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1. Engine/Generator/Base

1.1 General Configuration

The Stewart & Stevenson Model DM3580E marine Diesel generator set is provided in this application as a complete prime/emergency power supply on an isolated bus for a marine drilling application. The major equipment in the generator set as built by Stewart & Stevenson includes the Electro-Motive 710G Series Diesel engine for marine applications and the Kato generator. This generator set is rated to produce 3950 kW, 5642 kVa, 11 KV at 0.7 pf, 60 Hz, 3 phase at 900 rpm. The generator set has a continuous kW(e) rating of 3580 kW at 900 rpm.

The generator set is equipped with a complete common skid, heat exchanger, remote mount surge tank, air start system, remote mount silencer, local engine instrument panel, and local, off-skid engine control panel.

The engine, generator, and accessory rack are mounted on a common rail skid platform with grounding pad. Combustion air for the engine is obtained from ambient air inside the engine room and filtered prior to entering the engine assembly. The silencer for the unit is mounted remote of the generator set. The cooling system shell and tube heat exchanger is skid mounted on the accessory rack with the lube oil cooler. The coolant expansion tank is remote mounted.

The local engine control panel and engine instrument panel are locally mounted on or near the engine/generator skid. The generator set is controlled from the local engine control panel that also holds the programmable logic controller (PLC) manufactured by Allen-Bradley. The Diesel engine is electronically controlled by the EMD EMDEC system that is interfaced with the Allen-Bradley PLC.

Generator Set Dimensions & Weights

Length .... 41.375 ft. (12.6 m)

Width, Base OAW .... 123.5 in. (313 cm)

Width, Coolant Heat Exch. .... 93.5 in. (237 cm)

Height, Approx. OA .... 180 in. (457 cm)

Weight
    Dry... 133,000 lbs. (60,345 kg)
    Wet (est.).................................... 137,800 lbs. (62,523 kg)

1.2 Engine Description

The prime mover of the Diesel engine generator set is an Electro-Motive 710G Series, Model ME20-710G7C engine that has been specifically equipped with a skid-mounted accessory rack for use as a turbocharged marine engine. This turbocharged, two-cycle Diesel engine has a displacement of 710 cubic inches per cylinder and is rated at 5,000 bhp at a continuous 900 rpm.

Refer to *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual, EMD Marine Propulsion Unit Operating Manual, EMD Service Tools Catalog,* and *EMD S&S/Noble Drilling Service Parts Catalog No. D167* in Section VIII of this manual for engine details, procedures, and parts.

For a detailed description of the engine's reciprocating assembly and internal engine parts, refer to the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual. These assemblies include:

- Crankcase and Oil Pan
- Cylinder Head and Accessories
- Piston Assembly and Connecting Rods
- Cylinder Liner
- Cylinder Power Assembly
- Crankshaft Assembly and Accessory Drive Gear Train
- Camshaft Gear Train, Auxiliary Drive, and Camshaft Assemblies

The following engine description section covers each internal engine sub-system, e.g., air intake and exhaust, lube oil, cooling system, fuel oil system, etc. Descriptions of the external or add-on pieces to these systems, e.g., air cleaner, pre-lube and soak-back pumps, cooling system heat exchanger, etc. are covered later in this section.

1.2.1 Cylinder Designation and Arrangement

The engine cylinder designation and arrangement in relation to the front or rear end of the engine is shown in Figure 1. Left and right cylinder banks of the engine are in respect to the view looking toward the front end when facing the rear or flywheel end.

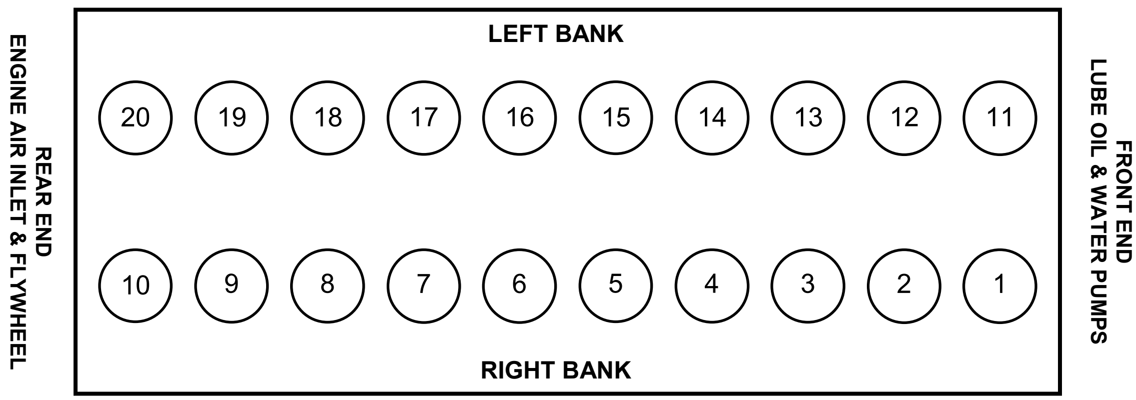


Figure 1 Electro-Motive 20V Cylinder Arrangement

1.2.2 Engine Data

Cylinders 20

Combustion Cycle ....2 Stroke

Cylinder Bore and Stroke ....9-1/16 in. X 11 in.

Cylinder Configuration ....45° “V”

Compression Ratio 16:1

Displacement per Cylinder ....710 cu. in.

Main Bearings 12

Full Load Speed ....900 rpm

Idle Speed ....350 rpm

Continuous Output Power
kW 3,580
BHP 5,000

Scavenging ....Uniflow

Scavenging Blower ....Turbo-Centrifugal

Weight (dry) ....46,400 lbs. (21,047 kg)

1.2.3 Engine Air Intake and Exhaust Systems

Air Flow — In a two cycle engine, each cylinder completes a power cycle in one revolution of the crankshaft. The piston does not function as an air pump during one revolution of the crankshaft, as is the case with four-cycle engines. A separate means is provided in the two-cycle engine to supply the needed air and to purge the combustion gases from the cylinder. To efficiently provide air for combustion and scavenging, the engine is equipped with a turbocharger assembly.

Intake air is drawn through the air filter by the turbocharger compressor wheel. The turbocharger compresses the air and pushes it through the aftercooler for cooling purposes. The aftercooler cools the air using coolant directly from the engine cooling system. The air is presented to the combustion chambers where it is burned with the fuel oil. Once the air/fuel oil mixture has been burned, the exhaust gases are pushed into the exhaust manifold by the exhaust cycle of the pistons. The exhaust gases flow through the turbocharger, driving the turbine wheel which is directly connected to the compressor wheel on the air intake side. From the turbocharger, the exhaust gases flow through the flexible exhaust connection, through the silencer, and then vented into the atmosphere.

Turbocharger — Turbocharger action pressurizes air entering the air box. As the piston moves upward, it compresses the trapped air. Initially, the turbocharger is driven by the engine gear train. When the engine approaches full load, the heat energy in the exhaust is sufficient to drive the turbocharger, and the engine gear train is disengaged by an over-running clutch.

Air Box — The air box is that portion of the engine crankcase that surrounds the cylinders. Accumulation of liquids from the engine air box is removed through the drain holes in the base rails of the crankcase. After completion of the power stroke, the piston continues downward and pressurized air from the air box enters the cylinder and scavenges the exhaust gases from the previous power stroke through the valves.

Lube Oil Separator — A lube oil separator is mounted on the turbocharger housing and a crankcase ejector assembly is mounted on top of the separator. A line from the turbocharger aftercooler duct passes through the ejector assembly creating a suction that draws oily vapor from the engine up through the separator element. The oil collects on the element and drains back into the engine crankcase. The suction of the engine oil vapors through the lube oil separator also creates the required negative pressure in the crankcase.

1.2.4 Lubricating Oil System

Description — The lube oil system of the Electro-Motive engine is a combination of three separate systems. The systems are the main lube oil system, the piston cooling system, and the scavenging system; each has its own engine-driven pump. The main lube oil pump and the piston-cooling pump are in the same housing and are driven from a common shaft but are individual pumps. The scavenging pump is a separate pump. Associated with the engine-driven lube oil systems are two auxiliary systems. These circulating systems are the pre-lube system and the soak back system, each with its own electrically driven pump mounted to the engine skid.

Main Lube Oil System — The main lube oil pump pulls oil from the lube strainer sump through a strainer and delivers it, under pressure, to the engine lube manifold. A pressure relief valve maintains pressure at 125 psi. The lube manifold delivers lube oil to each of the main bearings (through tubes), the gear train (including the idler gear), and to the turbocharger (through a strainer). Lube oil drains from these components into the engine oil sump.

Main Lubrication Pressure — Adequate lubricating oil pressure must be maintained at all times when the engine is running. With the engine idling, oil pressure should be noted immediately. If the oil is cold, the pressure may rise to 125 psi until the relief valve activates. Lubricating oil pressure is not adjustable. The operating pressure range is determined by such things as manufacturing tolerances, temperature, oil dilution, wear, and engine speed. The pipe plug can be removed from the opening in the main pump discharge elbow and a gauge installed to determine the pressure.

In the event of insufficient oil pressure, switches located in the lube oil system will automatically initiate an alarm signal or shut down the engine. Alarm/shutdown pressures are determined by system applications that are individualized to suit each installation.

Piston Cooling System — Oil for the piston cooling system is drawn from the lube strainer sump through the same strainer as in the main lube oil system. The piston-cooling pump pressurizes the lube oil and delivers it to the two piston cooling manifolds, one on each side of the engine. Lube oil is directed from the piston-cooling manifold to cool the underside of the piston crown and the rings. Some of the lube oil enters the piston pin bearings, and the remainder drains from the crown to the engine oil sump.

Pressure of the piston cooling oil will be governed by oil viscosity, engine speed, oil temperature, and wear of the pump parts. The pipe plug can be removed from the opening in the piston cooling pump discharge elbow and a gauge installed to determine the pressure.

Scavenging System — The scavenging system pump takes lube oil from the oil pan sump or reservoir via the scavenging oil strainer. The pump forces the lube oil through the lube oil filters and the lube oil cooler, then back to the lube strainer sump.

1.2.5 Cooling System

Engine-based cooling system parts are described in the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual. These assemblies include:

- Dual Centrifugal Water Pumps
- Water Inlet Manifold and Plumbing
- Water Discharge Manifold and Plumbing
- Air Intake Aftercoolers

Refer to Section 4 later in this section for descriptions of cooling system parts mounted on the accessory rack.

1.2.6 Fuel Oil System

Engine-based fuel oil system parts are described in the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual. These assemblies include:

EMDEC System — The EMDEC system provides 24 volt electronic control of the fuel injection system for improved fuel economy and reduction in exhaust emissions. The EMDEC system eliminates the need for a mechanical engine governor. Sensors are used to detect changes in the engine requirements or ambient conditions and adjust fuel delivery rates and injection timing accordingly.

The Engine Control Modules (ECMs) perform all the functions of the governor system such as engine control and protection. These self-contained microprocessors are individually programmed for this application and do not normally require operator or service interaction on-site. The internal wiring harnesses are connected to the injectors and various sensors to control fuel flow and timing.

The EMDEC system incorporates Electronically Controlled Unit Injectors (EUIs) that are fitted to the cylinder heads and are connected to the ECMs through a wiring harness for interface with the EMDEC system and engine sensors. The sensors are used to determine parameters such as crankshaft speed and position, system pressures, and temperatures.

Engine-Driven Fuel Pump — Fuel passes through the primary fuel filter to the engine driven pump or to the manually-operated fuel priming pump. The engine-driven pump is an internal gear design that is mounted on and directly driven by the lube oil scavenging pump.

Fuel Priming Pump — The fuel priming pump is a manually operated pump located on the accessory rack. Its function is to prime the fuel system after the engine has been shut down for an extended period. The pump draws fuel through the primary fuel filter, and pressurizes the engine mounted fuel manifold. The fuel flow from this point is the same as the engine-driven fuel pump.

Secondary Filter — The engine mounted, secondary spin-on fuel oil filters are installed at the front of the engine, immediately below the center of the counterweight housing. Each filter is a disposable type that is screwed directly to a common head. The filter block provides connections for fuel supply and return and internal relief valves. The relief valves provide for 40 psi injector back-pressure and 120 psi filter bypass if needed.

Refer to Section VIII for descriptions of the Racor primary fuel filter/water separator and other ancillary parts.

1.2.7 Engine Controls — EMDEC System

The Electro-Motive Diesel Engine Control (EMDEC) System is utilized on most modern-day Electro-Motive engine applications that also use micro-processor based master control systems. The EMDEC System is the first layer of engine controls and manages engine speed and fueling. It also protects the engine against serious damage from high engine temperature, low oil pressure, engine overspeed, etc.

For the 20 cylinder Electro-Motive engine, EMDEC equipment includes:

- Electronic Engine Control Modules (ECMs). A “sender” ECM and two “receiver” ECMs.
- Electronic Unit Injectors (EUIs).
- Various Engine Sensors.
- Wiring Harnesses (External, Injector, Sensor and Power).

The EMDEC System and protective devices are described in more detail in the *Electro-Motive EMDEC Operating and Troubleshooting Guide* and the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual.

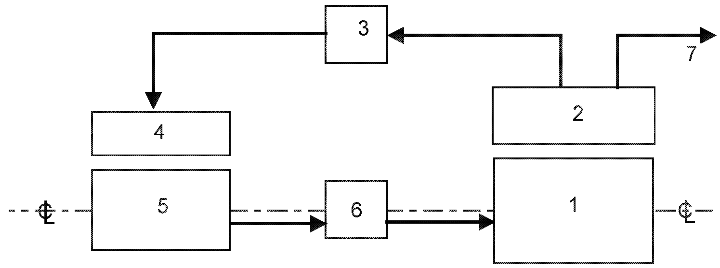
1.3 Generator Description

1.3.1 Description

The brushless, synchronous, revolving field generator used in this application is a Kato 8P12-4400, continuous duty, 8 pole, 6 wire, ‘Y’ connect, 900 rpm, 3 ph, 60 Hz with electrical rating of 3950 kW, 5462KVA at 0.7 power factor and special rating of additional 10% for drilling applications. The generator is a single-bearing configuration with a direct connected rotating brushless exciter, designed to be directly driven by a Diesel engine. The generator is of open drip-proof construction and is air-cooled with Class F insulation.

The frame of the generator is provided with removable, washable filters on the drive end, the sides, and the non-drive end to facilitate maintenance. Space heaters and resistance temperature detectors (RTD) are also provided. The space heaters are energized when the unit is at rest to prevent moisture from accumulating on the generator windings. The RTDs are used to monitor the stator coil and bearing temperatures during operation.

A high-grade precision-machined shaft carries the rotor assembly that comprises the alternator rotating field systems, the exciter rotator/rotating diode system and the cooling fan. The complete rotor assembly is dynamically balanced to ensure vibration free operation. At the drive end of the rotor assembly, a centrifugal fan draws cooling air through the ventilated covers at the non-drive end and discharges it through similar side mounted covers at the drive end. See Figure 2 for a typical functional diagram.



Item	Description	Item	Description
1.	Main Rotor	5.	Exciter Rotor
2.	Main Stator	6.	Rotating Diodes
3.	Automatic Voltage Regulator	7.	Power Output
4.	Exciter Stator		

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Figure 2 Block Diagram of Generator Operation

The generator terminal box is attached to the generator. The connection box contains bus-bar connections for the generator power leads.

- Line Side – T1, T2, T3. These conductors are brought out with individual bus connections.
- Neutral Side – T4, T4, T6. These individual conductors are brought out with a single bus connection T0.
- Metering/relaying current transformers are also housed in the connection box. One each is placed around each neutral side conductor.

For wiring details of the generator and assemblies, refer to the drawings in Section VII of this manual. For complete details on the generator, refer to generator manual in Section VIII of this manual.

1.3.2 Automatic Voltage Regulator

The generator control system consists of an automatic voltage regulator (AVR), protective circuits, and the necessary instruments to allow monitoring of the output of the generator set. The voltage regulator utilized is a digital, automatic regulator that maintains a no-load to full-load steady state voltage to tight tolerances. The AVR has a volts/hertz characteristic that proportionally reduces the regulated voltage at reduced speeds. This feature aids the engine response during sudden large additions of load.

1.3.3 Generator Heater Circuit

Generators, operating in a humid area, will have electrical heaters to keep the generator windings dry and free of condensation when idle. Electro-Motive generator sets intended for automatic operation may be equipped with integral heaters that are supplied by the generator manufacturer or with space heaters that are installed by Stewart & Stevenson. The heater circuit is energized when the engine is at rest.

2. Starting System

2.1 System Description

The air start system is a low pressure, high volume system for starting the Electro-Motive engine. Starting air is provided externally to the engine-generator skid by a customer-supplied air source that delivers 26.6 standard cubic feet per second to each starter motor at 150 psig maximum pressure. See Figure 3 below.

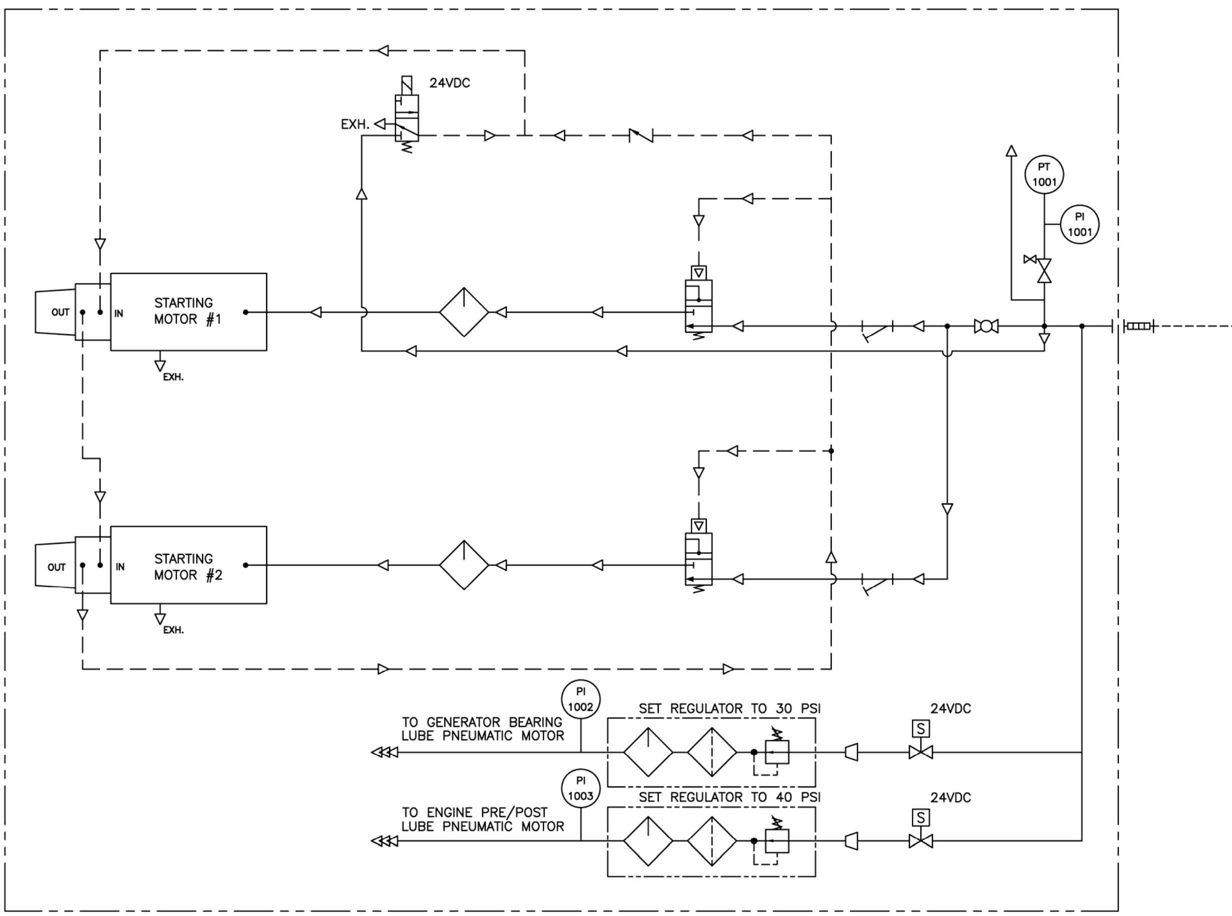

Figure 3 Air Starting System (20V)

Starting air enters the engine-generator skid from the external air source at 150 psig, maximum, at the starter inlets. This pressure is monitored on the local gauge panel. Starting air is piped through two separate strainers and relay valves, one each per starter motor.

Pilot air pressure is tapped off of the #1 starter motor relay valve and routed to the automatic start solenoid valve and manual start pushbutton valve. Pilot air from the #2 starter motor relay valve is routed to the air pressure gauge on the local gauge panel. Automatic or manual start selection is made via the 3-way selector valve located between the outlets of the automatic solenoid and manual start valves.

When cranking the engine, pilot air pressure from the automatic solenoid or manual start valve is routed through the 3-way selector valve and engages the drive mechanisms on both starter motors. After both starter motors are engaged with the engine flywheel, the pilot pressure actuates both relay valves and allows the full volume of starting air to drive the motors and crank the engine. When engine start has been verified by the automatic control system or the operator using the manual start valve, pilot pressure is released at either start valve, thereby causing the starter motors to disengage from the engine flywheel and relay valves to stop air flow to the motors.

CAUTION

Engine startup can be made without electrical control by using the manual start valve switch. If the turbocharger is not pre-lubricated before this procedure is used, severe damage to the assembly may occur.

More Information — System schematic and installation drawings of the air start system are provided in Drawings 26110889 and 26110756, respectively, in Section VII of this manual. For details on the air start motors and relay valves, refer to the TDI vendor data in Section VIII of this manual. Details on other air start components can also be found in Section VIII of this manual.

2.2 Cold Starting Aids

A jacket water heater, mounted in the accessory rack area, adjacent to the engine electrical junction box, assures a prompt engine start by ensuring that the engine coolant is kept at 150 °F while the engine is shut down. The heater improves engine efficiency and reduces engine maintenance and repair by maintaining a uniform block and head temperature prior to the engine start and warm-up period. A uniform temperature reduces thermal shock and stresses in the engine. A secondary function of the jacket water heater is to keep the engine lube oil above 85 °F by circulating warm engine coolant through the lube oil cooler while the pre-lube pump is circulating lube oil through the same cooler. The jacket water heater is equipped with automatic thermostatic controls and does not operate while the engine is operating.

3. Air Intake & Exhaust System

3.1 System Description

The primary components of the air intake/exhaust system are the turbocharger, lube oil separator, filters, indicators, rigsaver, and the exhaust manifold (Figure 4). For flow and assembly details of the air intake and exhaust system, refer to Drawings 26110757, 26110758, and 26110890 in Section VII of this manual.

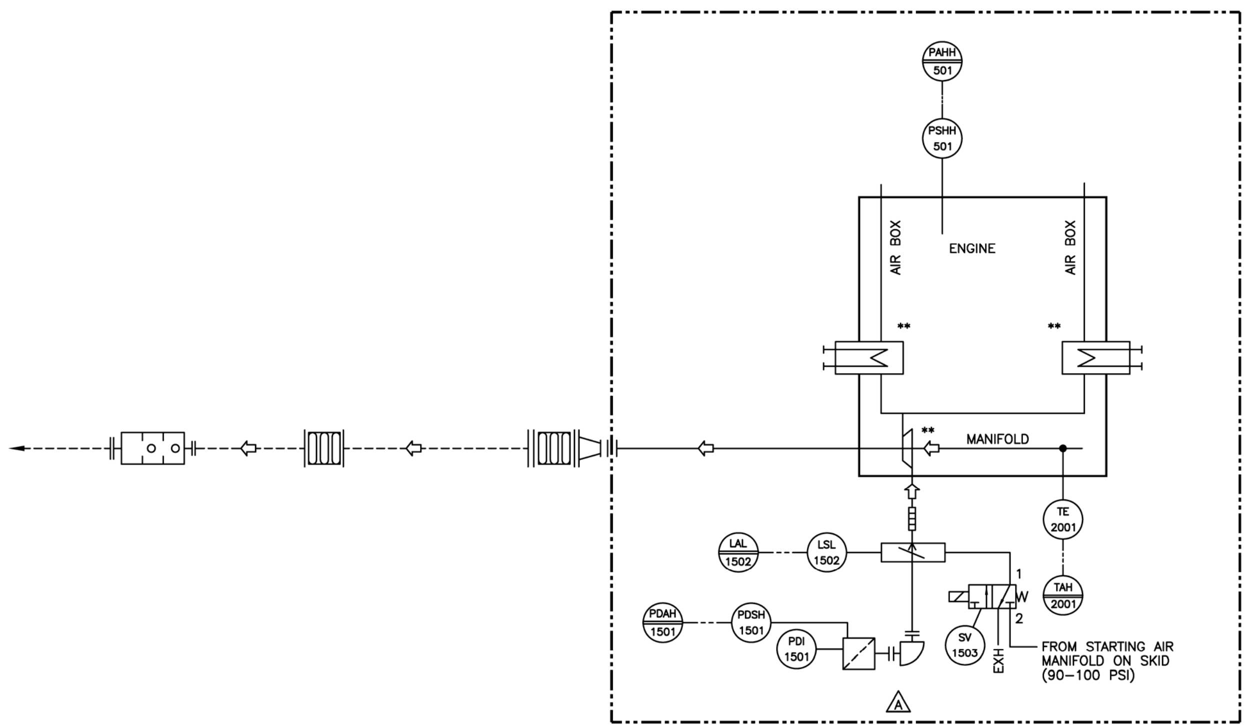

Figure 4 Air Intake and Exhaust System

3.1.1 Air Intake Filters

Engine intake air must be cleaned prior to entering the engine to allow satisfactory engine operation and extended service life of the components. The engine air dry-type intake filter provides an efficient means of assuring a clean air supply at large volume, and in addition serves effectively as an intake silencer. This unit is equipped with disposable filter elements contained within a housing that is attached to an adapter on top of the generator.

The air is drawn through the filter media that is effective in removing oil and water mist, debris, and foreign particles from the ambient air. The dirt and moisture are deposited on the element surface, allowing clean, filtered air to enter the air turning box and deflect into the engine. The media is comprised of multiple layers of pleated paper.

3.1.2 Rigsaver

A pneumatic-actuated overspeed shutdown or “rigsaver” is provided at the engine intake filter coupling as a safety mechanism. The rigsaver shuts off intake air when an overspeed condition is detected by the engine control system. The overspeed trip mechanism must be reset manually prior to restarting the engine.

3.1.3 Exhaust Manifold

The exhaust manifold is made up of chamber assemblies, expansion joints, and an adapter assembly. The expansion joints are used between chamber assemblies, adapter and screen assembly, and the turbocharger to compensate for expansion and contraction of the manifold due to temperature changes. The adapter assembly contains a screen and trap to prevent entry of foreign objects/debris into the turbocharger.

The exhaust system is one of the principal noise sources on the engine and requires a silencer to attenuate the decibel level around the generator set. The noise arises from pressure pulsations in the exhaust pipe. These pulsations lead not only to discharge noises at the outlet, but also to noise radiation from the exhaust pipe and silencer shell surfaces.

The silencer on the generator set will achieve sound attenuation with minimum exhaust restriction. Double wall piping may also be furnished to help reduce unnecessary radiant noise. An expansion joint is installed at the engine exhaust outlet to allow for engine displacement and thermal expansion of the exhaust piping.

Leakage from the exhaust system pipes and joints is a possible noise source. The likelihood of leakage increases because of wear, misalignment, or lack of maintenance of the exhaust system. Regular maintenance checks of the pipes and welded joints will prevent these sources of radiant noise from becoming a problem.

3.1.4 Instrumentation

The engine air filter assembly described above has a vacuum switch to indicate a high differential across the filter assembly. This signal is sent as an input to the engine control panel. Refer to Section IV of this manual for details on the alarm sequence.

In addition, a line mounted “filter minder” indicator is located on the filter housing. The indicator is a manually reset pressure sight gauge that allows the operator to determine the back-pressure created by the filter media as air moves through it. This indicator allows for immediate service before a clogged filter lowers fuel oil efficiency or creates an alarm situation.

3.2 Air Intake and Exhaust System Design Data

Air Intake System

Air Filter Type RC-300

Air Flow Rate .... 15,455 CFM

Intake Air Pressure .... 14.7 psi

Intake Air Temperature .... 115 °F

Filter Service Indicator

Normal/Clean Filter .... 6 inch w.c.

Clogged/Dirty Filter .... 14 inch w.c.

Exhaust System

Exhaust Gas Flow Rate .... 34,650 CFM @ 650 °F, 5500 HP

Ambient Heat Radiation per unit .... 26,400 BTU/min at 5500 HP

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4. Cooling System

4.1 System Description

The notable components of the cooling system are the engine driven water pumps, engine lube oil cooler, coolant/seawater heat exchanger, and remote mounted coolant expansion tank shown in Figure 5.

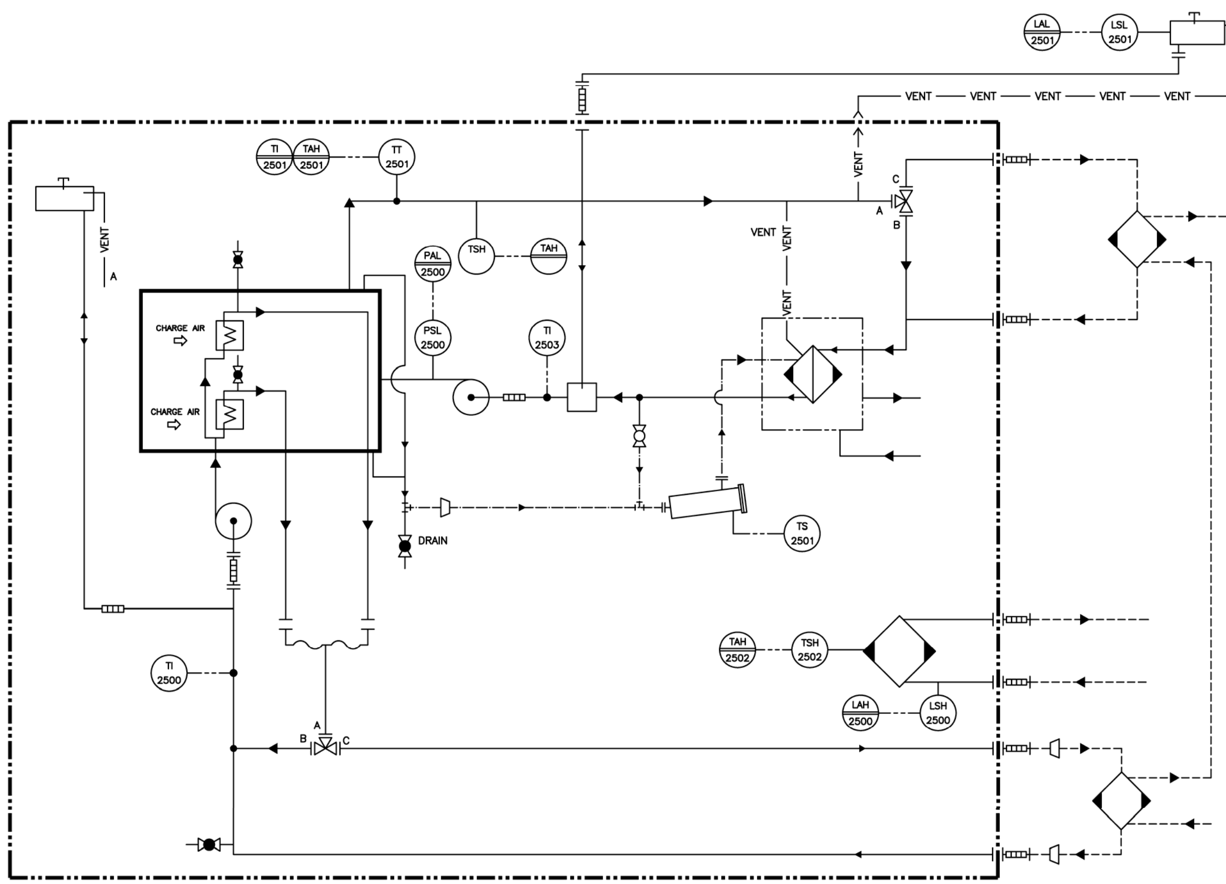

Figure 5 Cooling System

Coolant is pumped from the lube oil cooler to the engine water jacket by the centrifugal pumps. The pumps pull coolant from the lube oil cooler through aspirators that prevent cavitation. The pumps then circulate the coolant through the cylinder water jackets and turbocharger aftercoolers of both cylinder banks. From the water jackets and aftercoolers, the coolant rejoins into a single chamber at the top of the engine and flows to a thermostatically controlled valve or into the vent lines that lead to the expansion tank. Before operational temperature is achieved, the thermostatic valve remains closed and the coolant bypasses back to the input of the lube oil cooler.

After the coolant heats and expands, the thermostatic valve begins to open and coolant is routed through the shell and tube type heat exchanger and then back through the engine lube oil cooler.

The 70 gallon expansion tank is mounted remotely from the engine and equipped with a level sight gauge and low level alarm switch. The expansion tank is the entry point to add new coolant when necessary, according to the sight gauge on the side of the tank. The cooling system is filled through the pressure relief cap at the top of the expansion tank during standby periods. Coolant should be added until it reaches the full mark in the sight gauge.

<u>More Information</u> — For an overall schematic of the cooling system, refer to Drawing 26110892 in Section VII of this manual. Refer to the *EMD 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual for complete details on the engine mounted cooling system components and expansion tank. Refer to the vendor data for details on the coolant level switch and temperature transmitters. Refer to the Watlow vendor data for details on the jacket water heater.

4.1.1 Expansion Tank

The expansion tank is located at the high point in the cooling system so it will function properly and provide sufficient area for hot coolant to expand without leaking from the system prior to entering the shell and tube heat exchanger. A pressure cap on the expansion tank prevents loss of coolant due to evaporation during operation and maintains pressure on the cooling system to provide better cooling for the engine. The cap is designed to open and release excessive pressure during operation.

4.1.2 Thermostatic Valve

The thermostatic valve is a diverting type valve that allows the engine to warm-up and reach normal operating temperature. When an engine is started and cold, the valve bypasses all engine outlet water past the cooling system heat exchanger until the engine has warmed up sufficiently. After engine warm-up, a small portion of the heated water continues to bypass with most of it directed to the heat exchanger. The bypassed water is mixed with the cooler water returning from the heat exchanger before re-entering the engine water jacket. Valve action and mixing of water maintains the desired engine water temperature. If water, however, from the engine reaches the valve’s nominal temperature of 195 °F, the valve will close the bypass side entirely and all water will be directed through the heat exchanger.

The valve is self-contained and self-powered. It contains thermostatic element assemblies that hold valve sleeves in the bypass position by spring tension when cold water from the engine outlet passes over the elements. As water temperature increases, a thermostatic material that is highly sensitive to temperature changes expands to develop pressure that overcomes the force of the return spring. The thermostatic material drives a piston that forces the valve sleeves to open the valve outlet to the heat exchanger and at the same time constrict the bypass opening.

4.1.3 Jacket Water Heater

A Watlow immersion type jacket water heater, mounted in the accessory rack area adjacent to the engine electrical junction box, assures a prompt engine start by ensuring that the engine coolant is kept at 155 °F while the engine is shut down. The heater improves engine efficiency and reduces engine maintenance and repair by maintaining a uniform block and head temperature prior to the engine start and warm-up period. A uniform temperature reduces thermal shock and stresses in the engine. A secondary function of the jacket water heater is to keep the engine lube oil above 85 °F by circulating warm engine coolant through the lube oil cooler while the pre-lube pump is circulating lube oil through the same cooler. The jacket water heater is equipped with automatic thermostatic controls and does not operate while the engine is operating.

4.1.4 Instrumentation

The cooling system described above has instrumentation to indicate temperatures and pressure at several points in the system and also to initiate alarm and shutdown sequences when necessary. The instrumentation is either read directly by the operator at the unit or provides inputs to EMDEC (engine control) or the PLC (master controls). Refer to Section IV of this chapter for details on the alarm sequence. The following table lists the various instrumentation installed in the cooling system.

Device	Location	Range	Alarm/Shutdown Setting and Input
Temp. Gauge	Engine coolant pump inlet	50–300 °F	Visual
Temp. Gauge	Heat exchanger inlet	50–300 °F	Visual
Temp. Gauge	Heat exchanger outlet	50–300 °F	Visual
RTD	Engine jacket water outlet	(See EMDEC)	215 °F shutdown/EMDEC
RTD	Engine jacket water outlet	(See EMDEC)	208 °F alarm/EMDEC
RTD Transmitter	Engine jacket water outlet	4–20 mA = 0–400 °F	PLC
Press. Transmitter	Raw water inlet	4–20 mA = 0–200 psi	PLC
Level Switch	Surge tank	N.O., alarm sig. closed	Low JW alarm/EMDEC

4.2 Cooling System Design Data

<u>Aftercooler (AC) Side</u>

Sea Water Flow Rate .... 700 gpm
Max Sea Water Inlet to Heat Exchanger .... 90 °F
Max Sea Water Outlet to Heat Exchanger .... 101 °F
Heat Exchanger Shell Side Flow Rate .... 300 gpm
AC Inlet Temperature .... 141 °F
AC Outlet Temperature .... 115 °F
Heat Exchanged .... 3,849,120 BTU/HR

<u>Jacket Water (JW) Side</u>

Sea Water Flow Rate .... 700 gpm
Max Sea Water Inlet to Heat Exchanger .... 101 °F
Max Sea Water Outlet to Heat Exchanger .... 128.7 °F
Heat Exchanger Shell Side Flow Rate .... 1200 gpm
JW Inlet Temperature .... 190 °F
JW Outlet Temperature .... 173.5 °F
Heat Exchanged .... 9,580,032 BTU/HR

<u>Generator Cooler Data</u>

Sea Water Flow Rate .... 150 gpm
Max Sea Water Inlet .... 90 °F
Max Sea Water Outlet .... 97 °F
Design Pressure .... 87 psig
Thermal Input .... 154 KW

5. Engine and Generator Bearing Lubrication Systems

5.1 Engine Lube Oil System Description

In addition to the engine's internal lubricating system, other major lube oil system components are mounted on the unit's base frame and accessory rack. These include the pre-lube and soak back pumps, lube oil filter assembly, lube oil cooler assembly, various valves and in-line strainers, and instrumentation shown in Figure 6.

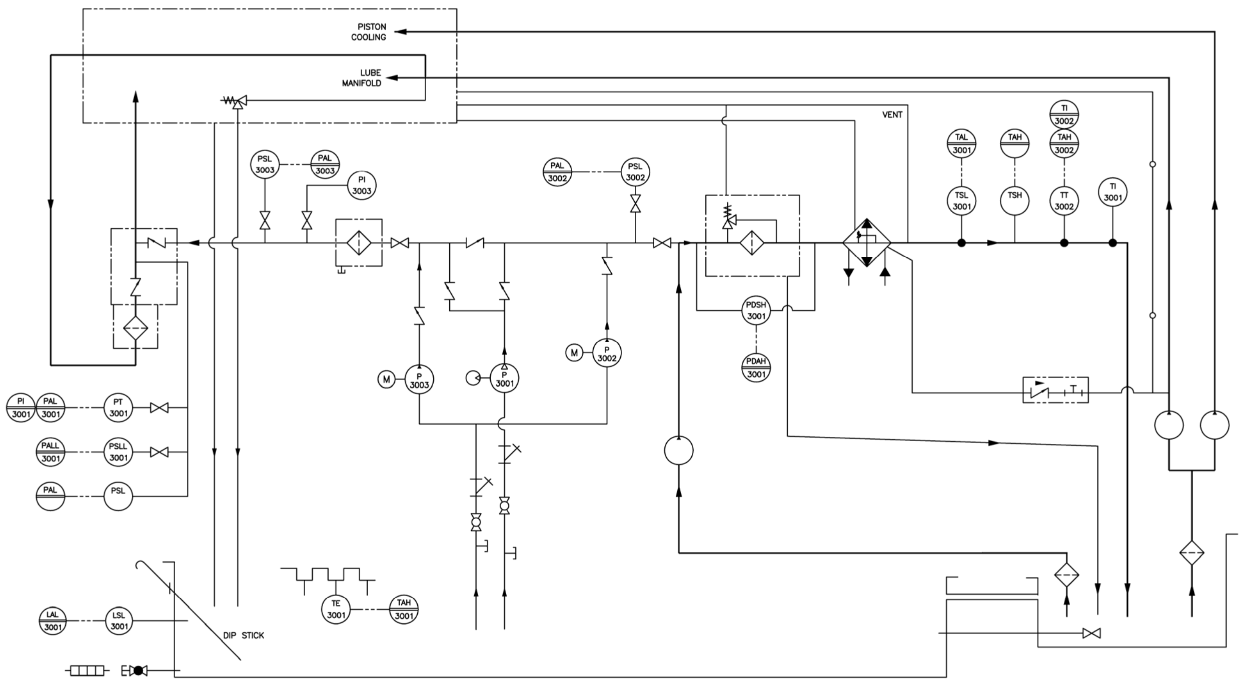

Figure 6 Engine Lube Oil System

More Information — Refer to Drawings 26110760 and 27101007 in Section VII of this manual for layout of the lube oil components on the main engine/generator skid. Refer to Drawing 26110893 for a schematic of the lube oil system. The Diesel engine's lubricating oil system is described in detail previously in Section 1.2.4 and also in the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* included in Section VIII of this manual.

5.1.1 Pre-Lube System

The purpose of pre-lube system is to maintain the engine in a ready-to-run state should it be called upon by the automatic control system. This is accomplished by circulating lube oil through the lube oil cooler where it is warmed above 85 °F by hot circulating coolant heated by the jacket water heater. Internal engine oil galleries are kept full and bearings lubricated via oil flow from the lube oil cooler and swing check valve assembly. The pre-lube pump runs continuously when the engine is shut down and stops when the engine is started, as does the jacket water heater.

The pre-lube system pump, driven by an electric motor, pulls lube oil from the engine oil sump and pushes it through a strainer. From the strainer, the lube oil flows through the lube oil filters, lube oil cooler and into the lube strainer sump. Oil levels in the main engine and strainer sumps are maintained by an overflow passage between the sumps. Pre-lube system pressure is also directed through a 1/2 inch connection from the lube oil cooler, through the swing check valve assembly, and into the main lube oil gallery to keep the crankshaft bearings and other engine moving parts well lubricated. All pre-lube oil flow eventually drains back to the main engine sump.

Two sight glasses are installed in series on the left side of the accessory rack, one above the other, for monitoring pre-lubrication oil flow when the engine is in standby mode. When the pre-lube system pump is functioning correctly, oil should be seen in the lower sight glass only. If oil is observed in the upper sight glass, this indicates that the engine's upper deck may be flooded with oil and consequently some of the engine cylinders could be flooded as well. This condition must be avoided to prevent expensive engine damage. If no oil is observed in the lower sight glass, this indicates a problem with the pre-lubrication system and the engine may not be ready for a critical start.

5.1.2 Soak Back System

The metal parts of the turbocharger turbine remain extremely hot after the engine is shut down. If the lube oil supply to the turbocharger were to shut off when the engine is shut down, the heat would penetrate to the turbocharger bearings, causing considerable damage. The purpose of soak back system is to cool down the turbocharger with circulating lube oil when the engine is shut down and maintain the turbocharger in a ready-to-run state should the engine be called upon by the automatic control system. The soak-back pump runs continuously when the engine is shut down and stops when the engine is started.

This system functions very similarly to the pre-lube system described above. The soak back pump, driven by an electric motor, provides constant lube oil circulation to the turbocharger. The pump pulls lube oil from the engine oil sump and pushes it through a strainer. From the strainer, the lube oil flows through the soak back filter and into the turbocharger housing. From there, lube oil flow cools and lubricates the turbo drive gears and turbo shaft bearings, carrying the heat back to the engine oil sump.

The soak back system also ensures that the bearings of the turbocharger are lubricated prior to engine start. When the engine starts, the soak back pump lubricates the turbocharger until the main lube oil pressure from the engine driven pump becomes greater than the soak back pressure. The soak back pump's power source is controlled automatically through the generator set PLC.

The soak back filter also contains a 70 psi bypass valve. This valve will open to bypass a plugged filter so that lubrication can be supplied to the turbocharger and prevent heat damage.

5.1.3 Lubricating Oil Filter

The lube oil filter is a full flow type and consists of a circular tank containing the filter elements mounted on standpipes. A hinged cover closes the open end of the tank and is held tightly by the cover hold-down bolts. An o-ring is used between the cover and the rim of the tank to prevent oil leakage during operation. Flanged openings are provided for the oil inlet and outlet connections and for the filter housing drain lines.

The capacity of the rack mounted lube oil filter depends on the engine model and application. This particular application is provided with a 10-element lube oil filter assembly.

5.1.4 Lubricating Filter Bypass Valve

All of the oil flowing through the lubricating oil system passes through the filter assembly. Normally, the oil flows through the filter elements into the perforated standpipes in the center of each element and then down to the filtered oil compartment, discharging into the system through the outlet connections.

The bypass valve is the provision in the filter assembly system for excessive pressure build-up from clogged filters. The bypass valve is spring loaded and built into the filter to permit incoming oil to bypass into the oil discharge compartment.

5.1.5 Engine Lube Oil Cooler

The fin and tube type lube oil cooler is contained in a housing mounted on the accessory rack. The housing contains tubes and baffles with the hot lube oil flowing on the outside of the tubes and heat exchanger discharge water through the tubes to take up and carry away the heat from the engine lube oil as it passes through the cooler. The coolant water passes through the tubes from one header to the next as the lube oil enters the shell at one end, flowing transversely around the tubes/baffles, leaving the shell at the other end. The coolant water and the lube oil flow through the heat exchanger in opposing directions for the maximum heat displacement and cooling effect.

5.1.6 Engine Lube Oil System Instrumentation

The lube oil system described above has instrumentation to indicate temperatures, pressures, and levels at different points in the system and also to initiate alarm and shutdown sequences when necessary. The instrumentation is either read directly by the operator at the unit or provides inputs to EMDEC (engine control) or the PLC (master controls). Refer to Section IV of this chapter for details on the alarm sequence. The following table lists the various instrumentation installed in the cooling system.

Device	Location	Range	Alarm/Shutdown Setting and Input
Temp. Gauge	Lube oil cooler outlet	50–300 °F	Visual
Temp. Gauge	Scavenging oil pump outlet	50–300 °F	Visual
RTD	Scavenging oil pump outlet	(See EMDEC)	220 °F shutdown/EMDEC
Temp Switch Low	Lube oil cooler outlet	85 °F make; 95 °F break	85 °F alarm/PLC
Temp Switch High	Lube oil cooler outlet	230 °F make; 220 °F break	230 °F shutdown/PLC
Temp. Transmitter	Lube oil cooler outlet	4–20 mA = 0–400 °F	PLC
Pressure Gauge	Local gauge panel	0–200 psi main LO press.	Visual
Pressure Gauge	Soak back filter outlet	0–100 psi soak back press.	Visual
Press. Switch	Engine main lube oil gallery	(See EMDEC)	27 psig alarm/EMDEC 20 psig shutdown/EMDEC
Press. Switch Low	Downstream of soak back filter	N.O., alarm signal closed	10 psig & falling alarm/PLC
Press. Switch Low	Turbocharger oil filter outlet	(See EMDEC)	37 psig & falling alarm/EMDEC
Press. Sw. Low-Low	Turbocharger oil filter outlet	(See EMDEC)	27 psig & falling alarm/EMDEC
Press. Switch Low	Downstream of pre-lube pump	N.O., alarm signal closed	20 psig & falling alarm/PLC
Press. Transmitter	Downstream of soak back filter	4–20 mA = 0–200 psi	PLC
Level Switch	Main engine sump	N.O., shutdown sig. closed	Low level shutdown/EMDEC

5.2 Engine Lube Oil System Design Data

Lube Oil Capacity

Engine Sump and Lube Strainer .... 274 gallons

Lube Oil Accessories .... 210 gallons

Main Lube Oil Pump Capacity.. 281 gpm

Piston Cooling Pump Capacity.. 136 gpm

Scavenging Pump Capacity .... 500 gpm

Soak Back Pump Capacity.. 6 gpm

Pre-lube Pump Capacity .... 6 gpm

5.3 Generator Bearing Lube Oil System Description

Major generator bearing lube oil system components include a pump driven by an air-driven motor, a pump driven by a 480/240 VAC motor, an air-oil cooler driven by a 240 VAC motor, a 25-gallon (approximately) oil tank, hoses, tubing, filters, strainers, and various valves, gauges, and transmitters shown in Figure 7.

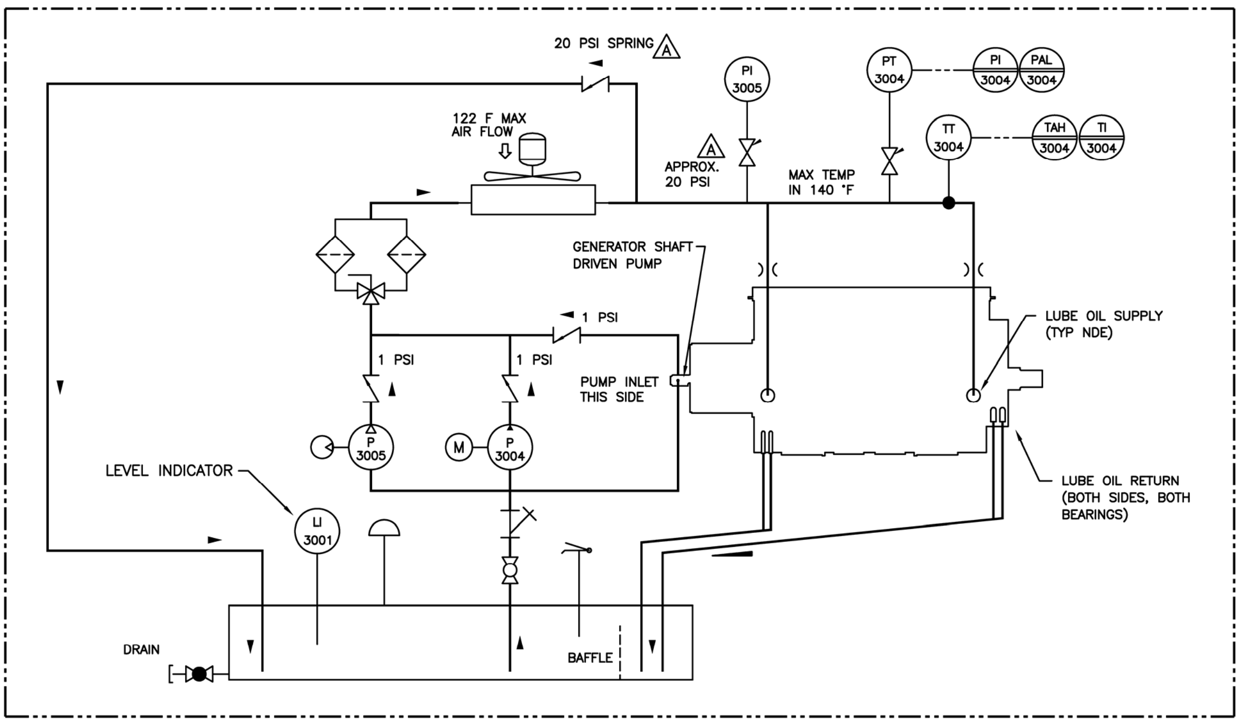

Figure 7 Generator Bearing Lube Oil System

More Information — Refer to Drawings 26110760 and 27101001 in Section VII of this manual for layout of the lube oil components on the main engine/generator skid. Refer to Drawing 26110895 for a schematic of the generator bearing lube oil system. The generator bearings and lubricating oil system is described in detail in the *Kato Instruction Manual* and *Kato Power Transmission Plain Bearing Manual* included in Section VIII of this manual.

Also refer to S&S Factory Test Procedure No. ES-749 and to Start-Up Procedures for Marine Drilling Units ES-750 for further details on starting, running, and controlling the engine-generator set.

5.4 Generator Bearing Lube Oil System Design Data

Generator Lube Oil..conforming to ISO VG 46
Filtration Rating..20–25 micron elements
Oil Flow to DE Bearing..3.0 gpm
Oil Flow to NDE Bearing..0.9 gpm

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6. Fuel System

6.1 System Description

Fuel is drawn from the customer's fuel tank through a one-way check valve, gate valve (cut-off), and the primary filter/water separator assembly (Figure 8). After being drawn through the primary filter, the fuel is pressurized by the engine driven pump and enters the fuel block. In parallel with the engine driven pump is the manual fuel priming pump which is used by the operator to prime the system after extended shutdown periods or system maintenance. Each pump has an anti-flood check valve set to 10 psi installed in its flowpath inside the fuel block. The purpose of the anti-flood check valves is to prevent reverse flow from the fuel block. From the fuel block, the fuel supply is pushed through the duplex secondary filter and back into the fuel block where it is locally monitored for pressure at the engine gauge panel. The fuel oil leaves the fuel block again and feeds the engine's injectors. Fuel metering by the injectors is electronically controlled by the EMDEC system.

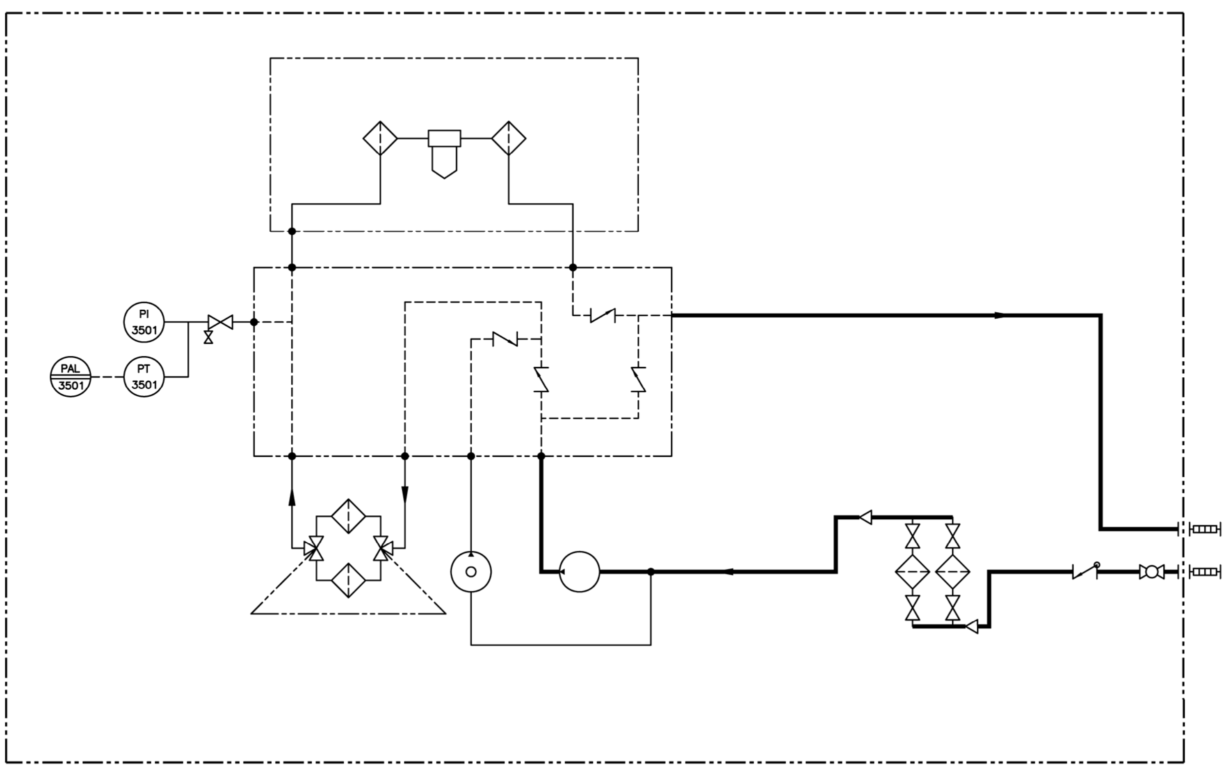

Figure 8 Fuel System

An excess of fuel is presented to the injector heads from the manifolds. This excess supply of fuel purges air from the injector heads and cools them. The unused portion of the fuel is then returned to the external supply via the fuel block. A check valve inside the fuel block maintains the fuel pressure to the injector heads at 40 psi. The fuel block also contains a fuel pump pressure relief valve (set at 120 psi) that discharges excess pressure into the fuel return line when necessary.

More Information — For schematic and flow details on the fuel system, refer to Drawing 26110894 in Section VII of this manual. For assembly details of the fuel system components, refer to Drawing 26110761. For fuel system specifications and requirements, refer to *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual*. Refer to the Racor vendor data for details on the primary fuel filter.

6.2 Primary Fuel Filter/Water Separator

Water contamination of Diesel fuel is the primary cause of damage to the fuel pump and fuel injectors. The remote primary fuel filter is installed inline in the fuel system between the fuel tank and the fuel supply pump.

The standard type of fuel/water separator used with the Electro-Motive 710G Series generator sets is the coalescing filter that generally operates in two stages. See Figure 8. In stage one, bulk separation of water is accomplished by the imparting of a centrifugal motion to the fuel stream. In stage two, the coalescing of tiny water droplets into heavier drops is accomplished on the filter shell and the chemically treated replaceable element. The third stage is a final filtration of foreign particles from the fuel.

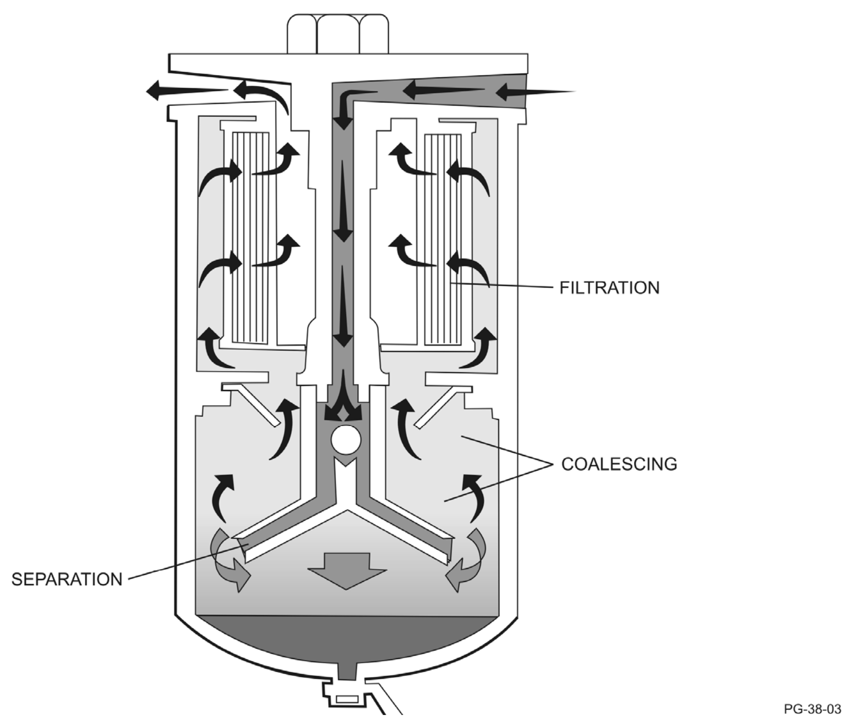

Figure 9 Coalescing Type Water Separator

6.3 Fuel System Design Data

Normal Fuel Flow .... 10 GPM

Fuel Pump Maximum Suction Lift .... 10 ft

Max. Height of Fuel in Tank above Crankshaft CL .... 15 ft

EUI Pressure Range .... 60-120 psi

Anti-Flood Check Valve Setting .... 10 psi

Block Check Valve Setting .... 10 psi

Block Relief Valve Setting .... 120 psig

Primary Fuel Oil Filter (Racor)
- Flow Rate .... 24 GPM
- Element Rating .... 40 micron
- Max Suction Pressure .... 15 psig
- Clean Pressure Drop .... 3.3 psi

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7. Controls & Instrumentation

7.1 Control System Hardware & Architecture

The control system hardware is supplied by both Stewart & Stevenson and other suppliers and installed at the unit(s) and/or customer-determined remote-control locations. Out-of scope control hardware is described in this section for clarity purposes only.

The control system hardware for this application includes:

- Electro-Motive EMDEC engine control system (ECUs) for each of the seven engine-generator units. These are supplied by Electro-Motive and are mounted on the engine. The EMDEC system is the basic, first layer engine control system and ultimately controls engine speed and fueling. It also protects the engine against serious damage from extreme operating conditions. All external EMDEC wiring terminates at the engine junction box.
- Direct Logic DL-405 PLC and EZtouch Panel HMI (local control) for each of the seven units. These controls are installed in the local control cabinets for each engine-generator unit. The local PLC is configured to accept inputs from local operator controls, EMDEC sensors, and custom instrumentation. Based on the input data and an internal customer program, the PLC outputs the appropriate signals to control relays, indicators,.
- Network communication:
  - The Modbus network is linking all local PLCs to the PMS for data collection.
  - SAE J1708/J1587 RS485 Bus linking EMDEC engine controls to the customer's Digital Maintenance System (DMS).

7.2 Electrical Drawings

Refer to the electrical drawings in Section VII of this manual as you read the following control system descriptions. The electrical drawings are grouped and detailed below for convenience.

- Drawing 26111179 – Assembly and Wiring Diagram
- Drawing 26111180 – System Interconnection Wiring Diagram
- Drawing 26111181 – Engine/Generator Controls and Monitoring Schematic

7.3 Local Engine Gauge Panel & Junction Box

The local engine gauge panel and wiring junction box are both mounted on the engine-generator skid at the accessory rack end.

The local engine gauge panel houses mechanical pressure gauges for local monitoring of the lube oil pressure, fuel oil pressure, raw water pressure, and air start pressure. Instrument isolation valves are located below each gauge to make gauge replacement or repair possible while the engine is running. For details on the pressure gauges, refer to the vendor data in Section VIII of this manual.

The local engine junction box is mounted below the gauge panel and serves as the central termination point for all wiring originating from the engine and engine-related accessories. The junction box includes terminations for the EMDEC controls, rig saver, air start system, engine sensors, and customer wiring that supplies power to the 480V 3-phase pump motors, jacket water heater, and the 120V single-phase generator space heaters.

7.4 Local Engine-Generator Control Panel

The local engine-generator control panel is mounted near the engine-generator skid. The outside of the panel door contains the local PLC HMI screen, engine status, alarm, and shutdown indicators, operational mode select switch, emergency stop pushbutton, and controls for manual engine-generator operation. The inside of the panel cabinet houses the local PLC microprocessor and I/O hardware, electronic speed switch, control relays, fuses, motor starters and protection, and terminal boards. Refer to descriptions below for more information.

7.4.1 Local PLC Components

The local PLC components are racked at the top of the cabinet and consist of the following items:

Direct Logic DL-405 PLC — This module is the central processing unit of the PLC. It operates from a 24 VDC power supply All local process programming for a particular engine-generator unit resides in this module. In case of power supply failure, programming is retained in memory by a lithium back-up battery.

7.4.2 Engine Speed Switch (ESS)

The ESS serves two purposes: it signals the PLC to disconnect the starter when the engine speed equals the crank disconnect speed setting and shuts down the engine if an overspeed situation occurs. On crank disconnect, re-engagement of the starter is inhibited until RPM returns to zero. The ESS operates on 24 VDC and receives input from the engine speed magnetic pick-up (MPU).

Trip points can be field adjusted, and LEDs next to the set point potentiometers indicate that the trip point has been reached and the relay(s) have operated. An overspeed test circuit is built-in, and it will actuate the output relay at a point 10% below actual overspeed set point. Also, an ESS overspeed input will always trigger the rigsaver. Refer to the Dynalco Speed Switch documentation in Section VIII of this manual for more detailed information.

7.4.3 Control Relays

The control relays are supplied by Automation Direct and have 24 VDC coils with spike suppression diodes. Also, signal voltage connected to the relay contacts is always 24 volts. Control contacts may be wired as normally open (NO) or normally closed (NC) or a combination of the two. The NO or NC connection is always determined with the relay coil in the de-energized state. Refer to the Automation Direct documentation in Section VIII of this manual for more detailed information. The devices that trigger the relays are shown in the following table.

7.4.4 AC-Powered Accessory Control and Protection

Circuit breakers, motor starters, and overload relays are provided for each AC-powered accessory mounted on the engine-generator skid. These accessories include the pre/post lube pump motor, turbo soak back/pre-lube pump motor, and jacket water heater. Protection for the generator space heater is provided by others.

The AC control and protection components are mounted in the lower right of the control cabinet. Accessory supply power is 480 VAC and flows through the 15A circuit breakers, motor starter contacts, and overload relays, before reaching the accessory load. The local PLC is programmed to energize the 24 VDC motor starter coils and run the accessories any time the engine is not running. Refer to the Cutler-Hammer (circuit breakers) and Fuji (contactors and overload relays) documentation in Section VIII of this manual for more detailed component information.

7.4.5 DC Circuit Protection

Fuses are used for DC circuit protection and are mounted below the control relays in the control cabinet. Refer to the Bussman fuse, Allen-Bradley 30A fuse block, and WAGO fuse block documentation in Section VIII of this manual for more detailed component information. The circuits are fused according to the following table.

7.5 Operation

For complete details on the local operation of the generator set, refer to Section IV of this manual.

7.6 Engine Control System

Electronic engine control systems eliminate the need for mechanical governors by electronically controlling the startup, rate of engine speed, monitoring of various sensors during operation, and shutdown.

The Electro-Motive Diesel Engine Control (EMDEC) is an advanced technological electronic fuel injection and control system. The EMDEC system offers significant operating advantages over traditional mechanically governed engines. The system optimizes control of critical engine functions that affect fuel economy and emissions. The system also provides the capability to protect the engine from serious damage resulting from conditions such as high engine temperatures or low oil pressure.

7.6.1 EMDEC System Description

The EMDEC system consists of:

- Engine Control Modules (ECMs)
- Electronic Engine Unit Injectors (EUIs)
- Engine Sensors
- Engine Harnesses

Three ECMs are used on the 20 cylinder 710 engine. One ECM is designated as the "Sender" and the remaining ECMs are designated as "Receiver 1" and "Receiver 2." The sender ECM is responsible for primary data processing and overall control of engine functions. Basic operating instructions such as fuel amount and injector timing originate from the Sender ECM and are received by the Receiver ECMs.

Each ECM has the ability to control up to eight injectors. Therefore, on the 20 cylinder engine, the Sender ECM controls the injectors for cylinders 1, 2, 11, and 12. The Receiver 1 ECM controls the left bank injectors 13 – 20, and the Receiver 2 ECM controls the right bank injectors 3 – 10.

The Sender ECM monitors oil temperature, oil pressure, oil level, coolant temperature, coolant level, crankcase pressure, and other vital engine parameters. The Sender ECM receives electronic inputs from sensors on the engine and uses the information to control engine operation. It also controls fuel injection quantity and timing.

7.6.2 EMDEC Harnesses

EMDEC requires the following harnesses:

- Interface Harness — This harness connects the Sender ECM to the control system interface (PLC). Individual wires from this harness connect to terminals in the engine junction box. The Sender ECM receives automatic or manual speed commands, external sensor inputs, and operational inputs from the control system via the interface. Furthermore, the Sender ECM communicates EMDEC alarm and shutdown conditions to the PLC via the same interface. Customer digital maintenance system and diagnostic connections are also made through this harness and interface.
- ECM Harness — This harness provides a two-way serial communications link between the Sender ECM and Receiver ECMs over which the Sender ECM can send and receive engine operational data signals.
- EUI Injector Harnesses — These harnesses connect the ECMs to the EUI injectors. ECM fuel injector timing and duration commands are sent via these harnesses.
- Sensor Harnesses — This harness facilitates the communication of engine sensor input to the Sender ECM. This allows the Sender ECM to make changes in engine performance, protect the engine, and provide diagnostic data.
- Power Supply Harnesses — Provide 24 VDC power to the ECMs. Fuses located inside the local control panel cabinet protect the ECMs against overcurrent damage.

7.6.3 EMDEC Sensors

Engine control system sensors provide information to the Sender ECM regarding various engine performance characteristics. The information is used to regulate engine and vehicle performance, provide diagnostic information, and activate the engine protection system. For more detailed information on the EMDEC sensors, refer to the *Electro-Motive 710G Series Turbocharged Engine Maintenance Manual* in Section VIII of this manual.

The following table lists the basic set of EMDEC engine sensors and how they are classified. Most EMDEC-equipped engines have all or almost all of the listed engine sensors.

EMDEC Engine Sensors	
Sensor	**EMD Classification**
Synchronous Reference Sensor (SRS)	System Sensor (Timing and Speed)
Timing Reference Sensor (TRS)	System Sensor (Timing and Speed)
Fuel Pressure Sensor (FPS)	Performance Sensor (Fuel Injection)
Fuel Temperature Sensor (FTS)	Performance Sensor (Fuel Injection)
Turbo Boost or Air Pressure Sensor (TBS)	Performance Sensor (Fuel Injection)
Air Temperature Sensor (ATS)	Performance Sensor (Fuel Injection)
Oil Temperature Sensor (OTS)	Protective Sensor
Oil Pressure Sensor (OPS)	Protective Sensor
Coolant Temperature Sensor	Protective Sensor
Coolant Pressure Sensor (CPS)	Protective Sensor
Crankcase Pressure Sensor (CCP)	Protective Sensor

7.6.4 EMDEC Inputs & Outputs

The following digital inputs are available to EMDEC:

- Engine Running (Ignition Enable)
- Engine Speed Idle/Rated

The following digital outputs are available from EMDEC:

- Low Oil Pressure – Shutdown
- High Oil Temperature – Shutdown
- High Crankcase Pressure – Shutdown
- High Jacket Water Temperature – Shutdown
- Check Engine Light – Alarm
- Low jacket water pressure shutdown

The following analog input is available to EMDEC:

- Speed Command Voltage (0–5 VDC)

7.6.5 EMDEC and PLC Engine Protection

EMDEC and PLC engine protection provides the capability to warn operators and automatically protect the engine from serious damage resulting from:

- Low Oil Pressure Shutdown (EMDEC initiated)
- High Crankcase Pressure Shutdown (EMDEC initiated)
- Low Oil Level Alarm
- High Oil Temperature Alarm (EMDEC initiated)
- High Jacket Water Temperature Alarm (EMDEC initiated)
- Low Jacket Water Level Alarm
- Engine Check Alarm (EMDEC initiated)
- Engine Overspeed Shutdown (PLC initiated)
- Low Soak Back Oil Pressure Alarm (PLC initiated)
- Low Pre/Post-Lube Oil Pressure Alarm (PLC initiated)
- High Air Cleaner Restriction Alarm (PLC initiated)
- Low Lube Oil Temperature Alarm (PLC initiated)
- Please see the control schematic for additional alarm and shutdown

7.6.6 EMDEC Power Requirements

Since the EMDEC system requires 24 VDC power, a battery source is used to operate the ECMs. EMDEC operates normally on 24 volts; however, in the event of a power supply malfunction, the system will continue to operate at reduced voltage.

EMDEC will detect a malfunction at reduced voltage. When this occurs the engine fault alarm (Common Alarm Light) will illuminate. The engine should perform correctly until the engine shuts down for an over- or under-voltage control system power supply.

8. Electrical Interconnect System

8.1 Introduction

The purpose of the electrical interconnect system is organize, tie together, and protect the following engine-generator electrical sub-systems:

- Control system 24 VDC power supply
- Engine accessory 480 VAC 3-phase power supply
- Generator heater 120 VAC single-phase power supply
- EMDEC control system 24 VDC power, inputs, and outputs
- Local PLC control system 24 VDC power, inputs, and outputs
- Generator breaker inputs and outputs (NOV supplied switchgear)

Refer to the drawings listed in Section 7.2 in this section for detailed information on looms, wire numbers, terminal board connections, device connections, customer connections, and the PLC communication network.

8.2 Wiring

Control wiring installed by S&S is typically #16 AWG, 600V copper, with gray cover. It is identified with wire number tags at each terminal connection. Covered wireways are typically used in control cabinets to loom the wire together for a cleaner, organized installation. Higher voltage accessory power cable is loomed separately from the control wiring and identified accordingly.

All wiring is protected in appropriately sized metal or flexible conduit when running between control cabinets, junction boxes, or devices.

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9. Optional Equipment

9.1 Enclosure

Enclosures or related items were not supplied with this work order.

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