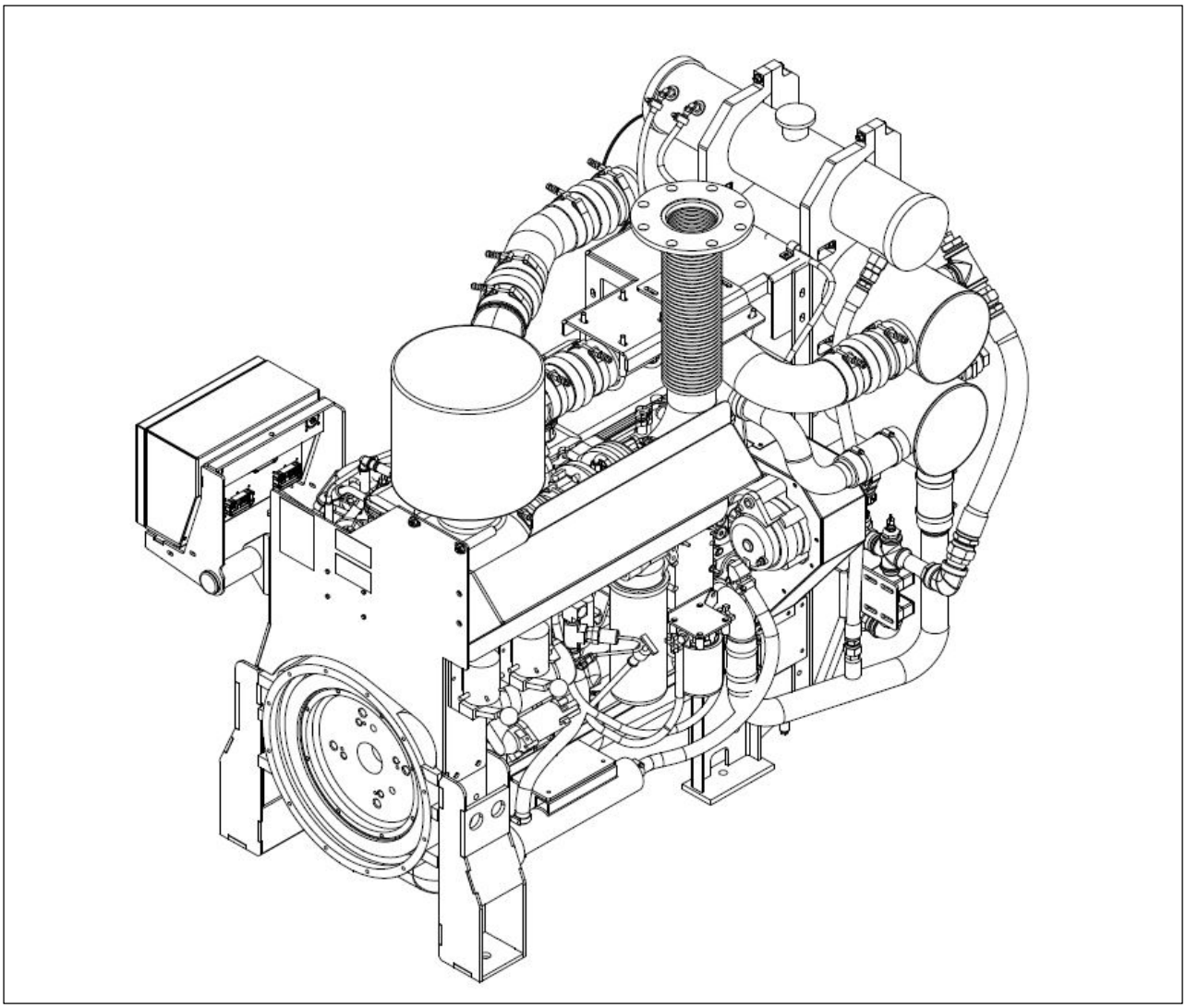
CFP9E HHP SERIES

Fire Power

Operation & Maintenance Manual

Fire Pump Drive Engines



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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 drive 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.

Table of Contents

Section 1 - Safety

1.1 Introduction . . . 1-1
1.2 General Safety Precautions . . . 1-1
1.3 Use of Advisory and Cautionary Statements . . . 1-1
1.3.1 Advisory Statements . . . 1-1
1.3.2 Cautionary Statements . . . 1-2

Section 2 - Description

2.1 Introduction . . . 2-1
2.2 Fire Pump Digital Panel (FPDP) . . . 2-1
2.3 Fire Pump Controller . . . 2-1
2.4 Air Intake System . . . 2-4
2.5 Cooling Water System . . . 2-5
2.6 Fuel Supply and Drain . . . 2-5
2.7 High Pressure Common Rail (HPCR) Fuel System . . . 2-7
2.8 Engine Oil System . . . 2-7
2.9 Exhaust System . . . 2-8

Section 3 - Installation

3.1 Introduction . . . 3-1
3.2 Receiving and Handling . . . 3-1
3.3 Site Preparation . . . 3-1
3.4 Drive Shaft Installation . . . 3-1
3.5 Fuel Supply Installation . . . 3-2
3.6 Cooling Water Supply Installation . . . 3-3
3.7 Battery Installation . . . 3-4
3.8 Signal and Control Installation . . . 3-5
3.9 Coolant System Preparation . . . 3-6
3.10 Charge Air Cooler (CAC) Inspection . . . 3-7
3.11 Lubricating Oil System Preparation . . . 3-7
3.12 Pre-Start Inspections . . . 3-7
3.13 Engine Monitoring . . . 3-8
3.14 Field Acceptance Testing . . . 3-8

Section 4 - Controls

4.1 Fire Pump Digital Panel (FPDP) . . . 4-1
4.1.1 Warning Lamp . . . 4-1
4.1.2 Fault Indicator Lamp . . . 4-1
4.1.3 Scroll UP and DOWN Buttons . . . 4-1
4.1.4 ENTER Button . . . 4-1
4.1.5 MENU Button . . . 4-1
4.1.6 Overspeed RESET/STOP Switch . . . 4-1
4.1.7 Battery “A” and “B” Voltmeters . . . 4-2
4.1.8 Tachometer . . . 4-2
4.1.9 Hour Meter . . . 4-2
4.1.10 ECM A/B Selector Switch and Indicator Lamps - Applicable on Electronic Engines . . . 4-2

Table of Contents

4.1.11 Crank Battery A and B Momentary Start Buttons . . . 4-2
4.1.12 Automatic or Manual Mode of Operation Indicator . . . 4-2
4.1.13 Coolant Temperature Gauge . . . 4-2
4.1.14 Engine Oil Pressure Gauge . . . 4-2
4.1.15 Engine Overspeed Warning Lamp . . . 4-2
4.1.16 ECM Fault Code Lamps - Applicable on Electronic Engines . . . 4-2
4.1.17 Engine STOP Button . . . 4-3
4.1.18 Engine Communications Port . . . 4-3
4.1.19 Contractor Access Port . . . 4-3
4.1.20 Engine ECM Power Supply . . . 4-3
4.1.21 Engine Harness Connection . . . 4-3
4.2 Electronic Control Module (ECM) - Applicable on Electronic Engines . . . 4-3

Section 5 - Operation

5.1 Introduction . . . 5-1
5.2 Starting and Stopping Procedures . . . 5-1
5.2.1 Local Starting/Stopping Procedure . . . 5-1
5.2.2 Emergency Starting/Stopping Procedure . . . 5-1
5.3 Fire Pump Digital Panel (FPDP) Screens and Adjustments . . . 5-2
5.3.1 Engine Setup Screen . . . 5-3
5.3.2 Overspeed Test Screen . . . 5-3
5.3.3 Parameter Units Screen . . . 5-4
5.3.4 Display Settings Screen . . . 5-4
5.3.5 Analog Values Screen . . . 5-4
5.3.6 Autoswitch Screen . . . 5-5
5.4 Active Fault Codes Display . . . 5-5

Section 6 - Maintenance

6.1 Introduction . . . 6-1
6.2 Engine Operation Reports . . . 6-1
6.3 Weekly Maintenance . . . 6-4
6.3.1 General . . . 6-4
6.3.2 Air Cleaner Filter and Piping . . . 6-4
6.3.3 Cooling System . . . 6-4
6.3.4 Engine Oil System . . . 6-5
6.3.5 Fuel System . . . 6-6
6.3.6 Engine Exhaust System . . . 6-6
6.3.7 Electrical Supply and Controls . . . 6-6
6.3.8 Crankcase Ventilation Hose . . . 6-6
6.3.9 Cooling Water Strainers . . . 6-6
6.3.10 Batteries . . . 6-7
6.3.11 Engine Test Run . . . 6-7
6.3.12 Engine Operation Checks . . . 6-8
6.3.12.1 Crank Termination Set Point . . . 6-8
6.3.12.2 Engine Speed Calibration . . . 6-8
6.3.13 Engine Coolant Heater . . . 6-9
6.4 Annual Maintenance . . . 6-9
6.4.1 Electrical Components . . . 6-9
6.4.2 Turbocharger Mounting Nuts . . . 6-9
6.4.3 Engine Supports . . . 6-10
6.4.4 Fuel Pumps and Filters . . . 6-10
6.4.5 Engine Oil and Filter . . . 6-11
6.4.6 Drive Shaft . . . 6-12

6.4.7 Coolant Pump/Alternator Belt 6-12
6.4.8 Raw Water Zinc Anode 6-13
6.4.9 Heat Exchanger 6-14
6.4.10 Turbocharger 6-14
6.5 Every Two Years 6-14
6.5.1 Coolant Pump 6-14
6.5.2 Cooling System 6-14
6.6 Every Four Years 6-16
6.6.1 Coolant Thermostat Removal/Installation 6-17
6.6.2 Coolant Pump/Alternator Belt Replacement 6-17
6.6.3 Charge Air Cooler (CAC) Heat Exchanger Cleaning 6-18

Section 7 - Troubleshooting

7.1 Introduction 7-1
7.2 Engine Will Not Start 7-2
7.3 Engine Cranks But Will Not Start 7-3
7.4 Engine Starts But Continues to Crank 7-5
7.5 Engine Will Not Stop 7-6
7.6 Low Battery Voltage 7-7
7.7 Fault Code Chart 7-8

Section 8 - Component Parts and Assemblies

8.1 Ordering Parts 8-1
8.2 Routine Service and Parts 8-1
8.3 Emergency Repairs and Technical Service 8-1
8.4 Recommended Spare Parts Inventory 8-1
8.5 Assembly Drawings 8-7

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Section 1 - Safety

1.1 Introduction

Cummins Fire Power 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 operation and maintenance of the equipment should read and thoroughly understand this manual.

1.2 General Safety Precautions

Read and understand all of the safety precautions and warnings before performing any repair. Special safety precautions are included in the procedures when they apply. This list contains the general safety precautions that **must** be followed to provide personal safety:

- Perform a walk around inspection and alert all area personnel that the equipment will be starting before manual operation.
- 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.
- After performing maintenance, remove all tools and foreign materials and reinstall and securely fasten ALL guards, covers and protective devices.
- Exposed in-running belt nips can cause severe personal injury or dismemberment. Ensure that guards are in place and securely fastened before operation.
- Rotating drive shafts can lacerate, dismember or cause strangulation. Keep hands, body parts, long hair, or loose-fitting clothing clear at all times.
- Never attempt to manually clean a machine while it is operating or in standby mode.
- Never open ports on tanks or piping while the engine is operating. Contact with pressurized agents can cause severe personal injury.
- Relieve all pressure in the air, oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected.
- Engine fuel is flammable when in contact with electrical spark or flame sources. Remove all sources of spark or flame from the work area.
- Always use the same fastener part number (or equivalent) when replacing fasteners.
- Some state and federal agencies in the United States have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Dispose of waste oil in accordance with applicable requirements.

1.3 Use of Advisory and Cautionary Statements

1.3.1 Advisory Statements

Advisory statements are used throughout this manual call attention to special information and correct operating procedures. Throughout this manual, these Advisory Statements are delineated by the terms “NOTE” and “IMPORTANT” in uppercase letters:

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.*

1.3.2 Cautionary Statements

Cautionary Statements highlight particular safety precautions pertaining to personal injury and/or damage to the equipment. Cautionary Statements are always preceded by the following symbols:

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 cause equipment damage.

Section 2 - Description

2.1 Introduction

This manual contains information for the correct operation and maintenance of a Cummins fire pump drive engine. Read and follow all safety instructions in Section 1 - Safety. Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

Cummins fire pump drive engines have been designed and tested in accordance with National Fire Protection Association (NFPA) 20 guidelines.

No deviations are permitted without prior written approval. These engines are to be used only for fire protection applications. Figure 2-1 and Figure 2-2 provide visual descriptions of the engine components for this fire pump drive engine.

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

Cummins Fire Power, Cummins NPower, and Cummins Inc. reserve the right to make changes at any time. 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. Cummins fire pump drive engines as packaged units (engine and accessories) have been approved by Factory Mutual (FM) Approvals and listed by Underwriters Laboratories (UL), Inc. and Underwriters Laboratories of Canada (ULC). When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

WARNING

Injury may result and warranty is voided if fuel rate, revolutions per minute (RPM), or altitudes exceed published maximum values for this model and application.

2.2 Fire Pump Digital Panel (FPDP)

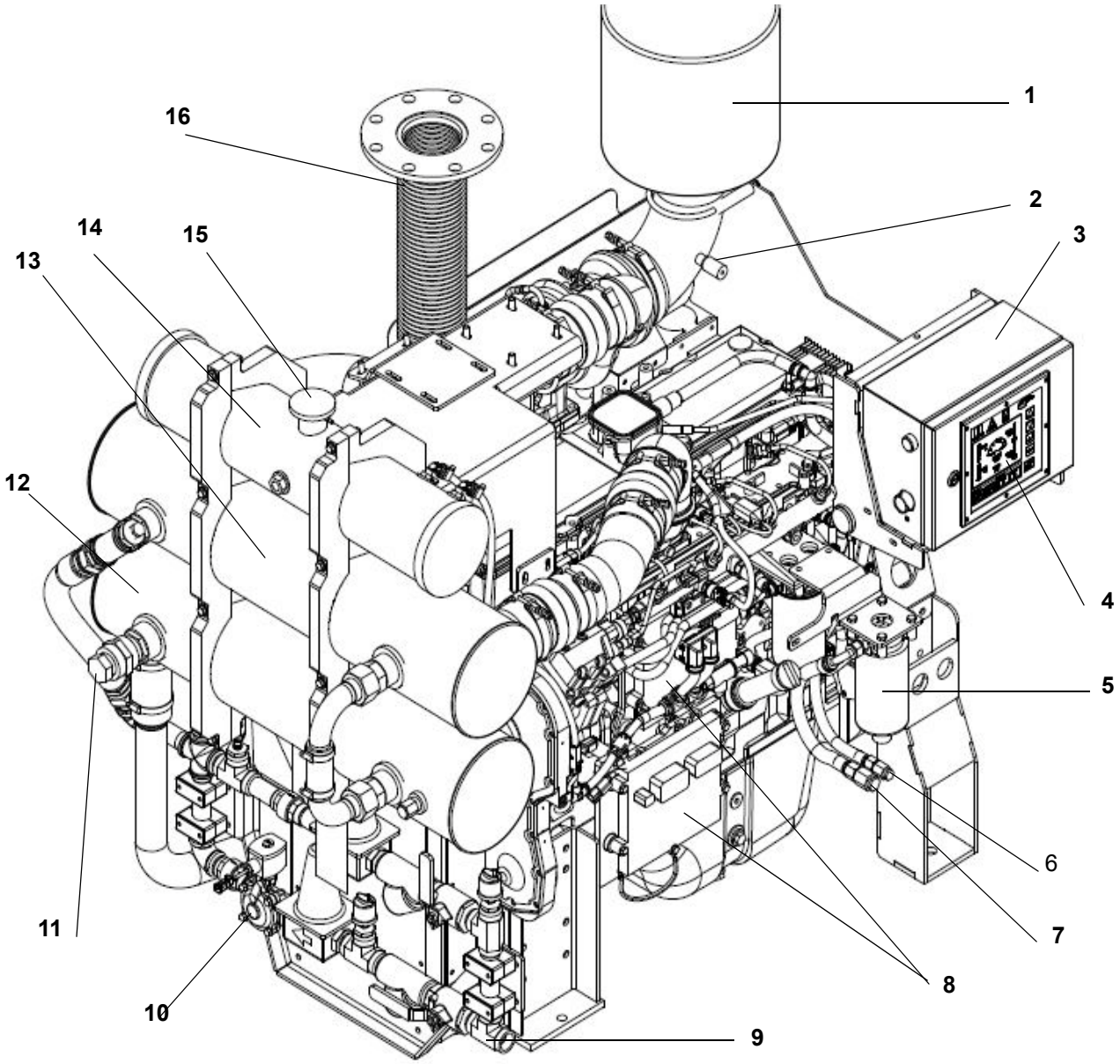
The Fire Pump Digital Panel (FPDP) is mounted on the left hand side (or right hand side - optional) on the flywheel end of the engine and contains controls for starting the engine, monitoring engine performance, and controlling fire pump drive engine operation. Section 4 - Controls illustrates the FPDP in detail.

Each engine is equipped with an electronic overspeed control which activates the fuel pump solenoid valve or the Engine Control Module (ECM) ignition to shut off the engine when the RPM exceeds a preset limit of 115% of rated speed. The overspeed control senses engine speed during the start cycle and stops the starting motor cranking cycle.

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

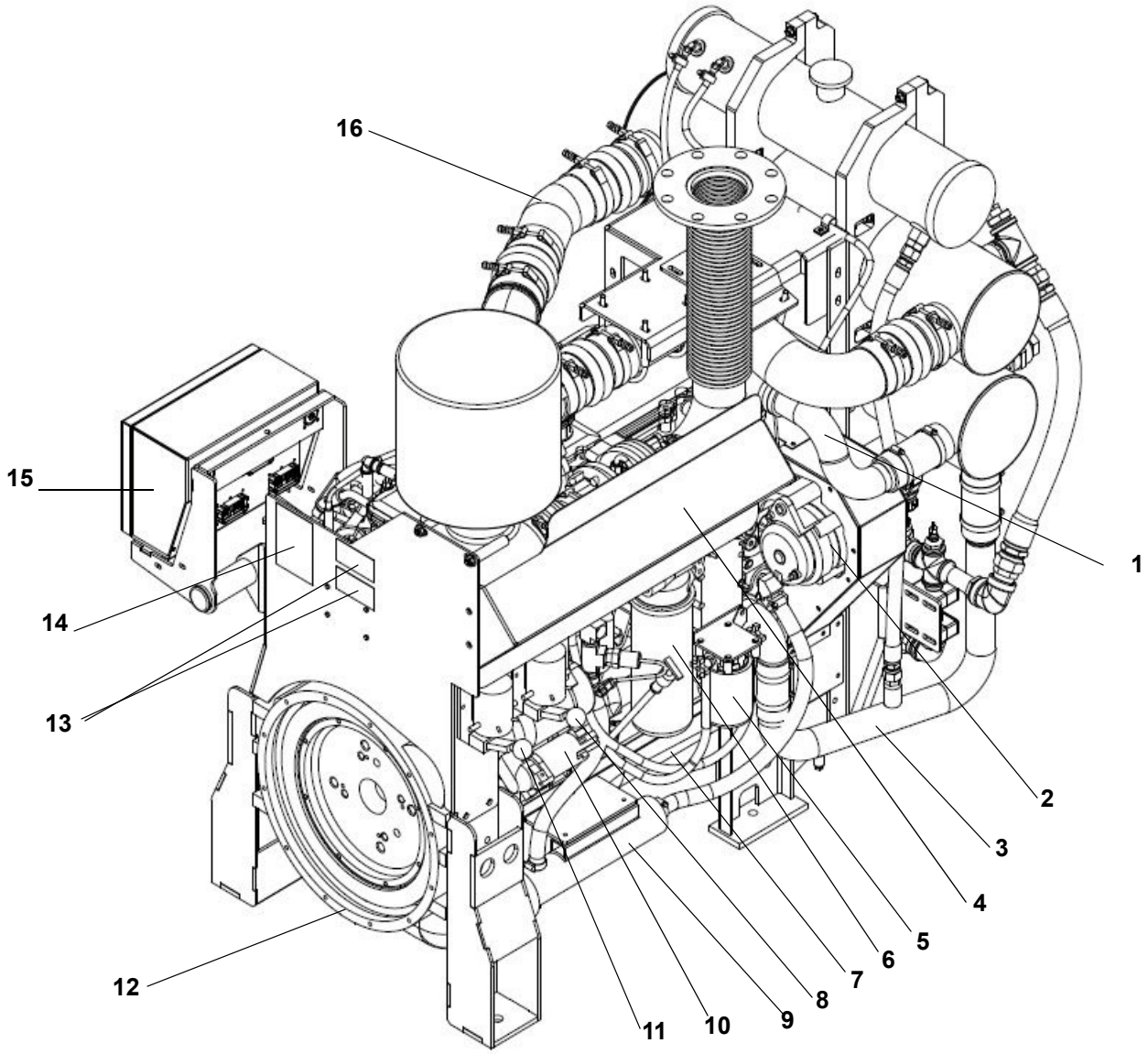
2.3 Fire Pump Controller

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 also be started locally in the MANUAL mode and shut down using the FPDP STOP button. The fire pump controller is not supplied by Cummins Fire Power or Cummins Inc.



1. Air Cleaner Assembly
2. Air Cleaner Service Indicator
3. Terminal Box
4. Fire Pump Digital Panel (FPDP)
5. Fuel Filter or Filter/Separator
6. Fuel Return Line
7. Fuel Supply Line
8. Electronic Control Modules (ECMs)
9. Cooling Water Inlet
10. Cooling Water Manifold
11. Heat Exchanger Cooling Water Discharge
12. Coolant Heat Exchanger
13. Charge Air Cooler (CAC) Heat Exchanger
14. Coolant Expansion Tank
15. Coolant Pressure/Fill Cap
16. Exhaust Flex Connection

Figure 2-1 Engine Components - Fire Pump Digital Panel (FPDP) Side



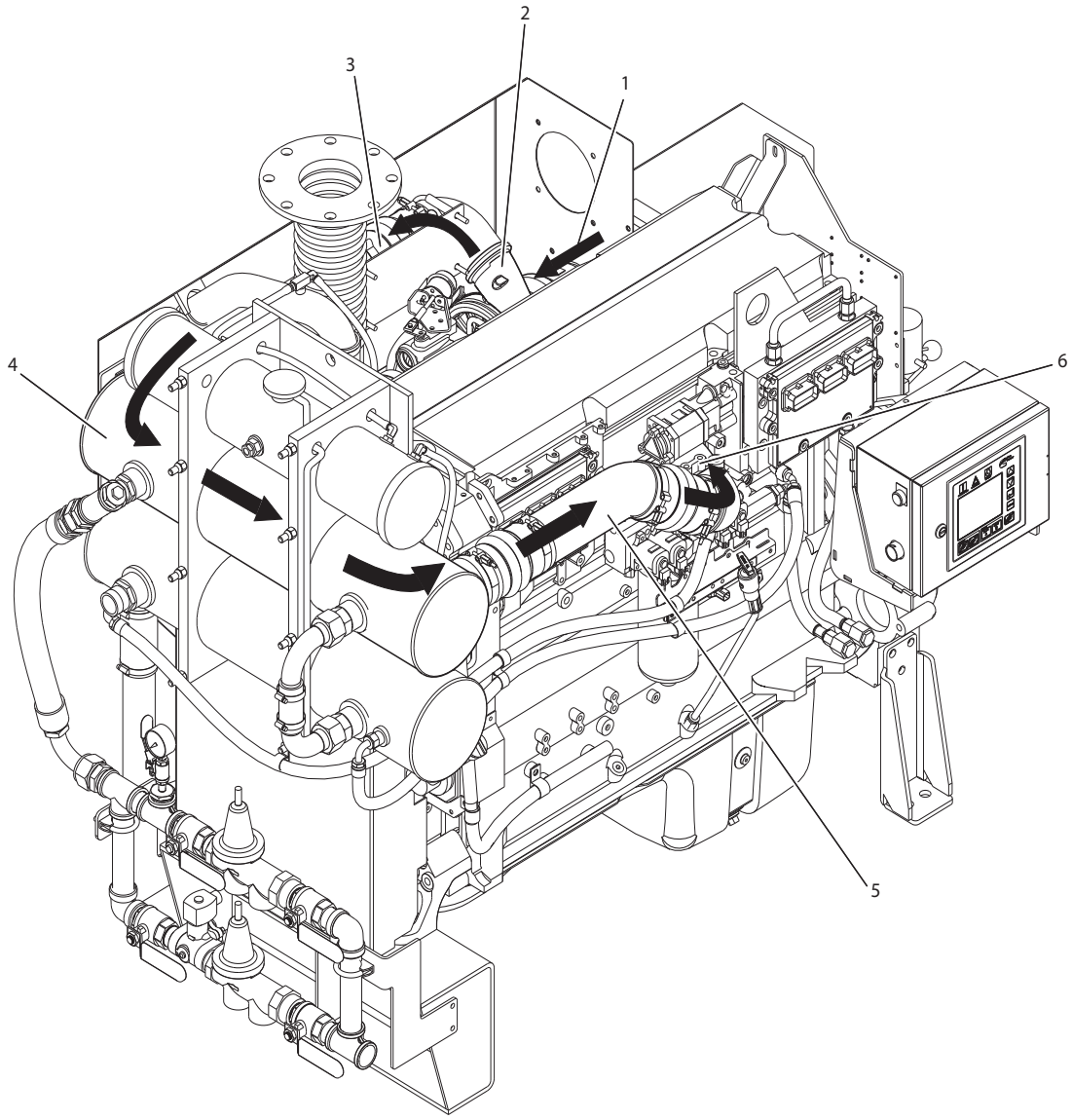
1. Upper Coolant Hose/Tube
2. Alternator
3. Lower Coolant Hose/Tube
4. Manifold Heat Shield
5. Coolant Filter
6. Engine Oil Filter
7. Oil Pan and Drain
8. Battery Starter Contactor B
9. Engine Coolant Heater
10. Starter Motor
11. Battery Starter Contactor A
12. Flywheel Housing
13. Engine Speed Setting Decals
14. Engine Serial Number Decal
15. Manual Start Instruction Decal
16. Charge Air Cooler Hose

Figure 2-2 Engine Components - Turbocharger Side

2.4 Air Intake System

The air intake system supplies combustion air to the fire pump drive engine cylinders. The air filters prevent particulate matter from entering the air intake.

Figure 2-3 shows how the combustion air is drawn into the system. The turbocharger directs the air through the Charge Air Cooler (CAC) heat exchanger for cooling before entering the cylinders.



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

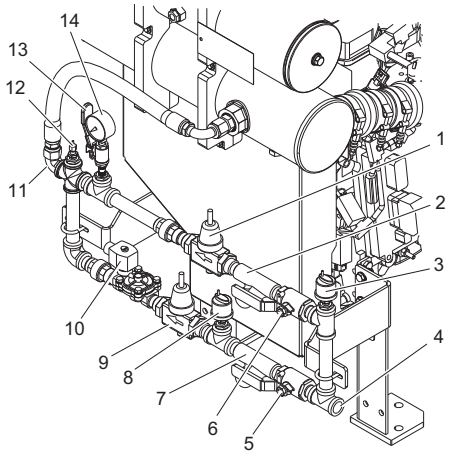
Figure 2-3 Engine Air Intake and Charge Air Cooling Flow Diagram (typical)

2.5 Cooling Water System

Figure 2-4 illustrates a typical cooling water manifold and Figure 2-5 shows the path of water through the engine cooling system. Water entering the cooling system through the cooling water inlet first circulates through the 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.

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

The cooling water from the CAC heat exchanger then passes through the engine coolant heat exchanger. The cooling water exits the coolant heat exchanger through a discharge connection.



CFP-101

1. Bypass Water Pressure Regulator
2. Bypass Water Strainer
3. Pre Strainer Pressure Sensor
4. Cooling Water Inlet
5. Normal Water Inlet Valve
6. Bypass Water Inlet Valve
7. Normal Water Strainer
8. Post Strainer Pressure Sensor
9. Normal Water Pressure Regulator
10. Normal Water Solenoid Valve
11. Outlet to Heat Exchanger
12. Temperature Sensor
13. Pressure Gauge Isolation Valve
14. Water Supply Pressure Gauge

Figure 2-4 Cooling Water Manifold (typical)

IMPORTANT: *Cooling water piping will be supplied by Cummins Fire Power as shown in the drawings in Section 8 - Component Parts and Assemblies. Refer to NFPA 20 for installation requirements.*

When the cooling water piping is installed:

1. Adjust both pressure regulator set points of the cooling water manifold before operating the pump.
2. Ensure that the bypass line (the upper line) is closed.
3. Ensure that the normal water inlet line valve is open.The lower line with the solenoid valve is the normal inlet line.
4. Ensure that the pressure gauge isolation valve is 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 Sheet in Section 8 - Component Parts and Assemblies for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does not meet the specifications.*

NOTE: *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).*

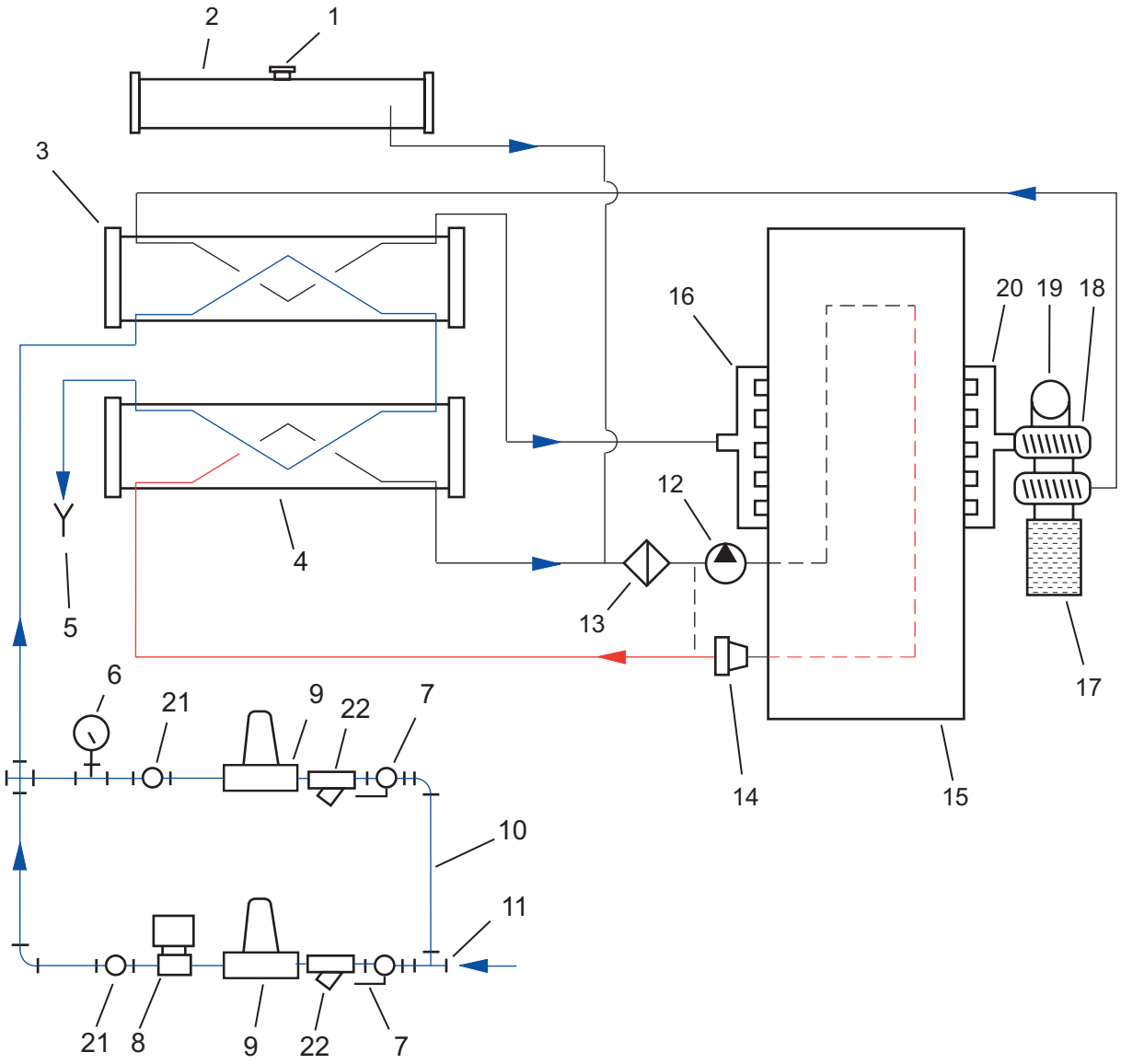
The engine coolant system contains a mixture of at least 50% antifreeze and 50% water. The coolant level should be maintained so it is visible in the coolant level sight gauge.

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 the cooling water pressure and flow to maintain a consistent operating temperature.

2.6 Fuel Supply and Drain

The fuel supply and return connections are centrally located on the FPDP side. Refer to the Engine Data Sheet in Section 8 - Component Parts and Assemblies for the maximum allowable fuel tank supply locations above the fuel pump.



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

Figure 2-5 Engine Cooling System Flow Diagram (typical)

2.7 High Pressure Common Rail (HPCR) Fuel System

The fire pump drive engine is equipped with an electronic fuel system that delivers precise fuel quantities with precise injection timing at injection pressures up to 24,000 psi (1600 BAR). The system consists of a high pressure pump that supplies a common fuel rail and accumulator manifold, feeding 6 high-pressure electronic controlled injectors which provide precise fuel metering and timing. The system is controlled by the engine control module for fueling and timing based on temperature, altitude, boost pressure, and throttle position.

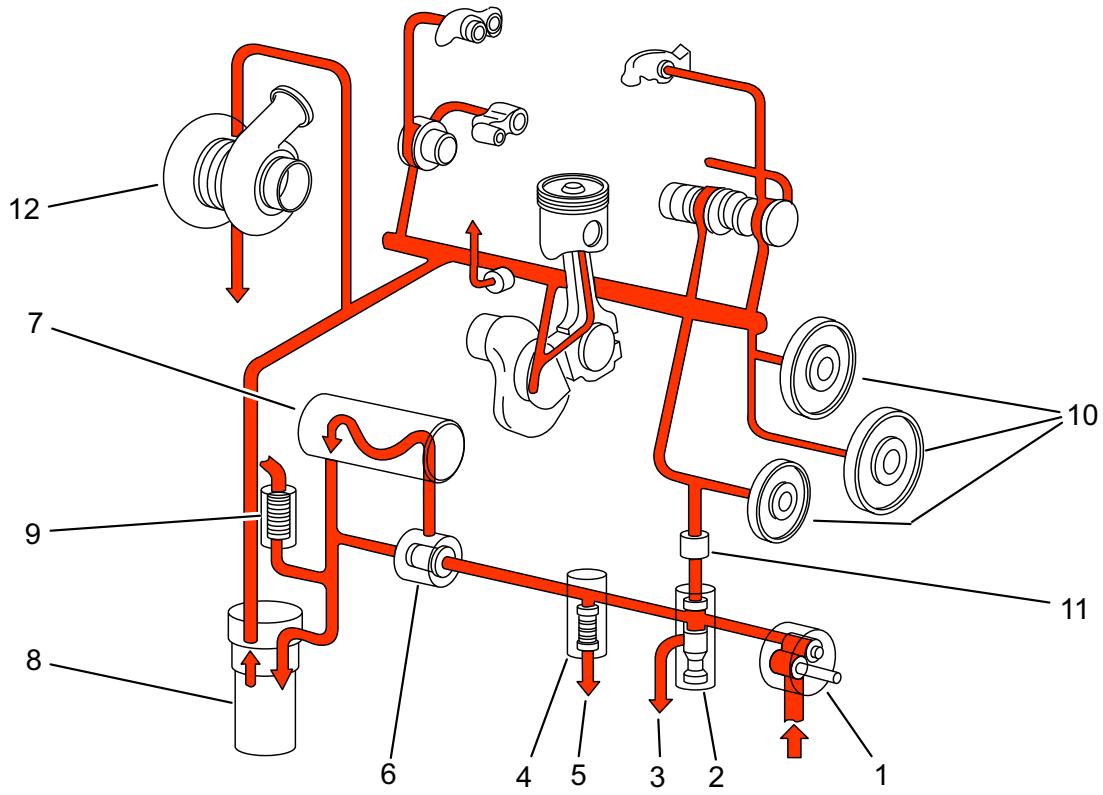
WARNING

With the High Pressure Common Rail (HPCR) fuel system, manually priming the fuel system is not required and should not be performed.

2.8 Engine Oil System

Figure 2-6 illustrates how the engine oil system lubricates moving internal engine parts (pistons, piston arms, valves, cam shafts, 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 the Cummins Engine Operation and Maintenance Manual for additional information.

NOTE: *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 shipping. Check the oil level at the dipstick. Add oil as necessary to bring the oil level to the H (high) mark on the dipstick.*

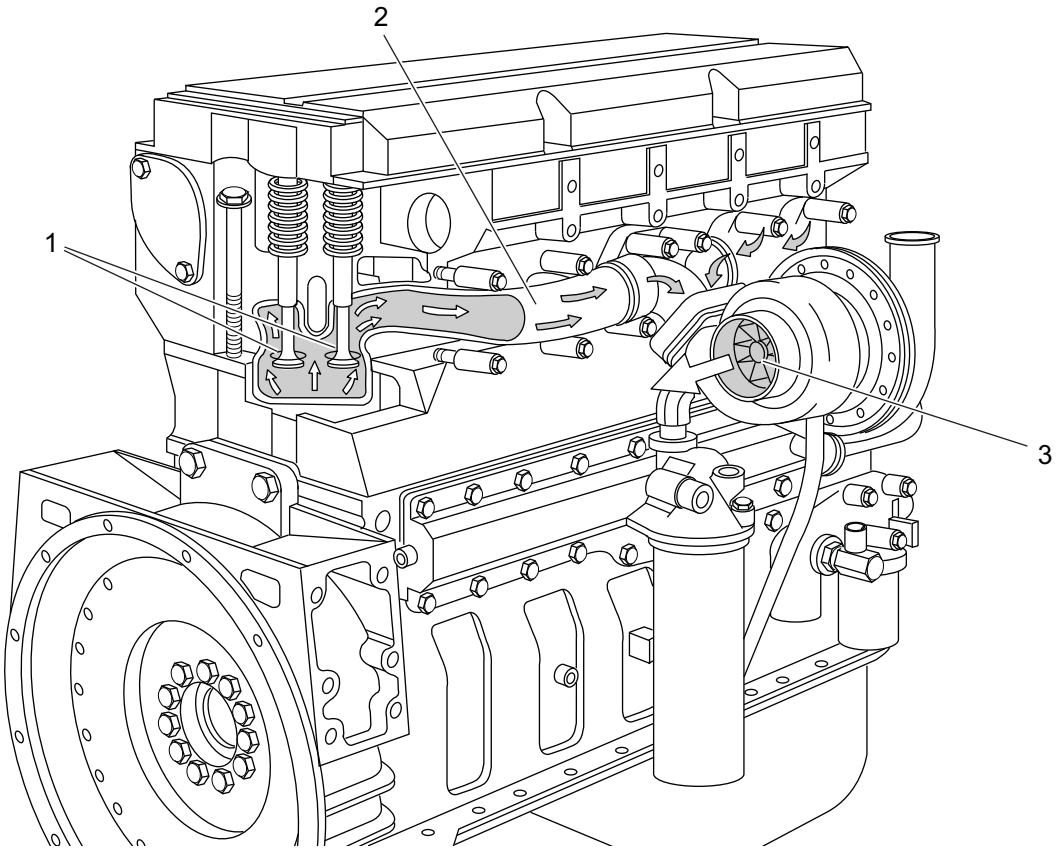


1. Oil Pump
2. Pressure Regulator Valve
3. Oil Return to Pan
4. High Pressure Relief Valve
5. Oil Return to Pan
6. Oil Thermostat
7. Oil Cooler
8. Combination Oil Filter
9. Filter Bypass Gears
10. Idler Gears
11. Viscosity Sensor
12. Turbocharger

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

2.9 Exhaust System

Figure 2-7 shows how 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 connection.



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

Figure 2-7 Exhaust System Flow Diagram (typical)

Section 3 - Installation

3.1 Introduction

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

3.2 Receiving and Handling

Cummins Fire Power fire pump drive 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. Upon receipt of the fire pump drive engine from the shipper:

1. Inspect the equipment for damage that may have occurred in shipping; and
2. Check each item carefully against the shipping manifest or bill of lading.

3.3 Site Preparation

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

CAUTION

Avoid installation in a dusty or dirty environment. Provide adequate physical protection from other physical damage as may be present in the specific location.

3.4 Drive Shaft Installation

Drive shaft installation should be done by trained technicians familiar with local, state, and federal codes and regulations.

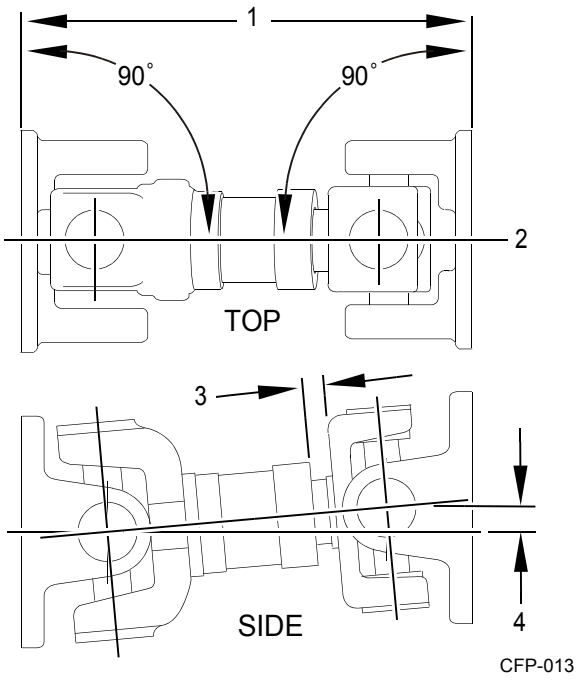
Refer to National Fire Protection Association (NFPA) 20 for installation and applicable local code requirements and NFPA 25 for inspection, testing, and maintenance requirements.

Follow these steps to install the drive shaft:

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. Do not use the engine lifting points for assembly!

1. Ensure that the engine and pump are correctly aligned.
   a. Ensure that the engine position is centered on the frame side to side within ± .76 mm (.03 in) by measuring outside of the frame side to the engine support leg mounting pad. (Compare the two front engine supports and two back engine supports.)
   b. As shown in Figure 3-1, align the engine center line to the pump center line within ± .76 mm (.03 in).
   c. Ensure that the pump center line to the engine crankshaft center line (in vertical plane) is 2° +/- 1°.
   d. Ensure that the drive shaft mounting flanges are parallel.
2. As illustrated in Figure 3-2, lubricate the grease fittings on the drive shaft universal joint.
3. Check that the fire pump drive engine is properly installed per the pump manufacturer's specifications.



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

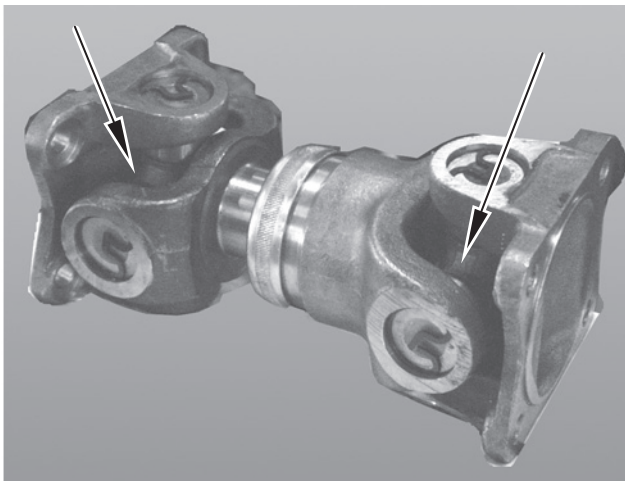


Figure 3-2 Drive Shaft Universal Joint Grease Fittings

NOTE: *Cummins Fire Power or Cummins Inc. recommends using a good quality semi-synthetic, molybdenum-fortified National Lubricating Grease Institute (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.*

3.5 Fuel Supply Installation

The following sections outline proper installation and connection of the fuel supply.

NOTE: *It is the responsibility of the customer to provide and install a properly-rated fuel tank per NFPA 20 guidelines.*

To properly install a fuel supply, follow these intstructions:

1. Install an elevated no. 2 diesel fuel tank or other fuel supply arrangement which is compatible with American Society of Testing and Materials (ASTM) no. 2 diesel fuel specifications.

NOTE: *The fuel supply line at the fuel tank must be higher than the fuel intake port on the engine fuel filter. Ensure that the fuel system is installed in a safe and effective manner.*

2. Size the fuel tank for the maximum expected full-load engine operation period with the initial fuel level at the minimum level for refueling.

3. Install a fuel return line and route this line to the bottom of the fuel tank in order to minimize the return head.

4. Install a fuel supply line to the fire pump drive engine.

NOTE: *For fuel line specifications, refer to 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.*

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

An optional fuel pre-filter and a fuel filter/water separator is integrated into the fuel delivery system of the fire pump drive engine. To ensure that the filter/separator is free of water, open the fuel filter/water separator drain at the bottom of the filter and 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.

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 (ASTM no. 2D) fuel. Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.

3.6 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

To install the cooling water supply:

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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.

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

2. Check the pressure regulator setting on the cooling loop with water flowing through the heat exchanger. The cooling loop is supplied by Cummins Fire Power; both water pressure regulators have been set at 207 kPa (30 psi) (or slightly less) water pressure during manufacture and testing.

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 Engine Data Sheet. The flow rate may need to be adjusted to maintain the 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. Adjust the cooling water based on the water *flow* rather than the 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. To measure the water flow, use an appropriate-sized container to measure the amount of water and the elapsed time of the water to flow from the discharge pipe and then formulate the calculations:

Flow rate = container size/ time to fill container.

Example:

Time to fill a 20 gallon container = 15 seconds.

20 gallons divided by 15 seconds = 1.33 gallons per second.

Multiply by 60 seconds = 80 gallons per minute (gpm) (FLOW RATE)

5. Adjust both pressure regulators to a pressure that will provide a flow rate at or above the specifications listed in the Engine Data Sheet.

CAUTION

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

3.7 Battery Installation

Redundant sets of batteries must be supplied for the required operating voltage. The minimum recommended Society of Automotive Engineers (SAE) reserve capacity (RC) and SAE cold cranking ampere (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. Refer to NFPA 20 for additional battery installation information.

WARNING

Battery electrolyte (sulfuric acid) is highly caustic and can burn clothing and skin. Wear impervious neoprene gloves and safety goggles, or a 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.

IMPORTANT: *Batteries must meet the requirement 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.*

To properly install the batteries:

1. As shown in Figure 3-3 or Figure 3-4, install the Battery Cable Kit or equivalent customer-supplied wiring. Install battery sets in a well-ventilated or otherwise protected location.

WARNING

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

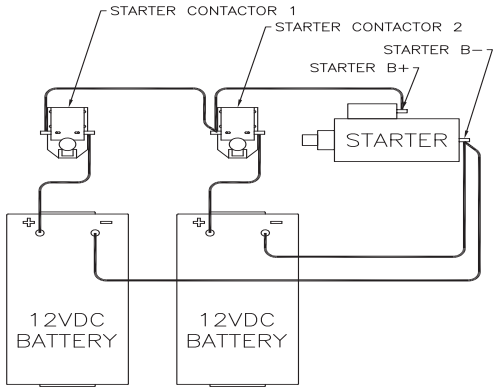


Figure 3-3 Series Battery Connection 12 VDC

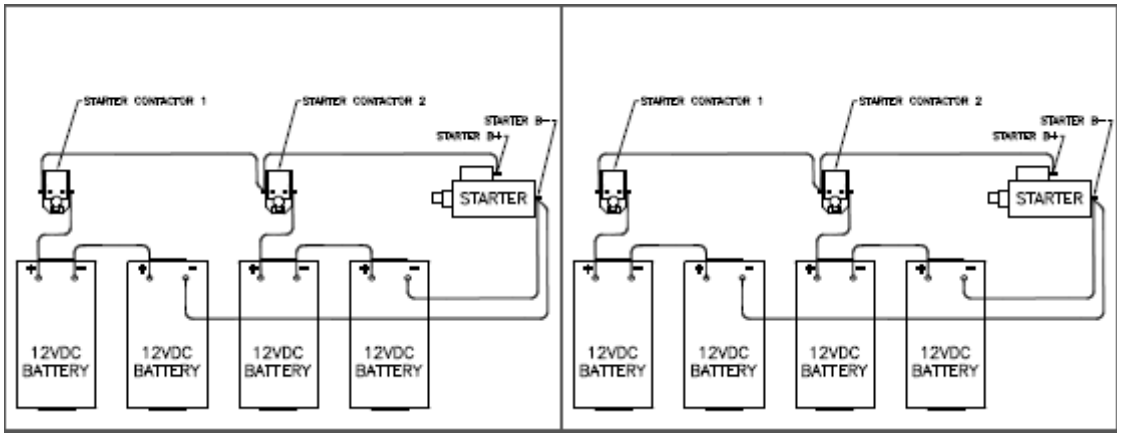


Figure 3-4 Series Battery Connection 24 VDC

2. Provide adequate room for servicing or replacing the batteries. Provide protection from extremes of temperature and weather.

3. Locate the batteries near the engine or increase the size of the conductors as required by applicable codes. Ensure that the batteries are configured properly for 12 - or 24 - VDC standard operations.

4. Check the battery cables and connections.

NOTE: *Coat the terminals with petroleum jelly to prevent corrosion. Install the cables and tighten the battery connections.*

3.8 Signal and Control Installation

The fire pump controller wires must be connected to the terminal blocks (TBs) on the FPDP Interface Terminal Strip (shown in Figure 3-5). To complete the signal and control installation:

1. Ensure that the fire pump controller is properly installed and configured per the manufacturer's instructions.

2. Complete the fire pump controller wiring (customer-supplied) per the manufacturer's instructions.

3. Ensure electrical continuity and adequate insulation resistance for the installed wiring.

4. The TBs between the fire pump controller and the FPDP Interface Strip are standard UL and FM controller terminals and follow a direct one-to-one correspondence (some TBs are optional):

   a. TB-1 [**Run Solenoid Circuit**]: This power source is necessary for fire pump operations while in the **AUTO** mode.

   b. TB-2 [**Crank Termination Switch**]: 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 [**Overspeed Switch**]: This signal is present when the overspeed control module has operated. If this event occurs, the fire pump drive engine will stop.

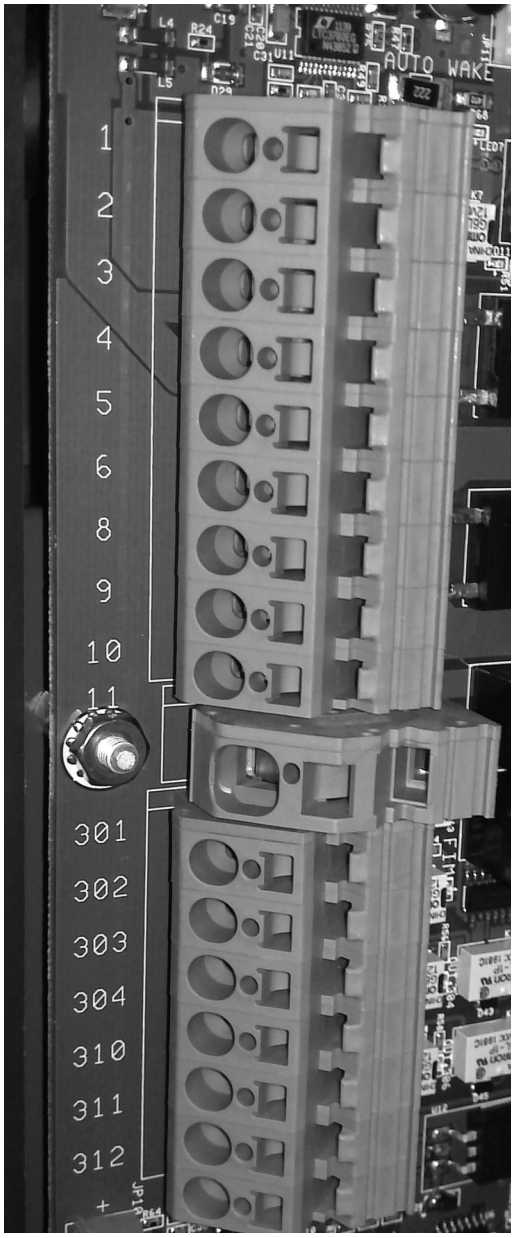


Figure 3-5 FPDP Interface Terminal Strip

   d. TB-4 [**Low Lubricant Pressure Switch**]: This zero VDC grounded signal is present when the oil pressure has dropped below the 83 ± 13 kPa (12 ± 2 psi) set point.

   e. TB-5 [**High Engine Temperature Signal**]: This zero 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 [**Battery One Positive**]: The fire pump controller senses Battery A charge state and charges Battery A through this heavy gauge wire.

g. TB-8 [**Battery Two Positive**]: The fire pump controller senses Battery B charge state and charges Battery B through this heavy gauge wire.

h. TB-9 [**Main Battery Contactor One Coil or Battery Relay One Coil**]: The battery positive signal is driven from the fire pump controller to contactor A when desiring to crank from Battery A. Current in this circuit shall not exceed 10A continuous.

i. TB-10 [**Main Battery Contactor Two Coil or Battery Relay Two Coil**]: The battery positive signal is driven from the fire pump controller to contactor B when desiring to crank from Battery B. Current in this circuit shall not exceed 10A continuous.

j. TB-11: Connect the common ground and battery negative for both Battery A and Battery B from between the fire 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.

NOTE: *Terminals 301 through 312 shall be electrically isolated from the ECM.*

k. TB-301 [**Electronic Control Module Switch**]: Battery negative signal driven from the FPDP when the engine is operating on Engine Control Module (ECM) B.

l. TB-302 [**Fuel Injection Malfunction**]: Battery negative signal driven from the FPDP when either of the ECMs triggers a fault code which can affect performance of the Fuel Injection System. See Section 7 - Troubleshooting for possible fault causes and solutions.

m. TB-303 [**Electronic Control Module Warning**]: Battery negative signal driven from the FPDP when a single ECM has failed.

n. TB-304 [**Electronic Control Module Failure**]: Battery negative signal driven from the FPDP when both ECMs have failed.

o. TB-310 [**Raw Water High Inlet Temperature**]: Battery negative signal driven from the FPDP when high raw water temperature is sensed.

p. TB-311 [**Clogged Raw Water Coolant Loop Strainer**] - *not applicable on radiator-cooled models:* Battery negative signal driven from the FPDP when the raw water supply restriction is sensed.

q. TB-312 [**Low Engine Temperature Signal**]: 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).

5. Provide the initial charge on the redundant batteries per the battery charger's instructions.

6. Check that both voltmeters on the FPDP indicate the approximate battery voltage. Both sets of batteries can be used for starting the engine in the event that one set is low.

3.9 Coolant System Preparation

The fire pump drive engine cooling and lubrication system was initially filled during manufacture and testing. To properly prepare the coolant system:

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 and ensure that all coolant hoses and clamps are properly installed and water tight.

2. Ensure that the engine coolant heater maintains 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.

WARNING

Do not remove the pressure/fill cap from a hot engine. Wait until the coolant temperature is below 50 °C (122 °F) before removing the pressure/fill cap. Heated coolant spray or steam can cause personal injury.

3.10 Charge Air Cooler (CAC) Inspection

The charge air cooler (CAC) system reduces the temperature of the compressed combustion air from the turbocharger before entering the air intake manifold.

Inspect the CAC 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.

3.11 Lubricating Oil System Preparation

The fire pump drive engine and turbocharger were initially lubricated during manufacture and testing. To prepare the lubricating oil system for operation:

1. Check the oil level using the dip stick before operating the fire pump drive engine.

2. Fill the oil fill port to the “H” mark on the dipstick with lubricating oil.

NOTE: *Do not use special “break-in” lubricating oils for new or rebuilt Cummins engines. Use the same type of oil during the “break-in” as used during normal operation.*

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.

NOTE: *Using multi-viscosity lubricating oil can improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures. Cummins Inc. recommends Premium Blue® 15W-40 oil for most climates.*

CAUTION

Ensure that all cooling and lubrication systems have been filled to the proper level before operation.

3.12 Pre-Start Inspections

Prior to starting the fire pump drive engine for the first time, perform a visual inspection:

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 drive engine is properly installed per the pump manufacturer’s instructions, is correctly aligned, and is free to rotate.

6. Lubricate the grease fittings on the auxillary drive shaft.

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

After completing preliminary set-up procedures, perform the engine start test as outlined in detail in Section 5 - Operation.

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.

CAUTION

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

3.13 Engine Monitoring

When the engine starts, it is important to monitor the displays:

1. Immediately check that water flow is established through the coolant heat exchanger. The 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

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

3. Operate the engine for eight to ten minutes.

4. Inspect the engine 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. Shortly after the engine stops, check that the water flow stops automatically.

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

8. Check the engine lubricating oil level at the dip stick. Add oil, if necessary.

9. Check the coolant expansion tank level. Add coolant, if necessary.

10. Check the cooling water strainers. Clean the strainers according to the maintenance schedule in Section 6 - Maintenance.

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

3.14 Field Acceptance Testing

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

Section 4 - Controls

4.1 Fire Pump Digital Panel (FPDP)

The Fire Pump Digital Panel (FPDP) shown in Figure 4-1 controls starting and monitoring engine performance, as well as the fire pump drive engine operation. 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 Terminal Block (TB) -1, otherwise it goes into STANDBY mode after thirty minutes of no battery voltage on TB-1.

4.1.1 Warning Lamp

The Warning Lamp (**1**) illuminates (yellow) in the event that the Electronic Control Module (ECM) has sensed a non-mission disabling fault.

4.1.2 Fault Indicator Lamp

The Fault Indicator Lamp (**2**) indicates Fuel Injection Malfunction (FIM) and illuminates (red) in the event that the ECM has detected a fuel injection fault or primary sensor fault.

The FPDP also sends a ground signal to TB-302, which sends a signal to set off an alarm on the fire pump controller to indicate a FIM.

4.1.3 Scroll UP and DOWN Buttons

The scroll buttons are used to scroll UP (**4**) or DOWN (**5**) when inside the FPDP menus.

4.1.4 ENTER Button

Press the ENTER button (**6**) when making selections in the FPDP menu screen.

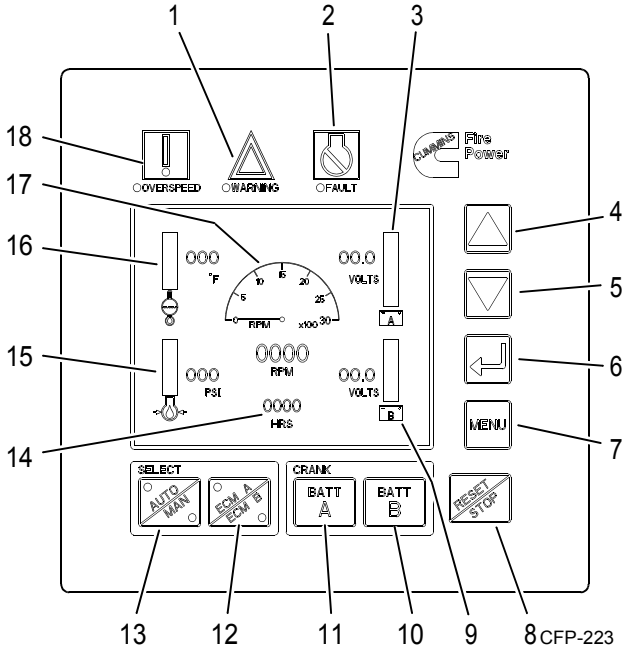
4.1.5 MENU Button

Press the MENU button (**7**) on the FPDP display to open the menu options.

4.1.6 Overspeed RESET/STOP Switch

The overspeed RESET/STOP switch (**8**) is used to shut off the engine at the FPDP. Momentarily pressing the switch removes the key switch for thirty seconds.

Pressing the Overspeed RESET/STOP Switch after correcting an engine overspeed shutdown resets the overspeed control module, allowing subsequent restarts of the fire pump drive engine.



1. Warning Lamp
2. Fault Indicator 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 Gauge
16. Coolant Temperature Gauge
17. Tachometer
18. Engine Overspeed Warning Lamp

Figure 4-1 Fire Pump Digital Panel (FPDP)

4.1.7 Battery "A" and "B" Voltmeters

The Battery "A" (**3**) and Battery "B" (**9**) Voltmeters display the charge status - or Voltage Direct Current (VDC) - of the relative battery connections.

4.1.8 Tachometer

The Tachometer (**17**) displays the engine speed in revolutions per minute (RPM) whenever the engine is operating.

4.1.9 Hour Meter

The Hour Meter (**14**) maintains a running total of the hours of operation (run time).

4.1.10 ECM A/B Selector Switch and Indicator Lamps - Applicable on Electronic Engines

The ECM A/B selector switch and indicator lamps (**12**) illuminate in yellow, indicating which ECM is being used to control the engine.

If ECM A (normal position) is selected, ECM A is controlling the engine.

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

4.1.11 Crank Battery A and B Momentary Start Buttons

The Crank Battery A (**11**) and Crank Battery B (**10**) momentary start buttons initiate an immediate engine start (momentary start) using the selected A or B crank battery.

Crank A energizes battery contactor A and Crank B energizes battery contactor B, depending on which one is selected.

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

4.1.12 Automatic or Manual Mode of Operation Indicator

The AUTO/MAN mode switch and indicator lamps (**13**) show whether the engine starts and is controlled by the operator (MANUAL) or by an automatic signal from the fire pump 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 by the fire pump controller. In the AUTO mode, the fire pump drive engine shuts down upon loss of signal power from the fire pump controller.

4.1.13 Coolant Temperature Gauge

The Coolant Temperature Gauge (**16**) displays the engine coolant temperature in degrees Fahrenheit.

4.1.14 Engine Oil Pressure Gauge

The Engine Oil Pressure Gauge (**15**) displays the engine oil pressure in pounds per square inch (PSI). This gauge is independent of the low oil pressure alarm.

4.1.15 Engine Overspeed Warning Lamp

The overspeed control module monitors engine speed. If the engine RPM exceed 115% rated speed, the Engine Overspeed Warning Lamp (**18**) is illuminated (yellow).

The FPDP will send a power signal to TB-3, which will send a signal to set off an alarm on the fire pump controller, indicating that an overspeed condition has occurred.

The FPDP 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 FPDP, 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 controller until the FPDP is reset.*

4.1.16 ECM Fault Code Lamps - Applicable on Electronic Engines

The amber engine warning lamp and the red engine shutdown lamp alert the operator of an engine malfunction:

- An illuminated amber lamp indicates an engine malfunction that requires timely operator attention.
- An illuminated red lamp indicates an engine malfunction that requires immediate and decisive operator response.

A three- or four-digit diagnostic fault code will display on the FPDP which can then be used to help describe the engine malfunction. Refer to the Fault Code Chart in Section 7 - Troubleshooting.

4.1.17 Engine STOP Button

The Engine STOP Button is located on the left side of the FPDP enclosure and is used to stop the operation of the engine in either manual or automatic mode. The button must be pressed and held until the engine has shut down.

4.1.18 Engine Communications Port

The Engine Communications Port plug-in is located on the left side of the FPDP 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.*

4.1.19 Contractor Access Port

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

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

4.1.20 Engine ECM Power Supply

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

4.1.21 Engine Harness Connection

Located on the lower side of the FPDP, the Engine Harness Connection plug-in connects the panel to the power source, start contactors, magnetic pick-up, alternator, and other engine-related functions controlled by the FPDP.

4.2 Electronic Control Module (ECM) - Applicable on Electronic Engines

The ECM is an electronically operated fuel control system that also provides many operator and vehicle or equipment features. It processes all of the inputs and sends commands to the fuel system vehicle and engine control devices. The base functions of the control system include fueling and timing control, limiting the engine speed operating range between the low- and high-idle set points, and reducing exhaust emissions while optimizing engine performance.

The ECM uses inputs from the operator and its sensors to determine the fueling and timing required to operate at the desired engine speed.

The ECM performs diagnostic tests on most of its circuits and will activate a fault code if a problem is detected in one of these circuits. Along with the fault code identifying the problem, a snapshot of the engine's operating parameters at the time of fault activation is also stored in memory. Some fault codes will cause a diagnostic lamp to activate to signal the driver.

The ECM also communicates with service tools and some other controllers.

⚠ CAUTION

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

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Section 5 - Operation

5.1 Introduction

This section outlines general operating information for starting and stopping the fire pump drive engine, as well as instructions for navigating the menu screens of the Fire Pump Digital Panel (FPDP). This 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 service, 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 Starting and Stopping Procedures

By default, the fire pump will turn on automatically in the event of low system water pressure. The engine will continue to operate as long as the RUN signal is present. When the RUN signal is terminated by the fire pump controller, the engine will stop.

For testing purposes, the fire pump drive engine can be turned on and off locally using the buttons on the FPDP (see Figure 4-1), If the engine fails to start automatically in the event of a fire emergency, follow the Emergency Starting/Stopping Procedure outlined in Section 5.2.2.

5.2.1 Local Starting/Stopping Procedure

To start the engine locally from the FPDP:

1. Press the AUTO/MAN mode switch on the FPDP to place the engine in MANUAL mode.
2. Press either the CRANK BATT A or CRANK BATT B button to start the engine.

The engine may be stopped locally by pressing the RESET/STOP button on the FPDP or by holding down the red ENGINE STOP button on the left side of the FPDP.

5.2.2 Emergency Starting/Stopping Procedure

The engine will start automatically in the event of a fire emergency. However, if it fails to start automatically, the engine can be started locally. The following procedure outlines an emergency manual mode electrical start:

1. As shown in Figure 5-1, open the water bypass valves in the cooling water supply piping or the emergency cooling supply.

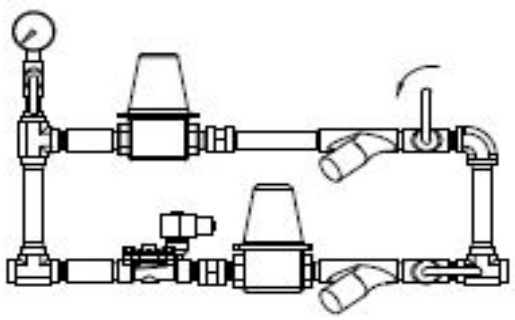

Figure 5-1 Fire Pump Drive Engine Bypass Valve

2. Verify that water is being discharged.
3. Press the AUTO/MAN mode switch on the FPDP to place the engine in MANUAL mode.
4. As shown in Figure 5-2, open the FPDP panel door and slide the keyswitch override to the “UP” position. Verify that the green LED next to the override switch is lit.

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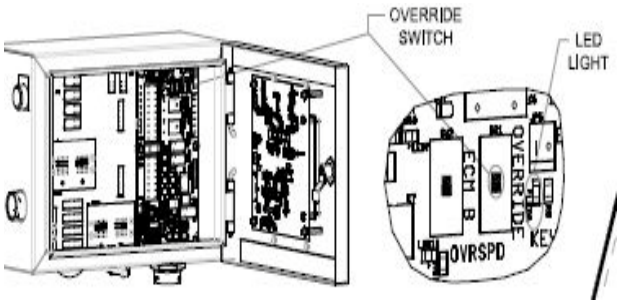


Figure 5-2 FPDP Override Switch

CAUTION

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

5. As shown in Figure 5-3, press downward on either the Battery A or Battery B contactor lever to start the engine.

   a. If crank contactor lever A does not engage the starter, repeat using crank contactor lever B.

   b. Release the contactor lever immediately after the engine starts.

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 that no fuel is being delivered.*

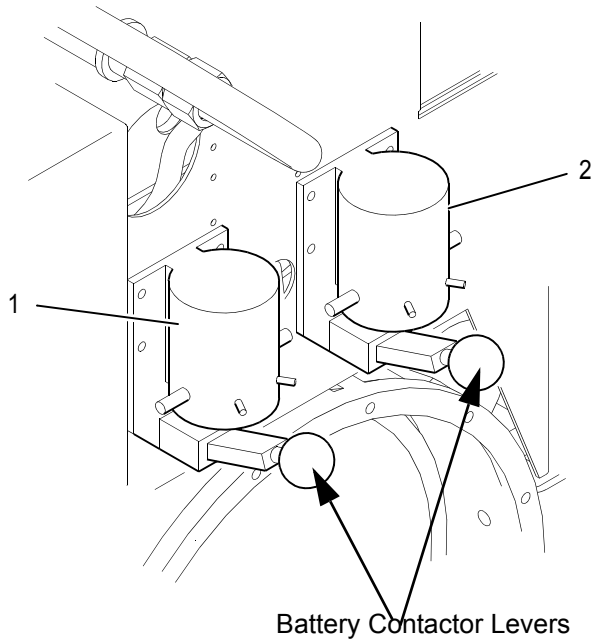
6. Check that the engine starts and operates at the rated speed.

NOTE: *Engine oil pressure must be indicated on the gauge within fifteen seconds after starting.*

The engine may be stopped locally by pressing the RESET/STOP button on the FPDP or by holding down the red ENGINE STOP button on the left side of the FPDP.

WARNING

Do not switch to the alternate Electronic Control Module (ECM) while the engine is running.



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

Figure 5-3 Manual Starter Contactors

5.3 Fire Pump Digital Panel (FPDP) Screens and Adjustments

As shown in Figure 5-4, the FPDP User Interface Screen (main screen) shows the fire pump drive engine tachometer, coolant temperature, oil pressure, Battery A voltage, Battery B voltage, hour meter, and fault codes (when present). The “MORE /\ \/” indicator at the top right of the screen signals the user to toggle the UP or DOWN buttons to switch easily between the FPDP User Interface Screen and the Analog Values Screen (see Section 5.3.6).

NOTE: *Electronic engines display J1939 tachometer, engine temperature, and oil pressure. Mechanical engines display parameters via sensors added by Cummins Fire Power.*

NOTE: *When the key switch is not on, the coolant temperature defaults to “0 °F” (or “-18 °C”) and the oil pressure defaults to “0 PSI” (or “0 kPa”).*

.

Figure 5-4 FPDP User Interface Screen (Typical)

If the operator presses the MENU button from the FPDP User Interface Screen, the Main Menu Screen appears as shown in Figure 5-5.

```
        ENGINE SETUP
        OVERSPEED TEST
        RPM INC/DEC
        PARAMETER UNITS
        DISPLAY SETTINGS
        ANALOG VALUES
        AUTOSWITCH
        RETURN TO MAIN

  Use the UP and DOWN keys to Scroll
  the Menu. Press the ENTER key to
  make a Selection.
```

CFP-224

Figure 5-5 Main Menu Screen (Typical)

This list shows the menu options for further operator input and monitoring of engine parameters. To reach any one of these submenu screens, use the UP or DOWN buttons to highlight a desired screen and then press ENTER.

5.3.1 Engine Setup Screen

As shown in Figure 5-6, the Engine Setup screen is password protected and for Cummins Fire Power internal use only.

```
        ENGINE SETUP

        PASSWORD:
           XXX

        SUBMIT PASSWORD
        RETURN TO MAIN
```

Figure 5-6 Engine Setup Screen (Typical)

5.3.2 Overspeed Test Screen

Figure 5-7 shows the Overspeed Test Screen. To simulate an overspeed for engine speed models above 2250 RPM or for instances when over-pressurizing of sprinkler systems can cause damage:

1. Using the DOWN/UP arrow buttons, toggle down to highlight “SIMULATE OVERSPEED”.
2. Press ENTER.

```
        OVERSPEED TEST

        RATED SPEED:
             2250 RPM
        OVERSPEED SETPOINT:
             2700 RPM
        ADJUST ENGINE SPEED
      → SIMULATE OVERSPEED
        RETURN TO MAIN
              XXXX

          ENGINE SPEED in RPM
Selecting This Item allows the UP/DOWN
keys to Inc./Dec. Speed by 10 RPM.
```

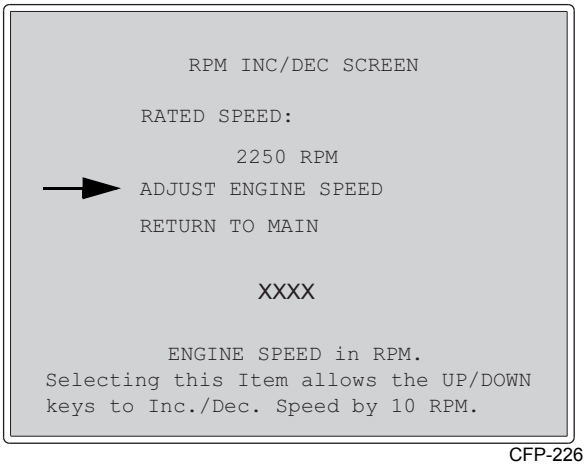
CFP-225

Figure 5-7 Overspeed Test Screen (Example)

3. A six-second timer will begin a countdown at the bottom of the screen and all buttons will be locked out, except for RESET/STOP.

4. The simulation test temporarily lowers the FPDP overspeed setpoint to below the engine speed. Upon completion of the overspeed simulation, the FPDP reverts back to its previous operating parameters.

The RPM INC/DEC Screen shown in Figure 5-8 allows the operator to make on-site adjustments by incrementing or decrementing the engine operating speed for electronic engines.



CFP-226

Figure 5-8 Electronic RPM INC/DEC Screen (Typical)

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, follow these steps to adjust the speed setting:

1. Using the DOWN/UP arrow buttons, toggle down to highlight “ADJUST ENGINE SPEED”.

2. Press ENTER.

3. Press the UP or DOWN arrow to increment the engine speed to match the field setting plate. Each increment is ten RPMs.

4. Press ENTER.

5.3.3 Parameter Units Screen

The Parameter Units Screen shown in Figure 5-9 allows the operator to select Imperial or Metric units. The default units of measure are degrees in Fahrenheit and pounds per square inch (PSI).

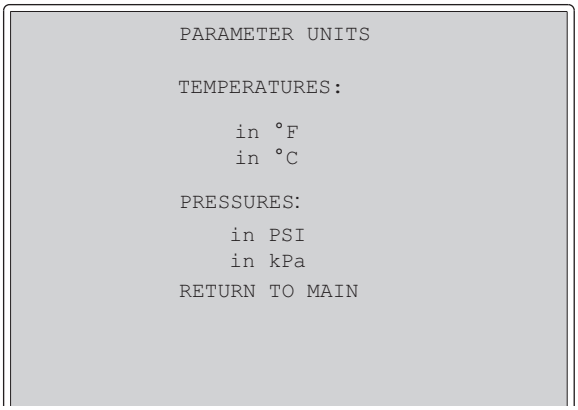
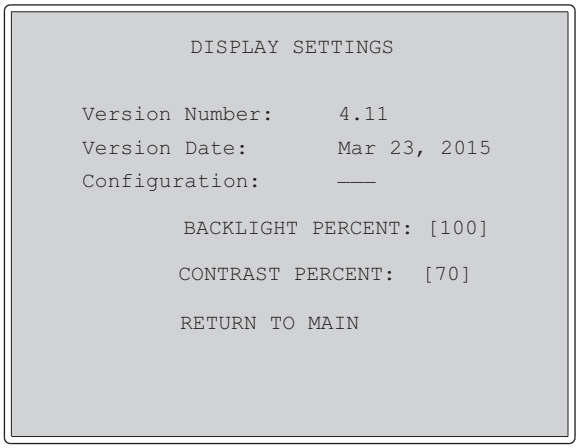


Figure 5-9 Parameter Units Screen (Typical)

5.3.4 Display Settings Screen

The Display Settings Screen (shown in Figure 5-10) enables adjustments to the backlight and contrast for optimal viewing in varying lighting environments. The version number of the FPDP software will also be indicated on this screen.



CFP-228

Figure 5-10 Display Settings Screen (Typical)

5.3.5 Analog Values Screen

The Analog Values Screen shown in Figure 5-11 provides analog output values for battery voltages, engine speed, water temperature, oil pressure, exhaust temperature, cooling loop temperature, cooling loop differential pressure, and hours of operation. The Analog Values Screen may be accessed either by toggling down and selecting ANALOG VALUES from the Main Menu Screen (Figure 5-5) or

by using the UP and DOWN buttons from the FPDP User Interface Screen (Figure 5-4).

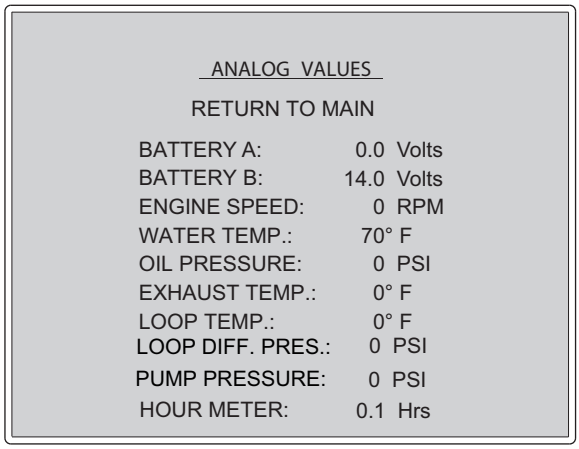


Figure 5-11 Analog Values Screen (Typical)

NOTE: *The choice of Metric or Imperial values is made using the Parameter 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°.*

5.3.6 Autoswitch Screen

The National Fire Protection Association (NFPA) 20 Standard, as well as Underwriters Laboratories (UL) and Factory Mutual (FM) Standards, requires redundancy for fire safety systems. If the autoswitch is **enabled** and the selected ECM fails to start, the fire pump drive engine will automatically switch to the other ECM and restart. As shown in Figure 5-12, the Autoswitch Setting Screen allows the operator to disable or enable this autoswitch capability.

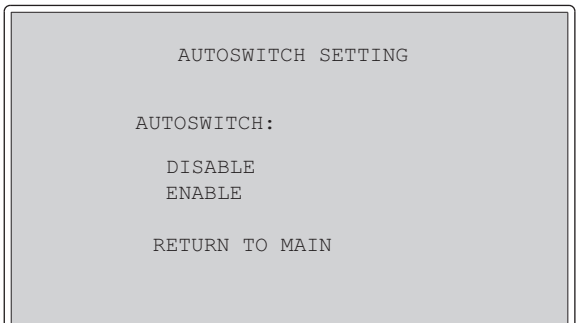


Figure 5-12 Autoswitch Screen (Typical)

5.4 Active Fault Codes Display

Operation irregularities are displayed as fault codes on the bottom of the User Interface Screen of the FPDP (see Figure 5-13). For a complete listing of Fault Codes and their meanings, see Section 7 - Troubleshooting.

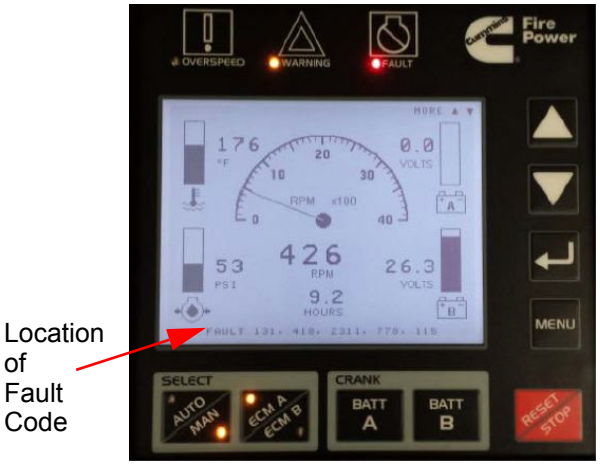


Figure 5-13 Fault Code Display

In the event that the FPDP experiences a loss of the pressure signal, the engine will default to the rated speed.

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Section 6 - Maintenance

6.1 Introduction

Before performing maintenance procedures, read and understand Section 1 - Safety 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 Original Equipment Manufacturer (OEM) products. See the Warranty Information section at the beginning of this manual.

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

The National Fire Protection Association (NFPA) 25 Standard outlines the maintenance tests to be performed to validate automatic and manual operational requirements for field acceptance testing.

Cummins recommends that the engine be maintained according to the Cummins Operation and Maintenance Manual for that engine family.

NOTE: *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 Reports

The engine must always be maintained in top mechanical condition. The maintenance department requires regular running reports to include the following:

- Low engine oil pressure.
- Engine surge.
- Erratic operation or frequent shutdowns.
- Any warning lamps flashing or staying illuminated.
- Abnormal coolant or oil temperature.
- Unusual engine noise or vibration.
- Excessive smoke.
- Excessive use of coolant, fuel, or engine oil.
- Any fluid leaks.
- Loose, worn, or damaged parts.

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

The Fault Codes displayed on the Fire Pump Digital Panel (FPDP) assist in recording operation irregularities. See Section 7 - Troubleshooting for a listing of Fault Codes.

Maintenance Chart

Task	Period	Page
Weekly Maintenance		
6.3.1 General	Weekly	6-4
6.3.2 Air Cleaner Filter and Piping	Weekly	6-4
6.3.3 Cooling System	Weekly	6-4
6.3.4 Engine Oil System	Weekly	6-5
6.3.5 Fuel System	Weekly	6-6
6.3.6 Engine Exhaust System	Weekly	6-6
6.3.7 Electrical Supply and Controls	Weekly	6-6
6.3.8 Crankcase Ventilation Hose	Weekly	6-6
6.3.9 Cooling Water Strainers	Weekly	6-7
6.3.10 Batteries	Weekly	6-7
6.3.11 Engine Test Run	Weekly	6-8
6.3.12 Engine Operation Checks	Weekly	6-8
6.3.13 Engine Coolant Heater	Weekly	6-9
Annual Maintenance		
6.4.1 Electrical Components	Annually	6-9
6.4.2 Turbocharger Mounting Nuts	Annually	6-9
6.4.3 Engine Supports	Annually	6-10
6.4.4 Fuel Pumps and Filters	per Cummins Engine Operation and Maintenance Manual	6-10
6.4.5 Engine Oil and Filter	per Cummins Engine Operation and Maintenance Manual	6-11
6.4.6 Drive Shaft	Annually	6-12
6.4.7 Coolant Pump/Alternator Belt	Annually	6-12
6.4.8 Raw Water Zinc Anode	Annually	6-13
6.4.9 Heat Exchanger	Annually	6-13
6.4.10 Turbocharger	Annually	6-14
Every 2 Years or 2000 Hours		
6.5.1 Coolant Pump	2 Years	6-14
6.5.2 Cooling System	2 Years	6-14
Every 4 Years or 5000 Hours		
6.6.1 Coolant Thermostat Removal/Installation	4 Years	6-17
6.6.2 Coolant Pump/Alternator Belt Replacement	4 Years	6-17
6.6.3 Charge Air Cooler (CAC) Heat Exchanger	4 Years	6-18

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

Maintenance Record Form

Table 6-1.

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

Each week, a general walk-around inspection should include the following areas:

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

2. 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.

3. Check the engine appearance for excessive heat, wiring short circuits, excessive end-play, vibrations, excessive wear, excessive abrasion, damaged electrical wiring, or loose electrical wiring.

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

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.

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. On a weekly basis, perform the following inspections:

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 2-2.

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

NOTE: *Cummins recommends using an air cleaner filter element as listed on the Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

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.

   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: See the Engine Data Sheet in Section 8 - Component Parts and Assemblies for maximum intake air restriction.

2. 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.

3. Replace any 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 chart in Section 8 - Component Parts and Assemblies.

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.

On a weekly basis, perform the following inspections on the cooling system:

1. Inspect the cooling water piping, coolant heat exchanger tanks, charge air cooling system, engine coolant hoses, and hose clamps for loose fittings, leaks, 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 as shown in Figure 2-1.

   a. Ensure that the coolant level is visible by checking 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.*

3. Check the antifreeze concentration at least six times a year or whenever coolant is added to the cooling system by using a refractometer.

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 chart in Section 8 - Component Parts and Assemblies. Replace damaged hoses and clamps as required.

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

6.3.4 Engine Oil System

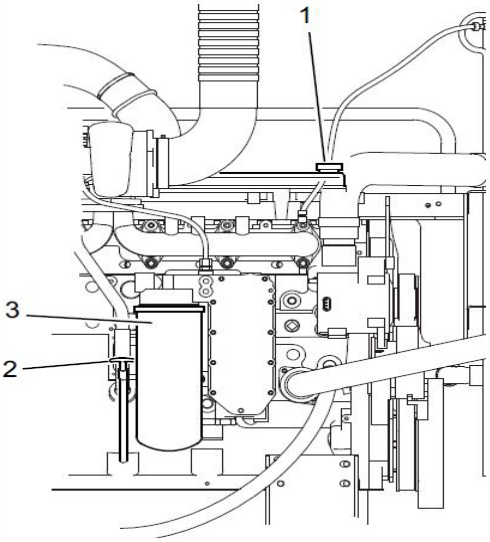
WARNING

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.

Inspect the engine oil system on a weekly basis following these steps:

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

2. As shown in Figure 6-1, check the oil level at the engine dipstick.



1. Oil Fill Port (on valve cover)
2. Oil Level Dipstick
3. Engine Oil Filter

Figure 6-1 Oil Level Dipstick

   a. If the oil level is greater than the high mark (H), drain the 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. If the oil level is below the low mark (L), add the equivalent type oil.

NOTE: *Cummins recommends using Premium Blue S.A.E. 15W-40 Multi-viscosity Lubricating Oil or equivalent.*

6.3.5 Fuel System

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.

To inspect the fuel system:

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 inlet line.

NOTE: *Refer to the Engine Data Sheet in Section 8 - Component Parts and Assemblies for Cummins recommended replacement components.*

6.3.6 Engine Exhaust System

With the engine operating, inspect the entire exhaust system: 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. Loose or corroded connections create resistance which can hinder starting. Inspect the FPDP harness connections to be sure they are secure.

6.3.8 Crankcase Ventilation Hose

Inspect the crankcase ventilation hose for wear, damage, sludge, blockage, or dirt buildup (refer to Figure 2-1). Clean the ventilation hose, if obstructed or blocked. Replace a worn or damaged hose.

6.3.9 Cooling Water Strainers

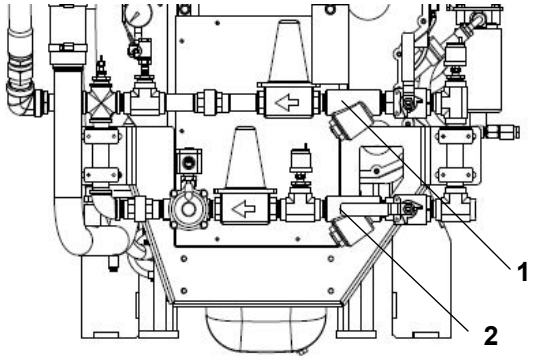
As shown in Figure 6-2, the (two) cooling water strainers should be cleaned weekly to remove sediment.

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

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

For each cooling water strainer:

1. 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 operation.



1. Bypass Water Line Strainer
2. Normal Water Line Strainer

Figure 6-2 Cooling Water Strainer (typical)

6.3.10 Batteries

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.

For proper weekly maintenance of the batteries:

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

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

   b. Use a 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 0.94 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 and 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. Reinstall the battery cables; attach the negative (-) battery cable last.

6.3.11 Engine Test Run

Start the engine at least once a week for a minimum of thirty 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. Refer to the operating instructions in Section 5 - Operation.

Check that the engine starts and operates at the recommended fire pump drive engine speed specification and inspect the following:

1. Check that the engine oil pressure is indicated on the gauge within fifteen seconds after starting.

2. Check that the engine has attained a normal running temperature after running the engine for a minimum of thirty minutes.

3. Observe that the engine is operating at the proper operating speed. (If the engine is not operating at the proper speed, see Section 6.3.12 Engine Operation Checks.)

4. Check for unusual engine noise. Listen for any unusual engine noise which can indicate that service is required.

5. Ensure that the oil pressure is greater than 69 kPa (10 psi).

6. Check that the coolant temperature is between 70 °C (158 °F) and 107 °C (225 °F).

7. Check that both battery voltmeters indicate 12 VDC for standard or 24 VDC for optional operating systems.

8. Check that the air filter service indicator has not popped-up, indicating an air filter blockage. Replace the air filter as required.

End the test run by pressing and holding the overspeed RESET/STOP switch until the engine stops.

6.3.12 Engine Operation Checks

The following service inspections 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.

6.3.12.1 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.

6.3.12.2 Engine Speed Calibration

If the speed does not match the engine RPM shown on the factory settings plate, calibrate the correct speed using the controls on the FPDP:

1. Set the ECM to “ECM A”.

2. Start the engine locally from the FPDP:

   a. Press the AUTO/MAN mode switch on the FPDP to place the engine in MANUAL mode.

   b. Press either the CRANK BATT A or CRANK BATT B button to start the engine.

3. Check to verify that the engine starts and accelerates to the speed set point listed on the factory settings plate.

4. Monitor the engine speed on the tachometer. Record the observed engine speed.

5. If the speed does not match the engine RPM shown on the factory setting plate, follow these steps to adjust the speed setting:

   a. As shown in Figure 6-3, using the DOWN/UP arrow buttons, toggle down to highlight “ADJUST ENGINE SPEED”.

   b. Press ENTER.

   c. Press the UP or DOWN arrow to increment the engine speed to match the field setting plate. Each increment is ten RPMs.

   d. Press ENTER.

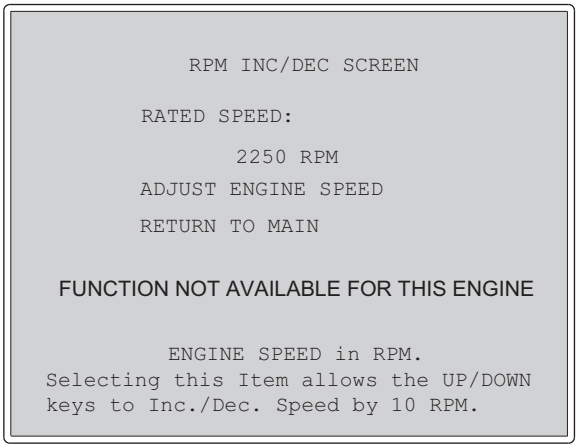


Figure 6-3 RPM INC/DEC Screen (Typical)

6. Stop the engine.
7. Start the engine.
8. Observe that the engine starts and accelerates to the rated speed set point.
9. The engine speed set point calibration is required for both the ECM A and ECM B subsystems.
10. 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.*

6.3.13 Engine Coolant Heater

NOTE: *Perform this inspection procedure twenty-four 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 (see 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 the time of the annual maintenance, in addition to those listed *only* under the annual maintenance interval.

6.4.1 Electrical Components

CAUTION

AVOID SERVICING complex components such as: printed circuit boards, programmable controllers, and ECMs 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.

The electrical components of the fire pump drive engine must be thoroughly inspected on an annual basis. Remove the battery terminal cables, starting with the negative (-) cable first and check the following:

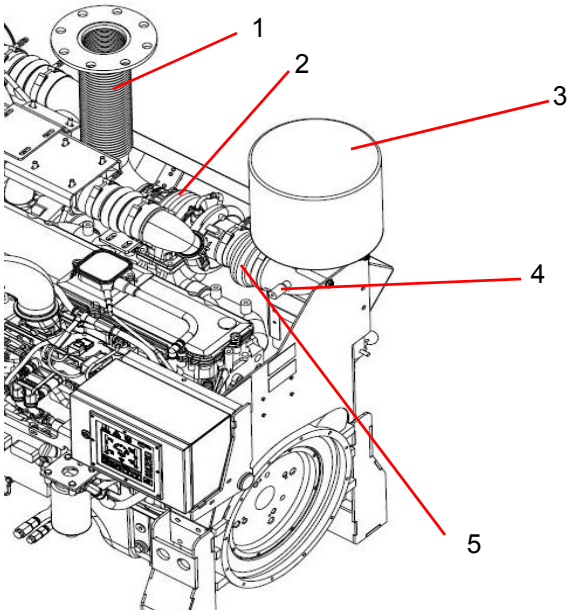
1. Inspect the electrical wiring harness, electrical terminal connections, and electrical plug-ins for secure, clean electrical contacts, worn or damaged insulation, burnt wires, broken wires, and loose connections (see Figure 2-1).
   a. Clean and tighten any loose electrical connections.
   b. Repair or replace worn, damaged, burnt, or poorly insulated wiring immediately. Refer to Section 8 - Component Parts and Assemblies.

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

2. Inspect the function of all gauges, voltmeters, switches, and warning lamps on the FPDP. Replace the FPDP if any are not functioning properly.
3. Reinstall the battery cables; attach the negative (-) battery cable last.

6.4.2 Turbocharger Mounting Nuts

As shown in Figure 6-4, check the turbocharger mounting nuts and torque the mounting nuts to the recommended torque value as specified in Section 8 - Component Parts and Assemblies.



1. Exhaust Flex Connection
2. Turbocharger
3. Air Cleaner/Filter
4. Service Indicator
5. Air Cleaner Piping

Figure 6-4 Turbocharger (typical)

6.4.3 Engine Supports

CAUTION

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

Refer to Figure 2-1 for the location of the engine supports and inspect all engine supports for cracks or loose hardware. Check the torque on the engine support mounting capscrews. Torque the engine mounting cap screws to the support bracket. Refer to the torque table in Section 8 - Component Parts and Assemblies for recommended torque values.

6.4.4 Fuel Pumps and Filters

As shown in Figure 6-5, inspect the fuel injection pump mounting nuts (including the support bracket) for loose or damaged hardware. Inspect the fuel line hoses and fuel filters for wear, damage, loose fittings, and leaks. Repair or replace damaged hoses and filters as required.

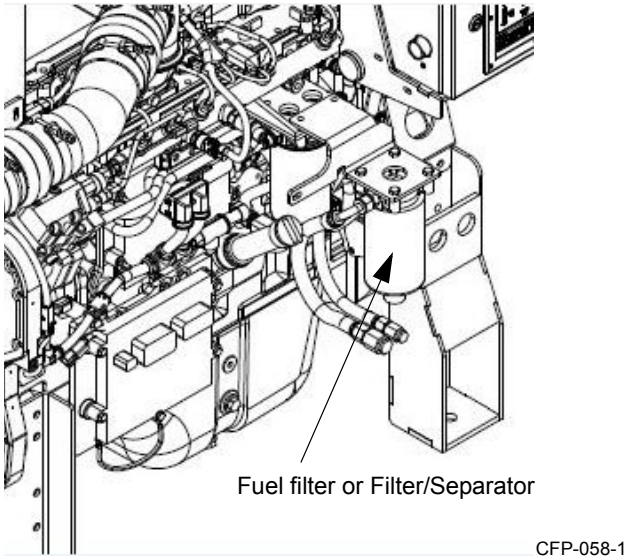


Figure 6-5 Fuel Pumps (typical)

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.

To change the fuel filters:

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 or fuel/water separator heads.

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

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

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

6. Lubricate the gasket seals with clean SAE 15W-40 lubricating oil.

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.

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

CAUTION

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

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 fifteen 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 fifteen seconds. Wait fifteen 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.*

6.4.5 Engine Oil and Filter

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.*

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

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.

To change the oil and filter to remove the contaminants suspended in the oil:

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

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

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

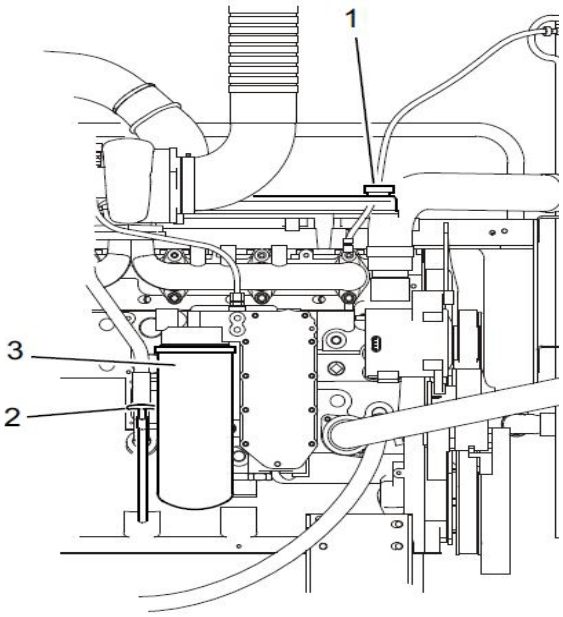
4. Remove the oil filter (see Figure 6-6) following these steps:

   a. Clean the area around the engine oil filter canister. Use a filter wrench to remove the filter.

   b. 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.

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

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



1. Oil Fill Port (on valve cover)
2. Oil Level Dipstick
3. Engine Oil Filter

Figure 6-6 Oil Filter and Oil Level Dipstick (Typical)

6. 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

7. Check and clean the oil pan drain plug threads and sealing surface. Install the oil pan drain plug. Torque the plug according to the Torque Chart in Section 8 - Component Parts and Assemblies.

8. Fill the engine to the proper level with clean, high quality 15W-40 oil at the fill port.

CAUTION

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

9. Restart the engine and let it run for approximately one to two minutes.

10. Stop the engine.

11. Wait approximately fifteen 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.

6.4.6 Drive Shaft

It is recommended that proper lubrication to drive shafts be completed on a regular schedule according to these steps:

1. Remove the drive shaft guards.

2. Wipe the grease fittings and grease gun nozzle with a clean cloth to avoid contamination.

3. Add grease to the drive shaft universal joint grease fittings (see Figure 3-2).

4. Wipe excess grease from the grease fittings.

NOTE: *Cummins Inc 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).*

6.4.7 Coolant Pump/Alternator Belt

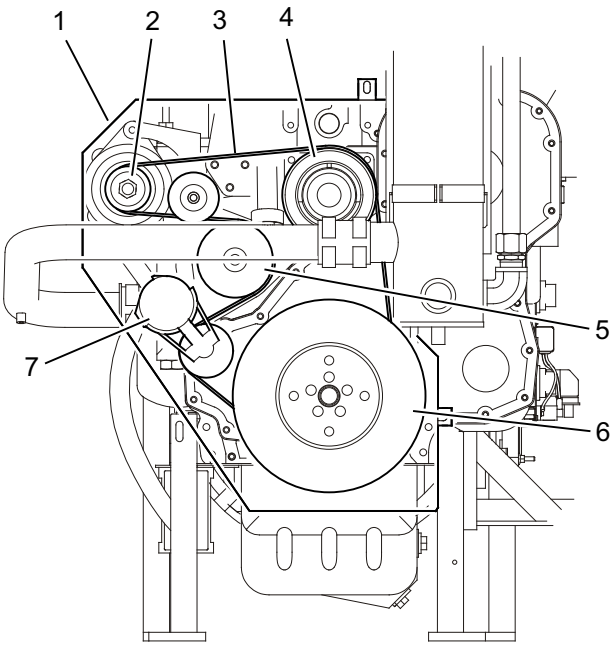
On some engine models, the pump and alternator belt drives both the pump and alternator.

To inspect the coolant pump and the alternator belt:

1. Press the AUTO/MAN button on the FPDP to place the fire pump drive engine in MANUAL operation.

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

3. Remove the belt guard capscrews and the belt guard. Set aside for re-installation (see Figure 6-7).



1. Belt Guard
2. Alternator Pulley
3. Drive Belt
4. Idler Pulley
5. Coolant Pump Pulley
6. Balancer Pulley
7. Belt Tensioner

Figure 6-7 Coolant Pump/Alternator Belt (typical)

4. Visually inspect the belt for frayed, worn, missing pieces, or cracked belt surfaces. Check the belt for intersecting cracks.

CAUTION

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

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 damaged.*

5. If the belt condition is acceptable, check the belt tension. There are two ways to check the belt condition:

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

CAUTION

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

   a. Use the Cummins belt tension gauge (Part Number 3822524) to measure the drive belt tension in the center span of the belt between the idler and alternator pulleys. Ensure that the belt tension is set to the specifications outlined in the Engine Operation Manual.

   b. Use the deflection method and measure the belt tension in the center span of the belt between the alternator and idler pulleys. If the belt deflection is more than one belt thickness per foot of pulley center-to-center distance, adjust the belt tension.

6. Reinstall the battery cables; attach the negative (-) battery cable last.

6.4.8 Raw Water Zinc Anode

The zinc anode (see Figure 6-8) acts as a raw water filter and must be checked for erosion and replaced, when necessary. If the anode has eroded more than fifty percent, it must be replaced.

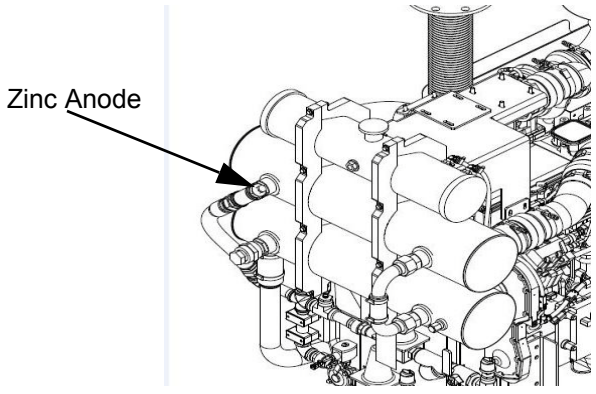


Figure 6-8 Raw Water Zinc Anode (typical)

6.4.9 Heat Exchanger

If internal leakage in the heat exchanger is suspected, a heat exchanger pressure test 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

To test the heat exchanger pressure:

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 five 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.

6.4.10 Turbocharger

As shown in Figure 6-4, follow these steps to thoroughly inspect the turbocharger:

1. Visually inspect the air intake filter and piping according to the steps outlined in Section 6.3.2.

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

NOTE: *Cummins recommends using an air cleaner filter element as listed on the Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

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. Remove the air intake and exhaust piping from the turbocharger.
3. Inspect the turbocharger turbine wheel for cracks in the housing or turbine blades, missing blades, mechanical binding, eccentric motion, or excessive end-play.
4. 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.*

5. 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 Two Years

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

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

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

6.5.2 Cooling System

Figure 6-9 illustrates the 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 the AUTO/MAN button on the FPDP to place the fire pump drive engine in MANUAL operation.

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

3. 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.

4. Disconnect the engine coolant heater power supply before draining the cooling system.

5. Place a container that will hold at least 57 liters (15 gal) of liquid under the coolant drain valve.

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

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

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

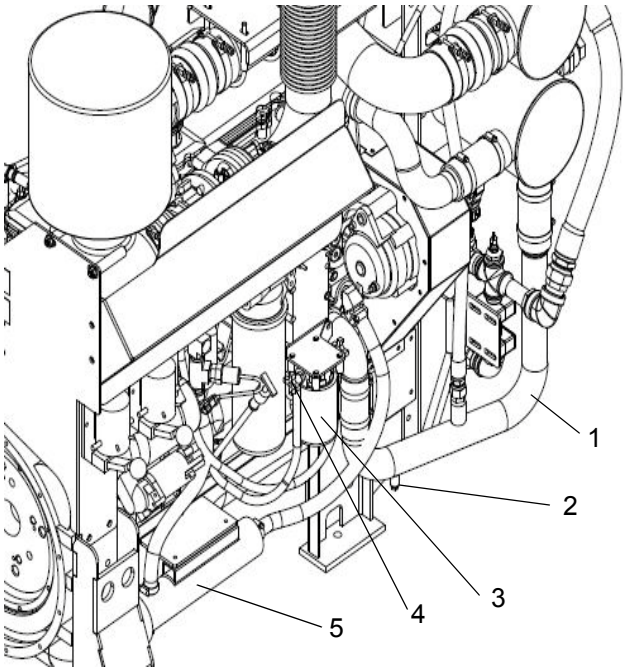
9. Disconnect either end of the engine heater coolant hose and drain the engine heater.

⚠ 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.

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

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



1. Lower Coolant Tube
2. Coolant Drain Petcock
3. Coolant Filter
4. Coolant Filter Shut-off Valve
5. Engine Coolant Heater

Figure 6-9 Engine Coolant Drain

⚠ 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 exceeded under any condition. Antifreeze protection decreases above 68%.

11. 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.

12. 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. 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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

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

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 Engine Data Sheet in Section 8 - Component Parts and Assemblies.*

14. 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.

CAUTION

Never use a sealing additive to stop leaks in the cooling system. This can result in cooling system blockage or restricted coolant flow, causing the engine to overheat.

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 Supplemental Coolant Additive (SCA) required for wet-sleeved engines in most climates. Contact your local Cummins Authorized Repair Location for additional information.*

Table 6-2.

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.

15. 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 filler cap.

    b. Re-install the expansion tank fill cap.

16. Re-install the heater wiring.

17. Reinstall the battery cables; attach the negative (-) battery cable last.

18. Operate the engine until it reaches a temperature of 82 °C (180 °F), and check for coolant leaks.

19. Ensure that the coolant level is just below the fill neck and that the coolant heater is reconnected.

6.6 Every Four Years

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

Disconnect both batteries (negative cable first) before performing service on the fire pump drive engine or on any of its controls. Wear safety glasses when disconnecting batteries!

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

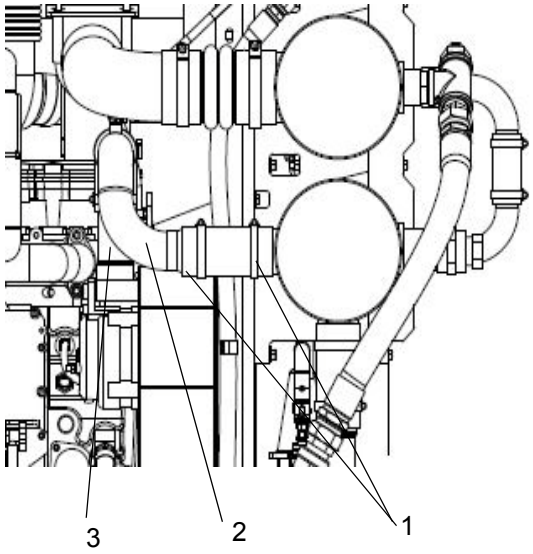
Always use the correct thermostat, and never operate the engine without a thermostat installed. The engine can overheat if operated without a thermostat because the path of least resistance for the coolant is through the bypass to the pump inlet.

1. Remove the upper coolant hose clamps and upper coolant hose at the thermostat housing.
2. Remove the (2) thermostat housing flange cap screws and the thermostat flange (see 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. If still in good condition, re-install the thermostat in the housing.

IMPORTANT: *Inspect the seal on the thermostat housing flange surface and - if damaged or cracked - apply a new seal.*

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

6. Replace the thermostat flange and cap screws.



1. Hose Clamps
2. Upper Coolant Hose
3. Thermostat Housing

Figure 6-10 Thermostat Housing (typical)

6.6.2 Coolant Pump/Alternator Belt Replacement

Referring to Figure 6-7, replace the coolant pump/alternator belt if it is cracked, frayed, or has pieces of material missing.

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 belt tensioner 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 Cleaning

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

1. Press the AUTO/MAN button on the FPDP to place the fire pump drive engine in MANUAL operation.
2. Disconnect both batteries at their terminals. Remove the negative (-) cable first.
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
6. When the tanks are empty, disconnect the inlet and outlet piping from the CAC tubing to the heat exchanger (see Figure 2-1).
7. Disconnect the cooling water inlet and outlet fittings from the charge air heat exchanger and the coolant heat exchanger.

WARNING

Do not use caustic cleaners to clean the CAC as these types of cleaners cause damage to the CAC. Follow the directions provided by the cleaning solution manufacturer.

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.

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 CAC internally with cleaning solution in the opposite direction of normal air flow.
11. Shake the CAC 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 CAC has been thoroughly cleaned of all oil and debris with solvent, wash the CAC internally with hot, soapy water to remove the remaining solvent.

13. Rinse thoroughly with clean water.

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

15. Depending on the condition of the heat exchanger, perform the pressure test outlined in Section 6.4.10.

16. Reassemble the coolant heat exchangers, coolant tubing, clamps, and cooling water lines per the instructions outlined in Section 6.5.2.

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

18. Position the heat exchanger assembly on the engine's mounting bracket and hand-tighten the mounting bolts (see Figure 2-1 and Figure 2-2).

19. Align the cooling loop assembly with the required hose connections and hand 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 - Component Parts and Assemblies.

21. When the heat exchanger cooling assembly is secured, re-tighten the mounting bracket fasteners, hose clamps, and cooling water lines according to the Torque Chart in Section 8 - Component Parts and Assemblies.

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

23. Reinstall the battery cables; attach the negative (-) battery cable last.

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

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Section 7 - Troubleshooting

7.1 Introduction

The following information is intended as a guide for some common non-technical equipment problems. The first part of this section includes troubleshooting charts that cross-reference the problem, the possible cause, and the solution. The second section includes complete Fault Code charts outlining a numerical listing of fault codes and their descriptions.

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 engine 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.

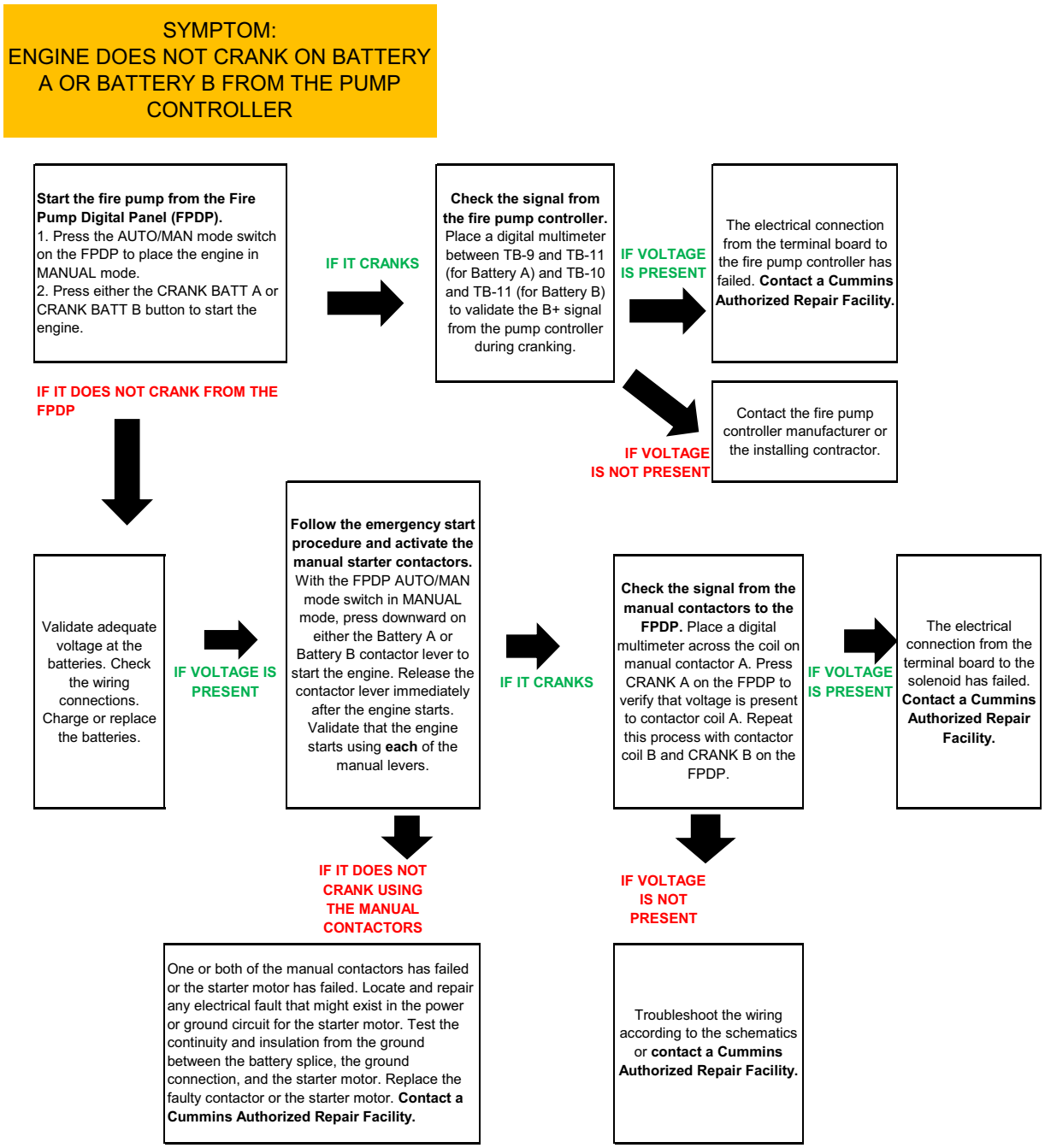
CAUTION

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

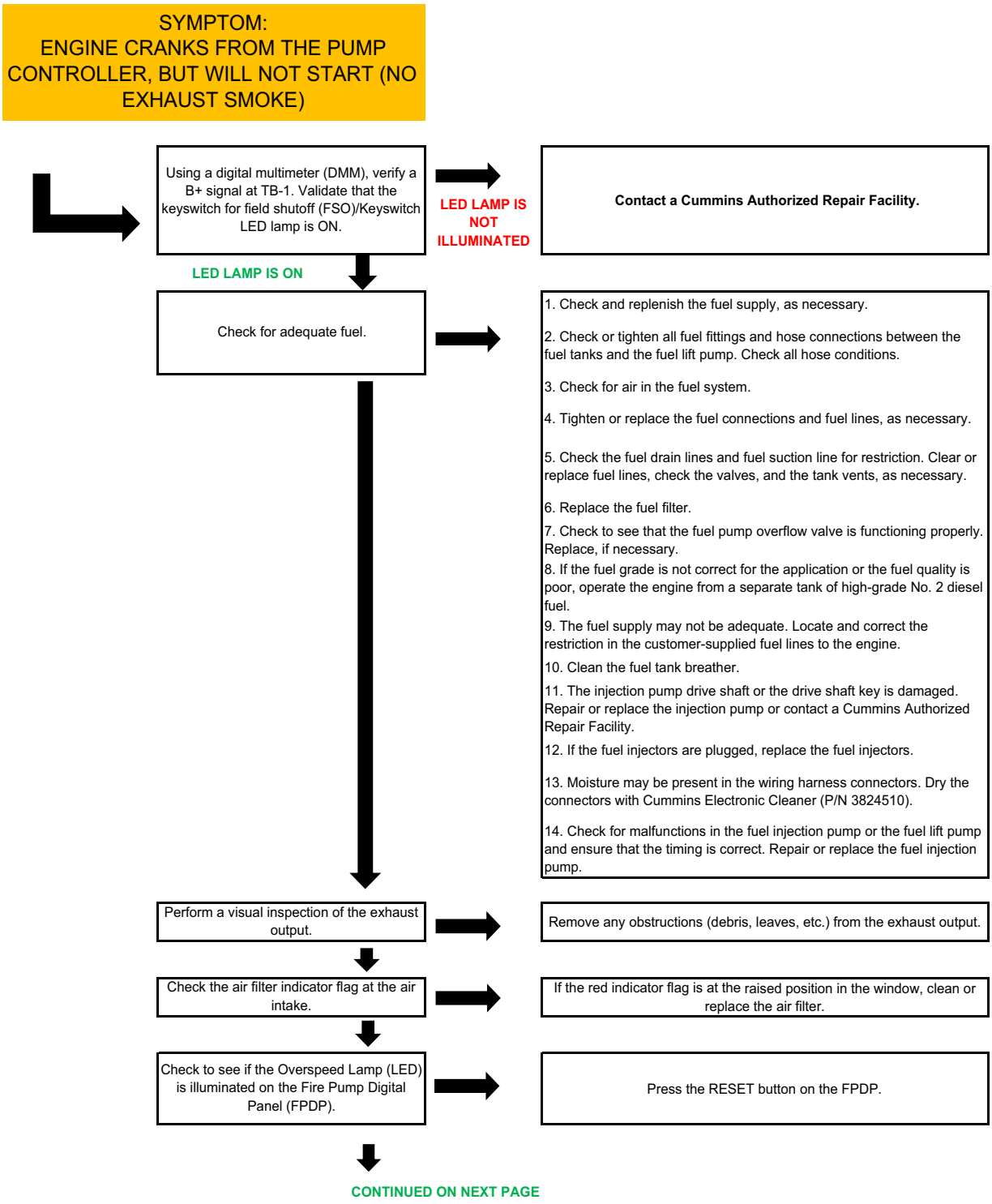
CAUTION

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

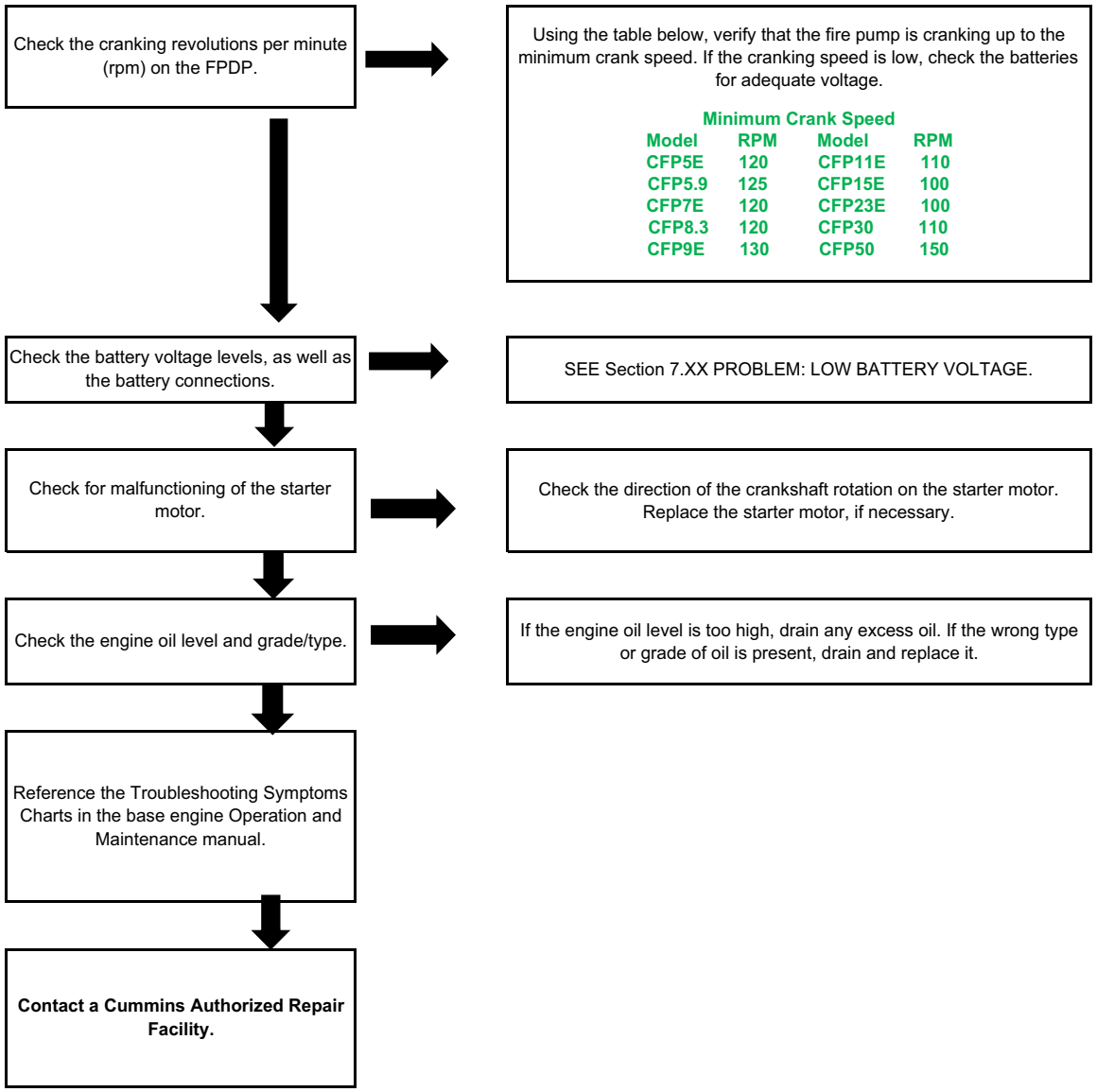
7.2 Engine Will Not Start



7.3 Engine Cranks But Will Not Start



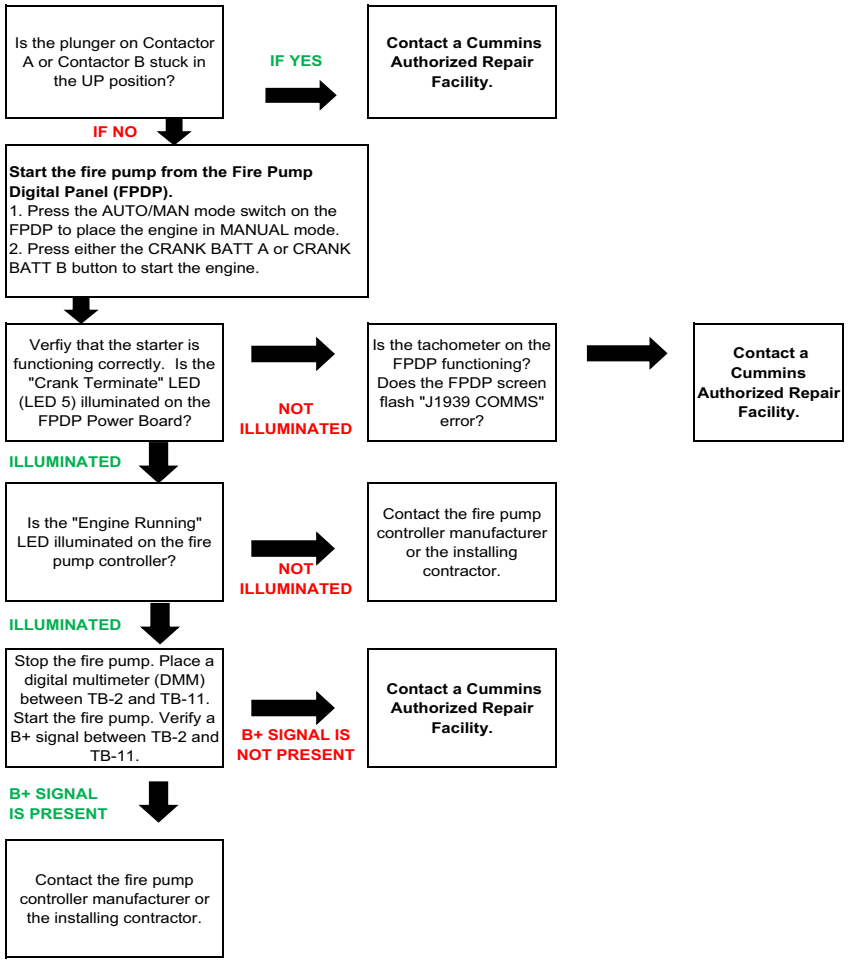
Engine Cranks But Will Not Start (continued)



7.4 Engine Starts But Continues to Crank

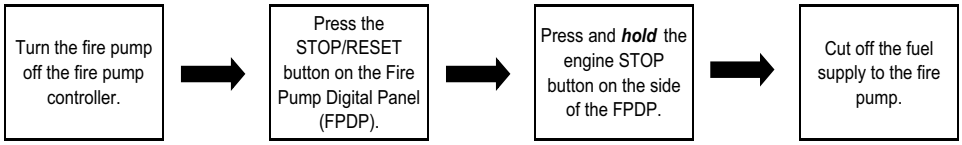
STOP THE ENGINE AT THE FIRE PUMP CONTROLLER (PLACE THE CONTROLLER IN THE OFF POSITION) AND TROUBLESHOOT FROM THE FIRE PUMP DRIVE ENGINE:

PRIOR TO MAKING A SERVICE CALL, PERFORM A VISUAL INSPECTION:

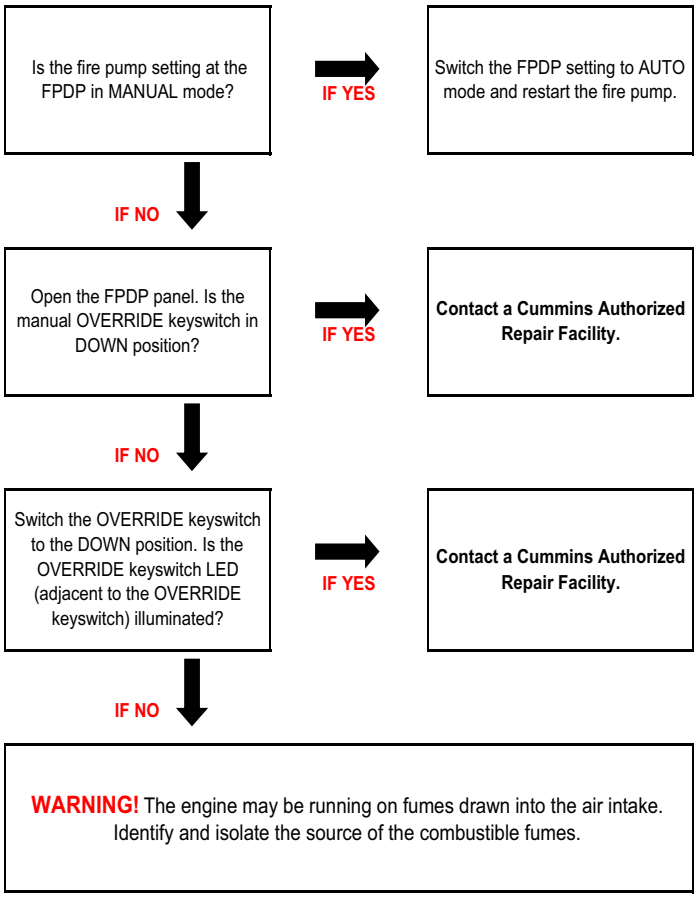


7.5 Engine Will Not Stop

TO STOP THE ENGINE:

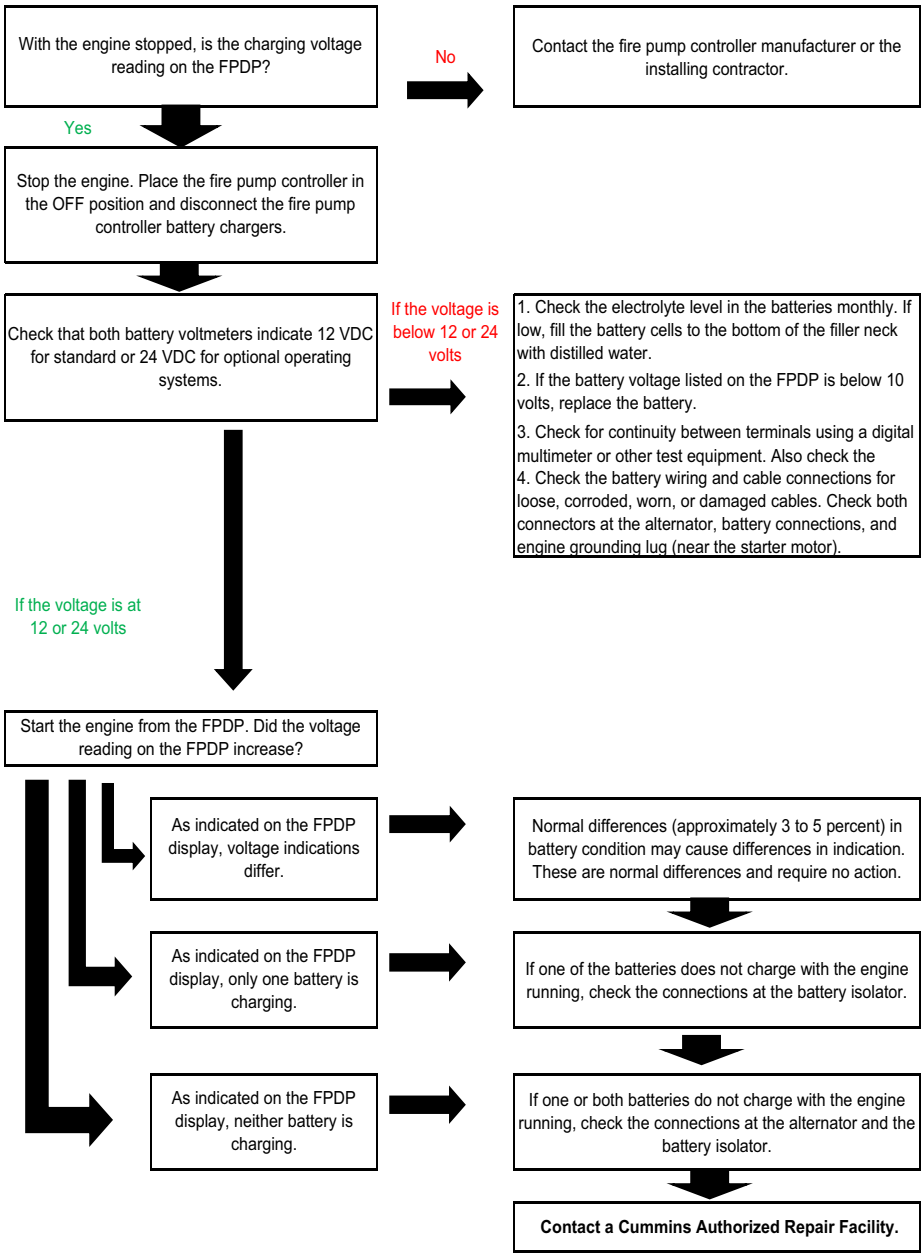


TO TROUBLESHOOT THIS PROBLEM, ONCE THE FIRE PUMP HAS STOPPED:



7.6 Low Battery Voltage

SYMPTOM: The Fire Pump Digital Panel (FPDP) will mometarily "blink" upon starting or the fire pump drive engine is slow to crank. There is a high probability that the engine will not start.



7.7 Fault Code Chart

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
111 (Red)	629 12	Controller #1	Engine Control Module Critical Internal Failure - Bad Intelligent Device or Component
115 (Red)	612 2	System Diagnostic Code #2	Engine Speed/Position Sensor Circuit - Lost Both of Two Signals from the Magnetic Pickup Sensor - Data Erratic, Intermittent, or Incorrect
122 (Yellow)	102 3	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
123 (Yellow)	102 4	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
124 (Yellow)	102 16	Boost Pressure	Intake Manifold 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
131 (Red)	91 3	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Above Normal or Shorted to High Source
132 (Red)	91 4	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal or Shorted to Low Source
133 (Red)	974 3	Remote Accelerator	Remote Accelerator Pedal or Level Position Sensor Circuit - Voltage Above Normal or Shorted to High Source
134 (Red)	974 4	Remote Accelerator	Remote Accelerator Pedal or Level Position Sensor Circuit - Voltage Below Normal or Shorted to Low Source
135 (Yellow)	100 3	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
141 (Yellow)	100 4	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
143 (Yellow)	100 18	Engine Oil Pressure	Oil Pressure Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
144 (Yellow)	110 3	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
145 (Yellow)	110 4	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
146 (Yellow)	110 16	Engine Coolant Temperature	Coolant Temperature High - Data Valid but Above Normal Operational Range - Moderately Severe Level
147 (Red)	91 1	Accelerator Pedal Position	Accelerator Pedal or Level Position Sensor Circuit - Abnormal Frequency, Pulse Width, or Period
148 (Red)	91 0	Accelerator Pedal Position	Accelerator Pedal or Level Position Sensor Circuit - Abnormal Frequency, Pulse Width, or Period
151 (Red)	110 0	Engine Coolant Temperature	Coolant Temperature Low - Data Valid but Above Normal Operational Range - Most Severe Level
153 (Yellow)	105 3	Intake Manifold #1 Temperature	Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
154 (Yellow)	105 4	Intake Manifold #1 Temperature	Intake Manifold Air Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
155 (Red)	105 0	Intake Manifold #1 Temperature	Intake Manifold Air Temperature High - Data Valid but Above Normal Operational Range - Most Severe Level
187 (Yellow)	3510 4	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit - Voltage Below Normal or Shorted to Low Source

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
195 (Yellow)	111 3	Coolant Level	Coolant Level Sensor Circuit - Voltage Above Normal or Shorted to High Source
196 (Yellow)	111 4	Coolant Level	Coolant Level Sensor Circuit - Voltage Below Normal or Shorted to Low Source
197 (Yellow)	111 18	Coolant Level	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level
199 (Yellow)	1661 4	Engine Automatic Start Lamp	Engine Automatic Start Lamp Driver Circuit - Voltage Above Normal or Shorted to High Source
211 (None)	1484 31	J1939 Error	Additional Auxiliary Diagnostic Codes Logged - Condition Exists
212 (Yellow)	175 3	Oil Temperature	Engine Oil Temperature Sensor #1 Circuit - Voltage Above Normal or Shorted to High Source
213 (Yellow)	175 4	Oil Temperature	Engine Oil Temperature Sensor #1 Circuit - Voltage Below Normal or Shorted to Low Source
214 (Red)	175 0	Oil Temperature	Engine Oil Temperature - Data Valid but Above Normal Operational Range - Most Severe Level
221 (Yellow)	108 3	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
222 (Yellow)	108 4	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
227 (Yellow)	3510 3	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit - Voltage Above Normal or Shorted to High Source
231 (Yellow)	109 3	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
232 (Yellow)	109 4	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
233 (Yellow)	109 18	Coolant Pressure	Coolant Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
234 (Red)	190 0	Engine Speed	Engine Speed High - Data Valid but Above Normal Operational Range - Most Severe Level
235 (Red)	111 1	Coolant Level	Coolant Level Low - Data Valid but Below Normal Operational Range - Most Severe Level
237 (Yellow)	644 2	External Speed Input	External Speed Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect
238 (Yellow)	3511 4	System Diagnostic Code #1	Sensor Supply Voltage #3 Circuit - Voltage Below Normal or Shorted to Low Source
239 (Yellow)	3511 3	System Diagnostic Code #2	Sensor Supply Voltage #3 Circuit - Voltage Above Normal or Shorted to High Source
241 (Yellow)	84 2	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit - Data Erratic, Intermittent, or Incorrect
242 (Yellow)	84 10	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit - Tampering has been Detected - Abnormal Rate of Change
244 (Yellow)	623 4	Red Stop Lamp	Red Stop Lamp Driver Circuit - Voltage Below Normal, or Shorted to Low Source
245 (Yellow)	647 4	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Below Normal or Shorted to Low Source
249 (Yellow)	171 3	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
256 (Yellow)	171 4	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
261 (Yellow)	174 16	Fuel Temperature	Engine Fuel Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
263 (Yellow)	174 3	Fuel Temperature	Engine Fuel Temperature Sensor #1 Circuit - Voltage Above Normal or Shorted to High Source
265 (Yellow)	174 4	Fuel Temperature	Engine Fuel Temperature Sensor #1 Circuit - Voltage Below Normal or Shorted to Low Source
268 (Yellow)	94 2	Fuel Delivery Pressure	Fuel Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
271 (Yellow)	1347 4	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal or Shorted to Low Source
272 (Yellow)	1347 3	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal or Shorted to High Source
281 (Yellow)	1347 7	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve #1 - Mechanical System Not Responding Properly or Out of Adjustment
284 (Yellow)	1043 4	Internal Sensor Voltage Supply	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal or Shorted to Low Source
285 (Yellow)	639 9	SAE J1939 Datalink	SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate
286 (Yellow)	639 13	SAE J1939 Datalink	SAE J1939 Multiplexing Configuration Error - Out of Calibration
287 (Red)	91 19	Accelerator Pedal Position	SAE J1939 Multiplexing Accelerator Pedal or Level Sensor System Error - Received Network Data in Error
288 (Red)	974 19	Remote Accelerator	SAE J1939 Multiplexing Remote Accelerator Pedal or Level Data Error - Received Network Data in Error
292 (Red)	441 14	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input #1 - Special Instructions
293 (Yellow)	441 3	OEM Temperature	Auxiliary Temperature Sensor Input #1 Circuit - Voltage Above Normal or Shorted to High Source
294 (Yellow)	441 4	OEM Temperature	Auxiliary Temperature Sensor Input #1 Circuit - Voltage Below Normal or Shorted to Low Source
295 (Yellow)	108 2	Barometric Pressure	Barometric Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
296 (Red)	1388 14	Auxiliary Pressure	Auxiliary Pressure Sensor Input #1 - Special Instructions
297 (Yellow)	1388 3	Auxiliary Pressure	Auxiliary Pressure Sensor Input #2 Circuit - Voltage Above Normal or Shorted to High Source
298 (Yellow)	1388 4	Auxiliary Pressure	Auxiliary Pressure Sensor Input #2 Circuit - Voltage Below Normal or Shorted to Low Source
319 Maint.	251 2	Real Time Clock Power	Real Time Clock Power Interrupt - Data Erratic, Intermittent, or Incorrect
322 (Yellow)	651 5	Injector Cylinder #1	Injector Solenoid Cylinder #1 Circuit - Current Below Normal or Open Circuit
323 (Yellow)	655 5	Injector Cylinder #5	Injector Solenoid Cylinder #5 Circuit - Current Below Normal or Open Circuit
324 (Yellow)	653 5	Injector Cylinder #3	Injector Solenoid Cylinder #3 Circuit - Current Below Normal or Open Circuit

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
325 (Yellow)	656 5	Injector Cylinder #6	Injector Solenoid Cylinder #6 Circuit - Current Below Normal or Open Circuit
331 (Yellow)	652 5	Injector Cylinder #2	Injector Solenoid Cylinder #2 Circuit - Current Below Normal or Open Circuit
332 (Yellow)	654 5	Injector Cylinder #4	Injector Solenoid Cylinder #4 Circuit - Current Below Normal or Open Circuit
334 (Yellow)	110 2	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Data Erratic, Intermittent, or Incorrect
338 (Yellow)	1267 3	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Above Normal or Shorted to High Source
339 (Yellow)	1267 4	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Below Normal or Shorted to Low Source
341 (Yellow)	630 2	Calibration Memory	Engine Control Module Data Lost - Data Erratic, Intermittent, or Incorrect
342 (Red)	630 13	Calibration Memory	Electronic Calibration Code Incompatibility - Out of Calibration
343 (Yellow)	629 12	Controller #1	Engine Control Module Warning Internal Hardware Failure - Bad Intelligent Device or Component
349 (Yellow)	191 16	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Above Normal Operational Range - Moderately Severe Level
351 (Yellow)	627 12	Controller #1	Injector Power Supply - Bad Intelligent Device or Component
352 (Yellow)	3509 4	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Below Normal or Shorted to Low Source
386 (Yellow)	3509 3	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Above Normal or Shorted to High Source
415 (Red)	100 1	Engine Oil Pressure	Oil Pressure Low - Data Valid but Below Normal Operational Range - Most Severe Level
418 Maint.	97 15	Water in Fuel Indicator	Water in Fuel Indicator High - Data Valid but Above Normal Operational Range - Least Severe Level
422 (Yellow)	111 2	Coolant Level	Coolant Level - Data Erratic, Intermittent, or Incorrect
425 (Yellow)	175 2	Oil Temperature	Engine Oil Temperature - Data Erratic, Intermittent, or Incorrect
428 (Yellow)	97 3	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Above Normal or Shorted to High Source
429 (Yellow)	97 4	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Below Normal or Shorted to Low Source
431 (Yellow)	558 2	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect
432 (Red)	558 13	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration
435 (Yellow)	100 2	Engine Oil Pressure	Oil Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
441 (Yellow)	168 18	Electrical Potential (Voltage)	Battery #1 Voltage Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
442 (Yellow)	168 16	Electrical Potential (Voltage)	Battery #1 Voltage High - Data Valid but Above Normal Operational Range - Moderately Severe Level

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
449 (Red)	157 0	Injector Metering Rail #1 Pressure	Fuel Pressure High - Data Valid but Above Normal Operational Range - Moderately Severe Level
451 (Yellow)	157 3	Injector Metering Rail #1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
452 (Yellow)	157 4	Injector Metering Rail #1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
488 (Yellow)	105 16	Intake Manifold	Intake Manifold #1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
489 (Yellow)	191 18	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Below Normal Operational Range - Moderately Severe Level
497 (Yellow)	1377 2	Switch Circuit	Multiple Unit Synchronization Switch Circuit - Data Erratic, Intermittent, or Incorrect
523 (Yellow)	611 2	System Diagnostic Code #1	OEM Intermediate (PTO) Speed Switch Validation - Data Erratic, Intermittent, or Incorrect
527 (Yellow)	702 3	Circuit - Voltage	Auxiliary Input/Output #2 Circuit - Voltage Above Normal, or Shorted to High Source
528 (Yellow)	93 2	Switch - Data	Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect
529 (Yellow)	703 3	Circuit - Voltage	Auxiliary Input/Output #3 Circuit - Voltage Above Normal or Shorted to High Source
546 (Yellow)	94 3	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
547 (Yellow)	94 4	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
551 (Yellow)	558 4	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source
553 (Yellow)	157 16	Injector Metering Rail #1 Pressure	Injector Metering Rail #1 Pressure High - Data Valid but Above Normal Operational Range - Moderately Severe Level
554 (Yellow)	157 2	Injector Metering Rail #1 Pressure	Fuel Pressure Sensor Error - Data Erratic, Intermittent, or Incorrect
559 (Yellow)	157 18	Injector Metering Rail #1 Pressure	Injector Metering Rail #1 Pressure High - Data Valid but Below Normal Operational Range - Moderately Severe Level
584 (Yellow)	677 3	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Above Normal or Shorted to High Source
585 (Yellow)	677 4	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Below Normal or Shorted to Low Source
595 (Yellow)	103 16	Turbocharger #1 Speed	Turbocharger #1 Speed High - Data Valid but Above Normal Operational Range - Moderately Severe Level
596 (Yellow)	167 16	Alternate Potential (voltage)	Electrical Charging System Voltage High - Data Valid but Above Normal Operational Range - Moderately Severe Level
597 (Yellow)	167 18	Alternate Potential (voltage)	Electrical Charging System Voltage High - Data Valid but Below Normal Operational Range - Moderately Severe Level
598 (Red)	167 1	Alternate Potential (voltage)	Electrical Charging System Voltage High - Data Valid but Below Normal Operational Range - Most Severe Level
599 (Red)	640 14	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown - Special Instructions
649 Maint.	1378 31	Engine Oil Change Interval	Change Lubricating Oil and Filter - Condition Exists
687 (Yellow)	103 18	Turbocharger #1 Speed	Turbocharger #1 Speed Low - Data Valid but Below Normal Operational Range - Moderately Severe Level

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
689 (Yellow)	190 2	Engine Speed	Primary Engine Speed Sensor Error - Data Erratic, Intermittent, or Incorrect
691 (Yellow)	1172 3	Turbocharger #1 Compressor Inlet Temp	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
692 (Yellow)	1172 4	Turbocharger #1 Compressor Inlet Temp	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
697 (Yellow)	1136 3	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
698 (Yellow)	1136 4	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
719 (Yellow)	22 3	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Above Normal or Shorted to High Source
729 (Yellow)	22 4	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Below Normal or Shorted to Low Source
731 (Yellow)	723 7	Engine Speed Sensor #2	Engine Speed/Position #2 Mechanical Misalignment Between Camshaft and Crankshaft Sensors - Mechanical System not Responding Properly or Out of Adjustment
757 (Yellow)	2802 31	Electronic Control Module	Electronic Control Module Data Lost - Condition Exists
778 (Yellow)	723 2	Engine Speed Sensor #2	Engine Speed Sensor (Camshaft) Error - Data Erratic, Intermittent, or Incorrect
779 (Yellow)	703 11	Auxiliary Equipment Sensor Input	Warning Auxiliary Equipment Sensor Input #3 (OEM Switch) - Root Cause Not Known
951 (None)	166 2	Cylinder Power	Cylinder Power Imbalance Between Cylinders - Data Erratic, Intermittent, or Incorrect
1117 (None)	627 2	Power Supply	Power Lost with Ignition On - Data Erratic, Intermittent, or Incorrect
1139 (Yellow)	651 7	Injector Cylinder #1	Injector Cylinder #1 - Mechanical System Not Responding Properly or Out of Adjustment
1141 (Yellow)	652 7	Injector Cylinder #2	Injector Cylinder #2 - Mechanical System Not Responding Properly or Out of Adjustment
1142 (Yellow)	653 7	Injector Cylinder #3	Injector Cylinder #3 - Mechanical System Not Responding Properly or Out of Adjustment
1143 (Yellow)	654 7	Injector Cylinder #4	Injector Cylinder #4 - Mechanical System Not Responding Properly or Out of Adjustment
1144 (Yellow)	655 7	Injector Cylinder #5	Injector Cylinder #5 - Mechanical System Not Responding Properly or Out of Adjustment
1145 (Yellow)	656 7	Injector Cylinder #6	Injector Cylinder #6 - Mechanical System Not Responding Properly or Out of Adjustment
1239 (Yellow)	2623 3	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor #2 Circuit - Voltage Above Normal or Shorted to High Source
1241 (Yellow)	2623 4	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor #2 Circuit - Voltage Below Normal or Shorted to Low Source
1242 (Red)	91 2	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor #1 and #2 - Data Erratic, Intermittent, or Incorrect
1256 (Yellow)	1563 2	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1257 (Red)	1563 2	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1852 (Yellow)	97 16	Water in Fuel Indicator	Water in Fuel Indicator - Data Valid but Above Normal Operational Range - Moderately Severe Level

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
1911 (Yellow)	157 0	Injector Metering Rail	Injector Metering Rail #1 Pressure - Data Valid but Above Normal Operational Range - Most Severe Level
2111 (Yellow)	52 3	Coolant Temperature	Coolant Temperature #2 Sensor Circuit - Voltage Above Normal or Shorted to High Source
2112 (Yellow)	52 4	Coolant Temperature	Coolant Temperature #2 Sensor Circuit - Voltage Below Normal or Shorted to Low Source
2113 (Yellow)	52 16	Coolant Temperature	Coolant Temperature #2 - Data Valid but Above Normal Operational Range - Moderately Severe Level
2114 (Red)	52 0	Coolant Temperature	Coolant Temperature #2 - Data Valid but Above Normal Operational Range - Most Severe Level
2115 (Yellow)	2981 3	Coolant Pressure	Coolant Pressure #2 Circuit - Voltage Above Normal or Shorted to High Source
2116 (Yellow)	2981 4	Coolant Pressure	Coolant Pressure #2 Circuit - Voltage Below Normal or Shorted to Low Source
2117 (Yellow)	2981 18	Coolant Pressure	Coolant Pressure #2 - Data Valid but Below Normal Operational Range - Moderately Severe Level
2182 (Yellow)	1072 3	Engine Brake Output #1	Engine Brake Actuator Driver #1 Circuit - Voltage Above Normal or Shorted to High Source
2183 (Yellow)	1072 4	Engine Brake Output #1	Engine Brake Actuator Driver #1 Circuit - Voltage Below Normal or Shorted to Low Source
2185 (Yellow)	3512 3	System Diagnostic Code #1	Sensor Supply Voltage #4 Circuit - Voltage Above Normal or Shorted to High Source
2186 (Yellow)	3512 4	System Diagnostic Code #1	Sensor Supply Voltage #4 Circuit - Voltage Below Normal or Shorted to Low Source
2195 (Yellow)	703 14	Auxiliary Equipment Sensor	Auxiliary Equipment Sensor Input #3 Engine Protection Critical - Special Instructions
2215 (Yellow)	94 18	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
2216 (Yellow)	94 1	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2217 (Yellow)	630 31	Calibration Memory	ECM Program Memory (RAM) Corruption - Condition Exists
2249 (Yellow)	157 1	Injector Metering Rail #1 Pressure	Injector Metering Rail #1 Pressure - Data Valid but Below Normal Operational Range - Most Severe Level
2261 Maint.	94 15	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Least Severe Level
2262 Maint.	94 17	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Least Severe Level
2263 (Yellow)	1800 16	Battery Temperature	Battery Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
2264 (Yellow)	1800 18	Battery Temperature	Battery Temperature - Data Valid but Below Normal Operational Range - Moderately Severe Level
2265 (Yellow)	1075 3	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit - Voltage Above Normal or Shorted to High Source
2266 (Yellow)	1075 4	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit - Voltage Below Normal or Shorted to Low Source
2292 (Yellow)	611 16	Fuel Inlet Meter Device	Fuel Inlet Meter Device - Data Valid but Above Normal Operational Range - Moderately Severe Level
2293 (Yellow)	611 18	Fuel Inlet Meter Device	Fuel Inlet Meter Device Flow Demand Lower Than Expected - Data Valid but Below Normal Operational Range - Moderately Severe Level

Fault Code Chart (Continued)

FAULT CODE (LAMP)	SPN FMI	J1939 SPN DESCRIPTION	Cummins DESCRIPTION
2311 (Yellow)	633 31	Fuel Control Valve #1	Fueling Actuator #1 Circuit Error - Condition Exists
2321 (None)	190 2	Engine Speed	Engine Speed/Position Sensor #1 - Data Erratic, Intermittent, or Incorrect
2322 (None)	723 2	Engine Speed Sensor #2	Engine Speed/Position Sensor #2 - Data Erratic, Intermittent, or Incorrect
2345 (Yellow)	103 10	Turbocharger #1 Speed	Turbocharger Speed Invalid Rate of Change Detected - Abnormal Rate of Change
2346 (None)	2789 15	System Diagnostic Code #1	Turbocharger Turbine Inlet Temperature (calculated) - Data Valid but Above Normal Operational Range - Least Severe Level
2347 (None)	2790 15	System Diagnostic Code #1	Turbocharger Turbine Outlet Temperature (calculated) - Data Valid but Above Normal Operational Range - Least Severe Level
2363 (Yellow)	1073 4	Engine Compression Brake Output #2	Engine Brake Actuator Circuit #2 - Voltage Below Normal, or Shorted to Low Source
2365 (Yellow)	1112 4	Engine Brake Output #3	Engine Brake Actuator Driver Output #3 Circuit - Voltage Below Normal or Shorted to Low Source
2367 (Yellow)	1073 3	Engine Compression Brake Output #2	Engine Brake Actuator Circuit #2 - Voltage Above Normal or Shorted to High Source
2368 (Yellow)	1112 3	Engine Brake Output #3	Engine Brake Actuator Driver Output #3 Circuit - Voltage Above Normal or Shorted to High Source
2372 (Yellow)	95 16	Engine Duel Filter Differential Pressure	Fuel Filter Differential Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2373 (Yellow)	1209 3	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Above Normal or Shorted to High Source
2374 (Yellow)	1209 4	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source
2375 (Yellow)	412 3	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Above Normal or Shorted to High Source
2376 (Yellow)	412 4	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Below Normal or Shorted to Low Source
2377 (Yellow)	647 3	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Above Normal or Shorted to High Source
2425 (None)	730 4	Intake Air Heater #2	Intake Air Heater #2 Circuit - Voltage Below Normal or Shorted to Low Source
2426 (None)	730 3	Intake Air Heater #2	Intake Air Heater #2 Circuit - Voltage Above Normal or Shorted to High Source
2555 (Yellow)	729 3	Intake Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Above Normal or Shorted to High Source
2556 (Yellow)	729 4	Intake Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Below Normal or Shorted to Low Source
2557 (Yellow)	697 3	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Above Normal or Shorted to High Source
2558 (Yellow)	697 4	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Below Normal or Shorted to Low Source
2963 (None)	110 15	Engine Coolant Temperature	Engine Coolant Temperature High - Data Valid but Above Normal Operational Range - Lease Severe Level
2973 (Yellow)	102 2	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect

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Section 8 - Component Parts and Assemblies

8.1 Ordering Parts

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.

- Model and serial number.
- Part description by name or number.
- Quantity required.
- 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 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 cannot 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 Spare Parts 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 a Cummins Authorized Repair Location for additional information.

Engine Data Sheet

Cummins Fire Power	**Engine Data Sheet** **Cummins Fire Power** De Pere, WI 54115 http://www.cumminsfirepower.com	Basic Engine Model **CFP9E-F65, F75, F85** Curve Number: **FR - 95175** CPL Code: **3001**
Configuration Number: **D563007GX03** Installation Drawing: **26729**		Engine Family: **G-Drive** Revision Date: **May 2016**

General Engine Data

Type	4 Cycle; In-Line; 6 Cylinder	
Aspiration	Turbocharged, Chrg Air Cooled	
Bore & Stroke - in. (mm)	4.49 x 5.69	(114 x 145)
Displacement - in.^{3} (litre)	543	(8.9)
Compression Ratio	16.1:1	
Valves per Cylinder - Intake	2	
Valves per Cylinder - Exhaust	2	
Maximum Allowable Bending Moment @ Rear Face of Block - lb.-ft. (N-m)	1000	(1356)

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)	18	(457)
Recommended Air Cleaner Element - (Standard)……FLG Industrial	AH1101	
Recommended Air Cleaner Element - (Optional) Heavy Duty	AH19074	

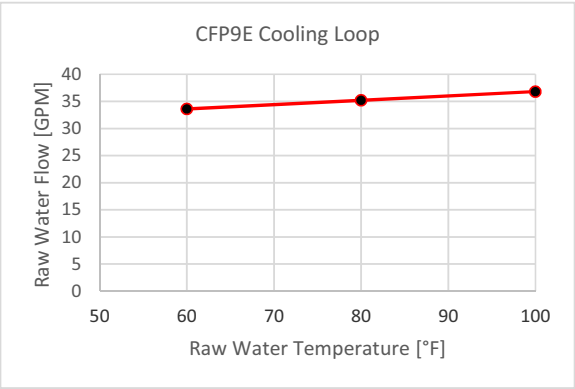
Lubrication System

Oil Pressure Range at Rated - PSI (kPa)	40-60	(276-414)
Oil Capacity of Pan (High - Low) - U.S. quarts (litre)	25-21	(24-20)
Total System Capacity - U.S. Gal. (litre)	7.0	(26.5)
Recommended Lube Oil Filter (Fleetguard)	LF9093	

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	(25.40)
Recommended Min. Water Disch. Pipe Size From Heat Exchanger - in. (mm)	1.25	(31.75)
Coolant Water Capacity (Engine Side) - U.S. gal. (litre)	2.9	(11.0)
Standard Thermostat - Type	Modulating	
Standard Thermostat - Range - deg F (deg C)	180-199	(82-93)
Minimum Raw Water Flow		
with Water Temperatures to 60 °F (16 °C) - U.S. GPM (litre/s)	28.5	(1.80)
with Water Temperatures to 80 °F (27 °C) - U.S. GPM (litre/s)	30.3	(1.91)
with Water Temperatures to 100 °F (38 °C) - U.S. GPM (litre/s)	32	(2.02)
Recommended Cooling Water Filter (Fleetguard)	WF9123	

A jacket water heater is mandatory on this engine. The recommended heater wattage is 2250 down to 40 °F (4 °C).



Engine Data Sheet (Continued)

Exhaust System

Max. Back Pressure Imposed by Complete Exhaust System inches H_2O (kPa)	30	(7.5)
Exhaust Pipe Size Normally Acceptable - in. (mm)	5.0	(127)

Noise Emissions

Top	119.5 dBa
Right Side	119.5 dBa
Left Side	119.5 dBa
Front	119.5 dBa
Exhaust	119.5 dBa

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

Fuel Supply / Drain System

Fuel Consumption	**1760**	
CFP9E-F85 Gal/hr (L/hr)	23.5	(89.1)
CFP9E-F75 Gal/hr (L/hr)	23.0	(87.2)
CFP9E-F65 Gal/hr (L/hr)	21.8	(82.6)

Fuel Type		Number 2 Diesel Only	
Minimum Supply Line Size - in. (mm)		0.5	(12.70)
Minimum Drain Line Size - in. (mm)		0.375	(9.53)
Maximum Fuel Height above C/L Fuel Pump in. (m)		227	(5.7)
Recommended Fuel Filter	- Primary ....Fleetguard (Cummins)	FF5580	
	- Secondary	FS1212	(3976312)
Maximum Restriction @ Lift Pump-Inlet - With Clean Filter - in. Hg (mm Hg)		6.0	(152)
Maximum Restriction @ Lift Pump-Inlet - With Dirty Filter - in. Hg (mm Hg)		10.0	(254)
Maximum Return Line Restriction - Without Check Valves - in. Hg (mm Hg)		10	(254)
Minimum Fuel Tank Vent Capability - ft^3/hr (m^3/hr)		7	(0.21)
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)	1800	750
Engine Only - Reserve Capacity - Minutes	430	430
Battery Cable Size (Maximum Cable Length Not to Exceed 5 ft. [1.5 m] AWG)	0	00
Maximum Resistance of Starting Circuit - Ohms	0.001	0.002
Typical Cranking Speed - RPM	130	130
Alternator (Standard), Internally Regulated - Ampere	95	45
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 ISO STD ISO-3046 conditions of 361 ft. (110 m) altitude, 29.53 in. (750 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)	3200	(974.4)
Correction Factor per 1000 ft. (305 m) above Altitude Limit	7%	
Temperature Above Which Output Should be Limited - °F (°C)	77	(25)
Correction Factor per 10 °F (11 °C) Above Temperature Limit	12	

Exhaust Emissions (EPA Tier T3) [Reference Emissions Data Doc. 9814]

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

Engine Data Sheet (Continued)

FM-approved and UL-listed Ratings for CFP9E-F65, F75, F85

Engine Speed - RPM	1760
CFP9E-F65 Output - BHP (kW)	**380 (283)**
Ventilation Air CFM (litre/sec)	832 (393)
Exhaust Flow - CFM (litre/sec)	2170 (1,024)
Exhaust Temp.- °F (°C)	977 (525)
Heat Rejection	
To Coolant BTU/min. (kW)	7657 (135)
To Ambient BTU/min (kW)	1884 (33)
CFP9E-F75 Output - BHP (kW)	**401 (299)**
Ventilation Air CFM (litre/sec)	878 (414)
Exhaust Flow - CFM (litre/sec)	2290 (1,081)
Exhaust Temp.- °F (°C)	977 (525)
Heat Rejection	
To Coolant BTU/min. (kW)	8081 (142)
To Ambient BTU/min (kW)	1988 (35)
CFP9E-F85 Output - BHP (kW)	**410 (306)**
Ventilation Air CFM (litre/sec)	898 (424)
Exhaust Flow - CFM (litre/sec)	2341 (1,105)
Exhaust Temp.- °F (°C)	977 (525)
Heat Rejection	
To Coolant BTU/min. (kW)	8262 (145)
To Ambient BTU/min (kW)	2033 (36)

All Data is Subject to Change Without Notice.

Engineering Manager: ***Mike Dawson***

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.

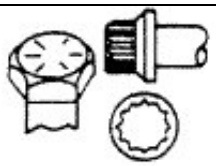
Commercial Steel Class	**8.8**	**10.9**	**12.9**
Caps Screw Head Markings			

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**
	

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 Arrangement, Installation, Fire Pump, CFP9E F65/F75/F85	26729		3/16
Assembly, Fire Pump, CFP9E F65/F75/F85	21653	B	8/16
Options, Engine, CFP9E F65/F75/F85	24600	A	6/15
Assembly, Engine 12V with Valve Cover	A042D247	-	
Assembly, Heat Exchanger	24782	C	3/16
Assembly, Air Intake	A042F826	-	
Assembly, Guarding	24781	B	12/15
Assembly, Coolant Heater	23526	B	
Assembly, Fuel Pre-Filter	A042A379	A	
Assembly, Sensor Package	15602	D1	
Assembly, Secondary ECM	15613	B1	
Assembly, Control Panel Mounting	21249	-	
Assembly, All Components Top-level:			
Assembly, Panel, Digital Electronic	22791	A	4/15
Assembly, Harness	23931	D	
Cables, Battery Contactors 4B, 6B, 6C, QSB, QSL	24234	B	
Battery Contactors 12V	8824-12	A	
Kit, Fuel Lines	15208	A	
Misc. Piping, Cooling Loop, Raw Water	A042D242	A	3/15
Assembly, Raw Water Cooling Loop, 1” Vertical	21515	C	7/16
Assembly, Raw Water Cooling Loop, 1" Horizontal 12V	21513	D	7/16
Assembly, Raw Water Cooling Loop, 1” Horizontal 24V	21522	E	7/16
Misc. Piping, Cooling Loop, Sea Water	A042H511		
Assembly, Sea Water Cooling Loop, 1" Vertical	21516	C	
Assembly, Sea Water Cooling Loop, 1" Horizontal 12V	21506	D	
Assembly, Sea Water Cooling Loop, 1" Horizontal 24V	21507	E	7/16
Assembly, Stub-Shaft, SAE#3 2.25”	8619	D	
Schematic, Control Panel, Electronic	16260	D	

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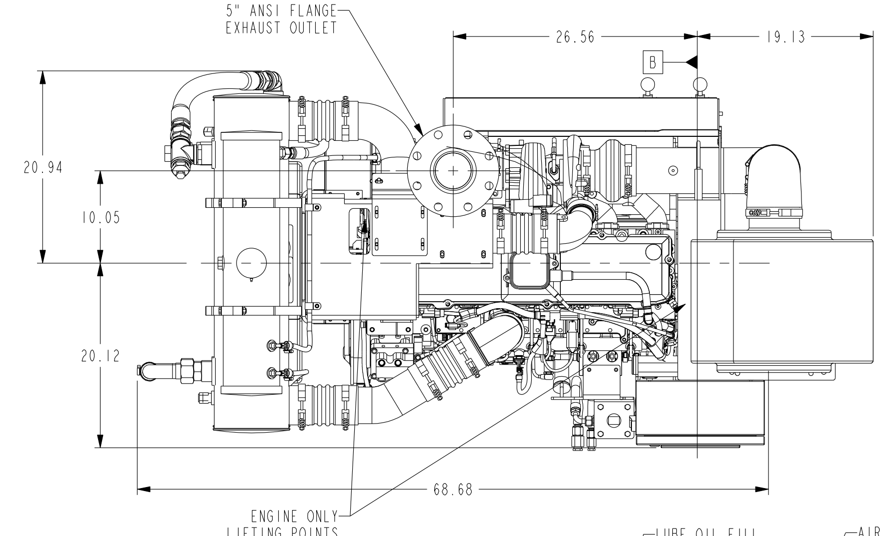
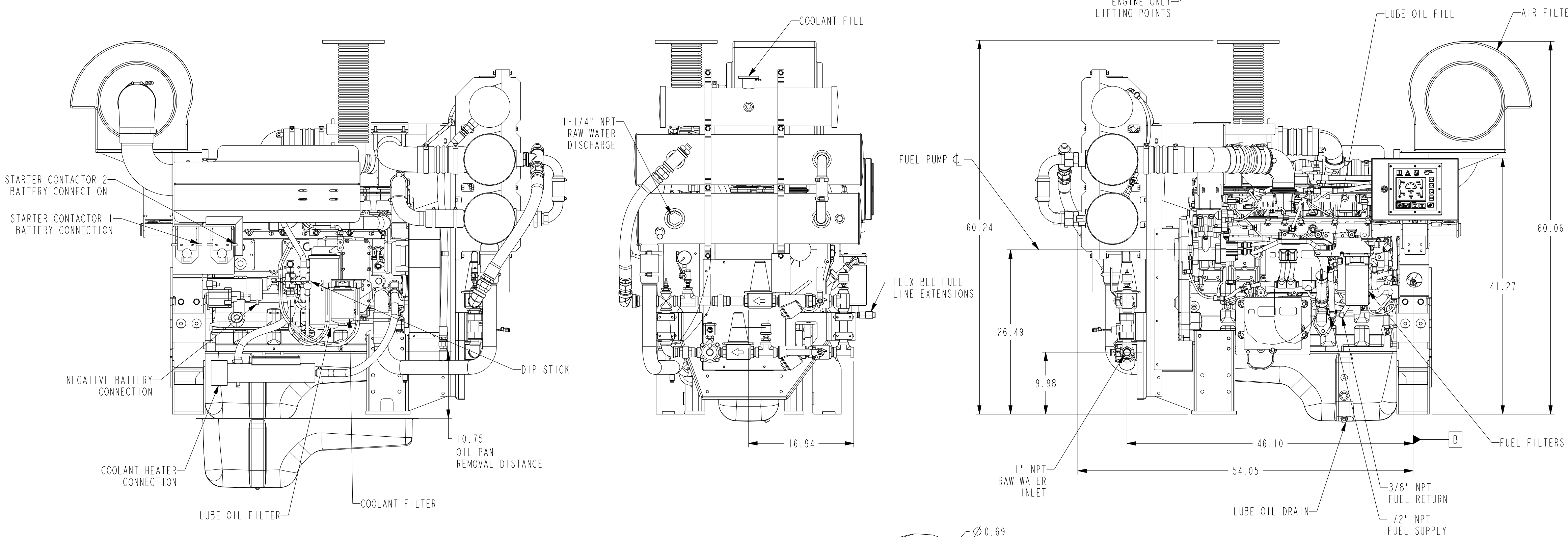
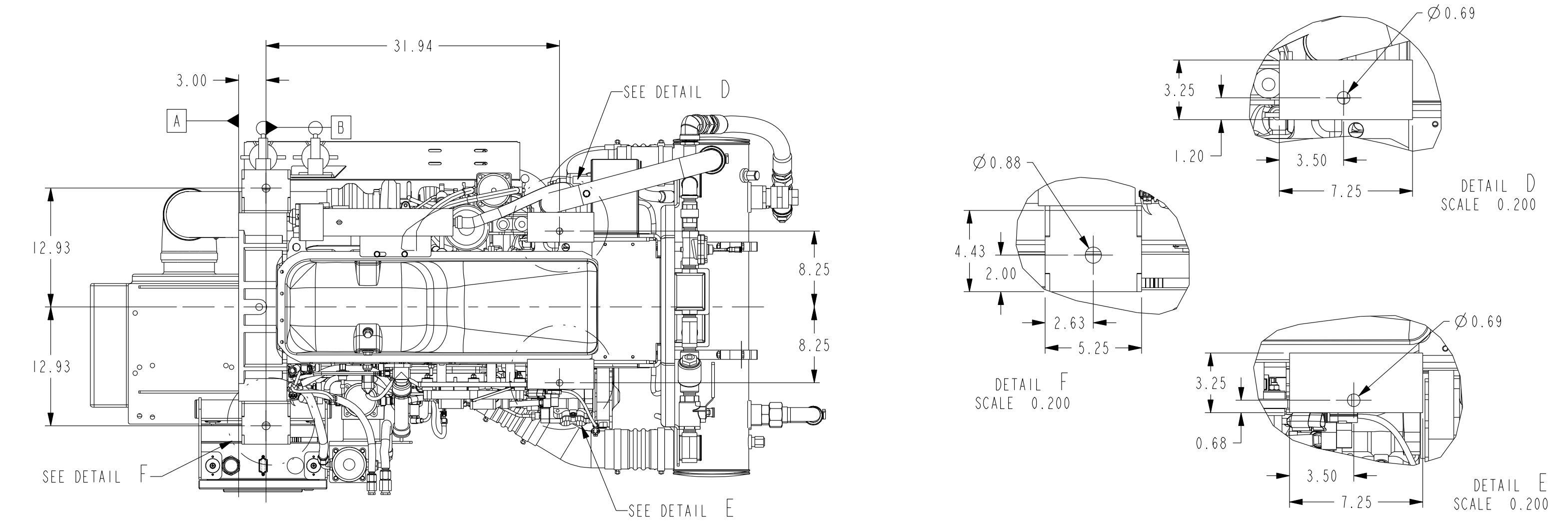
CFP9E CONNECTION INFORMATION	
SAE #3	FLYWHEEL HOUSING
1/2" NPT	FUEL INLET
3/8" NPT	FUEL OUTLET
1" NPT	RAW WATER INLET
1-1/4" NPT	RAW WATER DISCHARGE
120 / 240 VAC	COOLANT HEATER (2250 WATTS)
5" DIA NPT, CUFF, OR FLANGE	EXHAUST CONNECTION

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

LEGEND AND DATUM IDENTIFIER	
SHEET 1	INSTALLATION DRAWING
SHEET 2	GENERAL ARRANGEMENT - HORIZONTAL SPLIT CASE PUMP BASE OPTION
SHEET 3	GENERAL ARRANGEMENT - VERTICAL TURBINE PUMP BASE OPTION
SHEET 4	DRIVE LINE OPTIONS
DATUM "A"	FACE OF FLYWHEEL HOUSING
DATUM "B"	REAR LEG BOLT LOCATION
DATUM "C"	FLYWHEEL MOUNTING SURFACE
DATUM "D"	U-JOINT ADAPTER MOUNTING SURFACE
DATUM "EOS"	END OF PUMP SHAFT







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

Cummins Fire Power

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

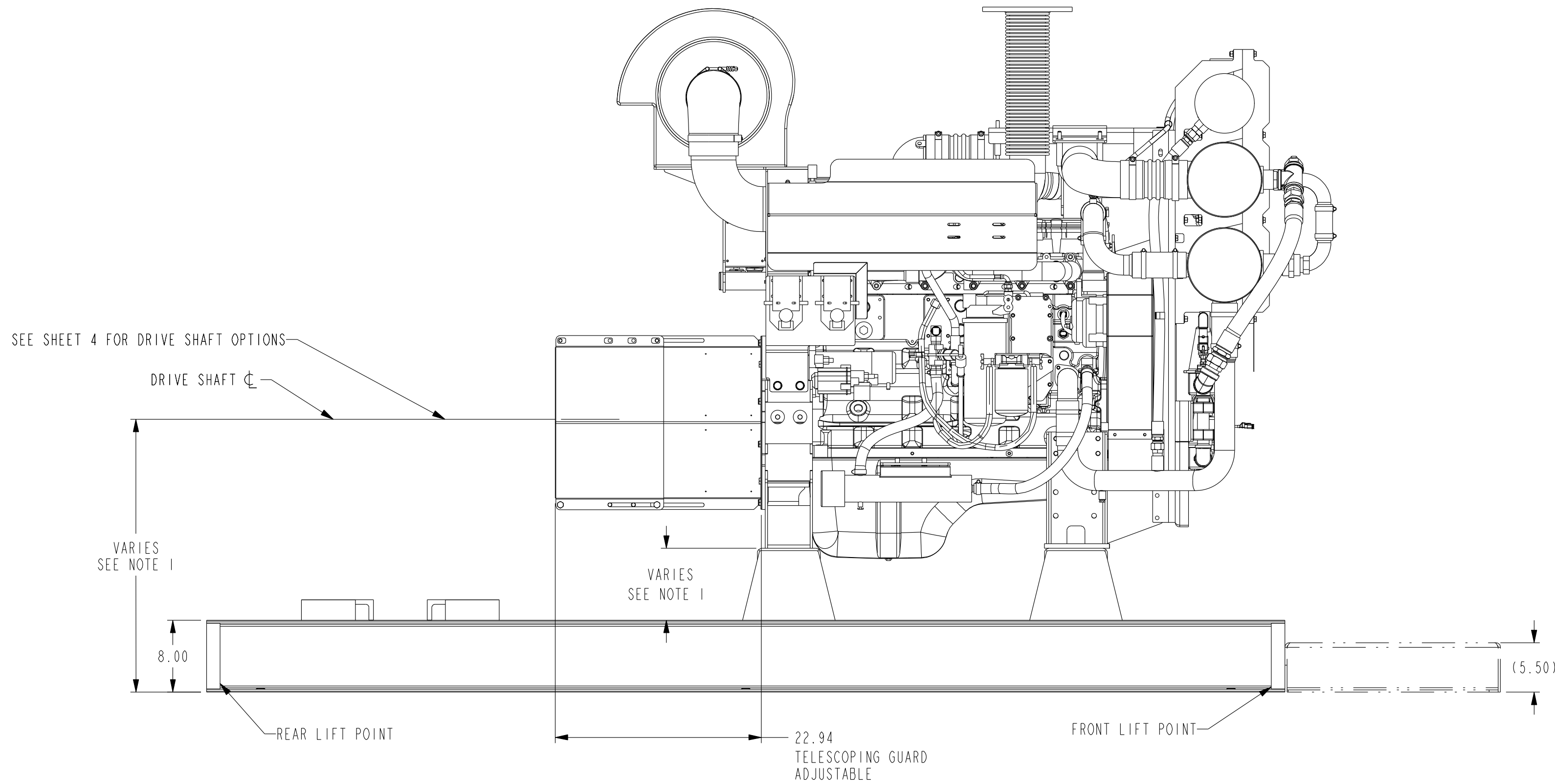
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

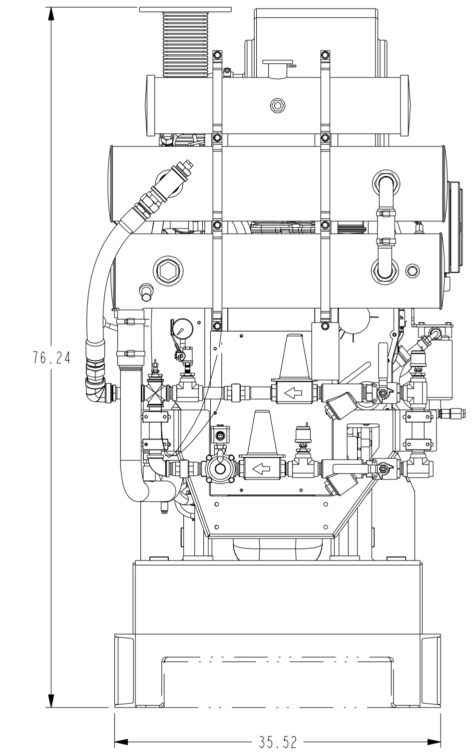
GENERAL ARRANGEMENT
CFP9E-F65/75/85

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 17MAR2016
	PRO-ENGINEER	INIT ECO: 2016-231
SCALE: 0.100	SHEET 1 OF 4	DRAWING NO: 26729
EST WEIGHT:		

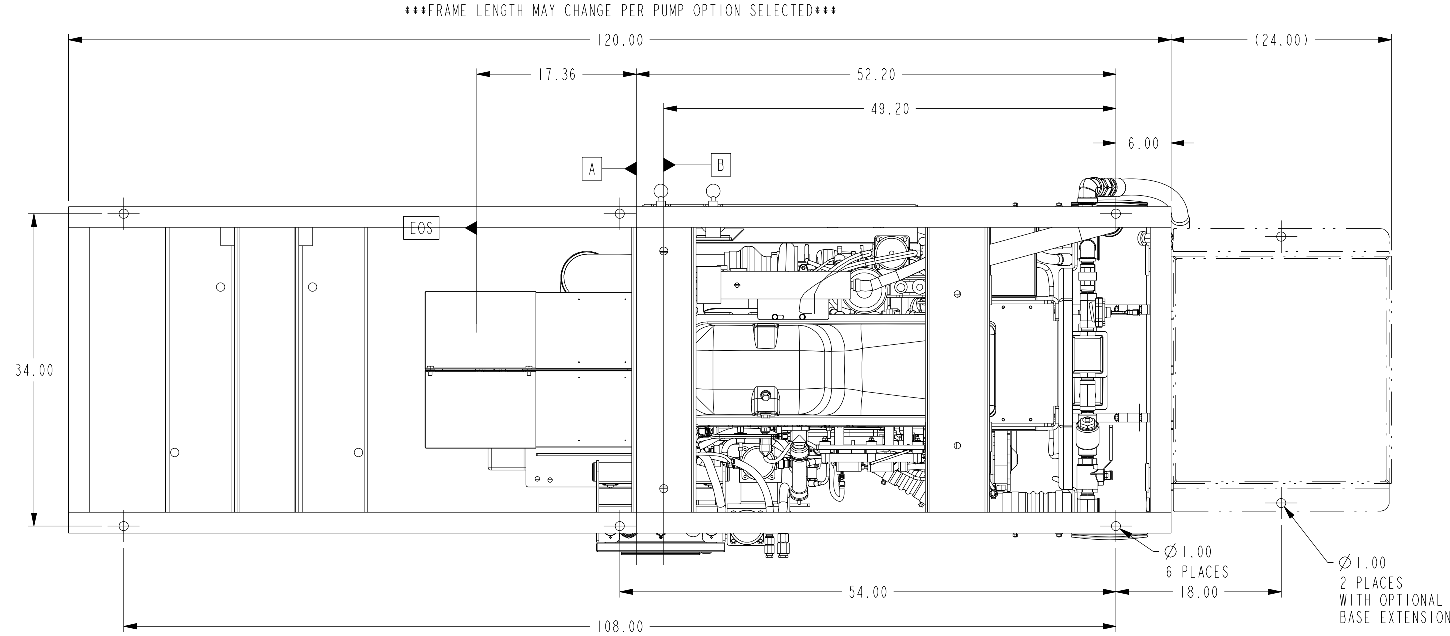
LEGEND AND DATUM IDENTIFIER

SHEET 1	INSTALLATION DRAWING
SHEET 2	GENERAL ARRANGEMENT - HORIZONTAL SPLIT CASE PUMP BASE OPTION
SHEET 3	GENERAL ARRANGEMENT - VERTICAL TURBINE PUMP BASE OPTION
SHEET 4	DRIVE LINE OPTIONS
DATUM "A"	FACE OF FLYWHEEL HOUSING
DATUM "B"	REAR LEG BOLT LOCATION
DATUM "C"	FLYWHEEL MOUNTING SURFACE
DATUM "D"	U-JOINT ADAPTER MOUNTING SURFACE
DATUM "EOS"	END OF PUMP SHAFT





FRAME LENGTH MAY CHANGE PER PUMP OPTION SELECTED



NOTES:
1. RISER HEIGHT VARIES TO ACCOMMODATE CUSTOMER SUPPLIED PUMPS
2. REFERENCE OWNERS MANUAL FOR DRIVE SHAFT ALIGNMENT SPECS
3. DRAWING SUBJECT TO CHANGE WITH OUT NOTICE.
4. REFERENCE SHEET 1 FOR BASE FIRE PUMP INTERFACE

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GENERAL ARRANGEMENT
CFP9E-F65/75/85

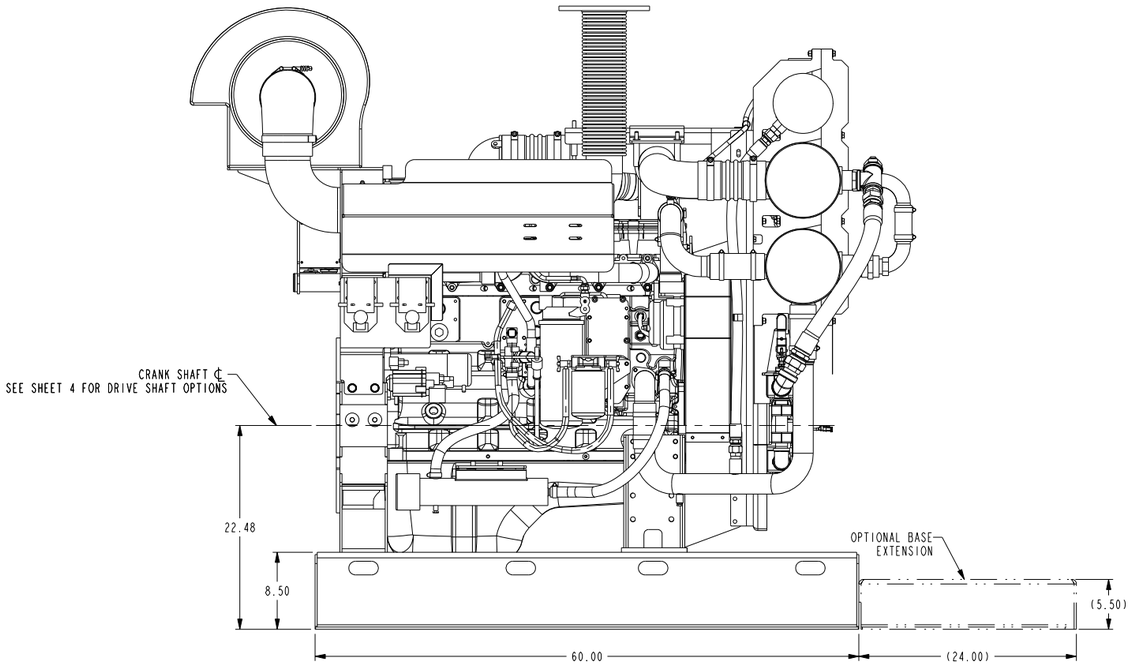
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

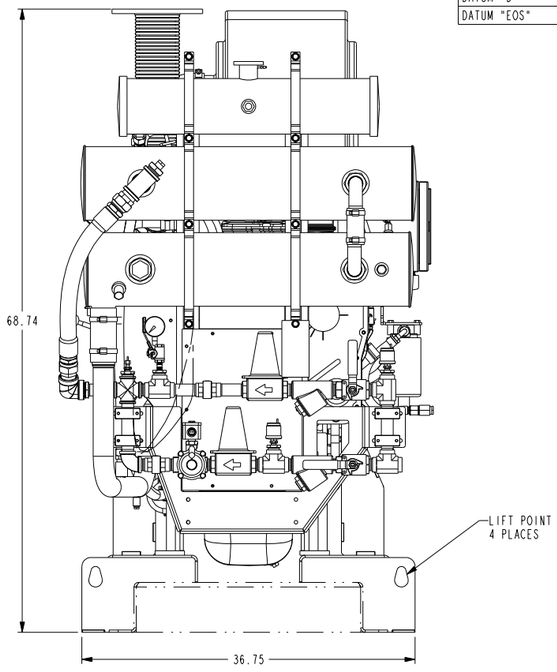
ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHINE TOLERANCES .XX : ± 0.010 .XXX : ± 0.005	MACHINE TOLERANCES .X : ± 0.4 .XX : ± 0.2
		FORM TOLERANCES .XX : ± 0.030 .XXX : ± 0.015	FORM TOLERANCES .X : ± 0.8 .XX : ± 0.4
		FAB TOLERANCES .XX : ± 0.060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

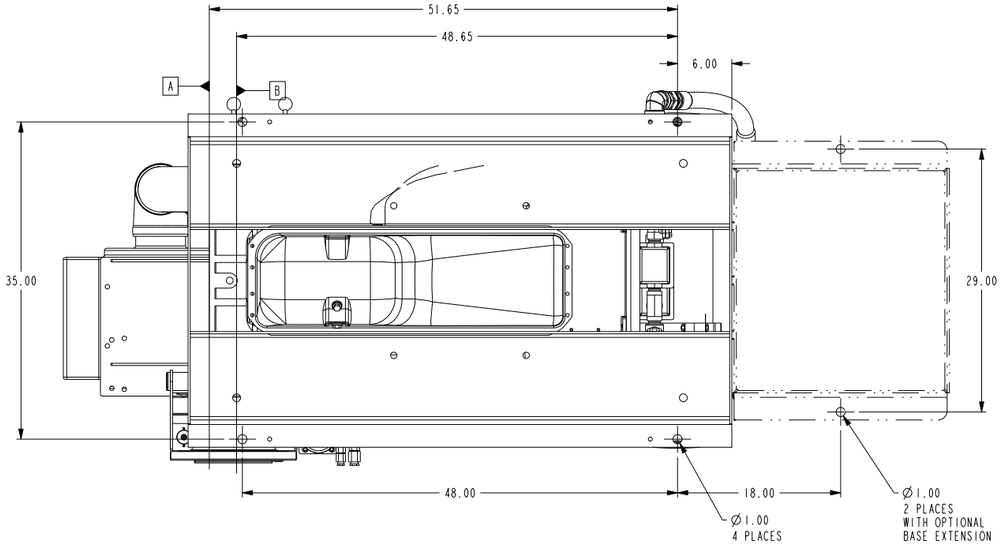
DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 17MAR2016
	PRO-ENGINEER	INIT ECO: 2016-231
SCALE: 0.100	SHEET 2 OF 4	DRAWING NO: 26729
EST WEIGHT:		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

LEGEND AND DATUM IDENTIFIER	
SHEET 1	INSTALLATION DRAWING
SHEET 2	GENERAL ARRANGEMENT - HORIZONTAL SPLIT CASE PUMP BASE OPTION
SHEET 3	GENERAL ARRANGEMENT - VERTICAL TURBINE PUMP BASE OPTION
SHEET 4	DRIVE LINE OPTIONS
DATUM "A"	FACE OF FLYWHEEL HOUSING
DATUM "B"	REAR LEG BOLT LOCATION
DATUM "C"	FLYWHEEL MOUNTING SURFACE
DATUM "D"	U-JOINT ADAPTER MOUNTING SURFACE
DATUM "EOS"	END OF PUMP SHAFT







NOTES:
1. TORSIONAL ANALYSIS REQUIRED FOR VERTICAL TURBINE INSTALLATION
2. REFERENCE OWNERS MANUAL FOR DRIVE SHAFT ALIGNMENT SPECS
3. DRAWING SUBJECT TO CHANGE WITH OUT NOTICE.
4. REFERENCE SHEET 1 FOR BASE FIRE PUMP INTERFACE

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

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

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
	.X ± 0.030	.X ± 0.75
	.XX ± 0.010	.XX ± 0.25
125	.XXX ± 0.005	.XXX ± 0.127
	FRACTIONS ± 1/64	FRACTIONS ± 0.4

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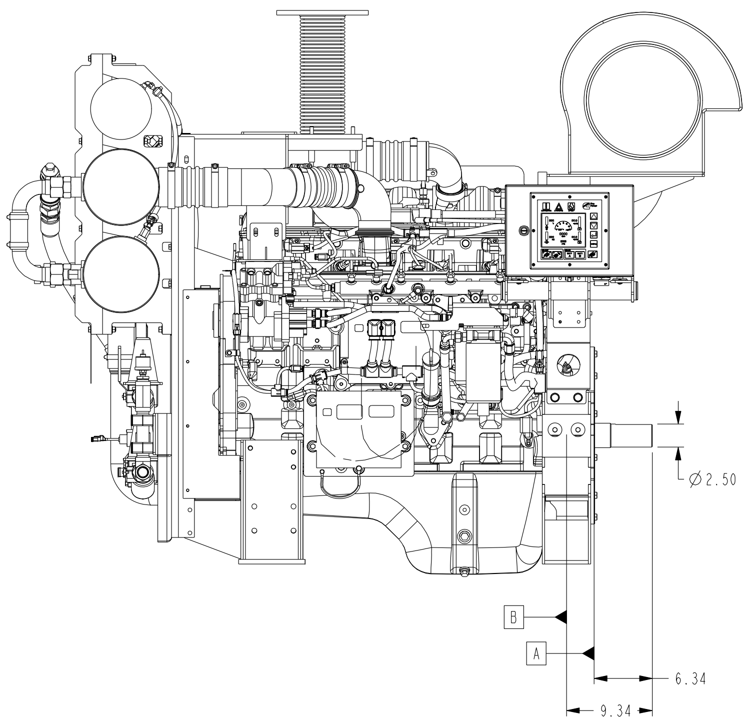
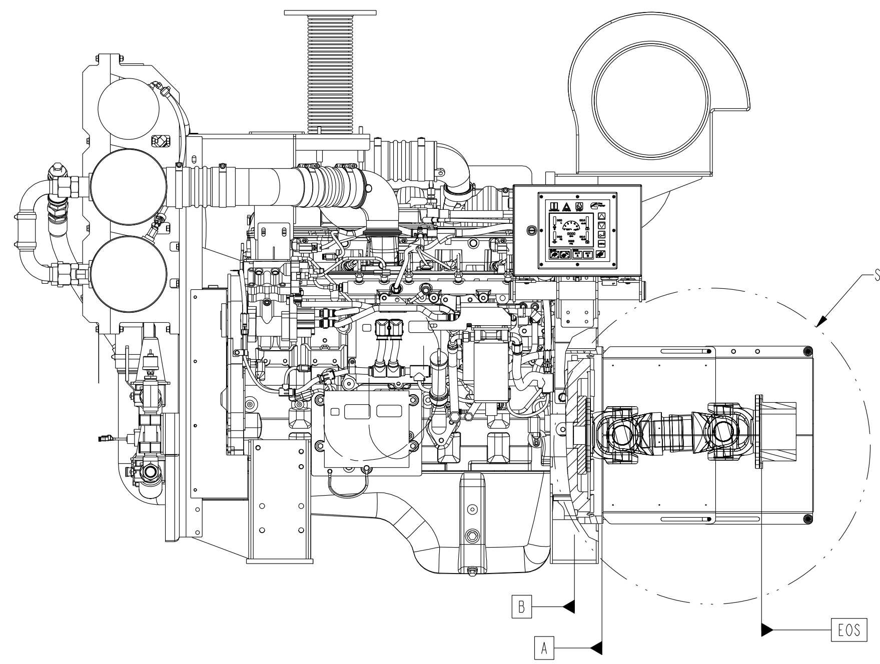
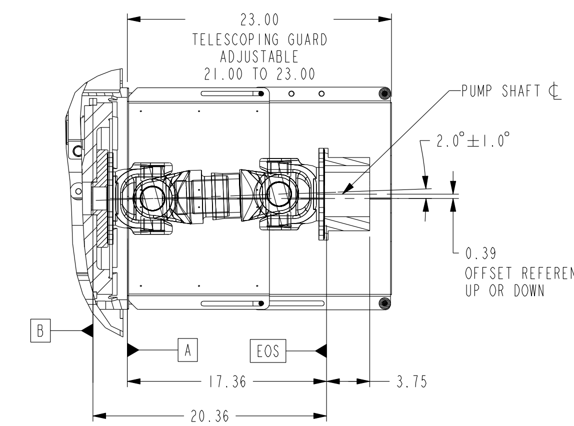
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

GENERAL ARRANGEMENT
CFP9E-F65/75/85

DWG UNITS: IN/LB/S
DRAWN BY: PBS
DATE: 17MAR2016
PRO-ENGINEER
INIT ECO: 2016-231
SCALE: 0.125
SHEET 3 OF 4
EST WEIGHT:
DRAWING NO: 26729

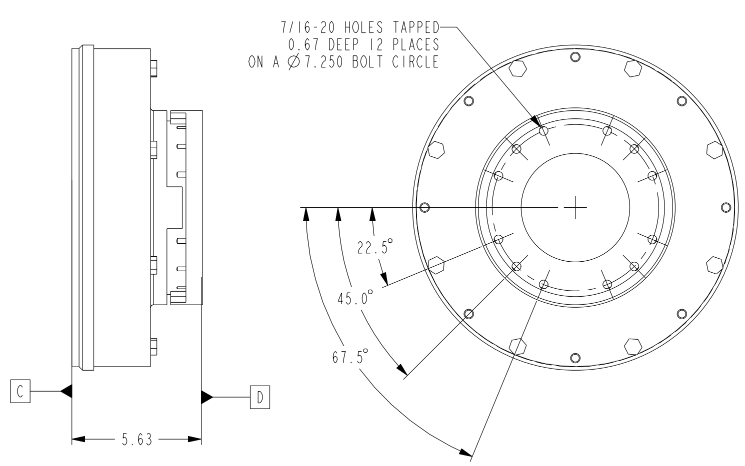




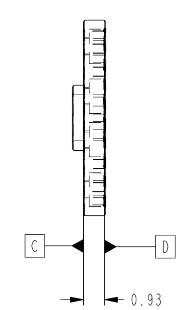


UL LISTED 3172
SHORT COUPLED SHAFT
ESTIMATED WEIGHT: 74 LBS

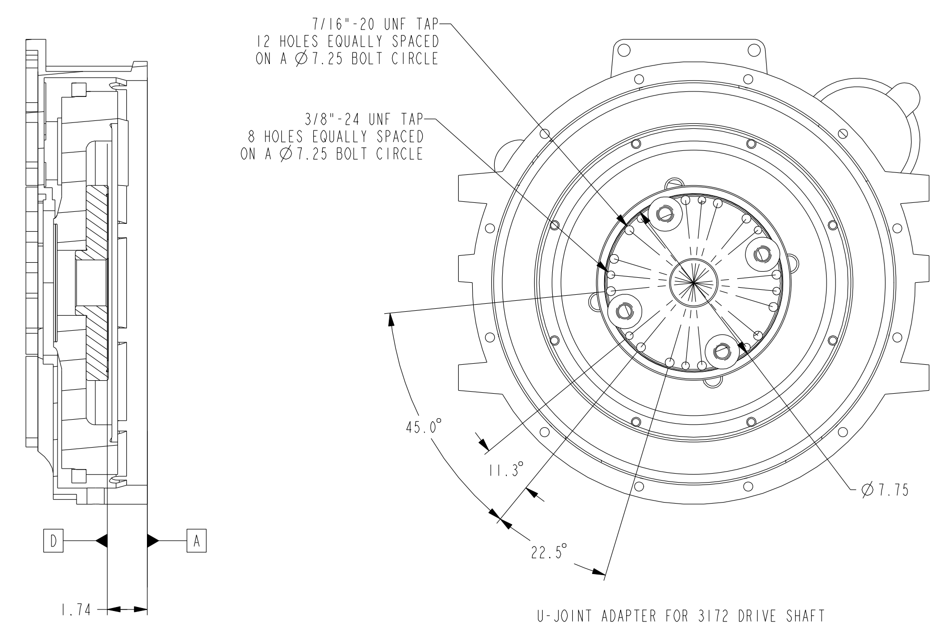
DETAIL A
SCALE 0.125



TORSIONAL COUPLING FOR 3172 DRIVE SHAFT



U-JOINT ADAPTER FOR 3172 DRIVE SHAFT



U-JOINT ADAPTER FOR 3172 DRIVE SHAFT

SCALE 0.250

NOTES:
1. REFERENCE OWNERS MANUAL FOR DRIVE SHAFT ALIGNMENT SPECS
2. DRAWING SUBJECT TO CHANGE WITH OUT NOTICE.
3. REFERENCE SHEET 1 FOR BASE FIRE PUMP INTERFACE

LEGEND AND DATUM IDENTIFIER

SHEET 1	INSTALLATION DRAWING
SHEET 2	GENERAL ARRANGEMENT - HORIZONTAL SPLIT CASE PUMP BASE OPTION
SHEET 3	GENERAL ARRANGEMENT - VERTICAL TURBINE PUMP BASE OPTION
SHEET 4	DRIVE LINE OPTIONS
DATUM "A"	FACE OF FLYWHEEL HOUSING
DATUM "B"	REAR LEG BOLT LOCATION
DATUM "C"	FLYWHEEL MOUNTING SURFACE
DATUM "D"	U-JOINT ADAPTER MOUNTING SURFACE
DATUM "EOS"	END OF PUMP SHAFT

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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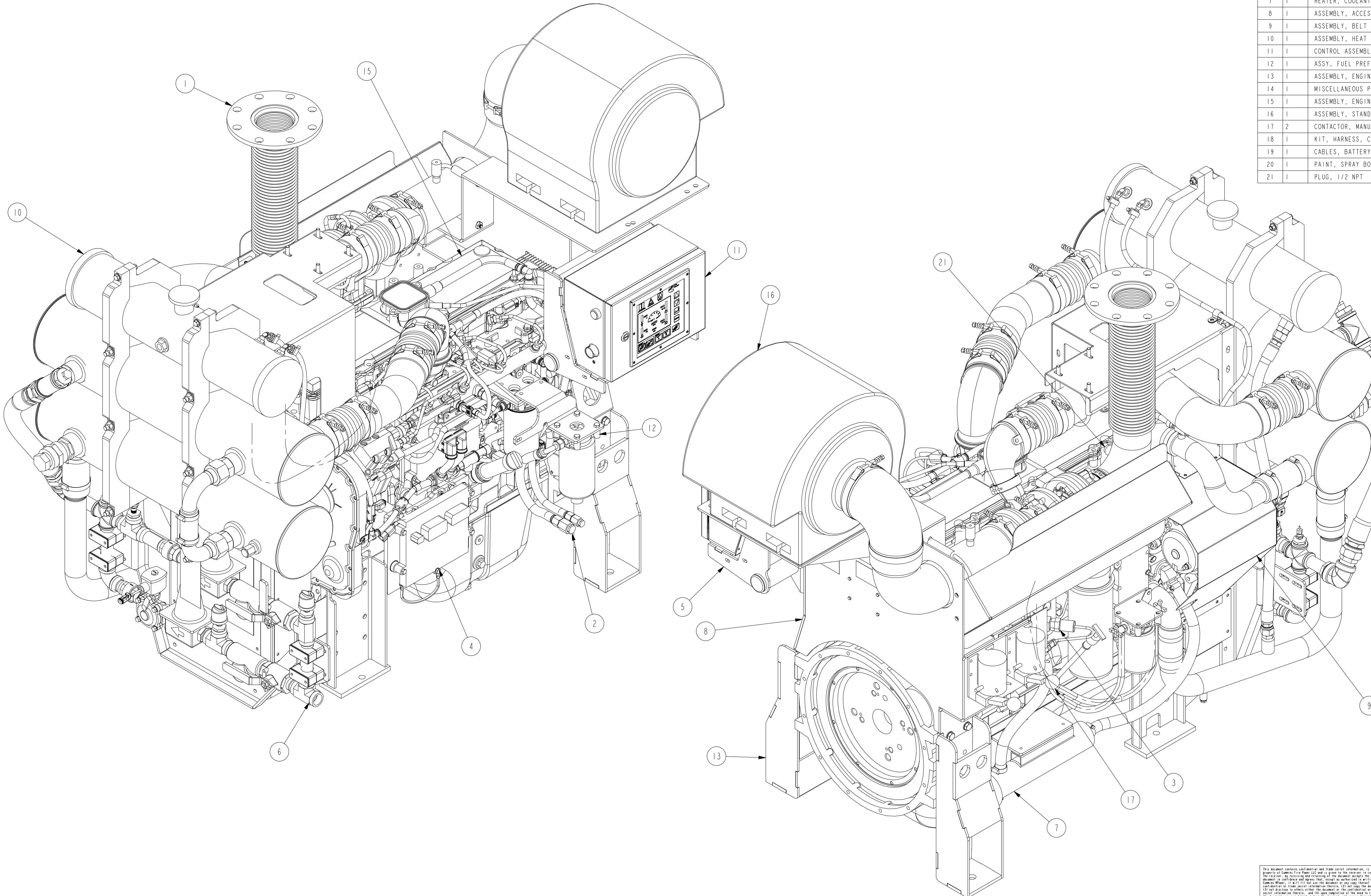
GENERAL ARRANGEMENT
CFP9E-F65/75/85

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 17MAR2016
	PRO-ENGINEER	INIT ECO: 2016-231
SCALE: 0.100	SHEET 4 OF 4	DRAWING NO: 26729
EST WEIGHT:		



BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	EXHAUST, 90 HALF MARMON, 4" TURBO OUT, 5" 125LB ANSI FLANGE	8780_04
2	1	KIT, FUEL LINES, CFP9E, F10/20/30/40/50/60 - EXT ONLY	15208
3	1	KIT, SENSOR & ADAPTER, CFP9E	15602
4	1	ASSEMBLY, SECONDARY ECM, CFP9E	15613
5	1	ASSEMBLY, CONTROL PANEL MOUNTING, CFP POWER UNITS	21249
6	1	COOLING LOOP, 1", 12V, RAW WATER	21513
7	1	HEATER, COOLANT, ASSEMBLY, CFP9E	23526
8	1	ASSEMBLY, ACCESSORY, REAR MOUNTING, CFP9E HHP HD/ DUAL STARTER	24409
9	1	ASSEMBLY, BELT GUARD, CFP9E	24781
10	1	ASSEMBLY, HEAT EXCHANGER, CFP9E, HHP	24782
11	1	CONTROL ASSEMBLY, FPDP ELECTRONIC CARBON STEEL	26764
12	1	ASSY, FUEL PREFILTER, CFP9E	A042A379
13	1	ASSEMBLY, ENGINE MOUNT, CFP9E HHP	A042D239
14	1	MISCELLANEOUS PIPING, RAW WATER, CFP9E HHP	A042D242
15	1	ASSEMBLY, ENGINE, CFP9E, HHP	A042D247
16	1	ASSEMBLY, STANDARD AIR FILTER, CFP9E HHP	A042F826
17	2	CONTACTOR, MANUAL OVERIDE, 12V, PN:535-0127, FIREPUMP	8824-12
18	1	KIT, HARNESS, CFP9E	23931
19	1	CABLES, BATTERY, CFP5E, 7E, 9E, 11E	24234
20	1	PAINT, SPRAY BOMB, CUMMINS RED	A15730-A12
21	1	PLUG, 1/2 NPT	LTL-SCSP12

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2016-567	UPDATED PER 24781 AND 24782	PBS	11AUG2016
A	2015-792	DELETE: A0420248 AND 24130 ADD: 24409 AND A042F826	PBS	15DEC2015

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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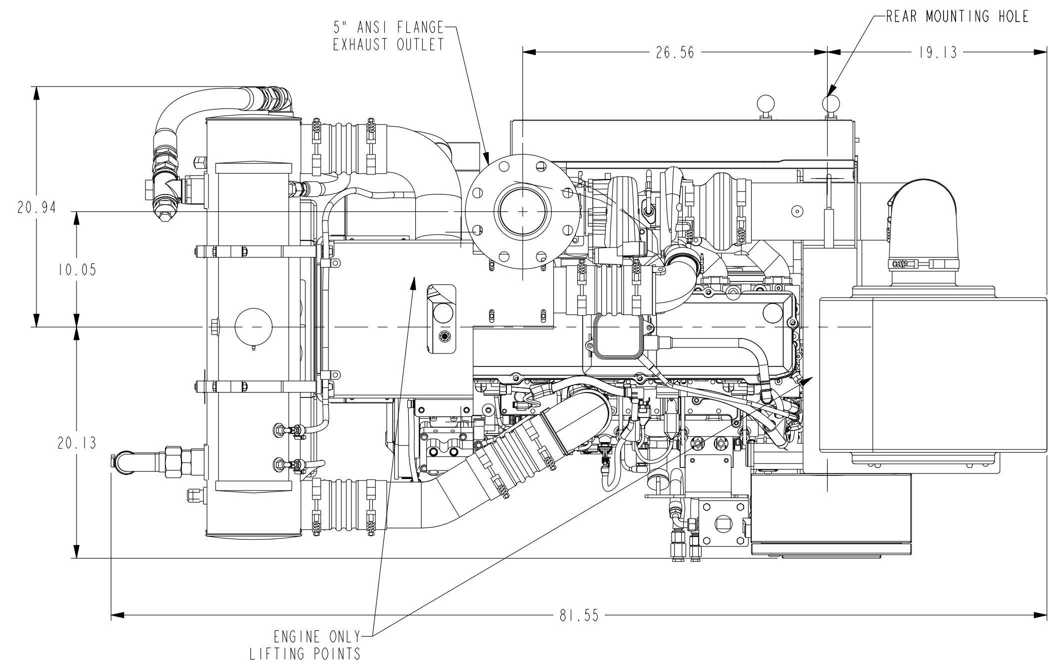
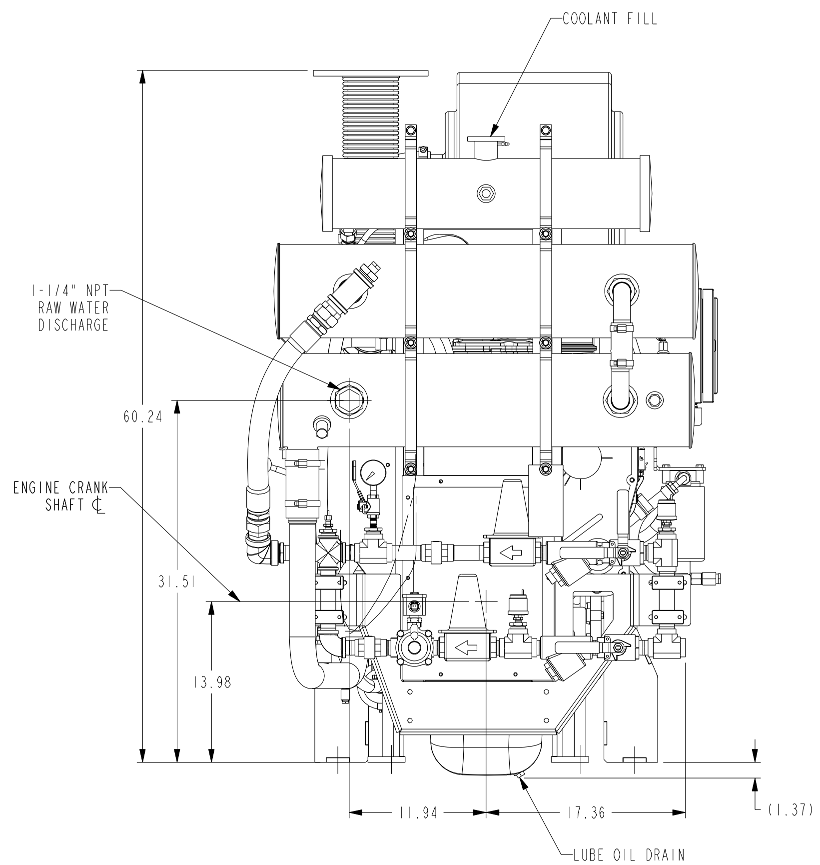
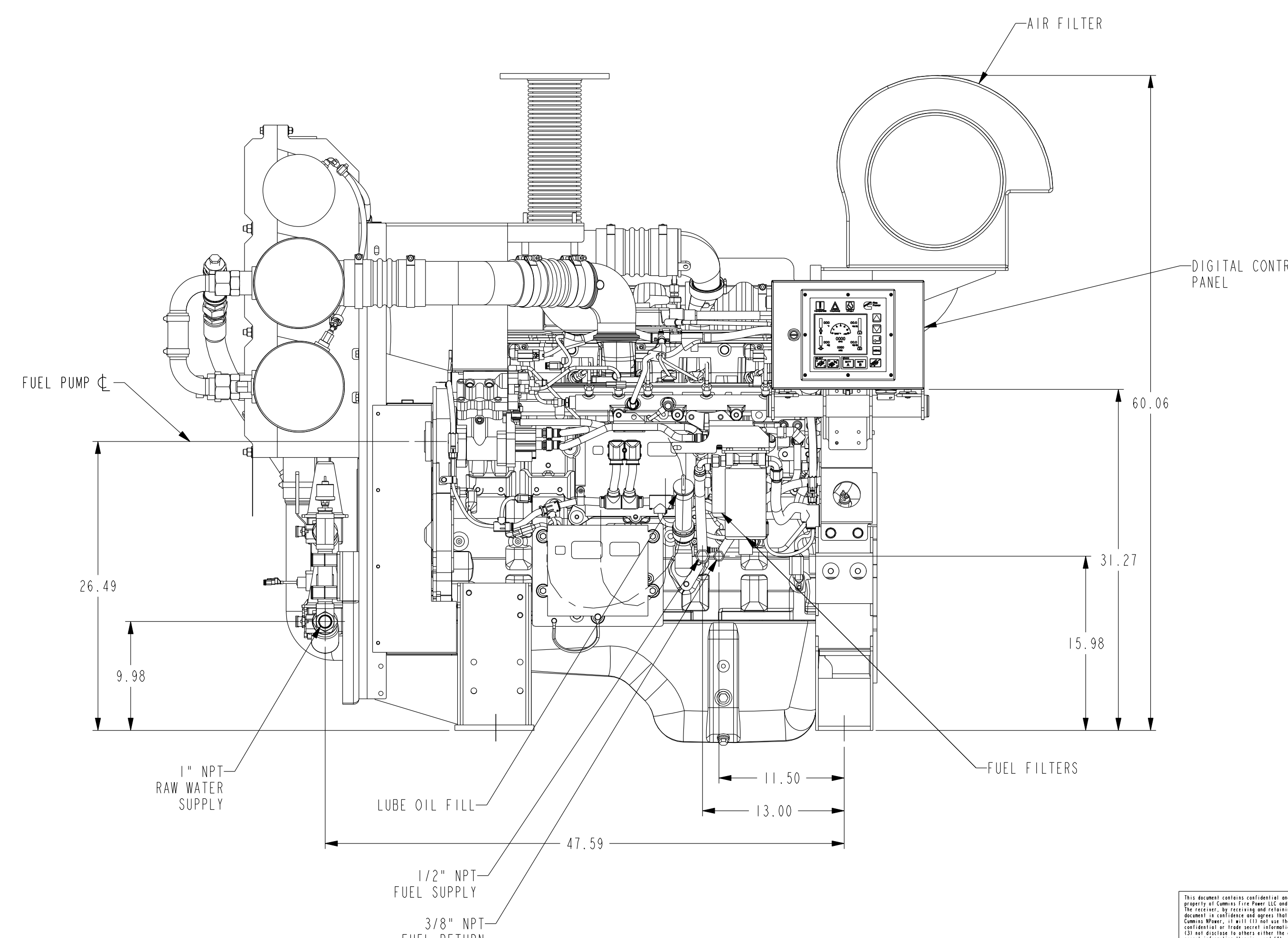
ASSEMBLY, FIRE PUMP
CFP9E-F65/75/85

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 19MAR2012
	PRO-ENGINEER	INIT ECO: 2013-135
SCALE: 0.190	SHEET 1 OF 3	DRAWING NO: 21653
EST WEIGHT:		







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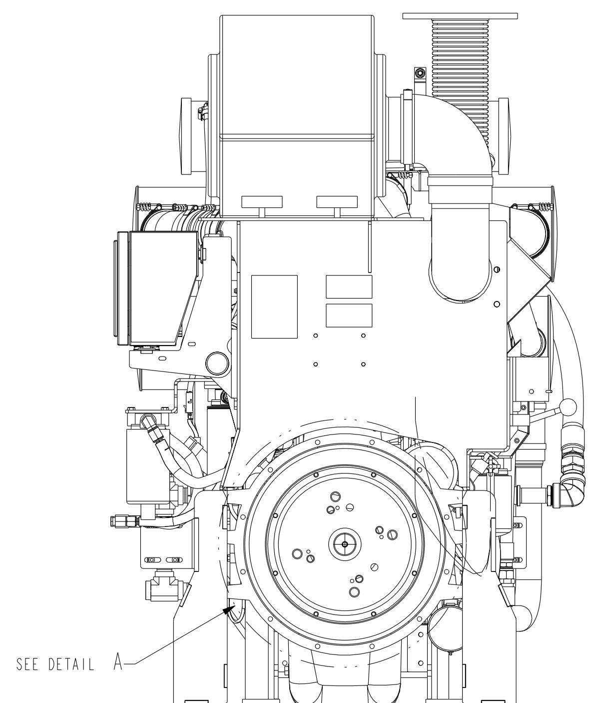
CFP9E-F65/75/85

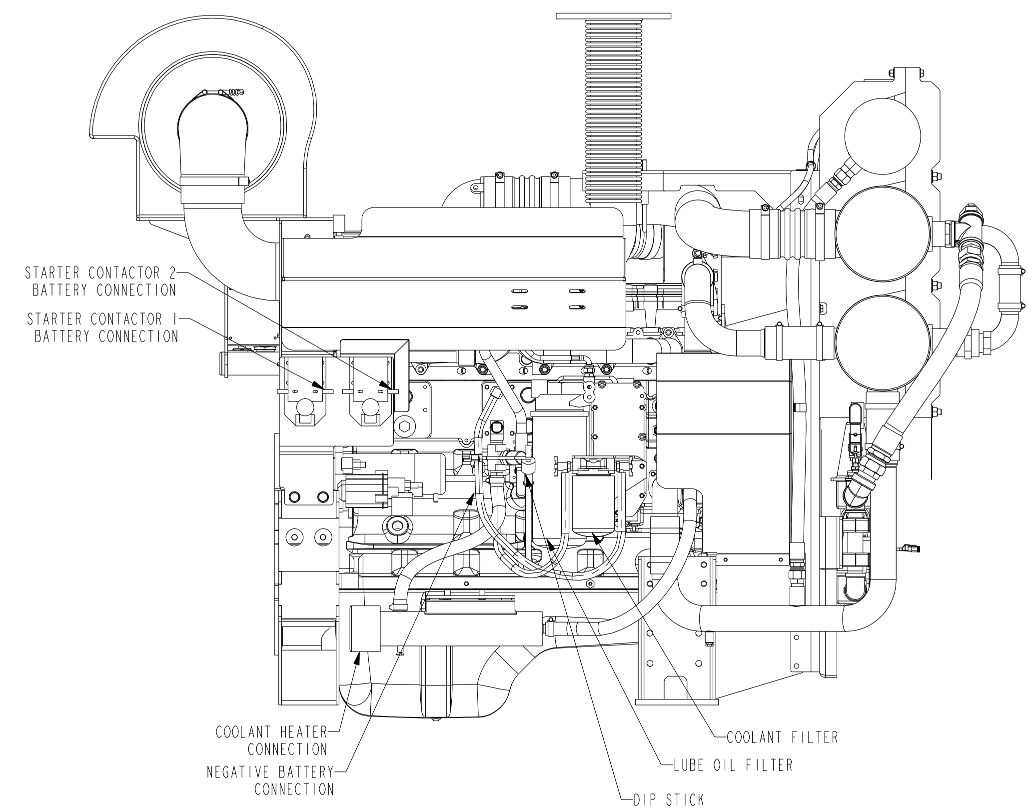
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION

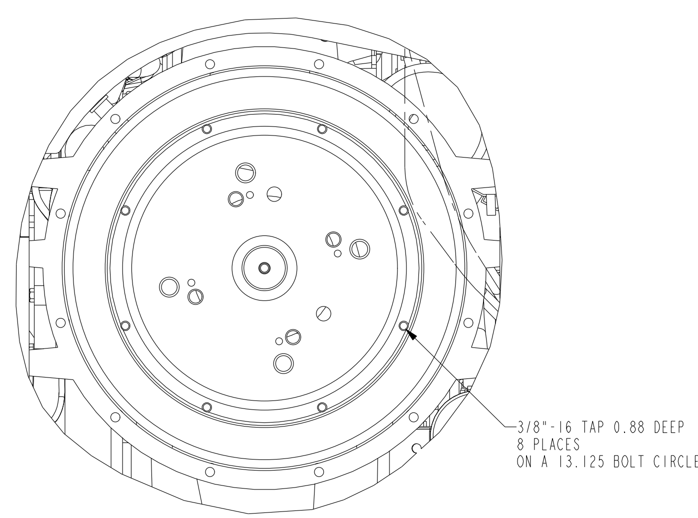
MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
125	MACHINE TOLERANCES .XX : ± 0.010 .XXX : ± 0.005	MACHINE TOLERANCES .X : ± 0.4 .XX : ± 0.2
	FORM TOLERANCES .XX : ± 0.030 .XXX : ± 0.015	FORM TOLERANCES .X : ± 0.8 .XX : ± 0.4
	FAB TOLERANCES .XX : ± 0.060 .XXX : ± 0.030	FAB TOLERANCES .X : ± 1.5 .XX :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

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 19MAR2012
	PRO-ENGINEER	INIT ECO: 2013-135
SCALE: 0.125	SHEET 2 OF 3	DRAWING NO: 21653
EST WEIGHT:		

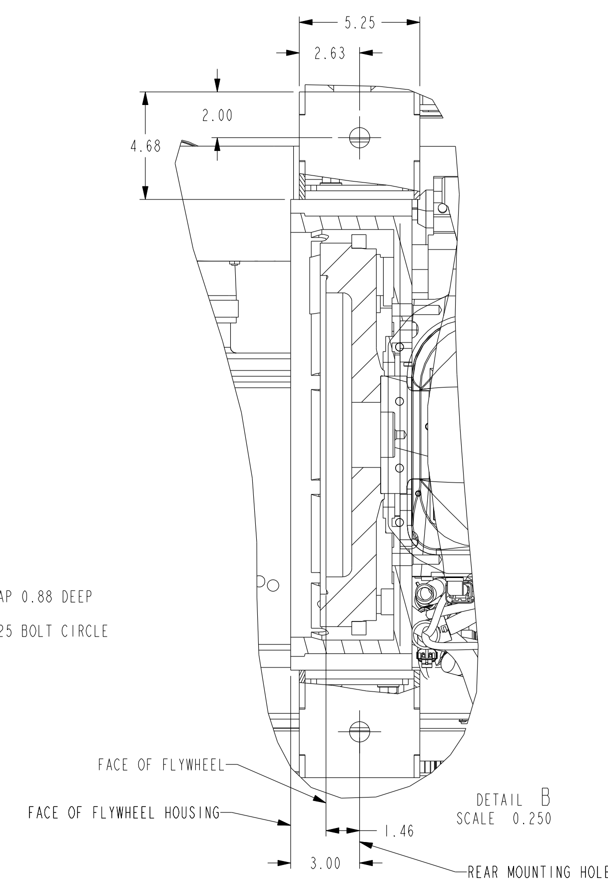
REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2016-567	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	11AUG2016



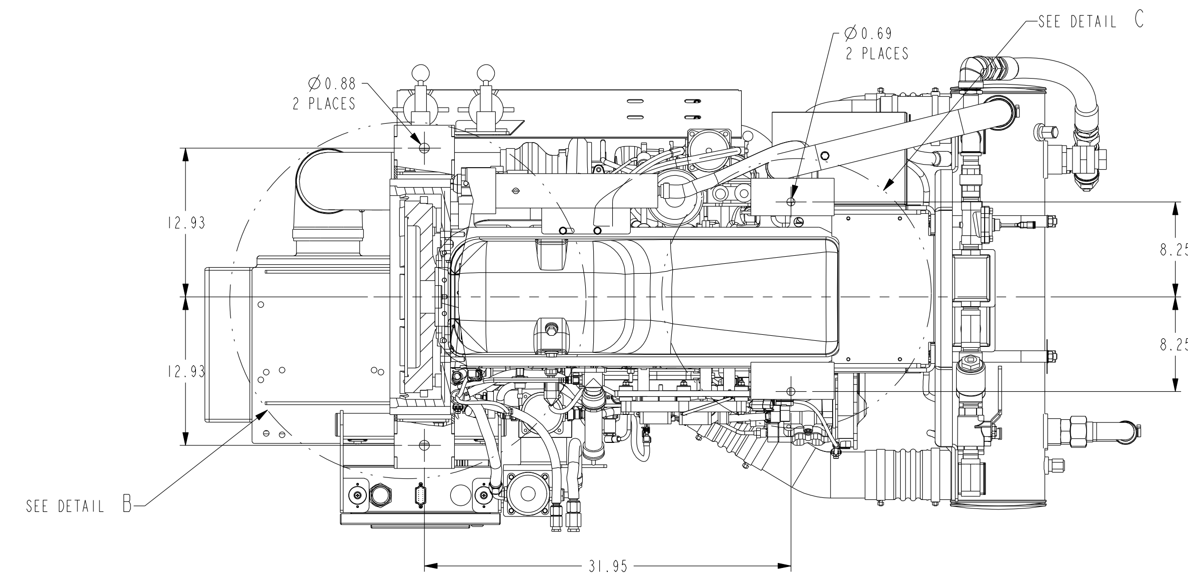


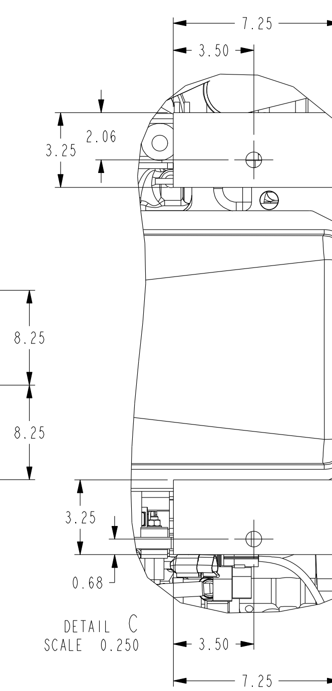


DETAIL A
SCALE 0.250



DETAIL B
SCALE 0.250





DETAIL C
SCALE 0.250

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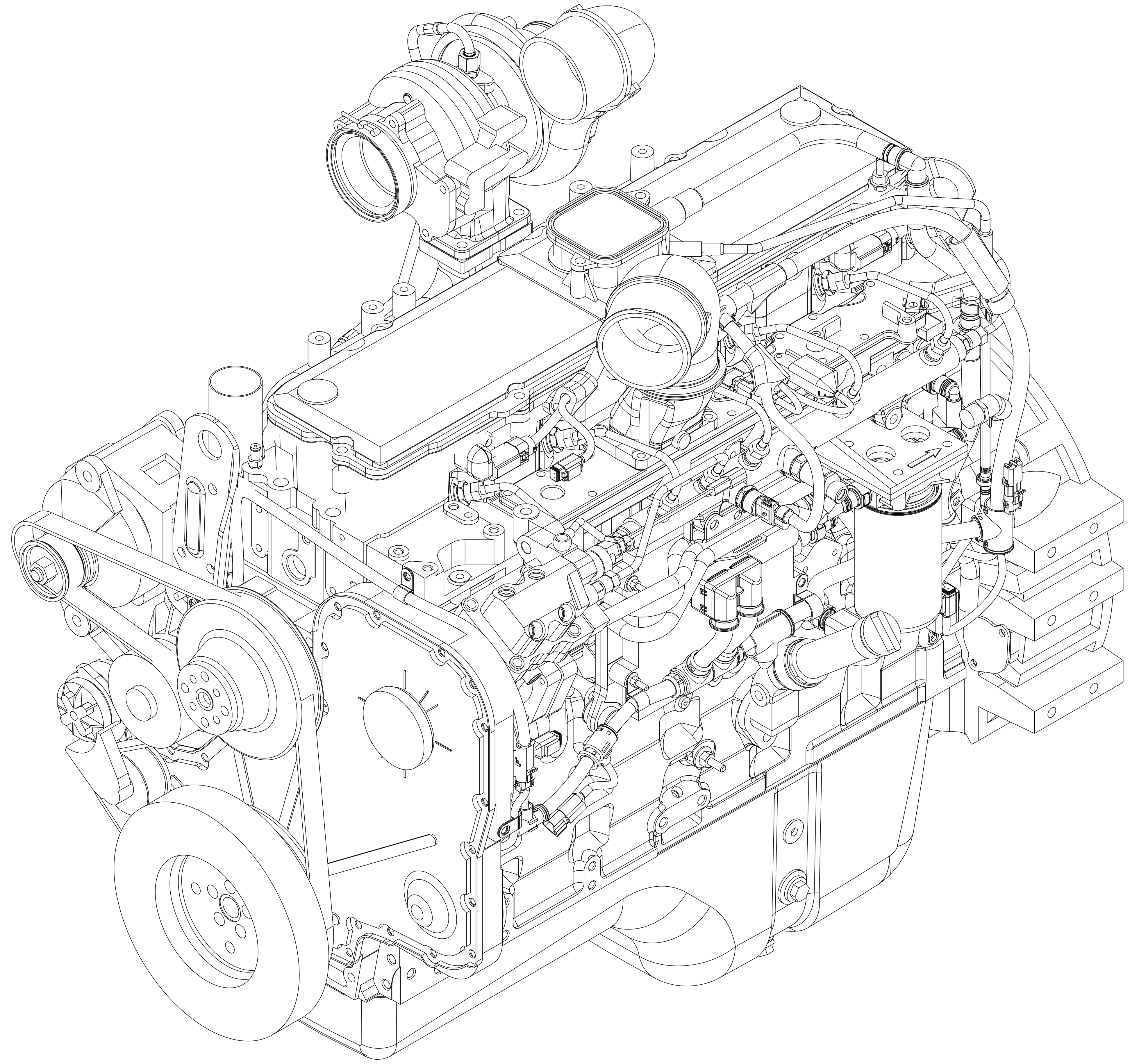
ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

ASSEMBLY, FIRE PUMP
CFP9E-F65/75/85

DWG UNITS: IN/LB/S | DRAWN BY: PBS | DATE: 19MAR2012
PRO-ENGINEER | INIT ECO: 2013-135
SCALE: 0.125 | SHEET 3 OF 3 | DRAWING NO: 21653
EST WEIGHT:

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2016-567	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	11AUG2016



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	FLYWHEEL, 11.5" OC, FW9878	3973497
2	1	BLOCK, CYLINDER	BB9081
3	1	AID,COO HEATER STARTING	CH9066
4	1	PLUMBING,COO HTR STG AID	CH9087
5	1	DAMPER, VIBRATION	DA9153
6	1	FRONT GEAR TRAIN ACC DRIVE MTG	DF9706
7	1	ALTERNATOR	EE9244
8	1	MOUNTING, ALTERNATOR	EH9434
9	1	DRIVE, FAN	FA9310
10	1	MOUNTING, FAN DRIVE	FA9734
11	1	FUEL FILTER PLUMBING	FF9425
12	1	FUEL FILTER	FF9587
13	1	FUEL PUMP MOUNTING	FP90238
14	1	FUEL PUMP	FP90239
15	1	PUMP, FUEL TRANSFER	FS9746
16	1	FUEL PLUMBING	FT9028
17	1	CABIN HEATER PLUMBING	HC9046
18	1	CONNECTION, AIR INTAKE	IC9367
19	1	AIR INTAKE MANIFOLD	IM9077
20	1	AIR TRANSFER CONNECTION	IT9043
21	1	LIFTING ARRANGEMENT	LA9151
22	1	AIR INTAKE HOSE	LC9765
23	1	LUBRICATING OIL FILTER	LF9093
24	1	FILTER, LUBRICATING OIL	LF9130
25	1	OIL, ENGINE	LO9701
26	1	PUMP, LUBRICATING OIL	LP9724
27	1	COVER, HAND HOLE	OB9365
28	1	ARRANGEMENT, OIL FILL	OB9445
29	1	PAN, OIL	OP9338
30	1	ENG CNT MODULE PLUMBING	PH9055
31	1	MODULE, ENGINE CONTROL	PH9321
32	1	PARTS, PERFORMANCE	PP43301
33	1	TURBOCHARGER	PP99603
34	1	LEVER, ROCKER	RL9753
35	1	RADIATOR PLUMBING	RP9042
36	1	PAINT	SS9591
37	1	MOTOR, STARTING	ST9494
38	1	VOLTAGE, ENGINE OPERATING	SV9001
39	1	EXHAUST MANIFOLD	TB91141
40	1	TORQUE CONVERTER OIL COOLER	TK9022
41	1	PLUMBING, TURBOCHARGER	TP97012
42	1	COVER, VALVE	VC9777
43	1	LOCATION, CRN RESISTOR	WF9123
44	1	WATER INLET CONNECTION	3944141
45	1	CONNECTION, WATER OUTLET	WO9028
46	1	TENSIONER, BELT	WP9916
47	1	DRIVE, WATER PUMP	WP9965
48	1	HARNESS, ETR CNT MDL WRG	WR9355
49	1	AGENCY APPROVAL	AP9980
50	1	AGENCY APPROVAL	AP90041
51	1	PLUMBING, CYL BLOCK COOLANT	BB9129
52	1	FRONT GEAR HOUSING	BB9837
53	1	BREATHER, CRANKCASE	BR9215
54	1	DRIVE, FRONT GEAR TRAIN ACCESSORY	DF9100
55	1	LOCATION, DRAIN	DL9146
56	1	SOFTWARE, CUSTOM INTERFACE	DO94834
57	1	THERMOSTAT	EC9076
58	1	HOUSING, FLYWHEEL	FH9506
59	1	FITTING, FUEL INLET	FI9092
60	1	CALIBRATION, FUEL PUMP	FP9164
61	1	RATING, FUEL	FR95175
62	1	MOUNTING, FLYWHEEL	FW9934
63	1	BASE ENGINE	GDRV00425
64	1	MOUNTING, GEAR COVER	GG9804
65	1	COVER, FRONT GEAR	GG9830
66	1	MOUNTING, LIFTING BRACKET	LA9119
67	1	GUAGE, OIL LEVEL	LG90104
68	1	LITERATURE	LT9304
69	1	MASKING, ENGINE	MK9097
70	1	MASKING, ENGINE	MK9098
71	1	PLUMBING, RADIATOR	RP9063
72	1	BRACKET, SHIPPING	SK9022
73	1	MOUNTING, STARTER MOTOR	SM9772
74	1	ARRANGEMENT, TURBOCHARGER	TB91438
75	1	ARRANGEMENT, VALVE COVER	VC9169
76	1	PUMP, WATER	WP97494
77	1	CONNECTION, EXHAUST OUTLET	XS9258

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2015-372	UPDATED PER LATEST COLS SPECIFICATION	PBS	18JUN2015

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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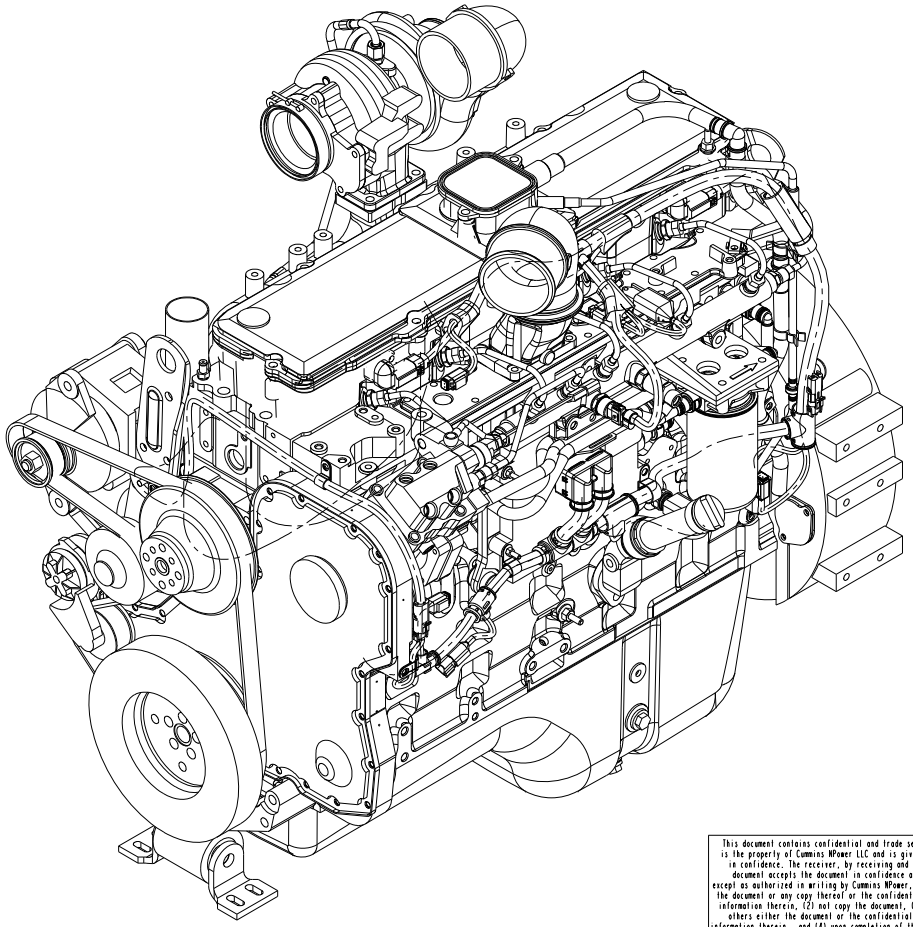
ASSEMBLY, ENGINE, FIREPUMP, G-DRIVE, QSL
TIER 3, 464 HP 1800 RPM

DWG UNITS: IN/LB/S
DRAWN BY: PBS
PRO-ENGINEER
DATE: 19MAR2012
INIT ECO:
SCALE: 0.250
EST WEIGHT:
SHEET 1 OF 1
DRAWING NO: 24600

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	VALVE COVER MODIFICATION, CFP9E, FIREPUMP	14454
2	1	ASSEMBLY, ENGINE, FIREPUMP, G-DRIVE, QSL, TIER 3, 464 HP 1800 RPM	24600
3	22	PREMIUM BLUE 15W40, (QUART)	V705290
4	1	MANUAL, O&M, CFP9E	24807
5	1	VALVE, PRESSURE RELIEF,	3947799



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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ASSEMBLY, ENGINE
CFP9E, HHP

DWG UNITS: IN/LB/S

DRAWN BY: PBS

DATE: 19NOV2014

PRO-ENGINEER

INIT ECO: 2013-135

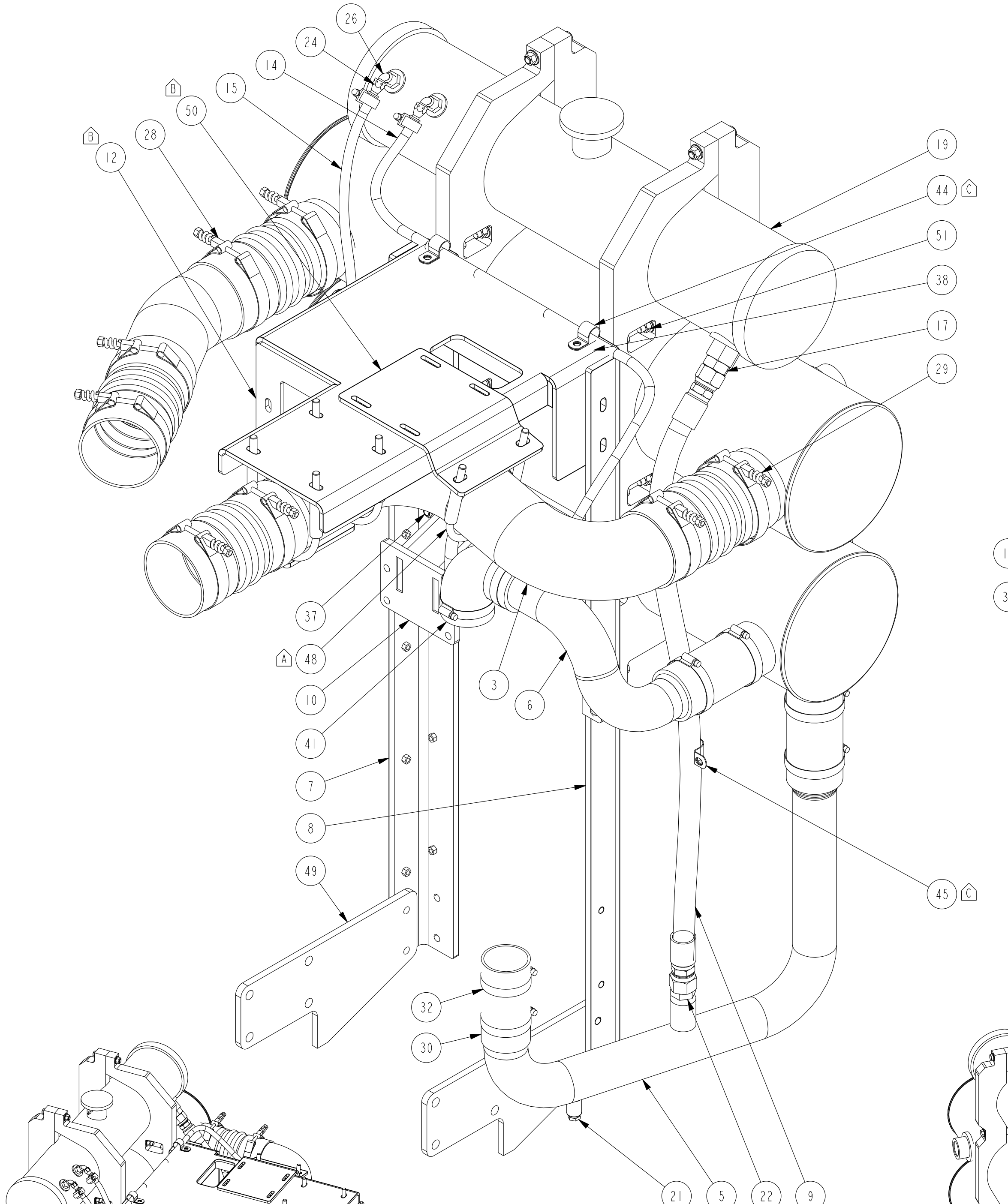
EST WEIGHT:

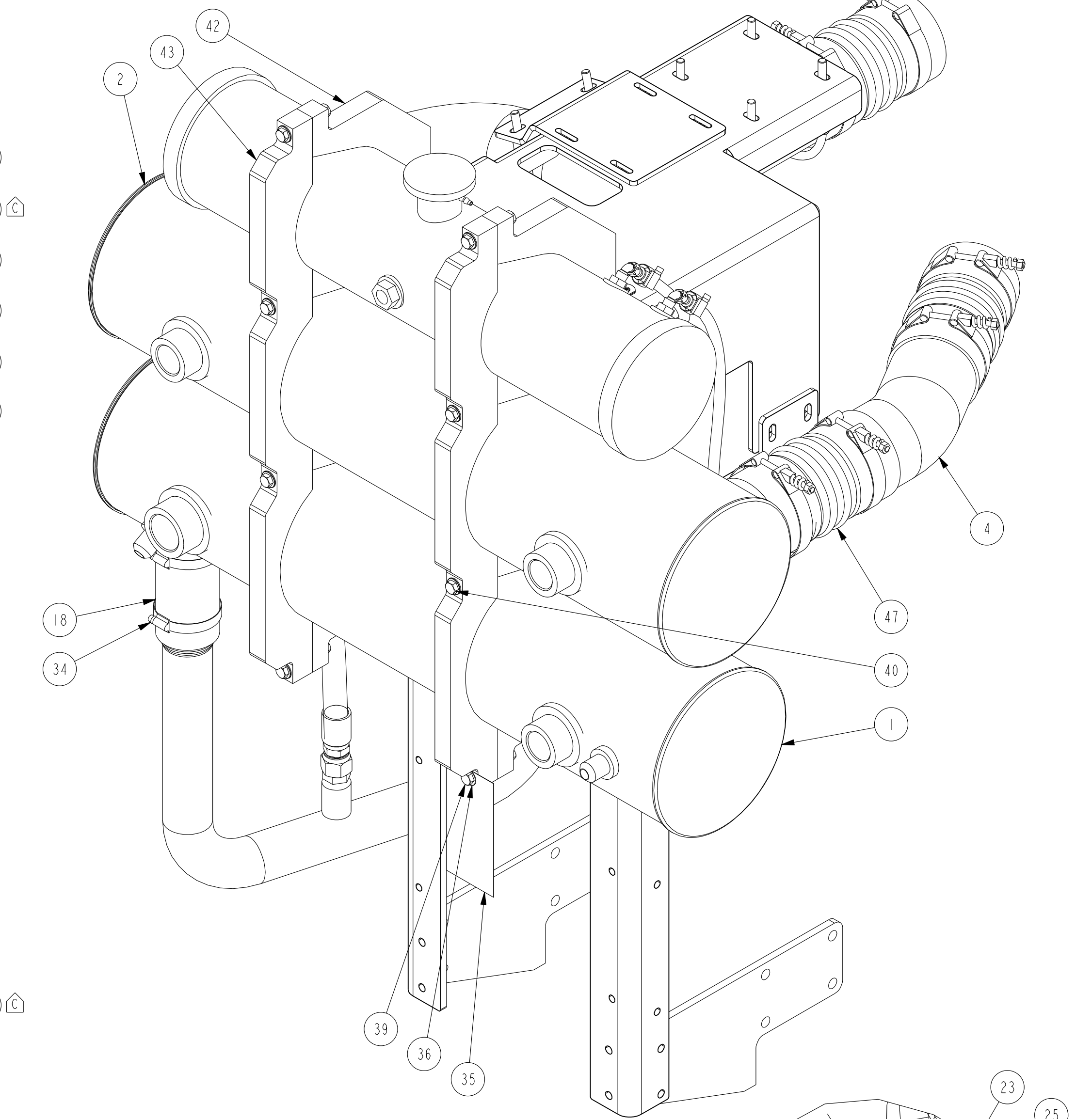
SCALE: 0.100

SHEET 1 OF 1

DRAWING NO: A042D247

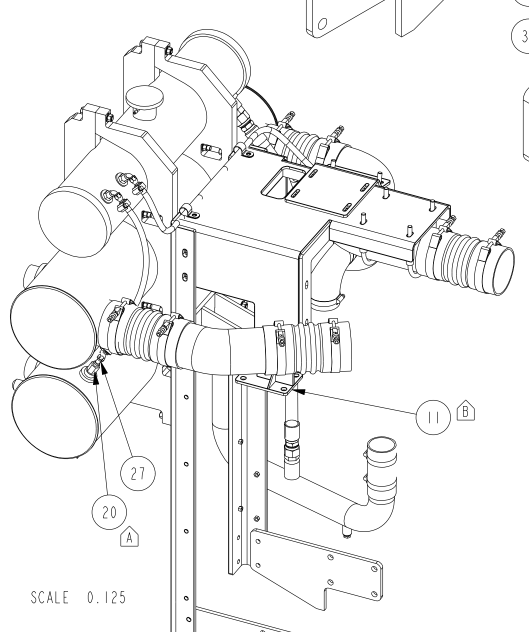
REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE





ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	COOLER, JACKET WATER, CFP15E	10847
2	1	HEAT EXCHANGER, CAC,, CFP15E	10848
3	1	TUBE, INTAKE, CFP9E, HHP	23148
4	1	TUBE, INTAKE, CFP9E, HHP	23150
5	1	TUBE, LOWER JW, CFP9E	24784
6	1	TUBE, UPPER JW, CFP9E	24786
7	1	SUPPORT, LH HEAT EXCAHNGER, CFP9E	24787
8	1	SUPPORT, RH HEAT EXCAHNGER, CFP9E, HHP	24788
9	1	HOSE, JW FILL	A042D241
10	1	BRACKET,HEAT EXCHANGER MOUNTING, CFP9E, HHP	A042D263
11	1	BRACKET, CAC TUBE, CFP9E	A042E578
12	1	BRACKET, CAC TUBE, CFP9E	A042E579
13	1	HOSE, VENT LINE, 3/8" ID x 8.00	R-801-6
14	1	HOSE, VENT LINE, 1/4" ID x 37.00	R-801-4
15	1	HOSE, VENT LINE, 1/4" ID x 18"	R-801-4
16	16	COOLANT, FC EG PM, 1 GALLON	CC2743
17	1	ADAPTER, MALE JIC 37 DEG X MALE SAE ORB, -12	12235-12-12
18	2	HOSE, CONNECTION, 2.5 ID X 6", 77250GL	8933
19	1	TANK, SURGE, CFP15E, FIREPUMP	10865
20	1	FTG, STR, -6 ORB X -4 FMNPT	12171-6-4
21	1	PLUG. PIPE, -4 NPT	12210-4
22	1	FTG, STR, -12 JIC X -12 NPT	12238-12-12
23	1	TEE, M BRANCH, -4 NPT	12533-4
24	4	HOSE END, STR, -4 FLR X -4 HS	12543-4-4
25	1	FTG, STR, -6 BARB X -4 NPT	12548-6-4
26	3	ELB, 90 DEG, -4 FLR X -4 NPT	12550-4-4
27	1	ELB, 45 DEG, -4 FLR X -4 NPT	12551-4-4
28	6	CLAMP, SPRING LOADED T-BOLT, 4.03-4.33	12975-0425
29	2	CLAMP, SPRING LOADED T-BOLT, 4.28-4.58	12975-0450
30	1	HOSE,COOLANT, DAYCO G.L., STRGHT-77225GL, 2-1/4" I.D. x 5.00"	14133_002
31	6	CLAMP, WORM, .63 - .88	14990-06
32	2	CLAMP, WORM, 1.56 - 2.50	14990-32
33	2	CLAMP, WORM, 1.81 - 2.75	14990-36
34	4	CLAMP, WORM, 2.06 - 3.00	14990-40
35	1	TAG, ENGINE WEIGHT	16825
36	36	WASHER,FLAT,SMALL, 0.38	20010-038
37	4	SCREW,HH, 0.38-16x1.25	20238-125
38	6	SCREW,HH, 0.38-16x1.75	20238-175
39	4	SCREW,HH, 0.38-16x2.75	20238-275
40	4	SCREW,HH, 0.38-16x7.50	20238-750
41	1	ELBOW, MOLDED, 2.25" I.D.	21194-002
42	2	CLAMP, HEAT EXCHANGER MOUNTING, CFP9E, HHP	21832
43	2	CLAMP, HEAT EXCHANGER MOUNTING, CFP9E, HHP	21833
44	2	CLAMP, LOOM, 0.75 ID	26963-12
45	1	CLAMP, LOOM, 1.00 ID	26963-16
46	1	HOSE,FUEL LINE,5/16ID, 72"L	27003
47	4	HOSE, HUMP, 4" I.D. X 7.5"L, CAC	3071049
48	3	CLAMP, U-BOLT, GUILLOTINE, 4.00", PLATED	89548K
49	2	BRACKET, MOUNTING	A042D283
50	1	BRACKET, CAC TUBE	A042E614
51	18	NUT,HEX,PT, .38-16	20130-038

BILL OF MATERIAL (C)



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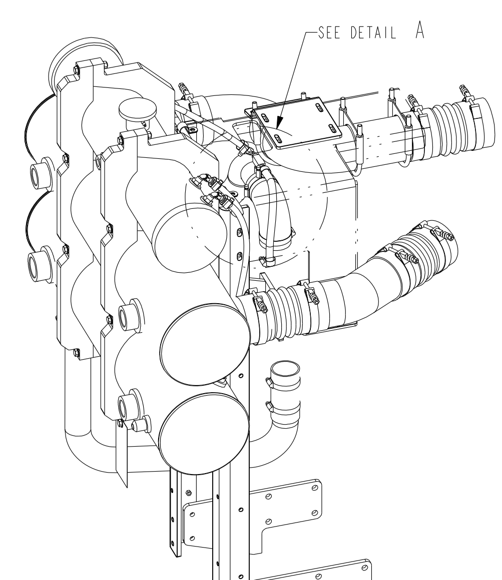

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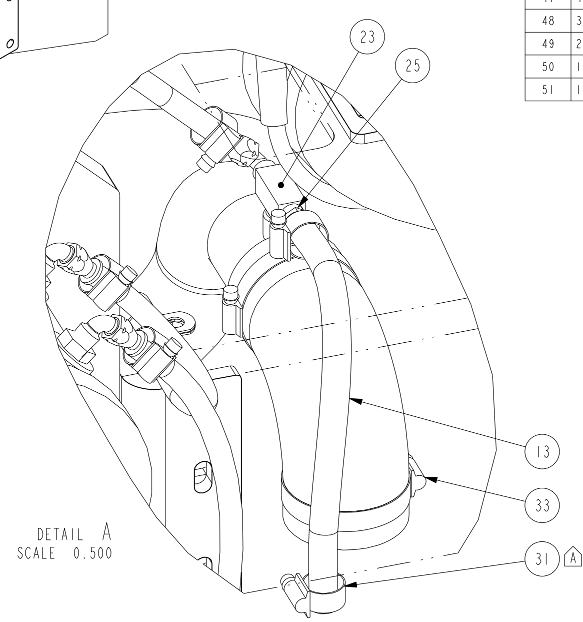

DETAIL A
SCALE 0.500

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2016-152	REPLACED LTL-SCPV12627 & 13745 W/ 26963-12 & 26963-16	KMS	04MAR2016
B	2015-317	89548K WAS QTY 1. ADDED A042E578, A042E579 AND A042E614	PBS	28MAY2015
A	2015-177	ADDED BRACKET A042E250, 89548K, 12171-6-4 AND SHEET 2. 14990-06 QTY WAS 1	PBS	19MAR2015

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

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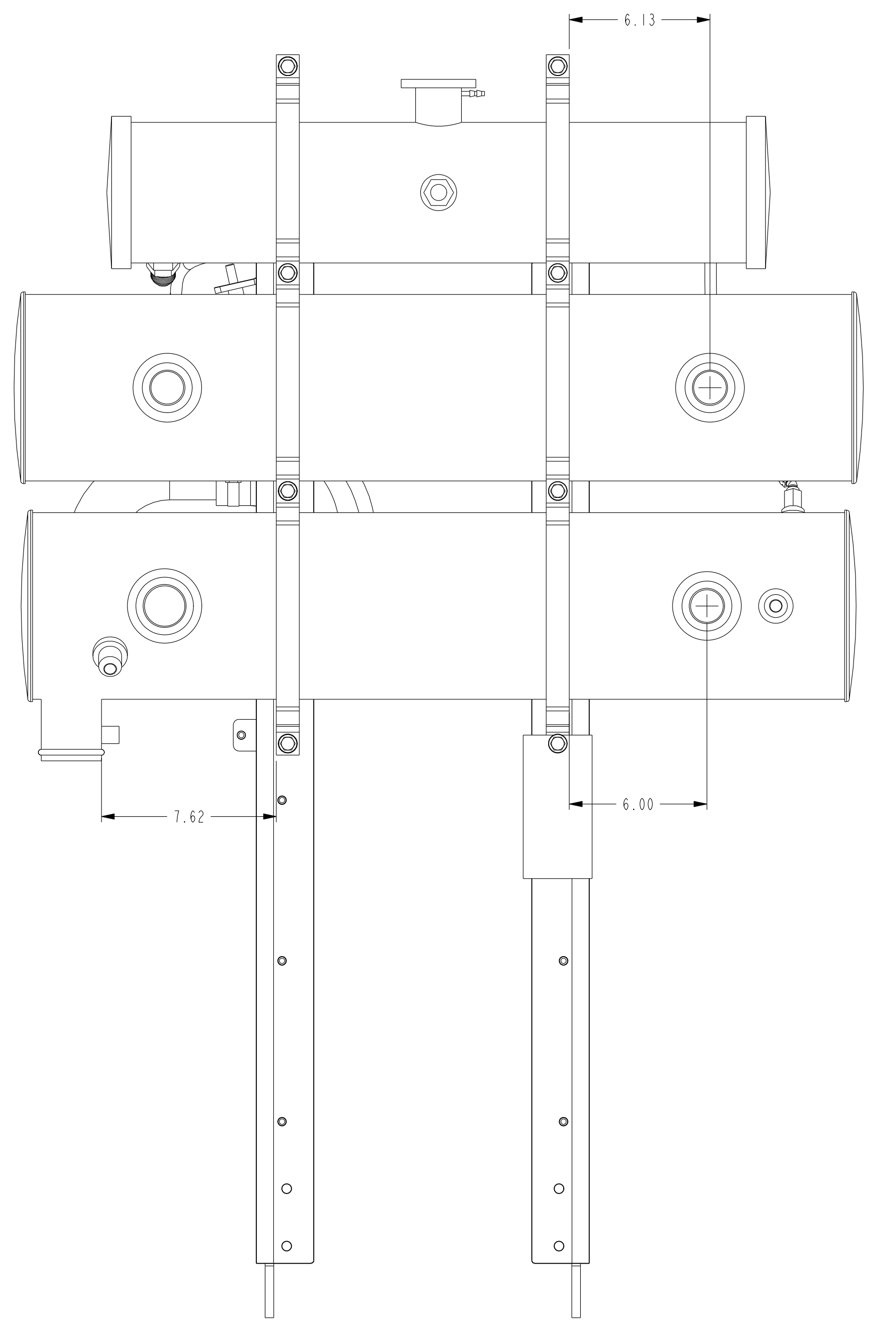
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, HEAT EXCHANGER
CFP9E, HHP

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 08MAR2013
	PRO-ENGINEER	INIT ECO: 2013-135
SCALE: 0.250	SHEET 1 OF 2	DRAWING NO: 24782
EST WEIGHT:		



REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2016-152	REPLACED LTL-SCPV12627 & 13745 W/ 26963-12 & 26963-16	KMS	04MAR2016
B	2015-317	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	28MAY2015

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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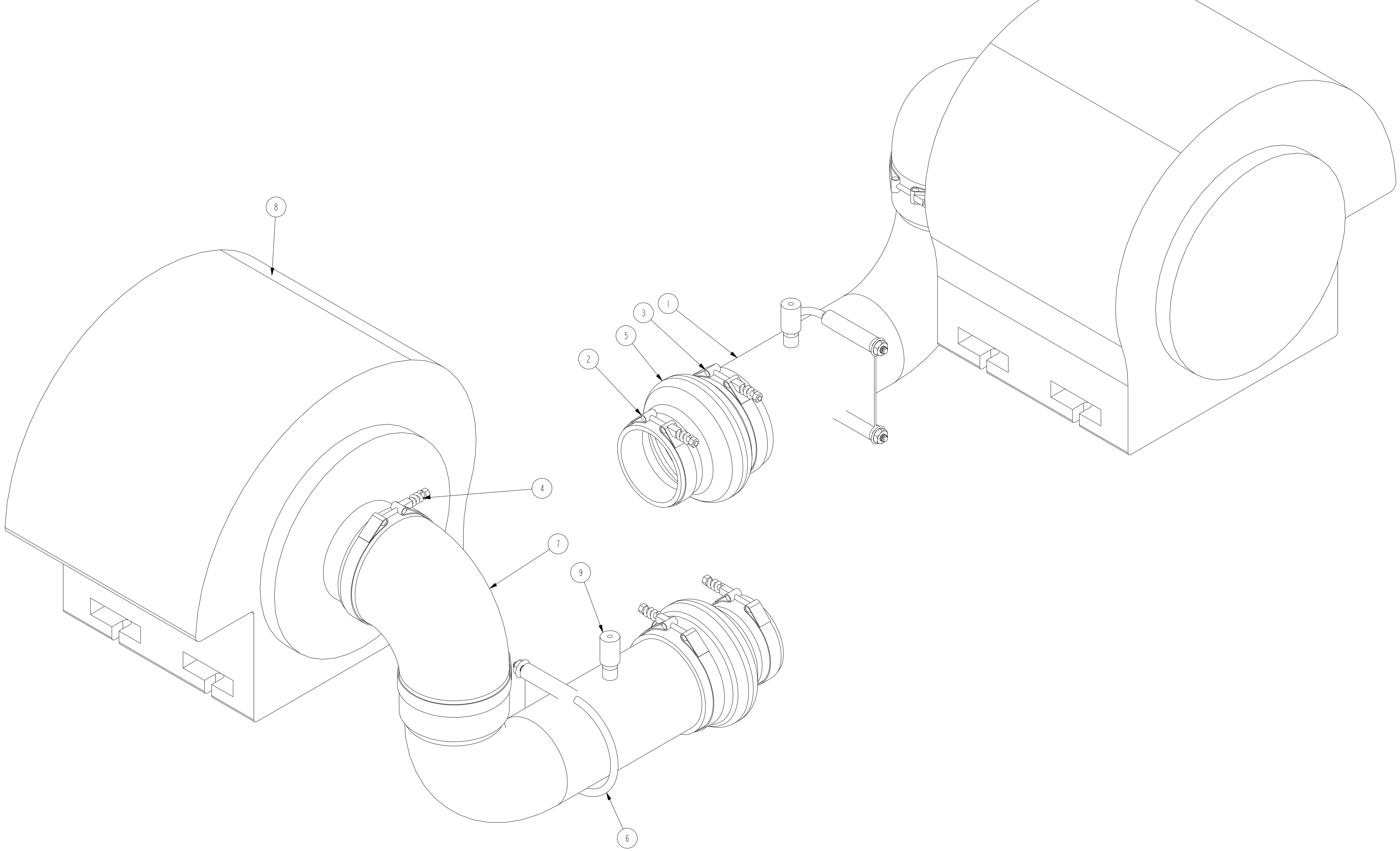
ASSEMBLY, HEAT EXCHANGER
CFP9E, HHP

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 08MAR2013
	PRO-ENGINEER	INIT ECO: 2013-135
SCALE: 0.250	SHEET 2 OF 2	DRAWING NO: 24782
EST WEIGHT: 42238.628		

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	TUBE, INTAKE, HEAVY DUTY AIR CLEANER, CFP9E	24442
2	1	CLAMP, SPRING LOADED T-BOLT, 4.28-4.58	12975-0450
3	2	CLAMP, SPRING LOADED T-BOLT, 5.28-5.58	12975-0550
4	1	CLAMP, SPRING LOADED T-BOLT, 5.78-6.08	12975-0600
5	1	HUMP HOSE REDUCER, 5.0" x 4.0"	3316618S
6	1	CLAMP, U-BOLT, GUILLOTINE, 5.00", PLATED	89549K
7	1	ELBOW, REDUCING, 5.5" TO 5", PUROSIL: 90L55R50	A042E783
8	1	FILTER, AIR	AH1101
9	1	RESTRICTION INDICATOR, 1/8" NPT	RAX00-2352



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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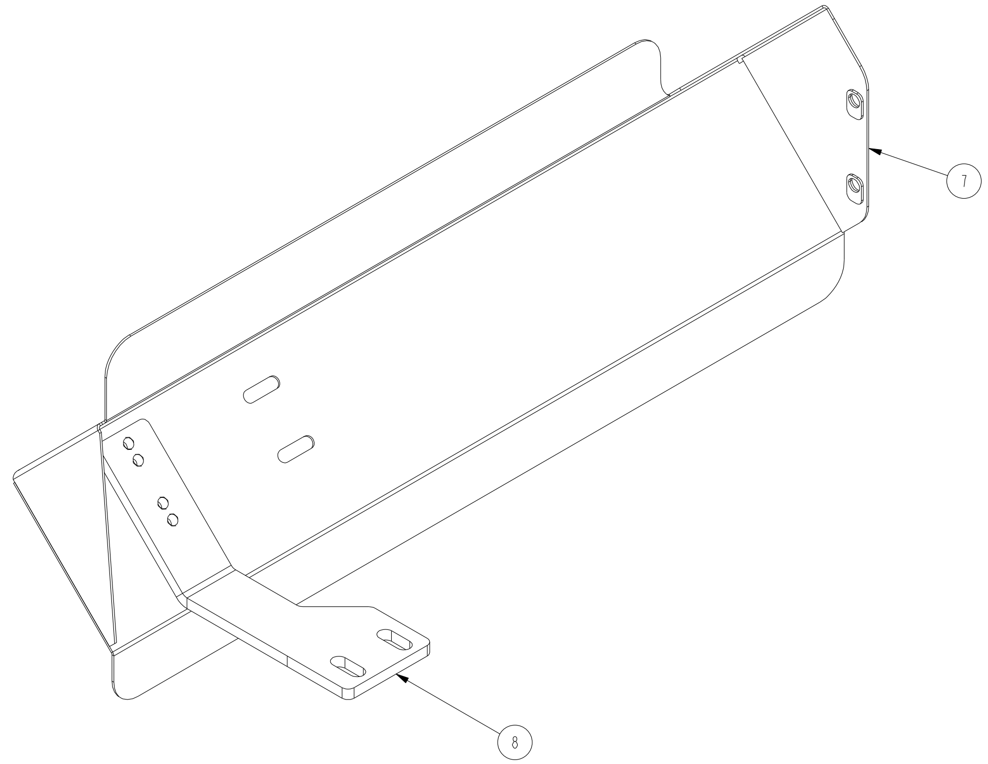
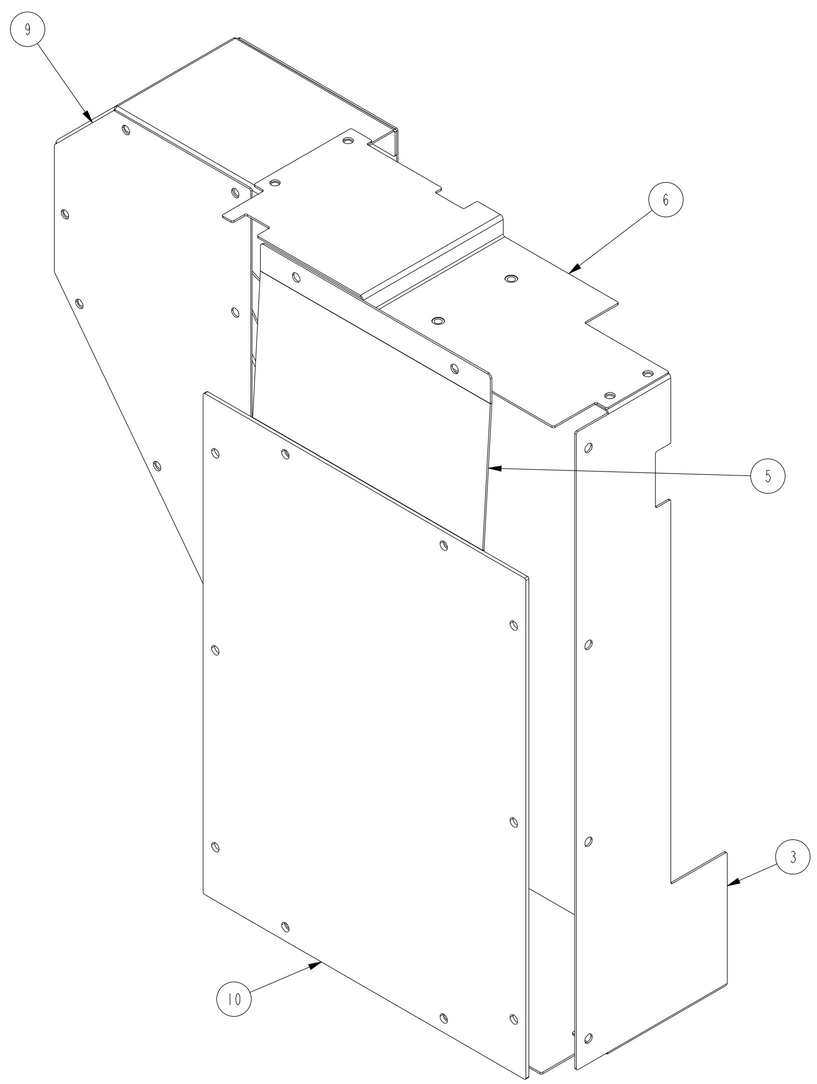
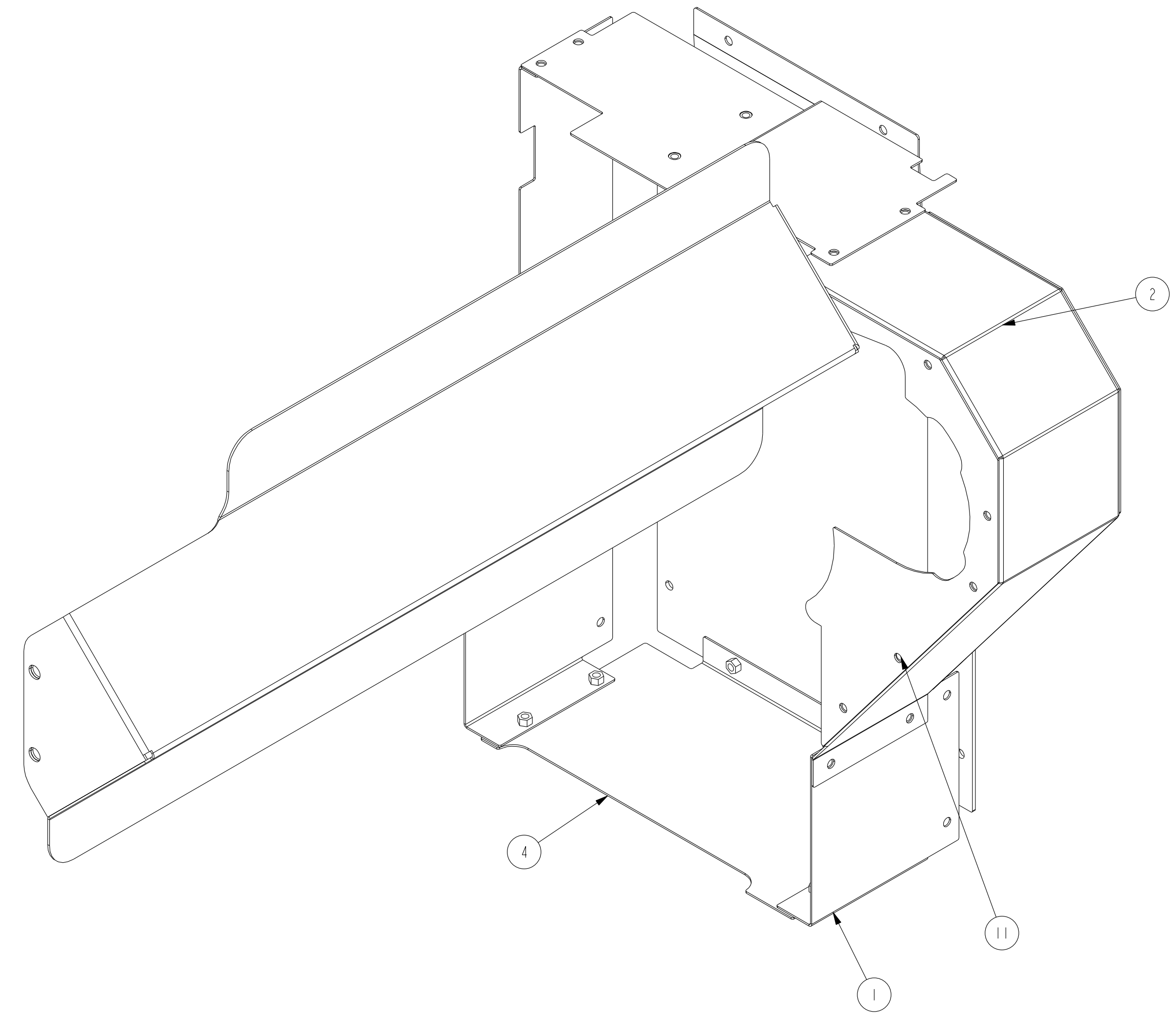
ASSEMBLY, STANDARD AIR FILTER
CFP9E HHP

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 14DEC2015
	PRO-ENGINEER	INIT ECO: 2015-792
SCALE: 0.375	SHEET 1 OF 1	DRAWING NO: A042F826
EST WEIGHT:		







BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	PANEL, LH SIDE	25459
2	1	GUARD, ALTERNATOR	25460
3	1	PANEL, LH SIDE	A042D268
4	1	PANEL, BOTTOM	A042D269
5	1	PANEL, UPPER FRONT	A042D270
6	1	GAURD, TOP	A042D272
7	1	HEAT SHIELD, CFP59	15383
8	1	BRACKET, HEAT SHIELD	15431
9	1	GUARD, FRONT ALTERNATOR	21861
10	1	PANEL, FRONT	A042D273
11	1	GUARD, REAR ALTERNATOR	A042D274

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2015-792	DELETED A042F076	PBS	11DEC2015
A	2015-452	ADDED A042F076	PBS	23JUL2015

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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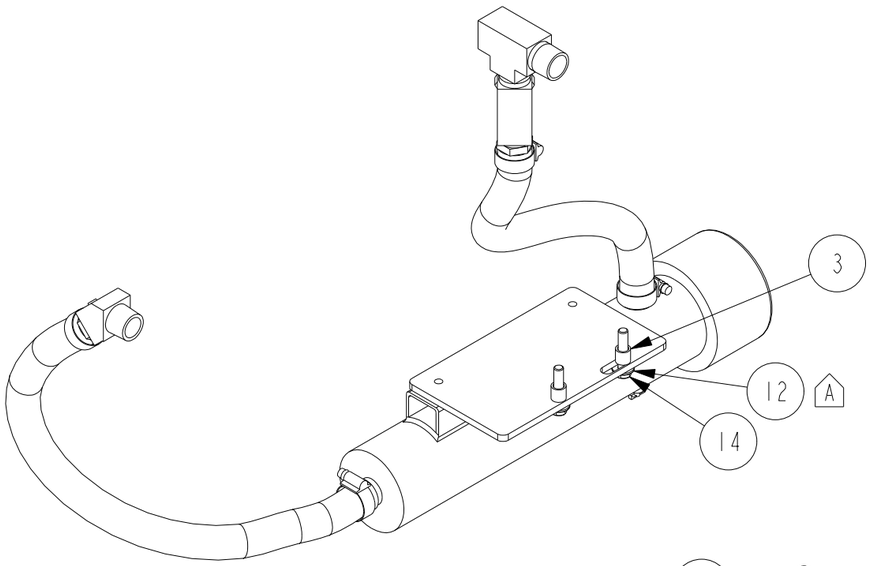
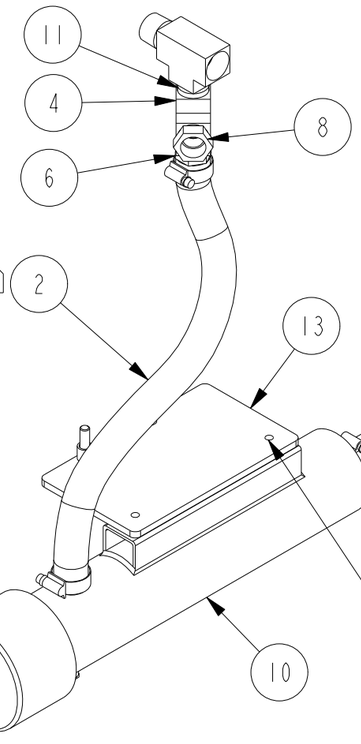
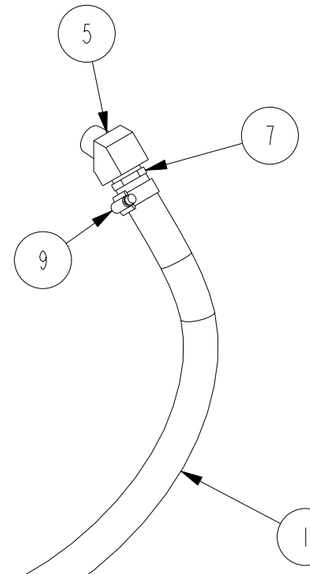
ASSEMBLY, BELT GUARD
CFP9E

DWG UNITS: IN/LB/S	DRAWN BY: PBS	DATE: 08MAR2013
	PRO-ENGINEER	INIT ECO: 2013-135
SCALE: 0.375	SHEET 1 OF 1	DRAWING NO: 24781
EST WEIGHT: 33.898		







BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	HOSE, SILICONE HEATER, 3/4" ID x 23.00"	80242GL
2	1	HOSE, SILICONE HEATER, 3/4" ID x 19.00"	80242GL
3	2	SPACER, 0.5 OD X 0.38 ID X 0.50 LG	9618
4	2	TEE, UNION, -12 NPT	12531-12
5	1	ELB, 45 DEG, -12 NPT X -12 FMNPT	12532-12-12
6	1	FTG, STR, -12 BEAD X -12 NPT	12545-12-12
7	1	FTG, STR, -12 BARB X -12 NPT	12548-12-12
8	1	BUSH, RED, -12 NPT X -8 FNPT	14783-12-8
9	4	CLAMP, WORM, .88 - 1.25	14990-12
10	1	HEATER, COOLANT, 2250W, 120/240 VOLT, 150 DEGREE THERMOSTAT	15167
11	2	NIPPLE, MARINE GRADE, 3/4" X 1-3/8"	15761
12	2	WASHER,FLAT, M8	20020-M8
13	1	BRACKET, COOLANT HEATER MOUNTING, CFP9E	23527
14	2	SCREW,HH, M8-1.25x40	20308-040

A NOTES:
1. ATTACH HOSE TO HEATER WITH OUT RADIAL TWIST
2. APPLY THREAD SEALANT ON ALL NPT THREADS

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B	2014-057	80242GL REPLACED 14194	S DUBICK	13-FEB-14
A	2013-013	ADDED HARDWARE AND NOTES	PBS	11-JAN-13

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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HEATER, COOLANT, ASSEMBLY
CFP9E

DWG UNITS: IN/LB/S

DRAWN BY: PBS

PRO-ENGINEER

DATE: 19NOV2012

INIT ECO: 2012-550

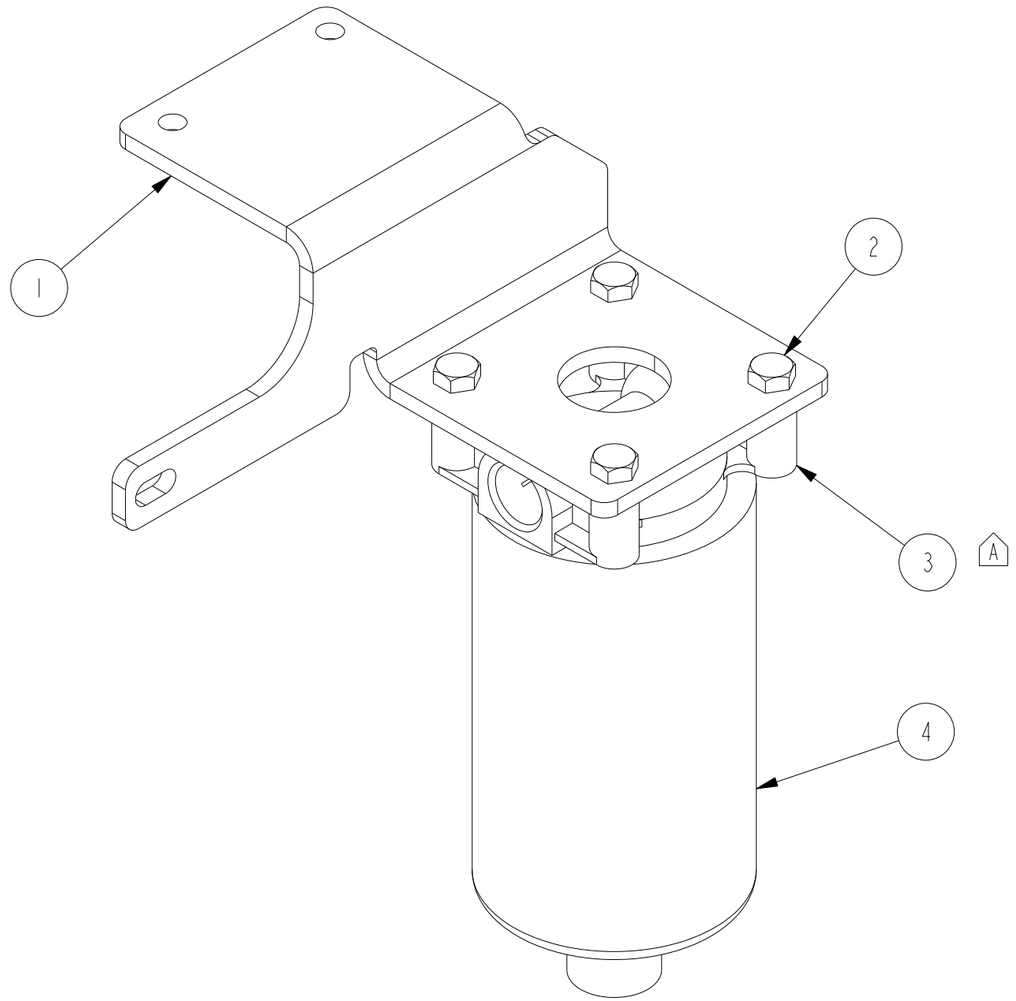
SCALE: 0.200

EST WEIGHT: 13.846

SHEET 1 OF 1

DRAWING NO: 23526

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	BRACKET, COOLING LOOP SUPPORT, UPPER, CFP9E	13583
2	4	SCREW,HH, 0.38-16x1.00	20238-100
3	1	FILTER HEAD, CUMMINS	142784-S
4	1	FILTER, FUEL	FS1212



REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2014-239	142784-S WAS 142784	PBS	16APR2014

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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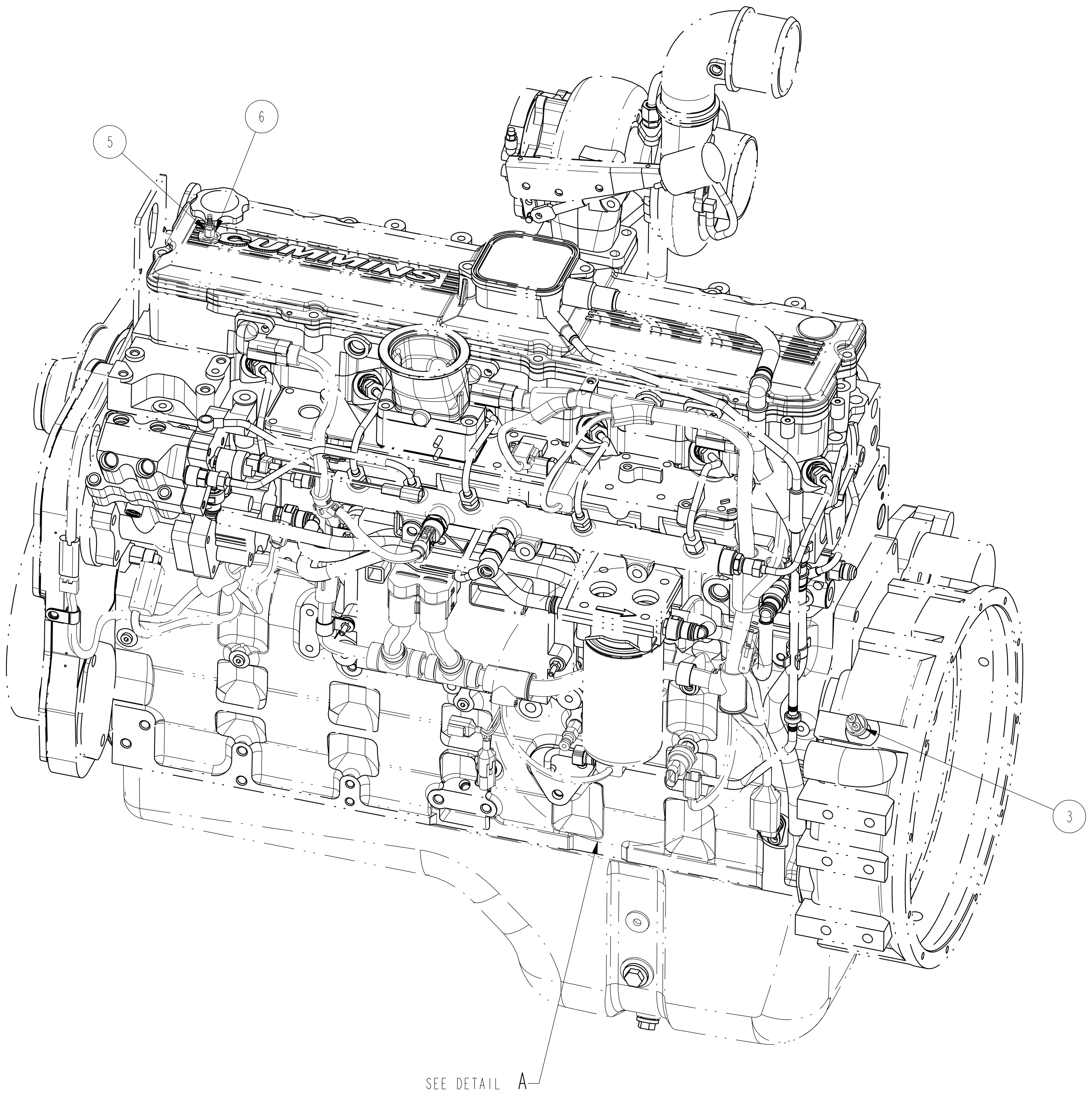
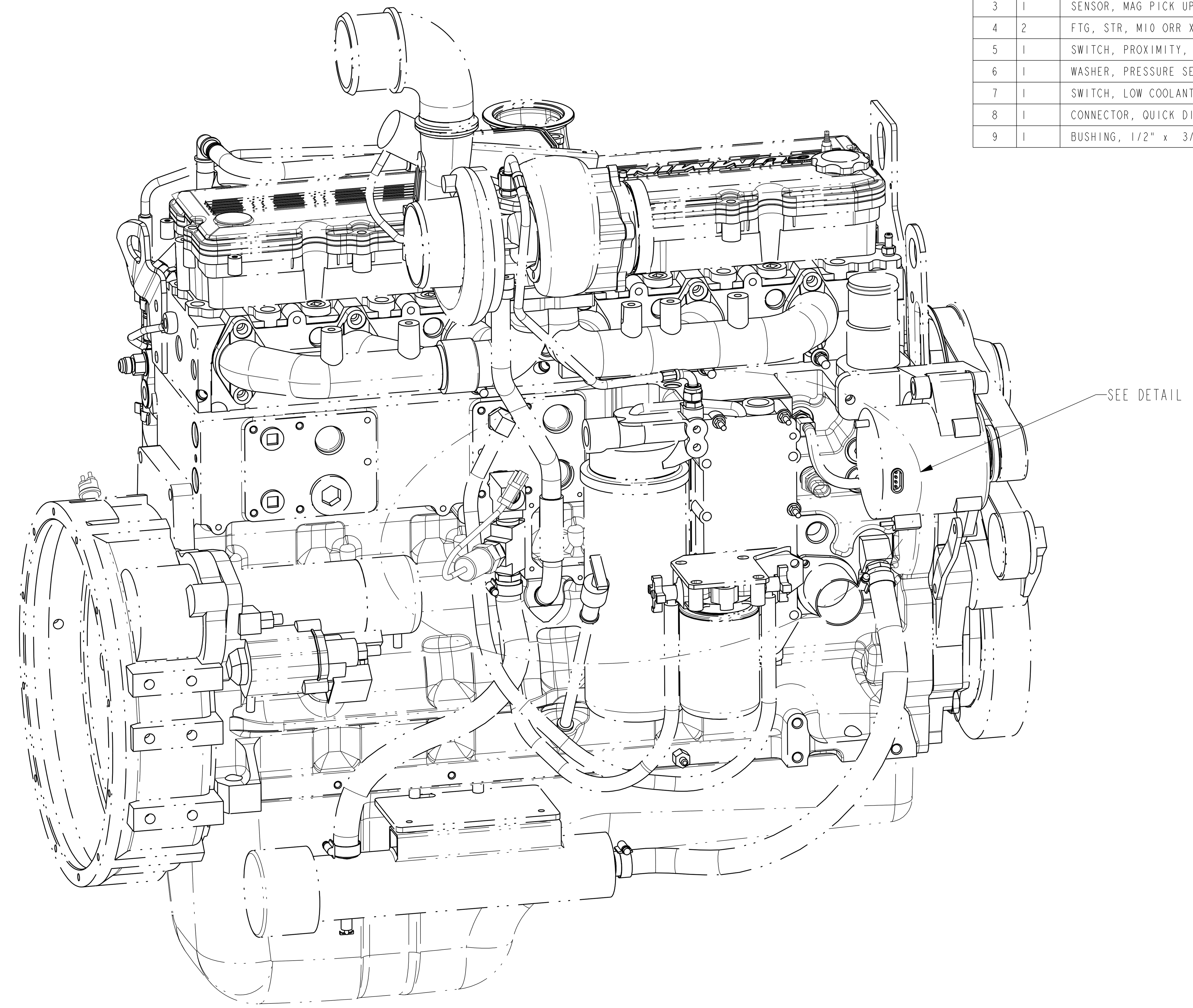
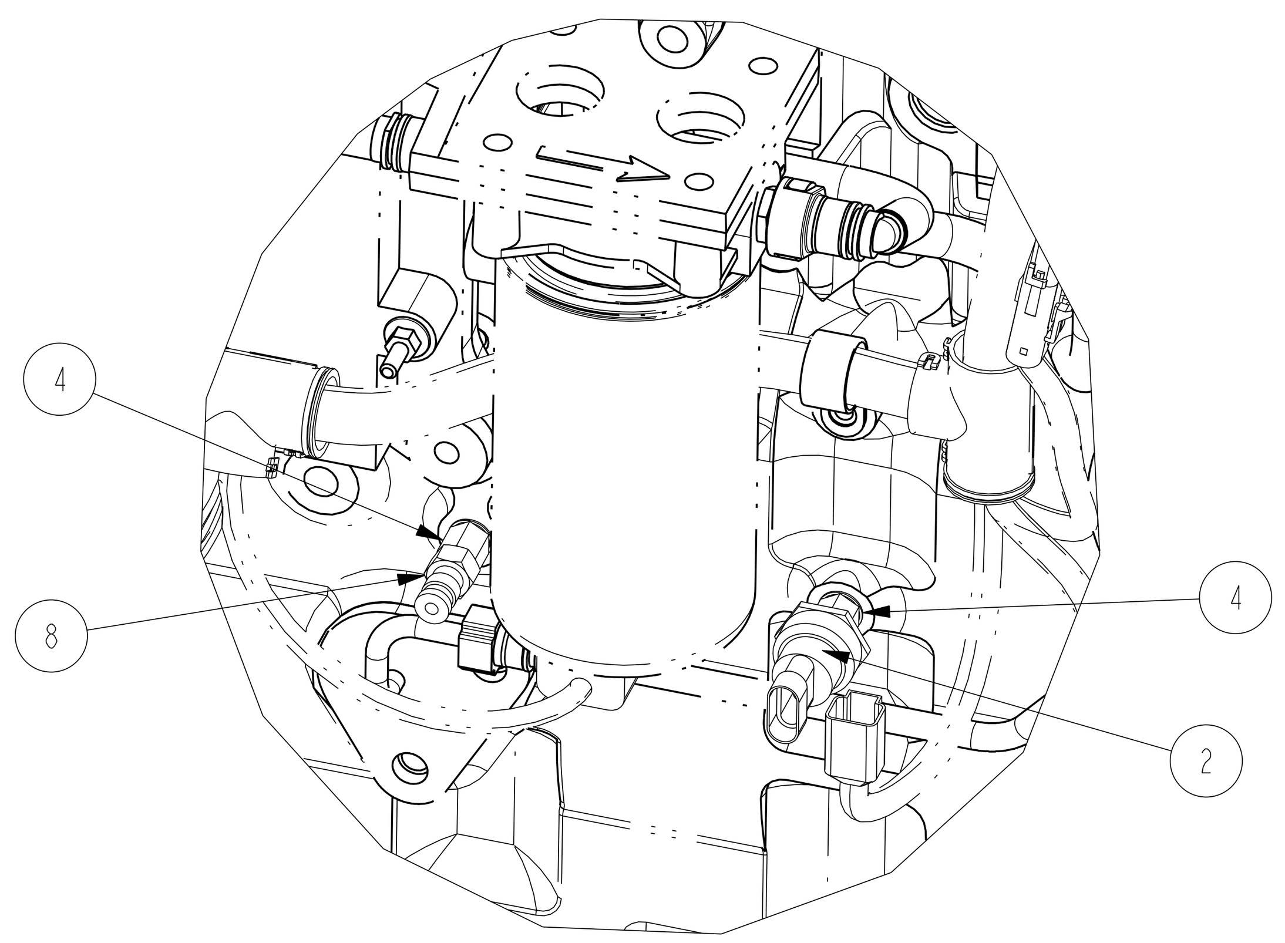
ASSY, FUEL PREFILTER CFP9E

DWG UNITS: IN/LB/S
DRAWN BY: GVD
PRO-ENGINEER
DATE: 15FEB2014
INIT ECO: 2014-049
SCALE: 0.500
EST WEIGHT: 9.226
SHEET 1 OF 1
DRAWING NO: A042A379

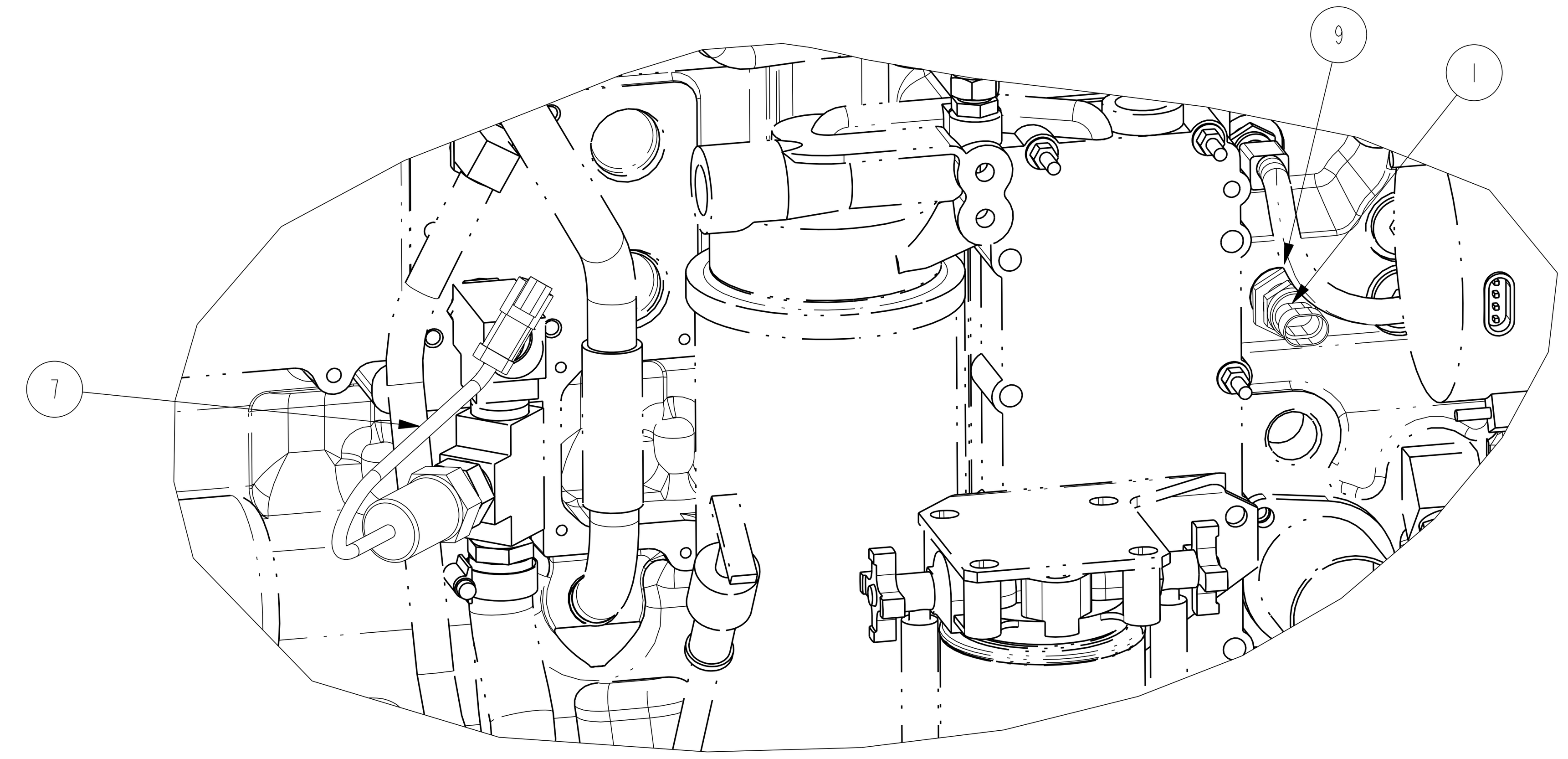
ITEM	QTY	DESCRIPTION	PART NUMBER
BILL OF MATERIAL			
1	1	SWITCH, WATER TEMP, 200F SETTING, #3408632	8860
2	1	SWITCH, OIL PRESSURE, 16 PSI, #3408607	8861
3	1	SENSOR, MAG PICK UP, #5MT2005	9569
4	2	FTG, STR, M10 ORR X -2 FNPT	12181-M10-2
5	1	SWITCH, PROXIMITY, 2M CABLE, 12-24V	12865
6	1	WASHER, PRESSURE SEALING WASHER, -	13769
7	1	SWITCH, LOW COOLANT TEMP, 110° F SET POINT	18105
8	1	CONNECTOR, QUICK DISCONNECT	3377244
9	1	BUSHING, 1/2" x 3/4" NPT	LTL-SRB3412







DETAIL A
SCALE 0.375



DETAIL B
SCALE 0.375

NOTES:
1. ADD THREAD SEALANT TO ALL NPT THREADS

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D1	2014-049	ADDED ITEMS 12865 AND 13769	GVD	13FEB2014
C1	2013-272	ADDED MAG PICK-UP	PBS	14MAY2013

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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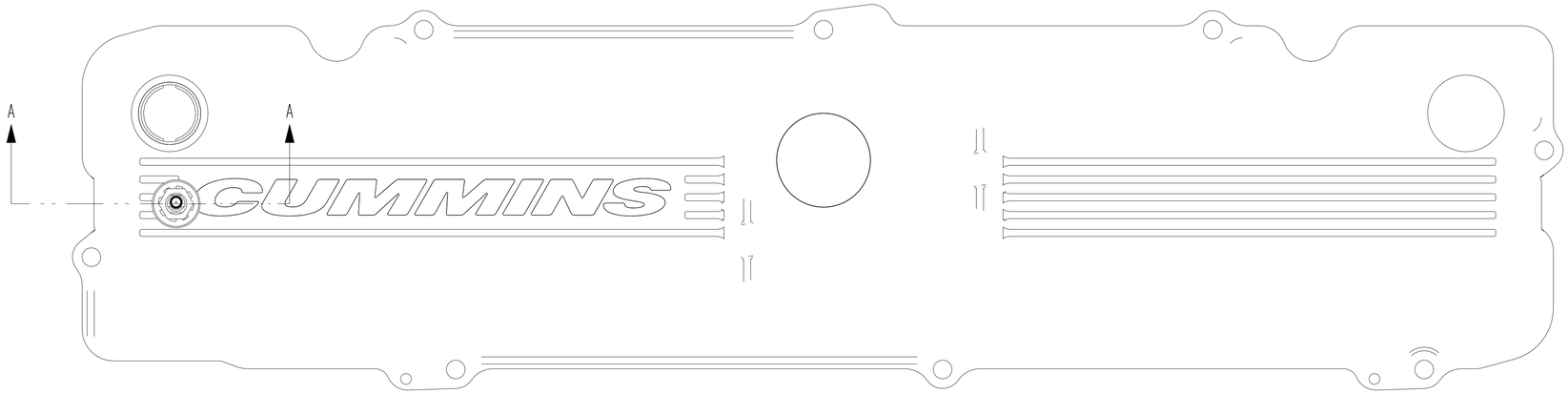
DEPERE, WISCONSIN

KIT, SENSOR & ADAPTER
CFP9E

DWG UNITS: IN/LB/S	DRAWN BY: MAC	DATE: 17SEPT2009
	PRO-ENGINEER	INIT ECO: -
SCALE: 0.250	SHEET 1 OF 2	DRAWING NO: 15602
EST WEIGHT: 3.047		



SECTION A-A
SCALE 2.000

NOTES:
1. USE TOOL 15341 TO SET PROXIMITY SENSOR (12865) HEIGHT
2. USE SOCKET THAT IS MODIFIED TO ACCOMMODATE SENSOR WIRES
3. RE-USE VALVE COVER GASKET AND HARDWARE

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

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

MACHINED SURFACES: 125

	IMPERIAL UNITS	METRIC UNITS
MACHINED SURFACES	.XX ± 0.02 .XXX ± 0.010	.X ± 0.5 .XX ± 0.25
FOR TOLERANCES NOT SHOWN	.XXX ± 0.005 .XXXX ± 0.0005	.XXX ± 0.13 .XXXX ± 0.013

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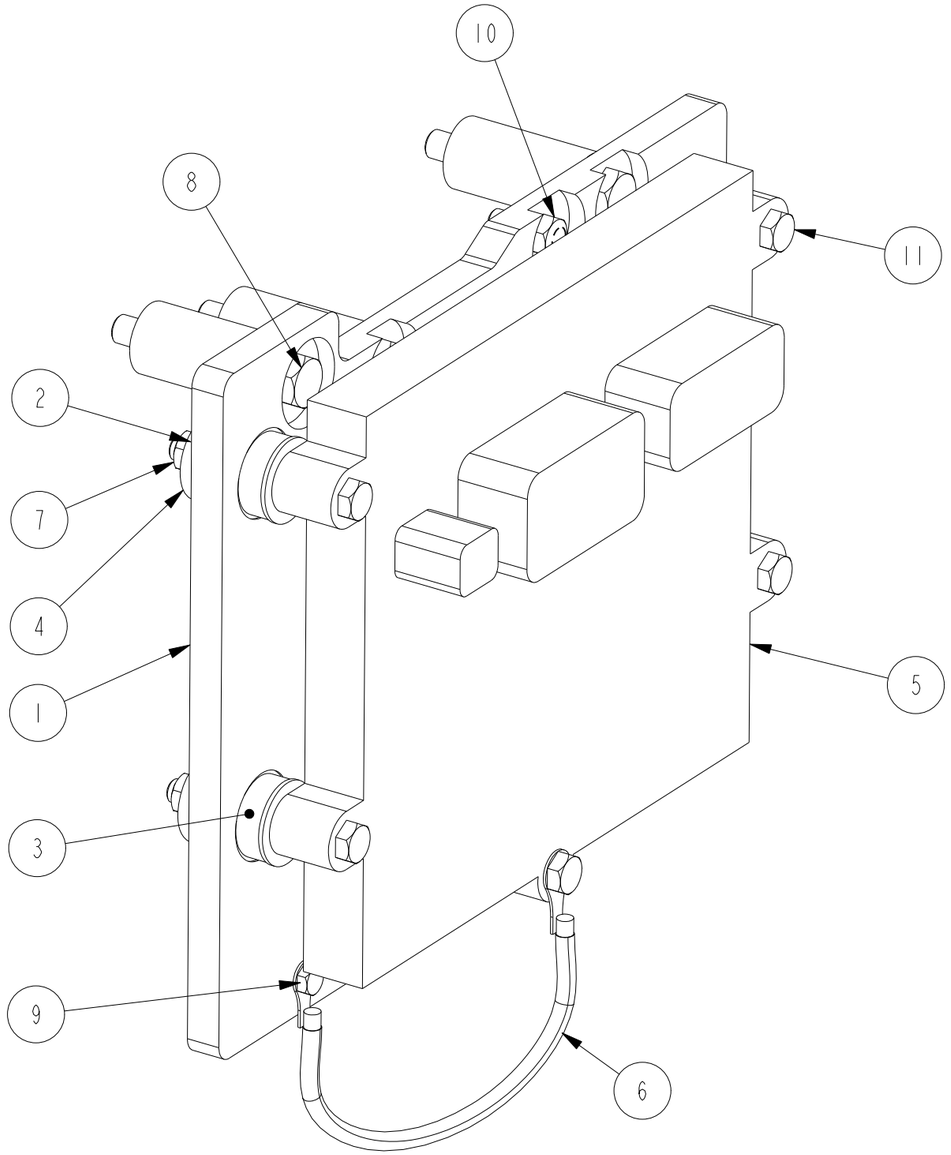
DEPERE, WISCONSIN

KIT, SENSOR & ADAPTER
CFP9E

DWG UNITS: IN/LB/S
DRAWN BY: MAC
DATE: 17SEPT2009
PRO-ENGINEER
INIT ECO: -
SCALE: 0.625
EST WEIGHT: 3.047
SHEET 2 OF 2
DRAWING NO: 15602



BILL OF MATERIAL

B1 A ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	BRACKET, SECONDARY ECM, CFP9E	14842
2	5	WASHER,FLAT, M8	20020-M8
3	5	ISOLATOR, VIBRATION, CUMMINS	3955219
4	5	ISOLATOR, VIBRATION, CUMMINS	3955220
5	1	ECM MODULE, CUMMINS, #4921776	12726
6	1	STRAP,GORUND,6" LONG, RING ENDS	AG-GLFW6
7	5	NUT,HEX,PT, M8-1.25	20140-M8
8	4	SCREW,HH, M10-1.50x70	20310-070
9	1	SCREW,HH, M6-1.00x16MM	20306-016
10	1	SCREW,HH, M8-1.25x20	20308-020
11	5	SCREW,HH, M8-1.25x70	20308-070

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
B1	2014-049	ADDED AG-GLFW6	GVD	17FEB2014
A	2011-056	ADD FASTENERS PER SIX SIGMA	SAD	10MAY2011

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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DEPERE, WISCONSIN

ASSEMBLY, SECONDARY ECM CFP9E

DWG UNITS: IN/LB/S

DRAWN BY: DAN

PRO-ENGINEER

DATE: 18-SEP-09

INIT ECO: -

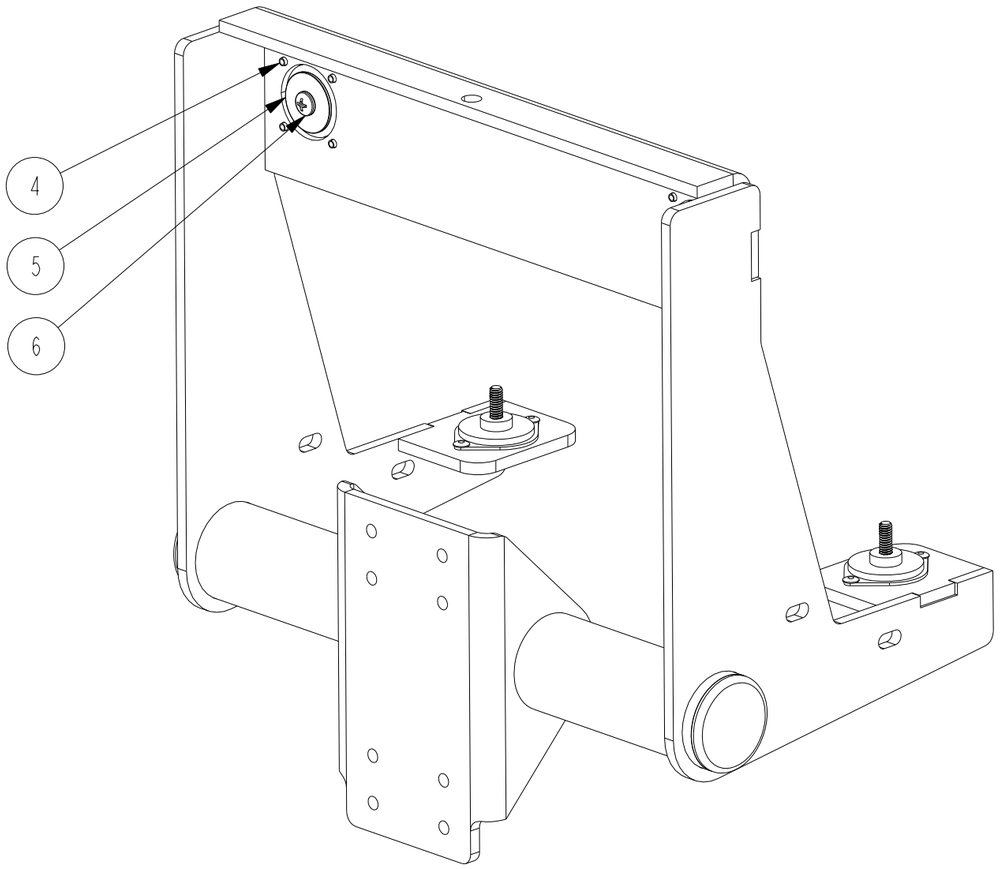
SCALE: 0.500

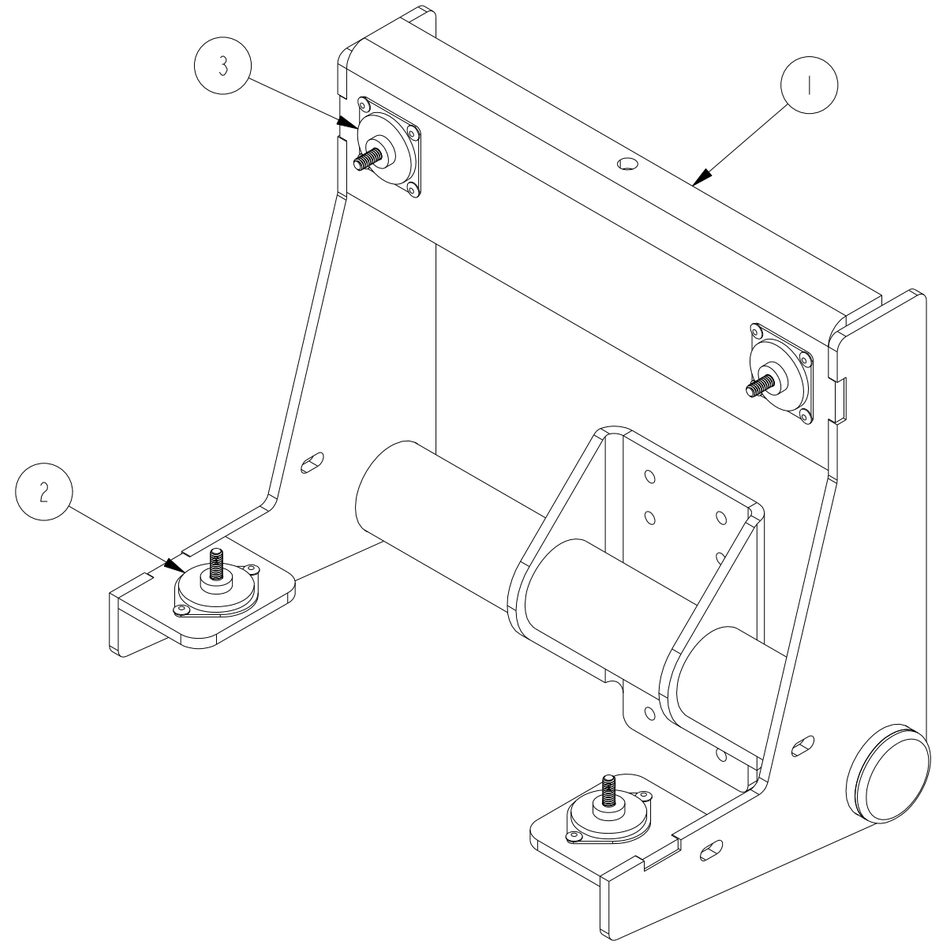
EST WEIGHT: 25.970

SHEET 1 OF 1

DRAWING NO: 15613

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
AND UPFIT CENTER
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

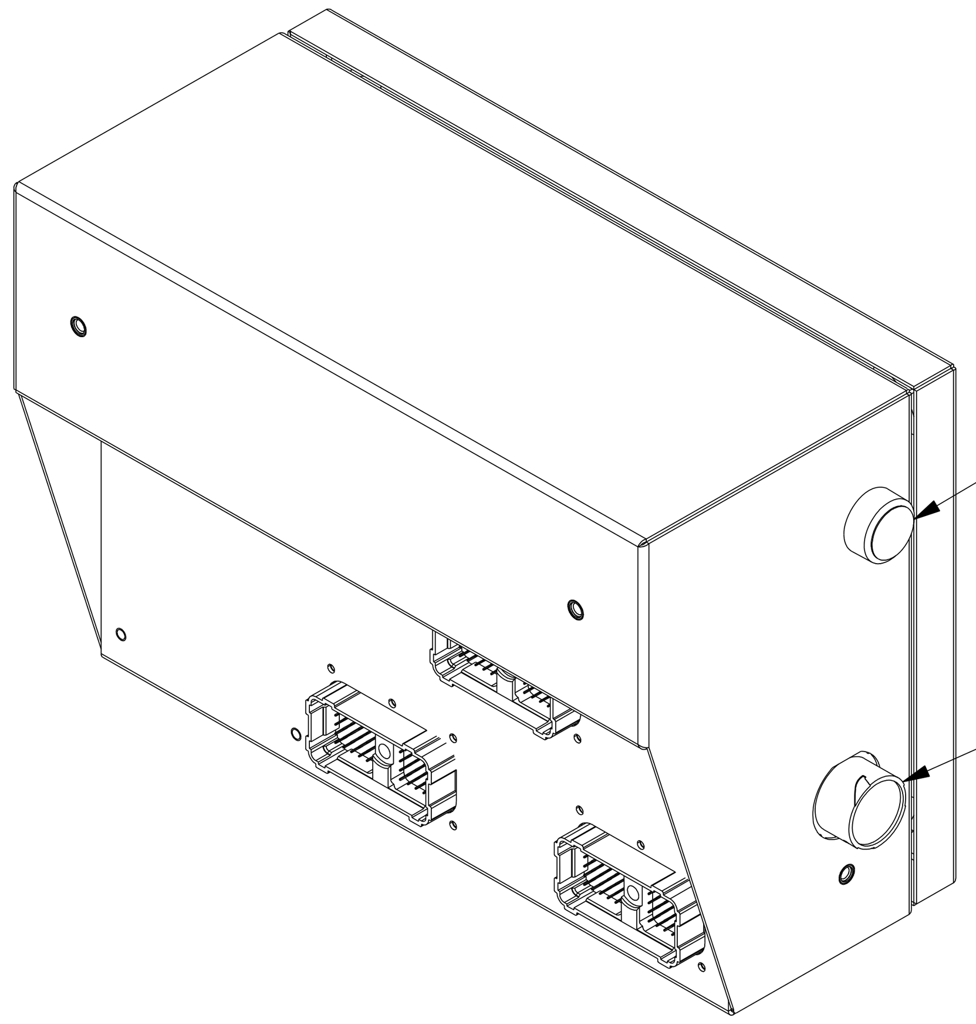
INIT ECO: 2012-392

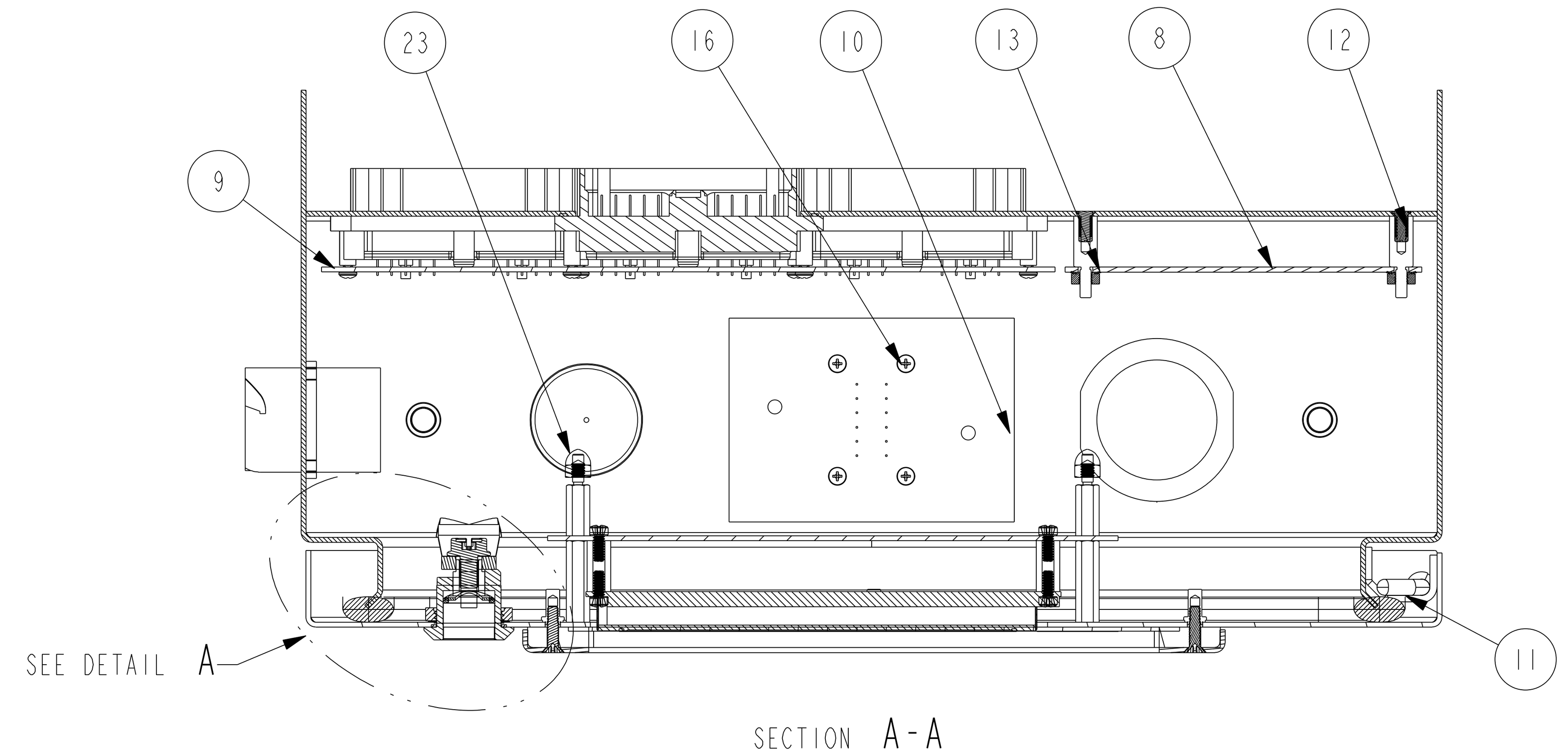
SCALE: 0.333

EST WEIGHT: 16.439

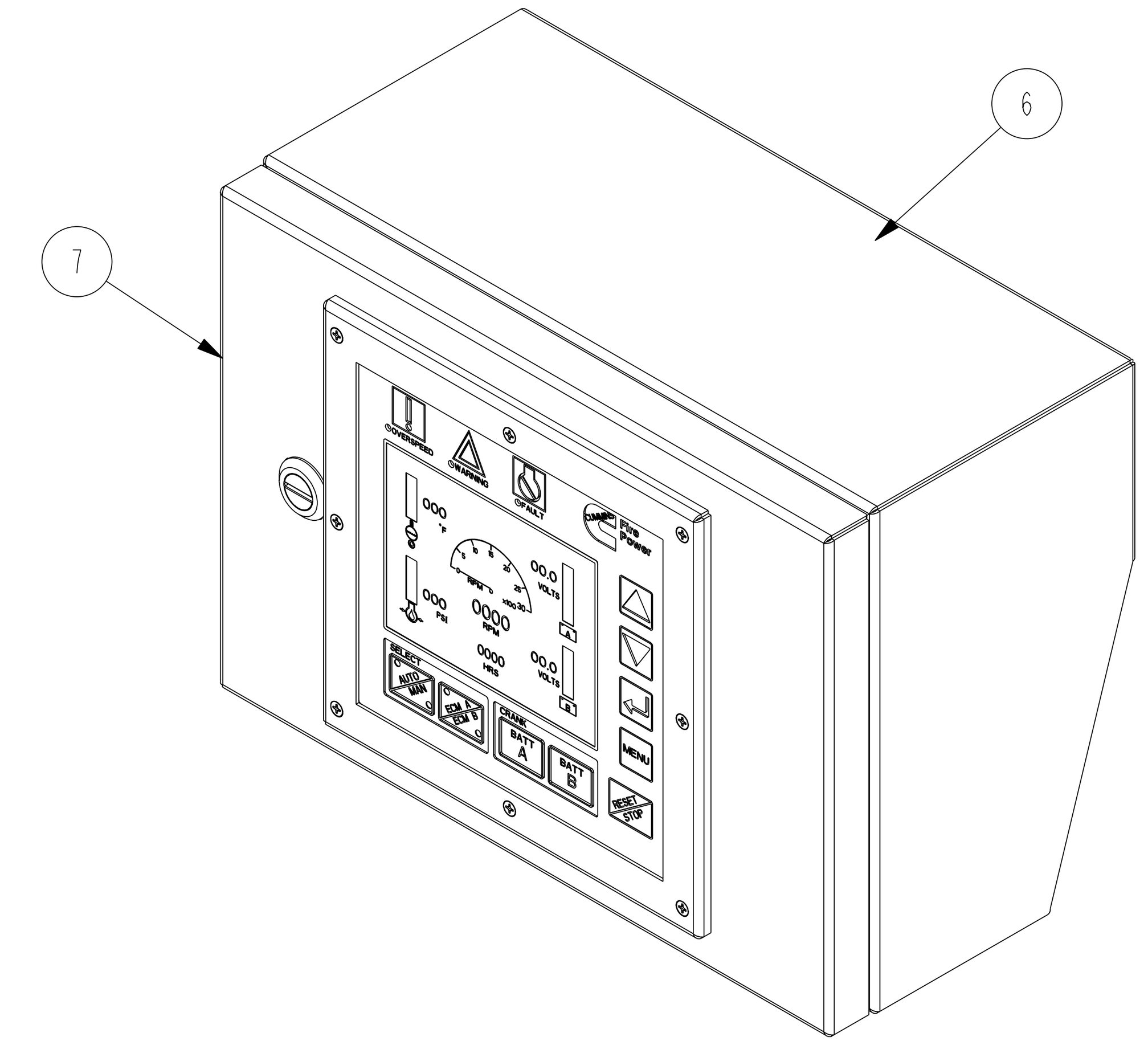
SHEET 1 OF 1

DRAWING NO: 21249



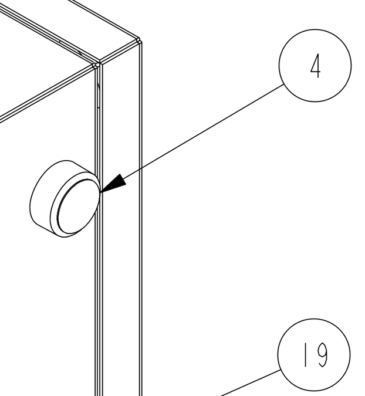


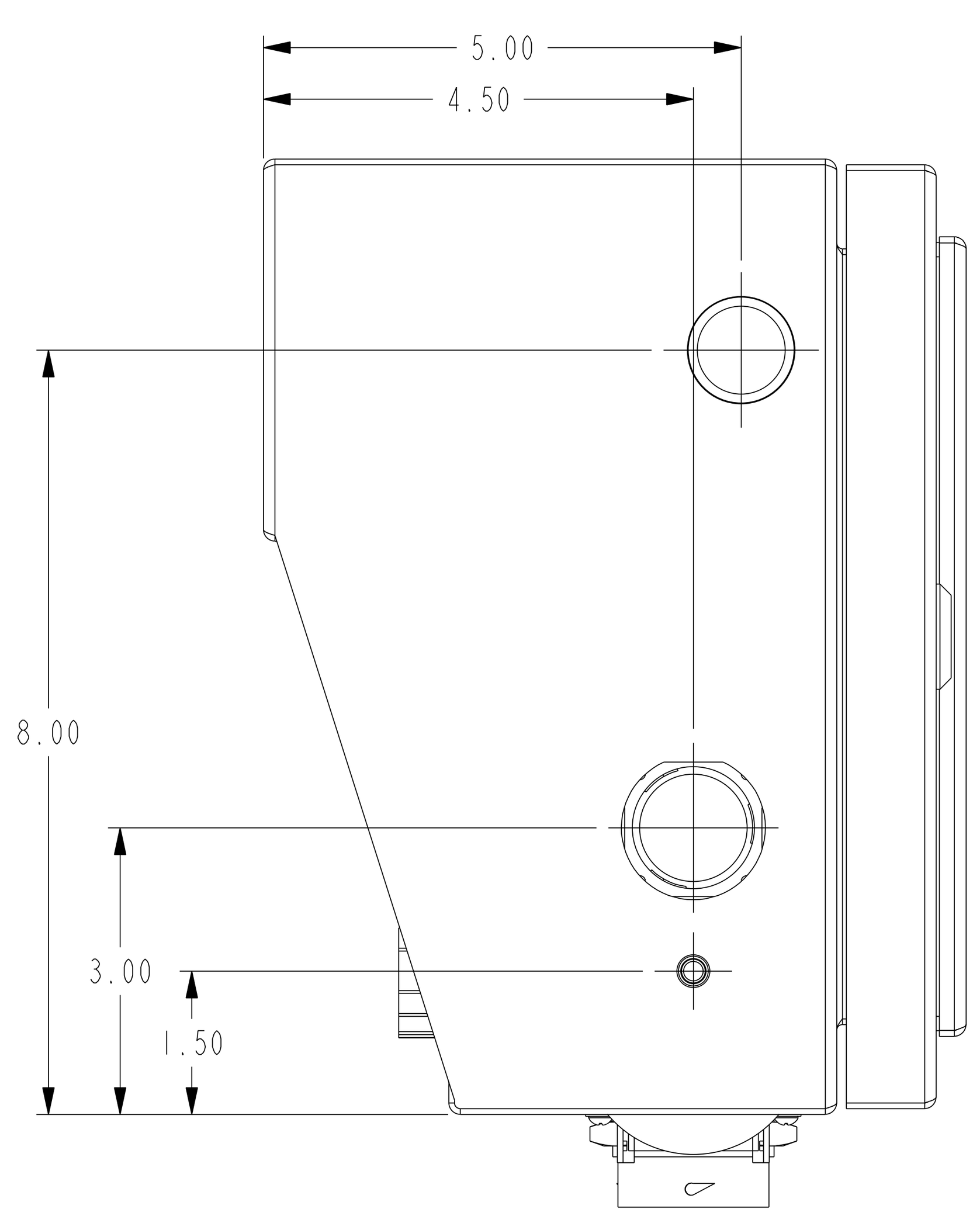
SECTION A-A

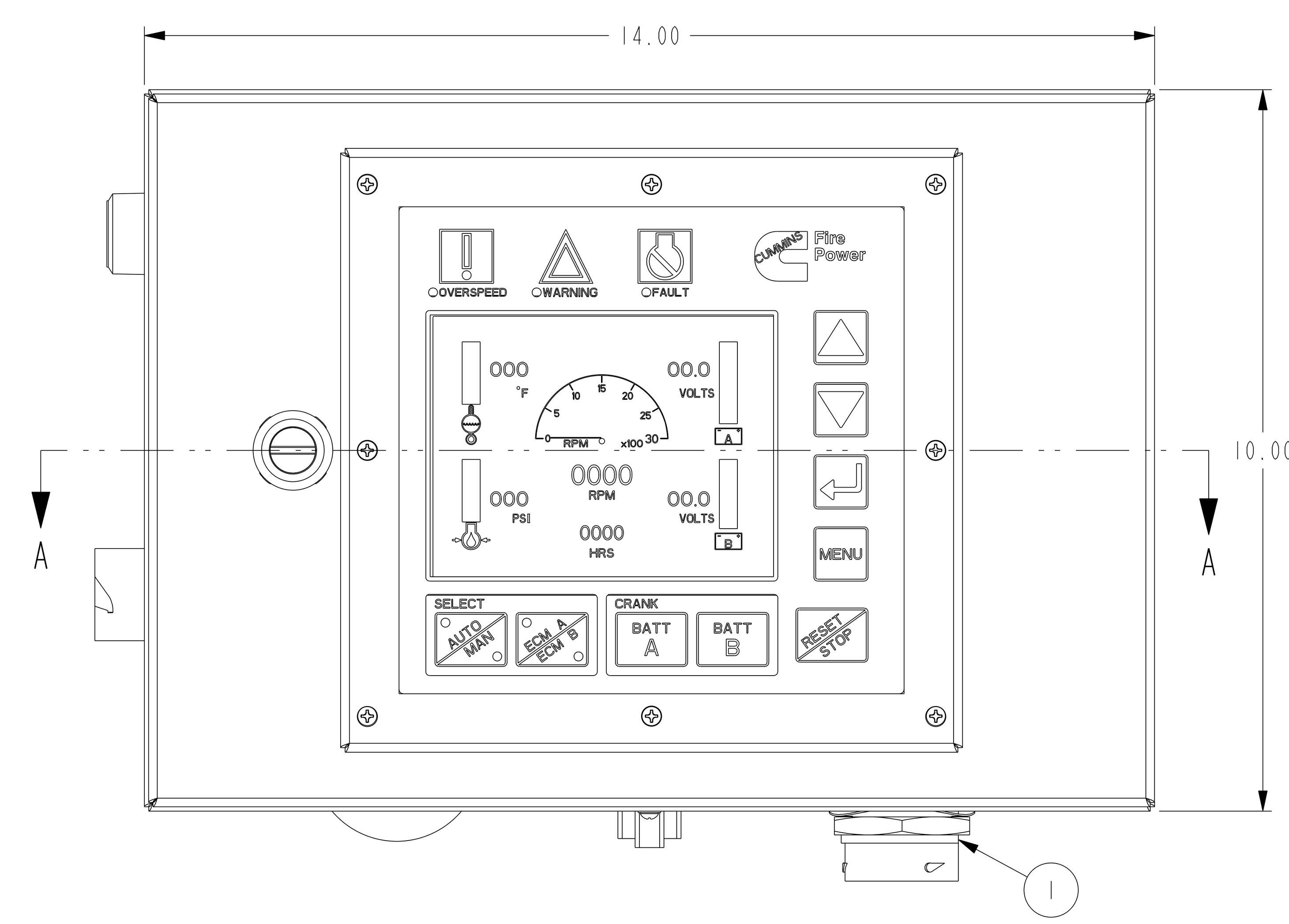


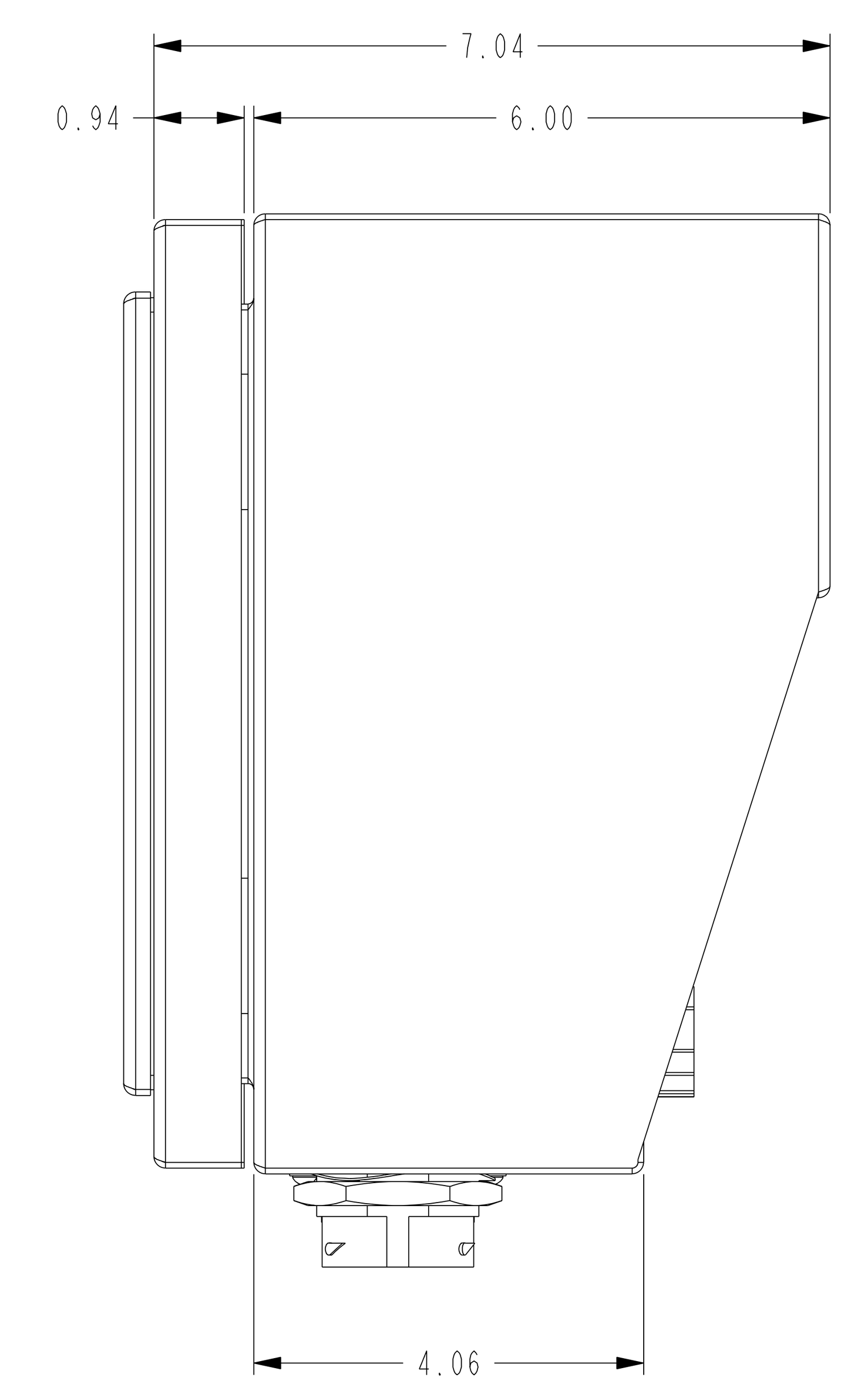
BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ASSY,BULKHEAD WIRING, DIGITAL PANEL, BULKHEAD TO POWER PCB	15156
2	1	CABLE, DIGITAL PANEL, POWER PCB TO DISPLAY PCB	15157
3	1	CABLE, DIGITAL PANEL, POWER PCB TO ECM SWITCH PCB	15158
4	1	ASSY, WIRING, DIGITAL PANEL, ENGINE STOP SWITCH	15160
5	1	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

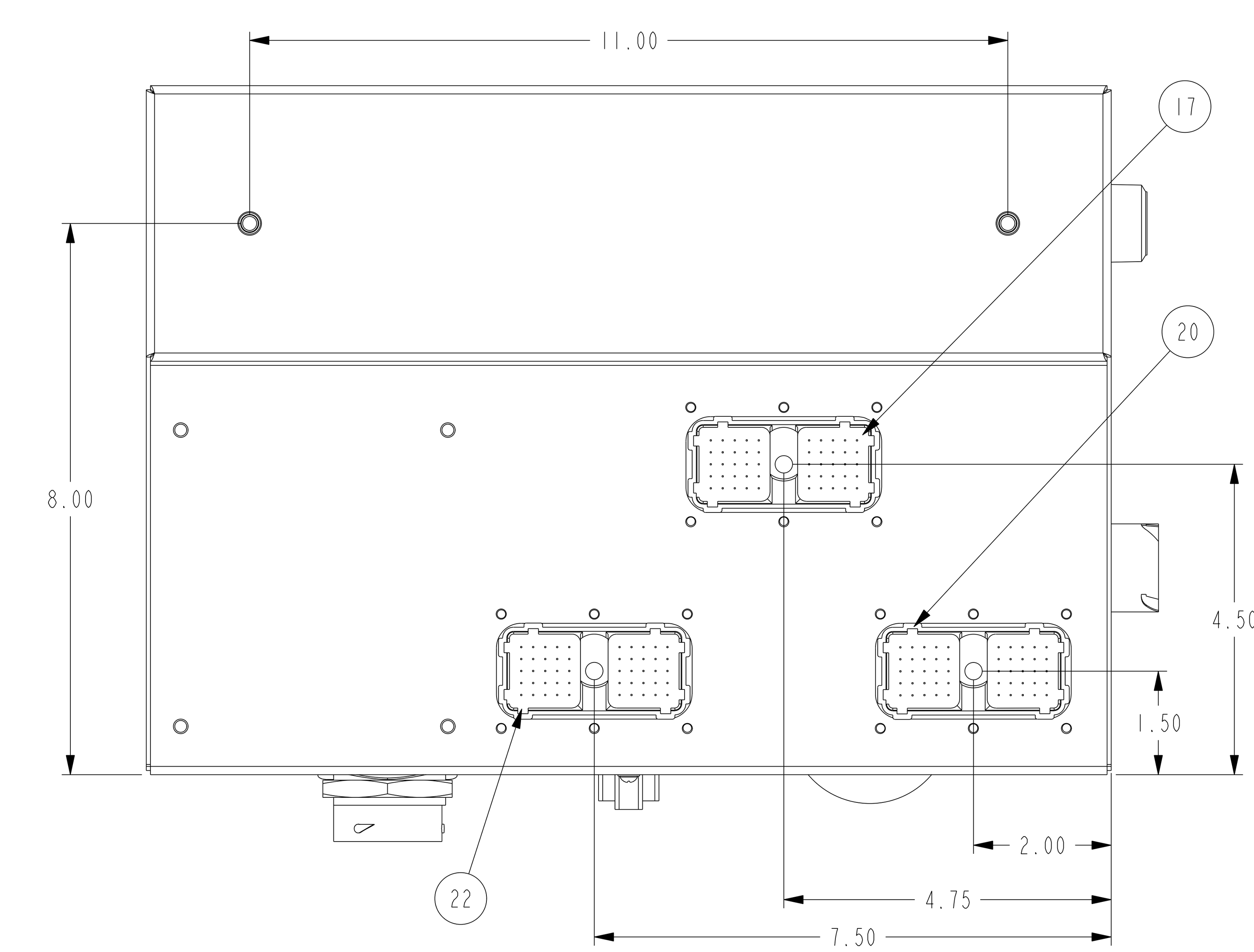
*** BOM IS FOR REFERENCE ONLY ***

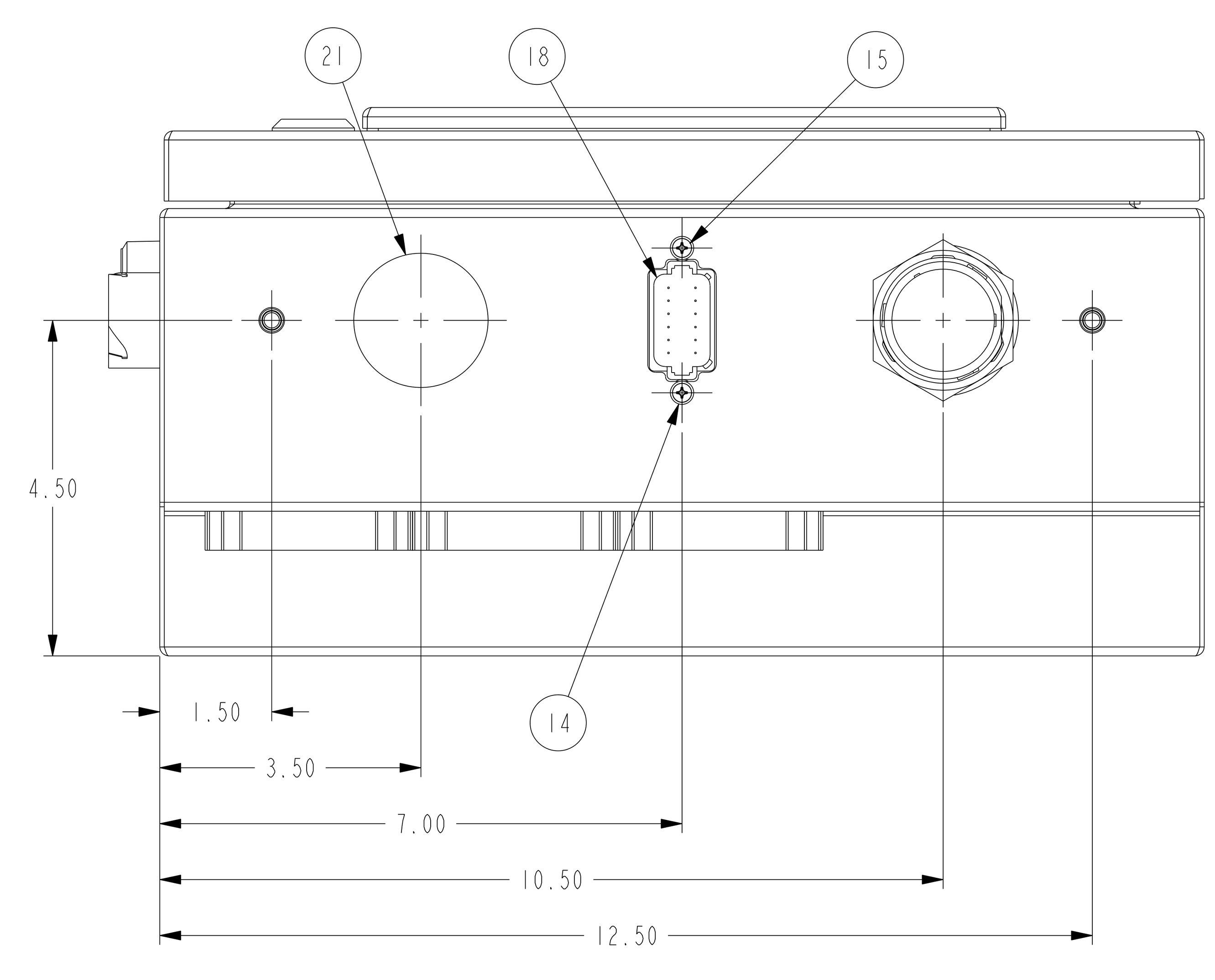


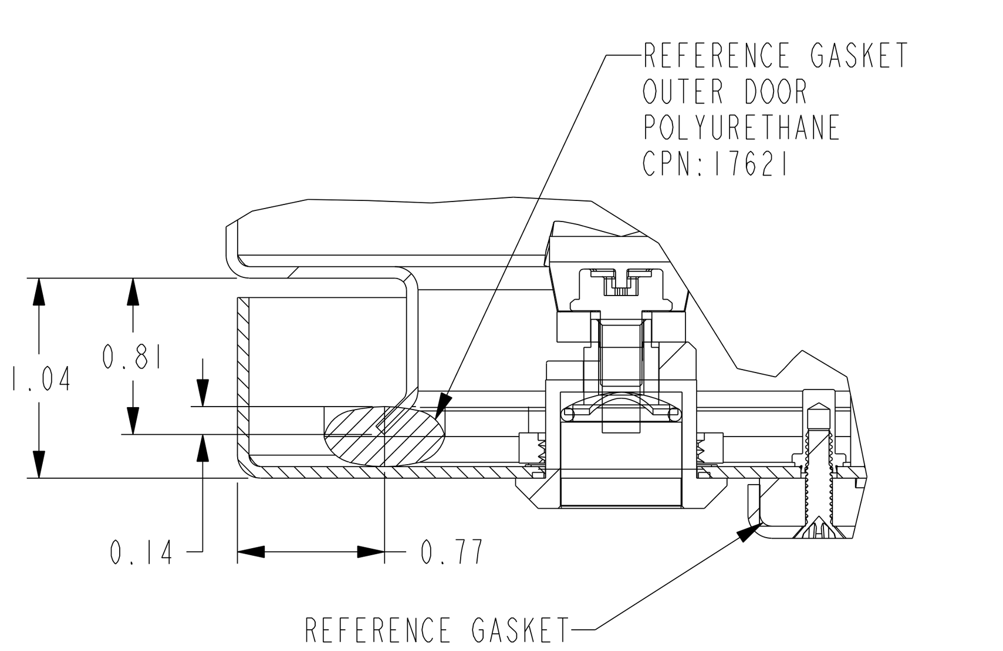












DOOR GASKET DETAIL A
SCALE 1.000

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

Fire Power

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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

ASSEMBLY, DIGITAL CONTROL PANEL
ELECTRONIC CFP ENGINES

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: S DUBICK	PRO-ENGINEER	DATE: 21-SEP-12 INIT ECO: 2012-348
SCALE: 0.500	EST WEIGHT: 28.994	SHEET 1 OF 1	DRAWING NO: 22791

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

KIT INCLUDES

1) 16089 HARNESS, WIRE, SENSOR AND ACTUATOR
2) 16090 HARNESS, WIRE, ECM A
3) 16091 HARNESS, WIRE, ECM B
4) 22813 HARNESS, WIRE, POWER
5) 23932 HARNESS, WIRE, INTERFACE

REV	ECO	DESCRIPTION OF REVISION	BY	DATE
D	2014-867	ITEM 5: ADDED VSP SEALING PLUG	BG	23DEC2014
C	2014-108	ITEM 5: ADDED VSP ADJUSTED LENGTHS	RMJ	11MAR2014
B	2013-386	ITEM 5: ADDED MPU AND COOLING LOOP CONNECTORS.	BG	7JUN2013
A	2013-165	ITEM 4: NEW PART NUMBER PULLED FOR ITEM 4 TO REACH MOVED CONTACTORS. ITEM 5: CHANGED TO REACH LCT SWITCH.	BG	22MAR2013

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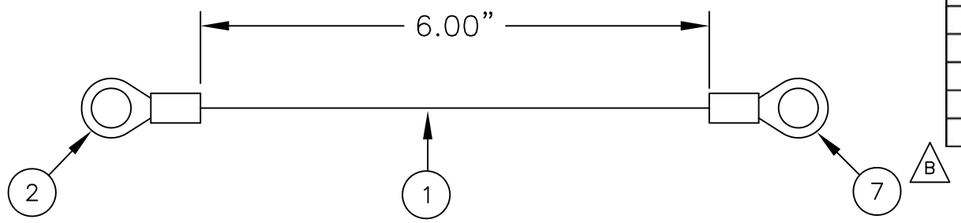
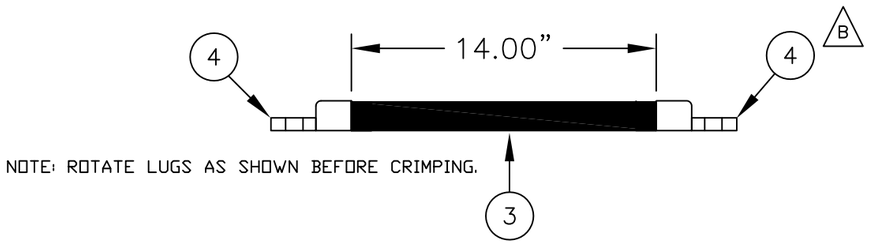
CUSTOM DESIGN AND
UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

KIT, WIRE HARNESSES
QSL9 FIRE PUMP DRIVER. LH OP

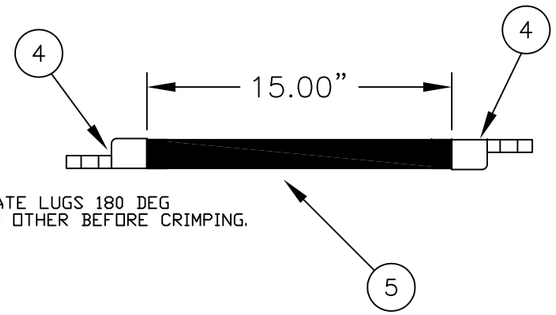
DWG UNITS: INCH/LB/S	DRAWN BY: BG	DATE: 15 JAN 2013
	AUTO CAD	INIT ECO: 2013-026
SCALE:	SHEET 1OF1	DRAWING NO: 23931
EST WEIGHT:		

TAGS	QTY	SUB	CATALOG	MFG	DESC
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	14"	WC00-0	WAYTEK	CABLE, WELDING, 2/0 AWG, BLACK
4	4	1	36534	WAYTEK	TERMINAL, EYELET, HEAVY DUTY, 3/8", 2/0 AWG, NON-INSULATED
5	1	15"	WC00-0	WAYTEK	CABLE, WELDING, 2/0 AWG, BLACK
6	1	1	WC90397-1	LTL	4GA, GROUND STRAP (CNP PART NUMBER 9757)
7	1	1	32702	WAYTEK	TERMINAL, RING, 10 STUD, 10 AWG, INSULATED

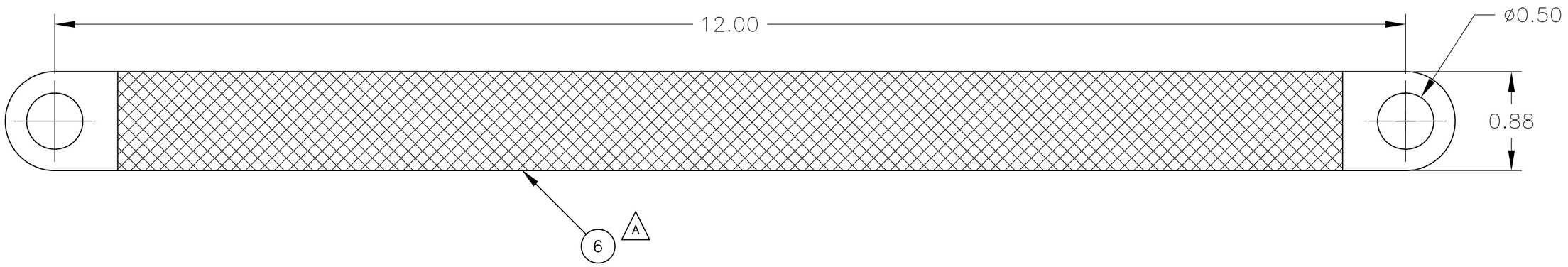




NOTE: ROTATE LUGS AS SHOWN BEFORE CRIMPING.



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.

REV	ECO	DESCRIPTION OF REVISION	BY	DATE
B	2014–528	14” WIRE HAD A BURNDY YAV2CLTC12FX90 ON ONE END. 6” WIRE HAD AN AMP 52717–2 ON ONE END	PBS	06FEB2014
A	2014–076	ADDED 9757	PBS	06FEB2014

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

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DEPERE, WISCONSIN

CABLES, BATTERY CFP5E, 7E, 9E, 11E

DWG UNITS: INCH/LB/S	DRAWN BY: BG	DATE: 16 JAN 2013
	AUTO CAD	INIT ECO: 2012–026
SCALE:	SHEET 1OF1	DRAWING NO: 24234
EST WEIGHT:		

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

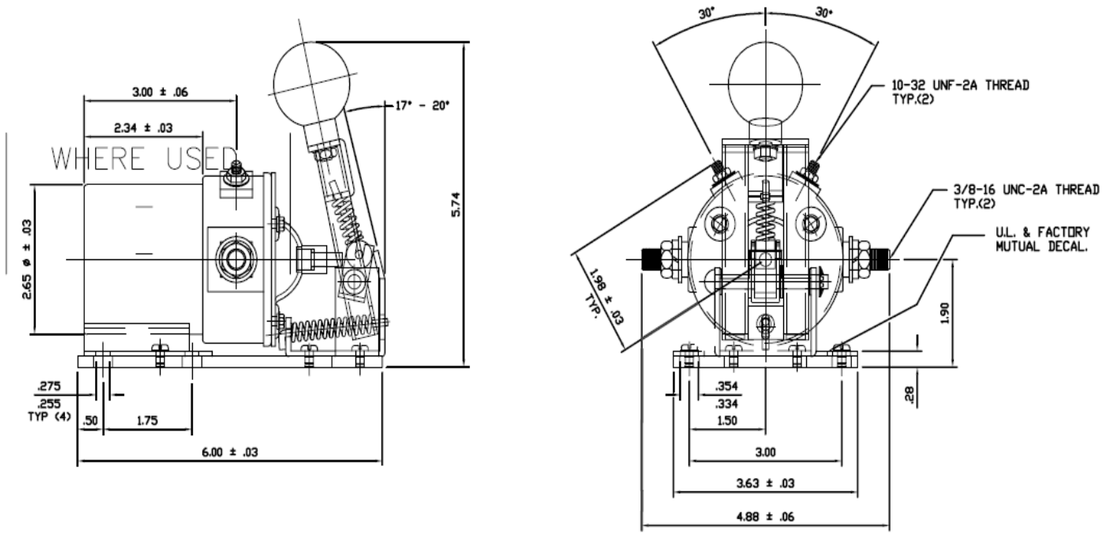
DWG. BY: CTH DATE: 7/19/01

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.

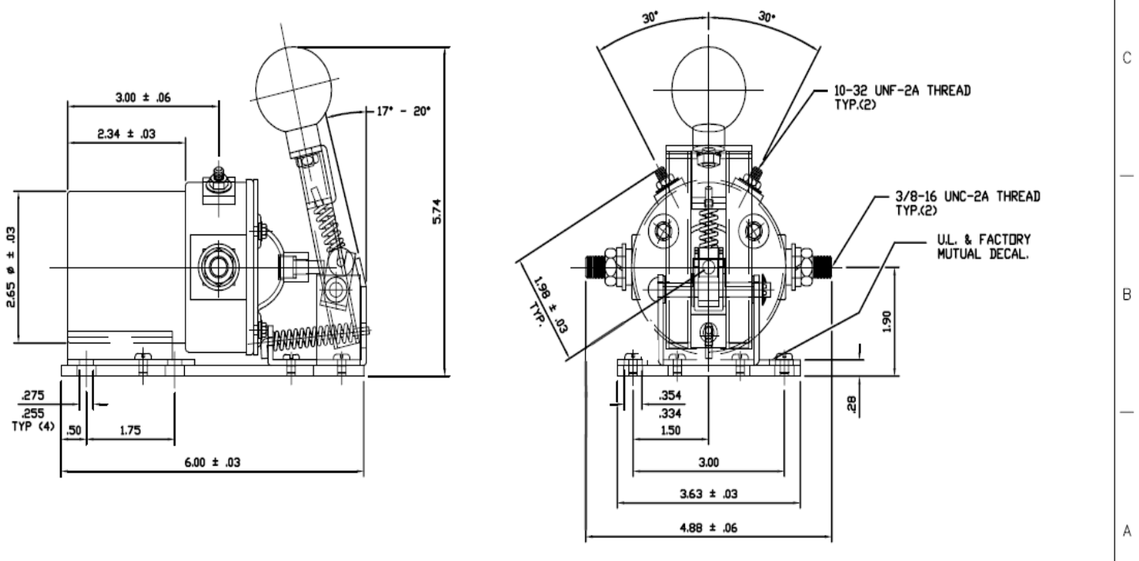
RECEIVED AS

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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DEPERE, WISCONSIN

MANUAL SOLENOID
-

DWG UNITS: IN/LB/S

DRAWN BY: CMC

DATE: 12JUNE2004

PRO-ENGINEER

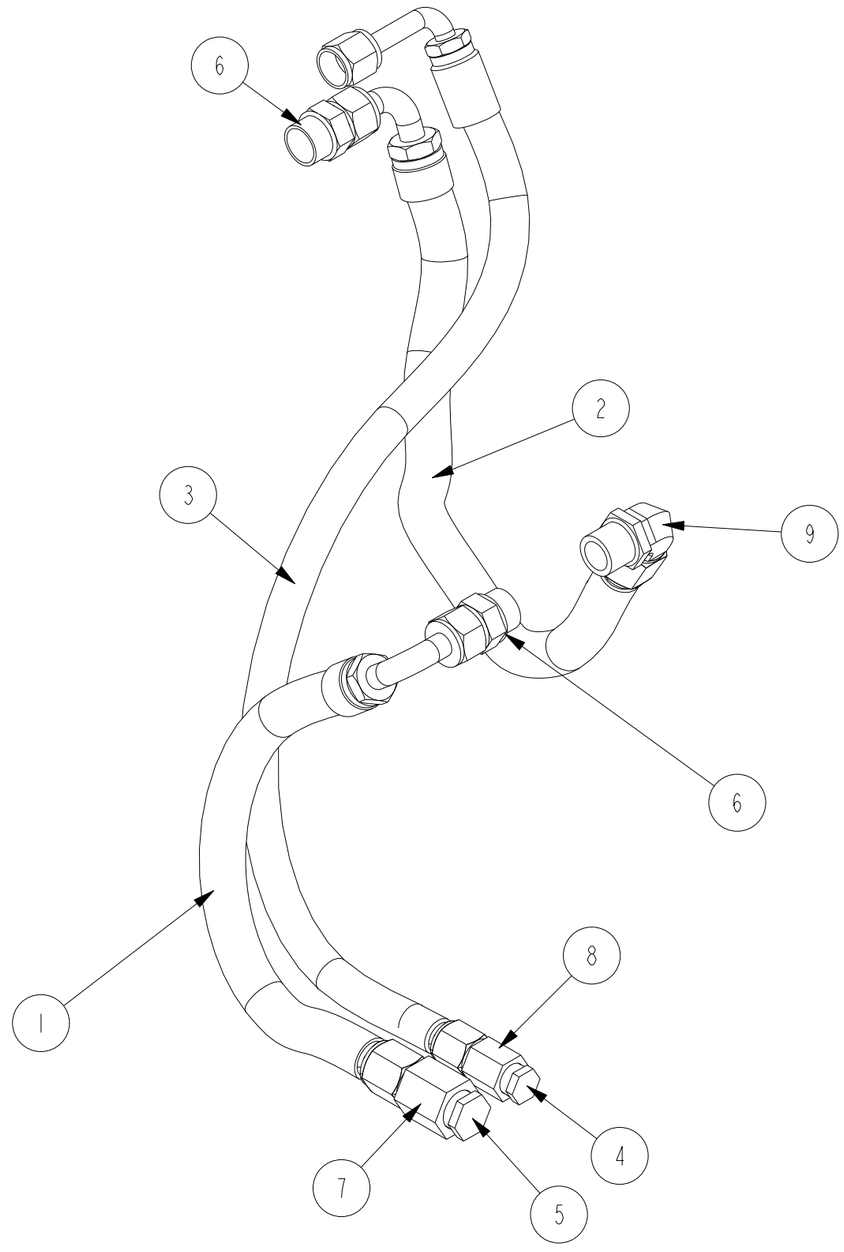
INIT ECO: -

SCALE: 1.000

EST WEIGHT: 42238.628

SHEET 1 OF 1

DRAWING NO: 8824



BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	ASSEMBLY, HOSE, FUEL LINE, CFP9E SUPPLY	15275
2	1	ASSEMBLY, HOSE, FUEL LINE, CFP9E JUMPER	15276
3	1	ASSEMBLY, HOSE, FUEL LINE, CFP9E RETURN	15277
4	1	PLUG. PIPE, -6 NPT	12210-6
5	1	PLUG. PIPE, -8 NPT	12210-8
6	2	FTG, STR, -10 JIC X -10 ORB	12235-10-10
7	1	FTG, STR, -10 JIC X -8 FMNPT	12240-10-8
8	1	FTG, STR, -8 JIC X -6 FMNPT	12240-8-6
9	1	ELB, 90 DEG, -10 JIC X -10 ORB	12268-10-10

A NOTE: ADD THREAD SEALANT TO ALL NPT THREADS.

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
FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4
FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2011-056	ADD NOTE	S DUBICK	09-MAY-11

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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

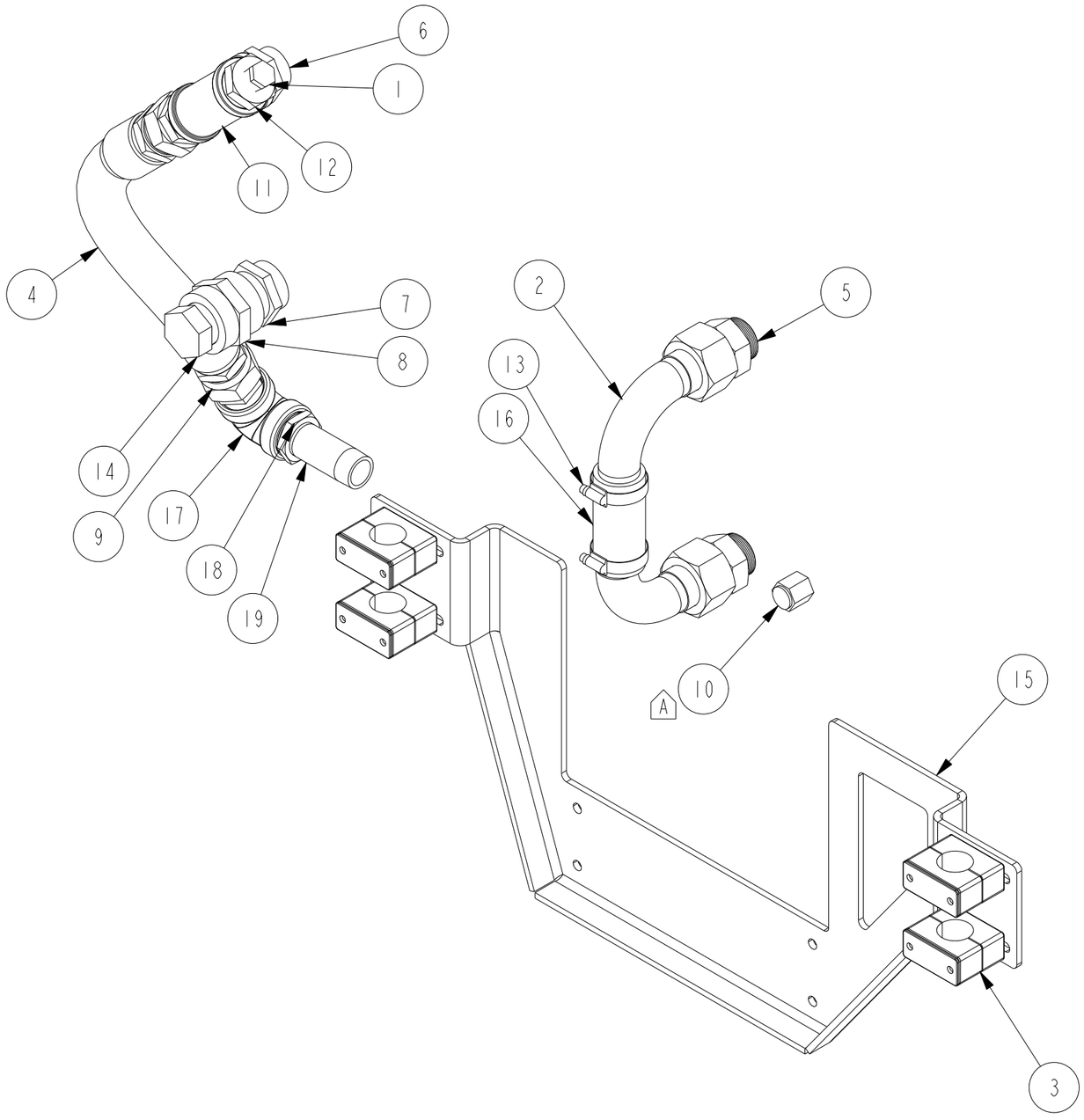
KIT, FUEL LINES, CFP9E
F10/20/30/40/50/60 - EXT ONLY

DWG UNITS: IN/LB/S | DRAWN BY: DAN | DATE: 09-JUL-09

PRO-ENGINEER | INIT ECO:

SCALE: 0.333 | SHEET 1 OF 1 | DRAWING NO: 15208

EST WEIGHT: 13.961



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	PLUG, ZINC W/ BRASS SUPPORT, 1/2" NPT, CHAMP #500129	9750
2	2	ELBOW, RAW WATER, FLARE X HOSE BEAD, STEEL, HX TO HX	10905
3	4	CLAMP,PIPE,1",PLASTIC, W/COVER PLATE	14925-01
4	1	HOSE, RAW WATER, CFP9E, HHP	A042D243
5	2	ADAPTER, MALE JIC 37 DEG X MALE SAE ORB, -24-20	12235-24-20
6	1	FTG, ORB (M) x NPT (M), 20-1 1/4	12163-20-20
7	1	FTG, ORB (M) x NPT (M), 24-1 1/2	12163-24-24
8	1	COUPLING, ZINC PLATED STEEL, 1 1/2 x 1 1/4	12168-24-20
9	2	FTG, STR, -20 JIC X -20 NPT	12238-20-20
10	2	CAP, -10 JIC	12296-10
11	1	TEE, 1 1/4" NPT FEMALE, BLK STEEL	12386
12	1	FITTING, REDUCER, 1 1/4 MALE NPTF X 1/2 FEMALE NPTF	12710
13	2	CLAMP, WORM, 1.25 - 2.00	14990-24
14	1	PLUG, NPT, PLASTIC, -20 (1-1/4") NPT	15255-20
15	1	BRACKET, COOLING LOOP, CFP9E	26633
16	1	HOSE, SILICONE, 1.50" I.D. x 4.0" LONG	78150GL-004
17	1	ELBOW, 90°, 1 1/4" NPT FEMALE, BLK STEEL	B90H
18	1	BUSHING,1-1/4xINPT, BLACK PIPE	BBHG
19	1	NIPPLE, BLK, 1 x 3-1/2"	BNGN

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
A	2015-195	12296-10 WAS 12296-14	PBS	25MAR2015

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

Cummins Fire Power

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

MISCELLANEOUS PIPING
RAW WATER, CFP9E HHP

DWG UNITS: IN/LB/S

DRAWN BY: PBS

DATE: 21NOV2014

PRO-ENGINEER

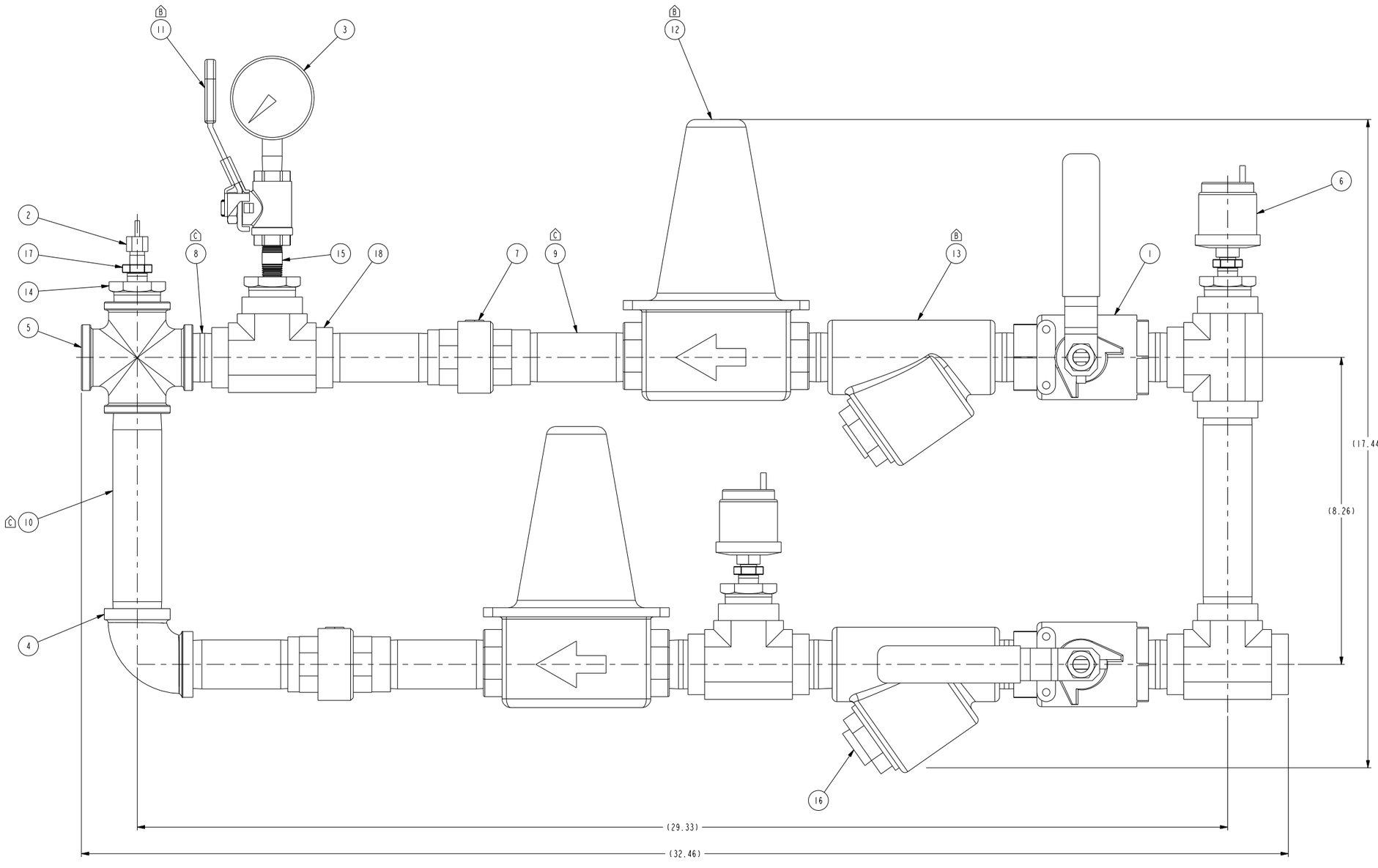
INIT ECO: 2013-135

SCALE: 0.210

EST WEIGHT: 36.969

SHEET 1 OF 1

DRAWING NO: A042D242



C	ITEM	QTY	DESCRIPTION	PART NUMBER
	1	2	VALVE, BALL,1NPT, BRASS,LOCKABLE	21505
	2	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
	3	1	GAUGE, PRESSURE, 1/4" NPT, DPG1-2 1/2, 0-100 PSI, (WATTS)	8892
	4	1	ELBOW, 90°, 1" NPTF, BLK IRON	LTL-E190
	5	1	CROSS,1NPT,STEEL, SCHEDULE 40 PIPE	21520
	6	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574
	7	2	VALVE, 1" NPT CHECK, VALUE ADDED: CV100	25503
	8	8	NIPPLE,1" NPT PIPE, 1.50" LONG	26969_0150
	9	4	NIPPLE,1" NPT PIPE, 3.50" LONG	26969_0350
	10	2	NIPPLE,1" NPT PIPE, 6.00" LONG	26969_0600
	11	1	VALVE, BALL, 1/4" NPT FEMALE	A042D838
	12	2	REGULATOR, 1" NPT, 400 PSI MAX, 25 TO 75 PSI OUT	A042D839
	13	2	STRAINER, 1" NPT	A042D840
	14	4	BUSHING,REDUCER,1" X 1/4" NPT, -	BBGB
	15	1	NIPPLE, 1/4" NPT x 1 1/2", BLK STEEL	LTL-CPN1412
	16	2	PLUG, PIPE, 3/4 BIP COUNTERSUNK	LTL-SCSP34
	17	3	REDUCER BUSHING, HEX, 1/4 x 1/8, BLK STEEL	LTL-SRB1418
	18	4	TEE, BLK, 1"	LTL-ST1

NOTES:
1. MATERIAL: SEE PARTS LIST
2. REMOVE ALL SHARP EDGES PRIOR TO COATING
3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. FINISH: COAT PER CUMMINS SPEC ES044 RAL 3001

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
B	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS A042D838 WAS FA60204-1, A042D839 WAS N45BU-M1-1" A042D840 WAS 1_7TS-M1-1"	PBS	16JAN2015
A	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1°
THIRD ANGLE PROJECTION
MACHINED SURFACES 125

	IMPERIAL UNITS	METRIC UNITS
MACHINED TOLERANCES	.X ± 0.100 .XX ± 0.030 .XXX ± 0.010	.X ± 2.5 .XX ± 0.75 .XXX ± 0.25
NON MACHINED TOLERANCES	.X ± 0.125 .XX ± 0.060 .XXX ± 0.030	.X ± 3.125 .XX ± 1.50 .XXX ± 0.750

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CUSTOM DESIGN AND UP-FIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1", VERT
RAW WATER

DWG UNITS: IN/LB/S
DRAWN BY: BOB KROPP
PRO-ENGINEER
DATE: 07MAR2012
INIT ECO: 2013-303
SCALE: 0.700
EST WEIGHT: NA
SHEET 1 OF 2
DRAWING NO: 21515

(C)

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21515			1" Vertical, Raw Water			
	21505	RUB, S95F445	1" 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	
	A042D839	Watts, N45BU-M1-1"	regulator			
				body	bronze	
				seat	thermoplastic	
				cage	thermoplastic	
				intregral strainer	stainless steel	
				diaphragm	reinforced EPDM	
				valve disc	elastomer	
	A042D840	Watts, 77S-M1-1"	strainer			
				body	cast iron	
				retainer cap	cast iron	ASTM A-126 Class B
				screen	304 stainless steel	
	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	
	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	
	LTL-E190		1" elbow		black steel	ASTM A53/A733
	21520		1" cross		black steel	ASTM A53/A733
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	25503	Euroblock, 100002	1" check valve			
				body	brass CW617N	EN12165
				end connection	brass CW617N	EN12165
				disc	polyetherimide	
				seat	NBP	
				spring	stainless steel	
	BBGB		1" X 1/4" reducing bushing		black steel	ASTM A53/A733
	26969_0350		1" x 3-1/2" nipple		black steel	ASTM A53/A733
	26969_0600		1" x 6" nipple		black steel	ASTM A53/A733
	26969_0150		1" close nipple		black steel	ASTM A53/A733
	LTL-CPN14112		1/4" x 1-1/2" nipple		black steel	ASTM A53/A733
	LTL-SCSP34		3/4" NPT plug		black steel	ASTM A53/A733
	LTL-SRB1418		1/4" x 1/8" reducing bushing		black steel	ASTM A53/A733
	LTL-ST1		1" TEE		black steel	ASTM A53/A733

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DEPERE, WISCONSIN

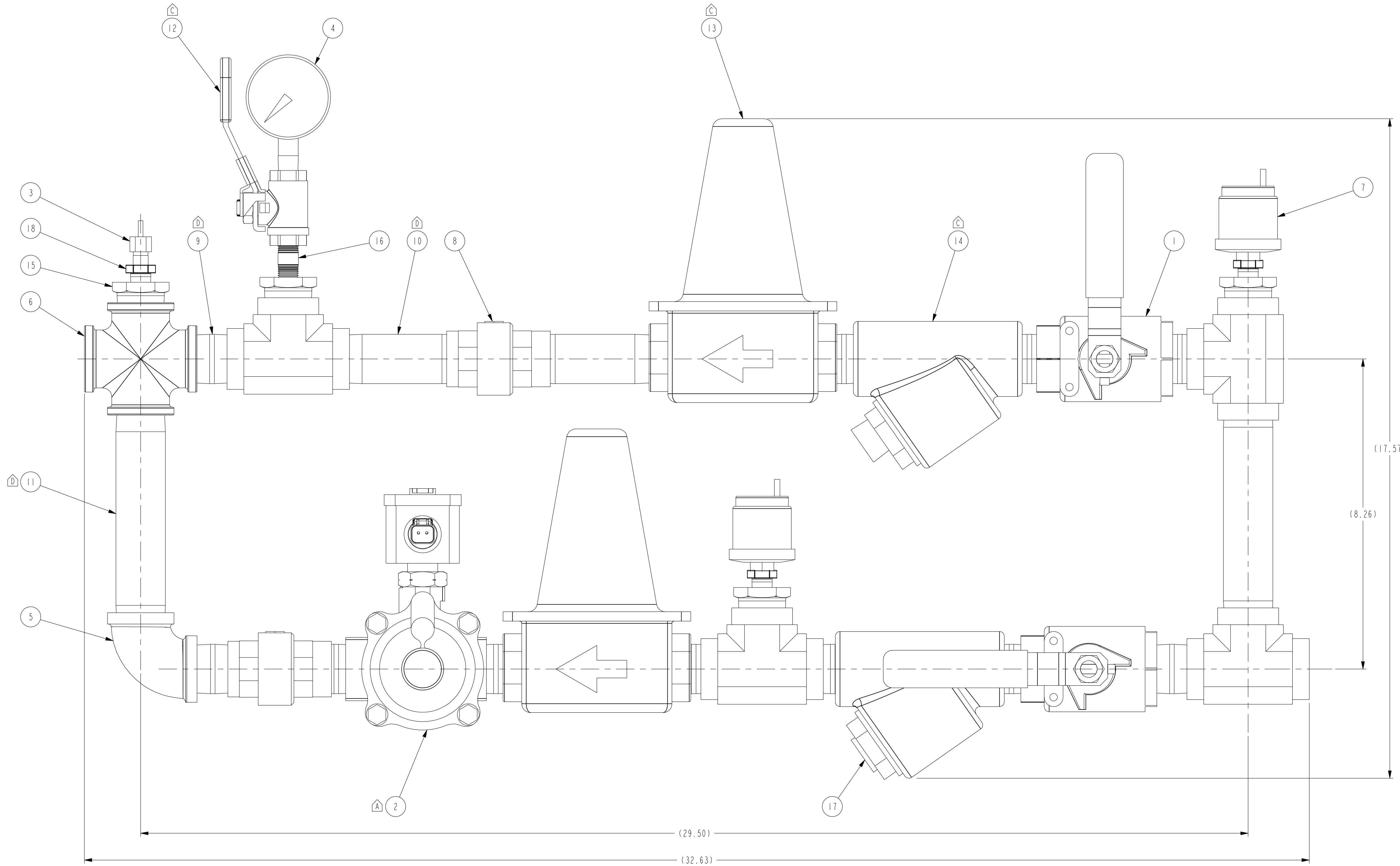
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

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

COOLING LOOP, 1", VERT
RAW WATER

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP	DATE: 07MAR2012
	PRO-ENGINEER	INIT ECO: 2013-303
SCALE: 0.700	SHEET 2 OF 2	DRAWING NO: 21515
EST WEIGHT: 42238.628		

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
B	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015



BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	VALVE, BALL, INPT, BRASS, LOCKABLE	21505
2	1	VALVE, SOLENOID, 1" NPT, 12VDC (NOT SHOWN)	A042B124
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	1	ELBOW, 90°, 1" NPTF, BLK IRON	LTL-E190
6	1	CROSS, INPT, STEEL, SCHEDULE 40 PIPE	21520
7	2	SENSOR, 300PSI, 1/8NPT, VEETHREE-977035	21574
8	2	VALVE, 1" NPT CHECK, VALUE ADDED: CV100	25503
9	11	NIPPLE, 1" NPT PIPE, 1.50" LONG	26969_0150
10	2	NIPPLE, 1" NPT PIPE, 3.50" LONG	26969_0350
11	2	NIPPLE, 1" NPT PIPE, 6.00" LONG	26969_0600
12	1	VALVE, BALL, 1/4" NPT FEMALE	A042D838
13	2	REGULATOR, 1" NPT, 400 PSI MAX, 25 TO 75 PSI OUT	A042D839
14	2	STRAINER, 1" NPT	A042D840
15	4	BUSHING, REDUCER, 1" X 1/4" NPT, -	BBGB
16	1	NIPPLE, 1/4" NPT x 1 1/2", BLK STEEL	LTL-CPN14112
17	2	PLUG, PIPE, 3/4 BIP COUNTERSUNK	LTL-SCSP34
18	3	REDUCER BUSHING, HEX, 1/4 x 1/8, BLK STEEL	LTL-SRB1418
19	4	TEE, BLK, 1"	LTL-ST1

NOTES:
1. MATERIAL: SEE PARTS LIST
2. REMOVE ALL SHARP EDGES PRIOR TO COATING
3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. FINISH: COAT PER CUMMINS SPEC ES044 RAL 3001

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
C	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS A042D838 WAS FA60204-1, A042D839 WAS N45BU-M1-1" A042D840 WAS 1_77S-M1-1"	PBS	16JAN2015
B	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014
A	2014-241	A042B124 WAS 8210G004-12V	PBS	17APR2014

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CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1", 12V
RAW WATER

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

DWG UNITS: IN/LB/S
DRAWN BY: BOB KROPP
DATE: 06MAR2012
PRO-ENGINEER
INIT ECO: 2013-303
SCALE: 0.700
EST WEIGHT: NA
SHEET 1 OF 2
DRAWING NO: 21513

D

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21513			1" 12VDC, Raw Water			
	21505	RUB, S95F45	1" 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	
	A042B124	Asco, 8210G004-12V	1" NPT 12V 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	
	A042D839	Watts, N45BU-MI-1"	regulator			
				body	bronze	
				seat	thermoplastic	
				cage	thermoplastic	
				intregral strainer	stainless steel	
				diaphragm	reinforced EPDM	
				valve disc	elastomer	
	A042D840	Watts, 77S-MI-1"	strainer			
				body	cast iron	
				retainer cap	cast iron	ASTM A-126 Class B
				screen	304 stainless steel	
	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	
	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	
	LTL-E190		1" elbow		black steel	ASTM A53/A733
	21520		1" cross		black steel	ASTM A53/A733
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	25503	Euroblock, 100002	1" check valve			
				body	brass CW617N	EN12165
				end connection	brass CW617N	EN12165
				disc	polyetherimide	
				seat	NBP	
				spring	stainless steel	
	BBGB		1" X 1/4" reducing bushing		black steel	ASTM A53/A733
	26969_0350		1" x 3-1/2" nipple		black steel	ASTM A53/A733
	26969_0600		1" x 6" nipple		black steel	ASTM A53/A733
	26969_0150		1" close nipple		black steel	ASTM A53/A733
	LTL-CPN14112		1/4" x 1-1/2" nipple		black steel	ASTM A53/A733
	LTL-SCSP34		3/4" NPT plug		black steel	ASTM A53/A733
	LTL-SRB1418		1/4" x 1/8" reducing bushing		black steel	ASTM A53/A733
	LTL-ST1		1" TEE		black steel	ASTM A53/A733

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
C	2015-043	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	16JAN2015

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

Cummins Fire Power

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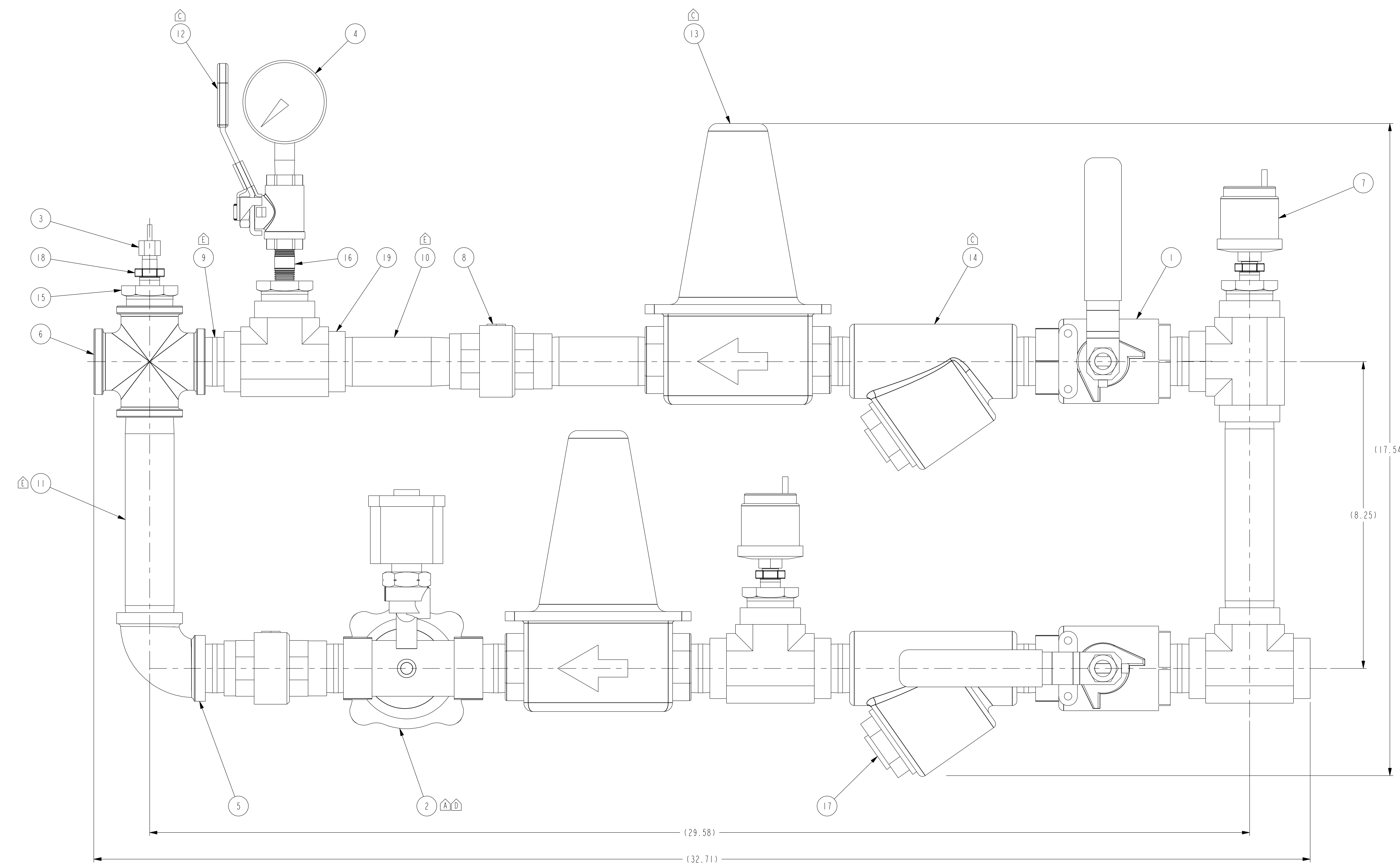
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1", 12V
RAW WATER

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP	DATE: 06MAR2012
	PRO-ENGINEER	INIT ECO: 2013-303
SCALE: 0.700	SHEET 2 OF 2	DRAWING NO: 21513
EST WEIGHT: 42238.628		



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	VALVE, BALL, INPT, BRASS, LOCKABLE	21505
2	1	VALVE, SOLENOID, 1" NPT, 24VDC	A042B126
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	1	ELBOW, 90°, 1" NPTF, BLK IRON	LTL-E190
6	1	CROSS, INPT, STEEL, SCHEDULE 40 PIPE	21520
7	2	SENSOR, 300PSI, 1/8NPT, VEETHREE-977035	21574
8	2	VALVE, 1" NPT CHECK, VALUE ADDED: CV100	25503
9	11	NIPPLE, 1" NPT PIPE, 1.50" LONG	26969_0150
10	2	NIPPLE, 1" NPT PIPE, 3.50" LONG	26969_0350
11	2	NIPPLE, 1" NPT PIPE, 6.00" LONG	26969_0600
12	1	VALVE, BALL, 1/4" NPT FEMALE	A042D838
13	2	REGULATOR, 1" NPT, 400 PSI MAX, 25 TO 75 PSI OUT	A042D839
14	2	STRAINER, 1" NPT	A042D840
15	4	BUSHING, REDUCER, 1" X 1/4" NPT, -	BBGB
16	1	NIPPLE, 1/4" NPT x 1 1/2", BLK STEEL	LTL-CPN14112
17	2	PLUG, PIPE, 3/4 BIP COUNTERSUNK	LTL-SCSP34
18	3	REDUCER BUSHING, HEX, 1/4 x 1/8, BLK STEEL	LTL-SRB1418
19	4	TEE, BLK, 1"	LTL-ST1

NOTES:
1. MATERIAL: SEE PARTS LIST
2. REMOVE ALL SHARP EDGES PRIOR TO COATING
3. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI
4. FINISH: COAT PER CUMMINS SPEC ES044 RAL 3001

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
D	2015-325	FLIPPED A042B126	PBS	26MAY2015
C	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS A042D838 WAS FA60204-1, A042D839 WAS N45BU-M1-1" A042D840 WAS 1_77S-M1-1"	PBS	16JAN2015
B	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014
A	2014-241	A042B126 WAS 8210G004-24V	PBS	17APR2014

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

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875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1", 24V
RAW WATER

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP	DATE: 07MAR2012
	PRO-ENGINEER	INIT ECO: 2013-303
SCALE: 0.700	SHEET 1 OF 2	DRAWING NO: 21522
EST WEIGHT: NA		

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21522			1" 24VDC, Raw Water			
	21505	RUB, S95F45	1" 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	
	A042B126	Asco, 8210G004-24V	1" 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	
	A042D839	Watts, N45BU-MI-1"	regulator			
				body	bronze	
				seat	thermoplastic	
				cage	thermoplastic	
				intregral strainer	stainless steel	
				diaphragm	reinforced EPDM	
				valve disc	elastomer	
	A042D840	Watts, 77S-MI-1"	strainer			
				body	cast iron	
				retainer cap	cast iron	ASTM A-126 Class B
				screen	304 stainless steel	
	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	
	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	
	LTL-E190		1" elbow		black steel	ASTM A53/A733
	21520		1" cross		black steel	ASTM A53/A733
	21574	Veethree, 977035	pressure sensor			
				housing	diecast	
				diaphragm	beryllium copper	
				wiper	phosphor bronze	
				contact	silver coated	
				wire	German nickel chrome resistance	
	25503	Euroblock, 100002	1" check valve			
				body	brass CW617N	EN12165
				end connection	brass CW617N	EN12165
				disc	polyetherimide	
				seat	NBP	
				spring	stainless steel	
	BBGB		1" X 1/4" reducing bushing		black steel	ASTM A53/A733
	26969_0350		1" x 3-1/2" nipple		black steel	ASTM A53/A733
	26969_0600		1" x 6" nipple		black steel	ASTM A53/A733
	26969_0150		1" close nipple		black steel	ASTM A53/A733
	LTL-CPN1412		1/4" x 1-1/2" nipple		black steel	ASTM A53/A733
	LTL-SCSP34		3/4" NPT plug		black steel	ASTM A53/A733
	LTL-SRB1418		1/4" x 1/8" reducing bushing		black steel	ASTM A53/A733
	LTL-STI		1" TEE		black steel	ASTM A53/A733

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

MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
125	.XX ± 0.030 (.XXX ± 0.010)	.X ± 0.8 (.XX ± 0.25)
	FRACTIONS ± 1/64	ANGLES ± 1°
	.XX TOLERANCE (.XXX TOLERANCE)	.X TOLERANCE (.XX TOLERANCE)

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2016-373	REPLACED LTL-CPN1, BNGN & BNGU W/ 26969_0150, 26969_0350 & 26969_0600	KMS	05JUL2016
D	2015-325	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	26MAY2015

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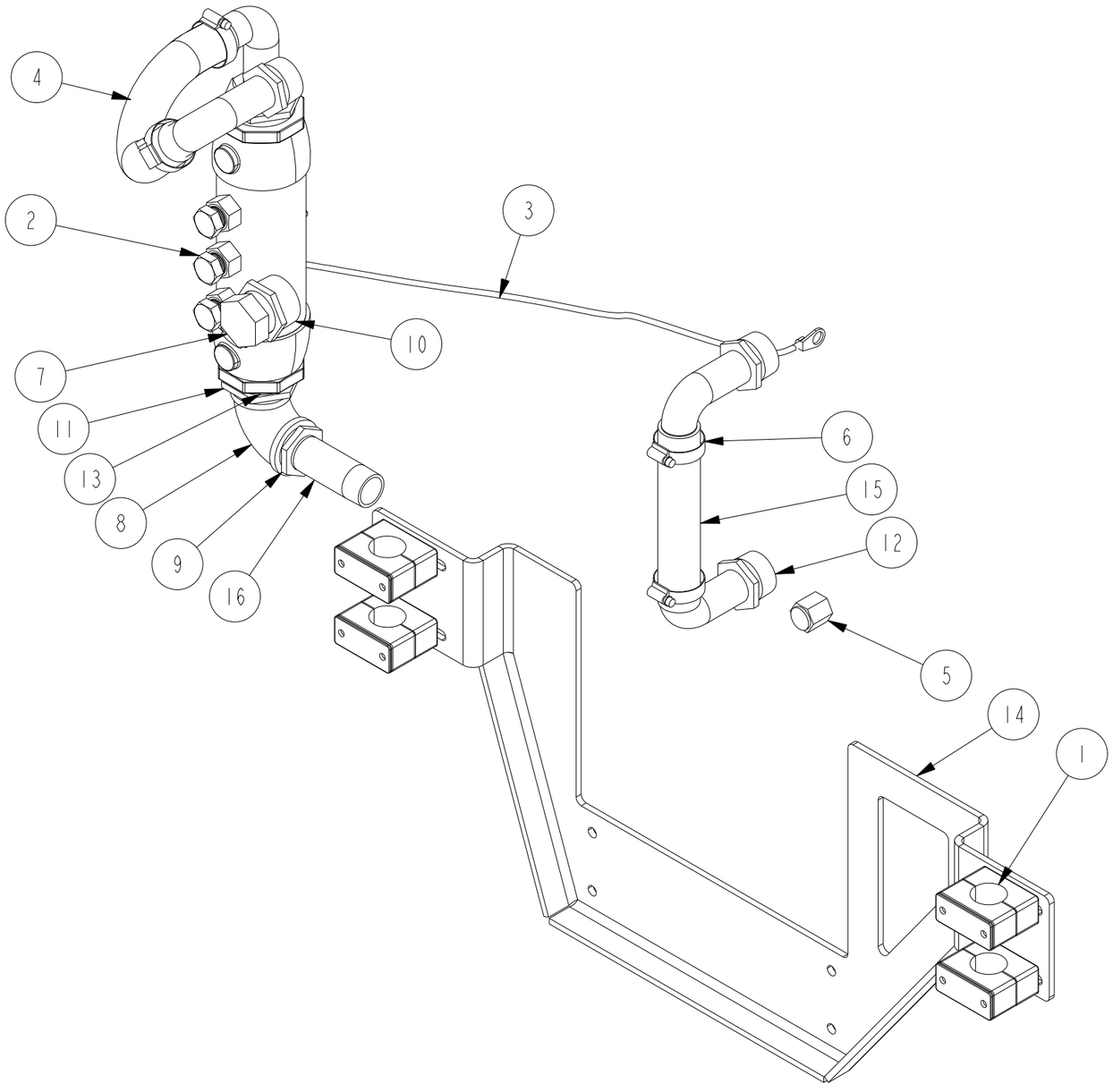
CUSTOM DESIGN
AND UPFIT CENTER
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

COOLING LOOP, 1", 24V
RAW WATER

DWG UNITS: IN/LB/S
DRAWN BY: BOB KROPP
PRO-ENGINEER
DATE: 07MAR2012
INIT ECO: 2013-303
SCALE: 0.700
EST WEIGHT: 42238.628
SHEET 2 OF 2
DRAWING NO: 21522



BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	PART NUMBER
1	4	CLAMP,PIPE,1",PLASTIC, W/COVER PLATE	14925-01
2	1	ZINC MODULE, 2" NPT, 3 ANODES	15804
3	1	GROUND STRAP, 1/4" BRAID, 24" LONG, 1/4" & 1/2" TERMINALS	15843
4	1	HOSE, 1-1/4" x 18" LONG SILICONE	A042F062
5	2	CAP, -10 JIC	12296-10
6	4	CLAMP, WORM, .81 - 1.75	14990-20
7	1	PLUG, NPT, PLASTIC, -20 (1-1/4") NPT	15255-20
8	1	ELBOW, MARINE GRADE, 1-1/4" NPT	15756-20
9	1	BUSHING, MARINE GRADE, 1-1/4" x 1"	15758-20-16
10	1	BUSHING, MARINE GRADE, 1-1/2" x1-1/4"	15758-24-20
11	2	BUSHING, MARINE GRADE, 2" x 1-1/4"	15758-32-20
12	4	ELBOW, NAVAL BRONZE, NPT X BARB, 1-1/4" NPT X 1-1/4" BARB	15767-20-20
13	1	NIPPLE, MARINE GRADE, 1-1/4" X 1-5/8"	15797
14	1	BRACKET, COOLING LOOP, CFP9E	26633
15	1	HOSE, SILICONE HI-TEMP, 1.25ID x 7.50"	A042F062
16	1	NIPPLE, 1" X 4", SEA WATER COMPATIBLE	A041Z958

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE

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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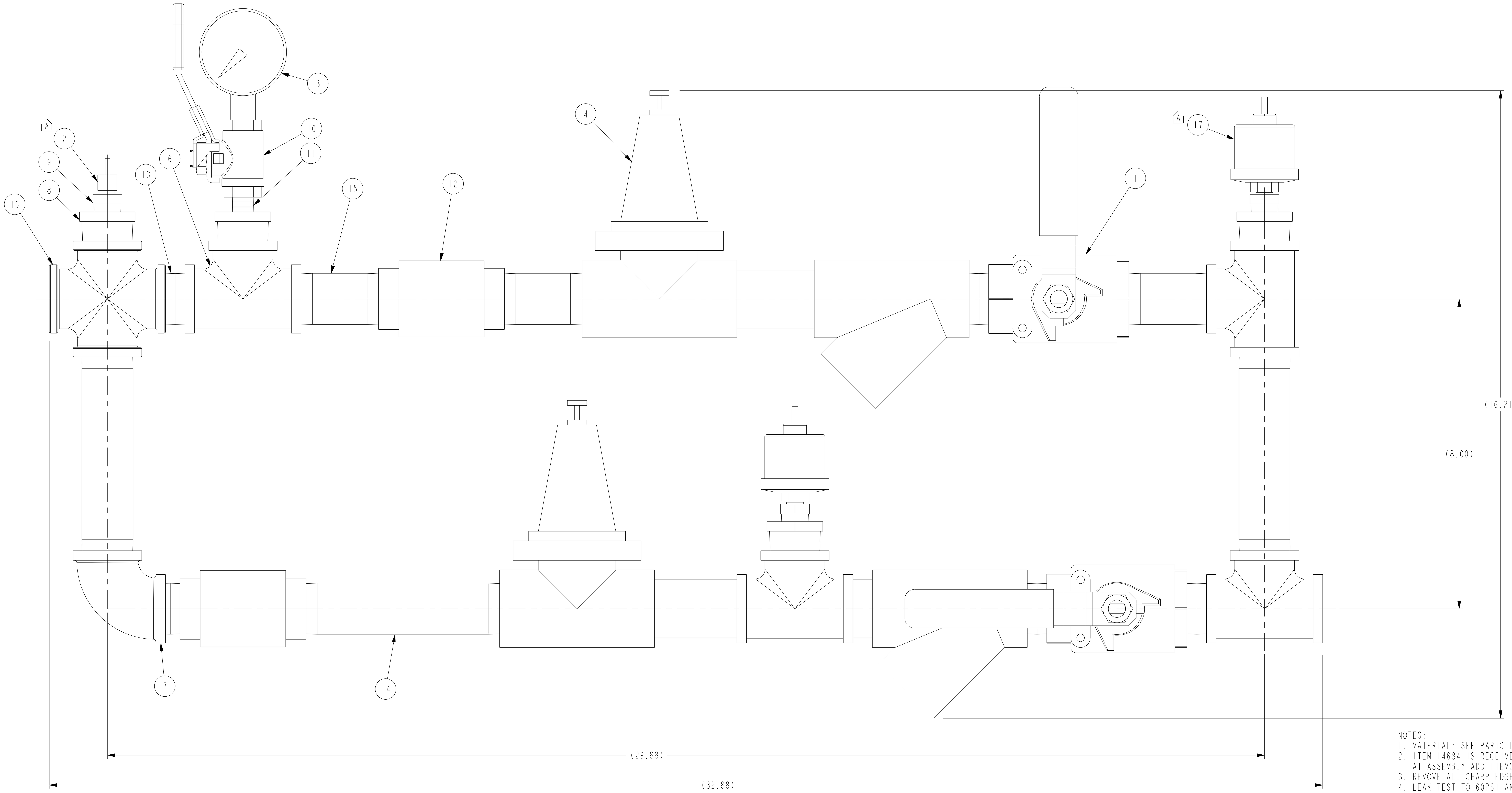
875 LAWRENCE DRIVE
DEPERE, WISCONSIN

MISCELLANEOUS PIPING
CFP9E HHP, SEA WATER

DWG UNITS: IN/LB/S
DRAWN BY: PBS
PRO-ENGINEER
DATE: 11AUG2016
INIT ECO: 2016-567
SCALE: 0.210
EST WEIGHT: 36.969
SHEET 1 OF 1
DRAWING NO: A042H511

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	2	VALVE, BALL, INPT, SEA WATER COMPATIBLE, LOCKABLE	21435
2	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
3	1	GUAGE, 0-100 PSI, 1/4" NPT STN STL	13113
4	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684
5	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684-01
6	4	TEE, MARINE GRADE, 1" NPT	15755-16
7	1	ELBOW, MARINE GRADE, 1" NPT	15756-16
8	4	BUSHING, MARINE GRADE, 1" X 1/4"	15758-16-4
9	3	BUSHING, MARINE GRADE, 1/4" x 1/8"	15758-4-2
10	1	VALVE, BALL, 1/4" NPT,, APOLLO 77-100 (MARINE)	15759-04
11	1	NIPPLE, NAVAL BRONZE, 1/4" X CLOSE	15760
12	2	CHECK VALVE, MARINE GRADE, 1" NPT	15768-16
13	6	NIPPLE, MARINE GRADE, 1" X 1-1/2"	15789
14	3	NIPPLE, MARINE GRADE, 1" X 6"	15792
15	3	NIPPLE, MARINE GRADE, 1" X 3"	15794
16	1	CROSS, 1, NVL-BRNZ, SCHEDULE 40 PIPE	21437
17	2	SENSOR, 300PSI, 1/8NPT, VEETHREE-977035	21574



NOTES:
1. MATERIAL: SEE PARTS LIST
2. ITEM 14684 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY ADD ITEMS SHOWN
3. REMOVE ALL SHARP EDGES AND BURRS
4. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI

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REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
C	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS	PBS	16JAN2015
B	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014
A	2013-611	REPLACED 21008 & 21009 WITH 21574 & 8862	PBS	02OCT2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1°

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

THIRD ANGLE PROJECTION

COOLING LOOP, 1", VERT
SEA WATER COMPATIBLE

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP	DATE: 08MAR2012
	PRO-ENGINEER	INIT ECO: 2013-303
SCALE: 0.700	SHEET 1 OF 2	DRAWING NO: 21516
EST WEIGHT: NA		

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21516			1" Vertical, Sea Water			
	21435	Apollo, 75-105-01	1" 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
	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	
	14684	Wilkins, 500YSBRHLRSW	1" 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	
	15755-16		1" tee		Copper Alloy	ASTM B62-09
	15756-16		1" elbow		Copper Alloy	ASTM B62-09
	15758-16-4		1" 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
	15768-16	Watts, series 600	1" check valve			
				body	bronze	
				guide bushing	stainless steel	
				spring	stainless steel	
				check	brass	
				seat	PTFE	
				O-ring	Nitrile	
				adapter	brass	
	15789		1" x 1-1/2" nipple		Copper Alloy	ASTM B62-09
	15792		1" x 6" nipple		Copper Alloy	ASTM B62-09
	15794		1" x 4" nipple		Copper Alloy	ASTM B62-09
	21437		1" cross		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	

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UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

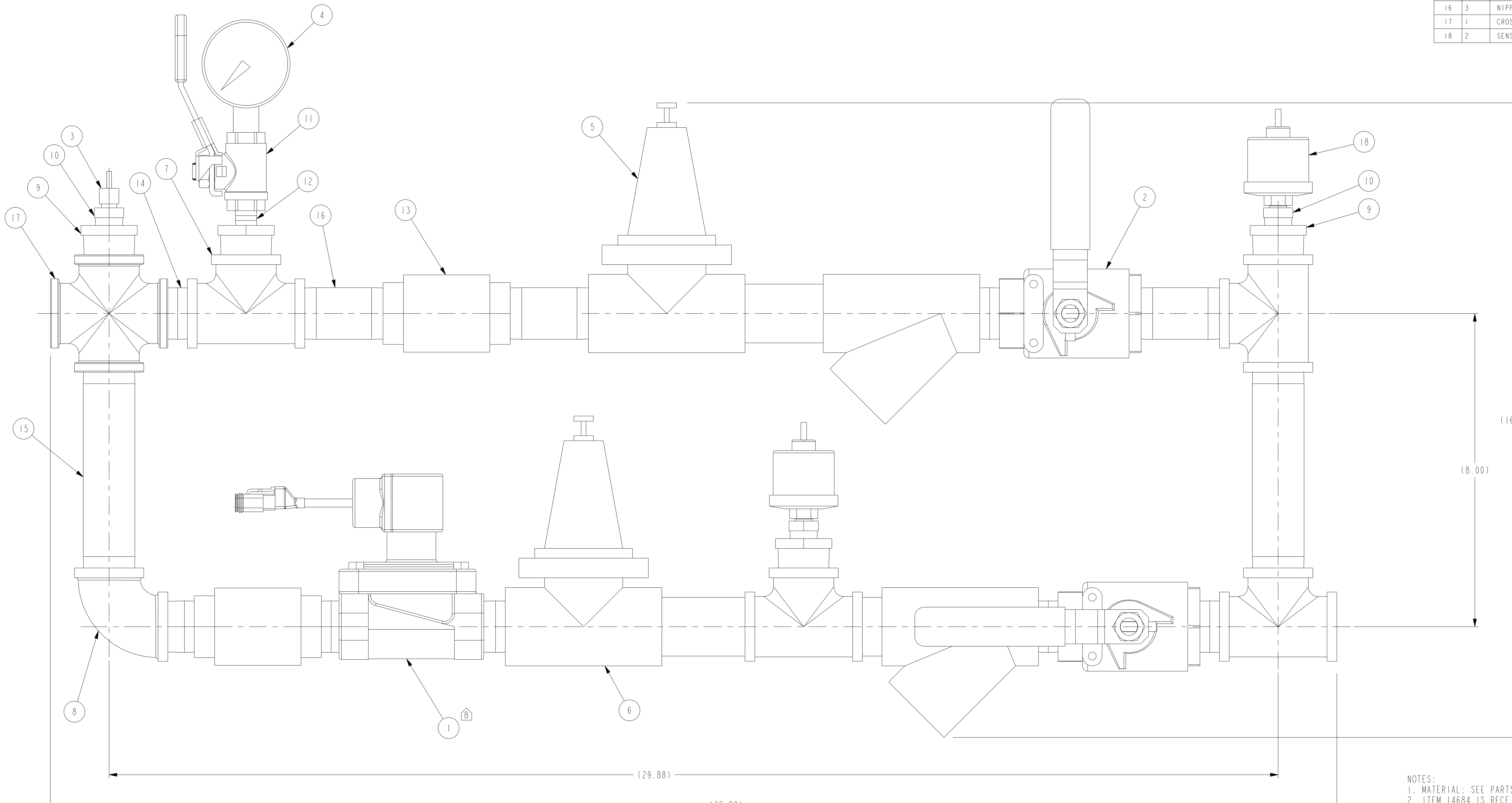
ANGULAR DIMENSIONS ± 1°	MACHINED SURFACES	IMPERIAL UNITS	METRIC UNITS
THIRD ANGLE PROJECTION	125	MACHD TOLERANCES .XX ± 0.02 FORM TOLERANCES .XX ± 0.01 FOR TOLERANCES .XXX ± 0.005	MACHD TOLERANCES X.X ± 0.5 FORM TOLERANCES X.X ± 0.2 FOR TOLERANCES X.XX ± 0.13

COOLING LOOP, 1", VERT
SEA WATER COMPATIBLE

DWG UNITS: IN/LB/S
DRAWN BY: BOB KROPP
DATE: 08MAR2012
PRO-ENGINEER
INIT ECO: 2013-303
SCALE: 0.700
SHEET 2 OF 2
DRAWING NO: 21516
EST WEIGHT: 42238.628

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

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	VALVE, SOLENOID, 1" NPT, 12VDC, SEA WATER COMPATIBLE	14680
2	2	VALVE, BALL, INPT, SEA WATER COMPATIBLE, LOCKABLE	21435
3	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
4	1	GUAGE, 0-100 PSI, 1/4" NPT STN STL	13113
5	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684
6	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684-01
7	4	TEE, MARINE GRADE, 1" NPT	15755-16
8	1	ELBOW, MARINE GRADE, 1" NPT	15756-16
9	4	BUSHING, MARINE GRADE, 1" X 1/4"	15758-16-4
10	3	BUSHING, MARINE GRADE, 1/4" x 1/8"	15758-4-2
11	1	VALVE, BALL, 1/4" NPT., APOLLO 77-100 (MARINE)	15759-04
12	1	NIPPLE, NAVAL BRONZE, 1/4" X CLOSE	15760
13	2	CHECK VALVE, MARINE GRADE, 1" NPT	15768-16
14	8	NIPPLE, MARINE GRADE, 1" X 1-1/2"	15789
15	2	NIPPLE, MARINE GRADE, 1" X 6"	15792
16	3	NIPPLE, MARINE GRADE, 1" X 3"	15794
17	1	CROSS, I, NVL-BRNZ, SCHEDULE 40 PIPE	21437
18	2	SENSOR, 300PSI, 1/8NPT, VEETHREE-977035	21574



NOTES:
1. MATERIAL: SEE PARTS LIST
2. ITEM 14684 IS RECEIVED AS AN UNASSEMBLED KIT.
   AT ASSEMBLY ADD ITEMS SHOWN
3. REMOVE ALL SHARP EDGES AND BURRS
4. LEAK TEST TO 90PSI AND PRESET REGULATORS TO 60PSI

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DEPERE, WISCONSIN

COOLING LOOP, 1", 12V
SEA WATER COMPATIBLE

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS	PBS	16JAN2015
C	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014
B	2014-241	UPDATED TO SHOW LEADS ON SOLENOID VALVE	PBS	17APR2014
A	2013-611	REPLACED 21008 & 21009 WITH 21574 & 8862	PBS	02OCT2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE
ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

	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

DWG UNITS: IN/LB/S | DRAWN BY: BOB KROPP | DATE: 08MAR2012
PRO-ENGINEER | INIT ECO: 2013-303
SCALE: 0.700 | SHEET 1 OF 2 | DRAWING NO: 21506
EST WEIGHT: NA

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21506			1" 12VDC, Sea Water			
	14680	GC Valves, S211GF15J7FG9	1" NPT 12V 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
	21435	Apollo, 75-105-01	1" 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
	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	
	14684	Wilkins, 500YSBRHLRSW	1" 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
				elastfomers	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	
	15755-16		1" tee		Copper Alloy	ASTM B62-09
	15756-16		1" elbow		Copper Alloy	ASTM B62-09
	15758-16-4		1" 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
	15768-16	Watts, series 600	1" check valve		Copper Alloy	ASTM B62-09
				body	bronze	
				guide bushing	stainless steel	
				spring	stainless steel	
				check	brass	
				seat	PTFE	
				O-ring	Nitrile	
				adapter	brass	
	15789		1" x 1-1/2" nipple		Copper Alloy	ASTM B62-09
	15792		1" x 6" nipple		Copper Alloy	ASTM B62-09
	15794		1" x 4" nipple		Copper Alloy	ASTM B62-09
	21437		1" cross		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	

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SEA WATER COMPATIBLE

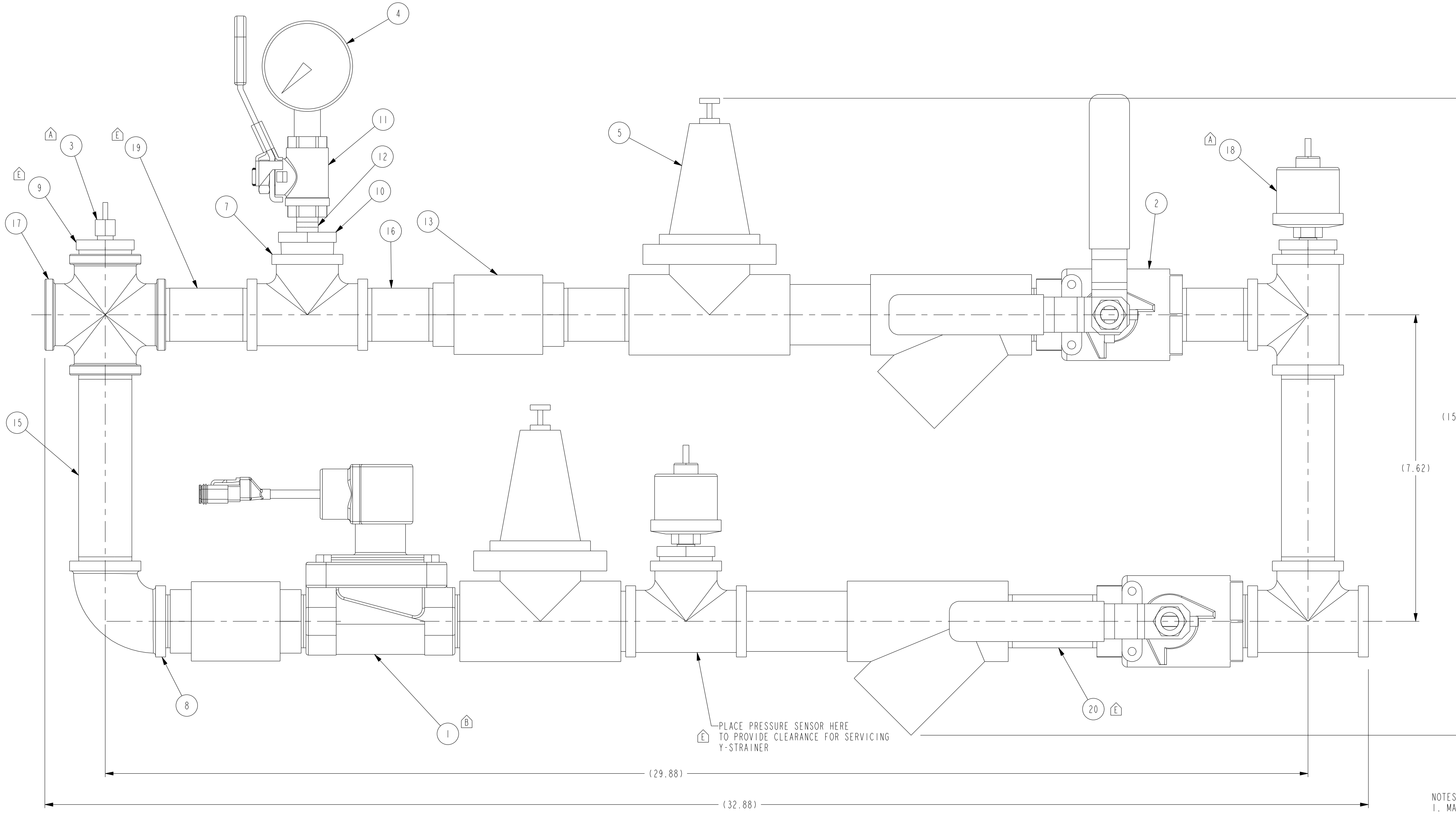
UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

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: 08MAR2012	
	PRO-ENGINEER	INIT ECO: 2013-303	
SCALE: 0.700	SHEET 2 OF 2	DRAWING NO: 21506	
EST WEIGHT: 42238.628			

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

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	VALVE, SOLENOID, 1" NPT, 24VDC, SEA WATER COMPATIBLE	14681
2	2	VALVE, BALL,1NPT, SEA WATER COMPATIBLE,LOCKABLE	21435
3	1	SENDER, TEMPERATURE, DATCON #02022-00	8862
4	1	GUAGE, 0-100 PSI, 1/4" NPT STN STL	13113
5	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684
6	1	REGULATOR/STRAINER, 1" NPT, SEA WATER COMPATIBLE	14684-01
7	4	TEE, MARINE GRADE, 1" NPT	15755-16
8	1	ELBOW, MARINE GRADE, 1" NPT	15756-16
9	3	BUSHING, MARINE GRADE, 1" x 1/8"	15758-16-2
10	1	BUSHING, MARINE GRADE, 1" x 1/4"	15758-16-4
11	1	VALVE, BALL, 1/4" NPT,, APOLLO 77-100 (MARINE)	15759-04
12	1	NIPPLE, NAVAL BRONZE, 1/4" X CLOSE	15760
13	2	CHECK VALVE, MARINE GRADE, 1" NPT	15768-16
14	6	NIPPLE, MARINE GRADE, 1" X 1-1/2"	15789
15	2	NIPPLE, MARINE GRADE, 1" X 6"	15792
16	3	NIPPLE, MARINE GRADE, 1" X 3"	15794
17	1	CROSS,1,NVL-BRNZ, SCHEDULE 40 PIPE	21437
18	2	SENSOR,300PSI,1/8NPT, VEETHREE-977035	21574
19	1	NIPPLE, 1" PIPE, 3.40" L, SEA WATER COMPATIBLE	A042H250
20	1	NIPPLE, 1" PIPE, 3.58" L, SEA WATER COMPATIBLE	A042H251



NOTES:
1. MATERIAL: SEE PARTS LIST
2. ITEM 14684 IS RECEIVED AS AN UNASSEMBLED KIT. AT ASSEMBLY ADD ITEMS SHOWN
3. REMOVE ALL SHARP EDGES AND BURRS
4. LEAK TEST TO 60PSI AND PRESET REGULATORS TO 60PSI

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2016-403	MOVED PRESSURE SENSOR TO CLEAR Y-STRAINER DELETE: 15758-4-2, 15792 ADD: 15758-16-2, A042H250, A042H251 CHANGED QTY: 15789 6 WAS 8, 15758-16-4 1 WAS 4, 15794 1 WAS 3	PBS	19JUL2016
D	2015-043	ADDED SHEET 2 WITH MATERIAL SPECIFICATIONS	PBS	16JAN2015
C	2014-874	ADDED VALVE HANDLES	PBS	30DEC2014
B	2014-241	UPDATED TO SHOW LEADS ON SOLENOID VALVE	PBS	17APR2014
A	2013-611	REPLACED 21008 & 21009 WITH 21574 & 8862	PBS	02OCT2013

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

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875 LAWRENCE DRIVE
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COOLING LOOP, 1", 24V
SEA WATER COMPATIBLE

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP	DATE: 08MAR2012
	PRO-ENGINEER	INIT ECO: 2013-303
SCALE: 0.700	SHEET 1 OF 2	DRAWING NO: 21507
EST WEIGHT: NA		

Assembly	Component	Manufacture/pn	Description	Sub-Component	Material	Specification
21507			1" 24VDC, Sea Water			
	14681	GC Valves, S211GF16J7FG9	1" 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
	21435	Apollo, 75-105-01	1" 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
	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	
	14684	Wilkins, 500YSBRHLRSW	1" 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	
	15755-16		1" tee		Copper Alloy	ASTM B62-09
	15756-16		1" elbow		Copper Alloy	ASTM B62-09
	15758-16-4		1" X 1/4" reducing bushing		Copper Alloy	ASTM B62-09
	15758-16-2		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
	15768-16	Watts, series 600	1" check valve			
				body	bronze	
				guide bushing	stainless steel	
				spring	stainless steel	
				check	brass	
				seat	PTFE	
				O-ring	Nitrile	
				adapter	brass	
	15789		1" x 1-1/2" nipple		Copper Alloy	ASTM B62-09
	15794		1" x 4" nipple		Copper Alloy	ASTM B62-09
	A042H250		1" x 3.4" nipple		Copper Alloy	ASTM B62-09
	A042H251		1" x 3.58" nipple		Copper Alloy	ASTM B62-09
	21437		1" cross		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	

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | MACHINED SURFACES 125 | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

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

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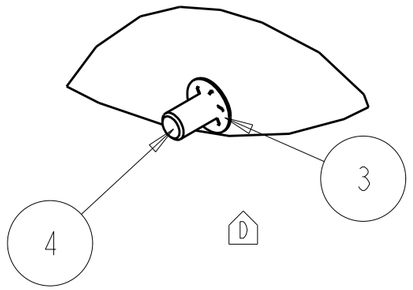
COOLING LOOP, 1", 24V
SEA WATER COMPATIBLE

DWG UNITS: IN/LB/S	DRAWN BY: BOB KROPP		DATE: 08MAR2012	
	PRO-ENGINEER		INIT ECO: 2013-303	
SCALE: 0.700		SHEET 2 OF 2	DRAWING NO: 21507	
EST WEIGHT: 42238.628				

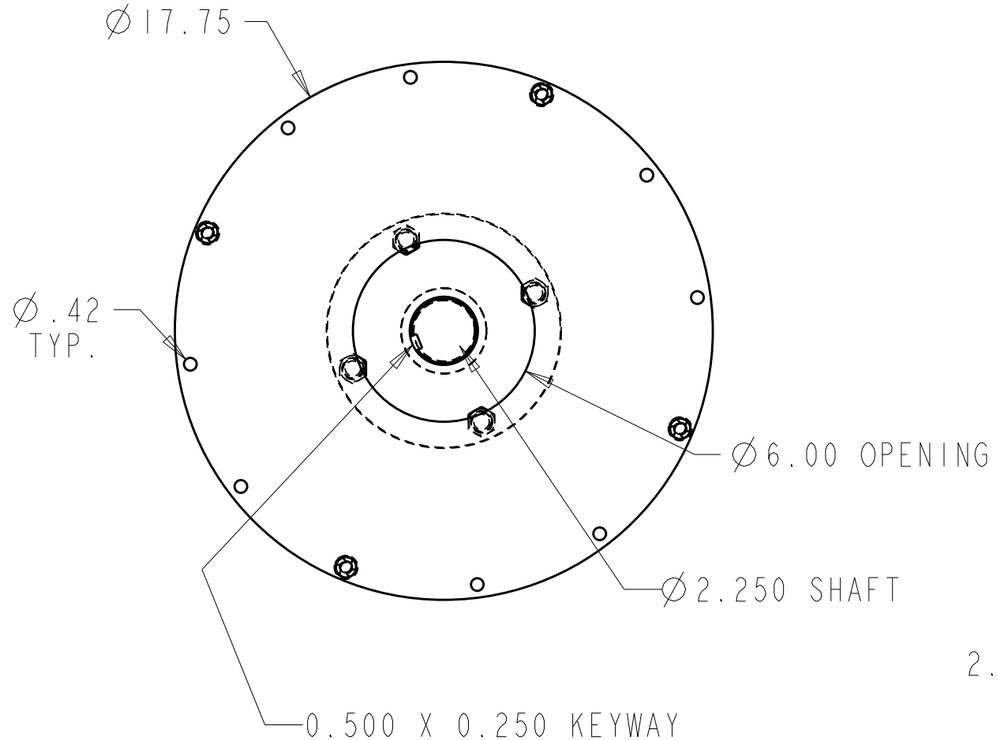
REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
E	2016-403	SEE SHEET 1 FOR LATEST REVISION DETAILS	PBS	19JUL2016

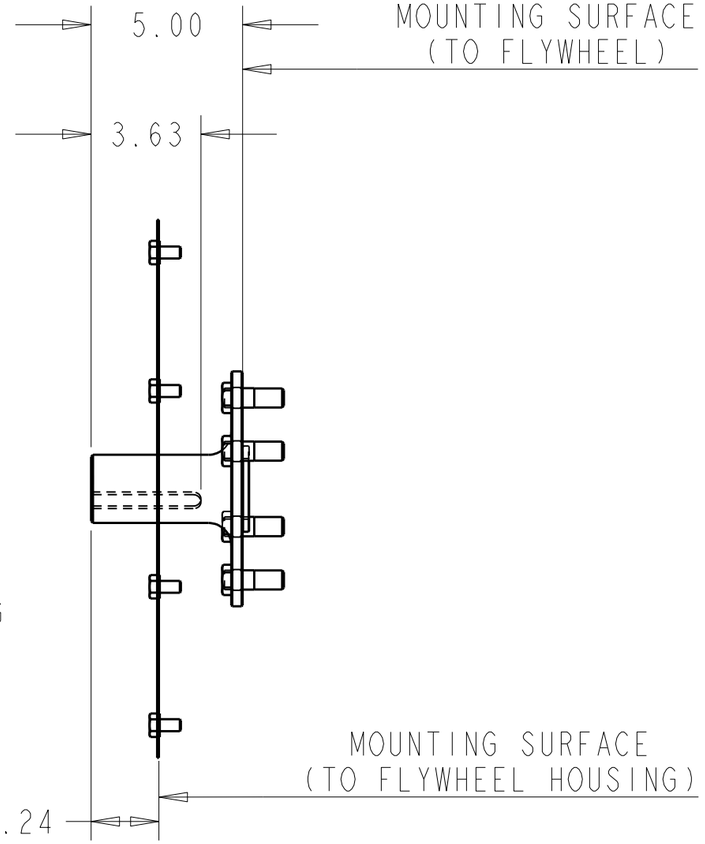
TYPICAL GUARDING FASTENERS
SCALE 0.500

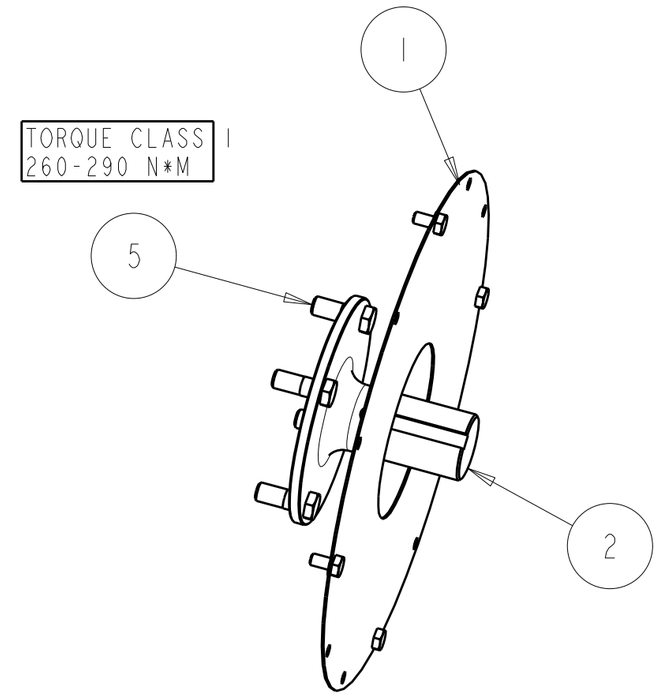


BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	GUARD, STUB SHAFT, SAE #3 FLYWHEEL, FIREPUMP	8611
2	1	STUB SHAFT, SAE #3 FLYWHEEL, HAYES #, FIREPUMP	9624
3	4	RETAINING WASHER, PUSHNUT, 3/8" BOLT	16662-06
4	4	SCREW, CAP, HEX HEAD, M10-1.5	HHCS_M10
5	4	SCREW, CAP, HEX HEAD, M16 x 50	HHCS_M16_50

D







C NOTES:
1. MASS: 13.9 LBS, INERTIA: 67.49 IB.IN^2

REV	ECO	DESCRIPTION OF REVISION	REV BY	DATE
D	2010-098	ADDED RETAINING FASTENERS	DAN	04-MAR-10
C	2009-620	ADDED MASS & INERTIA DATA	S DUBICK	12/23/09

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 FORM TOLERANCES .X = ± 0.8 .XX = ± 0.4 FAB TOLERANCES .X = ± 1.5 .XX = ± 0.8

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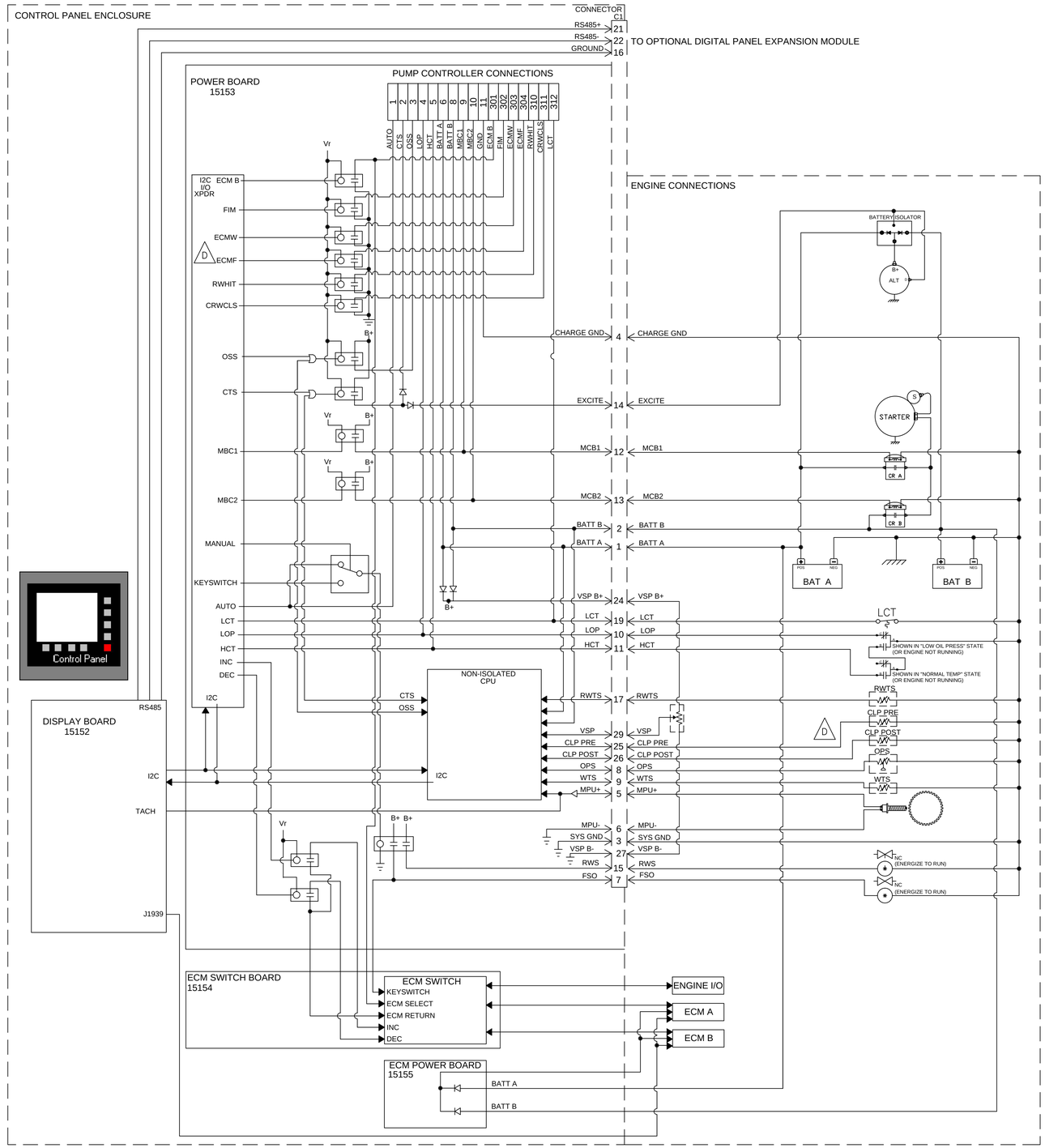
ASSEMBLY, STUB SHAFT, 2.25" DIA
FIREPUMP

DWG UNITS: IN/LB/S	DRAWN BY: DAVE N	DATE: 15OCT2004
	PRO-ENGINEER	INIT ECO:
SCALE: 0.200	SHEET 1 OF 1	DRAWING NO: 8619
EST WEIGHT: 33.399		



D

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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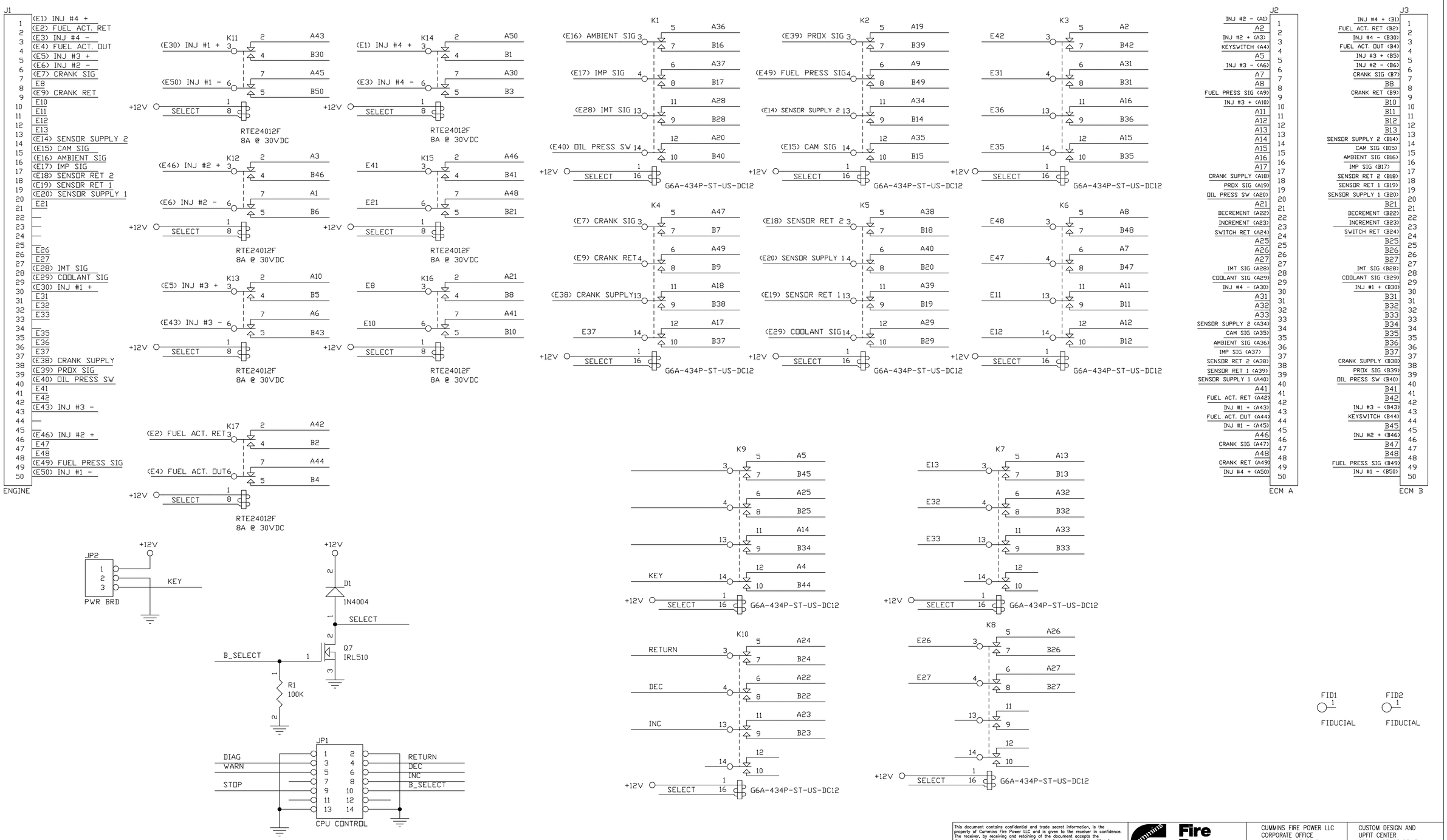
SCHEMATIC, FIRE PUMP DRIVERS
CFP MODELS: 5E, 7E, 9E, 11E, 15E, 23E

DWG UNITS: INCH/LB/S
DRAWN BY: KAK
DATE: 14 DEC 2009
AUTO CAD
REF DRWG:
SCALE:
EST WEIGHT:
SHEET 1OF7
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 = ± 0.020 .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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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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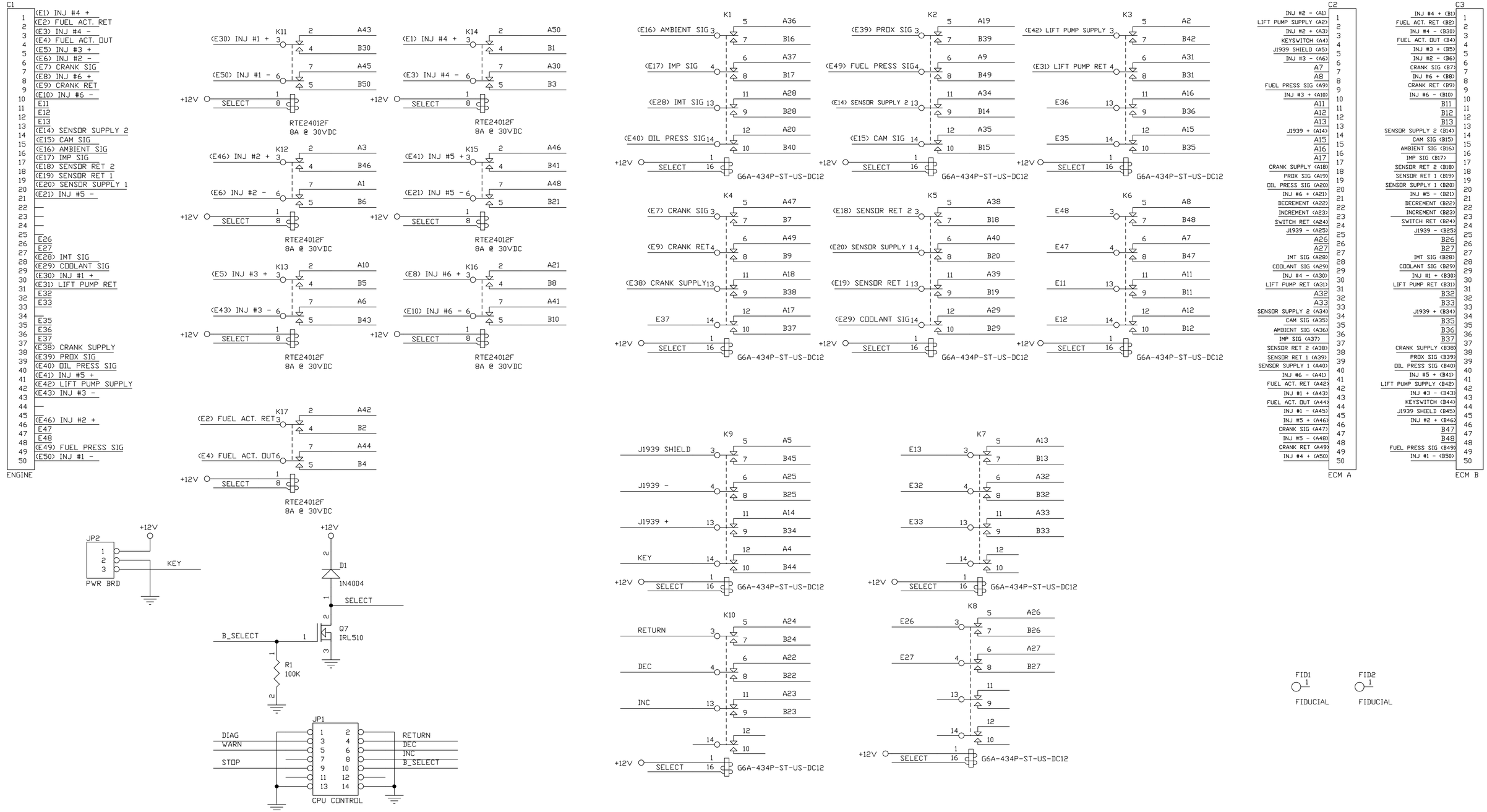
SCHEMATIC, ECM SWITCH
CFP7E FIRE PUMP DRIVER

UNLESS OTHERWISE SPECIFIED ALL DIMENSION TOLERANCES ARE

ANGULAR DIMENSIONS ± 1° | IMPERIAL UNITS | METRIC UNITS
THIRD ANGLE PROJECTION

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
D	2014-107	SEE SHEET 1 FOR LATEST REVISION.	RMJ	24FEB2014
C		SEE SHEET 1 FOR LATEST REVISION.	KAK	03DEC2013

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SCHEMATIC, ECM SWITCH CFP9E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S

DRAWN BY: KAK

DATE: 14 DEC 2009

AUTO CAD

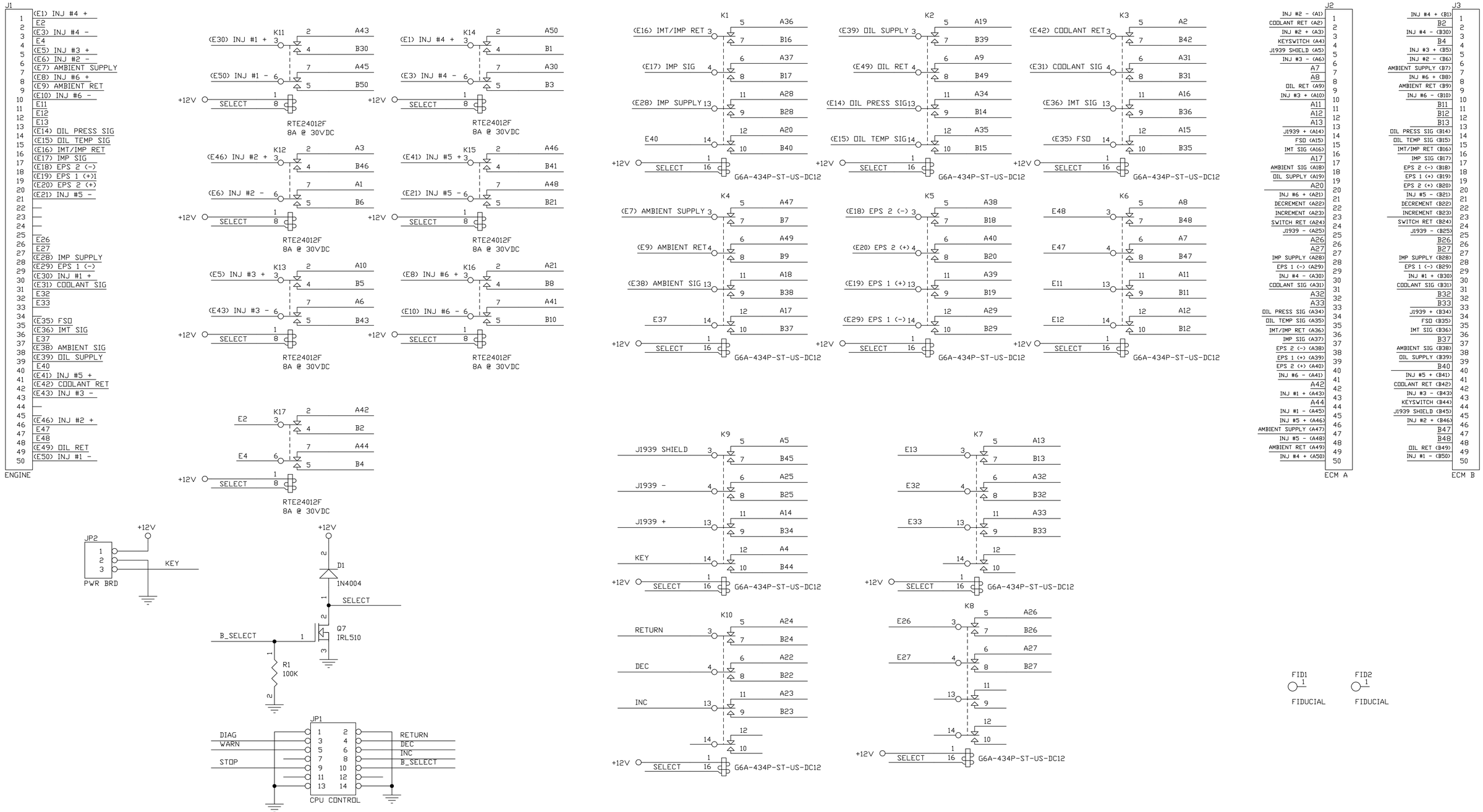
REF DRWG:

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
FORM TOLERANCES X = ± 0.8 XX = ± 0.4
FAB 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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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

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°	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

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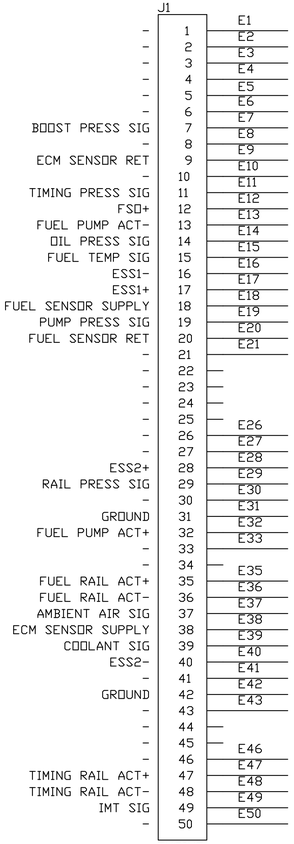
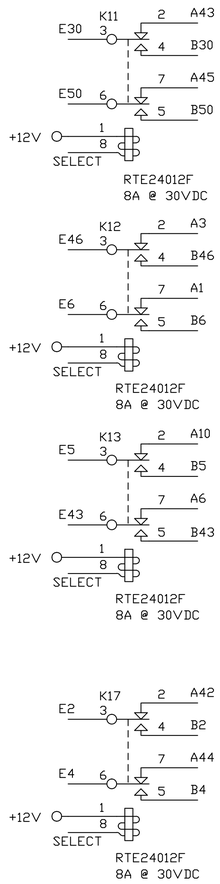
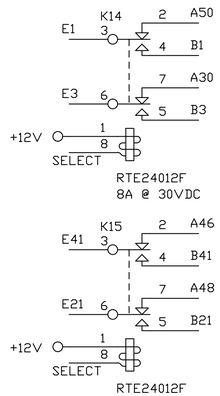
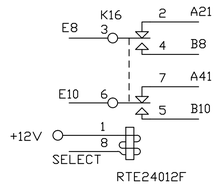
SCHEMATIC, ECM SWITCH CFP15E FIRE PUMP DRIVER

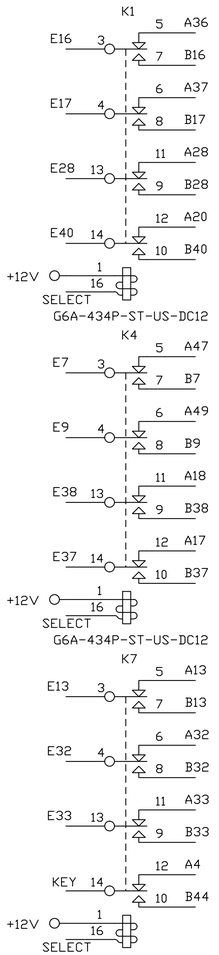
DWG UNITS: INCH/LB/S | DRAWN BY: KAK | DATE: 14 DEC 2009
AUTO CAD | REF DRWG:
SCALE:
EST WEIGHT:
SHEET 6OF7 | DRAWING NO: 16260

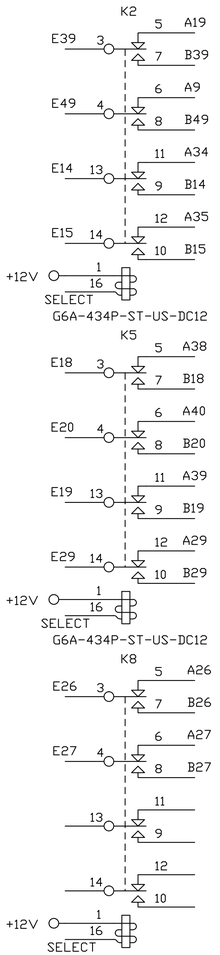


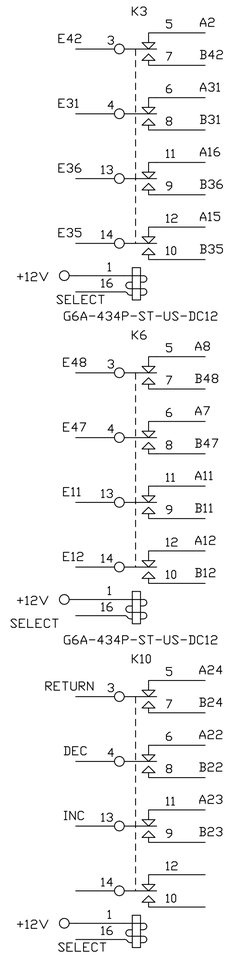


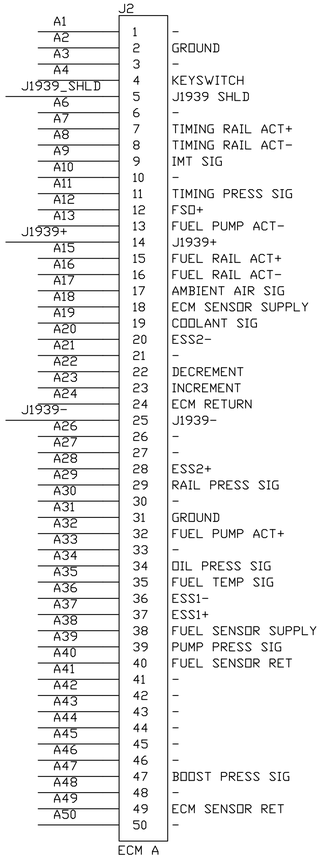


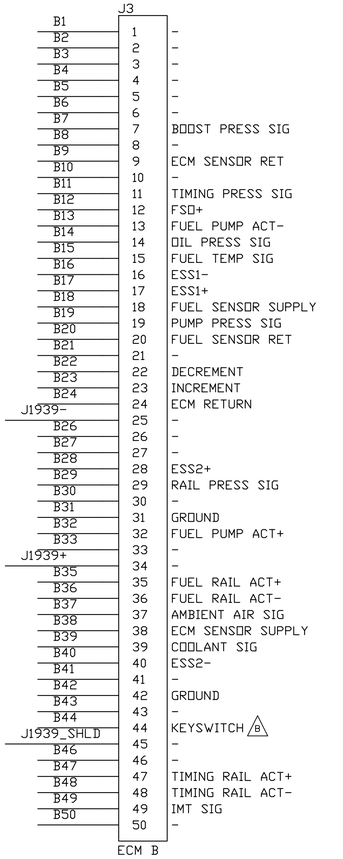


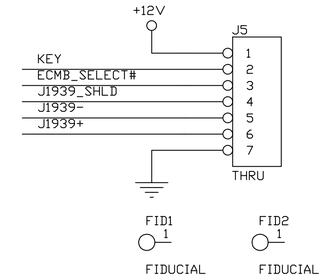


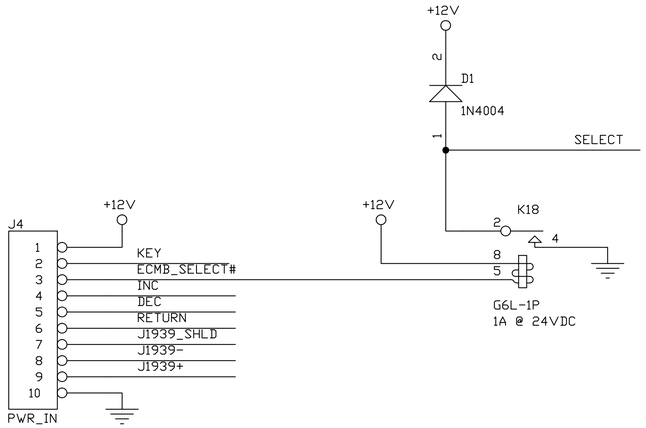












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ANGULAR DIMENSIONS ± 1° | IMPERIAL UNITS | METRIC UNITS

THIRD ANGLE PROJECTION

MACHINE TOLERANCES .XX = ± 0.010 .XXX = ± 0.005
FORM TOLERANCES .XX = ± 0.015 .XXX = ± 0.010
FAB TOLERANCES .XX = ± 0.060 .XXX = ± 0.030
MACHINE TOLERANCES .X = ± 0.2 .XX = ± 0.2
FORM TOLERANCES .X = ± 0.4 .XX = ± 0.4
FAB 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

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

SCHEMATIC, ECM SWITCH CFP23E FIRE PUMP DRIVER

DWG UNITS: INCH/LB/S
DRAWN BY: KAK
DATE: 14 DEC 2009
AUTO CAD
REF DRWG:
SCALE:
EST WEIGHT:
SHEET 7OF7
DRAWING NO: 16260