OPERATIONS MANUAL

QED

Environmental Systems

Leaders in Environmental Compliance Products

AP-3 AutoPump®

AutoPump Controllerless System
(for 3-inch wells or larger)

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The equipment in this manual is protected under U.S. and foreign patents issued and pending:

U.S. Patents:	
Selective Oil Skimmer (SOS)	4,497,370
Specific Gravity Skimmer (SPG)	4,663,037
AutoPump (AP)	5,004,405
Specific Gravity Skimmer (SPG) Product Sensing	5,474,685
Vacuum/Pressure Hydrocarbon Recovery System	4,761,225
SPG PSR technology	5,474,685
AP-2	5,641,272
Genie System	5,704,772
Canada Patent:	
Specific Gravity Skimmer (SPG)	1,239,868

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Introduction

Welcome to QED Environmental Systems' AutoPump® (AP-3) manual.

To ensure the best operator safety and system performance, it is strongly recommended that the operators read this entire manual before using the system.

This manual reflects our many years of experience and includes comments and suggestions from our sales and service personnel and most importantly from our customers. The chapters, their contents and sequence were designed with you, the user and installer, in mind. We wrote this manual so it can be easily understood by users who may not be familiar with systems of this type or are using a *QED* system for the first time.

Safety

Safety has been a cornerstone of our design which has been proven out in building and shipping systems throughout the world. Our high level of performance is achieved by using quality components, building in redundancies or backup systems, and not compromising our commitment to quality manufacturing. The net result is the highest quality and safest pneumatic pump recovery system on the market. We feel so strongly about safety, based on years of working with the hydrocarbon industry, that it is the first section in all of our manuals.

ATEX Certications

Equipment with an ATEX label similar to the example on **Figure 1, page 2** is ATEX certified. Equipment without the label is not ATEX certified.

Figures 1 and 2 explain the ATEX label, the label location and appearance.

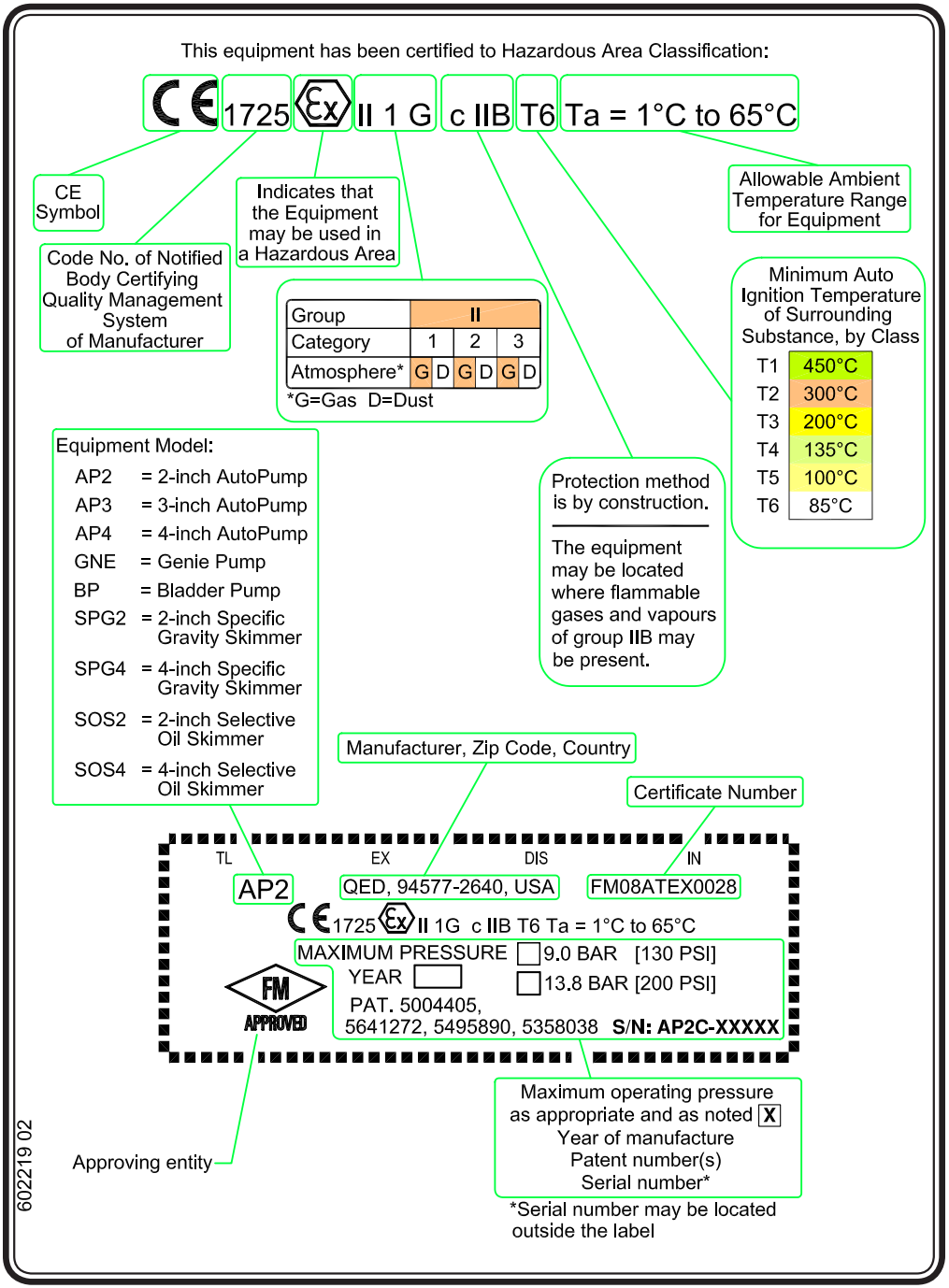


Figure 1 - ATEX Label Detail, Example and Explanation

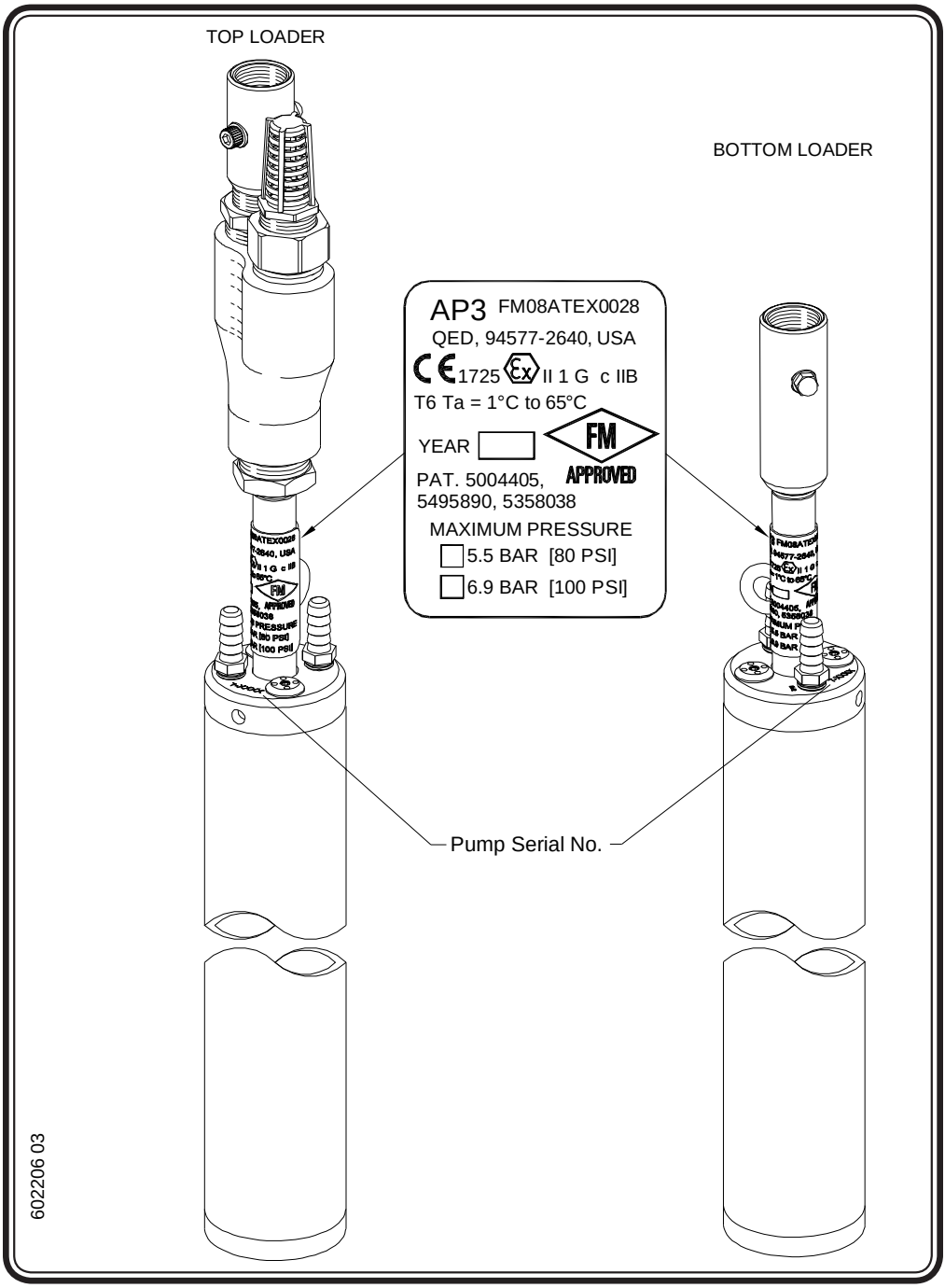


Figure 2 - ATEX Label Location and Apperance

How to Contact *QED*

If for any reason you are unable to find what you need in this manual please feel free to contact the *QED* Service Department at any time. We encourage you to use following communication methods to reach us at any time:

Service Department
QED Environmental Systems
www.qedenv.com

San Leandro Service Center
1565 Alvarado Street
San Leandro, California 94577-2640

(800) 537-1767 — North America Only
(510) 346-0400 — Tele.
(510) 346-0414 — Fax

Ann Arbor Service Center
PO Box 3726
6095 Jackson Road
Ann Arbor, Michigan 48106-3726

(800) 624-2026 — North America Only
(734) 995-2547 — Tele.
(734) 995-1170 — Fax
info@qedenv.com — E-mail

***QED* can be reached 24 hours a day**

We welcome your comments and encourage your feedback regarding anything in this manual and the equipment you have on-site.

Thank you again for specifying *QED* remediation equipment.

Chapter 1: Safety

Safety has been a prime consideration when designing the AutoPump System. Safety guidelines are provided in this manual, and the AutoPump System safety features are listed below. Please do not attempt to circumvent the safety features of this system.

We have also listed some possible hazards involved when applying this system to site remediation. Nothing will protect you as much as understanding the system, the site at which it is being used, and the careful handling of all the equipment and fluids. If you have any questions, please contact the *QED* Service Department for guidance.

As you read through this manual, you will encounter three kinds of warnings. The following examples indicate how they appear and lists their respective purposes.

Note:	Highlights information of interest.
Caution:	Highlights ways to avoid damaging equipment.
WARNING:	Highlights personal safety issues.

A Partial List of Safety Procedures

WARNING:
The air compressor and any other electrical equipment used with this pneumatic system must be positioned outside of any area considered hazardous because of possible combustible materials.

These safety procedures should be followed at all times when operating QED equipment on or off site, and should be considered as warnings:

- Wear safety goggles when working with the AutoPump System to protect eyes from any splashing or pressure release.

- Wear chemically resistant rubber gloves, boots, and coveralls when handling the AutoPump and fluid discharge hose to avoid skin contact with the fluid being recovered.

- Point all hoses away from personnel and equipment when connecting or disconnecting.
- Always ensure that the fluid discharge hose is connected before the air hose to prevent accidental discharge.

The AutoPump System minimizes the potential for accidents with the following safeguards:

Fire and Explosion Protection

Almost all of QED underground fluid extraction systems are pneumatic. This offers many inherent fire and explosion protection features:

- Compressed air lines eliminates electrical wiring in hazardous areas.
- Aluminum or fiberglass enclosures prevent sparking.
- Standard systems use brass fittings to help eliminate sparking hazard.

Personal Protection

On-site, service and maintenance personnel can safely use *QED* equipment. Safety-in-use is the primary design feature in all systems. Following are some samples:

- All standard high pressure air hoses have automatic shut off quick-connects on the supply side which prevents injury due to hose whip or air blown particles.
- Metal regulators and filter bowls are rated at 150 psi. The metal air filter bowl is made of aluminum, providing greater pressure and chemical resistance than plastic bowls and it is less prone to damage if dropped.

Spill Protection

On-site spills cannot always be prevented. *QED* equipment is designed to take into consideration such unpredictable occurrences that may happen despite strict adherence to standardized safety practices.

- The standard air and fluid hoses are rated at over 800 psi burst pressure to prevent accidental hose breakage.
- Down well quick-connects have locking features to prevent accidental disconnections.

Chapter 2: Overview

The AutoPump® fills and empties automatically, and is very easy to install, use, and maintain.

The AutoPump is a pneumatic fluid extraction pump that pumps in pulses. It handles any liquid which flows freely into the pump and is compatible with the component materials and with the connecting hoses.

The AutoPump is very versatile and available in a range of lengths and fluid inlet arrangements to meet particular site specifications.

Equipment will vary by application and site specifications. (See Chapter 3)

General Specifications

Minimum Internal Well Diameter	Bottom Loading	2.8-inch I.D. and larger	7.2-cm I.D. and larger
	Top Loading with Standard Fluid Inlet Fitting	3.75-inch I.D. and larger	9.53-cm I.D. and larger
	Top Loading with Optional Brass Inlet Fitting	3.0-inch I.D. and larger	7.6-cm I.D. and larger
	Top Loading Cup	3.2-inch I.D. and larger	8.1-cm I.D. and larger
Pressure Range	Long	5-100 psi	0.4-7.1 Kg/cm2
	Short	5-80 psi	0.4-5.7 Kg/cm2
Flow Range	Long BL	0 to 7.3 gallons per minute (GPM)	0 to 27.6 liters per minute (LPM)
	Long TL	0 to 5.4 gallons per minute (GPM)	0 to 21.2 liters per minute (LPM)
	Short BL	0 to 6.0 gallons per minute (GPM)	0 to 22.7 liters per minute (LPM)
	Short TL	0 to 4.8 gallons per minute (GPM)	0 to 18.1 liters per minute (LPM)

This is How it Works

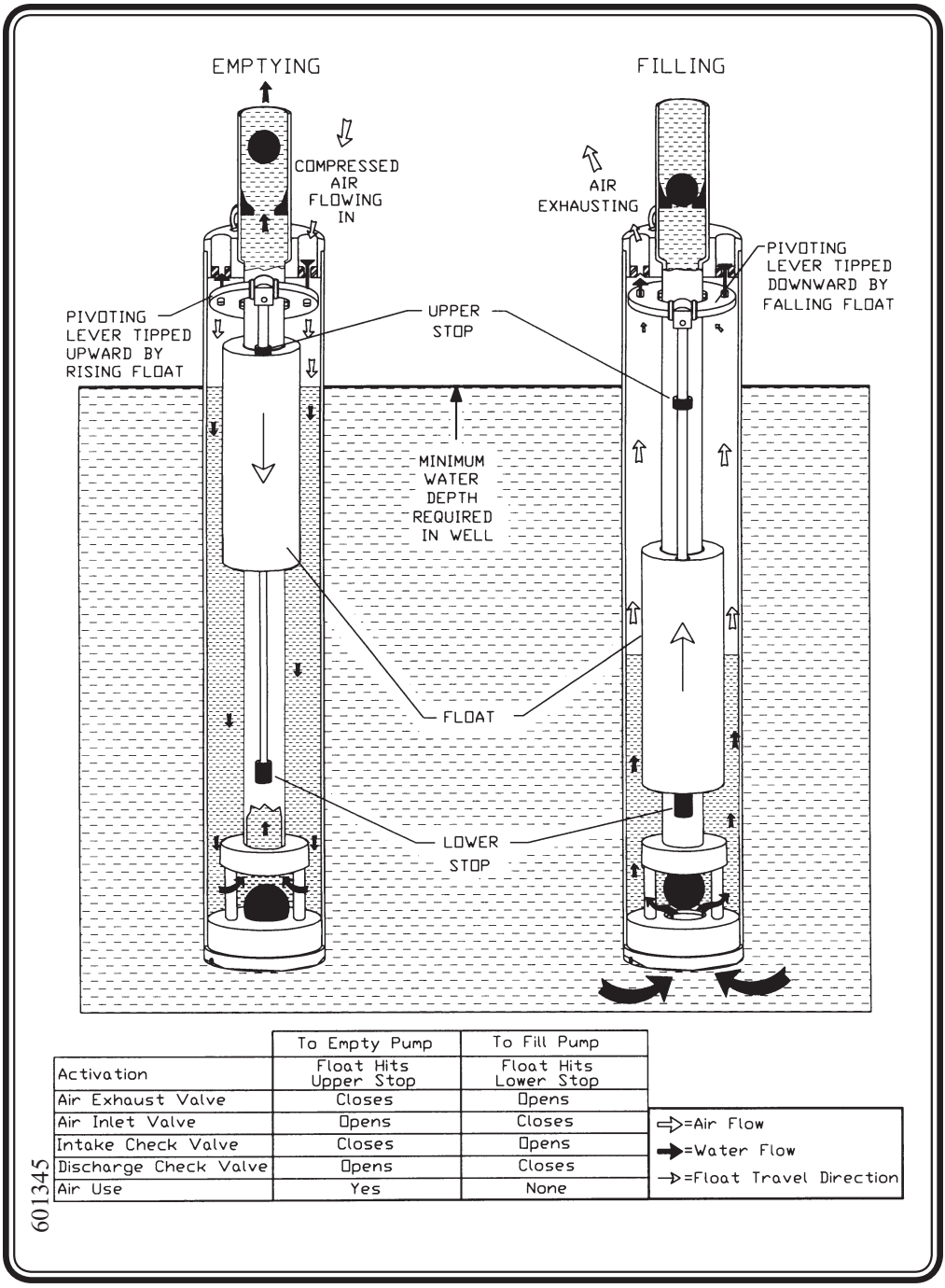
The AutoPump is a submersible compressed air-driven pump which fills and empties automatically. It also controls the fluid level in a well automatically. The pump fills (see Figure 1) when fluids enter either the top or bottom check valve. Air in the pump chamber exits through the exhaust valve as the fluid fills the pump. The float inside the pump is carried upwards by the fluid rising inside the casing until it pushes against a stop on the control rod, forcing the valve mechanism to switch to the discharge mode.

The switching of the valve causes the exhaust valve to close and the air inlet valve to open. This causes the pump to empty **(see Figure 3)** by allowing compressed air to enter the pump. This pressure on the fluid closes the inlet check valve and forces the fluid up the discharge tube and out of the pump through the outlet check valve. As the fluid level falls in the pump, the float moves downwards until it pushes against the lower stop on the control rod, forcing the valve mechanism to switch to the fill mode. The outlet check valve closes and prevents discharged fluids from re-entering the pump. The filling and discharging of the pump continues automatically.

Note: The figures shown here are simplified schematics.

Major AutoPump Features

- The AutoPump System is small and lightweight and can be easily moved from site to site, allowing quick response to changing conditions.
- The hoses are color coded and all the fittings are different so only the proper connections can be made.
- Rugged construction ensures long system life, even under harsh conditions.
- The entire system is pneumatically powered with no electrical components, thus avoiding sparks in control power and sensing devices.
- Durable stainless steel air valves that can pass liquids as viscous as 90 weight gear oil without fouling. The air valves can handle reverse flow and submersion for long periods of time. Unlike pumps with bubblers or bleed lines, there are no problems with start up, clogging, and failure under these difficult conditions when using the AP-3. This results in less downtime and lower training, maintenance, and repair costs.



Activation	To Empty Pump Float Hits Upper Stop	To Fill Pump Float Hits Lower Stop
Air Exhaust Valve	Closes	Opens
Air Inlet Valve	Opens	Closes
Intake Check Valve	Closes	Opens
Discharge Check Valve	Opens	Closes
Air Use	Yes	None

Figure 3 - How it Works

- Unlike systems that rely on bleeding air sensors or timers which pressurize and depressurize the air hoses for each stroke, the air hose for the AP-3 remains pressurized to the pumps at all times. Air compressor power consumption, compressor filter maintenance, and thus operating costs are substantially reduced.

- The AP-3 can be configured to fill from the top or the bottom.

Figure 4 on the next page illustrates an overview of an AutoPump System.

The AP-3 System provides everything required for pumping fluid from a well. QED can also supply the air compressor, if desired.

The system is designed to perform for years and comes with a two year warranty.

Note:
An automatic drain on the compressor is highly recommended since it dramatically decreases air filter maintenance. *QED* can supply an automatic drain.

Caution:
Alteration of the System: Do not change or modify the equipment without the expressed written approval of *QED*.

Special Operating Conditions

Conditions may require adjustment or adaptations to the equipment. Below is a list of some of these conditions, their possible effects, and solutions.

Since every site is different, please contact your QED representative for detailed assistance if needed.

Cold Weather

Moisture in the pneumatic lines can freeze causing problems with the system. Such freezing could result in regulators not reducing the air pressure, valves sticking, and hoses clogging.

Actions To Take

- Use water traps and automatic compressor tank drains. These are available at industrial distributing companies (e.g., W.W. Graingers®).

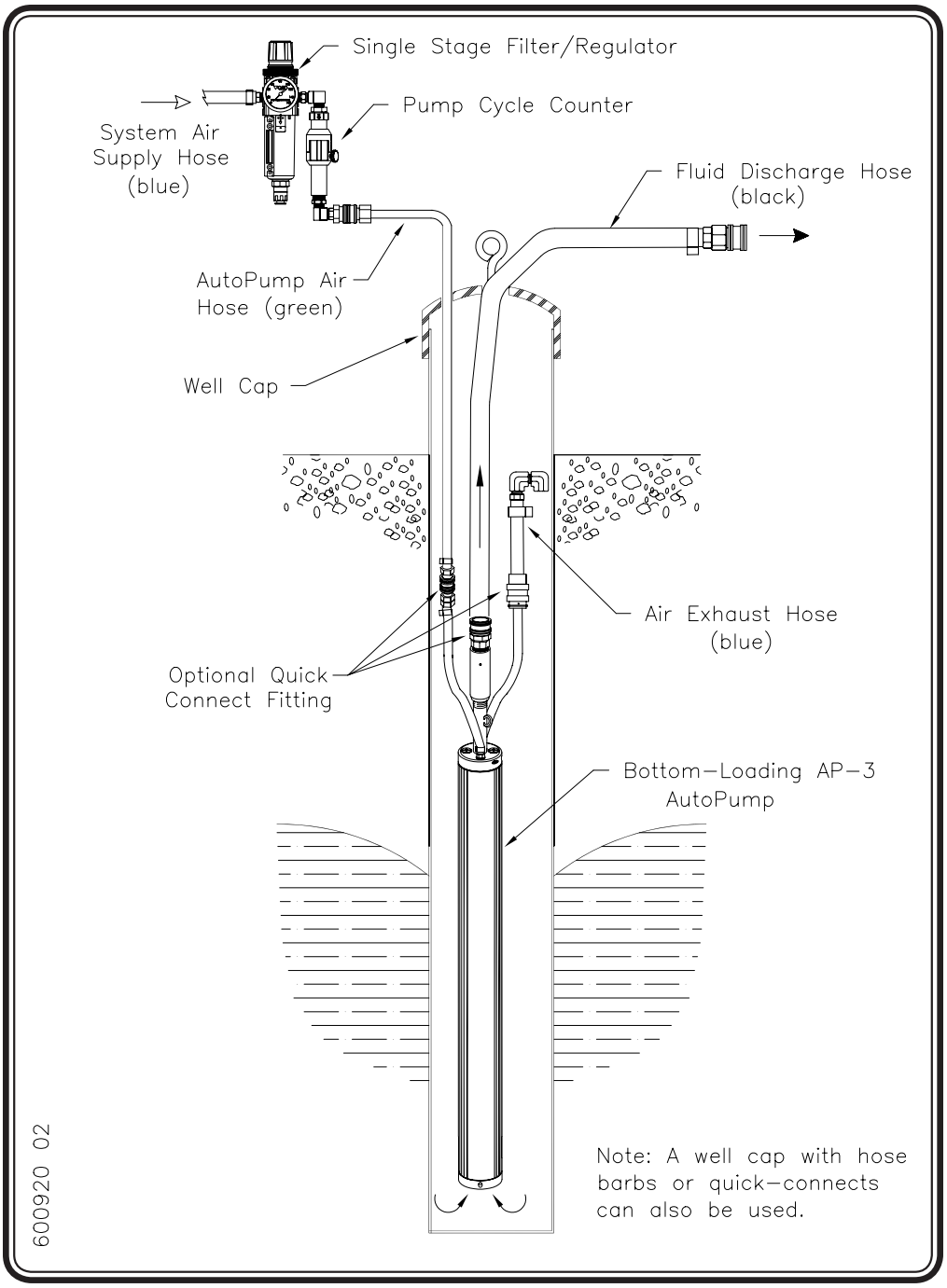


Figure 4 - Overview of the AutoPump System

- Reduce air line freezing by burying air hoses below the frost line, or insulating and heating with heat tape, or running hoses through a PVC pipe with warm air being blown through it.

- Remove all the moisture you can from the air by using drains on the compressor, filter, and low points in the air line. Use an air dryer to lower the dew point of the compressed air below the temperature of exposed lines.

- Protect the air regulator from freezing. During freezing conditions regulators may fail "open", allowing high pressure (e.g. 150 psi from the compressor) to enter components (e.g. gauges, hoses, fluid receptacles) that may be damaged, cause a safety problem, or release contaminating material.

- Locate the air intake to the compressor so the coolest (driest) air is drawn in. Usually it is better to draw air from outside a building than from the inside.

Flow induced freezing

Although it rarely occurs, air flow through an AutoPump may cause freezing internally at water temperatures well above 32˚F, slowing down the system. Cold water, moisture in the compressed air, high air pressure, a high pumping rate, and back pressure on the pump are variables that alone, or in combination with each other, may induce freezing. Should it occur, there are system adaptations which can decrease or eliminate the freezing. Please contact *QED* for advice.

The well is under a vacuum

The pump will work in a well that is under a vacuum, but there several conditions that must be considered.
(See Appendix D)

Abrasive particles in the well

Please contact QED service if you encounter problems with abrasives in the well.

Hard pipe air supply connection to the pump

These can cause debris and scale to travel down to the pump. It can also prevent the pump from cycling smoothly due to a solid connection (non-flexing) to the top of the pump. Blow out all of the hard pipe before connecting the pump. A short (6 feet) length of hose should be used between the hard pipe and the pump to allow the natural movement of the pump to occur without restraint. A small screen filter should be used at the lower end of the metal air pipe to prevent scale from reaching the air valve.

Options and Accessories

The following options and accessories are available from *QED*. Contact your *QED* Representative regarding the following:

- **AP Data Module** – This water-resistant enclosure protects and shields surface instrumentation from weather and/or harsh site conditions while providing easy visual access to key system instrumentation readings. The options available for inclusion inside the NEMA 3R enclosure are a filter/regulator, pump cycle counter, level sensor regulator and gauge with air flow meter. Also included are a fluid level indicator with an On/Off switch, an Air Inlet Supply Gauge, and a Vacuum/Pressure reference with Gauge.

- **Pump Cycle Counter (PCC)** – A PCC counts the number of times a pump cycles. The counter provides information for maintenance, service, and statistical purposes with minimal loss in air pressure or performance. A PCC is easily attached on the air inlet hose to the pump.

- **TFSO** – The Tank-Full Shut-Off (TFSO) System is a unique, self-contained pneumatic system that shuts down other pneumatic systems in the event of a liquid level rise or a pressure increase in a container. The TFSO provides dual safety by using two sensors. The system is expandable—the button sensor of the system can be teed to monitor many containers.

- **Inlet Conversions** – AutoPumps can be converted from Top- to Bottom-Loading and vice versa. See **Appendix C** for more information.

- **Top Loading Cups** – A factory installed stainless steel Top Loading Cup provides a lower drawdown level than a normal Top Loading pump and an increased flow rate. **(see figures 9 and 10)**

- **Extended 5-inch Leachate Screens** – **(see figure 7)**

- **Top loading Brass Fluid Inlet Fitting** – This fitting allows a Top Loading pump to fit in a well with and I.D. as small as 3 inches **(see figure 8**).

- **Extended Bottom Inlet** – A screened inlet many feet below the pump can be provided. This allows the pump to maintain a drawdown level next to a product skimmer while cleaner water deeper in the well is withdrawn to create a cone of depression.

Chapter 3: Equipment

Unpacking

During the unpacking procedure, check for the following:
- All parts on the packing list have been included in the box
- All fitting openings are unobstructed
- The equipment has not been damaged in shipment

Equipment List

The equipment list will vary depending on site specifications, but the following list is a typical configuration:.

1. Top-Loading or Bottom-Loading AP-3 with support ring
2. Single stage filter/regulator with:
    - 5 micron filter with manual drain (auto drain option)
    - Pressure regulator with gauge

3. Pump Cycle Counter (PCC)

4. Hoses:
    - Fluid discharge hose (black)
    - System air supply hose (blue)
    - AutoPump air hose (green)
    - Air exhaust hose (blue)

> **Note:**
> Black nylon tubing can be used in place of hose.

5. Pump support system:
- Well cap
- Polypropylene support rope with quick-link assembly or SS wire rope (Alternate materials as required)

Tools

The following tools are used to service the AP-3:
- Spanner wrench

Parts List

In aggressive sites over millions of cycles, the parts that one may anticipate replacing are:
- Discharge check valve ball

AP-3 AutoPumps

In both the Bottom-Loading and the Top-Loading models, the fluid is pushed out of the pump through a check valve located at the top of the pump. This check valve prevents the fluid from reentering the pump.

Bottom-Loading AP-3/BL

The Bottom-Loading AutoPump fills through a check valve at the bottom of the pump. There are two lengths of AP-3/BL: long and short. The fluid level in the well can be drawn down to 31 inches from the bottom of the long BL, and 22 inches from the bottom of the short BL **(See Figure 5)**

Top-Loading AP-3/TL

The Top-Loading AutoPump fills through a check valve at the top of the pump, therefore the fluid level in the well will never go below the level of this check valve. There are two lengths of AP-3/TL: long and short **(See Figure 6)**

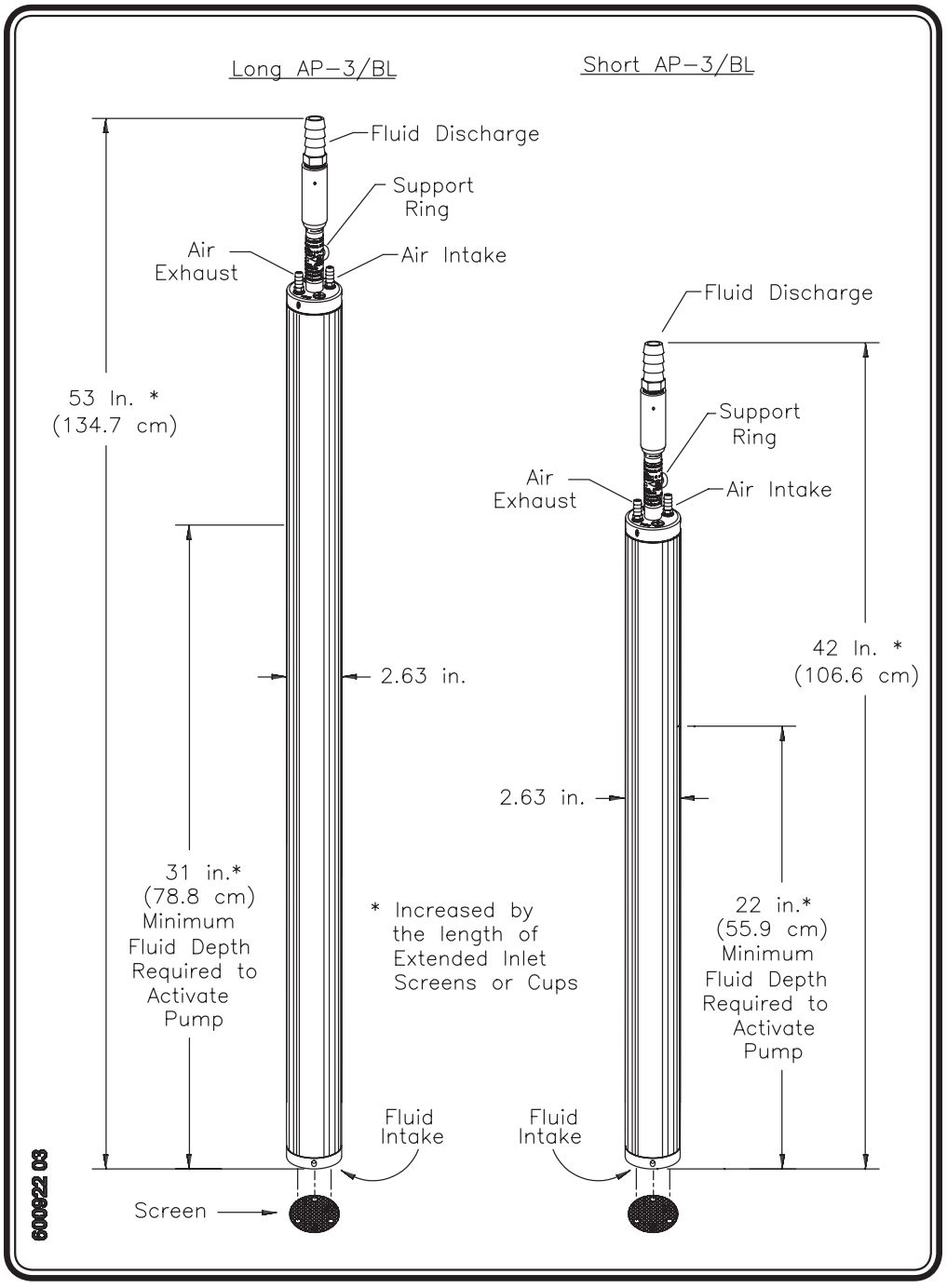


Figure 5 - Long and Short Bottom-Loading (AP-3/BL)

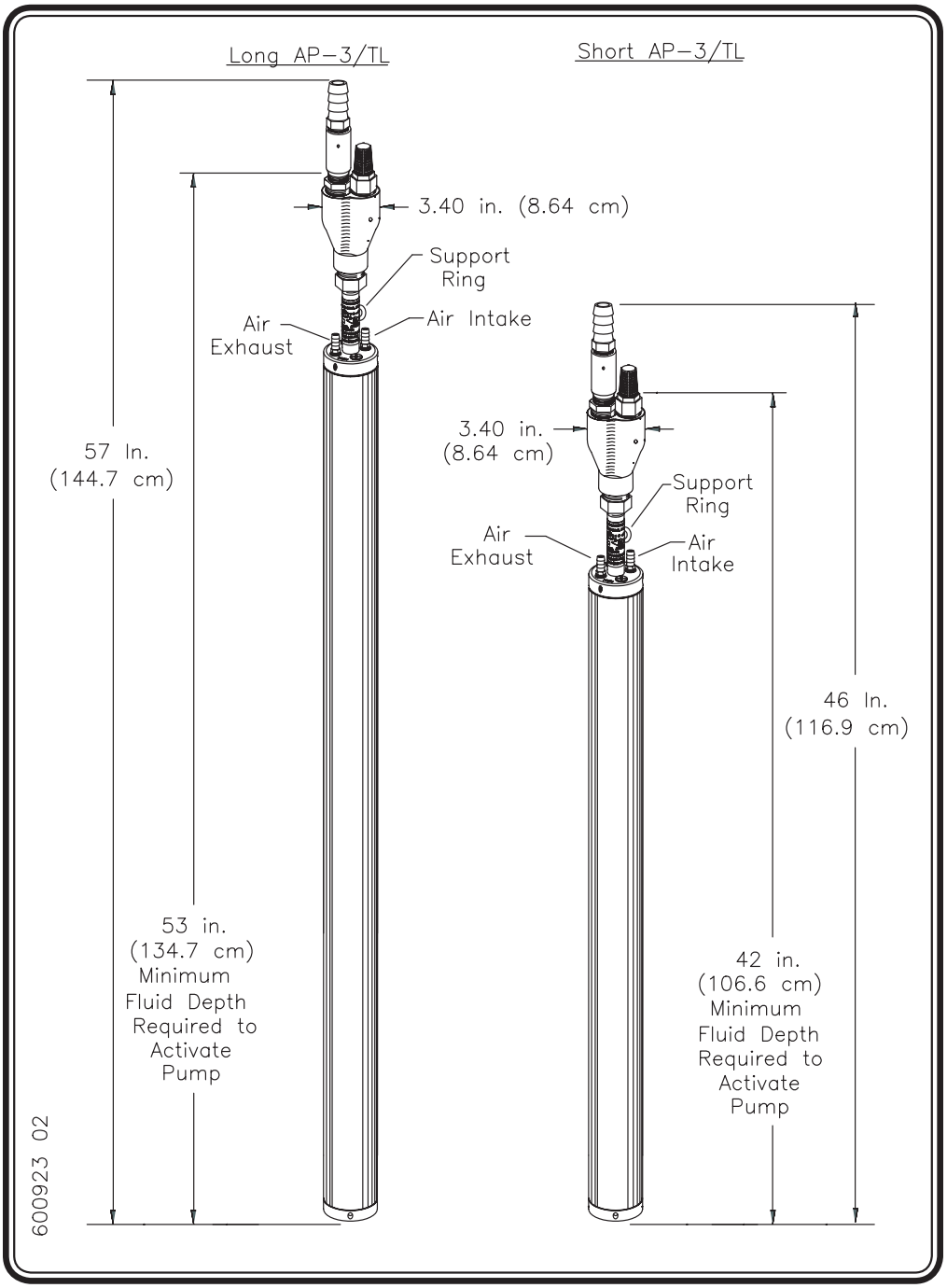


Figure 6 - Long and Short Top-Loading (AP-3/TL)

Specifications

Pump	*Overall Length*	*Vol/Cycle Range*	*Max* Flowrate*	*Weight*	*Operating Pressure Range*	*Outside Diameter*
Long AP-3/BL	52-in 132-cm	0.23-0.32 gal 0.87-1.21 l	7.3 gpm 27.6 lpm	11 lbs 5 kg	5 to 100 psi 0.4-7.0 Kg/cm^2	2.63-in 6.68-cm
Long AP-3/TL	57-in 145-cm	0.23-0.32 gal 0.87-1.21 l	5.4 gpm 20.4 lpm	11.5 lbs 5.3 kg	5 to 100 psi 0.4-7.0 Kg/cm^2	3.40-in 8.64-cm
Short AP-3/BL	42-in 107-cm	0.08-0.15 gal 0.30-0.57 l	6.0 gpm 22.7 lpm	10 lbs 4.5 kg	5 to 80 psi 0.4-5.6 Kg/cm^2	2.63-in 6.68-cm
Short AP-3/TL	47-in 119-cm	0.08-0.15 gal 0.30-0.57 l	4.8 gpm 18.1 lpm	10 lbs 4.5 kg	5 to 80 psi 0.4-5.6 Kg/cm^2	3.40-in 8.64-cm

*With 1-inch I.D. Hose

Component Materials

Typical component materials include stainless steel, acetal, Viton, fiberglass, PTFE (Teflon), UHMWPE, and brass.

Performance and Air Use Curves

See Appendices A and B.

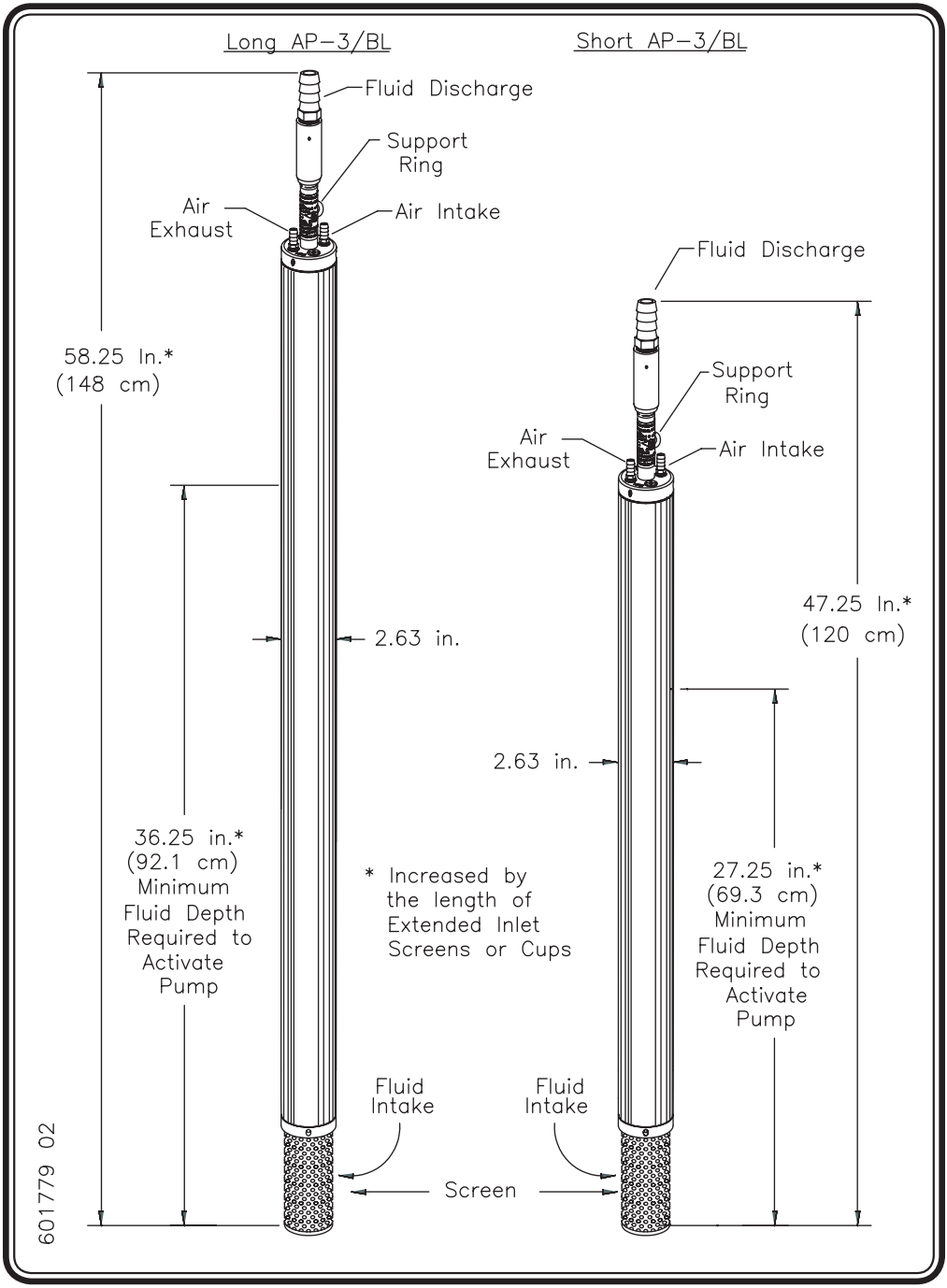


Figure 7 - Long and Short AP-3 Bottom Loading with Leachate Screen

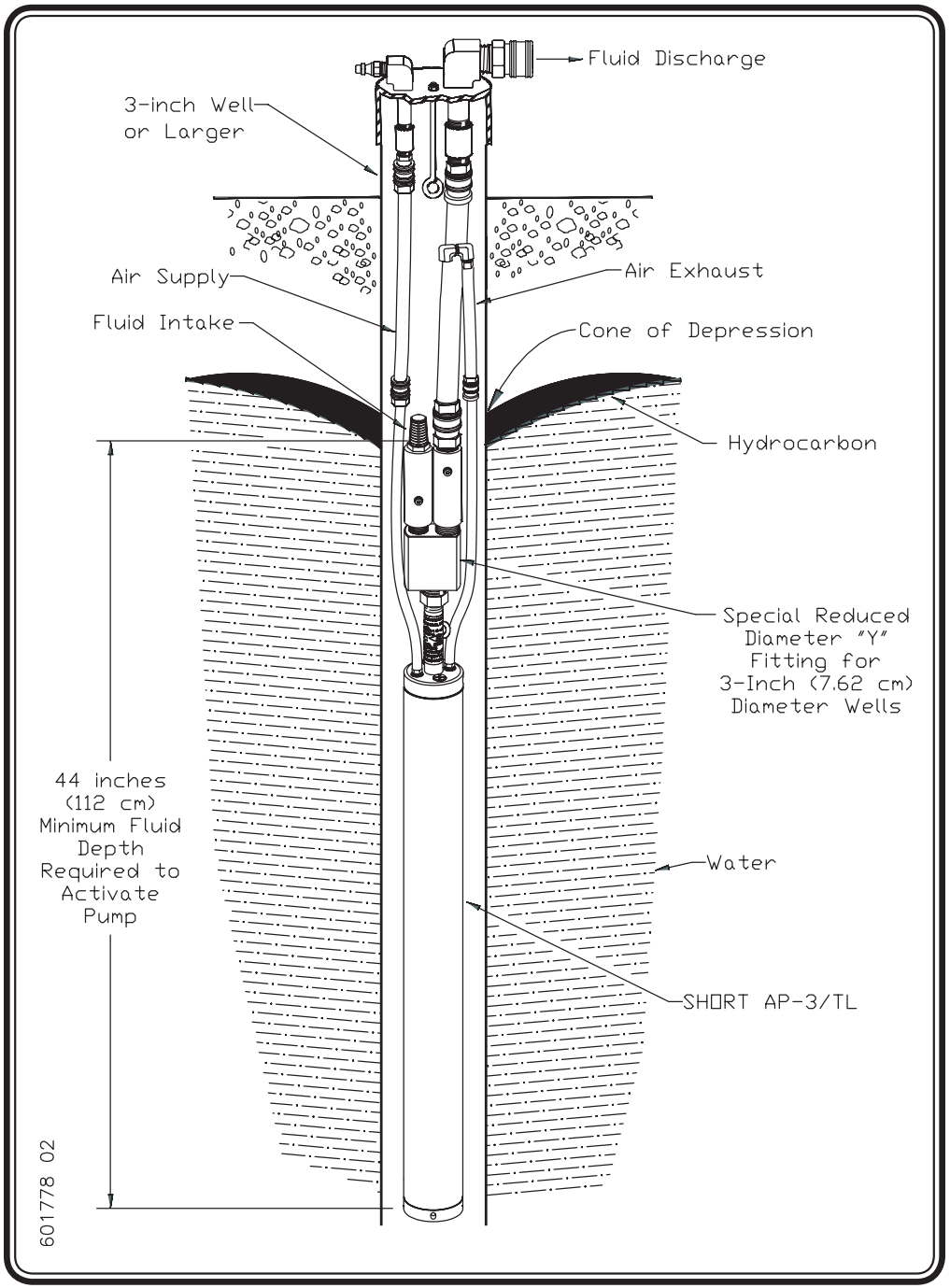
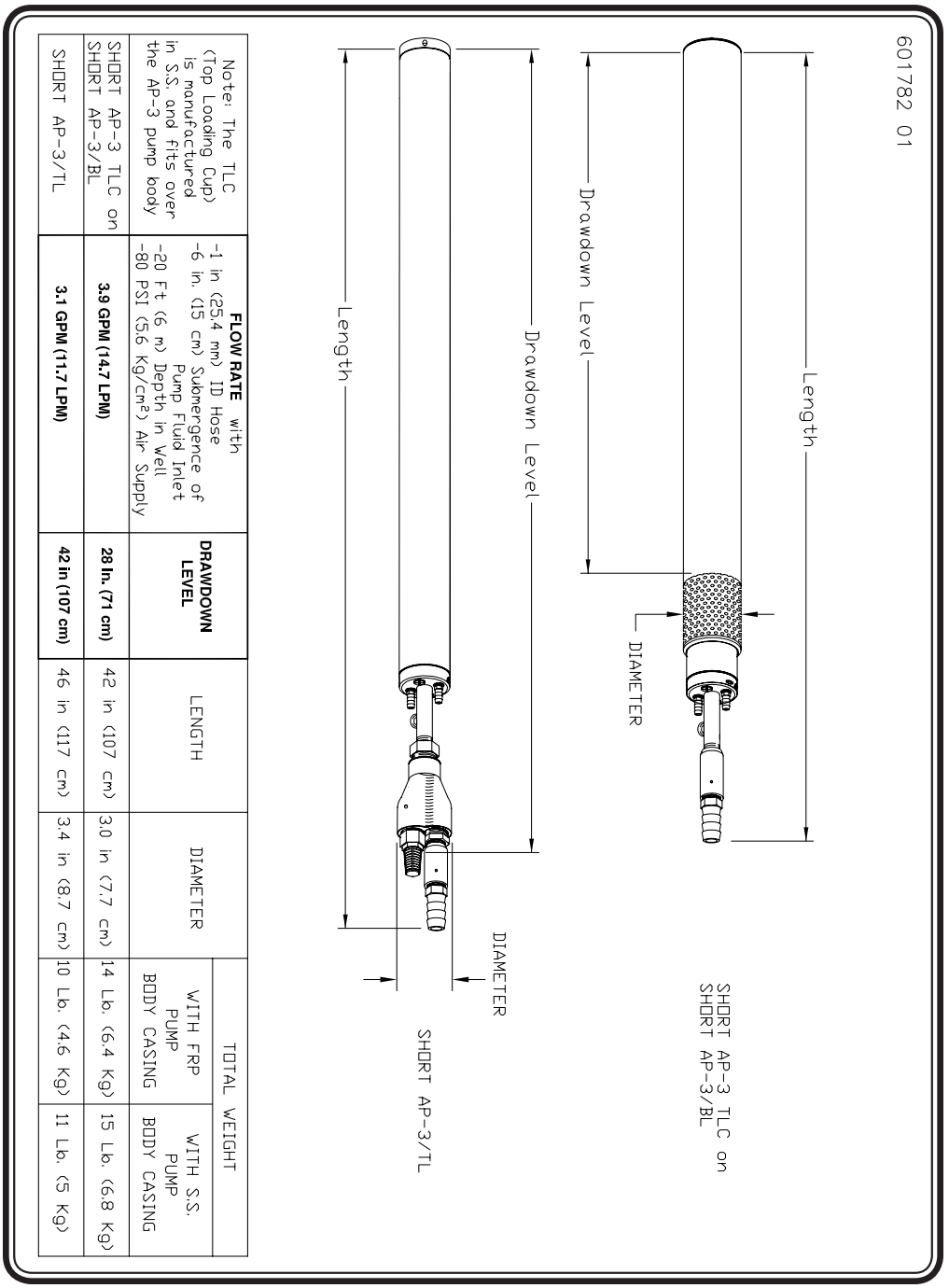


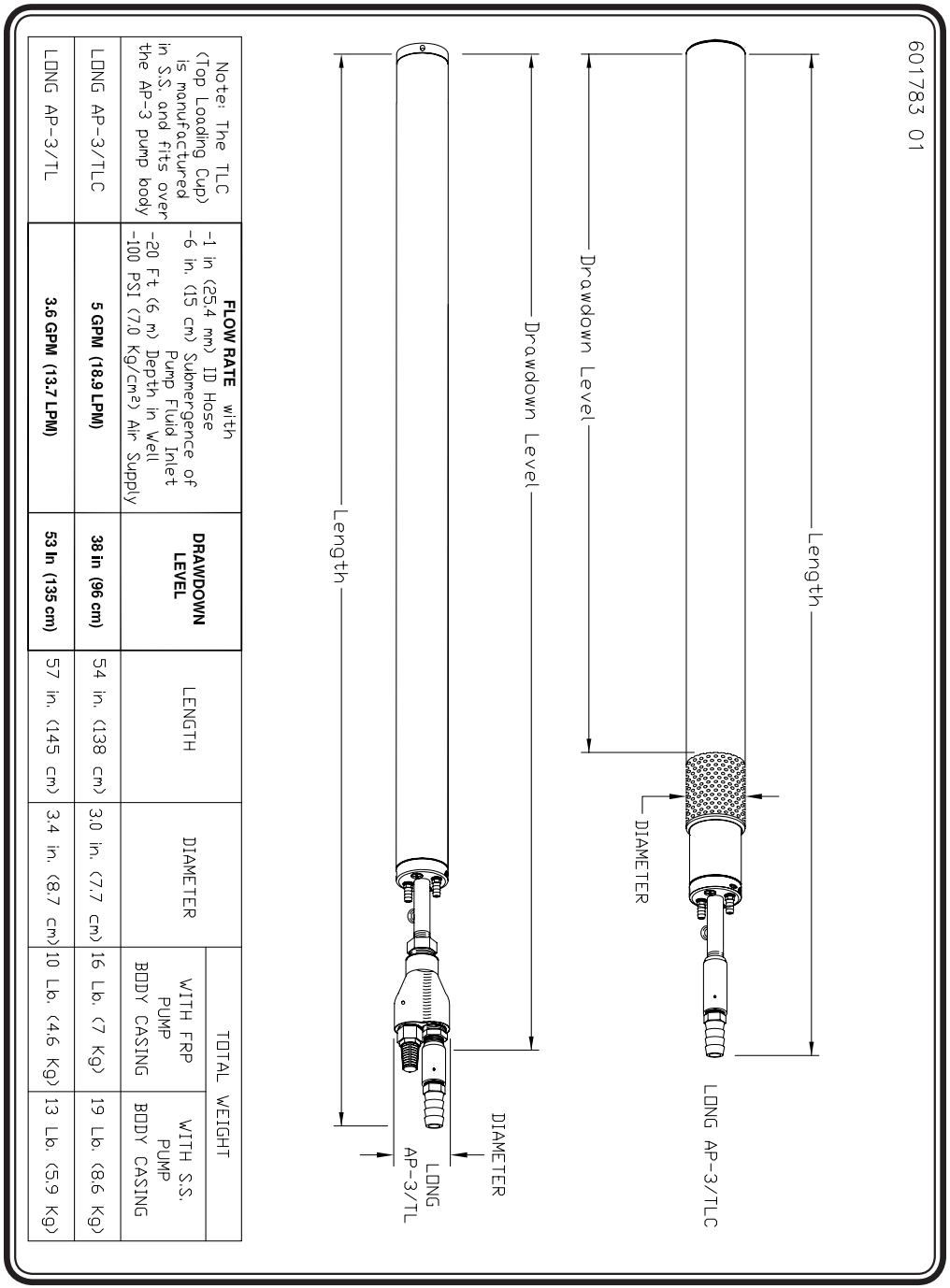
Figure 8 - Short AP-3 Top Loading with Optional Brass "WYE" Fitting



	FLOW RATE with -1 in (25.4 mm) ID Hose -6 in. (15 cm) Submergence of Pump Fluid Inlet -20 Ft (6 m) Depth in Well -80 PSI (5.6 Kg/cm²) Air Supply	DRAWDOWN LEVEL	LENGTH	DIAMETER	TOTAL WEIGHT	
					WITH FRP PUMP BODY CASING	WITH S.S. PUMP BODY CASING
SHORT AP-3 TLC on SHORT AP-3/BL	**3.9 GPM (14.7 LPM)**	**28 In. (71 cm)**	42 in (107 cm)	3.0 in (7.7 cm)	14 Lb. (6.4 Kg)	15 Lb. (6.8 Kg)
SHORT AP-3/TL	**3.1 GPM (11.7 LPM)**	**42 in (107 cm)**	46 in (117 cm)	3.4 in (8.7 cm)	10 Lb. (4.6 Kg)	11 Lb. (5 Kg)

Note: The TLC (Top Loading Cup) is manufactured in S.S. and fits over the AP-3 pump body

Figure 9 - Short AP-3/TLC and Short AP-3/TL Comparison



	FLOW RATE with -1 in (25.4 mm) ID Hose -6 in. (15 cm) Submergence of Pump Fluid Inlet -20 Ft (6 m) Depth in Well -100 PSI (7.0 Kg/cm²) Air Supply	DRAWDOWN LEVEL	LENGTH	DIAMETER	TOTAL WEIGHT	
					WITH FRP PUMP BODY CASING	WITH S.S. PUMP BODY CASING
LONG AP-3/TLC	**5 GPM (18.9 LPM)**	**38 in (96 cm)**	54 in. (138 cm)	3.0 in. (7.7 cm)	16 Lb. (7 Kg)	19 Lb. (8.6 Kg)
LONG AP-3/TL	**3.6 GPM (13.7 LPM)**	**53 In (135 cm)**	57 in. (145 cm)	3.4 in. (8.7 cm)	10 Lb. (4.6 Kg)	13 Lb. (5.9 Kg)

Note: The TLC (Top Loading Cup) is manufactured in S.S. and fits over the AP-3 pump body

Figure 10 - Long AP-3/TLC and Long AP-3/TL Comparison

Single Stage Filter/Regulator

A single stage 5 micron particulate air filter/regulator has an a manual or an optional automatic drain and is installed on the system air supply hose. The filter/regulator removes particles and some oil vapor, and water droplets from the air passing to the AP-3. The regulator should produce at least as much pressure as required to move the fluid from the depth at which the pump is installed. **(See Figure 11)**

Note:
Too much air pressure can result in low pump efficiency.

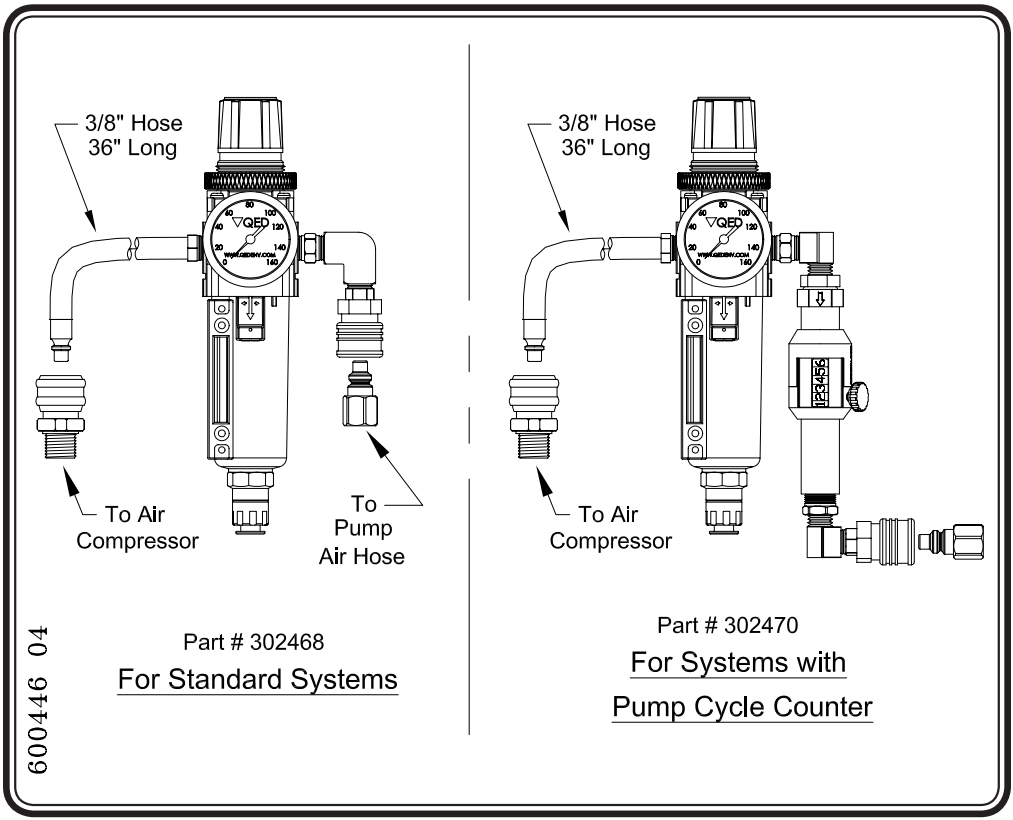


Figure 11 - Single Stage Filter/Regulator with Quick-Connects

Hoses and Fittings

The table below shows the normal hose colors. These may change due to application or need.

Hose and Tubing Color Code Table

	System Air Supply Hose	Fluid Discharge Hose	AutoPump Air Hose	Air Exhaust Hose
Hose Color	Blue	Black	Green	Blue
Hose Material	Nitrile	Nitrile	Nitrile	Nitrile
Hose Size I.D.	1/4-inch to 1/2-inch	5/8-inch to 1-1/4-inch	1/4-inch to 1/2-inch	1/2-inch to 3/4-inch
Tubing Color*	Black or White	Black or White	Black or White	Black or White
Tubing Material*	Nylon or Polyethylene	Nylon or Polyethylene	Nylon or Polyethylene	Nylon or Polyethylene
Tubing Size O.D.*	3/8-inch to 1-inch	5/8-inch to 1-1/4-inch	3/8-inch to 5/8-inch	5/8-inch to 1-inch
Function	Transports air from air compressor to filter/regulator	Transports product from AutoPump to discharge point	Transports air from filter/regulator to AutoPump	Exhausts air from AutoPump
Fittings	Hose barb and clamp or one-way quick-connect fitting	Hose barb and clamp or straight through quick-connects	Hose barb and clamp or one-way quick-connect fitting	Hose barb and clamp or straight through quick-connects

* Nylon tubing is available in single tube or jacketed bundles. Contact QED for the sizes and bundle configurations.

If optional quick-connects are used, the flow of air and fluid in the hoses runs *into* the male plug and *out* of the female socket.

The quick-connect fittings on one type of hose will usually not interchange with those of another, so it is very difficult to connect a hose to an incorrect fitting.

Note:
The down well hose fittings normally have locking quick-connects. On sites with water depths over 50 feet, special consideration may be required to support the hoses. Consult with *QED* regarding such applications.

Volumes Pumped Per Cycle

- The volume of fluid pumped per cycle from an AutoPump varies depending upon the inlet air pressure, the fluid inlet head and the force against which the pump must move the fluid. This force is a sum of the static head and dynamic losses incurred during fluid movement, usually referred to as Total Head.

- The Total Head depends upon back pressure in the surface lines, hose size, fittings, vertical and horizontal pumping distance, the number of pumps feeding the hose system, air pressure to the pump, and the type of pump.

- The effects of some of these variables may cause the volume pumped per cycle to vary from pump to pump on a single site.

Pump	Volume per Cycle: Range	Volume per Cycle: Typical
Long AP3	0.23 - 0.32 gal (0.87 - 1.21 L)	0.25 gal (0.95 L)
Short AP3	0.08 - 0.15 gal (0.30 - 0.57 L)	0.11 gal (0.42 L)

All figures above are dependent on site specific conditions under which the pump is operating

Pump Support System

To safely support the AP-3, a pump support system is offered. Included in the system are a well cap, support rope, and quick-link assembly.
(See Figure 18 on page 37, and Figure 19 on page 38)

Well caps with various fitting combinations are available.
(See Figure 17 on page 35)

Caution:
Although it may be possible to support the pump using only tubing, it is not always wise to do so. If a pump becomes jammed in a well, a strong rope or wire rope separate from the tubing may be needed to withstand the force required to free it. Thus a separate support line is recommended.

Chapter 4: Assembly & Installation

WARNING:
PVC pipe is generally not recommended for compressed air service.

Cautions

The following suggestions are offered to reduce the complications involved in assembly and installation.

- Cover the hose ends with tape if they are being pulled through trenches. Be sure the ends of the hoses that connect to the air compressor and fluid discharge have the correct fitting leading out of the well. If you are unsure, look at the respective fittings on the pump.

- Blow out all water and particles from compressed air conduits (trunk lines, sensor hoses, air supply hoses etc.) and fluid lines for at least 10 seconds after the water and particles exit before connecting them to the system.

- When running hoses in conduit, include a rope to pull additional hoses in case they are needed at a later date

- If solid metal piping is used for compressed air conduit, it is advised that an air filter or a "Y" strainer with a fine mesh screen (80 mesh or finer) be placed at the downstream end of the piping. Metal flakes, rust, galvanizing material, dirt, etc. can be dislodged from such metal piping and travel to the pump.

Compressed Air Supply

The AP-3 System includes a compressor-to-pump air line quick disconnect fitting for the compressor.

There is a distinct air inlet on the AP-3; an "I" is stamped next to it on the head of the pump. The air inlet quick connect fitting on the pump has a female counterpart on the air inlet hose. The air inlet must be connected for the AP-3 System to function. Do not lubricate the compressed air coming out of the compressor. The AP-3 does not require lubrication and excess oil may foul the filter/regulator.

WARNING:
The compressor should not provide more pressure than the filter can accept. The metal bowl can accept 150 psi. Maximum output air pressure setting on the standard regulator is 125 psi.

Component Assembly

Quick-Connects/Hose Barbs

Follow the instructions on **Figure 12** for properly securing the locking quick-connects. See **Figure 13 and Figure 14** for properly securing hose barbs.

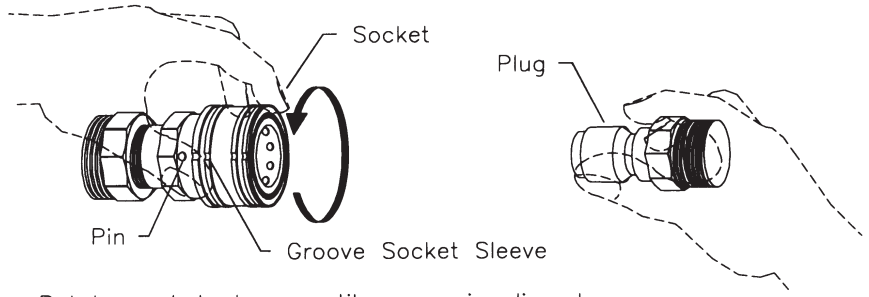
AutoPump Assembly

STEP 1 - Attach Fluid Discharge Hose (black)

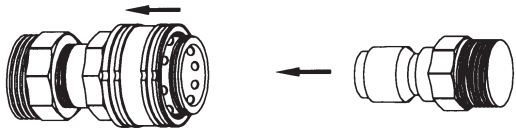
Note:
If a well cap with holes is used, insert the hoses through the cap before attaching hose.

a. Attach the fluid discharge hose or tubing to the AutoPump. **(See Figure 15 and Figure 16)**

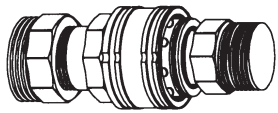
b. Attach the other end of the discharge hose to the fluid discharge point.



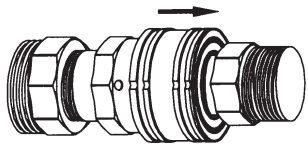
a. Rotate socket sleeve until groove is aligned with the pin close to the hex.



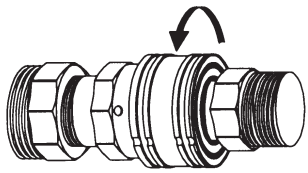
b. Pull socket sleeve against the hex (the pin will be totally covered). Hold in this position for plug insertion.



c. Push plug into socket until the plug is almost covered.



d. Let the socket sleeve go in. It must slide all the way until the pin is visible again.



e. Rotate the socket sleeve so the groove does not align with the pin. To test, gently pull hexes of both fittings in opposite directions. Fittings must remain attached.

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Figure 12 - Locking Quick-Connects

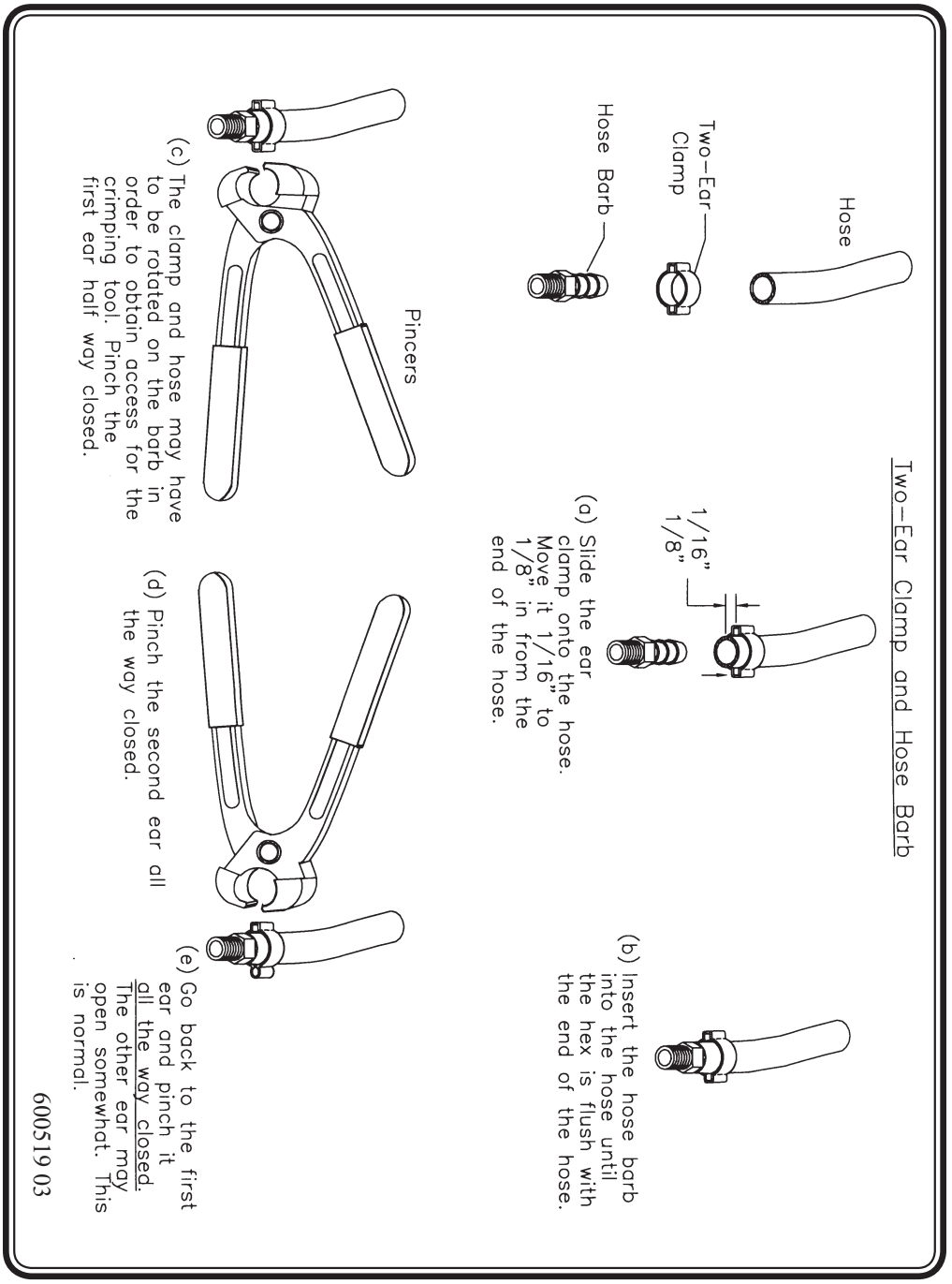


Figure 13 - Two-Ear Clamp and Hose Barb Assembly Instructions

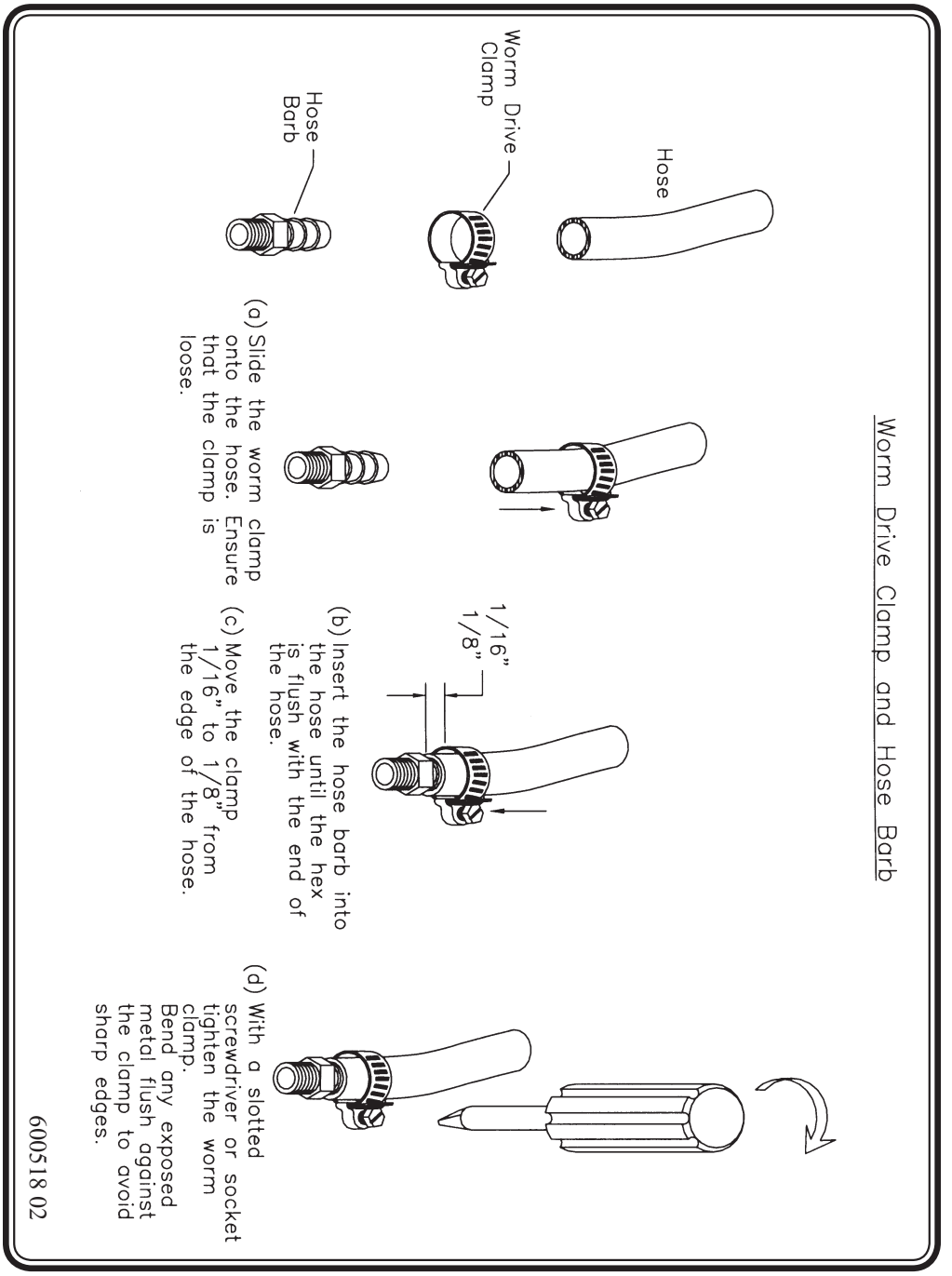


Figure 14 - Worm Drive Clamp and Hose Barb Assembly Instructions

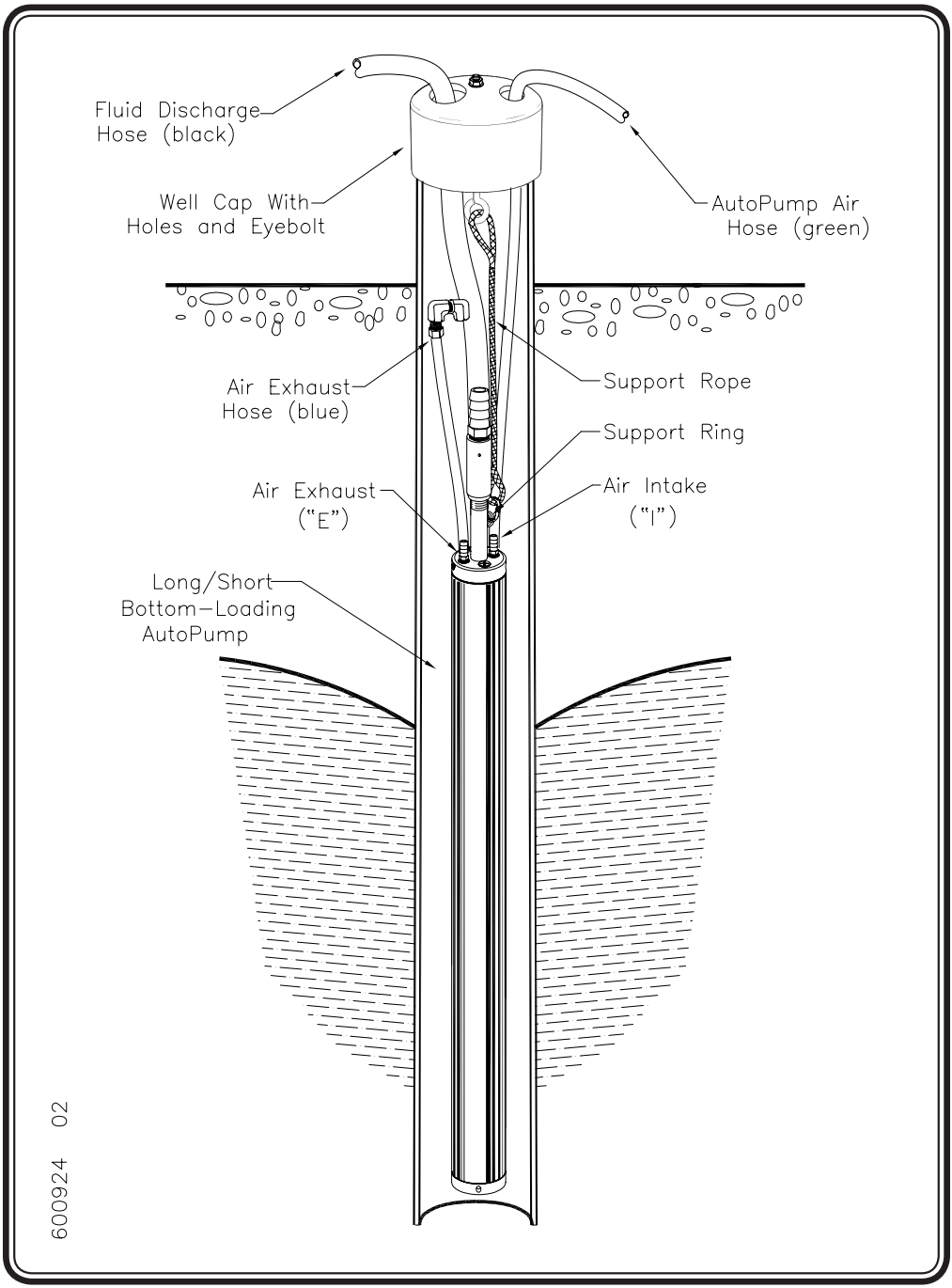


Figure 15 - AP-3 Assembly: Well Cap with Holes

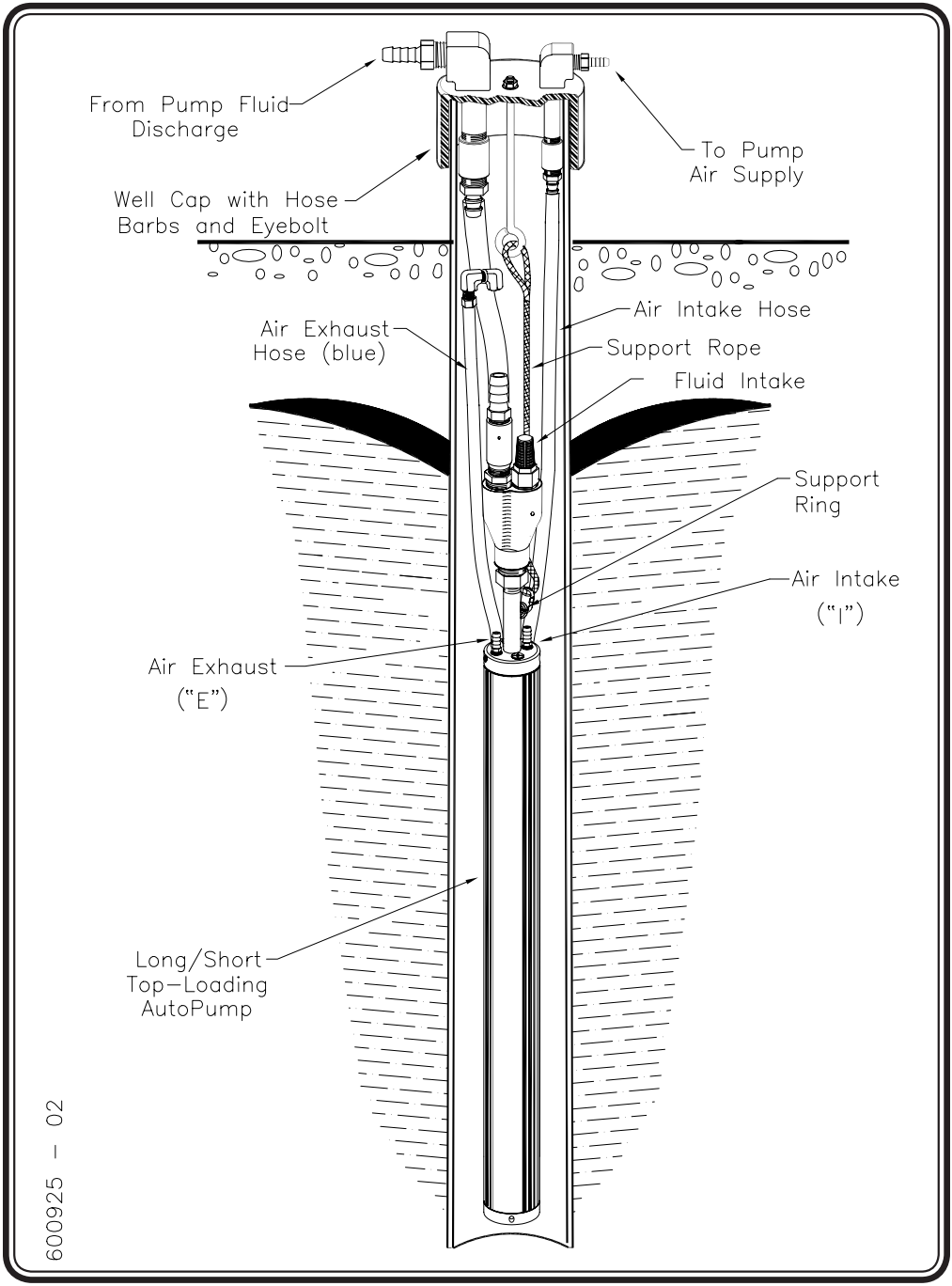


Figure 16 - AP-3 Assembly: Well Cap with Hose Barbs

STEP 2 - Attach AutoPump Air Hose (green)

a. If a Pump Cycle Counter (PCC) is used, install it downstream of the air filter regulator and as close to the pump as is reasonable.

b. Attach the AutoPump air hose to the single stage filter/regulator or optional Pump Cycle Counter **(See Figure 4 on page 11)**

c. Attach the other end of the AutoPump air hose to the AutoPump.

STEP 3 - Attach Air Exhaust Hose (blue)

a. Attach the air exhaust hose to the AutoPump. **(See Figure 15 and Figure 16)**

STEP 4 - Attach System Air Supply Hose (blue)

a. Thread the air hose socket with 1/4-inch MPT to the compressor. Use Teflon tape or sealant on the threads.

b. Attach the air hose plug end of the system air supply hose to the socket now attached to the compressor.

c. Attach the socket on the discharge end of the hose to the single stage filter/regulator. **(See Figure 4 on page 11)**

The pump will work in a well that is under vacuum, but there are several conditions that must be considered. **(See Appendix D)**

Dry Test

Before installing the AutoPump in the recovery well, it is important to test the system for proper operation. Before beginning this test, make sure that all hoses are properly connected as described in the previous section.

To test for float movement and air valve actuation follow these steps:

STEP 1 - Drain all fluid from the pump through the bottom inlet check valve (Bottom-loading) or air inlet fitting (Top-loading).

STEP 2 - Hold the pump horizontally.

STEP 3 - Tip the top of the pump downwards to about 45°. The float should slide to the top of the pump and open the air valve. Air should be heard going into the pump. It will exit the inlet fluid check valve (Bottom-loading) or the outlet check valve (Top-loading).

Caution:
If air is not acceptable in the fluid discharge hose, disconnect the hose before performing this test.

STEP 4 - Tip the head of the pump upwards past horizontal to 45° from the vertical. The float should slide to the bottom of the pump and close the air valve.

STEP 5 - Repeat this process 3 or 4 times to ensure the float moves freely and the air-valve opens and closes. If the pump must be tilted nearly vertical before the float slide or the air valve moves, open the pump and inspect for interference.

Pump Support System and Hose Bundling Assembly

A pump support system can be created to support the pump and hoses. The pump support system uses well caps with various fitting combinations. **(See Figure 15)**

Though it is possible in some instances to support a downwell pump with only the tubing, a separate support line is recommended.

Note:
The walls of some wells deform over time. They may trap a downwell pump. In some of those cases the support line has proven useful when retrieving the pump.

In addition to supporting the down-well equipment with a support rope, it may be important to support down-well hoses (in most cases nylon tubing does not need to be supported by the support line). Since the down-well hoses can weigh more than the pump, particularly in wells over 50 feet deep with fluid inside the discharge hose, hose support can avoid problems such as kinking, jamming, and breaking.

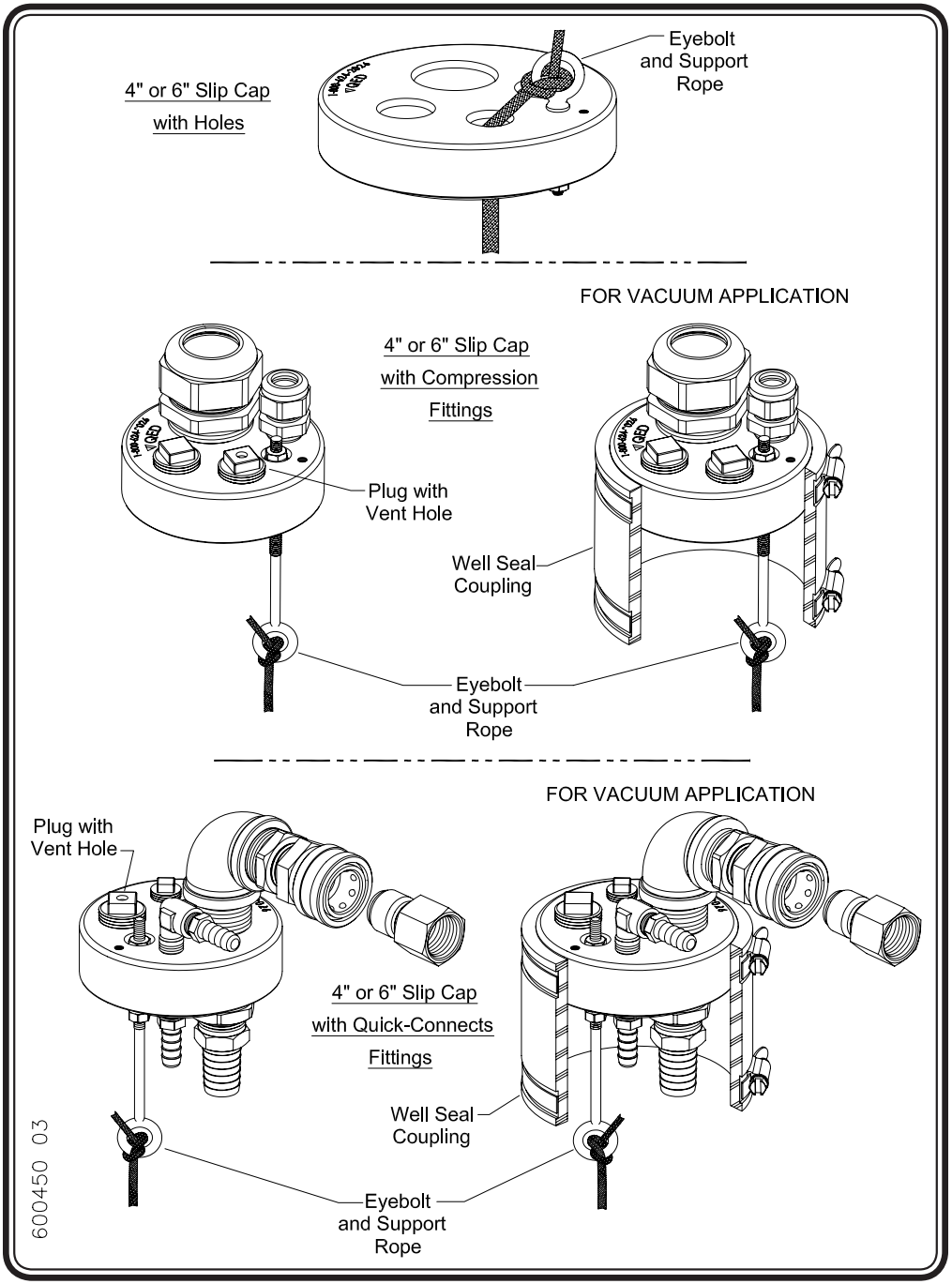


Figure 17 - Examples of Well Caps

Hose bundling or the use of jacketed tubing reduces equipment entanglement at the well surface, and aids the removal of the pump from the well. Bundling also assists in positioning the pump and down-well hose assembly against one side of the well casing. Maximum space is created for other items, such as probes, to be periodically placed inside the well.

Follow these instructions to create a hose bundle.

STEP 1 - Lay the equipment on the ground and make all of the necessary hose connections. **(See Component Assembly on pages 27 through 33)**

STEP 2 - If a well cap is supplied, install it on the hoses. (**See Figure 15** for well cap with holes; **see Figure 16** for well cap with hose barbs)

STEP 3 - Connect the quick-link assembly on the support rope to the eye on the AP-3 and lay the support rope out along with the hoses. Make sure that none of the hoses or support ropes are crossing over each other. **(See Figure 18)**

Note:
To make the next step easier, pull the support rope and the hoses taut.

STEP 4 - Starting at the AutoPump end of the hose, put a tie-wrap through the center of the braided support rope just above the uppermost quick-connect or barb on the AutoPump.
(See Figure 18 and Figure 19)

STEP 5 - Pulling the rope taut, put the tie-wrap around the fluid discharge hose with the rough surface outwards. Cross the ends and complete the figure-8 pattern by securing the ends around the exhaust hose. When you connect the tie-wrap make sure it is straight and is not kinking the hoses.
(See Figure 18 and Figure 19)

Note:
After completing this step, the fluid discharge hose will be attached to the support rope and the exhaust hose. At this point the air supply hose is still lying free.

STEP 6 - Place the next tie-wrap two feet towards the well cap from the first. Secure the air supply hose rather than the exhaust hose.

Note:
It is important to put the tie-wraps approximately two feet apart to keep a proper discharge hose/support rope bundle. Experience has shown that spreading the tie-wraps further apart than two feet increases the probability for hose kinking.

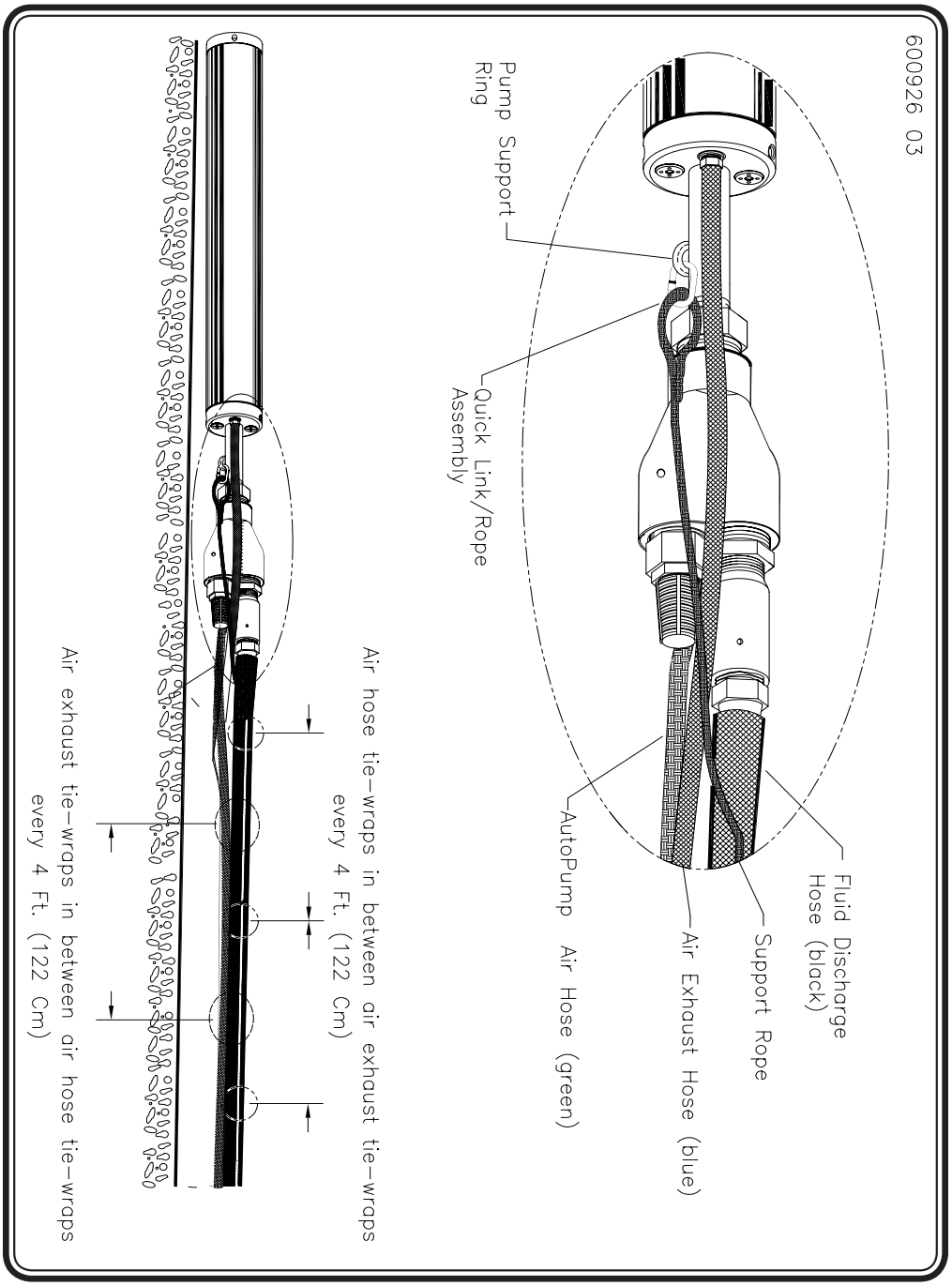


Figure 18 - Hose Bundling: Part 1 of 2

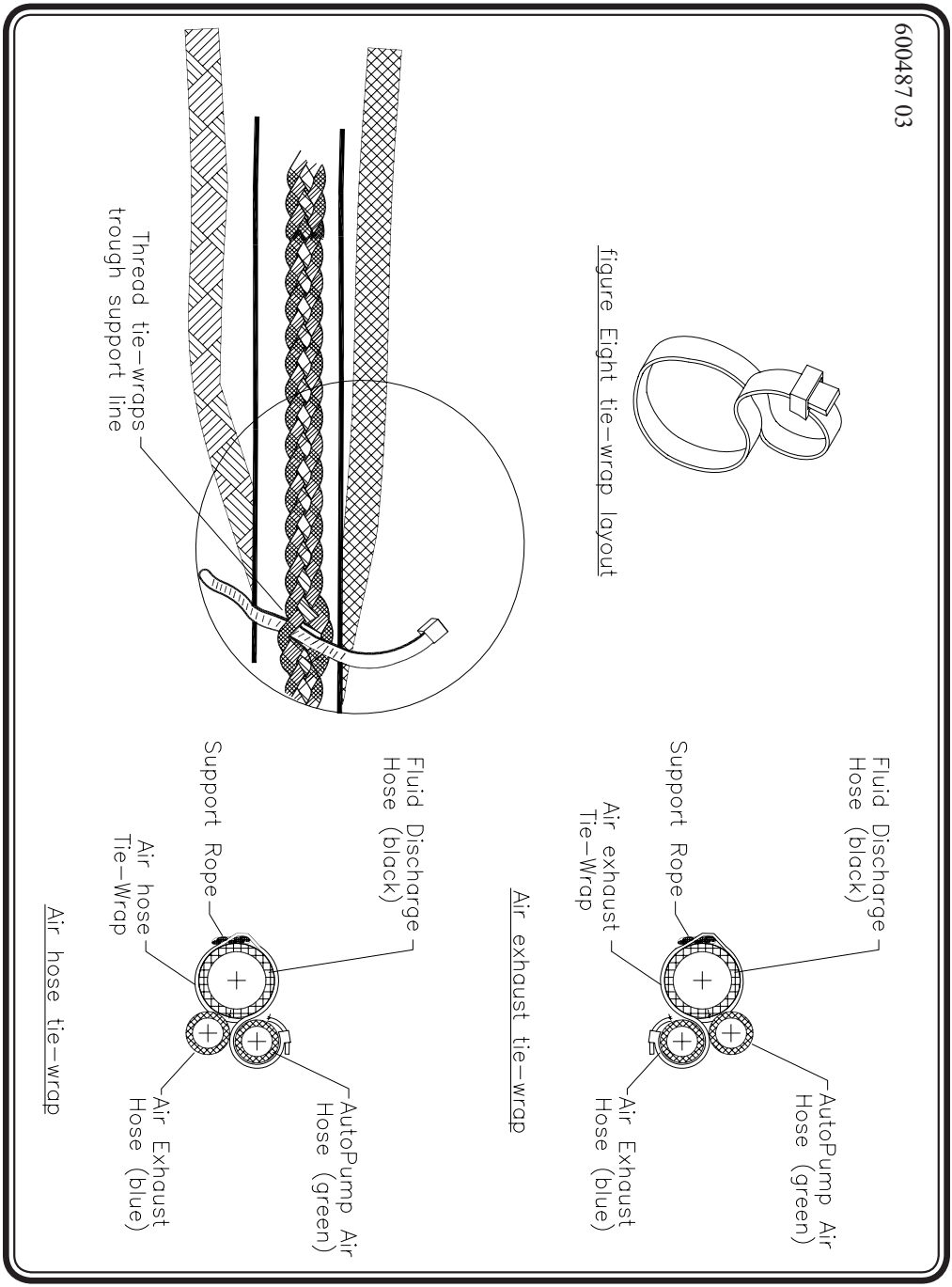


Figure 19 - Hose Bundling: Part 2 of 2

STEP 7- Continue to alternate the air exhaust and the air supply tie-wraps every two feet, stopping about five feet from the wellhead.

STEP 8- Being careful not to leave any sharp edges, cut the excess from the tie-wraps.

You now have a down-well bundled hose assembly that supports both the hoses and the down-well equipment.

AutoPump Installation

Once the installation of the pump support system is completed, you may install the AutoPump in the recovery well.

Note:
Submerging the pump before supplying it with air will result in fluids entering the exhaust hose. Those fluids will be discharged from the exhaust hose during the first few cycles of the pump. If such discharge will not be confined to the well, the operator may wish to install the pump with a low air pressure supplied to the pump. To obtain the value of that low pressure in psi, multiply the number of feet that the pump is to be submerged by one-half (0.5)

WARNING:
Be sure that the fluid discharge has a closed valve during such process because the pump may have enough pressure to begin pumping fluid from the well.

STEP 1 - Lower the pump until it is at the desired level.

STEP 2 - Secure the pump by tying off (securing) the support line or by placing the well cap on the well.

STEP 3 - Increase the air pressure to the pump until the pump is pushing the fluid out at the desired rate. With sufficient air pressure (at least 10 to 15 psi over the vertical static head), the AutoPump will gradually draw down the fluid level in the well to the level of the pump. The time required for this draw down varies with the yield of the well as compared to the flow rate of the pump. The maximum air supply pressure for the Long AP-3 is 100 psi. The maximum for the Short AP-3 is 80 psi.

The pump rate can be increased slightly by increasing the air pressure to the pump. However, under conditions with high inlet pressures and little discharge resistance, some air may exit with the fluid. That would be due to a brief residual pressure in the pump which discharges fluid (and air) even after the exhaust valve is opened.

Under normal operating conditions, no air should exit the pump with the fluid.

If the pump is moving air out the fluid discharge and this is undesirable, a needle valve in the air line can be used. This reduces the air flow rate to the pump and thus the pressure buildup in the pump. Alternately, reduce the pressure going to the pump though the pressure regulator.

Chapter 5: Start Up and Operation

Start Up Checklist

In normal operation, the AutoPump System requires little attention.

Before regulating the air pressure to the desired operating pressure, ensure that the following conditions exist:

1. Personal Protective Equipment (PPE) is being used by all personnel.

2. The pump is submerged below the fluid level.

3. All hoses are connected.

4. The exterior air filter is mounted vertically to allow the filter and its bowl drain to operate properly.

5. All out-of-well air and fluid valves are in their correct positions.

6. A method of rapid disconnect and exhaust (or at least a shut off) of compressed air to the pump is available in case of an unexpected occurrence.

7. When pumping is to begin, either gradually raise the air pressure to the pump or gradually open the air valve to the pump to allow the pump and hoses to slowly pressurize. Check for leaks as you do this.

8. As the air pressure overcomes the static and dynamic resistant forces, the pump will begin to cycle. Listen for the periodic exhaust of air from the pump to determine that the pump is working. The pump should push fluid out and then exhaust sharply to fill before pressurizing and pushing the fluid out again.

   Cycling can also be monitored by placing an air pressure gauge at the well head and by observing a pulse counter, if one is present.

9. If a pulse cycle counter is installed, it should be adjusted to accomodate the individual well conditions. Refer to the PCC manual, Document # 600473.

Observation of System Operation

Observe the system operation for at least 10 pump cycles to ensure everything is working. If the well influx is low so the pump seldom cycles, pour clean water into the well to check on the pump. If allowed, the pump discharge can be directed into the well so the pump will cycle within an acceptable period to allow for observance of operation. Check your local regulations to determine if these practices are permissible.

Note:
The Pump Cycle Counter may have to be readjusted if it is set when the water is recirculating to the well.

After the entire site is operating, return to each well to ensure that the pump and PCCs are functioning properly. The addition of other pumps and possible system back pressure can necessitate air pressure and counter readjustment.

Downwell Testing of the AutoPump

While the AutoPump is in the well, it can be tested by putting compressed air into the exhaust hose of the pump.

Note:
The air supply hose must be shut off or pressurized when this is done.

The compressed air will enter the pump through the exhaust valve and push any fluids in the pump up the discharge tube. If sufficient compressed air is continually supplied, it will also exit the discharge tube and cause the fluid in the discharge hose to be airlifted to the surface. This method can be used to lighten the pump and hoses before removing the pump from the well. This process can also show whether the fluid inlet check valve is sealing and if the pump is capable of discharging fluid.

AutoPump Shutdown while Submerged

The AutoPump can be submerged for long periods of time at most sites. If the well environment is such that deposition occurs on stainless steel parts, the operator may wish to raise the pump above the water level during a shutdown of the system.

AutoPump Removal Technique (optional)

By pressurizing the exhaust hose as noted above and airlifting the fluids out of the well, the fluid in an AutoPump and discharge hose can be reduced significantly. This can be used to lighten the system before removing it from the well.

Chapter 6: Maintenance

General Maintenance

The AutoPump should be relatively free of maintenance. The frequency of maintenance depends upon the nature of the fluids being pumped. Follow these general maintenance checks.

- Periodically inspect all hoses and connections for damage. Make sure that the hoses are not split or cracked, and listen for leaks in the system.

- Even if significant amounts of oil and water enters the air hose, the AP-3 System should perform reliably for years. Check the air filters and filter bowl drains on the filters/regulator for saturation and operation every few weeks.

- Periodically drain the air filters on the air hose to the pumps of collected particles, water and oil. Draining prevents the filter from clogging up or being otherwise damaged. Check the regulator to ensure the pressure setting has not drifted appreciably.

- An automatic drain on the compressor is highly recommended, since such an addition can dramatically increase air filter life and decrease maintenance. Automatic drains are available from QED.

- The pump can be opened up in the field if the area is clean and dry.

A maintenance video is available from QED.

Maintenance Table

A visual check and/or maintenance is recommended at least once every two weeks, but some site environments may demand more frequent service. The following table outlines the recommended minimum schedule for the AP-3 System.

Equipment	Biweekly	Monthly*	As Required
Air Quality Check • Single Stage Filter/Regulator	X		
AutoPump Service			X
Check Pump Cycle Counter	X		
Check Volume Pumped Per Cycle		X	

* Site conditions may require maintenance more often.

The following sections describe each maintenance activity in detail.

Air Quality Check

Single Stage Filter/Regulator Maintenance

Even using air which has some oil and water in it, the AutoPump System should operate trouble-free for years. The air filter is normally a 5 micron filter with a replaceable element.

To replace the element in the air filter on the single stage filter/regulator use the following procedure:

STEP 1 - Disconnect Air Source

- Valve off the air supply and drain the downstream air to the air filter. Or disconnect the blue system air supply hose from the single stage filter/regulator. The air filters will depressurize, allowing them to be safely serviced.

WARNING:
Do not remove a filter bowl that is pressurized.

STEP 2 - Remove Filter Bowl

- Different styles of air filters are available. The following instructions are given for the most typical filter used, one with 1/4" pipe thread.

- Remove the bowl of the air filter by sliding the button downward and twisting the bowl about 1/8 of a turn. The bowl should slide downward from the upper portion of the filter revealing the filter element. Unscrew the element as you would unscrew a light bulb. Hand tighten the element after replacing it.

  Make sure to replace the correct filter element.

  - Blue or black filter bowl:
    QED Filter element Part No. 205071

  - Silver filter bowl:
    QED Filter element Part No. 205800

STEP 3 - Bowl Drain

Standard Float Drain

- Wash out any deposits and oil buildup from the filter bowl with warm water and soap. To make sure the float drain is operating freely, shake it; the drain should rattle. Test the float drain by filling the bowl with water, assembling the bowl to the filter and reconnecting it to the air supply. The water should drain from the bowl. When under pressure, the drain should not leak.

Optional Manual Drain

- With water in the bowl, open the drain and ensure the liquid drains easily. When under pressure and closed, the drain should not leak.

AutoPump Service

AutoPump Shutdown and Removal from Well

To shut down and remove the AutoPump, follow these directions:

STEP 1 - Wait until the pump is in its discharge cycle and then raise it above the water level in the well. This will empty most of the fluid from the pump making it lighter to lift. There will also be less fluid to drain from the pump.

Note:
See Start Up and Operation for optional pump removal technique.

STEP 2 - Pull the pump and hoses to the surface.

STEP 3 - Shut off the air to the pump and disconnect the air hose from the pump.

STEP 4 - Ensure that there is a safe place to drain any fluid from the pump and discharge hose.

STEP 5 - Disconnect the fluid discharge hose from the pump.

For Bottom-loading pumps

Drain the fluid in the pump by lifting the bottom inlet check valve from its seat by using a thin wire or Allen wrench.

For Top-loading pumps

Drain the fluid by turning the pump upside-down and allowing fluid to flow from the air inlet fitting.

Caution:
Wear gloves and catch the draining fluid in a sump or bucket.

Removing Pump Casing

Follow these instructions for removing the pump casing:

Caution:
When assembling or disassembling the pump, do not rotate the casing. This action may cause the float and control rod to rotate with the casing. Instead of rotating the casing, spin the bottom check valve (or plug on a Top-Loading pump) and hold the casing stationary.

Caution:
After troubleshooting is completed and before assembling the pump, slowly move the float through its range to ensure that the lever will trip.

Unscrew the bottom check valve or plug from the discharge tube. **(See Figure 20)**

STEP 1 - Fit a spanner wrench in one of the holes in the circumference of the lower head. The lower head has right-handed threads, so the direction of rotation for disassembly is counterclockwise if looking at the bottom of the pump.

STEP 2 - Hold the top head of the pump with a vise or by inserting a large screwdriver through the pump ring.

Caution:
Do not press against the air hoses or air hose fittings.

STEP 3 - Turn the plug or check valve.

Note:
The O-rings at the top and bottom of the pump may have swollen due to solvents in the fluid being pumped and therefore make turning the plug or check valve difficult.

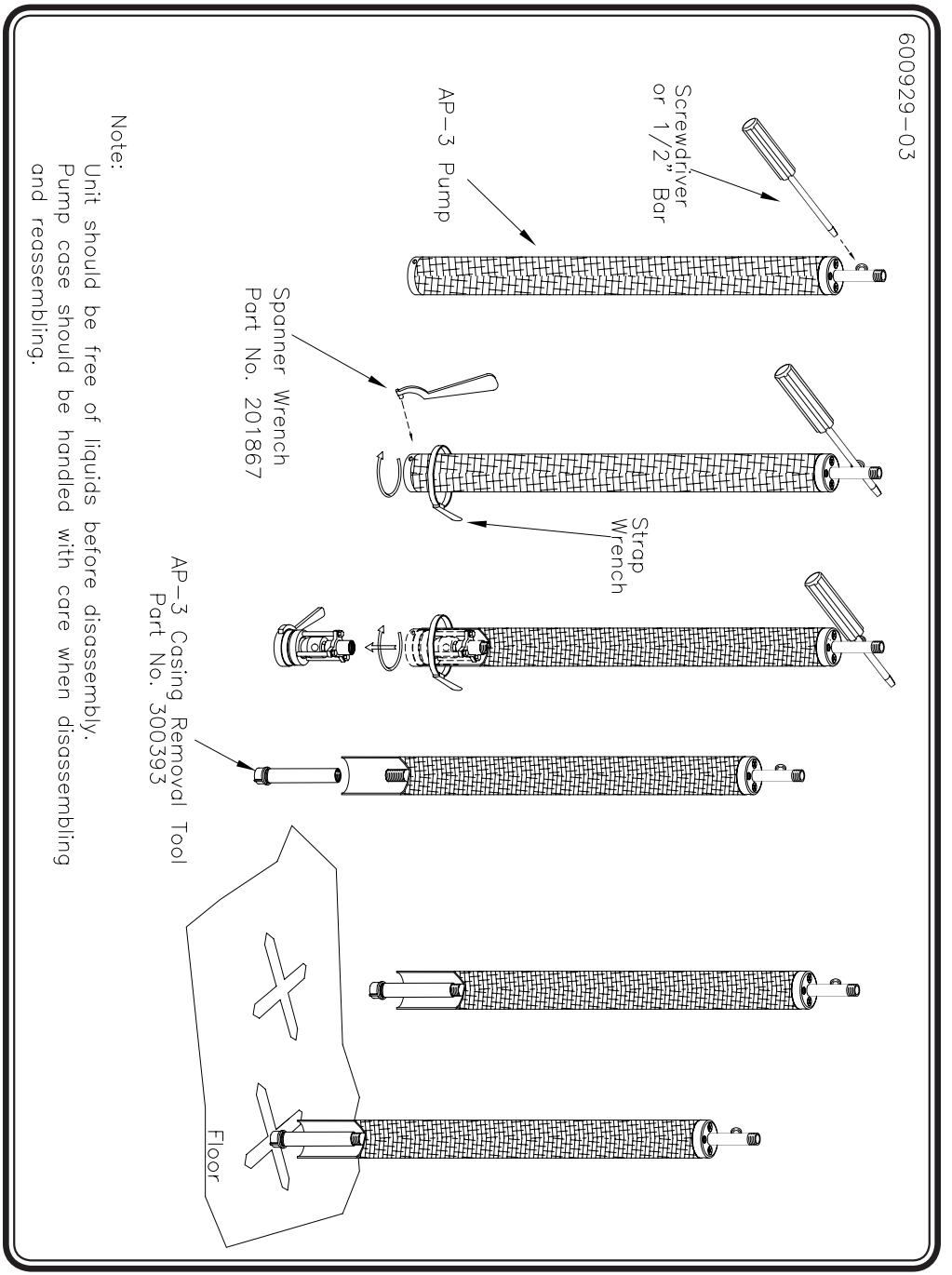


Figure 20 - Removing AP-3 Pump Casing

STEP 4 - If you suspect the pump of being clogged with mud or other particles, prevent the outer casing from turning while the lower plug or check valve is unscrewed.

STEP 5 - Have a second person hold a strap wrench around the pump casing. If there is only one person, hold the upper head in a vise while unscrewing the lower head. This allows a free hand to hold the strap wrench which prevents the pump casing from rotating.

STEP 6 - When the plug or check valve is removed, use a pump casing removal tool to remove the pump casing. The pump casing removal tool is a specially threaded pipe with internal threads at one end and a cap at the other.

STEP 7 - Thread the tool onto the bottom of the discharge pipe (onto the same threads from which the lower head was unscrewed).

STEP 8 - Hold the pump vertically upright with the pump casing removal tool extending down out of the pump casing.

STEP 9 - Hold the pump by the casing and strike the pump casing removal tool on the ground. This will cause the pump casing to slide off the upper O-ring and will allow it to slide off the pump.

Cleaning Pump Interior

The inner workings of the pump should now be exposed for inspection and cleaning. **(See Figures 22 through 26)**

Note:
A Scotch Brite® abrasive pad is useful for cleaning debris from the pump components.

STEP 1 - Gently brush off built-up solids from the float, the discharge tube, the pump casing and the control rod guide.

STEP 2 - The pump can be steam cleaned without damage.

STEP 3 - Remove thick deposits of hardened scale on the discharge tube by using a handbrush or by lightly tapping the discharge tube with a small hammer. Be careful not to strike any pins or other components, since they may be damaged.

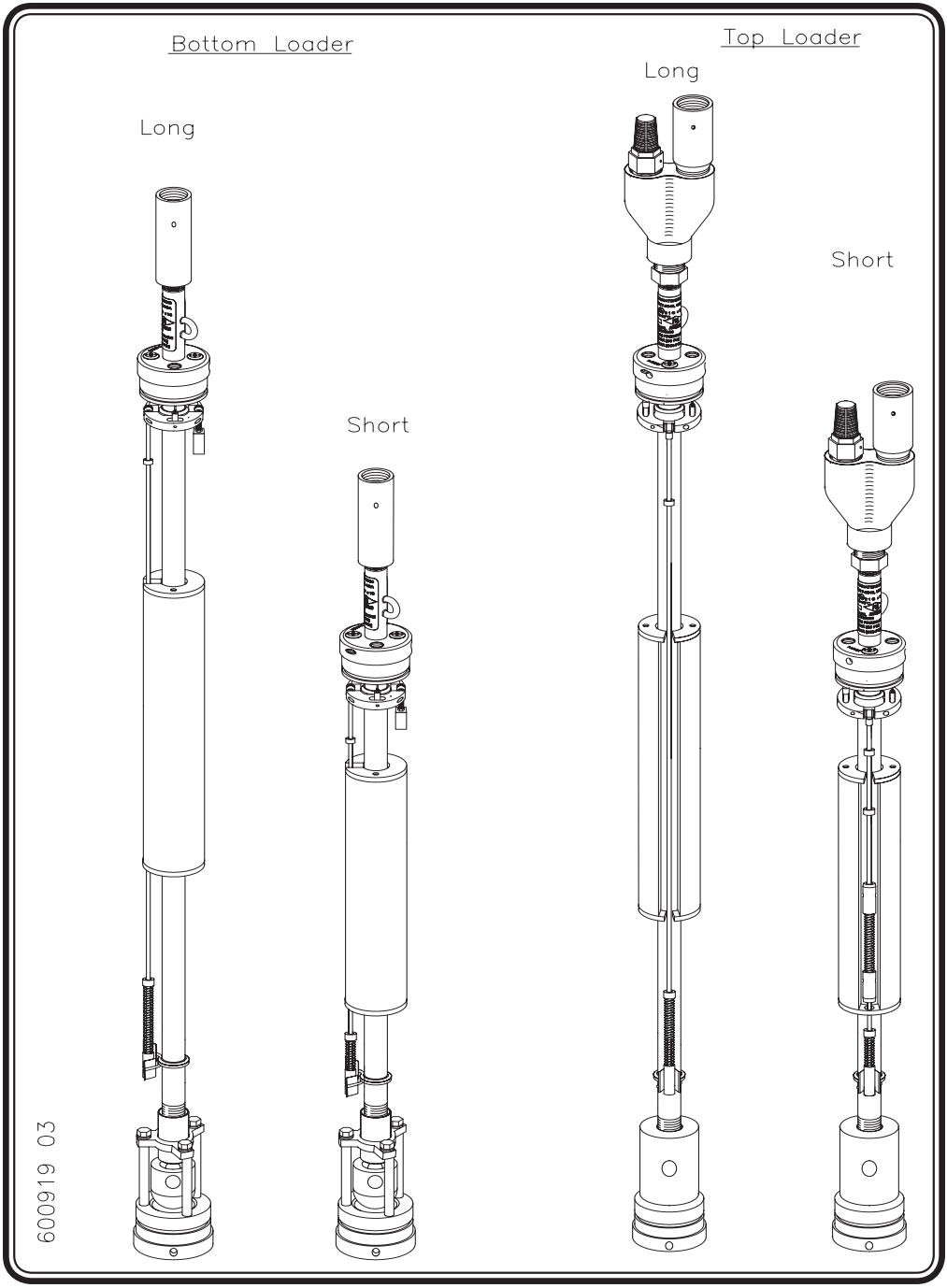


Figure 21 - Internal View of a Bottom-Loading and Top-Loading AP-3

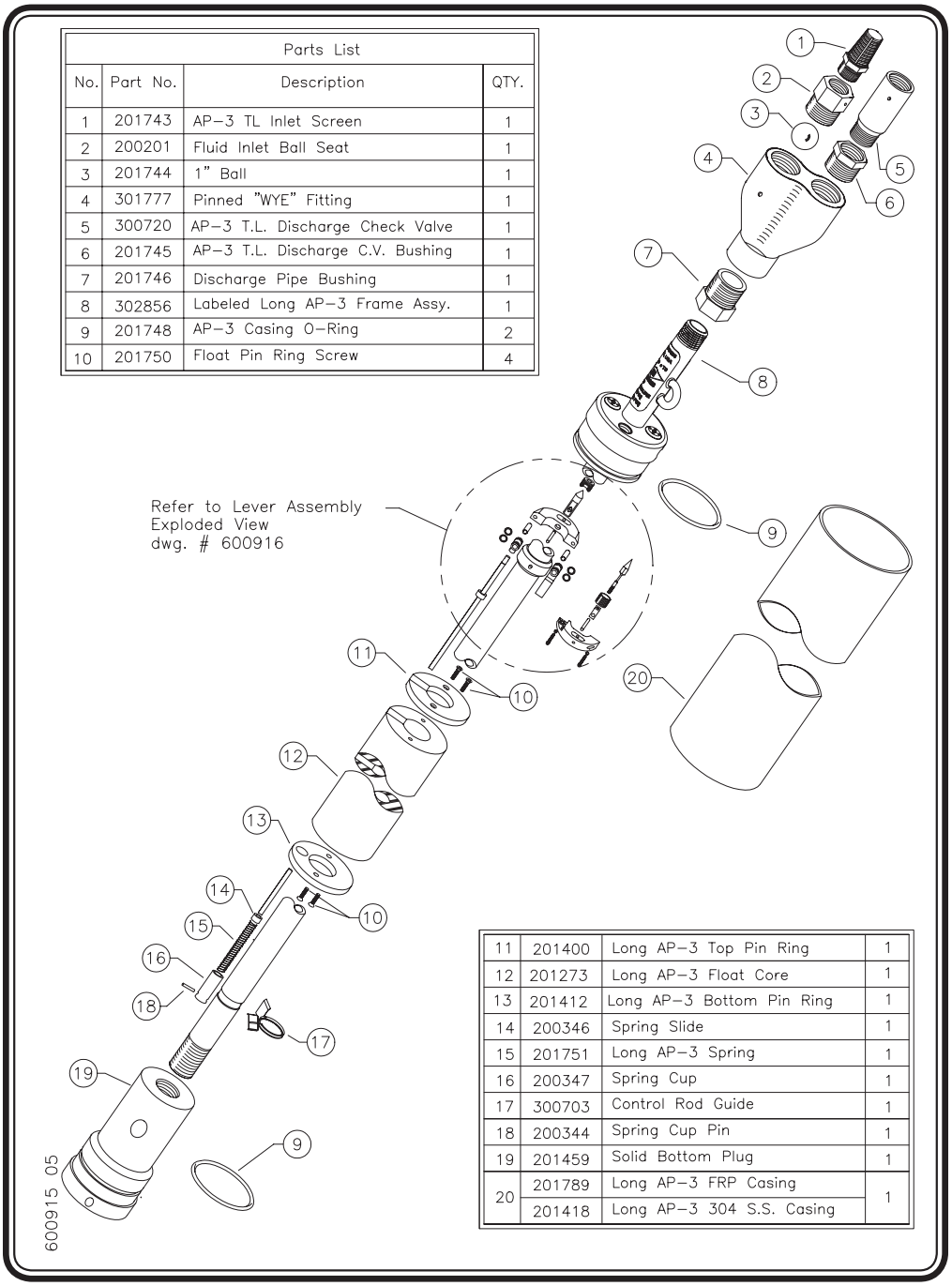
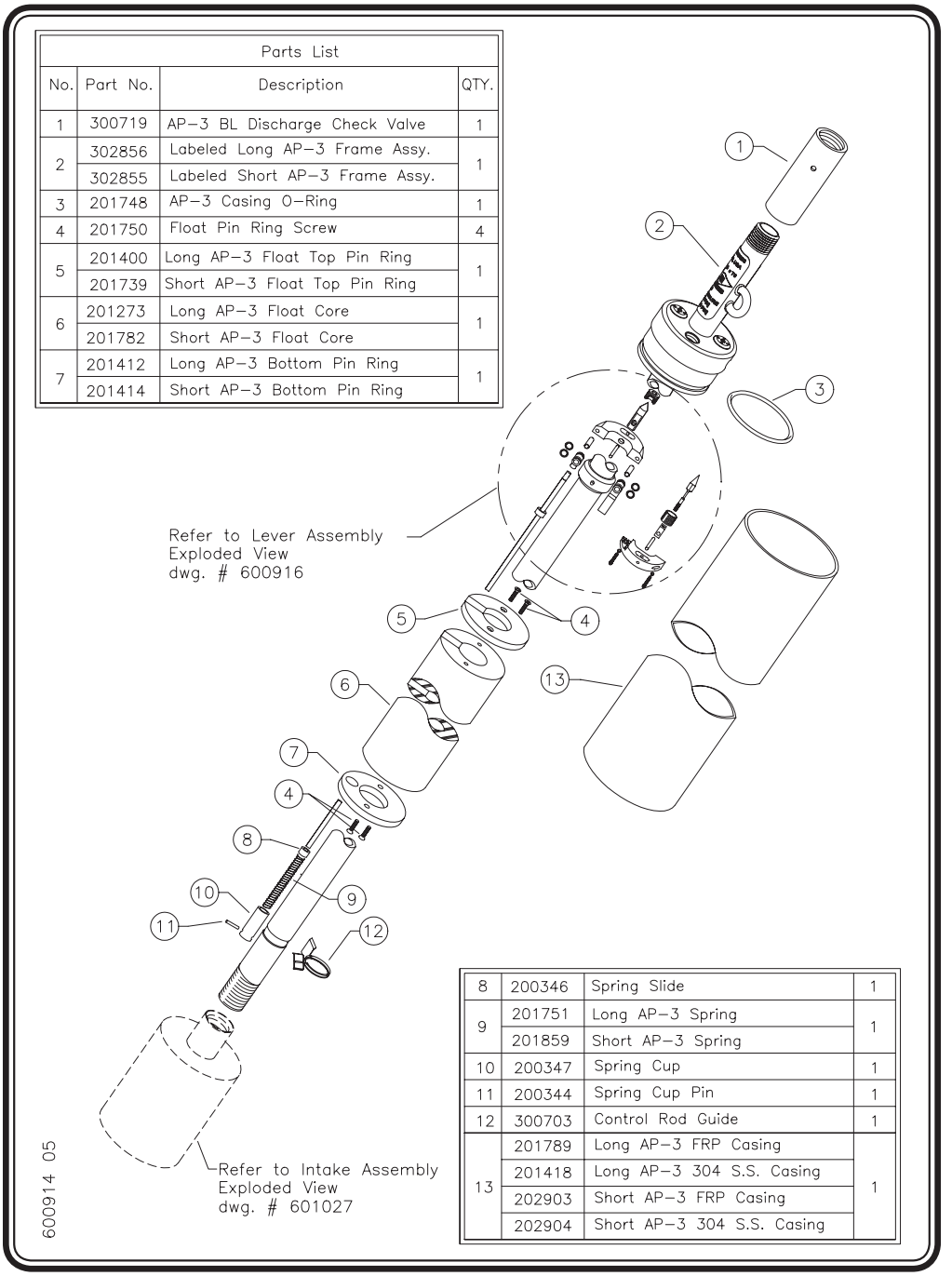


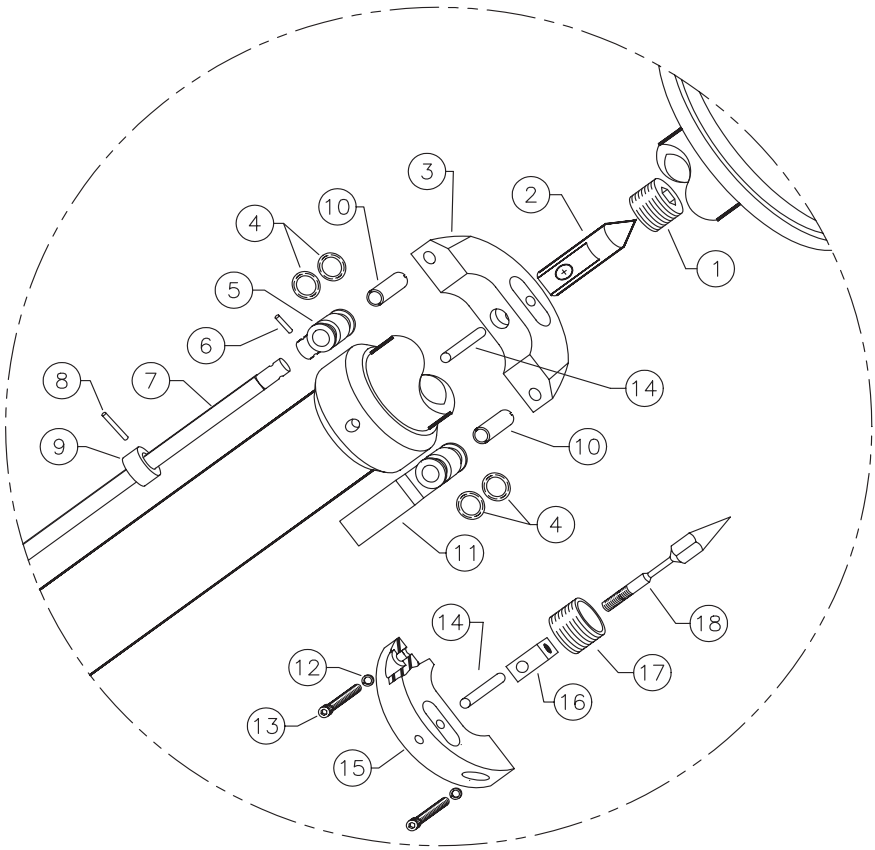
Figure 22 - Exploded View of a Top-Loading Long AP-3



Parts List			
No.	Part No.	Description	QTY.
1	300719	AP–3 BL Discharge Check Valve	1
2	302856	Labeled Long AP–3 Frame Assy.	1
	302855	Labeled Short AP–3 Frame Assy.	
3	201748	AP–3 Casing O–Ring	1
4	201750	Float Pin Ring Screw	4
5	201400	Long AP–3 Float Top Pin Ring	1
	201739	Short AP–3 Float Top Pin Ring	
6	201273	Long AP–3 Float Core	1
	201782	Short AP–3 Float Core	
7	201412	Long AP–3 Bottom Pin Ring	1
	201414	Short AP–3 Bottom Pin Ring	

8	200346	Spring Slide	1
9	201751	Long AP–3 Spring	1
	201859	Short AP–3 Spring	
10	200347	Spring Cup	1
11	200344	Spring Cup Pin	1
12	300703	Control Rod Guide	1
13	201789	Long AP–3 FRP Casing	1
	201418	Long AP–3 304 S.S. Casing	
	202903	Short AP–3 FRP Casing	
	202904	Short AP–3 304 S.S. Casing	

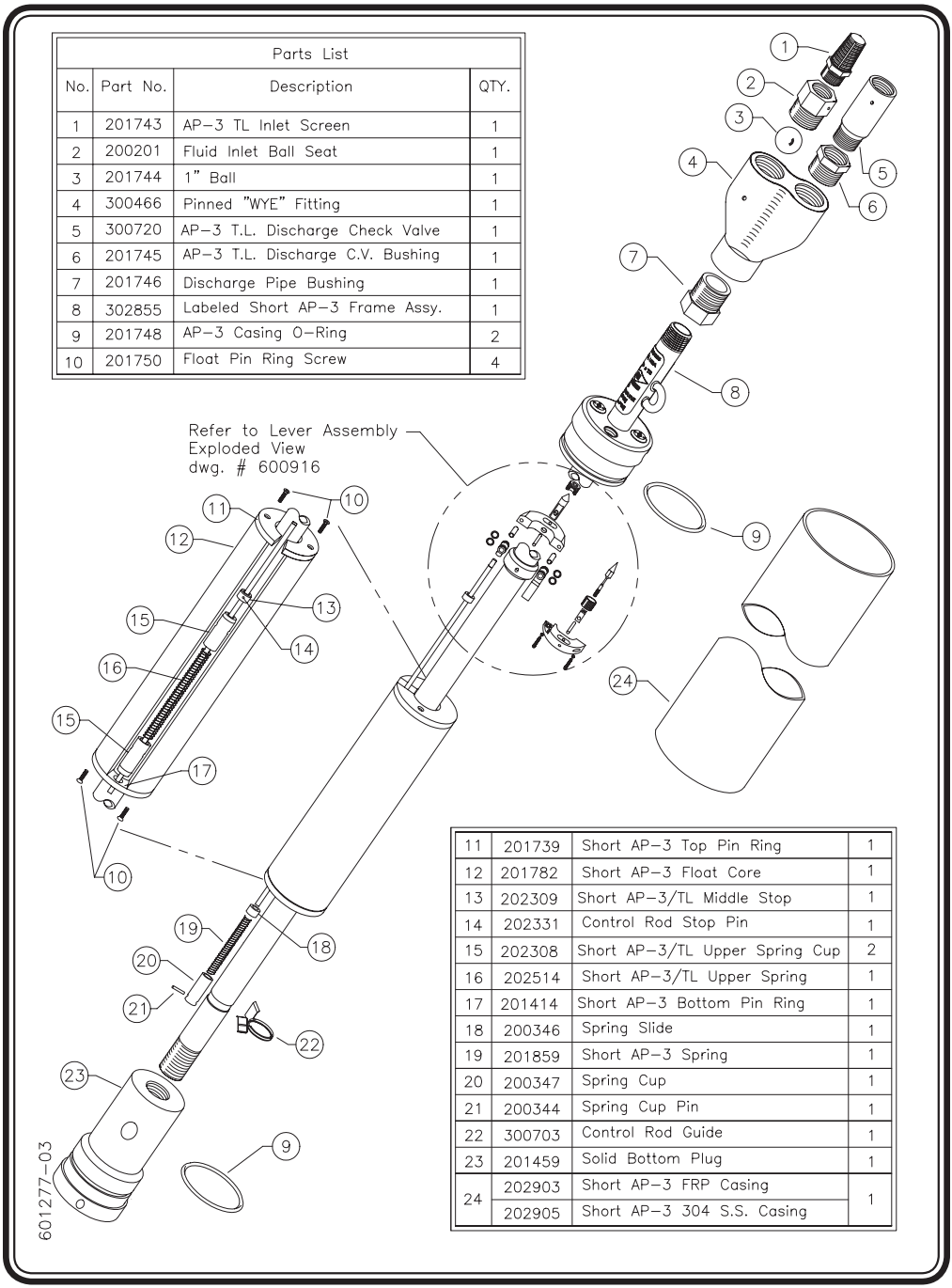
Figure 23 - Exploded View of a Bottom-Loading (Long & Short)



Parts List							
No.	Part No.	Description	QTY.	No.	Part No.	Description	QTY.
1	200663	Exhaust Seat	1	10	201266	Roller Bushing	2
2	201282	Exhaust Poppet	1	11	300402	Long AP–3 Counterweight Assy.	1
3	300390	Exhaust Lever Assembly	1		300433	Short AP–3 Counterweight Assy.	
4	200496	Roller Bumper	4	12	201632	Lever Screw Washer	2
5	300316	Control Rod Adapter Assembly	1	13	201631	Lever Screw	2
6	205102	Control Rod Adapter Pin	1	14	201197	Poppet Pivot Pin	2
7	202916	Long AP–3 Control Rod	1	15	201264	Intake lever	1
	202911	Short AP–3 Control Rod		16	201283	Intake Poppet Connector	1
8	202331	Control Rod Stop Pin	1	17	201457	Intake Poppet Seat	1
9	201401	Control Rod Upper Stop	1	18	201671	Intake Poppet	1

600916 04

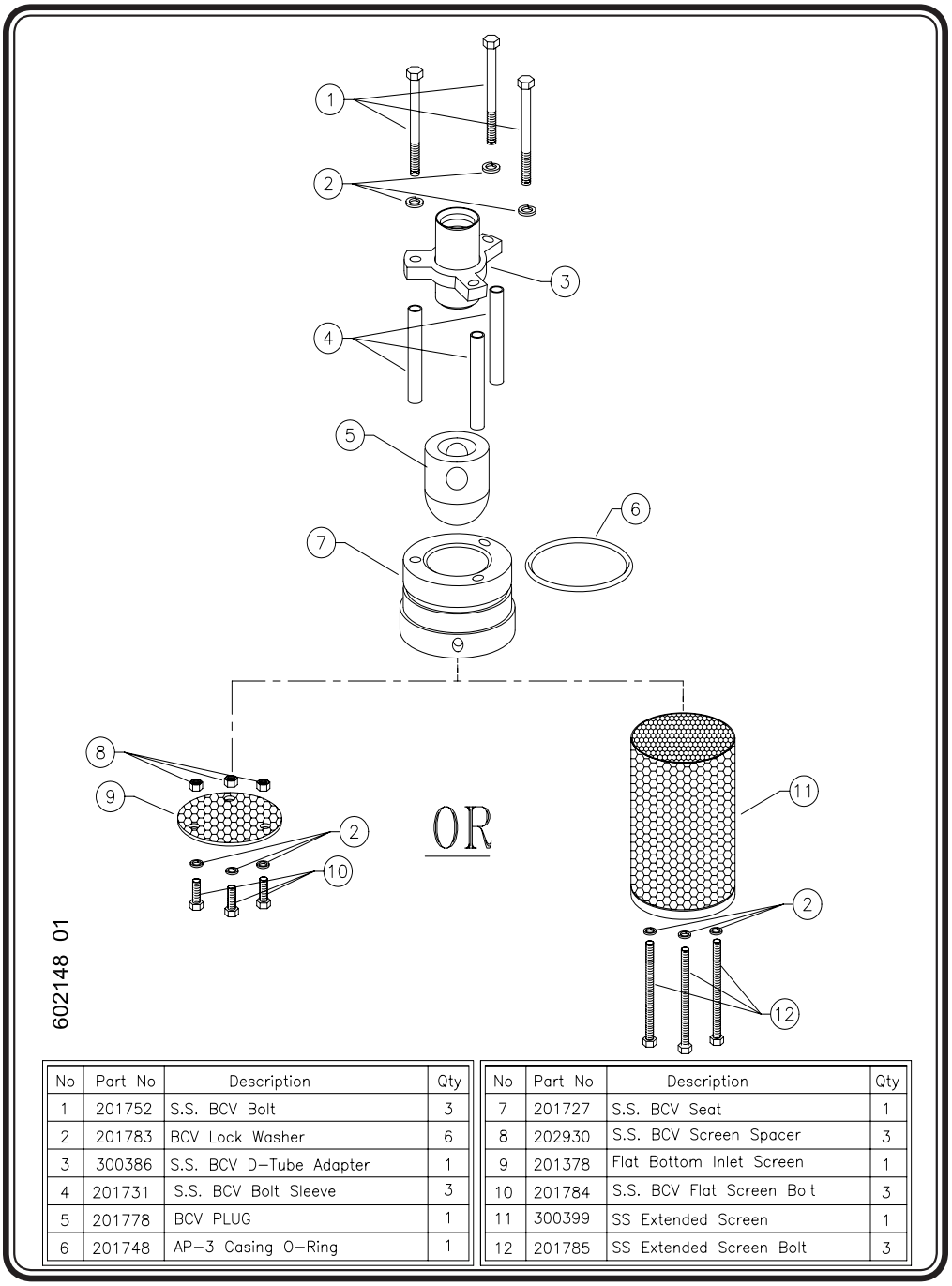
Figure 24 - Exploded View of AP-3 Lever Assembly



Parts List			
No.	Part No.	Description	QTY.
1	201743	AP–3 TL Inlet Screen	1
2	200201	Fluid Inlet Ball Seat	1
3	201744	1" Ball	1
4	300466	Pinned "WYE" Fitting	1
5	300720	AP–3 T.L. Discharge Check Valve	1
6	201745	AP–3 T.L. Discharge C.V. Bushing	1
7	201746	Discharge Pipe Bushing	1
8	302855	Labeled Short AP–3 Frame Assy.	1
9	201748	AP–3 Casing O–Ring	2
10	201750	Float Pin Ring Screw	4

11	201739	Short AP–3 Top Pin Ring	1
12	201782	Short AP–3 Float Core	1
13	202309	Short AP–3/TL Middle Stop	1
14	202331	Control Rod Stop Pin	1
15	202308	Short AP–3/TL Upper Spring Cup	2
16	202514	Short AP–3/TL Upper Spring	1
17	201414	Short AP–3 Bottom Pin Ring	1
18	200346	Spring Slide	1
19	201859	Short AP–3 Spring	1
20	200347	Spring Cup	1
21	200344	Spring Cup Pin	1
22	300703	Control Rod Guide	1
23	201459	Solid Bottom Plug	1
24	202903	Short AP–3 FRP Casing	1
	202905	Short AP–3 304 S.S. Casing	

Figure 25 - Exploded View of a Top Loading Short AP-3



No	Part No	Description	Qty
1	201752	S.S. BCV Bolt	3
2	201783	BCV Lock Washer	6
3	300386	S.S. BCV D-Tube Adapter	1
4	201731	S.S. BCV Bolt Sleeve	3
5	201778	BCV PLUG	1
6	201748	AP-3 Casing O-Ring	1

No	Part No	Description	Qty
7	201727	S.S. BCV Seat	1
8	202930	S.S. BCV Screen Spacer	3
9	201378	Flat Bottom Inlet Screen	1
10	201784	S.S. BCV Flat Screen Bolt	3
11	300399	SS Extended Screen	1
12	201785	SS Extended Screen Bolt	3

Figure 26 - Exploded View of Bottom Intake Check Valve Assembl with Standard Flat Screen and Leachate Screen

Iron Build-up Cleaning Procedure

After the casing has been removed from the AutoPump please follow the procedure below:

Note:
The procedure described below can be seen in the Maintenance Video Tape. This will aid the technicians understanding and ease of properly disassembling the AutoPump, effectively cleaning components and then re-assembling the AutoPump.

STEP 1 - The bottom intake check valve assembly should be removed from the casing. **(See page 47, and Figure 20 on page 48)**

STEP 2 - Visually inspect both the 1 inch stainless steel fluid discharge pipe for iron build-up or debris. Also, do the same with the float that rides up and down on the SS discharge pipe.

STEP 3 - Should there be iron deposits on either or both the discharge pipe or float, then remove the float from the SS fluid discharge pipe as follows:

- Remove the control rod guide. **(See Figure 22 and Figure 23)**
- Remove the small SS pin from the bottom spring cup "Stop". The Stop is the small white part located just below the Spring identified on **Figure 22 and Figure 23**. The pin and Stop removal will allow you to remove the spring and float from the SS discharge pipe.

STEP 4 - The 1/2 inch stainless steel fluid discharge pipe can now be cleaned using either a Scotch Brite pad, a wire brush or finally a wire wheel on either a drill or a grinding machine. After removing the iron debris, it is recommended the pipe be water rinsed.

STEP 5 - Both the internal and external surfaces of the float will generally require cleaning. The material choices include a Scotch Brite pad, and a light grade 150 sandpaper.

The float has a metal plate on each end. If these plates are removed to ease cleaning, they should be replaced on the same float end from which they came. That is, the plates should maintain their original top and bottom positions.

STEP 6 - The white plastic square Control Rod is the next component to be cleaned. The control rod is the item that fits through the smaller hole in the float and is adjacent to the SS discharge pipe in the assembled pump. Again, use the Scotch Brite pad or a razor or Exacto knife (not sandpaper).

STEP 7 - The final component to be cleaned is the outer AutoPump casing. Please note you may either have a stainless steel or FRP fiberglass pump casing. The fastest and most effective way to clean out the inside surface of the pump casing is to use a three-stone honing tool. The technique is to move the hone in-and-out a half dozen times or so through each end of the casing. The time for the casing cleaning should take no longer than 5 minutes.

The AutoPump is now ready for re-assembly by following the steps above in reverse order.

Installing Pump Casing

STEP 1 - Inspect the O-rings to ensure they are capable of sealing (no discernible cuts or abrasions).

STEP 2 - Lubricate both inside ends of the casing to a depth of 3/4" with a thin layer of food-grade grease. Ensure that the film reaches the edges of the casing.

STEP 3 - Place the bottom check valve (Bottom Loading Pump) or bottom plug (Top Loading Pump) upright on a clean level surface.

STEP 4 - Pull the casing down over the check valve or plug.

Warning:
The pump casing has beveled ends that allow it to slide over the O-rings easily. Keep fingers, hands and other body parts away from these edges as they approach the heads. These edges can pinch when the pump casing is slid over the lower and upper heads.

STEP 5 - Turn the pump upside down and spin the casing assembly on the discharge tube by hand until the edge of the casing contacts the O-ring on the pump head.

Caution:
Be careful to swing the counterweight inside the pump.

STEP 6 - Using a spanner wrench on the bottom fitting, or, a strap wrench on the bottom end of the casing (pump bottom), turn the parts together until the casing just contacts the pump head.

STEP 7 - Turn the bottom check valve or the plug in the reverse direction (counter clockwise) so it is looser by 1/4 turn.

Checking Volumes Pumped Per Cycle

See page 25 for information on the AutoPump volumes pumped per cycle. Ensure that volumes correspond with the previous experience on-site, and with the ranges indicated on page 25. If it doesn't correspond, then one of the following may exist:

1. The AutoPump is malfunctioning. **(See Chapter 7: Troubleshooting & Repair)**

2. The Pump Cycle Counter may not be counting correctly. Refer to the **Pump Cycle Counter Manual** for troubleshooting procedures.

3. Site conditions (e.g. air pressure, discharge head) may have changed substantially.

Chapter 7: Troubleshooting & Repairs

Problems may occur and usually can be easily resolved by following these instructions. If, after careful reading and service, you cannot resolve the problem, please contact the *QED Environmental Systems (QED)* Service Department at (800) 537-1767.

Caution:
Wear goggles, gloves, and coveralls when servicing this system.
After troubleshooting is completed and before assembling the pump, slowly move the float through its range to ensure that the lever will trip even if the pump fills and empties slowly.

Note:
See Chapter 6: Maintenance for disassembly and cleaning instructions.

Possible Causes	Symptoms		
Detailed Instructions Follow this Chart	Pump not cycling	Pump Cycles, but volume is reduced or there is no discharge	Air in fluid discharge
1. Air supply	X		X
2. Fluid level	X		
3. Air exhaust restricted	X		X
4. Fluid Inlet clogged	X		
5. Debris, scale or very viscous fluid	X	X	X
6. Float pins	X		X
7. Debris in air inlet valve	X		
8. Fluid check valve		X	
9. Valve timing	X		

Troubleshooting

1. Air Supply:

- If the air pressure is too low, or if the flow is severely restricted, the pump will not cycle. Check the flow by inserting the pump air fitting part way into the air line socket. A healthy discharge of air should result.

- If the air pressure exceeds the design limitations of the pump, the pump may fail to cycle, or the exhaust valve may have locked up and cause air to enter the fluid discharge.

2. Fluid Level:

- The fluid level must be above the fluid inlet on a Top-Loading pump. On a Bottom-Loading pump, the fluid must be no lower than 11 inches (Short pump) or 12 inches (Long pump) below the head of the pump.

3. Air Exhaust Restricted:

- The exhaust line must not be kinked, plugged, or too small in diameter.

- The air exhaust outlet must be above the fluid level.

- If the air exhausts in the well, the well must be vented to the atmosphere or a functioning vapor recovery line.

- If the air exhausts to the atmosphere (outside the well) and a vacuum is drawn on the well, the pump may fail to fill. In order for the pump to fill under these adverse conditions, the pump must be submerged to make up for the pressure difference between the atmosphere and the partial vacuum in the well.

  The pressure difference, expressed as feet of water column (FT. W. C.), is how far the fluid must be above the pump before it can fill.

- **See Appendix D** if there is a vacuum on the well.

- Ice may be forming on the exhaust valve seat due to the temperature drop that accompanies expansion of compressed air. Restrict the exhaust to lower the expansion rate of the exhaust. Restrict the air inlet hose or lower the pressure to reduce the rate of incoming compressed air. The previous three suggestions may reduce the flow rate from the pump. Submerge the head of the pump, if it is not already submerged. Protect the air lines from low temperatures and freezing by burial or insulation.

4. **Fluid Inlet Clogged**:
   - If the fluid inlet screen is clogged with debris, or if a Bottom-Loading pump is on the bottom of the well, water cannot enter the pump.

5. **Debris, Scale, or very Viscous Fluid**:
   - If debris, scale or a very viscous fluid has accumulated inside the pump, the float may not move freely up and down, or the control rod may not slide easily through the float.

   - Clean the float, control rod, and the casing. See **Chapter 6** for cleaning instructions.

6. **Float Pins**:
   - Determine if any part of the float material itself can contact the discharge pipe. Move each end of the float back and forth, sideways, to ensure that the pins on the plate of the float prevent float contact. Call *QED* for repair options.

> **Note:**
> If viscous materials cause continual problems, contact QED for possible solutions.

7. **Debris in Air Inlet Valve**:
   - Open the pump. Connect the air supply. Pull the control rod down. Listen to determine if significant volume of air leaks through. A leak rate of 3 SCFH at 30 psi is acceptable (this is a small leak that produces bubbles in a soapy water solution). If so, clean the valve by blowing air or water through it from both ends.

   - If air still leaks through the valve with the control rod down, the air-hose must be removed to access the valve inlet to check for debris in the valve or in the hose pigtail.

   - Push the rod upwards. If little or no air passes through, remove the air-in hose to access the valve inlet. Blow air through the valve from the poppet side to clear debris from the ball and seat.

8. Fluid Check Valves:

- Open the pump. Hold the pump vertically and pour water into the discharge check valve. If water flows through, clean the valve.

- Remove the valve and use emery cloth or a very fine sand paper to polish the surface where the ball seats.

- Inspect the ball for wear. If it is too small to seal on the seat, or if it is obviously out of round, replace it with a new ball.

- If the pump is a Bottom-Loading design, inspect the seat of the bottom check valve for debris and wear. Clean or replace if necessary.

- If the pump is a Top-Loading design, remove the fluid inlet check valve and inspect the seating surface and the ball for debris and wear.

9. Air Inlet Valve Timing:

- Remove the pump casing. Connect the air supply. Pull the control rod down to the bottom of its travel. Slowly raise the rod towards the pump head. Air should begin to flow through the valve when the lever is horizontal.

Returning Equipment for Service

If the equipment needs to be returned to *QED* for servicing, please follow these steps:

STEP 1 - Call the *QED* Service Department and obtain a Return Material Authorization **(RMA)** number. Please have available the customers contact person's name, company name and address, phone number, fax number, reason for the return, and the names of the chemicals to which the equipment has been exposed.

STEP 2 - Clean all equipment before shipping. See **Equipment Cleaning Requirements** at the end of this section.

If the equipment must be cleaned after it arrives at *QED*, the customer will be charged for the cleaning and disposal of material, if necessary. (Cost can be $200.00 per piece of equipment cleaned.) Drain and dry all equipment after cleaning.

STEP 3 - Package the equipment so that it will not be damaged in shipment. Use bubble pack rather than styrofoam flakes as packing material.

STEP 4 - Ship the equipment via a carrier and service level (i.e., one-day, two-day shipping) in consideration of probable service time and return shipment time.

STEP 5 - It is recommended that such shipments be insured so if the shipment is badly damaged or lost, the customer can replace the equipment at little or no cost.

STEP 6 - Include the contact's name, company, phone number and RMA number given by *QED* .

STEP 7 - Write the RMA number on the outside of the packaging so it will be directed immediately to the *QED* Service Department.

Equipment Cleaning Requirements

If the equipment is to be shipped to another site or to the factory for service, it needs to be thoroughly cleaned before leaving the site. Cleaning the equipment protects the user (sender), the shipper, and the receiver from dirt and/or contaminants. If the equipment is not cleaned prior to shipping for servicing, it may be severely delayed, refused or the shipper may be charged a cleaning fee. Before packing and shipping, ensure that the equipment is dry inside and out.

The following is a list of equipment and how it should be cleaned prior to shipment.

Hoses and Fittings

STEP 1 - Pump clean water or water with a gentle soap solution (e.g. Dove Dish Soap) through the pump to remove free product and particles.

STEP 2 - Rinse all soap off of the equipment.

STEP 3 - Soak and rinse the outside of the unit with water to remove loose debris and dirt.

STEP 4 - Steam clean inside and out to remove difficult dirt and contaminants.

Caution:
Use low pressure (less than 40 psi) when steam cleaning.

AutoPumps

STEP 1 - Pump clean water or water with a gentle soap (e.g. Dove Dish Soap) solution through the pump to remove free product and particles.

STEP 2 - Rinse all soap off of the equipment.

STEP 3 - Soak and rinse the outside of the unit with water to remove loose debris and dirt.

STEP 4 - Steam clean inside and out to remove difficult dirt and contaminants.

Caution:
Use low pressure (less than 40 psi) when steam cleaning.

Appendix A: Performance Curves

These curves were derived from in-house tests using a pump with average air flow capacity. Flow rates in the field may vary slightly due to temperature, air quality, flow restrictions and minor differences in pump adjustments. Flow rates can be affected due to the natural cooling effect of compressed air expansion. If this cooling effect is lowering the flow rate, decreasing the air pressure to the pump can actually increase the flow rate in some cases. Another way to reduce freezing of water vapor in compressed air is to use an air dryer on the compressed air line.

The following charts show the performance flow rate curves for the Long and Short pumps.

Long Bottom and Top-Loading AP-3 AutoPumps
- **See Figures 27 through 32.**

Short Bottom and Top-Loading AP-3 AutoPumps
- **See Figures 33 through 38.**

The curves are categorized by pump type, hose size, depth of submergence and air supply pressure. To determine the flow rate a pump will produce, the following information must be known:

1. **Pump** – Long, Short or Low Dardown; Top- or Bottom-Loading.
2. **Discharge hose size** – 3/4-inch or 1-inch is standard. A larger inside diameter may yield a higher flow rate. This depends on site conditions.
3. **Fluid Inlet** Submergence – Select the submergence depth of the pump below the fluid under normal operating conditions.
4. **Air pressure**.

With the previous information, obtain the flow rate by using the following steps:

- On the horizontal scale, find the depth in the well at which the pump will be located.
- Trace that depth upwards to the line for the air inlet pressure you selected.
- Travel horizontally over to the vertical scale and read the flow rate.

Example: A long Bottom-Loading AP-3 with a 1-inch discharge hose and 70 psi supply pressure positioned 100 feet below ground and submerged 6 inches below the fluid will produce about 3.0 gallons per minute (GPM).

The same pump submerged 10 feet below the fluid produces 3.8 GPM.

Note:
These flow rates are only applicable for the designated well head conditions. Any additional resistance from out-of-well equipment (e.g. surface hoses, valves, etc.) will affect the values shown on these curves.

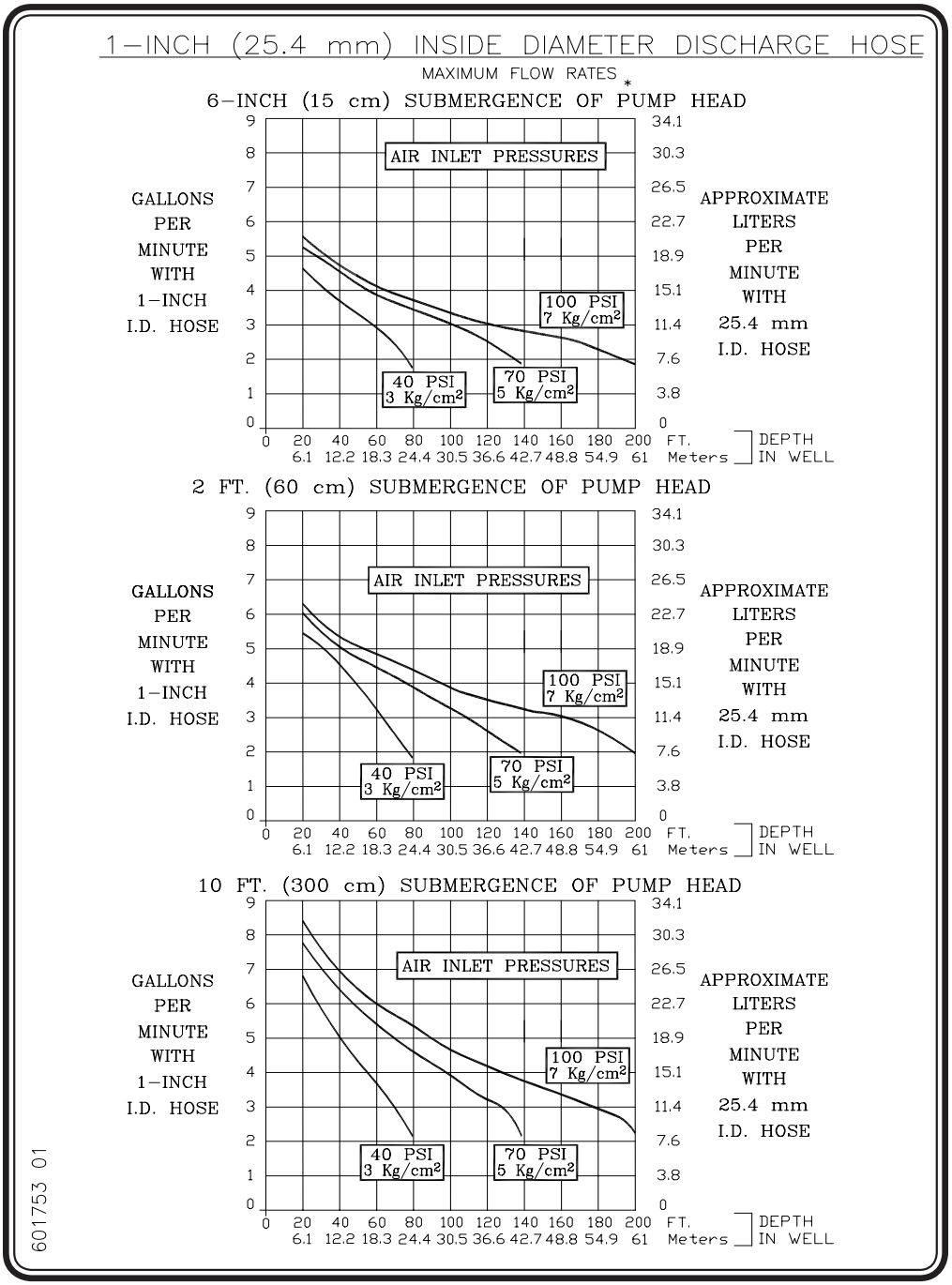


Figure 27 - Long AP-3/BL Performance Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

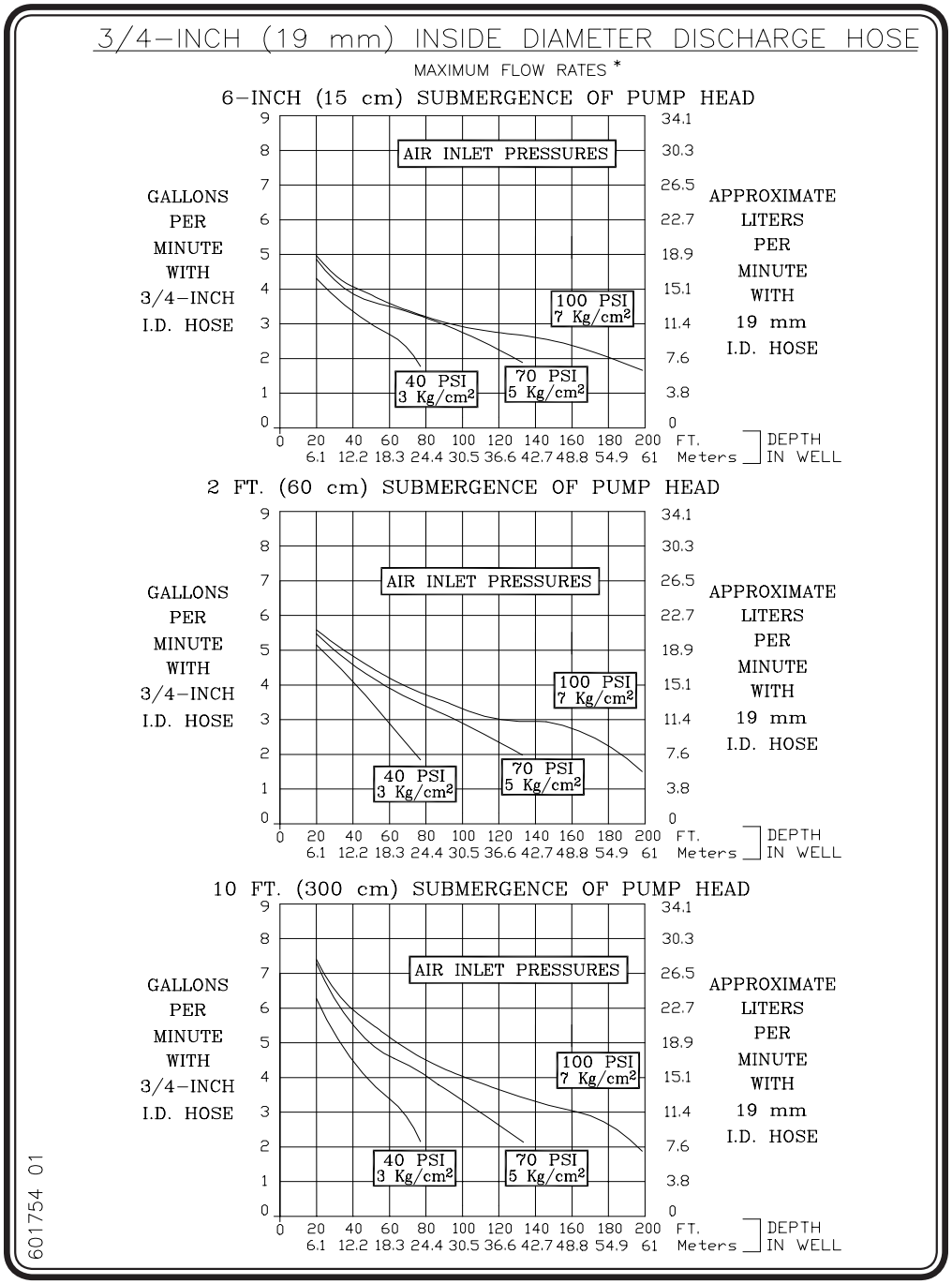


Figure 28 - Long AP-3/BL Performance Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

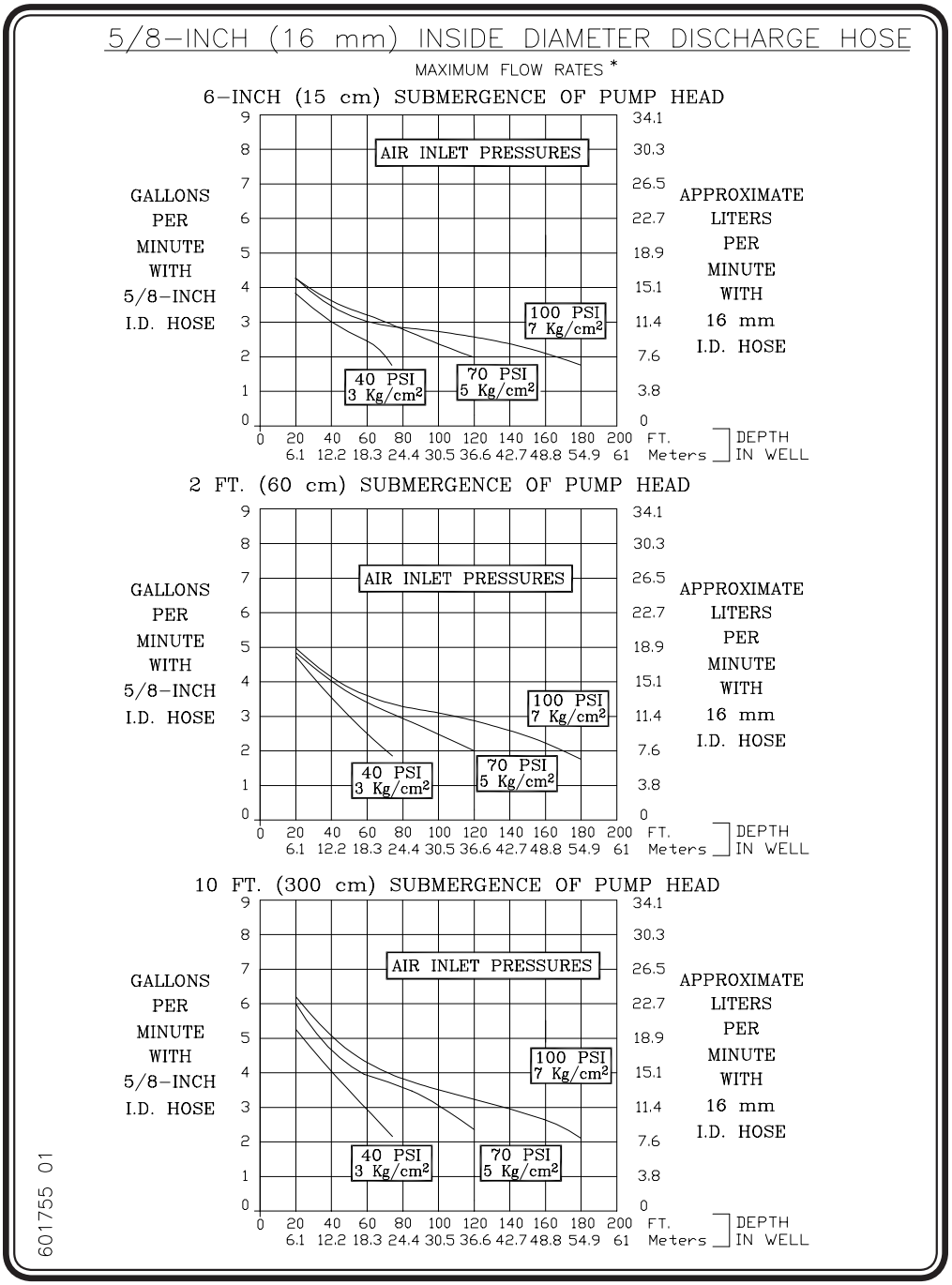


Figure 29 - Long AP-3/BL Performance Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

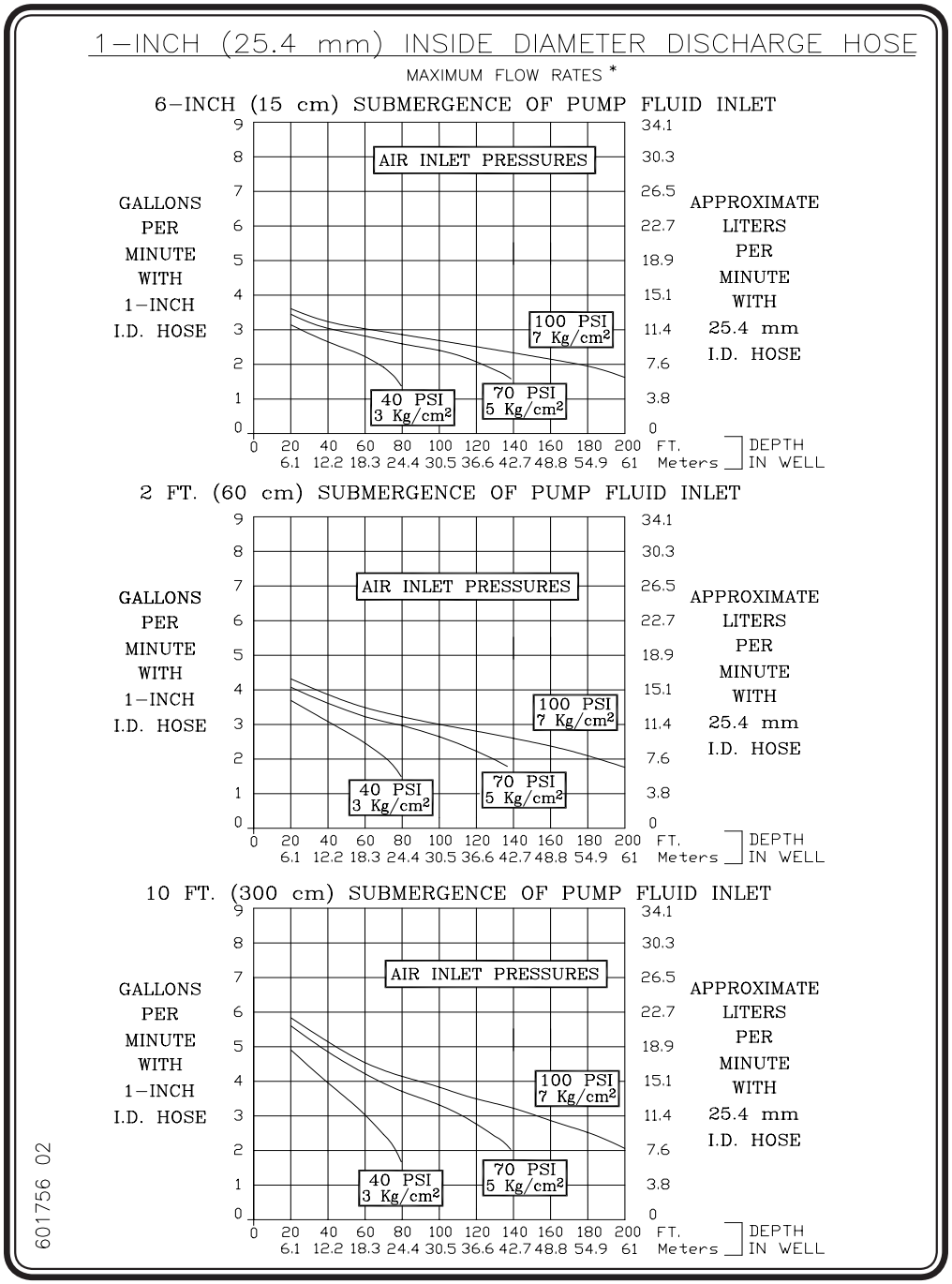


Figure 30 - Long AP-3/TL Performance Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

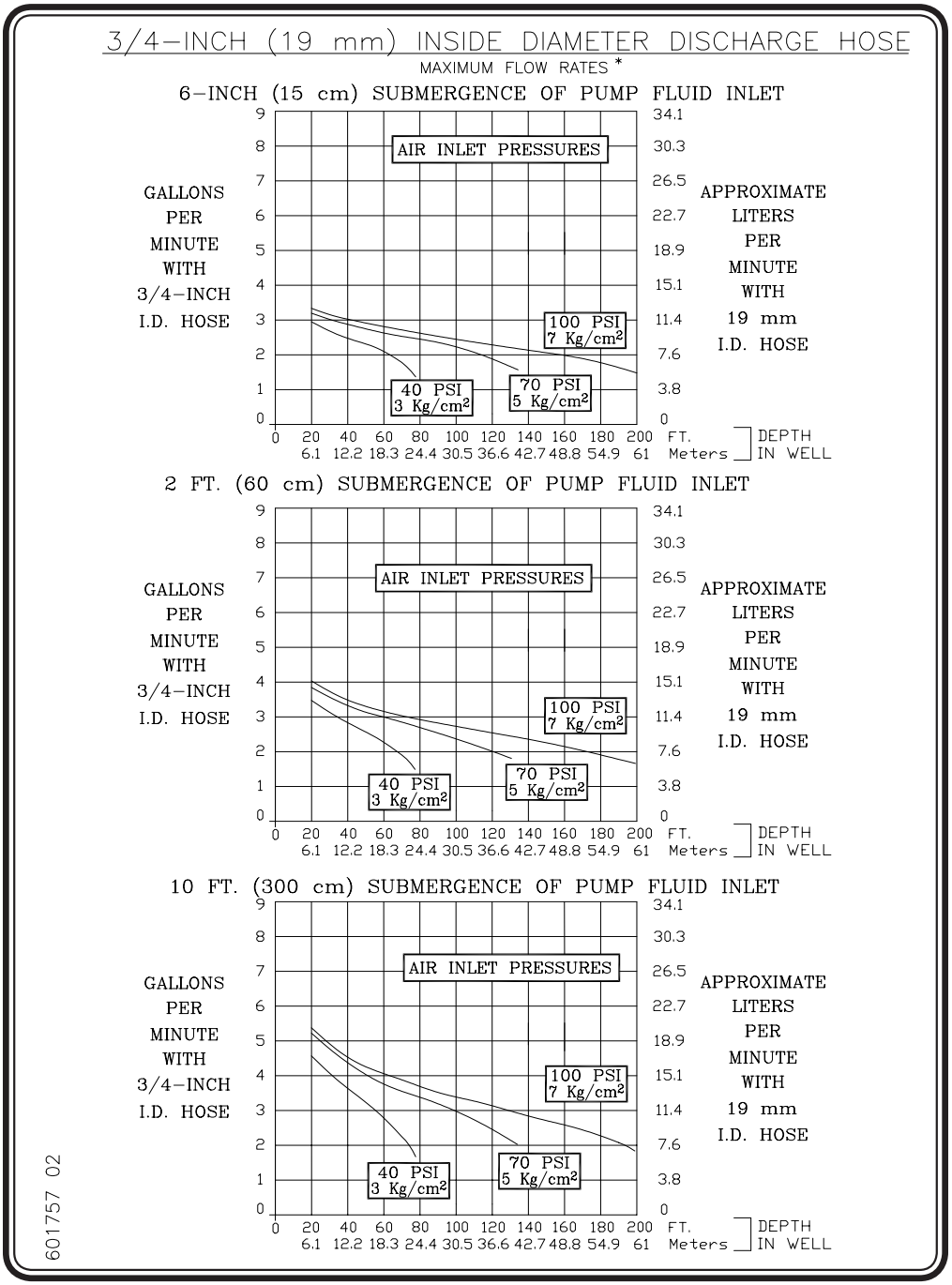


Figure 31 - Long AP-3/TL Performance Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

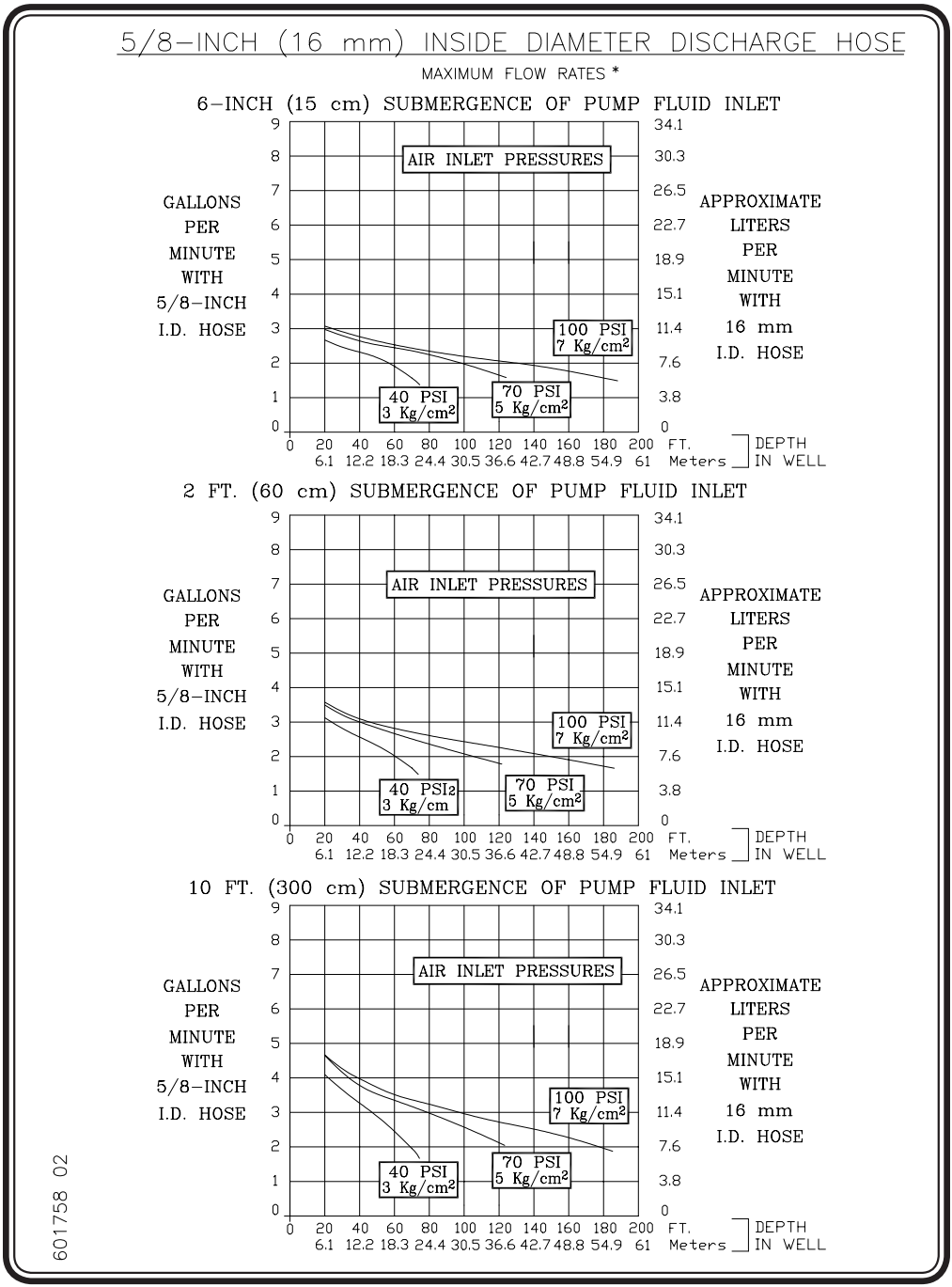


Figure 32 - Long AP-3/TL Performance Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

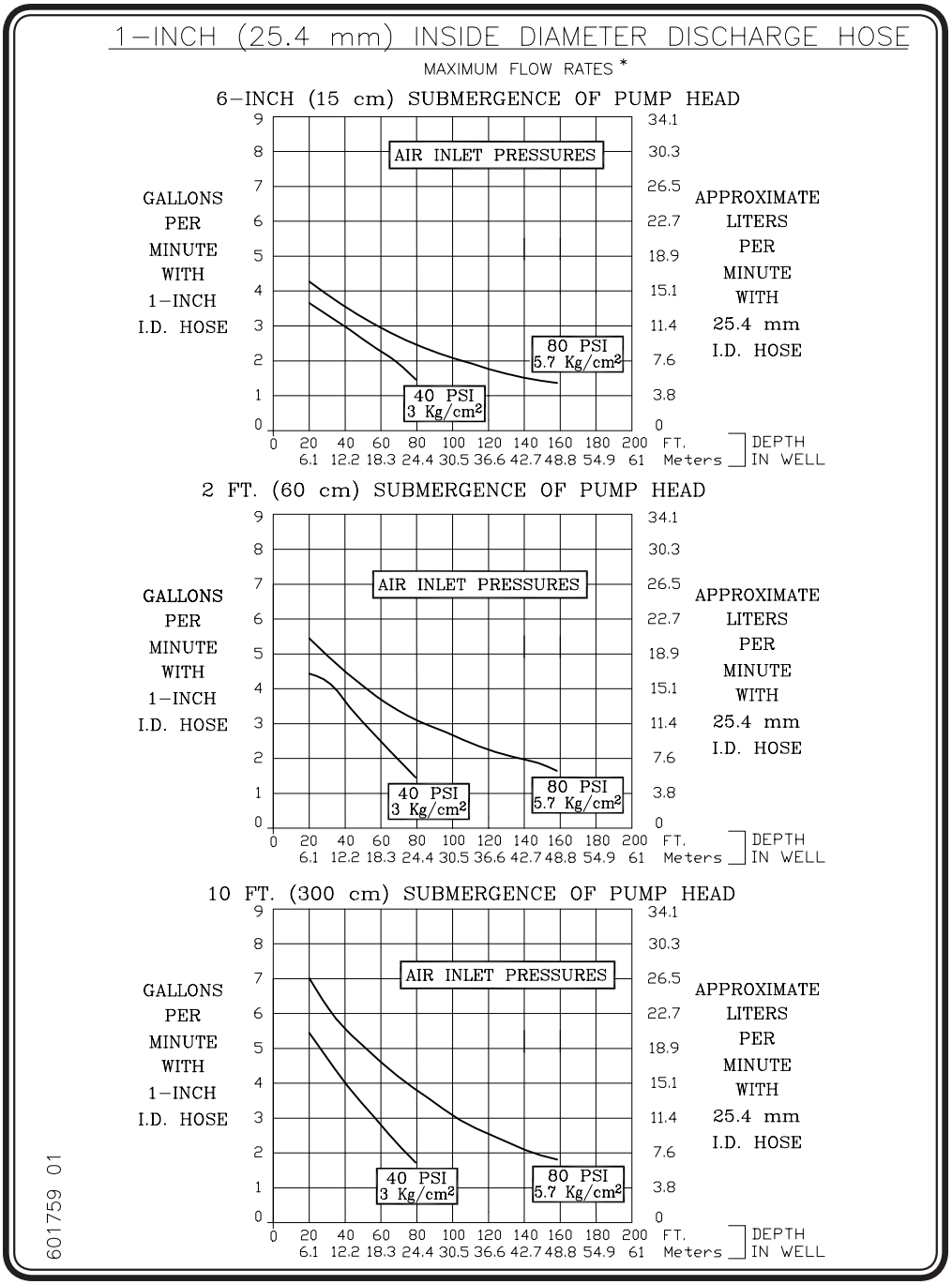


Figure 33 - Short AP-3/BL Performance Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

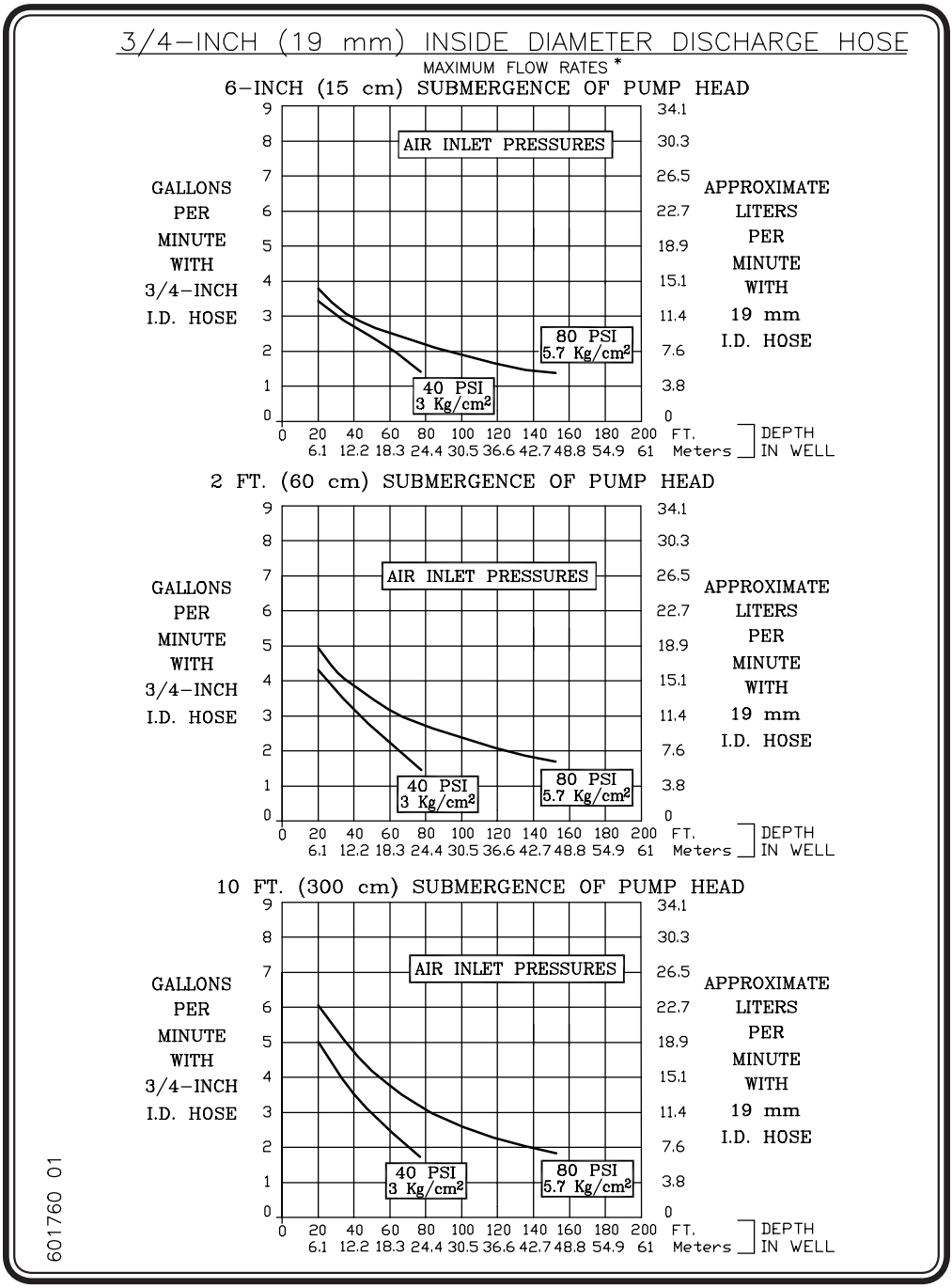


Figure 34 - Short AP-3/BL Performance Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

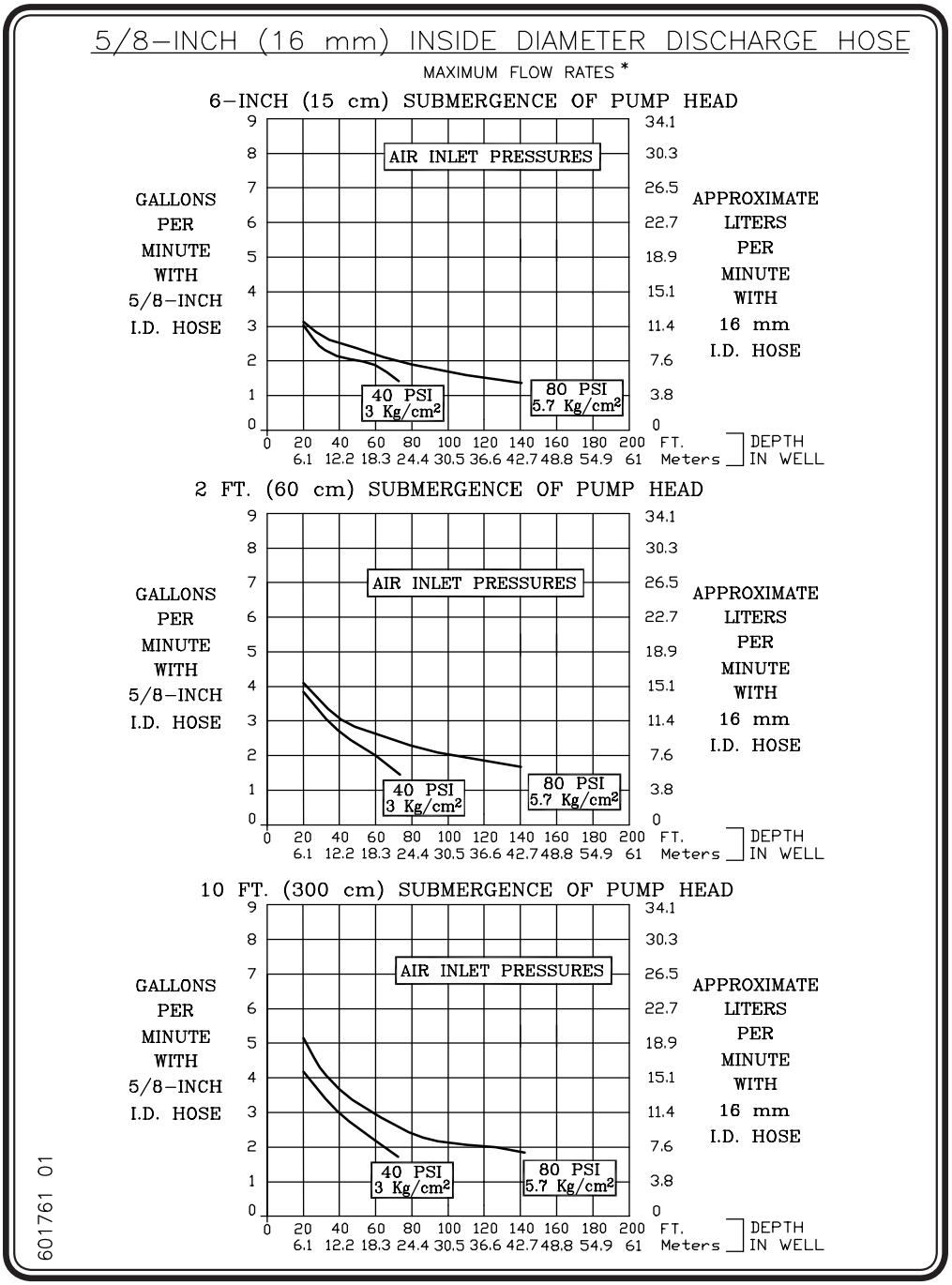


Figure 35 - Short AP-3/BL Performance Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

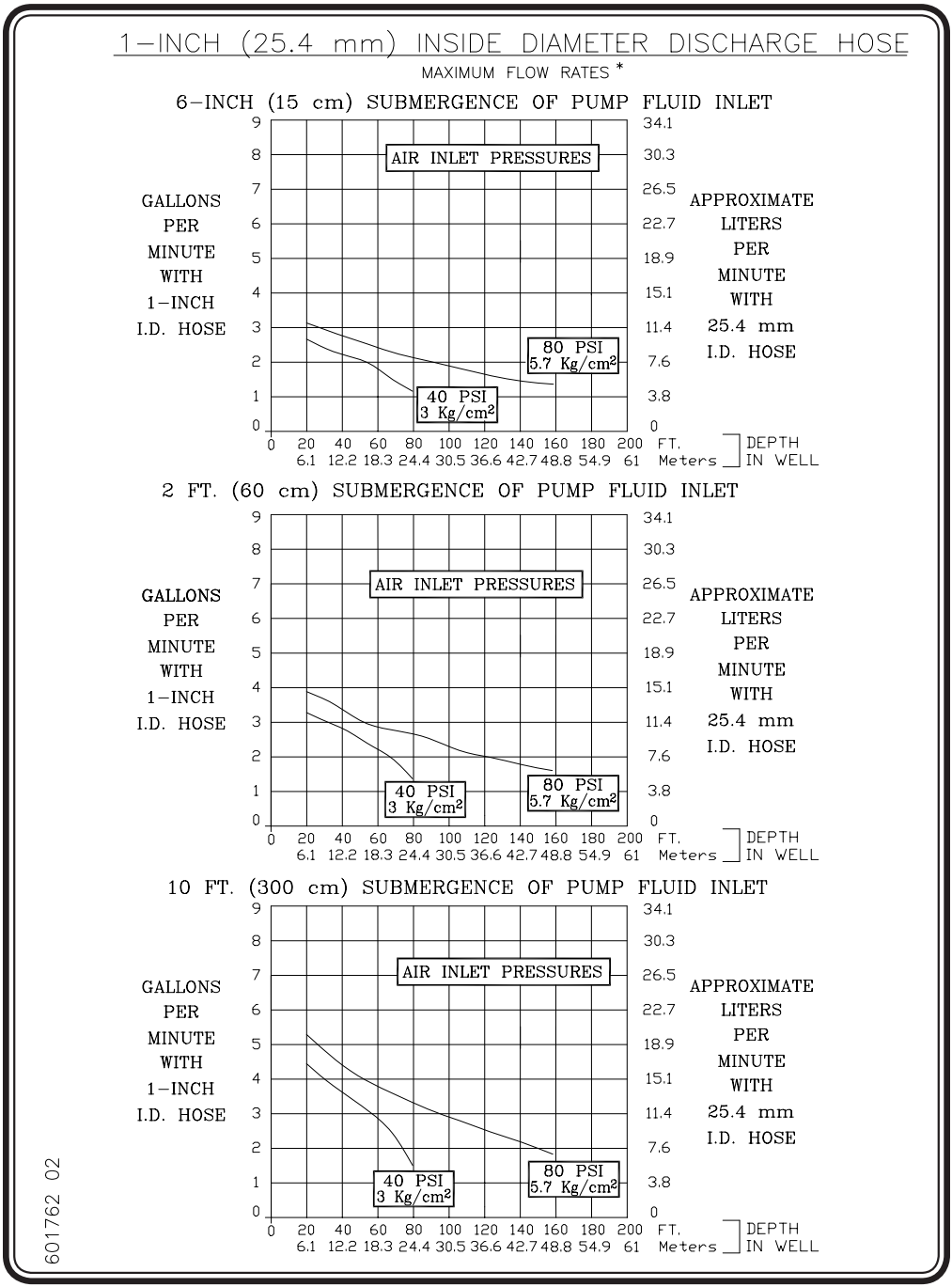


Figure 36 - Short AP-3/TL Performance Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

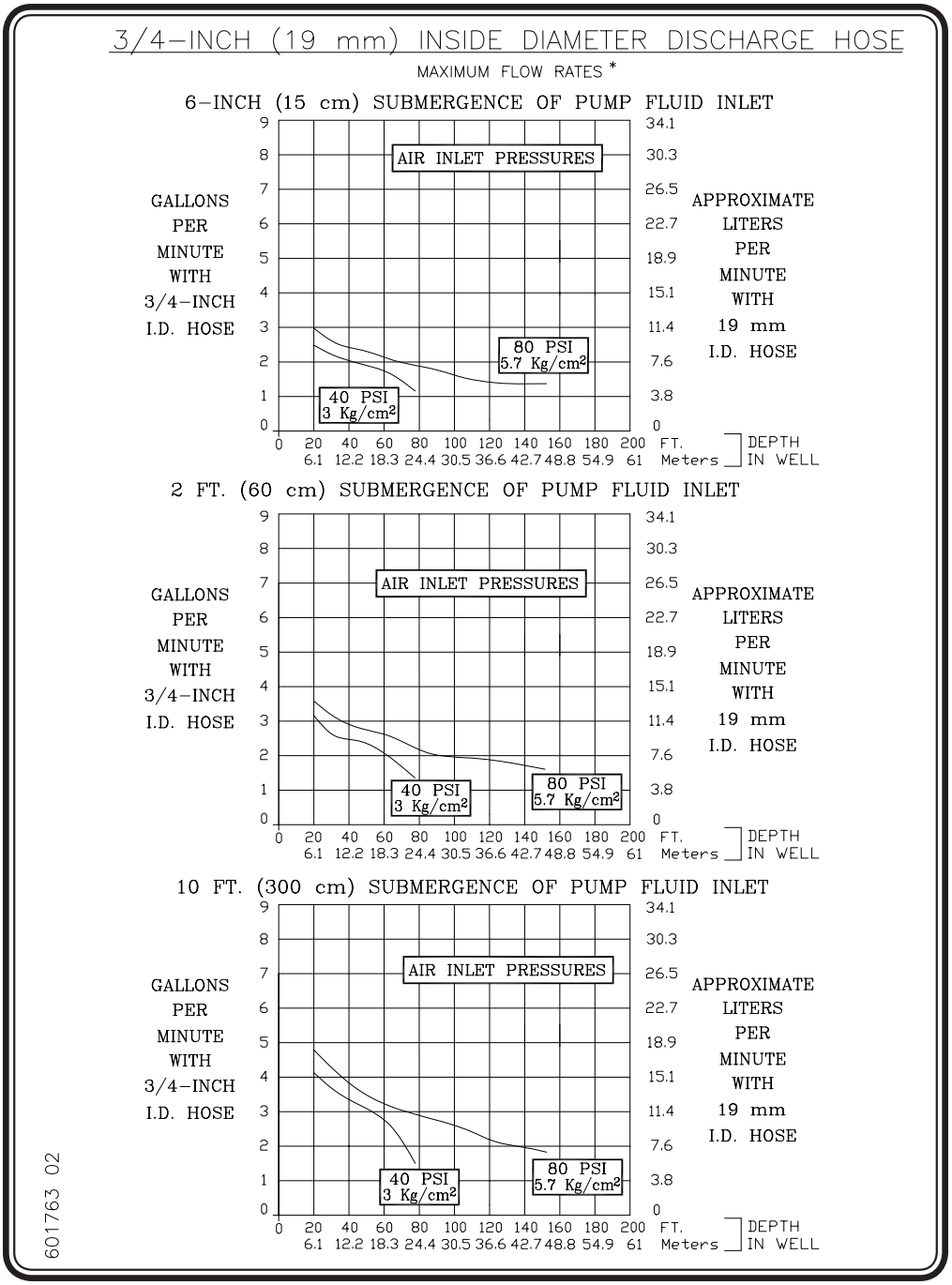


Figure 37 - Short AP-3/TL Performance Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

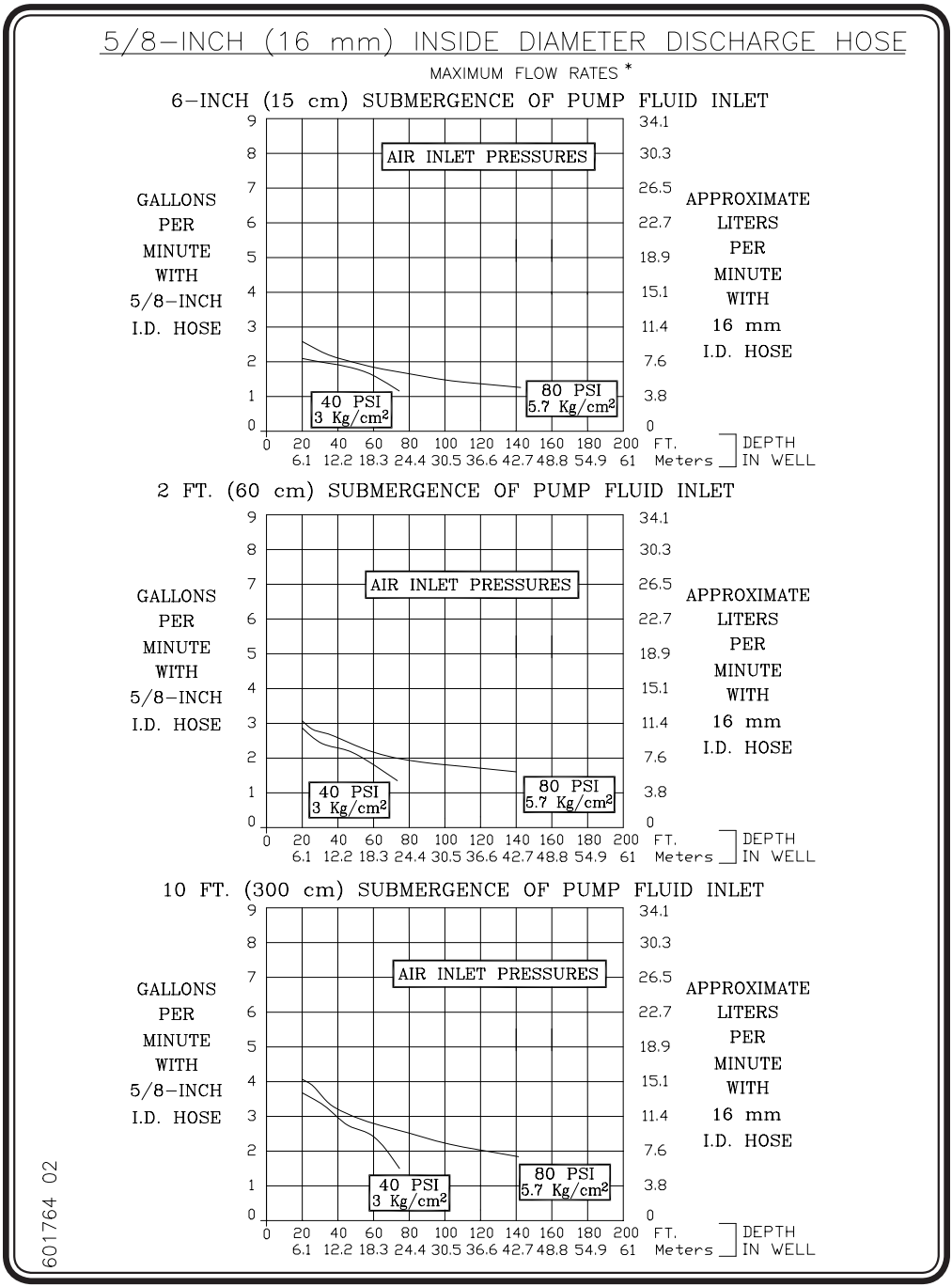


Figure 38 - Short AP-3/TL Performance Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

Appendix B: Air Consumption Curves

The following charts show the air consumption curves for the Long and Short length AP-3 AutoPumps. These curves can be used to estimate air use and compressor sizing. A compressor with reserve capacity is recommended.

The following charts show the air consumption curves for the Long and Short pumps.

Long Bottom and Top-Loading AP-3 AutoPumps
- **See Figures 39 through 44.**

Short Bottom and Top-Loading AP-3 AutoPumps
- **See Figures 45 through 50.**

The curves are categorized by pump length, hose size, depth of submergence and air supply pressure. To determine the amount of air used for each gallon of fluid pumped, the following information must be known:

1. **Pump** – Long or Short.
2. **Discharge hose size** – 5/8-inch, 3/4-inch or 1-inch I.D. A larger diameter may yield significantly lower air use rates, depending upon site conditions.
3. **Air pressure**.

With the above information, obtain the probable flow rate by using the following steps:
- On the horizontal scale, find the depth in the well at which the pump will be located.
- Trace that depth upwards to the line for the air inlet pressure you selected.
- Travel horizontally over to the vertical scale and read the air use factor.

Example: A long Bottom-Loading pump with a 1-inch discharge hose and 70 psi supply pressure positioned 50 feet below ground will use about 0.55 SCF of air for each gallon of fluid pumped.

The maximum flow rate for the pump, taken from the flow rate curves, when there is 10 feet of fluid over the pump and it is positioned 50 feet below ground is about 5.8 GPM.

Multiply the 5.8 GPM flow rate times the 0.55 SCF air use factor to generate a 3.2 SCFM (Standard Cubic Feet per Minute) air use result.

If the yield of the well is less than the maximum pump rate predicted by the appropriate flow rate graph, multiply the actual fluid recovery rate times the air use factor. This air use can be diminished if the regulator pressure is reduced. The maximum pump rate for the lower air pressure can be predicted using the performance curves.

Note:
These air use factors are only applicable for the designated well head conditions. Any additional resistance from out-of-well equipment (e.g. surface hoses, valves, etc.) will affect the factors shown on these curves.

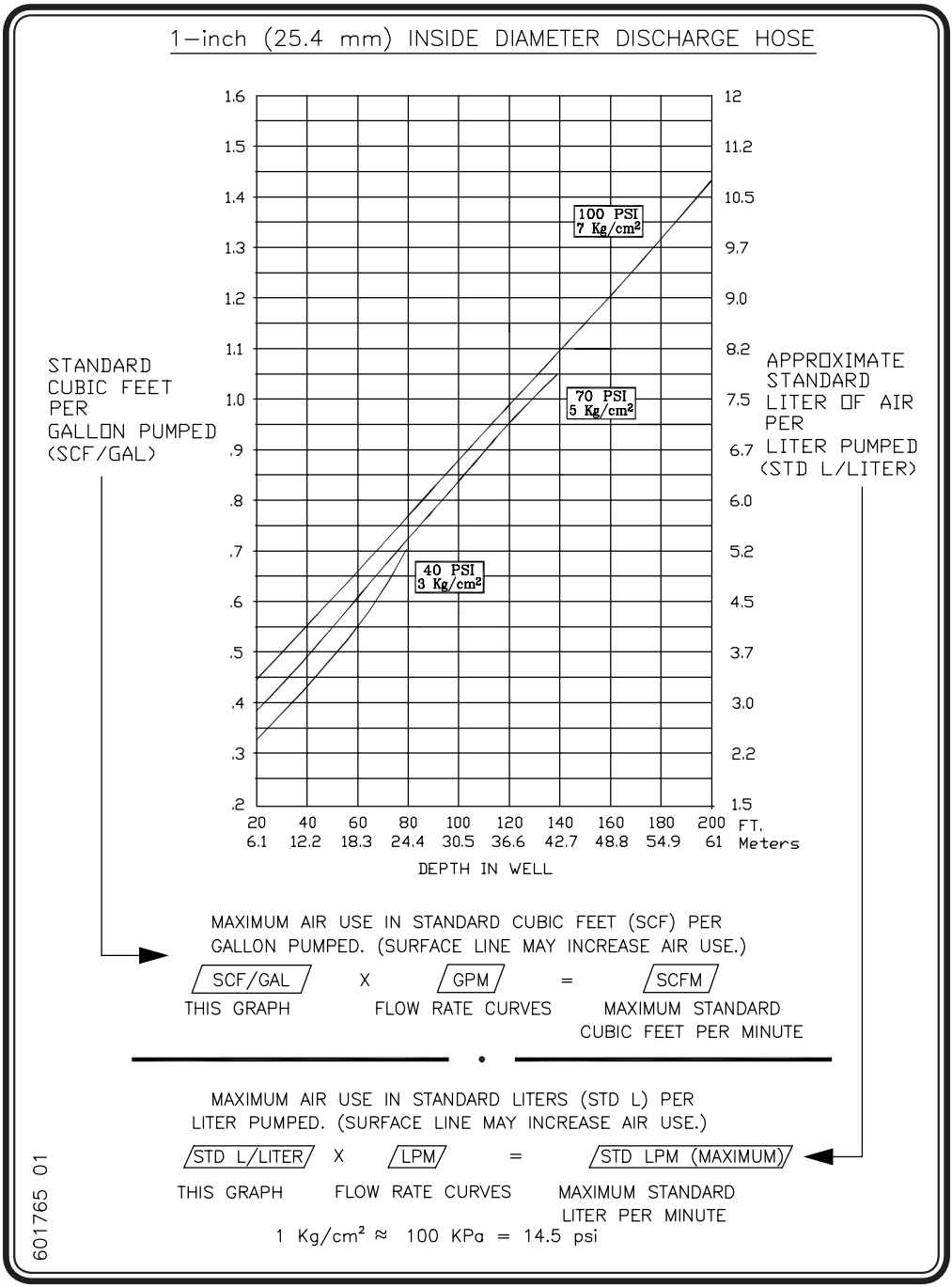


Figure 39 - Long AP-3/BL Air Consumption Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

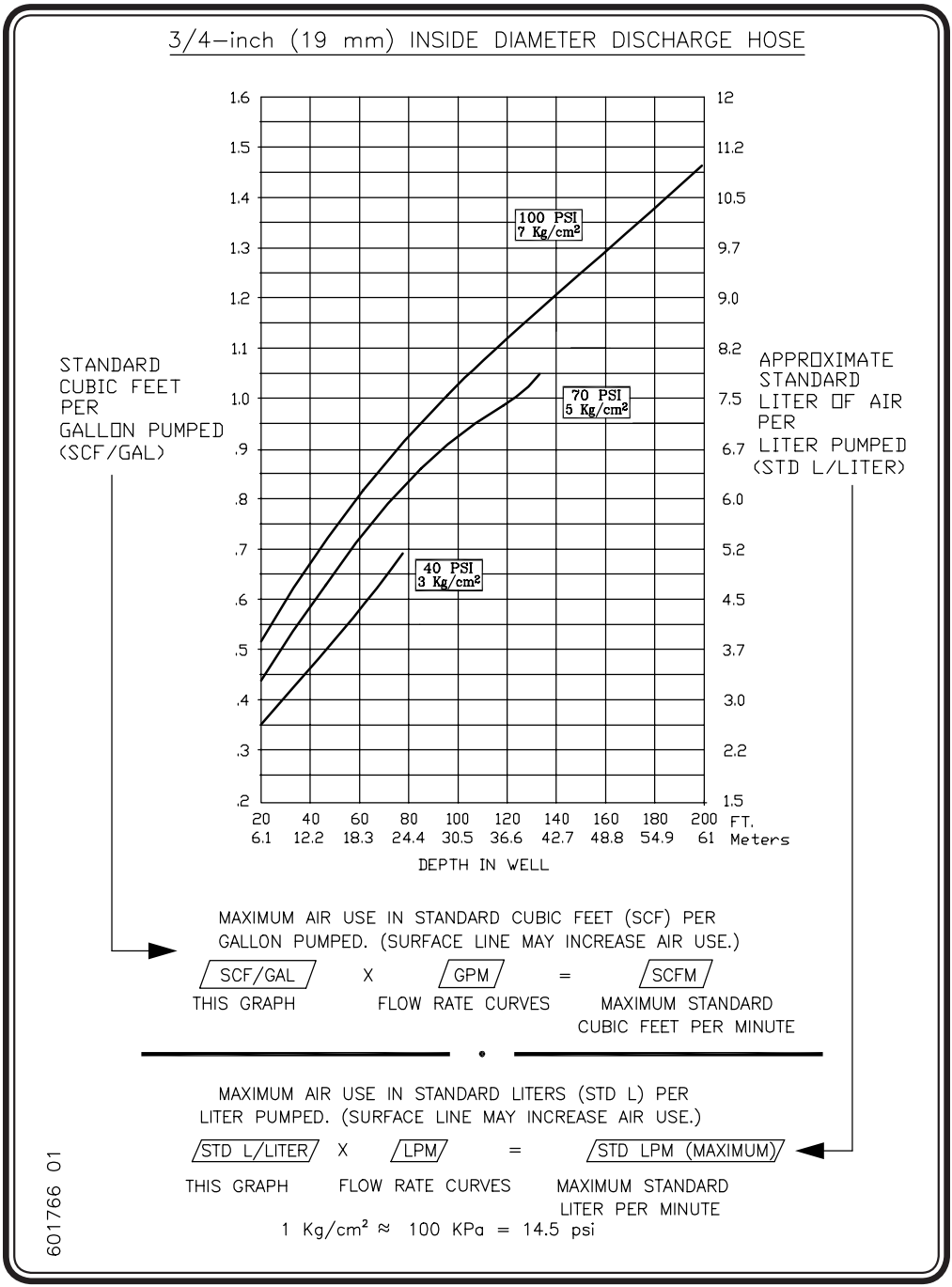


Figure 40 - Long AP-3/BL Air Consumption Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

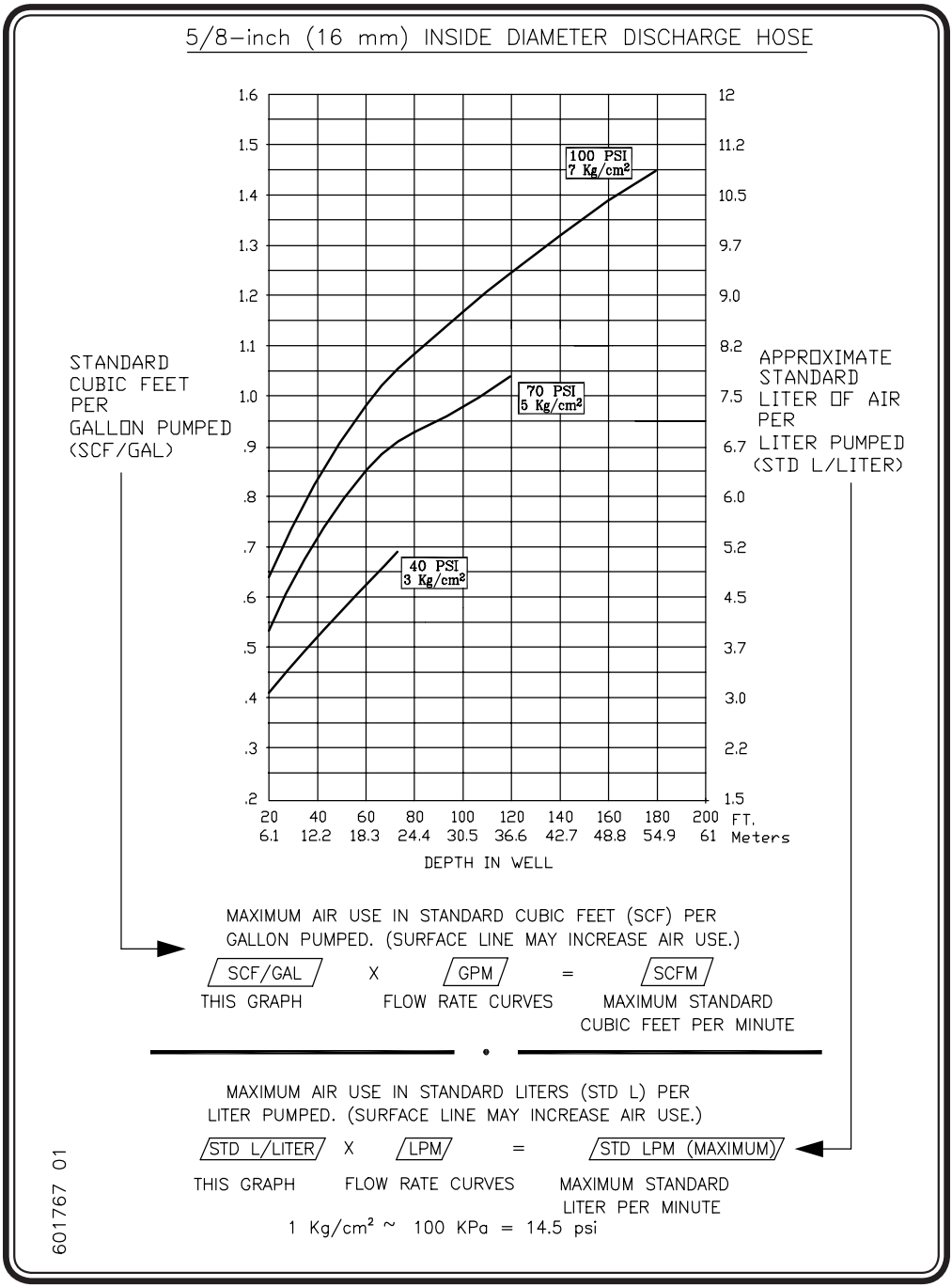


Figure 41 - Long AP-3/BL Air Consumption Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

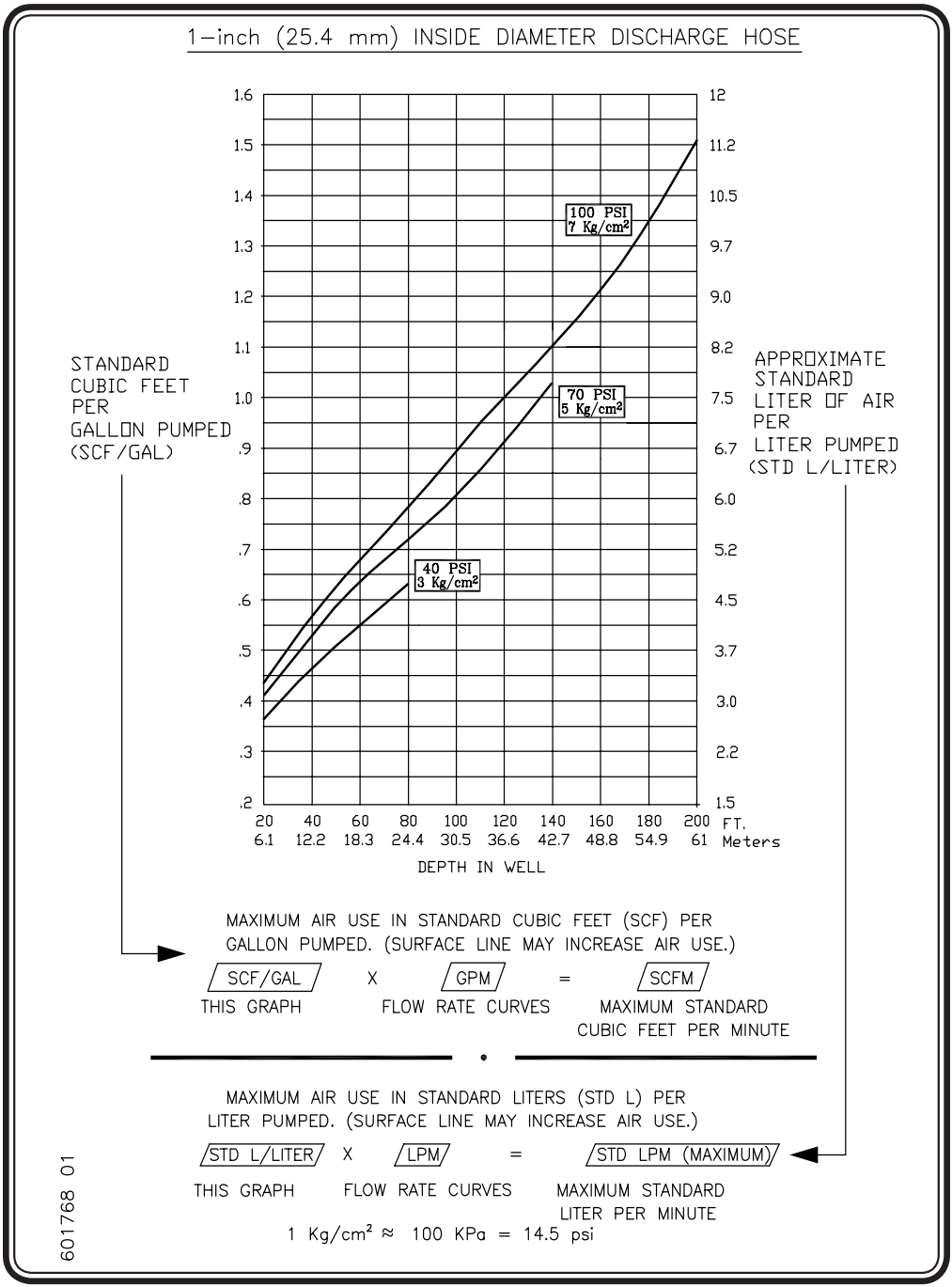


Figure 42 - Long AP-3/TL Air Consumption Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

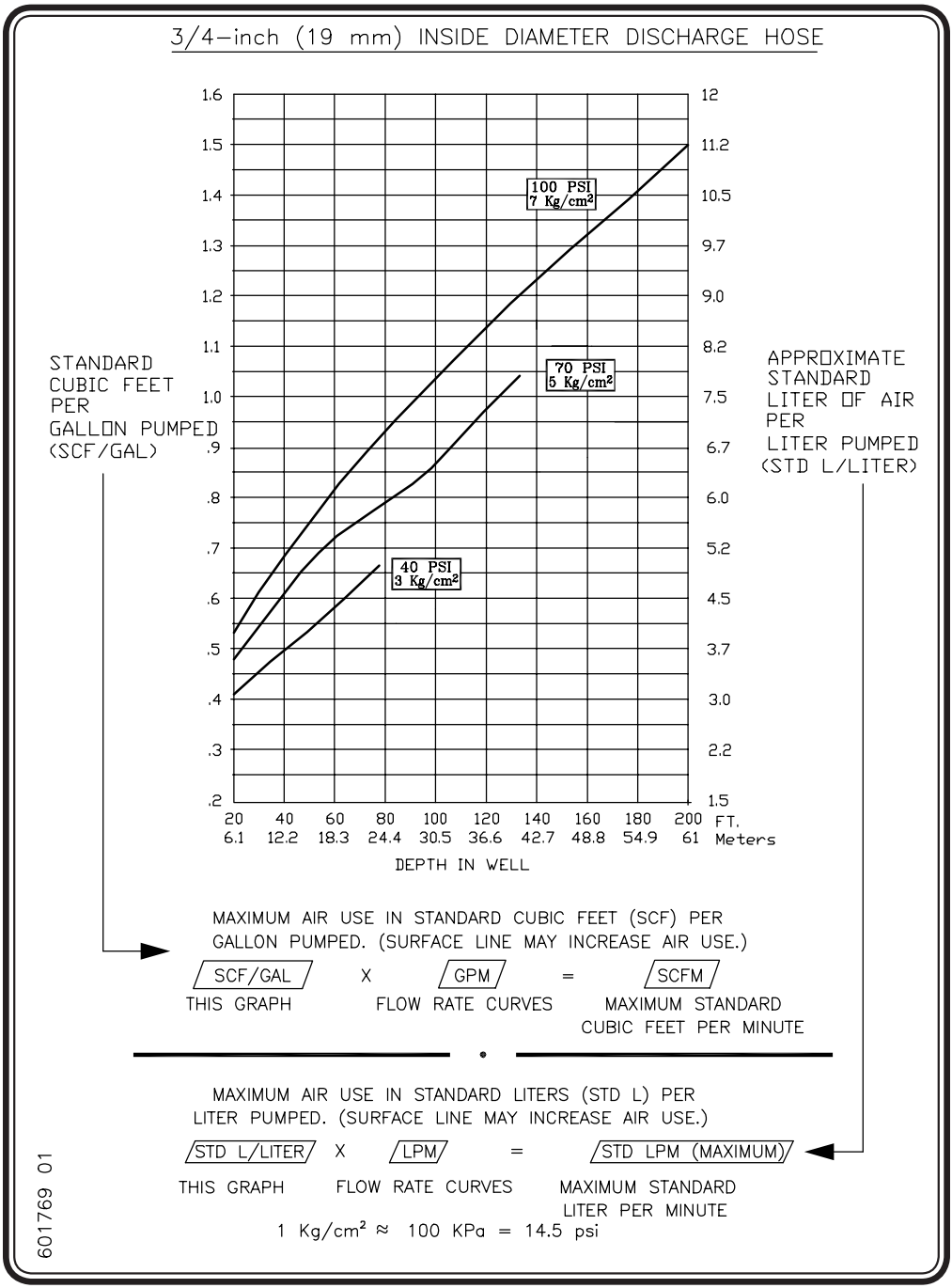


Figure 43 - Long AP-3/TL Air Consumption Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

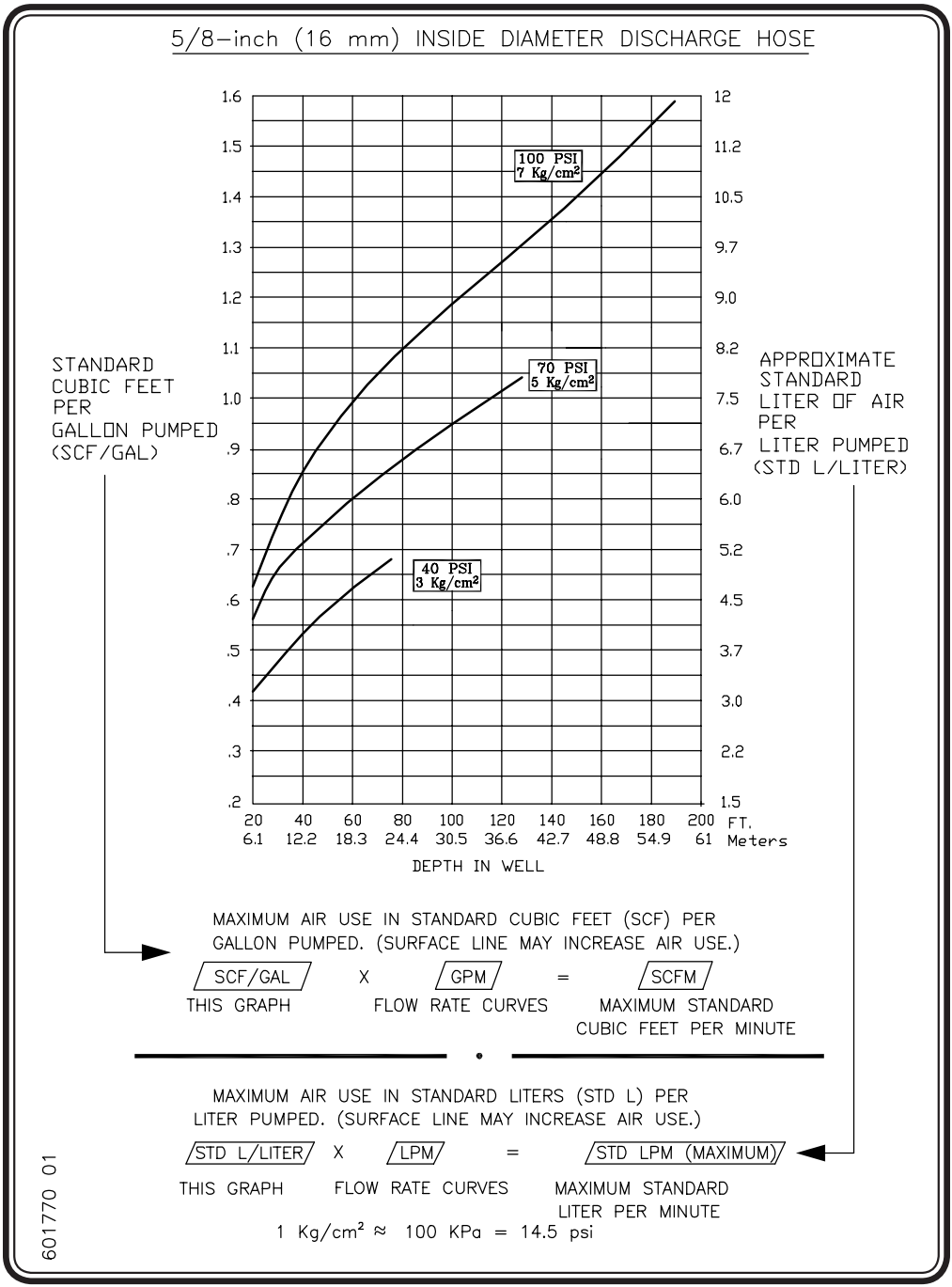


Figure 44 - Long AP-3/TL Air Consumption Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

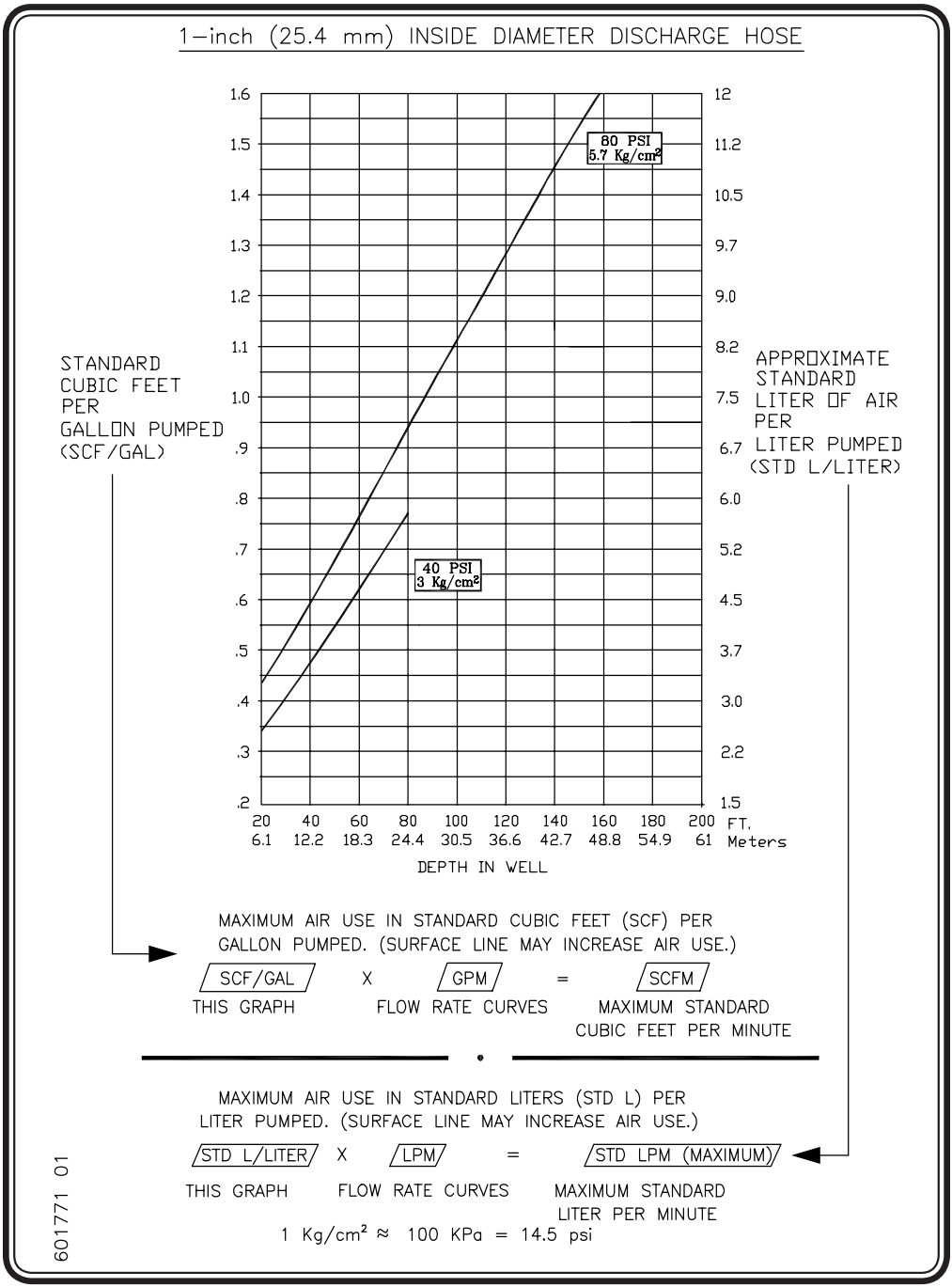


Figure 45 - Short AP-3/BL Air Consumption Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

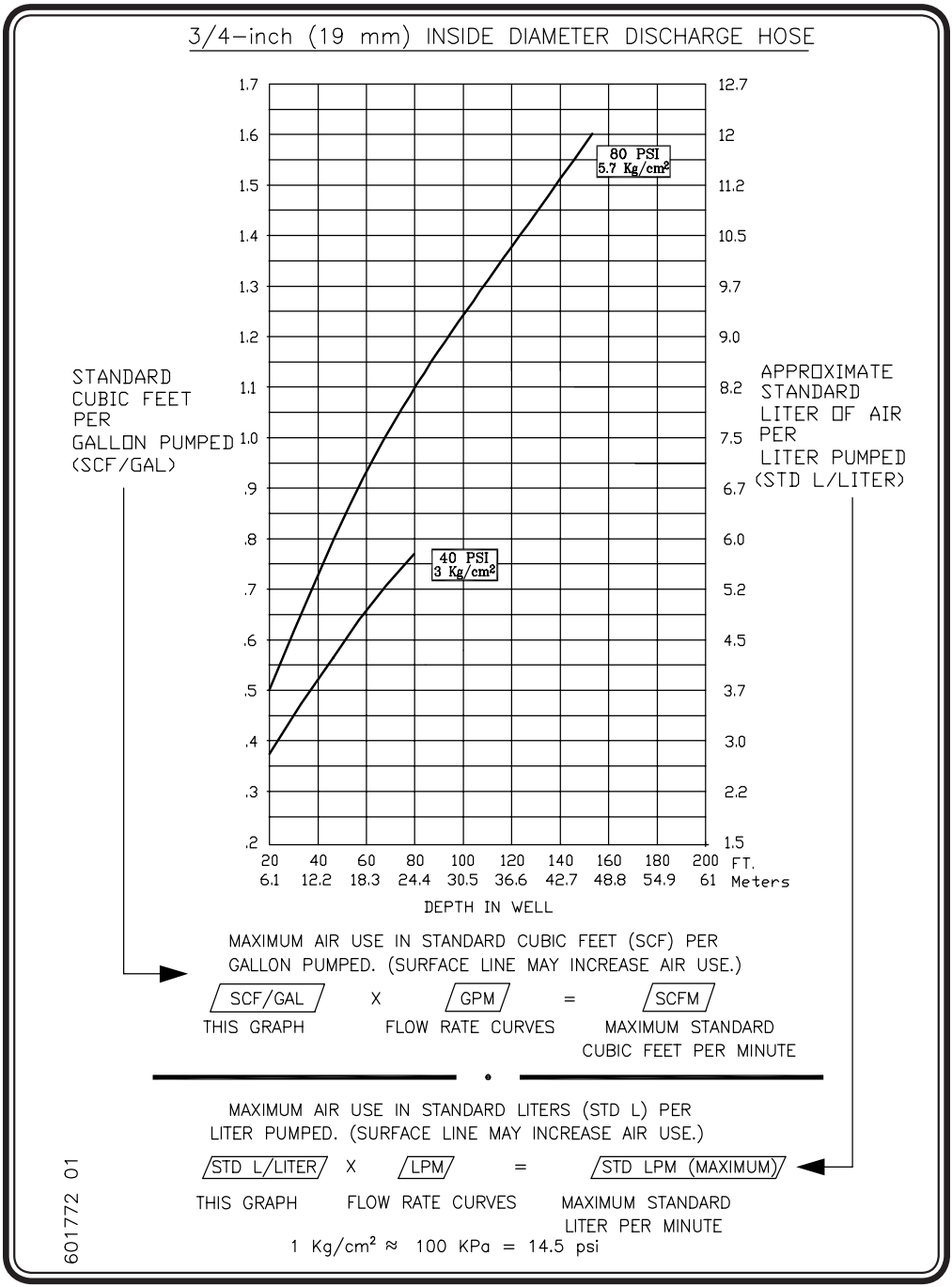


Figure 46 - Short AP-3/BL Air Consumption Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

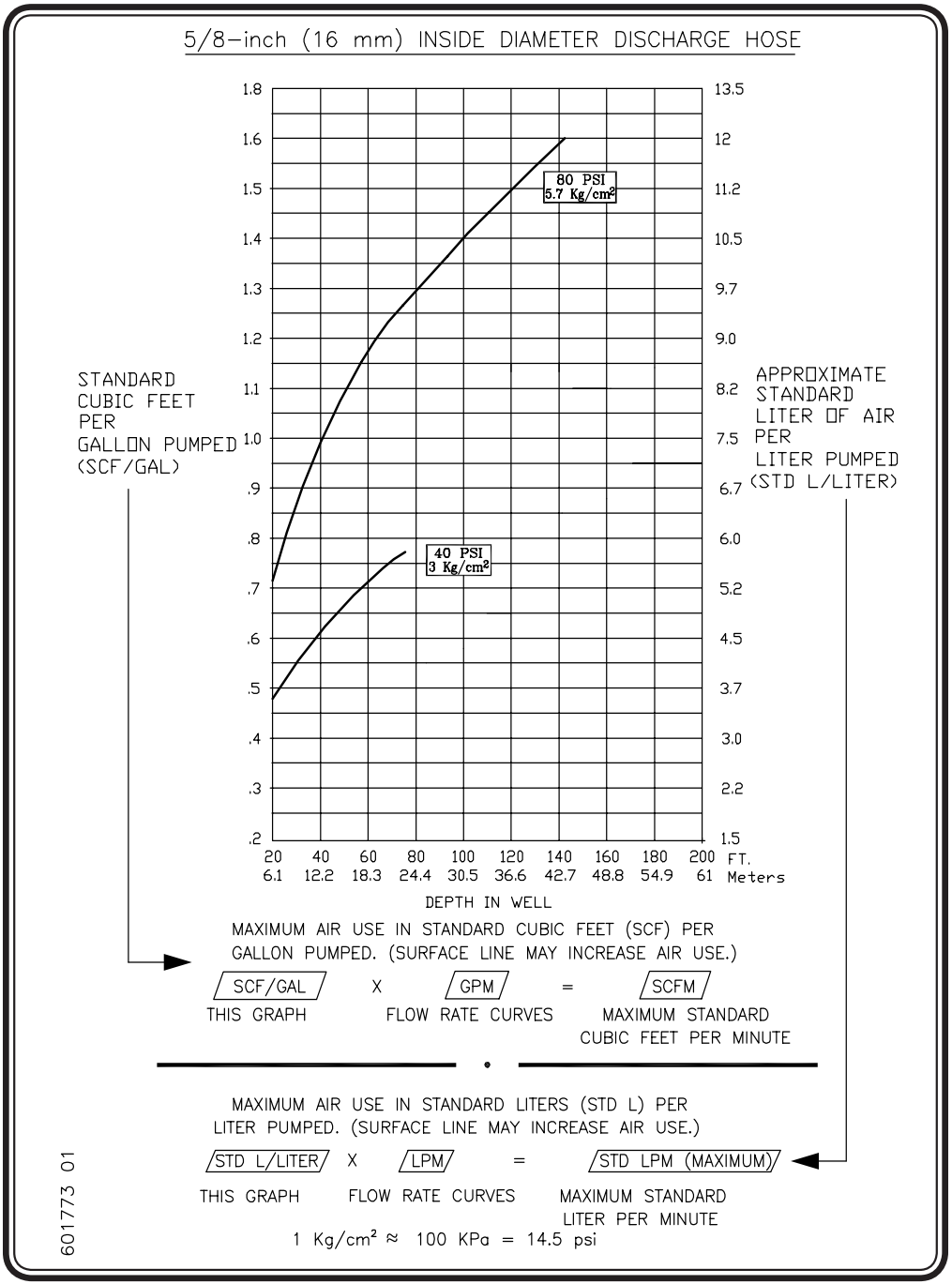


Figure 47 - Short AP-3/BL Air Consumption Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

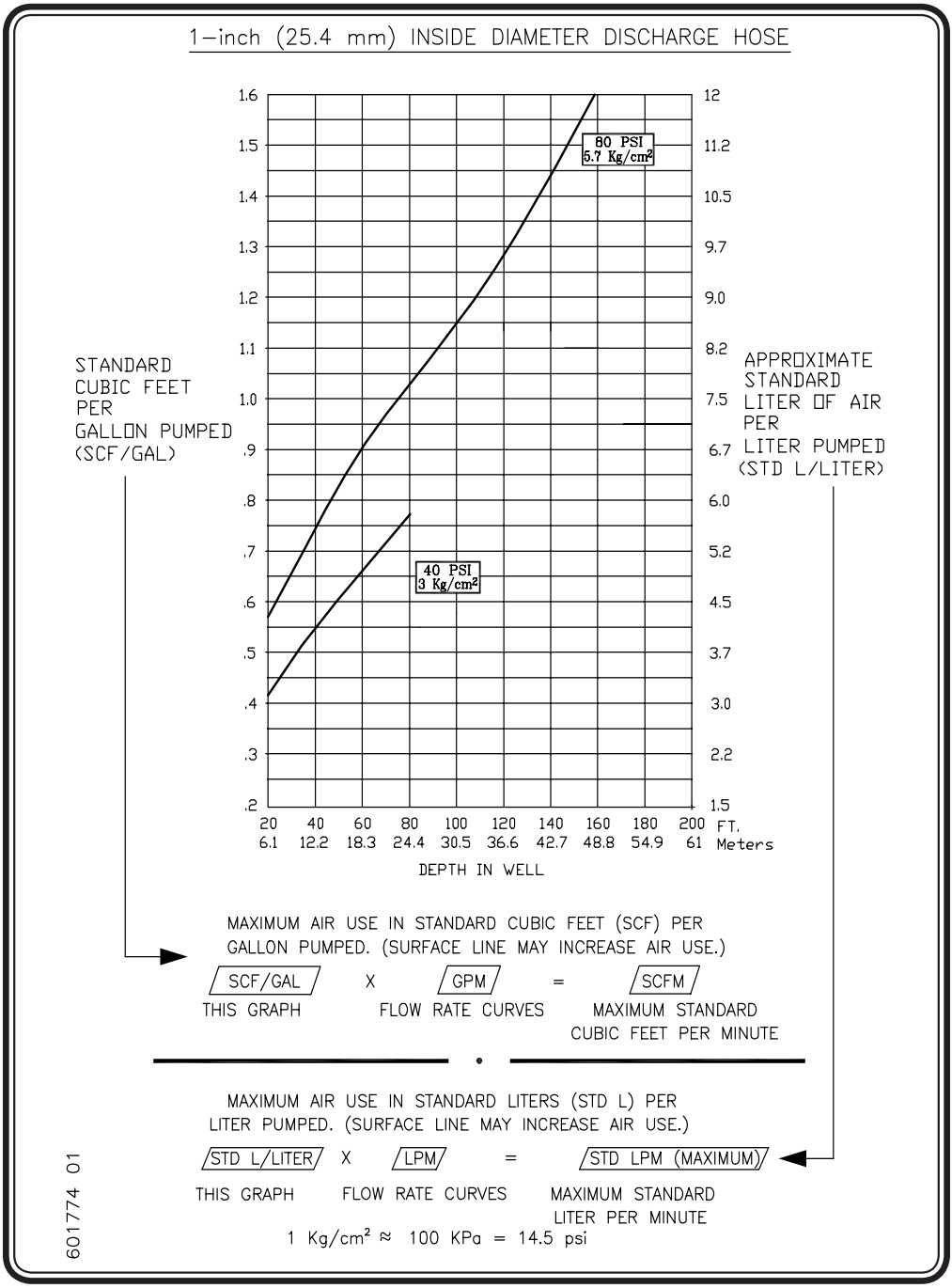


Figure 48 - Short AP-3/TL Air Consumption Curves: 1-inch (25.4 mm) I.D. Discharge US and METRIC UNITS

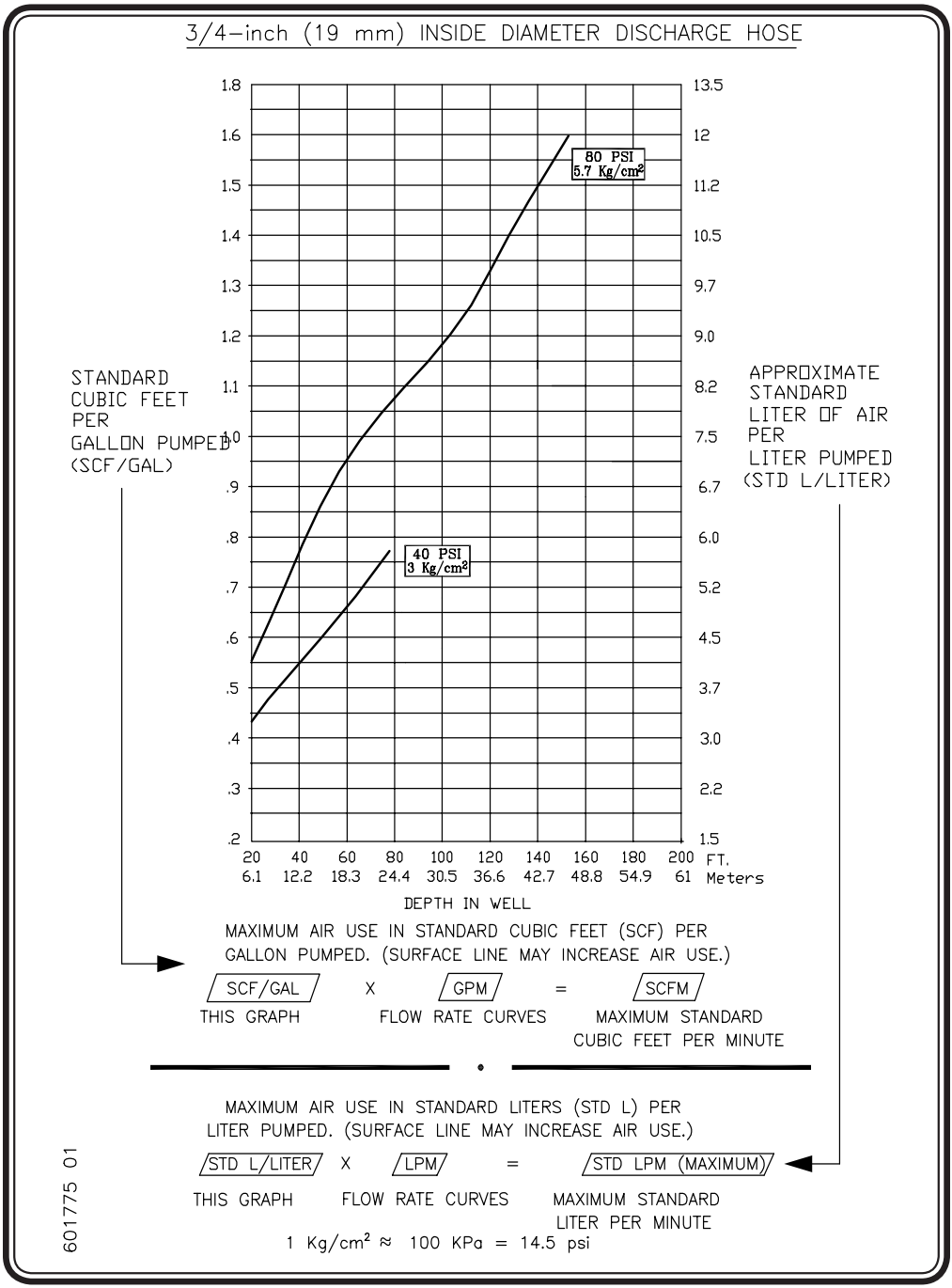


Figure 49 - Short AP-3/TL Air Consumption Curves: 3/4-inch (19 mm) I.D. Discharge US and METRIC UNITS

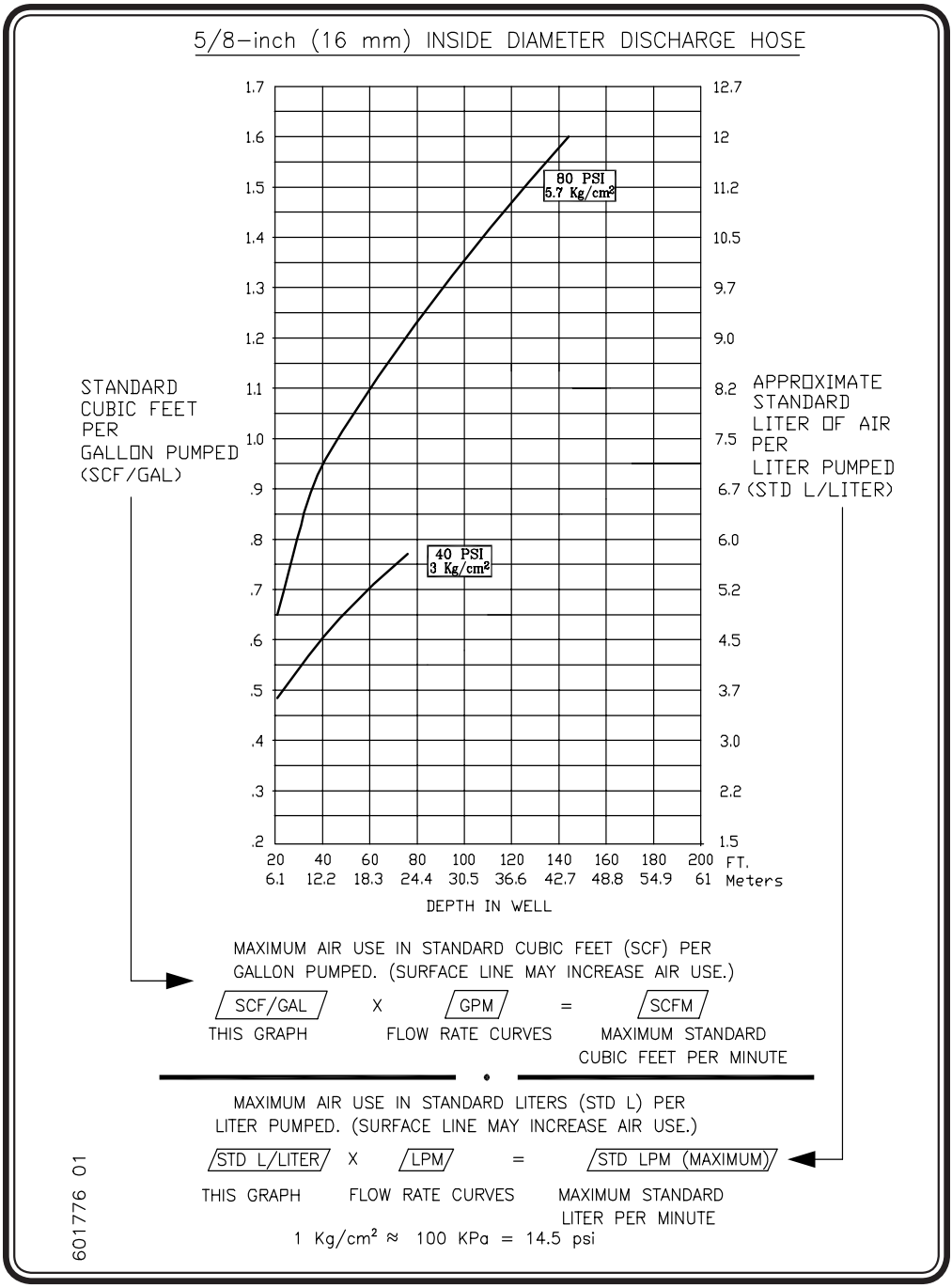


Figure 50 - Short AP-3/TL Air Consumption Curves: 5/8-inch (16 mm) I.D. Discharge US and METRIC UNITS

Appendix C: Conversions

The AP3 AutoPump can be converted from top-to-bottom loading, and from bottom-to-top loading. Please see the following pages for instructions.

Top-Loading to a Bottom-Loading conversion:

1. Secure the pump with a spanner wrench “A” on the head or with a screwdriver “B” through the support ring. **(See Figure 51)**

2. Unthread the “WYE” assembly “C” from the pump and clean the threads “D” on the pump. A strap wrench can be used.

3. Unthread the discharge check valve “E” from the wye assembly, clean the threads on the valve, and then wrap them with Teflon® tape.

4. Thread the discharge check valve into the coupling reducer “F”, making sure the pinned end is up, and thread the coupling on the pump discharge pipe “D”. Tighten the valve and coupling.

5. Unscrew the bottom plug “G” from the pump using a spanner wrench. If the casing comes off with the plug, the plug may be knocked out with a wooden 2”x2” or similar blunt tool inserted into the open end of the casing.

6. Remove the o-ring from the plug and install it on the bottom of the check valve “H”.

7. Lubricate the first 3/4 in of the inside of the casing with food-grade Teflon-filled grease.

8. Spin the bottom check valve on the pump with a spanner wrench. Do not use sealant or tape

Caution:
Turn the valve only until each end of the casing is just touching the head and the valve, and then back it off 1/4 turn. Do not tighten the parts hard against each other.

If the casing is off the pump, insert the bottom check valve until the o-ring is against the edge the casing. Then hold the casing vertical and place the open end against a resilient surface, like rubber, cardboard, or carpet. Press the valve downward into the casing. Spin the casing on the pump with a spanner wrench, screwdriver, or with a strap wrench on the last 1-1/2-inch of the casing.

Warning:
Keep hands away from the pinch point while pressing the plug into the casing

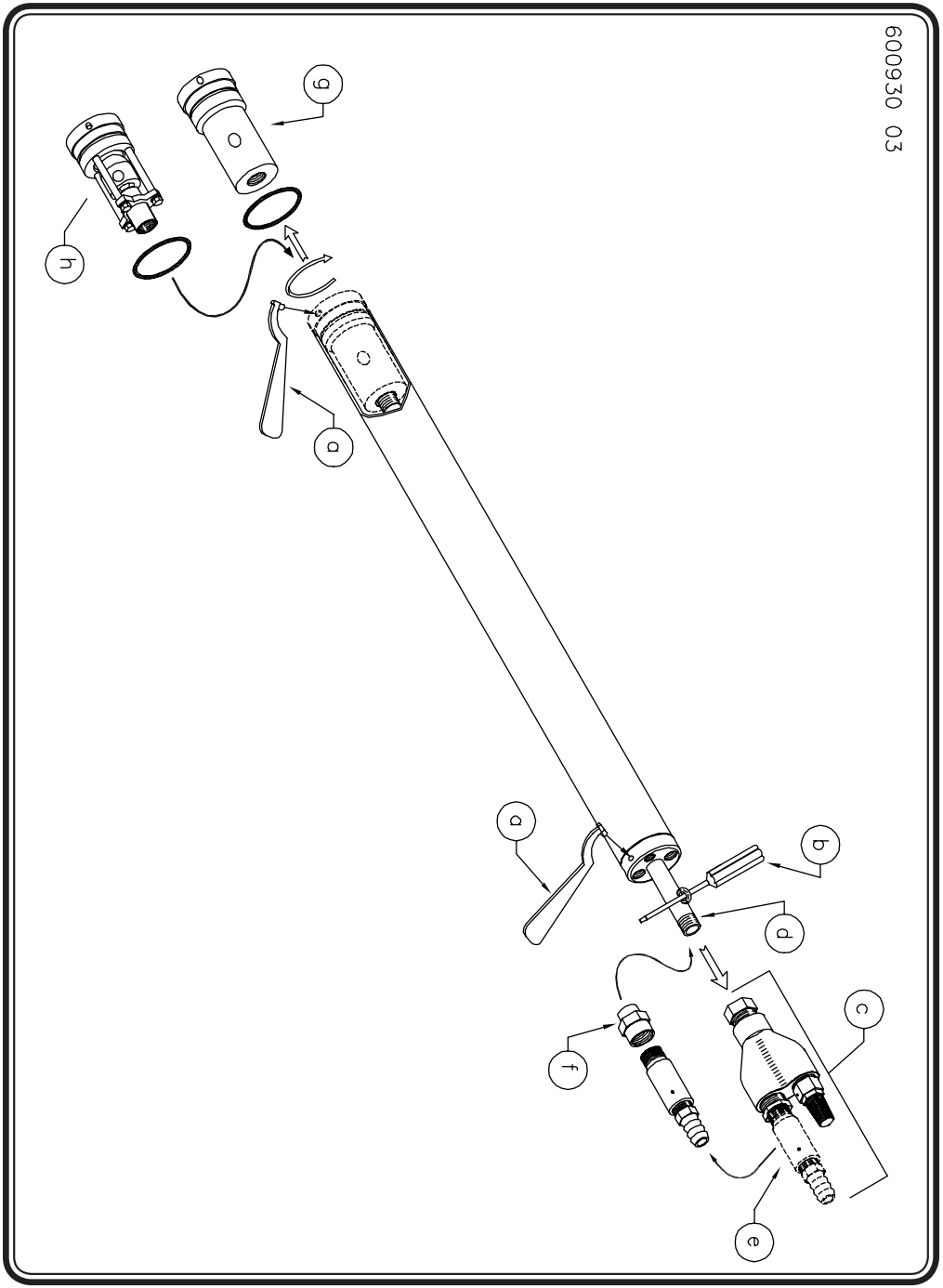


Figure 51 - Conversion from Top-Loading to Bottom Loading

Long bottom-loading to a long top-loading conversion:

1. Secure the pump with a spanner wrench “A” on the head or with a screwdriver “B” through the support ring. **(See Figure 52)**

2. Unthread discharge check valve “C” from the pump and clean the threads in the valve and on the pump “D”. A strap or pipe wrench can be used.

3. Apply Teflon tape to the threads on the wye assembly nipple “E” and thread on the discharge check valve. Check that the pinned end of the valve is up. Hold the bushing at the top of the "WYE" with a wrench and then tighten the valve with a pipe wrench or a strap wrench.

4. Apply Teflon tape to the pump threads “D”. Tighten the wye assembly on the pump by using a wrench on the bushing at the bottom of the "WYE". Align the "WYE" so that the air ports on the pump head are even with the indentations on each side of the "WYE".

5. Remove the bottom check valve “F” with a spanner wrench. If the casing comes off with the valve, the valve may be knocked out with a wooden “2x2” or similar blunt tool, inserted into the open end of the casing.

6. Remove the o-ring from the valve and install it on the bottom plug “G”.

7. Lubricate the first 3/4 in. of the inside with food-grade Teflon-filled grease.

8. Spin the bottom plug on the pump with a spanner wrench, or, with a screwdriver through the hole. Do not use sealant or tape.

Caution:
Turn the plug only until each end of the casing is just touching the head and the plug, and then back it off 1/4 turn. Do not tighten the parts hard against each other.

If the casing is off the pump, insert the plug until the o-ring is against the edge of the casing. Then hold the casing vertical and place the open end against a resilient surface, like rubber, cardboard, or carpet. Press the plug downward into the casing. Spin the casing on the pump with a spanner wrench, screwdriver, or with a strap wrench on the last 1-1/2-inch of the casing.

Warning:
Keep hands away from the pinch point while pressing the plug into the casing

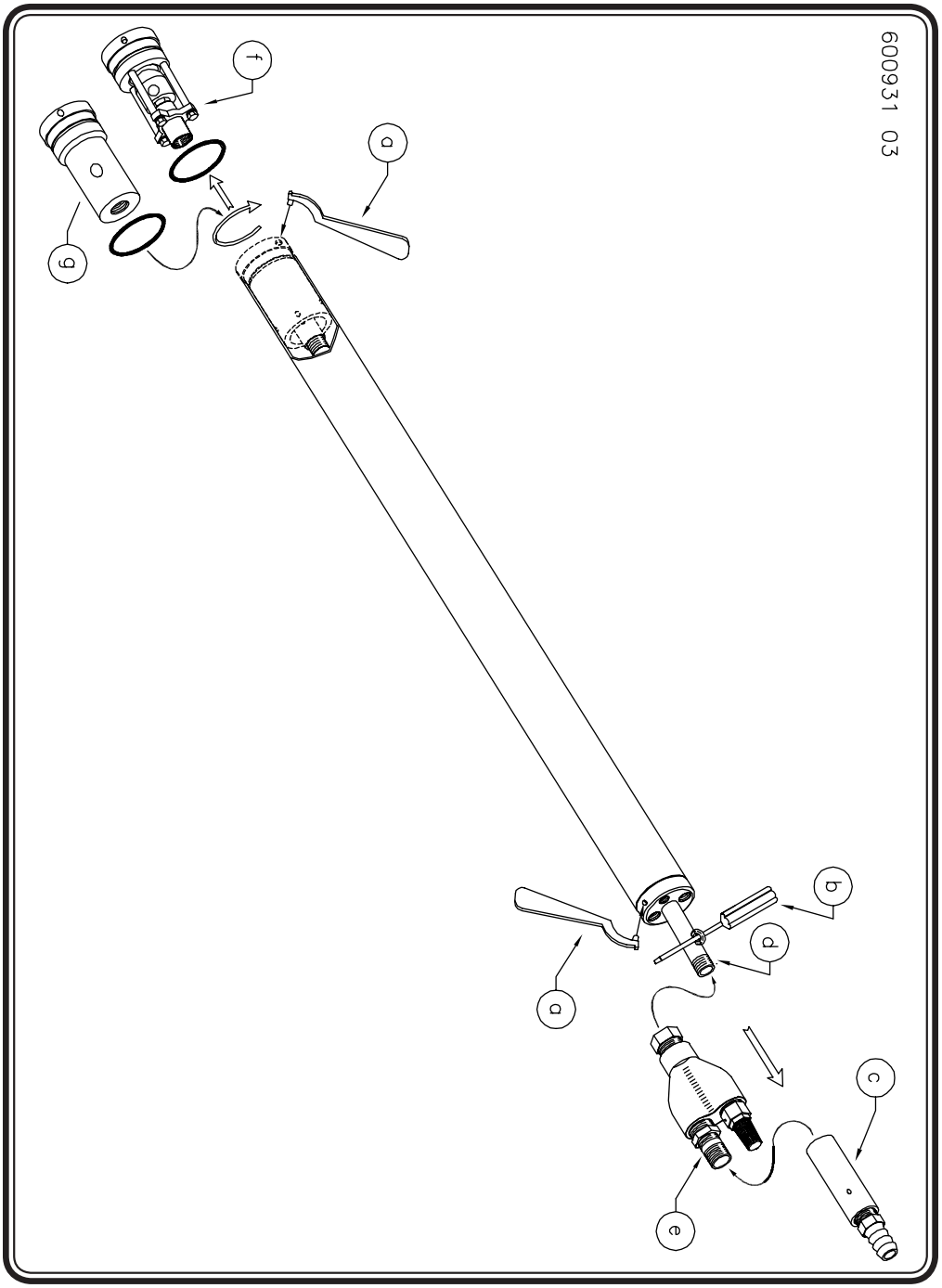


Figure 52 - Conversion from Long Bottom Loading to Long Top-Loading

Short bottom-loading to a short top-loading conversion:

1. Secure the pump with a spanner wrench “A” on the head or with a screwdriver “B” through the support ring. **(See Figure 53)**

2. Unthread discharge check valve “C” from the pump and clean the threads in the valve and on the pump “D”. A strap or pipe wrench can be used.

3. Apply Teflon tape to the threads on the wye assembly nipple “E” and thread on the discharge check valve. Check that the pinned end of the valve is up. Hold the bushing at the top of the "WYE" with a wrench and then tighten the valve with a pipe wrench or a strap wrench.

4. Apply Teflon tape to the pump threads “D”. Tighten the wye assembly on the pump by using a wrench on the bushing at the bottom of the "WYE". Align the "WYE" so that the air ports on the pump head are even with the indentations on each side of the "WYE".

5. Remove the casing and the intake check valve. **See page 47.**

6. Install the middle stop, spring cups, and spring. To remove the float drive out the bottom spring cup pin.

7. Remove the o-ring from the check valve and install it on the bottom plug “G”.

8. Lubricate the first 3/4 in. of the inside with food-grade Teflon-filled grease.

9. Insert the plug into the casing until the o-ring touches the edge. Hold the casing vertical and place the open end against a resilient surface like rubber, cardboard, or carpet. Press the plug downward into the casing.

> **Warning:**
> Keep hands away from the pinch point while pressing the plug into the casing.

10. Spin the casing and plug on the pump with a spanner wrench, screwdriver or, a strap wrench on the last 1-1/2-inch of the casing. Do not use sealant or tape.

> **Caution:**
> Turn the plug only until each end of the casing is just touching the head and the plug, and then back it off 1/4 turn. Do not tighten the parts hard against each other.

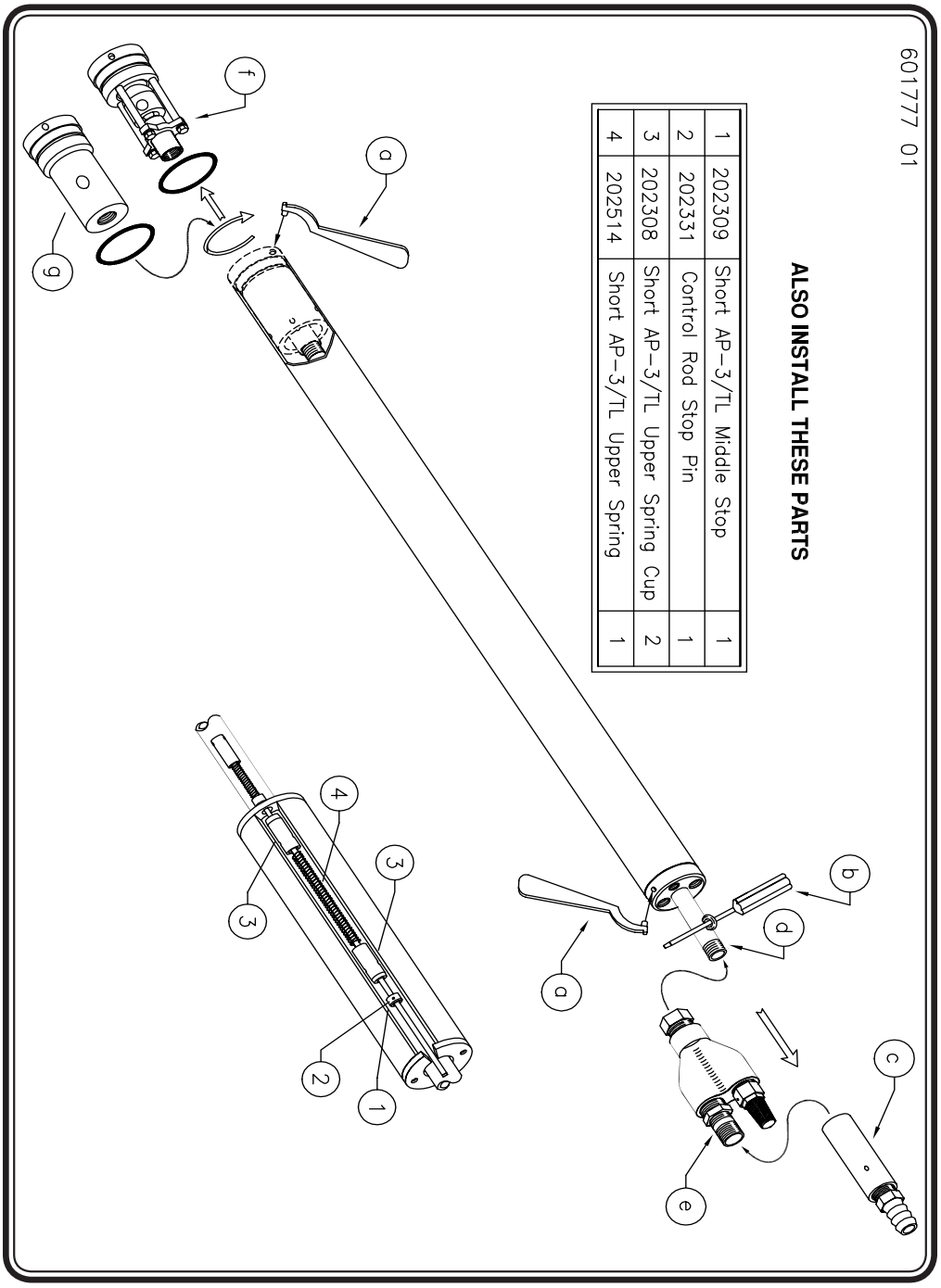
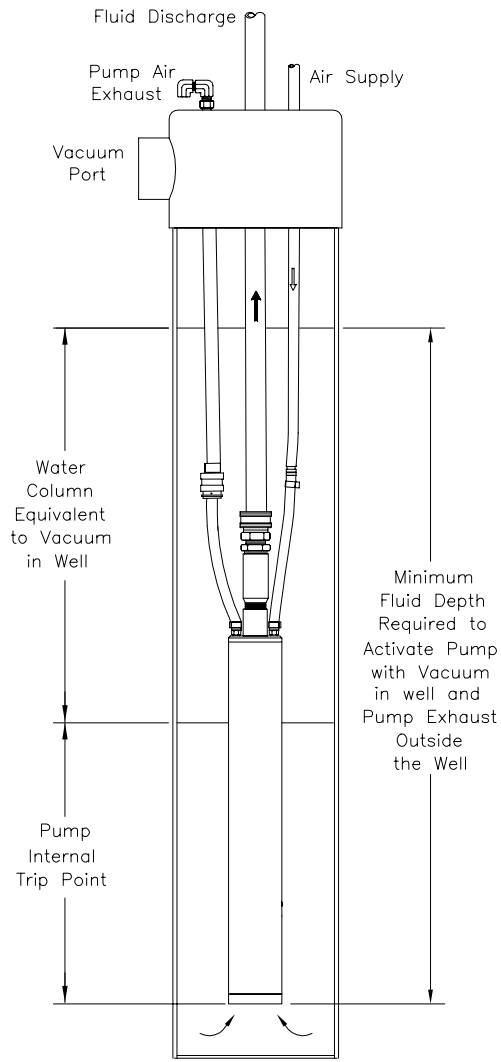


Figure 53 - Conversion from Short Bottom-Loading to Short Top Loading

Appendix D: Vacuum on Well

The AP-3 will work in a well that is under vacuum, but there are several conditions that must be considered. These conditions are described in **Figure 54, 55, 56, and 57** on the following pages.



- The water level required to activate the pump is equal to the pump internal trip point plus the vacuum water column.

  Example:

  – A Short AP–3/BL has an internal trip point of 22 in.

  – A well vacuum of 30 in. W.C. (water column)

  22+30 = 52 in. Water depth required to activate pump.

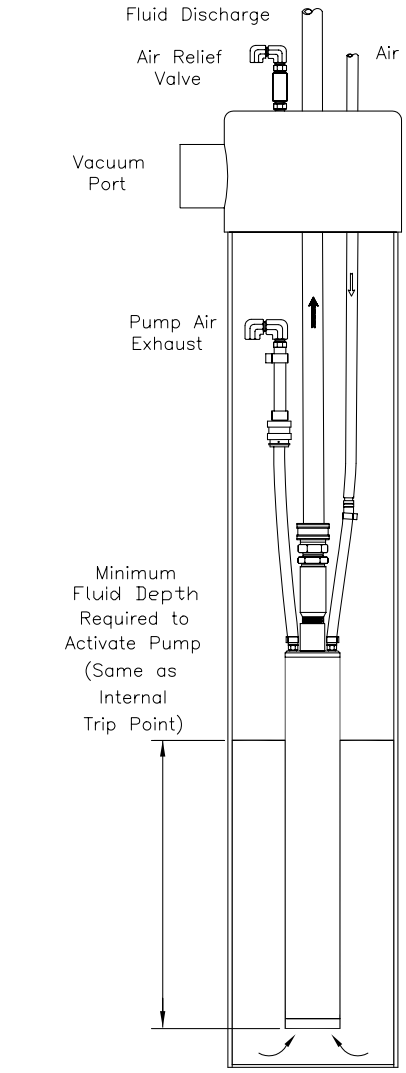
- The rated maximum operating pressure of the pump is not affected by this method of installation.

Pump Internal trip point *						
Long AP–4/BL	Short AP–4/BL	LDD AP–4/BL	Long AP–3/BL	Short AP–3/BL	Long AP–2/BL	Short AP–2/BL
35 in. 89 cm	27 in. 69 cm	11.5 in. 29.2 cm	31 in. 78.8 cm	22 in. 55.5 cm	35 in. 89 cm	20 in. 51 cm

601238 02

* Special or Extended Intake Screens may Alter Listed Specifications.

Figure 54 - AP-3/BL with Vacuum In the Well and Pump Exhaust Outside the Well



- For this condition the minimum fluid depth required to activate the pump is the same as the pump internal trip point.

- For this method of installation the fluid level required to activate the pump is unaffected by a vacuum or pressure in the well.

  If the well is completely sealed, however, and the well is pressurized (e.g. from the pump exhaust), the water level in the well may be depressed below the depth required to activate the pump. For this reason a QED air relief valve (as shown) is recommended.

- A vacuum on the pump exhaust will affect the maximum operating pressure of the pump. Subtract the vacuum in psi from the rated maximum operating pressure.

  Example:

  – A Long AP–4/BL with 120 psi maximum operating pressure. (200 psi option available).

  – A 90 in. W.C. (water column) vacuum in the well.

  $$\frac{90}{12(2.31)} = 3 \text{ psi}$$

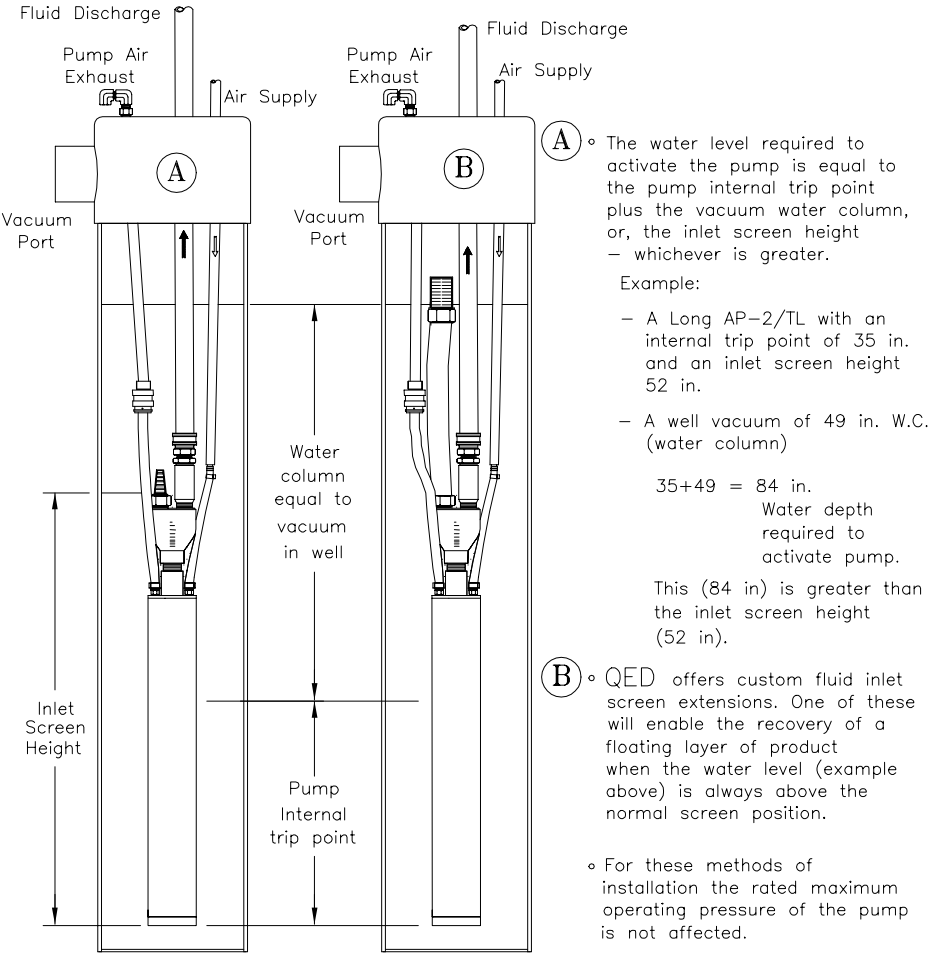
  120–3 = 117 psi maximum operating pressure of the pump.

Pump Internal trip point*						
Long AP–4/BL	Short AP–4/BL	LDD AP–4/BL	Long AP–3/BL	Short AP–3/BL	Long AP–2/BL	Short AP–2/BL
35 in. 89 cm	27 in. 69 cm	11.5 in. 29.2 cm	31 in. 78.8 cm	22 in. 55.5 cm	35 in. 89 cm	20 in. 51 cm

601237 02

* Special or Extended Intake Screens may Alter Listed Specifications.

Figure 55 - AP-3/BL with Vacuum In the Well and Pump Exhaust In the Well



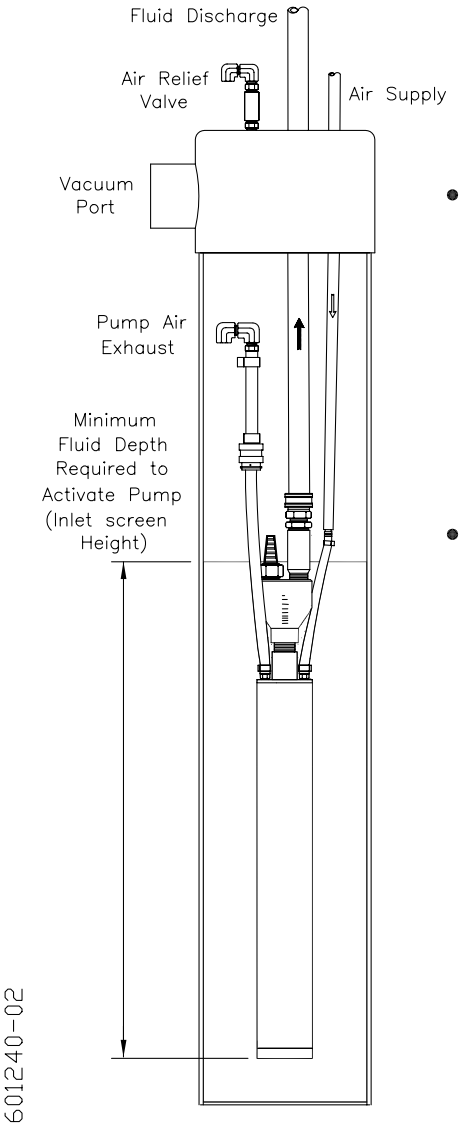
Internal trip point						
Long AP–4/TL	Short AP–4/TL	LDD AP–4/TL	Long AP–3/TL	Short AP–3/TL	Long AP–2/TL	Short AP–2/TL
35 in. 89 cm	27 in. 69 cm	10.6 in. 27 cm	31 in. 78.8 cm	22 in. 55.5 cm	35 in. 89 cm	20 in. 51 cm

Inlet screen height *						
Long AP–4/TL	Short AP–4/TL	LDD AP–4/TL	Long AP–3/TL	Short AP–3/TL	Long AP–2/TL	Short AP–2/TL
52 in. 132 cm	37 in. 94 cm	24 in. 61 cm	53 in. 134.7 cm	42 in. 106.6 cm	52 in. 132 cm	35 in. 89 cm

* Special or Extended Intake Screens may Alter Listed Specifications.

601241 02

Figure 56 - AP-3/TL with Vacuum In the Well and Pump Exhaust Outside the Well



- For this method of installation the fluid level required to activate the pump is unaffected by a vacuum or pressure in the well.

  If the well is completely sealed, however, and the well is pressurized (e.g. from the pump exhaust), the water level in the well may be depressed below the depth required to activate the pump. For this reason a QED air relief valve (as shown) is recommended.

- A vacuum on the pump exhaust will affect the maximum operating pressure of the pump. Subtract the vacuum in psi from the rated maximum operating pressure.

  Example:

  – A Long AP–4/BL with 120 psi maximum operating pressure. (200 psi option available).

  – A 90 in. W.C. (water column) vacuum in the well.

  $$\frac{90}{12(2.31)} = 3 \text{ psi}$$

  120–3 = 117 psi maximum operating pressure of the pump.

Inlet screen height *						
Long AP–4/TL	Short AP–4/TL	LDD AP–4/TL	Long AP–3/TL	Short AP–3/TL	Long AP–2/TL	Short AP–2/TL
52 in. 132 cm	37 in. 94 cm	24 in. 61 cm	53 in. 134.7 cm	42 in. 106.6 cm	52 in. 132 cm	35 in. 89 cm

* Special or Extended Intake Screens may Alter Listed Specifications.

Figure 57 - AP-3/TL with Vacuum In the Well and Pump Exhaust In the Well

Terms, Conditions, and Warranty

TWO YEAR warranty
This limited warranty is in lieu of and excludes all other representations made by advertisements, distributors, agents, or manufacturers sales representatives, and all other warranties, both express and implied. There are no implied warranties of merchantability or of fitness for a particular purpose for goods covered hereunder.

QED Environmental Systems warrants to the purchaser of its products that, subject to the limitations and conditions provided within the Terms & Conditions of Sale, products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in material and workmanship.

All warranty durations are calculated from the original date of purchase—determined as beginning the date of shipment from QED facilities and the date QED is notified of a warranty claim. This warranty shall be limited to the duration and conditions set forth below.

1. **AP-3 AutoPumps—**warranted for two (2) years: 100% material and 100% workmanship for both years. This limited warranty coverage only applies to AP-3 AutoPumps. There will be no warranty for application or material compatibility. The materials used in pumps vary depending upon application and the customer is responsible for knowing the environment in which the pump will be operating and working with QED to determine what materials of construction will be best for the application.

   The warranty is valid when the following conditions exist: when the site has a pH between 4 and 9, has a salinity of 3500 ppm or less, is between 40 and 120 degrees Fahrenheit, is non-corrosive to the construction materials of the pump; and is not abrasive. Typical commercial fuels are acceptable materials in free or dissolved phase. The pumps and accessories must be operated within the specifications and limits given in the manual for the particular piece of equipment.

2. **Pumps, hose, tubing, fittings, heater, condensers and air filtration housings** — warranted for one (1) year: 100% material and 100% workmanship. This does not include AP-3 AutoPumps. There will be no warranty for application or material compatibility. The materials used vary depending upon application and the customer is responsible for knowing the environment in which the equipment will be operating and working with QED to determine what materials of construction will be best for the application.

3. **Pneumatic Data Modules / Logic Control Panels** — warranted for one (1) year: 100% material and 100% workmanship.

4. **Parts and Repairs** — warranted for ninety (90) days: 100% material and 100% workmanship; when repairs are performed by QED or its appointed agent; from date of repair or for the full term of the original warranty, whichever is longer. Separately sold parts are warranted for ninety (90) days: 100% materials and 100% workmanship.

This warranty will be void in the event of unauthorized disassembly of component assemblies. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, use and applications other than for intended use or exposure to chemical or physical environments beyond the designated limits of materials and construction, will also void the warranty.

Chemical attack by liquids and/or abrasive substances contacting equipment and accessories shall not be covered by this warranty. A range of materials of construction is available from QED and it is the Buyer's responsibility to select materials of construction to fit the Buyer's application. QED will only warrant that the supplied site liquid contacting materials will conform to published QED specifications and generally accepted standards for that particular material.

QED Environmental Systems shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than QED service personnel (unless such repair by others is made with the written consent of QED); resold to other parties; and/or moved to or used on a remediation site other than originally specified.

It is understood and agreed that QED Environmental Systems shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application. Liability under this warranty is limited to repair or replacement F.O.B. QED's factory, or its appointed agent's shop, of any parts which prove to be defective within the duration and conditions set forth herein, or repayment of the purchase price at the option of QED, provided the products have been returned in accordance with the duration and conditions set forth herein.

Subassemblies and Other Equipment Manufactured by Others
The foregoing warranty does not apply to major subassemblies and other equipment, accessories, and other parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties, if any, supplied by their respective manufacturers. QED makes no warranty concerning products or accessories not manufactured by QED. In the event of failure of any such product or accessory, QED will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

Illustrations and Drawings
Reasonable Effort has been made to have all illustrations and drawings accurately represent the product(s) as it actually was at the time of doing the illustrations and drawings.

However, products may change to meet user requirements and therefore may not be reflected in the literature. In addition, literature may be updated to reflect the most recent equipment revision(s). Changes to either or both equipment and/or literature can be made without notice.

Buyer's Remedies
The buyer's exclusive and sole remedy on account of or in respect to the furnishing of defective material or workmanship shall be to secure replacement thereof as aforesaid. QED shall not in any event be liable for the cost of any labor expended on any such product or material or for any special, direct, indirect or consequential damages to any one by reason of the fact that it shall have been deemed defective or a breach of said warranty.

Changes without Notice
Prices and Specifications are subject to change without notice.

Shipping Dates
Shipping dates are approximate and are subject to delays beyond our control.

F.O.B. Point and Title
All material is sold F.O.B. factory. Title to all merchandise sold shall pass to Buyer upon delivery by Seller to carrier at factory. All freight insurance is the responsibility of the Buyer and shall be charged to the Buyer on the invoice unless directed in writing. All Freight claims are the Buyer's responsibility.

Terms
Payment terms are net 30 days; 1.5% per month past due.

State and Local Taxes
Any taxes, duties or fees which the seller may be required to pay or collect upon or with respect to the sale, purchase, delivery, use or consumption of any of the material covered hereby shall be for the account of the Buyer and shall be added to the purchase price.

Acceptance
All orders shall be subject to the terms and conditions contained or referred to in the Seller's quotation, acknowledgments, and to those listed here and to no others whatsoever. No waiver, alteration or modification of these terms and conditions shall be binding unless in writing and signed by an executive officer of the Seller. All orders subject to written acceptance by QED Environmental Systems, Ann Arbor, MI, U.S.A.

Warranty Claims Procedure (Responsibility of purchaser)
The original purchaser's sole responsibility in the instance of a warranty claim shall be to notify QED or its appointed agent, of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. The purchaser may secure performance of obligations hereunder by contacting the Customer Service Department of QED or its appointed agent, and:

1. Identifying the product involved by model or serial number, or other sufficient description, that will allow QED, or its appointed agent, to determine which product is defective.

2. Specifying where, when, and from whom the product was purchased.

3. Describing the nature of the defect or malfunction covered by this warranty.

4. After obtaining authorization from QED, sending the malfunctioning component via a RMA# (Return Material Authorization number) to the address below or to its appointed agent:

QED Environmental Systems
1565 Alvarado Street
San Leandro, California 94577-2640
USA

(800) 537-1767	Toll-Free in North America
(510) 346-0400	Tele.
(510) 346-0414	Fax

5. Equipment must be cleaned before shipment or it will be cleaned by QED before any work is performed. The customer will be charged for such cleaning.

If any product covered hereby is actually defective within the terms of this warranty, purchaser must contact QED, or its appointed agent, for determination of warranty coverage. If the return of a component is determined to be necessary, QED, or its appointed agent, will authorize the return of the component at Purchasers expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts, labor, and shipping and handling, as authorized by owner hereunder, shall be borne by the Purchaser. In no event shall such allegedly defective products be returned to QED, or its appointed agent, without its consent, and QED's, or its appointed agent's, obligations of repair, replacement or refund are conditional upon the buyer's return of the defective product to QED, or its appointed agent. All equipment returned to QED will be appropriately cleaned of contamination before shipping.