BLASTMAX 50 PUMP

ADVANCED PRESSURE SYSTEMS

OPERATION AND MAINTENANCE MANUAL

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APS
SHAPE TECHNOLOGIES GROUP®

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ADVANCED PRESSURE SYSTEMS 2022

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Overview

The APS Series 50 is a powerful positive displacement, triplex plunger pump system. These pumps are designed and manufactured to operate in continuous service at a designed flow and pressure. With pressures ranging from 3,000 psi to 40,000 psi (345 bar to 2,758 bar), the Series 50 is an extremely versatile pump. The Series 50 pump is designed for full-scale industrial use including but not limited to industrial cleaning, surface preparation and hydrostatic testing applications.

Features include:

- *A triplex, belt-drive, high-pressure pump with easy access to seals and check valves.*
- *Multiple electric motor options:*
    - *25 hp electric motor, 50 hp electric motor, 75 hp electric motor*
- *Sensor lights and automatic shutdown for low inlet water pressure (when equipped), low water level (when equipped), and pump oil pressure (when equipped).*
- *Splash lubrication system.*
- *Water filtration to 10 microns absolute.*
- *Inlet water booster pump (when equipped).*
- *Over-pressure protection discs, as equipped.*

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 Series 50 pump system.

Safety

Advanced Pressure Systems designed your 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 your body—it will cause serious injury.*
- *Never point a waterjet cutting or cleaning tool at yourself or any person. Do not aim any waterjet tool at anything you do not want to 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.*

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 you know how to stop it.*
- *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 informs you of 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.

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.

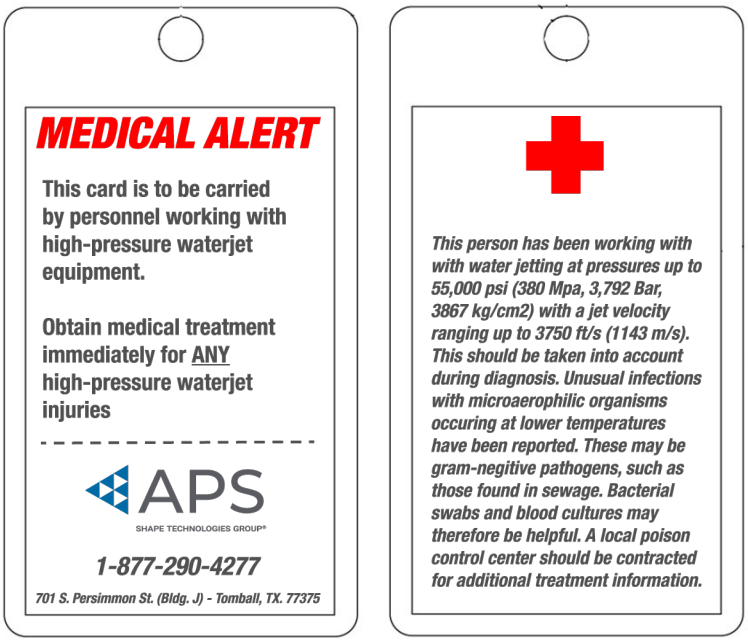
The operators must wear gloves at all times; leather gloves are preferred.

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

You can lock out the water supply and electrical systems separately. Under most circumstances, you should lock out both systems.
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.*
2. *Look at the gauges on the display to ensure that the fluid end pressure is bled down.*
3. *Turn off the water supply, and then install a lockout/tagout device.*
4. *Press the drain button on the top of the water filter canister to drain the filter canister. If the draining water appears to be under pressure, ensure that the inlet water is off.*

Electrical

1. *Shut down the system.*
2. *Disconnect from power source using main power disconnect.*
3. *Install a lockout/tagout device over the power source.*

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, particularly on the larger horsepower models. Do not attempt to lift the machine from either end. Note the warnings stamped on the unit. The center of gravity is located at approximately the location of the lifting eye if so equipped. 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 motor and drive train.

1. *Set unit on a level surface to ensure that oil in the power end reaches the crankshaft main bearings.*
2. *Check oil level in the pump. Refer to section 'Power End Assembly' for information regarding power end lubrication*
3. *If the pump has an oil level shutdown switch, set the shutdown trips 1/2 inch above and 1 inch below the dipstick Hi-Lo level marks.*
4. *Check charge pump drives, if applicable.*
5. *Ensure the plunger and intermediate rod connections are tight.*
6. *Verify all bolts are torqued to the specified level.*

7. *Verify connections on the manifold is tight and does not leak.*

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

8. *Ensure the supply water and the filters and strainers are clean.*
9. *Verify the pressure rating stamped on the application tag for the pump matches the pump speed, plunger size, motor horsepower and the accessories to be used with the unit.*
10. *If supplied, verify the pressure relief valve is set 10 to 15 percent above the specified maximum working pressure.*
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. *Attach a pressurized supply water line to the pump system inlet connector, 30 psi (1.4 bar) minimum or 80 psi (5.5 bar) minimum for 40,000 psi (2,758 bar) applications. The inlet supply line must be sized to flow at least double the GPM to be pumped from the system.*

    NOTICE *DO NOT gravity feed the pump. Fluid supplied to the suction side must be pressurized to help protect against cavitation damage.*

13. *Check to ensure supply water is flowing to the system.*

Startup

1. *Open the bypass flow regulating valve on electric powered units, if equipped. Open the regulator valve for the charge pump, if applicable.*
2. *Remove the nozzles or disconnect the pump for the work to allow maximum flow to be pumped without pressure for one minute.*
3. *Turn on the pressurized supply line water.*
4. *Start the electric motor.*
5. *Close the bypass flow regulating valve, if equipped.*
6. *With the nozzles removed, pump fluid through the system for at least one minute.*
7. *Stop the motor and replace the nozzles.*
8. *Start the motor and gradually increase flow through the system to the maximum allowable pressure. Observe the pump pressure gauge to ensure the reading does not rise above the specified allowable working pressure. If applicable, verify the charge pump pressure is at least 30 psi (1.4 bar), or 80 psi (5.5 bar) for 40,000 psi (2,758 bar) applications.*
9. *Set the by-pass flow regulating valve on electric motor driven systems to obtain the specified allowable working pressure, if equipped.*
10. *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' if the issue is not resolved.

11. *Ensure the suction and discharge valves remain fully open during operation.*

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

12. *Check the plunger packing for leakage.*

Proper Operation

In most jetting operations is it common practice to employ a minimum of two persons as a team. The nozzle operator holds a gun, lance or delivery hose and controls the motion and direction of the jet(s). The pump operator monitors and controls the pressurizing pump during jetting operation

1. *The nozzle and pump operators should be aware of the working pressure for the job and pump and nozzle orifice sizes should be selected to match these conditions.*
2. *The pump operator should not start the unit until told to do so by the nozzle operator. Before the bringing the system up to pressure, the pump operator should ensure the jetting nozzle is either directed at the work piece; that the nozzle operator has a secure stance and control of the nozzle; and each team member is in the proper position to perform their task.*
3. *The pump operator should slowly raise the pressure of the system to allow the nozzle operator to adjust to the changing reaction force from the nozzle. Once the operating pressure has been reached, the pressure should not be further adjusted without the operator's awareness. When the pressure is reduced at shutdown, the pressure should also be lowered slowly to prevent the sudden lack of force from causing the operator to lose their balance.*

   ⚠ CAUTION *The reaction force experienced by the nozzle operator can suddenly change when the trigger on a gun activates a dry shutoff or dump valve.*

   ⚠ CAUTION *The operator should be familiar with the change in thrust at various pressures, including the working pressure for the job. The operator's stance should allow them to withstand these changes.*

4. *Both before and after bringing the system up to pressure the pump operator should visually examine the hose and connections to the jetting gun or nozzle for leaks.*

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.

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.*

NOTICE *Fluids can be removed from the pump by blowing compressed air through the manifold.*

2. *Coat all bearings and machined surfaces inside the crankshaft with a rust inhibiting oil.*
3. *Rotate the crankshaft once each month.*
4. *Read the motor maintenance manual for instructions regarding storage.*

Cold Weather Storage

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

1. *If compressed air is available, connect an appropriately secured compressed air line to the inlet connection on the suction manifold and evacuate fluids from the pump and associated plumbing.*
2. *If compressed air is not available, introduce anti-freeze into the suction line and rotate the pump to mix any fluid remaining in the system with anti-freeze.*
3. *Read the motor maintenance manual for instructions regarding cold weather storage.*

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, motor, and drive train.*
2. *Verify the bearings are clean and in good condition.*
3. *Verify the plungers, valves and packing 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. *Pour oil into the crosshead reservoir and work into all the bearings, if applicable.*
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

⚠ DANGER *Never direct high-pressure fluid jets toward anyone or to any part of your 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.*

   ⚠ CAUTION *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 both primary and secondary pressure relief protection.

⚠ DANGER *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 a spring load relief valve is set at 1.25 times the maximum operation pressure. A relief valve is set at 12,500 psi (862 bar) if the maximum operating pressure is 10,000 psi (689 bar).*
- *For secondary protection a rupture disc assembly containing a manufacturer's approved disc with a burst rating of 1.5 times the maximum operating pressure is recommended.*

  If a rupture disc assembly is used for primary pressure relief protection, it should contain a manufacturer's approved disc with a burst rating of 1.25 times the maximum operating pressure.

DANGER *Only use a rupture disc holder that will not permit the use of coins or other objects in place of discs.*

CAUTION *Never adjust relief valves to open at more than 15 percent above the maximum working pressure of the pump.*

CAUTION *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, **at least every 40 operating hours.***
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

*The minimum burst rating for high pressure hoses must be a minimum of 2.5 times the operating pressure. For example, when operating at 10,000 psi (689 bar), the hose must have a minimum burst rating of 25,000 psi (1,724 bar). **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.*

DANGER *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 your 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.*

   ⚠ DANGER

   Do not use a hand-held control gun if the nozzle discharge can accidently strike the operator's body. *A 48-inch-long discharge barrel* ***must*** *be used on hand-held control guns to prevent nozzle discharge from accidently 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 200 psi (14 bar) 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 you suspect malfunctioned without having it repaired and/or thoroughly checked for proper operation by a qualified high-pressure maintenance mechanic or your 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. Protect the hose from traffic.*
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 a burst rating less than 3.0 times the operating pressure. A rigid lance operating at 10,000 psi (689 bar) must have a minimum burst rating of 30,000 psi (2,068 bar). Do not use a rigid lance with an unknown burst 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.*

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

Do not use a flex lance with a burst rating less than 2.5 times the operating pressure. A rigid lance operating at 10,000 psi (689 bar) must have a minimum burst rating of 25,000 psi (1,724 bar). 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 burst rating of less than 3.0 times, or 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 (NPT) 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.

   ⚠ CAUTION *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.

⚠ DANGER *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.

  ⚠ DANGER *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.

Maintenance Precautions

Observe these precautions whenever you maintain 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 with a minimum burst rating of 2.5 times the system operating pressure 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 you detect 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 you service and before you start the pump.*
- *Use only approved work platforms. Never climb on or around the equipment on makeshift devices.*

Protective Clothing

- *See Personal Protective Equipment (PPE) for more information.*

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"	47 – 60 (35 – 45)
9/16"	60 – 70 (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.*

  ⚠ DANGER *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 your specific 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 minimum burst rating for high pressure fittings must be a minimum of 2.5 times the system operating pressure.

- *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 wrenched turns.* ***Do not*** *tighten pipe threads past two wrenched 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.

Hydrostatic Testing

A hydrostatic test should be performed at periodic intervals to determine if a hose assembly is suitable for continued service. Hose assemblies must be hydrostatically tested for one minute for 1.5 times of the recommended working pressure every six (6) months.

Water is the usual test medium. During the hydrostatic test, the hose should be straight, not coiled or in a kinked position. A regular schedule for testing hose assemblies must be established and verified with formal Inspection Records maintained in a permanent and accessible file.

Prior to hydrostatic testing the hose assembly must be depressurized and laid out straight for visual inspection.

1. *Look for cuts, gouges or worn spots in the hose cover that expose the wire reinforcement. Remove hose with exposed reinforcement from service.*
2. *Look for bulges in the hose cover, or for sections with mashed flats or kinks. Remove hose showing any of these faults from service.*
3. *Inspect for hose cover blisters or loose outer cover. Remove hose showing either of these faults from service.*
4. *Examine the 18-inch length of hose adjacent to the coupling carefully for damage, such as kinks, soft spots, cover cracks or permanent deformation. Remove hose showing any of these faults from service.*
5. *If possible, inspect the inside of the hose assembly for blisters and soft or gummy spots. Remove hose showing any of these internal faults from service.*
6. *Check couplings for damage. Replace all damaged couplings and hydrostatically test the hose assembly before returning it to service.*
7. *Check couplings for worn threads. Replace all damaged couplings and hydrostatically test the hose assembly before returning it to service.*
8. *Inspect couplings for excessive corrosion or rust. Replace all rusted couplings and hydrostatically test the hose assembly before returning it to service.*

Only trained personnel, using proper tools and procedures, should conduct the hose assembly pressure tests.

Before conducting pressure tests on hose assemblies, provisions must be made to ensure the safety of personnel performing the tests and to prevent possible damage to property.

9. *Use only clean water with a maximum temperature of 80º F (27 º C). Air or other compressible gas must not be used as the test medium.*
10. *Prior to building up water pressure entrapped air should be bled through an outlet valve while the hose is being filled.*
11. *The hose being pressure tested must be restrained by placing it in a series of anchored steel straps close to each end and at approximately 10-foot (3 m) intervals along the length. If failure occurs during the test the anchored straps should not destroy the hose but can prevent a whipping action from causing other damage or injury.*
12. *The outlet end of the hose should be bulwarked so that a blown-out fitting cannot escape.*
13. *Sheet metal or a heavy matting shroud must be placed over the hose end to protect testing personnel from flying objects should a hose and bulwark failure occur during testing.*
14. *Test personnel must never stand in front of or to the rear of the hose ends during testing.*

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

Replacing Maintenance Items

Replace the Inlet Water Filters

Dirty or incorrect filters can shorten pump life.

TASK

1. *Go through the Lockout/Tagout procedure.*

   WARNING! *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. *To remove the filter canister, unscrew the canister body with provided tool.*
5. *Remove the filter canister.*
6. *Remove the filters from the canister. Examine them for unusual contamination and then discard them.*
7. *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.

8. *Flush the canister with fresh water or use a wet-dry vacuum to clean debris from the bottom of the canister.*
9. *Install new filter cartridge.*
10. *Align the filter canister lid to the filter body.*
11. *Flush the inlet line to the high-pressure manifold with fresh water to remove any contaminants that may have bypassed the filter housing.*
12. *Connect the inlet line to the high-pressure manifold.*
13. *Gradually open the inlet water valve and carefully examine the manifold and filters for leaks.*
14. *Use the bleeder valve on top of the filter housing to remove air from the system.*
15. *Do a final inspection to remove tools, parts, and rags from the equipment before startup.*

Power End Assembly

Overview

This section describes the instructions for repairing the Series 50 power frame. It must be read carefully and understood before performing any repair operations on the power frame. Proper use and adequate maintenance are fundamental for the power frame's functionality and longevity. Advanced Pressure Systems declines any responsibility for damage caused by the misuse, or the disregard of the instructions described in this section.

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.

Repair/Assembly Instructions

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

Crankcase Repair

1. *Crankcase repair operations may be carried out after draining the oil from the crankcase. To drain the oil, remove the oil dipstick (item 1, figure 1) and then the drain plug (item 2 figure 1).*

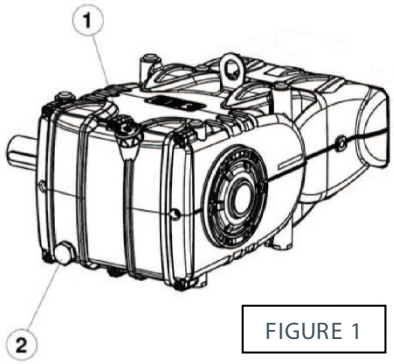


FIGURE 1

NOTICE *Used oil must be collected in an appropriate container and disposed of in authorized locations. In absolutely no case may it be disposed of into the environment.*

Crank Mechanism Removal

1. *Remove the pump shaft key and rear cover, place these items to the side.*
2. *Separate the connecting rod cap by removing the 2 bolts in each half. Remove the connecting rod caps and journal bearing halves (figure 2). Note the number marking during disassembly (figure 2/A).*

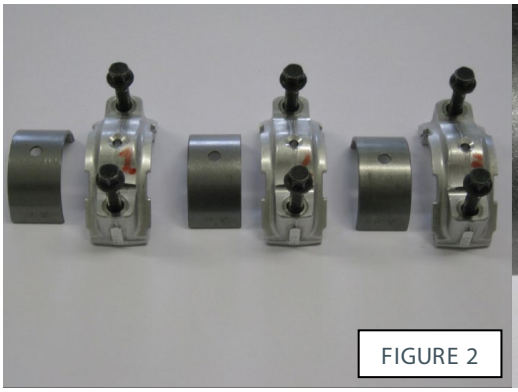


FIGURE 2

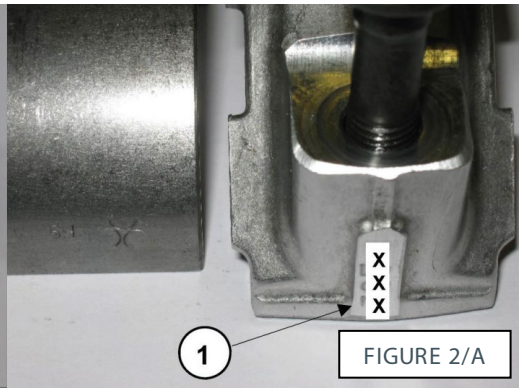


FIGURE 2/A

3. *Remove the side cover using 3 fully threaded M6 x 50mm screws, inserting them in the threaded holes as shown (figure 3).*

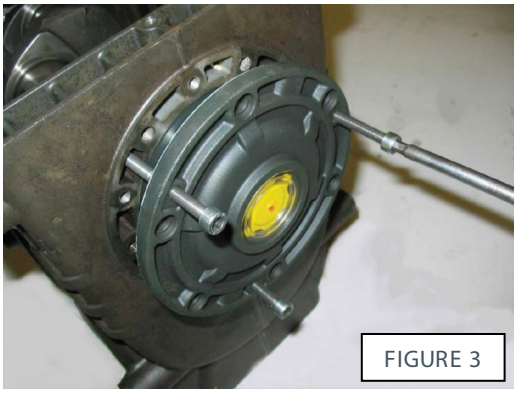


FIGURE 3

4. *Push the plunger guides and connecting rods forward in order to extract the crankshaft laterally. Two marks are visible on the crankshaft as shown (figure 4, item 1). They must be turned towards the operator in order to remove the crankshaft.*

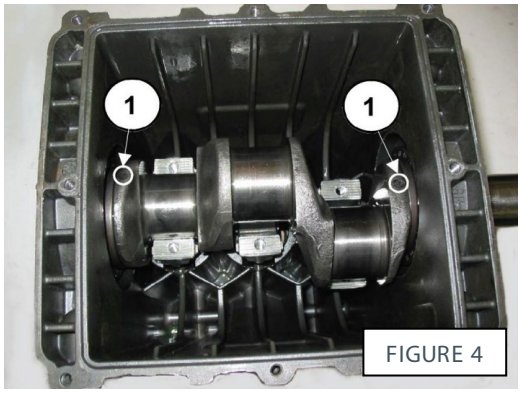


FIGURE 4

5. *Remove the crankshaft carfully.*
6. *To extract the plunger guide, the ceramic plunger and wiper must be removed first.*
7. *Remove the remaining connecting rod halves and plunger guides.*
8. *After removal, inspect the plunger guides for wear (figure 5, item 1). Replace the part at the sign of excessive wear. Remove the two M6 screws (figure 5, item 2) to separate the plunger guide from the connecting rod.*

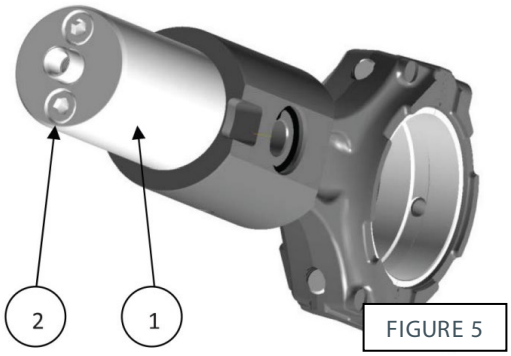


FIGURE 5

9. *Disassemble the crankshaft oil seals and the plunger guides using standard tools.*

Crank Mechanism Assembly

After cleaning the crankcase, reassemble the crank mechanism as follows:

1. *Assemble the upper and lower bearing halves into the connecting rod and connecting rod half. Make sure that the reference marks on the upper bearing half (figure 6, item 1) and lower bearing half (figure 6A, item 2) are positioned in their respective seats.*

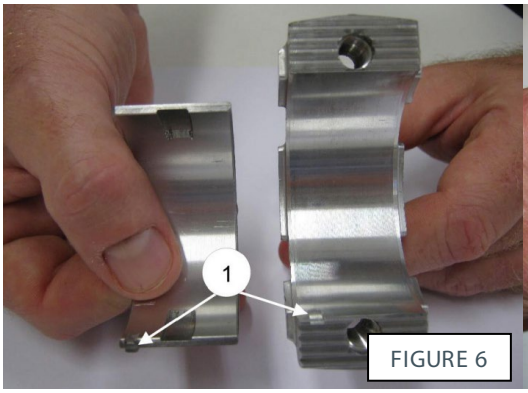


FIGURE 6

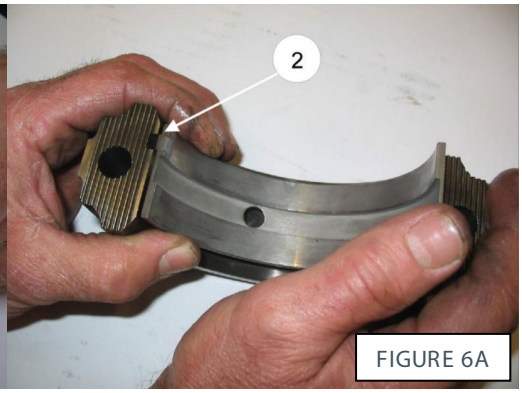


FIGURE 6A

2. *If the plunger guides have been disassembled, check the condition and placement of the o-ring (figure 6B, item 1) before reassembly. Replace as necessary.*
3. *If the plunger guides have been disassembled, install them onto the connecting rod using the two M6 screws previously removed (figure 5, item 2). Torque to the proper specification found in the section 'Torque Specification' in this section of the manual.*

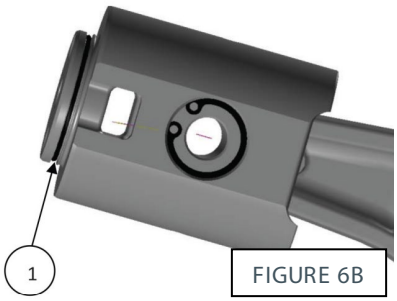


FIGURE 6B

4. *Insert the plunger guide into the crank case, making sure the numbering on the connecting rod is towards the top of the crank case.*
5. *To allow crankshaft installation, push the plunger guides as far forward as possible.*
6. *Before installing the crankshaft or the cover on the PTO side, check the condition of the lip seal and the relative contact area on the shaft. If replacement is necessary, position the new ring as shown in figure 7 (ring position on first assembly).*
7. *If the crankshaft shows wear in the relative area of contact with the lip seal, it is possible to reposition the lip seal as shown in figure 7 (ring position to remove shaft if worn).*

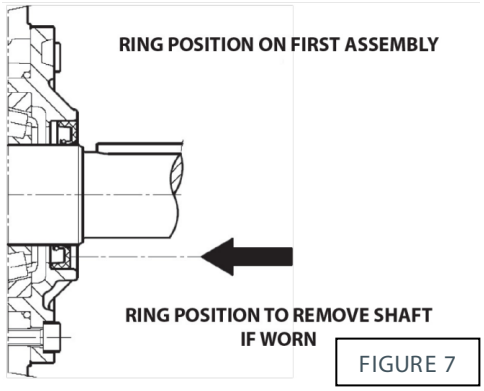


FIGURE 7

8. *Before assembling the side covers, ensure there are o-rings on both of them. Ensure there are shim rings on the indicator side cover only.*
9. *Carefully install the crankshaft.*
10. *To help the covers fit onto the crankcase, it is advised to use 3 M6 x 40mm screws for positioning (figure 8, item 1), then finish the operation with the supplied M6 x 18mm screws. Torque to the proper specification found in the section 'Torque Specification' in this section.*

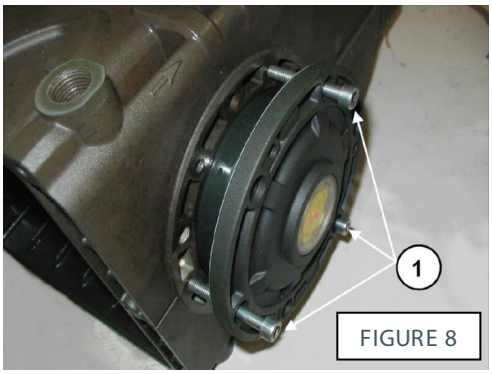


FIGURE 8

11. *Install the connecting rod cap, paying attention to the numbering and fasten the corresponding bolts (lubricating both the head and the threaded stem with the same oil used for the crankcase) proceeding in three different steps (figure 9).*
    I. *Manually install screws until they are hand tight.*
    II. *Fastening torque 22 ft-lbs. (30 Nm)*

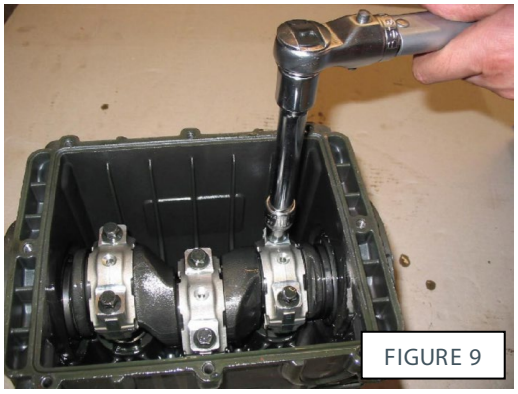


FIGURE 9

12. *Install the rear cover positioning the oil dipstick hole upward.*
13. *Fill the crankcase with 1 gallon (3.8 liters) of oil.*

Disassembly / Assembly of Bearings and Shims

The type of bearings used (tapered roller bearings), eliminates axial play on the crankshaft. The shims are to be used to reach this point. To assemble / disassemble, or to replace them if needed, carefully follow the indications below:

Disassembly / Assembly of Crankshaft

Without Bearing Replacement

After removing the side covers, as indicated in 'Crank Mechanism Disassembly', check the rollers and their races for wear. If all parts are in good condition, fully clean the components with a suitable degreaser and grease them again evenly using the same oil in the crankcase.

The same shims can be used again, being careful to fit them under the cover on the site glass side. After installing the complete unit (sight glass side flange and motor side flange), check that the shaft's rolling torque - with the connecting rods free - is at least 3 ft-lbs., max 5 ft-lbs. To position the two side covers on the crankcase, use three M6 x 40mm screws as shown (figure 8), and then fasten the screws.

The shafts rolling torque (with connecting rods coupled) must not exceed 6 ft. lbs.

With Bearing Replacement

After disassembling the side covers as indicated in 'Crank Mechanism Disassembly', remove the outer ring nut of the bearings from their covers and the inner ring nut. Remove the remaining part of the bearing, from the two shaft extremities using a standard pin extractor or similar tool as indicated (figure 10 and 11).

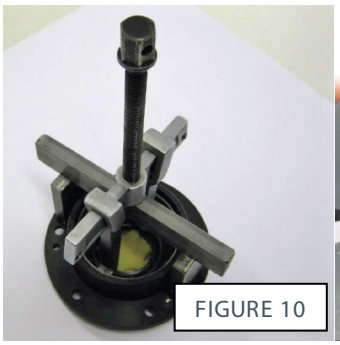


FIGURE 10

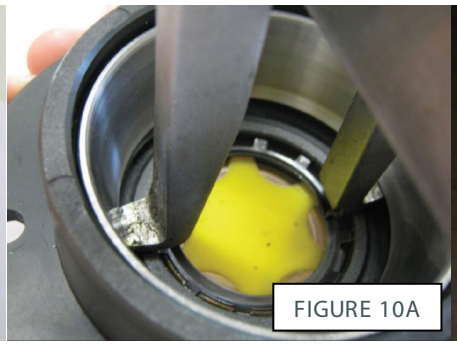


FIGURE 10A

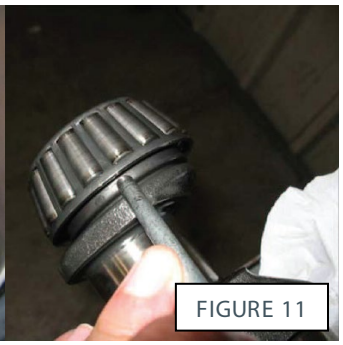


FIGURE 11

The new roller bearing can be mounted at room temperature with a press. It is necessary to lay them on the lateral side of the relevant ring nuts with opposite rings. The driving operation can be facilitated by heating the relevant parts to a temperature ranging between 250 - 300F, (120 - 150C), making sure that the ring nuts are correctly fitted in their seats.

⚠ CAUTION *Never invert the parts of the two bearings.*

Determining the Shim Pack

Perform the operation while the plunger/con-rod guides are assembled, the con-rod caps are disconnected, and the con-rods are pushed forward. Insert the pump crankshaft without key into the crankcase, making sure the PTO shank comes out the correct side.

Secure the PTO side flange to the casing, with the lip seal seated as described previously and tighten the screws to the recommended torque.

Install the flange on the indicator side without shims and start to move it closer, manually screwing the M6 x 40 service screws in equally, with small rotations. At the same time, check that the shaft rotates freely by turning it manually.

Continuing the procedure in this way, an increase in resistance during shaft rotation will be experienced. At this point, stop the forward moment of the cover and loosen the fixing screws completely. Using a feeler gauge, measure the clearance between the side cover and pump crankcase (figure 12).


FIGURE 12

To determine the shim pack, use the table below:

Measurement	Shim Type	No. of Pieces
From: 0.05 to 0.010	-	-
From: 0.11 to 0.20	0.1	1
From: 0.21 to 0.30	0.1	2
From: 0.31 to 0.35	0.25	1
From: 0.36 to 0.45	0.35	1
From: 0.46 to 0.55	0.35 0.10	1 1
From: 0.56 to 0.60	0.25	2
From 0.61 to 0.70	0.35 0.25	1 1

FIGURE 13

Once the type and number of shims have been determined using the table, proceed by assembling the shim pack on the indicator side cover centering (figure 13), secure the cover to the crankcase, following the procedure in 'Crank Mechanism Assembly' and tighten the screws to their recommended torque.

Check that the shaft rotation stall torque is between 3 ft-lbs. (4 Nm) and 4.5 ft-lbs. (6 Nm). If the torque is correct, connect the con-rods to the crankshaft. If it's not, add or remove shims to the shim pack, repeating the above operations.

Check the oil level by using the appropriate oil level dipstick with minimum and maximum value notches (figure 14, item 1). Refill if needed. Correct oil level inspection is done with the pump at room temperature; oil is changed with the pump at working temperature, by removing the rear plug (figure 14, item 2). Oil is to be changed every 1000 hours of operation. The amount required is ~1 gal. (3.8 liters).

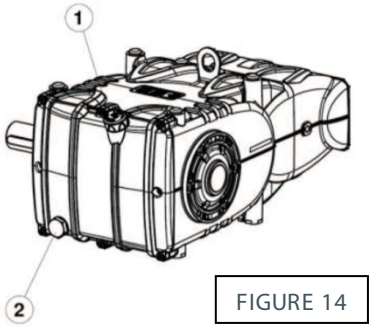


FIGURE 14

⚠ CAUTION *Oil must be changed at least once a year since it may deteriorate by oxidation.*

For room temperatures that differs from normal, follow the indications contained in the diagram below, keeping in mind that the oil must have a minimum viscosity of 180 cSt.

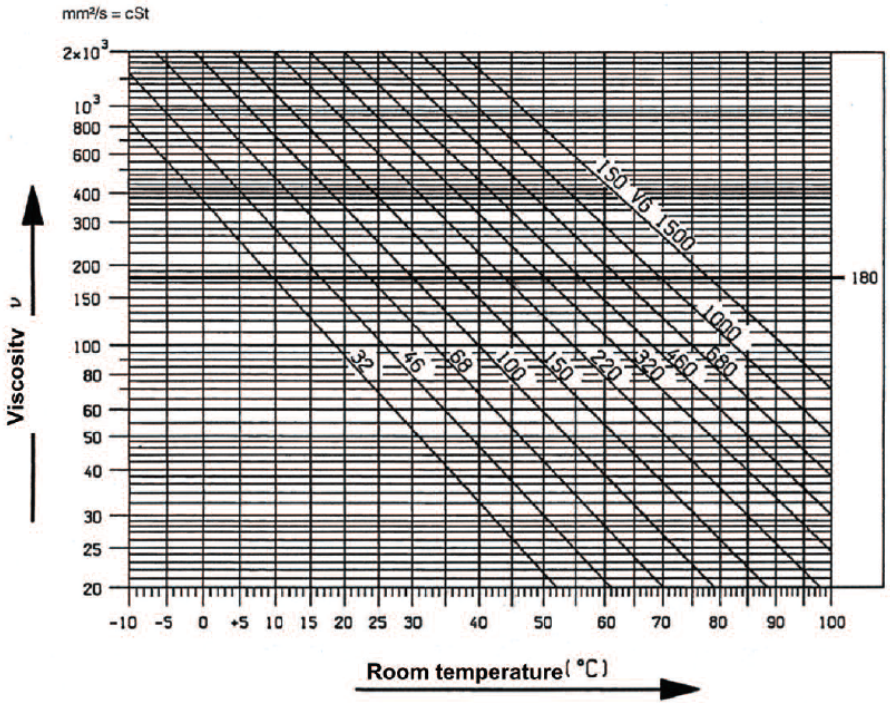
⚠ CAUTION *Used oil must be collected in an appropriate receptacle and disposed of in appropriate locations. In absolutely no case may it be dispersed into the environment.*

Recommended Lubricant Oil Types & Manufacturers

The pump is delivered with lubricant oil, compliant with room temperatures ranging between 0˚ and 30˚C (32˚ and 89.6˚ F). Some recommended lubricant types are indicated in the table below; these lubricants are treated with additives in order to increase corrosion protection and resistance to fatigue. As an alternative, Automotive SAE 85W-90 gearing lubricants may also be used.

BRAND	TYPE
GENERAL PUMP	SERIES 220
ARAL	Aral Degol BG220
BP	ENERGOL HLP 220
CASTROL	Hyspin VG 220, Magna 220
ELF	POLYTELIS 220
ESSO	NUTO 220
FINA	Cirkan 220
FUCHS	RENOLIN 220
MOBIL	DTE OIL BB
SHELL	TELLUS C 220
TEXACO	RANDO HD 220
TOTAL	CORTIS 220

VISCOSITY/ROOM TEMPERATURE DIAGRAM



In case of disassembly, to avoid letting dirt inside the front part of the crankcase, close the threaded hole with the appropriate cap, supplied.

Replace the crankcase cap with the oil dipstick and check oil level. The oil dipstick must always be accessible, even when the unit is assembled.

Torque Specification

Description	Exploded View Position (From Owner's Manual)	Fastening Torque (Ft. Lbs.)	Fastening Torque (Nm)
Cover fastening screws	19	7.4	10
Oil discharge plug	11	29.5	40
Lifting bracket fastening screw	17	73.8	100
Conrod caps fastening screw	18	28	38*
Support fastening screw	44	11	15****
Hydraulic motor flange screw	59	29.5	40

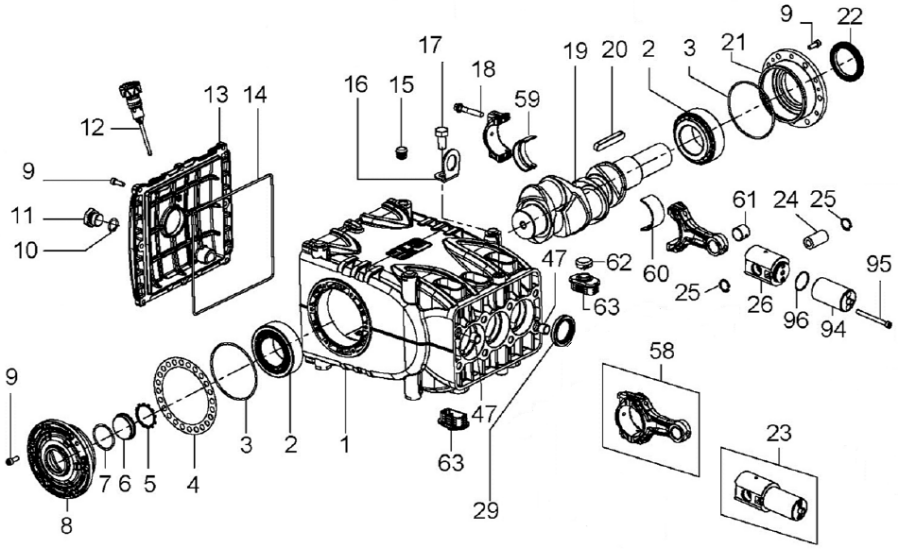
* The conrod caps fastening screws must be tighteded respecting the phases indicated in "Point D" of page 4-19

****The support fastening screws must be tightened in a single step

Maintenance Log

	HOURS & DATE						
OIL CHANGE							
GREASE							
PACKING REPLACEMENT							
PLUNGER REPLACEMENT							
VALVE REPLACEMENT							

Power End Exploded View and Parts List



ITEM NO.	PART NO.	DESCRIPTION
1	33-100-007.1	Pump Crankcase
2	33-100-007.2	Roller Bearing
3	33-100-007.3	O-ring, Ø 94.92 x 2.62
4	33-100-007.4.1	Shim, .25 mm
4	33-100-007.4.2	Shim, .1 mm
5	33-100-007.5	Retainer Clip, Ø 45
6	33-100-007.6	Oil Level Indicator
7	33-100-007.7	O-ring, Ø 39.34 x 2.62
8	33-100-007.8	Oil Level Indicator, Side Bearing Cover
9	33-100-007.9	Screw, M6 x 18
10	33-100-007.10	O-ring, Ø 17.13 x 2.62
11	33-100-007.11	Plug, G 1/2" x 13
12	33-100-007.12	Dipstick
13	33-100-007.13	Crankcase Cover
14	33-100-007.14	O-ring, Ø 215 x 3
15	33-100-007.15	Plug for Ø 15 Port
16	33-100-007.16	Lifting Eye Bolt
17	33-100-007.17	Screw, M16 x 1.5 x 25
18	33-100-007.18	Connecting Rod Screw, M8 x 48
19	33-100-007.19	Crankshaft
20	33-100-007.20	Crankshaft Key
21	33-100-007.21	Motor Side Bearing Cover
22	33-100-007.22	Oil Seal, Ø50 x 65 x 8
23	33-100-007.23	Plunger Guide
24	33-100-007.24	Wrist Pin, Ø 20 x 38
25	33-100-007.25	Seal, Ø 20
26	33-100-007.26	Plunger Guide
29	33-100-007.29	Seal, Ø 38 x 52 x 7/8.5
47	33-100-007.47	Center Bushing
58	33-100-007.58	Connecting Rod Assembly
59	33-100-007.59.1	BABBIT BEARING, NON-LOAD SIDE, SMOOTH, NOMINAL
59	33-100-007.59.2	BABBIT BEARING, NON-LOAD SIDE, SMOOTH, NOMINAL, +0.25
59	33-100-007.59.3	BABBIT BEARING, NON-LOAD SIDE, SMOOTH, NOMINAL, +0.50
60	33-100-007.60.1	BABBIT BEARING, LOAD BABBIT BEARING, LOAD SIDE
60	33-100-007.60.2	BABBIT BEARING, LOAD BABBIT BEARING, LOAD SIDE, +0.25
60	33-100-007.60.3	BABBIT BEARING, LOAD BABBIT BEARING, LOAD SIDE, +0.50
61	33-100-007.61	Bushing, Bronze
62	33-100-007.62	Cap, Vented
63	33-100-007.63	Plug, Drain
94	33-100-007.94	Plunger Guide Pin
95	33-100-007.95	Screw, M6x65
96	33-100-007.96	O-ring, Ø 30.00 x 1.5

LP Fluid End Assembly

Maintenance Overview

The following table provides a listing of low-pressure fluid end assemblies included in this portion of the manual.

LOW PRESSURE FLUID END ASSEMBLIES		
PART NO.	PLUNGER SIZE	DESIGN PRESSURE*
25-110-013	13/16" (.81)	10,000 PSI (689 BAR)
25-110-014	7/8" (.88)	10,000 PSI (689 BAR)
25-110-016	1" (1.0)	10,000 PSI (689 BAR)
25-110-020	1-1/4" (1.25)	10,000 PSI (689 BAR)

**Fluid end designed for stated pressure, rod load not to exceed 4,500 lbs.*

Never perform any type of maintenance on the fluid end assembly while it is pressurized. Always turn the power off and bleed the high-pressure water before servicing.

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.

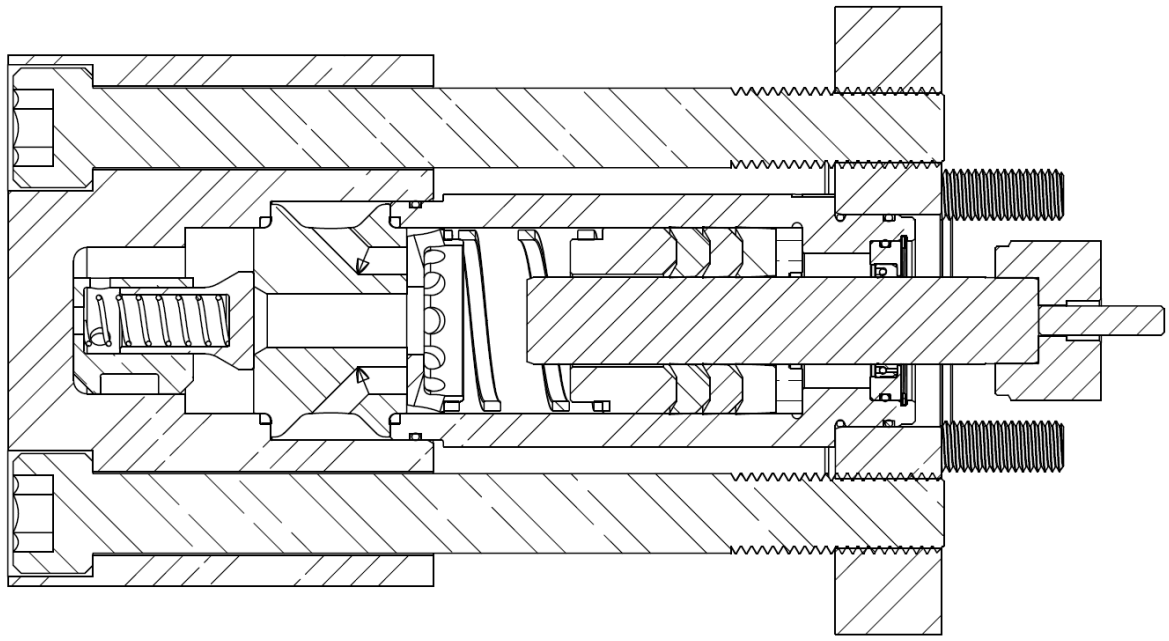
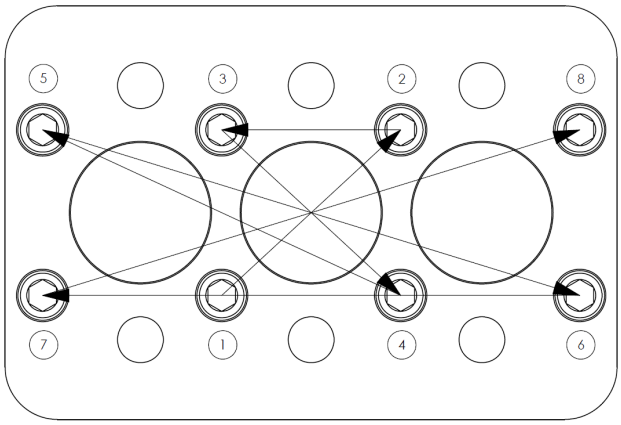


Figure 1: Fluid End Assembly

NOTICE *Refer to fluid end drawing for a complete listing of replacement parts and part numbers.*

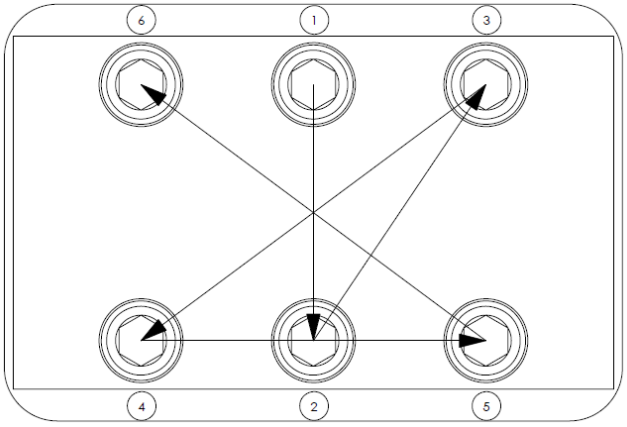
Torque Specification

- *Subplate:*



1. *Apply silver grade anti-seize to threads and torque to 62 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Manifold:*



1. *Apply silver grade anti-seize to threads and torque to 120 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Plunger Assembly*

1. *Apply silver grade anti-seize to threads and torque to 10 ft. lbs.*

Valve Assemblies

The fluid end valves are spring loaded, flat disc and seat type. Both the discharge and suction valves and seat can be removed from the front of the fluid end.

Valves and seating surfaces encounter high wear during operation. Frequent inspection, maintenance and/or replacement are required to ensure proper operation. Poor suction and water quality can reduce valve life and result in rapid mechanical wear of the power end components.

- *Valve springs should be replaced after 2,000 hours of operation to reduce the possibility of a fatigue break; or when the coils have flat wear spots due to rubbing during normal operation.*
- *The valve seat provides a seating surface for both the discharge and suction valve. Valve seat surfaces are flat and can be restored by surface grinding to a 4 to 16 RMS surface finish.*
- *Mating surfaces of the valve seat and the valves must be smooth and free from nicks and scratches.*

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws and washers attaching the manifold to the subplate. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*

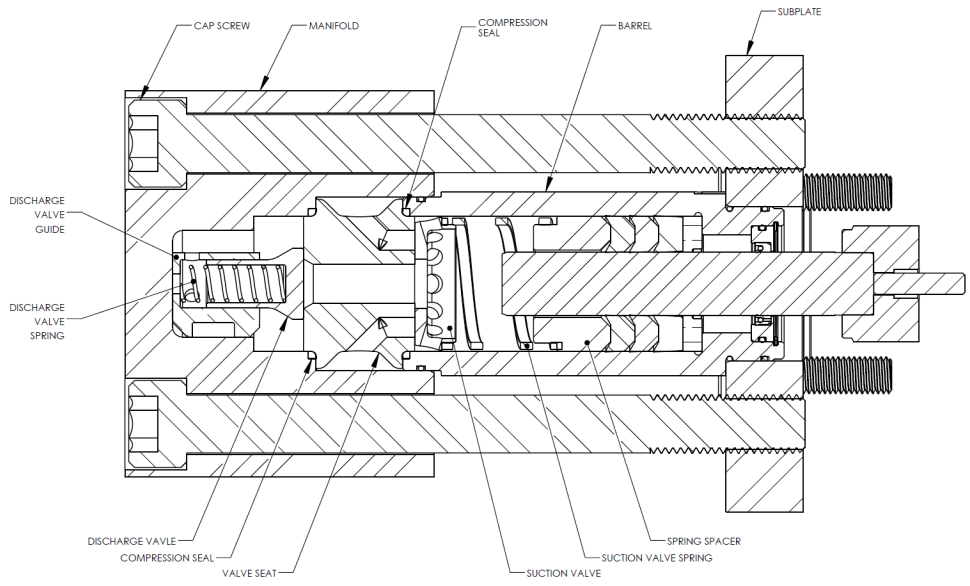


Figure 2: Valve Removal

3. *Lift the manifold off, separating it from the barrels. Place the manifold on a solid horizontal surface with the valve seats facing up.*
4. *Place a rod through the center bore of the valve seats and pry the seats from the manifold. Remove the discharge valves, valve springs and discharge valve guides from the manifold.*
5. *Remove the suction valves, valve springs and spring spacers from the barrels by sliding them out the front.*
6. *Install the compression seal in the counter-bore in the manifold with the radius facing up.*
7. *Install the discharge valve guides in the manifold, followed by the discharge valve springs and discharge valves.*

   ⚠ CAUTION *Do not damage the smooth sealing surface of the valve seat.*
8. *Clean the holes in the valve seats and position the valve seats in the manifold ensuring all of the holes are facing the correct direction.*
9. *Use a brass rod to tap the valve seat into the manifold. One swift strike should be sufficient. Repeat for the remaining valve seats.*
10. *Install the compression seal in the face of the barrels.*
11. *Install the spring spacers, suction valve springs and suction valves in the barrels.*
12. *Apply a thin layer of FML-2 grease to the O-rings on the end of the barrels. Lift the manifold and position it onto the barrels.*
13. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
14. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Barrel Assemblies

⚠ DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

⚠ DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws attaching the manifold to the transfer block. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*
3. *Lift the manifold off, separating it from the barrels. The valve seats may or may not remain in the manifold. If not, remove the valve seats from the barrels.*

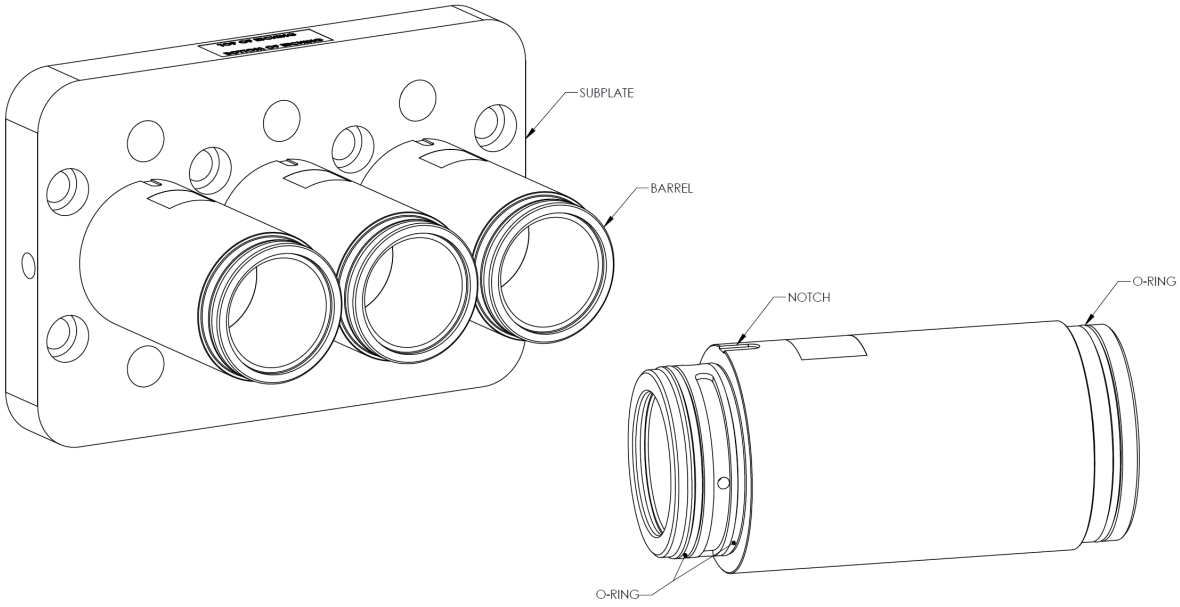


Figure 3: Barrel Assembly

4. *Grasp the barrel firmly and pull it from the power end. Remove the remaining barrels in the same manner.*

   ⚠ CAUTION *Use caution to not break the plungers when removing the barrels.*

5. *Apply FML-2 grease to the O-rings and insert them into the appropriate grooves on the barrel. Apply a light coat of Loctite 76764 anti-seize or equivalent to the transfer block bores.*
6. *Carefully push the barrel into the transfer block. Use two spring spacers to apply pressure to the packing as the barrel is being pushed into the block. This prevents the packing from separating when it goes over the plunger.*
7. *Align the notch in the barrel with the top of the pump.*
8. *Install the remaining barrels in the same manner.*
9. *Position the manifold onto the barrels.*
10. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
11. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Packing Assemblies

Before the packing assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

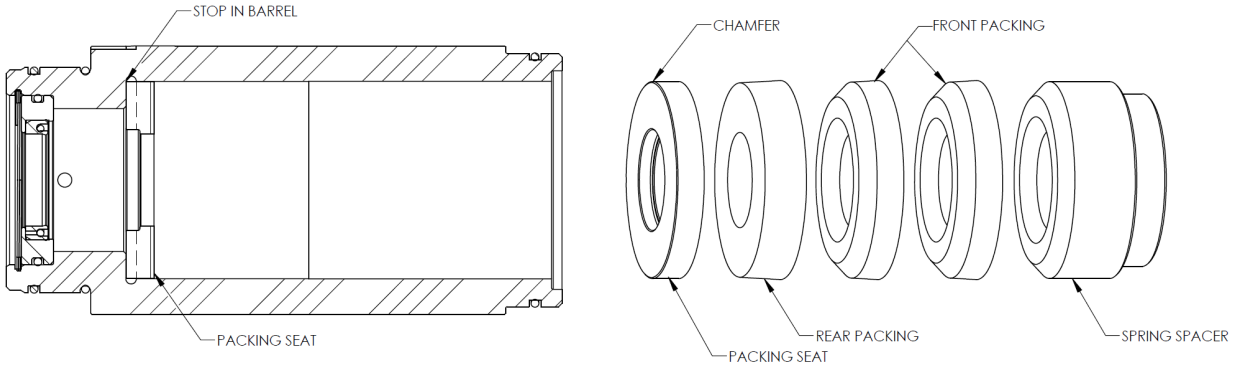


Figure 4: Packing Installation

1. *Remove suction valve, compression spring and spring spacer from the barrel.*
2. *Use a wooden dowel or brass bar to press the packing seat and the rear and front packing out of the barrel.*
3. *Install the new packing seat ensuring the chamfered edge rests against the stop in the barrel.*
4. *Slide the rear packing and the two front packing rings into the barrel. Install the spring spacer and use it to correctly position the packing.*
5. *Install the compression spring and the suction valve.*
6. *Replace the remaining packing assemblies and install the barrels following the procedure 'Barrel Assemblies'.*

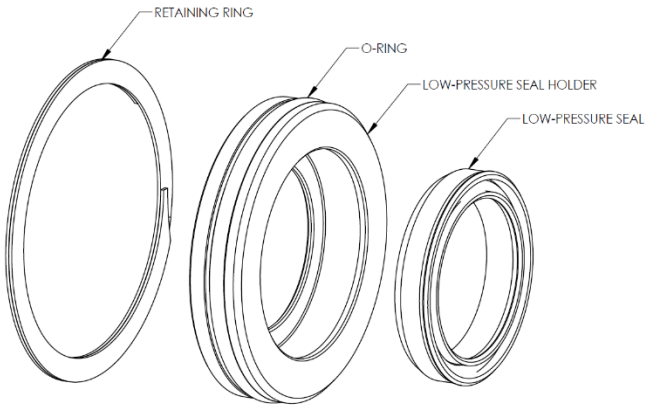
Low Pressure Seal Assemblies

Before the low-pressure seal assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance on the system components.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Remove the retaining ring securing the low-pressure seal holder.*
2. *Remove the holder from the barrel.*
3. *Remove the low-pressure seal and the o-ring from the holder, being sure not to damage the seal bore in the holder.*
4. *Install a new low-pressure seal in the seal holder and install a new o-ring on the holder.*



5. *Apply a small amount of FML-2 grease to the o-ring and insert the holder into the barrel. Secure the holder in position with the retaining ring.*
6. *Replace the remaining low-pressure seals and install the barrels following the procedure 'Barrel Assemblies'.*

Plungers

The following procedure is used to replace the plungers.

1. *Slowly rotate the crankshaft until a wrench can be inserted onto the back of the plunger.*
2. *Unscrew the plunger and remove it from the pump.*
3. *Inspect the plunger for wear or damage and replace if necessary.*
4. *To replace, apply Loctite 76764 and screw the plunger into the intermediate rod in the power end and torque to the specifications in section 'Torque Specifications'.*

HP Fluid End Assembly

Maintenance Overview

The following table provides a listing of high-pressure fluid end assemblies included in this portion of the manual.

LOW PRESSURE FLUID END ASSEMBLIES		
PART NO.	PLUNGER SIZE	DESIGN PRESSURE*
25-120-007	7/16" (.44)	20,000 PSI (1,379 BAR)
25-120-008	1/2" (.50)	20,000 PSI (1,379 BAR)
25-120-009	9/16" (.56)	20,000 PSI (1,379 BAR)
25-120-010	5/8" (.63)	20,000 PSI (1,379 BAR)
25-120-011	11/16" (.69)	20,000 PSI (1,379 BAR)
25-120-012	3/4" (.75)	20,000 PSI (1,379 BAR)

**Fluid end designed for stated pressure, rod load not to exceed 4,500 lbs.*

Never perform any type of maintenance on the fluid end assembly while it is pressurized. Always turn the power off and bleed the high-pressure water before servicing.

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.

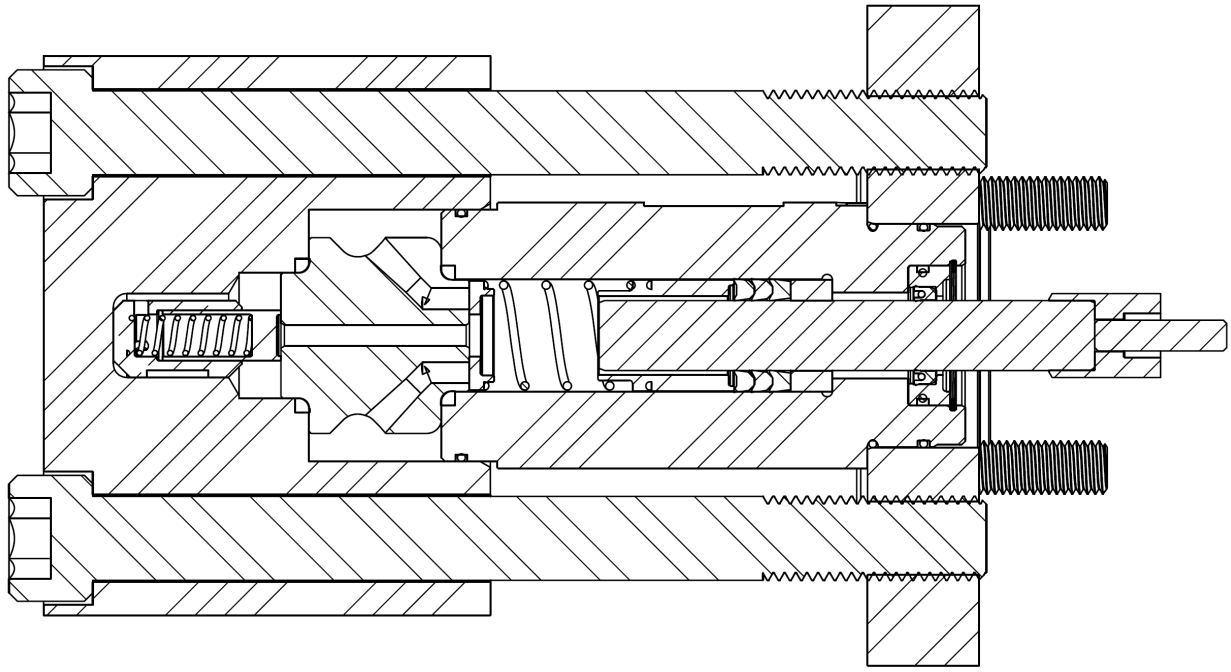
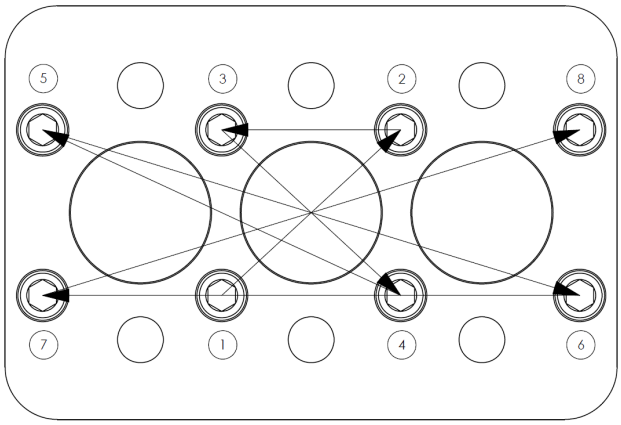


Figure 1: Fluid End Assembly

NOTICE *Refer to fluid end drawing for a complete listing of replacement parts and part numbers.*

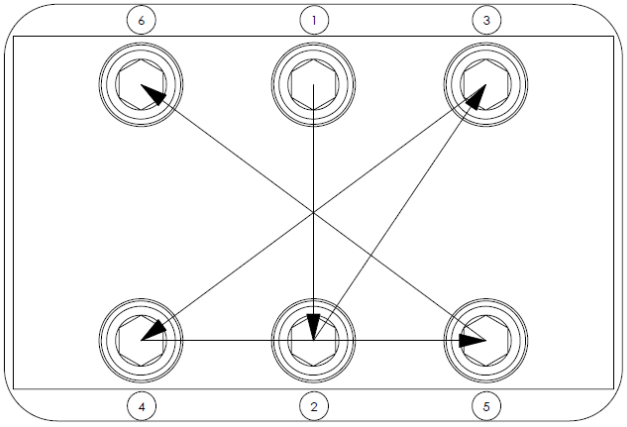
Torque Specification

- *Subplate:*



1. *Apply silver grade anti-seize to threads and torque to 62 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Manifold:*



1. *Apply silver grade anti-seize to threads and torque to 160 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Plunger Assembly*

1. *Apply silver grade anti-seize to threads and torque to 10 ft. lbs.*

Valve Assemblies

The fluid end valves are spring loaded, flat disc and seat type. Both the discharge and suction valves and seat can be removed from the front of the fluid end.

Valves and seating surfaces encounter high wear during operation. Frequent inspection, maintenance and/or replacement are required to ensure proper operation. Poor suction and water quality can reduce valve life and result in rapid mechanical wear of the power end components.

- *Valve springs should be replaced after 2,000 hours of operation to reduce the possibility of a fatigue break; or when the coils have flat wear spots due to rubbing during normal operation.*
- *The valve seat provides a seating surface for both the discharge and suction valve. Valve seat surfaces are flat and can be restored by surface grinding to a 4 to 16 RMS surface finish.*
- *Mating surfaces of the valve seat and the valves must be smooth and free from nicks and scratches.*

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws and washers attaching the manifold to the subplate. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*

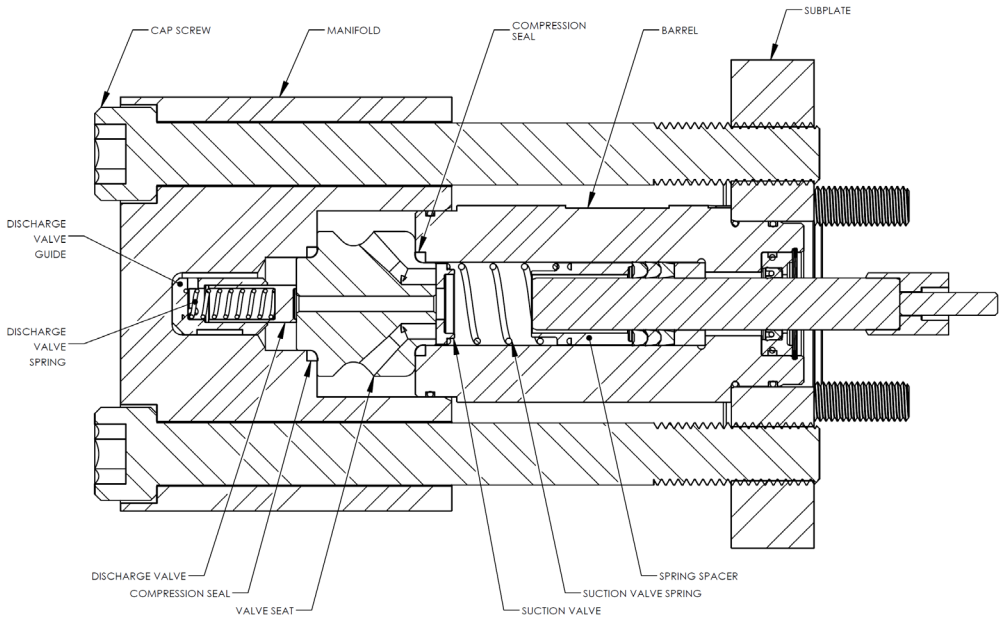


Figure 2: Valve Removal

3. *Lift the manifold off, separating it from the barrels. Place the manifold on a solid horizontal surface with the valve seats facing up.*
4. *Place a rod through the center bore of the valve seats and pry the seats from the manifold. Remove the discharge valves, valve springs and discharge valve guides from the manifold.*
5. *Remove the suction valves, valve springs and spring spacers from the barrels by sliding them out the front.*
6. *Install the compression seal in the counter-bore in the manifold with the radius facing up.*
7. *Install the discharge valve guides in the manifold, followed by the discharge valve springs and discharge valves.*

   ⚠ CAUTION *Do not damage the smooth sealing surface of the valve seat.*
8. *Clean the holes in the valve seats and position the valve seats in the manifold ensuring all of the holes are facing the correct direction.*
9. *Use a brass rod to tap the valve seat into the manifold. One swift strike should be sufficient. Repeat for the remaining valve seats.*
10. *Install the compression seal in the face of the barrels.*
11. *Install the spring spacers, suction valve springs and suction valves in the barrels.*
12. *Apply a thin layer of FML-2 grease to the O-rings on the end of the barrels. Lift the manifold and position it onto the barrels.*
13. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
14. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Barrel Assemblies

⚠ DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

⚠ DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws attaching the manifold to the transfer block. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*
3. *Lift the manifold off, separating it from the barrels. The valve seats may or may not remain in the manifold. If not, remove the valve seats from the barrels.*

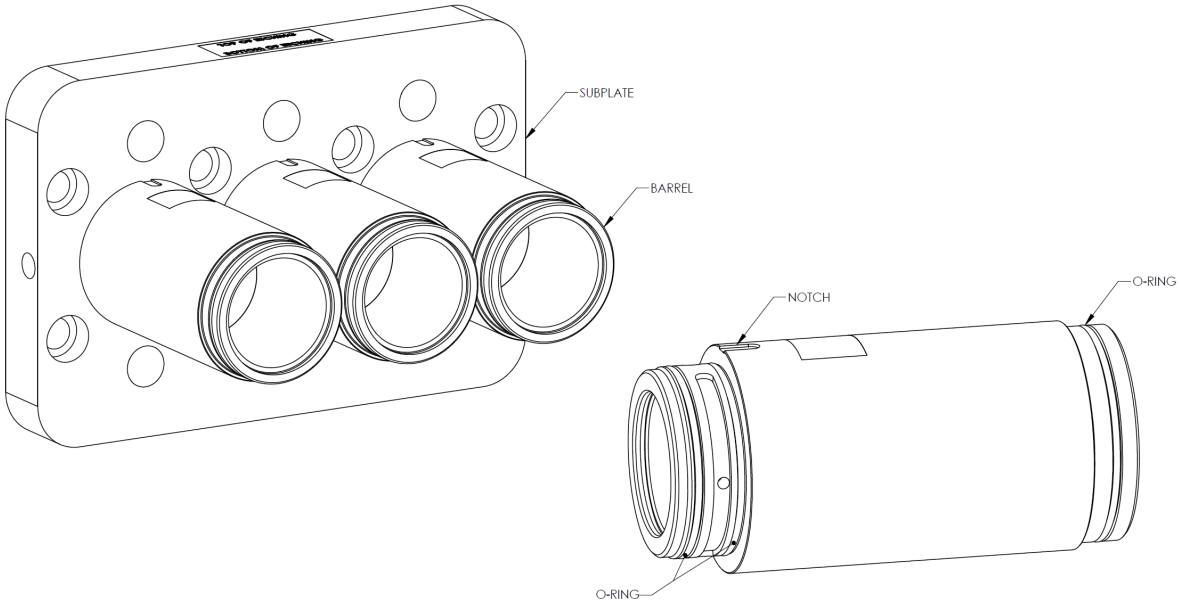


Figure 3: Barrel Assembly

4. *Grasp the barrel firmly and pull it from the power end. Remove the remaining barrels in the same manner.*

   ⚠ CAUTION *Use caution to not break the plungers when removing the barrels.*

5. *Apply FML-2 grease to the O-rings and insert them into the appropriate grooves on the barrel. Apply a light coat of Loctite 76764 anti-seize or equivalent to the transfer block bores.*
6. *Carefully push the barrel into the transfer block. Use two spring spacers to apply pressure to the packing as the barrel is being pushed into the block. This prevents the packing from separating when it goes over the plunger.*
7. *Align the notch in the barrel with the top of the pump.*
8. *Install the remaining barrels in the same manner.*
9. *Position the manifold onto the barrels.*
10. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
11. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Packing Assemblies

Before the packing assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

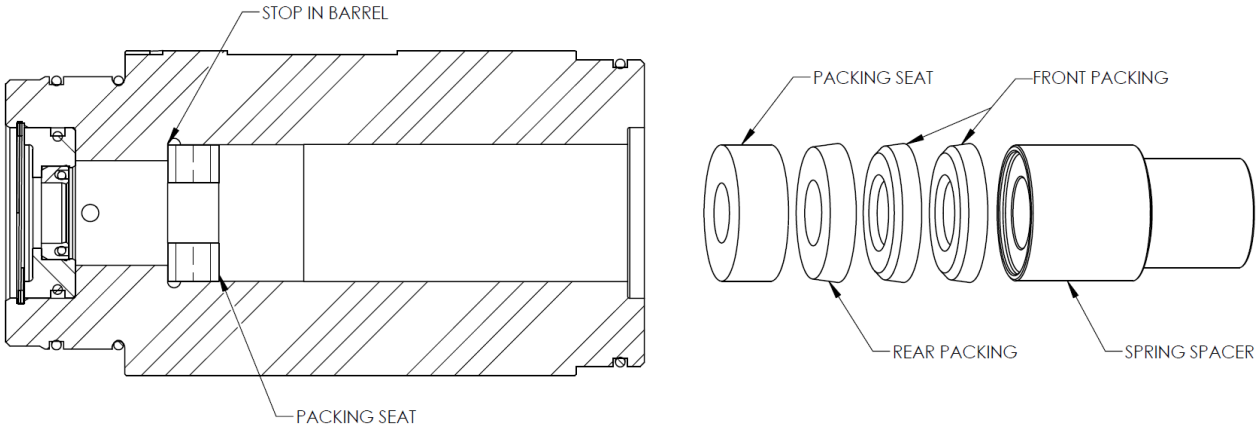


Figure 4: Packing Installation

1. *Remove suction valve, compression spring and spring spacer from the barrel.*
2. *Use a wooden dowel or brass bar to press the packing seat and the rear and front packing out of the barrel.*
3. *Install the new packing seat ensuring the edge rests against the stop in the barrel.*
4. *Slide the rear packing and the two front packing rings into the barrel. Install the spring spacer and use it to correctly position the packing.*
5. *Install the compression spring and the suction valve.*
6. *Replace the remaining packing assemblies and install the barrels following the procedure 'Barrel Assemblies'.*

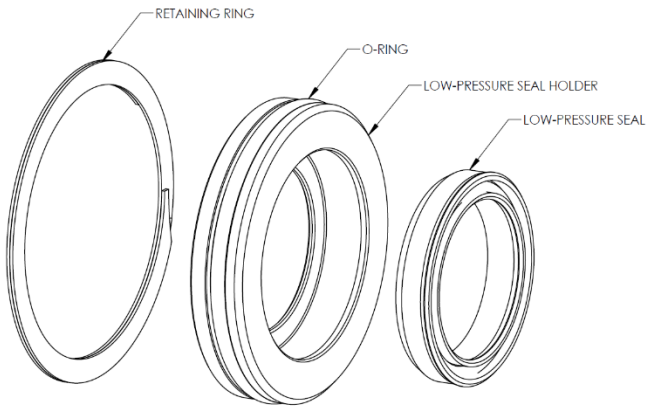
Low Pressure Seal Assemblies

Before the low-pressure seal assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance on the system components.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Remove the retaining ring securing the low-pressure seal holder.*
2. *Remove the holder from the barrel.*
3. *Remove the low-pressure seal and the o-ring from the holder, being sure not to damage the seal bore in the holder.*
4. *Install a new low-pressure seal in the seal holder and install a new o-ring on the holder.*



5. *Apply a small amount of FML-2 grease to the o-ring and insert the holder into the barrel. Secure the holder in position with the retaining ring.*
6. *Replace the remaining low-pressure seals and install the barrels following the procedure 'Barrel Assemblies'.*

Plungers

The following procedure is used to replace the plungers.

1. *Slowly rotate the crankshaft until a wrench can be inserted onto the back of the plunger.*
2. *Unscrew the plunger and remove it from the pump.*
3. *Inspect the plunger for wear or damage and replace if necessary.*
4. *To replace, apply Loctite 76764 and screw the plunger into the intermediate rod in the power end and torque to the specifications in section 'Torque Specification'*

UHP Fluid End Assembly

Maintenance Overview

The following table provides a listing of ultra-high-pressure fluid end assemblies included in this portion of the manual.

LOW PRESSURE FLUID END ASSEMBLIES		
PART NO.	PLUNGER SIZE	DESIGN PRESSURE*
25-140-005	5/16" (.32)	40,000 PSI (2,758 BAR)
25-140-006	3/8" (.38)	40,000 PSI (2,758 BAR)

**Fluid end designed for stated pressure, rod load not to exceed 4,500 lbs.*

Never perform any type of maintenance on the fluid end assembly while it is pressurized. Always turn the power off and bleed the high-pressure water before servicing.

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.

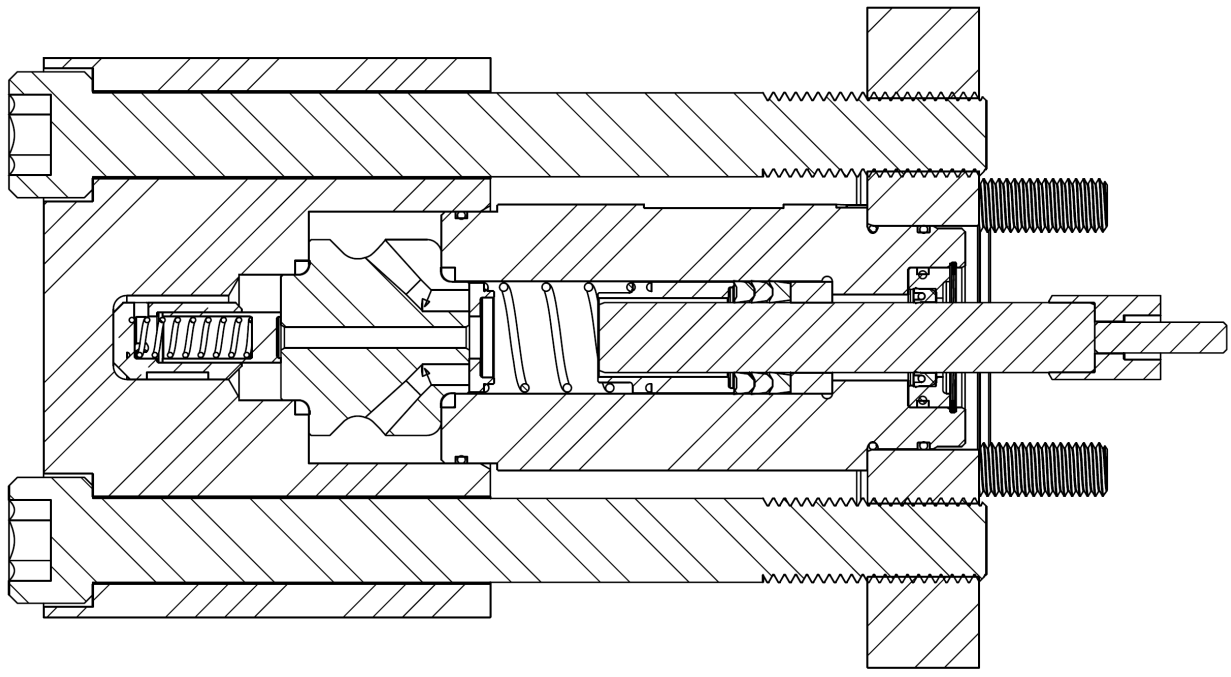
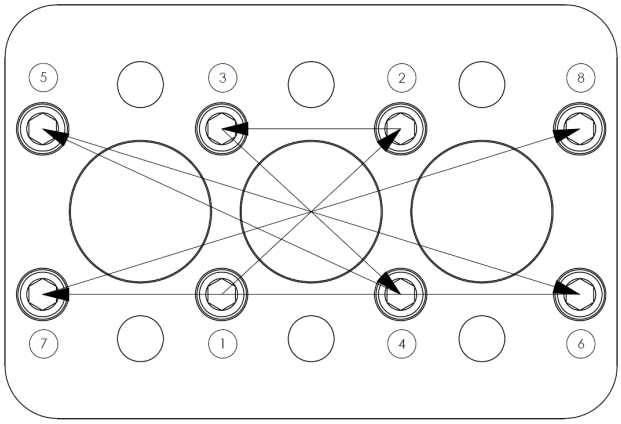


Figure 1: Fluid End Assembly

NOTICE *Refer to fluid end drawing for a complete listing of replacement parts and part numbers.*

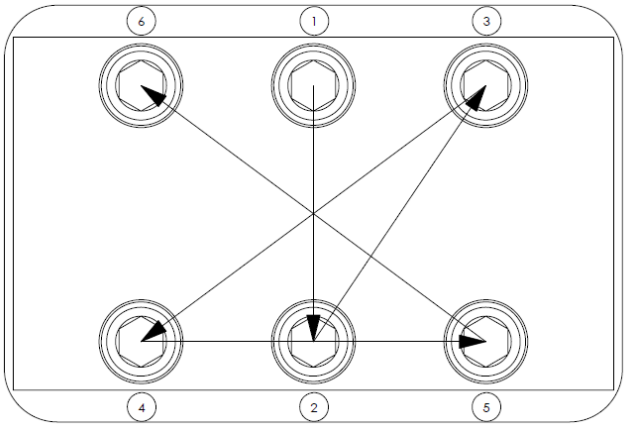
Torque Specification

- *Subplate:*



1. *Apply silver grade anti-seize to threads and torque to 62 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Manifold:*



1. *Apply silver grade anti-seize to threads and torque to 160 ft. lbs.*
2. *Tighten bolts in order indicated by numbers.*

- *Plunger Assembly*

1. *Apply silver grade anti-seize to threads and torque to 10 ft. lbs.*

Valve Assemblies

The fluid end valves are spring loaded, flat disc and seat type. Both the discharge and suction valves and seat can be removed from the front of the fluid end.

Valves and seating surfaces encounter high wear during operation. Frequent inspection, maintenance and/or replacement are required to ensure proper operation. Poor suction and water quality can reduce valve life and result in rapid mechanical wear of the power end components.

- *Valve springs should be replaced after 2,000 hours of operation to reduce the possibility of a fatigue break; or when the coils have flat wear spots due to rubbing during normal operation.*
- *The valve seat provides a seating surface for both the discharge and suction valve. Valve seat surfaces are flat and can be restored by surface grinding to a 4 to 16 RMS surface finish.*
- *Mating surfaces of the valve seat and the valves must be smooth and free from nicks and scratches.*

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws and washers attaching the manifold to the subplate. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*

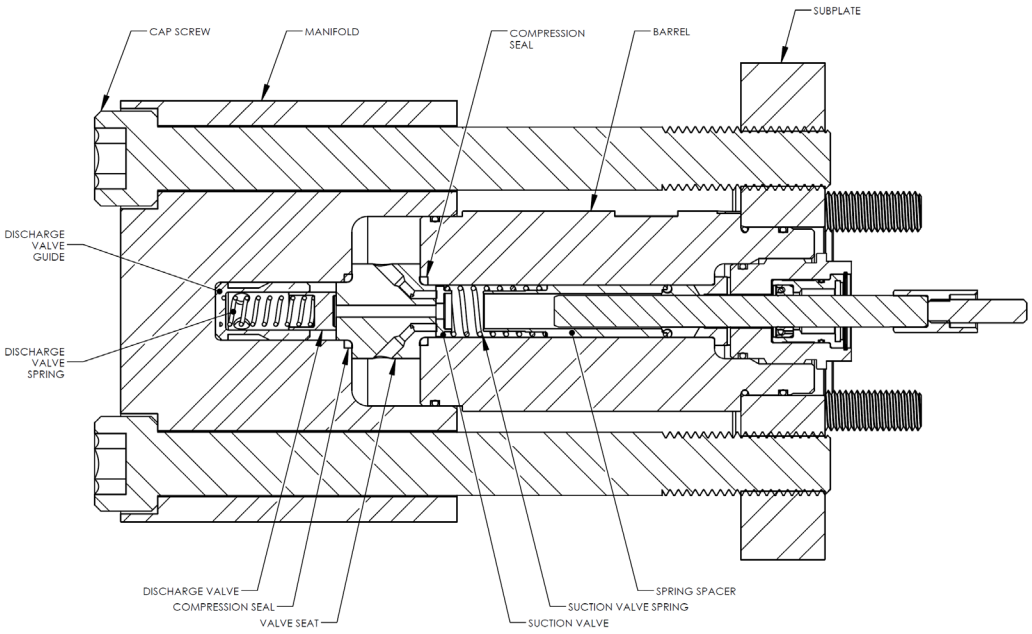


Figure 2: Valve Removal

3. *Lift the manifold off, separating it from the barrels. Place the manifold on a solid horizontal surface with the valve seats facing up.*
4. *Place a rod through the center bore of the valve seats and pry the seats from the manifold. Remove the discharge valves, valve springs and discharge valve guides from the manifold.*
5. *Remove the suction valves, valve springs and spring spacers from the barrels by sliding them out the front.*
6. *Install the compression seal in the counter-bore in the manifold with the radius facing up.*
7. *Install the discharge valve guides in the manifold, followed by the discharge valve springs and discharge valves.*

   ⚠ CAUTION *Do not damage the smooth sealing surface of the valve seat.*
8. *Clean the holes in the valve seats and position the valve seats in the manifold ensuring all of the holes are facing the correct direction.*
9. *Use a brass rod to tap the valve seat into the manifold. One swift strike should be sufficient. Repeat for the remaining valve seats.*
10. *Install the compression seal in the face of the barrels.*
11. *Install the spring spacers, suction valve springs and suction valves in the barrels.*
12. *Apply a thin layer of FML-2 grease to the O-rings on the end of the barrels. Lift the manifold and position it onto the barrels.*
13. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
14. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Barrel Assemblies

⚠ DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

⚠ DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Disconnect all piping to the manifold.*
2. *Remove the cap screws attaching the manifold to the transfer block. Use a flat screwdriver or other suitable tool to pry the manifold from each barrel, leaving the barrels in position.*
3. *Lift the manifold off, separating it from the barrels. The valve seats may or may not remain in the manifold. If not, remove the valve seats from the barrels.*

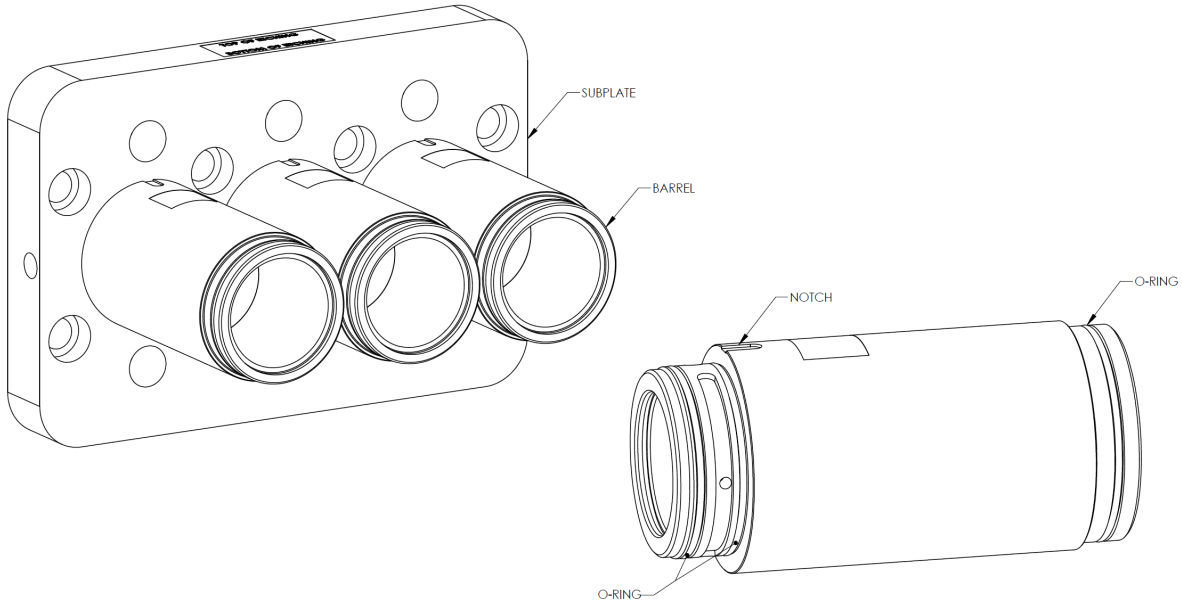


Figure 3: Barrel Assembly

4. *Grasp the barrel firmly and pull it from the power end. Remove the remaining barrels in the same manner.*

   ⚠ CAUTION *Use caution to not break the plungers when removing the barrels.*

5. *Apply FML-2 grease to the O-rings and insert them into the appropriate grooves on the barrel. Apply a light coat of Loctite 76764 anti-seize or equivalent to the transfer block bores.*
6. *Carefully push the barrel into the transfer block. Use two spring spacers to apply pressure to the packing as the barrel is being pushed into the block. This prevents the packing from separating when it goes over the plunger.*
7. *Align the notch in the barrel with the top of the pump.*
8. *Install the remaining barrels in the same manner.*
9. *Position the manifold onto the barrels.*
10. *Apply Loctite 76764 anti-seize or equivalent to the threads on the cap screws and install the screws. Torque the screws to the specifications in section 'Torque Specifications'.*
11. *Rotate the crankshaft at least three revolutions to ensure no parts are binding.*

Packing Assemblies

Before the packing assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

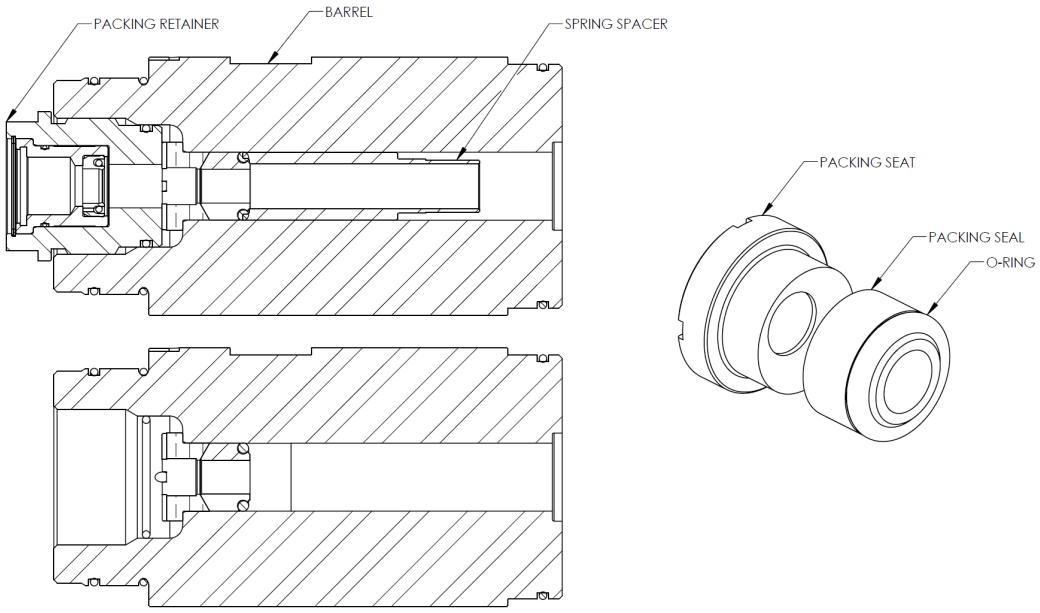


Figure 4: Packing Installation

1. *Remove suction valve, compression spring and spring spacer from the barrel.*
2. *Place the barrel in a vice and unscrew the packing retainer from the barrel.*
3. *Install the spring spacer and use a wooden dowel or brass bar to press against the spacer, forcing the packing seat and the packing seal out of the barrel.*
4. *Install a new o-ring on the new packing seal.*
5. *Apply a small amount of FML-2 grease to the o-ring and install the packing seal and the new packing seat into the back end of the barrel.*
6. *Inspect the o-ring on the packing retainer and replace if necessary. Thoroughly coat the threads on the packing retainer and on the barrel with Loctite 76764 anti-seize or equivalent. Place the barrel in a vice and thread the packing retainer into the barrel.*
7. *Install the spring spacer, compression spring and the suction valve.*
8. *Replace the remaining packing assemblies and install the barrels following the procedure, Barrel Assemblies.*

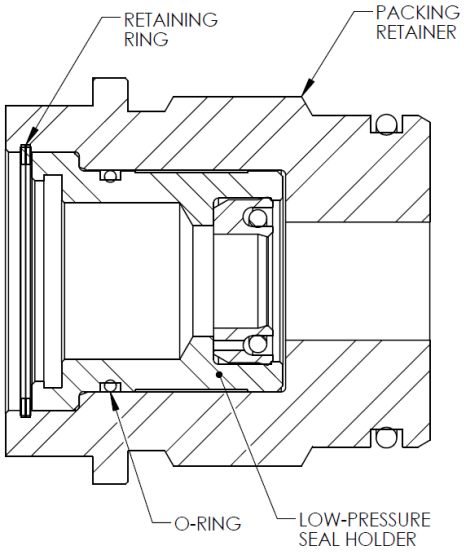
Low Pressure Seal Assemblies

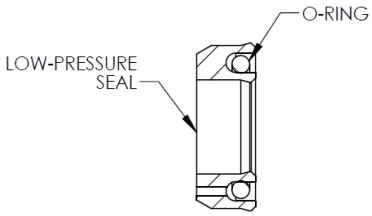
Before the low-pressure seal assembly can be removed for service, the barrels must be removed from the power end. Follow the procedure, Barrel Assemblies, and then proceed with Step 1 below.

DANGER *Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance on the system components.*

DANGER *Ensure all pressure is relieved or blocked from the hydraulic and high-pressure circuits before performing maintenance.*

1. *Place the barrel in a vice and unscrew the packing retainer.*
2. *Remove the retaining ring securing the low-pressure seal holder.*
3. *Remove the holder from the packing retainer.*
4. *Remove the low-pressure seal and the o-ring from the holder, being sure not to damage the seal bore in the holder.*
5. *Install a new low-pressure seal in the seal holder and install a new o-ring on the holder.*
6. *Apply a small amount of FML-2 grease to the o-ring and insert the holder into the packing retainer. Secure the holder in position with the retaining ring.*
7. *Inspect the o-ring on the packing retainer and replace if necessary. Thoroughly coat the threads on the packing retainer and on the barrel with Loctite 76764 anti-seize or equivalent. Place the barrel in a vice and thread the packing retainer into the barrel.*





8. *Replace the remaining low-pressure seals and install the barrels following the procedure, Barrel Assemblies.*

Plungers

The following procedure is used to replace the plungers.

1. *Slowly rotate the crankshaft until a wrench can be inserted onto the back of the plunger.*
2. *Unscrew the plunger and remove it from the pump.*
3. *Inspect the plunger for wear or damage and replace if necessary.*
4. *To replace, apply Loctite 76764 and screw the plunger into the intermediate rod in the power end and torque to the specifications in section 'Torque Specification'*

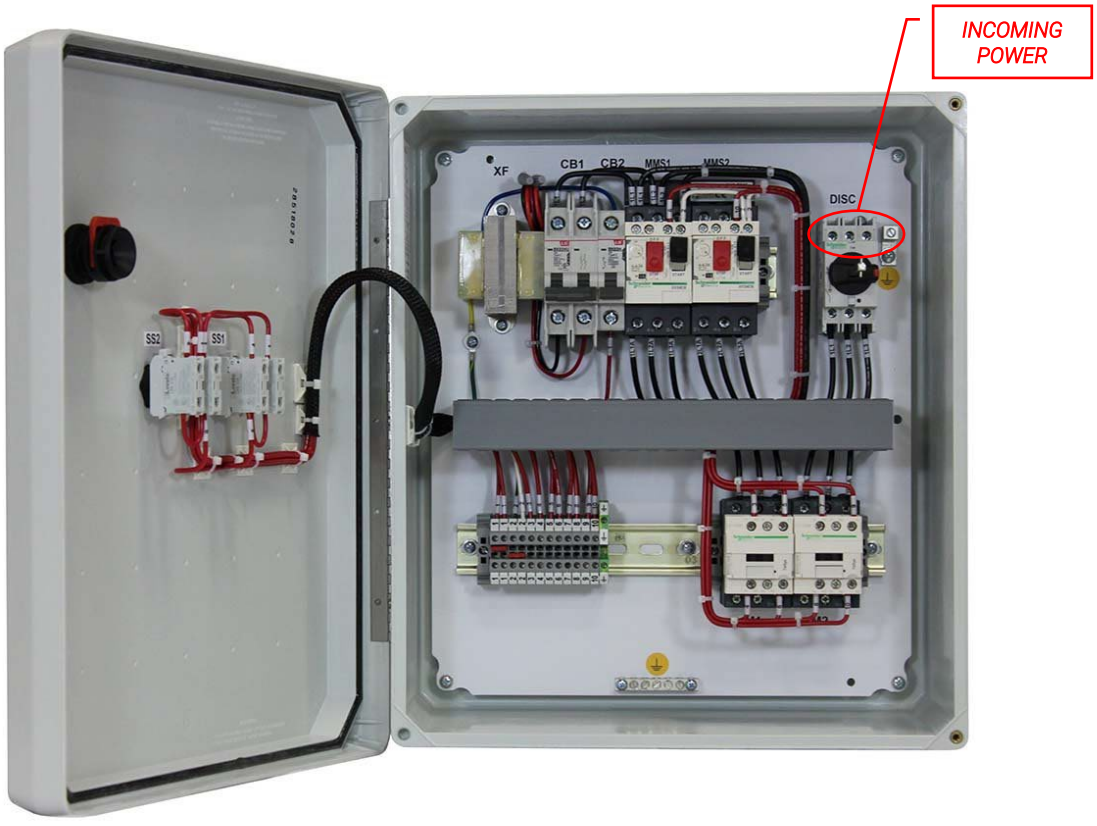
Motor Starters

Across-the-Line

The across-the-line starter is a common, general use motor starter. This starter connects the incoming power directly to the motor via contactor.

This starter features a thru-door disconnect to de-energize the internal components from the incoming power before opening the enclosure. A push button e-stop immediately cuts power to the motor and shuts down the pump. The start and stop push buttons are used to start and stop the pump under normal operation.

To install the starter, bring each of the three phases into the enclosure utilizing a strain relief device. Attach each phase of incoming power to the circuit breaker utilizing best practices and adhering to local codes. Be sure to check motor rotation. If the motor rotates in the wrong direction, switch two phases of incoming power.



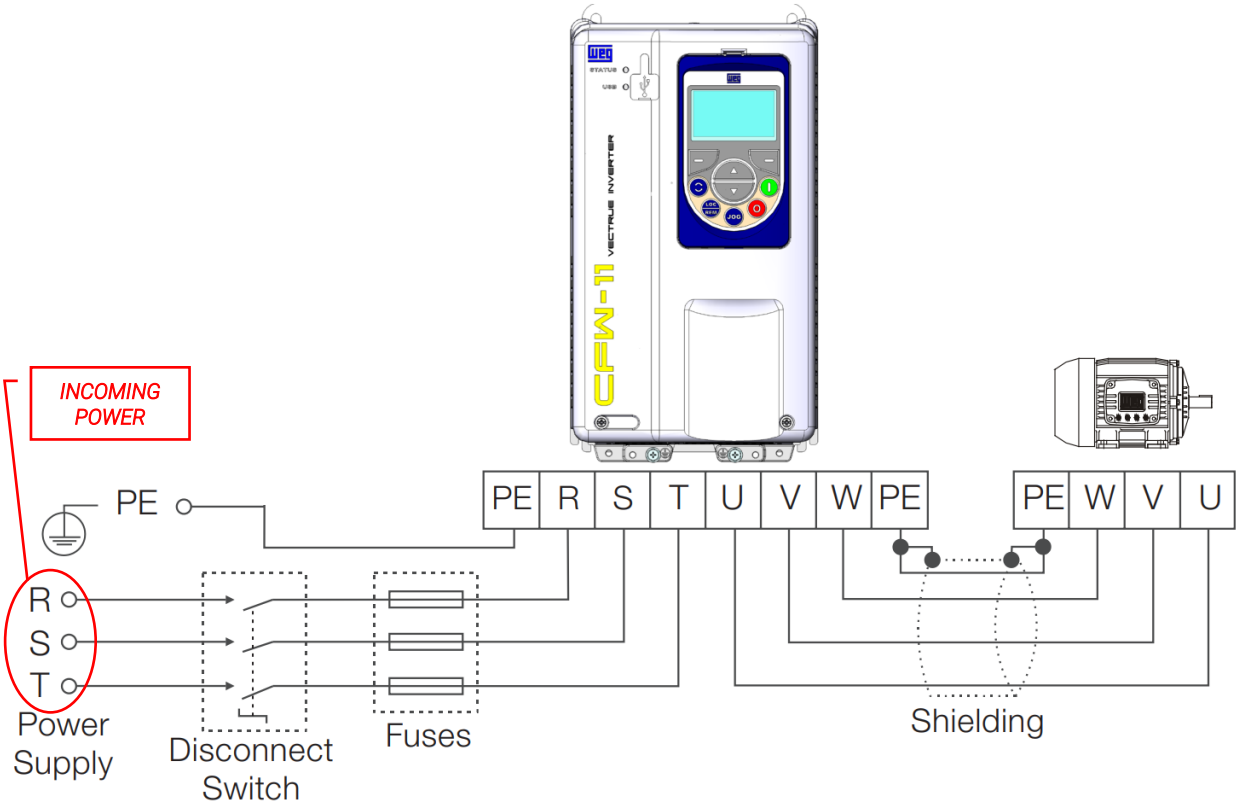
(Image used as reference only, actual item may vary)

Variable Frequency Drive (VFD)

The VFD is a type of motor starter that can safely start and stop the electric motor as well as fully control the speed of the motor during its operation. Since the speed of the motor depends on the supply frequency, the VFD is mostly used for varying the speed of the motor during operation.

When equipped, the remote pendant features a push button e-stop that immediately cuts power to the motor and shuts down the pump. The start and stop push buttons are used to start and stop the pump under normal operation. A speed dial allows for the control of the motor speed remotely. A green light indicates that the starter is active and energized. It is not recommended to maintain a zero speed input for extended periods when the starter is energized.

To install the starter, bring each of the three phases into the enclosure utilizing a strain relief device. Attach each phase of incoming power to the VFD utilizing best practices and adhering to local codes. For wiring details, see the figure below.



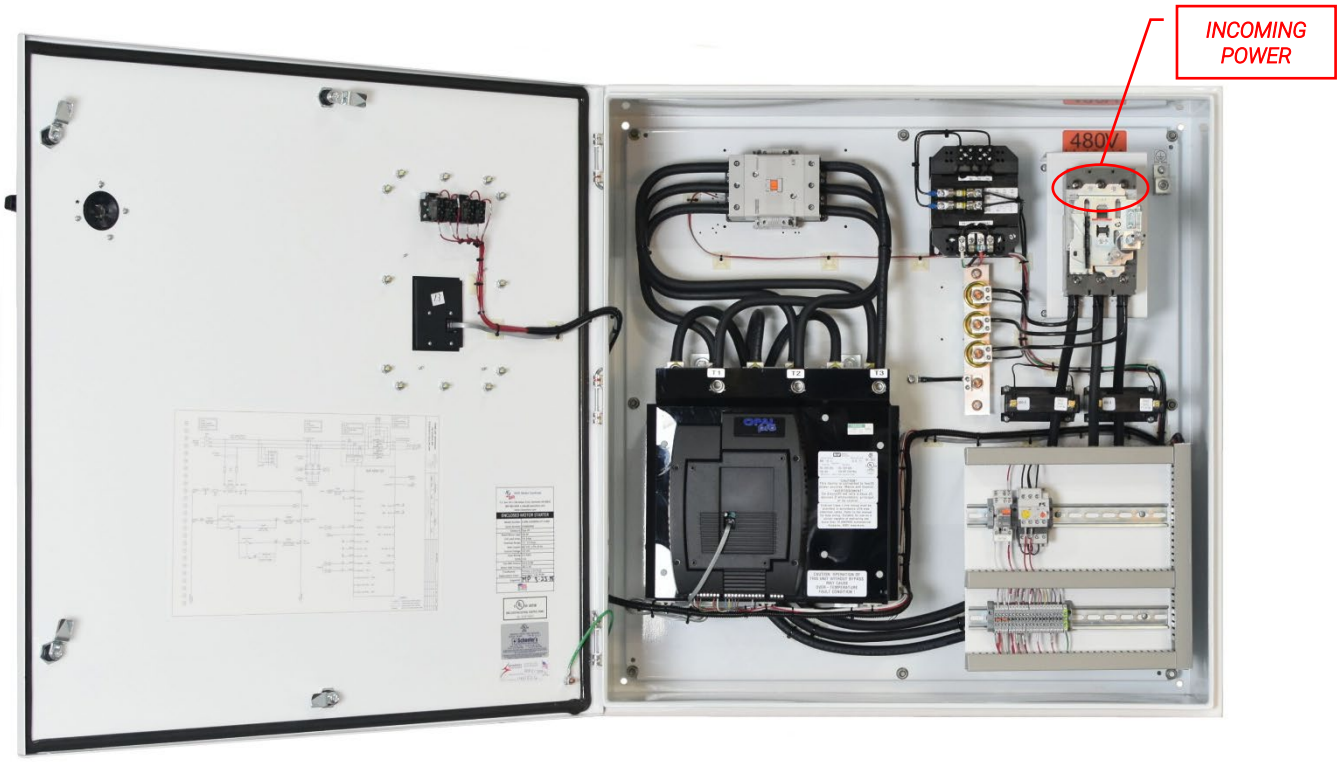
(Image used as reference only, actual item may vary)

Soft Start

The soft start is a type of motor starter that reduces the starting current or the high inrush current by reducing the voltage applied to the motor. Since the soft starter only reduces the supply voltage during starting & stopping of the motor, it cannot vary the speed of the motor during normal operation. Therefore, they are used for constant speed application.

This starter features a thru-door disconnect to de-energize the internal components from the incoming power before opening the enclosure. A push button e-stop immediately cuts power to the motor and shuts down the pump. The start and stop push buttons are used to start and stop the pump under normal operation. A display on the front of the enclosure allows for soft start parameters to be modified.

To install the starter, bring each of the three phases into the enclosure utilizing a strain relief device. Attach each phase of incoming power to the circuit breaker utilizing best practices and adhering to local codes. Be sure to check motor rotation. If the motor rotates in the wrong direction, switch two phases of incoming power.



(Image used as reference only, actual item may vary)

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, you may also need the manufacturer's manuals provided with your 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 you have the appropriate tools available.*
- *Make sure that you have the appropriate parts 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 ruptures 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
			Damaged plunger / Worn packing
3.	Water hammer/wheezing	Cavitation effects	Low supply line water pressure
			Stuck suction valve
		Plumbing design defects	Flow separation at elbows and fittings
			Variable fluid acceleration in the suction supply plumbing
4.	Valve wear	Contaminated supply water	Supply water quality or chemistry
			Filters are not correctly rated
		Cavitation effects	Worn valve guides / Damaged valve springs
5.	Packing failure	Contaminated supply water	Supply water quality or chemistry
			Filters are not correctly rated
		Cavitation effects	Cavitation due to insufficient or low supply water pressure
		Installation damage	Packing installation
		Lack of cooling	Packing lubrication holes in barrel blocked
6.	Plunger failure	Cavitation effects	Low supply line water pressure
			Air entering supply water line
			Air entering the barrel through worn packing
		Mechanical damage	Chipping from physical impact of foreign material entering the pump well
		Contaminated supply water	Supply water quality or chemistry
			Filters are not correctly rated
		Contact with the packing seat	Deformation and wear of packing seat
7.	Oil wiper seal leakage	Foreign material entering the pump well	Pump well cover is kept closed
			Dirt does not settle on the intermediate rod
		Running the pump without oil	Oil level is correctly set
			Oil quality is correct
		Scored intermediate rod	Oil wiper seal is contacting a smooth surface
			Oil wiper seal is not nicked from intermediate rod damage
8.	Packing seal leakage	Pump run without water	Supply water pressure
			Plunger coolant holes in barrels are not blocked
		Dirt accumulation	Packing damaged from dirt entering the pump well
		Installation	Packing installed backward
9.	Crankshaft oil seal leak	Dirt accumulation	Seal surface is clean
			Crankshaft contact point for seal lip wear into the shaft
		High oil level in the power end	Oil level is not over the high mark
			Water or condensation has overfilled the power end

Specifications

General

DIMENSIONS	BASE UNIT 47" H x 32.5" W x 32.5" D
	CASTERS + 7.5" H
	HYDROSTATC PANEL + 18" H
	AOL STARTER + 11" H
	VFD STARTER + 13.5" W
	SOFT STARTER + 15" W
DRY WEIGHT	1,200 LBS. (MAY VARY DEPENDING ON OPTIONS)
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	3,000 PSI TO 40,000 PSI
OUTPUT FLOW RATE (60HZ)	1.53 GPM TO 24.42 GPM

High Pressure Pump

TYPE	POSITIVE DISPLACEMENT TRIPLEX, BELT DRIVEN
HYDRAULIC LUBRICATION	SPLASH LUBRICATION
STROKE	1.97 IN.
PLUNGER DIAMETER	SEE 'LP, HP, UHP FLUID END ASSEMBLY' SECTION
OIL	SEE 'POWER END ASSEMBLY' SECTION
LUBRICANT CAPACITY	1 GALLON (3.8 LITERS)

Electric Motor

	WEG – W22 NEMA premium efficiency, 3PH								
HORSEPOWER (HP)	20	25		40	50		60	75	
VOLTAGE (VAC)	380	230	460	380	230	460	380	230	460
FREQUENCY (Hz)	50	60		50	60		50	60	
SPEED (RPM)	1465	1765		1475	1775		1480	1780	
RATED CURRENT (A)	29.1	59	29.5	58.7	118	59.2	88.5	174	87.2
LOCKED ROTOR CURRENT (A)	175	366	183	376	734	367	620	1116	558
FRAME SIZE	284/6T			324/6T			364/5T		
SERVICE FACTOR	1	1.25		1	1.25		1	1.25	

Lubrication Specification

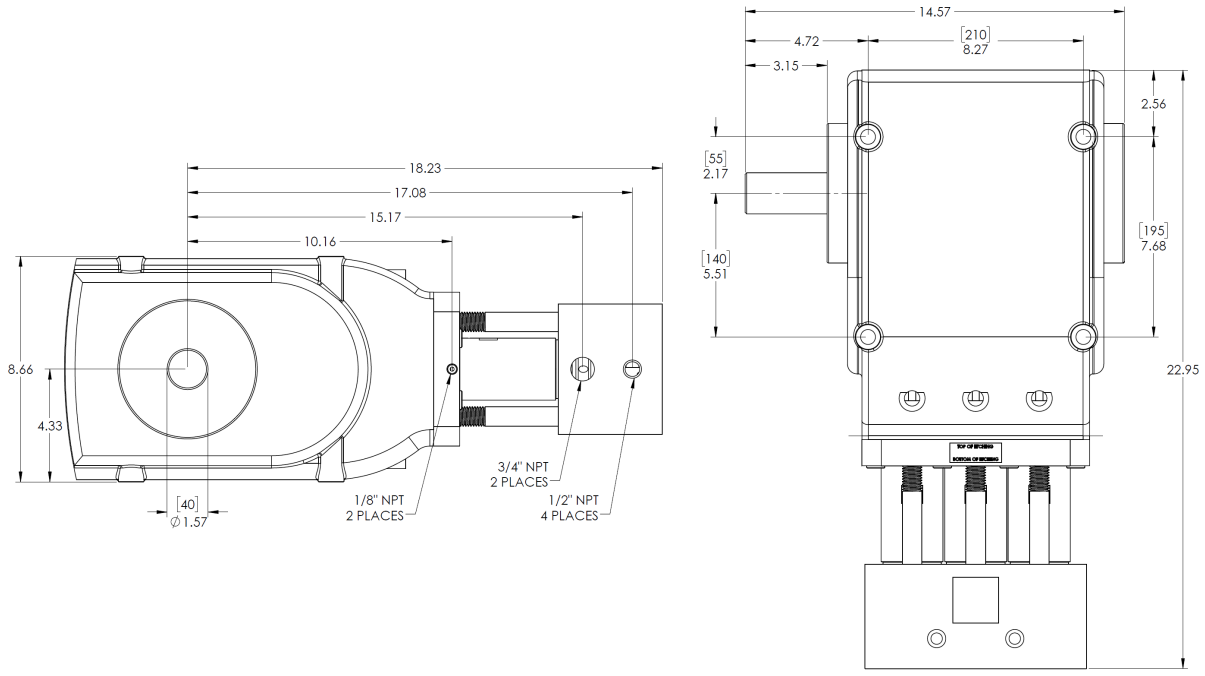
Series 50 pumps are splash lubricated by circulating oil or other specified lubricants in the power end. To ensure proper power end lubrication, the oil must pour freely at lowest ambient operating temperatures. Refer to section 'Power End Assembly', for recommended power end lubricants and maintenance intervals.

Service Connections

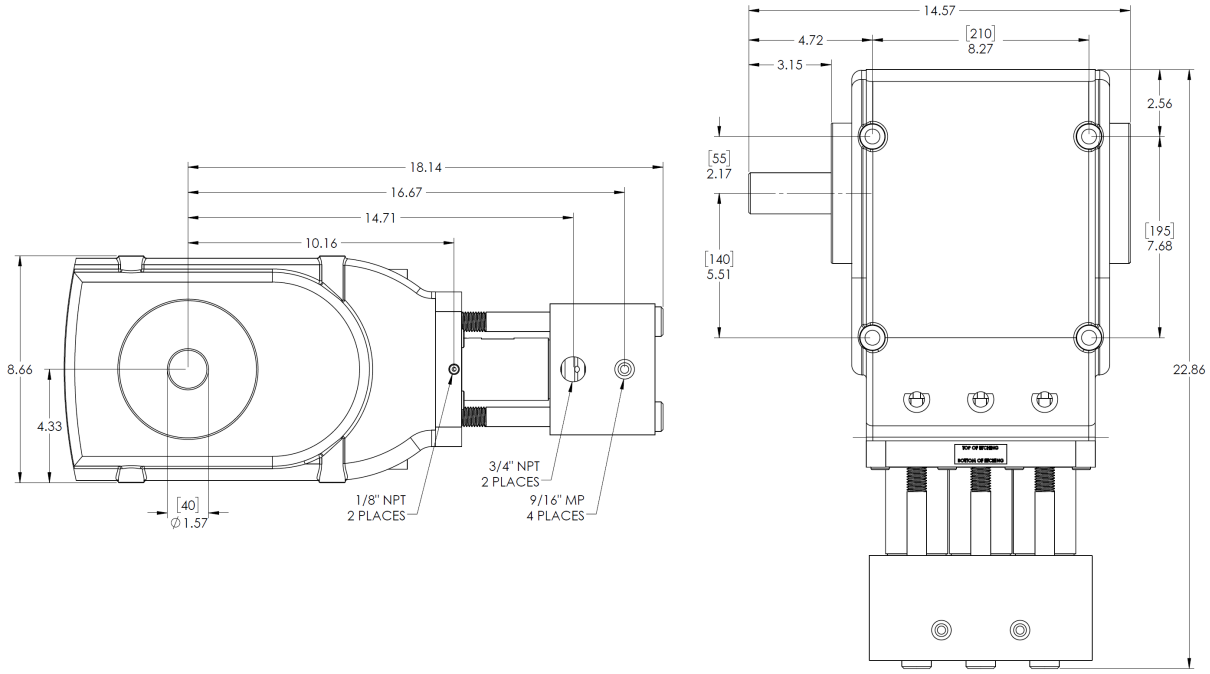
	LOW PRESSURE (10,000 PSI)				HIGH PRESSURE (20,000 PSI)						ULTRA-HIGH PRESSURE (40,000 PSI)	
PART NO.	25-110-013	25-110-014	25-110-016	25-110-020	25-120-007	25-120-008	25-120-009	25-120-010	25-120-011	25-120-012	25-140-005	25-140-006
PLUNGER SIZE	13/16"	7/8"	1"	1-1/4"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	5/16"	3/8"
INLET	3/4" NPT										1/2" NPT	
OUTLET	1/2" NPT				9/16" MP						3/8" HP	
COOLING LOOP	1/8" NPT											

Installation Dimensions

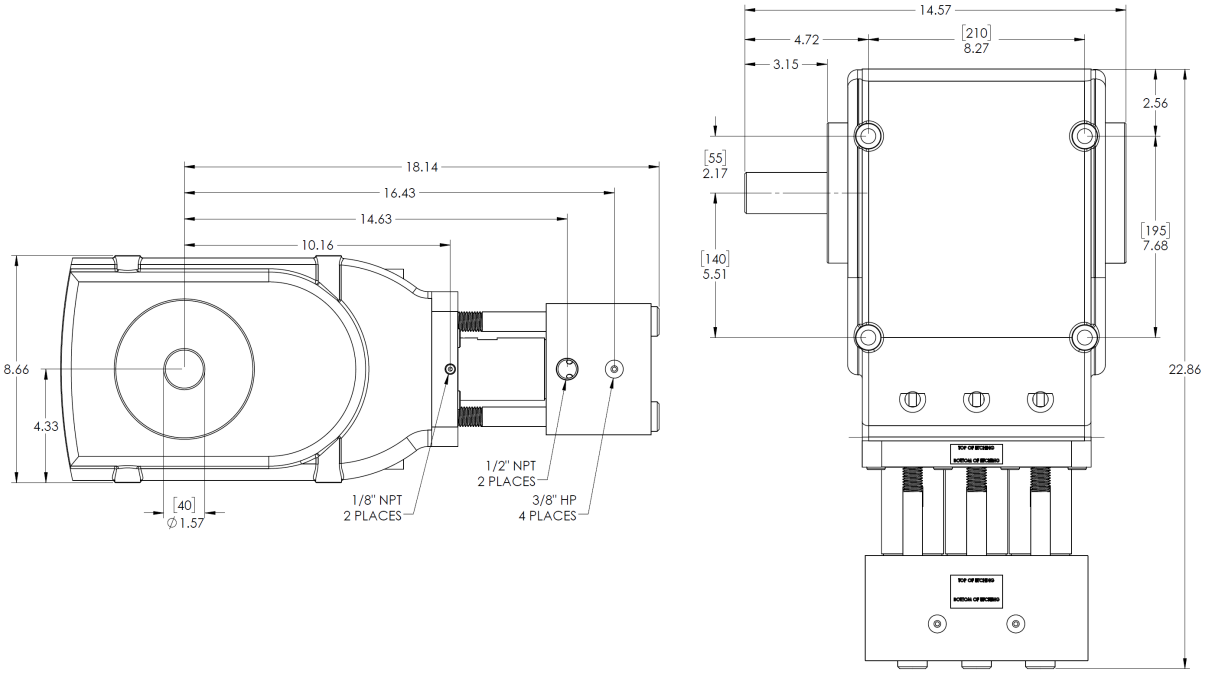
LOW PRESSURE



HIGH PRESSURE



ULTRA-HIGH PRESSURE



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 µS/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	100 PSI. MAX.
WATER SUPPLY FLOW RATE	10 GPM (HP & UHP FLUID ENDS) 25 GPM (LP FLUID ENDS)

Inlet Water Filtration

10 micron absolute

Carbide Nozzle Size Selector Chart

NOZZLE FLOW RATING IN GPM															
		ACTUAL NOZZLE PRESSURE [KSI (BAR)]													
NOZZLE #	ORIFICE IN (MM)	4 (276)	5 (345)	6 (414)	7 (483)	8 (552)	9 (621)	10 (689)	12 (827)	15 (1034)	20 (1379)	25 (1724)	30 (2068)	35 (2413)	40 (2758)
0.1	.008 (.207)	0.12	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.23	0.26	0.29	0.32	0.35	0.37
0.2	.012 (.293)	0.26	0.29	0.32	0.35	0.37	0.40	0.42	0.46	0.51	0.59	0.66	0.72	0.78	0.83
0.3	.014 (.358)	0.36	0.40	0.44	0.47	0.51	0.54	0.57	0.62	0.69	0.80	0.90	0.98	1.06	1.13
0.4	.016 (.414)	0.47	0.52	0.57	0.62	0.66	0.70	0.74	0.81	0.91	1.05	1.17	1.28	1.39	1.48
0.5	.018 (.463)	0.59	0.66	0.73	0.78	0.84	0.89	0.94	1.03	1.15	1.33	1.48	1.62	1.75	1.87
0.6	.020 (.507)	0.73	0.82	0.90	0.97	1.03	1.10	1.16	1.27	1.42	1.64	1.83	2.00	2.16	2.31
0.7	.022 (.547)	0.89	0.99	1.08	1.17	1.25	1.33	1.40	1.53	1.71	1.98	2.21	2.42	2.62	2.80
0.8	.023 (.585)	0.97	1.08	1.19	1.28	1.37	1.45	1.53	1.68	1.87	2.16	2.42	2.65	2.86	3.06
0.9	.024 (.621)	1.05	1.18	1.29	1.39	1.49	1.58	1.67	1.83	2.04	2.36	2.63	2.89	3.12	3.33
1.0	.026 (.654)	1.24	1.38	1.51	1.64	1.75	1.86	1.96	2.14	2.39	2.77	3.09	3.39	3.66	3.91
1.1	.027 (.686)	1.33	1.49	1.63	1.76	1.89	2.00	2.11	2.31	2.58	2.98	3.33	3.65	3.95	4.22
1.2	.028 (.717)	1.43	1.60	1.76	1.90	2.03	2.15	2.27	2.48	2.78	3.21	3.59	3.93	4.24	4.54
1.3	.029 (.746)	1.54	1.72	1.88	2.04	2.18	2.31	2.43	2.66	2.98	3.44	3.85	4.21	4.55	4.87
1.4	.030 (.774)	1.65	1.84	2.02	2.18	2.33	2.47	2.60	2.85	3.19	3.68	4.12	4.51	4.87	5.21
1.5	.032 (.801)	1.87	2.09	2.29	2.48	2.65	2.81	2.96	3.24	3.63	4.19	4.68	5.13	5.54	5.92
1.6	.033 (.827)	1.99	2.23	2.44	2.64	2.82	2.99	3.15	3.45	3.86	4.45	4.98	5.46	5.89	6.30
1.7	.034 (.853)	2.11	2.36	2.59	2.80	2.99	3.17	3.34	3.66	4.10	4.73	5.29	5.79	6.26	6.69
1.8	.035 (.878)	2.24	2.51	2.74	2.96	3.17	3.36	3.54	3.88	4.34	5.01	5.60	6.14	6.63	7.09
1.9	.035 (.902)	2.24	2.51	2.74	2.96	3.17	3.36	3.54	3.88	4.34	5.01	5.60	6.14	6.63	7.09
2.0	.036 (.925)	2.37	2.65	2.90	3.14	3.35	3.56	3.75	4.11	4.59	5.30	5.93	6.49	7.01	7.50
2.5	.041 (1.034)	3.08	3.44	3.77	4.07	4.35	4.61	4.86	5.33	5.96	6.88	7.69	8.42	9.10	9.73
3.0	.045 (1.133)	3.70	4.14	4.54	4.90	5.24	5.56	5.86	6.42	7.17	8.28	9.26	10.15	10.96	11.72
3.5	.048 (1.224)	4.22	4.71	5.16	5.58	5.96	6.32	6.66	7.30	8.16	9.43	10.54	11.54	12.47	13.33
4.0	.052 (1.308)	4.95	5.53	6.06	6.54	7.00	7.42	7.82	8.57	9.58	11.06	12.37	13.55	14.63	15.64
4.5	.055 (1.388)	5.53	6.19	6.78	7.32	7.83	8.30	8.75	9.59	10.72	12.37	13.84	15.16	16.37	17.50
5.0	.058(1.463)	6.15	6.88	7.54	8.14	8.70	9.23	9.73	10.66	11.92	13.76	15.39	16.85	18.21	19.46
5.5	.060 (1.534)	6.59	7.36	8.07	8.71	9.31	9.88	10.41	11.41	12.75	14.73	16.47	18.04	19.48	20.83
6.0	.063 (1.602)	7.26	8.12	8.89	9.61	10.27	10.89	11.48	12.58	14.06	16.24	18.15	19.89	21.48	22.96
6.5	.066 (1.668)	7.97	8.91	9.76	10.54	11.27	11.95	12.60	13.80	15.43	17.82	19.92	21.82	23.57	25.20
7.0	.068 (1.731)	8.46	9.46	10.36	11.19	11.96	12.69	13.38	14.65	16.38	18.92	21.15	23.17	25.02	26.75
7.5	.071 (1.791)	9.22	10.31	11.30	12.20	13.04	13.83	14.58	15.97	17.86	20.62	23.06	25.26	27.28	29.16
8.0	.073 (1.850)	9.75	10.90	11.94	12.90	13.79	14.62	15.42	16.89	18.88	21.80	24.37	26.70	28.84	30.83
8.5	.075 (1.907)	10.29	11.51	12.60	13.61	14.55	15.44	16.27	17.82	19.93	23.01	25.73	28.18	30.44	32.54
9.0	.077 (1.962)	10.85	12.13	13.28	14.35	15.34	16.27	17.15	18.79	21.01	24.25	27.12	29.71	32.09	34.30
9.5	.079 (2.016)	11.42	12.77	13.98	15.10	16.15	17.13	18.05	19.78	22.11	25.53	28.54	31.27	33.77	36.11
10.0	.081 (2.069)	12.00	13.42	14.70	15.88	16.98	18.01	18.98	20.79	23.24	26.84	30.01	32.87	35.51	37.96
11.0	.085 (2.170)	13.22	14.78	16.19	17.49	18.69	19.83	20.90	22.89	25.60	29.56	33.05	36.20	39.10	41.80
12.0	.089 (2.266)	14.49	16.20	17.75	19.17	20.49	21.74	22.91	25.10	28.06	32.40	36.23	39.69	42.87	45.83
12.5	.091 (2.313)	15.15	16.94	18.56	20.04	21.43	22.73	23.95	26.24	29.34	33.88	37.88	41.49	44.81	47.91
13.0	.093 (2.359)	15.82	17.69	19.38	20.93	22.38	23.74	25.02	27.41	30.64	35.38	39.56	43.33	46.81	50.04
14.0	.096 (2.448)	16.86	18.85	20.65	22.30	23.84	25.29	26.66	29.20	32.65	37.70	42.15	46.17	49.87	53.32
15.0	.100 (2.533)	18.30	20.45	22.41	24.20	25.87	27.44	28.93	31.69	35.43	40.91	45.74	50.10	54.12	57.85

References

Engineering Drawings

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

Spare Parts

Fluid End Parts

	LOW PRESSURE (10,000 PSI)				HIGH PRESSURE (20,000 PSI)						ULTRA-HIGH PRESSURE (40,000 PSI)		
PART NO.	25-110-013	25-110-014	25-110-016	25-110-020	25-120-007	25-120-008	25-120-009	25-120-010	25-120-011	25-120-012	25-140-005	25-140-006	
PLUNGER SIZE	13/16"	7/8"	1"	1-1/4"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	5/16"	3/8"	
PLUNGER	4012113	4012114	61155888	4012120	61145111	61134153	61127627	4010110	61143773	4010112	61158830	61146352	3*
HP PACKING	25-100-213	25-100-214	25-100-216	25-100-220	25-100-207	25-100-208	25-100-209	25-100-210	25-100-211	25-100-212	25-100-205	25-100-206	6*
LP PACKING	25-100-313	25-100-313	25-100-316	25-100-320	25-100-307	25-100-308	25-100-309	25-100-310	25-100-311	25-100-312	25-100-305	25-100-306	6*
SPRG SPACER	4012013	4012014	61155864	4012020	61145210	61134120	61134757	4006310	61143755	4006312	61146302		3*
SUBPLATE	61145600												
MANIFOLD	61155773				61126932						61146227		
BARREL	61155815				61141955						61146243		
VALVE SEAT	61155872				61152500						61168707		3*
COMP. SEAL	61155955				61117316						61117309		3*
COMP. SEAL	N/A				61117267						61117423		3*
DISCH VLV	61121942				61121927						61157144		3*
DISCH SPR	61120339				61120274						61120274		3*
DISCH GDE	61155913				61135756						61146310		3*
SUCT VLV	61122827				61135748						61122322		3*
SUCT SPR	61120529				61120199						61120308		3*
RTN RNG	91-002-150.SS				91-002-125.SS						91-001-088.SS		3*
PKG NUT	N/A										61146458		
PKG NUT O-RING	N/A										30-002-022		6*
MFLD O-RING	30-002-034												6*
SUBPLT O-RING	30-001-032												6*
SUBPLT BOLTS	10-412-145.SS												
MFLD BOLTS	90-122-800												

** Recommended spare parts quantities*

Lubricants

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

Water Quality Test Kit

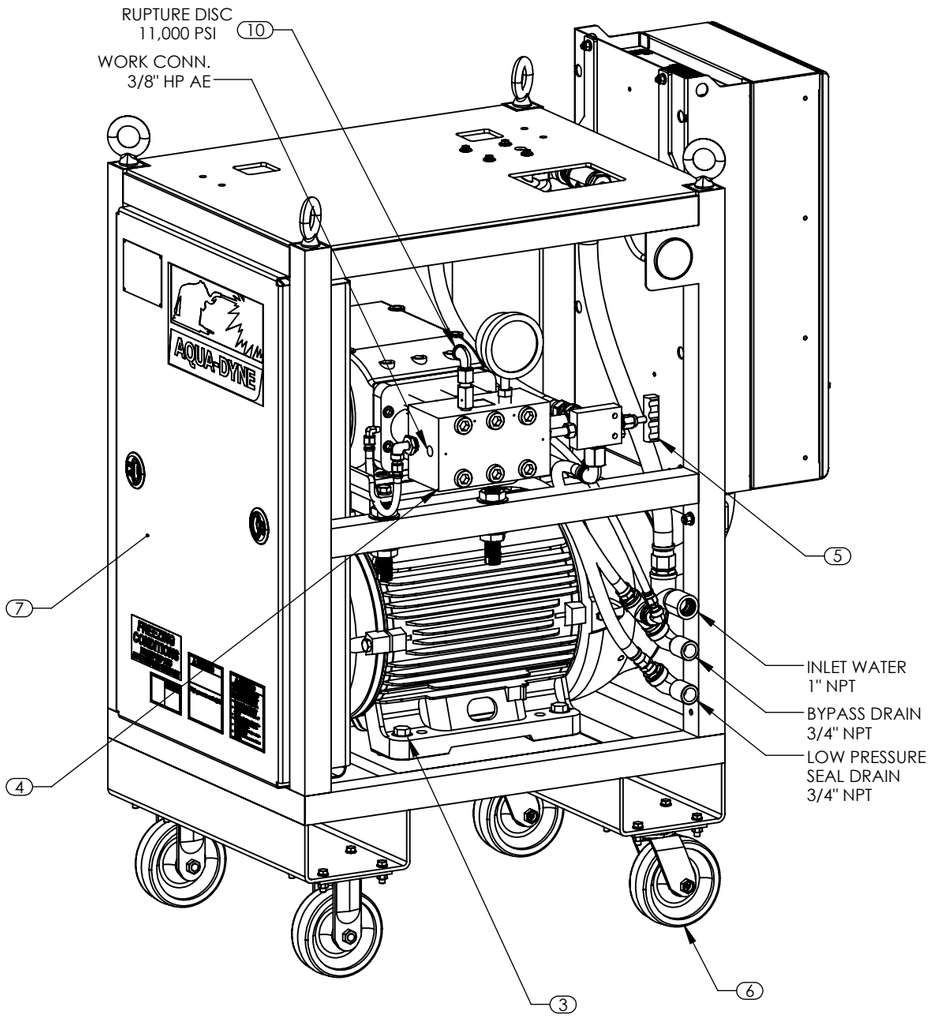
Water Test Kit	Part # 007851-1

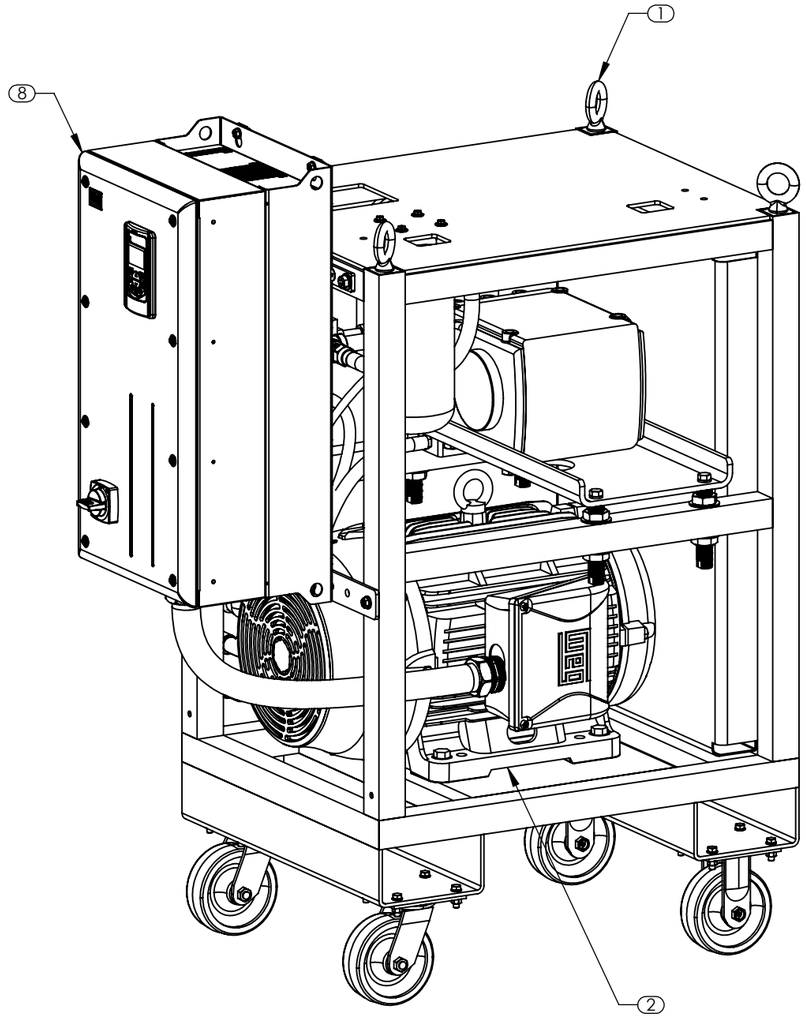
Appendix

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	61172641	TRPLX UNIT-BMX 25/50, BASE UNIT
2	1	61143929	MTR-ELEC,50HP,326T,TEFC,230-460/3/60
3	1	61173286	KIT-MNTG,MTR,50HP,BMX 25/50
4	1	61143607	FL END ASSY-SERIES 50,HP,20KSI,.69 PLGR
5	1	61173708	KIT-ACCESS,FL END,BMX 25/50,.56MP,W/BYP
6	1	61172807	KIT-CSTR,BMX 25/50
7	1	61173427	KIT-BELT DR,BMX 25/50,HI SPEED,50HP
8	1	11-150-003	KIT-ELEC, S50, 50HP, VFD, 380,460/3
9	1	61133773	NAME PL-PMP DATA,AQD,3.50X5.0,AQD S25560-00
10	2	20455995	DISC-RUPT,.25 ANG,INCNL,11,000PSI
11	2	20455998	DISC-RUPT,.25 ANG,INCNL,11,500PSI

NOTES:

1. PUMP SPEED: 780 RPM AT 60 HZ
2. OPERATING PRESSURE 10,000 PSI
3. THEORETICAL FLOW: 7.3 GPM
4. TEST FOR 1 HR. PUMP SHOULD DEVELOP 10KSI USING A #4.5 (0.055) NOZ @ 60 HZ





REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	8/2/2019	K. SMITH
	1	REPLACED DANFOSS VFD WITH WEG VFD	1/15/2020	K. SMITH
	2	UPDATED ELECTRICAL KIT	3/2/2022	K. SMITH

APS
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.	$\sqrt{}$
MACHINE FILLETS	R.02
ANGLE	±1°

DIM TOLERANCES: (in)
.X = ± .030
.XX = ± .010
.XXX = ± .005
.XXXX = ± .0005

TITLE: TRPLX UNIT-BMX 25/50, 50H10K7.3GC480VFDH

THIRD ANGLE PROJECTION

DWG BY K. SMITH

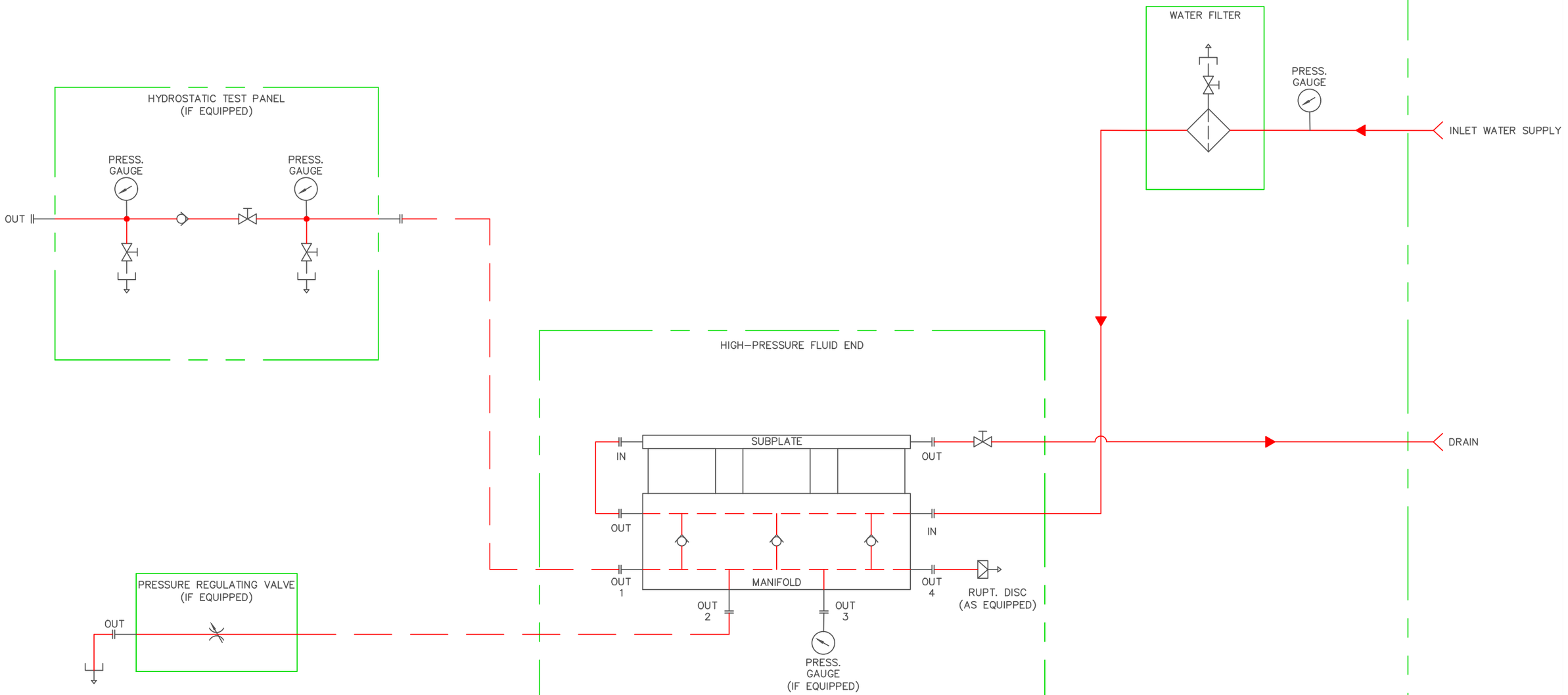
APRVD BY B. PARKER

MATERIAL

DWG. NO. 32-110-602 REV. 02

HEAT TREAT.

SHT 1 OF 1



REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	0	INITIAL RELEASE	5/3/2022	K. SMITH

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
MACHINE FILLETS	R.02
ANGLE	±1°

DIM TOLERANCES: (in)

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

TITLE: TRPLX UNIT-S50, ELECTRIC, HYD. SCHEMATIC

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

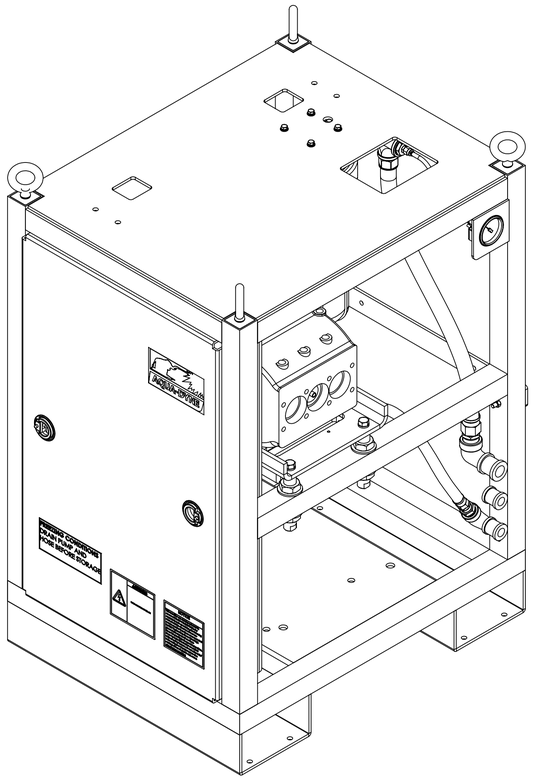
DWG. NO. 32-100-600.HYD

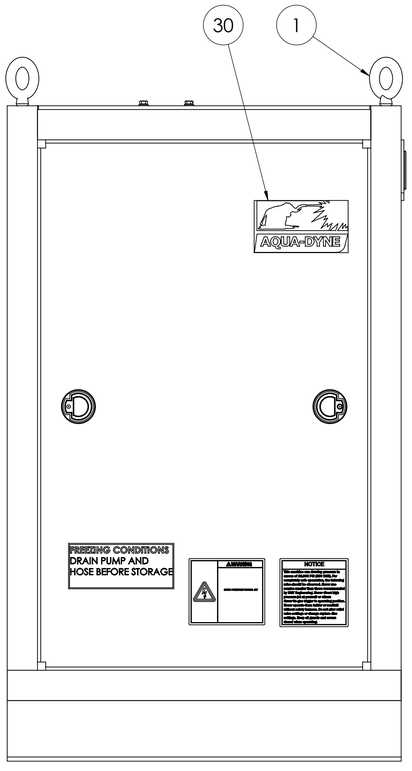
REV. 0

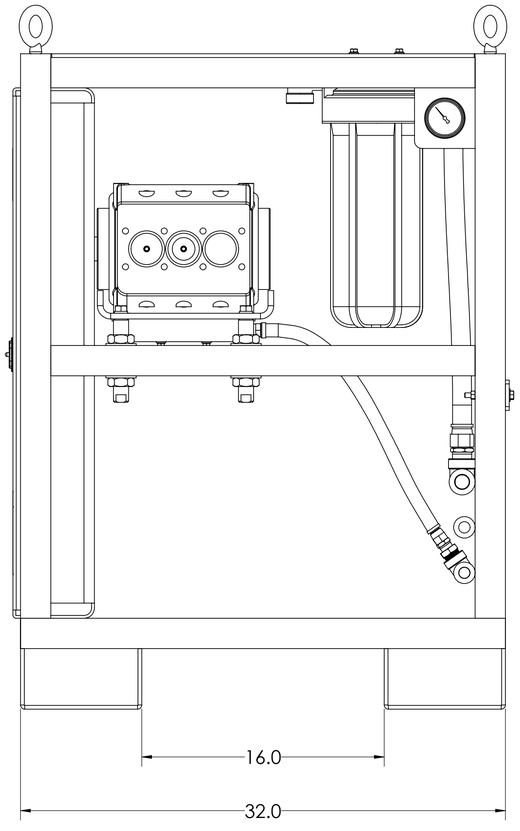
DRAWN IN AUTOCAD

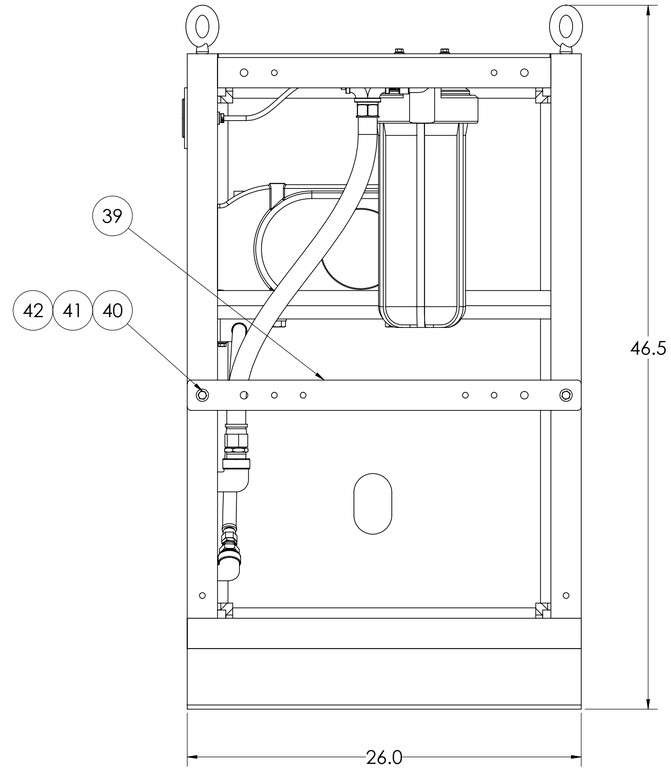
SHT 1 OF 1

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	01	ADDED FILTER SPCR, CHANGED .25" HOSE BARB TO JIC PUSH ON BARB REV06767	5/2/13	MBM
	-	REDRAWN IN SOLIDWORKS BY TOI	7/21/14 RPR TOI	6/25/15 PAF









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STANDARD TOLERANCES

UNLESS OTHERWISE NOTED:

-ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005 (.12)

-BREAK SHARP EDGES AND CORNERS .015 (.38)
-SURFACE FINISH ( )

-STANDARD TOLERANCES

X.X = ±.063 (1.6)
X.XX = ±.015 (.38)
X.XXX = ±.005 (.12)
ANGLE = ±2°

GD&T TO ASME Y14.5M 1994

ALL DIMENSIONS IN INCHES (mm)

THIRD ANGLE PROJECTION

MATERIAL PART NO.

MATERIAL DESCRIPTION
- - - - -

HARDNESS
- - - - - -

HEAT TREAT
- - - - - -

DRAWN MBM

CHECKED BY MBM

ENG. APPROVAL MBM

DATE 2/1/2013

AQUA-DYNE
635 W 12TH
BAXTER SPRINGS, KS
66713

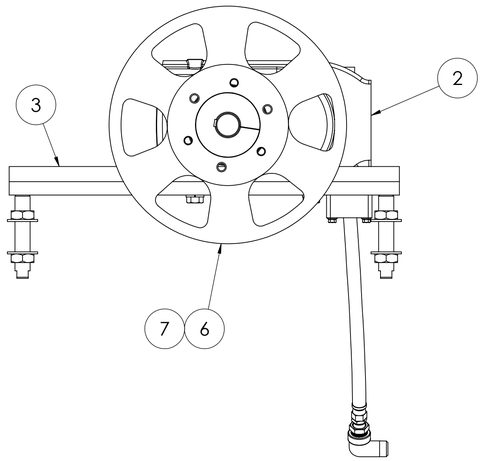
TITLE:

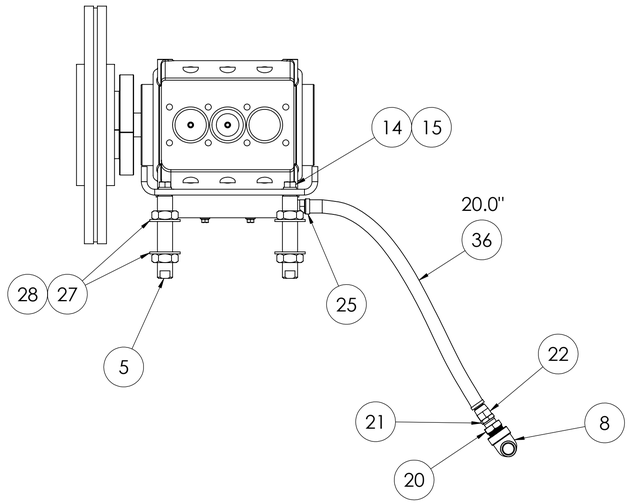
TRPLX UNIT BMX 25/50 BASE

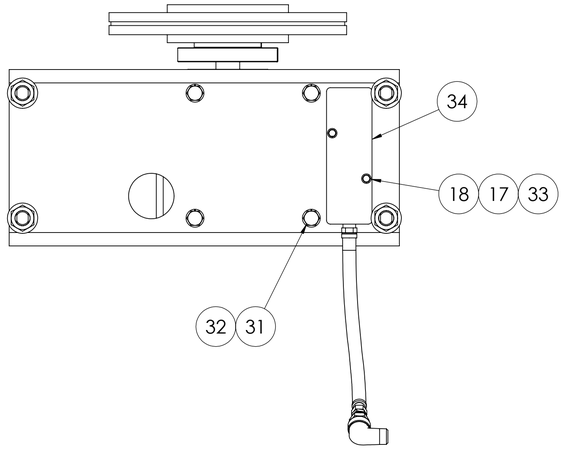
DWG. NO. 61172641

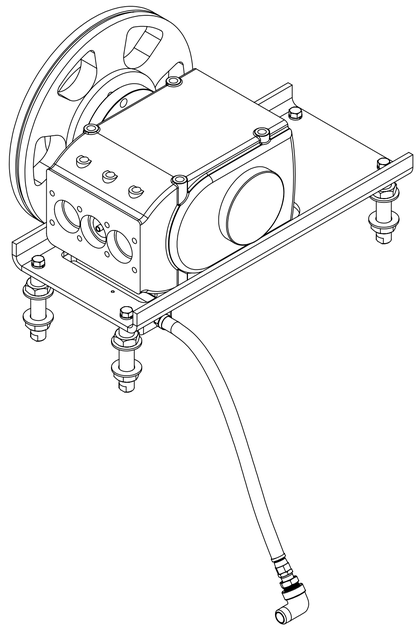
SHEET 1OF 2

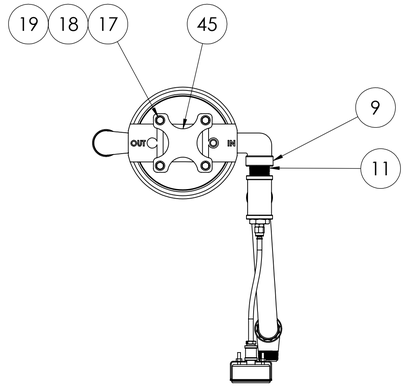
REV 1

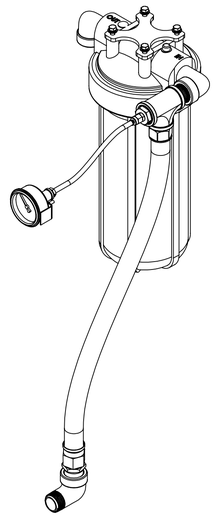


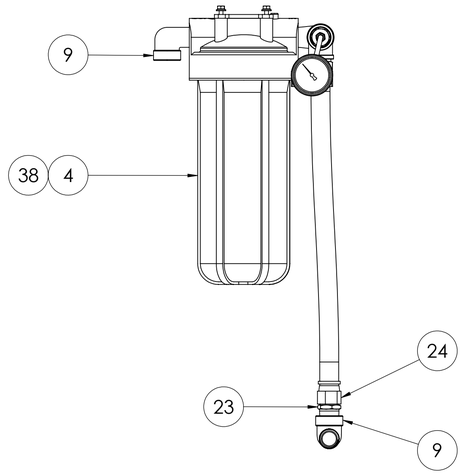


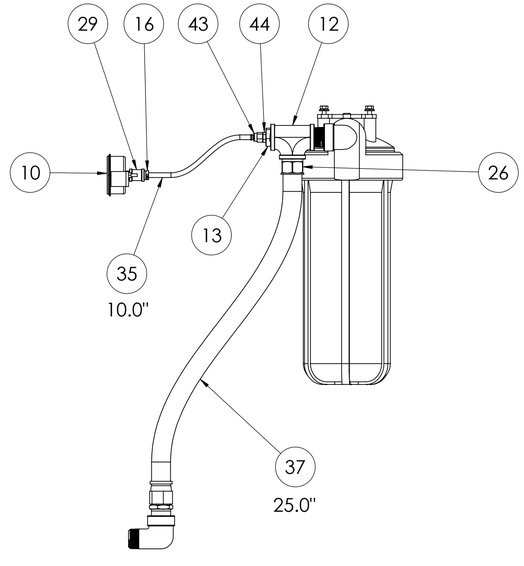






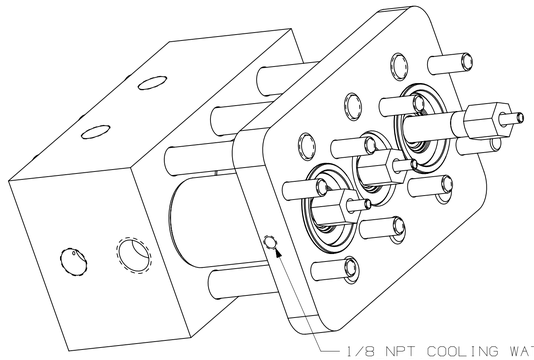


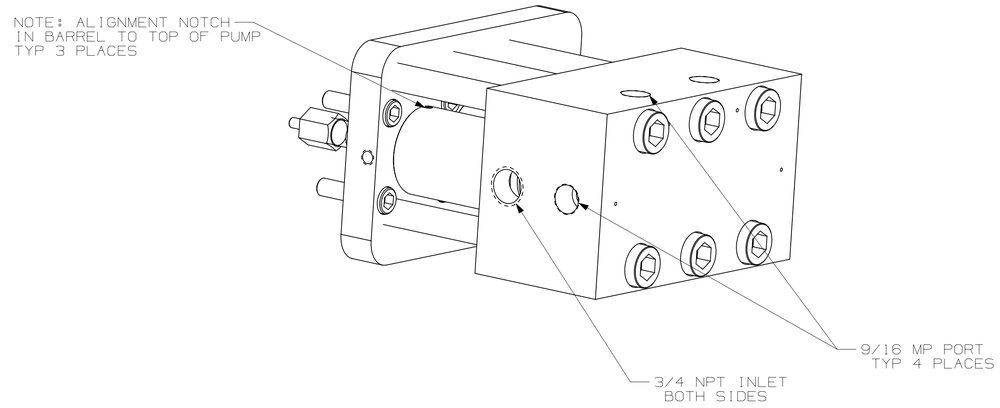


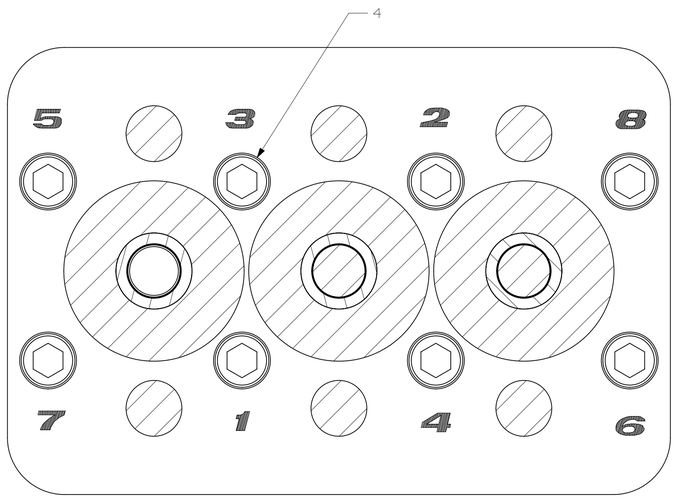


DWG. NO.		REV
61172641	SHEET 2OF 2	1

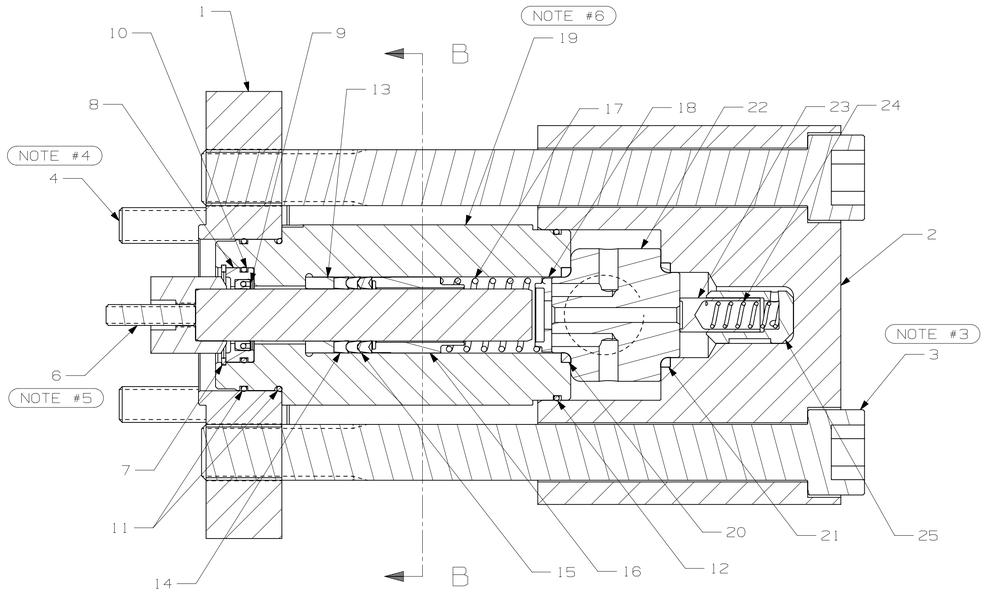
REVISIONS				
ZONE	NO.	DESCRIPTION	DATE	APPROVED
D-8 B-4	1 2	REV 06155 REV 06205	1/11/10 4/9/10	DRD DRD
--	3	ADDED LUBE AND TORQUE NOTES. REV06259.	06/25/10 K.A.J.	06/25/10 DRD

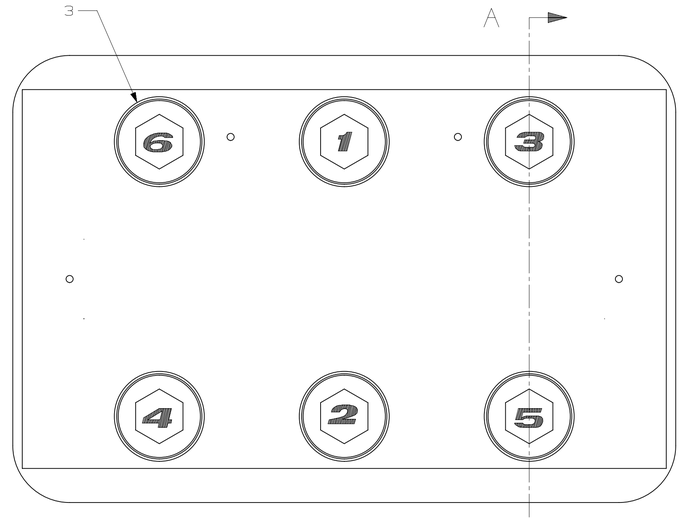






SECTION B-B





SECTION A-A

NOTES:

1. MAXIMUM ALLOWABLE PRESSURE: 10.2 KSI.
2. MINIMUM INLET PRESSURE: 20 PSI.
3. LUBE WITH LOCTITE 76764 (P/N 61101083) AND TORQUE ITEM #3 TO 160 FT-LBS [217 Nm] IN A CROSSING PATTERN STARTING AT BOLT LOCATION 1.
4. LUBE WITH LOCTITE 76764 (P/N 61101083) AND TORQUE ITEM #4 TO 62 FT-LBS [84 Nm] IN A CROSSING PATTERN STARTING AT BOLT LOCATION 1.
5. LUBE WITH LOCTITE 76764 (P/N 61101083) AND TORQUE ITEM #6 TO 10 FT-LBS [14 Nm].
6. LUBE BORE ON ITEM #1 WITH LOCTITE 76764 (P/N 61101083) PRIOR TO INSTALLING ITEM #19. ALIGN NOTCH IN ITEM #19 WITH TOP OF PUMP.
7. LUBE ALL O-RINGS (ITEMS #10, #11 AND #12 WITH FML-2 (P/N 10087385).

WARNING !

The export or reexport of this drawing or a product produced by this drawing is subject to U.S. Export Administration regulations and other applicable governmental restrictions or regulations.

PROPRIETARY NOTICE

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STANDARD TOLERANCES

UNLESS OTHERWISE NOTED:
- ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005 [.12]
- BREAK SHARP EDGES AND CORNERS .015 [.38]
- SURFACE FINISH 63/ [1.6] V [V]
- STANDARD TOLERANCES
  - X.X = ± .063 [1.6]
  - X.XX = ± .015 [.38]
  - X.XXX = ± .005 [.12]
  - ANGLE = ± 2°

GD&T TO ASME Y14.5M 1994

ALL DIMENSIONS IN INCHES [mm]

MATERIAL: -----

HEAT TREAT: -----

HARDNESS: -----

THIRD ANGLE PROJECTION

NEXT ASSY: -----

REF. DWG: -----

DRAWN	DRD	10/14/09
CHECKED	X	X
ENG. APPROVAL	X	X

KMT AQUA-DYNE

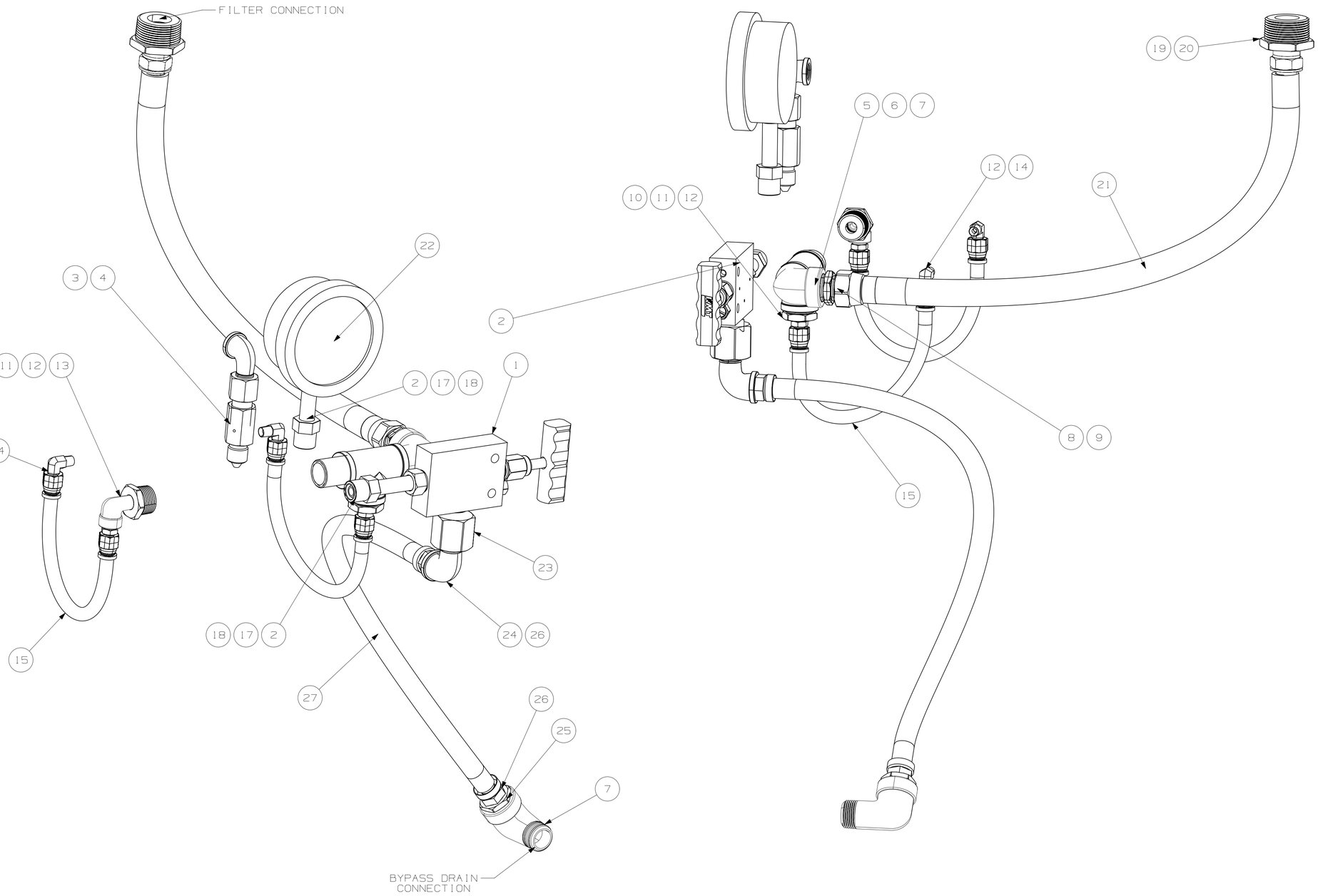
TITLE: FLUID END ASSY SERIES 50, 20KSI 11/16 PLUNGER

UG

SIZE	CODE IDENT NO.	DWG. NO.	REV
---	-----	61143607P	3

SCALE: ----- TITLE BLOCK REVISION: 0 SHEET 1 OF 1

REVISIONS				
ZONE	NO.	DESCRIPTION	DATE	APPROVED



STANDARD TOLERANCES

UNLESS OTHERWISE NOTED:
- ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005 [.12]
- BREAK SHARP EDGES AND CORNERS .015 [.38]
- SURFACE FINISH 63/ [1.6]
- STANDARD TOLERANCES

X.X : ± .063 [1.6]
X.XX : ± .015 [.38]
X.XXX : ± .005 [.12]
ANGLE : ± 2°

GD&T TO ASME Y14.5M 1994

ALL DIMENSIONS IN INCHES [mm]

MATERIAL: -----

HEAT TREAT: -----

HARDNESS: -----

THIRD ANGLE PROJECTION

NEXT ASSY: -----

REF. DWG: -----

DRAWN	MBM	DATE 3/8/13
CHECKED	X	X
ENG. APPROVAL	X	X

KMT AQUA-DYNE

TITLE UG

KIT-ACCESS
FL END
BMX 25/50
.56MP, W/BYP

SIZE	CODE IDENT NO.	DWG. NO.	REV
---	-----	61173708P	0

SCALE: ----- TITLE BLOCK REVISION: 0 SHEET 1 OF 1

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22

Frame	: 324/6T	Cooling method	: IC411 - TEFC
Insulation class	: F	Mounting	: F-1
Duty cycle	: Cont.(S1)	Rotation¹	: Both (CW and CCW)
Ambient temperature	: -20°C to +40°C	Starting method	: Direct On Line
Altitude	: 1000 m.a.s.l.	Approx. weight³	: 269 kg
Protection degree	: IP55	Moment of inertia (J)	: 0.3861 kgm²
Design	: B		

Output [HP]		50	40	50
Poles		4	4	4
Frequency [Hz]		60	50	50
Rated voltage [V]		230/460	380	380
Rated current [A]		118/59.2	58.7	71.6
L. R. Amperes [A]		734/367	376	372
LRC [A]		6.2x(Code G)	6.4x(Code G)	5.2x(Code E)
No load current [A]		47.0/23.5	23.0	23.0
Rated speed [RPM]		1775	1470	1460
Slip [%]		1.39	2.00	2.67
Rated torque [kgfm]		20.4	19.7	24.9
Locked rotor torque [%]		229	229	180
Breakdown torque [%]		270	260	210
Service factor		1.25	1.00	1.00
Temperature rise		80 K	80 K	105 K
Locked rotor time		27s (cold) 15s (hot)	19s (cold) 11s (hot)	19s (cold) 11s (hot)
Noise level²		66.0 dB(A)	63.0 dB(A)	63.0 dB(A)
Efficiency (%)	25%	92.5	91.9	93.3
	50%	93.0	92.5	93.0
	75%	94.1	93.1	93.0
	100%	94.5	93.6	92.4
Power Factor	25%	0.42	0.41	0.48
	50%	0.66	0.64	0.72
	75%	0.77	0.77	0.81
	100%	0.83	0.83	0.85

		Drive end	Non drive end
Bearing type	:	6312 C3	6212 C3
Sealing	:	V'Ring	V'Ring
Lubrication interval	:	20000 h	20000 h
Lubricant amount	:	21 g	13 g
Lubricant type	:	Mobil Polyrex EM	

Foundation loads
Max. traction : 673 kgf
Max. compression : 943 kgf

Notes
USABLE @208V 131A SF 1.15 SFA 151A

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

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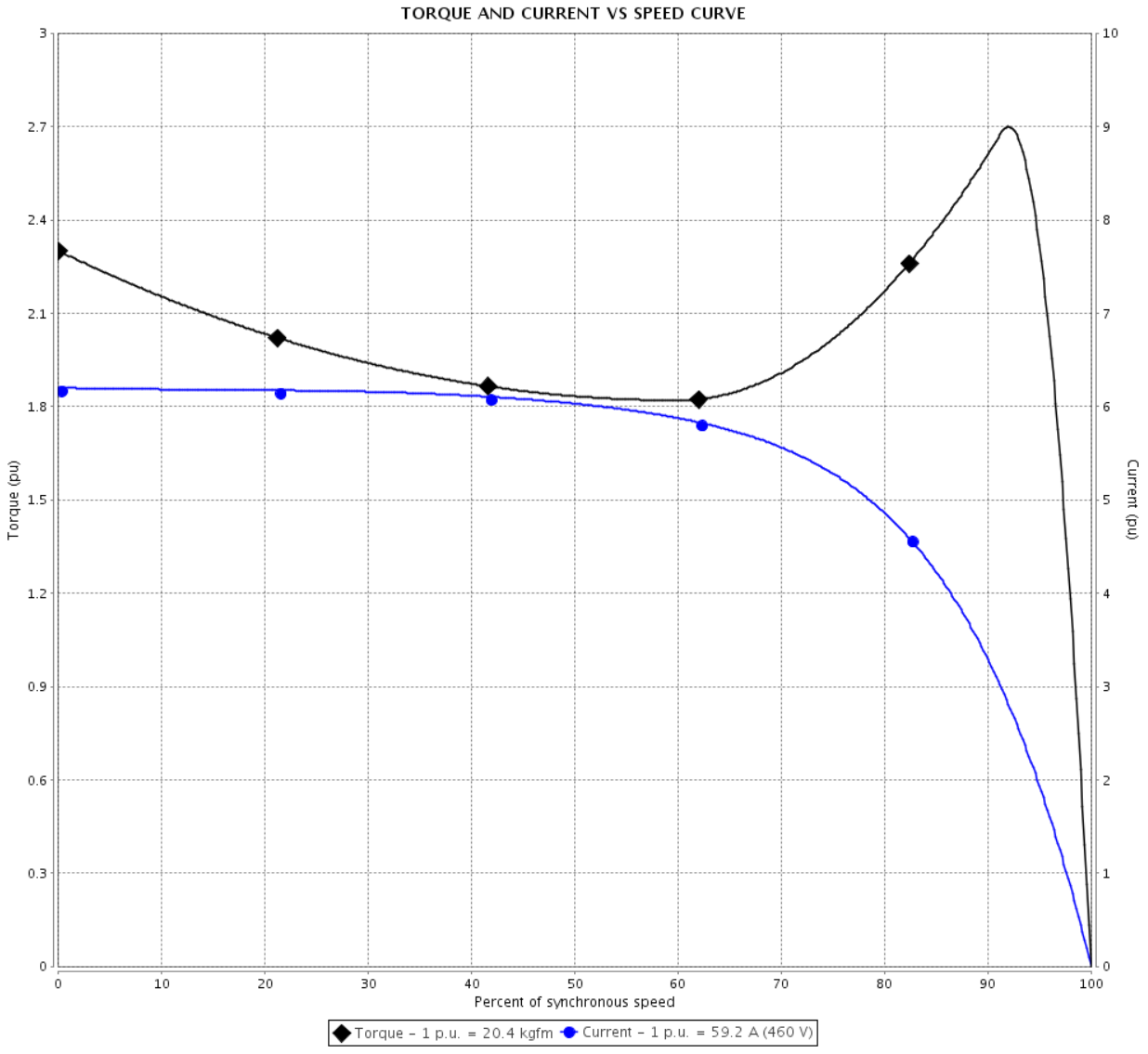
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 230/460 V 60 Hz 4P

Rated current	: 118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

Locked rotor time	: 27s (cold) 15s (hot)

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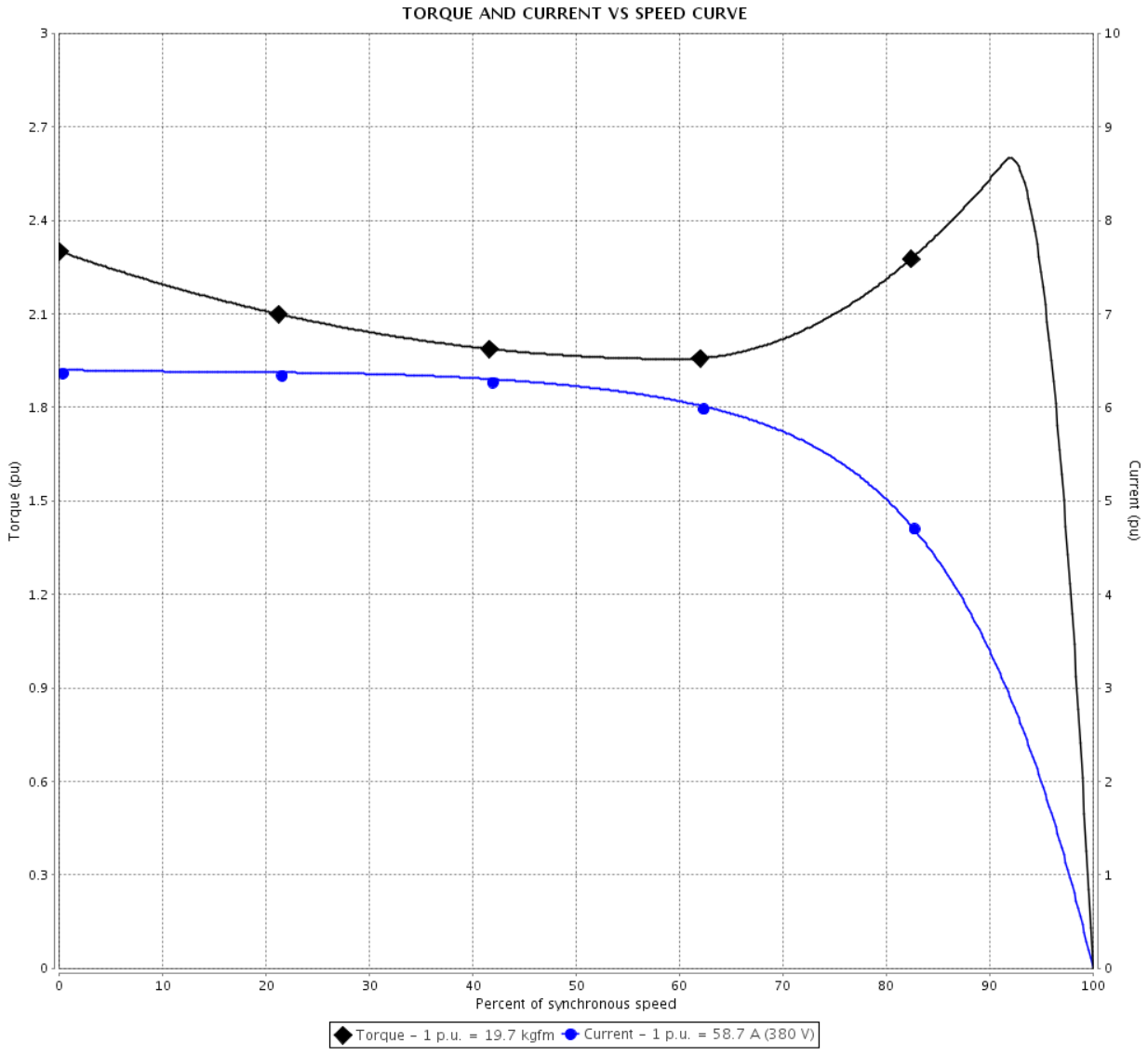
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE3

Rated current	: 58.7 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 19.7 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.00
Breakdown torque	: 260 %	Temperature rise	: 80 K
Rated speed	: 1470 rpm	Design	: B

Locked rotor time	: 19s (cold) 11s (hot)

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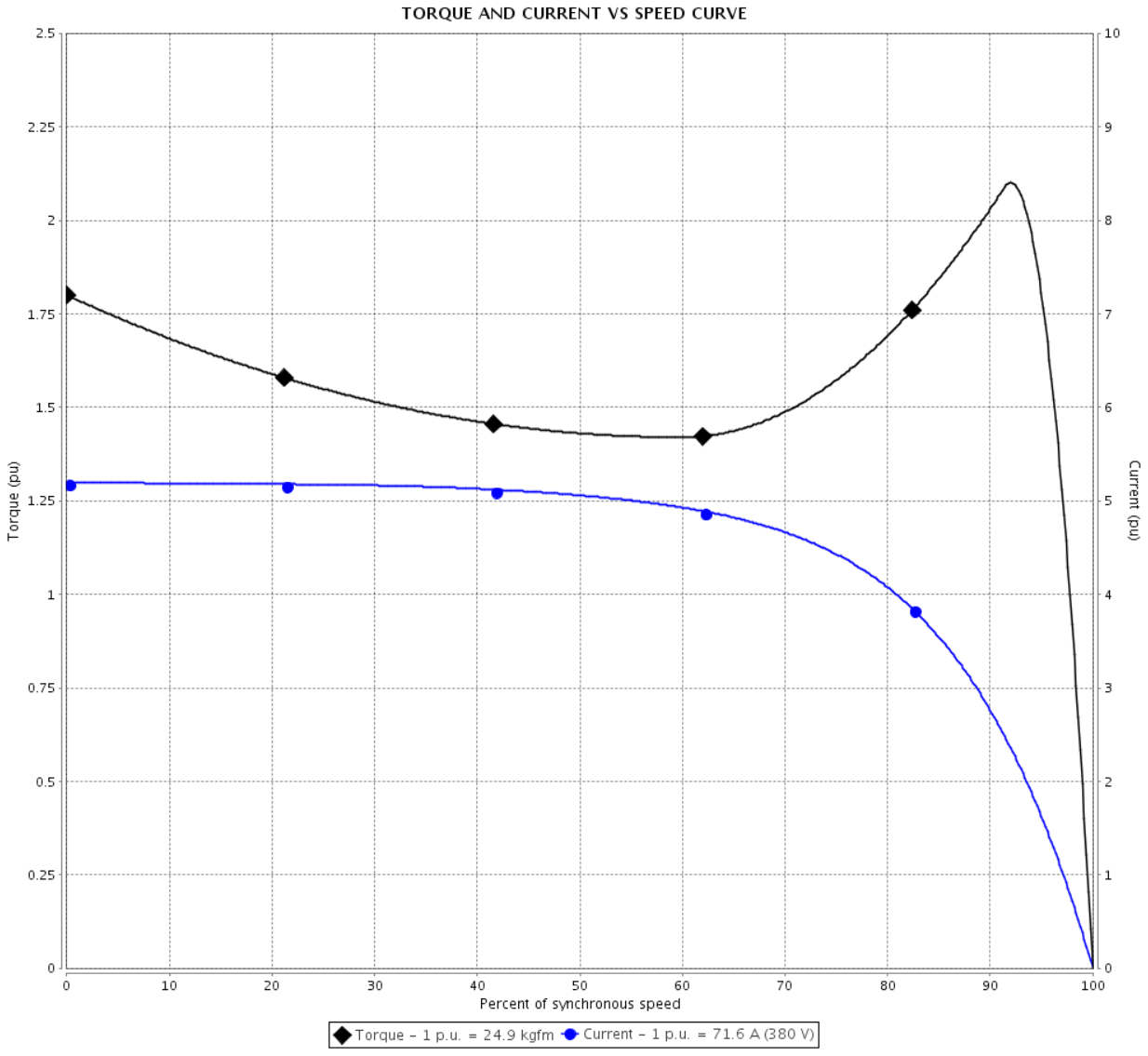
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE1

Rated current	: 71.6 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 5.2	Duty cycle	: Cont.(S1)
Rated torque	: 24.9 kgfm	Insulation class	: F
Locked rotor torque	: 180 %	Service factor	: 1.00
Breakdown torque	: 210 %	Temperature rise	: 105 K
Rated speed	: 1460 rpm	Design	: B

Locked rotor time	: 19s (cold) 11s (hot)

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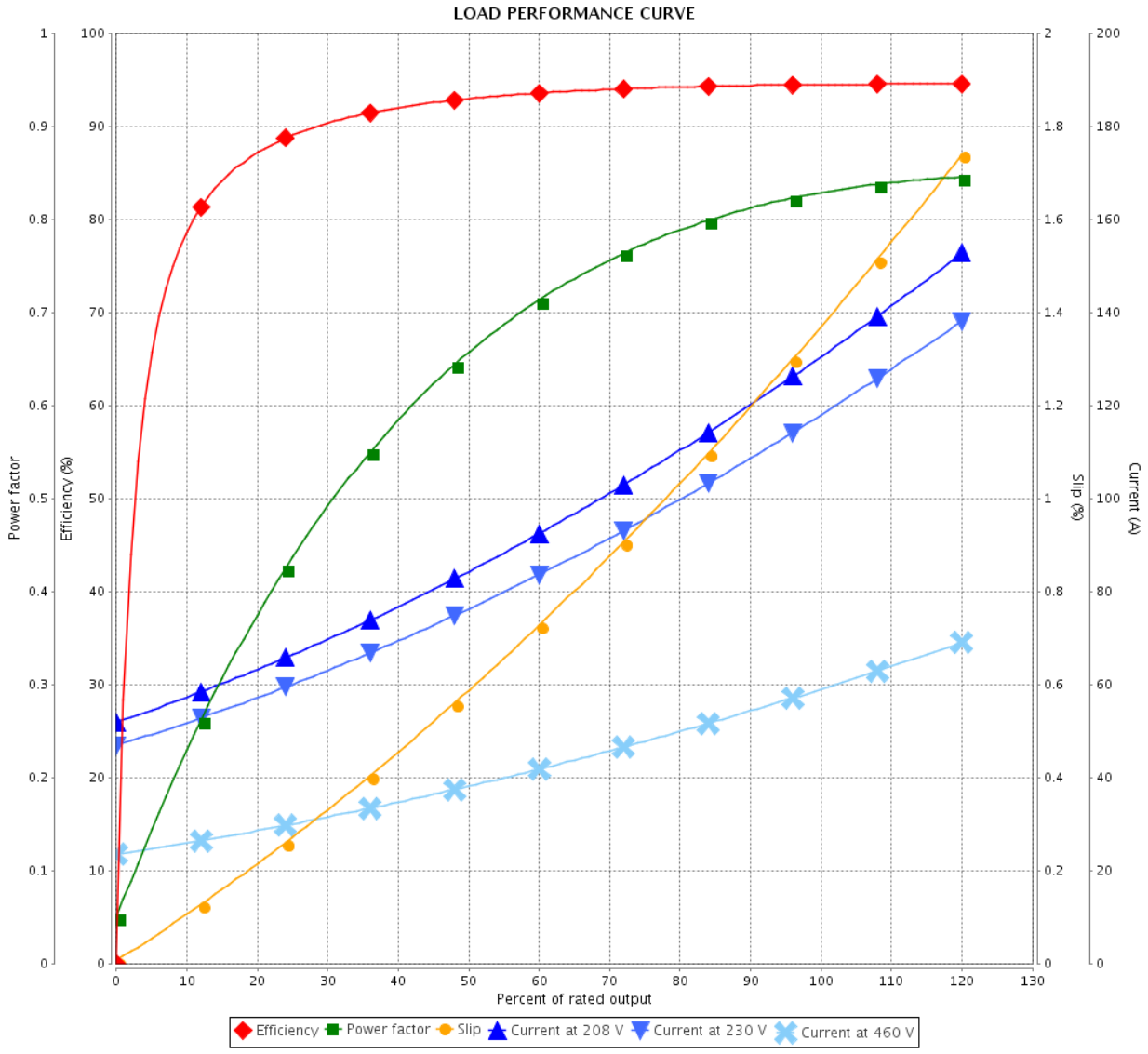
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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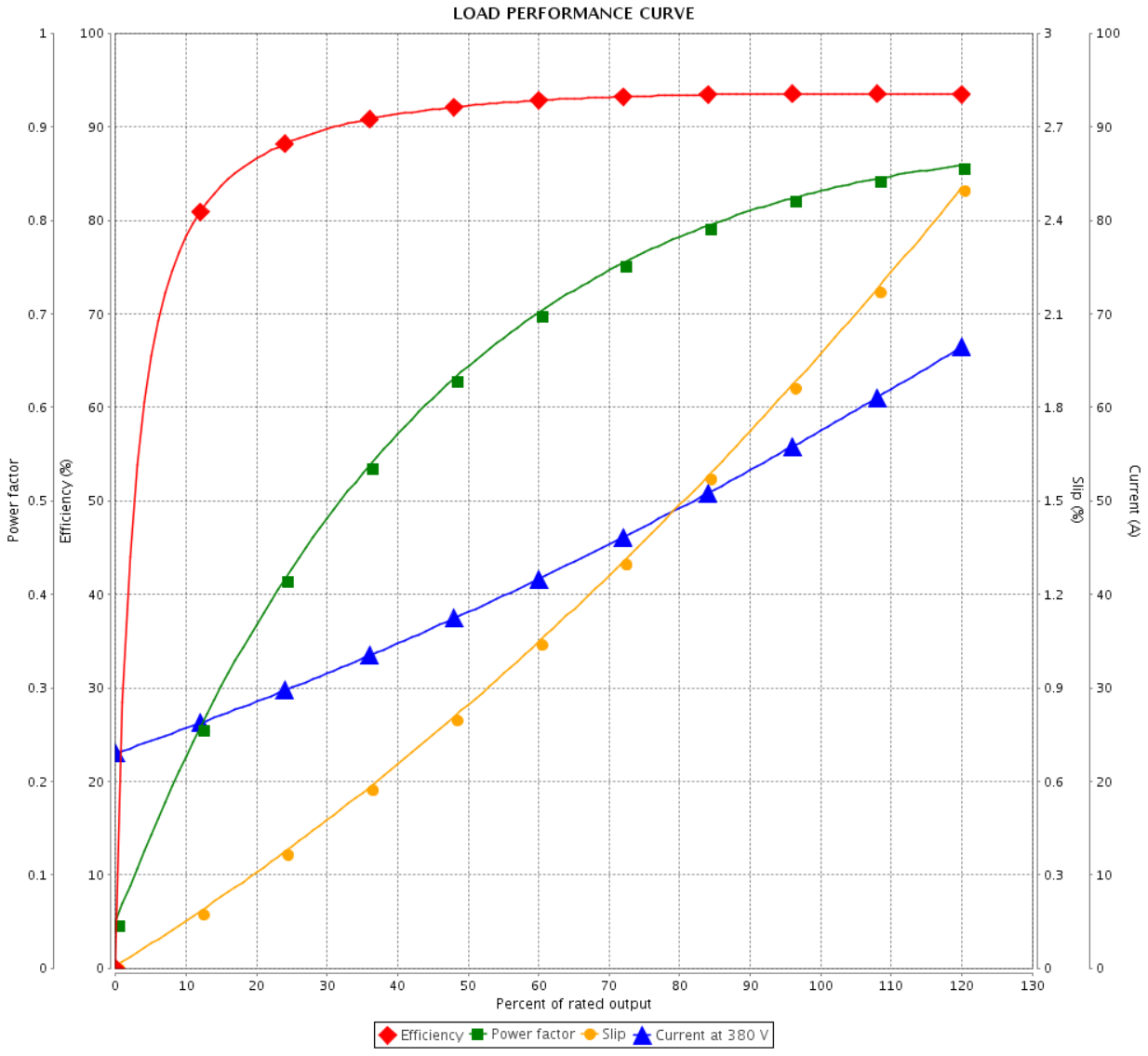
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE3

Rated current	: 58.7 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 19.7 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.00
Breakdown torque	: 260 %	Temperature rise	: 80 K
Rated speed	: 1470 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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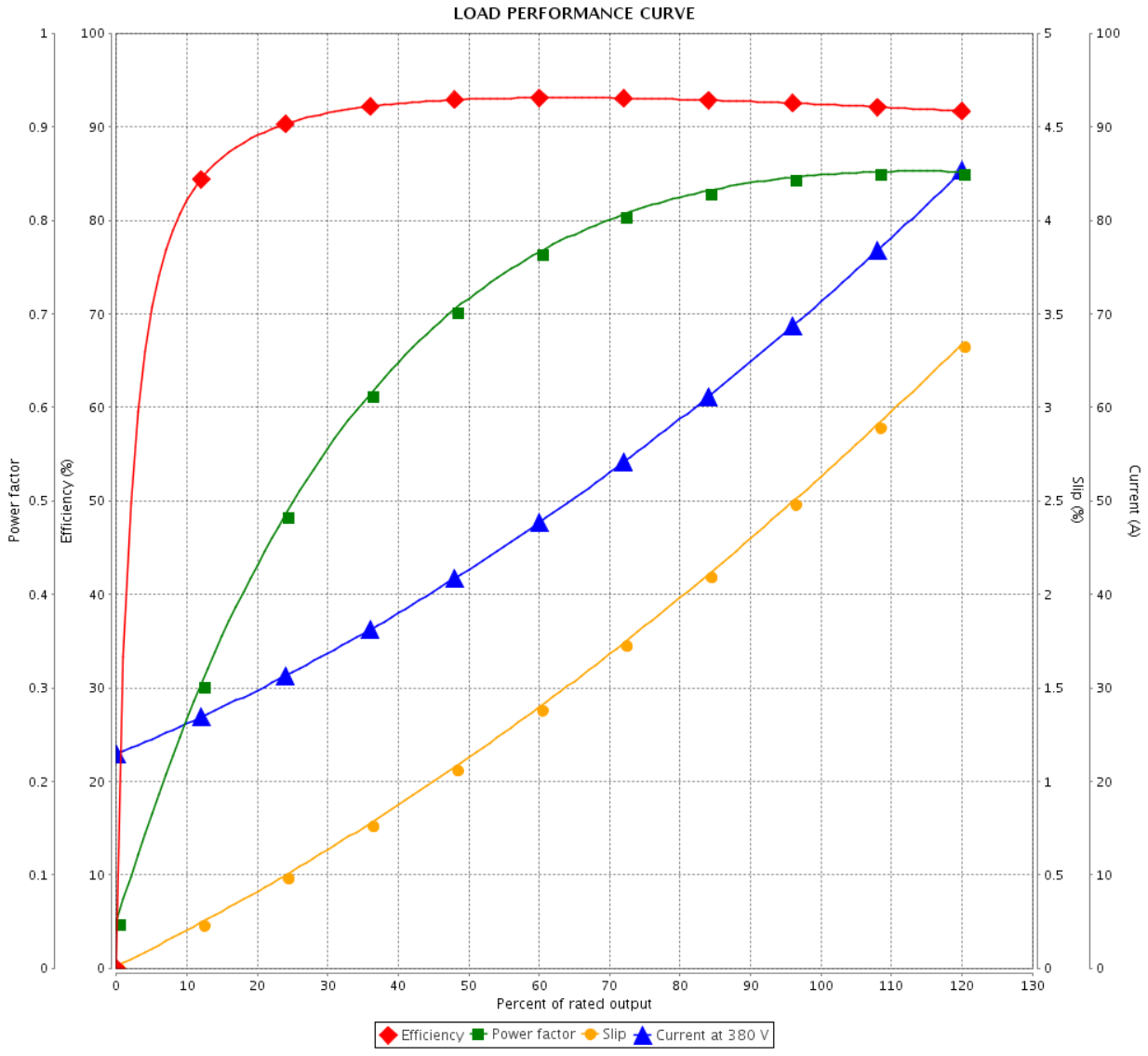
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE1

Rated current	: 71.6 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 5.2	Duty cycle	: Cont.(S1)
Rated torque	: 24.9 kgfm	Insulation class	: F
Locked rotor torque	: 180 %	Service factor	: 1.00
Breakdown torque	: 210 %	Temperature rise	: 105 K
Rated speed	: 1460 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22

Performance	: 230/460 V 60 Hz 4P

Rated current	: 118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

Heating constant	
Cooling constant	

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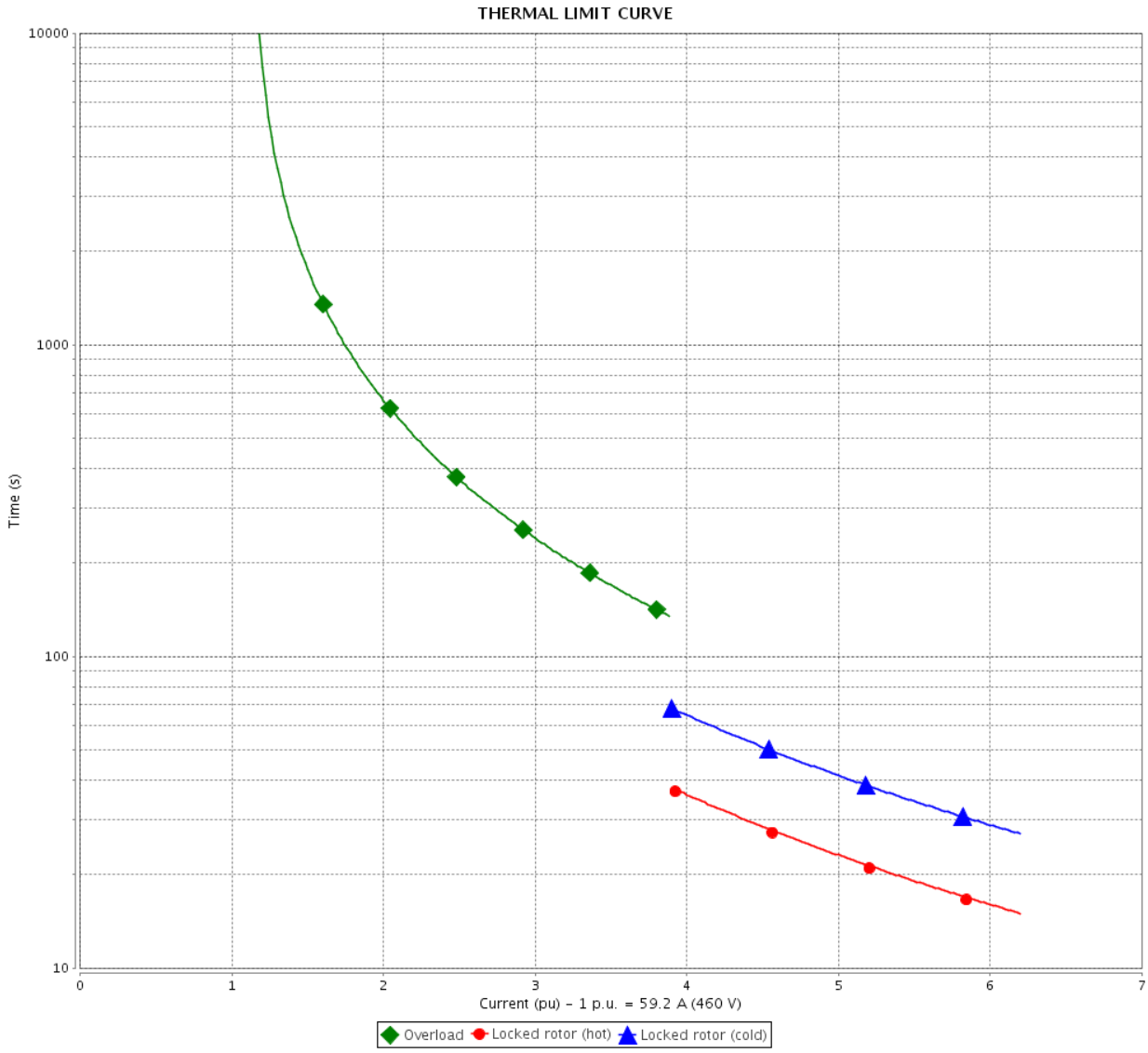
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22

Performance	: 380 V 50 Hz 4P IE3		
Rated current	: 58.7 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 19.7 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.00
Breakdown torque	: 260 %	Temperature rise	: 80 K
Rated speed	: 1470 rpm	Design	: B
Heating constant			
Cooling constant			

Rev.	Changes Summary	Performed	Checked	Date

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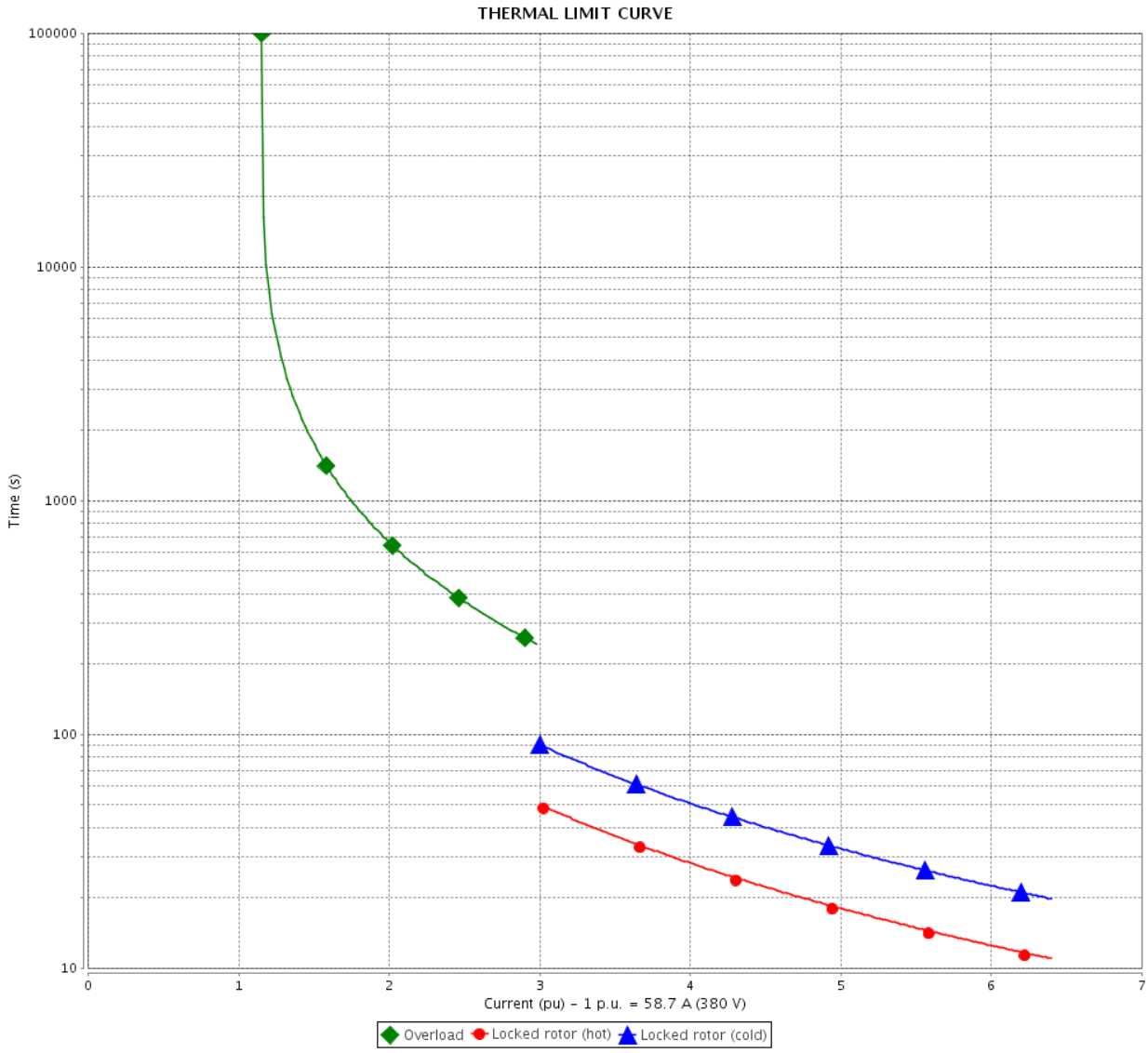
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



Rev.	Changes Summary	Performed	Checked	Date

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Checked by			Page	Revision
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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22

Performance	: 380 V 50 Hz 4P IE1

Rated current	: 71.6 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 5.2	Duty cycle	: Cont.(S1)
Rated torque	: 24.9 kgfm	Insulation class	: F
Locked rotor torque	: 180 %	Service factor	: 1.00
Breakdown torque	: 210 %	Temperature rise	: 105 K
Rated speed	: 1460 rpm	Design	: B

Heating constant	
Cooling constant	

Rev.	Changes Summary	Performed	Checked	Date

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Checked by			Page	Revision
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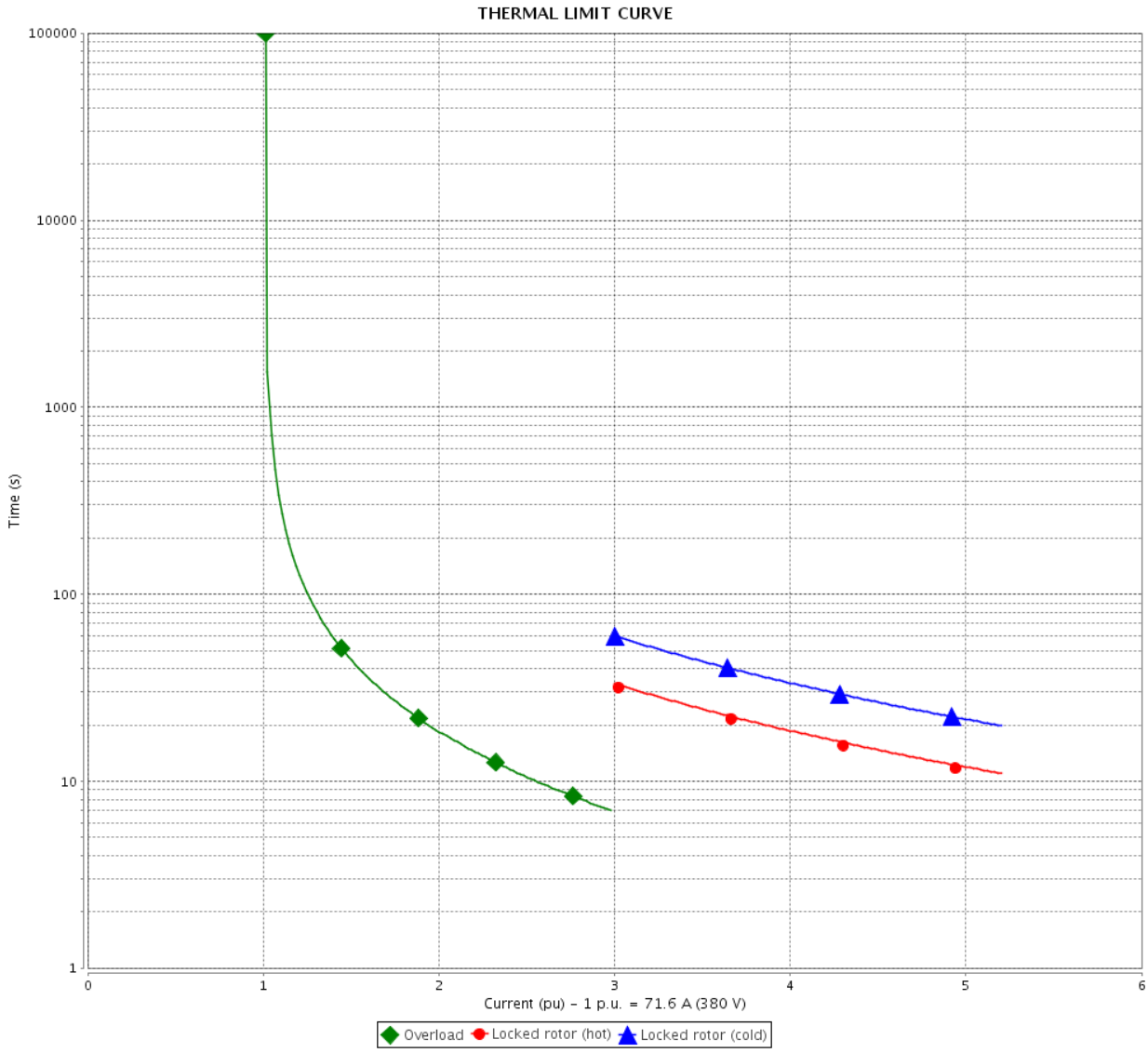
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



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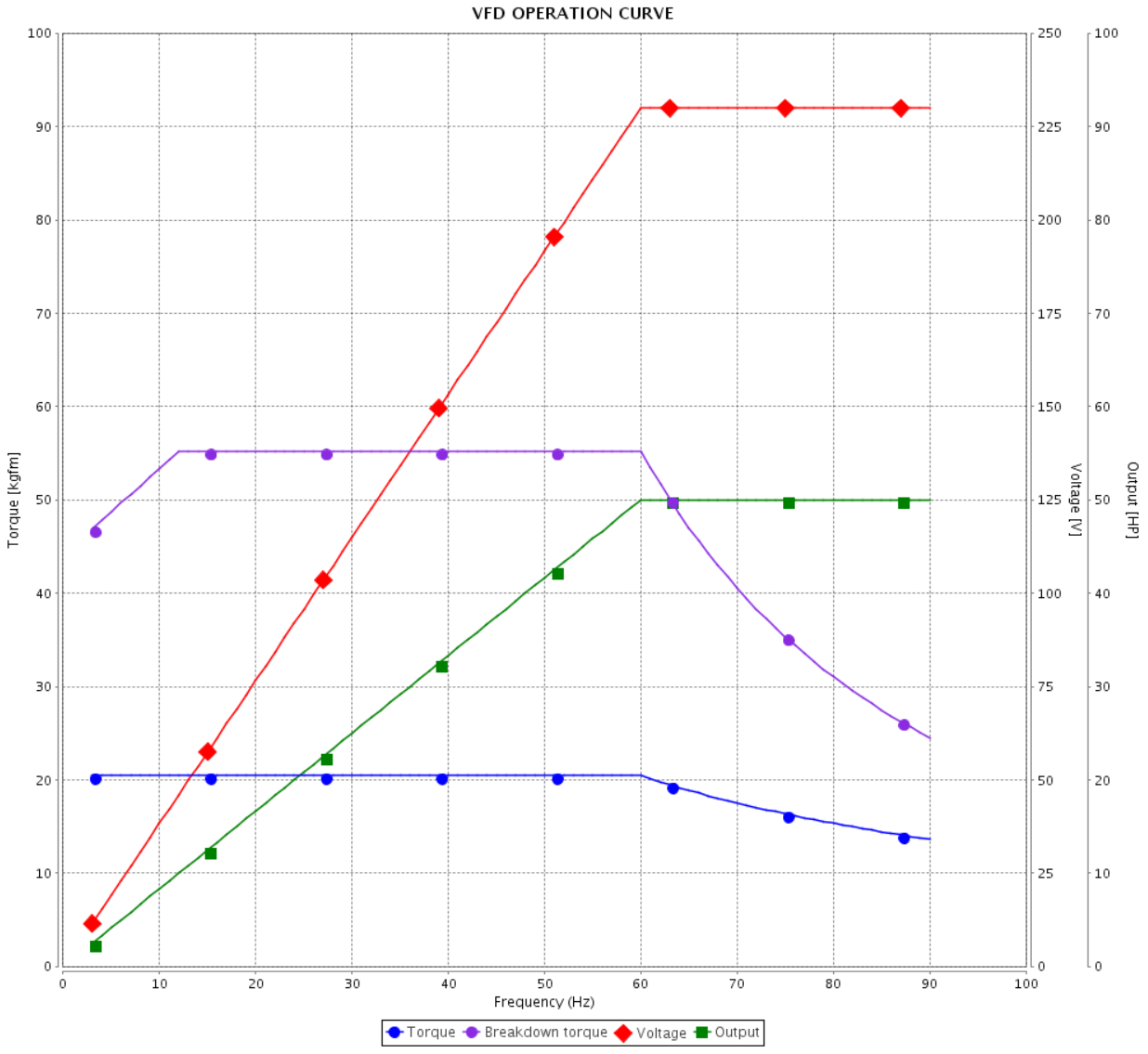
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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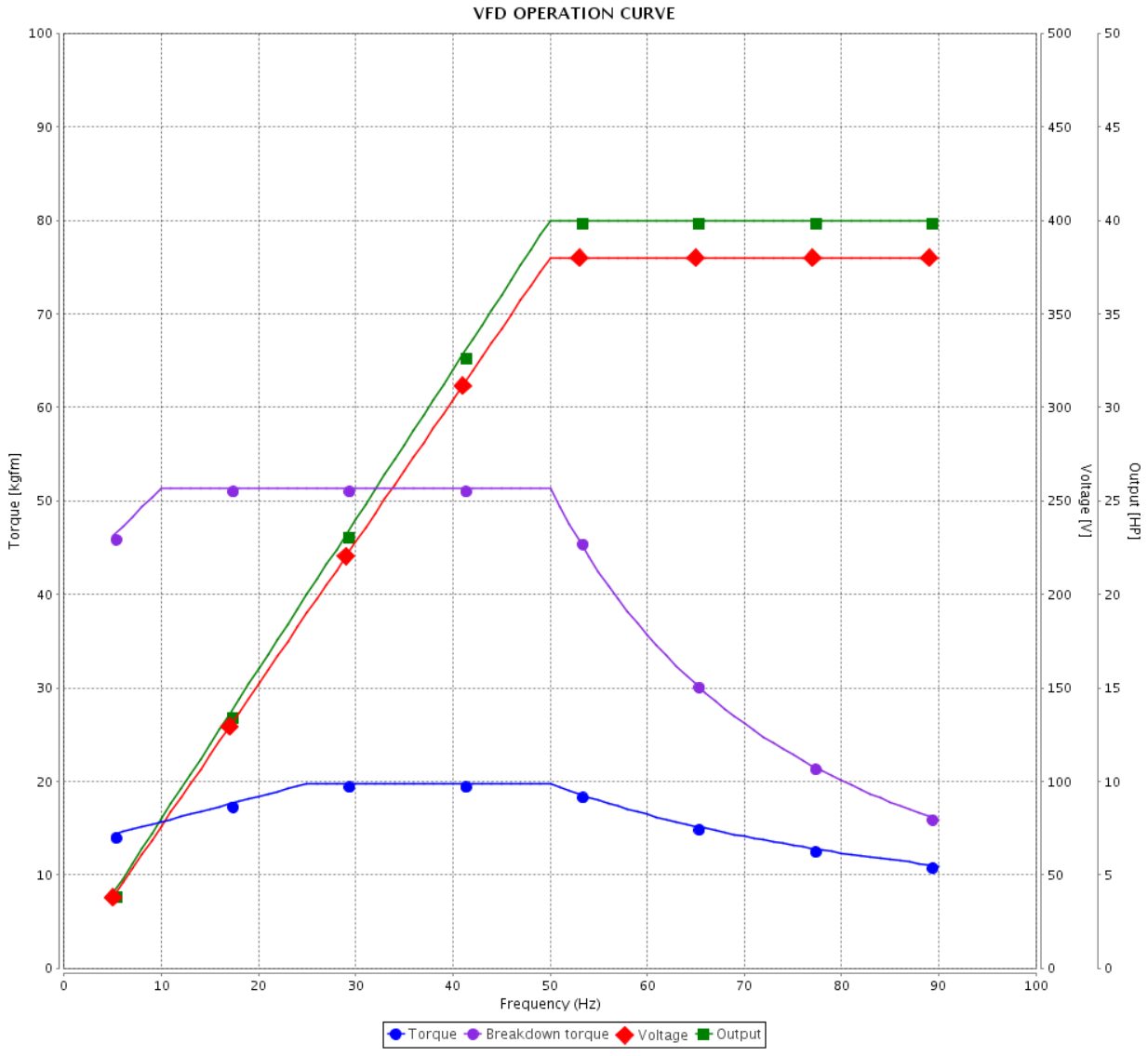
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE3		
Rated current	: 58.7 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 19.7 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.00
Breakdown torque	: 260 %	Temperature rise	: 80 K
Rated speed	: 1470 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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Checked by			Page	Revision
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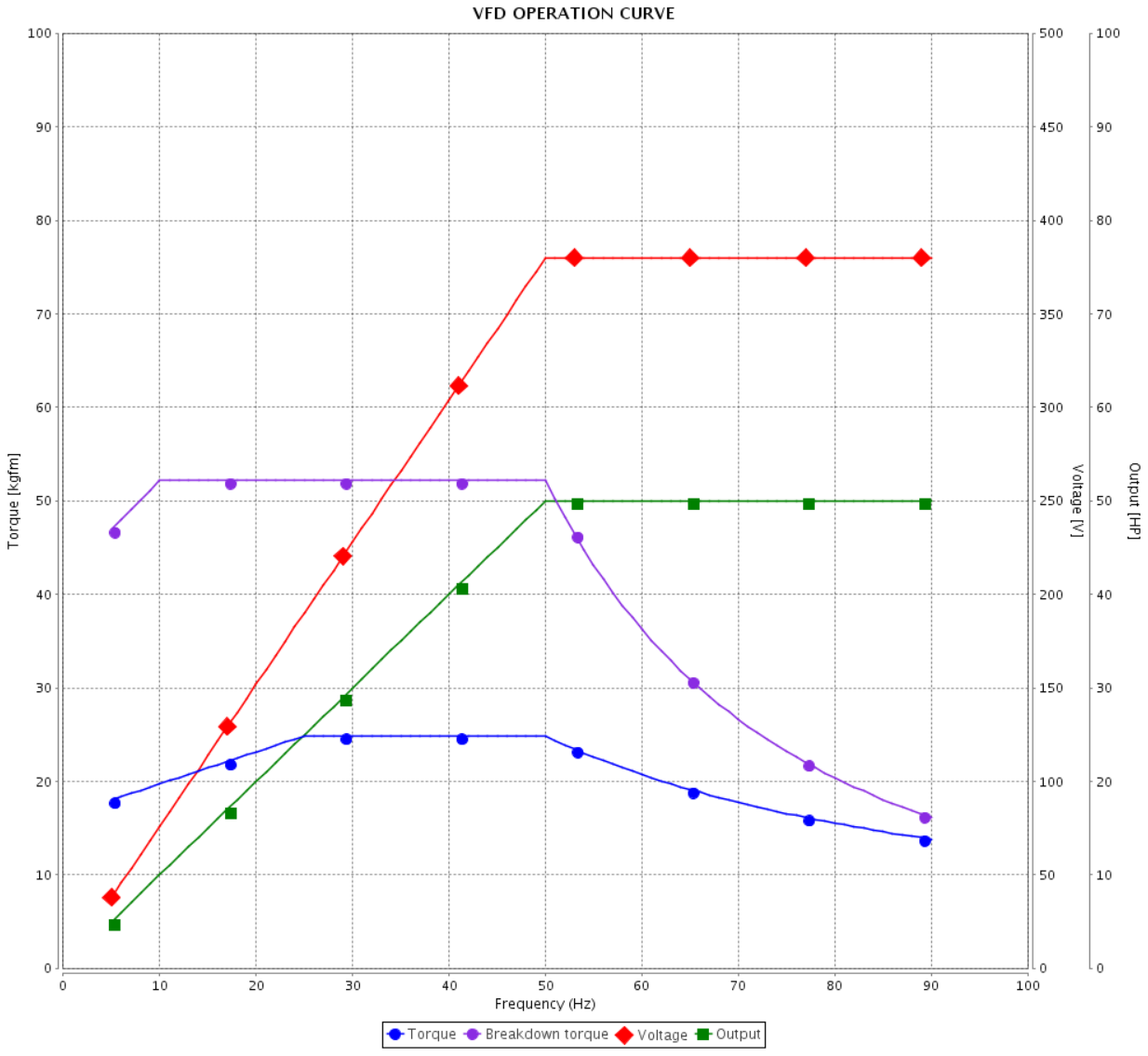
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11438076
		Catalog # :	05018ET3E326T-W22



Performance	: 380 V 50 Hz 4P IE1		
Rated current	: 71.6 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 5.2	Duty cycle	: Cont.(S1)
Rated torque	: 24.9 kgfm	Insulation class	: F
Locked rotor torque	: 180 %	Service factor	: 1.00
Breakdown torque	: 210 %	Temperature rise	: 105 K
Rated speed	: 1460 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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Frequency Inverter

Convertidor de Frecuencia

Inversor de Frequência

Frequenzumrichter

Variateur de Vitesse

Преодразователь частоты

Frequentie regelaar

Przemiennik częstotliwości

Convertitore di Frequenza

Frekans İnvertörü

变频器

CFW-11

Installation Guide
Guía de Instalación
Guia de Instalação
Installationsanleitung
Guide Rapide D'Installation
Руководство по установке
Installatiehandleiding
Instrukcja instalacji
Guida di Installazione
Kurulum Kılavuzu
安装指南

Frequency Inverter

Installation Guide

Series: CFW-11

Language: English

Document: 10001803811 / 04

Publication Date: 03/2022

ENGLISH
ESPAÑOL
PORTUGUÊS
DEUTSCH
FRANÇAIS
РУССКИЙ
NEDERLANDS
POLSKI
ITALIANO
TÜRK
英语

ABOUT THIS GUIDE

This guide shows how to install and how to start-up in V/f mode the CFW-11 inverter models from frame sizes A to H.

For detailed information please refer to the CFW-11 user's manual and programming manual.

It is also possible to operate the CFW-11 in the following control modes: VVW, Sensorless Vector Control and Vector Control with Encoder, for induction motors and Sensorless and Encoder Vector Control for Permanent Magnet (PM) machines. Please see the programming manual.

For information on other functions, accessories and communication, please see the WEG website www.weg.net for manual downloads.

SAFETY INSTRUCTIONS

Fully read this guide before installing or operating the inverter.

Only trained and qualified personnel should attempt to install, start-up, and troubleshoot this type of equipment. The personnel must follow all the safety instructions described in this guide and/or defined by the local regulations.

DANGER!
Failure to comply with the safety instructions may result in death, serious injury, and equipment damage.
Always disconnect the main power supply before touching any electrical device associated to the inverter.
Several components can remain charged with high voltage and/or in movement (fans), even after the AC power supply has been disconnected or switched off. Wait at least 10 minutes to assure the total discharge of the capacitors.
Always connect the equipment frame to the protection earth (PE).

DANGER!
Crushing hazard
In order to ensure safety in load lifting applications, electric and/or mechanical devices must be installed outside the inverter for protection against accidental fall of load.

DANGER!
This product was not designed to be used as a safety element. Additional measures must be taken so as to avoid material and personal damages.
The product was manufactured under strict quality control, however, if installed in systems where its failure causes risks of material or personal damages, additional external safety devices must ensure a safety condition in case of a product failure, preventing accidents.

ATTENTION!
When in operation, electric energy systems – such as transformers, converters, motors and cables – generate electromagnetic fields (EMC), posing a risk to people with pacemakers or implants who stay in close proximity to them. Therefore, those people must stay at least 2 meters away from such equipment.

NOTE!
For the purpose of this guide, qualified personnel are those trained and able to:
1. Install, ground, power-up, and operate the CFW-11 according to this guide and to the current legal safety procedures.
2. Use the protection equipment according to the established regulations.
3. Provide first aid.

NOTE!
Frequency inverter may interference with other electronic equipment. Follow the installation instructions for minimizing these effects.

CFW-11 MAIN DESCRIPTION

The CFW-11 frequency inverter is a high performance product with models covering the range from 1 to 1000 HP (0.75 to 750 kW) in eight different mechanical sizes and line voltages from 200 V to 690 V. It is designed for speed and torque control of three-phase induction motors and PM motors. The main characteristic of this product is the “Vectrue” technology, with the following control modes: Scalar control (V/f), VVW, “Sensorless vector control” and “Vector control with encoder”. Additional highlight functions and features: “Optimal Braking”, “Self-Tuning” and “Optimal Flux”.

For more detailed information refer to the CFW-11 user's manual and the programming manual.

RECEIVING AND STORAGE

When receiving the product verify if:

- The CFW-11 nameplate data matches the purchase order. See models and technical characteristic in tables A.1, A.2 and A.3.
- Any damage occured during transportation. If any problem is detected, contact the carrier immediately.

If the CFW-11 is not to be installed immediately, store it within its original cardboard box in a clean and dry room (storage temperatures between -25 °C (-13 °F) and 60 °C (140 °F).

MECHANICAL INSTALLATION

ENVIRONMENT

Avoid:

- Direct exposure to sunlight, rain, high humidity, or sea-air.
- Inflammable or corrosive gases or liquids.
- Excessive vibration.
- Dust, metallic particles, and oil mist.

Environment conditions according to tables A.1, A.2 and A.3.

GENERAL MOUNTING CONSIDERATIONS

Consult the inverter weight in tables A.1, A.2 and A.3.

Mount the inverter in the upright position on a flat and vertical surface.

External dimensions and fixing holes position according to the figure 1.

Minimum mounting clearances requirements for proper cooling air circulation are specified in figure 2.

Note:
Inverters of frame sizes A, B and C can be arranged side-by-side with no clearance required between them. In this case, the top cover must be removed. For more information, refer to the user's manual available for download on the website: **www.weg.net**.

Do not install heat sensitive components right above the inverter.

NOTE!
The detailed description of all models (IP2X/IP55) of the CFW-11 frequency inverter is found in the user's manual, available for download on **www.weg.net**.

CABINET MOUNTING

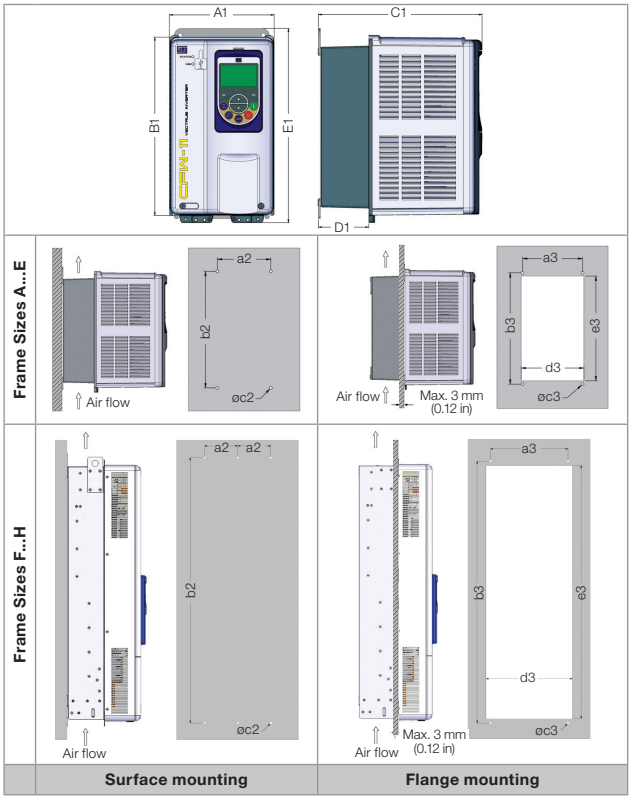
Surface assembly:

Provide adequate exhaustion so that the internal cabinet temperature remains within the allowed range for the inverter operations conditions.

The power dissipated by the inverter at its rated condition is specified in table A.1, A.2, A.3 and A.4 "Dissipated power in Watts – Surface Mounting".

The cabinet minimum air cooling flow requirements are as shown in table 1.

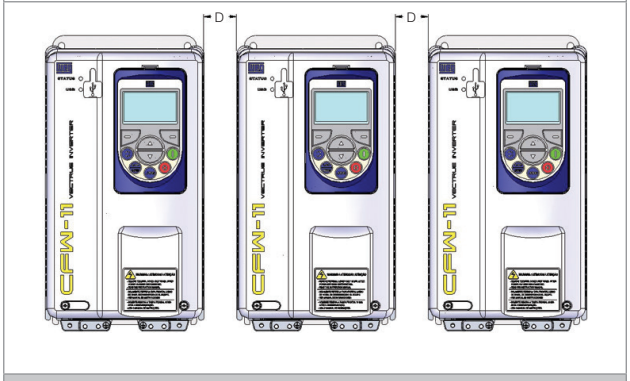
The position and diameter of the mounting holes are according to figure 1.



Model	A1	B1	C1	D1	E1	a2	b2	c2	a3	b3	c3	d3	e3	f3
	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	M	mm (in)	mm (in)	M	mm (in)	mm (in)	M
Frame size A	145 (5.71)	247 (9.73)	227 (8.94)	70 (2.75)	270 (10.63)	115 (4.53)	250 (9.85)	M5	130 (5.12)	240 (9.45)	M5	135 (5.32)	225 (8.86)	M5
Frame size B	190 (7.48)	293 (11.53)	227 (8.94)	71 (2.78)	316 (12.43)	150 (5.91)	300 (11.82)	M5	175 (6.89)	285 (11.23)	M5	179 (7.05)	271 (10.66)	M5
Frame size C	220 (8.67)	378 (14.88)	293 (11.53)	136 (5.36)	405 (15.95)	150 (5.91)	375 (14.77)	M6	195 (7.68)	365 (14.38)	M6	205 (8.08)	345 (13.59)	M8
Frame size D	300 (11.81)	504 (19.84)	305 (12.00)	135 (5.32)	550 (21.65)	200 (7.88)	525 (20.67)	M8	275 (10.83)	517 (20.36)	M8	285 (11.23)	485 (19.10)	M6
Frame size E	335 (13.19)	620 (24.41)	358 (14.09)	168 (6.61)	675 (25.57)	200 (7.88)	650 (25.59)	M8	275 (10.83)	635 (25.00)	M8	315 (12.40)	615 (24.21)	M8
Frame size F	430 (16.93)	1156 (45.51)	360 (14.17)	169 (6.65)	1234 (48.58)	150 (5.91)	1200 (47.24)	M10	350 (13.78)	1185 (46.65)	M10	391 (15.39)	1146 (45.12)	M8
Frame size G	535 (21.06)	1190 (46.85)	426 (16.77)	202 (7.95)	1264 (49.76)	200 (7.87)	1225 (48.23)	M10	400 (15.75)	1220 (48.03)	M10	495 (19.49)	1182 (46.53)	M8
Frame size H	686	1319.7	420.8	171.7	1414	175	1350	M10	595	1345	M10	647	1307	-

Tolerance for d3 and e3: +1.0 mm (+0.039 in)
General tolerance: ±1.0 mm (±0.039 in)

Figure 1: *Mechanical installation details*



Ventilation Clearances

Model		A mm (in)	B mm (in)	C mm (in)	D mm (in)
Frame size A		25 (0.98)	25 (0.98)	10 (0.39)	30 (1.18)
Frame size B		40 (1.57)	45 (1.77)		
Frame size C		110 (4.33)	130 (5.12)		
Frame size D					
Frame size E	0142 T2	100 (3.94)	130 (5.12)	20 (0.78)	40 (1.57)
	0180 T2	150 (5.91)	250 (9.84)		80 (3.15)
	0211 T2				
	0105 T4	100 (3.94)	130 (5.12)		40 (1.57)
	0142 T4	150 (5.91)	250 (9.84)		80 (3.15)
	0180 T4				
	0211 T4				
Frame size F					
Frame size G					
Frame size H					

Tolerance: ±1.0 mm (±0.039 in)

Figure 2: *Minimum clearance for inverter ventilation*

Table 1: *Minimun required cabinet cooling air flow*

Frame size	Model	CFM	l/s	m³/min
A	All	18	8	0.5
B	All	42	20	1.2
C	All	96	45	2.7
D	All	132	62	3.7
E	CFW110142T2	180	95	5.1
	CFW110180T2 and 0211T2	265	125	7.5
	CFW110105T4	138	65	3.9
	CFW110142T4	180	95	5.1
	CFW110180T4 and 0211T4	265	125	7.5
	CFW110053T6, 0063 T6 and 0080T6	180	95	5.1
	CFW110107T6, 0125T6 and 0150T6	265	125	7.5
F	CFW110242T4	250	118	7.1
	CFW110312T4	320	151	9.1
	CFW110370T4	380	180	10.1
	CFW110477T4	460	217	13.0
	CFW110170T6, 0216T6 and 0289T6	460	217	13.0
G	CFW110515T4, 0601T4 and 0720T4	680	321	19.3
	CFW110760T4	1020	481	28.9
	CFW110315T6, 0365T6 and 0435T6	680	321	19.3
	CFW110472T6	1020	481	28.9
H	All	1100	520	31.2

Flange mounting:

The losses specified in table A.1, A.2, A.3 and A.4, "Dissipated power in Watts - Flange mounting" will be dissipated inside the cabinet. The remaining losses will be dissipated through the back side.

The inverter securing supports and the hoisting eyes must be removed and repositioned, in frame sizes E, F, G and H. See figures 3 and 4.

The part of the inverter that is located outside the cabinet is rated IP54, for frame sizes A to E (for models 180T2, 211T2, 180T4 and 211T4 need special hardware H1), for frame sizes F, G and H it is rated IP20.

Provide an adequate gasket for the cabinet opening to ensure that the enclosure rating is maintained. Example: silicone gasket.

Mounting surface opening dimensions and positions/diameters of the mounting holes, as shown in figure 1.

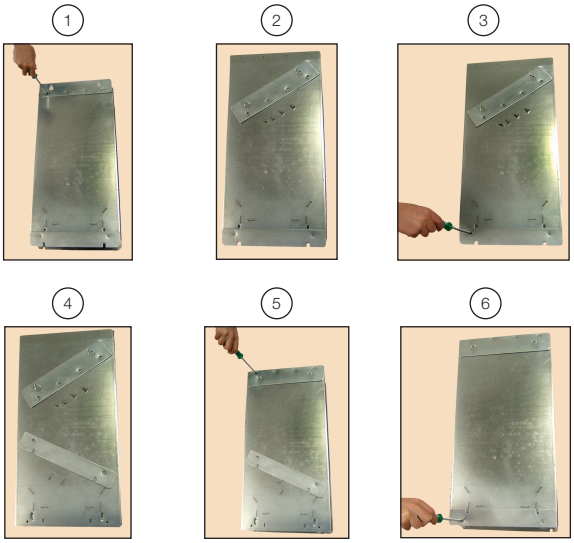


Figure 3: *Repositioning of the mounting supports for sizes A to E. In frame sizes F, G and H the mounting supports must be removed*

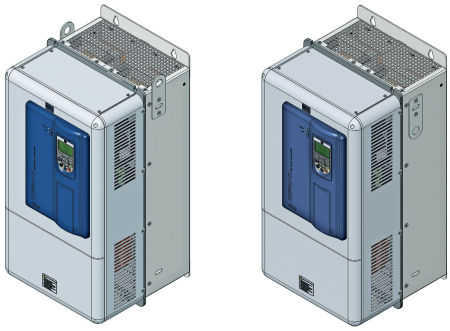


Figure 4: *Hoisting Eyes installation – frame sizes E, F, G and H*

Access to the Control and Power Terminals

In order to get access to the control and power terminals, it is necessary to remove the HMI and the front cover, in sizes A to C. See figure 5.

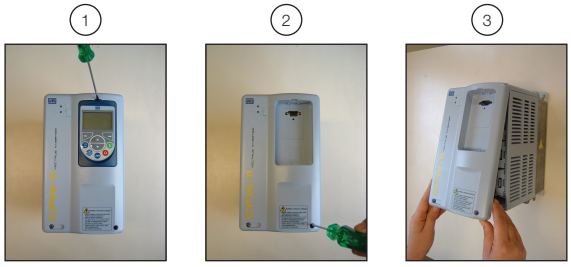


Figure 5: *Removal of the HMI and the front cover*

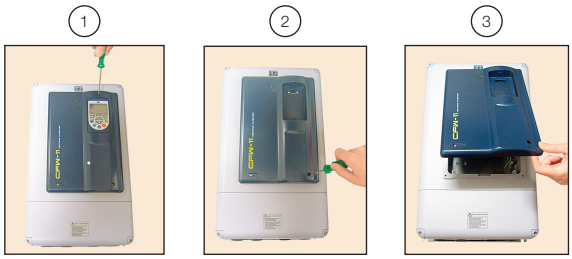


Figure 6: *Removal of the HMI and the control rack cover in frame sizes D, E, F, G and H to access control terminals*

In order to get access to the power terminals, it is necessary to remove the bottom front cover, as showed in figure 7, in sizes D to H.

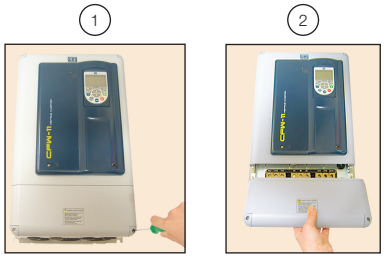


Figure 7: *Removal of the bottom front cover, to access to the power terminals in frame sizes D to H*

When neither IP20 nor Nema1 degree of protection is necessary in frames D and E, the cable passage plate may be removed to facilitate the electrical installation.

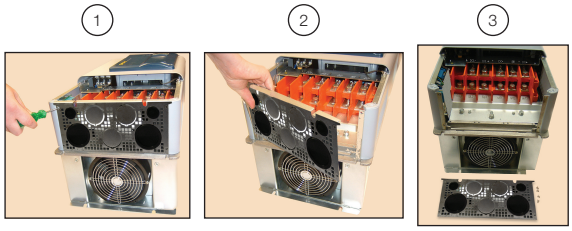


Figure 8: *Removal of the cable passage plate*

In sizes F, G and H always remove the bottom plate for connecting power cables (line and motor), as showed in the figure 9. In this case the protection degree of the inverter bottom part will be reduced.

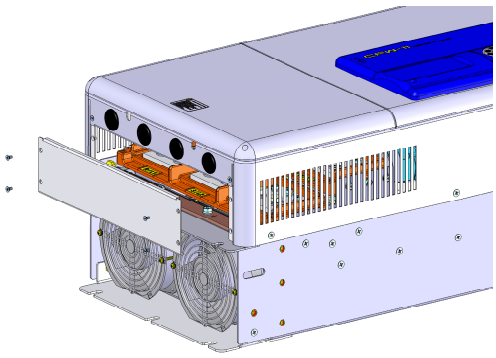


Figure 9: *Removal of the cable passage plate on sizes F, G and H*

ELECTRICAL INSTALLATION

DANGER!
Make sure the AC power supply is disconnected before starting the installation.

DANGER!
The following information is merely a guide for proper installation. Comply with applicable local regulations for electrical installations.

DANGER!
The inverter will be damaged in case the input power supply is connected to the output terminals.

CONECTION DIAGRAMS

Notes:
Technical specifications including line fuses are on tables A.1, A.2, A.3 and A.4.

Technical specification of braking resistors and braking currents on table A.5.

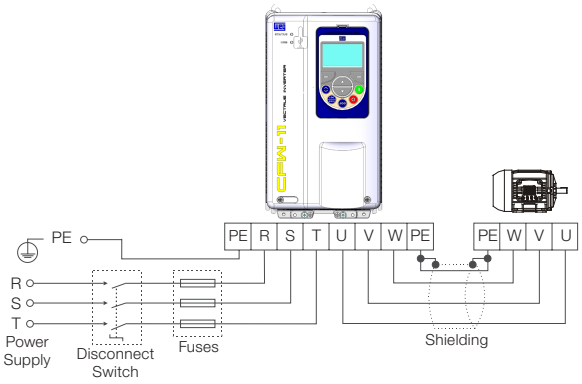


Figure 10: Power connection diagram for frame sizes A to G standard frames

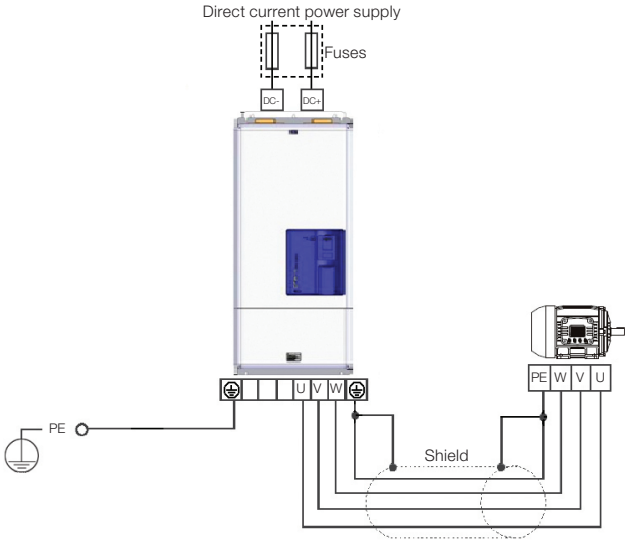


Figure 11: Power connection diagram for sizes F, G and H with special DC hardware

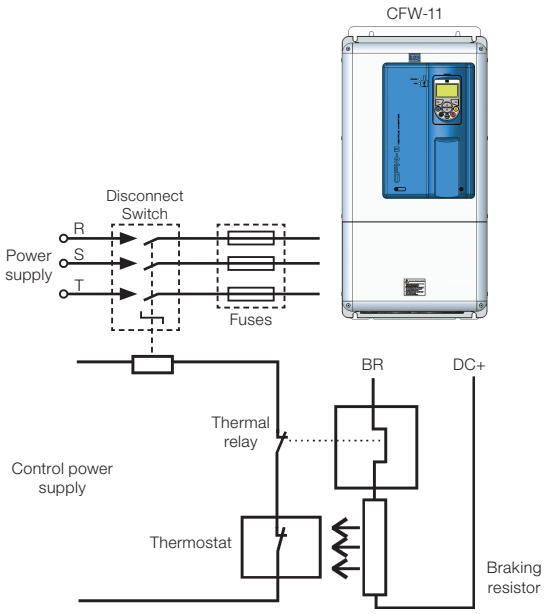


Figure 12: Braking resistor connection diagram for frame sizes A to E

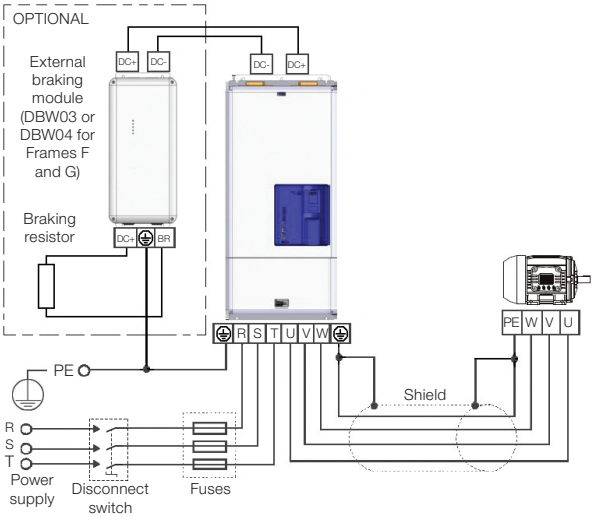


Figure 13: Power connection diagram for frame sizes F and G standard with braking resistor

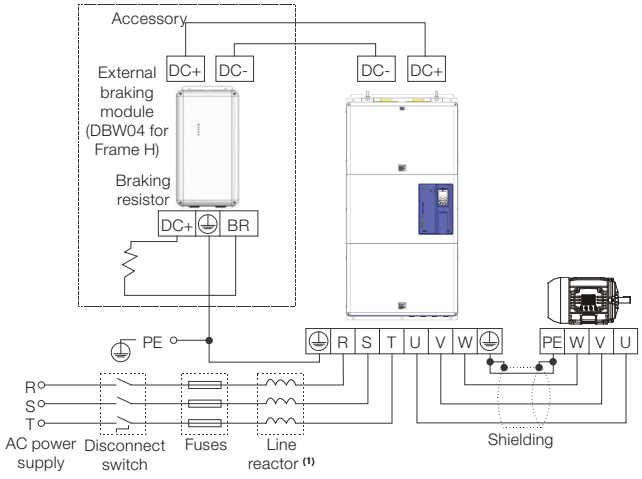
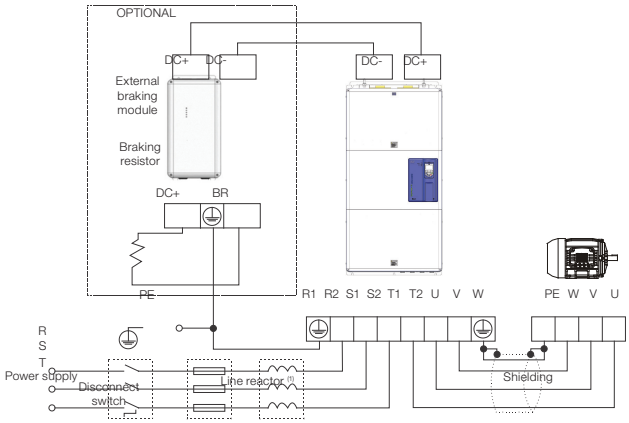


Figure 14: Power connection diagram for frame size H standard with braking resistor (models 584T6 and 625T6) - (IP20 degree of protection)

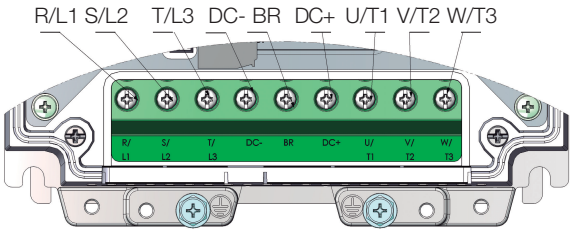


(1) For frame size H other models, two line reactances are required with minimum voltage drop of 3 % under rated condition of the inverter.

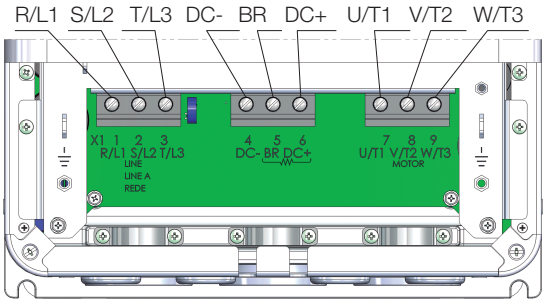
$$L = 919 \cdot \frac{\Delta V\,[\%] \cdot V_{LL}\,[V]}{f_R\,[Hz] \cdot I\,[A]}\ [\mu H]$$

ΔV = Percentage voltage drop. VLL = Inverter supply line voltage. fR = Line frequency.
I = Reactor current. Consider half the inverter input current for each reactor and an unbalance of 15 %. For example, in model 1141 A, the maximum current of each reactor is 1.15 (1141/2) = 656 A.

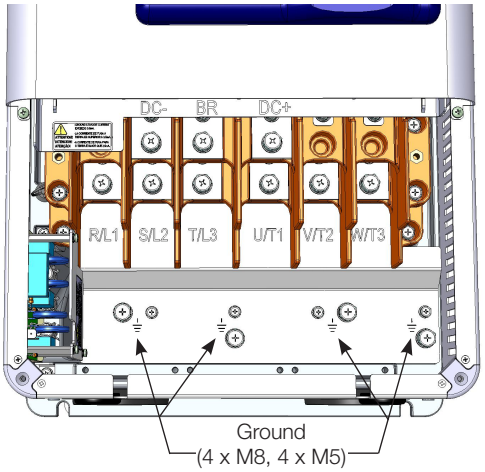
Figure 15: *Models with AC power supply (IP20 degree of protection) - frame size H - except models 584T6 and 625T6*



(a) Frame sizes A, B and C

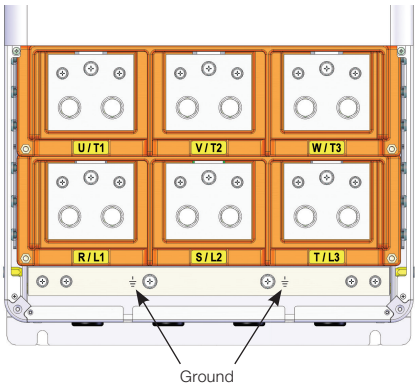


(b) Frame size D

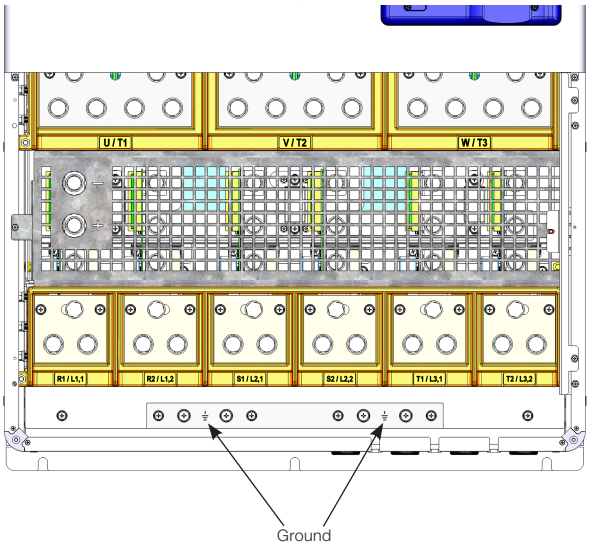


(c) Frame size E

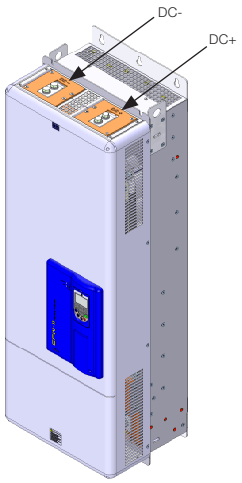
Figure 16 (a) to (c): *Power and grounding terminals frame sizes A, B, C, D and E*



(a) Frame sizes F and G

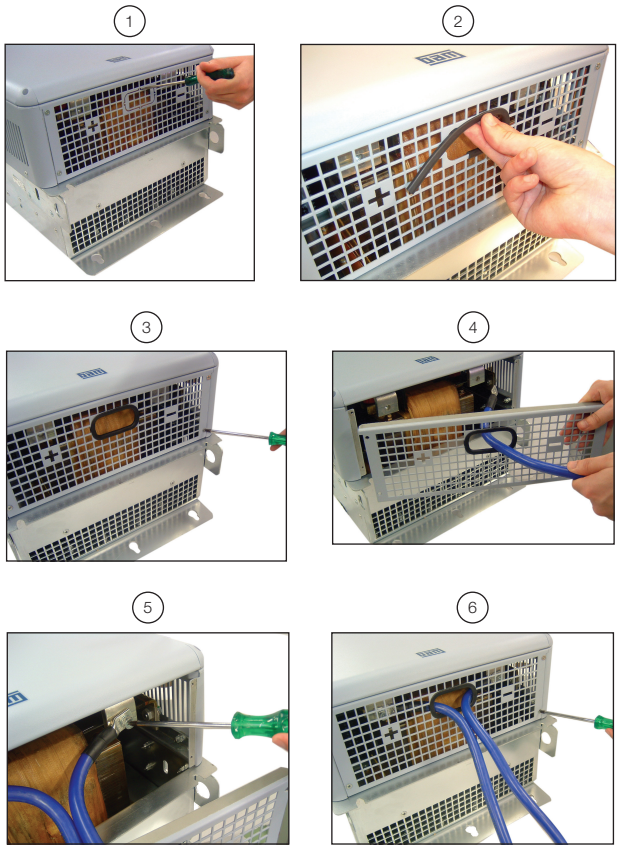


(b) Frame size H

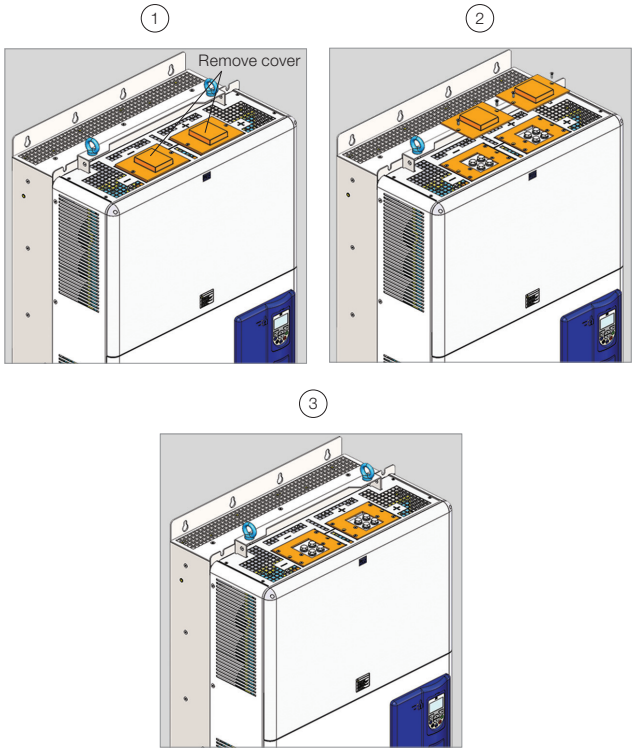


(c) Special Hardware DC

Figure 17 (a) to (c): *Power and grounding terminals sizes F, G and H*



(a) Frame sizes F and G



(b) Frame size H

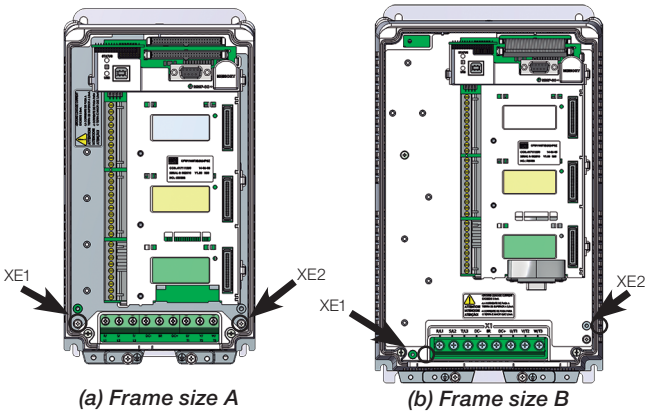
Figure 18: *Connection of dynamic braking module in standard models of sizes F, G and H*

NOTES ON CIRCUITS AND DEVICES

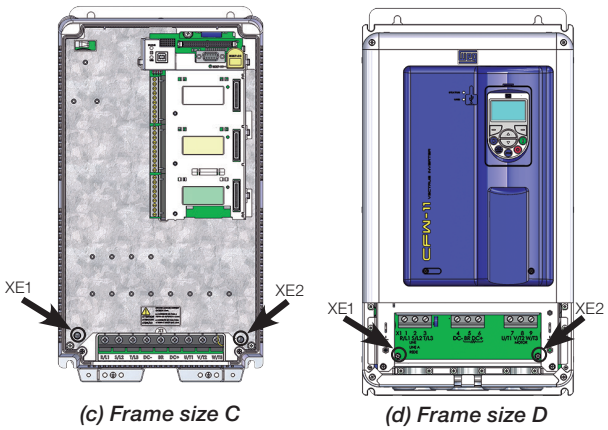
- The power supply that feeds the inverter must have a grounded neutral. For IT networks some internal components must be disconnected as shown in figure 19 to 22.
- Provide a disconnect device for the input power supply of the inverter. This device must disconnect the input power supply for the inverter when needed (for instance, during servicing).
- Suitable for circuits with capacity to deliver no more than:
  - 100 kA symmetric at 240 V or 480 V when the inverter is protected by fuses.
  - 65 kA symmetric at 240 V or 480 V when the inverter is protected by reverse-type circuit breakers.
- The fuse to be used in the input must have current and I^2t equal to or smaller than the specification in tables A.1, A.2, A.3 and A.4 [consider the cold current extinction value (not the melting value)] to protect the input rectifier diodes of the inverter and of the wiring.
- For compliance with the UL standard and current specifications for the fuses and circuit breaker, refer to the User's Manual available for download on: **www.weg.net**.
- Motor shielded cable recommended according to IEC 60034-25.
- Keep motor cables at least 25 cm (9.84 in) distant from other cables as signal cables, sensor cables, control cables, etc.

IT NETWORKS

When the neutral is not grounded, or the grounding is provided by a high ohm value resistor or in grounded delta networks (“delta corner earth”).

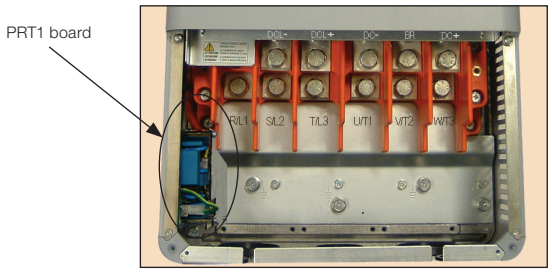


(a) Frame size A *(b) Frame size B*

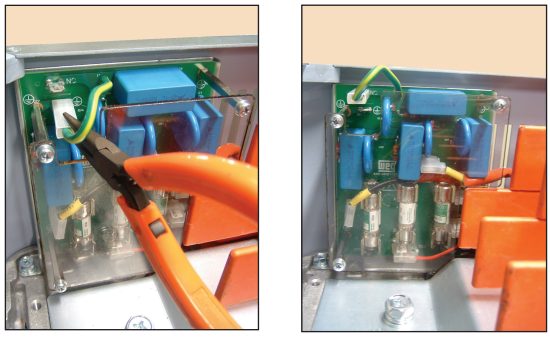


(c) Frame size C *(d) Frame size D*

Figure 19 (a) to (d): *Frame size A to D - Location of Grounding Screws - Remove for IT networks or delta-grounded*

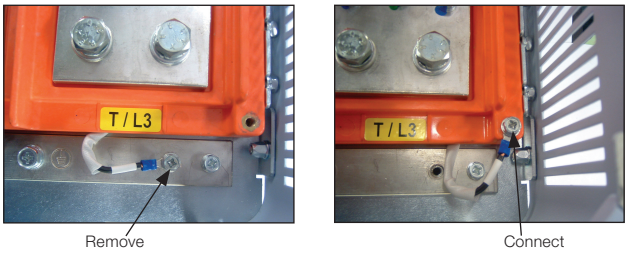


(a) Location of board



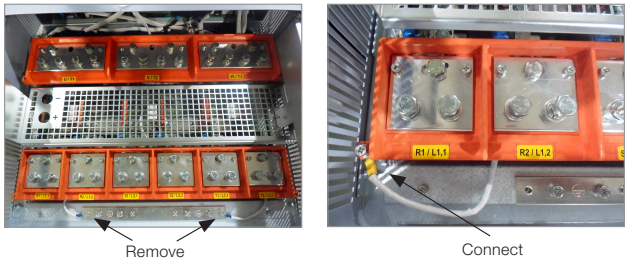
(b) Initial position *(c) Final position (IT)*

Figure 20 (a) to (c): *Frame size E grounding connections – location and procedure to adapt to the IT or delta-grounded networks - move ground RFI filter for NC (not connected)*

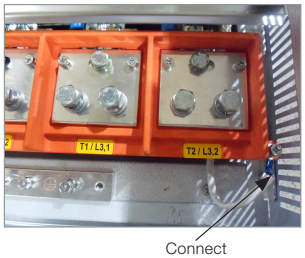


(a) Initial position *(b) Final position (IT)*

Figure 21 (a) and (b): *Frame sizes F and G grounding connections – location and procedure to adapt to the IT or delta-grounded networks - move ground RFI filter for NC (not connected)*



(a) Initial position *(b) Final position (IT)*



(c) Final position (IT)

Figure 22 (a) to (c): *Frame size H grounding connections - location and procedure to adapt to the IT or delta-grounded networks - move ground RFI filter for NC (not connected)*

GROUNDING CONNECTIONS

DANGER!
The inverter ground must be connected to a protective ground (PE).
Refer to local regulations and/or electrical codes for selecting grounding wire gauge.
Connect the inverter grounding connections to a ground bus bar, to a single ground point, or to a common grounding point (impedance ≤ 10 Ω).
To comply with IEC 61800-5-1 standard, connect the inverter to the ground by using a single conductor copper cable with a minimum wire gauge of 10 mm², since the leakage current is greater than 3.5 mAac.

ATTENTION!
The neutral conductor of the mains supply must be solidly grounded. However, this conductor must not be used to ground the inverter.

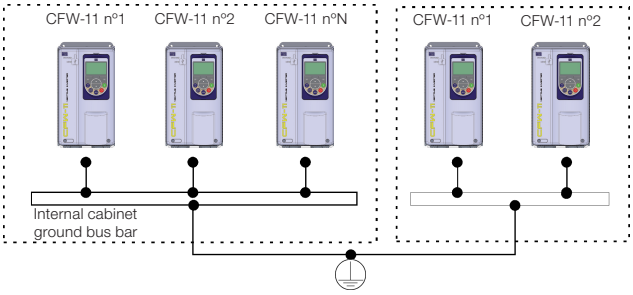
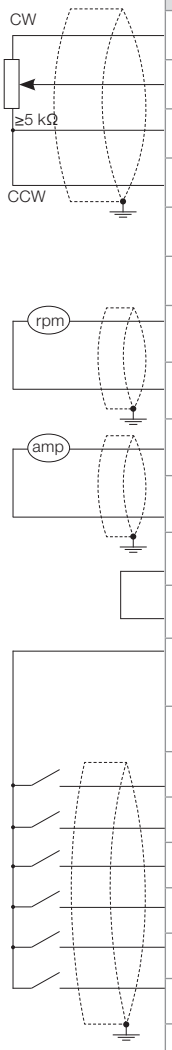


Figure 23: *Grounding connections with multiple inverters*

CONTROL CONNECTIONS

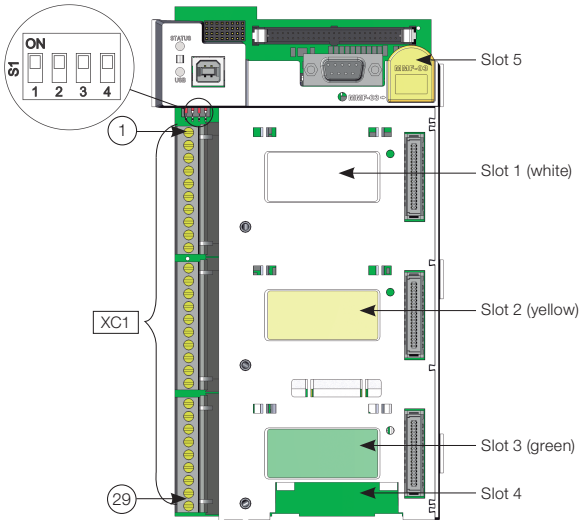
The control connections (analog inputs/outputs, digital inputs/outputs), must be made at the CC11 control board terminal strip XC1.



XC1 Terminal Strip		Factory Setting Function
1	REF+	Positive reference for potentiometer (5.4 V ± 5 %).
2	AI1+	Analog input # 1: Speed reference (remote).
3	AI1-	
4	REF-	Negative reference for potentiometer (-4.7 V ± 5 %).
5	AI2+	Analog input # 2: No function.
6	AI2-	
7	AO1	Analog output # 1: Speed.
8	AGND (24 V)	Reference (0 V) for the analog outputs.
9	AO2	Analog output # 2: Motor current.
10	AGND (24 V)	Reference (0 V) for the analog outputs.
11	DGND*	Reference (0 V) for the 24 Vdc power supply.
12	COM	Common point of the digital inputs.
13	24 Vdc	24 Vdc power supply.
14	COM	Common point of the digital inputs.
15	DI1	Digital input # 1: Start / Stop.
16	DI2	Digital input # 2: Direction of rotation (remote).
17	DI3	Digital input # 3: No function.
18	DI4	Digital input # 4: No function.
19	DI5	Digital input # 5: Jog (remote).
20	DI6	Digital input # 6: 2nd ramp.
21	NC1	Digital output #1 DO1 (RL1): No fault.
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): $N > N_x$ - Speed > P0288.
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): $N^* > N_x$ - Speed reference > P0288.
28	C3	
29	NO3	

Figure 24: *Signals at connector XC1 - digital inputs working as "active high"*

NOTE!
For changing to "Active Low" remove the jumpers between XC1:11 and 12, place this jumper between XC1:12 and 13 and connect common points of the switches on DI1 to DI6 to XC1:11, instead of XC1:13.



Signal	Factory Default Function	DIP-switch	Selection	Factory Setting
AI1	Speed reference (remote)	S1.4	OFF: 0 to 10 V (factory setting) ON: 4 to 20 mA / 0 to 20 mA	OFF
AI2	No function	S1.3	OFF: 0 to ±10 V (factory setting) ON: 4 to 20 mA / 0 to 20 mA	OFF
AO1	Speed	S1.1	OFF: 4 to 20 mA / 0 to 20 mA ON: 0 to 10 V (factory setting)	ON
AO2	Motor current	S1.2	OFF: 4 to 20 mA / 0 to 20 mA ON: 0 to 10 V (factory setting)	ON

Figure 25: *DIP Switches for setting signal type on analog inputs and outputs*

NOTE!
For further information on the Safety Stop function (STO - Safe Torque Off), refer to the user's manual available for download on: **www.weg.net**.

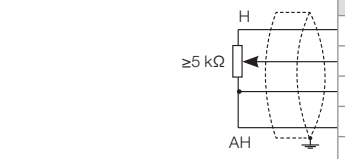
Typical Control Connections

Control connection # 1 - Run/Stop function controlled from the keypad (Local Mode).

With this control connection, it is possible to run the inverter in local mode with the factory default settings.
This operation mode is recommended for first-time users, since no additional control connections are required.

Control connection # 2 - 2-Wire Run/Stop function (Remote Mode).

This wiring example is valid only for the default factory settings and if the inverter is set to remote mode.
With the factory default settings, the selection of the operation mode (local/remote) is performed through the HMI key LOC REM (local mode is default). Set P0220 = 3 to change the default setting of HMI key LOC REM to remote mode.



XC1 Terminal Strip		
1	+ REF	
2	AI1+	
3	AI1-	
4	- REF	
5	AI2+	
6	AI2-	
7	AO1	
8	AGND (24 V)	
9	AO2	
10	AGND (24 V)	
11	DGND*	
12	COM	
13	24 Vdc	
14	COM	
15	DI1	
16	DI2	
17	DI3	
18	DI4	
19	DI5	
20	DI6	
21	NC1	DO1 (RL1)
22	C1	
23	NO1	
24	NC2	DO2 (RL2)
25	C2	
26	NO2	
27	NC3	DO3 (RL3)
28	C3	
29	NO3	

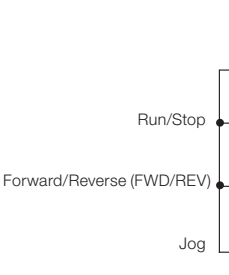
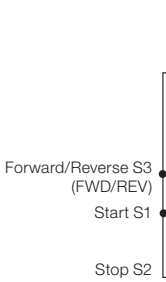


Figure 26: *XC1 wiring for control connection # 2*



XC1 Terminal Strip		
1	+ REF	
2	AI1+	
3	AI1-	
4	- REF	
5	AI2+	
6	AI2-	
7	AO1	
8	AGND (24 V)	
9	AO2	
10	AGND (24 V)	
11	DGND*	
12	COM	
13	24 Vdc	
14	COM	
15	DI1	
16	DI2	
17	DI3	
18	DI4	
19	DI5	
20	DI6	
21	NC1	DO1 (RL1)
22	C1	
23	NO1	
24	NC2	DO2 (RL2)
25	C2	
26	NO2	
27	NC3	DO3 (RL3)
28	C3	
29	NO3	

Figure 27: *XC1 wiring for control connection # 3*

Control connection # 3 - 3-Wire Start/Stop function.

Enabling the Run/Stop function with 3-wire control.
Parameters to set:
Set DI3 to START: P0265 = 6
Set DI4 to STOP: P0266 = 7
Set P0224 = 1 (DIx) for 3-wire control in Local mode.
Set P0227 = 1 (DIx) for 3-wire control in Remote mode.
Set the Forward/Reverse selection by using digital input # 2 (DI2).
Set P0223 = 4 for Local Mode or P0226 = 4 for Remote Mode.
S1 and S2 are Start (NO contact) and Stop (NC contact) pushbuttons respectively.
The speed reference can be provided through the analog input (as in control connection # 2), through the keypad (as in control connection # 1) or through other available source.

Control connection # 4 - Forward/Reverse.

Enabling the Forward/Reverse function.
Parameters to set:
Set DI3 to Forward run: P0265 = 4
Set DI4 to Reverse run: P0266 = 5
When the Forward/Reverse function is set, it will be active either in Local or Remote mode. At the same time, the HMI keys O and I will remain always inactive (even if P0224 = 0 or P0227 = 0).
The direction of rotation is determined by the Forward run and Reverse run inputs.
Clockwise direction for Forward run and counterclockwise for Reverse run.
The speed reference can be provided by any source (as in the control connection # 3).

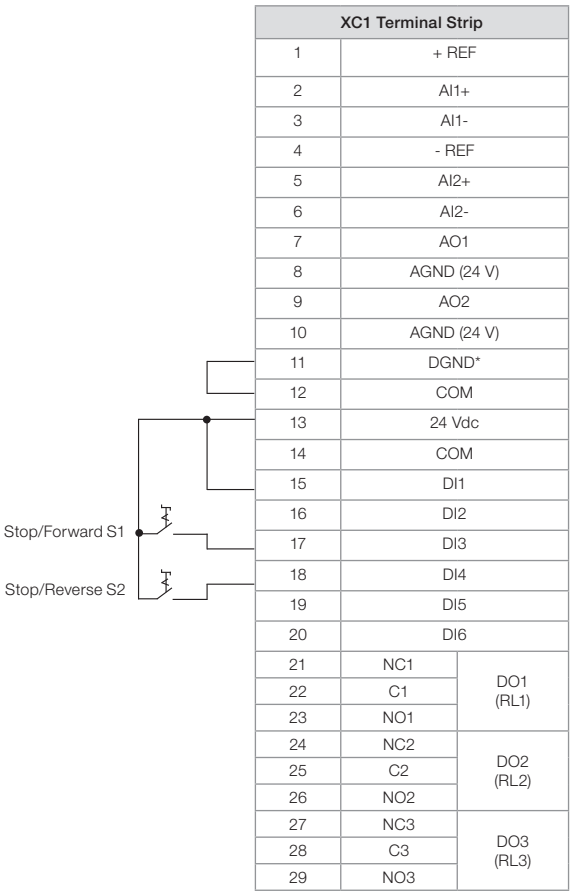


Figure 28: *XC1 wiring for control connection # 4*

INSTALLATION ACCORDING TO THE EUROPEAN DIRECTIVE OF ELECTROMAGNETIC COMPATIBILITY

The inverters at 200...240 V and 380...480 V, frames A to D with optional item FA (CFW11XXXXXXOFA) and the other standard inverters feature internal RFI filter to reduce the electromagnetic interference. These inverters, when properly installed meet the requirements of the electromagnetic compatibility directive “EMC Directive 2014/30/EU”.

ATTENTION!
For using models with internal RFI filters in IT networks follow the instructions on Figure 19 to 22.

Conformal Installation

For the conformal installation use:

1. Inverters: with internal RFI filter.
2. Shielded output cables (motor cables) and connect the shield at both ends (motor and inverter) with a low impedance connection for high frequency. Ensure good contact between the cable shield and the clamp. Keep the separation from the other cables. Maximum motor cable length and conducted and radiated emission levels according to table 2 and table 3. If a lower conducted emission level and/or longer motor cable is desired, then an external RFI filter must be used in the inverter input. For further information (RFI filter commercial code, motor cable length and emission levels) see table 2 and table 3.
   To use the option in the V/f and VVW control modes using sine wave output filter, refer to the user's manual available for download on: **www.weg.net**.
3. Shielded control cables.
4. Inverter solid grounding.

Table 2: *Conducted and radiated emission levels for sizes A to D*

Inverter Model (with Built-in RFI Filter)	Without External RFI Filter			With External RFI Filter				
	Conducted Emission - Maximum Motor Cable Length		Radiated Emission	External RFI Filter Part Number (Manufacturer: EPCOS)	Conducted Emission - Maximum Motor Cable Length		Radiated Emission - Category	
	Category C3	Category C2	Category (no Metallic Cabinet Required)		Category C2	Category C1	Without Metallic Cabinet	Inside a Metallic Cabinet
CFW11 0006 S 2 O FA	100 m (328.10 ft)	7 m (23.00 ft)	C2	B84142-A16-R122	75 m (246.06 ft)	50 m (164.04 ft)	C2	C2
				B84142-B16-R	100 m	100 m (328.10 ft)		
CFW11 0007 T 2 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G8-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A8-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0007 S 2 O FA	100 m (328.10 ft)	7 m (23.00 ft)	C2	B84142-A16-R122	75 m (246.06 ft)	50 m (164.04 ft)	C2	C2
				B84142-B16-R	100 m (328.10 ft)	100 m (328.10 ft)		
CFW11 0010 S 2 O FA	100 m (328.10 ft)	7 m (23.00 ft)	C2	B84142-A30-R122	75 m (246.06 ft)	50 m (164.04 ft)	C2	C2
				B84142-B25-R	100 m (328.10 ft)	100 m (328.10 ft)		
CFW11 0010 T 2 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G20-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A16-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0013 T 2 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G20-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A16-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0016 T 2 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G20-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A25-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0024 T 2 O FA	100 m (328.10 ft)	No	C2	B84143-A36-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0028 T 2 O FA	100 m (328.10 ft)	No	C2	B84143-A36-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0033 T 2 O FA	100 m (328.10 ft)	No	C2	B84143-A50-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0045 T 2 O FA	100 m (328.10 ft)	No	C3	B84143-A50-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0054 T 2 O FA	100 m (328.10 ft)	No	C3	B84143-A66-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0070 T 2 O FA	100 m (328.10 ft)	No	C3	B84143-A90-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0086 T 2 O FA	100 m (328.10 ft)	No	C3	B84143-A120-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0105 T 2 O FA	100 m (328.10 ft)	No	C3	B84143-A120-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0003 T 4 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G8-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A8-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0005 T 4 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G8-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A8-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0007 T 4 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G8-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A8-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0010 T 4 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G20-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A16-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0013 T 4 O FA	100 m (328.10 ft)	5 m (16.40 ft)	C2	B84143-G20-R110	100 m (328.10 ft)	-	C2	C2
				B84143-A16-R105	50 m (164.04 ft)	50 m (164.04 ft)		
CFW11 0017 T 4 O FA	100 m (328.10 ft)	No	C2	B84143-A25-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0024 T 4 O FA	100 m (328.10 ft)	No	C2	B84143-A36-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0031 T 4 O FA	100 m (328.10 ft)	No	C2	B84143-A36-R105	100 m (328.10 ft)	100 m (328.10 ft)	C2	C2
CFW11 0038 T 4 O FA	100 m (328.10 ft)	No	C3	B84143-A50-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0045 T 4 O FA	100 m (328.10 ft)	No	C3	B84143-A50-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0058 T 4 O FA	100 m (328.10 ft)	No	C3	B84143-A66-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0070 T 4 O FA	100 m (328.10 ft)	No	C3	B84143-A90-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2
CFW11 0088 T 4 O FA	100 m (328.10 ft)	No	C3	B84143-A120-R105	100 m (328.10 ft)	100 m (328.10 ft)	C3	C2

Table 3: Conducted and radiated emission levels for sizes E, F, G and H

Inverter Model (Built-in RFI Filter)	Frame Size	Without External RFI Filter		With External RFI Filter		
		Conducted Emission - Maximum Motor Cable Length	Radiated Emission	External RFI Filter Part Number - (Manufacturer: EPCOS)	Conducted Emission - Maximum Motor Cable Length	Radiated Emission - Without Metallic Cabinet
		Category C3	Category		Category C2	Category
CFW11 0142 T2	E	100 m (328.10 ft)	C3 (1)	B84143-B0150-S020	100 m (328.10 ft)	C2
CFW11 0180 T2	E	100 m (328.10 ft)	C3 (1)	B84143-B0180-S020 (1)	100 m (328.10 ft)	C2
CFW11 0211 T2	E	100 m (328.10 ft)	C3 (1)	B84143-B0250-S020 (2)	100 m (328.10 ft)	C2
CFW11 0105 T4	E	100 m (328.10 ft)	C3 (1)	B84143-B0150-S020	100 m (328.10 ft)	C2
CFW11 0142 T4	E	100 m (328.10 ft)	C3 (1)	B84143-B0150-S020	100 m (328.10 ft)	C2
CFW11 0180 T4	E	100 m (328.10 ft)	C3 (1)	B84143-B0180-S020 (1)	100 m (328.10 ft)	C2
CFW11 0211 T4	E	100 m (328.10 ft)	C3 (1)	B84143-B0250-S020 (2)	100 m (328.10 ft)	C2
CFW11 0242 T4	F	100 m (328.10 ft)	C3 (3)	B84143-B0250-S021	100 m (328.10 ft) (4)	C3
CFW11 0312 T4	F	100 m (328.10 ft)	C3 (3)	B84143-B01420-S021	100 m (328.10 ft) (4)	C3
CFW11 0370 T4	F	100 m (328.10 ft)	C3 (3)	B84143-B0400-S021	100 m (328.10 ft) (4)	C3
CFW11 0477 T4	F	100 m (328.10 ft)	C3 (3)	B84143-B0600-S021	100 m (328.10 ft) (4)	C3
CFW11 0515 T4	G	100 m (328.10 ft)	C3 (3)	B84143-B0600-S021	100 m (328.10 ft) (4)	C3
CFW11 0601 T4	G	100 m (328.10 ft)	C3 (3)	B84143-B0600-S021	100 m (328.10 ft) (4)	C3
CFW11 0720 T4	G	100 m (328.10 ft)	C3 (3)	B84143-B1000-S021	100 m (328.10 ft) (4)	C3
CFW110760T4	G	100 m	C3 (3)	B84143-B1000-S020	50 m (4)	C3
CFW110795T4	H	100 m	C4 (5)	B84143-1000-S80	-	-
CFW110877T4	H	100 m	C4 (5)		-	-
CFW111062T4	H	100 m	C4 (5)	B84143-B1250-S80	-	-
CFW111141T4	H	100 m	C4 (5)		-	-

Notes for table 3:
(1) For inverter/filter surrounding air temperature higher than 40 °C (104 °F) and continuous output current higher than 172 Arms, it's required to use B84143B0250S020 filter.
(2) For inverter/filter surrounding air temperature of 40 °C (104 °F) and HD applications (heavy duty cycle, output current < 180 Arms), it's possible to use B84143B0180S020 filter.
(3) With toroidal core in the three line power supply cables (the three cables connected to R/L1, S/L2 and T/L3 must pass through a single toroidal core). Example: TDK PN: PC40U120x160x20 ironxclube PN: U126x91x20-3F3. If the installation of the inverter is done inside the panel with attenuation of 10 dB in the frequency adjustable range [30; 50] mHz), the toroidal core is not necessary.
(4) 2.5 Hz minimum operating frequency.
(5) For further details, contact WEG.

Table 4: Conducted and radiated emission levels for frame sizes D, E, F, G and H- 500 to 690 Vca

Inverter Model	Without External RFI Filter		With External RFI Filter			
	Conducted Emission - Maximum MotorCable Length	Radiated Emission	External RFI Filter Part Number	Conducted Emission - Maximum Motor Cable Length	Radiated Emission	
	Category C3	Category without Metal Panel		Category C2	Category without Metal Panel	Category with Metal Panel
CFW110002T6	25 m	C3	B84143A25R21	75 m	-	C2
CFW110004T6	25 m	C3		75 m	-	C2
CFW110007T6	25 m	C3		75 m	-	C2
CFW110010T6	25 m	C3		75 m	-	C2
CFW110012T6	25 m	C3	B84143A36R21	75 m	-	C2
CFW110017T6	25 m	C3		75 m	-	C2
CFW110022T6	25 m	C3	B84143A50R21	75 m	-	C2
CFW110027T6	25 m	C3		75 m	-	C2
CFW110032T6	25 m	C3	B84143A80R21	75 m	-	C2
CFW110044T6	25 m	C3		75 m	-	C2
CFW110053T6	100 m	C3	B84143B180S081	50 m	C2	C1
CFW110063T6	100 m	C3		50 m	C2	C1
CFW110080T6	100 m	C3		50 m	C2	C1
CFW110107T6	100 m	C3		50 m	C2	C1
CFW110125T6	100 m	C3		50 m	C2	C1
CFW110150T6	100 m	C3		50 m	C2	C1
CFW110170T6	50 m	C3	B84143B0250S21	25 m	-	C2
CFW110216T6	50 m	C3		25 m	-	C2
CFW110289T6	50 m	C3	B84143B0320S21	25 m	-	C2
CFW110315T6	50 m	C3	B84143B0400S21	25 m	-	C2
CFW110365T6	50 m	C3		25 m	-	C2
CFW110435T6	50 m	C3	B84143B0600S21	25 m	-	C2
CFW110472T6	50 m	C3		25 m	-	C2
CFW110584T6	100 m	C4 (1)	B84143B1000S81	-	-	-
CFW110625T6	100 m	C4 (1)		-	-	-
CFW110758T6	100 m	C4 (1)		-	-	-
CFW110804T6	100 m	C4 (1)		-	-	-

(1) For more details contact Weg.

INTEGRAL KEYPAD - HMI-CFW11

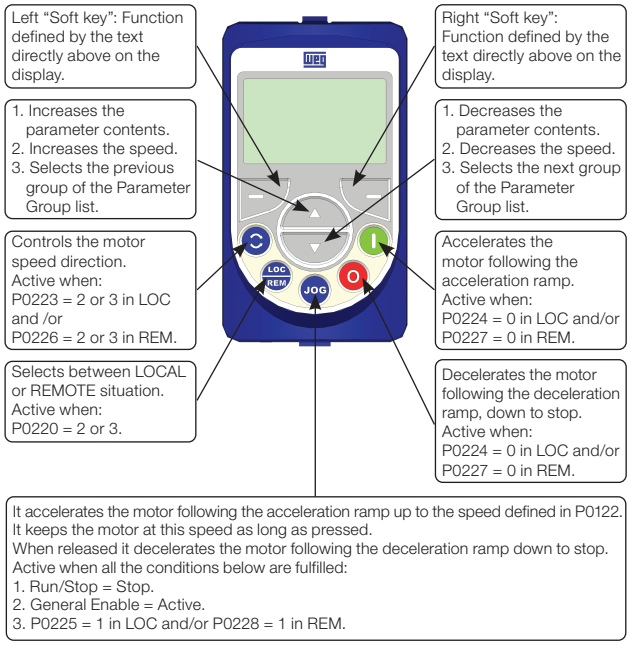


Figure 29: Keypad keys and functions

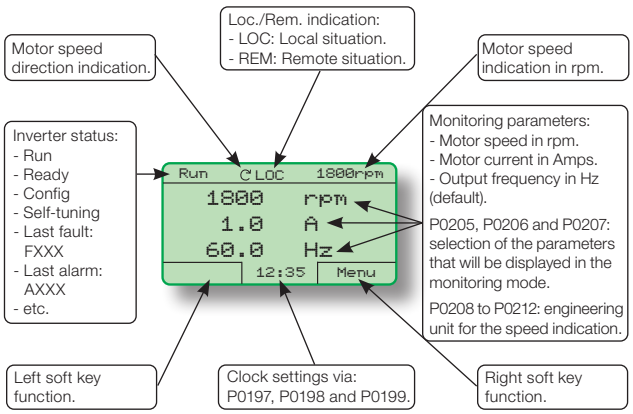


Figure 30: Keypad display and factory default functions example (monitoring mode)

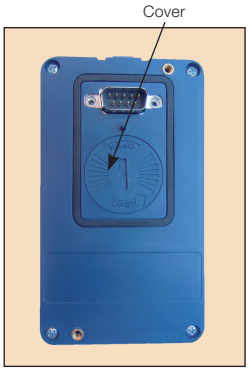


Figure 31: Keypad battery cover to access battery

Notes on Keypad:

- The HMI can be connected with the inverter power.
- Other monitoring screen types can be programmed, as bar graphs and larger font sizes, through P0205-207, P0208-212 adjustments.
- The battery is used only to keep the internal clock operation when the inverter stays without power. If the battery is completely discharged or if it is not installed in the keypad, the displayed clock time will be invalid and an alarm condition "A181 - Invalid clock time" will be indicated every time the inverter is powered up.
- At the end of the battery useful life, please do not discard batteries in your waste container, but use an appropriate battery disposal site.

PARAMETER STRUCTURE

When the right soft key ("MENU") is pressed in the monitoring mode, the display shows the first groups of parameters. The number and name of the groups may change depending on the firmware version used.

BEFORE ENERGIZING

1. Check if power, grounding, and control connections are correct and firmly secured.
2. Remove from inside the inverter or the cabinet all the materials left behind from the installation work.
3. Verify the motor connections and if its voltage and current are within the inverter rated values.
4. Mechanically uncouple the motor from the load. If the motor cannot be uncoupled, make sure that any speed direction (forward or reverse) will not result in personnel injury and/or equipment damage.
5. Close the inverter or cabinet covers.
6. Measure the power supply voltage and verify if it is within the allowed range.
7. Apply power to the input:
   Closing the input disconnect switch.
8. Check the result of the first time power-up:
   The keypad should display the standard monitoring mode and the status LED should be steady green.

STARTING UP IN V/F MODE

The start-up procedure for the V/f is described in three simple steps by using the **Oriented Start-up** routine and the **Basic Application** group.

1) P0000 Password Setting

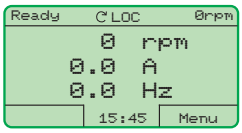
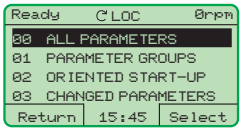
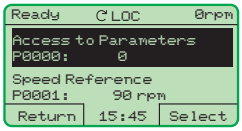
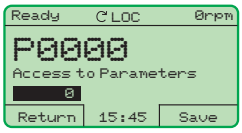
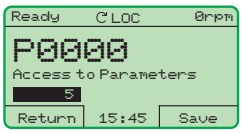
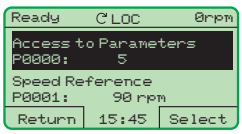
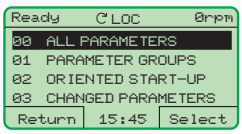
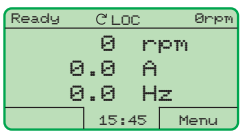
Step	Action/Result	Display Indication
1	- Monitoring Mode. - Press **"Menu"** (right soft key).	
2	- The group **"00 ALL PARAMETERS"** is already selected. - Press **"Select"**.	
3	- The parameter **"Access to Parameters P0000: 0"** is already selected. - Press **"Select"**.	
4	- In order to set the password, press until the number **5** appears on the display.	
5	- When the number **5** appears, press **"Save"**.	
6	- If the setting was performed correctly, the display must show **"Access to Parameters P0000: 5"**. - Press **"Return"** (left soft key).	
7	- Press **"Return"**.	
8	- The display returns to the Monitoring Mode.	

Figure 32: *Steps for allowing parameter modification via P0000*

2) Oriented Start-Up

There is a group of parameters named "Oriented Start-up", which makes the inverter settings easier. The parameter P0317 from this group allows entering the Oriented Start-up routine.

The Oriented Start-Up routine presents the main parameters on the HMI in a logical sequence. The minimum necessary parameters for proper operation are adjusted. Information like mains voltage and motor nameplate data is entered.

In order to enter into the Oriented Start-up routine, first change parameter P0317 to 1 and then, set all remaining parameters as they are presented on the display.

Setting the parameters in the Oriented Start-up routine causes the automatic content modification of the other parameters and/or internal inverter variables.

During the Oriented Start-up routine, the message "Config" will be displayed at the top left corner of the HMI display.

3) Basic Application Parameter Settings

After running the Oriented Start-up routine and properly setting the parameters, the inverter is ready to operate in V/f mode.

The group Basic Application has the more common application parameters.

DATE AND TIME SETTING

Access the group HMI and change: day (P0194), month (P0195) and year (P0196); time: hour (P0197), minutes (P0198) and seconds (P0199).

PARAMETER CHANGE PREVENTION

To prevent unauthorized or unintended parameter modifications, the parameter P0000 can be set to a value different from 5.

FLASH MEMORY MODULE FUNCTIONS

- Store a copy of the inverter parameters.
- Transfer parameters stored in the FLASH memory to the inverter.
- Transfer firmware stored in the FLASH memory to the inverter.
- Store the program created with SoftPLC.

Whenever the inverter is powered up, this program (SoftPLC) is transferred to the RAM memory located in the inverter control board and executed.

Refer to the CFW-11 programming manual and to SoftPLC manual for further details.

APPENDIX 1 – TECHNICAL SPECIFICATIONS

Table A.1: *Technical specifications of the sizes A to D (200... 240 V / 380... 480 V)*

Model	Frame Size	Number of Power Phases	Use with Normal Duty (ND) Cycle								Use with Heavy Duty (HD) Cycle								Fuse [A] According to the IEC European Standard	Fuse I²t [A²s] @ 25 °C	Surrounding Air Temperature [°C (°F)] (1)	Dynamic Braking	Weight [kg (lb)]		Availability of Option Kits that Can be Integrated into the Product (refer to the smart code in the user's manual available for download on the website: www.weg.net)			
			Rated Output Current [Arms]	Overload Current [Arms]		Rated Carrier Frequency [kHz]	Maximum Motor (2) [HP/kW]	Rated Input Current [Arms]	Dissipated Power [W]		Rated Output Current (1) [Arms]	Overload Current [Arms]		Rated Carrier Frequency [kHz]	Maximum Motor (3) [HP/kW]	Rated Input Current [Arms]	Dissipated Power [W]						IP2X/ Nema1	IP55	Cabinet Enclosure	RFI Filter	Safety Stop	24 Vdc External Control Power Supply
				1 min	3 s				Surface Mounting	Flange Mounting		1 min	3 s				Surface Mounting	Flange Mounting											
Models with 200... 240 V Power Supply																												
CFW11 0006 B 2	A (IP21/ Nema1) and B (IP55)	1o/3o	6.0	6.60	9.00	5	1.5/1.1	12.3/6.0 (5)	130	25	5.0	7.50	10.0	5	1.5/1.1	10.3/5.0 (5)	120	25	20	420	-10 ... 50 °C for inverters with degree of protection IP2X or NEMA1, and -10 °C...40 °C for inverters with degree of protection IP55	Built-in	5.7/12.6	17/37.5	Nema1 (conduit kit for frame A - 10413635) and IP55	Yes	Yes	Yes
CFW11 0006 S 2 O FA		1o	6.0	6.60	9.00	5	1.5/1.1	12.3	130	25	5.0	7.50	10.0	5	1.5/1.1	10.3	120	25	20	420			5.7/12.6	17/37.5		Built-in		
CFW11 0007 T 2		3o	7.0	7.7	10.5	5	2/1.5	7.0	140	25	5.5	8.25	11.0	5	1.5/1.1	5.5	120	25	20	420			5.7/12.6	17/37.5		Yes		
CFW11 0007 B 2		1o/3o	7.0	7.7	10.5	5	2/1.5	14.4/7.0 (5)	140	25	7.0	10.5	14.0	5	2/1.5	14.4/7.0 (5)	140	25	20	420			6.1/13.4	17/37.5		Built-in		
CFW11 0007 S 2 O FA		1o	7.0	7.7	10.5	5	2/1.5	14.4	140	25	7.0	10.5	14.0	5	2/1.5	14.4	140	25	20	420			6.1/13.4	17/37.5	Nema1 (conduit kit for frame A - 10413635) and IP55	Yes		
CFW11 0010 T 2		3o	10	11.0	15.0	5	3/2.2	10.0	170	30	8.0	12.0	16.0	5	2/1.5	8.0	170	30	20	1000			5.7/12.6	17/37.5				
CFW11 0010 S 2		1o	10	11.0	15.0	5	3/2.2	20.5	180	30	10	15.0	20.0	5	3/2.2	20.5	140	25	20	420			6.1/13.4	17/37.5				
CFW11 0013 T 2		3o	13	14.3	19.5	5	4/3.0	13.0	200	30	11	16.5	22.0	5	3/2.2	11.0	170	30	25	420			6.1/13.4	17/37.5				
CFW11 0016 T 2		3o	16	17.6	24.0	5	5/3.7	16.0	230	30	13	19.5	26.0	5	4/3.0	13.0	190	30	35	420			6.3/13.9	17/37.5				
CFW11 0024 T 2	B	3o	24	26.4	36.0	5	7.5/5.5	24.0	310	50	20	30.0	40.0	5	6/4.5	20.0	250	40	40	1000			9.1/20	17/37.5	Nema1 (conduit kit for frame B - 10413638) and IP55			
CFW11 0028 T 2		3o	28	30.8	42.0	5	10/7.5	28.0	370	60	24	36.0	48.0	5	7.5/5.5	24.0	290	40	50	1000			9.1/20	17/37.5				
CFW11 0033 T 2		3o	33.5	36.9	50.3	5	12.5/9.2	33.5	430	60	28	42.0	56.0	5	10/7.5	28.0	350	50	63	1000			9.1/20	17/37.5				
CFW11 0045 T 2	C	3o	45	49.5	67.5	5	15/11	45.0	590	90	36	54.0	72.0	5	12.5/9.2	36.0	450	70	80	2750			15.6/34.4	30/66.2	Nema1 (conduit kit for frame C - 10413640) and IP55			
CFW11 0054 T 2		3o	54	59.4	81.0	5	20/15	54.0	680	100	45	67.5	90.0	5	15/11	45.0	540	80	80	2750			16.0/35.3	30/66.2				
CFW11 0070 T 2		3o	70	77.0	105	5	25/18.5	70.0	900	140	56	84.0	112	5	20/15	56.0	680	100	100	2750			17.9/39.5	30/66.2				
CFW11 0086 T 2	D	3o	86	94.6	129	5	30/22	86.0	970	150	70	105	140	5	25/18.5	70.0	740	110	125	3150			29.5/65.1	49/108	IP21 (IP21 kit for frame D - 10525277) and IP55			
CFW11 0105 T 2		3o	105	116	158	5	40/30	105.0	1200	180	86	129	172	5	30/22	86.0	920	140	125	3150			31.4/69.2	49/108				
Models with 380... 480 V Power Supply																												
CFW11 0003 T 4	A (IP21/ Nema1) and B (IP55)	3o	3.6	3.96	5.40	5	2/1.5	3.6	130	25	3.6	5.40	7.20	5	2/1.5	3.6	110	25	20	190	-10 ... 50 °C for inverters with degree of protection IP2X or NEMA1, and -10 °C...40 °C for inverters with degree of protection IP55	Built-in	5.7/12.6	17/37.5	Nema1 (conduit kit for frame A - 10413635) and IP55	Yes	Yes	Yes
CFW11 0005 T 4		3o	5.0	5.50	7.50	5	3/2.2	5.0	140	25	5.0	7.50	10.0	5	3/2.2	5.0	140	25	20	190			5.9/13	17/37.5				
CFW11 0007 T 4		3o	7.0	7.7	10.5	5	4/3	7.0	180	30	5.5	8.25	11.0	5	3/2.2	5.5	140	25	20	190			5.9/13	17/37.5				
CFW11 0010 T 4		3o	10	11.0	15.0	5	6/4.5	10.0	220	30	10	15.0	20.0	5	6/4.5	10.0	200	30	20	495			6.1/13.4	17/37.5				
CFW11 0013 T 4		3o	13.5	14.9	20.3	5	7.5/5.5	13.5	280	40	11	16.5	22.0	5	6/4.5	11.0	220	30	25	495			6.3/13.9	17/37.5				
CFW11 0017 T 4	B	3o	17	18.7	25.5	5	10/7.5	17.0	360	50	13.5	20.3	27.0	5	7.5/5.5	13.5	270	40	35	495			9.1/20	17/37.5	Nema1 (conduit kit for frame B - 10413638) and IP55			
CFW11 0024 T 4		3o	24	26.4	36.0	5	15/11	24.0	490	70	19	28.5	38.0	5	10/7.5	19.0	360	50	40	500			9.7/21.4	17/37.5				
CFW11 0031 T 4		3o	31	34.1	46.5	5	20/15	31.0	560	80	25	37.5	50.0	5	15/11	25.0	430	60	50	1250			10.4/22.9	17/37.5				
CFW11 0038 T 4	C	3o	38	41.8	57.0	5	25/18.5	38.0	710	110	33	49.5	66.0	5	20/15	33.0	590	90	63	1250			16.4/36.2	30/66.2	Nema1 (conduit kit for frame C - 10413640) and IP55			
CFW11 0045 T 4		3o	45	49.5	67.5	5	30/22	45.0	810	120	38	57.0	76.0	5	25/18.5	38.0	650	100	80	2100			19.6/43.2	30/66.2				
CFW11 0058 T 4		3o	58.5	64.4	87.8	5	40/30	58.5	1050	160	47	70.5	94.0	5	30/22	47.0	800	120	100	2100			20.5/45.2	30/66.2				
CFW11 0070 T 4	D	3o	70.5	77.6	106	5	50/37	70.5	1280	190	61	91.5	122	5	40/30	61.0	1050	160	100	2100			31.1/68.6	49/108	IP21 (IP21 kit for frame D - 10525277) and IP55			
CFW11 0088 T 4		3o	88	96.8	132	5	60/45	88.0	1480	220	73	110	146	5	50/37	73.0	1170	180	125	3150			32.6/71.8	49/108				

(1) Steady state rated current in the following conditions: enter - Indicated switching frequency. For operation with switching frequencies of 10 kHz, it is necessary a derating of the rated output current. Enter - Ambient temperature around the inverter: -10 °C to 50 °C for inverters with degree of protection IP2X/Nema1 and -10 °C to 40 °C for inverters with degree of protection IP55. In order to operate the inverter in environments with a higher ambient temperature around the inverter, refer to the user's manual available for download on: **www.weg.net**. Enter - Air relative humidity: 5 % to 95 % non-condensing. Enter - Altitude: 1000 m; above 1000 m up to 4000 m, output current derating of 1% for each 100 m above 1000 m. - From 2000 m to 4000 m - 1% derating of the maximum voltage (240 V for models 220...240 V and 480 V for models 380...480 V) for each 100 m above 2000 m. Enter - Note that the derating specified in the items above also apply to the dynamic braking IGBT (effective braking current (Ieffective) column). Enter - Environment with pollution degree 2 (as per EN50178 and UL 508C).
(2) The motor outputs are only reference values for WEG 4-pole motors of 220 V or 440 V. The proper sizing of the inverter must be done according to the rated currents of the motors used.
(3) On the models with single-phase or three-phase power supply, the input current is presented for both cases. The input current for single-phase power supply is presented first.

Table A.2: *Technical specifications of the sizes E to H (380... 480 V)*

Model	Frame Size	Use with Normal Duty (ND) Cycle									Use with Heavy Duty (HD) Cycle								Weight [kg (lb)]	Fuse [A] According to the IEC European Standard	Fuse I²t [A²s] @ 25 °C	Surrounding Air Temperature [°C (°F)]	Dynamic Braking	Availability of Option Kits that Can be Incorporated Into the Product				
		Number of Power Phases	Rated Output Current [1] [Arms]	Overload Current [2] [Arms]		Rated Carrier Frequency [kHz]	Maximum Motor [HP/kW]	Rated Input Current [Arms]	Dissipated Power [W]		Rated Output Current [1] [Arms]	Overload Current [2] [Arms]		Rated Carrier Frequency [kHz]	Maximum Motor [HP/kW]	Rated Input Current [Arms]	Dissipated Power [W]							24 Vdc External Control Power Supply	Safety Stop	RFI Filter	Cabinet Enclosure
				1 min	3 s				Surface Mounting	Flange Mounting		1 min	3 s				Surface Mounting	Flange Mounting									
Models with 380... 440 V power supply																											
CFW11 0142 T 2	E	3o	142 [1]	156.2 [2]	213 [2]	2.5	50/37	142	1850	240	115 [1]	172.5 [2]	230 [2]	5	40/30	115	1700	230	64.0 (141.1)	250	39200	-10 ... 45 °C for inverters with degree of protection IP2X and -10...40 °C for inverters with degree of protection IP55	Optional (the standard product does not have dynamic braking)	Yes	Yes	Yes	Built-in	Nema 1 (kit KN1E-01)
CFW11 0180 T 2		3o	180 [1]	198 [2]	270 [2]	2.5	60/45	180	2200	410	142 [1]	213 [2]	284 [2]	5	50/37	142	2120	390	65.0 (143.3)	350	218000						Nema 1 (kit KN1E-02)
CFW11 0211 T 2		3o	211 [1]	232 [2]	317 [2]	2.5	75/55	211	2490	410	180 [1]	270 [2]	360 [2]	2.5	75/55	180	2240	400	65.0 (143.3)	400	218000						Nema 1 (kit KN1E-01)
CFW11 0105 T 4		3o	105 [1]	115.5 [2]	157.5 [2]	2.5	75/55	105	1650	230	88 [1]	132 [2]	176 [2]	2.5	60/45	88	1340	220	62.5 (137.8)	160	39200						Nema 1 (kit KN1E-02)
CFW11 0142 T 4		3o	142 [1]	156.2 [2]	213 [2]	2.5	100/75	142	2230	240	115 [1]	172.5 [2]	230 [2]	2.5	75/55	115	1710	230	64.0 (141.1)	250	39200						-
CFW11 0180 T 4		3o	180 [1]	198 [2]	270 [2]	2.5	150/110	180	2660	410	142 [1]	213 [2]	284 [2]	2.5	100/75	142	2140	390	65.0 (143.3)	350	218000						-
CFW11 0211 T 4		3o	211 [1]	232.1 [2]	317 [2]	2.5	175/132	211	3040	410	180 [1]	270 [2]	360 [2]	2.5	150/110	180	2530	400	65.0 (143.3)	400	218000						-
CFW11 0242 T 4	F	3o	242 [3]	266 [4]	363 [4]	2	200/150	242	2651	622	211 [3]	317 [4]	422 [4]	2	175/132	211	2296	524	130 (286.6)	450	320000						-
CFW11 0312 T 4		3o	312 [3]	343 [4]	468 [4]	2	250/185	312	3957	826	242 [3]	363 [4]	484 [4]	2	200/150	242	3046	614	132 (291.0)	630	414000						-
CFW11 0370 T 4		3o	370 [3]	407 [4]	555 [4]	2	300/220	370	4578	900	312 [3]	468 [4]	624 [4]	2	250/185	312	3829	722	135 (297.6)	710	414000						-
CFW11 0477 T 4		3o	477 [3]	525 [4]	716 [4]	2	400/300	477	6059	1227	370 [3]	555 [4]	740 [4]	2	300/220	370	4669	915	140 (308.6)	900	1051000						-
CFW11 0515 T 4		3o	515 [3]	567 [4]	773 [4]	2	400/300	515	6490	1339	477 [3]	716 [4]	954 [4]	2	400/300	477	6005	1232	204 (449.7)	1000	1445000						-
CFW11 0601 T 4	G	3o	601 [3]	662 [4]	900 [4]	2	500/370	601	7044	1584	515 [3]	773 [4]	1030 [4]	2	400/300	515	6005	1320	207 (456.4)	2 x 630 [5]	1445000						-
CFW11 0720 T 4		3o	720 [3]	792 [4]	1080 [4]	2	600/440	720	8532	1685	560 [3]	840 [4]	1120 [4]	2	450/330	560	6589	1253	215 (474.0)	2 x 710 [5]	1445000						-
CFW11 0760 T 4		3o	760 [3]	836 [4]	1140 [4]	2	650/480	760	10055	2008	600 [3]	900 [4]	1200 [4]	2	500/370	600	7909	1550	215 (474.0)	2 x 710 [5]	1445000						-
CFW11 0795 T 4	H	3o	795 [3]	875 [4]	1193 [4]	2	700/515	795	9851	755	637 [3]	956 [4]	1275 [4]	2	550/400	637	7824	747	213 (470.0)	2 x 800	1051000	-10... 40 °C					-
CFW11 0877 T 4		3o	877 [3]	965 [4]	1316 [4]	2	750/560	877	10993	759	715 [3]	1073 [4]	1430 [4]	2	600/440	715	8836	751	213 (470.0)	2 x 800	1051000						-
CFW11 1062 T 4		3o	1062 [3]	1168 [4]	1593 [4]	2	950/700	1062	12498	764	855 [3]	1283 [4]	1710 [4]	2	750/560	855	9916	753	220 (485.0)	2 x 900 [5]	1445000						-
CFW11 1141 T 4		3o	1141	1255	1712	2	1000/750	1141	13558	768	943	1415	1886	2	800/590	943	11022	757	220 (485.0)	2 x 900 [5]	1445000						-

(1) Steady state rated current in the following conditions: enter - Indicated switching frequency. For operation with higher switching frequencies, it is necessary to reduce the rated output current. Enter - Ambient temperature around the inverter: -10 °C to 45 °C (14 °F to 113 °F). The inverter may operate in environments with surrounding ambient temperature up to 55 °C (131 °F) if a derating of 2 % is applied to the output current for each degree Celsius above 45 °C (113 °F). Such current derating is valid for all the switching frequencies. Enter - CFW-11 inverters with degree of protection IP55: from -10 °C to 40 °C (14 °F to 104 °F) - rated conditions (measured around the inverter). Enter - CFW-11 inverters with degree of protection IP55: from 40 °C to 50 °C (104 °F to 122 °F) - apply a current derating of 2 % for each degree Celsius above 40 °C. Enter - Air relative humidity: 5 % to 95 % non-condensing. Enter - From 1000 m to 4000 m - apply a current derating of 1 % for each 100 m above 1000 m of altitude. Enter - From 2000 m to 4000 m - 1.1 % derating of the maximum voltage (240 V for models 220...240 V and 480 V for models 380...480 V) for each 100 m above 2000 m. Enter - Environment with pollution degree 2 (as per EN50178 and UL 508C).
(2) The motor outputs are only for guiding purposes for WEG motors of 230 V or 460 V with 4 poles. The proper sizing must be done according to the rated current of the motors used.
(3) Rated current in permanent duty under the following conditions: indicated switching frequencies. - For operation with switching frequency of 2.5 kHz (only models 242 A and 312 A), a derating of 10 % must be applied to the specified current values. . - For frames F and G (except for models 760 A) operating with switching frequency of 5 kHz, it is necessary to reduce the rated output current. - It is not possible to use the models of frames F, G and H of the CFW-11 inverter with switching frequency of 10 kHz. Ambient temperature around the inverter as specified in the table, 40 °C to 45 °C (104 °F to 113 °F) for frame G (only model 720 A): 2 % of current derating for each degree Celsius above the maximum temperature specified in the item above. 40 °C to 45 °C (104 °F to 113 °F) for frames G (only model 760 A) and H: 1 % of current derating for each degree Celsius above the maximum temperature specified in the item above. 45 °C to 55 °C (104 °F to 131 °F) for frames F, G and H: 2 % of current derating for each degree Celsius above the maximum temperature specified in the item above. Air relative humidity: 5 % to 95 % non-condensing. Altitude: 1000 m (3.300 ft). Above 1000 m up to 4000 m (3.300 ft to 13.200 ft) the output current must be derated by 1 % for each 100 m (330 ft) above 1000 m (3.300 ft). 2000 m to 4000 m (6.600 ft to 13.200 ft) above sea level – derating of 1.1 % of the maximum voltage for each 100 m (330 ft) above 2000 m (6.600). Environment with pollution degree 2 (as per EN50178 and UL508C).
(4) The motor outputs are only reference values for WEG 4-pole 460 V motor. The proper sizing must be done according to the rated current of the motors used.
(5) For this application, the fuse cannot be mounted on the SFWm; only on the individual mounting base.

***Table A.3:** Technical specification for 500 to 600 Vac, three-phase power supply*

Model	Frame Size	Use with Normal Duty (ND) Cycle – Rated Output Current [Arms] [1]	ND – Overload Current [Arms] 1 min	ND – Overload Current [Arms] 3 s	ND – Switching Frequency [kHz] [1]	ND – Maximum Motor [HP/kW] [2]	ND – Rated Input Current [Arms]	ND – Dissipated Power [W] Surface Mounting	ND – Dissipated Power [W] Flange Mounting
CFW110002T5	B	2,9	3,2	4,4	5	2/1,5	2,90	107	59
CFW110004T5	B	4,2	4,6	6,3	5	3/2,2	4,2	133	62
CFW110007T5	B	7,0	7,7	10,5	5	5/3,7	7	188	71
CFW110010T5	B	10	11,0	15,0	5	7,5/5,5	10	247	80
CFW110012T5	B	12	13,2	18,0	5	10/7,5	12	287	85
CFW110017T5	B	17	18,7	25,5	5	15/11	17	385	100
CFW110022T5	C	22	24,2	33	5	20/15	22	550	170
CFW110027T5	C	27	29,7	40,5	5	25/18,5	27	670	215
CFW110032T5	C	32	35,2	48	5	30/22	32	790	250
CFW110044T5	C	44	48,4	66	5	40/30	44	1080	350
CFW110002T6	D	2,9	3,2	4,4	5	2/1,5	2,9	107	59
CFW110004T6	D	4,2	4,6	6,3	5	3/2,2	4,2	133	62
CFW110007T6	D	7,0	7,7	10,5	5	5/3,7	7	188	71
CFW110010T6	D	10	11,0	15,0	5	7,5/5,5	10	247	80
CFW110012T6	D	12	13,2	18,0	5	10/7,5	12	287	85
CFW110017T6	D	17	18,7	25,5	5	15/11	17	385	100
CFW110022T6	D	22	24,2	33,0	5	20/15	22	484	115
CFW110027T6	D	27	29,7	40,5	5	25/18,5	27	582	130
CFW110032T6	D	32	35,2	48,0	5	30/22	32	681	145
CFW110044T6	D	44	48,4	66,0	5	40/30	44	918	180
CFW110053T6	E	53	58,3	79,5	2	50/37	53	878	191
CFW110063T6	E	63	69,3	94,5	2	60/45	63	1030	214
CFW110080T6	E	80	88,0	120,0	2	75/55	80	1289	253
CFW110107T6	E	107	117,7	160,5	2	100/75	107	1700	315
CFW110125T6	E	125	137,5	187,5	2	125/90	125	1975	356
CFW110150T6	E	150	165,0	225,0	2	150/110	150	2356	413
CFW110170T6	F	170	187,0	255,0	2	175/132	170	2740	1037
CFW110216T6	F	216	237,6	324,0	2	200/150	216	3441	1302
CFW110289T6	F	289	317,9	433,5	2	250/185	289	4554	1691
CFW110315T6	G	315	346,5	472,5	2	300/220	315	5000	1880
CFW110365T6	G	365	401,5	547,5	2	350/260	365	5762	2147
CFW110435T6	G	435	478,5	652,5	2	400/300	435	6828	2520
CFW110472T6	G	472	519,2	708,0	2	450/330	472	7409	2734
CFW110584T6	H	584	642	876	2	600/440	584	9306	3443
CFW110625T6	H	625	688	938	2	700/515	625	9959	3685
CFW110758T6	H	758	834	1137	2	800/590	758	12079	4469
CFW110804T6	H	804	884	1205	2	900/690	804	12812	4740

Model	Use with Heavy Duty (HD) Cycle – Rated Output Current [Arms] [1]	HD – Overload Current [Arms] 1 min	HD – Overload Current [Arms] 3 s	HD – Switching Frequency [kHz] [1]	HD – Maximum Motor [HP/kW] [2]	HD – Rated Input Current [Arms]	HD – Dissipated Power [W] Surface Mounting	HD – Dissipated Power [W] Flange Mounting
CFW110002T5	2,7	4,1	5,4	5	1,5/1,1	2,7	103	58
CFW110004T5	3,8	5,7	7,6	5	2/1,5	3,8	125	61
CFW110007T5	6,5	9,8	13,0	5	3/2,2	6,5	178	69
CFW110010T5	9,0	13,5	18,0	5	5/3,7	9	227	77
CFW110012T5	10	15,0	20,0	5	7,5/5,5	10	247	80
CFW110017T5	17	25,5	34,0	5	10/7,5	17	385	100
CFW110022T5	19	28,5	38	5	15/11	19	500	120
CFW110027T5	22	33	44	5	20/15	22	550	170
CFW110032T5	27	40,5	54	5	25/18,5	27	670	215
CFW110044T5	36	54	72	5	30/22	36	790	250
CFW110002T6	2,7	4,1	5,4	5	1,5/1,1	2,7	103	58
CFW110004T6	3,8	5,7	7,6	5	2/1,5	3,8	125	61
CFW110007T6	6,5	9,8	13,0	5	3/2,2	6,5	178	69
CFW110010T6	9,0	13,5	18,0	5	5/3,7	9	227	77
CFW110012T6	10	15,0	20,0	5	7,5/5,5	10	247	80
CFW110017T6	17	22,5	30,0	5	10/7,5	15	346	94
CFW110022T6	19	28,5	38,0	5	15/11	19	425	106
CFW110027T6	22	33,0	44,0	5	20/15	22	484	115
CFW110032T6	27	40,5	54,0	5	25/18,5	27	582	130
CFW110044T6	36	54,0	72,0	5	30/22	36	760	156
CFW110053T6	44	66,0	88,0	2	40/30	44	740	171
CFW110063T6	53	79,5	106,0	2	50/37	53	878	191
CFW110080T6	66	99,0	132,0	2	60/45	66	1076	221
CFW110107T6	90	135,0	180,0	2	75/55	90	1441	276
CFW110125T6	107	160,5	214,0	2	100/75	107	1700	315
CFW110150T6	122	183,0	244,0	2	125/90	122	1929	349
CFW110170T6	150	225,0	300,0	2	150/110	150	2436	950
CFW110216T6	180	270,0	360,0	2	150/110	180	2893	1110
CFW110289T6	240	360,0	480,0	2	200/150	240	3807	1430
CFW110315T6	289	433,5	578,0	2	250/185	289	4604	1741
CFW110365T6	315	472,5	630,0	2	300/220	315	5000	1880
CFW110435T6	357	535,5	714,0	2	350/260	357	5640	2104
CFW110472T6	418	627,0	836,0	2	400/300	418	6604	2464
CFW110584T6	504	756	958 (5s) [3]	2	500/370	504	8031	2972
CFW110625T6	540	810	1026 (5s) [3]	2	550/400	540	8605	3184
CFW110758T6	614	921	1167 (5s) [3]	2	600/440	614	9784	3620
CFW110804T6	682	1023	1296 (5s) [3]	2	700/515	682	10868	4021

Model	Weight [kg/lb]	Fuse [A] according to the IEC European Standard	Fuse I²t [A²s] @ 25 °C	Surrounding Air Temperature [°C (°F)]	Dynamic Braking	Availability of Option kits that can be Incorporated into – Cabinet Enclosure	Filtro RFI Categoria C3	Safety Sop	24 Vdc External Control Power
CFW110002T5	9,1 (20)	20	1250	-10...50 °C	Yes	Nema1	Yes, except in models CFW11...O...NF...	Yes	Yes
CFW110004T5	9,1 (20)								
CFW110007T5	9,1 (20)								
CFW110010T5	9,1 (20)								
CFW110012T5	9,1 (20)	25							
CFW110017T5	9,1 (20)	40							
CFW110022T5	19,6 (43,2)	40	7200						
CFW110027T5	19,6 (43,2)	50							
CFW110032T5	19,6 (43,2)	60							
CFW110044T5	19,6 (43,2)								
CFW110002T6	34 (75)	20			Yes, except in models CFW11...O...NB...	IP21			
CFW110004T6	34 (75)								
CFW110007T6	34 (75)								
CFW110010T6	34 (75)								
CFW110012T6	34 (75)	25							
CFW110017T6	34 (75)	40							
CFW110022T6	34 (75)	50							
CFW110027T6	34 (75)								
CFW110032T6	34 (75)	60							
CFW110044T6	34 (75)								
CFW110053T6	64 (141)	100	39200	-10...45 °C		Nema1/IP21	Yes		
CFW110063T6	64 (141)								
CFW110080T6	64 (141)	125							
CFW110107T6	64 (141)	160							
CFW110125T6	64 (141)	200	218000						
CFW110150T6	64 (141)	250							
CFW110170T6	168 (371)	315	320000		No	IP21			
CFW110216T6	168 (371)	400	414000						
CFW110289T6	168 (371)	500							
CFW110315T6	258 (569)	630	1051000						
CFW110365T6	258 (569)	710	1445000						
CFW110435T6	258 (569)	800	1445000						
CFW110472T6	258 (569)	900							
CFW110584T6	200 (440)	2 x 630	1620000	-10...40 °C		-			
CFW110625T6	200 (440)								
CFW110758T6	213 (470)	2 x 710							
CFW110804T6	213 (470)	2 x 800							

(1) Steady state rated current in the following conditions:
- Recommended or lower switching frequencies. For higher switching frequency, contact WEG.
- Frames E, F, G and H cannot operate with switching frequency of 10 kHz.
- Temperature around the inverter as specified in the tables. 40 °C to 45 °C for frame H: 1 % of current derating for each degree Celsius above the maximum temperature, as specified in the item above. 50 °C to 60 °C for frames B, C and D and 45 °C to 55 °C for frames E, F, G and H: apply 2 % of current derating for each degree Celsius above the maximum temperature.
- Air relative humidity: 5 % to 95 % non-condensing.
- Altitude: 1000m. Above 1000 m up to 4000 m, the output current must be derated by 1% for each 100 m above 1000 m.
- Environment with pollution degree 2 (as per EN50178 and UL508C).

(2) The motor outputs are only reference values, considering 575 V, 60 Hz for power supply of 500 to 600 Vac, or 690 V, 50 Hz for power supply 660 to 690 Vac, WEG 4-pole motors. The proper sizing of the inverter must be based on the rated current of the motor used.

(3) Maximum output current of those models. The overload time for frame H under heavy duty is 5 s.

Table A.4: *Technical specification for 660 to 690 Vac, three-phase power supply*

Model	Frame Size	Use with Normal Duty (ND) Cycle									Use with Heavy Duty (HD) Cycle									
		Rated Output Current [Arms] (1)	Overload Current [Arms] (2)		Switching Frequency [kHz] (1) (4)	Maximum Motor [hp/kW] (5)	Rated Input Current [Arms]	Dissipated Power [W] (6)		Rated Output Current [Arms] (1)	Overload Current [Arms] (2)		Switching Frequency [kHz] (1) (4)	Maximum Motor [hp/kW] (5)	Rated Input Current [Arms]	Dissipated Power [W] (6)		Weight [kg/lb]
			1 min	3 s				Surface Mounting	Flange Mounting		1 min	3 s				Surface Mounting	Flange Mounting	
Surrounding Air Temperature		-10...50 °C (14...122 °F)								-10...45 °C (13...104 °F)								-10...40 °C (14...104 °F)	
Built-in Dynamic Braking		Yes , except in models CFW11...O...NB...								No									
Built-in Category C3 RFI Filter		Yes, except in models CFW11...O...NF...								Yes									
CFW110002T6	D	2.9	3.2	4.4	5	2/1.5	2.9	119	60	2.7	4.1	5.4	5	1.5/1.1	2.7	114	60	34/75	
CFW110004T6	D	4.2	4.6	6.3	5	3/2.2	4.2	149	65	3.8	5.7	7.6	5	2/1.5	3.8	140	63		
CFW110007T6	D	7.0	7.7	10.5	5	5/3.7	7	216	75	6.5	9.8	13.0	5	3/2.2	6.5	204	73		
CFW110010T6	D	8.5	9.4	12.8	5	7.5/5.5	8.5	251	80	7.0	10.5	14.0	5	5/3.7	7	216	75		
CFW110012T6	D	11	12.1	16.5	5	10/7.5	11	310	89	9.0	13.5	18.0	5	7.5/5.5	9	263	82		
CFW110017T6	D	15	16.5	22.5	5	15/11	15	405	103	13	19.5	26.0	5	10/7.5	13	358	96		
CFW110022T6	D	20	22.0	30.0	5	20/15	20	523	121	17	25.5	34.0	5	15/11	17	452	110		
CFW110027T6	D	24	26.4	36.0	5	25/18.5	24	618	135	20	30.0	40.0	5	20/15	20	523	121		
CFW110032T6	D	30	33.0	45.0	5	30/22	30	760	156	24	36.0	48.0	5	25/18.5	24	618	135		
CFW110044T6	D	35	38.5	52.5	5	40/30	35	878	174	30	45.0	60.0	5	30/22	30	760	156		
CFW110053T6	E	46	50.6	69.0	2	50/37	46	911	196	39	58.5	78.0	2	40/30	39	783	177	64/141	
CFW110063T6	E	54	59.4	81.0	2	60/45	54	1057	218	46	69.0	92.0	2	50/37	46	911	196		
CFW110080T6	E	73	80.3	109.5	2	75/55	73	1405	270	61	91.5	122.0	2	75/55	61	1185	237		
CFW110107T6	E	100	110.0	150.0	2	125/90	100	1899	344	85	127.5	170.0	2	100/75	85	1624	303		
CFW110125T6	E	108	118.8	162.0	2	125/90	108	2045	366	95	142.5	190.0	2	125/90	95	1807	331		
CFW110150T6	E	130	143.0	195.0	2	150/110	130	2447	427	108	162.0	216.0	2	125/90	108	2045	366		
CFW110170T6	F	147	161.7	220.5	2	175/132	147	2838	1091	127	190.5	254.0	2	150/110	127	2472	963	168/371	
CFW110216T6	F	195	214.5	292.5	2	200/160	195	3716	1398	165	247.5	330.0	2	150/132	165	3167	1206		
CFW110289T6	F	259	284.9	388.5	2	250/200	259	4886	1808	225	337.5	450.0	2	200/160	225	4264	1590		
CFW110315T6	G	259	284.9	388.5	2	300/220	259	4936	1858	225	337.5	450.0	2	250/200	225	4314	1640	258/569	
CFW110365T6	G	312	343.2	468.0	2	350/250	312	5905	2197	259	388.5	518.0	2	300/220	259	4936	1858		
CFW110435T6	G	365	401.5	547.5	2	400/315	365	6874	2536	312	468.0	624.0	2	350/250	312	5905	2197		
CFW110472T6	G	427	469.7	640.5	2	500/370	427	8042	2967	365	547.5	730.0	2	400/300	365	6908	2570		
CFW110584T6	H	478	526	717	2	600/440	478	9140	3382	410	615	820	2	500/370	410	7840	2901	200	
CFW110625T6	H	518	570	777	2	650/480	518	9905	3665	447	671	894	2	600/440	447	8547	3163		
CFW110758T6	H	628	690.8	942	2	800/590	628	12009	4443	518	777	1036	2	650/480	518	9905	3665	213	
CFW110804T6	H	703	773	1055	2	900/690	703	13443	4974	594	891	1188	2	750/560	594	11358	4203		

(1) Steady state rated current in the following conditions:
- Indicated switching frequencies or lower. For higher switching frequency consult WEG.
- Models on frame sizes E, F, G and H are not allowed to operate at 10 kHz switching frequency.
- Surrounding air temperature as specified in tables. From 40 °C to 45 °C (104 °F to 113 °F) for frame size H: 1 % of current derating for each Celsius degree above maximum temperature as specified in item above. From 50 °C to 60 °C (122 °F to 140 °F) for frame sizes B, C and D models and from 45 °C to 55 °C (113 °F to 131 °F) for frame sizes E, F, G and H models: 2 % of current derating for each Celsius degree above maximum temperature as specified in item above.
- Relative air humidity: 5 % to 95 % non-condensing.
- Altitude: 1000 m (3.300 ft). Above 1000 m (3.300 ft) up to 4000 m (13.200 ft) the output current must be derated by 1 % for each 100 m (330 ft) above 1000 m (3.300 ft).
- Ambient with pollution degree 2 (according to EN50178 and UL508C).

(2) One overload each 10 minutes.

(3) The information provided about the inverter losses are valid for the rated operating condition, i.e., for rated output current and rated switching frequency.

(4) Only for frame sizes B, C and D: the switching frequency may be automatically reduced to 2.5 kHz depending on the operating conditions (surrounding air temperature, output current, etc.) - if P0350 = 0 or 1.
If it is desired to operate always in 5 kHz, set P0350 = 2 or 3 and derate the output current. For additional information, consult WEG.

(5) Motor power ratings are merely a guide considering 575 V, 60 Hz for 500 to 600 Vac supply, or 690 V, 50 Hz for 660 to 690 Vac supply, IV pole WEG motors. The adequate inverter sizing must be based on the used motor rated current.

Table A.5: *Dynamic braking specifications for sizes A to E*

Inverter Model	Maximum Braking Current (I_{max}) [A]	Maximum Braking Power (peak value) (P_{max}) (2) [kW]	Effective Braking Current ($I_{effective}$) (1) [A]	Dissipated Power (mean value) in the Braking Resistor (P_R) (2) [kW]	Recommended Resistor [Ω]	Power wire Size (terminals DC+ and BR) [mm² (AWG)]
CFW11 0006 B2	7.8	3.1	5.20	1.4	51	1.5 (16)
CFW11 0006 S2 O FA	7.8	3.1	5.20	1.4	51	1.5 (16)
CFW11 0007 B2	12.1	4.8	6.96	1.6	33	1.5 (16)
CFW11 0007 S2 O FA	12.1	4.8	6.96	1.6	33	1.5 (16)
CFW11 0007 T2	7.8	3.1	5.20	1.4	51	1.5 (16)
CFW11 0010 S2	14.8	5.9	10.83	3.2	27	2.5 (14)
CFW11 0010 T2	12.1	4.8	6.96	1.6	33	1.5 (16)
CFW11 0013 T2	14.8	5.9	8.54	2.0	27	2.5 (14)
CFW11 0016 T2	20.0	8.0	14.44	4.2	20	4 (12)
CFW11 0024 T2	26.7	10.7	19.15	5.50	15	6 (10)
CFW11 0028 T2	30.8	12.3	18.21	4.3	13	6 (10)
CFW11 0033 T2	30.8	12.3	16.71	3.6	13	6 (10)
CFW11 0045 T2	44.0	17.6	33.29	10.1	9.1	10 (8)
CFW11 0054 T2	48.8	19.5	32.17	8.49	8.2	10 (8)
CFW11 0070 T2	48.8	19.5	26.13	5.60	8.2	6 (8)
CFW11 0086 T2	133	53.3	90.67	24.7	3.0	35 (2)
CFW11 0105 T2	133	53.3	90.87	24.8	3.0	35 (2)
CFW11 0003 T4	8.0	6.4	3.54	1.3	100	1.5 (16)
CFW11 0005 T4	8.0	6.4	5.20	2.7	100	1.5 (16)
CFW11 0007 T4	8.0	6.4	5.20	2.7	100	1.5 (16)
CFW11 0010 T4	14.3	11.4	8.57	4.1	56	2.5 (14)
CFW11 0013 T4	14.3	11.4	10.40	6.1	56	2.5 (14)
CFW11 0017 T4	14.3	11.4	12.58	8.9	56	2.5 (12)
CFW11 0024 T4	36.4	29.1	16.59	6.1	22	4 (10)
CFW11 0031 T4	40.0	32.0	20.49	8.4	20	6 (10)
CFW11 0038 T4	40.0	32.0	26.06	13.6	20	6 (8)
CFW11 0045 T4	66.7	53.3	40.00	19.2	12	10 (8)
CFW11 0058 T4	66.7	53.3	31.71	12.1	12	10 (8)
CFW11 0070 T4	66.7	53.3	42.87	22.1	12	10 (6)
CFW11 0088 T4	129	103	63.08	24.7	6.2	25 (4)
CFW11 0142 T 2 O...DB...	266.7	106.7	142	30.2	1.5	70 (2/0) or 2x 25 (2x 4)
CFW11 0180 T 2 O...DB...	266.7	106.7	180	48.6	1.5	120 (4/0) or 2x 35 (2x 2)
CFW11 0211 T 2 O...DB...	333.3	133.3	211	53.4	1.2	150 (300) or 2x 50 (2x 1)
CFW11 0105 T 4 O...DB...	186	148.8	105	47.4	4.3	50 (1)
CFW11 0142 T 4 O...DB...	266.7	213.3	142	60.5	3	70 (2/0) or 2x 25 (2x 4)
CFW11 0180 T 4 O...DB...	266.7	213.3	180	97.2	3	120 (4/0) or 2x 35 (2x 2)
CFW11 0211 T 4 O...DB...	363.6	290.9	191.7	80.8	2.2	120 (250) or 2x 50 (2x 1)
CFW110002T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110004T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110007T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110010T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110012T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110017T5	36.4	43.6	31.9	33.5	33	6 (8)
CFW110022T5	45.5	42.7	31.7	15.1	22	10 (8)
CFW110027T5	45.5	42.7	31.7	15.1	22	10 (8)
CFW110032T5	45.5	42.7	31.7	15.1	22	10 (8)
CFW110044T5	45.5	42.7	31.7	15.1	22	10 (8)
CFW110002T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110004T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110007T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110010T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110012T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110017T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110022T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110027T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110032T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110044T6	45.5	54.5	45.5	54.5	26.4	10 (6)
CFW110053T6	181.8	218.2	152.0	152.5	6.6	95 (3/0)
CFW110063T6	181.8	218.2	152.0	152.5	6.6	95 (3/0)
CFW110080T6	181.8	218.2	152.0	152.5	6.6	95 (3/0)
CFW110107T6	181.8	218.2	152.0	152.5	6.6	95 (3/0)
CFW110125T6	272.7	327.3	152.0	101.7	4.4	2 x 50 (2 x 1/0)
CFW110150T6	272.7	327.3	152.0	101.7	4.4	2 x 50 (2 x 1/0)

Notes:

(1) The effective braking current presented is just an indicative value, because it depends on the braking duty cycle. The effective braking current can be obtained from the equation below, where t_{br} is given in minutes and corresponds to the sum of all braking times during the most severe cycle of 5 (five) minutes.

$$I_{effective} = I_{max} \cdot \sqrt{\frac{t_{br}}{5}}$$

(2) The P_{max} and P_R values (maximum and mean power of the braking resistor respectively) presented are valid for the recommended resistors and for the effective braking currents presented in the table. The resistor power must be changed according to the braking duty cycle.