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HYDRAMASTER® Corporation
Mukilteo, Washington

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TITAN 875

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REFERENCE DOCUMENTS

Tuthill Blower Competitor Manual

GM PSI Operation and Maintenance Manual

1- General Information

This section contains the following helpful information:

- Contact Information
- Warnings, Cautions, and Notices
- Responsibilities
- High Altitude Operation
- Local Water Precautions

Contact Information

Hours

Monday - Friday
7:00 am to 5:00 pm
PACIFIC STANDARD TIME

Telephone Numbers

(425) 775-7276 Parts
(425) 775-7275 Service
(800) 426-4225 Parts / Service FAX

Warnings, Cautions, and Notices

WARNING

This symbol indicates a situation which, if not avoided, could result in death or serious injury.

CAUTION

This symbol indicates a hazardous situation which, if not avoided, could result in damage to the truck mount.

NOTICE

This symbol indicates that federal or state regulatory laws may apply.

⚠ WARNING

During the operation of the truck mount many components are in motion. Never touch any part of the truck mount that is in motion. Serious injury may result.

⚠ WARNING

During the operation of the truck mount many surfaces will become extremely hot. Never touch hot surfaces. Serious injury may result.

⚠ WARNING

The operation of this truck mount can produce noise levels exceeding 85 decibels to a distance of 10 feet. The Occupational Safety and Health Administration (OSHA) recommends the use of hearing protective equipment if a person is exposed to an average of 85 decibels over an eight hour period. Check with local and state agencies concerning hearing conservation rules.

⚠ WARNING

During the operation of the truck mount carbon monoxide and other toxic fumes are produced. Position the vehicle so that any fumes produced will be directed away from inhabited areas and any points of building entry (doors, windows, air conditioning units, fans, etc.). Do not occupy the vehicle while the truck mount is in operation. Serious injury may result.

⚠ WARNING

During the operation of the truck mount chemicals known to the State of California to cause cancer, birth defects and other reproductive harm are produced by the engine exhaust.

⚠ WARNING

Never operate the truck mount with a portable gas container inside the vehicle. Doing so will increase the risk of fire and explosion. Serious injury or death may result.

⚠ WARNING

Transporting a vented fuel container that presently contains, or has ever contained in the past, a flammable liquid is strictly forbidden by HydraMaster and by federal and state regulations. Doing so will increase the risk of fire and explosion. Serious injury or death may result.

⚠ WARNING

Never smoke in or around the truck mount. Doing so will increase the risk of fire and explosion. Serious injury or death may result.

CAUTION

During the operation of the truck mount the exhaust system will become extremely hot. Keep all flammable materials away from the truck mount exhaust system. Failure to do so will increase the risk of fire and explosion. Serious property damage may result.

CAUTION

Never operate the truck mount when the vehicle is tilted more than 10 degrees in any direction. Doing so will result in improper lubrication of the internal components, and will increase the risk of serious component or engine damage.

CAUTION

Never perform cleaning operations when the truck mount engine is running at the IDLE throttle position. Failure to do so will increase the risk of serious component or engine damage.

CAUTION

Never operate the truck mount with the vehicle doors closed. Doing so results in extremely high temperatures inside the vehicle and will lead to serious component or engine damage.

CAUTION

Never use concentrated acids or solvents (including d-limonene) in the truck mount water system or chemical system. Use of these products will cause serious component damage.

CAUTION

Never operate the truck mount with a water hardness reading measuring 3.0 grains per gallon or higher. Using reading than 3.0 grains per gallon will cause scale to build up inside the truck mount water system. Scale build up causes serious component damage. Test all water prior to use and use water softening equipment if necessary.

CAUTION

Never allow water to freeze inside the truck mount. Serious component damage will occur. Perform all freeze guarding procedures outlined in this digital Owner's Manual.

CAUTION

Many vehicles have critical components mounted directly below the floor that can easily be damaged. Before drilling holes in the floor of the vehicle inspect the underside of the vehicle for critical components. Failure to do so may result in damage to the vehicle.

Responsibilities

THE PURCHASER'S RESPONSIBILITIES

- Prior to purchasing a van, ensure that the payload is suitable for all of the equipment that will be installed and transported. This includes and is not limited to: the truck mount, recovery tanks, fresh water tanks, on-board water, hose reels, hoses, cleaning tools, chemicals, drying equipment, etc. Payload capacity information is available through the auto dealer, the manufacturer's web site, and is also located on the door pillar of the driver's side door.
- Purchase a heavy duty Group 24 battery for this truck mount. This is normally available from the installation dealer.
- Prior to dropping your van off at the distributor for the truck mount to be installed, have a spray-on bed liner applied to the floor such as Rhino Lining® or Line-X®.
- Prior to operating the truck mount read this manual in its entirety and familiarize yourself with the information contained here. Special attention should be paid to all cautions and warnings.
- The distributor is responsible for the correct installation of the truckmount. The distributor is also responsible to train you in the correct and proper operation and maintenance of the truck mount.

NOTICE

Any modification of the truck mount may void the warranty.

THE DISTRIBUTOR'S RESPONSIBILITY

Acceptance of Shipment

Before accepting the truck mount, check the following:

- The truck mount should be free from any damage during shipping. Do not sign the delivery receipt until you have closely inspected the truck mount and noted any damage on the delivery receipt. Hidden damage may be present even if the box looks okay. It is recommended that the box be opened before signing for the shipment.
- Check the packing list and verify that all items are accounted for.

Installation Responsibilities

- Ensure proper payload capacity. It is the distributor's responsibility to verify that the equipment package does not exceed the vehicle capacity.
- Ensure installation of a safe fuel tap system and through-floor fittings as provided by HydraMaster.
- Proper placement of the truck mount, recovery tank, fresh water tank, and accessories in the vehicle and securing them with bolts and back up plates. The distributor should verify that the owner is in agreement with the layout.
- Proper connection of the fuel lines.
- Proper connection and installation of the battery. Verify that the battery is in accordance with HydraMaster's recommendation.
- Check the pump, vacuum blower and engine oil levels prior to starting the truck mount.
- Start and run the truck mount and check that all systems function properly.
- Test all hoses, wands, etc. for correct operation.
- Timely return of the document package.

Training

The distributor should provide a thorough review of the operation manual with the purchaser along with instruction and familiarization in:

- How all the truck mount's systems function.
- All safety precautions and their importance.
- How to correctly start and shut down the truck mount.
- How to correctly clean with the truck mount.
- Where and how often to check and change component oil levels.
- Freezing damage and how to avoid it. This includes explaining proper freeze guarding procedures.
- How to do basic troubleshooting of the truck mount.
- Hard water damage and how to avoid it. This includes how to determine if hard water exists in your area and the installation and use of water softening systems.
- The truck mount's warranty and warranty procedures.

Fuel Pump Installation Guidelines

General

The 1.6L GM engine on the Titan is Fuel Injected; this is a high pressure system and requires approved components and hose to operate within the specifications. The average operating pressure at the fuel rail should be 40-50 PSI. This pressure is controlled via an pressure manifold that is placed inline with the fuel pump. The fuel system should be hooked up in the following order:

1. Fuel Tank Tap
2. Fuel Pump
3. Fuel Filter
4. Fuel Pressure Manifold
5. Through Floor Kit
6. Machine

The fuel pump has a “domed” end and an end with the electrical terminations. The “domed” end is the inlet of the pump and the side with the terminations is the output.

The fuel pressure manifold has three ports. The side with the two ports is the return and the inlet, the side with the single port is the output. The dual port side has one connection almost in the center of the block, this is the inlet. The connection that is slightly offset is the return to the fuel tank. The electrical plug must be positioned at the top when the manifold is installed.

The supplied fuel quick connects are required per the engine certification requirements.

The fuel hose is specific to the Titan, this is required by the EPA to maintain the engine certification as well as the pressure requirements.

Locating Components

The Titan is equipped with a fuel pump mounting bracket assembly. This bracket should be located as close to the fuel source as possible. It should be oriented so the fuel pressure manifold plug is oriented upwards. (see **Figure 1-1**)

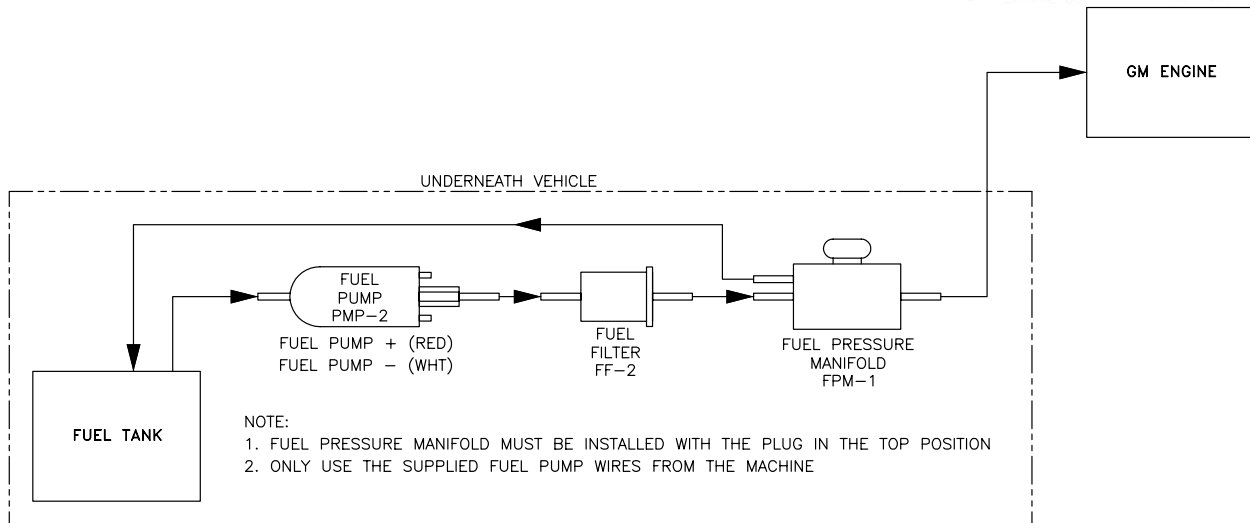


Figure 1-1. Fuel Pump Diagram

Precautions:

WARNING

Failure to use specified fuel hose can result in equipment failure or bodily injury.
Fuel hose specification: Fuel injection hose carb no. C-4-06-002 SAE 30R9 180 PSI

CAUTION

The fuel filter must be on the outlet side of the pump, failure to do so may cause the engine to run poorly.

CAUTION

It is important that the order of the fuel supply components are installed correctly, failure to do so may cause the engine or fuel components may not function properly or be damaged.

NOTICE

Failure to use this hose can result in non-compliance fines set forth by the EPA.

NOTICE

All components should be replaced with approved OEM parts.

Vehicle Preparation

When selecting a truck, remember the preferable vehicle for a Titan 875 installation is a cargo van with a heavy-duty suspension package and a 3/4 HD ton capacity. If a fresh water tank is added, a one ton or larger capacity van is required.

TRUCK PREPARATION

The manufacturer recommends the installation of a spray-on bed liner in the vehicle prior to installation of machine.

This provides 'metal to cushion' mounting rather than 'metal to metal' and makes for an attractive van interior. It is highly recommended to install roof vents in vehicles operated in hot weather locations. Roof vent positions are shown in Figure 1-2.

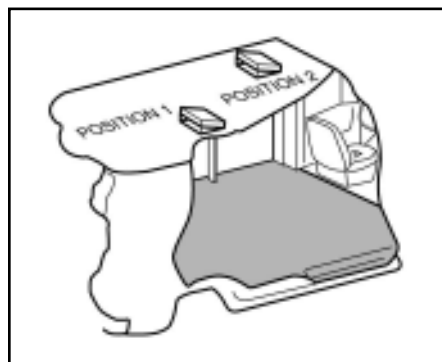


Figure 1-2. Roof Vent

CAUTION

Be cautious when drilling any holes through the van floor. Many vans have critical components mounted directly below the van floor that could be damaged by a misplaced drill bit.

Placement of Unit in Vehicle

There are two recommended unit placements:

SIDE DOOR

Most installations are side door. This provides rear access for accessories and hoses as well as unobstructed access to the component/working side of the machine, thus making it a bit easier to perform maintenance and/or repair without removing the unit from the truck.

REAR DOOR

Although this location partly limits working access, it does direct the noise away from the cleaning site. Some cleaners in the colder areas prefer this location because it puts the weight over the rear wheels for better traction in ice and snow. Rear mounting requires the unit to be slid to the right side as far as possible.

This not only provides adequate working space on the component side of the unit but also improves weight distribution inside the van (engine and component weight line up over drive shaft). Also, it is physically easier to load the unit into the rear door due to the height of the van bed.



Figure 1-3. Recommended Placement

Machine Tie Down Cleats

Secure the machine to the floor of the van with the six tie down cleats provided. This safety measure will ensure that the machine will not slide inside the van. See the following illustration for the correct installation.

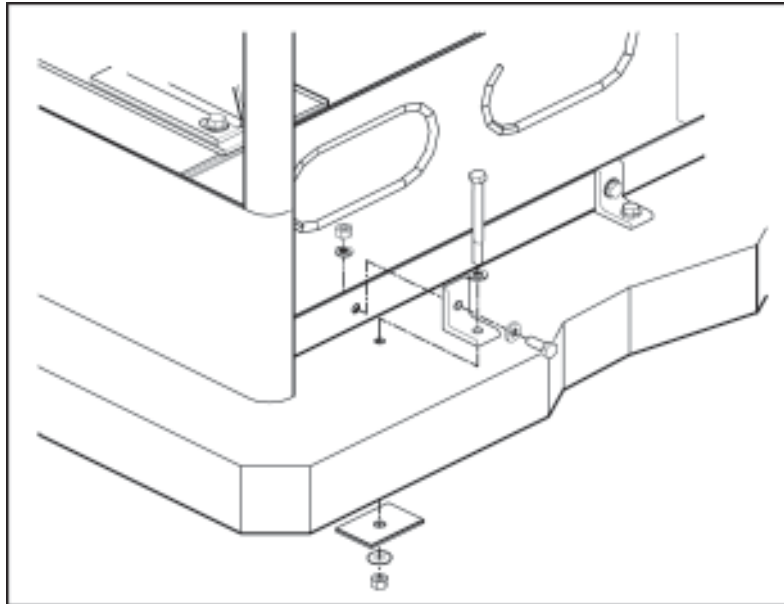


Figure 1-4. Installation Using Tie-down Cleats

Ensure that the machine is well secured to the floor of the van with the hardware supplied. A sudden or crash stop will cause the machine to rocket forward. Protect yourself and the machine. **SECURE IT!**

▲ WARNING

It is recommended by the manufacturer that the exhaust from the front of the machine be vented down under the truck to prevent carbon monoxide from entering the job site. **Always park the truck so the exhaust is blowing away from the job site.**

The manufacturer also recommends the installation of aluminum vents in the truck roof to allow heat to escape.

⚠ WARNING

Never operate this machine with a portable gas can inside the truck. Doing so increases the risk of a fire or explosion.

Mount a fire extinguisher just inside the rear or side door for emergencies.

⚠ WARNING

Do not use a portable propane tank inside of the truck or van. It is dangerous and illegal in most states.

⚠ WARNING

Transportation in a vehicle of any vented fuel container that presently holds or has ever held a flammable liquid is strictly forbidden by HydraMaster Corporation and by federal and state regulation.

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

High Altitude Operation

It is not required to change or adjust the fuel system due to altitude differences. The engine electronic control system constantly monitors the barometric pressure and fuel mixture in the exhaust. Using these two inputs, the engine can compensate for any elevation. This will be done each time the engine is turned on.

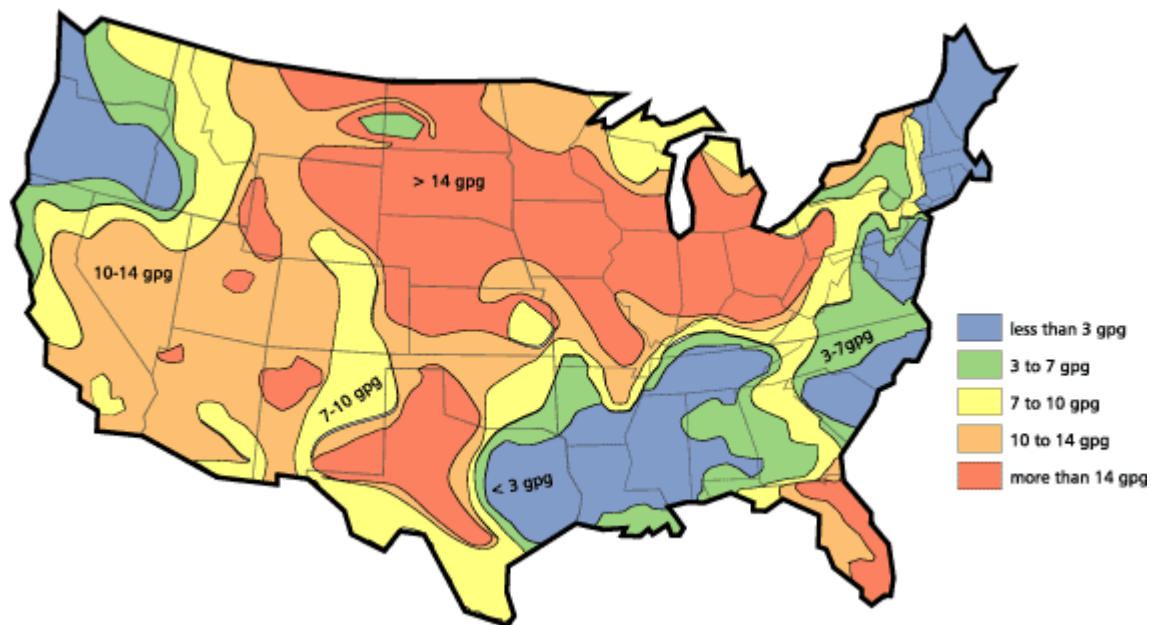
Local Water Precautions

Many areas of the country are regarded as hard water areas. Truck mounts operated in these areas are subject to heavy mineral buildup in internal machine components, hoses and cleaning tools. These mineral deposits cause many problems including reduced heat exchanger effectiveness, component failure and possible machine overheating. Below is a map that identifies areas of hard water. To get more info, visit www.systemsaver.com. You should always consider water from a well as hard water.

It is imperative that special precautions be taken with any truck mount operated in an area in which the water hardness exceeds 3.0 grains per gallon (60mg/l). HydraMaster strongly recommends the use of a water softener in these areas. The use of a water softener greatly reduces maintenance and related downtime. Periodic de-scaling and acid rinsing as described in this manual may not be adequate in hard water areas.

CAUTION

Failure to take appropriate measures to prevent scale build up can result in system failure and loss of warranty on affected parts.



2 - Cleaning and Chemicals

Your HydraMaster truck mount has been engineered using the latest and most sophisticated technology available to produce the finest carpet cleaning results possible. Despite this, it remains only a tool of the carpet cleaning trade and can produce only as good a job as the person operating it.

HydraMaster strongly recommends attending an Institute of Inspection, Cleaning and Restoration Certification (IICRC) approved school as soon as possible and to always follow the IICRC guidelines when cleaning.

This section describes the carpet cleaning procedure in the following areas:

- Precautions
- Preparing the Carpet for Extraction
- Rinse and Recover
- Over-Wetting
- Streaking

Precautions

The use of some chemicals (such as concentrated acids and/or solvents) in your truck mount can seriously damage the internal plumbing and high pressure pump.

HydraMaster strongly recommends purchasing a water softener system to prevent the buildup of scale and hard water deposits in your truck mount.

HydraMaster recommends only the use of chemicals containing rust and corrosion inhibitors and water softening agents to prevent chemical buildup which may lead to component failure and warranty invalidation.

CAUTION

Increased demand for a neutralizing rinse results in the need for special care when using these acid based chemicals in your truck mount. The negative side of these products is the corrosive effects the acid can have on metals, including fittings, pumps, heat exchangers, etc.

HydraMaster's *ClearWater Rinse*™ has been formulated to protect vital components. HydraMaster will not warranty parts that have been damaged from using acid products that have obviously caused failures.

Preparing the Carpet for Extraction

Pre-vacuum the carpet: Whether you instruct the customer to pre-vacuum or you offer it as part of your service, proper vacuuming will make your job easier with superior end results. The more time spent removing loose particulate soil, the easier it will be to remove the oily soil stuck to the fibers.

Pretreat the carpet: This process of applying traffic lane type chemicals to the carpet (whether by sprayer or rotary scrubber) is essential prior to extraction with your truck mount.

By applying cleaning agents to the carpet and letting them dwell 10-20 minutes prior to rinsing, you allow the product to dissolve and emulsify the oily, sticky binders holding the soil to the fiber. This will allow more soil to be removed in one or two cleaning passes and help prevent over-wetting.

Remember the solution coming out of your cleaning tool is only in contact with the carpet fiber for a few seconds. Relying on the rinse detergent to do the majority of the cleaning will result in overly long dry times and excess detergent residue left in the carpet.

HydraMaster recommends the use of our pre-sprays: **Fastbreak™** for residential carpet and **Blitz™** for commercial carpet needs.

Rinse and Recover

Whether you are using a wand, RDM™, or an RX-20™, you should clean an area approximately 3 ft. x 3 ft. with the solution valve open then immediately go over that area with vacuum only to remove any excess moisture.

CAUTION

Olefin fiber is becoming more popular, particularly in commercial installations. The process mentioned above can leave excessive residual moisture because olefin fibers will not absorb any of the cleaning solution. You must only apply solution during the backward stroke of the wand so it can be immediately captured by the vacuum head. RX-20™ and RDM™ users should follow each pass with a dry pass. Failure to follow this procedure will cause solution to flow to the back of the carpet along with some of the soil. This, along with any soil imbedded in the backing, will be wicked to the surface of the fibers as the carpet dries.

HydraMaster recommends the following rinse aids: Alkaline - **Hydra-Dri Powder™** or **Hydra-CleanLiquid™**. Acid - **Clear Water Rinse™**.

Over-Wetting

Over-wetting is an annoyance to all concerned. Extended drying times will leave the customer with a negative impression of both the cleaning company and the process used.

There are several factors that will cause over-wetting:

1. Too few vacuum strokes.
2. Clogged vacuum blower filter or vacuum tank lid not sealing properly.
3. Vacuum tank drain valve left partially open.
4. Obstructed, cut or kinked vacuum hoses.
5. Obstructed vacuum hoses while cleaning a heavily foam-saturated carpet (it is recommended to use a crystal type defoamer distributed evenly over the carpet).

Streaking

Streaks in the carpet can appear in both clean or dirty areas and normally appear in heavily soiled, light colored carpets.

Possible reasons of streaking may include:

1. Clogged or improperly angled spray nozzles.
2. Spray nozzles that overlap, concentrating the solution.
3. A partially clogged vacuum head.
4. Inconsistent solution temperature.

3 - System Operation

The Titan™ 875 is a carefully engineered truck mount designed by HydraMaster Corporation. The system utilizes an internal combustion engine to provide the power necessary to turn both a vacuum pump and a high pressure water pump. The heat of the engine and blower exhausts is transferred to the high pressure water in the finned tube heat exchanger and copper tube and shell of the system. Finally, the chemical is injected into the pressurized water stream and the heated solution is delivered to the cleaning tool. The solution is recovered by the vacuum generated by the vacuum pump. This solution is collected in the recovery tank for proper disposal.

It is the purpose of this manual to help the technician properly understand, maintain and service the truck mount. By following these guidelines carefully, years of reliable operation can be expected.

This section describes the system in the following areas:

- Machine Specifications
- Spare Parts Lists
- Operating Instructions

Machine Specifications

Overall Dimensions	28.0" W x 47" D x 42" H	
Weight	1200 lbs.	
Engine- GM 1.6L 4 Cylinder EFI 61 HP	Oil Type	5W-30 (Synthetic not recommended)
	Capacity	Approx. 4 quarts (128 oz.) when changing oil and <u>filter</u>
	Engine RPM	High 2700 RPM
		Mid 2500 RPM
Low 2150 RPM		
Vacuum Blower- Tuthill 5009 Competitor Plus SL (Dual Splash Lubrication)	Oil Type	PneuLube or other ISO 100 rating
	Gear End Capacity	Approx. 9.6 oz.
	Drive End Capacity	Approx. 7 oz.
	Blower RPM	2250 RPM
Pump- General Pump	Oil Type	15W-40
	Capacity	Approx. 40 oz.
	Pump Rate	5.5 gallons per minute
	Pump RPM	1450 RPM
Operating Pressure	0-1200 psi (heated)	0-3000 (no heat)
Chemical System	Last Step Chemical Injection	
Heating System	Finned Tube Heat Exchanger	Copper Tube and Shell
Standard Equipment	High Pressure Hose	1/4" High Temperature Lined/Vinyl Cover - 150 ft.
	Vacuum Hose	2" Vacuum Hose - 150 ft.
		1-1/2" Wand Whip Line - 10 ft.
	Recovery Tank	100 gallon MaxAir Universal Tank
	Cleaning Wand	Stainless Steel S-bend
		Replaceable Grip
		Rebuildable Solution Valve
	Chemical Jug	5 gallon
	Battery Box	
	Van Decal	
Van Installation Kit		
Operation Manual		
Optional Equipment	Recovery Tank	2.5 Vacuum Port
	Automatic Pump Out (APO)	Dura-Flow APO

Spare Parts List

Part No.	Description	Qty
Engine & Drivetrain Components		
106-125	Plug, Spark	4
049-097	Filter, Fuel	1
049-250	Filter, Oil	1
049-251	Filter, Primary Air	1
049-252	Filter, Secondary Air	1
010-127	Belt, 3VX464 Super HC	4
010-128	Belt, HD 9330 Gates	2
Electrical Components		
056-010	Fuse, 25A	1
056-008	Fuse, 15A	1
157-040	Switch, 20 Amp Rocker	2
157-022	Switch, Relay, 12V	2
Hydraulic Components		
052-050	Quick Connect, 440 Male	2
052-051	Quick Connect, 440 Female	2
052-052	Quick Connect, 660 Male	1
052-053	Quick Connect, 660 Female	1
046-011	Diaphragm, Chemical Pump	1
169-186	Valve, 100 PSI, Last Step Chemical	1
180-003	Orifice, 0.046 dia.	1
074-167	Gauge, High PSI (0-3000)	1
049-023	Screen, Garden Hose	1
078-005	Kit, Seal, and Spring High PSI Regulator	1

Operating Instructions

START-UP PROCEDURE

1. Perform all daily and periodic maintenance as specified in this manual.
2. Connect a garden hose to supply water to the truck mount. If used, turn the "PUMP-IN" switch to the "ON" position.
3. Connect the cleaning tool to the length of hose required to perform the cleaning job.
4. Start the truck mount with;
 - a. The throttle rotary switch in "IDLE".
 - b. The "PUMP CLUTCH" switch in the "OFF" position.
 - c. The "DIVERTER VALVE" switch in the "HEAT BYPASS" position.
5. After the engine starts allow the truck mount to run in "IDLE" for 1-2 minutes to warm up.
6. Rotate the throttle switch clockwise to "LOW", "MID", or "HIGH".
7. Turn the "PUMP CLUTCH" switch to the "ON" position.
8. Turn the "DIVERTER VALVE" switch to the "HEAT MODE" position.
9. Set the "HEAT SELECTOR" valve to the desired position.
 - a. Set to the "COOL" position for upholstery or single wand cleaning.
 - b. Set to the "HOT" position for dual or triple wand cleaning.
10. Set "PRESSURE SELECTOR" valve to the desired position.
 - a. "Pressure Washing Mode" for 1200-3000 PSI (Non-Heat).
 - b. "Carpet Cleaning Mode" for 0-1200 PSI (Heated).
11. If used, turn the "AUTO PUMP-OUT" switch to the "ON" position.
12. Set the cleaning pressure to the desired level.
 - a. Suggested settings:
 - i. Carpet Cleaning: 300-400 PSI.
 - ii. Hard Surface Cleaning: 1000 PSI or as indicated on the tool.
 - iii. High Pressure Cleaning: 3000 PSI or as indicated on the tool.
13. Turn the "CHEMICAL SELECTION VALVE" to the "PRIME" position to purge any air from the system.
 - a. With the truck mount running at "LOW", "MID", or "HIGH" block off the vacuum intake to the recovery tank. The vacuum gauge should read 12" to 14" Hg. This will assist in priming the chemical system.

CAUTION

Never perform cleaning operations when the truck mount engine is running at the IDLE throttle position. Failure to do so will increase the risk of serious component or engine damage.

SHUTDOWN PROCEDURE

1. Flush clean water through the chemical system for 10 seconds. Turn the “CHEMICAL SELECTION VALVE” to “OFF.”
2. Cool the truck mount down by turning the “DIVERter VALVE” switch to “HEAT BYPASS”. Spray the cleaning wand into the vacuum hose for 3-5 minutes. The chemical is now flushed from the truck mount, hoses and cleaning tool.
3. Remove the vacuum hose.
4. Lubricate the blower. Cap off the inlet(s) to the vacuum tank. Inject a small amount of light lubricating oil such as WD-40 Company’s 3-in-One® or WD-40® into the “BLOWER LUBE PORT”.
5. If freeze guarding is necessary perform the procedure at this time. See Freeze Guarding section of this digital Owner’s Manual.
6. Rotate the engine throttle to the “IDLE” position.
7. Turn the ignition switch to “OFF.”
8. Drain the water box using the valve.
9. Drain the vacuum tank in an appropriate location.

NOTICE

In accordance with the EPA, state and local laws, do not dispose of water into gutters, storm drains, streams, reservoirs, etc.

10. Perform daily maintenance as specified in this digital Owner’s Manual.

SETTING THE TEMPERATURE

Due to the high performance designed into the Titan 875 there will be times where you will not need the maximum heat and vacuum available. There are a few different ways you can optimize the Titan to the size of the job.

1. The different scenarios can be defined as follows:
 - a. **Maximum** – Triple wands or rotary machine usage. This means that all available power is required.
 - b. **High Heat/Reduced Vacuum** – Dual wand with short hose runs or single wand at longer hose runs to the job site.
 - c. **Reduced Heat/Full Vacuum** – Single wand with short hose runs to the job site.
 - d. **Low Heat/Reduced Vacuum** – Upholstery or any reduced solution flow cleaning.
2. Maximum
 - a. Set the Heat Selector valve to “Hot”
 - b. Rotate the thermostat dial to “260”
 - c. Increase engine RPM to “High”
3. High Heat/ Reduced Vacuum
 - a. Set the Heat Selector valve to “Hot”
 - b. Rotate the thermostat dial to “260”
 - c. Increase engine RPM to “Low” or “Mid”
4. Reduced Heat/ Full Vacuum
 - a. Set the Heat Selector valve to “Warm”
 - b. Rotate the thermostat dial to “Desired Level”
 - c. Increase engine RPM to “High”
5. Low Heat/ Reduced Vacuum
 - a. Set the Heat Selector valve to “Warm”
 - b. Rotate the thermostat dial to “Desired Level”
 - c. Increase engine RPM to “Low”

MACHINE SAFETIES

This machine is equipped with four safeties that shut down the clutch and 3 safeties that shut down the machine.

1. **Pump Protection Safeties** – When these safeties are activated they will latch the pump clutch relay. This will prevent the clutch from re-engaging after the condition is below the set point of the safety. To reset the circuit you must first turn the pump clutch switch off and they back on again.
 - a. Low Water Box
 - b. Pressure Switch
 - c. Low Pressure Solution Overheat Protection
 - d. High Pressure Solution Overheat Protection
2. **Machine Protection Safeties (When these safeties activate, they will shut the machine down)**
 - a. Oil Pressure Switch
 - b. Coolant Temperature Switch
 - c. Recovery Tank High Water Float – (Note: This circuit has a ten second delay)

4 - Machine Maintenance

To avoid costly repairs and downtime, it is imperative to develop and practice good maintenance procedures. These procedures fall into daily, weekly, monthly and quarterly increments and are outlined below. All maintenance must be performed by qualified service personnel.

A maintenance log is provided in the Owner's Guide. **This log must be maintained and may be required to be furnished to HydraMaster before a warranty claim is honored.** It is recommended that the log be affixed to the vehicle door near the truckmount for convenience and to serve as a maintenance reminder.

This section describes how to properly maintain the truckmount in the following areas:

- Operational Maintenance
- Overall Machine Maintenance
- High Pressure Pump Maintenance
- Vacuum System Maintenance
- De-scaling Procedure (Required)
- Freeze Guarding

Operational Maintenance

Daily Maintenance:

- Check the engine oil level. Add oil (non-synthetic only) if needed.
- Check the high pressure pump oil. Add oil if needed.
- Check the oil level in the blower. Add oil if needed.
- Check coolant overflow bottle level. Add coolant if needed.
- Inspect and clean the recovery tank filters.
- Inspect and clean the orifice and filter.
- Inspect and clean the garden hose screen.
- Inspect the truckmount for water and oil leaks, loose electrical connections, etc. and repair as needed.
- Lubricate the blower with a light oil based lubricant.

Weekly Maintenance:

- Inspect the recovery tank filters for tears, holes, etc. Repair or replace as needed.
- Inspect the vacuum relief valve. Clean and lubricate as necessary.
- Clean the recovery tank thoroughly with pressure washer.
- Check the pump, drive, blower belt drive, and fan belt for wear and proper tension. Tighten as needed.
- Check all the hoses and wiring for wear and chafing. Secure as needed.
- Flush the water and chemical systems with solution of equal parts white vinegar and water.
- Check all the nuts and bolts. Tighten as needed.
- One time change of the high pressure pump oil after 50 hours of operation. (Every 500 hours thereafter.)
- One time change of the engine oil after 50 hours of operation.
- Change the engine oil every 150 hours. (Every 100 hours if operating in high ambient temperatures.) Change oil filter every oil change.

Monthly Maintenance:

- Check the engine air filter. Clean or replace as necessary.
- Check the water level in battery. Fill as needed.
- Clean the battery terminals as needed.

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Quarterly Maintenance:

- Check the fuel lines. Repair or replace as needed.
- Clean and gap the spark plugs to 0.031-0.035 in (0.8-0.9 mm). Replace if excessive carbon buildup is visible.
- Change the blower oil after first 100 hours of use.

500 Hours:

- Change the blower oil.
- Change the high pressure pump oil.
- Check the engine valve clearance (intake and exhaust 0.004-0.006 in (.10-.15 mm))
- Replace spark plugs
- Change primary fuel filter
- Change coolant

1000 Hours:

- Replace spark plugs
- Change primary air filter
- Flush coolant system

Overall Machine Maintenance

Maintenance, troubleshooting and repair are much easier tasks to accomplish on a clean truckmount. Regular cleaning of the truckmount offers the user an opportunity to visually inspect all facets of the truckmount and spot potential problems before they occur. In addition to the operational maintenance the following “housekeeping” duties should be performed.

After each job:

- Check the recovery tank and the recovery tank filters. Empty and clean as necessary.

Daily:

- Wipe the truckmount down thoroughly with a damp cloth.
- Wipe down the vacuum and high pressure hoses as needed.
- Inspect and clean the vacuum slot on the cleaning wand.
- Check the wand head for sharp edges that could tear carpet. File down as needed.
- Clean the wand to maintain original appearance.
- Visually inspect the hoses for abrasions, cuts, etc. Repair or replace as needed.

Weekly:

- Empty the chemical container. Wash out thoroughly to remove any chemical buildup.
- Inspect the chemical feed line strainer and use solution of equal parts white vinegar and water to remove any chemical buildup.
- Thoroughly clean the wand and inspect for clogged jets, debris in vacuum slot and leaking fittings at valve.
- Thoroughly clean the vacuum and high pressure hoses including quick releases and cuffs.

Engine Maintenance

Engine Oil

Engine Oil Level Check

The engine oil level should be checked daily. It is recommended that the oil be checked just before the engine is started for the first time for that day. The oil level should be between the 'Add' and the 'Full' marks on the dipstick.

CAUTION

Do not operate the engine with the oil level below the bottom of the 'Add' mark on the dipstick, or above the top of the 'Full' mark.

Adding Engine Oil

It is normal to add some oil in the period of time between oil changes. The amount will vary with the severity of operation. When adding or replacing engine oil, be sure the oil meets or exceeds the recommended specification.

Changing Engine Oil and Filter

The engine oil and filter must be changed every 150 hours or every three months whichever occurs first. The oil and filter should be changed more often if the engine is operating in dusty or extremely dirty areas, or during cold weather.

Engine Oil Quality

To achieve proper engine performance and durability, it is important that you use only engine lubricating oils of the correct quality in your engine. Proper quality oils also provide maximum efficiency for crankcase ventilation systems, which reduces pollution.

CAUTION

Use only engine oils displaying the American Petroleum Institute (API) "starburst" certification mark 'FOR GASOLINE ENGINES' on the container.

Engine Oil Recommendation

Multi-viscosity oils are recommended. SAE 10W-30 is recommended for your engine from 0° F (-18 °C) or above. If ambient temperatures are consistently below 0° F, SAE 5W-30 oil should be used. Synthetic oils are not recommended for industrial or stationary engines.

Oil Filter

The GM powertrain engines use an AC Delco oil filter as the original equipment. An equivalent or better oil filter must be used when servicing the engine.

To replace the filter, use a proper filter wrench to remove the filter.

Clean the filter mounting base and lightly coat the gasket surface of the new filter with engine oil. Hand tighten the filter until the gasket contacts the base, then tighten another $\frac{1}{2}$ turn. Fill the engine with the correct amount of oil, run the engine and check for oil leaks at the drain plug and oil filter gasket.

Spark Plugs

Always use the recommended spark plugs for your engine. Hotter or colder plugs, or similar plugs that are not exact equivalents to the recommended plugs, can cause permanent engine damage, reduce the engines useful life, and cause many other problems such as hard starting, spark knock and run-on. Installing new spark plugs regularly is one of the best ways to keep your engine at peak performance.

Cooling System

Coolant Level

Check the coolant level of the radiator daily and only when the engine is cool. Generally a good time to do this is just prior to starting the engine for the first time each day.

Maintain the coolant level at $\frac{3}{4}$ of an inch below the filler neck seat of the radiator when the coolant is cold. When the coolant level is checked, inspect the condition of the radiator caps rubber seal. Make sure it is clean and free of any dirt particles which would keep it from seating on the filler neck seat. Rinse off with clean water if necessary. Also make sure that the filler neck seat is free of any dirt particles.

▲ WARNING

Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system, engine, or cause personal injury. DO NOT add coolant to any engine that has overheated until the engine cools.

The engine manufacture recommends the cooling system to be filled with a 50/50 mixture of antifreeze and water. The use of DexCool “Long Life” type coolant (orange) is required. The use of ethylene glycol based coolant (green) may contribute to premature wear of seals and moving parts in the engine’s cooling system.

Bleeding Air from Cooling System

It is necessary to remove all of the air from the engine to prevent overheating. If the coolant has been drained for any reason, it will be necessary to follow the bleed procedure.

When the engine is cold, remove the radiator cap. Fill the radiator until it is to the top of the filler neck. Start the engine and run in the low RPM position, pump clutch off, and no vacuum load. Allow the engine coolant to heat up and open the thermostat several times. As all the air is removed from the system, the level of the radiator should lower below the internal tubes. This process should take approximately 5 - 10 minutes. Top off the coolant and install the cap. In the event you experience a coolant shutdown due to overheat, allow the machine to cool down and repeat this procedure.

Radiator

Inspect the exterior of the radiator for obstructions. Remove all debris with a soft brush or cloth. Use care to avoid damaging the core fins.

Fuel Filter

The fuel filter is located between the fuel pump and the fuel pressure manifold underneath the vehicle. This is a high pressure fuel system and should be replaced with the properly specified filter.

High Pressure Pump Maintenance

DAILY

Check the oil level and the condition of the oil. The oil level should be up to the center of the sight glass on the side or rear of the pump or between the “MIN” and “MAX” lines on the dipstick. The dipstick may be found by removing the oil cap.

PERIODICALLY

Change the oil after the initial 50 hours of operation and every 500 hours after that. It may be necessary to replace the pump seals and check valves at 500 hours if the truckmount has been running in high ambient temperatures.

CAUTION

If the oil becomes discolored or contaminated one of the oil seals may be damaged. Do not operate the pump if the crankcase oil has become contaminated. Do not rotate the drive shaft without oil in the crankcase reservoir.

CAUTION

The pump should never be run dry. Running the pump dry will cause premature wear on the seals, packing and plungers. Running the pump dry for a prolonged period of time may cause damage that cannot be repaired and voids warranty.

CAUTION

Do not run the pump with frozen water in the manifold. If there is a risk of freezing, freeze guard the truckmount. See the Freeze Guarding section of this manual.

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SERVICE

The next few pages explain how to disassemble and inspect all user serviceable parts of the pump.

CAUTION

Do not disassemble the pump unless you are a skilled mechanic. For assistance, contact HydraMaster or your local HydraMaster distributor.

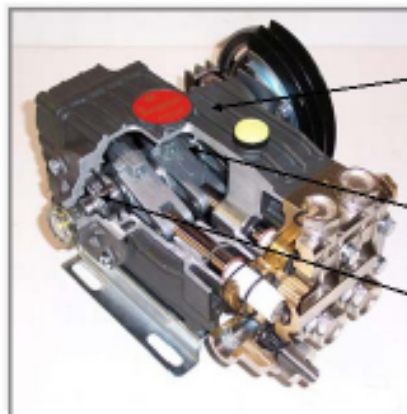
TITAN 875

The HydraPump “HT” Series



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Section 1 - Features and Benefits

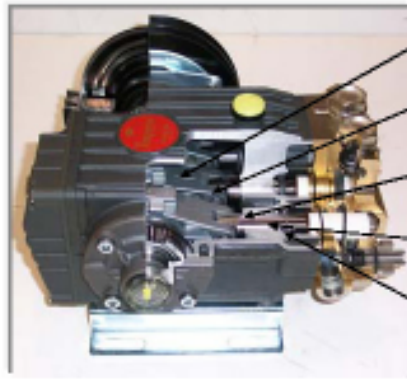


- Die cast aluminum crankcase
- All aluminum parts are anodized
- Forged, hardened and precision ground crankshaft
- Premium “SKF” taper roller bearings

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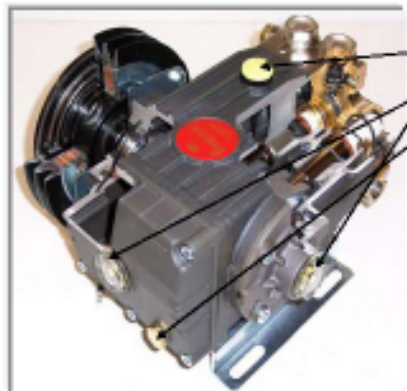
Section 1 - Features and Benefits



- Oversized two piece white bronze connecting rods
- Hardened steel connecting rod pin with retaining clips
- Nickel plated hardened steel plunger guide
- Plunger guide bushing in Teflon, graphite and bronze
- Premium oil seals

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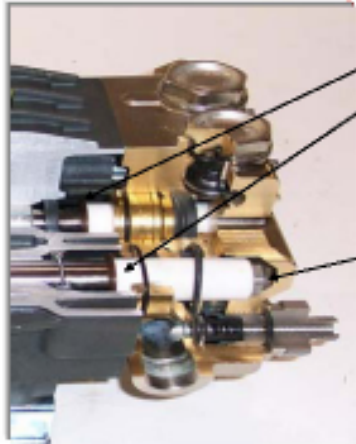
Section 1 - Features and Benefits



- Vented oil dipstick
- Dual oil sight glasses
- Oil drain port
- 40.6 oz oil capacity (SAE 15W40)
 - Initial oil change after break-in period between 50 and 100 hours.
 - Then every 3 months or 300 hours of operation thereafter.

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Section 1 - Features and Benefits



- Copper barrier slinger
- Hardened alumina ceramic plungers with highly polished finish to ensure long seal life. Easily replaced.
- Stainless steel plunger bolt

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Section 1 - Features and Benefits



- Low Pressure Seal Retainer
 - Aligns to crankcase
 - Taper area reduces friction between Retainer and Ceramic Plunger, allows for better drainage.
 - Low Pressure Seal (PTFE)
 - Special Compound of Teflon and Graphite
 - » Reduces Friction
 - Energized Stainless Steel Spring
 - » Holds shape
 - U Seal
- *Patent Pending*

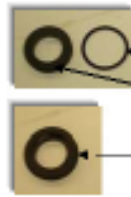
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Section 1 - Features and Benefits



Intermediate Ring

- Raised area fills some of the space of the low Pressure Seal.
- » Helps energize in suction conditions



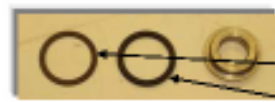
High Pressure Seal (PTFE)

- Special compound of Teflon & Graphite
- EPDM O-ring
- Energized Stainless Steel Spring
- U Seal Design

- Patent Pending

The HydraMaster logo, featuring the brand name in a stylized blue font with a red swoosh above the 'M'.

Section 1 - Features and Benefits



Inlet/Outlet Valve Seal

- Teflon Bronze Support
- Special O-Ring
 - » O-ring has curves shaped in the ID and OD, however the top and bottom are flat.
 - » Eases installation
 - » NBR 90
- Standard Style
- New Style

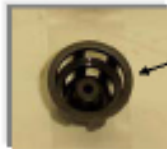
- Patent Pending

The HydraMaster logo, featuring the brand name in a stylized blue font with a red swoosh above the 'M'.

Section 1 - Features and Benefits



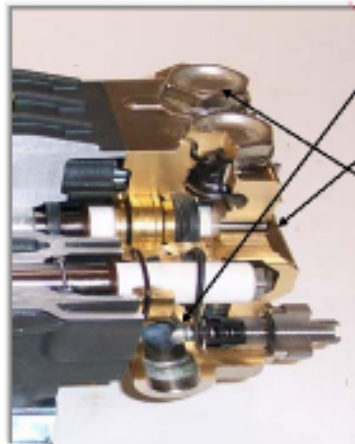
- Valve Cage- Inlet/Outlet
 - 6 Post design
 - » Stronger
 - » Reduce Fatigue
 - New High Temp Plastic
 - » 195 Deg F.



- Patent Pending



Section 1 - Features and Benefits

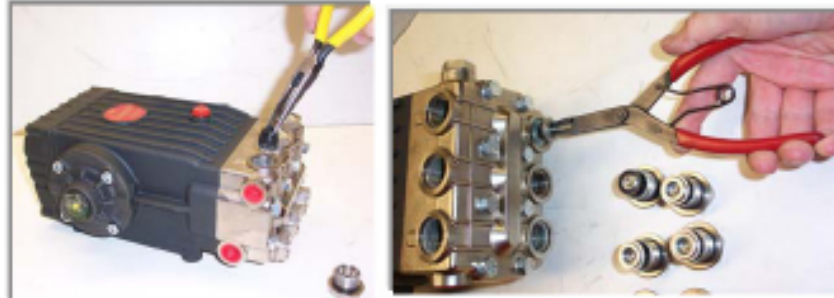


- Weep port between the high and low pressure seal
- Nickel plated forged brass manifold
- Nickel plated forged brass valve caps
 - Nickel plating provides corrosion resistance and a hard surface in critical areas like around the seals and valve seats



Section 2 – Servicing the Valves

- To remove any valve, remove valve cap (30mm) and extract valve assembly.
- Remove valve assembly (Retainer, spring, valve plate, valve seat) from valve cavity.
- Remove o-ring and support from valve cavity.
- Examine o-ring and replace if any evidence of cuts, abrasion, or distortion.



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Section 2 – Servicing the Valves

- Inspect the manifold for wear or damage.



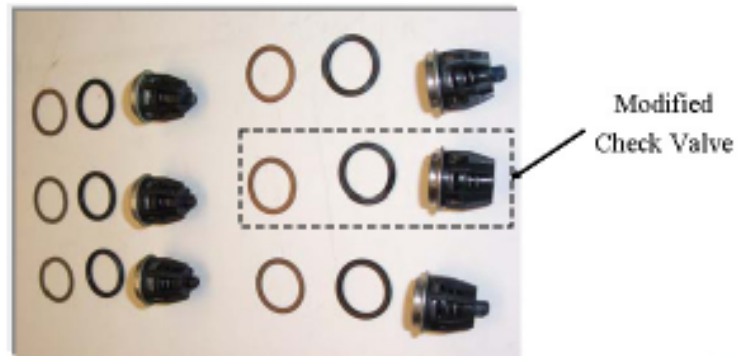
- Inspect the old valves for wear or damage



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Section 2 – Servicing the Valves

- Only one valve kit (000-078-519) is necessary to repair all the valves in the pump. The kit includes new supports, o-rings, valve seat, valve poppet, spring and retainer, all are pre-assembled.
- The center inlet check valve must be replaced with a modified check valve (000-169-212)



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Section 2 – Servicing the Valves

- Apply O-ring grease to O-ring's
- Install valves



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Section 2 – Servicing the Valves

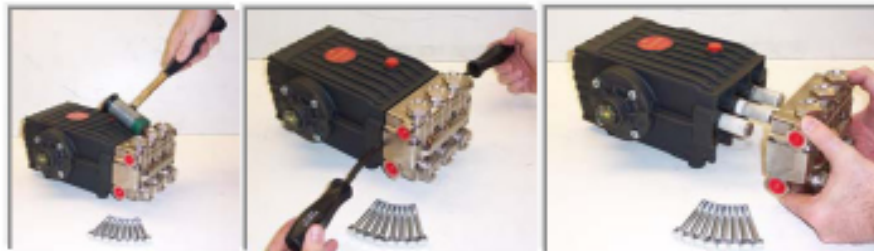
- Replace valve cap and torque to 95 ft. lbs.



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Section 3 – Removing Manifold

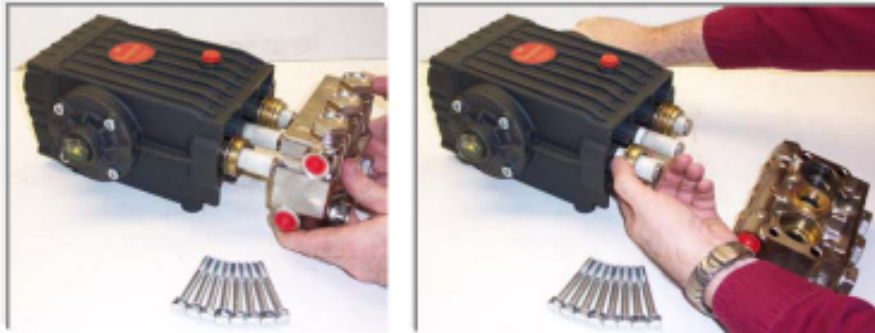
- Remove the fasteners retaining the manifold.
- Separate manifold from crankcase. **NOTE:** It may be necessary to rotate crankshaft or tap manifold with rawhide or plastic mallet to loosen. **CAUTION:** When sliding manifold from crankcase use caution not to damage ceramic plungers.



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Section 3 – Removing Manifold

- The seal assemblies may come off with the manifold.



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Section 4 – Servicing the Ceramic Plungers

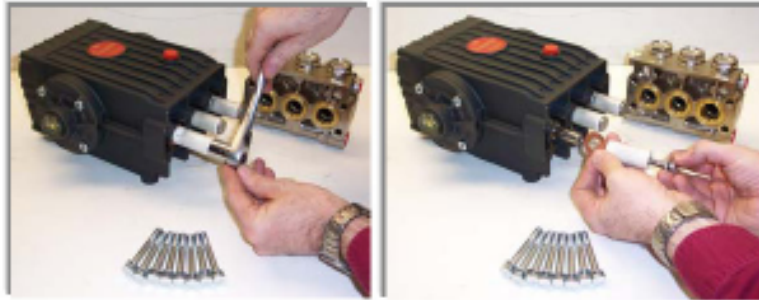
- Examine the ceramic plungers. The surface should be smooth and free from scoring, pitting or cracks; if not, replace.



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Section 4 – Servicing the Ceramic Plungers

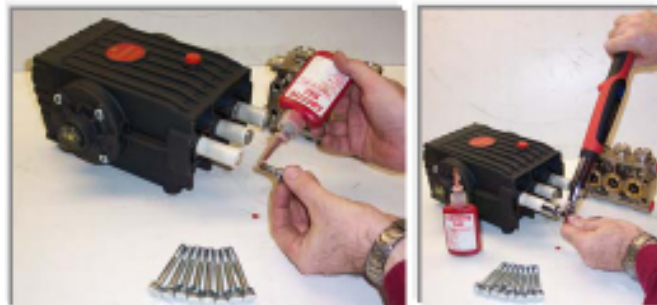
- Loosen the stainless steel plunger bolt.
- Remove the stainless steel plunger bolt and ceramic plunger from the plunger guide.
- If the slinger washer is removed be certain it is reinstalled or replaced.
- Separate plunger bolt from ceramic plunger.



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Section 4 – Servicing the Ceramic Plungers

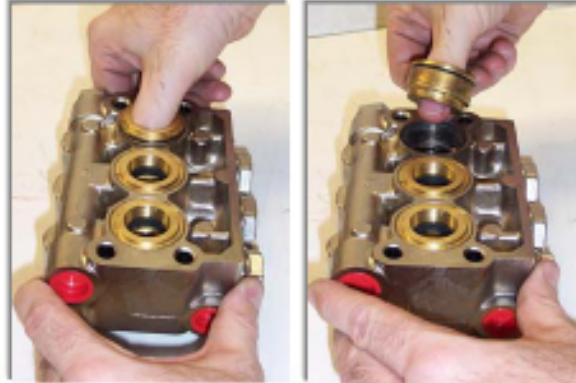
- Install new Teflon back-up ring and o-ring on plunger bolt. Apply a film of grease on the outside of the o-ring.
- Apply removable anaerobic thread sealant (LOCTITE 542) to the threads of the plunger bolt carefully press plunger bolt into ceramic plunger.
- Slide new ceramic plunger over the plunger guide.
- Torque plunger to 14.5 Ft. lbs.



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Section 5 – Servicing the Seals

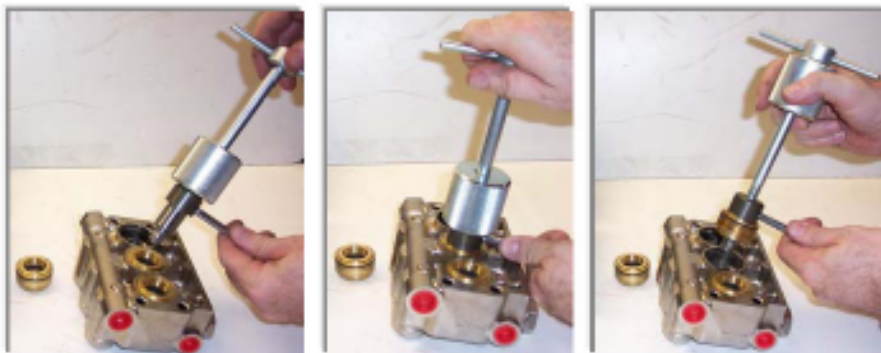
- Extract Seals
 - With manifold removed from crankcase.
 - Insert proper extractor collet through main seal retainer. Tighten collet and extract retainers and seals. NOTE: The Teflon seals of the HT series will be damaged during disassembly so new ones will have to be installed.



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Section 5 – Servicing the Seals

- Extract Seals (Cont.)



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Section 5 – Servicing the Seals

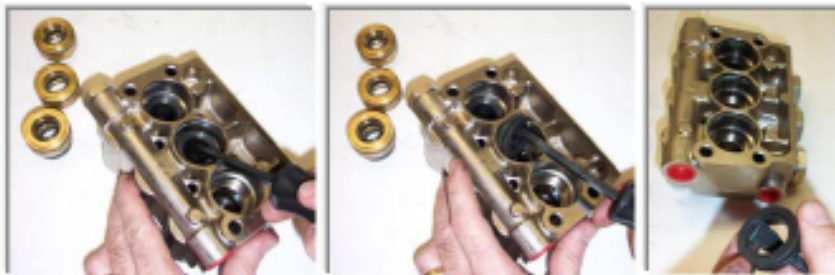
- Extract Seals (Cont.)



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Section 5 – Servicing the Seals

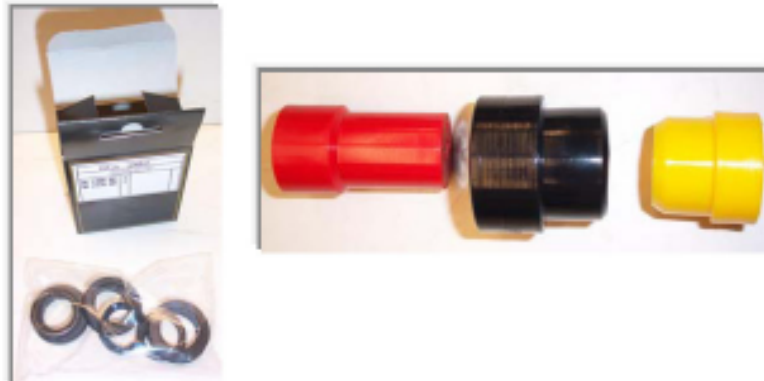
- Extract Seals (Cont.)



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Section 5 – Servicing the Seals

- Replacing the Seal Assemblies
 - Only one seal kit (000-078-516) is necessary to repair all the seals in the pump.
 - Insertion tool is recommended for seal installation.



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Section 5 – Servicing the Seals

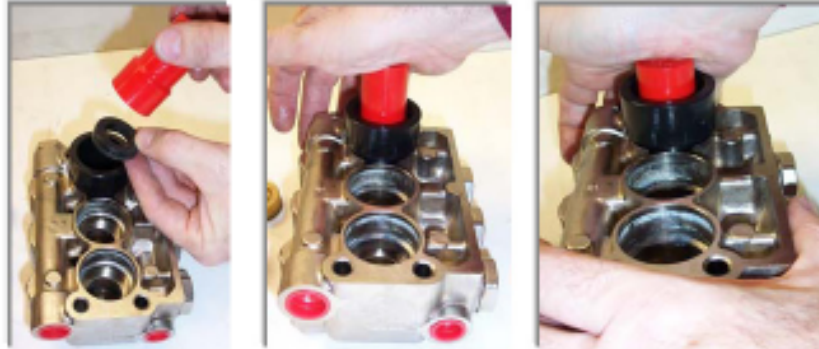
- Install Seal Assembly
 - Apply a film of grease on the o-ring on the outside of the new high pressure seal.
 - Insert high pressure seal into cavity with the “U” shape down.
 - Press high pressure seal into place.
 - Apply a film of grease on the o-ring on the brass retainer.



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Section 5 – Servicing the Seals

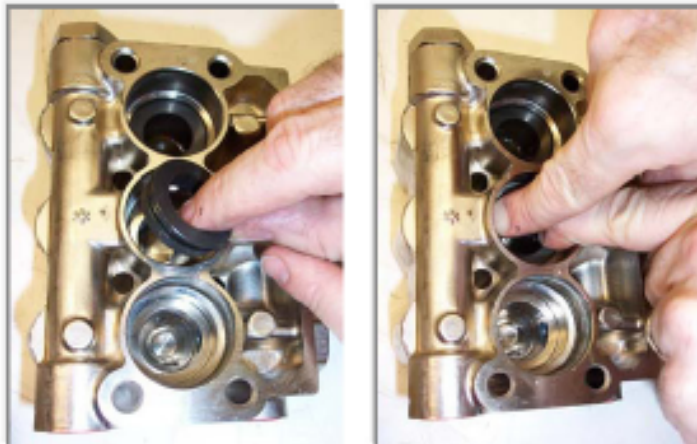
- Install Seal Assembly (Cont.)



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Section 5 – Servicing the Seals

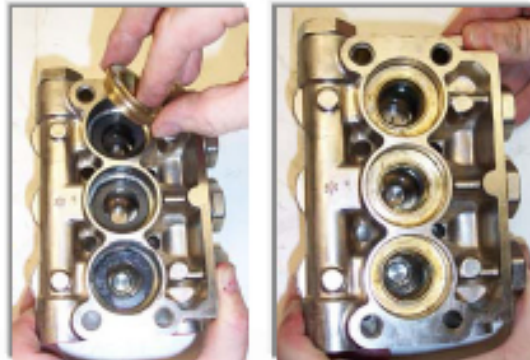
- Install Seal Assembly (Cont.)



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Section 5 – Servicing the Seals

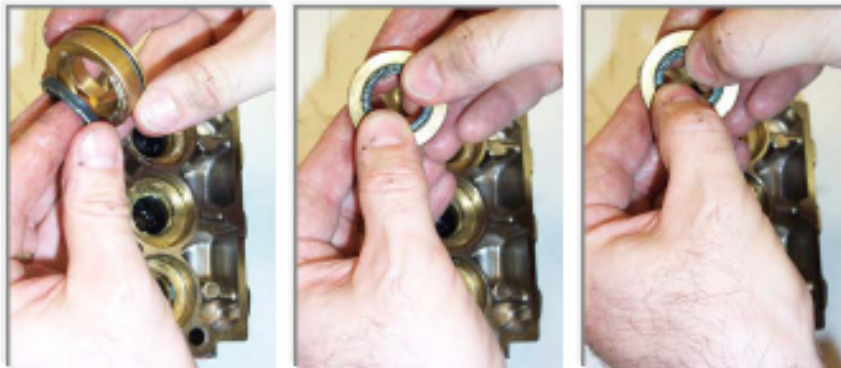
- Install Intermediate Retainers
 - Insert the brass intermediate retainer into cavity.
 - Press the new low pressure seal into brass low pressure seal retainer and install a new o-ring on the outside.
 - Press the low pressure seal assembly into the cavity.



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Section 5 – Servicing the Seals

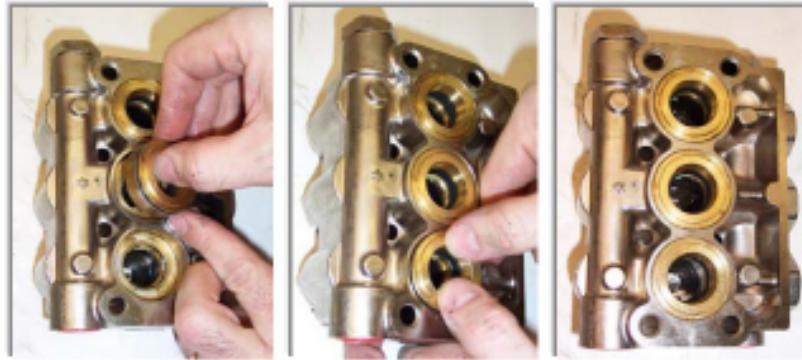
- Install Low Pressure Seals



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Section 5 – Servicing the Seals

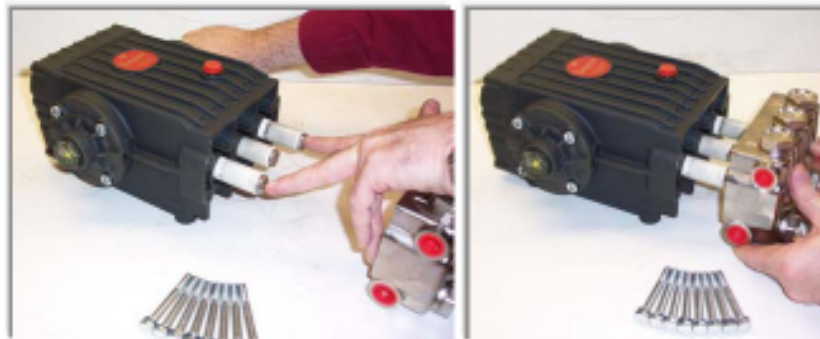
- Install Low Pressure Seals



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Section 6 – Re-installing Manifold

- Position the outer plungers at the same position.
- Reinstall manifold and torque the fasteners in an “X” pattern to 50% of specification and then retorque to 100% specification.



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Section 6 – Re-installing Manifold

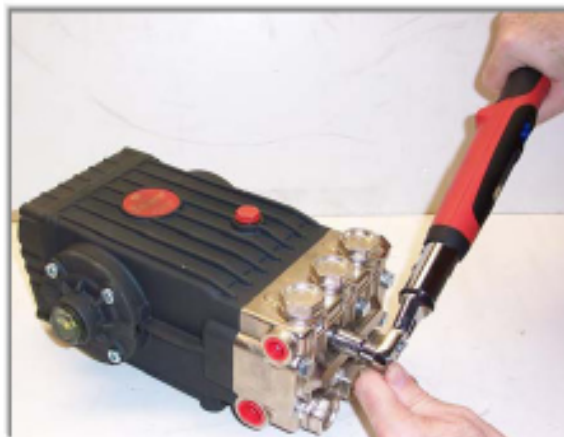
- Torque Sequence



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Section 6 – Re-installing Manifold

- Torque bolts to 22 Ft. lbs.



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Vacuum System Maintenance

The vacuum pump in this machine is commonly referred to as a “rotary positive displacement blower” or “blower” for short. The performance and life of the truckmount is greatly dependent on the care and proper maintenance it receives. The manual for the blower has been included. Review the manual for a better understanding of this piece of machinery.

To protect the blower from overloading and damaging itself, there is a vacuum relief system installed on the vacuum tank. When the vacuum tank inlet is completely sealed off a maximum of 14" Hg will be attained.

CAUTION

Solid objects entering the blower will cause serious damage to the internal components of the blower. Extreme caution should be used when the truckmount is being run for test purposes with the inlet to the blower open to the atmosphere.

CAUTION

Foam passing through the blower can lead to serious problems with the truckmount. It is important to keep the vacuum tank free of foam. The tank is protected from overflowing by a float kill switch; however, this switch is not activated by foam.

DAILY

At the end of each day the internal components of the blower need to be lubricated. This helps to prevent rust deposits and prolongs the life of the truckmount.

With the truckmount running and the recovery tank inlet(s) capped off, inject a small amount of light lubricating oil such as 3-in-One® or WD-40® into the “BLOWER LUBE PORT” located on the front of the machine. Spray the lubricant for three to five seconds, then run under load for an additional two to five minutes to properly coat the blower lobes.

PERIODICALLY

Change the oil in both ends of the blower after the initial 100 hours of use. The oil is to be changed each 500 hours of use thereafter.

De-scaling Procedure (Required)

Scale deposits on the interior of the heating system can cause a noticeable loss in heating performance. Deposits of this kind result from hard water deposits. The frequency with which de-scaling procedures are required will vary. If the area has particularly hard water, you may have to de-scale often.

To de-scale the system, add an appropriate de-scaler chemical to the water box. Circulate it through the system. Let it stand. Flush and repeat as necessary. Clean all screens and strainers, and check them frequently following de-scaling.

NOTE: If using TM DeScaler™ through the flow meter, make sure to run clean water through the flow meter after this procedure.

To de-scale using the recirculation kit (part no. 078-058), start with an empty water box. Fill a third of the water box with TM DeScaler™. Follow the recommendations on the TM DeScaler™ label for proportions. Verify that the float is not lying horizontal, but floats below.

Attach the recirculation fitting provided in the kit to the garden hose quick connect (see **Figure 4-1**) and this combination to the front of the truckmount.

Attach one section of the solution hose to the outgoing solution fitting on the front of the truckmount and the other end to the garden hose and recirculation fitting combination that is attached to the front of the truckmount. Additional hoses may be attached inline if de-scaling of hoses is needed.

Start the truckmount and allow it to run for three to five minutes. Do not leave the TM DeScaler™ solution in the system. Flush the system with clean water and turn the truckmount OFF.

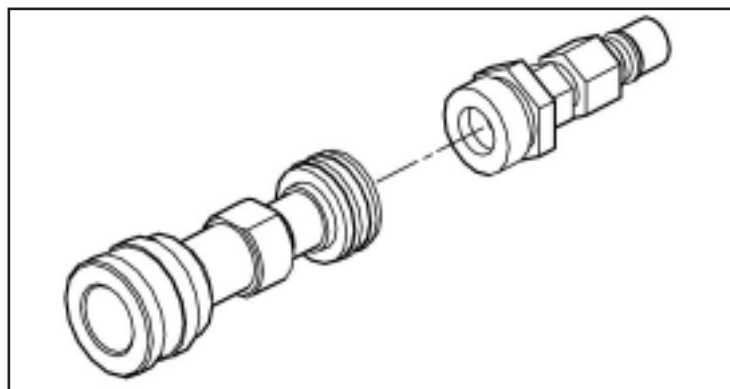


Figure 4-1 Recirculation Fitting

Freeze Guarding

To avoid permanent damage to the truckmount it is imperative to follow the Freeze Guard Procedure whenever the possibility of freezing temperatures exists.

CAUTION

When disposing of antifreeze follow local laws and regulations. Do not discard into storm sewers, septic systems, or onto the ground.

⚠ WARNING

Antifreeze is harmful or fatal if swallowed. Do not store in open or unlabeled containers. Keep out of reach of children and animals.

Freeze Guard Procedure

1. With the truckmount turned off and the incoming water line disconnected, open the water box drain valve on the front of the truckmount. Allow the system to fully drain.
2. Add 2 gallons of 50/50 antifreeze and water mix to the water box.

Attach a section of solution hose to the outgoing solution fitting on the front of the machine. Attach the opposite end to the recirculation fitting. (If more sections of hose are to be freeze guarded attach those inline.)

3. Start the truckmount and allow it to run for 2 to 3 minutes. This will distribute antifreeze solution throughout the truckmount.
4. Remove the chemical feed line from the chemical jug. Turn the selector valve to "Prime." This will vacuum the chemical remaining in the lines to the recovery tank.

When using the recirculation kit skip ahead to Step 7.

5. Remove the quick connect fitting from the garden hose. Attach the quick connect to the machine. Using a vacuum hose attached to the recovery tank, vacuum the water out of the quick connect. This will freeze guard the feed line to the water box.
6. Remove the quick connect from the truckmount.
7. Spray the antifreeze and water mix out of the truckmount and into a container to reclaim the solution. Run the truckmount until it stops.

8. The truckmount is now freeze guarded. **Remember to flush antifreeze from the system prior to carpet cleaning. See procedure below.**

NOTE: The reclaimed antifreeze solution may be used three times before being discarded.

NOTE: To freeze guard the hoses and wand perform Step 7 above with the items to be freeze guarded attached.

Recovering Antifreeze for Re-Use

1. Attach all hoses and wands which have been freeze guarded to the truckmount.
2. Attach the incoming water source to the front of the truckmount.
3. Start the truckmount.
4. Spray the solution through the hoses and wands into a sealable container until all signs of antifreeze are gone.

Freeze Protection of the Pump-In System

1. Drain the fresh water tank.
2. Remove the garden hose adapter from the pump-in pump hose and position the hose so it is pointing outside the van.
3. Turn on the pump-in pump and run for 1-2 minutes until all the water is purged from the hose.

NOTE: The next time the truckmount is used it may take a few minutes before the water box begins to fill.

TITAN 875

5 - Water and Chemical System

This section describes the water and chemical systems in the following areas:

- Water and Chemical Flow Operation
- Water and Chemical Flow Diagrams

Water and Chemical Flow Operation

Fresh water is brought through the front of the truck mount into the water box. The level of water in the box is maintained by the use of a float valve. The water is then gravity fed to the pump where it is pressurized.

Next, the pressurized water enters the bypass valve. This valve allows manual adjustment of the pressure level. When the valve at the wand is closed, nearly all of the water in the system is recirculated to the water box at this point. When solution is being used at the wand the necessary amount of high pressure water passes through the bypass valve and to the heat exchangers.

In the tube and shell heat exchanger the temperature is raised. The heat necessary to do this is provided by the engine coolant. The heated water then travels to the blower heat exchanger. In this finned tube heat exchanger the temperature of the water is raised once again. The heat necessary to do this is provided by both the engine and blower exhausts. The heated water finally travels to the high pressure manifold.

The high pressure manifold houses both the temperature sensor for the heat control system that also acts as a high temperature shutdown switch. There is one orifice located in the manifold. This is referred to as a recirculation orifice and allows a small amount of high pressure, high temperature water to pass back to the water box. This prevents excessive pressure building up in the heat exchanger when the wand valve is closed and no solution is exiting the truck mount.

Water that is recirculated through the pressure regulator back to the water box travels past a low pressure temperature sensor. This sensor monitors the water box temperature. When the controller senses the water in the water box has reached its set point it opens the low pressure solenoid on the side of the water box and closes once the temperature drops back below the set point.

The water that is being called for by the wand then exits the manifold and passes through a check valve. Finally, the water joins the chemical where the solution is created.

The chemical is pressurized by the HydraMaster diaphragm chemical pump attached to the head of the water pump. This pump pulls the chemical from the jug through the chemical meter. After being pressurized the chemical travels through the metering valve and is injected into the high pressure stream. This solution then exits the front of the truck mount and is delivered to the cleaning tool.

Figure 5-1 Flow Diagram
D-6701 Rev. A (Sheet 1)

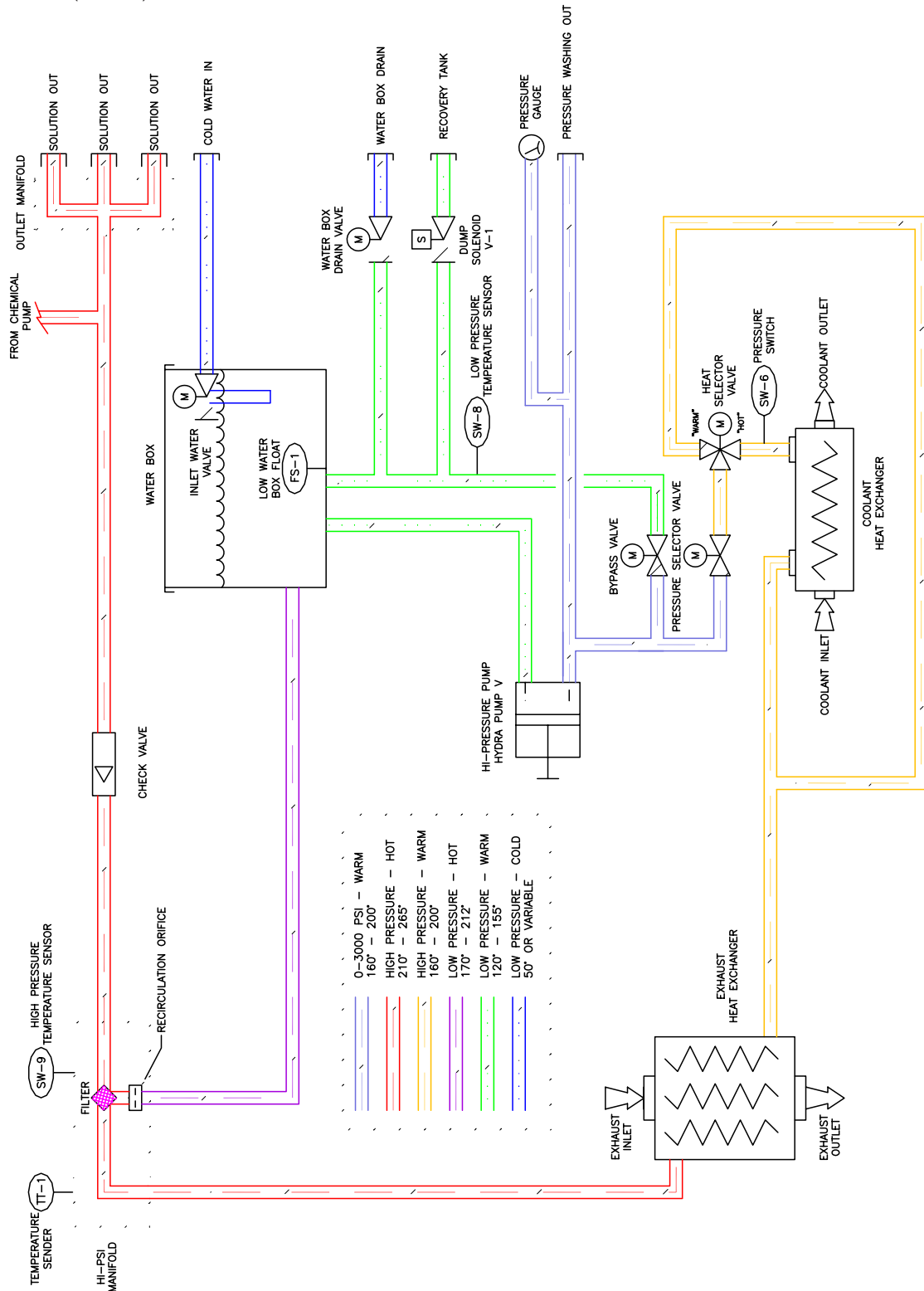


Figure 5-2 Flow Diagram

D-6701 Rev. A (Sheet 2)

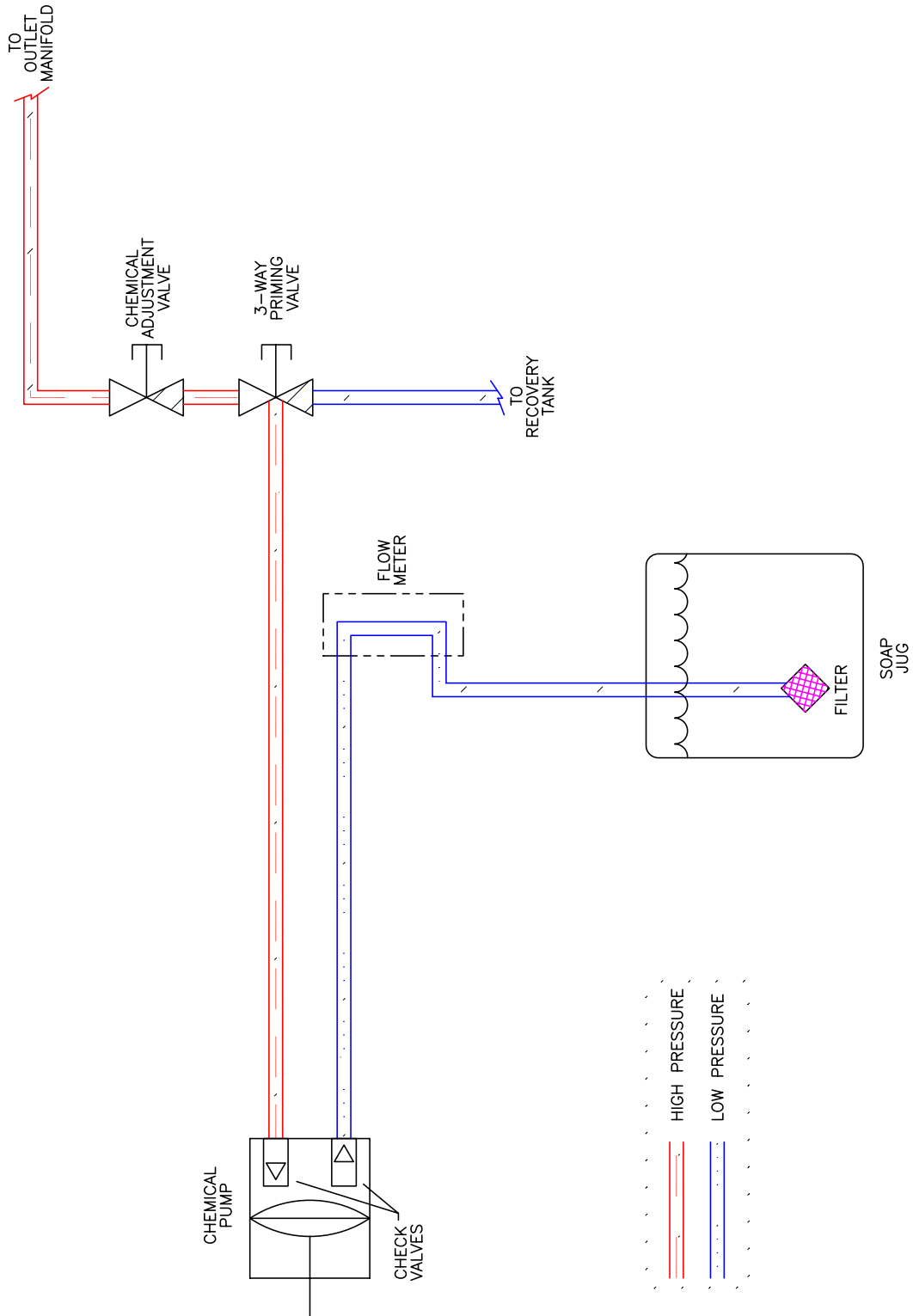
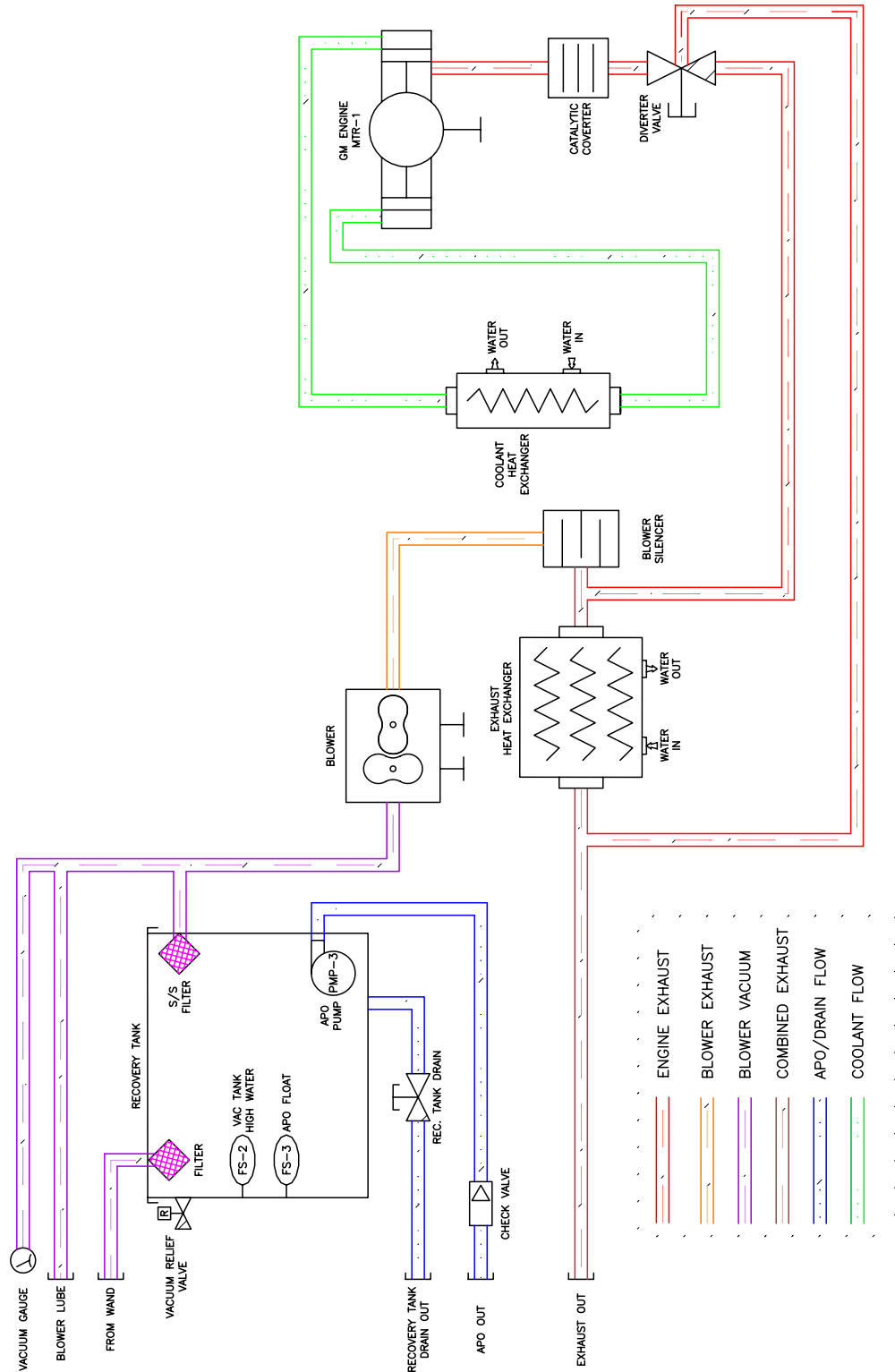


Figure 5-3 Flow Diagram
D-6701 Rev. A (Sheet 3)



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6 - Electrical System

This section describes how the electrical system functions in the following manner:

- Electrical System Information
- Electrical Schematic
- Wiring Diagram

Electrical System Information

The Titan 875 electrical system operates on 12 Volts DC which is provided by the battery. Battery levels are maintained by a 70 Amp generator mounted on the engine.

NOTE: When a new battery is installed, check that it is properly charged before installation or damage to the charging system may occur.

Figure 6-1 Electrical Schematic
D-6700 Rev. B

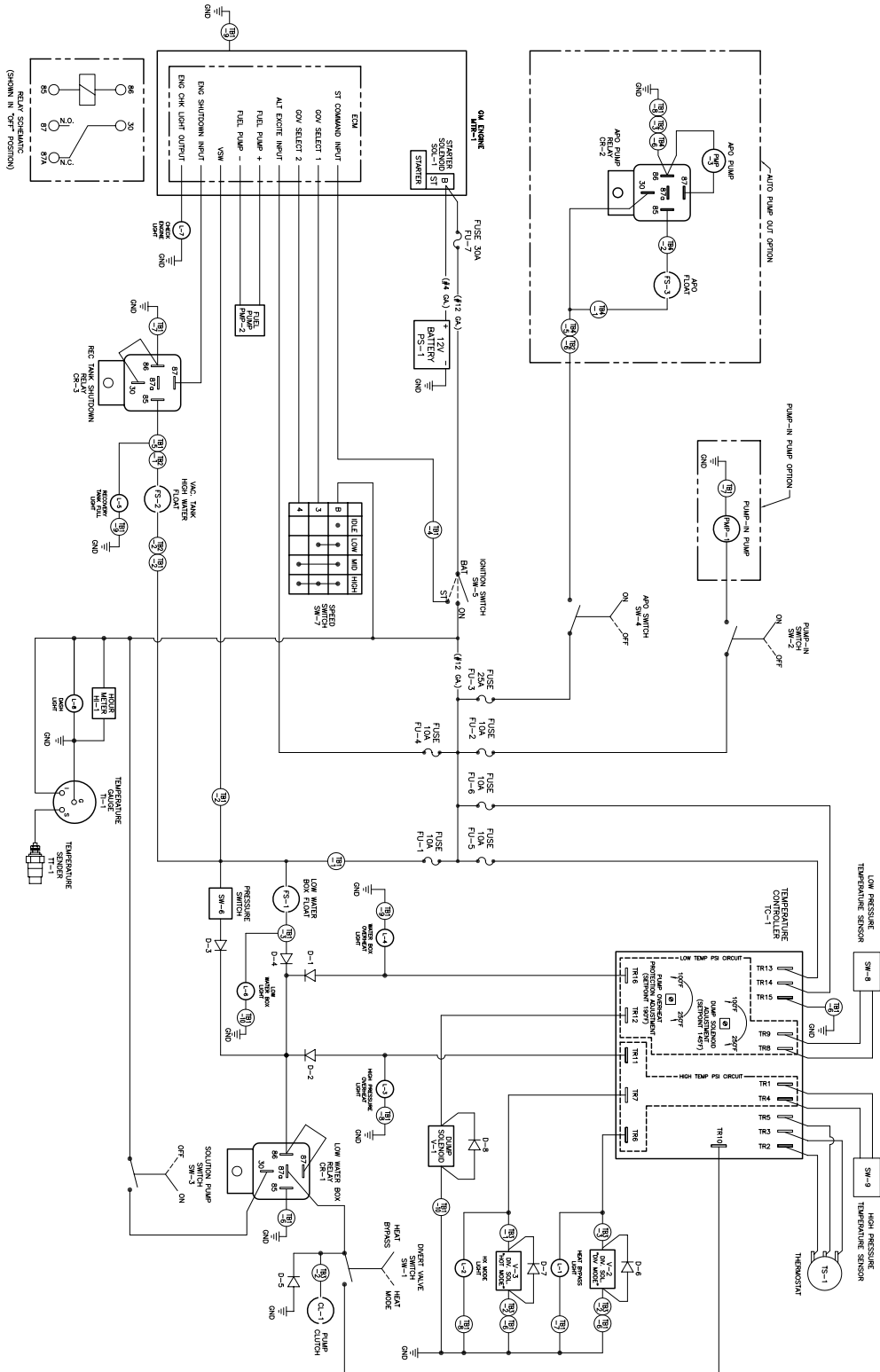


Figure 6-2 Wiring Diagram
D-6699 Rev. B (Sheet 2)

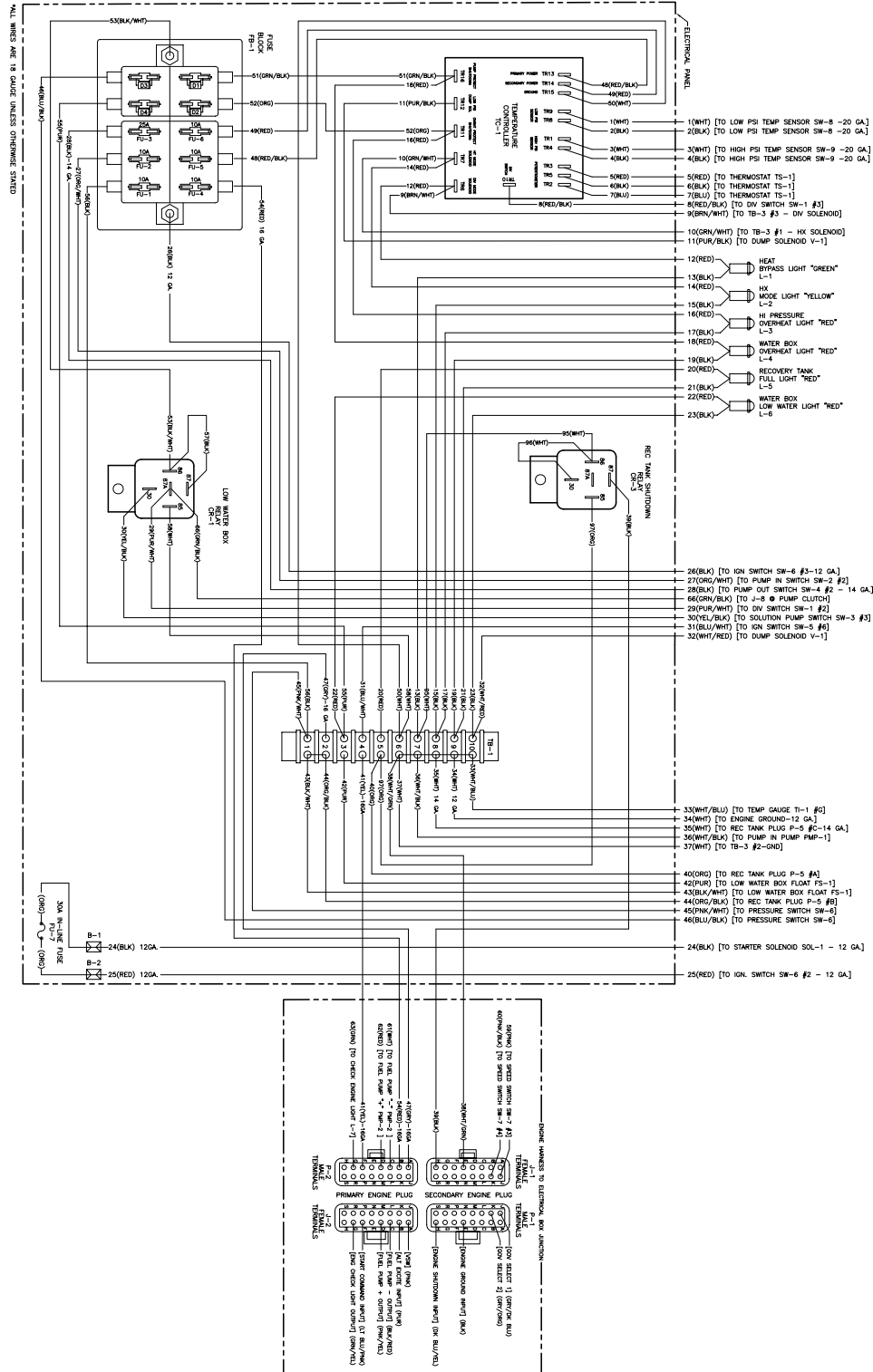


Figure 6-3 Wiring Diagram
D-6699 Rev. B (Sheet 3)

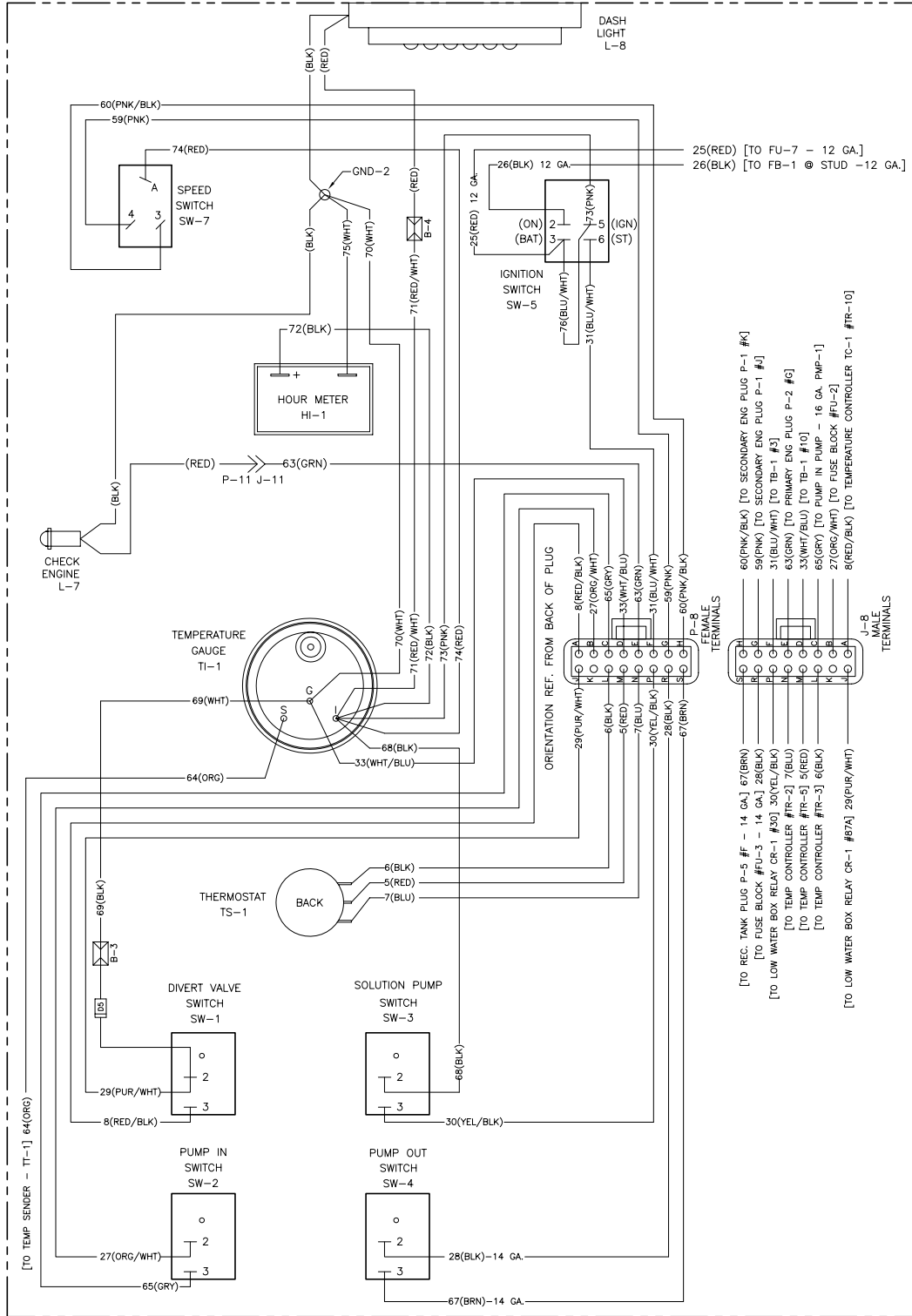
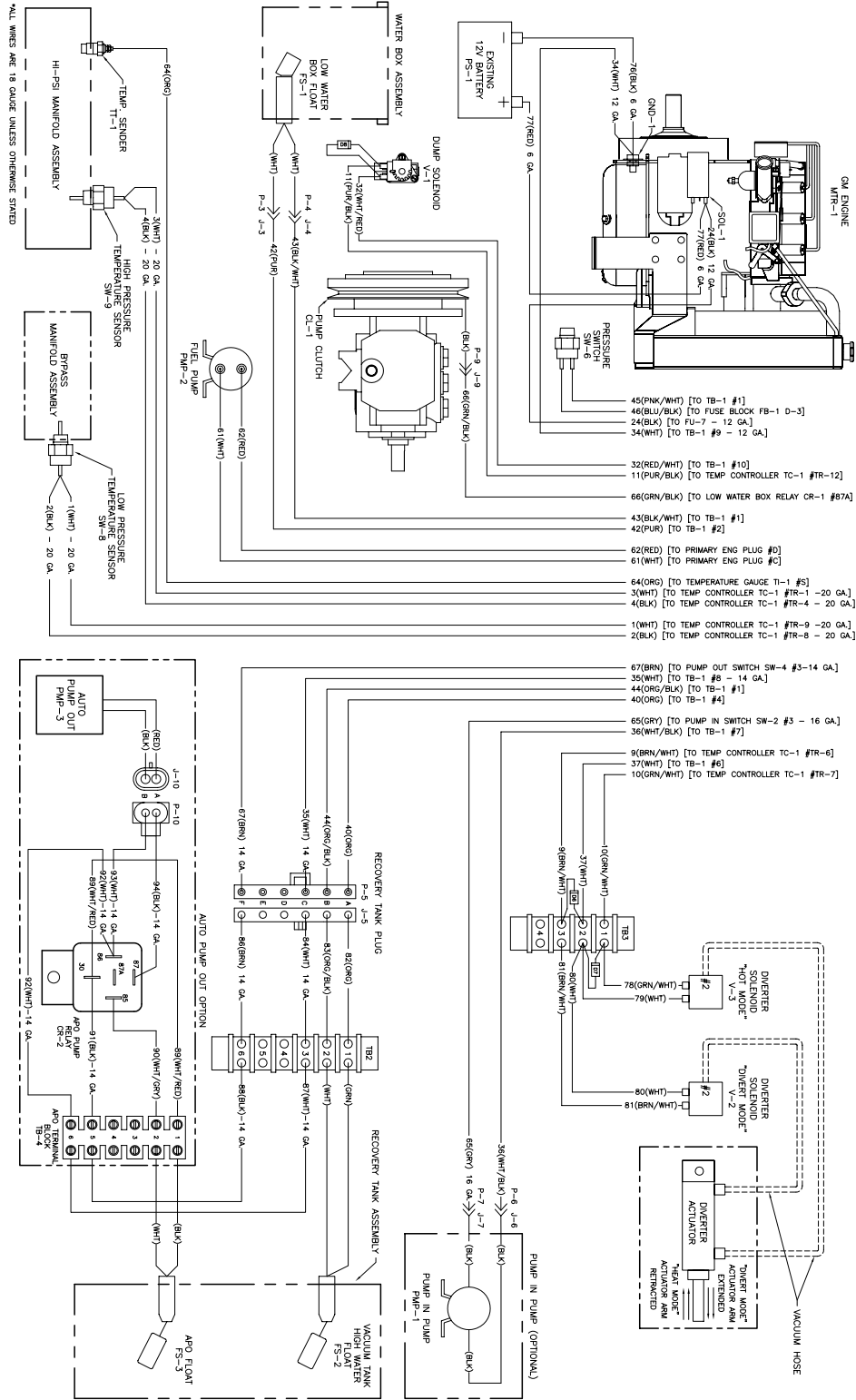


Figure 6-4 Wiring Diagram

D-6699 Rev. B (Sheet 4)



TITAN 875

7 - Troubleshooting

This section describes the standard troubleshooting procedures in the following areas:

- Heating System
- Chemical System
- Engine
- High Pressure System
- Vacuum System

Heating System

The truck mount overheats and shuts down	
Possible Cause	Solution
The orifice or filter screen are restricted	Remove and inspect. Clean as necessary.
The low pressure dump solenoid is restricted	Inspect the solenoid and the hose that delivers water to it. Clean or replace as necessary.
The dump solenoid is faulty	Check the main fuse. If the fuse is blown, inspect electrical system for worn or shorted wires. Repair or replace as necessary.
	Inspect dump the solenoid and test for functionality. If the solenoid is operable, refer to a qualified service technician to test the temperature controller and sensor.
Unable to achieve normal cleaning solution temperature	
Possible Cause	Solution
Temperature control knob is turned down	Inspect the knob. Adjust if necessary.
The dump solenoid is faulty	Inspect the solenoid and test for functionality. If the solenoid is operable, refer to a qualified service technician to test the temperature controller and sensor.
Excessive solution flow at tool	The cleaning tool jet is too large or worn. Inspect the jet. Replace if necessary.
The heat exchanger has hard water scale buildup	Descale the system
The heat exchanger has blockage on the exhaust side	Inspect the interior of heat exchanger. Remove the debris and clean as necessary.

Chemical System

System will not prime	
Possible Cause	Solution
The check valves in chemical pump are faulty	Remove the valves and inspect. Clean or replace as necessary.
The chemical pump diaphragm is faulty	Remove and inspect. Replace as necessary.
The check valve in high pressure pump is faulty (piston which chemical pump is attached to)	Remove the valve and inspect. Clean or replace as necessary.
The filter on feed line in chemical jug is clogged	Inspect and clean.
The feed line from chemical jug is loose, pinched or damaged	Inspect and repair.
The chemical selector valve is faulty	Inspect the valve for leaks between ports. Replace as necessary.
Chemical flow is unstable or low	
Possible Cause	Solution
Air is in the lines	Check that all fittings and connections are tight and in good condition. Repair or replace as necessary.
The filter screen in the chemical jug is partially obstructed	Inspect and clean.
The chemical selector valve is faulty	Inspect the valve for leaks between ports. Replace as necessary.
The chemical metering valve is faulty	Remove and inspect the valve. Clean or replace as necessary.
The high pressure check valve is faulty	Remove and inspect the valve. Clean or replace as necessary.
Chemical is present in water box	
Possible Cause	Solution
The chemical pump diaphragm is faulty	Remove and inspect the chemical pump diaphragm. Replace as necessary.
The high pressure check valve is faulty	Remove and inspect the valve. Clean or replace as necessary.

Engine

The engine will not turn over	
Possible Cause	Solution
A loose or corroded battery terminal	Clean and tighten the battery terminal connections.
The battery is dead	Recharge or replace the battery. Test the charging system. Repair if necessary. WARNING: Do not attempt to jump start the truck mount from a running vehicle. The amperage output from an automobile will damage the charging system of the truck mount.
The main fuse is blown	Check the main fuse. If the fuse is blown, inspect the electrical system for worn or shorted wires. Repair or replace as necessary.
The vacuum blower has seized	Attempt to turn the coupler by hand. If it will not turn refer to the Vacuum System Troubleshooting Section.
The ignition switch is faulty	Test to see if there is power both to and from the switch. Refer to the Electrical Section.
The starter solenoid is faulty	Test to see if there is power to solenoid with ignition in "Start" position. Refer to Electrical Section.
The starter motor is faulty	Test to see if there is power to the motor with the ignition in "Start" position. Refer to the Electrical Section.
None of the above	Refer to a qualified service technician for further troubleshooting.

The engine turns over but will not start. There is NO SPARK.

Possible Cause	Solution
The recovery tank is full	Drain the tank.
The recovery tank float is faulty	Inspect the float. Repair or replace as necessary.
The engine ignition system is faulty	Refer to a qualified service technician for further troubleshooting.

The engine turns over but will not start. There IS SPARK. Note: To check for spark refer to engine manual.

Possible Cause	Solution
Fuel is not reaching the injector rail	Test for power to the fuel pump. Refer to Electrical Section.
	If power is present, inspect the fuel pump. Replace if necessary.
	Inspect the fuel lines between the source and the carburetor. Repair or replace as necessary.
The engine is flooded	Remove spark plug and dry.
The spark plugs are worn or dirty	Inspect and replace as necessary.
None of the above	Refer to a qualified service technician for further troubleshooting.

Engine (cont.)

The Engine will not come up to normal operating RPM Note: Engine should be adjusted to run at 3150 RPM under a vacuum load of 14" Hg.	
Possible Cause	Solution
Excessive load on the engine	Inspect and clean the recovery tank filters.
	Inspect the recovery tank to the blower hose. Repair or replace as necessary.
Excessive back pressure on the engine exhaust	Inspect for blockage in the heat exchanger. Clean or replace as necessary.
Runs rough at high speed	
Possible Cause	Solution
The spark plug(s) are faulty	Remove and inspect the plugs. Clean or replace as necessary.
The spark plug wire(s) are faulty	Inspect the wires and connectors for damage or loose connections. Repair or replace as necessary.
Inadequate fuel supply to the fuel rail	Check for blockage in the filter. Repair or replace as necessary.
Runs rich. (Black smoke)	
Possible Cause	Solution
A dirty air filter	Inspect and replace as necessary.
Excessive fuel to the fuel rail	Refer to a qualified service technician for further troubleshooting
Engine Overheats	
Possible Cause	Solution
Poor ventilation in the van	Open all the van doors.
	Install a roof vent in the van.
	Remove any dividers or other objects impeding airflow around the truck mount.
Low oil level	Check the level and fill as necessary.
Excessive back pressure on the engine exhaust	Inspect for blockage in the heat exchanger. Clean or replace as necessary.
Low coolant	Check radiator level Check overflow bottle level CAUTION: USE DexCool Antifreeze Only!
Poor coolant mixture	Check the coolant with a test to determine mixture; adjust as necessary.

High Pressure System

The pump will not come up to normal cleaning pressure	
Possible Cause	Solution
The pressure adjusting valve is faulty	Inspect the valve. Repair or replace if necessary.
Worn seals or valves in the pump	Test the pump output volume directly from the pump at normal running RPM. If the volume is below the manufacturer's specifications, replace the seals and inspect for defective valves.
The pump RPM is too low	Check for a loose pump belt. Adjust or replace as necessary. Check the engine RPM and adjust as necessary to 3150 RPM under a 14" Hg vacuum load.
The primary orifice is missing or loose	Remove and inspect. Tighten or replace as necessary.
The primary and secondary orifices have been installed incorrectly	Inspect and reverse if necessary. Refer to the Machine Assemblies & Parts List Section.
The primary orifice is worn	Measure the orifice size and replace as necessary. Correct size is .033 in.
No pressure reading on gauge	
Possible Cause	Solution
The pump belt is broken	Inspect and replace if necessary.
The gauge is faulty	Replace the gauge.
The PSI gauge reads normal; low pressure from wand	
Possible Cause	Solution
Restriction in the cleaning tool	Inspect the tool jet(s) and clean or replace as necessary.
	Inspect any filters in the cleaning tool and clean or replace as necessary.
Faulty quick connect in the system	Inspect each quick connect and replace as necessary.
Restriction in one of the solution hoses	Remove the quick connects and inspect hoses. Clean or replace as necessary.
Hard water deposits restricting the system	De-scale the truck mount.

High Pressure System (cont.)

Pressure pulsation	
Possible Cause	Solution
Air leak between the water box and pump	Check all the hoses and fittings for cuts, breaks, cracks, etc. Repair as necessary.
The check valve(s) in the pump are faulty	Remove each valve and inspect for correct operation. See the Machine Maintenance Section.
Water box empty or fills slowly	
Possible Cause	Solution
Restriction in the water supply system	Inspect the supply system from the source through the incoming quick connect.
The float valve in the water box is faulty	Disassemble and inspect the valve. Repair or replace as necessary.
The water box overflows	
Possible Cause	Solution
The float valve in the water box is faulty	Disassemble and inspect the valve. Repair or replace as necessary.
The float has absorbed water and lost buoyancy	Detach the float and check to see if it will float to the surface. Replace as necessary.
The float has come out of adjustment	Adjust the float as necessary.

Vacuum System

A weak vacuum at wand. The gauge reads normal.	
Possible Cause	Solution
Blockage in the hoses or wand tube	Disconnect the hoses and check for an obstruction.
Excessive length of hose connected to the truck mount	Do not attach excessive lengths of hose.
A weak vacuum	
Possible Cause	Solution
Air leaks somewhere in the vacuum system	Check the vacuum relief valve for proper adjustment.
	Carefully check all the vacuum hoses for a cut or break.
	Check the recovery tank lid gasket.
	Make sure the recovery tank drain valve is fully closed.
The vacuum blower is turning too slowly	Check the RPM of the engine. Adjust as necessary to 3150 RPM under a 14" Hg. vacuum load.
The vacuum gauge is defective	Test the gauge and replace if necessary.
The vacuum gauge reads too high with no hoses attached	
Possible Cause	Solution
The filter in recovery tank is clogged	Remove and clean or replace as necessary.
The hose from recovery tank to the vacuum blower is collapsed internally	Inspect and replace as necessary.
Excessive noise produced by the blower	
Possible Cause	Solution
The blower is low on oil	Inspect the oil levels and replenish as necessary. Note: Running the blower with low oil levels can cause severe damage. If this situation occurs the blower should be inspected by a qualified service technician.
The vacuum blower has internal damage	Refer to a qualified service technician.

Vacuum System (cont.)

The vacuum blower is locked and will not turn	
Possible Cause	Solution
Truck mount has been inactive for a period of time and the blower was not properly lubricated prior to final shutdown. Rust has possibly built up on the internal surfaces.	Spray penetrating oil into the blower and let sit for at least one hour. Then very carefully use pipe wrench on the outer diameter of the pulley on the coupler to attempt to free lobes of the blower. Do not use a wrench directly on the blower shaft.
	If unable to free up the blower in this manner refer to a qualified service technician.
There is internal damage to the blower	Refer to a qualified service technician.
Water in truck mount exhaust	
Possible Cause	Solution
The recovery tank has been filled with foam or over filled with water	Inspect the recovery tank. If full, drain the tank.
	Inspect the high level shutoff switch for proper operation. Clean or replace the switch as necessary.
	If foam is in recovery tank, use defoamer on the carpet being cleaned.
Condensation in system	This will be more common in cool weather and humid climates. If this is the cause it should dissipate after a few minutes of running.
The heat exchanger is leaking water	Inspect and repair or replace as necessary.

8 - Machine Assemblies and Parts List

This section contains all the assemblies and parts lists associated with the truckmount.

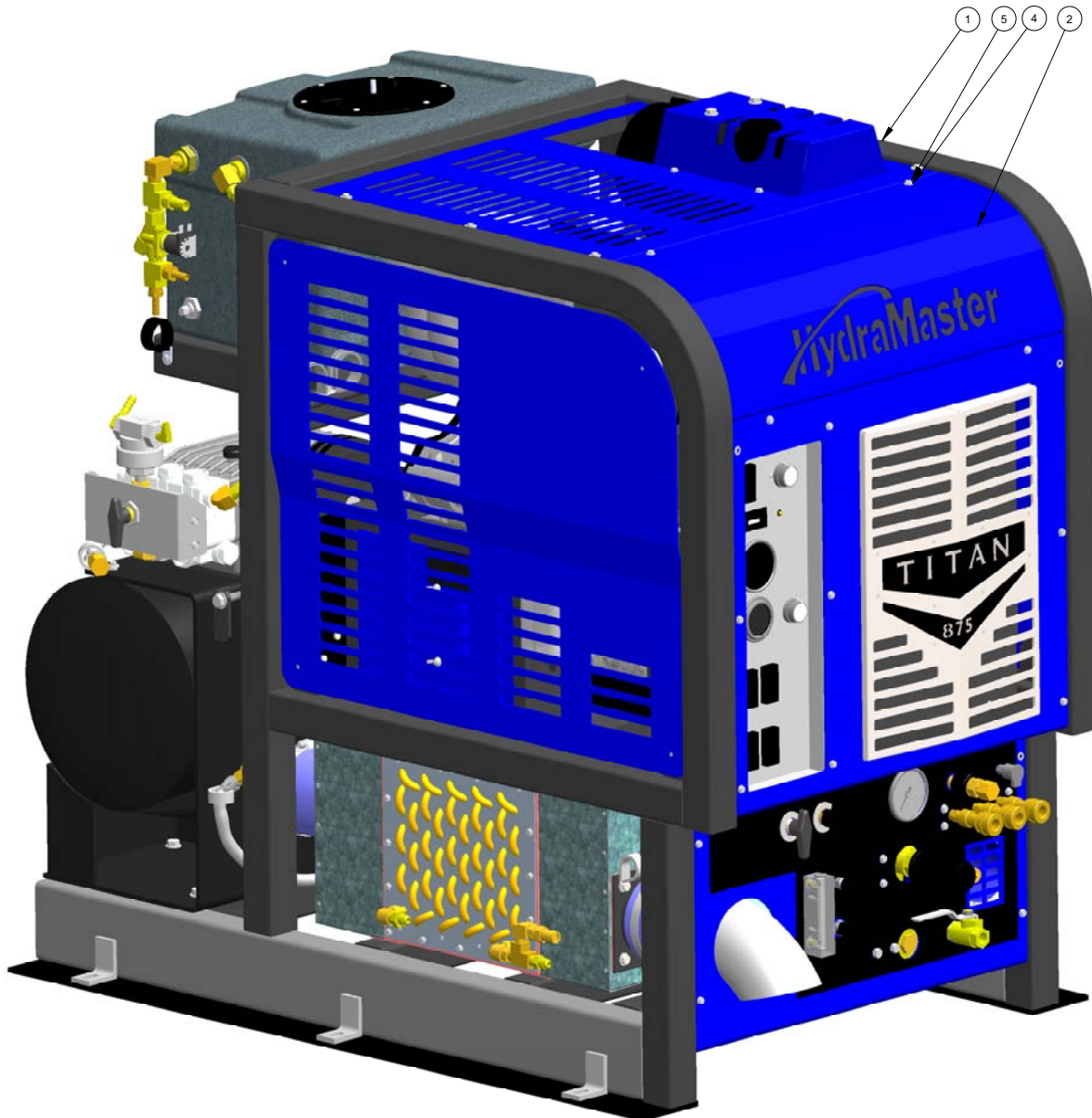
- Machine Assembly
- Frame Assembly
- Engine Assembly
- Solenoid Assembly
- Idler Pulley Tensioner Assembly
- Blower Assembly
- Air Actuator Assembly
- Pump & Silencer Assembly
- Pump Assembly
- Exhaust Assembly
- Blower Heat Exchanger Assembly
- Coolant Heat Exchanger Assembly
- Panel, Lower Instrument Assembly
- PSI Regulator Valve 0-3200 PSI Assembly
- Orifice Manifold Assembly
- Hi-Pressure Out Manifold Assembly
- 3 Way Valve Assembly
- 2 Way Valve Assembly
- Poly Water Box 8G Assembly
- Diffuser Assembly
- Upper Dash Assembly

Cont.

- Inset Dash Assembly
- Grill Assembly
- Electrical Panel Assembly
- Cover, Catalytic Assembly
- Top Cover - Machine Assembly
- Left Side Cover - Machine Assembly
- Right Side Cover - Machine Assembly
- 100 Gallon Universal Recovery Tank Assembly
- Cover, 100 Gallon Universal Recovery Tank Assembly
- Vacuum Relief Valve Assembly
- Dura-Flow APO Assembly
- Machine Hose Routings

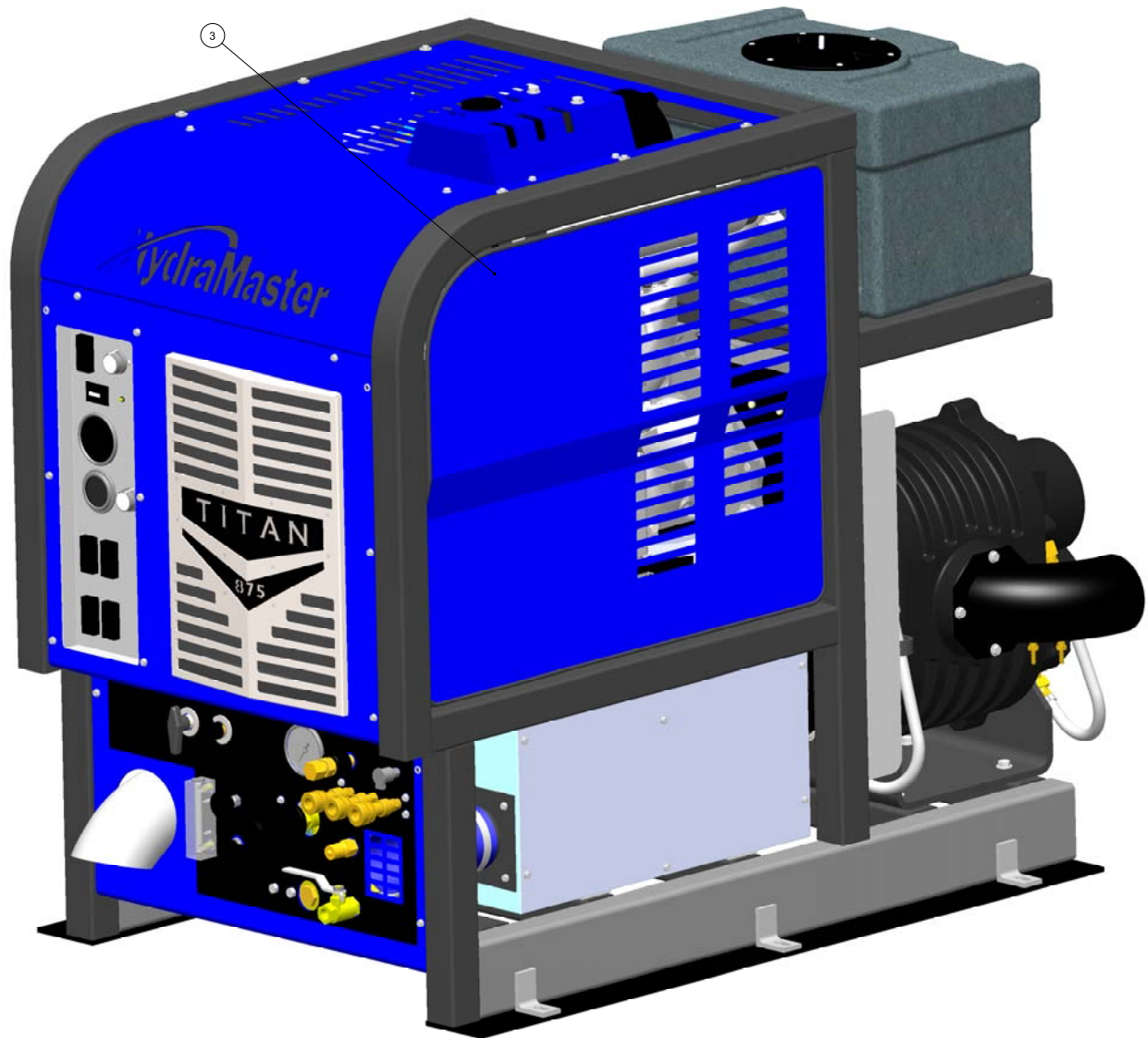
TITAN 875

Figure 8-1 Machine Assembly - Front Left View
D-6600 Rev. -



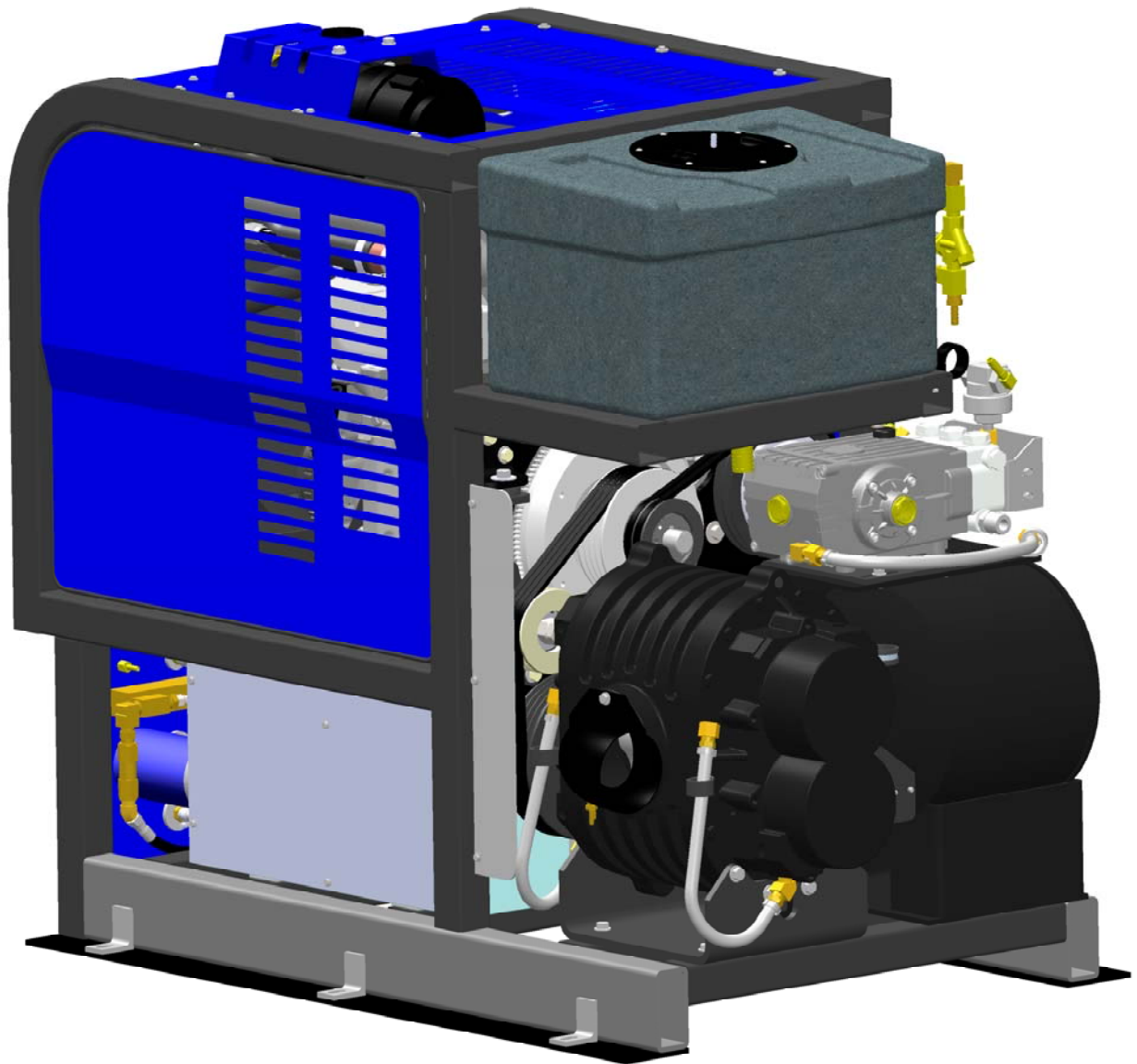
TITAN 875

Figure 8-2 Machine Assembly - Front Right View
D-6600 Rev. -



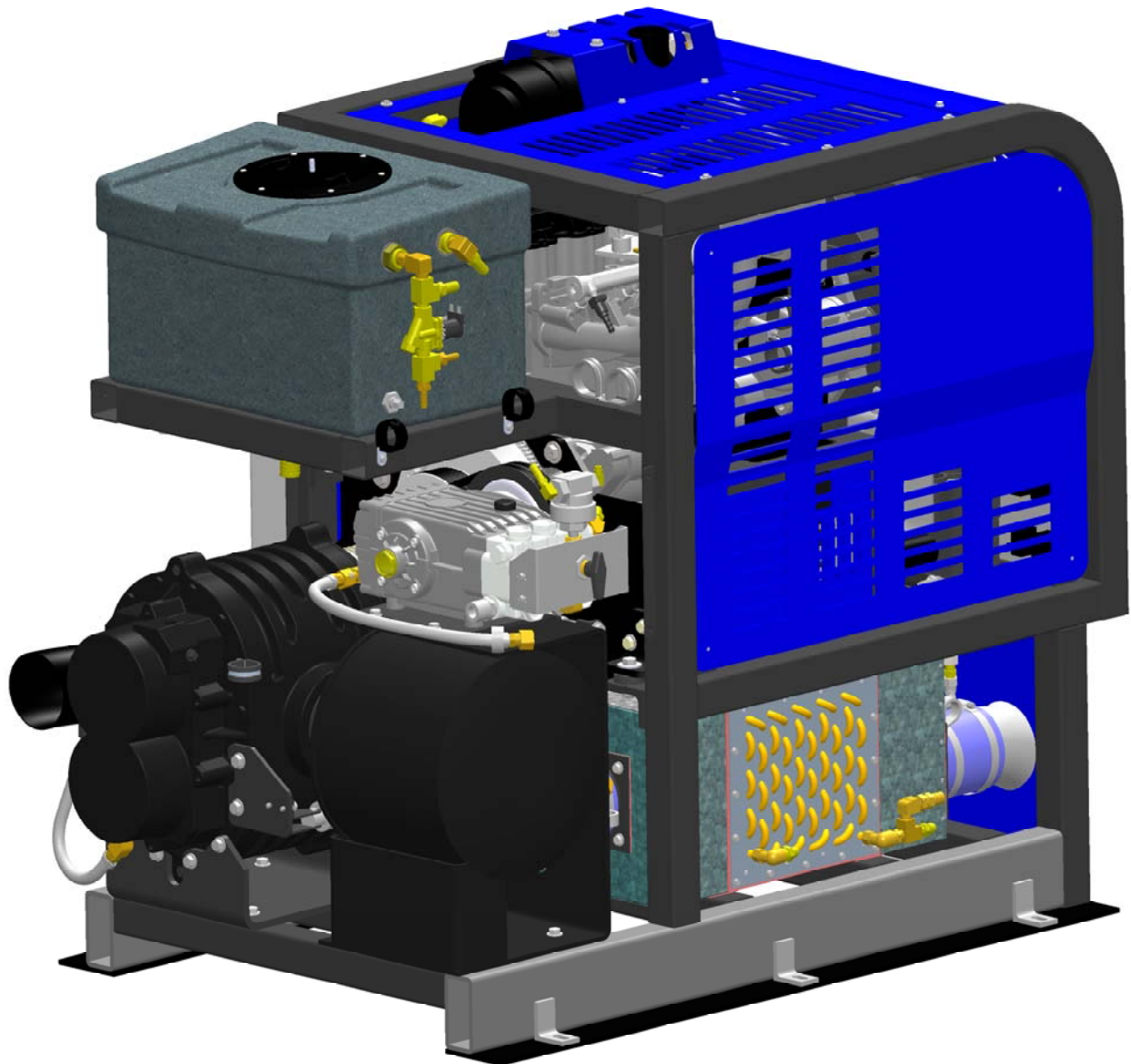
TITAN 875

Figure 8-3 Machine Assembly - Back Right View
D-6600 Rev. -



TITAN 875

Figure 8-4 Machine Assembly - Back Left View
D-6600 Rev. -

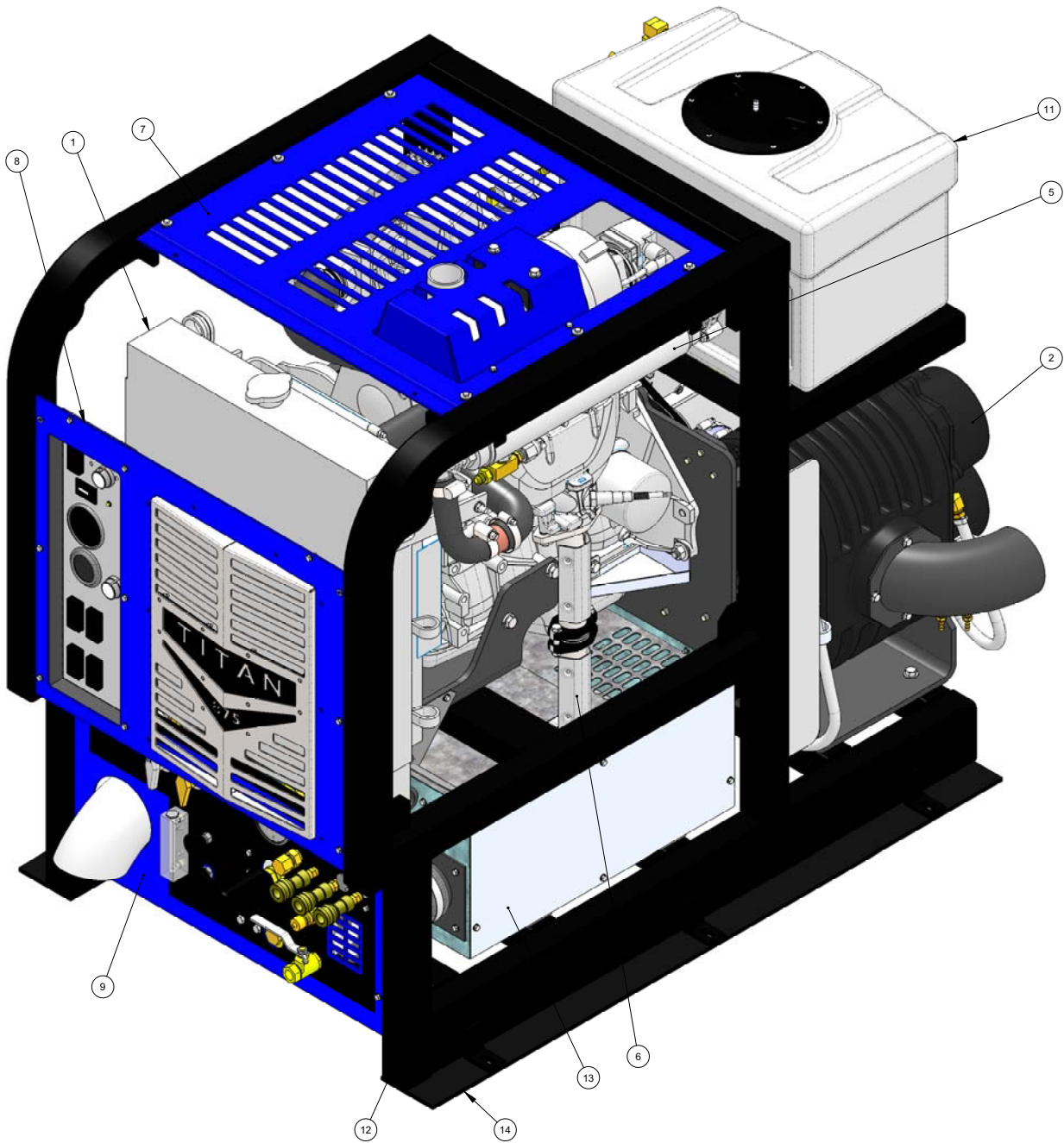


Machine Assembly Parts List

Item	Part Number	Description	Qty
1	Fig. 8-5 - 8-7	Assembly, Frame	1
2	000-041-454	Cover, Brow - Machine	1
3	Fig. 8-40	Assembly, Machine Right Side Cover	1
4	000-155-053	Spring, 1/4" Belleville Washer	2
5	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	2
6	Fig. 8-39	Assembly, Machine Left Side Cover	1

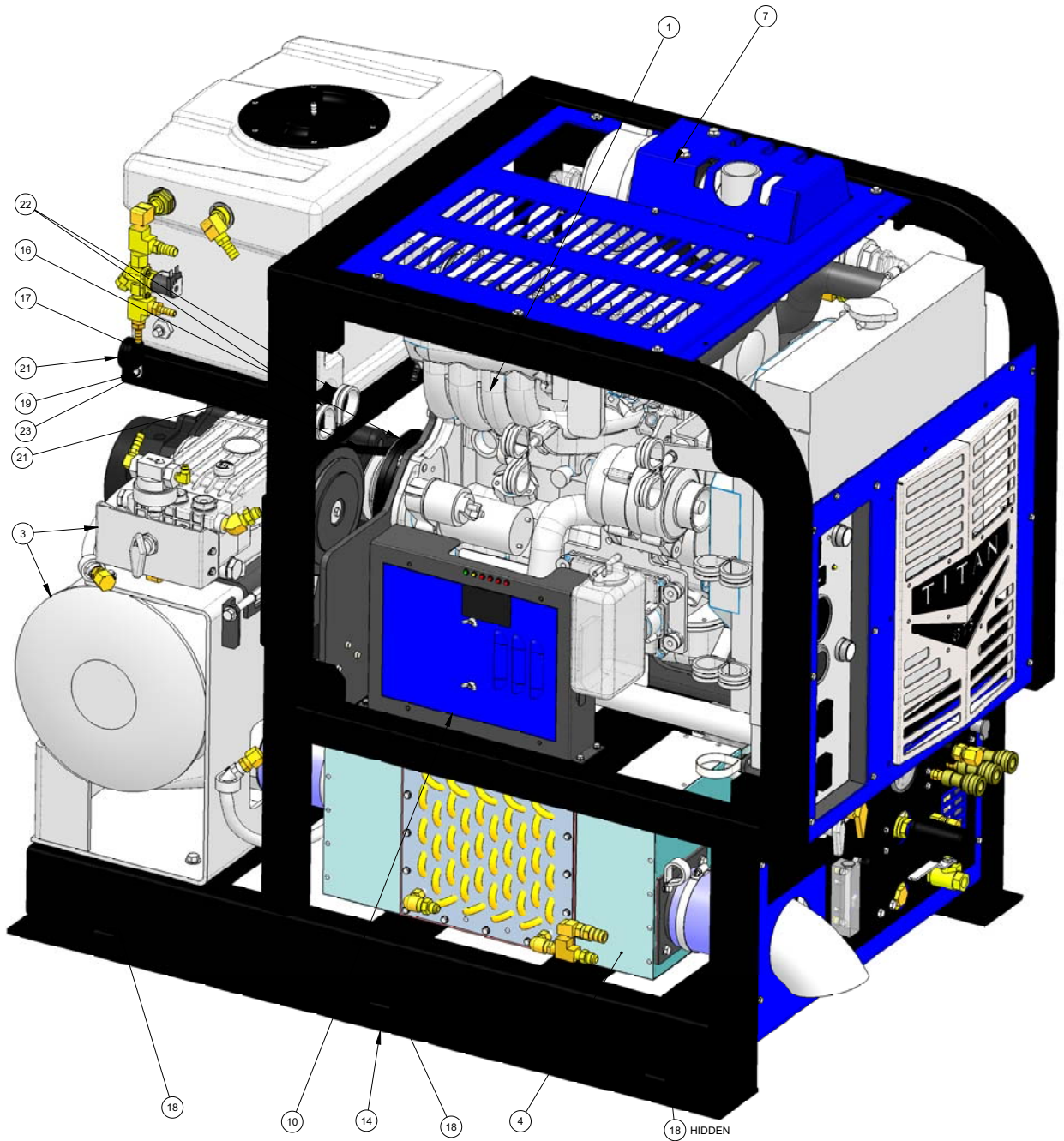
TITAN 875

Figure 8-5 Frame Assembly - Front Right View
D-6601 Rev. A



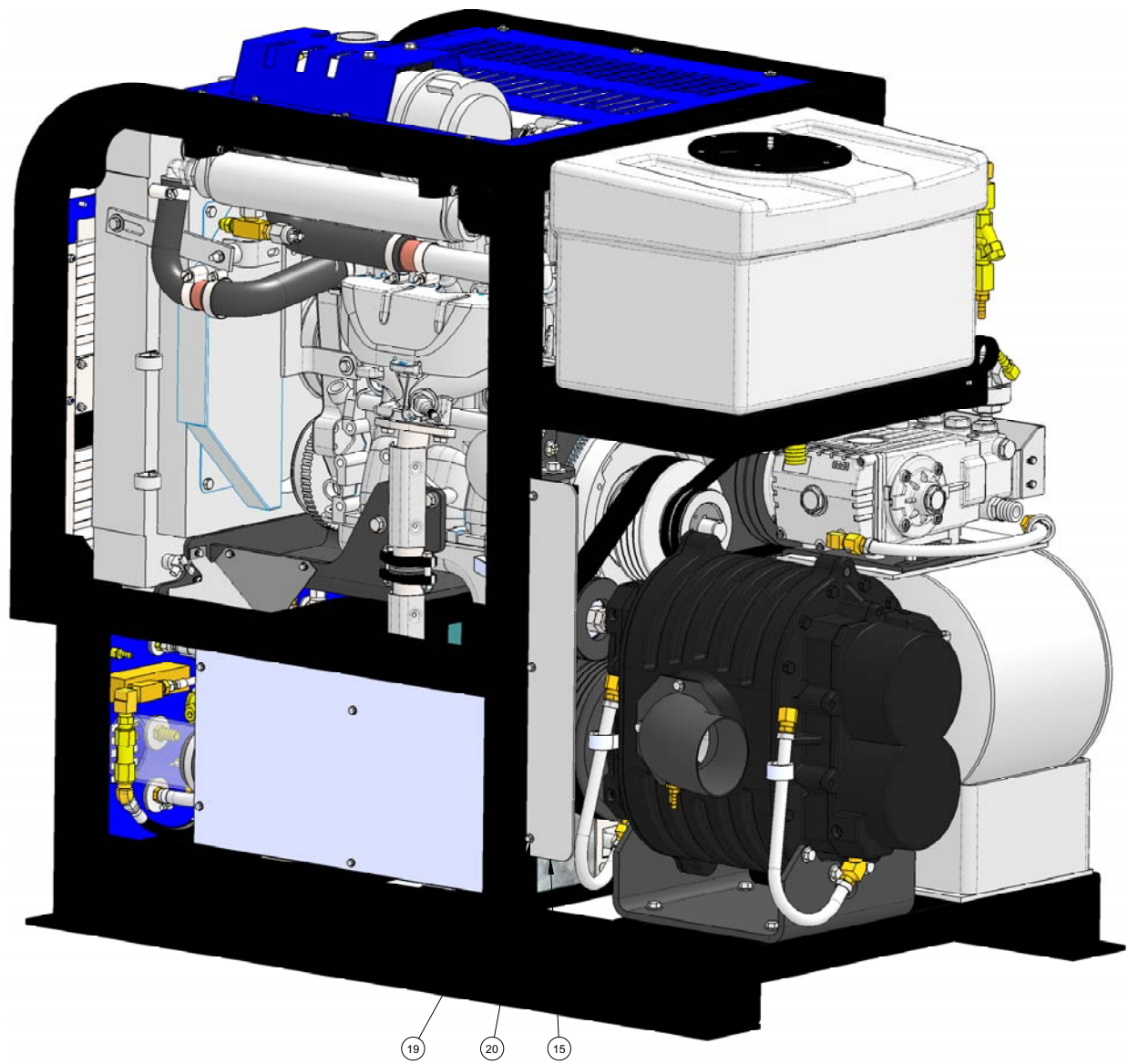
TITAN 875

Figure 8-6 Frame Assembly - Front Left View
D-6601 Rev. A



TITAN 875

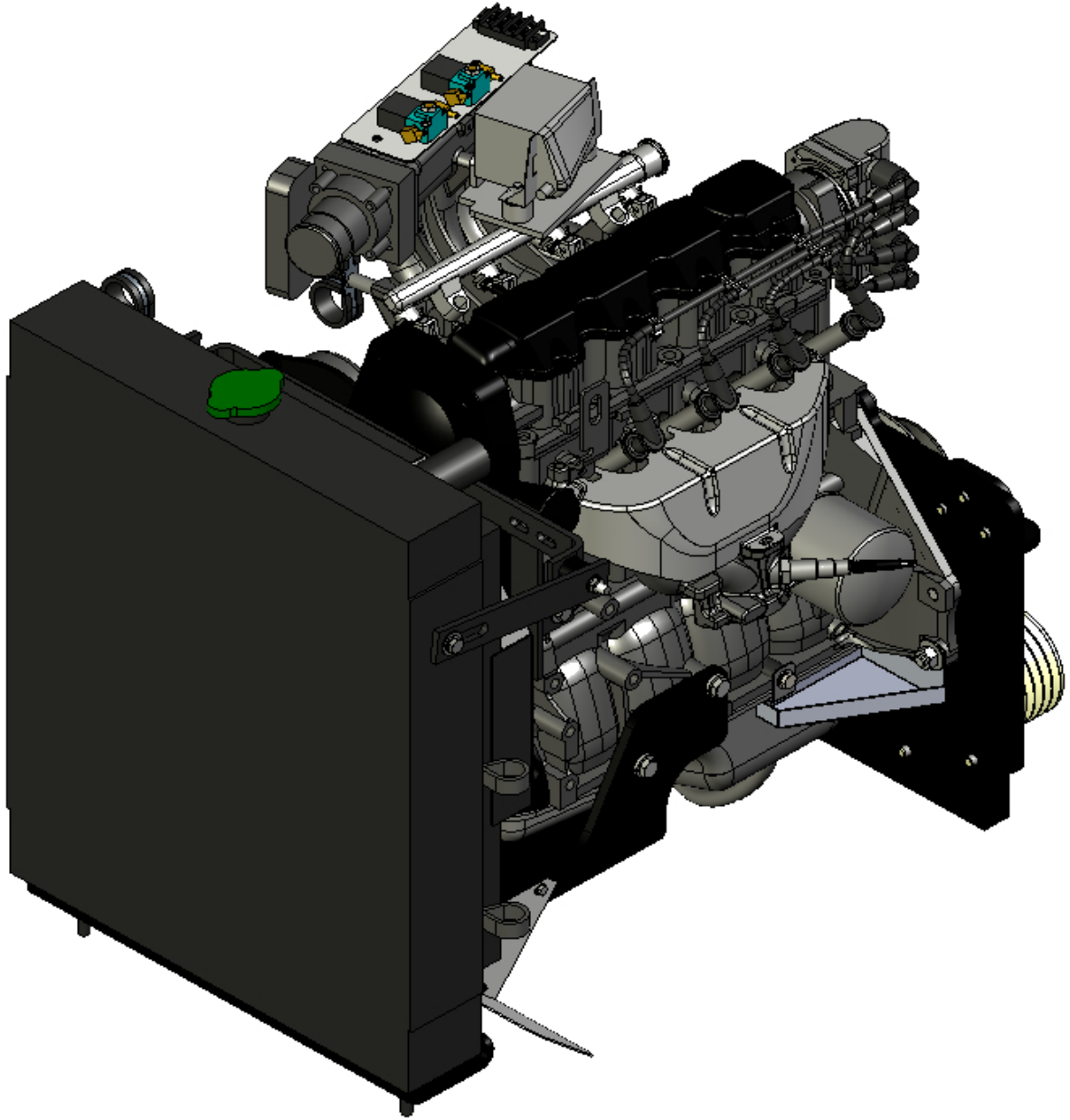
Figure 8-7 Frame Assembly - Back Right View
D-6601 Rev. A



Frame Assembly Parts List

Item	Part Number	Description	Qty
1	Fig. 8-8 - 8-10	Assembly, Engine	1
2	Fig. 8-14 - 8-15	Assembly, Blower	1
3	Fig. 8-17	Assembly, Pump & Silencer	1
4	Fig. 8-21	Assembly, Blower Heat Exchanger	1
5	Fig. 8-22	Assembly, Coolant Heat Exchanger	1
6	Fig. 8-20	Assembly, Exhaust	1
7	Fig. 8-38	Assembly, Top Cover - Machine	1
8	Fig. 8-33	Assembly, Upper Dash	1
9	Fig. 8-23 - 8-25	Assembly, Panel - Lower Instrument	1
10	Fig. 8-36	Assembly, Electrical Panel	1
11	Fig. 8-31	Assembly, Poly Water Box 8G	1
12	000-055-187	Frame, Titan - Weldment	1
13	Fig. 8-37	Assembly, Cover - Catalytic	1
14	000-154-157	Spacer, Machine Raising - 4" x 44"	2
15	000-108-150	Protector, Belt Guard	1
16	000-010-127	Belt, 3VX475 Super HC V	4
17	000-010-128	Belt, HD9330 Gates - Green Back	2
18	000-143-063	Screw, #10-24UNC x 0.75" Lg. Fh Phillips	6
19	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	6
20	000-155-053	Spring, 1/4" Belleville Washer	3
21	000-033-052	Clamp, 1-1/4" S/S EDPM	2
22	000-033-050	Clamp, 1-3/4" Cushion Loop	2
23	000-174-001	Washer, #10 Flat	3

Figure 8-8 Engine Assembly - Front View
D-6602 Rev. F



TITAN 875

Figure 8-9 Engine Assembly - Back Right View
D-6602 Rev. F

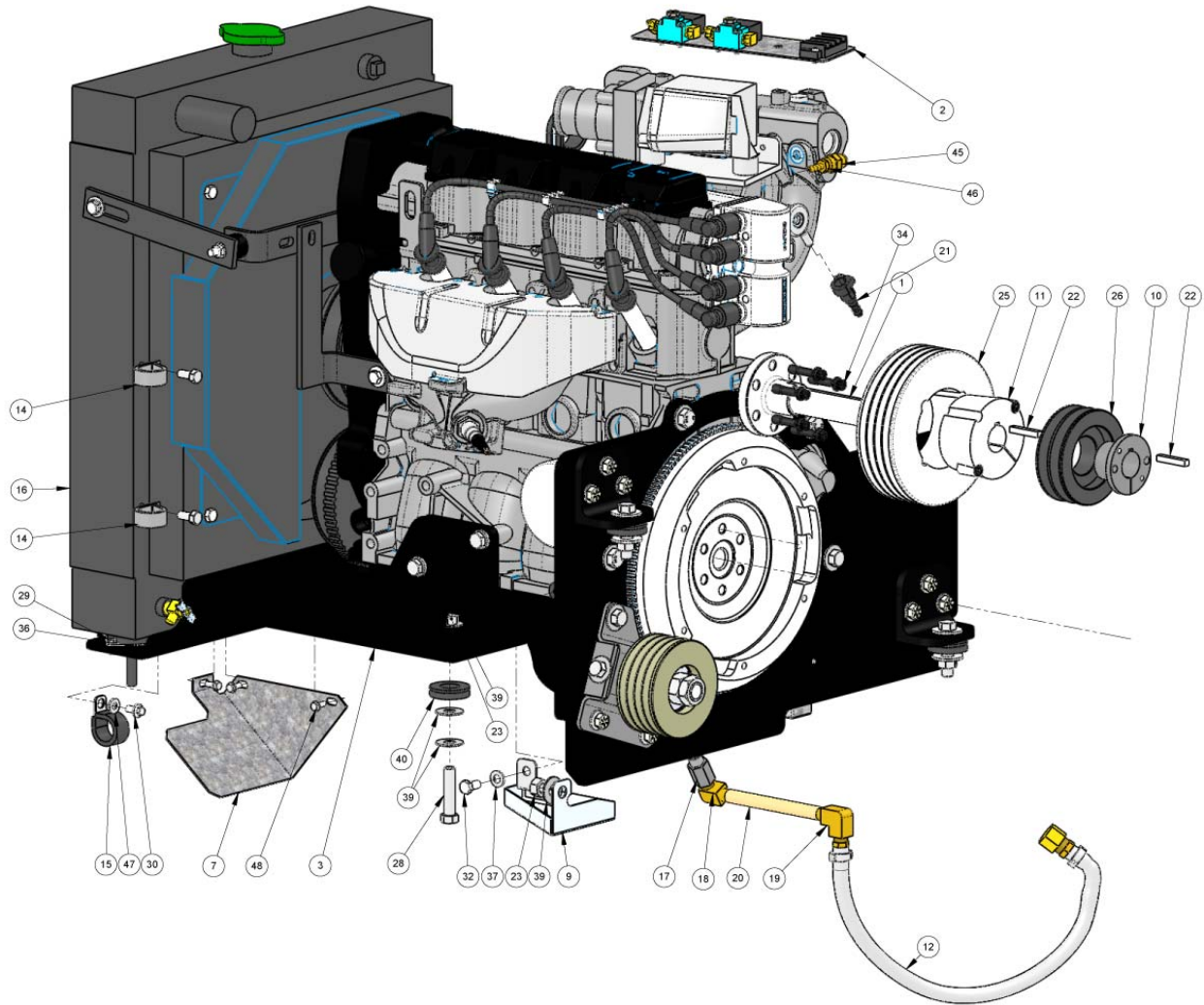


Figure 8-10 Engine Assembly - Back Left View
D-6602 Rev. F

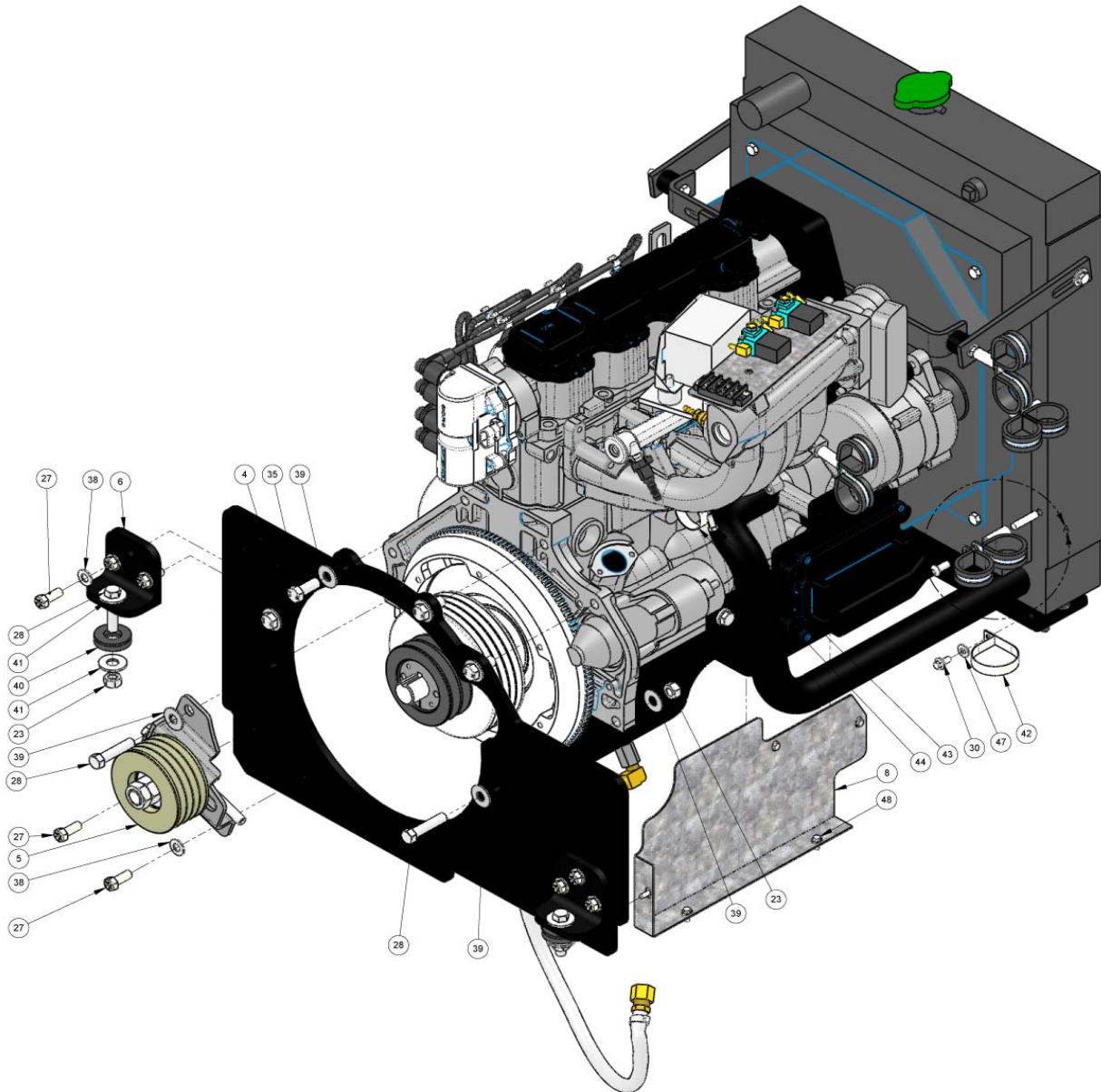
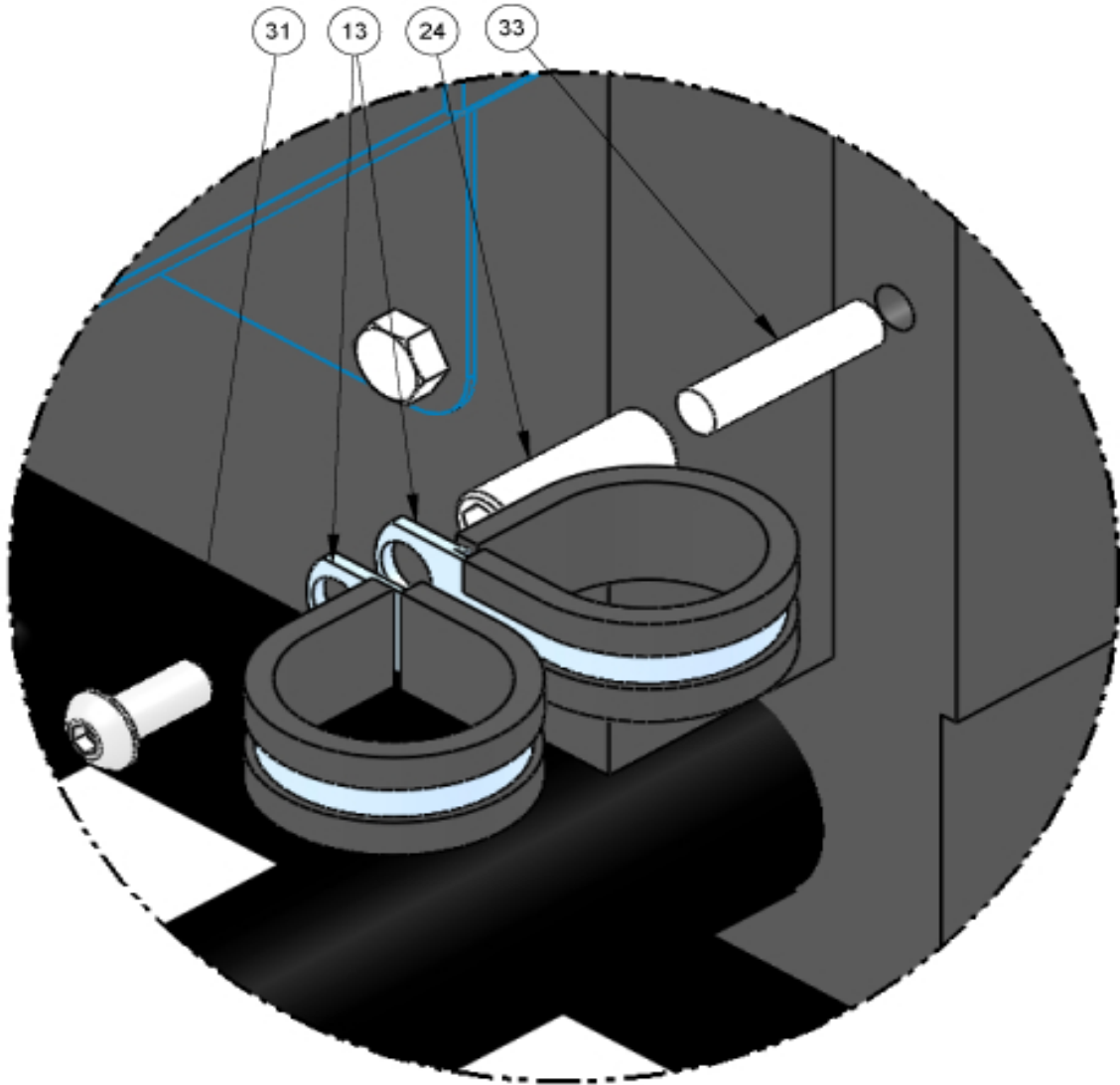


Figure 8-11 Engine Assembly - Back Left View - Detail
D-6602 Rev. F



DETAIL A
SCALE 1 : 1

Engine Assembly Parts List

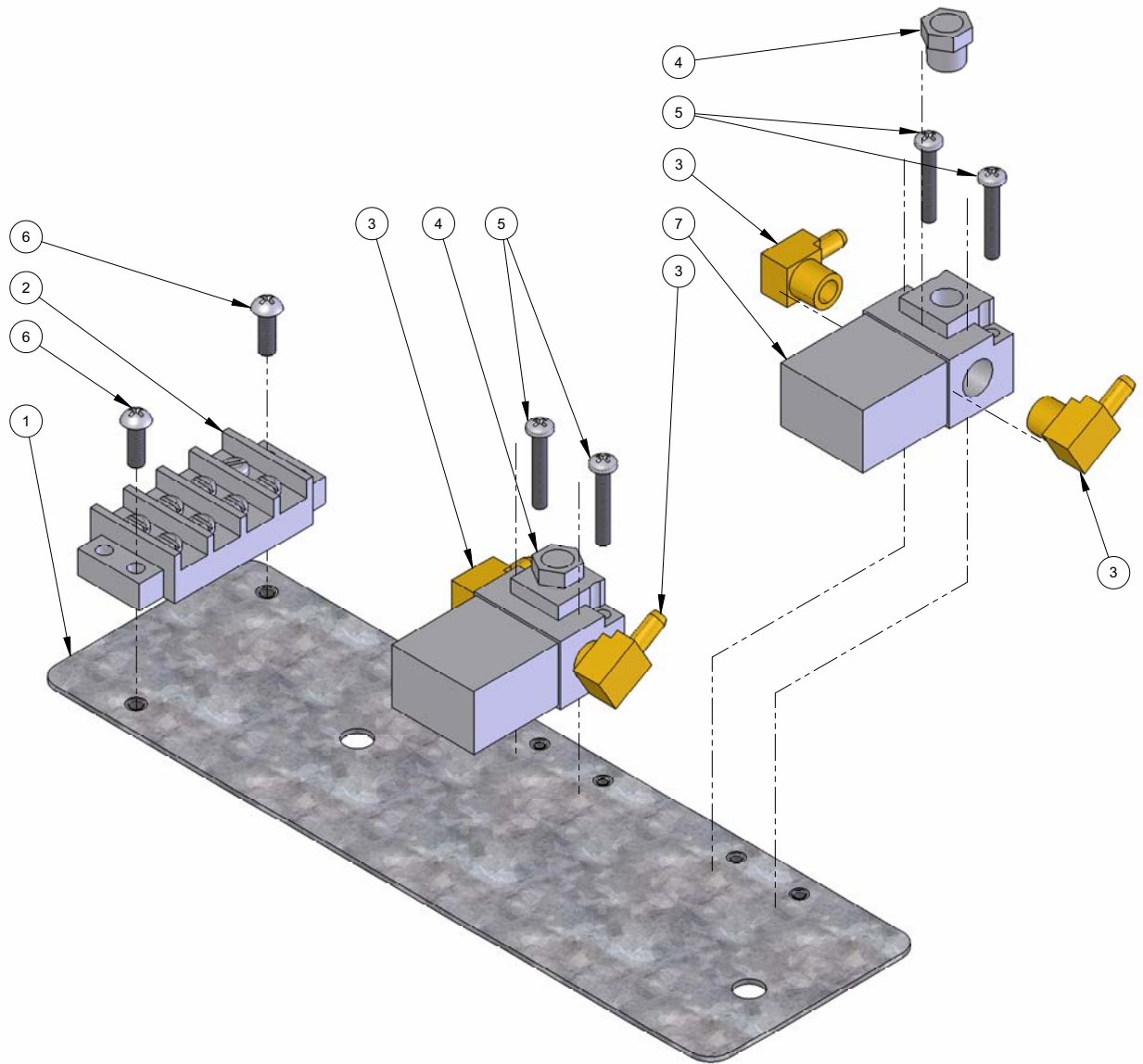
Item	Part Number	Description	Qty
1	000-150-161	Shaft, Stub	1
2	Fig. 8-12	Assembly, Solenoid	1
3	000-015-936	Bracket, Front Engine & Radiator Mount	1
4	000-015-935	Bracket, Engine - Rear Mount	1
5	Fig. 8-13	Assembly, Idler Pulley Tensioner	1
6	000-015-949	Bracket, Angle - Rear Engine Mount	2
7	000-108-148	Protector, Lower Panel	1
8	000-108-147	Protector, Electrical Panel	1
9	000-108-149	Protector, Oil Catch	1
10	000-020-055	Bushing, HQ 1-1/8	1
11	000-020-065	Bushing, Taper LOK Ø1-1/8" Bore	1
12	000-068-221	Hose, 3/8" x 24" Lg. Drain	1
13	000-033-116	Clamp, 1-1/2" Cushion Loop w/ 7/16" Mounting Hole	8
14	000-033-057	Clamp, 1" Cushion Loop	2
15	000-033-117	Clamp, 1" Cushion Loop w/ 7/16 Mount Hole	1
16	000-047-027	Engine, 1.6L Gm	1
17	000-052-063	Bushing, 14mm x 1/4" NPT Engine Oil Drain Adapter	1
18	000-052-085	Elbow, 1/4" NPT Street	1
19	000-052-088	Elbow, 1/4" FPT x FPT	1
20	000-052-767	Nipple, Extension 6"	1
21	000-052-770	Quick Connect, Fuel Straight Female	1
22	000-077-010	Key, 1/4" x 1-1/2" Lg.	2
23	000-094-018	Nut, 7/16"-14UNC Hex Z/P	5
24	000-094-104	Nut, Stacking, N-10 Clamping Unit	4
25	000-109-118	Pulley, 6-1/2" Quad Groove 3VX	1
26	000-109-120	Pulley, 4" Dual Groove AX	1
27	000-143-018	Screw, 3/8-16UNC x 1" Hex Head - Grade 8	8
28	000-143-587	Screw, 7/16"-14UNC x 2" Lg. Hex Head	5
29	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	4
30	000-143-141	Screw, 1/4"-20UNC x 1/2" Lg. Whiz Lock	2

Engine Assembly Parts List

Item	Part Number	Description	Qty
31	000-143-142	Screw, 5/16"-18UNC x 0.75" Lg. Bhcs	4
32	000-143-337	Screw, M8 x 1.25 x 16mm Lg. Hex Head s/s	1
33	000-143-199	Screw, Thread Adapter T-10, Clamping Unit	3
34	000-143-581	Screw, 9mm x 1.0 x 35mm (10.9)	6
35	000-143-582	Screw, 12mm x 30mm Hex Head 8.8	4
36	000-174-001	Washer, #10 Flat	4
37	000-174-004	Washer, 5/16" Flat	1
38	000-174-005	Washer, 3/8" Flat	8
39	000-174-006	Washer, 7/16" Flat	11
40	000-174-105	Washer, 1-1/16" I.D. SelfAligning Spherical 2 Pc Set	3
41	000-174-007	Washer, 1/2" Flat	4
42	000-033-067	Clamp, 2" Cushion Loop	1
43	000-143-221	Screw, M6-1 x 14mm Lg. Hex Head	1
44	000-033-053	Clamp, 1-1/2" Cushion Loop	1
45	000-052-778	Bushing, 3/8" SAE x 1/8" FPT	1
46	000-052-293	Insert, #23 (1/8" NPT x 3/16" Barb)	1
47	000-174-003	Washer, 1/4" Flat	2
48	000-143-587	Screw, 7/16-14 UNC x 2" Lg. Hex Head	2
49	000-143-583	Screw, #10-24UNC x 0.50" Lg. Hex Head Flange Z/P	8

Figure 8-12 Solenoid Assembly

C-6645 Rev. A



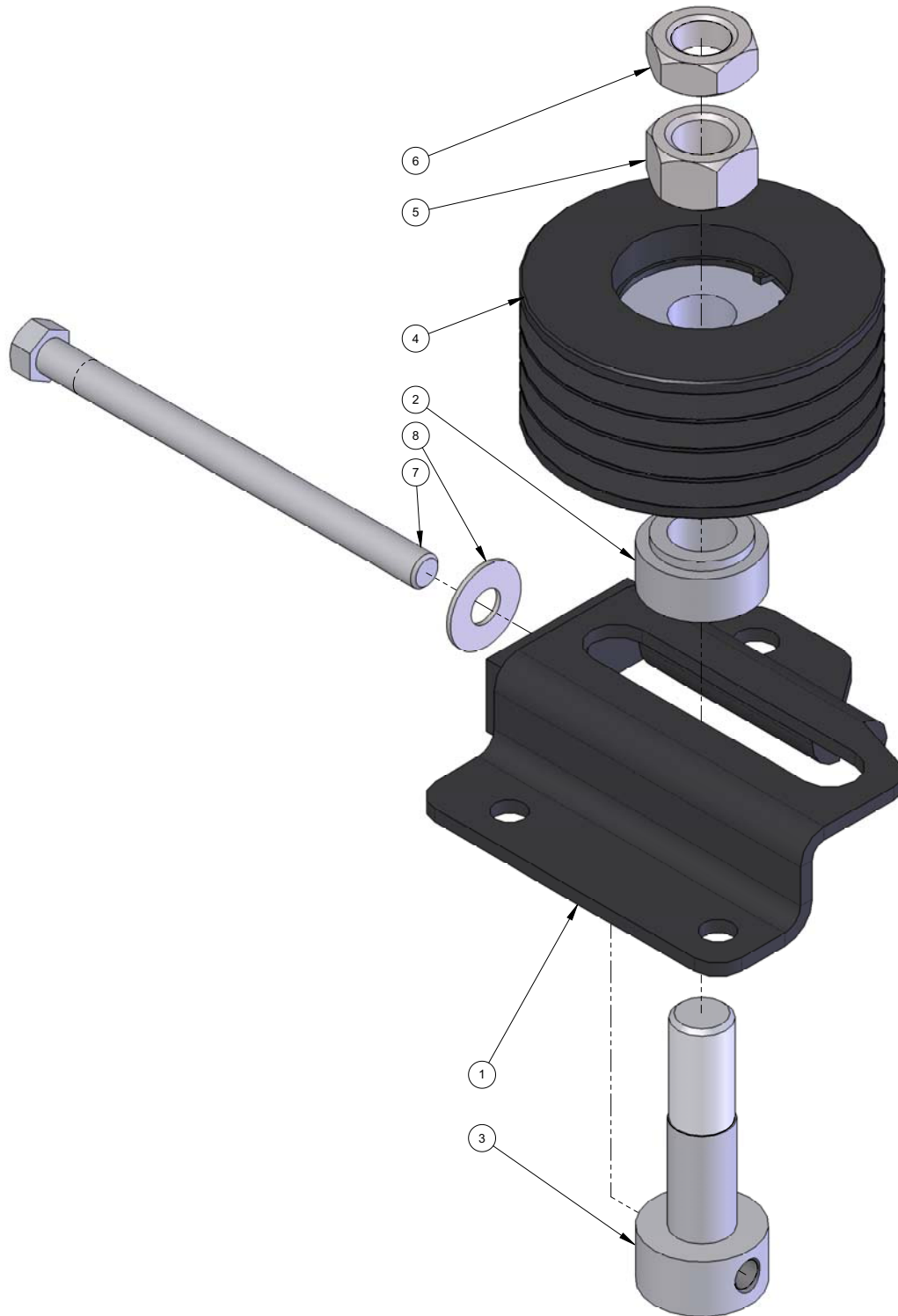
TITAN 875

Solenoid Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-945	Bracket, Solenoid Mount	1
2	000-012-001	Block, 4 Lead Electrical Terminal	1
3	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	4
4	000-106-014	Plug, Vent	2
5	000-143-047	Screw, #6-32 UNC x .875" Lg. PH Phillips	4
6	000-143-050	Screw, #8-32 Unc. x 0.50" Lg. PH Phillips	2
7	000-169-070	Valve, Primary Vac. Solenoid	2

Figure 8-13 Idler Pulley Tensioner Assembly

C-6660 Rev. -



Idler Pulley Tensioner Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-941	Bracket, Idler Pulley Tensioner	1
2	000-154-015	Spacer, Idler Pulley	1
3	000-150-011	Shaft, Idler Pulley	1
4	000-109-117	Pulley, Quad Groove 3VX Idler	1
5	000-094-105	Nut, 3/4"-16UNF Hex Zinc Plated	1
6	000-094-106	Nut, 3/4"-16UNF Hex Jam - Zinc Plated	1
7	000-143-554	Screw, 7/16-14 Unc. x 6.5" Lg. Ft Gr. 5	1
8	000-174-006	Washer, 7/16" Flat	1

Figure 8-14 Blower Assembly - Front View
D-6603 Rev. A

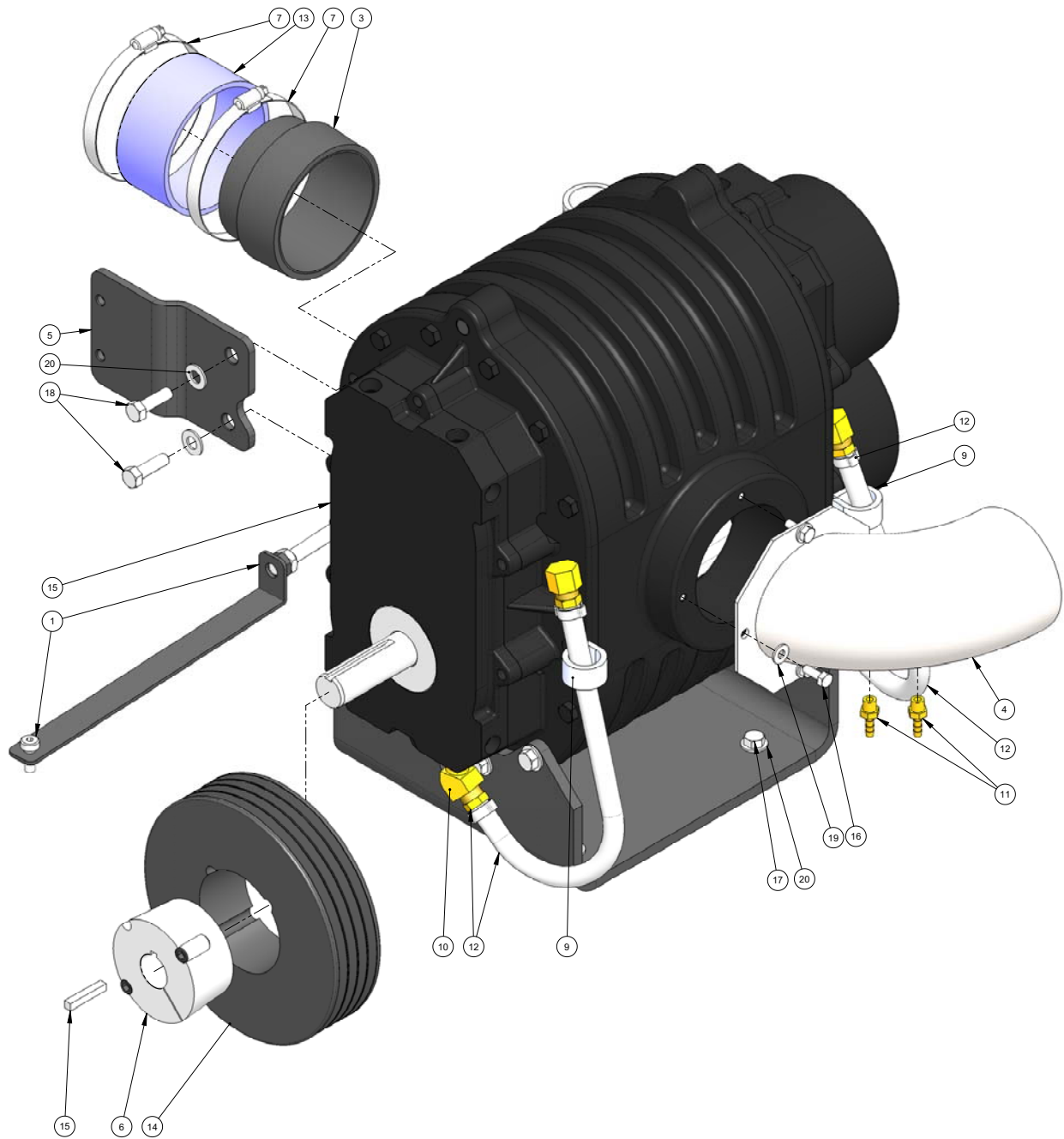
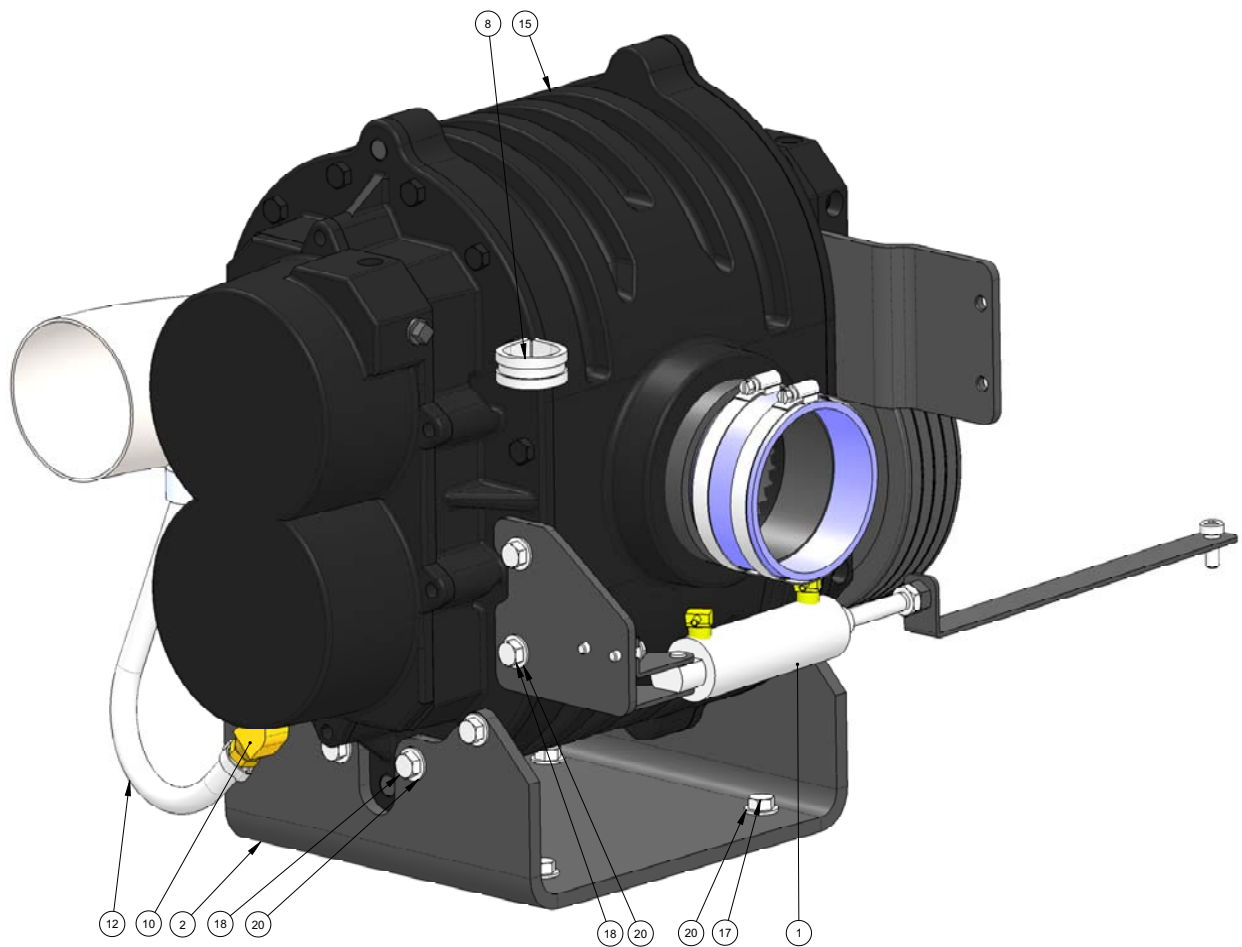


Figure 8-15 Blower Assembly - Back View
D-6603 Rev. A

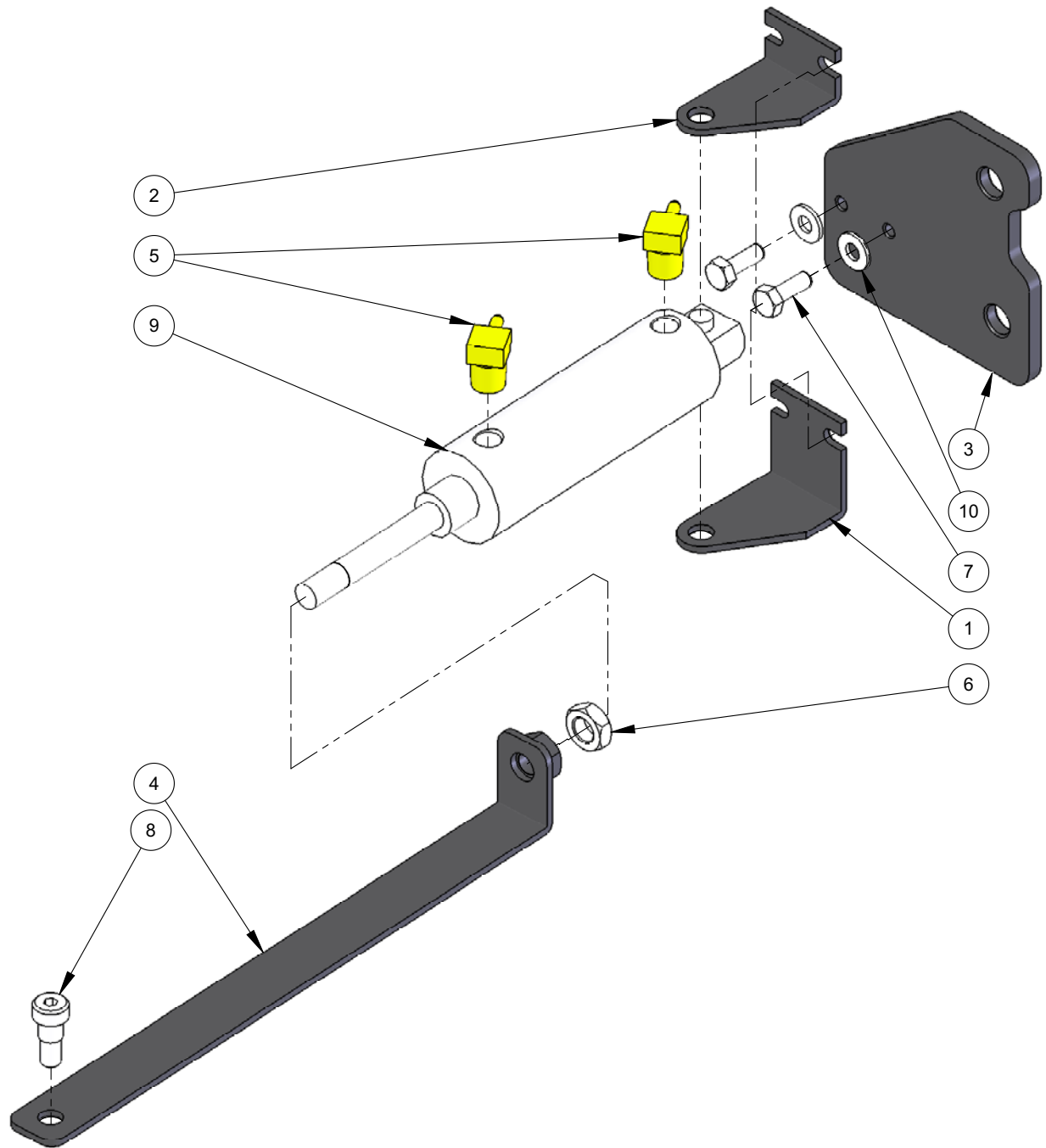


Blower Assembly Parts List

Item	Part Number	Description	Qty
1	Fig. 8-16	Assembly, Air Actuator	1
2	000-015-937	Bracket, Blower Mount	1
3	000-001-139	Adapter, 4" NPT To Slip Connection	1
4	000-001-147	Adapter, 4" Blower	1
5	000-015-958	Bracket, Blower To Silencer	1
6	000-020-065	Bushing, Taper LOK Ø1-1/8" Bore	1
7	000-033-015	Clamp, 4" Hose	2
8	000-033-116	Clamp, 1-1/2" Cushion Loop w/ 7/16" Mounting Hole	1
9	000-033-117	Clamp, 1" Cushion Loop w/ 7/16 Mount Hole	2
10	000-052-083	Elbow, 3/8" NPT Street x 45°	2
11	000-052-293	Insert, #23 (1/8" NPT x 3/16" Barb)	2
12	000-068-219	Hose, Pump Drain	2
13	000-068-778	Hose, 4" I.D. 3-Ply Silicone	1
14	000-109-119	Pulley, 8" Quad Grove 3VX	1
15	000-111-181	Blower, 5009	1
16	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	3
17	000-143-017	Screw, 3/8"-16UNC x 0.75" Lg. Hex Head Grd. 8	4
18	000-143-025	Screw, 3/8"-16Unc. x 1.25" Lg. Hex Head Gr. 8	12
19	000-174-003	Washer, 1/4" Flat	3
20	000-174-005	Washer, 3/8" Flat	16

Figure 8-16 Air Actuator Assembly

C-6608 Rev. -

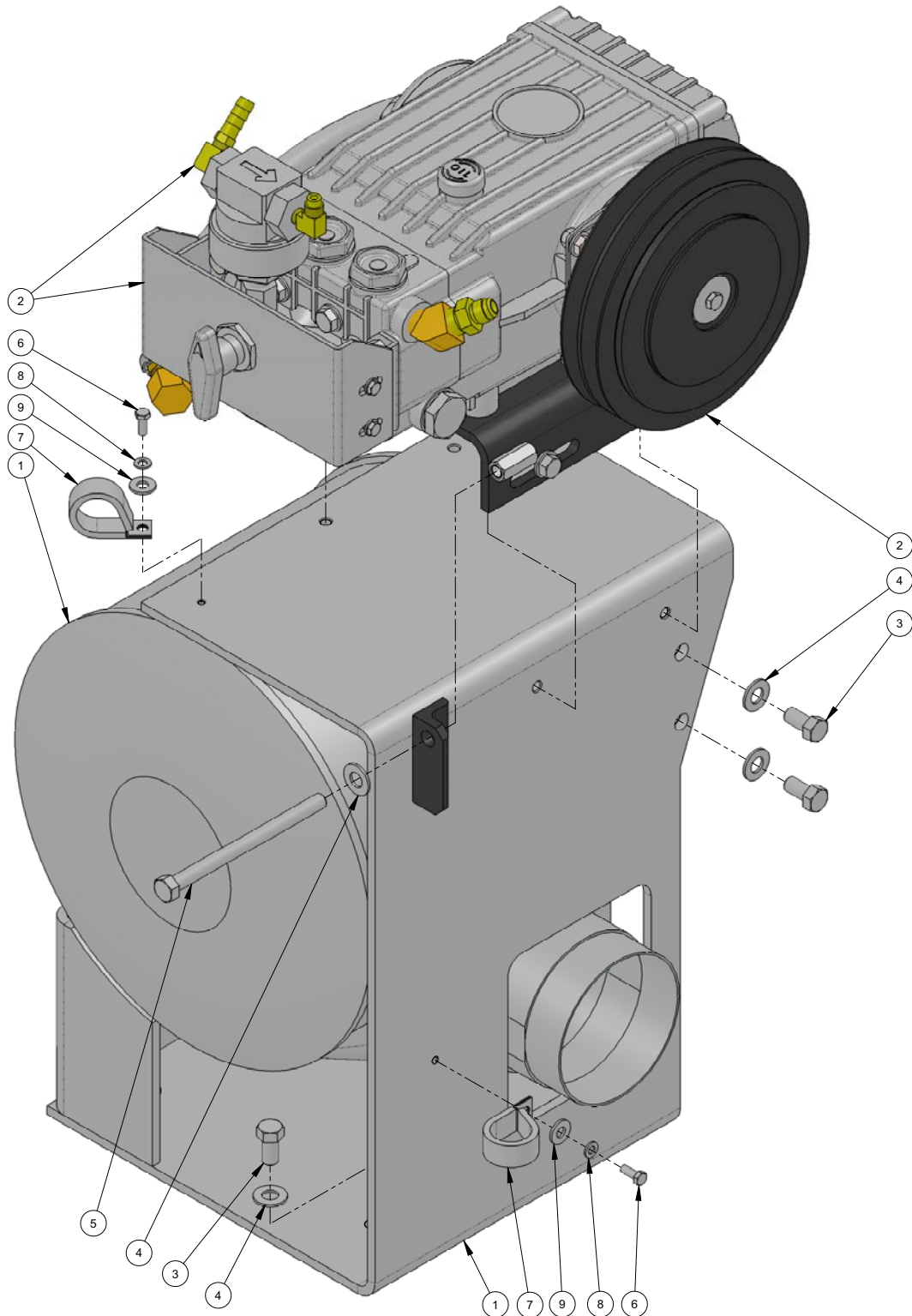


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Air Actuator Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-748	Bracket, Air Cylinder Mount - Outer	1
2	000-015-750	Bracket, Air Cylinder Mount - Inner	1
3	000-015-953	Bracket, Actuator Mount	1
4	000-015-954	Bracket, Actuator Extension	1
5	000-052-550	Elbow, 1/8" NPT x 3/16" Barb	2
6	000-094-092	Nut, 7/16"-20UNF Hex Jam	1
7	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	2
8	000-143-573	Screw, 5/16-18 x 1 Socket Head - Shoulder 3/8" Dia x 3/	1
9	000-169-169	Valve, Air Cylinder	1
10	000-174-003	Washer, 1/4" Flat	2

Figure 8-17 Pump & Silencer Assembly
D-6604 Rev. A



Pump & Silencer Assembly Parts List

Item	Part Number	Description	Qty
1	000-093-105	Silencer, 4' Slip Connection - Weldment	1
2	Fig. 8-18 - 8-19	Assembly, Pump	1
3	000-143-017	Screw, 3/8"-16UNC x 0.75" Lg. Hex Head Grd. 8	6
4	000-174-005	Washer, 3/8" Flat	7
5	000-143-024	Screw, 3/8"-16UNC x 5" Lg. Hex Head Tap	1
6	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	2
7	000-033-057	Clamp, 1" Cushion Loop	2
8	000-174-001	Washer, #10 Flat	2
9	000-174-003	Washer, 1/4" Flat	2

Figure 8-18 Pump Assembly - Back View
D-6618 Rev. C

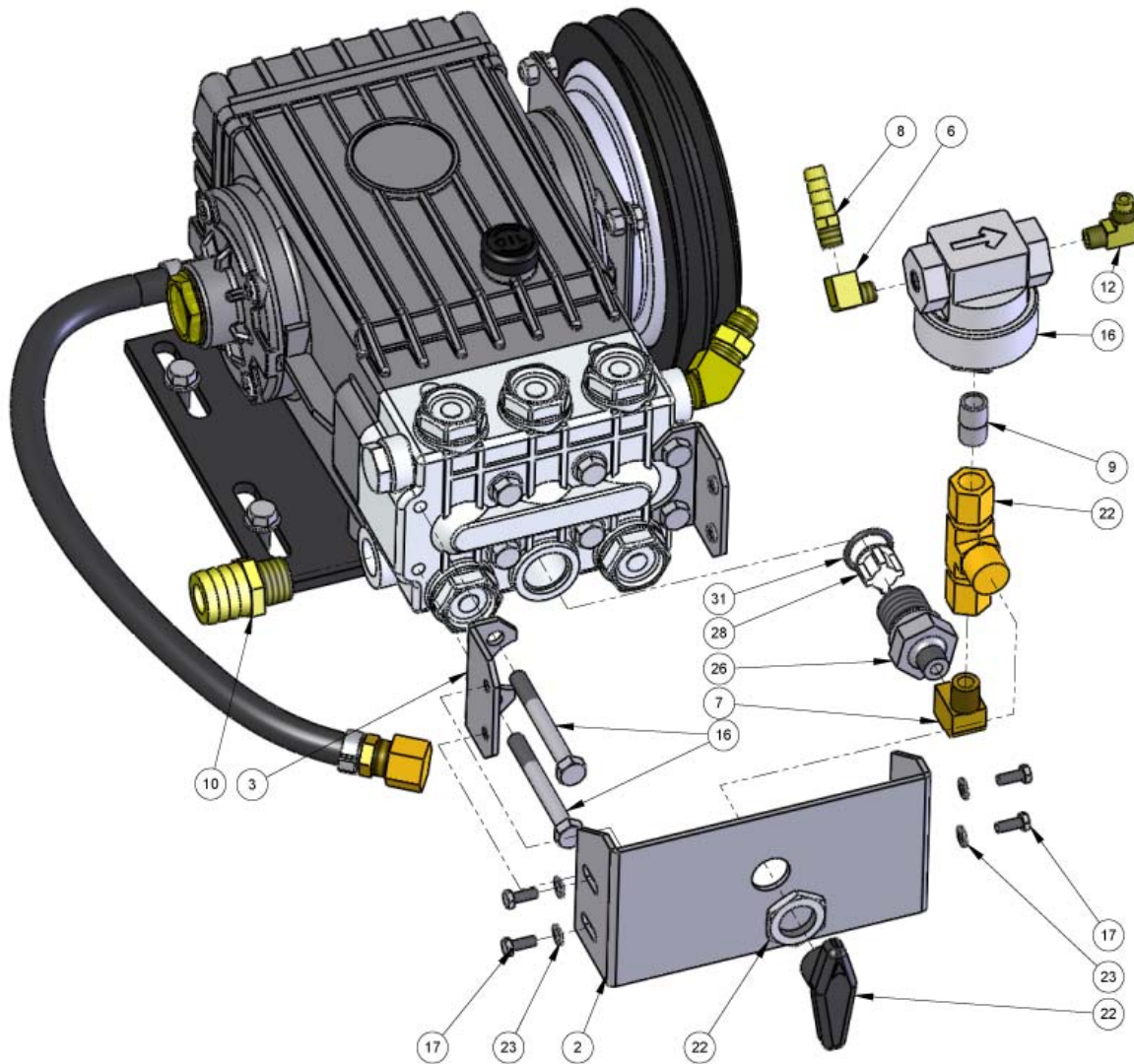
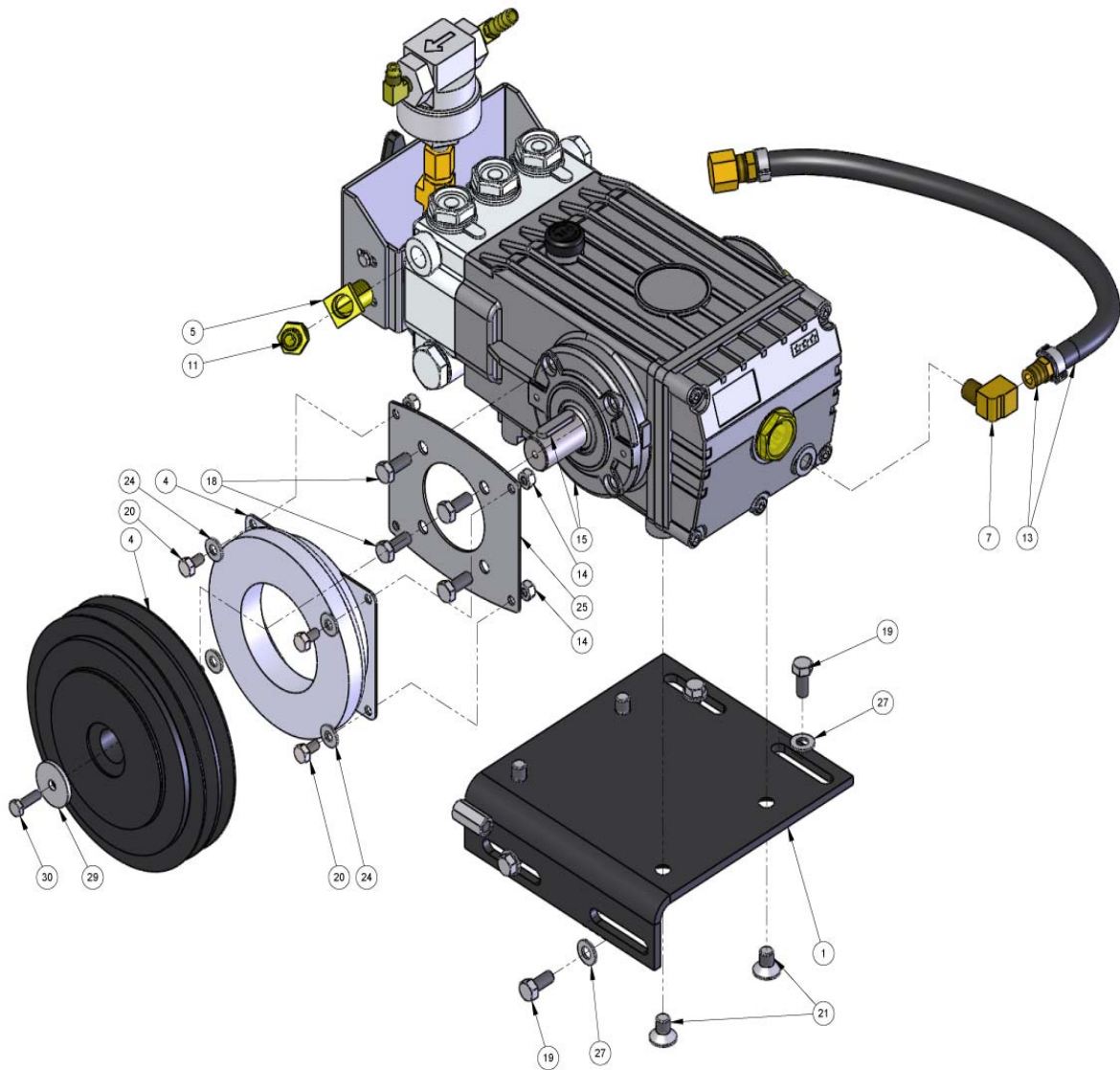


Figure 8-19 Pump Assembly - Front View
D-6618 Rev. C

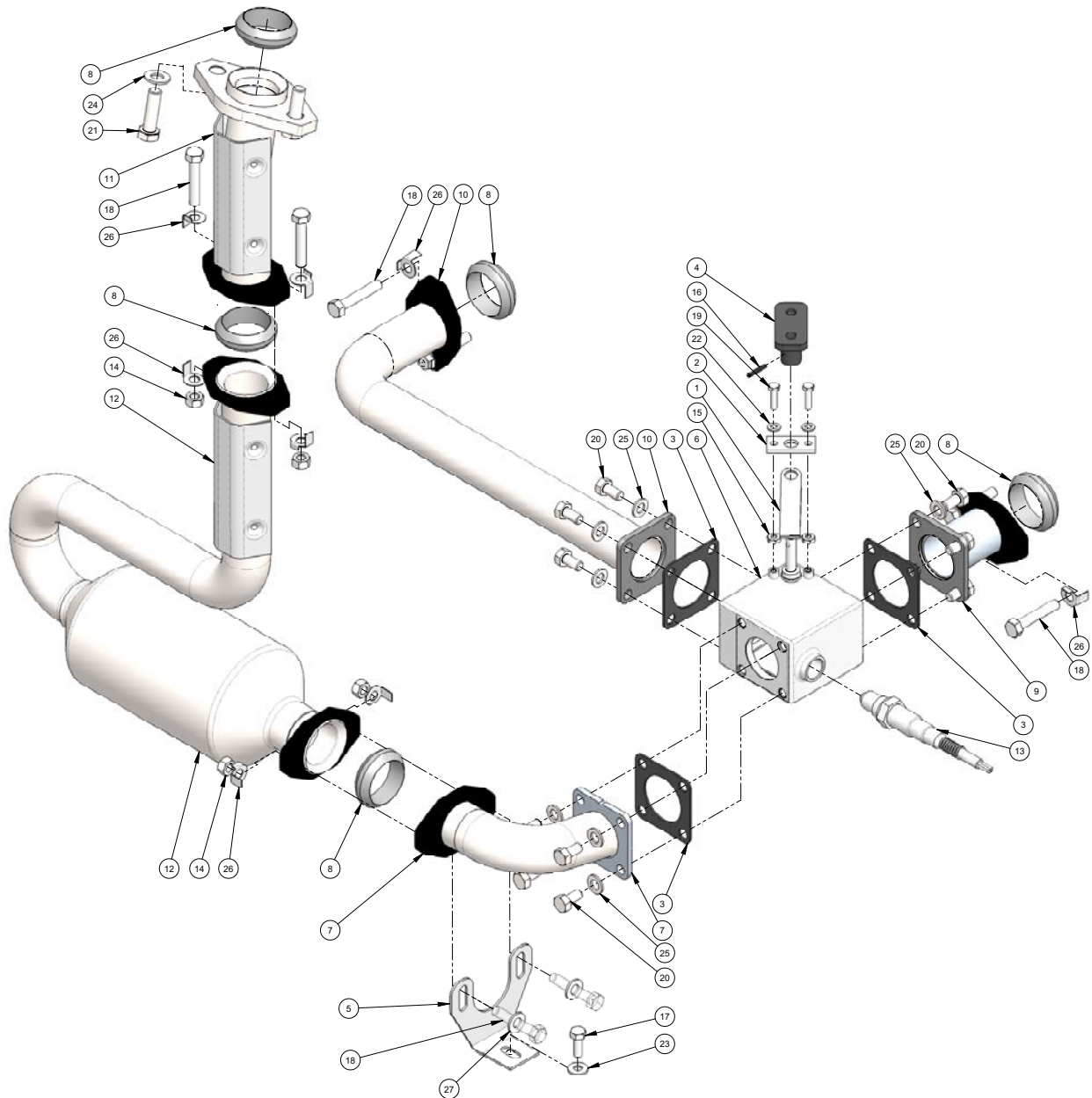


Pump Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-955	Bracket, Pump Mount - Weldment	1
2	000-015-957	Bracket, Chem Pump Main Support	1
3	000-015-956	Bracket, Chem Pump Mount	2
4	000-036-009	Clutch, Pump - 24mm Dual Groove	1
5	000-052-083	Elbow, 3/8" NPT Street x 45°	1
6	000-052-084	Elbow, 1/8" NPT Street	1
7	000-052-085	Elbow, 1/4" NPT Street	2
8	000-052-099	Insert, #26 (1/8" NPT x 3/8" Barb)	1
9	000-052-517	Nipple, 1/4" NPT Close	1
10	000-052-753	Insert, #816 (1/2" NPT x 1" Barb)	1
11	000-052-528	Nipple, 3/8" M JIC x 3/8" NPT	1
12	000-052-531	Elbow, 1/4" SAE x 1/8" NPT	1
13	000-068-794	Hose, 17" Lg. - Pump Drain	1
14	000-094-071	Nut, 1/4"-20UNC Nylock	4
15	000-111-183	Pump, General	1
16	000-111-184	Pump, GP Chemical	1
17	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	4
18	000-143-185	Screw, 8mm x 20mm Gr. 8.8 Hex Head	4
19	000-143-242	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head Grade 5	4
20	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	4
21	000-143-586	Screw, 10mm x 1.5 x 16mm Socket Flat Head	4
22	000-169-176	Valve, 2 Way Chem Pump	1
23	000-174-001	Washer, #10 Flat	4
24	000-174-003	Washer, 1/4" Flat	4
25	000-105-541	Plate, GP Clutch Mount	1
26	000-001-151	Adapter, Gp To Chem Pump s/s	1
27	000-174-004	Washer, 5/16" Flat	4
28	000-169-212	Valve, GP Pump Check - Modified	1
29	000-174-171	Washer, Ø1.25" x Ø0.285" I.D. x 0.125" Thk.	1
30	000-143-588	Screw, 6mm x 20mm x 0.75 Hex Head	1
31	000-097-057	O-Ring, Adapter - Chemical Pump	1

Figure 8-20 Exhaust Assembly

D-6607 Rev. A

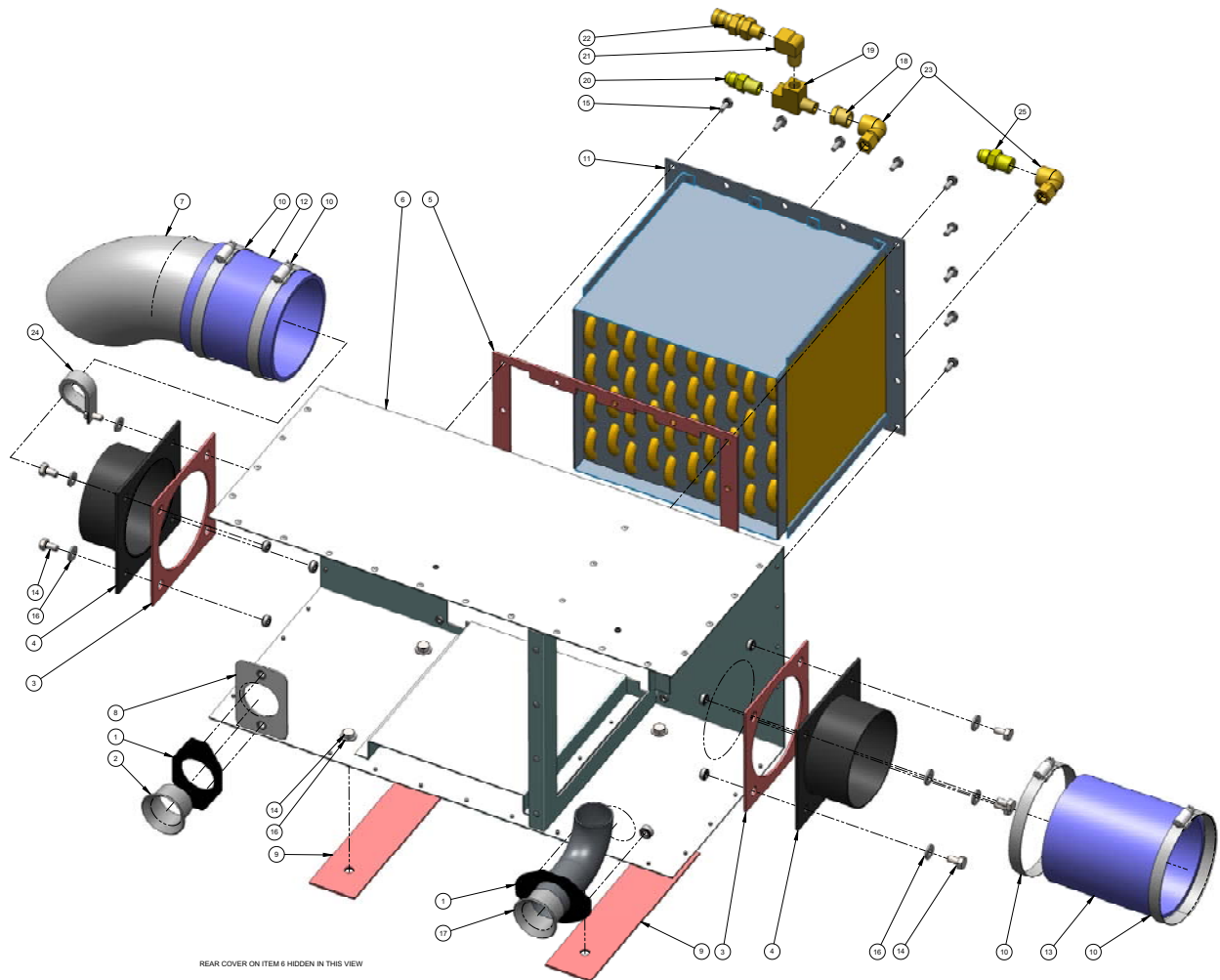


Exhaust Assembly Parts List

Item	Part Number	Description	Qty
1	000-155-030	Spring, Leaf	1
2	000-138-010	Retainer, Leaf Spring	1
3	000-057-146	Gasket, Four Hole Exhaust Diverter	3
4	000-015-631	Bracket, Air Cylinder Actuation	1
5	000-015-725	Bracket, Exhaust Support	1
6	000-169-045	Valve, Cast Exhaust Diverter	1
7	000-125-208	Tube, Diverter Inlet - Welded	1
8	000-057-199	Gasket, Exhaust Donut	5
9	000-001-142	Adapter, Exhaust 2-1/2" w/ Fixed Flange & Donut Seat - Wel	1
10	000-001-144	Adapter, Exhaust 90° Elbow w/ Fixed Flange & Donut Seat	1
11	000-001-143	Adapter, Exhaust 7.5" w/ Custom Fixed Flange & Donut Seat	1
12	000-093-110	Catalytic - Weldment	1
13	---	Sensor, O2 - GM 1.6L Engine	1
14	000-094-012	Nut, 5/16-18"UNC Hex	4
15	000-094-027	Nut, #10-24UNC Hex	2
16	000-103-014	Pin, 1/8" x 3/4" Long - Spring	1
17	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	1
18	000-143-124	Screw, 5/16"-18UNC x 1.75" Lg. Hex Head	8
19	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2
20	000-143-572	Screw, 5/16-18 Unc. x 5/8" Lg. Grd. 5 Hh	12
21	000-143-584	Screw, 10mm x 35mm Hex Head	2
22	000-174-001	Washer, #10 Flat	2
23	000-174-003	Washer, 1/4" Flat	1
24	000-174-005	Washer, 3/8" Flat	2
25	000-174-069	Washer, 5/16" Inconel Belleville	12
26	000-174-166	Washer, 5/16" Tab	10
27	000-174-049	Washer, 5/16" Flat	2

Figure 8-21 Blower Heat Exchanger Assembly

D-6605 Rev. E

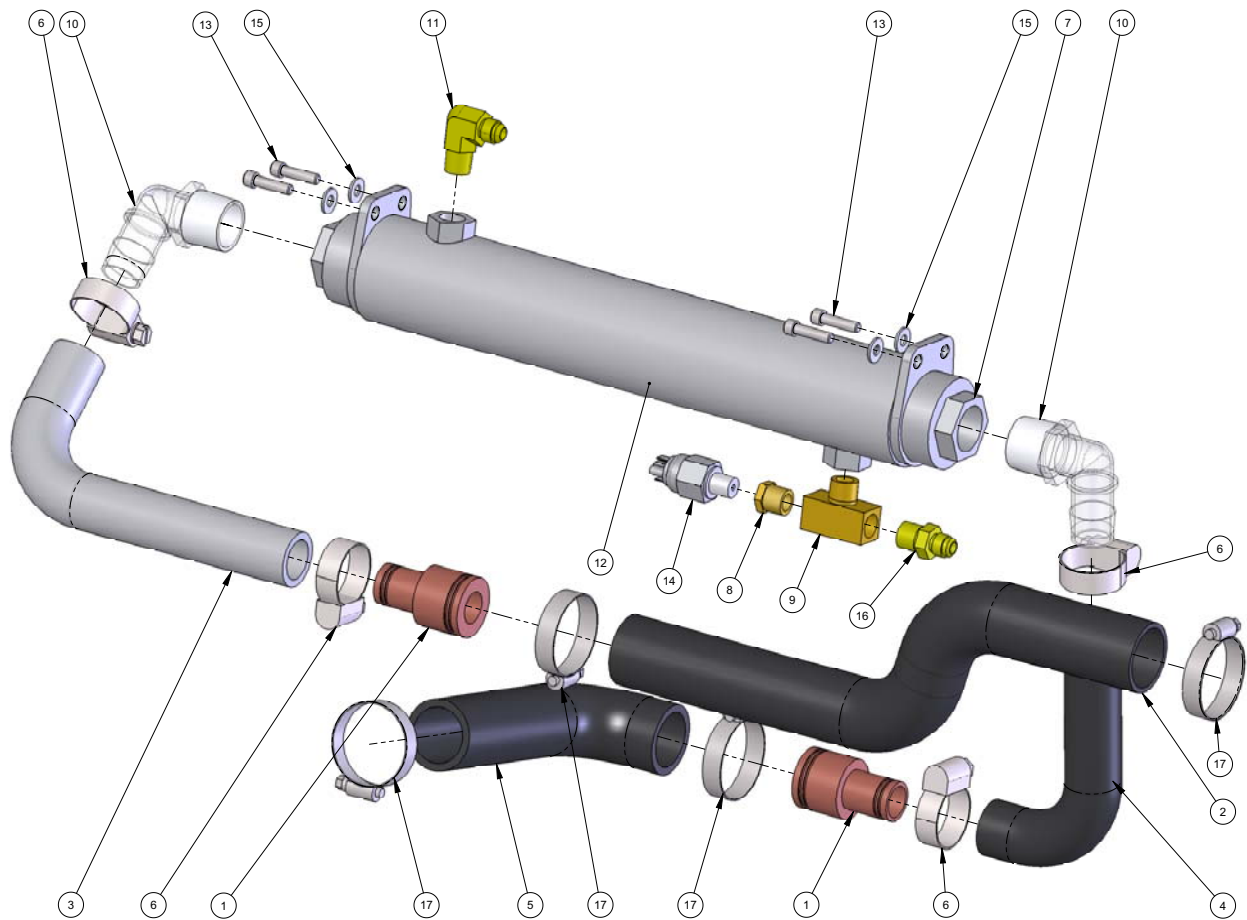


Blower Heat Exchanger Assembly Parts List

Item	Part Number	Description	Qty
1	000-105-177	Flange, 1.50" Exhaust Donut	2
2	000-125-120	Tube, Flange Donut End	1
3	000-057-210	Gasket, 4" Exhaust	2
4	000-001-133	Adapter, Tank To 4.0" Blower Hose	2
5	000-131-015	Gasket, Heat Exchanger Core	1
6	000-013-071	Box, Heat Exchanger Inlet & Outlet Plenum	1
7	000-125-240	Elbow, 4" O.D. w/ 2" Tangent x 75°	1
8	000-057-211	Gasket, Heat Exchanger Plenum	1
9	000-057-215	Gasket, Heat Exchanger Plenum - Silicone	2
10	000-033-015	Clamp, 4" Hose	4
11	000-038-073	Core, Heat Exchanger 8" x 8"	1
12	000-068-778	Hose, 4" I.D. x 3 Ply Silicone	1
13	000-068-778	Hose, 4" I.D. x 3 Ply Silicone	1
14	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	12
15	000-143-583	Screw, #10-24UNC x 0.50" Lg. Hex Head Flange Z/P	16
16	000-174-003	Washer, 1/4" Flat	12
17	000-125-234	Tube, Inlet Plenum - Weldment	1
18	000-052-061	Bushing, 3/8" NPT x 1/4" FPT	1
19	000-052-090	Tee, 1/4" NPT Branch M-F-F	1
20	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	1
21	000-052-085	Elbow, 1/4" NPT Street	1
22	000-169-050	Valve, High Pressure Safety (2200)	1
23	---	Elbow, 3/8" FPT x 3/8" Compression (Comes w/ Hx)	2
24	000-033-057	Clamp, 1" Cushion Loop	1
25	000-052-528	Nipple, 3/8" M JIC x 3/8" NPT	1

Figure 8-22 Coolant Heat Exchanger Assembly

D-6606 Rev. B



Coolant Heat Exchanger Assembly Parts List

Item	Part Number	Description	Qty
1	000-001-150	Adapter, Ø1" x Ø1.5"	2
2	000-068-783	Hose, 'S' 1-1/2" I.D.	1
3	000-068-796	Hose, 1" I.D. Coolant - Modified One End	1
4	000-068-797	Hose, 1" I.D. Coolant - Modified Both Ends	1
5	000-068-798	Hose, Coolant - Engine Modified	1
6	000-033-020	Clamp, Size #16 Hose	4
7	000-038-043	Heat Exchanger, Water To Water	1
8	000-052-061	Bushing, 3/8" NPT x 1/4" FPT	1
9	000-052-447	Tee, 3/8" Male Branch	1
10	000-052-131	Elbow, 1"NPT x 1" Barb(Glass Filled Black Nylon)	2
11	000-052-766	Elbow, 3/8 NPT x 3/8 JIC	1
12	000-108-134	Protector, Coolant HX Grey Silicone Blanket	1
13	000-143-080	Screw, 1/4"-20UNC x 1.00" Lg. Socket Head	4
14	000-157-154	Switch, Pressure - 1200Psi N/O	1
15	000-174-003	Washer, 1/4" Flat	4
16	000-052-528	Nipple, 3/8" M JIC x 3/8" NPT	1
17	000-033-009	Clamp, Size #24 Hose	4

Figure 8-23 Panel, Lower Instrument Assembly - Front View
D-6612 Rev. B

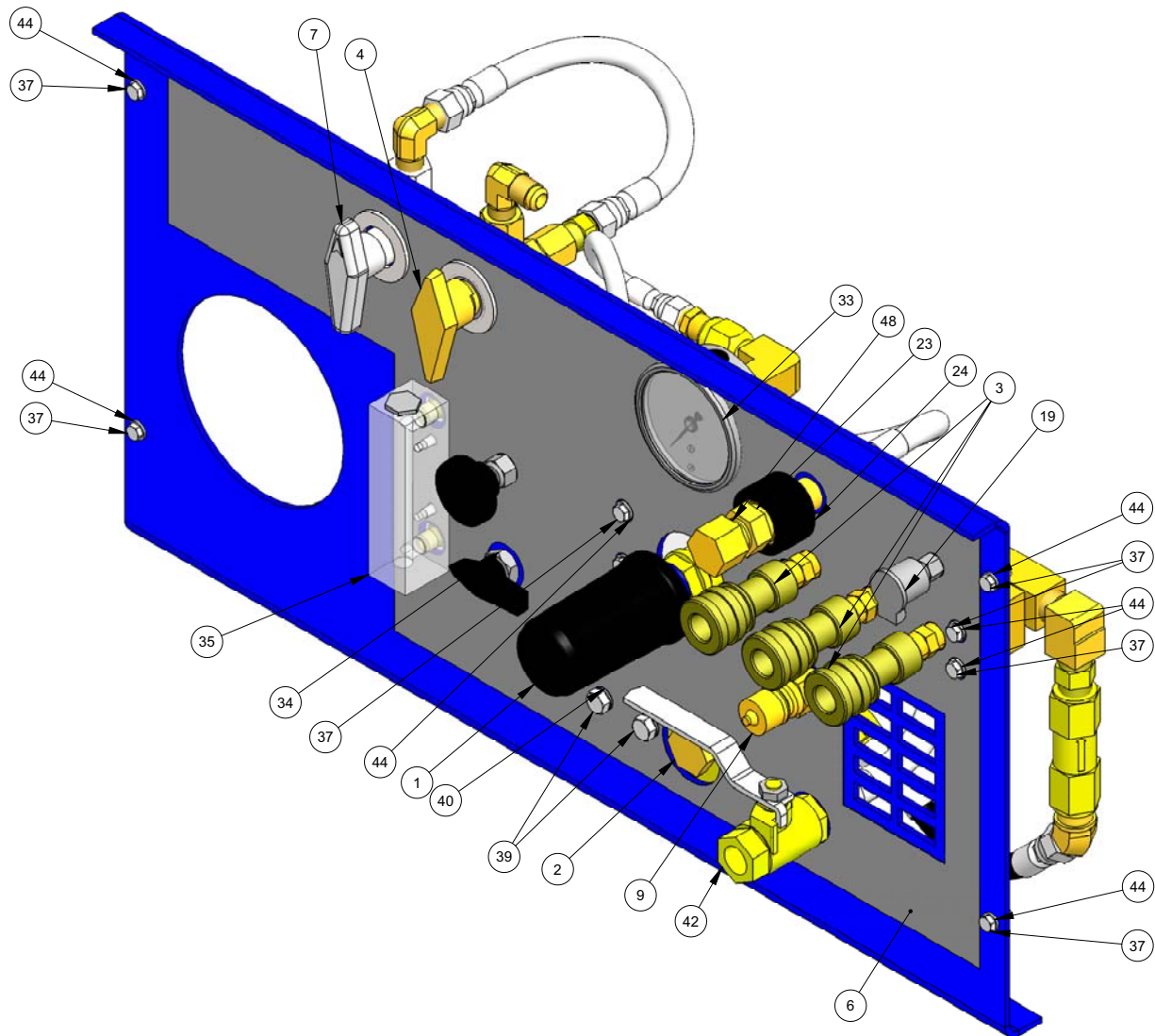


Figure 8-24 Panel, Lower Instrument Assembly - Back Left View
D-6612 Rev. B

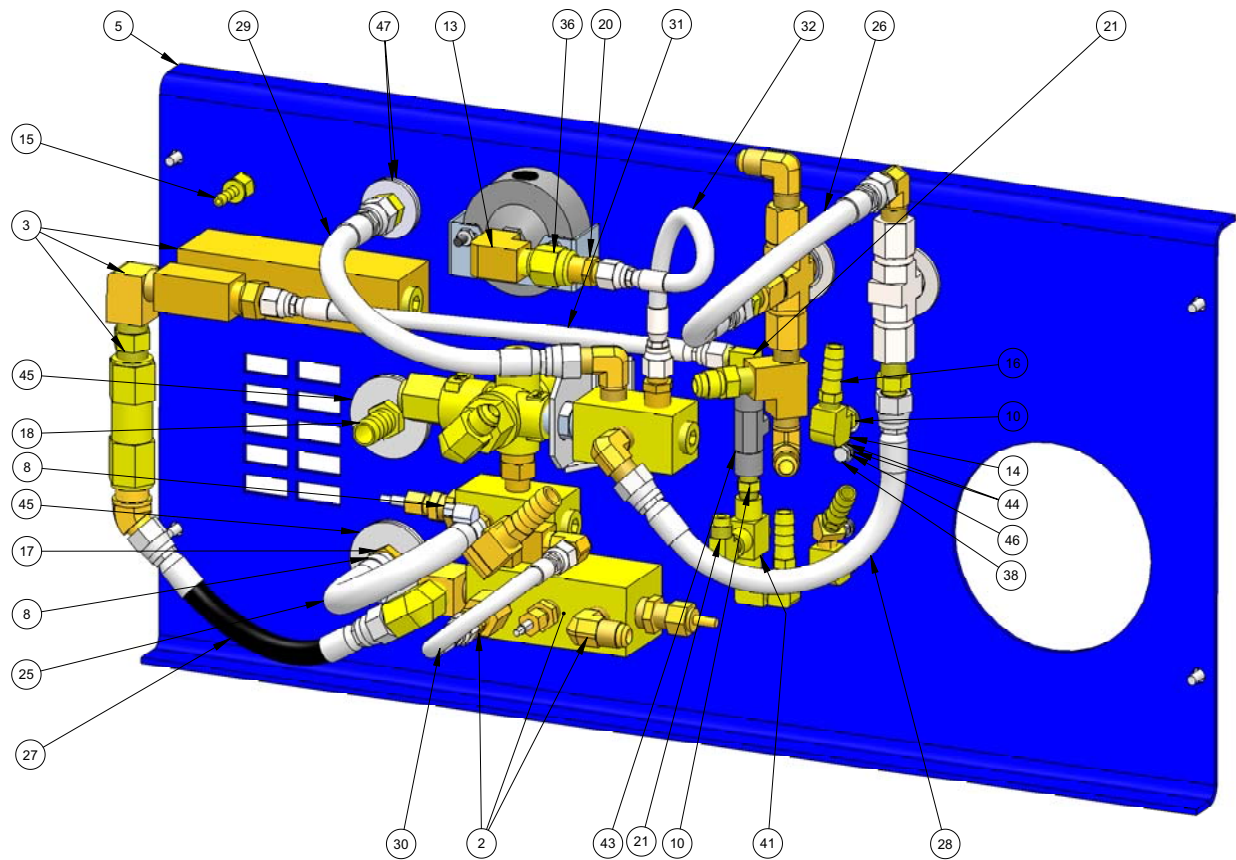
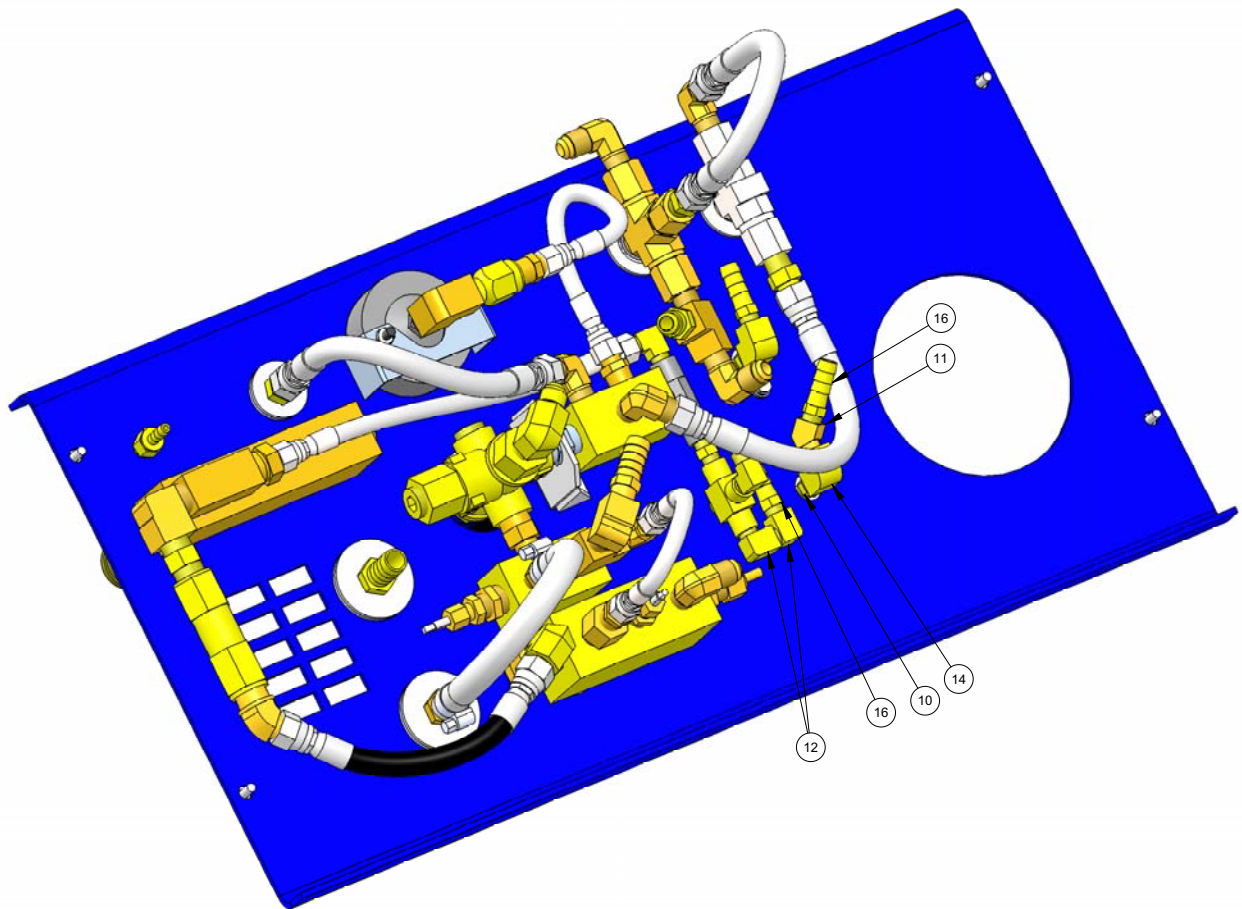


Figure 8-25 Panel, Lower Instrument Assembly - Back Right View
D-6612 Rev. B



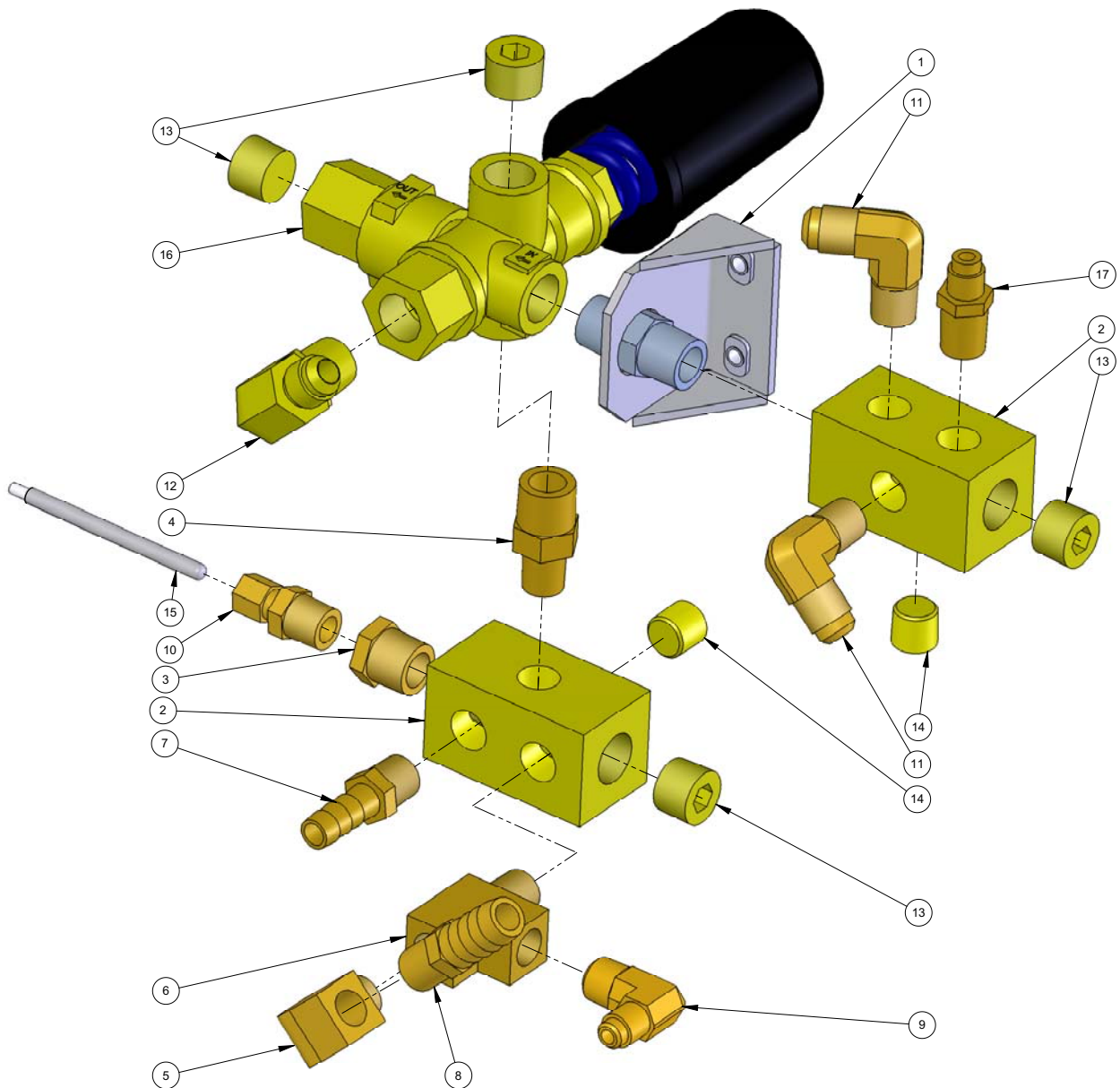
Panel, Lower Instrument Assembly Parts List

Item	Part Number	Description	Qty
1	Fig. 8-26	Assembly, PSI Regulator Valve 0-3200Psi	1
2	Fig. 8-27	Assembly, Orifice Manifold	1
3	Fig. 8-28	Assembly, Hi Pressure Out Manifold	1
4	Fig. 8-29	Assembly, 3 Way Valve	1
5	000-100-166	Panel, Lower - Instrument	1
6	000-081-301	Label, Lower Instrument Panel	1
7	Fig. 8-30	Assembly, 2-Way Valve	1
8	000-033-003	Clamp, Size 4 Mini Hose	2
9	000-052-052	Quick Connect, 660 3/8" Brass w/ EPDM O-Ring	1
10	000-052-069	Nipple, 1/8" NPT Hex	3
11	000-052-078	Elbow, 1/8" NPT x 45° Street	1
12	000-052-084	Elbow, 1/8" NPT Street	2
13	000-052-088	Elbow, 1/4" FPT x FPT	1
14	000-052-089	Elbow, 1/8" NPT Female	2
15	000-052-096	Insert, #F23 (1/8" FPT x 3/16" Barb)	1
16	000-052-099	Insert, #26 (1/8" NPT x 3/8" Barb)	3
17	000-052-104	Insert, #66 (3/8" NPT x 3/8" Barb)	1
18	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1
19	000-052-272	Cup, Gravity Feed Oil Blower Lube Port	1
20	000-052-527	Nipple, 1/4" SAE x 1/4" NPT	1
21	000-052-531	Elbow, 1/4" SAE x 1/8" NPT	2
22	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	1
23	000-052-768	Quick Connect, High PSI Male 1/4" NPT	1
24	000-052-769	Quick Connect, High PSI Female 1/4" NPT	1
25	000-068-017	Hose, 3/8" I.D. - Bulk	1
26	000-068-512	Hose, 3/8" x 10.25" Lg. Teflon w/ JIC Ends	1
27	000-068-806	Hose, 3/8" x 6" Lg. Teflon w/ JIC Ends	1
28	000-068-512	Hose, 3/8" x 10.25" Lg. Teflon w/ JIC Ends	1
29	000-068-512	Hose, 3/8" x 10.25" Lg. Teflon w/ JIC Ends	1
30	000-068-790	Hose, 3/16" x 8" Lg. Teflon w/ JIC Ends	1

Panel, Lower Instrument Assembly Parts List

Item	Part Number	Description	Qty
31	000-068-512	Hose, 3/8" x 10.25" Lg. Teflon w/ JIC Ends	1
32	000-068-789	Hose, 3/16" x 10.5" Lg. Teflon w/ JIC Ends	1
33	000-074-167	Gauge, Pressure (0-3000PSI)	1
34	000-094-098	Nut, 7/16"-24UNF Jam	1
35	000-074-030	Meter, Chemical Flow Raw	1
36	000-135-052	Regulator, Hi PSI Snubber	1
37	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	10
38	000-143-327	Screw, #10-32 UNF x 0.50" Lg. Hex Head	2
39	000-143-542	Screw, 1/4"-28UNF x 0.50" Lg. Hex Head	2
40	000-155-053	Spring, 1/4" Belleville Washer	2
41	000-169-0171	Valve, 3-Way Ball O-Ring Style	1
42	000-169-064	Valve, 3/8" NPT Full Port Ball	1
43	000-169-160	Valve, Chemical Metering	1
44	000-174-001	Washer, #10 Flat	14
45	000-174-008	Washer, 5/8" Flat	4
46	000-174-014	Washer, #10 Lock	2
47	000-174-007	Washer, 1/2" Flat	2
48	000-027-008	Cap, 3/8" Brass Pipe	1

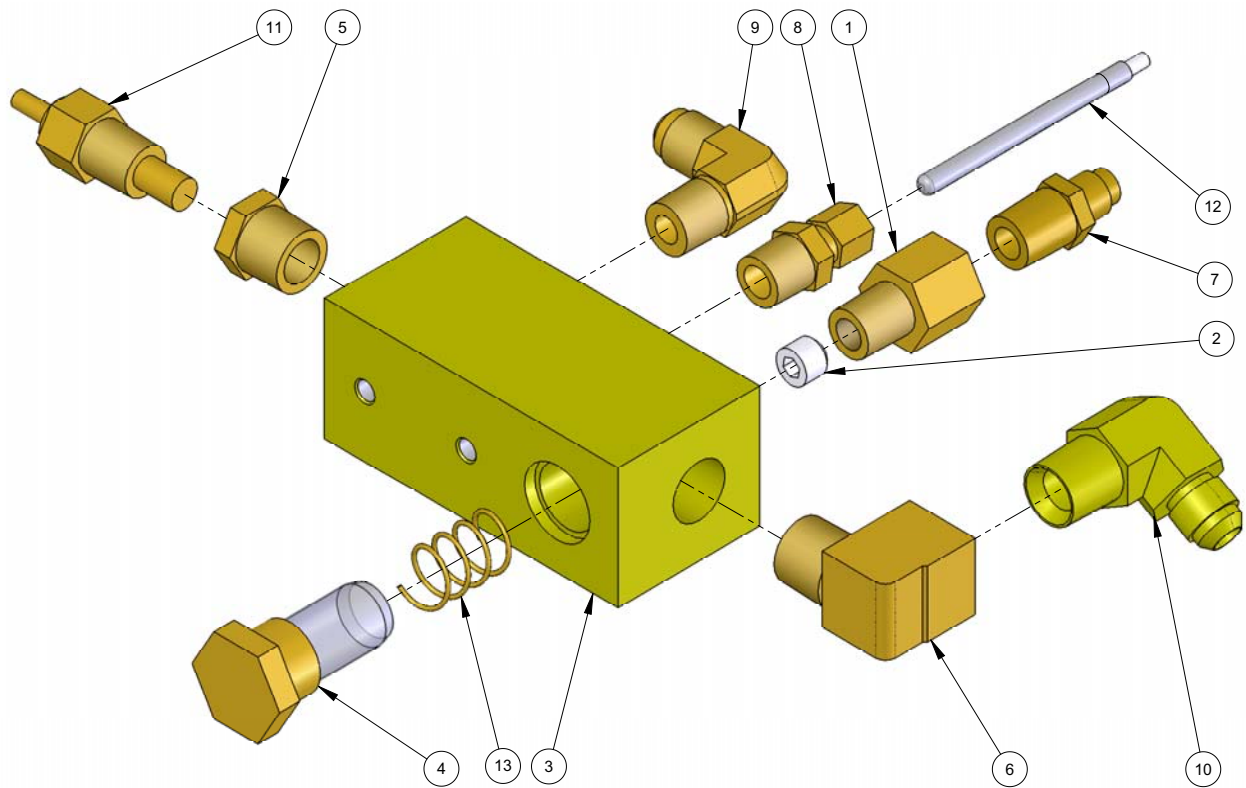
Figure 8-26 PSI Regulator Valve 0-3200 PSI Assembly
C-6615 Rev. A



PSI Regulator Valve 0-3200 PSI Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-515	Bracket, By-Pass Valve Mounting	1
2	000-090-068	Manifold, Multi Port	2
3	000-052-061	Bushing, 3/8" NPT x 1/4" FPT	1
4	000-052-073	Nipple, 3/8" NPT x 1/4" NPT Hex	1
5	000-052-085	Elbow, 1/4" NPT Street	1
6	000-052-090	Tee, 1/4" NPT Branch M-F-F	1
7	000-052-102	Insert, #46 (1/4" NPT x 3/8" Barb)	1
8	000-052-117	Insert, #48 (1/4" NPT x 1/2" Barb)	1
9	000-052-532	Elbow, 1/4" SAE x 1/4" NPT	1
10	000-052-587	Compression, 3/16" x 1/4" NPT Thermocouple	1
11	000-052-751	Elbow, 3/8" JIC x 1/4" NPT	2
12	000-052-766	Elbow, 3/8 NPT x 3/8 JIC	1
13	000-106-008	Plug, 3/8" NPT Allen Head	4
14	000-106-047	Plug, 1/4" BPT Brass Allen Head (British)	2
15	000-149-540	Sensor, RTD Compression Fitting Style	1
16	000-169-197	Valve, PSI Regulator 0-3200 PSI - Modified	1
17	000-052-527	Nipple, 1/4" SAE x 1/4" NPT	1

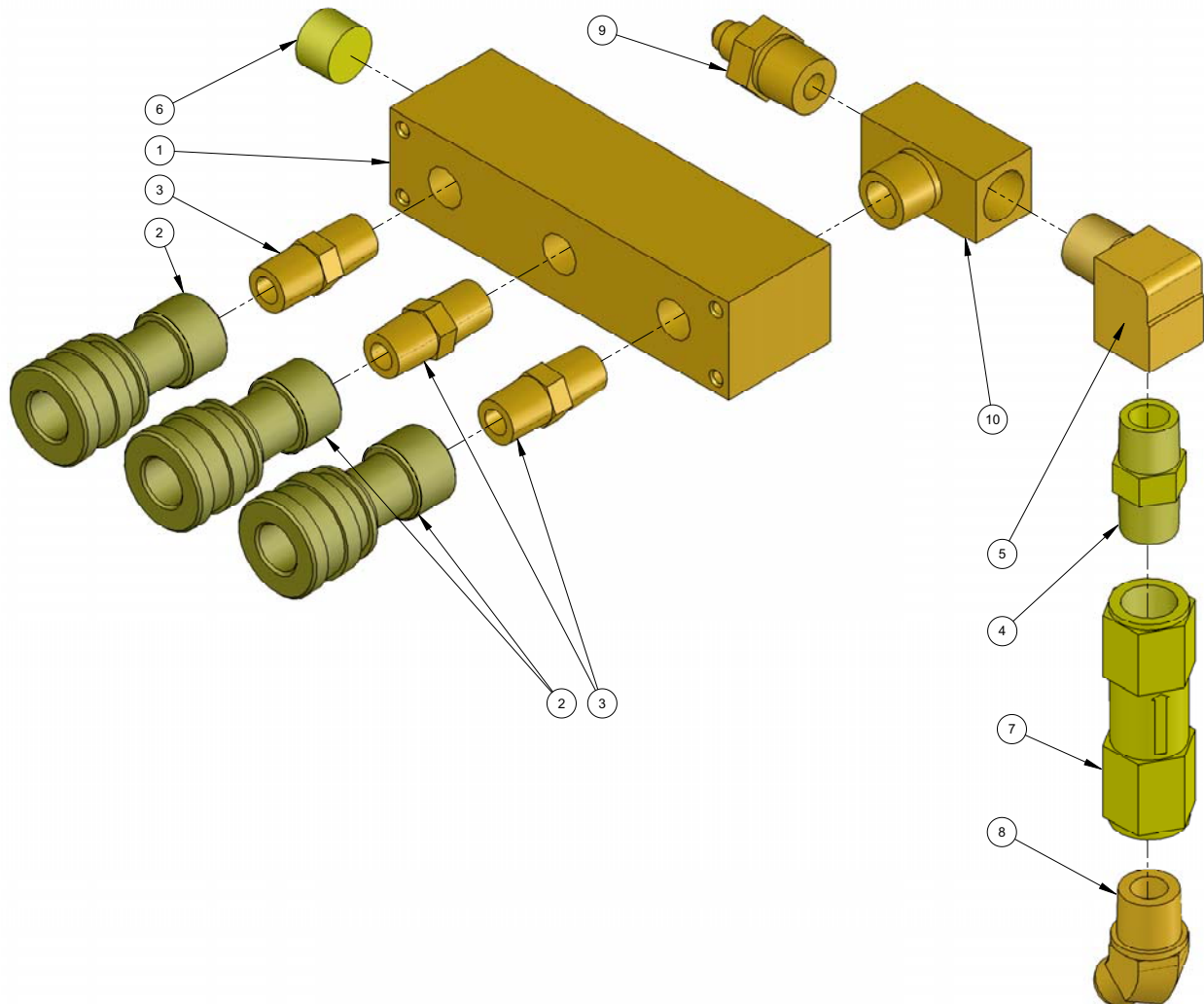
Figure 8-27 Orifice Manifold Assembly
C-6616 Rev. A



Orifice Manifold Assembly Parts List

Item	Part Number	Description	Qty
1	000-052-423	Bushing, Modified Set Screw Orifice	1
2	000-180-004	Orifice, Set Screw 0.033"	1
3	000-090-069	Manifold, Orifice	1
4	000-049-016	Filter, 1/4" NPT Replacement "Y"	1
5	000-052-061	Bushing, 3/8" NPT x 1/4" FPT	1
6	000-052-086	Elbow, 3/8" NPT Street	1
7	000-052-527	Nipple, 1/4" SAE x 1/4" NPT	1
8	000-052-587	Compression, 3/16" x 1/4" NPT Thermocouple	1
9	000-052-751	Elbow, 3/8" JIC x 1/4" NPT	1
10	000-052-766	Elbow, 3/8 NPT x 3/8 JIC	1
11	000-149-039	Sender, Temperature	1
12	000-149-540	Sensor, RTD Compression Fitting Style	1
13	000-155-020	Spring, 0.540 O.D. x 0.041 Wire x 1.00 Lg.	1

Figure 8-28 Hi Pressure Out Manifold Assembly
C-6646 Rev. B

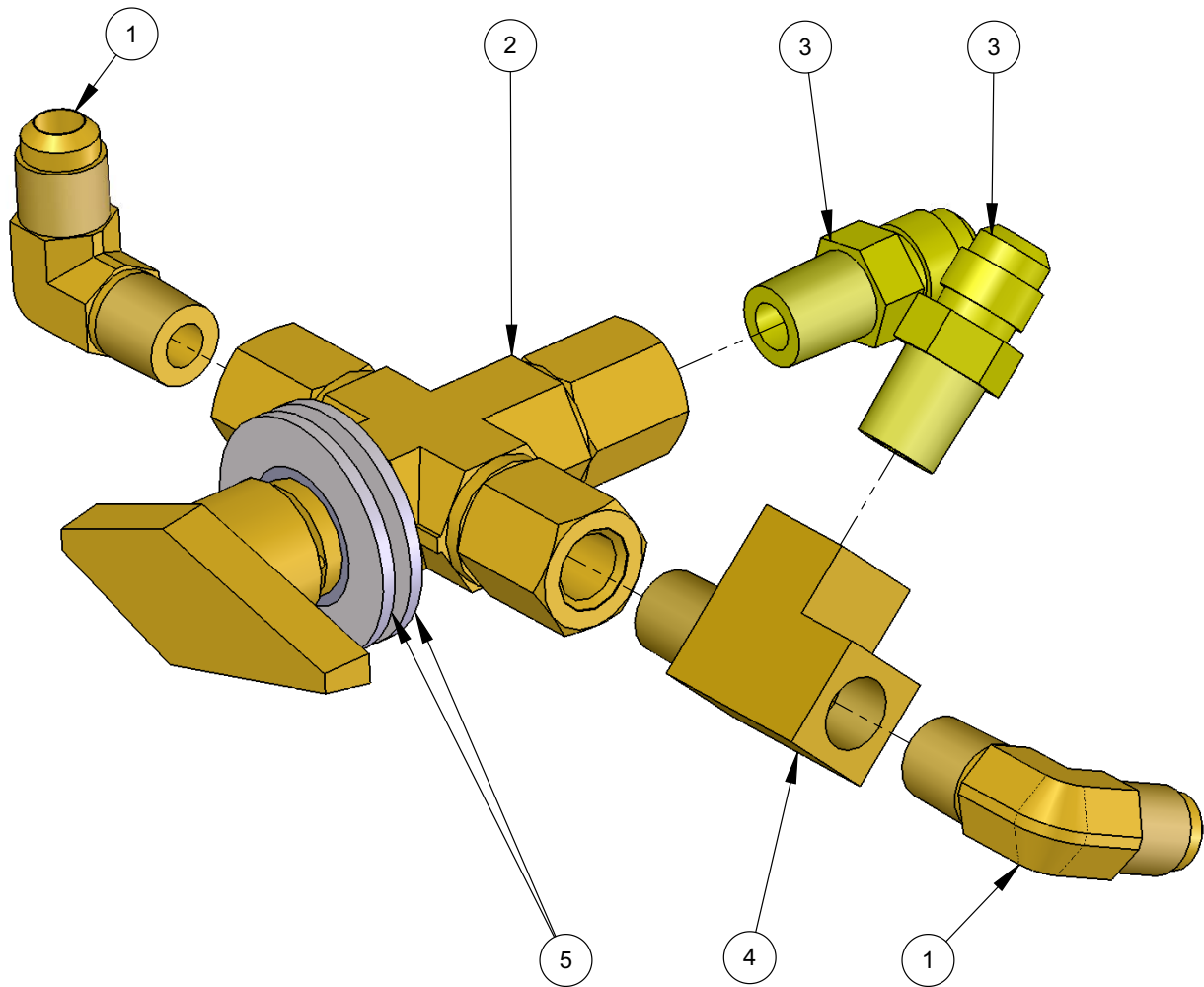


Hi Pressure Out Manifold Assembly Parts List

Item	Part Number	Description	Qty
1	000-090-070	Manifold, Hi Pressure Out	1
2	000-052-051	Quick Connect, 440 Female w/ EPDM O-Ring	3
3	000-052-071	Nipple, 1/4" NPT Hex	3
4	000-052-074	Nipple, 3/8" NPT Hex	1
5	000-052-086	Elbow, 3/8" NPT Street	1
6	000-106-008	Plug, 3/8" NPT Allen Head	1
7	000-169-177	Valve, 3/8" FPT Check 65 PSI	1
8	000-052-779	Elbow, 3/8" NPT x 3/8" M JIC x 45°	1
9	000-052-662	Nipple, 3/8" NPT x 1/4" M SAE	1
10	000-052-447	Tee, 3/8" Male Branch	1

Figure 8-29 **3 Way Valve Assembly**

C-6647 Rev. B

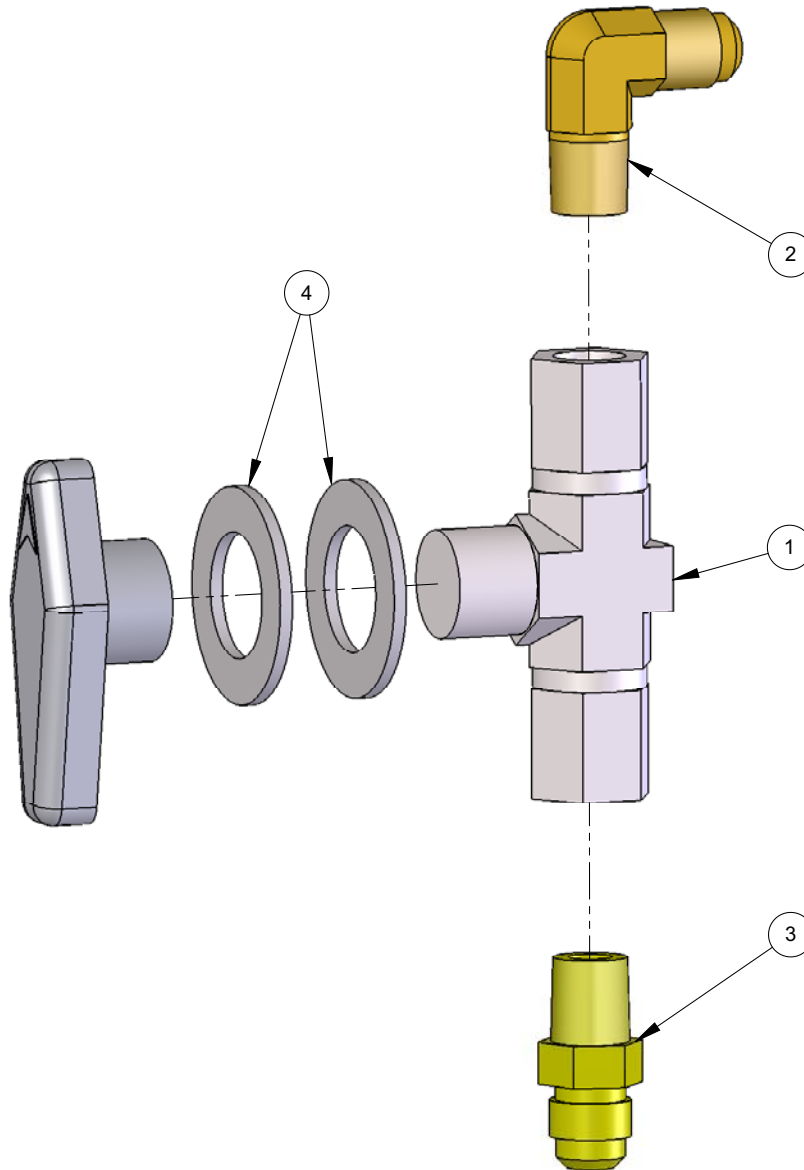


3 Way Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-052-751	Elbow, 3/8" JIC x 1/4" NPT	2
2	000-169-213	Valve, 3-Way 1/4" FPT	1
3	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	2
4	000-052-090	Tee, 1/4" NPT Branch M-F-F	1
5	000-174-028	Washer, 7/8" I.D. x 1.50" O.D. x 0.090" Thk.	2

Figure 8-30 **2 Way Valve Assembly**

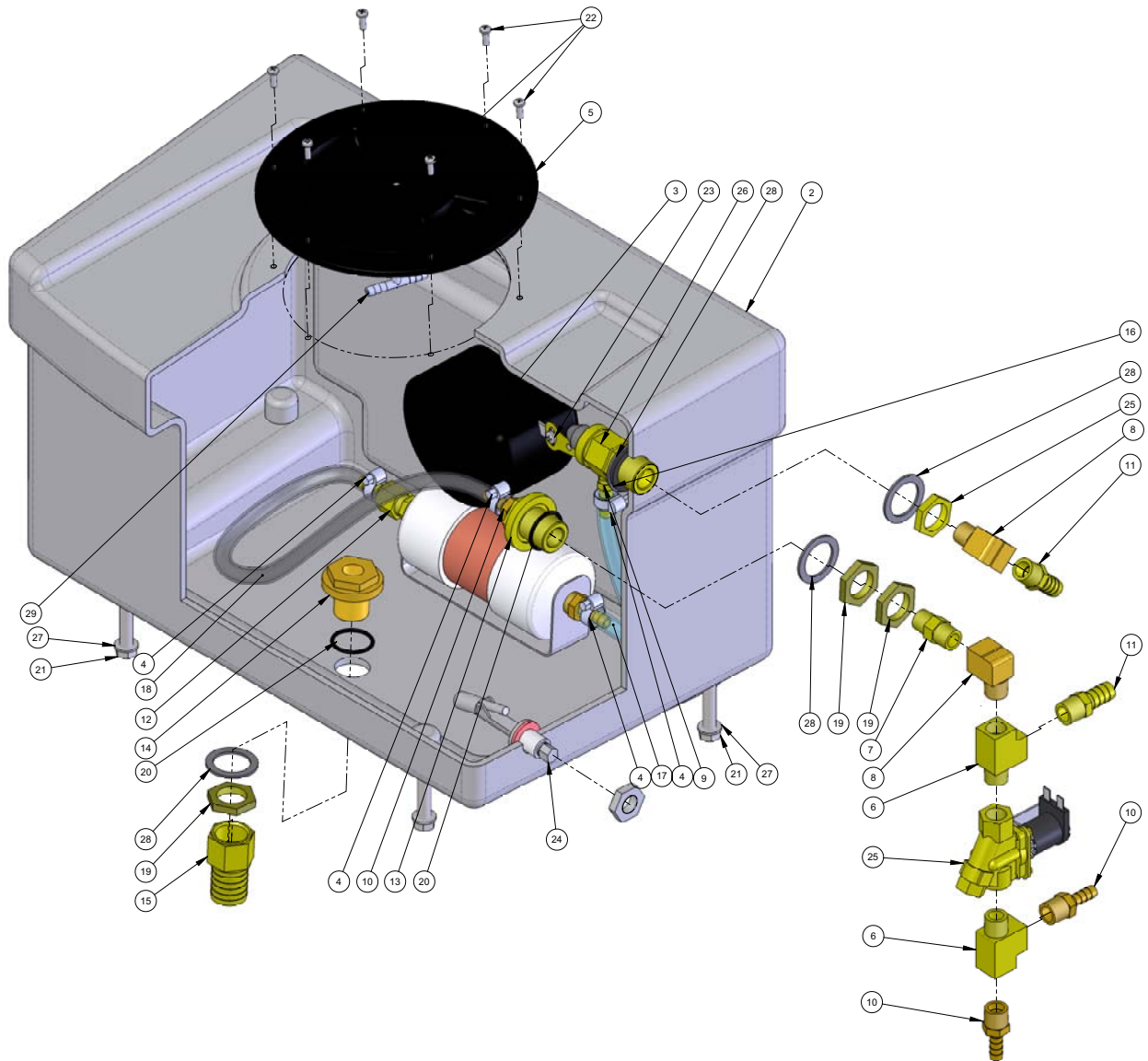
B-6644 Rev. C



2 Way Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-169-214	Valve, 2 Way Chem Pump - 1/4" FPT S/S	1
2	000-052-751	Elbow, 3/8" JIC x 1/4" NPT	1
3	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	1
4	000-174-028	Washer, 7/8" I.D. x 1.50" O.D. x 0.090" Thk.	2

Figure 8-31 Poly Water Box 8G Assembly
D-6619 Rev. A

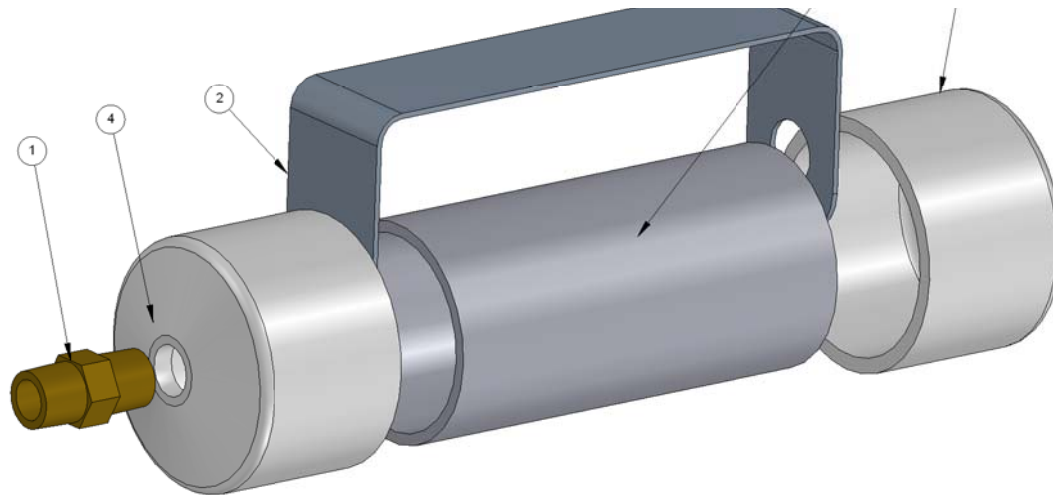


Poly Water Box 8G Assembly Parts List

Item	Part Number	Description	Qty
1	000-049-151	Assembly, Diffuser Filter (Fig. 8-32)	1
2	000-159-131	Tank, Poly Water Box 8G	1
3	000-005-007	Float, Water Box	1
4	000-033-003	Clamp, Size 4 Mini Hose	4
5	000-041-005	Cover, 6"	1
6	000-052-023	Tee, 3/8" NPT Male Street	2
7	000-052-074	Nipple, 3/8" NPT Hex	1
8	000-052-086	Elbow, 3/8" NPT Street	2
9	000-052-099	Insert, #26 (1/8" NPT x 3/8" Barb)	1
10	000-052-104	Insert, #66 (3/8" NPT x 3/8" Barb)	3
11	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	2
12	000-052-488	Insert, #F66 (3/8" NPT x 3/8" Hose Barb)	1
13	000-052-660	Bulkhead, 3/8" FPT x 3/8" FPT	1
14	000-052-728	Bulkhead, 1/2" FPT x 3/8" FPT	1
15	000-052-754	Insert, #F816 (1/2" FPT x 1" Barb)	1
16	000-057-052	Gasket, 1" Garden Hose	1
17	000-068-326	Hose, 3/8" I.D. Clear w/ Braid	1
18	000-068-326	Hose, 3/8" I.D. Clear w/ Braid	1
19	000-094-097	Nut, 1-14" Brass	3
20	000-097-041	O-Ring, 1/2" Bulk Head	2
21	000-143-097	Screw, 3/8"-6UNC x 2.50" Lg. Hex Head Grd. 5	4
22	000-143-314	Screw, #8 x 1/2" Lg. Pan Head	6
23	000-143-336	Screw, #10-32UNF x 0.25" Lg. PHF	1
24	000-157-031	Switch, Side Mount w/ Bulkhead Fitting	1
25	000-169-120	Valve, Chemical & Hi-Temp Solenoid - 12 Volt	1
26	000-169-167	Valve, Mechanical - Incoming Water	1
27	000-174-004	Washer, 5/16" Flat	4
28	000-174-063	Washer, 1.5" O.D. x 1.073" I.D. x 0.075" Thk.	4
29	000-052-156	Tee, 1/4" Plastic	1

Figure 8-32 **Diffuser Assembly**

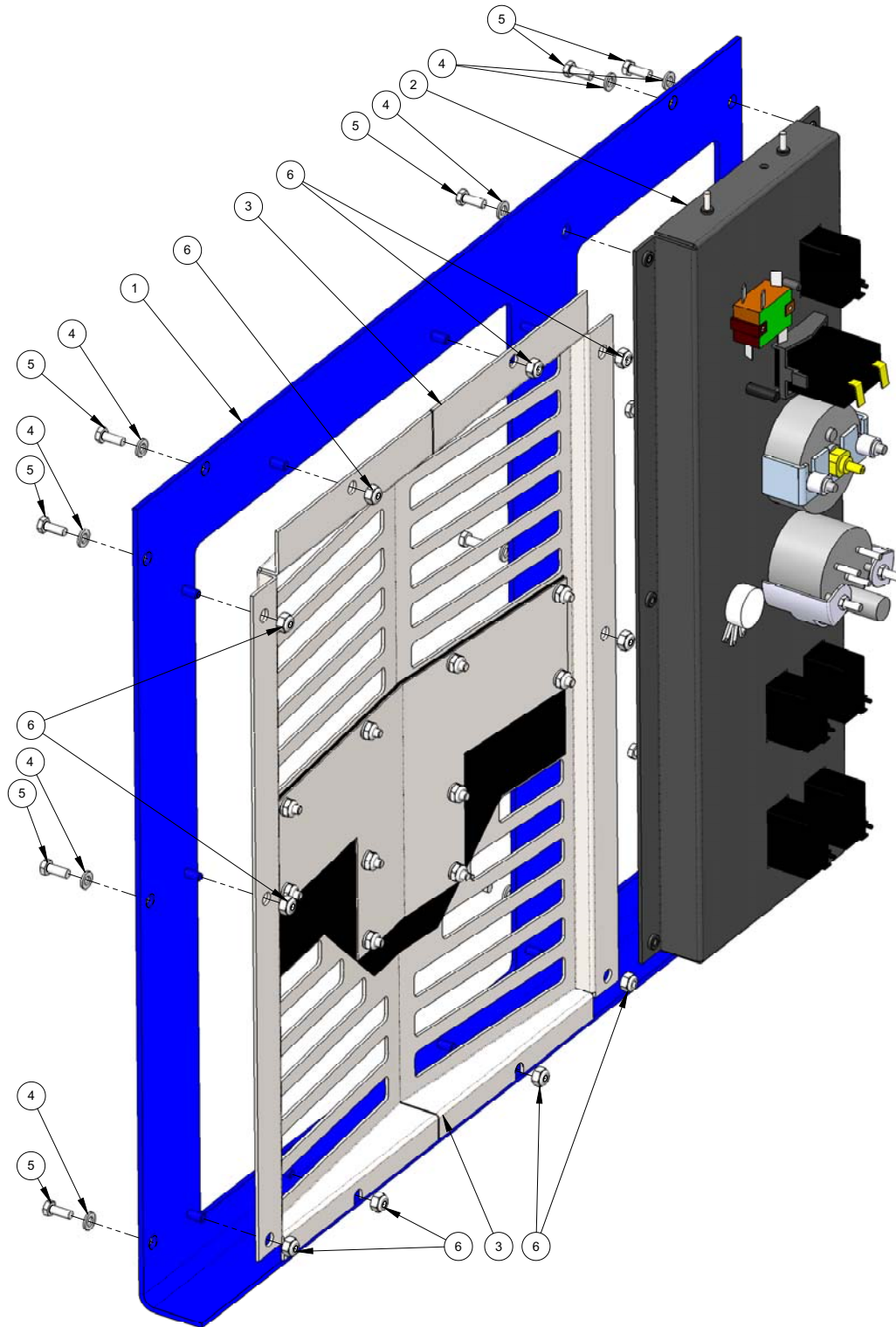
B-6554 Rev. -



Diffuser Assembly Parts List

Item	Part Number	Description	Qty
1	000-052-074	Nipple, 3/8" NPT Hex	1
2	000-033-131	Clamp, Diffuser	1
3	000-125-222	Tube, Diffuser	1
4	000-027-115	Cap, 2" Pvc Modified For Diffuser	2
5	000-052-104	Insert, #66 (3/8" NPT x 3/8" Barb)	1

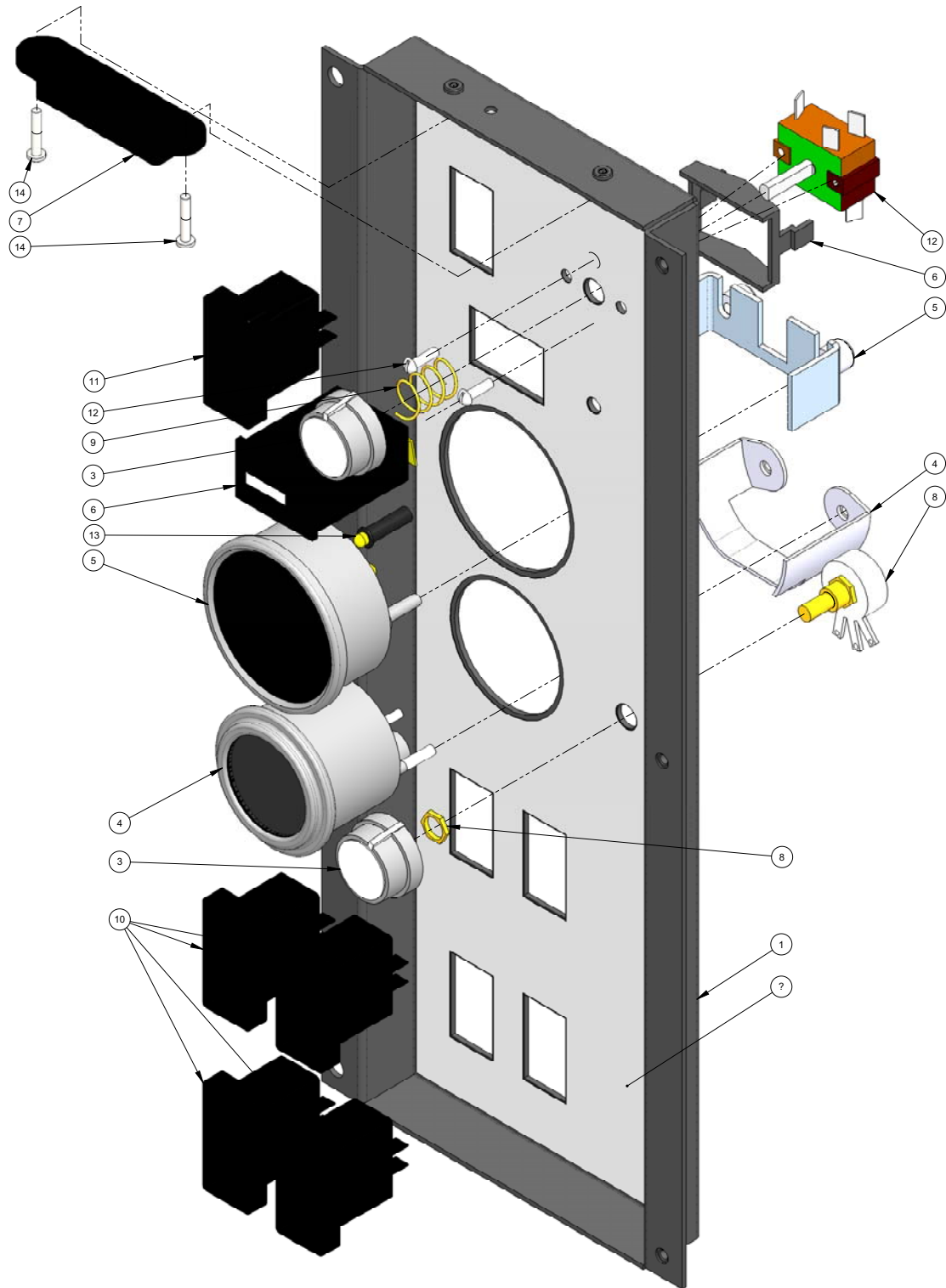
Figure 8-33 Upper Dash Assembly
C-6610 Rev. A



Upper Dash Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-164	Panel, Dash	1
2	Fig. 8-34	Assembly, Inset Dash	1
3	Fig. 8-35	Assembly, Grill	1
4	000-174-001	Washer, #10 Flat	11
5	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	11
6	000-094-034	Nut, #10-24UNC Nylock s/s	10

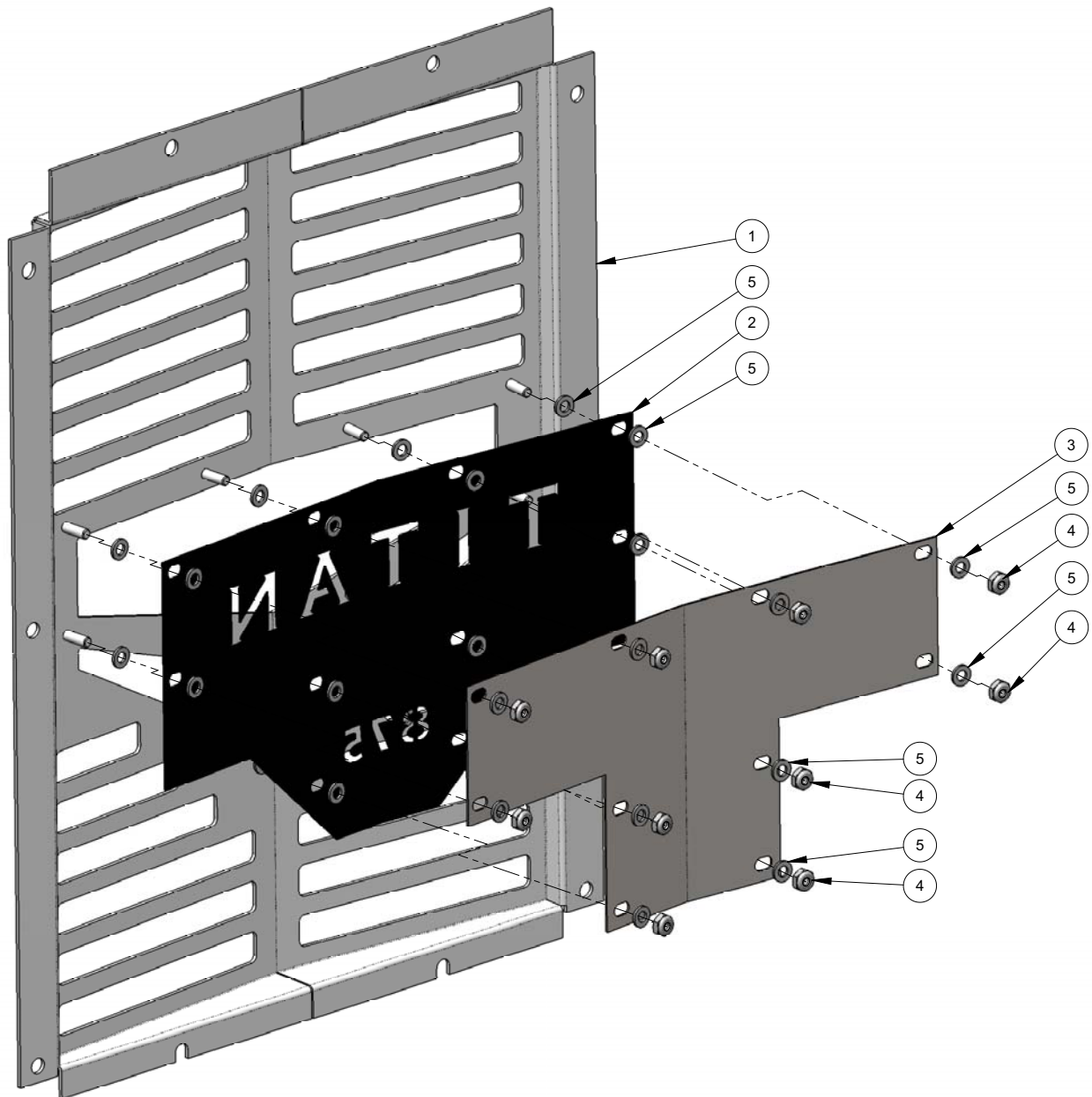
Figure 8-34 Inset Dash Assembly
D-6611 Rev. A



Inset Dash Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-165	Panel, Inset Dash	1
2	000-081-301	Label, Inset Dash Panel	1
3	000-061-056	Knob, Temperature Adjustment	2
4	000-074-016	Gauge, Temperature	1
5	000-074-017	Gauge, 0-30" Hg Vac. 2 1/2" HydraMaster Face	1
6	000-074-018	Meter, Rectangular w/o Bezel	1
7	000-084-019	Light, Blue LED Strip	1
8	000-149-551	Thermostat, Potentiometer Dual Controller	1
9	000-155-020	Spring, 0.540 O.D. x 0.041 Wire x 1.00 Lg.	1
10	000-157-040	Switch, 20 AMP Rocker	4
11	000-157-152	Switch, Ignition	1
12	000-157-153	Switch, Rotary	1
13	000-084-012	Light, Yellow LED Indicator Mini	1
14	000-143-326	Screw, #6-32 x .750" Lg. Php	2

Figure 8-35 Grill Assembly
C-6727 Rev. A

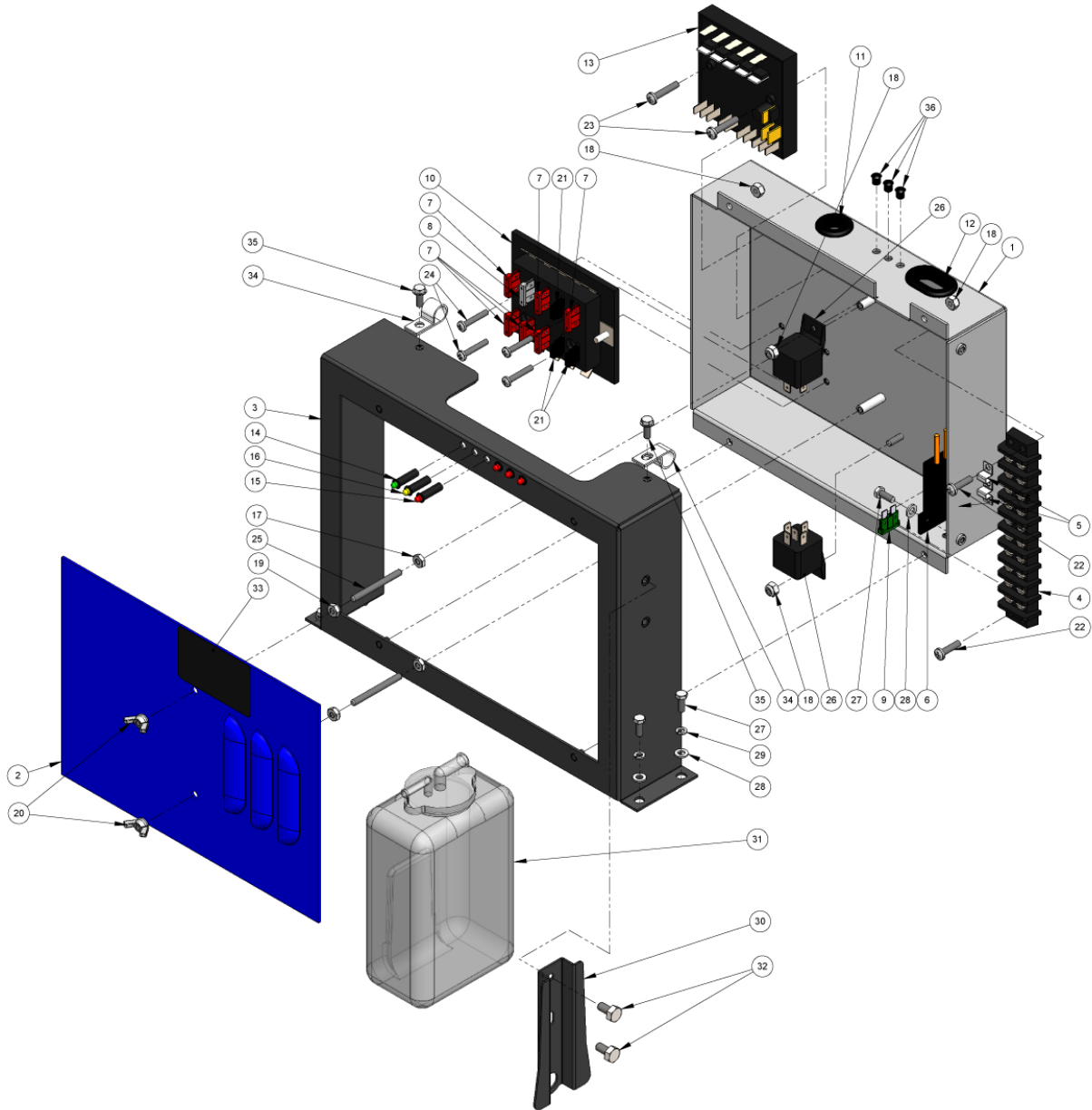


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Grill Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-172	Panel, Grill	1
2	000-100-173	Panel, Logo - Grill	1
3	000-100-174	Panel, Backing Plate - Grill	1
4	000-094-058	Nut, #10-32UNF - Nylock	10
5	000-174-001	Washer, #10 Flat	30

Figure 8-36 Electrical Panel Assembly
D-6617 Rev. C



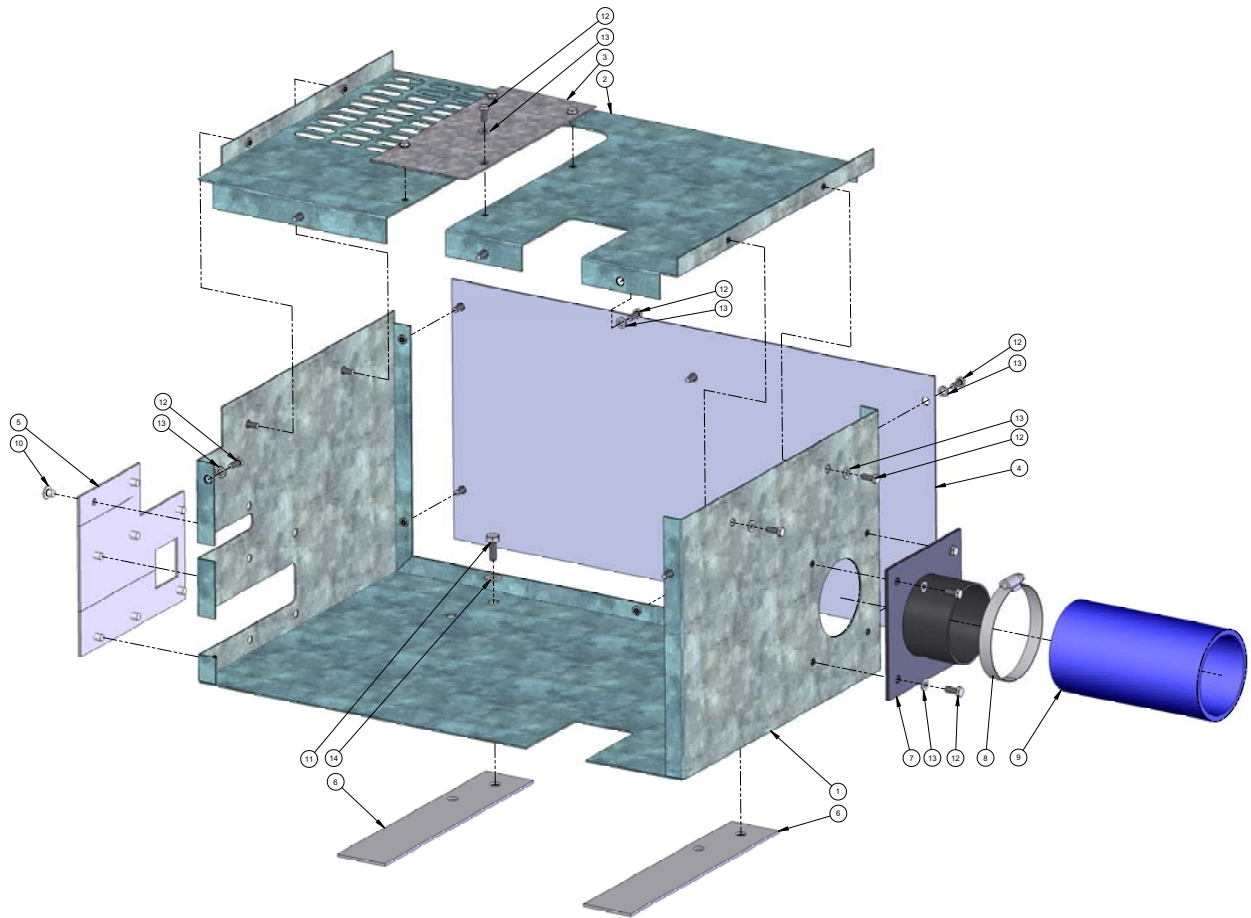
Electrical Panel Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-137	Panel, Electrical Control	1
2	000-041-418	Cover, Electrical Control Panel	1
3	000-015-944	Bracket, Electrical Panel Mount	1

Electrical Panel Assembly Parts List

Item	Part Number	Description	Qty
4	000-012-010	Block, Terminal 10 Post	1
5	000-037-011	Connector, "Jumper" Terminal Block	2
6	000-056-006	Fuse Holder, In-Line - Weatherproof	1
7	000-056-007	Fuse, 10 AMP	6
8	000-056-010	Fuse, 25 AMP	1
9	000-056-011	Fuse, 30 AMP	1
10	000-056-030	Panel, Diode	1
11	000-060-002	Grommet, Large Wiring	1
12	000-060-014	Grommet, 1.00" I.D. x 1.50" O.D.	1
13	000-074-130	Controller, Temp. Dual Independent	1
14	000-084-010	Light, Green LED Indicator Mini	1
15	000-084-011	Light, Red LED Indicator Mini	4
16	000-084-012	Light, Yellow LED Indicator Mini	1
17	000-094-003	Nut, #10-32UNF Hex	2
18	000-094-034	Nut, #10-24UNC Nylock s/s	6
19	000-094-058	Nut, #10-32UNF - Nylock s/s	2
20	000-094-108	Nut, #10-32UNF Wing	2
21	000-135-004	Diode, Plug In	3
22	000-143-062	Screw, #10-24UNC x 0.75" Lg. PPH	2
23	000-143-534	Screw, #10-24UNC x 1" Lg. PPH	2
24	000-143-545	Screw, #8-32UNC x 1" Lg. PPH	4
25	000-156-030	Stud, #10-32UNF x 2" Lg. s/s	2
26	000-157-022	Switch, Relay	2
27	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	5
28	000-174-001	Washer, #10 Flat	5
29	000-174-014	Washer, #10 Lock	4
30	---	Bracket, Overflow Jug (Comes w/ Engine)	1
31	---	Jug, Overflow (Comes w/ Engine)	1
32	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	2
33	000-081-301	Label, Electrical Panel	1
34	000-033-046	Clamp, 1/2 Wide x 1/2 Tube	2
35	000-143-583	Screw, #10-24UNC x 0.50" Lg. Hex Head Flange Z/P	2
36	000-106-172	Plug, 1/4" Plastic	3

Figure 8-37 Cover, Catalytic Assembly
D-6730 Rev. -

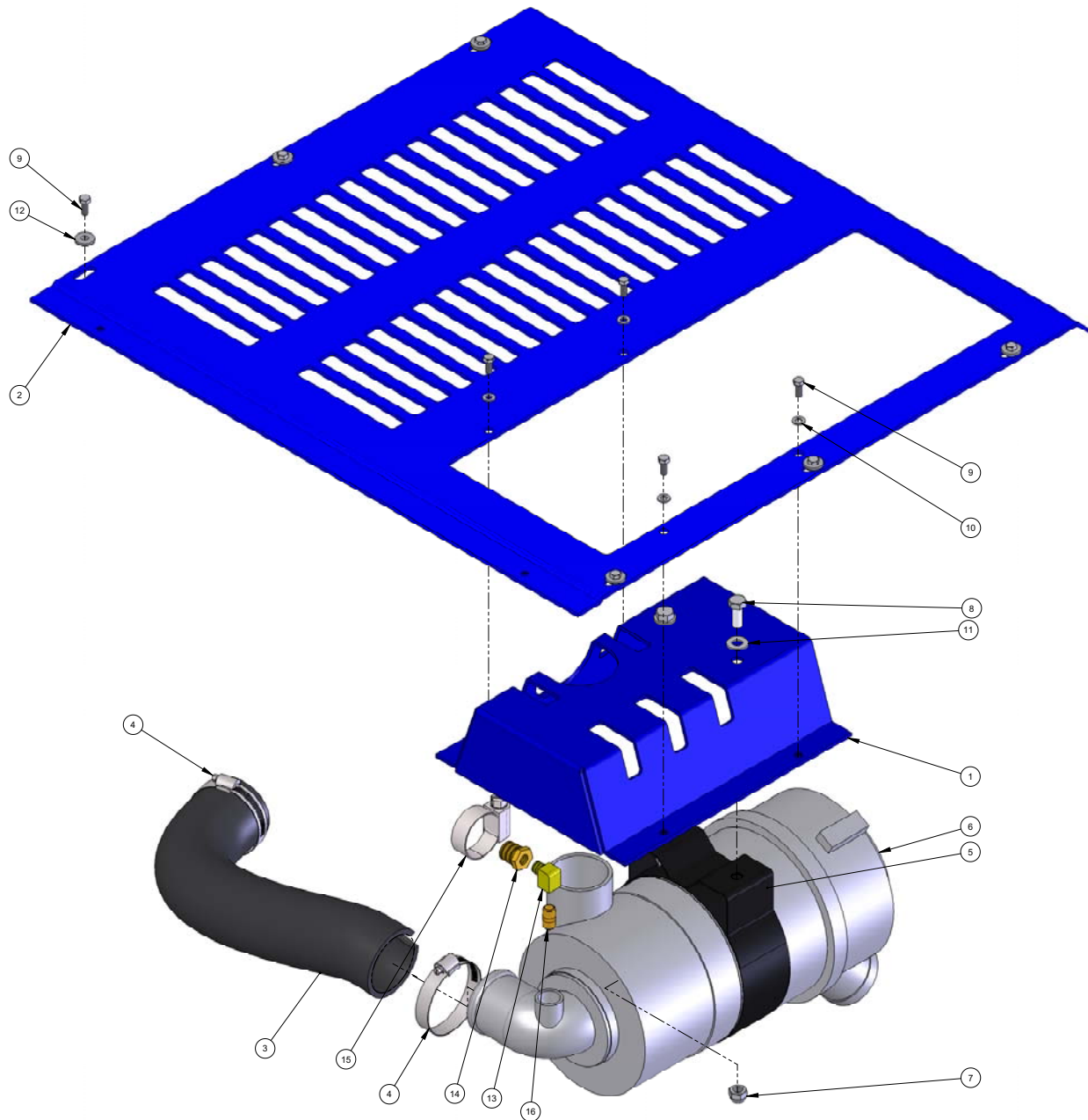


TITAN 875

Cover, Catalytic Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-455	Cover, Bottom & Ends Catalytic	1
2	000-041-456	Cover, Top - Catalytic	1
3	000-041-457	Cover, Removable - Catalytic	1
4	000-041-458	Cover, Side - Catalytic	1
5	000-108-146	Protector, CAT Cover	1
6	000-057-214	Gasket, CAT Heat Shield	2
7	000-001-132	Adapter, Tank To 3.0" Blower Hose	1
8	000-033-013	Clamp, #48 Hose (3")	1
9	000-068-398	Hose, 3" I.D. 3 Ply Silicone	1
10	000-140-021	Rivet, 1/4" Blind x 0.50" Lg.	8
11	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	2
12	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	23
13	000-174-001	Washer, #10 Flat	23
14	000-174-003	Washer, 1/4" Flat	2

Figure 8-38 Top Cover - Machine Assembly
D-6609 Rev. B

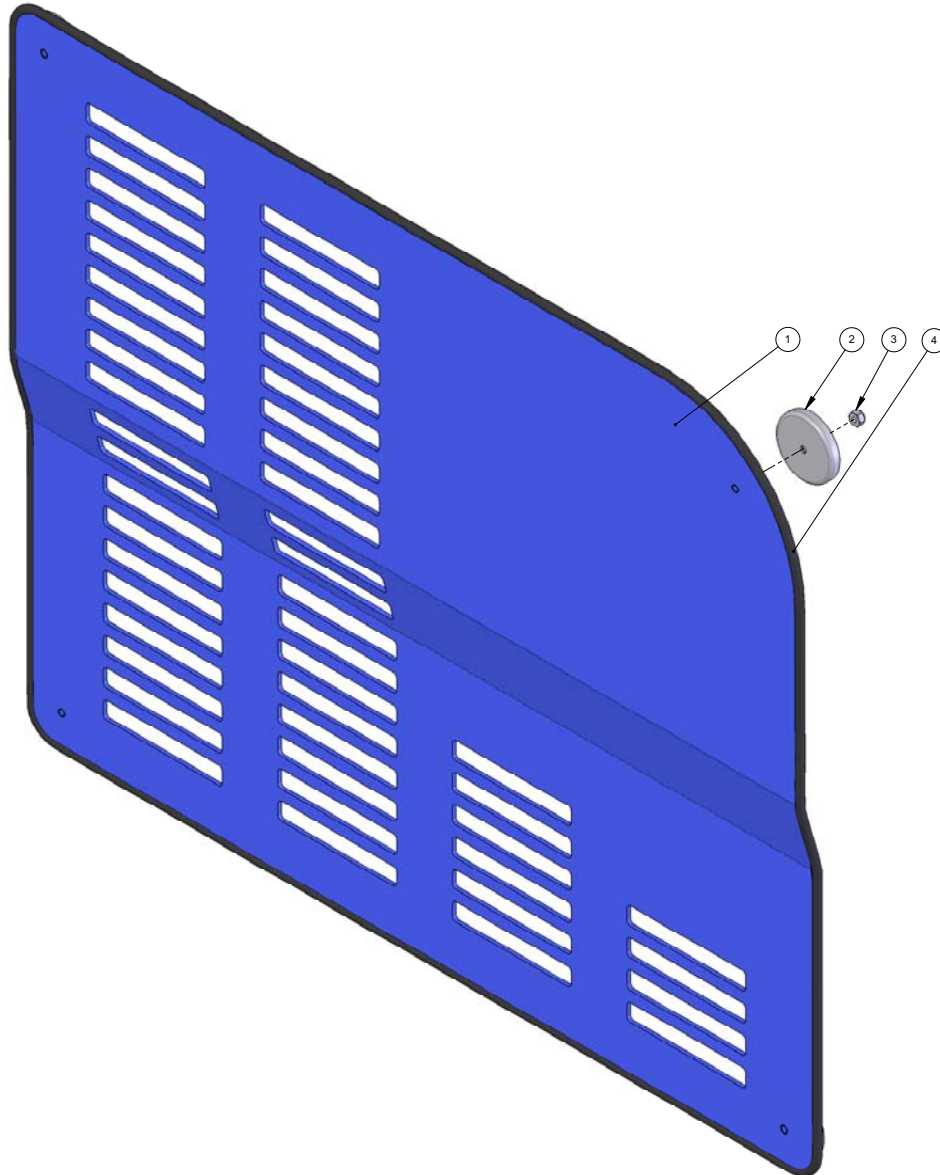


TITAN 875

Top Cover - Machine Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-943	Bracket, Air Cleaner Mount	1
2	000-041-448	Cover, Top - Machine	1
3	000-068-795	Hose, 'L' 2" I.D. Modified	1
4	000-033-010	Clamp, #32 Hose	2
5	000-015-943	Bracket, Air Cleaner	1
6	---	Air Cleaner, Engine (Comes w/ engine)	1
7	000-094-038	Nut, 5/16"-18UNC Nylock	2
8	000-143-012	Screw, 5/16"-18UNC x 3/4" Lg.	2
9	000-143-126	Screw, #10-24UNC x 0.50" Lg Hex Head	10
10	000-174-001	Washer, #10 Flat	4
11	000-174-049	Washer, 5/16" Flat	2
12	000-174-060	Washer, 1/4" Rubber Backed	6
13	000-052-084	Elbow, 1/8" NPT Street	1
14	000-052-060	Bushing, 3/8" NPT x 1/8" FPT	1
15	000-033-020	Clamp, Size #16 Hose	1
16	000-052-057	Nipple, 1/8" NPT Close	1

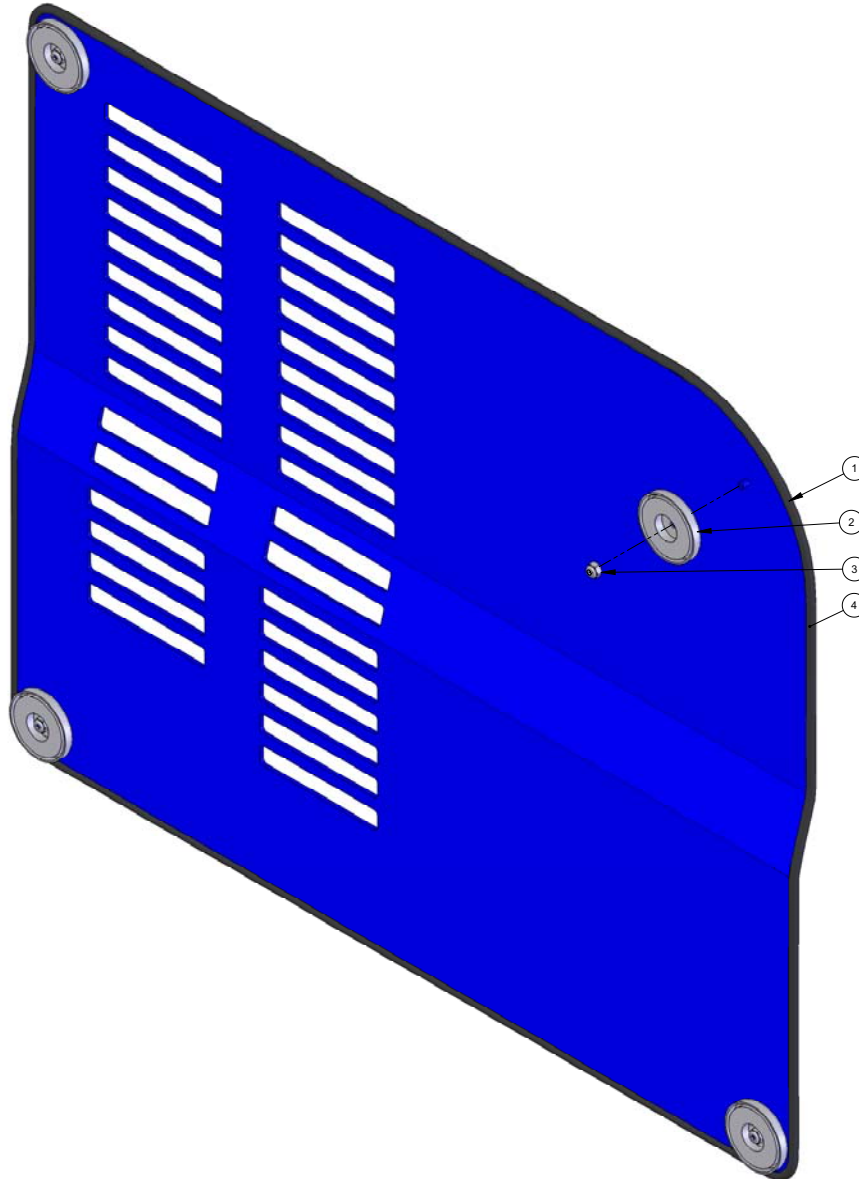
Figure 8-39 Left Side Cover - Machine Assembly
C-6613 Rev. -



Left Side Cover - Machine Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-449	Cover, Left Side - Machine	1
2	000-089-003	Magnet, Treadmaster	4
3	000-094-034	Nut, #10-24UNC Nylock s/s	4
4	000-131-131	Trimlok, 3/8" x 1/8" Rubber	1

Figure 8-40 **Right Side Cover - Machine Assembly**
C-6614 Rev. -

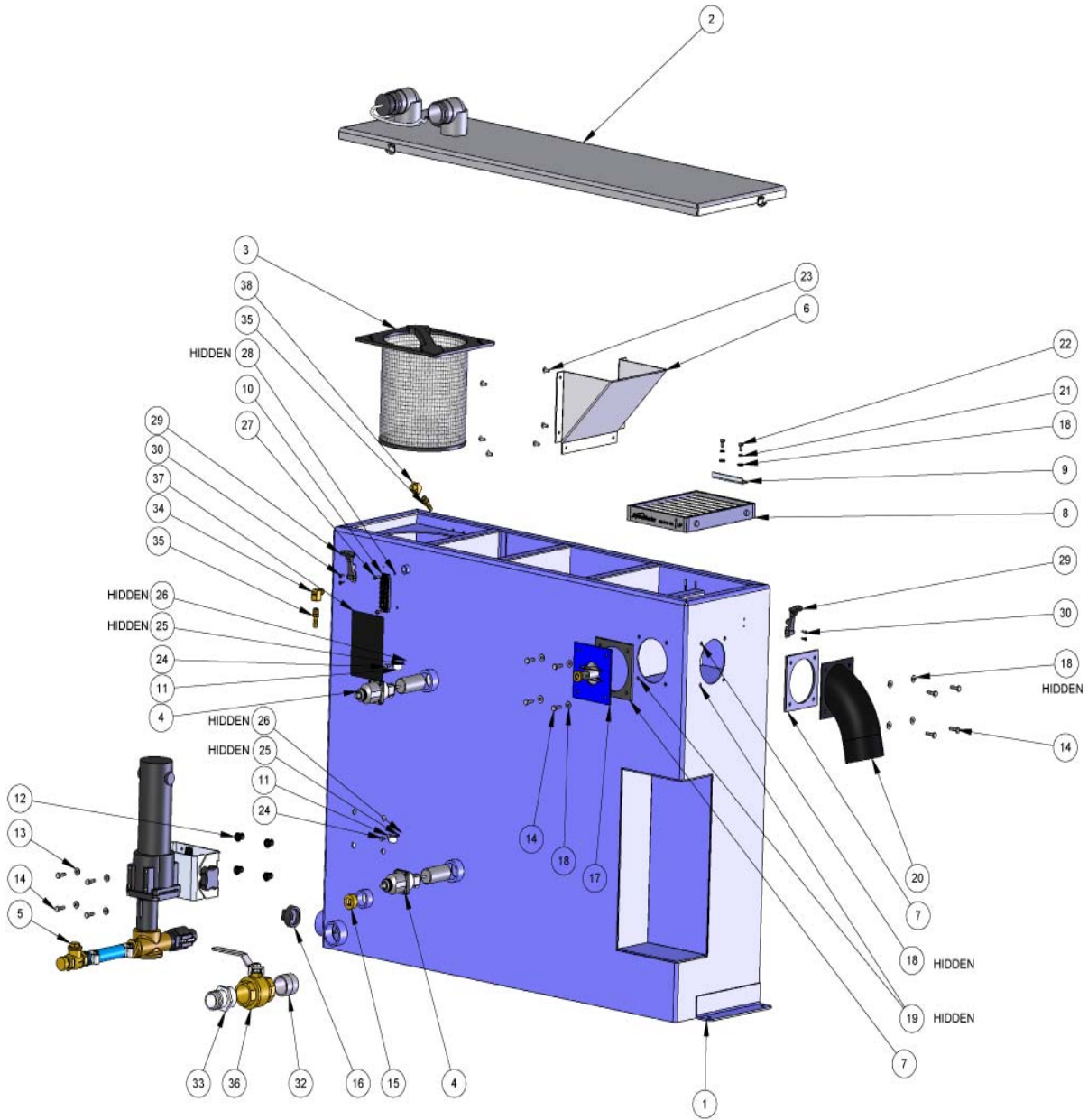


Right Side Cover - Machine Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-450	Cover, Right Side - Machine	1
2	000-089-003	Magnet, Treadmaster	4
3	000-094-034	Nut, #10-24UNC Nylock s/s	4
4	000-131-131	Trimlok, 3/8" x 1/8" Rubber	1

TITAN 875

Figure 8-41 100 Gallon Universal Recovery Tank Assembly
D-6787



100 Gallon Universal Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-159-133	Tank, Recovery - 100g	1
2	---	Assembly, Recovery Tank Cover	1
3	000-049-152	Filter, Recovery Tank Basket	1
4	000-157-090	Float, Lever Switch	2
5	SEE NOTES	Assembly, Dura-Flow Apo - Production	1
6	000-049-154	Deflector, Air - Universal Recovery Tank	1
7	000-057-206	Gasket, Adapter - Urt	2
8	000-049-153	Filter, Flat - Universal Recovery Tank	1
9	000-015-932	Bracket, Flat Filter Securing	1
10	000-012-002	Block, 6 Post Terminal	1
11	000-033-023	Clamp, 3/4" Nylon Hose	2
12	000-094-113	Nut, 1/4"-20UNC Neoprene Wellnut	4
13	000-174-060	Washer, 1/4" Rubber Backed	4
14	000-143-002	Screw, 1/4"-20UNC X 1.00" Lg. Hex Head	12
15	000-106-049	Plug, 1" Npt Allen Head	1
16	000-106-019	Plug, 1-1/2" Npt	1
17	SEE NOTES	Assembly, Vacuum Relief Valve - Urt	1
18	000-174-003	Washer, 1/4" Flat	18
19	000-094-009	Nut, 1/4"-20UNC Nylock	8
20	000-001-149	Adapter, 4" O.D. Elbow X 15 Deg.	1
21	000-174-019	Washer, 1/4" Lock	2
22	000-143-333	Screw, 1/4"-20UNC X 0.50" Lg. Hex Head	2
23	000-140-023	Rivet, Ab8-6a Aluminum Pop	6
24	000-143-126	Screw, #10-24UNC X 0.50" Lg. Hex Head	2
25	000-174-036	Washer, #10 Flat Rubber Backed	2
26	000-094-034	Nut, #10-24UNC Nylock S/S	2
27	000-143-051	Screw, #8-32UNC X 3/4" Lg. Binder Head	2
28	000-094-059	Nut, #8-32UNC Nylock	2

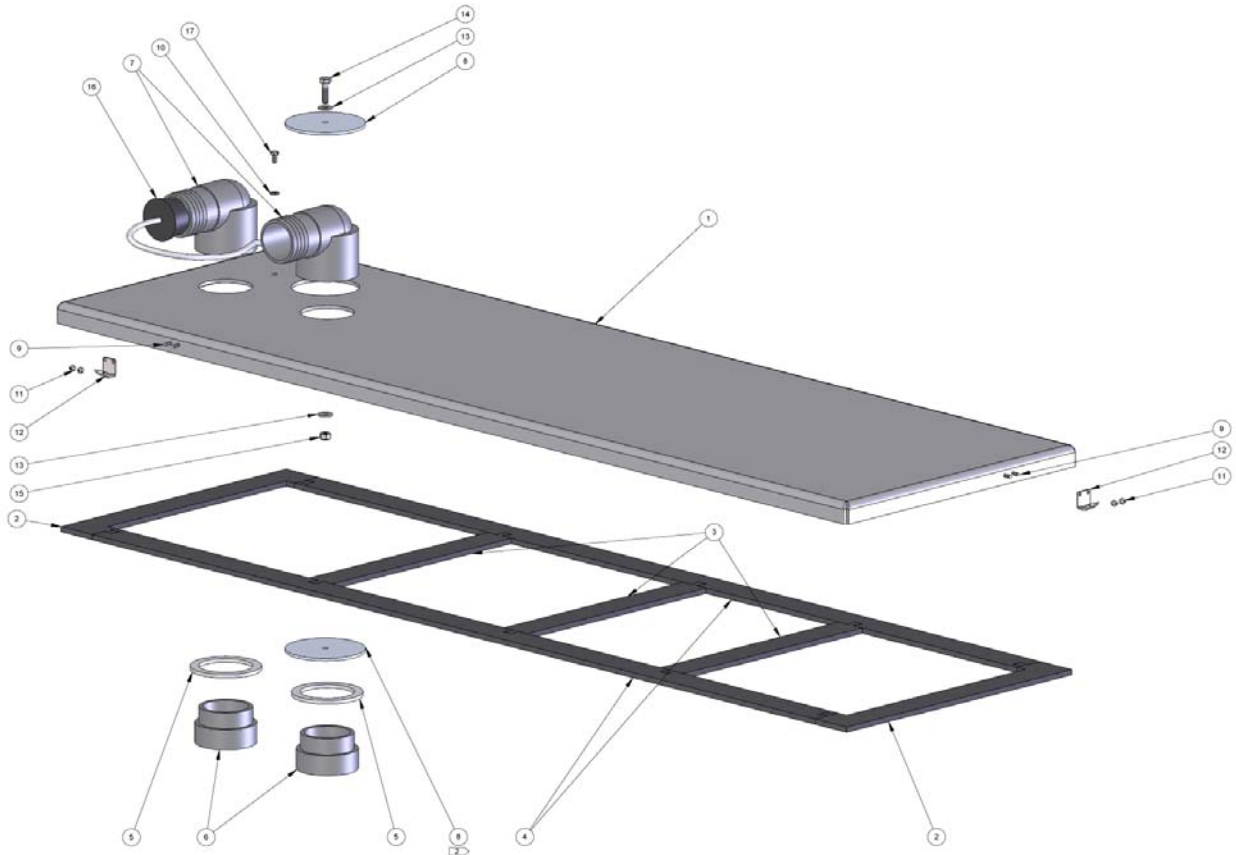
100 Gallon Universal Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
29	000-086-008	Latch, Bungee - Strike	2
30	000-143-539	Screw, #6-32UNC X 0.50" Lg. Button Head	4
31	000-094-063	Nut, #6-32UNC Nylock	4
32	000-052-763	Nipple, 1-1/2" Ips Close S/S	1
33	000-052-226	Insert, 1-1/2" Npt X 1-1/2" Barb (Grey)	1
34	000-052-085	Elbow, 1/4" Npt Street	1
35	000-052-102	Insert, #46 (1/4" Npt X 3/8" Barb)	2
36	000-169-022	Valve, 1-1/2" Full Port Ball	1
37	SEE NOTES	Label, Maintenance & Lube Schedule	1

Cover, 100 Gallon Universal Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-462	Cover, Recovery Tank - 100 Gallon W/ 2-1/2" Vac Port	1
2	000-057-202	Gasket, End - Urt	2
3	000-057-203	Gasket, Middle - Urt	3
4	000-057-205	Gasket, Side - Urt	2
5	000-057-015	Gasket, 1-1/2" Bulkhead Fitting	2
6	000-052-219	Adapter, 2" Npt X 2" F Slip	2
7	000-052-222	Elbow, 2" Barb X 2" Fpt	2
8	000-105-546	Plate, Ø3.50"	2
9	000-143-539	Screw, #6-32UNC X 0.50" Lg. Button Head	4
10	000-174-001	Washer, #10 Flat	1

Figure 8-42 Cover, 100 Gallon Universal Recovery Tank Assembly
D-6791

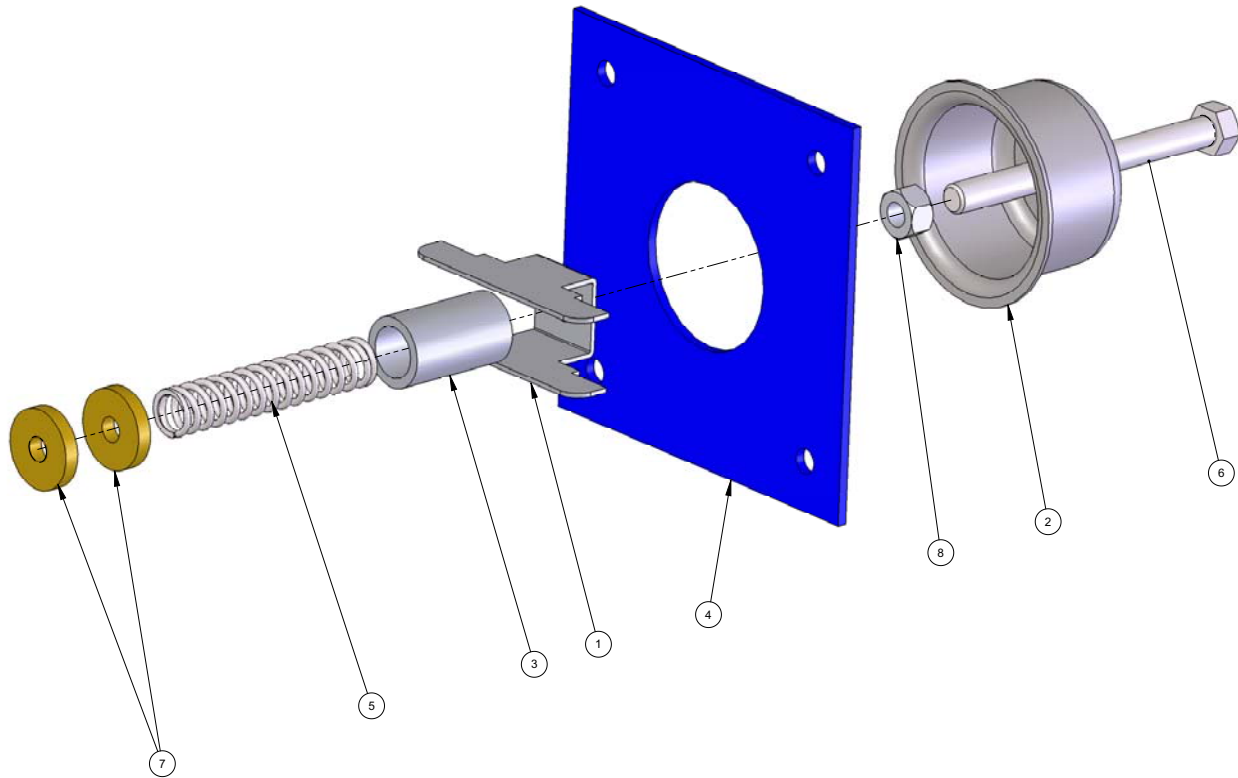


Cover, 100 Gallon Universal Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
11	000-094-063	Nut, #6-32UNC Nylock	4
12	000-086-008	Latch, Bungee - Catch	2
13	000-174-003	Washer, 1/4" Flat	2
14	000-143-002	Screw, 1/4"-20UNC X 1.00" Lg. Hex Head	1
15	000-094-009	Nut, 1/4"-20UNC Nylock	1
16	000-078-039	Assembly, Vacuum Inlet Stopper	1
17	000-143-166	Screw, #10-24UNC X 3/8" Lg. Hex Head	1

Figure 8-43 Vacuum Relief Valve Assembly

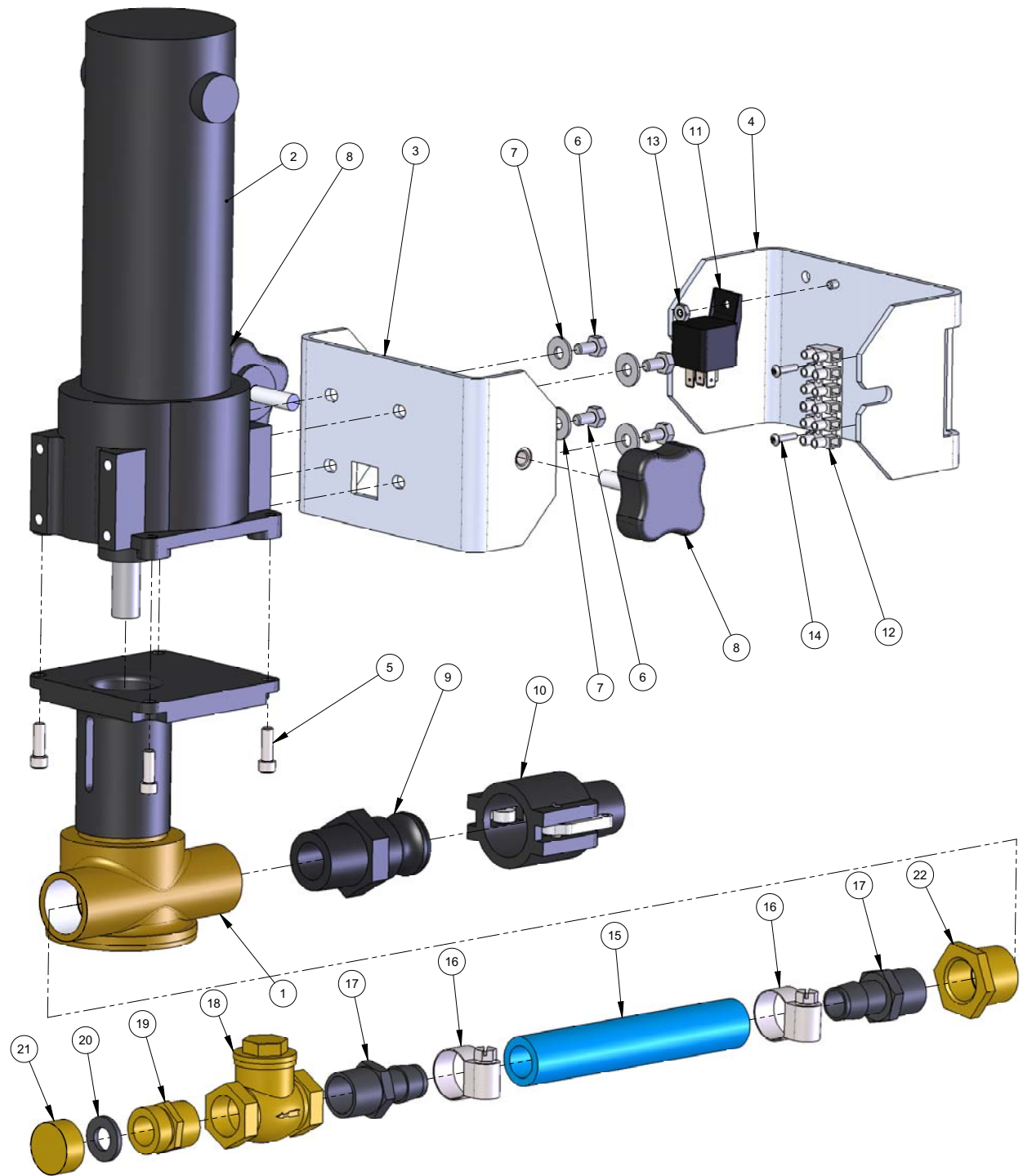
C-6894 Rev. -



Vacuum Relief Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-182	Bracket, Vacuum Relief Valve	1
2	000-027-032	Cap, Vacuum Relief Valve	1
3	000-125-111	Pipe, Vacuum Relief Spring Guide	1
4	000-105-332	Plate, Vacuum Relief Valve Mounting - Universal Recovery T	1
5	000-155-026	Spring, Vacuum Relief	1
6	000-143-198	Screw, 3/8"-16UNC x 4" Lg. Hex Head Full Thread	1
7	000-094-077	Nut, 3/8"-16UNC x 1.00" O.D. Knurled	2
8	000-094-101	Nut, 3/8"-16UNC Hex Jam	1

Figure 8-44 Dura-Flow APO Assembly
D-5654 Rev. E



Dura-Flow APO Assembly Parts List

Item	Part Number	Description	Qty
1	000-111-169	Assembly, APO Pump - Jabsco	1
2	000-091-042	Motor, Bison 438 Series	1
3	000-015-891	Bracket, APO Clamp	1
4	000-015-890	Bracket, Tank Mounted APO Support	1
5	000-143-566	Screw, 1/4-28UNF x 0.75" Lg. Socket Head	4
6	000-143-074	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head Self-Tapping	4
7	000-174-002	Washer, 1/4" Flat	4
8	000-061-131	Knob, Handle - RDM	2
9	000-052-723	Fitting, 1" NPT Cam Lock - Banjo 100F	1
10	000-052-724	Fitting, 1" NPT Cam Lock - Banjo 100B	1
11	000-157-022	Switch, Relay	1
12	000-012-011	Block, 6 Post	1
13	000-094-027	Nut, #10-24UNC Hex	1
14	000-143-532	Screw, #6-32UNC x 5/8" Lg. Socket Head	2
15	000-068-069	Hose, 3/4" I.D. Weatherhead - Blue - Bulk.	1
16	000-033-026	Clamp, Size #10 Hose	2
17	000-052-338	Insert, #1212 (3/4" NPT x 3/4" Barb)	2
18	000-169-009	Valve, 3/4" FPT Swing Check	1
19	000-052-281	Nipple, 3/4" NPT x 3/4" Male Garden Hose	1
20	000-057-055	Gasket, Garden Hose	1
21	000-027-014	Cap, Garden Hose	1
22	000-052-425	Bushing, 1" NPT x 3/4" FPT	1

Machine Hose Routings

P/N	Length	Description	Connection 1	Connection 2
068-018	72	1/2" Low Temp Rubber	Fresh Water-Dash	Water Tank [Inlet]
068-086	70	1/2" Hi-Temp Rubber	Bypass Valve	Water Tank [Return]
068-085	67	3/8" Hi-Temp Rubber	Chemical Prime	Water Tank [Solenoid]
068-326	62	3/8" Clear Braid	Flow Meter [Out/Top]	Chemical Pump
068-648	62	3/16" Teflon	Chemical Pump	Chemical Metering Valve
068-802	42	3/8" Teflon	Bypass Valve	Hi Pressure Pump
068-791	24	1" Rubber Low Temp	Hi Pressure Pump	Water Tank
068-801	37	3/8" Teflon	Coolant HX [Front]	3-Way Valve [Return/Bottom]
068-786	52	3/8" Teflon	3-Way Valve [Top/Out]	Coolant HX [Back]
068-787	18	3/8" Teflon	3-Way Valve [Out/Bottom]	Blower HX [Front]
068-788	27.5	3/8" Teflon	Orifice Manifold	Blower HX [Back]
068-326	52	3/8" Clear Braid	Chemical Jug	Flow Meter [In/Bottom]
068-806	6	3/8" Teflon	Check Valve [Sol.Manifold]	Orifice Manifold [Sol. Out]
068-512	10.25	3/8" Teflon	Bypass Valve Side Mainfold [Top]	Hi Presure Washing Outlet
068-512	10.25	3/8" Teflon	2-Way Valve [In/ Bottom]	Bypass Valve Side Manifold [Back]
068-512	10.25	3/8" Teflon	2-Way Valve [Out/Top]	3-Way Valve [Inlet/Middle]
068-790	10.25	3/16" Teflon	Chemical Metering Valve [Top]	Solution Manifold
068-789	7	3/16" Teflon	Bypass Bottom Manifold	Orifice Manifold [Orifice]
068-790	10.5	3/16" Teflon	Pressure Gauge	Bypass Valve Side Manifold [Top]
068-017	9.5	3/8" Hi-Temp Rubber	Water Box Drain Valve	Lower Bypass Manifold
068-086	60	3/8" Hi-Temp Rubber	Dump Solenoid	Recovery Tank

9 - How to Order Parts

This section describes how to obtain a proper diagnosis of any malfunctions, and how to order warranty replacement parts or repairs as outlined in the following areas:

- Warranty Parts Orders
- Parts Orders
- Emergencies
- One Final Note

WARRANTY PARTS ORDERS

1. Call the local distributor where you purchased your equipment and ask for the Service Department.
2. Have the following information ready:
 - A. Equipment Model
 - B. Date of Purchase
 - C. Hours on the Unit
 - D. Unit Serial Number
 - E. Description of Malfunction
3. Once it has been determined which parts are needed to correct the problem with your truckmount, make arrangements with your distributor to either perform the repairs or ship the parts to you.

PARTS ORDERS

Call your local distributor. In most instances, they either stock or have access to parts through a regional service center.

EMERGENCIES

If, for any reason, your distributor is unable to supply you with the necessary parts, they may call us and arrange for expedited shipping.

HydraMaster sells parts only through authorized distributors and service centers.

ONE FINAL NOTE

Any questions you have regarding the warranty program should be directed to the:

HydraMaster Customer Service Department
(425) 775-7275,
7 a.m. to 5 p.m.
Monday through Friday (PST).

We shall always endeavor to be fair in our evaluation of your warranty claim, and shall provide you with a complete analysis of our findings.

HydraMaster warranty covers only defective materials and/or workmanship for the periods listed. **Labor and/or diagnostic reimbursement is specifically excluded.**

10 - Warranty Information

This section lists causes of component failure that specifically void warranty coverage to avoid misunderstandings which might occur between truck mount owners and manufacturer. Such causes as listed in this section shall constitute **abuse** or **neglect**.

The following areas are covered in this section:

- Blower
- High Pressure Water Pump
- Vacuum Tank
- Chemical System
- Control Panel
- Vacuum and Solution Hoses
- Cleaning Wand
- Water Heating System
- Hard Water Deposits
- Warranty Procedure

Blower:

- Failure to lubricate the impellers daily with an oil based lubricant.
- Failure to lubricate the bearings as recommended in the blower manual.
- Failure to maintain the proper oil levels in the blower.
- Failure to use the correct oil grade and viscosity as recommended in the blower manual.
- Failure to properly maintain blower safeguard systems such as waste tank filter screen, vacuum safety relief valve and waste tank automatic shut-off system.
- Allowing foam to pass through the blower.

High Pressure Water Pump:

- Failure to maintain the proper oil level as recommended in the pump manual.
- Failure to change the oil in the pump at recommended intervals.
- Failure to protect the pump against freezing.
- Failure to maintain the pump protection shut-off system.
- Failure to use water softener in hard water areas.
- Use of improper chemicals.

Vacuum Tank:

- Failure to properly maintain the filtering devices in the tank.
- Failure to clean the tank as recommended by manufacturer.
- Failure to maintain the vacuum safety release in the tank.
- Use of improper chemicals.

Chemical System:

- Use of improper chemicals.
- Failure to use water softener in hard water area.
- Operating truck mount without a proper chemical filter screen.
- Failure to protect against freezing.

Control Panel:

- Failure to protect flowmeter and water pressure gauge against freezing.

Vacuum and Solution Hoses:

- Failure to protect the hoses against freezing.
- Failure to protect the hoses against burns from the engine and blower exhaust.
- Damage to the hoses from being run over by vehicles.
- Kinking or cracking from failure to store or unroll the hoses correctly.
- Normal wear and tear from everyday use.

Cleaning Wand:

- Failure to protect against freezing.
- Obvious physical abuse of the wand.

Water Heating System:

- Over-pressurization of the system (recommended maximum working pressure-1,000 PSI).
- Failure to protect against freezing.

Hard Water Deposits:

- Failure to use or maintain a water softening system or a properly installed magnetic-type de-scaler, whichever might be necessary, with truck mount's operating in designated "Hard Water Areas" (3.0 grains or more per gallon).

Warranty Procedure

Warranty coverage is available to you through *your local distributor*.

If you have moved to a new area or have purchased a used machine and need information regarding your local distributor, call HydraMaster at (425) 775-7275 or email us at custsvc@hydramaster.com.

When calling your distributor, be sure to have the machine's information (model and serial number) ready for the service representative.

IMPORTANT: HydraMaster's warranty policy provides replacement parts without charge for sixty (60) days to distributors maintaining current account status. An invoice will be sent to the distributor for the amount of the parts sent. The customer's faulty parts **must be** returned for evaluation prior to the expiration of the sixty (60) day period. Upon warranty approval, a credit will be issued the distributor for the replacement parts invoice. **Warranty disapproval or failure to return the faulty parts within the sixty (60) day period allowed will result in the customer being charged for the replacement parts sent.**

TITAN 875

Accessories

This section of the Owner's Manual is devoted to accessories and detergents which we have found to be helpful and useful. These products can enhance your cleaning and reduce your labor costs!

Genuine HydraMaster Accessories & Detergents

HydraMaster truck mount accessories are the most innovative collection available in the cleaning industry. Our patented **RX-20™ Rotary Extractors** have changed the shape of steam cleaning. Our hoses and tanks are of the finest quality construction.

HydraMaster chemicals have been specially prepared, not only to give you exceptional cleaning, but also to optimize your truck mount's operation and reliability. Most detergents don't work well under the high heat, high pressure conditions of truck mount use. SafeClean will maintain your machines's water pump and water heating systems at peak efficiency and help ensure fewer breakdowns.

For more information, or to order
Genuine HydraMaster Accessories and Detergents
Call your nearest authorized HydraMaster Distributor.

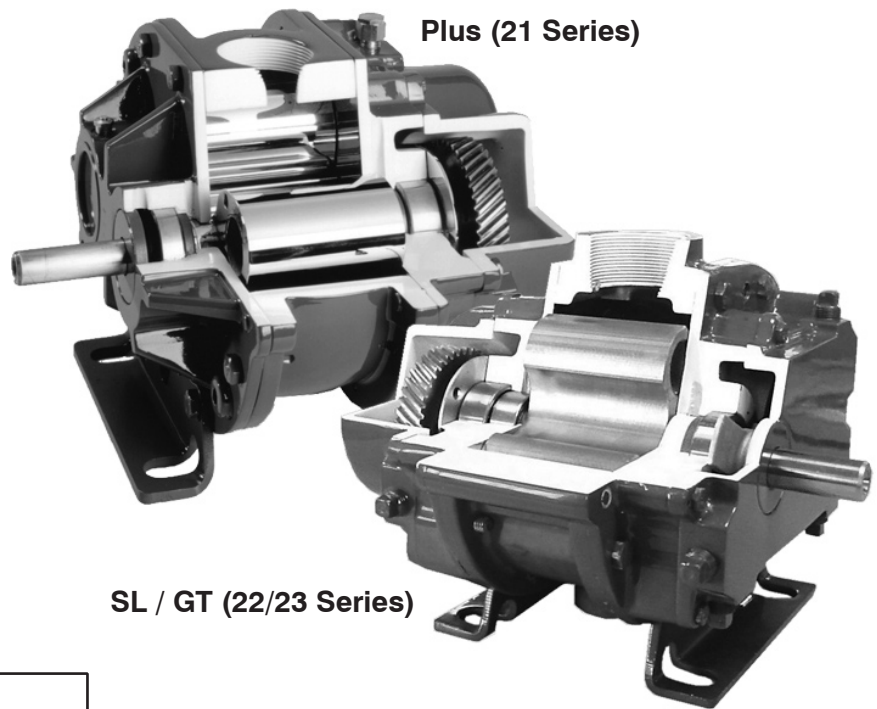
M-D Pneumatics™

COMPETITOR®

Rotary Positive Displacement Air & Gas Blowers

SERIES: 21 – Grease Lubrication / Air Service (Plus)
22 – Splash Lubrication / Air Service (SL)
23 – Splash Lubrication / Gas Service (GT)

INSTALLATION
OPERATION
MAINTENANCE
REPAIR
MANUAL



WARNING

DO NOT OPERATE
BEFORE READING MANUAL



6/2008

LEADING THE SEARCH FOR NEW SOLUTIONS



TUTHILL
Vacuum & Blower Systems

4840 West Kearney Street, P. O. Box 2877
Springfield, Missouri USA 65801-2877
Tel 417 865-8715 800 825-6937 Fax 417 865-2950
<http://vacuum.tuthill.com>

SAFETY INSTRUCTIONS

1. Do not operate before reading the enclosed instruction manual.
2. Use adequate protection, warning and safety equipment necessary to protect against hazards involved in installation and operation of this equipment.

NOTICE

1. The safety instruction tags shown below were attached to your unit prior to shipment. Do not remove, paint over or obscure in any manner.
2. Failure to heed these warnings could result in serious bodily injury to the personnel operating and maintaining this equipment.



SAFETY WARNINGS

- Keep hands and clothing away from rotating machinery, inlet and discharge openings.
- Blower and drive mounting bolts must be secured.
- Drive belts and coupling guards must be in place.
- Noise level may require ear protection.
- Blower heat can cause burns if touched.

TUTHILL VACUUM AND BLOWER SYSTEMS — SPRINGFIELD, MO USA

IMPORTANT

In order to assure you of the full benefits of our product warranty, please complete, tear out and return the warranty registration card located on the back cover of this manual, or you can register your product online at:

http://vacuum.tuthill.com/product_registration

SAFETY PRECAUTIONS

- For equipment covered specifically or indirectly in this instruction book, it is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should particularly be noted:
- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong, coarse screen over the inlet and avoid standing in discharge air stream.
- Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.
- Hearing protection may be required depending on silencing capabilities.

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INTRODUCTION

CONGRATULATIONS on your purchase of a new **COMPETITOR**[®] Rotary Positive Displacement Blower from Tuthill Vacuum & Blower Systems. Please examine the blower for shipping damage, and if any damage is found, report it immediately to the carrier. If the blower is to be installed at a later date make sure it is stored in a clean, dry location and rotated regularly. Make sure covers are kept on all openings. If blower is stored outdoors be sure to protect it from weather and corrosion.

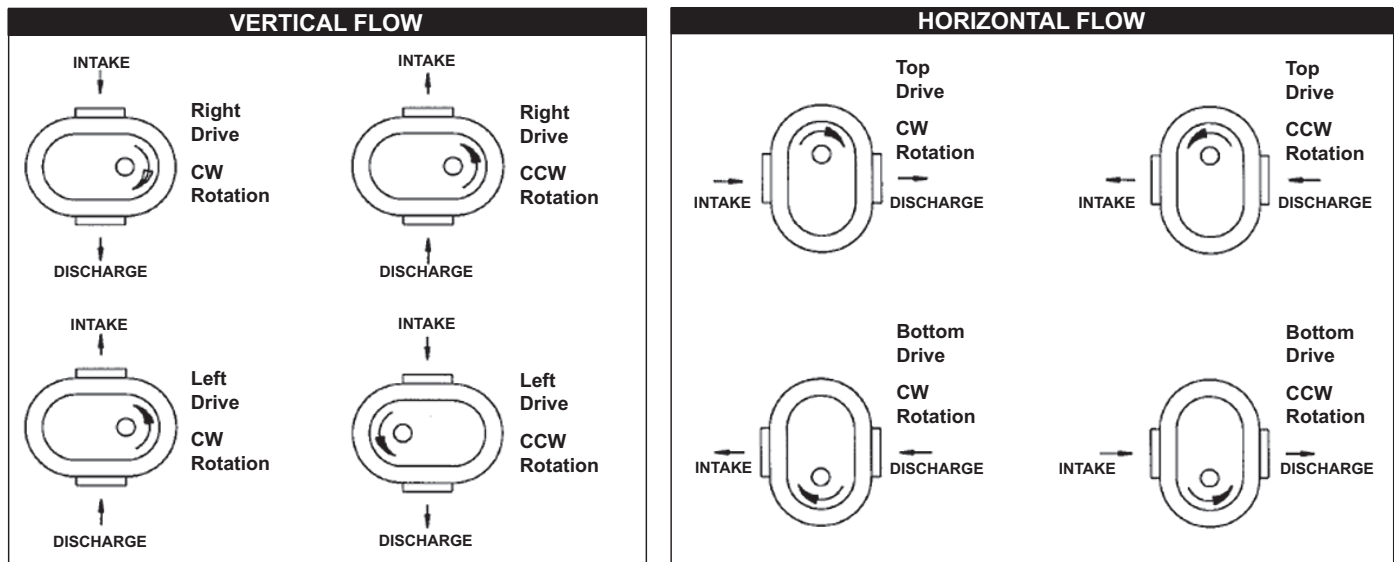
COMPETITOR blowers are built to exacting standards and if properly installed and maintained will provide many years of reliable service. We urge you to take time to read and follow every step of these instructions when installing and maintaining your blower. We have tried to make these instructions as straightforward as possible. We realize getting any new piece of equipment up and running in as little time as possible is imperative to production.

WARNING: Serious injury can result from operating or repairing this machine without first reading the service manual and taking adequate safety precautions.

IMPORTANT: Record the blower model and serial numbers of your machine in the OPERATING DATA form on the last page of this manual. You will save time and expense by including this reference identification on any replacement part orders, or if you require service or application assistance.

FLOW DIRECTION BY ROTATION

Refer to the illustrations below before installing inlet and discharge piping.



INSTALLATION

WARNING: Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in the installation and operation of this equipment in the system or facility.

Do not use air blowers on explosive or hazardous gases. Casing pressure must not exceed 25 PSIG (1.72 bar g). Each size blower has limits on pressure differential, running speed, and discharge temperature, which must not be exceeded. These limits are shown on the Specification Sheet "Maximum Operating Limits" on page 14.

LOCATION

Install the blower in a clean, dry, and well lighted area if possible. Leave plenty of room around the blower for inspection and maintenance.

FOUNDATION

We recommend a solid foundation be provided for permanent installation. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each.

Before tightening the bolts, check to see that both mounting feet are resting evenly on the foundation, shim as necessary to eliminate stress on the base when the bolts are tightened.

Where a solid foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members.

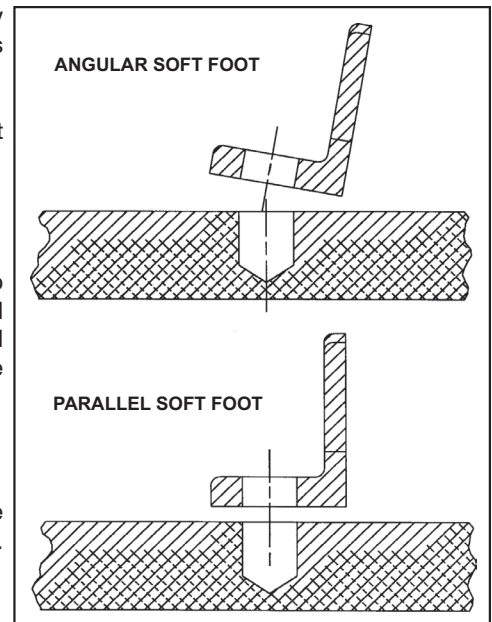
DRIVE

When the blower is V-belt driven the sheaves must be positioned so that the hub face of the blower sheave is not more than 1/4" (6.5 mm) from the blower drive end plate and the driver sheave is as close to the driver bearing as possible. Care should be taken when installing sheave onto shaft. The faces of the sheaves should be accurately in line to minimize belt wear.

Adjust the belt tension to the belt manufacturer's specifications.

For installations where the blower is to be operated by direct drive, selection of the driver should be such as not to exceed the maximum speed ratings of the blower. (See Specification Sheet "Maximum Operating Limits" on page 14.)

A flexible type coupling should be used to connect driver and blower shafts. The two shafts must be aligned within .005" (.13 mm) T.I.R. (Total Indicated Runout) Coupling face run out .003 (.8 mm) T.I.R..



Examples of Soft Foot

PROTECTIVE MATERIALS

Remove protective materials from the shaft. Remove the protective covers from the inlet and outlet ports and inspect the interior for dirt and foreign material.

WARNING: Keep hands, feet, foreign objects and loose clothes from inlet and outlet openings to avoid injury or damage if lobes are to be rotated at this point.

LUBRICATION

Do not start up the blower until you are positive that it has been properly and fully lubricated. (See Lubrication Section on page 6.)

PIPING

Inlet and outlet connections on all blowers are large enough to handle maximum volume with minimum friction loss. Maintain same diameter piping. Silencers must not be supported by the blower. Stress loads and bending moments must be avoided.

Be certain all piping is clean internally before connecting to the blower. We recommend placing a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Make provisions to clean the screen after a few hours of operation and completely discard it once the system is clean, as it will eventually deteriorate and small pieces going into the blower can cause serious damage. A horizontal or vertical air flow piping configuration is easily achieved by rearranging the mounting feet position.

WARNING: Do not operate equipment without adequate silencing devices since high noise level may cause hearing damage. (Reference OSHA Standards.)

RELIEF VALVES

We recommend the use of relief valves to protect against excessive pressure or vacuum conditions. These valves should be tested at initial start-up to be sure they are properly adjusted to relieve at or below the maximum pressure differential rating of the blower.

CAUTION: Upon completion of the installation, and before applying power, rotate the drive shaft by hand. It must move freely. If it does not, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment or any other cause for binding. If blower is removed and still does not rotate freely, check inside the blower housing for foreign material.

LUBRICATION

Every Tuthill blower is factory tested, oil drained and shipped dry to its installation point. Both independent oil reservoirs must be filled to the proper level before operation.

Shaft bearings at the gear end of the blower are splash lubricated by one or both gears dipping into an oil reservoir formed in the gear end plate and cover.

Shaft bearings at the drive end of the blower are lubricated by a slinger assembly dipping into an oil reservoir. Before starting the blower, fill oil sumps as shown below under "Filling Procedure." Tuthill approved mineral-based, synthetic and food grade lubricants are listed on page 15.

FILLING PROCEDURE

1. Remove fill plugs or breathers from both gear end and drive end plates.
2. SLOWLY pour oil through fill until oil appears in the oil sight glass. Bring oil level to center of sight glass.
3. Verify oil level is at proper level in BOTH gear end and drive end sight glasses.
4. Replace fill plugs or breathers that were removed in step 1.

CAUTION: Do not start the blower until you are sure oil has been put in the gear housing. Operation of the blower without proper lubrication will cause the blower to fail and void its warranty.

WARNING: NEVER ATTEMPT TO CHANGE OIL WHILE THE BLOWER IS IN OPERATION. Failure to heed this warning could result in damage to the equipment and/or serious personal injury. Oil level must be checked while the blower is not running.

APPROXIMATE OIL CAPACITIES

NOTE: Gear end amounts are for all series. Drive end amounts are for SL & GT (22 & 23 series).

MODEL	HORIZONTAL FLOW		VERTICAL AIR FLOW	
	GEAR END	DRIVE END	GEAR END	DRIVE END
2002 – 2004	1.7 ounces (50 mL)	N/A	3.4 ounces (100 mL)	N/A
3002 – 3006	3.4 ounces (100 mL)	2.5 ounces (75 mL)	6.0 ounces (180 mL)	4.0 ounces (120 mL)
4002 – 4007	5.8 ounces (170 mL)	4.7 ounces (140 mL)	8.5 ounces (250 mL)	6.4 ounces (190 mL)
5003 – 5009	7.1 ounces (210 mL)	5.4 ounces (160 mL)	18.3 ounces (540 mL)	10.2 ounces (300 mL)
6005 – 6015	16.9 ounces (500 mL)	9 ounces (265 mL)	25.5 ounces (750 mL)	18 ounces (530 mL)
7006 – 7018	20.3 ounces (600 mL)	N/A	28.7 ounces (850 mL)	N/A

** Oil capacities are based on filling from dry condition. Less oil may be needed depending on emptiness of oil reservoir(s) after draining. Always fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes. Following this procedure will insure proper oil level.*

LUBRICATION FAQ

What is the functional detriment if the "wrong oil" is used?

The lubricant is selected based on bearing and gear speed, and operating temperature. Too light of a lubricant increases wear by not separating the sliding surfaces and it will not remove the heat adequately. If the lubricant is too thick, the drag in the bearings is increased causing them to run hotter. Since it is thicker, it will not flow as readily into the gears and it will reduce the available backlash. Lubricants at our conditions are incompressible.

What is the functional detriment if the oil is not serviced?

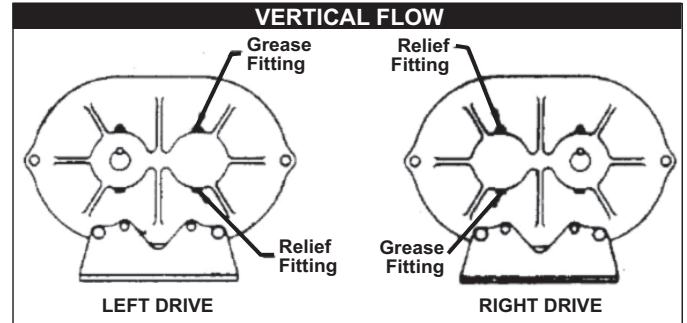
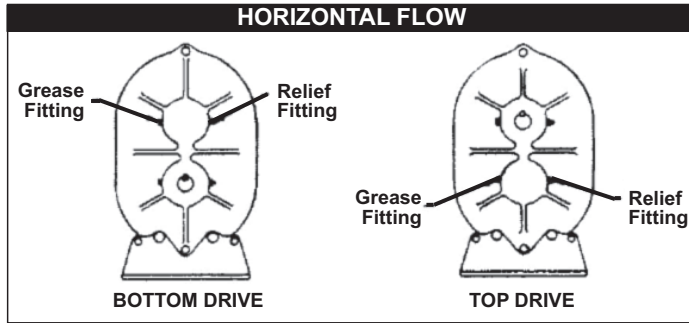
If the lubricant is not serviced at the proper interval the shearing action in the bearing and the gears will begin to take their toll and the lubricant will thicken, making matters worse. The unit will run hotter and the wear on running surfaces will increase. Generally, the lubricant will appear dirtier, this is actually material rubbed off the unit's components. The discoloration comes from overheating the additive package. An indicator of the breakdown of a lubricant is the increase in the TAN (Total Acid Number), and a change in the base viscosity of ten percent

GREASE LUBRICATED BEARINGS (21 SERIES ONLY)

Service drive end bearing at regular intervals. (See " Suggested Lubrication Intervals for Grease Lubricated Bearings" below.) Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability, such as PneuLube grease available from your local Tuthill Vacuum & Blower System Professional. Using a pressure gun, force new grease into each bearing until traces of clean grease comes out of the relief fitting.

CAUTION: To avoid blowing out the drive shaft seal, do not grease too rapidly.

NOTE: Drawings below show location of grease fitting and grease relief for horizontal and vertical flow units (21 series).

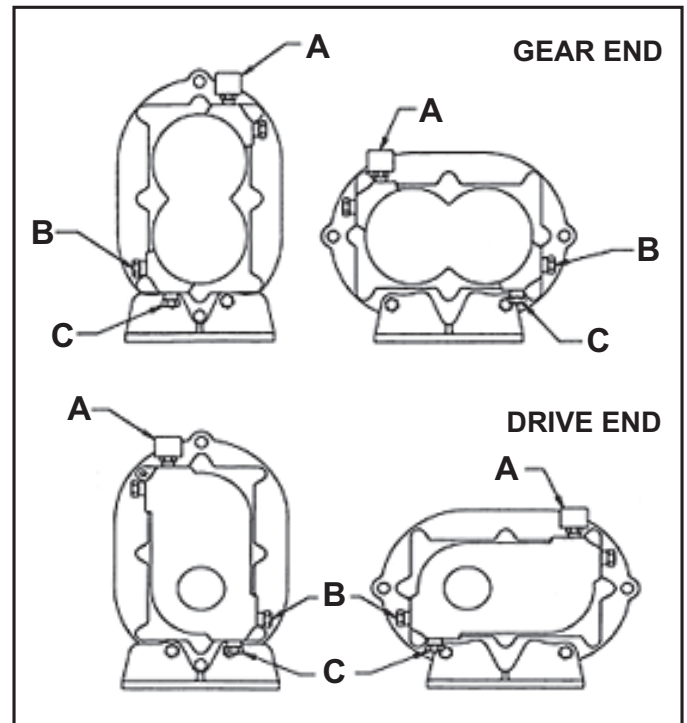


CAUTION:

Most Competitor blowers are shipped from the factory in a left hand drive, vertical flow configuration.

If drive shaft location is changed, the oil level plugs, sight glasses and breathers must be relocated to proper positions, as shown to the right.

Failure to change plug location will result in blower failure and void the product warranty.



- A = Breather
- B = Oil Level Sight Glass (Plug on 21 series)
- C = Magnetic Oil Drain Plug

LUBRICATION INSTRUCTIONS FOR OIL LUBRICATED GEARS AND BEARINGS

Add fresh oil as required to maintain proper level. Drain and refill after the first 100 hours of operation and thereafter every 1,000 hours of operation under normal service, more frequently depending on the type of oil and oil operating temperature. Use a good quality oil, such as PneuLube, available through your local Tuthill Pneumatics Sales Professional.

SEE PAGE 15 FOR A LIST OF RECOMMENDED LUBRICANTS.

SPEED IN RPM	OPERATING HOURS PER DAY		
	8	16	24
GREASING INTERVALS IN WEEKS			
750 - 1000	7	4	2
1000 - 1500	5	2	1
1500 - 2000	4	2	1
2000 - 2500	3	1	1
2500 - 3000	2	1	1
3000 and up	1	1	1

PREVENTATIVE MAINTENANCE

A good maintenance program will add years of service to your blower. A newly installed blower should be checked frequently during the first month of operation, especially lubrication. Check oil level in both the drive end and gear end of the blower and add oil as needed. Complete oil changes are recommended every 1000 operating hours, or more frequently depending on the type of oil and oil operating temperature. *The following is recommended as a minimum maintenance program.*

DAILY	WEEKLY	MONTHLY
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See Troubleshooting on page 8)	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage. 2. Check relief valve to assure it is operating properly	1. Inspect the entire system for leaks. 2. Inspect condition of oil and change if necessary (see page 6) 3. Check drive belt tension and tighten if necessary.

START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked off (☑) in the boxes provided in any of the following cases:

- During initial installation
- After any shutdown period
- After maintenance work has been performed
- After blower has been moved to a new location

DATES CHECKED:

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Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to Lubrication Section.

Check Alignment.

For Direct Drive: Check coupling and shaft alignment.

For Belt Drive: Check for proper belt alignment and tension.

Turn the rotors by hand to be certain they do not bind. **WARNING: Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor or drive components.**

Bump the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.

Start the unit and operate it for 30 minutes at no load. During this time feel the cylinder for hot spots. If minor hot spots occur, refer to the Troubleshooting Section (page 8).

Apply the load and observe the operation of the unit for one hour. Check the unit frequently during the first day of operation.

If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section (page 8).

RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

When high humidity or moisture is present in an air piping system, condensation of water can occur after the blower is shut down and the blower begins to cool. This creates an environment favorable to corrosion of the iron internal surfaces, or in cold weather, the formation of ice. Either of these conditions can close the operating clearances, causing the blower to fail upon future start-up.

The shutdown procedure outlined below minimizes the risk of moisture condensation, corrosion and freezing. Care must be taken to avoid overloading or overheating.

Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.

For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.

For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One®** or a spray lubricant such as WD-40®** into the inlet of the blower just prior to shutdown. The lubricant will provide an excellent protective coating on the internal surfaces.

If using a spray lubricant, exercise care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, most likely to the point that repair would be required.

* 3-in-One and WD-40 are registered trademarks of WD-40 Company.

TROUBLESHOOTING

Although Competitor blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The chart below lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly.	Tighten gear housing bolts.
	Lip seal failure.	Disassemble and replace lip seal.
	Insufficient sealant.	Remove gear housing and replace sealant. (See Disassembly and Inspection section on page 10)
	Loose drain plug.	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication.	Correct oil level. Replace dirty oil. (See Lubrication section on page 6)
	Excessive belt tension.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment.	Check carefully, realign if necessary.
Lack of volume	Slipping belts.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances.	Check for proper clearances (See Assembly Clearances on page 14)
	Speed too low.	Increase blower speed within limits.
	Obstruction in piping.	Check system to assure an open flow path.
Knocking	Unit out of time.	Re-time.
	Distortion due to improper mounting or pipe strains.	Check mounting alignment and relieve pipe strains.
	Excessive pressure differential.	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.
	Worn gears.	Replace timing gears (See Disassembly and Inspection section on page 10)
Excessive blower temperature	Too much or too little oil in gear reservoir.	Check oil level. (See Lubrication section on page 6)
	Too low operating speed.	Increase blower speed within limits.
	Clogged filter or silencer.	Remove cause of obstruction.
	Excessive pressure differential.	Reduce pressure differential across the blower.
	Elevated inlet temperature.	Reduce inlet temperature.
	Worn lobe clearances.	Check for proper clearances (See Assembly Clearances on page 14)
Rotor end or tip drag	Insufficient assembled clearances.	Correct clearances (See Assembly Clearances on page 14)
	Case or frame distortion.	Check mounting and pipe strain.
	Excessive operating pressure.	Reduce pressure differential.
	Excessive operating temperature.	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment.	Check carefully, realign if necessary.
	Lobes rubbing.	Check cylinder for hot spots, then check for lobe contact at these points. Correct clearances (See Assembly Clearances on page 14).
	Worn bearings or gears.	Check condition of gears and bearings; replace if necessary.
	Unbalanced or rubbing lobes.	Possible buildup on casing or lobes, or inside lobes. Remove buildup and restore clearances.
	Driver or blower loose.	Check mounting and tighten if necessary.
	Piping resonance.	Check pipe supports, check resonance of nearby equipment, check foundation.

TROUBLESHOOTING FAQ

What are the perceived modes of failure when units are run beyond the specified duty cycles?

Several things are happening as the lubricant goes through the unit. First, it is absorbing frictional energy in the form of heat. This heat has to be dissipated through either surface contact with cooler materials, or in a rest volume of lubricant. While reducing the friction, the lubricant is also going through a shearing process and the molecular structure is broken down.

The result is that the lubricant will begin to thicken. Because of the shorter molecular chains and the drop out of additive packages. The thickened lubricant will cause more drag, increasing the friction and heat, and further degrading the lubricant.

Operation of the blower (environment, run time, speed, and pressure) has a direct effect on duty cycles. Our published cycles are based on worst-case conditions.

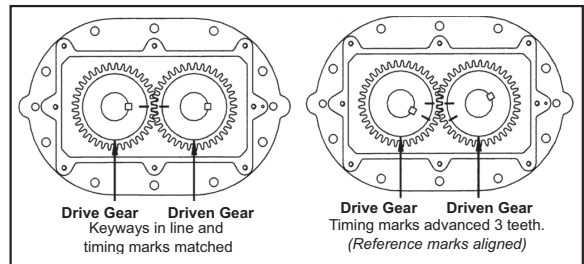


Figure 1. Timing Gear Alignment

DISASSEMBLY & INSPECTION

With proper maintenance and lubrication, normal life expectancy for gears, bearings, and seals can be achieved. However, over a period of time these parts must be repaired or replaced to maintain the efficiency of your blower. This section is written in a way that will allow you to completely disassemble your blower. The inspection of certain repairable or replaceable parts is referred to at the point of disassembly where these parts are exposed. If at any point of inspection, repair or replacement is deemed necessary, appropriate instruction will be given to achieve these repairs or replacements.

NOTE: Items in brackets [] reference item numbers on page 16.

1. Remove the oil drain plugs [18] in the bottom of the end covers [Items 5 & 10] and drain the oil.
2. Take out eight cap screws [16] and remove the gear cover. It may be necessary to tap the sides with a mallet or wooden block to break the seal joint. **NOTE: Gears are not exposed for visual inspection.**

Inspect the gears for the following:

- Broken Teeth
- Chipped Teeth
- Uneven Wear
- Excessive Wear
- Any Other Abnormalities

WARNING: Before performing any repair or replacement, disconnect and lock out power.

1. Position blower with the drive gear on the left when facing the gears. Remove socket head screws and washers. [items 29 & 26].
2. Align timing marks and count three (3) teeth up and place reference marks on the gears. (Refer to Figure 1)
3. Align reference marks and use puller to pull the driven gear. (shown on right side in Figure 2)
4. Use puller to remove drive gear. A bar puller (Refer to Figure 3 below) or jack screws can be used.
5. Remove shim and spacer. [Items 28 & 30], and note from which shaft the shim is removed.



Figure 2. Pulling Driven Gear with Jaw Puller

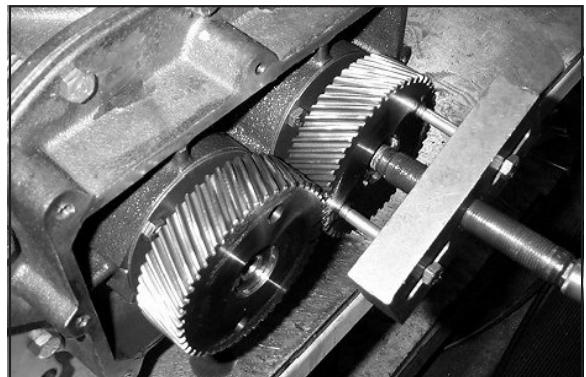


Figure 3. Pulling Drive Gear with Bar Puller

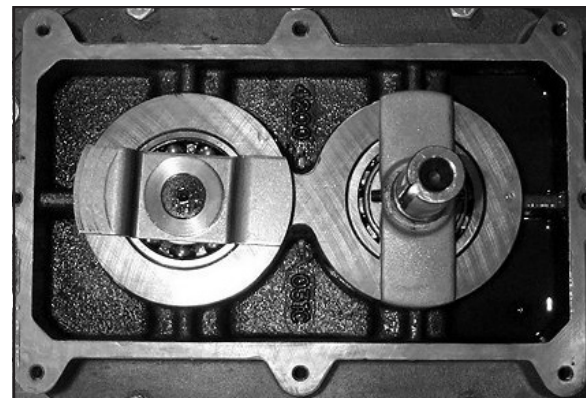


Figure 4. Pulling Drive End Plate

6. Turn blower around and remove eight (8) cap screws securing the drive end cover [10].
7. Remove cover.
8. Loosen the set screws on the oil slingers [Items 45 & 46] and remove the oil slingers from the rotor shafts. (Refer to Figure 4 below)
9. Remove ten (10) cap screws [15] that secure drive end plate [3] to housing [1].
10. Use a jaw puller to remove drive end plate. (Refer to Figure 5)
11. Press rotors out of end plate in press if available. If press is not available, support end plate and rotors in the housing. Block up housing and use a soft mallet to drive the rotors out. (Refer to Figure 6)
12. A jaw type puller can also be used. (Refer to Figure 7)
13. Using a tube or round bar of a slightly smaller diameter than the shaft clearance holes in the end plates, tap the bearings out of the end plates. Bearing retainers [22] must be removed before knocking out the bearings. (Refer to Figure 8)
14. Remove seals from both end plates with a punch or dull chisel. The seals will be damaged during removal and must be replaced.
15. Inspect all parts for wear and or damage.
16. Clean and inspect all parts for burrs and polish seal journals with at least 320 grit emery or crocus cloth.

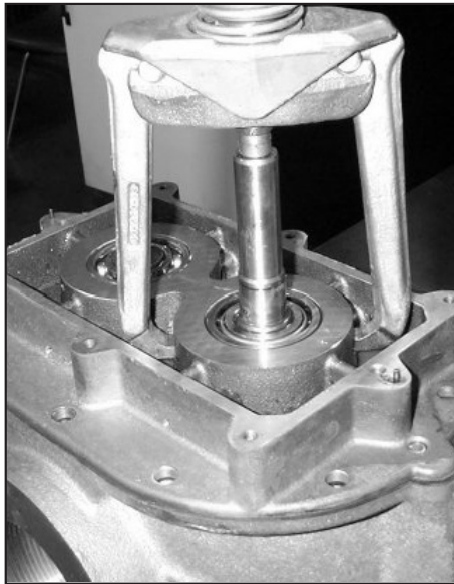


Figure 5. Pulling Drive End Plate

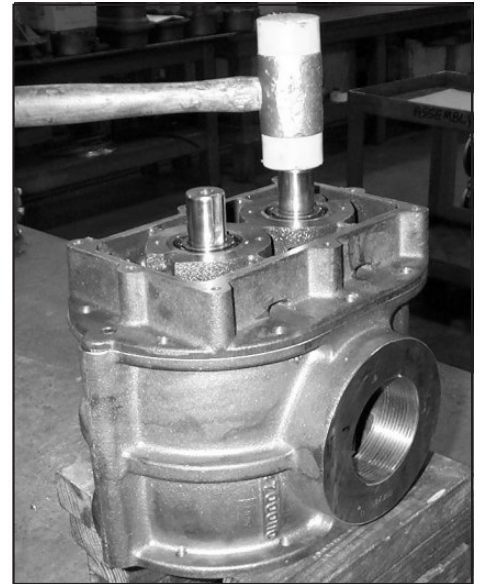


Figure 6. Driving Rotors Out Using Soft Mallet

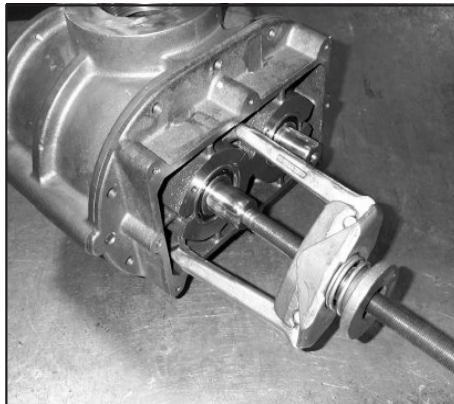


Figure 7. Driving Rotors Out Using Jaw Puller

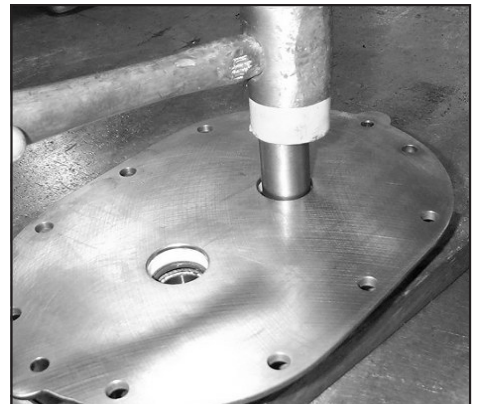


Figure 8. Tapping Bearings Out of End Plates

BLOWER ASSEMBLY

After thorough cleaning of the seal and bearing bores of both end plates apply a thin coat of sealant on the outside diameter of the new seals and press them into the end plate using a tool that will bear on the outer edge of the seal. Spring side of the seal should be facing you. Apply a thin coat of grease to the seal lip.

See page 15 for drawings and dimensions of seal and bearing pressing tools.

Using the drive end plate as a fixture, support it high enough so the input shaft of the drive rotor clears the assembly surface. (Refer to Figure 9). Place rotors in fixture with the drive rotor to the left. (See Figures 9 and 12 below)

MECHANICAL SEAL INSTALLATION

1. Clean and deburr seal bore in endplate. Clean the face of the carbon and mating ring with alcohol etc. Apply a thin layer of silicon to the bottom face of the seal.
2. Place end plate [Item 4] on rotors.
3. Apply a thin coat of lubricant on the rotor shafts and the inner race of the bearings. Tap the bearings [13] into place using a tube with a flanged end that will contact both the inner and outer bearing races. (Refer to Figure 10 below). **WARNING: Keep hands and loose clothing away from lobes and gears.**

4. Install bearing retainers [Items 22 & 25] to both bearings.
5. Check clearances between the end of the rotors and the face of the end plate. Refer to assembly clearances chart on page 14 for proper clearances for your model blower, and refer to page 13 for procedures for checking and adjusting clearances.
6. If clearances check OK, put a spacer [28] and a shim [30] on each shaft. Timing shims that were removed should be put back on the shaft from which they were removed.
7. Lubricate shafts and bores on gears. Begin by pressing on the DRIVE gear. This will be pressed on the drive rotor, which is to the left.
8. Start the driver gear on the shaft and align the reference timing marks and press gear on. Lock gears in place with socket head screw [29] and washer [26]. Turn assembly over and rest the unit on the socket head screws and washers on the gear end.
9. Set dowel pins [9] in housing and position housing over the rotors and fasten with cap screws [15]. Check housing to rotor clearance. (Refer to Figure 13) A depth mic can be used.
10. Set on drive end plate [3] and fasten with cap screws [15]. (*ATTENTION: There are four cap screws [17] which are used to attach the feet.*) Lubricate shafts and bearings. Install the ball bearing [12] on the driven rotor and the roller bearing [11] on the input shaft.
11. Apply a bead of a good quality RTV silicone sealant to the inner surface of the drive end cover [10] that mates to the drive end plate [3]. Install drive end cover and drive shaft seal [23].
12. Install any removed plugs [18], sight glasses [21] and replace breather [27] if required.



Figure 9. Rotors Assembled on Drive End Plate (Model 4000 with tri-lobe rotors shown)



Figure 10. Tapping Bearings into End Plates



Figure 11. Checking Gear End Clearances

LUBRICATION, FINAL ASSEMBLY AND MOUNTING

1. Apply a bead of a good quality RTV silicone sealant to the inner surface of the gear end cover [5] that mates to the gear end plate [4]. Install the gear end cover with cap screws [16] and tighten evenly.
2. Fill both end covers with oil. Refer to the Lubrication Section in this manual (page 6) for filling procedure, and page 15 for recommended lubricants.
3. To insure blower has not been distorted during mounting in the installation, turn the lobes by hand to make sure they are not making contact prior to connecting to the driver.

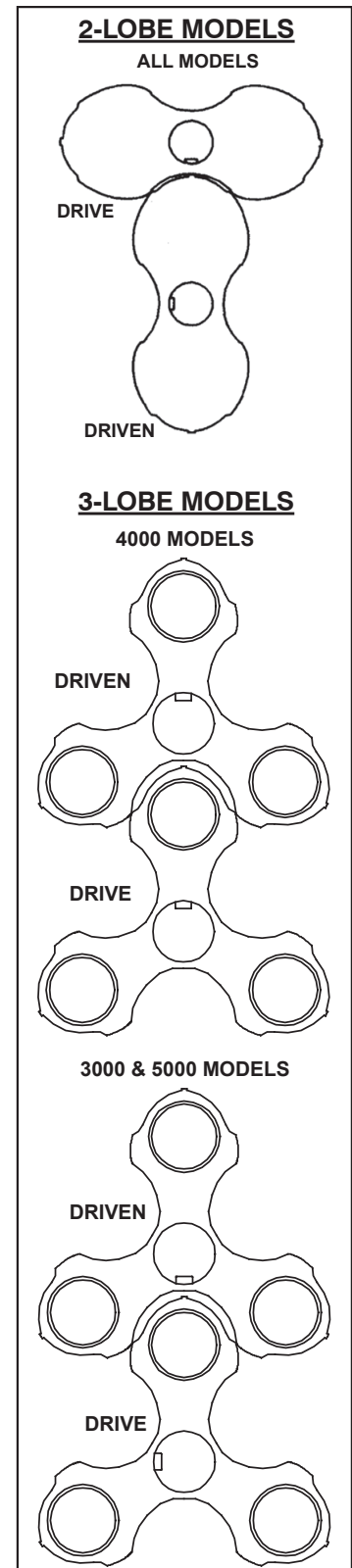


Figure 12. Details of Proper Keyway Positions

COMPETITOR®

MAINTENANCE AND SERVICE SPECIFICATIONS SHEET ASSEMBLY CLEARANCES

Metric values (mm) are shown in parentheses ()
All other values are in inches

MODEL	LOBES TO END PLATES			INTERLOBE	LOBE TO CASING	
	DRIVE END	GEAR END	TOTAL		TIP-DOWEL	TIP-PORT
2002, 2004	.004 - .007 .10 - .18	.003 - .005 .07 - .13	.008 - .011 .20 - .28	.005 - .009 .13 - .23	.002 - .004 .05 - .10	.003 - .006 .08 - .15
3002	.004 - .007 .10 - .18	.003 - .005 .07 - .13	.008 - .012 .20 - .30	.006 - .012 .15 - .30	.002 - .005 .05 - .13	.004 - .007 .10 - .18
3003	.005 - .008 .13 - .20	.003 - .005 .07 - .13	.009 - .012 .23 - .30	.010 - .014 .25 - .36	.002 - .005 .05 - .13	.004 - .007 .10 - .18
3006	.006 - .010 .15 - .25	.003 - .005 .08 - .13	.010 - .013 .25 - .33	.010 - .014 .25 - .36	.002 - .005 .05 - .13	.004 - .007 .10 - .18
4002	.004 - .009 .10 - .23	.004 - .006 .10 - .15	.009 - .013 .23 - .33	.012 - .016 .30 - .41	.003 - .006 .08 - .15	.005 - .008 .13 - .20
4005, 4007	.005 - .010 .12 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.012 - .016 .30 - .41	.003 - .006 .08 - .15	.005 - .008 .13 - .20
5003	.004 - .009 .10 - .23	.004 - .006 .10 - .15	.009 - .013 .29 - .33	.014 - .018 .36 - .46	.003 - .006 .08 - .15	.005 - .008 .13 - .20
5006, 5009	.005 - .010 .13 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.014 - .018 .36 - .46	.003 - .006 .08 - .15	.005 - .008 .13 - .20
6005, 6008	.008 - .013 .20 - .33	.005 - .007 .12 - .18	.015 - .019 .38 - .48	.010 - .014 .25 - .36	.004 - .007 .10 - .18	.006 - .009 .15 - .23
6015	.009 - .014 .23 - .36	.005 - .007 .13 - .18	.016 - .020 .40 - .50	.010 - .014 .25 - .36	.004 - .007 .10 - .18	.006 - .009 .15 - .23
7006	.008 - .012 .20 - .30	.005 - .007 .13 - .18	.015 - .018 .38 - .46	.012 - .016 .30 - .41	.004 - .007 .10 - .18	.006 - .009 .15 - .23
7011, 7018	.010 - .014 .25 - .36	.005 - .007 .13 - .18	.017 - .020 .43 - .51	.012 - .016 .30 - .41	.004 - .007 .10 - .18	.006 - .009 .15 - .23

MAXIMUM OPERATING LIMITS

MODEL	RPM	PRESSURE PSI / mbar	VACUUM in. Hg / mbar	TEMPERATURE RISE F° / C°
2002	5275	12 / 825	16 / 540	225 / 125
2004	5275	7 / 480	16 / 540	185 / 103
3002	3600	15 / 1035	16 / 540	210 / 116
3003	3600	12 / 825	15 / 508	180 / 100
3006	3600	7 / 480	15 / 508	170 / 94
4002	3600	15 / 1035	16 / 540	220 / 122
4005	3600	10 / 690	16 / 540	210 / 116
4007	3600	7 / 480	15 / 508	170 / 94
5003	2850	15 / 1035	16 / 540	195 / 108
5006	2850	13 / 900	16 / 540	195 / 108
5009	2850	7 / 480	15 / 508	160 / 89
6005	2350	15 / 1035	16 / 540	250 / 139
6008	2350	14 / 965	16 / 540	240 / 133
6015	2350	7 / 485	12 / 410	180 / 100
7006	2050	15 / 1035	16 / 540	235 / 130
7011	2050	10 / 690	16 / 540	210 / 116
7018	2050	6 / 415	12 / 410	120 / 66

RECOMMENDED LUBRICANTS
OIL CAPACITIES ARE SHOWN ON PAGE 6

RECOMMENDED MINERAL BASED LUBRICANTS				
AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON TEXACO	EXXONMOBIL
0° to 32° F (-18° to 0° C)	TELLUS® 68 (ISO 68)	A/W 68 (ISO 68)	RANDO HD 68 (ISO 68)	DTE HEAVY MEDIUM (ISO 68)
32° to 90° F (0° to 32° C)	TELLUS® 100 (ISO 100)	A/W 100 (ISO 100)	RANDO HD 100 (ISO 100)	DTE HEAVY (ISO 100)
90° to 120° F (32° to 50° C)	TELLUS® 150 (ISO 150)	A/W 150 (ISO 150)	RANDO HD 150 (ISO 150)	DTE EXTRA HEAVY (ISO 150)

RECOMMENDED SYNTHETIC BASED LUBRICANTS*			
AMBIENT TEMPERATURE	TUTHILL	EXXONMOBIL	SHELL
0° to 32° F (-18° to 0° C)	PneuLube™ (ISO 100)	SHC 626 (ISO 68)	OMALA® RL 68 (ISO 68)
32° to 90° F (0° to 32° C)		SHC 627 (ISO 100)	OMALA® RL 100 (ISO 100)
90° to 120° F (32° to 50° C)		SHC 629 (ISO 150)	OMALA® RL 150 (ISO 150)

* Blowers used in oxygen-enriched service should use only Castrol Brayco 1726 Plus non-flammable, PFPE synthetic lubricant. Blowers used in hydrogen service should use only PneuLube synthetic oil. Tuthill Vacuum & Blower Systems cannot accept responsibility for damage to seals, O-rings and gaskets caused by use of synthetic lubricants not recommended by Tuthill Vacuum and Blower Systems.

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact
0° to 32° F (-18° to 0° C)	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° to 90° F (0° to 32° C)	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° to 120° F (32° to 50° C)	CONSULT FACTORY	CONSULT FACTORY

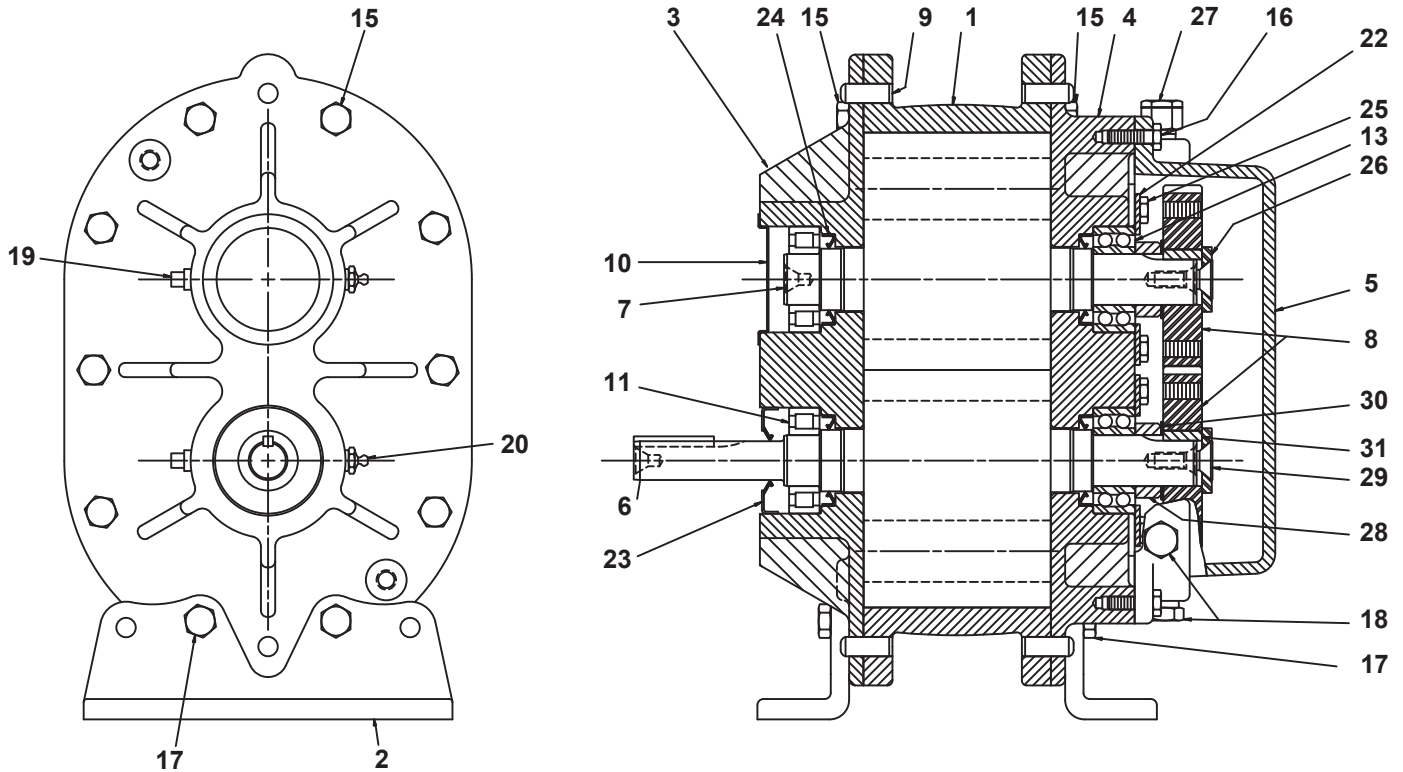
RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact
0° to 32° F (-18° to 0° C)	PneuLube™ FG (ISO 100)	CONSULT FACTORY
32° to 90° F (0° to 32° C)		
90° to 120° F (32° to 50° C)		

RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS (90/91, 92/93, 96, 31/33 AND 35/37 SERIES)	
REQUIREMENTS	TYPICAL LUBRICANTS
<ul style="list-style-type: none"> Suitable for high vacuum service 68-100 cSt @ 104° F (40° C) Vapor pressure of 1 micron or less @ 70° F (21° C) Straight mineral (no additives) or PAO synthetic oil 	TUTHILL: PneuLube (synthetic) MOBIL: DTE 16 (mineral based) SHELL: Turbo T 68 (mineral based) SUNOCO: Sunvis 31 (mineral based)

RECOMMENDED GREASE FOR COMPETITOR® PLUS BLOWERS:	
TUTHILL	CITGO
Tuthill PneuLube™ NLGI #2 premium grade, petroleum base lithium grease.	For food grade requirements: Use Citgo Clarion® Food Grade HTEP grease, NLGI No. 2 grade. It meets all requirements of FDA Regulation 21 CFR 178.3570 (the former USDA H-1 approval requirements) for lubricants having incidental contact with food.

COMPETITOR®

CUTAWAY VIEW AND PARTS LIST – 21 SERIES



ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	18	Plug, Oil	3
2	Mounting Foot	2 *	19	Relief Fitting	2
3	Drive End Plate	1	20	Grease Fitting	2
4	Gear End Plate	1	22	Bearing Retainer	4
5	Gear Cover	1	23	Lip Seal, Drive Shaft	1
6	Drive Rotor	1	24	Lip Seal	4
7	Driven Rotor	1	25	Screw, Hex Head	4
8	Timing Gear	2	26	Washer	2
9	Dowel Pin	4	27	Breather	1 †
10	Bearing Cover Plate	1	28	Spacer	2
11	Roller Bearing, Drive Shaft	1	29	Screw, Hex Head	2
12	Bearing	1	30	Timing Shims	10
13	Bearing	2	31	Gear Timing Key	2
15	Screw, Hex Head	16	42	Alum. Nameplate Kit	1
16	Screw, Hex Head	8 **	43	Dr, Screw	2
17	Screw, Hex Head	4	47	Teflon Vent Insert	8

* Item 2: Models 6005, 6008, 6015, 7006, 7011 and 7018 require (2) each of left and right feet.

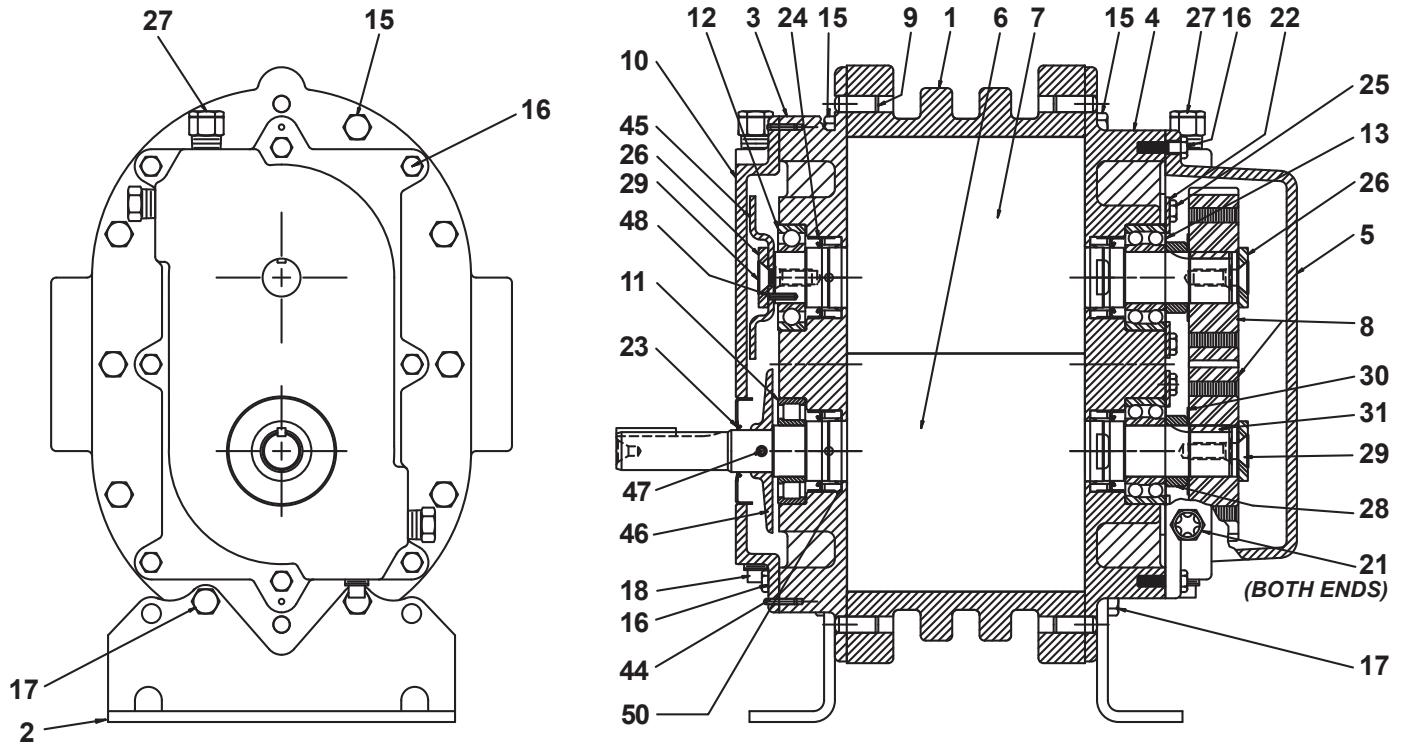
** Item 16: Models 5003, 5006 and 5009 require (6) each.

† Item 27: Models 2002 and 2004 requires a pipe plug in lieu of breather.

NOTE: When ordering parts, use the item number shown, plus your model and serial number.

COMPETITOR®

CUTAWAY VIEW AND PARTS LIST – 22 & 23 SERIES



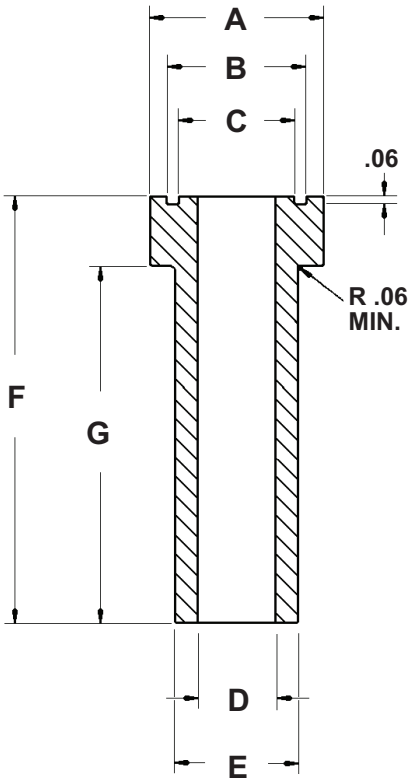
ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	21	Sight Gauge	2
2	Mounting foot	2	22	Bearing Retainer	2
3	Drive End Plate	1	23	Lip Seal	1
4	Gear End Plate	1	24	Lip Seal (Series 22 – SL units)	4
5	Gear Cover	1	24	Mechanical Seal (Series 23 – GT units)	4
6	Drive Rotor	1	25	Screw, Hex Head	4
7	Driven Rotor	1	26	Washer	2
8	Timing Gear	2	27	Breather	2
9	Dowel Pin	4	28	Spacer	2
10	Drive Cover	1	29	Screw, Socket Head	3
11	Roller Bearing	1	30	Timing Shims	1
12	Bearing	1	31	Timing Gear Key	2
13	Bearing	2	44	Dowel Pin	1
15	Screw, Hex Head	16	45	Slinger	1
16	Screw, Hex Head	16	46	Slinger	1
17	Screw, Hex Head	4	47	Set Screw	2
18	Drain Plug	2	48	Roll Pin	2
19	Pipe Plug	2	50	Lab Seal	4

NOTE: When ordering parts, use the item number shown, plus your model and serial number.

SPECIAL TOOL DRAWINGS

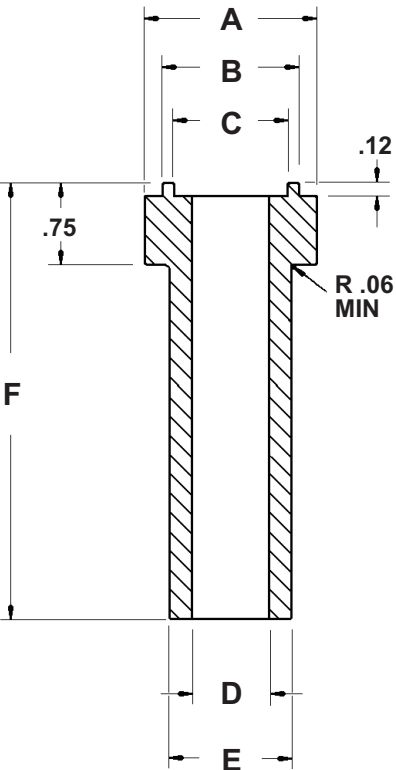
All dimensions shown are in inches.

BEARING PRESSING TOOL (FOR ALL SERIES)



MODEL	A	B	C	D	E	F	G
2000	1.560 ±.001	1.27 ±.005	.98 ±.005	.70 ±.005	1.10 ±.005	3.50 ±.005	3.00 ±.005
3000	2.035 ±.001	1.70 ±.005	1.335 ±.005	1.015 ±.005	1.415 ±.005	3.75 ±.005	3.00 ±.005
4000	2.425 ±.001	2.02 ±.005	1.61 ±.005	1.21 ±.005	1.61 ±.005	4.50 ±.005	3.75 ±.005
5000	2.820 ±.001	2.42 ±.005	1.81 ±.005	1.41 ±.005	1.81 ±.005	5.00 ±.005	4.25 ±.005
6000	3.135 ±.001	2.73 ±.005	2.00 ±.005	1.605 ±.005	2.00 ±.005	6.25 ±.005	5.50 ±.005
7000	3.525 ±.001	2.98 ±.005	2.46 ±.005	1.605 ±.005	2.00 ±.005	6.25 ±.005	5.50 ±.005

SEAL PRESSING TOOL (FOR 21 & 22 SERIES)

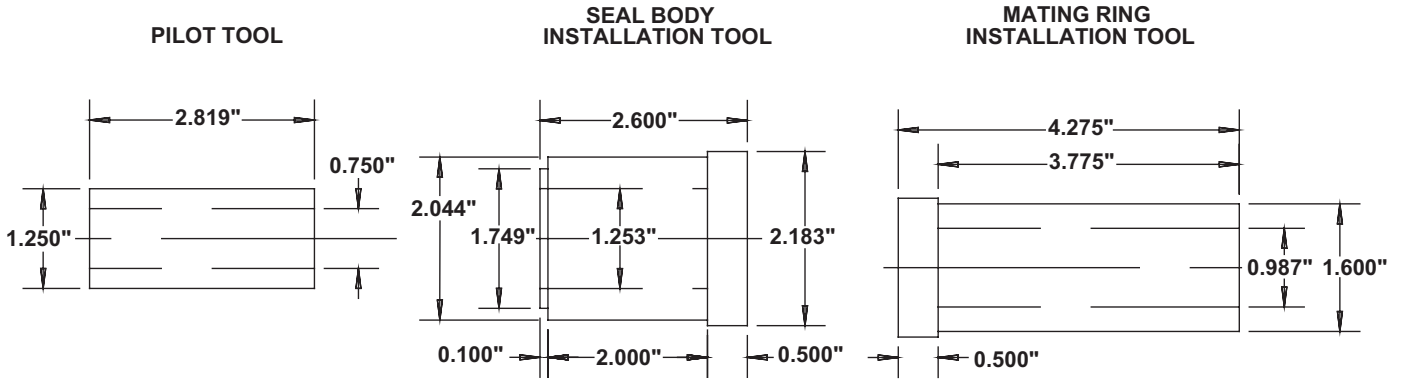


MODEL	A	B	C	D	E	F
2000	1.560 ±.001	1.24 ±.005	1.04 ±.005	.70 ±.005	1.10 ±.005	4.00 ±.005
3000	2.035 ±.001	1.74 ±.005	1.54 ±.005	1.015 ±.005	1.415 ±.005	4.37 ±.005
4000	2.425 ±.001	1.865 ±.005	1.665 ±.005	1.21 ±.005	1.61 ±.005	5.25 ±.005
5000	2.820 ±.001	2.427 ±.005	2.227 ±.005	1.41 ±.005	1.81 ±.005	5.68 ±.005
6000	3.135 ±.001	2.74 ±.005	2.54 ±.005	1.605 ±.005	2.00 ±.005	7.00 ±.005
7000	3.525 ±.001	2.99 ±.005	2.79 ±.005	1.605 ±.005	2.00 ±.005	7.00 ±.005

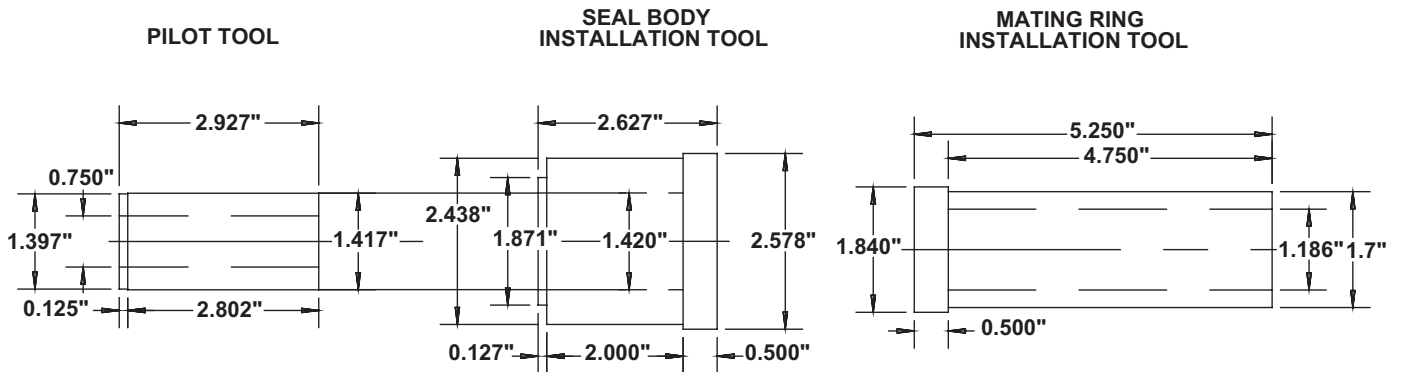
SPECIAL TOOL DRAWINGS

All dimensions shown are in inches.

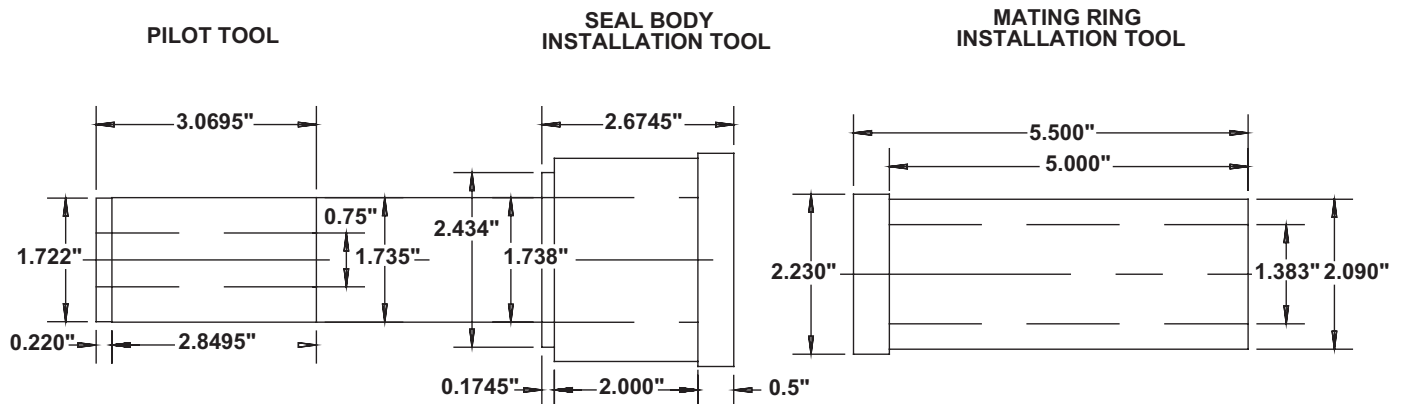
3" COMPETITOR GT SEAL INSTALLATION TOOLS (FOR MODEL 3000, 23 SERIES)



4" COMPETITOR GT SEAL INSTALLATION TOOLS (FOR MODEL 4000, 23 SERIES)



5" COMPETITOR GT SEAL INSTALLATION TOOLS (FOR MODEL 5000, 23 SERIES)



SETTING V-BELT TENSION

Proper belt tension is essential to long blower life. The following diagrams and procedures are provided to aid in field adjusting V-belts (when blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in Figure 14 below:

Factors outside the control of the belt tensioning system used on an individual blower package assembly may contribute to decreased belt life, such as environmental factors, and quality of the belts installed. This can cause wear of the belts beyond the ability of the tensioning system to compensate.

As such, it is recommended to check belt tension monthly and make any manual adjustments found necessary.

1. Turn off and lock out power.
2. Remove the fasteners from the belt guard (if equipped)
3. Remove the belt guard.
4. Check and adjust the belt tension as necessary. It should be $1/64$ " deflection per inch of span (0.157 mm) deflection per centimeter of span) between sheaves, with 8-10 lbs. (3.6-4.5 kg) force applied at center point of the top section of belt.
5. Install the belt guard, making sure that all drive components are free of contact with the guard.
6. Install belt guard fasteners removed in step 2.
7. Unlock the power and start your blower.
8. Resume normal operation.

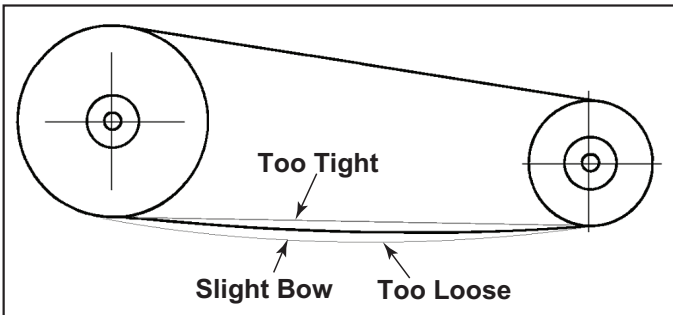


Figure 14. General appearance of V-belt drive

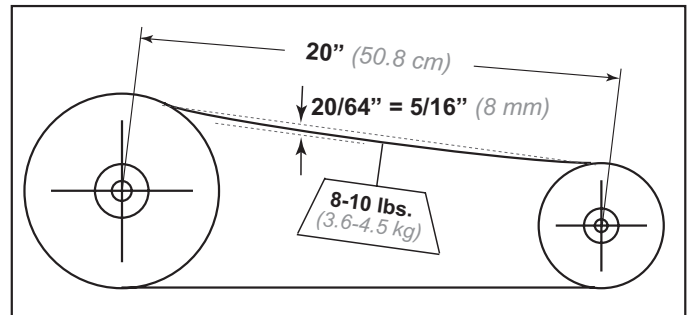


Figure 15. Setting of proper tension for a V-belt drive

NOTES: _____

WARRANTY

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Tuthill Vacuum & Blower Systems (the Seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and start-up) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period as stated in the table below. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation. (Non-standard materials are subject to a plus or minus 10% variation)

PRODUCT TYPE	TYPE OF APPLICATION	
	ATMOSPHERIC AIR OR PROCESS AIR WITHOUT LIQUIDS PRESENT	PROCESS GASES OTHER THAN AIR, OR ANY LIQUID INJECTED APPLICATION
New <i>(Qx™ models only)</i>	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
New <i>(all other models)</i>	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first
Repair	12 months from date of shipment, or remaining warranty period, whichever is greater	12 months from date of shipment, or remaining warranty period, whichever is greater

THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.

All accessories furnished by Seller but manufactured by others bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within one (1) year from date of completion thereof by Seller. Unless done with prior written consent of Seller, any repairs, alterations or disassembly of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's Ex-works point upon request.

THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.

After Buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by Seller, or any alteration or repair by others in such manner as in Seller's judgment affects the product materially and adversely shall void this warranty.

No employee or representative of Seller other than an Officer of the Company is authorized to change this warranty in any way or grant any other warranty. Any such change by an Officer of the Company must be in writing.

The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the General Terms of Sale in the sections on **CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE** and the **PATENTS** Clause hereof, the foregoing is **BUYER'S ONLY REMEDY HEREUNDER BY WAY OF BREACH OF CONTRACT, TORT OR OTHERWISE, WITHOUT REGARD TO WHETHER ANY DEFECT WAS DISCOVERED OR LATENT AT THE TIME OF DELIVERY OF THE PRODUCT OR WORK.** In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within one (1) year after the cause of action has occurred.

May 2008



Operation and Maintenance Manual



VORTEC 8100 V8



VORTEC 5000 V8



VORTEC 5700 V8



VORTEC 4300 V6



3.0L L4



1.6L L4

Industrial Gasoline & Alternative Fueled Engines

1.6L, 3.0L, 4.3L, 5.0L, 5.7L and 8.1L Engines

**A GM Powertrain Product
by Power Solutions, Inc.
Wood Dale, IL 60191**

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Power Solutions, Inc. cannot be responsible for information that has changed after this book was published.

Introduction

Power Solutions, Inc. is pleased that you have selected a GM Powertrain engine for your requirements. Power Solutions, Inc. takes great pride in our tradition of quality products produced from the GM Powertrain line of industrial gasoline and alternative fuel engines.

Power Solutions engines are inspected and tested before leaving the factory. However, certain checks should be made before placing the engine into regular service. Please read the Initial Start-Up inspection requirements in the Maintenance Section of this manual.

How to Use this Manual

This manual contains instructions on the safe operation and preventive maintenance of your GM Powertrain industrial engine. We urge you to read this manual prior to start up or operation of the engine.

The Table of Contents permits you to quickly open the manual to any section.

Power Solutions, Inc., engines are built with a variety of standard and/or optional components to suit a broad range of customer requirements. This manual does not identify equipment as standard or optional. All the equipment described in this manual may not be found on your engine or power unit.

Please pay special attention to the NOTES, CAUTIONS, and WARNINGS. WARNINGS remind you to be careful in areas where carelessness can cause personal injury. CAUTIONS are given to prevent you from error that could cause damage to the equipment. NOTES give you added information designed to help you.

The descriptions and specifications contained in this manual were in effect at the time of publication. Power Solutions, Inc. reserves the right to discontinue models at any time, or to change specifications or design without notice and without incurring obligation.

Engine Identification

An identification label is affixed to the right side of the engine on the rocker cover when looking at the engine from the flywheel end.. (The engine serial number is also stamped into the left side of the cylinder block near the engine flywheel.) The label contains the engine model number (i.e. 4.3L, 5.7L, etc.) and a serial number which identifies the engine from other GM Powertrain engines provided by Power Solutions, Inc. The engine model and serial number are required when seeking information concerning the engine and/or ordering replacement service parts.



Parts and Service

Replacement parts can be obtained from Power Solutions, Inc. by calling the Service Parts Department at 888-331-5769. The engine model and serial number will be required when seeking information and/or ordering parts.

Service and technical support for GM Powertrain engines supplied by Power Solutions, Inc. can be obtained by contacting the Service Department at 888-331-5764.

Service Literature

Additional operator manuals and service manuals for specific GM Powertrain engines provided by Power Solutions, Inc. can be obtained by contacting the Parts or Service Department at 888-331-5769.

Operating Instructions

Safety Gauges

Power Solutions, Inc., industrial power units are equipped with instrument panels which contain shut down gauges for High Engine Water Temperature and Low Engine Oil Pressure. A push button 'Tattletale' relay is utilized with this system. When starting the engine it is necessary to 'depress' the safety switch override button, until the engine starts and engine oil pressure is obtained (usually 2 to 5 seconds). The engine will continue to run when the button is released.

CAUTION: If the engine does not continue to run when the button is released, it will be necessary to check the instrument panel fuse and/or the engine lubrication system (i.e. oil level, etc.) before restarting the engine.

NOTE: Power Solutions, Inc. provides engines to many different original equipment manufacturers. Not all manufacturers use the PSI instrument panel. Please refer to the equipment Operators Manual for instructions on engine starting.

Fuel Systems

Several different fuel systems have been used on Power Solutions, Inc. GM Powertrain engines. A chart identifying the different types of fuel systems used by engine model can be found in the back of this manual.

NOTE: Some fuel systems are installed by the original equipment manufacturer. Therefore it may be necessary to contact the equipment manufacturer for information pertaining to your specific fuel system if it cannot be found in the chart.

Governors

As with fuel systems, several different governor types have also been used with the Power Solutions, Inc. GM Powertrain engines. A chart identifying the different types of governor systems used is included at the back of this manual.

NOTE: Some governors are installed by the original equipment manufacturer. If your governor is not included in the chart, it will be necessary to contact the equipment manufacturer.

Instruments

PSI Closed Power Unit Instrument Panel



The instrument panel is used to increase and decrease the programmed governor set speeds. To change the engine speeds press the up arrow to increase and the down arrow to decrease.

In addition, the instrument panel can also be used to display engine operating parameters such as coolant temperature, oil pressure and engine speed and trouble codes.

To access the menu items press and hold the Menu button and then press the Enter button. Use the Up and Down Arrow to shift between menus. Press the Enter button to access a menu. Press the Menu button to back out of a menu.

Contact the PSI Service Department for any additional questions regarding the function of this panel.

Oil Pressure Reading

The oil pressure reading shows the engine lubrication system pressure in pounds per square inch (psi) and should be checked frequently to ensure that the system is functioning correctly. Should the pressure fluctuate or drop, stop the engine and find the cause. Do not operate the engine at lower than normal oil pressure (see maintenance schedule for minimum engine oil pressure).

CAUTION: Do not continue to operate your engine below the normal operating range. Severe engine damage could occur.

Temperature Reading

The coolant temperature reading will indicate overheating which may arise from low coolant level, plugged radiator, loose fan belt or faulty thermostat. Coolant level should be checked daily.

CAUTION: If the engine continues to overheat, have the cooling system checked and serviced.

Voltage Reading

The voltage reading indicates the battery charging voltage. If the meter consistently indicates less than 13 volts or more than 15.7 volts under normal operating conditions, you should have the engine electrical system checked by a qualified service technician.

Tachometer/Hourmeter

The tachometer indicates the engine speed in hundreds of revolutions per minute (rpm). It serves, as a guide to insure that engine speed is set correctly.

The hour meter records the hours of operation and is used to determine when periodic maintenance is required.

Starting the Engine

Warning: All internal combustion engines give off various fumes and gases while running. Do not start or run the engine in a closed or poorly ventilated building where exhaust gases can accumulate. Avoid breathing these gases as they may contain poisonous carbon monoxide, which can endanger your health or life if inhaled steadily for even a few minutes.

If the engine is equipped with a manual clutch it must be disengaged prior to starting the engine. Starting the engine with the clutch engaged imposes unnecessary strain on the battery, starter, and driven components.

CAUTION: If the engine stalls or falters during starting, wait 3 to 4 seconds before re-engaging the starter. This will prevent possible damage to the starter or the engine. **DO NOT** operate the starter for periods longer than 30 seconds at a time. An interval of at least 1-minute should be observed between cranking periods to protect the starter from overheating.

LPG or NG Fuel Systems

Turn on the gas supply to the engine. Turn the ignition key to the START position. After the engine starts release the key to the ON position.

PSI Fuel Injection (Gasoline)

Turn the ignition key to the ON position, this energizes the electric fuel pump to charge the fuel system with fuel. Turn the ignition key to the START position. After the engine starts release the key to the ON position.

PSI Fuel Injection (Gasoline/LPG)(Dual Fuel)

Select the desired fuel switch position for starting the engine (Gasoline/LPG). Turn the ignition key switch ON, then move ignition key to the START position. After the engine starts release the key to the ON position.

Stopping the Engine

Return the engine to idle speed. If the machine is equipped with a clutch, move the clutch lever to the disengaged position. Run engine for a few minutes at idle to allow the coolant system to cool down before turning the ignition switch to the OFF position.

Note: Gasoline fuel injected engines will generally shut off immediately when the key is switched to the off position. When the key is switched off, power to the fuel injector(s), fuel pump and engine control module (ECM) is removed.

Note: LPG engines equipped with a distributorless ignition system (DIS) may run on several seconds after the key is switched to the off position. This may be a normal function of the engine control system running fuel out of the vapor hose to prevent engine backfiring on restart. The engine may run up to 5 seconds after the key is switched to off. Check with the Equipment Manufacture for proper shut down operation.

WARNING: Avoid injury when checking a Hot Engine. Allow the engine to cool down before removing the radiator cap.

CAUTION: Before restarting the engine ensure that both the coolant system and the engine oil level have been checked and re-filled if necessary.

Fuel Recommendations

Fuel Quality

Using a high quality unleaded gasoline will help maintain the power, fuel economy and emissions performance of your engine. A properly formulated gasoline will be comprised of well refined hydrocarbons and chemical additives and will perform the following functions:

- Minimize varnish, lacquer, and other induction system deposits.
- Prevent gum formation or other deterioration during storage.
- Protect fuel tank and other fuel system components from corrosion or degradation.
- Provide the correct seasonally and geographically adjusted volatility which should provide easy starting in the winter and summer.
- Avoid fuel system icing.

In addition, the fuel must be free of water, debris, and other impurities.

It is recommended that the fuel supply be kept fresh when the engine is in storage (especially in hot weather). The fuel tank should be kept at least $\frac{3}{4}$ full.

Fuel stored for more than two months should be drained, properly discarded, and the fuel tank re-filled.

Anti-Knock Index (Octane Rating)

This engine is designed to operate on unleaded 87 or 89 octane gasoline with an $(R + M)/2$ minimum anti-knock index. Federal regulations require that each retail gasoline dispensing pump must display a label bearing the minimum index rating.

Use of unleaded gasoline with anti-knock index rating lower than 87 can cause persistent, heavy spark knock, which can lead to engine damage. If your engine knocks heavily when you use gasoline with an anti-knock index rating of 87 or higher, or if you hear continuous spark knock while maintaining constant operating speeds, consult a dealer or qualified technician.

Gasohol and Alcohol/Gasoline Fuels

Gasohol, a mixture of gasoline and ethanol (grain alcohol), is available in some areas. PSI, GM Powertrain engines should operate satisfactorily on gasohol blends containing no more than 10% ethanol by volume and having an anti-knock index of 87 or 89.

CAUTION: In some cases, methanol (wood alcohol) or other alcohols may be added to gasoline. PSI GM Powertrain engines should operate satisfactorily on blends containing up to 5% methanol by volume when cosolvents and other necessary additives are used. **DO NOT USE** blends containing more than 5% methanol by volume or blends that do not contain cosolvents and corrosion inhibitors.

CAUTION: Discontinue use of any gasohol or alcohol/gasoline blend if fuel system problems occur. Do not use such fuels unless they are **UNLEADED**.

Spark plugs

Always use the recommended spark plugs for your engine. Hotter or colder plugs, or similar plugs that are not exact equivalents to the recommended plugs, can cause permanent engine damage, reduce the engine's useful life, and cause many other problems such as hard starting, spark knock and run-on. Installing new spark plugs regularly is one of the best ways to keep your engine at peak performance.

Power Loss at Higher Elevations

All engines will experience power loss when operated at elevations above sea level, unless they are turbocharged or supercharged. Turbochargers and superchargers are mechanical pumps that put extra air into the engine to make up for the lower air density at higher elevations.

Fuel Injected Engines

Fuel injected engines will lose 3.5% power for every 1000 feet the engine is operated above sea level. All fuel injection systems installed by Power Solutions, Inc. are equipped with a "manifold absolute pressure sensor" (MAP Sensor). The MAP sensor senses barometric pressure and automatically corrects the fuel system calibration for changes in altitude. This means the air/fuel mixture will always be optimized, regardless of elevation (or barometric pressure), however, the engine will still lose 3.5% power for every 1000 feet increase in elevation.

MAINTENANCE INSTRUCTIONS

Initial Start Up Maintenance

The initial start-up checks must be made before putting the engine into service. Please refer to the Maintenance Schedule and perform the initial start-up operations in the sequence shown in column 1.

Routine Maintenance

Routine maintenance provides the best solution for making sure that the engine is ready when you are. The following are some routine service points:

- Keep the fuel tank filled. A full tank of fuel reduces the possibility of condensation forming in the fuel tank and moisture entering the fuel system
- Make daily checks of the engine oil and coolant levels
- Repair any oil or coolant leaks immediately
- Check battery condition and cables frequently
- Keep the engine air filter clean
- Monitor engine coolant temperature
- Monitor engine oil pressure
- Check voltmeter and charging system

Scheduled Preventive Maintenance

Refer to the Maintenance Schedule on page II to ensure that all of the maintenance items listed are checked and replaced as recommended at the hours shown.

Engine Oil Level Check

The engine oil level should be checked daily. It is recommended that the oil be checked just before the engine is started for the first time for that day. The oil level should be between the 'Add' and the 'Full' marks on the dipstick.

CAUTION: Do not operate the engine with the oil level below the bottom or 'Add' mark on the dipstick, or above the top or 'Full' mark on the dipstick.

Adding Engine Oil

It is normal to add some oil in the period of time between oil changes. The amount will vary with the severity of operation. When adding or replacing engine oil, be sure the oil meets or exceeds the recommended specification.

Changing Engine Oil and Filter

The engine oil and filter must be changed every 200 hours or every 3 months whichever occurs first. Under normal operating conditions, you do not need to change them more often if you use oil and filters of the recommended quality.

The oil and filter should be changed more often if the engine is operating in dusty or extremely dirty areas, or during cold weather. No oil additives or break-in oil change is required.

Engine Oil Quality

To achieve proper engine performance and durability, it is important that you use only engine lubricating oils of the correct quality in your engine. Proper quality oils also provide maximum efficiency for crankcase ventilation systems, which reduces pollution.

Important: use only engine oils displaying the American Petroleum Institute (API) “Starburst” Certification Mark ‘FOR GASOLINE ENGINES’ on the container.



Gasoline engines that are converted for LPG or NG fuels MUST use oils labeled ‘FOR GASOLINE ENGINES’. Do not use oils that are specifically formulated for Diesel Engines only. CC or CD classification oils, even when labeled Heavy Duty or for Natural Gas Engines, ARE NOT ACCEPTABLE.

Engine Oil Recommendation

Multi-viscosity oils are recommended. SAE 10W-30 is recommended for your engine from 0 degrees F (-18 degrees C) or above. If ambient temperatures are consistently below 0 degrees F, SAE 5W-30 oil can be used. Synthetic oils are not recommended for industrial or stationary engines.

Oil Filter

The PSI GM Powertrain engines use an AC Delco oil filter as original equipment. An equivalent oil filter must be used when servicing the engine (see Engine Specifications for the recommended oil filter for your engine).

The filter protects your engine from harmful, abrasive, or sludgy particles without blocking the flow of oil to vital engine parts.

To replace the filter, use a proper filter wrench to remove the filter.

Clean the filter mounting base and lightly coat the gasket surface of the new filter with engine oil. Hand tighten the filter until the gasket contacts the base, then tighten another ½ turn. Fill the engine with the correct amount of oil, run the engine and check for oil leaks at the drain plug and oil filter gasket. Tighten as necessary to stop any oil leakage noted.

Engine Air Cleaner

The engine air cleaner filters air entering the engine intake system and acts as a silencer and flame arrester when assembled to the intake system.

Air that contains dirt and grit produces an abrasive fuel mixture and can cause severe damage to the cylinder walls and piston rings. Damage to the cylinder walls and piston rings will cause high oil consumption and shorten engine life.

A restricted or dirty air cleaner will also cause a rich fuel mixture. Thus, it is extremely important that the air cleaner be serviced properly at the recommended intervals.

CAUTION: Service the air cleaner more frequently under severe dusty or dirty conditions.

Remove the primary air cleaner element from the air cleaner assembly and inspect the element for foreign material restrictions or signs of excessive wear or damage. Replace the element if necessary. Remove all dust and foreign matter from the air cleaner housing. Reinstall the air cleaner element. Reinstall the air cleaner cup, and securely fasten the retaining clips.

Safety Element

If your engine is equipped with an air cleaner which utilizes a safety element, ensure that the element is properly in place before installing the primary element.

Change the safety element annually.

Cooling System

Coolant Level

Check the coolant level of the radiator daily and only when the engine is cool. Generally a good time to do this is just prior to starting the engine for the first time each day.

Maintain the coolant level at $\frac{3}{4}$ to $1\frac{1}{2}$ inches below the filler neck seat of the radiator when the coolant is cold. When ever coolant level checks are made inspect the condition of the radiator cap rubber seal. Make sure it is clean and free of any dirt particles which would keep it from seating on the filler neck seat. Rinse off with clean water if necessary. Also make sure that the filler neck seat is free of any dirt particles.

WARNING: Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system, engine, or cause personal injury. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme caution when removing the radiator cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn slowly to the first stop. Step back while the pressure is released from the cooling system. When all the pressure has been released, press down on the cap and remove it slowly.

DO NOT add coolant to any engine that has become overheated until the engine cools. Adding coolant to an extremely hot engine can result in a cracked block or cylinder head.

The engine manufacturer recommends the cooling system be filled with a 50/50 mixture of antifreeze and water. The use of DexCool "Long Life" type coolant (orange) is required. The use of ethylene glycol based coolant (green) may contribute to premature wear of seals and moving parts in the engine's cooling system.

Plain water may be used in an emergency (except in freezing temperatures), but replace it with the specified coolant as quickly as possible to avoid damage to the system.

Radiator

Inspect the exterior of the radiator for obstructions. Remove all bugs, dirt or foreign material with a soft brush or cloth. Use care to avoid damaging the core fins. If available, use low pressure compressed air or a stream of water in the opposite direction of the normal air flow. Check all hoses and connections for leaks. If any of the hoses are cracked, frayed, or feel spongy, they must be replaced.

Fan Belts

The water pump is usually belt driven. The same belt may also drive the fan and/or the alternator. The drive belts should be properly adjusted at all times. A loose belt can cause improper alternator, fan and water pump operation, in addition to overheating.

Serpentine Belt

Some GM Powertrain engines utilize serpentine belts on the front of the engine. This type of belt system incorporates a belt tensioning device which keeps the belt at the proper tension.

This belt should be checked routinely for cracks or 'checking' on the groove side of the belt. If cracks or 'checking' are apparent the belt must be changed.

V-Type Belt

V-Type belts are generally tensioned by adjusting the alternator, or through a mechanical belt tensioner. The belt is generally correctly tensioned when there is an ½ inch of depression on the belt between the water pump and the crankshaft pulley.

Fuel Filter

Fuel Injected Engines

On some PSI Fuel Injection or Fuel Injection/Dual Fuel as many as two fuel filters may be used in the gasoline fuel supply line to the engine. A coarse fuel filter may be located in the supply line between the fuel tank and the electric fuel pump. This filter protects the fuel pump from debris in the fuel tank. This filter must be changed every 200 hours or every 6 months whichever ever occurs first.

A primary fuel filter is located between the fuel pump and the engine. This filter protects the injectors from microscopic particles in the fuel which can cause plugging of the injectors. This filter **MUST** be changed every 500 hours or annually whichever ever occurs first.

CAUTION: Failure to change the fuel system filters as recommended can result in premature failure of the fuel system components.

NOTE: Some original equipment manufacturers install their own fuel systems. Please refer to the manufacturers manual if the gasoline fuel system is different than described here.

WARNING: Use extreme care when changing the fuel filters on gasoline engines. Gasoline is highly flammable and should not be exposed to open flame, sparks, or hot engine components. Allow the engine to cool to ambient temperatures prior to changing fuel filters. Insure that all pressure has been removed from the fuel system prior to opening any lines.

Ignition Systems

Types of Ignition Systems

Three types of ignition systems are used on PSI GM Powertrain engines. Solid state electronic distributor, solid state electronic distributor with ECU (Electronic Control Unit) timing control and distributor-less electronic ignition with ECU.

Please refer to the General Specification chart to determine the ignition system used on your particular engine.

Ignition Timing

Proper adjustment of the ignition timing must be obtained to provide the optimum engine power output and economy. To properly adjust timing refer to the timing procedure section of this manual.

Spark Plugs

Spark plugs should be replaced at the recommended intervals described in the Maintenance Schedule. Use only the recommended spark plug or an equivalent as described in the General Specifications.

Spark plug gap, should be adjusted as recommended in the General Specifications.

When removing spark plugs, always note which cylinder each plug came out of. Look at the porcelain around the center electrode of each plug. You can detect many engine problems from the color and type of deposits that have built up on the white porcelain. For example, if the deposits are a glossy brown, that cylinder is burning excess oil. If the deposits are a very dark gray or sooty black color, your engine is running rich, and you are burning excess fuel. The optimum color of the deposits on the porcelain is light tan or light brown. This shows optimum fuel mixture and proper engine running conditions. If the deposits are almost white, the engine may be running excessively lean. Lean running is very detrimental to your engine life, and should be corrected immediately.

If one or more cylinders are burning oil, the smoke from the engine will be a blue-gray color. Most common causes are piston rings (worn out or not broken in) and valve stem seals (cut, nicked, or worn out). If the engine is running rich the exhaust smoke will be a sooty black color and it will smell like gasoline (on gasoline engines).

Storage

One to Six Months

If the engine or machine is to be placed in storage for a period of one to six months it is recommended that the following steps be followed:

- Add 'Stabil' or equivalent fuel conditioner to the fuel tank as recommended on the bottle. Run the engine for approximately 10 to 15 minutes to insure that the treated fuel is completely through the fuel system.
- Fill the fuel tank with fuel
- Protect the air cleaner inlet from water entry
- Protect the exhaust outlet or muffler outlet from water entry
- Check the coolant protection and top off radiator
- Store indoors if possible

For Extended Periods

Follow the above recommended procedures, plus do the following:

- Drain the engine crankcase and refill with recommended oil
- Change the oil filter
- Disconnect and remove the battery
- Clean exterior surface of the engine
- If the engine is equipped with an automotive type clutch or PTO clutch, make sure that the clutch is disengaged

Removing the Engine From Extended Storage

When removing the engine from extended storage:

- Install a fully charged battery
- Remove all protective coverings from the air inlet, air cleaner, exhaust, and muffler openings
- Check the coolant level in the radiator and verify the protection level of the coolant
- Check the engine oil level.
- Start the engine and allow it to run at slow idle. Verify engine oil pressure
- Run the engine at idle until the coolant temperature approaches 120 degrees F (49 degrees C)
- Run the engine a various speeds for approximately 15 minutes
- Shut the engine down, drain the oil, change the oil filter, and re-fill with the recommended grade of oil

GM Engine Timing Procedures

Gasoline, LPG and NG 3.0L, 4.3L, 5.0L, 5.7L (Non-Certified Mobile Engines)

PSI Timing Connector Part Number 33000036 MUST be used when checking and adjusting the engine timing.

1. With the engine shut-off, plug the 33000036 Timing Connector into the distributor. DO NOT connect the alligator clip to any positive or negative terminal. (Connecting this wire to any battery terminal prior to starting the engine will cause the distributor module to fail when starting the engine.)
2. Start the engine and run at slow idle. 800 to 1000 rpm.
3. Connect the alligator clip to a B+ terminal. (This connection cancels the programmed timing advance from the distributor module. You will notice a change in engine sound and rpm when making this connection.)
4. Connect an electronic timing light to the No.1 spark plug wire. (The front cylinder on the 3.0L engine and the front cylinder on the left bank of the 4.3L, 5.7L and 7.4L engines.)
5. Check and adjust the distributor as necessary viewing the timing mark on the crankshaft pulley in relation to the pointer on the engine timing case. (On some engines there may be a timing port in the flywheel housing also.)
6. Refer to the General Specifications chart in this manual, for the initial timing specification for your engine and type of fuel being used.

Gasoline, LPG and NG 1.6L, 3.0L, 4.3L (Certified Mobile Engines)

PSI Certified mobile equipment engines do not have adjustable ignition timing. Do not rotate the distributor on the 3.0L or 4.3L engines as this may affect alignment of the camshaft position sensor. Spark timing will not change by rotating the distributor. Contact the PSI Service Department for any additional information on this topic at 888-331-5764.

Stationary Engine - Generator Engine Timing

PSI engines operating on generators are to have ignition timing checked and adjusted at their designated run speed. DO NOT use the Timing Connector discussed above. Check the General Specifications chart for the correct engine timing for the type of fuel and engine speed being used.

Recommended Maintenance Schedule

ENGINE MAINTENANCE REQUIREMENTS										
	Install Date	Interval Hours								
		Daily	200	400	800	1000	1250	1500	1750	2000
General Maintenance Section										
Visual check for leaks	X	X								
Check engine oil level	X	X								
Inspect and Tighten Loose Bolts		X								
Check coolant level	X	X								
Change engine oil and filter		Every 150 hours or 120 days of operation								
Check fuel system for leaks		Prior to any service or maintenance activity								
Inspect accessory drive belts						X				X
Inspect electrical system										X
Inspect all vacuum lines and fitting										X
Engine Coolant Section										
Clean debris from radiator core		Every 100 hours or 60 days of operation								
Change coolant					X					
Inspect coolant hoses for cracks, swelling or deterioration						X				X
Engine Ignition System										
Inspect Battery case for damage						X				X
Check all electrical connectors						X				X
Replace Spark Plugs										X
Replace Distributor Cap & Rotor					X					
Replace Spark Plug Wires					X					
Fuel System Maintenance										
Replace fuel filter (Gas & LPG)				X						X
Inspect lock off for leaks & closing										X
Check LPG/Gas regulator pressure										X
Leak check LPG/Gas fuel lines										X
Inspect/Drain EPR-LPR for oil build up		Every 150 hours or 120 days of operation								
Inspect LPR for coolant leaks		Annually or every 2000 hours								
Check air induction for leaks										X
Check manifold for vacuum leaks										X
Replace PCV Valve					X					
Check injector & rails for leaks										X
Inspect air cleaner		Every 200 hours, or every 100 hours in dusty environment								
Replace air filter element		Every 400 hours, or every 200 hours in dusty environment								
Engine Exhaust System										
Inspect exhaust manifold for leaks										X
Inspect exhaust piping for leaks										X
Inspect catalyst inlet and outlet										X
Check HEGO sensors connections										X
<p>The maintenance schedule represents manufacturers recommended maintenance intervals to maintain proper engine/equipment function. Specific state and federal regulations may require equipment operators to conduct comprehensive engine/equipment inspections at more periodic intervals than those specified above.</p>										

Power Solutions, Inc.

GM Powertrain Industrial Engines

Filter Chart

Engine	1.6L	3.0L	4.3L	5.0L/5.7L	8.1L
Oil Filter	94632619	P-25 or Equivalent	PF-47/PF-52 or Equivalent	PF-1218 Equivalent	PF-454 or Equivalent
Fuel Filter (PSI TBI Coarse)		32500111	32500111		
Fuel Filter (Primary)	32500916	32500916	32500916		
Fuel Filter Zenith Z.E.E.M.S	Gasoline C282-224 LPG C282-5	32500292	32500292		
Air Filter Primary (PSI Power Unit)		P822768	P822889		
Air Filter Safety (PSI Power Unit)		P822769	P829333		

Revised 11/2004

Fluid Capacities

Engine	1.6L	3.0L	4.3L	5.0L	5.7L	8.1L
Oil Capacity Without Filter	3.4 qts.	4 qts.	4.5 qts.	5 qts.	5 qts.	8 qts.
Oil Capacity With Filter	3.7 qts.	4.5 qts.	5 qts.	5.5 qts.	5.5 qts.	9 qts.
Coolant Capacity Without Radiator	3.5 qts.	4 qts.	7.75 qts.	8.1 qts.	8.1 qts.	14.5 qts.
Coolant Capacity With Radiator	10 qts.	12 qts.	17 qts.	17.5 qts.	17.5 qts.	28.5 qts.

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Power Solutions, Inc.
GM Powertrain Industrial Engines

Fuel System Chart

Engine	1.6L	3.0L	4.3L	5.0L	5.7L	8.1L
PSI/EControls Gasoline	x	x	x			
PSI/EControls /Impco LPG	x	x	x			
PSI/EControls/Impco Dual Fuel	x	x	x			
PSI/ Woodward (Stationary)		x	x	x	x	x
PSI/EControls (Stationary)			x	x	x	x

Governor Chart

Engine	1.6L	3.0L	4.3L	5.0L	5.7L	8.1L
Bosch ETC	x	x	x	x	x	x
Woodward LCS		x	x	x	x	
EControls LCI	x	x		x	x	

Revised 11/2004

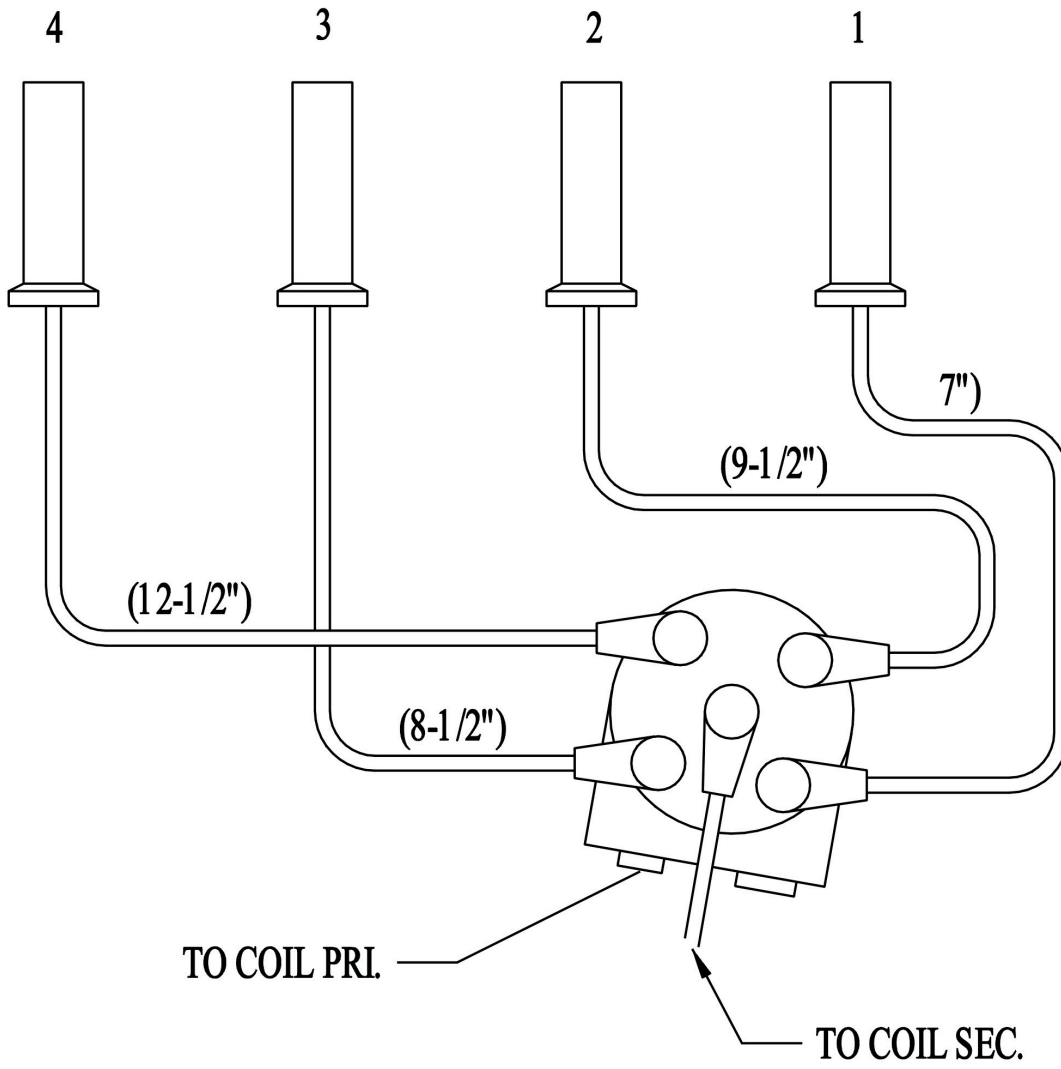
GENERAL SPECIFICATIONS

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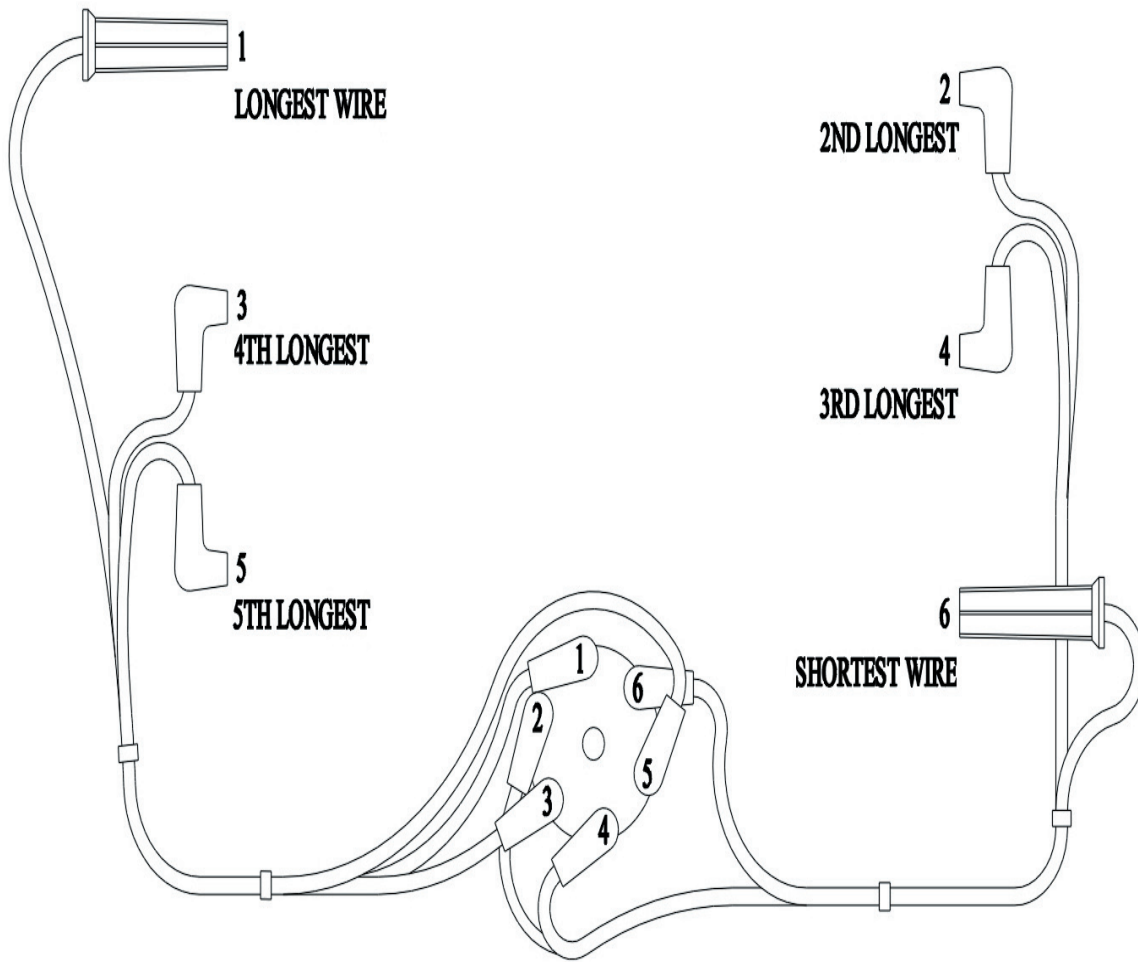
GM Powertrain Industrial Engines

Engine	1.6L	3.0L	4.3L	5.0L/5.7L	8.1L/8.1L Turbo
Type	1.6-2V	3.0L I-4	4.3L V-6	5.7L V-8 GEN-IE	8.1L V-8
Displacement cc (c.i.d.)	1600 (98)	2966 (181)	4294 (262)	5735 (350)	8127 (496)
Compression Ratio	9.4:1	9.2:1	9.4:1	9.4:1	9.1:1
Valve Configuration	Overhead Cam	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Valve
Valve Lifters	Hydraulic	Flat Follower	Hydraulic Roller	Hydraulic Roller	Hydraulic Roller
Bore x Stroke mm (inches)	79.0x81.5 (3.11x3.21)	101.60x91.44 (4.00x3.60)	101.60x88.39 (4.00x3.48)	101.60x88.39 (4.00x3.48)	107.95x111 (4.25x4.37)
Main Bearing Caps	2 Bolt	2 Bolt	2 Bolt	2 Bolt	4 Bolt
Balance Method	External	External	Internal Balance Shaft	External	External
Intake Manifold	TBI	TBI, Carburetor, Mixer	TBI, Carburetor, Mixer	Mixer	Mixer
Firing Order	1-3-4-2	1-3-4-2	1-6-5-4-3-2	1-8-4-3-6-5-7-2	1-8-7-2-6-5-4-3
Oil Capacity	3.4 qts. (3.2L)	4 qts. (3.8L)	4.5 qts. (4.3L)	4.5 qts. (4.3L)	8 qts. (7.6L)
With Oil Filter	3.7 qts. (3.5L)	5 qts. (4.7L)	5 qts. (4.7L)	5 qts. (4.7L)	9 qts. (8.5L)
Oil Filter		PF-25 or Equivalent	PF-47/PF-52 or Equivalent	PF-1218 or Equivalent	PF-454 or Equivalent
Minimum Oil Pressure (Hot)	21 psi @ idle	6 psi @ 1000 rpm 18 psi @ 2000 rpm	6 psi @ 1000 rpm 18 psi @ 2000 rpm	6 psi @ 1000 rpm 18 psi @ 2000 rpm	5 psi @ 1000 rpm 15 psi @ 2000 rpm
Coolant Capacity (Engine)	3.5 qts.	4 qts. (3.78L)	7.75 qts. (7.3L)	8.1 qts (7.8L)	14.5 qts (13.7L)
Coolant Capacity (W/PSI Rad)	10 qts	12 qts. (11.4L)	17 qts. (16L)	17.5 qts. (16.6L)	28 qts (26.5L)
Fuel Type	Gasoline, LPG	Gasoline, LPG, NG	Gasoline, LPG, NG	LPG, NG	LPG, NG
Engine Rotation (Flywheel End)	CCW	CCW	CCW	CCW	CCW
Ignition System	Distributor-less Electronic (ECU)	Solid State Distributor	Solid State Distributor	Solid State Distributor	Distributor-less Electronic ECU
Ignition Timing – Mobile Engines (Degrees BTDC)		0	0	0	
Gasoline (Carb)	DIS	0	0	0	DIS
Gasoline (TBI)	No Adjustment	10 (4 Europe)	10 (4 Europe)	10 (4 Europe)	No Adjustment
LPG		10	10	10	
NG		0	0	0	
Dual Fuel					
Ignition Timing - Stationary Engines (Degrees BTDC)		26	26	26	
Generators 1800 RPM	DIS	36	36	36	DIS
LPG	No Adjustment				No Adjustment
NG					
Generators 1500 RPM		23	23	23	
LPG		33	33	33	
NG					
Spark Plugs	AC Delco 93206675	AC Delco R45TS - Non-Cert AC Delco R42LTS - Certified	AC Delco R42LTS - Non-Cert AC Delco R44LTS - Certified	AC Delco R42LTS	AC Delco R42LTS
Spark Plug Gap					
TBI			.035	.035	
LPG	.8mm-.9mm	.035	.035	.035	.030 +.003/-.001
NG	all	all	.035	.035	all
Dual Fuel			.035	.035	
Valve Clearance (Lash)					
Intake	No Adjustment	½ to 1 Turn Down From	Net Lash	1 Turn Down From	Net Lash
Exhaust	OHC Engine	0 Lash	No Adjustment	0 Lash	No Adjustment
Manufactured	Brazil	Toluca, Mexico	Tonawanda, NY	Toluca, Mexico	Tonawanda, NY

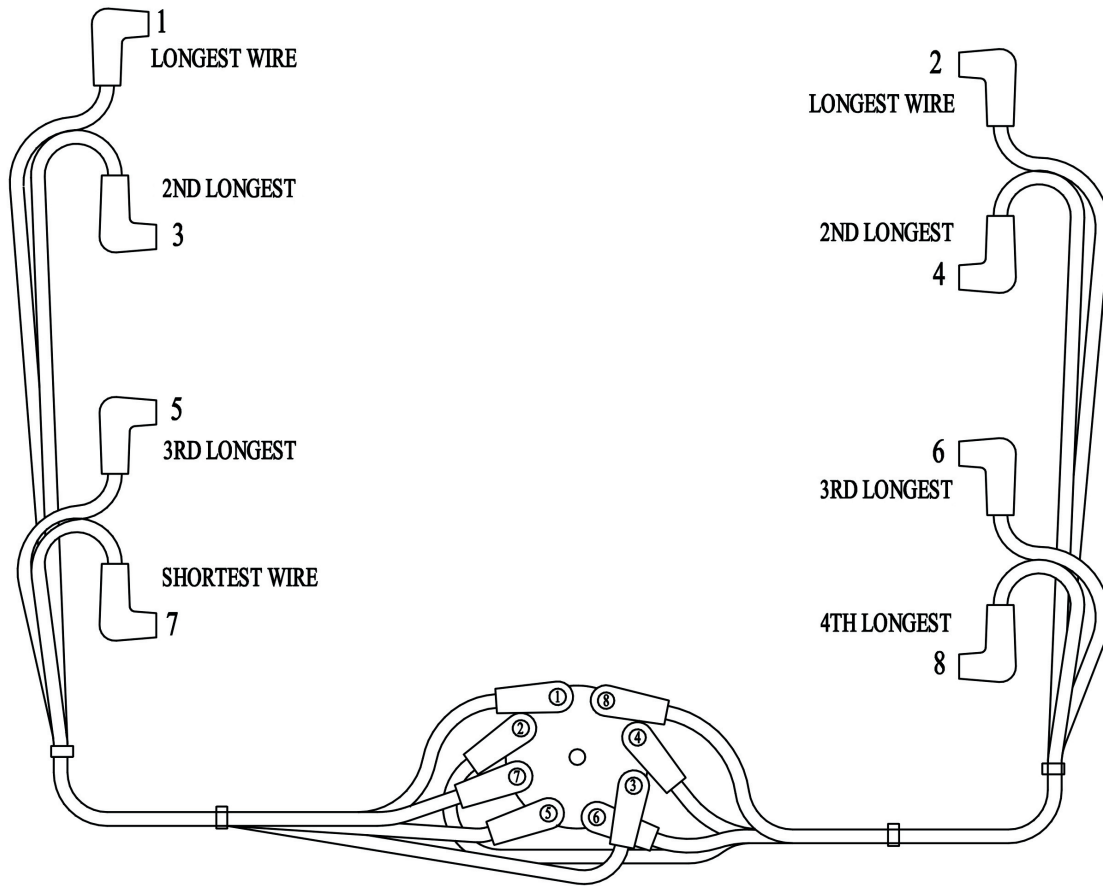
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3.0L Engine Spark Plug Wire Routing



4.3L Engine Spark Plug Wire Routing



5.0L/5.7L Engine Spark Plug Wire Routing