7.0 ft. SANDY SILT (ML-SP); dark yellow brown (10YR 4/4), ~70% silt, 30% very fine grained sand, dry.
	3960						7.0-12.0 ft. SILTY SAND (SM); brown (7YR 5/4), ~40% silt, ~60% fine grained sand, dry.
10							12.0-15.0 ft. SAND (SP); fine to medium gained sand, moist, strong brown (7.5YR 4/6), trace of silt, trace pebbles (up to1.25" in diameter), wet. @12.0 ft. hit water.
	3950						15.0-27.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), pebbles (up to 1.5" in diameter),
20							
	3940						27.0-45.4 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 4.0" in diameter), wet. Sand is fine to medium grained.
30							
	3930						~90% gravel below 38.0 ft.
40							
	3920						Total Depth 45.4 ft.





MONITORING WELL COMPLETION LOG MOA01-0680

PROJECT	MOAB	**WELL NUMBER**	MOA01-0680	**DATE DRILLED**	08/16/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663916.20	**SURFACE ELEV. (FT NGVD)**	3967.75
SITE	Moab Site	**EAST COORD. (FT)**	2186125.62	**TOP OF CASING (FT)**	3969.80
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	21.00	**MEAS. PT. ELEV. (FT)**	3969.80
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.04	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.43	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-2.05	to	9.87
WELL SCREEN:	1 in. 0.01 Slotted PVC	9.87	to	19.84
SUMP/END CAP:	1 in. PVC Sch 40	19.84	to	20.04
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.2
UPPER PACK:	10-20 Silica Sand	5.2	to	11.0
LOWER PACK:	Slough	11.0	to	21.0

WATER LEVEL DATE 08/23/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/23/2005
REMARKS Lithology description from well location # MOA01-0671.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); dark reddish brown (5YR 3/3), ~60% silt, 40% very fine to medium grained sand, trace of clay, damp.
	3965				Bentonite Chips		
5					PVC Sch 40		
	3960				10-20 Silica Sand		@8.0 ft. hit water.
10							10.0-15.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), ~40% silt, 60% very fine to medium grained sand, wet.
	3955				Slough		
15					0.010 Slotted PVC		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (10YR 4/3), ~30% subangular to rounded gravel (up to 3.0" in diameter), medium to coarse grained sand, wet. Lost fines in water.
	3950						
20					End Cap		20.0-21.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 3.0" in diameter), wet. ~30% gravel and 40% sand.
	3945						Total Depth 21.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0681

PROJECT	MOAB	**WELL NUMBER**	MOA01-0681	**DATE DRILLED**	08/16/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663951.49	**SURFACE ELEV. (FT NGVD)**	3967.65
SITE	Moab Site	**EAST COORD. (FT)**	2186177.22	**TOP OF CASING (FT)**	3970.67
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	21.00	**MEAS. PT. ELEV. (FT)**	3970.67
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.41	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.99	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-3.02	to	10.24
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.24	to	20.21
SUMP/END CAP:	1 in. PVC Sch 40	20.21	to	20.41
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	4.8
UPPER PACK:	10-20 Silica Sand	4.8	to	10.2
LOWER PACK:	Slough	10.2	to	21.0

WATER LEVEL DATE 08/22/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/22/2005
REMARKS Lithology description from well location # MOA01-0673.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), ~60% silt, 40% very fine to medium grained sand, trace of clay, damp.
	3965				Bentonite Chips		
5							
	3960				10-20 Silica Sand		@9.0 ft. hit water.
10					PVC Sch 40		10.0-15.0 ft. SILTY SAND (SM); dark yellow brown (10YR 4/4), ~30% silt, 70% very fine to medium grained sand, wet.
	3955				Slough		
15					0.010 Slotted PVC		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~60% fine to coarse grained sand, ~40% subangular to rounded gravel (up to 1.0" in diameter).
	3950						
20					End Cap		20.0-21.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 1.5" in diameter), wet.
	3945						Total Depth 21.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0682

PROJECT	MOAB	**WELL NUMBER**	MOA01-0682	**DATE DRILLED**	08/09/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663986.66	**SURFACE ELEV. (FT NGVD)**	3968.25
SITE	Moab Site	**EAST COORD. (FT)**	2186137.20	**TOP OF CASING (FT)**	3970.18
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	31.00	**MEAS. PT. ELEV. (FT)**	3970.18
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	29.72	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.94	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.93	to	19.55
WELL SCREEN:	1 in. 0.01 Slotted PVC	19.55	to	29.52
SUMP/END CAP:	1 in. PVC Sch 40	29.52	to	29.72
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	4.7
UPPER PACK:	10-20 Silica Sand	4.7	to	9.5
LOWER PACK:	Slough	9.5	to	31.0

WATER LEVEL DATE 08/23/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/23/2005
REMARKS Lithology description from well location # MOA01-0674.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-10.0 ft. SANDY SILT (ML-SP); brown (7.5YR 4/4), ~60% silt, 40% very fine grained sand, trace of clay, damp.
5	3965				Bentonite Chips		
	3960				10-20 Silica Sand		@9.0 ft. hit water.
10							10.0-15.0 ft. SILTY SAND (SM); dark yellow brown (10YR 4/4), ~30% silt, 70% very fine to medium grained sand, wet.
	3955				PVC Sch 40		
15					Slough		15.0-20.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~60% fine to coarse grained sand, ~40% subangular to rounded gravel (up to 1.0" in diameter), wet.
	3950						
20							20.0-31.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 1.5" in diameter), wet.
	3945				0.010 Slotted PVC		
25							
	3940						
30					End Cap		
	3935						Total Depth 31.0 ft.

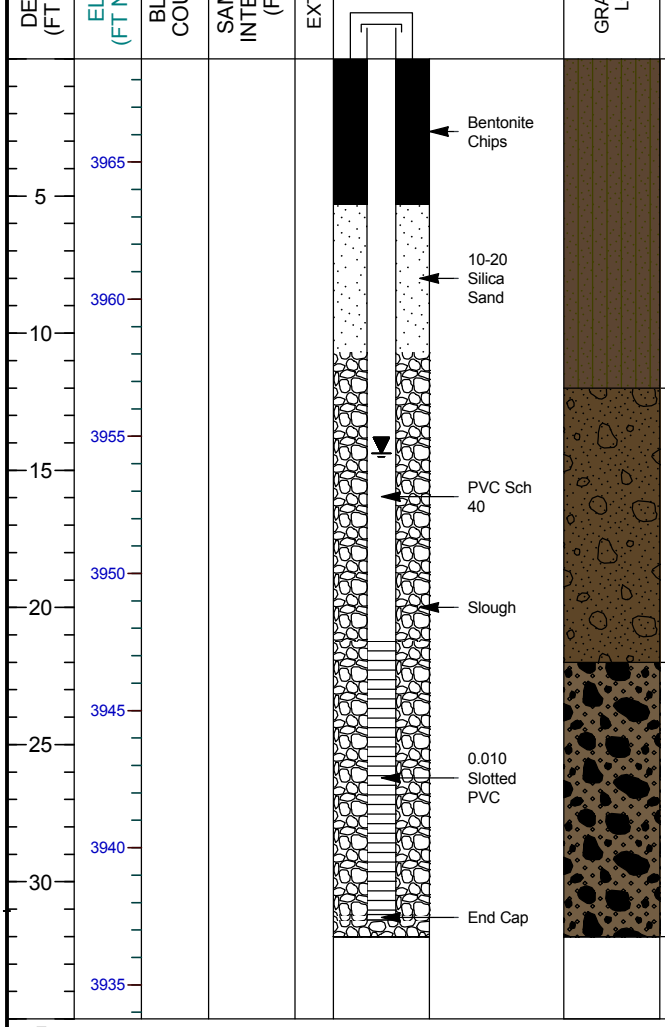
MONITORING WELL COMPLETION LOG MOA01-0683

PROJECT	MOAB	**WELL NUMBER**	MOA01-0683	**DATE DRILLED**	08/10/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664077.81	**SURFACE ELEV. (FT NGVD)**	3968.76
SITE	Moab Site	**EAST COORD. (FT)**	2186172.57	**TOP OF CASING (FT)**	3970.73
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	32.00	**MEAS. PT. ELEV. (FT)**	3970.73
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	31.40	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.35	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.97	to	21.23
WELL SCREEN:	1 in. 0.01 Slotted PVC	21.23	to	31.2
SUMP/END CAP:	1 in. PVC Sch 40	31.2	to	31.4
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.3
UPPER PACK:	10-20 Silica Sand	5.3	to	10.7
LOWER PACK:	Slough	10.7	to	32.0

WATER LEVEL DATE 08/16/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/16/2005
REMARKS Lithology description from well location # MOA01-0677.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-12.0 ft. SILTY SAND (SM); loose, moist ~80% sand, matix is brown, wet.
							12.0-22.0 ft. GRAVELLY SAND (SP-GP); dark yellow brown (10YR 3/4), loose, saturated, ~70% sand.
							22.0-32.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 2.0" in diameter), wet. ~30% sand and 70% gravel.
							Total Depth 32.0 ft.



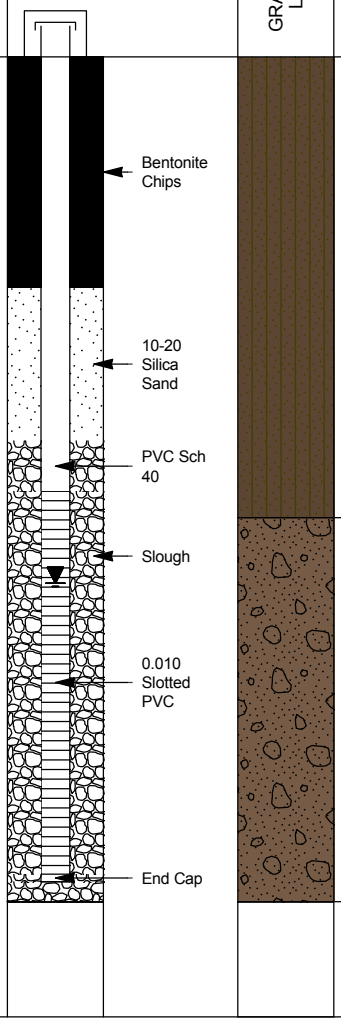
MONITORING WELL COMPLETION LOG MOA01-0684

PROJECT	MOAB	**WELL NUMBER**	MOA01-0684	**DATE DRILLED**	08/03/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664124.97	**SURFACE ELEV. (FT NGVD)**	3968.48
SITE	Moab Site	**EAST COORD. (FT)**	2186191.75	**TOP OF CASING (FT)**	3970.22
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	22.00	**MEAS. PT. ELEV. (FT)**	3970.22
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	21.48	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	15.45	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.74	to	11.31
WELL SCREEN:	1 in. 0.01 Slotted PVC	11.31	to	21.28
SUMP/END CAP:	1 in. PVC Sch 40	21.28	to	21.48
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	6.0
UPPER PACK:	10-20 Silica Sand	6.0	to	10.0
LOWER PACK:	Slough	10.0	to	22.0

WATER LEVEL DATE 08/03/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/03/2005
REMARKS Lithology description from well location # MOA01-0678.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-12.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/3), ~30% silt, 70% very fine to fine grained sand, moist.
5	3965				Bentonite Chips		
	3960				10-20 Silica Sand		
10					PVC Sch 40		@10.0 ft. hit water.
	3955				Slough		12.0-22.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~30% subangular to rounded gravel (up to 1.0" in diameter), 70% fine to medium grained sand, wet.
15					0.010 Slotted PVC		
	3950						
20					End Cap		
	3945						Total Depth 22.0 ft.



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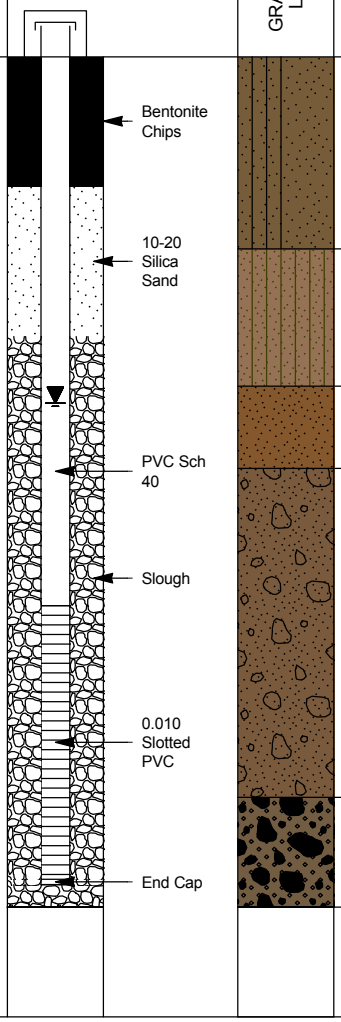
MONITORING WELL COMPLETION LOG MOA01-0685

PROJECT	MOAB	**WELL NUMBER**	MOA01-0685	**DATE DRILLED**	08/02/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664165.70	**SURFACE ELEV. (FT NGVD)**	3967.11
SITE	Moab Site	**EAST COORD. (FT)**	2186229.87	**TOP OF CASING (FT)**	3968.76
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	31.00	**MEAS. PT. ELEV. (FT)**	3968.76
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	30.18	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	14.27	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.65	to	20.01
WELL SCREEN:	1 in. 0.01 Slotted PVC	20.01	to	29.98
SUMP/END CAP:	1 in. PVC Sch 40	29.98	to	30.18
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	4.7
UPPER PACK:	10-20 Silica Sand	4.7	to	10.2
LOWER PACK:	Slough	10.2	to	31.0

WATER LEVEL DATE 08/02/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/02/2005
REMARKS Lithology description from well location # MOA01-0679.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-7.0 ft. SANDY SILT (ML-SP); dark yellow brown (10YR 4/4), ~70% silt, 30% very fine grained sand, dry.
5							
	3960				10-20 Silica Sand		7.0-12.0 ft. SILTY SAND (SM); brown (7YR 5/4), ~40% silt, ~60% fine grained sand, dry.
10							
	3955						12.0-15.0 ft. SAND (SP); fine to medium gained sand, moist, strong brown (7.5YR 4/6), trace of silt, trace pebbles (up to1.25" in diameter), wet. @12.0 ft. hit water.
15					PVC Sch 40		15.0-27.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), pebbles (up to 1.5" in diameter),
	3950						
					Slough		
20							
	3945						
25					0.010 Slotted PVC		
	3940						27.0-31.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, gravel is subangular to rounded (up to 4.0" in diameter), wet. Sand is fine to medium grained.
30					End Cap		
	3935						Total Depth 31.0 ft.



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GRAND JUNCTION, COLORADO

MONITORING WELL COMPLETION LOG MOA01-0686

PROJECT	MOAB	**WELL NUMBER**	MOA01-0686	**DATE DRILLED**	08/17/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664097.02	**SURFACE ELEV. (FT NGVD)**	3967.08
SITE	Moab Site	**EAST COORD. (FT)**	2186221.77	**TOP OF CASING (FT)**	3968.85
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	21.00	**MEAS. PT. ELEV. (FT)**	3968.85
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.17	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	13.51	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-1.77	to	10.0
WELL SCREEN:	1 in. 0.01 Slotted PVC	10.0	to	19.97
SUMP/END CAP:	1 in. PVC Sch 40	19.97	to	20.17
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.7
UPPER PACK:	10-20 Silica Sand	5.7	to	9.8
LOWER PACK:	Slough	9.8	to	21.0

WATER LEVEL DATE 08/17/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/17/2005
REMARKS Lithology description from well location # MOA01-0678.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-12.0 ft. SILTY SAND (SM); dark brown (7.5YR 3/3), ~30% silt, 70% very fine to fine grained sand, moist.
	3965				Bentonite Chips		
5					PVC Sch 40		
	3960				10-20 Silica Sand		
10							@10.0 ft. hit water.
	3955				Slough		12.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/3), ~30% subangular to rounded gravel (up to 1.0" in diameter), 70% fine to medium grained sand, wet.
15					0.010 Slotted PVC		
	3950						
20					End Cap		
	3945						Total Depth 21.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0687

PROJECT	MOAB	**WELL NUMBER**	MOA01-0687	**DATE DRILLED**	08/17/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664011.02	**SURFACE ELEV. (FT NGVD)**	3966.74
SITE	Moab Site	**EAST COORD. (FT)**	2186192.65	**TOP OF CASING (FT)**	3969.09
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	31.00	**MEAS. PT. ELEV. (FT)**	3969.09
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	30.16	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	15.38	**BIT SIZE(S) (IN)**	2.0 / 2.13

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	1 in. PVC Sch 40	-2.35	to	19.99
WELL SCREEN:	1 in. 0.01 Slotted PVC	19.99	to	29.96
SUMP/END CAP:	1 in. PVC Sch 40	29.96	to	30.16
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Chips	0.0	to	6.0
UPPER PACK:	10-20 Silica Sand	6.0	to	12.0
LOWER PACK:	Slough	12.0	to	31.0

WATER LEVEL DATE 08/22/2005
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD CORE BARREL
DATE DEVELOPED 08/22/2005
REMARKS Lithology description from well location # MOA01-0688.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		7.0-12.0 ft. SILTY SAND (SM); brown (7YR 3/3), ~20% silt, ~80% fine grained sand, trace of clay, dry.
5							
	3960				10-20 Silica Sand		@9.0 ft. hit water.
10							
	3955						
15					PVC Sch 40		15.0-27.0 ft. GRAVELLY SAND (SP-GP); strong brown (7.5YR 4/6), 60% medium to coarse grained sand, 40% subangular to rounded gravel (up to 1.0" in diameter),
	3950						
20					Slough		27.0-31.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, 60% gravel is subangular to rounded, wet, 40% sand, fine to medium grained.
	3945						
25					0.010 Slotted PVC		
	3940						
30					End Cap		
	3935						Total Depth 31.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0688

PROJECT	MOAB	**WELL NUMBER**	MOA01-0688	**DATE DRILLED**	06/25/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664007.19	**SURFACE ELEV. (FT NGVD)**	3966.57
SITE	Moab Site	**EAST COORD. (FT)**	2186189.94	**TOP OF CASING (FT)**	3968.66
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	45.00	**MEAS. PT. ELEV. (FT)**	3968.66
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	41.00	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	8.3	**BIT SIZE(S) (IN)**	10.87 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.09	to	30.6
WELL SCREEN:	6 in. 0.020 Wire Wrap	30.6	to	40.6
SUMP/END CAP:	6 in. PVC Sch 40	40.6	to	41.0
SURFACE SEAL:				
GROUT:	Bentonite Grout	0.0	to	18.1
SEAL:	Bentonite Chips	18.1	to	23.4
UPPER PACK:	16-40 Silica Sand	23.4	to	27.2
LOWER PACK:	10-20 Silica Sand	27.2	to	42.0

WATER LEVEL DATE 06/28/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-14.0 ft. SILTY SAND (SM); brown (7YR 3/3), ~20% silt, ~80% fine grained sand, trace of clay, dry.
	3960						
10					Bentonite Grout		@9.0 ft. hit water.
							14.0-20.0 ft. GRAVELLY SAND (SP-GP); strong brown (7.5YR 4/6), 60% medium to coarse grained sand, 40% subangular to rounded gravel (up to 1.0" in diameter),
	3950						
20					Bentonite Chips		20.0-45.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, 60% gravel is subangular to rounded, wet, 40% sand, fine to medium grained.
					16-40 Silica Sand		
	3940						
					PVC Sch 40		
30					10-20 Silica Sand		
					0.020" Wire Wrap		~90% gravel below 35.0 ft.
	3930						
40					End Cap		
					Slough		
	3920						Total Depth 45.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0689

PROJECT	MOAB	**WELL NUMBER**	MOA01-0689	**DATE DRILLED**	06/27/2005
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664014.43	**SURFACE ELEV. (FT NGVD)**	3966.62
SITE	Moab Site	**EAST COORD. (FT)**	2186193.26	**TOP OF CASING (FT)**	3968.66
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	58.00	**MEAS. PT. ELEV. (FT)**	3968.66
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	56.40	**SLOT SIZE (IN)**	0.020
RIG TYPE	Star 30K	**WATER LEVEL (FT BGS)**	8.3	**BIT SIZE(S) (IN)**	10.87 /

	WELL INSTALLATION	INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.04	to	46.0
WELL SCREEN:	6 in. 0.020 Wire Wrap	46.0	to	56.0
SUMP/END CAP:	6 in. PVC Sch 40	56.0	to	56.4
SURFACE SEAL:				
GROUT:	Bentonite	0.0	to	30.0
SEAL:	Bentonite Chips	30.0	to	38.0
UPPER PACK:	16-40 Silica Sand	38.0	to	42.0
LOWER PACK:	10-20 Silica Sand	42.0	to	57.0

WATER LEVEL DATE 06/28/2005
DRILLER Lamon, A.
LOGGED BY Pill, K.
SAMPLING METHOD Airlift/Cyclone
DATE DEVELOPED
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-14.0 ft. SILTY SAND (SM); brown (7YR 3/3), ~20% silt, ~80% fine grained sand, trace of clay, dry.
	3960						
10							@9.0 ft. hit water.
					Bentonite Grout		14.0-20.0 ft. GRAVELLY SAND (SP-GP); strong brown (7.5YR 4/6), 60% medium to coarse grained sand, 40% subangular to rounded gravel (up to 1.0" in diameter),
	3950						
20							20.0-45.0 ft. SANDY GRAVEL (GW-SW); most of sand washed out with water, 60% gravel is subangular to rounded, wet, 40% sand, fine to medium grained.
	3940						
30					Bentonite Chips		
	3930				16-40 Silica Sand		~90% gravel below 35.0 ft.
40					PVC Sch 40		
	3920				10-20 Silica Sand		45.0-58.0 ft. SANDY GRAVEL (GW-SW); ~60% subangular to subrounded gravel, ~40% medium to coarse grained sand. Most sand wash washed away with water.
50					0.020" Wire Wrap		
	3910				End Cap Slough		
							Total Depth 58.0 ft.

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GRAND JUNCTION, COLORADO

STATIC WATER LEVELS (USEE700) FOR SITE MOA01, Moab Site
REPORT DATE: 3/24/2006 9:32 am

LOCATION CODE	FLOW CODE	TOP OF CASING ELEVATION (FT)	MEASUREMENT		DEPTH FROM TOP OF CASING (FT)	WATER ELEVATION (FT)	WATER LEVEL FLAG
			DATE	TIME			
0670		3969.54	08/09/2005	14:35	15.22	3954.32	
0671		3969.50	08/09/2005	16:04	15.31	3954.19	
0672		3969.57	08/09/2005	17:10	15.22	3954.35	
0673		3969.44	08/09/2005	18:10	15.10	3954.34	
0674		3969.49	08/10/2005	07:26	14.93	3954.56	
0675		3969.64	08/10/2005	08:37	13.94	3955.70	
0676		3969.69	08/10/2005	09:35	14.46	3955.23	
0677		3969.61	08/10/2005	16:55	14.67	3954.94	
0678		3969.65	08/10/2005	15:33	13.92	3955.73	
0679		3969.59	08/10/2005	14:19	14.61	3954.98	
0688		3968.66	08/10/2005	10:39	14.28	3954.38	
0689		3968.66	08/10/2005	11:28	14.37	3954.29	

RECORDS: SELECTED FROM USEE700 WHERE site_code='MOA01' AND location_code in('0670','0671','0672','0673','0674','0675','0676','0677','0678','0679','0688','0689') AND LOG_DATE between #8/1/2005# and #8/15/2005#

FLOW CODES:

WATER LEVEL FLAGS:

Configuration 4

Well Boring and Construction Logs

MONITORING WELL COMPLETION LOG MOA01-0770

PROJECT	MOAB	**WELL NUMBER**	MOA01-0770	**DATE DRILLED**	5/22/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663072.47	**SURFACE ELEV. (FT NGVD)**	3966.39
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185981.17	**TOP OF CASING (FT)**	3968.86
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.86
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.24	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	8.9	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.47	to	14.9
WELL SCREEN:	6 in. PVC Vee Wire	14.9	to	34.8
SUMP/END CAP:	6 in. PVC Sch 40	34.8	to	35.24
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.24

WATER LEVEL DATE 5/23/2006
DRILLER Campbell, R
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/23/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/3), 65% silt 35% very fine to fine grained sand, well sorted sand, soft, damp.
5	3960				Bentonite Chips		5.0-10.0 ft. SAND (SP); brown, (7.5YR 5/4), 95-100% sand <5% silt, well sorted, fine to medium subangular sand, loose moist.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SAND (SW); dark brown (7.5YR 4/4), 100% sand . poorly sorted, very fine to coarse grained, subangular to rounded, loose saturated.
15	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand 15% gravel, poorly sorted, fine to very coarse sand, subangular to rounded, gravel is fine to medium, rounded, dense, saturated.
20	3945				0.020" Wire Wrap		20.0-25.0 ft. GRAVELLY SAND (SP); dark brown (7.5YR 4/4), 80% sand, 20% gravel, well sorted, medium to coarse grained, subrounded sand, fine to medium subrounded gravel, dense, saturated.
25	3940						25.0-30.0 ft. SILTY SANDY GRAVEL (GW-GM); reddish brown (5YR 4/4), 70% gravel, 20% sand, 10% silt, poorly sorted, fine to coarse subrounded gravel, fine to very coarse subrounded sand, dense, nonplastic saturated.
30	3935						30.0-37.0 ft. SANDY GRAVEL (GW-SW); dark reddish brown (5YR 3/3), 70% gravel, 30% sand, poorly sorted, fine to coarse subrounded gravel with some cobbles, mainly fine to medium subangular sand, dense to very dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0771

PROJECT	MOAB	**WELL NUMBER**	MOA01-0771	**DATE DRILLED**	5/22/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663098.30	**SURFACE ELEV. (FT NGVD)**	3966.20
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185984.89	**TOP OF CASING (FT)**	3969.04
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3969.04
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.34	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.68	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.85	to	15.0
WELL SCREEN:	6 in. PVC Vee Wire	15.0	to	34.9
SUMP/END CAP:	6 in. PVC Sch 40	34.9	to	35.34
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.34

WATER LEVEL DATE 5/22/2006
DRILLER Campbell, R
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/22/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML-SP); dark brown (7.5YR 4/4), 80% silt, 20% sand, soft, nonplastic, damp.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 60% silt, 20% clay, 20% sand, soft, no plasticity, moist, very fine to medium sand with depth, subangular to subrounded.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SILTY GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 90% sand, 10% silt and sand, poorly sorted sand, fine to coarse grained, subrounded subangular, loose, saturated.
15	3950						15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 90% sand, 10% gravel, poorly sorted sand, fine to very coarse grained , subrounded to subangular, loose saturated.
20	3945				10-20 Silica Sand		20.0-25.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 90% sand, 10% gravel, poorly sorted, fine to coarse grained, subrounded to subangular sand, medium dense, saturated.
25	3940				0.020" Wire Wrap		25.0-30.0 ft. SANDY GRAVEL (GW-SW); strong brown (7.5YR 4/6), trace silt, 60% gravel 40% sand, fine to coarse gravel, poorly sorted, sand is about 85% medium grain subangular, dense, saturated.
30	3935				Centralizer		30.0-37.0 ft. SANDY GRAVEL (GP-SP); dark brown (7.5YR 4/2), 70% gravel, 30% sand, moderately sorted gravel, fine to medium size- generally rounded - gravel, sand is poorly graded fine to very coarse and rounded to subangular, dense, saturated.
35	3930				End Cap; Native soil/fill		Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0772

PROJECT	MOAB	**WELL NUMBER**	MOA01-0772	**DATE DRILLED**	5/21/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663121.53	**SURFACE ELEV. (FT NGVD)**	3966.60
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185987.71	**TOP OF CASING (FT)**	3969.21
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3969.21
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.49	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.87	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.6	to	15.15
WELL SCREEN:	6 in. PVC Vee Wire	15.15	to	35.05
SUMP/END CAP:	6 in. PVC Sch 40	35.05	to	35.49
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.49

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/21/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML-SP); dark brown (7.5YR 4/4), 70% silt, 30% sand, soft, well sorted sand, nonplastic, damp.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 60% silt, 10% clay, 30% very fine grained sand, well sorted, no plasticity, soft, moist.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SILTY CLAYEY SAND (SC); dark brown (7.5YR 4/4), 75% sand, 25% clayey silt, fine to medium grain sand, some coarse grain, moderately sorted, subrounded, loose, nonplastic but clumps into clay balls, moist to saturated.
15	3950						15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 80% sand, 20% gravel, fine to very coarse grain sand, subrounded poorly sorted, gravel is fine to medium rounded, dense, saturated.
20	3945				10-20 Silica Sand		20.0-25.0 ft. SANDY GRAVELLY SILT (ML-GP); dark brown (7.5yr 4/2), 60% clayey silt, 20% sand, 20% gravel, moderately sorted fine gravel, fine to medium grained sand, subrounded, no plasticity, saturated.
25	3940				0.020" Wire Wrap		25.0-30.0 ft. SANDY SILTY GRAVEL (GM); dark brown (7.5YR 4/2), 75% gravel, 15% sand, 10% silt, moderately sorted, fine to medium gravel, medium to very coarse sand, subangular gravel to rounded, dense, saturated.
30	3935				Centralizer		30.0-37.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 4/0), 60% gravel, 40% sand, poorly sorted gravel, fine to very coarse rounded to subrounded sand, dense, saturated.
35	3930				End Cap; Native soil/fill		Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0773

PROJECT	MOAB	**WELL NUMBER**	MOA01-0773	**DATE DRILLED**	5/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663146.36	**SURFACE ELEV. (FT NGVD)**	3965.52
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185991.15	**TOP OF CASING (FT)**	3969.15
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3969.15
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.49	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.69	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-3.63	to	15.15
WELL SCREEN:	6 in. PVC Vee Wire	15.15	to	35.05
SUMP/END CAP:	6 in. PVC Sch 40	35.05	to	35.49
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.49

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/21/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/2), 60% silt, 30% very fine grained sand, 10% clay, soft, nonplastic, damp.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/2), 50% silt, 30% clay, 20% sand, soft, no plasticity, moist, fine grained sand.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SILTY CLAYEY SAND (SM); dark brown (7.5YR 4/4), 70% sand, 30% silt and clay, fine to coarse grained, subrounded subangular, loose, saturated.
15	3950						15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand, 15% gravel, well sorted sand. About 80% medium grained subrounded sand with some fine and coarse grains. Gravel is coarse (up to 2.0" in diameter), rounded, saturated, dense.
20	3945				10-20 Silica Sand		20.0-25.0 ft. GRAVELLY SILT/CLAY SAND (SM); dark yellowish brown (7.5YR 3/4), 80% sand, 7% gravel, 13% silt/clay, poorly sorted, fine to very coarse grained subrounded sand, medium dense, saturated.
25	3940				0.020" Wire Wrap		25.0-30.0 ft. SANDY CLAYEY SILT(ML); trace gravel dark brown (7.5YR 3/2), 60% silt, 25% clay, 15% fine sand, trace gravel, no plasticity, compact, saturated.
30	3935						30.0-37.0 ft. SANDY SILTY GRAVEL (GM); dark brown, (7.5YR 3/2), 85% gravel, 7% sand, 7% silt. Poorly sorted fine to coarse gravel, rounded, sand is medium-coarse grain subrounded dense to very dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

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GRAND JUNCTION, COLORADO

MONITORING WELL COMPLETION LOG MOA01-0774

PROJECT	MOAB	**WELL NUMBER**	MOA01-0774	**DATE DRILLED**	5/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663171.21	**SURFACE ELEV. (FT NGVD)**	3966.54
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185994.50	**TOP OF CASING (FT)**	3968.77
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.77
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.84	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.83	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.24	to	15.5
WELL SCREEN:	6 in. PVC Vee Wire	15.5	to	35.4
SUMP/END CAP:	6 in. PVC Sch 40	35.4	to	35.84
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.84

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/20/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/3), 60% silt, 35% very fine grained sand, soft, nonplastic, damp.
5	3960				Bentonite Chips		5.0-11.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/3), 50% silt, 20% clay, 30% sand, soft, no plasticity, moist, very fine grained sand, well sorted.
10	3955				20-40 Silica Sand		11.0-17.0 ft. SILTY CLAYEY SAND (SM); dark brown (7.5YR 4/4), 75% sand, 25% silt and clay, well sorted, fine to medium grained, subrounded sand, loose, saturated.
15	3950				Centralizer		17.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand, 15% gravel, well sorted sand. fine to coarse sand, medium grain subrounded, coarse rounded/flattened gravel (up to 2.0" in diameter), dense, saturated.
20	3945				10-20 Silica Sand		20.0-27.0 ft. GRAVELLY SAND (GW-SW); dark brown (7.5YR 4/4), with some clay, poorly sorted fine to coarse sand, subangular, to subrounded, medium gravel, dense, saturated.
25	3940				0.020" Wire Wrap		27.0-30.0 ft. SANDY GRAVEL (GW); dark brown (7.5YR 4/2), 60% gravel, 40% sand, fine to medium size rounded to subrounded gravel, fine to coarse subrounded sand, dense, saturated.
30	3935						30.0-37.0 ft. SANDY GRAVEL WITH COBBLES (GW); dark brown, (7.5YR 4/2), 70% gravel, 30% sand. Fine to coarse gravel with some cobbles, rounded, fine to very coarse subrounded/rounded sand, poorly sorted, dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0775

PROJECT	MOAB	**WELL NUMBER**	MOA01-0775	**DATE DRILLED**	5/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663195.63	**SURFACE ELEV. (FT NGVD)**	3966.19
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185997.91	**TOP OF CASING (FT)**	3969.18
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3969.18
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.44	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.86	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.99	to	15.1
WELL SCREEN:	6 in. PVC Vee Wire	15.1	to	35.0
SUMP/END CAP:	6 in. PVC Sch 40	35.0	to	35.44
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.44

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/20/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML-SP); dark brown (7.5YR 4/3), 60% silt, 40% very fine grained sand, well sorted, soft, nonplastic, damp.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/3), 60% silt, 30% very fine and fine grained sand, 10% clay.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SAND (SW); dark brown (7.5YR 4/4), trace silt, poorly sorted, very fine grained to medium coarse grained, subrounded, loose saturated.
15	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 80% sand, 20% gravel, fine to coarse grained subrounded sand poorly graded with medium rounded gravel, becoming dense, with depth, saturated.
20	3945						20.0-24.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), sand and gravel as above.
25	3940				0.020" Wire Wrap		24.0-30.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 4/2), 65% gravel 35% sand, trace of silt/clay, poorly sorted fine to coarse rounded gravel and fine to coarse grained subrounded sand, dense, saturated.
30	3935						30.0-37.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 4/2), sandy gravel as above, some cobbles freshly broken (up to 2.5 " in diameter).
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0776

PROJECT	MOAB	**WELL NUMBER**	MOA01-0776	**DATE DRILLED**	5/19/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663220.33	**SURFACE ELEV. (FT NGVD)**	3966.30
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186001.55	**TOP OF CASING (FT)**	3968.97
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.97
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.49	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.68	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.67	to	15.15
WELL SCREEN:	6 in. PVC Vee Wire	15.15	to	35.05
SUMP/END CAP:	6 in. PVC Sch 40	35.05	to	35.49
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.49

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/20/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. CLAYEY SILT (ML); dark brown (7.5YR 4/3), 70% silt, 30% clay, trace very fine sand, soft, no plasticity, moist.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); brown, (7.5YR 4/2), 70% silt, 20% clay, 10% very fine to fine grain sand, soft, no plasticity, moist.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SILTY CLAYEY SAND (SM); dark brown (7.5YR 4/4), 80% sand, 20% silt/clay, well sorted fine-medium grain sand, subrounded/subangular, some rounded, loose, saturated.
15	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SP-GP); dark brown (7.5YR 4/4), 80% sand, 20% gravel, well sorted, medium grain with some fine and coarse grain, subrounded, loose, saturated.
20	3945				0.020" Wire Wrap		20.0-27.0 ft. GRAVELLY SAND (SP-GP); dark brown (7.5YR 4/4), 80% sand, 20% gravel, well sorted, medium to coarse grained sand, subangular, dense with depth.
25	3940						27.0-30.0 ft. SANDY GRAVEL (GP-SP); very dark gray (7.5YR 3/1), 60% gravel, 40% sand trace silt/clay, well sorted gravel coarse with some medium, fine grain subangular sand, dense.
30	3935						30.0-37.0 ft. SANDY GRAVEL (GP-SP); very dark gray (7.5YR 3/3), 70% gravel, 30% sand, well sorted fine-medium size gravel with fine and medium grain subangular sand, dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0777

PROJECT	MOAB	**WELL NUMBER**	MOA01-0777	**DATE DRILLED**	5/19/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663244.68	**SURFACE ELEV. (FT NGVD)**	3966.30
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186004.63	**TOP OF CASING (FT)**	3968.76
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.76
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.64	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.7	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.46	to	15.3
WELL SCREEN:	6 in. PVC Vee Wire	15.3	to	35.2
SUMP/END CAP:	6 in. PVC Sch 40	35.2	to	35.64
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.64

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/19/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 3/3), 70% silt, 15% clay, 15% very fine grain sand, well sorted sand, no plasticity, moist.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 3/3), 60% silt, 30% clay, 10% very fine grain sand, well sorted, no plasticity, moist.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SAND (SP); dark brown (7.5YR 3/3), 90% sand, 10% silt moderate sorting mostly medium grain sand with some fine and coarse subangular, loose, saturated.
15	3950				10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand, 15% gravel (starting at ~18.0 ft.) poorly sorted sand, fine to coarse grained, subangular, gravel medium, round, loose to dense @18.0 ft., saturated.
20	3945						20.0-27.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 65% sand, 35% gravel, as above, dense, saturated.
25	3940				0.020" Wire Wrap		
30	3935						27.0-30.0 ft. SANDY GRAVEL (GW-SW); very dark gray (7.5YR 3/1),70% gravel, 30% sand, with trace silt, medium to coarse gravel, rounded, moderately sorted, sand is fine to coarse grain, rounded to subangular, formation is dense and saturated.
35	3930				Centralizer; End Cap; Native soil/fill		30.0-37.0 ft. SANDY GRAVEL (GW-SW); very dark gray (7.5YR 3/1), 70% gravel, 30% sand, moderately sorted gravel, fine to medium size-generally rounded - gravel, sand is poorly graded fine to very coarse and rounded to subangular, dense, saturated.
							Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0778

PROJECT	MOAB	**WELL NUMBER**	MOA01-0778	**DATE DRILLED**	5/19/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663272.16	**SURFACE ELEV. (FT NGVD)**	3966.13
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186008.48	**TOP OF CASING (FT)**	3968.93
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.93
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	35.44	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.66	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-2.81	to	15.1
WELL SCREEN:	6 in. PVC Vee Wire	15.1	to	35.0
SUMP/END CAP:	6 in. PVC Sch 40	35.0	to	35.44
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	35.44

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/19/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 70% silt, 30%, very fine grain sand, well sorted sand, no plasticity, soft, moist.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 50% silt, 20% clay, 30% very fine grain sand, subangular sand, loose, well sorted, no plasticity, moist.
10	3955				20-40 Silica Sand		10.0-15.0 ft. SAND (SP); dark brown (7.5YR 4/4), 90% sand, 10% silt/clay, well sorted medium grain sand with some fine and coarse subangular, loose, saturated.
15	3950				Centralizer; 10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 80% sand, 20% gravel, poorly sorted sand, medium to coarse grained, subangular to rounded with fine to coarse gravel (up to 2.0" in diameter) more dense at depth, saturated.
20	3945						20.0-25.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand, 15% gravel, poorly sorted medium to very coarse sand (60-70% medium), trace clay in lenses or thin layer. Gravel is medium size and sand is subrounded, dense , saturated.
25	3940				0.020" Wire Wrap		25.0-30.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 3/4), 55% gravel, 45% sand, poorly sorted, subrounded medium to coarse sand, rounded medium to coarse gravel, dense, saturated.
30	3935						30.0-37.0 ft. SANDY GRAVEL (GW-SW); dark gray (7.5YR 3/2), 70% gravel, 30% sand, poorly sorted, subrounded medium to coarse sand, rounded medium gravel, dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

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MONITORING WELL COMPLETION LOG MOA01-0779

PROJECT	MOAB	**WELL NUMBER**	MOA01-0779	**DATE DRILLED**	5/18/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663296.63	**SURFACE ELEV. (FT NGVD)**	3966.44
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186012.12	**TOP OF CASING (FT)**	3968.43
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	37.00	**MEAS. PT. ELEV. (FT)**	3968.43
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	36.00	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.8	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.99	to	15.66
WELL SCREEN:	6 in. PVC Vee Wire	15.66	to	35.56
SUMP/END CAP:	6 in. PVC Sch 40	35.56	to	36.0
GROUT:	Cement Grout	0.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	20-40 Silica Sand	10.0	to	13.0
LOWER PACK:	10-20 Silica Sand	13.0	to	36.0

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/18/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Grout; PVC Sch 40		0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/4), 90% silt, 10% very fine grain sand, well sorted sand, no plasticity, soft, moist.
5	3960				Bentonite Chips		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/3), 70% silt, 20% clay, 10% very fine grain sand, well sorted, no plasticity, moist.
10	3955				20-40 Silica Sand; Centralizer		10.0-15.0 ft. SILTY SAND (SM); dark brown (7.5YR 4/4), 65-70% sand, 30-35% silt/clay, very fine to medium grained sand, subangular/subrounded, moderately sorted, loose, moist to saturated.
15	3950						15.0-20.0 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 80% sand, 20% gravel, poorly sorted sand, medium to coarse gravel (up to 2.0" in diameter) and rounded. Sand is subangular to rounded, dense, saturated
20	3945				10-20 Silica Sand		20.0-25.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 50% sand and 50% gravel as described above. Increasing density and gravel with depth.
25	3940				0.020" Wire Wrap		25.0-30.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 3/2), 70% gravel, 30-40% sand, trace silt and clay, coarse subangular gravel with large angular fragments, medium to coarse sand, subangular dense, saturated.
30	3935						30.0-37.0 ft. SANDY GRAVEL (GW-SW); dark gray (7.5YR 3/2), 70% gravel, 30% sand, poorly sorted, subrounded medium to coarse sand, rounded medium gravel, dense, saturated.
35	3930				Centralizer; End Cap; Native soil/fill		Total Depth 37.0 ft.

MONITORING WELL COMPLETION LOG MOA01-0780

PROJECT	MOAB	**WELL NUMBER**	MOA01-0780	**DATE DRILLED**	5/16/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663195.38	**SURFACE ELEV. (FT NGVD)**	3966.54
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185982.23	**TOP OF CASING (FT)**	3968.45
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	32.00	**MEAS. PT. ELEV. (FT)**	3968.45
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	30.53	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	10.1	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.91	to	20.32
WELL SCREEN:	6 in. PVC Vee Wire	20.32	to	30.09
SUMP/END CAP:	6 in. PVC Sch 40	30.09	to	30.53
GROUT:	Cement Grout	0.0	to	10.0
SEAL:	Bentonite Pellets	10.0	to	15.0
UPPER PACK:	20-40 Silica Sand	15.0	to	18.0
LOWER PACK:	10-20 Silica Sand	18.0	to	30.53

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/16/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				PVC Sch 40 Grout		0-5.0 ft. SANDY SILT (ML); dark yellowish brown (10YR 4/4), 60% silt, 40% sand, well sorted sand, loose, dry to damp.
5	3960						5.0-10.0 ft. SANDY SILT (ML); dark yellowish brown (10YR 4/4), sandy silt as above with transition @ about 7.0 ft. grading to 90% sand and 10% silt by 10.0 ft. Sand is very fine to fine grained sand with trace of medium grains, subangular, loose, damp.
10	3955				Bentonite Chips		10.0-15.0 ft. SAND (SP); trace silt (<10%), dark yellowish brown, (10YR 4/4), well sorted, fine grained - trace of medium grained sand, subangular, loose , moist to saturated @15.0 ft.
15	3950				20-40 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 90% sand, 10% gravel, poorly sorted at depth, subangular, loose to medium dense, saturated.
20	3945				Centralizer; 10-20 Silica Sand		20.0-25.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 90% sand and 10% gravel (up to 1.5" in diameter), 80% medium grained sand, 10% fines, 10% coarse , subangular to subrounded, medium dense, saturated.
25	3940				0.020" Wire Wrap		25.0-32.0 ft. GRAVELLY SAND (SW-GW); trace silt and clay, strong brown (7.5YR 4/6) to dark brown (7.5YR 3/3). Sand same as above grading to Gravels @ ~27.0-28.0 ft. Very dense @28.0 ft. with 70% gravel, 30% sand. Trace silt and clay increasing @30.0 ft. Gravels are small to medium in size and subrounded to flattened subrounded.
30	3935				Centralizer; End Cap; Native soil/fill		
							Total Depth 32.0 ft.
35	3930						

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

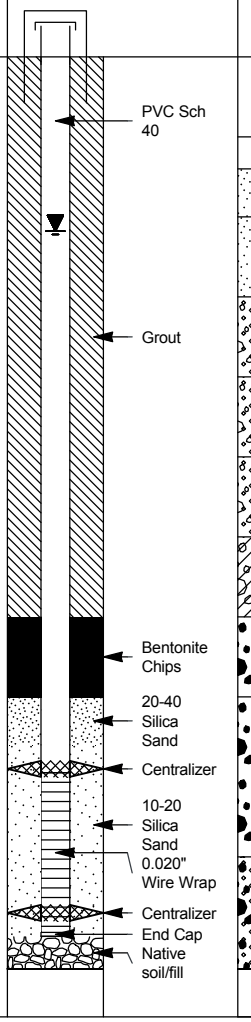
MONITORING WELL COMPLETION LOG MOA01-0781

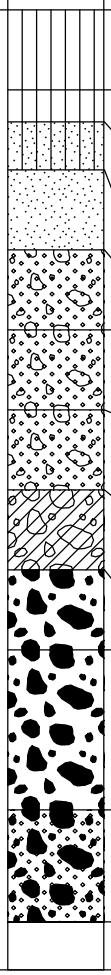
PROJECT	MOAB	**WELL NUMBER**	MOA01-0781	**DATE DRILLED**	5/16/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663190.93	**SURFACE ELEV. (FT NGVD)**	3966.62
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185971.25	**TOP OF CASING (FT)**	3968.56
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	57.00	**MEAS. PT. ELEV. (FT)**	3968.56
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	54.96	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	10.9	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.93	to	44.75
WELL SCREEN:	6 in. PVC Vee Wire	44.75	to	54.52
SUMP/END CAP:	6 in. PVC Sch 40	54.52	to	54.96
GROUT:	Cement Grout	0.0	to	35.0
SEAL:	Bentonite Pellets	35.0	to	40.0
UPPER PACK:	20-40 Silica Sand	40.0	to	43.0
LOWER PACK:	10-20 Silica Sand	43.0	to	55.0

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/17/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-5.0 ft. SANDY SILT (ML); dark yellowish brown (10YR 4/4), 60% silt, 40% very fine grain sand, well sorted sand, loose, dry to damp.
							5.0-7.0 ft. SANDY SILT (ML); dark yellowish brown (10YR 4/4), 60% silt, 40% sand, trace clay, damp.
							7.0-10.0 ft. SILTY SAND (SM); dark yellowish brown (10YR 4/4) sand 90% very fine to fine sand, well sorted, subangular to subrounded, loose, damp, 10% silt.
							10.0-15.0 ft. SAND (SP); dark yellowish brown (10YR 4/4), 90% very fine grain sand, trace silt/clay, subangular, loose, moist to saturated @ about 15.0 ft.
							15.0-20.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 90% sand, 10% gravel - gravel increases with depth, moderately sorted to poorly sorted, subangular, loose to medium dense, saturated.
							20.0-25.0 ft. GRAVELLY SAND (SW-GW); strong brown (7.5YR 4/6), 85-90% sand, 10-15% gravel (up to 2.0" in diameter), poorly sorted - fine to coarse grained sand, subangular to subrounded, medium dense, saturated.
							25.0-30.0 ft. GRAVELLY SAND (SW-GW); with trace silt/clay strong brown (7.5YR 4/6), to dark brown (7.5YR 3/3), gravels are small to medium, subrounded, some flattened, dense, 70% gravel and 30% sand.
							30.0-35.0 ft. CLAYEY GRAVEL (GC); 75% gravel, 25% silt/clay and fine to very fine grain sand, very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3), subrounded to subangular sand and gravel, dense to very dense saturated..
							35.0-40.0 ft. GRAVEL (GW); less than 10% silt/clay, dark brown (10YR 3/3), 75% gravel, 25% sand, poorly sorted sand, moderately sorted gravel, subangular, dense to very dense.
							40.0-50.0 ft. GRAVEL (GW); trace silt and very fine sand, dark brown (10YR 3/3), 80% gravel, 20% sand, moderately sorted, medium to coarse gravel (up to 2.0" in diameter), rounded to subangular, sand is mostly fine and medium grains, subrounded, dense to very dense, possible scattered cobbles probably less than 2%.
							50.0-57.0 ft. SANDY GRAVEL (GW-SW); increase sand to 30-40%.
							Total Depth 57.0 ft.





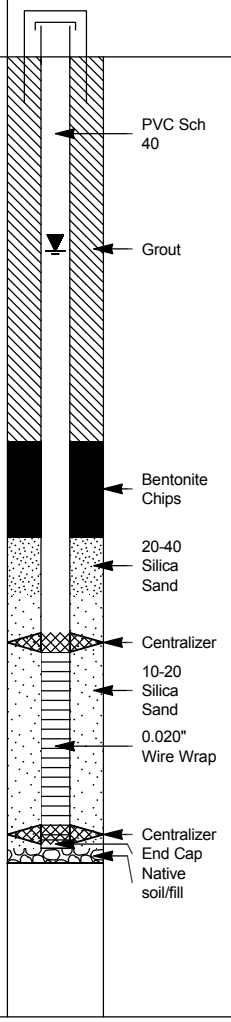
MONITORING WELL COMPLETION LOG MOA01-0782

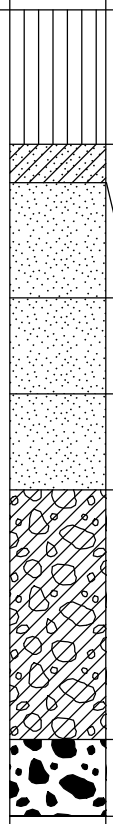
PROJECT	MOAB	**WELL NUMBER**	MOA01-0782	**DATE DRILLED**	5/15/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663183.70	**SURFACE ELEV. (FT NGVD)**	3966.57
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185980.42	**TOP OF CASING (FT)**	3968.46
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	42.00	**MEAS. PT. ELEV. (FT)**	3968.46
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	41.22	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	10.1	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.89	to	31.01
WELL SCREEN:	6 in. PVC Vee Wire	31.01	to	40.78
SUMP/END CAP:	6 in. PVC Sch 40	40.78	to	41.22
GROUT:	Cement Grout	0.0	to	20.0
SEAL:	Bentonite Pellets	20.0	to	25.0
UPPER PACK:	20-40 Silica Sand	25.0	to	28.0
LOWER PACK:	10-20 Silica Sand	28.0	to	41.22

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/22/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-7.0 ft. SANDY SILT (SM); dark yellowish brown (10YR 4/4), 60% silt, 40% very fine sand, well sorted, damp, no plasticity. 5.0-7.0 ft. trace clay, 50% silt and 40% very fine grained sand.
							7.0-9.0 ft. CLAYEY SILTY SAND (SC); dark dark yellowish brown (10YR 4/4), 70% sand, 20% clay, 10% silt. Moderately sorted very fine to fine grained sand, 60% fine grain, subrounded, no plasticity, loose, damp.
							9.0-15.0 ft. SAND (SP); trace clay (<5%), pale brown to brown (10YR 6/3-5/3), moderately sorted, fine to medium grain, subrounded to subangular quartz, moist.
							15.0-20.0 ft. SAND (SP); yellowish brown to dark brown (10YR 5/4-4/4), well sorted, medium grain, subrounded, saturated. Water Level 15.0 ft.
							20.0-25.0 ft. SAND (SP); poorly graded, coarse to very coarse, subrounded, loose, saturated, trace gravel.
							25.0-38.0 ft. CLAYEY GRAVEL (GC); 60-70% gravel with 30-40% silty clay and fine to very fine sand, some cobbles, very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3), subangular sand, no plasticity.
							38.0-42.0 ft. GRAVEL (GW); poorly sorted, fines <10%, dark brown (10YR 3/3), 75% gravel, 25% sand, subangular, hard.
							Total Depth 42.0 ft.





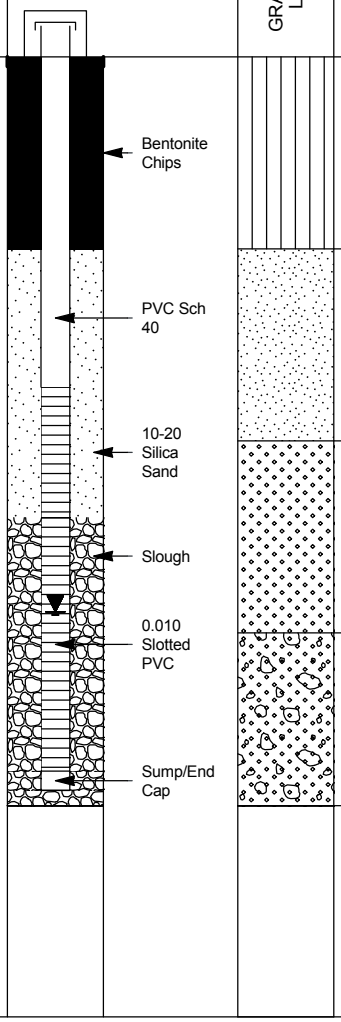
MONITORING WELL COMPLETION LOG MOA01-0783

PROJECT	MOAB	**WELL NUMBER**	MOA01-0783	**DATE DRILLED**	9/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663112.78	**SURFACE ELEV. (FT NGVD)**	3966.76
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2185954.80	**TOP OF CASING (FT)**	3968.82
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	19.50	**MEAS. PT. ELEV. (FT)**	3968.82
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.10	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.51	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-2.06	to	8.6
WELL SCREEN:	2 in. PVC Sch 40	8.6	to	18.6
SUMP/END CAP:	PVC Sch 40	18.6	to	19.1
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	12.0
LOWER PACK:	Slough	12.0	to	19.5

WATER LEVEL DATE 9/26/2006
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD DIRECT PUSH
DATE DEVELOPED 9/26/2006
REMARKS Lithology description from well location # MOA01-0771.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/3), 65% silt 35% very fine to fine grained sand, well sorted sand, soft, damp.
5	3960				PVC Sch 40		5.0-10.0 ft. SAND (SP); brown, (7.5YR 5/4), 95-100% sand <5% silt, well sorted, fine to medium subangular sand, loose moist.
10	3955				10-20 Silica Sand; Slough		10.0-15.0 ft. SAND (SW); dark brown (7.5YR 4/4), 100% sand . poorly sorted, very fine to coarse grained, subangular to rounded, loose saturated.
15	3950				0.010 Slotted PVC; Sump/End Cap		15.0-19.5 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand 15% gravel, poorly sorted, fine to very coarse sand, subangular to rounded, gravel is fine to medium, rounded, dense, saturated.
20	3945						Total Depth 19.5 ft.



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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

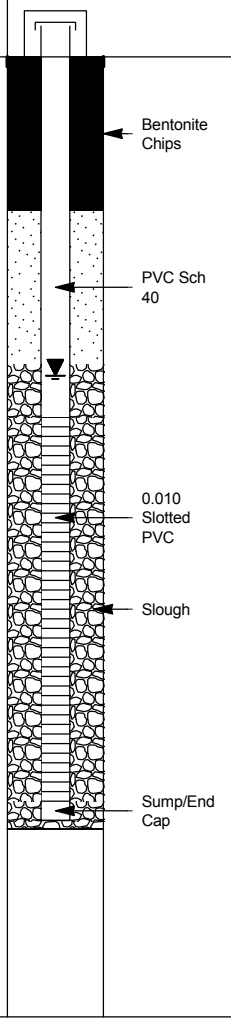
MONITORING WELL COMPLETION LOG MOA01-0784

PROJECT	MOAB	**WELL NUMBER**	MOA01-0784	**DATE DRILLED**	5/15/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663083.27	**SURFACE ELEV. (FT NGVD)**	3966.62
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186009.11	**TOP OF CASING (FT)**	3968.73
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.10	**MEAS. PT. ELEV. (FT)**	3968.73
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.88	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	10.41	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-2.11	to	9.38
WELL SCREEN:	2 in. PVC Sch 40	9.38	to	19.38
SUMP/END CAP:	PVC Sch 40	19.38	to	19.88
GROUT:				
SEAL:	Bentonite Chips	0.0	to	4.0
UPPER PACK:	10-20 Silica Sand	4.0	to	8.0
LOWER PACK:	Slough	8.0	to	20.1

WATER LEVEL DATE 5/25/2006
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD DIRECT PUSH
DATE DEVELOPED 5/25/2006
REMARKS Lithology description from well location # MOA01-0770.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/3), 65% silt 35% very fine to fine grained sand, well sorted sand, soft, damp.
5	3960				PVC Sch 40		5.0-10.0 ft. SAND (SP); brown, (7.5YR 5/4), 95-100% sand <5% silt, well sorted, fine to medium subangular sand, loose moist.
10	3955				0.010 Slotted PVC; Slough		10.0-15.0 ft. SAND (SW); dark brown (7.5YR 4/4), 100% sand . poorly sorted, very fine to coarse grained, subangular to rounded, loose saturated.
15	3950				Sump/End Cap		15.0-20.1 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 85% sand 15% gravel, poorly sorted, fine to very coarse sand, subangular to rounded, gravel is fine to medium, rounded, dense, saturated.
20	3945						Total Depth 20.1 ft.



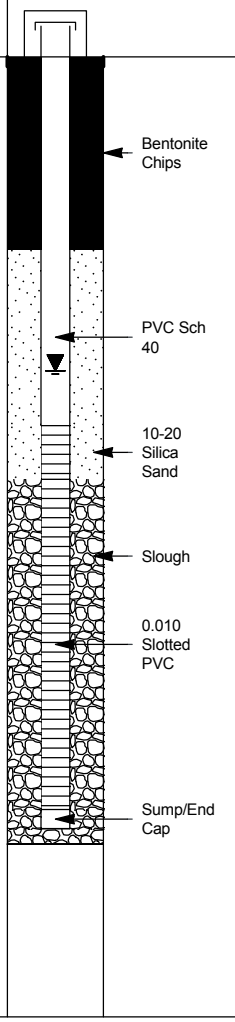
MONITORING WELL COMPLETION LOG MOA01-0785

PROJECT	MOAB	**WELL NUMBER**	MOA01-0785	**DATE DRILLED**	5/10/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663255.99	**SURFACE ELEV. (FT NGVD)**	3966.85
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186032.43	**TOP OF CASING (FT)**	3969.24
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.50	**MEAS. PT. ELEV. (FT)**	3969.24
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.10	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	10.56	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-2.39	to	9.6
WELL SCREEN:	2 in. PVC Sch 40	9.6	to	19.6
SUMP/END CAP:	PVC Sch 40	19.6	to	20.1
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	11.0
LOWER PACK:	Slough	11.0	to	20.5

WATER LEVEL DATE 5/24/2006
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD DIRECT PUSH
DATE DEVELOPED 5/24/2006
REMARKS Lithology description from well location # MOA01-0778.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				Bentonite Chips		0-5.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 70% silt, 30%, very fine grain sand, well sorted sand, no plasticity, soft, moist.
5	3960				PVC Sch 40		5.0-10.0 ft. CLAYEY SANDY SILT (ML); dark brown (7.5YR 4/4), 50% silt, 20% clay, 30% very fine grain sand, subangular sand, loose, well sorted, no plasticity, moist.
10	3955				10-20 Silica Sand; Slough		10.0-15.0 ft. SAND (SP); dark brown (7.5YR 4/4), 90% sand, 10% silt/clay, well sorted medium grain sand with some fine and coarse subangular, loose, saturated.
15	3950				0.010 Slotted PVC		15.0-20.5 ft. GRAVELLY SAND (SW-GW); dark brown (7.5YR 4/4), 80% sand, 20% gravel, poorly sorted sand, medium to coarse grained, subangular to rounded with fine to coarse gravel (up to 2.0" in diameter) more dense at depth, saturated.
20	3945				Sump/End Cap		Total Depth 20.5 ft.



MONITORING WELL COMPLETION LOG MOA01-0786

PROJECT	MOAB	**WELL NUMBER**	MOA01-0786	**DATE DRILLED**	5/18/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663191.19	**SURFACE ELEV. (FT NGVD)**	3966.20
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186019.25	**TOP OF CASING (FT)**	3968.14
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	32.00	**MEAS. PT. ELEV. (FT)**	3968.14
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	30.70	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	9.35	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.94	to	20.49
WELL SCREEN:	6 in. PVC Vee Wire	20.49	to	30.26
SUMP/END CAP:	6 in. PVC Sch 40	30.26	to	30.7
GROUT:	Cement Grout	0.0	to	10.0
SEAL:	Bentonite Pellets	10.0	to	15.0
UPPER PACK:	20-40 Silica Sand	15.0	to	18.0
LOWER PACK:	10-20 Silica Sand	18.0	to	31.0

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/18/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965				PVC Sch 40; Grout		0-5.0 ft. SANDY SILT (ML); trace clay, dark brown (7.5YR 4/3), 60% silt, 40% very fine grain sand, well sorted sand, no plasticity, damp.
5	3960						5.0-10.0 ft. SANDY CLAYEY SILT (ML); dark brown (7.5YR 4/3), 60% silt, 20% silt/clay, 20% sand, very fine grain sand, well sorted, no plasticity, damp.
10	3955				Bentonite Chips		10.0-15.0 ft. SAND (SP); trace silt, dark brown (7.5YR 4/4), 90% sand, 10% silt clay, well sorted, medium to coarse, sand, subangular/subrounded, loose, moist to saturated.
15	3950				20-40 Silica Sand; 10-20 Silica Sand		15.0-20.0 ft. GRAVELLY SAND (SP); dark brown (7.5YR 4/4), 95% sand, 5% gravel, well sorted medium to coarse sand and fine to medium gravel, subrounded sand and gravel, medium dense to loose, saturated, gravel increases with depth.
20	3945						20.0-25.0 ft. GRAVELLY SAND (SP-GP); strong brown (7.5YR 4/6), 70% sand, 30% gravel, well sorted, subrounded, medium to coarse grain sand. Poorly sorted, fine to coarse gravel (up 2.5" in diameter), rounded - some flattened, dense, saturated.
25	3940				0.020" Wire Wrap		25.0-32.0 ft. SANDY GRAVEL (GW-SW); strong brown (7.5YR 4/6), 60% gravel, 40% sand, increasing density and some fine sand.
30	3935				End Cap; Native soil/fill		
							Total Depth 32.0 ft.

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

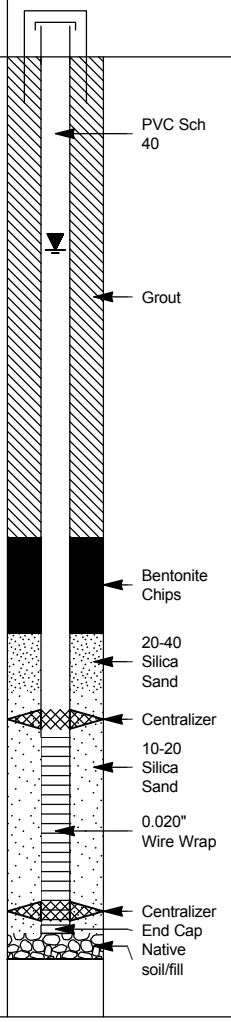
MONITORING WELL COMPLETION LOG MOA01-0787

PROJECT	MOAB	**WELL NUMBER**	MOA01-0787	**DATE DRILLED**	5/17/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6663179.23	**SURFACE ELEV. (FT NGVD)**	3966.67
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186018.12	**TOP OF CASING (FT)**	3968.43
DRILLING METHOD	ARCH	**HOLE DEPTH (FT)**	47.00	**MEAS. PT. ELEV. (FT)**	3968.43
DRILL COMPANY	WDC	**WELL DEPTH (FT)**	45.65	**SLOT SIZE (IN)**	0.020
RIG TYPE	Speedstar 40K	**WATER LEVEL (FT BGS)**	10.05	**BIT SIZE(S) (IN)**	10.63 /

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	6 in. PVC Sch 40	-1.76	to	35.44
WELL SCREEN:	6 in. PVC Vee Wire	35.44	to	45.21
SUMP/END CAP:	6 in. PVC Sch 40	45.21	to	45.65
GROUT:	Cement Grout	0.0	to	25.0
SEAL:	Bentonite Pellets	25.0	to	30.0
UPPER PACK:	20-40 Silica Sand	30.0	to	33.0
LOWER PACK:	10-20 Silica Sand	33.0	to	46.0

WATER LEVEL DATE 5/22/2006
DRILLER Rainbolt, C
LOGGED BY Rupp, R.
SAMPLING METHOD CYCLONE- 5.0 ft. intervals
DATE DEVELOPED 5/18/2006
REMARKS

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-5.0 ft. SANDY SILT (ML); dark brown (7.5YR 4/4); 70% silt, 30% very fine sand, trace clay. Well sorted no plasticity, loose.
	3960						5.0-10.0 ft. SANDY CLAYEY SILT (ML); dark brown (7.5YR 3/3), 60% silt, 15% very fine to fine grained sand, 25% clay, no plasticity, loose, damp.
10							10.0-15.0 ft. SILTY CLAYEY SAND (SM); dark brown (7.5YR 3/3), 80% sand, 20% silt/clay, well sorted medium to coarse grain sand, subrounded, loose, moist to saturated.
	3950						15.0-20.0 ft. SAND (SP); strong brown, (7.5YR 4/6); 90% sand, 5% gravel 5% silt/clay, well sorted, medium to coarse grain, subrounded, loose saturated. Gravel small sized flattened rounded to coarse gravel (up to 2.0" in diameter).
20							20.0-25.0 ft. SAND (SP); as above, strong brown (7.5YR 4/6), increased gravel.
	3940						25.0-40.0 ft. SILTY SANDY CLAYEY GRAVEL (GM); dark brown (7.5YR 3/3), 50/50% fine to coarse gravel mix with silty clayey sand, medium grain, subrounded, sand with some coarse grain and fine grain sand. 60-70% sand, 30-40% silt/clay, dense, no plasticity, saturated, poorly sorted.
30							
	3930						
40							40.0-47.0 ft. SANDY GRAVEL (GW-SW); dark brown (7.5YR 3/2), 60-70% gravel, 30-40% sand, poorly sorted gravel, fine to coarse, subangular to rounded, well sorted sand - fine to very fine grain sand, rounded, dense to very dense, saturated.
	3920						Total Depth 47.0 ft.



Infiltration Trench

Well Boring and Construction Logs

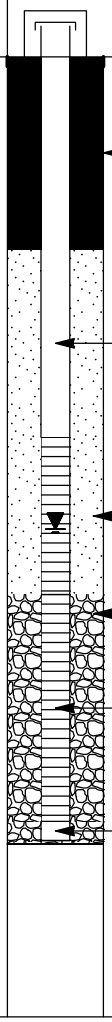
MONITORING WELL COMPLETION LOG MOA01-0730

PROJECT	MOAB	**WELL NUMBER**	MOA01-0730	**DATE DRILLED**	9/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664272.89	**SURFACE ELEV. (FT NGVD)**	3965.90
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186275.16	**TOP OF CASING (FT)**	3967.60
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.50	**MEAS. PT. ELEV. (FT)**	3967.60
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.41	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	14.0	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-1.7	to	9.9
WELL SCREEN:	2 in. PVC Sch 40	9.91	to	19.91
SUMP/END CAP:	2 in. PVC Sch 40	19.91	to	20.41
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	14.0
LOWER PACK:	Slough	14.0	to	20.5

WATER LEVEL DATE	9/28/2006
DRILLER	Trevino, Joe
LOGGED BY	Hopping, B.
SAMPLING METHOD	DIRECT PUSH
DATE DEVELOPED	9/28/2006
REMARKS	

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
	3965						0-20.5 ft. No lithology taken.
5	3960						
10	3955						
15	3950						
20	3945						Total Depth 20.5 ft.



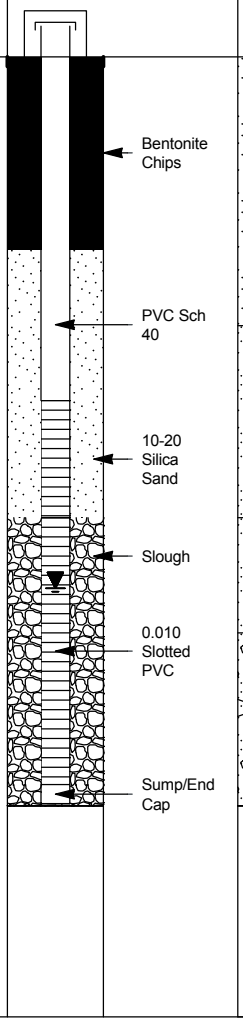
MONITORING WELL COMPLETION LOG MOA01-0731

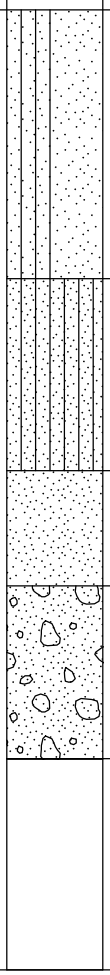
PROJECT	MOAB	**WELL NUMBER**	MOA01-0731	**DATE DRILLED**	9/20/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664190.84	**SURFACE ELEV. (FT NGVD)**	3966.95
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186257.80	**TOP OF CASING (FT)**	3968.77
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	19.50	**MEAS. PT. ELEV. (FT)**	3968.77
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.45	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	15.66	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-1.82	to	8.95
WELL SCREEN:	2 in. PVC Sch 40	8.95	to	18.95
SUMP/END CAP:	PVC Sch 40	18.95	to	19.45
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	12.0
LOWER PACK:	Slough	12.0	to	19.5

WATER LEVEL DATE 9/27/2006
DRILLER Trevino, Joe
LOGGED BY Hopping, B.
SAMPLING METHOD DIRECT PUSH
DATE DEVELOPED 9/27/2006
REMARKS Lithology description from well location # MOA01-0685.

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-7.0 ft. SANDY SILT (ML-SP): dark yellow brown (10YR 4/4), ~70% silt, 30% very fine grained sand, dry.
							7.0-12.0 ft. SILTY SAND (SM); brown (7YR 5/4), ~40% silt, ~60% fgine grained sand, dry.
							12.0-15.0 ft. SAND (SP); fine to medium grained sand, moist, strong brown (7.5YR 4/6), trace of silt, trace pebbles (up to 1.25" in diameter), wet.
							15.0-19.5 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), pebbles (up to 1.5" in diameter).
							Total Depth 19.5 ft.





5 10 15 20

3965 3960 3955 3950 3945

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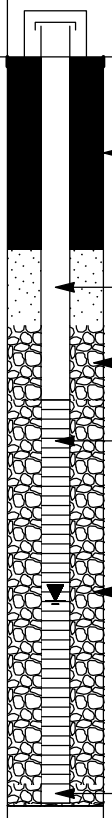
MONITORING WELL COMPLETION LOG MOA01-0732

PROJECT	MOAB	**WELL NUMBER**	MOA01-0732	**DATE DRILLED**	6/1/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664226.70	**SURFACE ELEV. (FT NGVD)**	3967.02
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186229.17	**TOP OF CASING (FT)**	3968.99
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	19.50	**MEAS. PT. ELEV. (FT)**	3968.99
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	19.43	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	16.14	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-1.97	to	8.93
WELL SCREEN:	2 in. PVC Sch 40	8.93	to	18.93
SUMP/END CAP:	PVC Sch 40	18.93	to	19.43
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:	10-20 Silica Sand	5.0	to	7.0
LOWER PACK:	Slough	7.0	to	19.5

WATER LEVEL DATE	6/12/2006
DRILLER	Trevino, Joe
LOGGED BY	Hopping, B.
SAMPLING METHOD	DIRECT PUSH
DATE DEVELOPED	6/12/2006
REMARKS	

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-19.5 ft. Lithology not taken.
	3965				Bentonite Chips		
5					PVC Sch 40		
	3960				Slough		
10					0.010 Slotted PVC		
	3955				Slough		
15							
	3950				Sump/End Cap		
20							Total Depth 19.5 ft.
	3945						



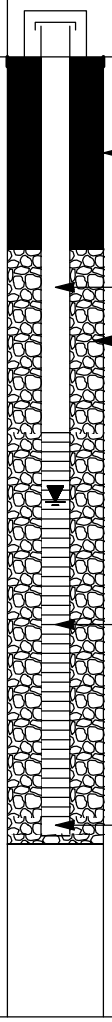
MONITORING WELL COMPLETION LOG MOA01-0733

PROJECT	MOAB	**WELL NUMBER**	MOA01-0733	**DATE DRILLED**	5/31/2006
LOCATION	Moab, UT	**NORTH COORD. (FT)**	6664288.54	**SURFACE ELEV. (FT NGVD)**	3966.31
SITE	Interim Action Well Field	**EAST COORD. (FT)**	2186250.83	**TOP OF CASING (FT)**	3968.50
DRILLING METHOD	GEOPROBE	**HOLE DEPTH (FT)**	20.50	**MEAS. PT. ELEV. (FT)**	3968.50
DRILL COMPANY	S.M. Stoller	**WELL DEPTH (FT)**	20.28	**SLOT SIZE (IN)**	0.010
RIG TYPE	GEOPROBE	**WATER LEVEL (FT BTOC)**	13.79	**BIT SIZE(S) (IN)**	2.5 / 2.5

	WELL INSTALLATION	**INTERVAL (FT)**		
SURFACE CASING:	6 in. PVC Sch 80	-2.09	to	.25
BLANK CASING:	2 in. PVC Sch 40	-2.2	to	9.73
WELL SCREEN:	2 in. PVC Sch 40	9.73	to	19.78
SUMP/END CAP:	PVC Sch 40	19.78	to	20.28
GROUT:				
SEAL:	Bentonite Chips	0.0	to	5.0
UPPER PACK:				
LOWER PACK:	Slough	5.0	to	20.5

WATER LEVEL DATE	6/1/2006
DRILLER	Trevino, Joe
LOGGED BY	Hopping, B.
SAMPLING METHOD	DIRECT PUSH
DATE DEVELOPED	6/1/2006
REMARKS	

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
							0-20.5 ft. Lithology not taken.
	3965						
5							
	3960						
10							
	3955						
15							
	3950						
20							
	3945						Total Depth 20.5 ft.



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Appendix B

Well Development Records

Baseline Area

Well Development Records

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0405

Date Jan 11, 07 **Static DTW** 14.00 **Well TD** 20.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1140	1145	Surge w/ air several times.		
1150	1240	Purge w/ peristaltic @ ½ gpm.	25	
		Final turbidity 5.19 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 406

Date 1-17-07 **Static DTW** 15.47 **Well TD** 20.51 (TOC) JV = 0.8 L

Pump Used S19910 Peristaltic pump **Field Rep** EB

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity
1252	1254	Shaked bottom, pumped water. Stirred with tubing	~~—~~ 1.0	—
1254	1300	Bubbled water column with pump to stir it	—	—
1300	1305	Pumped out water to purge	3.0	126
1305	1310	Bubbled water column with pump to stir it	—	—
1310	1314	Pumped water to purge	6.0	61.5
1314	1319	Continued pumping water to purge	9.0	9.15
1319	1323	↓	11.0	5.70
		Final TD = 20.54' TOC		
		[signature]		
		Well cleared out fairly fast.		
	EB	1-17-06		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0498

Date Jan 11, 07 **Static DTW** 14.01 **Well TD** 40.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1105	1110	Surge w/ air several times.		
1210	1240	Purge w/ Grundfos @ 6gpm	180	
		Final turbidity = 2.16 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No ~~09~~ 0493

Date Jan 11, 07 **Static DTW** 13.70 **Well TD** 55.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1100	1105	Surge w/air several times.		
1110	1205	Purge w/ Grundfos @ 6 gpm.	330	
		Final turbidity = 2.42		

MOAB WELL DEVELOPMENT RECORD

Moab Well No SM1 - PZ1S

Date 1-18-07 **Static DTW** 14.74 **Well TD** 21.54 (TOC)

Pump Used _____ **Field Rep** EB

IV: 4.6 L

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity
1515	1520	Stir water column with bailer (Shook it 5 times)	~2.0	—
1520	1530	Pumped with peristaltic pump to purge		O.R
1530	1542	Continued purging.	6.0	182
1542	1550	↓	9.0	43.7
1550	1600	↓	12.0	20.7
1600	1620	↓	18.0	13.4
1630	1635	↓	21.0	16.8
1635	1640	↓	23.0	5.56
		Final TD = 21.56' (TOC)		
		[signature]		
		EB 1-18-07		

MOAB WELL DEVELOPMENT RECORD

Moab Well No SMI-PW01

Date 1-18-07 **Static DTW** 13.94' **Well TD** 61.98 (TOC) IV = 31.2 gal

Pump Used Peristaltic ~~S19910~~ EB **Field Rep** EB

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1345	1400	Shook water column with 4" bailer. (4 times)	2	—
1400	1450	Pump water column to purge. Lots of	7	O.R
		problems with the silicon tubing of the hand		O.R.
		pump.		
1450	1502	Shook water column with 4" bailer (2 times)	9	—
1502	1522	Pump water column to purge	14	420
1522	1552	Continued pumping to purge	19	
1552	1625	↓	24	356
1625	1645	↓	26	300
1645	1705	↓	29	240
		Final TD = 62.28' (TOC)		
		Development not completed. Lost sunlight.		
		Eric R. Butler		
	BB	1-18-07		

Configuration 1

Well Development Records

MOAB WELL DEVELOPMENT RECORD

Moab Well No 470

Date 6/26/03 Static DTW 12.33 Well TD 20'

Pump Used Trash Field Rep DP S.L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1226	1253	Pump @ 16 gpm			
1255	1300	Surge			
1301	1309	Pump @ 16 gpm			
1310	1314	Surge			
1315	1322	Pump @ 16 gpm			
1323	1326	Surge			
1327	1333	Pump @ 16 gpm			
1334	1338	Surge			
1339	1352	Pump @ 16 gpm Turbidity = 3.21			

2.73 DTW 07-01-03

MOAB WELL DEVELOPMENT RECORD
Moab Well No 471

Date 6/26/03 **Static DTW** 12.29 **Well TD** 20'

Pump Used Trash **Field Rep** JP S.L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1117	1122	Pump @ 16 gpm			
1124	1130	Surge			
1131	1139	Pump @ 16 gpm			
1140	1144	Surge			
1144	1151	Pump @ 16 gpm			
1151	1155	Surge			
1155	1200	Pump @ 16 gpm			
1201	1206	Surge			
1206	1221	Pump @ 16 gpm Turbidity		4.47	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 472

Date 6/26/03 Static DTW 12.30' Well TD 20'

Pump Used Trash Field Rep DP S.L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0930	0936	Pump @ 16 gpm			
0937	0945	Surge			
0947	0954	Pump @ 16 gpm			
0955	0959	Surge			
1000	1005	Pump @ 16 gpm			
1006	1010	Surge			
1011	1016	Pump @ 16 gpm			
1018	1022	Surge			
1023	1035	Pump @ 16 gpm Turbidity 7.31			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 473

Date 6/26/03 Static DTW 12.25' Well TD 20'

Pump Used Trash Field Rep JP SL =10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0800	0815	Pump @ 15 gpm			
0816	0826	Surge			
0827	0836	Pump @ 16 gpm			
0837	0841	Surge			
0842	0849	Pump @ 16 gpm			
0850	0854	Surge			
0856	0902	Pump @ 16 gpm			
0903	0907	Surge			
0909	0920	Pump @ 16 gpm Turbidity 5.12'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 474

Date 6/24/03 **Static DTW** 12.58' **Well TD** 20'

Pump Used Trash **Field Rep** JP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1810	1823	Pump @ ≅ 18 gpm			
1824	1830	Surge			
1830	1840	Pump @ 18 gpm			
5 0750	0755	Surge			
0757	0818	Pump @ 18 gpm			
0819	0825	Surge			
~~0838~~		P			
0826	0838	Pump @ 18 gpm			
0839	0846	Surge			
0847	0726	Pump @ 18 gpm			
		WL = 16.27' Turbidity = 3.27			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 475

Date 6/24/03 **Static DTW** 12.77 **Well TD** 20'

Pump Used Trash **Field Rep** JP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1600	1620	Pump @ 18 gpm			
1630	1638	Surge			
1639	1651	Pump @ 18 gpm			
1652	1658	Surge			
1659	1715	Pump @ 18 gpm			
1716	1722	Surge			
1722	1738	Pump @ 18 gpm WL ≈ 15½' ??			
1738	1745	Surge			
1745	1808	Pump @ 18 gpm Turbidity	6.35	WL = 15½'	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 476

Date 6/24/03 **Static DTW** 12.61 **Well TD** 20'

Pump Used Trash **Field Rep** JP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0938	10:00	Pump @ 9 1/2 gpm WL = 14.05			
10:05	10:15	Surge w/ Swab			
1017	10:38	Pump @ ≅ 18 gpm			
10:39	1045	Surge.			
1047	1103	Pump @ ≅ 18 gpm			
1104	1115	Surge			
1116	1151	Pump @ ≅ 18 gpm WL = 15.05'			
		Turbidity = 9.92			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 477

Date 6/23/03 Static DTW ≅ 12' Well TD 20'

Pump Used Trash Field Rep JP

SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1640	1655	Pump ≅ 19 gpm			
1700	1706	Surge w/ Swed Rig.			
1707	1715	Pump @ ≅ 20 gpm - Drawdown to pump intake			
1716	1723	Surge			
1723	1745	Pump @ ≅ 17 gpm WL @ 16.9'			
1746	1757	Surge			
1757	1815	Pump @ ≅ 17 gpm WL @ 16.5'			
1815	1830	Pump @ ≅ 3 gpm			
		SPEC COND = 28150 AT ~17 GPM			
		REDUCED FLOW TO ~3 GPM, SC = 27640			
		WL = 12.95 FOR ~ 20 MIN			
1830	1835	Surge			
1835	1849	Pump @ ≅ 17 gpm WL = 15.15'			
4 0734	0740	Surge WL = 12.41'			
0740	0830	Pump @ 17 gpm			
0836	0843	Surge			
0845	0904	Pump @ 17 gpm Turbidity = 9.21	WL = 15.4'		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 478

Date 6/23/03 Static DTW 12.3 Well TD 25'

Pump Used Trash Field Rep JP/KP SL = 15'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
		INIT PUMPING AT ~3 GPM, AFTER ~5 MIN,			
		WL = 12.7, ~0.4' s			
		AT ~4 GPM WL = 13.0 (AFTER ONLY 2 MIN)			
		AT ~9 GPM WL = 14.0 (AFTER ONLY ~2 MIN)			
1342	1347	Surge			
1348	1405	Pump @ ≅ 18 gpm WL ≅ 19.8'			
1405	1413	Surge			
1414	1428	Pump @ ≅ 18 gpm No reliable WL			
1429	1435	Surge			
1437	1452	Pump @ ≅ 18 gpm			
1453	1500	Surge			
1501	1525	Pump @ ≅ 18 gpm No reliable WL ≅ 19'			
		Turbidity = 27.9			
1530	1535	Surge			
1535	1550	Pump @ 18 gpm			
		TURB = 98.0			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 479

Date 4/23/03 Static DTW 12.0' Well TD 25'

Pump Used Trash Field Rep [illegible] SL = 15'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
		INITIAL PUMPING AT ≈ 3 GPM, ~~DRAWDOWN~~ WL = 12.4'			
		AFTER 5 MIN OF PUMPING, ONLY ≈ 0.4 S			
1200	1216	Surge w/ Smell			
1217	1238	Pump @ ≈ 18 gpm w/ 4' of drawdown			
		Final drawdown of ≈ 5' Pump until clear water			
1240	1248	Surge			
1250	1326	Pump ≈ ~~15~~ 20 gpm V. turbid - Drawdown to 17'			
		Turbidity = 14.5			
1326	1336	Surge			
1336	1402	Pump ≈ 20 gpm Drawdown to 17.8' Turbid = 7.50			
1403	1413	Surge			
1415	1430	Pump ≈ 20 gpm			
1522	1529	Surge			
1530	1535	Pump ≈ 20 gpm			
1535	1543	Surge			
1543	1620	Pump ≈ 20 gpm Turbidity = 4.71			
		WL = 17.7'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 480

Date 6/25/03 Static DTW 14.14 Well TD 22.4' BTOC

Pump Used Trash Field Rep JP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0942	0954	Pump @ 18 gpm			
0955	1004	Surge w/ Small Rig			
1005	1012	Pump @ 18 gpm			
1013	1018	Surge			
1019	1027	Pump @ 18 gpm			
1028	1033	Surge			
1033	1107	Pump @ 18 gpm WL = 17.58'			
		Turbidity = 12.5			
1310		Finish development w/ small Grundfos pump		Q =	1/2 gpm
~~1310~~		Conductivity / Turbidity			
1312		27670 / 6.70			
1351		26560 / 1.28			
~~1408~~	1414	25340 / 1.25			
1426		26330 / 1.81			
1438		25110 / 0.98			
1448		24760 / 1.13			
		Stop Pumping 1450			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 481

Date 6/25/03 **Static DTW** 14.02 **Well TD** ~~481~~ 33.4' BTOC

Pump Used Trash **Field Rep** JP S.L. = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~11:15~~					
12:47	1257	Pump @ 20 gpm			
1324	1331	Surge w/ Swab			
1332	1346	Pump @ 18-20 gpm			
1350	1358	Surge			
1359	1418	Pump @ 18-20 gpm			
1419	1425	Surge			
1426	1446	Pump @ 18-20 gpm WL = 19.28			
		Turbidity = 64.0			
			1.0		
1505		Purge w/ small Grundfos pump @ ½ gpm			
~~1530~~		Conductivity / Turbidity			
1530		35610 / 8.73			
1544		35140 / 11.3			
1555		35340 / 12.1			
1606		35080 / 13.7			
1624		34680 / 13.7 Turned pump off 1625			
	1730				
1650	~~1745~~	Pump w/ trash pump @ 18-20 gpm.			
1730	1740	Surge			
1741	1805	Pump 18 gpm			
1810	1825	Surge			
1815	1825	Pump 18 gpm			
0710	0800	Pump 18 gpm - Slow rate to 10 gpm			
		Turbidity = 6.15			

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MOAB WELL DEVELOPMENT RECORD

Moab Well No 482

Date 6/25/03 **Static DTW** 13.33 **Well TD** 63.4

Pump Used Trash **Field Rep** CP SL. = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1454	1508	Pump @ 15-18 gpm			
1510	1520	Surge			
1521	1545	Pump @ 15-18 gpm			
1547	1557	Surge			
1559	1614	Pump @ 15-16 gpm			
		Turbidity = 3.44 WL =	22.40		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 483

Date 6/26/03 **Static DTW** 14.46 **Well TD** 22.4'

Pump Used Trash **Field Rep** JP SC = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1407	1418	Pump @ 16-17 gpm			
1419	1424	Surge			
1425	1431	Pump @ 16 gpm			
1432	1435	Surge			
1436	1443	Pump @ 16 gpm			
1443	1447	Surge			
1448	1455	Pump @ 16 gpm			
1455	1500	Surge			
1500	1508	Pump @ 16 gpm			
1508	1520	Pump @ 5 gpm Turbidity = 5.57			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 484

Date 6/26/03 **Static DTW** 14.50 **Well TD** 32.4

Pump Used Trash **Field Rep** JP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1522	1529	Pump - Well meter only 5 gpm			
1530	1535	Surge			
1540	1625	Pump - w/ Grundfos @ 2 1/2 gpm			
		Will need more development			
7/1/03 0840		WL = 15.20'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 485

Date 6/26/03 **Static DTW** 13.07 **Well TD** 62.4

Pump Used Trash **Field Rep** JP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1547	1558	Pump @ 20 gpm			
1559	1603	Surge			
1603	1622	Pump @ 20 gpm ~~Tub~~ Turbidity =			7.09

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0403

Date Jan 11, 07 **Static DTW** 15.95 **Well TD** 18.4

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0955	1000	Surge w/ air several times.		
1005	1040	Purge w/ peristaltic @ 1/4 gpm	≈ 8	
		Final turbidity = 2.10 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 407

Date 1-18-07 Static DTW 16.66' Well TD 20.21' (TOC)

Pump Used Peristaltic 519910 Field Rep EBS

IV = 0.45 L

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	EBS Turbidity
0910	0918	Stirred bottom. Shock tubing.	0.3	—
		There was a lot of roots and organic matter.		
0918	0925	Well dewatered. Waiting for recharge	0.8	—
0925	0928	Stirred up the water column by bubbling it up.	0.3	—
0928	0937	Pumped well to purge it. Well dewatered.	2.3	11.1
0937	0940	Stirred up the water column by bubbling it	2.8	—
0940	0947	Pumped well to purge it. Pumped relatively slow	4.8	10.4
		because the water column is small. Well		
		dewatered.		
0947	0950	Waited for recharge	4.8	—
0950	1002	Resumed purging well	7.8	11.9
1002	1012	Continued purging well	10.8	3.59
		Final TD = 20.23' (TOC)		
		Eulett Betts		
	EBS 1-18-07			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0480

Date 1/8/07 **Static DTW** 15.77 **Well TD** ~~JP~~ 20.3

Pump Used Peristaltic **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1500		Surge well with air several times	-	
		purge w/ small peristaltic pump.		
		Max turbidity only ≈ 60 NTUs.		
		Final turbidity = 3.52 NTU.	≈ 7 gal	
	@1700			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0481

Date 1/8/07 **Static DTW** 15.65 **Well TD** 31.3

Pump Used Peristaltic **Field Rep** DP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1500		Surge several times w/ air;		
		water becomes very turbid >1000 NTU's.		
		Purge with small peristaltic; get	≅ 5	
	1700	turbidity down to ≅ 30.		
		1/9/07 - 0730 Purge w/ 12 V submersible		
		@ ≅ 1gpm until 0900.	90 gal.	
	0910	Final turbidity = 3.30 NTU's.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0482

Date 1/8/07 **Static DTW** 16.62 **Well TD** 61.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1500		Surge w/ air several times;		
		water becomes ~~very~~ very turbid		
		7,000 NTUs.		
		Purge w/ small peristaltic;	≅5gal	
	1700	get turbidity down to ≥ 25 NTUs		
		1/9/07 0730 - Purge w/ 12 V		
		~~pu~~ submersible @ 1 gpm		
		Remove 12 V pump (~~decided~~ pump		
		decided to quit) @ 0830	60 gal	
	0910	Install new 12 V pump - purge @		
		1 gpm.		
	0935	Final turbidity = 1.56	25	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0483

Date Jan 7, 01 **Static DTW** 16.07 **Well TD** 20.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0945		Surge several times w/air - not		
		very turbid ≈ 80 NTUs		
0950	1010	Purge w/ large peristaltic @ 1gpm.	20gal	
1010	~~1010~~	Install small peristaltic.		
	1130	Finish purging - turbidity = 2.09 NTUs	15gal	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0494

Date Jan 9, 07 **Static DTW** 16.38 **Well TD** 30.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0950		Surge several times w/air -		
		quite turbid >1000 NTUs		
	1000	Install large peristaltic pump -		
		purge rate ≈ 1/2 gpm		
	1530	Finally get turbidity to 5.20!	165 g	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0485

Date Jan 9, 07 **Static DTW** 16.20 **Well TD** 60.4

Pump Used _____ **Field Rep** JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
	0955		Surge w/ air several times - not		
			very turbid ≈ 100 NTUs.		
	1000	~~1030~~	Purge w/ large peristaltic @	225	
			≈ 1/2 gpm.		
		1730	Turbidity still > 25		
1/10	0930	1100	Install large Grundfos ; purge @	6 gpm	
			Finally get turbidity down to 3.27 NTUs		
				540	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0557

Date 1/8/07 **Static DTW** 16.08 **Well TD** 45.9

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
~~1300~~	1500	Surge w/ air several times -		
		water becomes very turbid 71000 NTU		
		Purge w/ whale pump - remove ≅ 50 gal.		
		also purge from dedicated tubing w/		
		peristaltic to remove sediment from		
	1700	bottom of well.		
		1/9/07 0730 - Purge w/ large		
		peristaltic - still fair amount of		
		sediment on bottom of well.		
		Purge rate ≅ 1/2 gpm.		
	1000	Final turbidity = 1.85 NTUs	≅ 75 gal	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0558

Date Jan 9, 07 **Static DTW** 16.55 **Well TD** 45.1

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1000		Surge w/air several times -		
		not very turbid.		
1045	1310	Purge w/ 12V submersible @	145	
		≈ 1 gpm.		
		Final turbidity = 5.84 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0559

Date Jan 9, 07 **Static DTW** 16.62 **Well TD** 20.7

Pump Used ______________ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1510		Surge w/ air several times.		
1210	~~1710~~	Purge w/ large peristaltic @ 1/2 gpm	10	
	1730			
		Final turbidity = 1.96 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0560

Date Jan 9, 07 **Static DTW** 16.07 **Well TD** 40.4

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1500		Surge w/air several times - not		
		very turbid.		
1530	1700	Purge w/large peristaltic @ 1/2 gpm	45	
		Fair amount of mud on bottom.		
1200	1300	1-10-07 Install Grundfos, purge @	360	
		6 gpm.		
		Final turbidity = 1.74 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0561

Date Jan 9, 07 **Static DTW** 16.58 **Well TD** 55.3

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1500		Surge w/ air several times - not		
		very turbid - some mud on bottom.		
		black		
1530	1700	Purge w/ large peristaltic @ ½ gpm.	45	
1100	1200	Install Grundfos, purge @ 6gpm	360	
		Final turbidity = 0.52 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0596

Date Jan 9, 07 **Static DTW** 16.31 **Well TD** 25.5

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1515		Surge w/air several times.		
1710	1730	Purge w/ large peristaltic pump @ 1/2 gpm	10	
		Final turbidity = 2.03 NTUs		
		* - All monitoring wells should		
		be 1" !		

Configuration 2

Well Development Records

MOAB WELL DEVELOPMENT RECORD

Moab Well No 570

Date 8/9/04 **Static DTW** 15.20 **Well TD** 32.68

Pump Used SUCTION LIFT **Field Rep** TV/LW

Start Time	Finish Time	Development Activity
0730	1100	STARTED SURGE / PUMP CYCLES (~15 MIN / CYCLE)
		H_2O INITIALLY V. TURBID, STARTED TO CLEAR
		AFTER ~ 6 CYCLES.
1200	1300	CONTINUED W/ SURGE / PUMP CYCLES
		WELL PRODUCING < 5 GPM
		DEVELOPMENT COMPLETE.

MOAB WELL DEVELOPMENT RECORD

Moab Well No 571

Date 8/4/04 **Static DTW** 14.93 **Well TD** 41.76

Pump Used SUCTION LIFT **Field Rep** TU/LW

Start Time	Finish Time	Development Activity
1300	1615	STARTED SURGE / PUMP CYCLES (~15 MIN/CYCLE)
		H_2O INITIALLY V. TURBID, STARTED TO CLEAR
		AFTER ~ 5 CYCLES, WELL PUMPING < 5 GPM
		DEVELOPMENT COMPLETE

MOAB WELL DEVELOPMENT RECORD

Moab Well No 572

Date 8/4/04 **Static DTW** 14.95 **Well TD** 31.78

Pump Used SUCTION LIFT **Field Rep** TV/LW

Start Time	Finish Time	Development Activity
0730	1130	STARTED SURGE / PUMP CYCLES (~15 MIN CYCLES)
		H_2O STARTED TO CLEAR AFTER ~ 4 CYCLES
		DEVELOPMENT COMPLETE
		WELL PUMPING < 5 GPM

MOAB WELL DEVELOPMENT RECORD

Moab Well No 573

Date 8/3/04 **Static DTW** 15.23 **Well TD** 43.26

Pump Used SUCTION LIFT **Field Rep** TV/LW

Start Time	Finish Time	Development Activity
1300	1600	STARTED SURGE / PUMP CYCLES (~15 MIN CYCLES)
		AFTER ~5 CYCLES, H_2O STARTED TO CLEAR
		DEVELOPMENT COMPLETE
		WELL PUMPING LT 5 GPM

MOAB WELL DEVELOPMENT RECORD

Moab Well No 574

Date 3/3/04 **Static DTW** 14.45 **Well TD** 33.50

Pump Used SUCTION LIFT **Field Rep** TU/LW

Start Time	Finish Time	Development Activity
0730	1115	STARTED SURGE / PUMP CYCLES, INITIALLY
		H_2O V. TURBID. CONTINUED W/ SURGED / PUMP
		CYCLES (~15 MIN SURGE), H_2O CLEARED
		DEVELOPMENT COMPLETE.
		WELL PUMPING AT 5 GPM

MOAB WELL DEVELOPMENT RECORD

Moab Well No 575

Date 9/2/04 **Static DTW** 14.58 **Well TD** 42.60

Pump Used SUCTION LIFT **Field Rep** TV/LW

Start Time	Finish Time	Development Activity
1045	1200	INITIAL DEVELOPMENT, PUMP / SURGE CYCLES
		(~15 MIN / CYCLE). INITIAL H_2O V. TURBID
1300	1500	CONTINUED W/ PUMP / SURGE CYCLES, STARTED
		TO CLEAR UP, PUMPING LT 10 GPM
		COMPLETED DEVELOPMENT

MOAB WELL DEVELOPMENT RECORD

Moab Well No 576

Date 7/28/04 **Static DTW** 14.18 **Well TD** 31.37

Pump Used SUCTION LIFT **Field Rep** TV/LW

	Start Time	Finish Time	Development Activity
	1500	1600	SURGED /PUMP 3 CYCLES, ~15 MIN EACH CYCLE
7/29/04	0800	1130	WL - 14.10
			CONTINUED W/ SURGE /PUMP CYCLES, STARTED
			TO CLEAR UP. PUMPING LT 5 GPM
			DEVELOPMENT COMPLETE

MOAB WELL DEVELOPMENT RECORD

Moab Well No 577

Date 7/28/04 **Static DTW** 14.50 **Well TD** 40.55

Pump Used SUCTION LIFT **Field Rep** TV/LW

Start Time	Finish Time	Development Activity
0945	1145	PUMPED / SURGED 4 CYCLES ~15 MIN EACH CYCLE
1245	1445	WL = 14.18 CONTINUED W/ PUMP / SURGE CYCLES
		H_2O APPEARS FAIRLY CLEAR THROUGHOUT PUMPING
		CYCLE, FINISHED W/ DEVELOPMENT.

MOAB WELL DEVELOPMENT RECORD

Moab Well No 578

Date 7/26/04 **Static DTW** 14.4 **Well TD** 31.5

Pump Used SUCTION LIFT **Field Rep** JP/TV/LW

	Start Time	Finish Time	Development Activity
	15:30	16:50	SURGED AND PUMPED 4 TIMES (15 MIN CYCLES)
			WELL DOES NOT MAKE MUCH H_2O, ~3.5 GPM
7/27/04	15:00	16:15	CONTINUED DEVELOPMENT, PUMPED/SURGED
7/28/04	0700	0920	WL = 14.56 CONTINUED W/ DEVELOPMENT
			AFTER SEVERAL CYCLES (PURGE/PUMP), H_2O FAIRLY CLEAR
			THROUGH ENTIRE PUMPING CYCLE

MOAB WELL DEVELOPMENT RECORD

Moab Well No 579

Date 7/26/04 **Static DTW** ~14.0 **Well TD** ~41.6

Pump Used SUCTION LIFT **Field Rep** JP

Start Time	Finish Time	Development Activity
12:30	15:15	SURGED & PUMPED FOR SEVERAL CYCLES
		PURGE WATER STILL SLIGHTLY TURBID
		MAKES 15-20 GPM

MOAB WELL DEVELOPMENT RECORD

Moab Well No 538

Date 8/9/04 **Static DTW** 16.83 **Well TD** 37.0

Pump Used SUCTION LIFT **Field Rep** TN, LW

	Start Time	Finish Time	Development Activity
	1300	1600	STARTED SURGING / PUMPING CYCLES (~15 MIN LONG)
			WELL NOT RECHARGING V. FAST, CONTINUED W/
			SURGE / PUMP CYCLES, H_2O V. TURBID
8/10/04	0700	1130	CONTINUED W/ SURGE / PUMP CYCLES, STILL NOT
			RECHARGING V. FAST, H_2O STARTING TO CLEAR
			FINISHED W/ DEVELOPMENT

MOAB WELL DEVELOPMENT RECORD

Moab Well No 589

Date 8/9/04 **Static DTW** 15.93 **Well TD** 56.80

Pump Used SUCTION LIFT **Field Rep** TV/LW

	Start Time	Finish Time	Development Activity
	0930	1135	SURGED / PUMPED, H_2O INITIALLY V. TURBID
			WELL IS DEEPER THAN OTHERS, NOT ABLE TO PUMP
			OUT BOTTOM OF WELL, CONTINUED W/ SURGING
			AND PUMPING CYCLES, H_2O STARTED CLEARING UP.
8/10/04	1300	1500	CONTINUED W/ DEVELOPMENT AT GETTING LONGER
			PUMP INTAKE LINE, H_2O STARTED CLEARING UP,
			FINISHED W/ DEVELOPMENT.

MOAB WELL DEVELOPMENT RECORD

Moab Well No 570

Date 3/30/5 **Static DTW** 5' **Well TD** 29.8

Pump Used Trash **Field Rep** J. Price

Pump bottom = 29.87'
Flow sleeve intake = 28.4'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1300		Remove dedicated pump. Surge			
	1330	with Smed Rig and 6" surge block			
1330	1345	Begin pumping w/ trash pump @ ≅	50		
		3½ gpm. Purge water very turbid.			
		Purge water clears some what.			
1345	1400	Surge ~~well~~ well.			
1400	1406	Purge well; water is again very	25		
		turbid. Purge @ ≅ 4 gpm. Clears			
		sooner that previous purge cycle.			
1408	1420	Surge well.			
1420	1435	Purge; still very turbid. purge	75		
		rate ≅ 5 gpm. Fairly clear purge			
		water @ 1435.			
1435	1445	Surge well.			
1445	1520	Purge well; initial purge water not	175		
		as turbid as before. Purge rate			
		≅ 5 gpm. Final purge water is			
		fairly clear.			
				325	
		Re-install pump.			

* - Install pump flow sleeve (3" Diameter). Also, about .010-.015" thick scale build-up on pump.

Pump Bottom = 38'2"
Pump Intake = 36'2"
Effective Pump Intake = 38'2"

MOAB WELL DEVELOPMENT RECORD

Moab Well No 571

Date 3/30/5 Static DTW _____ Well TD 39.2

Pump Used Trash Field Rep JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
	1715	1730	Surge well with Smed rig and 6" surge block.			
	1730	1755	Purge well w/ trash pump. Purge rate ≅ 4½ gpm; Very turbid.	112		
	1755	1805	Surge			
	1805	1820	Purge; ~~again~~ again very turbid. Purge rate ≅ 6.7 gpm. Slowly clears.	100		
	1820	1830	Surge.			
	1830	1845	Purge; not quite so turbid. Purge rate ≅ 7½ gpm	112		
3/31	0700	0710	Surge			
	0710	0725	Purge - initial purge water very turbid. Purge rate ≅ 7½ gpm	112		
	0725	0740	Surge			
	0740	0800	Purge - Not quite as turbid Purge rate ≅ 7½ gpm; purge water still fairly turbid.	150	586	

*- Scale build-up on pump ≅ .010 - .015" thick

*- Install 3" flow sleeve over pump motor.

Pump Bottom = 28' 4"
Pump Intake = 26' 4"
Effective Pump Intake = 28' 4"

MOAB WELL DEVELOPMENT RECORD

Moab Well No 572

Date 3/31/5 Static DTW _____ Well TD 29.7

Pump Used Trash Field Rep JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0915	0925	Surge with Smedley & 6" surge block.			
0925	0940	Purge w/trash pump - very turbid Purge rate ≅ 3 gpm	45		
0940	0950	Surge.			
0950	1005	Purge; very turbid. Purge rate 4½ gpm	68		
1005	1010	Surge.			
1010	1033	Purge. Turbid; clears slightly Purge rate ≅ 4½ gpm.	104		
1035	1043	Surge.			
1045	1056	Purge. Turbid; clears slightly Purge rate ≅ 4½ gpm.	50		

* - Install 3" pump sleeve. Also, .010"-.015" build-up of scale on pump.

Pump Bottom = 38' 7"
Pump Intake = 36' 7"
Effective Pump Intake = 38' 7"

MOAB WELL DEVELOPMENT RECORD
Moab Well No 573

Date 3/31/5 **Static DTW** _____ **Well TD** 39.4'

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1250	1300	Surge w/ Smead Rig & 6" surge block			
1300	1312	Purge w/ trash pump; very turbid. Purge rate ≅ 5.7 gpm	68		
1313	1323	Surge.			
1324	1334	Purge; Very turbid. Purge rate ≅ 7.5	75		
1334	1344	Surge.			
1344	1400	Purge; very turbid. Purge rate ≅ 8.1 gpm.	130		
1400	1412	Surge.			
1413	1424	Purge; very turbid. Purge rate = 8.8 gpm.	97		
1425	1435	Surge			
1435	1445	Purge. Not quite as turbid. Purge rate ≅ 9.8 gpm	100		
				420	

* - Install 3" flow sleeve. Also, a .010"-.015" thick scale build-up on pump.

Pump Bottom = 28' 3"
Pump Inlet = 26' 3"
Effective Pump Inlet = 28' 3"

MOAB WELL DEVELOPMENT RECORD
Moab Well No 574

Date 3/31/15 **Static DTW** _____ **Well TD** _____

Pump Used TRASH **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1540	1550	Surge w/ Small rig & 6" block			
1550	1607	Purge. Very turbid. Purge rate ≅ 2.8 gpm.	48		
1608	1618	Surge.			
1618	1627	Purge. Very turbid. Purge rate ≅ 2.9 gpm.	32		
1627	1637	Surge			
1637	1647	Purge. Not quite as turbid. Purge rate ≅ 3.6 gpm	36		
1648	1658	Surge			
1658	1709	Purge. Turbidity similar to last purge. Purge rate ≅ 3.5 gpm	39		
1709	1719	Surge.			
1719	1727	Purge. Still turbid. Purge rate ≅ 3.6 gpm.			

* - Install a 3" flow sleeve on pump motor. Also, .010-.015" of ~~sal~~ scale build-up on pump.

Pump Bottom = 38'6"
Pump Intake = 36'6"
Effective Pump Intake = 38'6"

MOAB WELL DEVELOPMENT RECORD

Moab Well No 575

Date 4/1/5 Static DTW _____ Well TD ~~37~~ 39.6'

Pump Used Trash Field Rep JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0640	0650	Surge w/ Smeal rig : 6" surge block.			
0650	0702	Purge w/ trash pump ; very turbid. Purge rate = 7½ gpm.	90		
0703	0713	Surge.			
0714	0722	Purge. Very turbid. Purge rate ≅ 7½ gpm.	90		
0723	0733	Surge.			
0734	0744	Purge. Very Turbid. Q ≅ 7½ gpm.	75		
0745	0755	Surge.			
0756	0813	Purge. Not quite as turbid. Q ≅ 7½ gpm.	128		
0814	0824	Surge.			
0825	0835	Purge. Lower turbidity. Q ≅ 7½ gpm	75		

* - Install a 3" flow sleeve on pump motor. Also, .010"-.015" thick scale build-up on pump surface.

MOAB WELL DEVELOPMENT RECORD

Moab Well No 570

Date 12/26/06 **Static DTW** 11.95 **Well TD** 29.8

Pump Used Trash **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1245		REMOVE PUMP		
1300	1310	Swab well w/ brush		
1310	1330	SURGE WELL W/ PLUNGER		
1340	1350	Purge - very turbid		
1400	1415	SURGE		
1415	1420	PURGE		
1425	1440	SURGE		
1445	1450	PURGE - NOT AS TURBID - STILL	>1000	NTU
		RE-INSTALL PUMP		

MW

MOAB WELL DEVELOPMENT RECORD

Moab Well No 571

Date 12/26/06 **Static DTW** 11.92 **Well TD** 39.2

Pump Used Grundfos **Field Rep** JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
	1515	1530	Pull pump		
	1530	1540	Bos Brush well screen.		
	1540	1555	SURGE w/ block		
			RE-INSTALL PUMP - HOWEVER PUMP	DOES	NOT
2/27	0700	0800	WORK - INSTALL NEW PUMP		
	0800	0820	Purge - Very turbid; clears some what;		
			purge @ ≅ 4 gpm, well does not go dry		
	845	0900	Surge.		
	0900	0910	Purge - Very turbid; again clears some		
			what - seems like this is a pretty good		
			well.		

2¼ x 1¾

M

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0572

Date 12/27/06 **Static DTW** 12.10 **Well TD** 29.6

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0930	1250	Find that there is no union at well head (which allows for removal of pump). Install union and fix other problems		
1300		Pull pump - brush well screen.		
	1415	Complete 3 purge and surge cycles - Very turbid after each surge; purge dry each purge; however well does recover ≅ 75% fairly quickly.		

Clay

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0573

Date 12/27/06 **Static DTW** 12.35 **Well TD** 39.3

Pump Used Grundfos **Field Rep** JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
	1420		Remove pump - brush well screen.		
			Find that pump is bad - install		
			new pump - complete only one		
		1700	surge and purge cycle.		
2/28	0700	0830	Complete 2 surge & purge cycles. Very		
			turbid - does not make as much water		
			as the other 39' wells.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0574

Date 12/28/06 **Static DTW** 11.60 **Well TD** 29.7

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0900		No pump installed. Brush		
		well screen. Install new pump.		
	1100	Complete 3 surge & purge		
		cycles - turbid as usual.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0575

Date 12/28/06 **Static DTW** 11.80 **Well TD** 39.6

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1230		Pull pump - brush well screen.		
		Complete 3 surge & purge cycles.		
		Very turbid each time.		
	1425	* - First well that has the rust colored		
		bio-slime on riser pipe and cable.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 576

Date 12/28/06 **Static DTW** 11.75 **Well TD** 29.7

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1430		Another bad pump - remove and		
		install new pump. Brush well		
		screen.		
		Surge and purge well 3 times.		
	1610	Very turbid again		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 577

Date 12-28-06 **Static DTW** 11.78 **Well TD** 39.7

Pump Used Grundfos **Field Rep** JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
	1620		Pump OK! Brush well screen.		
		1700	Complete one R. surge & purge cycle.		
2/29		0715	Complete 2 more surge and		
			purge cycles - not as turbid		
		0830	as other wells.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0578

Date 12-29-08 **Static DTW** 11.67 **Well TD** 28.9

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0830		No pump in well - install new		
		pump. Brush well screen.		
	1030	Complete 3 surge & purge cycles.		
		Does not make as much water as the		
		more productive 29 wells.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 579

Date 12.29.06 **Static DTW** 11.72 **Well TD** 39.6

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1040		Pump is bad - install new pump.		
		Brush well screen.		
	1230	Complete 3 surge & purge cycles.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 570

Date 2/14/06 Static DTW Top of Casing Well TD 30'

Pump Used _____ Field Rep JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1200	1500	Surge well with Smeal rig and then purge with Grundfos pump; Repeat this surge & purge & cycle 6 times. Very turbid after each surge; however, duration of turbid water during the purge decreased each time. Also, the first 3 purge cycles, the well was pumped dry, but by the next purge, the well could maintain the purge rate and did not go dry.			
		Purge rate ≅ 5 gpm.			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 571

Date 2/14/06 Static DTW 6.50' Well TD 40'

Pump Used Grundfos Field Rep JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1500	1730	Surge well with Smeal rig and purge out turbid water. Repeat this cycle 6 times. Duration of turbid water purged decreased each time. Purge rate ≈ 5gpm.			
		Finish work at 0930 on 2/15/06.			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 572

Date 2/15/06 **Static DTW** 8.95 **Well TD** 30'

Pump Used Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0945	1300	Surge well w/ Smeed rig and purge turbid water out at ≈ 5gpm. Purge well dry on first purge cycle. Well recovery keeps up with pump on following purges.			

MOAB WELL DEVELOPMENT RECORD

Date ~~12/6~~ 02/15/06 Moab Well No 573

Static DTW 4.15 Well TD 40

Pump Used Grundfos Field Rep JP

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1300	1530	Surge well w/ Smeal rig and purge out turbid water. Deeper wells (ie 40') can keep up with purge rate of ≅ 5gpm. Complete 5 surge/purge cycles.			
		WELL-574 DTW = 2.23' TD = 30' 2/15/06			
1545	0815 2/16	Surge well w/ Smeal rig and purge out turbid water. Purge well dry first time. 0815 WL = 9.80' Surge & purge well 6 times; however, this well cannot yield enough water to keep up with ~~pump~~ pump.			
1000 2/16	1215	Well-575 DTW - 6.76' TD = 40			
		Surge well w/ Smeal Rig and purge out turbid water at ≅ 5gpm. Complete the surge and purge cycle 5 times. Like the other wells, after each surge, the purge water was very turbid. ~~Turbid~~ And like the other wells, ~~the~~ both the turbidity and the duration of turbid water decreased after each cycle.			
1215 2/16	1430	Well-576 DTW - 2.52' TD - 30'			
		Surge w/ Smeal rig and purge out turbid water. Complete 6 purge cycles. Same story as the previous wells.			

MOAB WELL DEVELOPMENT RECORD
Moab Well No _____

Date _____ Static DTW _____ Well TD _____

Pump Used _____ Field Rep ____

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1430	1715	Well - 577 DTW - 2.65' TD = 40'			
2/16/06					
		Surge well w/ Smeal rig and purge out turbid water. Completed 4 surge + purge cycles. Will need to return tomorrow to finish this well.			
0700	0915				
2/17		Resume work on 577; surge + purge 3 more cycles. Duration of turbid water becomes less each cycle.			
0815	1100	Well-578 DTW = 0.5' TD=30'			
2/17					
		Surge well w/ Smeal rig and purge out turbid water with gaundfor pump. This by far the least productive well in config II. Surged and purged several (> 6 times) times but the well could never keep up with the 5gpm pump rate. Also, I should note that clean water was used on this well, as it was on the other shallow wells, to aid in the development process. A total of about 500 gallons were added during the 4 day development process.			
1100	1245	Well - 579 DTW = 0.7' TD 40'			
		Surge with Smeal rig and purge with fresh pump at ≈ 9 gpm. Very turbid. After 4 purge cycles, well has cleaned up fairly well.			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0402

Date Jan 10, 01 **Static DTW** 15.20 **Well TD** 18 1/2 1"

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1635	1640	Surge w/ air several times.		
1640	1700	Purge w/ peristaltic @ 1/4 gpm.	5	
		Final turbidity = 2.16 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 408

Date 1-17-07 Static DTW 15.37 Well TD 28.72 (TOC) IV = 2.1 L

Pump Used Peristaltic pump S19910 Field Rep EB

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	EB Turbidity
1405	1407	Shaked bottom of well using tubing.	—	—
1407	1409	Pumped water from bottom to purge	0.5	—
1409	1412	Allowed for recharge	0.5	—
1412	1415	Bubbled-up the water column to stir it	0.5	—
1415	1421	Pumped water to purge	3.5	86.1
1421	1425	Bubbled up the water column. Shake tubing	3.5	—
1425	1432	Pumped water to purge	6.5	79.8
1432	1442	Continued to pump water	9.5	29.9
1442	1451	↓	12.5	14.3
1451	1500	↓	15.0	13.9
1500	1508	↓	18.0	8.70

Final TD = 29.61' (TOC)

Eric A. Betts

There was a fair amount of sand at the very bottom. Took extra purge to get NTUs < 10.0

EB 1-17-06

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0581

Date Jan 11, 07 **Static DTW** 15.97 **Well TD** 20.5

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0900	0905	Surge w/air several times		
0910	0955	Purge w/ peristaltic @ 1/4 gpm,	≅ 11	
		Final turbidity = 1.41 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0580

Date Jan 11, 07 **Static DTW** 16.13 **Well TD** 20.4

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0955	1000	Surge w/ air several times.		
1005	1040	Purge w/ peristaltic @ 1/4 gpm.	≅ 8	
		Final turbidity = 0.98 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0582

Date Jan 11, 07 **Static DTW** 15.90 **Well TD** 20

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0905	0910	Surge w/ air several times.		
0910	0955	Purge w/ peristaltic @ 1/4 gpm	≅ 11	
		Final turbidity = 2.41 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0583

Date Jan 10, 07 **Static DTW** 16.33 **Well TD** 19.1

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1655	1700	Surge w/air several times.		
1705	1725	Purge w/peristaltic @ 1/4 gpm	5	
0730	0800	Jan 11, 07 - Resume purging.	7 1/2	
		Final turbidity = 1.31		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 584

Date 1-17-07 **Static DTW** 15.43' **Well TD** 21.95' (TOC) IV = 1L

Pump Used Peristaltic **Field Rep** EB

519910

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity EB
1558	1602	Shook bottom. Initial purge. Shook taking	1.0	—
1602	1606	Bubble up the water column to stir it	1.0	—
1606	1612	Pumped water to purge	4.0	57.4
1612	1617	Bubble up the water column to stir it.	4.0	—
1617	1622	Pumped water to purge	7.0	83.0
1622	1630	↓	10.0	12.1
1630	1638	↓	13.0	3.47
		Final TD = 22.29 (TOC)		
		Earl A. Betton		
		There was quite a bit of sand at the bottom.		
		EB 1-17-07		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 585

Date 1-18-07 **Static DTW** 15.70' **Well TD** 21.88' (TOC)

Pump Used Peristaltic S19910 **Field Rep** EB

IV = 1 L

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity
1027	1031	Shook well bottom with tubing. Lots of sediment	0.8	—
1031	1035	Stir up the water column by bubbling it	0.3	—
1035	1041	Pumped well to purge it	3.8	57.3
1041	1045	Stir up the water column by bubbling and shaking tube	6.8	—
1045	1052	Pumped well to purge it	9.8	108
1052	1058	Continued purging well to purge it	12.8	20.2
1058	1104	↓	15.8	5.41
		Final TD = 22.22' (TOC)		
		Eric A. Butler		
		Well cleaned out fast		
	EB 1-18-07			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 586

Date 1-18-07 **Static DTW** 15.15 **Well TD** 21.82' (TOC)

Pump Used Peristaltic S19910 **Field Rep** EB

I.V = 1.1 L

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity
1121	1125	Stir the bottom of well. Pumped to purge	0.5	—
1125	1130	Bubbled up the water column to stir it.	0.5	—
1130	1134	Pumped well to purge it. ~~Stress~~	3.5	12.3
1134	1138	Bubbled up the water column to stir it. Shaken fairly	3.5	—
1138	1142	Pumped well to purge it.	6.5	10.6
1142	1150	Continued purging well	9.5	6.27
		Final TD: 22.04' (TOC)		
		End of Bailer		
		Well cleared very fast		
		EB 1-18-07		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0587

Date Jan 10, 07 **Static DTW** 15.27 **Well TD** 20.2 1"

Pump Used _____ **Field Rep** SP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1510	1515	Surge w/ air several times;		
		fairly turbid.		
1530	1615	Purge w/ peristaltic @ ≅ 1/4 gpm	2	
		Purge dry.		
0130	0800	Jan 11, 07 - Resume purging with		
		small peristaltic @ 1/8 gpm	≅ 3 1/2	
		Final turbidity = 3.63 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0588

Date Jan 10,07 **Static DTW** 15.42 **Well TD** 35

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1440	1450	Surge w/air several times;		
		not very turbid		
1450	1530	Purge w/ Grundfos @ 6gpm.	240	
		Final turbidity = 1.74 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0589

Date Jan 10, 07 **Static DTW** 15.07 **Well TD** 53

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1450	1500	Surge w/air several times; not		
		very turbid.		
1535	1605	Purge w/ Grundfos @ 6 gpm.	180	
		Final turbidity = 2.76 NTUs		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0600

Date Jan 10, 07 **Static DTW** 15.80 **Well TD** 29.7

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1710	1715	Surge w/air several times.		
1715	1725	Purge w/peristaltic @ 1/4 gpm.	2 1/2	
0730	0830	Jan 11, 07 - Resume purging.	15	
		Final turbidity = 2.97		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 601

Date 1-17-07 **Static DTW** 15.04 **Well TD** 31.62' (TOC) IV = 2.5 L

Pump Used Peristaltic S19910 **Field Rep** EB

Start Time	Finish Time	Development Activity	~~Gallons~~ Liters Removed	Turbidity
1520	1523	Shaked bottom of well and pulled sediment	1.0	—
1523	1528	Bubbled up the water column to stir it	—	—
1528	1534	Pumped water	4.0	14.1
1534	1539	Bubbled up the water column to stir it	4.0	—
1539	1544	Pumped water	7.0	21.3
1544	1551	Continued pumping water	11.0	6.69
		Final TD: 31.65' (TOC)		
		Emile M Bette		
		Well cleared out fast.		
		EB 1-17-07		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0602

Date Jan 10, 07 **Static DTW** 15.97 **Well TD** 19.7

Pump Used _____ **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1515	1520	Surge w/air several times;		
		fairly turbid.		
1530	1620	Purge w/peristaltic @ ≅ 1/4 gpm.	≅ 12	
		Final turbidity = 3.02		

Configuration 3

Well Development Records

5 gal 10 sec

MOAB WELL DEVELOPMENT RECORD

Moab Well No 670

Date 7-7-05 Static DTW 14.05 Well TD 48.20

Pump Used _____ Field Rep LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0730	1300	Pumped for 30 min Intervals			6.81
		Purged 3 times and pumped			
		for 30 min Interval			
		Well Appears to have			
		2 to 3 ft of Sediment			
		in the bottom			

5 gal 10 sec

MOAB WELL DEVELOPMENT RECORD
Moab Well No 671

Date 7-6-05 **Static DTW** 12.82 **Well TD** 48.72

Pump Used _____ **Field Rep** LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1120	1530	Pumped for 30 min interval			9.37
		purged and Pumped for			
		30 min Intervals for Approx			
		4 hrs. Well Appeared to			
		contain Approx. 3 Ft of			
		Sediment			

5 gal 10 sec

MOAB WELL DEVELOPMENT RECORD
Moab Well No 672

Date 7-11-05 **Static DTW** 13.22 **Well TD** 47.69

Pump Used _____ **Field Rep** LW & JT

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
10:30	1432	Pumped and purged in			6.20
		30 min Intervals for			
		4 hours Well Appeared to			
		contain Approx 2 Ft of			
		Sediment			

6.7 sec per 5 gal

MOAB WELL DEVELOPMENT RECORD

Moab Well No 673

Date 7-11-05 **Static DTW** 14.01 **Well TD** 47.44

Pump Used QP-2Th **Field Rep** JT + LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
10:50	3:00	Pumped and purged on			6.77
		Regular Intervals for			
		Approx 4 hrs until			
		turbidity cleared to			
		under 10			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 674

Date 7-11-05 **Static DTW** 14.34 **Well TD** 45.87

Pump Used _____ **Field Rep** LW & JT

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1445	1130	Pumped and Purged on			8.15
7-11-05	7-12-05	Regular Intervals			
		Well seemed to have			
		Approx 2 1/2 Ft of			
		Sediments in bottom			
		9-10 Second per 5gal			

MOAB WELL DEVELOPMENT RECORD
Moab Well No 675

Date 7-11-05 **Static DTW** 12.17 **Well TD** 47.42

Pump Used QP-2 Th **Field Rep** JT & LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1530	1130	Pumped Purged 30 min			3.10
		Intervals. New 2" pump			
		Well had Approx 2 to 3			
		Feet of Sediment			
		2" pumped 5 gal in			
		6 Seconds			

MOAB WELL DEVELOPMENT RECORD
Moab Well No 676

Date 7-13-05 **Static DTW** 14.03 **Well TD** 47.25

Pump Used _____ **Field Rep** LW + TRU

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1440	1430	Pumped and purged 30			7.50
7-13	7-14	min intervals. well			
		had almost 4 ft of			
		sediment			
		water level when not			
		pumping 14:03 when			
		pumping 16.15			

MOAB WELL DEVELOPMENT RECORD
Moab Well No 677

Date 7-13-05 **Static DTW** 14.71 **Well TD** 47.11

Pump Used _____ **Field Rep** JT & LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1400	1555	pumped and purged 30			9.47
		min intervals well seemed			
		to clear up faster than			
		most. Water level when			
		pumping 17.12 not pumping			
		14.71			

MOAB WELL DEVELOPMENT RECORD
Moab Well No 678

Date 7-13-05 **Static DTW** 13.99 **Well TD** 47.55

Pump Used _____ **Field Rep** ____

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1535	14:30	pumped purged 30 min			8.81
7-13-05	7-14-05	intervals water level when			
		pumping 14.28 when not			
		pumping 13.99			

MOAB WELL DEVELOPMENT RECORD
Moab Well No 679

Date 7-13-05 **Static DTW** 13.95 **Well TD** 46.62

Pump Used _____ **Field Rep** JT & Lee

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1535	1340	pumped purged on Regular			6.54
		intervals well seemed			
		to have A lot of			
		Sediment black Sand			
		Water level when not			
		pumping 13.95 when			
		pumping 16.19			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 680

Date 8-23-05 Static DTW 16.43 Well TD 22.04'

S/U = 2.00'

Pump Used S17225 Field Rep JT + TRM

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					
1300	1545	STARTED PUMPING			2.09

MOAB WELL DEVELOPMENT RECORD

Moab Well No 681

Date 8-22-05 Static DTW 16.99 Well TD 22.60'

Pump Used S-17225 Field Rep JT+TRM

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					
1400		STARTED PUMPING			
	1630	STOPPED PUMPING			~~4.21~~ 03 TM

S/u = 1.89'

MOAB WELL DEVELOPMENT RECORD

Moab Well No 682

Date 8-23-05 Static DTW 16.94' Well TD 31.61'

Pump Used S-17225 Field Rep. JT + TMU

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					
0745		STARTED PUMPING			
TMU ~~1130~~	1130	STOPPED PUMPING			2.79

MOAB WELL DEVELOPMENT RECORD

Moab Well No 683

Date 8-16-05 Static DTW 16.35 Well TD 33.40

Pump Used S 17225 Field Rep: LW

S/U 2.0'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					3.28
1330	0830				

MOAB WELL DEVELOPMENT RECORD

Moab Well No 684

Date 8-3-05 Static DTW 15.45 Well TD 23.57 stick up 2.09

Pump Used 5-17225 Field Rep: JT, LW

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0730 1445	1350	3 1/2 min to pump Approx		185	2.84
		5 gal Appeared to have			
		5-6 Ft of Sediment			
		DTW seem almost 1 Ft			
		Lower than the wells			
		to the South East			
		well is located on South			
		Burm of Planting Area #5			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 685

Date 8-2-05 Static DTW 14.27 Well TD 32.17 Stick up 1.99

Pump Used S-17225 Field Rep. KW, JT

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1030 ~~1445~~	1630	Well appears to have about 8 ft of sediment in bottom 3 1/2 min to pump 5 gal	235	235	1.70

MOAB WELL DEVELOPMENT RECORD

Moab Well No 686

Date 8-17-05 Static DTW 13.51 Well TD 22.05

Pump Used S-17225 Field Rep. LW

S/u 1.88'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					
1400 8-17-05	1630	Started pumping Lots of sediment			2.27
0730 8-18-05	1130	Started pumping thursday			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 687

Date 8-22-05 Static DTW 15.88' Well TD 32.51

Pump Used S-17225 Field Rep JT + TMC

SWL 2.35'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~1445~~					
0930		STARTED PUMPING			
	1345	COMPLETED PUMPING			3.14

14.38
19.46

MOAB WELL DEVELOPMENT RECORD

Moab Well No 688

Date 7-14-04 Static DTW 14.38 Well TD 42.02

Pump Used _____ Field Rep ____

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0930	1130	Pumped purgded At 30 min Intervals			5.1

2" pump

5 gal 6 sec
13.78
19.69

MOAB WELL DEVELOPMENT RECORD

Moab Well No 689

Date 7-14-05 Static DTW 13.78 Well TD 57.08

Pump Used _____ Field Rep LW TRL

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0730	~~1010~~ 0930	Pumped purgded At 30min Intervals			4.45

Configuration 4

Well Development Records

MOAB WELL DEVELOPMENT RECORD

Moab Well No 770

Date 6/7/06 **Static DTW** 13.62 **Well TD** 37.9'

Pump Used Trash / Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 37.3' (prior to development)		
1240	1255	Purge w/trash pump @ 55gpm	825	>1000
1255	1305	Surge w/ Smed Rig	550	
1305	1315	Purge @ 55 gpm	550	>1000
1315	1325	Surge	~~8~~	
1325	1340	Purge @ 55 gpm	825	>1000
		Install 10 gpm Grunfos	600	<10
			3350	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 771

Date 6/7/06 **Static DTW** 13.30 **Well TD** 37.7'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 37.6 (Prior to development)		
~~1210~~		Purge w/ trash pump @ 55 gpm	1375	>1000
1110	1135			
1135	1145	Surge w/ ~~trash~~, Smeal Rig		
1145	1200	Purge @ 55 gpm.	825	>1000
1200	1210	Surge		
1210	1230	Purge @ 55 gpm.	1100	>1000
1230	1330	Install 10 gpm Grundfos	600	<10
			3,900	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 772

Date 6/7/06 **Static DTW** 13.45 **Well TD** 37.85'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 37.85' prior to development		
0945	1000	Purge w/ trash pump @ 55 gpm	825	>1000
1005	1015	Surge w/ Smeal Rig.		
1015	1030	Purge @ 55 gpm.	825	>1000
1030	1040	Surge		
1040	1100	Purge @ 55 gpm	1100	>1000
1105	1205	Install 10 gpm Grundfos	600	TL<10
			3350	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 773

Date 6/7/06 **Static DTW** 13.31 **Well TD** 37.9'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 37.85 (Prior to dev.)		
0830	0840	Purge w/ trash pump @ 55 gpm	550	71000
0840	0850	Surge w/ Smedsig.		
0850	0905	Purge @ 55 gpm.	825	71000
0905	0910	Surge		
0910	0925	Purge @ 55 gpm.	825	71000
0930	1030	Install 10 gpm Grundfos	600	<10
			2,800	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 774

Date 6/7/06 **Static DTW** 12.86 **Well TD** 37.85

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0715		TD = 37.8 (Prior to development)		
	0730	Purge w/trash pump @ 55gpm	825	71000
0730	0740	Surge w/Smeal Rig	~~550~~	~~710~~
0745	0755	Purge @ 55gpm.	550	71000
0755	0805	Surge.		
0805	0825	Purge @ 55gpm.	1100	71000
0830	0930	Install Grundfos (10gpm) pump.	600	<10
			3075	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 775

Date 6/6/06 **Static DTW** 13.65 **Well TD** 37.85'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 37.4 (Prior to development)		
1545	1600	Purge @ 55 gpm	825	>1000
1600	1610	Surge w/ Small Rig.		
1610	1630	Purge @ 55 gpm	1100	>1000
1630	1635	Surge		
1635	1700	Purge @ 55 gpm	1375	>1000
6/7/06 0715	0915	Install 10 gpm Grundfos	600	<10
			3900	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 776

Date 6/6/06 **Static DTW** 13.30 **Well TD** 37.8'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1430	1445	~~DTW~~ = TD = 37.8 (Prior to development)		7000
		Purge @ 55 gpm.	825	
1445	1450	Surge w/ Smed rig.	1100	
			↓	
1450	1510	Purge @ 55gpm.		7000
1510	1515	Surge		
1515	1535	Purge @ 55 gpm.	550	7000
1545	1645	Install 10 gpm Grundfos	600	<10
			3,075	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 777

Date 6/6/06 **Static DTW** 13.11 **Well TD** 37.80'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1300	1325	TD = 36.1' before purging.		
		Purge @ ≅ 55 gpm.	1375	71000
1325	1335	Surge w/Smeal rig.		
1335	1350	Purge @ 55 gpm	825	71000
1350	1400	Surge		
1400	1420	Purge @ 55 gpm	1100	≅ 50
1430	1530	Install 10 gpm Grundfos pump.	600	< 10
			3400	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 778

Date 6/6/06 **Static DTW** 13.35 **Well TD** 37.7

Pump Used Trash **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
0715	0800	TD prior to development = 36.45'	(~~250~~)	2475
		Purge w/ large trash pump @ ~~50~~ 55 gpm ; TD		
		after purging = 37.27' bottom feels solid.		71000
0800	0820	Surge w/ Smeal Rig.		
0830	0845	Purge - Turbidity > 1000. WL = 17.5' after		
		purging for 10 min @ > ~~50~~ 55 gpm		
			825	
0845	0955	Surge		
0955	~~1005~~ 0905	Purge w/ trash pump. @ 55gpm	555	71000
1130	1230	Install grundfos 10 gpm pump.	600	< 10
			4,455	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 779

Date 6/6/06 **Static DTW** 12.82 **Well TD** 37.85' (After Purging)

Pump Used Trash / Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
1130	1200	TD = 37.3 (prior to purging) purge @ ≅ ~~50~~ 55 gpm	1650	>1000
1200	1210	Surge w/ Smeal Rig.		
1210	1220	Purge @ ≅ ~~50~~ 55 gpm. Turb ≅ 200 (after purge)	550	7000
1225	1235	Surge		
1235	1245	Purge @ ≅ 55 gpm (measure w/ 5 gal bucket)	550	
		WL = 16.32' after purging 10 min @ 55 gpm		
1250	1350	Install 10 gpm Grundfos pump.	600	<10
			3350	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0780

Date 6/22/06 **Static DTW** 14.30 **Well TD** 32.4

Pump Used Trash **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 32' before development		
0735	0910	Purge w/ trash pump @ 35 gpm.	3,325	6.85
		Surge w/ 4" bailer several times while		
		purging.		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0791

Date 6/21/06 **Static DTW** 14.36 **Well TD** 57.1

Pump Used Trash **Field Rep** JP

	Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
	1645	1735	TD = 55.0' before development		
			Because of well field construction, cannot get Smedling to well.		
			Purge w/ trash pump @ 12 gpm	600	9.87
1/22	0700	0730	Purge w/ trash pump @ 12 gpm plus surge w/ 4" bailer - bailer is fairly effective in freeing some fine material.	360	34.0
	0740	0930	Install 10 gpm Grundfos pump.	1,300	6.21
				2,260	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0792

Date 6/22/06 **Static DTW** 14.38 **Well TD** 42.4'

Pump Used Trash **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 41.4' before development		
0915	1015	Purge w/ trash pump @ 30 gpm	1,800	42.0
1020	1120	Purge w/ 10 gpm Grundfos.	600	6.19
			2,400	

Put in 9/20/06 Stick up 2.41

WELL DEVELOPMENT RECORD

Well No 0783

Pumped 5 ga. at 12 min

Date 9-26-06 Static DTW 16.51 Well TD 21.51

Pump Used Blue S-16935 Field Rep JT

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
9-26-06	9:40	4:00	Caved in at 12' sand to 5'	115		
9-27-06	8:40	10:00		45	160	

WELL DEVELOPMENT RECORD

Well No 0784

Top of well 2.41

Date 5/25/06 Static DTW 10.41 Well TD 22.29

Pump Used Blue S-16 935 Field Rep JT KM

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
			Cave in at 8' 4' Sand			
			Pumped at 5 gl every 10 Min			
1/15/06	1:20	4:00	Brushed every 10 gl	25		
1/17/06	9:35	11:25		20		
5/25/06	9:22			30	75	1.84

Stick up
2.41

WELL DEVELOPMENT RECORD

Well No 0784

Date 5/25/06 Static DTW 10.41 Well TD 22.29

Pump Used Blue S-16935 Field Rep T

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
			8' Cover in 4' sand			
			Pumped at 5gl every 10 min			
5/15/06	1:20	4:00	Brushed every 10 gal	25		
					75	
7/11/06	9:35	11:25		20		
7/25/06	9:22			30		1.84

Top

2'3"

WELL DEVELOPMENT RECORD

Well No 0785

Date 5/24/06 Static DTW 10.56 Well TD 22.44

Pump Used Blue S-16935 Field Rep VT

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
			20' caved in at 11 ft 6' sand 5' Bcal			
5/10/06	9:00 AM		5 gal. per 11 min Brushed 2 Times	20		
5/15/06	900 AM	11:30	Brushed 2 Times	30	90	
5/24/06	9:00		Brushed 3 Times	40		
			Pumping Water Level at 10.65			

Top of Well 2' 3"

WELL DEVELOPMENT RECORD

Well No 0785

Date 5/24/06 Static DTW 10.56 Well TD 22.44

Pump Used Blue S-16935 Field Rep JT

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
		Caved in at 20' 11 Ft SAND			
5/10/06	9:00	5 gl per 11 min Broshed every 10 gal	20		
5/15/06	9:00		30		
5/24/06 900			45	95	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0786

Date 6/22/06 **Static DTW** 14.10 **Well TD** ~~44~~ 32.2'

Pump Used Trash/Grundfos **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 30.7' prior to development.		
1030	1130	Purge w/ trash pump @ 30 gpm;	1,800	51.0
		frequently surge w/ 4" bailer		
1130	1245	Purge w/ 10 gpm Grundfos pump.	750	4.67
			2,550	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 0787

Date 6/22/06 **Static DTW** 14.52 **Well TD** 46.8'

Pump Used Trash **Field Rep** JP

Start Time	Finish Time	Development Activity	Gallons Removed	Turbidity
		TD = 44.9' prior to development.		
1130	1245	Purge w/ trash pump @ 30 gpm;	2,250	5.09
		Surge several times w/ 4" bailer.		

Infiltration Trench

Well Development Records

Put in 9-20-06

2' stick up

WELL DEVELOPMENT RECORD

Well No 0730

Date 9-28-06 Static DTW 14.01 Well TD 22.41

Pump Used Blue 5-16935 Field Rep ____

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1:00	3:51	Caved in at 14' sand to 5'	85	85	

Put in 9-20-06

2" stick up

WELL DEVELOPMENT RECORD

Well No 0731

Date 9-27-06 Static DTW 15.66 Well TD 21.45

Pump Used Blue 5-16935 Field Rep ____

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1:30	7:30	Pumped at 10 min per 5 gal	51		
7-28 7:30		Caved in a 12' sand to 5'	76	125	

WELL DEVELOPMENT RECORD

Well No 0732

Stick up 2' 6" from ground

Date 6-12-06 Static DTW 16.14 Well TD 21.93

Pump Used Blue S-16935 Field Rep VT

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
			Caved in at 7' 2' SAND			
-1-06	2:00	3:40	Brushed Every 10 To 20 gL	35		
	9:00	10:30		50	85	

2' 4"
TOP of well

WELL DEVELOPMENT RECORD

Well No 0733

Date 6-1-06 Static DTW 13.79 Well TD 22.61

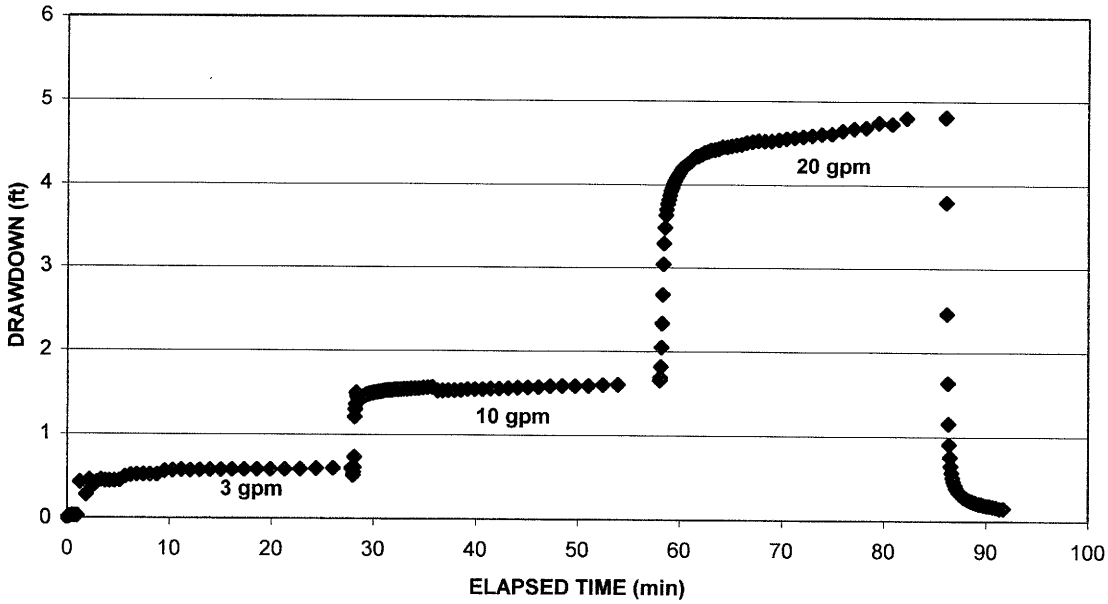
Pump Used Blue S-16935 Field Rep VT

	Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
			Caved in at 5'			
5/31/06	9:30	4:00	18	25	65	
6/1/06	7:40	2:00	after 7gl with brushing 15gl more	20		5.15
			Turbidity at 4.15	25		

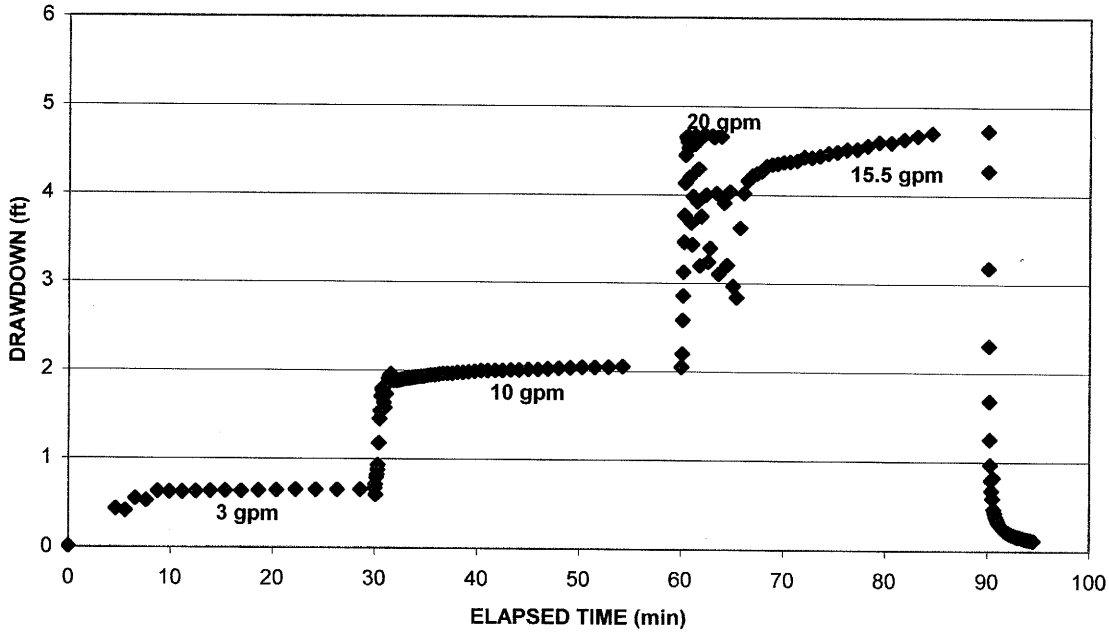
Appendix C

Step-Test Plots

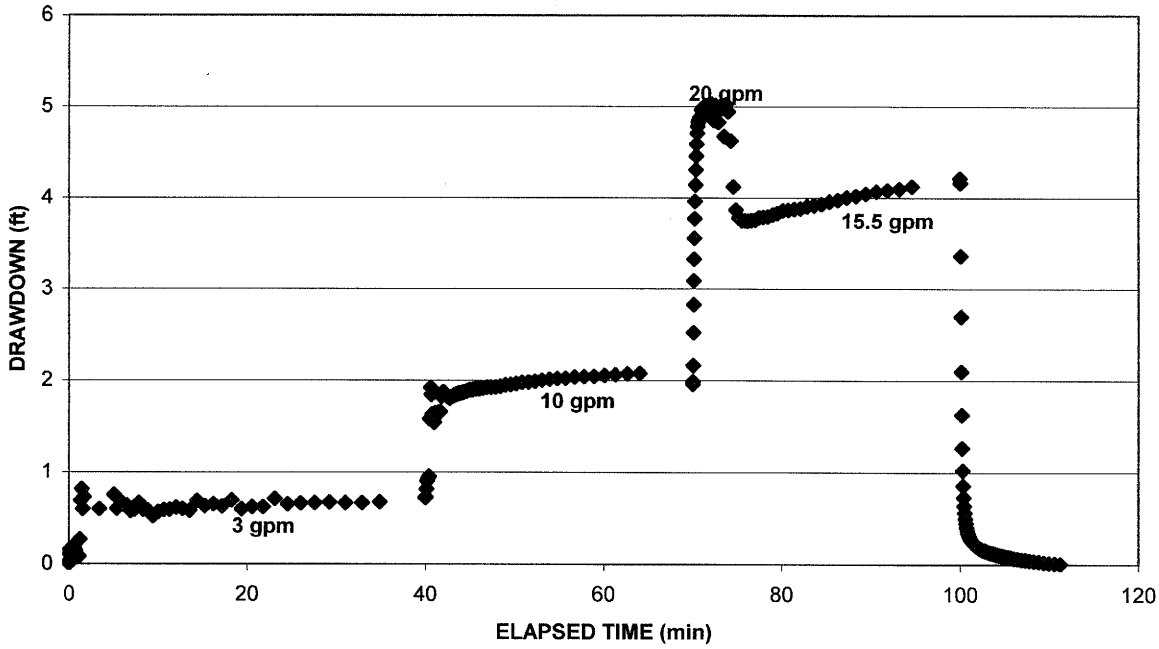
WELL 470



WELL 471



WELL 472



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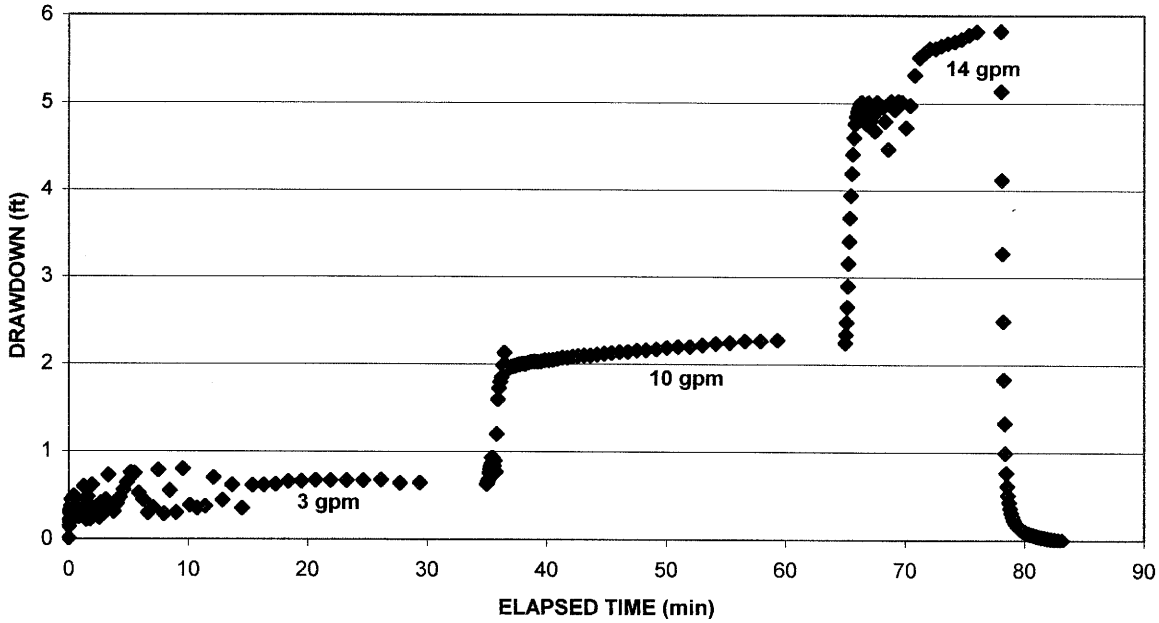
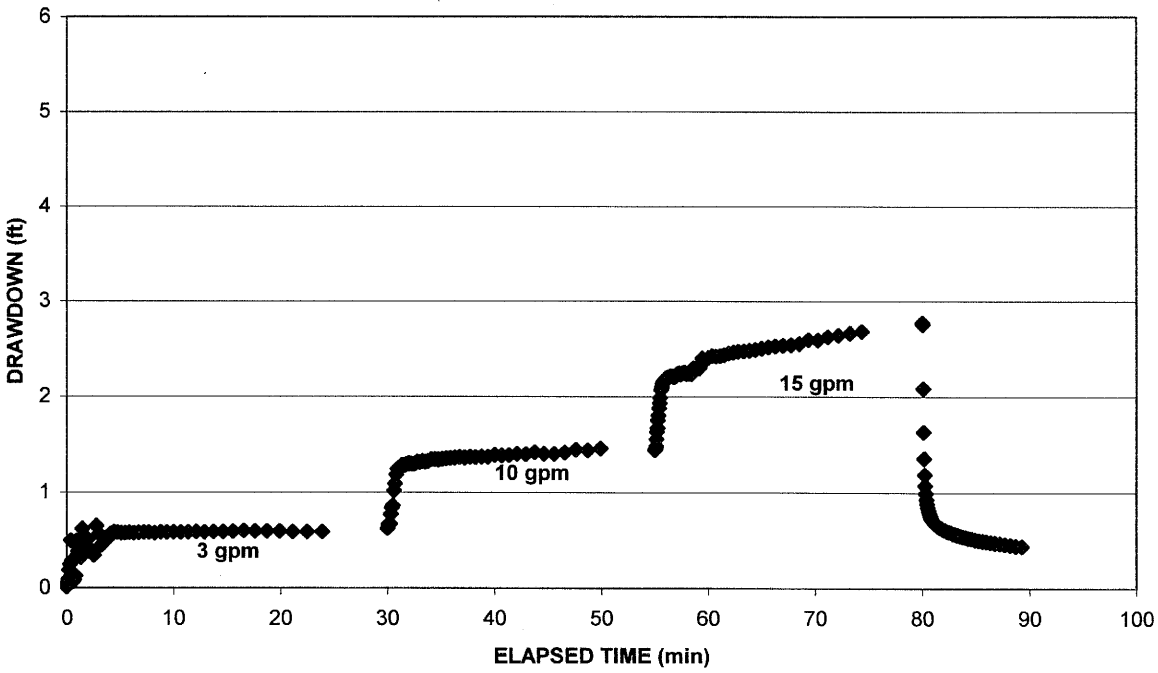


WELL 474



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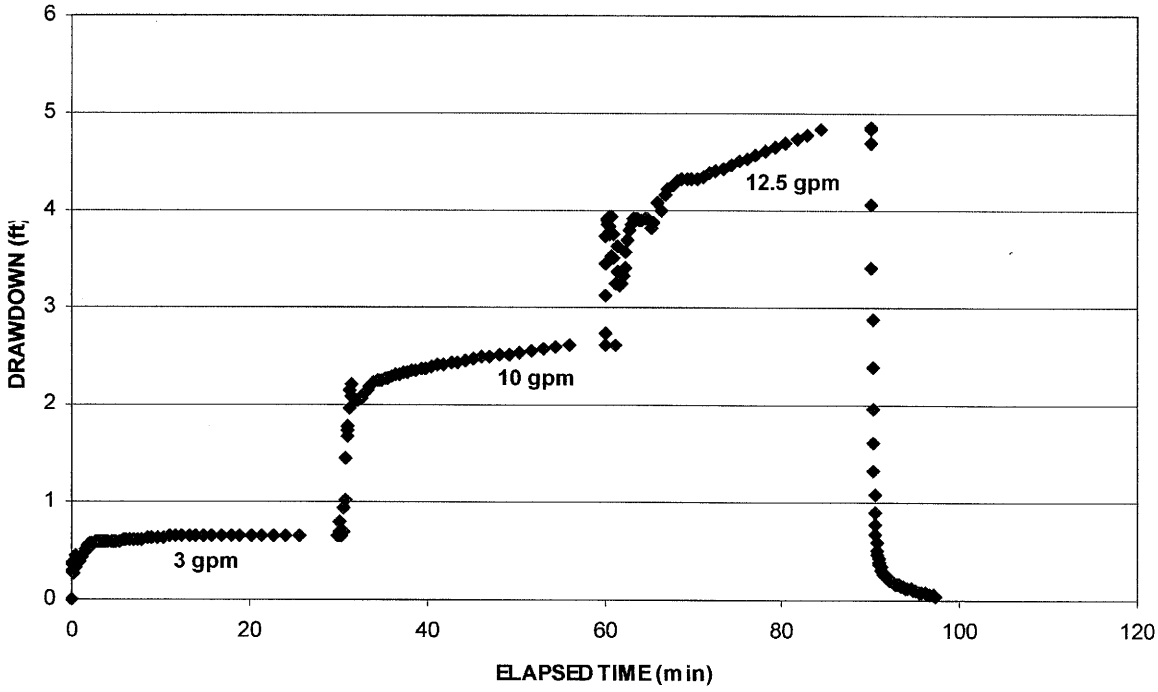

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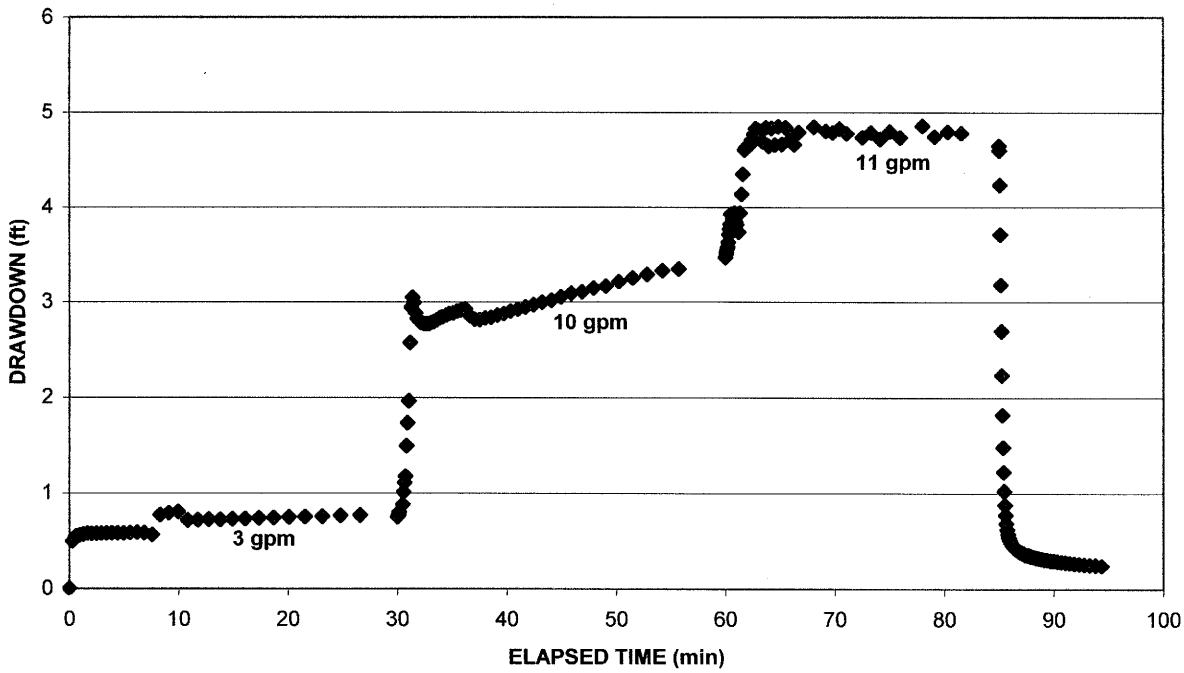

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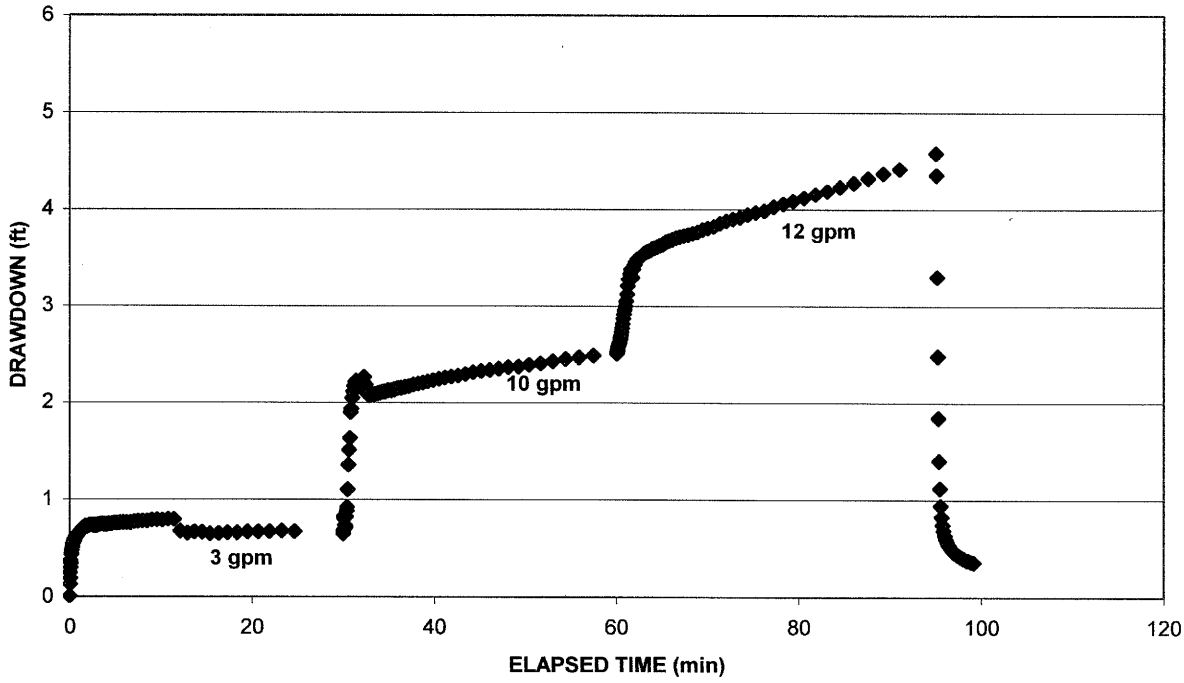

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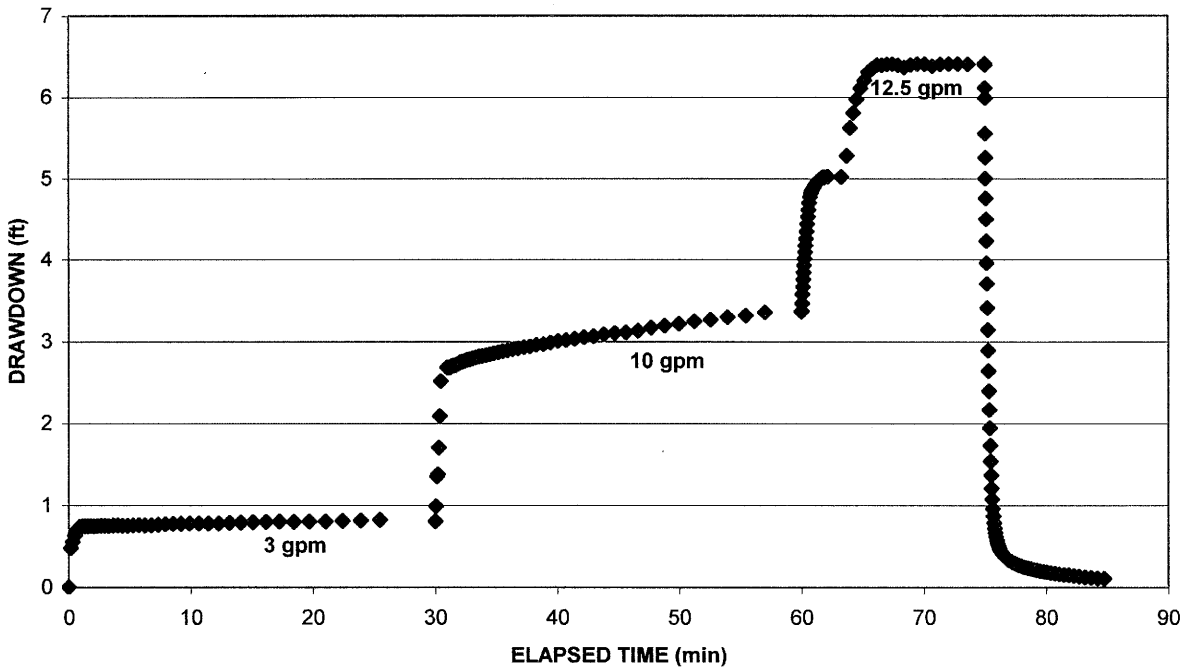
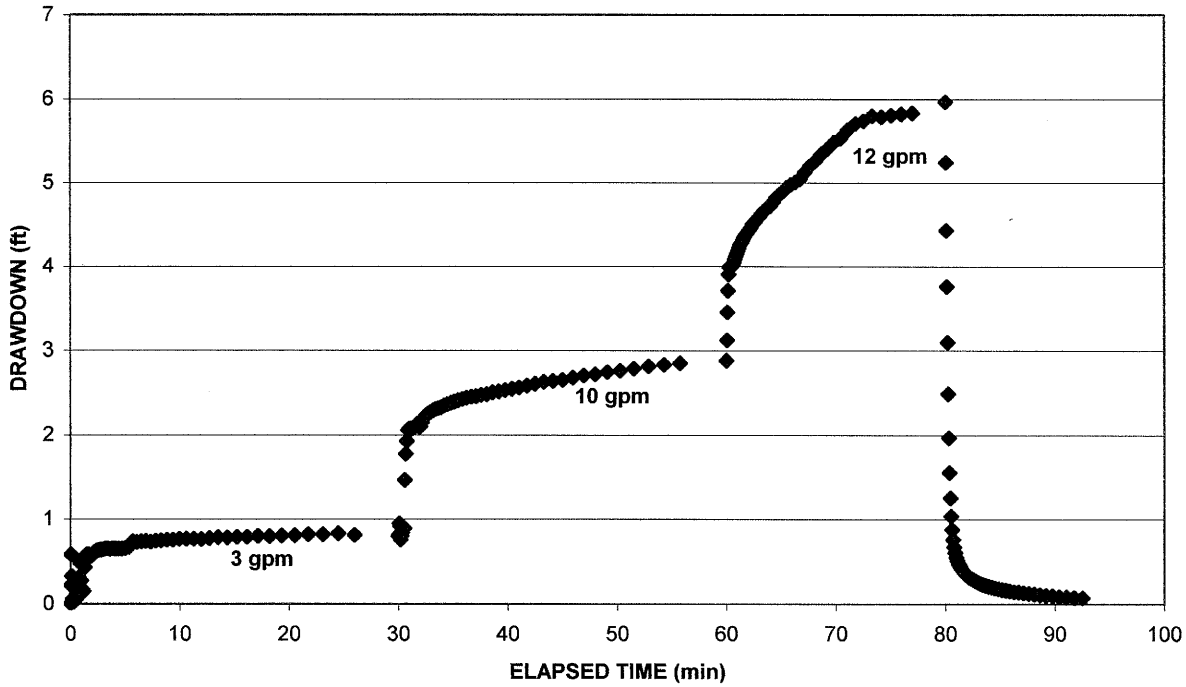
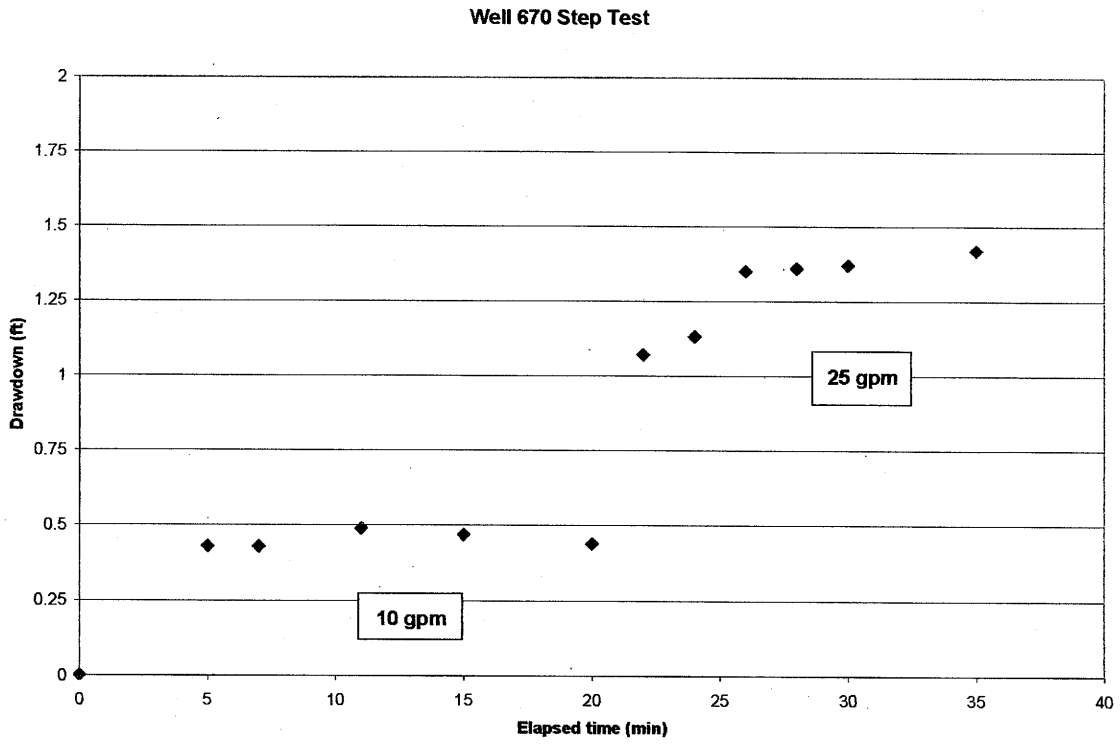
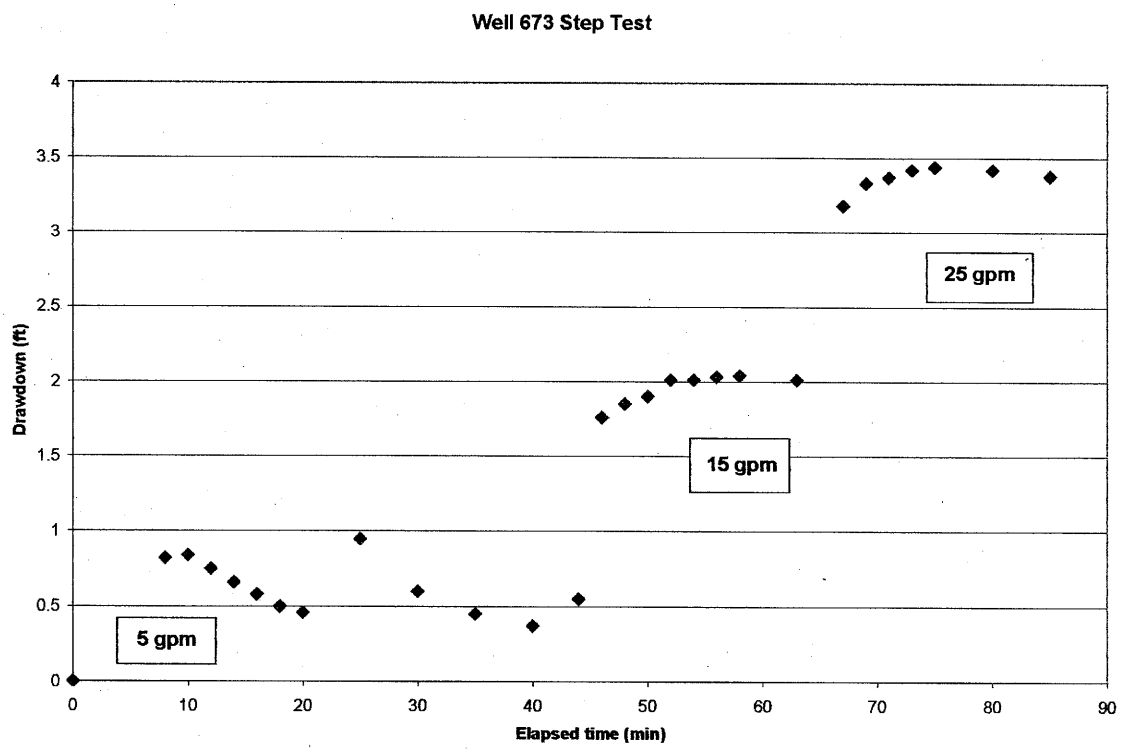
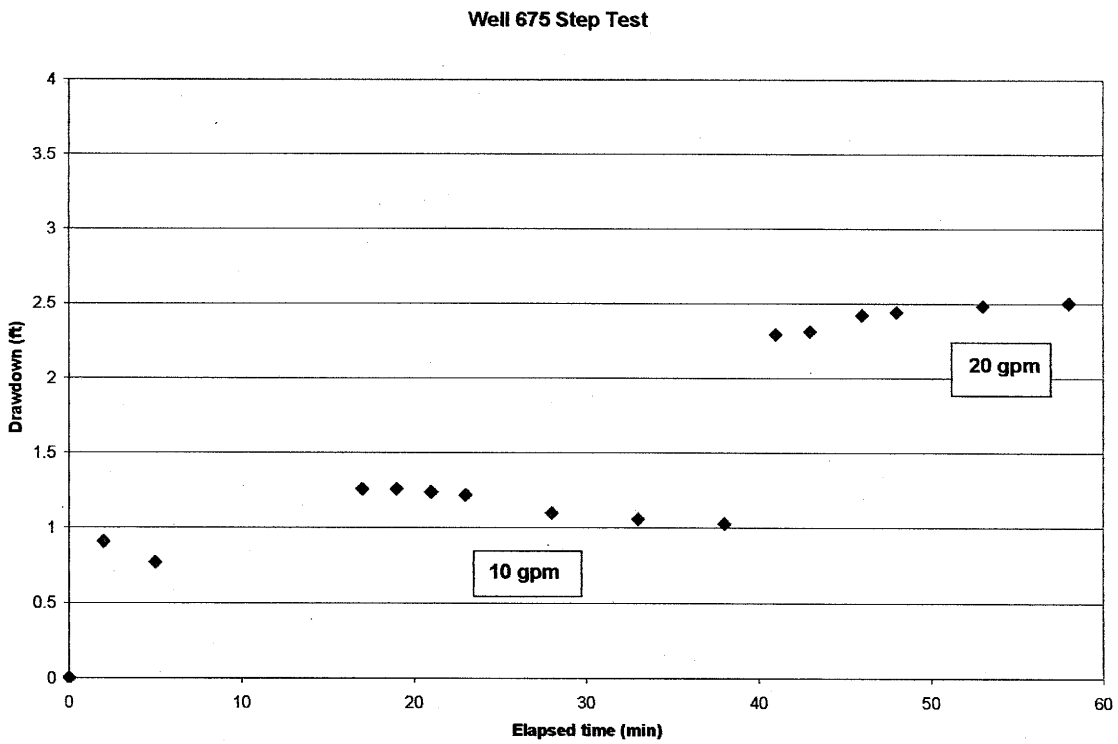


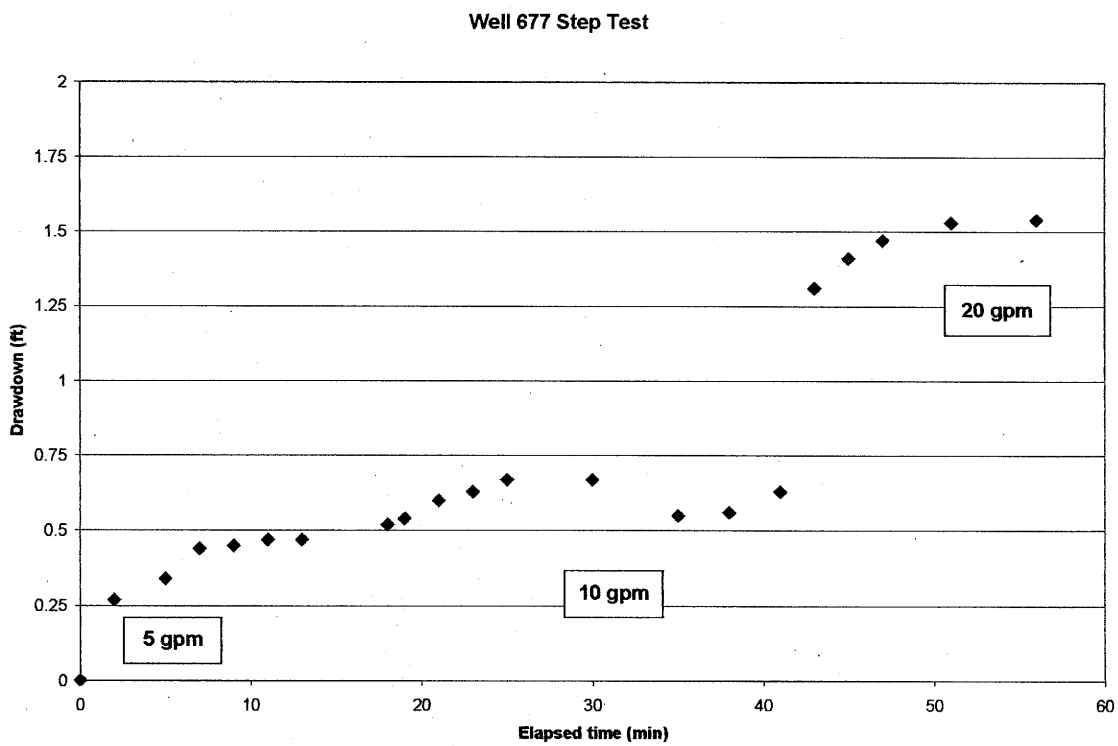
WELL 479

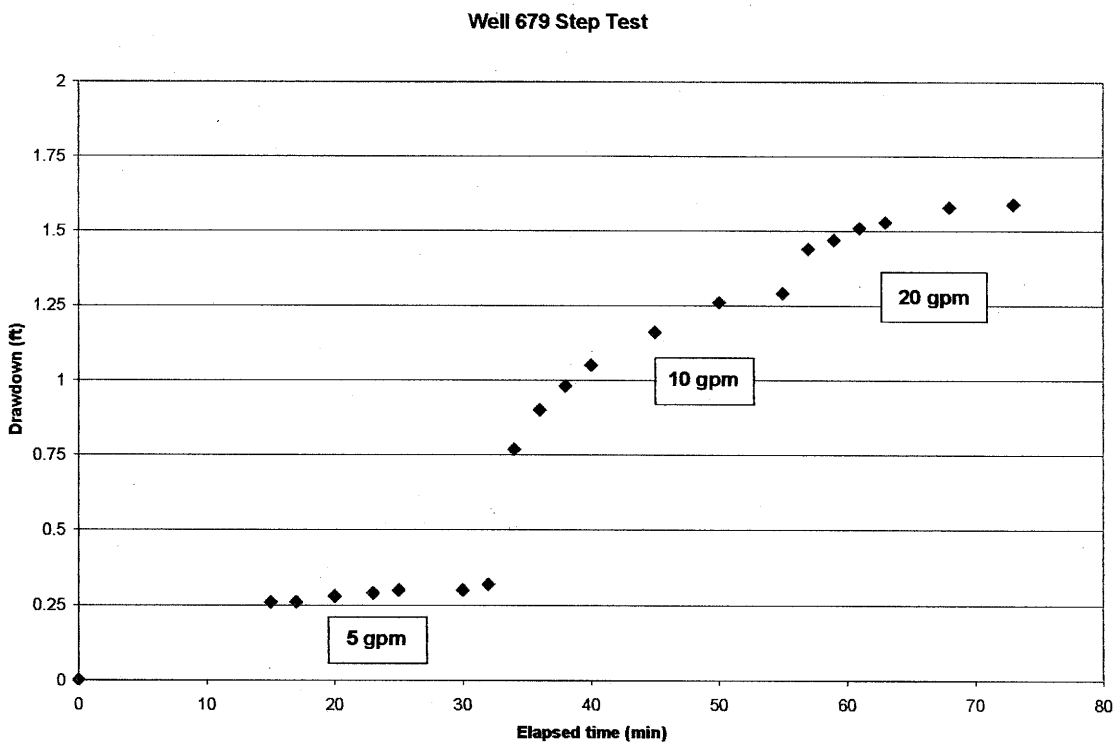



Well 670 Step Test
Drawdown (ft)
Elapsed time (min)
10 gpm
25 gpm
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
5
10
15
20
25
30
35
40

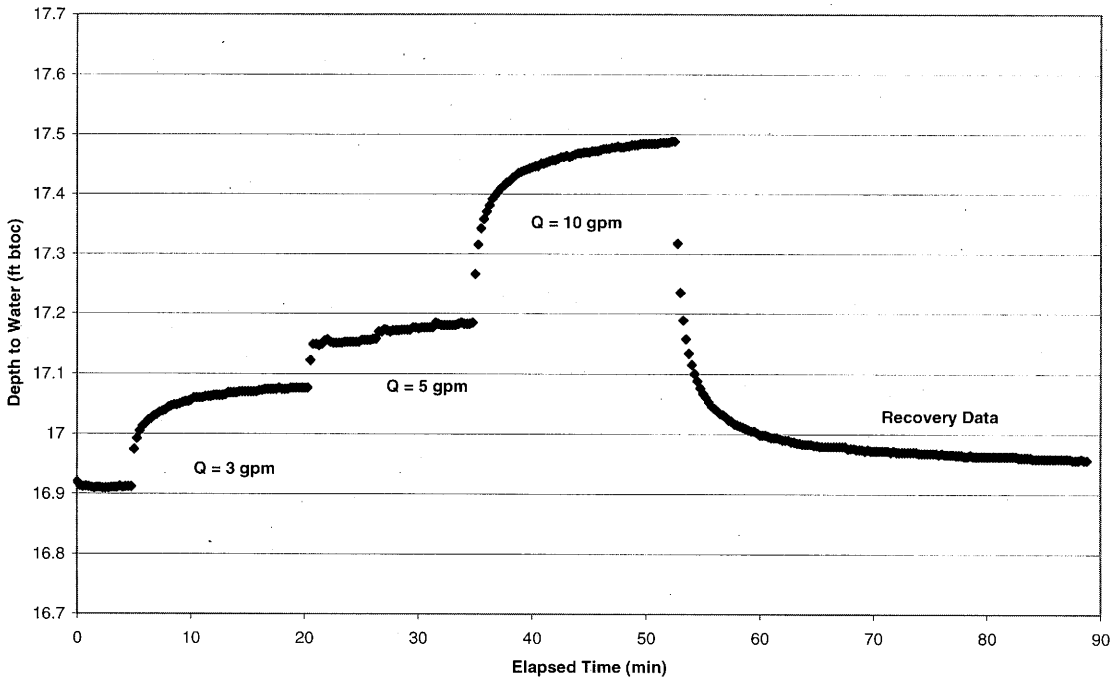

Well 673 Step Test
Drawdown (ft)
Elapsed time (min)
5 gpm
15 gpm
25 gpm
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80
90


Well 675 Step Test
Drawdown (ft)
Elapsed time (min)
10 gpm
20 gpm
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60

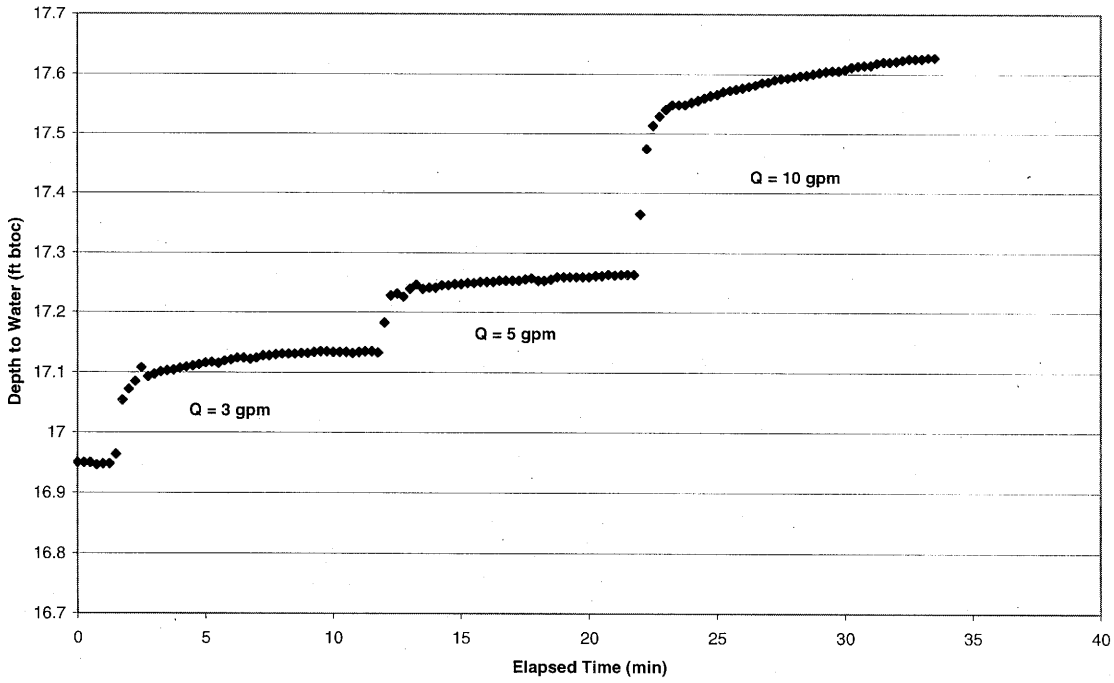

Well 677 Step Test
Drawdown (ft)
Elapsed time (min)
5 gpm
10 gpm
20 gpm
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
10
20
30
40
50
60


Well 679 Step Test
Drawdown (ft)
Elapsed time (min)
5 gpm
10 gpm
20 gpm
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
10
20
30
40
50
60
70
80

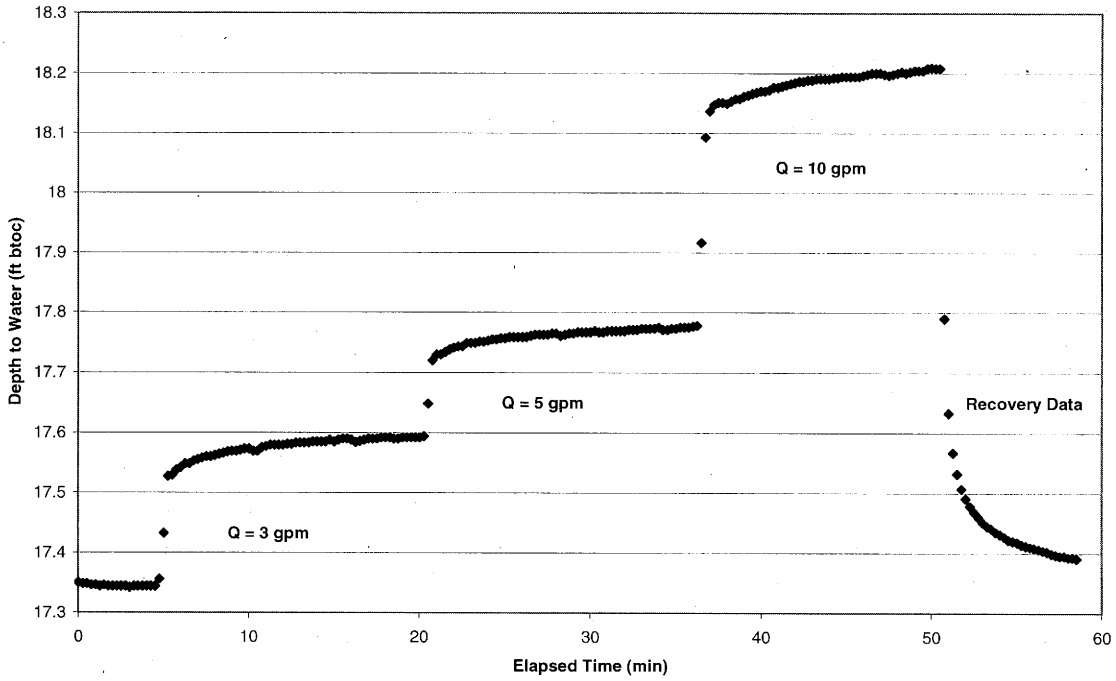
Well 770 Step Test



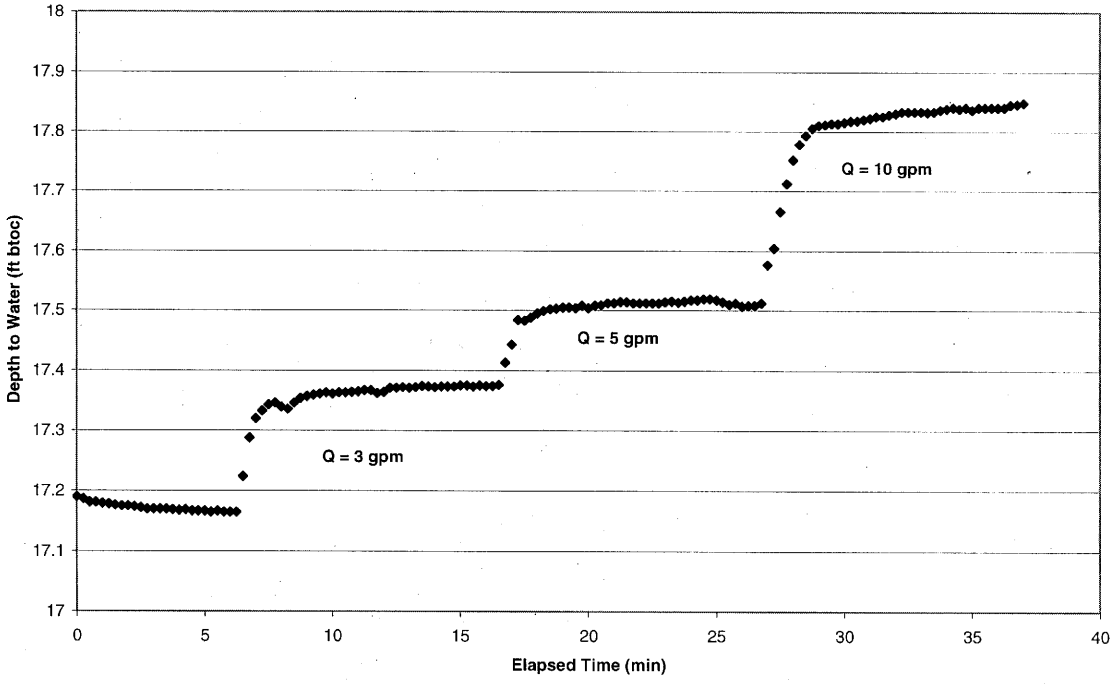
Well 771 Step Test



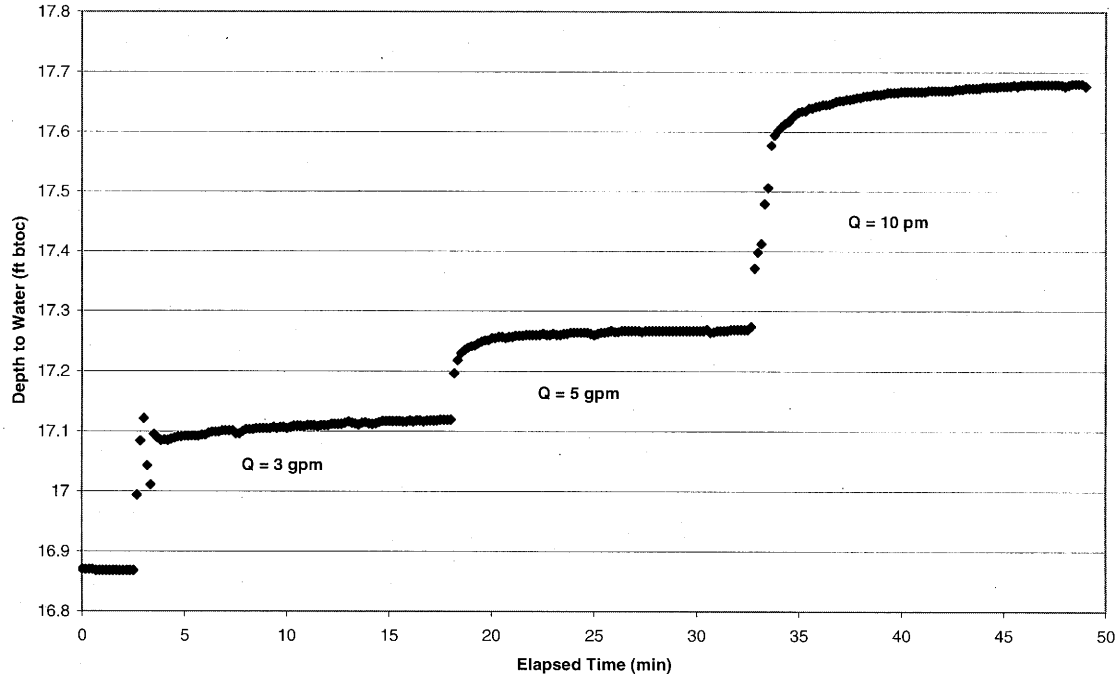
Well 772 Step Test



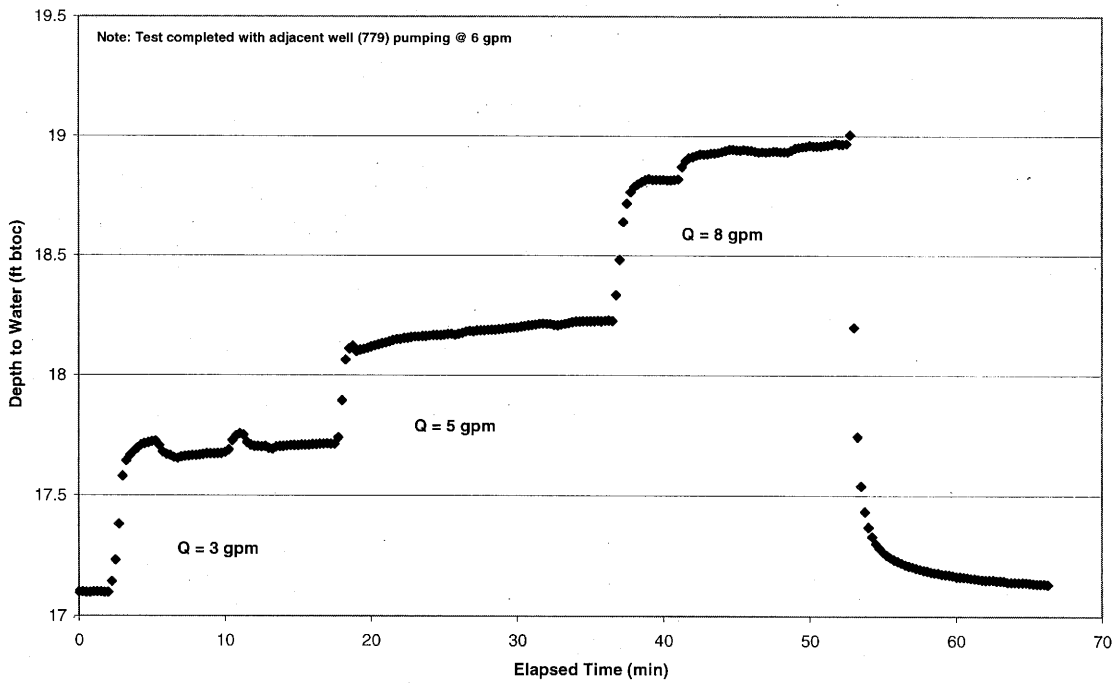
Well 773 Step Test



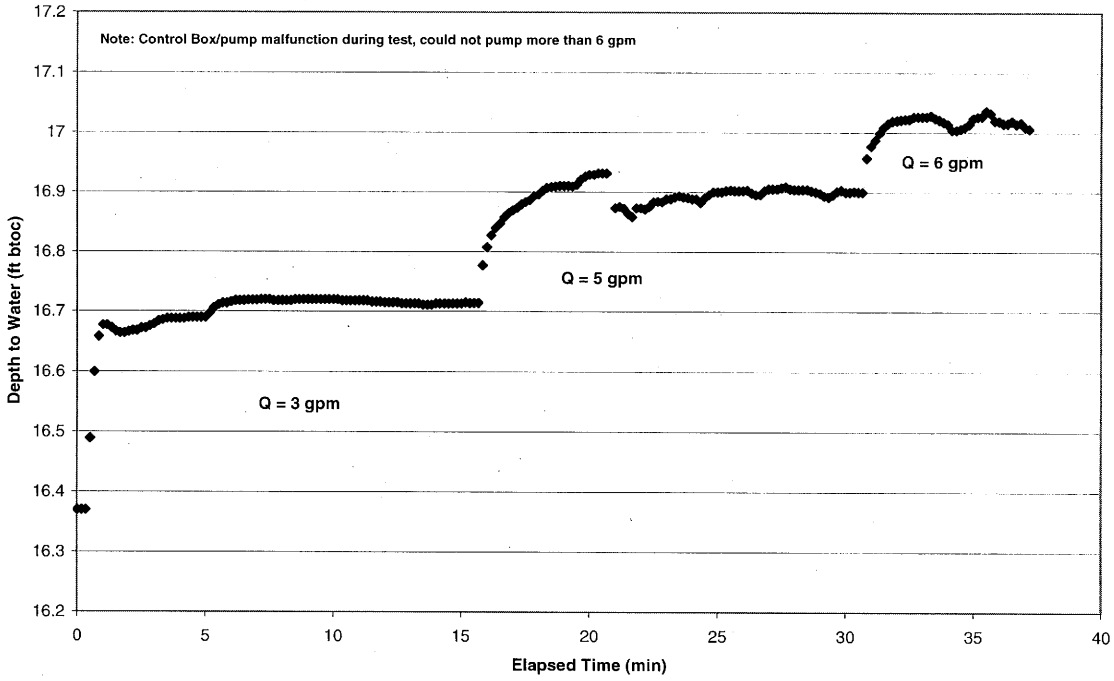
Well 776 Step Test



WII 778 Step Test



Well 779 Step Test



Appendix D

Equipment and Materials Cutsheets

Contents

Closeout Submittal-Liner Warranty

Liner Product Data

Manufacturer's Recommendations for Pipe

Warranty for Piping Components

Descriptive Product Data for Each Pump

Pump Owner's Manual

Pipe Fittings Manufacturer's Descriptive and Technical Literature

Test Procedures

Field Test Reports

Literature for Piping System Components

Meters Operation and Maintenance Manual

Mag Meter Spare Parts List

Mag Meters Factory Test Data

Catalog Cutsheets for all Basic Materials

Wire Meggered Test

Electrical Components Cutsheets

June 2006 Updates (Pumps, Well Screen, Sprinklers)

February 2007 Updates (Telemetry System, Well Points, Fresh Water Injection Sand Filter, and Sprinkler System Controllers)

Closeout Submittal-Liner Warranty

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

Colorado Lining International warrants workmanship performed by Colorado Lining International to be free of defects for five (5) year(s) from the date of acceptance.

This limited warranty does not include damages or defects in workmanship resulting from acts of God, including but not limited to earthquakes, floods, piercing hail, ice, tornadoes, wind, or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of seams to harmful chemicals, abuse of seams by machinery, equipment, or people, excessive pressure from any source, or strain from any source.

Any claim for any alleged breach of this warranty must be made in writing to the President of Colorado Lining International, by certified mail, within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the purchaser and purchaser shall have no right of recovery against Colorado Lining International. In the event said repairs are to be effected, said repairs shall not be due until the area subject to repair is in a clean, dry, unencumbered condition. This includes but is not limited to the area available for repair to be free from all water, dirt, sludge, residuals and liquids of any kind.

I hereby state that I have read and understand the above and foregoing Limited Warranty and agree to such by signing hereunder.

PURCHASER/USER: S.M. Stoller Corp / U.S. Department of Energy

ACCEPTED BY: Jud Hudson, Contract Administrator

COLORADO LINING INTERNATIONAL: [signature]

Colorado
(800) 524-8672
Texas
(888) 546-4641
Montana
(877) 448-2777

Colorado Lining INTERNATIONAL

California
(877) 578-5000
So. California
(888) 295-6100
South Dakota
(800) 661-2201

FOR GSE LINING TECHNOLOGY, INC.
(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

Date:	September 30, 2003	Warranty No.:	509539
Purchaser Name:	Department of Energy c/o S.M. Stoller	Project No.:	509539
Address:	2597 B ¾ Road	Effective Date:	August 13, 2003
City, State:	Grand Junction, Colorado 81503	Project Name:	Moab DOE
Product Type/Description:	GSE HD 40 mil	Project Address:	Palisade, Colorado

GSE Lining Technology, Inc. ("GSE") warrants each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of five (5) years from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product on a pro rata basis at the current price in such manner as to charge the Purchaser only for that portion of the warranted life which has elapsed since the purchase of the product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology, Inc., 19103 Gundle Road, Houston, Texas 77073, with the words "Warranty Claim" clearly marked on the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

INSTALLATION WARRANTY

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

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PURCHASER/USER: _____

ACCEPTED BY: _____

COLORADO LINING INTERNATIONAL: _____

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Montana
(877) 448-2777

Colorado Lining International

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So. California
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South Dakota
(800) 661-2201

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(GEOSYNTHETIC MANUFACTURED MATERIALS)
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ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

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Colorado Lining
INTERNATIONAL

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So. California
(888) 295-6100
South Dakota
(800) 661-2201

Liner Product Data

GSE

Product Data Sheet

GSE STANDARD PRODUCTS

GSE HD

GSE HD is a smooth, high quality, high density polyethylene (HDPE) geomembrane produced from specially formulated, virgin polyethylene resin. This polyethylene resin is designed specifically for flexible geomembrane applications. It contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. GSE HD has outstanding chemical resistance, mechanical properties, environmental stress crack resistance, dimensional stability and thermal aging characteristics. GSE HD has excellent resistance to UV radiation and is suitable for exposed conditions. *These product specifications meet or exceed GRI GM13.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, mils (mm)	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Thickness, mils (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	420 (128)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2341)	19,575 (1819)	12,600 (1171)	9,675 (899)	1,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS005 R10/01/02

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE Internal Specification Review

Clarifications

Project No. 509539
Project: Moab Tailings West Cell
Products: **1)** 40 mil Minimum Smooth HDPE Geomembrane; **2)** 16 oz/yd2 Nonwoven Geotextile
Sections: **Section 02271** page 6 of 14

Date: 15 May, 2003

Level 1 Exceptions
Page 02271-6 Section 2.2.B

Geomembrane Property	Project Specifications	GSE Specifications
Modulus at 100%	ASTM D638	Not Tested
Carbon Black Dispersion	Cat 1 or 2	9 of 10 views in Cat 1 or 2. No more than 1 view in Cat 3.

Level 2 Exceptions

Geomembrane Property	Project Specifications	GSE Specifications
Thickness	ASTM D1593	ASTM D5199
Density	ASTM D792	ASTM D792 or 1505

Level 3 Exceptions
None

SPECIFICATIONS

3 and 8 strand
standard construction

September 1990 **100**

resistent to rot, U.V. abrasion grease gas chemicals marine growth

3/4" *

SIZE		POLYPRO		NYLON		POLYESTER		POLY-PLUS®		STEEL-LITE®		MANILA		WORKING LOADS*	DACRON® (All Sixteenths Polyester)		LST MOORING LINE		POLY-CRON®		SUPER 800 LOCK LINE	
DIA.	CIR.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	★	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.
3/16"	5/8"	800	.70	1,000	1.0	1,000	1.2	—	—	—	—	406	1.5	10:1								
1/4"	3/4"	1,250	1.2	1,650	1.6	1,480	2.0	1,300	1.7	—	—	540	2.0	10:1								
5/16"	1	1,900	1.8	2,560	2.5	2,550	3.1	2,000	2.6	—	—	900	2.8	10:1								
3/8"	1-1/8"	2,700	2.8	3,700	3.5	3,700	4.5	3,200	3.6	—	—	1,220	4.1	10:1								
7/16"	1-1/4"	3,500	3.8	6,000	5.0	5,000	6.2	3,800	4.8	—	—	1,580	5.3	10:1								
1/2"	1-1/2"	4,200	4.7	8,400	6.5	6,400	8.0	5,400	6.7	—	—	2,380	7.5	9:1								
9/16"	1-3/4"	5,100	6.1	8,900	8.3	8,000	10.2	8,000	7.6	—	—	3,100	10.4	8:1								
5/8"	2"	6,200	7.5	10,400	10.5	10,000	13.0	7,200	9.2	—	—	3,960	13.3	8:1								
3/4"	2-1/4"	8,800	10.7	14,200	14.5	12,600	17.5	9,800	12.5	—	—	4,860	16.7	7:1								
13/16"	2-1/2"	9,900	12.7	17,000	17.0	15,300	21.0	11,200	14.7	—	—	5,850	19.5	7:1								
7/8"	2-3/4"	11,500	15.0	20,000	20.0	18,000	25.0	13,600	17.6			6,950	22.4	7:1								
1"	3"	14,000	18.0	25,000	26.4	22,000	30.4	17,000	22.0	..	—	8,100	27.0	7:1								
1-1/16"	3-1/4"	18,000	20.4	28,800	29.0	25,500	34.4	18,700	24.5	—	—	9,450	31.2	7:1								
1-1/8"	3-1/2"	18,300	23.6	33,000	34.0	29,500	40.0	21,000	27.5	—	—	10,800	34.0	7:1								
1-1/4"	3-3/4"	21,000	27.0	37,500	40.0	33,200	46.2	25,000	33.0	—	—	12,200	41.6	7:1								
1-5/16"	4"	23,800	30.4	43,000	46.0	37,500	52.5	27,800	37.0	—	—	13,500	47.8	7:1								
1-1/2"	4-1/2"	28,700	38.4	53,000	55.0	46,800	67.0	34,000	46.0	38,000	36.5	16,700	60.0	7:1	—				34,000	55.0	35,500	44.0
1-5/8"	5"	36,000	47.6	66,000	66.5	57,000	82.0	41,000	55.0	46,000	45.1	20,800	74.5	7:1	—	—	—	—	42,000	67.0	43,500	54.0
1-3/4"	5-1/2"	43,000	59.0	78,000	80.0	67,800	98.0	51,000	68.0	55,000	54.2	23,800	88.5	7:1	87,000	96.0	59,000	67.0	50,000	80.0	53,000	66.0
2"	6"	52,000	69.0	92,000	95.0	60,000	118.0	62,000	83.0	68,500	65.6	28,000	108.0	7:1	103,500	118.0	70,500	80.0	60,000	95.0	63,000	78.0
2-1/8"	6-1/2"	61,000	80.0	108,000	108.0	82,000	135.0	70,000	97.0	77,500	76.5	—	—	7:1	117,800	136.0	82,500	94.0	70,000	112.0	—	—
2-1/4"	7"	68,000	92.0	125,000	129.0	107,000	157.0	78,000	108.0	88,000	87.0	—	—	8:1	138,000	157.0	96,000	109.0	80,000	127.0	85,500	106.0
2-1/2"	7-1/2"	80,000	107.0	140,000	148.0	122,000	181.0	90,000	122.0	103,000	102.0	—	—	8:1	158,000	181.0	110,000	125.0	92,000	147.0	—	—
2-5/8"	8"	90,000	120.0	162,000	168.0	137,000	205.0	89,000	138.0	116,000	114.0	—	—	6:1	175,000	205.0	120,000	142.0	105,000	165.0	104,000	138.0
2-3/4"	8-1/2"	101,000	137.0	180,000	189.0	154,000	230.0	110,000	165.0	130,500	130.0	—	—	6:1	195,000	230.0	135,000	155.0	120,000	190.0	—	—
3"	9"	114,000	153.0	200,000	210.0	174,000	258.0	125,000	179.0	145,000	145.0	—	—	6:1	217,900	258.0	150,000	175.0	130,000	208.0	140,000	175.0
3-1/4"	10"	137,000	190.0	230,000	264.0	210,000	318.0	150,000	215.0	175,000	180.0	—	—	6:1	286,000	318.0	180,000	210.0	163,000	253.0	170,000	216.0
3-1/2"	11"	182,000	232.0	300,000	312.0	254,000	384.0	170,000	244.0	207,000	220.0	—	—	8:1	318,000	384.0	220,000	245.0	—	—	—	—
4"	12"	190,000	275.0	380,000	380.0	300,000	460.0	200,000	290.0	243,000	261.0	—	—	8:1	377,000	460.0	260,000	296.0	—	—	—	—

FOLLOWING IN 8 STRAND CONSTRUCTION ONLY

DIA.	CIR.	POLYPRO Tensile Strength	Lbs. Per 100 Ft.	NYLON Tensile Strength	Lbs. Per 100 Ft.	POLYESTER Tensile Strength	Lbs. Per 100 Ft.	POLY-PLUS Tensile Strength	Lbs. Per 100 Ft.	STEEL-LITE Tensile Strength	Lbs. Per 100 Ft.	MANILA Tensile Strength	Lbs. Per 100 Ft.	WORKING LOADS	DACRON Tensile Strength	Lbs. Per 100 Ft.
4-1/4"	13"	220,000	320.0	440,000	450.0	350,000	540.0	270,000	395.0	290,000	309.0	—	—	6:1	435,000	540.0
4-1/2"	14"	252,000	365.4	510,000	500.0	410,000	626.0	315,000	447.0	316,000	356.0	—	—	8:1	505,000	626.0
5"	15"	290,000	420.0	575,000	570.0	467,000	720.0	360,000	513.0	358,000	409.0	—	—	8:1	575,000	720.0
5-1/4"	16"	330,000	475.0	650,000	645.0	535,000	820.0	410,000	585.0	402,000	468.0	—	—	8:1	655,000	820.0
5-1/2"	17"	368,000	530.0	720,000	715.0	600,000	920.0	460,000	662.0	445,000	527.0	—	—	6:1	725,000	920.0
6"	18"	410,000	594.0	800,000	798.0	675,000	1010.0	515,000	747.0	500,000	593.0	—	—	6:1	825,000	1040.0

TENSILE STRENGTHS shown are average based on new ropes tested under laboratory conditions and can vary by 10%. WEIGHTS are average and may vary by 5%.

★ WORKING LOADS are expressed as a ratio to tensile strength.

8 STRAND ROPES not available in Manila or sizes under 1-1/2" dia. Consult customer service department.

MANILEX—same specs as Polypro.

*CAUTION: USE OF WORKING LOADS

Because of the wide range of rope use, rope condition, exposure to the several factors affecting rope behavior, and the degree of risk to life and property involved, it is impossible to make blanket recommendations as to working loads. However, to provide guidelines, working loads are tabulated for rope in good condition with appropriate splices, in non-critical applications and under normal service conditions.

A higher working load may be selected only with expert knowledge of conditions and professional estimate of risk and if the rope has not been subject to dynamic loading or other excessive use, has been inspected and found to be in good condition and is to be used in the recommended manner and the application does not involve elevated temperatures, extended periods under load, or obvious dynamic loading (see explanation below) such as sudden drops, snubs, or pickups. For all such applications and for applications involving more severe exposure conditions, or for recommendations on special applications, consult the manufacturer.

Many uses of rope involve serious risk of injury to personnel or damage to valuable property. This danger is often obvious, as when a heavy load is supported above one or more workmen. An equally dangerous situation occurs if personnel are in line with a rope under tension. Should the rope fail, it may recoil with considerable force. Persons should be warned against the serious danger of standing in line with any rope under tension. IN ALL CASES WHERE SUCH RISKS ARE PRESENT, OR THERE IS ANY QUESTION ABOUT THE LOADS INVOLVED OR THE CONDITIONS OF USE, THE WORKING LOAD SHOULD BE SUBSTANTIALLY REDUCED AND THE ROPE PROPERLY INSPECTED.

DYNAMIC LOADING VOIDS NORMAL WORKING LOAD

Normal working loads are not applicable when rope is subject to significant dynamic loading. Whenever a load is picked up, stopped, moved or swung there is an increased force due to dynamic loading. The more rapidly or suddenly such actions occur, the greater the increase will be. In extreme cases, the force [illegible]

Examples could be picking up a tow on a slack line or using a rope to stop a falling object. Therefore, in all such applications as towing lines, lifelines, safety lines, climbing ropes, etc., working loads as given DO NOT APPLY.

Users should be aware that dynamic effects are greater on a low elongation rope such as polyester than on a high elongation rope such as nylon, and greater on a shorter rope than on a longer one. The working load ratios listed contain provision for very modest dynamic loads. This means, however, that when this working load has been used to select a rope, the load must be handled slowly and smoothly to minimize dynamic effects and avoid exceeding the provision for them.

EFFECT OF TEMPERATURE ON TENSILE STRENGTH

The tensile strength charts apply to ropes tested at normal room temperature (70°F). Ropes have lower tensile strengths at higher temperatures. 30% (or more) lower at the boiling point of water (212°F) and continuing on down to zero [illegible]

SUBMITTAL REVIEW

Review is [illegible] conformity with the design concept and is limited to [illegible] contract documents. Subcontractor [illegible] of dimension, quantities and [illegible] with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

____	No Exceptions Taken
X	Furnish as Corrected
____	Amend and resubmit
____	Rejected

Date *8/15/03*
Department *[illegible]*
M. VHMartin

Manufacturer’s Recommendations for Pipe

INSTALLATION PROCEDURES FOR JOINING PVC PIPE

1. Pipe is cut square with the axis, using a fine tooth hand saw and a miter box or a fine toothed power saw with a suitable guide. All burrs should be removed with a knife, file or abrasive paper.

2. Surfaces to be joined should be clean and free of moisture. Clean surfaces with a clean, dry cloth and PVC solvent. Remove gloss from the mating surfaces with abrasive paper or steel wool.

3. Keep cement can closed and in a shady place when not in use. Discard the cement if it does not flow freely from the brush or if it appears lumpy and stringy.

4. Apply the PVC solvent cement as quickly as possible, as it is very fast drying. Quick application is very important to minimize condensation of moisture from the air on the cement surface, under conditions of high atmospheric humidity. The surface temperature of the mating surfaces should not exceed 110°F at the time of assembly. The pipe temperature may be reduced by swabbing the surfaces to be cemented with clean wet rags, provided all water is removed before the cement is applied. First, using a scrubbing motion, apply primer to both surfaces that are to be joined. Then apply a full even coat of cement to the pipe surface, to the depth of the fitting socket. Next, apply a uniform, thin coating of cement to the interior of the fitting socket, including the shoulders of the socket bottom. Recoat the pipe with a second uniform coat of cement, including the cut end of the pipe.

5. **NOTE:** The procedure above may be followed in the case of bell end pipe except that great care should be taken not to apply an excess of cement in the bell socket, nor should any cement be applied on the bell-to-pipe transition area. This precaution is particularly important for installation of bell end pipe with a wall thickness of less than 1/8".

6. Immediately after applying the last coat of cement to the pipe, insert the pipe into the fitting until it bottoms at the fitting shoulder. Turn the pipe or fitting 1/4 turn during assembly to evenly distribute cement. Hold the joints securely for approximately one minute for the cement to set. After assembly, wipe excess cement from the pipe at the end of the fitting socket.

7. Handle the newly assembled joints carefully until the cement has gone through a set period. Allow at least two hours before disturbing the pipe after the joint is made. This should be extended to four hours in extremely cold temperatures. Allow at least 12 hours before applying pressure to the line, as usually you do not get a complete cure for 24 to 48 hours.

8. After the set period, the pipe can be carefully placed in prepared ditch and snaked from side to side. It is best to place the pipe in the ditch early in the morning, rather than assembling the pipe in the heat of the day and laying it into the ditch at night, where it would cool rapidly. It is important that the line be pressure-tested before covering.

9. Because the tolerances are different on Schedule 80 vs. other types of PVC pipe, it is necessary that the installer use a heavy-bodied or Heavy Duty Cement. In addition, the curing time mentioned in Paragraph 7 above should be tripled for Schedule 80 pipe installation.

The above information was taken from the Plastics Pipe Institute Technical Report #10. If additional information is needed, write to: Plastics Pipe Institute, 355 Lexington Avenue, New York, New York 10017.

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

SPECIFICATION SHEET
Effective June 1, 1992

...L REVIEW
Review ... design concept and is limited to ... contract documents. Sub- contracto... and deta... ...nsions, quantities and for i... ...s or equipment, tion or co... ...ies of fabrica-
X ... Taken
... and Resubmit
Rejected
Date 6/27/03 Department ENG
By D.N.

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 21-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 40 Pressure Pipe Available in BOE	1/2"	.840	.612	.109	600	16.40	12000'	28
	3/4"	1.050	.824	.113	480	21.80	8100'	28
	1"	1.315	1.049	.133	450	32.10	6300'	28
	1¼"	1.660	1.380	.140	370	43.40	3920'	28
	1½"	1.900	1.610	.145	330	51.80	3020'	28
	2"	2.375	2.067	.154	280	69.50	2100'	28
	2½"	2.875	2.469	.203	300	109.60	1460'	28
	3"	3.500	3.068	.216	260	143.50	920'	28
	4"	4.500	4.026	.237	220	209.41	580'	28
	5"	5.563	5.047	.258	190	284.54	460'	24
	6"	6.625	6.065	.280	180	369.00	400'	20
	8"	8.625	7.962	332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 80 Pressure Pipe Available in Plain end only	1/2"	.840	.546	.147	850	20.50	12000'	28
	3/4"	1.050	.742	.154	690	27.80	8100'	28
	1"	1.315	.957	.179	630	40.90	6300'	28
	1¼"	1.660	1.278	.191	520	56.70	3920'	28
	1½"	1.900	1.500	.200	470	68.60	3020'	28
	2"	2.375	1.939	.218	400	94.90	2100'	28
	2½"	2.875	2.323	.276	420	144.90	1460'	28
	3"	3.500	2.900	.300	370	193.80	920'	28
	4"	4.500	3.826	.337	320	283.30	580'	28
	5"	5.563	4.813	.375	290	396.45	460'	24
	6"	6.625	5.761	.432	280	544.64	400'	20
	8"	8.625	7.625	.500	250	827.00	280'	16

Available in 20' lengths only. Available in white or gray. 8" in gray only.

Eagle PVC Schedule 40 and Schedule 80 meets all the requirements of ASTM D1785 and D1784 and is listed by NSF International for potable water.

Eagle PVC Schedule 40 and Schedule 80 is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts. PVC Schedule 40 **Not** recommended for threading. PVC Schedule 80 is suitable for threading, however, pressure ratings listed above are reduced by 50% when pipe is threaded.

NOTE: INSTALLATION OF PVC SCHEDULE 80 PIPE REQUIRES SPECIAL JOINING PROCEDURES AND SOLVENT CEMENTS. (See Paragraph #9 on reverse side.)

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

SUBMITTAL REVIEW

Review is only for general conformance with the design concept of the project and limited to requirements called for in the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring coordination, performance of equipment and for information [illegible] the techniques of fabrication or construction.

X

No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/21/93 Department ENG
By D.N.

SPECIFICATION SHEET
Effective June 1, 1992

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 22-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC 160 PSI Pressure Pipe SDR 26 Available in BOE	1¼"	1.660	1.532	.064	160	22.00	3920'	28
	G 1½"	1.900	1.754	.073	160	28.90	3020'	28
	G 2"	2.375	2.193	.091	160	43.00	2100'	28
	G 2½"	2.875	2.655	.110	160	63.30	1460'	28
	G 3"	3.500	3.230	.135	160	92.30	920'	28
	G 4"	4.500	4.154	.173	160	155.90	580'	28
	5"	5.563	5.135	.214	160	238.83	460'	24
	G 6"	6.625	6.115	.255	160	338.15	400'	20
	G 8"	8.625	7.962	.332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

SIZES MARKED WITH "G" AVAILABLE WITH MOLDED IN PLACE GASKET WHEN ORDERING GASKETED PIPE, PLEASE SPECIFY "GASKETED".

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC 200 PSI Pressure Pipe SDR 21 Available in BOE	1/2"**	.840	.716	.062	315	10.60	12000'	28
	3/4"	1.050	.930	.060	200	13.00	8100'	28
	1"	1.315	1.189	.063	200	17.00	6300'	28
	1¼"	1.660	1.502	.079	200	26.80	3920'	28
	G 1½"	1.900	1.720	.090	200	34.50	3020'	28
	G 2"	2.375	2.149	.113	200	52.00	2100'	28
	G 2½"	2.875	2.601	.137	200	76.80	1460'	28
	G 3"	3.500	3.166	.167	200	112.70	920'	28
	G 4"	4.500	4.072	.214	200	190.45	580'	28
	5"	5.563	5.033	.265	200	291.41	460'	24
**½" SDR 13.5	G 6"	6.625	5.993	.316	200	413.69	400'	20
	G 8"	8.625	7.804	.411	200	705.15	280'	16

Eagle PVC meets all the requirements of ASTM D2241 and D1784 and is listed by NSF International for potable water.

Eagle PVC is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts.

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

SUBMITTAL REVIEW

Review is only for general conformance with the design concept. Subject to limited to requirements called for by the contract documents. Sub-contractor is responsible for the accuracy of dimensions, quantities and details requiring conformance with the information on equipment and for information on the techniques of fabrication or construction.

X

No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/21/83 Department ENG
By D.N.

SPECIFICATION SHEET
Effective June 1, 1992

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 22-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC 160 PSI Pressure Pipe SDR 26 Available in BOE	1¼"	1.660	1.532	.064	160	22.00	3920'	28
	G 1½"	1.900	1.754	.073	160	28.90	3020'	28
	G 2"	2.375	2.193	.091	160	43.00	2100'	28
	G 2½"	2.875	2.655	.110	160	63.30	1460'	28
	G 3"	3.500	3.230	.135	160	92.30	920'	28
	G 4"	4.500	4.154	.173	160	155.90	580'	28
	5"	5.563	5.135	.214	160	238.83	460'	24
	G 6"	6.625	6.115	.255	160	338.15	400'	20
	G 8"	8.625	7.962	.332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

SIZES MARKED WITH "G" AVAILABLE WITH MOLDED IN PLACE GASKET WHEN ORDERING GASKETED PIPE, PLEASE SPECIFY "GASKETED".

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC 200 PSI Pressure Pipe SDR 21 Available in BOE	1/2"**	.840	.716	.062	315	10.60	12000'	28
	3/4"	1.050	.930	.060	200	13.00	8100'	28
	1"	1.315	1.189	.063	200	17.00	6300'	28
	1¼"	1.660	1.502	.079	200	26.80	3920'	28
	G 1½"	1.900	1.720	.090	200	34.50	3020'	28
	G 2"	2.375	2.149	.113	200	52.00	2100'	28
	G 2½"	2.875	2.601	.137	200	76.80	1460'	28
	G 3"	3.500	3.166	.167	200	112.70	920'	28
	G 4"	4.500	4.072	.214	200	190.45	580'	28
	5"	5.563	5.033	.265	200	291.41	460'	24
**½" SDR 13.5	G 6"	6.625	5.993	.316	200	413.69	400'	20
	G 8"	8.625	7.804	.411	200	705.15	280'	16

Eagle PVC meets all the requirements of ASTM D2241 and D1784 and is listed by NSF International for potable water.

Eagle PVC is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts.

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Eagle Plastics, Inc.

146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
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MEMBER PPFA Plastic Pipe and Fittings Association

EAGLE PLASTICS COMMITTED TO QUALITY

NSF TESTING LABORATORY ANN ARBOR MICH

SPECIFICATION SHEET
Effective June 1, 1992

TECHNICAL REVIEW
Review ... the design concept and is limited to ... contract documents. Subcontractor ... dimensions, quantities and details ... materials or equipment, and for information or co... techniques of fabrication.

X No Exceptions Taken
Exceptions Noted
Amend and Resubmit
Rejected
Date 6/27/03 Department ENG
By D.N.

EAGLE PVC 1120 PLASTIC PIPE TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 21-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 40 Pressure Pipe Available in BOE	1/2"	.840	.612	.109	600	16.40	12000'	28
	3/4"	1.050	.824	.113	480	21.80	8100'	28
	1"	1.315	1.049	.133	450	32.10	6300'	28
	1¼"	1.660	1.380	.140	370	43.40	3920'	28
	1½"	1.900	1.610	.145	330	51.80	3020'	28
	2"	2.375	2.067	.154	280	69.50	2100'	28
	2½"	2.875	2.469	.203	300	109.60	1460'	28
	3"	3.500	3.068	.216	260	143.50	920'	28
	4"	4.500	4.026	.237	220	209.41	580'	28
	5"	5.563	5.047	.258	190	284.54	460'	24
	6"	6.625	6.065	.280	180	369.00	400'	20
	8"	8.625	7.962	332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 80 Pressure Pipe Available in Plain end only	1/2"	.840	.546	.147	850	20.50	12000'	28
	3/4"	1.050	.742	.154	690	27.80	8100'	28
	1"	1.315	.957	.179	630	40.90	6300'	28
	1¼"	1.660	1.278	.191	520	56.70	3920'	28
	1½"	1.900	1.500	.200	470	68.60	3020'	28
	2"	2.375	1.939	.218	400	94.90	2100'	28
	2½"	2.875	2.323	.276	420	144.90	1460'	28
	3"	3.500	2.900	.300	370	193.80	920'	28
	4"	4.500	3.826	.337	320	283.30	580'	28
	5"	5.563	4.813	.375	290	396.45	460'	24
	6"	6.625	5.761	.432	280	544.64	400'	20
	8"	8.625	7.625	.500	250	827.00	280'	16

Available in 20' lengths only. Available in white or gray. 8" in gray only.

Eagle PVC Schedule 40 and Schedule 80 meets all the requirements of ASTM D1785 and D1784 and is listed by NSF International for potable water.

Eagle PVC Schedule 40 and Schedule 80 is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

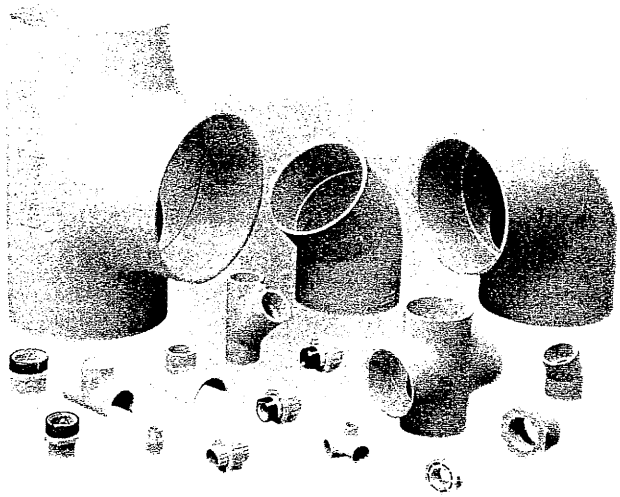
NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts. PVC Schedule 40 **Not** recommended for threading. PVC Schedule 80 is suitable for threading, however, pressure ratings listed above are reduced by 50% when pipe is threaded.

NOTE: INSTALLATION OF PVC SCHEDULE 80 PIPE REQUIRES SPECIAL JOINING PROCEDURES AND SOLVENT CEMENTS. (See Paragraph #9 on reverse side.)

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

PVC SCHEDULE 40 FITTINGS

40-2-0297



PERFORMANCE ENGINEERED & TESTED

SPEARS Schedule 40 PVC fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material reinforcement is uniformly placed in stress concentration areas for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure the very best PVC fittings available.

- **Full 1/4" Through 12" Availability**
  Spears comprehensive line of PVC fittings offers a variety of injection molded configurations in Schedule 40 sizes 1/4" through 12".
- **Exceptional Chemical & Corrosion Resistance**
  Unlike metal, PVC fittings never rust, scale, or pit, and will provide many years of maintenance-free service and extended system life.
- **High Temperature Ratings**
  GEON® PVC thermoplastic can handle fluids at service temperatures up to 140° F (60°C), allowing a wide range of process applications, including corrosive fluids.
- **Higher Flow Capacity**
  Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.
- **Lower Installation Costs**
  Substantially lower material costs than steel alloys or lined steel, combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.
- **GEON® PVC Valves**
  SPEARS GEON® PVC Valve products are available for total system compatibility and uniformity; see **SPEARS'** ***THERMOPLASTIC VALVES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS*** (V-4).
- **Additional Fabricated Configurations through 24"**
  Extra large, hard-to-find, and custom configurations are fabricated from NSF Listed Schedule 40 pipe. Fittings are engineered and tested to provide full pressure handling capabilities according to Spears specifications.
- **Advanced Design Specialty Fittings**
  Spears wide range of innovative, improved products include numerous metal-to-plastic transition fittings and unions with brass thread inserts and Spears' patented stainless steel reinforced (SR) plastic threads.

MADE IN THE U.S.A. WITH PRIDE

LPCB LOSS PREVENTION CERTIFICATION BOARD — NATIONAL ACCREDITATION OF CERTIFICATION BODIES

Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001

Sample Engineering Specifications

All PVC Schedule 40 injection molded fittings shall be produced by Spears Manufacturing Company from PVC, cell classification 12454-B, conforming to ASTM Standard D 1784. All PVC Schedule 40 injection molded fittings shall be listed for potable water service by the National Sanitation Foundation (NSF) and manufactured in strict compliance to ASTM D 2466.

GEON® is a trademark of The Geon Company

GEON® PVC Thermoplastic Material Temperature Pressure De-rating

System Operating Temperature °F (°C)	73 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)
PVC	100%	90%	75%	62%	50%	40%	30%	22%

NOTE: Threaded PVC products should not be used at temperatures above 110°F (43°C). Valves, Unions and Specialty Products have different elevated temperature ratings than pipe and fittings.

GEON® PVC Basic Physical Properties

Properties	ASTM Test Method	PVC
Mechanical Properties, 73°F		
Specific Gravity, g/cm^3	D 792	1.41
Tensile Strength, psi	D 638	7,000
Modulus of Elasticity, psi	D 638	440,000
Compressive Strength, psi	D 695	9,000
Flexural Strength, psi	D 790	13,200
Izod Impact, notched, ft-lb/in	D 256	.65
Thermal Properties		
Heat Deflection Temperature,°F at 66 psi	D 648	165
Thermal Conductivity, BTU/hr/sq ft/°F/in	C 177	1.2
Coefficient of Linear Expansion, in/in/°F	D 696	3.0×10^{-5}
Flammability		
Limiting Oxygen Index, %	D 2863	43
UL 94 Rating		94V-0
Other Properties		
Water Absorption, % 24 hr.	D 570	.05
Industry Standard Color		White/ Dark Gray
ASTM Cell Classification	D 1784	12454-B
NSF Potable Water Approved		Yes

GEON® PVC Chemical Resistance

PVC is generally inert to most mineral acids, bases, salts and paraffinic hydrocarbon solutions. For more information on PVC chemical resistance refer to the Chemical Resistance of Rigid GEON® Vinyls Based on Immersion Test, Technical Service Report 15.

NOT FOR USE WITH COMPRESSED AIR OR GASES

Spears Manufacturing Company **DOES NOT RECOMMEND** the use of thermoplastic piping products for systems to transport or store compressed air or gases, or the testing of thermoplastic piping systems with compressed air or gases in above and below ground locations. The use of our product in compressed air or gas systems automatically voids any warranty for such products, and its use against our recommendation is entirely the responsibility and liability of the installer.

WARNING: *DO NOT USE COMPRESSED AIR OR GAS TO TEST ANY PVC OR CPVC THERMOPLASTIC PIPING PRODUCT OR SYSTEM, AND DO NOT USE DEVICES PROPELLED BY COMPRESSED AIR OR GAS TO CLEAR SYSTEMS. THESE PRACTICES MAY RESULT IN EXPLOSIVE FRAGMENTATION OF SYSTEM PIPING COMPONENTS CAUSING SERIOUS OR FATAL BODILY INJURY.*

SPEARS® MANUFACTURING COMPANY

CORPORATE OFFICES

15853 Olden Street, Sylmar, California 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611 • http://www.spearsmfg.com

MADE IN THE U.S.A. WITH PRIDE

PACIFIC SOUTHWEST
15860 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611
(800) 862-1499
FAX: (818) 367-3014

NORTHWEST
3902 "B" Street N.W.
Auburn (Seattle), WA
98002
(253) 939-4433
(800) 347-7327
FAX: (253) 939-7557

ROCKY MOUNTAIN
4800 Nome Street
Denver, CO
80239
(303) 371-9430
(800) 777-4154
FAX: (303) 375-9546

SOUTH CENTRAL
1838 Forms Drive
Carrollton (Dallas), TX
75006
(972) 245-0387
(800) 441-1437
FAX: (972) 245-4205

UTAH
1415 South 700 West #3
Salt Lake City, UT
84104
(801) 972-0659
FAX: (801) 972-0688

NORTHEAST
543 Industrial Drive
Lewisberry (Harrisburg), PA
17339-9532
(717) 938-8844
(800) 233-0275
FAX: (717) 938-6547

SOUTHEAST
2751 Miller Road
Decatur (Atlanta), GA
30035
(770) 981-7122
(800) 662-6326
FAX: (770) 981-6106

FLORIDA
3445 Bartlett Boulevard
Orlando, FL
32811
(407) 843-1960
(800) 327-6390
FAX: (407) 425-3563

MIDWEST
854 Fairway Drive
Bensenville (Chicago), IL
60106
(630) 773-0075
(800) 662-6330
FAX: (630) 773-0435

INTERNATIONAL SALES
15853 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203
Sylmar, CA 91392
(818) 364-1611
FAX: (818) 898-3774

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Warranty for Piping Components

METERS

Manual No. 920685-8

Great Plains Industries, Inc. Limited Warranty Policy

Great Plains Industries, Inc., 5252 East 36th Street North, Wichita, Kansas 67220-3205, hereby provides a limited one year warranty against defects in material and workmanship on all products manufactured by Great Plains Industries, Inc. This warranty shall extend to the purchaser of this product and to any person to whom such product is transferred during the warranty period.

The warranty period shall begin on the date of the original new equipment purchase. Warrantor's obligation hereunder shall be limited to repairing defective workmanship or replacing or repairing any defective part or parts. This warranty shall not apply if:

a.) the product has been altered or modified outside the warrantor's duly appointed representative;

b.) the product has been subjected to neglect, misuse, abuse or damage or has been installed or operated other than in accordance with the manufacturer's operating instructions.

To make a claim against this warranty, notice of claim must be given in writing to the company at its above address no later than 30 days after the expiration of the warranty period. Such notice shall identify the defect in the product. The company shall, within 14 days of receipt of such notice, notify the customer to either send the product, transportation prepaid, to the company at its office in Wichita, Kansas, or to a duly authorized service center. The company shall perform all obligations imposed on it by the terms of this warranty within 60 days of receipt of the defective product.

GREAT PLAINS INDUSTRIES, INC. EXCLUDES LIABILITY UNDER THIS WARRANTY FOR DIRECT, INDIRECT, INCIDENTAL AND CONSEQUENTIAL DAMAGES INCURRED IN THE USE OR LOSS OF USE OF THE PRODUCT WARRANTED HEREUNDER.

The company herewith expressly disclaims any warranty of merchantability or fitness for any particular purpose other than for which it was designed.

This warranty gives you specific rights and you may also have other rights which vary from U.S. state to U.S. state.

NOTE: In compliance with MAGNUSON MOSS CONSUMER WARRANTY ACT - Part 702 (governs the resale availability of the warranty terms).

GPI®
5252 East 36th Street North
Wichita, KS USA 67220-3205
TEL: 316-686-7361
FAX: 316-686-6746

GREAT PLAINS INDUSTRIES, INC.

1-888-996-3837
www.gplains.com/gpi

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CHECK VALVES

FREIGHT TERMS: All shipments are F.O.B. shipping point. Shipments from factory less than 1000 lbs. are F.O.B. factory. Factory shipments OF $5000 and over within the continental U.S.A. will be prepaid and allowed when made at the lowest motor carrier transportation rate.

See page 3 for the advantages of buying the whole Watts line.

PAYMENT TERMS: The invoices are due and payable 30 days from the date of invoice. A 2% cash discount allowed on net amount of invoice if paid on or before the 10th of the following month. Invoices dated on or after the 25th will be considered as dated the first of the next month. Postmark on envelope will be considered date of check.

PURCHASE ORDER FORMS: Orders submitted on customer's own purchase order forms will be accepted only with the express understanding that no statements, clauses, or conditions contained in said order form will be binding on the Seller if they in any way modify the Seller's own terms and conditions of sales.

STOCKING WHOLESALER MINIMUM CHARGE: A minimum billing charge of $100.00 applies to shipments F.O.B. factory. Stocking Wholesaler Customers are encouraged to order sufficient material to avoid this charge which is necessitated by increased costs of processing small orders.

SPECIAL PRODUCTS: Orders for special or modified products are non-cancelable.

LIMITED WARRANTY: Watts Regulator Company warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Any implied warranties that are imposed by law are limited in duration to one year.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.

SERVICE POLICY: For inoperative products beyond the warranty period, we assume no liability for replacement of valves due to service conditions beyond our control.

RETURNED GOODS MINIMUM CHARGE: No material shall be returned without authorization. When credit is issued it will be at the price charged, or prevailing price if lower, less handling charges based on costs of reconditioning, boxing, etc. However, a minimum 15% handling charge will apply. A minimum handling charge of $10.00 is applied whenever the 15% handling deduction does not total $10.00. Products which are obsolete or made to special order are not returnable.

NOTE: Prices and terms are subject to change without notice and supersede all previous quotations. The right is reserved to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modifications on products previously or subsequently sold.

PRESS. GAUGES

GENERAL INFORMATION

PRODUCT

VALLEY INSTRUMENT is an industrial instrument manufacturer serving the needs of domestic and international customers for over 50 years. Our products include pressure gauges from 1.5" to 6", with capabilities in pressure from low pressure applications - inches of water, to high pressure applications - 20,000 PSI and bi-metal thermometers from 1" to 5" with temperature ranges up to 1000° F.

Custom pressure gauges are available with special calibration, custom logo's, special pressure ranges, unique color coding or any other special feature the customer may require.

PRESSURE:

When choosing a pressure range you should choose one that is twice the normal system pressure. EXAMPLE: If system runs at 50 PSI you should choose a 100 PSI gauge. This will make the gauge last longer and will be more safe and accurate

MEDIUM:

Consult the gauge selection guide for medium compatibility.

ENVIRONMENT:

Special consideration should be given in corrosive atmospheres such as chemical, salt air, water or dust. VALLEY INSTRUMENT can offer many styles that ward off these corrosive attacks.

LIQUID FILLING:

This feature adds to the life of a pressure gauge. When the case is filled with a dampening fluid, the internal components are protected from outside contaminants, providing continuous lubrication for the tube and movement, reducing the shock waves caused by vibration or pressure fluctuations, and virtually eliminating pointer flutter. It should not be used in conjunction with oxygen service or other explosive agents.

WARNING:

Misuse of this product may cause explosion and personal injury.

Liquid filled gauges should not be used in applications involving oxygen, chlorine, nitric acid, hydrogen peroxide, and other strong oxidizing agents, because of the danger of spontaneous chemical reaction, ignition, or explosion.

WARRANTY:

This warranty is in lieu of all other warranties expressed or implied. VALLEY INSTRUMENT warrants that all products sold shall be free from defects in workmanship and material when used within the service and scope for which they were designed. Such warranty shall apply for a period of one year after the shipment of the product. If at any time within this period, it is established to the satisfaction of VALLEY INSTRUMENT that the product was defective at time of shipment, VALLEY INSTRUMENT at its option, shall furnish replacements of , or repair the product. It is understood that the liability of VALLEY INSTRUMENT shall be limited to such repair or replacement and that VALLEY INSTRUMENT shall not be liable for any direct or consequential damages arising out of any defects or from any cause whatsoever. This warranty does not cover deterioration by normal wear and tear or any other cause of failure other than defects in workmanship and material as previously outlined. Unless repairs to, alterations of, or work done on the product by the purchaser is specifically authorized in writing by VALLEY INSTRUMENT, any warranty applicable to the product shall become null and void.

RETURNED GOODS:

VALLEY INSTRUMENT will make every effort possible to rectify errors which result in items being returned for credit. VALLEY INSTRUMENT requires a return authorization number and a copy of the packing list with all returned goods, a rehandling charge may apply. Our goal is to provide you with prompt and correct credit. Special order products may not be returned.

SPECIFICATIONS:

The design specifications found in this catalog are subject to change without notice.

350 SERIES BACKWASH VALVES

MODEL	DESCRIPTION	PRICE
350-22-A-XX Hydraulic	2" X 2" Backwash Valve	$180
350-55-22-A-XX Electric Remote	2" X 2" Backwash Valve	320
350-32-A-XX Hydraulic	3" X 2" Backwash Valve	380
350-55-32-A-XX Electric Remote	3" X 2" Backwash Valve	520
350-43-XX Hydraulic	4" X 3" Backwash Valve	760
350-55-43-A-XX Electric Remote	4" X 3" Backwash Valve	900

XX = 12- Flanged Class 125; GR-Grooved; NP-Threaded

1" BERMADON

MODEL	DESCRIPTION	PRICE
MT	FLOW 2.5 - 22 GPM Dial Capacity: 300; 550; 1,200; 2,600; 5,500; 13,000 Gal.	$70
MTA	FLOW .5 - 9 GPM Dial Capacity: 125; 500; 1,200; 2,000 Gal.	70

900 SERIES HYDROMETER WATER METER AND CONTROL VALVE

MODEL	BASIC MODELS	1 1/2"	2"	3"	4"	6"	8"
900	Water Meter Basic Control Valve-Included	$415	$460	$820	$1,450	$2,600	$3,725
910	Water Meter & Control Valve Electric Remote Control	530	590	990	1,665	2,810	3,945
920	Water Meter & Pressure Reducing Valve	610	680	1075	1,745	3,050	4,185
930	Water Meter & Pressure Sustaining/Relief Valve	610	680	1075	1,745	3,050	4,185
923	Water Meter with Pressure Reducing & Sustaining Valve	770	855	1,255	1,925	3,580	4,700

900 SERIES–OPTIONS AND ACCESSORIES

WATER METER	XX-P	Electric Pulse Transmission 1 1/2"-4" 1 pulse/.1 gal or /1 or /10 gal or /100 gal 6"-8" 1 pulse/1 gal or /10 gal or /100 gal or /1,000 gal	110
WATER METER	XX-D	Pre-Set Quantity Valve Shut-Off (3-Way Pilot Valve) **Dial Selection 1 1/2", 2", 3":** 13,000/50,000/130,000/210,000, **3"-8":** 130,000/210,000/500,000/870,000/1,300,000	90
WATER METER	XX-DD	Hydraulic Sequential Operation (5-Way Pilot Valve	110
WATER METER	XX-S	Pre-Set Quantity Pump Shut-Off (Electric Switch)	250
CONTROL VALVE	XX-20	Check Feature	80
CONTROL VALVE	XX-30	Two Stage Opening	140
CONTROL VALVE	XX-55	Electric Remote Control (Included in Model 910)	185
CONTROL VALVE	XX-Z	Manual Control - (Manual Select Valve-On/Off/Auto)	40
CONTROL VALVE	XX-F	Large Control Filter	290
CONTROL VALVE	XX-CT	Copper Tubing/Brass Fittings	125

Consult factory for other available control functions.

AIR RELEASE VALVE

BERMAD

ontrol Valves

4070 East Leaverton Court
Anaheim, California 92807
(714) 666-1100

1-800-821-6825
FAX (714) 666-2533
e-mail; bermad@bermadusa.com

Prices are F.O.B. Anaheim, California. Prices are subject to change without notice. A minimum order charge of $50.00 NET applies to all orders. Payment terms are NET THIRTY (30) DAYS.

TERMS OF SALE
No material shall be returned without prior written authorization from the factory. Merchandise returned for credit must be received in new unused condition and return freight must be prepaid. A 20% restocking charge will apply.

LIMITED WARRANTY:
Bermad, Inc. warrants each product against defects in material and workmanship for a period of one year from the date of original shipment when installed and operated according to Bermad, Inc. instructions. Defective materials will be repaired or replaced free of charge when returned to our factory freight prepaid provided Bermad, Inc. receives prompt written notice of the claimed defect. Bermad, Inc. shall not be liable for any incidental or consequential damage loss or expense arising directly or indirectly from the use of the product.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

GATE VALVES

NIBCO INC. 125% LIMITED WARRANTY

Applicable to NIBCO INC. Pressure Rated Metal Valves

NIBCO INC. warrants each NIBCO pressure rated metal valve to be free from defects in materials and workmanship under normal use and service for a period the lesser of one (1) year from the date put in service, or two (2) years from the date of purchase.

In the event any defect occurs which the owner believes is covered by this warranty, the owner should immediately contact NIBCO Technical Services, either in writing or by telephone at (888) 446-4226 or (574) 295-3000. The owner will be instructed to return said product, at the owner's expense, to NIBCO INC., or an authorized representative for inspection. In the event said inspection discloses to NIBCO INC.'s satisfaction that said valve is defective, it will be replaced at NIBCO INC.'s expense. Replacements shall be shipped free of charge to the owner. In the event of the replacement of any valve, NIBCO INC. shall further pay the owner the greater of Twenty-Five (25%) Percent of the price of the valve according to NIBCO INC.'s published suggested list price schedule in effect at the time of purchase, or Ten ($10.00) Dollars, to apply on the cost of the installation of said replacement valve.

TO THE EXTENT PERMITTED BY LAW, THIS WARRANTY SPECIFICALLY EXCLUDES INCIDENTAL AND CONSEQUENTIAL DAMAGES OF EVERY TYPE AND DESCRIPTION RESULTING FROM ANY CLAIMED DEFECT IN MATERIAL OR WORKMANSHIP, INCLUDING BUT NOT LIMITED TO, PERSONAL INJURIES AND PROPERTY DAMAGES. Some states do not allow the exclusion or limitation of incidental or consequential damages so these limitations may not apply to you. TO THE EXTENT PERMITTED BY LAW, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

NIBCO® NIBCO INC. World Headquarters •1516 Middlebury St. • Elkhart, IN 46516-4740 USA • *www.nibco.com*

how to order

State quantity, figure number and size for each valve you wish to order. See individual valve catalog pages for specific or special product designations.

HOW MANY TO ORDER

NIBCO valves are decimal packed for your convenience in handling, shipping and stock-keeping. Number in master carton varies with item.

POLICY ON RETURNS TO FACTORY

NO NIBCO valves are to be returned without prior written agreement. Transportation must be prepaid. A 20% charge will be made to cover cost of rehandling and reinspection.

TECHNICAL ASSISTANCE

Engineers, contractors, wholesalers or manufacturers may obtain special or technical assistance from any factory representative of NIBCO. Write, fax or phone.

NIBCO INC.
World Headquarters
1516 Middlebury Street
Elkhart, IN 46516-4740
USA

Phone: 1.574.295.3000
Fax: 1.574.295.3307
Technical Service Phone: 1.888.446.4226
Fax: 1.888.336.4226

To the best of our knowledge the information contained in this publication is accurate. However, NIBCO® does not assume any liability whatsoever for the accuracy or completeness of such information. Final determinations of the suitability of any information or product for the use to be contemplated is the sole responsibility of the user. The manner of that use, and whether there is any infringement of patents, is also the sole responsibility of the user.

PVC SCHEDULE 80 FITTINGS, UNIONS, CLASS 150 FLANGES & TANK ADAPTERS

SPEARS QUALITY POLICY

It is the policy and objective of Spears Manufacturing Company to produce a superior quality product suitable for its intended use, with regard to functionality, structural integrity, and conformance to established industry standards and practices. It is the commitment of this Company to do so in a manner which provides consistency of product quality, optimum availability, and superior customer service, while maintaining efficiency of operations and profitability necessary to perpetuate product improvement and customer satisfaction. Furthermore, it is recognized that the attainment of these objectives is the responsibility of all Company operations and personnel according to their respective functions.

LIMITED WARRANTY

Except as otherwise mandated by law, Spears Manufacturing Company warrants that the goods which have been directly manufactured by them shall be free from defects in material and workmanship for a period of one (1) year, from the date of shipment. CUSTOMER AGREES THAT THIS WARRANTY SHALL BE EFFECTIVE SO LONG AS THE GOODS ARE USED SOLELY FOR THE NORMAL PURPOSES FOR WHICH THEY ARE INTENDED AND IN CONFORMANCE WITH INDUSTRY ESTABLISHED ENGINEERING, INSTALLATION, OPERATING, AND MAINTENANCE SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS. VIOLATION THEREOF SHALL VOID THIS WARRANTY AND RELIEVE COMPANY FROM ANY OBLIGATION UNDER THIS WARRANTY. COMPANY CANNOT AND DOES NOT ASSUME RESPONSIBILITY, AND EXPRESSLY DISCLAIMS ANY LIABILITY, DUE TO CUSTOMER'S, ANY INSTALLER'S OR END USER'S FAILURE TO COMPLY WITH SUCH SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS.

If Customer receives any goods that appear to be defective, upon receipt of a Return Authorization (RA#) issued by Spears Customer Services Department, Customer may return such questionable goods. The material must be returned prepaid to Company at 15853 Olden Street, Sylmar, California 91342 along with completed Return Authorization documentation. After examination if the goods are determined to be defective in materials or workmanship directly provided by Company, Company, at its sole option, may either repair or replace the defective goods, or reimburse Customer for the cost of such goods. This shall be Customer's only remedy. All costs of shipping such questionable goods and any replacements thereof to and from Company's facility shall be borne by Customer. Customer agrees that Company will not be responsible for other parts or labor in connection with repairing, replacing, or returning such goods while goods are in possession of Company for analysis, nor for any delays beyond Company's reasonable control (including, with limitation, delays due to unavailability of materials, equipment, other supplies or labor, strikes, governmental regulation or other acts of God), provided that any delay shall toll the warranty period for the same amount of time as the delay itself.

COMPANY EXTENDS ONLY THIS WARRANTY AND EXPLICITLY WAIVES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ORAL OR STATUTORY (INCLUDING ANY IMPLIED WARRANTIES OR AFFIRMATION, SUITABILITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) APPLICABLE TO THE GOODS. NO AFFIRMATION BY COMPANY OR ANY OF ITS REPRESENTATIVES, BY WORDS OR CONDUCT, SHALL CONSTITUTE A WARRANTY. THIS WARRANTY MAY NOT BE EXTENDED, ALTERED OR OTHERWISE MODIFIED EXCEPT BY WRITTEN AGREEMENT SIGNED BY COMPANY.

BY ITS ACCEPTANCE OF THE GOODS, CUSTOMER HEREBY SPECIFICALLY AND EXPRESSLY WAIVES ALL OTHER LIABILITY OR OBLIGATION OF ANY KIND OR CHARACTER OF COMPANY, INCLUDING WITHOUT LIMITATION LIABILITY PREDICATED UPON STRICT LIABILITY OR TORT, AND ALL DAMAGES AND LOSSES AS A RESULT THEREOF, INCLUDING BUT NOT LIMITED TO ALL KNOWN, UNKNOWN, FORESEEABLE, UNFORESEEABLE, ABSOLUTE, CONTINGENT, LIQUIDATED, NON-LIQUIDATED, COMPENSATORY, GENERAL, SPECIAL, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES, AND WITH RESPECT TO THE GOODS, THEIR RETURN, REPAIR, RESTORATION AND REPLACEMENT. WITH RESPECT TO SUCH WAIVER, CUSTOMER HEREBY EXPLICITLY WAIVES CALIFORNIA CIVIL CODE §1542 WHICH STATES "A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS FAVOR AT THE TIME OF EXECUTING THIS RELEASE, WHICH IF KNOWN BY HIM MUST HAVE MATERIALLY ADVERSELY AFFECTED HIS SETTLEMENT WITH DEBTOR" AND ALL OTHER SIMILAR STATUTORY, COMMON AND CASE LAW RIGHTS, DEFENSES AND LIMITATIONS.

Having independently inspected a sample of the goods as fully as desired or having refused to make such examination upon acceptance of delivery of the goods, and except as otherwise herein provided, Customer hereby accepts the goods in its "AS IS" condition "WITH ALL FAULTS" without any other warranty, expressed or implied, and hereby accepts and assumes the entire risk and cost of all necessary servicing, repairs and remedy thereof.

STANDARDS & SPECIFICATIONS

Standards provide greater assurance of product performance and consistency, and are available to assist design engineers in system specification. The most frequently referenced industry standards for plastic piping systems are ASTM Standard Specifications and Practices. Along with ASTM Standards, additional product specifications and certifications form the basis of product conformance to which Spears products are manufactured.

ASTM D 2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
NSF	National Sanitation Foundation (NSF) Standard 61 and/or 14 Plastic Fittings for Potable Water.
Material	Spears Schedule 80 Fittings are produced from PVC Cell Classification 12454.
Fabricated Fittings	Spears Fabricated Fittings conform to Spears Manufacturing Company Special Engineering Specifications.

Prices subject to change without notice. Possession of this price schedule shall not be construed as an offer to sell the products listed. Product drawings and/or photographs are representative and may not fully reflect product configurations.

Made in the U.S.A.

PVC WHITE SCHEDULE 40 FITTINGS, UNIONS AND SADDLES

SPEARS QUALITY POLICY

It is the policy and objective of Spears Manufacturing Company to produce a superior quality product suitable for its intended use, with regard to functionality, structural integrity, and conformance to established industry standards and practices. It is the commitment of this Company to do so in a manner which provides consistency of product quality, optimum availability, and superior customer service, while maintaining efficiency of operations and profitability necessary to perpetuate product improvement and customer satisfaction. Furthermore, it is recognized that the attainment of these objectives is the responsibility of all Company operations and personnel according to their respective functions.

LIMITED WARRANTY

Except as otherwise mandated by law, Spears Manufacturing Company warrants that the goods which have been directly manufactured by them shall be free from defects in material and workmanship for a period of one (1) year, from the date of shipment. CUSTOMER AGREES THAT THIS WARRANTY SHALL BE EFFECTIVE SO LONG AS THE GOODS ARE USED SOLELY FOR THE NORMAL PURPOSES FOR WHICH THEY ARE INTENDED AND IN CONFORMANCE WITH INDUSTRY ESTABLISHED ENGINEERING, INSTALLATION, OPERATING, AND MAINTENANCE SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS. VIOLATION THEREOF SHALL VOID THIS WARRANTY AND RELIEVE COMPANY FROM ANY OBLIGATION UNDER THIS WARRANTY. COMPANY CANNOT AND DOES NOT ASSUME RESPONSIBILITY, AND EXPRESSLY DISCLAIMS ANY LIABILITY, DUE TO CUSTOMER'S, ANY INSTALLER'S OR END USER'S FAILURE TO COMPLY WITH SUCH SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS.

If Customer receives any goods that appear to be defective, upon receipt of a Return Authorization (RA#) issued by Spears Customer Services Department, Customer may return such questionable goods. The material must be returned prepaid to Company at 15853 Olden Street, Sylmar, California 91342 along with completed Return Authorization documentation. After examination if the goods are determined to be defective in materials or workmanship directly provided by Company, Company, at its sole option, may either repair or replace the defective goods, or reimburse Customer for the cost of such goods. This shall be Customer's only remedy. All costs of shipping such questionable goods and any replacements thereof to and from Company's facility shall be borne by Customer. Customer agrees that Company will not be responsible for other parts or labor in connection with repairing, replacing, or returning such goods while goods are in possession of Company for analysis, nor for any delays beyond Company's reasonable control (including, with limitation, delays due to unavailability of materials, equipment, other supplies or labor, strikes, governmental regulation or other acts of God), provided that any delay shall toll the warranty period for the same amount of time as the delay itself.

COMPANY EXTENDS ONLY THIS WARRANTY AND EXPLICITLY WAIVES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ORAL OR STATUTORY (INCLUDING ANY IMPLIED WARRANTIES OR AFFIRMATION, SUITABILITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) APPLICABLE TO THE GOODS. NO AFFIRMATION BY COMPANY OR ANY OF ITS REPRESENTATIVES, BY WORDS OR CONDUCT, SHALL CONSTITUTE A WARRANTY. THIS WARRANTY MAY NOT BE EXTENDED, ALTERED OR OTHERWISE MODIFIED EXCEPT BY WRITTEN AGREEMENT SIGNED BY COMPANY.

BY ITS ACCEPTANCE OF THE GOODS, CUSTOMER HEREBY SPECIFICALLY AND EXPRESSLY WAIVES ALL OTHER LIABILITY OR OBLIGATION OF ANY KIND OR CHARACTER OF COMPANY, INCLUDING WITHOUT LIMITATION LIABILITY PREDICATED UPON STRICT LIABILITY OR TORT, AND ALL DAMAGES AND LOSSES AS A RESULT THEREOF, INCLUDING BUT NOT LIMITED TO ALL KNOWN, UNKNOWN, FORESEEABLE, UNFORESEEABLE, ABSOLUTE, CONTINGENT, LIQUIDATED, NON-LIQUIDATED, COMPENSATORY, GENERAL, SPECIAL, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES, AND WITH RESPECT TO THE GOODS, THEIR RETURN, REPAIR, RESTORATION AND REPLACEMENT. WITH RESPECT TO SUCH WAIVER, CUSTOMER HEREBY EXPLICITLY WAIVES CALIFORNIA CIVIL CODE §1542 WHICH STATES "A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS FAVOR AT THE TIME OF EXECUTING THIS RELEASE, WHICH IF KNOWN BY HIM MUST HAVE MATERIALLY ADVERSELY AFFECTED HIS SETTLEMENT WITH DEBTOR" AND ALL OTHER SIMILAR STATUTORY, COMMON AND CASE LAW RIGHTS, DEFENSES AND LIMITATIONS.

Having independently inspected a sample of the goods as fully as desired or having refused to make such examination upon acceptance of delivery of the goods, and except as otherwise herein provided, Customer hereby accepts the goods in its "AS IS" condition "WITH ALL FAULTS" without any other warranty, expressed or implied, and hereby accepts and assumes the entire risk and cost of all necessary servicing, repairs and remedy thereof.

STANDARDS & SPECIFICATIONS

Standards provide greater assurance of product performance and consistency, and are available to assist design engineers in system specification. The most frequently referenced industry standards for plastic piping systems are ASTM Standard Specifications and Practices. Along with ASTM Standards, additional product specifications and certifications form the basis of product conformance to which Spears products are manufactured.

ASTM D 2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D 2609	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
NSF	National Sanitation Foundation (NSF) Standard 61 and/or 14 Plastic Fittings for Potable Water.
Material	Spears Schedule 40 Fittings are produced from PVC Type I, Cell Classification 12454.
Fabricated Fittings	Spears Fabricated Fittings conform to Spears Manufacturing Company Special Engineering Specifications.

Prices subject to change without notice. Possession of this price schedule shall not be construed as an offer to sell the products listed. Product drawings and/or photographs are representative and may not fully reflect product configurations.

Made in the U.S.A.

PVC PIPE

Warranty

This warranty covers all products sold by Eagle Plastics, Inc. which are not specifically covered by other product warranties. Eagle Plastics, Inc. warrants this product to be free from defects in material or workmanship for a period of one year from date of purchase. This warranty is in effect provided the proper installation and operating techniques have been employed and provided the product has not been subjected to misuse, negligence or abuse.

Eagle Plastics liability under this warranty is limited only to the replacement of pipe which is found to be defective. The defective pipe must be returned to Eagle Plastics, Inc. and all claims must be presented to Eagle in writing. This warranty does not cover the cost of installation for either the defective pipe or the replacement pipe furnished under the terms of this warranty.

As this is the only warranty applicable to this product, Eagle Plastics, Inc. does not authorize anyone to assume for it any other warranty.

A written notice of defect must be sent to Eagle Plastics, Inc., within a reasonable period of time after the defect becomes apparent. Written notice should be sent to: Eagle Plastics, Inc., P.O. Box 229, Hastings, NE 68901.

This warranty complies with the requirements of the Magnuson-Moss Warranty Act (the "ACT"), regulations of the Federal Trade Commission issued thereunder, and any applicable state or local laws, rules and regulations.

Eagle Plastics, Inc. shall not be liable for special or consequential damages or for damages resulting from negligence of others, misuse, casualties, acts of God or other matters beyond our control. The above limitation may not apply to you, as some states do not allow the limitation of special or consequential damages. This warranty gives you specific legal rights. You may have other rights which vary from state to state.

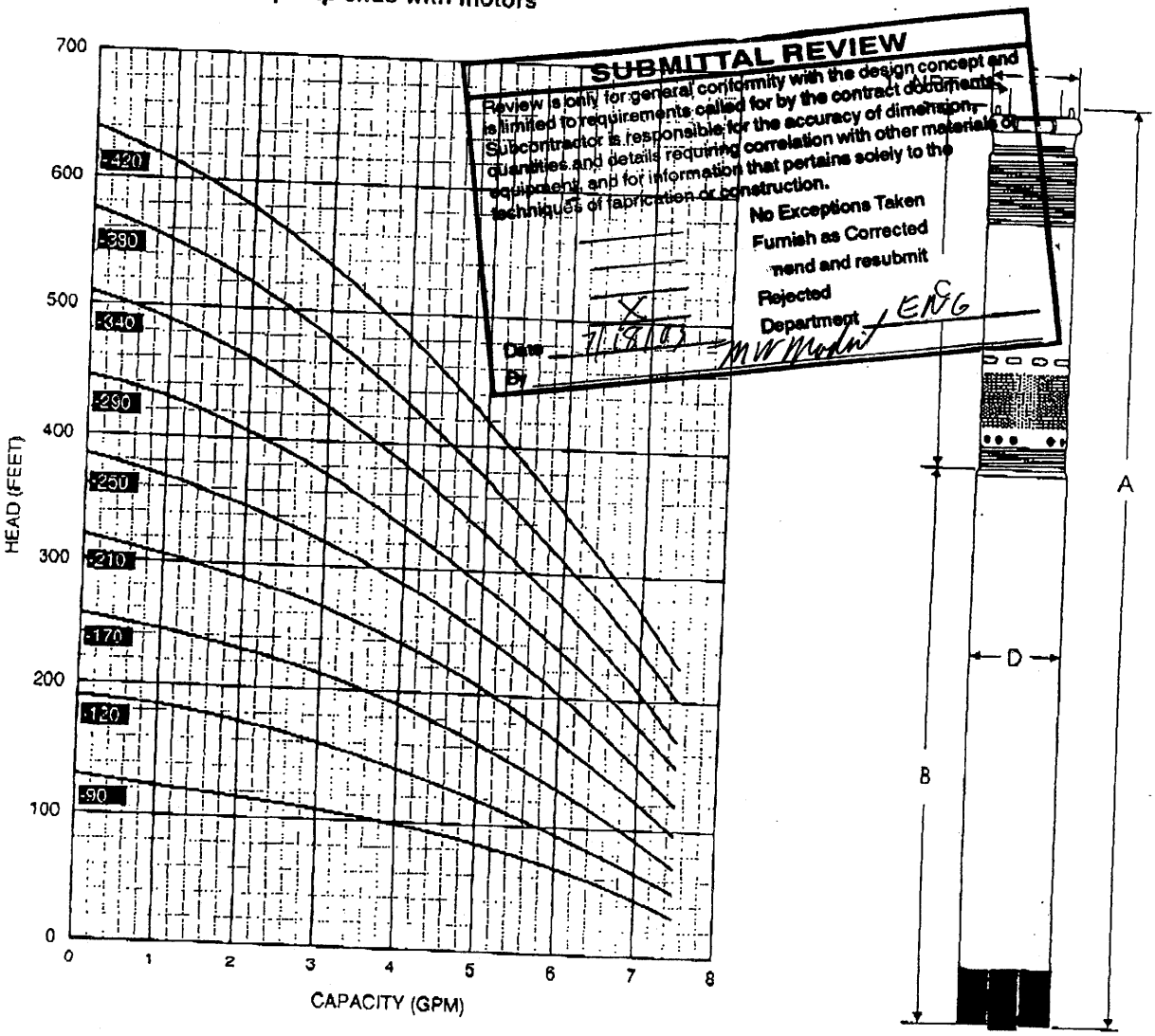
Effective January 1, 1988

Form No. EP-12

Descriptive Product Data for Each Pump

Model #	HP	Size	Disch. Size	Dimensions in Inches					Approx. Ship Wt.
				A	B	C	D	E	(pounds)
5Redi-Flo3-90	1/3A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5Redi-Flo3-120	1/3A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5Redi-Flo3-170	1/2A	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5Redi-Flo3-210	1/2B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5Redi-Flo3-250	1/2B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5Redi-Flo3-290	3/4B	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5Redi-Flo3-340	1C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5Redi-Flo3-380	1C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5Redi-Flo3-420	1C	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16

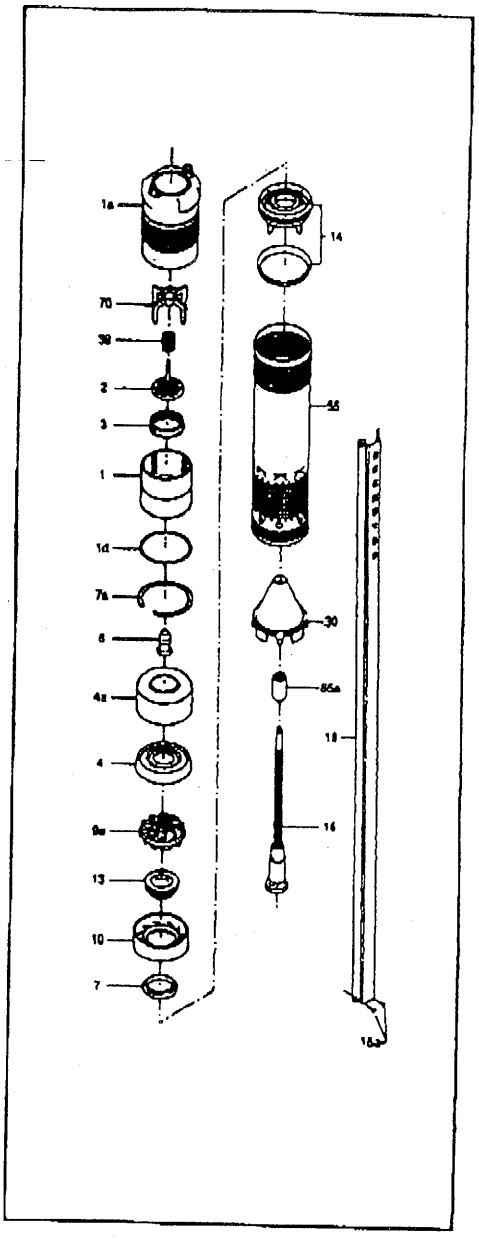
Note: Weights include pump ends with motors



SUBMITTAL REVIEW
Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.
No Exceptions Taken
Furnish as Corrected
Send and resubmit
Rejected
Department ENG
Date 7/18/03
By MW Modin

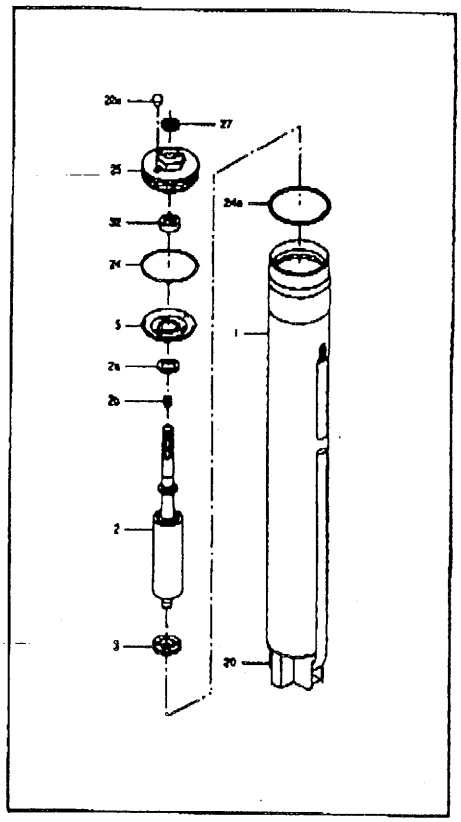
MATERIAL SPECIFICATION – REDI-FLO3 PUMP END

Pos.	Component	Material	DIN W. Nr.	AISI
1	Valve Casing	PVDF		
1a	Discharge Chamber	Stainless Steel	1.4401	316
1d	O-Ring	FPM Rubber		
2	Valve Cone	PVDF		
3	Valve Seat	FPM Rubber		
4	Top Chamber	PVDF		
4a	Empty Chamber	PVDF		
6	Top Bearing	FPM Rubber		
7	Neck Ring	PVDF		
7a	Lock Ring	Stainless Steel	1.4401	316
9a	Guide Vanes	PVDF		
10	Bottom Chamber	PVDF		
13	Impeller w/ tungsten carbide bearing	PVDF		
14	Suction Interconnector	PVDF		
14a	Ring	Stainless Steel	1.4401	316
16	Shaft w/ coupling	Stainless Steel	1.4401	316
		Sintered Steel		
18	Cable Guard	Stainless Steel	1.4401	316
18a	Cable Guard Screws	Stainless Steel	1.4401	316
30	Pressure Equalization Cone	PVDF		
39	Valve Spring	Stainless Steel	1.4406	316LN
55	Pump Sleeve	Stainless Steel	1.4401	316
70	Valve Guide	PVDF		
85a	Spacer	Stainless Steel	1.4401	316



MATERIAL SPECIFICATION – REDI-FLO3 PUMP MOTOR

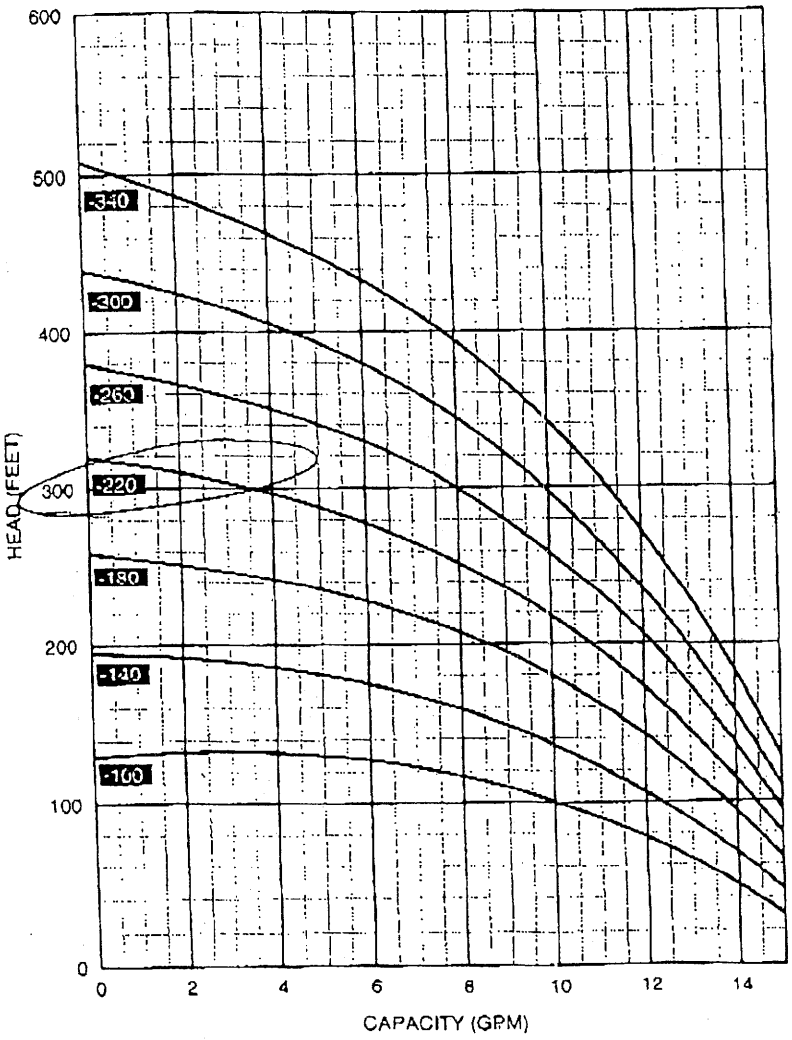
Pos.	Component	Material	DIN W. Nr.	AISI
1	Stator	Stainless Steel	1.4401	316
2	Rotor	Stainless Steel	1.4401	316
2a	Stop Ring	PP		
2b	Filter	Polyester		
3	Thrust Bearing	Carbon		
5	Radial Bearing	Ceramic/ tungsten carbide		
20	Motor Cable w/ plug	Tefzel		
		PVDF		
22a	Filling Plug	FPM Rubber		
24	O-Ring	FPM Rubber		
24a	O-Ring	FPM Rubber		
25	Top Cover	PPS		
27	Filter	Polyester		
32	Shaft Seal	FPM Rubber		
	Motor Liquid	SML-2		

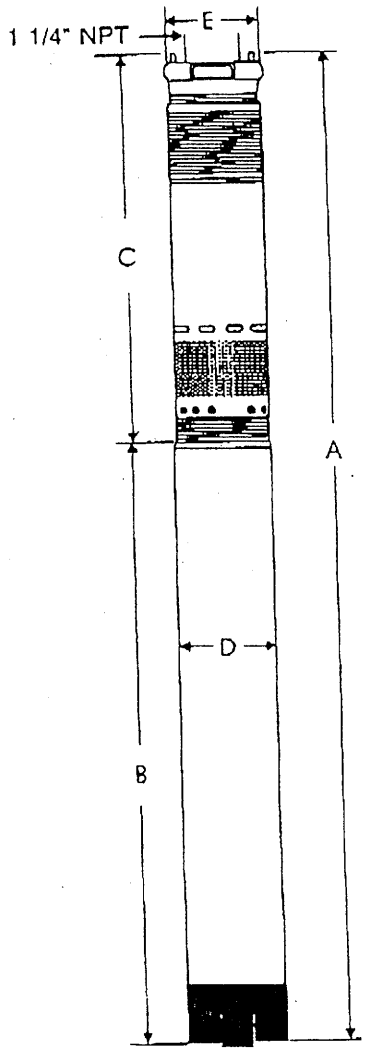


ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft-start
Run-up Time:	Maximum: 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Service Factor:	0.33-0.50A[Hp]-1.75 at 115V/230V 0.50-0.75B[Hp]-1.4 at 230V 1.0-1.5C[Hp]-1.15 at 230V
Motor Cable:	3 Wire, Tefzel Cable Kit
Motor Liquid:	Type SML 2
pH Values:	4-9
Liquid Temperature:	The temperature of the pumped liquid should not exceed 104°F.
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump is to be stored after use, it must be stored in a frost-free location or it must be ensured that the motor liquid is frost-proof. Otherwise motor must be stored without being filled with motor liquid.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	-4°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE - NE 3):	
0.33-0.50A[Hp]	20.9" length x 2.68" diameter
0.50-0.75B[Hp]	20.9" length x 2.68" diameter
1.0-1.5C[Hp]	22.3" length x 2.68" diameter
Pump Diameter, incl. cable guard:	2.91"
Motor Weights (MSE - NE 3):	
0.33-0.50A[Hp]	6.0 lbs
0.50-0.75B[Hp]	7.1 lbs
1.0-1.5C[Hp]	8.2 lb
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions (min. and max.):	
5 Redi-Flo3	10.6" to 18.0"
10 Redi-Flo3	10.6" to 16.9"
15 Redi-Flo3	10.6" to 16.9"
22 Redi-Flo3	10.6" to 16.9"
30 Redi-Flo3	10.6" to 13.7"
Pump End Weights (min. and max.):	
All	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (maximum):	500 feet, below static water level

Model #	HP	Size	Disch. Size	Dimensions in Inches					Approx. Ship Wt.
				A	B	C	D	E	(pounds)
10Redi-Flo3-100	1/3A	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10Redi-Flo3-140	1/2A	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10Redi-Flo3-180	1/2B	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10Redi-Flo3-220	3/4B	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10Redi-Flo3-260	1C	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10Redi-Flo3-300	1C	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
10Redi-Flo3-340	1 1/2C	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16

Note: Weights include pump ends with motors

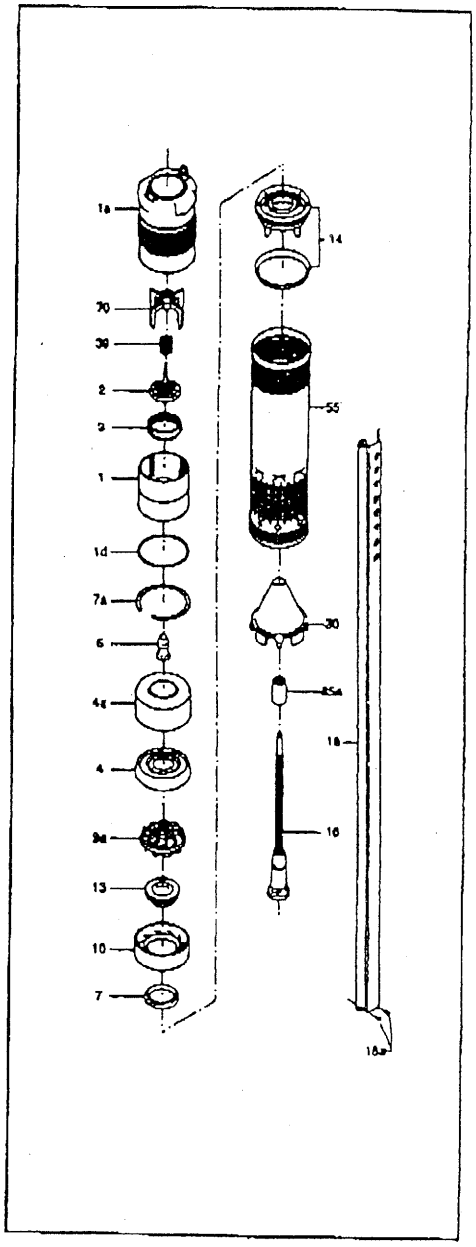




GRUNDFOS

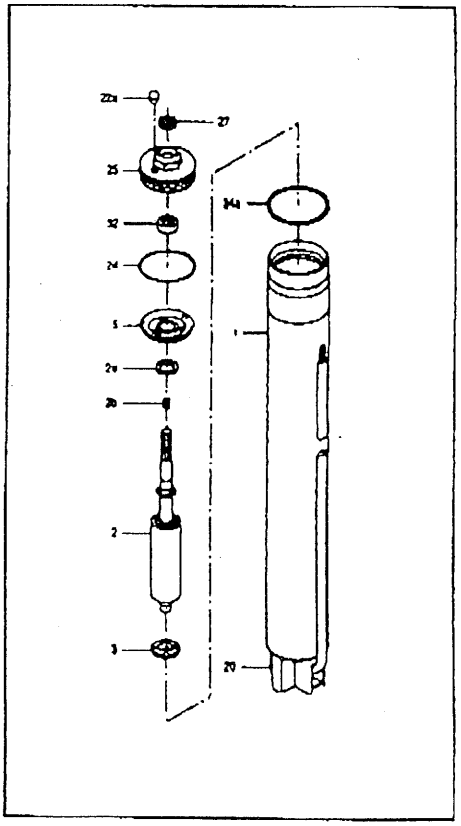
MATERIAL SPECIFICATION – REDI-FLO3 PUMP END

Pos.	Component	Material	DIN W. Nr.	AISI
1	Valve Casing	PVDF		
1a	Discharge Chamber	Stainless Steel	1.4401	316
1d	O-Ring	FPM Rubber		
2	Valve Cone	PVDF		
3	Valve Seat	FPM Rubber		
4	Top Chamber	PVDF		
4a	Empty Chamber	PVDF		
6	Top Bearing	FPM Rubber		
7	Neck Ring	PVDF		
7a	Lock Ring	Stainless Steel	1.4401	316
9a	Guide Vanes	PVDF		
10	Bottom Chamber	PVDF		
13	Impeller w/ tungsten carbide bearing	PVDF		
14	Suction Interconnector	PVDF		
14a	Ring	Stainless Steel	1.4401	316
16	Shaft w/ coupling	Stainless Steel	1.4401	316
		Sintered Steel		
18	Cable Guard	Stainless Steel	1.4401	316
18a	Cable Guard Screws	Stainless Steel	1.4401	316
30	Pressure Equalization Cone	PVDF		
39	Valve Spring	Stainless Steel	1.4406	316LN
55	Pump Sleeve	Stainless Steel	1.4401	316
70	Valve Guide	PVDF		
85a	Spacer	Stainless Steel	1.4401	316



MATERIAL SPECIFICATION – REDI-FLO3 PUMP MOTOR

Pos.	Component	Material	DIN W. Nr.	AISI
1	Stator	Stainless Steel	1.4401	316
2	Rotor	Stainless Steel	1.4401	316
2a	Stop Ring	PP		
2b	Filter	Polyester		
3	Thrust Bearing	Carbon		
5	Radial Bearing	Ceramic/ tungsten carbide		
20	Motor Cable w/ plug	Tefzel		
		PVDF		
22a	Filling Plug	FPM Rubber		
24	O-Ring	FPM Rubber		
24a	O-Ring	FPM Rubber		
25	Top Cover	PPS		
27	Filter	Polyester		
32	Shaft Seal	FPM Rubber		
	Motor Liquid	SML-2		



ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft-start
Run-up Time:	Maximum: 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Service Factor:	0.33-0.50A[Hp]-1.75 at 115V/230V 0.50-0.75B[Hp]-1.4 at 230V 1.0-1.5C[Hp]-1.15 at 230V
Motor Cable:	3 Wire, Tefzel Cable Kit
Motor Liquid:	Type SML 2
pH Values:	4-9
Liquid Temperature:	The temperature of the pumped liquid should not exceed 104°F.
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump is to be stored after use, it must be stored in a frost-free location or it must be ensured that the motor liquid is frost-proof. Otherwise motor must be stored without being filled with motor liquid.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	-4°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE - NE 3):	
0.33-0.50A[Hp]	20.9" length x 2.68" diameter
0.50-0.75B[Hp]	20.9" length x 2.68" diameter
1.0-1.5C[Hp]	22.3" length x 2.68" diameter
Pump Diameter, incl. cable guard:	2.91"
Motor Weights (MSE - NE 3):	
0.33-0.50A[Hp]	6.0 lbs
0.50-0.75B[Hp]	7.1 lbs
1.0-1.5C[Hp]	8.2 lb
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions (min. and max.):	
5 Redi-Flo3	10.6" to 18.0"
10 Redi-Flo3	10.6" to 16.9"
15 Redi-Flo3	10.6" to 16.9"
22 Redi-Flo3	10.6" to 16.9"
30 Redi-Flo3	10.6" to 13.7"
Pump End Weights (min. and max.):	
All	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (maximum):	500 feet, below static water level

Pump Owner’s Manual

Redi-Flo3

SQE-NE
Environmental Pumps

Installation and Operating Instructions

- **Efficient Permanent Magnet Motor**
- **High Starting Torque**
- **Soft Start**
  (2 seconds to reach maximum rpm, and maximum pressure)
- **Built-in "Smart" Motor Protection with automatic restart**
- **Communication Through the Redi-Flo3 Status Box**
- **Integrated Protection Against Adverse Conditions**
- **Environmental Materials of Construction**

Please leave these instructions with the pump for future reference

GRUNDFOS®

Leaders in Pump Techn

SAFETY WARNING

Electrical Work

WARNING: To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor (at least the size of the circuit supplying the pump) to the grounding screw provided within the wiring compartment.

Pre-Installation Checklist

1. Well Preparation

If the pump is to be installed in a new well then the well should be fully developed and bailed or blown free of cuttings and sand. The construction of the GRUNDFOS Redi-Flo3 submersibles makes it resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

2. Make Sure You Have the Right Pump

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

3. Pumped Fluid Requirements

Submersible well pumps are designed for pumping turbid free, cool water; free of air or gases. Possible decreased pump performance and life expectancy can occur when operating in conditions outside of this chemistry. Water temperature ideally should not exceed 104°F. Extended pump life and optimal performance can best be obtained through proper well development and in the case of higher fluid temperatures use a cooling shroud.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well (Fig.1). The bottom of the motor should never be installed lower than the bottom of the screen.

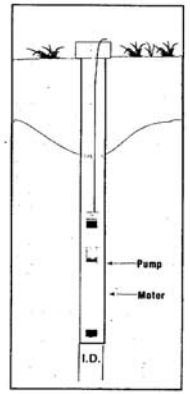


Fig. 1

4. Motor Cooling Requirements

To ensure proper motor cooling refer to the table below for minimum flow requirements:

Flow velocity past the motor	Maximum liquid temperature
0.0 f/s (free convection)	86° F(30°C)
Min. 0.5 f/s	104°F (40°C)

Pre-Installation Checklist

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

Liquid temperatures/cooling

Figure 2 shows an operating Redi-Flo3 pump installed in a well.

Figure 2 illustrates the following:

- Well diameter.
- Pump diameter.
- Temperature of pumped liquid.
- Flow past the motor to the pump strainer.

Note: The well diameter must be at least 3". If there is a risk that the motor will be covered with sediment or the pumped fluid is at an elevated temperature then it is recommended the pump be placed in a Flow Sleeve. The motor should always be installed above the well screen.

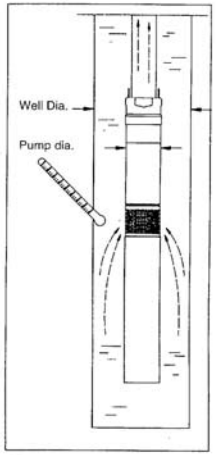


Fig. 2

5. Applications

Typical applications:

Environmental applications such as:

- Remediation pumping.
- Leachate recovery.
- Pollution recovery.
- Dewatering

6. Motor Preparation

GRUNDFOS MSE3-NE submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special GRUNDFOS motor liquid (type SML 2), which will protect the motor fluid down to -4°F(20°C) and to prevent the growth of bacteria. The level of motor fluid is important for the operating life of the bearings and consequently the life of the motor.

Refilling of motor liquid

It is recommended to check and if needed, refill the motor with GRUNDFOS motor fluid SML 2.

Pre-Installation Checklist

To refill the motor, proceed as follows:

1. Remove the cable guard and separate the pump end from the motor.

2. Place the motor in vertical position with an inclination of approx. 10°.

3. Remove the filling plug using a screwdriver or a similar tool.

4. Inject motor liquid into the motor with a filling syringe or similar tool,see fig. 3.

5. To allow possible air to escape, move the motor from side to side. And turn the shaft.

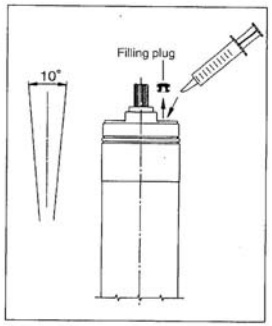


Fig. 3

6. Replace the filling plug and make sure it is tight.

7. Assemble pump end and motor.

8. Install the cable guard.

The pump is now ready for installation.

7. Installation Postions

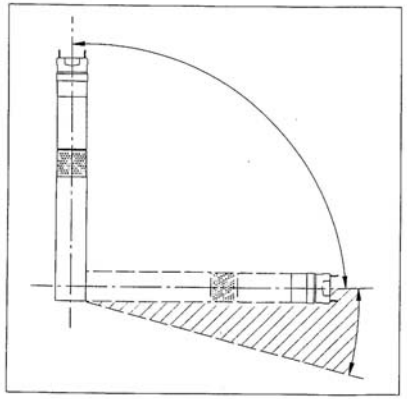


Fig. 4

Positional requirements
The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see fig. 4.

Installation Procedures

8. Electrical connection

General
The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

Before starting work on the pump, make sure the electricity supply has been switched off and that it cannot be accidentally switched on. The pump must be grounded. The pump must be connected to an external mains switch.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate. The required voltage for GRUNDFOS submersible MSE3-NE motors, measured at the motor terminals, is +6%/–10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

Supply voltage:1 x 100-115V or 1 x 200-240 V +6%/–10%, 50/60 Hz.

The current consumption can only accurately be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.
The Redi-Flo3 pumps can be connected to a Redi-Flo3 status box.

Note: The pump must never be connected to a capacitor or to another type of control box other than a Redi-Flo3 status box. The pump must never be connected to an external frequency converter.

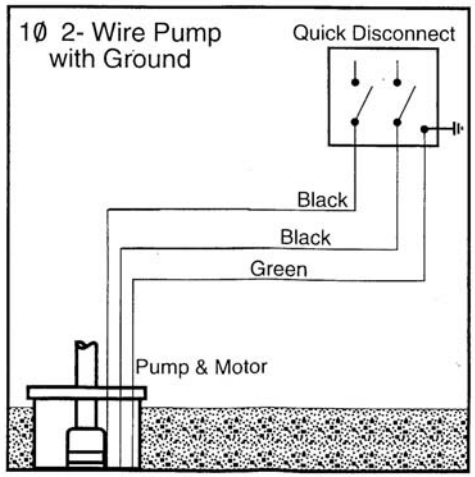
Motor protection
The motor has built-in automatic thermal overload protection and requires no additional motor protection.

Connection of motor
The motor can be connected directly to the main circuit breaker.

9. Making the Wiring Connections

WARNING!
To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.

Single-Phase 2-wire Wiring Diagram for GRUNDFOS Motors



A capacitor or control box should NEVER be connected to a Redi-Flo3 submersible pump.

Fig. 5

10. Cable Sizing

SINGLE-PHASE 60 HZ Maximum Cable Length Motor Service to Entrance

Motor Rating		Copper Wire Size								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240

11. Motor Cable

Redi-Flo3 pumps are specifically designed to be used with Grundfos SQE-NE Tefzel motor leads. Standard SQE-NE Tefzel motor leads are available between 25 and 300 foot lengths in 5 foot increments. Custom lengths longer than 300 feet are available in 10 foot increments up to 600 feet from the factory.

General
Note: Do not lower or lift the pump by means of the motor cable.

The loose data plate supplied with the pump should be placed close to the installation site.

12. Installing the cable plug to the motor

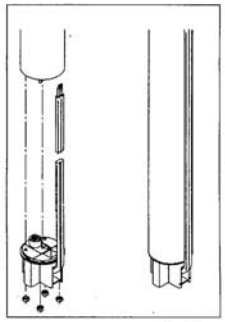


Fig. 6

To install the cable plug, proceed as follows:

1. Check that the cable is of the correct type, cross-section and length.
2. Check that the mains on the location has correct connection to ground.
3. Check that the motor socket is clean and dry.
4. Press the cable plug into the motor socket. The plug will only fit one way, see fig. 6.
5. Install and tighten the four nuts, see fig. 6. When the plug has been installed, there must not be a clearance between the motor and the cable plug.

13. Installing the cable guard

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. The two flaps of the cable guard must engage with the upper edge of the pump sleeve, see fig. 7.

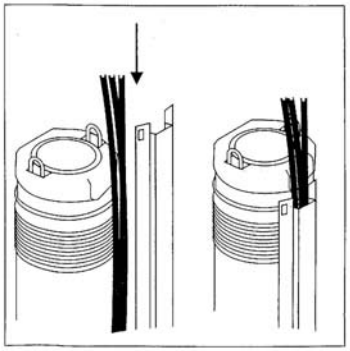


Fig. 7

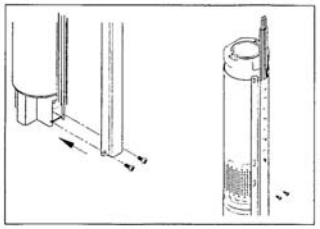


Fig. 8

3. Fasten the cable guard to the cable plug with the four screws supplied, see fig. 8.

14. Piping

- The pump should only be gripped by the two flats at the top of the pump, as shown in fig. 9.
- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.
- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, as shown in fig. 10.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

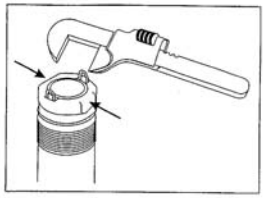


Fig. 9

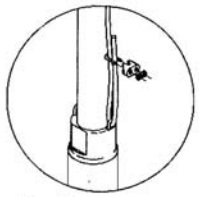


Fig. 10

15. Installing the Pump

Installation Depth
The dynamic water level should always be above the pump see fig. 11.

A = Dynamic water level
B = Static Water Level
C = Minimum 3" well diameter
D = Drawdown
E = Installation depth below static water level. Maximum 500 feet

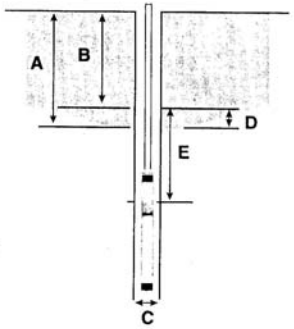


Fig. 11

Procedures
To install the pump, follow these steps:

1. Install the enclosed data plate sticker at the well head.
2. Check the well for proper clearance — the well must be at least 3" in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.

16. Installing the Pump(cont.)

4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well — especially in 3" wells. ***NOTE*: Do not lower or lift the pump using the motor cable.**
5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal. Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Attach the supplemental information label at the electrical installation site.
8. Complete the electrical connections. **Remember that a capacitor or a control box should NEVER be connected to a Redi-Flo3 submersible pump.**

Installation depths

Maximum installation depth: below the static water level: 500 feet,
Minimum installation depths: 1.75' below the dynamic water level:

Vertical installation:

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation:

The pump must be installed at least 1.75 ft. below the dynamic water level. If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

17. Generator Operation

- It is OK to operate the Redi-Flo3 with a generator.

The generator must be sized 10% above the pumps P1 (Input Power) values.
Use the table to select the correct size generator for the motor HP.

Motor HP	Min. Generator Size (Watts)
1/3 - 1/2 A	1000
1/2 - 3/4 B	1700
1- 1½ C	2000

18. Starting the Pump for the First Time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Motor Cooling and Other Considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Water Impurities

- If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.
- When the water is clean the valve should be fully opened.

Minimum flow rate

- To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than .2 gpm. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Note: **The pump's dry-running protection is effective only within the recommended duty range of the pump.**

Note: **Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.**

Operating the Pump

Built-in protection
The motor incorporates an electronic unit which protects the motor in various damaging situations.

In case of overload, the built-in overload protection will stop the pump for 5 minutes. After 5 minutes, the pump will attempt to restart.
If the pump is started and the well has not recovered, the pump will stop after 30 seconds.

If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes or the reset time set by the R100.

Resetting the pump:
Switch off the electricity supply for 1 minute.
The motor is protected against the following conditions:
- dry running,
- voltage surges (up to 5000 V),
- overvoltage,
- undervoltage,
- overload
- overtemperature.

MSE 3NE Motors:
Note: To set Dry-Run limit in the MSE-NE pumps, you need to connect the pump to a Redi-Flo3 status box. Refer to Redi-Flo3 status box I&O for proper connections.

To set Dry-Run protection, follow these steps:
1. Start the pump against closed discharge.
2. Rapidly read the power consumption value (W) in the R100 display 2.5.
3. Multiply this value by 0.9.
4. Within the R100, go to display 4.6 and enter the new value (minimum power limit).
5. Go to display 4.7 and change the setting to "Active".

For further information on dry-running, refer to RediFlo3 Status Box I&O.

Maintenance and service:
The pumps are normally maintenance-free. Deposits and wear may occur. For that purpose, service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request. The pumps can be serviced at a GRUNDFOS service center.

Assembly/Disassembly

19. Assembly of Pump and Motor

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see fig. 12.
2. Grease the motor shaft end with a vegetable based grease.
3. Screw the pump end on the motor. A spanner may be used on the clamping faces of the pump part, see fig.12.
4. Install cable guard as described on page 7.

When pump end and motor have been assembled correctly, there must not be a clearance between pump end and motor.

To disassemble reverse procedure.

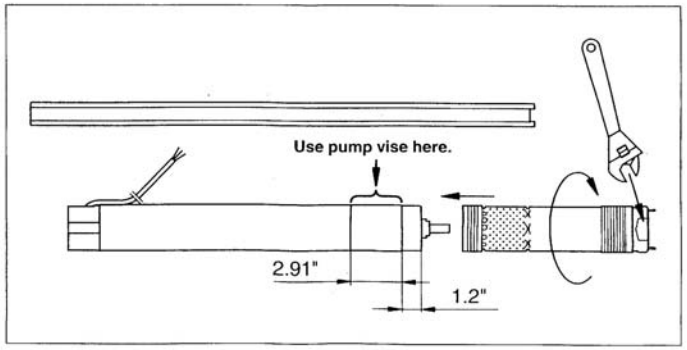


Fig. 12

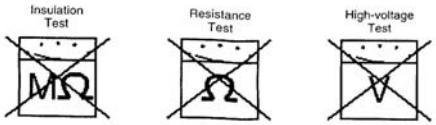
Fault	Cause	Remedy
1. The pump does not run	a. The fuses are blown	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b. The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c. No electricity supply.	Contact the Electricity provider.
	d. The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e. The drop cable is defective.	Repair/replace the pump/cable.
	f. Overvoltage has occurred.	Check the electricity supply
2. The pump runs but gives no water.	a. The discharge is closed.	Open the valve
	b. No water or too low water level in well.	See item 3a.
	c. Check valve is stuck in it's closed position.	Pull the pump and clean or replace the valve.
	d. The suction strainer is closed.	Pull the pump and clean the strainer.
	e. The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a. The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b. The valve s in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves as necessary.
	c. The discharge pipe is partly chocked by impurities (Iron bacteria).	Clean/replace the discharge pipe.
	d. The non- return valve of the pump is blocked.	Pull the pump and check/replace the valve.
	e. The pump and the riser pipe are partly choked by impurities (Iron bacteria).	Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	f. The pump is defective.	Repair/replace the pump.
	g. Hole in discharge pipe.	Check and repair the piping.
	h. The riser pipe is defective.	Replace.
	i. Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a. The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b. The water level electrodes or level switches in the reservior have not been installed correctly	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c. Checkvalve is leaking or stuck half-open.	Pull the pump and clean/replace the non-return valve.
	d. The supply voltage is unstable.	Check the electrical supply.
	e. The motor temperature is too high.	Check the water temperature.

Troubleshooting

Troubleshooting

Instruments not allowed:

Note: The use of the following instruments is not allowed during fault finding:



Note: When measuring, use RMS-instruments.

Checking the motor and cable:

1. Supply voltage	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified on Page 4, large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption	Measure the current (RMS) while the pump is operating at a constant discharge head(if possible, at capacity where the motor is heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full load current, there are the following possible faults: Poor connection in the leads, possibly in the cable joint. Too low supply voltage, see item 1 on Page 13.

Environment

During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

⚠ **When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurous to persons and the environment.**

Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. If such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service center.

Technical Data

Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft starting
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[HP]-1.75 at 230V 0.50-0.75A[HP]-1.4 at 230V 1.0 -1.5C[HP] -1.15 at 230V
Motor Cable: Length	3 Wire, 12 AWG TEFZEL Available in 5 ft. increments from 25ft.- 300ft.
Motor Liquid: **pH Values:**	Type SML 2 Redi-Flo3: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Discharge Port:	5SQE-NE- 1"NPT 10-15SQE-NE- 1 1/4" NPT 22-30SQE-NE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature: **Maximum Ambient Temperature:**	-4°F +140°F
Freeze Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. (**The motor must be stored without being filled with motor liquid.**)
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature: **Maximum Ambient Fluid Temperature:**	34°F +104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE3-NE):	
0.33-0.50A[hp]	20.9" length x 2.68" diameter
0.50-0.75B[hp]	20.9" length x 2.68" diameter
1.0-1.5C[hp]	22.3" length x 2.68" diameter
Motor Weights (MSE3-NE):	
0.33-0.50A[hp]	6.0 Lbs
0.50-0.75B[hp]	7.1 Lbs
1.0-1.5C[hp]	8.2 Lbs
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions(min. and max.):	
5SQE-NE	8.1" to 13.6"
10SQE-NE	8.1" to 14.5"
15SQE-NE	8.1" to 14.5"
22SQE-NE	8.1" to 14.5"
30SQE-NE	8.1" to 11.3"
Pump End Weights(min. and max.):	
All Redi-Flo3 Models	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (Maximum):	500 feet, below static water level.

PUMP TYPE	HP	VOLTAGE	MAX. AMPS
5SQE03A-90-NE	1/3 A	230V/115V	3.9/7.8
5SQE03A-120-NE	1/3 A	230V/115V	3.9/7.8
5SQE05A-170-NE	1/2 A	230V/115V	4.9/9.8
5SQE05B-210-NE	1/2 B	230V	4.9
5SQE05B-250-NE	1/2 B	230V	4.9
5SQE07B-290-NE	3/4 B	230V	7.6
5SQE10C-340-NE	1 C	230V	7.6
5SQE10C-380-NE	1 C	230V	7.6
5SQE10C-420-NE	1 C	230V	7.6
10SQE03A-100-NE	1/3 A	230V/115V	3.9/7.8
10SQE05A-140-NE	1/2 A	230V/115V	4.9/9.8
10SQE05B-180-NE	1/2 B	230V	4.9
10SQE07B-220-NE	3/4 B	230V	7.6
10SQE10C-260-NE	1 C	230V	7.6
10SQE10C-300-NE	1 C	230V	7.6
10SQE15C-340-NE	1 1/2 C	230V	11.1
15SQE03A-70-NE	1/3 A	230V/115V	3.9/7.8
15SQE05A-110-NE	1/2 A	230V/115V	4.9/9.8
15SQE05B-130-NE	1/2 B	230V	4.9
15SQE07B-170-NE	3/4 B	230V	7.6
15SQE10C-200-NE	1 C	230V	7.6
15SQE10C-230-NE	1 C	230V	7.6
15SQE15C-270-NE	1 1/2 C	230V	11.1
22SQE03A-40-NE	1/3 A	230V/115V	3.9/7.8
22SQE05A-80-NE	1/2 A	230V/115V	4.9/9.8
22SQE05B-110-NE	1/2 B	230V	4.9
22SQE07B-140-NE	3/4 B	230V	7.6
22SQE10C-180-NE	1 C	230V	7.6
22SQE15C-210-NE	1 1/2 C	230V	11.1
30SQE05A-40-NE	1/2 A	230V/115V	4.9/9.8
30SQE05B-80-NE	1/2 B	230V	7.6
30SQE10C-120-NE	1 C	230V	7.6
30SQE15C-160-NE	1 1/2 C	230V	11.1

ACCESSORIES	
PRODUCT	**PART NUMBER**
CU 300	96422776
Flow Sleeve	96037505
Grease	96037562
Grundfos SPP1 Potentiometer	625468
RediFlo3 Motor Leads - available in 5ft. increments	See price list
25ft	96037428
50ft	96037429
75ft	96037430
100ft	96037431
125ft	96037432
150ft	96037433
175ft	96037434
200ft	96037435
225ft	96037436
250ft	96037437
300ft	96037438
R100 Infrared Remote	625333
HP Infrared Printer 822408	620480

LIMITED WARRANTY

Products manufactured by GRUNDFOS are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS factory or authorized service station, any product of GRUNDFOS manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

MANUFACTURER WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD "AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING OR REPAIR.

Some jurisdictions do not allow the exclusion or limitation of implied warranties of merchantability and fitness for a particular purpose, of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last or require you to pay certain expenses as set forth above. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facilities is, 1-800-333-1366.

Federal Communications Commission Notice:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

GRUNDFOS®

Leaders in Pump Technology

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Phone: (800) 333-1366 • **Fax:** (800) 333-1363

Canada: Oakville, Ontario • **Mexico:** Apodaca, N.L.

Visit our website at www.us.grundfos.com

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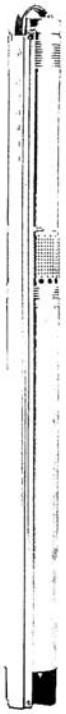
GRUNDFOS INSTRUCTIONS
Installation and Operation

SQ/SQE



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Drinking Water System Components
ANSI/NSF 61
(65GM)

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GRUNDFOS

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Before beginning installation procedures, these installation and operating instructions should be studied carefully. The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

General Description

The SQ/SQE is a 3 inch diameter submersible pump mainly designed for the pumping of raw water in domestic water supply. This manual is designed to assist in the proper set-up, installation and operation of these pumps.

Applications

Typical applications are:

- Residential Housing
- Small Waterworks
- Pressure Boosting
- Irrigation Systems
- Liquid Transfer in Tanks

Pre-Installation Checklist

1. Preinstallation

Well Preparation

If the pump is to be installed in a new well then the well should be fully developed and bailed or blown free of cuttings and sand. The construction of the GRUNDFOS SQ/SQE submersibles makes it resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, the well must be blown or bailed clear of oil.

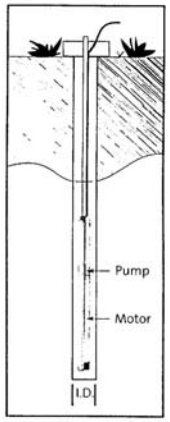


Figure 1

Make Sure You Have the Right Pump

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

Pumped Fluid Requirements

Submersible well pumps are designed for pumping clear, cold water; free of air or gases. Decreased pump performance and life expectancy can occur if the water is not clear, cold or contains air or gases. Water temperature should not exceed 104°F.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well. The bottom of the motor should never be installed lower than the top the screen or within five feet of the well bottom, as shown in Figure 1.

Motor Cooling Requirements

To ensure proper motor cooling refer to the table below for minimum flow requirements:

Flow velocity past the motor	Maximum liquid temperature
0.0 f/s (free convection)	86° F(30°C)
Min. 0.5 f/s	104°F (40°C)

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

Liquid temperatures/cooling

Figure 2 shows an SQ/SQE pump installed in a well. With the pump operating, Figure 2 illustrates the following:

- Well diameter.
- Pump diameter.
- Temperature of pumped liquid.
- Flow past the motor to the pump
- suction strainer.

Note: The well diameter must be at least 3 inches. If there is a risk that the motor will be covered with sediment then it is recommended the pump be placed in a Flow Sleeve. The motor should always be installed above the well screen.

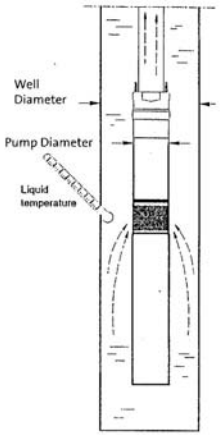


Figure 2

Motor Preparation

GRUNDFOS MS 3 and MSE 3 submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special GRUNDFOS motor liquid (type SML 2), which will protect the motor fluid down to -4°F(20°C) and to prevent the growth of bacteria. The level of motor fluid is important for the operating life of the bearings and consequently the life of the motor.

Refilling of motor liquid

It is recommended to refill the motor with GRUNDFOS motor fluid SML 2.

1. Remove the cable guard and separate the pump end from the motor.
2. Place the motor in vertical position with an inclination of approximately. 10°.
3. Remove the filling plug using a screwdriver or a similar tool.
4. Inject motor liquid into the motor with a filling syringe or similar tool, see Figure 3.
5. To allow possible air to escape, move the motor from side to side. And turn the shaft.
6. Replace the filling plug and make sure it is tight.
7. Assemble pump end and motor.
8. Install the cable guard.

The pump is now ready for installation.

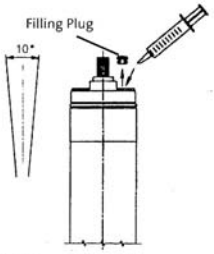


Figure 3

3. Installation Positions

Positional requirements:

The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see Figure 4.

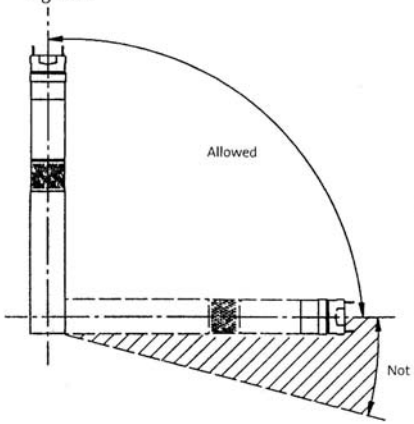


Figure 4

If the pump is to be installed horizontally, e.g.in a tank, it is recommended to fit it in a flow sleeve.

4. Electrical connection

General

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

Before starting work on the pump, make sure the electricity supply has been switched off and that it cannot be accidentally switched on. The pump must be grounded. The pump must be connected to an external mains switch.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate. The required voltage for GRUNDFOS submersible MS3/MSE3 motors, measured at the motor terminals, is +6%/–10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

5. Electrical connection

> Note: The pump must never be connected to a capacitor or to another type of control box other than a CU 300 or CU 301.
> The pump must never be connected to an external frequency converter.

Supply voltage: 1 x 100-115V or 1 x 200-240 V +6%/–10%, 50/60 Hz.

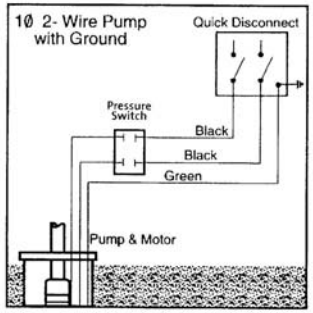
The current consumption can only accurately be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.
The SQE pumps can be connected to a CU 300 or CU 301 status box.

Motor protection
The motor has built-in automatic thermal overload protection and requires no additional motor protection.

Connection of motor
The motor can be connected directly to the main circuit breaker.
Start/stop of the pump will typically be done via a pressure switch, see Figure 5.

Note: The pressure switch must be rated for the maximum amps of the specific pump size.

> WARNING!
> Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.



Single-Phase 2-Wire Wiring Diagram for Grundfos Motors

Making the Wiring Connections

> A capacitor or control box should NEVER be connected to a SQ/SQE submersible pump.

Figure 5

6. Cable Sizing

SINGLE-PHASE 60 HZ Maximum Cable Length Motor Service to Entrance

Motor Rating		Copper Wire Size								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240

7. Splicing the Cable

Splice the drop cable with the motor cable. If the splice is carefully made, it will be as efficient as any other portion of the cable and will be completely watertight.
There are a number of cable splicing kits available today - epoxy filled, rubber-sealed, etc. Many perform well if the manufacturer's directions are followed carefully. If one of these kits is not used, we recommend the following method for splicing the motor cable to the drop cable:
Examine the motor cable and the drop cable carefully for damage.
Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads. Be sure to match the colors.
Strip back and strip off one-inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.
Insert a properly sized Sta-Kon-type connector on each pair of leads, again making sure that colors are matched. Using Sta-Kon crimping pliers, indent the lugs. Be sure to squeeze down hard on the pliers, particularly when using large cable.
Form a piece of electrical putty tightly around each Sta-Kon. The putty should overlap on the insulation of the wire.

Use a good quality tape such as #33 Scotch Waterproof or Plymouth Rubber Company Slipknot Grey.
Wrap each wire and joint tightly for a distance of about 2½ inches on each side of the joint.

Make a minimum of four passes over each joint and overlap each pass approximately one inch to assure a completely watertight seal.

GENERAL

Note: Do not lower or lift the pump by means of the motor cable.

The loose data plate supplied with the pump should be placed close to the installation site.

8. INSTALLING THE CABLE PLUG TO THE MOTOR

The cable plug supplied with the motor is factory-greased. Check that the plug is greased correctly, see Figure 6.

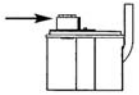


Figure 6

To install the cable plug, proceed as follows:

1. Check that the cable is of the correct type, cross-section and length.
2. Check that the mains on the location has correct connection to ground.
3. Check that the motor socket is clean and dry.
4. Press the cable plug into the motor socket. The plug will only fit one way, see Figure 7.
5. Install and tighten the four nuts, see Figure 7. When the plug has been installed, there must not be a clearance between the motor and the cable plug.

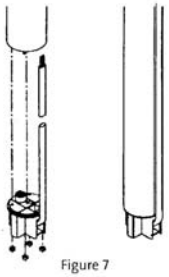


Figure 7

9. INSTALLING THE CABLE GUARD

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. The two flaps of the cable guard must engage with the upper edge of the pump sleeve, see Figure 8.
3. Fasten the cable guard to the cap plug with the four screws supplied, see figure 9.

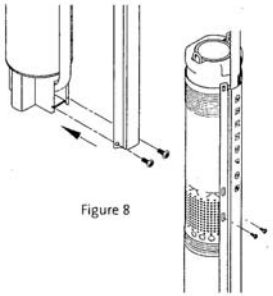


Figure 8

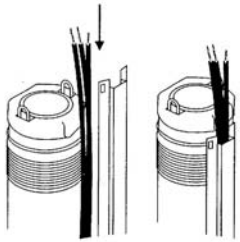


Figure 9

10. PIPING

- The pump should only be gripped by the two flats at the top of the pump, as shown in Figure 10.
- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.

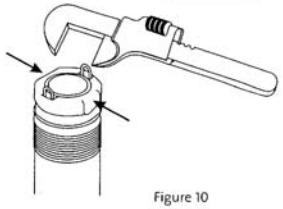


Figure 10

- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, as shown in circle insert 2, Figure 11.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

11. INSTALLING THE PUMP

Installation Depth

The dynamic water level should always be above the pump. See fig. 11.

A = Dynamic water level
B = Static Water Level
C = Minimum 3 inch well diameter
D = Drawdown
E = Installation depth below static water level. Maximum 500 feet

Procedures

To install the pump, follow these steps:

1. Install the enclosed data plate sticker at the well head.
2. Check the well for proper clearance — the well must be at least 3inches in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.

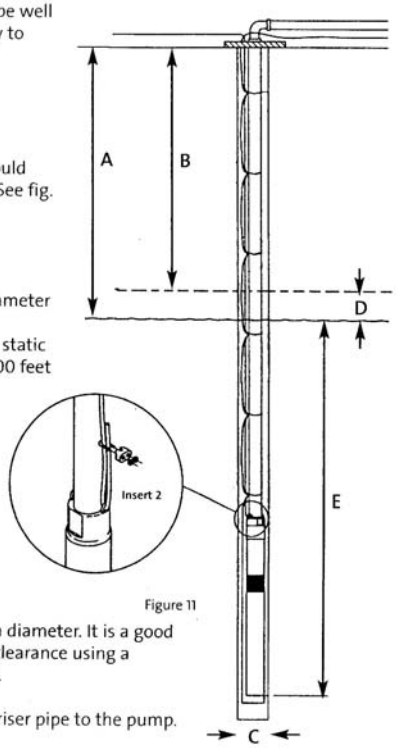


Figure 11

11. INSTALLING THE PUMP (CONTINUED.)

4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well — especially in 3 inch wells.

NOTE: Do not lower or lift the pump using the motor cable.

5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal. Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Attach the supplemental information label at the electrical installation site.
8. Complete the electrical connections.

Remember that a capacitor or a control box should NEVER be connected to a SQ/SQE submersible pump.

Installation depths

Maximum installation depth: below the static water level: 500 feet,
Minimum installation depths: 1.75 feet below the dynamic water level:

Vertical installation:

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation:

The pump must be installed at least 1.75 feet below the dynamic water level. If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

Note: Do not lower or lift the pump with the motor cable.

12. Generator Operation

It is safe to operate the SQ/SQE with a generator.
The generator must be sized 50% above the pumps P1 (input Power) values. See following chart.

Motor HP	Min. Generator Size (Watts)	Recommended Generator Output (Watts)
1/3 -1 /2 A	1100	1500
1/2 - 3/4 B	1700	2300
1 -1 1/2 C	2000	3500

13. Starting the Pump for the First Time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Motor Cooling and Other Considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must immediately be stopped and the fault remedied.

Water Impurities

- If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.
- When the water is clean the valve should be fully opened.

Minimum flow rate

- To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than 0.2 gpm. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must be stopped and the fault corrected.

Note: The pump's dry-running protection is effective only within the recommended duty range of the pump.

Note: Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.

Built-in protection
The motor incorporates an electronic unit which protects the motor in various situations.
In case of overload, the built-in overload protection will stop the pump for 5 minutes. After that period, the pump will attempt to restart.
If the pump is started and the well has not recovered, the pump will stop after 30 seconds.

If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes.

Resetting the pump:
Switch off the electricity supply for 1 minute.
The motor is protected against the following conditions:
- dry running,
- voltage surges (up to 4000 V),
- overvoltage,
- undervoltage,
- overload
- over-temperature.

MS 3 Motors:
Note: All MS 3 motors are factory set to detect dry running conditions. However, it is important to ensure that the configurations of both the SQ pump and motor are the same configuration. Configurations can be found on both SQ pump and motor nameplates as " Config."
EXAMPLE: Config. A-2, must match the other nameplate A-2. See Technical Data on page 17 for quick referencing on all configurations.

MSE 3 Motors:
Note: To set Dry-Run limit in the MSE/SQE pumps, you need to connect the pump to a CU 300. Refer to CU 300 I&O for proper connections.
To set Dry-Run protection, follow these steps:
1. Start the pump against closed discharge.
2. Rapidly read the power consumption value (W) in the R100 display 2.5.
3. Multiply this value by 0.9.
4. Within the R100, go to display 4.6 and enter the new value (minimum power limit).
5. Go to display 4.7 and change the setting to "Active".

For further information on dry-running, refer to CU 300 I&O.

Maintenance and service:
The pumps are normally maintenance-free.
Deposits and wear may occur. For that purpose, service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request.
The pumps can be serviced at a GRUNDFOS service center.

19. Assembly of Pump and Motor

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see Figure 12.
2. Grease the motor shaft end with the grease supplied with the motor.
3. Screw the pump end on the motor. A spanner may be used on the clamping faces of the pump part, see Figure 12.
4. Install cable guard as described on page 7.

When pump end and motor have been assembled correctly, there must not be a clearance between pump end and motor.

To disassemble reverse procedure.

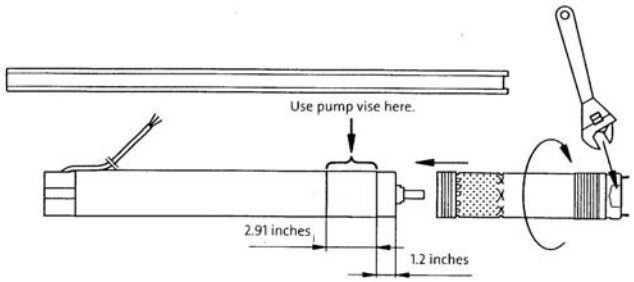
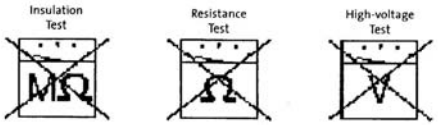


Figure 12

Fault	Cause	Remedy
1. The pump does not run	a. The fuses are blown	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b. The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c. No electricity supply.	Contact the Electricity provider.
	d. The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e. The drop cable is defective. f. Overvoltage has occurred.	Repair/replace the pump/cable. Check the electricity supply
2. The pump runs but gives no water.	a. The discharge is closed.	Open the valve
	b. No water or too low water level in well.	See item 3a.
	c. Check valve is stuck in it's closed position.	Pull the pump and clean or replace the valve.
	d. The suction strainer is closed.	Pull the pump and clean the strainer.
	e. The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a. The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b. The valve s in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves as necessary.
	c. The discharge pipe is partly chocked by impurities (Iron bacteria).	Clean/replace the discharge pipe.
	d. The non-return valve of the pump is blocked.	Pull the pump and check/replace the valve.
	e. The pump and the riser pipe are partly choked by impurities (Iron bacteria).	Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	f. The pump is defective.	Repair/replace the pump.
	g. Hole in discharge pipe.	Check and repair the piping.
	h. The riser pipe is defective.	Replace.
	i. Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a. The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b. The water level electrodes or level switches in the reservoir have not been installed correctly	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c. Check-valve is leaking or stuck half-open.	Pull the pump and clean/replace the non-return valve.
	d. The supply voltage is unstable.	Check the electrical supply.

Instruments not allowed:
Note: The use of the following instruments is not allowed during fault finding:



Note: When measuring, use RMS-instruments.
Checking the motor and cable:

1. Supply voltage	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified on Page 4, large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption	Measure the current (RMS) while the pump is operating at a constant discharge head(if possible, at capacity where the motor is heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full load current, there are the following possible faults: Poor connection in the leads, possibly in the cable joint. Too low supply voltage, see item 1 on Page 13.

Environment
During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurious to persons and the environment.

Disposal
Disposal of this product or parts of it must be carried out according to the following guidelines:
1. Use the local public or private waste collection service.
2. If such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service center.

Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, LE 1x100-115V +6%/-10%, 50/60 Hz, LE
Operation via Generator:	Recommended generator output must be equal to P1[KW] +50% and minimum P1+10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft starting
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, over-temperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[HP]-1.75 at 115V/230V 0.50-0.75A[HP]-1.4 at 230V 1.0 -1.5C[HP] -1.15 at 230V
Motor Cable: Length	3 Wire, 14 AWG XLPE 5 ft
Motor Liquid: **pH Values:**	Type SML 2 SQ and SQE: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Discharge Port:	5SQ/SQE- 1"NPT 10-15SQ/SQE- 1 1/4" NPT 22-30SQ/SQE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature: **Maximum Ambient Temperature:**	-4°F +140°F
Freeze Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. **(The motor must be stored without being filled with motor liquid.)**
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature: **Maximum Ambient Fluid Temperature:**	-4°F +104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MS 3 & MSE 3): 0.33-0.50A[hp] 0.50-0.75B[hp] 1.0-1.5C[hp]	 20.9" length x 2.68" diameter 20.9" length x 2.68" diameter 22.3" length x 2.68" diameter
Motor Weights (MS 3 & MSE 3): 0.33-0.50A[hp] 0.50-0.75B[hp] 1.0-1.5C[hp]	 6.0 Lbs. 7.1 Lbs. 8.2 Lbs.
Pump End Dimensions: **Pump Diameter:** **Pump Diameter, incl. cable guard:** **Pump End Dimensions(min. and max.):** 5SQ/SQE 10SQ/SQE 15SQ/SQE 22SQ/SQE 30SQ/SQE	 2.68" 2.91" 10.6" to 18.0" 10.6" to 16.9" 10.6" to 16.9" 10.6" to 16.9" 10.6" to 13.7"
Pump End Weights(min. and max.): All SQ/SQE Models **Well Diameter (minimum):** **Installation Depth (Maximum):**	 2.2 lbs. to 3.5 lbs. 3" 500 feet, below static water level.

TECHNICAL DATA

PUMP TYPE	HP	VOLTAGE	FLOW RANGE	MIN. WELL DIA	DISCH.
5SQ/SQE03A-90	1/3 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE03A-140	1/3 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05A-180	1/2 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05B-230	1/2 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05B-270	1/2 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE07B-320	3/4 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-360	1 C	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-410	1 C	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-450	1 C	230V	1.5-7.5 GPM	3"	1" NPT
10SQ/SQE03A-110	1/3 A	230V/115V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE05B-160	1/2 B	230V/115V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE05B-200	1/2 B	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-240	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-290	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-330	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE15C-380	1 1/2 C	230V	3-15 GPM	3"	1 1/4" NPT
15SQ/SQE03A-70	1/3 A	230V/115V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE05A-110	1/2 A	230V/115V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE05B-150	1/2 B	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE07B-180	3/4 B	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE10C-220	1 C	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE10C-250	1 C	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE15C-290	1 1/2 C	230V	4-20 GPM	3"	1 1/4" NPT
22SQ/SQE03A-40	1/3 A	230V/115V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE05A-80	1/2 A	230V/115V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE05B-120	1/2 B	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE10C-160	1 C	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE10C-190	1 C	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE15C-220	1 1/2 C	230V	7-33 GPM	3"	1 1/2" NPT
30SQ/SQE05A-40	1/2 A	230V/115V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE05B-90	1/2 B	230V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE10C-130	1 C	230V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE15C-170	1 1/2 C	230V	8-42 GPM	3"	1 1/2" NPT

ACCESSORIES	
PRODUCT	PART NUMBER
CU 300	96422776
CU 301	96436754
FLOW SLEEVE	96037505
GREASE	96037562
FLOW SWITCH	96022967
PRESSURE TRANSMITTER	96026030

NOTES

LIMITED WARRANTY

Products manufactured by (GRUNDFOS) GRUNDFOS PUMPS CORPORATION are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD"AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING AND REPAIR.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facility is, 1-800-333-1366.

Grundfos Pumps Corporation • 17100 W. 118th Terrace • Olathe, KS 66061
Customer Service Phone: 800.333.1366 • **Fax:** 800.333.1363
Canada: Oakville, Ontario • **Mexico:** Apodaca, N.L.

96 47 78 69

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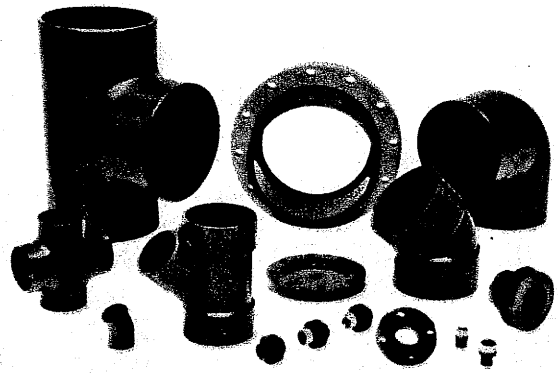
Printed in the U.S.A.

Pipe Fittings Manufacturer's Descriptive and Technical Literature

PVC SCHEDULE 80 FITTINGS

80-2-0199

Performance Engineered & Tested



SPEARS Schedule 80 PVC fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material reinforcement is uniformly placed in stress concentration areas for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure obtaining the very best PVC fittings available.

Full 1/4" Through 12" Availability

Spears comprehensive line of injection molded PVC fittings offers a variety of configurations in molded Schedule 80 sizes 1/4" through 12" conforming to ASTM D 2467 and Spears exclusive CL150 Flanges in sizes 1/2" through 16".

Exceptional Chemical & Corrosion Resistance

Unlike metal, PVC fittings never rust, scale, or pit, and will provide many years of maintenance-free service and extended system life.

High Temperature Ratings

PVC thermoplastic can handle fluids at service temperatures up to 140°F (60°C), allowing a wide range of process applications, including corrosive liquids.

Lower Installation Costs

Substantially lower material costs than steel alloys or lined steel, combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.

Higher Flow Capacity

Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.

Additional Fabricated Configurations through 36"

Extra large, hard-to-find, and custom configurations are fabricated from NSF Certified pipe. Fittings are engineered and tested to provide full pressure handling capabilities according to Spears specifications.

Advanced Design Specialty Fittings

Spears wide range of innovative, improved products include numerous metal-to-plastic transition fittings and unions with Spears' patented stainless steel reinforced (SR) plastic threads.

PVC Valves

SPEARS PVC Valve products are available for total system compatibility and uniformity; see SPEARS' THERMOPLASTIC VALVES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS (V-4).

Sample Engineering Specifications

All PVC Schedule 80 fittings shall be produced by Spears Manufacturing Company from PVC Type I, cell classification 12454, conforming to ASTM Standard D 1784. All injection molded PVC Schedule 80 fittings shall be Certified for potable water service by NSF International and manufactured in strict compliance to ASTM D 2467. All fabricated fittings shall be produced in accordance with Spears General Specifications for Fabricated Fittings. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001

PROGRESSIVE PRODUCTS FROM SPEARS INNOVATION & TECHNOLOGY

PVC Thermoplastic Pipe Temperature Pressure De-Rating

System Operating Temperature °F (°C)	73 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)
PVC	100%	90%	75%	62%	50%	40%	30%	22%

NOTE: Valves, Unions and Specialty Products have different elevated temperature ratings than pipe.

PVC Basic Physical Properties

Properties	ASTM Test Method	PVC
Mechanical Properties, 73°F		
Specific Gravity, g/cm	D 792	1.40
Tensile Strength, psi	D 638	7,000
Modulus of Elasticity, psi	D 638	440,000
Compressive Strength, psi	D 695	9,000
Flexural Strength, psi	D 790	13,200
Izod Impact, notched, ft-lb/in	D 256	.65
Thermal Properties		
Heat Deflection Temperature, °F at 66 psi	D 648	165
Thermal Conductivity, BTU/hr/sq ft/°F/in	C 177	1.2
Coefficient of Linear Expansion, in/in/°F	D 696	3.0×10^{-5}
Flammability		
Limiting Oxygen Index, %	D 2863	43
UL 94 Rating	94V-0	
Other Properties		
Water Absorption, % 24 hr.	D 570	.05
Industry Standard Color	White / Gray	
ASTM Cell Classification	D 1784	12454
NSF Potable Water Approved	Yes	

PVC Chemical Resistance

PVC is generally inert to most mineral acids, bases, salts and paraffinic hydrocarbon solutions. For more information on PVC chemical resistance refer to the Chemical Resistance of Rigid Geon® Vinyls Based on Immersion Test, published by the GEON® company.

NOT FOR USE WITH COMPRESSED AIR OR GASES

Spears Manufacturing Company DOES NOT RECOMMEND the use of thermoplastic piping products for systems to transport or store compressed air or gases, or the testing of thermoplastic piping systems with compressed air or gases in above and below ground locations. The use of our product in compressed air or gas systems automatically voids any warranty for such products, and its use against our recommendation is entirely the responsibility and liability of the installer.

WARNING: DO NOT USE COMPRESSED AIR OR GAS TO TEST ANY PVC OR CPVC THERMOPLASTIC PIPING PRODUCT OR SYSTEM, AND DO NOT USE DEVICES PROPELLED BY COMPRESSED AIR OR GAS TO CLEAR SYSTEMS. THESE PRACTICES MAY RESULT IN EXPLOSIVE FRAGMENTATION OF SYSTEM PIPING COMPONENTS CAUSING SERIOUS OR FATAL BODILY INJURY.

SPEARS® MANUFACTURING COMPANY

CORPORATE OFFICES
15853 Olden Street, Sylmar, CA 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611 • http://www.spearsmfg.com

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(818) 364-1611
(800) 862-1499
FAX: (818) 367-3014

NORTHWEST
3902 "B" Street N.W.
Auburn (Seattle), WA
98002
(253) 939-4433
(800) 347-7327
FAX: (253) 939-7557

ROCKY MOUNTAIN
4800 Nome Street
Denver, CO
80239
(303) 371-9430
(800) 777-4154
FAX: (303) 375-9546

SOUTH CENTRAL
1838 Forms Drive
Carrollton (Dallas), TX
75006
(972) 245-0387
(800) 441-1437
FAX: (972) 245-4205

UTAH
1415 South 700 West #3
Salt Lake City, UT
84104
(801) 972-0659
FAX: (801) 972-0688

NORTHEAST
543 Industrial Drive
Lewisberry (Harrisburg), PA
17339-9532
(717) 938-8844
(800) 233-0275
FAX: (717) 938-6547

SOUTHEAST
2751 Miller Road
Decatur (Atlanta), GA
30035
(770) 981-7122
(800) 662-6326
FAX: (770) 981-6106

FLORIDA
3445 Bartlett Boulevard
Orlando, FL
32811
(407) 843-1960
(800) 327-6390
FAX: (407) 425-3563

MIDWEST
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Bensenville (Chicago), IL
60106
(630) 773-0075
(800) 662-6330
FAX: (630) 773-0435

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Test Procedures

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 8, 2003

Test Procedure Submittal

A: Line Identification:
Spray system & supply line

B: Test Pressure:
75 pounds per square inch gauge pressure for 2 hours. The piping system shall be held at test pressure for a minimum of 30 minutes then the length of pipe will be walked to check for any visible leaks.

C: Identification of lines in Each Group:

Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 8, 2003

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Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

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August 8, 2003

Test Procedure Submittal

A: Line Identification:
Spray system & supply line

B: Test Pressure:
75 pounds per square inch gauge pressure for 2 hours. The piping system shall be held at test pressure for a minimum of 30 minutes then the length of pipe will be walked to check for any visible leaks.

C: Identification of lines in Each Group:

Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

Field Test Reports

Palisade **C**onstructors, **I**nc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 7, 2003 and August 8, 2003

2. 1 ¼" pipe fittings and valves from the check valve to pitless adapter (each well).

3. Test Medium - Water

4. Test Pressure and Duration:
   Each well pressured to 75 pounds PSI holding gauge pressure for 30 minutes.

5. Test Log:
   Each well vault section flushed of dirt and debris with water, pumped up to pressure.

   Well Number:
   470 – Leak at 1 ¼" T for sample valve. T replaced and brought back to pressure and held for 30 minutes.
   471 – No leaks detected.
   472 – Leak at T filter. T filter replaced and brought back to pressure and held for 30 minutes.
   473 – Leak at ¾" nipple on sample valve. ¾" nipple replaced and brought back to pressure and held for 30 minutes.
   474 – No leaks detected.
   475 – No leaks detected.
   476 – Leak at 1" to 1 ¼" bushing at flow control valve. Bushing replaced and brought back to pressure and held for 30 minutes.
   477 – Leak at ¾" nipple at drain valve. ¾" nipple replaced and brought back to pressure and held for 30 minutes.
   478 – No leaks detected.
   479 – No leaks detected.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Jesus Galindo	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
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Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 11, 2003

2. Well Field header from Well Number 470 to Station 3.75 including water meter, pressure gauge and sample valve, air vacuum release and 10 check valves to well laterals.

3. Test Medium - Water

4. Test Pressure and Duration:
   Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
   Line was flushed of dirt and debris with water and pumped up to pressure. Glue joint on 45 Degree at Station 2.75 was leaking. Replaced 45 Degree. 4x4x1 ½" leaking. Found it was not glued, glued together and brought back up to pressure and held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Jesus Galindo	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 14, 2003

2. 4" Class 160 field piping from Station 3+75 to 13+95 including drain and air vacuum release valve.

3. Test Medium - Water

4. Test Pressure and Duration:
   Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
   Line was flushed of dirt and debris with water and pumped up to pressure. No leaks detected and pressure held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Tony Satterfield	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 19, 2003

2. Spray System and Supply Line – 6" PVC 0+00 to 3+75 including associated valves and fittings. 4" PVC from 3+75 to 6+00 including associated valves an fittings. 3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

3. Test Medium - Water

4. Test Pressure and Duration:
   Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
   Line flushed of dirt and debris with water and pumped up to pressure. No leaks detected and pressure held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Tony Satterfield	Palisade Constructors, Inc.
Michael Reynolds	Palisade Constructors, Inc.

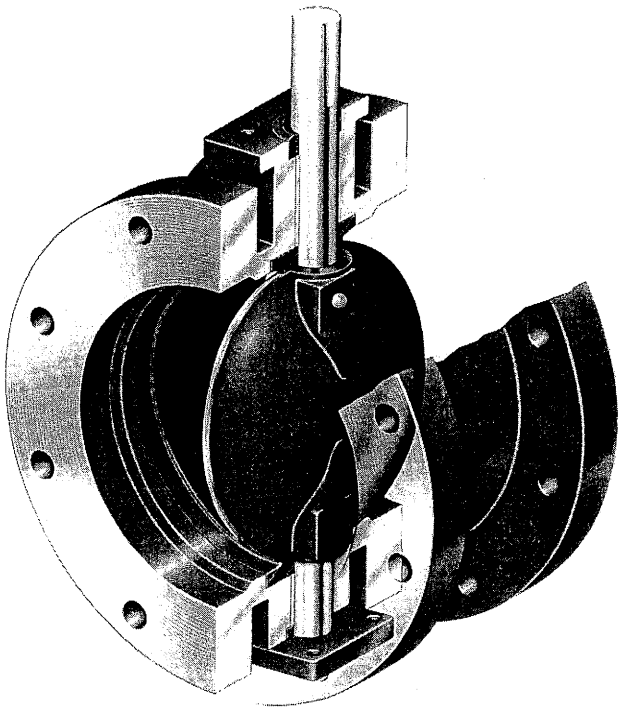
Literature for Piping System Components

MUELLER LINESEAL III Butterfly Valve Features

- CHEVRON V-TYPE PACKING--
  is self-adjusting, long lasting and should never need replacement because quarter-turn valve operation causes little or no wear. Packing bears on turned, ground and polished stainless steel.

- CORROSION RESISTANT SHAFT--
  is constucted of type 304, 18-8 stainless steel. Shaft is one-piece, through-shaft construction sized to meet or exceed requirements of AWWA Standard C504 for Class 150B service.

- HEAVY DUTY CAST IRON BODY--
  is extra heavy with flanges fully faced and drilled per ANSI B16.1 Class 125 Standard for cast-iron flanges. Other ends available include integrally cast mechanical joint, slip-on (for DI and PVC C900), and grooved style. Operator mounting trunnion is machined and drilled for four-bolt connection.



- SELF-LUBRICATING BEARINGS--
  are liberally sized, chemically inert nylon bearings that are self-lubricating and should outlast the life of the pipeline.

- STREAMLINED DISC--
  has lens-shaped design to minimize pressure drop and turbulence. Full open valve creates no more friction loss than a 45 elbow. Disc is secured to the shaft by stainless steel pins sized to transmit torques required and withstand stresses imposed under severe operating conditions. Disc is cast iron ASTM A-126 Class B with 316 stainless steel disc edge.

- ELASTOMERIC BODY SEAT--
  is made of a special rubber compound (Buna N) that is bonded to the body by a patented process. The seat cannot be torn from the body under normal pipeline conditions. The precision molding process also ensures that the disc-seat indentation cannot cause excessive wear or abrasion upon closing.

- TAMPER-PROOF DISC CENTERING--
  provided by precision molded flats in the bonded seat at the body trunnion mate with machined flats on the disc to provide tamperproof centering of the disc in the body. Positive disc alignment, without pinching, assures long seat life.

Need position locking handle

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

	No Exceptions Taken
X	Furnish as Corrected
	Amend and Resubmit
	Rejected

Date 6/27/03 Department ENG

By [illegible]

FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

MUELLER® 24"* - 48"** LINESEAL III® AND 6"*-48"** LINESEAL XP BUTTERFLY VALVES

MUELLER LINESEAL III and LINESEAL XP Butterfly Valve Features

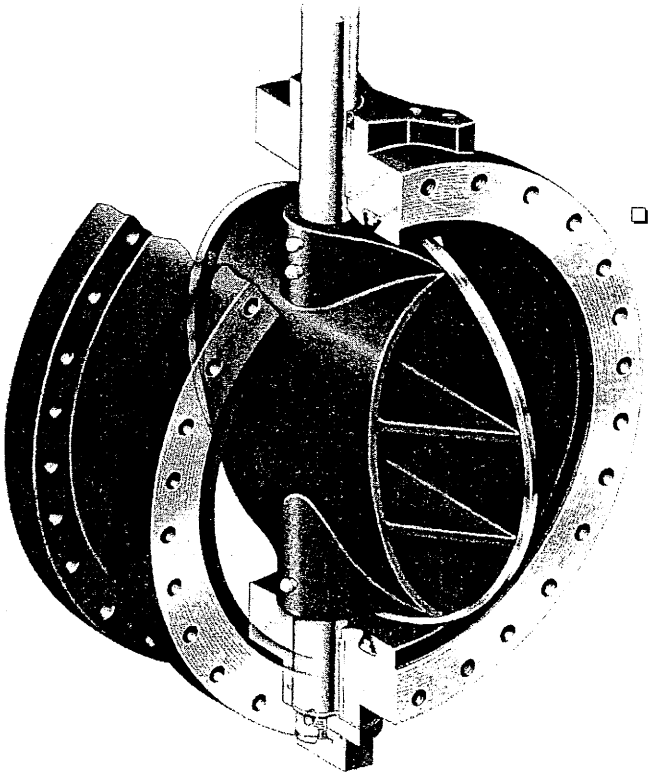
- CORROSION RESISTANT SHAFT--
  is constucted of ASTM A-276 Type stainless steel. Two-piece, stub-type shafts are sized per AWWA Standard C504, Class 150B or Class 250.

- CHEVRON V-TYPE PACKING--
  is self-adjusting packing in top trunnion of valve body where shaft protrudes, includes nylon retainer.

- STRONG DISC AND SHAFT CONNECTIONS--
  with generously sized stainless steel pins designed to transmit torques required and withstand stresses imposed under severe operating conditions.

- PRESET TWO-WAY THRUST BEARING ASSEMBLY--
  is preset at factory. On valves 30" and larger, assembly consists of stainless steel stud fastened to the bottom of the valve shaft. Stud extends beyond the bottom cover. Thrust collar is threaded to the stud and pinned. On 24" size Lineseal III and 6" to 24" Lineseal XP, thrust collar is pinned to shaft and adjustment provided by bronze spacers. Thrust collar cavity is packed with grease and fully gasketed to prevent leakage.

- HEAVY DUTY ASTM A-126 CAST IRON BODY--
  is extra heavy; on flange-end bodies, flange drilling per ANSI B16.1 Class 125 (or Class 250) Standard for cast iron flanges. Also available with Mechanical Joint ends.



- SELF-LUBRICATING, SLEEVE-TYPE BEARINGS--
  are used in both trunnions of the valve body. Teflon lined with special non-metallic backing. Provide electrical insulation between disc and shaft to prevent galvanic corrosion. Lower coefficient of friction reduces operating torque requirements.

- FLOW-THROUGH DISC*--
  provides less pressure drop in full-open position than conventional disc shapes. (On 24" size Lineseal III and 6" to 24" Lineseal XP the arch side of disc is closed and the flat side is open, forming a slightly concave surface.) Disc structure has no internal cores that can shift during casting, no hollow chambers that can collect water, freeze and fracture the disc. Disc edge has stainless steel spherically shaped seating surface. Ductile iron ASTM A-536 is used for 30"-48" Lineseal III and for 6"-8" and 24"-48" Lineseal XP. (Cast iron ASTM A-48 Class 40 is used for 24" size Lineseal III and for 10"-20" Lineseal XP.)

- ELASTOMERIC SEAT--
  is made of a special rubber compound (Buna N) that seals a full 360 against a stainless steel spherical disc edge. Unique grooved-seal design, coupled with the wide spherically shaped seating edge of the disc, allows greater disc closure tolerance (up to 1 off center in closed position without leakage). Seat is mechanically retained in body without metal hardware by a cast epoxy compound that ensures the seat conforms to the exact radius of the disc with uniform contact pressure.

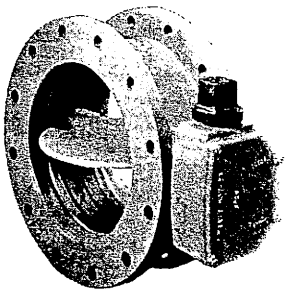
* Note: 6" - 24" disc is slightly modified, non flow-through disc design.

** Contact your Mueller representative for valves sizes larger than 48".

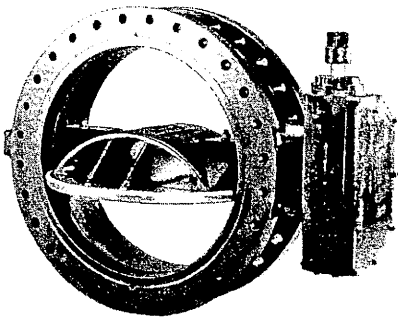
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

BUTTERFLY VALVES 4" - 48"*

- Catalog number--
  3211-6 Flanged Ends
  3211-20 Mechanical joint ends
  (with mechanical joint unassembled accessories)
  3211-23 Mechanical joint ends
  (without mechanical joint accessories)
  Sizes--4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 30", 36", 42", 48", 54"-72"*
  3211-16 Flanged by mechanical joint ends
  (with mechanical joint unassembled accessories)
  3211-19 Flanged by mechanical joint ends
  (without mechanical joint unassembled accessories)
  Sizes--6", 8", 10", 12", 14", 16"
  3211-41 Flanged by slip-on
  Sizes--4", 6", 8", 10", 12"
  3211-38 Slip-on by slip-on
  Sizes--4", 6", 8", 10", 12", 16Ó



- Meets or exceeds all applicable requirements of ANSI/AWWA C504 Standard Class 150B; NSF 61 certified
- Buried service valves: I.D. and O.D. coated with 5 mils Asphalt Varnish
- Above ground valves (ordered with either a handwheel, position indicator on the actuator, or lever): coated with 3 mils Tnemec Series 140F Pota-Pox Plus primeron the valve O.D. and 5 mils Asphalt Varnish on the I.D. as standard; meets AWWA C-504 standards.
- Seat-in-body design reduces seat failure due to corrosive buildup in the valve and pipeline
- Through-disc pinning provides a tight disc-to-shaft pin connection, greatly reducing the possibility of loosening through vibration
- Disc edge is 316 Stainless Steel
- Symetrical lens-shaped disc for higher Cv and lower head loss
- Nonmetallic bearings prevent galvanic corrosion and provides lower coefficient of friction
- Cheveron "V" type packing is self-adjusting to last the life of the valve



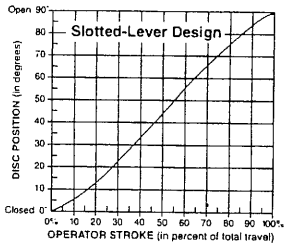
Options

- MDT Actuatorwith handwheel or chainwheel and position indicator
- MDT Actuator with cylinder actuator (also available with manual override, handjack and 4-way solenoid valve)
- Hand lever for 4"-10" valves
- 200 psi test
- Extension stems (see page 10.71)
- Expoxy interior and/or exterior
- Holiday testing
- Mueller ground position indicator

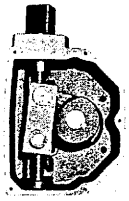
Standard Buried Service Actuators

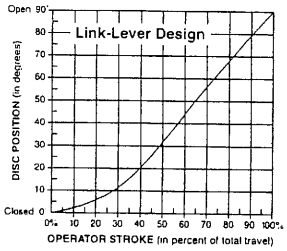
Valve size	Actuator	Number of turns
4" - 12"	MDT-2	32
14" - 20"	MDT-3	30
16" - 24"	MDT-4	40
20" - 30"	MDT-5	136
30" - 36"	MDT-5S	136
36" - 48"	MDT-6	215
36" - 48"	MDT-7	492

Slotted-Lever (4"-12")



Link-Lever (14"-48")





* Contact your Mueller representative for valve sizes larger than 48".

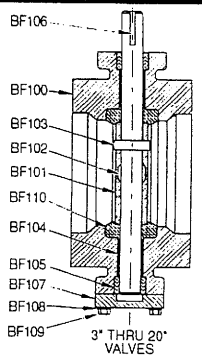
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

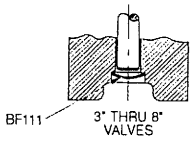
MUELLER® LINESEAL III® BUTTERFLY VALVES 4"-48"* CLASS 150B-PARTS

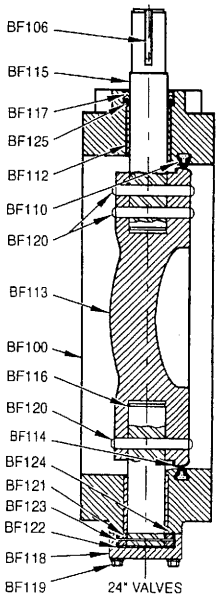
Lineseal III Butterfly Valve Replacement Parts

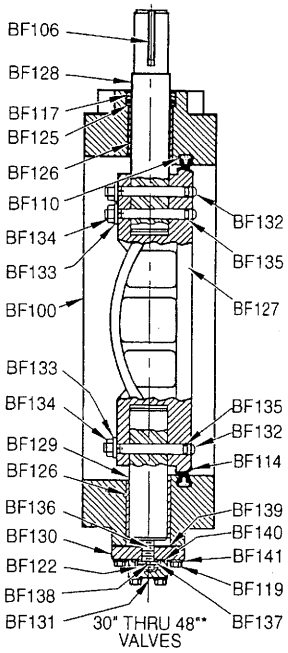
Catalog Part No.	Description	Material
BF100	Body	Cast iron ASTM A126 CL. B
BF101	Disc:**	Cast Iron ASTM A126, Class B with 316 Edge
BF102	Shaft	Stainless Steel 18-8 Type 304 ASTM A-276
BF103	Squeeze pin	Stainless Steel 18-8 Type 304 ASTM A-276
BF104	Bearing	Nylatron GS
BF105	Packing	Chevron V-Type
BF106	Key	Carbon Steel C-1045
BF107	Cover	Cast Iron ASTM A-48 Class 40
BF108	Lockwasher	Carbon Steel
BF109	Cap screw	Steel SAE Gr. 2
BF110	Seat	Buna-N
BF111***	Exp. plug	Stainless Steel 18-8 Type 304 ASTM A-276
BF112	Bearings	Teflon Lined, Filament Wound, Reinforced Plastic, Fiberglass Backed
BF113	Disc	Cast Iron ASTM A-48 Class 40
BF114	Disc edge	Stainless Steel Type 316 ASTM A-240
BF115	Top stub shaft	Stainless Steel Type 304 ASTM A-276 Stainless Steel Type 316 ASTM A-276 400 Monel ASTM B-164 Class A
BF116	Bottom stub shaft	Stainless Steel Type 304 ASTM A-276 Stainless Steel Type 316 ASTM A-276 400 Monel ASTM B-164 Class A
BF117	Packing	Buna-N
BF118	Bottom cover	Cast Iron ASTM A-48 Class 40
BF119	Cap screws	Carbon Steel
BF120	Squeeze pins	Stainless Steel Type 304 ASTM A-479
BF121	Thrust collar	Stainless Steel Type 420
BF122	Thrust collar shims	Bronze
BF123	Spring pin	Stainless Steel Type 420
BF124	O-ring	Buna-N
BF125	Packing retainer	Nylon
BF126	Bearings	Duralon
BF127	Disc	Ductile Iron ASTM A-536 Grade 65-45-12
BF128	Top stub shaft	Stainless Steel Type 304 ASTM A-276
BF129	Bottom stub shaft	Stainless Steel Type 304 ASTM A-276
BF130	Bottom cover	Cast Iron ASTM A-126 Class B
BF131	Bottom cover cap	Cast Iron ASTM A-126 Class B
BF132	Taper pins	Stainless Steel Type 630 ASTM A-564 Cond. H-1150
BF133	Lockwashers	Stainless Steel Type 304
BF134	Hex nuts	Stainless Steel Type 304
BF135	O-rings	Buna-N
BF136	Thrust bearing stud	Stainless Steel Type 304
BF137	Thrust collar	Bronze ASTM B-505 Alloy C93200
BF138	Dowel pin	Alloy Steel
BF139	Bottom cover gasket	Blended Fiber, Cured Nitril Binder
BF140	O-ring	Buna-N
BF141	Loctite	Loctite

* Contact you Meuller representative for sizes larger than 48".
**4" is ASTM A743 CF8M Stainless Steel.
***This plug is for 3"-8" sizes only.



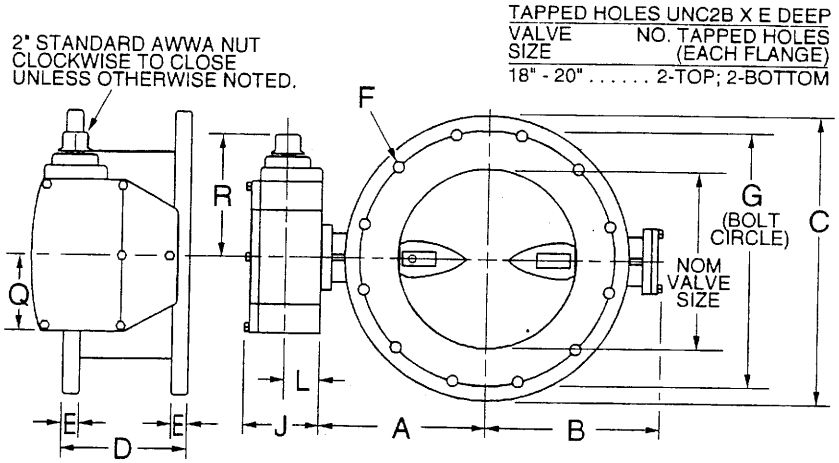




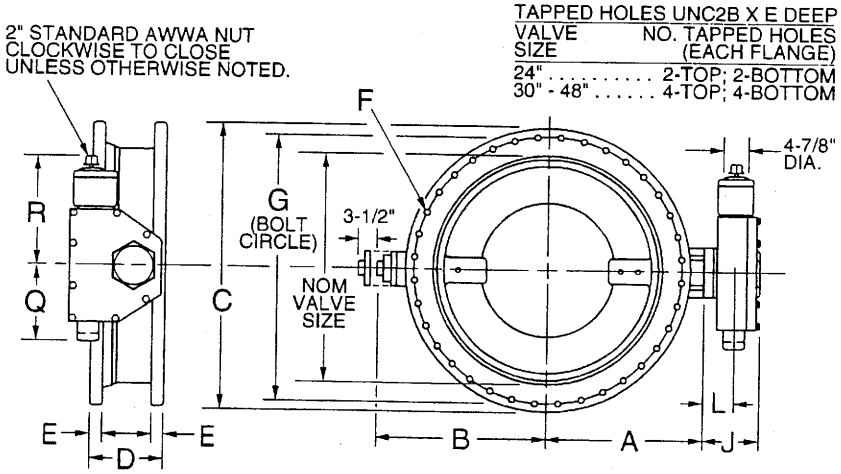


FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

Dimensions - for Mueller Lineseal III Butterfly Valves Flanged Ends, 4" - 20" Sizes.



Dimensions - for Mueller Lineseal III Butterfly Valves Flanged Ends, 24" - 48" Sizes.



Dimensions

Dimension +	Nominal size													
	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"
A	5-1/2	6-1/2	7-3/4	9	10-1/2	11-7/8	13-1/2	14-3/8	16	18-5/8	21-1/2	25-7/16	29-7/8	34-1/16
B	3-1/2	5-1/8	6-1/2	9-7/8	11-5/8	12-3/4	14-3/8	15-1/4	16-7/8	18-3/8	24-3/16	28-1/16	32-11/16	34-7/8
C	9	11	13-1/2	16	19	21	23-1/2	25	27-1/2	32	38-3/4	46	53	59-1/2
D ***	5	5	6	8	8	8	8	8	8	8	12	12	12	15
E	15/16	1	1-1/8	1-3/16	1-5/16	1-3/8	1-7/16	1-9/16	1-11/16	1-7/8	2-1/8	2-3/8	2-5/8	2-3/4
F (number and size of holes)	8---5/8	8---3/4	8---3/4	12---7/8	12---7/8	12---1	16---1	16---1-1/8	16---1-1/8	20---1-1/4	28---1-1/4	32---1-1/2	36---1-1/2	44---1-1/2
G	7-1/2	9-1/2	11-3/4	14-1/4	17	18-3/4	21-1/4	22-3/4	25	29-1/2	36	42-3/4	49-1/2	56
J	4-3/8	4-3/8	4-3/8	4-3/8	4-3/8	5-3/16	5-3/16	5-15/16	5-15/16	5-15/16	7-13/16	8-13/16	10-7/16	10-7/16
L	2	2	2	2	2	2-7/16	2-7/16	2-13/16	2-13/16	2-13/16	3-13/16	4-5/16	5-7/16	5-7/16
Q	4-1/4	4-1/4	4-1/4	4-1/4	4-1/4	5-3/8	5-3/8	6-3/4	6-3/4	6-3/4	10	15-15/16	18-5/8	18-5/8
R	7-5/8	7-5/8	7-5/8	7-5/8	7-5/8	9-1/4	9-1/4	10-1/2	10-1/2	10-1/2	17	19-11/16	26-1/2	26-1/2
Turns to open	32	32	32	32	32	30	30	40	40	40	44	136	215	215
Weight +	60	81	118	201	270	377	456	588	678	1029	1874	2735	3690	4340

Other sizes available upon request.
** Also available in FL.xFL. 30"-72" sizes: Class 75A, 75B, 25A, 25B.
*** ±1/16" for 10" valves, and ±1/8" for 12" - 48" valves per Flange Standard ANSI B16.1.
+ All dimensions are in inches. All weights are in pounds and are approximate.

FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

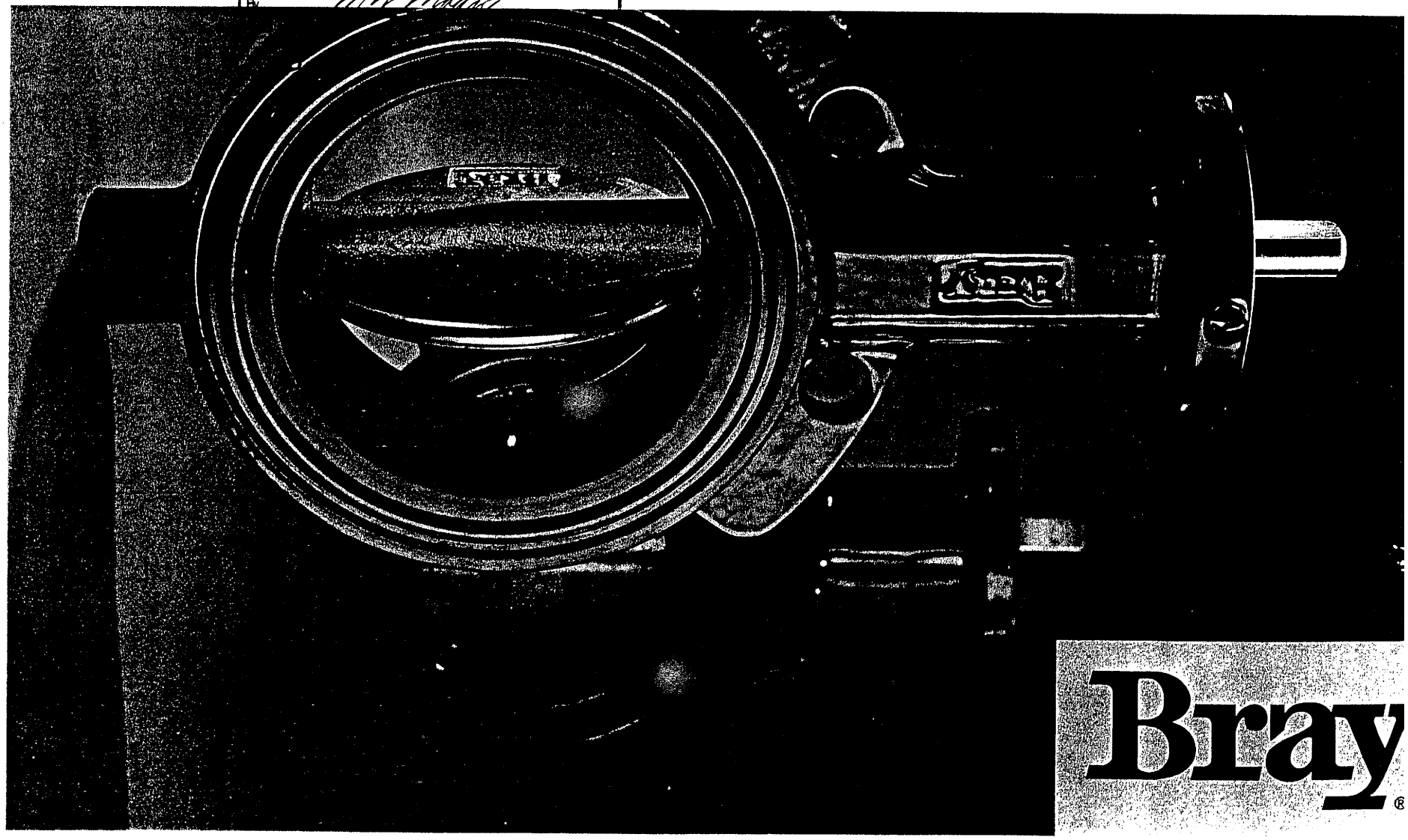
Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

	No Exceptions Taken
X	Furnish as Corrected
	Amend and Resubmit
	Rejected

Date 6/27/03 Department ENG

By Mr Martin

Need Positive locking handle



Bray®

The High Performance Company

BUTTERFLY VALVES

RESILIENT SEATED

SERIES 30/31 Wafer/Lug

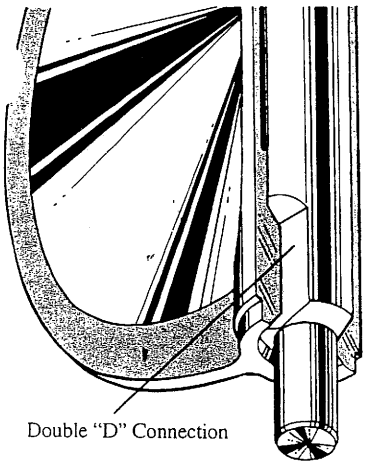
2" - 20" (50mm-500mm)

SERIES 30

2"–20" (50mm–500mm)
Bray® Controls is proud to offer a high quality line of butterfly valves to meet the requirements of today's market. Combining years of field application experience, research and development, Bray has designed many unique features in the Series 30/31 not previously available. The results are longer service life, greater reliability, ease of parts replacement and interchangeability of components.

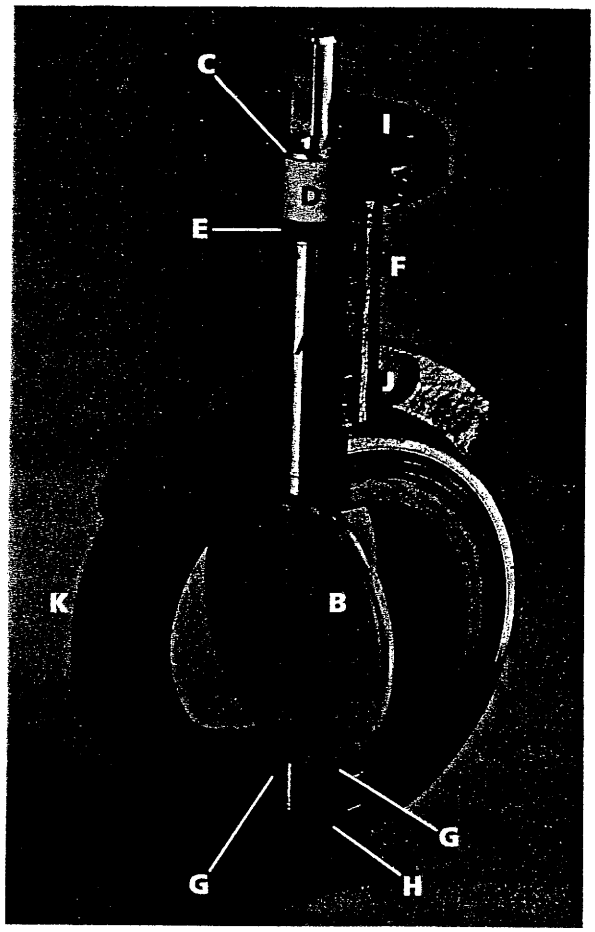
DISC AND STEM CONNECTION

(**A**) Features a high-strength through stem design. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. It eliminates stem retention components being exposed to the line media, such as disc screws and taper pins, which commonly result in leak paths, corrosion, and vibration failures. Disc screws or taper pins, due to wear and corrosion, often



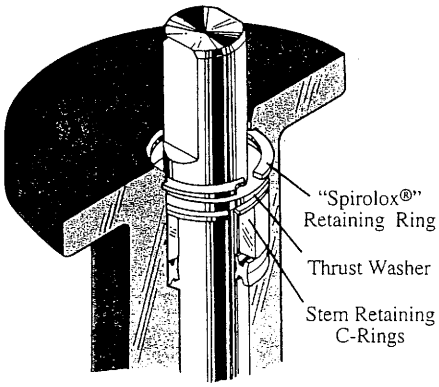
require difficult machining for disassembly. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc. Without fasteners obstructing the line flow, the Series 30/31 C_V values are higher than many other valves, turbulence is reduced, and pressure recovery is increased. The stem ends and top mounting flange are standardized for interchangeability with Bray actuators.

DISC (**B**) Casting is spherically machined and hand polished to provide a bubble-ght shut off, minimum torque, and ɔnger seat life. The disc O.D. clearance is designed to work with all standard piping.



STEM RETAINING ASSEMBLY (C)

The stem is retained in the body by means of a unique Stainless Steel "Spirolox®" retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.



STEM BUSHING (D)

Non-corrosive, heavy duty acetal bushing absorbs actuator side thrusts.

STEM SEAL (E)

Double "U" cup seal design is self-adjusting and gives positive sealing in both directions. Prevents external substances from entering the stem bore.

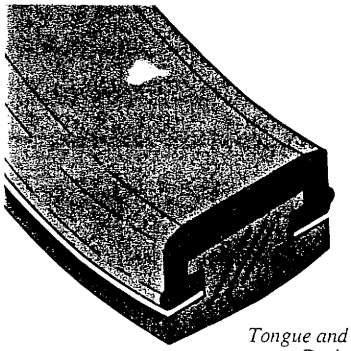
NECK (**F**) Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

PRIMARY AND SECONDARY SEALS (G)

The Primary Seal is achieved by an interference fit of the molded seat flat with the disc hub. The Secondary Seal is created because the stem diameter is greater than the diameter of the seat stem hole. These seals prevent line media from coming in contact with the stem or body.

BRAY UNIQUE SEAT DESIGN (H)

One of the valve's key elements is Bray's unique *tongue and groove* seat design. This resilient seat features lower torque than many valves on the market today and provides complete isolation of flowing media from the body. The tongue-and-groove seat to body retention method is superior to traditional designs, making field replacement simple and fast. The seat is specifically designed to seal with slip-on or weld-neck flanges. The seat features a molded O-ring which eliminates the use of flange gaskets. An important maintenance feature is



Tongue and Groove Design

*"Spirolox®" designation is a registered trademark of Kaydon Ring and Seal, Inc.

that all resilient seats for Bray butterfly valves Series 20, 21, 30, 31 and 34 are completely interchangeable.

ACTUATOR MOUNTING FLANGE AND STEM CONNECTION (I)

Universally designed to ISO 5211 for direct mounting of Bray® power actuators and manual operators.

FLANGE LOCATING HOLES (J)

Provide quick and proper alignment during installation.

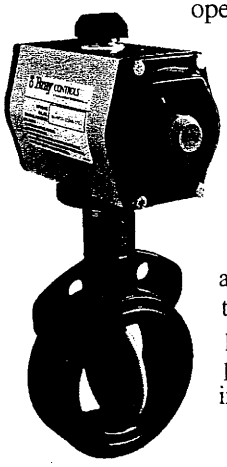
BODY (K) One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Bray valve bodies meet ANSI 150 pressure ratings for hydrostatic shell test requirements.

DESIGN FEATURES

Bray's Series 30 valve is a wafer version with flange locating holes, and the Series 31 is the companion lug version for dead-end service and other flange requirements. All Bray valves are tested to 110% of full pressure rating before shipment.

A major design advantage of Bray valve product lines is international compatibility. The same valve is compatible with most world flange standards – ANSI Class 125/150, BS 10 Tables D and E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10. In addition the valves are designed to comply with ISO 5752 face-to-face and ISO 5211 actuator mounting flanges. Therefore, one valve design can be used in many different world markets.

Due to a modular concept of design, all Bray® handles, manual gear operators and pneumatic and electric actuators mount directly to Bray valves. No brackets or adapters are required.



Bray interchangeability and compatibility offers you the best in uniformity of product line and low-cost performance in the industry today.

POLYESTER COATING CORROSION PROTECTION

Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistance – resists a broad range of chemicals including: dilute aqueous acids and alkalies, petroleum solvents, alcohols, greases and oils. Offers outstanding resistance to humidity and water.

Weatherability – outdoor tested resistant to ultra-violet radiation.

Abrasion Resistance – excellent resistance to abrasion.

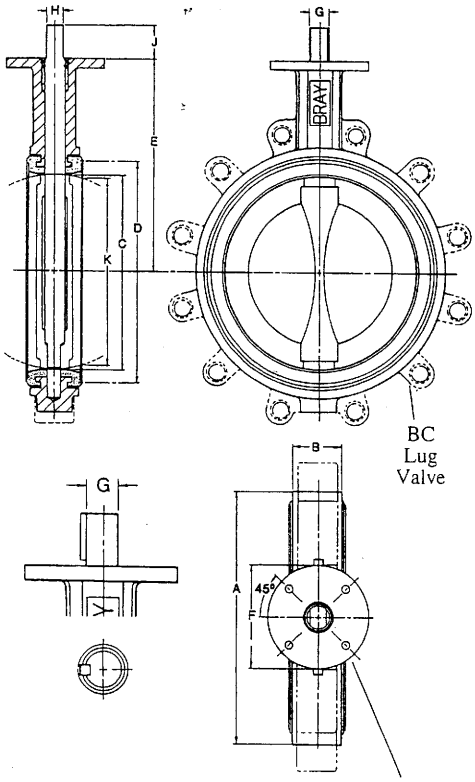
Impact Resistance – withstands impact without chipping or cracking.

NYLON 11 COATING

Optionally available for valve bodies where outstanding protection and performance is needed. A thermoplastic produced from a vegetable base, this coating is inert to fungus growth and molds. Nylon 11 is *USDA Approved*, as well as certified to ANSI/NSF 61 for water service.

Corrosion Resistance – superior resistance to a broad range of chemical environments. Salt spray tested in excess of 2,000 hours and seawater immersion tested for over 10 years without corrosion to metal substrates.

Nylon 11 features a very low coefficient of friction and excellent resistance to impact and ultra-violet radiation.



See chart for Actuator Mounting Flange Drilling.

DIMENSIONS SERIES 30 Wafer

Valve Size ins	Valve Size mm	A	B	C	D	E	F	Mounting Flange Drig. BC	No. Holes	Hole Dia.	G	H	J	K
2	50	3.69	1.62	2.00	2.84	5.50	3.54	2.76	4	.39	.55	.39	1.25	1.32
2 1/2	65	4.19	1.75	2.50	3.34	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91
3	80	4.88	1.75	3.00	4.03	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55
4	100	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57
5	125	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63
6	150	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45
8	200	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45
10	250	12.75	2.50	9.75	11.47	10.75	5.91	4.92	4	.57	1.18	.87	2.00	9.53
12	300	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47

SERIES 31 Lug

Lug Bolting Data BC	No. Holes	Threads UNC-2B
4.75	4	5/8-11
5.50	4	5/8-11
6.00	4	5/8-11
7.50	8	5/8-11
8.50	8	3/4-10
9.50	8	3/4-10
11.75	8	3/4-10
14.25	12	7/8-9
17.00	12	7/8-9

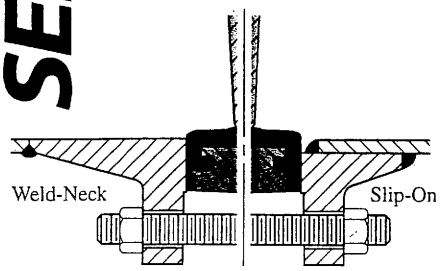
Valve Size ins	Valve Size mm	A	B	C	D	E	F	Mounting Flange Drig. BC	No. Holes	Hole Dia.	G	J	KEY SIZE	K
14	350	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	.39x.39	13.04
16	400	19.21	4.00	15.25	17.41	14.75	5.91	4.92	4	.57	1.38	2.00	.39x.39	14.85
18	450	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	.39x.47	16.85
20	500	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	.39x.47	18.73

Lug Bolting Data BC	No. Holes	Threads UNC-2B
18.75	12	1-8
21.25	16	1-8
22.75	16	1 1/8-7
25.00	20	1 1/8-7

SELECTION DATA

FLANGE REQUIREMENTS

Bray valves are designed for installation between ANSI Class 125/150 lb. weld-neck or slip-on flanges, BS 10 Tables D & E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10, either flat faced or raised faced. While weld-neck flanges are recommended, Bray has specifically designed its valve seat to work with slip-on flanges, thus eliminating common failures of other butterfly valve designs. When using raised face flanges be sure to properly align valve and flange. Type C stub-end flanges are not recommended.



PRESSURE RATINGS*

For bi-directional bubble-tight shut off, disc in closed position:

Inches	mm	psig	bar
2-12	50-300	175	12
14-20	350-500	150	10

For Dead-end Service Applications:
With *downstream flanges installed* or with *vulcanized seats,* the dead-end pressure ratings are equal to valve bi-directional ratings as stated above. With no downstream flanges or with seats that are not vulcanized, the dead-end pressure rating for 2"-12" valves is 75 psi (5 bar) for 14"-20" valves, 50 psi (3.5 bar).

*Pressure Ratings are based on standard disc diameters. For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and to extend seat life, thus increasing the valve's performance and reducing actuator costs for the customer.

VELOCITY LIMITS

For On/Off Services:
Fluids – 30 ft / sec (9m / s)
Gases – 175 ft / sec (54m / s)

C_V VALUES–VALVE SIZING COEFFICIENT

Valve Size		Disc Position (degrees)								
ins	mm	90°	80°	70°	60°	50°	40°	30°	20°	10°
2	50	144	114	84	61	43	27	16	7	1
2 1/2	65	282	223	163	107	67	43	24	11	1.5
3	80	461	364	267	154	96	61	35	15	2
4	100	841	701	496	274	171	109	62	27	3
5	125	1376	1146	775	428	268	170	98	43	5
6	150	1850	1542	1025	567	354	225	129	56	6
8	200	3316	2842	1862	1081	680	421	241	102	12
10	250	5430	4525	2948	1710	1076	667	382	162	19
12	300	8077	6731	4393	2563	1594	1005	555	235	27
14	350	10538	8874	5939	3384	2149	1320	756	299	34
16	400	13966	11761	7867	4483	2847	1749	1001	397	45
18	450	17214	14496	10065	5736	3643	2237	1281	507	58
20	500	22339	18812	12535	7144	4536	2786	1595	632	72

C_V is defined as the volume of water in U.S.G.P.M. that will flow through a given restriction or valve opening with a pressure drop of one (1) p.s.i. at room temperature. Recommended control angles are between 25°–70° open. Preferred angle for control valve sizing is 60°–65° open.

EXPECTED SEATING/UNSEATING TORQUES (Lb.-Ins.)

Valve Size		Full-Rated Pressure Valves				Reduced Disc Diameter
		ΔP (PSI)				ΔP (PSI)
ins	mm	50	100	150	175	50
2	50	125	130	135	140	125
2 1/2	65	195	205	215	220	195
3	80	260	275	290	297	260
4	100	400	425	450	462	267
5	125	615	670	725	755	410
6	150	783	871	953	1003	537
8	200	1475	1650	1825	1915	983
10	250	2240	2520	2800	2940	1493
12	300	3420	3870	4320	4545	2280
14	350	4950	5700	6450	—	3300
16	400	6400	7700	9000	—	4267
18	450	7850	9850	11850	—	5267
20	500	10300	12900	15500	—	6867

Valve Torque Rating – Bray has classified valve torque ratings according to 3 types: non-corrosive lubricating service, general service, and severe service. Torques listed above are for general services. Consult Bray for torque information corresponding to specific applications.

TO USE TORQUE CHART, NOTE THE FOLLOWING:
1) For Bray valves, Series 20, 21, 30, 31 and 34.
2) Review Technical Bulletin No. 1001, Expected Seating/Unseating Torques, for explanation of the 3 service classes and their related seating/unseating torque values for given pressure differentials of Full-Rated and Reduced Disc Diameter valves.
3) Dynamic Torque values are not considered. See Technical Bulletin No. 1002 for evaluation of Dynamic Torque values vs. Seating/Unseating Torque values.
4) Do not apply a safety factor to above torque values when determining actuator output torque requirement.
5) For 3 way assemblies where one valve is opening and other is closing, multiply torque by 1.5 factor.

SPECIFICATIONS

RECOMMENDED SPECIFICATIONS FOR BRAY SERIES 30/31 SHALL BE:

- Polyester coated, cast iron, wafer or lug bodies.
- With flange locating holes that meet ANSI Class 125/150 (or BS 10 Tables D & E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10) drillings.
- Through-stem direct drive double "D" design requiring no disc screws or pins to connect stem to disc with no possible leak paths in disc/stem connection.
- Stem mechanically retained in body neck and no part of stem or body exposed to line media.
- Tongue-and-groove seat design with primary hub seal and a molded O-ring suitable for weld-neck and slip-on flanges. Seat totally encapsulates the body with no flange gaskets required.
- Spherically machined, hand polished disc edge and hub for minimum torque and maximum sealing capability.
- Equipped with non-corrosive bushing and self-adjusting stem seal.
- Bi-directional and tested to 110% of full rating.
- Bi-directional pressure ratings:
2"-12" valves: 175 psi, 14"-20" valves: 150 psi
Lug bodies for dead end service
With downstream flanges or vulcanized seats, pressure ratings are equal to bi-directional ratings as stated above.
With no downstream flanges or non-vulcanized seats: 2"-12" valves: 75 psi, 14"-20" valves: 50 psi
- No field adjustment necessary to maintain optimum field performance.
- The valve shall be Bray Series 30 wafer / 31 lug or equal.

WEIGHTS

Valve Size ins	Valve Size mm	Series 30	Series 31
2	50	5.5	7.0
2 1/2	65	7.0	8.0
3	80	7.5	9.0
4	100	11.5	15.0
5	125	14.0	20.0
6	150	17.0	23.0
8	200	34.0	42.0
10	250	49.0	66.0
12	300	67.0	88.0
14	350	95.0	114.0
16	400	135.0	166.0
18	450	200.0	226.0
20	500	260.0	305.0

Weights are in lbs.

MATERIALS SELECTION

2"-20" (50mm-500mm)

BODY:

- Cast Iron ASTM A126 Class B
- Ductile Iron ASTM A536
- Cast Steel ASTM A216 WCB
- Aluminum ASTM B26

SEAT:

- Buna-N – Food Grade
- EPDM – Food Grade
- FKM*
- White Buna-N – Food Grade

STEM:

- Coated Carbon Steel
- 416 Stainless Steel ASTM A582 Type 416
- 304 Stainless Steel ASTM A276 Type 304
- 316 Stainless Steel ASTM A276 Type 316
- Monel

DISC:

- Aluminum Bronze ASTM B148-954
- Coated Ductile Iron ASTM A536 Gr. 65-45-12
- Ductile Iron, Nylon 11 Coated, ASTM A536 Gr. 65-45-12
- Ductile Iron, Halar® Coated, ASTM A536 Gr. 65-45-12
- 316 Stainless Steel ASTM A351 CF8M
- Hastelloy® C-276 ASTM B575 Alloy N10276

COMPONENTS

No.	Qty.	Description
1	1	Body
2	1	Seat
3	1	Disc
4	1	Stem
5	1	Stem Seal
6	1	Stem Bushing
7	2	Stem Retainer
8	1	Thrust Washer
9	1	Retaining Ring

TEMPERATURE RANGE OF SEATS

Type	Maximum	Minimum
EPDM	+250°F(121°C)	-40°F(-40°C)
Buna-N	+212°F(100°C)	0°F(-18°C)
FKM*	+400°F(204°C)	0°F(-18°C)

*FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (also called Fluoroelastomers).

Hastelloy® is a registered trademark of Haynes International, Inc.
Halar® is a registered trademark of Ausimont U.S.A., Inc.

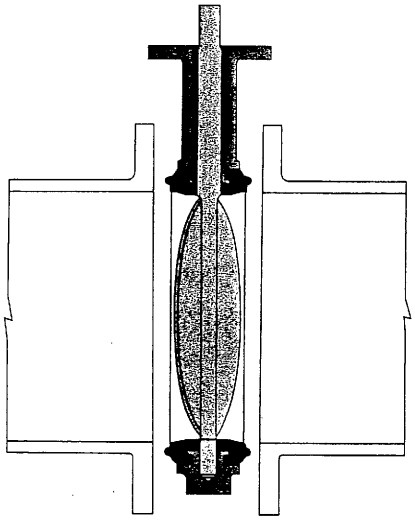
ASSEMBLY

INSTALLATION

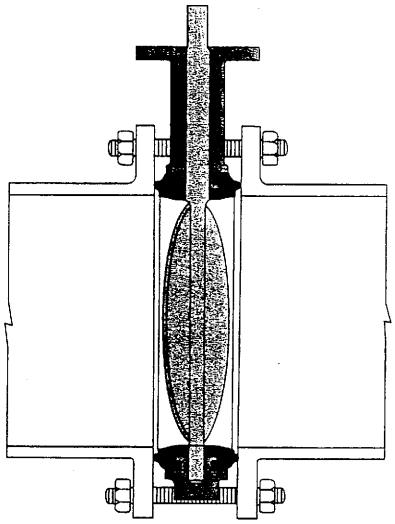
Position the disc in the partially open position, maintaining the disc within the body face-to-face. Place the body between the flanges and install flange bolts. *Do not use flange gaskets.* Before tightening flange bolts, carefully open the disc to the full open position to ensure proper alignment and clearance of the disc O.D. with the adjacent pipe I.D. Leave disc in the full open position and tighten flange bolts per required specification. Once bolts are tightened, carefully rotate disc to closed position to ensure disc O.D. clearance.

MAINTENANCE AND REPAIR

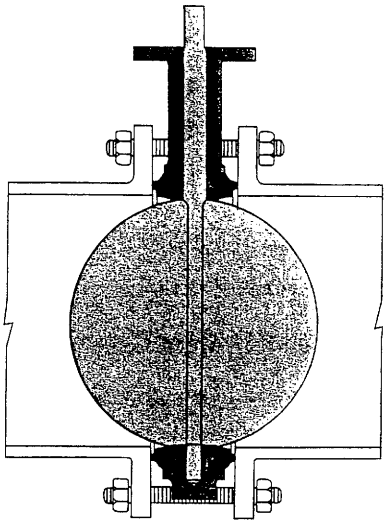
The many Bray features minimize wear and maintenance requirements. No routine lubrication is required. All components – stem, disc, seat, bushing, stem seal, etc., are field replaceable, no adjustment is needed. If components require replacement, remove the valve from the line by placing the disc near the closed position, spread the flanges, support the valve, then remove the flange bolts. No valve maintenance, including removal of manual or power actuators, should be performed until the piping system is completely depressurized.



Disc in the Near Closed Position



Disc in the Partially Open Position



Disc in the Full Open Position

DISASSEMBLY

Remove the handle, gear operator, or actuator from actuator mounting flange. Remove "Spirolox®" retaining ring. Remove stem with its thrust washer and two C-ring stem retainers. Remove bushing and seal. Remove the disc from the seat, protecting disc edge at all times. Push the seat into an oval shape, then remove the seat from the body.

ASSEMBLY

Push the valve seat into an oval and push it into the body with seat stem holes aligned to body stem holes. Push stem into the stem hole of body. For aid in inserting disc, slightly protrude stem beyond the I.D. of the top of the seat. Install a light coating of foodgrade silicone oil (for silicone free applications use soap and water) on the I.D. of seat. Insert the disc into the seat by lining up the disc hole with the stem hole of the seat. Note: the broached double "D" flats in the disc must be toward the bottom of valve body. (Take special care when lining disc up with stem.) With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole. Make certain that when pushing the stem through disc bottom, the broached flats of stem and disc are aligned. After the stem has engaged the disc, but before the stem is firmly seated in the body, replace the stem seal and bushing. Install the two C-ring stem retainers in the groove in the stem and thrust washer on top of the C-rings. Seat the stem firmly in the body and install the "Spirolox®" retaining ring back into position.

Accredited by the Dutch Council for Certification

ABS Quality Evaluations, Inc. Quality Assurance Certification

ACCREDITED REGISTRAR ANSI-RAB

ISO 9001

Certificate Number: 31938

DISTRIBUTOR

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United States patent number 5,152,501.
Other patents issued and applied for worldwide.

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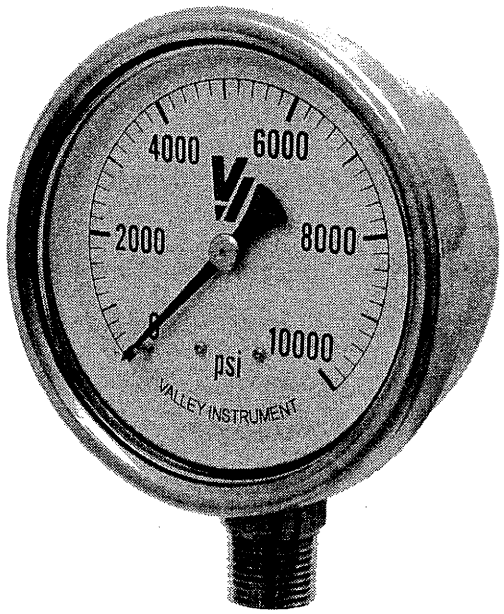


Model 58
All Stainless Gauges
Welded Connection
Field Repairable
(Single Scale)

SUBMITTAL REVIEW

Date 6/27/03 Department ENG

By

4" Case Only

Bottom Mount Only

These gauges are designed for use with any medium not corrosive to stainless steel. Liquid-filled gauges are recommended for reducing shock caused by pressure fluctuations or vibration.

FEATURES

MOVEMENT:	Stainless Steel
BOURDON TUBE:	316 Stainless Steel
POINTER:	Black enameled aluminum
DIAL:	White aluminum
WINDOW:	Polycarbonate
CASE MATERIAL	304 Stainless steel
BEZEL	304 Stainless steel, Bayonet type.
CONNECTION MATERIAL	316 Stainless steel
CONNECTION SIZE	1/2" MNPT Standard
ACCURACY:	ASME/ANSI B40.1 Grade 1A (1%)

STANDARD RANGES

Standard gauge scales - PSI Only

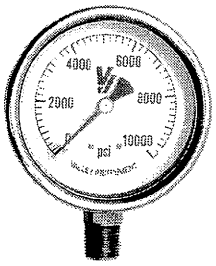
STANDARD DIAL RANGES	AVAILABILITY	GRADUATION	
PSI	4"	Major	Minor
0-30" VAC	✓	5	.5
0-15 psi	✓	2	.2
0-30 psi	✓	5	.5
0-60 psi	✓	10	1
0-100 psi	✓	20	2
0-160 psi	✓	20	2
0-200 psi	✓	50	5
0-300 psi	✓	50	5
0-400 psi	✓	100	10
0-600 psi	✓	100	10
0-1000 psi	✓	200	20
0-1500 psi	✓	200	20
0-2000 psi	✓	500	50
0-3000 psi	✓	500	50
0-5000 psi	✓	1000	100
0-10000 psi	✓	2000	200
0-15000 psi	✓	2000	200
0-20000 psi	✓	2000	200

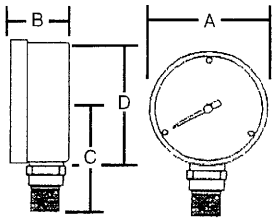
PRICING AND OPTIONS - (Stock)

4" CASE	. . . . . $116.00

CASE STYLES AND DIMENSIONS

BOTTOM MOUNT Style 1





SIZE	A	B	C	D	E
4"	4.344"	1.828"	3.391"	3.970"	n/a

ORDERING INFORMATION

To determine the ordering number, use the following information

Example - 4158GXX200 = 4", 1/2" Btm Mt., All Stainless - Field Repairable, Glycerin-filled, Stainless Case, 200 PSI

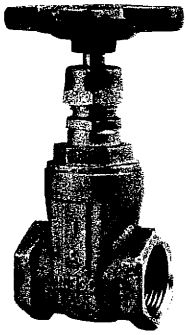
4	1	58	G	X	X	200	
1st Digit	2nd Digit	3rd & 4th Digits	5th Digit	6th Digit	7th Digit	Range	Suffix
Dial Size	Case Style	Model	Fill Material	Case Material	Wetted Parts	PSI	Options
4 = 4"	1 = Bottom	58 = Stainless Field Repairable	D - Dry G - Glycerin S - Silicone F - Florolube	X = Stainless	X = Stainless	SEE RANGE CHART	Custom Logo Color Dial Special Dial Etc.

Class 125 Bronze Gate Valves

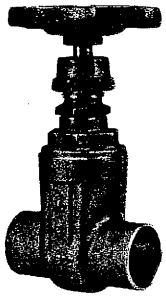
Screw-in Bonnet • Non-Rising Stem • Solid Wedge

Dezincification Resistant

125 PSI/8.6 Bar Saturated Steam to 353° F/178° C
200 PSI/13.8 Bar Non-Shock Cold Working Pressure*



T-113
Threaded



S-113
Solder

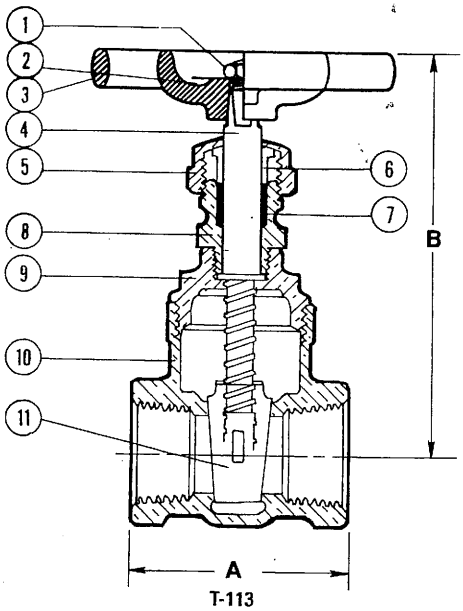
CONFORMS TO MSS SP-80

MATERIAL LIST

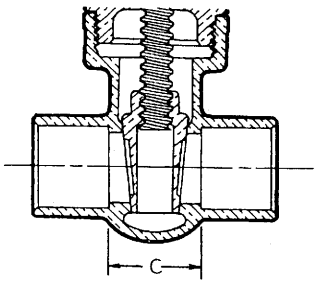
PART	SPECIFICATION
1. Handwheel Nut	Zinc Plated Steel with Clear Chromate
2. Identification Plate	Aluminum
3. Handwheel	a. Malleable Iron ASTM A 47 (T-113) b. Bronze (T-113-BHW) c. Bronze Cross (T-113-K)
4. Stem	Silicon Bronze ASTM B 371 Alloy C69400 or ASTM B99 Alloy C65100
5. Packing Nut	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
6. Packing Gland	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
7. Packing	Aramid Fibres with Graphite
8. Stuffing Box	Bronze ASTM B 62
9. Bonnet	Bronze ASTM B 62
10. Body	Bronze ASTM B 99
11. Wedge	Bronze ASTM B 62

NON-BURIED APPLICATION ONLY

SUBMITTAL REVIEW
Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.
X
No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected
Date 6/27/03 Department ENG
By MW Madrit



T-113
NPT x NPT



S-113
C x C

DIMENSIONS – WEIGHTS – QUANTITIES

Size		Dimensions A		Dimensions B		Dimensions C		T-113		S-113		Master
In.	mm.	In.	mm.	In.	mm.	In.	mm.	Lbs.	Kg.	Lbs.	Kg.	Ctn. Qty.
¼ †	8	1.69	43	3.38	86	x	x	0.74	0.33	x	x	50
⅜ †	10	1.69	43	3.38	86	.69	18	0.71	0.32	0.65	0.29	50
½ †	15	1.94	49	3.63	92	.75	19	0.82	0.37	0.67	0.31	50
¾	20	2.06	54	3.91	99	.88	22	1.10	0.50	0.99	0.45	50
1	25	2.44	62	4.69	119	1.00	25	1.82	0.82	1.60	0.72	30
1 ¼	32	2.63	67	5.22	133	1.19	32	2.40	1.09	2.25	1.02	20
1 ½	40	2.88	72	6.25	159	1.25	33	3.51	1.59	3.17	1.44	10
2	50	3.06	78	7.06	179	1.31	34	4.93	2.24	4.60	2.09	10
2 ½	65	4.13	105	8.41	224	1.81	46	9.96	4.52	8.78	3.98	5
3	80	4.50	114	10	254	1.94	49	14.40	6.53	12.84	5.82	4

† No packing gland, packing only in these sizes.
x Not available this size.

Freezing Weather Precaution – Subsequent to testing a piping system, valves should be in an open position to allow complete drainage.

* For detailed Operating Pressure, refer to Pressure Temperature Chart on page 107.

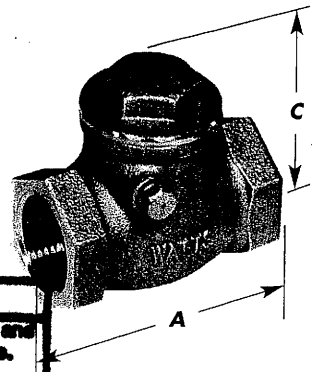
CHECK VALVES

SERIES CV ⅜" - 4" (10-100mm)
CVS† ½" - 3 (15-80mm)
BRONZE CHECK VALVES, TEE PATTERN

Used to prevent reverse fluid flow in commercial, industrial, steam, water, gas or oil lines.

- Pressure Rating 125 psi (9 bars) WSP/200 psi (14 bars)WOG
- Bronze body
- Metal to metal seating
- 90° straight pattern

CV Threaded connections, **CVS** Solder ends †



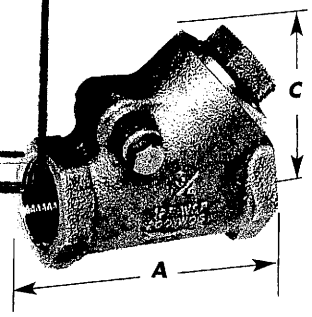
SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
mend and resubmit
Rejected
Date 6/27/03 Department Eng
By MWMuller

SERIES CVY ⅜" - 2" (10-50mm)
CVYS† ½" - 2" (15-50mm)
BRONZE CHECK VALVES, WYE PATTERN

Used to prevent reverse flow in commercial and industrial lines.

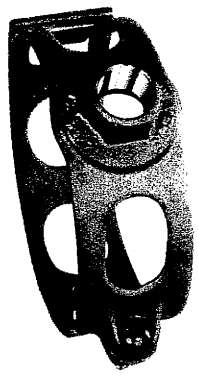


MATERIALS

Body	Cast Bronze - ASTM B62
Cap	Cast Bronze - ASTM B62
Disc	Cast Bronze - ASTM B62
Hanger Pin	Brass rod - ASTM B16

Size DN In.	Size DN mm	Ordering Code	Dimensions (approx.) A in.	A mm	C in.	C mm	Weight lbs.	Weight kgs.
Series CV - Tee pattern - threaded IPS connections - 125 WSP/200 WOG								
⅜	10	0700320	2 1/16	52	1½	38	.05	.02
½	15	0700330	2¼	57	1½	38	.53	.24
¾	20	0700340	2⅜	60	1 11/16	43	.67	.30
1	25	0700350	2¾	70	1 15/16	49	1.01	.46
1¼	32	0700360	3¼	83	2 3/16	55	1.54	.70
1½	40	0700370	3⅝	92	2 5/16	58	1.94	.88
2	50	0700380	4¼	108	2⅞	73	3.21	1.46
2½	65	0700390	5½	140	3½	89	6.00	2.72
3	80	0700400	5⅞	149	3¾	95	7.90	3.58
4	100	0700410	7¼	184	4½	114	13.00	5.90
Series CVS - Tee pattern - solder ends †								
½	15	0700430	2½	64	1½	38	.53	.24
¾	20	0700440	2	50	1¾	44	.71	.32
1	25	0700450	3½	89	1⅞	48	.95	.43
1¼	32	0700460	4	100	2 1/16	52	1.54	.70
1½	40	0700470	4¾	121	2⅜	60	1.87	.85
2	50	0700480	5¼	133	2¾	70	3.20	1.45
2½	65	0700490	6⅜	162	3½	89	5.80	2.63
3	80	0700500	7 3/16	183	3¾	95	7.60	3.44

Size DN In.	Size DN mm	Ordering Code	Dimensions (approx.) A in.	A mm	C in.	C mm	Weight lbs.	Weight kgs.
Series CVY - Wye pattern - threaded IPS connections - 125 WSP/200 WOG								
⅜	10	0700520	2 3/16	55	1⅝	41	.62	.28
½	15	0700530	2 3/16	55	1⅝	41	.62	.28
¾	20	0700540	2¾	70	2	50	.88	.40
1	25	0700550	3⅛	79	2¼	57	1.32	.60
1¼	32	0700560	3¾	95	2 11/16	68	2.00	.91
1½	40	0700570	4 5/16	108	3 1/16	78	2.87	1.30
2	50	0700580	5 1/16	129	3¾	95	4.76	2.16
Series CVYS - Wye pattern - solder ends								
½	15	0700630	2 11/16	68	1⅝	41	.60	.27
¾	20	0700640	3⅜	86	1 15/16	49	.82	.37
1	25	0700650	4 1/16	102	2¼	57	1.24	.56
1¼	32	0700660	4¾	121	2⅝	67	1.87	.85
1½	40	0700670	5⅜	137	3 1/16	78	2.71	1.23
2	50	0700680	6 11/16	168	3¾	95	4.76	2.16



MODEL 3401 BRONZE SADDLE FOR IPS PVC

BODY CASTINGS: Waterworks Bronze (85-5-5-5) per ASTM B584 and AWWA C800.
FASTENERS: Silicon Bronze per ASTM B98.
GASKET: Patented SBR Twinseal® dual o-ring design incorporating both hydro-static and mechanical qualities to affect a dynamic seal.

SUBMITTAL REVIEW
Review is only for general conformity with the design concept and is limited to requirements for the product specified. Sub-contractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.
X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected
Date 6/27/03 Department CNC
By mr Mehta

Pipe Size		Pipe OD		TwinSeal Hinged Design for IPS PVC Pipe					
in.	mm.	in.	mm.	Box Qty	3/4 CC or NPT Outlet	1 CC or NPT Outlet	1 1/4 CC or NPT Outlet	1 1/2 CC or NPT Outlet	2 CC or NPT Outlet
1 1/4	32	1.66	42	25	$18.80*		N/A		
1 1/2	40	1.90	48	25	18.80*		N/A		
2	50	2.38	60	20	18.90		N/A		
2 1/2	65	2.88	73	12	22.50		N/A		
3	80	3.50	84	10	23.40		$44.20		
3 1/2	90	4.00	101	10	26.00		N/A		
4	100	4.50	114	8	27.40		46.20		
5	125	5.56	141	8	35.20		N/A		
6	150	6.63	168	8	35.30		55.30		
8	200	8.63	219	6	44.00		62.50		
10	250	10.75	273	6	85.00		113.10		
12	300	12.75	324	3	113.10		118.90		

HOW TO ORDER : Choose nominal pipe size x outlet size and thread configuration.
EXAMPLE: 4" PVC O.D. 4.50 with 3/4CC outlet. Order 3401 - 4 x 3/4 CC.

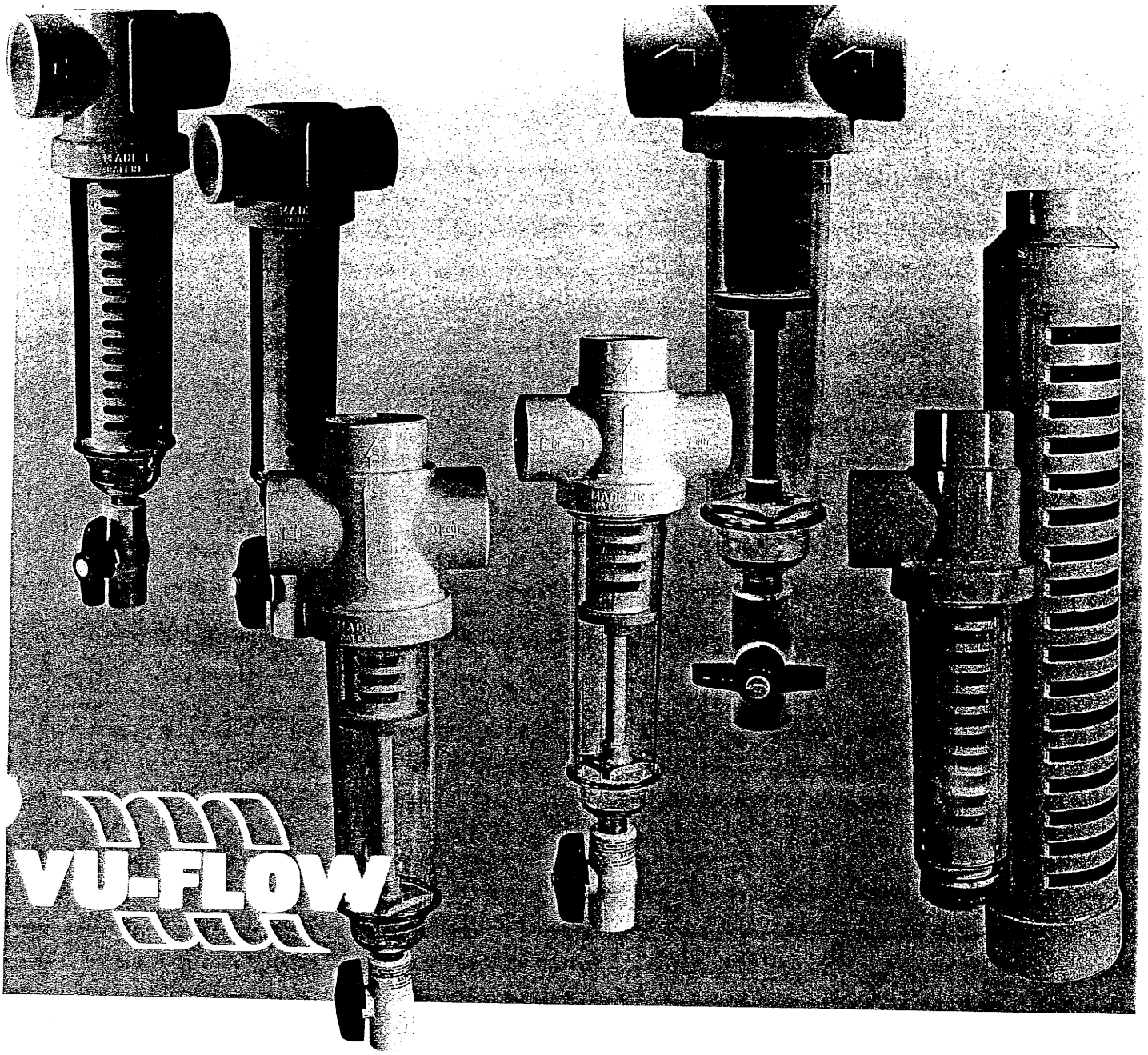
***NOTE :** 1 1/2", 1 1/4" x 1" NOT AVAILABLE

MODEL 3402 BRONZE SADDLE FOR COPPER TUBING

Pipe Size		Pipe OD		TwinSeal Hinged Design for Copper Tubing		
in.	mm.	in.	mm.	Box Qty	1 CC or NPT Outlet	3/4 CC or NPT Outlet
2	50	2.13	60	20	$25.30	
2 1/2	65	2.63	73	12	30.00	
3	80	3.13	84	10	31.20	

Note: Saddles on pages B-1 and B-2 must be ordered in box quantities

Material Specifications Subject to Change.



Screen Filters & Sand Separators

Engineered Protection

PL200 5/99

SUBMITTAL REVIEW

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No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/29/03 Department ENG
By MW Mudd

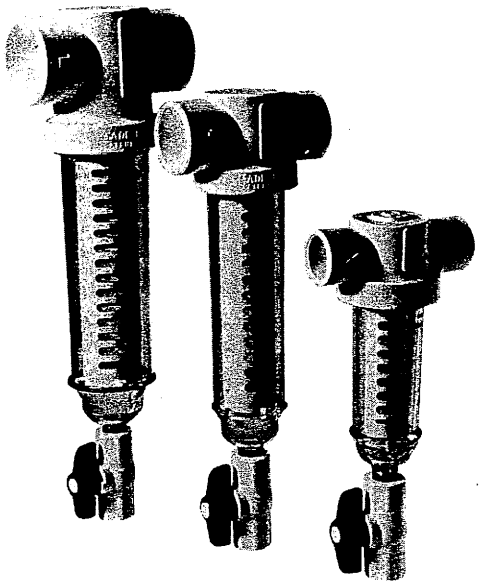
Must be able to be used w/ filter in up position

FEATURES

- Clear cover allows quick view of collected sediment
- Molded PVC filter body allows glue together installation similar to standard PVC pipe fittings
- Most models have ½" MNPT cover drain outlet for quick one step purge cleaning
- Polyester or stainless steel screen mesh is easily cleaned and reusable eliminating expensive element replacement
- Molded from U.V. stabilized weather resistant materials for long service life
- Maximum operating pressure 150 PSI at 73°F (23°C)
- High flow rates 1 to 100 Gallons per Minute
- All models now available for use with reclaimed water. Bodies are purple and all materials are chemical resistant (See literature # PL400).

VU-FLOW T Style Screen Filters

- 180 degree in-line "T" style installation
- Increased effective screen area



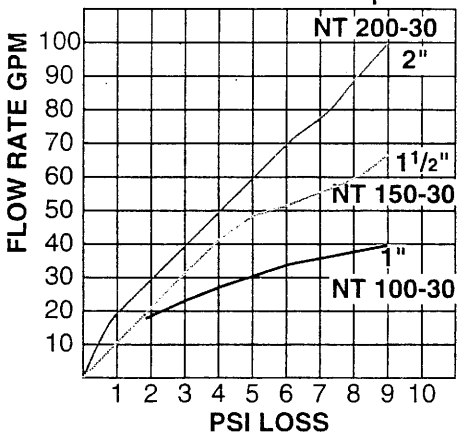
Case Quantity - 10 filters per case.
All filters are individually boxed to prevent loss or damage.

SPECIFICATIONS

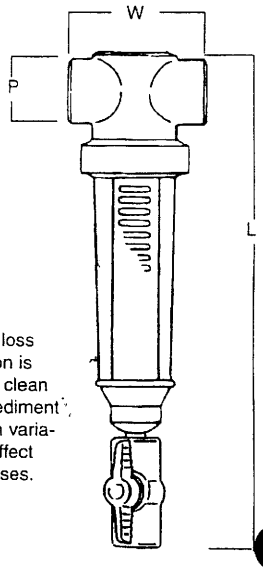
Model No.	*Min./Max. Flow	Inlet/ Outlet P	Length L	Width W
NT 100	1-25 GPM	1" SLIP	11 3/8"	5"
NT 150	10-50 GPM	1 1/2" SLIP	15 3/8"	5 1/4"
NT 200	18-100 GPM	2" SLIP	17 7/8"	5 1/2"

* Minimum flow needed for "Spin-out" action.
Reducer Bushings are available for Custom Inlet/Outlet Connection - See Reducer Chart in Price List

Pressure Loss Graph

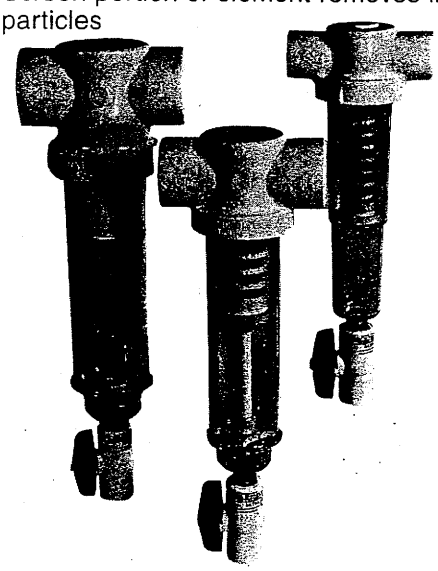


Pressure loss information is based on clean water. Sediment and mesh variation will effect actual losses.



VU-FLOW T Style Sand Separator Filters

- 180 degree in-line "T" style installation
- "Spin-out" action separates heavier than water particles away from screen into the collection chamber
- Screen portion of element removes lighter than water particles



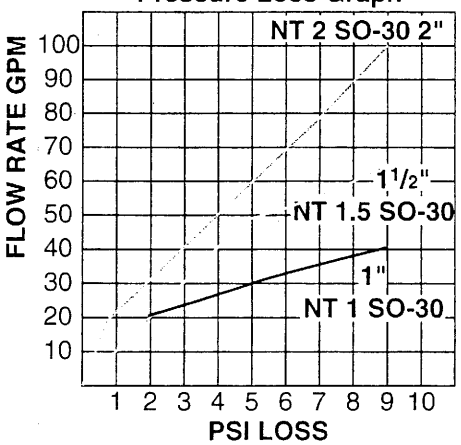
Case Quantity - 10 filters per case
All filters are individually boxed to prevent loss or damage.

SPECIFICATIONS

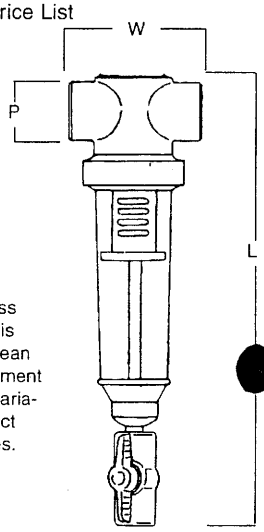
Model No.	*Min./Max. Flow	Inlet/ Outlet P	Length L	Width W
NT 1 SO	1-25 GPM	1" SLIP	14 3/8"	5"
NT 1.5 SO	10-50 GPM	1 1/2" SLIP	15 3/8"	5 1/4"
NT 2 SO	18-100 GPM	2" SLIP	17 7/8"	5 1/2"

* Minimum flow needed for "Spin-out" action.
Reducer Bushings are available for Custom Inlet/Outlet Connection - See Reducer Chart in Price List

Pressure Loss Graph



Pressure loss information is based on clean water. Sediment and mesh variation will effect actual losses.



BERMAD AIR VALVES...protection and performance for all pipelines

Air can dramatically effect the efficiency and integrity of your pipeline system. When filling an empty pipeline air should be uniformly released to eliminate possible damaging pressure surges in your system and to allow valves and other hydraulic components to operate correctly. Air must also be admitted to an emptying pipeline to prevent potentially destructive vacuums from forming. And, lastly, air entrained in the fluid will build up at the high points of the pipeline restricting flow capacity and increasing pumping costs.

Bermad's unique Air and Vacuum Release Valves offer simple, trouble-free, economical solutions to the problems of air in pipelines. Their advanced features include:

- *A minimum number of moving parts.*
- *Corrosion-resistant construction.*
- *Pressure-balanced floats to prevent distortion.*
- *Positive sealing under system pressures as low as 2 PSI.*
- *Exclusive kinetic design prevents float from being blown shut.*
- *High flow capacity.*

USE PLASTIC MODEL

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

No Exceptions Taken
Furnish as Corrected
Amend and resubmit
Rejected
Department ENG

Date 7/23/03
By [signature]

1" Automatic Air Release Valve – Model 4405

The 4405 Air Release Valve releases entrapped air pockets which accumulate at the high points of piping systems. These accumulated air pockets reduce system efficiency by decreasing the effective flow area of the pipe.

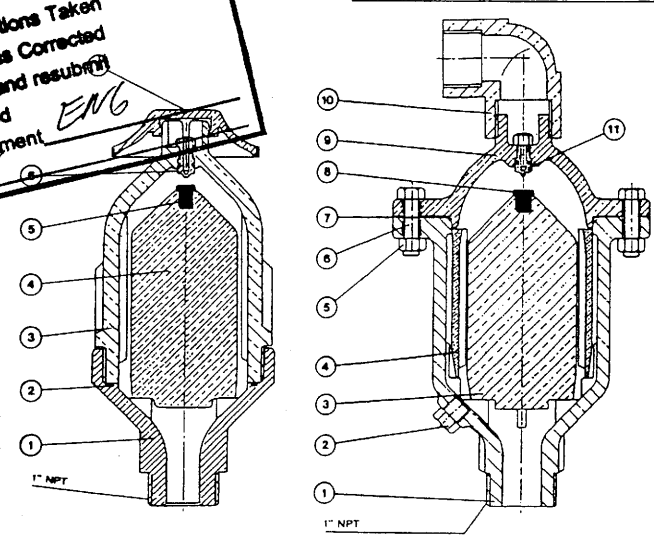
Initially, fluid in the pipeline raises the float and positively seals the specially designed small orifice. During operation air entrained in the fluid rises to the valve high point displacing an equal amount of water and lowering the liquid level. As the air accumulates the float loses buoyancy and drops. This opens the orifice allowing the air to escape. The returning water again raises the float sealing the orifice. This cycle is repeated as often as needed to release the air being accumulated.

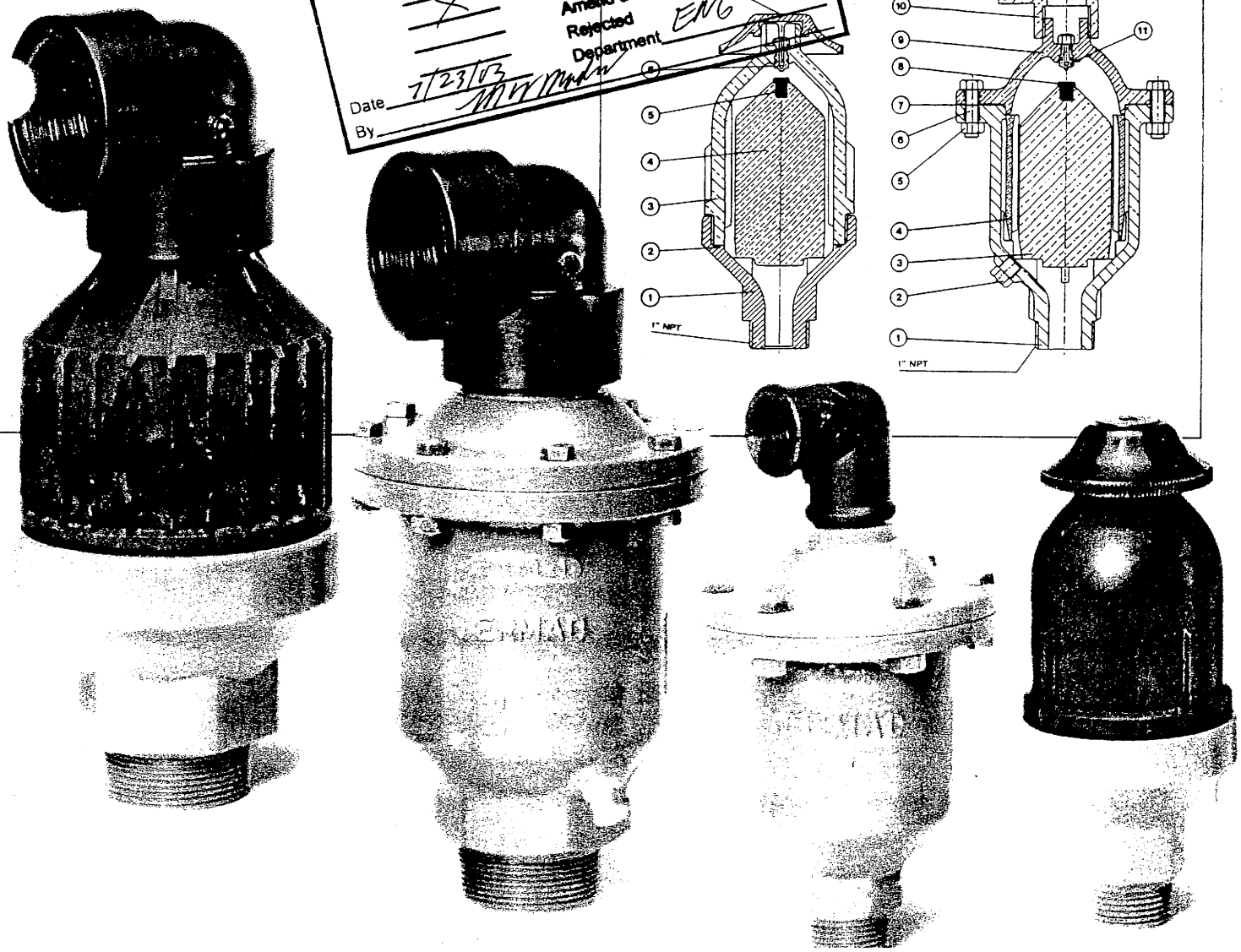
Plastic Model 4405
Automatic Air Release Valve

Parts List	Material
1. Base	Plastic
2. Base O-ring seal	Buna N
3. Body	Glass fibre reinforced nylon
4. Automatic Float	Polypropylene
5. Automatic seal plug	Buna N
6. Automatic Orifice	Brass/Stainless steel
7. PERMAD special protective cap	Polypropylene

Cast Iron Model 4405M
Automatic Air Release Valve

Parts List	Material
1. Base & Body	Cast iron/ Epoxy coat
2. Drainage plug	Brass
3. Automatic Float	Polypropylene
4. Float housing	Glass fibre reinforced nylon
5. Nut	Stainless steel
6. Bolt	Stainless steel
7. O-ring	Buna N
8. Automatic seal plug	Buna N
9. Cover	Cast iron/ Epoxy coat
10. Elbow	Polypropylene
11. Automatic Orifice	Brass/Stainless steel





No. 200
REVISED 8/1/89

Poly Ethylene bodies are required

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

No Exceptions Taken
Furnish as Corrected
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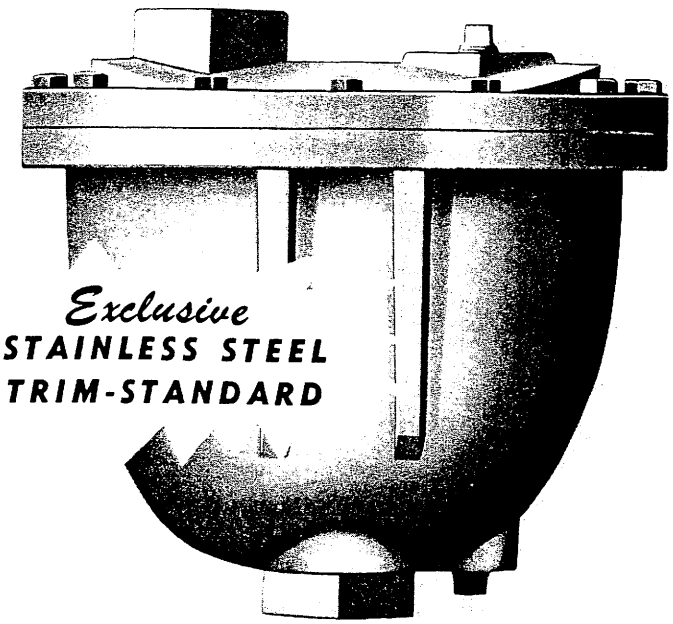
Rejected
Date X Department

6/27/03 ENG
MW Modyl

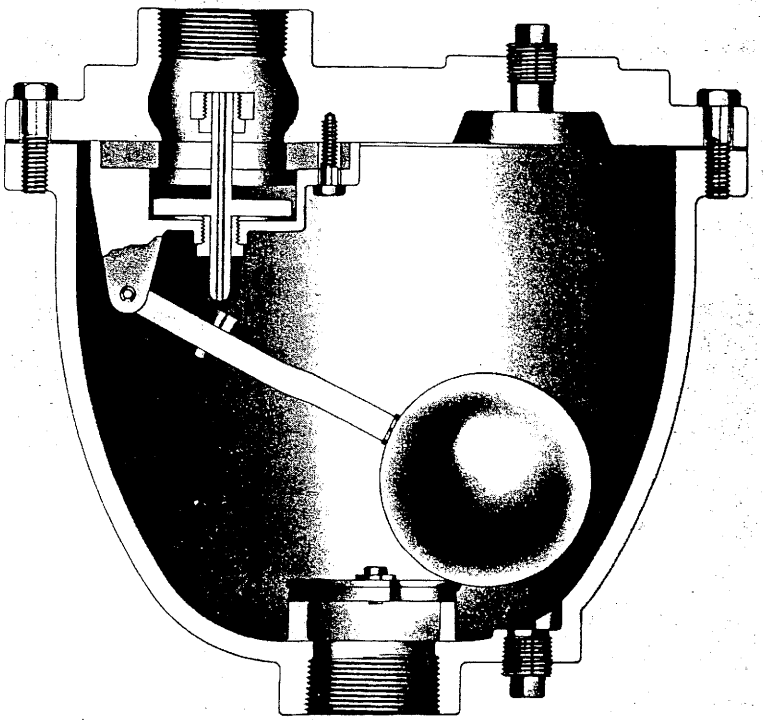
COMBINATION AIR VALVES

FOR:

High Capacity Venting
Pipeline Protection
Flow Efficiency



Exclusive
STAINLESS STEEL TRIM-STANDARD



- ALL S.S. TRIM ELIMINATES DESTRUCTIVE ELECTROLYTIC ACTION WHICH CAN OCCUR WHEN DISSIMILAR METALS SUCH AS S.S. & BRONZE ARE USED TOGETHER

Other Features

- FULL PORTED VALVES— NO RESTRICTIVE AREAS
- STAINLESS STEEL TRIM ASSURES LOW MAINTENANCE
- STAINLESS STEEL FLOATS UNCONDITIONALLY GUARANTEED
- SYNTHETIC SEATING ASSURES DROP TIGHT SEAL AT VERY LOW PRESSURES
- RUGGED CAST IRON BODY AND COVER
- WORKING PRESSURES UP TO 300 P.S.I.
- COMPLETE INTERCHANGEABILITY OF ALL PARTS
- EASILY MAINTAINED WITHOUT SPECIAL TOOLS

VAL-MATIC
VAL-MATIC VALVE AND MANUFACTURING CORP.
905 RIVERSIDE DRIVE • ELMHURST, IL 60126 • 708/941-7600 • TELEX: 28-1001 • FAX: 708/941-8042

COMBINATION AIR VALVES

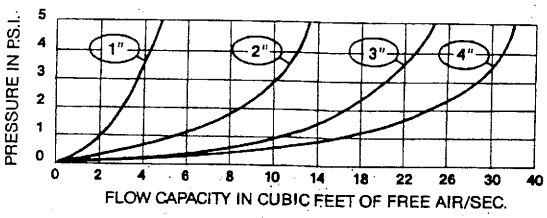
YOU SHOULD USE

Most piping systems require both Air Release Valves and Air Vacuum Valves to maintain pipeline efficiency and provide pipeline protection. Because of this need, the "Combination Air Valve" was developed.

The Val-Matic Combination Air Valve performs both the functions of Air Release and Air/Vacuum Valves. The Air Release valve portion vents air which accumulates at high points in a system during its operation. The Air/Vacuum valve portion will exhaust the larger quantities of air present in a system during the filling and allow air to re-enter during draining.

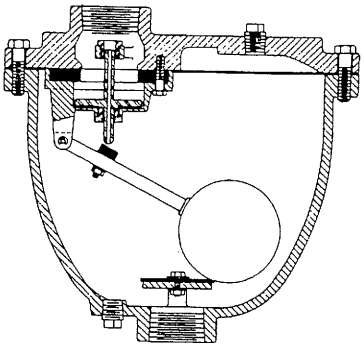
As with all air valves, these should also be installed at each high point in the system to effectively maintain pipeline efficiency and provide pipeline protection. Refer to Val-Matic "Air Valve Calculator" for sizing information.

MODEL NO.	AIR/VACUUM INLET X OUTLET N.P.T.	LARGE ORIFICE DIAMETER	AIR RELEASE ORIFICE DIAMETER	MAXIMUM WORKING PRESSURE	HEIGHT	WIDTH	WT. LBS.
201C	1 x 1	1"	5/64"	300 P.S.I.	10½"	11⅜"	40
202C	2 x 2	2"	3/32"	300 P.S.I.	13"	14"	71
203C	3 x 3	3"	3/32"	300 P.S.I.	17"	16"	120
204C	4 x 4	4"	3/32"	300 P.S.I.	19"	18½"	170

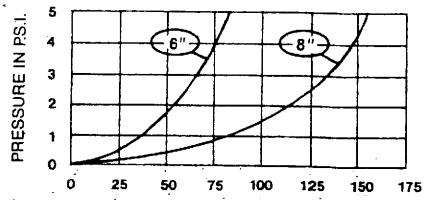


Single Housing Type
1" thru 4" N.P.T. Inlets and Outlets

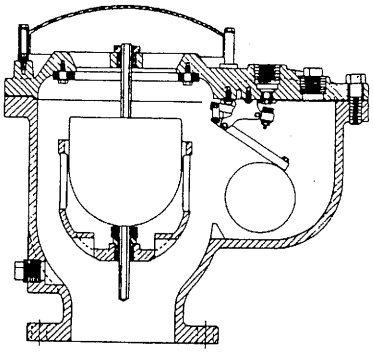
3"-4" Available W/ANSI Class 125 or 250 Flanged Inlets



MODEL NO.	VALVE SIZE	INLET SIZE	OUTLET SIZE	HEIGHT	WIDTH	ORIFICE SIZE		WT. LBS.
						150 P.S.I.	300 P.S.I.	
206C	6"	6" Flg.	6"	20¼"	21"	3/8"	7/32"	225
208C	8"	8" Flg.	8"	23½"	25"	3/8"	7/32"	320



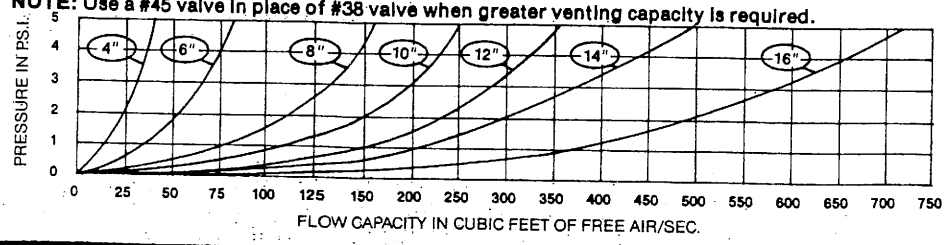
Single Housing Type
6" and 8" ANSI Class
125 or 250 Flanged Inlets

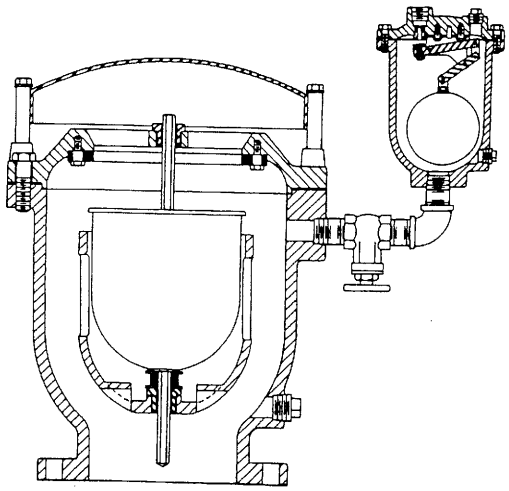


MODEL NO.	*INLET X OUTLET SIZE INCHES	*MAXIMUM WORKING PRESSURE	HEIGHT	WIDTH	WT. LBS.
104/22	4 x 4	150/300 P.S.I.	18"	21"	113
104/38	4 x 4	150/300 P.S.I.	22"	21"	133
106/22	6 x 6	150/300 P.S.I.	21"	24"	160
106/38	6 x 6	150/300 P.S.I.	23"	24"	190
108/38	8 x 8	150/300 P.S.I.	26"	27"	236
110/38	10 x 10	150/300 P.S.I.	28"	30"	398
112/38	12 x 12	150/300 P.S.I.	32"	33"	615
114/38	14 x 14	150/300 P.S.I.	34"	36"	705
116/38	16 x 16	150/300 P.S.I.	34"	39"	903

*Flanged Inlet ANSI Class 125 for 150 P.S.I. & ANSI Class 250 for 300 P.S.I. W.P. Higher working pressures available upon request.

NOTE: Use a #45 valve in place of #38 valve when greater venting capacity is required.





Custom Built Type
4" thru 16" ANSI Class
125 or 250 Flanged Inlets

N.P.T. and Flanged Outlets Available Upon Request

VAL-MATIC

VAL-MATIC VALVE AND MANUFACTURING CORP.
905 RIVERSIDE DRIVE • ELMHURST, IL 60126
708/941-7600 • TELEX 28-1001 • FAX 708/941-8042

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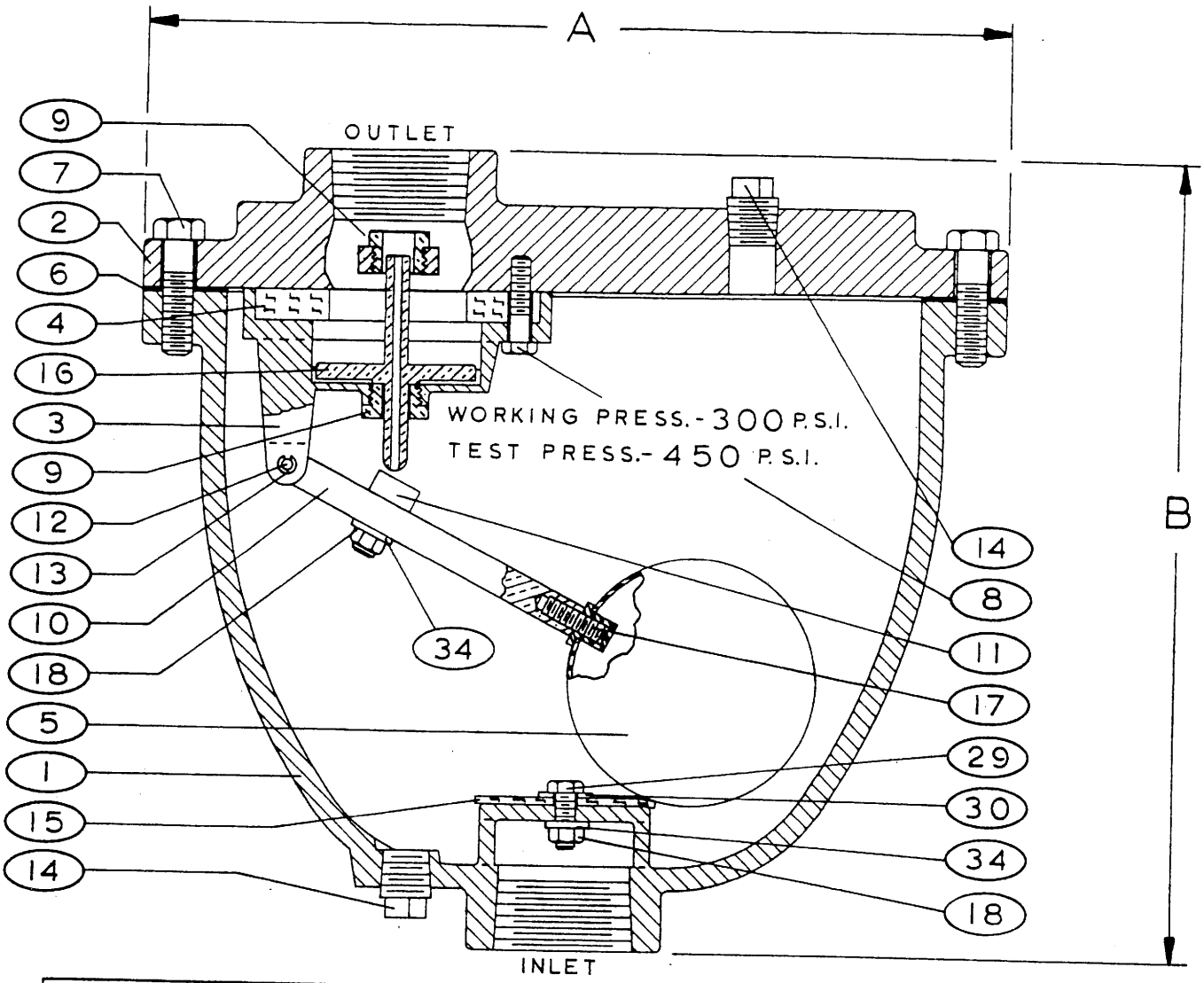


VALVE SIZE	*VALVE NO.	A	B	INLET SIZE	OUTLET SIZE	ORIFICE SIZE
1"	201C.2	11 3/8"	10 1/2"	1" N.P.T.	1" N.P.T.	5/64"
2"	202C.2	14"	13"	2" N.P.T.	2" N.P.T.	3/32"

1 BODY
2 COVER
3 BAFFLE
4 SEAT
5 FLOAT
6 GASKET
7 COVER BOLTS
8 BAFFLE SCREWS
9 BUSHING
10 FLOAT ARM
11 ORIFICE BUTTON
12 PIVOT PIN
13 RETAINING RING
14 PIPE PLUG
15 CUSHION
16 PLUG
17 FLOAT RETAINER
18 LOCK NUT
29 CUSHION RETAINER
30 WASHER
34 LOCK WASHER

*ABOVE MODEL NUMBERS REFLECT STAINLESS STEEL TRIM, IF BRONZE TRIM IS REQUIRED, OMIT THE .2 FROM THE MODEL NUMBER.

REV. 8-15-90

COMBINATION AIR RELEASE, AIR & VACUUM VALVE

DATE 2-2-69

VAL-MATIC VALVE AND MANUFACTURING CORP.

DRWG. NO. VM-201C

COMBINATION AIR VALVES
MATERIALS OF CONSTRUCTION
SERIES 200C, STAINLESS STEEL TRIM
SIZES 1" THROUGH 4"

PART NO.	PART NAME	MATERIAL
1	BODY	CAST IRON A.S.T.M. A126, CLASS B
2	COVER	CAST IRON A.S.T.M. A126, CLASS B
3	BAFFLE	CAST IRON A.S.T.M. A126, CLASS B
4	SEAT	BUNA - N
5	FLOAT	STAINLESS STEEL A.S.T.M. A240
6	GASKET	LEXIDE NK-511 (NON-ASBESTOS)
7	COVER BOLT	ALLOY STEEL A.S.T.M. A449, GRADE 5
8	RETAINING SCREWS	STAINLESS STEEL A.S.T.M. A276
9	GUIDE BUSHING	STAINLESS STEEL S.A.E. 30303
10	FLOAT ARM	STAINLESS STEEL S.A.E. 30303
11	ORIFICE BUTTON	STAINLESS STEEL & BUNA - N
12	PIVOT PIN	STAINLESS STEEL S.A.E. 30303
13	RETAINING RING	STAINLESS STEEL PH 15-7 MO
14	PIPE PLUG	MALLEABLE IRON
15	CUSHION	BUNA - N
16	PLUG	STAINLESS STEEL A.S.T.M. A276
17	FLOAT RETAINER	STAINLESS STEEL A.S.T.M. A276
18	LOCK NUT	STAINLESS STEEL A.S.T.M. A276
29	CUSHION RETAINER	STAINLESS STEEL A.S.T.M. A276
30	WASHER	STAINLESS STEEL A.S.T.M. A276

NOTE: ALL SPECIFICATIONS AS LAST REVISED.

REV. 8-15-90

MATERIALS OF CONSTRUCTION (STAINLESS STEEL TRIM)	DATE 11-15-77
VAL-MATIC VALVE AND MANUFACTURING CORP.	DRWG. NO. VM-201C-M

Meters Operation and Maintenance

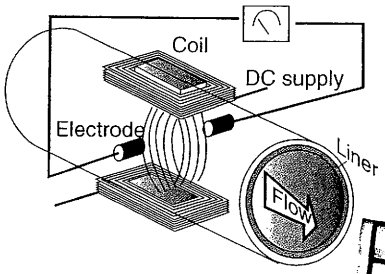
Magnetoflow® Mag Meter	Model Magnetoflow Flanged	Technical Brief

GENERAL

Badger's Magnetoflow line is the result of 35 years of research and field use in electromagnetic flow meters. Based on Faraday's law of induction, these meters can measure almost any liquid, slurry or paste that has a minimum of electrical conductivity. Designed, developed and manufactured under the strictest quality standards, the Magnetoflow meter ranks among the best in the market. Its sophisticated, processor based signal conversion represents the state of the art in the industry with accuracies of 0.25% or better. The wide selection of liner and electrode materials insures maximum compatibility and minimum maintenance over a long operating period.

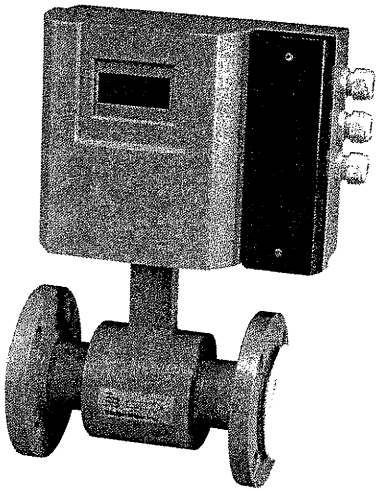
OPERATION

The flow meter is basically a stainless steel tube lined with a nonconductive material. Outside the tube two DC powered electromagnetic coils are positioned diametrically opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. When the coils are energized, a magnetic field is created across the whole diameter of the pipe. When a conductive fluid flows through this magnetic field, a voltage is induced across the electrodes. This voltage is directly proportional to the average flow velocity of the fluid and is picked up by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce a very accurate analog or digital signal. The signal can then be used to indicate flow rate, totalization or to communicate to remote sensors and controllers. The main advantages of this technology are that with no parts in the flow stream, there is no pressure loss, the accuracy is not affected by temperature, pressure, viscosity, density or flow profile and with no moving parts there is practically no maintenance required.



APPLICATION

Because of its inherent advantages over other more conventional technologies, this meter can be used in the majority of industrial flow applications. Whether the fluid is water or something highly corrosive, very viscous, contains a moderate amount of solids or requires special handling, this meter will be able to accurately measure it. Today Magnetoflow meters are successfully being used in most industries including food and beverage, pharmaceutical, water and wastewater and chemical.



Magnetoflow® Flanged

FEATURES

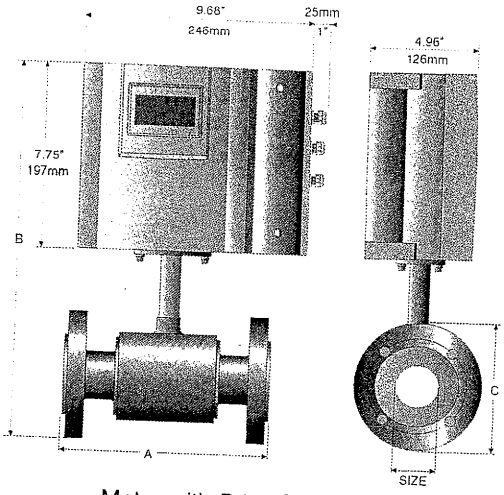
- 0.25% accuracy independent of fluid viscosity, density and temperature
- Unaffected by most solids contained in fluids
- Pulsed DC magnetic field for zero point stability
- No pressure loss for low operational costs
- Long life corrosion resistant liners
- Calibrated in state of the art facilities
- Integral and remote signal converter availability
- Optional grounding rings or grounding electrode
- Measurement largely independent of flow profile

Electrodes

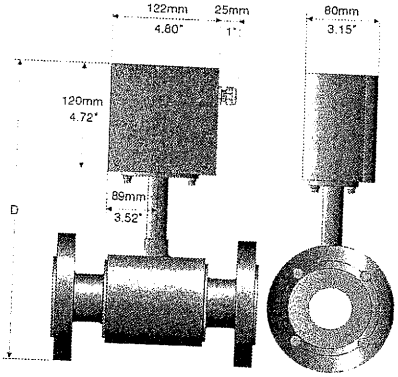
The two measuring electrodes, when looking from the end of the meter into the inside bore, are positioned at 3 o'clock and 9 o'clock. Badger Meter's Magnetoflow Mag meters have an "Empty Pipe Detection" feature. This is accomplished by the use of a third electrode that is positioned between 12 o'clock and 1 o'clock in the meter. At any time this electrode is not covered by fluid (for a minimum of a five second duration), the meter will display an Empty Pipe Detection condition, send out an error message if desired, and stop measuring to maintain accuracy. When the electrode again becomes covered with fluid, the error message will disappear and the meter will continue measuring.

SUBMITTAL REVIEW
Review is only for general conformity with the design concept and is limited to requirements [illegible] for by the contract documents.
Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials, equipment, and for information that pertains solely to the techniques of fabrication or construction.
No Exceptions Taken
Furnish as Corrected
Amend and resubmit
Rejected
Date 6/27/03
By M W Madsen
Department Eng.

As an option to the use of a set of grounding rings, to assure proper grounding in a given installation a grounding electrode (4th electrode) can be installed in the meter when initially fabricated. The position of this electrode is about 5 o'clock.



Meter with Primo® Amplifier



Meter with junction box for remote Primo® Amplifier

Size		A		B		C		D		Est. Weight with Primo		Flow Range			
												LPM		GPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	Lbs	Kg	Min	Max	Min	M
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.063	20	0.02	
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.114	34	0.03	
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.177	53	0.05	
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.416	125	0.11	
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5	0.75	225	0.2	
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0	1.20	350	0.3	
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0	2.00	575	0.5	1
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5	3.00	900	0.8	2
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5	4.70	1400	1	3
2 1/2	65	11.0	280	17.1	434	7.0	178	14.4	366	54	24.5	8	2400	2	6
3	80	11.0	280	17.3	440	7.5	191	14.7	372	56	25.5	12	3600	3	9
4	100	11.0	280	18.4	466	9.0	229	15.7	398	58	26.5	19	5600	5	14
5	125	15.8	400	19.6	498	10.0	254	16.9	430	60	27.0	30	8800	8	23
6	150	15.8	400	20.6	524	11.0	279	17.9	456	62	28.0	40	12700	11	33
8	200	15.8	400	22.5	572	13.5	343	20.4	518	88	40.0	75	22600	20	59
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0	120	35300	30	93
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0	170	50800	45	134
14	350	23.6	590	30.8	782	21.0	533	28.2	716	260	118	230	69200	60	182
16	400	23.6	590	33.7	856	23.5	597	31.0	788	308	140	300	90400	80	239
18	450	23.6	590	35.0	890	25.0	635	32.4	822	287	130	380	114000	100	302
20	500	23.6	590	38.2	969	27.5	699	35.5	901	495	225	470	140000	125	373
22	550	23.6	590	39.6	1005	29.5	749	36.9	937	441	200	570	170000	150	451
24	600	23.6	590	42.2	1071	32.0	813	39.5	1003	554	252	680	200000	180	537
28	700	23.6	590	46.2	1173	36.5	927	44.0	1118	650	295	920	275000	240	731
30	750	31.5	800	48.3	1228	39.0	984	45.7	1161	704	320	1060	315000	280	840
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350	1200	361000	320	956
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386	1500	457000	400	1210
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420	1900	565000	500	1493
42	1050	36.0	800	66.0	1675	53.0	1346	63.4	1610	1100	500	2100	620000	550	1646
48	1200	39.4	1000	69.9	1775	59.4	1455	67.2	1707	1210	550	2700	814000	720	2151
54	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620	3700	1100000	980	2927

SPECIFICATIONS - Detector

Flow Range: 0.1 - 39.4 fps (0.03-12 m/s)
Sizes: 1/4" to 54" (16 to 1400 mm)
Min. Conductivity: ≥ 5 micromhos/cm
Accuracy:
± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Electrode Materials: Standard: Alloy C
Optional: 316 Stainless Steel, Gold/Platinum Plated, Tantalum, Platinum/Rhodium
Liner Material: PFA up to 3/8", PTFE 1/2" thru 24", PTFE up to 24", Soft and Hard Rubber from 1" to 54", Halar® from 14" to 40"

Fluid Temperature:
With Remote Converter:
PFA, PTFE & Halar 311°F, (155°C)
Rubber 178°F, (80°C)
With Meter Mounted Converter:
PFA, PTFE & Halar 212°F, (100°C)
Rubber 178°F, (80°C)
Pressure Limits:
150 psi (10Bar) optional 300psi (20Bar)
Coil Power: Pulsed DC
Ambient Temperature: -4°F to 140°F, (-20°C to 60°C)
Pipe Spool Material: 316 Stainless Steel
Meter Housing Material: Carbon Steel welded

Flanges: Carbon Steel - Standard (ANSI B16.5 (
150 RF) 316 Stainless Steel - Optional
Meter Enclosure Classification: Nema 4
Optional: Submersible Nema 6P (Remote Amplifi
Required)
Junction Box Enclosure Protection:
(For Remote Converter Option) Powder coated di
cast aluminum, Nema 4
Cable Entries: 1/2" NPT Cord Grip
Optional Stainless Steel Grounding Rings:

Meter Size	Thickness (of one ring)
up thru 10"	.135"
12" to 20"	.187"

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Please see our website at
www.badgermeter.com
for specific contacts.

Due to continuous research, product improvements and enhanceme
Badger Meter reserves the right to change product or system specificat
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www.badgermeter.com

Magnetoflow® Mag Meter	Model Magnetoflow Primo® (3.1 Electronics)	Technical Brief

GENERAL

Badger's Primo amplifier was specifically designed to be used with the entire line of Magnetoflow electromagnetic flow meters. This amplifier represents the culmination of years of research into mag meter signal processing and includes the latest developments in microprocessor signal conditioning technology. The advanced design of the unit allows the accuracy of the detector to be better than .25% and the flow range better than 300:1. The Primo amplifier can be used as an integral part of the detector or it can be mounted remotely when necessary. The Primo electronics are housed in a NEMA 4X aluminum powder coated enclosure with easy access to all wiring and programming functions.

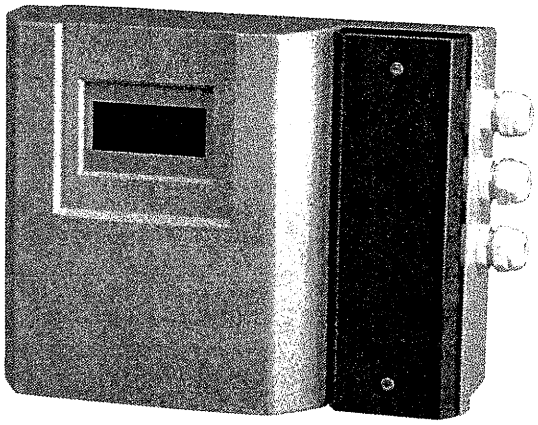
OPERATION

As the analog signal is received from the detector, the Primo unit amplifies the signal and converts it into digital information. At the processor level, the signal is analyzed through a series of sophisticated software algorithms and after separating it from electrical noise, it is converted into both analog and digital signals that are used to display rate of flow and totalization. In addition the processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Primo's 4 line, 16 character LCD display simultaneously indicates rate of flow, forward and reverse totalizers and diagnostic messages. It also serves to guide the user in simple English terms through the user-friendly programmable routines.

Programmable parameters of the Primo amplifier include: calibration factors, reset of totalizers, pulse value with auto decimal point position, selection of unit of measure, selection of flow direction, analog signal output, relay and open collector high and low flow alarm signals, low flow cut-off percent of flow and noise dampening factor.

APPLICATION

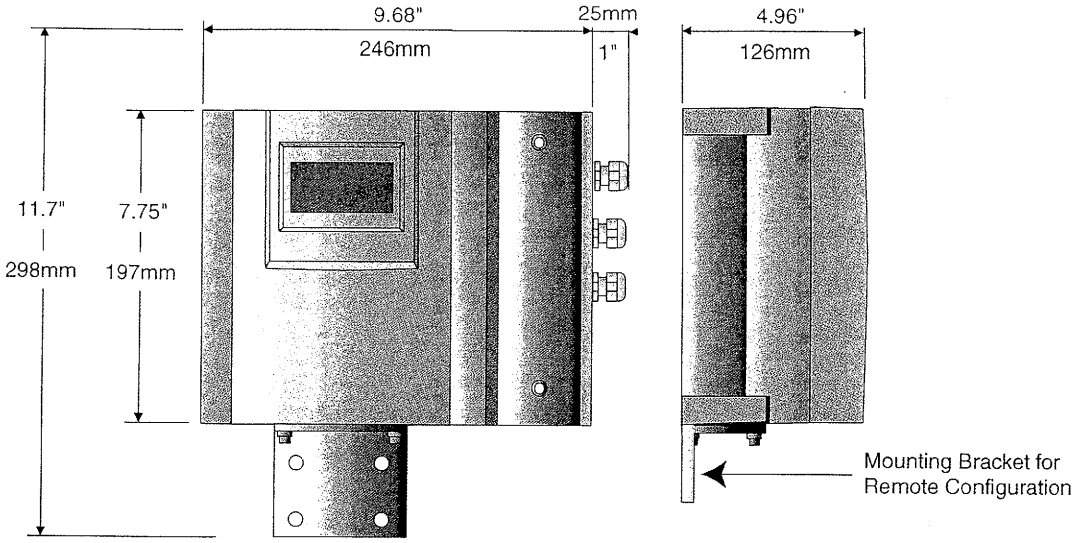
The Primo amplifier main function is to detect and condition the flow information from the electromagnetic detector. The unit is ideally suited for use in applications where the flow is continuous and indication of rate and totalization is required. Also, in applications where a minimum and/or a maximum flow rate must be kept and carefully monitored, the unit also provides pulse signals that can be fed to dedicated batch controllers, PLCs and other more specialized instrumentation.



Magnetoflow® Primo®

FEATURES

- Microprocessor based
- Large 4 line x 16 character back-lit LCD display
- User friendly programming procedure
- Digital and analog outputs
- NEMA 4X enclosure
- Sensor or remote wall mount
- Bidirectional flow sensing/totalization
- Automatic zero point stability
- Better than 0.1% repeatability
- Measures fluids with as low as 5.0 micromhos/cm conductivity
- Empty pipe detection



SPECIFICATIONS

Power Supply: 85-265 VAC, 45-65 Hz
Power Consumption: 20W
Accuracy: ± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from .1-1 fps.
Repeatability: <0.1%
Minimum Fluid Conductivity: 5.0 micromhos/cm
Processing: Microprocessor H8 (16 bit)
Flow Direction: Unidirectional or bidirectional, 2 separate totalizers (programmable)
Analog Outputs:

Current		Voltage
± 4 - ± 20mA < 800 Ω	or	± 2 - ± 10V < 1K Ω
± 2 - ± 10mA < 800 Ω	or	± 1 - ± 5V < 1K Ω
0 - ± 20mA < 800 Ω	or	0 - ± 10V < 1K Ω
0 - ± 10mA < 800 Ω	or	0 - ± 5V < 1K Ω

Ouput Frequency: Scaled Pulse output (open collector), Max 5Khz
Digital Outputs:
Voltage sourcing transistor, 24VDC, 100mA max
(3) AC Solid state relays, 48VAC, 0.5 amp max

Outputs: All outputs are short circuit safe.
Noise Dampening: Programmable from 1 to 6
Pulse Width: Programmable from 5ms to 500ms
Min-Max Flow Alarm: Programmable relay outputs 0 to 100% of flow
Units of Measure: Gallons, Ounces, Pounds, MGD, Liters, Cubic Meters, Cubic Feet, Acre Feet
Galvanic Separation: ≤ 500 volts
Low-flow-cutoff : Programmable 0-10% of max flow
Zero-point Stability: Automatic correction
LCD Display: 4 lines x 16 character back-lit alphanumeric; Displays (2) Totalizers, Flow Rate, Alarm Conditions
Programming: Three button manual
Housing: Cast aluminum, powder coated paint
Housing Rating: NEMA 4X
Mounting: Detector mount or remote wall mount (bracket supplied)
Cable Connection: 1/2" NPT Cord Grip
Ambient Temperature: -4 to 140° F (-20 to 60° C)
Serial Communication: RS232

Please see our website at
www.badgermeter.com
for specific contacts.

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Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Magnetoflow Primo Advanced

28. Mai. 03

Serial number: 0305-007 /18282346

Part number: 9010101

Part code: MID 2-80/150-A/St-HG-ML/HC-St PA0

Detector type: Type 2

Size DN: 80 **Pressure rating:** 150 ASA

Amplifier: Primo Advanced US

Mounting: Remote mounted Submersible **Cable length:** 15 Ft.

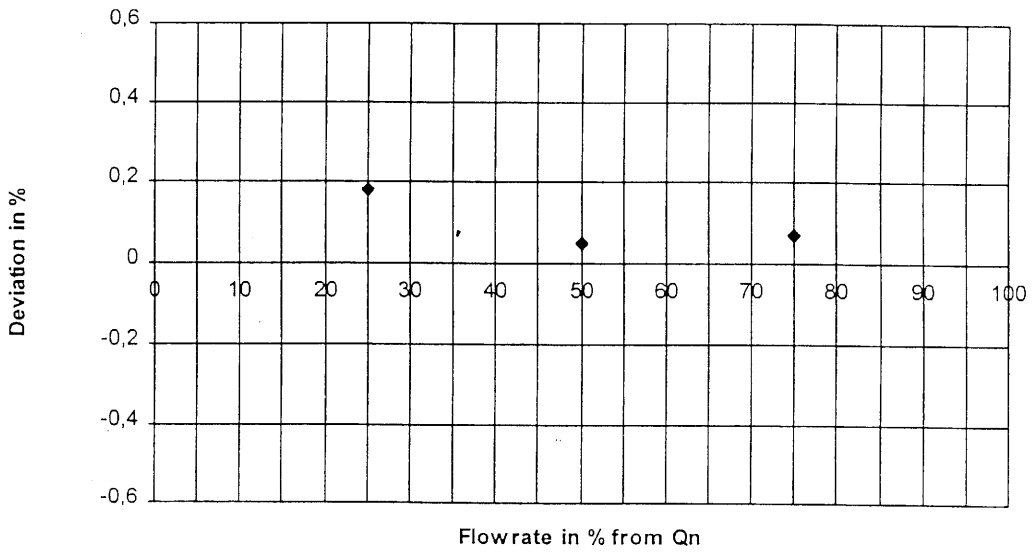
Detector constant: 89,80

Amplifier constant: 2,50

Full scale Qn: 200 GPM

	Flow rate in % f. Qn	Deviation in %
Measure point 1	25	0,18
Measure point 2	50	0,05
Measure point 3	75	0,07

Calibration chart



Magnetoflow Primo Advanced

28. Mai. 03

Serial number:	0305-007 /18282346		
Part number:	9010101		
Part code:	MID 2-80/150-A/St-HG-ML/HC-St PA0		
Detector type:	Type 2		
Nominal size:	80	Pressure rating:	150 ASA
Connection:	Flanges acc. ANSI	Material:	C-Steel
Liner:	Hard Rubber	Max. temperature:	80 °C
Electrode:	Measuring and empty pipe electrodes		
Electrode material:	Hastelloy C		
Detector housing:	C-Steel painted	Protection class:	IP 65
Transformer:	Primo Advanced US		
Mounting:	Remote mounted submersible	Cable length:	15 Ft.
Transformer housing:	Cast aluminium	Protection class:	IP 65
Power supply:	85 - 265 VAC		
Flow range:	2,4 bis 800 GPM		
Detector constant:	89,80		
Amplifier constant:	2,50		
Flow direction:	Uni-directional		
Min/Max Alarm:	Min = 0 % Max = 100 %		
Low flow cut off:	0,2 %		
Empty pipe detection active:	☑		
Pre selection counter:	☑		
Analog output:	+/- 4...20 mA	Full scale (20 mA):	200 GPM
Pulse rate:	1 pulse per Galon		
Pulse width:	1:1 ms		
Pulse output:	24 V DC / Optocoupler		
Interface:	No		
Software version:	V3.1Ues		
Coil adjustment:	3x10 Ohm		

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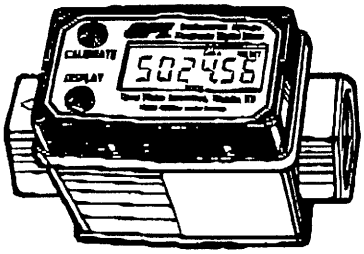

Model S100 Turbine shown with standard Computer Electronics, which are sold separately.

Industrial Grade Metering Products

Stainless Steel Turbine
Model S100

Technical Specifications

6/00 ML-1233-8

Flow Ranges		**Temperatures** (Turbine only without computer)	
Linear:	5 to 50 GPM (18.9 to 190 LPM)	Operational:	-40° to +250°F (-40° to +121°C)
Extended:	2.5 to 50 GPM (9.5 to 190 LPM)	Storage:	-40° to +250°F (-40° to+121°C)
Maximum Flow: 75 GPM (284 LPM)			
Fluid Velocity in Extended Range: 0.93-18.6 ft./sec. (0.28-5.7 m/sec.)		**Wetted Components**	
		Housing:	316 Stainless Steel
Performance*		Journal Bearings:	Ceramic (96% Alumina)
Linear Range:	10:1 @ ±1.5% of reading	Shaft:	Tungsten Carbide
Extended Range:	20:1 @ ±5.0% of reading	Rotor and Supports:	PVDF
Repeatability:	±0.1%	Retaining Rings:	316 Stainless Steel
Maximum Pressure Drop in 10:1 Range:	10 PSIG (0.34 bar)	**Weight**	
Pressure Rating:	1,500 PSIG (103 bar)	Turbine only:	2.4 lbs.(1.1 kg)
Frequency Range:	45-475 Hz @ 5-50 GPM	Turbine with computer:	2.6 lbs.(1.2 kg)
Connections		**Shipping Weight**	
Inlet and Outlet:	1 inch female NPT or ISO	Turbine only:	2.6 lbs.(1.2 kg)
Wrench Flat Size:	1-5/8 in. (41mm)	Turbine with computer:	2.8 lbs.(1.3 kg)

- Field Replaceable Internal Parts
- High Accuracy
- Signal Output Capabilities
- Excellent Chemical Compatibility
- High Turndown Ratio
- Accessories easily upgrade meter

All GPI turbines are Factory Mutual Approved and carry a Class 1, Division 1 Approval for hazardous environments.

FM APPROVED

CLASSIFIED C UL BOAL

GPI is a registered trademark of Great Plains Industries, Inc. Patent Pending. Conformity with the design, concept and Europeanal Patent 68 190 97 Canadian Patent 1,123,464. equipments claimed by the contained in the information. Subcontractor's human relations organization with other patents P34784942-08 responsible for the accuracy of the information, quantities and details relating to the parts solely to the equipment, and for information that pertains techniques of fabrication or construction.

SUBMITTAL REVIEW

Review is only for submittal conformance with the contract documents and is limited to requirements called for in the submittal. Review is not a waiver of any requirements of the contract documents.

No Exceptions Taken
Furnish as Corrected
Amend and resubmit
Rejected
Department ENG.

Date 7/23/03
By

* Results determined with 1 centistoke stoddard solvent test fluid at 70°F (21°C).

GREAT PLAINS INDUSTRIES, INC.
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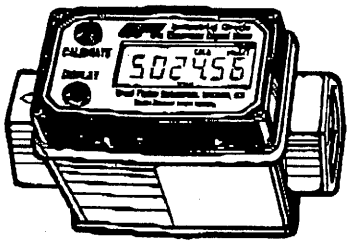
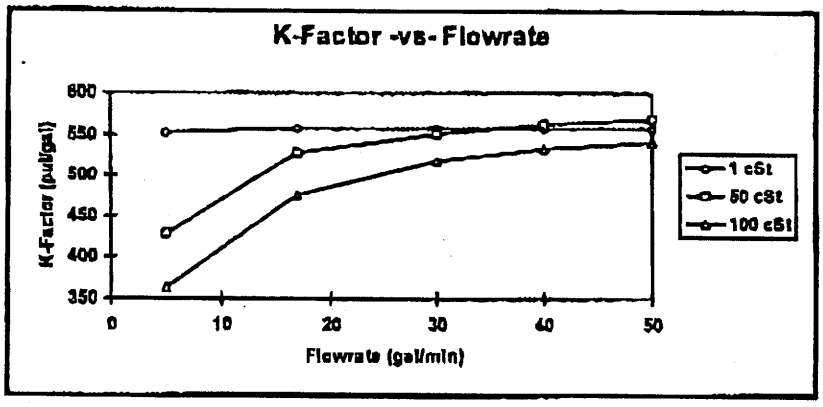
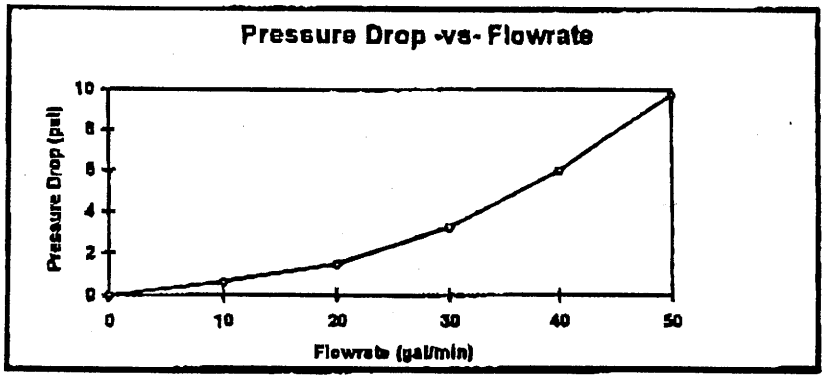


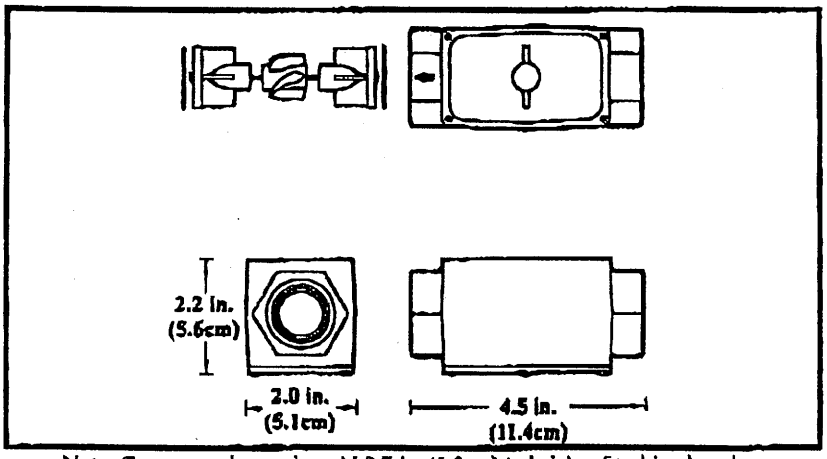
Industrial Grade Metering Products

Stainless Steel Turbine
Model S100

6/00 ML-1233-8





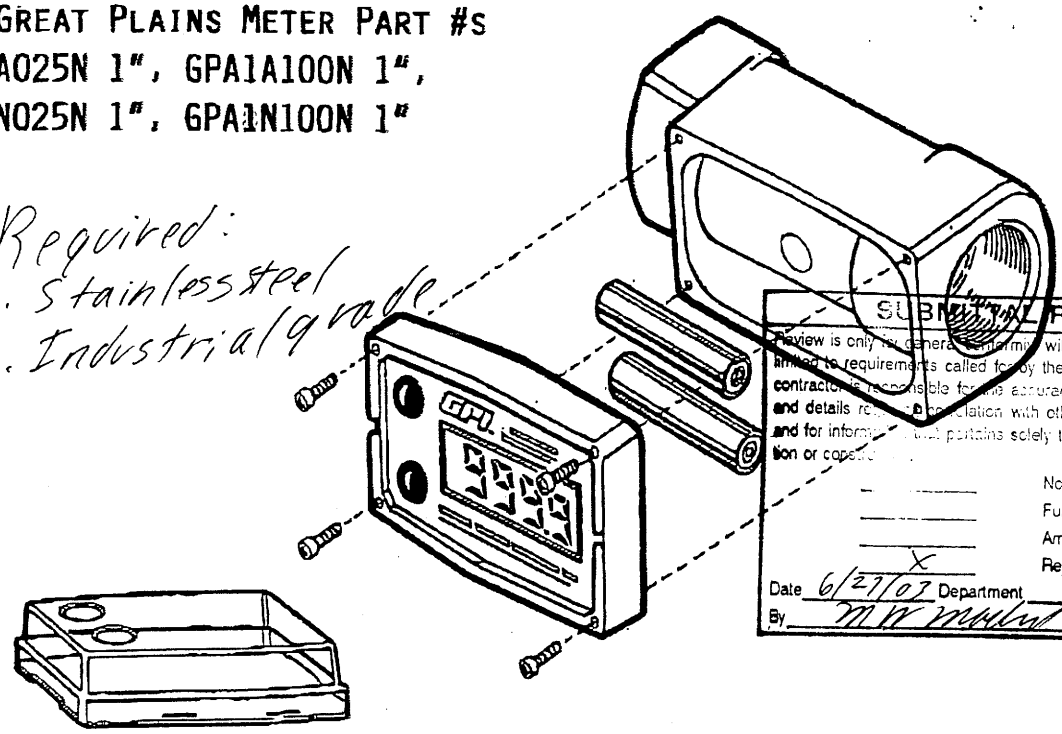


Note: Computer electronics add 0.7 in. (1.8cm) to height of turbine housing.

GPI® Commercial Grade Metering Products

FOR GREAT PLAINS METER PART #S
GPA1A025N 1", GPA1A100N 1",
GPA1N025N 1", GPA1N100N 1"

Required:
1. Stainless steel
2. Industrial grade



SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details relative to correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
X Rejected

Date 6/27/03 Department ENG
By M W Mahl

HOUSING SPECIFICATIONS

	Aluminum			Nylon	
	Low Flow	One Inch	Two Inch	Low Flow	One Inch
U.S. Measurements					
Units*	Gallons	Gallons	Gallons	Gallons	Gallons
Flow Range in GPM	0.3 to 3	3 to 50	30 to 300	0.3 to 3	3 to 50
Threads*	NPT	NPT	NPT	NPT	NPT
Pressure Rating	300 PSIG	300 PSIG	300 PSIG	150 PSIG	150 PSIG
Pressure Drop at Max. Flow Rate	2 PSIG at 3 GPM	5 PSIG at 50 GPM	7 PSIG at 300 GPM	2 PSIG at 3 GPM	5 PSIG at 50 GPM
Dimensions					
Length	4 inches	4 inches	6 inches	4 inches	4 inches
Height	2.5 inches	2.5 inches	4.25 inches	2.5 inches	2.5 inches
Width	2 inches	2 inches	3 inches	2 inches	2 inches
U.S. and Metric					
Female Inlet and Outlet	1 inch	1 inch	2 inch	1 inch	1 inch
Internal Diameter	1/4 inch	1 inch	2 inch	1/4 inch	1 inch
Design Type	Paddlewheel	Turbine	Turbine	Paddlewheel	Turbine
Accuracy					
Factory Calibration**	N/A †	±1.5%	±1.5%	N/A †	±1.5%
Field Calibration**	±1.5%	±1%	±1%	±1.5%	±1%
Readout Totals					
Minimum	.01	.01	.01	.01	.01
Maximum	999,999	999,999	999,999	999,999	999,999

* Models are also available in litre measurement with NPT threads

** [illegible]

Commercial Grade Metering Products

COMPUTER SPECIFICATIONS

Computer Models*	Readout Label	03	04	05	06	07	08
Field Replaceable Batteries		Yes	Yes	Yes	Yes	Yes	Yes
On/Off							
Automatic On		Yes	Yes	Yes	Yes	Yes	No
Manual On		Yes	Yes	Yes	Yes	Yes	Yes
Automatic Off		Yes	Yes	Yes	Yes	Yes	Yes
Totalizers							
Cumulative Total	TOTAL 1 LOCKED	Yes	Yes	Yes	Yes	Yes	No
First Batch Total	TOTAL 2	Yes	Yes	Yes	Yes	Yes	No
Second Batch Total	TOTAL 3	No	No	Yes	No	Yes	No
Calibration							
Factory Calibration Curve	CAL A PRESET	Yes	Yes	Yes	Yes	Yes	Yes
First Field Calibration Curve	CAL B	Yes	Yes	Yes	No	Yes	Yes
Second Field Calibration Curve	CAL C	No	No	Yes	No	Yes	No
Rate of Flow	FLOWRATE	No	Yes	No	No	Yes	Yes
Bypass Feature	BYPASS	No	No	Yes	No	Yes	No

* Computer electronics operate from +14° to +140°F (–10° to +60°C).

COMPUTER FEATURES

Power source is two lithium batteries for approximately 4,000 hours of actual use.

- **Automatic or manual on and automatic off** are contained in most models.
- The **Batch Total** is the total liquid metered since the last manual clearing of this total.
- The **Cumulative Total** is the total of all liquid metered since battery connection.
- The **Field Calibration Curve**, with accuracy within ± 1%, is set and changed by the user.
- The **Factory Calibration Curve**, with accuracy within ± 1.5%, is preset by the manufacturer and covers a wide variety of fluids.
- **Rate of Flow** allows the display of rate of flow, as opposed to volume of flow.
- **Bypass** conserves power in continuous flow situations. After a few minutes in bypass, the meter's readout goes off.

REMOTE KIT SPECIFICATIONS

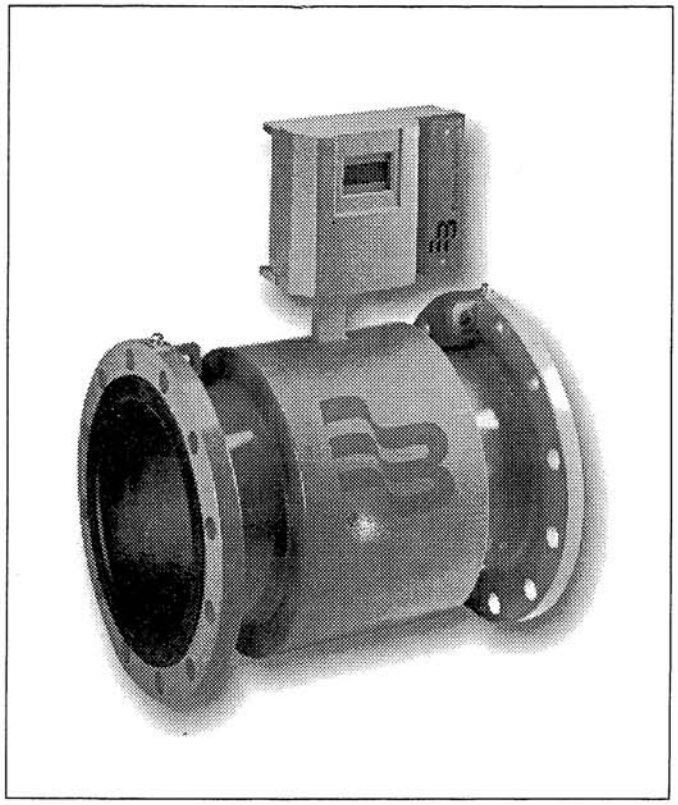
	Low Flow	One Inch	Two Inch
U.S. Measurement			
Fluid Temperature Range*	–40° to +250°F	–40° to +250°F	–40° to +250°F
Transmission Distance	Up to 300 feet	Up to 300 feet	Up to 300 feet
Metric Measurement			
Fluid Temperature Range*	–40° to +121°C	–40° to +121°C	–40° to +121°C
Transmission Distance	Up to 30.5 meters	Up to 30.5 meters	Up to 30.5 meters
U.S. and Metric			
Signal Type	Sine Wave	Sine Wave	Sine Wave
Peak to Peak Voltage	33 mV to 900 mV	48 mV to 825 mV	50 mV to 500 mV
Frequency	11 Hz to 111 Hz	30 Hz to 608 Hz	40 Hz to 360 Hz

Call GPI Sales for further information on Factory Mutual Approved Remote Kits.

GREAT PLAINS INDUSTRIES, INC.

NEMA

Magnetoflow® Mag Meter	Flanged Meter with Model Primo® 3.1	Installation & Operation Manual



IMPORTANT !!!! This manual contains important warnings and information. READ AND KEEP FOR REFERENCE.

BadgerMeter,Inc.

IOM-089-01
53400-089
1-03

SCOPE OF THIS MANUAL

This manual contains information concerning the installation, operation and maintenance of Badger's Magnetoflow® electromagnetic flow meter models with Primo® Amplifier.

To ensure proper meter performance, the instructions given in this manual should be thoroughly understood. Keep a copy of this manual in a readily accessible location for future reference.

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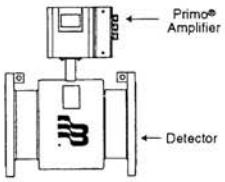
SYSTEM DESCRIPTION

Magnetoflow® electromagnetic flow meters are intended for fluid metering in most industries including water, wastewater, food and beverage, pharmaceutical and chemical.

The basic components of an electromagnetic flow meter are two: 1) The Detector; which includes the flow tube, isolating liner and measuring electrodes, and 2) the Amplifier, which is the electronic device responsible for the signal processing, flow calculation, display and output signals.



The materials of construction of the wetted parts (liner and electrodes) should be appropriate for the specifications on the intended type of service. Review of the compatibilities consistent with the specifications is recommended.

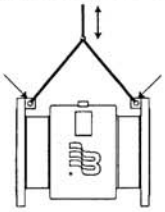
All Badger's Magnetoflow mag flow meters are factory tested and calibrated. A calibration certificate is included in the shipment of each meter.

UNPACKING AND INSPECTION

Magnetoflow mag flowmeters are shipped in special shipping containers. Upon receipt of the meter, perform the following unpacking and inspection procedures. If damage to the shipping container is evident, be present when the meter is unpacked.

A) Carefully open the shipping container following any instructions that may be marked on the exterior. Remove all cushioning material surrounding the meter.

B) Carefully lift the meter from the container. Always use the lifting lugs provided for safety on meter sizes 10" and larger.



C) Retain the shipping box or crate and all packing materials for possible use in reshipment or storage.

D) Visually inspect the meter for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection report by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A formal claim for equipment damaged in transit is the responsibility of the customer.

E) Verify that the meter received is consistent with the product ordered. The detail on the product labels on the detector and the amplifier should help this verification.

F) All detectors with PTFE liner are shipped from the factory with a liner protector. This protector maintains the proper form of the PTFE material and protects it during shipping and storage. Do not remove this protector until you are ready to install the unit.

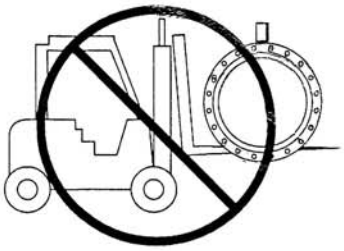
G) Storage: If the meter is not to be immediately installed, store it in its original container in a dry, sheltered location. Storage temperature: -4 to 158 °F (-20 to 70 °C)

TRANSPORTATION AND HANDLING

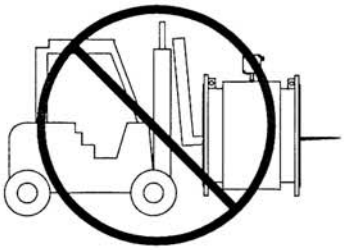
Do not lift the detector from the amplifier housing, the junction box or the connecting cable. As noted earlier, use lifting lugs for larger sizes.

Very large meter sizes are packed and crated with the meter laying on its side for shipping safety and stability reasons. In order to lift the meter in vertical position, it's recommended to use a sling rigged method as shown below.

If using a forklift, do not lift the detector from its body between the flanges. The housing could be accidentally dented and permanent damage could be caused to the internal coil assemblies.



IMPORTANT:
NEVER introduce the forks of a forklift, chains, wire slings or any other sharp object inside the flow tube for lifting or handling purposes. This could permanently damage the isolating liner and could render the meter inoperable.



METER INSTALLATION

METER LOCATION GUIDELINES

The following are several guidelines for determination of a good location for meter installation:

Temperature Ranges

In order to prevent damage to the meter, the maximum temperature ranges must be observed.

Primo® Amplifier

Ambient temperature: -4 to 140°F (-20 up to +60°C)

Meter with Meter Mount Primo

Fluid temperature: PTFE/PFA, -40 to 212°F (-40 up to +100°C)
Hard/Soft Rubber, 32 to 138°F (0 up to +80°C)

Meter with Remote Mount Primo

Fluid temperature: PTFE/PFA, -40 to 302°F (-40 up to +150°C)
Hard/Soft Rubber, 32 to 178°F (0 to +30°C)

Chemical Injection Applications

For water line applications with a chemical injection point, the meter should be installed upstream of the chemical injection point to eliminate any issues with the meter performance. If an upstream location is not possible for the meter, consider moving the injection point downstream of the meter location. If the meter must be installed downstream of the chemical injection point, the distance between these (2) locations must be significant; frequently 50 - 100 feet.

When the solution made up of the water and the injected chemical reach the Mag meter, it must be a complete homogeneous mixture. If too close, the Mag meter will sense (2) different liquids (conductivity different for each) and will be confused as to how to process the information. Many other factors such as the type of injection method, (spaced bursts versus continuous stream of drops), or whether the chemical is injected in a liquid or gas form, can cause a wide variation in the distance required from one application to another.

Due to this wide range of factors, it is difficult to specify a distance that will always work for any application without establishing a value far in excess of what would usually be required. Please contact Badger Meter's Technical Support at 1-800-616-3837 with your application detail and they can assist in determining if the Mag meter should properly perform. As noted, the meter may require 50 - 100 feet from the injection point to assure the complete homogeneous state.

Submersible Option

If the meter is to be installed in a meter vault, it should be ordered with the remote amplifier option to be sure the amplifier is not installed inside the vault. It is also recommended that the remote style meter package be ordered with the submersible option (Nema 6P). This will eliminate any potential problems from occurring should the vault become flooded or from any presence of humidity in the vault.

Other Considerations

Avoid all pipe locations where the flow is pulsating, such as in the outlet side of piston or diaphragm pumps.

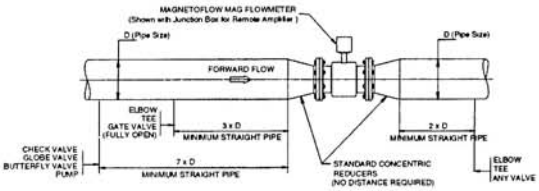
Avoid locations near equipment producing electrical interference such as electric motors, transformers, variable frequency, etc.

Install the meter with enough room for future access for maintenance purposes.

The mag meter isolating liner, whether if it is PTFE or Rubber, is not intended to be used as gasket material. Standard gaskets (not provided) should be installed to ensure a proper hydraulic seal. When installing the gaskets, make sure they are properly centered to avoid flow restriction or turbulence. Do not use graphite or any electrically conductive sealing compound to hold the gaskets in place during installation. This could affect the reading accuracy of the measuring signal.

STRAIGHT PIPE REQUIREMENTS

For optimum accuracy performance, it is required to provide sufficient inlet and outlet straight pipe runs. An equivalent to 3 diameters of straight pipe is required on the inlet side, and 2 diameters on the outlet side. There are no special requirements for standard concentric pipe reducers.



By using pipe reducers, a smaller meter size can be mounted in larger pipeline sizes. This may also increase low flow accuracy performace.

In order to minimize flow disturbances and excessive loss of head, custom fabricated pipe reducers must have a minimum slope angle of 15 degrees. If this is not possible, install the custom pipe reducers as if they were fittings, leaving the minimum straight pipe required.

Mounting Location

The detector should never be installed on the suction side of a pump where a vaccuum exists to eliminate the possibility of damage to the liner.

If vibration exits on the pipeline, secure the piping before and after the meter. If a strong vibration exists, the amplifier should be mounted remotely.

Remote Version

Do not install cables near power cables, electrical machines, etc.

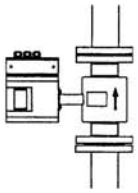
Be sure both ends of signal cable are securely fastened. Run power and signal cables in separate conduit.

METER ORIENTATION

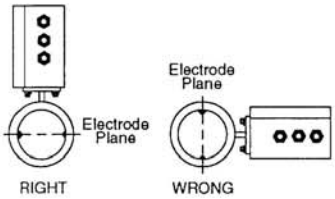
Magnetoflow® Mag meters can operate accurately in any pipe orientation and can measure the volumetric flow in the forward and reverse directions (note FORWARD FLOW direction printed on the detector label). The most recommended installation position is vertical piping, with the liquid flowing upward (see figure below).

This installation practice ensures two objectives:

1. The pipe remains completely full of liquid, even at low flow, low pressure applications with a discharge to the atmosphere.
2. Solid build-ups or sediments that could be part of the process fluid will not deposit or accumulate on the liner and/or electrodes.

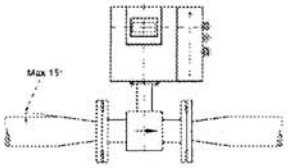


In horizontal piping orientation, the detector should be mounted in a position at which the measuring electrodes axis will remain in a horizontal plane (3 and 9 o'clock position; see figure below)



For very low flow rate applications, the flow rate can be increased by reducing the meter size and therefore the measuring accuracy can be improved.

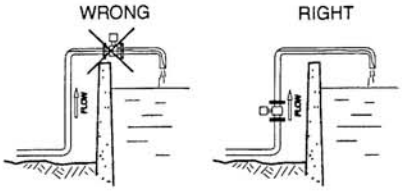
Pipe reducers can be mounted directly to the inlet and outlet of the meter. The reducer can not have an angle greater than 15°. The resultant pressure drop is negligible; in most cases less that 1 psi.

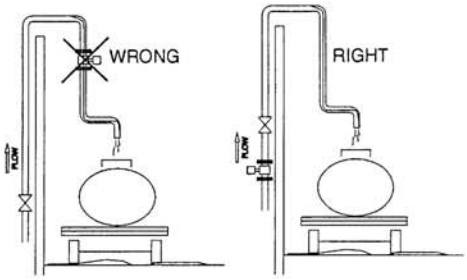


PARTIALLY FILLED PIPE SITUATIONS

Magnetoflow® mag meters are designed to operate in closed, full pipes.

It is relatively common to encounter situations where the process pipe will remain momentarily partially filled due to certain hydraulic conditions. Examples of this include discharge to the atmosphere (lack of back pressure), insufficient line pressure, gravity flow applications, etc.

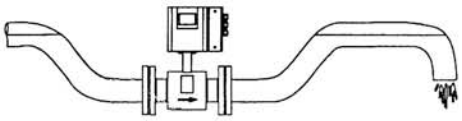




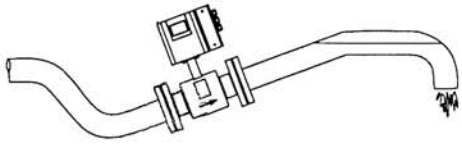
To eliminate the negative effect of these situations on the performance of the mag meter, observe the following guidelines:

- Avoid installing the detector in the highest point of the pipe line
- Do not install the detector in vertical, downward flow sections of the pipe
- ON/OFF valves should ALWAYS be located on the downstream side of the meter
- Select the recommended vertical orientation with flow upwards whenever possible
- Make sure that the flow range of the meter size selected is consistent with the application flow range

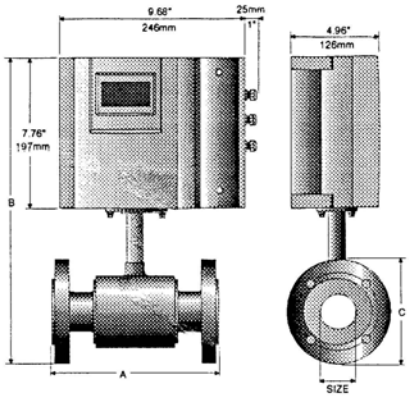
To minimize the possibility of partially full pipe flows in horizontal, gravity or low pressure applications, it is recommended to create a pipe arrangement as shown in the figure below. This arrangement ensures the detector remains full of liquid at all times.



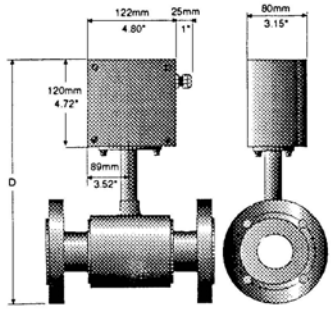
Open Discharge
Horizontal Installation



Open Discharge
Horizontal



Meter with Primo®



Meter with junction box for remote Primo®

Size		A		B		C		D		Est. Weight with Primo		Flow Range LPM		Flow Range GPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	Lbs	Kg	Min	Max	Min	Max
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.063	20	0.02	5
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.114	34	0.03	9
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.177	53	0.05	14
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.416	125	0.11	33
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5	0.75	225	0.2	59
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0	1.20	350	0.3	93
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0	2.00	575	0.5	152
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5	3.00	900	0.8	239
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5	4.70	1400	1	373
2 1/2	65	11.0	280	17.1	434	7.0	178	14.4	366	54	24.5	8	2400	2	631
3	80	11.0	280	17.3	440	7.5	191	14.7	372	56	25.5	12	3600	3	956
4	100	11.0	280	18.4	466	9.0	229	15.7	398	58	26.5	19	5600	5	1493
5	125	15.8	400	19.6	498	10.0	254	16.9	430	60	27.0	30	8800	8	2334
6	150	15.8	400	20.6	524	11.0	279	17.9	456	62	28.0	40	12700	11	3361
8	200	15.8	400	22.5	572	13.5	343	20.4	518	88	40.0	75	22600	20	5975
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0	120	35300	30	9336
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0	170	50800	45	13444
14	350	23.6	590	30.8	782	21.0	533	28.2	716	260	118	230	69200	60	18299
16	400	23.6	590	33.7	856	23.5	597	31.0	788	308	140	300	90400	80	23901
18	450	23.6	590	35.0	890	25.0	635	32.4	822	287	130	380	114000	100	30250
20	500	23.6	590	38.2	969	27.5	699	35.5	901	495	225	470	140000	125	37346
22	550	23.6	590	39.6	1005	29.5	749	36.9	937	441	200	570	170000	150	45188
24	600	23.6	590	42.2	1071	32.0	813	39.5	1003	554	252	680	200000	180	53778
28	700	23.6	590	46.2	1173	36.5	927	44.0	1118	650	295	920	275000	240	73100
30	750	31.5	800	48.3	1228	39.0	984	45.7	1161	704	320	1060	315000	280	84000
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350	1200	361000	320	95600
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386	1500	457000	400	121000
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420	1900	565000	500	149300
42	1050	36.0	800	66.0	1675	53.0	1346	63.4	1610	1100	500	2100	620000	550	164600
48	1200	39.4	1000	69.9	1775	59.4	1455	67.2	1707	1210	550	2700	814000	720	215100
54	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620	3700	1100000	980	292700

SPECIFICATIONS - Detector

Flow Range: 0.1 - 39.4 fps (0.03-12 m/s)
Sizes: 1/4" to 54" (6 to 1400 mm)
Min. Conductivity: ≥ 5 micromhos/cm
Accuracy: ± 0.25% accuracy of rate from 1-33 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Electrode Materials: Standard: Alloy C
Optional: 316 Stainless Steel, Gold/Platinum Plated, Tantalum, Platinum/Rhodium
Liner Material: PTFE up to 24", Soft and Hard Rubber from 1" to 54", Halar® from 14" to 40"
Fluid Temperature:
With Remote Converter:
PTFE & Halar 311°F, (155°C)
Rubber 178°F, (80°C)
With Meter Mounted Converter:
PTFE & Halar 212°F, (100°C)
Rubber 178°F, (80°C)
Pressure Limits: 150 psi (10Bar) optional 300psi (20Bar)
Coil Power: Pulsed DC

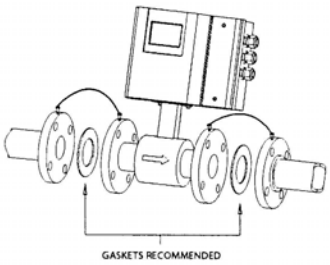
Ambient Temperature: -4°F to 140°F, (-20°C to 60°C)
Pipe Spool Material : 316 Stainless Steel
Meter Housing Material: Carbon Steel welded
Flanges: Carbon Steel - Standard (ANSI B16.5 Class 150 RF)
316 Stainless Steel - Optional
Meter Enclosure Classification: Nema 4
Optional: Submersible Nema 6P (Remote Amplifier Required)
Junction Box Enclosure Protection: (For Remote Converter Option) Powder coated die-cast aluminum, Nema 4
Cable Entries: 1/2" NPT Cord Grip
Optional Stainless Steel Grounding Rings:

Meter Size	Thickness (of one ring)
up thru 10"	.135"
12" to 20"	.187"

GROUNDING

IMPORTANT! In order to ensure proper operation, it is essential that the mag meter amplifier's input ground (zero voltage reference) will be electrically connected to the liquid media and to a good, solid earth ground reference.

Conductive Pipe Grounding



To achieve this, the meter body MUST be electrically connected to the liquid media. The mag meter flanges are provided with grounding bolts for this purpose.

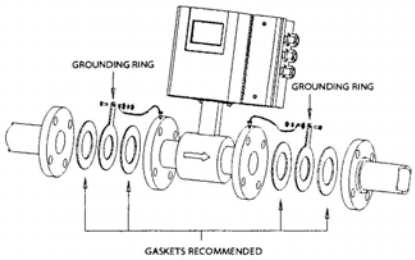
If the pipe material is electrically conductive, simply install grounding straps between these grounding bolts and the mating flanges.

To ensure a good electrical connection at the mating flanges, it is recommended to actually drill and tap the flanges to allow the installation of a grounding screw (not provided).

These grounding straps must be copper wire, at least 12AWG size, and must be connected on both sides (inlet and outlet) of the detector, and to a local earth ground.

IMPORTANT! If the process pipe is not electrically conductive (PVC, fiberglass or cement lined pipes) and the meter was not originally ordered with an optional grounding electrode, a pair of grounding rings must be installed between the mating flanges at both ends of the meter. See figure below.

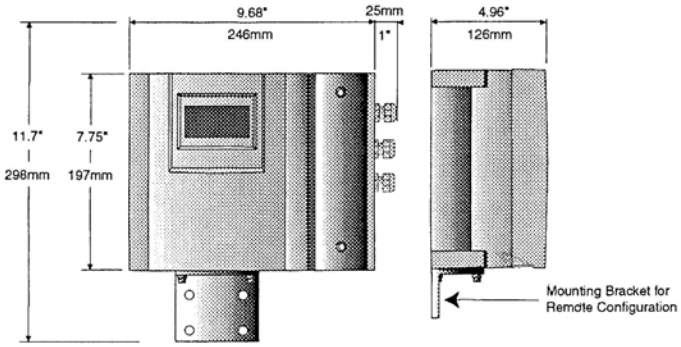
Non-Conductive Pipe Grounding



In this case, the grounding straps should be connected both to the grounding rings and to a good, solid earth ground.

Grounding rings are availabe in stainless steel. If your fluid to be measured is too aggressive for stainless steel, order meter with the optional grounding electrode in material option that will be compatible with the fluid.

PRIMO® AMPLIFIER (3.1 ELECTRONICS)



SPECIFICATIONS

Power Supply: 85-265 VAC, 45-65 Hz
Power Consumption: 20W
Accuracy: ± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Repeatability: 0.1%
Minimum Fluid Conductivity: 5.0 micromhos/cm
Flow Direction: Unidirectional or bidirectional, 2 separate totalizers (programmable)
Analog Outputs: 0/4-20mA, 800ohms Max Load
Ouput Frequency: Scaled Pulse output, (open collector) Max 5Khz
Digital Outputs:
Voltage sourcing transistor, 24VDC, 100mA max
(3) AC electro-mechanical relays, 48VAC, 0.5 amp max
Outputs: All ouputs are short circuit safe

Noise Dampening: Programmable from 1 to 6
Pulse Width: Programmable up to 500ms
Galvanic Isolation: ≤ 500V
Zero-point Stability: Automatic correction
LCD Display: 4 lines x 16 character back-lit alphanumeric Displays (2) Totalizers, Flow Rate, Alarm conditions
Housing: Cast aluminum, powder coated paint
Housing Rating: NEMA 4X
Mounting: Detector mount or remote mount (bracket supplied)
Cable Connection: 1/2" NPT Cord Grip
Ambient Temperature: -4 to 140° F (-20 to 60° C)
Serial Communication: RS232

WIRING

At installation, be sure to comply with the following requirements:

IMPORTANT!

- Disconnect power to the unit before attempting any connection or service to the unit
- Do not bundle or route signal lines with power lines
- Keep all lines as short as possible
- Use twisted pair shielded wire for all output wiring
- Observe all applicable local electrical codes

For the AC power connections use three wire sheathed cable with overall cable diameter of 0.2" to 0.45" (5mm to 12mm). For signal output use 18 to 22 gauge (0.25 mm^2 to 0.75mm^2) shielded wire. Overall cable diameter between 0.12" to 0.35" (3mm to 9mm).

WIRING FOR REMOTE PRIMO® CONFIGURATION

Wiring between the detector and the Primo amplifier comes complete from the factory. If your installation requires the use of conduit, the following are recommended steps for wiring of the detector to the amplifier.

1. Remove the junction box lid. Carefully remove the wires connected to the terminal blocks that run to the Primo amplifier. Note which wire goes into which terminal. The chart below may be of assistance for reference of wire color and terminal connection.

2. Run cable through conduit from Primo amplifier location, retaining the wiring of the cable to the amplifier as supplied.

3. Complete conduit assembly on both ends and rewire cable into junction box as wired when received. See wiring diagram below.

Connection No.	Description	Wire color
11	Coil	Green
12	Coil	Yellow
13	Main Shield	Yellow/green
45	Electrode	White
44*	Electrode Shield	Black
46	Electrode	Brown
40	Empty Pipe	Pink
44*	Empty Pipe Shield	Black

*Connections with the No. 44 are lying on the same potential

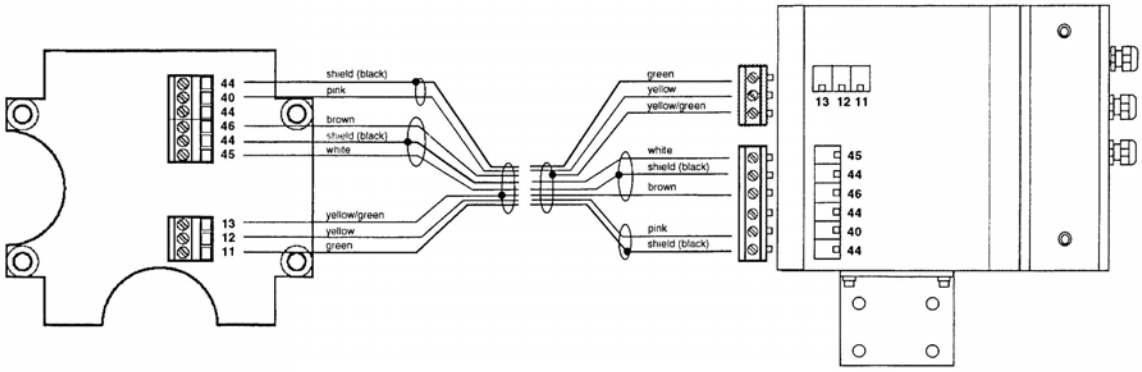
Remote style Primo Amplifier models can be ordered with longer cable than our standard stock lengths of the standard cable; 15, 30, 50 and 100 feet. The following chart shows the cable style options and the maximum flow medium temperature that can exist in the application environment at a given length of that cable.

		Cable Size		
		Standard	Medium	Large
		AWG 23	AWG 20	AWG 18
		0.25mm^2	0.50mm^2	0.75mm^2
		Fluid Temperature		
Cable Length (Ft)	100	311F	311F	311F
	125	306F	311F	311F
	150	294F	311F	311F
	175	283F	311F	311F
	200	271F	311F	311F
	225	260F	312F	311F
	250	249F	306F	311F
	275		300F	311F
	300		295F	311F
	325		289F	311F
	350		283F	311F
	375		278F	309F
	400		272F	305F
	425		266F	302F
	450		260F	298F
	475		255F	294F
	500		249F	291F

Empty Pipe Detection Considerations

Cable Length (ft)	Minimum Conductivity Required (µS/cm)
0 (Meter Mount)	5
100	20
500	100

Wiring for Remote Primo Configuration



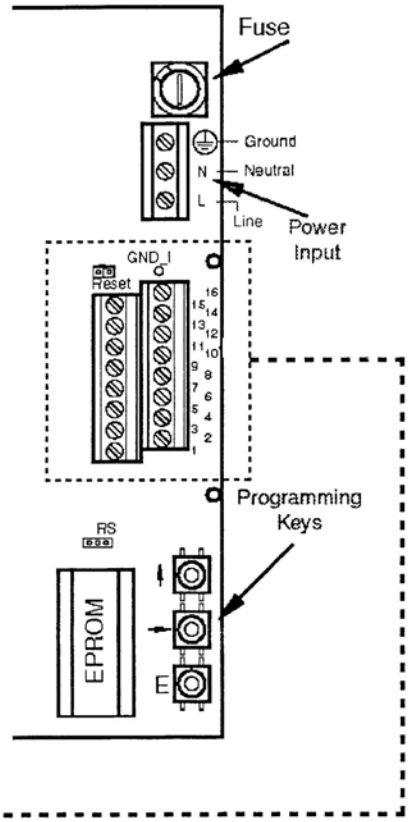
WIRING INPUTS AND OUTPUTS TO THE PRIMO® AMPLIFIER

Once the wiring between the sensor and the amplifier is done proceed to wire any inputs and outputs to the Primo amplifier.

IMPORTANT! For safety reasons leave AC power connections to the unit as the last step. Follow all the safety precautions and local code to prevent electrical shock and/or damaging of the electronic components.

1. Loosen the two bolts on the red amplifier cover. Remove the cover. Inside the amplifier you will see a terminal strip similar to the one depicted in the figure to the right.

Board Accessible with Red Cover Removed



POWER

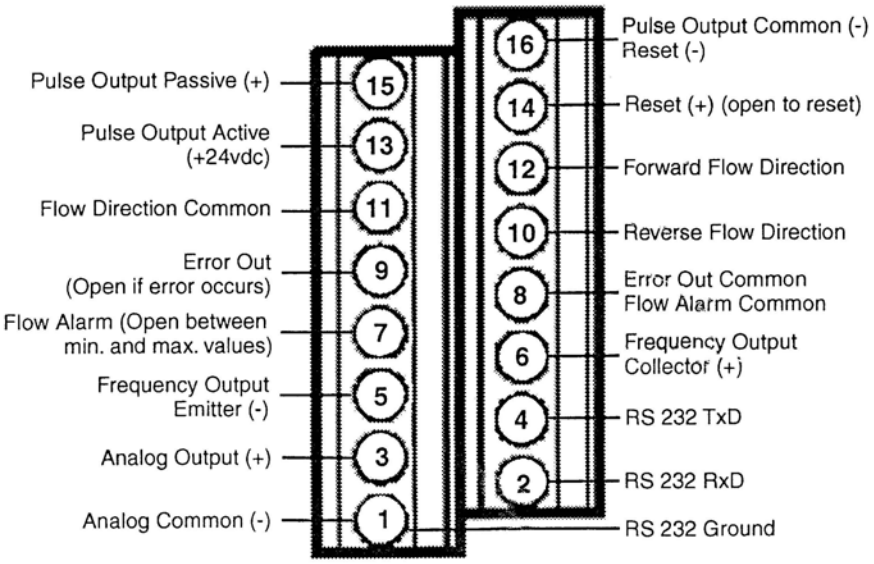
⚠CAUTION
To prevent accidents, power connection should be made only after all other connections have been completed.

The PRIMO amplifier is a microprocessor based device. **It is important that the power supply be as "clean" as possible.** Avoid using power lines that feed heavy loads such as pumps, motors, etc. If dedicated lines are not available, a filtering or isolation system might be required.

It is recommended that the internal fuse protection be maintained. Use a 2 amp slow blow fuse.

How to connect the amplifier to remote digital indicators/totalizers that do not require external power supply
This connection is intended for use with indicators that do not require an external power supply such as the ER series indicators from Badger Meter. For the ER-6, ER-8 or ER-9, connect terminal 15 of the Amplifier to terminal 2 of the ER series and terminal 16 to ground or terminal 1 of the ER indicator.

For connection to the PC 100 Controller, connect terminal 15 of the amplifier to terminal 14 of the PC 100 and terminal 16 of the amplifier to terminal 12 of the PC 100.



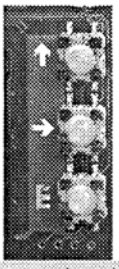
PROGRAMMING (3.1 Electronics)

The Primo® amplifier comes preprogrammed from the factory and in most instances will not require any additional manipulation. However, if you will be using the flow signal outputs or need to reprogram the meter to suit your particular needs, it will be necessary to familiarize yourself with the programming procedures.

Programming of the Primo amplifier is very simple
This section gives step by step instruction on how to program each of the functions of the amplifier and an explanation of the choices that are available for each one.

First, using a small flat screwdriver, remove the red cover from the main amplifier housing. At the lower right corner of the unit you will see three square buttons. These buttons are used to perform all programming procedures.

Programming Keys



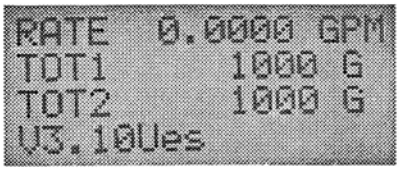
NOTE: The programming buttons have been placed inside the amplifier enclosure to prevent tampering or accidental reprogramming of the unit. After programming, be sure to reassemble the red cover on the enclosure.

The four line 16 digit LCD display of the Primo amplifier will guide you through each of the programming options/steps. The main screen will display:

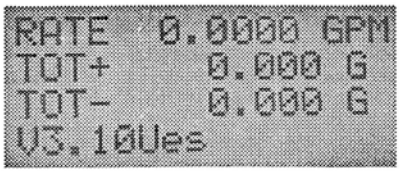
1st Line:	Flow Rate
2nd Line:	Totalizer (TOT+ or TOT1)
3rd Line:	Totalizer (TOT- or TOT2)
4th Line:	Displays revision of software to assist in troubleshooting. This line is also used to display any error messages that may occur during operation of the meter.

The main display screen will be in one of the following modes. (See Flow Direction on page 11 for additional detail.)

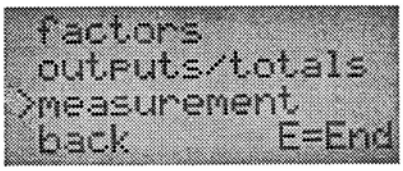
Uni-Directional Mode



Bi-Directional Mode



By pressing the Enter or E key (bottom key), you will be at the main submenu screen. If no entry is done within 5 minutes while in any of the programming parameters, the program returns automatically to the main screen. Even during the parameter setting mode, the meter will be measuring and totalizing any flow that occurs.



There are three main submenus: factors, outputs/totals and measurement. Each submenu gives access to the following appropriate functions:

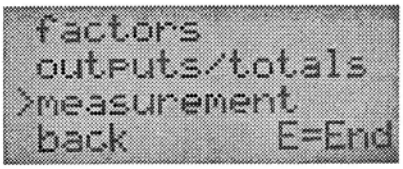
Factors:
1) Detector factor
2) Pipe diameter
3) Password protection

Outputs/Totals:
1) Reset totals
2) Analog outputs
3) Pulse outputs
4) Frequency
5) Flow alarm

Measurement:
1) Unit
2) Full scale
3) Low flow cutoff
4) Empty pipe detection
5) Flow direction
6) Filter
7) Error list

PROGRAMMING OF MEASUREMENT PARAMETERS

When the programming submenu screen appears, notice the right arrow on the far left side. Using the up ↑ arrow key, you can position the arrow in front of the submenu that you wish to interrogate. We recommend starting with the "measurement" submenu followed by the "outputs/totals" submenu and finally the "factors" submenu.

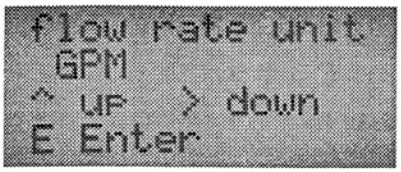


Use the ↑ key to position the > arrow next to "measurement" and press the → key. The following screen will appear:

UNIT OF MEASURE

This is where you will select the unit of measurement for the flow rate indication and the totalizers. Use the ↑ key to place the → arrow next

to "change" and press → key. The first unit of measurement screen will appear:



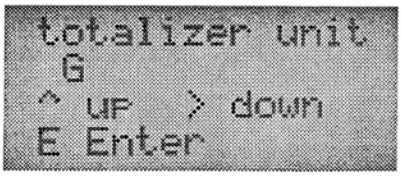
Using the ↑ or→ keys,select the desired unit of measure for flow rate indication.

Choices are:

L/h	Liters/hour
L/m	Liters/minute
l/s	Liters/second
m^3/h	Cubic meters/hour
m^3/m	Cubic meters/minute
m^3/s	Cubic meters/second
GPM	US gallons/minute
MGD	US million gallons/day
LbM	US liquid pounds/minute
oz	US fluid ounces/minute
IGM	Imperial gallons/minute

The existing totalizer values are automatically converted into the selected unit of measure.

After selecting unit of measure for flow rate, press Enter. You will see the following screen for selecting unit of measure for the totalizer.



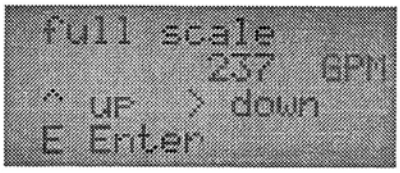
Choices are as follow; any existing values on the totalizers will automatically be converted into the new selected unit of measure

L	Liter
m^3	Cubic meter
G	US gallons
MG	US million gallons
Lb	US liquid pounds
oz	US fluid ounces
IG	Imperial gallons
aft	Acre feet
ft^3	Cubic feet

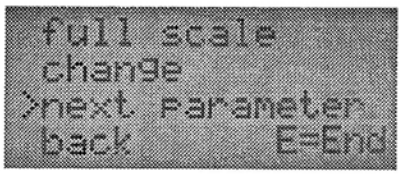
After the totalizer unit of measure selection, press the E key the following screen will appear:

FULL SCALE (MAXIMUM FLOW)

If you changed the unit of measure, the full scale or maximum flow may also need to be changed to reflect the maximum flow rate with the new unit of measure. **This is a very important parameter as it relates to other parameters including frequency output, low-flow cut-off, alarm outputs and analog signal outputs.** Adjust the desired new full scale setting based on your meter size and your applications requirements, making sure that it falls within the suggested flow range of the meter.



When done, press enter and then the → key and the next parameter will appear.



This is the same full scale parameter as previously visited. It is positioned here to provide ability to change full scale setting if no unit of measure change is necessary.

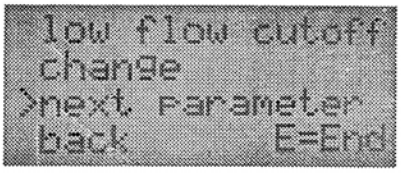
The full scale can be chosen in a range of 0.4 up to 39.4 ft/sec. A flow value is assigned to the analog output as well as the frequency output by the full scale scaling. The scaling is valid for both flow directions.

NOTE: If the flow rate is exceeding the full scale setting by more than 5%, an error is indicated that the selected full scale range is exceeded. (Terminals 7 and 8)

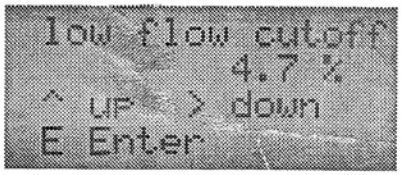
Once this is done, press E and then the → key and the next parameter will appear:

LOW FLOW CUTOFF

This is the low flow cutoff function. It is used to assign a low flow rate at which measurement will stop, preventing measurement and thus totalization errors. This parameter can be programmed from 0 % up to 10% of selected full scale flow rate.



Place the > arrow next to "change" and then press the → key. The following screen will appear:



The factory setting is 0.2%. Increasing this value will help prevent false readings during "no flow" conditions due to fluid movement in the pipe caused by vibrations or piping arrangements.

Using the ↑ and → keys select a value and then press ENTER.

Press → key and you will see the next parameter:

EMPTY PIPE DETECTION

The empty pipe detection parameter when programmed to be ON will provide an error relay indication if the meter is partially filled with liquid. This will also show an empty pipe error message on the display.

```
empty pipe det.
change
>next parameter
back        E=End
```

Position the > next to "change" and press the → key. The following screen will appear:

```
empty pipe det.
 OFF
^ up   > down
E Enter
```

NOTE: The empty pipe detection can be calibrated if required if the fluid conductivity is different than water or the remote cable length is significantly changed.

Use the ↑ and → keys to turn the feature ON or OFF as desired.

If off is selected, hit ENTER and then the →key to go to the next parameter. If ON is selected, hit ENTER and the following screen will appear:

```
calibrate ?
 YES
^ up   > down
E Enter
```

To proceed with calibration, leave "YES" selected and hit ENTER for the next screen.

The pipe has to be filled with the media that will be measured by the meter. A value between 0 and 5000 mV will be measured and displayed. The value increases with decreasing conductivity, increasing cable length or size. For normal water, the value should be between 10mV and 500mV. Afterwards the signal difference between full and empty pipe is determined by the hysteresis value.

```
fill the pipe !
Value    =360mV
^ cancel
E pipe full now
```

Make sure your pipe is full of fluid and when ready, hit ENTER. This new screen is the hysteresis value entered. This value is set at the factory at 1000 mV to allow some variation in empty pipe detection to eliminate the potential for false "empty pipe signals." It is not necessary for this value to be changed.

```
Hysteresis Value
        1000 mV
^ up   > down
E Enter
```

When calibration is complete, hit ENTER.

The switching threshold for the empty pipe detection is when the measuring signal "full pipe" plus hysteresis value is exceeded (i.e. = 360 mV + 1000 mV). The maximum value for the switching threshold is at 4000 mV.

If full pipe calibration value is higher than 3000mV, please contact customer service for assistance.

Hit →key for next parameter screen:

FLOW DIRECTION

The flow direction can be programmed to uni- or bi-directional modes.

```
flow direction
change
>next parameter
back        E=End
```

Place the > next to "change" and press the → key. One of the following (2) screens will appear:

Uni-directional totalizes the flow only in one direction (flow direction on the detector label). If the fluid is flowing in the opposite direction, the counter will indicate zero on the display and no outputs. Both totalizers can be used as resettable counters in this mode. The totalizers are indicated as "TOT1" and "TOT2".

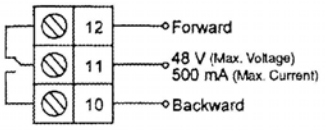
```
flow direction
uni-directional
^ up   > down
E Enter
```

The bi-directional setting measures the flow in both directions. The first totalizer (TOT+) is measuring in the forward flow direction and the second totalizer (TOT-), the reverse direction. A change of flow direction is indicated via the flow direction relay.

```
flow direction
bi-directional
^ up   > down
E Enter
```

Relay Wiring Terminals

Flow Direction Relay

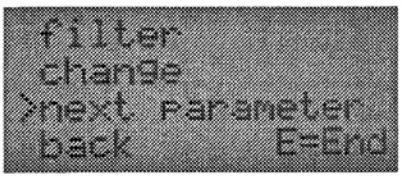


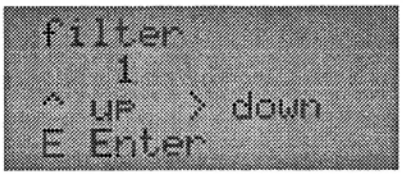
Using the ↑ and → key select which flow direction mode you want and press ENTER. Hit the → key to go to the next parameter.

FILTER DAMPENING

This feature is for dampening of all output signals and flow rate display. This function has no effect on the totalizers.

The factory setting is 1. If you notice too much back and forth oscillation of the flow rate indication, increase this value incrementally until the display is more stable. Your choices are 1 though 6 or "Inactive." To change the filter value, place the arrow next to "change" and press the → key. The following screen will show:

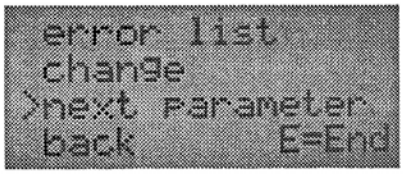




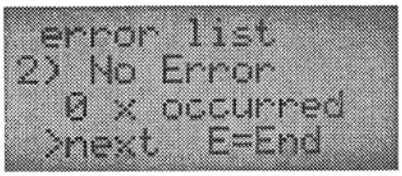
Using the ↑ and → keys select the desired filter value and then press ENTER. Hit → key to go to last parameter of this submenu.

ERROR LIST (MESSAGES)

The error list in the program menu indicates the last 8 error types that have occurred and the frequency of each. The sum of all switching on processes can be read on the "Power Up - Counter." This can assist in checking possible power failures.

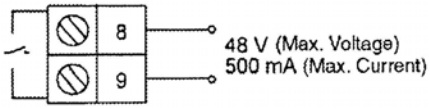


Line up the > with "change" and hit the → key. This will bring up the 1st error. Continue hitting the → key to toggle through the last 8 errors that occured, with #1 being the most recent error and the power-up indication screens.

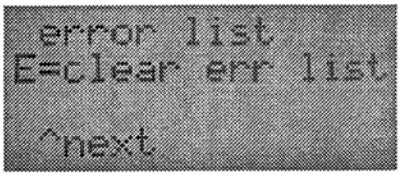


Any error is indicated via the error relay as well as displayed on line 4 of the LCD display. The relay is normally closed during normal operation and is opened when an error occurs.

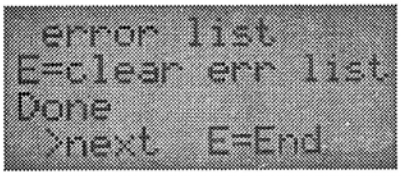
Error Relay



Now hit the → key again and you will be at the screen for clearing all the error list information.



Hit Enter to clear and the following screen will appear with "Done" indication.



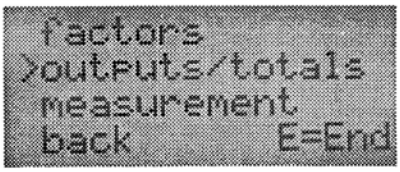
An overview of the possible errors and causes can be found in the Troubleshooting section.

Now hit enter twice and you will be back at the submenu screen.

PROGRAMMING OF OUTPUTS/TOTALS PARAMETERS

The next submenu is outputs/totals.

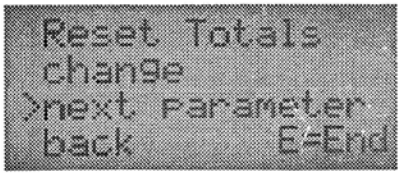
From the main submenu screen, position the > next to the "outputs/totals" submenu and press the → key.



The following screen will appear:

RESETTING OF TOTALIZERS

This parameter is used to reset either of the totalizers to zero.



Line up the > with change and hit → key.

```
Reset Totals
Tot+
Tot-
>back        E=End
```

Now line up the > next to the totalizer you wish to reset. Hit → key and that totalizer will now indicate "DONE."

```
Reset Totals
>Done
Tot-
back         E=End
```

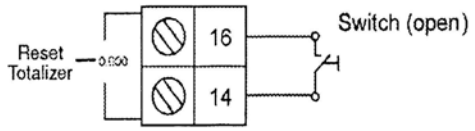
If desired to reset the other totalizer, repeat the same steps.

```
Reset Totals
Done
>Done
back         E=End
```

The "TOT2" totalizer in the uni-directional flow mode, can be reset externally.

The following is the wiring connections diagram for external reset.

External resetting



When finished, hit Enter. Hit → key to go to the next parameter.

ANALOG OUTPUTS

This parameter is for selection of the desired analog output and also calibration if required.

```
analog outputs
change
>next parameter
back         E=End
```

The following are the options available for the analog output ranges.

4 to 20 mA
0 to 20 mA
2 to 10 mA
0 to 10 mA

Press the →key at the "change" line the following screen will appear:

```
analog outputs
 4 - 20 mA
^ up   > down
E Enter
```

Press ↑ or → keys until you find the type of analog output that you desire among the following screens:

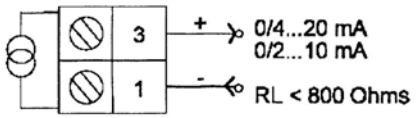
```
analog outputs
 0 - 20 mA
^ up   > down
E Enter
```

```
analog outputs
 0 - 10 mA
^ up   > down
E Enter
```

```
analog outputs
 2 - 10 mA
^ up   > down
E Enter
```

NOTE: The flow value is limited to 105% of the programmed full scale value. If this value is exceeded, an overflow error will appear on the LCD display. In bi-direction operation, the flow direction is indicated via the flow direction relay. The following diagram illustrates wire connections for the analog ouput signal.

Analog output (active)



Once you have selected the output, press the ENTER key to select that particular output. You will then be at the calibration screen. You should calibrate the analog output after you have it connected to your PLC or chart recorder.

```
calib output ?
 YES
^ up   > down
E Enter
```

If calibration is in fact desired, hit ENTER again to get to the following screen:

```
Outputs will not
equal flow if
you continue!
>continue  E=End
```

This is an important reminder to make sure that if the meter is part of a closed loop system, you must put the system in manual operation while performing the calibration process.

Hit the → key to continue and this screen will apprear:

```
Offset: 4.000 mA
Signal =     0%
 ^ up  > down
E continue
```

Hooking up an amp meter in series with the connected chart recorder (Terminals 1 and 3), you may use the ↑ and → keys to calibrate the 4mA signal for "0" flow. Hit ENTER to continue.

```
Range: 20.000 mA
Signal =   100%
 ^ up  > down
E continue
```

Now the 20 mA signal may be calibrated for 100% flow based on maximum flow rate set in programming.

NOTE: When you use a different analog output setting than 4-20mA, (i.e. 0-20mA) that the output calibration will still be performed with 4-20mA and applied to the selected setting (i.e. 0-20mA).

Hit ENTER to complete calibration and the → key for next parameter.

PULSE OUTPUTS

The pulse output parameter will determine how many pulses per gallon, liter, etc. will be sent out to remote counters, controllers, etc. It will also set how many decimal digits will be displayed on the totalizers. If, for example, you choose 100 pulses per gallon, then the display totalizers will have two digits after the decimal point.

```
 pulse outputs
 change
>next parameter
 back        E=End
```

Move the > arrow next to "change", then press the → key and the following screen will appear:

```
 pulse value
        1 puls/G
 ^ up  > down
 E Enter
```

Use the ↑ and → keys to change the value to the desired pulse rate. This value may be set from .001 to 10,000 pulses/unit of measure. Maximum frequency of 10kHz can not be exceeded. Based on maximum flow rate setting, the program will not permit a value that exceeds this frequency.

Press ENTER when you have programmed the desired number.

```
 pulse width
        50 %
 ^ up  > down
 E Enter
```

This parameter is pulse width, or the time duration that each pulse will be "ON". The 50% setting means 50% on 50% off. You can set the width in increments of 5 ms from 5-500 ms. The factory setting is 20 ms. Program this parameter to match the required pulse width of the remote accessory that will receive the pulse output. For output to any AMR device, see steps below.

```
 pulse width
   50ms (AMR)
 ^ up  > down
 E Enter
```

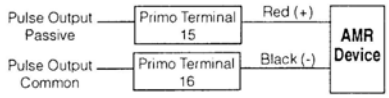
Hit enter and the next screen is:

```
 pulse type
 normally open
 ^ up  > down
 E Enter
```

This parameter permits changing of the factory setting of "Normally Open" for the pulse output to "Normally Closed." After complete, hit enter and the → key for the next parameter.

WIRING OF AMR UNIT TO MAG METER

AMR Wiring Diagram

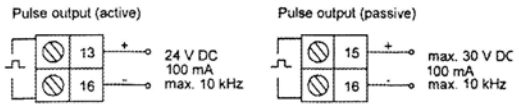


Step 1: Check to make sure your pulse output settings are correct per chart.

Maximum Flow Rate	Pulse Output Setting
Less than 5500 gpm	1 pulse per 100 or 1000 gallons
Greater than 5500 gpm	1 pulse per 1000 gallons
Less than 5500 Cu. Ft./min.	1 pulse per 100 or 1000 Cu. Ft.
Greater than 5500 Cu. Ft./min.	1 pulse per 1000 Cu. Ft.

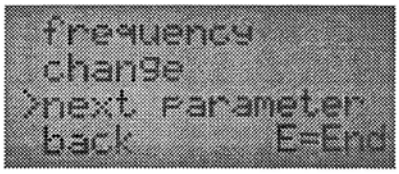
Step 2: Set pulse width to "50 ms (AMR)"
Step 3: Set pulse type to "normally open"

The following diagram is for other wiring connections for pulse outputs.

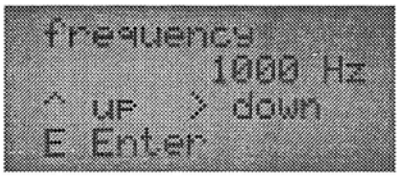


FREQUENCY OUTPUT

This is the Frequency Output parameter. The setting can range from 500 Hz up to 5000 Hz for the Full Scale Value. (Example: If 1600 Hz is selected, then when meter display indicates full scale value, this output is equal to 1600 Hz).

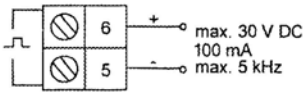


If a change is desired, line up > cursor with change and hit → key.



When complete, hit Enter.

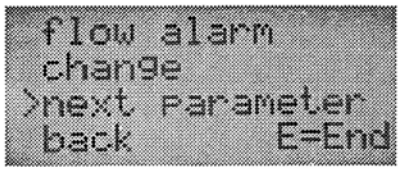
Frequency output (passive)



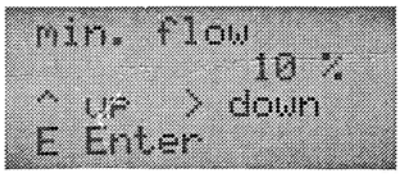
Hit → key for next parameter.

FLOW ALARMS

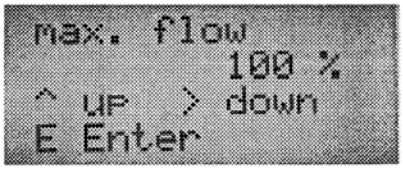
This parameter allows the setting of a minimum and maximum percentage (%) of the Full Scale flow rate value. Settings can be made in 1% increments from 0 to 100%. The minimum value must be smaller than the maximum value.



Move the > next to "change" and press the → key. The following screen will appear:



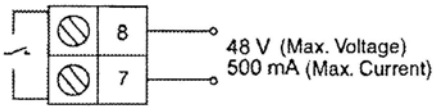
Use the ↑ and → keys to select the minimum flow percentage and press ENTER; the following screen will appear:



Use the ↑ and → arrows to change the maximum flow percentage and press ENTER.

NOTE: On the signal output, the relays will remain energized until the flow rate returns to within the flow limits.

Flow Alarm Relay

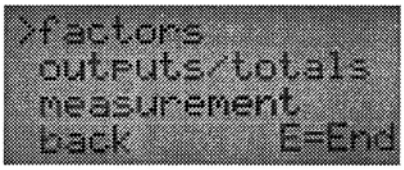


Press ENTER again to return to submenu screen.

PROGRAMMING OF FACTORS PARAMETERS

The third and last submenu "Factors" contains parameters that usually do not require changes.

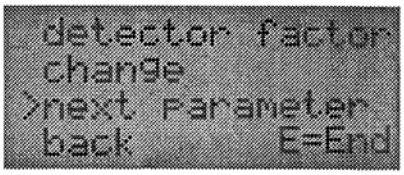
Press ENTER until you reach the submenu screen if not already there.



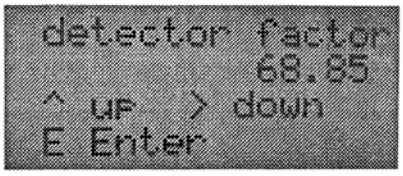
Position the > next to the "factors" submenu and press the → key. The following screen will appear:

DETECTOR FACTOR (FIELD CALIBRATION)

This is the Detector factor setting. When the meter was calibrated, this value was programmed in this parameter as a result of that calibration. Each detector has its individual factor. This detector factor is also included on the label of the meter body.



Line up the > with "change" and hit → key. This is the detector factor setting.



With this parameter, you can fine tune your calibration to meet your applications needs. If you find that the meter is off by a certain percentage, you can modify the detector factor to achieve the desired accuracy.

Even though all meters are calibrated at the factory, sometimes your specific installation and fluid parameters make it necessary to recalibrate a meter under actual operating conditions with the liquid being metered.

The following instructions are provided to assist in performing an on-site calibration check and adjustment. This procedure may require either a test tank or vessel of known capacity or a second flow meter installed in the same line.

ACCURACY TEST

1. Place a test tank of calibrated volume at the output of the meter.
2. Operate meter until test tank is filled to the appropriate calibrated level. Since meter accuracy can vary somewhat with flow rate, we recommend making test run at the same flow rate used in actual operation.
3. Record quantity indicated on display totalizer.
4. Repeat run three times and calculate an average for the (4) tests.
5. Perform the following calculation to determine the percent of accuracy of the meter.

$$\frac{\text{Qty. Delivered in vessel}}{\text{Average Meter Reading}} \times \text{Old Detector Factor} = \text{New Detector Factor}$$

Example 1.

$$\frac{100 \text{ Gallons}}{95 \text{ Gallons}} \times 68.85 = 72.47$$

In this example, the meter accuracy is low and must be increased by a calibration correction.

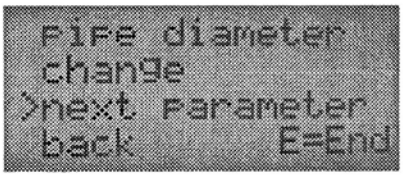
Example 2.

$$\frac{100 \text{ Gallons}}{104 \text{ Gallons}} \times 68.85 = 66.20$$

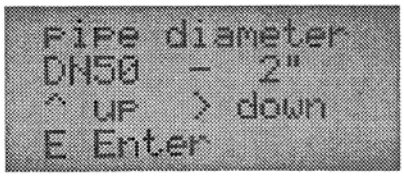
In this example, the meter accuracy is high by 4% and must be reduced by a calibration correction.

When finished with detector factor parameter, hit ENTER and then hit → key to go to the next parameter.

METER/PIPE SIZE



Place the arrow next to "change" and press the → key. The following screen will show:



This parameter will come preprogrammed from the factory matching the line size of the detector. However, if you replace the entire amplifier in the field, you may need to reprogram this parameter.

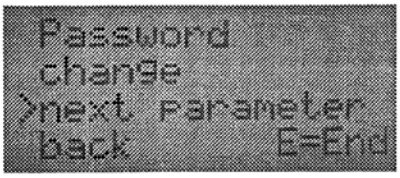
Select the pipe diameter of your flow meter by using the ↑ and → keys to match your meter size.

When complete, press Enter.

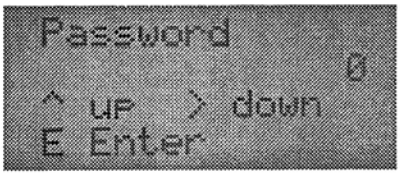
Hit → key to go to the next parameter.

PASSWORD PROTECTION

This is the password protection parameter. The unit will be set at "0" (no password required) from the factory. If activated, whenever you want to go into any of the submenus, the unit will ask for the password number.



To activate the password, line up the > with "change" and hit → key.

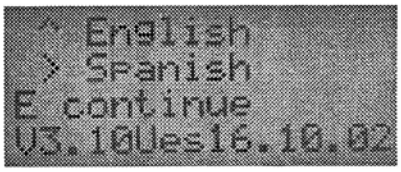


Change "0" to any desired number from 1 to 999. Hit enter and after returning to the main screen, you will always have to enter the new password to get into the submenus. If the password is lost or forgotten, a factory "333" password value can also be used to satisfy the password entry. If later no password is desired, change the value back to "0", hit Enter and a password will no longer be required to enter any of the submenus.

Hit ENTER twice and you will be back at the main screen.

LANGUAGE SELECTION

The software permits the selection of English or Spanish languages. To change the language, switch off power to Primo Amplifier. While holding the ENTER key down, re-power the unit. Hit ENTER to get to the following screen:



Select desired language and hit ENTER several times until main menu screen appears.

TROUBLESHOOTING

The Magnetoflow® mag meter should give you many years of maintenance free operation. However, should it malfunction, there are certain things that we recommend you check before contacting our technical support department or your local Badger® Representative.

Note: If the fluid measured has a high concentration of conductive solids, deposits may accumulate on the internal liner walls and electrodes. These deposits will cause a reduction of the measuring output. Thus, it is recommended to remove the meter and inspect the liner and electrodes after 6 months. If deposits are found, remove them with a soft brush. Repeat inspection process every 6 months or until an appropriate inspection cycle, (likely longer) can be established for the specific application. Some general conditions as follows:

DESCRIPTION	POSSIBLE CAUSE	RECOMMENDED ACTION
Flow is present but display is "0"	Signal cable not connected.	Check signal cable.
	Detector mounted opposite of the main flow direction (see arrow on the nameplate).	Turn detector by 180° or switch terminal 45 and 46 or reprogram to biodirectional mode.
	Coil or electrode cables exchanged.	Check cable connections for cross wiring.
Inaccurate measuring	Parameter wrong.	Check the parameters (transmitter, detector factor and size) according to attached data sheet.
	Pipe not fully filled.	Check if meter is fully filled.
No display	No power.	Apply power.
	Incorrect power.	Check power value.
	Wiring connections.	Check power input/output connections.
	Fuse blown.	Replace fuse. (2 Amp slow blow 5 x 20 mm)
Flow rate value known to be wrong	Maximum flow rate setting.	Change setting.
	Detector Factor.	Check value on label.
	Deposits on electrodes and/or liner.	Check and remove deposits.
	Incorrect pipe size programmed.	Check size if necessary.
Flow rate indication unstable	Filter value too low.	Increase filter value setting.
	Cable issue.	Make sure cable is shielded and not vibrating.
	Grounding issue.	Make sure meter is properly grounded to a good earth ground.
	Partially full pipe.	Make sure pipe is full of fluid.
	Air.	Make sure fluid does not contain air bubbles.
	Amplifier location - outside electrical interference.	Make sure amplifier is not too close to sources of electrical interference.
	Chemical injections.	Check location of injection in relation to location of meter.

ERROR MESSAGE EXPLANATION

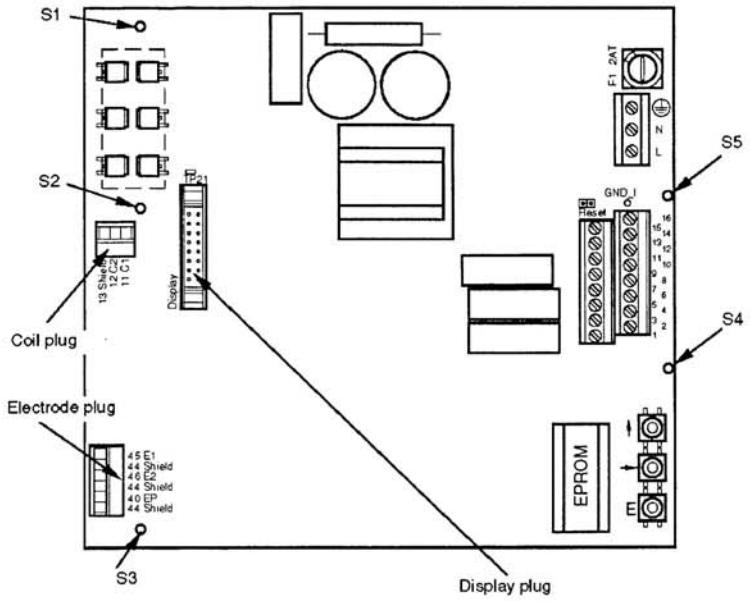
Some general conditions to keep in mind: When certain connections are sensed by the electronics, the following error messages can be indicated on the display (line 4) as well as on relay 3. The relay is closed during normal operation and is opened by an error appearing.

The following error messages can appear:

ERROR MESSAGE	POSSIBLE CAUSE	RECOMMENDED ACTION
Err: Detector	No detector connection with amplifier.	Check detector and cable connections in accordance with Instruction Manual.
	Connection between amplifier and detector interrupted.	Contact Technical Support.
	Supply voltage too low.	Contact Technical Support.
	Grounded coils in meter.	Contact Technical Support.
	Water in detector.	Contact Technical Support.
Err: Output	Micro processor output control defective.	Contact Technical Support.
Err: unknown	Program error.	Contact Technical Support.
Err: empty pipe	Pipe may not be full.	Make sure all trapped air is out of system. If fluid or fluid conductivity recalibrate the parameter.
Err: full scale	Actual flow rate is exceeding the programmed full scale value by more than 5%.	Reduce flow rate or increase the programmed full scale value.
Err: AD-Range	AD-Converter is exceeding signal limits.	Check the grounding scheme of the meter installation. See grounding section in manual.
Err: AD-Init	Initialization of AD-Converter unsuccessful.	Contact Technical Support.

If additional assistance is required, please contact our **TECHNICAL SUPPORT department at 1-800-456-5023** or contact your local Badger® Representative.

COMPLETE BOARD ASSEMBLY REPLACEMENT



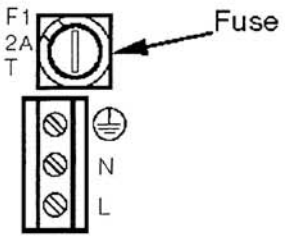
⚠WARNING
Make sure power to Primo® amplifier is off before proceeding.

1. Pull the electrode, coil and display wiring plugs. Loosen the screws S1 to S5 and remove the existing board assembly.
2. Put in new board assembly and reassemble screws to S1 and S5. Reinstall the (3) wiring plugs.
3. Program the new board assembly with the previous detector factor and meter size.

FUSE REPLACEMENT

⚠WARNING
Make sure power to Primo amplifier is off before proceeding.

Fuse type: 250 V, 2 A (time-lag)



Please see our website at
www.badgermeter.com
for specific contacts.

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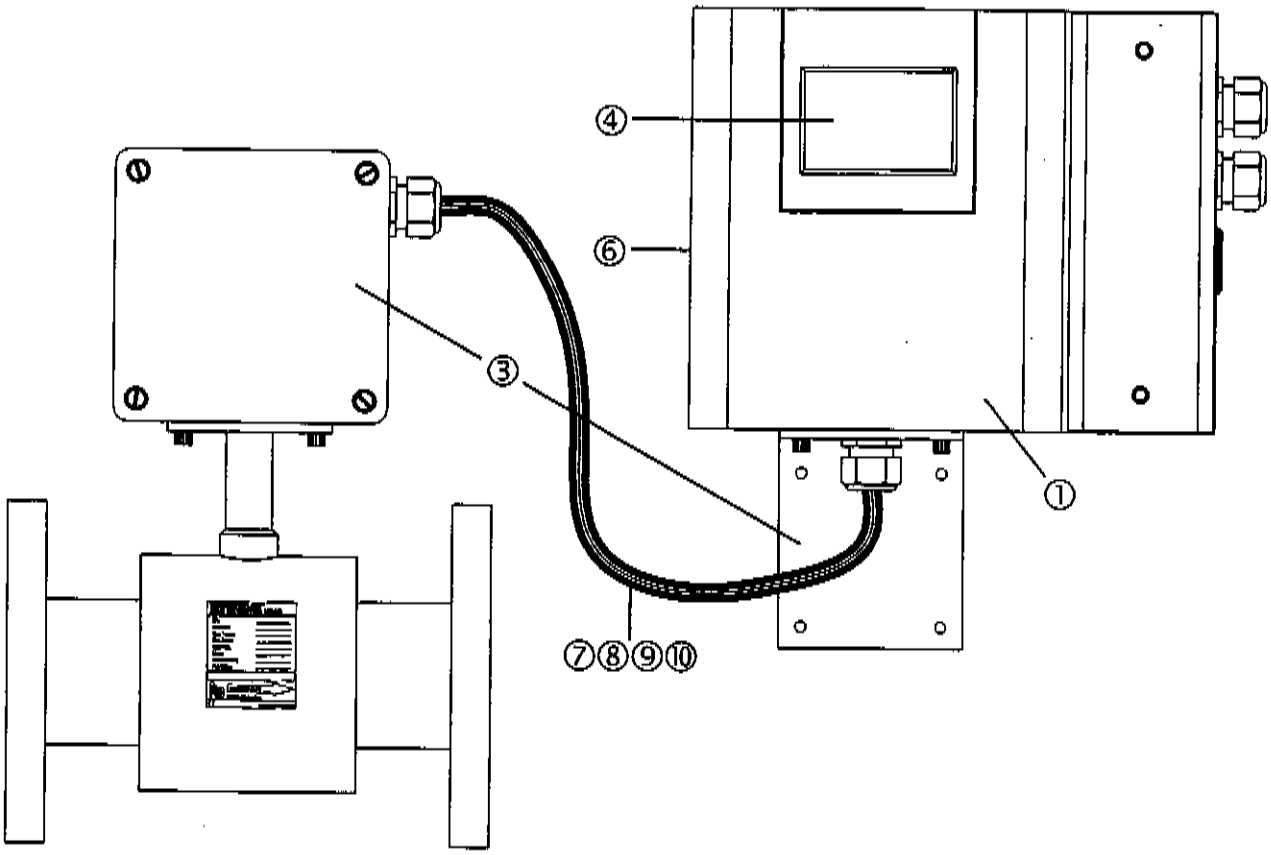
Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Mag Meter Spare Parts List

Magnetoflow® Mag Meter	Model Magnetoflow (3.1 Electronics)	Repair Parts



ITEM NO.	DESCRIPTION	PART NUMBER
1	Primo® Amplifier Assembly Complete	63384-036
3	Remote Mounting Kit less Cable (includes wall mount bracket)	63384-035
4	Primo LCD Display	63384-019
5	Primo Mother Board Assembly (Not Pictured)	63384-037
6	Primo Housing less Display and Board Assembly	63384-021
7	Cable - 15 feet	64574-002
8	Cable - 30 feet	64574-003
9	Cable - 50 feet	64574-004
10	Cable - 100 feet	64574-005

IRP-206-01

12-02

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

Please see our website at
www.badgermeter.com
for specific contacts.

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Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

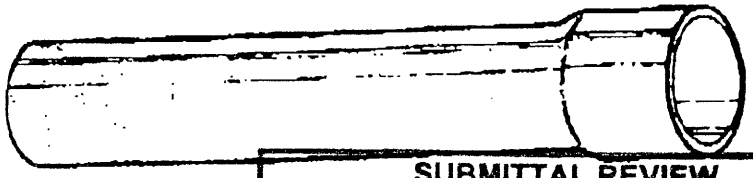
Catalog Cutsheets for all Basic Materials

(ATTN: JEFF)

PWPipe

PVC Rigid Electrical Conduit

Schedule 40 Conduit



UL LISTED

Conforms to UL 651 and NEMA TC 2

1. Conduit conforms to UL 651 including 90° C rating and sunlight resistance criteria.
2. All conduit is produced with integral solvent-weld bells. Plain-end conduit may be available.
3. Conduit is produced in 10-foot lengths. 20-foot lengths may be available.
4. Conduit color is gray, except where noted.

SUBMITTAL REVIEW

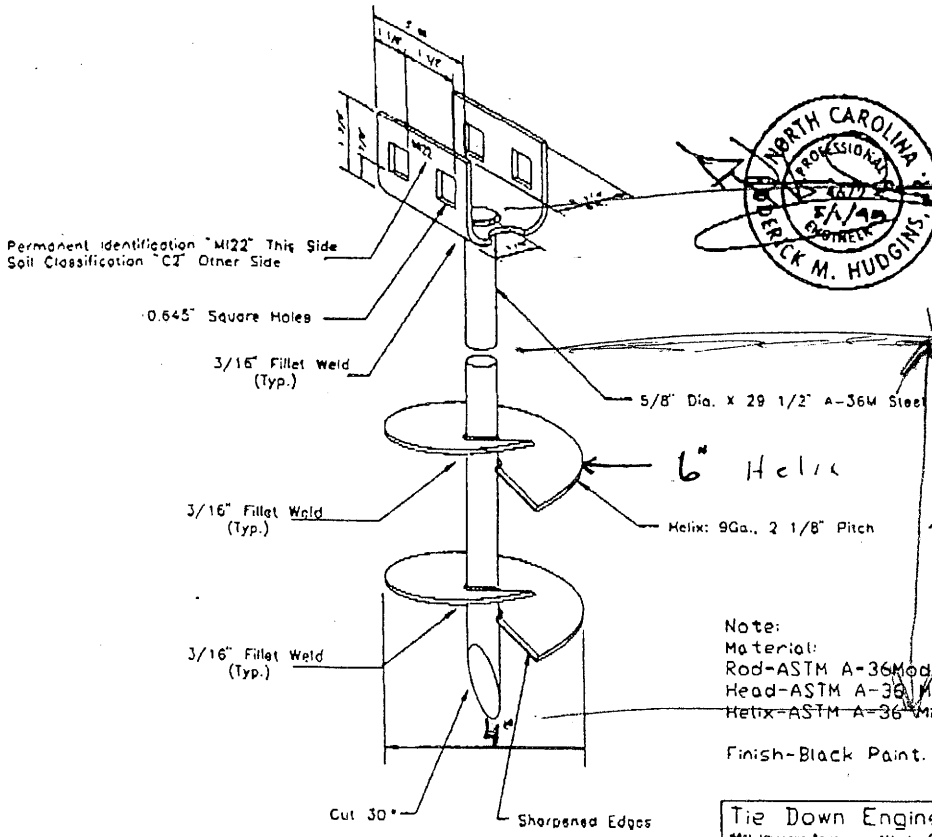
Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X — No Exceptions Taken
____ Furnish as Corrected
____ Amend and resubmit
____ Rejected

Date 8/25/03 Department ENG.
By [illegible]

Item Number	Trade Size	Average Outside Diameter (inches)	Approximate Inside Diameter (inches)	Minimum Wall Thickness (inches)	Approximate Weight (lbs/100')
4600500103	½	0.084	0.60	0.109	16
4600750103	¾	1.050	0.80	0.113	22
4601000103	1	1.315	1.03	0.133	32
4601250103	1¼	1.660	1.36	0.140	46
4601500103	1½	1.900	1.59	0.145	54
4602000103	2	2.375	2.04	0.154	73
4602500103	2½	2.875	2.44	0.203	120
4603000103	3	3.500	3.03	0.216	170
4603500103	3½	4.000	3.51	0.226	200
4604000103	4	4.500	3.99	0.237	230
4605000103	5	5.563	5.01	0.258	320
4606000103	6	6.625	6.02	0.280	410

P.O. Box 10049, Eugene, Oregon 97440-2049 (800) 347-0200 (541) 343-0200 Fax (541) 686-9253



NORTH CAROLINA PROFESSIONAL ENGINEER 4677 5/1/95 ROBERICK M. HUDGINS, JR.

maintain sufficient clearance above Grou To accommodate Pipe, Rope, and Bracket

Model MI225/8
Part # ~~59090~~
59250"

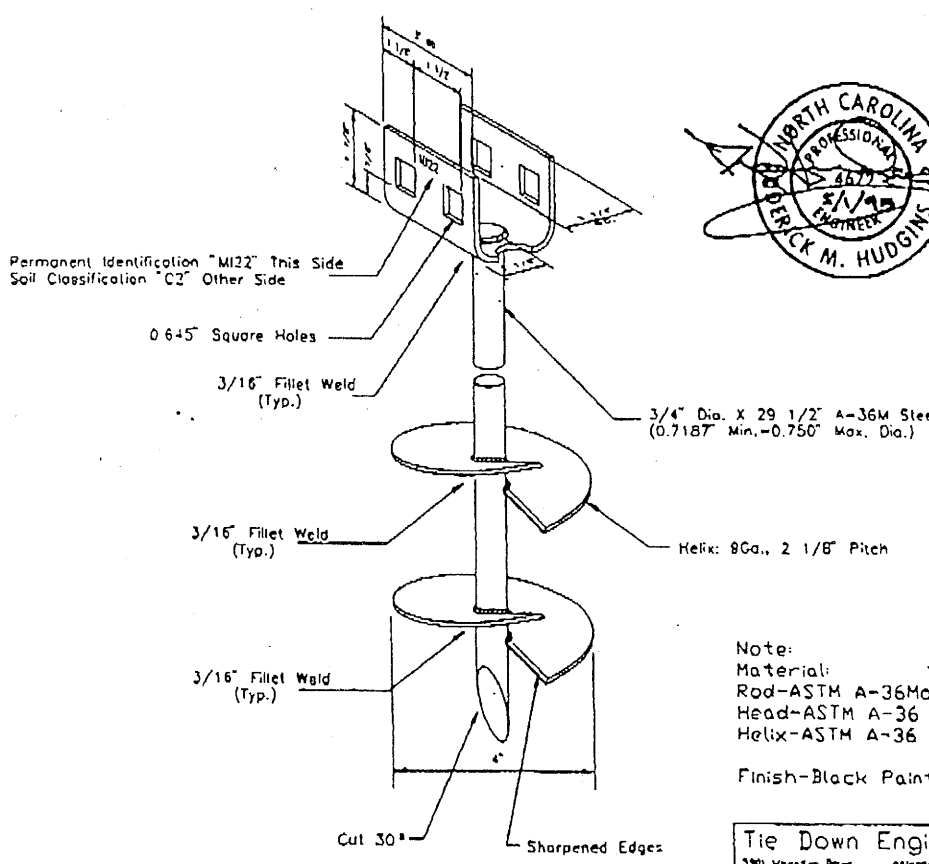
36" Length Minimum

Note:
Material:
Rod-ASTM A-36Mod. 5/8" Dia.
Head-ASTM A-36 Mild 8Ga.
Helix-ASTM A-36 Mild 9Ga.

Finish-Black Paint.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model MI225/8, Double Helix Earth Anchor Part Number 59090	
SCALE None	DWG NO. 59090

40" Total per Addendum #4, and Adequate amount above Ground To facilite Attachment



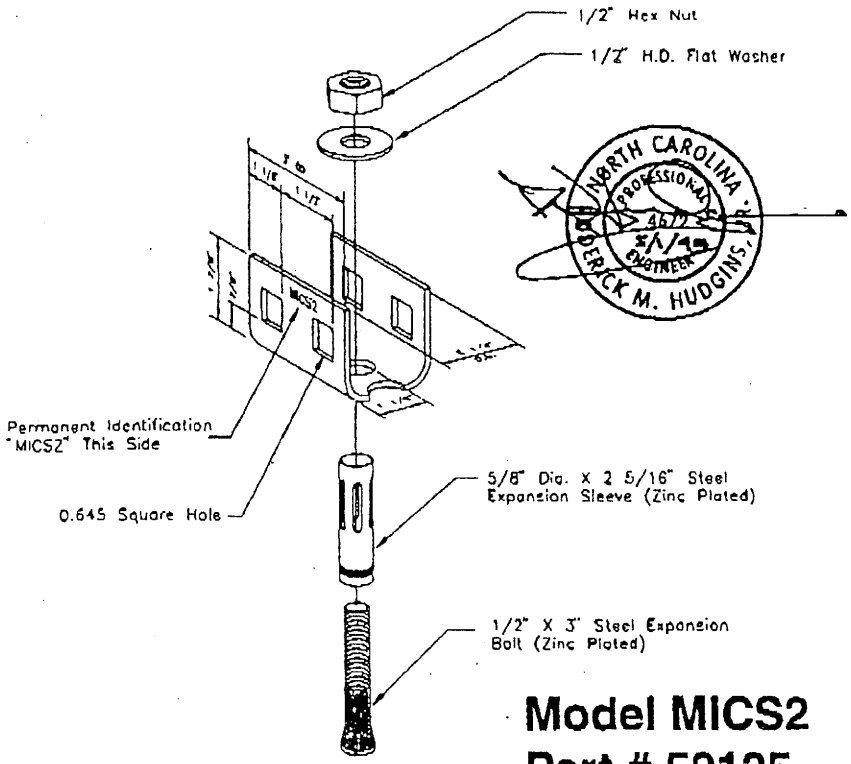
NORTH CAROLINA PROFESSIONAL ENGINEER 4677 5/1/95 ROBERICK M. HUDGINS, JR.

Model MI223/4
Part # 59095

Note:
Material:
Rod-ASTM A-36Mod. 3/4" Dia.
Head-ASTM A-36 Mild 8Ga.
Helix-ASTM A-36 Mild 9Ga.

Finish-Black Paint.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model MI223/4, Double Helix Earth Anchor Part Number 59095	
SCALE None	DWG NO. 59095



Model MICS2
Part # 59125

Installation Instructions

1. Drill 5/8" x 3" Hole In Slab.
2. Place Steel Expansion Sleeve Over Bolt & Place Into Hole.
3. Place Washer Over Tip Of Expansion Bolt.
4. Thread Nut Onto Expansion Bolt & Tighten Until Maximum Expansion Of Steel Expansion Sleeve Has Been Achieved.
5. Remove Nut & Washer.
6. Place MICS2 Head, Washer & Nut Over Tip Of Expansion Bolt & Tighten Nut.

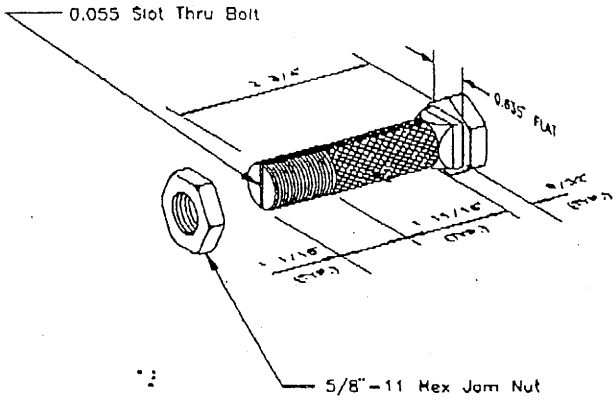
Note:
Concrete To Be 2500 PSI Min. Slab To Be 4" Min. Thickness With 6/6 x 10/10 Wire Mesh.

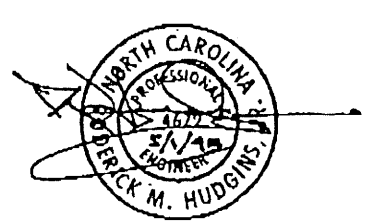
Concrete Slab Size To Allow 4750 LBS. Vertical Tension On Anchor Without Lifting Slab. Assume Concrete Wt. Of 150 LBS./CU. FT.

Note:
Material:
Head-ASTM A-36 Mild 8Ga.
Rod-ASTM A-36Mod.

Finish-Black Paint.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model MICS2-Patio Slab Anchor W/Expansion Bolt, Part Number 59125	
SCALE None	DWG. NO. 59125





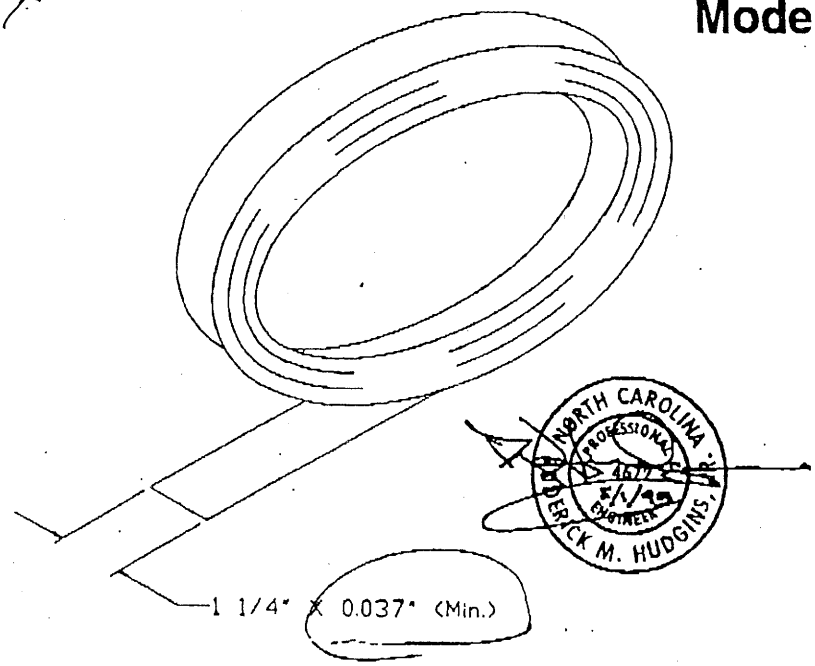
Model BISB
Part # 59135

Note:
Slotted Bolt Labeled TD
On Head.
Made To ASTM A-307.
Hardness: SAE J429 GR-2
HRB 80-100 Degree.
Finish-Zinc Plated.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model BISB, Slotted Bolt Part Number 59135	
SCALE None	DWG. NO. 59135

JUL-21-2003 MON 02:32 PM WESTLAND DIST. INC. FAX NO. 3032373677 P. 01/09

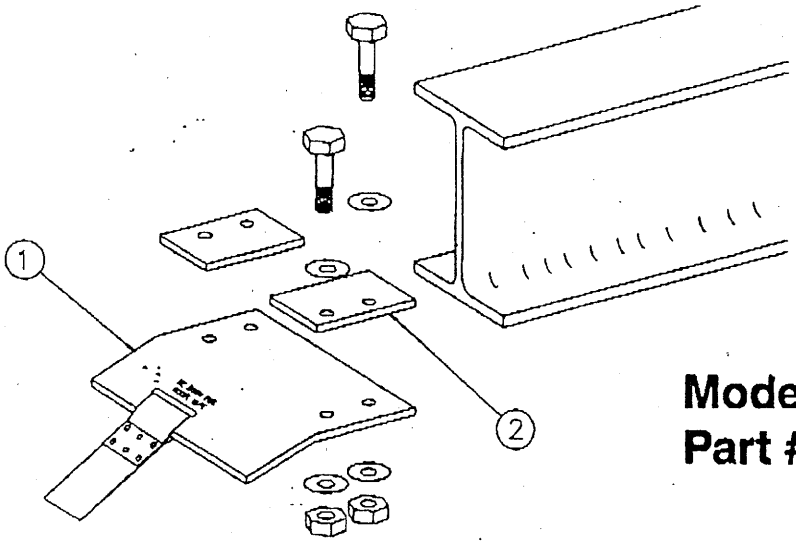
Model MH1000



Model No.	Length
MS33	33'
MS35	35'
MS37	37'
MS42	42'
MS60	60'
MS600	600'

Strap Marked Every 12"
TIE DOWN ENGINEERING
CERTIFIED TO ASTM D 3953-91
FED. SPEC. QQ-S781-H

Tie Down Engineering
Galvanized Strap
3-12-93
Drawing No. MH1000



Model MLFT
Part # 59188

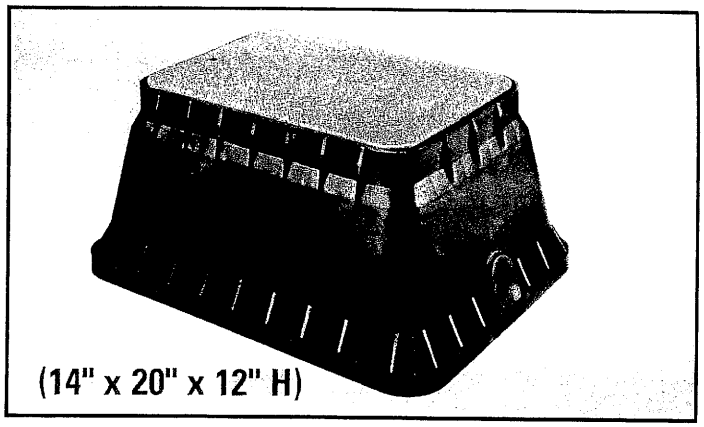
Installation Instructions:
1. Install Bolts, Washers And Nuts Though End Frame Tie, Base (1) And Clips (2), As Shown.
2. Slide Assembly Over Lower Flange Of Trailer Beam. (Position Clips Above The Flange And The Base Plate Below)
3. Tighten The Fasteners To 25-30 Ft.Lbs.
4. Attach The Strap To the appropiate Ground Anchor Following The Proper Installation Instructions.

Note:
Material:
End Frame Tie: AISI-C1008 8Ga.
Strap: ANSI A 225.1 (0.035' Min.)
1 1/4" x 7 Ft. Galvanized.
Strap Marked Every 12" As Per:
Tie Down Engineering
Certified To ANSI A 225.1
Fed. Spec. QQ-S781-B
ASTM D3953.91

Tie Down Engineering	
3394 Wheaton Drive · Atlanta, Georgia 30324	
TITLE MLFT End Frame Tie Part Number 59188	
SCALE None	DWG NO 59188

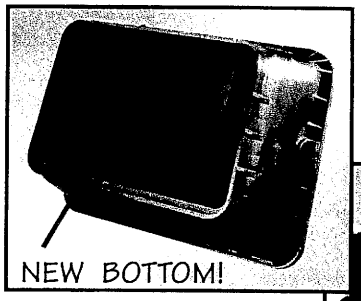
JUL-21-2003 MON 02:32 PM WESTLAND DIST. INC. FAX NO. 3032373677 P. 02/09

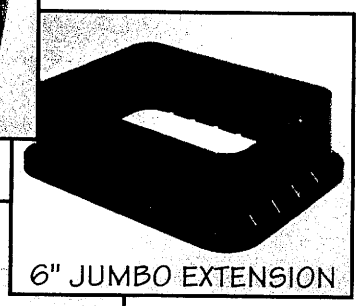
JUMBO BOX

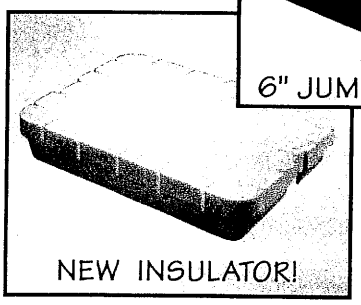


FEATURES:

- 10 Year Lid Guarantee
- Allows More Space
- Ametek's SUPERFLEXON® is Easier to Handle, Install, and Store
- Reader Lid Available







JUMBO BOX ASSEMBLIES

Assembly Weight = 17.7 Pounds
Skid Quantity = 48
Skid Weight = 850 Pounds

Control Valve	
Black Box, Green Lid w/Snap Lock	190106
Black Box, Green Lid w/Pentagon Lock	190121
Black Box, Brown Mulch Lid w/Snap Lock	190125
Electric	
Black Box, Black Lid w/Pentagon Lock	190104
Black Box, Black Lid w/Snap Lock	190117
Black Box, Black Lid w/Hex Bolt Lock	190129
Water	
Black Box, Black Lid w/Snap Lock	190109
Black Box, Black Reader Lid w/Snap Lock	190107
Reclaimed Water	
Black Box, Purple Lid w/Snap Lock ***NEW COLOR!***	190122
CATV	
Black Box, Green Lid w/Snap Lock	190112
Blank	
Black Box, Green (Blank) Insulator Lid, 6" Extension	190133

JUMBO BOX (Boxes Only)

Box Weight = 11.9 Pounds
Skid Quantity = 48
Skid Weight = 610 Pounds

Black	190101
Black Box w/3 - 6" Extensions	190130

JUMBO BOX (Lids Only)

Lid Weight = 5.8 Pounds
Skid Quantity = 132
Skid Weight = 810 Pounds

Green (Blank), no Lock, use with 190131 Insulator	190135
Green (Blank) w/Snap Lock	192103
Green "Control Valve" w/Snap Lock	192101
Green "Control Valve" w/Pentagon Lock	192109
Brown Mulch "Control Valve" w/Snap Lock	192112
Brick Red "Control Valve" w/Snap Lock	192113
Black "Electric" w/Snap Lock	191102
Black "Electric" w/Pentagon Lock	191105
Black "Water" w/Snap Lock	191101
Purple "Reclaimed Water" w/Pentagon Lock	192012
Purple "Reclaimed Water" w/Snap Lock	192110

SUBMITTAL REVIEW

Reviewed for general conformity with the design concept. Limited to requirements called for by the contract documents. Contractor is responsible for the accuracy of dimensions, quantities, details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/21/03 Department EWG
Mr Mady

JUMBO BOX EXTENSIONS

Black, 6" Height	190110

Extension Weight = 30 Pounds
Skid Quantity = 40
Skid Weight = 280 Pounds

Black 6" Height and Green "Control Valve" Lid w/Snap Lock	190115

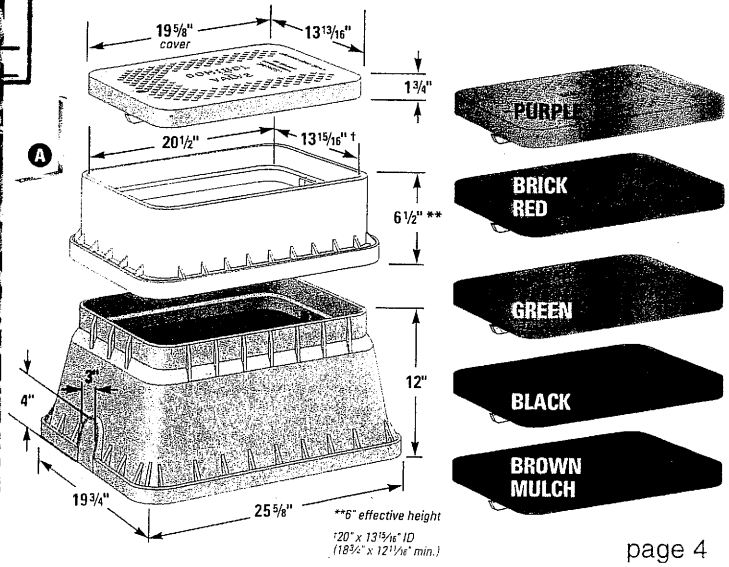
Assembly Weight = 11.8 Lbs.
Skid Quantity = 32
Skid Weight = 420 Lbs.

JUMBO BOX BOTTOM

Flat Base for Jumbo Box	190132

JUMBO BOX ACCESSORIES

Insulator (Used only with 190135 Lid)	190131
Lexan Bolt-Pentagon Lock	143003
Lexan Locking Nut-Pentagon Lock	143013
Hexagon Steel Bold	143014
8" Hinge Pin (for #172002 & 172114)	144004
Snap Lock Set	144017
Snap Lock Unlocking Tool (A)	144022
Locator Washer	143020
Screw for Locator Washer	143004



Wire Meggered Test

MOGENSEN ELECTRIC INC.

INDUSTRIAL • COMMERCIAL

P.O. Box 308 • Moab, Utah 84532
Telephone/Fax: 435.259.6386

10/24/2003

TO: Palisade Contractors, Inc.
Attn: Mark

RE: Stoller/ Atlas Mill Site
Electrical test results.

Testing done by Jeff Mogensen and was found to be in good order.

480 Volt single phase line: 7/31/03 – Test was done for continuity and grounding with ohm meter. Continuity was found to be in order for both phases and ground.
Megger test was done at 500 volt and 1000 volt. No insulation leakage was detected.

480 volt three phase line: 8/5/03 – Continuity test was done on all three phases and ground. Continuity was found to be in order on all four wires.
Megger test was done at 500 volt and 1000 volt. No insulation leakage was detected.

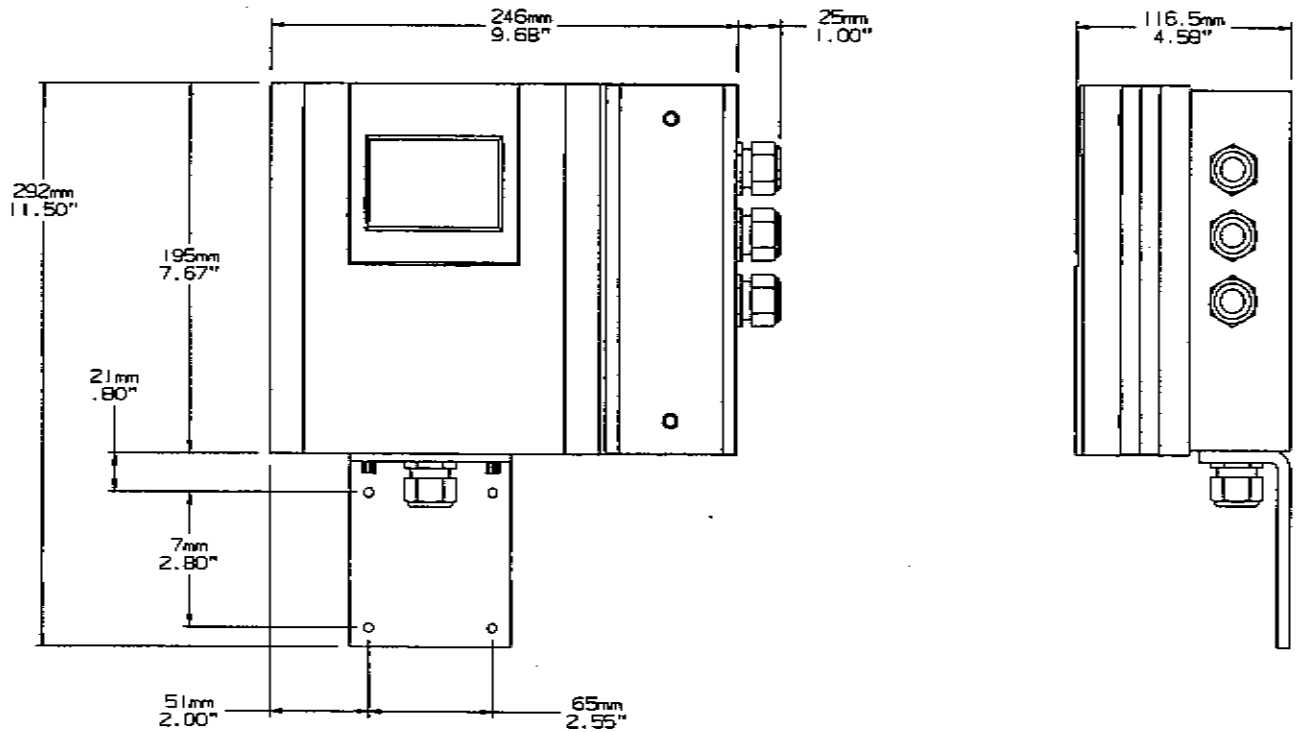
Jeff Mogensen

President

Mag Meters Factory Test Data

CHG in ocess

S-885
DRAWING NO.



CERTIFIED

Signature 6/11/03 Date

CONFIDENTIAL ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER SHOWN ON THIS DRAWING ARE EXCLUSIVE PROPERTY OF BADGER METER INC.	UNLESS OTHERWISE SPECIFIED TOL. ON THREE PLACE DECIMAL DIMENSIONS = .005 TOL. ON TWO PLACE DECIMAL DIMENSIONS = .010 TOL. ON ANGULAR DIMENSIONS = MICRO-FINISH DEBURR:			BADGER METER, INC. MAG MTR REM PRIMO AMPLIFIER TYPE MODEL SIZE INSTALLATION DIMENSIONS PART NAME MATERIAL:	PART NO. REV. DRAWN JK 05/27/98 CHECKED RF 05/27/98 APPROVED SCALE: NONE SHEET 1 OF 1 S-885 A DRAWING NO. ISSUE
		A	JK 05/27/98		
		ISSUE	CHANGE	BY	DATE

CHG in ess

S-884 DRAWING NO.

METER SIZE		A		B		C		D		EST. WEIGHT WITH PRIMO	
inch	mm	Inch	mm	Inch	mm	Inch	mm	inch	mm	Lbs.	Kg.
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5
2 1/2	65	11.0	279	17.1	434	7.0	178	14.4	366	54	24.5
3	80	11.0	279	17.3	440	7.5	191	14.7	372	56	25.5
4	100	11.0	279	18.4	466	9.0	229	15.7	398	58	26.5
5	125	15.8	400	19.6	498	10.0	254	16.9	430	101	46.0
6	150	15.8	400	20.6	524	11.0	279	17.9	456	110	50.0
8	200	15.8	400	22.5	572	13.5	343	20.4	518	110	50.0
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0
14	350	23.6	600	30.8	782	21.0	533	28.2	716	260	118
16	400	23.6	600	33.7	856	23.5	597	31.0	788	308	140
20	500	23.6	600	38.2	969	27.5	699	35.5	901	495	225
24	600	23.6	600	42.2	1071	32.0	813	39.5	1003	554	252
28	700	23.6	600	46.2	1173	36.5	927	44.0	1118	650	295
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420
48	1200	39.4	1000	69.9	1775	59.4	1455	67.2	1707	1210	550
56	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620

CONFIDENTIAL

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UNLESS OTHERWISE SPECIFIED
TOL. ON THREE PLACE DECIMAL DIMENSIONS ± .005
TOL. ON TWO PLACE DECIMAL DIMENSIONS ± .010
TOL. ON ANGULAR DIMENSIONS ±
MICRO-FINISH
DEBURR: PER. MFG. STD.

ISSUE	CHANGE	BY	DATE
A		JK	05/27/98

BADGER METER, INC.

TYPE: MAG MTR REM MODEL: FLANGED SIZE: 1/4" - 56"

INSTALLATION DIMENSIONS

PART NAME

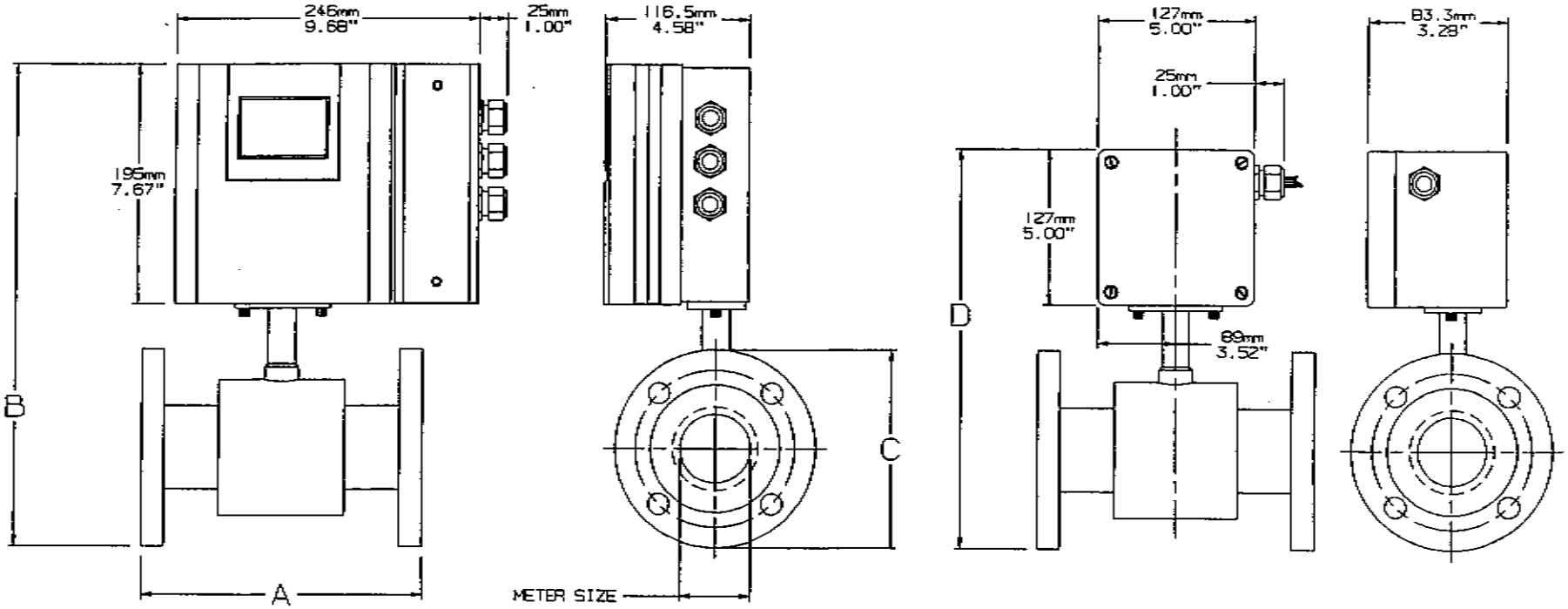
MATERIAL:

DRAWN JK 05/27/98
CHECKED RF 05/27/98
APPROVED
SCALE: NONE
SHEET 2 OF 2
DRAWING NO. S-884
ISSUE A

6/11/2003

CHG in cess

S-884
DRAWING NO.



CERTIFIED

Signature 6/11/03 Date

CONFIDENTIAL ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER SHOWN ON THIS DRAWING ARE EXCLUSIVE PROPERTY OF BADGER METER INC.	UNLESS OTHERWISE SPECIFIED TOL. ON THREE PLACE DECIMAL DIMENSIONS ± .005 TOL. ON TWO PLACE DECIMAL DIMENSIONS ± .010 TOL. ON ANGULAR DIMENSIONS ± MICRO-FINISH DEBURR: PER MFG STD. 6/11/2003	A	JK 05/27/98 ISSUE CHANGE BY DATE	BADGER METER, INC. MAG MTR REM FLANGED 1/4" - 56" TYPE MODEL SIZE INSTALLATION DIMENSIONS PART NAME MATERIAL:	DRAWN JK 05/27/98 CHECKED RF 05/27/98 APPROVED SCALE: NONE SHEET 1 OF 2 S-884 A DRAWING NO. ISSUE

well Field Dist. panel 1/1

1	BAB2100H	BAB2020	2
3			4
5	BAB2020	BAB2020	6
7			8
9	BAB2020	BAB2020	10
11			12
13	BAB2020	BAB2020	14
15			16
17	BAB2020	BAB2020	18
19			20
21	BAB2020	BAB1020	22
23		BAB1020	24
25	BAB1020	BAB1020	26
27	PROVBAB1	PROVBAB1	28
29	PROVBAB1	PROVBAB1	30
31	PROVBAB1	PROVBAB1	32
33	blank	blank	34
35	blank	blank	36
37	blank	blank	38
39	blank	blank	40
41	blank	blank	42

General Information

Service Voltage:	120/240 1Ph 3W
Bus Bar:	100A-Al
Neutral:	100A
S.C. Rating:	10k A.I.C. Fully-Rated
Enclosure:	NEMA3R

	Main:	Outgoing:
Catalog #	BAB2100H	(None)
Type:	Breaker	
Location:	Top	
Trip:	100	
Terminal:	Mechanical (Al)	
Qty/Range:	(1) #8-1/0 (Cu/Al)	

Box Catalog#: WPQ2036

Box		Gutter	
Height:	36"/914.4mm	Top:	5.5"/139.7mm
Width:	20"/508.0mm	Bottom:	5.5"/139.7mm
Depth:	6"/152.4mm	Left:	5.0"/127.0mm
		Right:	5.0"/127.0mm

Ground Bar: Bolted

Mastic Nameplate: (1) (2) (3)

NEC Lighting & Appliance, UL CTL — Standard Panel

Plant Information

Non-Interchangeable Main Device

Main Chassis:	2C11810G01	Bus Cat:	1C968-7H31
Bus Assembly:	1C96627G01	Assembly BFC:	1C966-3G02
Neutral:	1C96646G01	Nameplate:	24A-[illegible]
Ground Bar:	5158C05G02		
Panel Packing:	1C96637G02		
UL CTL:	1C96624G01		

Modifications

Qty	Ref #	Catalog #	Description

Branch Devices

Qty	Poles	Trip	Frame	Amps	KAIC
4	1	20	BAB	100	10
10	2	20	BAB	100	10
6	1	0	PROVBAB	[illegible]	[illegible]

Notes

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department EN6
By [signature]

THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

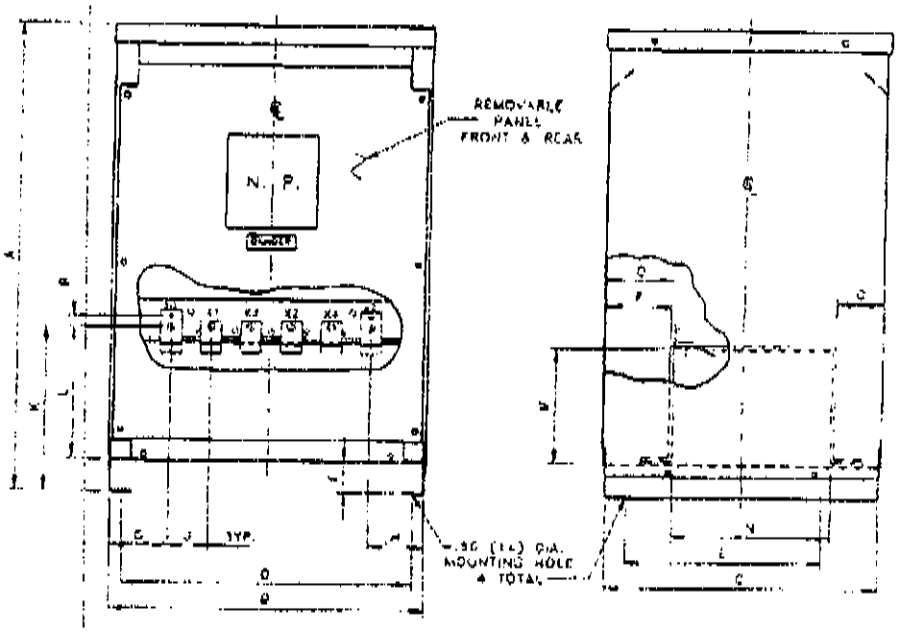
PREPARED BY: J107	DATE: 06/30/03	Cutler-Hammer	Sumter, SC
APPROVED BY	DATE	JOB NAME: ATLAS	
		DESIGNATION	
VERSION: 4.3		TYPE: Pow-R-Line1a	DRAWING TYPE: Customer Appr.
REQUEST NUMBER: J107063023 61-0000	REVISION	DWG SIZE: A	0.0
			ITEM
			SHEET 1 OF 1

37.5 KVA X-FORMER at wellfield

1/2

REF
DWG NO 42-4464

NOTES:
1. ALL UNITS ARE DESIGNED IN ACCORDANCE WITH APPLICABLE NEMA, UL, ANSI AND IEEE STANDARDS.
2. DRY-TYPE VENTILATED, CLASS AA, NEMA TYPE 2 ENCLOSURE.
3. FOR NEMA 3R OUTDOOR APPLICATION, USE WEATHERSHIELD # WS-11
4. TRANSFORMERS ARE FLOOR MOUNTED.
5. 220°C CLASS INSULATION SYSTEM.
6. PAINT COLOR IS ANSI #61.
7. ALUMINUM UNITS HAVE ALUMINUM WINDINGS AND TERMINATIONS. COPPER UNITS HAVE COPPER WINDINGS AND TERMINATIONS.



DIMENSIONS IN Inches (mm)

FRAME	KVA	APPROX NET WT. LBS(KG) ALUMINUM	COPPER	A	B	C	D	E	F
817	25.0/37.5	308(139)	343(150)	37.53(953)	22.59(574)	19.50(495)	20.91(531)	16.00(406)	2.53(64)
				G	H	J	K	L	M
				4.13(105)	3.91(99)	2.58(73)	13.47(342)	10.85(276)	9.27(235)
				N	O	P	Q	R	
				11.37(288)	4.88(124)	4.63(117)	3.26(83)	.88(22)	

THIS DIMENSION DRAWING IS FOR REFERENCE ONLY. IT IS NOT TO BE REGARDED AS INDICATING THE EXACT DETAILS OF CONSTRUCTION.

5/02

THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IT ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

DRAWN	DATE 12/01/01	Cutler-Hammer	
APPD FFR	DATE 12/01/01	TITLE DRY TYPE TRANSFORMER OUTLINE	
CO		TYPE TRANSFORMER	
PRODUCT CODE TRANSFORMER	REVISION 03	DWG SIZE A	FR817

THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON'S CUTLER-HAMMER BUSINESS. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

NEG-ALT NUMBER
SL5105265302-0000

PREPARED BY TAYLOCS	DATE 06/26/03	Eaton's Cutler-Hammer Business	
APPROVED BY	DATE	JOB NAME	
		DESIGNATION	
VERSION 4.4.0		TYPE T20P11S37	
REVISION	DWG SIZE A	G.O	

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

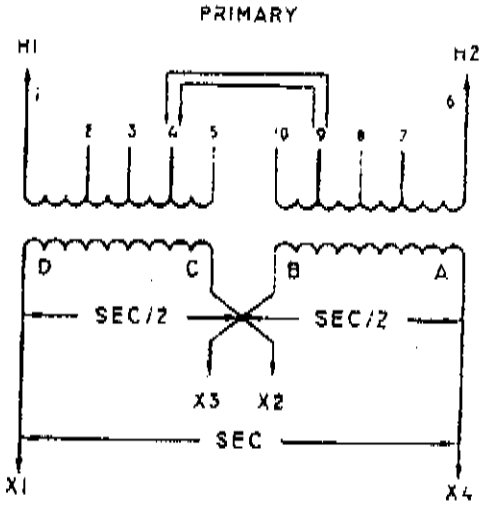
X DRAWING TYPE
Customer Approval
ITEM
No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department ENG
By MW Madrid

FIGURE 3XA

	VOLTS	CONNECT	LINE
PRI		USE 2 CABLES	H1-H2
	504	5 TO 10	
	492	5 TO 9	
	480	4 TO 9	
	468	4 TO 8	
	456	3 TO 8	
	444	3 TO 7	
	432	2 TO 7	
		USE 1 CABLE:	
	252	5 TO H2 & 10 TO H1	
	240	4 TO H2 & 9 TO H1	
	228	3 TO H2 & 8 TO H1	
	216	2 TO H2 & 7 TO H1	
SEC	240	X2 TO X3	X1-X4
	120	X1 TO X3 & X2 TO X4	
	* 120/240	X2 TO X3	X1-X3-X4

* THREE WIRE OPERATION



THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON'S CUTLER-HAMMER BUSINESS. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.	PREPARED BY TAYLOCB	DATE 08/26/03	Eaton's Cutler-Hammer Business Pittsburgh, PA
	APPROVED BY	DATE	JOB NAME XFMR for CED
			DESIGNATION
	VERSION 4.4.0		TYPE T20P11S37
			DRAWING TYPE Customer Approval
RECALT NUMBER SL5106265302-0000	REVISION	DWG SIZE A	G.O.
			ITEM
			SHEET 2 OF 2

JEPT

Enclosures

Main breakers at each site 1/2

Type 1 General Purpose

- Surface or flush mounting
- 15 – 1200 ampere range
- 600V AC, 500V DC

Type 1 enclosed breakers are designed for use in commercial buildings, apartment buildings and other areas where a general purpose enclosure is applicable. The breaker is front operable and is capable of being padlocked in either the ON or OFF position. Ratings through 1200 amperes are listed with Underwriters Laboratories as approved for service entrance application. Both surface and flush mounted enclosures are available.

Type 3R Rainproof Surface Mounting

- Interchangeable hubs (through 400 amperes)
- 15 – 1200 ampere range
- 600V AC, 500V DC

This general purpose outdoor service center employs a circuit breaker inside a weatherproof sheet steel breaker enclosure to serve as a main disconnect and protective device for feeder circuits. Ratings through 1200 amperes are listed by Underwriters Laboratories as suitable for service entrance application.

Type 12 Dustproof Surface Mounting

- No knockouts or other openings
- 15 – 1200 ampere range
- 600V AC, 500V DC

The Type 12 enclosure is designed in line with specifications for special industry application where unusually severe conditions involving oil, coolant, dust and other foreign materials exist in the operating atmosphere. The handle padlocks in the OFF position and the cover is interlocked with the handle mechanism to prevent opening the cover with the circuit breaker in the ON position. Ratings through 1200 amperes are listed by Underwriters Laboratories as suitable for service entrance application.

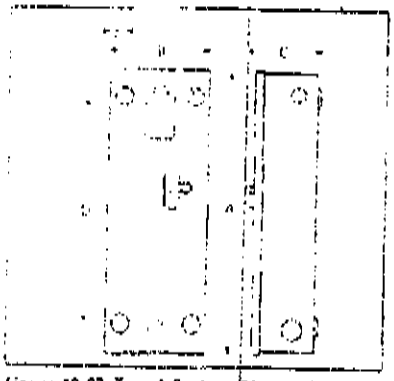


Figure 12-27. Type 1 Surface Mounted

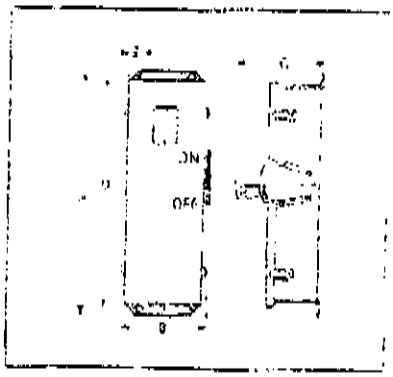


Figure 12-28. Type 3R Rainproof

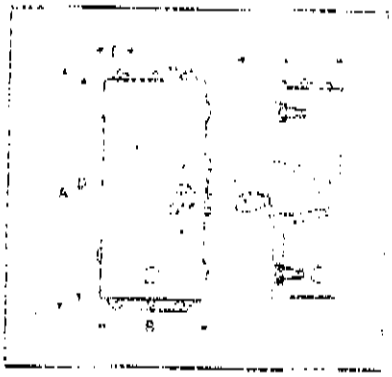


Figure 12-29. Type 12, 12K Dustproof

Table 12-267. Enclosure Selection Data

Breaker Frame Amperes	Enclosure Type Class	Dimensions A Inches	A mm	B Inches	B mm	C Inches	C mm	D Inches	D mm	E Inches	E mm	App. Wt. Lbs.	Conduit Sizes, Inches	Catalog Number	Price U.S. $
FC 15 – 225	Type 1	23.25	591	8.41	214	6.28	160	18.75	476	1.20	31	16	.25, .50, .75, 1, 1.25, 1.50, 2, 2.50	SFDN225	18[illegible]
	Type 3R	25.66	652	8.84	225	9.31	237	24.28	617	1.70	43	19	.25, .50, .75, 1, 1.25, 1.50, 2, 2.60	RFDN225	46[illegible]
	Type 12	25.66	652	8.84	225	9.31	237	24.28	618	1.70	43	19		JFDN225	252
JG 175 – 250	Type 1	34.70	881	10.92	277	7.20	183	30.00	762	1.84	46	31	.25, .50, 2, 2.50, 3	SJDN250	188
	Type 3R	37.50	951	11.56	294	10.22	260	35.77	909	1.94	49	40	.25, .50, 2, 2.50, 3	RJDN250	390
	Type 12	37.50	953	11.56	294	10.22	260	35.77	909	1.94	49	37		JJDN250	335
KG 300 – 400	Type 1	38.81	986	11.06	281	10.94	278	34.00	863	2.28	58	53	.25, .50, .75, 1.50, 2, 2.50, 3, 3.50	SKDN400	265
	Type 3R	41.89	997	11.75	298	14.06	357	39.90	1014	1.87	50	60	.25, .50, .75, 2.50, 3, 3.50	RKDN400	[illegible]
	Type 12	41.89	997	11.75	298	14.06	357	39.90	1015	1.87	[illegible]	53		JKDN400	390
LG 450 – 600	Type 1	46.89	1168	14.31	363	12.38	314	46.56	1183	1.91	[illegible]	[illegible]	[illegible]	SLDN600	[illegible]
	Type 3R	48.31	1227	14.91	379	15.50	394	46.56	1183	1.92	[illegible]	[illegible]	[illegible]	RLDN600	[illegible]
	Type 12	48.31	1227	14.91	379	15.50	394	46.56	1183	1.92	[illegible]	[illegible]	[illegible]	JLDN600	[illegible]
NG 700 – 1200	Type 1	61.22	1555	21.44	544	15.41	391	61.84	1571	1.97	[illegible]	[illegible]	[illegible]	SNDN1200	[illegible]
	Type 3R	63.59	1616	22.00	559	17.63	448	61.84	1571	1.97	[illegible]	[illegible]	[illegible]	RNDN1200	[illegible]
	Type 12	63.59	1615	22.00	559	17.63	448	61.84	1571	1.97	[illegible]	[illegible]	[illegible]	JNDN1200	[illegible]

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and the submittal to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities, and details requiring correlation with other materials or equipment, and for information that pertains solely to the fabrication or construction.

X

No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department Electrical
By [illegible]

2/2

Product Selection

Table 12-33. Types ED, EDH, and EDC Thermal-Magnetic Circuit Breakers with Non-interchangeable Trip Units Suitable for Reverse Feed

Maximum Continuous Ampere Rating @ 40°C	240V AC Maximum, 125V DC (Includes Terminals on Load End Only)											
	65 kAIC @ 240V AC				100 kAIC @ 240V AC				200 kAIC @ 240V AC			
	Type ED				Type EDH				Type EDC Current Limiting			
	2-Pole		3-Pole		2-Pole		3-Pole		2-Pole		3-Pole	
	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
100	ED2100	357.	ED3100	885.	EDH2100	850.	EDH3100	1,280	EDC2100	1,200.	EDC3100	1,655
125	ED2125	357.	ED3125	885.	EDH2125	850.	EDH3125	1,280	EDC2125	1,200.	EDC3125	1,655
150	ED2150	357.	ED3150	885.	EDH2150	850.	EDH3150	1,280.	EDC2150	1,200	EDC3150	1,655
175	ED2175	357	ED3175	885.	EDH2175	850.	EDH3175	1,280.	EDC2175	1,200	EDC3175	1,655
200	ED2200	357	ED3200	885.	EDH2200	850.	EDH3200	1,280.	EDC2200	1,200	EDC3200	1,655
225	ED2225	357.	ED3225	885	EDH2225	850.	EDH3225	1,280	EDC2225	1,200.	EDC3225	1,655.

Note: Instruction Leaflet/FRED Number 29C101

Table 12-34. Type EHD Thermal-Magnetic Circuit Breakers with Non-interchangeable Trip Units

Maximum Continuous Ampere Rating @ 40°C	277V AC Maximum, 125V DC		480V AC Maximum, 250V DC			
	14 kAIC @ 277V AC		14 kAIC @ 480V AC			
	Type EHD (Includes Terminals on Load End Only)					
	1-Pole		2-Pole		3-Pole	
	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
10	EHD1010	123.	EHD2010	387.	EHD3010	498.
15	EHD1015	123.	EHD2015	387.	EHD3015	498
20	EHD1020	123.	EHD2020	387.	EHD3020	498.
25	EHD1025	123.	EHD2025	387.	EHD3025	498.
30	EHD1030	123.	EHD2030	387.	EHD3030	498.
35	EHD1035	123.	EHD2035	387.	EHD3035	498.
40	EHD1040	123.	EHD2040	387.	EHD3040	498.
45	EHD1045	123.	EHD2045	387.	EHD3045	498.
50	EHD1050	123.	EHD2050	387.	EHD3050	498.
60	EHD1060	123.	EHD2060	387.	EHD3060	498.
70	EHD1070	238.	EHD2070	505.	EHD3070	600.
80	EHD1080	239	EHD2080	505.	EHD3080	600
90	EHD1090	238.	EHD2090	505.	EHD3090	600
100	EHD1100	238.	EHD2100	505.	EHD3100	600

Not UL listed. 5 kAIC interrupting rating.
UL listed for SWD applications, see NEC Article 240-83 (d).

Note: Instruction Leaflet/FRED Number 29C101

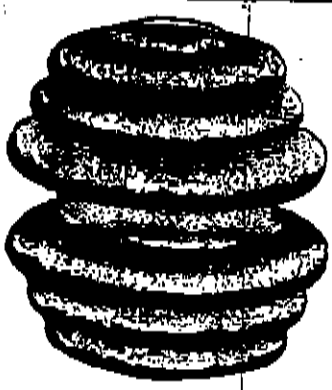
12

Industries
PP 226 N. Patterson Street
Carey, Ohio 43316
419/396-7621

ATTN. JEFF.. "
ATLAS SUBS"

SPOOL AND GUY STRAIN INSULATORS

WET PROCESS PORCELAIN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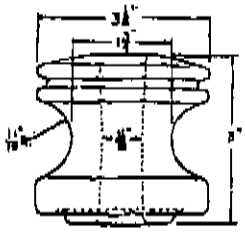
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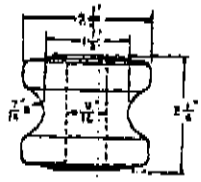
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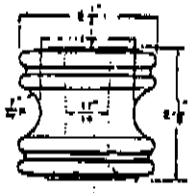
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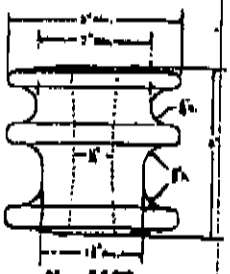
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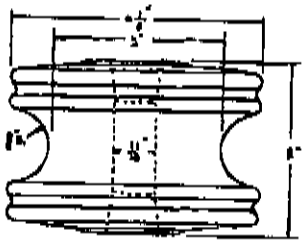
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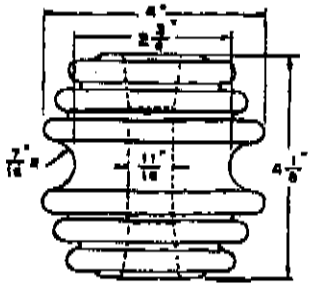
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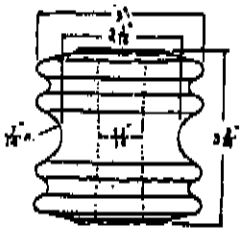
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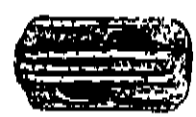
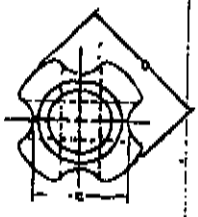
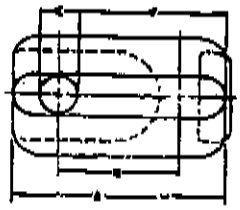
MECHANICAL AND ELECTRICAL CHARACTERISTICS

Catalog Number	ANSI Class	Ultimate Strength Lbs.	LOW-FREQUENCY FLASHOVER-KV Dry	Wet Vert.	Wet Horiz.	Approximate Net Weight Per 100 Pcs.	Standard Package Quantity
†5101	53-2	3000	25	12	15	120	50
5102	—	3000	20	10	12	110	50
5104	53-3	4000	25	12	15	135	50
†5107	—	1750	18	7	9	45	100
5112	53-1	2000	20	8	10	50	100
5116	53-5	6000	35	18	25	260	20
†5119	53-4	4500	25	12	15	252	25

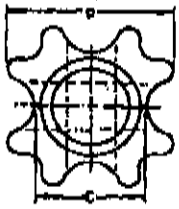
Standard Glaze "Skyline" ANSI-70, Munsell 5 BG 7.0/0.4
†REA Accepted

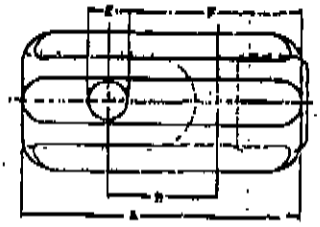






Nos. 502-504-506





No. 708

Cat. No.	ANSI Class	Tensile Strength Pounds	Low Frequency Flashover KV Dry	Low Frequency Flashover KV Wet	Leakage Distance Inches	Maximum Cable Diameter Inches	DIMENSIONS IN INCHES A	B	C	D	E	F	Approx. Net Wt. Per 100 Pcs.	Standard Package Quantity
†502	54-1	10,000	25	12	1⅝	⅝	3⅛	1¾	1¾	2½	⅝	2 5/16	112	50
†504	54-2	12,000	30	15	1⅞	½	4¼	2¼	2⅛	2⅞	¾	2 13/16	188	25
†506	54-3	20,000	35	18	2¼	⅝	5⅛	3⅛	2⅝	3⅜	1	3 13/16	296	25
708	54-4	20,000	40	23	3	⅝	6¾	2⅝	2⅝	3½	1	4⅛	475	20

Standard Glaze "Skyline" ANSI-70, Munsell 5 BG 7.0/0.4
†REA Accepted

JUL-23-2003 WED 09:38 AM ROYAL UTILITY SUPPLY 8015233530 P. 02

BUST-CLEAN™ Expanding Anchor

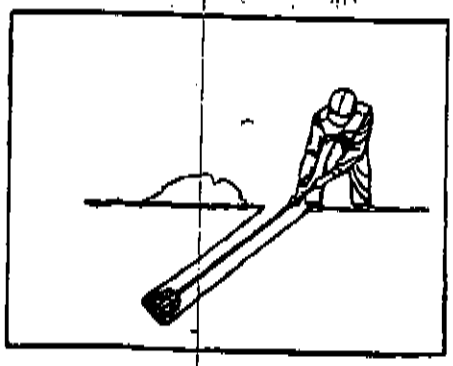
U.S. Patent No. 5,775,848

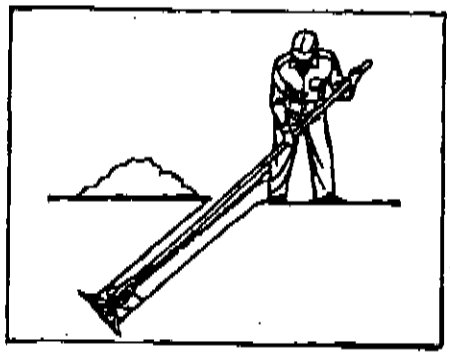
MORE HOLDING CAPACITY FOR LESS

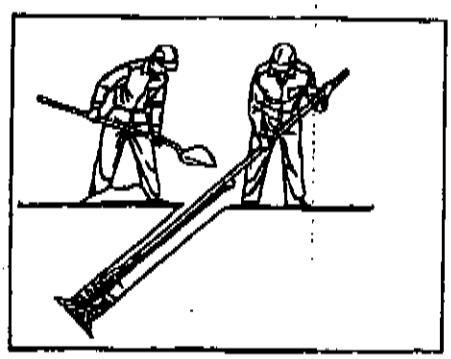
Four different sizes are available with holding capacity as high as 40,000 pounds.

Chance 8-Way Expanding Anchors expand to take full advantage of the available area. All eight blades wedge into undisturbed earth . . . there is no wasted space between blades.

This anchor should be installed in relatively dry and solid soils. The effectiveness of the anchor is dependent upon the thoroughness of backfill tamping.







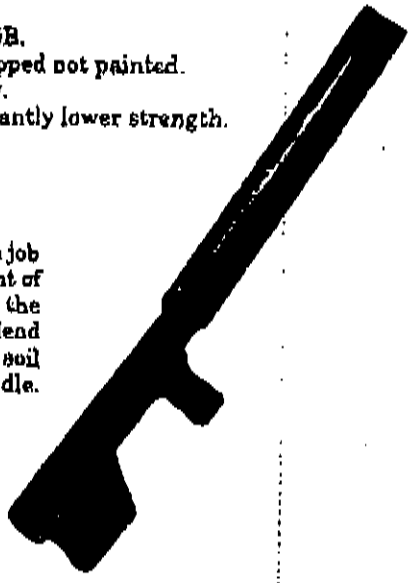
APPLICATION AND ORDERING INFORMATION

Catalog Number	Anchor Hole Size	Area Sq. In.	Rod Size (Order Separately)	Std. Pkg./ Pallet	8-Way Anchor Holding Strengths - (lbs.) vs Chance Soil Class				
					Class 3	Class 4	Class 5	Class 6	Class 7
6870*	6"	70	⅝"	12/288	16000	14000	11000	8500	5000
88135*	8"	135	⅝" or ¾"	6/150	26500+	22000+	18000+	15000	10000
1082	10"	200	1"	4/48	31000	26500	21000	16500	12000
1082-¾	10"	200	¾"	4/48	31000+	26500+	21000	16500	12000
1283	12"	300	1¼"	2/26	40000	34000	26500	21500	16000
1283-1	12"	300	1"	2/26	40000+	34000	26500	21500	16000

+Ultimate strength of rod may control. (See page 4-19 for rod ratings and selection.)
Add suffix "G" for galvanized. Example: 88135G.
Add suffix "B" for plastic wrapped (88135 and 6870 only) example 88135B.
*RUS Accepted, painted version only. Standard anchors are plastic wrapped not painted.
Note: Ultimate strength ratings apply to properly installed anchors only.
Failure to install within 10° of alignment with the guy load may significantly lower strength.

EXPANDING & TAMPING BAR

The Improved Chance fiberglass handle Expanding and Tamping Bar simplifies the job of expanding anchors. The curved Tamper and Expander Head distributes the weight of the bar evenly around the anchor rod to reduce handle vibration. The hook of the Expanding and Tamping Bar wraps around the anchor rod to keep the Expanding Head from slipping off the anchor top plate. This tool is also effectively used for tamping in soil above the installed anchor. The base casting is attached directly to the Epoxiglas handle.



Cat. No.	Description	Length	Weight
C302-0003	Expanding & Tamping Bar	10'	22 lbs.
C302-0004	Expanding & Tamping Bar	12'	24 lbs.

To order fiberglass replacement handles or expander head, see page 4A-11.

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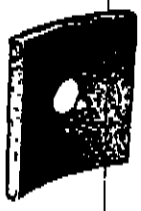

Curved

Square

Round

WASHERS

Galvanized

Curved Washers

Catalog No	Dimensions in Inches: Washer Size	Hole Dia	Bolt Dia	Approx. Ship Wt. Lbs. Per 100 Pcs.
*6809½	4 x 4 x ¼	15/16	7/8	120
*6810½	2¼ x 2¼ x 3/16	11/16	5/8	31
6822	2½ x 2½ x 3/16	11/16	5/8	28
*6822½	3 x 3 x ¼	13/16	3/4	66
6823	3 x 3 x ¼	7/8	3/4	62
*6823½	3 x 3 x ⅞	13/16	5/8	62
6826	3½ x 3¼ x ¼	13/16	3/4	76

Square Washers

*6811	2 x 2 x ⅛	9/16	1/2	13
*6812	2 x 2 x ⅛	11/16	5/8	12
*6813	2½ x 2½ x 3/16	11/16	5/8	24
†*6814	2½ x 2½ x 3/16	13/16	3/4	23
6816	3 x 3 x 3/16	13/16	3/4	51
†*6817	3 x 3 x ¼	15/16	7/8	64
†6818	4 x 4 x 3/16	13/16	3/4	87
*6818½	4 x 4 x ¼	7/8	3/4	120
*6819	4 x 4 x ¼	15/16	7/8	118
†6819½	4 x 4 x ½	15/16	3/4	236
6820	4 x 4 x ½	1⅛	1	228

Round Washers

*6801	1 O.D. x 14 Ga.	7/32	1/8	1.64
†*6802	1¼ O.D. x 14 Ga.	9/16	5/8	2.84
†*6803	1⅜ O.D. x 12 Ga.	9/16	1/2	4.50
†*6805	1¾ O.D. x 10 Ga.	11/16	5/8	8.50
*6806	2 O.D. x 9 Ga.	15/16	3/4	11.80

*NEMA Standard
†RUS listed

Spring Clip

Spring Lock

Double Coil Spring

Spring Clip Washers

Catalog No	Stock	Dimensions in Inches: Hole Size	Bolt Size	Approx. Ship Wt. Lbs. Per 100 Pcs.
3539	3/32" x 1"	9/16	1/2	22
T3540	1/4" x 1 3/4"	11/16	5/8	93
T3541	1/4 x 1 3/4"	13/16	3/4	91
C205-0092	1/4" x 1½"	11/16	5/8	62

Spring Lock Washers

4035	1/64 x 1/8"	3/16	1/2	1.6
4036	13/64 x 5/32	11/16	5/8	2.4
4037	1/4 x 3/16	13/16	3/4	4.8

Double Coil Spring Lockwasher

C205-0185	5/32" x 1"	7/16	1/2	4
C205-0186	3/16" x 1 3/16"	11/16	5/8	6.6
C205-0187	7/32" x 1 3/8"	15/16	3/4	10.40
C205-0188	7/64" x 1/2"	7/16	7/8	1.50

†RUS listed

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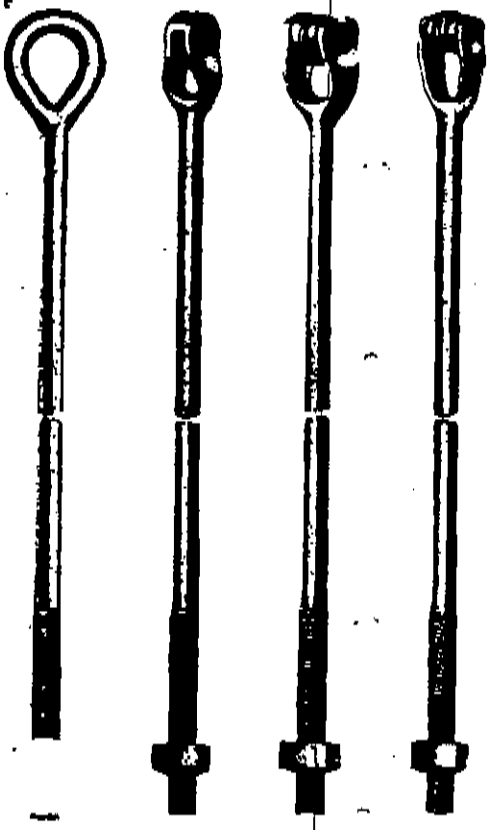
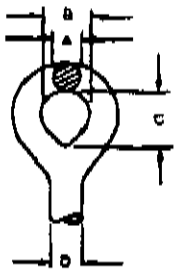
CHANCE

RODS, ANCHOR, GALVANIZED

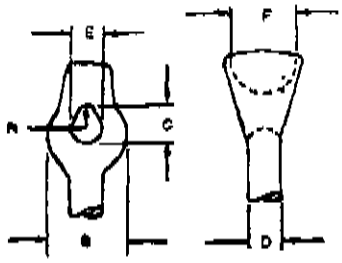


Available for one, two, or three guys for use with expanding, cone, and cross-plate anchors. The Thimbleye®, Twineye® and Tripleye® distribute pulling stresses uniformly over individual strands of guy wire and keep the guy wire from spreading, kinking, or bending. The drop-forged eye of each anchor rod is stronger than the rod itself. Rod length and diameter are stamped below the eye of each rod eye. Each rod is threaded 3½" minimum length.



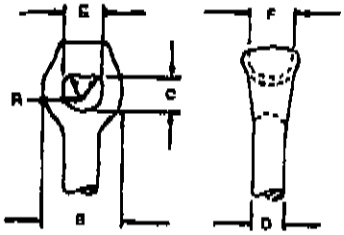
OVALEYE

D	A	B	C
5/8"	5/16"	1 1/8"	2"
1"	7/8"	1 1/4"	2"



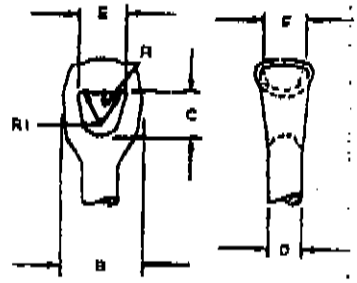
THIMBLEYE®

D	*R	B	C	E	F
1/2"	5/16"	1 1/4"	5/16"	1/2"	1 1/4"
5/8"	1/4"	1 1/2"	11/16"	9/16"	1 3/8"
3/4"	9/32"	1 5/8"	13/16"	11/16"	1 1/4"
1"	13/32"	2 1/16"	1 1/8"	13/16"	1 5/8"



TWINEYE®

D	*R	B	C	E	F
5/8"	7/32"	1 3/4"	7/8"	13/16	1 1/4"
3/4"	1/4"	2"	1"	1 1/16"	1 3/8"
1"	9/16"	2 5/8"	1 3/16	1 9/16	1 1/2"
1 1/4"	5/8"	2 15/16"	1 1/4"	1 9/16"	1 5/8"



TRIPLEYE®

D	*R	*R1	B	C	E	F
3/4"	1/4"	7/32"	2 1/2"	1 11/16"	1 3/4"	1 1/4"
1"	1/4"	7/32"	2 9/16"	1 11/16"	1 5/8"	1 1/2"
1 1/4"	1/4"	7/32"	2 3/4"	1 11/16"	1 15/16"	1 3/8"

Nuts included. To order extras, see Page 5-36.

TENSILE STRENGTH

ROD"	STRENGTH LBS.
1/2	16,000
5/8	16,000
3/4	23,000
1	36,000
1 1/4	56,000

*(2 x R or 2 x R1) + maximum-diameter guy strand.

Catalog No.				Approx. Ship Wt., Lbs. For 100 Pieces				
Thimbleye	Twineye	Tripleye	Ovaleye	Size	Thimbleye	Twineye	Tripleye	Ovaleye
5305	—	—	—	1/2 x 5'	379	—	—	—
5306	—	—	—	1/2 x 6'	450	—	—	—
5307	—	—	—	1/2 x 7'	520	—	—	—
5316	—	—	—	5/8" x 6'	574	—	—	—
†*5316	5346	—	—	5/8" x 5'	650	680	—	—
†*5317	†*5347	—	6417	5/8" x 7'	760	780	—	760
†*5318	†*5348	—	—	5/8" x 8'	876	890	—	—
*5326	*5356	—	—	3/4" x 6'	980	1012	1162	—
*5327	*5357	7557	—	3/4" x 7'	1160	1120	1280	—
†*5328	†*5358	7558	—	3/4" x 8'	1216	1300	1433	—
—	†*5359	7559	—	3/4" x 9'	—	1400	—	—
—	†5360	—	—	3/4" x 10'	—	1660	2280	—
*5338	*5368	7568	—	1" x 8'	2150	2160	—	—
—	†5369	—	—	1" x 9'	—	2450	2670	—
340	†*5370	*7570	6440	1" x 10'	2655	2700	—	2700
—	—	C200-0028	—	1 1/4 x 8'	—	—	3500	—
—	15129	7574	—	1 1/4 x 10'	—	4290	4290	—

*N.E.M.A. Standard †RUS Listed

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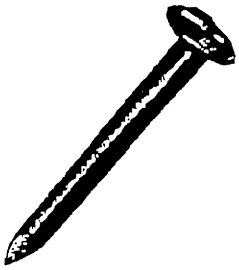
NAILS, POLE DATING



Used to indicate the year in which poles are set. Heads are 5/8" diameter. Hot dip galvanized. Year determines catalog number.

Catalog No.	For Year	Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
C205-1997	1997	2 1/2	5.3
C205-1998	1998	2 1/2	5.3
C205-1999	1999	2 1/2	5.3
C205-2000	2000	2 1/2	5.3
C205-2001	2001	2 1/2	5.3
C205-2002	2002	2 1/2	5.3

NUTS

Made to give tight connections. Galvanized.

MF

Curved Lock Nuts

Catalog No.	Bolt Size, Inches	Wt. Lbs. Per 100 Pcs.
†3510	3/8	1.25
†3511	1/2	2.6
†3512	5/8	4.44

Curved Lock Nuts

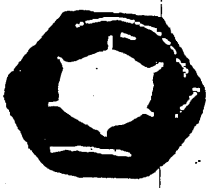
Catalog No.	Bolt Size, Inches	Wt. Lbs. Per 100 Pcs.
†3513	3/4	5
†3514	7/8	8.5

Painut Lock Nuts

Catalog No.	Dimensions in Inches			Approx. Ship Wt. Lbs. Per 100 Pcs.
	Bolt Size	Width	Height	
3530	3/8	5/8	.160	.39
3531	1/2	13/16	.190	.92
3532	5/8	1	.224	1.34
3533	3/4	1 1/8	.246	1.73

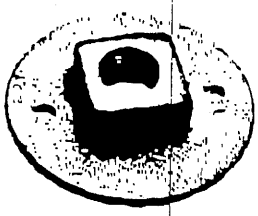
Washer Nuts

Catalog No.	Dimensions in Inches			Approx. Ship Wt. Lbs. Per 100 Pcs.
	Bolt Size	Washer Dia.	Sq. Size	
*3194	5/8	2 1/2	15/16	38



No. 3530

No. 3510



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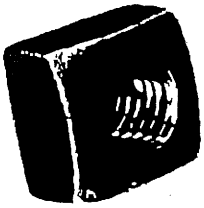

55083P

For Bolts
Regular Square Nuts

Catalog No.	Bolt Size, Inches	Threads Per Inch	Wt. Lbs. Per 100 Pcs.
*8600M	5/8	16	2.6
*55083P	1/2	13	8
*55084P	5/8	11	10.4
*55085P	3/4	10	14.4
*56538P	7/8	9	30
*56073P	1	8	50

For Rods
Heavy Square Nuts

Catalog No.	Rod Size, Inches	Wt. Lbs. Per 100 Pcs.
*55058P	1/2	12.5
*55006P	5/8	12.8
*55312P	3/4	22
*55320P	1	50
*56001P	1 1/4	100

† RUS listed
*ANSI B18.2.2

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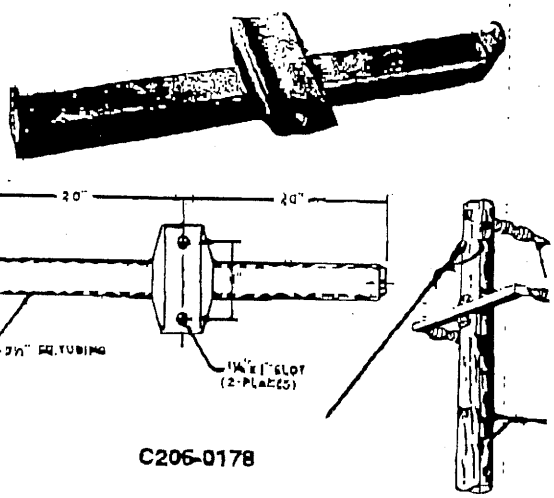
CROSSARM, STEEL DEADEND

Withstands high cantilever loading and provides extra strength for deadending, reducing conductor size or supporting slack spans. Both single and double deadends will accommodate a crossarm pin shank of either 3/4" or 5/8" diameter for jumper applications.

Catalog No.	Application	Length	Each Phase Rating	Pieces Per Package	Wt. Per 100 Pieces
C206-0178	Single	40"	*5500 lbs.	1	8700 lbs.
†C206-0179	Double	40"	*5500 lbs.	1	8600 lbs.
†C206-0211	Double	48"	*8000 lbs.	1	4400 lbs.

†RUS listed
*Balanced Load



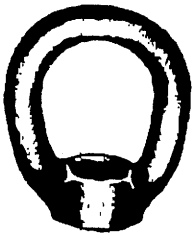
C206-0178

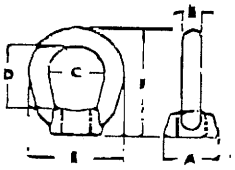
EYENUTS, STANDARD

Most commonly used for deadending, back-guying, and attaching pole head guys on the threaded ends of crossarm bolts. Drop-forged hot dip galvanized steel.

Catalog No.	Dimensions In Inches							Approx. Wt. Lbs. Per 100 Pcs.
	For Bolt Dia.	A	B	C	D	E	F	
6500	1/2	1 1/4	1/2	1 1/8	1 1/8	2 1/8	2 5/8	51
6501	3/4	1 1/4	1/2	1 1/4	1 1/8	2 1/8	2 5/8	46
†*6502	5/8	1 3/4	1/2	1 1/2	1 3/4	2 1/4	3	51
6503	3/4	1 3/4	1/2	1 1/2	1 3/4	2 1/2	3	54

*NEMA Standard
†RUS listed





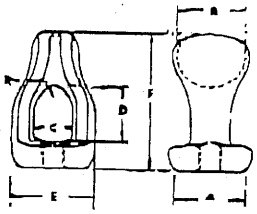
No. 6502

EYENUTS, THIMBLEYE®

For attaching to thru-bolts or threaded end of straight or angle-Thimbleye bolts for straight-away head guys. Drop-forged galvanized steel. Nuts are contoured to minimize bending and kinking of guy strand.

Catalog No.	Dimensions In Inches								Approx. Wt. Lbs. Per 100 Pcs.
	Tapped For	A	B	C	D	E	F	R	
†6510	5/8 Bolt	1 1/2	1 1/2	7/8	1 3/8	1 7/8	3 1/4	1/4	78
*6511	3/4 Bolt	1 1/2	1 1/2	7/8	1 3/8	1 7/8	3 1/4	1/4	72

*ANSI Standard
†RUS listed



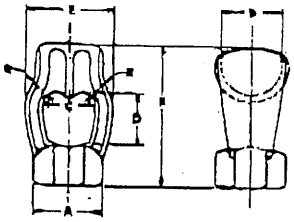
No. 6510

EYENUTS, TWINEYE®

Used for head or stub guying of two strands, Twineye Nuts can be attached to thru-bolts or threaded end of straight or angle Thimbleye Bolts. Grooves are contoured to protect guy strands. Drop-Forged Galvanized steel.

Catalog No.	Dimensions In Inches								Approx. Ship Wt. Lbs. Per 100 Pcs.
	Tapped For	A	B	C	D	E	F	R	
6560	5/8 Bolt	1 7/8	1 11/16	1 1/8	1 9/16	2 3/8	3 5/8	5/16	190
6561	3/4 Bolt	1 7/8	1 11/16	1 1/8	1 5/16	2 3/8	3 5/8	5/16	184
*6562	1" Bolt and PISA	1 7/8	1 11/16	1 1/8	1 5/16	2 3/8	3 5/8	5/16	183

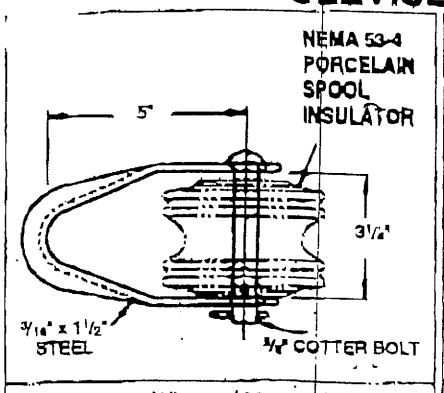
*6562 1" eyenut fits both 1" and 3/4" PISA rods.



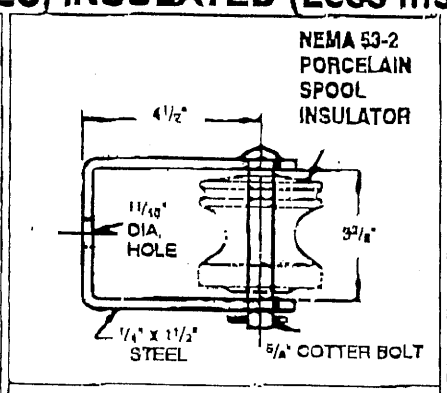
No. 6562

JUL-23-2003 WED 09:39 AM ROYAL UTILITY SUPPLY 8015233530 P. 07
HUBBELL / CHANCE - CENTRALIA, MISSOURI

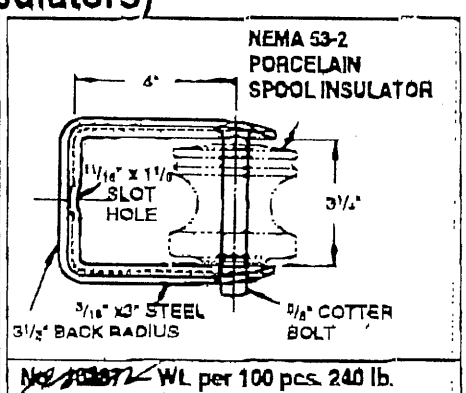
CLEVISES, INSULATED (Less Insulators)



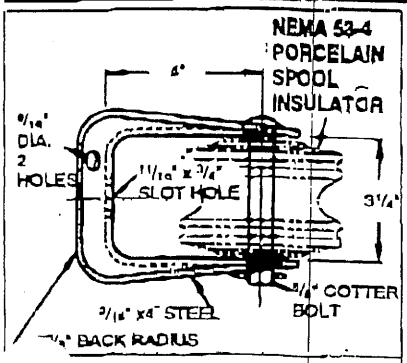
No. 0352 — Wt. per 100 pcs. 152 lb.
RUS listed



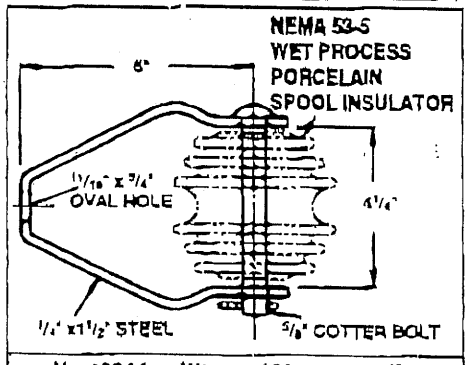
No. *0322 — Wt. per 100 pcs. 186 lb.



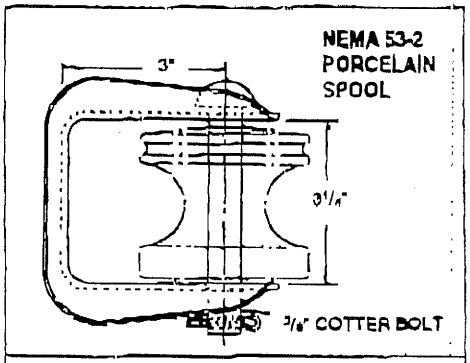
No. 0337 — Wt. per 100 pcs. 240 lb.
No. 0338 Clevis is identical to No. 0337 except length from back of clevis to cotter bolt is 3" insted of 4" and weight is 204 lb.



0327 — Wt. per 100 pcs. 276 lb.
listed



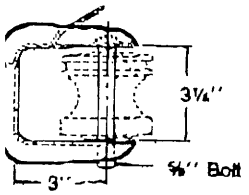
No. *0344 — Wt. per 100 pcs. 272 lb.



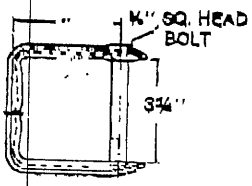
No. *C207-0024 — Wt. per 100 pcs. 184 lb.

*NEMA Standard

NEMA 53-2
INSULATOR
No. C207-0072



USE NEMA 53-3
INSULATOR
No. C207-0116

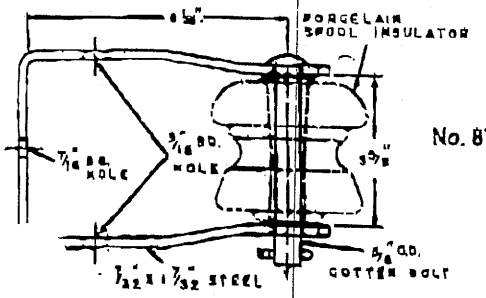


CLEVISES, INSULATED (Less Insulators)

Sagger Bracket

Double duty bracket may be used to support conductor during stringing operations and then may be rotated upright to become a permanent clevis. Catalog Number C207-0072 has same overall dimensions as C207-0024 clevis.

Catalog No.	Description	Approx. Ship Wt. Lbs. Per 100 Pcs.
C207-0072	Sagger Bracket – Less Insulator	140
C207-0116	Sagger Bracket – Less Insulator	240



No. 8795

Crossarm Mounting Bracket

For attachment over crossarm with a 1/2" carriage bolt installed vertically through the arm, or a 3/8" lag screw.

Catalog No.	Description	Approx. Ship Wt. Lbs. Per 100 Pcs.
8795	Clevis – less insulator	192

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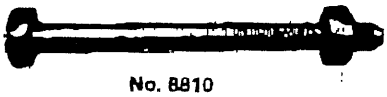
BOLTS, MACHINE

Are also called crossarm bolts or through bolts. Bolts have rolled threads and one square nut. Bolts six inches or longer have cone-type points. Hot dip galvanized.



No. 8810

3/8-Inch Diameter

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
8504	4	3	15
8504½	4½	3	17.2
*8605	6	3	18.8
8605½	6½	3	12.8

4,250 Pound Rated Tensile Strength

1/2-Inch Diameter

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
8701½	1½	1¼	17.8
*8704½	4½	3	33
*8705	5	3	35
†*8706	6	3	39
†8707	7	3	45
†*8708	8	4	48
†8709	9	4	57
†*8710	10	4	60
*8712	12	6	71
8714	14	6	73

7,800 Pound Rated Tensile Strength

5/8-Inch Diameter

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
8805	5	3	60
†*8806	6	3	69
*8807	7	4	75
†*8808	8	4	78
*8809	9	4	84
†*8810	10	6	99
†*8812	12	6	112
†*8814	14	6	126
†*8816	16	6	134
†*8818	18	6	149
†*8820	20	6	164
†8822	22	6	176
†8824	24	6	194

12,400 Pound Rated Tensile Strength

3/4-Inch Diameter

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
†*8908	8	4	126
†*8910	10	6	154
†*8912	12	6	166
†*8914	14	6	188
†*8916	16	6	225
†*8918	18	6	232
†8920	20	6	252
†8922	22	6	288
†8924	24	6	304
†8926	26	6	308

18,250 Pound Rated Tensile Strength

7/8-Inch Diameter

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
†*C205-0254	14	6	284
†*C205-0256	16	6	352
†C205-0258	22	6	426
†*C205-0256	16	6	316
†C205-0257	20	6	390

25,400 Pound Rated Tensile Strength

*ANSI Standard
†RUS Listed

No. 8605½

BOLTS, OVALEYE

Bolts with 5/8" and 3/4" shanks have 1½" x 2" ovaleyes. Drop-forged, galvanized steel bolts have cone type points and rolled threads.

No. 29960

1/2-Inch Shank Diameter 7/16" x 1 1/4" x 1 5/8" Ovaleye

Catalog No.	Length Under Eye Inches	Thread Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
*29939	6	4	77
*29943	12	6	100

7,800 Pound Rated Tensile Strength

5/8" Shank Dia — 7/16 x 1 7/8" x 2" Ovaleye

Catalog No.	Length Under Eye Inches	Thread Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
†29956	8		100
†*29958	8	4	104
†*29959	9	4	113
†*29960	10	6	122
†*29962	12	6	144
†*29964	14	6	166
†29966	16	6	188
†29968	18	6	208
†29970	20	6	220

12,400 Pound Rated Tensile Strength

3/4" Shank Dia — 3/4" x 1 1/2" x 2" Ovaleye

Catalog No.	Length Under Eye Inches	Thread Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
†29978	8	4	180
†29980	10	4	200
†29982	12	6	228
†29984	14	6	248
†29986	16	6	268
†29988	18	6	314

18,250 Pound Rated Tensile Strength
*NEMA Standard
†RUS Listed

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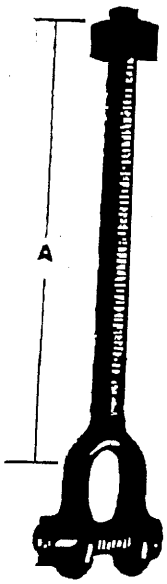
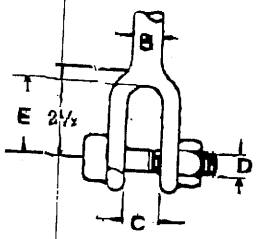
BOLTS, CLEVIS



No. 15828

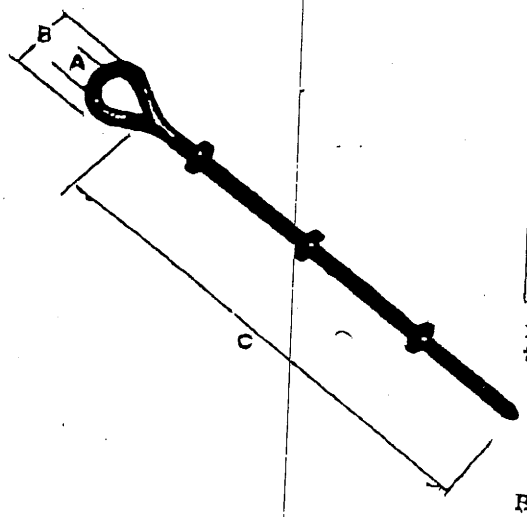


For supporting crossarm suspension insulator strings. Cotter bolt is 2¾" long and comes with cotter pin and hex nut. Clevis Bolts are drop-forged steel. Hot dip galvanized.

Catalog No.	Dimensions in Inches					Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
	A	B	C	D	E		
†15808	8	5/8	13/16	1/2	1 13/16	6	150
†15810	10	5/8	13/16	1/2	1 13/16	6	199
†15812	12	5/8	13/16	1/2	1 13/16	6	217
†15814	14	5/8	13/16	1/2	1 13/16	6	220
†15828	8	3/4	13/16	5/8	1 13/16	6	200
†15830	10	3/4	13/16	5/8	1 13/16	6	267
†15832	12	3/4	13/16	5/8	1 13/16	6	280
†15834	14	3/4	13/16	5/8	1 13/16	6	304

†RUS Listed
5/8" Bolt has 12,400 Pound Rated Tensile Strength
3/4" Bolt has 18,350 Pound Rated Tensile Strength

BOLTS, DOUBLE-ARMING EYE



Bolts have a cone type point and are threaded to within 2" of the 1½" x 2" eye. Three Square Nuts. Drop-forged steel. Hot dip galvanized.

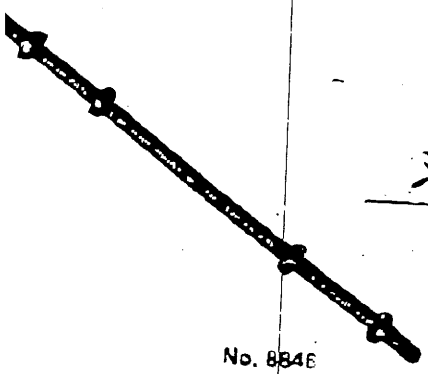
5/8-Inch Diameter

Catalog No.	Inside Dim. A	Outside Dim. B	Length Under Eye C (Inches)	Approx. Ship Wt. Lbs. Per 100 Pcs.
†19784	1 1/2	2 5/8	14	196
†19786	1 1/2	2 5/8	16	220
†19788	1 1/2	2 5/8	18	232
†19790	1 1/2	2 5/8	20	256
†19792	1 1/2	2 5/8	22	260

12,400 Pound Rated Tensile Strength
†RUS Listed

BOLTS, DOUBLE-ARMING FULL THREAD

Bolts permit replacement ease in double arms and offer added flexibility of use. Cone type point for easy starting and driving-out without damage to threads. Each bolt provided with four square nuts. Hot dip galvanized steel.



No. 8846

Catalog No.	Length, Inches	Approx. Ship Wt. Lbs. Per 100 Pcs
8846	16	117
5/8-Inch Diameter		
†*8862	12	126
†*8864	14	156
†*8866	16	176
†*8868	18	196
†*8870	20	204
†*8872	22	220
†*8874	24	240
8876	26	256
8877	28	268
8878	30	270
8879	32	280

12,400 Pound Rated Tensile Strength
*ANSI Standard
†RUS Listed

Catalog No.	Length, Inches	Approx. Ship Wt. Lbs. Per 100 Pcs
1/2-Inch Shank Diameter		
8848	18	125
3/4-Inch Diameter		
C205-0140	6	128
C205-0141	8	150
*8882	12	234
*8884	14	240
*8886	16	248
*8888	18	272
†*8890	20	292
†*8892	22	316
†*8894	24	328
8896	26	365

18,350 Pound Rated Tensile Strength

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GALVANIZED WIRE & STRAND

7-WIRE GALVANIZED STEEL STRAND
CLASS A, B, AND C COATING

NOMINAL STRAND DIA. INCHES (mm)	NOMINAL WIRE DIA. INCHES (mm)	NET WEIGHT POUNDS PER 1,000 FT (kg/m)	MINIMUM STRENGTH IN POUNDS (kN)	% ‡ ELONGATION
		SIEMENS-MARTIN		
1/4 (6.35)	0.080 (2.03)	121 (.180)	3,150 (14.01)	8
5/16 (7.94)	0.014 (2.64)	205 (.305)	5,350 (23.80)	8
3/8 (9.52)	0.120 (3.05)	273 (.407)	6,950 (30.92)	8
7/16 (11.11)	0.145 (3.68)	399 (.594)	9,350 (41.59)	8
1/2 (12.70)	0.165 (4.19)	517 (.768)	12,100 (53.82)	8
9/16(14.79)	0.188 (4.78)	671 (.997)	15,700 (69.84)	8
5/8 (15.88)	0.207 (5.28)	813 (1.211)	19,100 (84.96)	8
		HIGH STRENGTH		
3/16 (4.79)	0.062 (1.57)	73 (.108)	2,850 (12.68)	5
1/4 (6.35)	0.080 (2.03)	121 (.180)	4,750 (21.13)	5
5/16 (7.94)	0.104 (2.64)	205 (.305)	8,000 (35.59)	5
3/8 (9.52)	0.120 (3.05)	273 (.407)	10,800 (48.04)	5
7/16 (11.11)	0.145 (3.68)	399 (.594)	14,500 (64.50)	5
1/2 (12.70)	0.165 (4.19)	517 (.768)	18,800 (83.63)	5
9/16 (14.79)	0.188 (4.78)	671 (.997)	24,500 (108.98)	5
5/8 (15.88)	0.207 (5.26)	813 (1.211)	29,600 (131.67)	5
		EXTRA HIGH STRENGTH		
3/16 (4.76)	0.062 (1.57)	73 (.108)	3,990 (17.75)	4
1/4(6.35)	0.080(2.03)	121 (.180)	6,650 (29.58)	4
5/16 (7.96)	0.104 (2.64)	205 (.305)	11,200 (49.82)	4
3/8 (9.52)	0.120 (3.05)	273 (.407)	15,400 (68.50)	4
7/16 (11.11)	0.145 (3.68)	399 (.594)	20,800 (92.52)	4
1/2 (12.70)	0.165 (4.19)	517 (.768)	26,900 (119.66)	4
9/16 (14.29)	0.188 (4.78	671 (.997)	35,000 (155.69)	4
5/8 (15.88)	0.207 (5.26)	813 (1.211)	42,400 (188.60)	4
		UTILITIES		
3/16 (4.76	0.065 (1.65)	80 (.118)	2,400 (10.68)	10
5/16 (7.94)	0.109 (2.77)	225 (.335)	6,000 (26.69)	10
3/8 (9.52)	0.120 (3.05)	273 (.407)	11,500 (51.16)	4
7/16 (11.11)	0.145 (3.68)	399 (.594)	18,000 (80.07)	4
1/2 (12.70)	0.165 (4.19)	517 (.768)	25,000 (111.21)	4

‡ Minimum Elongation in a 24- in gauge length of galvanized strand

REA Approvals

The CCA Pole Dimension Table

Class		H-4	H-3	H-2	H-1	1	2	3	4	5	6	7	8	10
Minimum Circumference at Top (Inches)		36	33	31	29	27	25	23	21	19	17	15	13	12
	Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (Inches)												
Southern Pine	20	-	-	-	-	31.0	29.0	27.0	25.0	23.0	21.0	19.5	17.5	14.0
	25	-	-	-	-	33.5	31.5	29.5	27.5	25.5	23.0	21.5	19.5	15.0
	30	-	-	-	-	36.5	34.0	32.0	29.5	27.5	25.0	23.5	20.5	-
	35	-	-	43.5	41.5	39.0	36.5	34.0	31.5	29.0	27.0	25.0	-	-
	40	51.0	48.5	46.0	43.5	41.0	38.5	36.0	33.5	31.0	28.5	-	-	-
	45	53.5	51.0	48.5	45.5	43.0	40.5	37.5	35.0	32.5	30.0	-	-	-
	50	56.5	53.0	50.5	47.5	45.0	42.0	39.0	36.5	34.0	-	-	-	-
	55	58.0	55.0	52.0	49.5	46.5	43.5	40.5	38.0	-	-	-	-	-
	60	59.5	57.0	54.0	51.0	48.0	45.0	42.0	39.0	-	-	-	-	-
	65	61.5	58.5	55.5	52.5	49.5	46.5	43.5	40.5	-	-	-	-	-
	70	63.5	60.5	57.0	54.0	51.0	48.0	45.0	41.5	-	-	-	-	-
	75	65.0	62.0	59.0	55.5	52.5	49.0	46.0	-	-	-	-	-	-
	80	66.5	63.5	60.0	57.0	54.0	50.5	47.0	-	-	-	-	-	-
	85	68.0	65.0	61.5	58.5	55.0	51.5	48.0	-	-	-	-	-	-
	90	69.5	66.5	63.0	59.5	56.0	53.0	49.0	-	-	-	-	-	-
	95	71.0	67.5	64.5	61.0	57.0	54.0	-	-	-	-	-	-	-
	100	72.5	69.0	65.5	62.0	58.5	55.0	-	-	-	-	-	-	-
	105	74.0	70.5	67.0	63.0	59.5	56.0	-	-	-	-	-	-	-
	110	75.0	71.5	68.0	64.5	60.5	57.0	-	-	-	-	-	-	-
	115	76.5	72.5	69.0	65.5	61.5	58.0	-	-	-	-	-	-	-
	120	77.5	74.0	70.0	66.5	62.5	58.0	-	-	-	-	-	-	-
	125	78.5	75.0	71.0	67.5	63.5	59.5	-	-	-	-	-	-	-
Jack Pine, Red Pine, Lodgepole Pine	20	-	-	-	-	32.5	30.5	28.0	26.0	24.5	22.5	21.0	18.0	14.5
	25	-	-	-	-	35.0	33.5	31.0	29.0	27.0	25.0	23.0	20.0	15.5
	30	-	-	-	-	38.0	36.5	34.0	31.5	29.0	27.0	25.0	21.0	-
	35	-	-	-	-	41.5	38.5	36.0	33.5	31.0	28.5	26.5	-	-
	40	-	-	-	-	44.0	41.0	38.0	35.5	33.0	30.5	-	-	-
	45	-	-	-	-	46.0	43.0	40.0	37.0	34.5	32.0	-	-	-
	50	-	-	-	-	48.0	45.0	42.0	39.0	36.0	-	-	-	-
	55	-	-	-	-	49.5	46.5	43.5	40.5	-	-	-	-	-
	60	-	-	-	-	51.5	48.0	45.0	42.0	-	-	-	-	-
	65	-	-	-	-	53.0	49.5	46.0	43.0	-	-	-	-	-
	70	-	-	-	-	54.5	51.0	47.5	44.5	-	-	-	-	-
	75	-	-	-	-	56.0	52.5	49.0	-	-	-	-	-	-
	80	-	-	-	-	57.5	54.0	50.5	-	-	-	-	-	-
	85	-	-	-	-	58.5	55.0	51.5	-	-	-	-	-	-
	90	-	-	-	-	60.0	56.5	52.5	-	-	-	-	-	-
Ponderosa Pine, Western Red Cedar*	20	-	-	-	-	33.5	31.5	29.5	27.0	25.0	23.0	21.5	18.5	15.0
	25	-	-	-	-	37.0	34.5	32.5	30.0	28.0	25.5	24.0	20.5	16.5
	30	-	-	-	-	40.0	37.5	35.0	32.5	30.0	28.0	26.0	22.0	-
	35	-	-	48.0	45.5	42.5	40.0	37.5	34.5	32.0	30.0	27.5	-	-
	40	56.5	53.5	51.0	48.0	45.0	42.5	39.5	36.5	34.0	31.5	-	-	-
	45	59.0	56.0	53.5	50.5	47.5	44.5	41.5	38.5	35.0	33.0	-	-	-
	50	61.5	58.5	55.5	52.5	49.5	46.5	43.5	40.0	37.5	-	-	-	-
	55	64.0	61.0	57.5	54.5	51.5	48.5	45.0	42.0	-	-	-	-	-
	60	66.0	63.0	59.5	56.5	53.5	50.0	46.5	43.5	-	-	-	-	-
	65	68.0	65.0	61.5	58.5	55.0	51.5	48.0	45.0	-	-	-	-	-
	70	70.0	67.0	63.5	60.0	56.5	53.0	49.5	46.0	-	-	-	-	-
	75	72.0	68.5	65.0	61.5	58.0	54.5	51.0	-	-	-	-	-	-
	80	74.0	70.5	67.0	63.0	59.5	56.0	52.0	-	-	-	-	-	-
	85	75.5	72.0	68.5	64.5	61.0	57.0	53.5	-	-	-	-	-	-
	90	77.0	73.5	70.0	66.0	62.5	58.5	54.5	-	-	-	-	-	-
	95	79.0	75.0	71.5	67.5	63.5	59.5	-	-	-	-	-	-	-
	100	80.5	76.5	72.5	69.0	65.0	61.0	-	-	-	-	-	-	-
	105	82.0	78.0	74.0	70.0	66.0	62.0	-	-	-	-	-	-	-
	110	83.5	79.5	75.5	71.5	67.5	63.0	-	-	-	-	-	-	-
	115	84.5	80.5	76.5	72.5	68.5	64.0	-	-	-	-	-	-	-
	120	86.0	82.0	78.0	74.0	69.5	65.0	-	-	-	-	-	-	-
	125	87.5	83.0	79.0	75.0	70.5	66.0	-	-	-	-	-	-	-

*Specifications of H Classes are applicable for western red cedar only.
Specifications NATIONAL STANDARD 05.1

Treatment Specifications

To order your CCA wood pole and to be sure you obtain the oxide formulation, the following should be part of your specifications:

Treatment with CCA-C oxide preservatives.

All poles shall meet the requirements of the latest revision of A.N.S.I. 05.1 "Specifications and Dimensions for Wood Poles."

Poles will be treated in accordance with the requirements of the American Wood-Preservers' Association Standard C1, "All Timber Products - Preservative Treatment by Pressure Process," and C4, "Preservative Treatment with Water-borne Preservatives," except as noted in this specification.

Conditioning

- Poles should have a moisture content of 35% or less in the third inch from the surface of the pole.
- Only air-drying and kiln-drying are permitted.
- Poles must be cool prior to treatment.
- Heating poles in the preservative is not permitted.

Fixation

- A maximum fixation period of six hours by heating in steam or hot water at 220°F is permitted in southern pine poles only.

Results of Treatment

- Retention - Poles are to be treated to a retention level of 0.60 pcf as determined by an assay of the 0.50"-2.0" zone (southern and ponderosa pine), 0.10"-0.75" zone (lodgepole and jack pine), 0.10"-1.60" zone (red pine), or 0.10"-0.75" zone (western red cedar).
- Penetration - Poles shall be penetrated in accordance with A.W.P.A. Standard Section 3.2.

7. Retreatment
   - Poles may be retreated, providing none of the limitations specified in A.W.P.A. Standard C1, paragraph 6-retreatment are exceeded.
8. Chemical Constituents
   - CCA-Type C waterborne preservatives used in the treatment of utility poles shall be of the oxide form and not use constituents copper sulfate, sodium arsenate, or pyro-arsenate, potassium or sodium dichromate, or other constituents that will form water soluble electrolytes in utility poles.
9. Species
   - Only southern pine, red pine, lodgepole pine, ponderosa pine, Jack pine (Canada) and western red cedar poles can be treated effectively with CCA preservatives.

1991 Hickings Corporation

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is promulgated according to a consensus procedure and is under the jurisdiction of AWPA Subcommittee T-4)

C4-99©

This Standard is expressed in metric units with English units shown in parentheses.

POLES - PRESERVATIVE TREATMENT BY PRESSURE PROCESSES

Note: AWPA Standard C4-99 consists of eight pages.

Note: AWPA Standard C4, covers preservative treatment requirements for poles. When buying under this Standard, however, purchase orders, to be complete, should cover the following: Species, quality of poles before treatment, size requirements, surface preparation limitations (if any), special conditioning requirements, preservative, preservative retention, and method of retention determination if more than one is indicated in Par. 3.1 of this Standard. AWPA Standard M1, Standard for the Purchase of Treated Wood Products, provides general information for the purchaser who is unfamiliar with wood preservatives and wood preservation procedures. Standard C4 is to be used in conjunction with AWPA Standard C1, All Timber Products-Preservative Treatment by Pressure Processes, and Standard C1 is hereby made a part of this Standard.

Major regional differences in potential for deterioration of wood used in contact with the ground are shown in Figure 1 of this Standard. With preservatives for which multiple retentions are given, users have opportunity to develop management plans (retention specifications and/or maintenance programs) that address the environmental challenge in their region. Such plans should recognize that in certain modified environments such as banks along irrigation canals, irrigated residential or agricultural lands, a higher degree of protection might be needed than would be required in local, natural environment. It must also be recognized that within individual regions, certain natural sub-environments such as river valleys or coastlines may present greater potential for wood deterioration than the region, as a whole. Users should consult the Deterioration Zones Map shown in Figure 1 of this Standard when determining the preservative retention level. The higher retention level shall be specified when poles are to be installed in the higher deterioration zones. See Deterioration Zones map on the following page.

On succeeding pages are given specific requirements for the treatment of poles of the following species:

Treatment with Creosote & Oil-Borne Preservatives

Pages 3 and 4

Southern Pine
Coastal Douglas-fir
Jack Pine

Page 5

Red Pine
Lodgepole Pine
Western Red Cedar
Alaska Yellow Cedar

Page 6

Western Larch
Ponderosa Pine

Page 7

Treatment with Waterborne Preservatives
All Species Listed Above
Discontinued Species

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1. SPECIFIC REQUIREMENTS -- TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of American Wood-Preservers' Association Standard C1 All Timber Products -- Preservative Treatment by Pressure Processes. See AWPA Standards M1, M2, M3, M4, and M13 for additional information.

	Southern Pine		Douglas-Fir		Jack Pine
1.3 Conditioning	Air-seasoning, kiln drying, steaming, heating in the preservative, or a combination.		Air-seasoning, kiln drying, Boulton drying, heating in the preservative, or a combination		Air-seasoning, kiln drying, steaming, (for ice-coated or frozen poles only), heating in the preservative or a combination.
1.3.2 Steaming					
Temp. – deg C (deg. F) -- Max		116 (240)	Not permitted		116 (240)
Duration – hr. – Max	Group A			Group B	
Total of Initial (Par 1.3.1) plus Final (Par 2.2.4)	17			20	
Vacuum					4
KPa (in.) at sea level -- Min		559 (27)			559 (27)
1.3.3 Heating in Preservative					
Temp. – deg C (deg F) – Max		104 (220)	104 (220)		104 (220)
Duration – hr. – Max		No time limit	No time limit		No time limit
2. TREATMENT					
2.2.2 Pressure – kPa (psig) – Max		1400 (200)	1050 (150)		1050 (150)
2.2.3 Expansion Bath					
Temp. – deg C (deg. F) – Max		104 (220)	104 (220)		104 (220)
2.2.4 Final Steaming [note 1]					
Temp. – deg C (deg. F) -- Max		116 (240)	116 (240)		116 (240)
Duration – hr. -- Max.		3	3		3
3. RESULTS OF TREATMENT					
3.1 Retention – Min by assay m kg/m³ (pcf)					
Sampling zone for assay -- millimeters (inches) from surface		11 to 50 mm (0.50 to 2.00 in.)	6 to 25 mm (0.25 to 1.00 in.)		3 to 19 mm (0.10 to 0.75 in.)
For deep incised or radial drilled poles, in addition			50 to 63 mm (2.00 to 2.50 in.) or the inner 13 mm (1/2 inch) of the depth of penetration specified, when deeper penetration is specified by the purchaser		
Number of borings, each and every charge		20	20		20
Creosote and Creosote Solution Standards P1/P13 and P2 – By assay -- Kg/m³ [pcf]					
Outer zone	96 (6.0)	120 (7.5)	144 (9.0)	144 (9.0) 192 (12.0)	272 (17.0)
Inner zone when required				72 (4.5) 96 (6.0)	192 (12.0) 256 (16.0)
Oil-Borne Preservatives					
Copper Naphthenate, Standards P8 & P9 (Type A only) by assay – kg/m3 (pcf)					
Outer zone (Outer metal)	0.96 (0.06)	1.28 (0.08)	2.08 (0.130)	1.2 (0.075) 1.6 (0.095) 2.4 (0.150)	1.6 (0.095) 1.9 (0.120)
Inner zone when required				0.61 (0.038) 0.79 (0.049) 1.2 (0.075)	
Pentachlorophenol, Standards P8 & P9 (Types A and C) [note 5] – By assay [note 2]					
Outer zone	4.8 (0.30)	6.1 (0.38)	7.2 (0.45) [Note 3]	7.2 (0.45) 9.6 (0.60)	9.6 (0.60) 12.8 (0.80)
Inner zone when required				3.7 (0.23) 4.8 (0.30)	

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3.2 Penetration is mm (in.) of wood and/or percent of sapwood – Minimum (C1, 3.2.1)	63 mm (2.00 in) or 95%	75 mm (3.00 in) or 90%	90 mm (3.50 in) or 90%	19 mm (0.75 in.) and 65% of sapwood	38 mm (1.50 in.) and 80 % of sapwood
For deep incised or radial drilled poles, Min. mm (in.)				63 mm (2.5 in.) or to max. depth of deep incising or radial drilling specified	
3.2.1 Determination of Penetration (note 4)					
3.2.1.1 Group A-poles whose 1.8m (6ft) from butt circumference is less than 950 mm (37.5 inches).	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of 20 poles in each charge. If 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be rebored. If 16 or 17 of the borings meet the requirements each Group A pole in the charge shall be bored and only those meeting the requirement shall be accepted. If less than 16 of the borings meet the requirement all Group A poles in the charge shall be rejected.				
3.2.1.2 Group B – poles whose 1.8 m (6 ft.) from butt circumference is 950 mm (37.5 inches) or more.	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of each pole and only those meeting the penetration requirements shall be accepted. On poles 15 m (50 ft.) and longer (except WRC) each pole will be bored twice at 90° apart. Only those poles meeting the penetration requirements on both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in a plane approximately 300 to 600 mm (1 to 2 ft.) above the brand. Deep incised or radial drilled poles shall have the borings taken at least 300 mm (one ft.) above the standard ground line and about one ft. below the top of the deep incising or radial drilling section and shall be taken on any diagonal of the diamond pattern and not directly in the center of the four incisions of the diamond pattern.				
4 PRESERVATIVES	All standard preservatives listed above		All standard preservatives listed above		All standard preservatives listed above
5 RETREATMENT (note 1)	Poles may be retreated providing none of the limitations specified in AWPA Standard C1, par. 8 (Retreatment), are exceeded.				

[1] Retreatment of Stored Poles – Poles treated within the current calendar year as well as those treated in the period one calendar year previously, as indicated by the date on the face brand and/or bulk marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if lot size is less than standard, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

[2] When the copper pyridine method is used, multiply the result by 1.1 to convert to lime ignition result.

[3] Pentachlorophenol solvent systems Types B and D for Southern Pine were deleted from the Standard in 1989 without prejudice due to non-use.

[4] Penetration must be continuous through both heartwood and sapwood on each annual ring.

[5] Treating solution concentration: Min. 5%, Max. 9%.

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1. SPECIFIC REQUIREMENTS – TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of American Wood-Preservers' Association Standard C1, All Timber Products – Preservative Treatment by Pressure Processes, except as modified or supplemented by the following note. Users of this Standard should refer to AWPA Standards M1, M2, M3, M4 and M13 for additional information.

	Red Pine		Lodgepole Pine		Western Red Cedar / Alaska Yellow Cedar
1.3 Conditioning	Air-seasoning, kiln drying, steaming, heating in the preservative, or a combination.		Air-seasoning, kiln drying, solution drying, heating in the preservative, or a combination.		Air-seasoning, kiln drying, steaming, (for ice-coated or frozen poles only), heating in the preservative or a combination.(3)
1.3.2 Steaming					
Temp. – deg C (deg. F) – Max.	116 (240)		116 (240)		116 (240)
Duration – hr. – Max.					
Total of Initial (Par. 1.3.2) plus final (Par. 2.2.4)	4		4		4
Vacuum					
kPa (in. Hg) at sea level – Min.	-77kPa (22 in Hg)		-77kPa (22 in Hg)		-77kPa (22 in Hg)
1.3.3 Heating in Preservative					
Temp. – deg C (deg. F) – Max.	104 (220)		104 (220)		104 (220)
2. TREATMENT					
2.2.2 Pressure – kPa (psig) – Max.	1050 (150)		1050 (150)		700 (100)
2.2.3 Expansion Bath					
Temp. – deg C (deg. F) – Max.	104 (220)		104 (220)		104 (220)
2.2.4 Final Steaming(1)					
Temp. – deg C (deg. F) – Max.	116 (240)		116 (240)		116 (240)
Duration – hr. – Max.	3		4		5
3. RESULTS OF TREATMENT					
3.1 Retention – kg/m (pcf)					
Sampling zone for assay -- millimetres (inches) from surface	2.5 to 41 mm (0.10 to 1.60 in.)		2.5 to 19 mm (0.10 to 0.75 in.)		0.00 to 13 mm (0.00 to 0.50 in.)
Number of borings, each and every charge.	20		20		20
Creosote and Creosote Solution Standards P1/P13 and P2					
-- By assay in kg/m3 (pcf)	160 (10.0)	192 (12.0)	192 (12.0)	256 (16.0)	320 (20)
Oil-Borne Preservatives					
Copper Naphthenate, Standards P8 & P9 (Type A only) by assay, kg/m3 (pcf)	12.0 (0.075) 1.52 (0.095)	2.40 (0.150)	1.52 (0.095)	1.92 (0.120)	1.92 (0.120)
Pentachlorophenol, Standard P8 & P9 P8 & P9 (Types A,B, & C) (note 6) – By assay in kg/m3 (pcf) [note 4]	8.0 (0.50)	9.6 (0.60)	9.6 (0.60)	13 (0.80)	16 (1.0)
3.2 Penetration in millimetres (inches) of wood and/or percent of sapwood Minimum (C1, 3.2.1)	63 mm (2.50 in) or 85%	75 mm (3.00 in) or 90%	19mm (0.75 in.) and 85 % of sapwood		12mm (0.50 in.) or 100 % of Sapwood

3.2.1.1 Group A -- poles whose 1.8 m (6 ft.) from butt circumference is less than 950 mm (37.5 in.)

A bored core shall be taken at a point in a plane approximately 300 to 600mm (1 to 2 ft.) below the brand 300mm (1 ft.) below the groundline in Western Red Cedar) of 20 poles in each charge, if 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be retreated. If 16 or 17 of the borings meet the requirements, each Group A pole in the charge shall be bored and only those meeting the requirements shall be accepted. If less than 16 of the borings meet the requirement all Group A poles in the charge shall be rejected.

3.2.1.2 Group B – poles whose 1.8 m (6 ft.) from butt circumference is 950 mm (37.5 in.) or more

A bored core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand 300 mm (1 ft.) below the groundline in Western Red Cedar) of each pole and only those meeting the penetration requirements shall be accepted. On poles 13 m (50 ft.) and longer (except WRC) each pole will be bored twice at 90° apart. Only those poles meeting the penetration requirements in both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in plane approximately 300 to 600 mm (1 to 2 ft.) above the brand.

4. PRESERVATIVES	All standard Preservatives listed above	All standard Preservatives listed above	All standard Preservatives listed above

5. RETREATMENT (note 2) Poles may be retreated providing none of the limitations specified in AWPA Standard C1, par. 6 (Retreatment), are violated.

(2) Retreatment of Stored Poles -- Poles treated within the current calendar year as well as those treated in the period one calendar year previously, as indicated by the date on the hole brand and/or butt marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if not able to test than standard, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

(3) Heating in the preservative for pulpwood other than drying is permitted either at atmospheric pressure or under vacuum, provided that the temperature of the preservative does not exceed 93 degrees C (200°F).

(4) When the copper pyridine method is used, multiply the result by 1.1 to convert to lime ignition result.

(5) For oil-borne treatment of Red pine, the retention of 128 kg/m3 (8.0 pcf) creosote and 9.6 Kg/m3 (0.60 pcf) pentachlorophenol were deleted from the Standard in 1972 without prejudice for lack of use.

(6) Treating solution concentration: Min 5%, Max 9%.

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1. SPECIFIC REQUIREMENTS – TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of AWPA Standard C1, All Timber Products -- Preservative Treatment by Pressure Processes, except as modified or supplemented by the following table. Users of this Standard should refer to AWPA Standards M1, M2, M3, M4, and M10 for additional information.

	Western Larch	Ponderosa Pine
1.3 Conditioning	Air-seasoning, kiln drying, Boulton drying, heating in the preservative, or a combination	Air-seasoning, kiln drying, steaming, heating in the preservative, or a combination.
1.3.2 Steaming	Not Permitted	
Temp. -- deg C (deg. F) – Max		116 (240)
Duration – hr. – Max.		8 [note 1]
Vacuum		
kPa (in. Hg) at sea level – Min		-77 kPa (22 in. Hg)
1.3.3 Heating in Preservative		
Temp. – deg C (deg. F) – Max	Seasoned: 99 deg C (210°F) and 8 hr. Green or partially seasoned, 104 deg C (220 deg F) and no time limit	104 (220)
Duration – hr. – Max		No time limit
2. TREATMENT		
2.2.2 Pressure – kPa (psig) – Max	1050 (150)	1400 (200)
2.2.3 Expansion Bath		
Temp. -- deg C (deg. F) – Max.	104 (220)	104 (220)
2.2.4 Final Steaming(1)		
Temp. deg C (deg. F) – Max	116 (240)	116 (240)
Duration – hr. -- Max.	3	3 [note 1]
3. RESULTS OF TREATMENT		
3.1 Retention – Min. by assay kg/m3 (pcf)		
Sampling zone for assay – millimeters (inches) from surface	2.5 to 15 mm (0.10 to 0.60 in.)	13 to 50 mm (0.50 to 2.00 in.)
Number of borings, each and every charge, Creosote and Creosote Solution	30	20
Standards P1/P13 and P2 -- By assay in kg/m3 (pcf)	256 (16)	96 (6.0) 120 (7.5) 144 (9.0)
Oil-Borne Preservatives		
Copper Naphthenate, Standards P8 & P9 -- By assay in kg/m3 (pcf)		0.96 (0.060) 1.25 (0.080) 2.08 (0.130)
Pentachlorophenol, Standard -- By assay in kg/m3 (pcf) [notes 3 & 5]	12.8 (0.8)	4.8 (0.30) 6.1 (0.38) 7.2 (0.48)
3.2 Penetration in millimeters (inches) of wood and/or percent of sapwood	12mm (0.50 in.) and 100% of sapwood up to a max. of 19 mm (0.75 in.)	63 mm (2.5 in) or 85% 75 mm (3.00 in) or 90% 87 mm (3.50 in) or 90%
Minimum (C1, 3.2.1)		
3.2.1 Determination of Penetration		
3.2.1.1 Group A – poles whose 1.8 m (6 ft.) from butt circumference is less than 950 mm (37.5 in.)	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of 20 poles in each charge. If 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be retreated. If 16 or 17 of the borings meet requirements each Group A pole in the charge shall be bored and only those meeting the requirement shall be accepted. If less than 16 of the borings meet the requirement all Group A poles in the charge shall be rejected.	
3.2.1.2 Group B -- poles whose 1.8 m (6 ft.) from butt circumference is 950 mm (37.5 in.) or more	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of each pole and only those meeting the penetration requirements shall be accepted. On poles 15.2 m (50 ft.) and longer (except WRC) each pole will be bored at 90 degrees apart. Only those poles meeting the penetration requirements in both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in a plane approximately 300 to 600 mm (1 to 2 ft.) above the brand.	
4. PRESERVATIVES	All standard preservatives listed above	All standard preservatives listed above
5. RETREATMENT [note 2]	Poles may be retreated providing none of the limitations specified in Standard C1, par. 8 (Retreatment), are exceeded.	

(1) The total of the steaming time (para. 1.3.2) and the final steaming time (para. 2.2.4) shall not exceed 4 hours, with the exception that ponderosa pine may be for a total of 8 hours provided that the moisture content of the poles involved is 20 percent or less at 63 mm (2.50 in.) from the surface at mid-length when steaming commences. Otherwise, total steaming time permitted for this species is 4 hours.

(2) Retreatment of Stored Poles -- Poles treated within the current calendar year as well as those treated in the period one calendar year previously, as indicated by the date on the face brand and/or butt marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if lot size is less than standard, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

(3) When the copper pyridine method is used, multiply the result by 1.1 to convert to lime ignition result.

(4) Treating solution concentration: Min. 5%, Max. 9%.

(5) Treating solution concentration: Min. 5%, Max. 9%.

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1. SPECIFIC REQUIREMENTS – TREATMENT WITH WATERBORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of AWPA Standard C1 -- All Timber Products, Preservative Treatment by Pressure Processes, except as modified or supplemented in the following table. Specific requirements for waterborne treatments are the same as for treatment with creosote and oil-borne preservatives for the species being treated. Users of this Standard should refer to Standards M1, M2, M3, M4, and M13 for additional information.

1.2 The listing of Coastal Douglas-fir as an acceptable species for treatment with CCA is not intended to imply that this species can generally be satisfactorily treated. Treatment of this species is usually only satisfactory if the material chosen from permeable wood, selected by trials. If treatable wood is not available, the treatment of Coastal Douglas-fir with CCA is not recommended.

1.3 Conditioning	Air-seasoning, kiln drying, or a combination.
1.3.2 Steaming	Permitted (note 1)
1.3.3 Heating in Preservative	Not permitted
2. TREATMENT	
2.2.2 Pressure – kPa (psig) – Max.	See previous pages of this Standard for maximum allowable pressure for the species being treated.
2.2.3 Expansion Bath	Not permitted
2.2.4 Final Steaming	Final steaming is not permitted except when solely performed to promote fixation as specified in Section 2.2.5.3

2.2.5 Fixation Period

When a post-treatment fixation process is specified as an optional process by the purchaser of Poles treated under this Standard, the following post-treatment processing limits have been found to significantly enhance preservative fixation while also avoiding conditions which would cause losses in mechanical properties. While the Chromotropic Acid Test (AWPA Standard A3, Method 11) is valid only for chromium-containing preservatives, comparable tests are being developed for other preservatives and will be incorporated as they become available. The time-temperature limitations specified below are appropriate for all species and all waterborne preservatives.

2.2.5.1 Liquid Processes

Temp. – deg. C (deg. F) – Max.

Duration

105°C (220°F)

Until outer 0-12mm (0-0.5 in.) portion of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11) or not to exceed the Maximum time-temperature combinations listed below.

Temperature	Time
105°C (220°F)	8 hr
95°C (203°F)	9 hr
85°C (185°F)	12 hr
75°C (167°F)	18 hr
65°C (149°F)	24 hr

2.2.5.2 Air Processes

Dry-bulb Temp. – deg. C (deg. F)

Max. wet-bulb Depression Temp. – deg. C (deg. F)

Duration

Any temperature above ambient (max. 71°C (160°F))

10°C (20°F)

Until outer 0-12 mm (0-0.5 in.) of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11)

2.2.5.3 Steaming Processes

Temp. – deg. C (deg. F) – Max.

Duration

105°C (220°F)

Until outer 0-12mm (0-0.5 in.) portion of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11) or Maximum time-temperature combinations listed below.

Temperature	Time
105°C (220°F)	8 hr
95°C (203°F)	9 hr
85°C (185°F)	12 hr
75°C (167°F)	18 hr
65°C (149°F)	24 hr

3. RESULTS OF TREATMENT

3.1 Retention – Min by assay in kg/m3 (pcf).	Same as for oil-borne preservatives	
Sampling zone for assay	Same as for oil-borne preservatives	
Number of borings, each and every charge.		

Continued on Next Page

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ACA	9.6 (0.60)	4.8 (0.30)
ACQ Type B	9.6 (0.60)	4.8 (0.30)
CCA	9.6 (0.60)	4.8 (0.30)
ACZA	9.6 (0.60)	4.8 (0.30)

3.2 Penetration in mm (inches) of wood and/or percent of sapwood – Min. (C1, 3.2.1) — Same as for heaviest oil-borne preservatives

5. RETREATMENT [note 4] — Poles may be re-treated providing none of the limitations specified in Standard C1, par. 5 (Retreatment) are exceeded.

[1] Poles treated with ACA, ACZA and ACQ-B formulations may be steamed up to a maximum temperature of 115° C (240°F) for air-seasoned and kiln-dried southern pine, and western larch – 6 hrs; Coastal Douglas-fir – 8 hrs., all other species – 4 hrs. Poles treated with CCA formulations may be steamed only to remove ice or thaw frozen material in accordance with paragraph 1.3 of AWPA Standard C1.

[2] For greater accuracy, the use of actual specific gravity of the wood is preferred to using the assumed average species density. For reference analysis actual wood specific gravities must be determined and used. (See AWPA Standard A12.)

[3] Waterborne preservatives are available either as oxides which form non-ionizing compounds in the wood or as salts which leave non-ionizing and ionizing compounds in the wood. If there is a preference for one formulation as compared to the other, the purchaser should so specify.

[4] See Footnote 1, Page 4.

DISCONTINUED SPECIES

Species removed from this Standard due to non-use: Western Hemlock (1987), Spruce (1987).
Should any person wish to reinstate a standard for these species using standard preservatives, it may be done without the usual pre-investigation and data submission required for new species per usual practice.

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FS and FD Cast Device Boxes: Malleable Iron, Aluminum

UNILETS® for use with Threaded Rigid Condult and IMC.
All Device Boxes have Ridge Top Construction.

Applications

- Accommodate wiring devices such as switches and receptacles.
- Provide excellent service in areas where boxes are subject to rough usage.
- Serve as pull boxes for conductors.
- Permit access to conductors for maintenance.
- Provide openings for making splices.
- Allow connections for branch conduit runs.
- FS and FD blank bodies—for special conduit-entrance arrangements.

Features: All FS and FD Boxes

- Corrosion-resistant—ideal for indoor and outdoor installations.
- Weatherproof, raintight and dust-tight when used with cast gasketed covers.
- FS and FD boxes take standard flush wiring devices.
- FD boxes take devices exceeding 1-5/8" in depth under fastening ears.
- Malleable iron for high tensile strength and ductility—provides greater resistance to impact and shock.
- Both malleable iron and aluminum boxes have ridge top construction for positive cover/gasket/box fit.
- Accurately tapped, tapered threads for tight, rigid joints, ground continuity.
- Complete selection of covers, receptacles, plugs, gaskets and accessories.
- Covers have captive stainless steel screws to speed installation, prevents loss of screws.
- Internal grounding screws standard.

Features: Cast Hub Boxes

❶ Available in single, two and three gang and tandem.

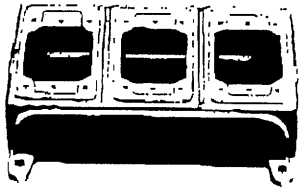
- Smooth, rounded integral bushing in each hub protects conductor insulation.

Features: FDB Blank Bodies for Drilling and Tapping

❷ Available in single, two and three gang boxes.

- Drilling and tapping from 1/2" thru 1-1/2".
- Minimum engagement of 3-1/2 threads.
- With mounting lugs.
- FDB-2GL and FDB-3GL can also be drilled and tapped in back of box (wall pposite cover).

❶ Cast Hub Boxes. Single Gang shown.



❷ Blank Bodies for Drilling and tapping. FDB-3L shown.

❸ Blank Bodies for Brazed Hubs. FS-2G shown.

Features: FS & FD Blank Bodies for Brazed Hubs

❸ Available in single, two, three and four gang boxes.

- Brazed threaded hubs for threaded conduit from 1/2" thru 1-1/2" and brazed union hubs from 1/2" thru 1-1/4.
- Smooth, rounded integral bushing in each hub protects conductor insulation.

Standard Materials

- *Cast Hub Device Boxes and Boxes for Drilling and Tapping:* malleable iron or copper-free (4/10 of 1% max.) aluminum.
- *Brazed Hubs:* malleable iron.
- *Covers:* malleable iron, steel, or copper-free (4/10 of 1% max.) aluminum.

Standard Finishes

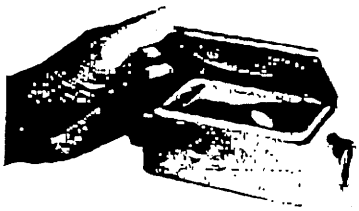
- *Malleable Iron Device Boxes:* triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat.
- *Aluminum Device Boxes:* epoxy powder coat.
- *Malleable Iron Covers with Gaskets:* triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat.
- *Steel Covers:* zinc electroplate.
- *Aluminum Covers:* epoxy powder coat.

Compliances

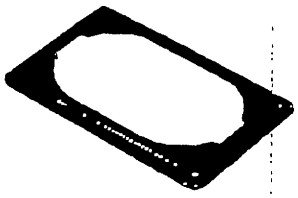
- UL Standard: 498 and 514A.
- U.S. Federal Specification W-C-586B.
- Appleton malleable iron products conform to ASTM A47-77, Grade 32510, which has the following properties: tensile strength, 50,000 psi; yield, 32,000 psi; and elongation, 10%.
- Appleton aluminum products are produced from a high strength copper-free (4/10 of 1% max.) alloy.

Reference Data

- When ordering drilled and tapped openings or brazed hubs for blank bodies, refer to "Ordering Information" pages.



Gasket is designed so that it wraps around ridge top of Appleton aluminum or malleable iron device box. Result is a positive seal against moisture.



Gasket construction. Cover tightens on largest perimeter of gasket and fits snugly against portion of gasket that wraps around ridge top of box.

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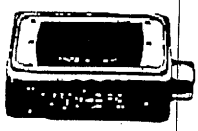
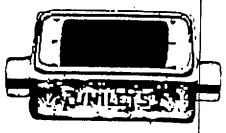
EGS Appleton
7770 N. Frontage Road
Skokie, Illinois 60077

FS and FD Cast Device Boxes: Single Gang; Malleable Iron, Aluminum

UNILETS® for use with Threaded Rigid Metal Conduit and IMC. FS Box 2.00" Deep, FD Box 2.69" Deep. Furnished with Internal Ground Screw.

	Type	Depth	Hub Size (Inches)	Catalog Number Malleable Iron Ridge Top	Catalog Number Aluminum Ridge Top
	FS	Shallow	1/2	FS-1-50	FS-1-50-A
			3/4	FS-1-75	FS-1-75-A
			1	FS-1-100	FS-1-100-A
	FD	Deep	1/2	FD-1-50	FD-1-50-A
			3/4	FD-1-75	FD-1-75-A
	FSC	Shallow	1/2	FSC-1-50	FSC-1-50-A
			3/4	FSC-1-75	FSC-1-75-A
			1	FSC-1-100	FSC-1-100-A
	FDC	Deep	1/2	FDC-1-50	FDC-1-50-A
			3/4	FDC-1-75	FDC-1-75-A
	FSS	Shallow	1/2	FSS-1-50	FSS-1-50-A
			3/4	FSS-1-75	FSS-1-75-A
	FDS	Deep	1/2	FDS-1-50	FDS-1-50-A
			3/4	FDS-1-75	FDS-1-75-A
			1	FDS-1-100	FDS-1-100-A
	FSLA	Shallow	1/2	FSLA-1-50	

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EGS Appleton
7770 N. Frontage Road
Skokie, Illinois 60077

THHN

600 Volt. Copper Conductor. Thermoplastic Insulation/Nylon Sheath.
Heat, Moisture, Oil, and Gasoline Resistant[1].
All Sizes Rated THWN-2. All Stranded Sizes Rated MTW.
AWG Sizes 14 Through 6 Rated AWM (105°C).
AWG Sizes 14 Through 1 Rated VW-1 and Larger Sizes Rated for CT Use.

APPLICATIONS

Southwire Type THHN or THWN-2 conductors are primarily used in conduit and cable trays for services, feeders, and branch circuits in commercial or industrial applications as specified in the National Electrical Code[2]. When used as Type THHN, conductor is suitable for use in dry locations at temperatures not to exceed 90°C. When used as Type THWN-2, conductor is suitable for use in wet or dry locations at temperatures not to exceed 90°C or not to exceed 75°C when exposed to oil or coolant. When used as Type MTW, conductor is suitable for use in wet locations or when exposed to oil or coolant at temperatures not to exceed 60°C or dry locations at temperatures not to exceed 90°C (with ampacity limited to that for 75°C conductor temperature per NFPA 79). Conductor temperatures not to exceed 105°C in dry locations when rated AWM and used as appliance wiring material. Voltage for all applications is 600 volts.

SPECIFICATIONS

Southwire Type THHN or THWN-2 or MTW (also AWM) meets or exceeds all applicable ASTM specifications, UL standard 83, UL standard 1063 (MTW), Federal Specification J-C-30B, and requirements of the National Electrical Code.

CONSTRUCTION

Southwire Type THHN or THWN-2 or MTW copper conductors are annealed (soft) copper, insulated with a tough heat and moisture resistant polyvinyl chloride (PVC), over which a nylon (polyamide) or UL-listed equal jacket is applied. Available in black, white, red, blue, green, yellow, brown, orange, and grey. Some colors standard, some subject to economic order quantity. Sizes 1 AWG through 1,000 kcmil available in black only.

[1] Oil and gasoline resistance II as defined by Underwriters Laboratories.
[2] 1999 Edition.

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THHN

Conductor Size (AWG or kcmil)	Conductor No. Strands	Insulation Thickness (mils)	Jacket Thickness (mils)	Nominal O.D. (mils) Sol.	Nominal O.D. (mils) Str.	Approx. Net Weight Per 1000' (lbs.) Sol.	Approx. Net Weight Per 1000' (lbs.) Str.	Allowable Ampacities+ 60 C	Allowable Ampacities+ 75 C	Allowable Ampacities+ 90 C	Standard Package
**14	19*	15	4	102	109	15	16	15	15	15	DNF
**12	19*	15	4	119	128	23	24	20	20	20	DNF
**10	19*	20	4	150	161	37	38	30	30	30	DQF^
**8	19	30	5	--	213	--	63	40	50	55	F
**6	19	30	5	--	249	--	95	55	65	75	E
4	19	40	6	--	318	--	152	70	85	95	C
3	19	40	6	--	346	--	188	85	100	110	BC
2	19	40	6	--	378	--	234	95	115	130	C
1	19	50	7	--	435	--	299	110	130	150	B
1/0	19	50	7	--	474	--	371	125	150	170	B
2/0	19	50	7	--	518	--	461	145	175	195	B
3/0	19	50	7	--	568	--	574	165	200	225	B
4/0	19	50	7	--	624	--	717	195	230	260	B
250	37	60	8	--	694	--	850	215	255	290	B
300	37	60	8	--	747	--	1011	240	285	320	B
350	37	60	8	--	796	--	1172	260	310	350	B
400	37	60	8	--	842	--	1333	280	335	380	B
500	37	60	8	--	925	--	1653	320	380	430	B
600	61	70	9	--	1024	--	1965	355	420	475	C
750	61	70	9	--	1126	--	2462	400	475	535	C
1000	61	70	9	--	1276	--	3255	455	545	615	C

**Construction available in sizes 14, 12, & 10 as Types THHN or THWN-2 or AWM only, suitable for 105 C appliance wiring material (AWM).

*Four 500' spools per carton.

^Two 500' spools per carton.

+Allowable Ampacities:

Allowable ampacities shown are for general use as specified by the National Electrical Code, 1999 Edition, section 310-16.

60 C - When terminated to equipment for circuits rated 100 amperes or less or marked for #14 through #1 conductors. MTW wet locations or when exposed to oil or coolant.

75 C - When terminated to equipment for circuits rated over 100 amperes or marked for conductors larger than #1. THWN-2 when exposed to oil or coolant. MTW dry locations.

90 C - THHN dry locations. THWN-2 wet or dry locations.

All AWG sizes 14 through 1 rated VW-1. Larger sizes rated for CT Use.

STANDARD PACKAGE CODE.

B - 1000' Reel
C - 500' Reel
D - 2500' Spool
E - 1000' Spool
F - 500' Spool
N - 2000' Carton
Q - 350' Carton

RECOMMENDED SAMPLE SPECIFICATIONS:

(MTW OR THHN OR THWN-2)

Conductors shall be UL-listed Type MTW or THHN or THWN-2 gasoline and oil resistant II, suitable for operations at 600 volts as specified in the National Electrical Code. AWG sizes 14 through 1 shall be rated VW-1, larger sizes shall be rated for CT use. Conductors shall be annealed copper, insulated with high-heat and moisture resistant PVC, jacketed with abrasion, moisture, gasoline, and oil resistant nylon or UL-listed equivalent, as manufactured by Southwire Company or approved equal.

(AWM)

Conductors shall be UL-listed Type THHN or THWN-2 or MTW or AWM, suitable for operation at 600 volts at conductor temperatures not to exceed 105°C.

Southwire

One Southwire Drive
Carrollton, GA 30119 USA
770/832-4242
www.southwire.com

® Southwire is a registered trademark of Southwire Company.

Hot-Dipped Galvanized

Rigid Steel Conduit

DIMENSIONS

Trade Size (Inches)	Threads per Inch	Inside Diameter (Inches)	Outside Diameter (Inches)	Wall Thickness (Inches)	Length without coupling Feet and Inches)	Wheatland Minimum Weight per 100 ft. (10 ft. lengths with couplings)
½	14	0.622	0.840	.104	9-11¼	82
¾	14	0.824	1.050	.107	9-11¼	109
1	11½	1.049	1.315	.126	9-11	161
1¼	11½	1.380	1.660	.133	9-11	218
1½	11½	1.610	1.900	.138	9-11	263
2	11½	2.067	2.375	.146	9-11	350
2½	8	2.469	2.875	.193	9-10½	559
3	8	3.068	3.500	.205	9-10½	727
3½	8	3.548	4.000	.215	9-10¼	880
4	8	4.026	4.500	.225	9-10¼	1030
5	8	5.047	5.563	.245	9-10	1400
6	8	6.065	6.625	.266	9-10	1840

PACKAGING

Trade Size (Inches)	N.E.M.A. Color Code Thread Protectors	Pieces per Bundle	Quantity per Crane Lift	Feet per Lift	Wheatland Wt. per Crane Lift
½	Black	10	25 Bundles	2,500	2,050 lbs.
¾	Red	5	40 Bundles	2,000	2,180 lbs.
1	Blue	5	25 Bundles	1,250	2,013 lb.s
1¼	Red	–	90 Pieces	900	1,962 lbs.
1½	Black	–	80 Pieces	800	2,104 lbs.
2	Blue	–	60 Pieces	600	2,100 lbs.
2½	Black	–	37 Pieces	370	2,068 lbs.
3	Blue	–	30 Pieces	300	2,181 lbs.
3½	Black	–	25 Pieces	250	2,200 lbs.
4	Blue	–	20 Pieces	200	2,060 lbs.
5	Blue	–	15 Pieces	150	2,100 lbs.
6	Blue	–	10 Pieces	100	1,840 lbs.

Rigid Steel Conduit Specifications

Wheatland Hot-dipped Galvanized Rigid Steel Conduit is manufactured n conformance to standards established by the American National Standards Institute, the Underwriters Laboratories and the Federal Specification. In preparing bids, it may be stated that Wheatland Rigid Conduit conforms to:

- American National Standard Institute C80.1-
- Federal Specification WW-C-581
- Underwriters Laboratories Specification No. 6
- National Electrical Code—Article 346

UNDERWRITERS LABORATORIES SPECIFICATION NO. 6

The specifications for rigid steel conduit established by the Underwriters Laboratories cover both the manufacture and testing of the conduit in detail. The sections referring to the qualifications of the conduit are condensed and summarized below. Be assured that Wheatland Hot-dipped Galvanized Rigid Steel Conduit meets or exceeds the UL specifications.

The Tube

Each tube used in the manufacture of rigid metal conduit shall be steel (or other suitable metal) and shall have a circular cross-section sufficiently accurate to permit the cutting of clean, true threads. The wall thickness shall be uniform through the length of the tube. The welding of all seams shall be thoroughly well done. The welded seam shall be free from metal trimmings, sharp edges and sharp projections.

Both the inside and outside surfaces of the tube shall be thoroughly cleaned so that the protective coating will have a smooth finish. Before the protective coating is applied, the interior surface of the tube shall be examined to be sure it is free from scale.

Each tube used for rigid metal conduit shall be capable of being bent cold into a quarter circle around a mandrel, the radius of which is four times the trade size of the tube, without developing cracks or opening a weld.

The Protective Coating

Both the inside and outside of ferrous metal rigid conduit shall be protected against corrosion by a coating of zinc (or enamel or equivalent corrosion-resistant coating). The coating shall be sufficiently elastic to prevent its cracking or flaking off when a finished sample of ½-inch conduit is tested up to a year after manufacture by bending it into a semi-circle, the inner edge of which has a radius of 3½ inches.

A protective coating of zinc shall be such that a sample of finished rigid ferrous-metal conduit will not show a fixed deposit of cooper after four one-minute immersions in a standard copper sulfate solution.

The Threads

Each length of conduit is to be threaded on both ends and chamfered to remove burrs and sharp edges on the interior surface. All threads are to be clean and full cut. If threads are cut after the protective coatings are applied, they shall be treated to prevent corrosion before the conduit is installed.

The Finished Conduit

Every piece of conduit is to be inspected prior to shipment to be sure it is free from poor coating, scale, burrs or fins, embossing on interior surfaces or other defects.

Each length of conduit shall be marked "rigid metal conduit" and indicate the type of material. In addition, it shall be marked with manufacturer's name or trade mark.

FEDERAL SPECIFICATION WW-C-581

This specification covers zinc-coated rigid steel conduit in all common trade sizes. Its general requirements are that products furnished under this specification conform as applicable to ANSI C80.1 and UL 6 for rigid steel conduit.

Other provisions of WW-C-581 which should be noted when preparing bids are summarized here. For details on packaging and quality assurance, refer to the full specification.

Standard Commercial Product

The conduit shall, as a minimum, be the manufacturer's standard commercial product with any added features needed to comply with the requirements.

Identical Items

Conduit, couplings, elbows and nipples of the same classification furnished under any specific contract shall be physically and mechanically identical. No deviation will be acceptable without prior written approval of the contracting officer.

Material

All material shall be new and unused. Material not specified shall be of the same quality used for the intended purpose in commercial practice. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual component or the overall assembly.

Fire and Casualty Hazards
Each contractor shall submit proof that the conduit proposed under this specification conforms to UL6. The UL listing mark may be accepted as evidence that the conduit conforms to this requirement.

Marking
Conduit shall be permanently marked in accordance with ANSI C80.1 and UL6.

Workmanship
All threaded portions of conduit shall be clean and undamaged. Plastic thread protectors shall be furnished on all exposed conduit threads. The exterior zinc coating, and all other protective coatings, including the interior coating and thread coating, all completely and uniformly cover metal substrate.

AMERICAN NATIONAL STANDARD INSTITUTE SPECIFICATION FOR ZINC-COATED RIGID STEEL CONDUIT

The ANSI Specification C80.1 is very precise and explicit in setting standards for rigid steel conduit. Wheatland's rigid steel conduit matches these standards in every way. It meets the general requirements of having an accurate circular cross section, a uniform wall thickness, a defect-free interior surface and continuously welded seams. It is thoroughly cleaned before coating so the protective coating adheres well and is smooth. The exterior surface is thoroughly and evenly coated with metallic zinc applied directly to the steel so that metal-to-metal contact and galvanic protection against corrosion are provided. The interior surface is protected by zinc for corrosion resistance.

DETAILED REQUIREMENTS
Some of the pertinent detailed requirements of Specification C80.1 are interpreted and summarized below for your reference and assurance that Wheatland Rigid Steel Conduit is produced to precise standards.

Zinc Coating
The zinc content of the coating on the outside surface shall be equivalent to a minimum thickness of 0.0008 inches.

Threading and Chamfering
Each length of conduit shall be threaded on both ends, and each end shall be chamfered or otherwise treated to remove burrs and sharp edges. If threads are cut after the zinc coating has been applied, the threads shall be treated with a protective coating to prevent corrosion before installation. This treatment shall not impair electrical continuity through couplings or fittings after installation.

Identification
Each length of conduit shall be identified with the manufacturer's name and trade mark and the words "Rigid Steel Conduit."

Threads
The number of threads per inch and the length of the threaded portion at each end of each length conduit shall be as shown in the accompanying table and shall conform to American Standard Pipe Threads. The perfect thread shall be tapered for its entire length, and the taper shall be 3/4 in/ft.

Dimensions of Threads for Rigid Steel Conduit, Zinc Coated

Nominal or Trade Size of Conduit (inches)	Threads per Inch	Pitch Diameter at End of Thread E_o	Length of Thread (Inches)	
		Taper ¾ Inch per Foot	Effective L_2	Overall L_4
⅜	18	0.6120	0.41	0.60
½	14	0.7584	0.53	0.78
¾	14	0.9677	0.55	0.79
1	11½	1.2136	0.68	0.98
1¼	11½	1.5571	0.71	1.01
1½	11½	1.7961	0.72	1.03
2	11½	2.2690	0.76	1.06
2½	8	2.7195	1.14	1.57
3	8	3.3406	1.20	1.63
3½	8	3.8375	1.25	1.65
4	8	4.3341	1.30	1.75
5	8	5.3907	1.40	1.85
6	8	6.4461	1.50	1.95

Overhead
3φ+1φ

Description

Alcan Multiplexed Overhead Service and Secondary Cable assemblies consist of one or more insulated conductors and one bare neutral conductor. The cable assembly may be used as a service drop (power pole to service entrance) or as a secondary cable (pole to pole). XLPE insulated cables are rated for 90° C operation.

Insulated Conductors:

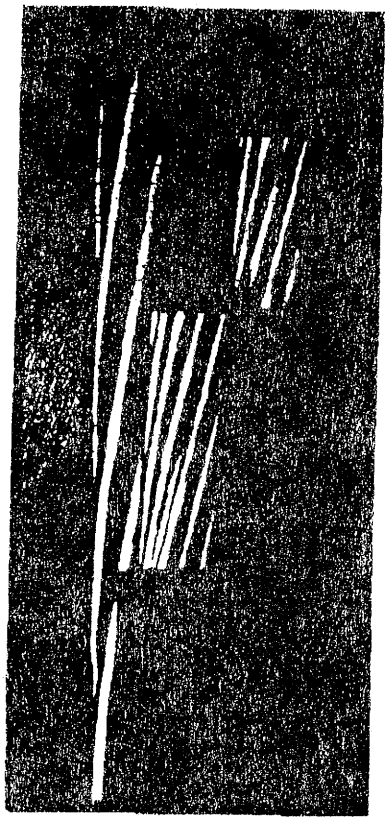
The phase conductors may be either solid or compressed stranded 1350 H-19 (hard drawn) aluminum complying with the following specifications:

ASTM—B-231
1-19 Round Aluminum Wire

ASTM—B-231
Stranded 1350 Aluminum Conductor

Insulation

Insulation is black low density cross linked polyethylene (XLPE) in accordance with ICEA S-76-4 [illegible].



The cable Assemblies bear the following surface markings of intervals not to exceed 24 inches: Alcan (Plant of Manufacture) XLPE (Year of Manufacture)

Neutral:

Cable assemblies are available with any of the following neutral conductors:

1. Stranded All Aluminum (AAC), ASTM—B-231
2. Aluminum Conductor Steel Reinforced (ACSR), ASTM—B-232
3. Aluminum Alloy Conductor 6201 (AAAC), ASTM—B-394

Assembly:

One or more insulated conductors are twisted around the neutral conductor with a lay length of 25 to 60 times the diameter of one phase conductor. The direction of lay is right hand.

Electrical Testing:

After a one hour immersion in water at room temperature each length of cable, while still immersed, will withstand 2.5 kV AC (60 Hz) phase to ground for one minute.

Markings:

The cable Assemblies bear the following surface markings at intervals not to exceed 24 inches: Alcan (Plant of Manufacture) XLPE (Year of Manufacture)

1. Data on this sheet are not subject to normal manufacturing tolerances.

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department ENG
By [signature]

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ACSR Neutral

Overhead
3Ø + 1Ø

Crosslinked Polyethylene Duplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
SETTER/XLP	6 solid	45	162	252	6-6/1	1190	13	49	12	74	65	1000	3300
SHEPHERD/XLP	6-7	45	178	268	6-6/1	1190	16	60	12	77	65	1000	3300
TERRIER/XLP	4-7	45	225	315	4-6/1	1860	19	79	18	116	110	1000	2400

(40° C ambient, 90° C conductor temperature; sun and wind)

Crosslinked Polyethylene Triplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
VOLUTA/XLP	6-7	45	178	268	6-6/1	1190	31	74	12	117	85	1000	2200
STROMBUS/XLP	4-7	45	225	315	6-6/1	1190	39	103	12	154	110	500	1500
WHELK/XLP	4-solid	45	204	294	4-6/1	1860	31	116	18	165	110	500	1700
PERIWINKLE/XLP	4-7	45	225	315	4-6/1	1860	39	118	18	175	110	500	1500
COCKLE/XLP	2-7	45	283	373	4-6/1	1860	49	164	18	231	150	500	1800
CONCH/XLP	2-7	45	283	373	2-6/1	2850	49	188	29	266	150	500	1600
JANTHINA/XLP	1/0-7	60	357	477	2-6/1	2850	61	262	29	372	200	500	1200
PANELLA/XLP	1/0-19	60	362	482	2-6/1	2850	76	282	29	387	200	500	1200
NERITINA/XLP	1/0-7	60	357	477	1/0-6/1	4380	61	298	47	426	200	500	1200
OLIVA/XLP	1/0-19	60	362	482	1/0-6/1	4380	76	298	47	421	200	00	1200
PORCINA/XLP	2/0-7	60	401	521	2/0-6/1	5300	92	376	59	527	230	-	1500
TRITON/XLP	2/0-19	60	406	526	2/0-6/1	5300	84	376	59	519	230	-	1500
MUREX/XLP	3/0-19	60	456	576	3/0-6/1	6620	94	474	74	642	260	-	1300
CERAPUS/XLP	4/0-19	60	512	632	2/0-6/1	5300	106	524	59	689	300	-	1000
ZUZARA/XLP	4/0-19	60	512	632	4/0-6/1	8350	106	593	93	797	300	-	1000
COWRY/XLP	336.4-19	80	646	806	4/0-6/1	8350	176	834	93	1105	380	-	000
CAMEO/XLP	336.4-19	80	646	806	336.4-18/1	8680	178	952	50	1180	380	-	000

(40° C ambient, 90° C conductor temperature; sun and wind)

Crosslinked Polyethylene Quadruplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
HACKNEY/XLP	4-7	45	225	315	4-6/1	1860	58	157	18	233	100	500	1700
PALOMINO/XLP	2-7	45	283	373	2-6/1	2850	73	250	29	352	135	-	1800
COSTENA/XLP	1/0-19	60	362	482	1/0-6/1	4380	113	398	47	558	180	-	1200
GRULLO/XLP	2/0-19	60	406	526	2/0-6/1	5300	126	502	59	687	205	-	1500
SUFFOLK/XLP	3/0-19	60	456	576	3/0-6/1	6620	141	632	74	847	235	-	1300
STALLION/XLP	4/0-7	60	508	628	4/0-6/1	8350	178	798	93	1069	270	-	1100
APPALOOSA/XLP	4/0-19	60	512	632	4/0-6/1	8350	159	798	93	1050	270	-	1100
GELDING/XLP	336.4-19	80	646	806	4/0-6/1	8350	267	1151	93	1511	330	-	1000
BRONCO/XLP	336.4-19	80	646	806	336.4-8/1	8680	267	1270	50	1587	330	-	1000

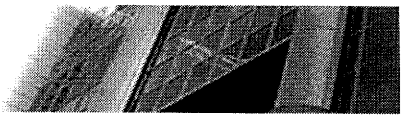
(40° C ambient, 90° C conductor temperature; sun and wind)

NOTES 1. See Table 7 of Aluminum Association "Ampacities for Aluminum and ACSR Overhead Electrical Conductors for Additional Cases."
2. See Table 8 of Aluminum Association "Ampacities for Aluminum and ACSR Overhead Electrical Conductors for Additional Cases."

June 2006 Updates

Pumps, Well Screen, Sprinklers

Environmental



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Redi-Flo3 Accessories

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Accessories
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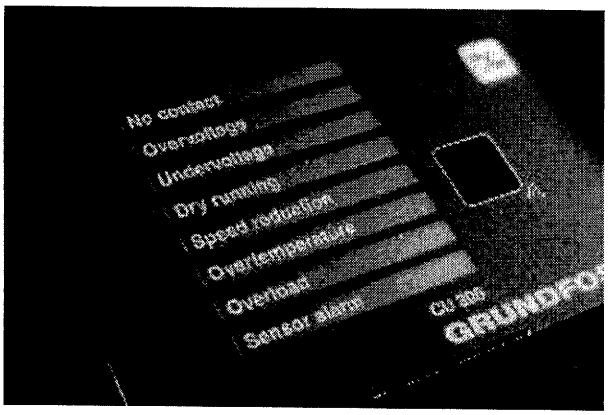
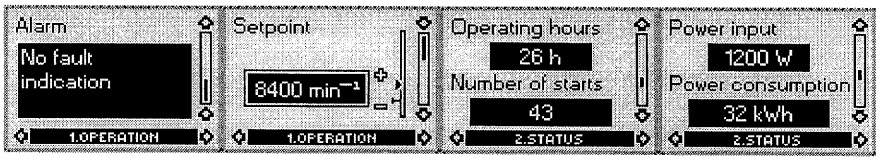


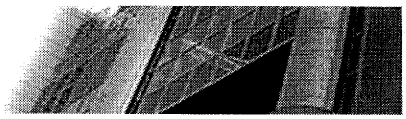
CU300 Status Box
The **CU300** was developed for advanced control and operation of the SQE submersible pump. Two analog sensor inputs and one digital input are provided for controlling pump operation based on signals from external 4-20mA, 0-10vdc or dry contact sensors. Some typical applications are constant water level maintenance, float switch control or PLC control. Additionally the **CU300** is supported by optional software tools designed to provide local or remote computer access to the **CU300** displaying pump performance and offering control and configuration capabilities.

R100 Infrared Remote
The R100 infrared remote allows you to communicate with the **CU300** to retrieve important pump and performance data and change system parameters.

Here are examples of the menu screens you would see on the R100 Infrared Remote:



Environmental



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Redi-Flo3

Redi-Flo3 Submersibles
Grundfos brings environmental pumping systems into the 21st century with the new Redi-Flo3 submersible pump.

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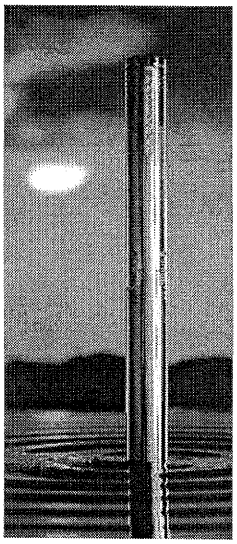

As part of Grundfos Pumps Corporation's continuing development of Redi-Flo Environmental Products, Grundfos has developed the Redi-Flo3 (SQE-NE) pump line. The Redi-Flo3 brings environmental submersible pumping systems into the 21st century.
>
These new pumps feature an all new high efficiency permanent-magnet motor that not only delivers an ultra-high starting torque, but also provides internal protection against pump dry-run, over and under voltage, plus overload and over-temperature safety.

The Redi-Flo3 pump-end uses a floating impeller technology and environmentally tough materials of construction to give excellent wear resistance and solids handling capability. This meets the stringent requirements of environmental applications.

The combination of integrated microelectronics in the pump and the optional Redi-Flo3 status box at the surface allows communication with the pump through standard electrical motor leads. No additional wires are required. This feature also provides the integration of multiple sensors, digital input and relays without traditional extra electronics and cost.

Environmental

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Redi-Flo3 Cutaway

Rugged by Design, Illustration

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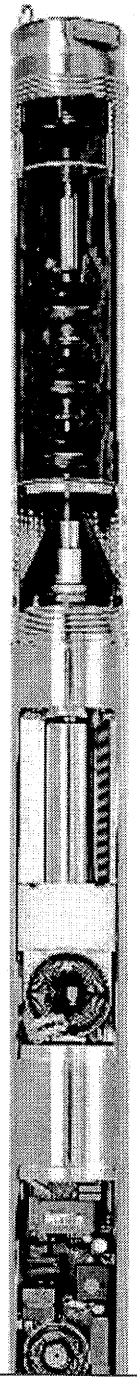
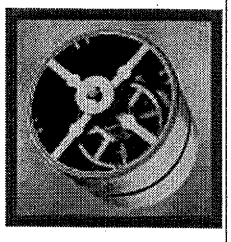
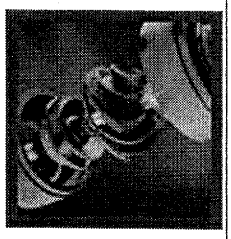


Reliable Check Valves



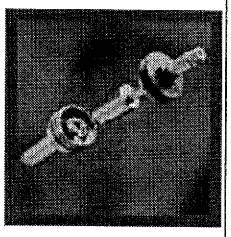
Reliable built-in spring loaded check valves let you operate the pump in any position from vertical to horizontal.

Rugged Design



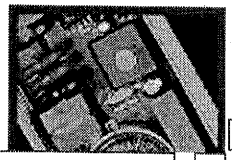
The SQ/SQE pump design uses "floating" impellers. Each impeller has its own tungsten carbide/ceramic bearing. This design and the high quality of materials make the pump very wear resistant, especially in sandy conditions.

Permanent-Magnet Motor



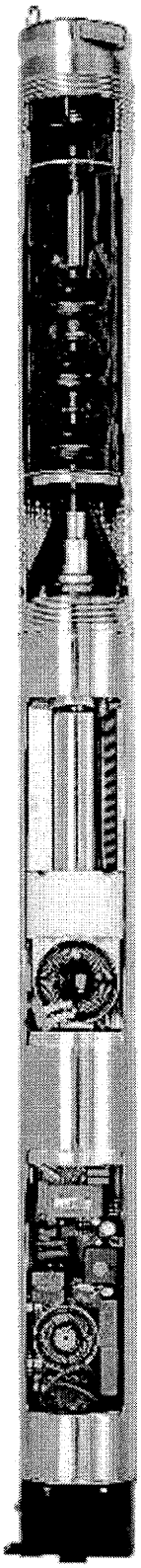
The SQ and SQE motors are based on a permanent-magnet rotor which produces high efficiency output within a wide load range. The high and flat efficiency curve of the permanent-magnet motor allows us to cover a wide power range with the same motor, as compared to conventional AC motors. For SQE pumps, this means three motors to cover the horsepower range from 1/3 to 1.5 Hp.

Advanced Electronics

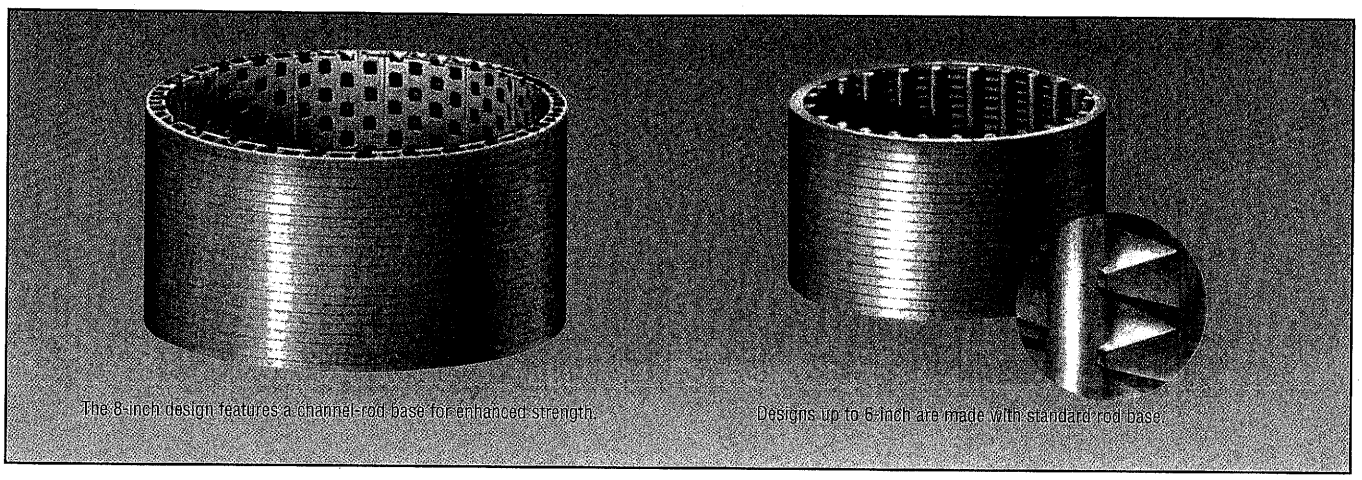


By combining advanced electronics, permanent-magnet motors, and Grundfos' own micro-frequency converter, we

THINK INNOVATE



are now able to control and
communicate with pumps in ways never be
possible. A few of the features that come o
this combination are Constant Pressure Cor
Soft-Start and integrated Dry-Run Protectic



The 8-inch design features a channel-rod base for enhanced strength.

Designs up to 6-inch are made with standard rod base.

PVC VEE-WIRE® SCREENS

Commonly used in shallow wells, Johnson Screen's proprietary, sonic-welded PVC Vee-Wire® screens present higher open area for given slot size than any other non-metallic screen available. More economical than metal screens, PVC Vee-Wire screens resist corrosion from salts and gases commonly found in either salt or fresh water, and they may be treated repeatedly with hydrochloric acid or Johnson's Nu-Well® pellets to remove incrustations. PVC screens are furnished with F480 flush threads or plain ends for connecting to standard PVC fittings.

SIZE (INCHES)	NOMINAL O.D. (INCHES)	DIAMETER I.D. (INCHES)(1)	WEIGHT/FT LBS	TENSILE STRENGTH LBS (2)	HANG WEIGHT LBS (4)	OPEN AREA (SQ INCHES) PER FOOT OF SCREEN COLLAPSE STRENGTH - PSI (3) SCREEN SLOT SIZE (INCHES)					
						0.006	0.010	0.020	0.030	0.040	0.050
1 - 1/4 PS	1.66	1.12	0.7	780	195	3.0 269	4.8 261	8.9 242	12.5 226	15.6 212	18.4 199
1- 1/2 PS	1.90	1.41	0.8	1245	310	3.4 181	5.5 175	10.2 163	14.3 152	17.9 143	21.0 134
2P/3T	2.37	1.88	0.8	1325	330	4.2 95	6.9 92	12.8 85	17.8 79	22.3 74	26.3 70
2 PS*	2.60	2.00	0.9	1325	330	4.6 72	7.5 70	14.0 65	19.6 61	24.5 57	28.8 54
3 PS	3.50	2.89	1.5	1820	455	5.4 169	8.8 164	16.5 154	23.3 145	29.3 137	34.7 130
4 Special	4.50	3.81	1.7	2100	525	6.9 81	11.3 78	21.2 74	30.0 69	37.7 65	44.6 62
4 PS*	4.62	4.00	1.8	2100	525	7.1 75	11.6 73	21.8 68	30.7 64	38.7 60	45.8 57
5 PS	5.56	4.81	2.5	3920	980	8.1 73	13.1 72	24.6 68	34.9 65	44.1 62	52.4 59
6 PS	6.61	5.75	3.7	4600	1150	8.0 73	13.1 72	24.9 68	35.6 65	45.3 62	54.2 59
8 PS	8.62	7.50	4.6	5500	1375	13.3 60	21.6 59	40.6 55	57.3 52	72.2 49	85.5 46

(1) Clear ID's are minimum inside diameters
(2) Tensile values are based on support rod area, other values are based on flush-thread test values
(3) Collapse strengths are calculated values - no safety factor included
(4) Hang weights are the maximum combined weight of riser and screen to be hung from the top screen joint
All strength properties are based on 73° F temperature

*Alternate construction for environmental applications

GO

Business Divisions

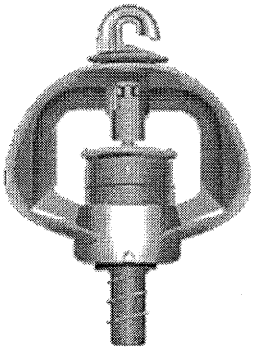
Irrigation Products

- Agriculture Drip Products
- Landscape Drip Products
- Sprinklers/Micro Sprinklers
  - Products
    - SuperNet™
    - StripNet ™
    - GyroNet ™
    - GyroNet Turbo ™
    - SpinNet ™
    - CoolNet ™
    - PowerNet
    - R - 2000
    - A.D. Valve
    - Accessories
  - Applications
- Irrigation Control Products
- Filters
- Fertilizer Injectors

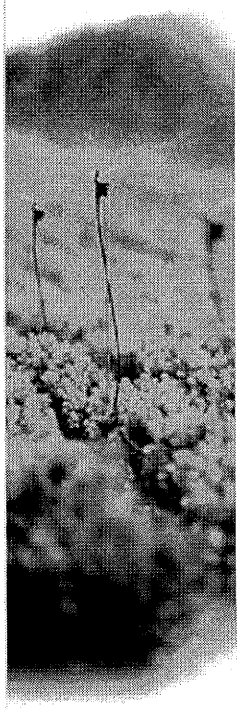
Crops

Global Presence

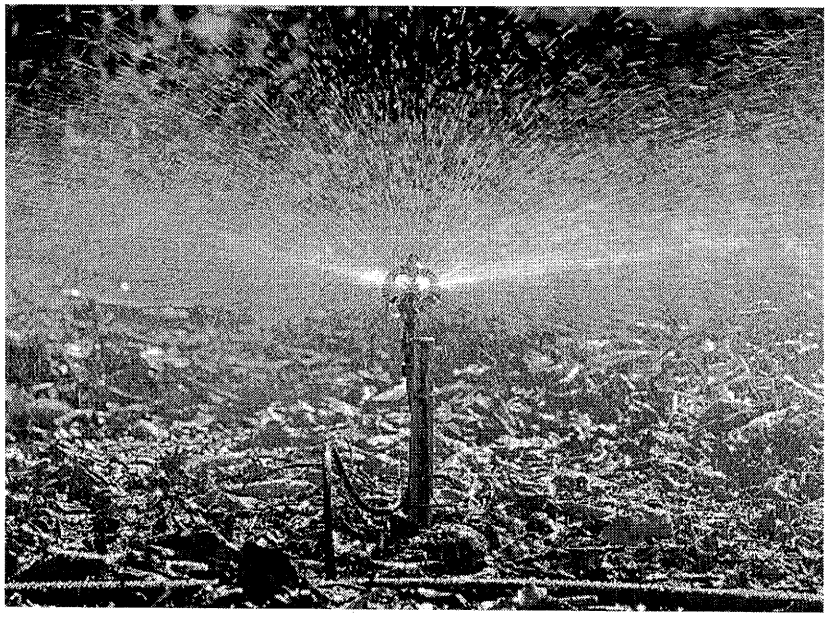
GyroNet ™



A sprinkler made of plastic materials resistant to all agrochemicals, and efficient anti-ant design. Available in 3 models with a variety of swivels and wetting diameters.
Designed for fruit, landscaping trees, and other crops requiring full area coverage.
Irrigation system with anti-ant capabilities.
Possesses very high distribution uniformity, and is suitable for a wide range of crops.
Manufactured from weather-proof plastic materials, with a modular design enabling easy addition of accessories and optimized equipment utilization.



- For Under Tree and Landscape Irrigation
- Irrigation system with anti-ant design
- Weather proof plastic materials
- Resistance to harsh conditions and agrochemicals



Gyronet LR

Irrigation of tree plantations with large root volumes.

Gyronet LRD

The stream deflector concentrates all the water in the area surrounding the young tree during the first part of its growing period.

Gyronet SR

Irrigation of tree plantations, vineyards, and orchards where the ground is shaded by the foliage, leaving dry strips between the rows.

Gyronet SRD

The stream deflector concentrates all the water in the area surrounding the young tree during the first part of its growing period.

Technical Specifications
Datos Tecnicos

Send to a Friend Printable Version

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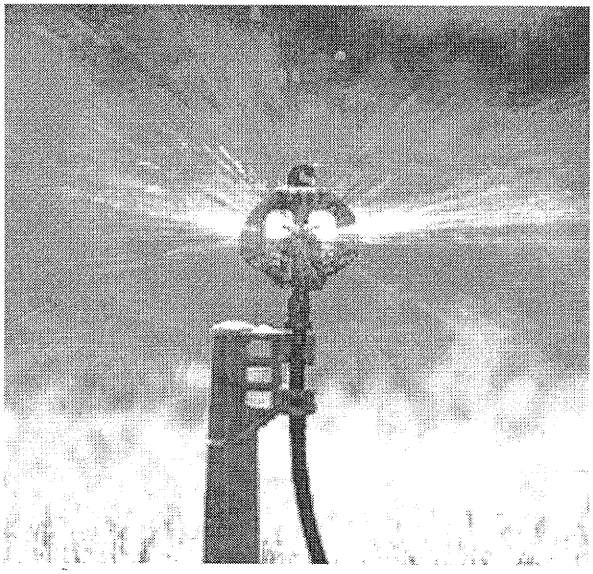
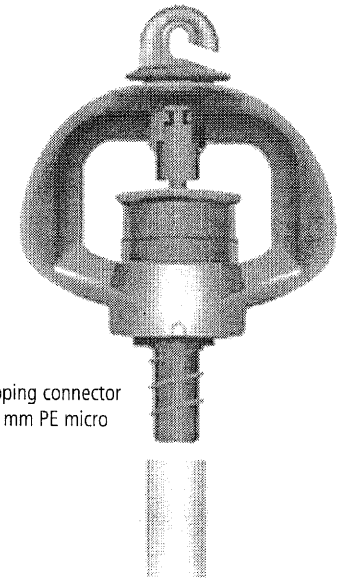
GyroNet®

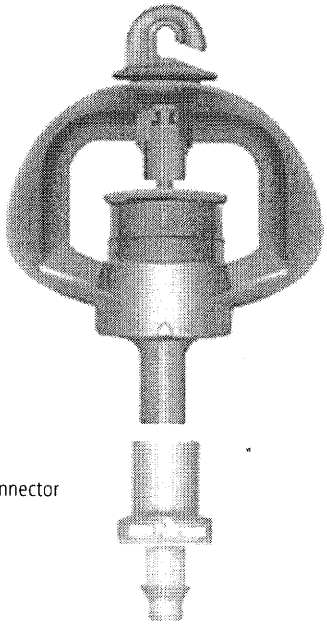
Low to medium flow rate micro-sprinkler

- Precision irrigation
- Precision fertigation
- Frost protection, cooling and chemical treatment
- Anti-insect swivel





Self tapping connector for Ø 4 mm PE micro tube



Press fit male co

Barb connector

MICRO SPRINKLERS

NETAFIM™

PERFORMANCE DATA

GyroNet LR + LRD + HF

Model	Color code	Size nozzle Ø (mm)	Pressure (bar)	Flow rate (l/h)	Wet Ø *(m) LR swivel	Wet Ø *(m) LRD swivel	Wet Ø color LR swivel	Wet Ø ***(m) HF swivel	Swivel code color HF swivel
			1.5	26					
027	Brown	0.75	2.0	29	5.0	0.7	purple	NR	NR
			3.0	36					
			1.5	38					
040	Blue	0.90	2.0	44	6.0	0.7	purple	NR	NR
			3.0	54					
			1.5	51					
058	Gray	1.10	2.0	59	7.5	0.7	black	6.5	NR
			3.0	72					
			1.5	68					
070	Black	1.20	2.0	78	7.5	1.0	black	6.5	NR
			3.0	96					
			1.5	90					
090	Orange	1.40	2.0	104	8.5	1.0	black	7.5	NR
			3.0	128					
			1.5	116					
120	Red	1.57	2.0	134	8.5	NR	black	8.0	Gray
			3.0	165					
			1.5	132					
150	Sky blue	1.77	2.0	152	NR	NR	NR	9.5	Gray
			2.5	170					
			1.5	196					
200	Yellow	2.04	2.0	226	NR	NR	NR	10.0	Gray
			2.5	253					
			1.5	247					
250	Purple	2.28	2.0	285	NR	NR	NR	11.0	NR
			2.5	319					
			1.5	292					
300	Green	2.48	2.0	337	NR	NR	NR	11.5	NR
			2.5	377					

*20 cm above ground, ** 60 cm above ground, *** 100 cm above ground, **** Everspin bearing is recommended in flow rates exceeding 120 l/h.

GyroNet SR + SRD +SSR + UD

Model	Color code	Size nozzle Ø (mm)	Pressure (bar)	Flow rate (l/h)	Wet Ø *(m) SR swivel	Wet Ø *(m) SRD swivel	Swivel code color SR swivel	Wet Ø *(m) SSR swivel	Swivel code color SSR swivel	Wet Ø **(m) ****UD swivel	Swivel code color UD swivel
			1.5	26							
027	Brown	0.75	2.0	29	4.5	1.8	blue	1.8	Turquoise	NR	NR
			3.0	36							
			1.5	38							
040	Blue	0.9	2.0	44	4.5	1.8	blue	2.5	Turquoise	6.0	Green
			3.0	54							
			1.5	51							
058	Gray	1.1	2.0	59	5.5	1.8	blue	NR	Turquoise	6.5	Green
			3.0	72							
			1.5	68							
070	Black	1.2	2.0	78	5.5	1.8	blue	NR	Turquoise	7.0	Green
			3.0	96							
			1.5	90							
090	Orange	1.4	2.0	104	6.5	1.8	blue	NR	Turquoise	7.0	NR
			3.0	128							
			1.5	116							
120	Red	1.6	2.0	134	6.5	1.8	blue	NR	Turquoise	7.5	NR
			3.0	165							

*20 cm above ground, ** 60 cm above ground, *** 100 cm above ground.

GyroNet Jet

Model	Color code	Nozzle size	Pressure	Nominal flow rate	360°	300°	90°*2	180°	90°	Deflector color
					Wet Ø	Wet Ø	Wet Ø	Wet Ø	Wet Ø	
		(mm)	(bar)	(l/h)	*(m)	*(m)	*(m)	*(m)	*(m)	code
			1.0	31	3.6	4.0	1.8	2.4	-	
040	Blue	0.9	1.5	38	3.8	4.4	2.1	2.8	-	orange
			2.0	44	5.0	5.0	2.2	3.0	-	
			1.0	42	4.4	5.2	2.2	3.1	2.4	
058	Gray	1.1	1.5	51	5.6	5.6	2.4	3.5	2.7	orange
			2.0	59	6.4	6.4	2.8	4.2	3.1	
			1.0	55	5.4	5.6	2.3	2.8	2.4	
070	Black	1.2	1.5	68	6.2	6.4	2.7	4.0	2.9	orange
			2.0	78	7.0	7.2	3.0	4.2	3.2	
			1.0	73	6.0	6.0	2.6	4.0	2.8	
090	Orange	1.4	1.5	90	7.0	7.0	3.0	4.8	3.3	orange
			2.0	103	7.2	7.6	3.1	4.8	3.8	
			1.0	95	7.2	6.4	2.8	4.0	3.2	
120	Red	1.6	1.5	116	7.8	7.6	3.2	4.9	4.6	orange
			2.0	134	8.4	8.0	3.3	5.6	4.4	

cm above ground, ** 60 cm above ground, *** 100 cm above ground 20*

GyroNet LR + LRD + SR + SRD + UD

032 [ ] [ ] - [ ] - [ ] [ ] - [ ]

Inlet connector | Swivel | Flow | Stand * assembly | Connector to lateral pipe | Accessories

Ordering guide
03221-040-058
(this configuration)

Self tapping . 2
Press fit - male 5

Long range swivel.....1
Long range swivel w/ stream deflector.....2
Short range swivel 3
Short range swivel w/ stream deflector.....4
UD swivel 5
SSR super short swivel ..6

27 l/h.... 027
40 l/h.... 040
58 l/h.... 058
70 l/h.... 070
90 l/h.... 090
120 l/h.. 120

Male/barb (2 parts) to PE... 1
Male/3/8" conic (2 parts) to PVC 2
Connector barb/barb (1 part) to P.E. 8

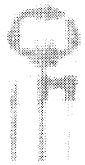
Stand w/o stake, 60 cm tube length..... 02
Stand w/ stake, 60 cm tube length..... 05
Stand w/o stake, 90 cm tube length..... 06
Stand w/ stake, 90 cm tube length..... 07

Everspin bearing . . . 6
Spring bearing 7
Stream splitter 8
U shape adapter . . . 9

GyroNet HF

032 [ ] [ ] - [ ] - [ ] [ ] - [ ]

Inlet connector | Swivel | Flow | Stand * assembly | Connector to lateral pipe | Accessories



Ordering guide
03221-040-058
(this configuration)

Press fit - male 5

Gray swivel.....7

150 ....l/h 150
200 ....l/h 200
250 ....l/h 250
300 ....l/h 300

Male/barb (2 parts) to PE 1
Male/3/8" conic (2 parts) to PVC 2

Stand w/o stake, 60 cm tube length . . 02
Stand w/o stake, 90 cm tube length . . 06
Stand w/o stake, 120 cm tube length . 10
Stand w/o stake, special tube length**08

Stream splitter . . 8
Everspin bearing . 9

* Standard tube: SPE 9*12
** Please, add required tube length in writing

GyroNet Jet deflector

360°, 12 jets	63520-005350
300°, 10 jets	63520-005360
2x90°, 8 jets	63520-005370
180°, 6 jets	63520-005380
90°, 4 jets	63520-005390

ORDERING GUIDE

SPARE PARTS

Description	Catalog number
GyroNet universal stake	63520-005900
Universal Stake 30 cm, blue	63000-009800
Universal Stake 30 cm, brown	63000-009850
Universal Stake 30 cm, black	63000-009750

Description	Catalog number
Steel stake only	
Ø 6mm, 60cm	65080-001000
Ø 6 mm, 100 cm	65080-001100
Ø 6 mm, 120 cm	65080-001200

Description	Catalog number
Stream splitter	63520-005800

Description	Catalog number
Frame	63520-005500

Description	Catalog number
Universal stand adapter Ø4.5 mm (black)	64020-002150
Universal stand adapter Ø6 mm (blue)	64020-002000
Universal stand adapter Ø8 mm (black)	64020-002100

Description	Catalog number
Adaptor field stand Gyronet HF Ø 8 mm stand	64020-002820

Description	Catalog number
Adaptor for Ø 6 mm rod	64020-002840

Description	Catalog number
Adaptor for tube collar 6/8 mm	64020-002800

Description	Catalog number
Adaptor for tube collar 9/12 mm	64020-002900

Description	Catalog number
Insert barb	64020-001700

Description	Catalog number
Supernet stand adapter Ø 6 mm	63520-005950

Description	Catalog number
U shape adaptor for hanged upright systems	63520-005990

Description	Catalog number
Upper bearing square hole for Gyronet models 027.	63520-005400
63520-005450 circular hole for all other models.	

Description	Catalog number
Spring upper bearing	63520-011500

Description	Catalog number
Everspin bearing with Sapphire stone for wear reduction	63520-011400

Description	Catalog number
Self tapping inlet connector + nozzle	
27 l/h	64020-000900
40 l/h	64020-001100
58 l/h	64020-001150
70 l/h	64020-001200
90 l/h	64020-001210
120 l/h	64020-001400

Description	Catalog number
Press fit (male) inlet connector + nozzle	
27 l/h	64020-000800
40 l/h	64020-001000
58 l/h	64020-001130
70 l/h	64020-001300
90 l/h	64020-001310
120 l/h	64020-001500
150 l/h	64020-001700
200 l/h	64020-001750
250 l/h	64020-001850
300 l/h	64020-001950

LR swivel
63520-005100
(purple) [1]

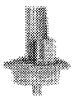
LRD swivel
63520-005160
(purple) [1]

LR swivel
63520-005000
(black) [2]

LRD swivel
63520-005150
(black) [2]

SR swivel
63520-005200
(blue) [2]

SRD swivel
63520-005300
(blue) [2]



UD swivel
63520-005180
(green) [2]

SSR swivel
63520-005320
(green) [2]

HF swivel
63520-005120 (gray) [2]

[1] to use with model: 027

[2] to use with all other models

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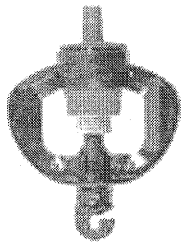
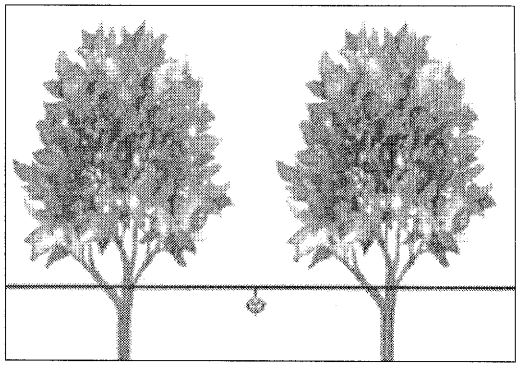
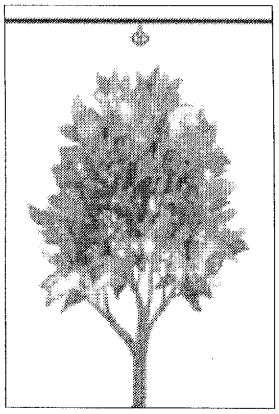
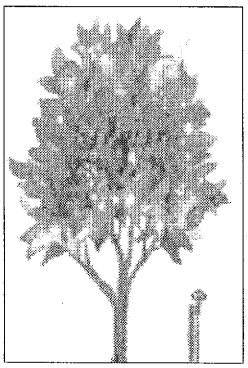
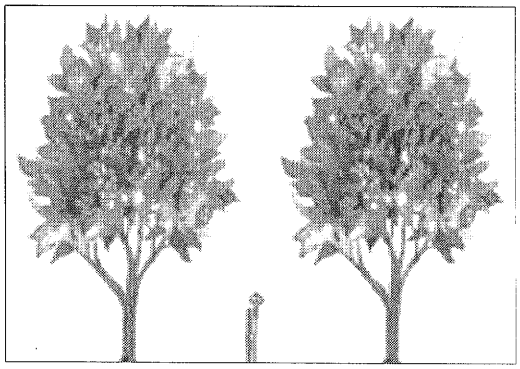




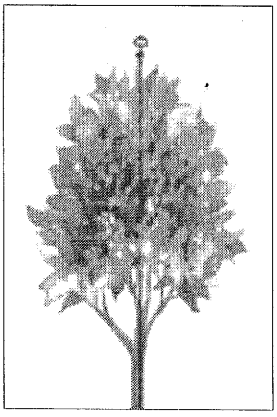




Under tree irrigation, Fertigation, Chemigation, cooling and frost protection with all flow rates and all sviwels.
Single sprinkler per tree.



Upright under tree irrigation, Fertigation, Chemigation, cooling and frost protection with all flow rates and all sviwels. For upside down a minimum of 30 l/h with SR or UD green swivel is required. Full coverage.



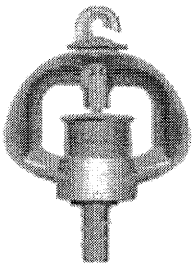
Upright ,over tree irrigation, Fertigation, Chemigation, cooling and frost protection with all flow rates and all sviwels. For upside down a minimum of 30 l/h with SR or UD green swivel is required.

MiningNet (Minimum order quantity required)

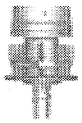
Irrigation system for mining. Made of special plastic materials to withstand acid water.

Working pressure: 1.0-2.5 bar

Description	Catalog number
MiningNet 120 l/h, self tapping inlet conn., head only	64000-050000
MiningNet 150 l/h, self tapping inlet conn., head only	64000-053500
MiningNet 200 l/h, self tapping inlet conn., head only	64000-055500
MiningNet 250 l/h, self tapping inlet conn., head only	64000-057500

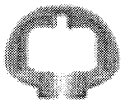


Description	Catalog number
Upper bearing	63520-005455



Description	Catalog number
MiningNet nozzle	
120 l/h	64020-001550
150 l/h	64020-001720
200 l/h	64020-001770
250 l/h	64020-001870

Description	Catalog number
Swivel (gray)	63520-005120



Description	Catalog number
Frame	63520-005500

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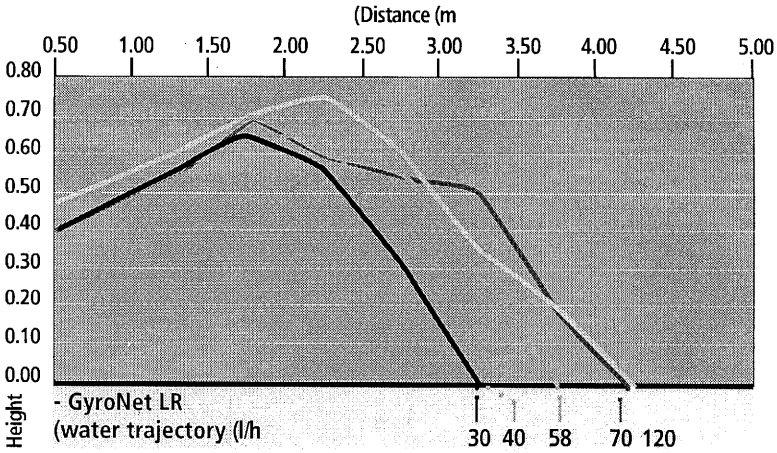
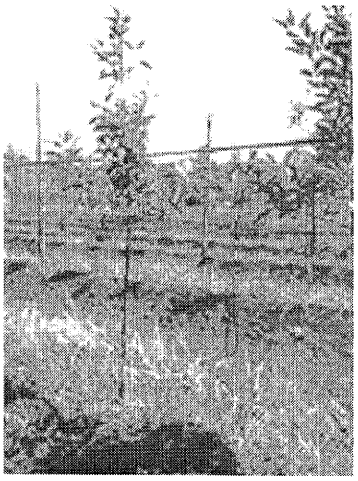
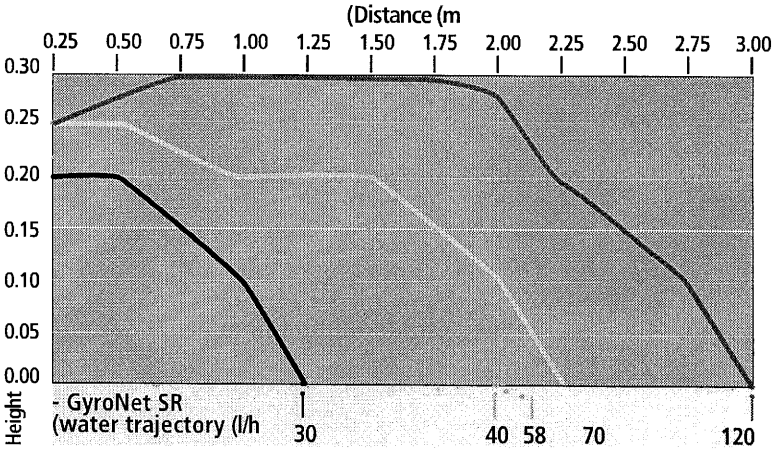
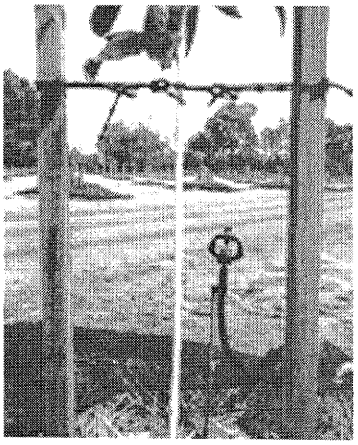








GyroNet HF distribution uniformities

Swivel rotor	Nozzle	Sprinklers position	Pressure (bar)	Distance between sprinklers (m)	Distance between lines (m)	CU (%)	(SC (5%	Precipitation (mm/hr)
Gray HF	Sky Blue	Rectangular	1.50	5.20	5.20	90%	1.1	5.70
Gray HF	Sky Blue	Triangle	1.50	4.20	5.20	91%	1.1	7.00
Gray HF	Sky Blue	Triangle	1.50	4.60	5.20	91%	1.1	6.40
Gray HF	Sky Blue	Triangle	1.50	4.80	5.20	91%	1.1	6.20
Gray HF	Sky Blue	Triangle	1.50	5.80	5.20	90%	1.1	5.10
Gray HF	Sky Blue	Triangle	1.50	4.20	5.40	90%	1.1	6.80
Gray HF	Sky Blue	Triangle	1.50	4.60	5.40	90%	1.1	6.20
Gray HF	Sky Blue	Triangle	1.50	4.80	5.40	90%	1.1	5.90
Gray HF	Yellow	Rectangular	2.00	6.00	5.40	91%	1.1	7.40
Gray HF	Yellow	Rectangular	2.00	6.00	5.60	92%	1.1	7.20
Gray HF	Yellow	Rectangular	2.00	5.40	5.80	92%	1.1	7.70
Gray HF	Yellow	Rectangular	2.00	6.00	5.80	91%	1.1	6.90
Gray HF	Yellow	Rectangular	2.00	5.40	6.00	91%	1.1	7.40
Gray HF	Yellow	Rectangular	2.00	5.60	6.00	92%	1.1	7.20
Gray HF	Yellow	Rectangular	2.00	6.00	6.00	91%	1.1	6.70
Gray HF	Yellow	Triangle	2.00	5.80	5.40	92%	1.1	7.70
Gray HF	Yellow	Triangle	2.00	6.00	5.40	91%	1.1	7.40
Gray HF	Yellow	Triangle	2.00	5.80	5.60	91%	1.1	7.40
Gray HF	Yellow	Triangle	2.00	6.00	5.60	91%	1.1	7.20
Gray HF	Purple	Rectangular	1.50	5.60	5.60	89%	1.1	7.70
Gray HF	Purple	Rectangular	1.50	5.60	5.80	90%	1.1	7.40
Gray HF	Purple	Rectangular	1.50	5.80	5.80	90%	1.1	7.10

Note: All tests are at 1 m high in laboratory conditions and with winspace single grid

01-0406-SPR-PS-0602-EN

February 2007 Updates

Telemetry System, Well Points, Fresh Water Injection Sand Filter, and Sprinkler System Controllers

Telemetry System Equipment

CR1000

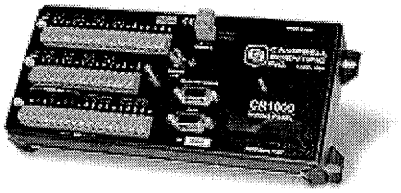
Datalogger for Measurement and Control

The CR1000 datalogger builds on the foundation of our CR10 and CR10X dataloggers. The CR1000 retains the versatility of the earlier loggers with a detachable wiring panel, separate power supply, and optional keyboard display. It features increased memory, more measurement channels, and an RS-232 port for communication than previous dataloggers in this series.

Add to Quick Quote

When used as part of a data acquisition system, the CR1000 datalogger provides the measurement and control functions. A complete system would include a power supply, weatherproof enclosure, sensors, programming/communications software, and communications peripherals.

Features



- Designed for unattended network applications
- Consists of a measurement and control module and the CR1000WP, a detachable wiring panel
- 2 M SRAM for data storage, program storage and CPU usage
- Memory upgrades available for 4 M SRAM
- Additional data storage using CFM100 Module with a CompactFlash® card
- Data stored in table format
- Operating system: PakBus®
- Software support offered in LoggerNet 3.x, PC400 1.2, or ShortCut 2.2
- Detachable keyboard/display, the CR1000KD, can be carried to multiple stations

Specifications

- Analog inputs: 16 single-ended or 8 differential, individually configured
- Pulse counters: 2
- Switched voltage excitations: 3
- Control/digital ports: 8
- RS-232 port: 1
- CS I/O port: 1
- Scan rate: 100 Hz
- Burst mode: 1500 Hz
- Analog volt. resolution: to 0.33 uV
- A/D bits: 13
- Programming: CRBasic
- Data Storage: Table
- Telecommunications: PakBus

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PakBus Guide

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Related Products

CR1000KD Keyboard/Displa...

PS100 12 Vdc Power Suppl...

BPALK 12 V Alkaline Batt...

NL115 Ethernet Interface...

CFM100 CompactFlash Modu...

Events

CR1000/LoggerNet Training
March 5-8, 2007

Related Systems

RAWS-F Remote Automated W...

Custom Weather Station

Eddy Covariance Measure w...

CS110 Electric Field Meter

TGA100A Trace Gas Analyze...

ET107 Evapotranspiration ...

more

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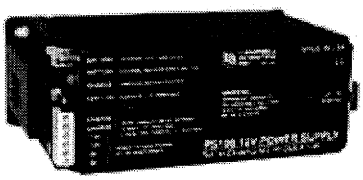
PS100

12 Vdc Power Supply with Rechargeable Battery

The PS100 provides a 12 Vdc, 7.0 Ahr rechargeable power supply for the CR500, CR510, CR800, CR850, CR10, CR10X, or CR1000 dataloggers and peripherals. The rechargeable battery can be trickle-charged from ac power (requires optional wall charger) or from an external solar panel. The user can add an external rechargeable battery.

Add to Quick Quote

Features



- Powers our CR500, CR510, CR800, CR850, CR10, CR10X, and CR1000
- Provides a nominal rating of 7.0 Ahrs
- Includes charging regulator and sealed rechargeable battery
- Can be float-charged by ac power or solar panel
- Compatible with the A100 Null Modem Adapter and A105 12 Volt Terminal Adapter; contact one of our Applications Engineers to determine appropriate combinations

Specifications

- Weight: 6.9 lbs (3.1 kg)
- Battery Only: 5.9 lbs (2.7 kg)
- Dimensions (including mounts and connectors): 4.1" x 7.5" x 2.76" (10.5 x 19.0 x 7.0 cm)

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Related Products

A100 Null Modem Adapter ...

A105 12 V Terminals Adap...

CR1000 Datalogger for Me...

CR800 Datalogger

CR850 Datalogger

CR10X Datalogger for Mea...

CR510 Basic Datalogger

Related Systems

Custom Weather Station

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SP10

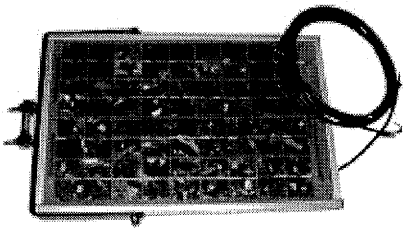
10-Watt Solar Panel

The SP10 is one of our most popular solar panels. It is typically a sufficient charging source for most of our system configurations at most tropical to temperate latitudes.

Add to Quick Quote

Features

- Replaces our MSX10 Solar Panel
- Connects to the PS100, CH100, PS12LA, PS512M, or the battery base of a CR23X, CR3000, CR5000, 21XL, CR7, or CR9000X
- Provides a 10 W typical peak power and 9 W guaranteed minimum power



Specifications

- Current at peak: 0.59 A
- Voltage at peak: 16.8 V
- Weight: 3.3 lbs (1.5 kg)
- Dimensions: 17" x 11" x 1" (42 x 26.9 x 2.3 cm)

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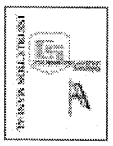

Manual

Application Note

Related Systems

Custom Weather Station

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Interval Timer

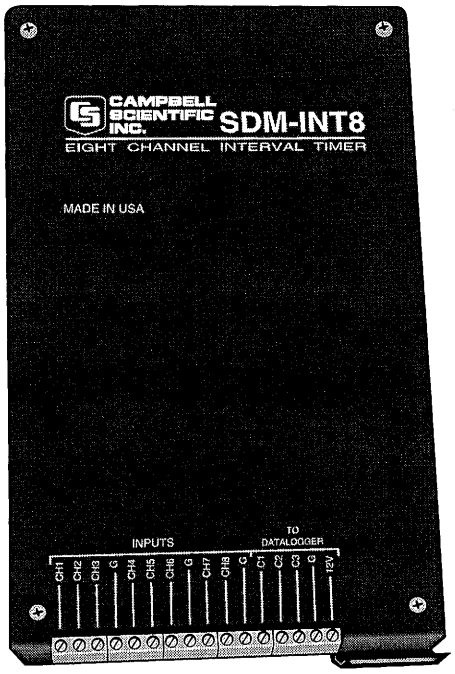
Model SDM-INT8

The SDM-INT8 is an eight-channel interval timer that outputs processed timing data to a CR10X, CR800, CR1000, CR3000, CR5000, CR7, or CR9000X datalogger. Input channels are programmed to record the timing of input voltage transitions (events). The SDM-INT8 outputs period, pulse width, frequency, counts, or time intervals. Processing by the datalogger or a computer yields RPM, duty cycle, velocity, crank angle, etc.

The SDM-INT8 is programmed by the datalogger but functions independently. This allows the SDM-INT8 to make measurements and process data while the datalogger performs other tasks. Multiple SDM-INT8s, each with a unique address, may be controlled by one datalogger.

SDM-INT8 measurement capabilities include:

- Period (ms)
- Frequency (kHz)
- Elapsed time between events on adjacent channels
- Number of counts measured on channel 2 between a "start" event on channel 1 and a "stop" event on any other channel
- Elapsed time between events on channel 1 and any other channel
- Pulse Counting (any channel can function as a pulse counter)



Typical Applications:

- Ignition and fuel injection timing
- Velocity/elapsed time between two points
- Wind speed measurements (ac generator type)
- Cold crank engine testing
- Independent wheel speed measurements for anti-lock brake testing

Features:

- Internal microprocessor allows measurement independent of datalogger's execution interval.
- Captures timing events with ±1 microsecond resolution over a maximum range of 16.7 seconds.
- Programmable output options record results as:
  - Execution interval averages
  - Continuous averages
  - Specified interval averages
  - Capture all events

SPECIFICATIONS

- Operating voltage: 9.6 V to 16 Vdc
- Current drain: 13 to 20 mA, active; 400 μA, quiescent
- Operating temperature range: -25° to +50°C
- Size and weight: 8" x 5" x 1"; 1.8 lbs. (20.3 x 12.7 x 2.5 cm; 0.82 kg)
- Resolution: ±1 microsecond
- Maximum timing measurement: 16.7 seconds

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SPECIFICATIONS (continued)

INPUT VOLTAGE OPTIONS

(Each channel may be programmed independently)

High Level Voltage Input Pulses:

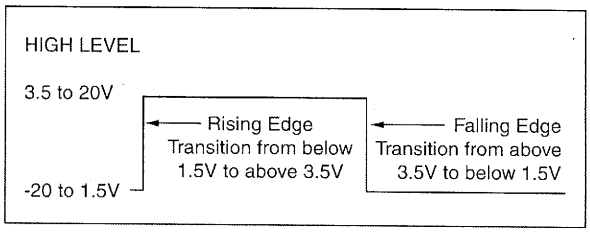
-Minimum pulse width: 2 microseconds

-Signal edges:

rising: transition from <1.5 to >3.5 V
falling: transition from >3.5 to <1.5 V
maximum input voltage: ±20 Vdc

-Maximum frequency:

high resolution (32-bit) values, assumes all eight channels in use
5.1 kHz when using Averaging Options
10 kHz when Capturing All Events
low resolution (16-bit) values (Execution Interval Averaging only)
Maximum frequency increases depending on the number of channels programmed.



No. of Channels	Max Freq. (kHz)
1	42.5
2	17.5
3	11.0
4	8.6
5	5.2
6	4.8
7	4.5
8	4.28

Low Level AC Voltage Input:

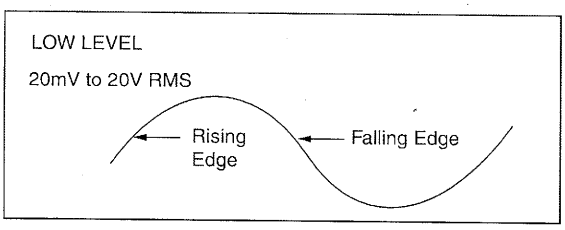
-Minimum ac voltage: 20 mV RMS

-Input Hysteresis: 11 mV

-Maximum ac voltage: 20 V RMS

-Minimum frequency: 1 Hz

-Maximum frequency:



Minimum ac voltage RMS	Max Freq. (Hz)
20 mV	100
50 mV	400
150 mV	1000
2.5 V - 20 V	4000

Cautionary Note: Total cable length connecting all SDM devices cannot exceed 20 feet (6 m).

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Printed June 2006

AM16/32A

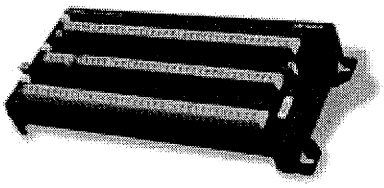
16-channel or 32-channel Relay Multiplexer

Add to Quick Quote

The AM16/32A multiplexer allow our dataloggers to measure more sensors. The number of analog inputs is increased by sequentially multiplexing sensor leads into "common" leads. The individual common leads are connected to datalogger analog inputs, excitation channels, or ground as required by the sensor. The datalogger controls the multiplexer using two control ports or one control port and one excitation channel.

Compatible dataloggers include our CR10X, CR1000, CR800, CR850, CR3000, CR5000, and CR7. Please note that the AM16/32A is not compatible with our CR200-series, CR500, or CR510 dataloggers.

Features



- Multiplexes up to 32 single-ended or differential two-wire sensors at a time
- Alternately, multiplexes up to 16 single-ended or differential four-wire sensors at a time
- Supports thermistors, potentiometers, load cells, strain gages, vibrating wire sensors, soil moisture sensors, etc.
- Conforms to EN55022-1:1995 and EN50082-1:1992
- MUXPOWER-L and MUXSIGNAL-L cables available to interface with datalogger

Specifications

- Power: 9.6 to 16 Vdc (under load), unregulated
- Current drain: <210 microamps quiescent; 6 mA active (typical)
- Maximum actuation time for relay: 20 ms
- Maximum switching current: 500 mA. Switching currents greater than 30 mA (occasional 50 mA acceptable) degrade the suitability of that channel for switching low-voltage signals.

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Related Products

CR10X Datalogger for Mea...

CR1000 Datalogger for Me...

CR3000 Micrologger®

CR5000 Datalogger for Me...

ENC10/12 Enclosure Series

ENC16/18 Enclosure Series

Product in Action

Saco, MT: Bridge Deck Per...

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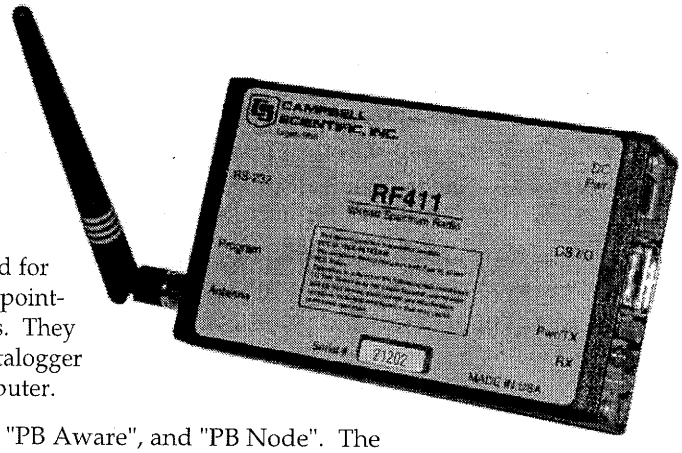
Spread Spectrum Radio Modems

Models RF401, RF411, RF416

Spread spectrum radios spread the normally narrow-band information signal over a relatively wide band of frequencies. This allows the communications to be more immune to noise and interference from RF sources such as pagers, cellular phones and multipath.[1] The RF401, RF411, and RF416 radios reduce susceptibility to RF interference from other spread spectrum devices by providing user-selectable frequency hopping patterns.



The RF401-series spread spectrum radio modems can be used for general purpose wireless data communications and support point-to-point and point-to-multipoint datalogger communications. They can serve as a field modem/radio while connected to the datalogger or as a base station modem/radio when connected to a computer.

The modems have three protocol settings: "Transparent", "PB Aware", and "PB Node". The "PB Aware" and "PB Node" protocols are intended for PAKBUS® networks. The radio must be set to the "Transparent" protocol if it will be used in a network containing an RF400, RF410, or RF415 radio[2].

Features

- Individual FCC license not required[3]
- Up to one mile transmission range when using inexpensive omnidirectional antennas (shown). Up to 10 mile transmission range when using higher gain directional antennas at ideal conditions (please note that line-of-sight obstructions and RF interference will affect transmission distance)
- 25-channel frequency-hopping radio
- Built-in simplified and advanced setup menus for configuring port modes, network/radio addresses, protocol, hop table, and power saving modes; settings stored in non-volatile memory
- Setup that allows different addresses for multiple dataloggers in a point-to-multipoint network (call about repeater capability)
- Reduced power consumption by the datalogger, as the radios perform "packet address filtering"
- Greater immunity to interference and RF collisions (by using RF retries)
- Ability to have standalone RF router/repeaters (up to 8 repeaters)
- Faster communication due to elimination of some of the small "link state packets"
- Automatic selection of the best RF path when there is a marginal RF link in parallel with a good RF path (based on RF signal strength)

---

1. *The operating frequency band of these radio modems may be shared with other non-licensed services such as cordless telephones and with licensed services including emergency, broadcast, and air-traffic control.*
2. *The RF400, RF410, and RF415 were retired in May 2005.*
3. *RF401-series modems, like all FCC Part 15 devices, are not allowed to cause harmful interference to licensed radio communications and must accept any interference that they receive. Most Campbell Scientific users operate in open or remote locations where interference is unlikely. If there is a problem, interference can be reduced using methods such as moving the device, reorienting or using a different type of antenna, or adding RF shielding. We recommend the use of licensed UHF or VHF narrowband frequencies for critical communication links.*

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Radios

RF401	900 MHz Spread Spectrum Radio/Modem (US/Canada) w/standard temperature range (-25° to +50°C)
-XT	Extended temperature testing (-55° to +85°C)
RF411	922 MHz Spread Spectrum Radio/Modem (Australia/Israel) w/standard temperature range (-25° to +50°C)
-XT	Extended temperature testing (-55° to +85°C)
RF416	2.4 GHz Spread Spectrum Radio/Modem (Worldwide) w/temperature range of -25° to +50°C

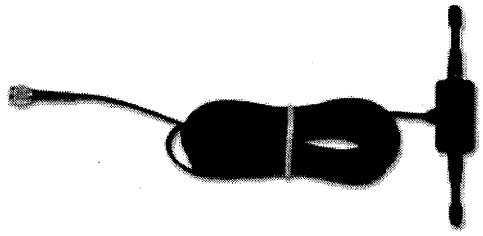
Antennas and Antenna Accessories

Omnidirectional antennas are normally used at the base station and nearby stations. Yagi antennas are needed at distant stations or other special cases. Call one of our Applications Engineers for help in choosing an antenna. Only the following FCC approved antennas can be used.

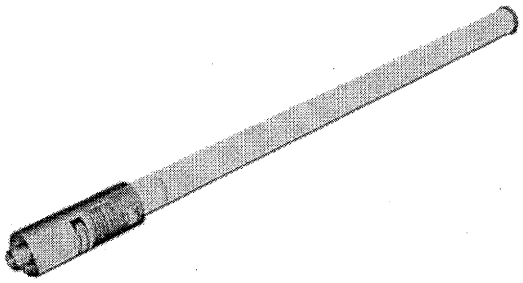
RF401 and RF411 (900 MHz) Antennas

Indoor

14310	0 dBd, omnidirectional ¼ wave whip, straight 3.2". RPSMA connector connects directly to the radio; no antenna cable is needed.
14204	0 dBd, omnidirectional ½ wave whip, jointed, adjustable from 0° to 90°. RPSMA connector connects directly to the radio; no antenna cable is needed.
15970	1 dBd, dipole, window/wall mount. Supplied with a 10-foot RG-174 cable with an RPSMA connector that connects to the radio.
15730	0 dBd, omnidirectional ¼ wave whip, right angle, adjustable from 0° to 90°. RPSMA connector connects directly to the radio; no antenna is cable needed.
15731	0 dBd, omnidirectional ¼ wave whip, straight, 3". RPSMA connector connects directly to the radio; no antenna cable is needed.



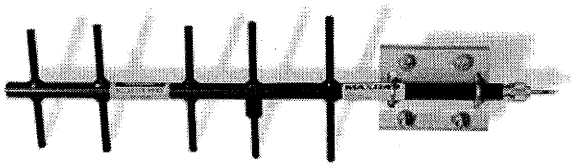
The 15970 has adhesive backing to allow it to adhere to a wall, rear-view mirror, or other suitable flat non-conductive surface.



The 14203 is suitable for base station use where it needs to communicate with multiple stations located in different directions.

Outdoor, Omnidirectional

14203	3 dBd with cable clamp mounts. Has a Type N female connector; requires an antenna cable to connect to the radio.
14221	3 dBd with rugged FM2 antenna mounts. Has a Type N female connector; requires an antenna cable to connect to the radio.



The 14201 Yagi antenna is intended for longer transmission distances.

Outdoor, Yagi

14201	9 dBd, with mounts. Has a Type N female connector; requires an antenna cable to connect to the radio.

RF416 (2.4 GHz) Antennas

Indoor, Omnidirectional

16005	0 dBd, ½ wave whip articulating. An RPSMA connector connects directly to the radio; no antenna cable is needed.

The 16005 antenna has an articulating knuckle joint that can be oriented vertically or at right angles.

Outdoor, Yagi

16755	13 dBd with mounts. Has a Type N female connector; requires an antenna cable to connect to the radio.

For the 16755 Yagi antenna, the primary and secondary elements are enclosed in a white cylinder.

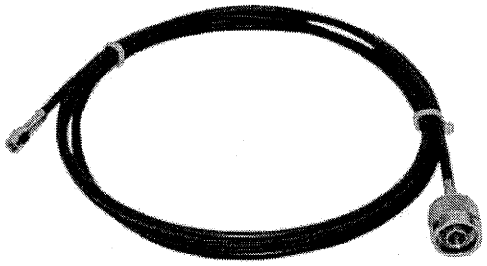
Antenna Cables and Surge Protectors for Outdoor Antennas

Recommended for cable lengths <10 ft

COAXRPSMA-L	Low-loss RG58 antenna cable with reverse polarity, SMA connector and type N male connector. Specify length, in feet, after the L.

Recommended for cable lengths greater than 10 ft and/or use with lightning protection

COAXNTN-L	Low-loss RG8 antenna cable with type N male to type N male connectors (requires 14462 or 16982). Specify length, in feet, after the L.
14462	Antenna surge protector kit for 900 MHz radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.
16982	Antenna surge protector kit for 2.4 GHz radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.

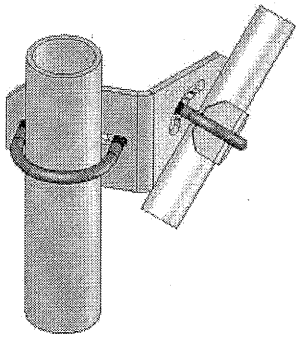


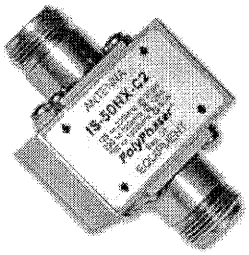
The purchase of an antenna cable (COAXRPSMA-L shown) is required for our outdoor antennas.

Additional Accessories

14291	Optional power cable
CM230	Adjustable Angle Mounting Kit for our outdoor antennas
14162	Mounting bracket kit that attaches the radio to the backplate of an environmental enclosure.
15966	Wall charger for base station radio

When using the CM230, fix the declination of the antenna by tightening the u-bolt that mounts on the mast. The inclination is then adjusted with the other set of u-bolts and nuts.





The surge protectors help protect the radios from electrical transients conducted through the antenna cable.

Specifications

Operating Frequency:	910 to 918 MHz RF401, 920 to 928 MHz RF411, 2.450 to 2.460 GHz RF416
Type:	Frequency Hopping Spread Spectrum (FHSS) Transceiver
I/O Data Rate:	9600 bps
Channel Capacity:	65,000 Network Identifiers share 25 hop channels
Frequency Hopping Patterns:	Six different selectable patterns
Frequency Control:	Direct FM
Receiver Sensitivity:	-110 dBm (-104 dBm RF416) at 10^{-4} bit error rate (Campbell Scientific protocols will issue retries wherever a bit error occurs)
Interference Rejection:	70 dB at pager and cellular phone frequencies
Transmitter Power Output:	100 mW nominal (RF401, RF411) 60 mW nominal (RF416)
Antenna Connector:	Reverse polarity SMA
FCC ID:	OUR9XTREAM (RF401, RF411) OUR-24XSTREAM (RF416)
Operating Temperature Range:	-25° to +50°C standard (-55° to +85°C extended option for RF401, RF411 only; please note that the push button that allows customers to check/edit programmable settings while the radio is connected to a computer may not operate at temperatures colder than -25°C)
Dimensions:	4.75 x 2.75 x 1.3 inches (12.1 cm x 7.0 cm x 3.3 cm)
Power:	9 to 16 Vdc
Average Current Drain:	<1 mA stand-by (assuming power-saving options used), 24 mA while receiving, <75 mA while transmitting (RF401, RF411) 36 mA while receiving, 75 mA while transmitting (RF416)
LEDs:	Power on, TX, RX, diagnostics
CS I/O Connector:	9-pin "D" Male for all needed communications lines. Newer loggers provide power to the radio on this connector. Older loggers may require optional power cable #14291*
RS-232 Connector:	9-pin "D" Female for TX, RX, CTS, ground RS-232 levels
Power Connector:	Barrel connector, center positive 12 V for use in base station configuration or with older dataloggers (newer loggers provide power to the radio on the CS I/O connector)
Compatible Devices:	21X(L), CR10(X)*, CR800, CR1000, CR200-series, CR23X, CR3000, CR510, CR7, CR5000, CR500, RAD Modem, and COM200/COM210 (with A100/PS100 at a nondatalogger site). If the protocol is set to "Transparent", the RF401, RF411, and RF416 are compatible with the retired RF400, RF410, and RF415, respectively.

**Older wiring panels (CR10 silver or CR10 black with gray terminal strips) will require optional power cable #14291.*

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In-Situ Inc.

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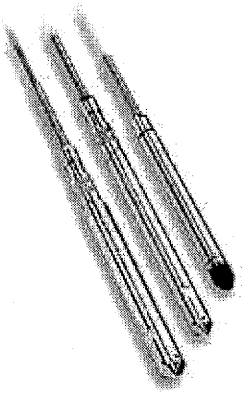

PXD Transducers

For measuring pressure/water level, the In-Situ® PXD-261 pressure transducer combines the benefits of durability, accuracy, compactness, and convenience.

- Durable: all stainless steel construction; 2X overpressure rating
- Accurate: 0.05% of full scale. Calibrated to NIST standards
- Compact: 0.86 inch (22 mm) diameter, 8.5 inches (216 mm) long. Easily fits down a 1" well
- Convenient: No field calibration required. Quick-Connect cable up to 4,500 feet without loss of accuracy. Absolute or gauged pressure measurement. 7 pressure ranges

Key Features

- Excellent thermal stability and overpressure rating
- Quick-Connect cable system
- 316 stainless steel construction
- Detailed calibration documentation included
- 4-20 mA output
- Available in seven pressure ranges from 10 PSIA/PSIG (23 ft, 7 m) to 250 PSIA/PSIG (577 ft, 176 m)
- Cable for PSIG models is vented to the atmosphere to compensate for fluctuations in barometric pressure; cable for PSIA transducers is non-vented
- 1/4" NPT threads for piping installations
- Full one year warranty

Product Details

How to Order

Brochure

Specifications

PXD-461

Designed for high-pressure applications, the PXD-461 is available in 500 PSIA and 1000 PSIA models. It provides excellent accuracy and reliability for monitoring deep wells, wells with high shut-in pressure, or high pressure piping. Only 0.7 inch (18 mm) in diameter, the PXD-461 has a 1.5X overpressure rating

- The PXD-461 has all the quality features of the PXD-261:
- Quick-Connect cable system, non-vented
- 316 stainless steel construction
- NIST-traceable calibration; calibration documentation included
- 4-20 mA output
- □} 0.05% full scale accuracy
- Excellent thermal stability
- 1/4" NPT threads

Applications

- High pressure piping monitoring
- Industrial and municipal monitoring
- Aquifer characterization
- Regulatory monitoring
- Packer installations
- Surge tank monitoring
- Marine and reservoir monitoring

PTX-1830

The PTX-1830 is manufacturered by Druck, Inc. A mere 0.69 inch in diameter (17.5 mm), weighing just 4 oz, the PTX-1830 is available in various ranges. 4-20 mA output, titanium/316 stainless steel construction.

Specifications	PXD-261	PXD-461	PTX-1830
Operating principle	Stainless-encased integrated silicon strain gauge bridge	Stainless-encased integrated silicon strain gauge bridge	Titanium-encased silicon strain gauge bridge
Wetted materials	316L stainless steel, Viton®	316 stainless steel, Viton®	Titanium, 316 stainless steel, acetal
Dimensions	8.5 inches (21.6 cm) long 0.86 inches (2.2 cm) diameter	8.5 inches (21.6 cm) long 0.7 inches (1.78 cm) diameter	7.86 inches (20.0 cm) long 0.69 inches (1.75 cm) diameter
Weight	1 lb. (0.45 kg)	0.5 lb. (0.22 kg)	0.26 lb. (0.12 kg)
Signal current	4-20 mA	4-20 mA	4-20 mA
Min. warmup time	50 milliseconds	50 milliseconds	50 milliseconds
Ranges	10 PSI (23 ft. water, 7 m.) 15 PSI (35 ft. water, 11 m.) 20 PSI (46 ft. water, 14 m.) 30 PSI (69 ft. water, 21 m.) 50 PSI (115 ft. water, 35 m.) 100 PSI (231 ft. water, 70 m.) 250 PSI (577 ft. water, 176 m.)	500 PSIA (1153 ft. water, 352 m.) 1000 PSIA (2307 ft. water, 703 m.)	5 PSI (11.5 ft. water, 3.5 m.) 10 PSI (23 ft. water, 7 m.) 15 PSI (35 ft. water, 11 m.) 30 PSI (69 ft. water, 21 m.) 50 PSI (115 ft. water, 35 m.) 100 PSI (231 ft. water, 70 m.) (contact In-Situ® for other ranges)
Accuracy	+/- 0.05% full scale at 15C (59F)	+/- 0.04% full scale at 15C (59F)	+/- 0.1% full scale at 15C (59F)
Pressure rating	2X full scale	1.5X full scale	2X full scale
Operating temperature	5 to 30C (41 to 86F)	5 to 30C (41 to 86F)	-20 to 60C (-4 to 140F) compensated: -2 to 30C (28 to 85F)
Quick-Connect cable	Yes	Yes	No

Contact Us

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Well Points

Drive-Point Piezometer

Previous | 1 | 2 | 3 | 4 |

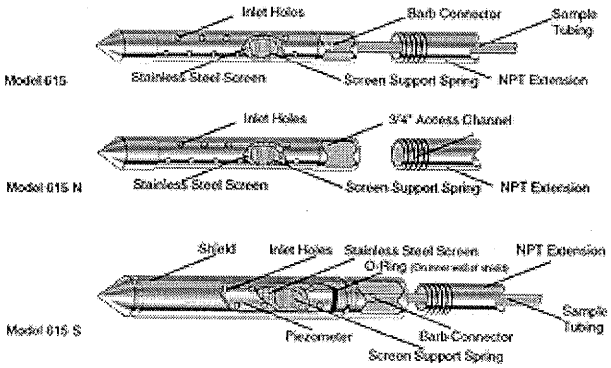
Model 615 Drive-Point Piezometers

| Quote | Drive-Point Piezometers | Standpipe Piezometers |

Hydraulic Head

Water levels can be measured in any of the drive-points described, using a Solinst Model 102, or the Narrow Tape Solinst Model 101 Water Level Meter for the most accurate hydraulic head measurements.

It is possible to conduct falling or rising head tests much more rapidly in narrow diameter tubes than in conventional 2" (50 mm) wells.



Couplings

Heavy duty couplings are available for the Model 615 Drive-Point Piezometers. The reinforced shoulder gives added support to the pipe threads, to withstand driving stresses and to give more accura te alignment. The maximum OD is 1.5" (38 mm).

Vibrating Power Hammer

615 Piezometers can be installed using a variety of vibrating 'rock breaker' type hammers.

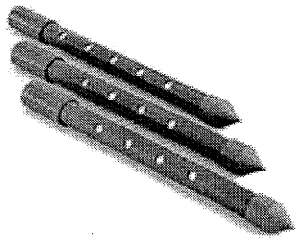
A two piece drive head assembly has a hardened steel adaptor to suit the threads of the drive pipe used. The drive head is sized to suit standard bit sizes, 1-1/8" and 7/8" (28mm and 22 mm) and has a tubing by-pass slot in the side.

The Drive Head Assembly can be reused installation after installation.

Depth Limitations

Drive-point piezometers are not suitable for all sites. The depth limitations vary, especially with soil conditions and the drive technology used.

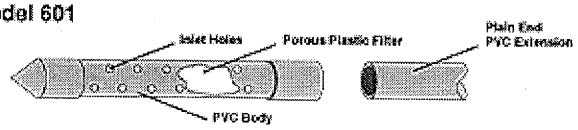
Standpipe Piezometers



The Solinst Standpipe Piezometer, Model 601 is the least expensive of the drive-point line, and is designed to be placed within an open hole. The pointed PVC tip is suitable for pushing into very loose sands at the base of a borehole, or for backfilling in place within test pits.

The piezometer uses a porous plastic filter set inside a perforated PVC body, which connects to the surface with 3/4" ID PVC riser pipe connected with slip couplings. The piezometer tips come in a variety of lengths.

Model 601



The Model 601 is suited to:

- water level monitoring
- permeability measurement
- construction control
- de-watering/drainage operations
- slope stability investigations
- metals monitoring

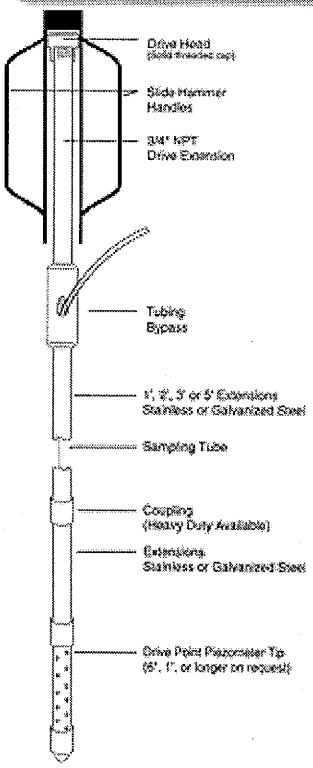
Drive-Point Piezometer

Previous | 1 | 2 | 3 | 4 | Next

Model 615 Drive-Point Piezometers

| Quote | Drive-Point Piezometers | Standpipe Piezometers |

Manual Slide Hammer



For the most inexpensive wellpoint installations, the Manual Slide Hammer can be used to install the Solinst Drive-Point Piezometers without the need for any expensive equipment on site. The slide hammer and all other equipment can easily be transported in a car or truck to most sites.

A heavy duty drive head is used, on which the slide hammer impacts, and a tubing by-pass ensures that the tubing does not get damaged during installation.

A vibrating power hammer can also be used for installation of drive-points.

Applications

Model 615 Drive-Points are suitable for the following uses:

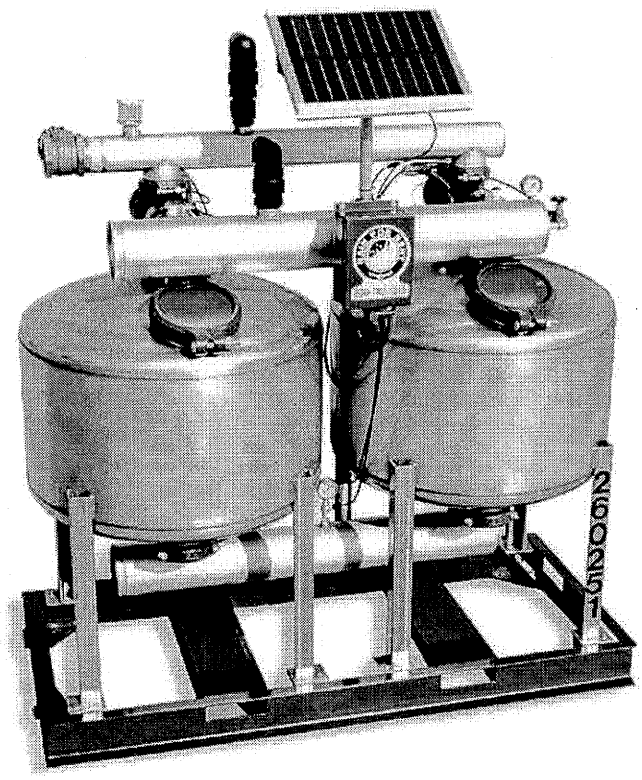
- groundwater sampling, including VOCs
- water level monitoring
- contaminant plume delineations
- sparge points
- soil gas sampling
- UST monitoring
- low cost and minimal disturbance site assessment

High Quality Groundwater & Surface Water Instrumentation

Fresh Water Injection Sand Filter

SAND MEDIA FILTRATION

36-2 SSK



- Up to **284** GPM
- 100 PSI Max

FEATURES

- Filter tank are constructed out of 304 stainless steel
- Skid is constructed out of galvanized carbon steel with integral forklift slots.
- Stainless steel inlet, outlet and backwash manifolds
- Corrosion resistant
- AC and DC powered automatic filter backwash controller that allows for timed, pressure differential or manual backwash intervals
- Equipped with continuos acting air vents
- System can stand alone or be used in combination with additional filtration equipment

AVAILABLE ACCESSORIES

- Power Prime Pumps
- Spill Guard Containment berms
- Stainless Steel 304 and Carbon Steel storage tanks in Bi-Level, Mixer, Weir and Manifold configurations
- Polyethylene storage tanks
- Cartridge and bag filters
- HDPE pipe and fittings
- Roll off boxes, dewatering bins and vacuum boxes
- Flow meters and pressure reducing/ sustaining valves
- Aluminum Victaulic pipe and fittings
- Suction and discharge hose

TECHNICAL

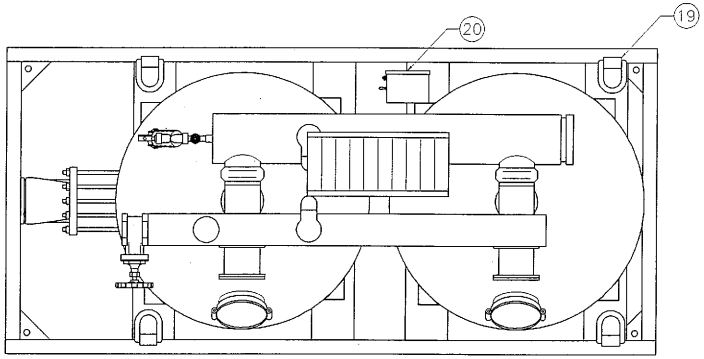
- Consist of two 36" filter tanks
- Fitted with air vents and pressure gauges
- Tanks provide 14.2 square feet of filtration area
- Inlet and outlet manifold connection are 6" victaulic
- Backwash manifold connection is 4" female NPT
- 8" media loading ports
- 8" media removal ports
- 100 psig working pressure
- 400 lbs. of gravel per tank
- 800 lbs. of sand per tank
- Most effective backwash rate is **110** GPM min.
- Footprint: ~120" long by ~48" wide.
- Pressure sustaining valve to aid in backwash operation.
- Solar battery charger for DC operation in remote locations.

RAIN FOR RENT

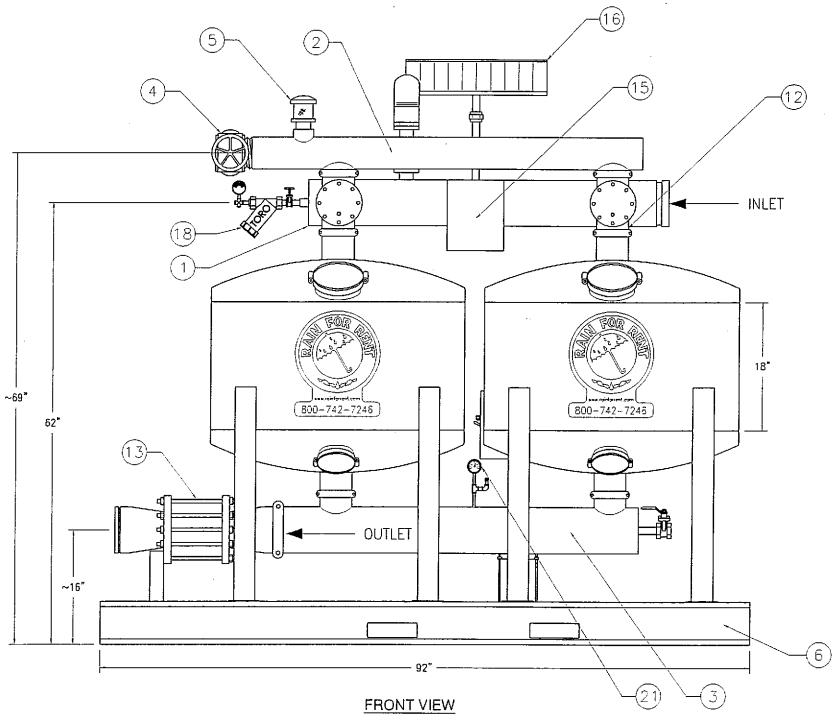
Postal Box 2248 • Bakersfield CA 93303
800 742-7246 • 661 399-9124 • FAX 661 393-1542
Internet: www.rainforrent.com

REV.NO.	DESCRIPTION	PREVIOUS DWG	BY	DATE
1	CHANGED INLET TO OPPOSITE SIDE OF OUTLET	102238	MS	06-25-2002
2	ADDED EVERLIFT VOLTAGE CONVERSION BOX AND PRESSURE GAUGE	102238	SH	03-20-2003

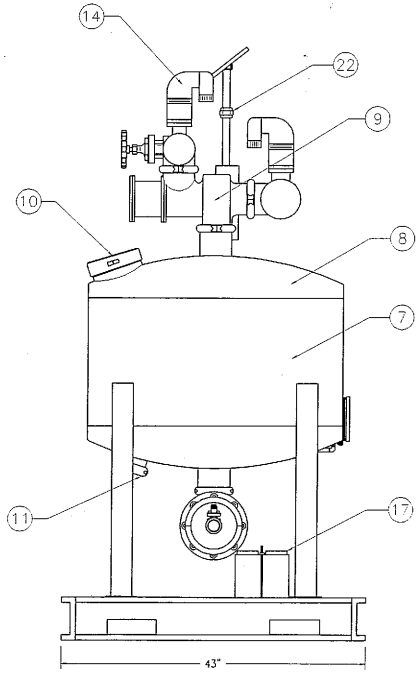
ITEM	QTY.	REF.	DESCRIPTION
1	1	–	6" GROOVED INLET PIPELINE
2	1	–	4" BACKWASH PIPELINE
3	1	–	6" OUTLET PIPELINE
4	1	–	4" GATE VALVE
5	1	–	1-1/2" ABF-20 SIGHT GLASS
6	1	–	6" X 43" X 92" SKID
7	2	–	36"O.D. X 18"H. TANK JACKET
8	4	–	36"O.D. TANK HEAD
9	2	–	4" 2-WAY THREE PORT BACKWASH VALVE
10	2	–	8" GROOVED FILL PORT
11	2	–	3" GROOVED DRAIN PORT
12	8	–	4" GROOVED VICTALIC COUPLING
13	1	–	NELSON PRESSURE SUSTAINING VALVE
14	2	–	2" NELSON AIR VENT
15	1	–	94B-4L BACKWASH CONTROL PANEL
16	1	–	SOLAR PANEL
17	1	–	12V, U1 BATTERY
18	1	–	1/2" GATE VALVE, TORO SPIN-CLEAN FILTER, PRESSURE GAUGE
19	4	–	ø5/8" WELD ON D-RING
20	1	–	EVERFILT VOLTAGE CONVERSION BOX
21	1	–	1/2" H.C. FOR LOW PRESS. AND PRESSURE GAUGE
22	1	–	1" UNION TO DISCONNECT SOLAR PANEL



PLAN VIEW



FRONT VIEW



SIDE VIEW

DATE: 04-05-2002
SCALE: 1:8
DRAWN: EVERFILT
CHECKED:
DRWN: M.STEVENSON
SHEET D

36-2 FILTER UNIT

36-2 SAND

MEDIA FILTER

Rain For Rent
Engineering
3404 STATE ROAD PO BOX 2249 BAKERSFIELD CA 93303

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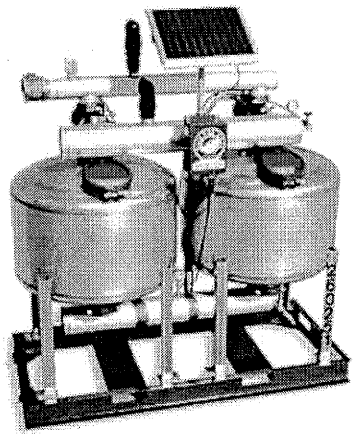
SHEET 1 OF 1

DRAWING NUMBER
102238

JOB NUMBER
1020402

Sand Media Filter Troubleshooting Guide

Rain for Rent
Engineering Department
Ext. 450



This guide was designed for Rain for Rent Sand Media Filters in general, however, some variation of equipment may apply.

Unit Stuck in Backwash

- Check position of adjustment knob on solenoid. Small arrow should point to "C" for closed. If in any other position, rotate knob until small arrow is pointing to the closed position. (See Figure A)
- Check the time settings on the control panel to make sure that the backwash cycle time isn't set too high. Set the backwash cycle time to 2 – 3 minutes and the interval to 2 hours. (See Figure B)
- Check to make sure that the pressure differential switch is not set at too low of a setting. Open control box and look at bottom of box to see what it is set at. If too low, readjust to 7 psi. by turning small knob located on gauge. (See Figure B)
- Make sure the backwash valve is not upside-down. The cross-tube nearest the inlet tube should be pointing down to the filter vessel. The cross-tube more distant from the inlet tube should be pointing up to backwash line. There may be arrows on valve to assist.
- Manually change settings on solenoid valve to check condition of valve. If water comes out of small plastic discharge tube when you go from open to close, then valve is good. If no water comes out, check next instruction. (System must be pressurized and operating to test.) (See Figure A)
- Check for breaks in tubing and wires going to solenoid. Replace any wires that have metal exposed, and any tubes that have cuts or cracks. If still no water, replace valve. (System must be pressurized and operating to test.)
- Remove backwash valve and check for debris that may have lodged the valve open. Remove any trash that may have collected and reinstall valve. While valve is off filter, check all gaskets and shafts for excessive wear. Rebuild unit if necessary, and reinstall.

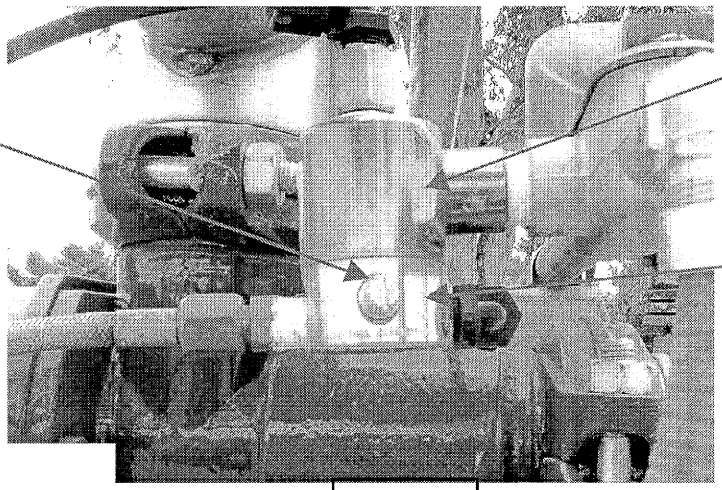


Figure A

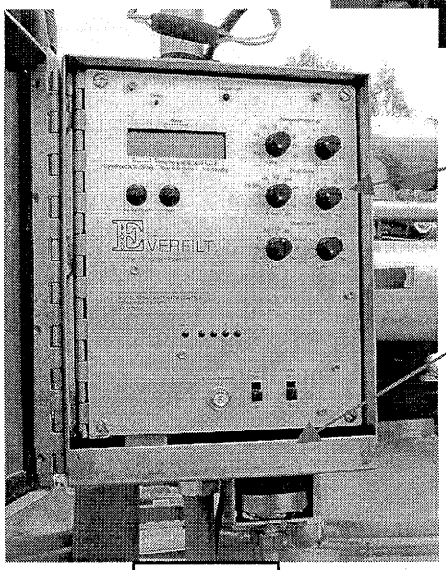
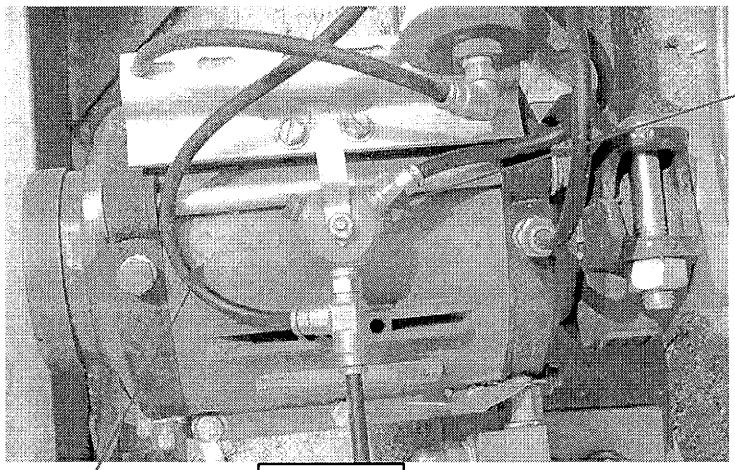


Figure B

No Flow Through Unit

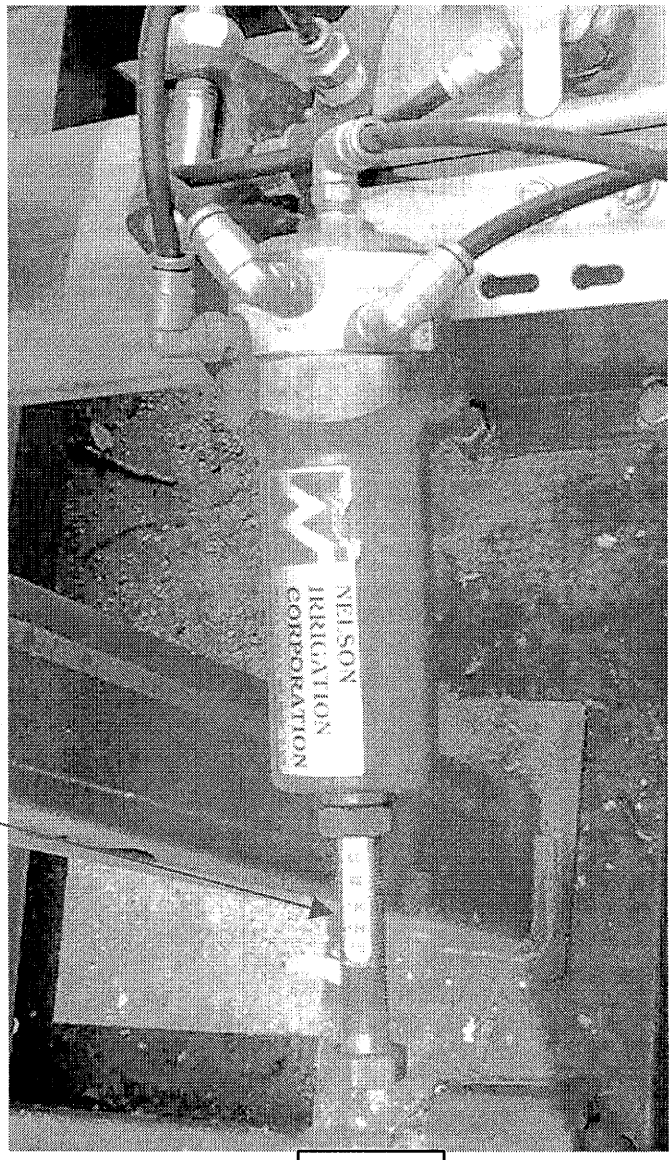
- If unit was not backwashed three times immediately upon startup, then do so.
- Check to ensure that fluid is actually getting to the filter unit. Ensure all valves before and after are open, pump is running, suction end is not clogged, and pump is primed.
- Check position of control valve located on top of pressure sustaining valve. Control valve should be in "Auto" position. (See Figure C)
- System pressure must be higher than setting on sustaining valve. Sustaining valve should be set at a minimum of 20 psi. If there is less system pressure, the sustaining valve will not open. (See Figure D)
- Clean filter screen on sustaining valve. (See Figure F)



Control valve on top of pressure sustaining valve. Should be set to auto.

Figure C

Check valve for proper flow direction.

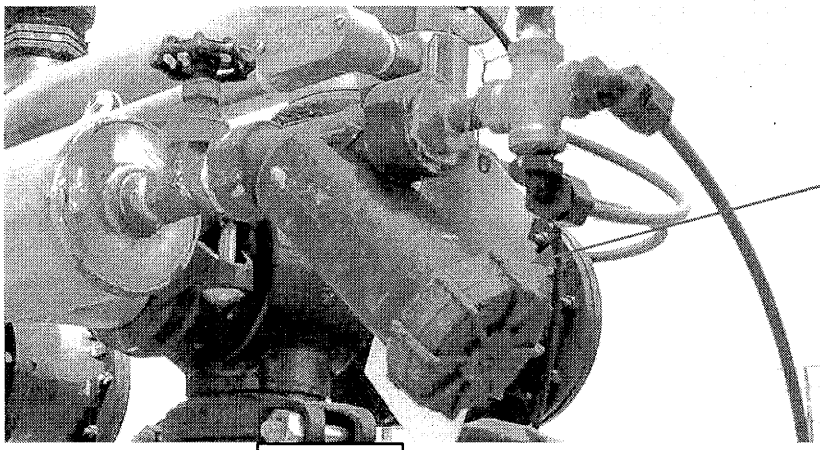


Adjust to 20 psi minimum, but less than system pressure.

Figure D

No Flow Through Unit Continued

- Check the hoses on the sustaining valve going to and from the pilot (see Figure D) Water should be flowing through all hoses. If no water is coming out of pilot, then replace pilot.
- Make sure that the pump is able to do at least 25 psi at the desired flow. If pump is unable to perform, then the pump should be replaced with one that can provide the minimum 25 psi at the desired flow rate.
- Shutdown system and remove fill port on top of filter vessel. Reach in with protected hand and feel if top of bed is blinded off. An indicator for this is high pressure on the top fill line, and little or no pressure on the discharge line. If bed is blinded off, backwash three or four times. If still not flowing, scrape off top of bed, backwash two or three times with clean water through drain valve on bottom discharge line. If still not flowing, remove all sand media and replace with coarser media, backwash three times.



Unscrew bottom and clean filter inside. Replace if torn or broken.

Figure E

Unscrew fitting from valve and remove filter. After cleaning, reinstall filter and fittings. Use Teflon on any threaded fittings.

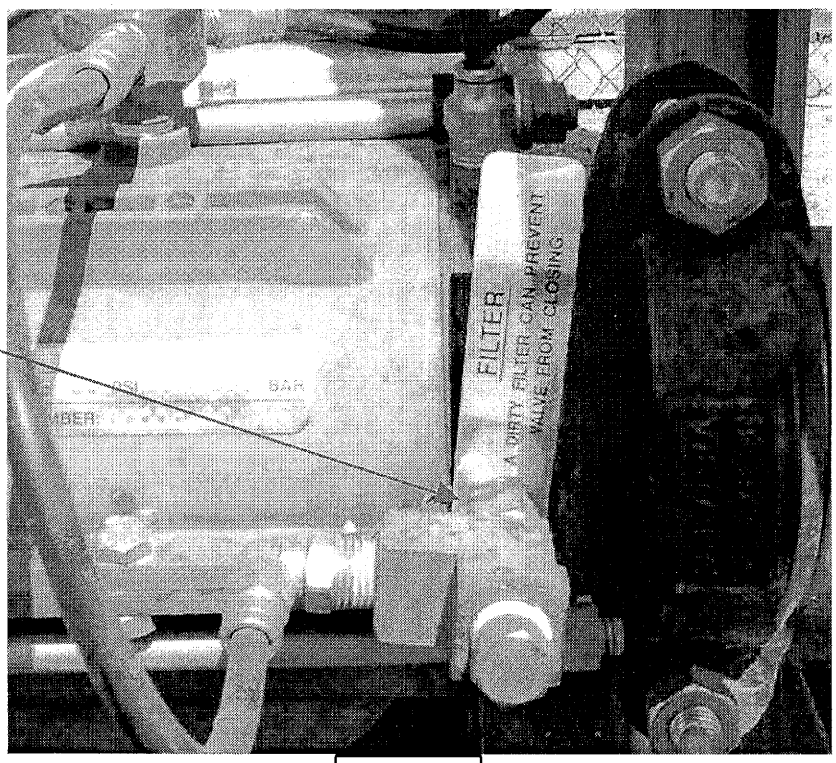


Figure F

Unit is not Backwashing

- Check control panel for proper settings. If unsure what to set at, turn on pressure differential, and adjust small knob to 7 psi on gauge located at bottom of control panel box, or use a 2 hour interval, 2 minute flush time, and 30 sec dwell time. Adjust unit as necessary from these settings.
- Check that control panel (see Figure B) has power. If battery powered, check the battery for proper voltage. If solar powered, check to make sure that unit is plugged in and that the solar panel is facing the sun. If AC supply is used, check for proper voltage, and that the power is turned on. Check for any inline fuses, replace as necessary. Also, check the breaker inside control panel by pressing to reset. If breaker does not reset, then you will need to replace it. (do we want them to send the panel in to get fixed???)
- Clean filter on end of inlet tube. Open valve located in front of filter after having replaced filter and closed housing. (See Figure E)
- Push the test button on the control panel (see Figure B) and listen for all the solenoids to click. If one of the solenoids (see Figure B) does not click, manually change settings on solenoid valve to check condition of solenoid. If water comes out of small plastic discharge tube when you go from open to close, then valve is good. (System must be pressurized and operating to test.)
- Backwash flow control valve (brass gate valve on backwash line) should be slightly open initially. Adjust as necessary once system is operating. (See Figure G)
- Ensure that there is enough system pressure and flow in order to establish a backwash cycle.
- Check for breaks in tubing and wires going to solenoid. Replace any wires that have metal exposed, and any tubes that have cuts or cracks. If still no water, replace solenoid. (System must be pressurized and operating to test.)
- Remove backwash valve and check for rocks and twigs that may have lodged the valve open. Remove any trash that may have collected and reinstall valve. While valve is off filter, check all gaskets and shafts for excessive wear. Rebuild unit if necessary, and reinstall.
- Shutdown system and remove fill port on top of filter vessel. Reach in with protected hand and feel if top of bed is blinded off. An indicator for this is high pressure on the top fill line, and little or no pressure on the discharge line. If bed is blinded off, backwash three or four times. If still not flowing, scrape off top of bed, backwash two or three times with clean water. If still not flowing, remove all sand media and replace with coarser media, backwash three times.
- If fitted, select the preferred power supply on power source selection box.

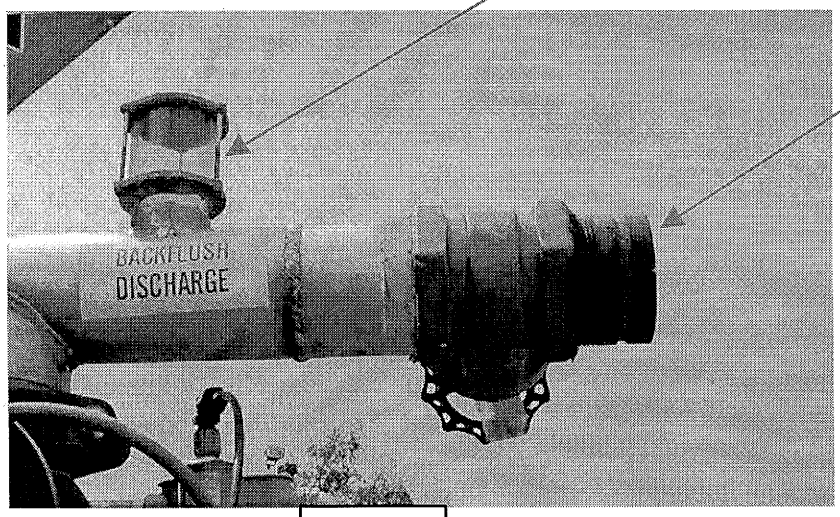


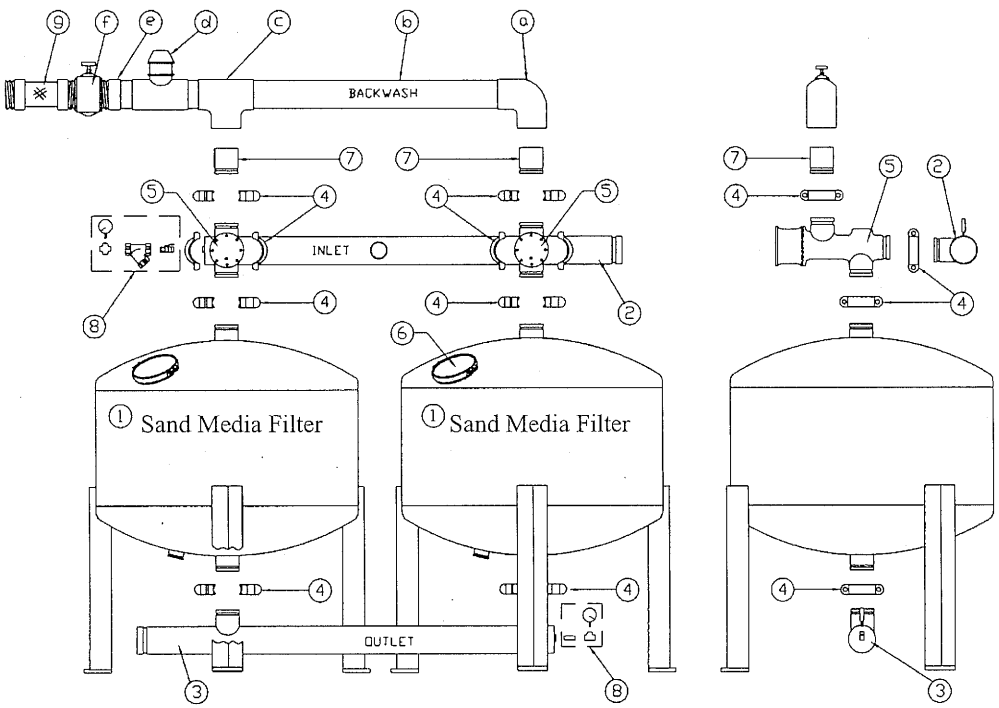
Figure G

Specialty Rental

- 1 - GENERAL COMPONENTS

A. TANK LOCATION: PLACE FILTER UNITS ON LEVELED SURFACE IN THE APPROXIMATE POSITION IN, WHICH THEY WILL BE INSTALLED FOR OPERATION. THIS POSITION SHOULD ALLOW THE BEST ACCESS TO THE FILLPORT.

MANIFOLD AND VALVE ASSEMBLY

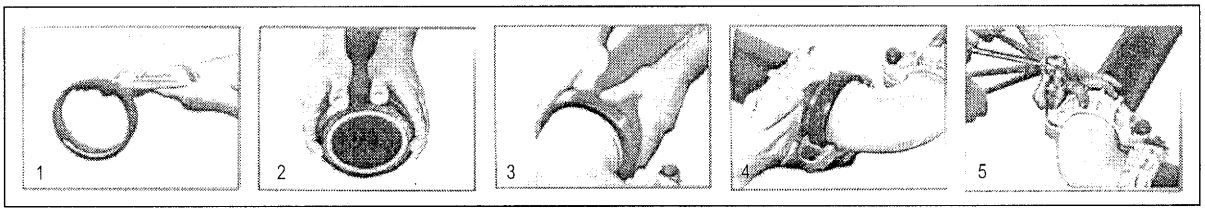


SUPPLIED WITH FILTER UNITS
1. SAND FILTER TANK
2. INLET MANIFOLD WITH COUPLING
3. OUTLET MANIFOLD WITHOUT COUPLING
4. GROOVED COUPLINGS
5. BACKWASH VALVE
NOTE: Backwash valve must be installed as shown-DO NOT REVERSE.
6. FILLPORT
7. PVC ADAPTER (GxS)
8. HYDRAULIC PICK-UP KIT (See Hydraulic Pick-Up Kit Drawing)

a. PVC 90° ELBOW
b. PVC PIPING
c. PVC TEE
d. AIR, VACUUM VENT
e. PVC MALE ADAPTER
f. RESTRICTOR VALVE
g. VIEW TUBE

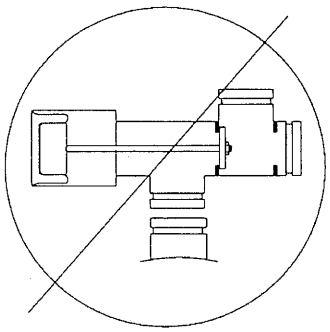
UNIT ASSEMBLY

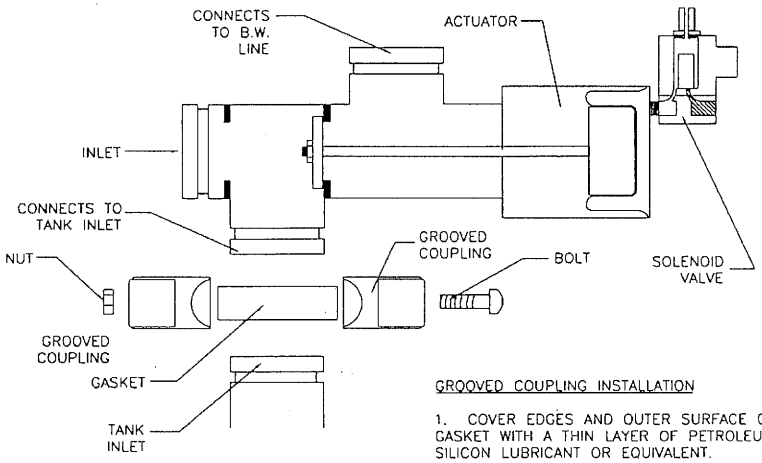
A. INSTALL OUTLET MANIFOLD: COUPLE OUTLET MANIFOLD TO TANK BOTTOM PORTS. DO NOT FULLY TIGHTEN GROOVED COUPLINGS. REFER TO GROOVE COUPLING ASSEMBLY BELOW.

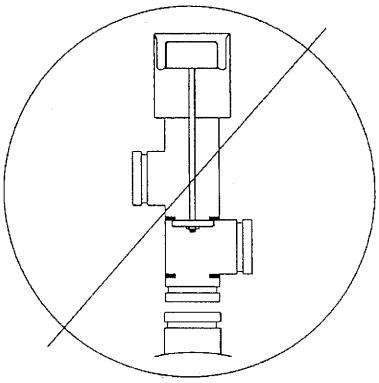


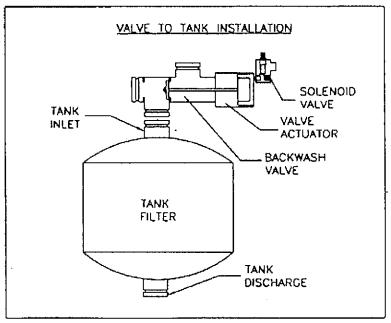
1. CHECK GASKET AND LUBRICATE: APPLY A THIN COAT OF LUBRICANT OR SOAPY WATER TO GASKET LIPS AND OUTSIDE OF GASKET.
2. INSTALL GASKET: PLACE GASKET OVER PIPE END, BEING SURE GASKET LIP DOES NOT OVERHANG PIPE END.
3. ALIGN AND BRING TWO PIPE ENDS TOGETHER AND SLIDE GASKET INTO POSITION CENTERED BETWEEN THE GROOVES ON EACH PIPE. NO PORTION OF THE GASKET SHOULD EXTEND INTO THE GROOVE ON EITHER PIPE.
4. APPLY HOUSING: PLACE HOUSINGS OVER GASKET, BEING SURE THE HOUSING KEYS ENGAGE INTO THE GROOVES. INSERT BOLTS AND APPLY NUTS FINGER TIGHT.
5. TIGHTEN NUTS ALTERNATELYAND EQUALLY UNTIL HOUSING BOLT PADS ARE FIRMLY TOGETHER. CAUTION: UNEVEN TIGHTENING MAY CAUSE GASKET TO PINCH.

B. INSTALL BACKWASH VALVES: COUPLE BACKWASH VALVES TO MEDIA TANKS AS SEEN HERE. DO NOT INSTALL BACKWASH VALVE UP SIDE DOWN. DO NOT FULLY TIGHTEN GROOVED COUPLINGS. REFER TO GROOVED COUPLING ASSEMBLY BELOW.









GROOVED COUPLING INSTALLATION

1. COVER EDGES AND OUTER SURFACE OF THE GASKET WITH A THIN LAYER OF PETROLEUM-FREE SILICON LUBRICANT OR EQUIVALENT.
2. INSTALL THE GASKET BY PLACING THE GASKET OVER THE PIPE AND ENSURE THAT THE GASKET LIP DOES NOT OVERHANG THE PIPE END.
3. BRING BOTH PIPE ENDS TOGETHER, ENSURE PROPER ALIGNMENT AND SLIDE THE GASKET INTO POSITION, PROPERLY CENTERING IT BETWEEN THE GROOVED PORTIONS OF EACH PIPE.
4. PLACE THE COUPLING HOUSINGS OVER THE GASKET SO THAT THE HOUSING KEYS FULLY ENGAGE INTO GROOVES. INSERT THE BOLTS INTO THE COUPLINGS AND ROTATE THE NUTS UNTIL FINGERTIGHT.
5. TIGHTEN BOLTS ALTERNATELY AND EVENLY. CAUTION: UNEVEN TIGHTENING CAN CAUSE THE GASKETS TO PINCH.

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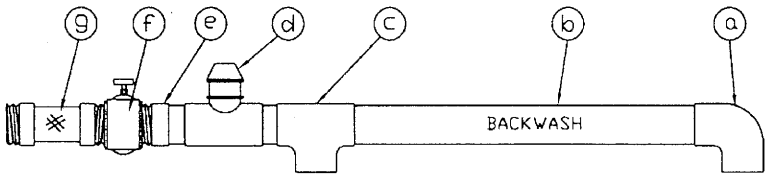
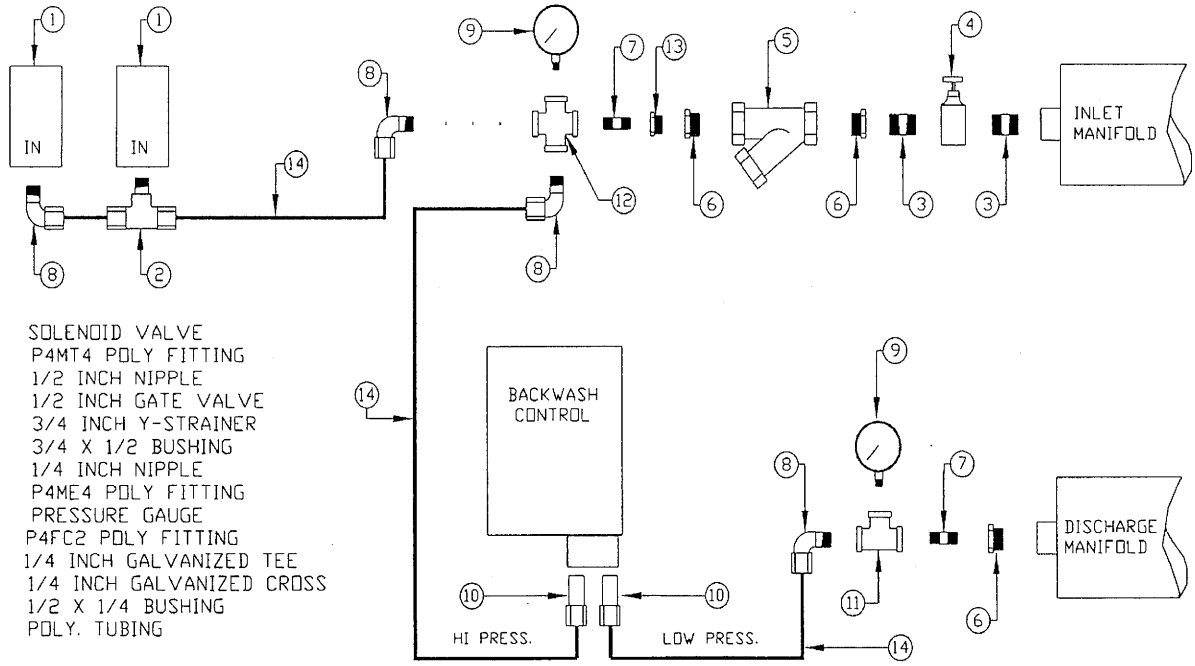
C. INLET MANIFOLD: COUPLE INLET MANIFOLD TO BACKWASH VALVE INLET PORTS. REFER TO THE 'BASIC SYSTEMS COMPONENT TP-190' DRAWING FOR CORRECT POSITIONING OF INLET MANIFOLD. DO NOT FULLY TIGHTEN GROOVED COUPLINGS.

D. INSTALL PVC GROOVED ADAPTERS: GROOVE ADAPTERS CONNECTED TO BACKWASH PORT.

E. INSTALL BACKWASH MANIFOLD ASSEMBLY: IT IS NECESSARY TO INSTALL A RESTRICTOR VALVE/GATE VALVE FOR PROPER BACKWASH FLOW REGULATION. ALWAYS INSTALL AN AIR VENT/VACUUM RELIEF VALVE ON THE BACKWASH MANIFOLD. THE OPTIONAL VIEW TUBE WILL FACILITATE PROPER ADJUSTMENT OF THE RESTRICTOR VALVE AND AID IN ADJUSTING THE LENGTH OF THE BACKWASH CYCLE.

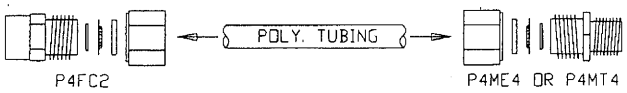


HYDRAULIC PICK-UP KIT INSTALLATION



1. SOLENOID VALVE
2. P4MT4 POLY FITTING
3. 1/2 INCH NIPPLE
4. 1/2 INCH GATE VALVE
5. 3/4 INCH Y-STRAINER
6. 3/4 X 1/2 BUSHING
7. 1/4 INCH NIPPLE
8. P4ME4 POLY FITTING
9. PRESSURE GAUGE
10. P4FC2 POLY FITTING
11. 1/4 INCH GALVANIZED TEE
12. 1/4 INCH GALVANIZED CROSS
13. 1/2 X 1/4 BUSHING
14. POLY. TUBING

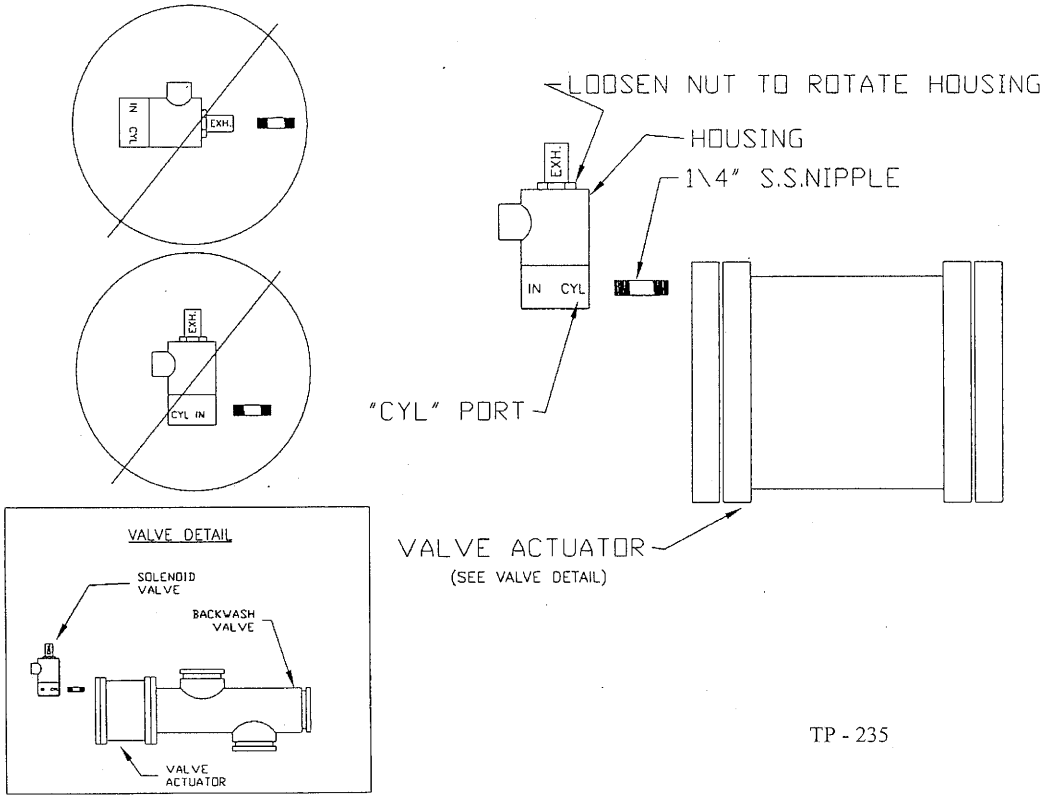
INSTALLATION OF TUBING



CUT THE TUBE SQUARELY AND REMOVE ANY BURRS. LOOSEN NUT ON FITTING UNTIL THREE THREADS ARE VISIBLE. MOISTEN END OF THE TUBE WITH WATER. PUSH TUBE STRAIGHT INTO FITTING UNTIL IT BOTTOMS ON THE FITTING'S SHOULDER. TIGHTEN NUT BY HAND.

NOTE:
A LENGTH OF TUBING SHOULD BE ATTACHED TO THE EXHAUST PORT OF EACH SOLENOID VALVE TO CHANNEL EXHAUST WATER FROM THE ACTUATOR.

SOLENOID CONNECTION:



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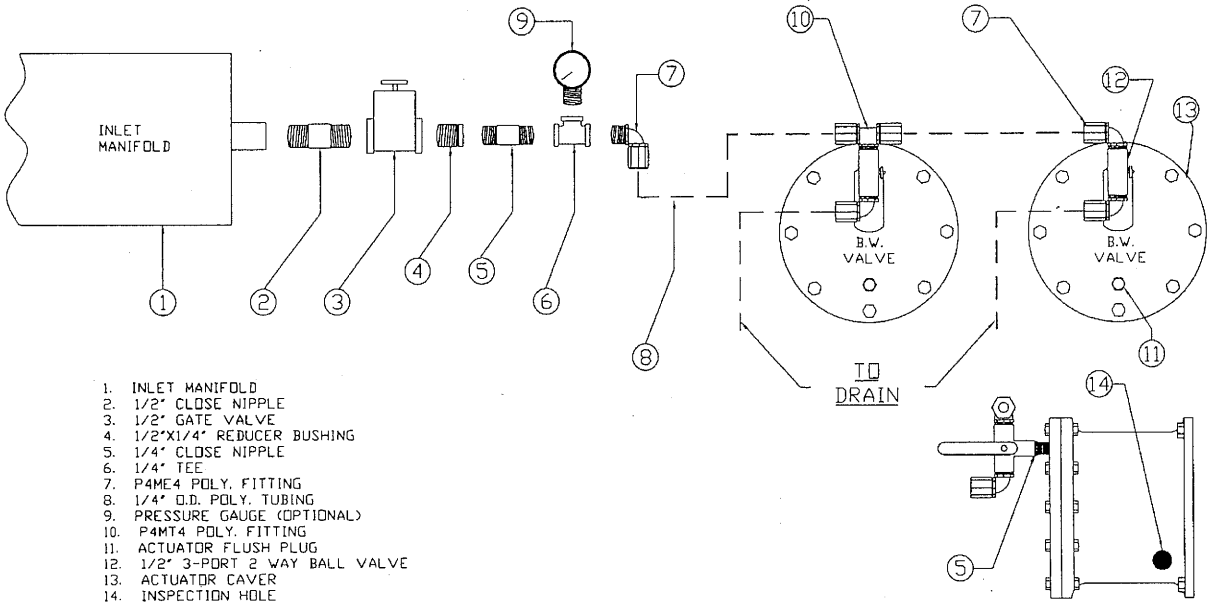
SEMI-AUTO SCHEMATIC:



1. INLET MANIFOLD
2. 1/2" CLOSE NIPPLE
3. 1/2" GATE VALVE
4. 1/2"X1/4" REDUCER BUSHING
5. 1/4" CLOSE NIPPLE
6. 1/4" TEE
7. P4ME4 POLY. FITTING
8. 1/4" O.D. POLY. TUBING
9. PRESSURE GAUGE (OPTIONAL)
10. P4MT4 POLY. FITTING
11. ACTUATOR FLUSH PLUG
12. 1/2" 3-PORT 2 WAY BALL VALVE
13. ACTUATOR CAVER
14. INSPECTION HOLE

NOTES:
1. BALL VALVES MUST BE INSTALLED WITH LEVER ON R.H. SIDE OF VALVE WHEN VIEWING COVER.
2. PUSH LEVER DOWN TO BACKWASH

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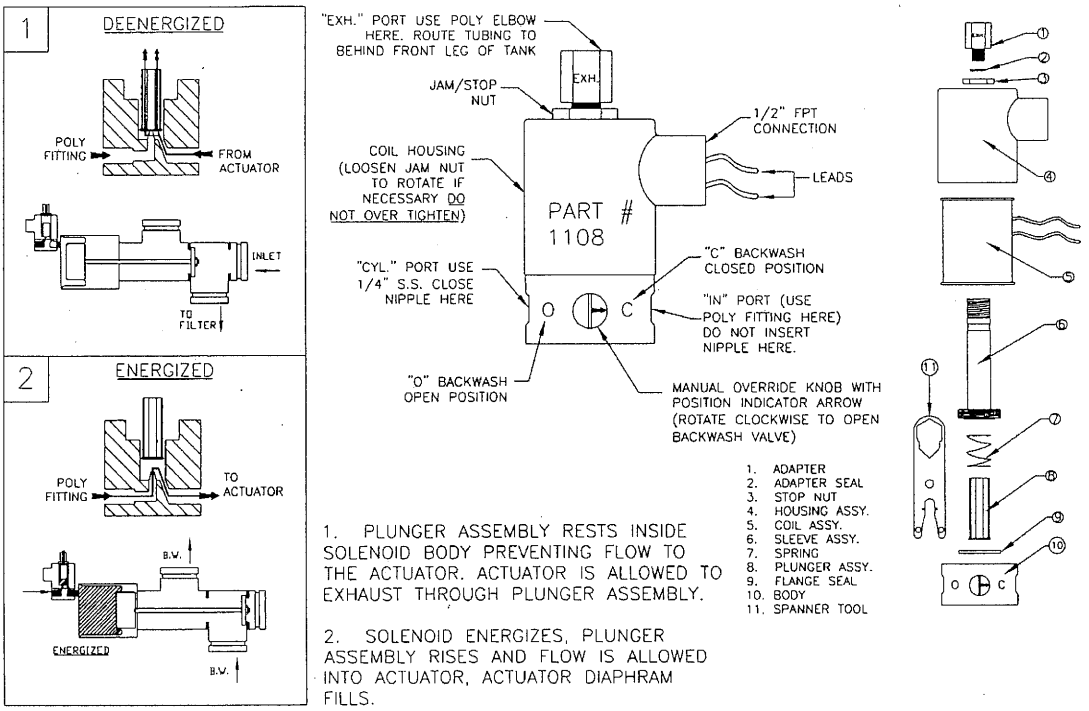
SOLENOID VALVE ASSEMBLY:



1. PLUNGER ASSEMBLY RESTS INSIDE SOLENOID BODY PREVENTING FLOW TO THE ACTUATOR. ACTUATOR IS ALLOWED TO EXHAUST THROUGH PLUNGER ASSEMBLY.

2. SOLENOID ENERGIZES, PLUNGER ASSEMBLY RISES AND FLOW IS ALLOWED INTO ACTUATOR, ACTUATOR DIAPHRAM FILLS.

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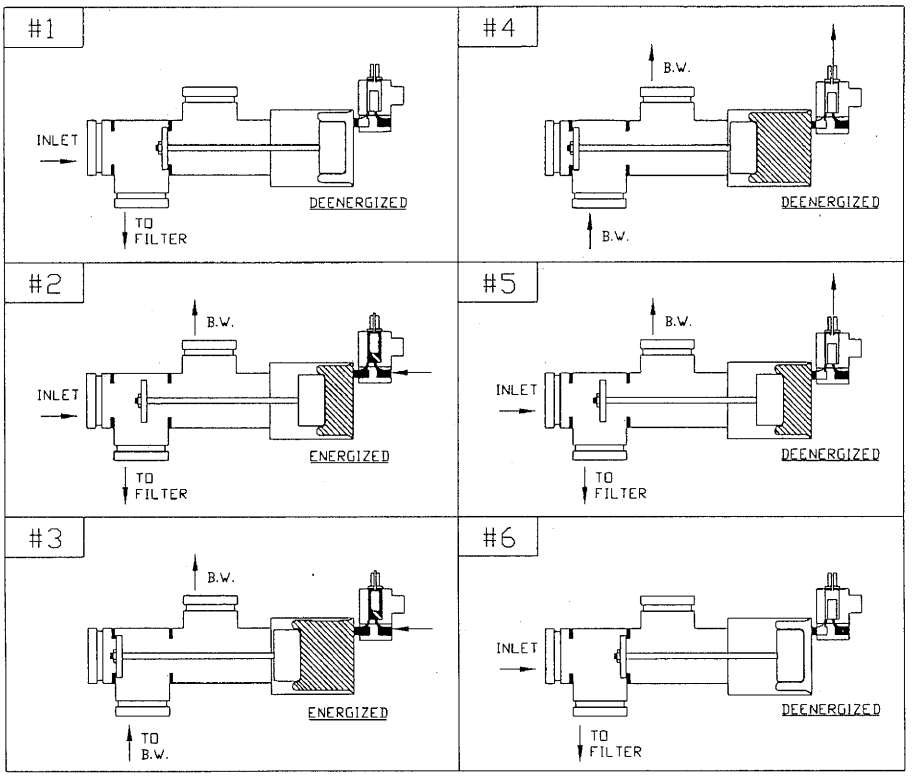
BACKWASH AND SOLENOID VALVE OPERATION:



1. FLOW FROM INLET TO FILTER. SOLENOID VALVE DEENERGIZED.
2. SOLENOID VALVE ENERGIZED. FLOW FROM INLET TO FILTER AND TO BACKWASH LINE.
3. SOLENOID VALVE ENERGIZED. FLOW FROM TANK TO BACKWASH LINE.
4. SOLENOID VALVE DEENERGIZED. FLOW FROM TANK TO BACKWASH LINE.
5. SOLENOID VALVE DEENERGIZED. FLOW FROM INLET TO FILTER AND TO BACKWASH LINE.
6. FLOW FROM INLET TO FILTER. SOLENOID VALVE DEENERGIZED.

HI PRESS. WATER

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MEDIA INSTALLATION

NOTE: SSM MODELS USE THE SAME MEDIA AMOUNTS.

1. REMOVE FILL PORT COVER AND CHARGE FILTER WITH CORRECT AMOUNT OF GRAVEL AND HALF MEDIA. SEE FIGURES 1 & 2.

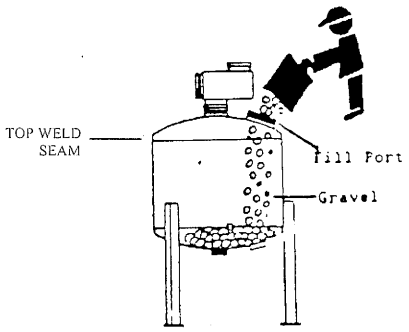

FIGURE 1

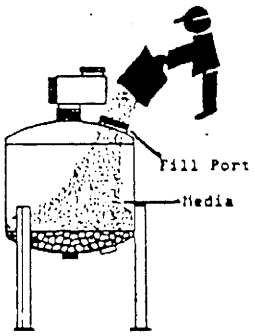

FIGURE 2

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2. REPLACE FILL PORT COVER AND TIGHTEN CLAMPS.

3. RESTRICT OR SHUT-OFF DISCHARGE (OUTLET LINE) OF FILTERS FOR MAXIMUM PRESSURE AND FLOW DURING BACKWASH.

4. START UP SYSTEM AND BACKFLUSH FILTERS. OPEN RESTRICTOR VALVE UNTIL A SMALL AMOUNT OF MEDIA IS PRESENT IN THE BACKWASH WATER (VIEW THROUGH SIGHT GLASS). REPEAT 4 OR 5 TIMES FOR EACH FILTER.

5. SHUT DOWN THE SYSTEM AND ALLOW FILTER TO DRAIN.

6. REMOVE FILL PORT COVER AND CHARGE FILTER WITH REMAINING HALF OF MEDIA.

7. REPLACE FILL PORT COVER.

8. REPEAT STEP 4.

9. SYSTEM IS NOW READY FOR NORMAL OPERATION AND FINAL ADJUSTMENT OF BACKWASH RESTRICTOR VALVE.

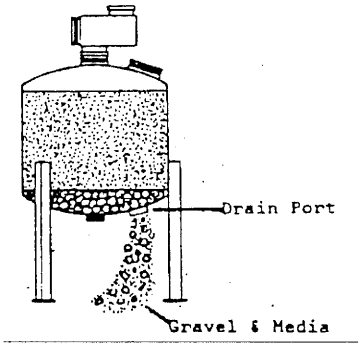
10. ADJUST RESTRICTOR VALVE FOR MAXIMUM CLEANING WHEN NORMAL OPERATING FLOW AND PRESSURE HAVE STABILIZED. MAXIMUM CLEANING IS REACHED WHEN NO MORE UNWANTED PARTICLES ARE SEEN THROUGH SIGHT GLASS.

NOTES:
FILTERS SHOULD BE BACKWASHED AT THE FOLLOWING PRESSURE DIFFERENTIAL:

25 GPM/FT^2	---- ---- ---- ---- ---- ----	7 PSI DIFFERENTIAL
20 GPM/FT^2	---- ---- ---- ---- ---- ----	5 PSI DIFFERENTIAL
15 GPM/FT^2	---- ---- ---- ---- ---- ----	3 PSI DIFFERENTIAL
10 GPM/FT^2	---- ---- ---- ---- ---- ----	2 PSI DIFFERENTIAL
BELOW 10 GPM/FT^2	---- ---- ---- ---- ---- ----	1 PSI DIFFERENTIAL

PRESSURE DIFFERENTIAL SWITCH FOR AUTOMATIC CONTROL SHOULD BE SET USING THE ABOVE PARAMETERS.

11. MEDIA REMOVAL: SHUT DOWN WATER SUPPLY TO SYSTEM AND REMOVE BOTTOM DRAIN PLUG. TURN ON WATER SUPPLY TO SYSTEM AND DRAIN MEDIA FROM TANK AS SHOW BELOW.



MEDIA CLEANING

IT IS RECOMMENDED THAT THE FILTERS BE BACKWASHED WHEN A 5-PSI DIFFERENTIAL, AT 20 GPM/FT^2 FLOW IS REACHED. TO BACKWASH, OPERATE BACKWASH VALVE FOR A MINIMUM OF TWO-MINUTE PER FILTER. CHECK DIFFERENTIAL AND IF NOT NORMAL, REPEAT BACKWASH PROCEDURE.

FILTER INSPECTION

PERIODIC INSPECTION IS NECESSARY AND SHOULD BE DONE AT LEAST MONTHLY OR MORE FREQUENTLY IN SEVERE CONDITIONS. CHECK THE FOLLOWING:

1. MEDIA ---------- ADD MEDIA WHEN 2" BELOW TOP WELD SEAM. BREAK UP ANY SOLIDIFICATION OF MEDIA AND BACKFLUSH UNTIL CLEAN. READJUST BACKWASH RESTRICTOR VALVE AS REQUIRED.

2. EXTERIOR ------- TOUCH UP OR REPAINT AS REQUIRED.

AUTOMATIC BACKWASH CONTROLS

DESCRIPTION

AUTOMATIC BACKWASH OF THESE SYSTEMS ARE ACCOMPLISHED VIA THE MODEL 94B SERIES CONTROLLERS - A SOLID STATE ELECTRONIC CONTROL UNIT, CAPABLE OF OPERATING ONE MASTER VALVE AND UP TO 12 BACKWASH VALVES.

THE CONTROL WILL INITIATE A BACKWASH CYCLE AFTER REACHING A PRE-SET TIME OR BY RECEIVING A SIGNAL FROM THE PRESSURE DIFFERENTIAL (P.D.) SWITCH INDICATING A DIRTY FILTER CONDITION.

OPERATION

THE CONTROLLER WILL BEGIN TIMING OF THE BACKWASH INTERVAL WHEN THE POWER SWITCH IS TURNED ON. WHEN THE BACKWASH INTERVAL TIME HAS EXPIRED, THE CONTROLLER WILL INITIATE A BACKWASH CYCLE. IF THE P.D. ON-OFF SWITCH IS IN THE "ON" POSITION, IT WILL INITIATE A BACKWASH CYCLE IF THE PRESSURE DIFFERENTIAL REACHES ITS SETTING AND REMAINS THERE FOR APPROXIMATELY FIFTEEN (15) SECONDS.

THE MASTER VALVE WILL ENERGIZE AND REMAIN IN THIS CONDITION AS EACH STATION IS ENERGIZED, DE-ENERGIZED AND ALLOWED TO PASS THROUGH ITS DWELL PERIOD. AT THE END OF THE BACKWASH CYCLE THE MASTER VALVE WILL DE-ENERGIZE. THE CONTROL WILL CONTINUE TO REPEAT THIS PROCEDURE UNTIL THE POWER SWITCH IS TURNED OFF.

SPECIFICATIONS:

VOLTAGES

VOLTAGE INPUT (TRANSFORMER)	120 VAC	50-60 HZ
VOLTAGE INPUT (CONTROL PANEL)	12 VDC/12 VAC	50-60 HZ
VOLTAGE OUTPUT	12 VDC	

LOADING

CONTROL PANEL DORMANT	25 MA
SEQUENCING	300 MA
MASTER VALVE	1.0 AMP
STATIONS	2.0 AMPS

TIMING

BACKWASH INTERVAL	0 HRS. TO 168 HRS.
FLUSH TIME	0 SEC. TO 330 MIN.
DWELL TIME	0 SEC. TO 90 MIN.
P.D. DELAY	0 SEC. TO 360 SEC.

CAPACITY

MASTER VALVE	1
STATIONS (STD. SOLENOID VALVES)	1-12

ENCLOSURE DIMENSIONS

HEIGHT 11.50"
WIDTH 7.62"
DEPTH 4.62"

WEIGHT

10.5 LBS.

BACKWASH VALVES (3" AND 4")

THE BACKWASH VALVE IS A THREE (3) PORT, TWO (2) WAY VALVE, COMBINING BOTH FILTRATION AND BACKWASH MODES IN A SINGLE RUGGED UNIT. THIS ONE VALVE ACCOMPLISHES WHAT WOULD NORMALLY REQUIRE TWO VALVES MOUNTED IN A "TEE" CONFIGURATION.

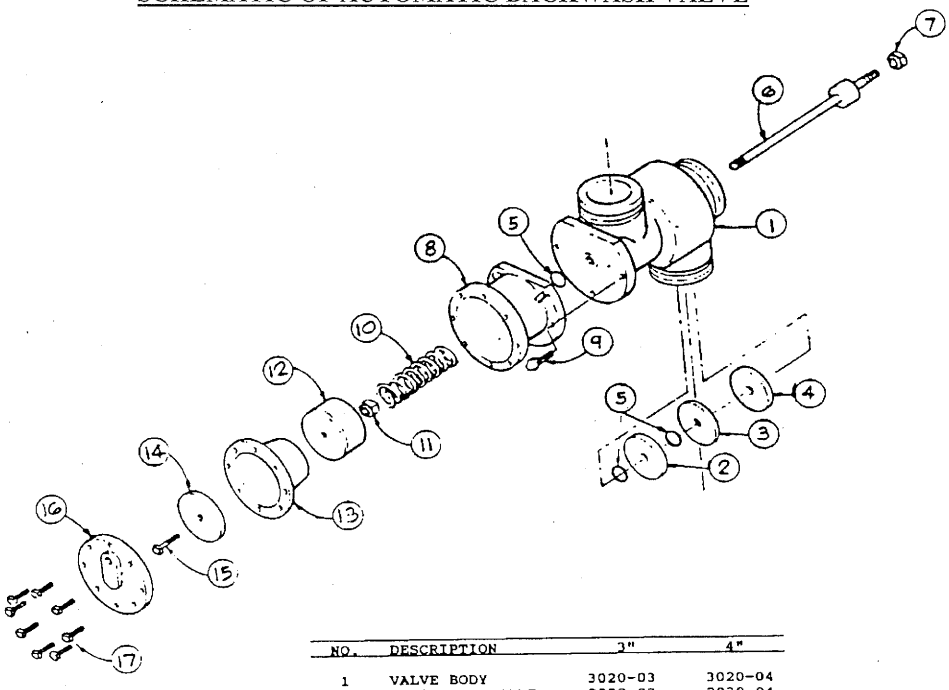
THE VALVE IS PICTURED ON THIS PAGE. IT IS FULLY OPEN IN EITHER THE FILTRATION OR BACKWASH POSITION, GIVING FULL UNRESTRICTED FLOW.

THE VALVE BODY IS CAST FROM DUCTILE IRON AND THEN COATED WITH 3M 134 FUSION BONDED EPOXY. THE USE OF THESE MATERIALS, AS COMPARED TO PLASTIC OR OTHER METALS, YIELDS AN EXTREMELY STRONG RUGGED UNIT THAT WILL WITHSTAND THE ABUSE OF HEAVY WRENCH OR OTHER OVERLOAD.

THE SHAFT IS 303 STAINLESS STEEL AND IS CORROSION AND WEAR-RESISTANT FOR LONG HEAVY DUTY SERVICE. THE POLYURETHANE VALVE SEAL IS BACKED UP WITH DUCTILE IRON SUPPORT PLATES TO ASSURE A POSITIVE SHUT OFF.

THE ACTUATOR FOR AUTOMATIC OPERATION HAS AN ALUMINUM HOUSING, PISTON AND COVER FOR LONG SERVICE LIFE. THE RETURN SPRING AND ROLLING DIAPHRAGM ARE DESIGNED TO OPERATE THE VALVE SMOOTHLY UNDER A VARIETY OF CONDITIONS, WITHOUT DANGER OF VALVE SLAMMING.

SCHEMATIC OF AUTOMATIC BACKWASH VALVE



NO.	DESCRIPTION	3"	4"
1	VALVE BODY	3020-03	3020-04
2	VALVE TOP PLATE	2039-03	2039-04
3	VALVE SEAL	1065-01	1065-02
4	VALVE BOTTOM PLATE	2040-03	2040-04
5	"O" RINGS	1066	1066
6	BACKWASH SHAFT	3018-01	3018-02
7	NUT	1069	1069
8	ACTUATOR HOUSING	2035	2035
9	BOLTS & NUTS	1071 & 1072	1071 & 1072
10	SPRING	1070	1070
11	JAM NUT	1069	1069
12	PISTON	2034	2034
13	DIAPHRAGM	1059	1059
14	DISC	2032	2032
15	CAPSCREW	1074	1074
16	COVER	2033	2033
17	BOLTS & NUTS	1077 & 1073	1077 & 1073

VALVE OPERATION

VALVE ACTUATION IS ACCOMPLISHED HYDRAULICALLY, USING WATER INTERNAL TO THE FILTER SYSTEM. THE WATER IS DRAWN OFF THE INLET MANIFOLD, THROUGH A STRAINER, AND INTO POLY TUBING, WHICH IS CONNECTED TO A SOLENOID VALVE ON EACH OF THE FILTERS IN THE SYSTEM.

WHEN THE BACKWASH CYCLE IS INITIATED THE FOLLOWING OCCURS:

1) THE BACKWASH CONTROL UNIT SENDS A SIGNAL TO THE SOLENOID VALVE THAT IS ATTACHED TO THE ACTUATOR COVER OF THE FIRST FILTER IN THE SYSTEM. (ONCE THE FIRST FILTER IS BACKWASHED, THE CONTROL WILL SEND A SIGNAL TO THE SOLENOID VALVE ON THE SECOND FILTER, AND THEREAFTER TO EACH FILTER IN TURN UNTIL ALL IN THE SYSTEM HAVE BEEN BACKWASHED.)

2) THE SOLENOID PLUNGER MOVES FROM THE CLOSED TO THE OPEN POSITION.

3) THE POLY TUBING, WHICH IS ATTACHED TO THE SOLENOID, ALLOWS WATER FROM THE INLET MANIFOLD TO PASS THROUGH THE SOLENOID AND INTO THE ACTUATOR HOUSING.

4) AS WATER ENTERS THE ACTUATOR HOUSING THE HYDRAULIC PRESSURE MOVES THE PISTON AND ROLLING DIAPHRAGM FORWARD CAUSING THE BACKWASH SHAFT TO ALSO MOVE FORWARD.

5) AS THE BACKWASH SHAFT MOVES FORWARD IT ALSO DRIVES THE VALVE PLATES AND SEAL FORWARD UNTIL THEY CLOSE OFF THE INLET PORT OF THE VALVE. THIS PREVENTS WATER IN THE INLET MANIFOLD FROM ENTERING THE FILTER.

6) AS THE INLET PORT ON THE BACKWASH VALVE IS CLOSED, THE BACKWASH PORT IS SIMULTANEOUSLY OPENED. THIS ALLOWS THE BACKWASH WATER COMING UP THROUGH THE MEDIA BED TO CARRY DEBRIS OUT THE TOP OF THE FILTER, THROUGH THE BACKWASH PORT AND INTO THE BACKWASH MANIFOLD.

7) WHEN THE END OF THE FLUSH TIME HAS BEEN REACHED, THE SOLENOID VALVE IS DE-ENERGIZED. THE WATER IN THE ACTUATOR HOUSING DRAINS OUT OF THE HOUSING AND OUT THROUGH THE EXHAUST PORT ON TOP OF THE SOLENOID VALVE. THE WATER IS CARRIED AWAY FROM THE SOLENOID VALVE VIA POLY TUBING.

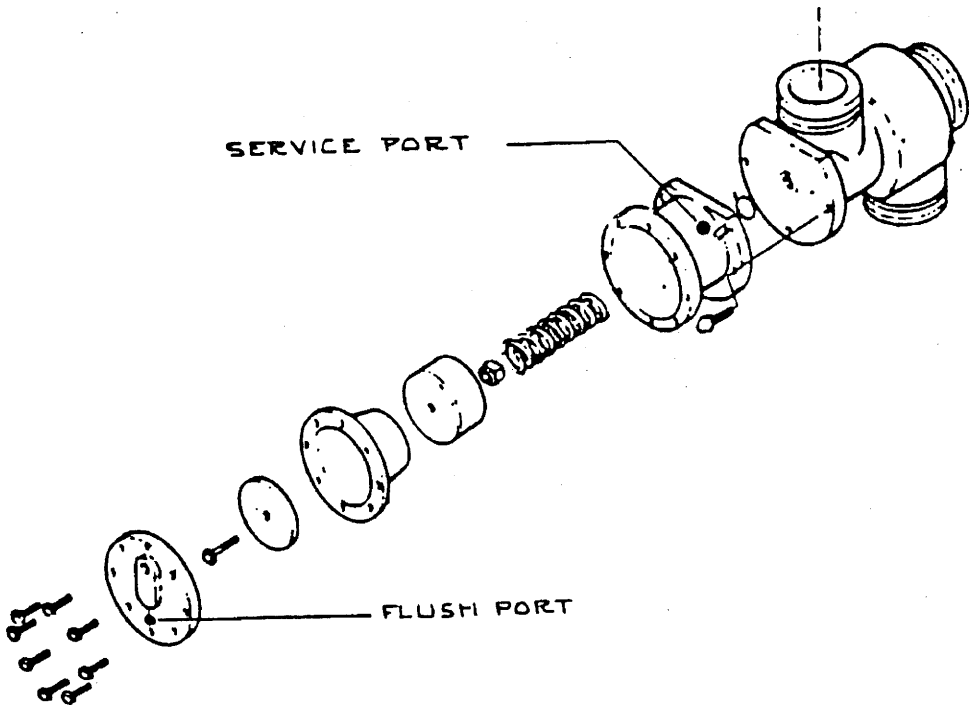
8) AS THE HYDRAULIC PRESSURE INSIDE THE ACTUATOR HOUSING DECREASES, THE PISTON AND DIAPHRAGM RETURN TO THEIR NORMAL POSITION, CAUSING THE VALVE PLATES AND SEAL TO OPEN THE INLET PORT ON THE BACKWASH VALVE AND CLOSE THE BACKWASH PORT.

9) WITH THE RE-OPENING OF THE INLET PORT, THE FILTER WILL RETURN TO THE FILTRATION MODE, AND THIS SAME PROCESS WILL BE REPEATED ONE AT A TIME WITH THE OTHER FILTERS IN THE SYSTEM.

MAINTENANCE AND SERVICING

COMPONENT	FREQUENCY	PROCEDURE
INLET MANIFOLD	**MONTHLY**	CLEAN Y STRAINER ON THE INLET MANIFOLD
FILTERS	**MONTHLY**	CHECK TEXTURE AND CONSISTENCY OF MEDIA TO MAKE SURE IT IS STILL LOOSE AND FREE OF CAKING OR CRUSTING CHECK LEVEL OF MEDIA AND ADD AS NEEDED.
	ANNUALLY	CHECK CONDITION OF EXTERIOR PAINT AND TOUCH UP AS NEEDED.
AUTO CONTROLS	**BI-ANNUALLY**	ROTATE KNOBS ON CONTROL PANEL TO BREAK ANY OXIDATION THAT MAY BE OCCURRING CHECK SEALS ON CONTROL ENCLOSURE FOR INTEGRITY

BACKWASH VALVES	**SEMI-ANNUALLY**	LUBRICATE BACKWASH SHAFT AND "O"RINGS IN PACKING GLAND WITH A MOLYDISULFIDE GREASE OR EQUIVALENT FOR VALVES THAT HAVE STAINLESS STEEL PACKING GLANDS. FOR VALVES WITH PVC PACKING GLANDS USE 112 SILICONE GREASE. FLUSH ACTUATOR IF HEAVY SILTING CONDITIONS EXIST
	ANNUALLY	DISASSEMBLE, INSPECT AND REGREASE BACKWASH VALVE



BACKWASH VALVES

SEMI-ANNUAL SERVICING

REFERRING TO THE DIAGRAM BELOW, REMOVE THE RUBBER COVER FROM THE SERVICE PORT AND INSPECT THE INTERIOR OF THE ACTUATOR HOUSING AND BACKWASH SHAFT.

LUBRICATE WITH A LIGHT WEIGHT OIL OR AEROSOL SPRAY (WD-40). HYDRAULICALLY OPERATE THE ACTUATOR TO INSURE PROPER OPERATION. REPLACE RUBBER COVER TO PROTECT ACTUATOR INTERIOR.

REMOVE THE 1/4" DRAIN PLUG FROM THE FLUSH PORT. MANUALLY OPERATE THE SOLENOID VALVE BY TURNING THE KNOB WITH THE ⟶ (ARROW) FROM THE "C" POSITION TO THE "O" POSITION. THIS WILL INITIATE A BACKWASH.

SOURCE WATER WILL ENTER THE ACTUATOR AND FLUSH THE ACCUMULATED DEBRIS OUT THE FLUSH PORT. REPEAT THIS CYCLE AS REQUIRED. REPLACE THE 1/4" DRAIN PLUG, AND TURN THE KNOB ON THE SOLENOID FROM THE "O" POSITION BACK TO THE "C" POSITION.

TROUBLE SHOOTING GUIDE

SYMPTON	POSSIBLE CAUSE
BACKWASH FREQUENCY INCREASES	A) CHANGE IN WATER QUALITY B) INCREASE IN FLOW ABOVE DESIGN PARAMETERS C) LOW MEDIA LEVEL D) BACKWASH RESTRICTOR VALVE IS SHUT E) CHANGE IN PRESSURE F) BACKWASH FLUSH TIME (DURATION) IS TOO SHORT G) MEDIA IS BECOMING HARDENED OR CRUSTED H) INLET LINE PRESSURE TOO LOW
HIGH PRESSURE DIFFERENTIAL	A) CHANGE IN WATER QUALITY B) LOW MEDIA LEVEL C) BACKWASH RESTRICTOR VALVE IS SHUT D) INCREASE IN FLOW E) INLET LINE PRESSURE TOO LOW F) INSUFFICIENT BACKWASH FREQUENCY AND/OR DURATION G) WRONG MEDIA IN FILTERS H) UNDERDRAIN SCREENS ARE BLOCKED
MEDIA NOT FLUIDIZING DURING BACKWASH OR CRUSTED	A) INSUFFICIENT BACKWASH FREQUENCY OR DURATION B) REDUCED PRESSURE C) FLOCCULATING OR COAGULATING AGENTS PREVENTING THOROUGH MEDIA CLEANING DURING BACKWASH D) RESTRICTOR VALVE IS CLOSED
SLUGGISH VALVES	A) LOW PRESSURE CAUSING VALVE TO OSCILLATE B) DRIED OUT O-RING (LUBRICATE) C) DIRTY "Y" STRAINER ON INLET LINE
LEAKAGE OUT BACKWASH LINE	A) BAD VALVE SEAT OR SEAL B) VALVE NOT COMPLETELY SEATED C) BENT BACKWASH SHAFT D) LOOSE BACKWASH SHAFT NUT
LEAKAGE OUT OF ACTUATOR	A) RUPTURED DIAPHRAGM B) COMPRESSION PLATE LOOSE
FILTER IS NOT BACKWASHING WHEN OTHERS IN SYSTEM ARE	A) SOLENOID VALVE DEFECTIVE B) HYDAULIC POLY TUBING LOOSE OR DISCONNECTED C) MALFUNCTION OF BACKWASH VALVE (DISASSEMBLE & INSPECT) D) WIRING ON CONTROL PANEL LOOSENED E) DEFECTIVE CONTROL PANEL F) SOLENOID VALVE IMPROPERLY ATTACHED

LAMPS NOT LIGHTING DURING TEST OF AUTO BACKWASH CONTROL	A) WIRING IN PANEL IS LOOSE OR DISCONNECTED B) INCORRECT VOLTAGE INPUT C) DEFECTIVE CONTROL PANEL - REPLACE
FILTER WILL NOT STOP BACKWASHING	A) SOLENOID VALVE MANUAL OVERRIDE BUTTON IS SET ON "O" INSTEAD OF "C" B) MALFUNCTION OF BACKWASH VALVE (DISASSEMBLE AND INSPECT) C) MALFUNCTION OF CONTROL PANEL

RAIN FOR RENT
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SPECIFICATION 105065

ENGINEERING:	ENGINEERING Combined Effort	REVISION:	**16**
INDUSTRIAL FLEET MGR.:		DATE:	**08/31/2005**
QUALITY ASSURANCE:		PREVIOUS DOC.:	**104390**
P.O. # OR DATE EXPIRED:			

SPECIFICATION FOR ALL SAND MEDIA FILTERS

1. **Scope**
   1.1. This document is intended to provide specifications and assistance for the construction and assembly of 18", 24", 36" and 48" sand media filter units.
   1.2. It is the sole responsibility of the contractor to furnish all labor, materials, equipment and incidentals necessary to complete the assembly in its entirety
   1.3. The contractor also has sole responsibility to use only approved conforming materials for the construction and assembly of all filter units.
   1.4. Changes to major components shall require approval by Rain for Rent Engineering Department
   1.5. Equipment suppliers are identified as the "manufacturer".
   1.6. The "contractor" is defined as the assembler of the final product.

2. **Workmanship**
   2.1. All assembly including cutting, welding, painting, galvanizing and wiring shall be done in a professional workmanship like manner in accordance with these specifications.

3. **Equipment Specifications**
   3.1. **Performance**
      3.1.1. Maximum working pressure of all units shall be at least **80 PSIG**.
      3.1.2. The minimum required line pressure on all units should be **30 PSIG** on the inlet and **20 PSIG** on the outlet.
      3.1.3. All units there shall be an initial pressure drop of no more than **1-3 psig** when in a clean condition, and no more than **6-10 PSIG** when dirty.

3.2. **Backwash performance:**

3.2.1. Required flow:

3.2.1.1. All units shall have a backwash flow based upon 10-15 gpm per square foot. (Depending on the media used) flows shall be as follows.

3.2.1.1.1. **18"** units – **18-27** gallons per minute

3.2.1.1.2. **24"** units – **32-47** gallons per minute

3.2.1.1.3. **36"** units – **71-107** gallons per minute

3.2.1.1.4. **48"** units – **125-188** gallons per minute

3.3. **Backwash Cycle:**

3.3.1. The filter system shall be set up so that each filter can be back washed in **2-4** minute cycles.

3.3.2. System shall also be configured so that filters backwash one at a time (so that flow is not interrupted).

3.4. **Backwash water source:**

3.4.1. The filter system shall be set up so that the clean water from the other filters shall provide the backwash water in the system.

3.5. **Pressure vessels:**

3.5.1. **Quantity**:

3.5.1.1. **18"** units shall have **2** or **3** pressure vessels;

3.5.1.2. **24"** units shall have **3** pressure vessels;

3.5.1.3. **36"** units shall have **2** or **3** pressure vessels;

3.5.1.4. **48"** units shall have **2**, **3** or **4** pressure vessels.

3.5.2. **Materials of construction:**

3.5.2.1. **Standard vessel units**:

3.5.2.1.1. **18"** through **48",** 304 stainless steel, 10 gauge.

3.5.2.2. **Deep bed vessel units:**

3.5.2.2.1. **36"** and **48"**, 304 stainless steel, 3/16" thick.

3.5.2.3. **Dimensions:**

3.5.2.3.1. **18"** units shall have an outside diameter of 18", with a sidewall 18" high; 36" high for deep bed units.

3.5.2.3.2. **24"** units shall have an outside diameter of 24", with a sidewall 18" high; 36" high for deep bed units.

3.5.2.3.3. **36"** units shall have an outside diameter of 36", with a sidewall 18" high; 36" high for deep bed units.

3.5.2.3.4. **48"** units shall have an outside diameter of 48", with a sidewall 18" high; 36" high for deep bed units.

3.5.2.4. **Mounting Bolts**

3.5.2.4.1. Vessels shall be mounted to skid with galvanized bolt and nut combination.

3.5.2.5. **Supports:**

3.5.2.5.1. Four (4) legs on each vessel shall support all pressure vessels.

3.5.2.6. **Top Fill port:**

3.5.2.6.1. All top fill ports shall be welded and be industrial groove. (Victaulic) sizes are as follows.

3.5.2.6.2. **18"** units shall have a **4"** top fill port.

3.5.2.6.3. **24"** units shall have a **6"** top fill port.

3.5.2.6.4. **36"** units shall have an **8"** top fill port.

3.5.2.6.5. **48"** units shall have an **8"** top fill port.

3.5.2.7. **Bottom Drain Port:**

3.5.2.7.1. All bottom drain ports shall be welded and be industrial groove. (Victaulic) sizes are as follows.

3.5.2.7.2. **18"** units shall have a **4"** bottom drain port.

3.5.2.7.3. **24"** units shall have a **6"** bottom drain port.

3.5.2.7.4. **36"** units shall have an **8"** bottom drain port.

3.5.2.7.5. **48"** units shall have an **8"** bottom drain port.

3.5.2.8. **Side Manway Port (Deep Bed Units Only):**

3.5.2.8.1. **18"** units shall have a **6"** side manway.

3.5.2.8.2. **24"** units shall have an **8"** side manway.

3.5.2.8.3. **36"** units shall have an **11"x 15"** side manway.

3.5.2.8.4. **48"** units shall have an **11"x 15"** side manway.

3.5.2.9. **Under Drain:**

3.5.2.9.1. Under drains for all deep bed units shall be threaded for removal.

3.5.2.10. All industrial groove (Victaulic) blind caps shall be made of stainless steel.

3.5.2.11. **18"** thru **36"** Units will have a 1.5" plated ball valve on the drain port.

3.5.2.12. **48"-4** units will have a **3"** butterfly valve with corresponding flange by thread connection.

3.5.2.12.1. **Butterfly Valve:**

3.5.2.12.1.1. Elastomer shall be **Buna-N**

3.5.2.12.1.2. Valve stem shall be stamped with a metal punch with the letter **N**

3.5.2.12.1.3. Valve handle will be color-coded **Blue** for Buna-N, Grainger Part Number **V2124** or equivalent.

3.5.3.**Manifolds:**

3.5.3.1. **Materials Of Construction:**

3.5.3.1.1. **18"** and **24"** units shall be **304** stainless steel, **.083"** thick.

3.5.3.1.2. **36"** and **48"** units shall be **304** stainless steel, **.083"** thick.

3.5.3.2. **Sizes:**

3.5.3.2.1. **18"** units – all manifolds shall be **3"**.

3.5.3.2.2. **24"** units – inlet and outlet manifolds shall be **4"**.

3.5.3.2.2.1. Backwash manifold shall be **3"**.

3.5.3.2.3. **36"** units – inlet and outlet manifolds shall be **6"**.

3.5.3.2.3.1. Backwash manifold shall be **4"**.

3.5.3.2.4. **48"** units – inlet and outlet manifolds shall be **6"**.

3.5.3.2.4.1. Backwash manifold shall be **4"**.

3.5.3.2.5. **48"-4** units will be 8" for inlet and outlet.

3.5.3.2.5.1. Backwash manifold shall be **4"**.

3.6. **Accessory Outlets:**

3.6.1. **Backwash Manifold:**

3.6.1.1. A **1-1/2"** pipe coupler welded into the top of the backwash manifold, next to the restrictor valve.

3.6.1.1.1. Coupler shall be used for installation of a sight glass.

3.6.1.2. **Sight Glass:**

3.6.1.2.1. Sight glass shall have extended scoop 1-1/4" for low flow applications.

3.6.1.2.2. A **2"** pipe coupler welded into the top of the backwash manifold, upstream of the 1-1/2" coupler for air vent.

3.6.2. **Inlet manifold:**

3.6.2.1. A **2"** pipe coupler welded into the top of the inlet manifold, directly in front of the 2" coupler on the backwash manifold for air vent.

3.6.3. **Air Vents:**

3.6.3.1. Air vents shall discharge to SCH 80 PVC by hose combination manifolded together.

3.6.3.2. Discharged to the center of the unit under control box.

3.6.3.3. Discharge terminating five inches from top of skid.

3.6.3.4. All piping shall be secured to filtration unit. With stainless steel hose clamp connections.

3.6.3.5. Use two-part high strength adhesive by IPS Corporation (www.ipscorp.com), #815, or equivalent for transition from air vent to SCH 80 PVC.

3.6.3.5.1. Air vent design and drawing supplied upon request. Contact RFR Engineering Department.

3.7. **Line Connections:**

3.7.1. All line connections shall be industrial groove. (Victaulic).

3.7.2. The 48"-4 filter units will have two 8"x 6" concentric reducers with 8" grooved couplers.

3.7.3. Concentric reducer's assemblies shall be made of stainless steel.

3.7.3.1. **Inlet / Outlet:**

3.7.3.1.1. Inlet and outlet locations for all sizes will be on opposite sides of the filter unit for ease of operation.

3.7.3.2. **Inlet:**

3.7.3.2.1. Inlet shall be constructed with a welded Z- drop piping to locate the inlet pipe at the same level as the discharge line.

3.7.3.2.1.1. Z-Drop shall be supported to skid.

3.7.3.2.1.2. Add and center a 1" ball valve to Z-drop for drain.

3.8. **Valves:**

3.8.1. Backwash Valves:

3.8.1.1. Each pressure vessel shall have a backwash valve on the inlet.

3.8.1.1.1. These valves shall be three-port and shall be actuated hydraulically with water internal to the system.

3.8.1.1.2. These valves shall be made of ductile iron, with interior and exterior epoxy lining.

3.8.1.1.3. Valves shall also have a finish coat of high gloss urethane with UV protection.

3.8.1.1.3.1. Color Rain For Rent blue.

3.8.1.1.3.2. Paint color card shall be supplied upon request.

3.8.1.2. Sizes For Backwash Valves:

3.8.1.2.1. **18"** Units Shall Have **3"** Backwash Valves.

3.8.1.2.2. **24"** Units Shall Have **3"** Backwash Valves.

3.8.1.2.3. **36"** Units Shall Have **4"** Backwash Valves.

3.8.1.2.4. **48"** Units Shall Have **4"** Backwash Valves.

3.8.2. All line connections shall be industrial groove. (Victaulic).

3.9. **Drain Lines:**

3.9.1. All solenoid drain lines shall be manifolded in one (1) stainless steel line extended to five inches from top of skid top of the skid with a 90° elbow terminating the assembly.

3.10. **Controls:**

3.10.1. All filter units shall be equipped with a control box.

3.10.1.1. Model number for this box shall be **94b-4L**.

3.10.1.2. This box shall have solid state electronics in a stainless steel enclosure.

3.10.1.3. It shall be capable of initiating the backwash cycle on pre-set time intervals or a pressure differential override.

3.10.1.4. This box shall be fully programmed, with field adjustable settings and a manual override.

3.10.1.5. It shall also have a circuit breaker, mode lamps, a transformer, a pressure differential switch, and a LCD readout.

3.10.1.6. The control shall operate from a **12vdc** or **120vac**.

3.10.1.7. Internal compartment of the control box shall be secured with hex-head screws inside of the control panel.

3.10.2. **P.D. Switch - Gauge:**

3.10.2.1. The pressure differential switch (P.D. switch) shall be mounted under the control box in a separate type of enclosure.

3.10.2.2. Enclosure must have a protecting lid. P.D. switch shall be mounted in a way to interchange with existing rain for rent fleet control boxes and mounting points

3.11. **Accessories:**

3.11.1. Unit shall be equipped with inlet and outlet pressure gauges (0-100psi).

3.11.2. The sight glass shall have an impact resistant lens.

3.11.3. The hydraulic lines to the backwash valves shall be braided stainless steel.

3.11.4. **Solar Panel:**

3.11.4.1. All sand media units shall be equipped with a solar panel with quick disconnect hardware.

3.11.4.2. The solar panel shall have integral **18 AWG** wiring with insulation rated at **70°c**.

3.11.4.3. Wire length shall be **8 feet**.

3.11.4.4. The solar panel shall have a rated power **of 10.3 watts**, an operating voltage of **16.5 volts**, and an operating current of **0.62 amps**.

3.11.4.5. Wire leads from solar panel on the female connection shall be red with corresponding male connection.

3.11.4.6. **Solar Panel Storage:**

3.11.4.7. Solar panel shall be placed in a stainless steel lockable storage slide pocket or enclosure that is bolted to the sand media filter skid and protects the glass face from sketches and breakage.

3.11.4.7.1. Design must be approved with Rain for Rent Engineering Dept.

3.11.5. **Y-Filter:**

3.11.5.1. Y-filter shall have a ball valve drain

3.11.5.2. (API 3/4" male NPT w/MHT ball valve (80 PSI) (a) / 150 mesh, model # 4E-3/4B-200, part # 12130078 or equivalent)

3.11.6. **Battery:**

3.11.6.1. Battery shall be a marine deep cycle battery, lockable stainless steel battery box with stainless steel hinge and bolted to the skid.

3.11.6.2. Battery shall be secured inside of the box with two threaded stainless steel L-bolts and stainless steel top brace.

3.11.6.3. Grommets of battery lead protection shall be placed in all battery lead holes.

3.11.7. **Grounding Lug:**

3.11.7.1. A copper grounding lug capable of holding AWG size #2 minimum wire to AWG #2/0 maximum wire shall be attached to the skid adjacent to the voltage conversion box.

3.11.7.2. Ground wire shall be attached between Control Box and Grounding Lug.

3.11.8. Voltage Conversion Box:

3.11.8.1. A voltage conversion box shall be provided to switch from 12V DC power to 120 VAC power.

3.11.8.2. It shall consist of a NEMA type 12 rated enclosures, solid state charge regulator with status light, 15amp 125 VAC marine type receptacles, warning label for grounding voltage indicator and 12V DC/120vac.

3.11.8.3. The voltage box shall also include an environmentally sealed toggle switch and the ability to be added as a retrofit.

3.12. **Skid:**

3.12.1. **Skid:**

3.12.1.1. **Skid shall be designed by manufacture and to include the following**

3.12.1.1.1. Skids for all units shall be constructed of carbon steel and be equipped with 4) d-rings for lifting.

3.12.1.1.2. The skid shall have an extension and support to provide protection for the pressure sustaining valve.

3.12.1.1.3. All side forklift pockets shall be designed with rectangular tube as follows.

3.12.1.1.3.1. 18"-2 will have 8" by 4", 3/16" minimum wall thickness.

3.12.1.1.3.2. 24"-3 will have 8" by 4", 3/16" minimum wall thickness.

3.12.1.1.3.3. 36"-2 will have 8" by 4", 3/16" minimum wall thickness.

3.12.1.1.3.4. 36"-3 will have 8" by 4", 1/4" minimum wall thickness.

3.12.1.1.3.5. 48"-2 will have 8" by 4", 1/4" minimum wall thickness.

3.12.1.1.3.6. 48"-4 will have 8" by 4", 1/4" minimum wall thickness

3.12.2. **Dimensions:**

3.12.2.1. No item is to hang over or extends beyond the skid edges.

3.13. **Weld:**

3.13.1. All welds must comply with American welding society, weld code AWS structural D1.1

3.14. **Galvanize:**

3.14.1. In compliance with ASTM A-123, ASTM A-143, ASTM A-153, ASTM A-384 and ASTM A-385 standards.

3.15. Touch-Up:

3.15.1. Touch-up with organic Zink-Rich Paint complying with MIL-P-21035B or MIL-P-26915C in multiple coats.

3.15.1.1. Touch-up paint shall be a minimum of 8 mil.

4. **Welding:**

4.1. All welds must comply with American welding society, weld code AWS structural D1.1

4.2. Remove all welding slag and burrs.

5. **Miscellaneous:**

5.1. Air Vents and Pressure Reducing/Sustaining Valves Will Be Provided By Manufacturer For Assembly To Filter Units Before Hydro-testing.

6. **Quality Control:**

6.1. The completed filter skid shall be hydro-tested for leaks @ 100psi for a period of fifteen minutes.

6.2. Filter control will be tested for proper solenoid valve operation and wiring.

6.3. A detailed quality control checklist should be completed and signed by the inpsecting agent.

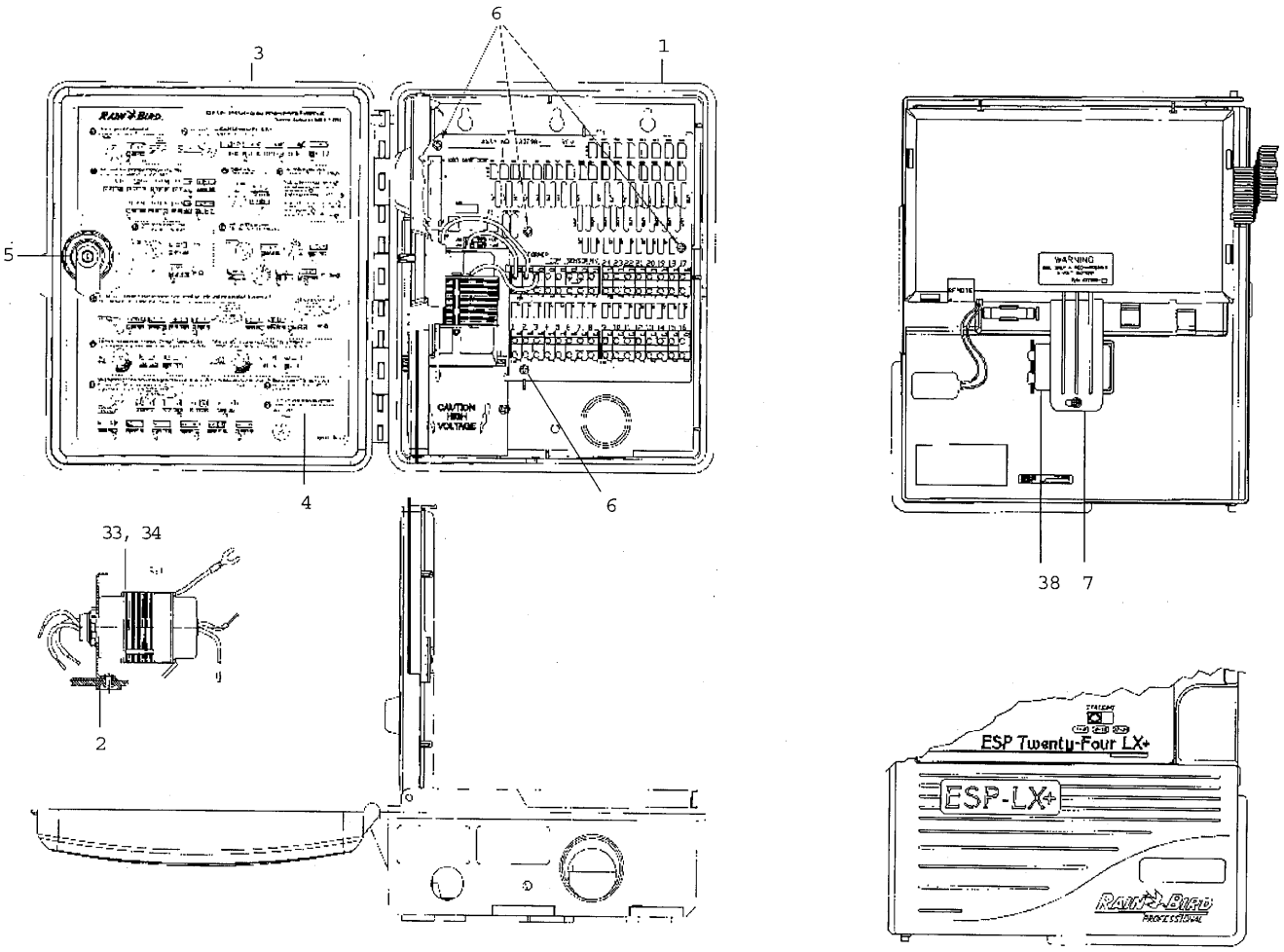
7. **Workmanship**
   7.1. All assembly including cutting, welding, painting, galvanizing and wiring shall be done in a professional workmanship like manner in accordance with these specifications.
   7.2. All units must meet current state and federal vehicle regulations where applicable.
   7.3. Units not meeting minimum standards are considered non-conforming and will not be accepted by Rain For Rent™
8. **Painting and Finish**
   8.1. Skid assembly shall be hot dipped galvanized as per ASTM A384, A385.
   8.2. Completed assembly non-galvanized items shall receive a primer base coat, allowed to cure prior to application of finish paint coats. Color to be specified by the customer.
   8.3. Material preparation and application of prime and finish paint coats to meet WOSCO Carbon Steel Equipment Coating Specification 101009.
   8.4. Decals
      8.4.1. The contractor is responsible to apply all required decals and unit numbers.
      8.4.2. The contractor may be required to supply the unit number decals.
      8.4.3. Rain for Rent will be responsible for supplying all required decals.
      8.4.4. Rain for Rent will be responsible for specifying location of all decals and unit numbers.
9. **Inspection**
   9.1. Rain for Rent reserves the right to inspect the equipment being constructed at any time. The contractor will be responsible for providing safe access, inspection equipment and any assistance required for inspection.
   9.2. It is the responsibility of the contractor to perform his own quality control inspection prior to the release of any equipment to Rain for Rent. After this point, any and all corrective work must be done at the contractor's expense, and re-inspected to confirm that the deficiencies have been corrected.
   9.3. The Rain for Rent Engineering Department may require a demonstration of such condition.
   9.4. The completed Sand Media Filter assembly shall be inspected by qualified Rain for Rent™ personnel prior to acceptance into inventory and/or shipment. The unit(s) may be rejected for receipt if contractors do not meet standards.
   9.5. The completed filter unit shall be test run to certify unit is qualified personnel shall perform this test.
10. **Parts and Warranty**
   10.1. The warranty period for all new filter units shall be one year from date of purchase.
11. **Drawings, Specifications, And E.C.O.'S Specified:**
   11.1. **Rain For Rent Drawing #:**
      11.1.1.
   11.2. **Specification #:**
      11.2.1. 101009
   11.3. **ECO #:**
      11.3.1.
12. **Specification:**
   12.1. Specification is only valid to construct Rain for Rent equipment when a valid P.O. number or expiration date is listed. Specification needs to be returned to Rain for Rent upon completion of P.O. or after expired date or destroyed per Rain for Rent engineering specifications.

Sprinkler System 1 Controller

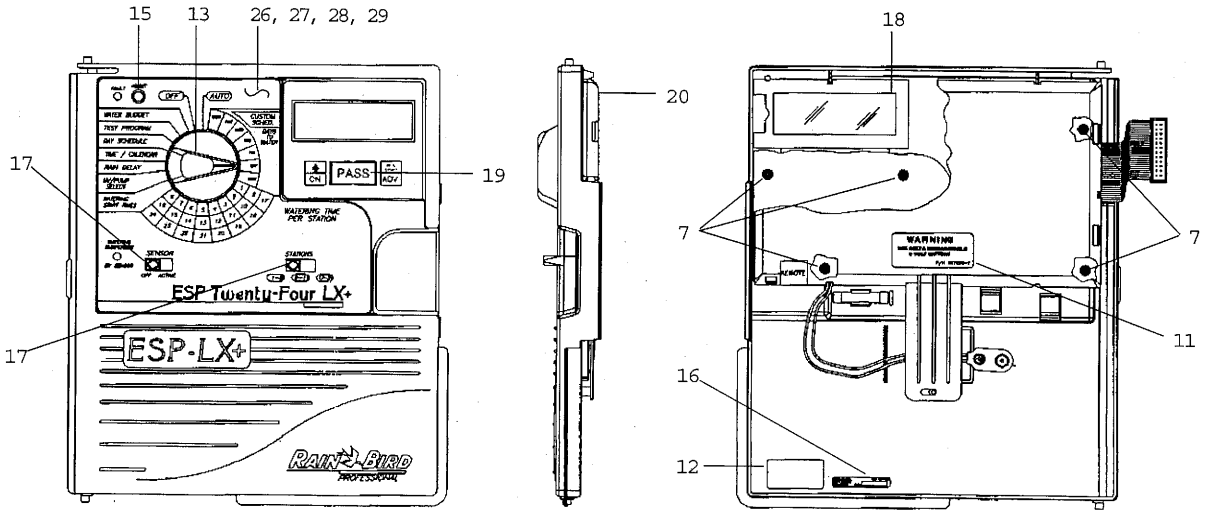
ESP-LXI+ & ESP-LX+ CONTROLLER
ESP-20LX+ AND ESP-24LX+

RAIN BIRD

ESP-LX+ Front Panel & Door Assemblies - Front Panel in Open Position



ESP-LX+ Front Panel & Door Assemblies - Front Panel in Closed Position

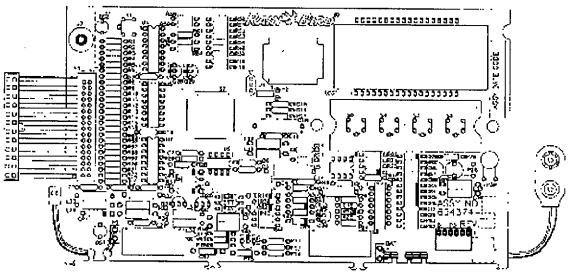


Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

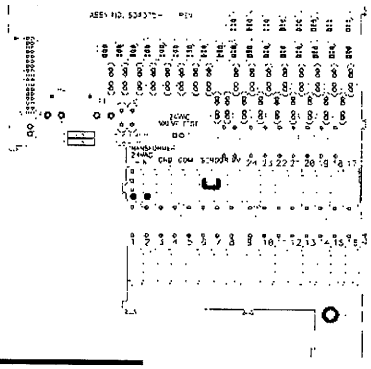
TO BUY GENUINE RAIN BIRD PARTS, CONTACT YOUR LOCAL DISTRIBUTOR OR VISIT OUR ONLINE STORE AT WWW.RAINBIRD.COM

ESP-LXI+ & ESP-LX+ CONTROLLER
ESP-20LX+ AND ESP-24LX+

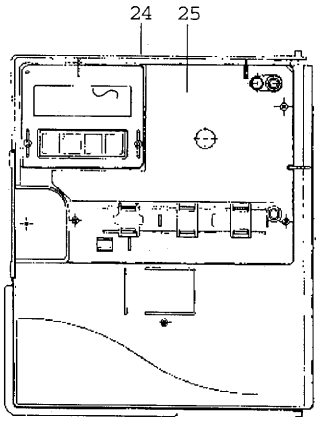
Control PWB Assembly



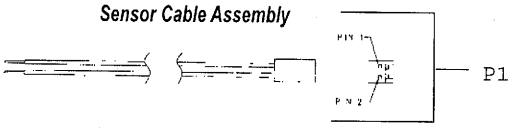
Terminal PWB Assembly



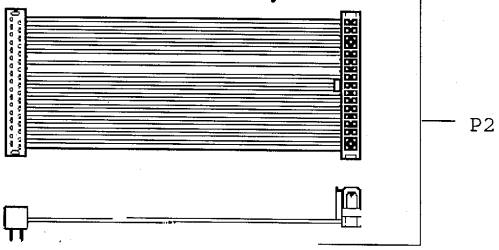
Front Panel and Shield



Sensor Cable Assembly



Cable Harness Assembly



Ref.	Description	Qty.	ESP-20LX+	ESP-24LX+
CABINET ASSEMBLY				
1	Case, ESP-LX+	1	(631750)	(631750)
2	Rivet Blind 0.19	1	(650434-13)	(650434-13)
DOOR ASSEMBLY ESP-LX+		1	(633430)	(633430)
3	Door ESP-LX+	1	(631751)	(631751)
4	Label programming ESP-LX+	1	633431	633431
5	Lock Cam	1	650755	650755
6	Screw PHL PNH HI-LO 6-19X3/8	5	(650183-46)	(650183-46)
7	Screw, 4-24 x 5/16 HI-LO w/WSHR	1	(650563-23)	(650563-23)
8	Hinge Pin	1	631757	631757
9	Washer, Nylon # 3 size	1	(650878)	(650878)
10	Cable Tie, Nylon 7/8 Bundle	1	650131	650131
FRONT PANEL ASSEMBLY ESP-LX+		1	K94912	K94412
11	Label warning C/C 8/12	1	(627298)	(627298)
12	Label Date Code	1	(627867)	(627867)
13	Funct. Select Knob Assy. Gray	1	630946	630946
14	Ring Compression	1	(650505-06)	(650505-06)
15	Button ,TM PB Swich	1	(631136)	(631136)
16	Label serial, ESP	1	(631183)	(631183)
17	Actuator Slide Switch	2	(632510)	(632510)
18	Lens ,LCD ESP-C/LX	1	632700	632700
19	Keypad Silicone	1	(632908)	(632908)
20	Cover/Shield, Assy. CPU	1	(632912-02)	(632912-02)
21	Cover, CPU Board- ESP-LX+	1	(632516)	(632516)
22	Shield, CPU Board Cover	1	(632911-02)	(632911-02)

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

RAIN BIRD

ESP-LXI+ & ESP-LX+ CONTROLLER
ESP-20LX+ AND ESP-24LX+

Ref.	Description	Qty.	ESP-20LX+	ESP-24LX+
23	Shield, Front Panel Assy.,ESP-LX+	1	(632914)	(632914)
24	Front Panel ESP-LX+	1	(632294)	(632294)
25	Shield Front Panel ESP-LX+	1	(632913)	(632913)
26	Overlay ESPLX+ 24 stations	1	–	(633329)
27	Overlay ESPLX+ 20 stations	1	(634233)	–
28	Overlay Remote Ready ESP-LX+ 24 stations	1	–	(634456)
29	Overlay Remote Ready ESP-LX+ 20 stations	1	(634455)	–
CABLE ASSEMBLIES				
P2	Cable Harness Assy.	1	(633322)	(633322)
P1	Sensor Cable Assy.	1	(632048-02)	(632048-02)
CONTROL PWB ASSEMBLY		1	(634374)	(634374)
S7	Switch Rotary 24 POSITIO	1	(630609)	(630609)
S6	Switch 4 POS Slide	1	(630651)	(630651)
S8	Switch 4 POS Slide	1	(630651)	(630651)
30	Label Bar Code 39, Date Code	1	(631356-01)	(631356-01)
(LCD1)	Spacer LCD	1	(632046)	(632046)
J3	Spring Shield	1	(632898-01)	(632898-01)
(J3)	Spring Shield	1	(632898-02)	(632898-02)
LCD1	Display Liquid Crystal	1	(633087)	(633087)
U1	Masked MicrocomputerTMP87PP21F	1	(633088)	(633088)
CR6	Diode Switching 1N4148	1	650037-01	–
CR4,8,9,11, 12,13	Diode Switching 1N4148	6	650037-01	650037-01
VR1	Diode Zener 1N5242 12V	1	650038-17	650038-17
VR2,VR3	Diode Zener 1N5232B 5.6V	2	(650038-71)	(650038-71)
C5,C18	CAP Elect AX 10V 47MF	2	(650044-03)	(650044-03)
BAT	Battery Snap 9V	1	650075	650075
CR1,2,7,10,14	Diode, Gen Purpose 1 AMP 1N4002	5	650077-02	650077-02
R20,27,37	Res. 1/4W 10% 10 OHM	3	(650079-25)	(650079-25)
R38	Res. 1/4w 10% 150 OHM	1	(650079-53)	(650079-53)
R1-R17 , R65-R72	Res. 1/4w 10% 270 OHM	25	–	(650079-59)
R1-17, R65-68	Res. 1/4w 10% 270 OHM	21	(650079-59)	–
R26,31, R44,45, R76	Res. 1/4w 10% 1.0 K	5	(650079-73)	(650079-73)
R19,21,22,23, 30,35,36,39, 49,77,78	Res. 1/4w 10% 4.7 K	11	650079-89	650079-89
R24	Res. 1/4w 10% 10 K	1	(650079-97)	(650079-97)
R18,40	Res. 1/4w 10% 47 K	2	(650080-14)	(650080-14)
R62	Res. 1/4W 10% 82K	1	(650080-20)	(650080-20)
R25,41, R50-61, R63,64,73	Res. 1/4w 10% 100 K	17	(650080-22)	(650080-22)
R28,29,75, R42,43,74	Res. 1/4w 10% 220 K	6	(650080-30)	(650080-30)
R33,34	Res. Power metal film, 2W, 10 OHM	2	(651322)	(651322)
R32,46,47	Res. 1/2w 10% 1.0K	3	(650202-73)	(650202-73)
C3,6,7,12,16, 17,19,22,23	Cap. .10MF 50V	9	(650085-55)	(650085-55)
C1,2,13,14, 15,20,21	Cap. .01 uF 100V	7	(650882-01)	(650882-01v
C10,11	Cap. CER 100V 10% 15PV	2	(650883-03)	(650883-03)
C4	Cap. Elctl, 33OUF AX 25V	1	(650624)	(650624)
C24	Cap. .001uF	1	(650882-31)	(650882-31)

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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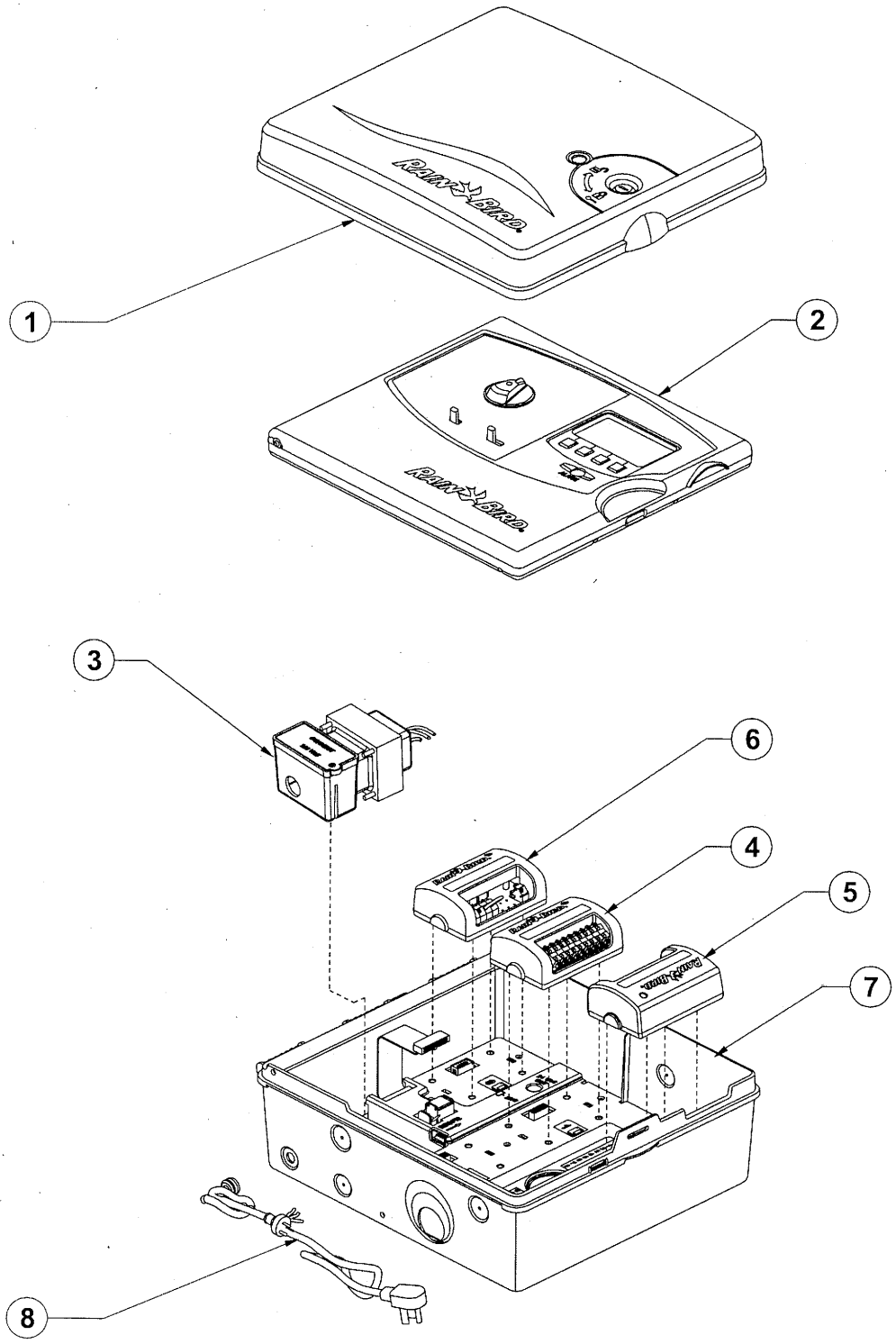
ESP-LXI+ & ESP-LX+ CONTROLLER
ESP-20LX+ AND ESP-24LX+

Ref.	Description	Qty.	ESP-20LX+	ESP-24LX+
CONTROL PWB ASSEMBLY (cont.)				
C5,C18	Cap. Elctl, AX 10V 47UF	2	(650044-03)	(650044-03)
C25	Cap. NPO, Axial	1	(650883-17)	(650883-17)
31	Solder "SN 63" Was 626894	0.01	(650160)	(650160)
L26-L34	Inductor Ferrite	9	650300-05	650300-05
U3	IC LM324 Quad OP AMP	1	650358	650358
U6	I.C EEPROM, Serial AT24C32-10PC	1	(651012)	(651012)
U2	IC Power Regulator 8 PIN DIP	1	(650874)	(650874)
U4,5,7	IC 74HC259 8 BIT	3	650889	650889
Q26,30,31	Transistor MPS 4124	3	650367	650367
Q28,Q29	Transistor PNP	2	650369	650369
Y2	Crystal 861-T 32.768	1	(650484)	(650484)
S6-S8	Switch Lubricant	0.0001	(650588)	(650588)
S1-5	Switch Push button SPST	5	(650748)	(650748)
DS1,DS2	LED, Red	2	650910	650910
Q27	Triac, 1 AMP 200V	1	(650933)	(650933)
(J3)	Eyelet , Spring.089 O.D.	1	(650985)	(650985)
Y1	Resonator, Ceramic 8.00 MHZ	1	(651013)	(651013)
P3	6 pin Right angle header	1	(651306-05)	(651306-05)
LP28,29,30	Varistor, metal-oxide 7mm 50V 1200A	3	(651111)	(651111)
32	Mounting Plate , XFMR	1	(631662)	(631662)
33	Transformer 120V / 60HZ.	1	631661-01	631661-01
34	Transformer 230V / 50HZ.	1	633457-01	633457-01
TERMINAL PWB ASSEMBLY		1	(635801)	(635801)
35	Label, Bar code 39	1	(631356-01)	(631356-01)
(TB4)	Pin Dial	2	622866	622866
(TB4)	Pin, Snap-lock	2	(651651-07)	(651651-07)
(TB4)	Pin, Snap-lock	2	(651651-01)	(651651-01)
(TB4)	Sensor Jumper Wire	1	(633442)	(633442)
TB6	Terminal Block, .300SPC 2 POS	1	(651663)	(651663)
TB3,TB4	Terminal Block, .300SPC 6 POS	2	(651662)	–
TB2	Terminal Block, .300SPC 6 POS	1	(651662)	(651662)
TB3,TB4	Terminal Block, .300SPC 8 POS	2	–	(651449)
TB1	Terminal Block, .300SPC 8 POS	1	(651449)	(651449)
TB5	Single Terminal Block	1	(651327)	(651327)
(F1)	Clip Fuse 1/4 DIA. PCB Mount	2	(650098)	(650098)
37	Solder "SN 63" Was 626894	0.01	(650160)	(650160)
L1-20,L25, L26	Inductor, Axial, 22uH, 1A	22	(651618-17)	–
L1-L26	Inductor, Axial, 22uH, 1A	26	–	(651618-17)
F1	Fuse, 1 1/2A 250V	1	650431-23	650431-23
R48	Res. Metal Oxide, .10HM 2W, 350V, 2%	1	(650766-01)	(650766-01)
J1	Header, Polzd., .100 CTRS 34PIN	1	(650872-34)	(650872-34)
J2	Header, Polzd., .156 CTRS 2PIN	1	(650893-02)	(650893-02)
LP26,27	MOV. 56V, 500A	2	624624	624624
LP1-25, LP28-52	MOV. 14 mm, 47V, 1000A	50	–	651467
LP1-20,LP25, Lp28-47,LP52	MOV. 14 mm, 47V, 1000A	42	651467	–
Q1-20,Q25	Triac, 6 AMP, 400V Isolated Tab	21	651138	–
Q1-Q25	Triac, 6 AMP, 400V Isolated Tab	25	–	651138
C1-20,C25	Capacitor, Axial .01uF	21	(650882-01)	–
C1-C25	Capacitor, Axial .01uF	25	–	(650882-01)
GT1	Gas Tube 300V 10,000A	1	(651427)	(651427)
ACCESSORIES				
38	Battery NIMH 9V	1	650929	650929
39	Chart, programming valve I.D. ESP-LX+	1	633474	633474
40	English/Spanish Instructions Manual	1	634415	634415
41	International Instructions Manual	1	634229	634229
42	Addendum, ESP-LX+ Raster Test	1	634846	634846

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

Sprinkler System 2 Controller



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ENSURE QUALITY - USE ONLY GENUINE RAIN BIRD PARTS

Ref.	Description	Qty.	ESPLXMI F42000	ESPLXM F42100	IESPLXM F42150	IESPLXMCHI F42170	ESPLXMAUS F42180
1	**Door Assembly**	1	636157-020	636157-010	636157-010	636157-030	636157-010
-	Hook, Manual Holder	1	(635056)	(635056)	(635056)	(635056)	(635056)
-	Door, ESP-LX Modular (Indoor)	1	(636144)	-	-	-	-
-	Overlay, LED, ESP-LX Modular	1	(636195)	(636195)	(636195)	(636195)	(636195)
-	Overlay, Quick Reference, ESP-LX Modular	1	(636283)	(636283)	(636283)	-	(636283)
-	Cam, Lock	1	651656	651656	651656	651656	651656
-	Door, ESP-LX Modular Outdoor	1	-	(636614)	(636614)	(636614)	(636614)
2	**Front Panel Assembly, ESP-LX Modular**		F42010	F42010	F42010	-	F42010
-	Front Panel ESP-LX Modular	1	(636158-01)	(636158-01)	(636158-01)	(636158-02)	(636158-01)
-	Label, Date Code & Serial Number	1	(635600-20)	(635600-20)	(635600-20)	(635600-20)	(635600-20)
-	Select Knob, ESP-LX Modular	1	(635684)	(635684)	(635684)	(635684)	(635684)
-	Slide Switch ACT ESP-LX Modular	2	(635685)	(635685)	(635685)	(635685)	(635685)
-	PWB Assy, Main CPU, ESP-LX Modular	1	(636030-010)	(636030-010)	(636030-010)	(636030-010)	(636030-010)
-	Switch 4 Pos Slide	2	(630651)	(630651)	(630651)	(630651)	(630651)
-	Label, Bar Code 39, Date Code	1	(631356-01)	(631356-01)	(631356-01)	(631356-01)	(631356-01)
-	Retainer Clip, COIN Cell	1	(635535)	(635535)	(635535)	(635535)	(635535)
-	PWB FAB, MainCPU, ESP-LX Modular	1	(636031-010)	(636031-010)	(636031-010)	(636031-010)	(636031-010)
-	Rotary Switch, Gray Code	1	(636285)	(636285)	(636285)	(636285)	(636285)
-	Switch, P.B.	4	(650748-01)	(650748-01)	(650748-01)	(650748-01)	(650748-01)
-	LED, Clear Red Super Bright	1	(650910-R)	(650910-R)	(650910-R)	(650910-R)	(650910-R)
-	RES 2W 22 OHM 5%	1	(650955-33)	(650955-33)	(650955-33)	(650955-33)	(650955-33)
-	Battery, Lithium, 3.0 Volts	1	(651009)	(651009)	(651009)	(651009)	(651009)
-	Resistor, Surf MT, 100K OHM, 1/10	5	(651129)	(651129)	(651129)	(651129)	(651129)
-	Resistor, SMD 1/10W, 0805	9	(651586-14)	(651586-14)	(651586-14)	(651586-14)	(651586-14)
-	Thick Film Chip Resistor, 0805, 5%	2	(651586-21)	(651586-21)	(651586-21)	(651586-21)	(651586-21)
-	Thick Film Chip 1K	1	(651586-26)	(651586-26)	(651586-26)	(651586-26)	(651586-26)
-	Thick Film Chip 10K	14	(651586-37)	(651586-37)	(651586-37)	(651586-37)	(651586-37)
-	Thick Film Chip Resistor, 0805, 5%	8	(651586-80)	(651586-80)	(651586-80)	(651586-80)	(651586-80)
-	Multilayer Ceramic Chip	17	(651587-03)	(651587-03)	(651587-03)	(651587-03)	(651587-03)
-	Resonator, Ceramic, 8SMT	1	(651684)	(651684)	(651684)	(651684)	(651684)
-	Resistor 5%, 1/4W SMD, 1206	1	(651686-33)	(651686-33)	(651686-33)	(651686-33)	(651686-33)
-	Resistor 5% 1/4W SMD 12	1	(651686-89)	(651686-89)	(651686-89)	(651686-89)	(651686-89)
-	Capacitor, Ceramic Chip, 0805	3	(651708-05)	(651708-05)	(651708-05)	(651708-05)	(651708-05)
-	Capacitor, Tantalum, SMT 16V	5	(651738-01)	(651738-01)	(651738-01)	(651738-01)	(651738-01)
-	Capacitor, Tantalum, SMT 16V	4	(651738-03)	(651738-03)	(651738-03)	(651738-03)	(651738-03)
-	Capacitor, Ceramic Chip, SMD	2	(651739-25)	(651739-25)	(651739-25)	(651739-25)	(651739-25)
-	Switching Diode, Dual SMT, SOT23	4	(651741)	(651741)	(651741)	(651741)	(651741)
-	ZIF, HOR-MNT T-Contact	1	(651742)	(651742)	(651742)	(651742)	(651742)
-	Header, Dual, Right Angle, TH	1	(651745-12)	(651745-12)	(651745-12)	(651745-12)	(651745-12)
-	Resistor, Power, Axial, 1W	1	(651748-15)	(651748-15)	(651748-15)	(651748-15)	(651748-15)
-	IC, Transparent Latch, SMT	2	(651752)	(651752)	(651752)	(651752)	(651752)
-	SRAM 32KB, SOJ-28, IDT71V256SA20	1	(651753)	(651753)	(651753)	(651753)	(651753)
-	Decoder 3-8, SO-16, T&R	1	(651754)	(651754)	(651754)	(651754)	(651754)
-	NOR Gate, SMT SOIC-14	1	(651755)	(651755)	(651755)	(651755)	(651755)
-	Timekeeping Chip, 3.3V	1	(651757)	(651757)	(651757)	(651757)	(651757)
-	Transistor, PNP, 600MA	1	(651765)	(651765)	(651765)	(651765)	(651765)

Note: Part Number enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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Ref.	Description	Qty.	ESPLXMI F42000	ESPLXM F42100	IESPLXM F42150	IESPLXMCHI F42170	ESPLXMAUS F42180
-	Tactile Switch, TH-2Pin	1	(651766)	(651766)	(651766)	(651766)	(651766)
-	Diode, Rectifier, SMD	3	(651787)	(651787)	(651787)	(651787)	(651787)
-	Voltage Regulator, DPAK	1	(651791)	(651791)	(651791)	(651791)	(651791)
-	Diode Zener, 1/2W SOD	1	(651794-20)	(651794-20)	(651794-20)	(651794-20)	(651794-20)
-	Capacitor, Electrolytic, SMD, 35V	1	(651796-10)	(651796-10)	(651796-10)	(651796-10)	(651796-10)
-	Capacitor, Electrolytic, SMD, 25V	1	(651797-09)	(651797-09)	(651797-09)	(651797-09)	(651797-09)
-	Cap Tantalum, SMD 6.3V	2	(651875-01)	(651875-01)	(651875-01)	(651875-01)	(651875-01)
-	Capacitor, Ceramic Chip SMD, 1206, X7R	2	(651876)	(651876)	(651876)	(651876)	(651876)
-	Resistor, SMD, 1/10W	1	(51880-50)	(51880-50)	(51880-50)	(51880-50)	(51880-50)
-	Resistor, SMD, 1/10W	1	(651880-71)	(651880-71)	(651880-71)	(651880-71)	(651880-71)
-	Thick Film Chip Resistor, 0805, 1%	1	(651882-30)	(651882-30)	(651882-30)	(651882-30)	(651882-30)
-	Thick Film Chip Resistor, 0805, 1%	2	(651882-38)	(651882-38)	(651882-38)	(651882-38)	(651882-38)
-	Thick Film Chip Resistor, 0805, 1%	9	(651882-68)	(651882-68)	(651882-68)	(651882-68)	(651882-68)
-	Thick Film Chip Resistor, 0805, 1%	1	(651883-59)	(651883-59)	(651883-59)	(651883-59)	(651883-59)
-	Micro-Cntr, SMT TQFP-64	1	(651886)	(651886)	(651886)	(651886)	(651886)
-	OPAMP LMV 358, SMT, SOIC-8	1	(651991)	(651991)	(651991)	(651991)	(651991)
-	Battery Snap, 9V	1	(651993)	(651993)	(651993)	(651993)	(651993)
-	Cap, Ceramic Chip, SMD, 0805 X7R	1	(652001-30)	(652001-30)	(652001-30)	(652001-30)	(652001-30)
-	Crystal, SMT, 6PF, 32.768Khz	1	(652152)	(652152)	(652152)	(652152)	(652152)
-	Inductor, Chip, Multilayer, 0805	1	(652153-04)	(652153-04)	(652153-04)	(652153-04)	(652153-04)
-	Display Visual Area 82X41 mm	1	(636083)	(636083)	(636083)	(636083)	(636083)
-	Panel Top ESP-LX Modular	1	(636146)	(636146)	(636146)	(636146)	(636146)
-	Panel, Bottom ESP-LX Modular	1	(636147)	(636147)	(636147)	(636147)	(636147)
-	IQ Door	1	(636149)	(636149)	(636149)	(636149)	(636149)
-	Lens/Gasket, LCD, ESP-LX Modular	1	(636153)	(636153)	(636153)	(636153)	(636153)
-	Keypad, 4 Postions	1	(636155)	(636155)	(636155)	(636155)	(636155)
-	Overlay, Main Panel, ESP-LX Modular	1	(636194)	(636194)	(636194)	(636609)	(636194)
-	Overlay, LED, ESP-LX Modular	1	(636195)	(636195)	(636195)	(636195)	(636195)
-	Screw, SLFTPG, PNH, #4-24.500L	6	(650104-03)	(650104-03)	(650104-03)	(650104-03)	(650104-03)
-	ESP-LX Modular Hardware Package	1	(636263-02)	(636263-01)	(636263-01)	(636263-01)	(636263-02)
-	Screw, TRHD Phil, Type A, 1 1/4	4	(651021-16)	(651021-16)	(651021-16)	(651021-16)	(651021-16)
-	Plastic Anchor 10-12 X 1" ESPM	4	(651393-03)	(651393-03)	(651393-03)	(651393-03)	(651393-03)
-	Cabinet Assy, ESP-LX Modular	1	(636266-02)	(636266-01)	(636266-04)	(636266-04)	(636266-03)
3	**Transformer Assembly, ESP-LX Modular**	**1**	**637118-010**	**637118-010**	**637118-020**	**637118-020**	**637118-030**
-	J-Box	1	(636145)	(636145)	(636145)	(636145)	(636145)
-	Transformer, Power, 120Vac	1	(636209)	(636209)	-	-	-
-	J-Box Cover	1	(636181-01)	(636181-01)	(636181-02)	(636181-02)	(636181-03)
-	Transformer, Power, 230VAC	1	-	-	(636210-02)	(636210-02)	(636210-06)
4	**8-Station Module, ESP-LX Modular**	**1**	**F42210**	**F42210**	**F42210**	**F42210**	**F42210**
-	PWB Assy, Generic Module, ESP-LX Modular	1	(636039-010)	(636039-010)	(636039-010)	(636039-010)	(636039-010)
-	PWB FAB, Generic Module, ESP-LX Modular	1	(636040-010)	(636040-010)	(636040-010)	(636040-010)	(636040-010)
-	LED, Clear Red, Super Bright	1	(650910)	(650910)	(650910)	(650910)	(650910)
-	Terminal Blk, W/ANG LED Condut.	8	(651000-01)	(651000-01)	(651000-01)	(651000-01)	(651000-01)
-	Resistor, Surf MT, 100K OHM, 1/10	1	(651129)	(651129)	(651129)	(651129)	(651129)
-	Triac, 6AMP, 400V, Isolated Tab	8	651138	651138	651138	651138	651138
-	MOV, 47 V, 1000 A	8	651467	651467	651467	651467	651467

Note: Part Number enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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Ref.	Description	Qty.	ESPLXMI F42000	ESPLXM F42100	IESPLXM F42150	IESPLXMCHI F42170	ESPLXMAUS F42180
-	Resistor, SMD 1/10W, 0805	8	(651586-14)	(651586-14)	(651586-14)	(651586-14)	(651586-14)
-	Thick Film Chip Resistor, 0805, 5%	1	(651586-21)	(651586-21)	(651586-21)	(651586-21)	(651586-21)
-	Thick Film Chip 1K	8	(651586-26)	(651586-26)	(651586-26)	(651586-26)	(651586-26)
-	Thick Film Chip 1M OHMS	1	(651586-49)	(651586-49)	(651586-49)	(651586-49)	(651586-49)
-	Resistor 5% 1/4W SMD 12	1	(651686-89)	(651686-89)	(651686-89)	(651686-89)	(651686-89)
-	Shrouded Header, Low Profile, TH, 2X5	1	(651768-03)	(651768-03)	(651768-03)	(651768-03)	(651768-03)
-	Schottky Diode, Dual SMT	3	(651786)	(651786)	(651786)	(651786)	(651786)
-	Diode, Rectifier, SMD	1	(651787)	(651787)	(651787)	(651787)	(651787)
-	Transistor, PNP, 350 MW	1	(651788)	(651788)	(651788)	(651788)	(651788)
-	Resistor, SMD, 1/2W	1	(651789-26)	(651789-26)	(651789-26)	(651789-26)	(651789-26)
-	Resistor, SMD, 1/2W	1	(651789-47)	(651789-47)	(651789-47)	(651789-47)	(651789-47)
-	8-Bit Micro, TQFP-32	1	(651790)	(651790)	(651790)	(651790)	(651790)
-	Voltage Regulator, DPAK	1	(651791)	(651791)	(651791)	(651791)	(651791)
-	Diode Zener, 1/2W SOD	1	(651794-20)	(651794-20)	(651794-20)	(651794-20)	(651794-20)
-	Resonator, Ceramic, 8SMT	1	(651684)	(651684)	(651684)	(651684)	(651684)
-	Capacitor, Electrolytic, SMD, 35V	1	(651796-07)	(651796-07)	(651796-07)	(651796-07)	(651796-07)
-	Capacitor, Electrolytic, SMD, 25V	1	(651797-07)	(651797-07)	(651797-07)	(651797-07)	(651797-07)
-	Cap Tantalum, SMD 6.3V	1	(651875-01)	(651875-01)	(651875-01)	(651875-01)	(651875-01)
-	Resistor, SMD, 1/10W	1	(651880-50)	(651880-50)	(651880-50)	(651880-50)	(651880-50)
-	Resistor, SMD, 1/10W	1	(651880-71)	(651880-71)	(651880-71)	(651880-71)	(651880-71)
-	Thick Film Chip Resistor, 0805, 1%	7	(651882-01)	(651882-01)	(651882-01)	(651882-01)	(651882-01)
-	Thick Film Chip 220 ohms	8	(651586-17)	(651586-17)	(651586-17)	(651586-17)	(651586-17)
-	Thick Film Chip Resistor, 0805, 1%	2	(651883-43)	(651883-43)	(651883-43)	(651883-43)	(651883-43)
-	TB, 0.300 Spc, W/2 ANG LED Conductor, Black	1	(651994-01)	(651994-01)	(651994-01)	(651994-01)	(651994-01)
-	Inductor, Radial, High Current (3.9 To 10, 000UH)	8	(652032-18)	(652032-18)	(652032-18)	(652032-18)	(652032-18)
-	Inductor, Chip, Multilayer, 0805	1	(652153-040)	(652153-040)	(652153-040)	(652153-040)	(652153-040)
-	Transistor, N-Channel Mosfet, SOT23	2	(652168-010)	(652168-010)	(652168-010)	(652168-010)	(652168-010)
-	Capacitor, Softterm, 0805, X7R	7	(652288-370)	(652288-370)	(652288-370)	(652288-370)	(652288-370)
-	Capacitor, Softterm, 0805, X7R	3	(652289-250)	(652289-250)	(652289-250)	(652289-250)	(652289-250)
5	**4-Station Module, ESP-LX Modular**	**1**	**F42200**	**F42200**	**F42200**	**F42200**	**F42200**
-	PWB Assy, Generic Module, ESP-LX Modular	1	(636039-010)	(636039-010)	(636039-010)	(636039-010)	(636039-010)
-	PWB FAB, Generic Module, ESP-LX Modular	1	(636040-010)	(636040-010)	(636040-010)	(636040-010)	(636040-010)
-	LED, Clear Red, Super Bright	1	(650910)	(650910)	(650910)	(650910)	(650910)
-	Terminal Blk, W/ANG LED Condut.	4	(651000-01)	(651000-01)	(651000-01)	(651000-01)	(651000-01)
-	Resistor, Surf MT, 100K OHM, 1/10	1	(651129)	(651129)	(651129)	(651129)	(651129)
-	Triac, 6AMP, 400V, Isolated Tab	4	651138	651138	651138	651138	651138
-	MOV, 47 V, 1000 A	4	651467	651467	651467	651467	651467
-	Capacitor, Ceramic Chip, SMD	3	(651739-25)	(651739-25)	(651739-25)	(651739-25)	(651739-25)
-	Resistor, SMD 1/10W, 0805	8	(651586-14)	(651586-14)	(651586-14)	(651586-14)	(651586-14)
-	Thick Film Chip Resistor, 0805, 5%	1	(651586-21)	(651586-21)	(651586-21)	(651586-21)	(651586-21)
-	Thick Film Chip 220 ohms	4	(651586-17)	(651586-17)	(651586-17)	(651586-17)	(651586-17)
-	Thick Film Chip 1K	4	(651586-26)	(651586-26)	(651586-26)	(651586-26)	(651586-26)
-	Thick Film Chip 1M OHMS	1	(651586-49)	(651586-49)	(651586-49)	(651586-49)	(651586-49)
-	Multilayer Ceramic Chip	7	(651587-03)	(651587-03)	(651587-03)	(651587-03)	(651587-03)
-	Resistor 5% 1/4W SMD 12	1	(651686-89)	(651686-89)	(651686-89)	(651686-89)	(651686-89)
-	Shrouded Header, Low Profile, TH, 2X5	1	(651768-03)	(651768-03)	(651768-03)	(651768-03)	(651768-03)

Note: Part Number enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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Ref.	Description	Qty.	ESPLXMI F42000	ESPLXM F42100	IESPLXM F42150	IESPLXMCHI F42170	ESPLXMAUS F42180
-	Schottky Diode, Dual SMT	3	(651786)	(651786)	(651786)	(651786)	(651786)
-	Diode, Rectifier, SMD	1	(651787)	(651787)	(651787)	(651787)	(651787)
-	Transistor, PNP, 350 MW	1	(651788)	(651788)	(651788)	(651788)	(651788)
-	Resistor, SMD, 1/2W	1	(651789-26)	(651789-26)	(651789-26)	(651789-26)	(651789-26)
-	Resistor, SMD, 1/2W	1	(651789-47)	(651789-47)	(651789-47)	(651789-47)	(651789-47)
-	8-Bit Micro, TQFP-32	1	(651790)	(651790)	(651790)	(651790)	(651790)
-	Voltage Regulator, DPAK	1	(651791)	(651791)	(651791)	(651791)	(651791)
-	Diode Zener, 1/2W SOD	1	(651794-20)	(651794-20)	(651794-20)	(651794-20)	(651794-20)
-	Resonator, Ceramic, 8SMT	1	(651684)	(651684)	(651684)	(651684)	(651684)
-	Capacitor, Electrolytic, SMD, 35V	1	(651796-07)	(651796-07)	(651796-07)	(651796-07)	(651796-07)
-	Capacitor, Electrolytic, SMD, 25V	1	(651797-07)	(651797-07)	(651797-07)	(651797-07)	(651797-07)
-	Cap Tantalum, SMD 6.3V	1	(651875-01)	(651875-01)	(651875-01)	(651875-01)	(651875-01)
-	Resistor, SMD, 1/10W	1	(651880-50)	(651880-50)	(651880-50)	(651880-50)	(651880-50)
-	Resistor, SMD, 1/10W	1	(651880-71)	(651880-71)	(651880-71)	(651880-71)	(651880-71)
-	Thick Film Chip Resistor, 0805, 1%	7	(651882-01)	(651882-01)	(651882-01)	(651882-01)	(651882-01)
-	Thick Film Chip Resistor, 0805, 1%	2	(651883-43)	(651883-43)	(651883-43)	(651883-43)	(651883-43)
-	TB, 0.300 Spc, W/2 ANG LED Conductor, Black	1	(651994-01)	(651994-01)	(651994-01)	(651994-01)	(651994-01)
-	Inductor, Chip, Multilayer, 0805	1	(652153-040)	(652153-040)	(652153-040)	(652153-040)	(652153-040)
-	Transistor, N-Channel Mosfet, SOT23	2	(652168-010)	(652168-010)	(652168-010)	(652168-010)	(652168-010)
-	Capacitor, Softterm, 0805, X7R	7	(652288-370)	(652288-370)	(652288-370)	(652288-370)	(652288-370)
6	**Module Assy, Base, ESP-LX Modular**	**1**	**636161-010**	**636161-010**	**636161-010**	**636161-010**	**636161-010**
-	Sensor, Jumper Wire-E-Class	1	(633574)	(633574)	(633574)	(633574)	(633574)
-	PWB Assy, Module 0, ESP-LX Modular	1	(636036-010)	(636036-010)	(636036-010)	(636036-010)	(636036-010)
-	PWB FAB, Module 0, ESP-LX Modular	1	(636037-010)	(636037-010)	(636037-010)	(636037-010)	(636037-010)
-	LED, Clear Red Super Bright	1	650910	650910	650910	650910	650910
-	Polyswitch, RXE Series	1	(651055-08)	(651055-08)	(651055-08)	(651055-08)	(651055-08)
-	Resistor, Surf MT, 100K OHM, 1/10	1	(651129)	(651129)	(651129)	(651129)	(651129)
-	Triac, 6AMP, 400V, Isolated Tab	1	651138	651138	651138	651138	651138
-	MOV, 47 V, 1000 A THK<0.15"	3	651467	651467	651467	651467	651467
-	Resistor, SMD, 1/10W	1	(651586-10)	(651586-10)	(651586-10)	(651586-10)	(651586-10)
-	Thick Film Chip Resistor, 0805, 5%	1	(651586-21)	(651586-21)	(651586-21)	(651586-21)	(651586-21)
-	Thick Film Chip 1K	1	(651586-26)	(651586-26)	(651586-26)	(651586-26)	(651586-26)
-	Thick Film Chip 10K	1	(651586-37)	(651586-37)	(651586-37)	(651586-37)	(651586-37)
-	Thick Film Chip RES 1/2	2	(651614-26)	(651614-26)	(651614-26)	(651614-26)	(651614-26)
-	Cap. Ceramic Chip, SMD	2	(651739-25)	(651739-25)	(651739-25)	(651739-25)	(651739-25)
-	Switching Diode, Dual SMT, SOT23	1	(651741)	(651741)	(651741)	(651741)	(651741)
-	Receptacle, TH, 2X5	1	(651771-03)	(651771-03)	(651771-03)	(651771-03)	(651771-03)
-	TB, 0.300 Spc, W/1 ANG LED Conductor	1	(651772-01)	(651772-01)	(651772-01)	(651772-01)	(651772-01)
-	Transistor, PNP, 350 MW	1	(651788)	(651788)	(651788)	(651788)	(651788)
-	Diode Zener, 1/2W SOD	1	(651794-24)	(651794-24)	(651794-24)	(651794-24)	(651794-24)
-	Cap Tantalum, SMD 6.3V	1	(651875-01)	(651875-01)	(651875-01)	(651875-01)	(651875-01)
-	TB, 0.300 Spc, W/1 ANG LED Conductor, Black	1	(651995-01)	(651995-01)	(651995-01)	(651995-01)	(651995-01)
-	Inductor, Radial, High Current (3.9 To 10, 000UH)	2	(652032-18)	(652032-18)	(652032-18)	(652032-18)	(652032-18)
-	Module Top, ESP-LX Modular	1	(636150-010)	(636150-010)	(636150-010)	(636150-010)	(636150-010)
-	Module Bottom, ESP-LX Modular	1	(636151-010)	(636151-010)	(636151-010)	(636151-010)	(636151-010)
-	ID Strip, Module, ESP-LX Modular (Light Gray)	1	(636152-010)	(636152-010)	(636152-010)	(636152-010)	(636152-010)

Note: Part Number enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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Ref.	Description	Qty.	ESPLXMI F42000	ESPLXM F42100	IESPLXM F42150	IESPLXMCHI F42170	ESPLXMAUS F42180
-	Button Module ESP-LX Modular	2	(636180-010)	(636180-010)	(636180-010)	(636180-010)	(636180-010)
-	Screw, SLFTPG, PNH, #4-24.500L	2	(650104-03)	(650104-03)	(650104-03)	(650104-03)	(650104-03)
7	**Rear Housing Assy, ESP-LX Modular**	**1**	**(636267-020)**	**(636267-010)**	**(636267-010)**	**(636267-010)**	**(636267-010)**
-	PWB Assembly Backplane ESP-LX Modular	1	(636033-010)	(636033-010)	(636033-010)	(636033-010)	(636033-010)
-	PWB FAB, Backplane, ESP-LX Modular	1	(636034-010)	(636034-010)	(636034-010)	(636034-010)	(636034-010)
-	Harness, Flat Cable 24 POS	1	(636089)	(636089)	(636089)	(636089)	(636089)
-	Terminal Block W/ Protection, 3-Position	1	(636817-010)	(636817-010)	(636817-010)	(636817-010)	(636817-010)
-	Wire, A.I.	20	(650625-03)	(650625-03)	(650625-03)	(650625-03)	(650625-03)
-	RES, Metal Oxide .10HM 2W 2%	1	(650766-01)	(650766-01)	(650766-01)	(650766-01)	(650766-01)
-	Cap, .01 UF 100V	2	(650882-01)	(650882-01)	(650882-01)	(650882-01)	(650882-01)
-	Resistor, 1/4W, 1%, Metal	1	(650983-32)	(650983-32)	(650983-32)	(650983-32)	(650983-32)
-	Resistor, 1/4W, 1%, Metal	1	(650983-52)	(650983-52)	(650983-52)	(650983-52)	(650983-52)
-	Resistor, 1/4W, 1%, Metal	1	(650983-70)	(650983-70)	(650983-70)	(650983-70)	(650983-70)
-	Resistor, 1/4W, 1%, Metal	1	(650983-87)	(650983-87)	(650983-87)	(650983-87)	(650983-87)
-	Polyswitch, RXE Series	1	(651055-08)	(651055-08)	(651055-08)	(651055-08)	(651055-08)
-	Polyswitch, RXE Series	1	(651055-16)	(651055-16)	(651055-16)	(651055-16)	(651055-16)
-	MOV, 50 Vac, 2500 A, 10 mm	1	(651272)	(651272)	(651272)	(651272)	(651272)
-	Single Terminal Blck Rising CL	1	(651327)	(651327)	(651327)	(651327)	(651327)
-	MOV, 47 V, 1000 A THK<0.15"	1	651467	651467	651467	651467	651467
-	Header Right Angle Lock	1	(651630-05)	(651630-05)	(651630-05)	(651630-05)	(651630-05)
-	Shrouded Header, Low Profile, TH, 2X5	1	(651768-03)	(651768-03)	(651768-03)	(651768-03)	(651768-03)
-	Receptacle, TH, 2X5	4	(651771-03)	(651771-03)	(651771-03)	(651771-03)	(651771-03)
-	Conector, 3mm, Header W/Clips, Dual, V, Lf	1	(652191-05)	(652191-05)	(652191-05)	(652191-05)	(652191-05)
-	Housing, Rear, ESP-LX Modular (Indoor)	1	(636143-010)	-	-	-	-
-	Backplane Cover, ESP-LX Modular	1	(636148-010)	(636148-010)	(636148-010)	(636148-010)	(636148-010)
-	Screw, SLFTPG, PNH, #4-24.500L	8	(650104-03)	(650104-03)	(650104-03)	(650104-03)	(650104-03)
-	Screw, SLFTPG, PNH, #4-24.500L	2	(650104-03)	(650104-03)	(650104-03)	(650104-03)	(650104-03)
-	Screw PHL PNH Hi-Lo 6-19X3/8	1	(650183-46)	(650183-46)	(650183-46)	(650183-46)	-
-	Wire Nut 22-14, E-Class	3	(651351)	-	-	-	-
8	**AC Cord Insulated**	**1**	**(635038)**	**-**	**-**	**-**	**(636706)**

Accessories

	Programming Chart, Eng/Span	1	636282
	Manual, Eng/Span	1	636281-010
	Quick Reference Guide, Eng/Span	1	636283-010

Note: Part Number enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

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Appendix E

Statement of Understanding

I, the undersigned have received, read, and understand the *Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System—Moab, Utah, Site*.

	Name (Please Print)	Signature	Date	Position
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

Appendix F

Interim Action Operating Data Worksheets

Configuration 1 Extraction Well Field Data Worksheet

Date _____ **Field Rep** _____

Location	Time	Water Depth (ft btoc)	Flow Rate (gpm)	P (psi)	Cumulative Volume (gal)			Field Parameters			Comments
					Total 1	Total 2	T2 Reset (Y/N)	T (^oC)	Spec Cond (x1000 uS/cm)	pH	
470											
471											
472											
473											
474											
475											
476											
477											
478											
479											
Total Flow	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA
Badger Totalizer		NA						NA	NA	NA	
PW−02											

Configuration 2 Well Field Data Worksheet

Date _____ ☐ **Extraction Mode** ☐ **Injection Mode** **Field Rep** _____

Location	Time	Water Depth (ft btoc)	Flow Rate (gpm)	P (psi)	Cumulative Volume (gal)			Field Parameters			Comments
					Total 1	Total 2	T2 Reset (Y/N)	T (^oC)	Spec Cond (x1000 uS/cm)	pH	
570											
571											
572											
573											
574											
575											
576											
577											
578											
579											
Total Flow	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA
Badger Totalizer		NA						NA	NA	NA	

Configuration 3 Well Field Data Worksheet

Date _____ ☐ **Extraction Mode** ☐ **Injection Mode** **Field Rep** _____

Location	Time	Water Depth (ft btoc)	Flow Rate (gpm)	P (psi)	Cumulative Volume (gal)			Field Parameters			Comments
					Total 1	Total 2	T2 Reset (Y/N)	T (^oC)	Spec Cond (x1000 uS/cm)	pH	
670											
671											
672											
673											
674											
675											
676											
677											
678											
679											
Total Flow	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA
Badger Totalizer		NA						NA	NA	NA	

Configuration 4 Well Field Data Worksheet

Date _____ ☐ **Extraction Mode** ☐ **Injection Mode** **Field Rep** _____

Location	Time	Water Depth (ft btoc)	Flow Rate (gpm)	P (psi)	Cumulative Volume (gal)			Field Parameters			Comments
					Total 1	Total 2	T2 Reset (Y/N)	T (^{o}C)	Spec Cond (x1000 uS/cm)	pH	
770											
771											
772											
773											
774											
775											
776											
777											
778											
779											
Total Flow	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA
Badger Totalizer		NA						NA	NA	NA	

Infiltration Trench

Date _____						Field Rep _____			
Injection Ports						**Observation Wells**			**Comments**
Location	**Time**	**Flow Rate (gpm)**	**Volume Data (gal)**			**Location**	**Time**	**Depth to Water (ft bgs)**	
			Total 1	**Total 2**	**T2 Reset ?**				
740						**730**			
741						**731**			
742						**732**			
743						**733**			

Fresh Water Pond Field Data Worksheet

Field Rep _____

Date	Time	Flow Rate (gpm)	P (psi)	Area C Pumps Cumulative Volume (gal)			Field Parameters		
				Total 1	Total 2	T2 Reset (Y/N)	T (°C)	Spec Cond (x1000 µS/cm)	pH

Comment

Date	Time	Flow Rate (gpm)	P (psi)	Area A/B Pump Cumulative Volume (gal)			Field Parameters		
				Total 1	Total 2	T2 Reset (Y/N)	T (°C)	Spec Cond (x1000 µS/cm)	pH

Comment

Area C Irrigation System Totalizer (well field)				Other Uses (Water truck, irrigation system, etc.)		
Date	Time	gpm	Total (gal)	Date	Time	Total (gal)

Evaporation Pond and Sprinkler System Field Data Worksheet

Date _____ **Field Rep** _____

Evaporation Pond

Location	Time	Water Depth (ft)	Flow Rate (gpm)	P (psi)	Cumulative Volume (gal)			Field Parameters			Comments
					Total 1	Total 2	T2 Reset (Y/N)	T (°C)	Spec Cond (x1000 µS/cm)	pH	
Inlet 0547		NA	NA	NA	NA	NA	NA				
Recirc 0548		NA	NA	NA	NA	NA	NA				
Staff Gage			NA	NA	NA	NA	NA	NA	NA	NA	
Totalizer System 1		NA				NA	NA	NA	NA	NA	
Totalizer System 2		NA				NA	NA	NA	NA	NA	

Sprinkler Zones

System 1	Start Time 1 (HHMM)	Start Time 2 (HHMM)	Operating Duration (min)	Operating Schedule (days per week)	Flow Rate (gpm)	Comments
1						
2						
3						
4						
5						
6						
7						
System 2						
1						
2						
3						
4						
5						
6						

Observation Well Field Data Worksheet

Date: **Field Rep:**

Configuration 1			Configuration 2			Configuration 3		
Location	**Time**	**Depth to Water (ft btoc)**	**Location**	**Time**	**Depth to Water (ft btoc)**	**Location**	**Time**	**Depth to Water (ft btoc)**
403			401			680		
407			402			681		
480			408			682		
481			580			683		
482			581			684		
483			582			685		
484			583			686		
485			584			687		
551			585			688		
552			586			689		
553			587					
554			588			**Configuration 4**		
555			589			780		
556			600			781		
557			601			782		
558			602			783		
559						784		
560						785		
561						786		
596						787		

Flow Meter Check Worksheet

Date _____ **Field Rep** _____

Well	Electronic Flow Meter (gpm)	Rotometer (gpm)	Difference (electronic – rotometer) (gpm)	Ratio: Rotometer / Electronic	Rotometer		Comments
					SN	Flow Range (gpm)	

YSI Daily Calibration Check Worksheet

YSI # _____ **Field Rep** _____

Date	Time	Standard	Standard Value	Standard Exp. Date	Measured Value	Within Range ? (Y/N)	Recalibrated (Y/N)	Comments
		Temp.	NA	NA		NA	NA	
		pH 4						
		pH 7						
		pH 10						
		Cond.	10,000					
		ORP						
		D.O.		NA				
Date	**Time**	**Standard**	**Standard Value**	**Standard Exp. Date**	**Measured Value**	**Within Range ? (Y/N)**	**Recalibrated (Y/N)**	**Comments**
		Temp.	NA	NA		NA	NA	
		pH 4						
		pH 7						
		pH 10						
		Cond.	10,000					
		ORP						
		D.O.		NA				
Date	**Time**	**Standard**	**Standard Value**	**Standard Exp. Date**	**Measured Value**	**Within Range ? (Y/N)**	**Recalibrated (Y/N)**	**Comments**
		Temp.	NA	NA		NA	NA	
		pH 4						
		pH 7						
		pH 10						
		Cond.	10,000					
		ORP						
		D.O.		NA				

Wick System Field Data Worksheet				
Date	**Time**	**Total Gallons**	**Gallons Pumped**	**Field Rep**

Appendix G

Interim Action Sampling and Analysis Worksheets

Moab
Water Sampling
Field Data

Configurations _____

RIN No. _____

Sampling Event Date _____

GJO Phone Numbers

877 695-5322 PhoneMail 800 Number

7741	Tim Bartlett	
6654	Sam Campbell	858-1725
6588	Clay Carpenter	
6519	Lila Castella	
6168	Steve Donivan	
6550	Craig Goodknight	243-9496
6560	Lauren Goodknight	
6468	Mike Hurshman	
6564	Ken Karp	
6652	David Miller	245-1225
6598	Keith Miller	
6514	Sarah Morris	
6607	Pauline Myers (GSA Vehicles)	
7787	Ken Pill	241-3790
6592	Jeff Price	241-0398
6557	Dave Traub	245-8421
6549	Environmental Sciences Lab	
6195	Bldg. 32 North End	

970-248-6000 Switchboard
970-248-6070 Security Center Gate (24 hr)
970-260-3308 Security Cell Phone
970-248-6052 Phonemail
970-248-7628 FAX - Lila
970-248-6040 FAX – Center Gate
S. M. Stoller Fed. Ex. # 255 05 8649

Moab Phone Numbers

435 259-5131 Moab Office / Irwin Stewart
435 259-4892 Tom Guthrie (H&S Trailer)
970 640-3101 Tom Guthrie Cell
970 255-9268 Tom Guthrie Home
435 435-4898 Bob Hopping

Moab Address:

PO Box A
2021 North Highway 191

3/29/06

Water Sampling Field Data Quality Assurance Sample Log

Date _____ Well / Location No._____

Sample Number _____

False Identification Location _____

Sample Type: Duplicate Equipment Blank Other:_____

Comment: _____

_____

Date _____ Well / Location No._____

Sample Number _____

False Identification Location _____

Sample Type: Duplicate Equipment Blank Other:_____

Comment: _____

_____

Date _____ Well / Location No._____

Sample Number _____

False Identification Location _____

Sample Type: Duplicate Equipment Blank Other:_____

Comment: _____

_____

YSI Daily Calibrations / Checks

Date _____ Time _____ Initials

YSI # _____ 2100P #_____

Calibration Check

Standard	Standard Value	Measured Value	Within Range? (Y/N)	Recalibrated? (Y/N)	Comments
Temp.	NA		NA	NA	
pH 4					
pH 7					
pH 10					
Cond.	10,000				
ORP					
D. O.					
Turb (low)			NA	NA	
Turb (med)			NA	NA	
Turb (high)			NA	NA	

Note: D.O. Correction Factor for Moab = 0.86

Date _____ Time _____ Initials _____

YSI # _____ 2100P # _____

Calibration Check

Standard	Standard Value	Measured Value	Within Range? (Y/N)	Recalibrated? (Y/N)	Comments
Temp.	NA		NA	NA	
pH 4					
pH 7					
pH 10					
Cond.	10,000				
ORP					
D. O.					
Turb (low)			NA	NA	
Turb (med)			NA	NA	
Turb (high)			NA	NA	

Note: D.O. Correction Factor for Moab = 0.86

WATER LEVELS and WELL MAINTENANCE DATA SHEET

Site: _____ **Date:** _____ **Measuring Device:** _____

	Subsurface Inspection			Surface Components Inspection*							
Well	Time	Depth to Water (ft.)	Total Depth (ft.)	Well Label	Guard-posts	Lock	Conc. Pad	Protective Casing	Riser Cap	Initials	Comments

YSI Pre-Trip Calibration

Date _____ Time _____ YSI No. _____

pH Buffers

4 Manufacturer _____ Lot No. _____ Expiration Date _____

7 Manufacturer _____ Lot No. _____ Expiration Date _____

10 Manufacturer _____ Lot No. _____ Expiration Date _____

Zobell Solution

Lot Number _____ Expiration Date _____ Date Hydrated _____

Nitric Acid

Manufacturer _____ Lot No. _____

Sulphuric Acid

Manufacturer _____ Lot No. _____

Conductivity Calibration

10,000 µmhos/cm **Temp** _____ Pre Cal. Value_____ Cal. Value_____ Exp. Date _____

pH – ORP Calibration

1 Point Calibration 2 Point Calibration 3 Point Calibration (circle) (Cal 7 buffer first)

pH 4 Buffer _____ mV Range +180 ± 50 mV Pre Cal actual value_____ Cal. Value _____

pH 7 Buffer _____ mV Range 0 ± 50 mV Pre Cal actual value_____ Cal. Value _____

pH 10 Buffer _____ mV Range – 180 ± 50 mV Pre Cal actual value_____ Cal. Value _____

ORP cal Temp _____ Pre Cal. Value_____ Cal. Value_____ Exp. Date _____

HACH 2100P Turbidity Calibration

Instrument Number: _____

Primary Calibration Standards Expiration Date: _____

Date of Primary Calibration: _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Dissolved Oxygen Calibration

DO Membrane changed? Y N

DO Charge _____ Range 50 ± 25

DO Gain _____ Range 1.0 -.3 to + .4

Temperature Check

(Compare temperature of any liquid with both YSI and NIST reference thermometer.)

Nist Temp_____ YSI Temp. _____ NIST Cal Date _____ NIST Cal Due Date _____

Name _____

Dissolved Oxygen Saturation Values at Various Temperatures

Temp (°C)	Sat Value (ppm)	Temp (°C)	Sat Value (ppm)	Temp (°C)	Sat Value (ppm)	Temp (°C)	Sat Value (ppm)
0	14.6	11	11.1	22	8.8	33	7.3
1	14.2	12	10.8	23	8.7	34	7.2
2	13.9	13	10.6	24	8.6	35	7.1
3	13.5	14	10.4	25	8.5	36	7.0
4	13.2	15	10.2	26	8.2	37	6.8
5	12.8	16	9.9	27	8.1	38	6.7
6	12.5	17	9.7	28	7.9	39	6.6
7	12.2	18	9.5	29	7.8	40	6.5
8	11.9	19	9.3	30	7.7	41	6.4
9	11.6	20	9.2	31	7.5	42	6.3
10	11.3	21	9.0	32	7.4	43	6.2

Volume Information

Tubing Volume

ID Size	Gallons / Foot	Liters / Foot
1/4”	0.003	0.011
3/8”	0.006	0.023
1/2”	0.010	0.039

1.0 Gallon = 3.785 Liters
1.0 Liter = 0.264 Gallons

Small QED PVC Bladder pumps have a volume of: 130 ml.
Large QED PVC Bladder pumps have a volume of: 395 ml.
YSI 6920 (w/o turbidity) flow cells have a volume of: 360 ml.
YSI 600 XLM flow cells have a volume of 470 ml.

Moab Water Sampling Field Data

Date _____ **Configuration** _____ **EXTR Well / OBS Well / SW Location / PZ No.** _____

Sample Intake Depth
_____ **(ft BGS)**

Well Purging Information

Sample Number _____

Water Level _____ **(ft BTOC)** **Casing Diameter (in)** _____
Depth of well _____**(ft BTOC)** **One pump / tubing Volume** _____ **(L)**

For Extr Wells Only: **Q (gpm)** _____ **Totalizer 1 (gal)** _____ **Totalizer 2 (gal)**_____ **Reset Tot 2?**_____

For Piezometers Only: **Stick up Height** _____ **(ft AGS)** **Depth to Surface Water** _____ **(ft BTOC)**

Sampling Equipment: **Peristaltic** **Bladder (Dedicated)** **Poly Tubing (Dedicated)** **Dedicated Submersible**

Measurement Equipment: **YS I No.** **Hach 2100P Turbidimeter**

Calibration Time_____ **Purge Start Time**_____ **Open container ( )** **Air exclusion ( )** **In-situ ( )**

Time	Total Volume Purged (L)	Water Level	Temp. (°C)	Conductivity ATC (µmhos/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)
Final Sample Data						**Sample Time**		

Alkalinity (Filtered) Hach Kit Method (1.6N H_2SO_4 titration cartridge)

Time _____ Total alkalinity _____ppm as $CaCO_3$ Phenolphthalein alkalinity (for pH 8.3 or greater) ____

Filters: Number of 0.45 µ disposable filters used _____ Filter Type: Low Volume Standard

Sample Preservation: Is ice in cooler (YES) (NO) **Weather:** _____

Well Category **I** **II** **III** **IV** **PZ** Reason for category:
_____

Comments: _____

_____

_____

_____

Signature of Sampler _____ **Date Signed**_____

Checked by _____ **Date Checked**_____

Grand Junction Office
2597 B 3/4 Road
P.O. Box 14000
Grand Junction CO 81503

Water Sampling Equipment List

PUMPS AND ACCESSORIES

- Small peristaltic pumps (2)
  - Extra pump head tubing
  - Power cords
- Downhole tubing
- Surface water hose reel
- Small generator / gas
- Air compressor / control box (*routine events only*)

MONITORING EQUIPMENT

- YSI
- Flow cell w/ 3L container
- 5 gal buckets (2)
- Calibration solutions
  - pH 4 / 7 / 10
  - Cond 1K / 10K / 100K
  - Zobell
- Turbidity meter
- Alkalinity kit
  - Titration cartridges
  - Bromo-methyl packets
- Water level indicators (2 - one w/ small diameter probe)

PAPERWORK

- Field notebook
- Water sampling field data notebooks
- Ticket books
- Labels
- COC forms
- FEDEX airbills / custody seals
- Tape
  - Duct / Strapping

CHEMICALS

- HNO_3
- H_2SO_4

MISC

- Filters (both reg and low vol for pzs)
- Sample bottles (mostly 125's, 6-1L, 6-0.5 L)
- Ice chests
- Table
- Computer (w/ datalogger cables)
- Camera
- Phone
- Paper towels / kimwipes
- Gloves
- DI water / bottles
- Detergent
- Pipettes
- Trash bags
- Beta boots / waders
- Saw / pruning shears