
55K DIESEL HUSKY

ADVANCED PRESSURE SYSTEMS

OPERATION AND MAINTENANCE MANUAL

32-755-500.M - APRIL 2023



APS

SHAPE TECHNOLOGIES GROUP®

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ADVANCED PRESSURE SYSTEMS 2023



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About This Content

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Overview

The Husky pump is a powerful positive displacement, ultrahigh-pressure (UHP) triplex plunger pump system. These waterjet cleaning pumps are designed and manufactured to operate in continuous service at a designed flow and pressure. With pressures ranging from 2,758 bar (40,000 psi) to 3,793 bar (55,000 psi), the Husky is an extremely versatile pump. The Husky pump is designed for full-scale industrial use with minimal maintenance and reliable performance.

Features include:

- *A triplex, direct-drive, high-pressure pump with easy access to seals and check valves.*
- *Multiple prime mover options:*
 - *302 hp Caterpillar C7.1 Tier 4*
 - *335 hp Caterpillar C9.3 Tier 3 engine (export only)*
 - *275 hp Caterpillar C7.1 Tier 3 engine (export only)*
- *Sensor lights and automatic shutdown for low inlet water pressure, high engine or pump temperature, and low engine or pump oil pressure.*
- *A closed-loop oil lubrication system.*
- *An inlet water booster pump with water filtration to 10 microns absolute.*
- *An over-pressure protection valve.*

Adhering to the recommended procedures for operation and maintenance outlined in this manual will ensure optimum benefit from the high-quality components used in the design and construction of the Husky pump system.

How It Works

Several items work together to operate the UHP fluid end. These items are the inlet water, the diesel engine, the pump, and the cooling system. When all of these items work together high pressure water is created.

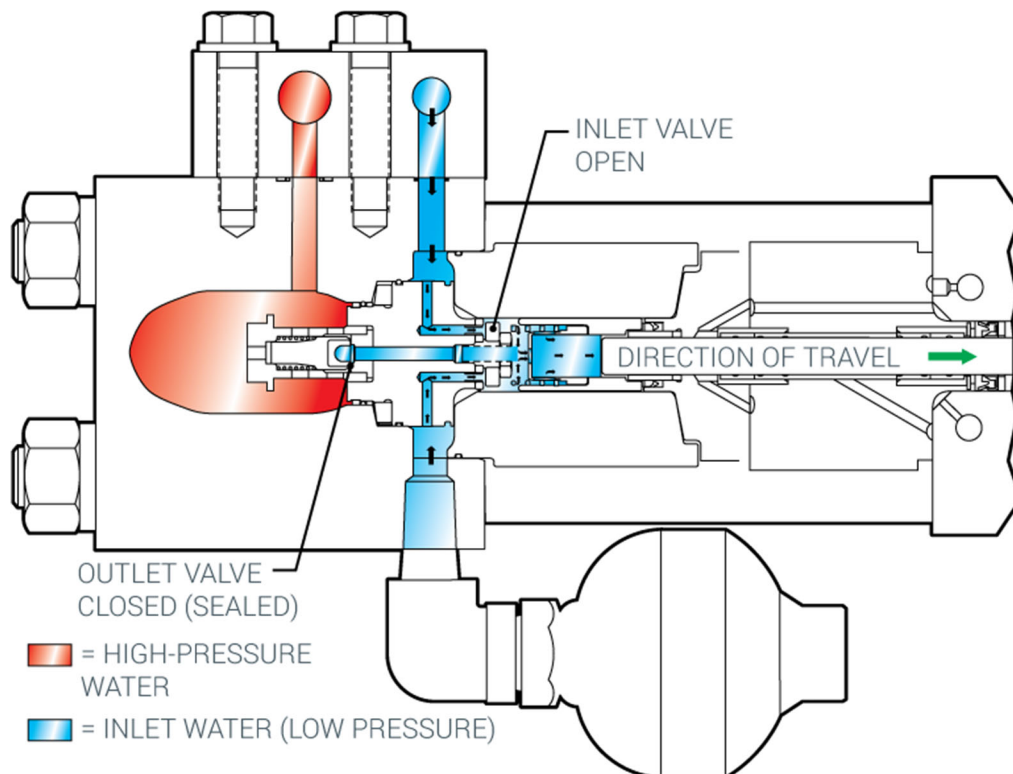
Inlet water is the first item. The inlet water flows through a water filter to ensure it is clean enough to flow through the rest of the system. From there, the water continues to the inlet check valve.

For the water to continue through the system, the diesel engine must run. When the diesel engine runs, it turns the crankshaft of the pump. In turn, the crankshaft moves the plungers.

The pump is connected to the engine and operates in a two-stroke cycle: the inlet stroke, and the pressure stroke.

The sequence of the inlet stroke has four steps:

1. The outlet check valve closes.
2. The plunger moves back.
3. The inlet check valve opens.
4. Water enters the pump.

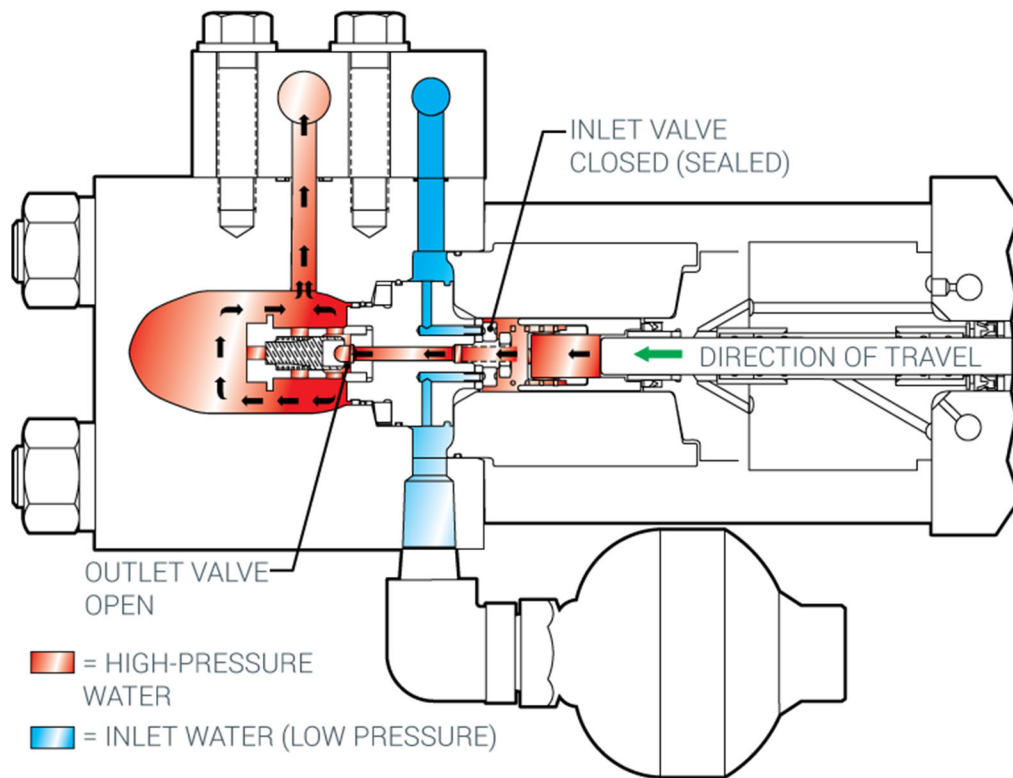


(image is used as reference only)

After the inlet stroke is the pressure stroke which has five steps:

1. The inlet check valve closes.
2. The plunger moves forward.
3. The water is pressurized.
4. The outlet check valve opens.
5. High pressure water goes to the manifold.

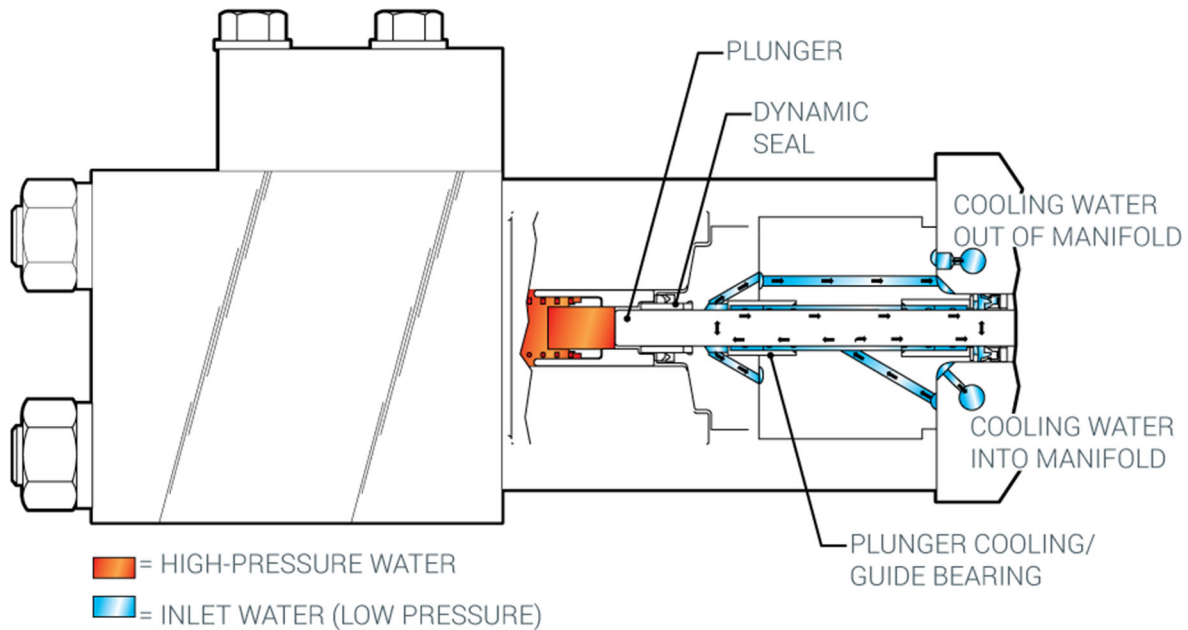
At this point, the two-stroke cycle repeats.



(image is used as reference only)

The cooling system is the last item. It operates to make sure that the rest of the systems are at the correct temperature. The charge pump supplies low-pressure water to cool the UHP fluid end. The low-pressure water also lubricates the plungers and the plunger bearings.

A failed dynamic seal causes high-pressure water to leak into the low-pressure water that cools the bearing, cools the plunger, and lubricates the plunger. The symptoms of a failed dynamic seal are heat and pulsing water at the cooling water outlet line of the manifold. The temperature sensors on the cooling water outlet line measure the heat in that circuit.



(image is used as reference only)

Safety

Advanced Pressure Systems designed this high-pressure waterjet cutting system and related equipment with safety in mind. Although the waterjet can appear harmless, it is a high-energy cutting tool capable of cutting many materials such as composites, metals, plastics, and wood products. Misuse of this equipment or carelessness in its application is extremely hazardous to personnel. Always treat the waterjet system with respect.



READ CAREFULLY BEFORE USE. KEEP FOR FUTURE REFERENCE!

Safety Precautions

Follow all safety precautions to ensure safe operation of the equipment.

- Only trained, qualified personnel shall service and maintain the equipment.
- Safety glasses and ear protection shall be worn when operating or working near the pump.
- Do not allow the waterjet stream to touch any part of the body—it will cause serious injury.
- Never point a waterjet cutting or cleaning tool at oneself or any person. Do not aim any waterjet tool at anything not intended to be cut.
- During equipment maintenance, take the system out of service. Lock and mark the controls with a warning sign. See section 'Lockout/Tagout' for details.
- All personnel required to do any system operation or service function must pay particular attention to all warning signs and notices posted in the plant and on the equipment.
- All protective guards, shields, and covers must be in place on the equipment at all times.
- First aid facilities shall be provided in convenient locations throughout the plant. All personnel must know the locations of the first aid facilities.
- Always keep the work area around the equipment clean and free of debris. Fluid spillage results in slippery floors. Clean up spills immediately.
- Any unfavorable conditions that can result in injuries must be reported to the plant supervisor immediately.
- Do not wear loose clothing or jewelry while working around equipment with moving parts.
- Pressurized air can drive particles into the eyes and skin if handled incorrectly. Use appropriate personal protective equipment and exercise caution.
- Only use water-based solvents for cleaning parts.

Diesel Engines

- *Do not allow the engine to exhaust into a closed work area. Provide either adequate ventilation or vent the exhaust outdoors.*
- *Do not overfill the fuel tank.*
- *Do not operate the engine in an explosive or flammable environment.*
- *Do not allow flammable liquids to touch the engine while it is hot.*
- *Do not operate the engine without its protective covers in place.*
- *Do not attempt to service the engine while it is in operation.*
- *Do not allow moving parts to contact clothing or body.*
- *Do not allow fuel to contact exposed portions of the body.*

Electrical

- *Only a certified electrician shall do electrical and/or electronic troubleshooting and servicing of electrical devices.*
- *Always assume that power is ON in all electrical systems. Always examine and lockout the main power switches before servicing the equipment. Post a sign, "Maintenance in Progress—Do Not Energize."*
- *Be aware that live electrical circuits are present in the control console whenever the master disconnect switch is in the ON position, regardless of whether the E-Stop is engaged.*
- *Turn off the circuit breakers located inside the electrical enclosure before servicing the electrical system. If this is not possible, have someone stand by to prevent someone from powering up the system.*
- *Take extra precautions when servicing the power system in a damp environment.*
- *Never alter or bypass protective interlocks or devices.*
- *Never use jumper wires across fuses, fuse holders, or breakers.*
- *Never use metal rulers, flashlights, pencils, or tools that have exposed conductive material when working near electrical/electronic components.*
- *Ensure all tools are correctly insulated for the job. Use only correct test apparatus; regularly examine to ensure they are working correctly. Use caution when connecting a test probe to test points.*
- *When connecting a voltmeter to terminals for measurement, use a range higher than the expected voltage.*
- *All replacement wires shall conform to the manufacturer's specifications, including color-coding, wire numbers, and size.*
- *Close and latch the control panel doors or junction box covers after servicing.*
- *Maintain all electrical components, protective guards, and shutdown devices according to approved practices.*

High-Pressure Cleaning Tools

- Turn off equipment and relieve water pressure before replacing nozzles, tips, or bits.
- Hang a warning sign on the control panel that states that the equipment is being serviced and is not available for use until servicing is complete.
- Install all protective covers and shielding on equipment before starting the pump.
- Examine for leakage after nozzle or tip replacement and correct the leak immediately.
- Use only APS manufactured or approved waterjet nozzles, cleaning tips, and drilling or cutting bits.

Mechanical

- Do not start the system unless the operator can properly shut it down.
- Never maintain, service, or clean around the equipment while it is operating.
- Do not use incorrect tools—they can cause injury or costly damage to equipment.
- Use only approved test equipment. Examine the equipment regularly for correct operation and calibration.
- Never climb on or around the equipment on makeshift devices. Use only approved catwalks, ladders, or platforms.
- Do not exceed specified pressure setting limits for pneumatic or hydraulic components. Exceeding these limits may result in serious injury to personnel or damage to the equipment.
- Shield and bundle equipment hoses and cables so they do not obstruct the operator's freedom of movement.
- Always be alert when working around the equipment.
- Remove all tools, parts, and rags from moving parts after servicing the equipment.

Safety Messages

Safety messages are highlighted with the safety alert symbol and a signal word or a signal word panel. Pay particular attention to these safety messages and all safety precautions posted on the equipment.

Safety Alert Symbol



This is the safety alert symbol. The safety alert symbol indicates a potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Signal Words

WARNING! WARNING indicates a hazardous situation, which if not avoided, can result in death or serious injury.

CAUTION! CAUTION indicates a hazardous situation, which if not avoided, can result in minor or moderate injury.

Signal Panel Words



DANGER indicates a hazardous situation, which if not avoided, will result in death or serious injury.



CAUTION emphasize operating or service procedures, or conditions that can result in equipment damage or impairment of system operation.



NOTICE indicates a non-hazardous situation, which if not avoided, can result in property damage.

Safety Labels

The section describes the safety labels and their locations.

High-Pressure Hose

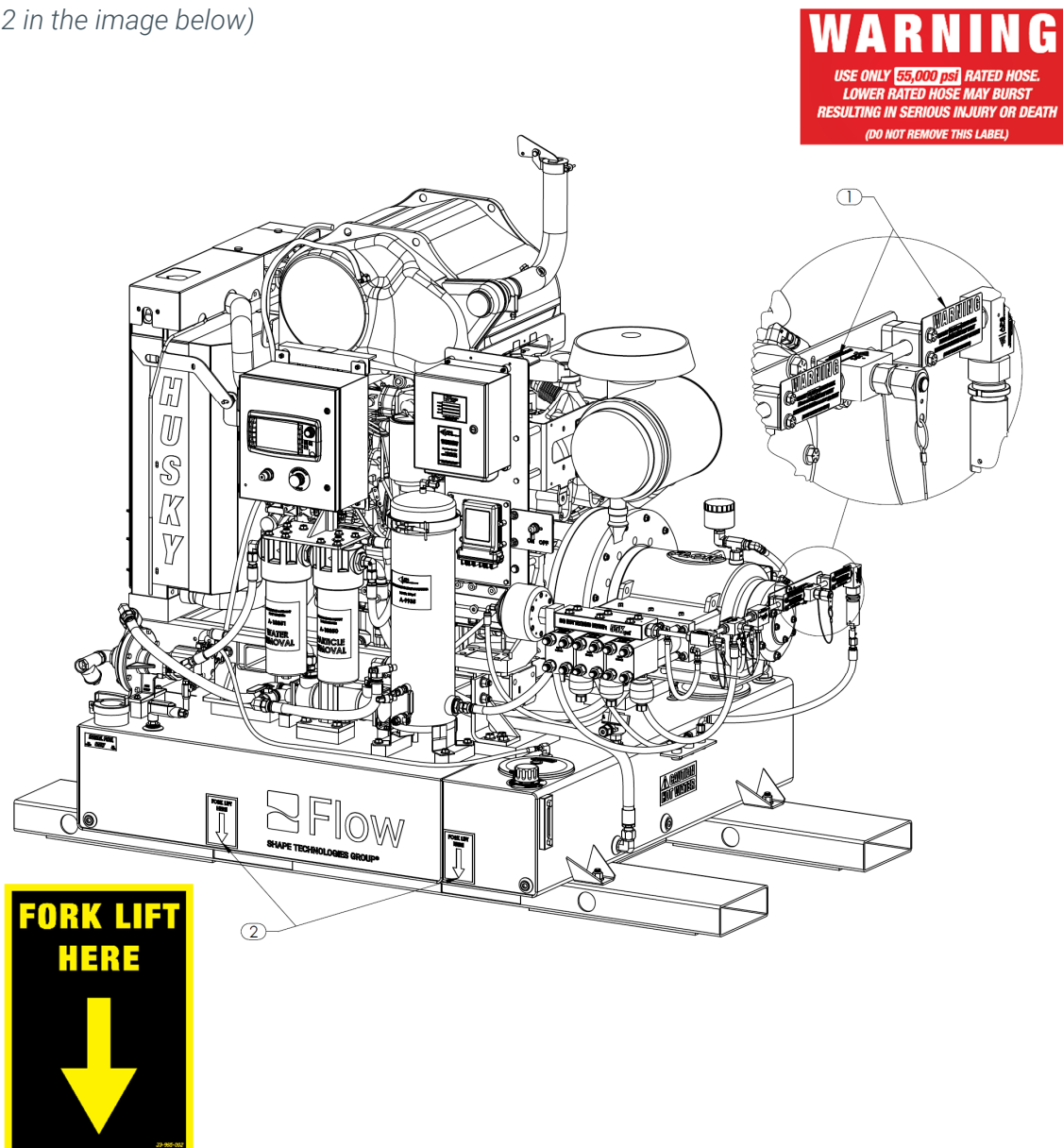
This label indicates the minimum pressure rating of the hose to be used with the unit.

(Item 1 in the image below) This label is located on the high-pressure tubing assembly.

Forklift

This label indicates the location of the forklift pockets to properly lift the pump on the diesel Husky.

(Item 2 in the image below)



Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is equipment worn to minimize exposure to serious workplace injuries and illnesses.



Helmets must be worn at all times by all personnel within the work area. Helmet material must withstand a mechanical shock to 10 G in 8 m.s. without fracturing.



Operators must wear safety glasses with side shields and a visor, or goggles and a visor, to guard against spray and flying debris.



Operators and other personnel must wear safety footwear with steel toecaps a minimum of 5 mm (0.02-in.) thick. The toecap must cover at least 30% of the footwear length. Footwear must have metatarsal guards to provide instep protection.



The operators and other personnel exposed to noise levels of more than 90 dBa for more than 1 hour must wear suitable ear protection. Earplugs and muffs are usually adequate.



The operators must wear gloves at all times; leather gloves are preferred.



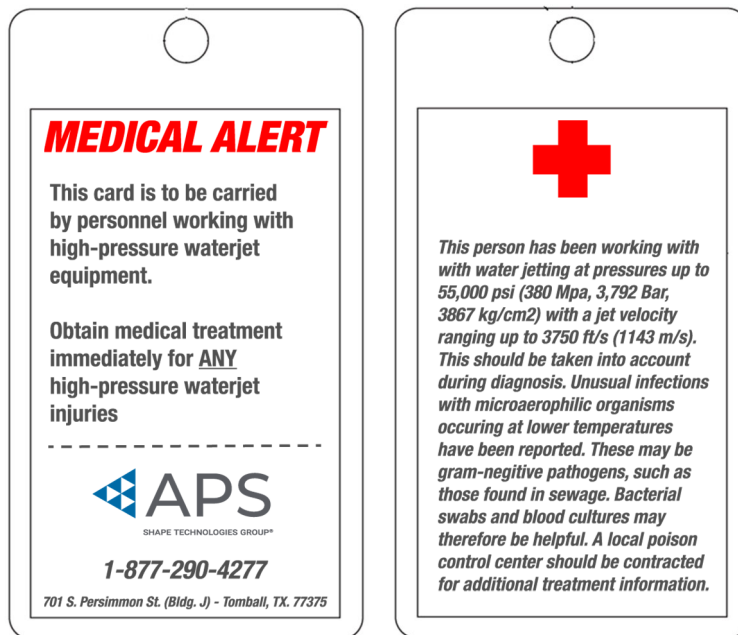
Waterproof garments only protect the operator from spray and flying debris. They do NOT deflect direct jet impact.

Emergency Medical Information



WARNING! Obtain medical treatment immediately for ANY high-pressure waterjet injuries.

It is vital that medical personnel have information about this type of injury. We recommend that all personnel working with waterjet equipment carry a medical alert card or tag that describes their work and the nature of injuries inherent in using waterjets.



Lockout/Tagout

The water supply and electrical systems can be locked out separately. Under most circumstances, both systems should be locked out.

This lockout/tagout procedure is designed to protect all employees from injuries caused by the unexpected energizing or startup of the machine, or the release of stored energy during service and maintenance.

This is accomplished with energy isolating devices that prevent the transmission or release of energy. An energy source is any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy source that could cause injury to personnel.

A lockout device utilizes a lock and key to hold an energy isolating device in the safe position and prevents the machine from being energized. A tagout device is a prominent warning device that can be securely attached to the machine warning personnel not to operate the energy isolating device. This procedure requires the combination of a lockout device and a tagout device.

Water Supply

- 1. Shut down the pump using the 'Standard System Shutdown' procedure below.*
- 2. Look at the gauges on the display to ensure that the fluid end pressure is bled down.*
- 3. Turn off the water supply to the charge pump.*
- 4. Close the inlet water valve, and then install a lockout/tagout device.*
- 5. Open the top and bottom petcocks on the water filter canister to drain the filter canister. If the draining water appears to be under pressure, ensure that the inlet water valve is closed.*
- 6. Ensure isolation of the inlet water by looking at the Pre-Filter and After-Filter pressure on the Pump Data screen. Both readings should be at zero.*

Electrical

- 1. Shut down the pump using the 'Standard System Shutdown' procedure below.*
- 2. Remove the battery box cover.*
- 3. Use a 9/16-in. wrench to remove the negative (black) lead from the battery. This cable goes from the battery to the battery disconnect.*
- 4. Install a lockout/tagout device over the negative battery cable.*
- 5. Use a 9/16-in. wrench to remove the positive (red) lead from the positive battery post. This wire goes from the battery to the engine starter motor.*
- 6. Install a lockout/tagout device over the positive battery cable.*

Operation

Overview

Commissioning requirements and procedures are detailed in this section. These procedures require a thorough understanding of the individual components, safety issues, and the overall operation of the system.

All personnel involved in the operation and/or service of the system must carefully review this manual prior to commissioning and operating the machine.

The Technical Service Department at Advanced Pressure Systems is available to assist in the commissioning and operation process. Service and repair training for maintenance personnel is also available.

Transporting

The weight of the machine is not evenly distributed from one end to the other. Note the warnings stamped on the unit. The forklift should be positioned accordingly.

When the machine has been removed from the crate, note the position of the fork pockets on the bottom of the machine if so equipped. The pockets are positioned in relationship to the center of gravity to balance the weight on the forklift.

Before Starting the System

Prior to starting the system review the manufacturer's manuals included in the appendix covering the operation of the engine and drive train.

- 1. Set unit on a level surface.*
- 2. Check oil level and any water contamination in the hydraulic reservoir.*
- 3. Check all electrical cables and connections.*
- 4. Check fuel level, engine oil level, coolant level and engine belt tension.*
- 5. Check the fuel/water separator for the presence of water.*
- 6. If the pump is located in a closed space, make sure that the exhaust tubing connects to the engine exhaust.*
- 7. Verify all bolts are torqued to the specified level.*
- 8. Verify connections on the manifold are tight and do not leak.*



CAUTION Do not tighten high pressure connections when the system is pressurized. Remove all pressure from the system before tightening connections.

9. Ensure the supply water and the filters and strainers are clean.
10. Verify the pressure relief valve has been calibrated. Procedures for this can be found in the 'Calibrating the Safety Valve' section later in this manual.
11. Ensure the supply water line to the pump is airtight. Air entering the suction side, supply line will cause severe knocking and cavitation of the pump.
12. Check to ensure supply water is flowing to the system.
13. Inspect the pump for visible damage, debris, and cleanliness.

Startup

1. Ensure that supply line water is connected to the unit.
2. Turn on the pressurized supply line water.
3. Turn the inlet water valve to the ON position.



CAUTION Failure to open the inlet water valve can severely damage the pump.

4. Open the top petcock on the water filter canister to purge the air from the filter canister. Close the petcock after water begins flowing from the valve.
5. Examine the pump for leaks. Fix any leaks before starting the pump.
6. Turn the key switch to ON.
7. After the screen turns on, press the ignition button to start fuel pump. Once primed press and hold the start button. Release the button after the engine starts.
8. Listen for unusual noises in the system. For diesel units, it is normal for the engine to make a knocking noise while it warms up. The knocking noise should go away after the engine is warm.
9. With the pump operating at its rated full speed the maximum working pressure should be reached easily. If the maximum working pressure cannot be reached at full speed, check the nozzle size or the system plumbing for leakage. Refer to section 'Troubleshooting' later in this manual if the issue is not resolved.
10. Ensure the suction and discharge valves remain fully open during operation.



CAUTION Never close the suction or discharge valves while the pump is running.

Shutdown

Standard System Shutdown

1. Use the rotary knob on the screen to dial back pressure as low as possible.
2. Push the idle button, and then let the engine run for a minimum of three minutes to cool down.
NOTICE The engine should idle to allow the turbo to cool down.
3. Press the stop button to initialize shutdown. Engine may continue to run and indicate "DES" this process is to comply with tier 4. DO NOT force a shutdown unless necessary.
4. Once engine has stopped turn the key off to shut down control system.
5. Switch the battery disconnect switch to the off position to disconnect electrical power.

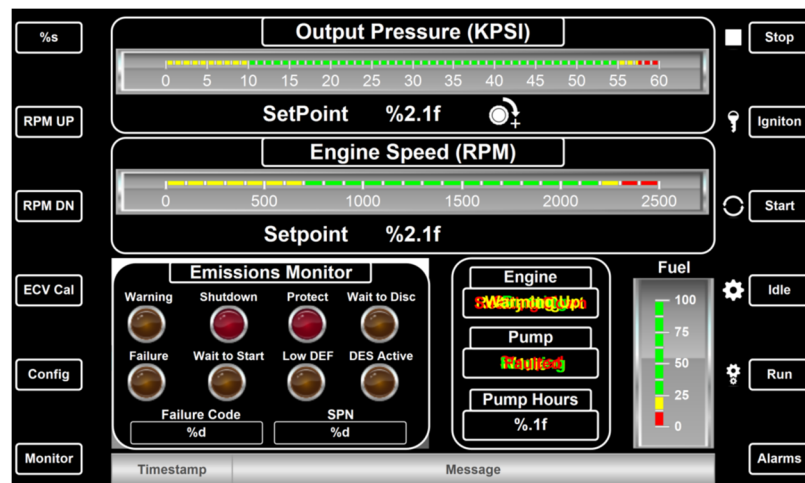
Emergency System Shutdown

1. Push the red E-Stop button on the control panel.

Operating the User Interface

Run Screen

1. On the run screen shown below there are 12 boxes, 6 on each side. These indicate which physical button to push on the display screen to activate the labeled function.

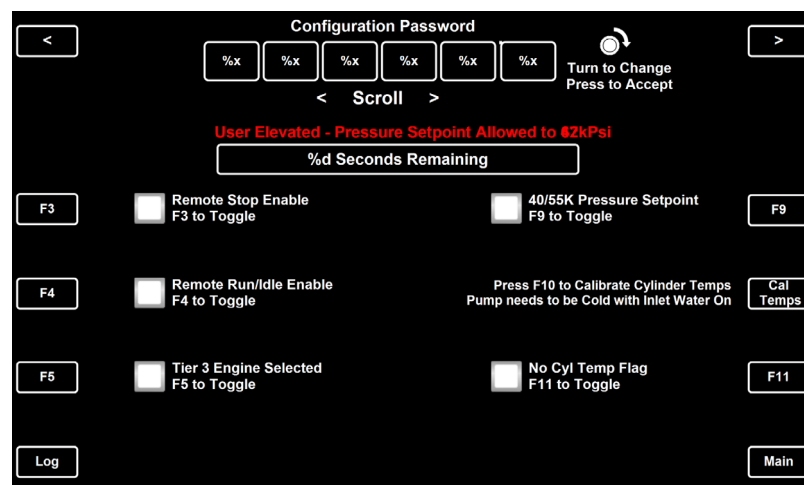


2. Starting from top left is the "Metric" / "English" units changer button. The text displayed in the box will be the units shown AFTER the button is pressed.
3. Moving down, the next two buttons control the commanded engine RPM up and down. The current engine speed is displayed graphically in the horizontal bar graph and the setpoint is shown digitally below. These numbers may not match. Use the graph for reference when setting RPM.

4. The 4th button down on the left side is used to initiate the ECV calibration procedure.
5. The 5th button navigates to the configuration screen where a password will be required to modify some parameters of the pump.
6. The bottom most button on the left side of the display navigates to the monitor pages. The first page is the pump monitor. This displays pertinent information regarding the UHP pump and the hydraulic system digitally. The second monitor page shows more detailed engine information.
7. The buttons on the right side are used to start and stop the engine and run and idle the pump.
8. The bottom most button on the right side navigates to the alarm page where details of current alarms and past alarms are viewed.
9. On the home page, the output pressure in KPSI is shown. Depending on the pressure range the scale and setpoint will be limited appropriately.
10. The pressure setpoint is changed by rotating the dial on the right side of the display. If fine adjustment is needed simply push the knob until a click is felt and adjustments will be in 6.9 bar (100 psi) increments.
11. The motor speed and pump pressure setpoints can be changed at any time the pump will only try to meet the setpoints when the "Run" button is active and no faults are present.
12. **Note:** Caution must be taken when turning on a cold pump. The previous ECV calibration will likely not be saved for a cold pump. This could cause the pressure to rise over the limit of the fluid end. It is best to start low and come up to pressure gradually until the pump warms up.
13. Also shown on the home screen are basic engine and pump status, pump hours, diesel fuel level, and any active alarms. For diesel units, emissions data are shown if the engine is tier 4 compliant.

Configuration Screen

1. The configuration screen is where different parameters of the pump can be changed.

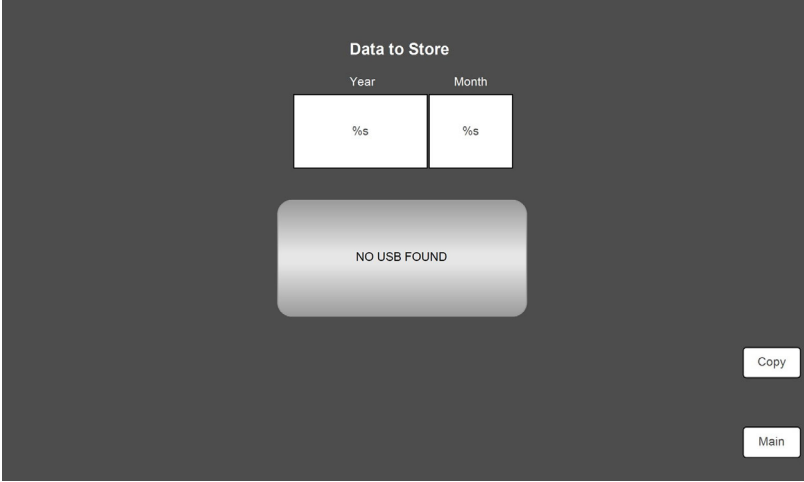


2. A password is needed to access the configuration screen. Depending on the authorization level of the password entered options will vary and may not include all that are shown above. At any time entering an incorrect password will clear all options and reset permissions to none.

3. Use the top left and top right buttons to highlight the password boxes. Use the knob to change characters. A valid password must be entered to proceed.
4. If authorization level is high enough, the pressure setpoint will be able to be set higher than normal to allow the calibration of the safety valve. The box below the red text will display how many seconds before the permission is reset.
5. Other options such as enabling the remote stop are available. This option shuts down the engine like an e-stop. Enabling the remote run/idle option, which can change the pump state remotely with a digital input, are also present.
6. The tier 3 engine and 40k/55k toggles must not be changed unless authorized by an APS service technician or engineer.
7. The "Cal Temps" button synchronizes the thermistors in the fluid end with the 4-20mA temperature transducer in the water filter. To do this the pump must be off, and cooled down, with water circulating through the fluid end.
8. F11 is a toggle to enable or disable the fluid end temperature monitoring if the thermistors are equipped.
9. The bottom most button on the left will navigate to the data log retrieval page where past logs can be downloaded to a USB device.

Log Screen

1. The log screen is where operating data for the pump can be retrieved.

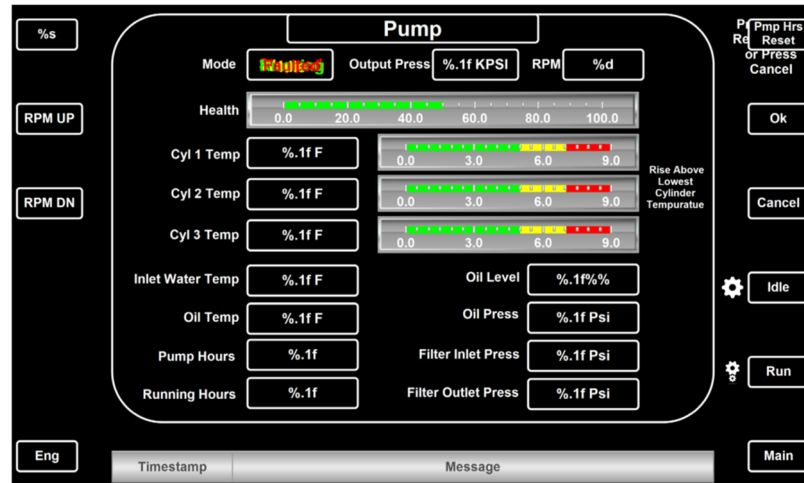


The screenshot shows a user interface for retrieving data logs. It features a dark grey background. At the top center, the text "Data to Store" is displayed. Below this, there are two white input boxes side-by-side, labeled "Year" and "Month". Each box contains the placeholder text "%s". Below these input boxes is a large, rounded rectangular button with a gradient, displaying the text "NO USB FOUND". In the bottom right corner, there are two smaller white buttons: "Copy" and "Main".

2. In the two boxes, enter the year "YYYY" and month "MM" of the data to retrieve. For example, 2019 04 for April 2019.
3. Once the USB device is inserted press the button next to "Copy" and the status message will update appropriately indicating if the data file exists or if the USB device is not connected. If the file is found during the transfer it will display "Copying" once complete it will indicate that the operation is complete. It is recommended that data is pulled often as after a year it will be overwritten by the new data.

Pump Monitoring Screen

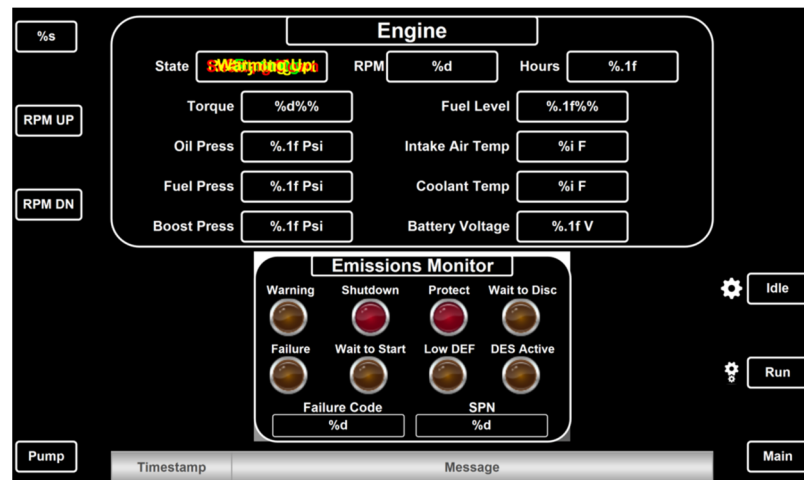
1. The pump monitoring screen is where detailed pump status can be viewed.



2. From this screen engine RPM can be controlled and whether the pump is in 'idle' or 'run' with the corresponding buttons.
3. Selecting "Eng" in the bottom left will bring up the engine monitoring screen

Engine Monitoring Screen

1. The engine monitoring screen is where detailed engine status can be viewed.



2. From this screen engine RPM can be controlled and whether the pump is in 'idle' or 'run' with the corresponding buttons.

Alarm Screen

1. The alarm screen is where current and previous alarm codes and shutdowns are displayed.
2. To view previous alarms, select "All" and use the knob on the right of the display to scroll the screen up and down.

Decommissioning

All local regulations must be adhered to for recycling and decontamination before the pump is decommissioned and taken out of service for any reason.

1. Shutdown the pump according to the 'Standard System Shutdown' procedure above.
2. Remove all of the following fluids: engine oil, hydraulic oil from the hydraulic circuit, diesel fuel and coolant from the radiator and cooling circuit.
3. Remove oil filters from the hydraulic circuit, oil and fuel filters from the engine, batteries and control box and electronics.
4. Dispose of (or recycle) the oil, fuel, coolant, filters, batteries, and electronics in accordance with local regulations.

System Storage

If the system will be idle for an extended period, it must be prepared for storage as detailed below.

1. Drain and clean the power end. Leave the drain open to permit air circulation and prevent condensation buildup.
2. Coat all bearings and machined surfaces inside the crankshaft with a rust inhibiting oil.
3. Rotate the crankshaft once each month.
4. For diesel units, refer to the engine manual for proper storage procedures.

NOTICE

If a pump is to be stored for extended periods it is recommended by Caterpillar that the engine is turned on and allowed to warm up every 2 weeks. This is to prevent crystallization of the def components used to meet Tier 4 emissions standards. Failure to do so increases risk of def related engine codes causing the engine not to run.

Cold Weather Storage

The following additional steps should be taken when the system is taken out of service in temperatures below freezing.

1. Open the top and bottom petcocks on the water filter canister to drain the canister. Close once all water is drained.
2. Drain all of the water from the high-pressure components: Disconnect the water supply hose at the connection point, and then attach a compressed air line. **DO NOT TURN ON THE AIR SUPPLY AT THIS TIME.**
3. Before the air is turned on, loosen the gland nut to the pressure transducer.
4. Loosen the gland nut to the safety valve.
5. Disconnect all high-pressure hoses and/or accessories connected to the high-pressure water outlets. These are to be stored independently.

6. Open the inlet water valve.
7. Slowly turn on compressed air to the pump. Allow the air to run until the system contains no more water—approximately 10 minutes.
8. Turn off the air supply and remove it from the connection point.
9. Connect the antifreeze supply line to the inlet water connection on the charge pump. Turn on the antifreeze pump.
10. Start the pump. Run at idle, watch for antifreeze to leak from the loose connections and outlet water ports to leak antifreeze—approximately 60 seconds.
11. Shut down the pump using the 'Standard System Shutdown' procedure above.
12. Plug the water inlet port.
13. For diesel units, refer to the engine manual for proper cold weather storage procedures.

NOTICE

If a pump is to be stored for extended periods it is recommended by Caterpillar that the engine is turned on and allowed to warm up every 2 weeks. This is to prevent crystallization of the def components used to meet Tier 4 emissions standards. Failure to do so increases risk of def related engine codes causing the engine not to run.

Startup After Storage

A system that is removed from storage must be thoroughly inspected for damage before it is returned to service. Verify that all component parts are in working order.

CAUTION

Failure to observe the following instructions can result in equipment damage.

1. Open the covers on the power end and verify the bearings are clean and in good condition.
2. Replace all fluids previously removed for long term storage.
3. Verify the plungers, valves and seals are properly installed and in good condition.
4. Verify proper tightness of bolts, nuts, studs, and fluid connections.
5. Fill the power end to the proper level with clean oil of the proper viscosity.
6. If antifreeze was added to the system, drain and flush this with water.
7. Follow the startup and operations instructions in this section.

Operation Safety Guidelines

Overview

Advanced Pressure Systems products are sold with the understanding that the purchaser agrees to thoroughly train all operating and maintenance personnel in the correct and safe installation, operation, and maintenance of waterblast equipment and to provide adequate supervision of personnel at all times.

Waterblast operators must be made aware that the cleaning nozzle's discharge jet can inflict serious bodily injury.

Additional safety information and updates may be obtained from the Waterjet Technology Association website at www.wjta.org.

General Safety Guidelines

Advanced Pressure Systems high pressure pump systems are designed to produce specifically related flows and pressures. Use caution when selecting nozzles and adjusting pressures to match the flow and working pressure of the specific pump model.

 **CAUTION** Never over-pressurize the system.

1. Use only products intended for high pressure water blasting. No product should be altered without the written consent of the manufacturer.
2. Read and follow all manufacturers' instructions prior to using any waterblast product. Contact the manufacturer should questions remain.
3. Inspect the condition of all components prior to use. Do not use an item in questionable condition.
4. Place barricades with warning signs or barricade tape around the work area.

Operational Safety



Never direct high-pressure fluid jets toward anyone or to any part of the body. High pressure water will penetrate all parts of the human body. The liquid stream and the material ejected by the extreme pressure can result in severe injury.

1. The operator handling the cleaning device and nozzle **must always** have control of the water pressure.

A surface cleaner operator should operate a trigger style, control gun capable of instantaneously stopping pressure to the nozzle.

A tube cleaning lance operator should operate a foot gun capable of instantaneously stopping pressure to the lance.

2. *Before attaching a nozzle to the control gun or tube cleaning lance operate the pump at low speed to purge dirt and debris from the system.*



Dirt and debris can clog the nozzle orifice(s) and cause excessive system pressures that could lead to a lance failure.

3. *With the nozzle installed, operate the pump at a low pressure to test the system. If system repairs or adjustments are necessary, stop the pump and relieve all pressure before making required repairs or adjustments.*
4. *With the system operating properly, increase pump pressure slowly until the operating pressure is reached and adjusted. Pressure adjustments should always be made slowly.*
5. *Use the minimum pressure required for cleaning. Do not exceed the operating pressure of the system's lowest pressure rated component. All equipment pressure rating markers and warning tags should be left intact.*
6. *If equipment or system malfunction is suspected, immediately stop cleaning activities, and relieve the pressure in the system before attempting any repairs. Always follow the manufacturer's repair instructions.*
7. *Following any repairs, operate the pump at a low pressure to test the system. Bring the system up to the operating pressure slowly.*
8. *If the system is shutdown, even for brief periods, in freezing conditions, drain the water from all components. Prior to startup in freezing conditions, the operation of all components must be carefully checked to ensure they are not frozen and will operate properly.*

Pressure Relief Devices

A waterblast system should include pressure relief protection.



Properly adjusted and maintained pressure relief devices are imperative for the protection of both the operator and the equipment against dangerous over pressurization.

- *For primary protection the spring load relief valve is set at 4,241 bar (61,500 psi).*



Never adjust relief valves to open at more than directed above.



Never adjust relief valves while the pump is operating under pressure.

1. *Relief devices should **never** be mounted so the discharge could strike personnel.*
2. ***Never** install a shut-off valve between the pump and the relief device.*
3. ***Set pressure must be prominently displayed on all relief devices.** Never install a relief device unless its set pressure is known.*

4. *The operation of relief valves and the accuracy of the set pressure should be field checked in accordance with manufacturer's instructions at regular intervals.*
5. *Do not attempt to correct a leaking relief valve by increasing spring tension. This will increase the set pressure.*
6. *Do not use a pressure relief valve as a combination relief and throttling device.*
7. *Keep relief valves dry during freezing conditions.*

High Pressure Hose and Lance Assemblies

Do not use a high-pressure hose with an operating pressure less than 3,793 bar (55,000 psi).

Do not use a high-pressure hose with an unknown burst rating or manufacturer's operating pressure rating.

- *Use of a safety shroud where the hose connects to the control gun is strongly recommended.*
- *Position the wrench on the wrench flats when making threaded connections. **Do not** position wrench on the fitting ferrule (collar).*
- *Protect the hose from contact with sharp objects, abrasive surfaces and foot or wheel traffic.*
- *Support hoses, pipes, and fittings to prevent excessive sway and/or wear created by vibration or stress on the end connections.*
- *Inspect hoses for damage, wear, or imperfections prior to and periodically during operation.*
- *Disconnect, drain, coil and store hoses properly after use.*



Never attempt to repair or re-couple hoses in the field. High pressure hose fittings are permanently crimped and can only be properly installed with hydraulic crimping equipment.

Hoses must be removed from service if the:

- *cover is damaged and reinforcing wires are exposed to rust and corrosion.*
- *cover is loose, has blisters or bulges.*
- *hose has been crushed or kinked.*
- *end fittings show evidence of damage, slippage, or leakage.*
- *hose has been exposed to pressures greater than 50% of burst rating.*
- *hose is three or more years old, regardless of condition.*

Control Gun and Control Device Safety

1. Prior to use, thoroughly inspect the control gun or device for smooth and proper operation. Control guns and devices should also be inspected for proper operation before each operating shift. **Do not** use any device that has not been inspected before the operating shift.
2. A control gun operator using a hand-held gun should position and brace their body for the gun's rearward reaction force before depressing the gun trigger. The rearward reaction force is high and is usually 40 to 50 pounds of force. The operator should maintain firm, solid footing to counter the rearward reaction.



Do not use a hand-held control gun if the nozzle discharge can accidentally strike the operator's body. A 48-inch-long discharge barrel **must** be used on hand-held control guns to prevent nozzle discharge from accidentally striking the operator's feet, legs or body.

3. The use of a safety shroud and a safety whip hose is strongly recommended for operator protection against a possible burst in the high-pressure hose connected to the gun. Use of a hand grip and a shoulder stock with hand-held guns will provide greater comfort and thus increase cleaning production.
4. Fall protection should be provided when blasting on scaffolding or sloping surfaces. Do not operate a hand-held control gun while standing on slippery surfaces.
5. The control gun operator should always start blasting with a **low system pressure** and **slowly increase** blasting pressure. When operating pressure is reached **depress and release the control gun trigger/pedal several times to check the gun's operation before starting cleaning operation.**
6. A dump-type control gun should **always** open fully and reduce the system pressure to near zero **immediately** when the trigger/pedal is released. If the gun does relieve system pressure immediately or pressure does not fall below to 13.8 bar (200 psi) when the trigger/pedal is released, do not use the control gun.
7. The operator should **never** pass a control gun to another operator without first stopping the pump and water flow to the gun. Failure to do so is dangerous because of possible accidental trigger actuation.
8. **Do not** use a control gun or control device that has malfunctioned, or is suspected to have malfunctioned without having it repaired and/or thoroughly checked for proper operation by a qualified high-pressure maintenance mechanic or a supervisor.
9. **Do not** use a control gun that does not have a trigger guard.
10. **Never** tie, wedge, or clamp a control gun's trigger in the blast position.
11. Hand-operated control guns **should never** be used as foot-operated devices.
12. Any hose used for transporting dump water back to the pump should have a large enough diameter and short enough length to keep potentially dangerous back pressure low.
13. All electric throttle control cords should be rated for wet conditions. All cord connectors and switches should be kept out of water.

Rigid Tube Cleaning Lance Safety

Do not use a rigid lance with an operating pressure less than 3,793 bar (55,000 psi).

Do not use a rigid lance with an unknown burst rating or manufacturers' operating pressure rating.

1. **Clearance** between the lance and tube **must be enough** to permit the unrestricted backflow of water and debris. With tubes containing hard deposits, this clearance should be a **minimum** of 1/8 inch on the diameter, or 1/16 inch per side, of the lance. With tubes containing soft, pliable deposits, this clearance should be greater. **Insufficient side clearance may cause lance to blow back toward the operator.**
2. Where practicable, a safety shield should be installed around the lance to prevent a lance nozzle from inadvertently being withdrawn and possibly causing injury.
3. **Ensure the nozzle, lance and adapter thread sizes are compatible** before installing the nozzle and adapter on the lance. Do not use a rigid lance that has damaged or missing threads.
4. When a pipe wrench is used to connect the lance, **avoid deep wrench marks** that may weaken the lance or lance connectors.
5. A rigid lance over 4 feet long requires two operators for support and safe operation. The **operator at the tube entrance should use a foot control gun** so they can instantly relieve system pressure in case of emergency.
6. When using and moving the lance support it in a manner to avoid stress and possible breakage at the inlet end connection.
7. **Never 'ramrod' the lance** into tube blockage.
8. Transport and store lances in tubes or racks to avoid bending, corrosion or other damage. Damaged lances (bends, marks, etc.) should be removed from service.

Flexible Tube Cleaning Lance Safety

The following lance accessories are strongly recommended for safer lance operation:

- A lance flex guard helps prevent fitting failure on the inlet end of the lance.
- A lance stinger provides greater control of the nozzle, establishes a safety zone so the operator knows when the nozzle is about to exit the tube and eliminates the possibility of nozzle and lance 'double back' toward the operator in large diameter pipe.
- A safety grip prevents the lance from exiting the tube unexpectedly.



Serious injury may occur if a lance with a live nozzle exits the tube.

Do not use a flex lance with an operating pressure less than 3,793 bar (55,000 psi).

Do not use a flex lance with an unknown burst or manufacturers' operating pressure rating.

1. **Do not use a flex lance that is kinked, worn, frayed** or when its ability to hold pressure is questionable.
2. **Do not** use a flex lance with damaged or missing threads.
3. **Clearance** between the lance and tube **must be enough** to permit the unrestricted backflow of water and debris. With tubes containing hard deposits this clearance should be a **minimum** of 1/8 inch on the diameter, or 1/16 inch per side, of the lance. With tubes containing soft, pliable deposits this clearance should be greater. **Insufficient side clearance may cause lance to blow back toward the operator.**
4. Use only nozzles designed for use with flex lances. For example, a nozzle drilled with enough rearward orifices, so nozzle pulls the lance through the tube.
5. Where the length of the nozzle and rigid coupling is less than the inside diameter of the pipe, a length of rigid pipe, not less than the diameter of the pipe being cleaned, should be fitted directly behind the nozzle, or a suitable safety shield should be provided to protect the operator.
6. If end fittings do not have wrench flats, use properly adjusted pipe wrenches to connect the nozzle onto the lance and to connect the lance to a pressure source. When installing the nozzle on the lance apply the wrench on the end fitting directly behind the end fitting thread, **not on the fitting ferrule or collar**. Do not clamp the lance hose in a vice when installing the nozzle.
7. Avoid rough handling, stretching or straining of the lance.
8. **Never attempt to 'ramrod' the lance** into tube blockage or to repair or re-couple lances.
9. After use, drain, coil and restore the lance properly. Ensure safety tags remain intact.

Nozzles

Do not use a nozzle with a manufacturers' pressure rating of a least the nozzle's operating pressure.

1. Prior to installation make sure the nozzle has no clogged orifices. Blocked orifices can cause excessive system pressure and failure. If an orifice appears clogged or partially blocked with dirt or debris, immediately remove the nozzle from the control gun or lance and clean.
2. Use Teflon tape when connecting nozzles with male pipe threads. Do not let the tape overlap the thread end, tape fragments may enter the water stream and clog the orifices in the nozzle.

Pipe thread connections should be hand-tight plus two (2) full wrench turns. Do not tighten past two (2) turns. All pipe thread connections must have a minimum engagement of four (4) threads.



Use wrench flats when available or a properly adjusted pipe wrench for tightening nozzle. Avoid deep wrench marks that may weaken the nozzle.

3. Special nozzles requiring a thread locking pin **must** have the pin installed prior to use or the nozzle may unscrew from the lance while in service, causing the lance to blow back toward the operator.
4. With nozzles requiring adjustment, always read applicable instructions.

Personal Protective Equipment

Proper safety apparel should be provided to all operators. It is strongly recommended that instructions be given regarding when and how specific clothing and other types of protective devices shall be worn.



Protective equipment may not prevent injuries to operators and other workers caused by the direct impact of high-pressure waterjets or from debris that may be thrown out by the impact of the jet.

- **Head Protection**

All operators shall be issued suitable head protection which shall be worn at all times while at the worksite. Where possible, head protection should include a full-face shield.

- **Eye Protection**

Eye protection shall be provided to, and worn by, all high-pressure waterjet equipment operators and all visitors to waterjet operations while they are in the working area. Eye protection must provide the protection needed and must fit properly. Eye protection shall meet appropriate ANSI requirements for that type of eye protection. Side shields to glasses and goggles should prevent liquids from getting through.



In some cases, liquids may be in use that can cause eye damage. In those cases, a combination visor and goggles or a full hood with shield should be used.

- **Hearing Protection**

Waterjets generate considerable noise; both in the air and under water. All operators and all visitors shall be issued and shall wear hearing protection while in the working area. Hearing protectors should be regularly inspected and properly maintained and should comply with federal and/or state OSHA standards.

All personnel, operators, and others in the vicinity of waterjet equipment should be taught how to fit and properly use ear protection so that their exposure to noise does not exceed OSHA or other regulatory limits.

- **Body Protection**

Protective clothing should be waterproof and have an outer layer that repels casual rebounding water. Protective clothing should also provide some protection from the impact of rebounding debris from the jet impact point where this may be a hazard to the operator.



Waterjets can penetrate clothing, most protective suits, skin, and cause serious injury.

- Everyone working around a waterjet operation should be provided with, and should wear, sufficient waterproof clothing to provide protection from the type of exposure to water and debris that the work might create. Garments should completely cover the operator, including their arms.

Liquid or chemical resistant suits shall be worn when there is a reasonable chance such equipment can prevent an injury.

- **Hand Protection**

All operators should be provided with adequate means to protect their arms and hands. This protective equipment shall be worn when there is a reasonable chance it can prevent an injury.

- **Foot Protection**

All operators and workers in the vicinity of a jetting operation should be supplied with, and shall wear, waterproof boots that have been fitted with steel toe caps. A metatarsal guard should also be worn by jetting gun operators.

- **Respiratory Protection**

A respiratory program shall be implemented where there is a reasonable chance it can prevent an injury.

Maintenance

Overview

In order to keep the equipment in optimum operating condition, routine and preventive maintenance is essential.

*Only trained personnel should be authorized to perform maintenance or repairs to the equipment. All manufacturers' repair instructions, including tool, torque, clearance, and lubrication recommendations should be followed. **Do not attempt to install or use a part whose dimensions, clearances, function, or use are suspect.***

Repaired equipment must be thoroughly and carefully tested before it is returned to service. Do not put any piece of repaired equipment in service if its performance is questionable.

NOTICE For diesel units: if a pump is to be stored for extended periods it is recommended by Caterpillar that the engine is turned on and allowed to warm up every 2 weeks. This is to prevent crystallization of the def components used to meet Tier 4 emissions standards. Failure to do so increases risk of def related engine codes causing the engine not to run.

Maintenance Precautions

Observe these precautions when maintaining the equipment.

- *Protect all machined and lapped mating surfaces against nicks, scratches, and burrs.*
- *Carefully clean and blow out all parts to be reassembled. Do not use paper towels. Do not create airborne dust.*
- *Do not use any substitutes for the fluids, sealants, and lubricants recommended by Advanced Pressure Systems.*
- *Lubricate threads for all high-pressure connections with blue lubricant before assembly.*
- *Lubricate new bearings before installation.*

General Precautions

Observe the following general precautions at all times.

Mechanical

- *Do not make any unauthorized alterations to the equipment or components.*
- *Use only high-pressure fittings, hoses, valves, and tubing rated for 3,793 bar (55,000 psi) or greater when making alterations or additions to the high-pressure water system.*
- *Repair any leaks in fittings or connections immediately. Do not over-torque fittings to stop leakage. Refer to the 'Torque Specifications' table below.*

- Torque all fittings to the manufacturer's specifications.
- Follow the tubing manufacturer's recommendations for high-pressure tubing bending radii.
- When pressurizing any new, rebuilt, or serviced high pressure components, remove all personnel from the immediate area until the system pressure has been applied for three minutes and has been cycled on and off at least three times. Gradually increase pressure [maximum of 1,379 bar (20,000 psi) per minute].
- High-pressure water may remain in the system for a prolonged period after closing the high-pressure water source. Bleed the system pressure off before servicing any part of the pump.
- Follow the manufacturer's recommendations for servicing the pump and use only original manufacturer replacement parts.
- Visually examine the entire system before placing it in operation. If any fault or malfunction, correct it.

Tools

- Use only approved test equipment. Examine the equipment regularly for correct operation and calibration.
- Use the correct tools for the job. Use of incorrect tools can result in injury to personnel or costly damage to the equipment.
- Remove all tools and rags from around the machine after servicing and before starting the pump.
- Use only approved work platforms. Never climb on or around the equipment on makeshift devices.

Protective Clothing

- Do not wear loose clothing while working around rotating parts of machinery.
- Pressurized air can drive particles into eyes and skin if handled incorrectly. To prevent injury, use appropriate protective equipment and clothing, and exercise extreme caution.
- See Personal Protective Equipment (PPE) for more information.

Gland Nut Torque Specification

If a torque value for a gland nut is not specified, reference this table to determine torque value. Always leave 3–4 threads showing between the end of the high-pressure tubing and gland nut collar.

TUBING O.D.	TORQUE [FT. LB. (Nm)]
1/4"	15 – 25 (20 – 34)
3/8"	35 – 45 (47 – 60)
9/16"	60 – 75 (80 – 100)

Daily Inspection

The following inspection procedures should be performed each day before use. If problems are detected, they should be remedied before placing the equipment in service.

- Prior to startup, check power end and inspect oils for dirt or contamination.



Do not check the oil while the pump is running.

- Check all system connections to ensure they are tight and leak proof.
- Check suction and discharge supply line valves to ensure they are fully open.
- Review relevant sections of motor and drive train manuals.
- As the machine is started and water pressure increases, listen for unusual sounds.
- Check for plunger packing leakage.
- Check for leakage between the barrels and suction manifold.
- Check the intermediate rod and main bearing oil seals for leakage.
- Review relevant sections of engine and drive train manuals.

Monthly Maintenance

A number of factors can contribute to component failure: poor water quality, operating conditions, or improper maintenance procedures. Maintaining a service log can be a useful method of tracking component life and maintenance trends. Analyzing service intervals will assist in preparing a preventive maintenance schedule tailored to specific application requirements. Periodic maintenance, at regularly scheduled intervals, will minimize unscheduled downtime and premature component failure.

Improper assembly can lead to the premature failure of components. Maintenance procedures must be followed carefully; components must be properly cleaned prior to assembly and tightened to the correct torque specifications.

- Degrease, wash, and clean the system monthly.
- Drain and refill the power end every 500 hours or as often as required to maintain clean, sludge free oil of the proper viscosity.
- Clean the pump with a non-explosive solvent.
- Check studs, nuts and bolts for tightness and tighten as required.
- Check gaskets for leaks and replace as required.

To avoid unsafe conditions and the risk of equipment damage, operating personnel and service technicians must carefully read and follow the procedures in this manual.

High Pressure Fittings and Connections

The pressure rating for high pressure fittings must be a minimum of 3,793 bar (55,000 psi).

- All fittings shall be cleaned before installing in the system.
- **Never** use a damaged or corroded fitting, or one with damaged or missing threads.
- Check the condition of thread connections prior to the makeup of any high-pressure connection. **Do not** use a component with missing or damaged threads on high pressure connections.
- Use Teflon tape on male pipe threads (NPT) for sealing purposes. Do not let the tape overlap the pipe thread end. Tape fragments may enter the system water stream and clog nozzle orifices.
- Properly tighten all high-pressure connections. All pipe connections **must have a minimum engagement of four (4) threads**. Pipe connections should be hand-tight plus two (2) full wrench turns. **Do not** tighten pipe threads past two wrench turns.
- Position the wrench on the wrench flat when making threaded connections. Do not position the wrench on the fitting ferrule. If wrench flats are not available, use a properly adjusted pipe wrench to tighten fittings. Deep wrench flats weaken fittings.

Filters and Strainers

Regular checks should be made of all fluid filters to ensure they are not blocked or damaged. Care should be taken when examining, changing, or cleaning filters to ensure that no solid particles escape into the supply lines to the pump and nozzle. Solid particles can damage valves and nozzles and make the pump run poorly. All fluid filters should be checked at regular intervals, especially when the supply water is of a poor quality.

Nozzles, Holders, and Lance Connections

The system should be flushed with water before installing the nozzle. Nozzles should be checked to ensure they are not blocked or damaged and that they seat properly in the holder or manifold. The condition of the threads holding the nozzle in place should be checked to ensure they are in good condition and not worn. All damage shall be repaired, or the parts replaced, before jetting begins.

Trigger and Valve Controls

Each hand-operated and foot-operated valve shall be manually checked before a unit is placed in operation to ensure it is clean and properly functioning. Valves should be periodically disassembled to examine the condition of the internal components and to replace worn parts. Valve guards should also be inspected and any defects that might interfere with the proper operation of the unit shall be corrected.

High Pressure Hoses

Hose assemblies must be visually inspected prior to each use and thoroughly tested every six (6) months or sooner, regardless of whether they were in use or not.

A visual inspection should be made at periodic intervals to determine if a hose assembly is suitable for continued service.

The visual inspection must include checking for loose covers, kinks, bulges or soft spots that might indicate broken or displaced reinforcement. Couplings or fittings must be closely examined and, if there is an indication of displacement of the hose from the couplings, the hose must be removed from service.

Proper Hose Storage

Hose assemblies in storage can be affected adversely by temperature, humidity, ozone, sunlight, oils, solvents, corrosive liquids and fumes, insects, rodents, and radioactive materials.

The appropriate method for storing hose depends largely on the diameter and length, the quantity to be stored and the way it is packaged. Hose should not be piled or stacked to the extent that the weight of the stack creates distortions on the lengths at the bottom. Hoses with a very thin wall will not support as much load as hoses with a heavier wall or wire reinforcement. Hose shipped in coils or bales should be stored so the coils lie flat on a horizontal plane.

Hose assemblies should be stored in a container. Containers can provide protection against the deteriorating effects of oils, solvents, and corrosive liquids. Containers also give some protection against ozone and sunlight.

Rodents and insects can damage rubber hose products. Protection from them must be considered.

The ideal temperature for storing hose assemblies ranges from 35° to 80° F (2° to 27° C) with a maximum limit of 100° F (38° C). If stored below 32° F (0° C) some hose will become stiff and will require warming before being placed in service. Hose assemblies should not be stored near sources of heat, such as radiators or space heaters.

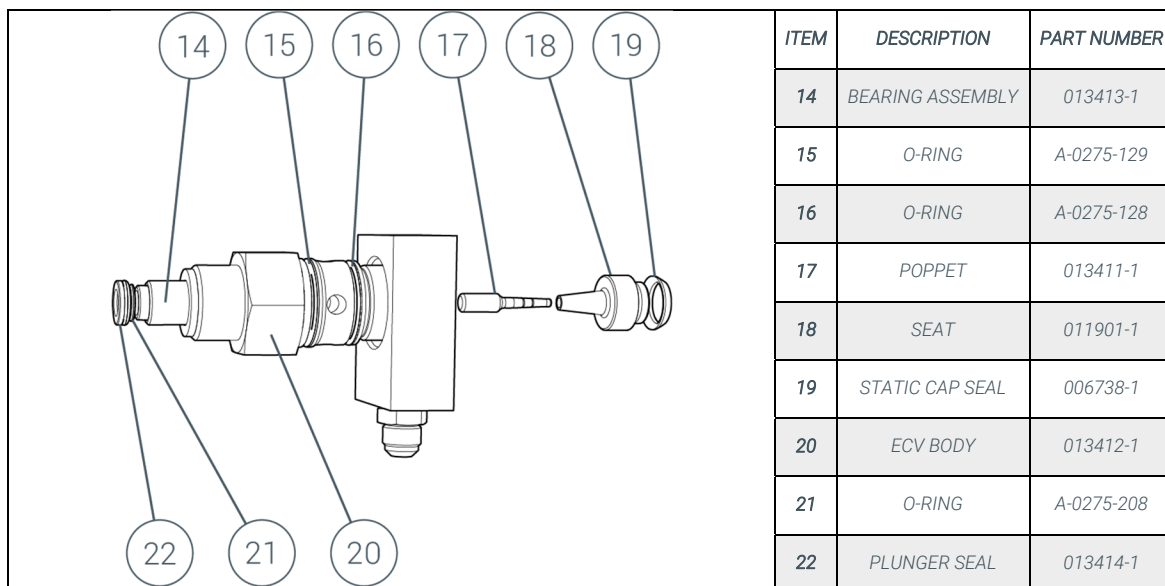
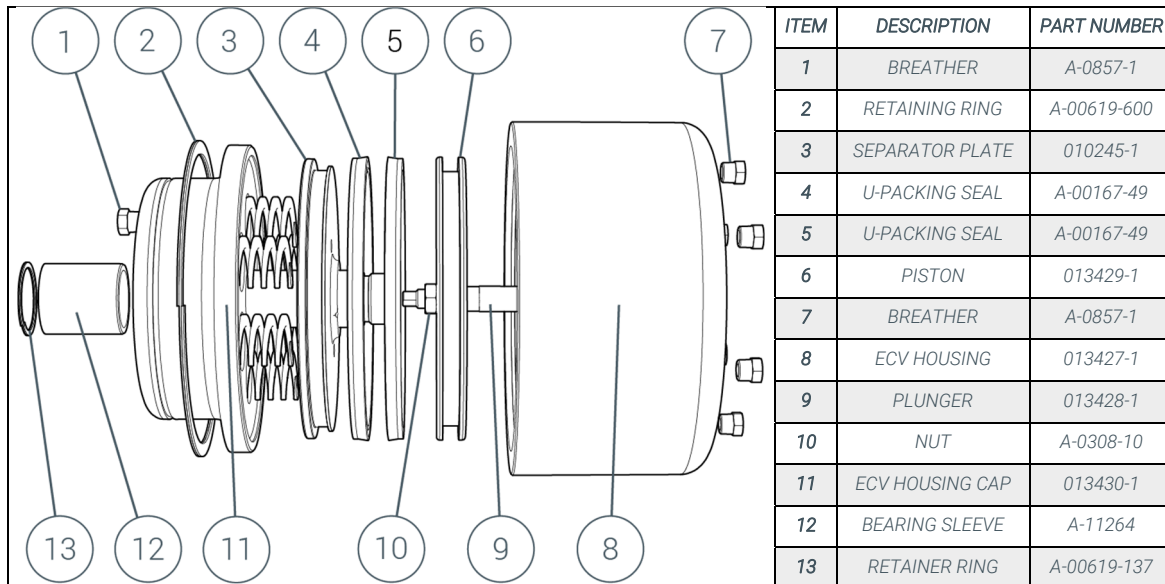
Preventative Maintenance Schedule

Install minor maintenance kit	Every 150 hours of operation
Install major maintenance kit	Every 600 hours of operation ¹
Replace water filters	Every major kit installation or $\Delta P > 25$ psi
Replace hydraulic oil filters	Every 1000 hours or annually
Examine accumulators for charge	Every 6 months

1) Major kit includes minor kit parts

2) If water quality does not meet the specifications outlined, then water filters may require more frequent replacement

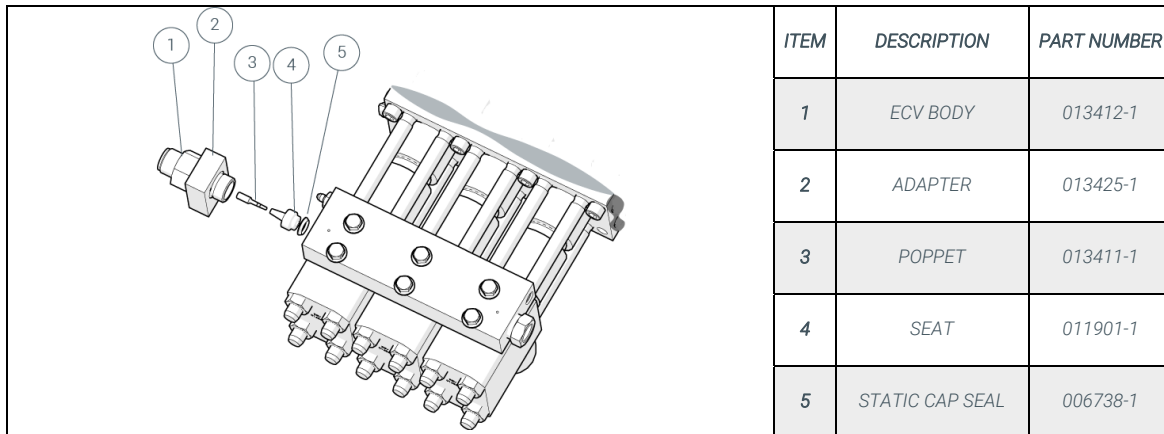
ECV Rebuild



1. Disconnect the hydraulic hose attached to the oil connector.
2. To remove the ECV housing from the ECV body, hold the body nut with a wrench and then turn the ECV housing with a spanner wrench.
3. Loosen the ECV body from the high-pressure manifold with a wrench and remove the body, adapter, poppet, seat, and static cap seal.
4. Examine the bearing assembly, the plunger seal, the O-ring, the poppet, the seat, and the static cap seal for obvious unusual wear, and then discard them. If unusual wear is found, determine the cause and make appropriate repairs as required or call APS technical support.

5. Remove the retainer ring from the ECV body.
 6. Remove the ECV housing cap together with the springs from the ECV housing body.
 7. Pull the shaft and the attached separator plate out of the ECV housing.
 8. Remove the piston by pressing it out from the ECV body housing.
 9. Remove the seven breather vents.
 10. Remove the retainer ring and bearing sleeve from the cap.
 11. Remove the nut that holds the plunger to the piston, and then separate the plunger and piston by tapping from the plunger nut side with a soft mallet.
 12. Clean the separator plate, the piston, and the ECV housing cap and body with a water-soluble cleaning compound.
 13. Thoroughly dry the components.
 14. Install new U-packing seals on the separator plate and the piston.
 15. Lubricate the inside of the ECV housing and the piston and separator plate seals with food grade grease.
 16. Install the new plunger through the piston. Install new nut. Torque nut to 34-40 N-m (25-30 ft-lb).
- NOTICE** When correctly installed, the open areas of the U-packing seals face each other.
17. Install the piston/plunger assembly into the ECV housing.
 18. Install the separator plate into the ECV housing.
 19. Set the ECV housing cap with the spring pockets facing up and then place the springs into the pockets of the cap.
 20. Lower the ECV housing body onto the cap.
 21. Turn the assembly over and install the retainer ring. If the retainer ring is not easily installed, then the separator plate or the piston is not installed correctly. Disassemble the ECV and reassemble it.
 22. Install new breather vents.
 23. Lubricate the plunger seal and accompanying O-ring with FOOD GRADE GREASE and install them into the ECV body.
 24. Install the bearing sleeve into the ECV housing cap. Install the retainer ring to hold it in position.
 25. Lubricate the bearing assembly with FOOD GRADE GREASE and install it into the ECV body.
 26. Install new O-rings onto the ECV body. Set the ECV body aside, in a clean area.
 27. The ECV body, the poppet, the seat, and the static cap will be installed directly to the manifold during reassembly.

ECV Installation



1. Install the new ECV static cap seal onto the seat.
2. Lubricate all visible ECV O-rings with FOOD GRADE GREASE.
3. Apply BLUE LUBRICANT on the ECV body-to-manifold threads.
4. Install the ECV body, the poppet, the seat, and the static cap seal into the manifold hand tight.
5. While ensuring that the fitting on the adapter points down, tighten the ECV body to the manifold.
6. Apply BLUE LUBRICANT on threads of the ECV body.
7. Support the ECV housing from the bottom and install the ECV housing onto the ECV body. Turn the ECV housing onto the ECV body as far as possible by hand.

NOTICE During installation, support and rotate the ECV housing from the bottom. Use this method to get correct thread alignment and to prevent cross threading.

8. Use a spanner wrench in the holes in the rear of the ECV housing to tighten the ECV housing to the ECV body.
9. Connect the high-pressure water and ECV connections.
10. Connect the high-pressure water line to the manifold.
11. Connect the low-pressure water hoses to the manifold.
12. Connect the drain lines.
13. Remove tools, parts, and rags from around the pump.
14. Open the inlet water valve and check for leaks.

NOTICE Failure to open the inlet water valve before starting the pump may cause severe damage to the pump.

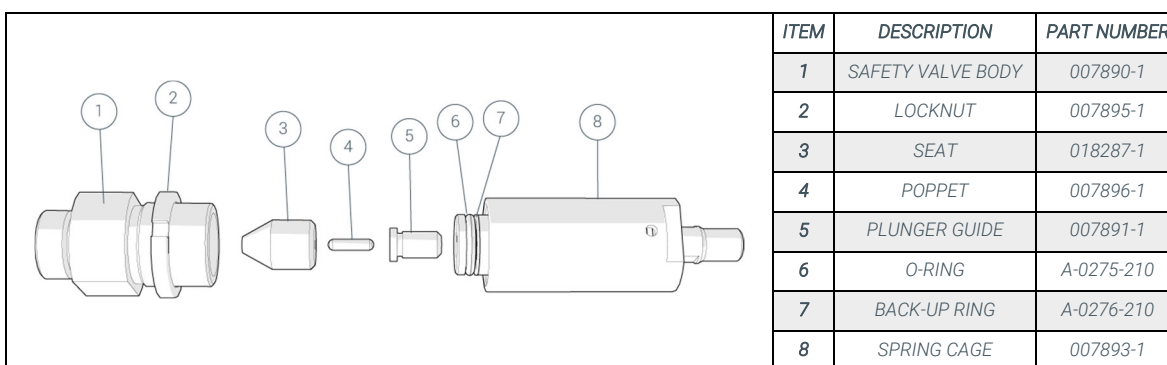
15. Do the 'Calibrate the External Control Valve' procedure found later in this manual.
16. Run the pump at 690 bar (10,000 psi) for three minutes, then three minutes each at 1379 bar (20,000 psi), 2069 bar (30,000 psi), 2758 bar (40,000 psi), 3,793 bar (55,000 psi) examining for leaks and heat.

Safety Valve Service

The safety valve protects the operator and pump from high pressure during a catastrophic failure. If an over-pressure condition occurs, the safety valve opens and unloads the circuit. The safety valve is set to discharge above 4241 bar (61,500 psi).

Signs of a Problem:

If the safety valve opens, reset it by returning the engine to idle. Operate the pump at low pressure and idle for one minute, then increase to full speed. If the safety valve opens again, the restriction must be located. Turn the ENGINE switch to OFF and examine the nozzle and hoses for restrictions. Do not restart the engine before solving the problem.



Disassembly:

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.

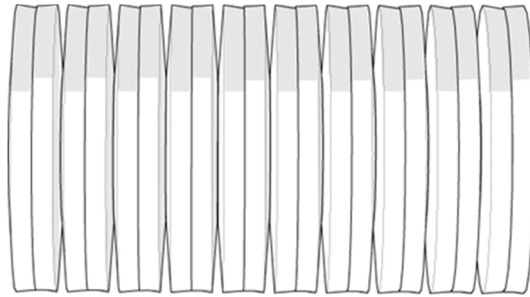


Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

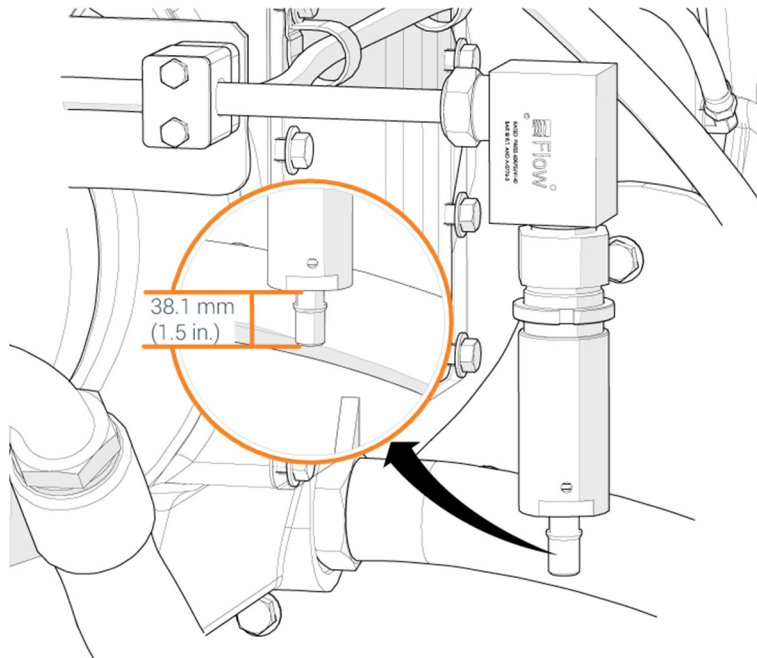
2. Remove the hose from the safety valve.
3. Loosen the locknut with a spanner wrench.
4. Release the spring tension by turning the spring cage counterclockwise with the spanner wrench until it is loose enough to remove by hand.
5. Be careful of the spring washers located in the spring cage; remove the spring cage from the safety valve body. If the spring washers fall out of the spring cage, put them in a safe place. They are required for reassembly. There are 20 spring washers.
6. Remove and discard the O-ring and back-up ring.
7. Remove the seat and poppet and discard them.

Assembly:

1. Examine all parts of the safety valve assembly for damage to the threads and sealing surfaces. Repair or replace as necessary.
2. Install the back-up ring and O-ring. Lubricate them with FOOD GRADE GREASE.
3. Stack the spring washers in the spring cage in the order shown below.



4. Place the poppet into the plunger insert guide and install a new seat.
5. Apply BLUE LUBRICANT to the safety valve body threads.
6. Install the spring cage onto the valve body until there is 38.1 mm (1.5 in.) of the stem extending from the spring cage.



7. Do the 'Calibrate the Safety Valve' procedure found later in this manual.

Water Filter Element Replacement

Dirty or incorrect filters can shorten pump life.

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.



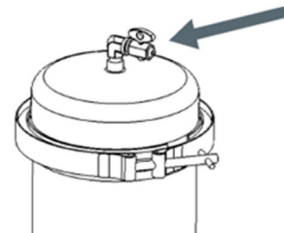
Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Remove the inlet line to the high-pressure manifold and then drain the filter canister.
3. Open the air bleed valve located on the filter canister lid.
4. Open the drain valve located at the bottom of the filter body to drain the filter canister.
5. To remove the filter canister lid, unscrew the canister lid clamp T-bolt.
6. If the clamp does not disengage from the filter assembly, gently strike the clamp with a mallet to disengage it.
7. Remove the filter lid.
8. Remove the filters from the canister. Examine them for unusual contamination and then discard them.
9. Examine the contents of the canister.



These inspections can provide early warning of a change in inlet water quality. The quality of the inlet water directly affects the life of the filter.

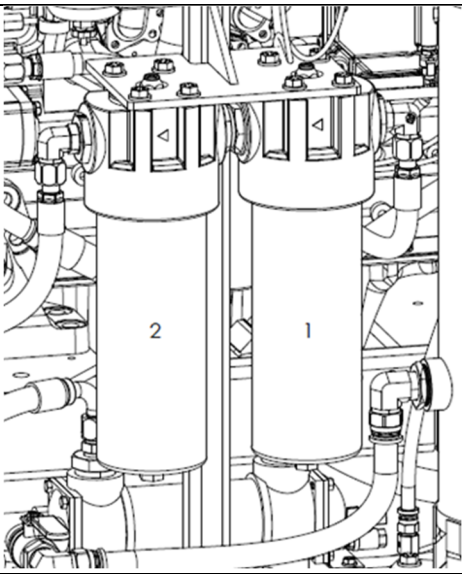
10. Flush the canister with fresh water or use a wet-dry vacuum to clean debris from the bottom of the canister.
11. Install new filter cartridges.
12. Align the filter canister lid to the filter body. Orientate the bleed valve as shown.
13. Apply a thin layer of BLUE LUBRICANT to the threads and face of the clamp T-bolt, and then tighten the clamp.



The clamp may need to be struck gently with a mallet to seat correctly on the flanges.

14. Flush the inlet line to the high-pressure manifold with fresh water to remove any contaminants that may have bypassed the filter housing.
15. Connect the inlet line to the high-pressure manifold.
16. Gradually open the inlet water valve and carefully examine the manifold and filters for leaks.
17. Use the bleeder valve on top of the filter housing to remove air from the system.
18. Do a final inspection to remove tools, parts, and rags from the equipment before startup.

Hydraulic Filter Element Replacement

	ITEM	DESCRIPTION	PART NUMBER
	1	PARTICULATE FILTER	A-18850
	2	WATER REMOVAL FILTER	A-18851

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.



Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Remove the filter housing by turning the 36 mm nut located at the bottom of the housing.
3. Remove the filter.
4. Clean the housing.
5. Install a new filter.
6. Apply SILVER ANTI-SEIZE to the housing threads.
7. Reinstall the filter housing.
8. Run the pump. While the pump is running, monitor the level of oil in the pump hydraulic oil reservoir. Add oil to the reservoir until the oil level is between the low and high marks of the site gauge.

Dynamic Seal Temperature Sensor Replacement

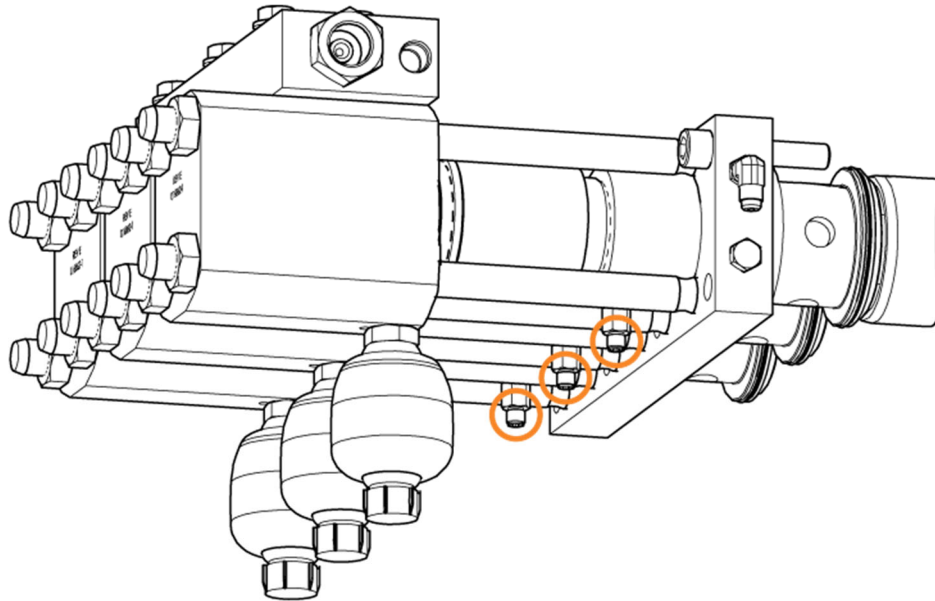
This portion of the manual is for fluid ends equipped with Dynamic seal temperature sensors.

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.



Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Disconnect the cable from the appropriate sensor.



3. Remove the sensor.
4. Install the new sensor.
5. Do the 'Calibrate the Dynamic Seal Sensors' procedure found later in this manual.

Calibrations

Calibration Overview

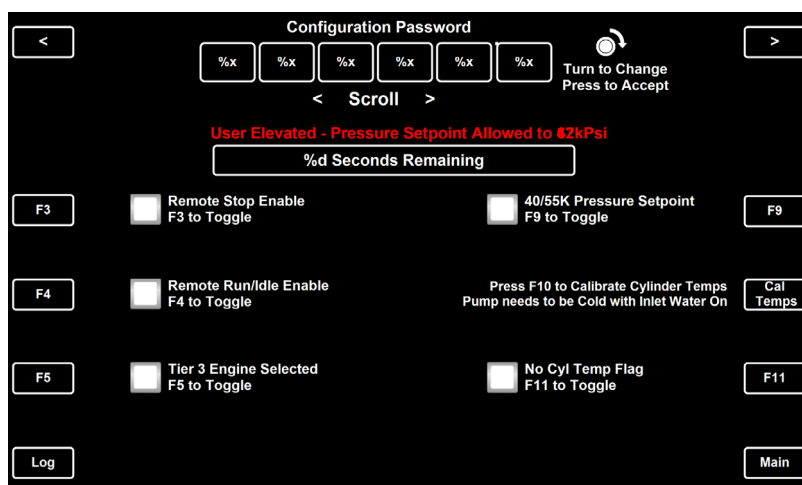
The following calibrations are required to keep the pump operating correctly.

Calibrating the Dynamic Seal Temperature Sensor

The dynamic seal temperature sensors require periodic calibration. Such instances include after replacing a sensor or after maintenance that requires disconnecting the sensor.

The system recognizes if the sensors need calibrating and automatically adjusts them. The calibration process terminates after 5 minutes, if the engine is started, or if inlet water pressure is lost. The Pump data screen 2 can be viewed while the engine is off and with cooling water flowing past the sensors to make sure that the calibration has been effective. When correctly calibrated, the sensors should have no more than a 1.5-degree Fahrenheit difference in temperature.

1. Turn the key switch to RUN, but do not start the engine.
2. Open the inlet water valve to apply water pressure to the pump to let cooling water flow past the inlet water temperature sensor and the three cylinder sensors.
3. Let the pump temperatures stabilize. Temperature stabilization takes approximately 5 minutes.
4. Enter the configuration screen by clicking the 'Config' button on the home screen.
5. Use the top left and top right buttons to highlight the password boxes. Use the knob to change characters. A valid password must be entered to proceed.
6. Select the 'Cal Temps' button to complete the calibration.

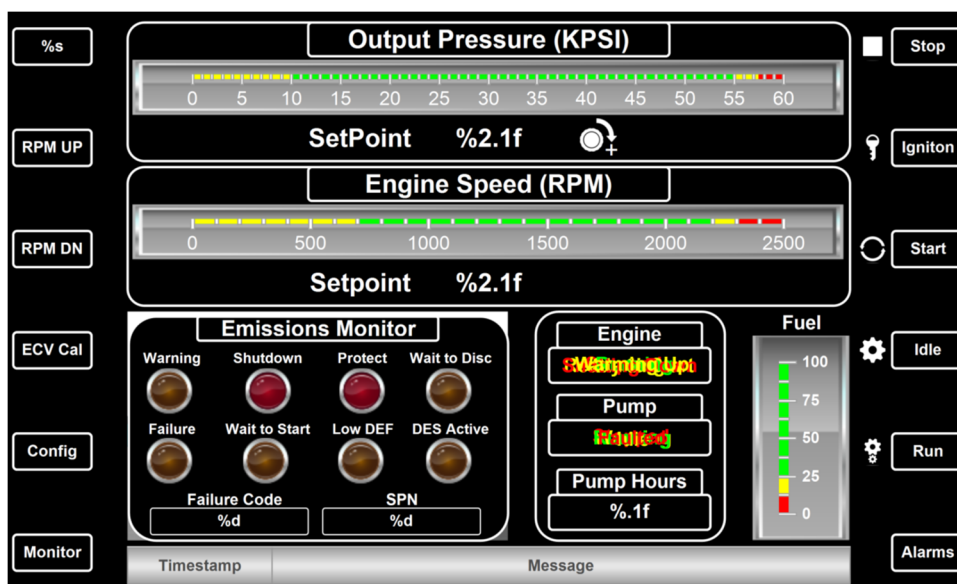


Calibrating the External Control Valve

Calibrate the ECV every time the poppet or poppet seat is replaced, the pump is rebuilt, or whenever the ECV starts to affect output water pressure.

If operating the pump in a cold environment, the oil may take an excessive amount of time to warm up enough to calibrate the ECV correctly. Contact APS technical service if assistance is required.

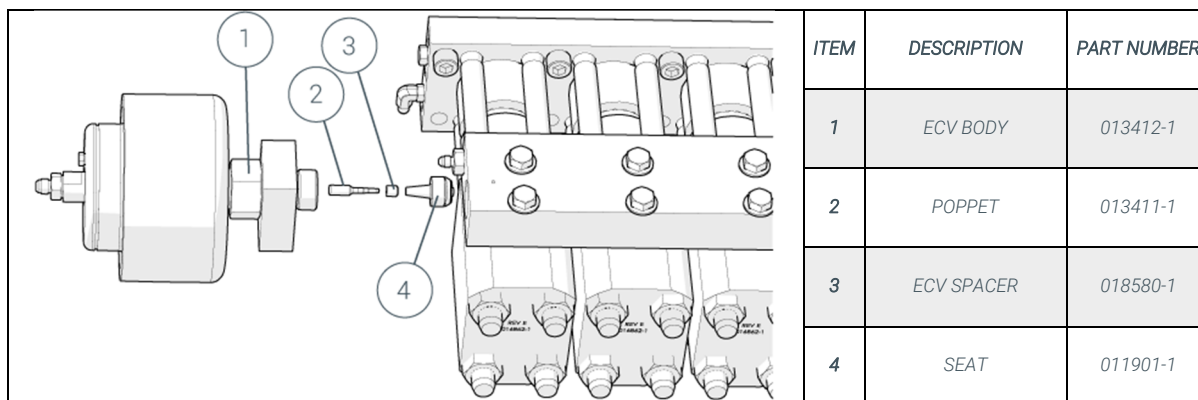
1. Make sure that the following conditions are met, or the calibration will not be accurate:
 - Deadhead the UHP system by closing all output water valves so that all water goes over the ECV.
 - Pump oil is at operating temperature [$>24^{\circ}\text{C}$ (75°F)].
2. On the programmed display, navigate to the Calibration screen and then press begin to start the calibration.
 - For the duration of the test (2 minute or less), this process can be stopped by pressing abort, pressing the E-stop, pushing the SYSTEM IDLE button, or a shutdown occurs.
 - During the test, the pump sets to 2100 RPM and the PLC adjusts the control signal to the ECV up in steps to calibrate signal from 0-3,793 bar (55,000 psi).
 - When finished, the pump returns to idle and zero pressure The calibration curve generated can then be stored. If not stored when power is cycled calibration will revert to previous calibration setting.
 - Run the pump at 690 bar (10,000 psi) for three minutes, then three minutes each at 1,379 bar (20,000 psi), 2,069 bar (30,000 psi), 2,758 bar (40,000 psi), 3,793 bar (55,000 psi) examining for leaks and heat.



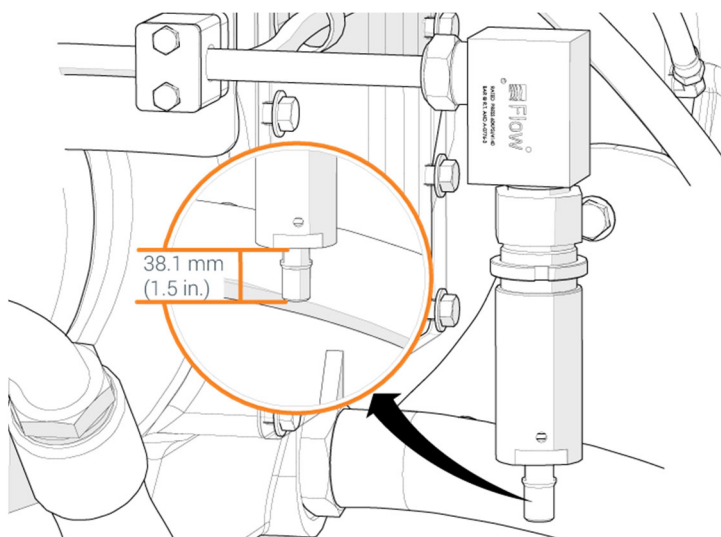
Calibrating the Safety Valve

Although the maximum system output under normal operating conditions is 3,793 bar (55,000 psi), the safety valve is set to discharge above 4,241 bar (61,500 psi). This accommodates expected pressure spikes. The safety valve protects the operator and pump from high pressure during a catastrophic failure. Calibrating the safety valve at pressures below 4,241 bar (61,500 psi) can cause excessive actuation of the safety valve, resulting in premature wear to the safety valve poppet and seat.

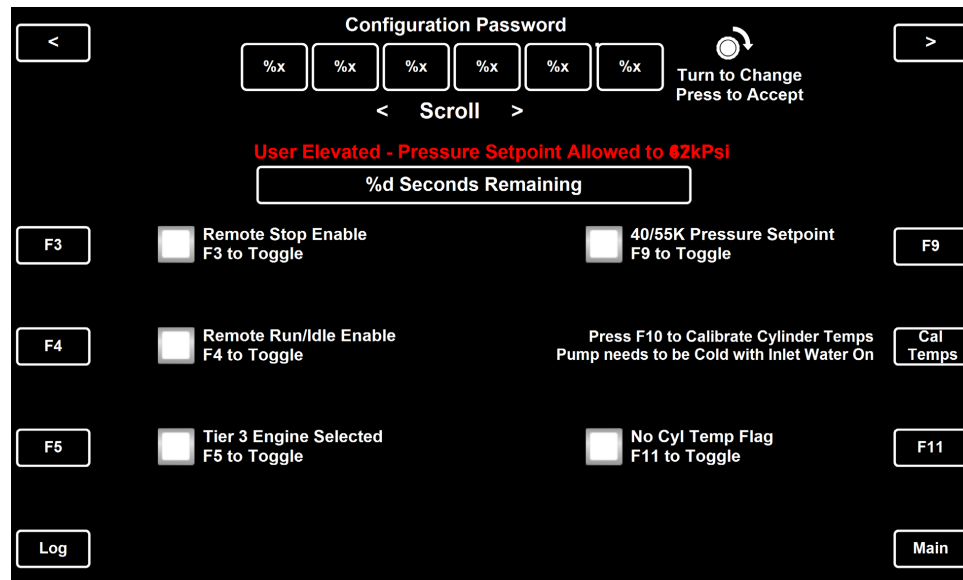
The pump must be able to deliver 4,241 bar (61,500 psi) minimum water pressure.



1. Install the ECV spacer onto the ECV poppet.
 - Remove the ECV housing and ECV body from the manifold.
 - Install the ECV spacer between the poppet and the seat.
 - Reinstall the ECV housing and ECV body to the manifold.
2. Disconnect the hose from the safety valve.
3. Adjust the safety valve spring cage so that 38.1 mm (1.5 in.) of the stem extends from the spring cage.



4. Deadhead the pump.
5. Activate the extended pressure range on the control display by navigating to the config screen and entering the correct password. Extended pressure range will be available for 12 minutes.



6. The pump can now be set up to 4,275 bar (62,000 psi). Run the pump and increase the water pressure to 4,103 bar (59,500 psi). Make sure that the valve does not dribble or discharge. If the valve dribbles or discharges, push the SYSTEM IDLE button, tighten the spring cage approximately 1/4 turn, and then go back to Step 5.

NOTICE One turn is equivalent to 82.7–103.4 bar (1,200–1,500 psi).

7. Increase the pump pressure to 4,241 bar (61,500 psi) see if the valve dribbles at this pressure.
 - If the safety valve discharges completely, return to Step 3.
 - If the valve does not dribble:
 - Push the SYSTEM IDLE button on the control.
 - Loosen the spring cap 1/4 turn.
 - Continue to step 8.

8. Enter the Run screen and run the pump at 4,103 bar (59,500 psi). Make sure that leakage does not occur. Continue to step 9 if no leakage is observed.

NOTICE If leakage is noted, install a safety valve service kit, and then restart this calibration procedure.

9. After the valve is correctly calibrated, shut off the pump.
10. Tighten the locknut against the spring cage.
11. Reconnect the hose to the safety valve.
12. Remove the spacer from the ECV.
13. Lubricate all visible ECV O-rings with FOOD GRADE GREASE.

14. *While supporting the ECV assembly from the bottom of the housing, install the ECV into the manifold. Turn the ECV into the manifold most of the way by hand.*
15. *During installation, support and rotate the ECV assembly from the bottom of the ECV housing. Use this method to get correct thread alignment and to prevent cross threading. Additionally, if a wrench is used on the ECV body, do not over torque the ECV nut, as this damages the threads in the manifold body.*
16. *Tighten the ECV body to the manifold.*
17. *Use a spanner wrench in the holes in the rear of the ECV housing and then tighten the ECV housing to the ECV body.*

55K Fluid End Assembly

Maintenance Overview

In order to keep the equipment in optimum operating condition, routine and preventive maintenance is essential.

*Only trained personnel should be authorized to perform maintenance or repairs to the equipment. All manufacturers' repair instructions, including tool, torque, clearance, and lubrication recommendations should be followed. **Do not attempt to install or use a part whose dimensions, clearances, function, or use are suspect.***

Repaired equipment must be thoroughly and carefully tested before it is returned to service. Do not put any piece of repaired equipment in service if its performance is questionable.

NOTICE For diesel units: if a pump is to be stored for extended periods it is recommended by Caterpillar that the engine is turned on and allowed to warm up every 2 weeks. This is to prevent crystallization of the def components used to meet Tier 4 emissions standards. Failure to do so increases risk of def related engine codes causing the engine not to run.

Maintenance Precautions

Observe these precautions when maintaining the equipment.

- *Protect all machined and lapped mating surfaces against nicks, scratches, and burrs.*
- *Carefully clean and blow out all parts to be reassembled. Do not use paper towels. Do not create airborne dust.*
- *Do not use any substitutes for the fluids, sealants, and lubricants recommended by Advanced Pressure Systems.*
- *Lubricate threads for all high-pressure connections with blue lubricant before assembly.*
- *Lubricate new bearings before installation.*

General Precautions

Observe the following general precautions at all times.

Mechanical

- *Do not make any unauthorized alterations to the equipment or components.*
- *Use only high-pressure fittings, hoses, valves, and tubing rated for 3,793 bar (55,000 psi) or greater when making alterations or additions to the high-pressure water system.*
- *Repair any leaks in fittings or connections immediately. Do not over-torque fittings to stop leakage. Refer to the 'Torque Specifications' table below.*

- Torque all fittings to the manufacturer's specifications.
- Follow the tubing manufacturer's recommendations for high-pressure tubing bending radii.
- When pressurizing any new, rebuilt, or serviced high pressure components, remove all personnel from the immediate area until the system pressure has been applied for three minutes and has been cycled on and off at least three times. Gradually increase pressure [maximum of 1380 bar (20,000 psi) per minute].
- High-pressure water may remain in the system for a prolonged period after closing the high-pressure water source. Bleed the system pressure off before servicing any part of the pump.
- Follow the manufacturer's recommendations for servicing the pump and use only original manufacturer replacement parts.
- Visually examine the entire system before placing it in operation. If any fault or malfunction is detected, correct it.

Tools

- Use only approved test equipment. Examine the equipment regularly for correct operation and calibration.
- Use the correct tools for the job. Use of incorrect tools can result in injury to personnel or costly damage to the equipment.
- Remove all tools and rags from around the machine after service and before starting the pump.
- Use only approved work platforms. Never climb on or around the equipment on makeshift devices.

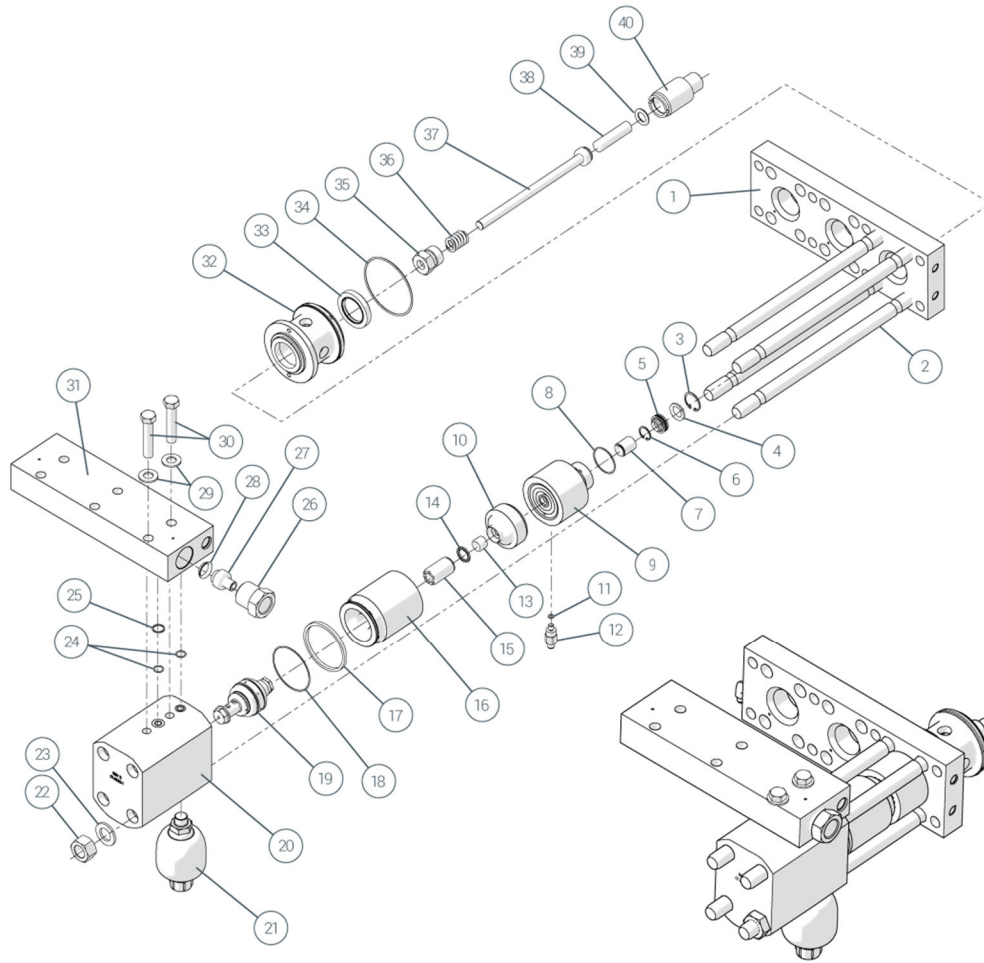
Protective Clothing

- Do not wear loose clothing while working around rotating parts of machinery.
- Pressurized air can drive particles into eyes and skin if handled incorrectly. To prevent injury, use appropriate protective equipment and clothing, and exercise extreme caution.
- See Personal Protective Equipment (PPE) for more information.

Gland Nut Torque Specification

If a torque value for a gland nut is not specified, reference this table to determine torque value. Always leave 3–4 threads showing between the end of the high-pressure tubing and gland nut collar.

TUBING O.D.	TORQUE [FT. LB. (Nm)]
1/4"	15 – 25 (20 – 34)
3/8"	35 – 45 (47 – 60)
9/16"	60 – 75 (80 – 100)



ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1	013533-1	SUBPLATE	21	A-12749	DAMPER, PULSATION, BLDR, 8 SAE
2	013539-1	TIE ROD	22	A-21080-1	NUT, HEX, GR 8, PLATED, 7/8-14
3	A-0265-118	SNAP RING, INT, 3/16 HSNG	23	A-9926	WASHER, HARD, 1.5 OD X 7/8 ID
4	013540-1	SPACER, SEAL, LOW PRESS, 55K	24	A-0290-014	O-RING, HIGH RISILIENCY
5	A-9566	SEAL, HP, 9/16 SHAFT	25	006112-1	MANIFOLD, BACKUP RING, S-200
6	A-0265-086	SNAP RING, INT	26	006113-1	NUT, ADAPTER, MANIFOLD, S-200
7	009217-1	BEARING ASSY, S-200	27	006114-1	INSERT, MANIFOLD, S-200
8	A-0275-030	O-RING, BUNA, 70 DURO, 2-030	28	006738-1	STATIC CAP SEAL, END CAP
9	013525-1	ADAPTER	29	A-00315-9	WASHER, HARD, 9/16, CAD PLATED
10	013517-1	SEAL CARRIER	30	A-00299-44	SCREW, HEX HD, 2-3/4 LG X 9/16-18
11	A-0274-1	O-RING, STR THD, BUNA, 1/8 OD	31	016856-1	MANIFOLD
12	A-13262	THERMISTOR, 10K OHM, BRASS	32	013537-1	PILOT, PONY ROD
13	016170-1	SEAL, DYNAMIC	33	A-11216	SEAL, OIL
14	A-10654	SEAL, LIP	34	A-0275-153	O-RING, BUNA-N, 70 DURO, 2-153
15	017793-1	FILLER TUBE	35	006068-1	NUT, PLUNGER ADAPTER
16	013387-1	CYLINDER, HP	36	A-9412	SPRING, COMPRESSION
17	014252-1	GUIDE RING, CYLINDER	37	018020-1	PLUNGER ASSY
18	A-0275-040	O-RING, BUNA, 70 DURO, 2-040	38	014676-1	ROD, PONY
19	016863-1	CHECK VALVE ASSY	39	A-0275-313	O-RING, BUNA-N, 70 DURO, 2-313
20	016862-1	END CAP	40	006069-1	ADAPTER, PONY ROD, S-200

Using the Loading Tool

Unloading the Tie Rods

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.



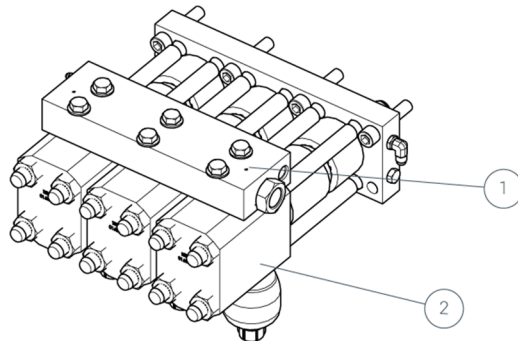
Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Close the inlet water valve.
3. Disconnect the ECV drain line connection.



If the ECV can be set aside so that there is no interference with maintenance, then the ECV drain line can remain connected.

4. Disconnect the hydraulic hose from the ECV.
5. Use a 2 in. wrench to remove the ECV from the manifold. Set the ECV aside.
6. Disconnect the inlet and the low-pressure cooling water hoses from the manifold.
7. Disconnect the high-pressure tube assembly from the manifold.
8. Remove the six manifold screws that hold the manifold to the end caps. Remove the manifold.

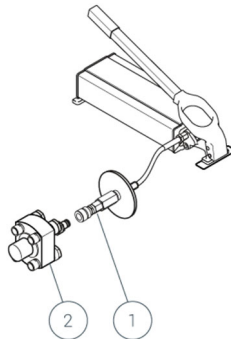


ITEM	DESCRIPTION	PART NUMBER
1	MANIFOLD	016856-1
2	END CAP	016862-1

9. Open the hand pump relief valve, and then attach the pressure-loading tool body to the hand pump quick-disconnect.

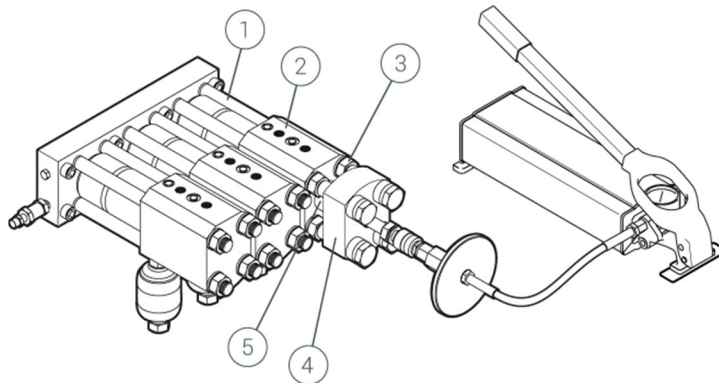


The hand pump hydraulic hose must be installed to the tool with the hand pump relief valve open.



ITEM	DESCRIPTION
1	HAND PUMP QUICK DISCONNECT
2	LOADING TOOL BODY

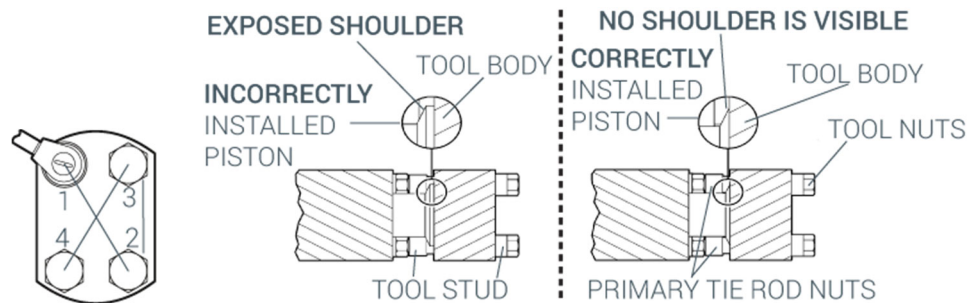
10. Install the pressure-loading tool onto the tie rods. Turn the tool studs onto the exposed tie rod threads by hand.



ITEM	DESCRIPTION	PART NUMBER
1	TIE ROD	013539-1
2	END CAP	016862-1
3	HEX NUT	A-21080-1
4	TOOL	042512-2
5	PISTON	018088-1

11. Tighten the tool studs firmly with a wrench or ratchet to seat the tool piston fully into the pressure-loading tool body and against the end cap. While tightening the studs, alternate between opposite studs. Use a crisscross pattern to avoid binding.

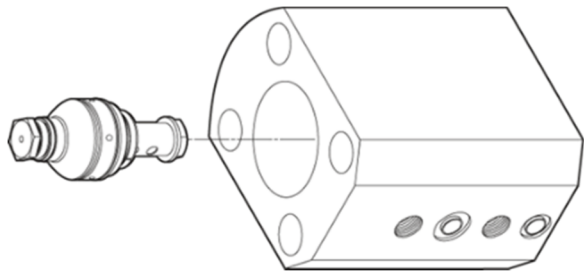
NOTICE A correctly installed piston has no visible shoulder, as shown in this illustration.



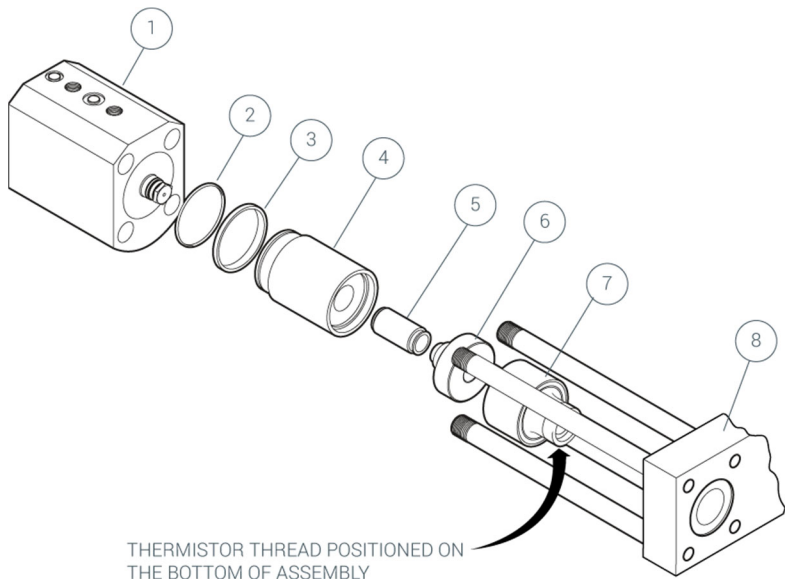
12. Index-mark the pressure-loading tool studs and the pressure-loading tool body with a permanent marker. The marks help to monitor rotation of the tool studs.
13. Loosen each of the four tool studs exactly one turn. Use the previously made index-marks to monitor rotation.
14. Close the hand pump relief valve.
15. Pump the hand pump until the gauge pin reaches the Husky icon.
16. Loosen each of the primary tie rod nuts of the pump two full turns. (The wrench supplied with the pressure-loading tool may need to be used).
17. Turn the hand pump relief valve.
18. While the pressure-loading tool is still attached to the pump, tighten two pressure-loading tool studs (opposite corners) to compress the piston back into the pressure-loading tool body.
19. Remove the pressure-loading tool from the tie rods.
20. Do Steps 10-19 for the remaining positions of the pump.

Loading the Tie Rods

1. Push the check valves into the end caps by hand.



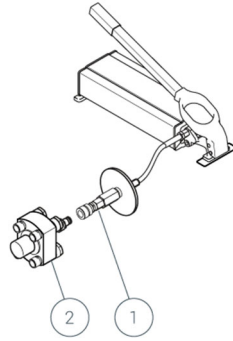
2. Assemble the UHP components into position on the tie rods as shown below.
- Point the filler tube and high-pressure cylinder in the direction shown in the image below.
 - Make sure that the port for the thermistor located in the subplate adapter points straight down.



ITEM	DESCRIPTION	PART NUMBER	NOTES
1	END CAP	016862-1	
2	O-RING	A-0275-040	REPLACED DURING MAJOR AND MINOR MAINTENANCE
3	GUIDE RING	014252-1	
4	HP CYLINDER	013387-1	REPLACED DURING MAJOR MAINTENANCE
5	FILLER TUBE	017793-1	
6	SEAL CARRIER	013517-1	REPLACED DURING MAJOR AND MINOR MAINTENANCE
7	SUBPLATE ADAPTER	013525-1	
8	SUBPLATE	013533-1	

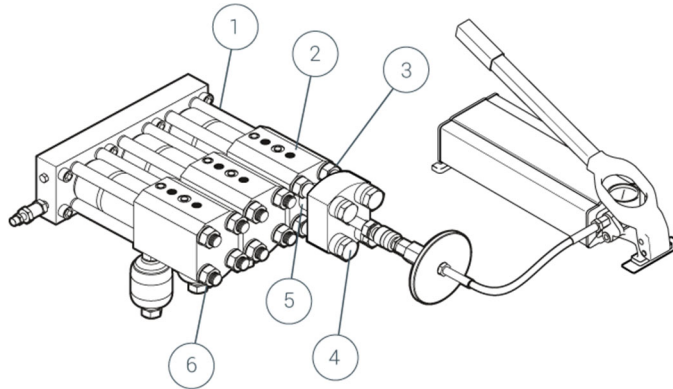
3. Lubricate the threads of the tie rods and both sides of the washers with SILVER ANTI-SEIZE.
4. Install the washers and primary tie rod nuts by hand, and then firmly seat all components using a 1/2 in. drive ratchet with a 1-5/16 in. socket.

5. Open the hand pump relief valve and attach the pressure-loading tool to the hand pump quick-disconnect fitting.



ITEM	DESCRIPTION
1	HAND PUMP QUICK DISCONNECT
2	LOADING TOOL BODY

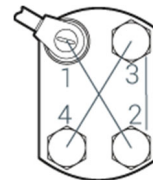
6. Install the pressure-loading tool onto the tie rods by turning the tool studs onto the exposed threads of the tie rods by hand.



ITEM	DESCRIPTION	PART NUMBER
1	TIE ROD	013539-1
2	END CAP	016862-1
3	TOOL STUD	018090-1
4	TOOL	042512-2
5	PISTON	018088-1
6	NUT	A-21080-1

7. Tighten the pressure-loading tool onto the tie rods and end cap following the tightening sequence below:

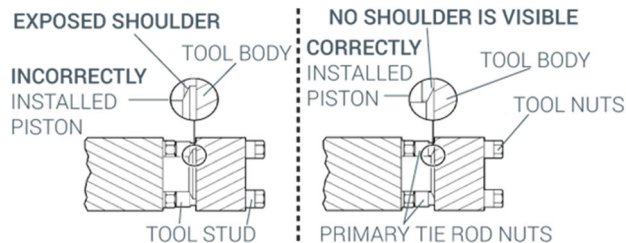
- When tightening, alternate in a crisscross pattern to avoid binding.
- Tighten the tool studs firmly to seat the tool piston fully into the tool body and against the end cap. See the figure below for examples of incorrect and correct piston installation.



Once tightened, do not back off the tool studs during this step.

NOTICE

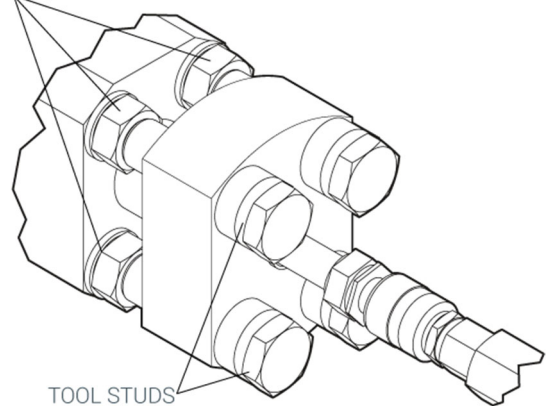
To insert the piston fully into the cylinder, the hydraulic hose of the hand pump must be installed to the tool with the pump pressure released. A correctly installed piston has no visible shoulder, as shown in the following illustration.



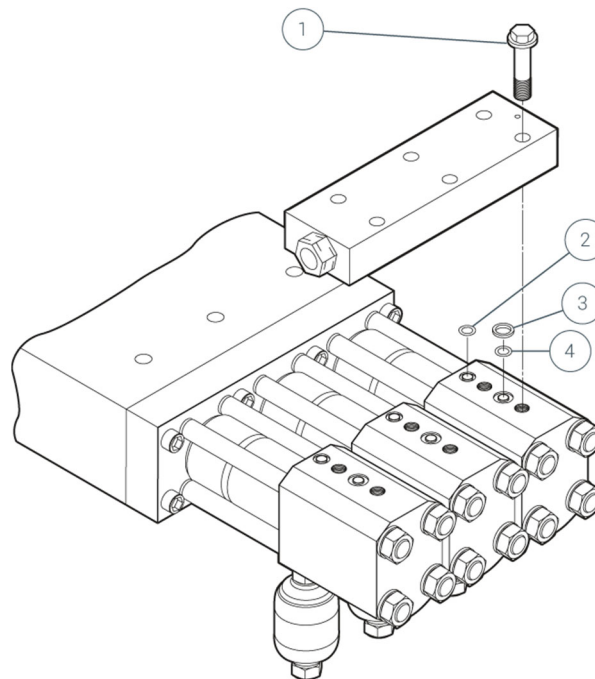
8. Close the hand pump relief valve.
9. Pump the hand pump until the gauge pin reaches the Husky icon. Watch the pressure gauge for several seconds to make sure that there are no leaks in the hydraulic lines.
10. Tighten the primary tie rod nuts of the pump, by hand, until they are firmly against the washers and end caps.

Do not use any tools when installing the
NOTICE tie rod nuts—tighten the nuts by hand.

Tighten nuts by hand

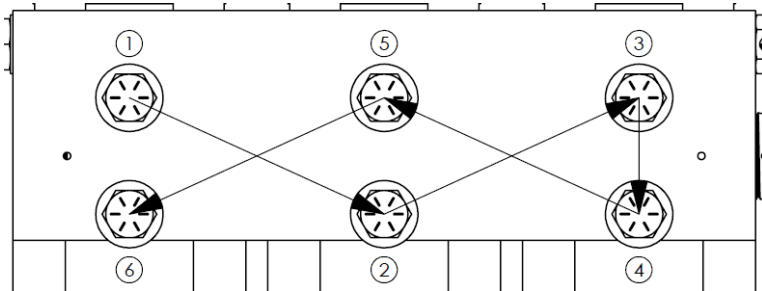


11. Release the pump pressure.
12. Remove the pressure-loading tool from the tie rods.
13. Do Steps 2 through 12 for the remaining positions of the pump.
14. Install the manifold onto the end caps:



ITEM	DESCRIPTION	PART NUMBER	NOTES
1	MANIFOLD BOLTS		
2	O-RING	A-0290-014	REPLACED DURING MAJOR AND MINOR MAINTENANCE
3	BACKUP RING	006112-1	REPLACED DURING MAJOR MAINTENANCE
4	O-RING	A-0290-014	REPLACED DURING MAJOR AND MINOR MAINTENANCE

- Install the O-rings and backup rings onto the top face of the UHP end caps.
- Lubricate the six manifold screw threads and washers with SILVER ANTI-SEIZE.
- Torque the manifold screws in three steps using the following pattern:
 - 81.3 N-m (60 ft-lb)
 - 122 N-m (90 ft-lb)
 - 176.3 N-m (130 ft-lb)



15. While supporting the ECV assembly from the bottom of the housing, install the ECV into the manifold. Turn the ECV into the manifold most of the way by hand.
16. Tighten the ECV body to the manifold.
17. Use a spanner wrench in the holes in the rear of the ECV housing and then tighten the ECV housing to the ECV body.
18. Connect the high-pressure water and ECV connections.
19. Connect the high-pressure water line to the manifold.
20. Connect the low-pressure water hoses to the manifold.
21. Connect the drain lines.
22. Open the inlet water valve at a slow rate and do a check for leaks.

NOTICE Failure to open the inlet water valve before starting the pump may cause severe damage to the pump.

23. Remove the tools, parts, and rags from around the pump.



WARNING! High-pressure leaks can severely injure or kill someone. When pressurizing any new, rebuilt, or serviced high-pressure component, remove all personnel from the immediate area until the system pressure has been applied for three minutes and has been cycled on and off at least three times. Gradually increase pressure.

24. Do the 'Calibrate the External Control Valve' procedure.
25. Run the pump at 690 bar (10,000 psi) for three minutes, then three minutes each at 1,379 bar (20,000 psi), 2,069 bar (30,000 psi), 2,758 bar (40,000 psi), and 3,793 bar (55,000 psi), examine for leaks and heat while pressure is increased.
26. The pump is ready for operation.

Installing the Minor Maintenance Kit

Install the minor maintenance kit every 150-service hours.

- Install all of the parts at the same time—do not replace components individually when doing scheduled maintenance.
- Clean all of the components before assembly. It is important to keep the work area clean while working on the equipment.
- Read the entire procedure before starting service, pay particular attention to safety instructions.

Prepare to Install the Kit

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.

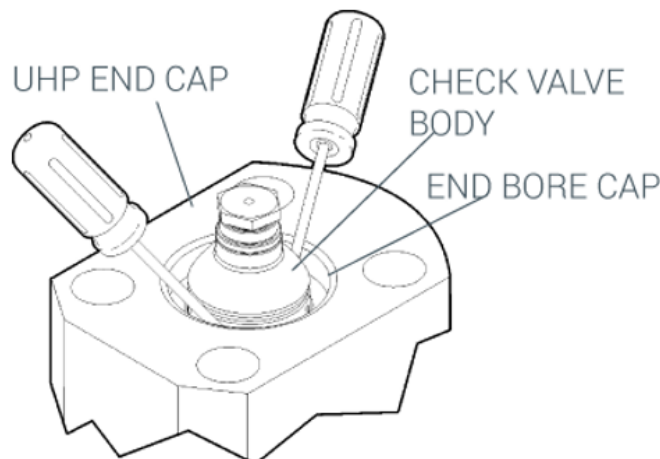


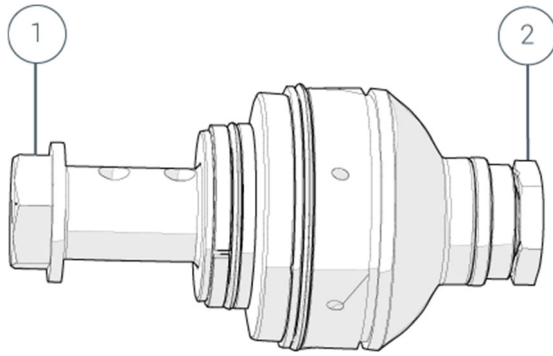
Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Do the 'Unloading the Tie Rods' procedure.
3. Remove the UHP end cap from the UHP tie rods. Slowly pull the end cap back about 51 mm (2 in.). Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them. Be careful not to damage the plastic guide ring.
4. Remove the UHP cylinder, filler tube, seal carrier, and subplate adapter.

Check Valve Maintenance

1. Pry the check valve body from the end cap using two screwdrivers as shown.
2. Disassemble the check valve body assembly by removing the outlet poppet cage and the inlet screw.
 - The check valve body can be held in the rebuild clamp to remove the inlet screw.
 - The outlet poppet cage will be reused.

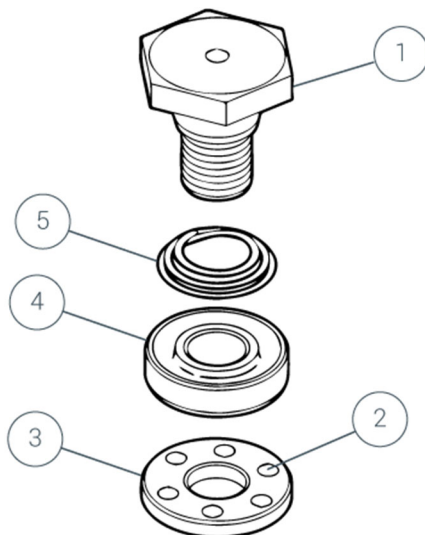




ITEM	DESCRIPTION	PART NUMBER
1	OUTLET POPPET CAGE	006101-1
2		013515-1

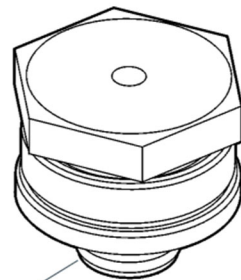
3. Assemble the inlet check valve as shown in the following figure. Position the components as follows:

- Position of the conical spring: the large spring diameter must point towards the inlet poppet.
- Position of the inlet seat: make sure that the chamfered holes point away from the poppet.



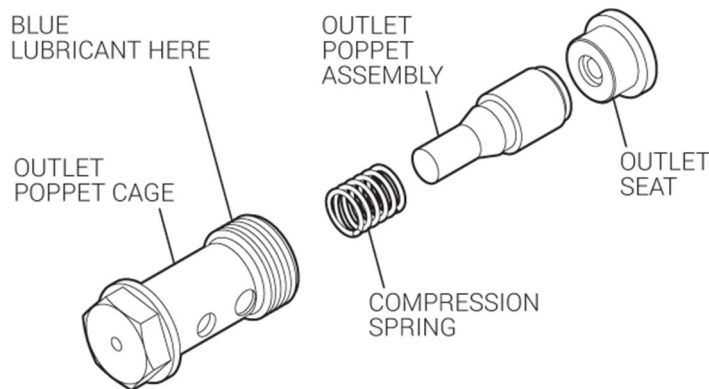
ITEM	DESCRIPTION	PART NUMBER
1	INLET SCREW	013515-1
2	CHAMFERED HOLES	
3	INLET SEAT	016896-1
4	INLET POPPET	002078-1
5	CONICAL SPRING	A-19088

4. Apply a small drop of LOCTITE 242 to the inlet screw threads. Be careful not to get any LOCTITE on any other component. Clean all excess LOCTITE from the threads. Set this assembly aside for the LOCTITE to dry while continuing with this procedure.



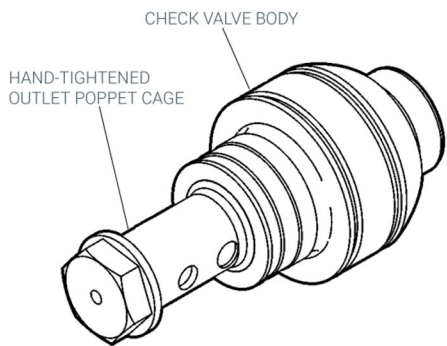
Apply LOCTITE 242
on threads only

5. Apply *BLUE LUBRICANT* to the threads of the outlet poppet cage.
6. Assemble the components of the outlet cage assembly as shown below.

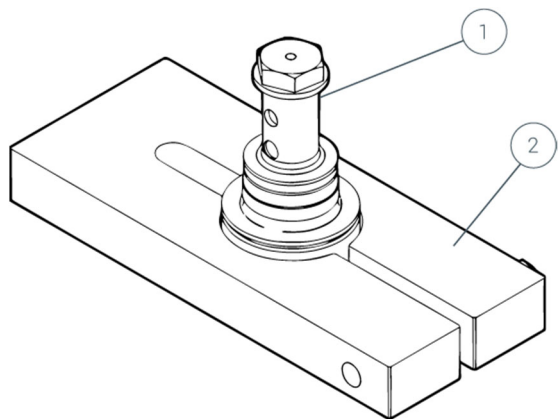


ITEM	DESCRIPTION	PART NUMBER
1	OUTLET POPPET CAGE	006101-1
2	COMPRESSION SPRING	A-9636
3	OUTLET POPPET ASSY	014643-1
4	OUTLET SEAT	014641-1

7. Install the outlet cage assembly into the check valve body until it is hand tight.



8. Install the check valve body in the rebuild clamp as shown and then torque the outlet poppet cage to 81 N-m (60 ft-lb).

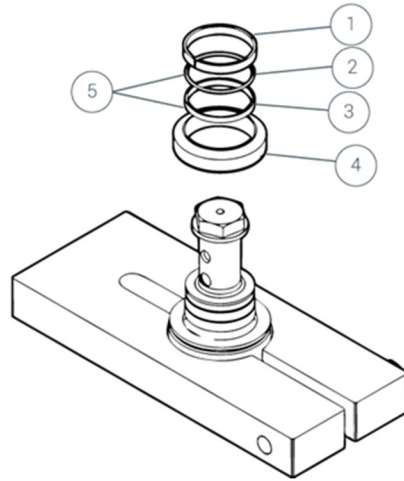


ITEM	DESCRIPTION
1	OUTLET POPPET CAGE
2	REBUILD CLAMP

NOTICE

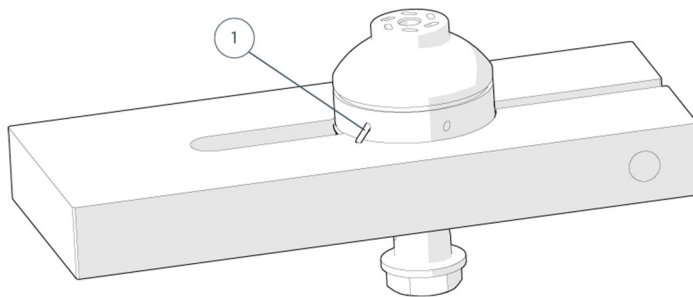
The rebuild clamp included with the toolkit is the preferred method to hold the check valve while torquing the outlet cage. If the clamp is unavailable, use a soft-jawed vise as a substitute.

9. Install the end cap seal, the new check valve seal, the new O-ring, and the retainer ring as shown. Lubricate the check valve seal and O-ring with FOOD GRADE GREASE. Install the components in the following order to prevent damage to the O-ring:



ITEM	DESCRIPTION	PART NUMBER
1	RETAINER RING	008014-1
2	O-RING	A-0290-028
3	CHECK VALVE SEAL	008015-1
4	END CAP SEAL	008016-1
5	FOOD GRADE GREASE	

10. Adjust the valve in the rebuild clamp so that the ASSEMBLY PINS have enough room to travel down below the surface of the inlet face hole.



ITEM	DESCRIPTION	PART NUMBER
1	ASSEMBLY PIN	A-21146-1

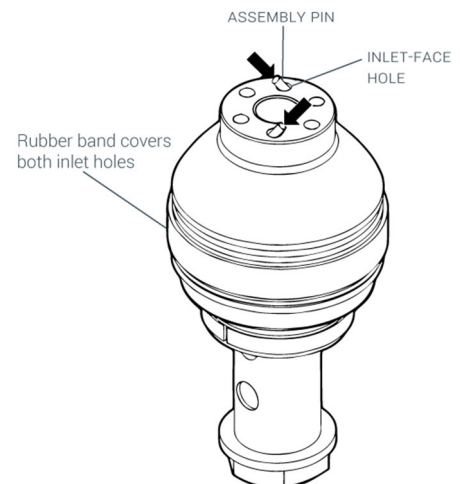
11. Install the rubber band (included in the check valve service kit) around the perimeter of the check valve body so that it covers the check valve body inlet holes.

12. Insert the assembly pins (included with the check valve service kit) down, through two opposing inlet face holes, as shown in the preceding figure. The pins stop against the rubber band and extend above the inlet face of the body.

NOTICE The assembly pins orientate the inlet seat during the next steps.

13. Install the inlet components to the check valve body. Turn the inlet screw into the check valve body face approximately halfway.

14. Orientate the inlet seat by slowly turning the inlet seat counterclockwise until a click is heard to show that the assembly pins are indexing against the holes in the seat. At this point, the seat should not be able to rotate clockwise.

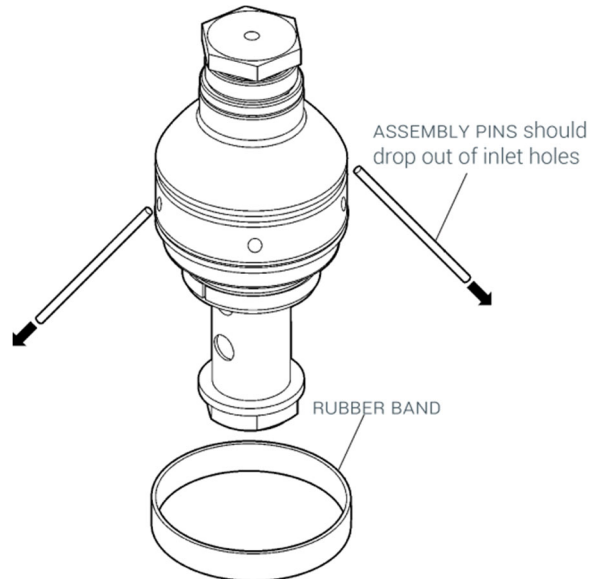


15. Finish hand tightening the inlet screw the rest of the way.

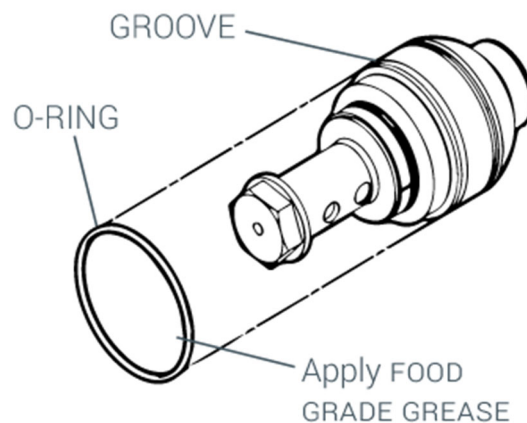
NOTICE Be sure there is enough room for the assembly pins to drop below the inlet face hole surface after removing the rubber band.

16. Torque the inlet screw to 13.6 N-m (120 in-lb.).

17. Remove the clamp and the rubber band and then let the assembly pins drop out of the inlet holes. If the pins do not drop out, the inlet seat is misaligned or installed incorrectly, which binds the assembly pins. If the assembly pins bind, remove the inlet components, and do this procedure from Step 10.

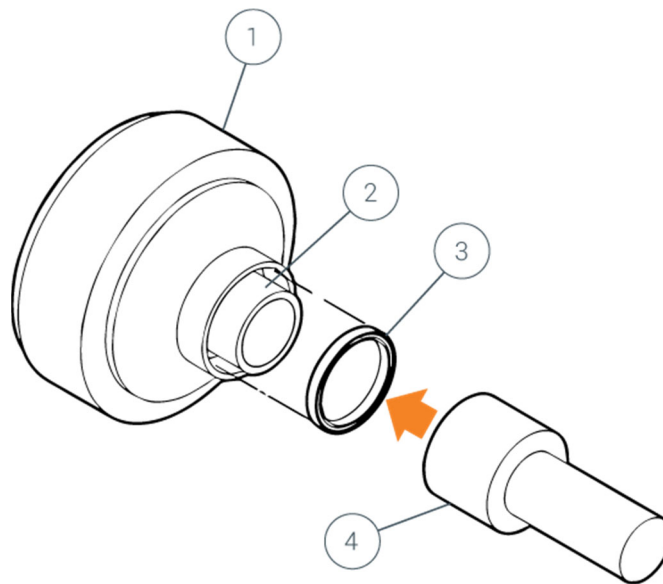


18. Lubricate the O-ring (A-0275-032) with FOOD GRADE GREASE and then install it into the groove of the check valve body.



19. Set the check valve aside on a clean surface and repeat this process for the remaining check valves.

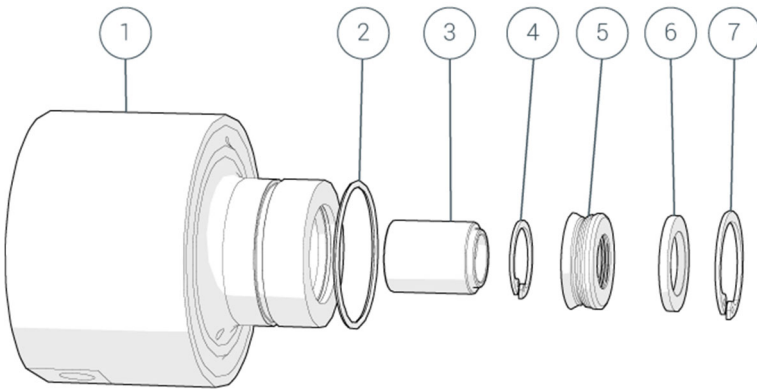
Seal Carrier Maintenance



ITEM	DESCRIPTION	PART NUMBER
1	SEAL CARRIER	013517-1
2	DYNAMIC SEAL	016170-1
3	U-CUP SEAL	A-10654
4	U-CUP INSTALL TOOL	009588-1

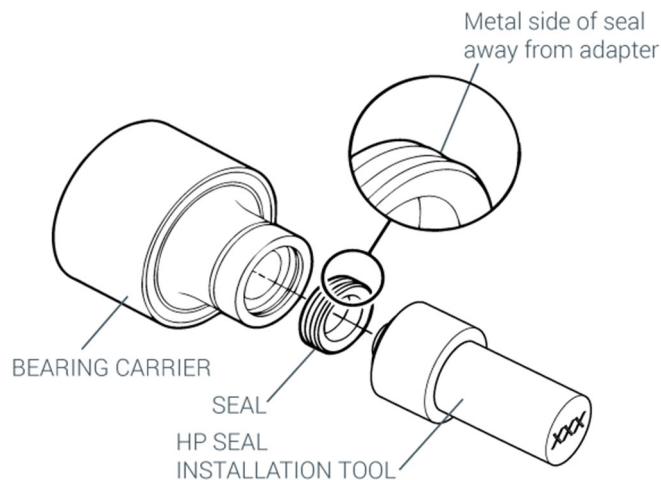
1. Remove the dynamic seal and U-cup seal.
2. Examine and clean the seal carrier. Make sure that the cooling ports are free of debris.
3. Manually install the dynamic seal fully against the shoulder of the seal carrier.
4. Use the U-cup seal installation tool and manually install the U-cup seal against the shoulder of the seal carrier. Make sure that the U-cup lip seal groove faces towards the tool.
5. Set the seal carrier aside on a clean surface and repeat this process for the remaining seal carriers.

Subplate Adapter Maintenance



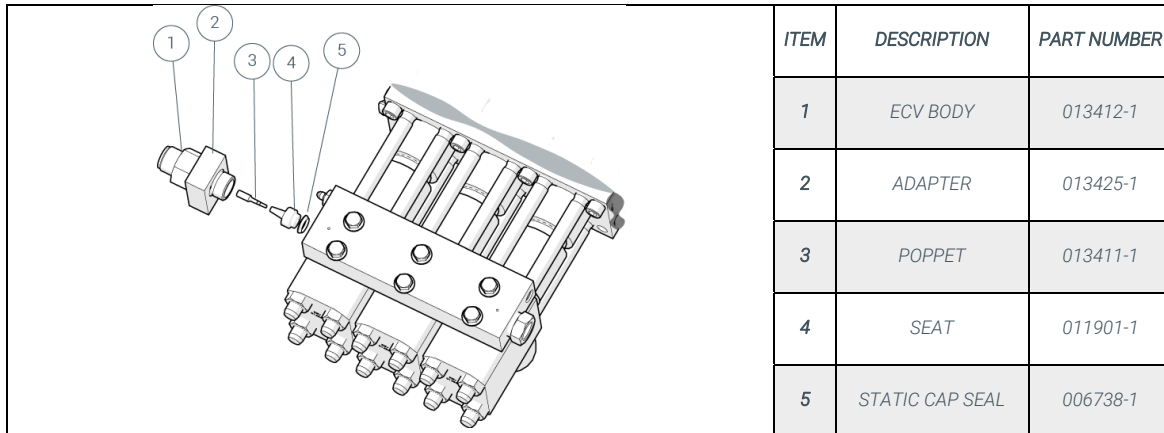
ITEM	DESCRIPTION	PART NUMBER
1	SUBPLATE ADAPTER	013525-1
2	O-RING	A-0275-030
3	BEARING ASSEMBLY	009217-1
4	BEARING SNAP RING	A-0265-086
5	HIGH PRESSURE SEAL	A-9566
6	SPACER	013540-1
7	SNAP RING	A-0265-118

1. In the following order, remove the o-ring, snap ring and spacer, high pressure seal, bearing snap ring and the bearing assembly.
2. Examine and clean the subplate adapter. Make sure that the cooling ports are free of debris.
3. Install the bearing assembly. Make sure that the side of the bearing with the metal lip points away from the subplate adapter.
4. Install the bearing snap ring.
5. Use the HP seal installation tool (007725-2) to install the HP seal and press down until the tool bottoms out against the subplate adapter. Make sure that the metal side of the HP seal points away from the subplate adapter. Remove the tool.



6. Install the spacer and then snap ring.
7. Lubricate the O-ring with FOOD GRADE GREASE and install it into the groove of the subplate adapter.

Install the Kit



1. Do the 'Load the Tie Rods' procedure.
2. Install the new ECV static cap seal onto the seat.
3. Lubricate all visible ECV O-rings with FOOD GRADE GREASE.
4. Apply BLUE LUBRICANT on the ECV body-to-manifold threads.
5. Install the ECV body, poppet, adapter, seat, and the static cap seal into the manifold hand tight.
6. While ensuring that the fitting on the adapter points down, tighten the ECV body to the manifold.
7. Apply BLUE LUBRICANT on threads of the ECV body.
8. Support the ECV housing from the bottom and install the ECV housing onto the ECV body. Turn the ECV housing onto the ECV body as far as possible by hand.

NOTICE During installation, support and rotate the ECV housing from the bottom. Use this method to get correct thread alignment and to prevent cross threading.

9. Use a spanner wrench in the holes in the rear of the ECV housing to tighten the ECV housing to the ECV body.
10. Connect the high-pressure water and ECV connections.
11. Connect the high-pressure water line to the manifold.
12. Connect the low-pressure water hoses to the manifold.
13. Connect the drain lines.
14. Remove tools, parts, and rags from around the pump.
15. Open the inlet water valve and do a check for leaks.

NOTICE Failure to open the inlet water valve before starting the pump may cause severe damage to the pump.

16. Do the 'Calibrate the External Control Valve' procedure found later in this manual.
17. Run the pump at 690 bar (10,000 psi) for three minutes, then three minutes each at 1,379 bar (20,000 psi), 2,069 bar (30,000 psi), 2,758 bar (40,000 psi), 3,793 bar (55,000 psi) examining for leaks and heat.

Installing the Major Maintenance Kit

Install the minor maintenance kit every 150-service hours.

- Install all of the parts at the same time—do not replace components individually when doing scheduled maintenance.
- Clean all of the components before assembly. It is important to keep the work area clean while working on the equipment.
- Read the entire procedure before starting service, pay particular attention to safety instructions.

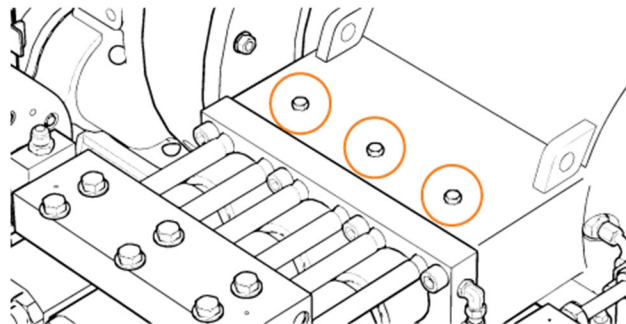
Prepare to Install the Kit

1. Do the 'Lockout/Tagout' procedure found in the 'Safety' section above.

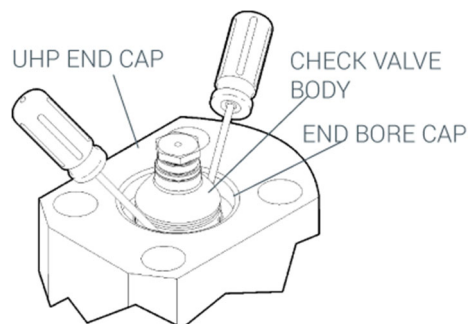


Failure to do the lockout/tagout procedure can result in equipment damage or injury to personnel.

2. Remove the three breather vents located on the top of the crankcase and replace them with the new ones (A-0857-2) included in the major maintenance kit.



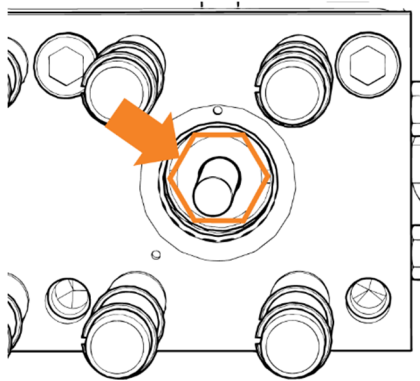
3. Do the 'Unloading the Tie Rods' procedure.
4. Remove the UHP end cap from the UHP tie rods. Slowly pull the end cap back about 51 mm (2 in.). Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them. Be careful not to damage the plastic guide ring.
5. Pry the check valve body from the end cap using two screwdrivers as shown.



6. Discard the check valves. The major maintenance kit includes new check valves.
7. Remove the HP cylinder, filler tube, seal carrier, and subplate adapter.

Pony Rod Replacement

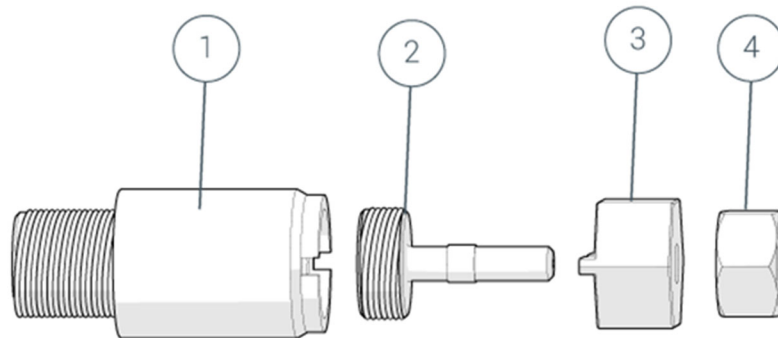
1. Do Use the plunger installation tool to remove the three plungers.



2. Remove the subplate from the crankcase (eight hex screws).
3. Remove the pony rod pilots.

NOTICE If needed, 5/16-18 screws can be installed into the pony rod pilots to assist with removing them.

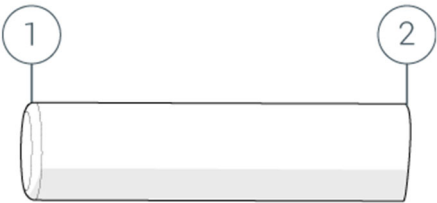
4. Remove the plunger adapter nuts from the pony rod adapters.
5. Remove the pony rod adapters. Use the pony rod adapter tools and steel nut. Assemble the tools into the pony rod adapter as shown.



ITEM	DESCRIPTION	PART NUMBER
1	PONY ROD ADAPTER	006069-1
2	PONY ROD TOOL	007738-1
3	PONY ROD TOOL	007737-1
4	3/8-16 STEEL NUT	A-0301-6

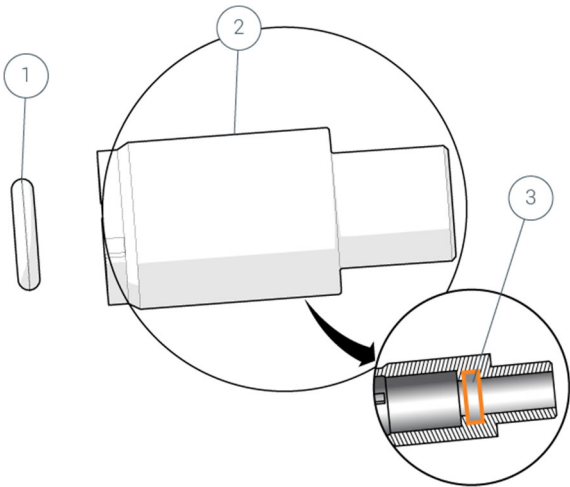
- Install the pony rod adapter tool B into the pony rod adapter.
- Slide the pony rod adapter tool A over the pony rod adapter tool B.
- Align the tongue of the pony rod adapter tool A with the groove in the pony rod adapter.
- Install the steel nut finger tight.
- Turn the pony rod adapter tool A to remove the pony rod adapters.

6. Remove the three pony rods from the pony rod adapters.
7. Install the three new pony rods into the wrist pins with the tapered end orientated into the crankcase and the machined flat end facing away from the crankcase.



ITEM	DESCRIPTION
1	TAPERED END
2	MACHINED FLAT END

8. Install the new pony rod adapter O-rings. Make sure that the O-rings are fully in the grooves located inside of the pony rod adapters.

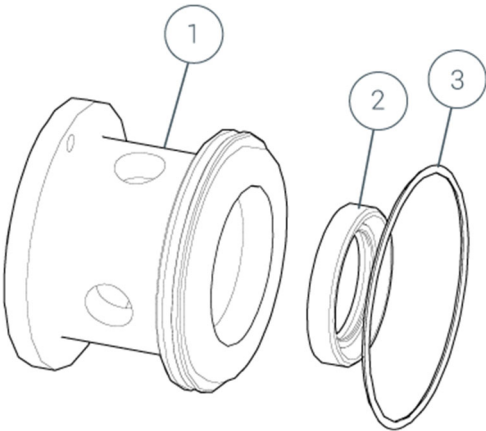


ITEM	DESCRIPTION	PART NUMBER
1	O-RING	A-0275-313
2	PONY ROD ADAPTER	006069-1
3	O-RING GROOVE	

9. Install the pony rod adapters. Apply LOCTITE 242 to the threads. Use the pony rod adapter tools and steel nut. Torque the pony rod adapters to 102 N-m (75 ft-lb).

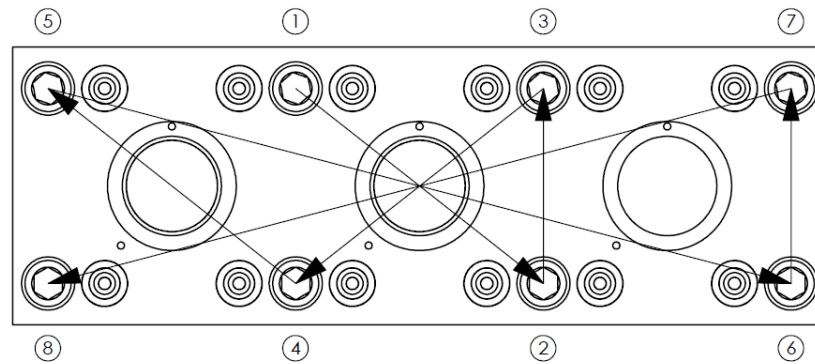
NOTICE Only apply a very small drop of LOCTITE 242 to the threads.

10. Install the oil seals and O-rings on the pony rod pilots. Lubricate the O-rings with FOOD GRADE GREASE.

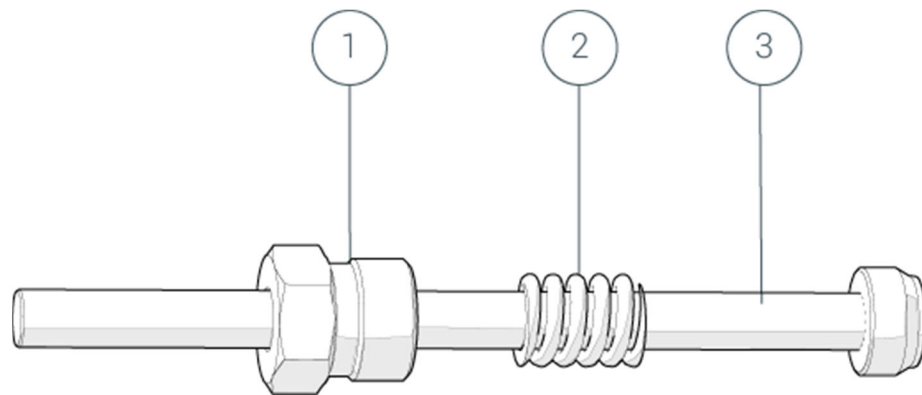


ITEM	DESCRIPTION	PART NUMBER
1	PONY ROD PILOT	013537-1
2	SEAL	A-11216
3	O-RING	A-0275-153

11. Install the pony rod pilots. Orientate the pony rod pilots so that the O-ring and oil seal points towards the crankcase and the side with the screw holes points away from the crankcase.
12. Apply SILVER ANTI-SEIZE to the subplate hex screws.
13. Install the subplate. Torque the hex screws to 169 N-m (125 ft-lb) in the sequence shown in the following figure.

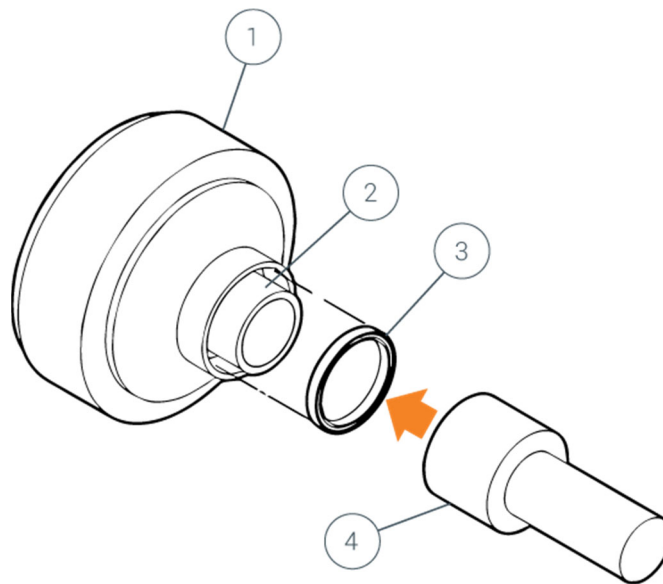


14. Apply BLUE LUBRICANT to the adapter nut threads.
15. Install the plungers, springs, and adapter nuts to the pony rod adapters. Torque the adapter nuts to 95 N-m (70 ft-lb).



ITEM	DESCRIPTION	PART NUMBER
1	ADAPTER NUT	006068-1
2	SPRING	A-9412
3	PLUNGER	018020-1

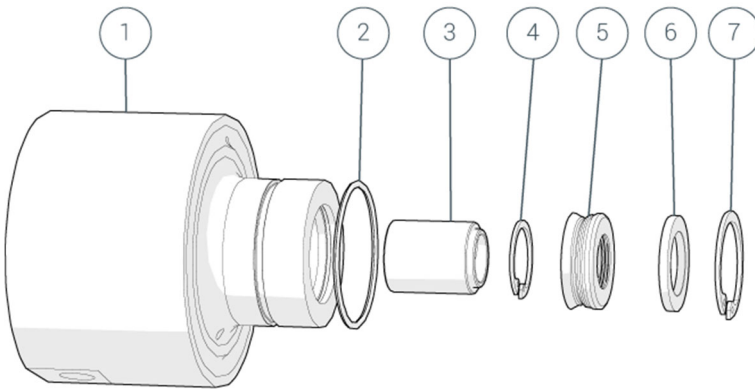
Seal Carrier Maintenance



ITEM	DESCRIPTION	PART NUMBER
1	SEAL CARRIER	013517-1
2	DYNAMIC SEAL	016170-1
3	U-CUP SEAL	A-10654
4	U-CUP INSTALL TOOL	009588-1

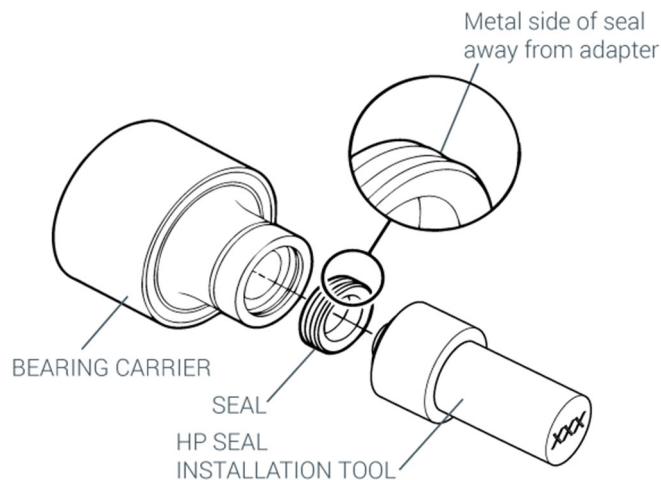
1. Remove the dynamic seal and U-cup seal.
2. Examine and clean the seal carrier. Make sure that the cooling ports are free of debris.
3. Manually install the dynamic seal fully against the shoulder of the seal carrier.
4. Use the U-cup seal installation tool and manually install the U-cup seal against the shoulder of the seal carrier. Make sure that the U-cup lip seal groove faces towards the tool.
5. Set the seal carrier aside on a clean surface and repeat this process for the remaining seal carriers.

Subplate Adapter Maintenance



ITEM	DESCRIPTION	PART NUMBER
1	SUBPLATE ADAPTER	013525-1
2	O-RING	A-0275-030
3	BEARING ASSEMBLY	009217-1
4	BEARING SNAP RING	A-0265-086
5	HIGH PRESSURE SEAL	A-9566
6	SPACER	013540-1
7	SNAP RING	A-0265-118

1. In the following order, remove the o-ring, snap ring and spacer, high pressure seal, bearing snap ring and the bearing assembly.
2. Examine and clean the subplate adapter. Make sure that the cooling ports are free of debris.
3. Install the bearing assembly. Make sure that the side of the bearing with the metal lip points away from the subplate adapter.
4. Install the bearing snap ring.
5. Use the HP seal installation tool (007725-2) to install the HP seal and press down until the tool bottoms out against the subplate adapter. Make sure that the metal side of the HP seal points away from the subplate adapter. Remove the tool.



6. Install the spacer and then snap ring.
7. Lubricate the O-ring with FOOD GRADE GREASE and install it into the groove of the subplate adapter.

Troubleshooting

Overview

The troubleshooting guide will help identify the probable cause of a system malfunction and assist in providing corrective action. In addition to this manual, the manufacturer's manuals may be needed. They are provided with the pump. The following symptoms are discussed in this section:

- High pressure line pulsation
- Knock in power end
- Water hammer
- Valve wear
- Packing failure
- Plunger failure
- Oil wiper seal leakage
- Packing seal leakage
- Crankshaft oil seal leak

Before starting any procedure:

- Look for obvious problems.
- Read and understand each procedure.
- Make sure that the appropriate tools are available.
- Make sure that the appropriate parts are available.

Troubleshooting Guide

Listen to the machine and observe it in operation. Learn to recognize the normal sounds and operating conditions of the system. Carefully define the symptom of the problem. Locate the symptom on the troubleshooting guide that most closely corresponds to the problem.

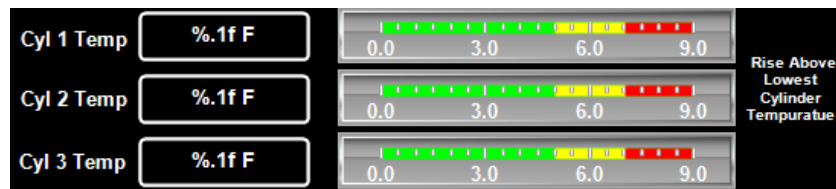
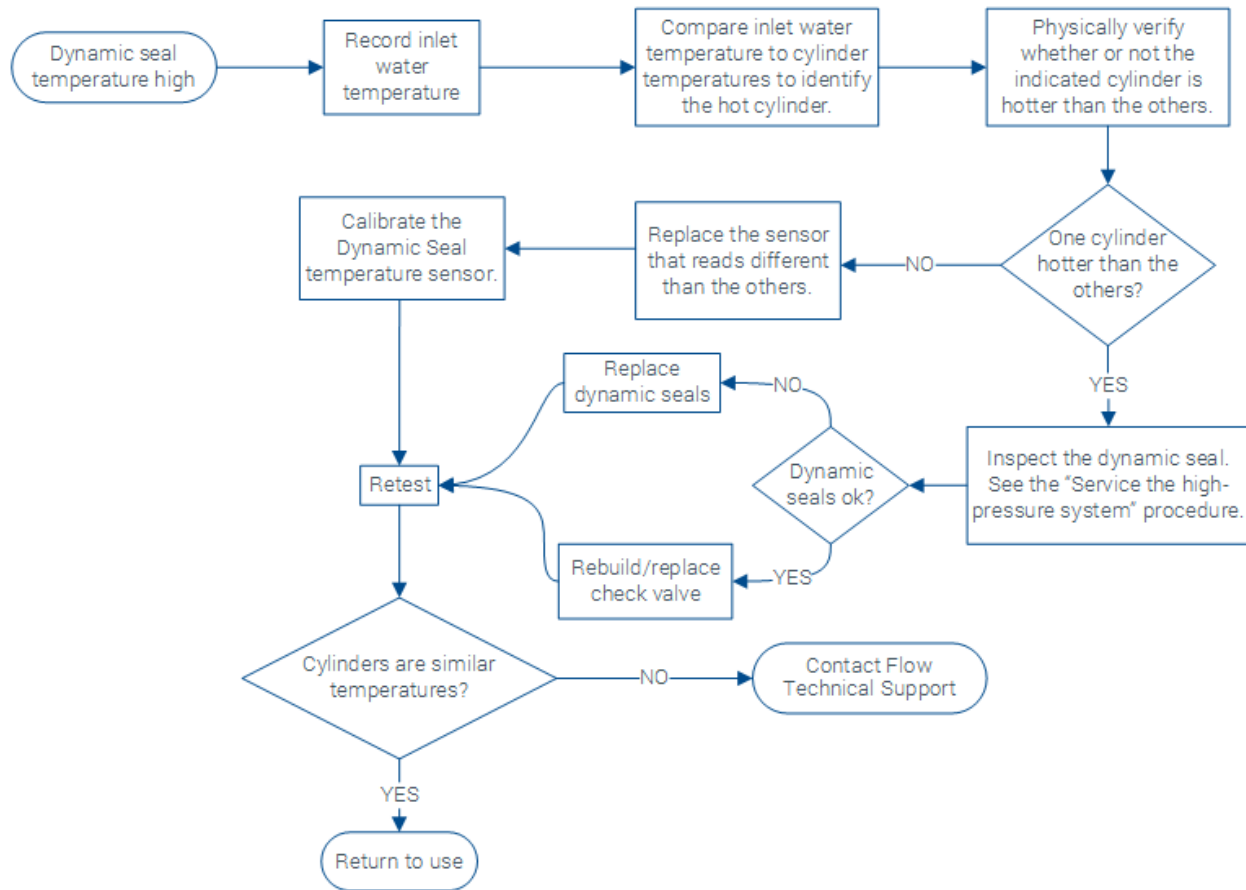
If the symptoms in the guide do not correspond to the malfunction, or if the problem is not resolved by the recommended corrective action, contact the APS Service Department for assistance.

	Malfunction	Indication	Check
1.	High pressure line pulsation	Suction supply line has been affected	Debris or scale back
			Partially closed valve in suction line
			Air entering the suction supply line through a loose connection or a ruptured pipe
			Low supply line water pressure
		High pressure fluid loss	Worn or broken suction or discharge valves
			Loose packing retainer nut
			Damaged or broken plunger
			Damaged suction or discharge valve spring
			Damaged discharge valve guide
			Worn packing assembly and/or packing seat

	Malfunction	Indication	Check
2.	Knock in power end	Loosely connected components	Tightness of intermediate rod in crosshead
			Plunger collet is fully compressed
			Connecting rod wrist pin bearings
			Crankshaft journal bearing wear
			Crankshaft main roller bearings and shims
		Fluid end effects	Cavitation in fluid end
			Damaged suction or discharge valve or seats
			Damaged suction or discharge valve springs
3.	Water hammer/wheezing	Cavitation effects	Damaged plunger / Worn packing
			Low supply line water pressure
		Plumbing design defects	Stuck suction valve
			Flow separation at elbows and fittings
4.	Valve wear	Contaminated supply water	Variable fluid acceleration in the suction supply plumbing
			Supply water quality or chemistry
		Cavitation effects	Filters are not correctly rated
			Worn valve guides / Damaged valve springs
5.	Packing failure	Contaminated supply water	Packing installation
			Supply water quality or chemistry
		Cavitation effects	Filters are not correctly rated
			Cavitation due to insufficient or low supply water pressure
		Installation damage	Packing lubrication holes in barrel blocked
6.	Plunger failure	Cavitation effects	Lack of cooling
			Low supply line water pressure
			Air entering supply water line
		Mechanical damage	Air entering the barrel through worn packing
			Chipping from physical impact of foreign material entering the pump well
		Contaminated supply water	Supply water quality or chemistry
			Filters are not correctly rated
7.	Oil wiper seal leakage	Foreign material entering the pump well	Deformation and wear of packing seat
			Pump well cover is kept closed
		Running the pump without oil	Dirt does not settle on the intermediate rod
			Oil level is correctly set
		Scored intermediate rod	Oil quality is correct
			Oil wiper seal is contacting a smooth surface
8.	Packing seal leakage	Pump run without water	Oil wiper seal is not nicked from intermediate rod damage
			Supply water pressure
		Dirt accumulation	Plunger coolant holes in barrels are not blocked
			Packing damaged from dirt entering the pump well
9.	Crankshaft oil seal leak	Dirt accumulation	Packing installed backward
			Seal surface is clean
		High oil level in the power end	Crankshaft contact point for seal lip wear into the shaft
			Oil level is not over the high mark
			Water or condensation has overfilled the power end

High Dynamic Seal Temperature

If inlet water temperature is higher than the specification, dynamic seals fail prematurely.

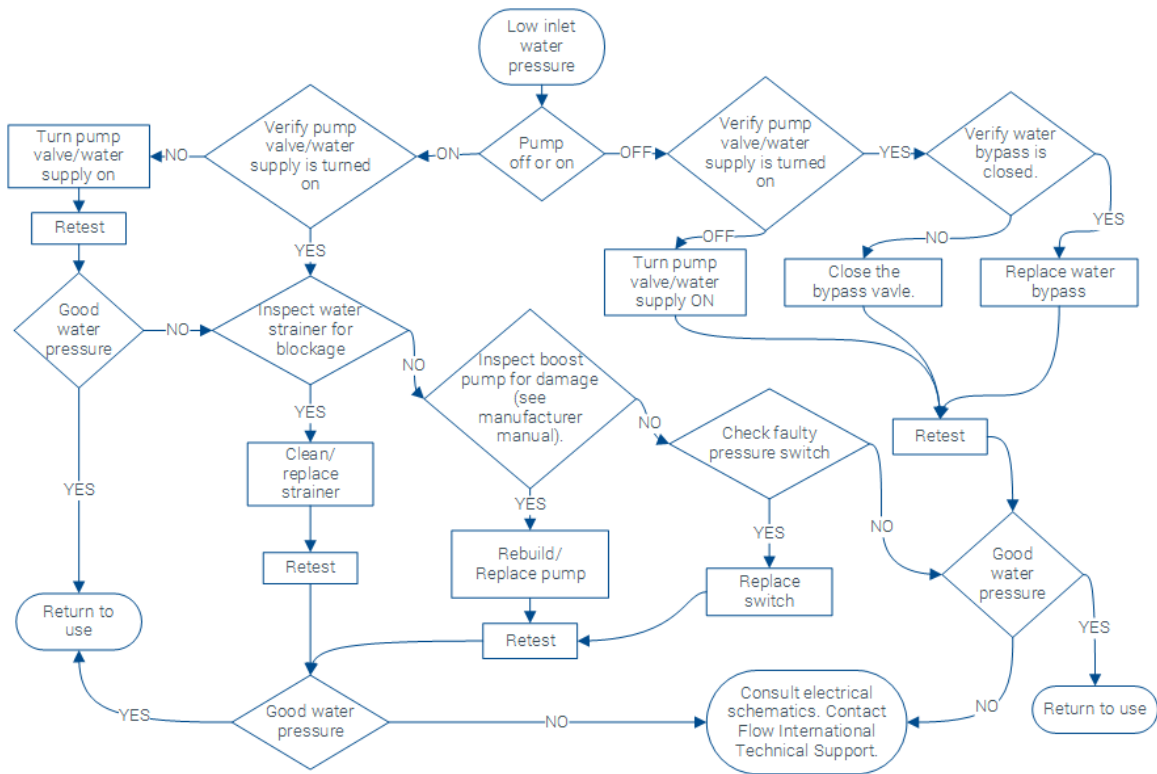


The "Monitor" screen shows the data from the dynamic seal temperature sensors if equipped. There is a bar graph for each of the cylinder sensors. The bar graph plots the temperature difference between given cylinder and the coldest cylinder.

When one dynamic seal is hot as compared to the others, it displays as the highest temperature. The cylinders normally run hotter than the inlet water temperature. An excessively hot seal temperature generates a dynamic seal temperature warning.

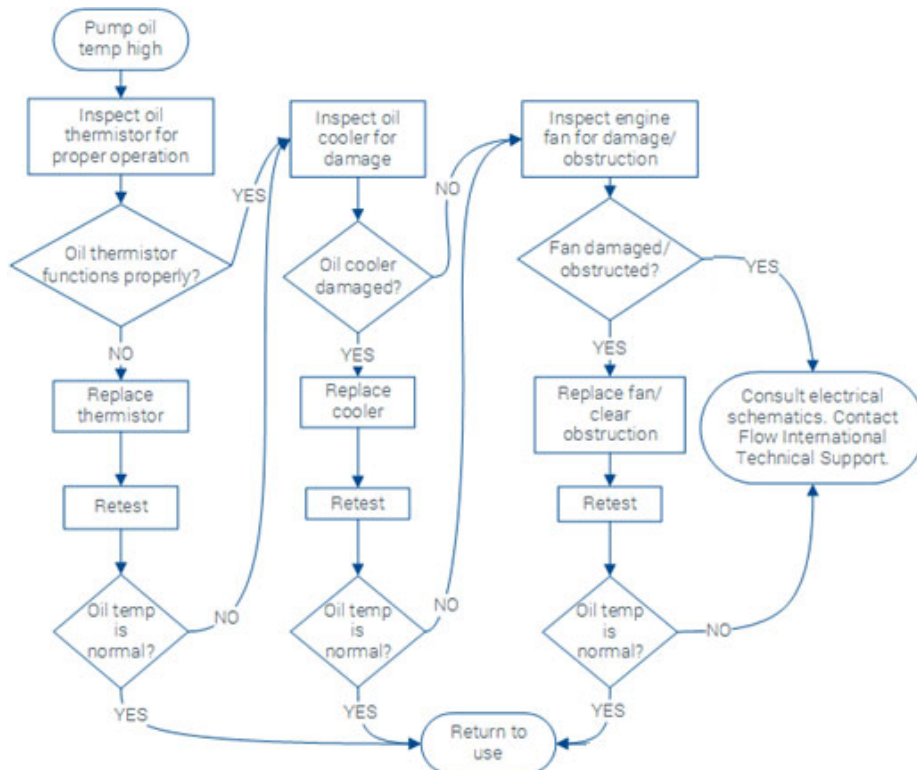
APS recommends that all three dynamic seals are changed when the pump displays an alarm because of a seal failure. A single new seal runs "cold" when compared to the two older seals and may show an error code when there is no reason to. The alarm is designed to help prevent a plunger failure, which is a far more expensive component than the dynamic seals.

Low Inlet Water Pressure

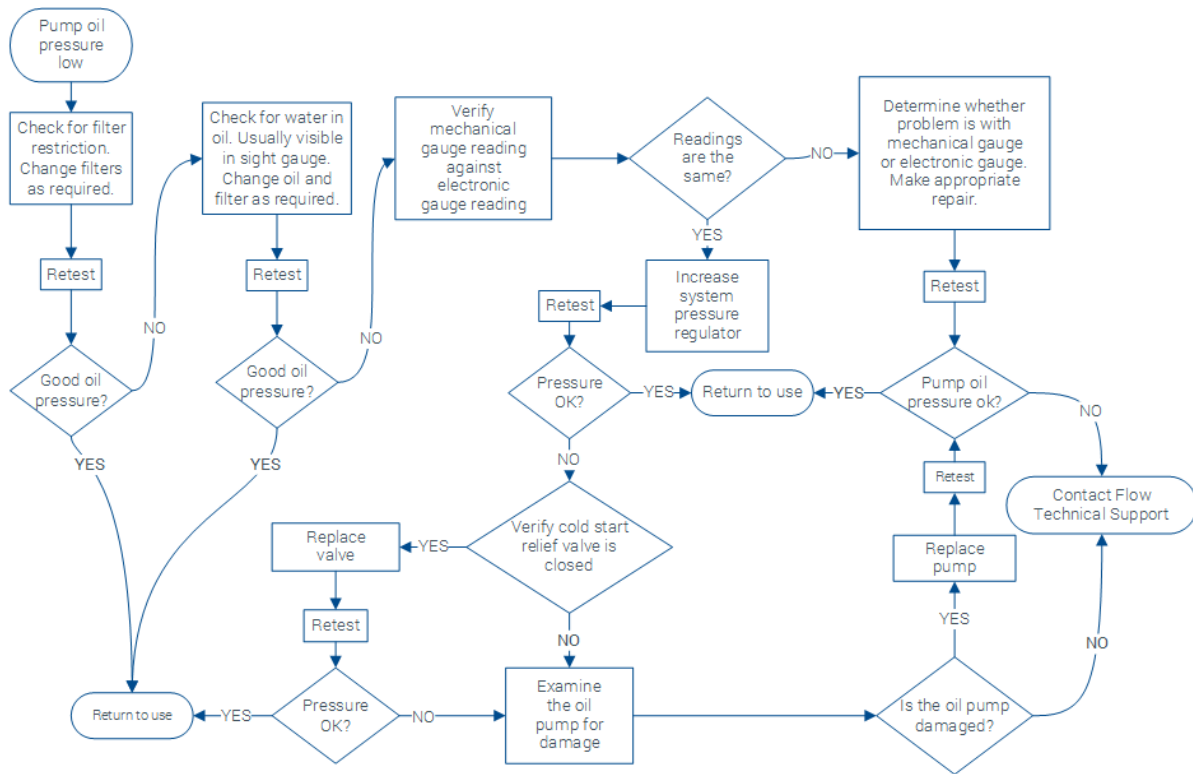


High Oil Temperature

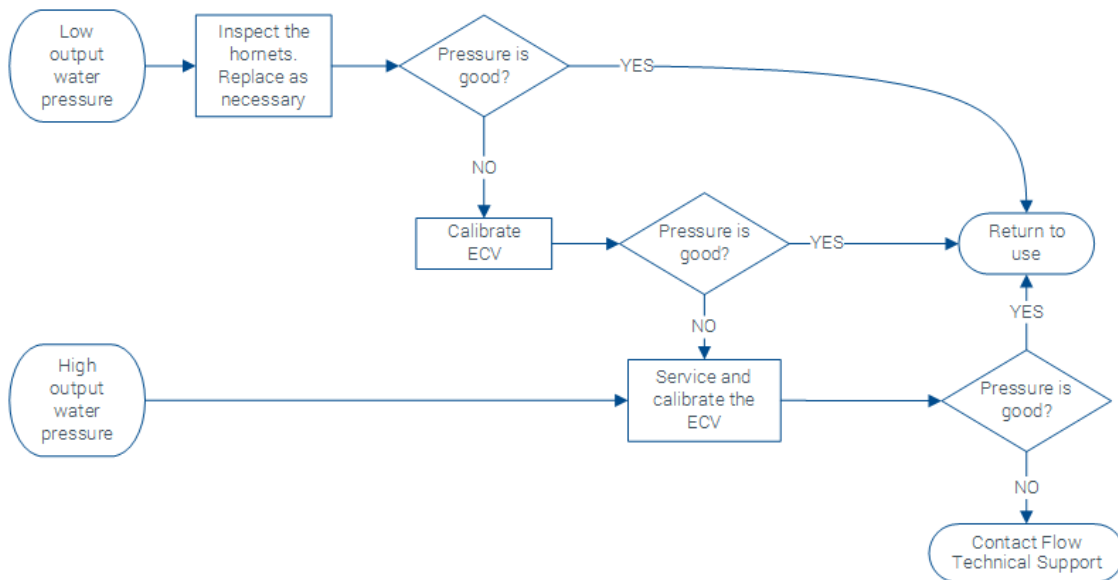
Compare the oil temperature on the display to the temperature gauge on the oil reservoir site gauge.



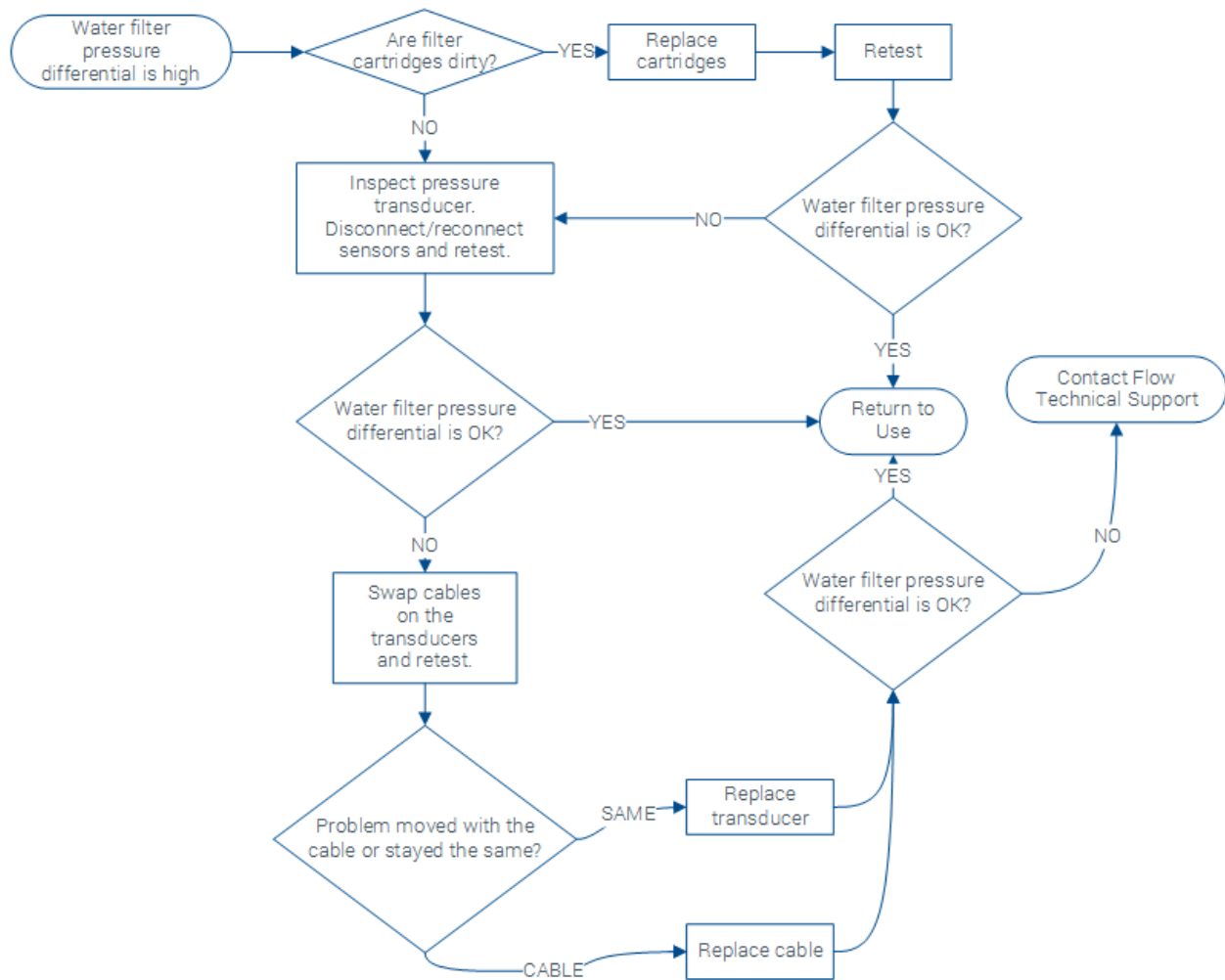
Low Oil Pressure



Low or High Output Pressure



High Water Filter Differential Pressure



Specifications

General

DIMENSIONS	94.25" H x 102" W x 64" D
DRY WEIGHT	6,245 LBS. (EST.)
REQUIRED CLEARANCE	3 FT. ON ALL SIDES
SITE GRADE	LEVEL; SLOPE LESS THAN 8" FROM HORIZONTAL
MOUNTING TYPE	SKID FRAME

Standard Operating Parameters

OUTPUT PRESSURE	3,793 bar (55,000 PSI)
OUTPUT FLOW RATE	6.5 GPM @ 2100 RPM
OUTPUT FLOW RATE	5.5 gpm @ 1800 RPM

High Pressure Pump

TYPE	TRIPLEX, DIRECT DRIVE
HYDRAULIC LUBRICATION	FORCED
STROKE	1.4 IN.
PLUNGER DIAMETER	0.562 IN.
OIL	SHELL MORLINA S3 BA 100
LUBRICANT CAPACITY	40 GALLONS

Recommended Environmental Conditions

2100 RPM	45° - 115°F (7° - 46°C)
1100 RPM	42° - 92°F (6° - 33°C)

Diesel Engine

	TIER 4 C7.1	TIER 3 C7.1	TIER 3 C9.3
MANUFACTURER	CATERPILLAR	CATERPILLAR	CATERPILLAR
TYPE	6 CYLINDER TWIN-TURBO	6 CYLINDER TURBO	6 CYLINDER TURBO
ENGINE DISPLACEMENT	7.1 LITERS	7.1 LITERS	9.3 LITERS
HORSEPOWER (CONT. DUTY)	302 HP	275 HP	335 HP
FUEL FILTERS	WATER / PARTICLE	WATER / PARTICLE	WATER / PARTICLE
EXHAUST MUFFLER CLASS	RESIDENTIAL ZONE	RESIDENTIAL ZONE	RESIDENTIAL ZONE
SPEED (CONT. DUTY)	2200 RPM	2200 RPM	2200 RPM
COOLING SYSTEM	AIR TO WATER	AIR TO WATER	AIR TO WATER
EMISSIONS STANDARD	TIER 4 FINAL	TIER 3	TIER 3
ENGINE OIL	SAE 15/40W (CAT CF-4)	SAE 15/40W (CAT CF-4)	SAE 15/40W (CAT CF-4)

Fuel

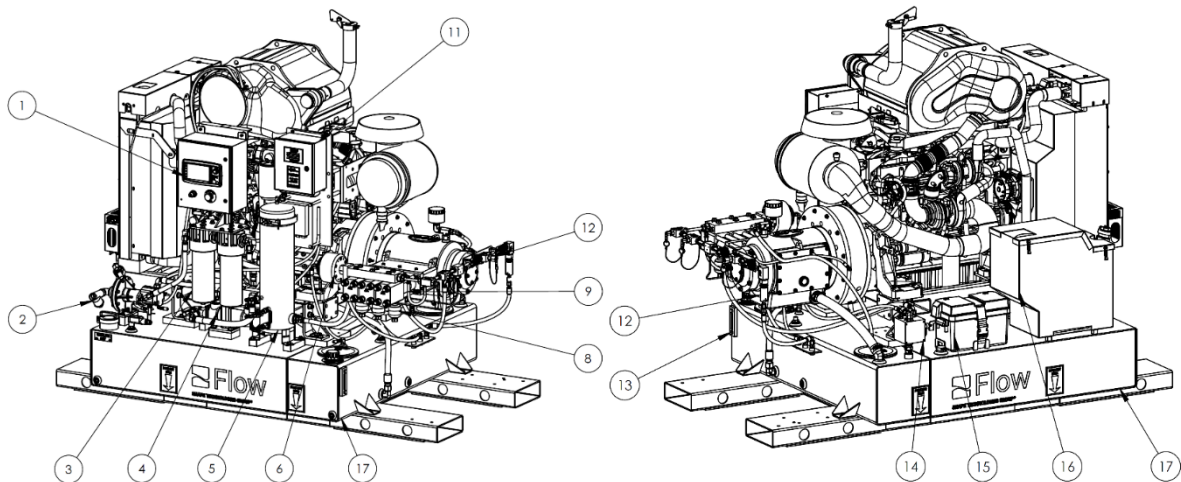
TYPE	LOW SULFUR DIESEL
CAPACITY	180 GALLONS (680 L)
CONSUMPTION	APPROX. 13 GAL/HR (49 L/HR)

Service Connections

FLUID END	40K	55K
INLET (CHARGE PUMP)	1" NPT	1" NPT
INLET (FLUID END)	-12 JIC	-12 JIC
OUTLET	3/8" HP (F)	5 MM TYPE-M (2X)
OUTLET	-	8 MM TYPE-M (1X)
COOLING LOOP	-06 JIC	-06 JIC

Component Identification

DIESEL UNIT



(image is used as reference only)

ITEM	DESCRIPTION	FUNCTION
1	VISUAL DISPLAY	PRIMARY USER INTERFACE WITH THE PUMP
2	WATER CHARGE PUMP	BOOSTS SUPPLY WATER PRESSURE TO THE UHP ASSEMBLY
3	HYDRAULIC FILTER BANK	FILTERS HYDRAULIC OIL (WATER REMOVAL / PARTICULATE)
4	HEAT EXCHANGER	REMOVES HEAT FROM HYDRAULIC OIL
5	INLET WATER FILTER	FILTERS WATER FROM THE INLET SOURCE
6	EXTERNAL CONTROL VALVE (ECV)	CONTROLS UHP OUTLET PRESSURE
7	HYDRAULIC OIL RESERVOIR	STORES OIL FOR THE CRANKCASE AND OTHER COMPONENTS
8	ACCUMULATORS	REDUCES CAVITATION ON CHECK VALVES
9	HIGH PRESSURE FLUID END	CREATES THE UHP OUTPUT
10	HIGH PRESSURE OUTLET	CONNECTION POINT FOR TOOLING
11	I/O PANEL	LOCATION FOR SENSOR WIRING POINTS
12	SAFETY VALVE	RELEASES PRESSURE OVER SET POINT
13	SIGHT GAUGE / THERMOMETER	VISUAL INDICATOR OF HYDRAULIC OIL LEVEL & TEMPERATURE
14	HYDRAULIC CONTROL BLOCK	SETS LUBRICATION PRESSURE AND CONTAINS ECV CONTROL VALVE
15	STARTING BATTERIES	PROVIDES STARTING POWER TO THE ENGINE
16	DEF RESERVOIR (AS EQUIPPED)	HOLDS DIESEL EXHAUST FLUID FOR EMISSIONS EQUIPMENT
17	PUMP FUEL TANK	STORES FUEL FOR THE ENGINE

Inlet Water

The quality of the inlet water supply is one of the most important factors affecting component life and performance. Water treatment requirements can be determined by a water analysis.

The cutting water supply must meet the following standards. A high concentration of dissolved solids, especially calcium, silica and chlorides will affect high pressure component life.

Water Condition

The inlet water source must meet the minimum required levels for the following parameters.

GENERAL PROPERTIES		
CLARITY	-	CLEAR
COLOR	-	COLORLESS
ODOR	-	NONE PRESENT
ELECTRICAL CONDUCTIVITY	-	100-400 μ S/cm
pH	-	6-8.5

WATER QUALITY GUIDELINES		
TDS	LOW TDS (<100 PPM)	GOOD QUALITY WATER (MAY USE SOFTENING)
TDS	MODERATE TDS (100-200 PPM)	CAN BE TREATED BY SOFTENING OR TDS REDUCTION (REVERSE OSMOSIS OR DEIONIZATION)
TDS	HIGH TDS (>200 PPM)	POOR QUALITY WATER, SHOULD BE TREATED WITH REVERSE OSMOSIS OR DEIONIZATION
SILICA	HIGH CONTENT (>15 PPM)	TREAT WITH DUAL STRING BASE DEIONIZATION

Inlet Water Temperature

Higher than specified water temperature causes more wear of internal seals and components.

Ideal inlet water temperature should not exceed 77°F (25°C).

If the temperature of the inlet water to the pump is not within the parameters as specified in this manual, a chiller may be required to achieve the expected pump maintenance cycles. Horsepower, application, and site-specific conditions determine the capacity of a chiller. Contact APS Technical Service for more information.

Inlet Water Pressure

WATER SUPPLY PRESSURE	6.9 BAR (100 PSI) MAX.
WATER SUPPLY FLOW RATE	10 GPM (HP & UHP FLUID ENDS) 25 GPM (LP FLUID ENDS)

Inlet Water Filtration

10 micron absolute

References

Engineering Drawings

Engineering drawings are supplied with the pump in the appendix of this manual.

Spare Parts

Fluid End Parts

DESCRIPTION	PART NUMBER	MAJOR KIT	MINOR KIT
SUBPLATE, 55K HUSKY	013533-1		
SUBPLATE ADAPTER	013525-1		
SEAL CARRIER	013517-1	3X	
HP CYLINDER	013387-1	3X	
CHECK VALVE ASSY, 55K	016863-1	3X	
END CAP ASSY, 55K	016862-1		
ACCUMULATOR	A-12749		
THERMISTOR	A-13262		
O-RING, BUNA-N. 90 DURO, -902	A-0274-1		
U-CUP SEAL, PUR, 3/4 ID	A-10654	3X	3X
DYNAMIC SEAL	016170-1	3X	3X
FILLER TUBE	017793-1		
PLUNGER BEARING	009217-1	3X	
BACKUP RING	006112-1	3X	3X
O-RING, HIGH RESILIENCY, -014	A-0290-014	6X	6X
GUIDE RING, HP CYLINDER	014252-1		
O-RING, BUNA-N. 70 DURO, -040	A-0275-040	3X	3X
RETAINING RING, INT, .866 IN.	A-0265-086	3X	
SHAFT SEAL, 9/16	A-9566	3X	
SPACER RING, LP SEAL	013540-1	3X	
RETAINING RING, INT, 13/16 IN.	A-0265-118	3X	
O-RING, BUNA-N. 70 DURO, -030	A-0275-030	3X	3X
PONY ROD SEAL CARRIER	013537-1		
SHAFT SEAL, 1-5/8	A-11216	3X	
PLUNGER ASSY	018020-1		
COMPRESSION SPRING, .90 OD	A-9412		
PLUNGER RETAINER NUT	006068-1		
PONY ROD ADAPTER	006069-1		
PONY ROD	014676-1	3X	
O-RING, BUNA-N. 70 DURO, -313	A-0275-313	3X	
O-RING, BUNA-N. 70 DURO, -153	A-0275-153	3X	
TIE ROD, 55K	013539-1		
WASHER, 7/8	A-9926		
MANIFOLD	016856-1		
STATIC SEAL	006738-1		
MANIFOLD INSERT	006114-1		
ADAPTER NUT, MANIFOLD	006113-1		
BOLT, HEX, 9/16"-18 X 2-3/4"	90-019-275		
BOLT, SHCS, 5/8"-11 X 3"	90-120-300		
NUT, HEX, 7/8"-14	90-625-000		
FLAT WASHER, 9/16"	90-818-000		

Maintenance Kits

MINOR MAINTENANCE KIT	014756-1	EVERY 150 HOURS
MAJOR MAINTENANCE KIT	018306-1	EVERY 600 HOURS
MAJOR MAINTENANCE PACKAGE	059563-1	1 MAJOR, 1 MINOR, 1 SPARES KIT
CHECK VALVE MAINTENANCE KIT	018624-1	INCLUDED IN MINOR KIT
ECV MAINTENANCE KIT	014490-1	INCLUDED IN MAJOR AND MINOR KIT
SAFETY VALVE REBUILD KIT	017086-3	INCLUDED IN MAJOR KIT
WATER FILTER ELEMENT	A-9935	
OIL PARTICULATE FILTER	A-18850	
WATER REMOVAL FILTER	A-18851	
SPARES KIT	015104-1	
STARTUP KIT	018625-1	
CRANKCASE BREATHER	A-7461	

Lubricants

Silver Anti-Seize	24-002-001
Blue Lubricant	24-001-001
Loctite 242	24-001-026
LubriMatic® White Lithium Grease	24-001-016

Water Quality Test Kit

Water Test Kit	007851-1
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Electronic Components

PRESSURE TRANSDUCER	11-001-001
TEMPERATURE TRANSDUCER	11-001-002
LEVEL/TEMP SENSOR	11-001-003
CONTROL SCREEN	11-001-017

Tools and Tool Kits

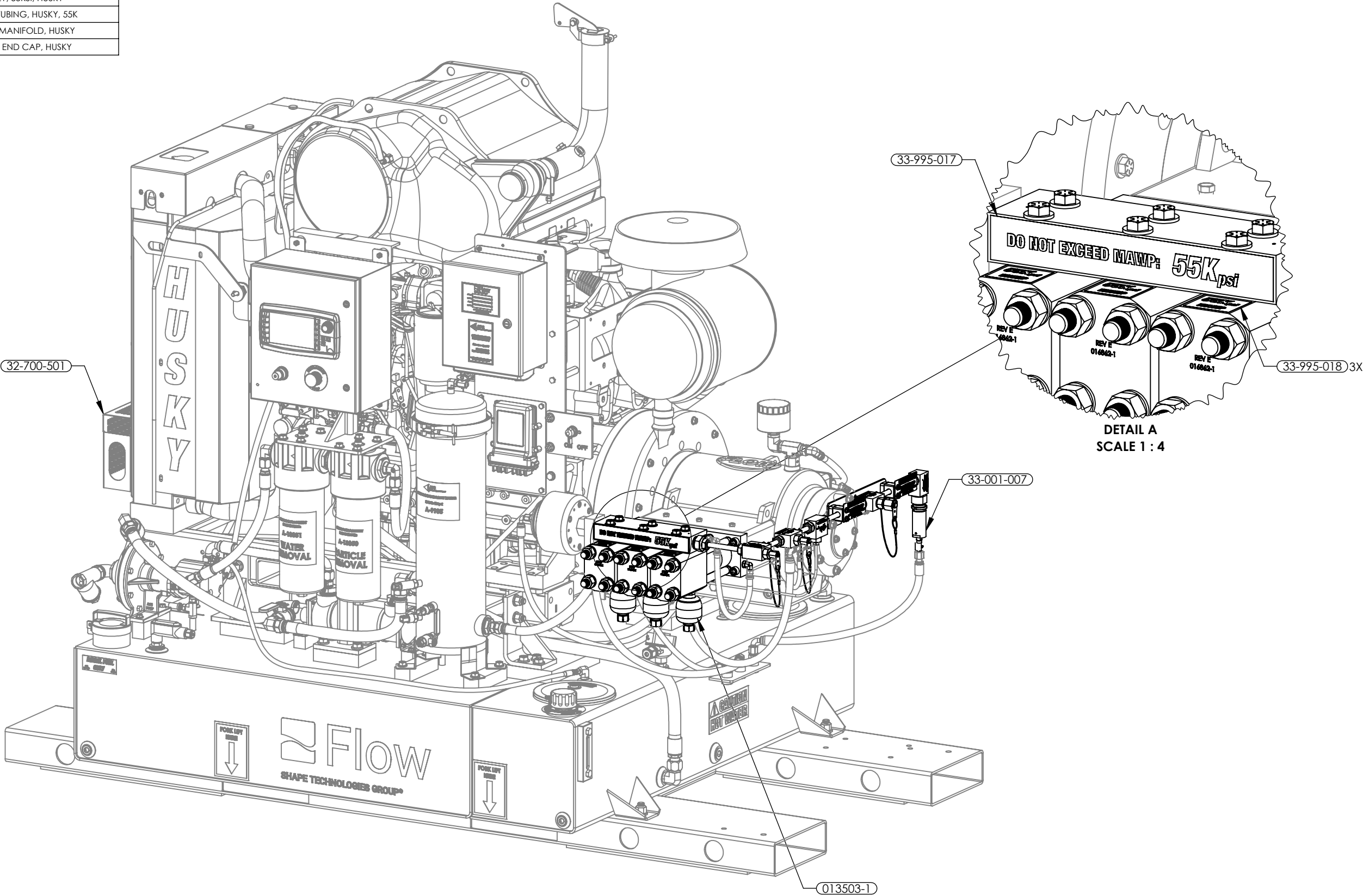
55K TOOLKIT	014757-1
LOADING TOOL	042512-2
LOADING TOOL OIL	A-24498-1
LOADING TOOL HOSE	A-245022
LOADING TOOL QD (MALE)	A-24496-2
LOADING TOOL QD (FEMALE)	A-24497-2
LOADING TOOL GAUGE	A-24500-2
LOADING TOOL ADAPTER	A-26017-1
LOADING TOOL O-RING	A-0275-039
LOADING TOOL BACKUP RING	A-0276-039
LOADING TOOL SEAL KIT	A-24501-1

Appendix


ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	32-700-501	TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE
2	1	013503-1	HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY
3	1	33-001-007	ASSEMBLY, HIGH PRESSURE TUBING, HUSKY, 55K
4	1	33-995-017	DECAL, VINYL, 55K MAWP, MANIFOLD, HUSKY
5	3	33-995-018	DECAL, VINYL, 55K MAWP, END CAP, HUSKY

FLOW HUSKY

PART NUMBER: 32-755-501
55,000 PSI MAXIMUM OPERATING PRESSURE
ASSEMBLED BY ADVANCED PRESSURE SYSTEMS, TOMBALL, TX.
PRIME MOVER: CAT TIER 4 C7.1 DIESEL ENGINE
ESTIMATED WEIGHT: 6,000 LBS. (DRY)
NOISE EMISSION: 105 DBA @ 3 FT. @ 2100 ENGINE RPM
OIL CAPACITY: 45 GALLONS / USE SHELL MORLINA S3 BA 100
FUEL CAPACITY: 180 GALLONS / USE DIESEL FUEL ONLY
MAX. FUEL CONSUMPTION: 13 GAL./HOUR



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	12/5/2019	K. SMITH
	1	UPDATED ENGINE MODEL, ENGINE MOUNT, COOLED DIESEL HOSE	4/13/2020	K. SMITH
	2	ADDED SECOND BATTERY, BATTERY DISCONNECT	6/20/2020	K. SMITH
	3	UPDATED BASED ON MANUFACTURING PROCESS	11/6/2020	K. SMITH

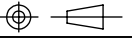


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ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375
UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009
DIMS IN MM ARE FOR REFERENCE ONLY
BREAK SHARP EDGES AND DEBURR .015
TOLERANCES (EXCEPT AS NOTED)

MACHINE S.F.	63/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = ± .063
ANGLE	±1°	.XX = ± .015
		.XXX = ± .005
		.XXXX = ± .0005

TITLE:
TRPLX UNIT-HUSKY, C7.1 TIER 4, 55K

THIRD ANGLE PROJECTION 

DWG BY
K. SMITH

APRVD BY
B. PARKER

REF. DWG.
32-700-501

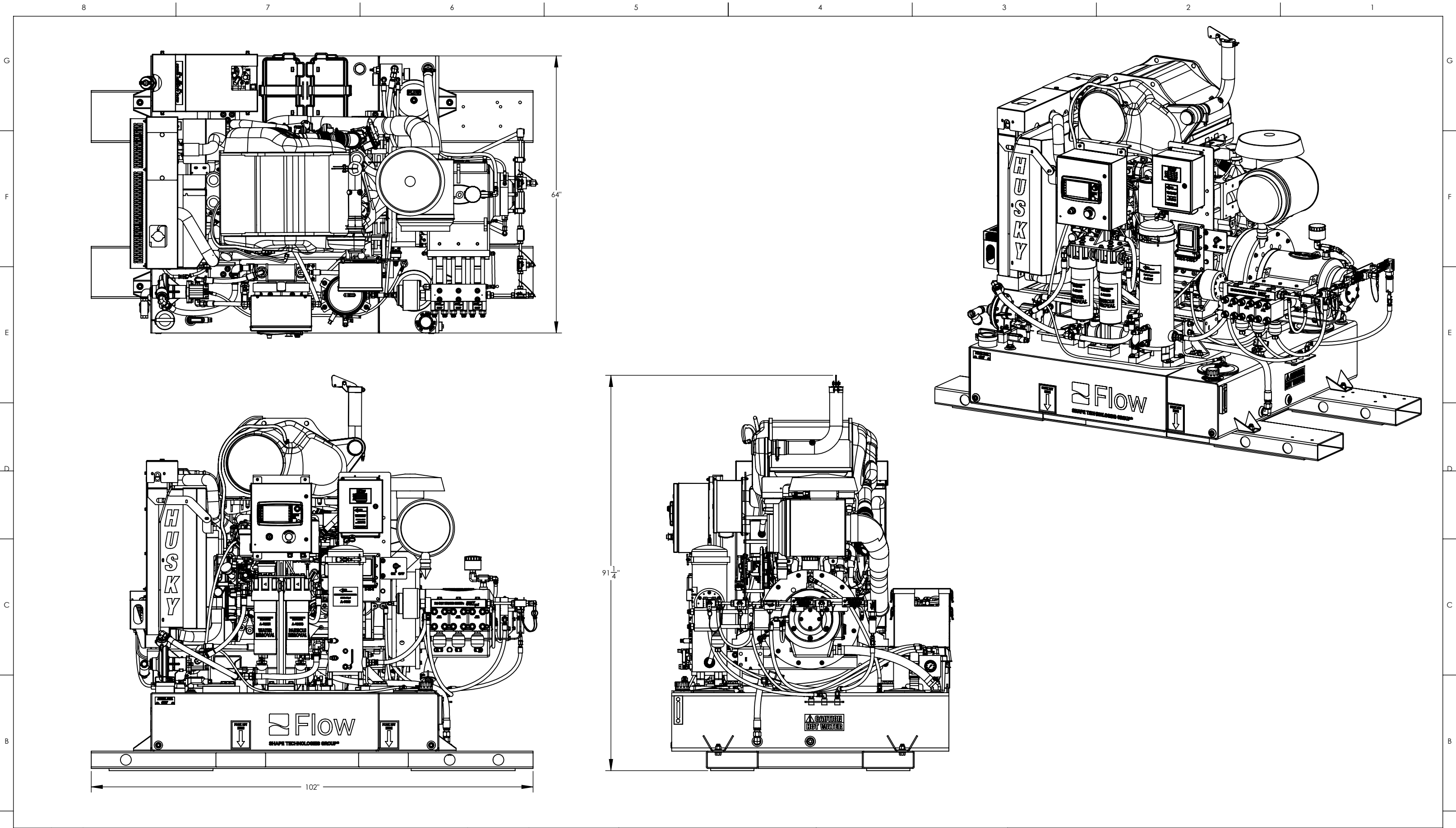
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DWG. NO.
32-755-501


HEAT TREAT.

REV.
03

SHT 1 OF 2



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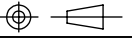
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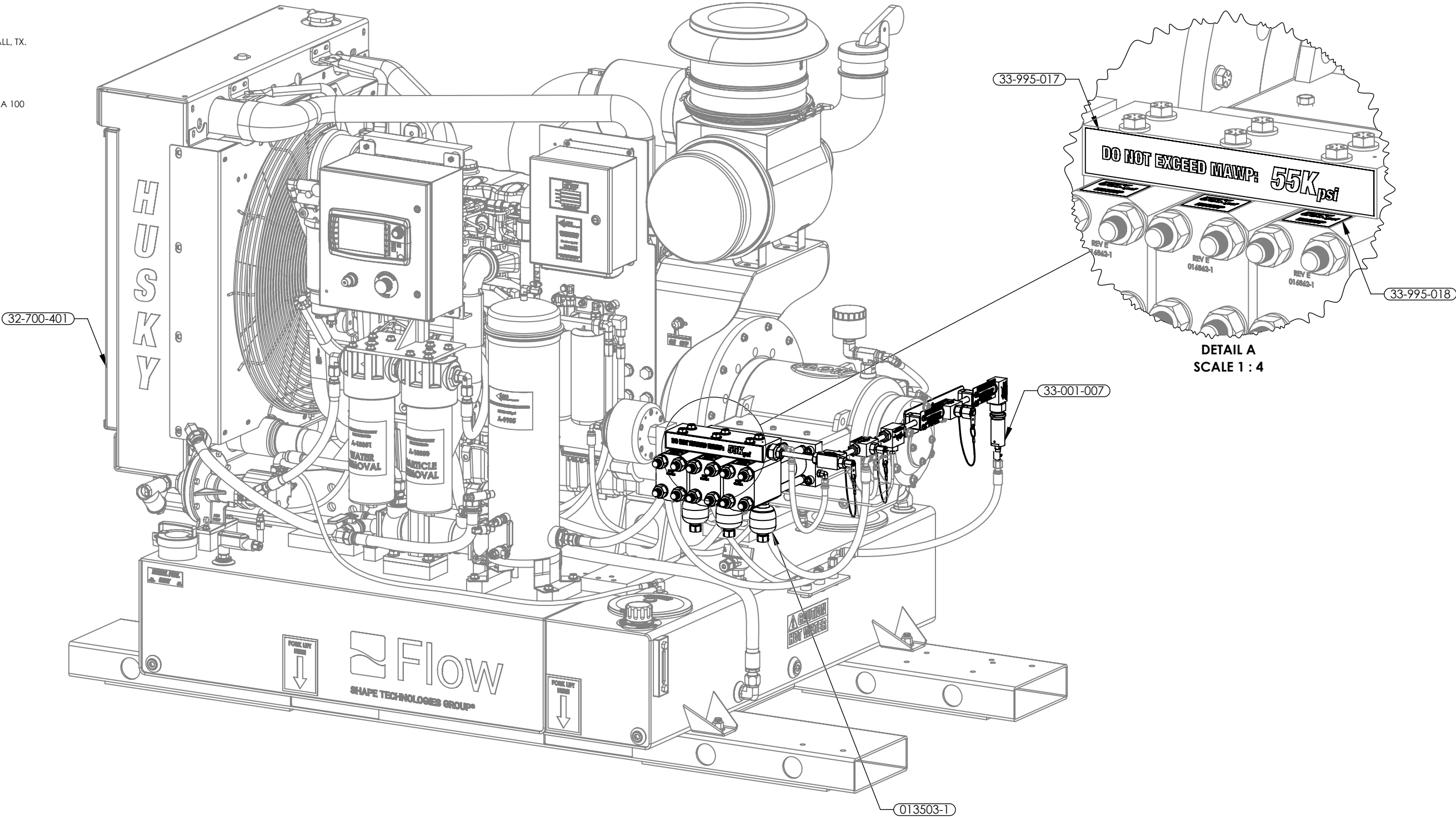
TITLE: TRPLX UNIT-HUSKY, C7.1 TIER 4, 55K

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DWG BY	K. SMITH		
APRVD BY	B. PARKER	DWG. NO.	32-755-501
REF. DWG.	32-700-501	HEAT TREAT.	REV. 03
		SHT 2 OF 2	



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	32-700-401	TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE
2	1	013503-1	HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY
3	1	33-001-007	ASSEMBLY, HIGH PRESSURE TUBING, HUSKY, 55K
4	1	33-995-017	DECAL, VINYL, 55K MAWP, MANIFOLD, HUSKY
5	3	33-995-018	DECAL, VINYL, 55K MAWP, END CAP, HUSKY

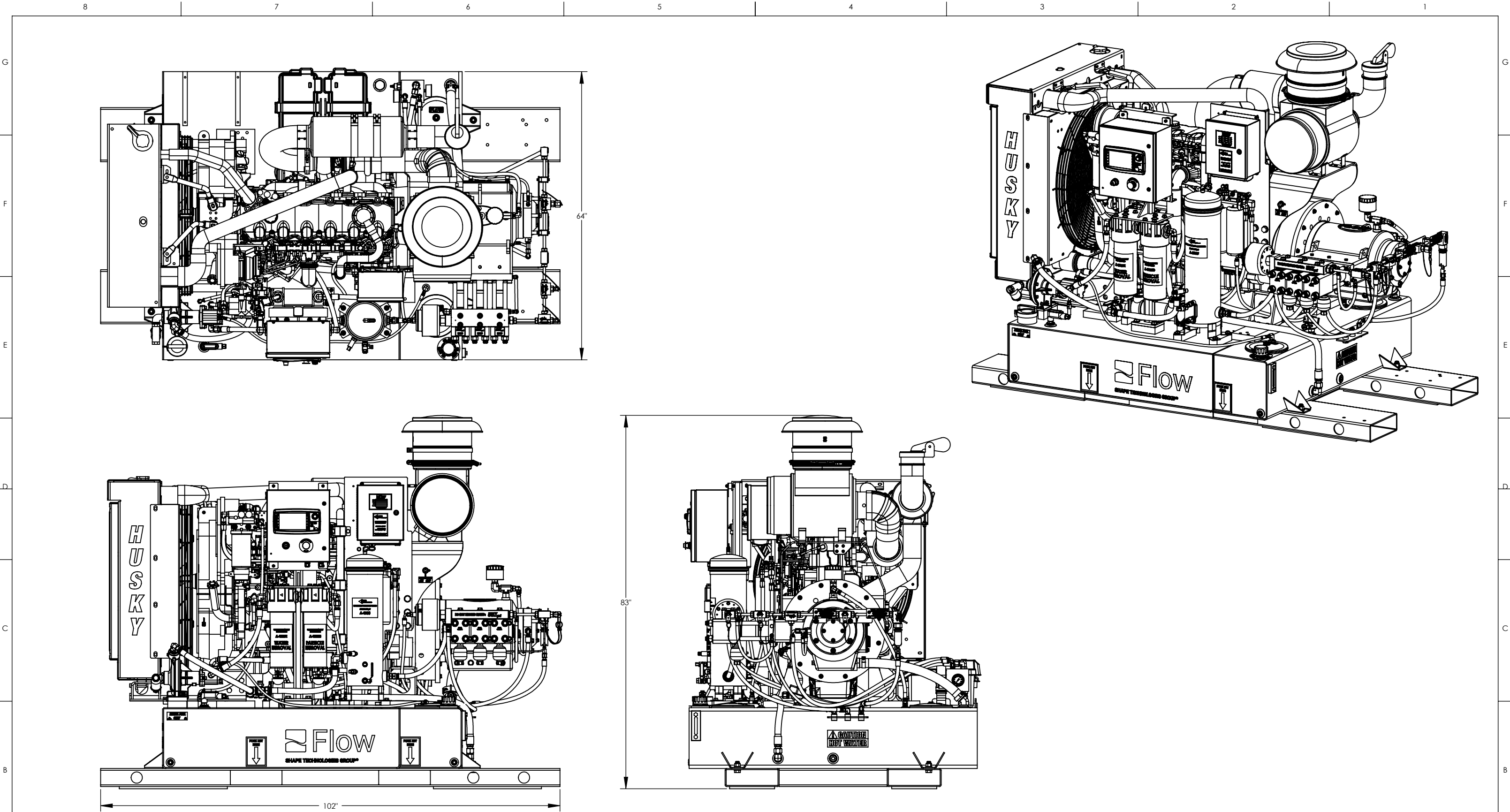
FLOW HUSKY

PART NUMBER: 32-755-401
55,000 PSI MAXIMUM OPERATING PRESSURE
ASSEMBLED BY ADVANCED PRESSURE SYSTEMS, TOMBALL, TX.
PRIME MOVER: CAT TIER 3 C9.3 DIESEL ENGINE
ESTIMATED WEIGHT: 6,500 LBS. (DRY)
NOISE EMISSION: 105 DBA @ 3 FT. @ 2100 ENGINE RPM
OIL CAPACITY: 45 GALLONS / USE SHELL MORLINA S3 BA 100
FUEL CAPACITY: 180 GALLONS / USE DIESEL FUEL ONLY





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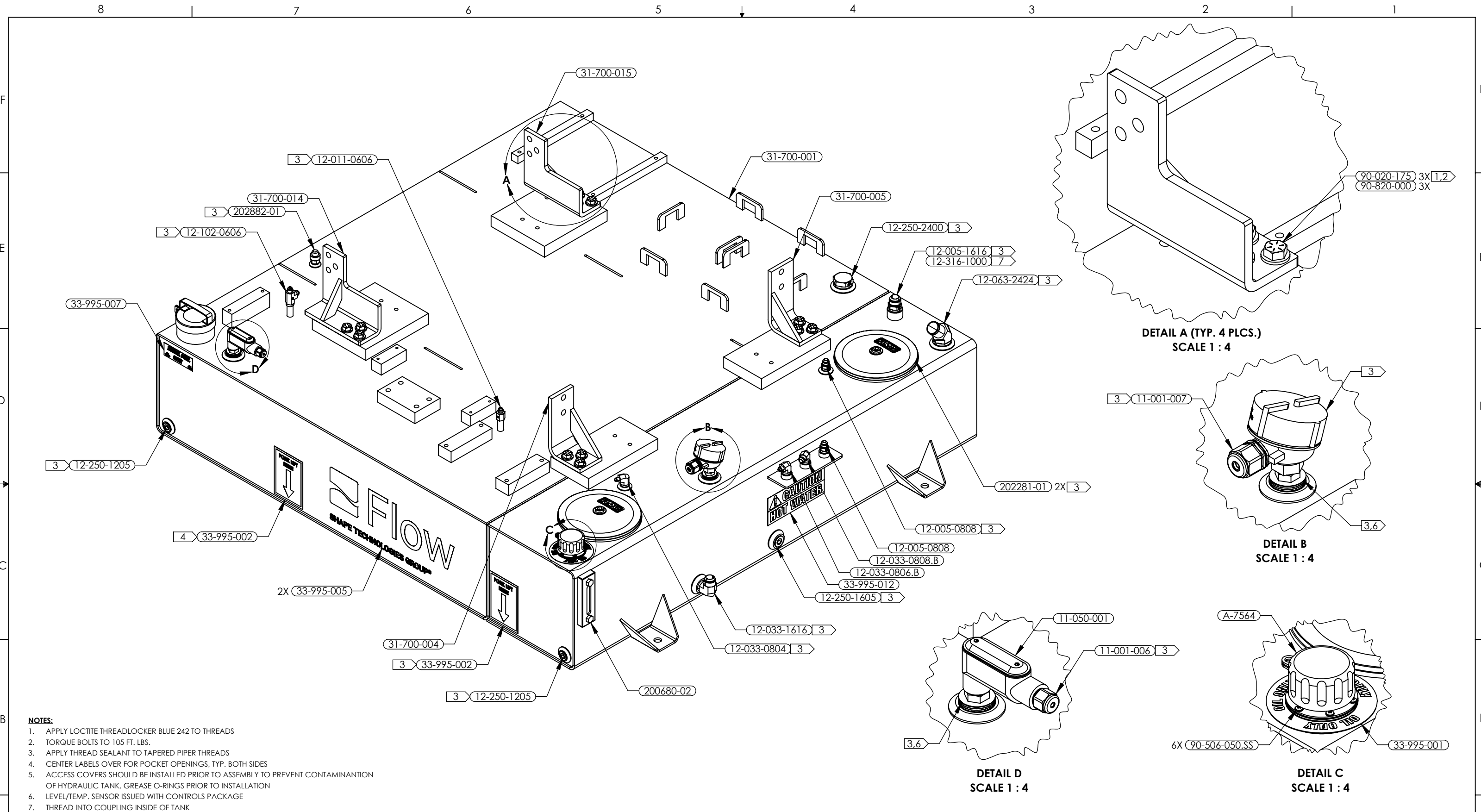
 <div>APS SHAPE TECHNOLOGIES GROUP®</div>	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, 55K			
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			THIRD ANGLE PROJECTION 		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.	
			DWG BY K. SMITH			
APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES	MACHINE S.F. $\frac{63}{8}$	DIM TOLERANCES: (in) .X = $\pm .063$.XX = $\pm .015$.XXX = $\pm .005$.XXXX = $\pm .0005$	APRVD BY B. PARKER	DWG. NO. 32-755-401	REV. 01	
	MACHINE FILLETS R.02		REF. DWG. 32-700-401	HEAT TREAT.	SHT 1 OF 2	
	ANGLE $\pm 1^{\circ}$					



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	12/5/2019	K. SMITH
	1	UPDATED BASED ON MANUFACTURING PROCESS	11/6/2020	K. SMITH

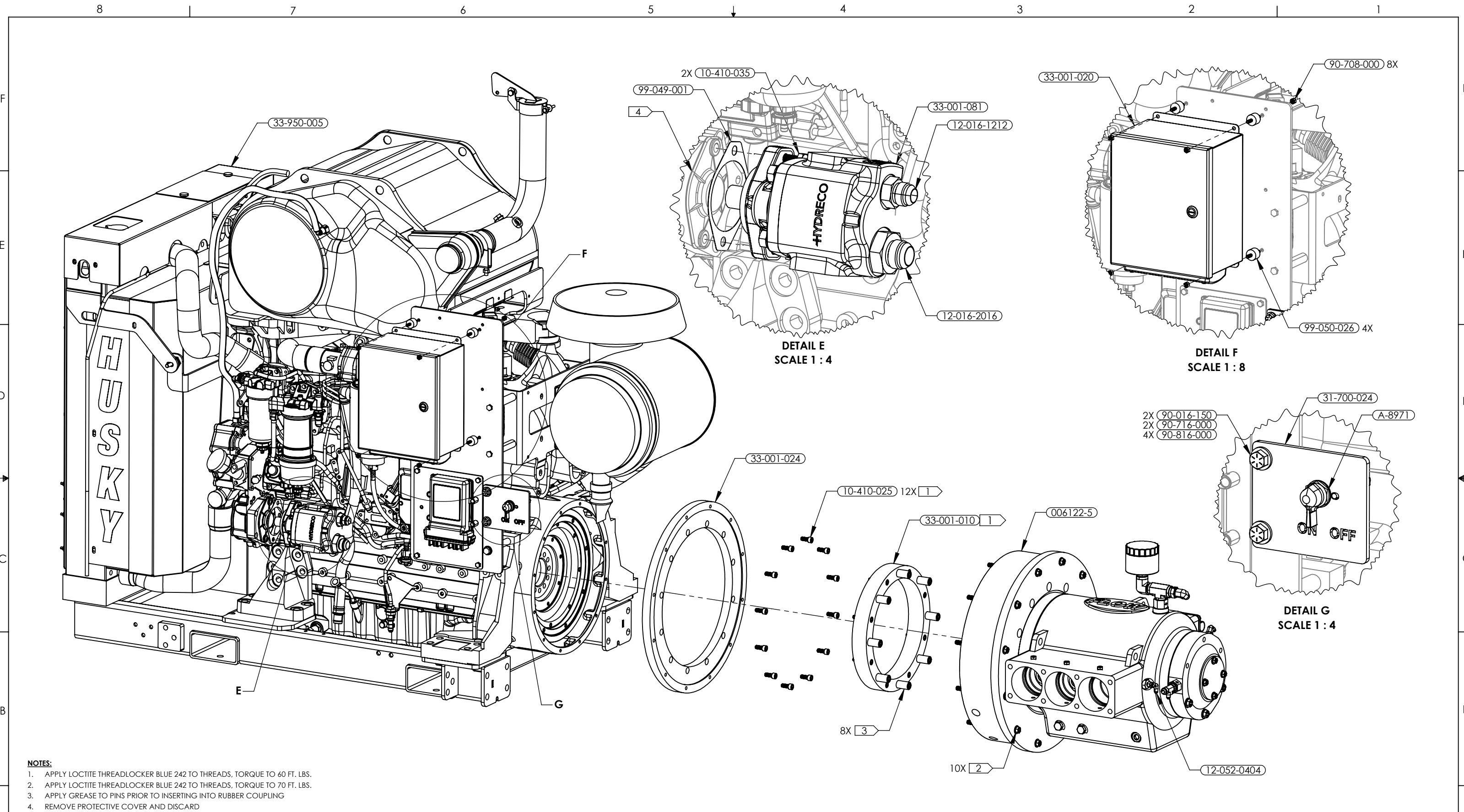
	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, 55K				
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			DWG BY	K. SMITH			
APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES	MACHINE S.F.	43/	APRVD BY		DWG. NO.	32-755-401	REV. 01
	MACHINE FILLETS	R.02	B. PARKER				
	ANGLE	±1°	32-700-401		HEAT TREAT.		
		DIM TOLERANCES: (in)					
		.X = ± .063					
		.XX = ± .015					
		.XXX = ± .005					
		.XXXX = ± .0005					

8				7				6				5				4				3				2				1			
ITEM NO.	QTY.	PART NO.	DESCRIPTION				ITEM NO.	QTY.	PART NO.	DESCRIPTION				ITEM NO.	QTY.	PART NO.	DESCRIPTION														
1	1	31-700-001	WELDMENT, TANK, HUSKY, HYDRAULIC/DIESEL				56	1	12-016-1212	FITTING, STRT, MSAE-MJIC, 12-12				109	2	33-995-009	DECAL, VINYL, HUSKY NAME, VERTICAL, RADIATOR														
2	1	12-316-1000	NIPPLE, 1" NPT, 10" LG, STEEL				57	1	12-016-2016	FITTING, STRT, MSAE-MJIC, 20-16				110	1	33-995-010	DECAL, VINYL, WATER FILTER TAG														
3	1	31-700-034	WLDMNT, FORK PCKT, HUSKY				58	1	12-052-0404	FITTING, 90, MJIC-FJIC, 04-04				111	2	33-995-011	DECAL, VINYL, DEF FLUID														
4	1	31-700-004	WELDMENT, BRACKET, HUSKY, TIER 4, PORT				59	1	12-052-0606.SS	FITTING, 90, MJIC-FJIC, 06-06.SS				112	1	33-995-012	DECAL, VINYL, CAUTION HOT WATER														
5	1	31-700-005	WELDMENT, BRACKET, HUSKY, TIER 4, STARBOARD				60	1	12-055-0606	FITTING, 90, FJIC-HOSE, 06-06				113	1	33-995-013	DECAL, VINYL, FILTER, WATER SEPERATOR														
6	1	200680-02	GAUGE, LIQUID LEVEL, ALUMINUM, 5 INCH				61	1	12-063-2424	FITTING, 45, MNPT-HOSE, 24-24				114	1	33-995-014	DECAL, VINYL, FILTER, PARTICULATE REMOVAL														
7	2	202281-01	COVER, ACCESS, TOP FRONT, TANK, HISKY, 1.625 INCH				62	2	7219011639	CONN, FUEL, ENGINE, 90D, PUSH-ON				117	4	90-022-200	BOLT, HEX, 3/4"-10 X 2"														
8	1	202882-01	BREATHER, VENT, NON-SPLASH, 1/4" NPT				63	1	12-250-2400	PLUG, MNPT, 24				118	4	90-722-000	NUT, NY-LOCK, 3/4"-10														
9	1	A-7564	BREATHER, PRESSURIZED, 40 MICRON				64	2	12-250-1205	PLUG, MNPT, HOLLOW HEX, 12				119	8	90-822-000	FLAT WASHER, 3/4"														
10	1	33-950-005	ENGINE, CAT, C7.1, TIER 4, 302 HP, BASE				65	1	12-250-1605	PLUG, MNPT, HOLLOW HEX, 16				120	1	31-700-014	WELDMENT, BRACKET-MOD , HUSKY, PORT														
11	1	33-001-010	ASSEMBLY, FLYWHEEL ADAPTER PLATE, TIER 4, C7.1				66	7	12-027-0606.B	FITTING, STRT, FJIC-HOSE, 06-06.B				121	1	31-700-015	WELDMENT, BRACKET-MOD , HUSKY, STARBOARD														
12	1	33-001-024	PLATE, ADAPTER, SAE 1 TO SAE 3, TIER 4 C7.1				67	4	12-027-0808.B	FITTING, STRT, FJIC-HOSE, 08-08.B				122	1	31-700-024	PLATE, SWITCH, BATTERY, ON-OFF														
13	1	006122-5	ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1				68	2	12-027-1212.B	FITTING, STRT, FJIC-HOSE, 12-12.B				123	1	A-8971	SWITCH, SELECTOR, KNOB, 2 POSN, PNL MT														
15	1	013410-1	VALVE ASSEMBLY, EXTERNAL CONTROL, HUSKY, 55KSI				69	4	12-027-1616.B	FITTING, STRT, FJIC-HOSE, 16-16.B				124	2	90-016-150	BOLT, HEX, 1/2"-13 X 1-1/2"														
16	1	33-001-003	ASSEMBLY, HYDRAULIC FILTER, HUSKY				70	1	11-001-005	ASSEMBLY, CONTROL PANEL, HUSKY				125	2	90-716-000	NUT, NY-LOCK, 1/2"-13														
17	1	33-001-004	ASSEMBLY, HEAT EXCHANGER, HUSKY				71	1	11-001-006	CORD GRIP, ALUM.1/2" NPT,,13-.25" LIQ TIGHT				126	2	11-005-011	CABLE, BATTERY, BLK, 2/0, 3/8 RNG, 72" LG														
18	1	33-001-005	ASSEMBLY, WATER FILTER, HUSKY				72	1	11-001-007	CORD GRIP,ALUM, 3/4"NPT, LIQ TIGHT				127	1	11-005-015	CABLE, BATTERY, RED, 2/0, 3/8 RNG, 36" LG														
20	1	33-001-008	ASSEMBLY, CONTROL/RELIEF VALVE MANIFOLD, HUSKY				73	2	11-001-011	ENCLOSURE, BATTERY, 31M, (ALSO A-9407)				128	1	12-102-0606	RUN TEE, MJIC-MJIC-FNPT, 06-06-06														
21	1	33-001-016	ASSEMBLY, DEF TANK ENCLOSURE, HUSKY				74	2	11-001-016	BATTERY, 12V, 31M, 1000 CCA (A-9338)																					
22	1	33-001-019	ASSEMBLY, CHARGE PUMP, HUSKY				75	1	11-050-001	LB BOX, 90 DEG, 1/2" NPT, ZINC PLATED																					
23	1	33-001-020	ASSEMBLY, IO PANEL ENCLOSURE, HUSKY				76	1	99-050-024	CLAMP, LOOP, 1" ID, VIBR DAMP																					
24	1	33-001-081	PMP-EXT GR, 44CC, SAE-A, 11TH, CW, BP				77	1	A-19090-1	SENSOR, XDCR, 60 KSI, 0-10V																					
25	1	31-700-006	WELDMENT, BRACKET, HUSKY, FILTER/E-BOX				78	1	A-0689-1	GLAND/COLLAR, ANTI-VIBRATION, 60 KSI, 1/4 INCH																					
26	1	31-700-007	WELDMENT, BRACKET, HUSKY, HP TANSDUCER				79	1	52-500-001	TUBE, HIGH PRESSURE, 1/4 INCH, 60KSI, 27 IN LONG																					
27	3	002839-1	SPACER, CYLINDER, MOUNTING PLATE, HUSKY, SS, 1.5"				80	1	13-700-001	HOSE KIT, HYDRAULIC, TIER 4 HUSKY																					
28	4	90-010-075	BOLT, HEX, 5/16"-18 X 3/4"				81	6	10-416-050	BOLT, HEX HEAD, M16 X 2MM X 50MM, CLASS 10.9																					
29	1	90-012-075	BOLT, HEX, 3/8"-16 X 3/4"				82	2	10-950-201	HOSE CLAMP, T-BOLT, STAINLESS, 2-1/8" OD																					
30	2	90-012-100	BOLT, HEX, 3/8"-16 X 1"				83	2	10-960-006	HOSE CLAMP, WORM DR, 7/16 - 25/32, .5 IN WD																					
31	4	90-016-100	BOLT, HEX, 1/2"-13 X 1"				84	2	99-050-005	STRAP, CINCH, SQZ BCKL, 2" WD, 8FT LG, NYLON																					
32	3	90-016-450	BOLT, HEX, 1/2"-13 X 4-1/2"				85	1	99-049-001	GASKET, FLAT, SAE-A 2-BOLT, N8090, 1/64"																					
33	8	90-017-125	BOLT, HEX, 1/2"-20 X 1-1/4"				86	4	99-050-025	STUD, VIBRATION DAMPING, 50 DUR, 5/16"-18 X 5/8"																					
34	16	90-020-175	BOLT, HEX, 5/8"-11 X 1-3/4"				87	1	33-995-001	LABEL, PLATE, WARNING, OIL ONLY																					
35	4	90-020-225	BOLT, HEX, 5/8"-11 X 2-1/4"				88	4	33-995-002	LABEL, STICKER, FORK LIFT HERE																					
36	12	10-410-025	BOLT, SHCS, M10X1.5MM X 25MM, 12.9 ALLOY				89	1	33-995-003	LABEL, PLATE, SERVICE/SUPPORT																					
37	6	90-506-050.SS	BUTTON PHILIPS, #10-24 X 1/2" SS				90	1	33-995-004	LABEL, PLATE, MODEL/SERIAL																					
38	8	90-710-000	NUT, NY-LOCK, 5/16"-18				91	2	33-995-005	LABEL, STICKER, FLOW LOGO, TANK																					
39	1	90-712-000	NUT, NY-LOCK, 3/8"-16				92	1	33-995-007	LABEL, STICKER, DIESEL FUEL ONLY, 180 GAL																					
40	4	90-720-000	NUT, NY-LOCK, 5/8"-11				93	4	99-050-026	STUD, VIBRATION DAMPING, 50 DUR, 1/4-20 X 3/4"																					
41	4	90-810-000	FLAT WASHER, 5/16"				94	1	12-089-0606	FITTING, STRT, FFS-MJIC, 06-06																					
42	2	90-812-000	FLAT WASHER, 3/8"				95	8	90-708-000	NUT, NY-LOCK, 1/4"-20																					
43	19	90-816-000	FLAT WASHER, 1/2"				96	1	33-995-008	LABEL, STICKER, APS WEBSITE / PHONE NUM																					
44	30	90-820-000	FLAT WASHER, 5/8"				97	27 IN.	A-2883	TUBING, FLEX, 9/32"																					
45	2	10-410-035	BOLT, HEX, M10X1.5MM X 35MM, 10.9 ALLOY				98	51 IN.	13-006-2000.BLU	HOSE, PUSH-LOK, -6, BLUE, 250 PSI, PRK 801																					
46	4	90-512-075.SS	BUTTON PHILIPS, 3/8"-16 X 3/4" SS				99	102 IN.	13-006-2000.YLW	HOSE, PUSH-LOK, -6, YLW, 300 PSI, PRK 7212																					
47	2	12-005-0808	FITING, STRT, MNPT-MJIC, 08-08				100	26 IN.	13-008-2000.BLU	HOSE, PUSH-LOK, -8, BLUE, 250 PSI, PRK 801																					
48	1	12-005-0808.B	FITTING, STRT, MNPT-MJIC, 08-08.B				101	42 IN.	13-008-2000.BLK	HOSE, PUSH-LOK, -8, BLACK, 250 PSI, PRK 801																					
49	1	12-005-1616	FITTING, STRT, MNPT-MJIC, 16-16				102	20 IN.	13-012-2000.BLU	HOSE, PUSH-LOK, BLUE, 250 PSI, PRK 801																					
50	1	12-011-0606	FITTING, STRT, FNPT-MJIC, 06-06				103	42 IN.	13-016-2000.BLU	HOSE, PUSH-LOK, BLUE, 250 PSI, PRK 801																					
51	1	12-016-0806	FITTING, STRT, MSAE-MJIC, 08-06				104	1	11-005-001	CABLE, BATTERY, BLK, 2/0, 3/8" RNG, 30" LG																					
52	1	12-033-0804	FITTING, 90, MNPT-MJIC, 08-04				105	2	11-005-002	CABLE, BATTERY, RED, 2/0, 3/8" RNG, 30" LG																					
53	1	12-033-0806.B	FITTING, 90, MNPT-MJIC, 08-06				106	1	11-005-007	CABLE, BATTERY, BLK, 4GA, 3/8 RNG, 64" LG																					
54	1	12-033-0808.B	FITTING, 90, MNPT-MJIC, 08-08.B				107	1	11-005-008	CABLE, BATTERY, RED, 4GA, 3/8 RNG, 64" LG																					
55	1	12-033-1616	FITTING, 90, MNPT-MJIC, 16-16				108	1	A-10248	OIL, HYD, MORLINA 100, 55 GAL																					
												APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES				UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES INTERPRET PER ANSI Y14.5-2009 DIMS IN [mm] ARE REFERENCE ONLY BREAK SHARP EDGES & DEBURR .015				TITLE: TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE											
												THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.				TOLERANCES (EXCEPT AS NOTED)				THIRD ANGLE PROJECTION											
																SURFACE FINISH MACHINE FILLETS ANGLE				DWG BY APRVD BY											
																63/ R.02 ±1°				K. SMITH B. PARKER											
																DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005															
REVISIONS																															
ZONE	REV.	DESCRIPTION				DATE		APPROVED																							
	0	INITIAL RELEASE				11/5/2020		K. SMITH																							
	1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS				7/9/2021		K. SMITH																							



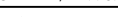
- NOTES:**
- 1. APPLY LOCTITE THREADLOCKER BLUE 242 TO THREADS
 - 2. TORQUE BOLTS TO 105 FT. LBS.
 - 3. APPLY THREAD SEALANT TO TAPERED PIPER THREADS
 - 4. CENTER LABELS OVER FOR POCKET OPENINGS, TYP. BOTH SIDES
 - 5. ACCESS COVERS SHOULD BE INSTALLED PRIOR TO ASSEMBLY TO PREVENT CONTAMINATION OF HYDRAULIC TANK, GREASE O-RINGS PRIOR TO INSTALLATION
 - 6. LEVEL/TEMP. SENSOR ISSUED WITH CONTROLS PACKAGE
 - 7. THREAD INTO COUPLING INSIDE OF TANK

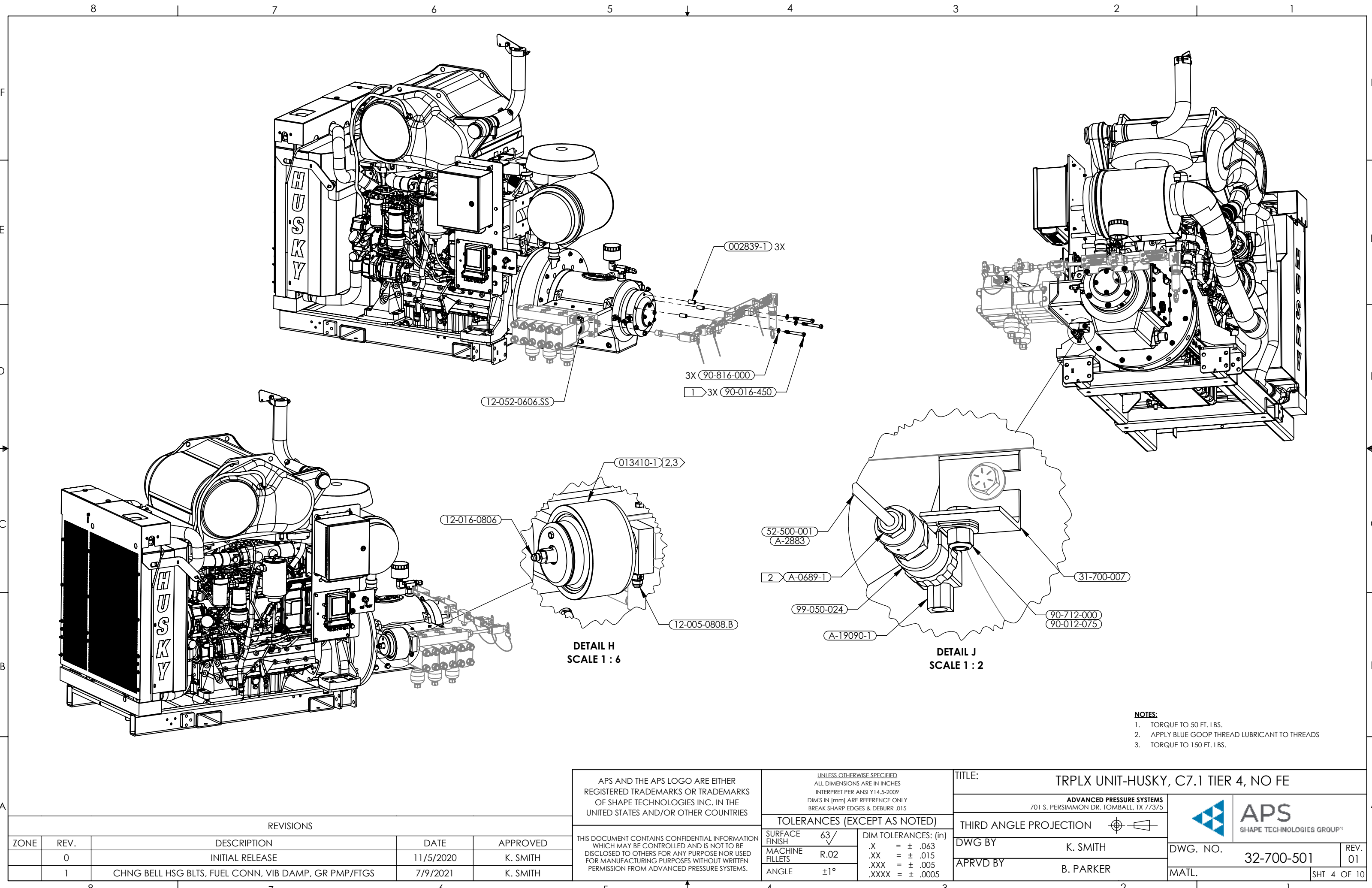
APPS AND THE APPS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES					UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES. INTERPRET PER ANSI Y14.5-2009. DIMS IN [mm] ARE REFERENCE ONLY. BREAK SHARP EDGES & DEBURR .015		TITLE: TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		THIRD ANGLE PROJECTION		DWG. NO. 32-700-501		REV. 01	
THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.					TOLERANCES (EXCEPT AS NOTED)		DWG BY K. SMITH		APRVD BY B. PARKER		MATERIAL		SHT 2 OF 10			
					SURFACE FINISH 63		DIM TOLERANCES: (in)									
					MACHINE FILLETS R.02		.X = ± .063									
					ANGLE ±1°		.XX = ± .015									
							.XXX = ± .005									
							.XXXX = ± .0005									



- NOTES:**
- 1. APPLY LOCTITE THREADLOCKER BLUE 242 TO THREADS, TORQUE TO 60 FT. LBS.
 - 2. APPLY LOCTITE THREADLOCKER BLUE 242 TO THREADS, TORQUE TO 70 FT. LBS.
 - 3. APPLY GREASE TO PINS PRIOR TO INSERTING INTO RUBBER COUPLING
 - 4. REMOVE PROTECTIVE COVER AND DISCARD



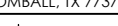
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<div>REVISIONS</div> <table><tr><th>ZONE</th><th>REV.</th><th>DESCRIPTION</th><th>DATE</th><th>APPROVED</th></tr><tr><td></td><td>0</td><td>INITIAL RELEASE</td><td>11/5/2020</td><td>K. SMITH</td></tr><tr><td></td><td>1</td><td>CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS</td><td>7/9/2021</td><td>K. SMITH</td></tr></table>					ZONE	REV.	DESCRIPTION	DATE	APPROVED		0	INITIAL RELEASE	11/5/2020	K. SMITH		1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH	<div>APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES</div> <div>THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.</div>		<div>UNLESS OTHERWISE SPECIFIED</div> <div>ALL DIMENSIONS ARE IN INCHES</div> <div>INTERPRET PER ANSI Y14.5-2009</div> <div>DIM'S IN [mm] ARE REFERENCE ONLY</div> <div>BREAK SHARP EDGES & DEBURR .015</div>		TITLE: TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE			
					ZONE	REV.	DESCRIPTION	DATE	APPROVED																		
						0	INITIAL RELEASE	11/5/2020	K. SMITH																		
						1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH																		
TOLERANCES (EXCEPT AS NOTED)		<div>ADVANCED PRESSURE SYSTEMS</div> <div>701 S. PERSIMMON DR. TOMBALL, TX 77375</div>		<div><div><div></div></div><div>APS</div><div>SHAPE TECHNOLOGIES GROUP[®]</div></div>																							
THIRD ANGLE PROJECTION 																											
DWG BY K. SMITH		DWG. NO. 32-700-501		REV. 01																							
APRVD BY B. PARKER		MATL.		SHT 3 OF 10																							



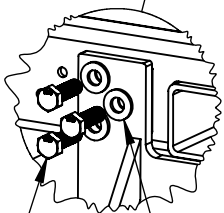
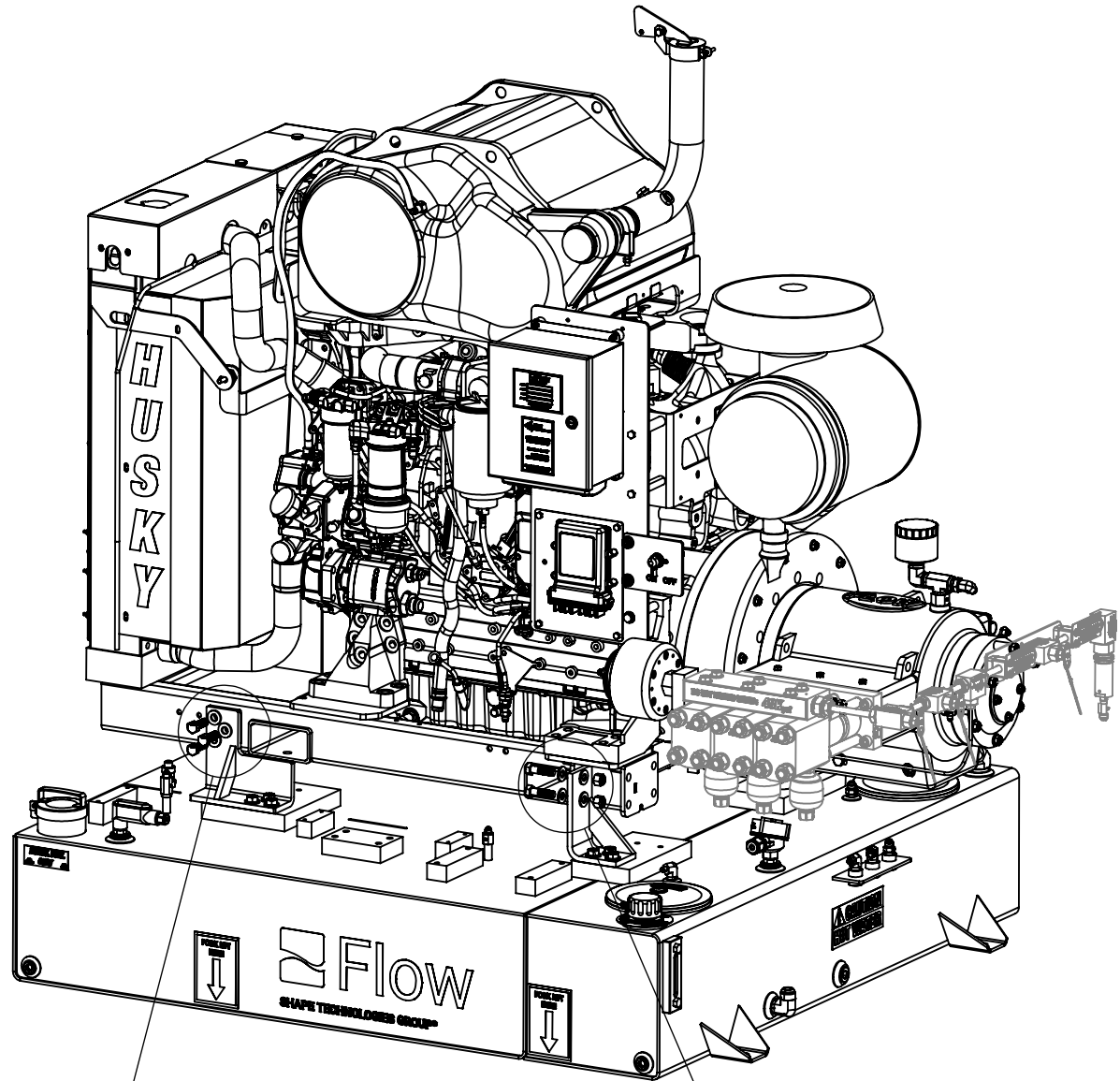
- NOTES:
- 1. TORQUE TO 50 FT. LBS.
 - 2. APPLY BLUE GOOP THREAD LUBRICANT TO THREADS
 - 3. TORQUE TO 150 FT. LBS.

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/5/2020	K. SMITH
	1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH

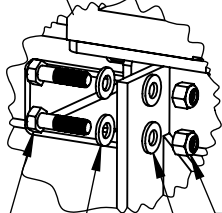
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	TOLERANCES (EXCEPT AS NOTED)		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		 		
THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.	SURFACE FINISH	63/√	DIM TOLERANCES: (in)		THIRD ANGLE PROJECTION 		
	MACHINE FILLETS	R.02			DWG BY K. SMITH		
	ANGLE	±1°	.X	= ± .063	APRVD BY B. PARKER	DWG. NO. 32-700-501	REV. 01
			.XX	= ± .015			
			.XXX	= ± .005			
		.XXXX	= ± .0005	MATL.	SHT 4 OF 10		

NOTES:

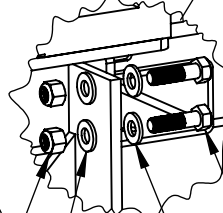
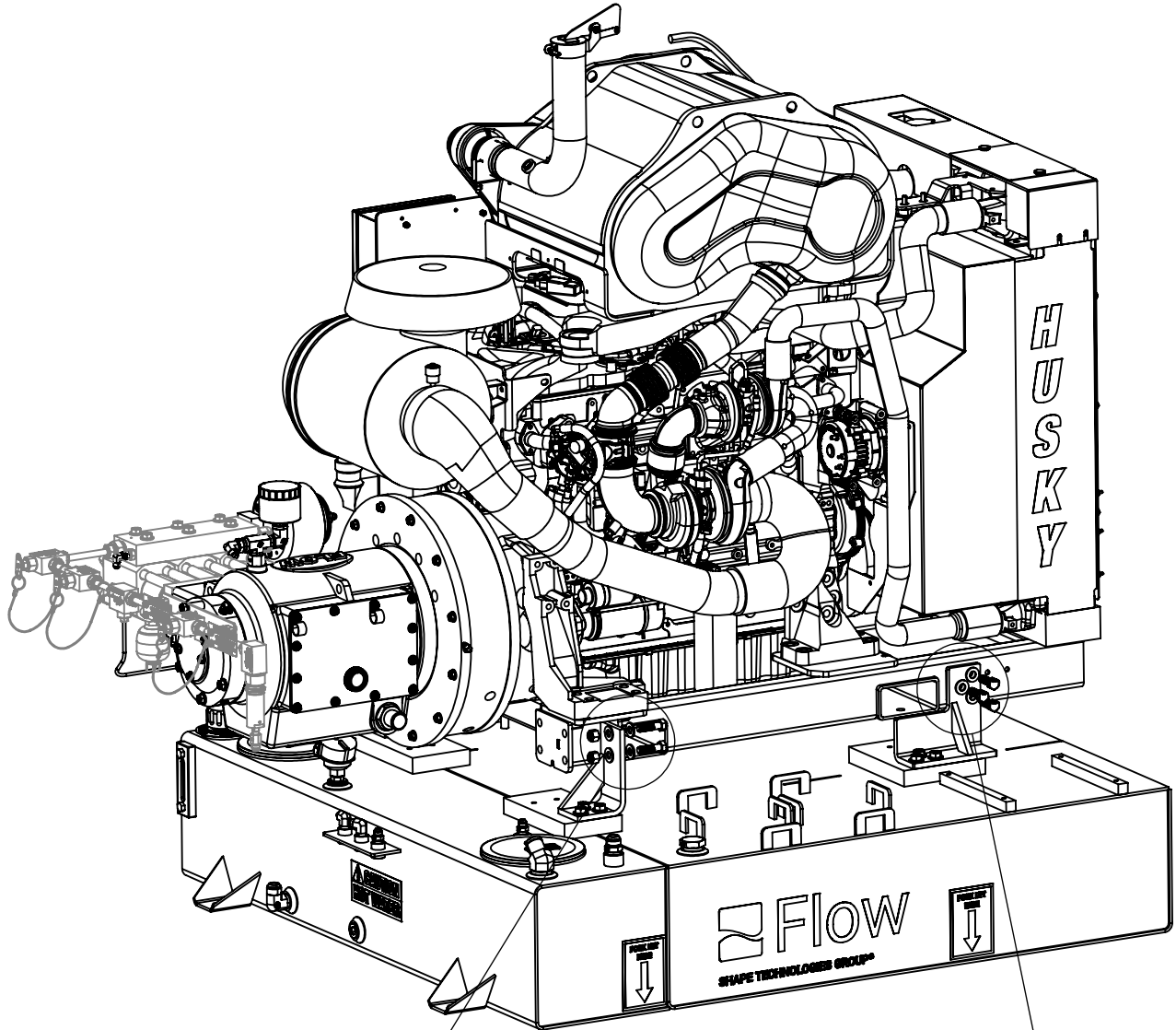
1. TORQUE TO 35 FT. LBS.
2. TORQUE TO 200 FT. LBS.



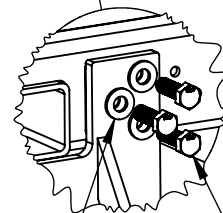
DETAIL K
SCALE 1 : 8



DETAIL L
SCALE 1 : 8



DETAIL M
SCALE 1 : 8



DETAIL N
SCALE 1 : 8

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/5/2020	K. SMITH
	1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH

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UNLESS OTHERWISE SPECIFIED,
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DIM'S IN [mm] ARE REFERENCE ONLY
BREAK SHARP EDGES & DEBURR .015

TOLERANCES (EXCEPT AS NOTED)	
SURFACE FINISH	63/
MACHINE FILLETS	R.02
ANGLE	±1°

DIM TOLERANCES: (in)	
.X	= ± .063
.XX	= ± .015
.XXX	= ± .005
.XXXX	= ± .0005

TITLE:		TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE	
		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375	
THIRD ANGLE PROJECTION			
DWG BY		K. SMITH	
APRVD BY		B. PARKER	
		DWG. NO. 32-700-501	
		REV. 01	
		MATL.	
		SHT 5 OF 10	

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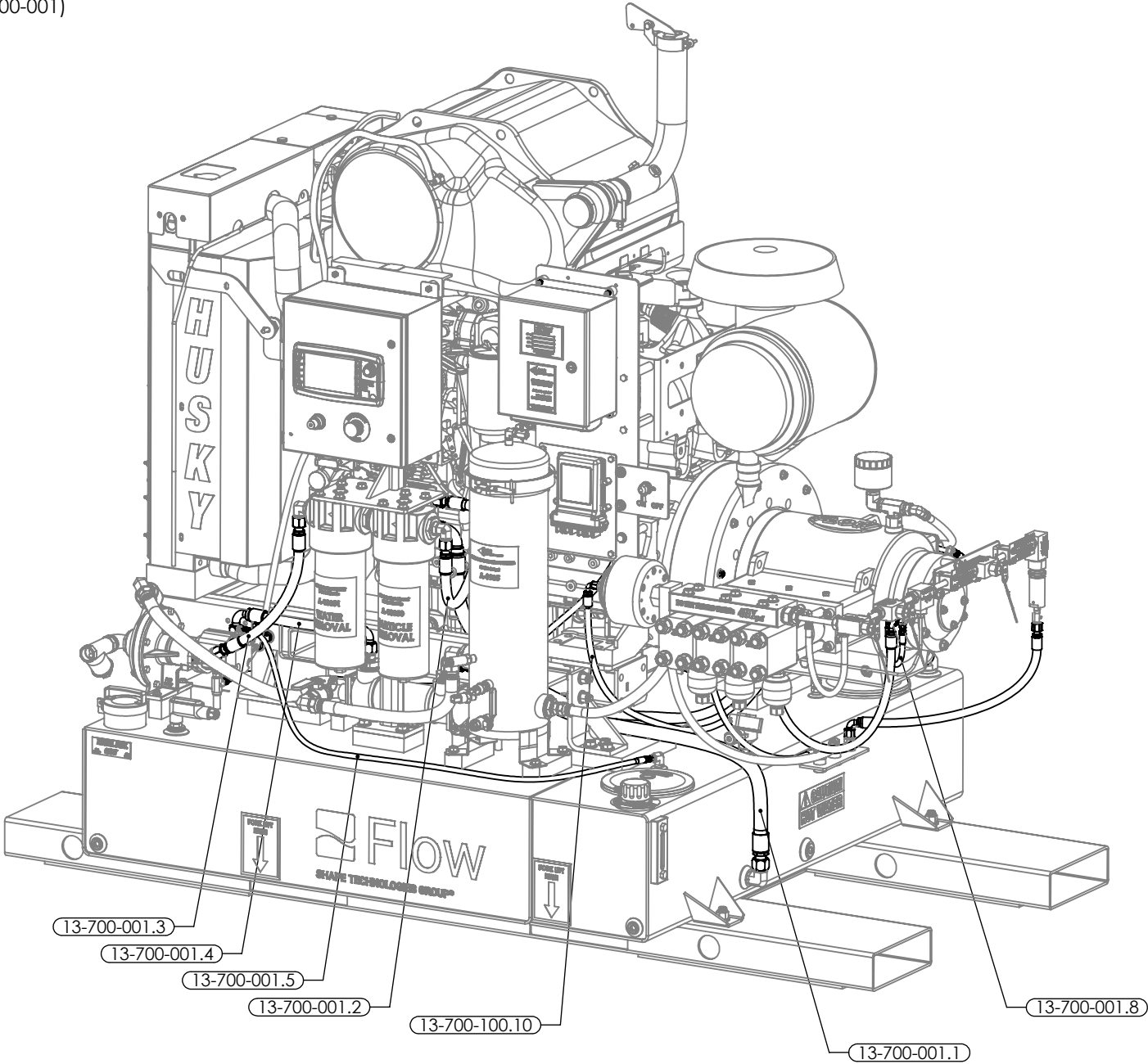
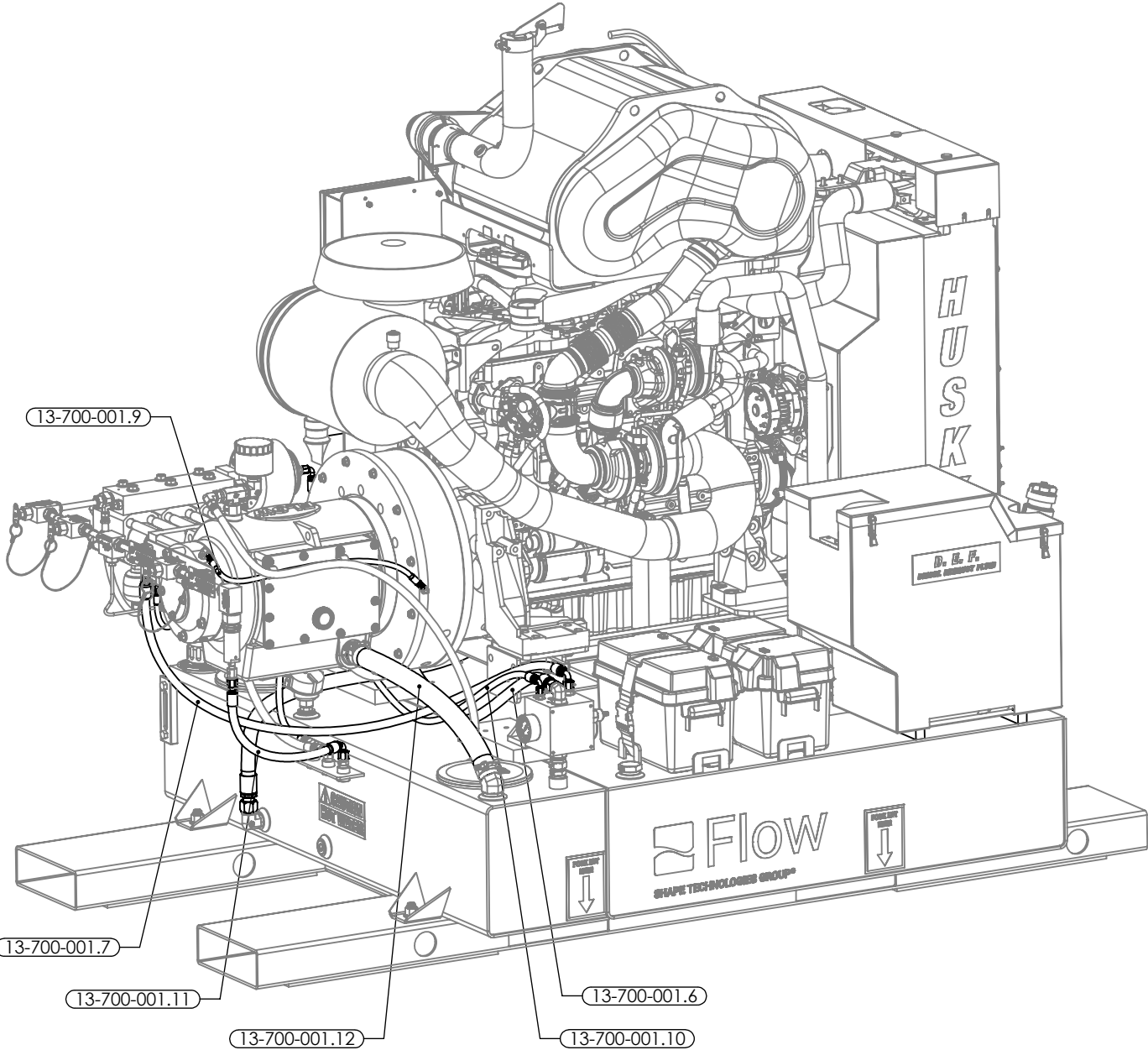
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HYDRAULIC HOSE PLAN
(PART NO. 13-700-001)



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/5/2020	K. SMITH
	1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH

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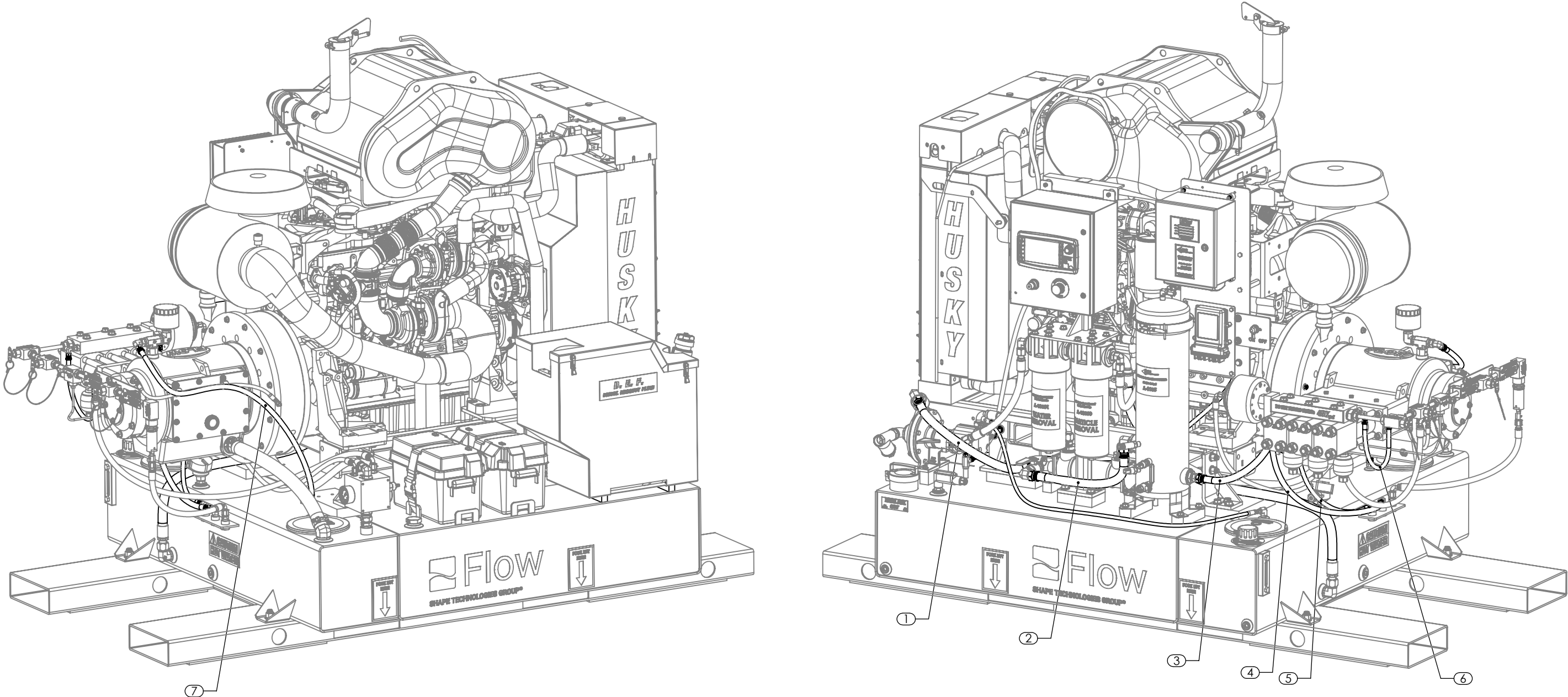
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DIMS IN [mm] ARE REFERENCE ONLY
BREAK SHARP EDGES & DEBURR .015

TOLERANCES (EXCEPT AS NOTED)		
SURFACE FINISH	63/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = ± .063
ANGLE	±1°	.XX = ± .015
		.XXX = ± .005
		.XXXX = ± .0005

TITLE:		TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE	
		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375	
THIRD ANGLE PROJECTION		APS SHAPE TECHNOLOGIES GROUP®	
DWG BY		K. SMITH	
APRVD BY		B. PARKER	
DWG. NO.		32-700-501	
MATL.		REV. 01	
		SHT 8 OF 10	

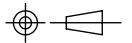

8 7 6 5 4 3 2 1

PUSH-LOK HOSE PLAN



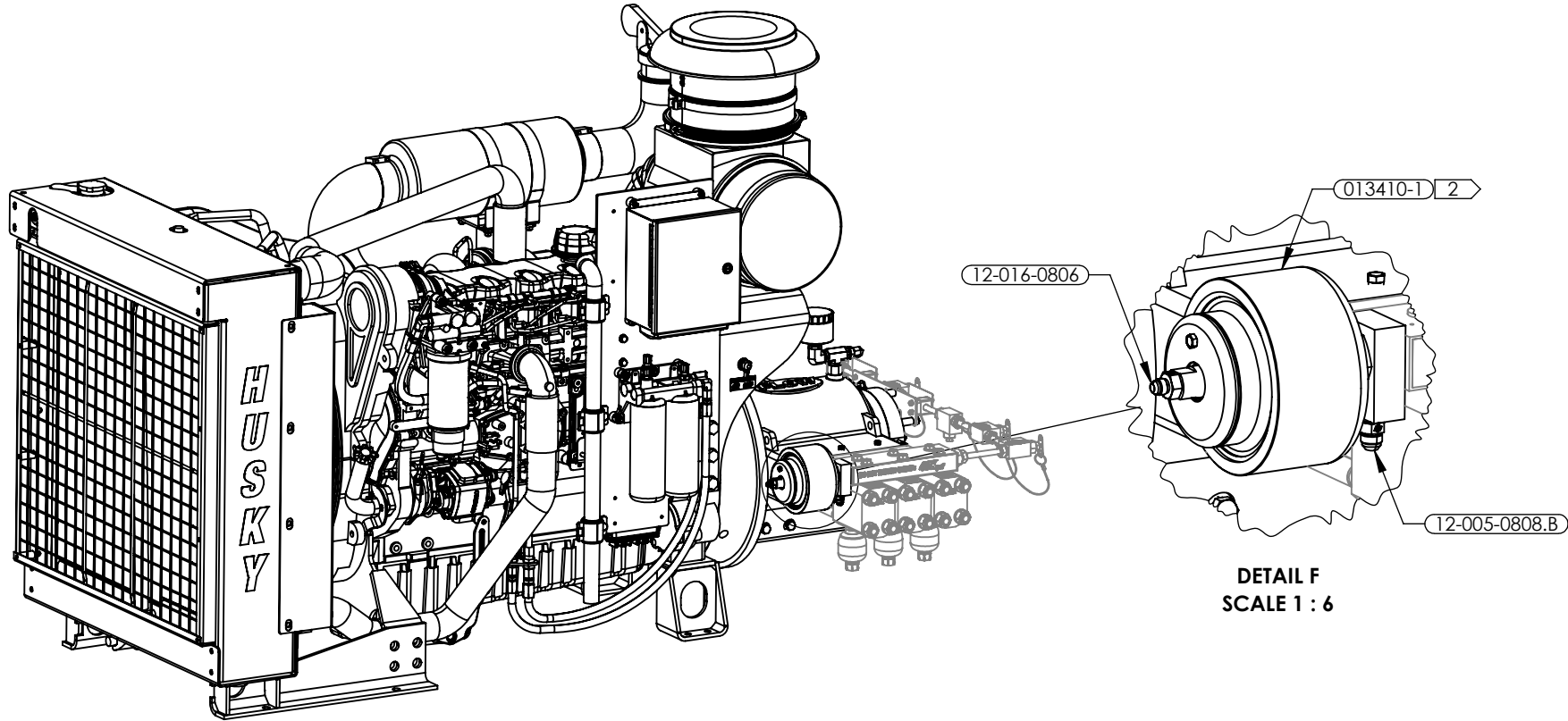
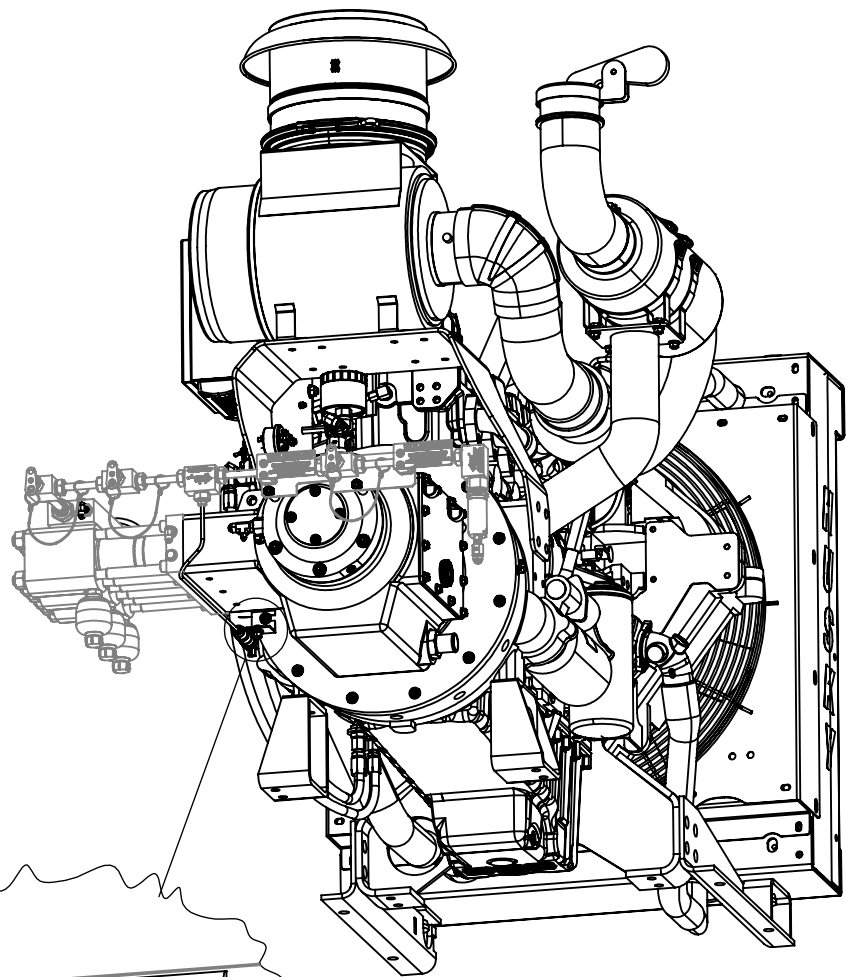
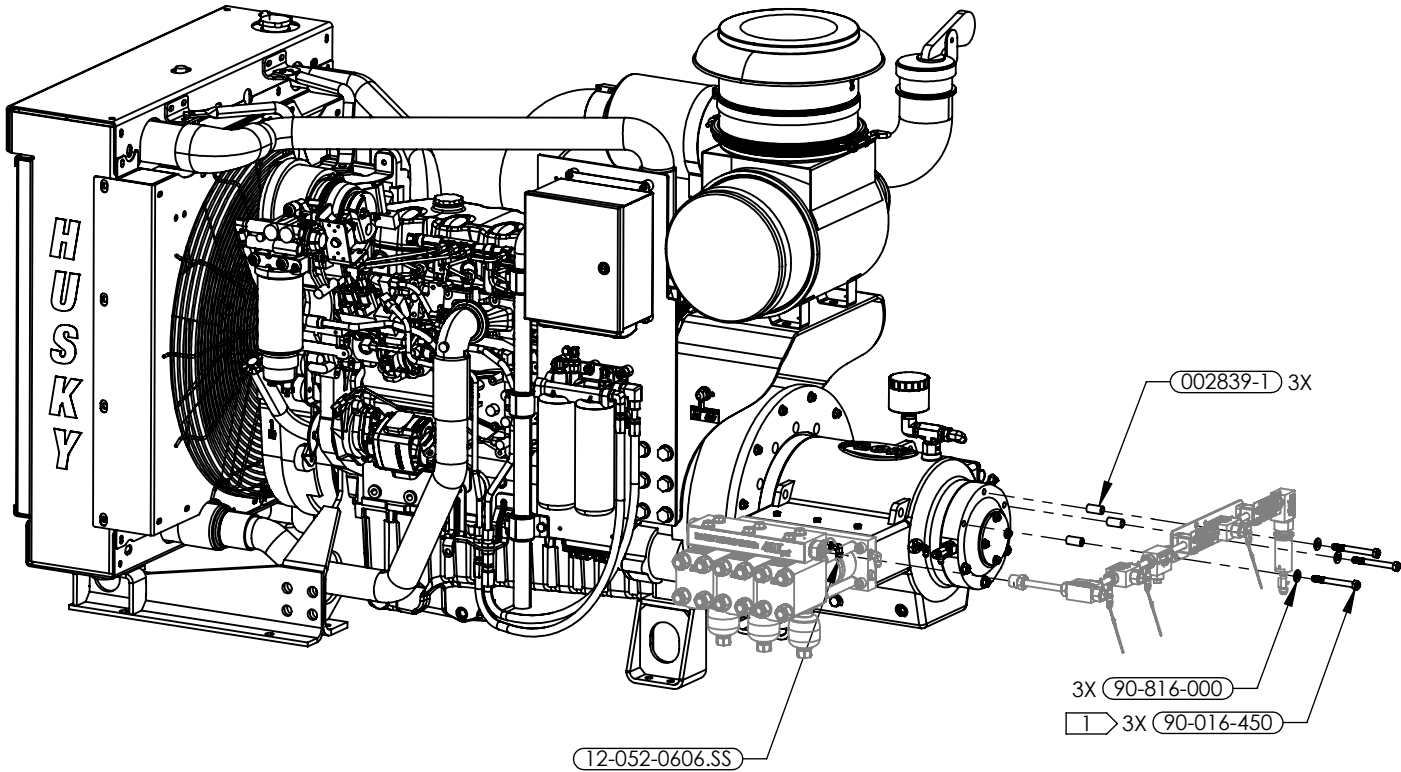
REF. NO.	HOSE SIZE	FITTING 1	LOCATION FROM	FITTING 2	LOCATION TO	EST. OAL	COLOR
[1]	-16	12-027-1616.B	CHARGE PUMP OUTLET	12-027-1616.B	HEAT EXCHANGER INLET	24 IN.	BLUE
[2]	-16	12-027-1616.B	HEAT EXCHANGER INLET	12-027-1616.B	WATER FILTER INLET	18 IN.	BLUE
[3]	-12	12-027-1212.B	WATER FILTER OUTLET	12-027-1212.B	FLUID END INLET	20 IN.	BLUE
[4]	-8	12-027-0808.B	ECV ADAPTER BLOCK	12-027-0808.B	BULKHEAD	26 IN.	BLUE
[5]	-6	12-027-0606.B	SUBPLATE OUTLET	12-027-0606.B	BULKHEAD	36 IN.	BLUE
[6]	-6	12-027-0606.B	MANIFOLD OUTLET (LP)	12-027-0606.B	SUBPLATE INLET	15 IN.	BLUE
[7]	-8	12-027-0808.B	CRANK CASE VENT	12-027-0808.B	HYDRAULIC TANK	42 IN.	BLACK

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/5/2020	K. SMITH
	1	CHNG BELL HSG BLTS, FUEL CONN, VIB DAMP, GR PMP/FTGS	7/9/2021	K. SMITH

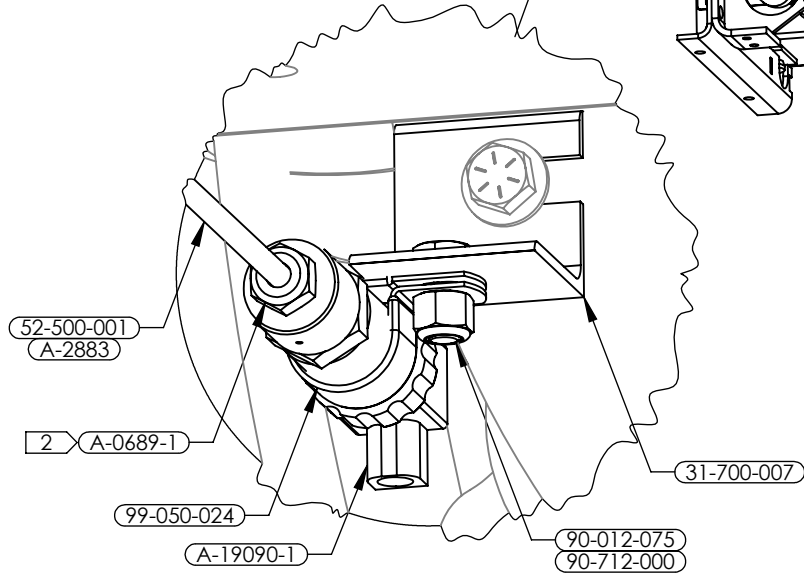
THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES INTERPRET PER ANSI Y14.5-2009 DIMS IN [mm] ARE REFERENCE ONLY BREAK SHARP EDGES & DEBURR .015		TITLE: TRPLX UNIT-HUSKY, C7.1 TIER 4, NO FE	
	TOLERANCES (EXCEPT AS NOTED)		THIRD ANGLE PROJECTION 	
	SURFACE FINISH 63/ MACHINE FILLETS R.02 ANGLE ±1°	DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005	DWG BY K. SMITH APRVD BY B. PARKER	DWG. NO. 32-700-501 MATL. SHT 9 OF 10
	APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES		 APS SHAPE TECHNOLOGIES GROUP®	

		8		7		6		5		4		3		2		1									
ITEM NO.		QTY.	PART NO.		DESCRIPTION		ITEM NO.		QTY.	PART NO.		DESCRIPTION													
1		1	31-700-001		WELDMENT, TANK, HUSKY, HYDRAULIC/DIESEL		51		8	90-016-175		BOLT, HEX, 1/2"-13 X 1-3/4"		97		1	13-700-001		HOSE ASSEMBLIES, HYDRAULIC, CRIMP, HUSKY						
2		1	12-316-1000		NIPPLE, 1" NPT, 10" LG, STEEL		52		3	90-016-450		BOLT, HEX, 1/2"-13 X 4-1/2"		98		1	A-10248		OIL, HYD, MORLINA 100, 55 GAL						
3		1	31-700-034		WLDMNT, FORK PKCT, HUSKY		53		8	90-017-125		BOLT, HEX, 1/2"-20 X 1-1/4"		99		1	11-005-001		CABLE, BATTERY, BLK, 2/0, 3/8 RNG, 30" LG						
4		1	200680-02		GAUGE, LIQUID LEVEL, ALUMINUM, 5 INCH		54		6	90-020-175		BOLT, HEX, 5/8"-11 X 1-3/4"		100		1	11-005-002		CABLE, BATTERY, RED, 2/0, 3/8 RNG, 30" LG						
5		2	202281-01		COVER, ACCESS, TOP FRONT, TANK, HISKY, 1.625 INCH		55		4	90-022-200		BOLT, HEX, 3/4"-10 X 2"		101		1	11-005-011		CABLE, BATTERY, BLK, 2/0, 3/8 RNG, 72" LG						
6		1	202882-01		BREATHER, VENT, NON-SPLASH, 1/4" NPT		56		6	90-506-050.SS		BUTTON PHILIPS, #10-24 X 1/2" SS		102		1	11-005-016		CABLE, BATTERY, RED, 2/0, 3/8 X 1/2 RNG, 36" LG						
7		1	A-7564		BREATHER, PRESSURIZED, 40 MICRON		57		8	90-708-000		NUT, NY-LOCK, 1/4"-20		103		51 IN.	13-006-2000.BLU		HOSE, PUSH-LOK, -6, BLUE, 250 PSI, PRK 801						
8		1	33-950-008		ENGINE, CAT, C9.3, TIER 3, 335 HP, BASE		58		8	90-710-000		NUT, NY-LOCK, 5/16"-18		104		85 IN.	13-006-2000.YLW		HOSE, FUEL, PUSH-LOK, -6, YLW, 300 PSI, PRK 7212						
9		1	006122-5		ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1		59		1	90-712-000		NUT, NY-LOCK, 3/8"-16		105		26 IN.	13-008-2000.BLU		HOSE, PUSH-LOK, -8, BLUE, 250 PSI, PRK 801						
11		1	013410-1		VALVE ASSEMBLY, EXTERNAL CONTROL, HUSKY, 55KSI		60		4	90-722-000		NUT, NY-LOCK, 3/4"-10		106		42 IN.	13-008-2000.BLK		HOSE, PUSH-LOK, -8, BLACK, 250 PSI, PRK 801						
12		1	33-001-003		ASSEMBLY, HYDRAULIC FILTER, HUSKY		61		4	90-810-000		FLAT WASHER, 5/16"		107		70 IN.	13-012-2000.BLU		HOSE, PUSH-LOK, -12, BLUE, 250 PSI, PRK 801						
13		1	33-001-004		ASSEMBLY, HEAT EXCHANGER, HUSKY		62		2	90-812-000		FLAT WASHER, 3/8"		108		75 IN.	13-016-2000.BLU		HOSE, PUSH-LOK, -16, BLUE, 175 PSI, PRK 801						
14		1	33-001-005		ASSEMBLY, WATER FILTER, HUSKY		63		31	90-816-000		FLAT WASHER, 1/2"		109		1	A-8971		SWITCH, SELECTOR, KNOB, 2 POSN, PNL MT						
15		1	33-001-008		ASSEMBLY, CONTROL/RELIEF VALVE MANIFOLD, HUSKY		64		6	90-820-000		FLAT WASHER, 5/8"		110		1	33-995-037		LABEL, PLATE, DISCONNECT, BATTERY, ON-OFF						
16		1	33-001-019		ASSEMBLY, CHARGE PUMP, HUSKY		65		8	90-822-000		FLAT WASHER, 3/4"		111		1	11-005-005		CABLE, BATTERY, BLK, 2/0, 3/8 X 1/2 RNG, 48" LG						
17		1	33-001-020		ASSEMBLY, IO PANEL ENCLOSURE, HUSKY		66		1	99-049-001		GASKET, FLAT, SAE-A 2-BOLT, N8090, 1/64"		112		1	A-19325		ADAPTER, COUPLING, SAE 14						
18		1	33-001-086		PMP-EXT GR, 44CC, SAE-A, 11TH, CCW, BP		67		2	99-050-005		STRAP, CINCH, SQZ BCKL, 2" WD, 8FT LG, NYLON													
20		1	33-995-001		LABEL, PLATE, WARNING, OIL ONLY		68		1	99-050-024		CLAMP, LOOP, 1" ID, VIBR DAMP													
21		4	33-995-002		LABEL, STICKER, FORK LIFT HERE		69		4	99-050-025		STUD, VIBRATION DAMPING, 50 DUR, 5/16"-18 X 5/8"													
22		1	33-995-003		LABEL, PLATE, SERVICE/SUPPORT		70		4	99-050-026		STUD, VIBRATION DAMPING, 50 DUR, 1/4-20 X 3/4"													
23		1	33-995-004		LABEL, PLATE, MODEL/SERIAL		71		2	12-005-0808		FITTING, STRT, MNPT-MJIC, 08-08													
24		2	33-995-005		LABEL, STICKER, FLOW LOGO, TANK		72		1	12-005-0808.B		FITTING, STRT, MNPT-MJIC, 08-08.B													
25		1	33-995-007		LABEL, STICKER, DIESEL FUEL ONLY, 180 GAL		73		1	12-005-1616		FITTING, STRT, MNPT-MJIC, 16-16													
26		1	33-995-008		LABEL, STICKER, APS WEBSITE / PHONE NUM		74		2	12-011-0606		FITTING, STRT, FNPT-MJIC, 06-06													
27		2	33-995-009		DECAL, VINYL, HUSKY NAME, VERTICAL, RADIATOR		75		2	12-016-0806		FITTING, STRT, MSAE-MJIC, 08-06													
28		1	33-995-010		DECAL, VINYL, WATER FILTER TAG		76		1	12-016-1212		FITTING, STRT, MSAE-MJIC, 12-12													
29		1	33-995-012		DECAL, VINYL, CAUTION HOT WATER		77		5	12-027-0606.B		FITTING, STRT, FJIC-HOSE, 06-06.B													
30		1	33-995-013		DECAL, VINYL, FILTER, WATER SEPERATOR		78		4	12-027-0808.B		FITTING, STRT, FJIC-HOSE, 08-08.B													
31		1	33-995-014		DECAL, VINYL, FILTER, PARTICULATE REMOVAL		79		2	12-027-1212.B		FITTING, STRT, FJIC-HOSE, 12-12.B													
34		1	31-700-006		WELDMENT, BRACKET, HUSKY, FILTER/E-BOX		80		4	12-027-1616.B		FITTING, STRT, FJIC-HOSE, 16-16.B													
35		1	31-700-007		WELDMENT, BRACKET, HUSKY, HP TANSDUCER		81		1	12-033-0804		FITTING, 90, MNPT-MJIC, 08-04													
36		3	002839-1		SPACER, CYLINDER, MOUNTING PLATE, HUSKY, SS, 1.5"		82		1	12-033-0806.B		FITTING, 90, MNPT-MJIC, 08-06													
37		2	10-410-035		BOLT, HEX, M10X1.5MM X 35MM, 10.9 ALLOY		83		1	12-033-0808.B		FITTING, 90, MNPT-MJIC, 08-08.B													
38		2	10-950-201		HOSE CLAMP, T-BOLT, STAINLESS, 2-1/8" OD		84		1	12-033-1616		FITTING, 90, MNPT-MJIC, 16-16													
39		1	12-016-1006		FITTING, STRT, MSAE-MJIC, 10-06		85		1	12-016-2016		FITTING, STRT, MSAE-MJIC, 20-16													
40		1	11-001-005		ASSEMBLY, CONTROL PANEL, HUSKY		86		1	12-052-0404		FITTING, 90, MJIC-FJIC, 04-04													
41		1	11-001-006		CORD GRIP, ALUM.1/2" NPT,.13-.25" LIQ TIGHT		87		1	12-052-0606.SS		FITTING, 90, MJIC-FJIC, 06-06.SS													
42		1	11-001-007		CORD GRIP,ALUM, 3/4"NPT, LIQ TIGHT		88		3	12-055-0606		FITTING, 90, FJIC-HOSE, 06-06													
43		2	11-001-011		ENCLOSURE, BATTERY, 31M, (ALSO A-9407)		89		1	12-063-2424		FITTING, 45, MNPT-HOSE, 24-24													
44		2	11-001-016		BATTERY, 12V, 31M, 1000 CCA (A-9338)		90		2	12-250-1205		PLUG, MNPT, HOLLOW HEX, 12													
45		1	11-050-001		LB BOX, 90 DEG, 1/2" NPT, ZINC PLATED		91		1	12-250-1605		PLUG, MNPT, HOLLOW HEX, 16													
46		4	90-010-075		BOLT, HEX, 5/16"-18 X 3/4"		92		1	12-250-2400		PLUG, MNPT, 24													
47		1	90-012-075		BOLT, HEX, 3/8"-16 X 3/4"		93		1	52-500-001		TUBE, HIGH PRESSURE, 1/4 INCH, 60KSI, 27 IN LONG													
48		2	90-012-100		BOLT, HEX, 3/8"-16 X 1"		94		1	A-0689-1		GLAND/COLLAR, ANTI-VIBRATION, 60 KSI, 1/4 INCH													
49		4	90-016-100		BOLT, HEX, 1/2"-13 X 1"		95		1	A-19090-1		SENSOR, XDCR, 60 KSI, 0-10V													
50		8	90-016-125		BOLT, HEX, 1/2"-13 X 1-1/4"		96		27 IN.	A-2883		TUBING, FLEX. 9/32"													
														APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES				UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES INTERPRET PER ANSI Y14.5-2009 DIMS IN [mm] ARE REFERENCE ONLY BREAK SHARP EDGES & DEBURR .015				TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE			
														THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.				TOLERANCES (EXCEPT AS NOTED)				THIRD ANGLE PROJECTION			
														SURFACE FINISH 63/√				DIM TOLERANCES: (in)				DWG BY K. SMITH			
														MACHINE FILLETS R.02				.X = ± .063				DWG. NO. 32-700-401			
														ANGLE ±1°				.XX = ± .015				REV. 01			
																		.XXX = ± .005				MTRL.			
																		.XXXX = ± .0005				SHT 1 OF 10			

- NOTES:
- TORQUE TO 50 FT. LBS.
 - APPLY BLUE GOOP THREAD LUBRICANT TO THREADS

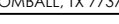


DETAIL F
SCALE 1 : 6

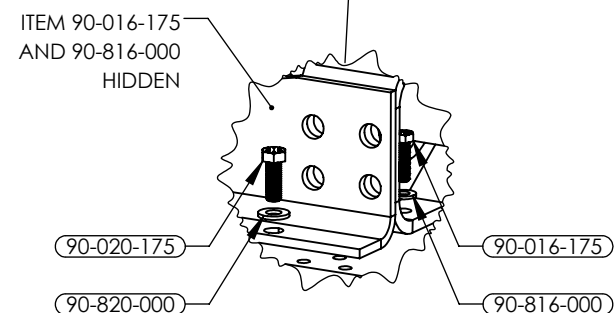


DETAIL G
SCALE 1 : 2

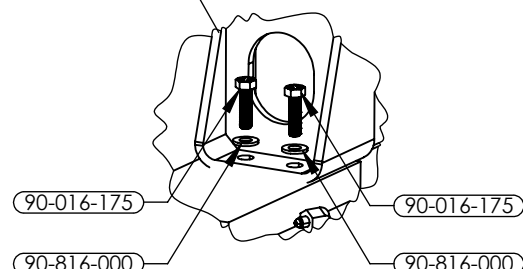
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH

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	TOLERANCES (EXCEPT AS NOTED)		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375						
			THIRD ANGLE PROJECTION 						
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	MACHINE FILLETS	R.02			APRVD BY	B. PARKER			
	ANGLE	±1°			MATL.		SHT 4 OF 10		

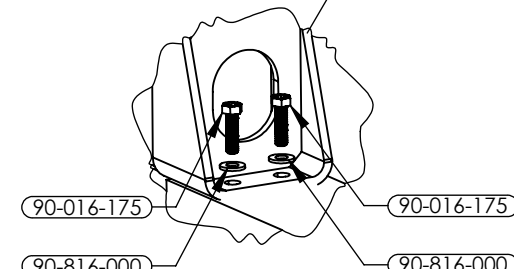
1. TORQUE ITEM 90-016-175 TO 50 FT. LBS.
2. TORQUE ITEM 90-020-175 TO 100 FT. LBS.
3. APPLY LOCTITE THREADLOCKER BLUE 242 TO ITEM 90-016-175 AND 90-020-175



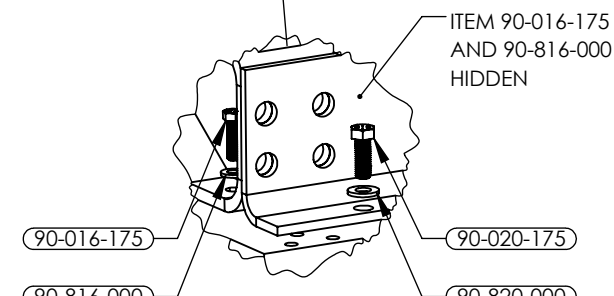
DETAIL H
SCALE 1 : 8



DETAIL J
SCALE 1 : 8



DETAIL K
SCALE 1 : 8



DETAIL L
SCALE 1 : 8

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH

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UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
INTERPRET PER ANSI Y14.5-2009
DIM'S IN [mm] ARE REFERENCE ONLY
BREAK SHARP EDGES & DEBURR .015

TOLERANCES (EXCEPT AS NOTED)		
SURFACE FINISH	63 $\sqrt{\text{ }}$	DIM TOLERANCES: (in) .X = \pm .063 .XX = \pm .015 .XXX = \pm .005 .XXXX = \pm .0005
MACHINE FILLETS	R.02	
ANGLE	$\pm 1^\circ$	

TITLE:	TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE
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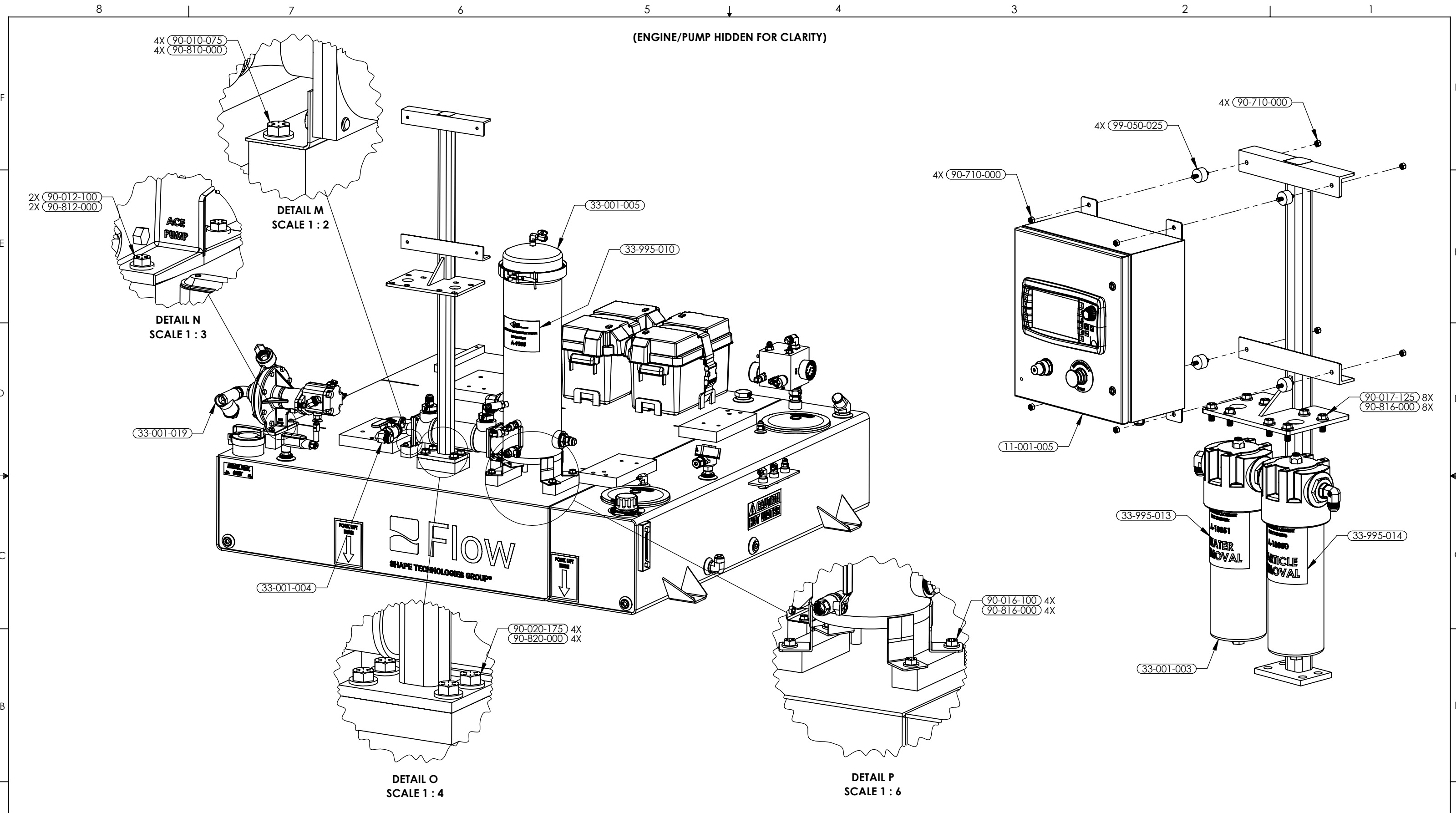
ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375

THIRD ANGLE PROJECTION	
DWG BY	K S

APRVD BY	B. PARKER
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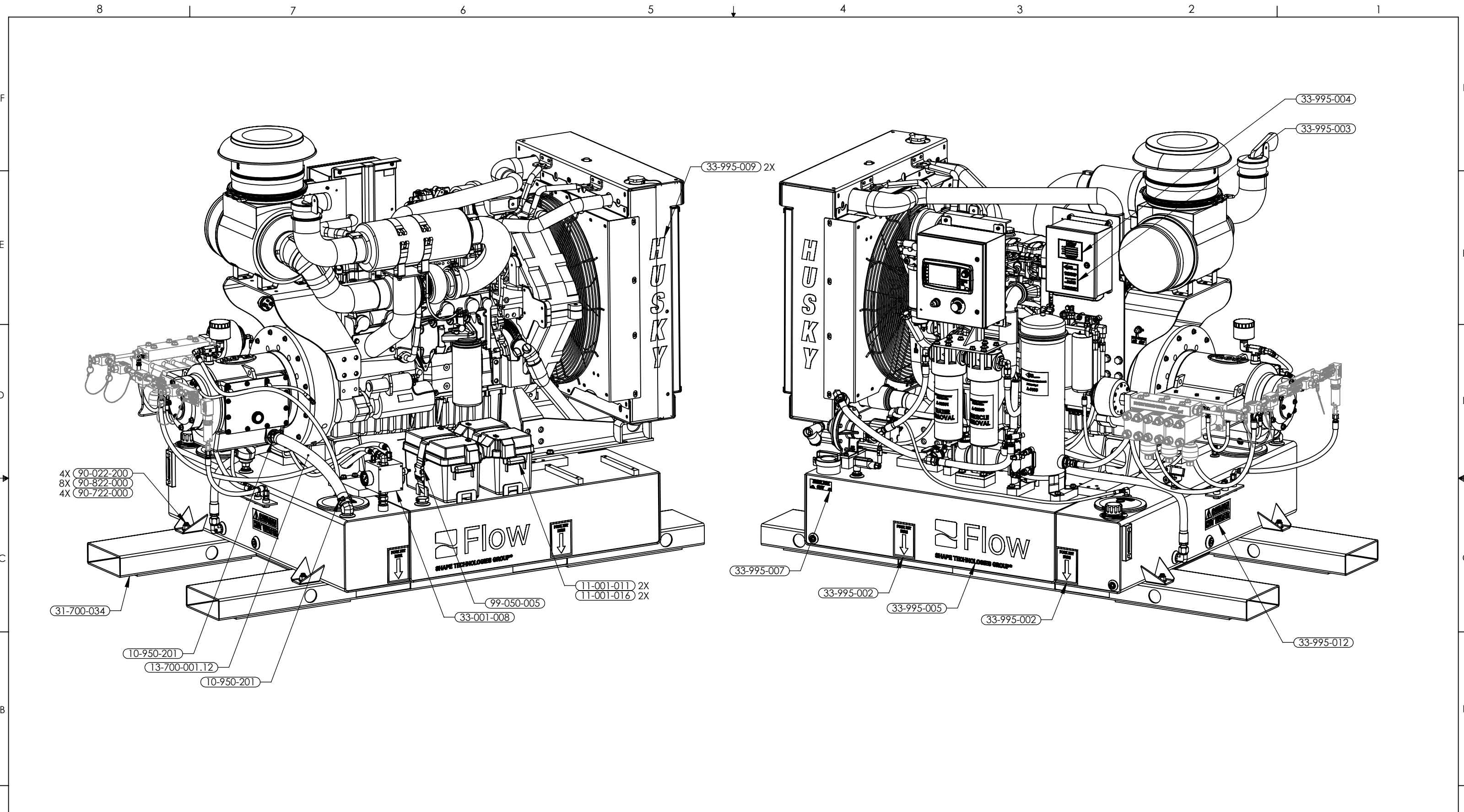


DWG. NO.	32-700-401	REV	01
MATL.	SHT 5 OF 1		



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					SURFACE FINISH 63/ MACHINE FILLETS R.02 ANGLE ±1°		DWG BY K. SMITH APRVD BY B. PARKER	
					DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005		DWG. NO. 32-700-401 MATL.	
							REV. 01 SHT 6 OF 10	

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH



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THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.					TOLERANCES (EXCEPT AS NOTED)		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		
					SURFACE FINISH 63/ MACHINE FILLETS R.02 ANGLE ±1°		THIRD ANGLE PROJECTION		
					DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005		APRVD BY B. PARKER		
							DWG. NO. 32-700-401		
							REV. 01		
							SHT 7 OF 10		

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH

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F

E

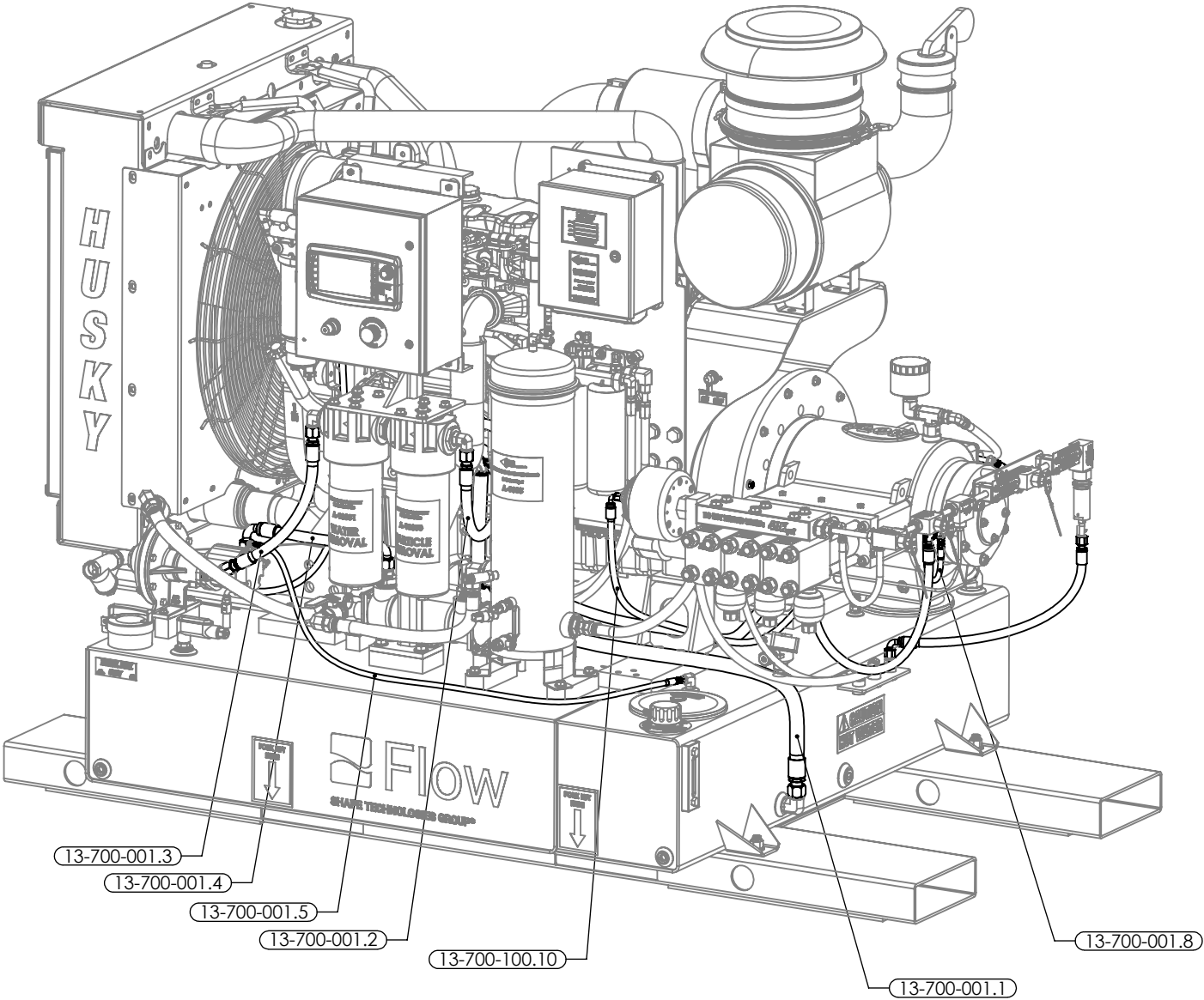
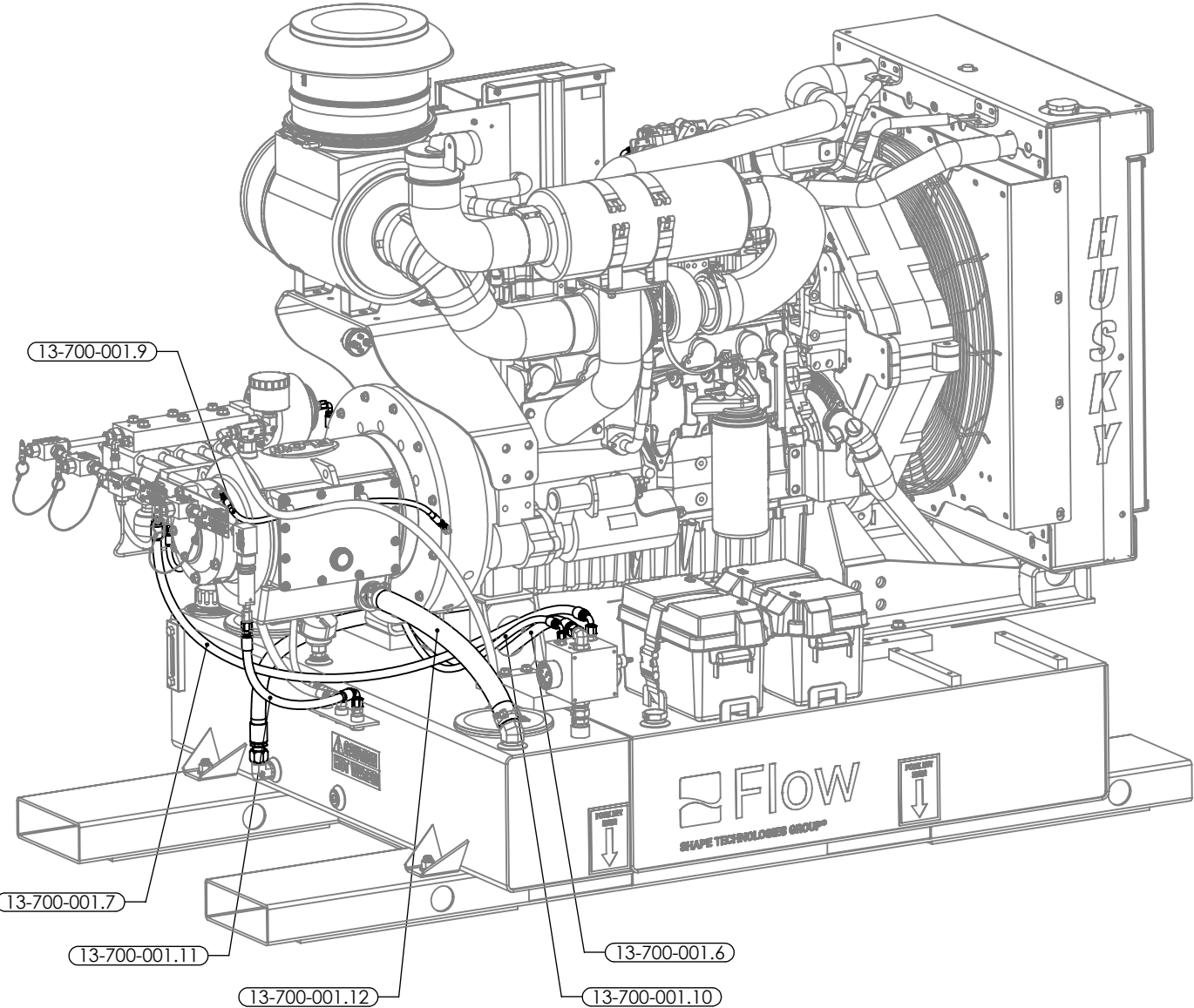
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C

B

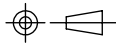
A

HYDRAULIC HOSE PLAN
(PART NO. 13-700-001)



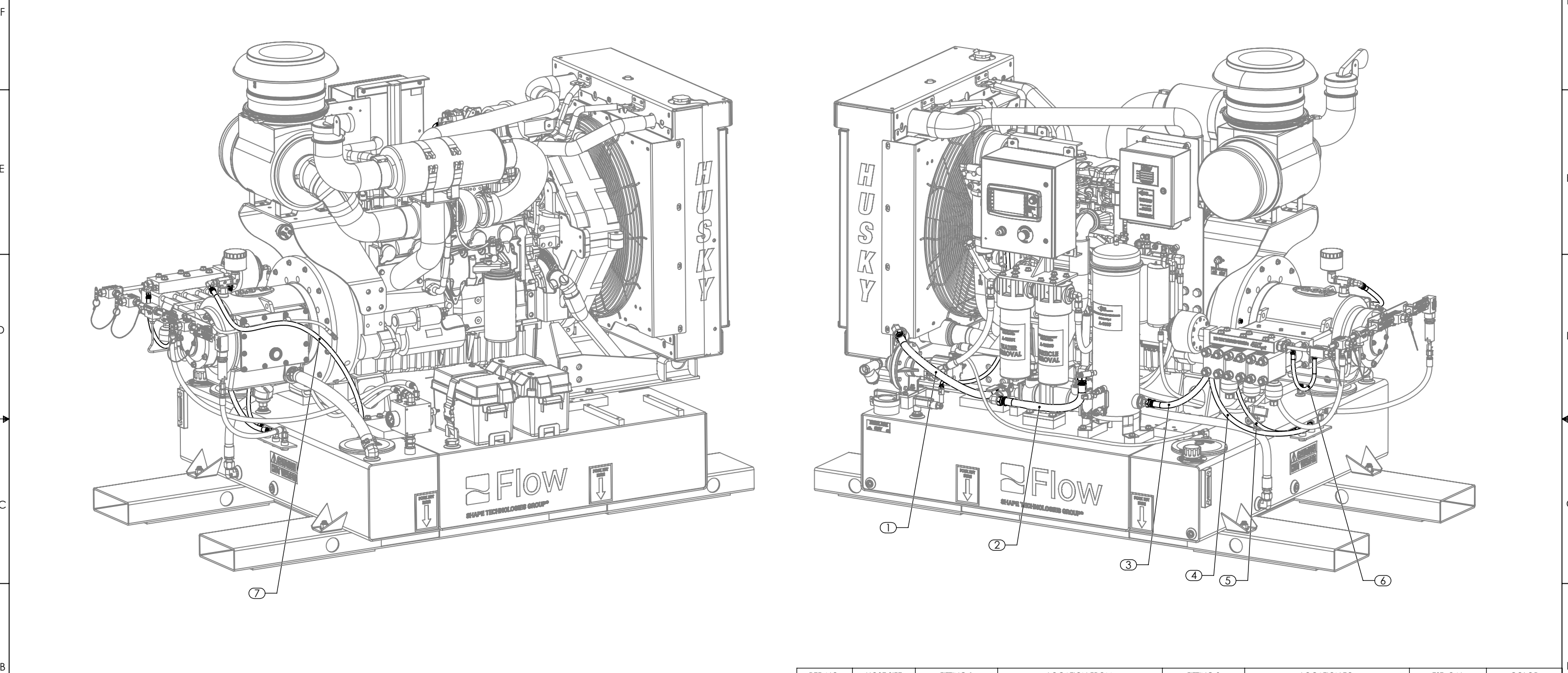
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REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH

APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES	UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES INTERPRET PER ANSI Y14.5-2009 DIM'S IN [mm] ARE REFERENCE ONLY BREAK SHARP EDGES & DEBURR .015		TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE	
	TOLERANCES (EXCEPT AS NOTED)		THIRD ANGLE PROJECTION 	
	SURFACE FINISH 63/ MACHINE FILLETS R.02 ANGLE ±1°	DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005	DWG BY K. SMITH APRVD BY B. PARKER	DWG. NO. 32-700-401 REV. 01
	THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.		MATL. SHT 8 OF 10	

8 7 6 5 4 3 2 1

PUSH-LOK HOSE PLAN



REF. NO.	HOSE SIZE	FITTING 1	LOCATION FROM	FITTING 2	LOCATION TO	EST. OAL	COLOR
[1]	-16	12-027-1616.B	CHARGE PUMP OUTLET	12-027-1616.B	HEAT EXCHANGER INLET	24 IN.	BLUE
[2]	-16	12-027-1616.B	HEAT EXCHANGER INLET	12-027-1616.B	WATER FILTER INLET	18 IN.	BLUE
[3]	-12	12-027-1212.B	WATER FILTER OUTLET	12-027-1212.B	FLUID END INLET	20 IN.	BLUE
[4]	-8	12-027-0808.B	ECV ADAPTER BLOCK	12-027-0808.B	BULKHEAD	26 IN.	BLUE
[5]	-6	12-027-0606.B	SUBPLATE OUTLET	12-027-0606.B	BULKHEAD	36 IN.	BLUE
[6]	-6	12-027-0606.B	MANIFOLD OUTLET (LP)	12-027-0606.B	SUBPLATE INLET	15 IN.	BLUE
[7]	-8	12-027-0808.B	CRANK CASE VENT	12-027-0808.B	HYDRAULIC TANK	42 IN.	BLACK

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TOLERANCES (EXCEPT AS NOTED)

SURFACE FINISH	63/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	
ANGLE	±1°	

.X	= ± .063
.XX	= ± .015
.XXX	= ± .005
.XXXX	= ± .0005


TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE

ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375

THIRD ANGLE PROJECTION

DWG BY K. SMITH

APRVD BY B. PARKER

 **APS**
SHAPE TECHNOLOGIES GROUP®

DWG. NO. 32-700-401

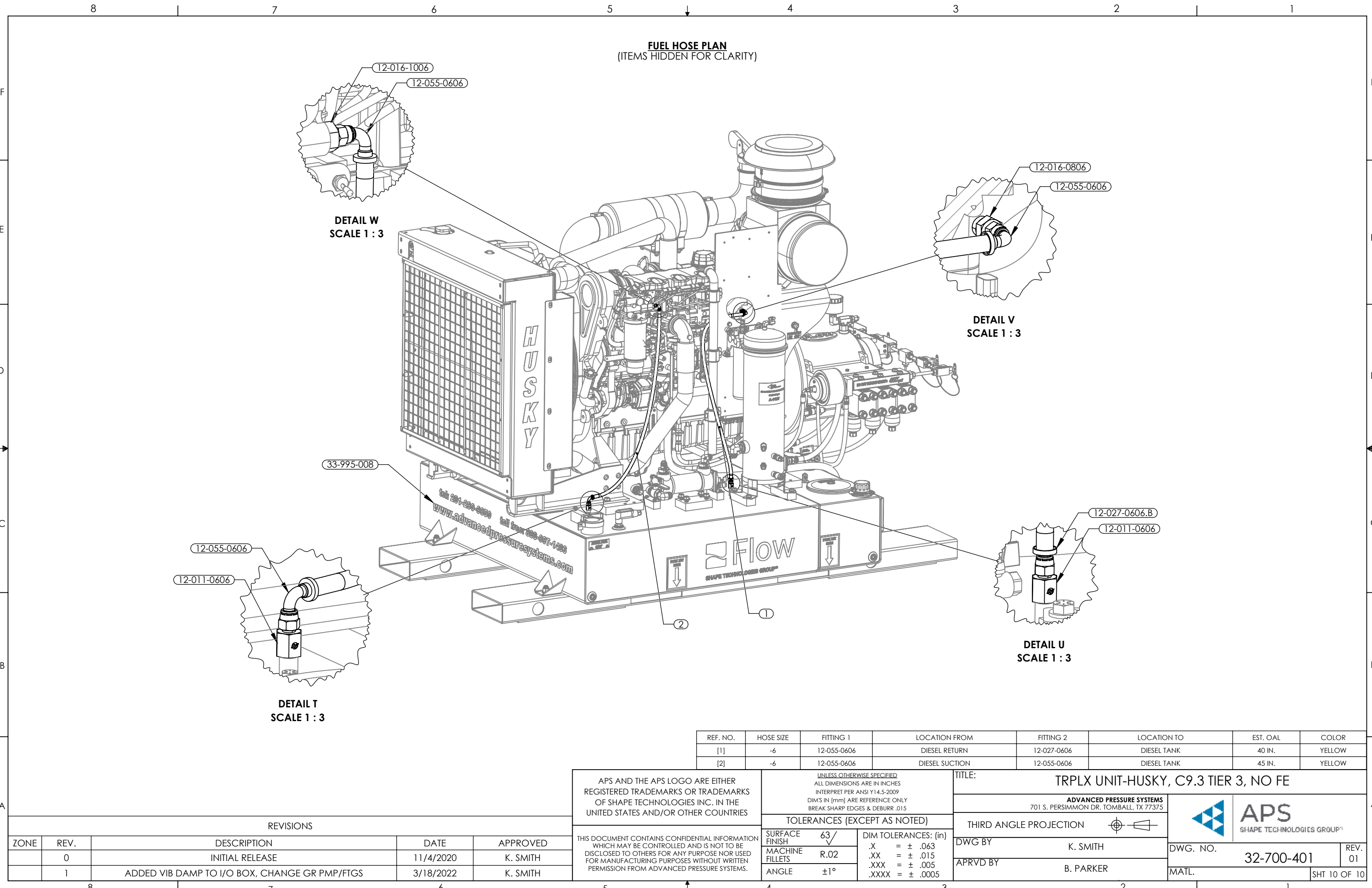
REV. 01

MATL.

SHT 9 OF 10

REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	11/4/2020	K. SMITH
	1	ADDED VIB DAMP TO I/O BOX, CHANGE GR PMP/FTGS	3/18/2022	K. SMITH



FUEL HOSE PLAN
(ITEMS HIDDEN FOR CLARITY)

DETAIL W
SCALE 1 : 3

DETAIL V
SCALE 1 : 3

DETAIL T
SCALE 1 : 3

DETAIL U
SCALE 1 : 3

REF. NO.	HOSE SIZE	FITTING 1	LOCATION FROM	FITTING 2	LOCATION TO	EST. OAL	COLOR
[1]	-6	12-055-0606	DIESEL RETURN	12-027-0606	DIESEL TANK	40 IN.	YELLOW
[2]	-6	12-055-0606	DIESEL SUCTION	12-055-0606	DIESEL TANK	45 IN.	YELLOW

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
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BREAK SHARP EDGES & DEBURR .015

TOLERANCES (EXCEPT AS NOTED)		DIM TOLERANCES: (in)
SURFACE FINISH	63/	
MACHINE FILLETS	R.02	
ANGLE	±1°	
		.X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005

TITLE: TRPLX UNIT-HUSKY, C9.3 TIER 3, NO FE

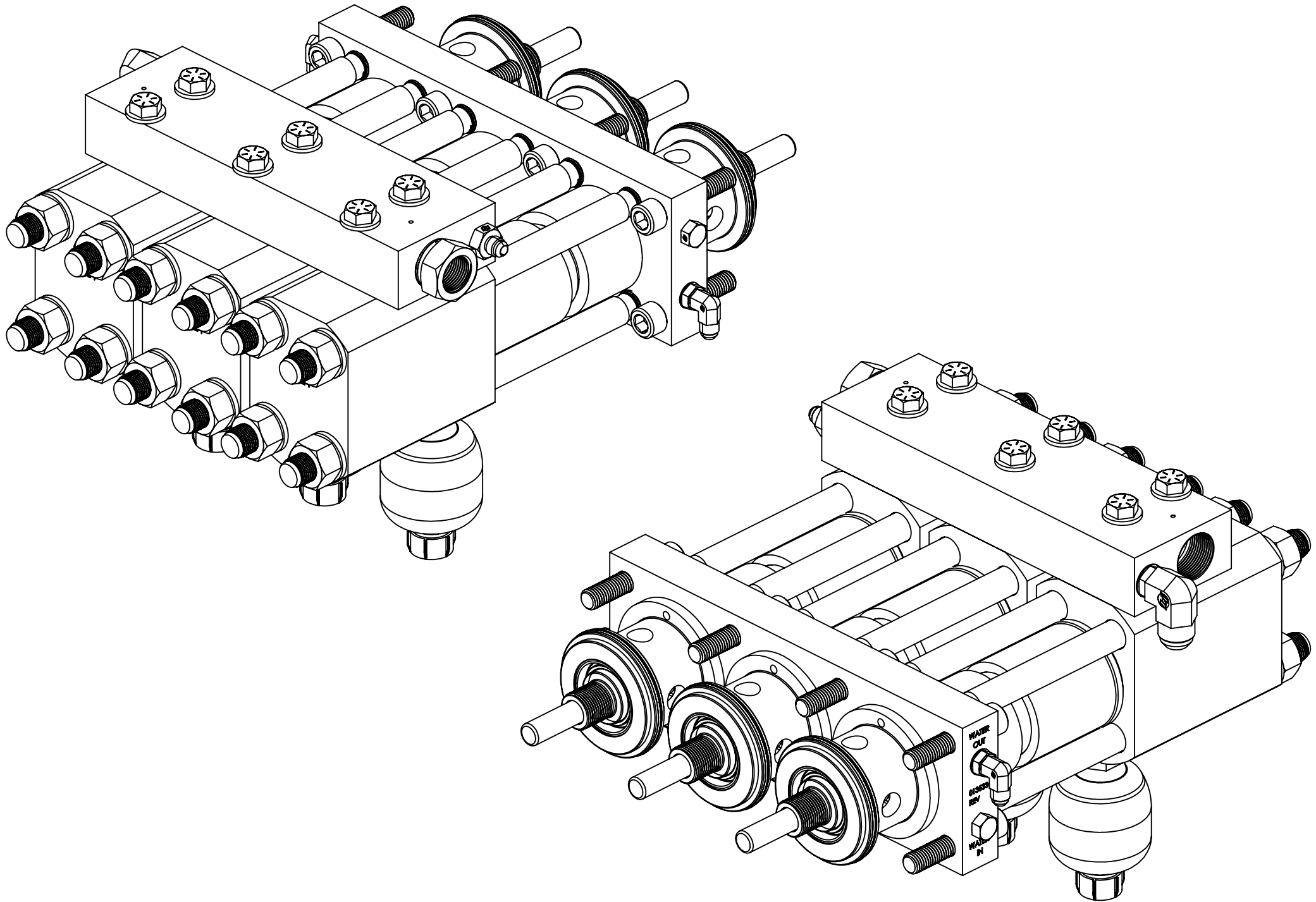
ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375

THIRD ANGLE PROJECTION

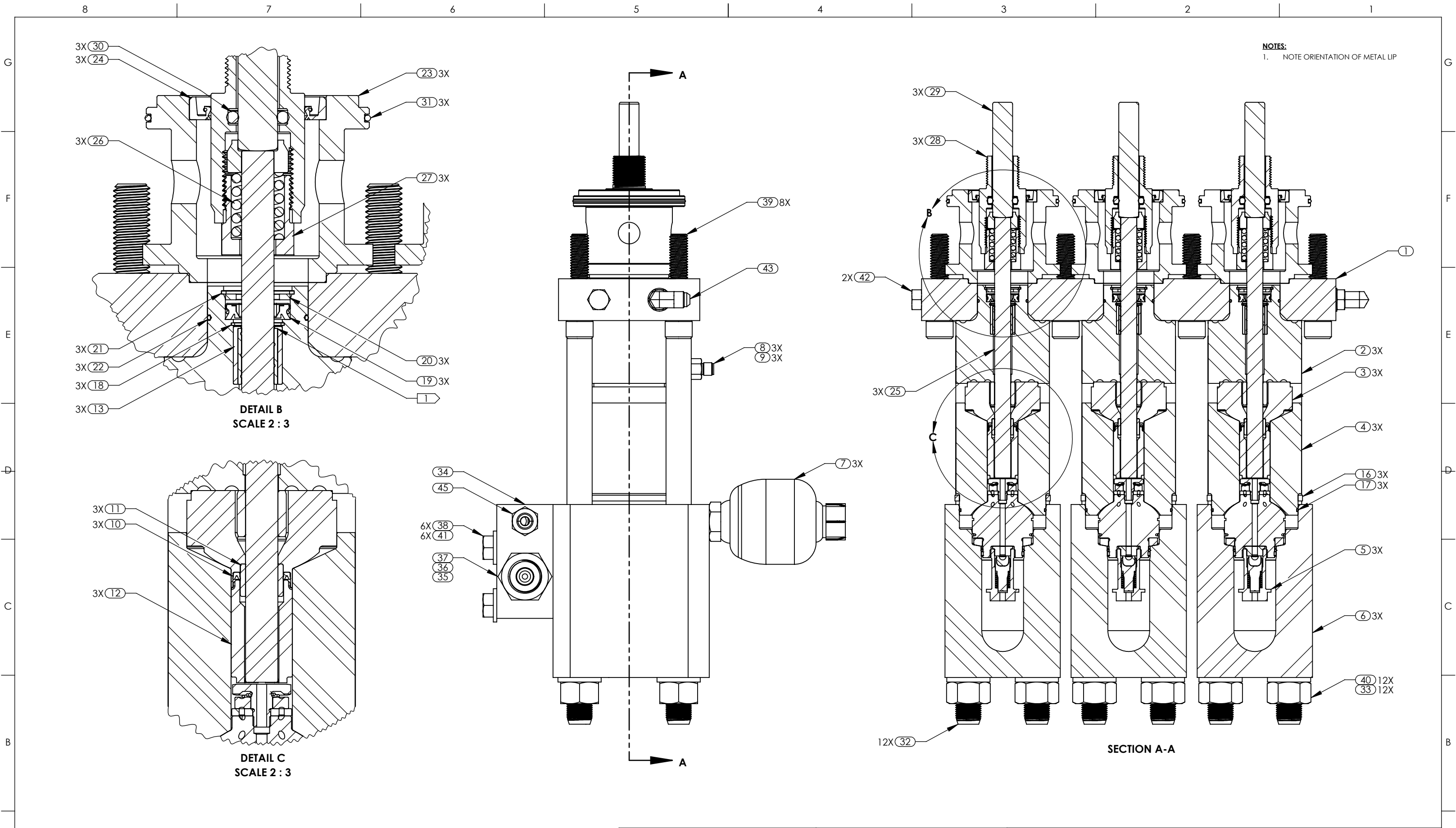
DWG BY	K. SMITH	DWG. NO. 32-700-401	REV. 01
APRVD BY	B. PARKER		

MATL. SHT 10 OF 10


8			7
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	013533-1	SUBPL-55KSI HUSKY
2	3	013525-1	ADPTR-SUBPLATE, 55KSI
3	3	013517-1	SEAL CARR-55KSI HUSKY
4	3	013387-1	CYL-HP, HUSKY, 55KSI
5	3	016863-1	VLV ASSY-CHK, 55KSI
6	3	016862-1	END CAP ASSY-55KSI
7	3	A-12749	ACCUMULATOR, BLADDER, 2600 PSI, 10 CU IN
8	3	A-13262	SENSOR, THERMISTOR, 10K OHM
9	3	A-0274-1	O-RING, BUNA-N, 90 (SHORE A)
10	3	A-10654	SEAL, U-CUP, PUR, 3/4 ID, 1 OD, 1/8 IN
11	3	016170-1	SEAL, DYN, 3/4 OD, HDS WHITE
12	3	017793-1	FLR TBE-55KSI
13	3	009217-1	BRG-SLVE, PLGR, GRAPHITE
14	3	006112-1	RNG-B/U, MANF, LSP BLUE
15	6	A-0290-014	O-RING, DISOGRIN, HIGH RESILIENCY, -014
16	3	014252-1	GDE-RNG, HP CYL, 55KSI, HUSKY
17	3	A-0275-040	O-RING, BUNA-N, 70 (SHORE A), -.040
18	3	A-0265-086	RETAINING RING, INT, SST, .866 IN
19	3	A-9566	SEAL, SHAFT, PTFE, 9/16 ID, 1-1/8 OD, .281 IN
20	3	013540-1	SPCR-RNG, LP SEAL, HUSKY, SST
21	3	A-0265-118	RETAINING RING, INT, SST, 13/16 IN
22	3	A-0275-030	O-RING, BUNA-N, 70 (SHORE A), -.030
23	3	013537-1	ROD-PONY, 55KSI HUSKY, 3.24 IN LG
24	3	A-11216	SEAL, SHAFT, CRWA6, 1-5/8 ID, 2-3/8 OD, .395
25	3	018020-1	PLGR ASSY-CERAMIC, HUSKY
26	3	A-9412	SPRING, COMPR, SST, .576 ID, .900 OD
27	3	006068-1	NUT, RTNR, PLUNGER, HUSKY, SST
28	3	006069-1	ADAPTER, PONY ROD, HUSKY
29	3	014676-1	ROD, PONY, 55 KSI HUSKY, 4 IN LONG
30	3	A-0275-313	O-RING, BUNA-N, 70 (SHORE A), -.313
31	3	A-0275-153	O-RING, BUNA-N, 70 (SHORE A), -.153
32	12	013539-1	TIE ROD-END CAP, HUSKY, 55 KSI, 15-5 SST
33	12	A-9926	WASHER, FLAT, HDND, STL, ZINC, 7/8
34	1	016856-1	MANF-WTR, END CAP, HUSKY, 55KSI
35	1	006738-1	SEAL, STATIC, 0.8405 ID, ALUM BRZ
36	1	006114-1	INSR-MANF, 1.130 IN
37	1	006113-1	NUT, ADAPTER, MANIF, HUSKY, SST
38	6	90-019-275	BOLT, HEX, 9/16"-18 X 2-3/4"
39	8	90-120-300	BOLT, SHCS, 5/8"-11 X 3"
40	12	90-625-000	NUT, HEX, 7/8"-14
41	6	90-818-000	FLAT WASHER, 9/16"
42	2	12-200-0600.SS	PLUG, MSAE, 06.SS
43	2	12-044-0606.SS	FITTING, 90, MSAE-MJIC, 06-06.SS
44	1	12-044-0812.SS	FITTING, 90, MSAE-MJIC, 08-12.SS
45	1	12-016-0806.SS	FITTING, STRT, MSAE-MJIC, 08-06.SS



					 <div> <div>APS</div> <div>SHAPE TECHNOLOGIES GROUP</div> </div>	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		TITLE: HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY		
REVISIONS						UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009 DIMS IN MM ARE FOR REFERENCE ONLY BREAK SHARP EDGES AND DEBURR .015 TOLERANCES (EXCEPT AS NOTED)		THIRD ANGLE PROJECTION 		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.
ZONE	REV.	DESCRIPTION	DATE	APPROVED				DWG BY K. SMITH		
	F	LEGACY FLOW REVISION	4/15/2015					APRVD BY B. PARKER		
	27	INITIAL RELEASE, APS VERSION	4/20/2020	K. SMITH				DWG. NO. 013503-1		
	28	UPDATED MANIFOLD BOLTS, SUBPLATE FITTINGS, TORQUE SPEC	4/26/2021	K. SMITH	APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES		MACHINE S.F. $\frac{63}{\sqrt{\quad}}$ MACHINE FILLETS R.02 ANGLE $\pm 1^\circ$		DIM TOLERANCES: (in) .X = $\pm .030$.XX = $\pm .010$.XXX = $\pm .005$.XXXX = $\pm .0005$	REV. 28
							MATERIAL		HEAT TREAT.	SHT 1 OF 6



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
A	F	LEGACY FLOW REVISION	4/15/2015	
	27	INITIAL RELEASE, APS VERSION	4/20/2020	K. SMITH
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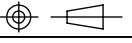


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TOLERANCES (EXCEPT AS NOTED)

MACHINE S.F.	$\frac{1}{8}$	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = $\pm .030$
ANGLE	$\pm 1^\circ$.XX = $\pm .010$
		.XXX = $\pm .005$
		.XXXX = $\pm .0005$

TITLE:
HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY

THIRD ANGLE PROJECTION 

DWG BY
K. SMITH

APRVD BY
B. PARKER

MATERIAL

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DWG. NO.
013503-1

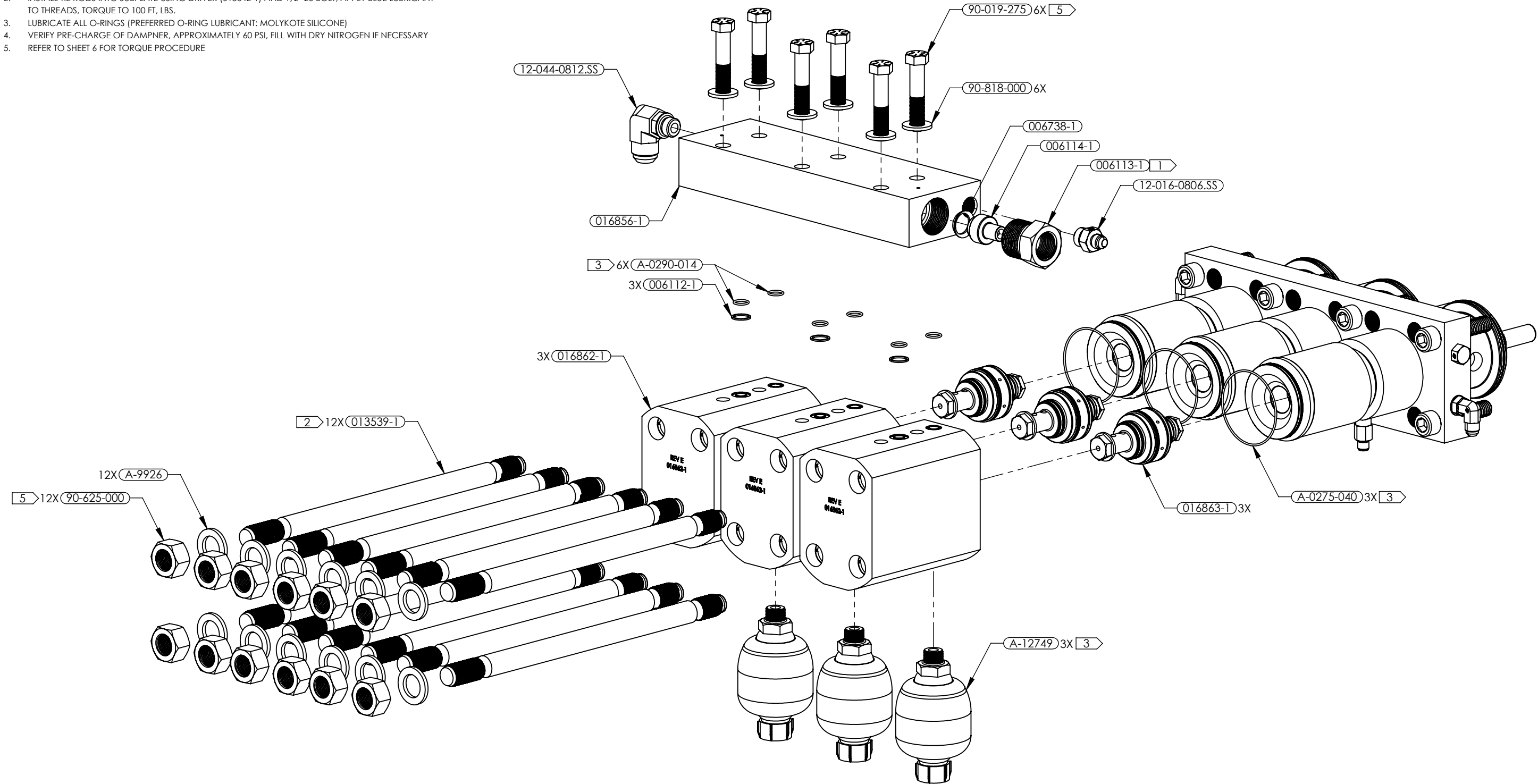
HEAT TREAT.

REV.
28

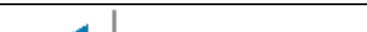

SHT 2 OF 6

NOTES:

1. APPLY BLUE LUBRICANT TO THREADS, TORQUE TO 150 FT. LBS.
2. INSTALL TIE RODS INTO SUBPLATE USING DRIVER (015642-1) AND 1/2"-20 BOLT, APPLY BLUE LUBRICANT TO THREADS, TORQUE TO 100 FT. LBS.
3. LUBRICATE ALL O-RINGS (PREFERRED O-RING LUBRICANT: MOLYKOTE SILICONE)
4. VERIFY PRE-CHARGE OF DAMPNER, APPROXIMATELY 60 PSI, FILL WITH DRY NITROGEN IF NECESSARY
5. REFER TO SHEET 6 FOR TORQUE PROCEDURE

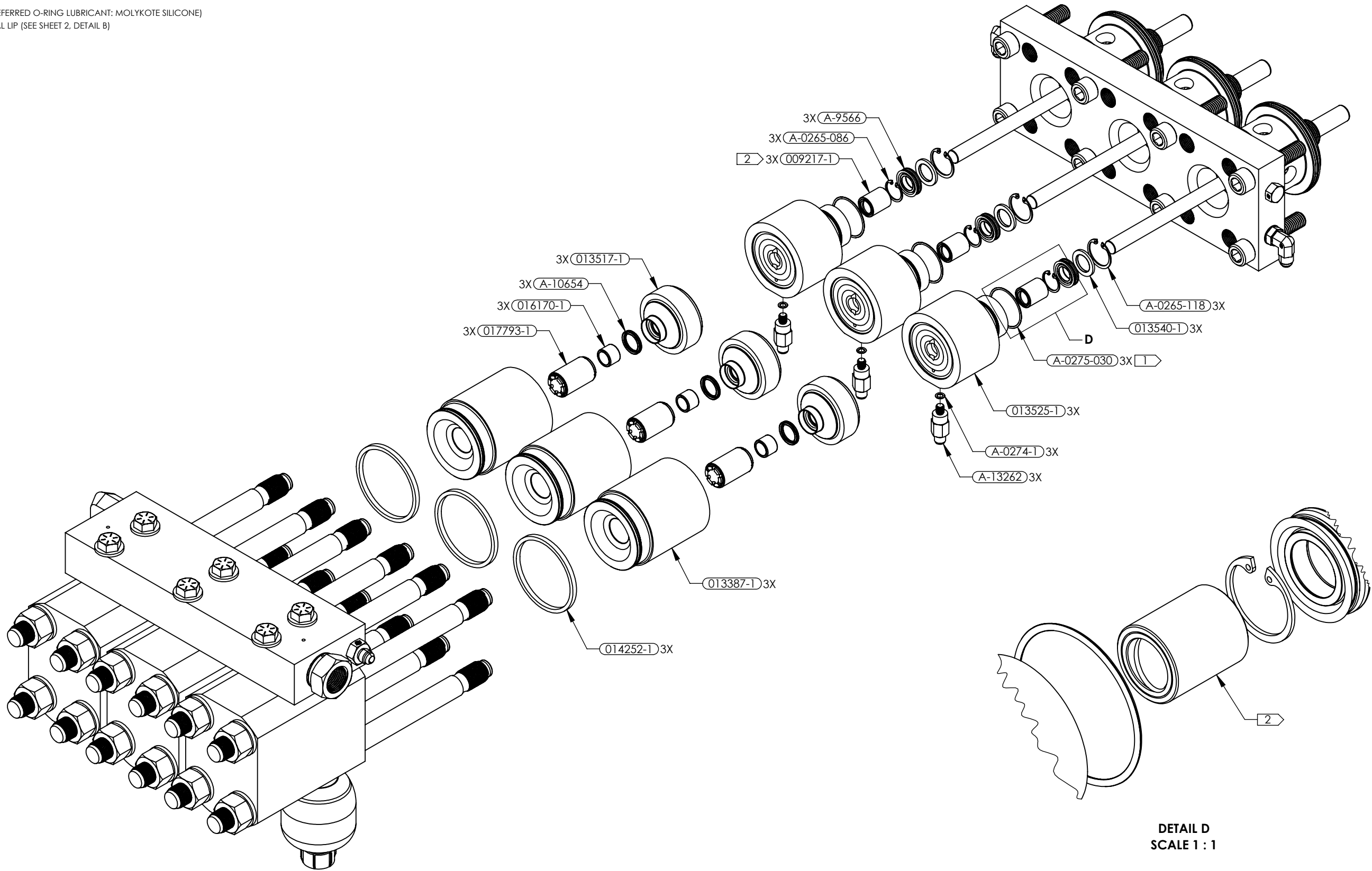


REVISIONS				
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	28	UPDATED MANIFOLD BOLTS, SUBPLATE FITTINGS, TORQUE SPEC	4/26/2021	K. SMITH


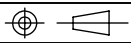
	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		TITLE: HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY				
	UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009 DIMS IN MM ARE FOR REFERENCE ONLY BREAK SHARP EDGES AND DEBURR .015 TOLERANCES (EXCEPT AS NOTED)						
	MACHINE S.F. $\frac{63}{8}$ MACHINE FILLETS R.02 ANGLE $\pm 1^\circ$		THIRD ANGLE PROJECTION 		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.		
	DIM TOLERANCES: (in) .X = $\pm .030$.XX = $\pm .010$.XXX = $\pm .005$.XXXX = $\pm .0005$		DWG BY K. SMITH				
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			MATERIAL		HEAT TREAT.		SHT 3 OF 6

NOTES:

1. LUBRICATE ALL O-RINGS (PREFERRED O-RING LUBRICANT: MOLYKOTE SILICONE)
2. NOTE ORIENTATION OF METAL LIP (SEE SHEET 2, DETAIL B)

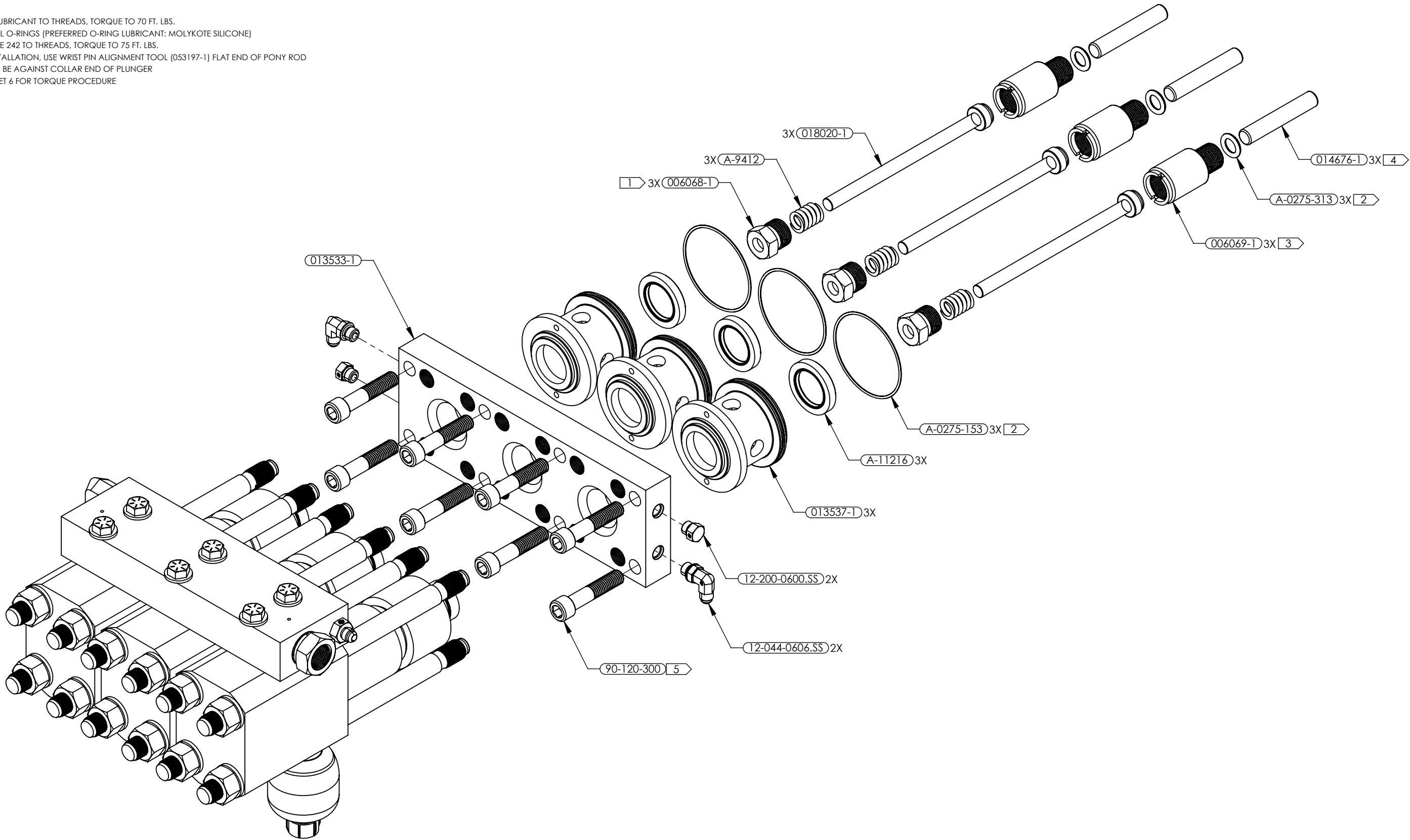


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	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		TITLE: HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY			
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		MATERIAL		HEAT TREAT.		SHT 4 OF 6

NOTES:

1. APPLY BLUE LUBRICANT TO THREADS, TORQUE TO 70 FT. LBS.
2. LUBRICATE ALL O-RINGS (PREFERRED O-RING LUBRICANT: MOLYKOTE SILICONE)
3. APPLY LOCTITE 242 TO THREADS, TORQUE TO 75 FT. LBS.
4. PRIOR TO INSTALLATION, USE WRIST PIN ALIGNMENT TOOL (053197-1) FLAT END OF PONY ROD (014676-1) TO BE AGAINST COLLAR END OF PLUNGER
5. REFER TO SHEET 6 FOR TORQUE PROCEDURE



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
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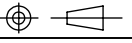


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MACHINE S.F.	63/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = ± .030
ANGLE	±1°	.XX = ± .010
		.XXX = ± .005
		.XXXX = ± .0005

TITLE: HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY

THIRD ANGLE PROJECTION 

DWG BY K. SMITH

APRVD BY B. PARKER

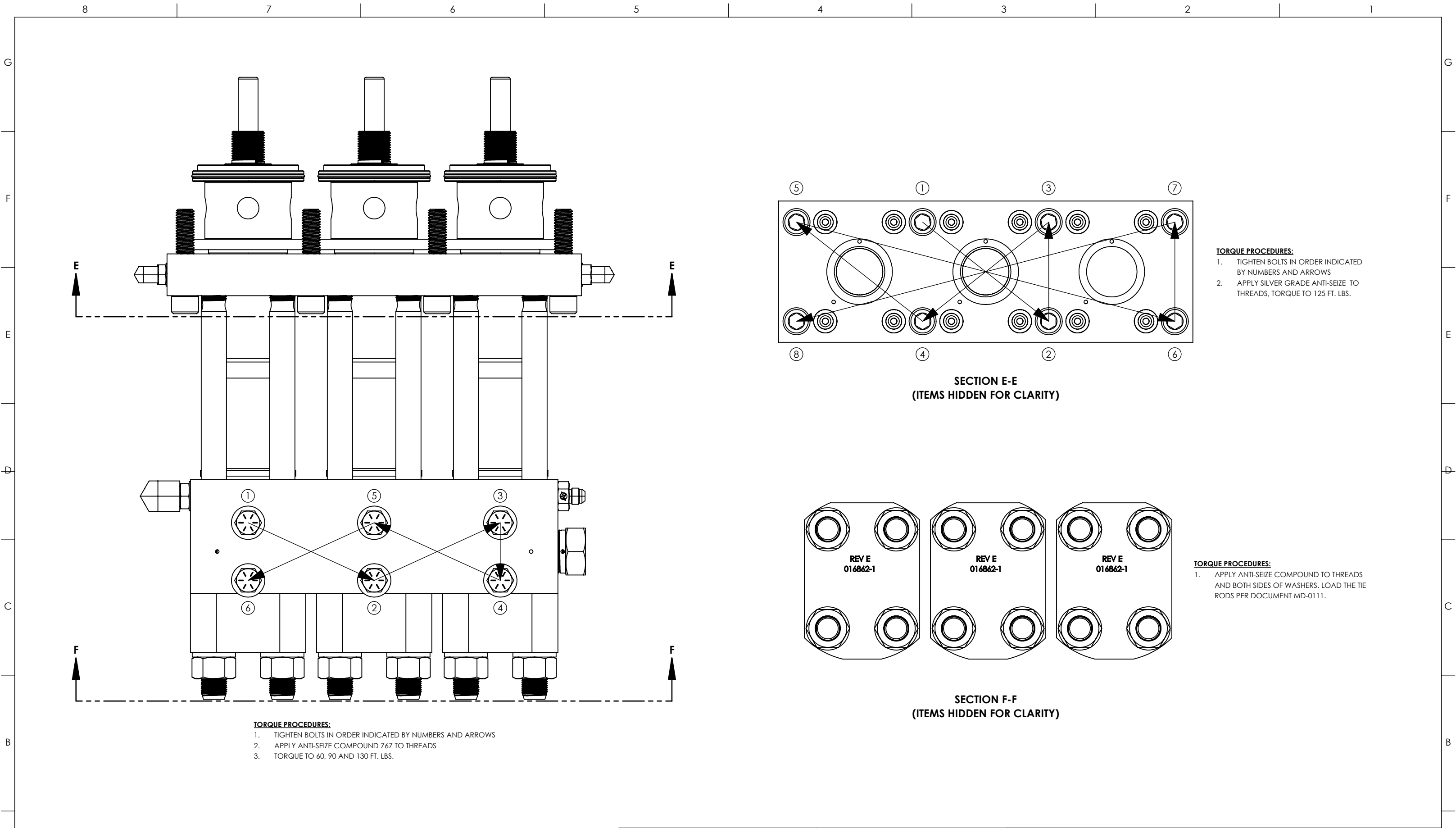
MATERIAL

HEAT TREAT.

DWG. NO. 013503-1

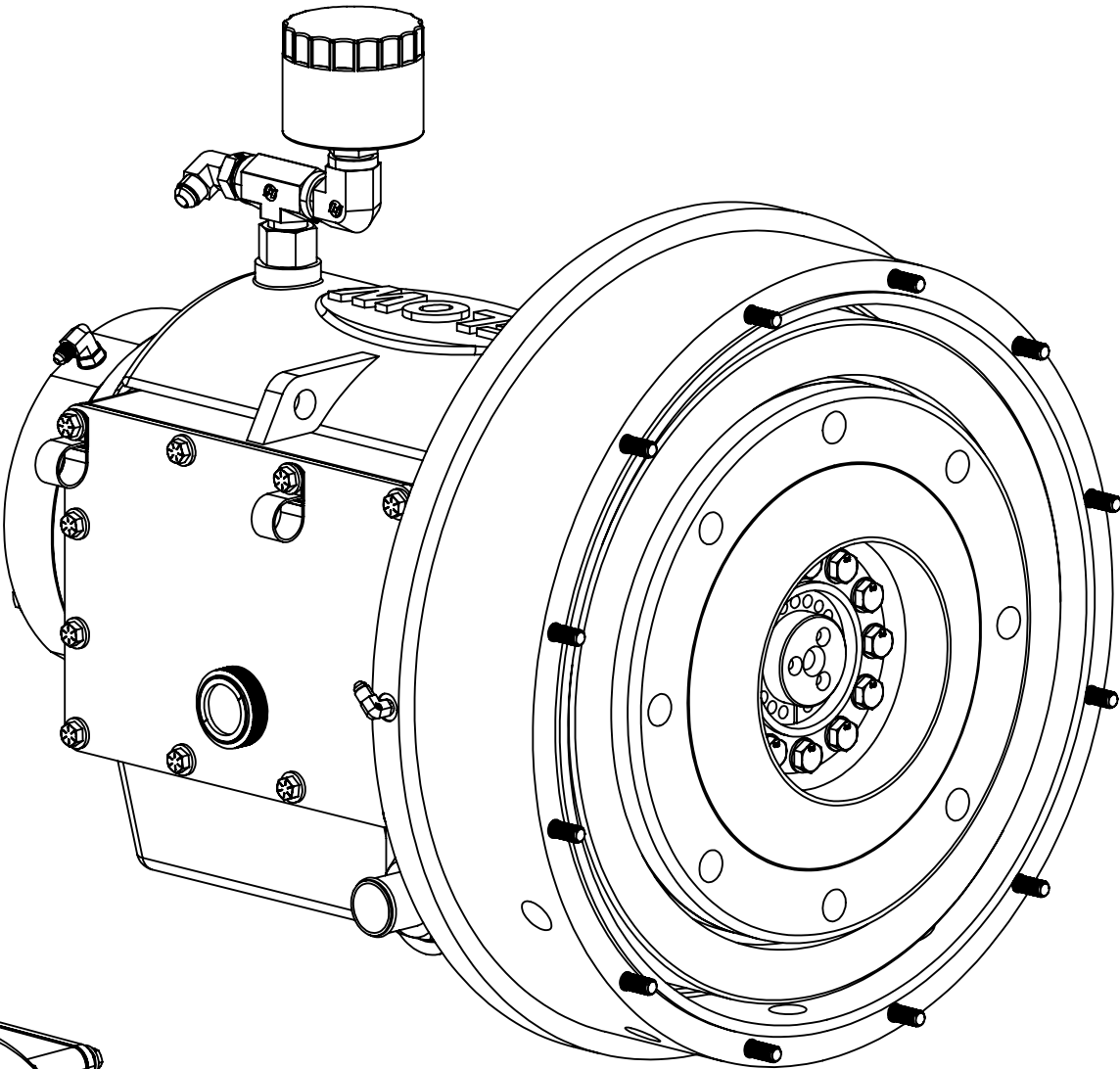
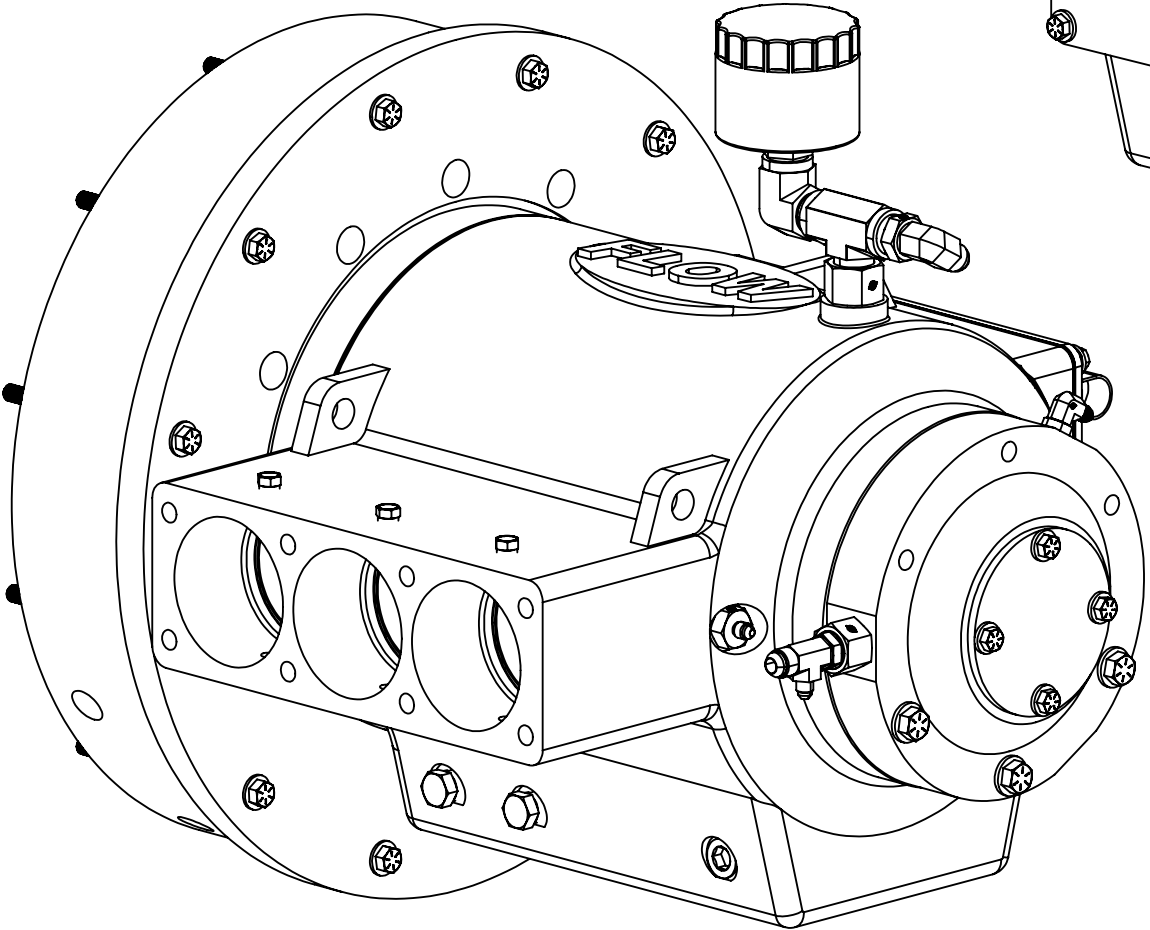
REV. 28

SHT 5 OF 6




REVISIONS						ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375 UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009 DIMS IN MM ARE FOR REFERENCE ONLY BREAK SHARP EDGES AND DEBURR .015 TOLERANCES (EXCEPT AS NOTED)		TITLE: HIGH PRESSURE ASSEMBLY, 55KSI, HUSKY				
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	F	LEGACY FLOW REVISION	4/15/2015			DWG BY K. SMITH						
	27	INITIAL RELEASE, APS VERSION	4/20/2020	K. SMITH		MACHINE S.F. $\frac{3}{4}$	DIM TOLERANCES: (in) .X = ± .030 .XX = ± .010 .XXX = ± .005 .XXXX = ± .0005	APRVD BY B. PARKER		DWG. NO. 013503-1		REV. 28
	28	UPDATED MANIFOLD BOLTS, SUBPLATE FITTINGS, TORQUE SPEC	4/26/2021	K. SMITH		MACHINE FILLETS R.02		MATERIAL		HEAT TREAT.		SHT 6 OF 6
					APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES		ANGLE ±1°					

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	006080-1	CRANK CASE, YELLOW, HUSKY
2	1	015018-1	ADAPTER WELDMENT, ENGINE, PUMP ASSEMBLY, C9 HUSKY
3	1	A-9308	BEARING, RADIAL, SPHERICAL, DBL ROW
4	1	A-9309	BEARING, RADIAL, SPHERICAL, DBL ROW
5	1	006078-1	SHAFT, CRANK SHAFT, 6.2 INCH, STEEL
6	1	006088-1	SPACER, BEARING, HUSKY, STEEL
7	1	A-9310	BUSHING, TAPER, 3-3/16 IN ID, 4-5/8 IN OD
8	1	A-9391	BUSHING, TAPER, 2.5 IN ID, 3.75 IN OD
9	1	006086-1	CAP, BEARING, HUSKY
10	1	006122-3-1	PLATE, BLANK, HUSKY POWER FRAME
11	1	006089-1	COVER, CRANK CASE, HUSKY, YELLOW
12	1	006090-1	GASKET, CRANK CASE, HUSKY
13	3	007422-1	CONNECTING ROD ASSEMBLY, CRANK CASE, HUSKY
14	6	008691-1	BUSHING, CON ROD, MODIF. S-200
15	3	006074-1	PIN, WRIST, HUSKY, 1-1/2 OD
16	3	006072-1	CROSS HEAD, WRIST PIN, HUSKY
17	1	A-9311	SEAL, OIL, CRWA1, VITON, 3-5/8 ID, 4-5/8 OD
18	1	006130-1	COUPLING, LUBE PUMP, HUSKY
19	1	A-0275-043	O-RING, BUNA-N, 70 (SHORE A), -.043
20	1	A-0275-168	O-RING, BUNA-N, 70 (SHORE A), -.168
21	1	A-0275-270	O-RING, BUNA-N, 70 (SHORE A), -.270
22	1	A-10741	SHAFT COUPLING, FLEXIBLE, 4 INCH, 13 INCH
23	1	009570-1	FLYWHEEL, CRANK CASE, DIESEL, 18.5" OD
24	2	201706-12	CLAMP, SUPPORT, STEEL, 3/4 INCH
25	3	A-0857-2	BREATHER VENT, 1/4 NPT, SINTERED BRZ, 40 MIC
26	1	A-3438	GAUGE, LIQUID LEVEL, ALUM
27	1	A-7461	FILTER, AIR, BREATHER, 3-3/4 IN DIA
28	12	10-412-030	BOLT, HEX HEAD, M12X1.75MM X 30MM, CLASS 8.8
29	1	12-002-1208	FITTING, STRT, MNPT-FNPT, 12-08
30	1	12-009-1212	FITTING, STRT, FNPT-MSAE, 12-12
31	1	12-015-1208	FITTING, STRT, MSAE-FSAE, 12-08
32	1	12-016-1004	FITTING, STRT, MSAE-MJIC, 10-04
33	1	12-018-2424	FITTING, STRT, MSAE-HOSE, 24-24
34	1	12-030-1212	FITTING, 90, MNPT-FNPT, 12-12
35	1	12-033-0204	FITTING, 90, MNPT-MJIC, 02-04
36	1	12-033-0808	FITTING, 90, MNPT-MJIC, 08-08
37	1	12-044-0604	FITTING, 90, MSAE-MJIC, 06-04
38	1	12-100-0804	RUN TEE, MJIC-MSAE-MJIC, 08-08-04
39	1	12-104-1212	BRCH TEE, FNPT-FNPT-MNPT, 12-12-12
40	1	12-200-0600	PLUG, MSAE, HOLLOW HEX, 06
41	2	12-250-0800	PLUG, MNPT, 08
42	1	12-250-1205	PLUG, MNPT, HOLLOW HEX, 12
43	16	90-012-075	BOLT, HEX, 3/8"-16 X 3/4"
44	12	90-014-650	BOLT, HEX, 7/16"-14 X 6-1/2"
45	3	90-016-275	BOLT, HEX, 1/2"-13 X 2-3/4"
46	6	90-020-225	BOLT, HEX, 5/8"-11 X 2-1/4"
47	3	90-108-125	BOLT, SHCS, 1/4"-20 X 1-1/4"
48	16	90-812-000	FLAT WASHER, 3/8"
49	24	90-814-000	FLAT WASHER, 7/16"
50	3	90-816-000	FLAT WASHER, 1/2"
51	6	90-820-000	FLAT WASHER, 5/8"



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/30/2019	K. SMITH
	1	UPDATED ITEM 90-014-650, UPDATED JOURNAL BEARINGS	4/14/2020	K. SMITH
	2	UPDATED NOTES, ADDED CLARITY FOR ASSEMBLY	10/29/2020	K. SMITH



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SHAPE TECHNOLOGIES GROUP[®]

ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375
UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009
DIMS IN MM ARE FOR REFERENCE ONLY
BREAK SHARP EDGES AND DEBURR .015
TOLERANCES (EXCEPT AS NOTED)

MACHINE S.F.	Ⓜ/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = ± .063
ANGLE	±1°	.XX = ± .015
		.XXX = ± .005
		.XXXX = ± .0005

TITLE:
ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1

THIRD ANGLE PROJECTION

DWG BY
K. SMITH

APRVD BY
B. PARKER

MATERIAL

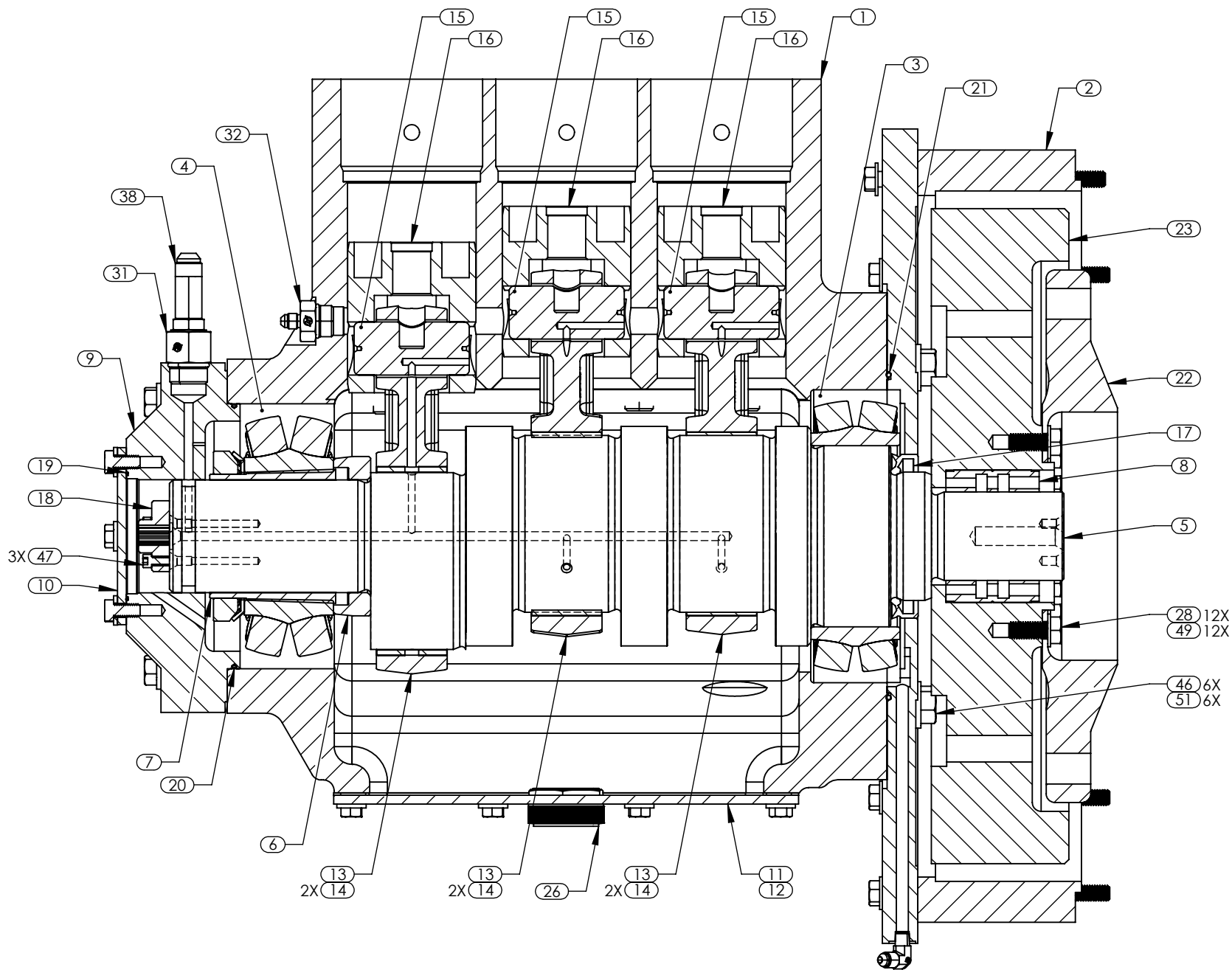
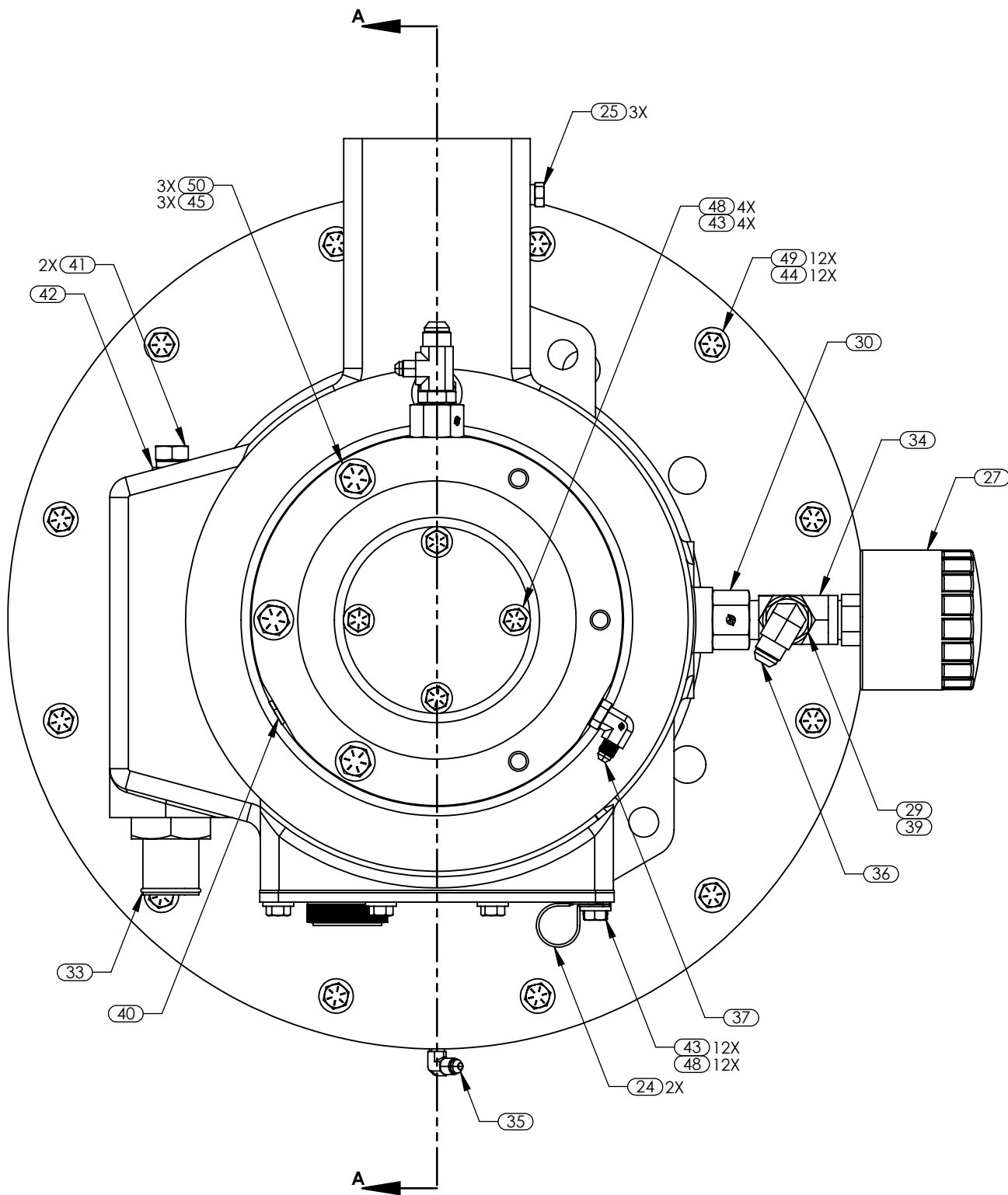
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DWG. NO.
006122-5

REV.
02


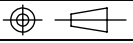
HEAT TREAT.

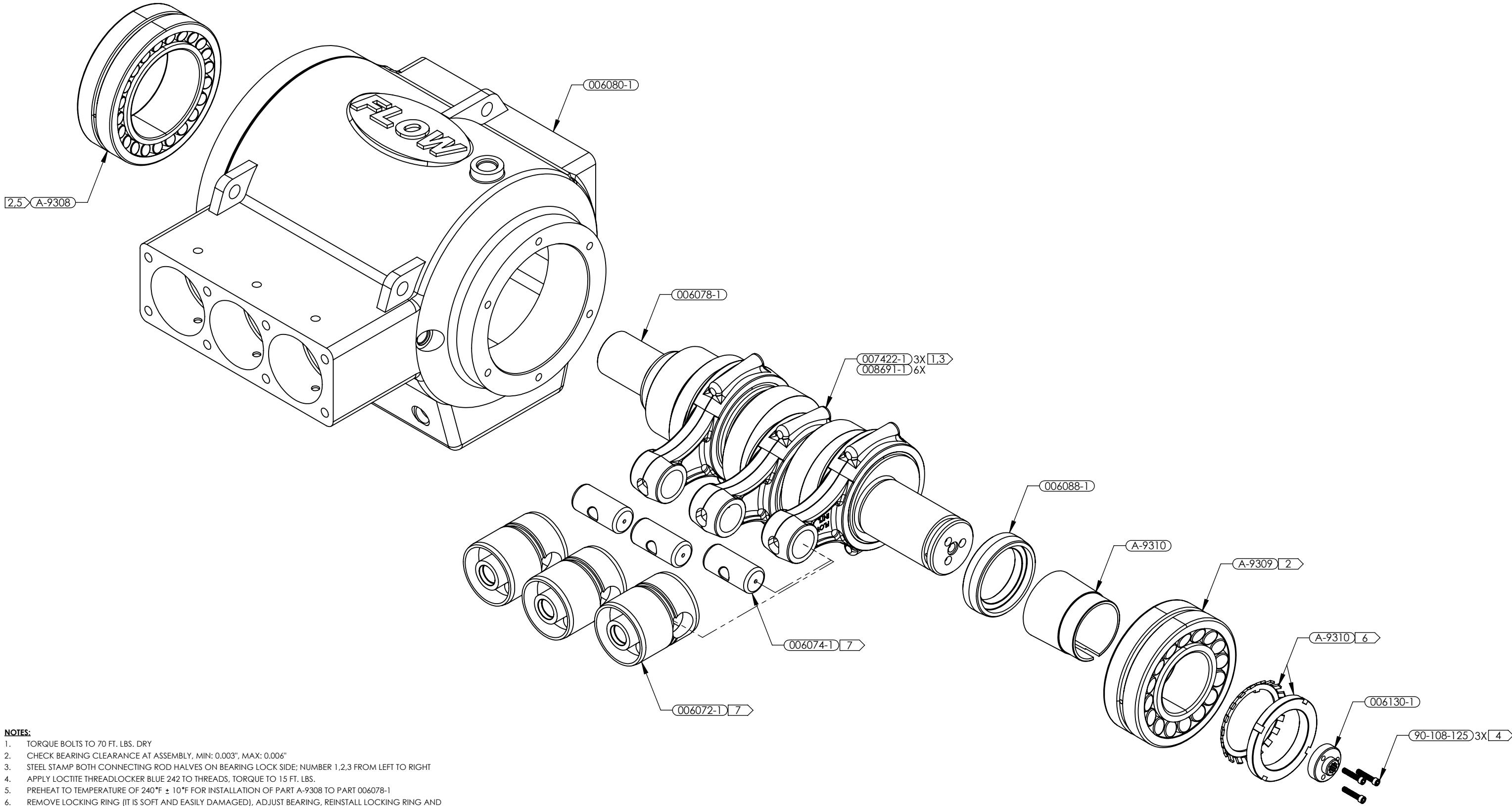
SHT 1 OF 4



SECTION A-A


REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/30/2019	K. SMITH
	1	UPDATED ITEM 90-014-650, UPDATED JOURNAL BEARINGS	4/14/2020	K. SMITH
	2	UPDATED NOTES, ADDED CLARITY FOR ASSEMBLY	10/29/2020	K. SMITH

	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR, TOMBALL, TX 77375		TITLE: ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1					
	UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009 DIMS IN MM ARE FOR REFERENCE ONLY BREAK SHARP EDGES AND DEBURR .015 TOLERANCES (EXCEPT AS NOTED)							
			THIRD ANGLE PROJECTION 		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.			
			DWG BY K. SMITH					
APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES		MACHINE S.F. 63/	DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005		APRVD BY B. PARKER		DWG. NO. 006122-5	REV. 02
		MACHINE FILLETS R.02			MATERIAL			
		ANGLE ±1°			HEAT TREAT.		SHT 2 OF 4	



- NOTES:**
- TORQUE BOLTS TO 70 FT. LBS. DRY
 - CHECK BEARING CLEARANCE AT ASSEMBLY, MIN: 0.003", MAX: 0.006"
 - STEEL STAMP BOTH CONNECTING ROD HALVES ON BEARING LOCK SIDE; NUMBER 1,2,3 FROM LEFT TO RIGHT
 - APPLY LOCTITE THREADLOCKER BLUE 242 TO THREADS, TORQUE TO 15 FT. LBS.
 - PREHEAT TO TEMPERATURE OF 240°F ± 10°F FOR INSTALLATION OF PART A-9308 TO PART 006078-1
 - REMOVE LOCKING RING (IT IS SOFT AND EASILY DAMAGED), ADJUST BEARING, REINSTALL LOCKING RING AND VERIFY BEARING CLEARANCE PER MANUFACTURERS INSTRUCTION; SET LOCK TABS
 - PRE-LUBE BEARINGS, WRIST PINS AND CROSSHEADS AT ASSEMBLY

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/30/2019	K. SMITH
	1	UPDATED ITEM 90-014-650, UPDATED JOURNAL BEARINGS	4/14/2020	K. SMITH
	2	UPDATED NOTES, ADDED CLARITY FOR ASSEMBLY	10/29/2020	K. SMITH



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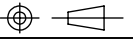
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ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375

UNLESS OTHERWISE SPECIFIED:
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BREAK SHARP EDGES AND DEBURR .015
TOLERANCES (EXCEPT AS NOTED)

MACHINE S.F.	63/	DIM TOLERANCES: (in)
MACHINE FILLETS	R.02	.X = ± .063
ANGLE	±1°	.XX = ± .015
		.XXX = ± .005
		.XXXX = ± .0005

TITLE:
ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1

THIRD ANGLE PROJECTION 

DWG BY K. SMITH

APRVD BY B. PARKER

MATERIAL

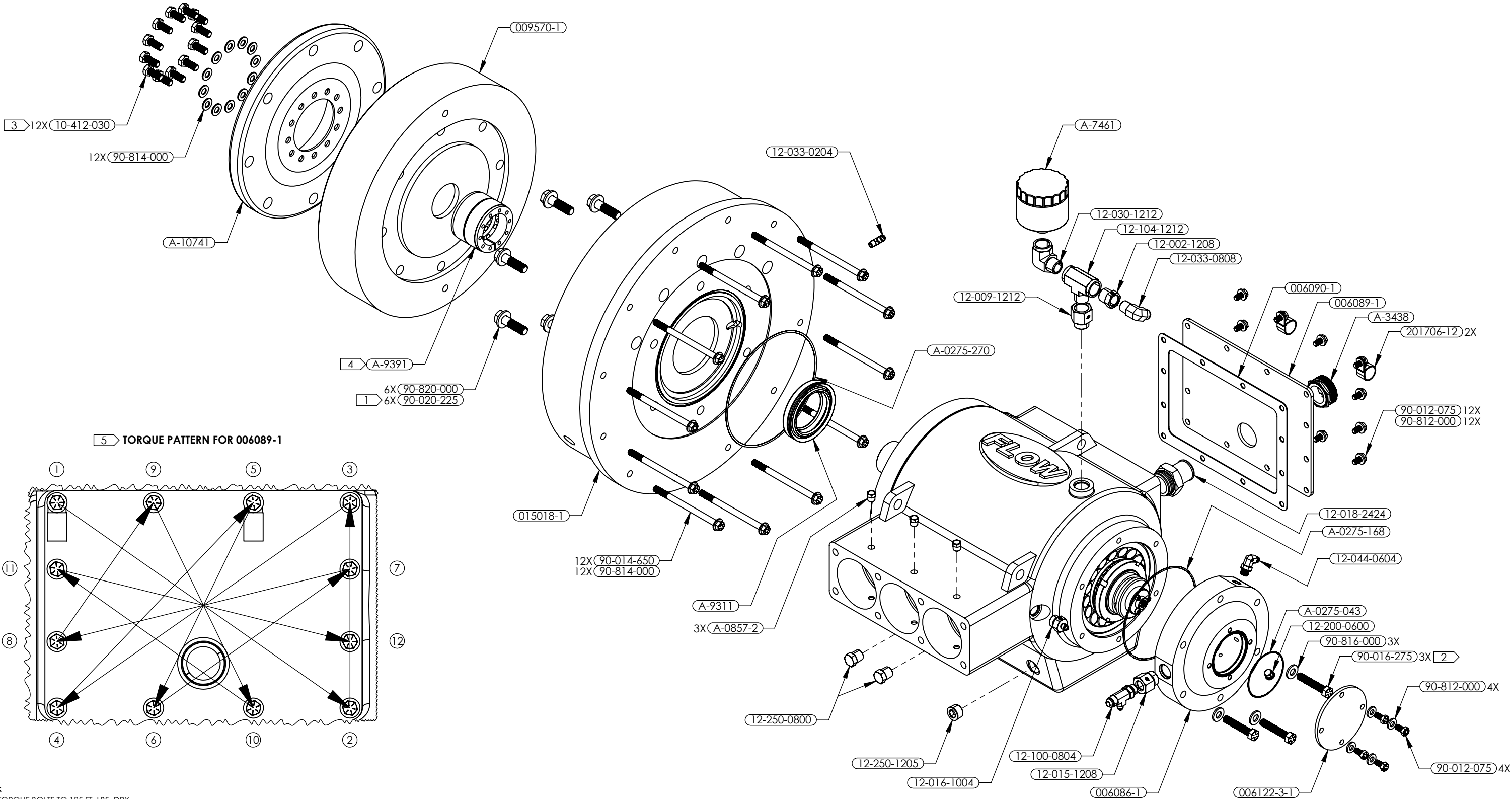
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DWG. NO. 006122-5

HEAT TREAT.

REV. 02


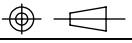
SHT 3 OF 4

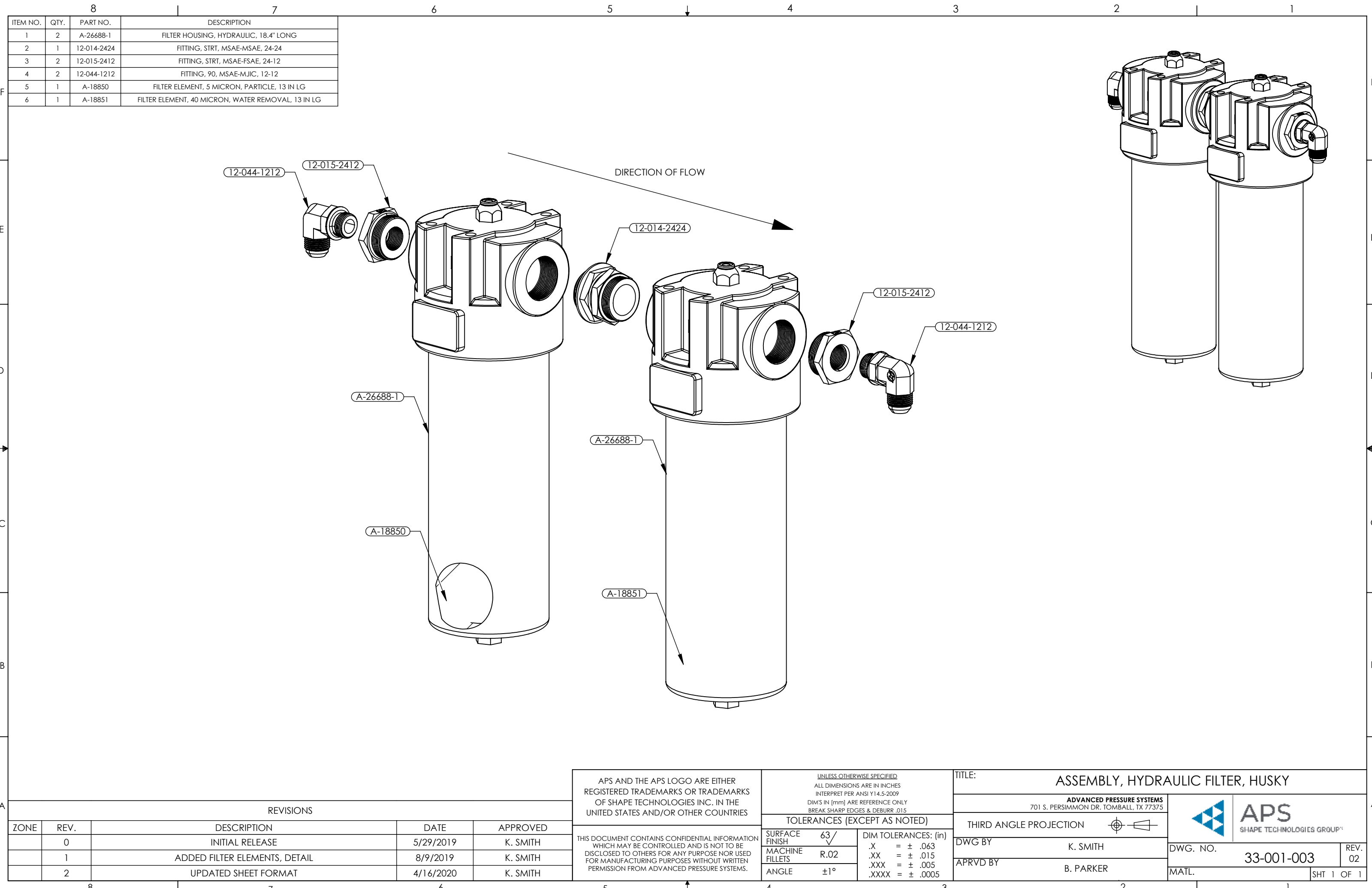


NOTES:

1. TORQUE BOLTS TO 125 FT. LBS. DRY
2. LUBRICATE THREADS WITH SILVER GRADE ANTI-SEIZE AND TORQUE TO 40 FT. LBS.
3. TORQUE BOLTS TO 80 FT. LBS. DRY
4. TORQUE BOLTS TO 30 FT. LBS. PER MANUFACTURERS INSTRUCTIONS
5. TORQUE BOLTS TO 40 FT. LBS. DRY



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/30/2019	K. SMITH
	1	UPDATED ITEM 90-014-650, UPDATED JOURNAL BEARINGS	4/14/2020	K. SMITH
	2	UPDATED NOTES, ADDED CLARITY FOR ASSEMBLY	10/29/2020	K. SMITH

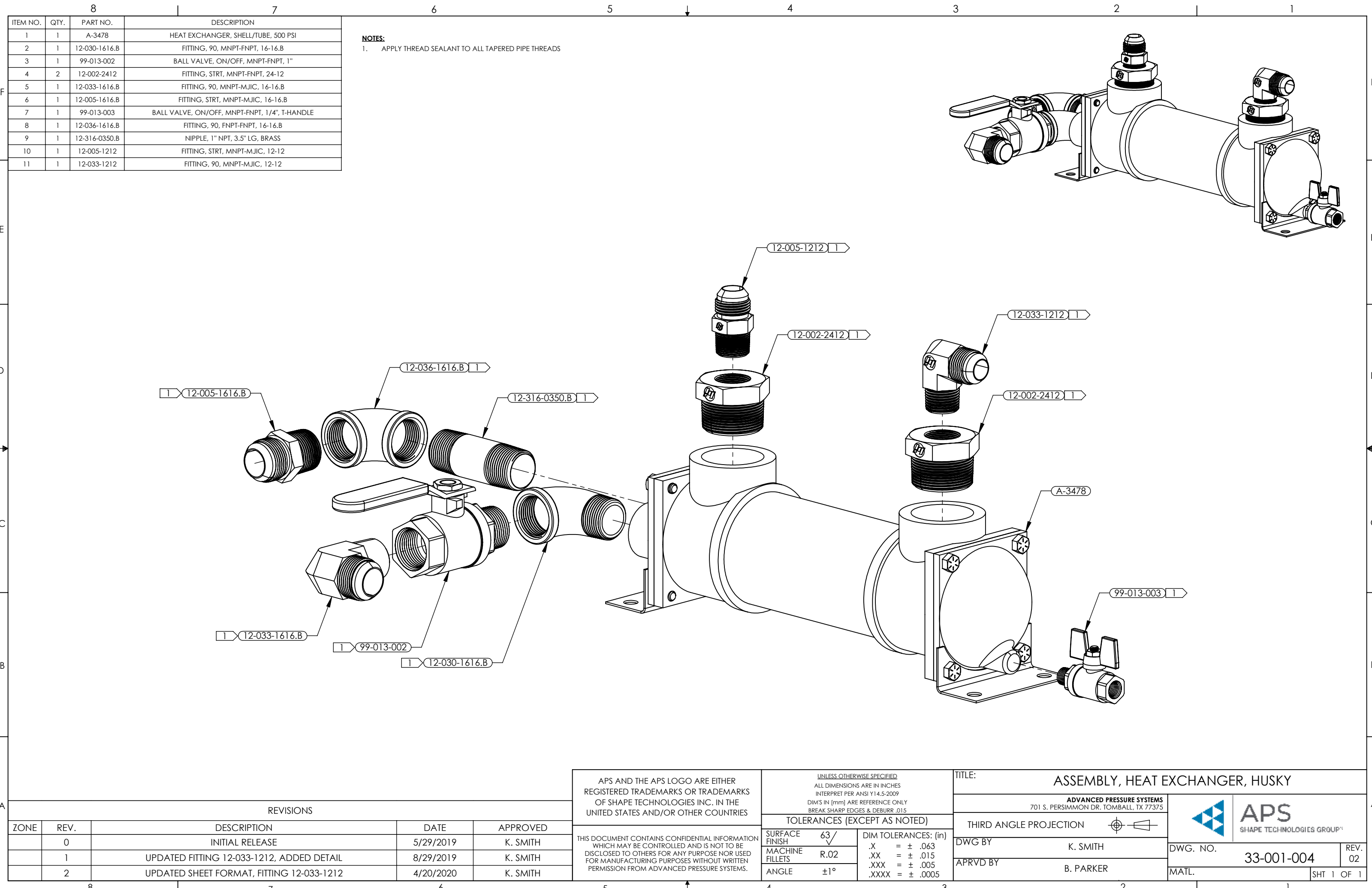
 <div>APS SHAPE TECHNOLOGIES GROUP[®]</div>	ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375 UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES, INTERPRET PER ANSI Y14.5-2009 DIMS IN MM ARE FOR REFERENCE ONLY BREAK SHARP EDGES AND DEBURR .015 TOLERANCES (EXCEPT AS NOTED)		TITLE: ASSEMBLY, CRANK CASE, HUSKY, TIER 4 C7.1					
			THIRD ANGLE PROJECTION 		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.			
			DWG BY K. SMITH					
			APRVD BY B. PARKER		DWG. NO. 006122-5		REV. 02	
APS AND THE APS LOGO ARE EITHER REGISTERED TRADEMARKS OR TRADEMARKS OF SHAPE TECHNOLOGIES INC. IN THE UNITED STATES AND/OR OTHER COUNTRIES	MACHINE S.F. $\frac{1}{16}$	DIM TOLERANCES: (in) .X = $\pm .063$.XX = $\pm .015$.XXX = $\pm .005$.XXXX = $\pm .0005$		MATERIAL		HEAT TREAT.		SHT 4 OF 4
	MACHINE FILLETS R.02							
	ANGLE $\pm 1^\circ$							

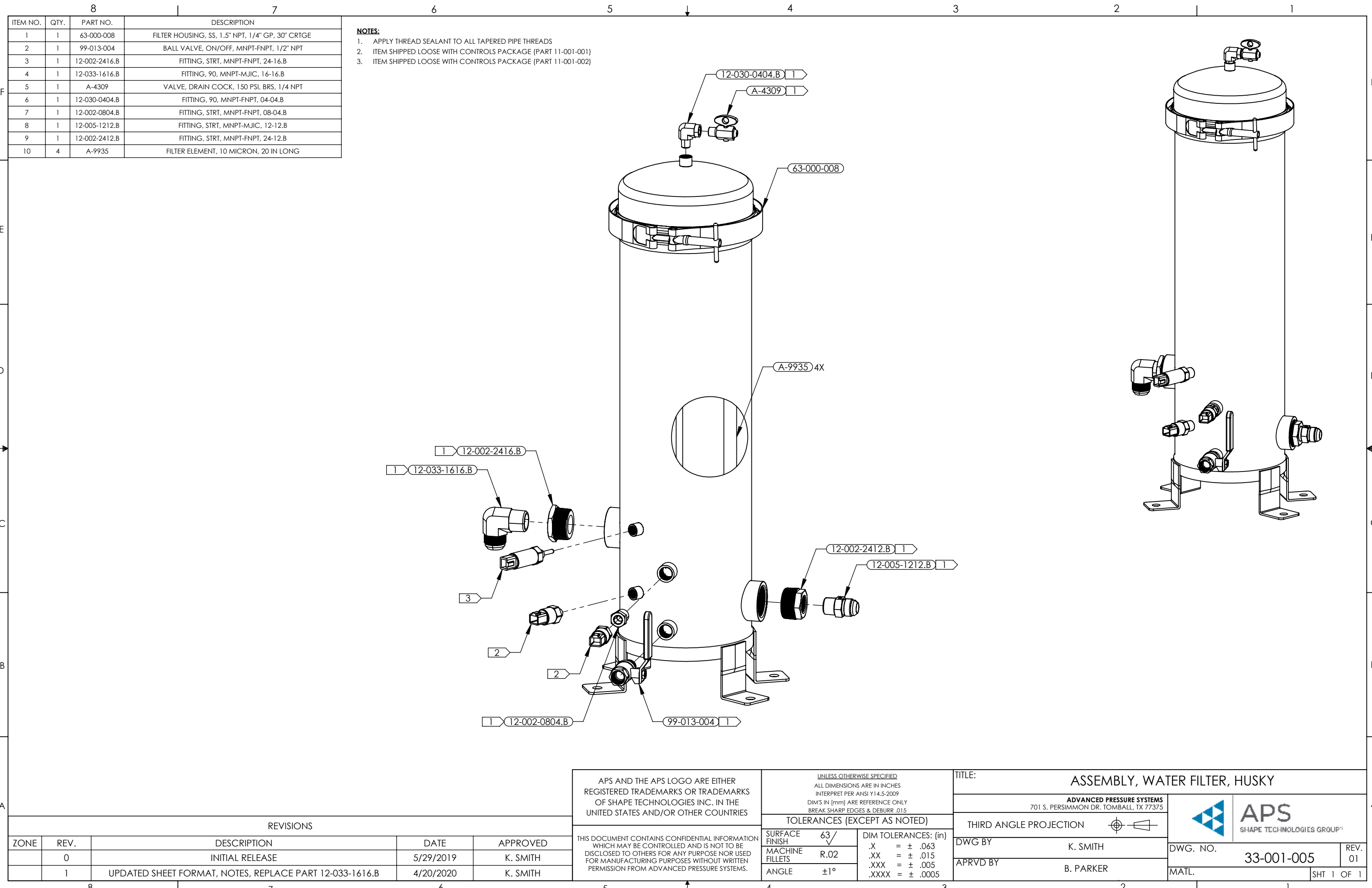


ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	A-26688-1	FILTER HOUSING, HYDRAULIC, 18.4" LONG
2	1	12-014-2424	FITTING, STRT, MSAE-MSAE, 24-24
3	2	12-015-2412	FITTING, STRT, MSAE-FSAE, 24-12
4	2	12-044-1212	FITTING, 90, MSAE-MJIC, 12-12
5	1	A-18850	FILTER ELEMENT, 5 MICRON, PARTICLE, 13 IN LG
6	1	A-18851	FILTER ELEMENT, 40 MICRON, WATER REMOVAL, 13 IN LG

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/29/2019	K. SMITH
	1	ADDED FILTER ELEMENTS, DETAIL	8/9/2019	K. SMITH
	2	UPDATED SHEET FORMAT	4/16/2020	K. SMITH

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	TOLERANCES (EXCEPT AS NOTED)		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375				
THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.	SURFACE FINISH 63/		THIRD ANGLE PROJECTION				
	MACHINE FILLETS R.02		DWG BY K. SMITH		DWG. NO.		
	ANGLE ±1°		APRVD BY B. PARKER		33-001-003		
					REV. 02		
					MATL.		
						SHT 1 OF 1	





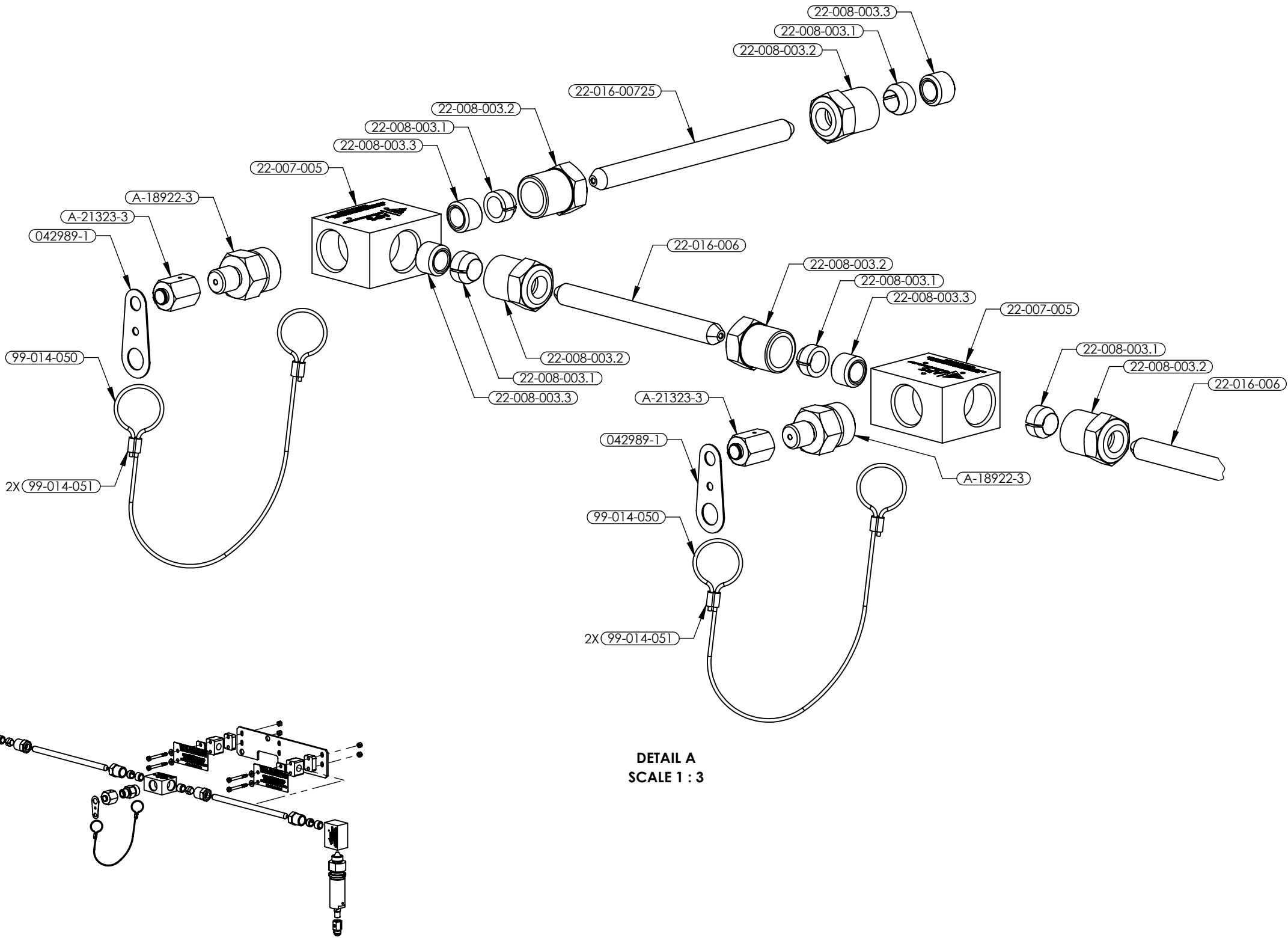
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	63-000-008	FILTER HOUSING, SS, 1.5" NPT, 1/4" GP, 30" CRTGE
2	1	99-013-004	BALL VALVE, ON/OFF, MNPT-FNPT, 1/2" NPT
3	1	12-002-2416.B	FITTING, STRT, MNPT-FNPT, 24-16.B
4	1	12-033-1616.B	FITTING, 90, MNPT-MJIC, 16-16.B
5	1	A-4309	VALVE, DRAIN COCK, 150 PSI, BRS, 1/4 NPT
6	1	12-030-0404.B	FITTING, 90, MNPT-FNPT, 04-04.B
7	1	12-002-0804.B	FITTING, STRT, MNPT-FNPT, 08-04.B
8	1	12-005-1212.B	FITTING, STRT, MNPT-MJIC, 12-12.B
9	1	12-002-2412.B	FITTING, STRT, MNPT-FNPT, 24-12.B
10	4	A-9935	FILTER ELEMENT, 10 MICRON, 20 IN LONG

- NOTES:**
1. APPLY THREAD SEALANT TO ALL TAPERED PIPE THREADS
 2. ITEM SHIPPED LOOSE WITH CONTROLS PACKAGE (PART 11-001-001)
 3. ITEM SHIPPED LOOSE WITH CONTROLS PACKAGE (PART 11-001-002)

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/29/2019	K. SMITH
	1	UPDATED SHEET FORMAT, NOTES, REPLACE PART 12-033-1616.B	4/20/2020	K. SMITH

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	TOLERANCES (EXCEPT AS NOTED)		THIRD ANGLE PROJECTION	
	SURFACE FINISH MACHINE FILLETS ANGLE	63/ R.02 ±1°	DWG BY APRVD BY	K. SMITH B. PARKER
	DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005		DWG. NO. 33-001-005 REV. 01	

NOTES:
1. APPLY BLUE LUBRICANT TO ALL HIGH PRESSURE THREADED CONNECTIONS



DETAIL A
SCALE 1 : 3

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	10/24/2019	K. SMITH
	1	UPDATED DWG NAME, BOM, ADDED EXPLODED VIEW, NOTES	9/3/2019	K. SMITH
	2	UPDATED SHEET FORMAT, APS PART NUMBERS, MORE DETAIL	4/21/2020	K. SMITH

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DIM'S IN [mm] ARE REFERENCE ONLY
BREAK SHARP EDGES & DEBURR .015

TOLERANCES (EXCEPT AS NOTED)

SURFACE FINISH	63/	DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005
MACHINE FILLETS	R.02	
ANGLE	±1°	

TITLE: ASSEMBLY, HIGH PRESSURE TUBING, HUSKY, 55K

ADVANCED PRESSURE SYSTEMS
701 S. PERSIMMON DR. TOMBALL, TX 77375

THIRD ANGLE PROJECTION

DWG BY K. SMITH

APRVD BY B. PARKER




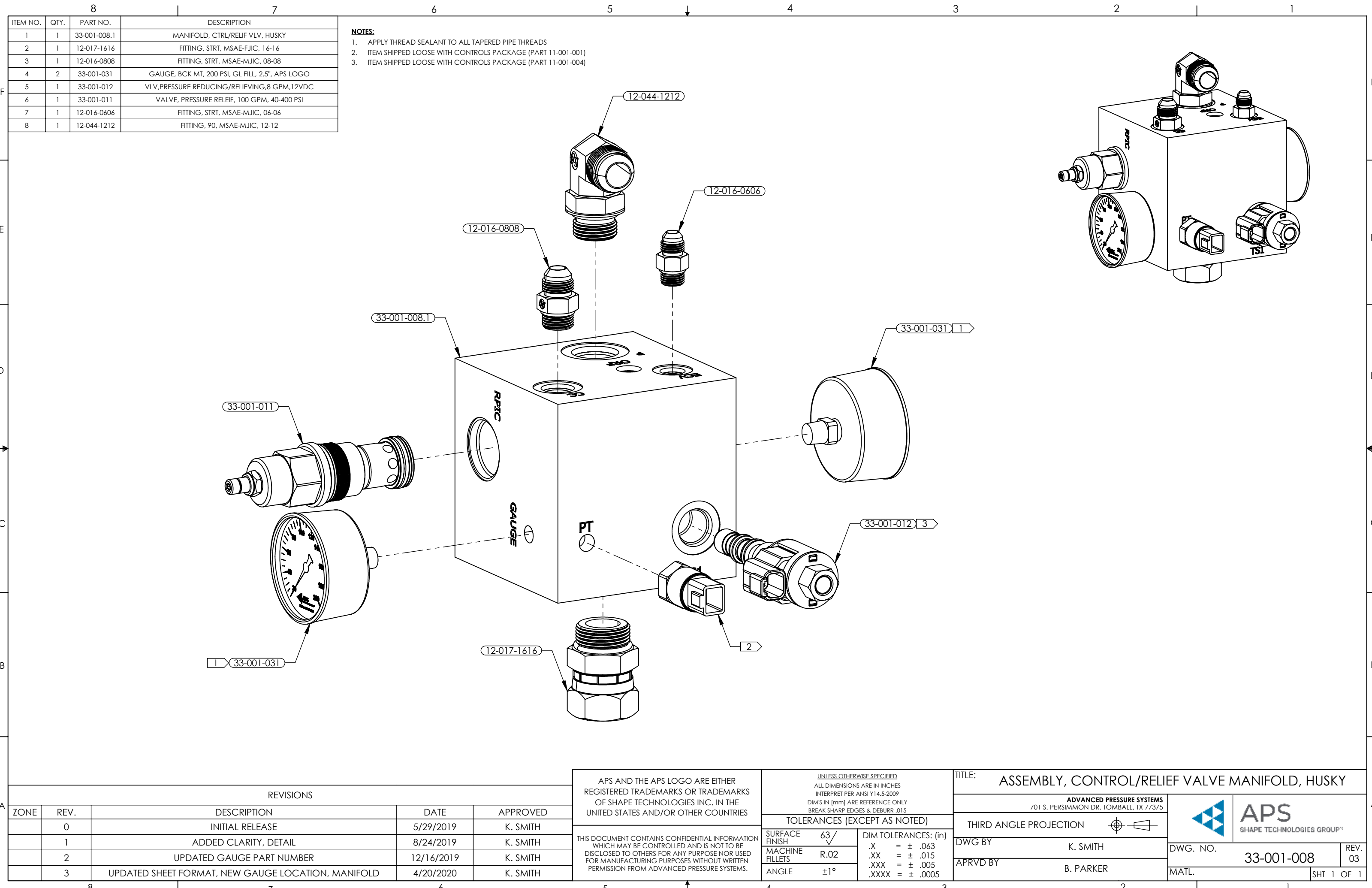
DWG. NO. 33-001-007
REV. 02

MATL. SHT 2 OF 3

1. APPLY BLUE LUBRICANT TO ALL HIGH PRESSURE THREADED CONNECTIONS



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REVISIONS						TOLERANCES (EXCEPT AS NOTED)		THIRD ANGLE PROJECTION		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		 APS SHAPE TECHNOLOGIES GROUP [®]		
ZONE	REV.	DESCRIPTION	DATE	APPROVED		SURFACE FINISH 63/√ MACHINE FILLETS R.02 ANGLE ±1°		DIM TOLERANCES: (in) .X = ± .063 .XX = ± .015 .XXX = ± .005 .XXXX = ± .0005		DWG BY K. SMITH			DWG. NO. 33-001-007	REV. 02
	0	INITIAL RELEASE	10/24/2019	K. SMITH						APRVD BY B. PARKER			MATL.	SHT 3 OF 3
	1	UPDATED DWG NAME, BOM, ADDED EXPLODED VIEW, NOTES	9/3/2019	K. SMITH	THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION WHICH MAY BE CONTROLLED AND IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM ADVANCED PRESSURE SYSTEMS.									
	2	UPDATED SHEET FORMAT, APS PART NUMBERS, MORE DETAIL	4/21/2020	K. SMITH										



F

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C

B

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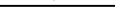
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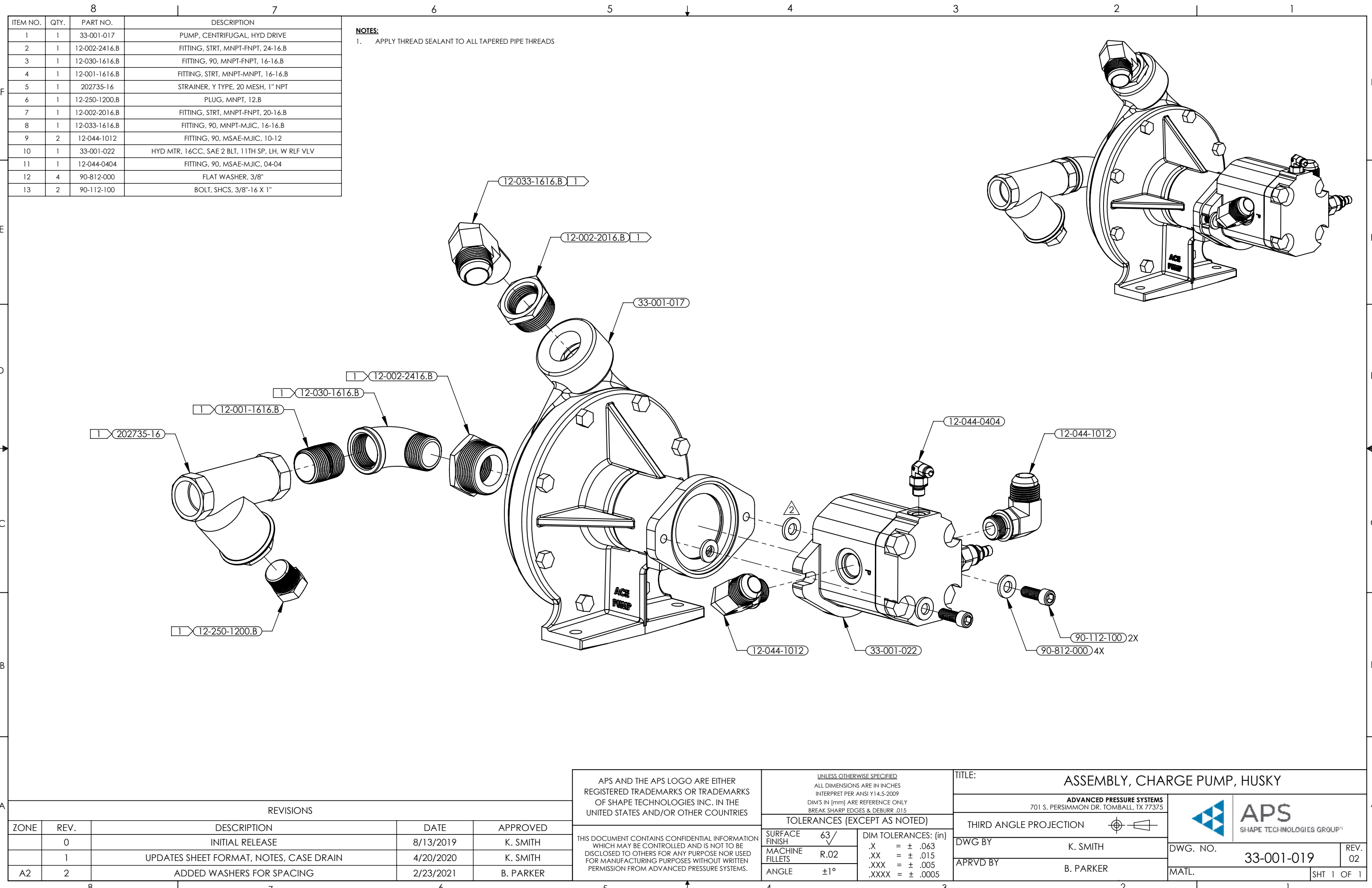
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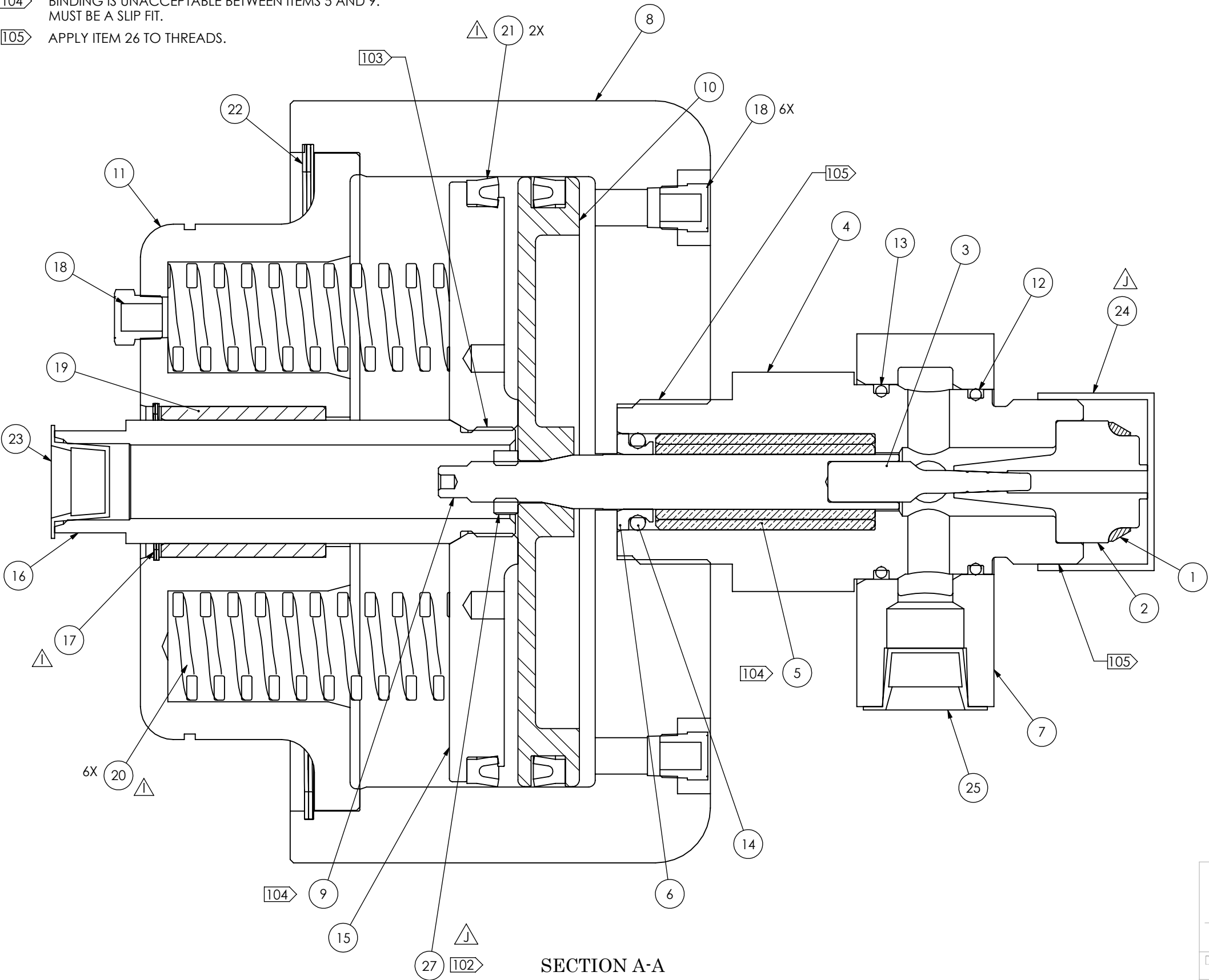
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/29/2019	K. SMITH
	1	ADDED CLARITY, DETAIL	8/24/2019	K. SMITH
	2	UPDATED GAUGE PART NUMBER	12/16/2019	K. SMITH
	3	UPDATED SHEET FORMAT, NEW GAUGE LOCATION, MANIFOLD	4/20/2020	K. SMITH

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		TOLERANCES (EXCEPT AS NOTED)		ADVANCED PRESSURE SYSTEMS 701 S. PERSIMMON DR. TOMBALL, TX 77375		 APS SHAPE TECHNOLOGIES GROUP TM					
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		MACHINE FILLETS R.02				DWG BY K. SMITH					
		ANGLE ±1°		APRVD BY B. PARKER		MATL.		SHT 1 OF 1			


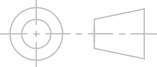


NOTES:

101. LUBRICATE O-RINGS AND SEALS WITH DOW CORNING #55 O-RING LUBRICANT (REF A-1893).
- 102 TORQUE TO 25-30 FT. LBS.
- 103 APPLY A CONTINUOUS BEAD OF LOCTITE #242 TO THREADS.
- 104 BINDING IS UNACCEPTABLE BETWEEN ITEMS 5 AND 9. MUST BE A SLIP FIT.
- 105 APPLY ITEM 26 TO THREADS.



ITEM	QTY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	006738-1	STATIC CAP SEAL;END CAP
2	1	EA	011901-1	SEAT;ECV;DIESEL EAGLE
3	1	EA	013411-1	POPPET;55K ECV
4	1	EA	013412-1	BODY;55K ECV
5	1	EA	013413-1	BEARING ASSY;55K ECV
6	1	EA	013414-1	SEAL;PLUNGER;55K ECV
7	1	EA	013425-1	ADAPTER;55K ECV
8	1	EA	013427-1	HOUSING;55K ECV
9	1	EA	013428-1	PLUNGER;55K ECV
10	1	EA	013429-1	PISTON;55K ECV
11	1	EA	013430-1	CAP;HOUSING;55K ECV
12	1	EA	A-0275-128	O-RING;BUNA-N;70 DUR;NO.2-128
13	1	EA	A-0275-129	O-RING;BUNA-N;70 DUR;NO.2-129
14	1	EA	A-0275-208	O-RING;BUNA-N;70 DUR;NO.2-208
15	1	EA	010245-1	PLATE;SEPARATOR;MCV
16	1	EA	010246-1	CONNECTER;OIL;MCV
17	1	EA	A-00619-137	RING;RETAINER;INT;MEDIUM;1.375
18	7	EA	A-0857-1	VENT;BREATHER;BRONZE;1/8 NPT
19	1	EA	A-11264	BEARING;SLEEVE;1-1/8" BORE
20	6	EA	A-11319	SPRING;DIE;1";MEDIUM-HEAVY;RED
21	2	EA	A-00167-49	SEAL;U-PCKNG;5/32X5X5 9/16
22	1	EA	A-00619-600	RING;RETAINER;INT;MEDIUM;6.0"
23	1	EA	A-11322	CAPLUG;TAPERED;W-8
24	1	EA	A-32252-1	CAP;PET;RED;1 1/2 IN;1 IN LG
25	1	EA	200860-10	PLUG;TAPERED PLASTIC; .683
26	0	EA	A-2185	LUBRICANT;BLUE
27	1	EA	A-0308-10	NUT;HEX;S/L;STL;3/8-24

THIRD ANGLE PROJECTION		 Flow		THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL SEE BOM			
DRAWN BY K.MADDEN		STARTED 3/5/2002	ENG K.KOSTOHRIS	EST WEIGHT N/A	MODELED IN SOLIDWORKS
TITLE VALVE ASSY;ECV;55 KSI					
REVISION J	SCALE 1:1	BASE PART NUMBER 013410			1 OF 1