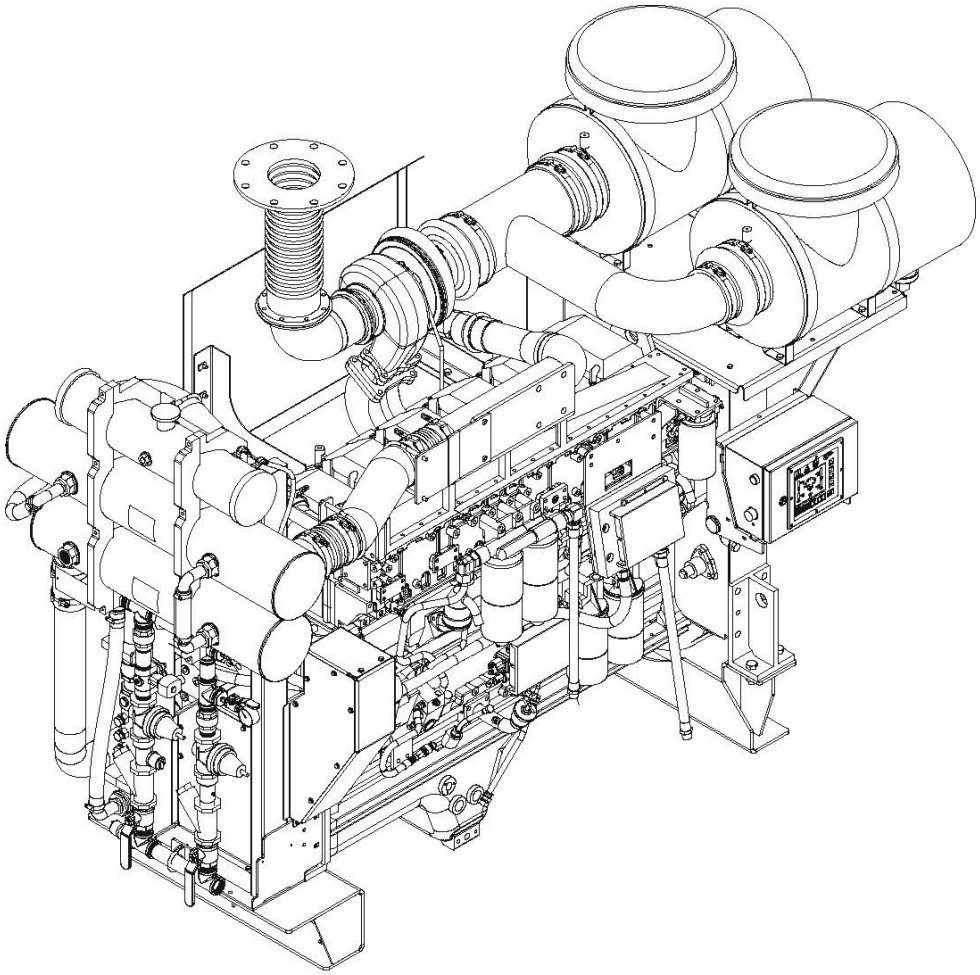
CFP23E SERIES

Fire Power

Operation & Maintenance Manual

Fire Pump Drive Engines



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English Version

Fire Power

This manual contains proprietary information to equipment produced by Cummins Fire Power or Cummins Inc. and is being supplied solely for the purpose of operating, maintaining, and servicing the fire pump engine purchased from Cummins Fire Power.

Cummins Fire Power
Limited Warranty

Fire Pump Package
This limited warranty applies to all Cummins Fire Power (hereinafter referred to as “Cummins Fire Power” branded fire pump driver and associated accessories (hereinafter referred to as "Product"). This warranty covers any failures of the Product, under normal use and service, which result from a defect in material or factory workmanship.

Warranty Period:
The warranty start date for stationary Product is the date of initial start up, demonstration or 18 months after factory ship date, whichever is sooner.

Base Warranty Duration (whichever occurs first): 2 years/2000 hours.

Cummins Fire Power Responsibilities:
In the event of a failure of the Product during the warranty period due to defects in material or workmanship, Cummins Fire Power will only be responsible for the following costs:

- All parts and labor required to repair the Product.
- Reasonable travel expenses to and from the Product site location.
- Maintenance items that are contaminated or damaged by a warrantable failure.

Owner Responsibilities:
The owner will be responsible for the following:

- Notifying Cummins Fire Power distributor or dealer within 30 days of the discovery of failure.
- Installing, operating, commissioning and maintaining the Product in accordance with Cummins Fire Power’s published policies and guidelines.
- Providing evidence for date of commissioning.
- Providing sufficient access to and reasonable ability to remove the Product from the installation in the event of a warrantable failure.

In addition, the owner will be responsible for:

- Incremental costs and expenses associated with Product removal and reinstallation resulting from difficult or non-standard installations.
- Costs associated with Fire Watch Protection during Product being repaired.
- Costs associated with labor overtime and premium shipping requested by the owner.
- All downtime expenses, fines, all applicable taxes, and other losses resulting from a warrantable failure.

Limitations:
This limited warranty does not cover Product failures resulting from:

- Inappropriate use relative to designated power rating or application guidelines.
- Normal wear and tear, negligence, accidents or misuse.
- Improper and/or unauthorized installation.
- Lack of maintenance or unauthorized repair.
- Noncompliance with any Cummins Fire Power published guideline or policy.
- Use of improper or contaminated fuels, coolants or lubricants.
- Improper storage before and after commissioning.
- Owner’s delay in making Product available after notification of potential Product problem.
- Replacement parts and accessories not authorized by Cummins Fire Power.
- Owner or operator abuse or neglect such as: operation without adequate coolant or lubricants; over-fueling; over-speeding; lack of maintenance to lubricating, cooling or air intake systems; late servicing and maintenance; improper storage, starting, warm-up, run-in or shutdown practices, or for progressive damage resulting from a defective warning device.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the fire pump package.

Limitations (cont.):

This limited warranty does not apply to:

- Costs of maintenance, adjustments, installation, commissioning or start-up.
- Starting batteries and enclosures.
- Components added to the Product after shipment from Cummins Fire Power.
- Block heaters are warranted for 1 year from date in service

Please contact your local Cummins NPower Distributor for clarification concerning these limitations.

Extended Warranty

Cummins Inc offers several levels of Extended Warranty Coverage (**Base Engine Only**). Please contact your local Cummins Distributor for details.

Cummins Fire Power Right to Failed Components:

Failed components claimed under warranty remain the property of Cummins Fire Power. Cummins Fire Power has the right to reclaim any failed component that has been replaced under warranty.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS FIRE POWER IN REGARD TO THE PRODUCT. CUMMINS FIRE POWER MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT IS CUMMINS FIRE POWER LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This limited warranty shall be enforced to the maximum extent permitted by applicable law. This limited warranty gives the owner specific rights that may vary from state to state or from jurisdiction to jurisdiction.

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Section 1 - Safety

1.1 Introduction

Cummins Fire Power Manuals and Engine Manuals should be considered part of the equipment. Keep the manuals with the equipment. If the equipment is traded or sold, give the manuals to the new owner.

All personnel responsible for the operation and maintenance of the equipment should read and thoroughly understand this manual.

1.2 Advisory and Cautionary Statements

Advisory and Cautionary Statements are used throughout this manual to call attention to special information, correct operating procedures, and safety precautions.

NOTE: *A general advisory statement relating to equipment operation and maintenance procedures.*

IMPORTANT: *A specific advisory statement intended to prevent damage to the equipment or associated components.*

Cautionary Statements consist of two levels:

WARNING

Indicates the presence of a hazard which CAN cause severe personal injury.

CAUTION

Indicates the presence of a hazard which CAN cause personal injury or equipment damage.

1.3 Safety Precautions

Warning: Read and understand all of the safety precautions and warnings before performing any repair. This manual contains the general safety precautions that must be followed to provide personal safety. When they apply, special safety precautions are included with operating procedures.

Warning: Before manual operation, perform a walk around inspection and alert all area personnel that the equipment will be starting.

Warning: Do not operate faulty or damaged equipment. Ensure that all hoses, pipe connections, clamps, and guards are in place and securely fastened. Electrical components should be kept in good working condition and repaired immediately by qualified personnel.

Warning: After performing maintenance, remove all tools and foreign materials, reinstall and securely fasten ALL guards, covers, and protective devices.

Warning: Exposed in-running belt nips can cause severe personal injury or dismemberment. Ensure that guards are in place and securely fastened before operation.

Warning: Rotating drive shafts can lacerate, dismember, or cause strangulation. Keep hands, body parts, long hair, or loose-fitting clothing clear at all times.

Warning: Never attempt to manually clean a machine while it is operating or in standby mode.

Warning: Never open ports on tanks or piping while the engine is operating. Contact with pressurized agents can cause severe personal injury.

Warning: Relieve all pressure in the air, oil, and cooling systems before any lines, fittings, or related items are removed or disconnected.

Caution: Engine fuel is flammable when in contact with electrical spark or flame sources. Remove all sources of spark or flame from the work area.

Caution: Always use the same fastener part number (or equivalent) when replacing fasteners.

Caution: Some state and federal agencies in the USA have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Dispose of waste oil in accordance with applicable requirements.

Section 2 - Description

2.1 Introduction

This manual contains information for the correct operation and maintenance of a Cummins Fire Pump Engine. Read and follow all safety instructions. Refer to the General Safety Instructions in Section 1 - Safety.

This manual covers installation, operation, and maintenance of specific engine models. Most illustrations are representations that are common between all models. Where differences occur, refer to Section 8 - Component Parts and Assemblies for model specific information.

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

Cummins Fire Power, Cummins NPower, and Cummins Inc. reserve the right to make changes at any time without obligation. If any differences are found between an engine and the information in this manual, contact the local Cummins Authorized Repair Location.

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

2.2 Fire Pump Engines

Cummins complete line of fire pump engines have been approved as packaged units (engine and all accessories) by Factory Mutual Approvals and listed by Underwriter's Laboratories, Inc. and Underwriter's Laboratories of Canada.

No deviations are permitted without prior written approval. These engines are to be used only for fire protection applications.

NOTE: *Refer to the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies for emission levels.*

Emission Control Information:

In the U.S. this engine may be used only in stationary emergency applications in accordance with requirements of 40 CFR Part 60 and is excluded from the requirements of 40 CFR Parts 89 and 1039. Installing or using this engine in any other application may be a violation of U.S. Federal law subject to civil penalty.

NOTE: *This engine is certified to operate on diesel fuel.*

WARNING

Injury may result and warranty is voided if fuel rate, RPM, or altitudes exceed published maximum values for this model and appplication.

2.3 Engine Digital Control Panel

The engine digital control panel is mounted on the left hand side on the flywheel end of the engine. Refer to Section 4 - Controls for additional information.

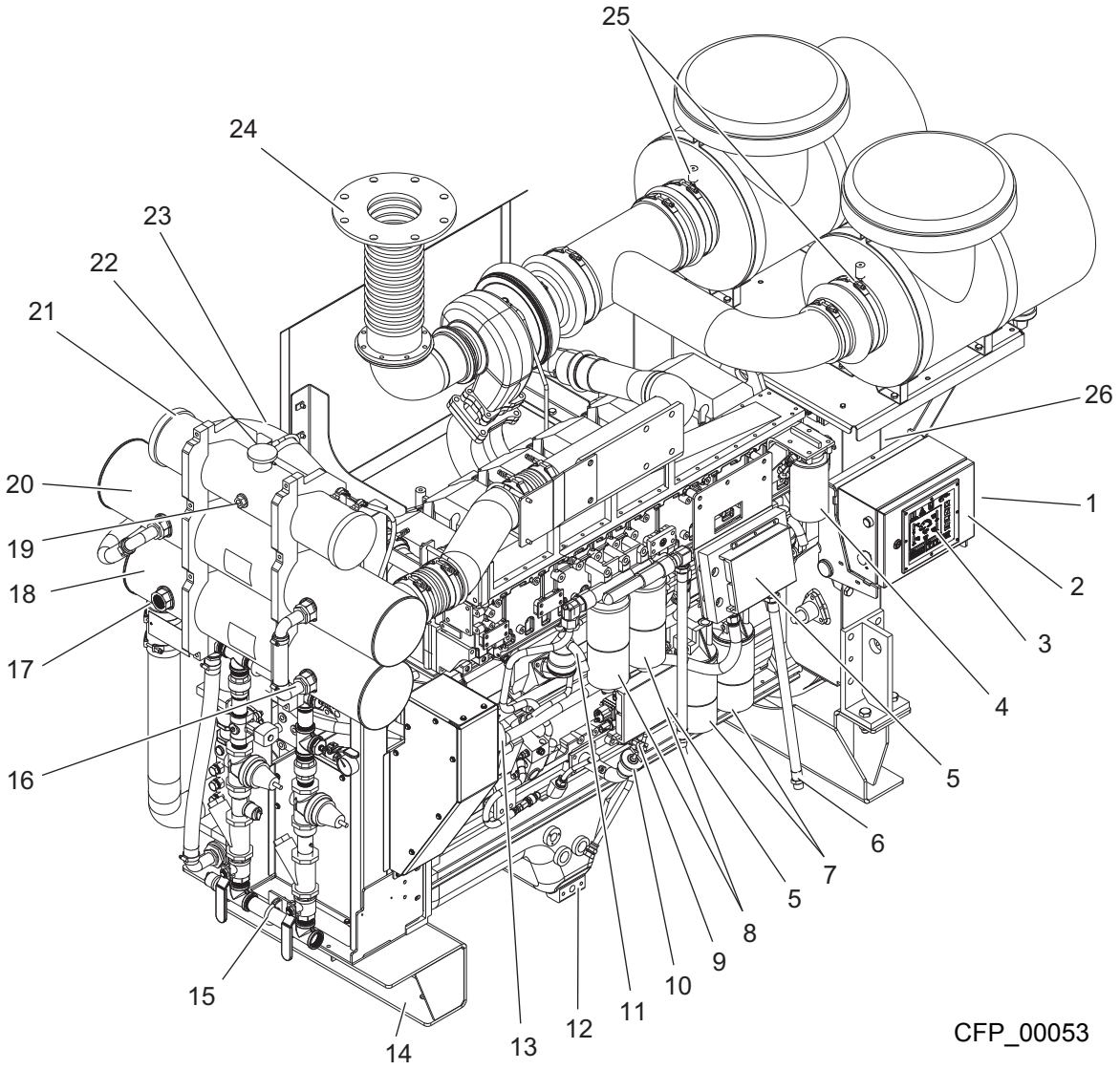
The engine digital control panel contains controls for starting, monitoring engine performance, and controlling fire pump engine operation.

2.3.1 Overspeed Function Feature

Each engine is equipped with an electronic overspeed control which activates the fuel pump solenoid valve or ECM ignition to shut off the engine when the RPM exceeds a preset limit. The overspeed control senses engine speed during the start cycle and stops the starter motor cranking cycle.

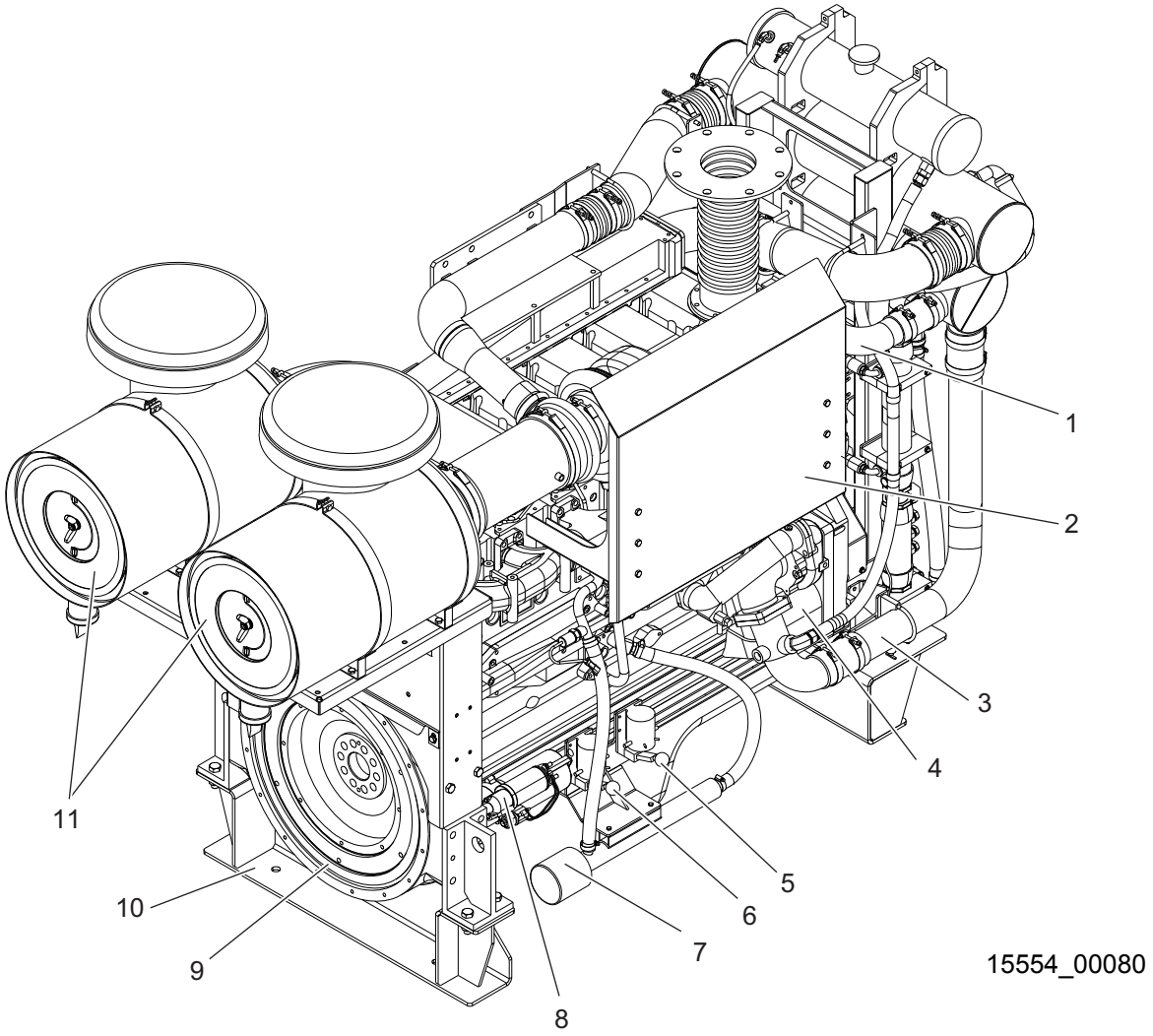
2.3.2 Operating Speed

All Cummins fire pump engines are shipped from the factory adjusted to the requested operating speed (RPM). Final operating speed adjustment must be made during the in-service inspection to obtain the required operating speed specified by the pump manufacturer.



1. Manual Start Instruction Decal
2. Terminal Box
3. Engine Digital Control Panel
4. Coolant Filter
5. Electronic Control Modules (ECMs)
6. Fuel Return Line
7. Oil Filter (2)
8. Fuel Filter/Water Separator (2)
9. Oil Level Dipstick
10. Oil Fill Port
11. Crankcase Ventilation Hose
12. Oil Drain Valve
13. Alternator
14. Engine Supports
15. Cooling Water Manifold
16. Cooling Water Discharge
17. Cooling Water Drain
18. Coolant Heat Exchanger
19. Expansion Tank Level Sight Gauge
20. Charge Air Cooler (CAC) Heat Exchanger
21. Coolant Expansion Tank
22. Coolant Pressure/Fill Cap
23. Charge Air Cooler (CAC) Tube
24. Exhaust Flex Connection
25. Air Cleaner Service Indicator (2)
26. ESN and Engine Speed Setting Plates Coolant Expansion Tank

Figure 2-1 Engine Components - Instrument Panel Side (typical)



1. Upper Coolant Tube
2. Manifold Heat Shield
3. Lower Coolant Tube
4. Coolant Pump
5. Battery Starter Contactor B
6. Battery Starter Contactor A
7. Engine Coolant Heater
8. Starter Motor
9. Flywheel Housing
10. Engine Supports
11. Air Cleaner Assembly (2)

Figure 2-2 Engine Components - Turbocharger Side (typical)

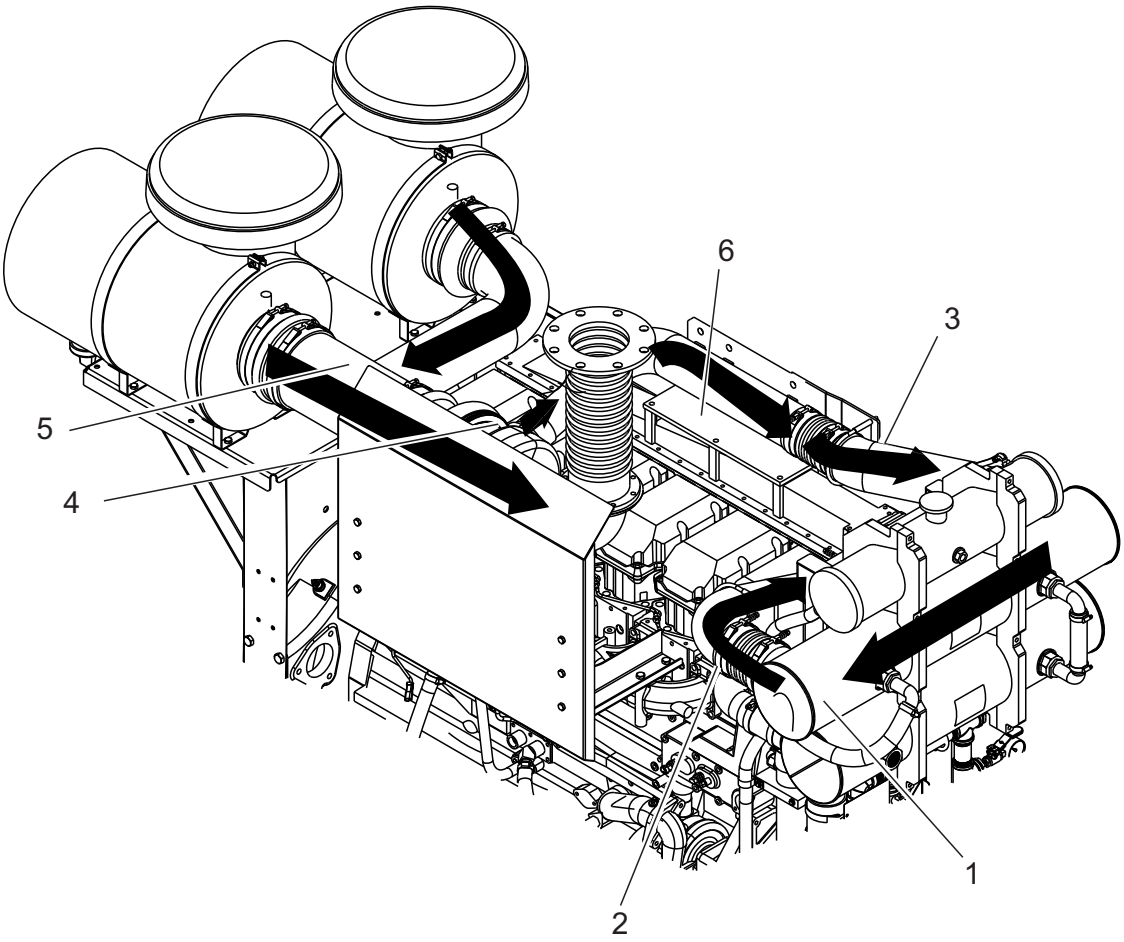
2.4 Fire Pump Controller

The fire pump controller is not supplied by Cummins Fire Power or Cummins Inc. The fire pump controller starts the engine automatically when a remote fire demand signal is initiated and automatically shuts down the engine when the fire demand signal is discontinued.

The engine may be started locally in the manual mode and shut down using the engine digital control panel stop button.

2.5 Air Intake System

The air intake system supplies combustion air to the fire pump engine cylinders. The air filter prevents particulate matter from entering the air intake. Combustion air drawn into the system by the turbocharger is directed through the Charge Air Cooler (CAC) heat exchanger for cooling before entering the intake manifold where the charge air is mixed with fuel.

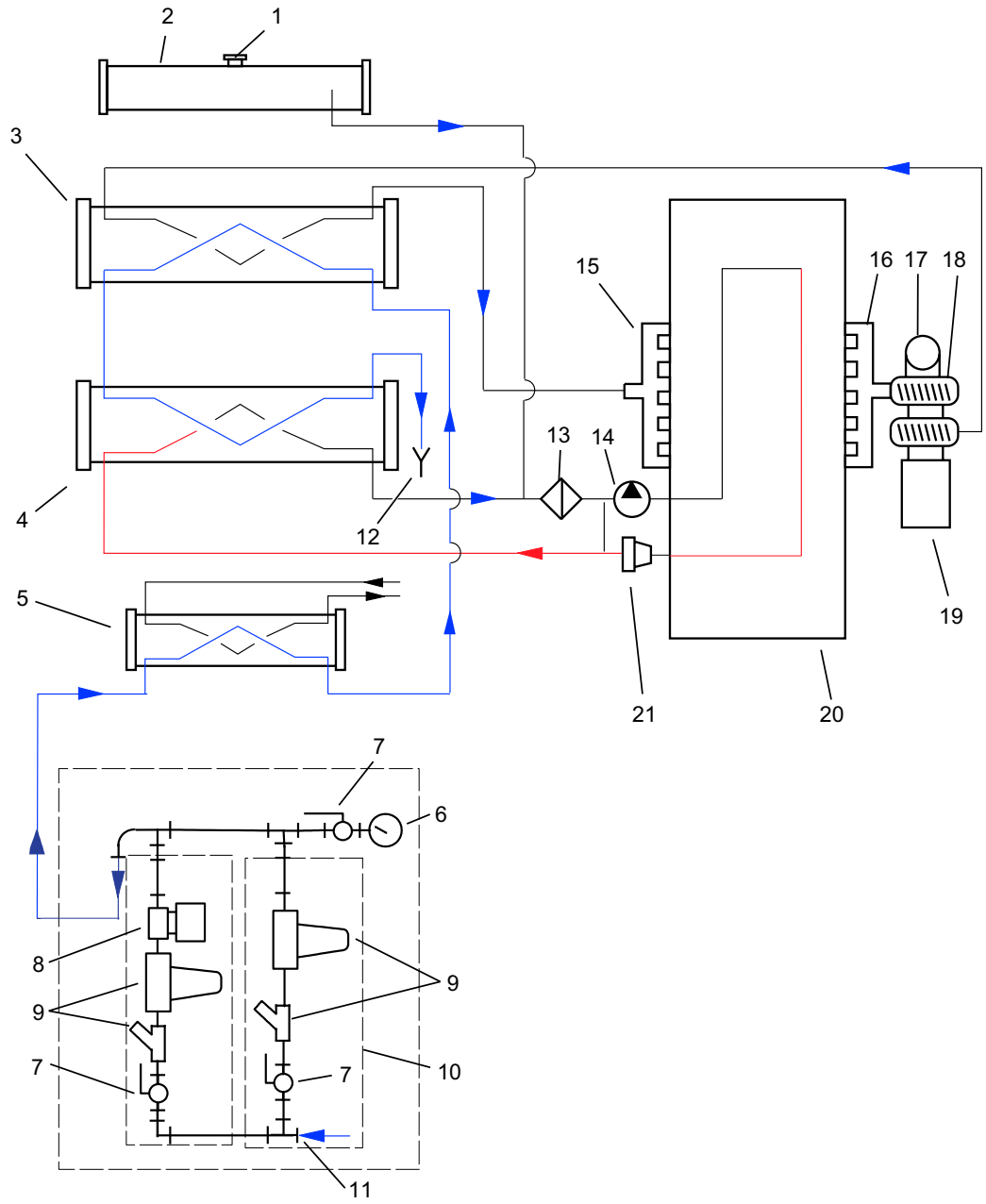


1. Charge Air Cooler (CAC) Heat Exchanger
2. Charge Air Cooler Tube
3. Air Hose to Charge Air Cooler
4. Turbocharger
5. Filtered Intake Air from Air Cleaners
6. Combustion Air Intake Manifold

Figure 2-3 Engine Air Intake and Charge Air Cooling Flow Diagram (typical)

2.6 Water Cooling System

The fire pump cooling water supply provides cooling water for the engine heat exchanger system. Water entering the cooling system through the cooling water inlet, first circulates through the Charge Air Cooler (CAC) heat exchanger, cooling the compressed air from the turbocharger outlet ducting. The cooled combustion air exits the CAC outlet duct to the engine air intake manifold. Refer to Figure 2-4.



1. Coolant Pressure/Fill Cap
2. Coolant Expansion Tank
3. Charge Air Cooler (CAC) Heat Exchanger
4. Coolant Heat Exchanger
5. Fuel Cooler
6. Coolant Water Pressure Gauge
7. Manual Shut-off Valve
8. Coolant Water Solenoid Valve
9. Coolant Water Pressure Regulator/Strainer
10. Bypass Piping
11. Coolant Water Inlet Pipe
12. Coolant Water Drain Line
13. Coolant Filter
14. Coolant Pump
15. Combustion Air Intake Manifold
16. Exhaust Manifold
17. Exhaust Flex connection
18. Turbocharger
19. Air Filter
20. Engine Block
21. 77° C (170° F) Thermostat

Figure 2-4 Engine Cooling System Flow Diagram (typical)

NOTE: *The cooling water supply must be immediately available when the engine is started.*

The cooling water enters the CAC heat exchanger then passes through the fuel cooler and then enters and circulates throughout the engine coolant heat exchanger. The cooling water exits the coolant heat exchanger through a discharge connection. Refer to Figure 2-4.

IMPORTANT: *If the piping will be supplied by the customer, provide cooling water supply piping and components equivalent to components supplied by Cummins Fire Power. Refer to National Fire Protection Association NFPA 20 for installation requirements. When choosing components for the cooling water supply and bypass, ensure that the internal cross sectional area of the component is at least as large as the recommended pipe size.*

1. When the cooling water piping is installed, adjust both pressure regulator set points before operating the pump.

2. The upper line is the bypass line. The bypass line outlet valve should be closed.

3. The lower line with the solenoid valve is the normal inlet line. The pressure gauge isolation valve must be open. The normal water inlet line valve should be open.

IMPORTANT: *Monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System Specifications or Cooling System Specifications in the Engine Data Sheets for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does not meet the specifications.*

Maximum engine coolant temperature should not exceed the temperature listed on the Engine Data Sheet found in Section 8 - Component Parts and Assemblies. The coolant expansion pressure/fill cap must meet the minimum pressure of 10 kPa (15 psi).

The engine coolant system contains a mixture of at least 50% antifreeze and 50% water. The coolant level should be maintained so it is visible in the coolant level sight gauge.

CAUTION

Continuous operation with low coolant temperature (below 70° C [158° F]) or high coolant temperature (above 107° C [225° F]) can damage the engine. Verify cooling water pressure and flow.

2.7 Fuel Cooling System

A fuel cooling heat exchanger maintains fuel temperature to meet the maximum allowable fuel inlet temperature (71° C [160° F]). Performance of the fuel cooling system is critical to engine durability, performance, and emissions compliance.

2.8 Fuel Supply and Drain Location

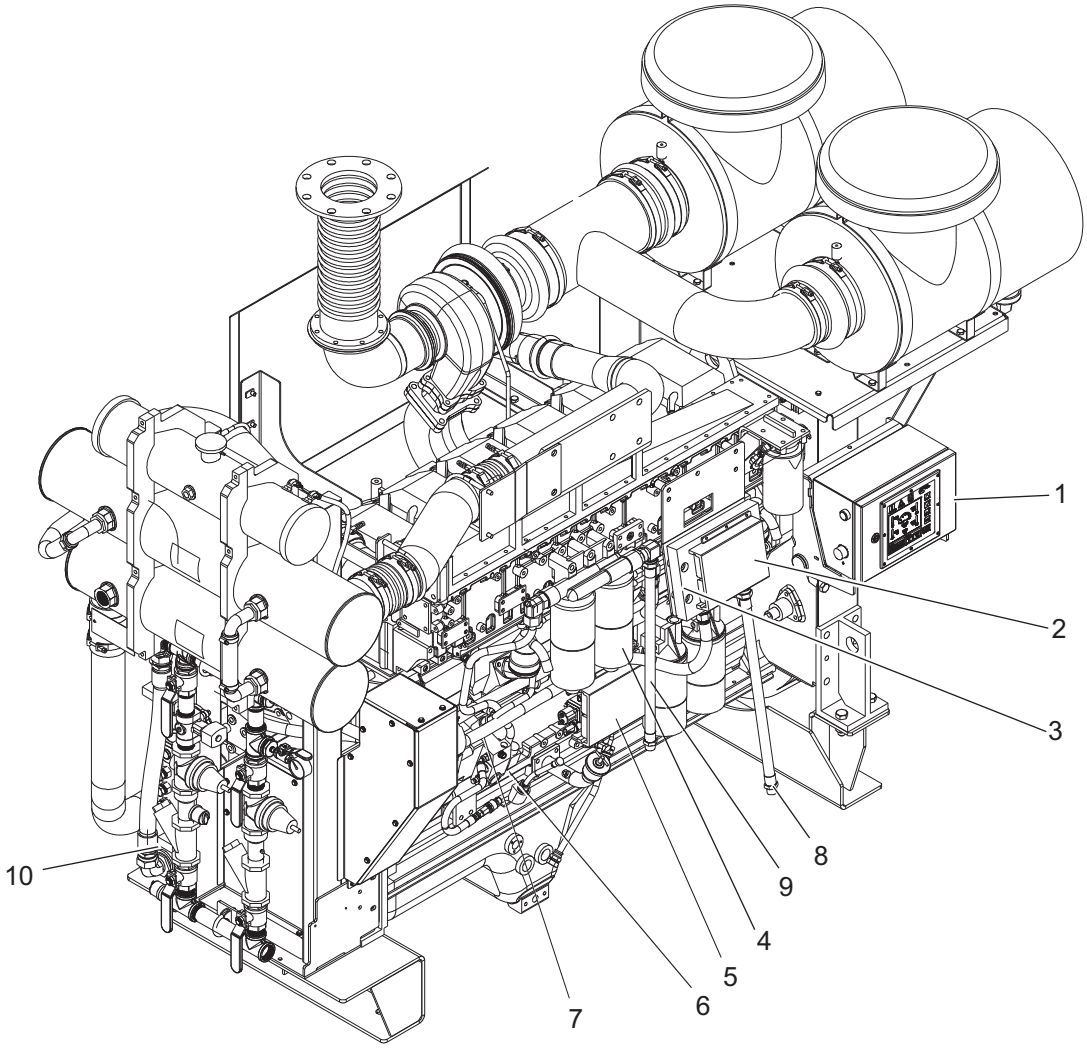
The fuel supply and return connections are located on the engine digital control panel side. Refer to Figure 2-5. Refer to the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies for maximum allowable fuel tank supply locations above the fuel pump.

2.9 High Pressure Injector (HPI) Fuel System

The fire pump engine is equipped with an electronic fuel system that delivers precise fuel quantities with precise injection timing at high injection pressures. The system consists of six (6) high-pressure unit injectors and an Integrated Fuel System Module (IFSM). The IFSM provides individual cylinder control fuel metering and injection timing and controls the fuel supply pump and regulator pressure using various system monitoring sensors. The system is controlled by CM500 Engine Control Modules (ECMs) for fueling and timing based on temperature, altitude, boost pressure, and throttle position. Refer to Figure 2-5.

The CFP23E comes with a gear type fuel pump driven by the engine.

With the HPI fuel system, fuel priming is required for conditions such as: initial start-up, running out of fuel and maintenance of fuel system components (i.e., filter change).



1. Engine Digital Control Panel
2. ECM B
3. ECM Cooling Plate (behind each ECM)
4. Fuel Filter/Separators
5. ECM A
6. Fuel Pump
7. Fuel Lines to/from Fuel Cooler
8. Fuel Return Line (Optional Extensions)
9. Fuel Supply Line (Optional Extensions)
10. Fuel Cooler

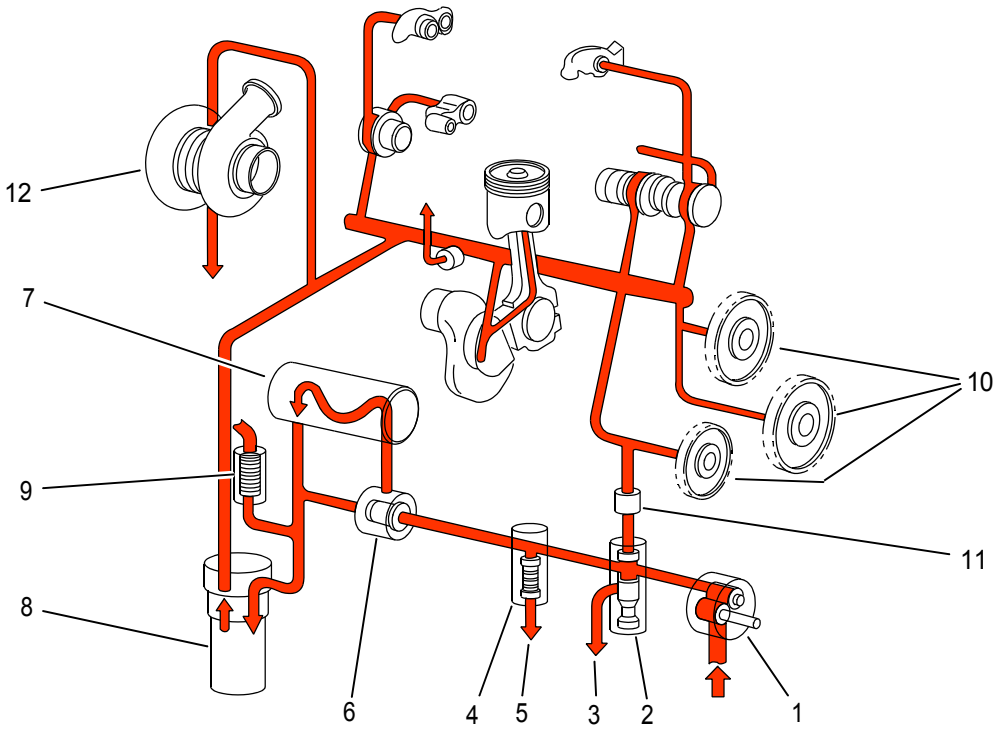
Figure 2-5 Fuel System Components (typical)

2.10 Engine Oil System

The engine oil system lubricates moving internal engine parts (pistons, piston arms, valves, cam shafts, drive shafts, and bearings). The oil pump circulates oil from the oil pan, through the oil filter and into engine areas where friction may develop. Refer to Cummins Engine Operation and Maintenance Manual for additional information. Refer to Figure 2-6.

Typically, engine oil has been added during manufacture and testing procedures, however, shipping restrictions can affect whether the oil is maintained in the engine or drained for shipment.

Check the oil level at the dipstick. Add oil as necessary to bring the oil level to the H (high) mark on the dipstick. Refer to Figure 3-8.

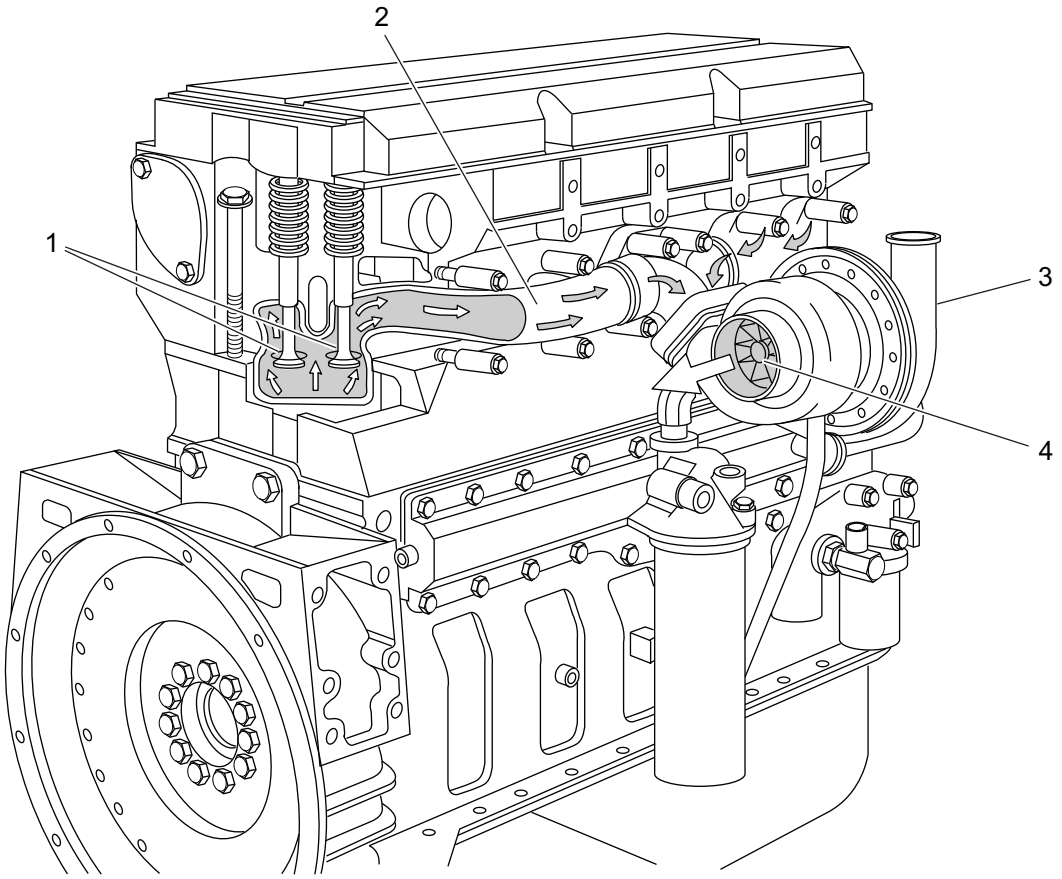


1. Oil Pump
2. Pressure Regulator Valve
3. Oil Return to Pan
4. High Pressure Relief Valve
5. Oil Return to Pan
6. Oil Thermostat
7. Oil Cooler
8. Combination Oil Filter
9. Filter Bypass Gears
10. Idler Gears
11. Viscosity Sensor
12. Turbocharger

Figure 2-6 Engine Lubricating Oil System Flow Diagram (typical)

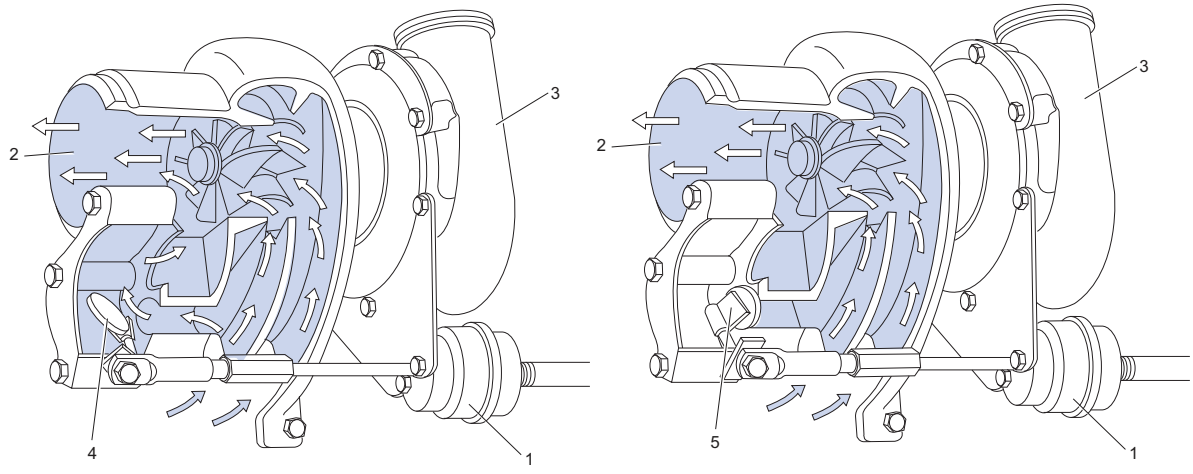
2.11 Exhaust System

The exhaust system removes engine exhaust from the cylinders after the combustion process. The exhaust discharges from the exhaust manifold, passes through (drives) the turbocharger, and exits through the exhaust flex pipe. Refer to Figure 2-7 and Figure 2-8.



1. Exhaust Valve Ports
2. Exhaust Manifold
3. Combustion Air to Charge Air Cooler
4. Turbocharger Turbine

Figure 2-7 Flow Diagram - Exhaust System (typical)



1. Wastegate Actuator Cylinder
2. Exhaust Flow to Flex Pipe
3. Combustion Air to Charge Air Cooler
4. Wastegate OPEN
5. Wastegate CLOSED

Figure 2-8 Turbocharger Exhaust Flow Diagram (typical)

Section 3 - Installation

3.1 Receiving and Handling Information

Cummins Fire Power Pump Engines are pre-assembled and tested before shipment. Parts not shipped attached to the engine are sometimes shipped individually. The equipment was thoroughly inspected and prepared for shipping before it was turned over to the carrier.

1. Carefully remove the components from the shipping container. Remove crating, shipping tape, braces, and tie-downs.

2. Inspect the equipment for damage that may have occurred in shipping.

3. Check each item carefully against the shipping manifest or bill of lading.

3.2 Site Preparation

This section provides instructions for the initial installation, adjustment, and testing of the Cummins Fire Pump Engine. Appropriate portions of this section should be used when returning the engine to operation after overhaul or major maintenance.

The site should be clean and relatively level. Clear the proposed equipment area of overhanging obstructions and obstacles protruding from the floor.

Cooling water piping should be installed by trained technicians familiar with local, state, and federal codes and regulations, per the equipment layouts supplied by Cummins Fire Power or Cummins Inc.

Refer to the general fire pump and engine layout drawings for installation dimensions supplied with this manual.

Refer to National Fire Protection Association NFPA 20 for US installation and applicable local code requirements and NFPA 25 for inspection, testing, and maintenance requirements.

1. Lay out a designated center line on the site floor. Find the center line of the engine drive shaft. Lay out a center line on the cross frame members.

2. If the engine is assembled with the drive line, pump, and mounting base, use the lifting points provided on the mounting base or lift the entire skid using an approved fork lift.

CAUTION

Ensure that the lifting device is capable of safely lifting the weight of the engine or the combined weight of the assembled pump base, drive line, and pump. Refer to the bill of lading for combined shipping weights.

3. Position the engine as required for the interface with the fire pump, water piping, fuel piping, exhaust, and air system connections.

3.2.1 Drive Shaft Installation

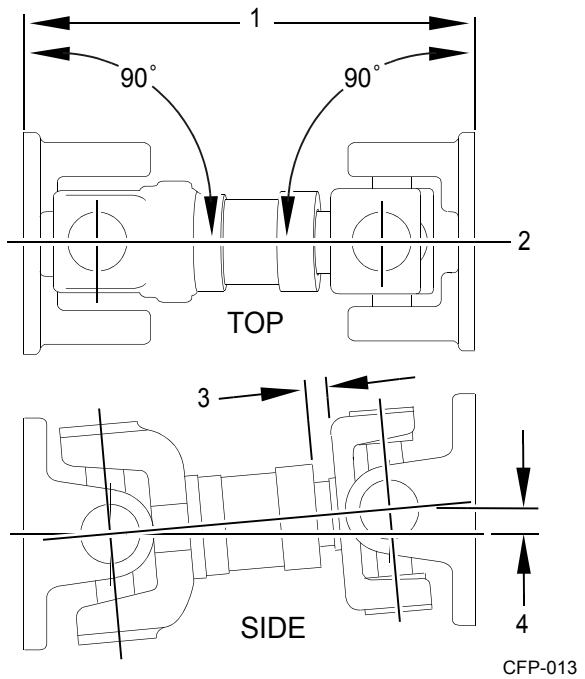
1. Position the engine center line to align the engine drive shaft with the fire pump drive. Ensure that the engine and pump are correctly aligned.

   a. Ensure engine position is centered on frame side to side within ± .76 mm (.03 in) by measuring outside of frame side to engine support leg mounting pad. (Compare the two front engine supports and two back engine supports).

   b. Align engine center line to pump center line within ± 76 mm (.03 in). Refer to Figure 3-1.

   c. The pump center line to the engine crankshaft center line (in vertical plane) is to be 2° +/- 1°.

   d. Drive shaft mounting flanges must be parallel.



1. Planes Must Be Parallel
2. Align Both Mounting Center lines to ± .76 mm (.03 in)
3. Distance to Equal Half of Total Travel
4. 2° +/- 1°

Figure 3-1 Drive Shaft Alignment

2. Lubricate the grease fittings on the drive shaft universal joint. Refer to Figure 3-2.

   a. Wipe the grease fittings and grease gun nozzle with a clean cloth.

   b. Add grease to the drive shaft universal joint grease fittings.

   c. Wipe excess grease from the grease fittings.

NOTE: *Cummins Fire Power or Cummins Inc. recommends using a good quality semi-synthetic, molybdenum-fortified NLGI #2 lithium complex grease.*

NOTE: *Some lubrication loss may occur during transport and storage. It is recommended that the drive shaft be re-lubricated upon installation.*

3. Check that the fire pump is properly installed per the pump manufacturer's specifications.

4. Connect the exhaust piping to a safe location, away from building air intake sources (air conditioners, windows, fresh air intake pipes, etc.).

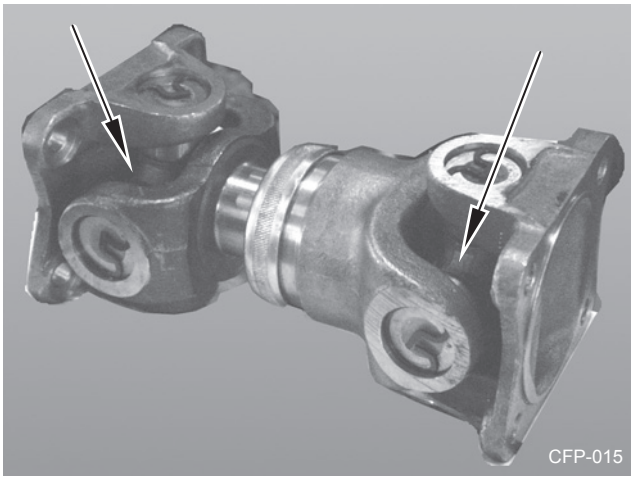


Figure 3-2 Drive Shaft Universal Joint Grease Fittings

5. Check that the alternator and coolant pump drive belts are properly installed.

6. Check that all hoses and tubes are properly installed and all clamps secure.

3.3 Fuel Supply Installation

1. Install a properly rated fuel tank per NFPA 20 guidelines.

2. Install a proper sized fuel line per the Engine Data Sheet in Section 8 - Component Parts and Assemblies.

NOTE: *DO NOT use copper or galvanized pipe for the fuel return or supply lines.*

3.3.1 Fuel System Preparation

The fire pump engine fuel system has been primed during manufacturing and test procedures. The engine is equipped with an engine driven (gear) fuel pump.

Two fuel filter/water separators are integrated into the fuel delivery system of the fire pump engine.

1. Ensure that each filter/separator is free of water by opening the fuel filter/water separator drain at the bottom of the filter. Refer to 6.3.5 Fuel System Inspections for additional information.

2. Drain the fuel into a container until no water is present. Dispose of the contaminated fuel in accordance with local environmental regulations.

CAUTION

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the fuel pump and the fuel injectors.

3.3.2 Fuel Recommendations

WARNING

Do not mix gasoline, alcohol, gasohol, ethanol or methanol with diesel fuel. This mixture will cause severe engine damage or explosion.

CAUTION

Use ONLY no. 2 diesel fuel. Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.

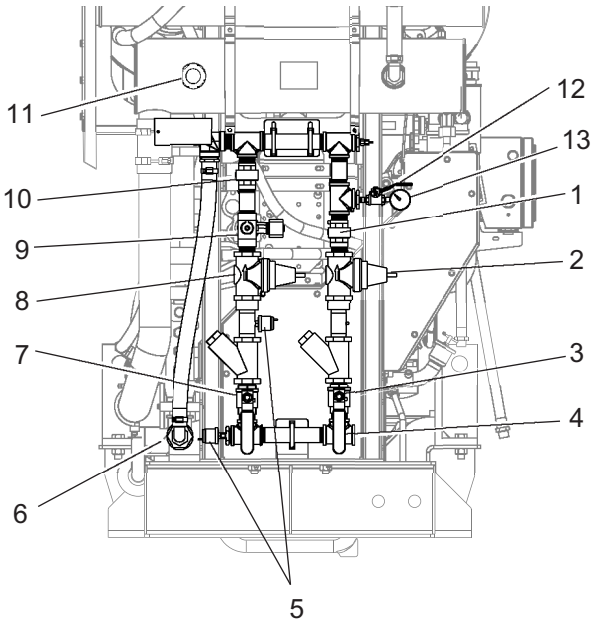
3.4 Cooling Water Supply Installation

IMPORTANT: *The cooling water supply must be immediately available when the engine is started. Ensure that the supply line valves are in the OPEN position.*

NOTE: *The velocity of the cooling water should be as great as possible without exceeding the maximum allowable pressure shown in the appropriate Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

1. Provide a cooling water discharge line at the outlet of the engine coolant heat exchanger and provide a cooling water supply line to the cooling water inlet per the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies. Refer to Figure 3-3.

NOTE: *Cooling water outlet piping from the heat exchanger should be one pipe size larger than the supply piping.*



CFP-00081

1. Bypass Water Check Valve
2. Bypass Pressure Regulator/Strainer
3. Bypass Water Inlet Valve
4. Cooling Water Supply Inlet
5. Differential Pressure Sensors
6. Connection to Fuel Cooler
7. Normal Water Inlet Valve
8. Normal Pressure Regulator/Strainer
9. Normal Water Solenoid Valve
10. Normal Water Check Valve
11. Cooling Water Drain Plug
12. Pressure Gauge Isolation Valve
13. Water Supply Pressure Gauge

Figure 3-3 Cooling Loop Manifold

2. Check the pressure regulator setting with water flowing through the heat exchanger. If supplied as an option from CFP, both water pressure regulators have been set at 207 kPa (30 psi) or slightly less water pressure during manufacture and testing. Refer to Figure 3-3.

IMPORTANT: *The manual water valves for the automatic loop should remain OPEN at ALL times. The manual valves for the bypass loop should be CLOSED during automatic (pump controller) operation. When running, the engine should stabilize between temperatures identified on the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies. The flow rate may need to be adjusted to maintain desired engine temperature.*

NOTE: *Excessively cold (4° C to 23° C [40° F to 75° F]) cooling water flow can cause condensation inside the charge air cooler.*

IMPORTANT: *Continuous operation with low coolant temperature (below 70° C [158° F]) or high coolant temperature (above 107° C [225° F]) can damage the engine.*

3. The cooling water should be adjusted based on water flow rather than water pressure. The flow is dependent on the cooling water temperature. Refer to the Engine Data Sheet in Section 8 - Component Parts and Assemblies for details.
4. Use an appropriate sized container to measure and time the flow from the discharge pipe.

   Flow rate = time to fill container/container size.

Example: Time to fill 19 liter (5 gal) container = 15 seconds.

Divide 15 by 5 = 3 (seconds per liter [gal]).

Divide 60 seconds by 3 = 76 liters (20 gal) per minute.

5) Adjust both pressure regulators to a pressure that will provide a flow rate at or above the specifications.

CAUTION

When the cooling water piping is installed, adjust both pressure regulator set points before operating the pump. Damage to the heat exchanger may occur from improperly regulated cooling water supply pressure.

3.5 Battery Requirements

Two redundant sets of batteries must be supplied for the 24 VDC operating voltage. Refer to National Fire Protection Association Standard NFPA 20 and Section 1 - Safety of this manual for additional battery installation information.

The minimum recommended reserve capacity (SAE RC) and cold cranking ampere (SAE CCA) values for a particular engine can be found on the Engine Data Sheet in Section 8 - Component Parts and Assemblies. RC and CCA definitions can be found in SAE Standard J537.

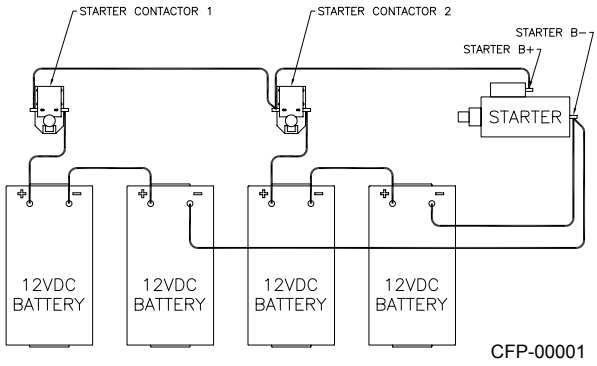


Figure 3-4 Battery Connection Schematic 24 VDC (Typical)

3.5.1 Battery Installation

1. Provide adequate room for servicing or replacing the batteries. Provide protection from extremes of temperature and weather.
2. Refer to National Fire Protection Association NFPA 20 for proper location of batteries and applicable local codes requirements. Ensure that the batteries are configured properly for 24 VDC operations. Refer to Figure 3-4.

NOTE: *Coat the terminals with petroleum jelly to prevent corrosion. Tighten the battery connections.*

3. Install the Battery Cable Kit or equivalent customer supplied wiring.
4. Follow battery connection schematic Figure 3-4 to ensure adequate starting requirements for the system.

IMPORTANT: *Batteries must meet the requirements listed in the electrical system specifications. Batteries may be supplied by Cummins Fire Power or Cummins Inc. as an option, or may be supplied by the customer.*

WARNING

Battery electrolyte (sulfuric acid) is highly caustic and can burn clothing and skin. Wear impervious neoprene gloves and safety goggles, or full face shield, when working with the batteries.

CAUTION

DO NOT connect battery charging cables to any electronic control system component. This can damage the electronic control system.

WARNING

Batteries can emit explosive gases during charging. Always ventilate the compartment before servicing the batteries. Remove sources of spark or open flame. To avoid arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

3.6 Signal and Control Installation

This section explains how to connect the controller wires to the terminal block.

CAUTION

If the batteries have been installed prior to the control wiring, disconnect the negative (-) cable first and then disconnect the positive (+) battery lead. Install the cables with the positive (+) cable first and the negative (-) cable last before testing.

NOTE: *Install signal and control wiring at Terminal Board (TB). Refer to the terminal wiring schematic decal on the inside of the instrument enclosure.*

1. Ensure that the fire control system is properly installed and configured per the manufacturer's instructions. Refer to the wiring schematic drawings provided with the pump manual.

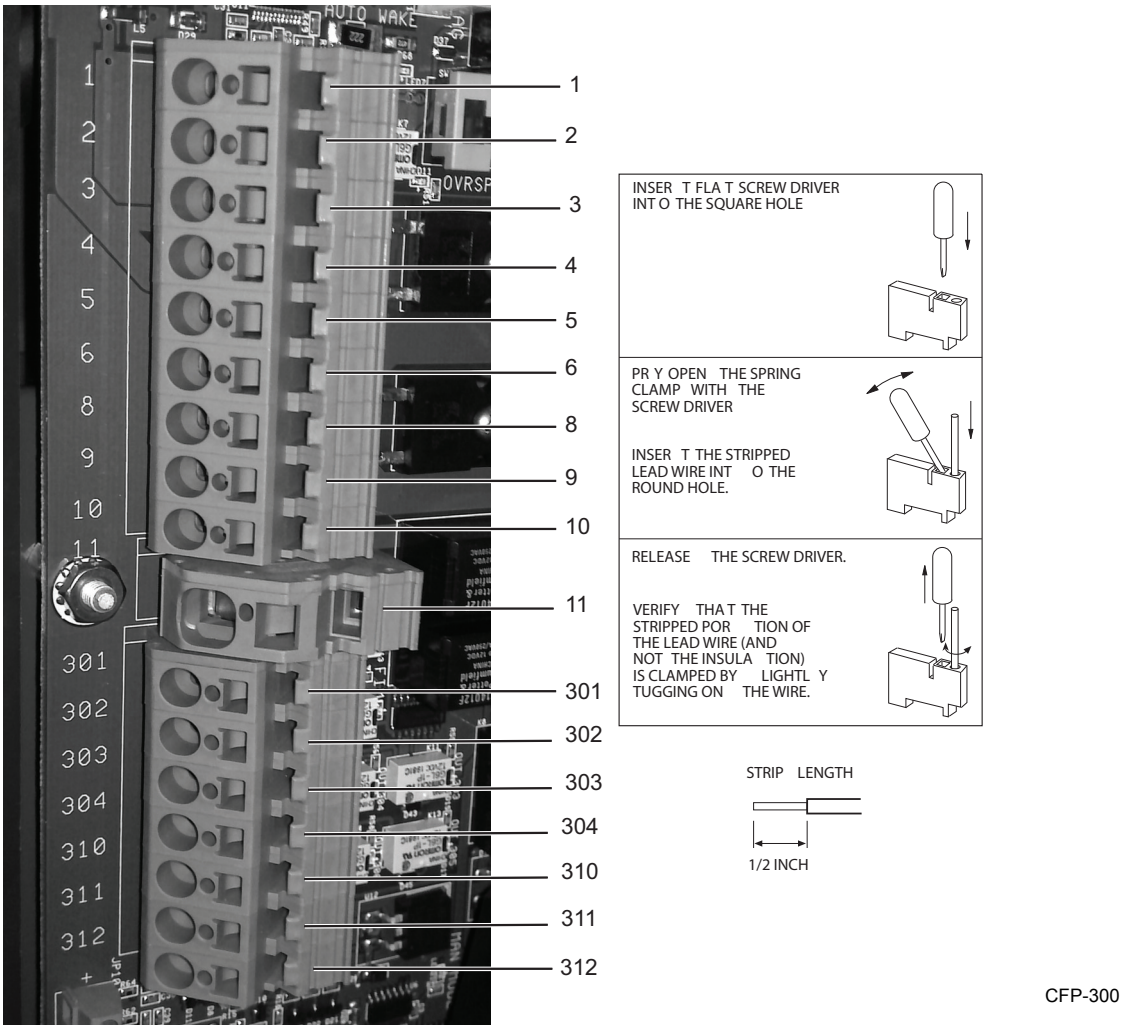


Figure 3-5 Termination Blocks and Wiring Decal

2. Complete the fire pump controller wiring (customer supplied) per the manufacturer's instructions.
3. Connect the following wires to the fire pump engine digital control panel per the engine electrical diagrams. Refer to Figure 3-5.

    a. TB-1: Connect the control power from the fire pump controller. This power source is necessary for fire pump operations while in the AUTO mode.

    b. TB-2: Connect the crank termination input signal for the fire pump controller. This signal is present when the engine is running. This signal indicates that the engine has started and that the crank command from the fire pump controller should stop immediately.

    c. TB-3: Connect the remote overspeed alarm input to the fire pump controller. This signal is present when the overspeed control module has operated. If this event occurs, the fire pump engine will stop.

    d. TB-4: Connect the low oil pressure alarm input from the fire pump controller. This 0 VDC grounded signal is present when the oil pressure has dropped below the 83 ± 13 kPa (12 ± 2 psi) set point.

    e. TB-5: Connect the high coolant temperature alarm input from the fire pump controller. This 0 VDC grounded signal is activated when the engine is running and the coolant temperature is at or above 93° C (200° F). The alarm will deactivate when the engine is running and the coolant temperature drops below 88° C (190° F).

    f. TB-6: Connect battery set A lead from the controller. The controller senses battery A charge state and charges A battery through this heavy gauge wire.

    g. TB-8: Connect battery set B lead from the controller. The controller senses battery B charge state and charges B battery through this heavy gauge wire.

    h. TB-9: Battery positive signal driven from the Pump Controller to contactor A when desiring to crank from Battery A. Current in this circuit shall not exceed 10A continuous.

    i. TB-10: Battery positive signal driven from the Pump Controller to contactor B when desiring to crank from Battery B. Current in this circuit shall not exceed 10A continuous.

    j. TB-11: Common ground and battery negative for both Battery A and Battery B from between the pump controller and engine. This is not intended to create a fully isolated battery negative or ground system. Current in this circuit shall not exceed 20A continuous.

    k. TB-301: Battery negative signal driven from the Fire Pump Digital Controller when the engine is operating on ECM B.

    l. TB-302: Battery negative signal driven from the Fire Pump Digital Controller when either ECM triggers a fault code which can affect performance of the Fuel Injection system. See CFP23E Fault Code Chart in Section 7 for related fault codes.

    m. TB-303: Battery negative signal driven from the Fire Pump Digital Controller when a single ECM has failed.

    n. TB-304: Battery negative signal driven from the Fire Pump Digital Controller when both ECMs have failed.

    o. TB-310: Battery negative signal driven from the Fire Pump Digital Controller when cooling water high temperature is sensed.

    p. TB-311: Battery negative signal driven from the Fire Pump Digital Controller when the cooling water supply restriction is sensed.

    q. TB-312: Battery negative signal driven from an engine temperature switch when engine coolant reaches or falls below 43.3 ± 2.78° C (110 ± 5° F). The signal will be removed when the coolant temperature reaches or exceeds 60 ± 2.78° C (140 ± 5° F).

4. Ensure electrical continuity and adequate insulation resistance for the installed wiring.
5. Provide the initial charge on the redundant batteries per the battery charger's instructions.
6. Check that both voltmeters on the engine digital control panel indicate the approximate battery voltage.

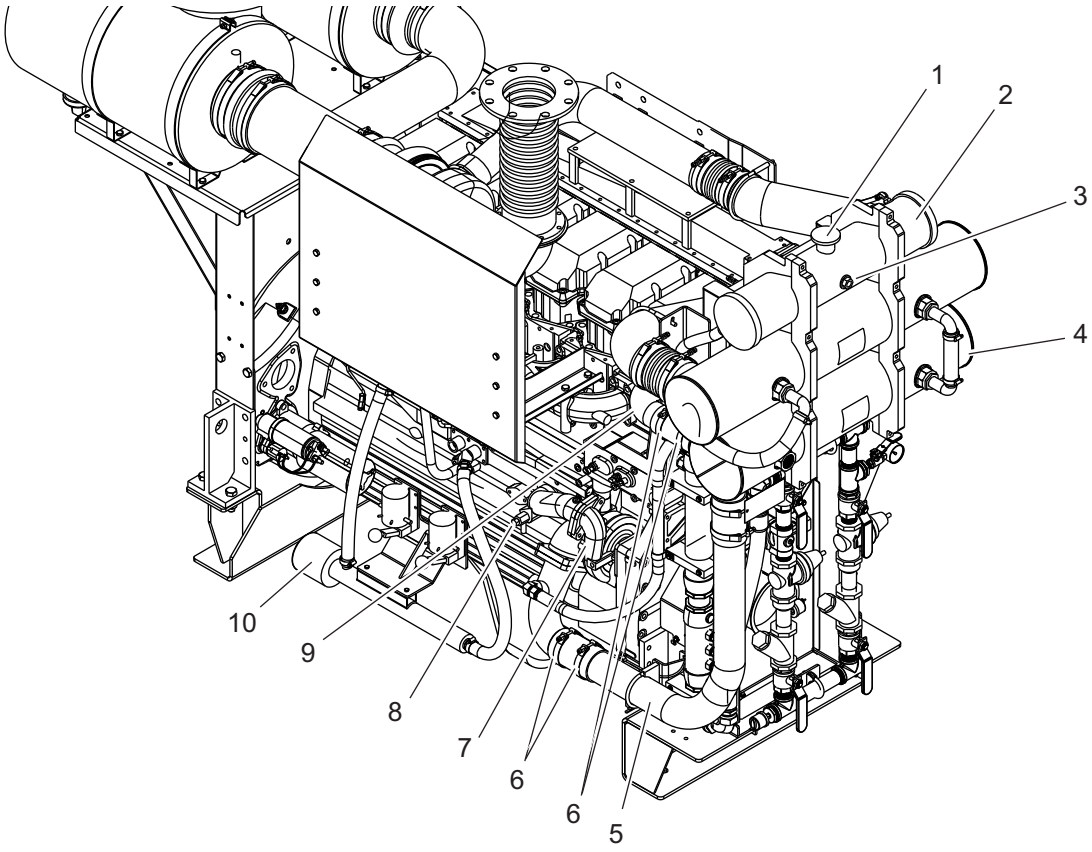
3.7 Coolant System Preparation

The fire pump engine cooling and lubrication system was initially filled during manufacture and testing.

CAUTION

Ensure that all coolant systems have been filled to the proper level before operation by checking the coolant level sight gauge on the heat exchanger.

1. Inspect the engine coolant hoses and hose clamps. Ensure that all coolant hoses and clamps are properly installed and water tight.
2. The engine coolant heater must maintain an engine coolant temperature of 49° C (120° F) or above.
3. Ensure that coolant is present in the engine coolant heater before plugging the heater element into a dedicated circuit. Refer to Figure 3-6.



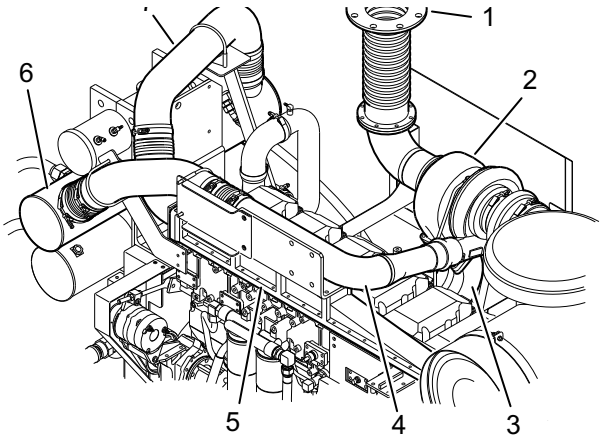
1. Coolant Expansion Tank Pressure/Fill Cap
2. Engine Coolant Expansion Tank
3. Expansion Tank Level Sight Gauge
4. Coolant Heat Exchanger
5. Lower Coolant Tube
6. Hose Clamps
7. Coolant Pump
8. Coolant Drain Valve
9. Upper Coolant Tube
10. Engine Coolant Heater

Figure 3-6 Cooling System Components

3.8 Charge Air Cooler System

The charge air cooler system reduces the temperature of the compressed combustion air from the turbocharger before entering the air intake manifold. Refer to Figure 3-7.

Inspect the charge air cooler piping and hoses for loose/missing hose clamps, hose punctures, leaking manifold seals, or corrosion. Torque the hose clamps to the recommended torque value. Refer to the Torque Table in Section 8.



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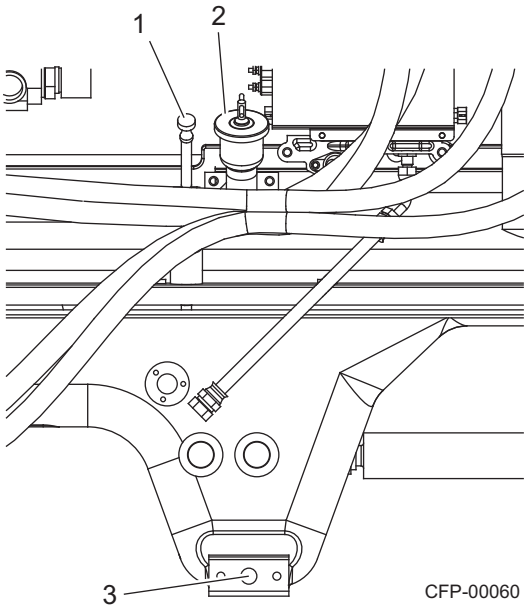
1. Exhaust Flex Connection
2. Charge Air Turbocharger
3. Exhaust Manifold
4. CAC Tubing and Clamps
5. Intake Manifold
6. Charge Air Cooler (CAC) Heat Exchanger
7. Charge Air Cooler (CAC) Tubing

Figure 3-7 Charge Air Cooler System

3.9 Lubricating Oil System Preparation

CAUTION

Some regulatory and shipping restrictions may require that all lubricants, fuels, and coolants be drained for transport. Ensure that all cooling and lubrication systems have been filled to the proper level before operation.



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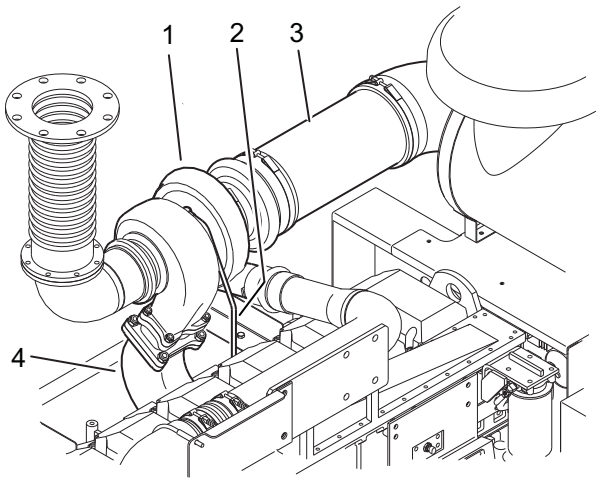
1. Oil Level Dipstick
2. Oil Fill Port
3. Oil Drain Plug (one each side)

Figure 3-8 Oil Level Dipstick & Oil Fill Port

1. Check the oil level using the crankcase dip stick before operating. Refer to Figure 3-8.

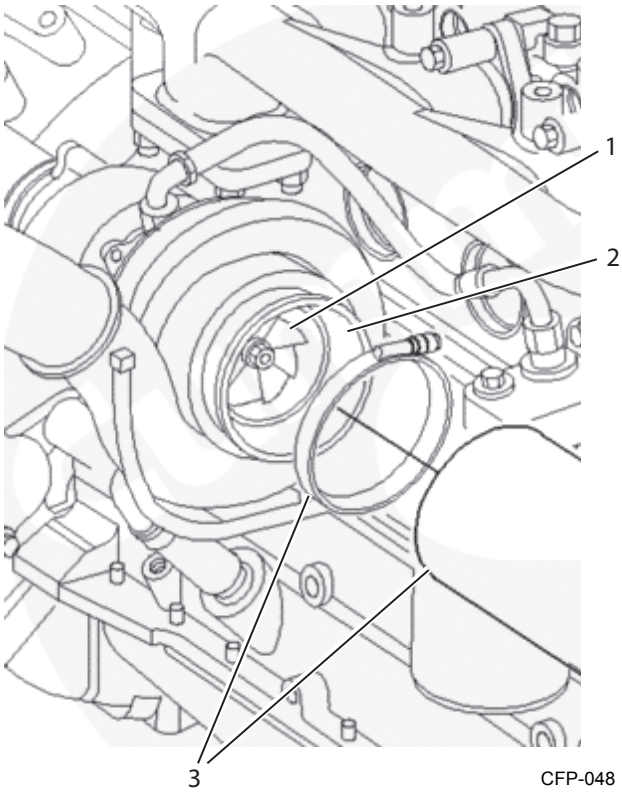
2. Fill the crankcase at the oil fill port to the “H” mark on the dipstick with engine oil.



CFP-166

1. Turbocharger
2. Turbocharger Oil Line
3. Turbocharger Air Intake Tubing
4. Exhaust Manifold

Figure 3-9 Turbocharger Oil Line Location



1. Turbocharger Turbine Wheel
2. Turbocharger Intake Housing
3. Air Intake Tube and Clamp

Figure 3-10 Turbocharger Turbine Wheel (Typical)

3. The turbocharger has been lubricated during manufacture and testing. Refer to Figure 3-9.

   a. Remove the turbocharger air intake tubing.

   b. Rotate the turbine wheel to allow oil to enter the bearing housing. Any excess oil will drain through the oil drain line. Refer to Figure 3-10.

   c. Lubricate the bearings by pouring 59 to 89 ml (2 to 3 oz.) of clean engine lubricating oil into the turbocharger oil supply line fitting.

   d. Reconnect the turbocharger oil inlet line.

   e. Install the air intake filter assembly.

3.10 Pre-Start Inspections

Perform a visual inspection as follows:

1. Check that there is no apparent damage and that all components are installed.
2. Check that the drive belt is properly installed.
3. Check that all hoses and tubes are properly installed.
4. Check that all electrical connections are properly installed.
5. Check that the fire pump is properly installed per the pump manufacturer's instructions, is correctly aligned, and is free to rotate.
6. After completing preliminary set-up procedures, perform the engine start test as outlined in detail in Section 5 - Operation.

NOTE: *Use the same type of oil as used in normal operation. Cummins Inc. recommends Premium Blue® 15W-40 oil for most climates.*

WARNING

Before operating the equipment, complete all safety checks, remove all tools and foreign objects from the equipment, and ensure that all guards are in place and securely fastened. Alert area personnel that the equipment will be starting. Unintentional equipment start-up or contact with exposed or moving components can cause personal injury or equipment damage.

3.11 Engine Monitoring

When the engine starts it is important to monitor the oil pressure and cooling water temperature gauges to ensure safe operation.

CAUTION

If the oil pressure is not displayed on the gauge or if the low oil pressure message is displayed within 5 seconds, STOP THE ENGINE immediately! Continued operation without proper lubrication will cause engine damage.

1. Immediately check that cooling water flow is established through the coolant heat exchanger. Cooling water flow should be established immediately, but some delay may occur before the flow exits the heat exchanger drain connection.

NOTE: *Ensure that cooling water is flowing through the heat exchanger and the water pressure shown on the local pressure gauge is no more than 414 kPa (60 psi). The minimum cooling water flow rate is identified in the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

CAUTION

If the cooling water flow is not evident at the discharge outlet or cone within 15 seconds, STOP THE ENGINE immediately! Continued operation without proper cooling water flow will cause engine damage.

2. Ensure that the engine operating temperature stabilizes between applicable ranges as identified in the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.

NOTE: *If the temperature does not stabilize, stop the engine and refer to Coolant Temperature Above Normal or Coolant Temperature Below Normal (Engine Running) in Section 7 - Troubleshooting.*

3. Operate the engine for 8 to 10 minutes.

4. Inspect for leaks, unusual noises, or other indications of incorrect operation.

5. Shut off the engine by pressing and holding the overspeed RESET/STOP switch.

6. Check that cooling water flow stops automatically shortly after the engine stops.

7. Correct any problems found during the inspection before proceeding.

8. Check the engine lubricating oil level at the crankcase dip stick. Top off if necessary.

9. Check the coolant expansion tank level. Top off if necessary.

10. Check the cooling water strainers. Clean the strainers as required per the instructions in Section 6 - Maintenance.

11. Perform engine speed control and safety system tests per the instructions in Section 5 - Operation.

Section 4 - Controls

4.1 Engine Digital Control Panel

The Engine Digital Control Panel (EDCP) contains controls for starting, monitoring engine performance, and controlling fire pump engine operation. Refer to Figure 4-1. In manual mode, the panel remains active as long as battery power is available. In auto mode, the panel is active when battery power is present on TB-1, otherwise it goes into standby mode after 30 minutes of no battery voltage on TB-1.

4.1.1 Warning Lamp

Illuminates (yellow) in the event that the ECM has sensed a non-mission disabling fault.

4.1.2 Fault Indicator Lamp

Indicates Fuel Injection Fault (FIF) and illuminates (red) in the event that the ECM has detected a fuel injection fault or primary sensor fault.

The engine digital control panel also sends a ground signal to terminal buss #302, which sends a signal to set off an alarm on the fire pump system controller to indicate a FIF fault.

4.1.3 Scroll Buttons

Used to scroll up or down when in the menus.

4.1.4 Enter Button

Used when making changes in the menu screen.

4.1.5 Menu Button

Opens the menu option on the display.

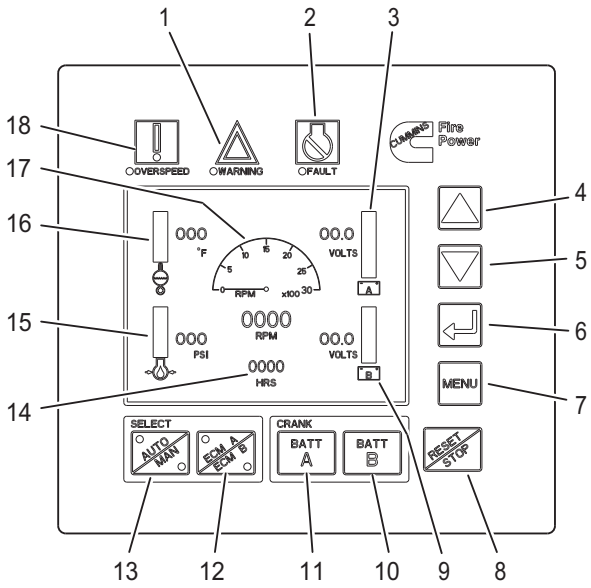
4.1.6 Overspeed RESET/STOP Switch

Used to shut off the engine at the engine digital control panel. Momentarily pressing the switch removes key switch for 30 seconds.

Pressing the overspeed RESET switch after correcting an engine overspeed shutdown resets the overspeed control module, allowing subsequent restarts of the fire pump engine.

4.1.7 Battery A and B Voltmeters

The battery voltmeters display the charge status (VDC) of the relative battery connections.



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1. Warning Lamp
2. Fault Lamp
3. Battery “A” Voltmeter
4. Scroll UP Button
5. Scroll DOWN Button
6. ENTER Button
7. MENU Button
8. Overspeed RESET/STOP Switch
9. Battery “B” Voltmeter
10. Crank Battery B Momentary Start Button
11. Crank Battery A Momentary Start Button
12. ECM A/B Selector Switch & Indicator Lamps
13. AUTO/MAN Mode Switch & Indicator Lamps
14. Hour Meter
15. Engine Oil Pressure
16. Coolant Temperature
17. Tachometer
18. Overspeed Warning Lamp

Figure 4-1 Engine Digital Control Panel (EDCP)

4.1.8 Tachometer and Hour Meter

The tachometer displays the engine speed in Revolutions Per Minute (RPM) whenever the engine is operating. The hour meter maintains a running total of the hours of operation (run time).

4.1.9 ECM A/B Indicator Lamps - Applicable on Electronic Engines

The ECM indicator lamps (yellow) will illuminate, indicating the ECM is being used to control the engine. If ECM A (normal position) is selected, ECM A is controlling the engine. Refer to Figure 4-1.

If ECM B (alternate position) is selected, ECM B is controlling the engine, and the EDCP will send a ground signal to terminal buss #301, which will send a signal to set off an alarm on the fire pump system controller to indicate that the engine is operating on the alternate ECM.

4.1.10 Crank Battery A or B Buttons

The CRANK BATT A or CRANK BATT B buttons initiate an immediate engine start (momentary start) using the selected A or B crank battery.

Crank A or B will energize battery contactor A or B, depending on which one is selected.

Both A and B buttons can be energized at the same time in the event both batteries are weak.

4.1.11 AUTO/MANUAL Mode

The AUTO/MANUAL mode determines whether the engine starts and is controlled by the operator (MANUAL) or by an automatic signal from the fire pump system controller (AUTO). The lamp (yellow) is illuminated on which mode is selected.

The MANUAL mode is typically used for engine setup, testing, and emergency and maintenance procedures.

The AUTO mode is used to start the engine under the control of the fire pump control system. In the AUTO mode, the fire pump engine stops upon loss of signal power from the fire pump controller.

4.1.12 Coolant Temperature Gauge

The coolant temperature gauge displays the engine coolant temperature.

4.1.13 Engine Oil Pressure Gauge

The engine oil pressure gauge displays the engine oil pressure. The gauge is independent of the low oil pressure alarm.

4.1.14 Engine Overspeed Warning Lamp

The overspeed control module monitors engine speed. If the engine RPM's exceed 115% rated speed, the engine overspeed warning lamp is illuminated (yellow).

The Engine Digital Control Panel (EDCP) will send a power signal to terminal buss #3, which will send a signal to set off an alarm on the fire pump system controller, indicating that an overspeed condition has occurred.

The EDCP will automatically switch to Manual mode and will shut the engine down. After the overspeed has been reset by using the RESET/STOP switch on the EDCP, the engine operation will revert to the original AUTO mode position.

NOTE: *The engine will not be allowed to restart automatically from the fire pump system controller until the EDCP is reset.*

4.1.15 ECM Fault Code Lamps

The amber engine warning lamp and the red engine shutdown lamp alert the operator of an engine malfunction that is categorized as follows:

1. An illuminated amber lamp indicates an engine malfunction that requires timely operator attention.

2. An illuminated red lamp indicates an engine malfunction that requires immediate and decisive operator response.

3. A 3-4 digit diagnostic fault code will display on the EDCP, which can then be used to help describe the engine malfunction. Refer to the CFP23E Fault Code Chart in Section 7.

4.1.16 Engine Stop Button

The engine stop button is located on the left side of the EDCP enclosure and is used to stop the operation of the engine in either manual or auto mode. The button must be pressed and held until the engine has stopped.

4.1.17 Engine Communications Port

This plug-in is located on the left side of the EDCP enclosure and is used for the communications connection port for Cummins Insite.

NOTE: *Insite is a Cummins Inc. computer software tool used to monitor or report engine performance criteria.*

4.1.18 Contractor Access Port

The contractor access knock-out is located on the lower side of the EDCP enclosure. This is the only 25.4 cm (1 in) knock-out provided for the installing contractor to connect the fire pump system controller to the EDCP.

IMPORTANT: *If this port is not used for the installation, all warranty on the fire pump engine will be void.*

4.1.19 Engine ECM Power Supply

This plug-in is located on the lower side of the EDCP enclosure. The power supply port supplies unswitched battery power to both ECM A and ECM B.

4.1.20 Engine Harness Connection

This plug-in is located on the lower side of the EDCP enclosure. The engine harness connection connects the panel to the power source, start contactors, magnetic pick-up, alternator, and other engine related functions controlled by the EDCP.

4.2 Electronic Control Module (ECM)

The engine control system is an electronically operated fuel control system. The ECM performs diagnostic tests on most of its circuits and will activate a fault code if a problem is detected.

4.3 Engine Protection System - Applicable on Electronic Engines

The engine ECM identifies any 3-4 digit engine fault codes and illuminates the appropriate amber warning lamp or red shutdown lamp on the operator engine digital control panel. Refer to the CFP23E Fault Code Chart in Section 7 for additional information.

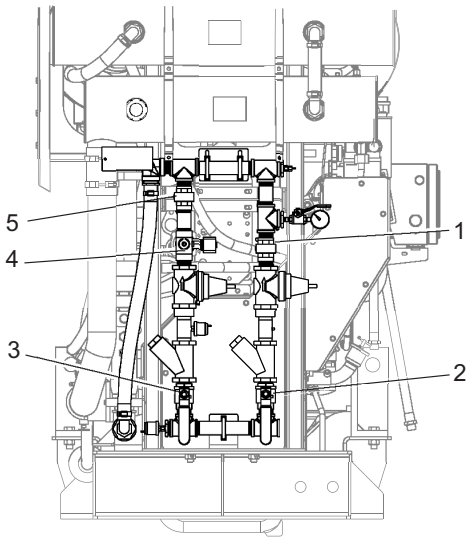
CAUTION

Normally, Cummins engines with ECMs have derate and shutdown protection calibrated into the ECM. However, the ECM on this Cummins engine has no derate or shutdown protection. The engine will run to destruction. Therefore, preventive maintenance is essential.

4.4 Cooling Water Flow Control Valves

1. The fire pump system controller opens the cooling water normal loop solenoid valve in either manual or automatic mode. In the OPEN position, water can flow through the heat exchangers. Refer to Figure 4-2. Manual cooling water valves for the automatic loop should remain OPEN at ALL times.

2. Manual cooling water valves for the bypass loop should be CLOSED during automatic (fire pump system controller) operation.



1. Bypass Water Check Valve
2. Bypass Water Inlet Valve (shown open)
3. Normal Water Inlet Valve (shown open)
4. Normal Water Solenoid Valve
5. Normal Water Check Valve

Figure 4-2 Cooling Water Flow Control Valves (typical)

Section 5 - Operation

5.1 Start-up Procedures

This section provides the operator with the information required to prepare the fire pump engine for normal operation, in a safe manner. This Operator's Manual is provided for your specific equipment and should be considered a part of that equipment. All personnel responsible for the operation and maintenance of the equipment should read and thoroughly understand this manual.

WARNING

Before preparing the equipment for normal production, complete all safety checks, remove all tools and foreign objects from the equipment, ensure all guards are in place and securely fastened, and alert area personnel that the equipment will be starting.

5.2 Remote Starting Procedure

To start the engine from the fire pump controller panel:

1. Press the AUTO/MANUAL mode switch on the engine digital control panel to place the engine in the AUTO mode position. Refer to Figure 4-1.
2. Start the engine by initiating an engine crank signal from the fire pump controller.

CAUTION

If the crank termination signal is absent, the engine starter motor will continue to operate. Shut the engine off immediately at the fire pump controller panel to avoid damage to the starter.

3. The engine continues to operate as long as the RUN signal is present. When the RUN signal is terminated by the fire pump control panel, the engine stops.
4. The engine may be stopped locally by pressing the engine stop button on the side of the engine digital control panel.

5.3 Local Starting Procedure

To start the engine locally from the engine digital control panel:

1. Press the AUTO/MANUAL mode switch on the engine digital control panel to the MANUAL mode position to place the engine in manual mode.
2. Press either the CRANK BATT A or CRANK BATT B button to start the engine.

5.4 Emergency Starting Procedure

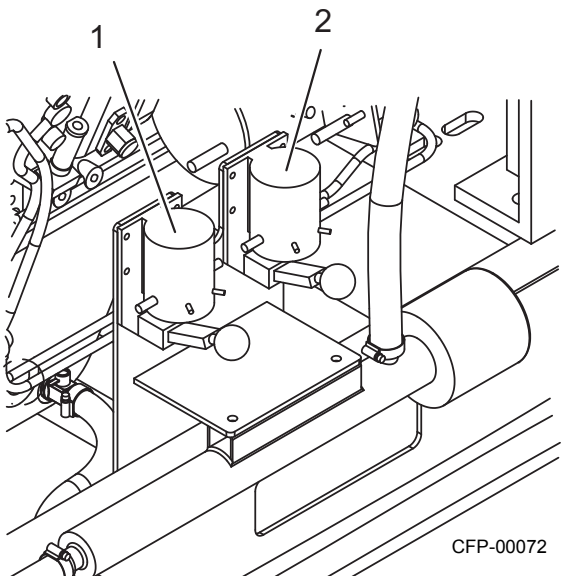
The engine starts automatically in the event of a fire emergency. However, if it fails to start automatically, the engine can be started locally from the engine digital control panel:

1. If necessary, open both manual bypass valves in the cooling water supply manifold (if equipped). Refer to Figure 4-2.
2. Press the AUTO/MANUAL mode switch on the engine digital control panel to MANUAL mode position to place the engine in manual mode. Refer to Figure 4-1.
3. Press downward on the desired battery contactor lever for up to 15 seconds or until the engine starts. Repeat up to three times if necessary. Refer to Figure 5-1.
4. Release the contactor lever immediately after the engine starts.

CAUTION

To prevent damage to the starter, do not engage the starting motor more than 15 seconds. Wait 15 seconds between each attempt to start, up to six attempts.

5. The engine may be stopped locally by pressing and holding the stop button on the left hand side of the engine digital control panel enclosure.



1. Battery A Starter Contactor
2. Battery B Starter Contactor

Figure 5-1 Manual Starter Contactors (Typical)

5.5 Engine Digital Control Panel Screens and Adjustments

The following menu screens are available for operator input and monitoring of engine parameters on the engine digital control panel menu screens.

5.5.1 Main Menu

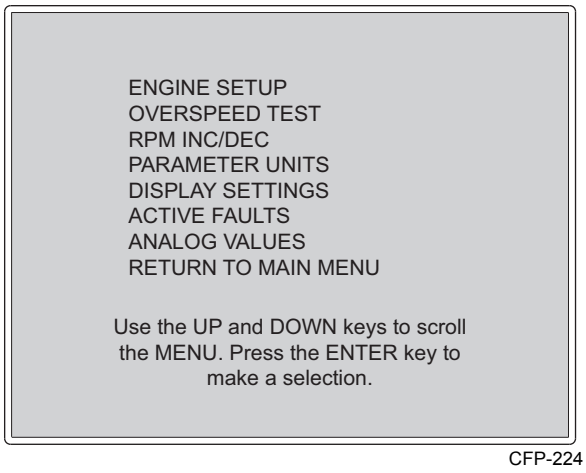


Figure 5-2 Main Menu Screen

This screen is the main menu screen for all functions.

5.5.2 Engine Set-up Screen

This screen is for Cummins Fire Power internal use.

5.5.3 Overspeed Test Screen

The engine overspeed set point was set during manufacturing and test procedures. It may, however, be necessary to adjust the overspeed set point based on the actual fire pump application.

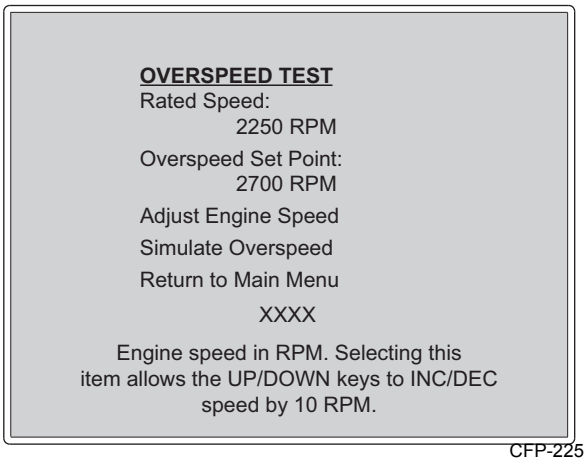


Figure 5-3 Overspeed Test Screen (Example)

The overspeed test screen will allow for two options to demonstrate overspeed:

1. Increment the engine speed up to reach the overspeed set point for the specific engine model. Example above identifies 2250 RPM.
2. Used to simulate overspeed for engine speed models above 2250 RPM or for instances when over-pressurizing of sprinkler systems can cause damage.

NOTE: *If Option 1 is selected, the engine speed will have to be manually reset back to pump rated speed after the overspeed test is completed. Use the RESET/STOP switch to reset the engine back to the original values.*

5.5.4 RPM INC/DEC Screen

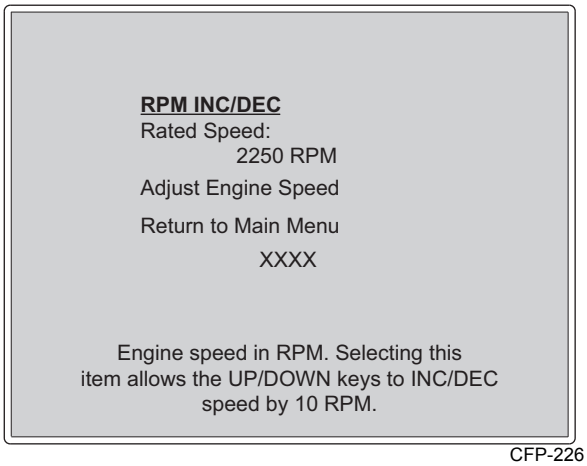


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Figure 5-4 RPM INC/DEC Screen (Typical)

This screen allows the operator to make on-site adjustments by incrementing or decrementing the engine operating speed of electronic engines. The engine operating speed was factory set during manufacturing and test procedures.

If the speed does not match the engine RPM shown on the factory setting plate, scribe the actual RPM on the field setting plate.

5.5.5 Parameter Units Screen

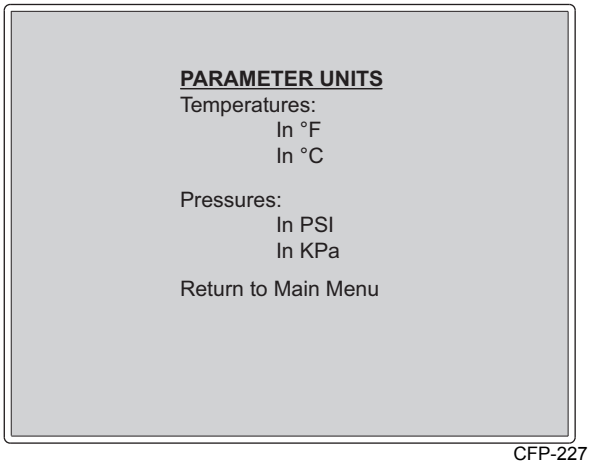

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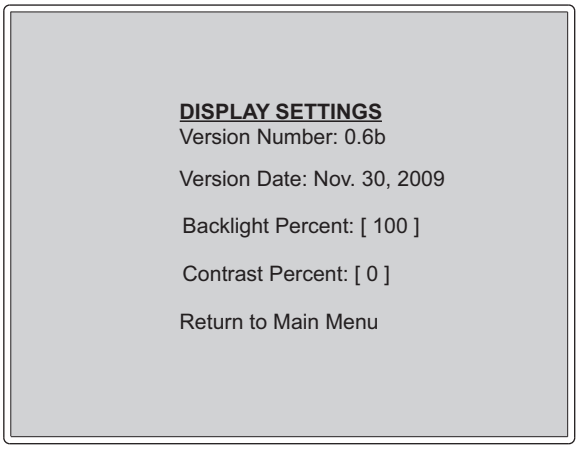
Figure 5-5 Parameter Units Screen (Typical)

This screen will allow the operator to select Imperial or Metric units.

5.5.6 Display Settings Screen

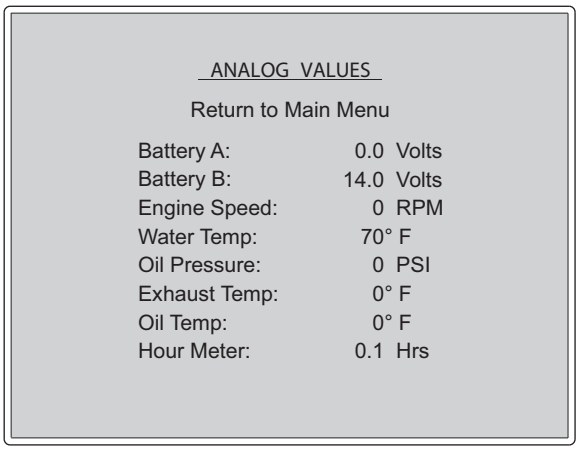


CFP-228

Figure 5-6 Display Settings Screen (Typical)

This screen will enable adjustments to the backlight and contrast for optimal viewing in varying lighting environments. The version number of the EDCP software will be indicated on this screen.

5.5.7 Analog Values Screen



CFP-00012

Figure 5-7 Analog Values Screen (Typical)

This screen will provide analog output values for battery voltages, engine speed, water temperature, oil pressure and temperature, exhaust temperature, differential oil pressure, and hours of operation.

NOTE: *Metric or Imperial values can be changed using the Parametric Units screen.*

NOTE: *For exhaust temperature values less than 93° C (200° F), or not monitored, the value will be displayed as 0°. For oil temperature values less than 24° C (75° F), or not monitored, the value will be displayed as 0°.*

5.6 Active Fault Codes - Applicable on Electronic Engines

The Electronic Control Module (ECM) can display and record operation irregularities, which are displayed as fault codes on the engine digital control panel.

5.7 Field Acceptance Testing

The required tests are outlined in the NFPA 20 and NFPA 25 Standards and shall be performed to validate automatic and manual operational requirements for field acceptance testing.

Section 6 - Maintenance

6.1 Introduction

Before performing maintenance procedures, read and understand the Safety Section of this manual. Improper performance or lack of critical information could result in personal injury or equipment damage.

Cummins encourages our customers to perform maintenance and repairs whenever necessary. However, servicing complex components within the normal warranty period may void the Cummins warranty and any specified warranty extended by the manufacturer of OEM products.

Cummins recommends that the engine be maintained according to the maintenance schedule in this section.

Maintenance procedures should be performed by skilled technicians, who are familiar with the equipment, local regulations, and service procedures for fire pump engine and pump systems. Improper maintenance can damage the engine or the fire pump, or cause severe personal injury.

IMPORTANT: *If your engine is equipped with a component or accessory not manufactured by Cummins Inc, refer to the component manufacturer's vendor supplied literature for specific maintenance recommendations.*

6.2 Engine Operation Report

The engine must be maintained in top mechanical condition. The maintenance department needs daily running reports from the operator to make necessary adjustments.

The weekly running report also helps to make provisions for more extensive maintenance, as the reports indicate the necessity.

Report to the maintenance department any of the following conditions:

1. Low engine oil pressure.
2. Engine surge.
3. Erratic operation or frequent shutdowns.
4. Any warning lamps flashing or staying illuminated.
5. Abnormal coolant or oil temperature.
6. Unusual engine noise or vibration.
7. Excessive smoke.
8. Excessive use of coolant, fuel, or engine oil.
9. Any fluid leaks.
10. Loose, worn, or damaged parts.

Maintenance Chart

NOTE: *All maintenance and inspections intervals are accumulative. When performing annual maintenance, also perform maintenance listed under daily, weekly, monthly, and 3 month intervals.*

Maintenance Record Form

Engine Serial Number:			Engine Model:		
Owner's Name:			Equipment Name/Number:		
Date	**Hours or Time Interval**	**Actual Hours**	**Check Performance**	**Performed By**	**Comments**

6.3 Weekly Maintenance

When the engine is running, be alert for mechanical problems that could create unsafe or hazardous conditions.

6.3.1 General Walk Around Inspection

The following areas should be inspected weekly to maintain safe and reliable operation.

1. Check fluid levels before starting the engine. Check oil pressure and coolant temperatures frequently. Most engine problems give an early warning.

   a. Look and listen for changes in engine performance, sound, or appearance that will indicate that service or repair is needed. Be alert for misfires, vibration, excessive exhaust smoke, loss of power, or increases in oil or fuel consumption.

   b. Check the engine appearance for excessive heat, wiring short circuits, excessive endplay, vibrations, excessive wear, excessive abrasion, damaged electrical wiring or loose electrical wiring.

   c. Check the engine for odors of diesel fuel, burning rubber, electrical system failure, exhaust fumes, or smoke.

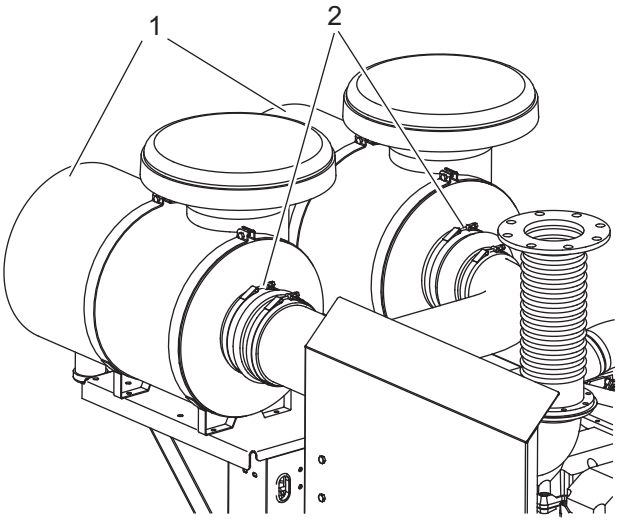
6.3.2 Air Cleaner Filter and Piping

The frequency of cleaning or replacing the air cleaner filter element is determined by the conditions in which the engine operates.

1. Visually inspect the air intake filter and piping daily for blockage, damage to piping, loose clamps, or punctures that can allow debris to enter the engine. If there is a blockage, the service indicator will be activated. Refer to Figure 2-1.

NOTE: *Turbocharged engines must be operated at rated RPM and full load to check maximum intake air restriction.*

Cummins recommends using an air cleaner element as listed on the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies



CFP-00062

1. Air Filter Element (2)
2. Air Filter Service Indicator (2)

Figure 6-1 Air Filter Assembly

CAUTION

Never operate the engine without an air cleaner. Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear. Dirt or foreign objects could cause engine damage.

2. The air cleaner filter service indicator is actuated when excessive air restriction has occurred at the air cleaner.

   a. If the red indicator flag is at the raised position in the window, clean or replace the air filter per the manufacturer's recommendation as required. Do not remove the felt washer from the indicator. The felt washer absorbs moisture.

   b. After the air cleaner has been serviced, push the flag in to reset the service indicator.

IMPORTANT: Maximum intake air restriction is 762 mm H_2O (25.0 in H_2O) for turbocharged engines.

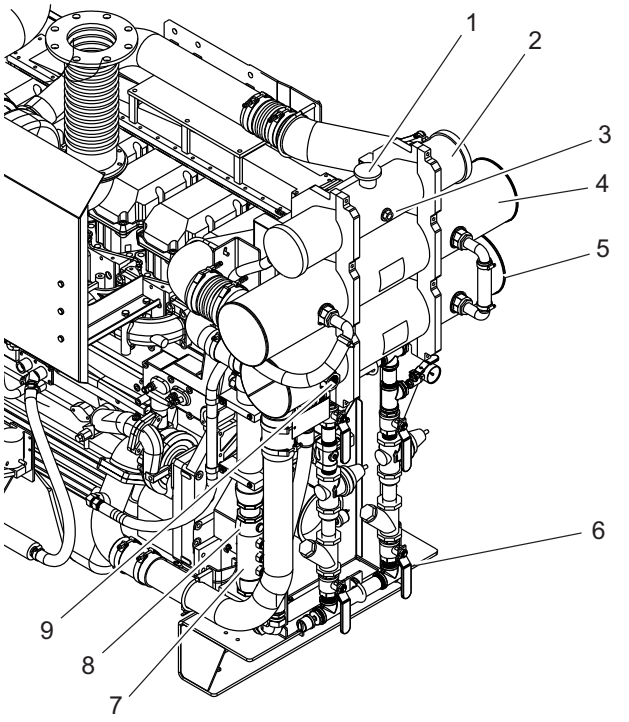
3. Check for corrosion under the clamps and hoses of the intake system piping. Corrosion can allow corrosive products and dirt to enter the intake system. Disassemble and clean as required.

4. Replace damaged air filter or hoses, and tighten loose clamps, as necessary, to prevent the air system from leaking. Torque hose clamps to the recommended torque value. Refer to the Torque Table in Section 8.

6.3.3 Cooling System

CAUTION

Do not remove a coolant pressure/fill cap from a hot engine. Shut down the engine and wait until the coolant temperature is below 50° C (120° F) before removing the pressure cap. Heated coolant spray or steam can cause severe personal injury.



1. Coolant Expansion Tank
2. Expansion Tank Level Sight Gauge
3. Coolant Pressure/Fill Cap
4. Charge Air Cooler (CAC) Heat Exchanger
5. Coolant Heat Exchanger
6. Cooling Water Inlet
7. Fuel Cooler
8. Sacrificial Anode (optional)
9. Cooling Water Discharge

Figure 6-2 Heat Exchanger Tanks

1. Inspect the cooling water piping, coolant heat exchanger tanks, charge air cooling system, engine coolant hoses and hose clamps for loose fittings, leaks, holes, damage, and corrosion.

   a. Tighten the hose clamps as necessary.

   b. Check for cracks, holes, or other damage. Repair or replace as necessary.

CAUTION

Never use a sealing additive to stop leaks in the cooling system. This can result in cooling system plugging and inadequate coolant flow, causing the engine to overheat.

2. With the coolant expansion tank at ambient temperature, press down, unscrew, and remove the pressure cap. Refer to Figure 6-2.

   a. Ensure that the coolant level is visible at the center of the coolant level sight gauge.

   b. Add coolant as required. DO NOT OVERFILL!

NOTE: *Supplemental engine coolant should be a mixture of 50% ethylene glycol antifreeze and 50% water to avoid engine damage. Refer to antifreeze information in Section 6.5.2 Drain and Flush Cooling System.*

3. Check the antifreeze concentration at least 6 times a year or whenever coolant is added to the cooling system by using a refractometer (such as Fleetguard Part Number CC2806).

4. Drain a small amount of coolant from the return line petcock and inspect the coolant for excessive rust or particulate matter. Change the coolant more frequently if particles are present.

CAUTION

Do not mix coolant brands or chemical solutions, as this could damage the cooling system. Keep a record of the coolant concentration and manufacturer with the engine maintenance records.

5. Check for soft, overly pliant hoses, oxidation, and loose hose clamps. Torque hose clamps to the recommended torque value. Refer to the

Torque Table in Section 8. Replace damaged hoses and clamps as required.

6. Check the coolant/fuel heat exchanger for leaks, damage, and dirt buildup. Clean and repair as required.

6.3.4 Engine Oil System

WARNING

Perform the specific checks in this section only after the engine is fully stopped. Unless tests require engine operation, disconnect the battery leads from the batteries (negative terminal first). Contact with exposed or moving components can cause severe personal injury.

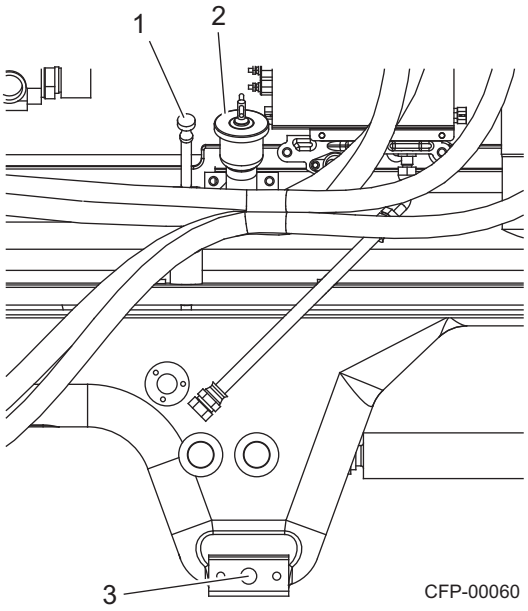
1. For accurate dipstick readings, shut off the engine and wait approximately 10 minutes to allow the oil in the upper portions of the engine to drain back into the crankcase.

2. Check the oil level at the engine dipstick. Refer to Figure 6-3.

   a. If the oil level is greater than the high mark (H), drain excess oil and recheck the level.

   b. If the oil level is consistently below normal after a fill, check for leaks, loose or damaged gaskets, or oil in the coolant system. Troubleshoot per Engine Oil Consumption Excessive in Section 7 - Troubleshooting.

   c. If the oil level is below the low mark (L), add the equivalent type oil.



1. Oil Level Dipstick
2. Oil Fill Port
3. Drain Valve

Figure 6-3 Engine Oil Components

NOTE: *Cummins recommends using Premium Blue S.A.E. 15W-40 Multi-viscosity Lubricating Oil or equivalent. Refer to the oil change interval and the procedures in Section 6.4.5 Engine Oil and Oil Filter Change.*

6.3.5 Fuel System Inspections

WARNING

Engine fuel is highly flammable and represents an extreme hazard for fire or explosion when exposed to electrical sparks or open flame. Clean up spilled fuel immediately. Keep sources of electrical spark or open flame away from a fuel source.

1. Shut off the engine.

2. Inspect the fuel supply line, return line, filter, and fittings for cracks or abrasions.

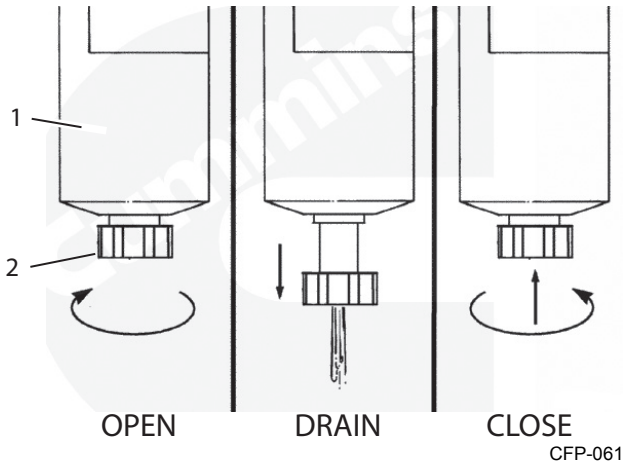
   a. Ensure the lines are not rubbing against anything that could damage the fuel system hoses. Repair any leaks or alter line routing to eliminate wear immediately.

   b. Relieve fuel line pressure by carefully loosening the fuel supply line.

3. Drain each fuel filter/water separator. Refer to Figure 6-4

NOTE: *A water separator must be integrated into the fuel delivery system of the fire pump engine. A fuel filter/water separator may be installed directly in the fuel delivery system near the fire pump engine assembly.*

a. Open the drain valve: Turn th evalve counter-clockwise approximately 3-1/2 turns until the valve drops down 25.4 mm (1 in.) and drain-ing occurs. Drain th efuel filter/water sepa-raator until clear fuel is visible. Refer to



1. Fuel Filter/Water Separator Canister
2. Drain Valve

Figure 6-4 Engine Fuel Filter/Water Separator

NOTE: *Refer to the model specific Engine Data Sheet in Section 8 - Component Parts and Assem-blies for recommended replacement components.*

6.3.6 Engine Exhaust System

With the engine operating, inspect the entire exhaust system, including the exhaust manifold, exhaust flex pipe, muffler, and piping.

Check for leaks at all connections, welds, gaskets, and joints. Make sure that the exhaust pipes are not heating surrounding areas excessively. Repair any leaks immediately.

6.3.7 Electrical Supply and Controls

Check the terminals on the starting batteries for clean and tight connections. Inspect EDCP harness con-nections to be sure they are secure.

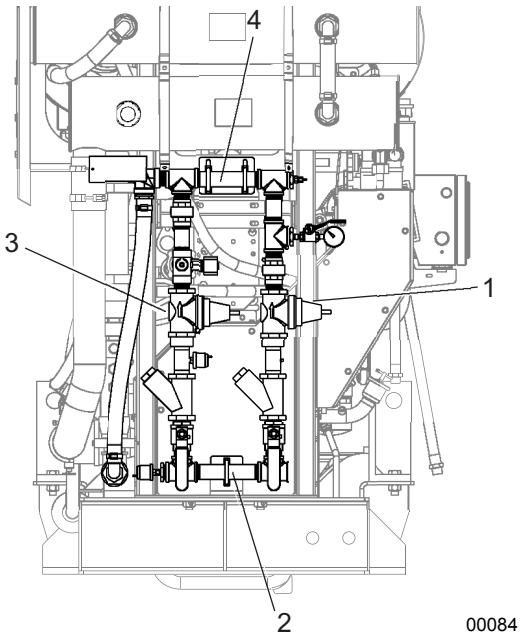
6.3.8 Crankcase Ventilation Hose

1. Inspect the crankcase ventilation hose for wear, damage, sludge, blockage, or dirt buildup. Refer to Figure 6-7.

2. Clean the ventilation hose if obstructed or blocked. Replace worn or damaged hose as required.

6.3.9 Clean Cooling Water Strainers

The (2) cooling water strainers should be cleaned weekly to remove sediment. Refer to Figure 6-5.



1. Bypass Pressure Regulator/Strainer
2. Bypass Cooling Water Line
3. Normal Pressure Regulator/Strainer
4. Normal Cooling Water Line

Figure 6-5 Cooling Water Strainers

To clean the bypass line strainer, ensure that the bypass line valves are closed and the normal line valves are open.

1. For each cooling water strainer, remove the plug.

2. Inspect and remove any debris.

3. Install the strainer plugs.

4. When finished, open the normal line valves and close the bypass line valves for normal opera-tion.

6.3.10 Check Battery Condition

CAUTION

Batteries can emit explosive gases during charging. To reduce the possibility of personal injury, always ventilate the battery compartment before servicing the batteries.

CAUTION

To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

1. Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive.

2. Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. A fully charged battery will have a specific gravity of 1.260. Charge the battery if the specific gravity reading is below 1.215.

3. Check battery wiring and cable connections for loose, corroded, worn, or damaged cables. Include both connectors at the alternator, battery connections, and engine grounding lug (near starter motor). See Figure 3-4.

   a. If the battery cables are corroded, remove the battery cable clamps, starting with the negative (-) battery cable.

   b. Use fine emery cloth or a wire brush to clean the cable clamps and battery cables. The metal should be shiny.

   c. Wash the battery terminals with a solution of baking soda and water - 2 oz (1/4 cup) baking soda to .94 liter (1 qt) of water.

   d. Be careful to prevent the solution from entering the battery cells, and flush the batteries with clean water when done.

   e. After cleaning the connections, coat the terminals with a light application of petroleum jelly.

   f. Reinstall and tighten the cable clamps.

WARNING

Battery electrolyte (sulfuric acid) is highly caustic and can burn clothing, the skin, or cause blindness. Wear protective clothing, impervious neoprene gloves, safety goggles, or full-face shield when working with the batteries.

4. Check the electrolyte level in the batteries monthly. If low, fill the battery cells to the bottom of the filler neck with distilled water.

5. Check for continuity between terminals using a digital multimeter or other test equipment. Also check the insulation resistance to ground. Correct any electrical faults.

6.3.11 Engine Test Run

1. Start the engine at least once a week for a minimum of 30 minutes with as much load as possible. Periods of no-load operation should be held to a minimum, because unburned fuel tends to accumulate in the exhaust system.
2. Refer to the instructions in Section 5 - Operation.
3. Check that the engine starts and operates at the recommended fire pump speed specification.
4. Engine oil pressure must be indicated on the gauge within 15 seconds after starting.
5. Run the engine no less than 30 minutes to attain normal running temperature. Observe that the engine is operating at proper operating speed.
6. Check unusual engine noise. Listen for any unusual engine noise which can indicate that service is required.
7. Ensure oil pressure is greater than 69 kPa (10 psi).
8. Check that the coolant temperature is between 70° C (158° F) and 107° C (225° F).
9. Check that both battery voltmeters indicate 24 VDC.
10. Check that the air filter service indicator has not popped-up; indicating an air filter blockage. Replace the air filter as required.
11. End test run by pressing and holding the overspeed RESET/STOP switch until the engine stops.

6.3.12 Engine Coolant Heater

NOTE: *Perform this inspection procedure 24 hours after shutting off the engine.*

The engine coolant heater must maintain an engine coolant temperature of 49° C (120° F) or above. The engine block must be warm to the touch in the water jacket areas. Refer to Figure 2-2.

If the heater does not appear to be working correctly, contact a Cummins Authorized Repair Location.

6.4 Annual Maintenance

All checks or inspections listed under previous maintenance intervals must also be performed at this time, in addition to those listed under this maintenance interval.

6.4.1 Electrical Components

CAUTION

AVOID SERVICING complex components such as: printed circuit boards, programmable controllers, and ECM's not specifically authorized by Cummins Inc. Contact a Cummins Authorized Repair Location before performing any extensive maintenance.

CAUTION

To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

1. Remove the battery terminal cables, starting with the negative (-) cable first.

2. Inspect the electrical wiring harness, terminal panels, and electrical plug-ins for secure, clean electrical contacts, worn or damaged insulation, burnt wires, broken wires, and loose connections.

   a. Clean and tighten any loose electrical connections.

   b. Replace worn, damaged, burnt, or poorly insulated wiring immediately.

IMPORTANT: *Refer to the vendor supplied literature for recommended maintenance procedures.*

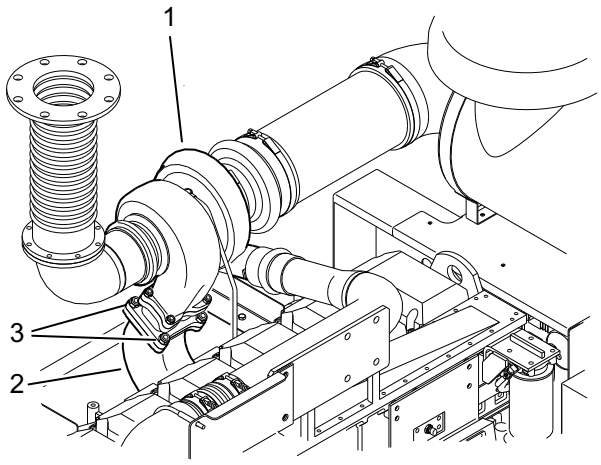
   c. Repair or replace damaged components. Refer to Section 8 - Component Parts and Assemblies.

3. Inspect the function of all gauges, voltmeters, switches, and warning lamps on the engine digital control panel. Replace the EDCP if any are not functioning properly.

6.4.2 Turbocharger Mounting Nuts

1. Check the turbocharger mounting nuts. Refer to Figure 6-6.

2. Torque the mounting nuts to the recommended torque value. Refer to the Torque Table in Section 8.



1. Turbocharger
2. Exhaust Manifold
3. Turbocharger Mounting Nuts (4)

Figure 6-6 Turbocharger

6.4.3 Engine Mounting Bolts

CAUTION

Loose engine mounting bolts or damaged brackets can cause engine misalignment or excessive vibration. These conditions can cause engine or pump damage.

1. Inspect all engine supports for cracks or loose bolts. Refer to Figure 2-1 for location of engine supports.

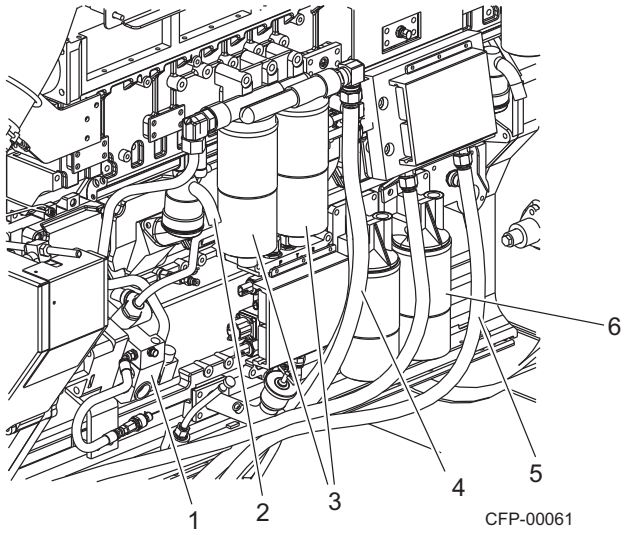
2. Check the torque on the engine support mounting bolts. Torque the engine mounting cap screws to the support bracket. Refer to the

Torque Table in Section 8 for recommended torque values.

6.4.4 Inspect Fuel Pump and Filters

1. Inspect the fuel injection pump mounting nuts, including the support bracket, for loose or damaged hardware. Refer to Figure 6-7.

2. Inspect the fuel line hoses and fuel filters for wear, damage, loose fittings, and leaks. Repair or replace damaged hoses and filters as required.



1. Fuel Return Connection
2. Crankcase Ventilation Hose
3. Fuel Supply Connection
4. Fuel Filter/Separators
5. Fuel Pump
6. Oil Filter (2)

Figure 6-7 Fuel Pump, Filters, Lines and Hoses

6.4.5 Engine Oil and Oil Filter Change

Engine oil becomes contaminated and essential oil additives are depleted with use. The amount of contamination is related to the total amount of fuel and oil consumed. Change the oil at least once annually.

NOTE: *For composite oil pans, always use a new sealing washer on the oil drain plug. Hold the external locking nut in place while tightening the oil drain plug.*

WARNING

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin. Some state and federal agencies have determined that used engine oil can be carcinogenic. Prolonged, repeated contact can cause skin disorders or other bodily injury. Wash thoroughly after contact. Avoid inhalation of vapors and ingestion of used engine oil. Dispose of the oil in accordance with local environmental regulations.

1. Change the oil and the oil filter to remove the contaminants suspended in the oil.

IMPORTANT: *If the engine oil is drained from the oil pan to make an engine repair, new oil must be used.*

NOTE: *Cummins does not recommend exceeding 600 hours on oil change intervals.*

2. Operate the engine until the coolant temperature reaches 70° C (158° F). Shut the engine off.

3. Place an appropriate container under the oil pan drain plug. Refer to the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies for oil pan capacity.

4. Remove the oil drain plug and drain the oil immediately to make sure all the oil and suspended contaminants are removed from the engine.

5. Remove the oil filters. Refer to Figure 6-7.

   a. Clean the area around the engine oil filter canister.

   b. Use a filter wrench to remove the filter.

   c. Remove and discard the O-ring seal if it has remained attached to the mounting flange. Clean the filter mounting flange with a clean lint-free cloth.

   d. Apply a light film of 15W-40 lubricating oil to the replacement filter gasket before installing the filter.

6. Fill the oil filter with a high-quality 15W-40 multi-viscosity lubricating oil, such as Premium Blue®, or its equivalent.

7. Center the filter ring on the threaded mounting nipple. Screw the filter canister onto the mounting flange until the gasket is snug against the

mounting flange, then tighten an additional 1/4 turn.

CAUTION

Mechanical over-tightening can distort the threads or damage the filter element seal.

NOTE: *Cummins recommends using oil filter replacement parts as outlined in the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

8. Check and clean the oil pan drain plug threads and sealing surface. Install the oil pan drain plug. Torque the plug to the recommended torque value per the Engine Manual.

9. Fill the engine to the proper level with clean oil at the fill port. Refer to Figure 6-3.

CAUTION

If no oil pressure is noted within 15 seconds after the engine is started, shut down the engine to reduce the possibility of internal damage.

10. Stop the engine.

11. Wait approximately 15 minutes to let the oil drain from the upper parts of the engine.

12. Check the oil level again. Add oil as necessary to bring the oil level to the H (high) mark on the dipstick.

Refer to the Engine Data Sheet in Section 8 - Component Parts and Assemblies for oil capacity information.

6.4.6 Change Fuel Filter/Separators

WARNING

Engine fuel is highly flammable and represents an extreme hazard for fire or explosion when exposed to electrical sparks or open flame. Clean up spilled fuel immediately. Keep sources of electrical spark or open flame away from a fuel source.

WARNING

Do not open the fuel filter/water separator drain valve or dismantle the fuel lines on the high-pressure fuel system with the engine running. High pressure fuel spray from an operating engine can cause serious personal injury or fire hazard.

1. Shut off the engine.

2. Close any fuel valves (if equipped) to prevent fuel from draining or siphoning.

3. Clean the area around the fuel filter head.

NOTE: *Refer to the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies for filter replacement recommendations.*

4. Remove the spent filter canister using a filter wrench.

5. Clean the filter mounting head surface of sludge buildup and foreign particles. Ensure mating gasket surfaces are clean.

6. Lubricate the gasket seal with clean S.A.E. 15W-40 lubricating oil.

7. Center the filter on the threaded mounting nipple. Screw the filter canister onto the mounting nipple until the gasket is snug against the mounting flange, then tighten an additional 1/4 turn.

CAUTION

Mechanical over-tightening can distort the threads or damage the filter element seal.

8. Open the fuel supply valves (if equipped).

9. Press either the CRANK BATT A or CRANK BATT B button to start the engine to allow the fuel to flow through the system.

10. Depress the contactor switch for up to 15 seconds or until the engine starts. Repeat up to three times, if necessary.

CAUTION

To prevent damage to the starter, do not engage the starting motor more than 15 seconds. Wait 15 seconds between each start attempt.

IMPORTANT: *If the engine does not start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.*

NOTE: *Engines used in fire pumps or standby service are expected to immediately accelerate from crank to full load.*

6.4.7 Output Shaft Lubrication

It is recommended that proper lubrication to drive shafts and output shafts is to be completed on a regular schedule.

1. Remove the output shaft guards.
2. Wipe the grease fittings and grease gun nozzle with a clean cloth to avoid contamination.
3. Add grease to the universal joint grease fittings. Refer to Figure 3-2. Wipe excess grease from the grease fittings.

NOTE: *Cummins recommends using a good quality semi-synthetic, molybdenum-fortified NLGI #2 lithium complex grease which protects from -47° to 204° C (-54° to 400° F).*

6.4.8 Engine Operation Checks

The following service procedures ensure that the engine starts and operates properly under normal conditions.

WARNING

Before equipment operation, ALL guards, covers and protective devices MUST BE in place and securely fastened. Serious personal injury could result from contact with exposed or moving components.

6.4.8.1 Crank Termination Set Point

The speed switch crank termination set point is factory set at 600 RPM and should not be changed from this value.

6.4.8.2 Engine Speed Calibration

If the speed does not match the engine RPM shown on the factory settings plate, refer to section 5.5.4 RPM INC/DEC Screen on the engine digital control panel.

1. Start the engine using the local start method.
2. Observe that the engine starts and accelerates to the speed set point listed on the factory settings plate.
3. Monitor engine speed on the tachometer. Record the observed engine speed.

   If the speed does not ramp up to the setting shown on the factory settings plate, the engine operating speed set point must be calibrated.
4. Depress the up (increase) and down (decrease) arrows on the EDCP display to set the desired speed. Refer to Figure 4-1.
5. Stop the Engine.

NOTE: *Each time the speed INCREASE/DECREASE arrow is depressed, the idle speed is increased or decreased by 10 RPM. Holding the arrows in either the INC or DEC position ramps the engine speed in the selected direction.*

6. Start the engine.
7. Observe that the engine starts and accelerates to the rated speed set point.
8. The engine speed set point calibration is required for both the ECM A and ECM B subsystems.
9. Repeat steps 2 through 6 while the ECM selector switch is set to ECM B.

IMPORTANT: *Never switch from ECM A to ECM B while the engine is running.*

IMPORTANT: *The final pump speed is typically set while the pump is flowing 150%.*

6.4.9 Coolant Pump/Alternator Belt Inspection

On some engine models, the pump and alternator belt drives both the pump and the alternator.

CAUTION

Belt damage can be caused by, incorrect tension, incorrect size or length, pulley misalignment, incorrect installation, severe operating environment, and oil or grease on the belt or pulley.

1. Place the AUTO/MANUAL mode switch in the MANUAL position.

2. Disconnect both batteries at their terminals Remove negative (-) cable first. Install the negative (-) cable last.

3. Remove the belt guard bolts and the belt guard. Set aside for re-installation.

4. Visually inspect the belt for frayed, worn, missing pieces, or cracked belt surfaces. Check the belt for intersecting cracks. Refer to Figure 6-8.

NOTE: *Transverse cracks (across the belt width) are acceptable. Longitudinal cracks (direction of belt length) that intersect with transverse cracks are not acceptable. Replace the belt if it is cracked, frayed, or has pieces of material missing.*

5. If the belt condition is acceptable, check the belt tension.

NOTE: *Belts with glazed or shiny surfaces indicates belt slippage. Correctly installed and tensioned belts will show even pulley and belt wear.*

6.4.10 Coolant Pump/Alternator Belt Tension

CAUTION

Disconnect the batteries (negative cable first) before performing service on the fire pump engine or on any of its controls.

1. Check the coolant pump drive belt tension.

2. Use the Cummins belt tension gauge, Part Number 3822524, to measure the drive belt tension.

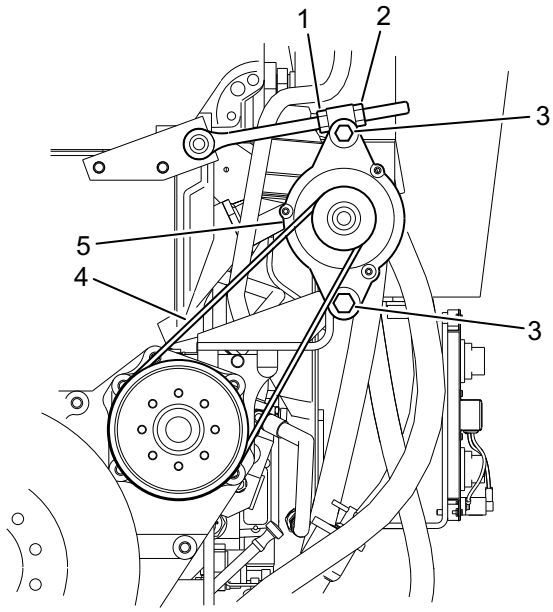
   a. Measure the belt tension in the center span of the belt pulleys.

   b. Belt tension should be set and checked per the Engine Operation Manual.

3. The deflection method can also be used to measure drive belt tension.

   a. Measure the belt tension in the center span of the belt between the alternator and idler pulleys.

   b. If belt deflection is more than one belt thickness per foot of pulley center-to-center distance, adjust the belt tension.



CFP-181

1. Inner Adjusting Hex Nut
2. Outer Locking Hex Nut
3. Alternator Mounting Bolt (2)
4. Alternator Drive Belt
5. Alternator

Figure 6-8 Alternator Drive Belt

6.4.11 Heat Exchanger Pressure Test

This test is required if internal leakage in the heat exchanger is suspected. It may be performed prior to removal from the engine.

NOTE: *Use Teflon™ tape or other pipe sealant when installing the test setup in order to prevent leaks.*

NOTE: *The size of fittings required on the water outlets and inlets are listed on the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

1. Install an adapter at the cooling water outlet of the heat exchanger.

2. Install a pressure test setup with 689 kPa (100 psi) pressure gauge at the cooling water inlet to the heat exchanger.

3. Apply air pressure at 414 kPa (60 psi).

   a. Isolate the pressure source and monitor the pressure gauge for 5 minutes.

   b. There should be no change in pressure for the duration of the test.

4. After testing, release the pressure. Remove the tubing adapters, plug, and test equipment.

5. If leakage is detected, the heat exchanger must be replaced.

6.4.12 Turbocharger Inspection

1. Visually inspect the filter and piping for dirt buildup, blockage, wear points, soft hoses, loose clamps, or punctures.

2. Replace damaged filters, pipes, or hoses, and tighten loose clamps, as necessary, to prevent the air system from leaking.

3. Check that the air filter service indicator has not indicated a filter blockage. Clean or replace blocked filters.

4. Check for corrosion under the clamps and hoses of the intake system piping. Corrosion can allow foreign particles and dirt to enter the intake system.

5. Disassemble and clean, as required.

6. Remove the air intake and exhaust piping from the turbocharger.

7. Inspect the turbocharger turbine wheel for cracks in the housing or turbine blades, missing blades, mechanical binding, eccentric motion, or excessive end-play.

8. Replace the turbocharger if damage, excessive end-play, binding, wear, or eccentric motion is found. Contact a Cummins Authorized Repair Location for replacement.

IMPORTANT: *The turbocharger must be removed for replacement or rebuild if the clearance is beyond the limits, the housing is cracked, or the turbine wheel is damaged.*

9. Reinstall the air intake filter and exhaust piping. Tighten the clamps. Torque loosened clamps to the recommended torque value. Refer to the Torque Table in Section 8 - Component Parts and Assemblies.

6.5 Every 2 Years or 2000 Hours

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time, in addition to those listed under this maintenance interval.

6.5.1 Coolant Pump Inspection

1. Inspect the coolant pump for eccentric motion, mechanical binding, excessive end play, seal damage and grease or coolant leakage around the pump shaft.

2. Replace with a new or rebuilt pre-lubricated unit as necessary. Contact a Cummins Authorized Repair Location for replacement.

6.5.2 Drain and Flush Cooling System

The cooling system must be clean to work properly. If the system shows excessive mineral buildup, particulate matter, scale, oxidation, or oil contamination, drain and flush the cooling system. If the coolant is excessively dirty or is mixed with oil, contact a Cummins Authorized Repair Facility.

WARNING

Do not remove the pressure/fill cap from a hot engine. Shut down the engine and wait until the coolant temperature is below 50° C (120° F) before removing the pressure cap. Heated coolant spray or steam can cause severe personal injury.

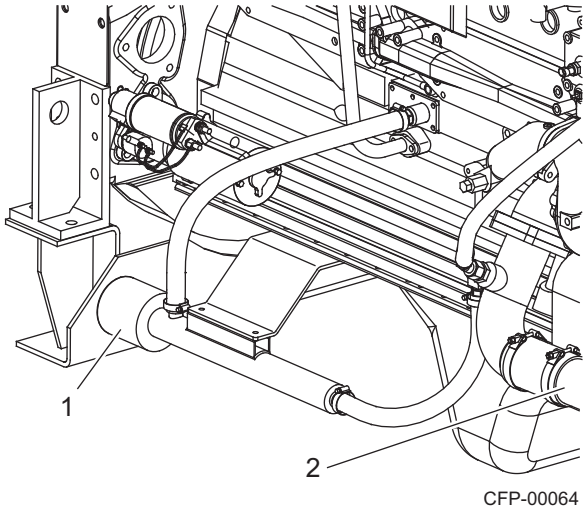
1. Press down, unscrew, and remove the coolant expansion tank pressure/fill cap. The cap must be removed to allow air to vent the cooling system during the draining process.

2. Disconnect the engine coolant heater power supply before draining the cooling system. Refer to Figure 6-9.

3. Place a container that will hold at least 57 liters (15 gal) of liquid under the engine heater coolant hose.

4. Ensure that the coolant filter shut-off valves are OPEN.

5. Open the drain petcock on the lower coolant tube, allowing the coolant to drain into the waste container.



1. Engine Coolant Heater
2. Lower Coolant Tube (petcock not shown-located on bottom)

Figure 6-9 Engine Coolant Drain

NOTE: *Some cooling system cleaners or commercial solvents require a soapy water rinse after use. Follow the directions on the cleaning solution or solvent.*

CAUTION

Over-concentration of antifreeze or use of high silicate antifreeze can damage the engine. Do not use more than 50% antifreeze in the mixture unless additional freeze protection is required. Antifreeze at 68% concentration provides the maximum freeze protection, and must never be exceed under any condition. Antifreeze protection decreases above 68%.

6. When the system is empty, move the container under the engine coolant heater.

7. Disconnect either end of the engine heater coolant hose and drain the engine coolant heater.

8. Flush with clean fresh water or heavy-duty heat exchanger cleaner. Follow the manufacturer's directions on the product container.

CAUTION

Coolant is toxic. Avoid prolonged and repeated skin contact with used antifreeze - wash thoroughly after contact. Prolonged, repeated contact can cause skin disorders. Dispose of waste antifreeze in accordance with local environmental regulations.

NOTE: *During filling, air must be vented from the engine coolant passages. The air vents through the coolant filler port. The fill rate can be found in the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

9. When the flushing water has fully drained, use a filter wrench to remove the water coolant filter from the filter housing.

   a. Clean the filter housing gasket mount of dirt buildup, oxidation, or particulate matter with a clean cloth.

   b. Coat the replacement filter gasket with a light coating of 15W-40 lubrication oil.

10. Center the filter ring on the threaded mounting nipple. Screw the filter canister onto the mounting flange until the gasket is snug against the mounting flange, then tighten and additional 1/4 turn. If using a soapy water solution, flush again with clear water. Allow time for the water to fully drain.

CAUTION

Mechanical over-tightening can distort the threads or damage the filter element seal.

NOTE: *Recommendations on filter replacements and fill rates can be found on the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

11. Reconnect the engine heater coolant hose and close the drain petcock and the lower coolant tube petcock.

12. Fill the coolant tanks with the proper antifreeze. Use a mixture of 50% water and 50% ethylene-glycol base or propylene-glycol antifreeze (or pre-mixed solution) to protect the engine to -37° C (-34° F) year-around.

CAUTION

Use soft or distilled water in the coolant mixture. Contaminants in hard water neutralize the corrosion inhibitor components. Water must not exceed 300-ppm hardness or contain more than 100 ppm of either chloride or sulfate.

NOTE: *Cummins Inc. recommends using Fleetguard® ES COMPLEAT™ Ethylene-Glycol (EG) or Fleetguard® Propylene-Glycol (PG) Plus™ Antifreeze/Coolants. Both products are available in concentrated or pre-mixed formulations. Use a 50% concentration level (40% to 60% range) of ethylene-glycol or propylene-glycol and SCA (Supplemental Coolant Additive) required for wet sleeved engines in most climates. Contact your local Cummins Authorized Repair Location for additional information.*

Ethylene-Glycol	Propylene-Glycol
40% = -23° C (-10° F)	40% = -21° C (-6° F)
50% = -37° C (-34° F)	50% = -33° C (-27° F)
60% = -54° C (-65° F)	60% = -54° C (-65° F)
68% = -71° C (-96° F)	68% = -63° C (-82° F)

CAUTION

The system must be filled properly to prevent air locks. During filling, air must be vented from the engine coolant passages.

13. Check the condition of the pressure/fill cap.
    a. If the pressure/fill cap seal is worn, damaged, missing, or the pressure spring is damaged or shows signs of sticking, replace the fill cap.
    b. Install the expansion tank fill cap.
14. Operate the engine until it reaches a temperature of 82° C (180° F), and check for coolant leaks.
15. Ensure that the coolant level is just below the fill neck.

6.6 Every 4 Years or 5000 Hours

All maintenance checks and inspections listed in previous maintenance intervals must also be performed at this time.

Cummins recommends performing maintenance on valve lash settings.

CAUTION

Valve lash maintenance should be performed by a skilled technician. Improper maintenance can damage the engine or cause severe personal injury. Contact your local Cummins Authorized Repair Location before performing any extensive maintenance.

6.6.1 Coolant Thermostat Removal/Installation

The thermostat regulates the temperature of the engine coolant circulating through the engine cooling system. Refer to the Engine Manual for complete instructions.

CAUTION

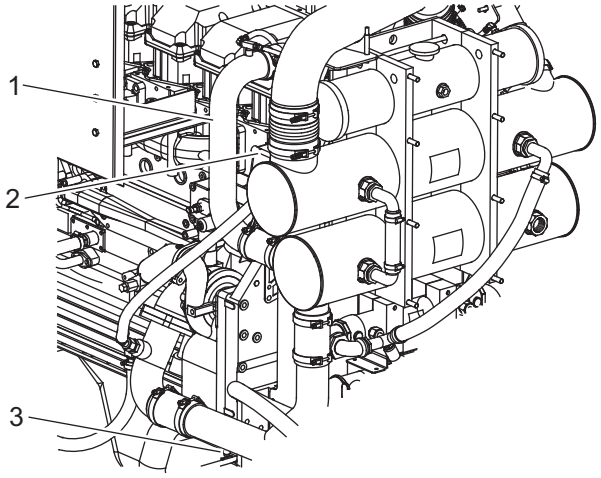
Always use the correct thermostat, and never operate the engine without a thermostat installed. The engine can overheat if operated without a thermostat because the path of least resistance for the coolant is through the bypass to the pump inlet.

1. Remove the upper coolant hose clamps and upper coolant hose from the thermostat housing.
2. Remove the (2) thermostat housing flange cap screws and the thermostat flange. Refer to Figure 6-10.
3. Remove the thermostat and gasket from the housing.
4. Clean the housing flange faces of dirt buildup, oxidation, and sludge.
5. Install the thermostat in the housing.
6. Install a new thermostat seal on the thermostat housing flange surface.
7. Replace the thermostat flange and cap screws.

NOTE: *Recommendations on thermostat replacement components can be found on the model specific Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

CAUTION

Disconnect both batteries (negative cable first) before performing service on the fire pump engine or on any of its controls.



1. Upper Coolant Tube
2. Thermostat Housing
3. Coolant Drain Petcock (located on bottom)

Figure 6-10 Thermostat Housing

6.6.2 Coolant Pump Belt Replacement

Replace the coolant pump belt if it is cracked, frayed, or has pieces of material missing. Refer to Figure 6-8.

1. Remove the belt guard.

2. Use a 3/8” drive ratchet or breaker bar to rotate the tensioner arm away from the belt and remove the belt.

3. Check the belt tensioner cap screw torque. For recommended torque values, refer to the Torque Table in Section 8 - Component Parts and Assemblies.

4. Check the tensioner arm, pulley, and stops for cracks. If any cracks are noticed, the tensioner must be replaced.

5. Verify that the tensioner arm stop is not in contact with the spring casing stop. If either stop is touching, the tensioner must be replaced.

6. Inspect the tensioner for evidence of the tensioner arm contacting the tensioner cap.

   If there is evidence of the two areas making contact, the pivot tube bushing has failed and the tensioner must be replaced.

7. Check the tensioner bearing.

   a. Rotate the tension pulley. The pulley should spin freely with no mechanical binding, eccentric motion, or excessive end-play.

   b. If the arm rotates with mechanical binding, eccentric movement, or excessive end play, replace the tensioner.

8. Inspect the clearance between the tensioner spring case and the tensioner arm for uneven bearing wear.

   If the clearance exceeds 3 mm (0.12 in) at any point, the tensioner must be replaced as a complete assembly. Contact a Cummins Authorized Repair Location for replacement.

NOTE: *Experience has shown that tensioners generally will show a larger clearance gap near the lower portion of the spring case, resulting in the upper portion rubbing against the tensioner arm. Always replace the belt when a tensioner is replaced.*

9. After checking the torque, use a 3/8” drive ratchet or breaker bar to rotate the tensioner slowly away from the area of belt contact.

10. Install the replacement drive belt.

CAUTION

To prevent pulley or belt damage, do not roll a belt over the pulley or pry it on with a tool. Move the tensioner arm away from the belt area before installing the drive belt.

11. Check the location of the drive belt on the belt tensioner pulley. The belt should be centered on, or centered close to, the middle of the pulley.

12. Reinstall the belt guard.

CAUTION

Unaligned belts, either too far forward or backward, can cause belt wear, belt roll-off failures, or increase uneven tensioner bushing wear.

6.6.3 Charge Air Cooler (CAC) Heat Exchanger

The charge air cooler heat exchanger should be removed and cleaned internally at least once every four years.

1. Press the AUTO/MANUAL mode switch to select the MANUAL position.

2. Disconnect both batteries at their terminals. Remove negative (-) cable first. Install the negative (-) cable last.

3. Shut off the manual cooling water and bypass water hand valves on the cooling loop water supply.

4. Open the coolant filter shut-off valve.

5. Drain the coolant system per the instructions in Section 6.5.2 Drain and Flush Cooling System.

6. When the tanks are empty, disconnect the inlet and outlet piping from the charge air cooler tubing to the heat exchanger. Refer to Figure 2-2.

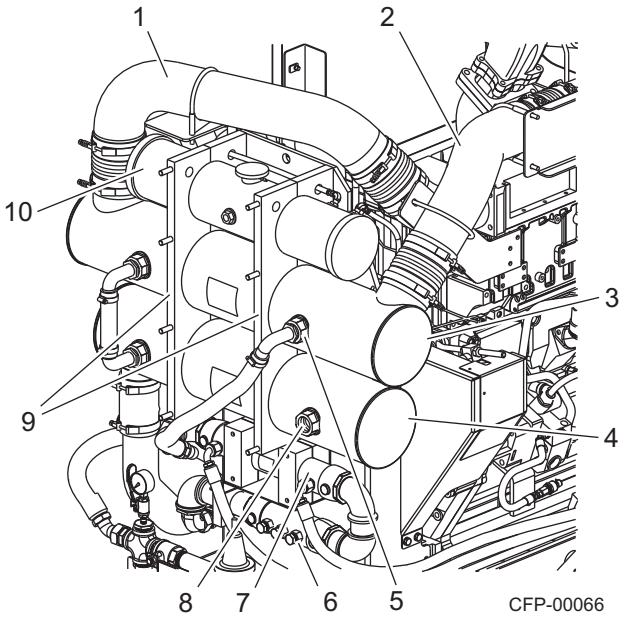
7. Disconnect the cooling water inlet and outlet fittings from the charge air heat exchanger and the coolant heat exchanger.

WARNING

Cleaning chemicals may be caustic and cause skin irritation. Follow the instructions on cleaning containers. Wear protective clothing, eye wear, and rubber gloves when working with cleaning solutions. Dispose of solvents and cleaning solutions properly.

CAUTION

Do not use caustic cleaners to clean the charge air cooler. Damage to the charge ar cooler will result. Follow the directions provided by the cleaning solution manufacturer.



1. Charge Air Tubing to Engine
2. Charge Air Tubing from Turbocharger
3. Charge Air Cooler (CAC) Heat Exchanger
4. Coolant Heat Exchanger
5. Cooling Water Inlet Fitting
6. Zinc Anode Assembly (optional)
7. Fuel Cooler
8. Cooling Water Discharge
9. Charge Air Cooler Mounting Brackets
10. Coolant Expansion Tank

Figure 6-11 Charge Air Cooler (CAC) Heat Exchanger

8. Remove the heat exchanger mounting bracket bolts from the mounting bracket and set aside for later reuse.

9. Provide support for the heat exchanger in order to avoid dropping it. Remove the charge air heat exchanger from the mounting plates.

10. Flush the charge air cooler internally with cleaning solution in the opposite direction of normal air flow.

11. Shake the charge air cooler and lightly tap on the tank ends with a rubber mallet to dislodge trapped debris. Continue flushing until all debris or oil is removed.

CAUTION

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

12. After the charge air cooler has been thoroughly cleaned of all oil and debris with solvent, wash the charge air cooler internally with hot, soapy water to remove the remaining solvent.

13. Rinse thoroughly with clean water.

14. Blow compressed air into the charge air cooler in the opposite direction of normal air flow until the charge air cooler is dry internally.

15. Depending on the condition of the heat exchanger, perform the pressure test outlined in section 6.4.11 Heat Exchanger Pressure Test.

16. Reassemble the coolant heat exchangers, coolant tubing, and water-cooling loop lines per the instructions outlined in section 6.5.2 Drain and Flush Cooling System.

17. Provide support for the coolant heat exchanger in order to avoid dropping it.

18. Position the heat exchanger and clamps on the engine's mounting bracket and hand-tighten the mounting bolts. Refer to Figure 2-1 and Figure 2-2.

19. Align the heat exchanger with the required hose connections and tighten the hose clamp fasteners.

20. Reinstall all water supply and drain fittings. Use Teflon™ pipe tape to prevent leaks. Torque the hose clamp screws to the recommended torque value. Refer to the Torque Table in Section 8.

21. When the charge air heat exchanger hose clamps and cooling water lines are secure, tighten the mounting bracket bolts.

22. Open the cooling loop cooling water supply manual valves and check for leaks.

23. After completing all service work, start the engine and check for air leaks, loose clamps, and blowby.

Section 7 - Troubleshooting

7.1 Troubleshooting

The following information is intended as a guide to troubleshooting some common non-technical equipment problems. Many problems can be resolved using corrective maintenance, adjustment, or minor repair. Refer to the vendor supplied literature, electrical schematics, and mechanical prints for additional information.

For engine related issues, refer to the Operation and Maintenance Manual or contact the Cummins Customer Assistance Center at 1-800-DIESELS (1-800-343-7357).

WARNING

The status checks should be performed ONLY by a qualified technician. Contact with exposed electrical components could cause extreme personal injury or death.

WARNING

Before equipment operation, ALL guards, covers, and protective devices MUST BE in place and securely fastened. Serious personal injury could result from contact with exposed or moving components.

CAUTION

AVOID SERVICING complex components such as: printed circuit boards, programmable controllers, and ECM's not specifically authorized by Cummins Inc. Contact a Cummins Fire Power Customer Service Department toll free at 1-800-343-7357 before performing any extensive maintenance.

CAUTION

Never climb or stand on the equipment frame, guards, or enclosures. Contact with exposed or moving components can cause personal injury or equipment damage.

Table of Contents

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.1 Alternator Overcharging with the Engine Running **NOTE:** *If the batteries are overcharged while the engine is not running, troubleshoot the customer supplied battery charging system.*	Batteries have failed.	Replace the alternator and batteries. Test the battery charger electrically. Replace the battery charger as necessary.
7.1.2 Neither Battery is Charging with the Engine Running **NOTE:** *If one or both batteries do not charge with the engine stopped, troubleshoot the customer supplied battery charging system.*	Battery cables or connections are loose, broken, or corroded (excessive resistance). Alternator not functioning. Battery isolator input has faulted. Alternator internal voltage regulator is malfunctioning.	Check the battery cables and connections. Ensure that all connections are free of corrosion and that no cables are broken. Replace the alternator. Contact a Cummins Authorized Repair Facility. Test continuity from the alternator to the battery isolator input. Repair any open circuit. Test continuity through the battery isolator. If an internal open circuit exists, replace battery isolator. Test the alternator electrically. If required, replace the alternator. Contact a Cummins Authorized Repair Facility.
7.1.3 Only One Battery is Charging with the Engine Running **NOTE:** *If one or both batteries do not charge with the engine stopped, troubleshoot the customer supplied battery charging system.*	Battery has failed. Battery cables or connections are loose, broken, or corroded (excessive resistance). Battery isolator has failed.	Check battery charge. Check the battery cables and connections. Ensure connections are clean and that no cables are broken. Replace the battery isolator as necessary.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.4 Voltage Indications Differ **NOTE:** *Normal differences in battery condition may cause differences in indication. These are normal differences and require no action.*	One battery is discharged or failing.	Check battery condition. Check wiring for corrosion. Ensure good electrical contact. Charge discharged batteries by running the engine or with an external battery charger. If the battery does not charge with the engine running, go to Only One Battery is Charging with the Engine Running. Check for apparent wire damage or shorts to grounds. Replace the failed battery if necessary.
	Open circuit or short to ground in indicator wiring.	Locate and repair the electrical fault.
7.1.5 Coolant Contamination	Coolant is rusty or contaminated.	Drain and flush the cooling system per the instructions in Section 6 - Maintenance. Replace the coolant water filter per the instructions in Section 6 - Maintenance. Refill with correct mixture of antifreeze and water per the instructions in Section 6 - Maintenance. If the problem persists, the cylinder block may be cracked or porous. Contact a Cummins Authorized Repair Facility.
	Coolant heat exchanger is leaking cooling water into the coolant. Coolant volume increases and pressure is relieved when the unit is operating. Antifreeze concentration decreases.	Drain and flush the cooling system per the instructions in 6.5.2 Drain and Flush Cooling System in Section 6. Perform a pressure test of the cooling water side of the heat exchanger. If the heat exchanger leaks, it should be replaced.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.5 Coolant Contamination (continued)		Check and adjust cooling water pressure regulator set points. Check and replace the zinc plug, if required. Refill with correct mixture of anti-freeze and water per the instructions in Section 6 - Maintenance.
7.1.6 Excessive Coolant Loss	Adequate coolant was not added following previous maintenance activities.	Check the coolant level. Add coolant as required and check engine operation. If coolant loss persists, check for other problems.
	Coolant leak is present.	Inspect the engine for coolant leaking from drain cocks or vents. Close the leaking drain or vent. Add coolant as required and check engine operation.
	Cooling system hose is leaking.	Check the condition of the hoses. Replace and/or tighten loose hose clamps. Replace any damaged hoses as necessary. Add coolant as required and check engine operation.
	Pressure cap is malfunctioning or has low-pressure rating.	Check that the pressure cap does not relieve coolant under normal operating conditions. Replace a leaking pressure cap. Add coolant as required and check engine operation.
	Manifold coolant leak.	Inspect the engine for coolant leaking from the manifold, expansion and pipe plugs, fittings, engine oil cooler, water pump seal, cylinder block, and other components that have coolant flow. Repair leaking components. Add coolant as required and check engine operation.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.7 Coolant Temperature Above Normal **NOTE:** *The thermostat's normal operating temperature range is 82°-95° C (180°-203° F). The high water temperature lamp on the engine digital control panel only illuminates if the engine is running. If the lamp is illuminated or if temperature is otherwise excessive, the engine should be stopped as soon as practical and the problem corrected.*	Incorrect cooling water flow.	Measure cooling water flow and adjust per Engine Data Sheet values in Section 8 - Component Parts and Assemblies.
		Check the cooling water piping for blockage. Clean the piping if necessary.
	Cooling water pressure regulator is improperly adjusted. **NOTE:** *Pressure should not exceed 414 kPa (60 psi).*	Check the cooling water pressure gauge. If pressure is inadequate, adjust the regulator.
	Cooling water solenoid has failed. (Applicable to Horizontal Pump installations only)	Replace the solenoid.
	Coolant level is low.	Refill to proper level.
	Cooling system hose is collapsed, restricted, or leaking.	Inspect the hoses. Replace any damaged hoses as necessary.
	Coolant thermostat is malfunctioning.	Remove and replace the defective thermostat.
	Coolant pump is malfunctioning.	Contact a Cummins Authorized Repair Facility.
	Contaminated coolant.	Refer to Coolant Contamination in this section. Contact a Cummins Authorized Repair Facility.
	Engine oil is contaminated with coolant or fuel.	Check the appearance of the engine oil. If the color and texture is abnormal, refer to Engine Oil is Contaminated in this section.
	Coolant mixture of antifreeze and water is not correct.	Verify the concentration of antifreeze in the coolant. Correct the concentration as necessary.
	Coolant temperature switch is malfunctioning.	Repair or replace the switch.
7.1.8 Coolant Temperature Below Normal when Engine is not Running	The standard 120 VAC or optional 240 VAC power supply to the coolant heater is not connected.	Connect the power supply. Correct any electrical faults in the supply circuit.
	The heater's overload thermostat has operated.	Ensure that there is coolant in the heater. Allow time for the automatic overload reset to occur.
	Coolant temperature switch is malfunctioning.	Repair or replace the switch.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.8 Coolant Temperature Below Normal when Engine is not Running (continued)	Coolant is not free to circulate through the heater.	Ensure that the coolant hoses are clear. Repair or replace hoses as necessary.
	The coolant heater has failed.	Replace the coolant heater.
	Coolant thermostat has failed.	Test operation of the thermostat. Replace the thermostat per instructions in Section 6 - Maintenance as necessary.
7.1.9 Cooling Water Drain Steaming **NOTE:** *The cooling water drain from the coolant heat exchanger may steam if cooling water flow is inadequate when the engine is running. It may also steam shortly after the engine is stopped. If coolant is leaking into the cooling water drain piping, the steaming may last for some time while the engine cools. Antifreeze may also be observed in the cooling water drain.*	Cooling water flow did not start when the engine started.	Check engine coolant temperature. Refer to Coolant Temperature Above Normal in this section.
	Engine coolant is leaking into the cooling water piping in the coolant heat exchanger.	Remove the coolant heat exchanger and perform a pressure test. Refer to Section 6 - Maintenance. If pressure is not maintained, replace the heat exchanger.
	Cooling water flow not adequate.	Compare actual flow rate against required flow rate - adjust regulators to required flow.
7.1.10 Cooling Water Solenoid Valve Fails to Operate (Applicable to Horizontal Pump Installations) **NOTE:** *The cooling water solenoid may fail to open or to close. The normally closed valve may fail to open when the engine starts. This fault will prevent cooling water flow through the normal valves. Bypass flow should be aligned in this event. The valve may also fail to close because of mechanical blockage. In this event, the cooling water flow from the heat exchanger does not stop when it should. Depending upon the fire protection system piping, the open solenoid valve may drain all water from the fire protection system piping that is higher than the engine's piping.*	Solenoid valve fails to operate. **NOTE:** *Apply 24 VDC to operating systems.*	Clean the cooling water strainer more frequently. Increase the frequency of operational testing.
		Check electrical continuity and insulation from ground to the solenoid. Repair any open or short circuits in the wiring.
		Apply temporary voltage to the solenoid. If the solenoid fails to operate, replace the solenoid valve. Contact a Cummins Authorized Repair Facility.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.11 Auto Start Failure - Does not Crank on Battery A or B	The electrical connection from the fire protection system controller to the terminal board has failed.	Test continuity and insulation from the ground between the fire protection system controller and the engine digital control panel. Locate and repair any electrical fault in the field wiring or in the fire protection system controller.
	The electrical connection from the terminal board to the solenoid has failed.	Test continuity and insulation from the ground between the terminal board and the solenoid. Locate and repair any electrical fault.
	The fire protection system controller fails to produce either redundant start signal to the fire pump.	Locate and correct the common mode fault in the fire protection system controller.
7.1.12 Auto Start Failure - Cranks but does not Start **NOTE:** *The fire pump engine will crank automatically when either contactor A or contactor B is selected at the fire protection system controller. However, the engine does not start. The engine will start locally. If local starting problems are identified, go to the applicable Manual Start Failure troubleshooting table.*	The overspeed control module has activated. The overspeed lamp is illuminated on the engine digital control panel.	Press the RESET switch on the engine digital control panel.
	Crank termination signal from the Engine Digital Control Panel (EDCP) is not received by the fire protection system controller.	Verify the signal from the fire protection system controller or the field wiring to the engine digital control panel is adequate. Replace the EDCP as necessary.
	The AUTO/MAN mode switch fails to select AUTO mode.	Replace the engine digital control panel or repair other electrical faults as necessary.
	The overspeed control module has failed. **NOTE:** *Check system basics* *- Battery voltage level* *- Fuel supply* *- Crank speed* *Reference base engine T/R manual.*	Check power and grounding to the overspeed control module. Repair any electrical faults. Test the overspeed setting. 4.1.6 Overspeed RESET/STOP Switch in Section 4. Replace module as necessary.
7.1.13 Auto Start Failure - Engine Starts but Continues to Crank	The crank termination signal has failed. The tachometer indicates zero RPM.	With the engine running, verify tachometer is reading speed. Replace the EDCP as necessary. Contact a Cummins Authorized Repair Facility.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.14 Manual Start Failure from Contactor Lever - Does not Crank on A or B **NOTE:** *The fire pump engine will not crank locally when either contactor lever is actuated.*	Crank battery A or B contactor fails to make contact.	Replace the faulty contactor as necessary.
	Both batteries dead or not connected.	Check wiring connections. Charge or replace the batteries.
	Starter motor has failed.	Replace the starter motor.
	An electrical fault exists in the power or ground circuit for the starter motor.	Test continuity and insulation from ground between the battery splice, the ground connection, and the starter motor. Locate and repair any electrical fault.
	Engine is seized.	Contact a Cummins Authorized Repair Facility.
7.1.15 Manual Start Failure from Control Panel - Does not Crank on A or B **NOTE:** *The fire pump engine will not crank locally from the control panel when either CRANK BATT A or CRANK BATT B is selected, however, it does start when a contactor lever is actuated.*	The AUTO/MANUAL mode switch contact fails to close.	Test the electrical operation of the AUTO/MANUAL mode switch. Replace the engine digital control panel, as necessary.
	An electrical fault exists in the signal power circuit or the ground to the solenoids.	Test continuity and insulation from the ground between the AUTO/MANUAL switch and the solenoids. Check the solenoid connection to the ground. Locate and repair any electrical fault.
	Overspeed switch crank circuit fails to reset with engine shutdown.	Replace the overspeed switch as necessary.
7.1.16 Engine Cranks Normally but will not Start (No Exhaust Smoke)	Electronic fault codes are active.	Refer to the model specific CFP23E Fault Code Chart in this section or contact a Cummins Authorized Repair Facility for assistance.
	Electronic Control Module (ECM) is locked up.	Disconnect the battery cables for 30 seconds. Then reconnect the battery cables and start the engine.
	Battery voltage supply to the ECM is low, interrupted, or open.	Check the battery connections, fuses, and battery supply circuit.
	No fuel in supply tank.	Check and replenish the fuel supply. Check the fittings, hose connections, and hose conditions.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.16 Engine Cranks Normally but will not Start (No Exhaust Smoke) (continued)	Air is in the fuel system.	Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank stand pipe, and fuel filters as necessary. Vent air from the system.
	Fuel drain line is restricted.	Check the fuel drain lines for restriction. Clear or replace the fuel lines, check valves, or tank vents as necessary.
	Fuel filter is clogged.	Replace the fuel filter. Refer to 6.4.6 Change Fuel Filter/Separators in Section 6 - Maintenance.
	Fuel grade is not correct for the application or fuel quality is poor.	Operate the engine from a separate tank of high-quality no. 2 diesel fuel.
	Fuel injection pump or fuel lift pump is malfunctioning. Pump timing incorrect.	Contact a Cummins Authorized Repair Facility.
	Fuel pump overflow valve is malfunctioning.	Check the overflow valve. Replace if necessary.
	Fuel suction line is restricted.	Check the fuel suction line for restriction.
	Fuel connections on the fuel pump are loose.	Tighten all the fuel fittings and connections between the fuel tanks and fuel lift pump.
	Fuel suction stand pipe in the fuel tank is broken.	Check and repair the stand pipe, if necessary.
	Fuel supply is not adequate.	Locate and correct the restriction in the customer supplied fuel lines to the engine.
	Fuel tank air breather is blocked.	Clean the fuel tank breather.
	Injection pump drive shaft or drive shaft key is damaged.	Repair or replace the injection pump or contact a Cummins Authorized Repair Facility.
	Fuel injectors are plugged.	Replace the fuel injectors.
	Moisture is in the wiring harness connectors.	Dry the connectors with Cummins electronic cleaner, Part Number 3824510.
	Starter motor is malfunctioning.	Check the direction of crankshaft rotation. Replace the starter motor as necessary. Contact a Cummins Authorized Repair Facility.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.17 Engine Cranks Slowly but does not Start **NOTE:** *Typical engine cranking speed is 120 RPM. Engine cranking speed can be checked with a hand-held tachometer, stroboscope, or electronic service tool.*	The battery cable connections are loose, broken, or corroded, creating excessive resistance.	Check the battery cables and connections. Ensure that connections are clean and tight.
	The battery is not properly charged or has failed.	Recharge the battery. If the battery does not take the charge, replace it.
	Engine oil level is too high.	Check the oil level per instructions in Section 6 - Maintenance. Drain any excess oil.
	Engine oil is the wrong grade or type.	Check the grade and type of oil. Refer to 6.3.4 Engine Oil System in Section 6 - Maintenance. If the wrong type or grade of oil is present, drain and replace it. Refer to 6.4.5 Engine Oil and Oil Filter Change in Section 6 - Maintenance.
	Starter motor is malfunctioning.	Replace the starter motor. Contact a Cummins Authorized Repair Facility.
7.1.18 Engine Stops During Operation	Normal automatic mode shutdown occurs when the fire protection system controller removes the signal power feed to the engine digital control panel.	No action required. This is a desirable outcome.
	The selected Electronic Control Module (ECM) has detected a serious fault condition. The ECM's STOP light is displayed.	For instructions on how to read active fault codes, Refer to the CFP23E Fault Code Chart in this section or contact a Cummins Authorized Repair Facility for assistance.
	In the automatic mode, the signal power feed is lost from the fire protection system controller to the engine digital control panel.	Locate and correct the electrical fault in the fire protection system controller or the field wiring to the engine digital control panel.
	An overspeed trip has occurred. The overspeed trip lamp is illuminated on the engine digital control panel.	Remote indications may also be present. Overspeed switch failure has occurred. The trip indications may not be present.
	Power supply or grounding fault exists at the ECM.	Locate and correct the electrical fault in the power supply or grounding for the ECM.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.18 Engine Stops During Operation (continued)	The selected ECM has failed.	Select the alternate ECM. Replace the failed ECM. Contact a Cummins Authorized Repair Facility.
	Fuel tank level is low.	Fill the fuel tank. Fill and bleed the fuel lines to the engine.
	Clogged fuel tank air breather hose.	Clean the fuel tank breather.
	Fuel piping to engine or fuel filter is clogged.	Clean and repair engine fuel piping. Replace the fuel filter.
	Air is trapped in the low pressure fuel lines at the engine.	Bleed the fuel lines.
	Fuel lift pump has failed	Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Contact a Cummins Authorized Repair Facility.
	Fuel injection pump has failed	Replace the fuel injection pump. Contact a Cummins Authorized Repair Facility.
	Electronic fault codes are active.	Refer to the model specific CFP23E Fault Code Chart in this section or contact a Cummins Authorized Repair Facility for assistance.
7.1.19 Engine will not Reach Rated Speed (RPM)	Tachometer is not reading correctly or is erratic. Compare the tachometer reading with a hand held tachometer or an electronic service tool reading.	Replace the engine digital control panel. Contact a Cummins Authorized Repair Facility for assistance.
	Fuel filter requires replacement.	Refer to 6.4.6 Change Fuel Filter/ Separators per the instructions in Section 6 - Maintenance.
	Fuel grade not correct for the application, or fuel quality is poor.	Operate the engine with a good quality no. 2 diesel fuel.
	Fuel suction line is restricted.	Check the fuel suction line for restriction.
	Charge air cooler restricted.	Inspect the air cooler for internal and external restrictions. Replace the restricted cooler if necessary.
	Fuel supply is not adequate.	Locate and correct the restriction in the fuel lines to the engine.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.19 Engine will not Reach Rated Speed (RPM) (continued)	Stop circuit malfunction in the fire pump controller or field wiring.	In AUTO mode operation, the fire pump engine stops upon loss of signal power from the fire pump controller. Check the stop circuit in the fire pump controller.
7.1.20 Engine will not Shut Off Remotely	Stop circuit malfunction in the fire pump controller or field wiring.	Check for short to voltage on the signal wiring from the fire pump controller to the engine digital control panel. Correct any faults. Check operation of the AUTO/MANUAL switch at the engine digital control panel. Replace the engine digital control panel if necessary.
	Electronic fault codes are active.	Refer to the CFP23E Fault Code Chart in this section or contact a Cummins Authorized Repair Facility for assistance.
	Engine running on fumes drawn into the air intake.	Identify and isolate the source of the combustible fumes. Contact a Cummins Authorized Repair Facility.
7.1.21 Engine will not Shut Off Locally	Power source has not been removed by the fire pump controller.	Depress and hold the stop button on left side of the engine digital control panel until the engine is stopped.
	Electronic fault codes are active.	Refer to the CFP23E Fault Code Chart in this section or contact a Cummins Authorized Repair Facility for assistance.
	Engine running on fumes drawn into the air intake.	Identify and isolate the source of the combustible fumes.
7.1.22 Fuel Consumption is Excessive	Fuel is leaking.	Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Repair any leaks.
	Poor-quality fuel is being used.	Assure good-quality no. 2 diesel fuel is being used.
	Defective or clogged injection nozzle.	Replace the defective or clogged injection nozzle.
	Injection pump is adjusted incorrectly, causing excessive injection.	Adjust or replace the injection pump.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.22 Fuel Consumption is Excessive (continued)	Air intake or exhaust leaks.	Check for loose or damaged piping connections and missing pipe plugs. Check the turbo-charger and exhaust manifold mounting. Repair any leaks.
	Air intake system restriction is above specification.	Check the air intake system for restriction. Refer to 6.3.2 Air Cleaner Filter and Piping in Section 6. Replace the air filter as necessary.
7.1.23 Fuel or Engine Oil Leaking From Exhaust Manifold	Intake air restriction is high.	Check the air intake system for restriction. Refer to 6.3.2 Air Cleaner Filter and Piping in Section 6. Replace the air filter if required.
	Turbocharger drain line is restricted.	Remove the turbocharger drain line and check for restriction. If required, clean or replace the drain line.
	Turbocharger oil seal is leaking.	Check the turbocharger for oil seal leaks.
7.1.24 Engine Oil is Contami-nated	Oil supply is contaminated.	Check the oil supply. Replace it as necessary. Drain the oil and replace with non-contaminated oil. Also, replace the oil filter. Refer to 6.4.5 Engine Oil and Oil Filter Change in Section 6.
	Fuel is present in the engine oil.	Contact a Cummins Authorized Repair Facility.
	Coolant is present in the engine oil.	Contact a Cummins Authorized Repair Facility.
	Metal is present in the engine oil.	Contact a Cummins Authorized Repair Facility.
7.1.25 Engine Oil Consumption is Excessive	Verify the oil consumption rate.	Check the amount of oil added versus the operating hours.
	Engine crankcase overfilled.	Remove excess oil and recali-brate dipstick.
	External engine leak is present.	Inspect the engine and its compo-nents for seal, gasket, tappet cover, oil cooler, or drain cock leaks. Repair or correct any leaks.

Troubleshooting Chart (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
7.1.25 Engine Oil Consumption is Excessive (continued)	Crankcase ventilation system is plugged.	Check and clean the crankcase ventilation hose per the instructions in Section 6 - Maintenance.
	Turbocharger oil seal is leaking.	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.
	Engine oil cooler is leaking.	Check for engine oil in the coolant. Refer to Lubrication Oil in the Coolant in this section.Contact a Cummins Authorized Repair Facility.
	Engine oil does not meet specifications for operating conditions.	Change the oil and filters per the instructions in Section 6 - Maintenance.
	Engine oil drain interval is excessive.	Verify the correct engine oil drain interval. Refer to 6.4.5 Engine Oil and Oil Filter Change in Section 6 - Maintenance
	Piston, cylinder liner, or piston rings are worn or damaged.	Check for air intake system leaks. Contact a Cummins Authorized Repair Facility.
	Piston rings are not seated correctly (after an engine rebuild or piston installation).	Check blowby. If blowby is excessive, check the piston rings for correct seating. Contact a Cummins Authorized Repair Facility.
7.1.26 Lubrication Oil in the Coolant	Coolant is contaminated.	Drain the coolant and replace with non-contaminated coolant. Refer to 6.5.2 Drain and Flush Cooling System in Section 6. Replace the coolant filter.
	Engine oil cooler is malfunctioning.	Check the oil cooler. Contact a Cummins Authorized Repair Facility.
	Cylinder head gasket is damaged or leaking.	Contact a Cummins Authorized Repair Facility.
	Cylinder block or head is cracked or porous.	Contact a Cummins Authorized Repair Facility.

CFP23E Fault Code Chart

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
111 (Red)	629 12	Engine Control Module - Critical Internal Failure
112 (Red)	635 7	Engine Timing Actuator is not Responding to ECM Commands
113 (Yellow)	635 3	Engine Timing Actuator Circuit - Shorted High
114 (Yellow)	635 4	Engine Timing Actuator Circuit - Shorted Low
115 (Red)	190 2	Engine Speed/Position Sensor Circuit - Lost Both of Two Signals from the Magnetic Pickup Sensor
116 (Red)	156 3	Fuel Timing Pressure Sensor Circuit - Shorted High
117 (Red)	156 4	Fuel Timing Pressure Sensor Circuit - Shorted Low
118 (Yellow)	135 3	Fuel Pump Delivery Pressure Sensor Circuit - Shorted High
119 (Yellow)	135 4	Fuel Pump Delivery Pressure Sensor Circuit - Shorted Low
121 (Yellow)	190 10	Engine Speed/Position Sensor Circuit - Lost One of Two Signals from the Magnetic Pickup Sensor
122 (Yellow)	102 3	Intake Manifold Pressure Sensor #1 Circuit - Shorted High
123 (Yellow)	102 4	Intake Manifold Pressure Sensor #1 Circuit - Shorted Low
131 (Red)	91 3	Accelerator Pedal Position Sensor Circuit - Shorted High
132 (Red)	91 4	Accelerator Pedal Position Sensor Circuit - Shorted Low
133 (Red)	974 3	Remote Accelerator Pedal Position Sensor Circuit - Shorted High
133 (Red)	29 3	Remote Accelerator Pedal Position Sensor Circuit - Shorted High
134 (Red)	974 4	Remote Accelerator Pedal Position Sensor Circuit - Shorted Low
134 (Red)	29 4	Remote Accelerator Pedal Position Sensor Circuit - Shorted Low
135 (Yellow)	100 3	Engine Oil Pressure Sensor Circuit - Shorted High
141 (Yellow)	100 4	Engine Oil Pressure Sensor Circuit - Shorted Low
143 (Yellow)	100 18	Engine Oil Pressure Low - Warning
143 (White)	100 1	Engine Oil Pressure Low - Warning
144 (Yellow)	110 3	Engine Coolant Temperature Sensor Circuit - Shorted High
145 (Yellow)	110 4	Engine Coolant Temperature Sensor Circuit - Shorted Low

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
147 (Red)	91 8	Accelerator Pedal Position Sensor Circuit - Low Frequency
148 (Red)	91 8	Accelerator Pedal Position Sensor Circuit - High Frequency
151 (Red)	110 0	Engine Coolant Temperature High - Critical
151 (White)	110 0	Engine Coolant Temperature High - Critical
153 (Yellow)	105 3	Intake Manifold Temperature Sensor #1 Circuit - Shorted High
154 (Yellow)	105 4	Intake Manifold Temperature Sensor #1 Circuit - Shorted Low
155 (Red)	105 0	Intake Manifold Temperature #1 High - Critical
155 (White)	105 0	Intake Manifold Temperature #1 High - Critical
187 (Yellow)	620 4	Sensor Supply Voltage #2 Circuit - Shorted Low
211 (None)	1484 31	Additional OEM/Vehicle Diagnostic Codes have been Logged
212 (Yellow)	175 3	Engine Oil Temperature Sensor Circuit - Shorted High
213 (Yellow)	175 4	Engine Oil Temperature Sensor Circuit - Shorted Low
214 (Red)	175 0	Engine Oil Temperature High - Critical
219 (Maint.)	1380 17	Low Oil Level in the Centinel Makeup Oil Tank
219 (White)	1380 1	Low Oil Level in the Centinel Makeup Oil Tank
221 (Yellow)	108 3	Ambient Air Pressure Sensor Circuit - Shorted High
222 (Yellow)	108 4	Ambient Air Pressure Sensor Circuit - Shorted Low
223 (Yellow)	1265 4	Engine Oil Burn Valve Solenoid Circuit - Shorted Low
225 (Yellow)	1266 4	Engine Oil Replacement Valve Solenoid Circuit - Shorted Low
227 (Yellow)	620 3	Sensor Supply Voltage #2 Circuit - Shorted High
231 (Yellow)	109 3	Engine Coolant Pressure Sensor Circuit - Shorted High
232 (Yellow)	109 4	Engine Coolant Pressure Sensor Circuit - Shorted Low
233 (Red)	109 1	Engine Coolant Pressure Low - Warning
233 (Yellow)	109 18	Engine Coolant Pressure Low - Warning

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
234 (Red)	190 0	Engine Speed High - Critical
235 (Red)	111 1	Engine Coolant Level Low - Critical
235 (White)	111 1	Engine Coolant Level Low - Critical
237 (Yellow)	644 2	External Speed Input (Multiple Unit Sychronization) - Data Incorrect
241 (Yellow)	84 2	Vehicle Speed Sensor Circuit - Data Incorrect
242 (Yellow)	84 10	Vehicle Speed Sensor Circuit - Tampering has been Detected
245 (Yellow)	647 4	Fan Clutch Circuit - Shorted Low
254 (Red)	632 4	Fuel Shut-off Valve Circuit - Shorted Low
254 (None)	632 4	Fuel Shut-off Valve Circuit - Shorted Low
255 (Yellow)	632 3	Fuel Shut-off Valve Circuit - Shorted High
259 (Red)	632 7	Fuel Shut-off Valve - Stuck Open
261 (White)	174 0	Fuel Temperature High - Warning
263 (Yellow)	174 3	Fuel Temperature Sensor Circuit - Shorted High
265 (Yellow)	174 4	Fuel Temperature Sensor Circuit - Shorted Low
284 (Yellow)	1043 4	Engine Speed/Position Sensor #1 (Crankshaft) Supply Voltage Circuit - Shorted Low
285 (Yellow)	639 9	SAE J1930 Multiplexing PGN Timeout Error
286 (Yellow)	639 13	SAE J1930 Multiplexing PGN Configuration Error
287 (Red)	91 19	SAE J1930 Multiplexing Accelerator Pedal Sensor System Error
288 (Red)	974 19	SAE J1930 Multiplexing Remote Throttle Data Error
292 (White)	1083 14	Auxiliary Temperature Sensor Input #1 Engine Protection - Critical
293 (Yellow)	1083 3	Auxiliary Temperature Sensor Input #1 Circuit - Shorted High
294 (Yellow)	1083 4	Auxiliary Temperature Sensor Input #1 Circuit - Shorted Low
295 (Yellow)	108 2	Ambient Air Pressure Sensor Circuit - Data Incorrect
296 (White)	1084 14	Auxiliary Pressure Sensor Input #2 Engine Protection - Critical

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
297 (Yellow)	1084 3	Auxiliary Pressure Sensor Input #2 Circuit - Shorted High
298 (Yellow)	1084 4	Auxiliary Pressure Sensor Input #2 Circuit - Shorted Low
299 (None)	1384 31	Engine Shutdown Commanded by J1939
311 (Yellow)	651 6	Injector Solenoid Valve Cylinder #1 Circuit - Grounded Circuit
312 (Yellow)	655 6	Injector Solenoid Valve Cylinder #5 Circuit - Grounded Circuit
313 (Yellow)	653 6	Injector Solenoid Valve Cylinder #3 Circuit - Grounded Circuit
314 (Yellow)	656 6	Injector Solenoid Valve Cylinder #6 Circuit - Grounded Circuit
315 (Yellow)	652 6	Injector Solenoid Valve Cylinder #2 Circuit - Grounded Circuit
316 (Yellow)	931 3	Fuel Supply Pump Actuator Circuit - Shorted High
318 (Yellow)	931 7	Fuel Supply Pump Actuator - Mechanically Stuck
319 (None)	251 2	Real Time Clock - Power Interrupt
321 (Yellow)	654 6	Injector Solenoid Valve Cylinder #4 Circuit - Grounded Circuit
322 (Yellow)	651 5	Injector Solenoid Valve Cylinder #1 Circuit - Open Circuit
323 (Yellow)	655 5	Injector Solenoid Valve Cylinder #5 Circuit - Open Circuit
324 (Yellow)	653 5	Injector Solenoid Valve Cylinder #3 Circuit - Open Circuit
325 (Yellow)	656 5	Injector Solenoid Valve Cylinder #6 Circuit - Open Circuit
331 (Yellow)	652 5	Injector Solenoid Valve Cylinder #2 Circuit - Open Circuit
332 (Yellow)	654 5	Injector Solenoid Valve Cylinder #4 Circuit - Open Circuit
341 (Yellow)	630 2	Engine Control Module - Data Lost
343 (Yellow)	629 12	Engine Control Module - Warning Internal Hardware Failure
346 (Yellow)	630 12	Engine Control Module - Warning Software Error
349 (Yellow)	191 16	Transmission Output Shaft (Tailshaft) Speed High - Warning
349 (Yellow)	191 0	Transmission Output Shaft (Tailshaft) Speed High - Warning
352 (Yellow)	1079 4	Sensor Supply Voltage #1 Circuit - Shorted Low

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
378 (Yellow)	633 5	Fueling Actuator #1 Circuit - Open Circuit
379 (Yellow)	633 6	Fueling Actuator #1 Circuit - Grounded Circuit
384 (Yellow)	626 11	Start Assist Device Control Circuit Error (Ether Injection)
386 (Yellow)	1079 3	Sensor Supply Voltage #1 Circuit - Shorted High
387 (Yellow)	1043 3	Accelerator Pedal Position Sensor Supply Voltage Circuit - Shorted High
394 (Yellow)	635 5	Tiiming Actuator #1 Circuit - Open Circuit
395 (Yellow)	635 6	Tiiming Actuator #1 Circuit - Grounded Circuit
396 (Yellow)	1244 5	Fueling Actuator #2 Circuit - Open Circuit
397 (Yellow)	1244 6	Fueling Actuator #2 Circuit - Grounded Circuit
398 (Yellow)	1245 5	Timing Actuator #2 Circuit - Open Circuit
399 (Yellow)	1245 6	Timing Actuator #2 Circuit - Grounded Circuit
415 (Red)	100 1	Engine Oil Pressure Low - Critical
418 (None)	97 15	Water in Fuel Indicator High - Maintenance
422 (Yellow)	111 2	Engine Coolant Level Sensor Circuit - Data Incorrect
423 (Yellow)	156 2	Fuel Timing Pressure or Timing Actuator Stuck
426 (None)	639 2	SAE J1939 Datalink - Cannot Transmit
426 (Yellow)	639 2	SAE J1939 Datalink - Cannot Transmit
427 (None)	639 9	SAE J1939 Not Fast Enough
428 (Yellow)	97 3	Water in Fuel Sensor Circuit - Shorted High
429 (Yellow)	97 4	Water in Fuel Sensor Circuit - Shorted Low
431 (Yellow)	558 2	Accelerator Pedal Idle Validation Circuit - Data Incorrect
431 (Yellow)	91 2	Accelerator Pedal Idle Validation Circuit - Data Incorrect
432 (Red)	558 13	Accelerator Pedal Idle Validation Circuit - Out of Calibration
432 (Red)	91 13	Accelerator Pedal Idle Validation Circuit - Out of Calibration

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
433 (Yellow)	102 2	Intake Manifold Pressure Sensor Circuit - Data Incorrect
434 (Yellow)	627 2	Power Lost without Ignition Off
435 (Yellow)	100 2	Engine Oil Pressure Sensor Circuit - Data Incorrect
441 (Yellow)	168 18	Battery #1 Voltage Low - Warning
441 (None)	168 1	Battery #1 Voltage Low - Warning
442 (Yellow)	168 16	Battery #1 Voltage High- Warning
442 (Yellow)	168 0	Battery #1 Voltage High- Warning
443 (Yellow)	1043 4	Accelerator Pedal Position Sensor Supply Voltage Circuit - Shorted Low
449 (Yellow)	94 16	Fuel Pressure High - Warning
451 (Yellow)	157 3	Injector Metering Rail #1 Pressure Sensor Circuit - Shorted High
452 (Yellow)	157 4	Injector Metering Rail #1 Pressure Sensor Circuit - Shorted Low
455 (Red)	633 3	Fuel Control Valve Circuit - Shorted High
466 (Yellow)	1188 4	Turbocharger #1 Wastegate Control Circuit - Shorted Low
467 (Yellow)	635 2	Timing Rail Actuator Circuit - Data Incorrect
468 (Yellow)	633 2	Fuel Rail Actuator Circuit - Data Incorrect
482 (Yellow)	94 18	Fuel Pressure Low - Warning
483 (Yellow)	1349 3	Injector Metering Rail #2 Pressure Sensor Circuit - Shorted High
484 (Yellow)	1349 4	Injector Metering Rail #2 Pressure Sensor Circuit - Shorted Low
485 (Yellow)	1349 16	Injector Metering Rail #2 Pressure High - Warning
486 (Yellow)	1349 18	Injector Metering Rail #2 Pressure Low - Warning
487 (None)	626 1	Start Assist Device - Canister Empty (Ether Injection)
489 (Yellow)	191 18	Transmission Output Shaft (Tailshaft) Speed Low - Warning
489 (Yellow)	191 1	Transmission Output Shaft (Aux Gov) Speed Low - Warning
496 (Yellow)	1043 11	Engine Speed/Position Sensor #2 (Camshaft) Supply Voltage

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
497 (Yellow)	1377 2	Multiple Unit Sychronization Switch Circuit - Data Incorrect
514 (Red)	633 7	Fuel Control Valve - Mechanically Stuck
527 (Yellow)	702 3	Auxiliary Input/Output #2 Circuit - Shorted High
528 (Yellow)	93 2	OEM Alternate Torque Validation Switch - Data Incorrect
529 (Yellow)	703 3	Auxiliary Input/Output #3 Circuit - Shorted High
546 (Yellow)	94 3	Fuel Delivery Pressure Sensor Circuit - Shorted High
547 (Yellow)	94 4	Fuel Delivery Pressure Sensor Circuit - Shorted Low
551 (Yellow)	558 4	Accelerator Pedal Idle Validation Circuit - Shorted Low
551 (Red)	91 4	Accelerator Pedal Idle Validation Circuit - Shorted Low
553 (Yellow)	157 16	Injector Metering Rail #1 Pressure High - Warning Level
553 (Red)	157 0	Injector Metering Rail #1 Pressure High - Warning Level
554 (Yellow)	157 2	Fuel Pressure Sensor Error
555 (Yellow)	1264 16	Engine Blowby - Warning Level
555 (White)	1264 0	Engine Blowby - Warning Level
581 (Yellow)	1381 3	Fuel Supply Pump Inlet Pressure Sensor Circuit - Shorted High
582 (Yellow)	1381 4	Fuel Supply Pump Inlet Pressure Sensor Circuit - Shorted Low
583 (Yellow)	1381 18	Fuel Supply Pump Inlet Pressure Sensor Low - Warning Level
595 (Yellow)	103 16	Turbocharger #1 Speed High - Warning Level
596 (Yellow)	167 16	Electrical Charging System Voltage High - Warning Level
597 (Yellow)	167 18	Electrical Charging System Voltage Low - Warning Level
598 (Red)	167 1	Electrical Charging System Voltage Low - Critical Level
611 (None)	1383 31	Engine Hot Shutdown
649 (None)	1378 0	Change Lubricating Oil and Filter
719 (Yellow)	1264 3	Crankcase Blowby Pressure Sensor Circuit - Shorted High

CFP23E Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	Cummins DESCRIPTION
729 (Yellow)	1264 4	Crankcase Blowby Pressure Sensor Circuit - Shorted Low
753 (None)	723 2	Engine Speed/Position #2 - Cam Sync Error
755 (Yellow)	157 7	Injector Metering Rail #1 Pressure Malfunction
758 (Yellow)	1349 7	Injector Metering Rail #2 Pressure Malfunction
951 (None)	166 2	Cylinder Power Imbalance Between Cylinders

Section 8 - Component Parts and Assemblies

8.1 Part Ordering Information

Replacement parts for the Cummins Inc. equipment are manufactured to the same quality standards and specifications as the original equipment. Unapproved substitution may result in poor performance, reduced service life, lost production, or unsafe operation.

Cummins Inc. relies on the best and most cost effective shipping methods, unless specific instructions or requirements are requested by the customer. When ordering parts, please be prepared to provide the following information.

PARTS REQUESTS REQUIRE:

1. Model and serial number.
2. Part description by name or number.
3. Quantity required.
4. Purchase order number.

NOTE: *A purchase order number is desirable, even if the part(s) are supplied on a Returned Goods Authorization (RGA) issue number. A purchase order number helps Cummins NPower Inc. and its customer track the parts and necessary credits.*

8.2 Routine Service and Parts

Personnel at Cummins Authorized Repair Locations can assist you with the correct operation and service of your engine. Cummins has a worldwide service network of more than 5,000 Distributors and Dealers who have been trained to provide sound advice, expert service, and complete parts support.

Check the telephone directory yellow pages or refer to the directory in this section for the nearest Cummins Authorized Repair Location.

8.3 Emergency Repairs and Technical Service

The Cummins Customer Assistance Center provides a 24-hour, toll free telephone number to aid in technical and emergency service when a Cummins Authorized Repair Location can not be reached or is unable to resolve an issue with a Cummins product.

If assistance is required, call Toll-Free: 1-800-DIESELS (1-800-343-7357). Includes all 50 states, Bermuda, Puerto Rico, Virgin Islands, and the Bahamas.

Outside of North America contact your Regional Office. Telephone numbers and addresses are listed in the International Directory.

Refer also to the Cummins Inc. web site at www.cummins.com.

8.4 Recommended Spares Inventory

To minimize downtime and increase productivity, Cummins Inc. recommends maintaining a stock of spare parts critical to uninterrupted engine operation. Shipping costs can be lower using ground transportation rather than overnight or next day air freight. For this reason Cummins Inc. can provide a list of recommended spare parts. Contact the Cummins Authorized Repair Location for additional information.

CFP23E Engine Data Sheet

Engine Data Sheet **Cummins Fire Power** DePere, WI 54115 http://www.cumminsfirepower.com	Basic Engine Model **CFP23E-F15, F25, F35**	
	Curve Number:	**FR - 50049**
	CPL Code:	**2852**
Configuration Number: **D893002CX03**	Engine Family:	**Industrial**
Installation Drawing: **23497**	Revision Date:	**March 2015**

General Engine Data

Type	4 Cycle; In-Line; 6 Cylinder	
Aspiration	Turbocharged, Aftercooled	
Bore & Stroke - in. (mm)	6.69 x 6.69	(170 x 170)
Displacement - $in.^3$ (litre)	1413	(23.2)
Compression Ratio	16.0:1	
Valves per Cylinder - Intake	2	
- Exhaust	2	
Dry Weight - lb (kg)	7460	(3357)
Wet Weight - lb (kg)	7570	(3407)
Maximum Allowable Bending Moment @ Rear Face of Block - lb.-ft. (N-m)	2340	(3173)

Air Induction System

Max. Temperature Rise Between Ambient Air and Engine Air Inlet - delta °F (delta °C)	30	(16.7)
Maximum Inlet Restriction with Dirty Filter - in. H_2O (mm H_2O)	25	(635)
Recommended Air Cleaner Element - (Standard) (Fleetguard) Primary	(1) AF25544	
(Fleetguard) Secondary	(1) AF25545	

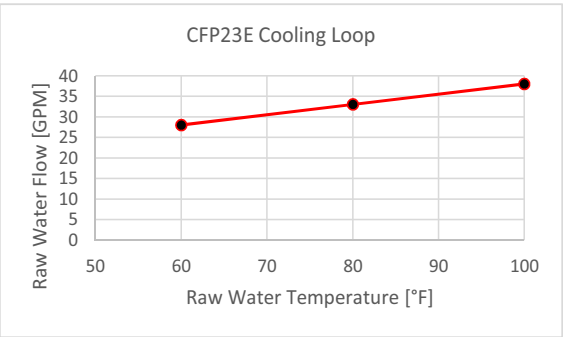
Lubrication System

Oil Pressure Range at Rated - PSI (kPa) ...(Warm)	50-65	(345-448)
Oil Capacity of Pan (High - Low) - U.S. Gal. (litre)	15-12	(56-46)
Total System Capacity - U.S. Gal. (litre)	16.1	(61)
Recommended Lube Oil Filter Cummins Filtration (Fleetguard)	(2) LF9325	

Cooling System

Raw Water Working Pressure Range at Heat Exchanger - PSI (kPa)	60	(413) MAX
Recommended Min. Water Supply Pipe Size to Heat Exchanger - in. (mm)	1.25	(31.75)
Recommended Min. Water Disch. Pipe Size From Heat Exchanger - in. (mm)	1.50	(38.10)
Coolant Water Capacity (Engine Side) - U.S. gal. (litre)	17.3	(65.5)
Standard Thermostat - Type	Modulating	
- Range - deg F (deg C)	170-194	(76.5-90)
Normal Operating Temperature - °F (°C)	180-212	(82-100)
Minimum Raw Water Flow		
with Water Temperatures to 60 °F (16 °C) - U.S. GPM (litre/s)	28	(1.77)
with Water Temperatures to 80 °F (27 °C) - U.S. GPM (litre/s)	33	(2.08)
with Water Temperatures to 100 °F (38 °C) - U.S. GPM (litre/s)	38	(2.40)
Recommended Cooling Water Filter: Cummins Filtration (Fleetguard)	(1) WF2076	

A jacket water heater is mandatory on this engine. The recommended heater wattage is 3000 down to 40 °F (4 °C).



CFP23E Engine Data Sheet (Continued)

Exhaust System

Max. Back Pressure Imposed by Complete Exhaust System in in. H_2O (kPa)	40.8	(10.2)
Exhaust Pipe Size Normally Acceptable - in. (mm)	8.0	(203)

Noise Emissions

Top	104.4 dBa
Right Side	105.0 dBa
Left Side	105.0 dBa
Front	103.0 dBa
Exhaust	121.0 dBa

The noise emission values are estimated sound pressure levels at 3.3 ft. (1 m.).

Fuel Supply / Drain System - RPM	**1470**		**1760**		**1900**		**2100**		**2250**	
CFP23E-F35 Nominal Fuel Consumption - Gal./hr. (L/hr)	34.1	(129)	37.9	(143)	39.0	(148)	41.3	(156)	34.5	(130)
CFP23E-F25 Nominal Fuel Consumption - Gal./hr. (L/hr)	32.0	(121)	35.6	(135)	36.7	(139)	38.8	(147)	32.4	(123)
CFP23E-F15 Nominal Fuel Consumption - Gal./hr. (L/hr)	29.6	(112)	33.0	(125)	34.0	(129)	35.9	(136)	30.0	(113)

Fuel Type	Number 2 Diesel Only	
Minimum Supply Line Size - in. (mm)	1	(25.40)
Minimum Drain Line Size - in. (mm)	1	(25.40)
Maximum Fuel Line Length Between Supply Tank & Fuel Pump - ft. (m)	40	(12)
Maximum Fuel Height above C/L Fuel Pump - in. (m)	96	(2.4)
Recommended Fuel Filter - Primary	Cummins Filtration (Fleetguard)	(2) FS1006
- Secondary	None Required	None
Maximum Restriction @ Lift Pump-Inlet - With Clean Filter - in. Hg (mm Hg)	4.0	(102)
Maximum Restriction @ Lift Pump-Inlet - With Dirty Filter - in. Hg (mm Hg)	8.0	(203)
Maximum Return Line Restriction - Without Check Valves - in. Hg (mm Hg)	9	(229)
Minimum Fuel Tank Vent Capability - ft^3/hr (m^3/hr)	100	(3.00)
Maximum Fuel Temperature @ Lift Pump Inlet - °F (°C)	160	(71)

Starting and Electrical System	**12V**	**24V**
Min. Recommended Batt. Capacity - Cold Soak at 0°F (-18°C) or Above		
Engine Only - Cold Cranking Amperes - (CCA)	12 volt	1400
Engine Only - Reserve Capacity - Minutes	option is	460
Battery Cable Size (Maximum Cable Length Not to Exceed 5 ft. [1.5 m] AWG)	not	2/0
Maximum Resistance of Starting Circuit - Ohms	offered	0.002
Typical Cranking Speed - RPM		100
Alternator (Standard), Internally Regulated - Ampere		75
Wiring for Automatic Starting (Negative Ground)	Standard	
Reference Wiring Diagram		16260

Performance Data

All data is based on the engine operating with fuel system, water pump, lubricating oil pump, air cleaner, and alternator; not included are compressor, fan, optional equipment, and driven components. Data is based on operation at SAE standard J1394 conditions of 300 ft. (91.4 m) altitude, 29.61 in. (752 mm) Hg dry barometer, and 77 °F (25 °C) intake air temperature, using No.2 diesel or a fuel corresponding to ASTM-D2.

Altitude Above Which Output Should be Limited - ft. (m)	300	(91.4)
Correction Factor per 1000 ft. (305 m) above Altitude Limit	3%	
Temperature Above Which Output Should be Limited - °F (°C)	77	(25)
Correction Factor per 10 °F (11 °C) Above Temperature Limit	1%	(2%)

Exhaust Emissions (EPA Tier T2)

See emissions data available for this rating on the Cummins Fire Power website www.cumminsfirepower.com.

CFP23E Engine Data Sheet (Continued)

NFPA-20 Non-Listed Ratings for CFP23E-F15, F25, F35

Engine Speed - RPM	**1470**	**1760**	**1900**	**2100**	**2250**
CFP23E-F35 Output - BHP (kW)	**724 (540)**	**801 (597)**	**830 (619)**	**864 (644)**	**709 (529)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1465 (691)	1730 (817)	1858 (877)	2041 (963)	2143 (1011)
Exhaust Gas Flow - CFM (litre/sec)	3993 (1885)	4470 (2110)	4700 (2219)	5029 (2374)	5281 (2493)
Exhaust Gas Temperature - °F (°C)	904 (485)	847 (453)	819 (437)	779 (415)	732.3 (389)
Engine Heat Rejection to Coolant- BTU/min. (kW)	9107 (160)	10083 (177)	10555 (185)	11228 (197)	11341 (199)
Engine Heat Rejection to Ambient - BTU/min. (kW)	3799 (67)	4169 (73)	4348 (76)	4603 (81)	4557 (80)
CFP23E-F25 Output - BHP (kW)	**681 (508)**	**753 (562)**	**781 (582)**	**812 (606)**	**666 (497)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1465 (691)	1730 (817)	1858 (877)	2041 (963)	2143 (1011)
Exhaust Gas Flow - CFM (litre/sec)	3993 (1885)	4470 (2110)	4700 (2219)	5029 (2374)	5281 (2493)
Exhaust Gas Temperature - °F (°C)	904 (485)	846.6 (453)	818.7 (437)	779 (415)	732.3 (389)
Engine Heat Rejection to Coolant- BTU/min. (kW)	9107 (160)	10083 (177)	10555 (185)	11228 (197)	11341 (199)
Engine Heat Rejection to Ambient - BTU/min. (kW)	3799 (67)	4169 (73)	4348 (76)	4603 (81)	4557 (80)
CFP23E-F15 Output - BHP (kW)	**630 (470)**	**698 (520)**	**722 (538)**	**751 (560)**	**617 (460)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1465 (691)	1730 (817)	1858 (877)	2041 (963)	2143 (1011)
Exhaust Gas Flow - CFM (litre/sec)	3993 (1885)	4470 (2110)	4700 (2219)	5029 (2374)	5281 (2493)
Exhaust Gas Temperature - °F (°C)	904 (485)	846.6 (453)	818.7 (437)	779 (415)	732.3 (389)
Engine Heat Rejection to Coolant- BTU/min. (kW)	9107 (160)	10083 (177)	10555 (185)	11228 (197)	11341 (199)
Engine Heat Rejection to Ambient - BTU/min. (kW)	3799 (67)	4169 (73)	4348 (76)	4603 (81)	4557 (80)

All Data is Subject to Change Without Notice.

Engineering Manager: ***Mike Dawson***
Cummins Fire Power, DePere, WI 54115 U.S.A.

CFP23E Engine Data Sheet (Continued)

Engine Data Sheet **Cummins Fire Power** DePere, WI 54115 http://www.cumminsfirepower.com	Basic Engine Model **CFP23E-F10,F20,F30,F40,F50,F60,F70**	
	Curve Number:	**FR - 50047**
	CPL Code:	**2621**
Configuration Number: **D893001GX03**	Engine Family:	**G Drive**
Installation Drawing: **15554**	Revision Date:	**March 2015**

General Engine Data

Type	4 Cycle; In-Line; 6 Cylinder	
Aspiration	Turbocharged, Aftercooled	
Bore & Stroke - in. (mm)	6.69 x 6.69	(170 x 170)
Displacement - in.^{3} (litre)	1413	(23.2)
Compression Ratio	16.0:1	
Valves per Cylinder - Intake	2	
- Exhaust	2	
Dry Weight - lb (kg)	7560	(3402)
Wet Weight - lb (kg)	7770	(3497)
Maximum Allowable Bending Moment @ Rear Face of Block - lb.-ft. (N-m)	2340	(3173)

Air Induction System

Max. Temperature Rise Between Ambient Air and Engine Air Inlet - delta °F (delta °C)	63	(35.0)
Maximum Inlet Restriction with Dirty Filter - in. H_2O (mm H_2O)	25	(635)
Recommended Air Cleaner Element - (Standard)	(Fleetguard) Primary	(1) AF25544
	(Fleetguard) Secondary	(1) AF25545

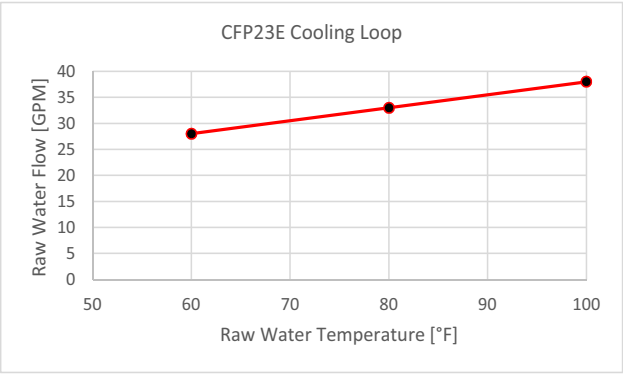
Lubrication System

Oil Pressure Range at Rated - PSI (kPa)	50-65	(345-448)
Oil Capacity of Pan (High - Low) - U.S. Gal. (litre)	15-12	(57-45)
Total System Capacity - U.S. Gal. (litre)	16.1	(60.9)
Recommended Lube Oil Filter	Cummins Filtration (Fleetguard)	(2) LF9325

Cooling System

Raw Water Working Pressure Range at Heat Exchanger - PSI (kPa)	60	(413)	MAX
Recommended Min. Water Supply Pipe Size to Heat Exchanger - in. (mm)	1.25	(31.75)	
Recommended Min. Water Disch. Pipe Size From Heat Exchanger - in. (mm)	1.50	(38.10)	
Coolant Water Capacity (Engine Side) - U.S. Gal. (litre)	17.3	(65.5)	
Standard Thermostat - Type	Modulating		
- Range - deg F (deg C)	170-194	(76.5-90)	
Normal Operating Temperature - °F (°C)	180-212	(82-100)	
Minimum Raw Water Flow			
with Water Temperatures to 60 °F (16 °C) - U.S. GPM (litre/s)	28	(1.77)	
with Water Temperatures to 80 °F (27 °C) - U.S. GPM (litre/s)	33	(2.08)	
with Water Temperatures to 100 °F (38 °C) - U.S. GPM (litre/s)	38	(2.40)	
Recommended Cooling Water Filter	Cummins Filtration (Fleetguard)	(1) WF2076	

A jacket water heater is mandatory on this engine. The recommended heater wattage is 3000 down to 40 °F (4 °C).



CFP23E Engine Data Sheet (Continued)

Exhaust System

Max. Back Pressure Imposed by Complete Exhaust System in in. H_2O (kPa)	40.8	(10.2)
Exhaust Pipe Size Normally Acceptable - in. (mm)	8.0	(203)

Noise Emissions

Top	104.4 dBa
Right Side	105.0 dBa
Left Side	105.0 dBa
Front	103.0 dBa
Exhaust	121.0 dBa

The noise emission values are estimated sound pressure levels at 3.3 ft. (1 m.).

Exhaust Emissions (EPA/CARB Tier T2)

See emissions data available for this rating on the Cummins Fire Power website www.cumminsfirepower.com.

Fuel Supply / Drain System	**1470**		**1760**	
CFP23E-F70 Nominal Fuel Consumption - Gal./hr. (L/hr)	38.8	(146.7)	50.3	(190.3)
CFP23E-F60 Nominal Fuel Consumption - Gal./hr. (L/hr)	37.2	(140.7)	46.8	(177.0)
CFP23E-F50 Nominal Fuel Consumption - Gal./hr. (L/hr)	34.2	(129.5)	43.3	(163.7)
CFP23E-F40 Nominal Fuel Consumption - Gal./hr. (L/hr)	34.0	(128.6)	39.7	(150.5)
CFP23E-F30 Nominal Fuel Consumption - Gal./hr. (L/hr)	32.9	(124.7)	37.5	(141.8)
CFP23E-F20 Nominal Fuel Consumption - Gal./hr. (L/hr)	31.0	(117.3)	35.2	(133.3)
CFP23E-F10 Nominal Fuel Consumption - Gal./hr. (L/hr)	28.7	(108.5)	32.6	(123.6)
Fuel Type	Number 2 Diesel Only			
Minimum Supply Line Size - in. (mm)	1	(25.40)		
Minimum Drain Line Size - in. (mm)	1	(25.40)		
Maximum Fuel Line Length Between Supply Tank & Fuel Pump - ft. (m)	40	(12)		
Maximum Fuel Height above C/L Fuel Pump - in. (m)	94	(2.4)		
Recommended Fuel Filter - Primary	Cummins Filtration (Fleetguard)... (2) FS1006			
- Secondary	None			
Maximum Restriction @ Lift Pump-Inlet - With Clean Filter - in. Hg (mm Hg)	4.0	(102)		
Maximum Restriction @ Lift Pump-Inlet - With Dirty Filter - in. Hg (mm Hg)	8.0	(203)		
Maximum Return Line Restriction - Without Check Valves - in. Hg (mm Hg)	9.0	(229)		
Minimum Fuel Tank Vent Capability - ft^3/hr (m^3/hr)	100	(3.00)		
Maximum Fuel Temperature @ Lift Pump Inlet - °F (°C)	160	(71)		

Starting and Electrical System	**24V**
Min. Recommended Batt. Capacity - Cold Soak at 0°F (-18°C) or Above	
Engine Only - Cold Cranking Amperes - (CCA)	1400
Engine Only - Reserve Capacity - Minutes	460
Battery Cable Size (Maximum Cable Length Not to Exceed 5 ft. [1.5 m] AWG)	2/0
Maximum Resistance of Starting Circuit - Ohms	0.002
Typical Cranking Speed - RPM	120
Alternator (Standard), Internally Regulated - Ampere	35
Wiring for Automatic Starting (Negative Ground)	Standard
Reference Wiring Diagram	16260

Performance Data

All data is based on the engine operating with fuel system, water pump, lubricating oil pump, air cleaner, and alternator; not included are compressor, fan, optional equipment, and driven components. Data is based on operation at SAE standard J1394 conditions of 300 ft. (91.4 m) altitude, 29.61 in. (752 mm) Hg dry barometer, and 77 °F (25 °C) intake air temperature, using No.2 diesel or a fuel corresponding to ASTM-D2.

Correction Factor per 1000 ft. (305 m) above Altitude Limit	3%	
Temperature Above Which Output Should be Limited - °F (°C)	77	(25)
Correction Factor per 10 °F (11 °C) Above Temperature Limit	1%	(2%)

CFP23E Engine Data Sheet (Continued)

FM Approved and UL Listed Ratings for CFP23E-F10, F20, F30, F40, F50, F60, F70

Engine Speed - RPM	**1470**	**1760**
CFP23E-F70 Output - BHP (kW)		**1075 (802)**
Ventilation Air Required for Combustion - CFM (litre/sec)		2210 (1,043)
Exhaust Gas Flow - CFM (litre/sec)		5220 (2,464)
Exhaust Gas Temperature - °F (°C)		870 (466)
Engine Heat Rejection to Coolant- BTU/min. (kW)		14085 (248)
Engine Heat Rejection to Ambient - BTU/min. (kW)		4785 (84)
CFP23E-F60 Output - BHP (kW)		**1000 (746)**
Ventilation Air Required for Combustion - CFM (litre/sec)		2056 (970)
Exhaust Gas Flow - CFM (litre/sec)		4856 (2,292)
Exhaust Gas Temperature - °F (°C)		809 (432)
Engine Heat Rejection to Coolant- BTU/min. (kW)		13102 (230)
Engine Heat Rejection to Ambient - BTU/min. (kW)		4451 (78)
CFP23E-F50 Output - BHP (kW)	**752 (560)**	**925 (690)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1475 (696)	1895 (894)
Exhaust Gas Flow - CFM (litre/sec)	4104 (1,937)	4476 (2,113)
Exhaust Gas Temperature - °F (°C)	849 (454)	746 (397)
Engine Heat Rejection to Coolant- BTU/min. (kW)	10506 (185)	12078 (212)
Engine Heat Rejection to Ambient - BTU/min. (kW)	3157 (55)	4103 (72)
CFP23E-F40 Output - BHP (kW)	**747 (557)**	**850 (634)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1327 (626)	1705 (805)
Exhaust Gas Flow - CFM (litre/sec)	3692 (1,743)	4026 (1,900)
Exhaust Gas Temperature - °F (°C)	764 (407)	671 (355)
Engine Heat Rejection to Coolant- BTU/min. (kW)	9451 (166)	10864 (191)
Engine Heat Rejection to Ambient - BTU/min. (kW)	2840 (50)	3691 (65)
CFP23E-F30 Output - BHP (kW)	**724 (540)**	**801 (597)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1204 (568)	1547 (730)
Exhaust Gas Flow - CFM (litre/sec)	3351 (1,582)	3655 (1,725)
Exhaust Gas Temperature - °F (°C)	693 (367)	609 (321)
Engine Heat Rejection to Coolant- BTU/min. (kW)	8579 (151)	9862 (173)
Engine Heat Rejection to Ambient - BTU/min. (kW)	2578 (45)	3351 (59)
CFP23E-F20 Output - BHP (kW)	**681 (508)**	**753 (562)**
Ventilation Air Required for Combustion - CFM (litre/sec)	1084 (512)	1393 (657)
Exhaust Gas Flow - CFM (litre/sec)	3106 (1,466)	3289 (1,553)
Exhaust Gas Temperature - °F (°C)	624 (329)	548 (287)
Engine Heat Rejection to Coolant- BTU/min. (kW)	7721 (136)	8876 (156)
Engine Heat Rejection to Ambient - BTU/min. (kW)	2320 (41)	3015 (53)
CFP23E-F10 Output - BHP (kW)	**630 (470)**	**698 (520)**
Ventilation Air Required for Combustion - CFM (litre/sec)	936 (442)	1203 (568)
Exhaust Gas Flow - CFM (litre/sec)	2605 (1,230)	2842 (1,341)
Exhaust Gas Temperature - °F (°C)	539 (282)	474 (245)
Engine Heat Rejection to Coolant- BTU/min. (kW)	6670 (117)	7668 (135)
Engine Heat Rejection to Ambient - BTU/min. (kW)	2004 (35)	2605 (46)

All Data is Subject to Change Without Notice.

Engineering Manager: *Mike Dawson*

Cummins Fire Power, DePere, WI 54115 U.S.A.

Torque Table

Cap Screw Markings and Torque Values

CAUTION

Always use a cap screw of the same measurement and strength as the cap screw being replaced. Using the wrong cap screws can result in engine damage.

Always use the torque values listed in the following tables when specific torque values are not available.

When the ft-lb value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Metric Cap Screw Identification

Sample:	**M8-1.25 x 25**		
Value:	**M8**	**1.25**	**X 25**
Meaning:	Major thread diameter in millimeters	Distance between threads in millimeters	Length in millimeters

Metric Cap Screw Head Markings

Metric cap screws and nuts are identified by the grade number stamped on the head of the cap screw or on the surface of the nuts.

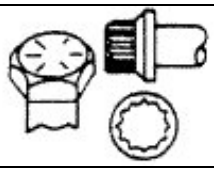
Commercial Steel Class	**8.8**	**10.9**	**12.9**
Caps Screw Head Markings			

US Customary Cap Screw Identification

Sample:	**5/16 x 18 x 1-1/2**		
Value:	**5/16**	**18**	**1-1/2**
Meaning:	Major thread diameter in inches	Number of threads per inch	Length in inches

U.S. Customary Cap Screw Head Markings

U.S. Customary cap screws are identified by radial lines stamped on the head of the cap screw.

SAE Grade 5 w/ three lines	**SAE Grade 8**
	

Torque Table (Continued)

Metric Cap Screw Torque Values (lubricated threads)

Class:	8.8				10.9				12.9			
Diameter	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	13	10	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	23	17	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	65	50	30	25	70	50	30	25
12	80	60	55	40	115	85	55	40	125	95	55	40
14	125	90	90	65	180	133	90	65	195	145	90	65
16	195	140	140	100	280	200	140	100	290	210	140	100
18	280	200	180	135	390	285	180	135	400	290	180	135
20	400	290	—	—	550	400	—	—	—	—	—	—

U.S. Customary Cap Screw Torque Values (lubricated threads)

Grade:	SAE Grade 5				SAE Grade 8			
Cap Screw Body Size	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4-20	9	7	8	6	15	11	8	6
1/4-28	12	9	9	7	18	13	9	7
5/16-18	20	15	16	12	30	22	16	12
5/16-24	23	17	19	14	33	24	19	14
3/8-16	40	30	25	20	55	40	25	20
3/8-24	40	30	35	25	60	45	35	25
7/16-14	60	45	45	35	90	65	45	35
7/16-20	65	50	55	40	95	70	55	40
1/2-13	95	70	75	55	130	95	75	55
1/2-20	100	75	80	60	150	110	80	60
9/16-12	135	100	110	80	190	140	110	80
9/16-18	150	110	115	85	210	155	115	85
5/8-11	180	135	150	110	255	190	150	110
5/8-18	210	155	160	120	290	215	160	120
3/4-10	325	240	255	190	460	340	255	190
3/4-16	365	270	285	210	515	380	285	210
7/8-9	490	360	380	280	745	550	380	280
7/8-14	530	390	420	310	825	610	420	310
1-8	720	530	570	420	1100	820	570	420
1-14	800	590	650	480	1200	890	650	480

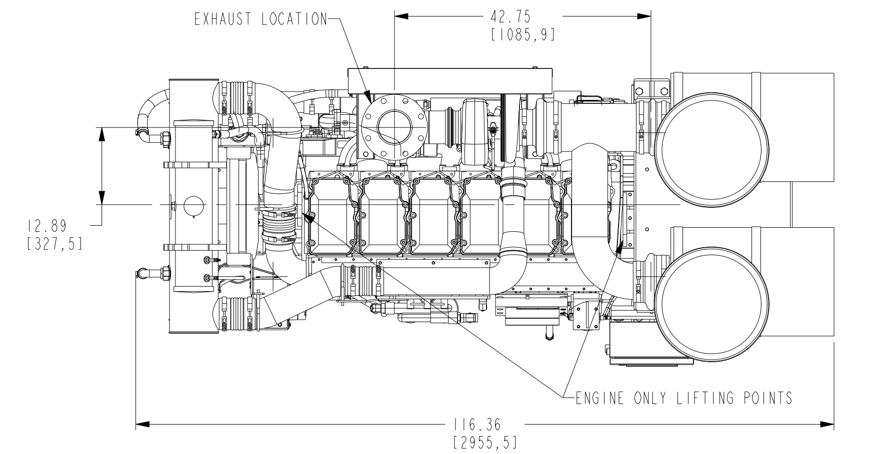
8.5 Assembly Drawings

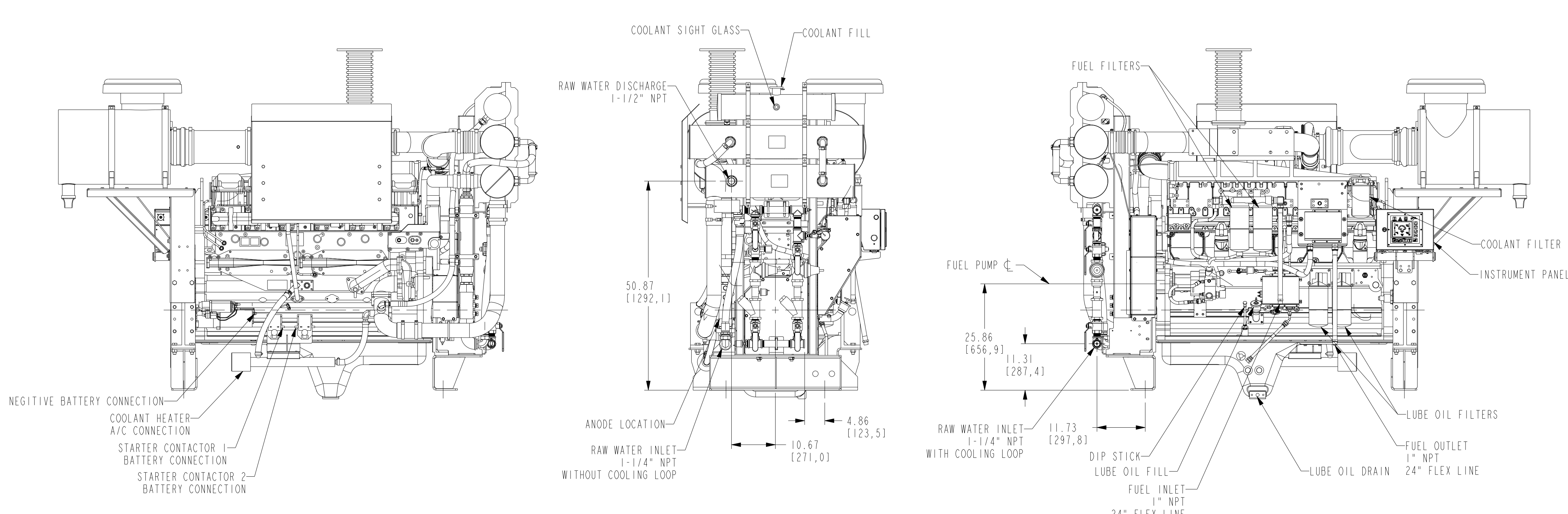
The most current revisions to these drawings and related documents are accessible at: http://www.cumminsfirepower.com/products.html.

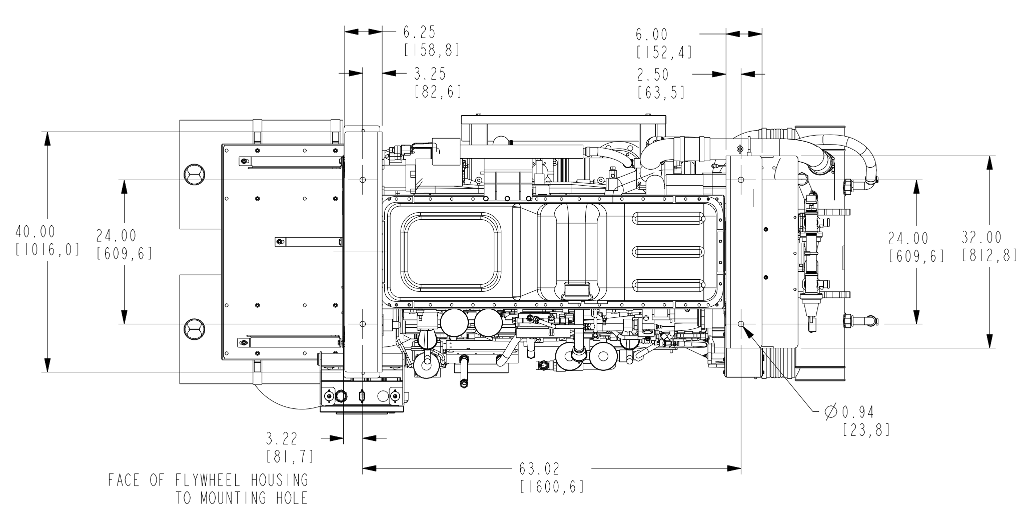
Description	Drawing No.	Revision Level	Change Date
General Layout, Fire Pump, CFP23E	23581	-	11/12
Drawing, Installation, Fire Pump, G-Drive CFP23E F10-F70	15554	C	3/14
Drawing, Installation, Fire Pump, Industrial CFP23E F15-F25-F35	23497	C	3/14
Options, Engine, G-Drive, CFP23E F10-F70 (QSK23)	12888/15397	A/-	2/11
Options, Engine, Industrial, CFP23E F15-F25-F35 (QSK23)	16301	-	-
Assembly, Heat Exchanger/CAC, CFP23E F10-F70	23166	G	1/15
Assembly, Heat Exchanger/CAC, CFP23E F15-F25-F35	23762	F	5/14
Assembly, Air Intake	17669	D	5/14
Assembly, Guarding, CFP23E F10-F70	23293	C	3/14
Assembly, Guarding, CFP23E F15-F25-F35	23784	B	3/14
Assembly, Coolant Heater	13196	F	5/14
Assembly, Sensor Package	14033	B	10/12
Assembly, Secondary ECM	16124	C	8/14
Assembly, Control Panel Mounting	21249	-	9/12
Assembly, All Components Top-level:	CFP23E-AC-2013		
Assembly, Panel, Digital Electronic	22791	A	2/14
Assembly, Harness	23669	C	2/15
Cables, Battery Contactors	23939	A	3/14
Battery Contactors 24V	8824-24	A	2/11
Kit, Fuel Lines	A042A380	-	2/14
Assembly, Raw Water Cooling Loop, 1 1/4" Vertical	25514	B	2/15
Assembly, Raw Water Cooling Loop, 1 1/4" Horizontal 24V	23427	E	2/15
Assembly, Sea Water Cooling Loop, 1 1/4" Vertical	25516	B	2/15
Assembly, Sea Water Cooling Loop, 1 1/4" Horizontal 24V	21006	E	2/15
Assembly, Stub Shaft and Guarding	16768	-	3/10
Schematic, Control Panel, Electronic	16260	D	3/14

CFP23E CONNECTION INFORMATION

SAE #0	FLYWHEEL HOUSING
1" NPT	FUEL INLET
1" NPT	FUEL OUTLET
1 1/4" NPT	RAW WATER INLET
1 1/2" NPT	RAW WATER DISCHARGE
120 / 240 VAC	COOLANT HEATER (3000WATTS)
6" DIA FLANGE	EXHAUST CONNECTION
OPTIONAL DRIVESHAFT	APT225
OPTIONAL STUB SHAFT	4.0" DIAMETER (101.6MM)







NOTES:
1. ALL PLUMBING MUST BE SUPPORTED AND OR ISOLATED SO THAT NO WEIGHT OR STREE IS APPLIED TO ANY ENGINE COMPONENT
2. REFER TO ENGINE DATA SHEET FOR CUSTOMER CONNECTION RECOMENDATIONS
3. DRAWING SUBJECT TO CHANGE WITH OUT NOTICE

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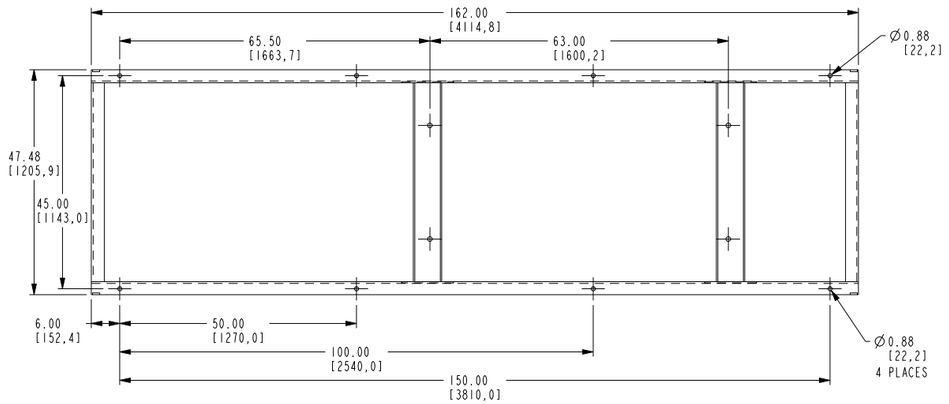
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

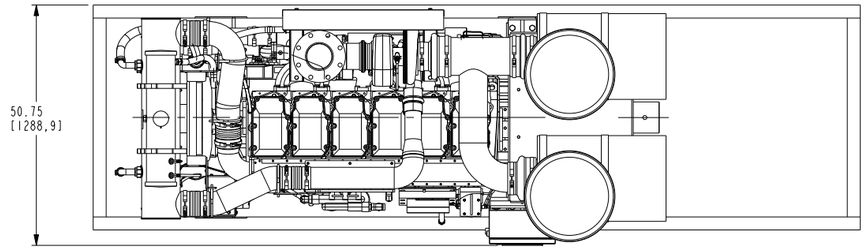
ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005 FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015 FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2 FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4 FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

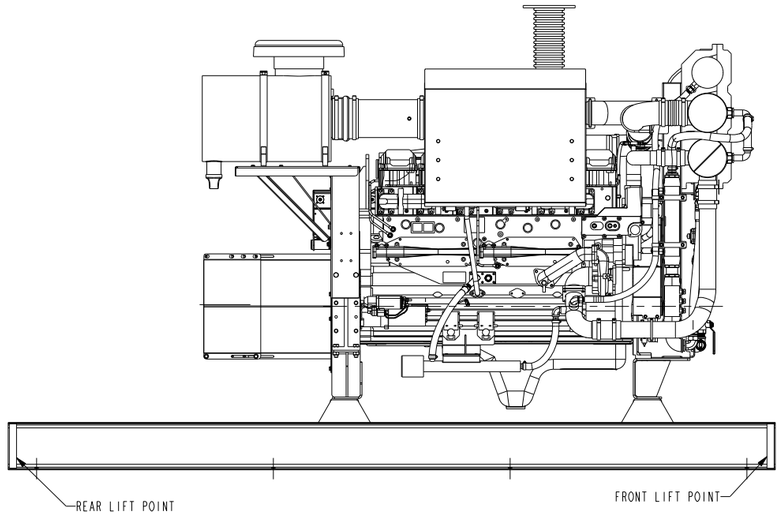
GENERAL ARRANGEMENT, INSTALLATION
CFP23E, F10-70

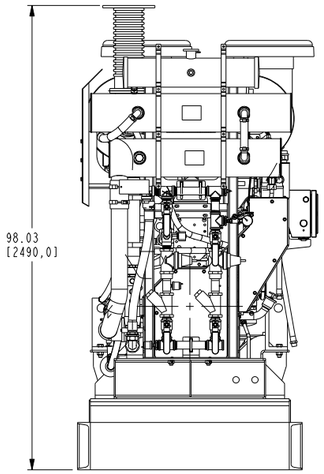
DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14NOV2012
	PRO-ENGINEER	INIT ECO:
SCALE: 0.063	SHEET 1 OF 4	DRAWING NO: 23581
EST WEIGHT: 0.000		

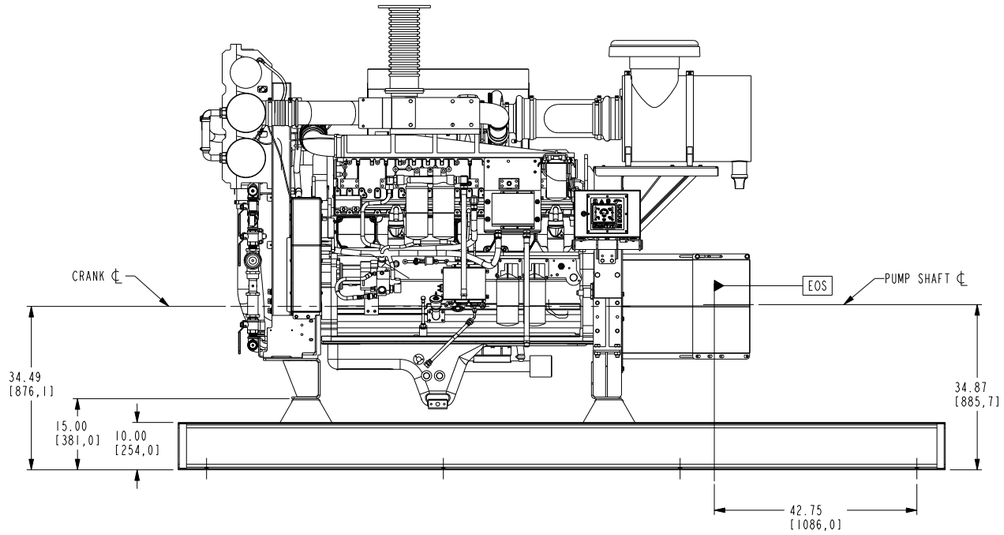
REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE











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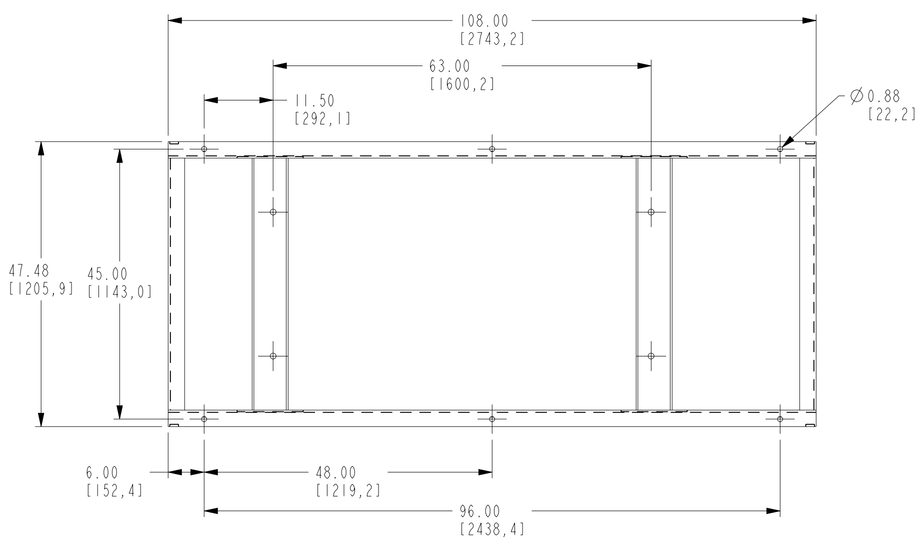
GENERAL ARRANGEMENT, INSTALLATION
CFP23E, F10-70

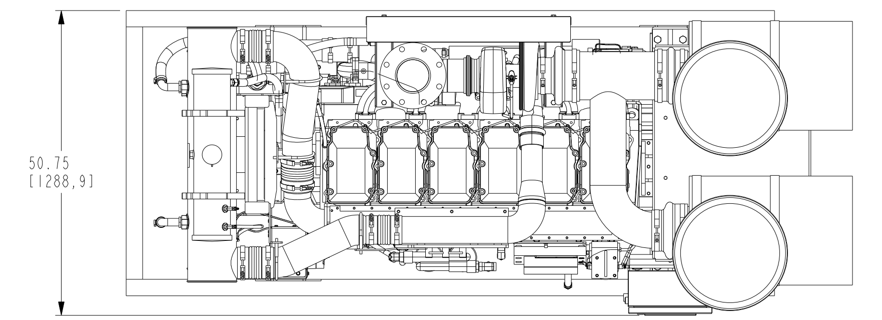
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

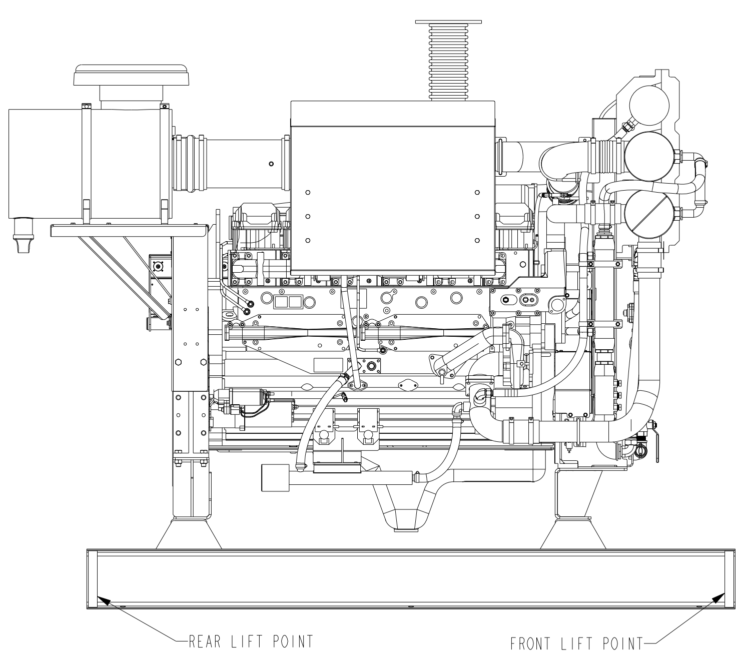
ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	.XX ± 0.02 .XXX ± 0.010 FOR THICKNESS .XX ± 0.05 FOR THICKNESS .XXX ± 0.025	.X ± 0.5 .XX ± 0.25 FOR THICKNESS .X ± 1.0 FOR THICKNESS .XX ± 0.50

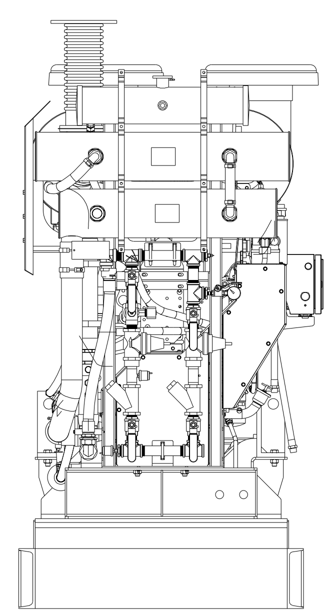
DWG UNITS: IN/LB/S
DRAWN BY: PBS
DATE: 14NOV2012
PRO-ENGINEER
INIT ECO:
SCALE: 0.063
SHEET 2 OF 4
DRAWING NO: 15554
EST WEIGHT: 0.000

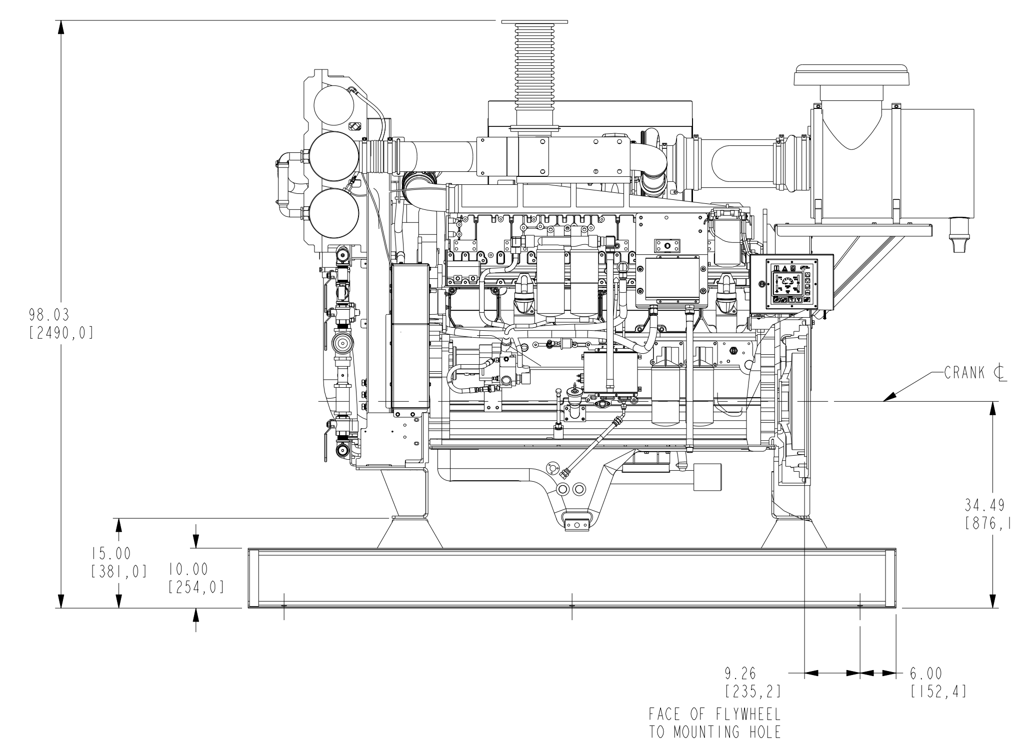
REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE











REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005 FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015 FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2 FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4 FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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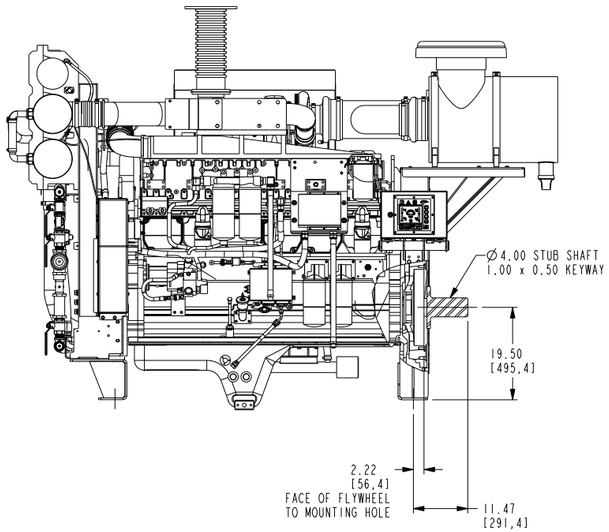
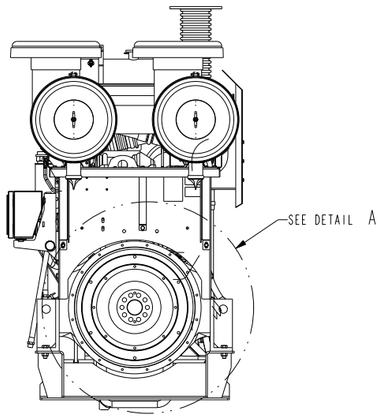
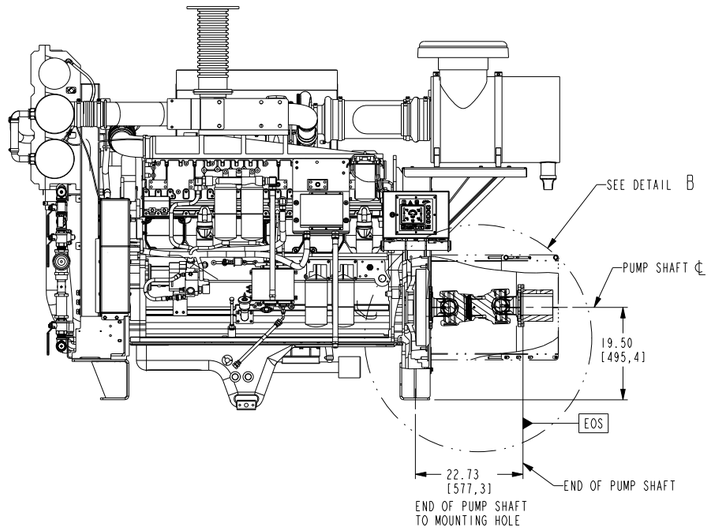
GENERAL ARRANGEMENT, INSTALLATION
CFP23E, F10-70

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14NOV2012
	PRO-ENGINEER	INIT ECO:
SCALE: 0.063	SHEET 3 OF 4	DRAWING NO: 15554
EST WEIGHT: 0.000		

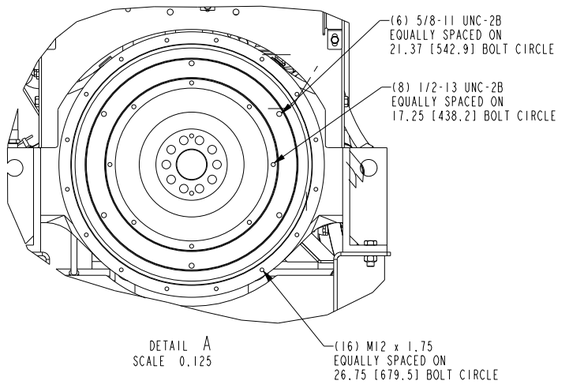


STUB SHAFT OPTION

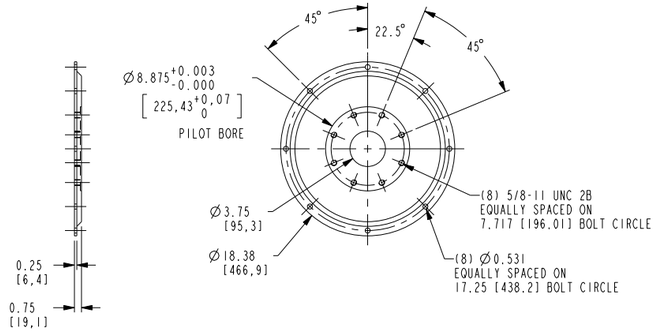




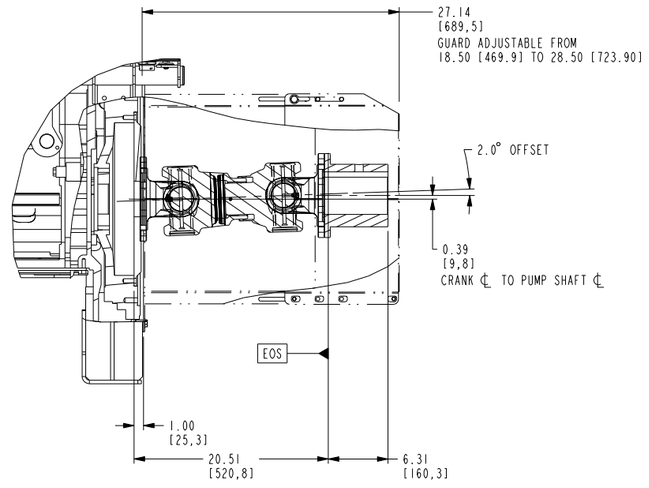
APT225 SHORT COUPLED SHAFT OPTION



FLYWHEEL DETAIL



U-JOINT ADAPTER DETAIL



REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	ONE PLACE DECIMALS ± 0.100 / TWO PLACE DECIMALS ± 0.030 / THREE PLACE DECIMALS ± 0.010 / FOUR PLACE DECIMALS ± 0.005	ONE PLACE DECIMALS ± 2,5 / TWO PLACE DECIMALS ± 0,75 / THREE PLACE DECIMALS ± 0,25 / FOUR PLACE DECIMALS ± 0,13

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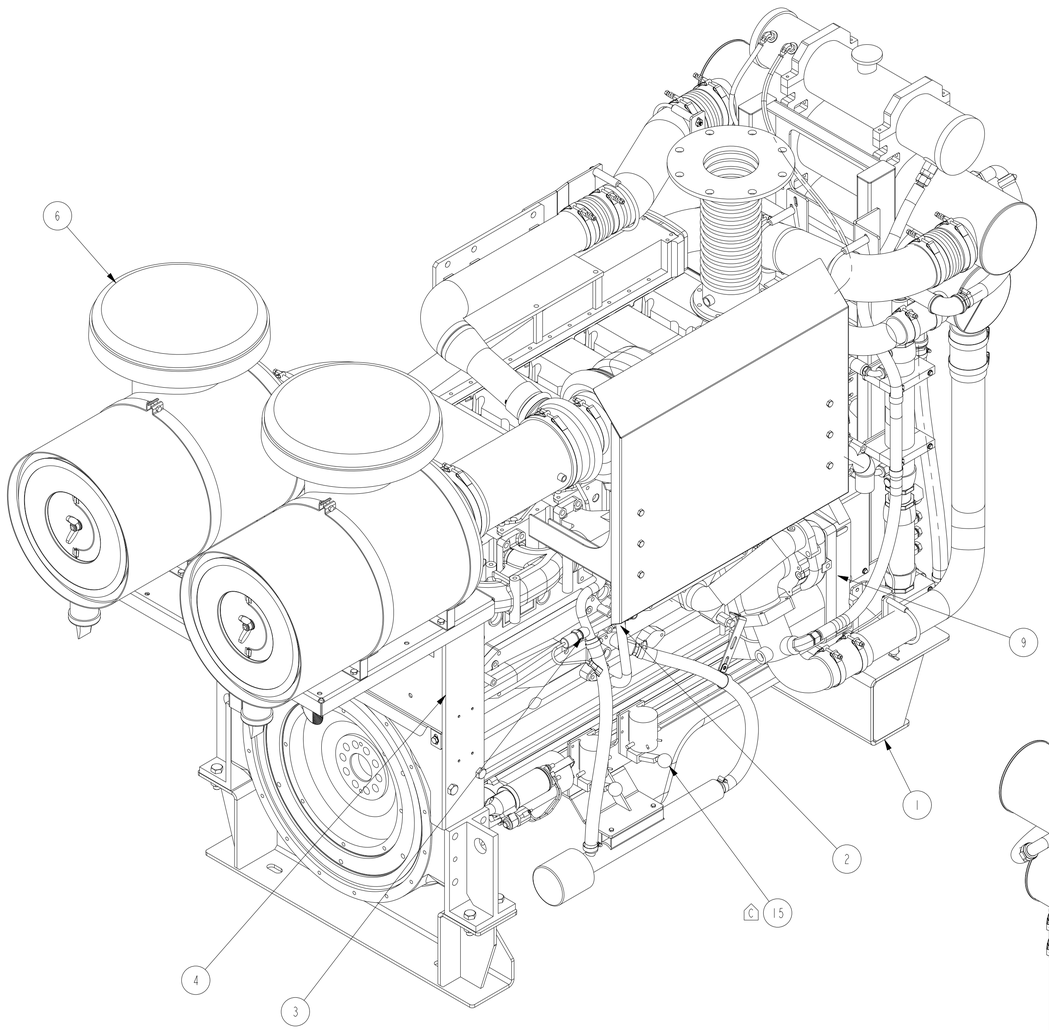
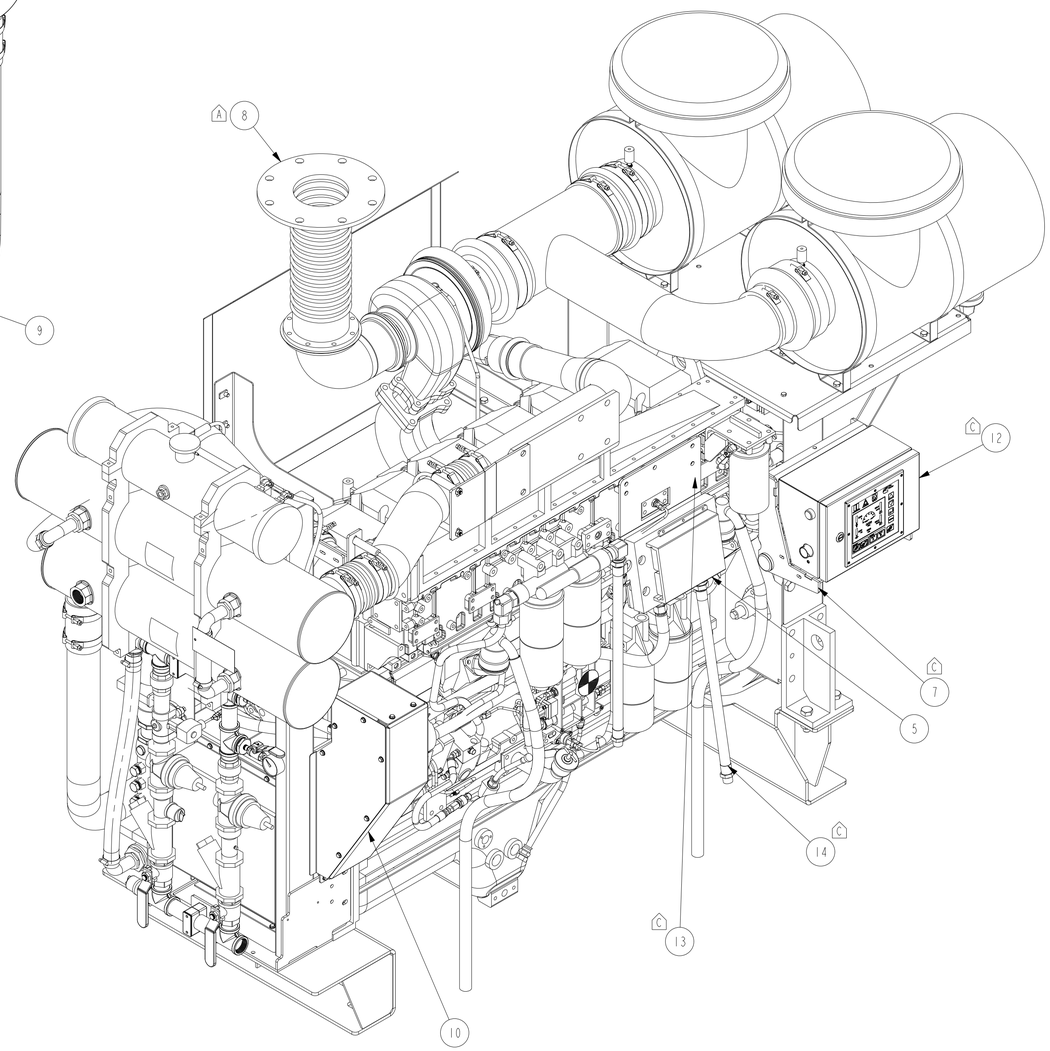
GENERAL ARRANGEMENT, INSTALLATION
CFP23E, F10-70

DWG UNITS: IN/LB/S
DRAWN BY: PBS
DATE: 14NOV2012
PRO-ENGINEER
INIT ECO:
SCALE: 0.063
EST WEIGHT: 0.000
SHEET 4 OF 4
DRAWING NO: 15554

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ASSY, SUPPORTS, ENGINE, CFP23E	13118
2	1	ASSEMBLY, COOLANT HEATER, CFP23E	13196
3	1	ASSEMBLY, SENSOR KIT, DIGITAL PANEL, CFP23E	14033
4	1	ASSEMBLY, OPERATOR STATION, CFP23E	14039
5	1	ASSEMBLY, ECM SECONDARY, CFP23E INDUSTRIAL	16124
6	1	SYSTEM, AIR CLEANER, CFP23E	17669
7	1	ASSEMBLY, CONTROL PANEL MOUNTING, CFP POWER UNITS	21249
8	1	FLEX, EXHAUST, 8" FLANGE, CFP23E	21839
9	1	ASSEMBLY, COOLING, CFP23E	23166
10	1	ASSEMBLY, GUARDING, CFP23E-F10-70	23293
11	1	COOLING LOOP, 1-1/4", 24V, RAW WATER, CFP23E	23427
12	1	CONTROL ASSEMBLY, FPDP ELECTRONIC CARBON STEEL	26764
13	1	ASSEMBLY, ENGINE, CFP23E-F10/20/30/40/50/60/70	26781
14	1	KIT, FUEL LINE, CFP23E	A042A380
15	2	CONTACTOR, MANUAL OVERIDE, 24V, PN:535-0098, FIREPUMP	8824-24
16	1	KIT, HARNESS, CFP23E, LEFT HAND	23669
17	1	KIT, LOOSE WIRE, CFP23E	23939
18	1	PAINT, SPRAY BOMB, CUMMINS RED	AI5730-AI2





REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	DELETED:15397, 12235-16-10, 15749, 23509 16825, 16889, 22791, 24805, 23342, 23343 23496-016, 10632, 13124 ADDED: 21249 26764, 26781, AI5730-AI2, A042A380, 8824-24	PBS	04FEB2014
B	2013-747	UPDATED PER DETAILS	PBS	13DEC2013
A	2013-266	21839 WAS 13119	S DUBICK	21MAY2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
	MACHINE TOLERANCES .XX = ± 0.010	MACHINE TOLERANCES .X = ± 0.3
125	FORM TOLERANCES .XX = ± 0.005	FORM TOLERANCES .X = ± 0.3
	FAB TOLERANCES .XX = ± 0.030	FAB TOLERANCES .X = ± 0.8

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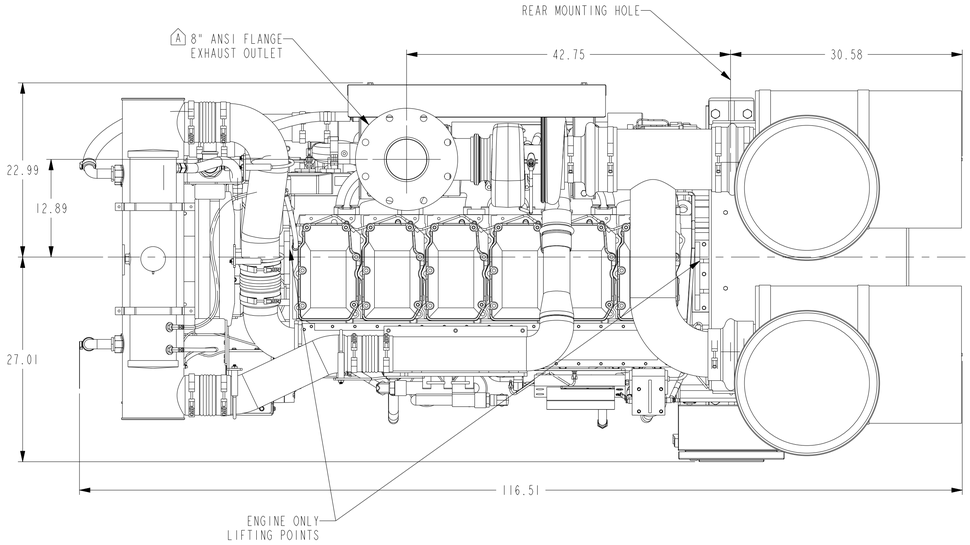
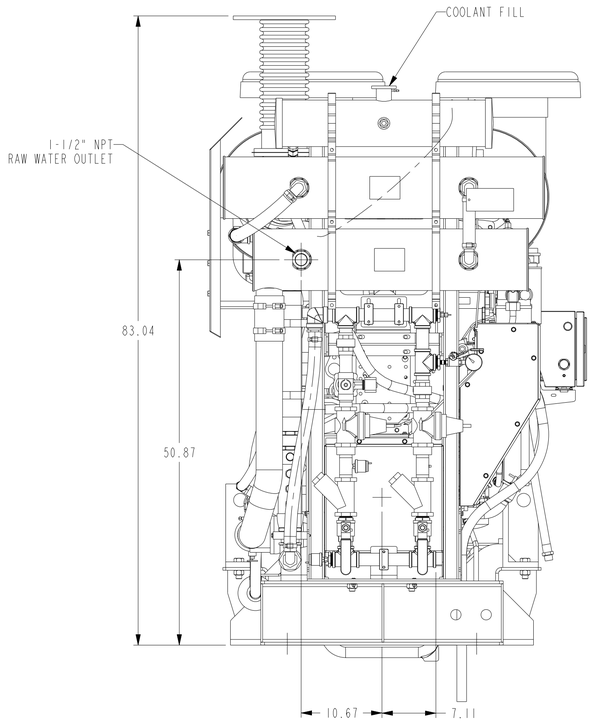
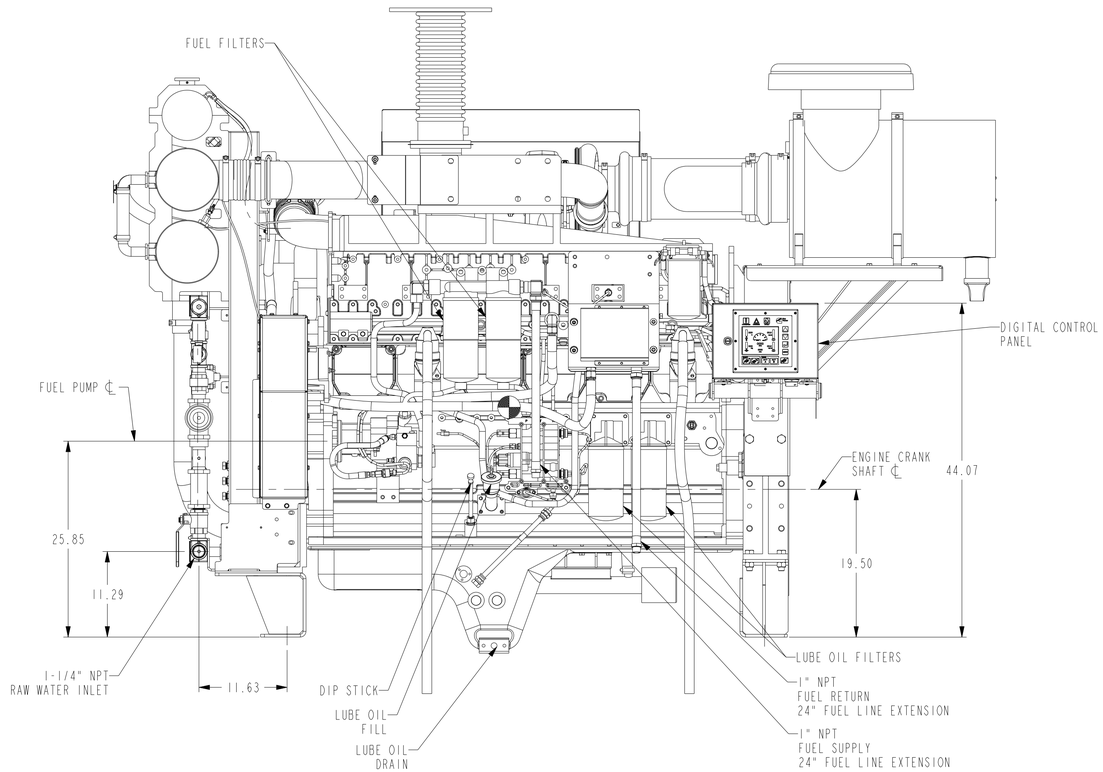
POWER UNIT
CFP23E F10/F20/F30/F40/F50/F60/F70

DWG UNITS: IN/LB/S
DRAWN BY: PBS
DATE: 14-NOV-12
PRO-ENGINEER
INIT ECO: 2011-232
SCALE: 0.125
EST WEIGHT: 0.000
SHEET 1 OF 3
DRAWING NO: 15554







REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	04FEB2014

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
	MACHINE TOLERANCES	MACHINE TOLERANCES
	.XX ± 0.010	.X ± 0.25
	.XXX ± 0.005	.XX ± 0.13
	FOR TOLERANCES OF FITS SEE ANSI B4.1	FOR TOLERANCES OF FITS SEE ANSI B4.2

125

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POWER UNIT
CFP23E F10/F20/F30/F40/F50/F60/F70

DWG UNITS: IN/LB/S

DRAWN BY: PBS

DATE: 14-NOV-12

PRO-ENGINEER

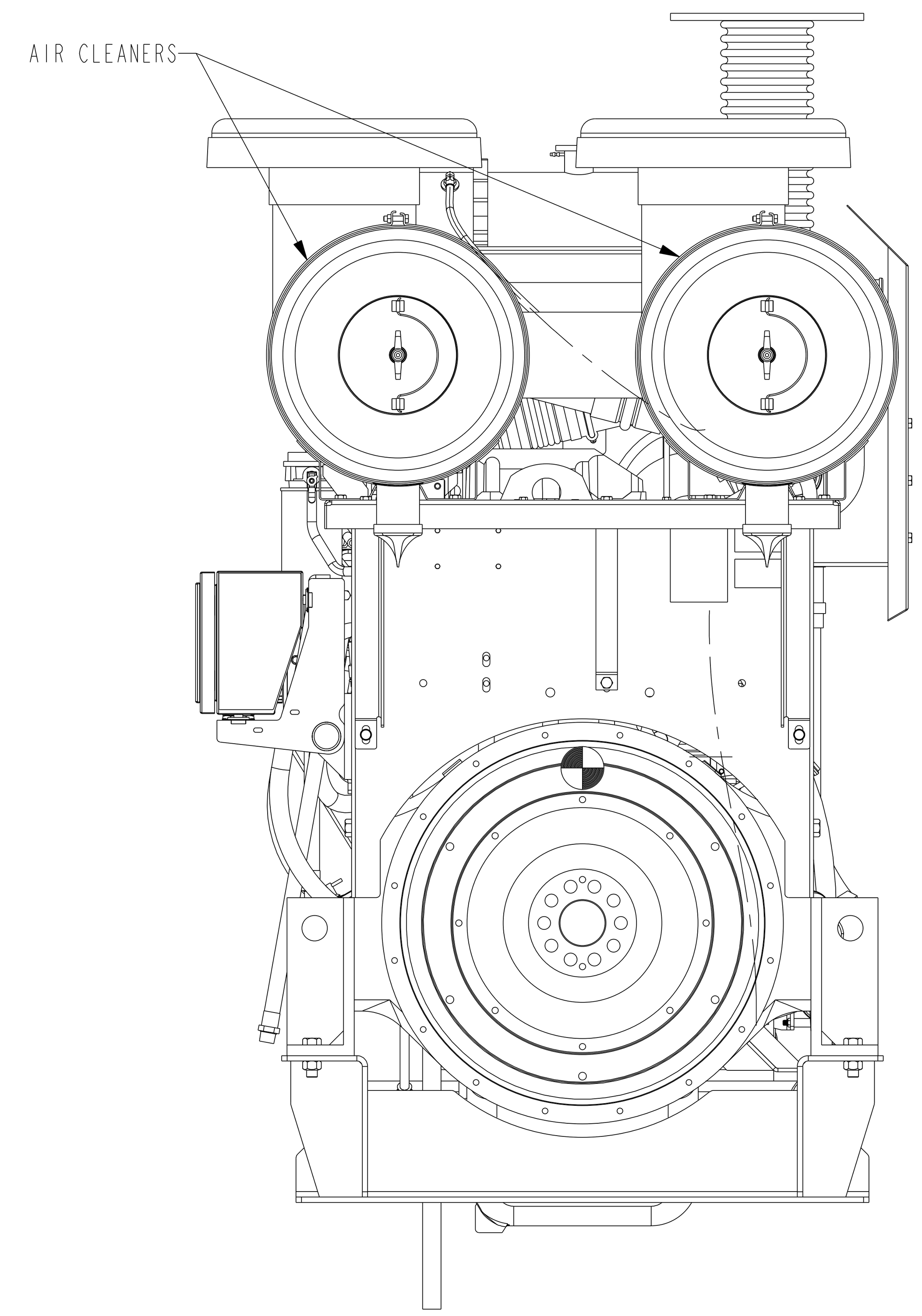
INIT ECO: 2011-232

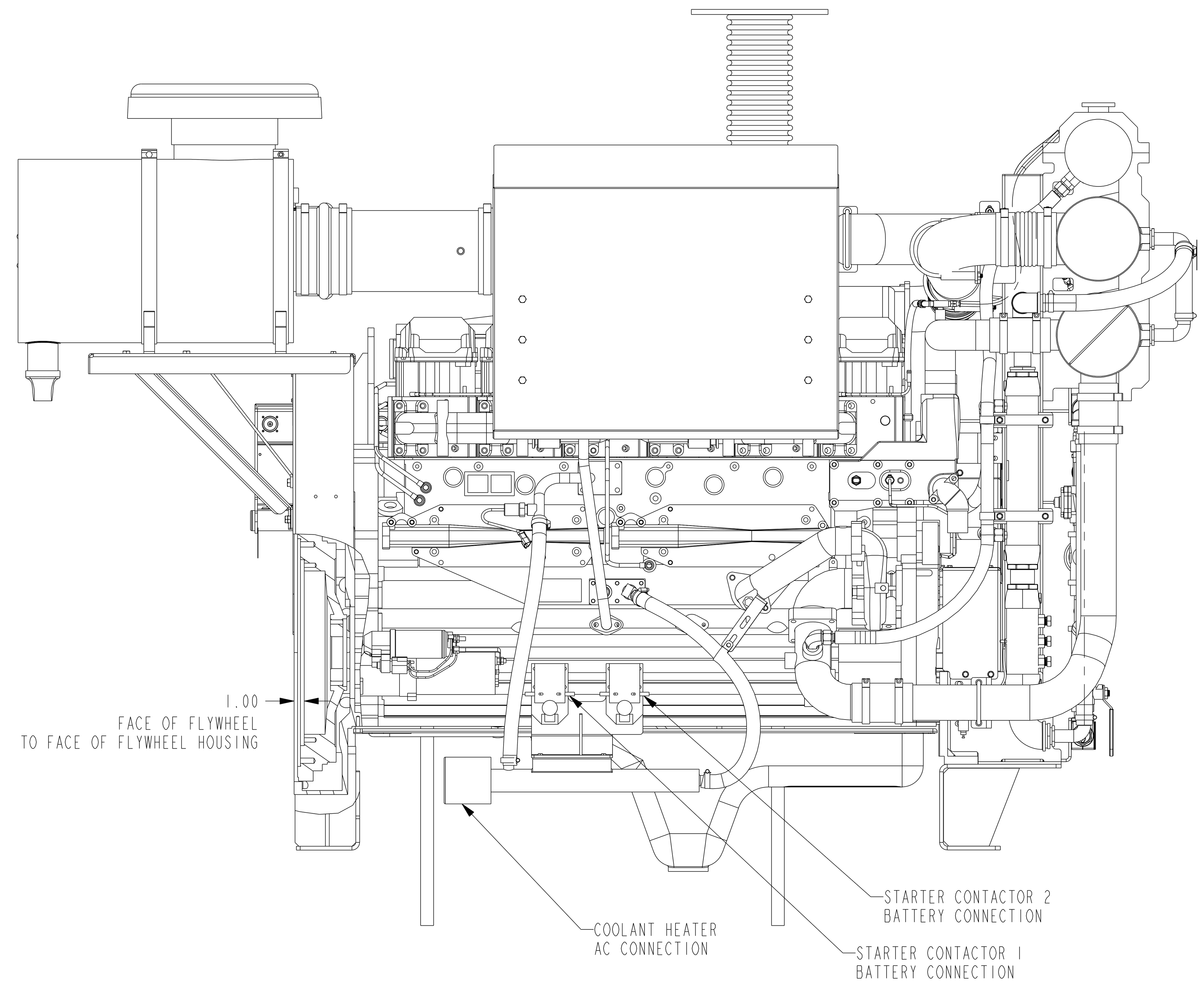
SCALE: 0.100

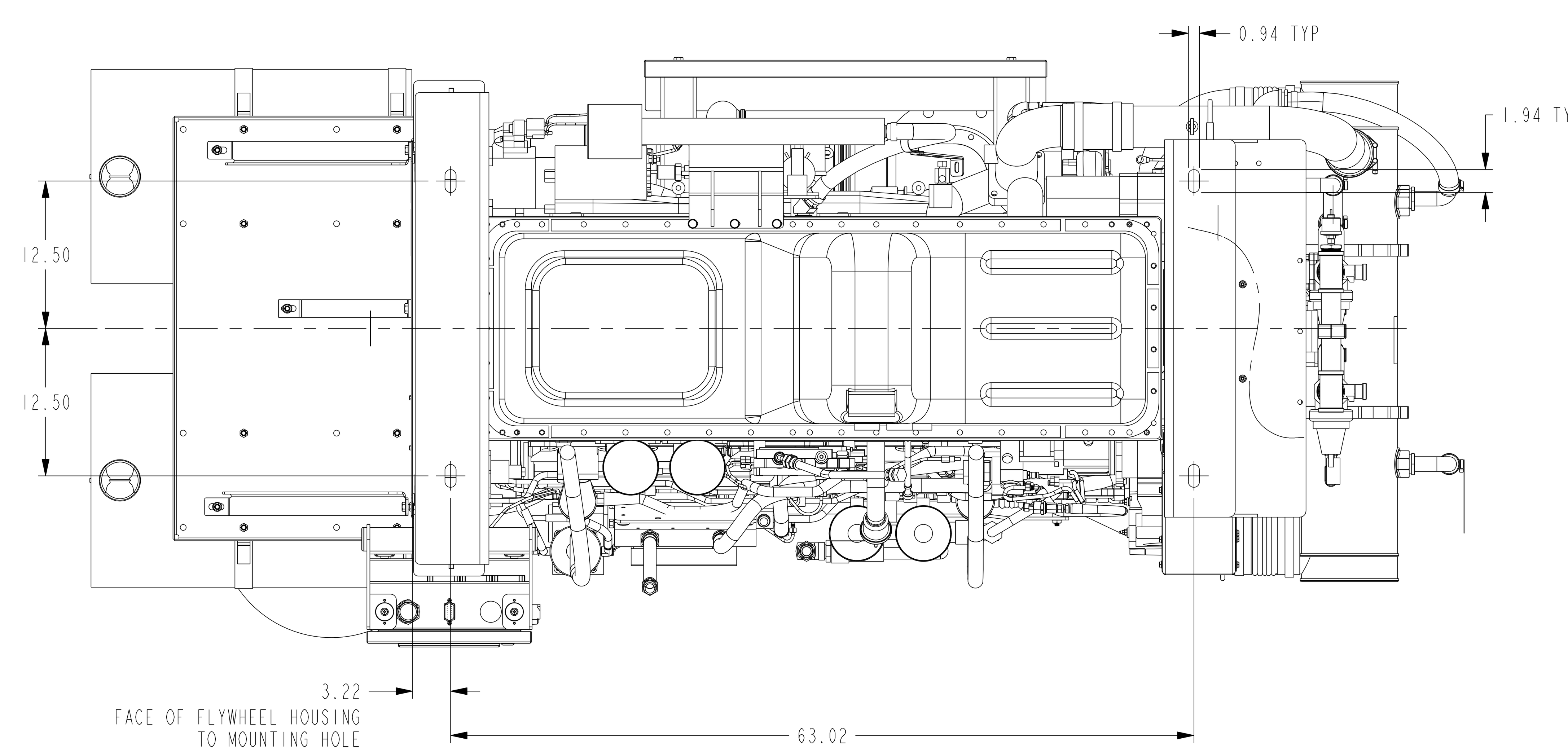
EST WEIGHT: 0.000

SHEET 2 OF 3

DRAWING NO: 15554







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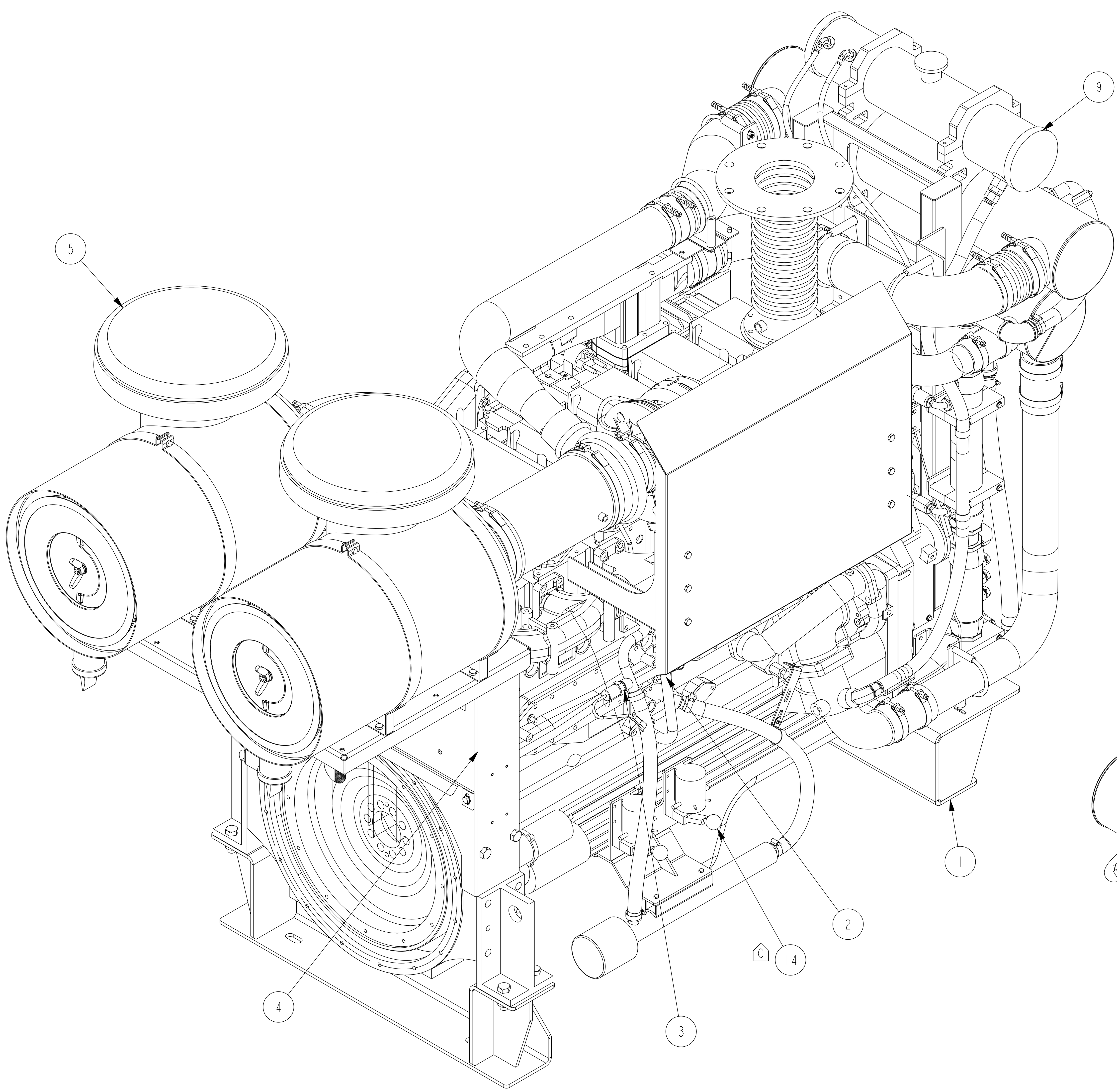
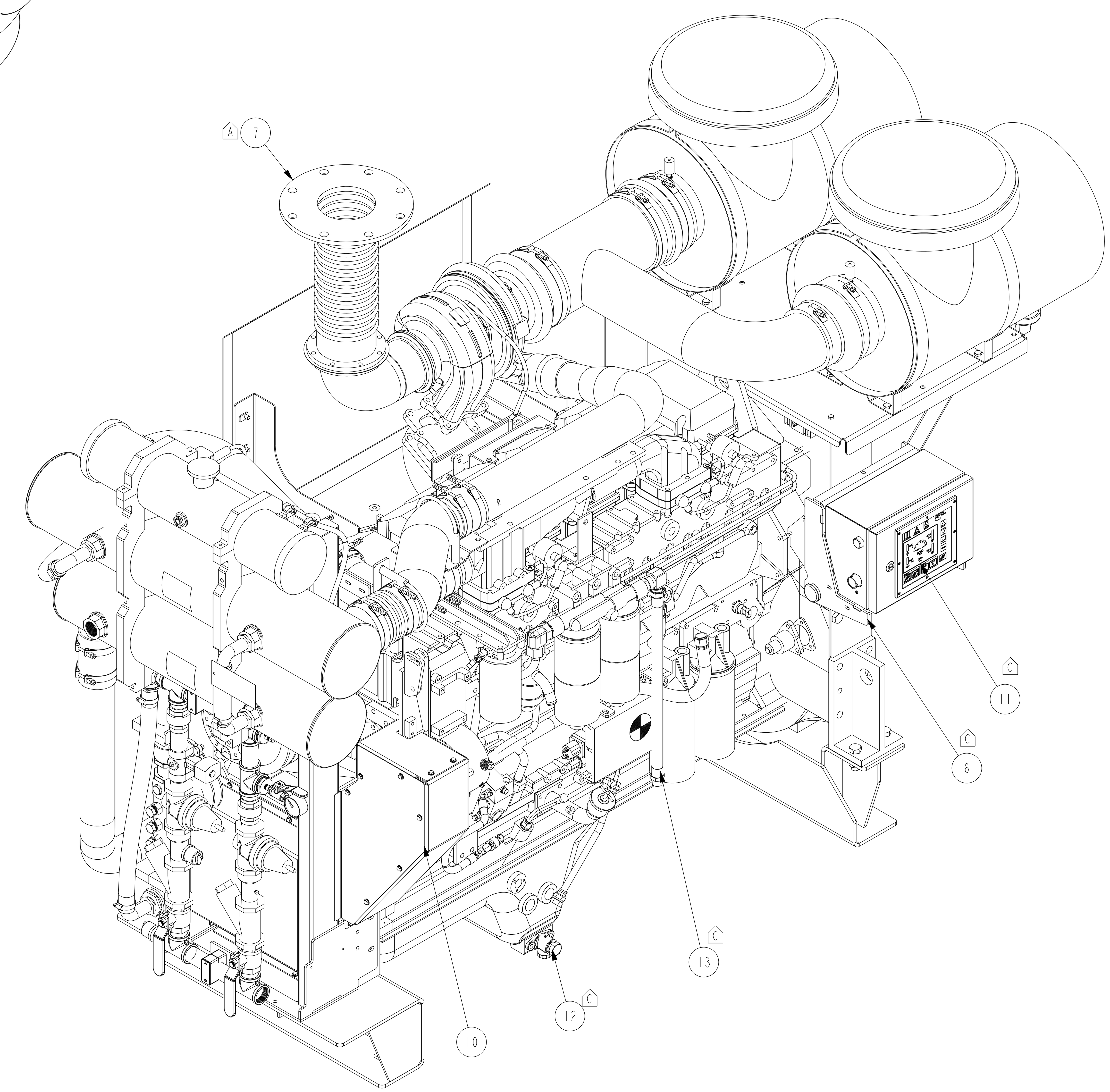
ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

POWER UNIT
CFP23E F10/F20/F30/F40/F50/F60/F70

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14-NOV-12
	PRO-ENGINEER	INIT ECO: 2011-232
SCALE: 0.100	SHEET 3 OF 3	DRAWING NO: 15554
EST WEIGHT: 0.000		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	04FEB2014





BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ASSY, SUPPORTS, ENGINE, CFP23E	13118
2	1	ASSEMBLY, COOLANT HEATER, CFP23E	13196
3	1	ASSEMBLY, SENSOR KIT, DIGITAL PANEL, CFP23E	14033
4	1	ASSEMBLY, OPERATOR STATION, CFP23E	14039
5	1	SYSTEM, AIR CLEANER, CFP23E	17669
6	1	ASSEMBLY, CONTROL PANEL MOUNTING, CFP POWER UNITS	21249
7	1	FLEX, EXHAUST, 8" FLANGE, CFP23E	21839
8	1	COOLING LOOP, 1-1/4", 24V, RAW WATER, CFP23E	23427
9	1	SYSTEM, COOLING ASSEMBLY, CFP23E	23762
10	1	ASSEMBLY, GUARDING, CFP23E-F15-35	23784
11	1	CONTROL ASSEMBLY, FPDP ELECTRONIC CARBON STEEL	26764
12	1	ASSEMBLY, ENGINE, CFP23E-F15/25/35	26782
13	1	KIT, FUEL LINE, CFP23E	A042A380
14	2	CONTACTOR, MANUAL OVERIDE, 24V, PN:535-0098, FIREPUMP	8824-24
15	1	KIT, HARNESS, CFP23E, LEFT HAND	23669
16	1	KIT, LOOSE WIRE, CFP23E	23939
17	1	PAINT, SPRAY BOMB, CUMMINS RED	A15730-A12

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	DELETED: 16301, 15749, 16825, 23342, 23343 13124, 23496, 23509, 16889, 22791, 24805 106322, 23767 ADDED: A15730-A12, 26764 21249, 26782, A042A380, 8824-24	PBS	04FEB2014
B	2013-747	UPDATED PER DETAILS	PBS	13DEC2013
A	2013-266	21839 WAS 13119	S DUBICK	21-MAY-13

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

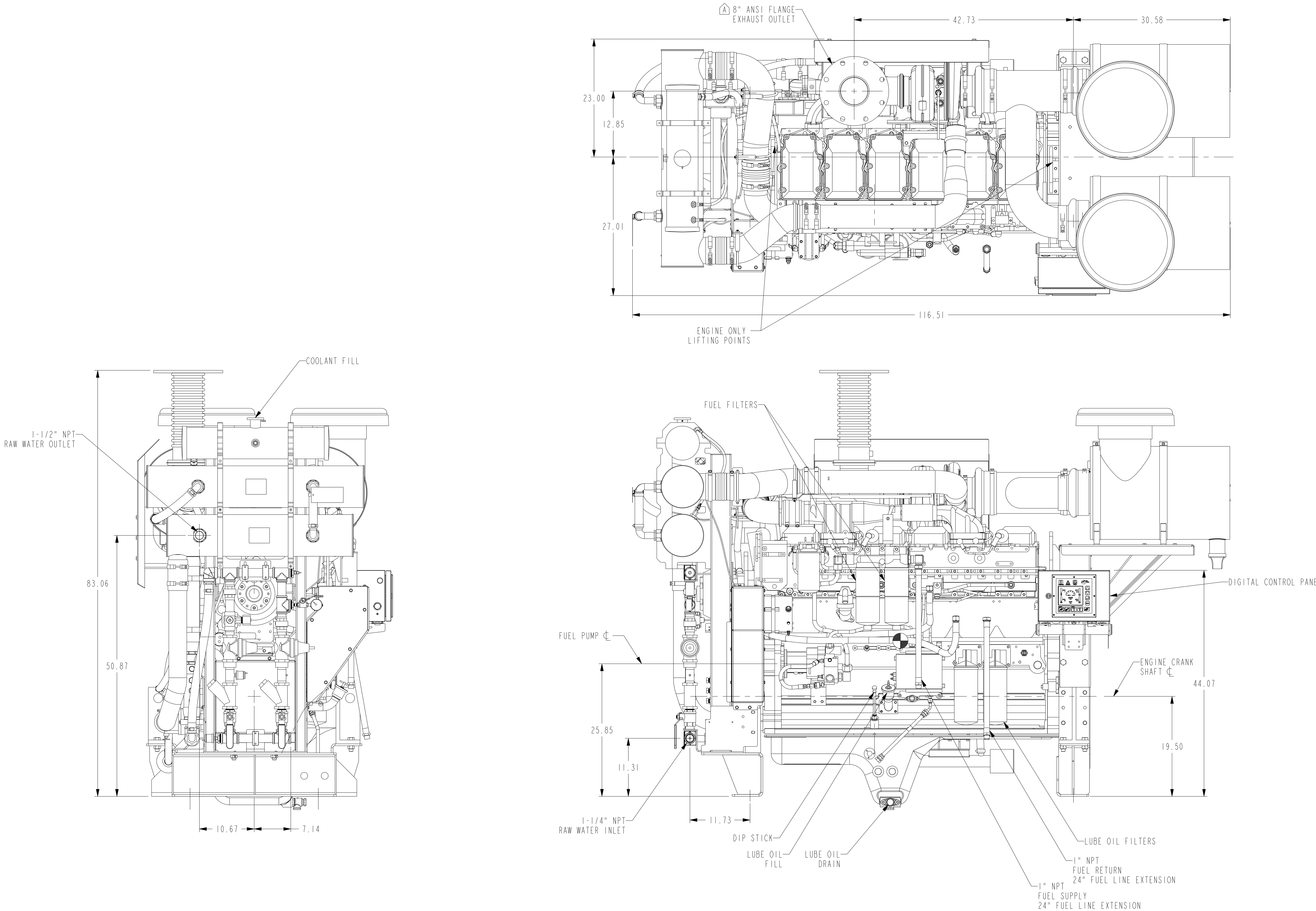
Cummins Fire Power

CUMMINS FIRE POWER LLC
CORPORATE OFFICE
1600 BUERKLE ROAD
WHITE BEAR LAKE, MN
WWW.CUMMINSFIREPOWER.COM

CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

POWER UNIT
CFP23E F15/F25/F35

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14NOV2012
	PRO-ENGINEER	INIT ECO: 2011-232
SCALE: 0.125	SHEET 1 OF 3	DRAWING NO: 23497
EST WEIGHT:		



UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
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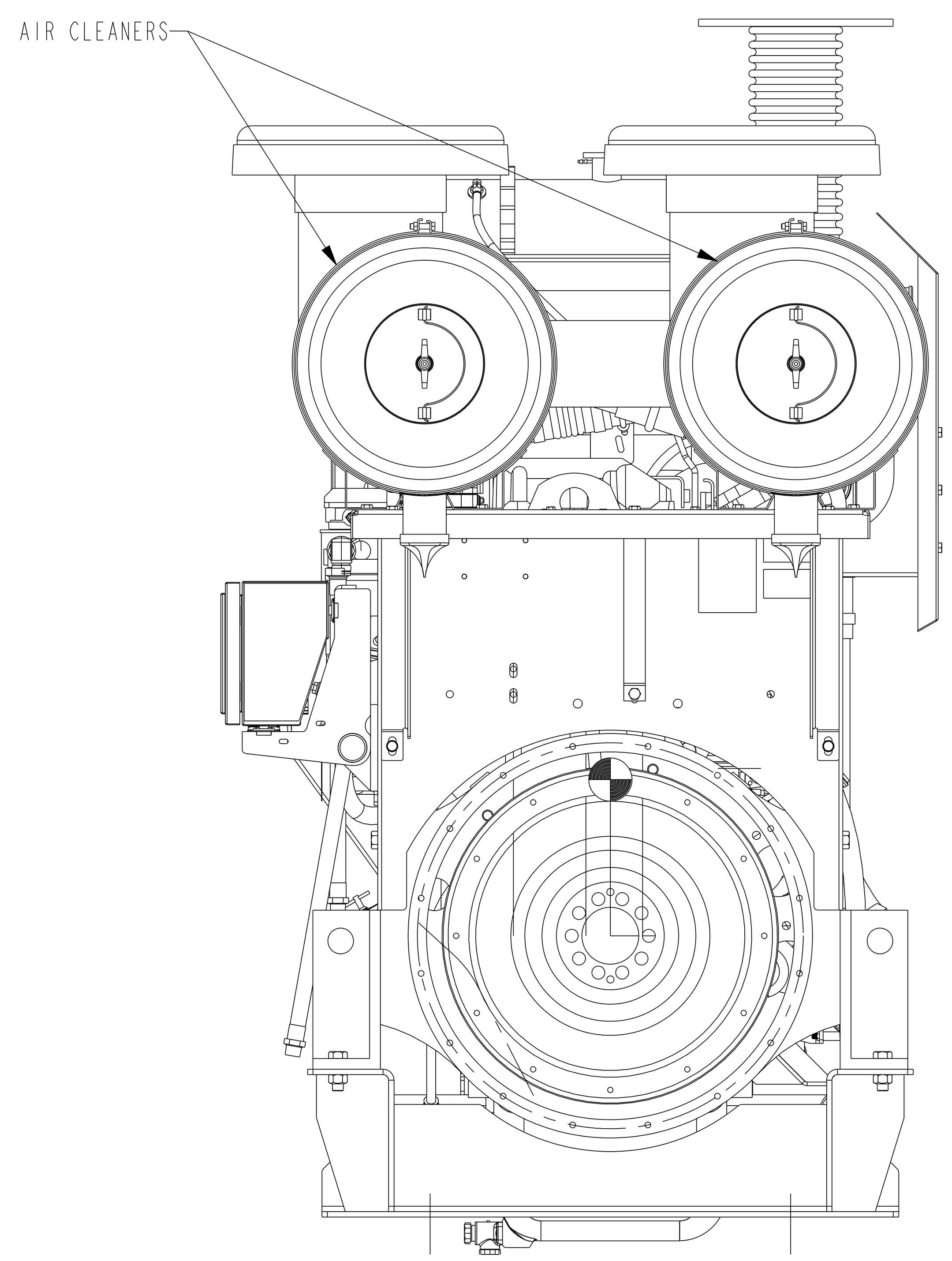
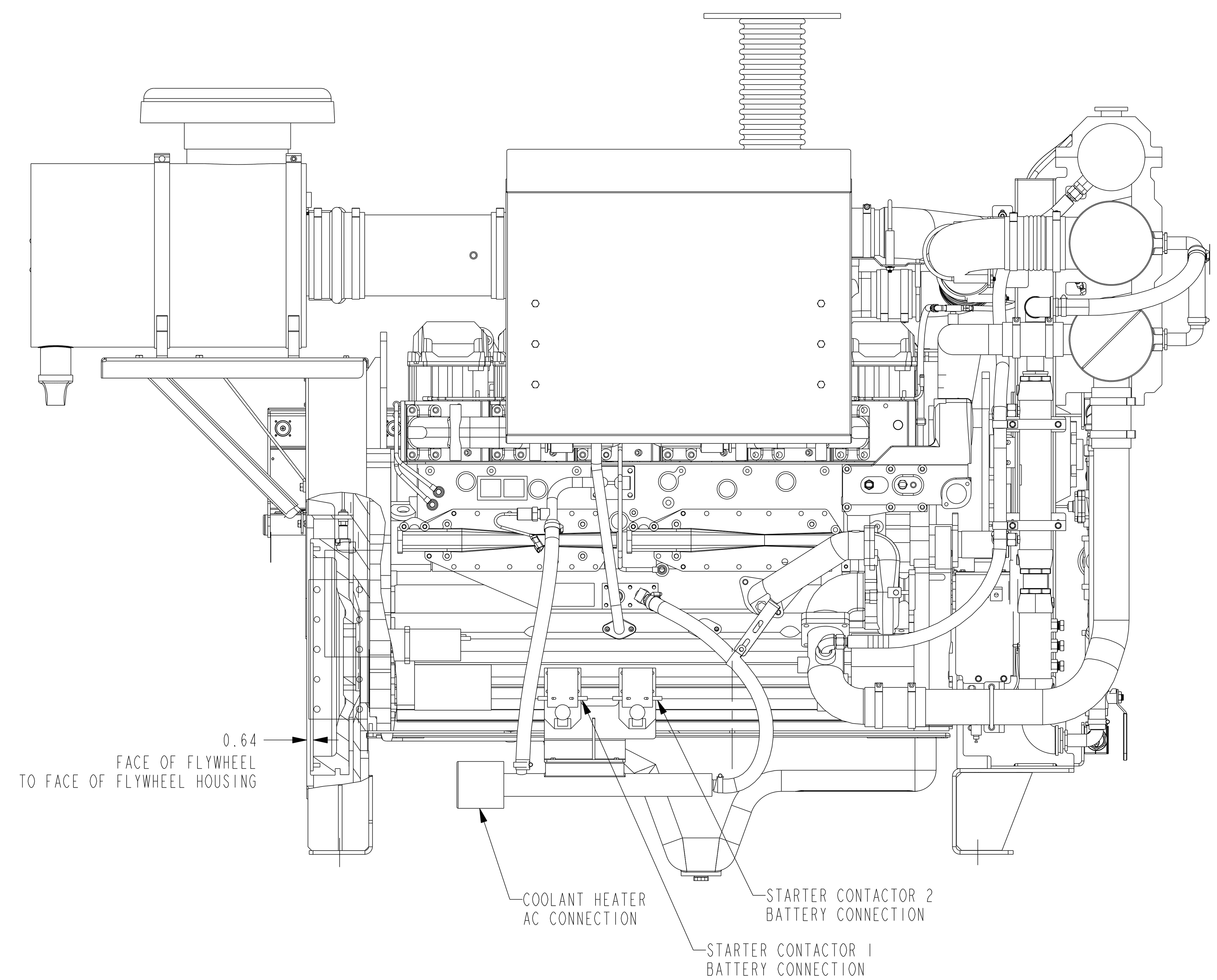
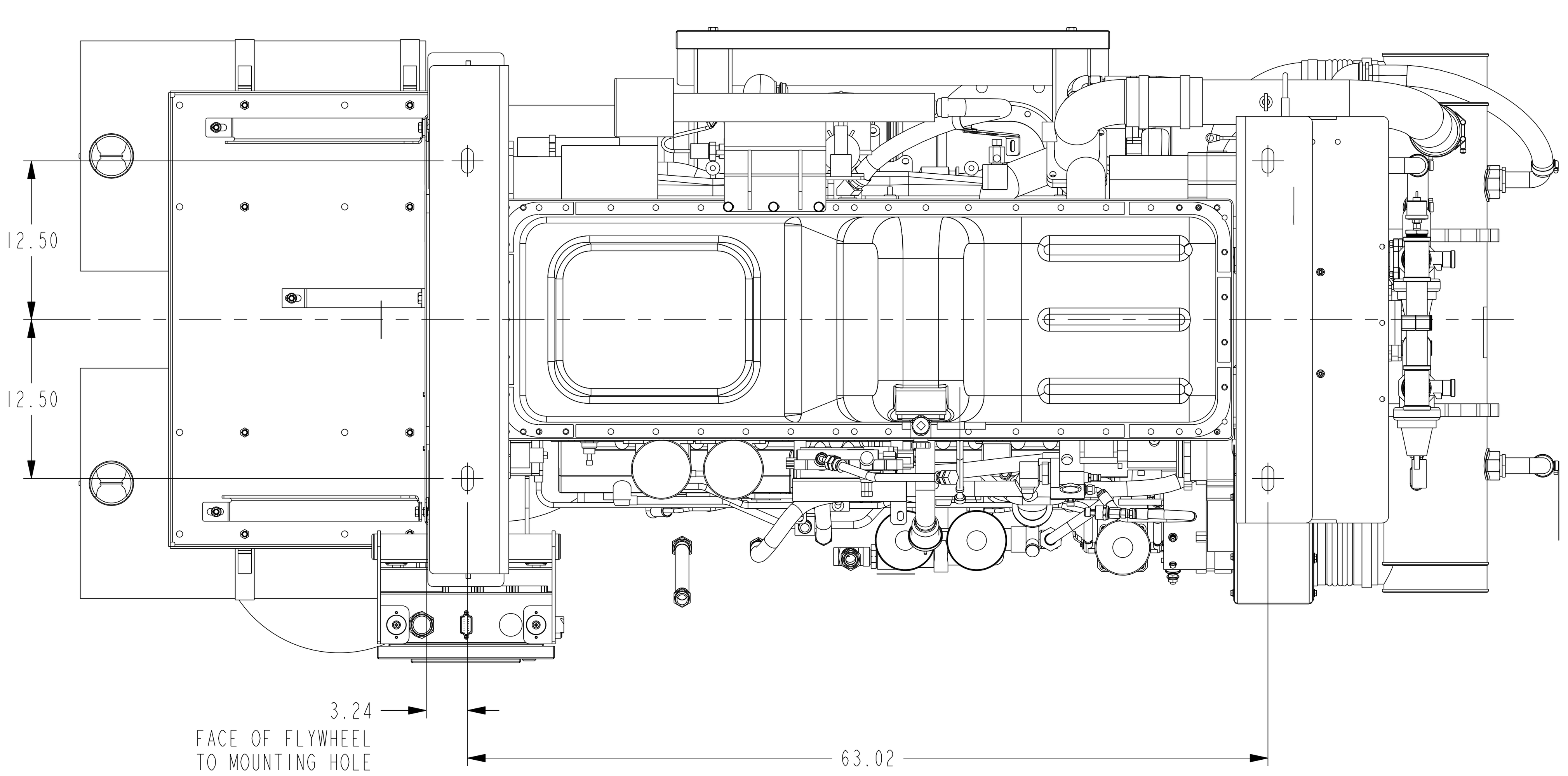
POWER UNIT
CFP23E F15/F25/F35

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14NOV2012
	PRO-ENGINEER	INIT ECO: 2011-232
SCALE: 0.100	SHEET 2 OF 3	DRAWING NO: 23497
EST WEIGHT:		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	04FEB2014







UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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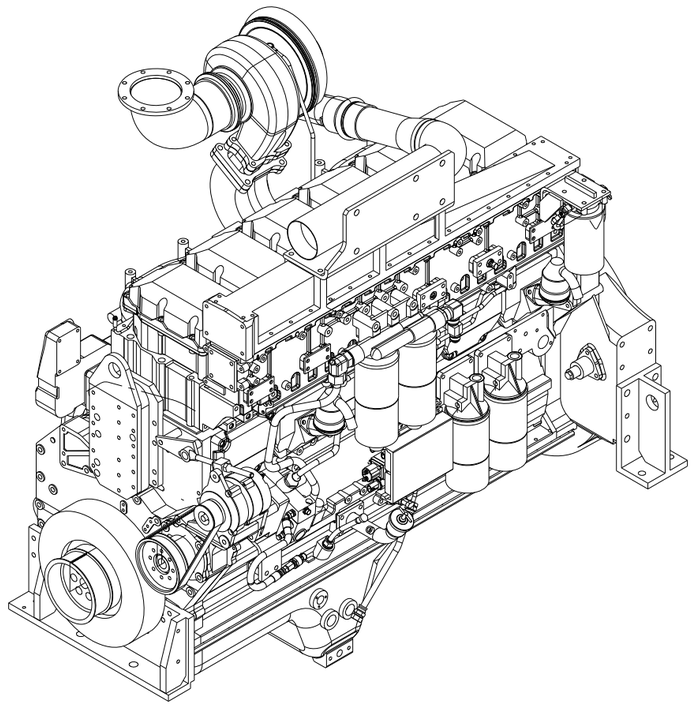
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

POWER UNIT
CFP23E F15/F25/F35

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14NOV2012
	PRO-ENGINEER	INIT ECO: 2011-232
SCALE: 0.100	SHEET 3 OF 3	DRAWING NO: 23497
EST WEIGHT:		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	04FEB2014



TP50017	PLUMBING, TURB	AH50005	AID, AIR HEATE
TP50018	PLUMBING, TURB	BB50005	BLOCK, CYLINDE
VC50003	ARRANGEMENT, V	BB50006	BLOCK, CYLINDE
VC50004	MOUNTING, VALV	BB50007	BLOCK, CYLINDE
WF50004	RESISTOR, CORR	BB50008	PLUMBING, CYLI
WF50008	RESISTOR, CORR	BB50009	BLOCK, CYLINDE
WF50009	RESISTOR, CORR	BB50010	BLOCK, CYLINDE
WI50002	CONNECTION	BB50011	BLOCK, CYLINDE
		BB50013	FOLLOWER, CAM
		BB50018	CRANKSHAFT, EN
		BR50005	ARRANGEMENT, C
		CB50004	ARRANGEMENT, E
		CM50005	COVER, CAM FOL
		CM50006	COVER, CAM FOL
		CM50008	COVER, CAM FOL
		CM50009	COVER, CAM FOL
		CM50010	COVER, CAM FOL
		DA50005	ARRANGEMENT, V
		DA50006	ARRANGEMENT, V
		DP50004	DRIVE, FUEL PU
		EC50003	THERMOSTAT
		EE50005	ALTERNATOR
		EH50012	MOUNTING, ALTE
		EH50013	MOUNTING, ALTE
		EM50005	SUPPORT, FRONT
		FA50023	MOUNTING, FAN
		FA50002	FILTER, FUEL
		FF50005	PLUMBING, FUEL
		FF50007	PLUMBING, FUEL
		FH50010	PLUMBING, FLYW
		FP57002	PUMP, FUEL INJ
		FT50017	PLUMBING, FUEL
		FT50023	PLUMBING, FUEL
		FT50024	PLUMBING, FUEL
		FT50025	PLUMBING, FUEL
		FW50009	FLYWHEEL
		GG50003	COVER, FRONT G
		GG50005	COVER, FRONT G
		IM50004	MANIFOLD, AIR
		IM50011	MANIFOLD, AIR
		IT50006	CONNECTION, AI
		LA50006	ARRANGEMENT, L
		LC50006	COOLER, ENGINE
		LC50008	COOLER, ENGINE
		LF50002	FILTER, FULL F
		LG50006	LOCATION, OIL
		LP50003	PUMP, LUBRICAT
		OB50002	ARRANGEMENT, O
		OP50006	PAN, OIL
		OP50007	PLUMBING, OIL
		OP50008	PLUMBING, OIL
		OP50009	MOUNTING, OIL
		PH50004	MOUNTING, ENG
		PH50006	MOUNTING, ENG
		PH50012	MOUNTING, ENG
		PH50015	MOUNTING, ENG
		PH50016	MOUNTING, ENG
		PH50017	MODULE, ENGINE
		PH50019	MOUNTING, ENG
		PH50022	MOUNTING, ENG
		PH50031	MOUNTING, ENG
		PH50032	PLUMBING, ENG
		PP50010	HEAD, CYLINDER
		PP50012	HEAD, CYLINDER
		PP50014	TURBOCHARGER
		PP50015	CAMSHAFT
		PP50028	INJECTOR
		PP50029	PISTON, ENGINE
		RD50002	DRAIN, REMOTE
		RL50003	LEVER, ROCKER
		RL50004	LEVER, ROCKER
		SM50001	MOUNTING, STAR
		ST50004	MOTOR, STARTIN
		TB50005	MANIFOLD, EXHA
		TH50005	PLUMBING, THM
		TH50007	ARRANGEMENT, T
		TP50016	PLUMBING, TURB

KAMATSU BC51061

CUMMINS FIRE POWER LLC
CORPORATE OFFICE
1600 BUERKLE ROAD
WHITE BEAR LAKE, MN
WWW.CUMMINSFIREPOWER.COM

CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ENGINE, QSK23, 1760 RPM, 1220 HP
G-DRIVE, HEAT EXCHANGER COOLED

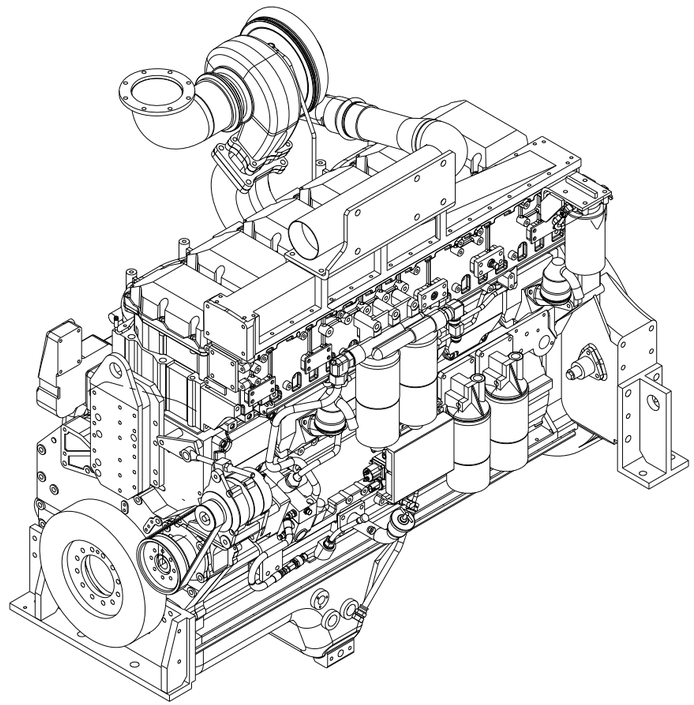
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	DECIMAL TOLERANCES .X ± 0.1 .XX ± 0.030 .XXX ± 0.010 FRACTIONS ± 1/64 ANGLES ± 1/2°	DECIMAL TOLERANCES .X ± 0.25 .XX ± 0.25 .XXX ± 0.25 FRACTIONS ± 1/64 ANGLES ± 1/2°

DWG UNITS:
DRAWN BY:
PRO-ENGINEER
DATE:
INIT ECO:
SCALE: 0.125
EST WEIGHT:
SHEET 1 OF 1
DRAWING NO: 12888

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2011-164	UPDATE BC OPTION	S DUBICK	24JUN2011

ST50004	MOTOR, STARTIN	AH50005	AID, AIR HEATE
TB50005	MANIFOLD, EXHA	BB50005	BLOCK, CYLINDE
TH50005	PLUMBING, THM	BB50006	BLOCK, CYLINDE
TH50007	ARRANGEMENT, T	BB50007	BLOCK, CYLINDE
TP50016	PLUMBING, TURB	BB50008	PLUMBING, CYLI
TP50017	PLUMBING, TURB	BB50009	BLOCK, CYLINDE
TP50018	PLUMBING, TURB	BB50010	BLOCK, CYLINDE
VC50003	ARRANGEMENT, V	BB50011	BLOCK, CYLINDE
VC50004	MOUNTING, VALV	BB50013	FOLLOWER, CAM
WF50004	RESISTOR, CORR	BB50018	CRANKSHAFT, EN
WF50008	RESISTOR, CORR	BR50005	ARRANGEMENT, C
WF50009	RESISTOR, CORR	CB50004	ARRANGEMENT, E
WI50002	CONNECTION, WA	CM50005	COVER, CAM FOL
WO50005	CONNECTION, WA	CM50006	COVER, CAM FOL
WP50006	PLUMBING, WATE	CM50008	COVER, CAM FOL
WP50007	PUMP, WATER	CM50009	COVER, CAM FOL
XS50002	CONNECTION, EX	CM50010	COVER, CAM FOL
		DA50005	ARRANGEMENT, V
		DA50006	ARRANGEMENT, V
		DP50004	DRIVE, FUEL PU
		EC50003	THERMOSTAT
		EE50005	ALTERNATOR
		EH50012	MOUNTING, ALTE
		EH50013	MOUNTING, ALTE
		EM50005	SUPPORT, FRONT
		FA50021	DRIVE, FAN
		FA50023	MOUNTING, FAN
		FA50025	DRIVE, FAN
		FA50026	DRIVE, FAN
		FA0035	DRIVE, FAN
		FA50002	FILTER, FUEL
		FF50005	PLUMBING, FUEL
		FF50007	PLUMBING, FUEL
		FH50010	PLUMBING, FLYW
		FP50045	MOUNTING, FUEL
		FP57002	PUMP, FUEL INJ
		FT50017	PLUMBING, FUEL
		FT50023	PLUMBING, FUEL
		FT50024	PLUMBING, FUEL
		FT50025	PLUMBING, FUEL
		FW50009	FLYWHEEL
		GG50003	COVER, FRONT G
		GG50005	COVER, FRONT G
		IM50004	MANIFOLD, AIR
		IM50011	MANIFOLD, AIR
		IT50006	CONNECTION, AI
		LA50006	ARRANGEMENT, L
		LC50006	COOLER, ENGINE
		LC50008	COOLER, ENGINE
		LF50002	FILTER, FULL F
		LG50006	LOCATION, OIL
		LP50003	PUMP, LUBRICAT
		OB50002	ARRANGEMENT, O
		OP50006	PAN, OIL
		OP50007	PLUMBING, OIL
		OP50008	PLUMBING, OIL
		OP50009	MOUNTING, OIL
		PH50004	MOUNTING, ENG
		PH50006	MOUNTING, ENG
		PH50012	MOUNTING, ENG
		PH50015	MOUNTING, ENG
		PH50016	MOUNTING, ENG
		PH50017	MODULE, ENGINE
		PH50019	MOUNTING, ENG
		PH50022	MOUNTING, ENG
		PH50032	PLUMBING, ENG
		PH50046	MOUNTING, ENG
		PP50010	HEAD, CYLINDER
		PP50012	HEAD, CYLINDER
		PP50014	TURBOCHARGER
		PP50015	CAMSHAFT
		PP50028	INJECTOR
		PP50029	PISTON, ENGINE
		RD50002	DRAIN, REMOTE
		RL50003	LEVER, ROCKER
		RL50004	LEVER, ROCKER
		SM50001	MOUNTING, STAR



KAMATSU BC51063

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	DECIMAL TOLERANCES	DECIMAL TOLERANCES
		.XX ± 0.03	.X ± 0.8
		.XXX ± 0.010	.XX ± 0.25
		.XXXX ± 0.005	.XXX ± 0.13

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

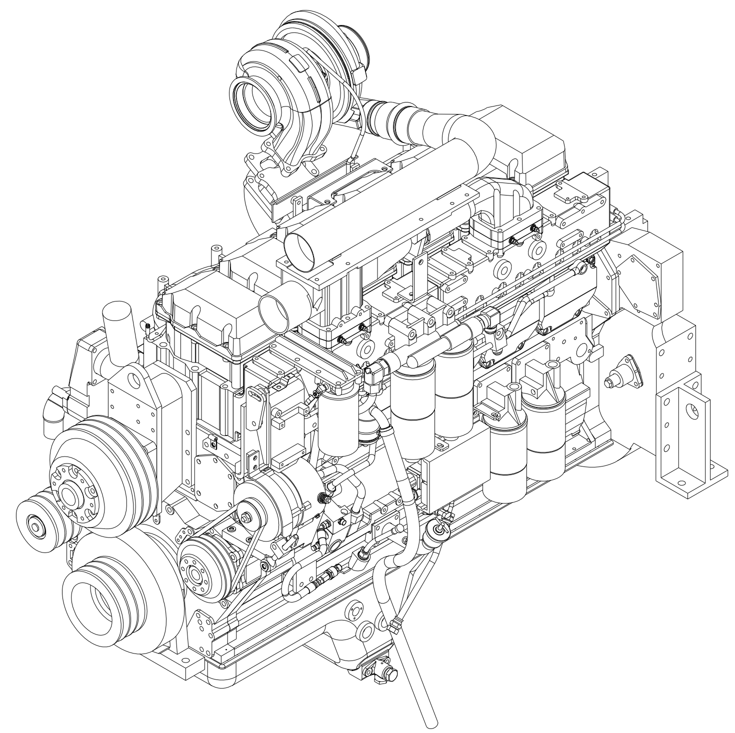
CUMMINS FIRE POWER LLC
CORPORATE OFFICE
1600 BUERKLE ROAD
WHITE BEAR LAKE, MN
WWW.CUMMINSFIREPOWER.COM

CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ENGINE, QSK23, 1470 RPM, 968 HP
G-DRIVE, HEAT EXCHANGER COOLED

DWG UNITS:
DRAWN BY:
PRO-ENGINEER
DATE:
INIT ECO:

SCALE: 0.125
EST WEIGHT:
SHEET 1 OF 1
DRAWING NO: 15397



PP50026	TURBOCHARGER
PP50029	PISTON, ENGINE
RD50002	DRAIN, REMOTE
RL50003	LEVER, ROCKER
RL50004	LEVER, ROCKER
SM50001	MOUNTING, STAR
ST50004	MOTOR, STARTIN
TB50005	MANIFOLD, EXHA

AD50004	PULLY, ACCESS
AF50001	PULLY, CRANKS
AH50002	AID, AIR HEATE
AH50004	AID, AIR HEATE
BB50005	BLOCK, CYLINDE
BB50006	BLOCK, CYLINDE
BB50007	BLOCK, CYLINDE
BB50008	PLUMBING, CYLI
BB50009	BLOCK, CYLINDE
BB50010	BLOCK, CYLINDE
BB50011	BLOCK, CYLINDE
BB50013	FOLLOWER, CAM
BB50018	CRANKSHAFT, EN
BR50006	BRATHER, CRAN
CB50004	ARRANGEMENT, E
CF50002	COMPRESSOR, RE
CM50005	COVER, CAM FOL
CM50006	COVER, CAM FOL
CM50008	COVER, CAM FOL
CM50009	COVER, CAM FOL
CM50013	COVER, CAM FOL
DA50004	ARRANGEMENT, V
DP50004	DRIVE, FUEL PU
EC50003	THERMOSTAT
EE50005	ALTERNATOR
EH50009	MOUNTING, ALTE
EH50010	MOUNTING, ALTE
EH50011	MOUNTING, ALTE
EM50003	SUPPORT, FRONT
FA50016	DRIVE, FAN
FA50017	DRIVE, FAN
FA50018	MOUNTING, FAN
FA50019	DRIVE, FAN
FA50020	DRIVE, FAN
FF50002	FILTER, FUEL
FF50004	PLUMBING, FUEL
FH50005	PLUMBING, FUEL
FH50007	HOUSING, FLYWH
FH50010	PLUMBING, FLYW
FP50045	MOUNTING, FUEL
FP57002	PUMP, FUEL INJ
FT50017	PLUMBING, FUEL
FT50020	PLUMBING, FUEL
FT50024	PLUMBING, FUEL
FT50025	PLUMBING, FUEL
FW50009	FLYWHEEL
GG50004	COVER, FRONT G
GG50008	COVER, FRONT G
IC50005	CONNECTION, AI
IM50007	MANIFOLD, AIR
IM50009	MANIFOLD, AIR
IT50010	CONNECTION, AI
LA50006	ARRANGEMENT, L
LC50003	COOLER, ENGINE
LC50005	COOLER, ENGINE
LF50002	FILTER, FULL F
LG50006	LOCATION, OIL
LP50003	PUMP, LUBRICAT
OB50002	ARRANGEMENT, O
OP50006	PAN, OIL
OP50007	PLUMBING, OIL
OP50008	PLUMBING, OIL
OP50009	MOUNTING, OIL
PH50011	MOUNTING, ENG
PH50016	MOUNTING, ENG
PH50017	MODULE, ENGINE
PH50022	MOUNTING, ENG
PH50026	MOUNTING, ENG
PH50027	MOUNTING, ENG
PH50032	PLUMBING, ENG
PH50033	MOUNTING, ENG
PH50043	MOUNTING, ENG
PH50053	MOUNTING, ENG
PP50009	CAMSHAFT
PP50010	HEAD, CYLINDER
PP50012	HEAD, CYLINDER
PP50013	INJECTOR

KAMATSU OPTION: BC51104

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS: MACHINE TOLERANCES .XX = ± 0.010, .XXX = ± 0.005; FORM TOLERANCES .XX = ± 0.030, .XXX = ± 0.015; FAB TOLERANCES .XX = ± 0.060, .XXX = ± 0.030 | METRIC UNITS: MACHINE TOLERANCES .X = ± 0.4, .XX = ± 0.2; FORM TOLERANCES .X = ± 0.8, .XX = ± 0.4; FAB TOLERANCES .X = ± 1.5, .XX = ± 0.8

THIRD ANGLE PROJECTION

Cummins Fire Power

CUMMINS FIRE POWER LLC
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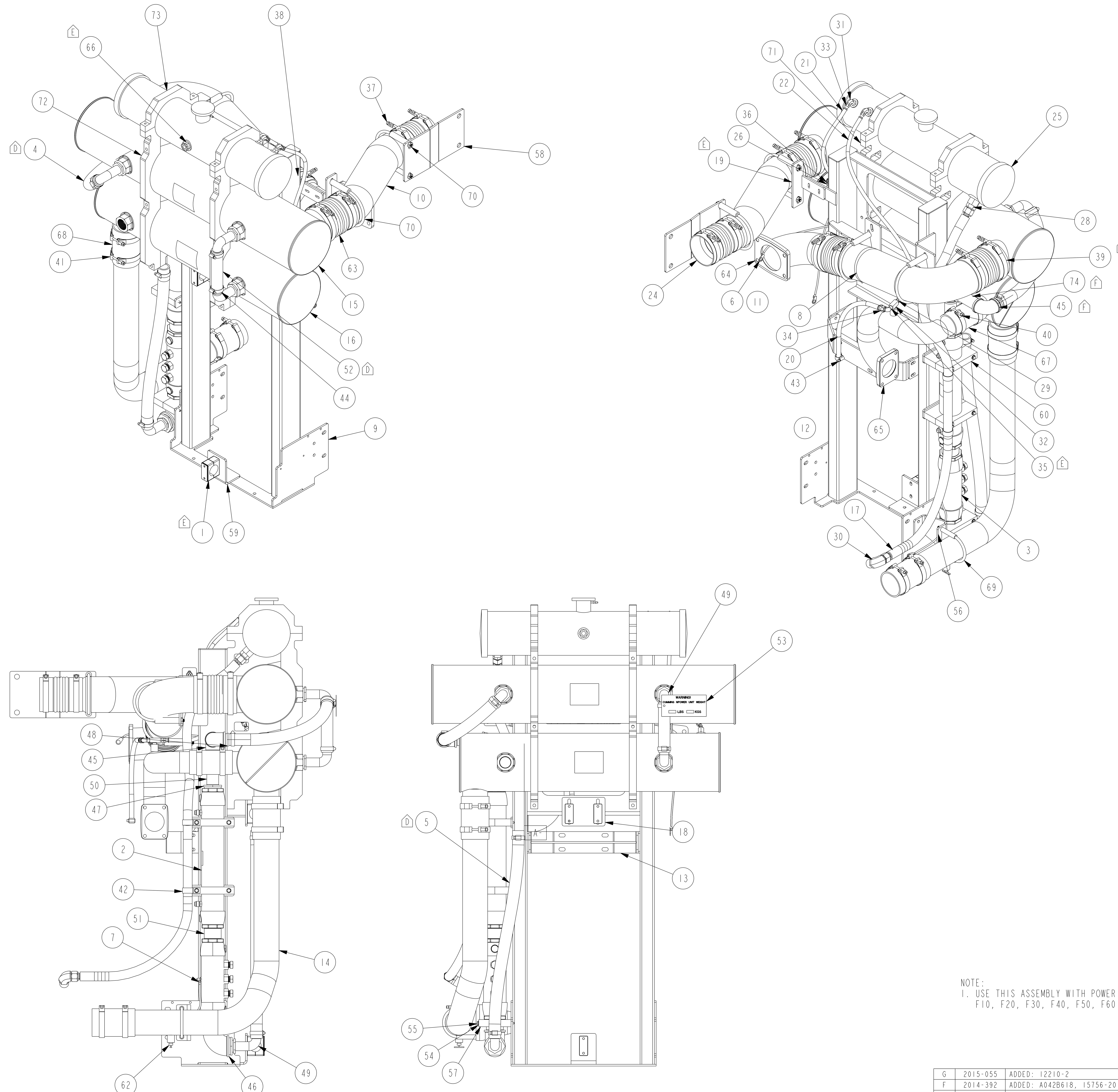
WWW.CUMMINSFIREPOWER.COM

CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ENGINE, QSK23, 2100 RPM, 950 HP
INDUSTRIAL, RADIATOR/HEAT EXCHANGER COOLED

DWG UNITS:	DRAWN BY: PRO-ENGINEER	DATE:
		INIT ECO:
SCALE: 0.100	SHEET 1 OF 1	DRAWING NO: 16301
EST WEIGHT:		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	3	CLAMP,PIPE,1.25",PLASTIC, W/COVER PLATE	14924
2	1	FUEL COOLER, COPPER NICKEL, 3" DIA, 2" NPT ENDS, FP23E	15729
3	1	ZINC MODULE, 2" NPT, 3 ANODES	15804
4	1	HOSE, SILCONE, 1-1/4" I.D., 19" LONG	78125GL
5	1	HOSE, SILCONE, 1-1/4" I.D., 30" LONG	78125GL
6	2	GROUND STRAP, 1/4" BRAID, 24" LONG, 1/4" & 1/2" TERMINALS	15843
7	1	GROUND STRAP, 1/4" BRAID, 12" LONG, 1/4" & 1/2" TERMINALS	15813
8	1	TUBE, INTAKE, CFP23E	23178
9	1	MOUNT, COOLING ASSEMBLY, CFP23E	23179
10	1	TUBE, INTAKE, CFP23E	23212
11	1	ELBOW, INTAKE, CFP23E	23223
12	1	ELBOW, JACKET WATER, CFP23E	23231
13	1	BRACE, HEAT EXCHANGER STAND, CFP23E	23236
14	1	TUBE, JACKET WATER, CFP23E	23256
15	1	HEAT EXCHANGER, CAC, COPPER NICKEL, 8" DIA, CFP23E	23312
16	1	HEAT EXCHANGER, JW, COPPER NICKEL, 8" DIA, CFP23E	23317
17	1	HOSE, WATER FILL, CFP23E	23338
18	1	BRACKET, COOLING LOOP, CFP23E	23432
19	1	BRACKET, CAC, CFP23E	A042B293
20	1	HOSE, VENT LINE, 16" LENGTH	R-801-6
21	1	HOSE, VENT LINE, 19" LENGTH	R-801-4
22	1	HOSE, VENT LINE, 31" LENGTH	R-801-4
23	25	COOLANT, FC EG PM, 1 GALLON	CC2743
24	1	HOSE, HUMP, 4.5", CAC	10467
25	1	TANK, SURGE, CFP15E, FIREPUMP	10865
26	1	FTG, STR, -6 ORB X -4 FMNPT	12171-6-4
27	1	PLUG. PIPE, -2 NPT	12210-2
28	1	FTG, STR, -12 JIC X -12 ORB	12235-12-12
29	1	FTG, STR, -4 JIC X -4 NPT	12238-4-4
30	1	ELB, 90 DEG, -12 JIC X -16 NPT	12270-12-16
31	2	ELB, 90 DEG, -4 JIC X -4 NPT	12270-4-4
32	1	TEE, M BRANCH, -4 NPT	12533-4
33	4	HOSE END, STR, -4 FLR X -4 HS	12543-4-4
34	1	HOSE END, STR, -6 FLR X -6 HS	12543-6-6
35	1	ELB, 90 DEG, -6 FLR X -4 NPT	12550-6-4
36	1	ELB, 45 DEG, -4 FLR X -4 NPT	12551-4-4
37	2	CLAMP, SPRING LOADED T-BOLT, 4.53-4.83	12975-0475
38	4	CLAMP, SPRING LOADED T-BOLT, 5.03-5.32	12975-0525
39	2	CLAMP, SPRING LOADED T-BOLT, 5.28-5.58	12975-0550
40	2	CLAMP, T-BOLT, 3.28-3.59	13164-0350
41	4	CLAMP, T-BOLT, 3.78-4.09	13164-0400
42	2	CLAMP,P-STYLE,1-1/4", LTL-SCPV20627 AS ALTERNATE	13746
43	1	CLAMP, WORM, .63 - .88	14990-06
44	6	CLAMP, WORM, 1.13 - 1.75	14990-20
45	2	ELBOW, MARINE GRADE, 1-1/4" NPT	15756-20
46	1	ELBOW, MARINE GRADE, 2" NPT	15756-32
47	2	BUSHING, MARINE GRADE, 2" x 1-1/4"	15758-32-20
48	1	ADAPTER, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15766-20-20
49	4	ELBOW, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15767-20-20
50	1	NIPPLE, NAVAL BRONZE, 1-1/4" X 6"	15799
51	2	NIPPLE, NAVAL BRONZE, 2" X 3"	15806
52	1	HOSE, SILICONE, 1.25" I.D., 7" LENGTH	78125GL
53	1	TAG, ENGINE WEIGHT	16825
54	6	WASHER,FLAT,SMALL, 0.25	20010-025
55	6	SCREW,HH, 0.25-20x5.00	20225-500
56	1	BRACKET, LOWER TUBE, CFP23E	23303
57	2	SADDLE, FUEL COOLER, CFP23E	23305
58	1	BRACKET, CAC TUBE, CFP23E	23331
59	1	BRACKET, COOLING LOOP, CFP23E	23340
60	4	SADDLE, FUEL COOLER, CFP23E	25956
61	1	HOSE,FUEL LINE,5/16ID, 72"L	27003_72
62	1	DRAIN VALVE, 1/4" NPT	80511
63	3	HOSE, HUMP, 5", CAC	3331516
64	1	GASKET, CONNECTION	4095450
65	1	GASKET, COVER PLATE	4095546
66	1	SIGHT GLASS, 1/2" NPT	3277K34
67	1	HOSE,DAYCO GOLD LABEL, 3.00" ID X 6" LG	77300GL-6IN
68	2	HOSE,DAYCO GOLD LABEL, 3.50" ID X 6" LG	77350GL-6IN
69	1	CLAMP, U-BOLT, GUILLOTINE, 3.50", PLATED	89547K
70	4	CLAMP, U-BOLT, GUILLOTINE, 5.00", PLATED	89549K
71	2	MOUNT, HEAT EXCHANGER	A042A018
72	2	CAP, HEAT EXCHANGER MOUNT	A042A019
73	2	CLAMP, SURGE TANK	A042A020
74	1	NIPPLE, 1-1/4" x 5.00, SEAWATER COMPATIBLE	A042B618

NOTE:
1. USE THIS ASSEMBLY WITH POWER UNITS THAT USE THE G-DRIVE ENGINE F10, F20, F30, F40, F50, F60 AND F70 RATINGS

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
G	2015-055	ADDED: 12210-2	PBS	28JAN2015
F	2014-392	ADDED: A042B618, 15756-20 WAS QTY 1	PBS	04JUN2014
E	2014-275	12975-0525 WAS QTY 6. DELETE: 12270-6-4 517134. ADDED: 12550-6-4, 12975-0550, 27003 3277K34, A042B293, 14924-01	PBS	01MAY2014
D	2014-131	78125GL REPLACED 15811	S DUBICK	26-FEB-14

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS: MACHINE TOLERANCES .XX : ± 0.010, .XXX : ± 0.005; FORM TOLERANCES .XX : ± 0.030, .XXX : ± 0.015; FAB TOLERANCES .XX : ± 0.060, .XXX : ± 0.030 | METRIC UNITS: MACHINE TOLERANCES .X : ± 0.4, .XX : ± 0.2; FORM TOLERANCES .X : ± 0.8, .XX : ± 0.4; FAB TOLERANCES .X : ± 1.5, .XX : ± 0.8

THIRD ANGLE PROJECTION

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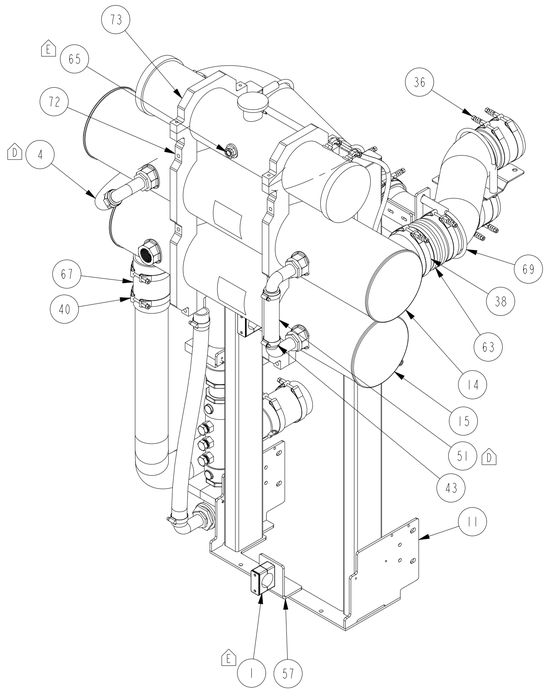
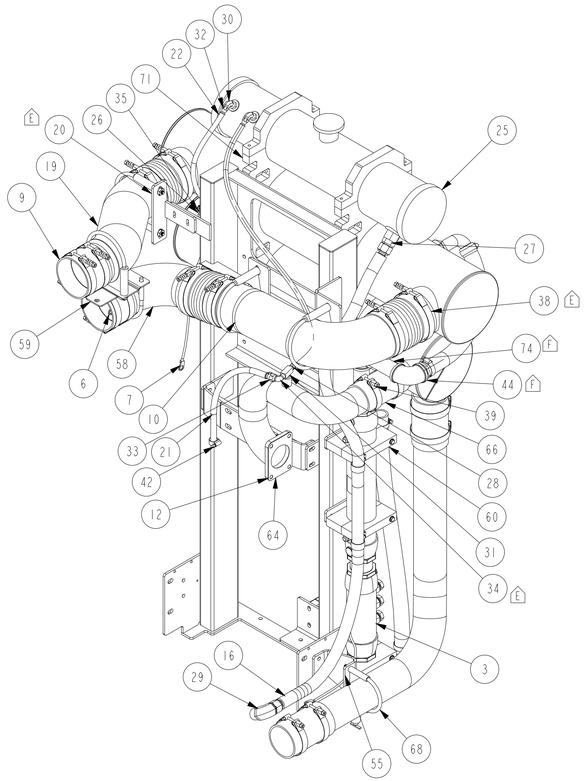
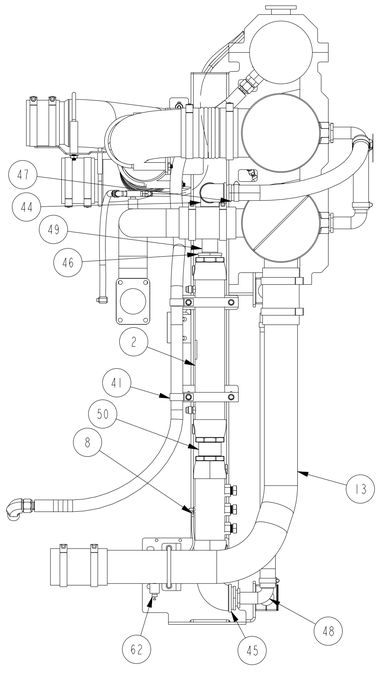
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

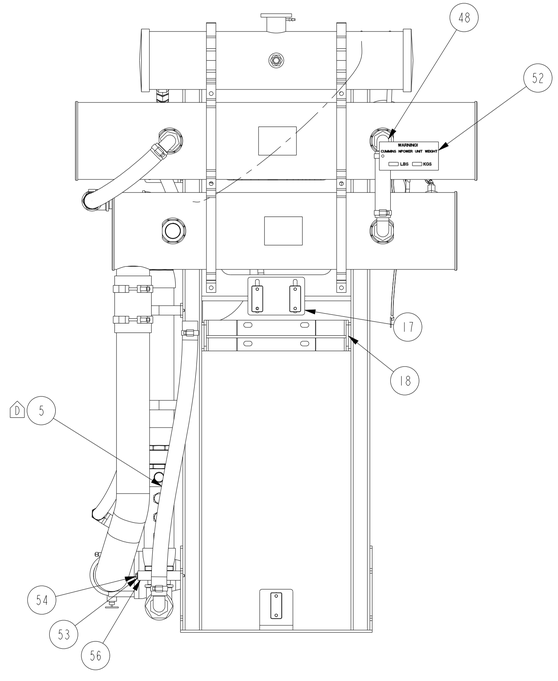
ASSEMBLY, COOLING
CFP23E

DWG UNITS: IN/LB/S	DRAWN BY: PBS PRO-ENGINEER	DATE: 09OCT2012 INIT ECO: 2011-232
SCALE: 0.125 EST WEIGHT: 353.930	SHEET 1 OF 1	DRAWING NO: 23166









NOTE:
1. USE THIS ASSEMBLY WITH POWER UNITS THAT USE THE INDUSTRIAL ENGINE F15, F25 AND F35 RATINGS

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	3	CLAMP,PIPE,1.25",PLASTIC, W/COVER PLATE	14924-01
2	1	FUEL COOLER, COPPER NICKEL, 3" DIA, 2" NPT ENDS, FP23E	15729
3	1	ZINC MODULE, 2" NPT, 3 ANODES	15804
4	1	HOSE, SILCONE, 1-1/4" I.D., 19" LONG	78125GL
5	1	HOSE, SILCONE, 1-1/4" I.D., 30" LONG	78125GL
6	2	GROUND STRAP, 1/4" BRAID, 24" LONG, 1/4" & 1/2" TERMINALS	15843
7	1	GROUND STRAP, 1/4" BRAID, 24" LONG, 1/4" & 1/2" TERMINALS	15843
8	1	GROUND STRAP, 1/4" BRAID, 12" LONG, 1/4" & 1/2" TERMINALS	15813
9	2	HOSE, CAC, 4.5" I.D. X 3.5" LG, 500F RATING,, CFP15E FIREPUMP	21364
10	1	TUBE, INTAKE, CFP23E	23178
11	1	MOUNT, COOLING ASSEMBLY, CFP23E	23179
12	1	ELBOW, JACKET WATER, CFP23E	23231
13	1	TUBE, JACKET WATER, CFP23E	23256
14	1	HEAT EXCHANGER, CAC, COPPER NICKEL, 8" DIA, CFP23E	23312
15	1	HEAT EXCHANGER, JW, COPPER NICKEL, 8" DIA, CFP23E	23317
16	1	HOSE, WATER FILL, CFP23E	23338
17	1	BRACKET, COOLING LOOP, CFP23E	23432
18	1	BRACE, HEAT EXCHANGER STAND, CFP23E	23763
19	1	TUBE, INTAKE, CFP23E	23766
20	1	BRACKET, CAC, CFP23E	A042B293
21	1	HOSE, VENT LINE, 16" LENGTH	R-801-6
22	1	HOSE, VENT LINE, 19" LENGTH	R-801-4
23	1	HOSE, VENT LINE, 31" LENGTH	R-801-4
24	25	COOLANT, FC EG PM, 1 GALLON	CC2743
25	1	TANK, SURGE, CFP15E, FIREPUMP	10865
26	1	FTG, STR, -6 ORB X -4 FMNPT	12171-6-4
27	1	FTG, STR, -12 JIC X -12 ORB	12235-12-12
28	1	FTG, STR, -4 JIC X -4 NPT	12238-4-4
29	1	ELB, 90 DEG, -12 JIC X -16 NPT	12270-12-16
30	2	ELB, 90 DEG, -4 JIC X -4 NPT	12270-4-4
31	1	TEE, M BRANCH, -4 NPT	12533-4
32	4	HOSE END, STR, -4 FLR X -4 HS	12543-4-4
33	1	HOSE END, STR, -6 FLR X -6 HS	12543-6-6
34	1	ELB, 90 DEG, -6 FLR X -4 NPT	12550-6-4
35	1	ELB, 45 DEG, -4 FLR X -4 NPT	12551-4-4
36	4	CLAMP, SPRING LOADED T-BOLT, 4.53-4.83	12975-0475
37	4	CLAMP, SPRING LOADED T-BOLT, 5.03-5.32	12975-0525
38	2	CLAMP, SPRING LOADED T-BOLT, 5.28-5.58	12975-0550
39	2	CLAMP, T-BOLT, 3.28-3.59	13164-0350
40	4	CLAMP, T-BOLT, 3.78-4.09	13164-0400
41	2	CLAMP,P-STYLE,1-1/4", LTL-SCPV20627 AS ALTERNATE	13746
42	1	CLAMP, WORM, .63 - .88	14990-06
43	6	CLAMP, WORM, 1.13 - 1.75	14990-20
44	2	ELBOW, MARINE GRADE, 1-1/4" NPT	15756-20
45	1	ELBOW, MARINE GRADE, 2" NPT	15756-32
46	2	BUSHING, MARINE GRADE, 2" X 1-1/4"	15758-32-20
47	1	ADAPTER, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15766-20-20
48	4	ELBOW, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15767-20-20
49	1	NIPPLE, NAVAL BRONZE, 1-1/4" X 6"	15799
50	2	NIPPLE, NAVAL BRONZE, 2" X 3"	15806
51	1	HOSE, SILICONE, 1.25" I.D., 7" LENGTH	78125GL
52	1	TAG, ENGINE WEIGHT	16825
53	6	WASHER,FLAT,SMALL, 0.25	20010-025
54	6	SCREW,HH, 0.25-20x5.00	20225-500
55	1	BRACKET, LOWER TUBE, CFP23E	23303
56	2	SADDLE, FUEL COOLER, CFP23E	23305
57	1	BRACKET, COOLING LOOP, CFP23E	23340
58	1	ELBOW, INTAKE, CFP23E	23770
59	1	BRACKET, CAC TUBE	23776
60	4	SADDLE, FUEL COOLER, CFP23E	25956
61	1	HOSE,FUEL LINE,5/16ID, 72"L	27003_72
62	1	DRAIN VALVE, 1/4" NPT	80511
63	3	HOSE, HUMP, 5", CAC	3331516
64	1	GASKET, COVER PLATE	4095546
65	1	SIGHT GLASS, 1/2" NPT	3277K34
66	1	HOSE,DAYCO GOLD LABEL, 3.00" ID X 6" LG	77300GL-6IN
67	2	HOSE,DAYCO GOLD LABEL, 3.50" ID X 6" LG	77350GL-6IN
68	1	CLAMP, U-BOLT, GUILLOTINE, 3.50", PLATED	89547K
69	4	CLAMP, U-BOLT, GUILLOTINE, 5.00", PLATED	89549K
70	1	CLAMP, U-BOLT, GUILLOTINE, 4.50", PLATED	90092A
71	2	MOUNT, HEAT EXCHANGER	A042A018
72	2	CAP, HEAT EXCHANGER MOUNT	A042A019
73	2	CLAMP, SURGE TANK	A042A020
74	1	NIPPLE, 1-1/4" x 5.00, SEAWATER COMPATIBLE	A042B618

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
F	2014-392	ADDED: A042B618, 15756-20 WAS QTY 1	PBS	04JUN2014
E	2014-275	12975-0525 WAS QTY 6. DELETED: 12270-6-4 51734. ADDED: 12550-6-4, 12975-0550, 27003 3277K34, 14924-01, A042B293	PBS	01MAY2014
D	2014-131	78125GL REPLACED 15811	S DUBICK	26-FEB-14

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION
MACHINED SURFACES
IMPERIAL UNITS: FRACTIONS ± 1/64 | .XX ± 0.02 | .XXX ± 0.010 | .XXXX ± 0.0005
METRIC UNITS: DECIMALS .X ± 0.1 | .XX ± 0.05 | .XXX ± 0.025
1.25

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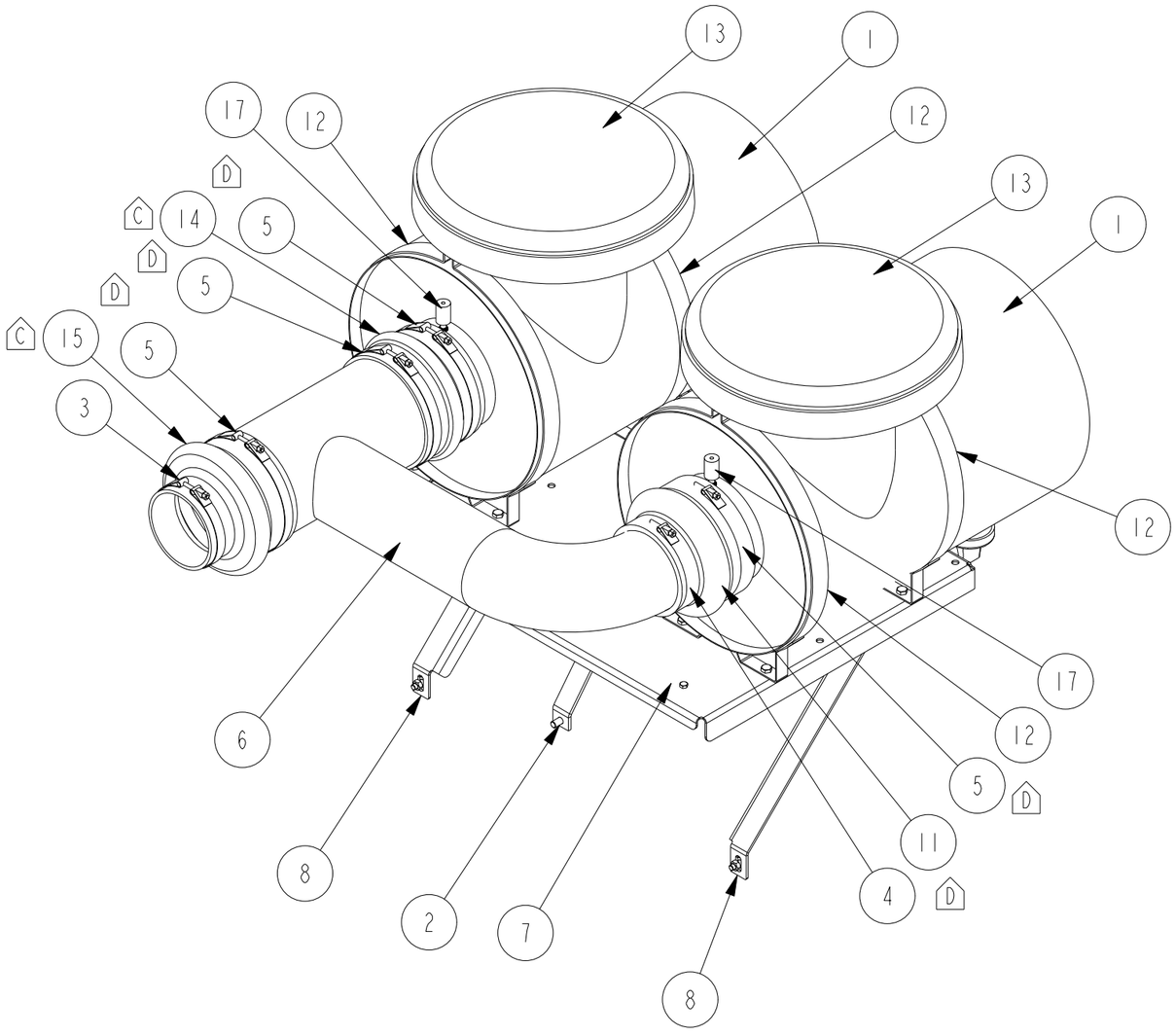
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

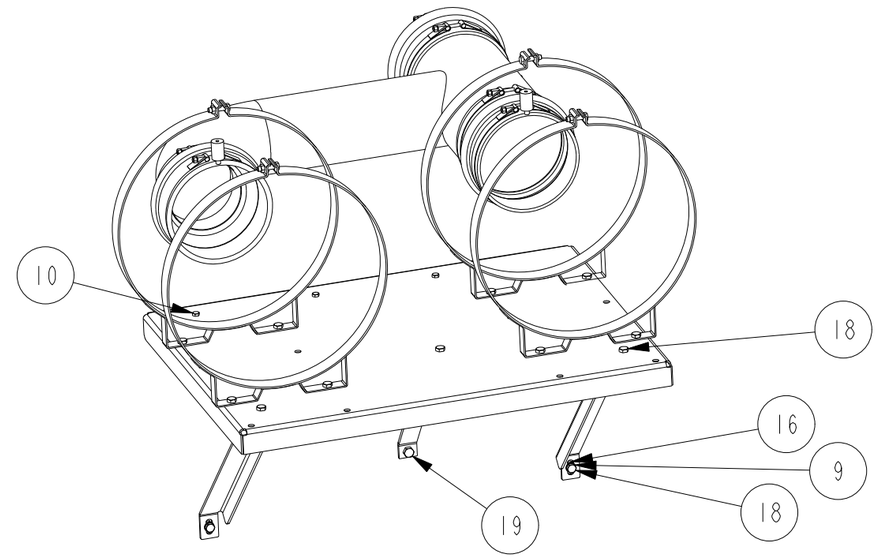
SYSTEM: COOLING ASSEMBLY CFP23E

DWG UNITS: IN/LB/S
PRO-ENGINEER
DRAWN BY: PBS
DATE: 090CT2012
INIT ECO: 2011-232
SCALE: 0.125
SHEET 1 OF 1
EST WEIGHT: 336.600
DRAWING NO: 23762



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	AIR HOUSING ASSEMBLY, FLEETGUARD AHI9076	AHI9076
2	1	BRACKET, STIFFENER, OPERATOR STATION, CFP23E FIREPUMP	13121
3	1	CLAMP, T-BOLT, 5.78-6.09	13164-0600
4	1	CLAMP, T-BOLT, 6.28-6.59	13164-0650
5	4	CLAMP, T-BOLT, 8.25-8.56	13164-0850
6	1	TUBE, AIR CLEANER, CFP23E	17693
7	1	BRACKET, AIR CLEANER, CFP23E	17694
8	2	BRACE, HD AIR CLEANER, CFP23E	18607
9	5	WASHER,FLAT, M10	20020-M10
10	3	SCREW,HH, 0.31-18x0.75	20231-075
11	1	HUMP HOSE, 8" TO 6"	3316626S
12	4	BRACKET,AIR CLEANER, 18.10 INCH ID	3918237S
13	2	INTAKE BONNET, 10", FLEETGUARD 3940356S OR EQUIV	3940356S
14	1	HOSE, HUMP, 8"x8"	3316614-S
15	1	HOSE, HUMP-REDUCER, 8.0" TO 5.5"	3316625-S
16	13	NUT,HEX,PT, M10-1.50	20140-M10
17	2	RESTRICTION INDICATOR, 1/8" NPT	RAX00-2352
18	13	SCREW,HH, M10-1.50x25	20310-025
19	1	SCREW,HH, M12-1.75x25	20312-025



REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D	2014-275	DELETE: 13164-0675, 13164-0875 ADD: 13164-0650, 13164-850	PBS	01MAY2014
C	2014-131	3316614-S REPLACED 89841K 3316625-S REPLACED 89855K	S DUBICK	25-FEB-14

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX ± 0.010 .XXX ± 0.005 FORM TOLERANCES .XX ± 0.030 .XXX ± 0.015 FAB TOLERANCES .X ± 0.060 .XX ± 0.030	MACHINE TOLERANCES .X ± 0.4 .XX ± 0.2 FORM TOLERANCES .X ± 0.8 .XX ± 0.4 FAB TOLERANCES .X ± 1.5 .XX ± 0.8

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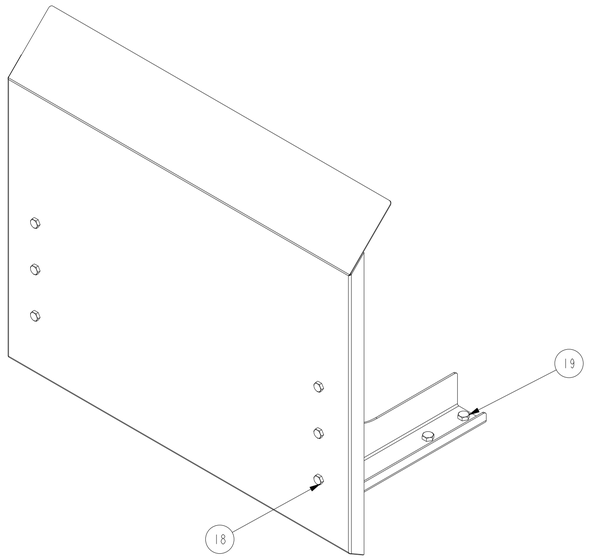
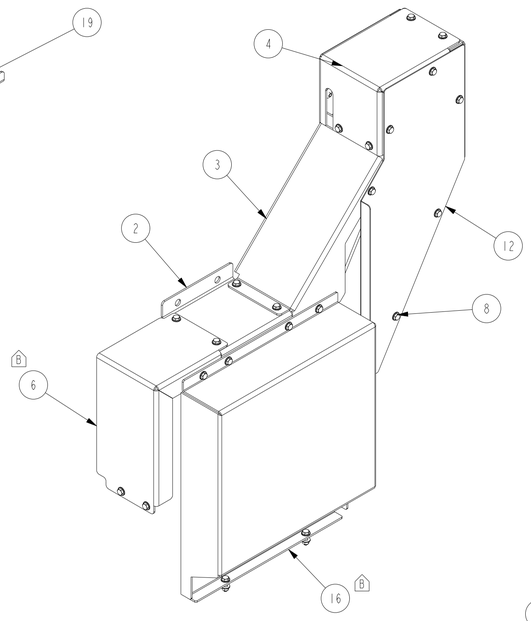
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

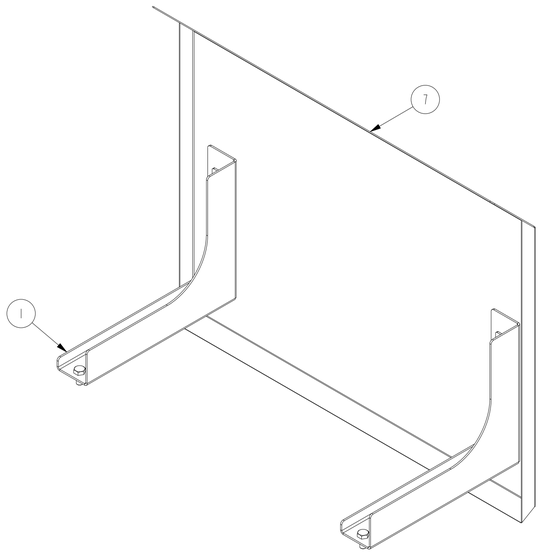
SYSTEM, AIR CLEANER
CFP23E

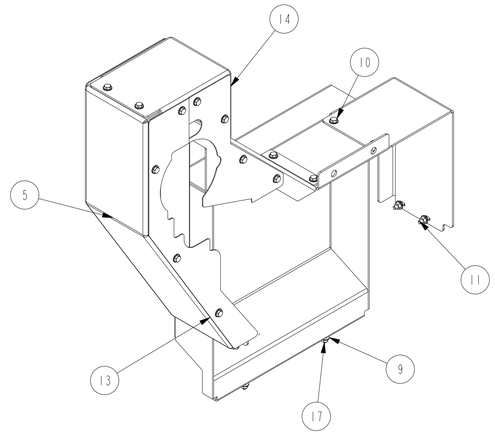
DWG UNITS: IN/LB/S	DRAWN BY: DAN	DATE: 23-AUG-10
	PRO-ENGINEER	INIT ECO: 2010-373
SCALE: 0.100	SHEET 1 OF 1	DRAWING NO: 17669
EST WEIGHT: 0.000		

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	BRACKET, HEAT SHEILD MOUNT, CFP23E	13134
2	1	GUARD, CFP23E	23287
3	1	GUARD, CFP23E	23289
4	1	GUARD, TOP, CFP23E	23290
5	1	GUARD, CFP23E	23291
6	1	GUARD, ENGINE, CFP23E	A042A015
7	1	HEAT SHIELD, CFP23E	13135
8	6	WASHER, RETAINING, 1/4"	16662-04
9	38	WASHER,FLAT,SMALL, 0.25	20010-025
10	26	SCREW,HH, 0.25-20x0.50	20225-050
11	6	SCREW,HH, 0.25-20x1.00	20225-100
12	1	COVER, BELT, CFP23E	23254
13	1	GUARD, REAR BELT, CFP23E	23255
14	1	GUARD, SMALL REAR BELT, CFP23E	23262
15	1	DECAL, VALVE POSITION, CFP23E	23509
16	1	GUARD, FRONT PULLY, CFP23E	A042A013
17	6	NUT,HEX, 0.25-20	20100-025
18	6	SCREW,HH, M10-1.50x20	20310-020
19	4	SCREW,HH, M12-1.75x25	20312-025









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CUSTOM DESIGN
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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

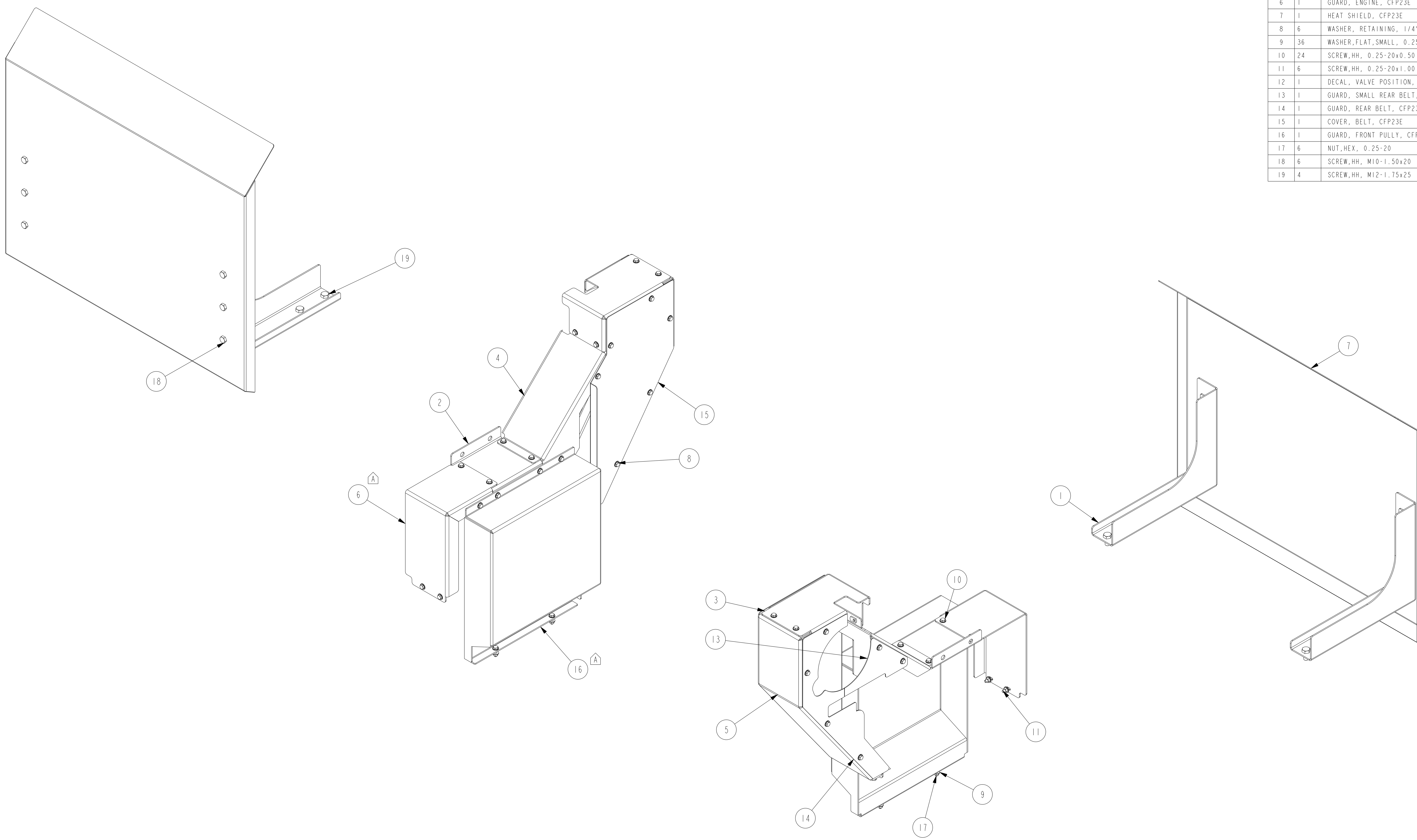
ASSEMBLY, GUARDING
CFP23E-F10-70

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-071	ADDED 23509	PBS	04FEB2014
B	2013-747	DELETED: 26702, 23288, 23278 ADDED: A042A013, A042A015	PBS	16DEC2013
A	2013-656	ADDED 26702	PBS	18OCT2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION
MACHINED SURFACES 125
IMPERIAL UNITS: FRACTIONS ±1/64 | .X ±0.030 | .XX ±0.010 | .XXX ±0.005 | ANGLES ±1°
METRIC UNITS: .X ±0.8 | .XX ±0.25 | .XXX ±0.127 | ANGLES ±1°

DWG UNITS: IN/LB/S
PRO-ENGINEER
SCALE: 0.188
SHEET 1 OF 1
EST WEIGHT: 42238.628

DRAWN BY: PBS
DATE: 12OCT2012
INIT ECO: 2011-232
DRAWING NO: 23293



BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	BRACKET, HEAT SHEILD MOUNT, CFP23E	13134
2	1	GUARD, CFP23E	23287
3	1	GUARD, TOP, CFP23E	23785
4	1	GUARD, CFP23E	23789
5	1	GUARD, CFP23E	23791
6	1	GUARD, ENGINE, CFP23E	A042A015
7	1	HEAT SHIELD, CFP23E	13135
8	6	WASHER, RETAINING, 1/4"	16662-04
9	36	WASHER,FLAT,SMALL, 0.25	20010-025
10	24	SCREW,HH, 0.25-20x0.50	20225-050
11	6	SCREW,HH, 0.25-20x1.00	20225-100
12	1	DECAL, VALVE POSITION, CFP23E	23509
13	1	GUARD, SMALL REAR BELT, CFP23E	23793
14	1	GUARD, REAR BELT, CFP23E	23794
15	1	COVER, BELT, CFP23E	23795
16	1	GUARD, FRONT PULLY, CFP23E	A042A013
17	6	NUT,HEX, 0.25-20	20100-025
18	6	SCREW,HH, M10-1.50x20	20310-020
19	4	SCREW,HH, M12-1.75x25	20312-025

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2014-071	ADDED 23509	PBS	04FEB2014
A	2013-747	ADDED: A042A013, A042A015 DELETED: 23278, 23288	PBS	13DEC2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
	FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
	FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

Cummins Fire Power

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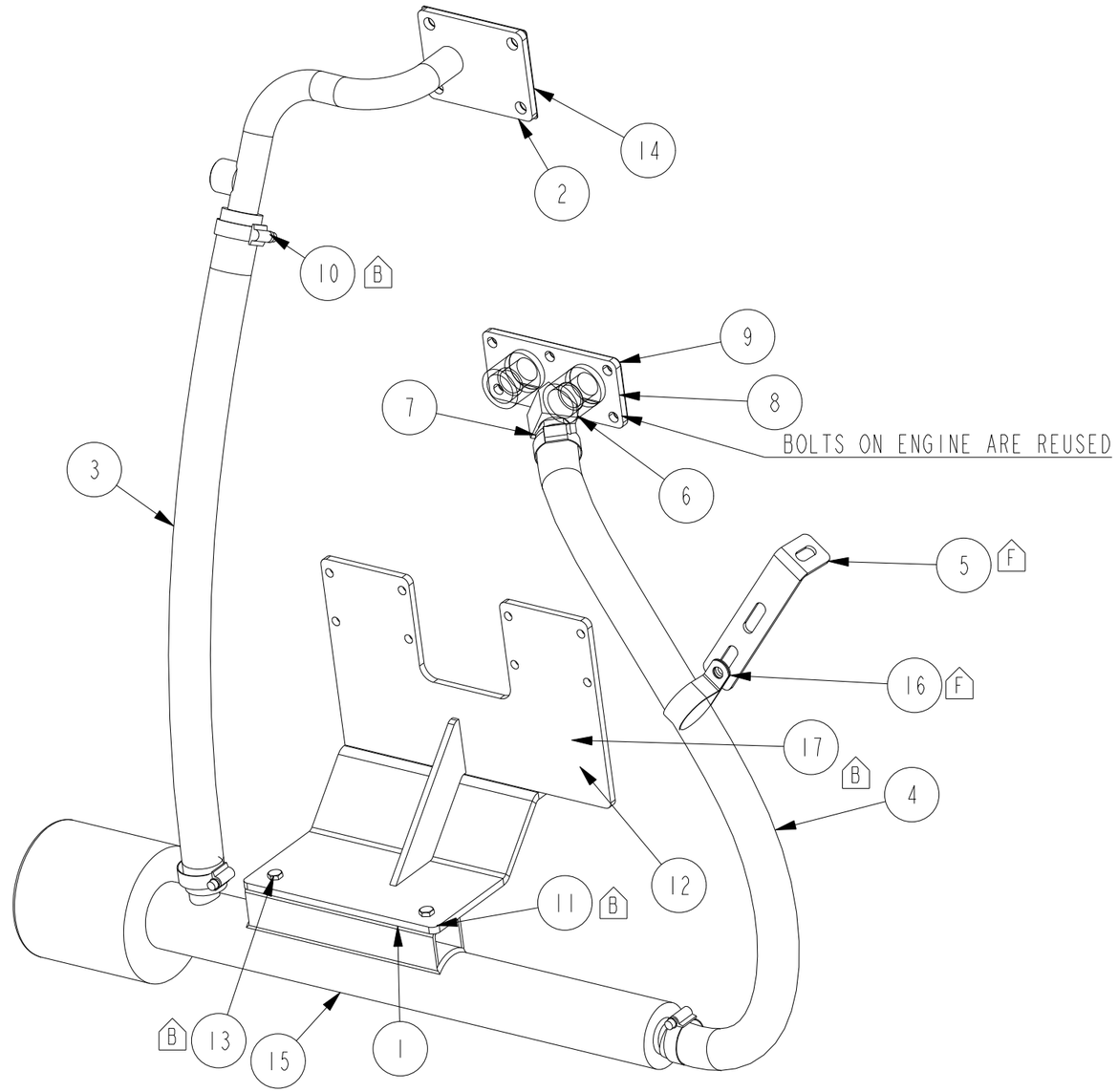
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, GUARDING
CFP23E-F15-35

DWG UNITS: IN/LB/S
DRAWN BY: PBS
PRO-ENGINEER
DATE: 18DEC2012
INIT ECO: 2011-232
SCALE: 0.188
EST WEIGHT: 42238.628
SHEET 1 OF 1
DRAWING NO: 23784



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	BRACKET, COOLANT HEATER/CONTACTOR, CFP23E	14046
2	1	PLATE, COVER, CFP23E	24710
3	1	HOSE, HI-TEMP SILICONE, 1" ID x 26"	78100GL
4	1	HOSE, HI-TEMP SILICONE, 1" ID x 29"	78100GL
5	1	BRACKET, MOUNTING, TUBE SUPPORT, FIREPUMP	8657
6	1	ELB, 45 DEG, -12 NPT X -12 FMNPT	12532-12-12
7	1	FTG, STR, -16 BEAD X -12 NPT	12545-16-12
8	1	BRACKET, COOLANT HEATER CONNECT, CFP23E	13585
9	1	GASKET, COOLANT HEATER, CFP23E	13875
10	4	CLAMP, WORM, 1.00 - 1.50	14990-16
11	2	WASHER,FLAT, 0.25	20000-025
12	3	WASHER,FLAT, M10	20020-M10
13	2	SCREW,HH, 0.25-20x0.75	20225-075
14	1	GASKET, COVER PLATE, CUMMINS	3094281
15	1	HEATER, COOLANT, 4000W, ADJ. VOLTAGE, WATLOW CPBPH7S12	CPBPH7S12
16	1	CLIP,CSHN,1.50 ID, -	LTL-SCPV24627
17	3	SCREW,HH, M10-1.50x50	20310-050

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
F	2014-275	ADDED: 8657, LTL-SCPV24627	PBS	01MAY2014
E	2014-071	DELETED 8824	PBS	17FEB2014
D	2011-232	UPDATED PER UL TESTING DELETED: 12195-12-12, 12531-12 14783-12-8, LTL-CPN34, 11577 ADDED: 24710, 3094281, CPBPF7S12 12545-16-12 WAS QTY 2	PBS	28FEB2013
C	2012-160	ADDED CONTACTORS	PBS	08MAY2012

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX : ± 0.010 .XXX : ± 0.005 FORM TOLERANCES .XX : ± 0.030 .XXX : ± 0.015 FAB TOLERANCES .XX : ± 0.060 .XXX : ± 0.030	MACHINE TOLERANCES .X : ± 0.4 .XX : ± 0.2 FORM TOLERANCES .X : ± 0.8 .XX : ± 0.4 FAB TOLERANCES .X : ± 1.5 .XX : ± 0.8

Cummins Fire Power

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1600 BUERKLE ROAD
WHITE BEAR LAKE, MN
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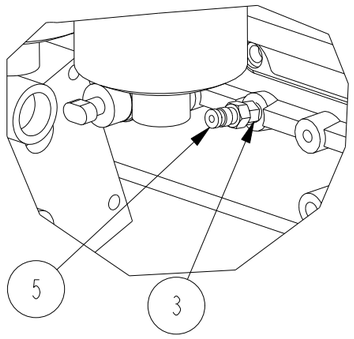
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

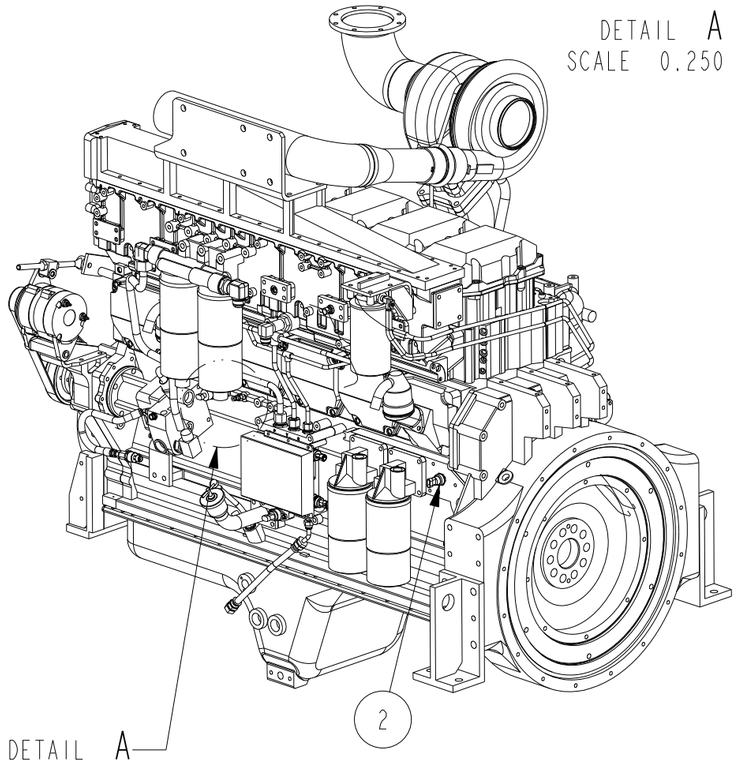
ASSEMBLY, COOLANT HEATER
CFP23E

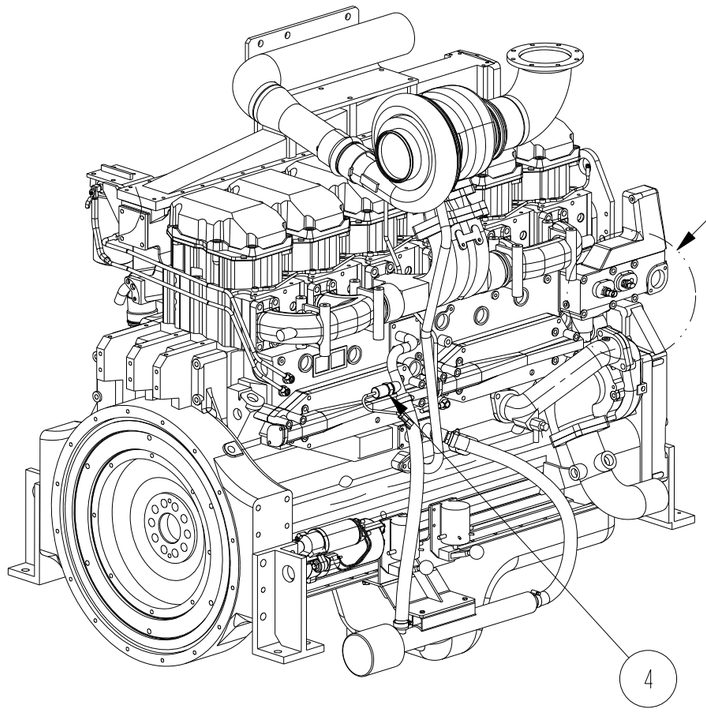
DWG UNITS: IN/LB/S	DRAWN BY: S DUBICK	DATE: 09/05/08
	PRO-ENGINEER	INIT ECO:
SCALE: 0.210	SHEET 1 OF 1	DRAWING NO: 13196
EST WEIGHT: 42.973		

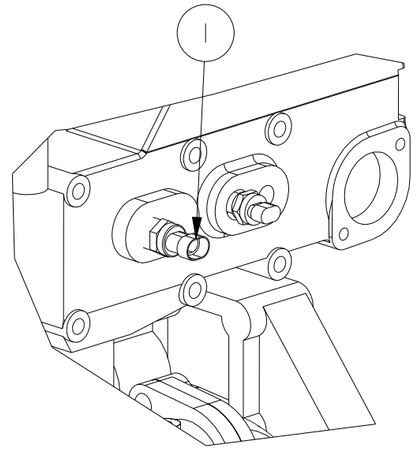
BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	SWITCH, WATER TEMP, 200F SETTING, #3408632	8860
2	1	SWITCH, OIL PRESSURE, 16 PSI, #3408607	8861
3	1	BUSH, RED, -4 NPT X -2 FNPT	14783-4-2
4	1	SWITCH, LOW COOLANT TEMP, 110° F SET POINT	18105
5	1	CONNECTOR, QUICK DISCONNECT	3377244



DETAIL A
SCALE 0.250







DETAIL B
SCALE 0.250

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2012-427	REMOVED: 8862, 8863, 12181-MI4-4 12181-MI6-6, 12534-4, 13873 14783-4-2, 14783-6-2, 3034572	PBS	04OCT2012
A	2011-164	ADDED 18105	S DUBICK	28-JUN-11

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX ± 0.010 .XXX ± 0.005 FORM TOLERANCES .XX ± 0.030 .XXX ± 0.015 FAB TOLERANCES .XX ± 0.060 .XXX ± 0.030	MACHINE TOLERANCES .X ± 0.4 .XX ± 0.2 FORM TOLERANCES .X ± 0.8 .XX ± 0.4 FAB TOLERANCES .X ± 1.5 .XX ± 0.8

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CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

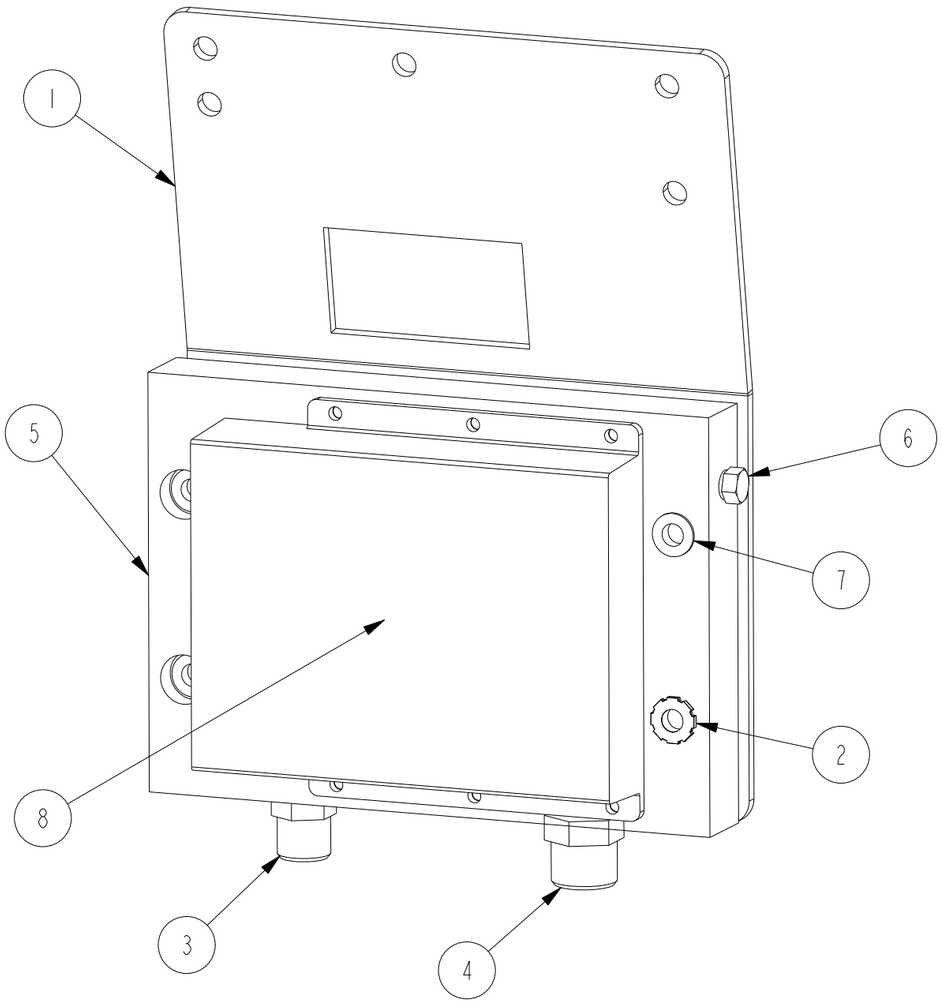
ASSEMBLY, SENSOR KIT, DIGITAL PANEL
CFP23E

DWG UNITS: IN/LB/S	DRAWN BY: S DUBICK	DATE: 25-MAR-11
	PRO-ENGINEER	INIT ECO:
SCALE: 0.063	SHEET 1 OF 1	DRAWING NO: 14033
EST WEIGHT: 2.318		

C B A

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	PLATE, ECM MOUNT, CFP23E	13171
2	1	WASHER, GROUNDING, CECO # 3335562	3335562
3	1	FTG, STR, -12 JIC X -10 ORB	12235-12-10
4	1	FTG, STR, -16 JIC X -10 ORB	12235-16-10
5	1	MANIFOLD, ECM COOLING, CFP23E	13172
6	1	PLUG, 1/2" UNF-2A 20, HEX HEAD O-RING	13173
7	7	WASHER, INSULATING, CECO # 3335561	3335561
8	1	ECM, CM500	4921411



REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2014-606	DELETED: A042A456 & 16123	JJW	28AUG2014
B	2014-112	A042A456 WAS 9508	PBS	18FEB2014
A	2011-232	12235-16-10 WAS 12235-12-10	PBS	07DEC2012

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

MACHINED SURFACES 125

	IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES	.XX : ± 0.010 .XXX : ± 0.005	.X : ± 0.4 .XX : ± 0.2
FORM TOLERANCES	.XX : ± 0.030 .XXX : ± 0.015	.X : ± 0.8 .XX : ± 0.4
FAB TOLERANCES	.XX : ± 0.060 .XXX : ± 0.030	.X : ± 1.5 .XX : ± 0.8

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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, ECM SECONDARY CFP23E INDUSTRIAL

DWG UNITS: IN/LB/S

DRAWN BY: S DUBICK

PRO-ENGINEER

DATE: 05/10/10

INIT ECO: 2010-228

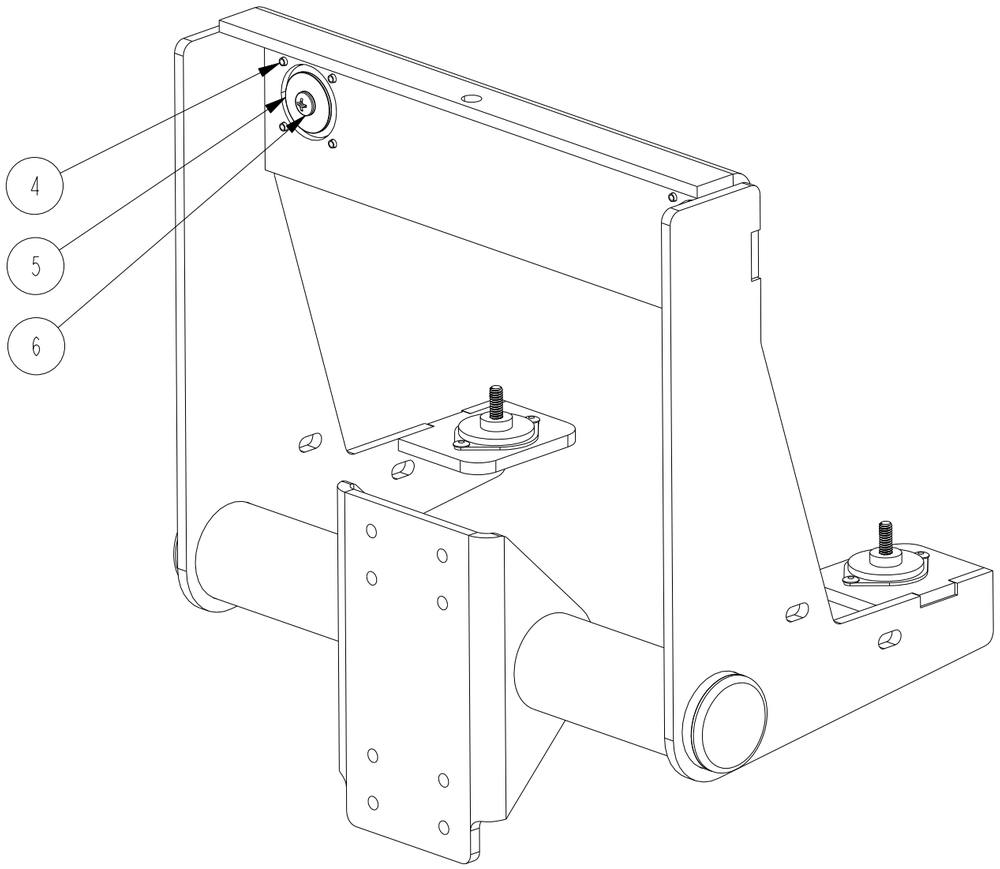
SCALE: 0.333

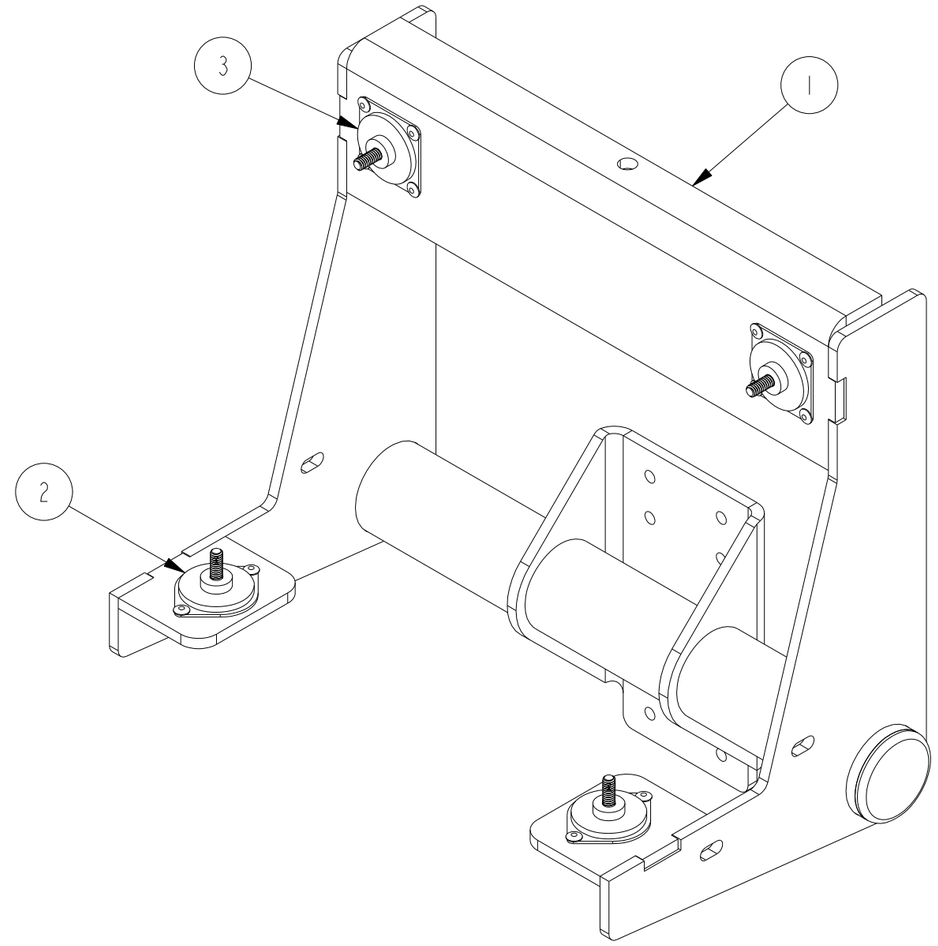
EST WEIGHT: 677816.47

SHEET 1 OF 1

DRAWING NO: 16124

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	MOUNT, OPERATOR STATION, CFP CONTROL PANEL	22318
2	2	ISOLATOR, PLATE MOUNT, 3 LB (YELLOW MARK)	15400
3	2	ISOLATOR, PLATE MOUNT, 6 LB (RED MARK)	15412
4	12	RIVET, ALUMINUM, STEEL SHANK, 0.156 DIA, 0.25-0.38 GRIP	15414
5	2	FENDER WASHER, 0.281 X 1.25	15421
6	4	SCREW, SELF LOCKING, 0.25-20 X 1.00, PH OR BH	15422





UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

MACHINED SURFACES: 125

	IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES	.XX = ± 0.010 .XXX = ± 0.005	.X = ± 0.4 .XX = ± 0.2
FORM TOLERANCES	.XX = ± 0.030 .XXX = ± 0.015	.X = ± 0.8 .XX = ± 0.4
FAB TOLERANCES	.XX = ± 0.060 .XXX = ± 0.030	.X = ± 1.5 .XX = ± 0.8

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

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CUSTOM DESIGN
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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, CONTROL PANEL MOUNTING CFP POWER UNITS

DWG UNITS: IN/LB/S

DRAWN BY: S DUBICK

PRO-ENGINEER

DATE: 26-SEP-12

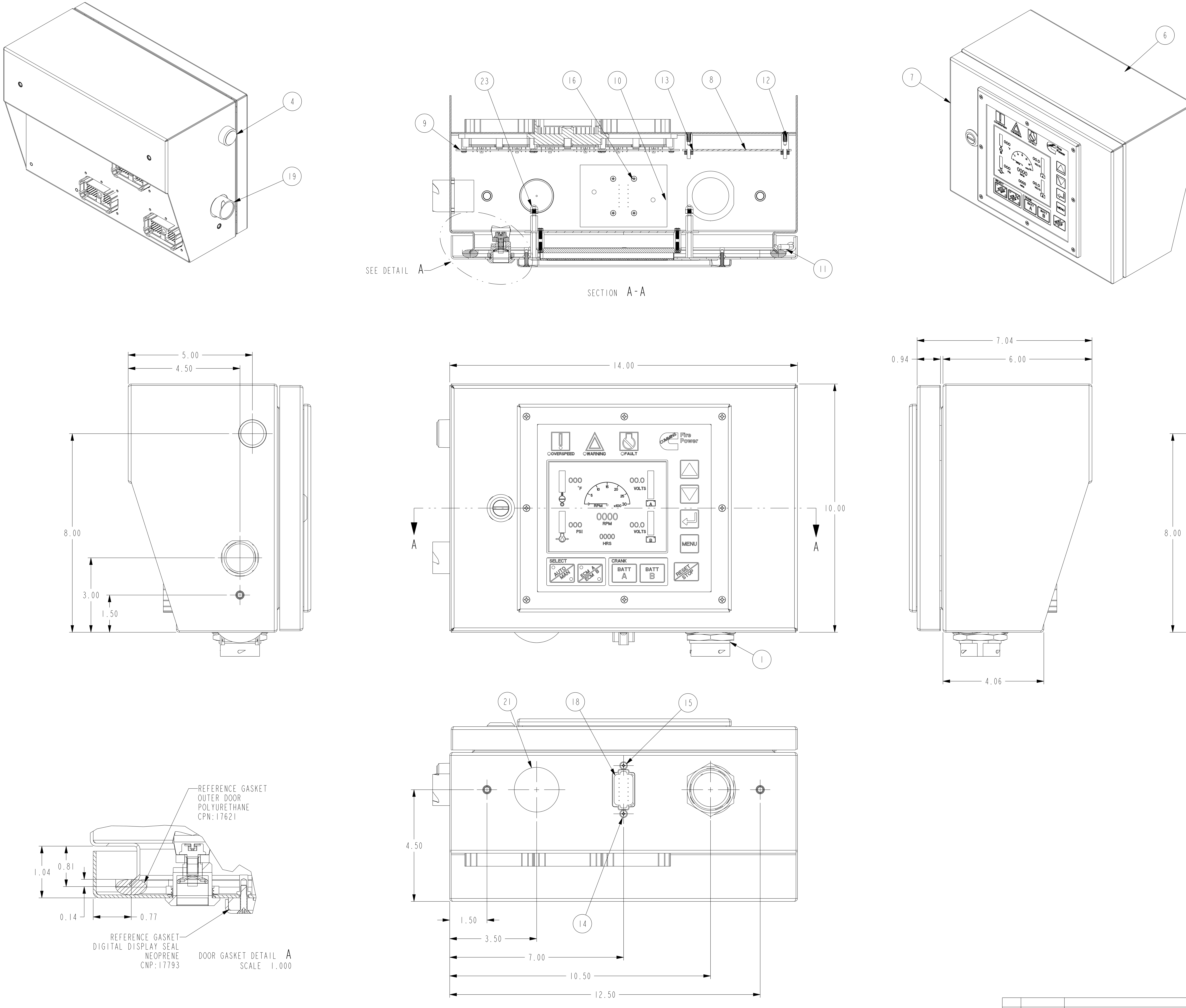
INIT ECO: 2012-392

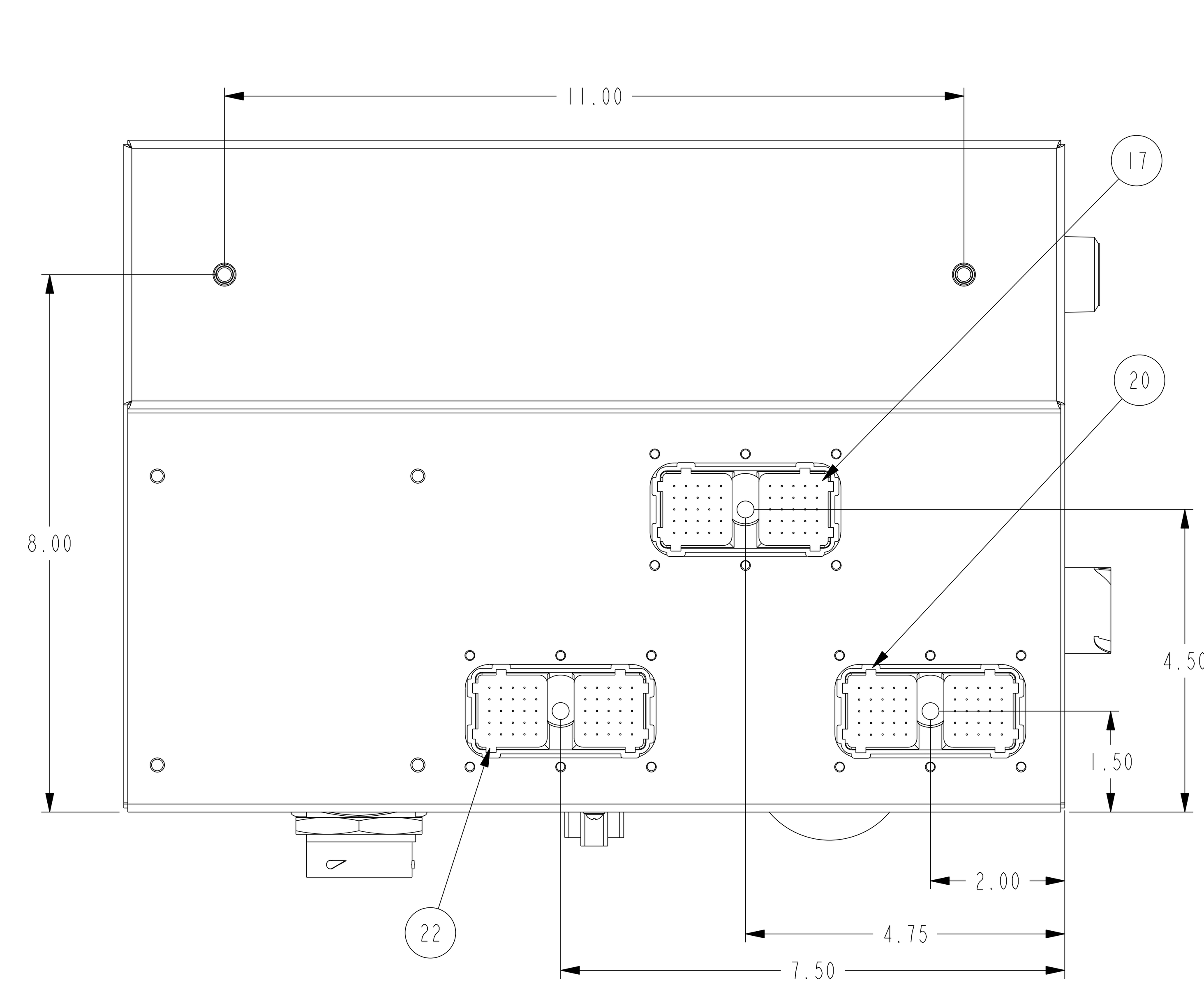
SCALE: 0.333

EST WEIGHT: 16.439

SHEET 1 OF 1

DRAWING NO: 21249





BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ASSY,BULKHEAD WIRING, DIGITAL PANEL, BULKHEAD TO POWER PCB	15156
2	1	CABLE, DIGITAL PANEL, POWER PCB TO DISPLAY PCB	15157
3	1	CABLE, DIGITAL PANEL, POWER PCB TO ECM SWITCH PCB	15158
4	1	ASSY, WIRING, DIGITAL PANEL, ENGINE STOP SWITCH	15160
5	1	DIAGNOSTICS, DIGITAL PANEL, RECEPTACLE AND CABLE	15161
6	1	WELDMT, DIGITAL PANEL, BOX, ELECTRONIC	15569
7	1	ASSEMBLY, DOOR, CONTROL PANEL	15575
8	1	POWER PCB, DIGITAL PANEL, ELECTRONIC	15153
9	1	SWITCH PCB, DIGITAL PANEL, MODULE, ECM	15154
10	1	POWER MODULE ECM , DIGITAL PANEL, ELECTRONIC	15155
11	2	HINGE, ASSEMBLY W/PIN, MILD STEEL, EMKA 1069-U2	15573_02
12	9	STANDOFF HEX M/F,8-32, ALUM. .63"L	15579
13	9	NUT, 8-32, W/TOOTH WASHER, ZNC -PLTD	15582
14	2	WASHER, 5/32"I.D x 5/16"O.D. x .02TK, STNL STL	15588
15	2	SCREW, 6-19 x 3/8"L, FH PHILIPS HD, STNL STL	15590
16	16	SCREW, 1/4"-20 SELF TAPPING, STNL STL	15591
17	1	RECEPTACLE, W/FLANGE 50 PIN,BLACK, CRC SERIES, DEUTSCH, DRC22-50P01	15593
18	1	RECEPTACLE, PCB MOUNT, 12 PINS STRAIGHT DT-SERIES, DEUTSCH, DT15-12P	15594
19	1	CONNECTOR, RECEPTACLE SQ. FLANGE HD10 SERIES, DEUTSCH, HD10-9-1939P	15596
20	1	RECEPTACLE, W/FLANGE 50 PIN,BLACK, CRC SERIES, DEUTSCH, DRC22-50P03	15599
21	1	PLUG, LIQUID TIGHT, HEYCO, 3837	15645
22	1	RECEPTACLE, W/FLANGE 50 PIN,BLACK, CRC SERIES, DEUTSCH, DRC22-50P02	15657
23	4	NUT, ACORN,SELF-LOCKING, 8-32, 18-8 STNL STL	17149

*** BOM IS FOR REFERENCE ONLY ***

NOTES:
1. TYPE 4X INDOOR USE CONSTRUCTION
2. UPDATED SOFTWARE

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

Fire Power
CUMMINS FIRE POWER LLC
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CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, DIGITAL CONTROL PANEL
ELECTRONIC CFP ENGINES

DWG UNITS: IN/LB/S	DRAWN BY: S DUBICK	DATE: 21-SEP-12
	PRO-ENGINEER	INIT ECO: 2012-348
SCALE: 0.500	SHEET 1 OF 1	DRAWING NO: 22791
EST WEIGHT: 28.994		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2015-001	UPDATED PER DETAILS	PBS	02JAN2014

KIT INCLUDES

1. 18497 HARNESS, ENGINE SENSOR AND ACTUATOR
2. (B) 18498 HARNESS, ECM A
3. (B) 18499 HARNESS, ECM B
4. 21231 HARNESS, POWER WIRE
5. (C)(B)(A) 24649 HARNESS, INTERFACE
6. (A) 13972 HARNESS, WIRE EXTENSION, SPEED SENSOR
7. 22324 HARNESS, JUMPER, J1587

REV	ECO	DESCRIPTION OF REVISION	BY	DATE
C	2015-077	ITEM 5: BATTERY ISOLATOR LENGTHS EXTENDED	BG	30JAN2015
B	2014-427	ITEM 5: LENGTH CHANGES	RMJ	13JUN2014
A	2014-108	ITEM 5: ADDED CIRCUITS 29-31	RMJ	11MAR2014

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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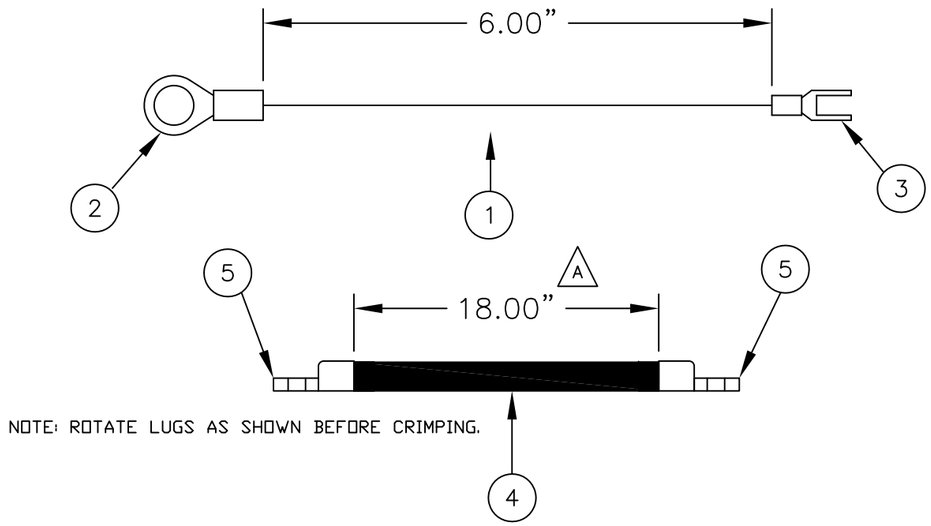
CUSTOM DESIGN AND
UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

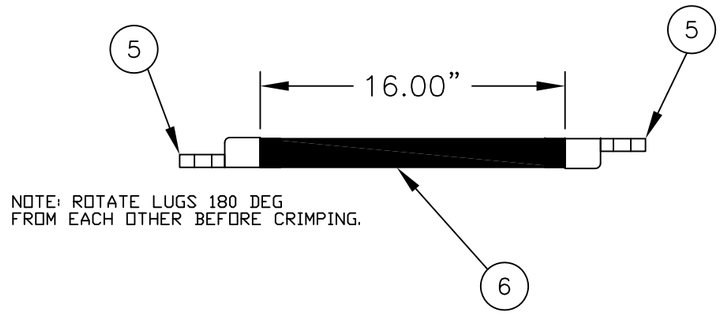
KIT, WIRE HARNESSES
QSK23 FIRE PUMP DRIVER, LEFT HAND

DWG UNITS: INCH/LB/S
DRAWN BY: BG
DATE: 25FEB2013
AUTO CAD
INIT ECO: 2013-108
SCALE:
EST WEIGHT:
SHEET 1OF1
DRAWING NO: 23669

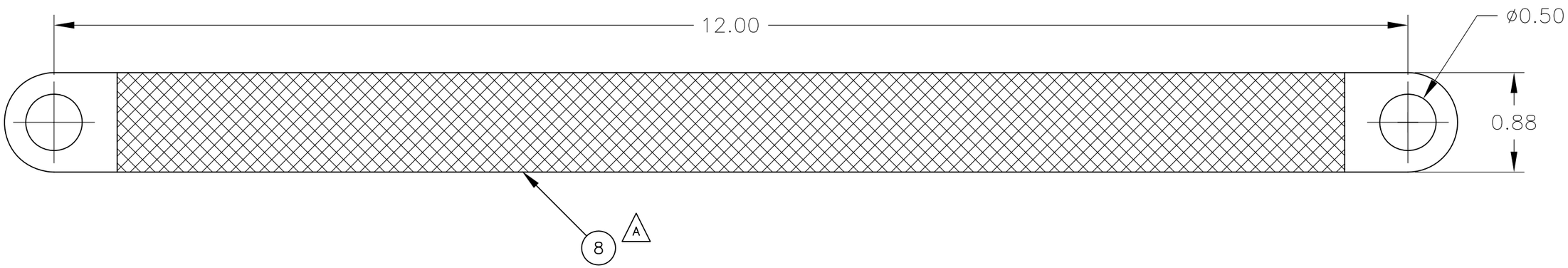
TAGS	QTY	SUB	CATALOG	MFG	DESCRIPTION
1	1	6"	WL10-9	WAYTEK	WIRE, GXL, WHITE, 10 AWG
2	1	1	32706	WAYTEK	TERMINAL, RING, 1/2", 10 AWG, INSULATED
3	1	1	52717-2	AMP	TERMINAL, SPADE, #10
4	1	15"	WC00-0	WAYTEK	CABLE, WELDING, 2/0 AWG, BLACK
5	4	1	36534	WAYTEK	TERMINAL, EYELET, HEAVY DUTY, 3/8", 2/0 AWG, NON-INSULATED
6	1	16"	WC00-0	WAYTEK	CABLE, WELDING, 2/0 AWG, BLACK
7	1	1	WC90397-1	LTL	4GA, GROUND STRAP (CNP PART NUMBER 9757)



NOTE: ROTATE LUGS AS SHOWN BEFORE CRIMPING.



NOTE: ROTATE LUGS 180 DEG
FROM EACH OTHER BEFORE CRIMPING.



NOTES:

1) USE RED HEAT SHRINK ON ALL BATTERY CABLE TERMINALS.
2) COMPONENTS MAY BE SUBSTITUTED AS LONG AS FIT, FORM, FUNCTION AND REGULATORY STANDARDS ARE MET OR EXCEEDED.

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES XX = ± 0.010 XXX = ± 0.005	MACHINE TOLERANCES X = ± 0.4 XX = ± 0.2
FORM TOLERANCES XX = ± 0.030 XXX = ± 0.015	FORM TOLERANCES X = ± 0.8 XX = ± 0.4
FAB TOLERANCES XX = ± 0.060 XXX = ± 0.030	FAB TOLERANCES X = ± 1.5 XX = ± 0.8

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CUSTOM DESIGN AND
UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

CABLES, BATTERY
CFP23E

DWG UNITS: INCH/LB/S

DRAWN BY: BG

AUTO CAD

DATE: 11 APR 2013

INIT ECO: 2013-207

SCALE:

EST WEIGHT:

SHEET 1OF1

DRAWING NO: 23939

REV	ECO	DESCRIPTION OF REVISION	BY	DATE
A	2014-071	18” WAS 15”. ADDED 9757	PBS	14FEB2014

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	CONTACTOR, MANUAL OVERIDE, 12V, PN:535-0127, FIREPUMP	8824-12
2	1	CONTACTOR, MANUAL OVERIDE, 24V, PN:535-0098, FIREPUMP	8824-24

PR00010

THE 535-0127 SOLENOID ASSEMBLY MUST
BE INSTALLED IN A NEMA 2 ENVIRDMENT

ELECTRICAL SPECIFICATIONS
VOLTS: 12 VDC
CONTACT RATING: 400 AMPS (ROLLING CURRENT)
800 AMPS (BREAKAWAY CURRENT)
DUTY TYPE: INTERMITTENT
CONTACT POSITION: NORMALLY OPEN

DESIGN APPROVAL	DATE
DES.ENG.	
MFG.ENG.	
Q.C.	
SALES	

UNSPECIFIED TOLERANCES
.xxx ±.005
.xx ±.015
.x ±.060
Machine Finish √125 Max.
Angles ±1°
Concentricity .005 TIR
Squareness .001 per in.

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PART NO. 535-0127

DUMORE CORPORATION
1030 VETERANS ST. MAUSTON, WI 53948

DO NOT SCALE DRAWING

REMOVE ALL BURRS
BREAK SHARP CORNERS

TITLE: ASSEMBLY, SOLENOID

MATERIAL SPEC:

Req. per Piece
Pattern No.

RECEIVED AS

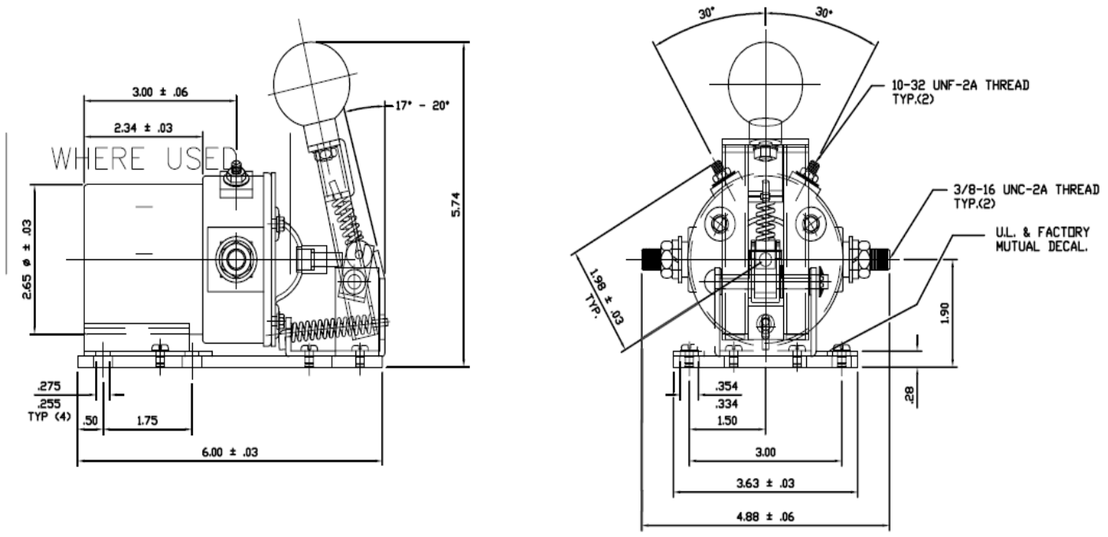
DWG. BY: CTH DATE: 7/19/01

CKD. BY: DATE:

SCALE: 1:2

REVISIONS

RELEASED
ECN # 25159
7/19/01 CTH



ITEM: 1 - 8824-12

SP4847

THE 535-0098 SOLENOID ASSEMBLY MUST
BE INSTALLED IN A NEMA 2 ENVIRDMENT

ELECTRICAL SPECIFICATIONS
VOLTS: 24 VDC
CONTACT RATING: 400 AMPS (ROLLING CURRENT)
800 AMPS (BREAKAWAY CURRENT)
DUTY TYPE: INTERMITTENT
CONTACT POSITION: NORMALLY OPEN

DESIGN APPROVAL	DATE
DES.ENG.	
MFG.ENG.	
Q.C.	
SALES	SEE ECN # 19248 FOR SIGNATURES

UNSPECIFIED TOLERANCES
.xxx ±.005
.xx ±.015
.x ±.059
Machine Finish √125 Max.
Angles ±1°
Concentricity .005 TIR
Squareness .001 per in.

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PART NO. 535-0098

DUMORE CORPORATION
1030 VETERANS ST. MAUSTON, WI 53948

DO NOT SCALE DRAWING

REMOVE ALL BURRS
BREAK SHARP CORNERS

TITLE: ASSEMBLY, SOLENOID

MATERIAL SPEC:

Req. per Piece
Pattern No.

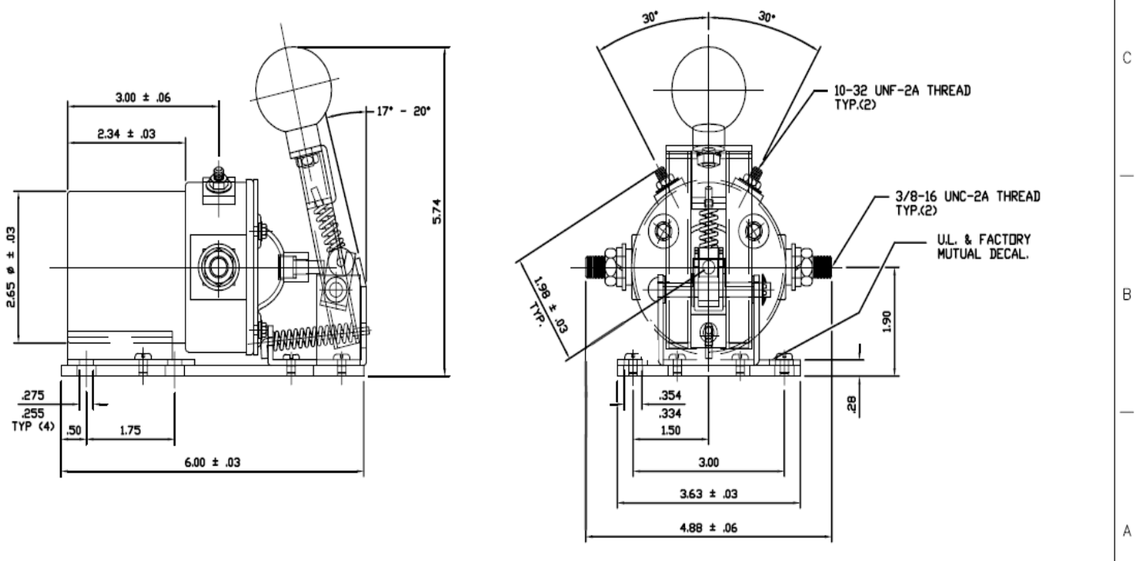
RECEIVED AS

DWG. BY: MEB DATE: 2/16/89

CKD. BY: RS DATE: 8/13/91

SCALE: 1:2

REVISIONS



ITEM: 2 - 8824-24

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2011-068	UPDATED DRAWING FORMAT ADDED CNP LABEL TO PDF DRAWING	MAC	18FEB2011

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

MANUAL SOLENOID
-

DWG UNITS: IN/LB/S

DRAWN BY: CMC

DATE: 12JUNE2004

PRO-ENGINEER

INIT ECO: -

SCALE: 1.000

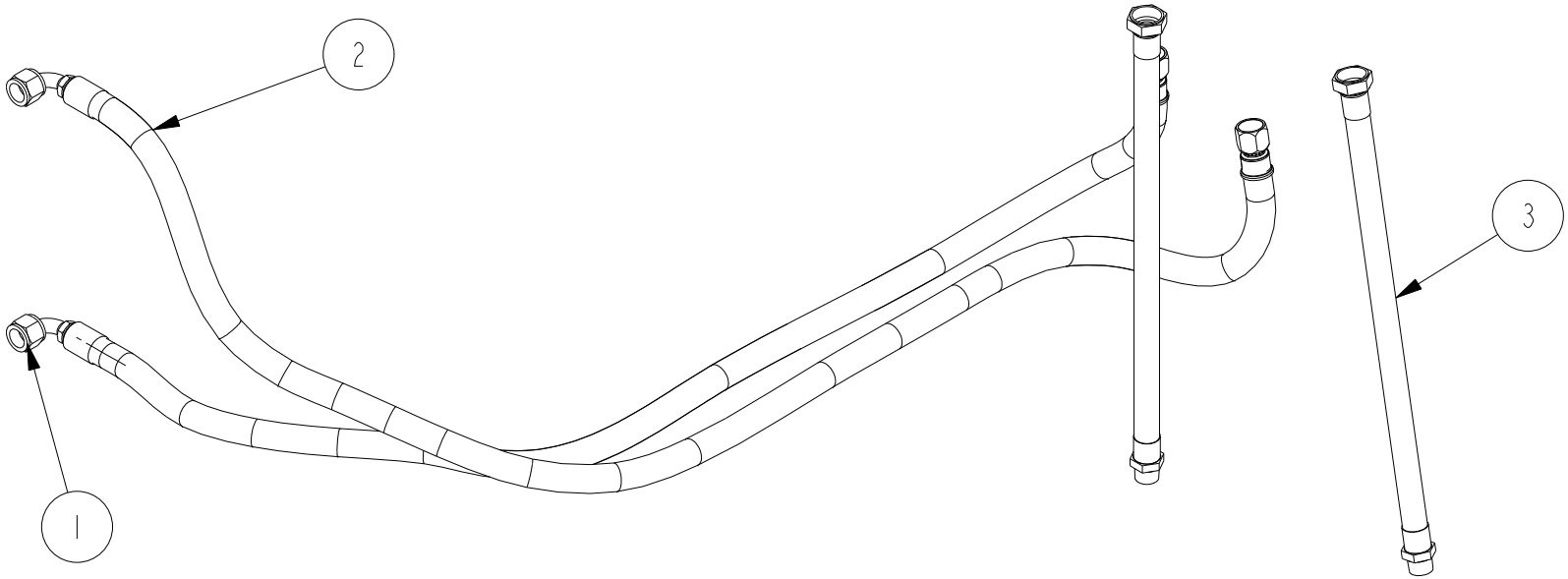
EST WEIGHT: 42238.628

SHEET 1 OF 1

DRAWING NO: 8824

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	HOSE, FUEL, ENG-COOLER, CFP23E	23342
2	1	HOSE, FUEL, ECM-COOLER, CFP23E	23343
3	2	FUEL LINE, 24" EXTENSION, #16 FEM JIC X #16 22IFR X 1" NPT	23496-016



UNLESS OTHERWISE SPECIFIED
ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
125	MACHINE TOLERANCES .X ± 0.06 .XX ± 0.010 .XXX ± 0.001 WELD TOLERANCES .X ± 0.25 .XX ± 0.12 .XXX ± 0.06	MACHINE TOLERANCES X ± 1.5 X.X ± 0.5 X.XX ± 0.05 WELDED TOLERANCES X ± 5 X.X ± 3 X.XX ± 1.50

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DEPERE, WISCONSIN

KIT, FUEL LINE
CFP23E

DWG UNITS: IN/LB/S

DRAWN BY: PBS

DATE: 04FEB2014

PRO-ENGINEER

INIT ECO: 2014-071

EST WEIGHT: 15.233

SCALE: 0.125

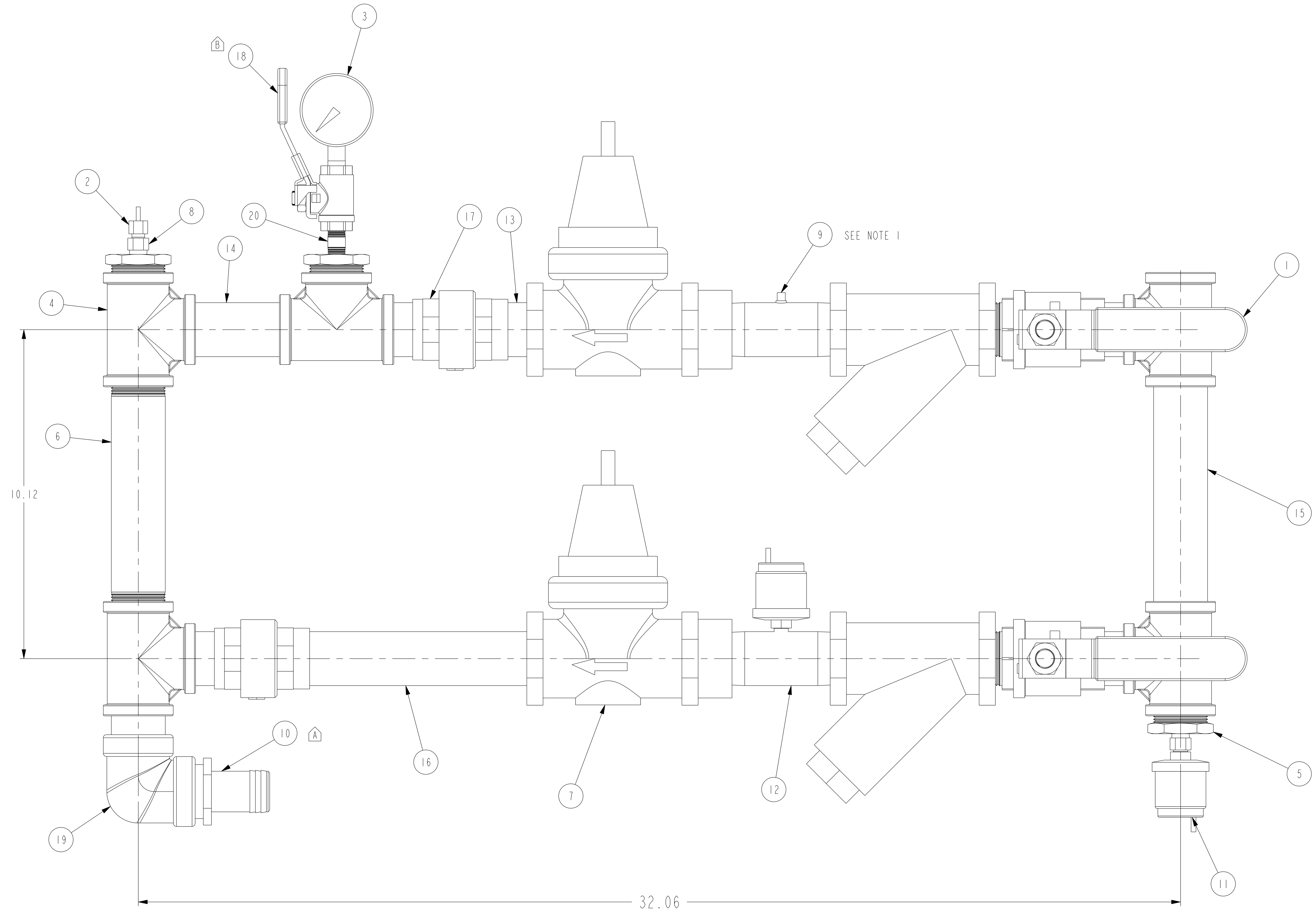
SHEET 1 OF 1

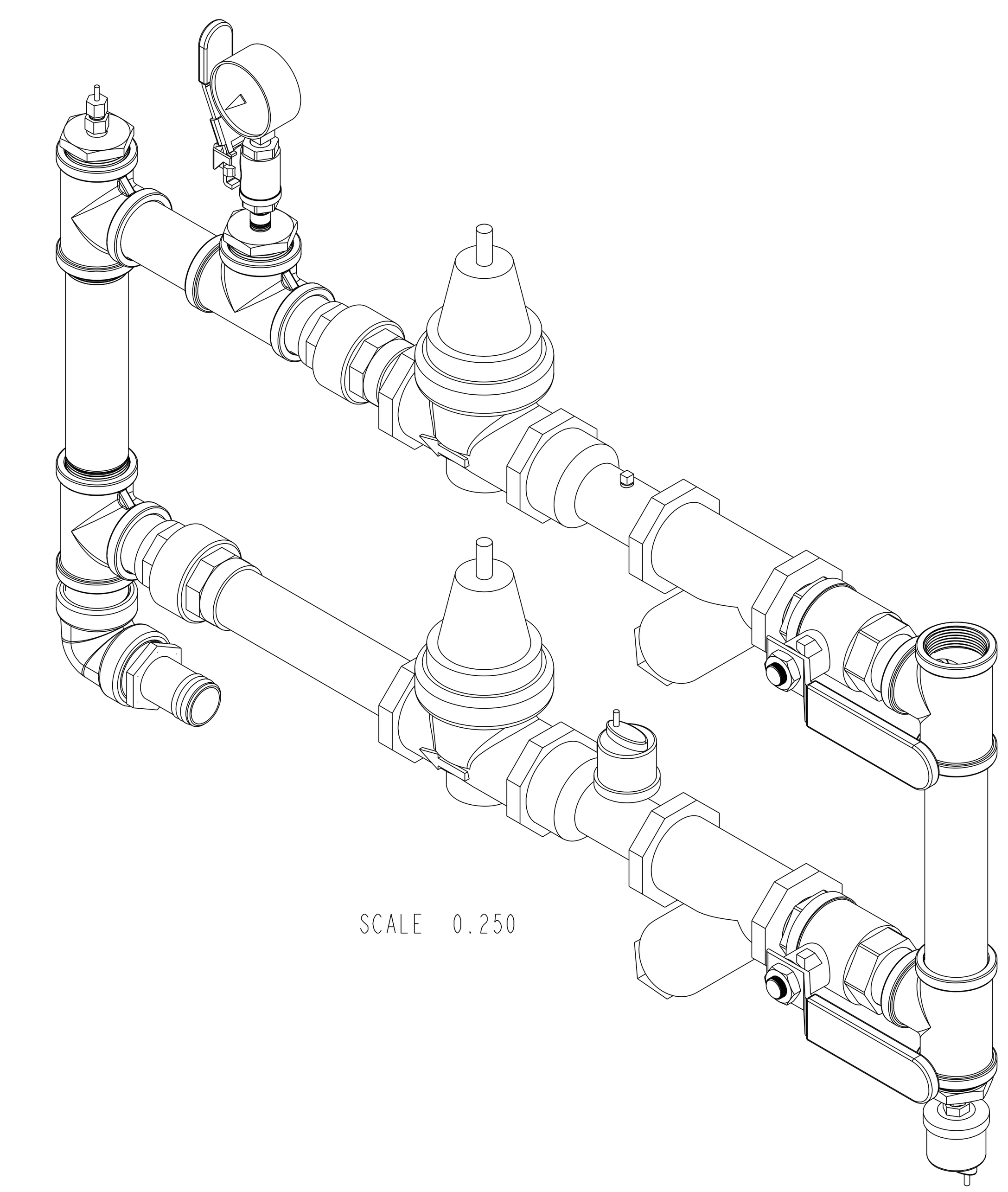
DRAWING NO: A042A380

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	BALL VALVE, 1_1/4 NPT MALE X FEMALE	12709
2	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
3	1	GAUGE, PRESSURE, 1/4" NPT, DPGI-2 1/2, 0-100 PSI, (WATTS)	8892
4	5	TEE, 1 1/4" NPT FEMALE, BLK STEEL	12386
5	3	BUSHING, REDUCING, 1 1/4" X 1/4" NPT, BLK STEEL	12391
6	1	NIPPLE,1-1/4NPTx8"LG(USE25483), BLK STEEL	12395
7	2	REGULATOR/STRAINER, 1-1/4" NPT, SEA WATER COMPATIBLE	13702
8	2	BUSH, RED, -4 NPT X -2 FNPT	14783-4-2
9	1	PLUG, NAVAL BRONZE, NPT, 1/8" SQR HD	15793-2
10	1	ADAPTER,STEEL,NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	16766-20-20
11	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574
12	2	NIPPLE, 1-1/4 X 4", BLACK IRON, W/PORT	23426
13	6	NIPPLE,1-1/4 INCH PIPE, 2.00 IN LONG	25483.0200
14	1	NIPPLE,1-1/4 INCH PIPE, 4.00 IN LONG	25483.0400
15	1	NIPPLE,1-1/4 INCH PIPE, 8.00 IN LONG	25483.0800
16	1	NIPPLE,1-1/4 INCH PIPE, 8.10 IN LONG	25483.0810
17	2	VALVE, 1-1/4" NPT CHECK, VALUE ADDED: CV125	25504
18	1	VALVE, BALL, 1/4" NPT FEMALE	A042D838
19	1	ELBOW, 90°, 1 1/4" NPT FEMALE, BLK STEEL	B90H
20	1	NIPPLE, 1/4" NPT x 1 1/2", BLK STEEL	LTL-CPN14112

BILL OF MATERIAL (A)





SCALE 0.250

NOTES:
1. ITEM 13702 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY REPLACE THE CLOSE NIPPLE WITH ITEM 21005
2. REMOVE ALL SHARP EDGES AND BURRS
3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. DO NOT SUBSTITUTE COMPONENTS
5. FINISH: COAT PER ES044 RAL 3001

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DEPERE, WISCONSIN

COOLING LOOP, 1-1/4", VERT
RAW WATER, CFP23E

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX : ± 0.010 .XXX : ± 0.005; FORM TOLERANCES .XX : ± 0.030 .XXX : ± 0.015; FAB TOLERANCES .XX : ± 0.060 .XXX : ± 0.030	MACHINE TOLERANCES .X : ± 0.4 .XX : ± 0.2; FORM TOLERANCES .X : ± 0.8 .XX : ± 0.4; FAB TOLERANCES .X : ± 1.5 .XX : ± 0.8

DWG UNITS: IN/LB/S	DRAWN BY: PBS / PRO-ENGINEER	DATE: 30OCT2012 / INIT ECO: 2013-303
SCALE: 0.500 / EST WEIGHT: 57.397	SHEET 1 OF 2	DRAWING NO: 25514

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS A042D838 WAS FA60204-1	PBS	16JAN2015
A	2014-583	ADDED: 16766-20-20. DELETED: 12238-20-20	JJW	22AUG2014

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
25514			1-1/4" Vertical, Raw Water			
	12709	RUB, S92G42	1-1/4" ball valve			
				body	CW617N	EN12165
				seat	PTFE	
				ball	CW617N	EN12165
				end cap	CW617N	EN12165
				stem	CW617N	EN12164
				nut	CB4FF	EN10263-2
				O-ring	FPM	
				handle	DD11	EN10111
				handle coating	PVC	
				washer	PTFE	
	8862	Datcon 02022-00	temperature sender	Body	brass	
	8892	Watts, DPG1-2	pressure gauge			
				case	ABS polymer	
				window	Kostil polymer	
				sensing element	copper alloy Bourdon tube	
				welding	tin alloy	
				connection	brass	
	12386		1-1/4" tee		black steel	ASTM A53/A733
	A042D838	RUB, S95B45	1/4" ball valve			
				body	CW617N	EN12165
				seat	PTFE	
				ball	CW617N	EN12165
				end cap	CW617N	EN12165
				stem	CW617N	EN12164
				nut	CB4FF	EN10263-2
				O-ring	FPM	
				handle	DD11	EN10111
				handle coating	PVC	
				washer	PTFE	
	12391		1-1/4" x 1/4" reducing bushing		black steel	ASTM A53/A733
	12395		1-1/4" x 8" nipple		black steel	ASTM A53/A733
	13702	Wilkins, 500YSBRHLRSW	1-1/4" regulator/strainer			
				body	cast bronze	ASTM B584
				access covers	cast bronze	ASTM B584
					brass	ASTM B16
				fasteners	300 series stainless steel	
				stem & plunger	cast bronze	ASTM B584
					brass	ASTM B16
				elasttomers	Buna Nitrile	FDA approved
					EPDM	FDA approved
				cap gaskets	natural vulcanized fibre	
					Acetal (Delrin 500)	NSF Listed
				springs	oil tempered wire	ASTM A229
				strainer screen	300 series stainless steel	
				seat	300 series stainless steel	
	14783-4-2		1/4" x 1/8" reducing bushing		black steel	ASTM A53/A733
	15793-2		1/8" plug		black steel	ASTM A53/A733
	16766-20-20		1-1/4" NPT to barb adapter		steel	
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	23426		1-1/4" x 4" nipple		black steel	ASTM A53/A733
	25483-0200		1-1/4" x 2" nipple		black steel	ASTM A53/A733
	25483-0400		1-1/4" x 4" nipple		black steel	ASTM A53/A733
	25483-0800		1-1/4" x 8" nipple		black steel	ASTM A53/A733
	25483-0810		1-1/4" x 8.1" nipple		black steel	ASTM A53/A733
	25504	Euroblock, 100002	1-1/4" check valve			
				body	brass CW617N	EN12165
				end connection	brass CW617N	EN12165
				disc	polyetherimide	
				seat	NBP	
				spring	stainless steel	
	B90H		1-1/4" elbow		black steel	ASTM A53/A733
	LTL-CNP14112		1/4" x 1-1/2" nipple		black steel	ASTM A53/A733

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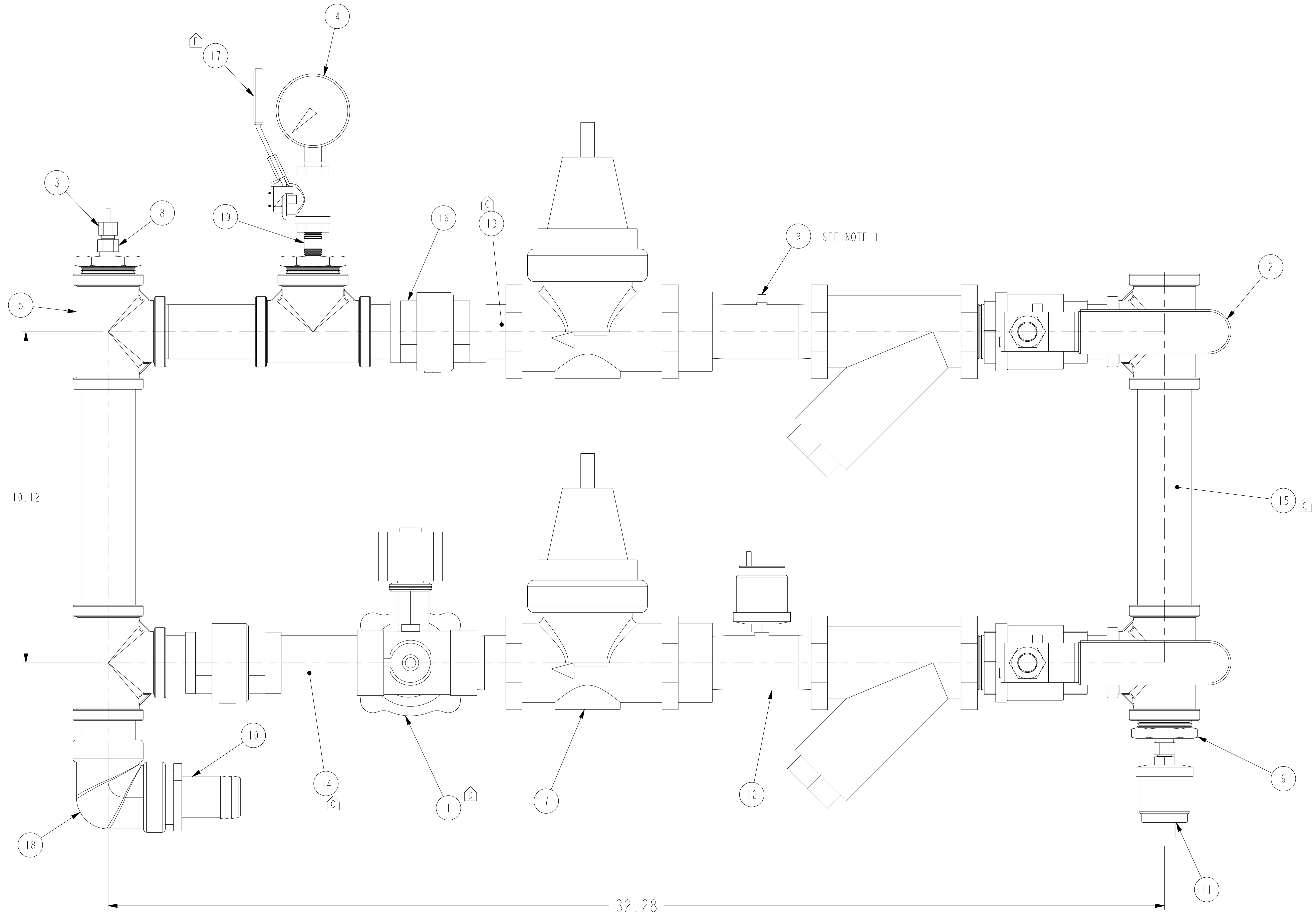
COOLING LOOP, 1-1/4", VERT
RAW WATER, CFP23E

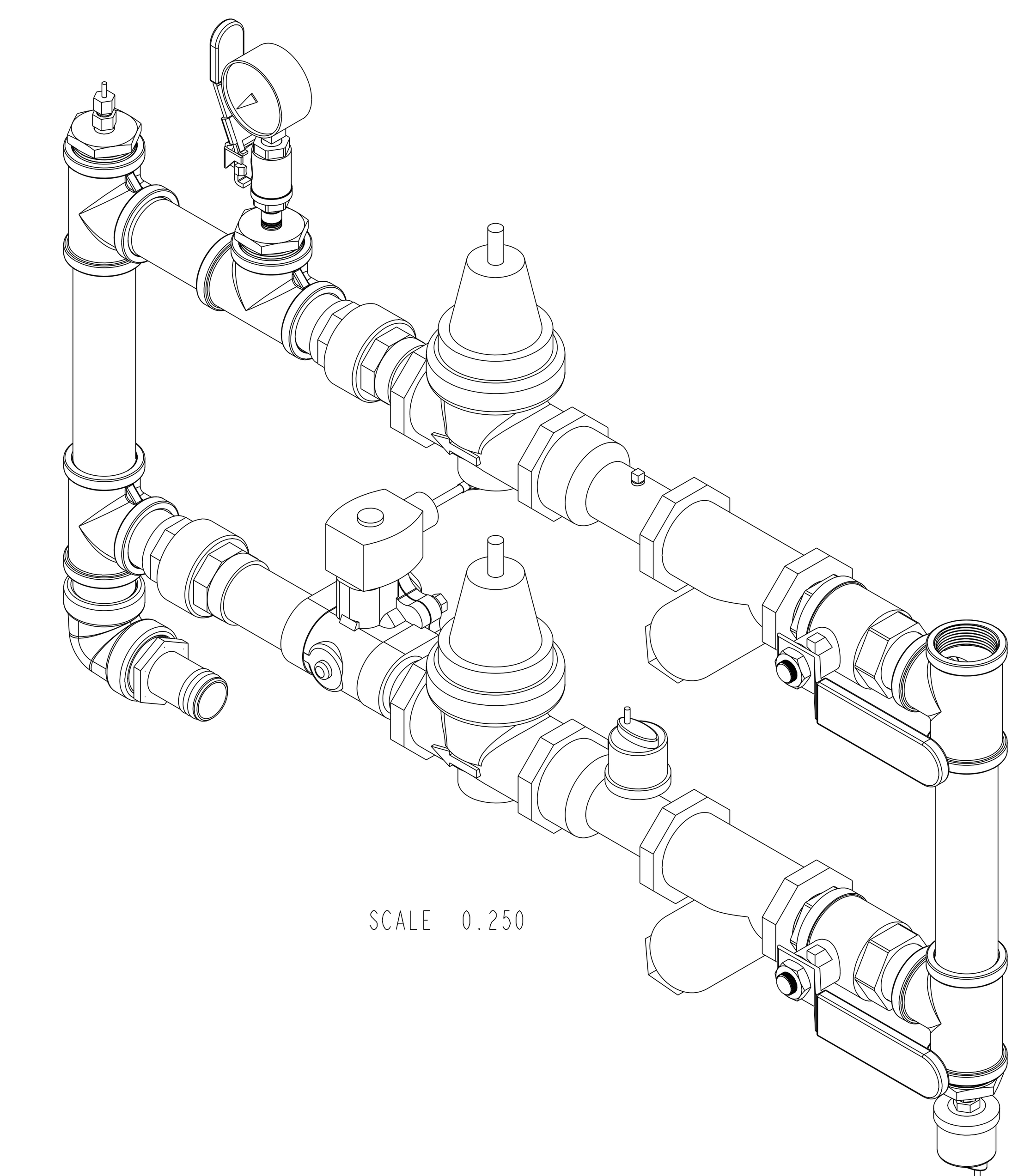
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

DWG UNITS: IN/LB/S	DRAWN BY: PBS	PRO-ENGINEER	DATE: 30OCT2012
			INIT ECO: 2013-303
SCALE: 0.500	SHEET 2 OF 2		DRAWING NO: 25514
EST WEIGHT: 57.397			

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015





SCALE 0.250

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	VALVE, SOLENOID, 1-1/4" NPT, 24VDC, 150PSI	12389
2	2	BALL VALVE, 1.1/4 NPT MALE X FEMALE	12709
3	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
4	1	GAUGE, PRESSURE, 1/4" NPT, DPG1-2 1/2, 0-100 PSI, (WATTS)	8892
5	5	TEE, 1 1/4" NPT FEMALE, BLK STEEL	12386
6	3	BUSHING, REDUCING, 1 1/4" X 1/4" NPT, BLK STEEL	12391
7	2	REGULATOR/STRAINER, 1-1/4" NPT, SEA WATER COMPATIBLE	13702
8	2	BUSH, RED, -4 NPT X -2 FNPT	14783-4-2
9	1	PLUG, NAVAL BRONZE, NPT, 1/8" SQR HD	15793-2
10	1	ADAPTER,STEEL,NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	16766-20-20
11	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574
12	2	NIPPLE, 1-1/4 X 4", BLACK IRON, W/PORT	23426
13	7	NIPPLE,1-1/4 INCH PIPE, 2.00 IN LONG	25483_0200
14	2	NIPPLE,1-1/4 INCH PIPE, 4.00 IN LONG	25483_0400
15	2	NIPPLE,1-1/4 INCH PIPE, 8.00 IN LONG	25483_0800
16	2	VALVE, 1-1/4" NPT CHECK, VALUE ADDED: CV125	25504
17	1	VALVE, BALL, 1/4" NPT FEMALE	A042D838
18	1	ELBOW, 90°, 1 1/4" NPT FEMALE, BLK STEEL	B90H
19	1	NIPPLE, 1/4" NPT x 1 1/2", BLK STEEL	LTL-CPN14112

NOTES:
1. ITEM 13702 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY REPLACE THE CLOSE NIPPLE WITH ITEM 21005
2. REMOVE ALL SHARP EDGES AND BURRS
3. (A) LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. DO NOT SUBSTITUTE COMPONENTS

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS A042D838 WAS FA60204-1	PBS	16JAN2015
D	2014-241	UPDATED TO SHOW LEADS ON SOLENOID VALVE	PBS	17APR2014
C	2013-360	REPLACE 12394 W/25483_0200, 12395 W/25483_0800 & 23431 W/25483_0400	RMJ	31JUL2013
B	2013-395	DELETED: 12238-20-20. ADDED 16766-20-20	PBS	12JUL2013
A	2013-303	ADDED: 25504. 12709 WAS QTY 4, 12394 WAS QTY 5, CHANGED LEAK TEST PRESSURE.	PBS	23MAY2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
		FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
		FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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COOLING LOOP, 1-1/4", 24V
RAW WATER, CFP23E

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 30OCT2012
	PRO-ENGINEER	INIT ECO: 2011-232
SCALE: 0.500	SHEET 1 OF 2	DRAWING NO: 23427
EST WEIGHT: 49.026		

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
23427			1-1/4" 24VDC, Raw Water			
	12389	Asco, 8210G008-24V	1-1/4" NPT 24V solenoid valve			
				body	brass	
				seals and discs	NBR or PTFE	
				disc holder	PA	
				core tube	305 stainless steel	
				core and plugnut	430F stainless steel	
				springs	302 stainless steel	
				shading coil	copper	
	12709	RUB, S92G42	1-1/4" ball valve			
				body	CW617N	EN12165
				seat	PTFE	
				ball	CW617N	EN12165
				end cap	CW617N	EN12165
				stem	CW617N	EN12164
				nut	CB4FF	EN10263-2
				O-ring	FPM	
				handle	DD11	EN10111
				handle coating	PVC	
				washer	PTFE	
	8862	Datcon 02022-00	temperature sender	Body	brass	
	8892	Watts, DPGI-2	pressure gauge			
				case	ABS polymer	
				window	Kostil polymer	
				sensing element	copper alloy Bourdon tube	
				welding	tin alloy	
				connection	brass	
	12386		1-1/4" tee		black steel	ASTM A53/A733
	A042D838	RUB, S95B45	1/4" ball valve			
				body	CW617N	EN12165
				seat	PTFE	
				ball	CW617N	EN12165
				end cap	CW617N	EN12165
				stem	CW617N	EN12164
				nut	CB4FF	EN10263-2
				O-ring	FPM	
				handle	DD11	EN10111
				handle coating	PVC	
				washer	PTFE	
	12391		1-1/4" x 1/4" reducing bushing		black steel	ASTM A53/A733
	13702	Wilkins, 500YSBRHLRSW	1-1/4" regulator/strainer			
				body	cast bronze	ASTM B584
				access covers	cast bronze	ASTM B584
					brass	ASTM B16
				fasteners	300 series stainless steel	
				stem & plunger	cast bronze	ASTM B584
					brass	ASTM B16
				elasttomers	Buna Nitrile	FDA approved
					EPDM	FDA approved
				cap gaskets	natural vulcanized fibre	
					Acetal (Delrin 500)	NSF Listed
				springs	oil tempered wire	ASTM A229
				strainer screen	300 series stainless steel	
				seat	300 series stainless steel	
	14783-4-2		1/4" x 1/8" reducing bushing		black steel	ASTM A53/A733
	15793-2		1/8" plug		black steel	ASTM A53/A733
	16766-20-20		1-1/4" NPT to barb adapter		steel	
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	23426		1-1/4" x 4" nipple		black steel	ASTM A53/A733
	25483-0200		1-1/4" x 2" nipple		black steel	ASTM A53/A733
	25483-0400		1-1/4" x 4" nipple		black steel	ASTM A53/A733
	25483-0800		1-1/4" x 8" nipple		black steel	ASTM A53/A733
	25504	Euroblock, 100002	1-1/4" check valve			
				body	brass CW617N	EN12165
				end connection	brass CW617N	EN12165
				disc	polyetherimide	
				seat	NBP	
				spring	stainless steel	
	B90H		1-1/4" elbow		black steel	ASTM A53/A733
	LTL-CNP14112		1/4" x 1-1/2" nipple		black steel	ASTM A53/A733

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

MACHINE TOLERANCES .XX ± 0.02 | MACHINE TOLERANCES X ± 0.5

FORM TOLERANCES .XX ± 0.05 | FORM TOLERANCES X ± 0.5

FAB TOLERANCES .XX ± 0.06 | FAB TOLERANCES X ± 0.5

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015

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DEPERE, WISCONSIN

COOLING LOOP, 1-1/4", 24V
RAW WATER, CFP23E

DWG UNITS: IN/LB/S

DRAWN BY: PBS

PRO-ENGINEER

DATE: 30OCT2012

INIT ECO: 2011-232

SCALE: 0.500

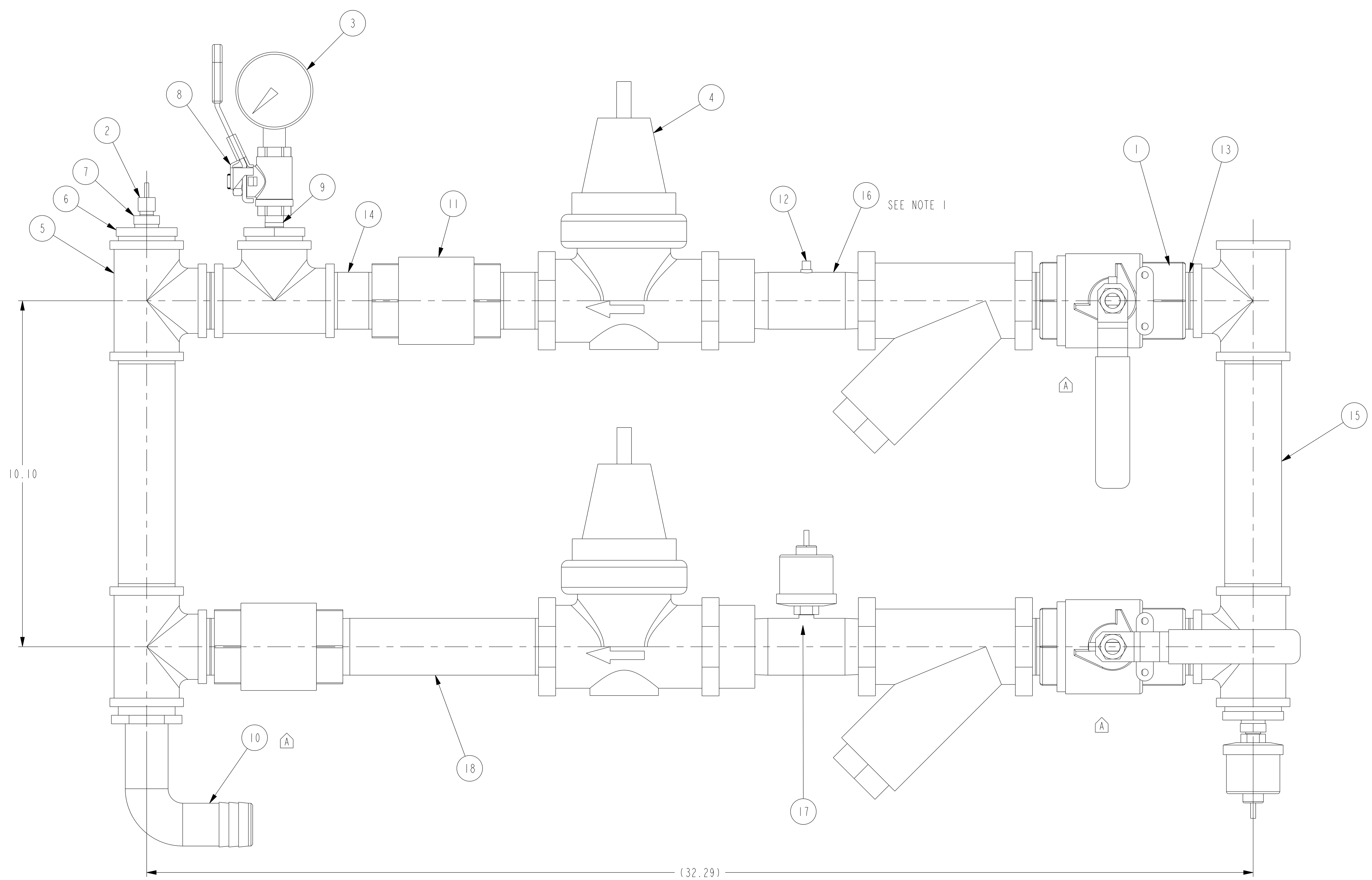
EST WEIGHT: 49.026

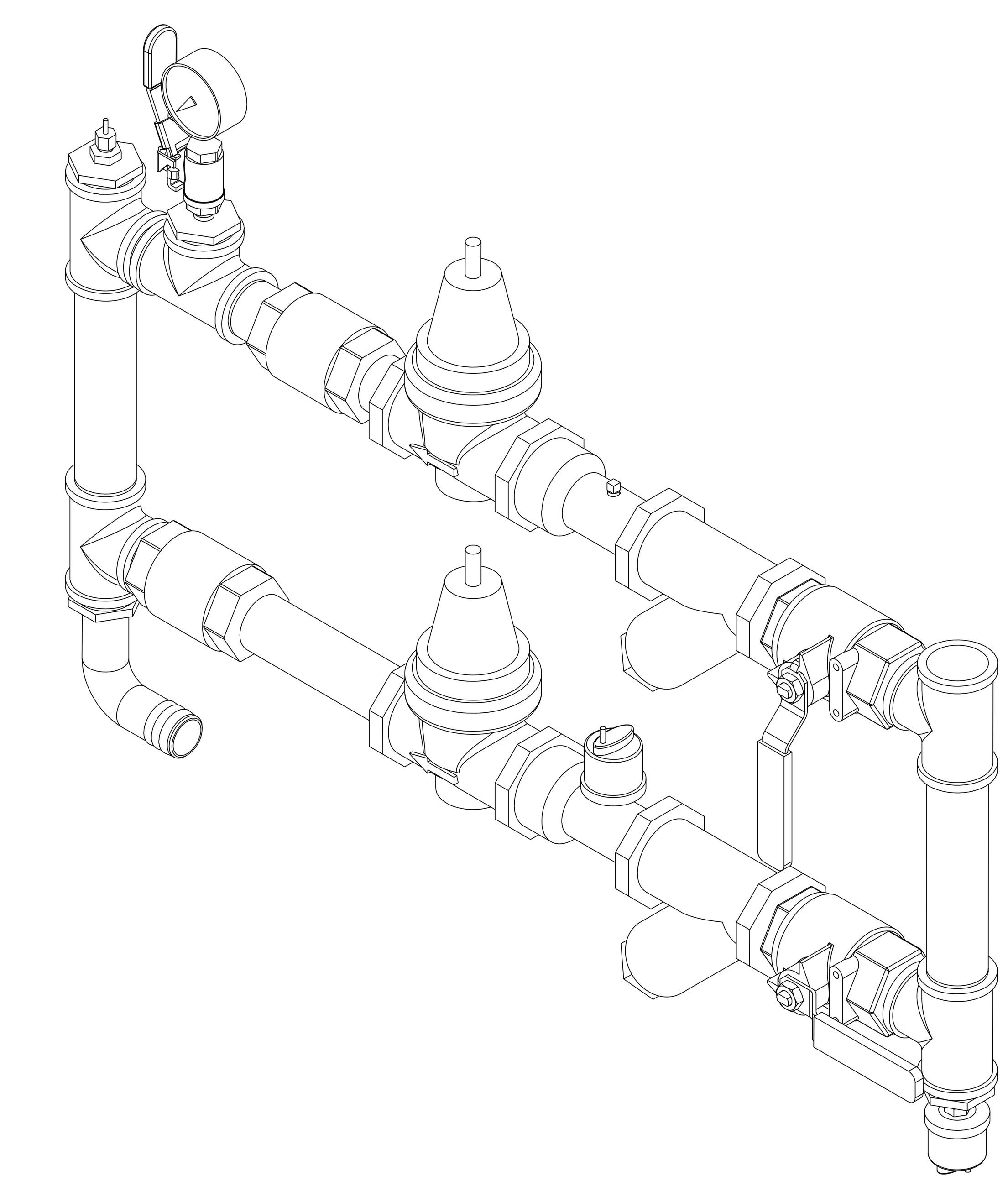
SHEET 2 OF 2

DRAWING NO: 23427

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	VALVE, MARINE GRADE, 1-1/4" NPT	15759-20
2	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
3	1	GUAGE, 0-100 PSI, 1/4" NPT STN STL	13113
4	2	REGULATOR/STRAINER, 1-1/4" NPT, SEA WATER COMPATIBLE	13702
5	5	TEE, MARINE GRADE, 1-1/4" NPT	15755-20
6	3	BUSHING, MARINE GRADE, 1-1/4" x 1/4"	15758-20-4
7	2	BUSHING, MARINE GRADE, 1/4" x 1/8"	15758-4-2
8	1	VALVE, BALL, 1/4" NPT,, APOLLO 77-100 (MARINE)	15759-04
9	1	NIPPLE, NAVAL BRONZE, 1/4" X CLOSE	15760
10	1	ELBOW, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15767-20-20
11	2	CHECK VALVE, MARINE GRADE, 1-1/4" NPT	15768-20
12	1	PLUG, NAVAL BRONZE, NPT, 1/8" SQR HD	15793-2
13	6	NIPPLE, MARINE GRADE, 1-1/4" X 1-5/8"	15797
14	2	NIPPLE, MARINE GRADE, 1-1/4" X 2-1/2"	15798
15	2	NIPPLE, MARINE GRADE, 1-1/4" X 8"	15803
16	2	NIPPLE,1-1/4x4"LONG, NAVAL BRONZE WITH 1/8NPT PORT	21005
17	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574
18	1	NIPPLE, NAVAL BRONZE, 1-1/4" X 7.00" LG	25518





NOTES:
1. ITEM 13702 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY REPLACE THE CLOSE NIPPLE WITH ITEM 21005
2. REMOVE ALL SHARP EDGES AND BURRS
3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. DO NOT SUBSTITUTE COMPONENTS

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COOLING LOOP, 1-1/4", VERT
SEA WATER COMPATIBLE, CFP23E

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS: MACHINE TOLERANCES .XX = ± 0.010, .XXX = ± 0.005; FORM TOLERANCES .XX = ± 0.030, .XXX = ± 0.015; FAB TOLERANCES .XX = ± 0.060, .XXX = ± 0.030 | METRIC UNITS: MACHINE TOLERANCES .X = ± 0.4, .XX = ± 0.2; FORM TOLERANCES .X = ± 0.8, .XX = ± 0.4; FAB TOLERANCES .X = ± 1.5, .XX = ± 0.8

THIRD ANGLE PROJECTION

DWG UNITS: IN/LB/S	DRAWN BY: PBS		DATE: 29MAY2013
	PRO-ENGINEER		INIT ECO: 2013-303
SCALE: 0.500	SHEET 1 OF 2		DRAWING NO: 25516
EST WEIGHT: 56.860			

REV	ENF	DESCRIPTION OF REVISION	REV BY	DATE
B	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS	PBS	16JAN2015
A	2014-583	UPDATE VALVE POSITION VIEWS. ADDED: 15767-20-20. DELETED: 15797, 15756-20 & 12238-20-20.	JJW	20AUG2014

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
25516			1-1/4" Vertical, Sea Water			
	15759-20	Apollo, 77-106-01	1-1/4" ball valve			
				lever and grip	steel, zinc plated w/vinyl	
				stem packing	MPTFE	
				stem bearing	RPTFE	
				ball	chrome plated	ASTM B16
				seat	RPTFE	
				retainer		ASTM B524-C84400
				gland nut		ASTM B16
				stem		ASTM B16
				lever nut	steel, zinc plated	
				body seal	PTFE	
				body		ASTM B524-C84400
	8862	Datcon 02022-00	temperature sender	Body	brass	
	13113	Grainger, 4RY95	pressure gauge			
				case	stainless steel	
				socket	316 stainless steel	
				tube	316 stainless steel	
				lens	polycarbonate	
				ring	316 stainless steel	
	13702	Wilkins, 500YSBRHLRSW	1-1/4" regulator/strainer			
				body	cast bronze	ASTM B584
				access covers	cast bronze	ASTM B584
					brass	ASTM B16
				fasteners	300 series stainless steel	
				stem & plunger	cast bronze	ASTM B584
					brass	ASTM B16
				elasttomers	Buna Nitrile	FDA approved
					EPDM	FDA approved
				cap gaskets	natural vulcanized fibre	
					Acetal (Delrin 500)	NSF Listed
				springs	oil tempered wire	ASTM A229
				strainer screen	300 series stainless steel	
				seat	300 series stainless steel	
	15755-20		1-1/4" tee		Copper Alloy	ASTM B62-09
	15758-20-4		1-1/4" x 1/4" reducing bushing		Copper Alloy	ASTM B62-09
	15758-4-2		1/4" x 1/8" reducing bushing		Copper Alloy	ASTM B62-09
	15759-04	Apollo, 77-101-01	1/4" ball valve			
				lever and grip	steel, zinc plated w/vinyl	
				stem packing	MPTFE	
				stem bearing	RPTFE	
				ball	chrome plated	ASTM B16
				seat	RPTFE	
				retainer		ASTM B16
				gland nut		ASTM B16
				stem		ASTM B16
				lever nut	steel, zinc plated	
				body seal	PTFE	
				body		ASTM B524-C84400
	15760		1/4" close nipple		Copper Alloy	ASTM B62-09
	15767-20-20		1-1/4" NPT to barb adapter		Copper Alloy	ASTM B62-09
	15768-20	Watts, series 600	1-1/4" check valve			
				body	bronze	
				guide bushing	stainless steel	
				spring	stainless steel	
				check	brass	
				seat	PTFE	
				O-ring	Nitrile	
				adapter	bronze	
	15793-2		1/8" plug		Copper Alloy	ASTM B62-09
	15797		1-1/4" x 1-5/8" nipple		Copper Alloy	ASTM B62-09
	15798		1-1/4" x 2-1/2" nipple		Copper Alloy	ASTM B62-09
	15803		1-1/4" x 8" nipple		Copper Alloy	ASTM B62-09
	21005		1-1/4" x 4" nipple		Copper Alloy	ASTM B62-09
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	25518		1-1/4" x 7" nipple		Copper Alloy	ASTM B62-09

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINED SURFACES .xx ± 0.02 .xxx ± 0.010 FOR TAPPED HOLES .xx ± 0.03 .xxx ± 0.015	MACHINED SURFACES .x ± 0.5 .xx ± 0.25 FOR TAPPED HOLES .x ± 0.75 .xx ± 0.375

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015

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AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1-1/4", VERT
SEA WATER COMPATIBLE, CFP23E

DWG UNITS: IN/LB/S

DRAWN BY: PBS

DATE: 29MAY2013

PRO-ENGINEER

INIT ECO: 2013-303

SCALE: 0.500

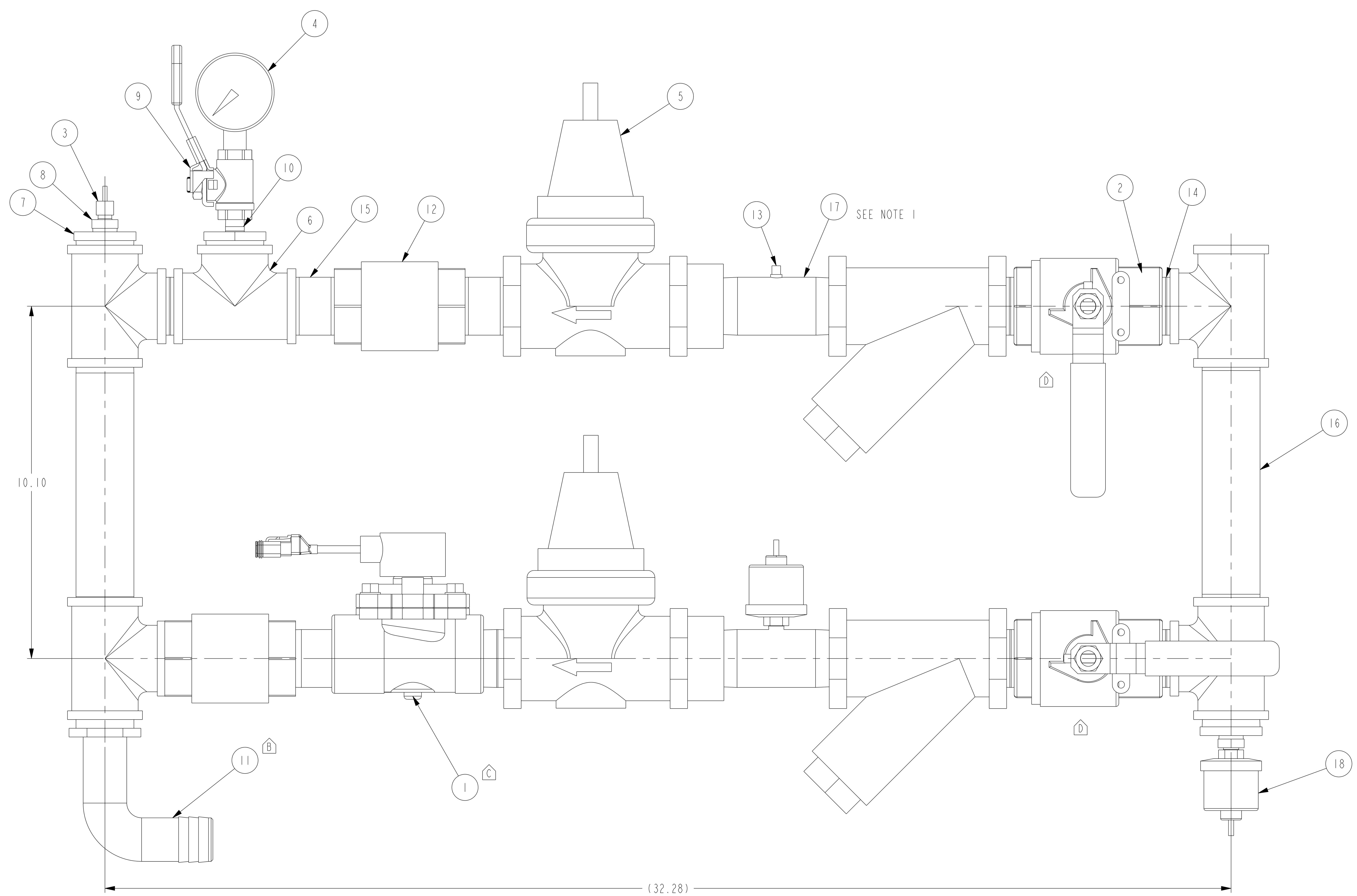
SHEET 2 OF 2

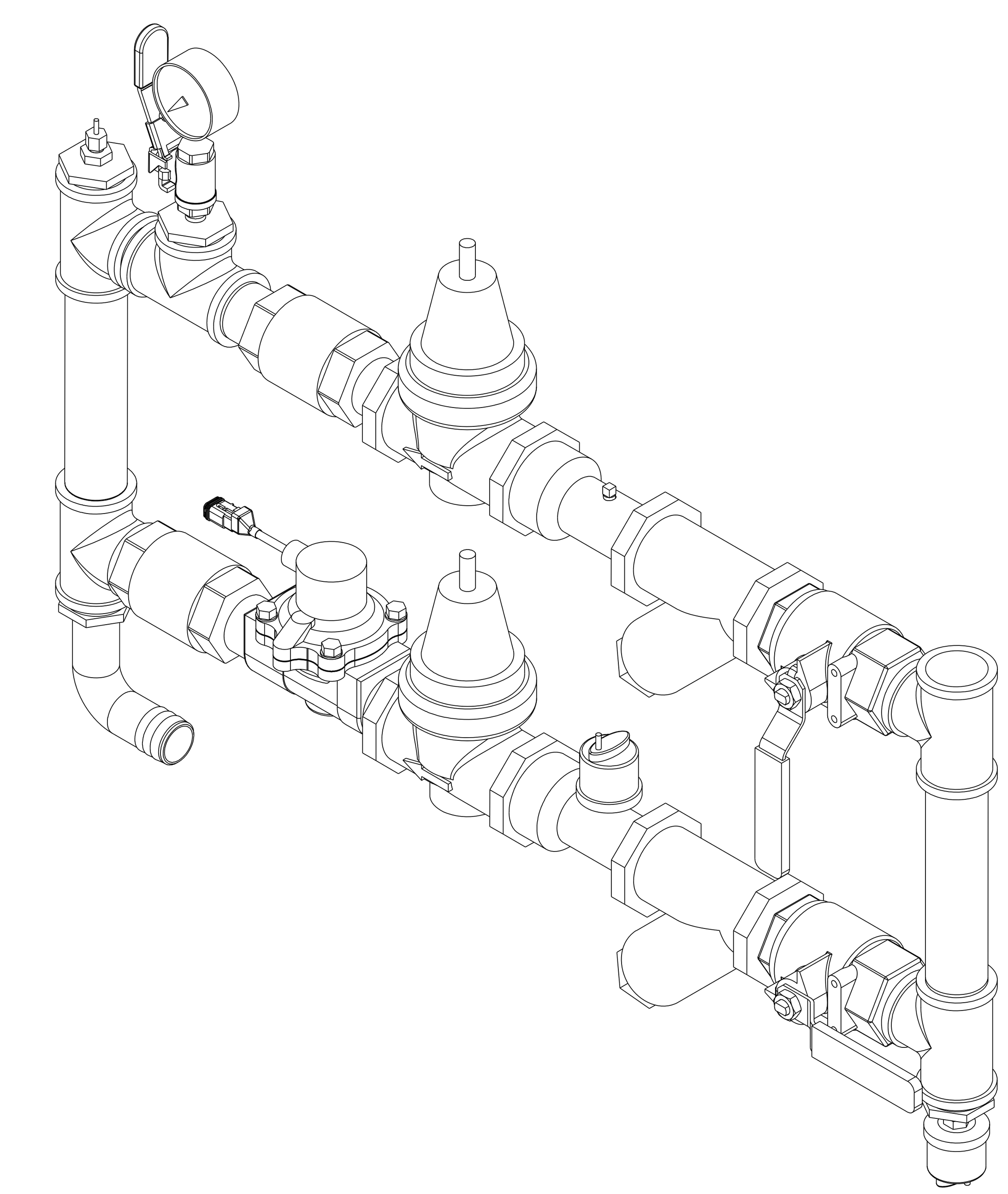
DRAWING NO: 25516

EST WEIGHT: 56.860

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	VALVE, SOLENOID, 1-1/4" NPT, 24VDC, SEA WATER COMPATIBLE	14683
2	2	VALVE, MARINE GRADE, 1-1/4" NPT	15759-20
3	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
4	1	GUAGE, 0-100 PSI, 1/4" NPT STN STL	13113
5	2	REGULATOR/STRAINER, 1-1/4" NPT, SEA WATER COMPATIBLE	13702
6	5	TEE, MARINE GRADE, 1-1/4" NPT	15755-20
7	3	BUSHING, MARINE GRADE, 1-1/4" x 1/4"	15758-20-4
8	2	BUSHING, MARINE GRADE, 1/4" x 1/8"	15758-4-2
9	1	VALVE, BALL, 1/4" NPT,, APOLLO 77-100 (MARINE)	15759-04
10	1	NIPPLE, NAVAL BRONZE, 1/4" X CLOSE	15760
11	1	ELBOW, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15767-20-20
12	2	CHECK VALVE, MARINE GRADE, 1-1/4" NPT	15768-20
13	1	PLUG, NAVAL BRONZE, NPT, 1/8" SQR HD	15793-2
14	7	NIPPLE, MARINE GRADE, 1-1/4" X 1-5/8"	15797
15	3	NIPPLE, MARINE GRADE, 1-1/4" X 2-1/2"	15798
16	2	NIPPLE, MARINE GRADE, 1-1/4" X 8"	15803
17	2	NIPPLE,1-1/4x4"LONG, NAVAL BRONZE WITH 1/8NPT PORT	21005
18	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574





NOTES:
1. ITEM 13702 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY REPLACE THE CLOSE NIPPLE WITH ITEM 21005
2. REMOVE ALL SHARP EDGES AND BURRS
(A) 3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. DO NOT SUBSTITUTE COMPONENTS

REV	ENF	DESCRIPTION OF REVISION	REV BY	DATE
E	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS	PBS	16JAN2015
D	2014-583	UPDATE VALVE POSITION VIEWS	JJW	20AUG2014
C	2014-241	UPDATED TO SHOW LEADS ON SOLENOID VALVE	PBS	17APR2014
B	2013-395	DELETED: 12238-20-20, 15756-20. 15797 WAS QTY 8. ADDED: 15767-20-20	PBS	12JUL2013
A	2013-303	CHANGED LEAK TEST PRESSURE.	PBS	28MAY2013

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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1-1/4", 24V
SEA WATER COMPATIBLE

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX : ± 0.010 .XXX : ± 0.005	MACHINE TOLERANCES .X : ± 0.4 .XX : ± 0.2
		FORM TOLERANCES .XX : ± 0.030 .XXX : ± 0.015	FORM TOLERANCES .X : ± 0.8 .XX : ± 0.4
		FAB TOLERANCES .XX : ± 0.060 .XXX : ± 0.030	FAB TOLERANCES .X : ± 1.5 .XX : ± 0.8

DWG UNITS: IN/LB/S | DRAWN BY: BOB KROPP | DATE: 05JAN2012
PRO-ENGINEER | INIT ECO:
SCALE: 0.500 | SHEET 1 OF 2 | DRAWING NO: 21006
EST WEIGHT: 56.860

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21006			1-1/4" 24VDC, Sea Water			
	14683	GC Valves, S211GF16J7FG2	1-1/4" NPT 24V solenoid valve			
				valve boby/bonnet	316 stainless steel	ASTM A351 CF8M
				plunger tube -tub head	430FR	ASTM A838 alloy 2
				tube head shading ring	commercial grade silver	ASTM B742-90
				plunger tube	304 stainless steel	ASTM A269
				valve plunger	430FR	ASTM A838 alloy 2
				plunger spring	302 stainless steel	ASTM 313-08
				diaphragm spring	302 stainless steel	ASTM 313-08
				diaphragm dish plate	304 stainless steel	ASTM A276-13
				pilot orifice insert	304 stainless steel	ASTM A240
				diaphragm hardware - M6 screw	18-8 stainless steel	ASTM F837M
				diaphragm hardware - lock washer	18-8 stainless steel	ASTM B18.21.1
				diaphragm hardware - nut	18-8 stainless steel	ASTM F593-85
	15759-20	Apollo, 77-106-01	1-1/4" ball valve			
				lever and grip	steel, zinc plated w/vinyl	
				stem packing	MPTFE	
				stem bearing	RPTFE	
				ball	chrome plated	ASTM B16
				seat	RPTFE	
				retainer		ASTM B524-C84400
				gland nut		ASTM B16
				stem		ASTM B16
				lever nut	steel, zinc plated	
				body seal	PTFE	
				body		ASTM B524-C84400
	8862	Datcon 02022-00	temperature sender	Body	brass	
	13113	Grainger, 4RY95	pressure gauge			
				case	stainless steel	
				socket	316 stainless steel	
				tube	316 stainless steel	
				lens	polycarbonate	
				ring	316 stainless steel	
	13702	Wilkins, 500YSBRHLRSW	1-1/4" regulator/strainer			
				body	cast bronze	ASTM B584
				access covers	cast bronze	ASTM B584
					brass	ASTM B16
				fasteners	300 series stainless steel	
				stem & plunger	cast bronze	ASTM B584
					brass	ASTM B16
				elasttomers	Buna Nitrile	FDA approved
					EPDM	FDA approved
				cap gaskets	natural vulcanized fibre	
					Acetal (Delrin 500)	NSF Listed
				springs	oil tempered wire	ASTM A229
				strainer screen	300 series stainless steel	
				seat	300 series stainless steel	
	15755-20		1-1/4" tee		Copper Alloy	ASTM B62-09
	15758-20-4		1-1/4" x 1/4" reducing bushing		Copper Alloy	ASTM B62-09
	15758-4-2		1/4" x 1/8" reducing bushing		Copper Alloy	ASTM B62-09
	15759-04	Apollo, 77-101-01	1/4" ball valve			
				lever and grip	steel, zinc plated w/vinyl	
				stem packing	MPTFE	
				stem bearing	RPTFE	
				ball	chrome plated	ASTM B16
				seat	RPTFE	
				retainer		ASTM B16
				gland nut		ASTM B16
				stem		ASTM B16
				lever nut	steel, zinc plated	
				body seal	PTFE	
				body		ASTM B524-C84400
	15760		1/4" close nipple		Copper Alloy	ASTM B62-09
	15767-20-20		1-1/4" NPT to barb adapter		Copper Alloy	ASTM B62-09
	15768-20	Watts, series 600	1-1/4" check valve			
				body	bronze	
				guide bushing	stainless steel	
				spring	stainless steel	
				check	brass	
				seat	PTFE	
				O-ring	Nitrile	
				adapter	bronze	
	15793-2		1/8" plug		Copper Alloy	ASTM B62-09
	15797		1-1/4" x 1-5/8" nipple		Copper Alloy	ASTM B62-09
	15798		1-1/4" x 2-1/2" nipple		Copper Alloy	ASTM B62-09
	15803		1-1/4" x 8" nipple		Copper Alloy	ASTM B62-09
	21005		1-1/4" x 4" nipple		Copper Alloy	ASTM B62-09
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION
MACHINED SURFACES 125
IMPERIAL UNITS: MACHINE TOLERANCES .XX ± 0.02, FORM TOLERANCES .XX ± 0.010, FAB TOLERANCES .XX ± 0.06
METRIC UNITS: MACHINE TOLERANCES .X ± 0.5, FORM TOLERANCES .X ± 0.25, FAB TOLERANCES .X ± 1.5

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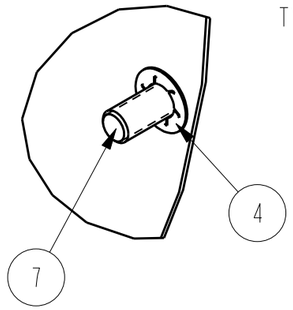
COOLING LOOP, 1-1/4", 24V
SEA WATER COMPATIBLE

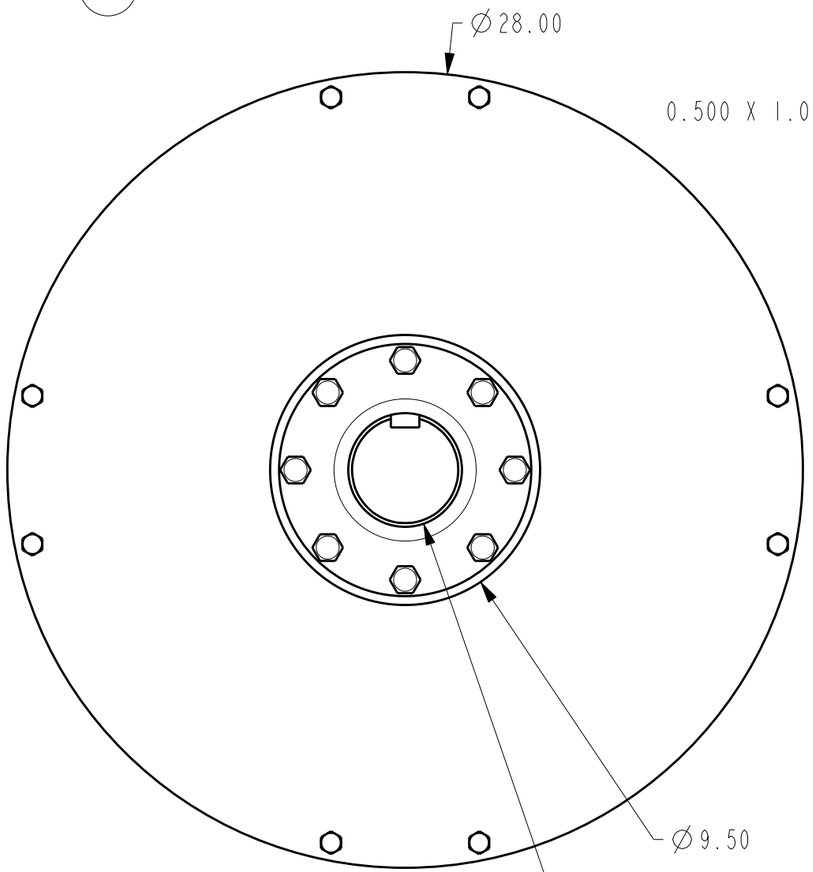
DWG UNITS: IN/LB/S
DRAWN BY: BOB KROPP
DATE: 05JAN2012
PRO-ENGINEER
INIT ECO: 2011-232
SCALE: 0.500
EST WEIGHT: 56.860
SHEET 2 OF 2
DRAWING NO: 21006

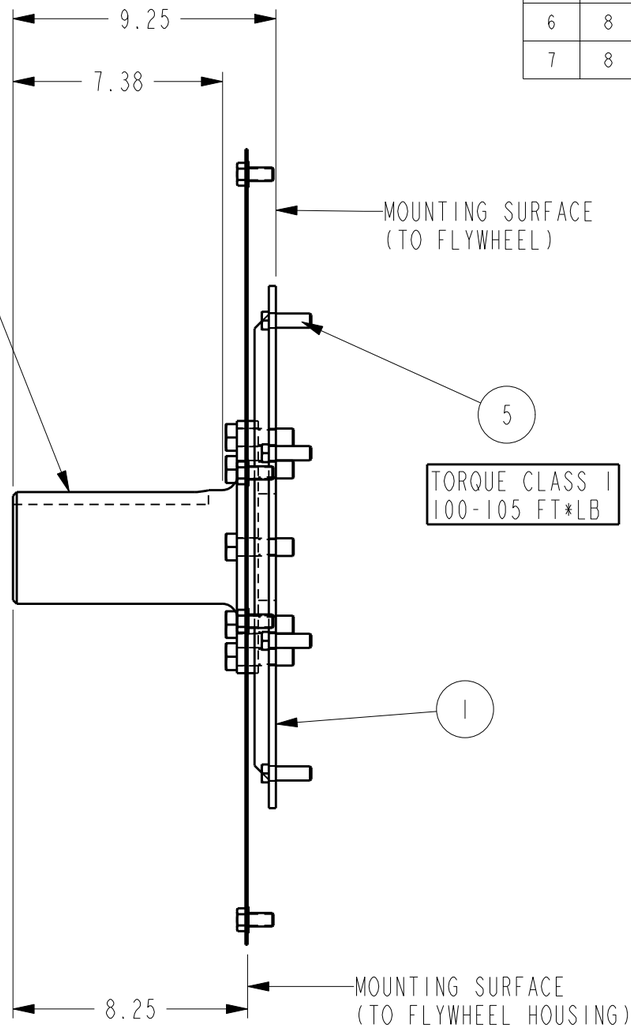
BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ADAPTER, STUB SHAFT, SAE #1, CFP23E	13197
2	1	STUB SHAFT, 4" DIA. x 1" KEY, CFP23E	13198
3	1	GUARD, FLYWHEEL, SAE#0, CFP23E	13199
4	8	RETAINING WASHER, PUSHNUT, 1/2" BOLT	16662-08
5	8	SCREW, CAP, HEX HEAD, 1/2-13 UNC X 1.50"	HHCS_0500_0150
6	8	SCR,CAP,HEX,5/8-11 X 2.00, -	HHCS_0625_0200
7	8	HHCS m12 -1.75 X 25, COMMON HARDWARE	HHCS_M12_25

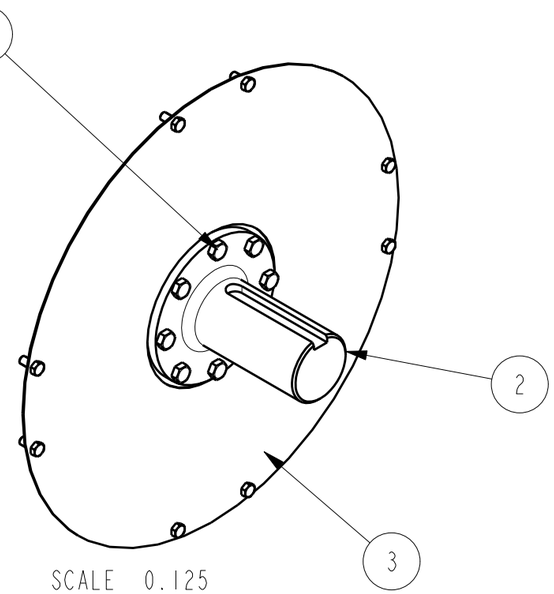
TYPICAL GUARDING FASTENERS
SCALE 0.500







TORQUE CLASS 1
195-210 FT*LB



SCALE 0.125

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	MACHINE TOLERANCES .XX: ± 0.010 .XXX ± 0.005 FORM TOLERANCES .XX: ± 0.020 .XXX: ± 0.015 FAB TOLERANCES .XX: ± 0.060 .XXX: ± 0.030	MACHINE TOLERANCES .X: ± 0.4 .XX: ± 0.2 FORM TOLERANCES .X: ± 0.8 .XX: ± 0.4 FAB TOLERANCES .X: ± 1.5 .XX: ± 0.8

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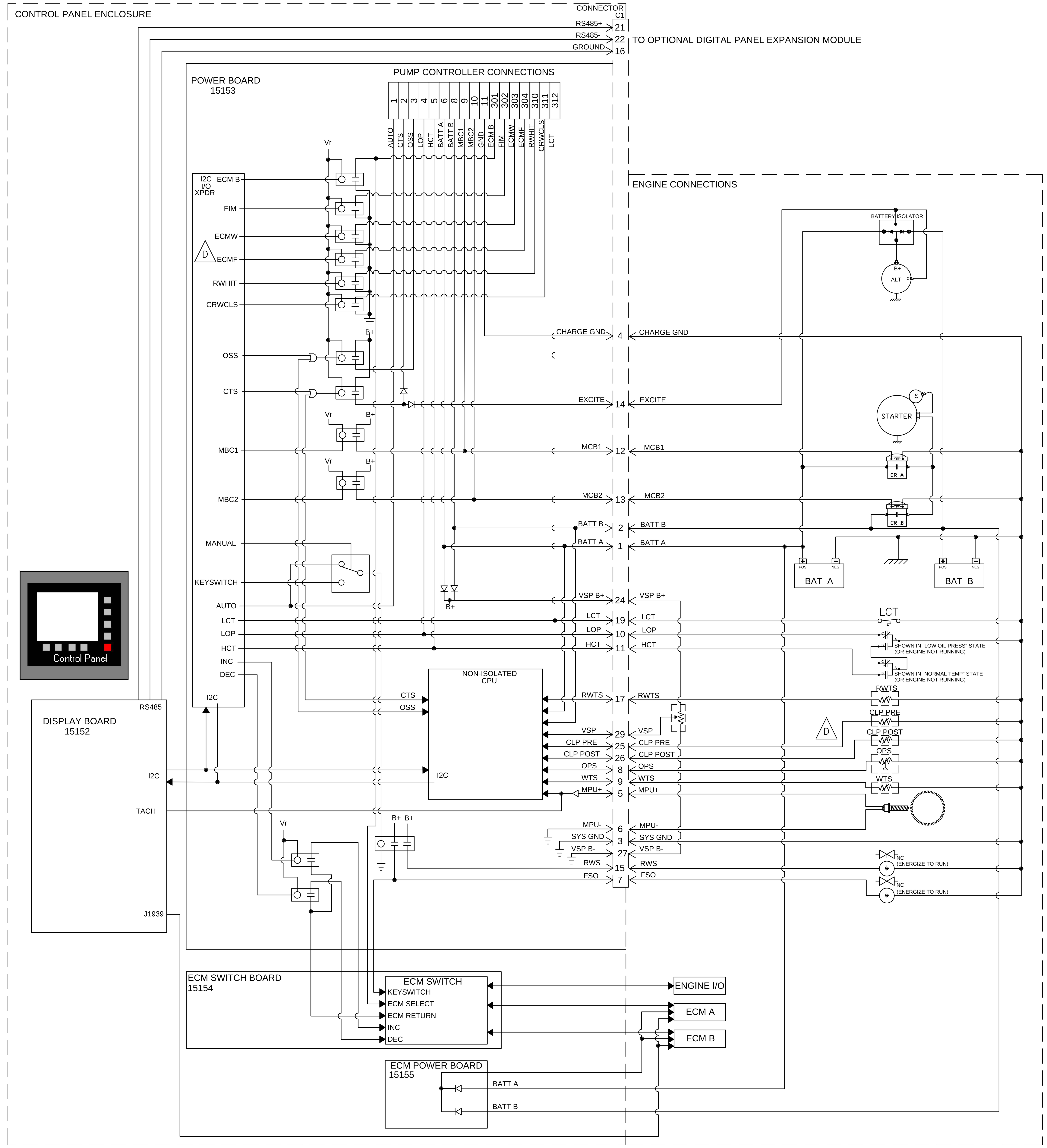
ASSEMBLY, STUB SHAFT
SAE #1 W/ 4.00" DIA SHAFT & GUARD

DWG UNITS: IN/LB/S	DRAWN BY: DAN	DATE: 04-MAR-10
	PRO-ENGINEER	INIT ECO: 2010-098
SCALE: 0.188	SHEET 1 OF 1	DRAWING NO: 16768
EST WEIGHT: 96.558		



LEGEND:

OSS = OVER SPEED SWITCH
CTS = CRANK TERMINATION SWITCH
MBC1 = MAIN BATTERY CONTACTOR 1
MBC2 = MAIN BATTERY CONTACTOR 2
LCT = LOW COOLANT TEMPERATURE
HCT = HIGH COOLANT TEMPERATURE
LOP = LOW OIL PRESSURE
FSO = FUEL SHUT OFF
RWS = RAW WATER SOLENOID
VSP = VARIABLE SPEED PRESURE
DOP PRE = DIFFERENTIAL OIL PRESSURE PRE
DOP POST = DIFFERENTIAL OIL PRESSURE POST
OPS = OIL PRESSURE SENDER
WTS = WATER TEMPERATURE SENDER
MPU = MAGNETIC PICK-UP
RWHIT = RAW WATER HIGH INLET TEMP
CRWCLS= CLOGGED RAW WATER COOLING LOOP STRAINER
CLP PRE = COOLING LOOP PRESSURE PRE STRAINER
CLP POST = COOLING LOOP PRESSURE POST STRAINER
RWTS = RAW WATER TEMPERATURE SENDER
ECMW = ELECTRONIC CONTROL MODULE WARNING
ECMF = ELECTRONIC CONTROL MODULE FAILURE

NOTES:
1) SEE SHEET 2 FOR CFP5E ECM SWITCH SCHEMATIC
2) SEE SHEET 3 FOR CFP7E ECM SWITCH SCHEMATIC
3) SEE SHEET 4 FOR CFP9E ECM SWITCH SCHEMATIC
4) SEE SHEET 5 FOR CFP11E ECM SWITCH SCHEMATIC
5) SEE SHEET 6 FOR CFP15E ECM SWITCH SCHEMATIC
6) SEE SHEET 7 FOR CFP23E ECM SWITCH SCHEMATIC

REV	ENF	DESCRIPTION OF REVISION	BY	DATE
D	2014-107	ADDED COOLING LOOP SENSORS	RMJ	21FEB2014
C		ADDED LOW COOLANT TEMP SWITCH WIRING.	KAK	03DEC2013
B	2011-307	MODIFIED SHEET 7, CFP23E	S DUBICK	12-JAN-12
A	2011-189	ADDED RS485 WIRES.	PBS	15JUN2011

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1° | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

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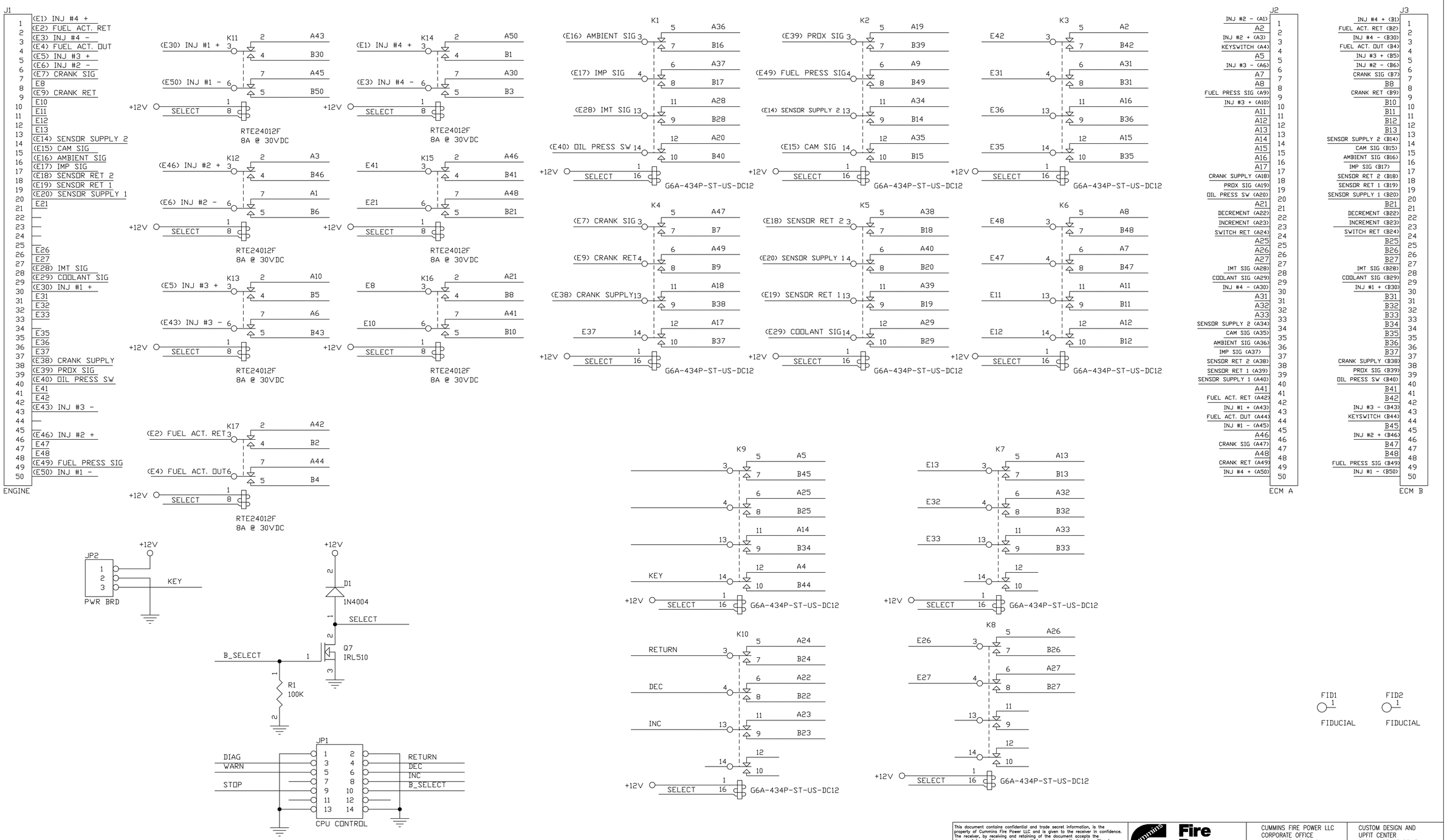
SCHEMATIC, FIRE PUMP DRIVERS
CFP MODELS: 5E, 7E, 9E, 11E, 15E, 23E

DWG UNITS: INCH/LB/S | DRAWN BY: KAK | DATE: 14 DEC 2009
AUTO CAD | REF DRWG:
SCALE: | SHEET 1OF7 | DRAWING NO: 16260
EST WEIGHT:



UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005 FORM TOLERANCES .XX = ± 0.020 .XXX = ± 0.010 PAD TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2 FORM TOLERANCES .X = ± 0.4 .XX = ± 0.2 PAD TOLERANCES .X = ± 1.5 .XX = ± 0.8

REV	ENF	DESCRIPTION OF REVISION	BY	DATE
D	2014-107	SEE SHEET 1 FOR LATEST REVISION.	RMJ	24FEB2014
C		SEE SHEET 1 FOR LATEST REVISION.	KAK	03DEC2013

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UPFIT CENTER
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DEPERE, WISCONSIN

SCHEMATIC, ECM SWITCH CFP5E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S	DRAWN BY: KAK	DATE: 14 DEC 2009
	AUTO CAD	REF DRWG:
SCALE:	SHEET 20F7	DRAWING NO: 16260
EST WEIGHT:		

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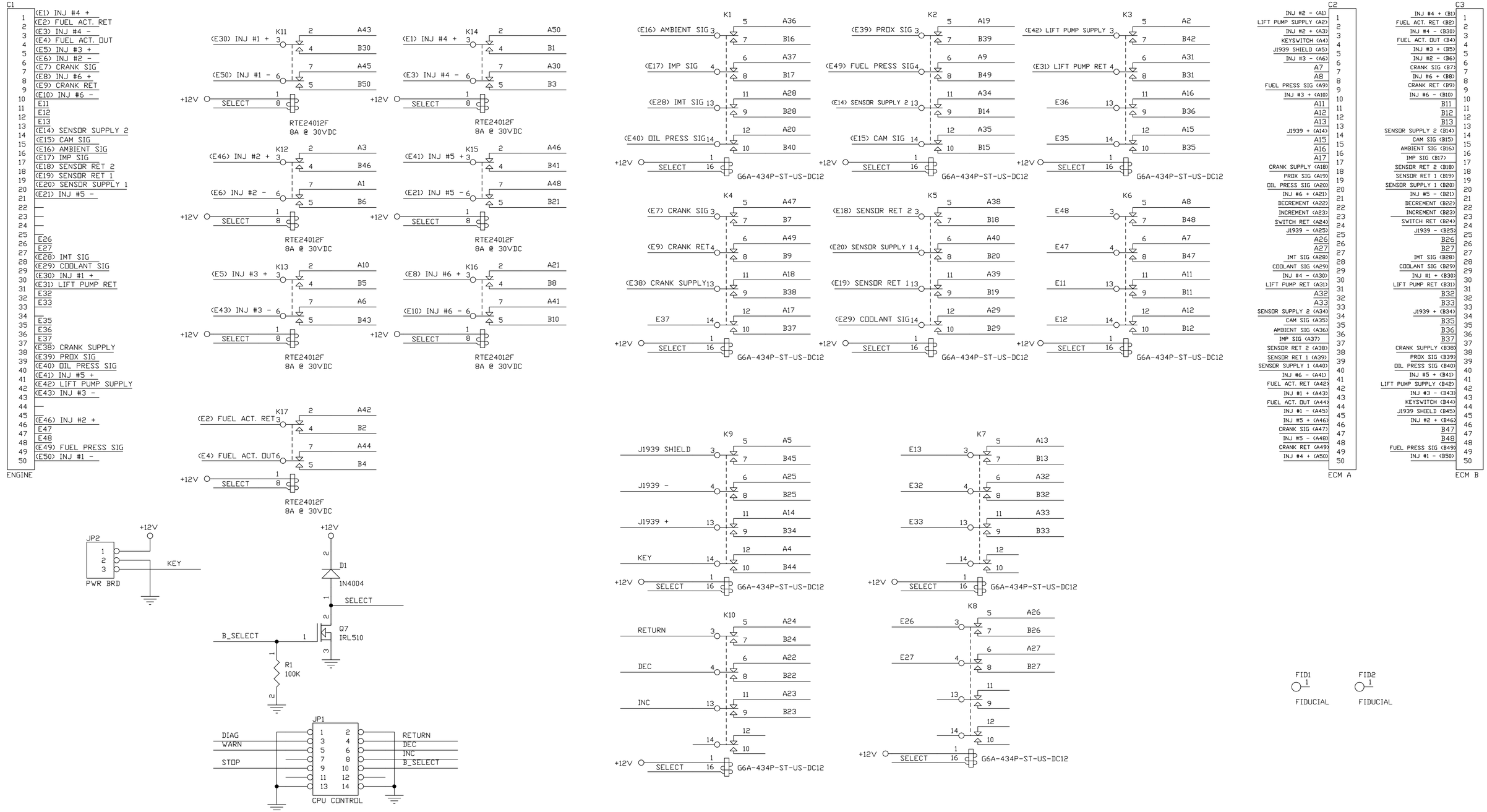
SCHEMATIC, ECM SWITCH CFP7E FIRE PUMP DRIVER

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
	FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
	FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

DWG UNITS: INCH/LB/S	DRAWN BY: KAK		DATE: 14 DEC 2009
	AUTO CAD		REF DRWG:
SCALE:	SHEET 3OF7	DRAWING NO: 16260	
EST WEIGHT:			

REV	ENF	DESCRIPTION OF REVISION	BY	DATE
D	2014-107	SEE SHEET 1 FOR LATEST REVISION.	RMJ	24FEB2014
C		SEE SHEET 1 FOR LATEST REVISION.	KAK	03DEC2013



UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

THIRD ANGLE PROJECTION

IMPERIAL UNITS	METRIC UNITS
MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005	MACHINE TOLERANCES .X = ± 0.4 .XX = ± 0.2
FORM TOLERANCES .XX = ± 0.030 .XXX = ± 0.015	FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030	FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

REV	ENF	DESCRIPTION OF REVISION	BY	DATE
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WHITE BEAR LAKE, MN
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CUSTOM DESIGN AND
UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

SCHEMATIC, ECM SWITCH CFP9E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S

DRAWN BY: KAK

DATE: 14 DEC 2009

AUTO CAD

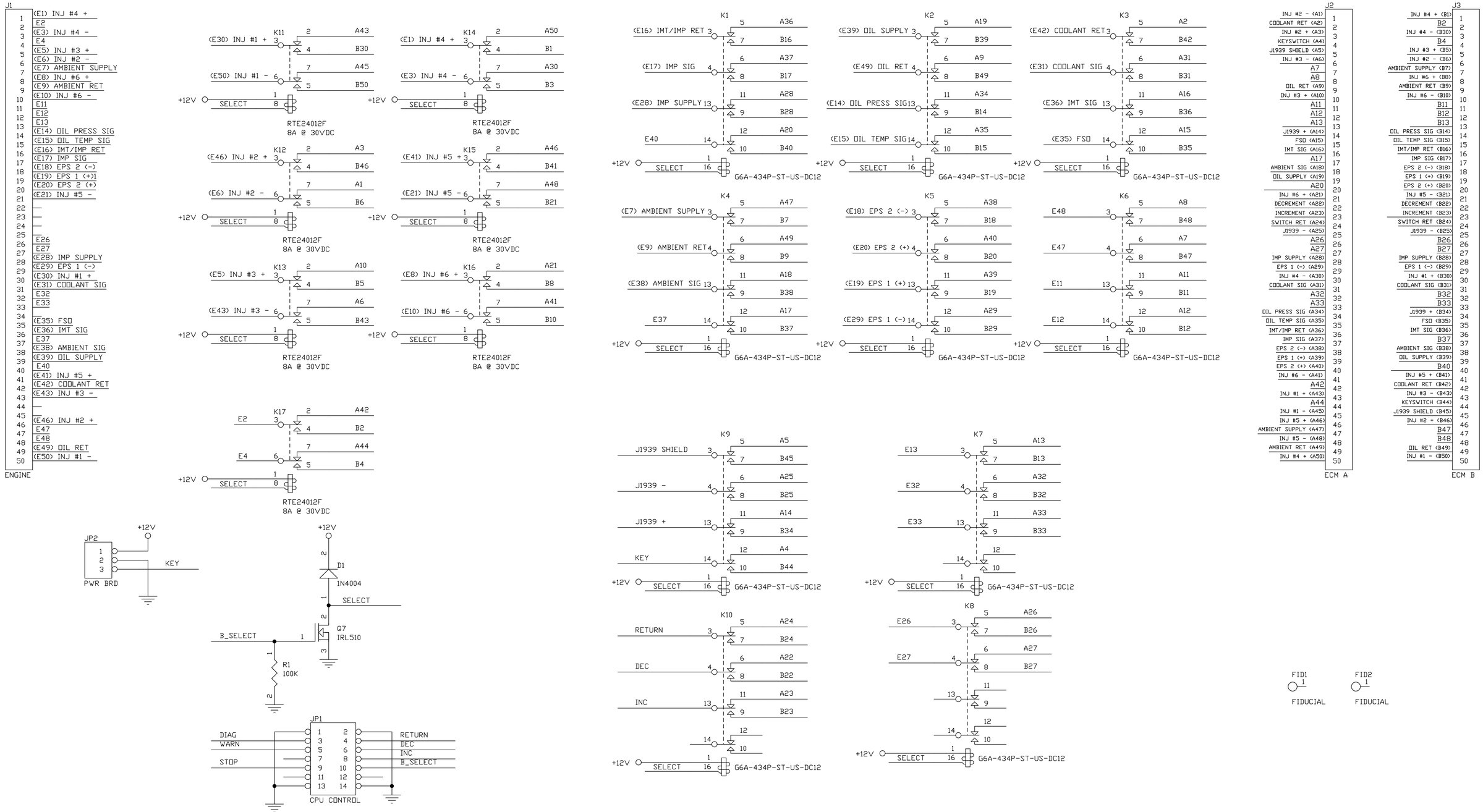
REF DRWG:

SCALE:

EST WEIGHT:

SHEET 4OF7

DRAWING NO: 16260



UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

MACHINE TOLERANCES XX = ± 0.010 XXX = ± 0.005
FORM TOLERANCES XX = ± 0.030 XXX = ± 0.015
FAB TOLERANCES XX = ± 0.060 XXX = ± 0.030
MACHINE TOLERANCES X = ± 0.4 XX = ± 0.2
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DEPERE, WISCONSIN

SCHEMATIC, ECM SWITCH CFP11E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S | DRAWN BY: KAK | DATE: 14 DEC 2009

AUTO CAD | REF DRWG:

SCALE:

EST WEIGHT:

SHEET 50F7 | DRAWING NO: 16260

ABBREVIATIONS: FFA = FRONT FUELING ACTUATOR
FTA = FRONT TIMING ACTUATOR
RTA = REAR TIMING ACTUATOR
RFA = REAR FUELING ACTUATOR
FSV = FUEL SHUTOFF VALVE
IMT = INTAKE MANIFOLD TEMP
IMP = INTAKE MANIFOLD PRESS

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UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1° | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

SCHEMATIC, ECM SWITCH
CFP15E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S
DRAWN BY: KAK
DATE: 14 DEC 2009
AUTO CAD
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SHEET 6OF7
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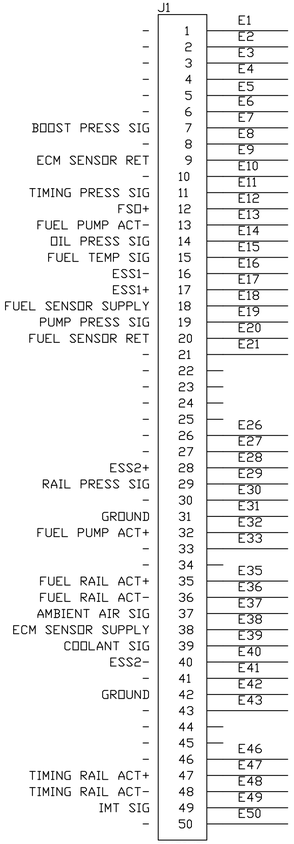

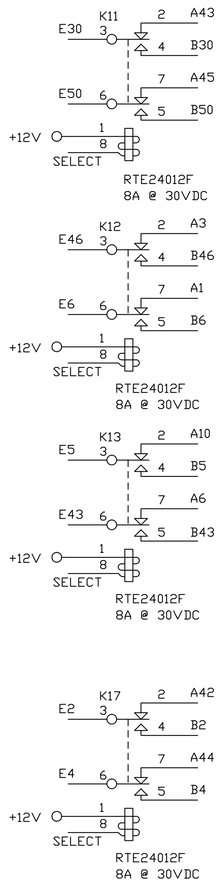

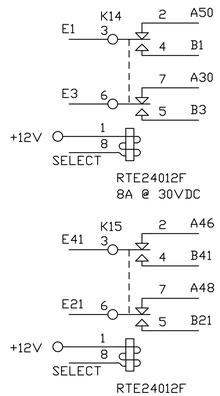

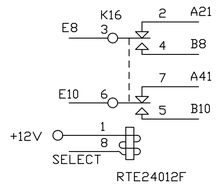

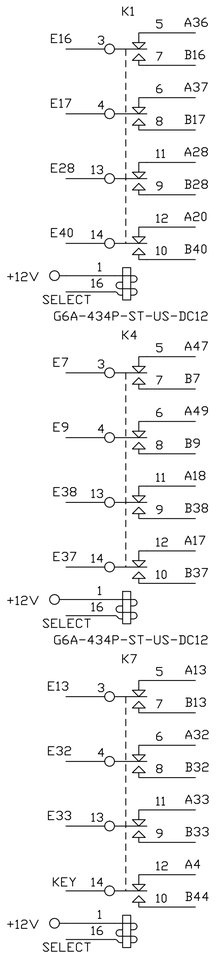

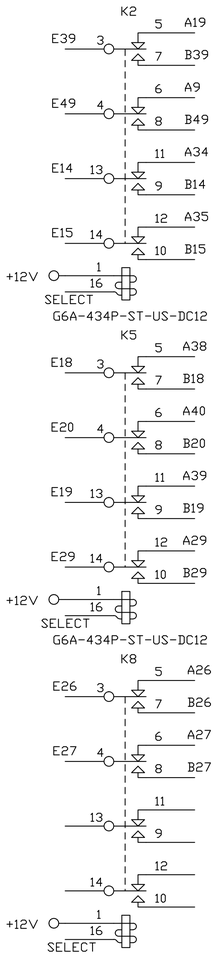

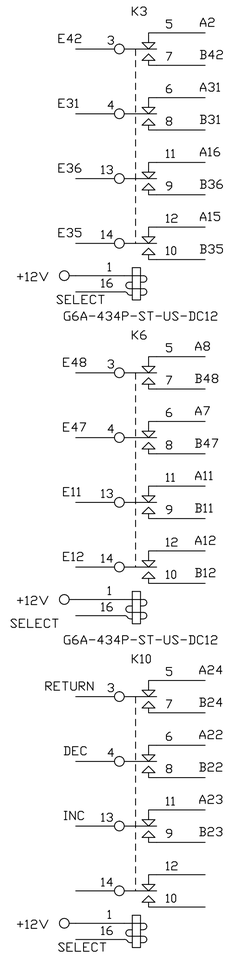

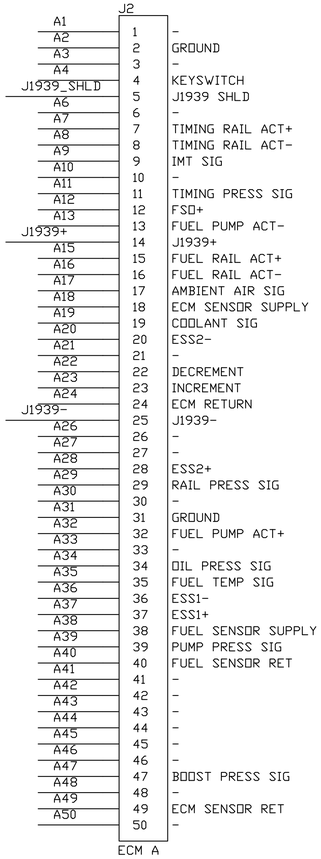

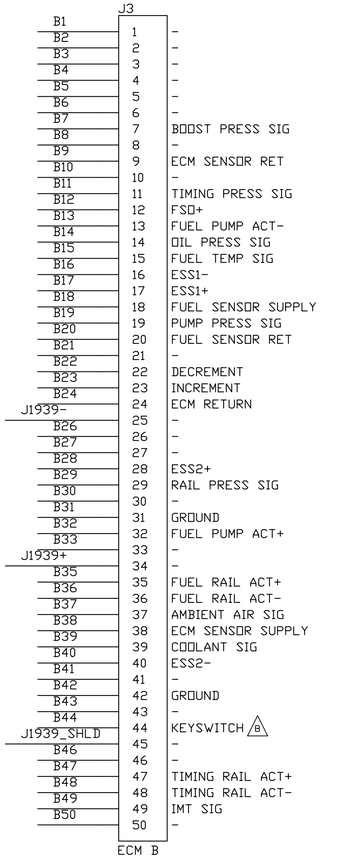

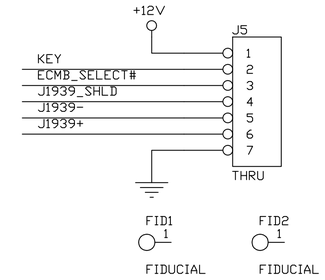

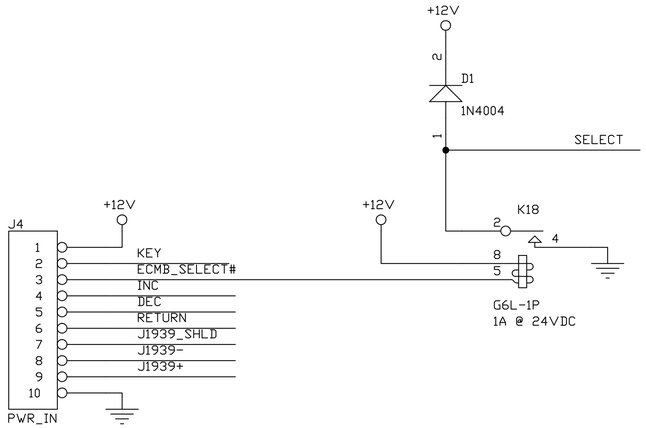

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