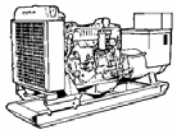
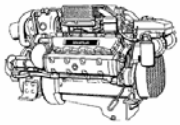
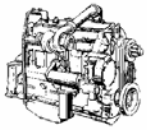
Blanchard POWER SYSTEMS


SUBMITTAL DATA:

ANDERSON REGIONAL LANDFILL SITE

CATERPILLAR
LANDFILL GAS POWERED GENERATOR
3520C 1600kW

EMERGENCY POWER SYSTEM

Distributor: BLANCHARD MACHINERY, SC – PO#E10278-E10281 &E10295
Contractor: **SANTEE COOPER**
Equipment: CATERPILLAR

SUBMITTAL DATA

EMERGENCY STANDBY GENERATOR

Project Name:

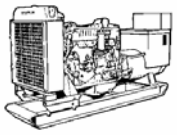
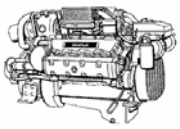
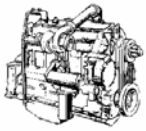
Anderson Regional Landfill
203 Landfill Road
Belton, SC 29461

Prepared for:

SANTEE COOPER REGIONAL WATER
1 RIVERWOOD DR
MONCKS CORNER, SC 29461

Blanchard Machinery job file #E10278-81 & E10295
October 2007

Please Direct All Technical Questions To:
JAMES ADAMS
Project Manager
LARRY MORGAN
INSIDE ENGINEER


INDEX

ANDERSON REGIONAL LANDFILL SITE

Blanchard Engines
Columbia- 3151 Charleston Highway - (803) 791-7100 - (866) 882-2216 fax
Greenville – 6755 Frontage Road – (864) 672-0500 – (866) 741-3513 fax

START UP REQUEST FORM

Project: ANDERSON LANDFILL Attn: SANTEE COOPER

***Two Weeks Scheduling Time Is Required. ***

Please fill in the below requested information and return by mail, fax or email to:

3151 Charleston Hwy
W. Columbia, SC 29172
Attn: Engine Division, James Adams, Project Manager, jdadams@BlanchardMachinery.com
(866) 882-2216 fax

STARTUP REQUIREMENTS: Items Checked must be completed PRIOR to START UP.

(Return trip WILL be charged if the following items are NOT complete when tech arrives at the job site)

- ❑ Fuel (Natural or LP Gas sets) – The gas or propane supplier has installed an additional regulator. Record gas/propane pressure supplies to the generator_____(psi or in/H2O) *
- ❑ Voltage of generator and /or Switchgear verified correct by electrician
- ❑ Generator breaker(s) connections complete and power available by electrician
- ❑ AC & DC wires pulled to control panel, but **NOT** terminated. (Packaged Gensets) *
- ❑ Battery charger mounted and AC completed by electrician. Do **NOT** terminate DC. (Blanchard Engines will provide acid, fill batteries, and terminate DC).**Note: Do not turn on power to the battery charger or batteries until the batteries are filled with acid.**
- ❑ Remote annunciator connections pulled to remote and generator by electrician. Will be terminated by Blanchard technician. *
- ❑ Expect generator to be ABC rotation. Rotation has been matched to utility source.
- ❑ Operation and Service manuals will be brought to training by contractor.

Comments / Exceptions:

DIRECTIONS TO SITE:

CUSTOMER REQUESTED STARTUP: _____ (date/time)

NOTE: TWO WEEKS IS REQUIRED FOR SCHEDULING PURPOSES

Requested by: tel: fax:

On-Site Contact: tel: _____ cell:

.

REQUESTED DATE FOR OWNER TRAINING: _____/_____ (date/time)

ONLY ONE TRAINING SESSION IS INCLUDED WITH START UP.
ADDITIONAL TRAINING TRIPS WILL BE BILLED AT DAY RATES.

BLANCHARD MACHINERY USE: (Project Manager will complete and return the customer)

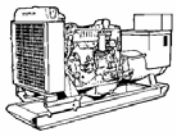
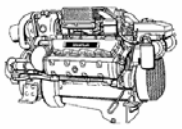
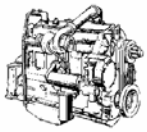
Confirmed Date of Startup: **Signature: _James Adams**

Contractor:

Model #: 3520C **S/N:** **ID #: ENG-** **PO#:** **ACCT#: 9C13000**

6/1/2004 Rev. 01

Blanchard CAT


SUBMITTAL DATA

SECTION 1

BILL OF MATERIALS

Columbia
3151 Charleston Hwy
West Columbia, SC 29172
803.791.7100 tel
803.926.4230 fax

Greenville
6755 Frontage/Whitehorse
Greenville, SC 29605
864.672.0500 tel
864.672.0501 fax

Charleston
2209 Mechanic St
Charleston, SC 29405
843.266.2600 tel
843.266.2604 fax

BILL OF MATERIALS

Re: Generator Set- Santee Cooper Anderson County Landfill

One New Caterpillar G3520C Landfill Gas Powered Generator Set, equipped as follows:

1600 ekW Continuous rating (without fan), 60Hz, 4160V, 1200 RPM
105C/54C Two stage jacket water aftercooling, 1.0 g/bhp-hr (DM5739)
Premium Electronic modular control panel (EMCPII plus), includes AC metering, engine metering with auto start-stop Logic w/ indicators, panel lights, auxiliary run relay, loss of coolant shutdown. Also includes the following Programmable protective relaying functions: U/O voltage, U/O frequency, reverse power, over current (phase and total), and kW total
Battery charger- Dual rate, 20A, 24VDC with alarms
Radiator cooling package- remote horizontal with electric fan- includes separate circuits for jacket coolant and aftercooler Coolant. Fan motor to require 23 ekw 480V 3-phase supply. Motor starter not included. Jacket water connections To be 6" and aftercooler connections to be 3".
Exhaust silencer, 18" inlet/outlet "Industrial" degree chamber type- shipped loose
Fuel system, gas pressure regulator
Generator- Caterpillar 866 frame, PM excited with digital voltage regulator
Governor- Caterpillar Gas Engine Control Module (GECM) with isochronous speed control
Dual 24VDC electric starting motors
24VDC lead acid type electric starting batteries with racks and cables
9ekw, 480V three phase input jacket water heaters with circulating pumps
Initial fluids fill
Weather protective enclosure with conditioned switchgear room
One Lot Caterpillar LM switchgear
Factory Acceptance Testing
Freight to Anderson, SC
Start up assistance and commissioning
Site emissions testing
Special tools as defined in section 6

Notes:

1. Scope of supply limited to the items listed in the BOM. Offloading, setting, piping and installation not included.
2. Filtration of gas supply to one micron must be supplied by others. A gas analysis is requested to confirm performance.
3. Acceptance testing to be performed on natural gas. We have also made provision for emissions testing on site gas.

EXCEPTIONS AND CLARIFICATIONS: (NOTICE TO CONTRACTOR)

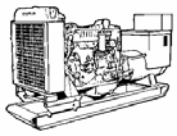
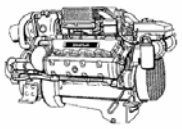
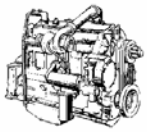
FOR INTIAL START UP SERVICE AND CHECK OUT SERVICE/TESTING/PERSONNEL INSTRUCTIONS, PLEASE ALLOW TEN (10) WORKING DAYS FROM TIME OF NOTIFICATION. ONLY ONE SERVICE CALL FOR START UP IS INCLUDED, ADDITIONAL CALLS WILL BE CHARGED AT CUSTOMARY SERVICE RATES.

BLANCHARD ENGINE DIVISION DOES NOT SUPPLY FUEL OR EXHAUST PIPING OTHER THAN WHAT IS SHOWN IN SUBMITTAL BILL OF MATERIALS. WE DO NOT SUPPLY FUEL FOR FIELD TESTING, OR TANK FILL UP REGARDLESS OF SPECIFICATIONS. THIS WILL BE THE RESPONSIBILITY OF OTHERS.

OUR BILL OF MATERIAL IS PREPARED ACCORDING TO THE SPECIFICATIONS PUBLISHED AT TIME AND DATE OF BID UNLESS OTHERWISE NEGOTIATED.

BLANCHARD ENGINE DIVISION CAN NOT AND WILL NOT ACCEPT PURCHASE ORDERS WHICH WILL INCLUDE A RETAINAGE. OUR TERMS ARE NET THRITY (30) DAYS. IF THERE ARE ANY QUESTIONS ON THIS MATTER, PLEASE CONTACT OUR OFFICE.

Blanchard CAT


SECTION 2

CATERPILLAR LANDFILL GAS ENGINE

ADEM III CONTROLLER
JACKET WATER HEATER
REMOTE RADIATOR

GAS GENERATOR SET

CATERPILLAR®

Image shown may not reflect actual package

Low Energy Fuel Continuous 1600 ekW 60 Hz 1200 rpm 4160 Volts

Caterpillar® is leading the power generation market place with power solutions engineered to deliver unmatched performance, reliability, durability and cost-effectiveness.

BENEFITS

EMISSIONS
- Meets most worldwide emissions requirements down to 0.5 g/bhp-hr No_x level without after-treatment.

FULL RANGE OF ATTACHMENTS
- Wide range of bolt-on system expansion attachments, factory designed and tested

WORLDWIDE PRODUCT SUPPORT
- With nearly 200 Caterpillar® dealers, 1700 branch locations and another 1400 Caterpillar Rental outlets, our worldwide dealerships has the local expertise, specialists and extensive parts inventory you'll need – no matter where you or your business is providing power
- Comprehensive post-sales support including maintenance and repair agreements that a re-tailored to your specific equipment application.
- 99.7% of parts orders filled within 24 hours. The best product support record in the industry.
- High skilled technicians are trained to service every aspect of your electric power generation system.
- The Cat® SOS℠ Service monitors and tracks internal engine component condition providing the capability to maximize product performance and minimizing owning and operating costs.

CAT G3520C GAS ENGINE
- Robust high speed block design provides prolonged life and lower owning and operating costs.
- Designed for maximum performance on low pressure pipeline natural gas
- Simple open chamber combustion system for reliability and fuel flexibility
- Leading edge technology in ignition system and air/fuel ratio control for lower emission and engine efficiency.
- One electronic control module handles all engine functions: ignition, governing, air/fuel ratio control and engine protection

CAT® SR4B GENERATOR
- Designed to match performance and output characteristics of Caterpillar gas engines
- Industry leading mechanical and electrical design
- High efficiency

CAT CONTROL PANEL
- Designed to meet individual customer needs: Gas Engine Control Module provides full-featured engine management and control functions, purge cycle, staged shutdown logic, plus programmable protective relaying functions.
- Remote control and monitor capability options

Continuous 1600 ekW 60 Hz 1200 RPM 4160V

CATERPILLAR®

Factory Installed Standard & Optional Equipment

System	Standard	Optional
Air Inlet	Two element, single-stage air cleaner with enclosure and service indicator, horizontal mount (shipped loose)	2 elements with enclosure vertical mount (shipped loose Stand to mount horizontal or optional vertical air cleaner Heavy duty air cleaner w/precleaner horizontal mount (shipped loose)
Control Panel	EMCP II+	Local alarm module; Remote annuciator; Customer Communication Module (CCM); Synchronizing module; Engine failure relay
Cooling	Engine driven water pumps for jacket water and aftercooler; Jacket water and SCAC thermostats; ANSI/DN customer flange connections for JW inlet and outlet Cat flanges on SCAC circuit	Remote radiator for JW and SCAC circuits, level switch included but not wired, 480V electric driven fans with guard motor control and disconnect switch
Exhaust	Dry exhaust manifolds, Cat flanged outlet Individual exhaust port and turbocharger outlet wired to integrated Temperature Sensing Module with Gas ECM providing alarms and shutdowns	15 dBA, 18 bDS, 25 dBA attenuation mufflers with ANSI style flanges, welf flanges, elbows, expanders and flexible fittings
Engine Control Module	Fuel/air ratio control transient richening and turbo bypass control Start/stop logic:gas purge cycle, staged shutdown Engine Protection Systems:detonation sensitive timing, high jacket water temperature, low oil pressure, failure to start, overcrank, overspeed, high oil temperature, emergency stop	
Integrated Thermo Sensing Module (ITSM)	24 thermocouples to input individual exhaust port temperatures and inlet and outlet temperatures of both turbochargers	CCM transfers Cat DataLink information through RS232 to customer terminal
Fuel	Electronic air fuel ratio control (Electronic Control Module) ADEM III based, electronic fuel control valve, throttle plate; throttle, electrically actuated and electronically controlled by ECM, low pressure pipeline natural gas fuel supply (105-350 mbar). Sized for 10.8 to 25.6 MJ/Nm^3 (275 to 650 Btu/cu ft) low energy gas	Fuel filter (non-coalescent)
Generator	Permanent magnet excitiation, two bearing, six lead, Caterpillar's Digital Voltage Regulator (CDVR) with 3-phase sensing and KVAR/PF control; Reactive droop; Bus bar connections; Winding temperature detectors; Anti-condensation space heater.	Oversize and premium generators Low voltage extension box
Governing	Electronic (ADEM III), ProAct actuator	Electronic load sharing module
Ignition	ECM provides electronic ignition, individual cylinder timing and individual cylinder detonation control	
Lubrication	Lubricating oil and filter, oil drain valve, filler and dipstick; Integral lube oil cooler; gear type lube oil pump crankcase breathe	Closed crankcase ventilation system prelube pump
Mounting	330 mm structural steel base (for low and medium voltage units); Anti-vibration mounts (shipped loose)	
Starting / Charging	24V starting motors; Battery with cables and rack (shipped loose); Battery disconnect switch;	24V Charging alternator; Battery charger; Oversized battery; Jacket water heater; Air starting system, 9 kW (480V/3 phases with 240V/1 phase pump, include isolation valves
General	Damper Anti-vibration mounts (shipped loose)	Manual barring device, certifications, crankcase explosion relief valve

Continuous 1600 ekW 60 Hz 1200 RPM 4160V

CATERPILLAR®

SPECIFICATIONS

CAT GAS ENGINE

G3520C SCAC 4-stroke-cycle watercooled gas engine

Bore --- mm (in)	170 (6.7)
Stroke --- mm (in)	190 (7.5)
Displacement --- L (cu in)	86 (5248)
Compression Ratio	11.3:1
Aspiration	Turbocharged Separate Circuit Aftercooled
Fuel System	Low Pressure
Governor Type	Electronic (ADEM™ III)

CAT SR4B GENERATOR

Frame size	868
Excitation	Permanent Magnet
Pitch	0.67
Number of poles	6
Number of bearings	2
Number of leads	6
Insulation	Class H
IP rating	Drip proof IP22
Alignment	Pilot Shaft
Overspeed capability -- % of synchronous speed	125%
Waveform deviation line to line, no load	less than 5.0%
Reactive droop	Standard
Voltage regulator	3-phase sensing w/adjustable 1:1 or 2:1 Volts/Hz, UL 508 A L
Telephone Influence Factor (TIF)	less than 50

Consult your Caterpillar dealer for available voltages

CAT EMCPII+ CONTROL PANAL

* Power by 24 volts DC
* NEMA 12, IP44 dust-proof enclosure
* Lockable hinged door
* Single-location customer connection
* Auto start/stop control switch
* Voltage adjustment potentiomenter
* True RMS AC metering, 3 phase
* Pruge cycle and staged shutdown logic
* Digital indication for:
  - RPM
  - Operating hours
  - Oil pressure
  - Coolant temperature
  - DC voltage
  - L-L volts, L-N volts, phase amps, Hz, ekW, kVA, kVAR, kWhr, %kW, pf
  - System diagnostic codes
* Shutdown with indicating lights;
  - Low oil pressure
  - High coolant temperature
  - High oil temperature
  - Overspeed
  - Overcrank
  - Emergency stop
  - High inlet air temperature (for TA engine only)
  - Detonation sensitive timing (for LE engine only)
* Programmable protective relaying functions:
  - Under / Over voltage
  - Under / Over frequency
  - Overcurrent
  - Reverse power
* Spare indicator LEDs
* Spare alarm/shutdown inputs

Continuous 1600 ekW 60 Hz 1200 RPM 4160V

CATERPILLAR®

TECHNICAL DATA

60 Hz 1200 rpm 4160 Volts		DM5740		DM5739	
G3520C Gas Generator Set (Low Energy Fuel)					
Emission level (NOx)	g/bhp-hr	0.5		1	
Aftercooler SCAC	Deg C	54	130	54	130
Package Performance (1)					
Power Rating @ 0.8 pf	ekW Continuous	1600		1600	
Power Rating @ 1.0 pf	ekW Continuous	1617		1617	
Electric Efficiency @ 1.0 pf (ISO 3046/1) (5)	%	40.1%		41.2%	
Mechanical Power (w/ 2 water pumps and w/o fan)	bkW hp	1665	2233	1665	2233
Fuel Consumption (2)					
Low heat value (LHV) fuel input (ISO3046/1)	kW Btu/min	4032	235,181	3929	229,195
100% load w/o fan	Nm^3/hr	408	14,774	398	15,224
75% load w/o fan	Nm^3/hr	318	11,510	310	11,866
50% load w/o fan	Nm^3/hr	226	8364	221	8438
Altitude Capability (3)					
At 25 Deg C (77 Deg F) ambient	m ft	420	1378	880	2888
Cooling System					
Ambient air temperature	Deg C Deg F	25	77	25	77
Jacket water temperature (Maximum outlet)	Deg C Deg F	110	230	110	230
Exhaust System					
Combustion air inlet flow rate	Nm^3/hr scf/hr	113	4360	108	4157
Exhaust stack gas temperature	Deg C Deg F	480	896	490	914
Exhaust gas flow rate	Nm^3/hr scf/hr	122	12,045	117	11,657
Exhaust flange size (internal diameter)	mm in	360	14.17	360	14.17
Heat Rejection (4)					
Heat rejection to jacket water and AC - Stage 1	kW Btu/min	676	38,427	657	37,363
Heat rejection to oil cooler and AC - Stage 2	kW Btu/min	339	19,298	332	18,866
Heat rejection to exhaust (LHV to 350^{0F})	kW Btu/min	1158	55,468	1141	54,952
Heat rejection to atmosphere from engine	kW Btu/min	127	7210	127	7210
Heat rejection to atmosphere from generator	kW Btu/min	47.7	2713	47.7	2713
Generator					
Frame		868		868	
Temperature rise	Deg C	105		105	
Motor starting capability @ 30% voltage dip (6)	sKVA	4280		4280	
Lubrication System					
Standard sump refill with filter change	L Gal	541	141	541	141
Emissions (7)					
NOx	g/bhp-hr	0.5		1	
CO (nominal) (8)	g/bhp-hr	2.5		2.5	
THC	g/bhp-hr	5.34		4.27	
NMHC	g/bhp-hr	.81		.65	
Exhaust O2 (dry)	%	8.5		8.1	

DEFINITIONS AND CONDITIONS

(1) **Continuous** --- Maximum output available without varying load for an unlimited time

Ratings are based on low energy methane-based gas having a Low Heat Value (LHV) of 18 MJ/NM3 (456 Btu/ft3) and 100 Caterpillar Methane Number.
For values in excess of altitude, ambient temperature, inlet/exhaust restriction, or different from the conditions listed, contact your local Caterpillar dealer.

(2) Ratings and fuel consumption are based on ISO3046/1 standard reference conditions of 25 deg C (77 deg F) of ambient temperature and 100 kPa (29.61 in Hg) of total barometic pressure with 0, +5% fuel tolerance.

(3) **Altitude** capability is based on 2.5 kPa inlet and 5.0 kPa exhaust restriction.

(4) **Heat Rejection** --- Values based on ISO3046/1 with fuel tolerence of +/-3% and 2.5 kPa inlet and 5.0kPa exhaust restriction.

(5) **Efficiency** of standard generator is used. For higher efficiency generators, contact your local Caterpillar dealer.

(6) Assume synchronous driver

(7) **Emissions data** measurements are consistent with those described in EPA CFR 40 Part 89 Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state engine operating conditions of 25 deg C (77 deg F), 96.28 kPa (28.43 in Hg) and fuel having a LHV of 18 MJ/N.m3 (456 Btu/cu ft) at 101.60 kPa (30.00 in Hg) absolute and 0 deg C (32 deg F).
Emission darta shown is subject to instrumentation, measurement, facility, and engine fuel system adjustment.

(8) **Nominal Value** --- Emissions from a new engine during first 100 hrs of operation. Contact local Caterpillar dealer for more information.

Package Dimensions		
Length	6367.1 mm	250.67 in
Width	1996.5 mm	78.60 in
Height	2465.1 mm	97.05 in

Note: Do not use for installation design.
See general dimension drawings
for detail

TMI Reference No. DM5740,DM5739
Feature Code: 520GE38
Generator Arrangement No: 158-6432
U.S. Sourced
DTO # 380251

October 11,2007

Refill Capacities and Recommendations

SMCS - 1348; 1395; 7560

Coolant Capacities

To properly maintain the cooling system, the Total Cooling System capacity must be determined. The Total Cooling System capacity will vary between individual installations. The External System capacity includes the following components: engine, expansion tank, heat exchanger, radiator and piping. Refer to the specifications that are provided by Caterpillar or by the OEM of the equipment. Record the Total Cooling System capacity in the following Table:

Table 5

Cooling System Approximate Refill Capacities				
System	G3516C G3516E		G3520C G3520E	
	Liters	US Gallons	Liters	US Gallons
Jacket Water System Only	201	53	344	91
SCAC System Only	47.5	12.5	47.5	12.5
External System				184
Total Cooling System				287.5

EXTERNAL RADIATOR CAPACITY CALCULATED FROM THE IEA MANUFACTURER SUMITTAL INFORMATION. THIS CAPACITY DOES NOT INCLUDE PIPING FROM THE ENGINE TO THE RADIATOR.

Lubrication System

Lubricant Recommendations

Due to significant variations in the quality and in the performance of commercially available oils, Caterpillar makes the following recommendations:

- **Caterpillar Natural Gas Engine Oil (NGEO)**
- **Caterpillar EL250 Natural Gas Engine Oil (NGEO)**
- **Caterpillar EL350 Natural Gas Engine Oil (NGEO)**

The proper SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation. To determine the oil viscosity that is required for starting a cold soaked engine, refer to the minimum temperature in Table 1. To select the oil viscosity for operation at the highest anticipated ambient temperature, refer to the maximum temperature in the Table. Use the highest oil viscosity that is available in order to meet the required temperature during start-up.

Table 1

Engine Oil Viscosity		
Caterpillar NGEO Grade of Viscosity	**Ambient Temperature**	
	Minimum	**Maximum**
SAE 30 (1)	0 °C (32 °F)	40 °C (104 °F)
SAE 40 (1)	5 °C (41 °F)	50 °C (122 °F)

(1) Caterpillar NGEO is available in these grades only. Multigrade oils are NOT recommended for use in Caterpillar Gas Engines. If other grades of viscosity are selected, ensure that the oil meets the requirements for Caterpillar Gas Engines.

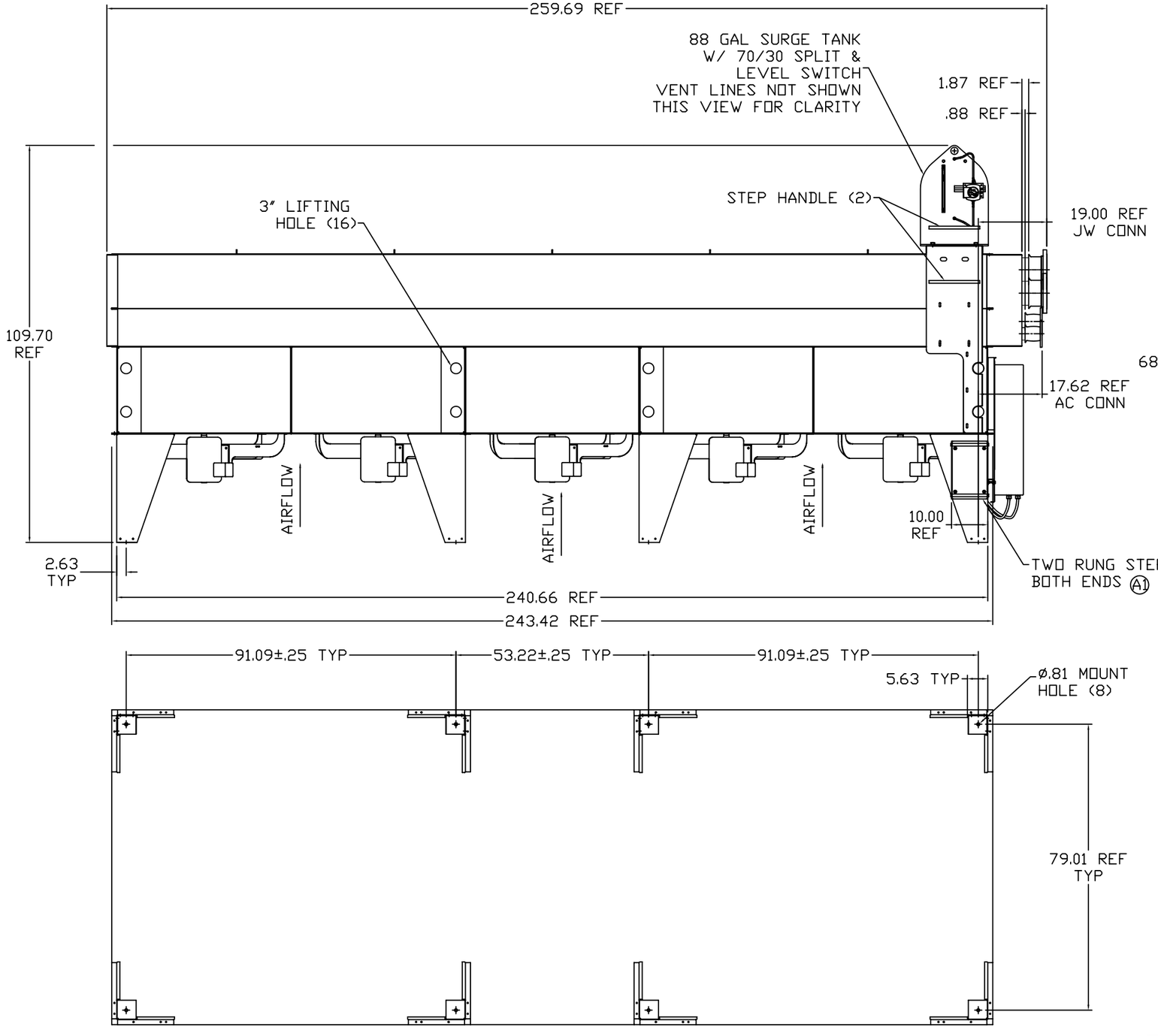
For further information about oils, see Special Publication, SEBU6400, "Caterpillar Gas Engine Lubricant, Fuel, and Coolant Recommendations".

Lubricant Capacities

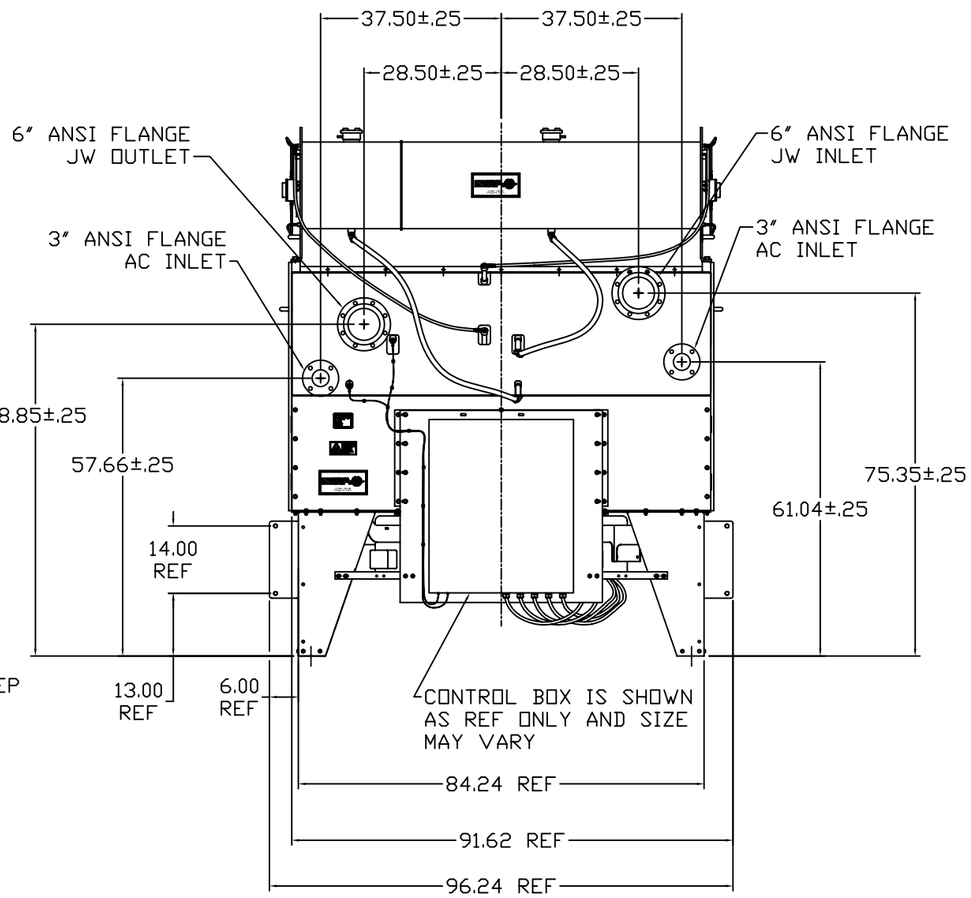
The capacity of the engine crankcase includes the capacity of the oil filters that are installed at the factory.

Table 2

Lubrication System Approximate Refill Capacities		
Engine	**Liters**	**US Gallons**
G3516C G3516E	423	112
G3520C G3520E	541	141



BASE PLAN VIEW



NOTES:

1) PIPING TO RADIATOR SHOULD BE EXTERNALLY SUPPORTED-NOT HUNG ON RADIATOR ASSEMBLY. FLEXIBLE CONNECTIONS SHOULD BE USED WHEN PIPING TO RADIATOR.
2) DIMENSIONS ARE GIVEN IN INCHES.
3) NAMEPLATE IS STAMPED WITH COMPLETE MODEL NO., SERIAL (S.O.) NO., AND MANUFACTURING DATE
4) FOR PERIODIC LUBRICATION AND GENERAL MAINTENANCE REFER TO I.O.M. MANUAL.

***

FLUID CAPACITY	AC: 84 GALLONS
	JW: 100 GALLONS
DRY WEIGHT	8300 LB
FAN	7 BLADE
MOTOR (10)	5HP 3/60/460 1760 RPM

IMPORTANT
MAX. RADIATOR OPERATING PRESSURE: 150 PSIG
MAX. OPERATING TEMPERATURE: 300° F

CHANGE #	REV.	CHECKED	DATE	MATERIAL
07-454	A1	SMB	10/09/07	SEE PARTS LIST
				REF. ES3017

NAME: HCR-M140 SQ FT 10 FAN ROUND TUBE RADIATOR 2PJW/2PAC

TOLERANCES UNLESS OTHERWISE SPECIFIED

1 PLACE (.X)	±.1	TOLERANCES ARE NON-CUMULATIVE & DO NOT APPLY TO MATERIAL GAGES OR COMMERCIAL FEATURES.
2 PLACE (.XX)	±.06	
3 PLACE (.XXX)	±.015	
ANGULAR	±1 DEG.	

DATE: 09/20/07
DRAWN BY: SMB
CHECKED: PB
SCALE: 1: 34
PART NUMBER: HCR-M140-05-22-S01

IEA, INC. KENOSHA, WISCONSIN

G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED:	1200	FUEL:	LOW ENERGY (1.43 CH4:CO2 RATIO)
COMPRESSION RATIO:	11.3:1	FUEL SYSTEM:	CAT LOW PRESSURE WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 1 MAX. INLET (°F):	218		
AFTERCOOLER - STAGE 2 MAX. INLET (°F):	130	FUEL PRESS. RANGE (PSIG):	1.5 - 5.0
JACKET WATER - MAX. OUTLET (°F):	230	MIN. METHANE NUMBER:	135
COOLING SYSTEM:	JW+1AC, OC+2AC	RATED ALTITUDE (FT):	1378
IGNITION SYSTEM:	ADEM3	AT AIR TO TURBO. TEMP. (°F):	77
SPARK PLUG TYPE:	J-GAP	NOx EMISSION LEVEL:	0.5 g/bhp-hr
EXHAUST MANIFOLD:	DRY	FUEL LHV (BTU/SCF):	456
COMBUSTION:	LOW EMISSION	APPLICATION:	GENSET

RATING AND EFFICIENCY		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	BHP	2233	1675	1116
GENERATOR POWER	(WITHOUT FAN)	(2)	EKW	1600	1200	800
ENGINE EFFICIENCY	**(ISO 3046/1)**	**(3)**	**%**	**40.1**	**38.6**	**36.1**
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	39.1	37.7	35.2
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	41.3	40.6	42.2
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	80.4	78.3	77.4

ENGINE DATA						
FUEL CONSUMPTION	**(ISO 3046/1)**	**(6)**	**BTU/bhp-hr**	**6354**	**6592**	**7047**
FUEL CONSUMPTION	(NOMINAL)	(6)	BTU/bhp-hr	6509	6753	7219
AIR FLOW (77 °F, 14.7 psi)		(7)	SCFM	4512	3415	2286
AIR FLOW		(7)	lb/hr	20006	15141	10136
COMPRESSOR OUT PRESSURE			in. HG (abs)	105.8	80.8	55.5
COMPRESSOR OUT TEMPERATURE			°F	375	306	220
AFTERCOOLER AIR OUT TEMPERATURE			°F	142	138	135
INLET MAN. PRESSURE		(8)	in. HG (abs)	94.4	71.5	48.9
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	142	138	135
TIMING		(10)	°BTDC	27	27	27
EXHAUST STACK TEMPERATURE		(11)	°F	898	943	984
EXHAUST GAS FLOW (@ stack temp.)		(12)	CFM	12476	9780	6770
EXHAUST MASS FLOW		(12)	lb/hr	22318	16940	11418

EMISSIONS DATA					
NOx (as NO2)	(13)	g/bhp-hr	0.5	0.5	0.5
NTE CO	(14)	g/bhp-hr	4.13	4.25	4.4
NOMINAL CO	(15)	g/bhp-hr	2.5	2.5	2.5
THC (molecular weight of 15.84)	(14)	g/bhp-hr	5.84	6.49	7.51
NMHC (molecular weight of 15.84)	(14)	g/bhp-hr	0.88	0.98	1.13
EXHAUST O2	(16)	% DRY	9.0	8.8	8.6
LAMBDA	(16)		1.71	1.67	1.57

HEAT BALANCE DATA					
LHV INPUT	(17)	BTU/min	242216	188451	134313
HEAT REJECTION TO JACKET	(18)	BTU/min	28738	23806	21929
HEAT REJECTION TO ATMOSPHERE	(19)	BTU/min	7210	6034	4857
HEAT REJECTION TO LUBE OIL	(20)	BTU/min	10108	9524	8917
HEAT REJECTION TO EXHAUST (LHV to 77°F)	(21)	BTU/min	76779	65253	45101
HEAT REJECTION TO EXHAUST (LHV to 350°F)	(21)	BTU/min	57574	47602	34587
HEAT REJECTION TO A/C - STAGE 1	(22)	BTU/min	13823	5157	102
HEAT REJECTION TO A/C - STAGE 2	(23)	BTU/min	8895	5684	4086

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1. DATA REPRESENTS CONDITIONS OF 77°F, 29.6 IN HG BAROMETRIC PRESSURE, 30% RELATIVE HUMIDITY, 10 IN H2O AIR FILTER RESTRICTION, AND 20 IN H2O EXHAUST STACK PRESSURE. ENGINE EFFICIENCY AND FUEL CONSUMPTION SPECIFICALLY NOTED AS ISO 3046/1 ARE REPRESENTED WITH 5 IN H2O AIR FILTER RESTRICTION AND 0 IN H2O EXHAUST STACK PRESSURE. CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE. NO OVERLOAD PERMITTED AT RATING SHOWN.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS AND ADJUSTED TO THE SPECIFIED NOx LEVEL AT 100% LOAD. EMISSION TOLERANCES SPECIFIED ARE DEPENDENT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA IS WITH AIR FUEL RATIO CONTROL.

ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. PUMP POWER IS NOT INCLUDED IN HEAT BALANCE DATA.

FOR NOTES INFORMATION CONSULT PAGE THREE.

FUEL USAGE GUIDE

CAT METHANE NUMBER	40	50	60	70	80	90	100	110	120	130	140	150
IGNITION TIMING	-	-	-	-	-	-	-	-	24	26	28	30
DERATION FACTOR	0	0	0	0	0	0	0	0	1.00	1.00	1.00	1.00

ALTITUDE DERATION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	0.96	0.93	0.89	0.86	0.83	0.79	0.76	0.74	0.71	0.68	0.65	0.63	0.60
120	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.64	0.61
110	0.99	0.96	0.92	0.89	0.86	0.82	0.79	0.76	0.73	0.70	0.68	0.65	0.62
100	1.00	0.97	0.94	0.90	0.87	0.84	0.81	0.77	0.74	0.72	0.69	0.66	0.63
90	1.00	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.65
80	1.00	1.00	0.97	0.94	0.90	0.87	0.84	0.80	0.77	0.74	0.71	0.68	0.66
70	1.00	1.00	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67
60	1.00	1.00	1.00	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68
50	1.00	1.00	1.00	0.99	0.96	0.92	0.88	0.85	0.82	0.79	0.76	0.73	0.70

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.33	1.37	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
120	1.26	1.31	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
110	1.19	1.24	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
100	1.13	1.17	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
90	1.06	1.11	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
80	1.00	1.04	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALTITUDE (FEET ABOVE SEA LEVEL)

FREE FIELD MECHANICAL & EXHAUST NOISE

100% Load Data			dB(A)	(dB)							
			Overal SPL	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 khz
Free Field Mechanical	DISTANCE FROM THE ENGINE (FEET)	**3.2**	108.5	51.5	78.7	88.2	92.9	99.9	97.3	93.2	99.2
		22.9	91.6	34.6	59.0	68.1	74.0	83.0	79.4	75.1	85.2
		49.2	85.0	28.0	55.2	64.7	69.4	76.4	73.8	69.7	75.7
Free Field Exhaust	DISTANCE FROM THE ENGINE (FEET)	**4.9**	106.1	67.5	86.5	96.0	88.5	88.7	90.1	95.6	92.7
		22.9	92.7	54.1	73.1	82.6	75.1	75.3	76.7	82.2	79.3
		49.2	86.1	47.5	66.5	76.0	68.5	68.7	70.1	75.6	72.7

Octave Band Center Frequency (OBCF)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

INLET AND EXHAUST RESTRICTION CORRECTIONS FOR ALTITUDE CAPABILITY:

To determine the appropriate altitude derate factor to be applied to this engine for inlet or exhaust restrictions differering from the standard conditions listed on page 1, a correction to the site altitude can be made to adjust for this difference. Add 141 feet to the site altitude for each additional inch of H2O of exhaust stack pressure greater than spec sheet conditions. Add 282 feet to the site altitude for each additional inch of H2O of inlet restriction greater than spec sheet conditions. If site inlet restriction or exhaust stack pressure are less than spec sheet conditions, the same trends apply to lower the site altitude.

ACTUAL ENGINE RATING:

It is important to note that the Altitude/Temperature deration and the Fuel Usage Guide deration are not cumulative. They are not to be added together. The same is true for the Low Energy Fuel deration (reference the Caterpillar Methane Number Program) and the Fuel Usage Guide deration. However, the Altitude/Temperature deration and Low Energy Fuel deration are cumulative; and they must be added together in the method shown below. To determine the actual power available, take the lowest rating between 1) and 2).

1) (Altitude/Temperature Deration) + (Low Energy Fuel Deration)
2) Fuel Usage Guide Deration

Note: For NA's always add the Low Energy Fuel deration to the Altitude/Temperature deration. For TA engines only add the Low Energy Fuel deration to the Altitude/Temperature deration whenever the Altitude/Temperature deration is less than 1.0 (100%). This will give the actual rating for the engine at the conditions specified.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the standard aftercooler heat rejection. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail. For 2 Stage Aftercoolers with separate circuits, the 1st stage will collect 90% of the additional heat.

SOUND DATA:

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3. SPL = Sound Pressure Level.

NOTES

1 ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 96.1% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 2.5% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + STAGE 1 A/C HEAT + EXH. HEAT TO 350°F.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 2.5 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 9°F.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)63°F, (-)54°F.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX TOLERANCES ARE ± 18 % OF SPECIFIED VALUE.

14 NTE CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 NOMINAL CO IS A NOMINAL VALUE AND IS REPRESENTATIVE OF A NEW ENGINE DURING THE FIRST 100 HOURS OF ENGINE OPERATION.

16 O2% TOLERANCE IS ± 0.5; LAMBDA TOLERANCE IS ± 0.05. LAMBDA AND O2 LEVEL ARE THE RESULT OF ADJUSTING THE ENGINE TO OPERATE AT THE SPECIFIED NOX LEVEL.

17 LHV RATE TOLERANCE IS ± 2.5%.

18 TOTAL JW HEAT (based on treated water) = JACKET HEAT + STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 10 % OF FULL LOAD DATA.

19 RADIATION HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 50% OF FULL LOAD DATA.

20 LUBE OIL HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 20% OF FULL LOAD DATA.

21 EXHAUST HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 10% OF FULL LOAD DATA.

22 STAGE 1 A/C HEAT (based on treated water) = STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 5 % OF FULL LOAD DATA.

23 STAGE 2 A/C HEAT (based on treated water) = (STAGE 2 A/C HEAT + (STAGE 1 + STAGE 2) x 0.10 x (ACHRF - 1)) + LUBE OIL HEAT. TOLERANCE IS ± 5 % OF FULL LOAD DATA.

G3500B Generator Set Engine Control Module

The GECM is designed as a state-of-the art engine monitoring and control system. The unified and electronic nature of the system allows for wider range of uses while maintaining low emissions across the engine's power range.

FEATURES

RELIABLE, DURABLE

All GECM controllers are designed to survive the harshest environments.

- Environmentally sealed, die-cast aluminum housing isolates and protects electronics components from moisture and dirt contamination.
- Rigorous vibration testing ensures product reliability and durability.
- Accuracy maintained from –40° C to 120° C
- Electronic noise immunity to 100 volts/meter
- Internal circuits are designed to withstand shorts to +battery and –battery.

SIMPLE SERVICING

Each GECM system works in combination with Caterpillar ET service tool software to keep the gas engine operating at peak performance.

- Displays measured parameters
- Retrieves active and logged diagnostic codes
- Retrieves logged event codes documenting abnormal system operation
- Performs calibrations and diagnostic tests
- Supports flash programming of new software into the GECM

SELF DIAGNOSTIC

Each GECM has a full compliment of self-diagnostics. The GECM can detect faults in the electrical system and report those faults to the service technician for quick repair.

- Self-diagnostic capability pinpoints operational problems in need of attention.

ADVANCE FEATURES

- Isochronous or droop speed control
- Enhanced performance from variable spark ignition timing and duration
- Adjustable monitoring of vital engine parameters
- Idle/rated speed setting
- Programmable speed acceleration ramp rate
- Adjustable cooldown duration
- Data link interfaces.
- Timing Controls for primary and alternate fuel
- Integrated Temperature Sensing Module for cylinders exhaust port, turbocharger inlet/outlet, average left/right cylinder banks. ITSM differential temperature monitoring is especially effective for single cylinder misfires detection.
- Adjustable Air/Fuel Ratio Control for humidity and atmospheric pressure
- Electronic fuel control valve for quick response in gas flow variation
- Fuel quality compensation with oxygen sensor
- Integrated temperature sensing module protects the engine from high operating temperature
- Customer programmed fuel energy content
- Engine purge cycle time to allow unburned fuel to exit through the exhaust before engine start cycle.
- Detonation sensor to monitor the engine for excessive detonation
- Transient richening software and turbo bypass to maximize response time
- Share engine information over Cat Data Link via Customer Communication Module

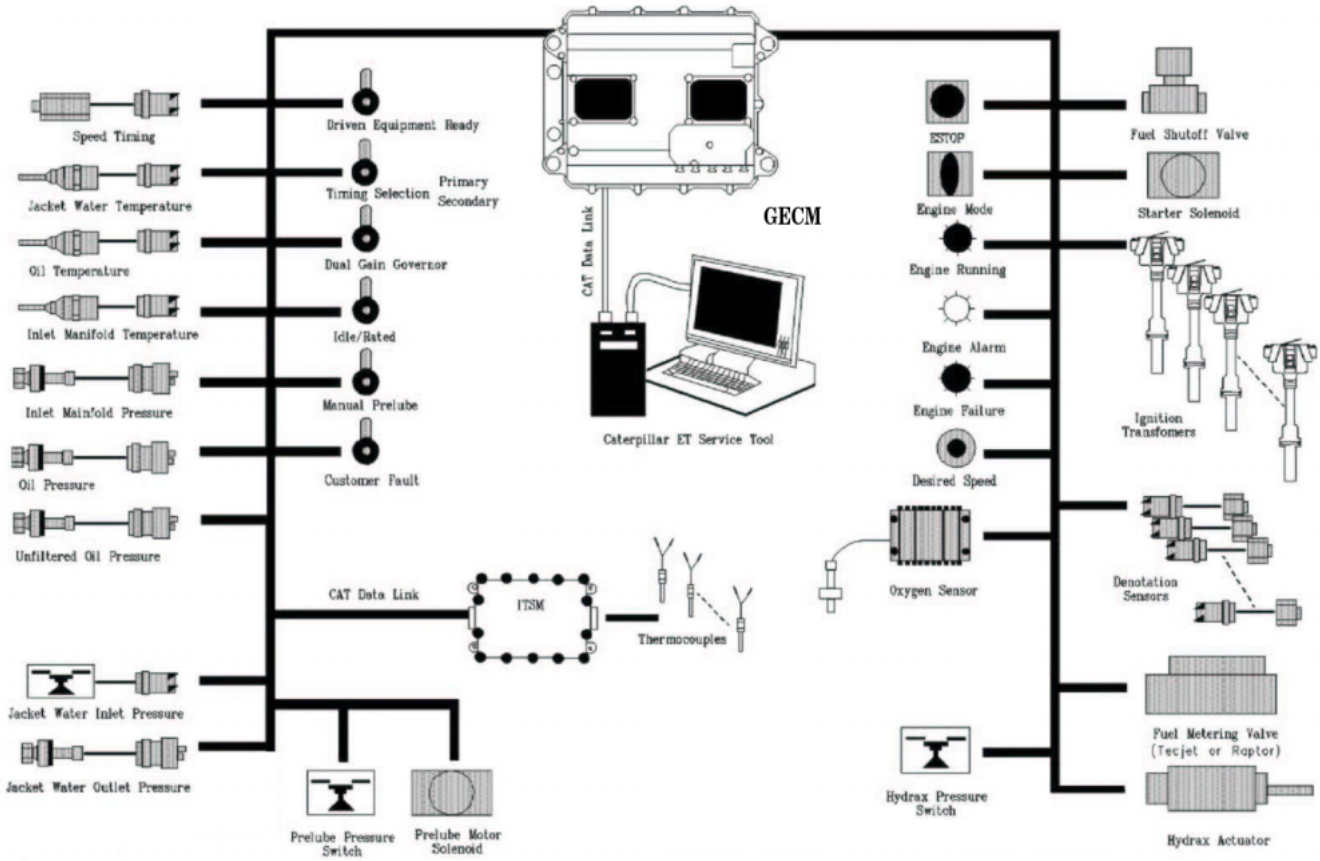
LEHE2666

SPECIFICATIONS

Humidity
0 to 100% relative humidity
Impervious to:
Salt spray, fuel, oil and oil additives, coolant
Spray cleaners, chlorinated solvents, hydrogen sulfide and methane gas, and dust
Input and output protection
all inputs and outputs are protected against short circuits to +battery and –battery
Input voltage range (24 VDC nominal)
18 to 32 VDC

Mounting
Engine mounted
Reverse polarity protected
Shock, withstands 20 g
Temperature range
Operating: –40° C to 105° C (–40° F to 248° F)
Storage: –55° C to 105° C (–67° F to 221° F)
Vibration
Withstands 2.0 g @ 18 to 500 Hz

EXAMPLE BLOCK DIAGRAM OF G3500B GENERATOR SET GECM ELECTRONICS



LEHE2666

DESCRIPTION

The GECM is housed in an environmentally sealed casting. The GECM monitors various inputs from sensors in order to activate relays, solenoids, etc. at the appropriate levels. All wiring connections to the GECM are made at the two sealed fifty-pin connectors.

The Gas Engine Control Module (GECM) controls most of the functions on the engine. The GECM supports the following primary functions:

- Engine speed governing
- Ignition control
- Air/Fuel ratio control
- Start/Stop sequencing
- Engine monitoring and protection

ENGINE SPEED GOVERNING

Actual engine speed is detected from the speed/timing sensor. The GECM maintains the desired engine speed by controlling the actuator of the throttle. The actuator is electrically controlled and hydraulically actuated. An independent high pressure pump provides hydraulic pressure with oil from a system that is separate from the engine oil. Desired engine speed is determined by the status of the idle/rated switch, the desired speed input, and parameters such as maximum engine high idle speed that are programmed into the software.

IGNITION CONTROL

The GECM provides variable ignition timing that is sensitive to detonation. The “Desired Timing” feature of the GECM allows the customer to electronically program the timing of the ignition spark in order to meet the needs for the specific installation. To give more fuel flexibility, two “Desired Timing” controls are available to the user. Each cylinder has an ignition transformer. To initiate combustion, the GECM sends a pulse of approximately 100 volts to the primary coil of each ignition transformer based on speed and loads. The transformers step up the voltage to 34 kV to create a spark across the spark plug electrode. Detonation sensors monitor the engine for excessive detonation.

AIR/FUEL RATIO CONTROL

The GECM provides control of the air/fuel mixture for performance and efficiency at low emission levels. The system consists of an electronic fuel metering valve, an oxygen sensor, and performance maps in the GECM. The control compensates for changes in the BTU level of the fuel in order to maintain desired emission levels. The GECM determines the desired flow rates for the air and the fuel. The flow rates are a factor of desired engine speed, actual engine speed, and calculated engine load. And it also adjusts the signal for the flow of air and fuel to achieve the desired level of exhaust oxygen.

START/STOP SEQUENCING

A Caterpillar Mode Control Switch controls the Start/Stop System. The system provides the following control logic: Driven Equipment Delay Time, Crank Terminate Speed, Engine Purge Cycle Time, Engine Cooldown Duration, Cycle Crank Time, Engine Overcrank Time, Engine Speed Drop Time, Engine Pre-Lube Time Out Period.

ENGINE MONITORING AND PROTECTION

The following sensors are available on the GECM: Jacket Water Temperature, Oil Temperature, Intake Manifold Temperature, Filtered Oil Pressure, Unfiltered Oil Pressure, Voltage Supply Monitoring, Hydrax Pressure Switch, Jacket Water Inlet Pressure, Jacket Water Outlet Pressure, Inlet Manifold Pressure, Differential Oil Pressure, Jacket Water to Oil Differential Temperature, Detonation (Knock), Atmospheric Pressure, Intake Air Humidity.

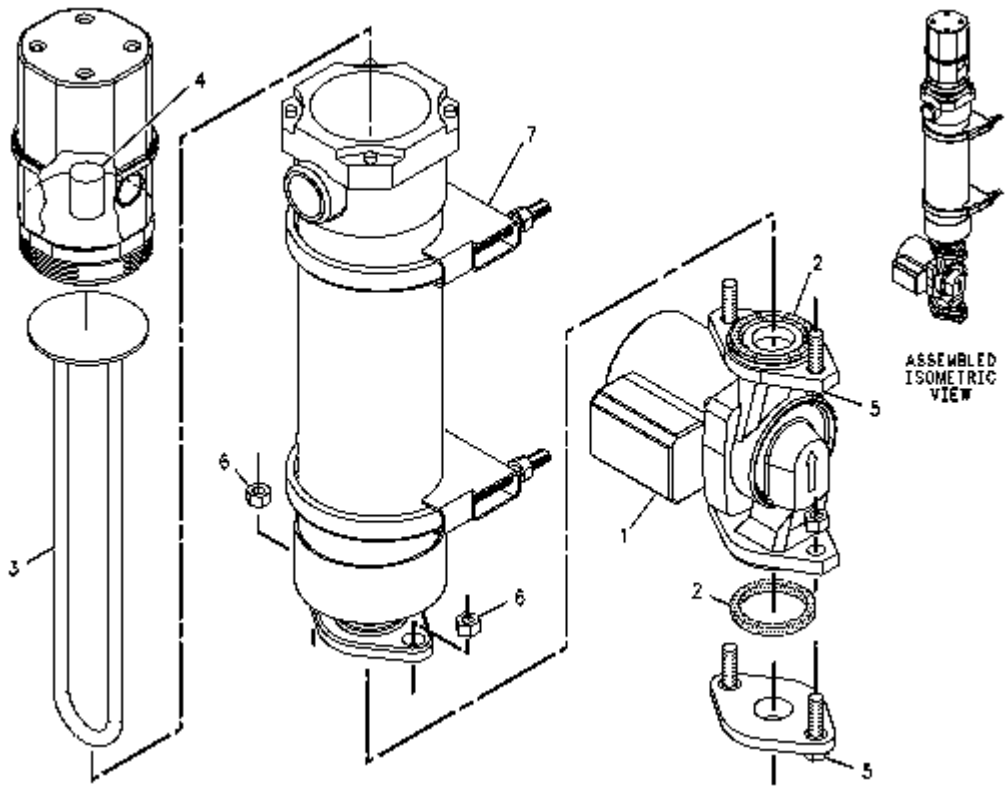
CAT DATA LINK INTERFACES

The GECM control can communicate with other electronic modules over the Cat Data Link. These modules include: Electronic Modular Control Panels (EMCP II+), electronic service tools, and Customer Communication Module (CCM).

LEHE2666

View Image

Graphic Only



GRAPHIC #1
g01007105

G3520C Generator Set
Media Number - SEBP3635-32 | Publication Date - 01/08/2007 | Date Updated - 14/08/2007
View Latest Kit Information i02196364
189-6642 HEATER GP-JACKET WATER
S/N CWY1-UP
480-VOLT. 9-KILOWATTS. 3-PHASE
PART OF 236-8192 HEATER GP-JACKET WATER
AN ATTACHMENT

ENTIRE GROUP

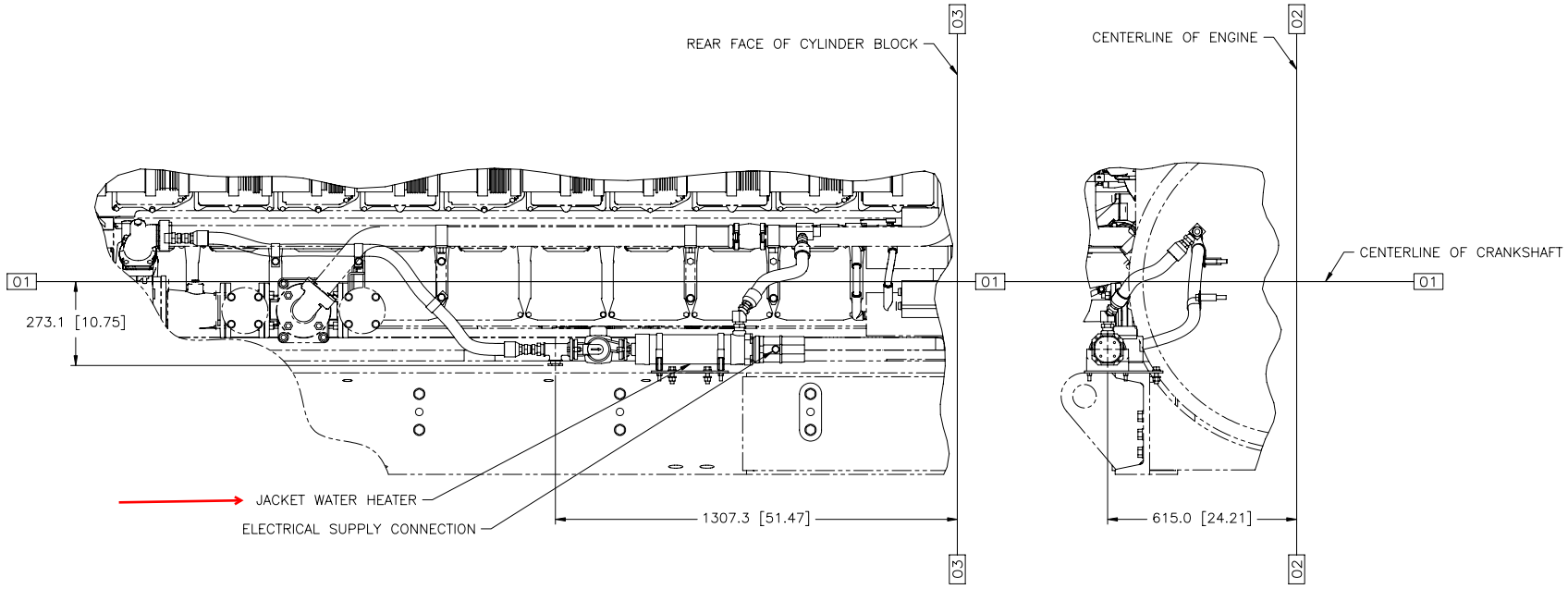
Ref.	Qty.	NPR Note	Part No.	Part Name
Grp		NPR	189-6642	HEATER GP-JACKET WATER

INDIVIDUAL PARTS

Ref.	Qty.	NPR Note	Part No.	Req. Qty.	Part Name
1		NPR	149-2285	1	PUMP (CIRCULATION)
2		NPR	191-5079	2	SEAL
3		NPR	191-5083	1	ELEMENT-HEATING
4		NPR	191-5088	1	THERMOSTAT (110-DEG F)
5		NPR	4L-9337	4	BOLT (3/8-16X1.5-IN)
6		NPR	6V-8801	4	NUT (3/8-16-THD)
7		NPR	196-2343	1	KIT-CLAMP (JACKET WATER HEATER)

Fri Oct 12 11:00:03 EDT 2007

METRIC 5N-8707



LEFT SIDE VIEW

REAR VIEW

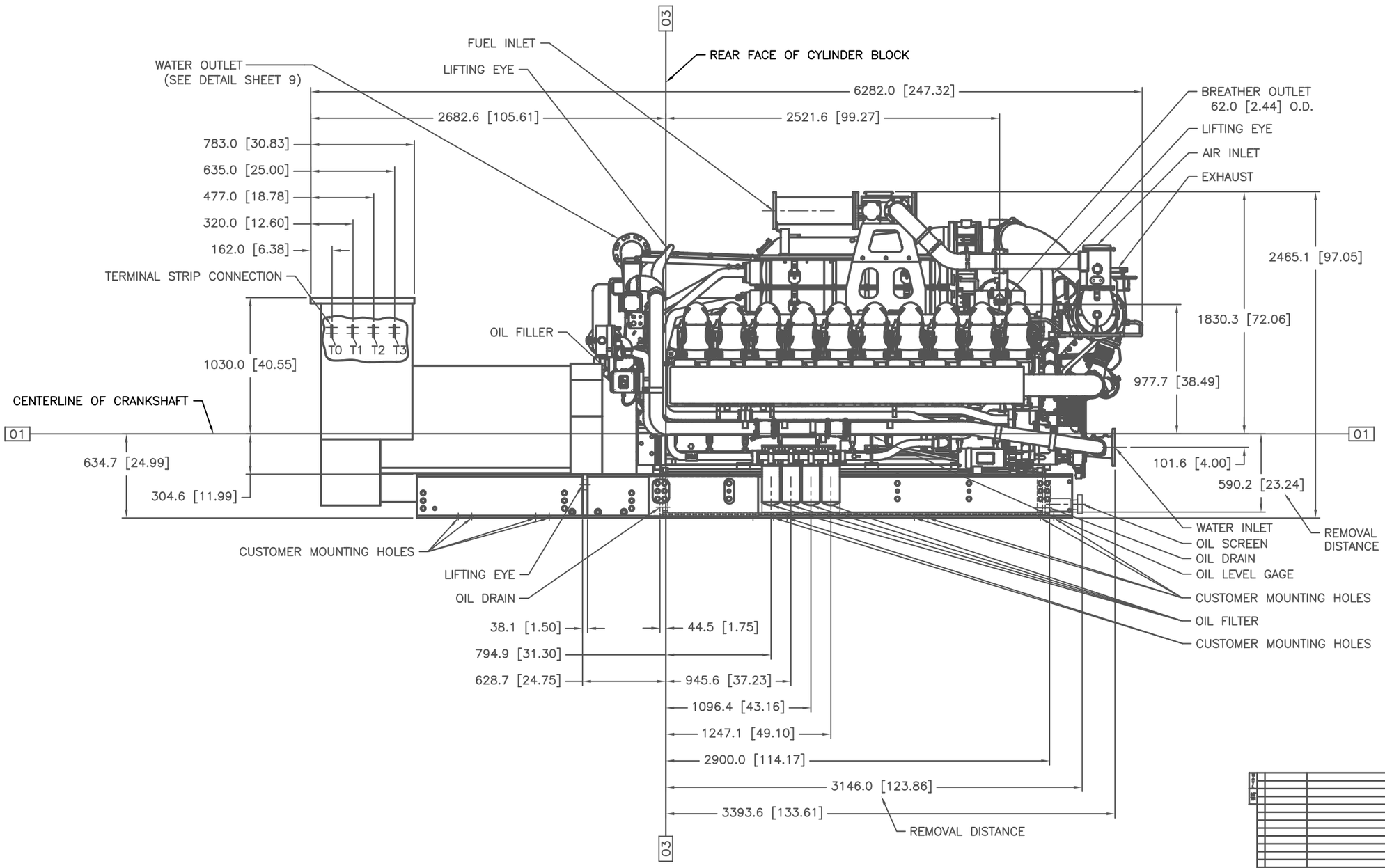
LE-6558 SHOWN

MODEL	TYPE	PRICING AR
G3520C	IN	LE-6558 CHG 03
		LE-6834 CHG 01
	IQ	LE-6542 CHG 04
		LE-6823 CHG 03

1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
SPEC NO. NAME
DRN W.J. WEBER
CHK A.W. SMITH
APPD B.J. BROCK
TOOL DSYS EXP NO PRDN PRDN X
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM [INCH] DIMENSIONS W/O TOL ARE BASIC
SCALE 1 = 5
THIRD ANGLE PROJECTION
SHEET 5 OF 6
CHG
DATE 27APR06

CATERPILLAR INC.

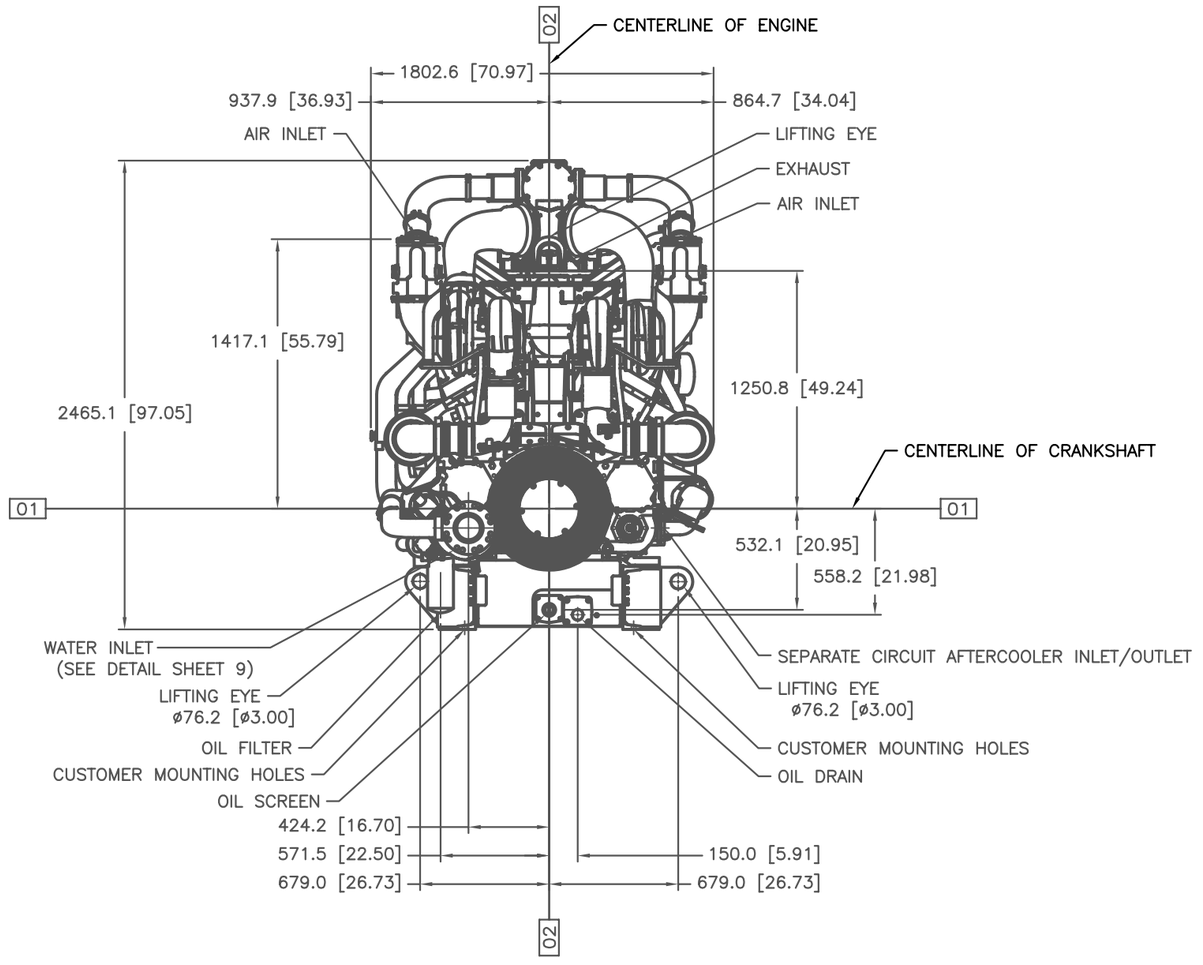
INSTALLATION-ATTACHMENT
JACKET WATER HEATER
5N-8707 - LE
USER CONTROL W857
REV E



G3520C PACKAGE GENERATOR SET
DWG # 267-7367 CHG 01
METRIC [INCH]
RIGHT SIDE VIEW
LA-4308 CHG 00 SHOWN

MODEL	PRICING AR	PACKAGING AR
G3520C	LA-4310 CHG 00	LE-6567 CHG 07
	LA-4308 CHG 00	

1E2733 DRAWING-AUTOCAD
1E0011 INTER & TOL
B.E.NORDLING
M.R.PETERSON
B.J.BROCK
01 06JUL05
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
267-7367 E



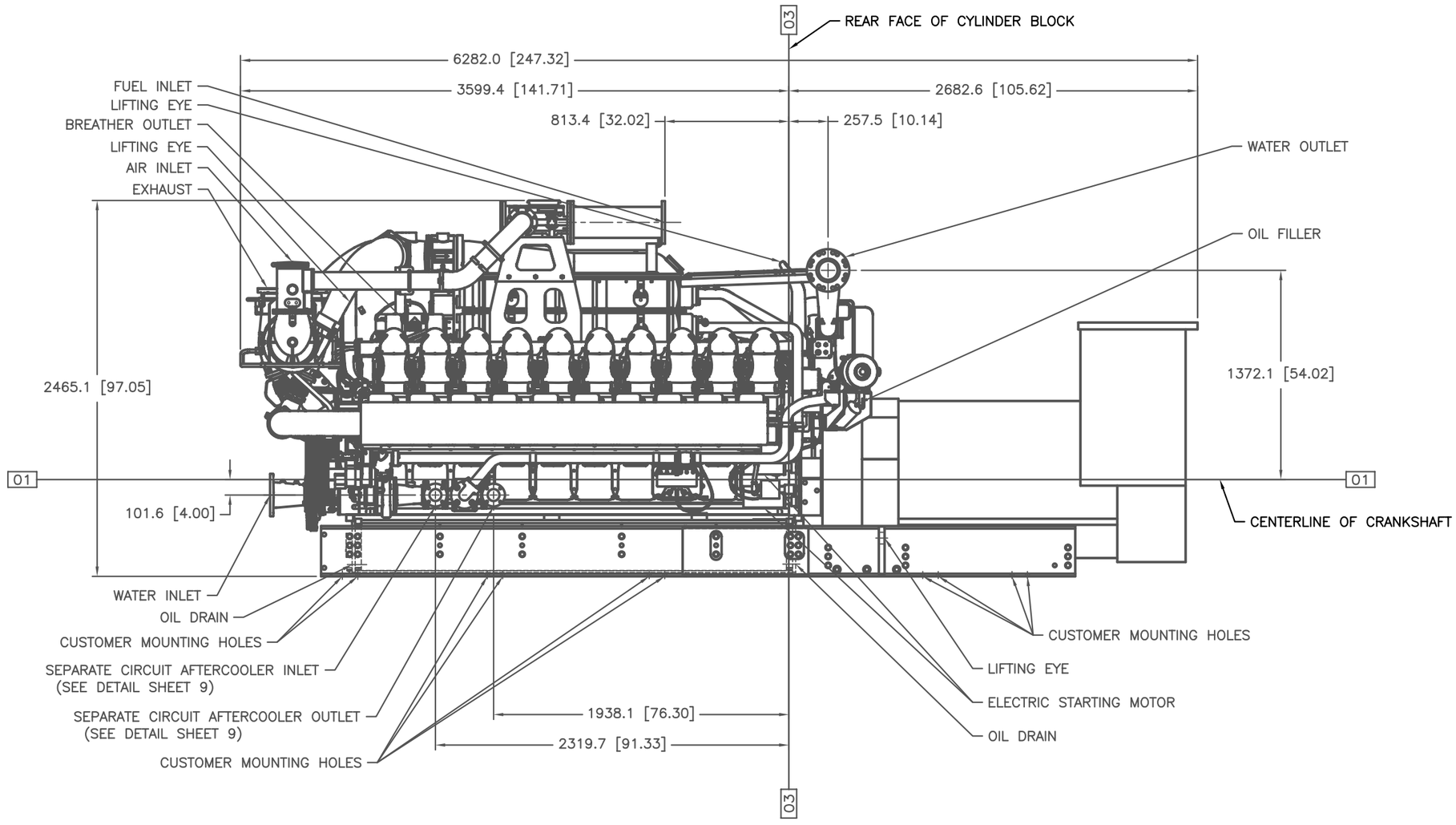
G3520C PACKAGE GENERATOR SET
DWG # 267–7367 CHG 01
METRIC [INCH]
FRONT VIEW
LA–4308 CHG 00 SHOWN

	1E2733	DRAWING–AUTOCAD
	1E0011	INTER. & TOL.
DRN	B.E.NORDLING	
CHK	M.R.PETERSON	
APPD	B.J.BROCK	
		X
SCALE	1 = 10	
SHEET	2 of 11	01 06JUL05

CATERPILLAR INC.

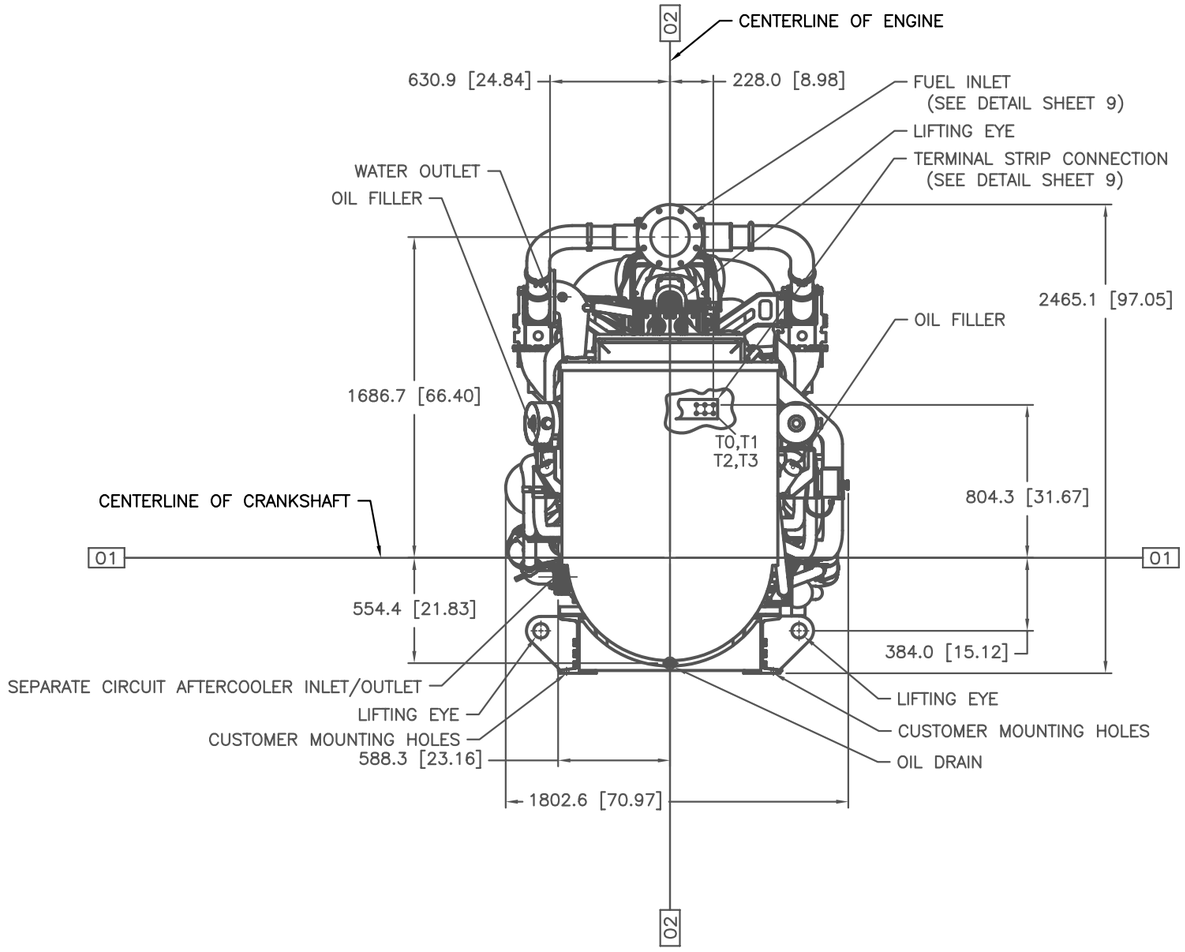
INSTALLATION–ENGINE
GAS PACKAGE GEN SET

267–7367 – H1 W888 E



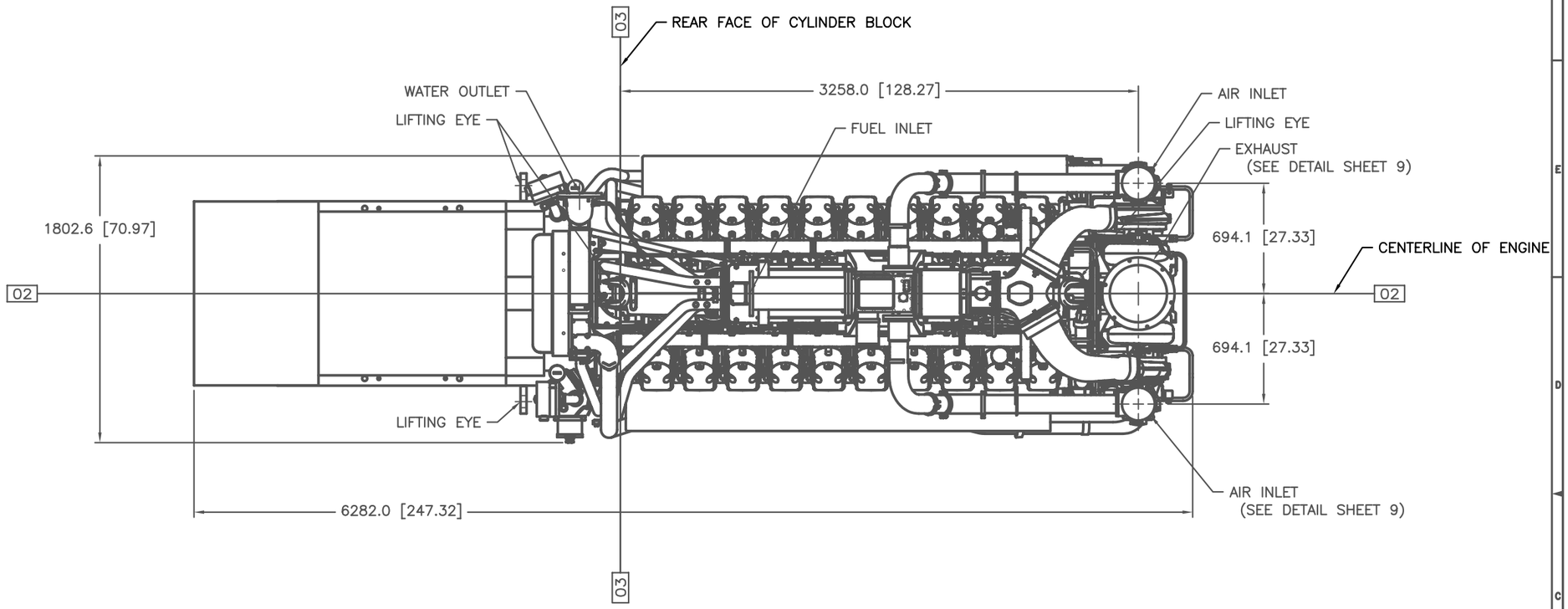
G3520C PACKAGE GENERATOR SET
DWG # 267-7367 CHG 01
METRIC [INCH]
LEFT SIDE VIEW
LA-4308 CHG 00 SHOWN

1E2733 DRAWING-AUTOCAD
1E0011 INTER & TOL
IB.E.NORDLING
M.R.PETERSON
B.J.BROCK
SCALE 1 = 10
SHEET 3 OF 11
01 06JUL05
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
267-7367 - 01
E



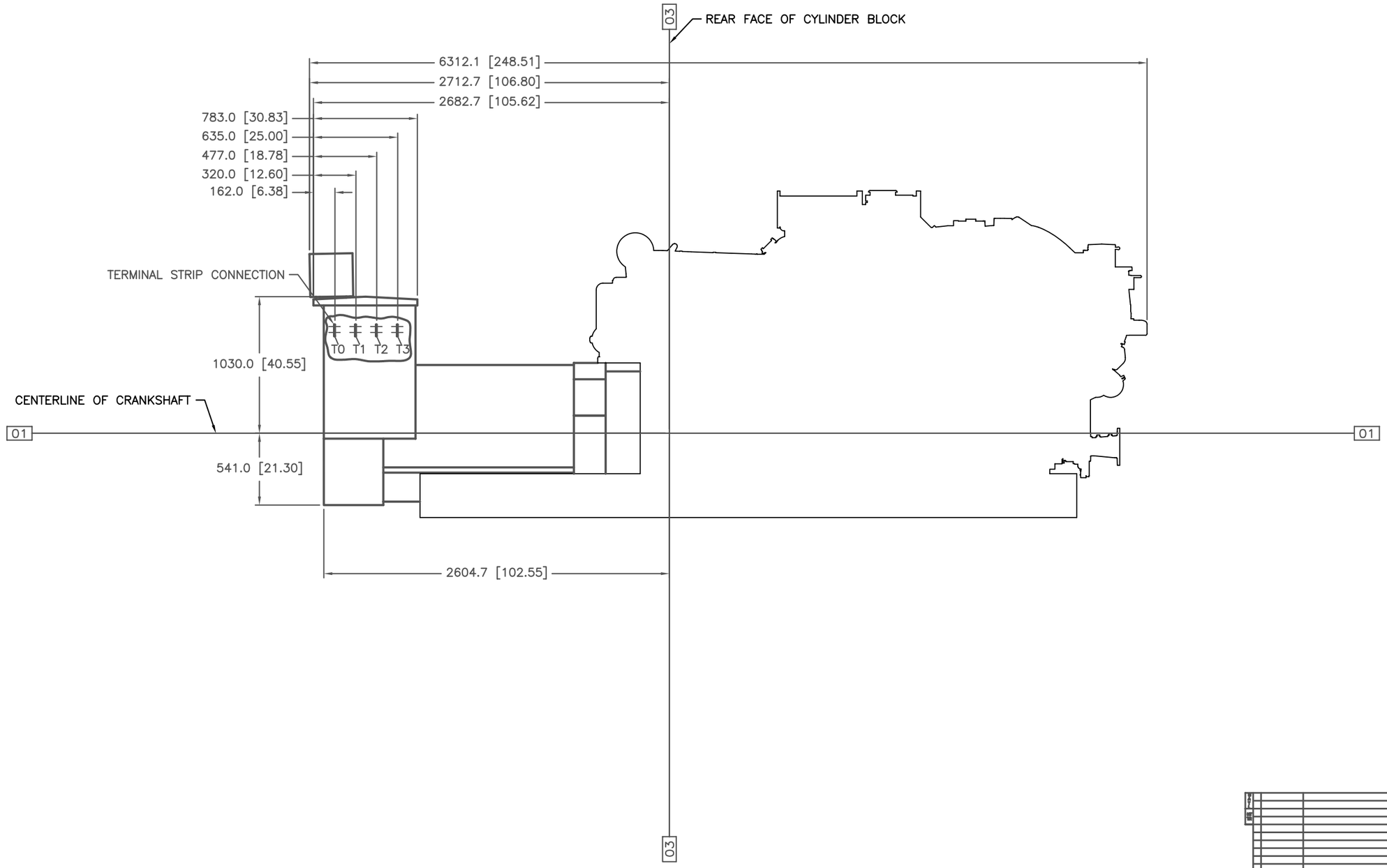
G3520C PACKAGE GENERATOR SET
DWG # 267-7367 CHG 01
METRIC [INCH]
REAR VIEW
LA-4308 CHG 00 SHOWN

1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
B.E.NORDLING
M.R.PETERSON
B.J.BROCK
SCALE 1 = 10
SHEET 4 OF 11
01 06JUL05
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
267-7367 - W068 E



G3520C PACKAGE GENERATOR SET
DWG # 267–7367 CHG 01
METRIC [INCH]
TOP VIEW
LA–4308 CHG 00 SHOWN

1E2733 DRAWING–AUTOCAD
1E0011 INTPR & TOL
B.E.NORDLING
M.R.PETERSON
B.J.BROCK
SCALE 1 = 10
SHEET 5 OF 11
01 06JUL05
CATERPILLAR INC.
INSTALLATION–ENGINE
GAS PACKAGE GEN SET
267–7367 – W868 E

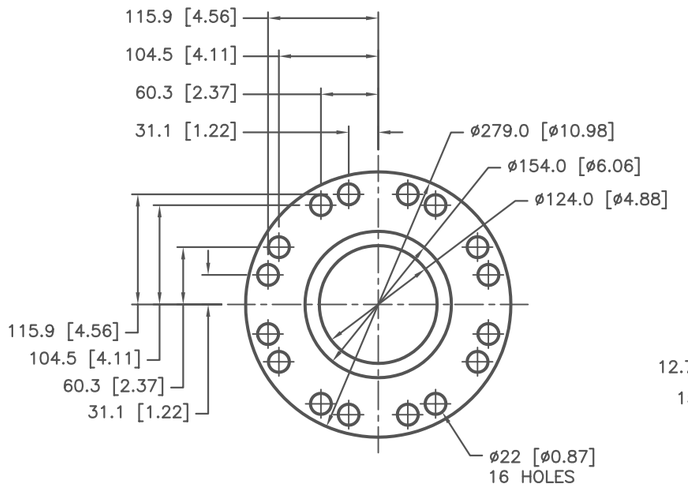


RIGHT SIDE VIEW

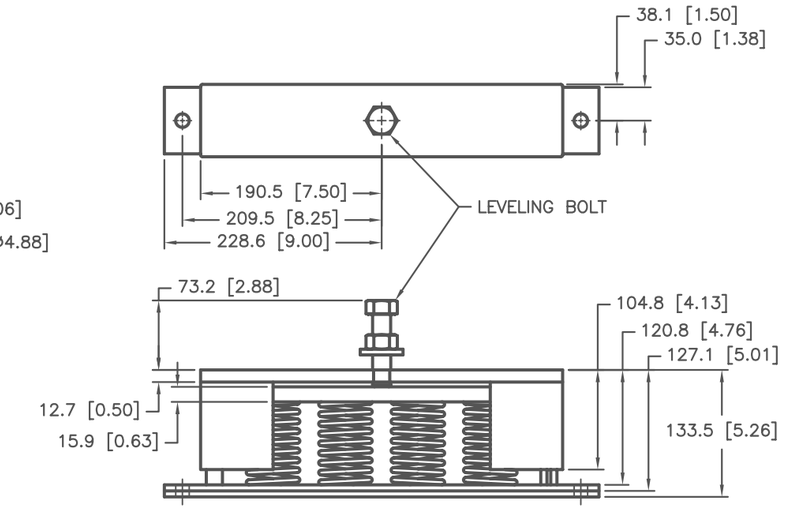
MODEL	PRICING AR	PACKAGING AR
G3520C	LA-4310 CHG 00	LE-6731 CHG 07
	LA-4308 CHG 00	

LE-6731 SHOWN SAME AS LE-6567
EXCEPT FOR DIFFERENCES SHOWN

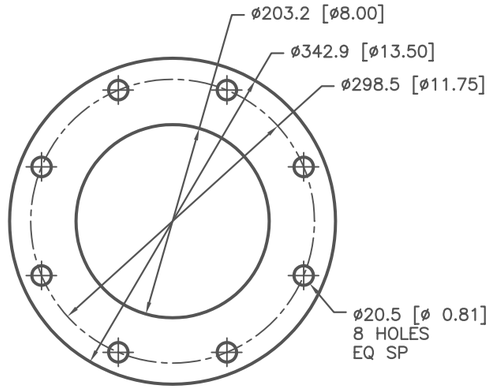
1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
B.F.NORDLING
M.R.PETERSON
B.J.BROCK
SCALE 1 = 10
SHEET 7 of 11
01 08JUL05
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
267-7367 -
E



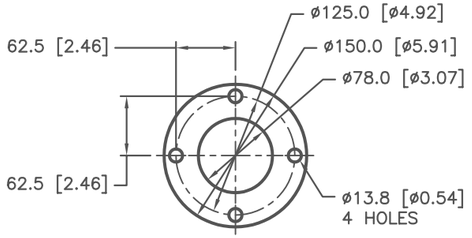
DETAIL OF JACKET WATER INLET/OUTLET FLANGE
SCALE 1=2



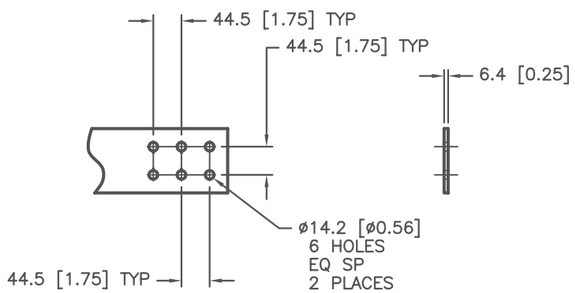
DETAIL OF MOUNTING ISOLATORS
(SHIPPED LOOSE)
F/U/W LA-4308
SCALE 1=2



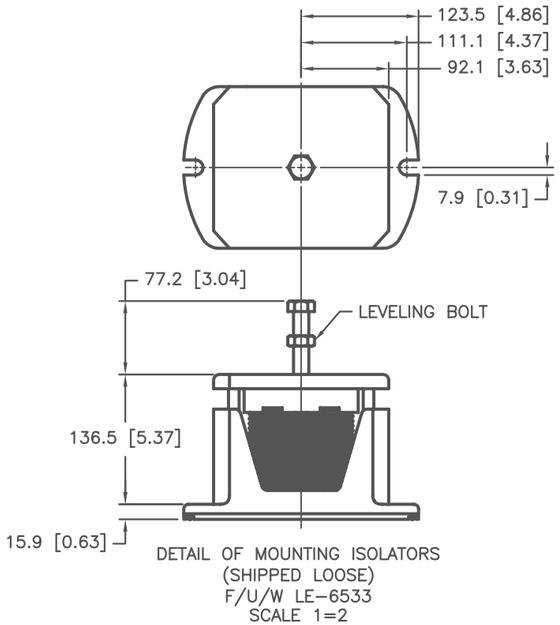
DETAIL OF FUEL INLET
SCALE 1=2



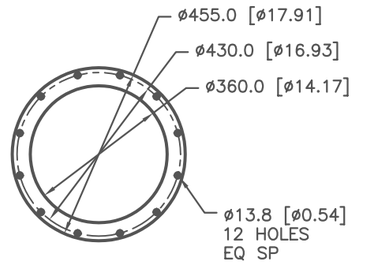
DETAIL OF SEPARATE CIRCUIT AFTERCOOLER INLET/OUTLET FLANGE
SCALE 1=2



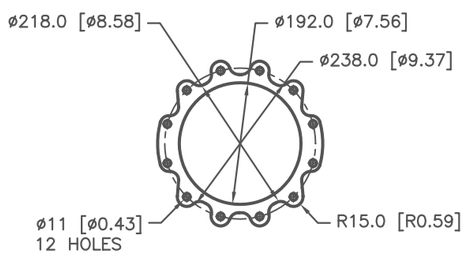
DETAIL OF 6 HOLE TERMINAL STRIP
F/U/W LE-6567 AND LE-6731
SCALE 1=3



DETAIL OF MOUNTING ISOLATORS
(SHIPPED LOOSE)
F/U/W LE-6533
SCALE 1=2



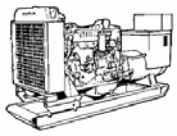
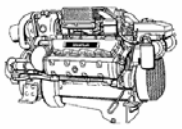
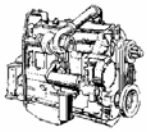
DETAIL OF EXHAUST FLANGE
SCALE 1=5



DETAIL OF AIR INLET FLANGE
SCALE 1=3

1E2733 DRAWING-AUTOCAD
1E0011 INTPR & TOL
B.E.NORDLING
M.R.PETERSON
B.J.BROCK
SCALE 1 = 10
SHEET 11 OF 11
01 06JUL05
CATERPILLAR INC.
INSTALLATION-ENGINE
GAS PACKAGE GEN SET
267-7367 -1
W066
E

Blanchard CAT®


SECTION 3

CATERPILLAR GENERATOR

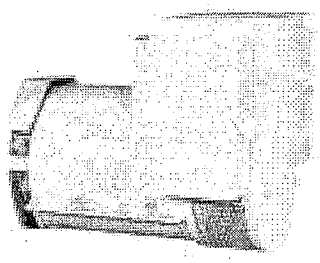
SR4B 866 FRAME
DIGITAL VOLTAGE REGULATOR
SPACE HEATER

CATERPILLAR®

SR4B Generators

Medium Voltage

50 Hz 500-2500 kV•A
60 Hz 500-2500 kW



CATERPILLAR ENGINE FACILITIES ISO 9001 CERTIFIED

CATERPILLAR® SR4B GENERATOR (shown with optional equipment)

Type	Brushless, revolving field, solid-state automatic voltage regulator
Construction	Single bearing, two bearing three phase, 4160 V Wye, or 2400 V Delta
Insulation	Class H
Enclosure	Drip proof IP 22, guarded
Alignment	Caterpillar pilot shaft
Overspeed capability	150%
Waveform	less than 5% deviation
Paralleling capability	Standard with adjustable voltage droop
Voltage regulator	3-phase sensing with Volts-per-Hertz response
Voltage regulation	Less than ±1%
Voltage gain	Adjustable to compensate for engine speed droop and line loss
TIF	Less than 50
THD	Less than 5%
Number of leads	6
Frame sizes	590, 690, 820

STANDARD FEATURES

General

Class H insulation (rotor, stator, and leads)
Improved efficiency
Motor starting capability in excess of 1.9 SkVA per continuous kW
New compact size – reduction in length
Six leads standard for differential protection
Standards: meets or exceeds the requirements of IEC 34-1, NEMA MG 1-22, BS4999, BS5000, VDE0530, UTE5100, CSA22.2, ISO8528-3

Mechanical

Full cage construction
Oversized terminal box standard with:
- dimensions 1009 H x 685 W x 304 D mm (690 & 820 frame only)
- DIN rail mounted terminal blocks (690 & 820 frame only)
- improved wire & terminal identification ensuring reliable connections (690 & 820 frame only)
- modular design allowing RH or LH mount
- separate compartment for control devices

Six-hole power bus bars for convenient customer load connection (690 & 820 frame only). Four-hole on 590 frame.
Wet layer wound rotors individually tested to 125% of rated speed; prototypes to 150% @ 170° C for two hours

Stator

Anticondensation heaters standard
Form wound stator windings provide:
- longer life
- lower turn-to-turn voltage
- rectangular wire with double dacron-glass covering
- superior handling of high switching loads & harmonics
- taped coils with half lap overlay

Standard voltages: 2400V Delta, 4160V wye @ 60 Hz; 3300V wye @ 50 Hz
Stator temperature detectors – embedded RTDs – 100Ω Pt (standard on 690 & 820 frame only)
2/3 Pitch for convenient full rated 2400 V Delta
Vacuum pressure impregnation (VPI) process – void- free VPI system with polyester resin
Vented & braced end turns for added mechanical strength and cooling

Excitation System

Built-in paralleling capability with adjustable voltage droop and sensing isolation transformers (standard on 690 & 820 frame only)
Improved transient response with a standard V/Hz regulator

STANDARD FEATURES (continued)

Permanent magnet excitation system standard:
- eliminates the need for series boost improved performance with non-linear loads provides power isolation to voltage regulator
- radio frequency noise suppression exceeds industry standards:
  - MIL-STD-461
  - 82/449/EEC
  - VDE 875/10.84
- short circuit current sustaining to 300% rated current for 10 seconds

VR3 automatic voltage regulator with three phase sensing

ROTOR CONSTRUCTION

The main rotor uses a precision "wet" layer wound process, with epoxy painted on the bare rotor and on each layer. This ensures bonding of all the wire layers together, bonding of the coils to the rotor laminations, and a sealed insulation system. The rotor epoxy is then oven-cured.

The exciter rotor is machine wound and receives two dips and bakes of a fungus-resisting resin.

Numerically controlled turning and grinding machines produce rotor shafts with close repeatable tolerances. Grade-8 bolts are used wherever joints are subject to induced stresses.

A complete coating of red sealer is applied to protect the rotors and shaft from moisture corrosion.

All rotor designs are prototype tested to 150% of rated speed at 170° C for two hours without any movement of material. Every production rotor is dynamically balanced in two planes to within 0.025 mm peak-to-peak amplitude and run at 125% of rated speed before assembly into the stator.

MAIN STATOR CONSTRUCTION

New square lamination stator design

Stator coil pitch, is designed for 2/3 for convenient 2400 V Delta connection

Stator windings are wound with precision formed coils

Each conductor and turn is positioned for better turn-turn, impulse, and surge voltage, and harmonic loads

Even spaces between coils improves winding cooling and reduces moisture retention

Lacing, double surge ropes, and blocking of coil end turns minimizes coil movement during surges

After being wound, the stator assembly is vacuum pressure impregnated with polyester material and then given an overcoat of epoxy resin.

OPTIONAL FEATURES

Air filter (available on 690 & 800 frame only)

Bearing temperature detectors – 100Ω Pt or 10Ω Cu

Custom voltages

VR3F (2V/Hz) for enhanced transient response and block loading

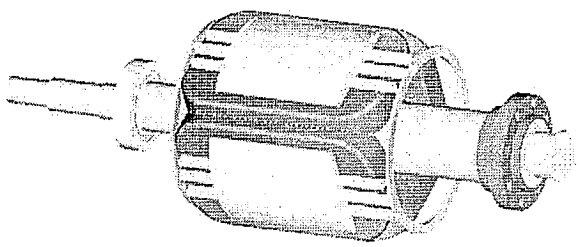
Digital voltage regulator for superior transient response, block loading, generator protection, and flexibility

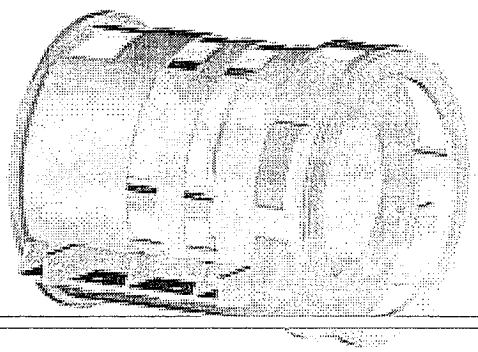
Digital voltage regulator with KVAR/PF controller and reverse power protection

Manual voltage control

RFI filter – 82/499/EEC, VDE 875/10.84 A2 Level N, BS800 standards, and MIL-STD-461B (conducted, radiated, and susceptibility)

Stator temperature detectors – embedded RTDs – 100Ω Pt (590 frame only – standard on 690 & 820 frame)





Materials and specifications are subject to change without notice.

The International System of Units (SI) is used in this publication.

LEHX6380
Supersedes LEHX4470

GENERATOR DATA *OCTOBER 12, 2007*

Selected Model

Engine: 3520 **Generator Frame:** 866 **Genset Rating (kW):** 1600.0 **Line Voltage:** 4160
Fuel: Gas **Generator Arrangement:** 1586432 **Genset Rating (kVA):** 2000.0 **Phase Voltage:** 2402
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 277.6
Duty: CONTINUOUS **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 39272 /38778 /38180 /9577

Spec Information

Generator Specification

Frame: 868 **Type:** SR4B **No. of Bearings:** 2
Winding Type: FORM WOUND **Flywheel:** 21.0
Connection: SERIES STAR **Housing:** 00
Phases: 3 **No. of Leads:** 6
Poles: 6 **Wires per Lead:** 1
Sync Speed: 1200 **Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	400.0	92.0
0.5	800.0	94.8
0.75	1200.0	95.4
1.0	1600.0	95.5
1.1	1760.0	95.4

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1496	1.2945
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1506	1.3035
TRANSIENT - SATURATED X'_d	0.2383	2.0623
SYNCHRONOUS - DIRECT AXIS X_d	1.8161	15.7143
SYNCHRONOUS - QUADRATURE AXIS X_q	0.9949	8.6085
NEGATIVE SEQUENCE X_2	0.1501	1.2986
ZERO SEQUENCE X_0	0.0092	0.0800

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	3.6290
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.4762
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0169
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0112
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.0114
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0085
EXCITER TIME CONSTANT T_e	0.1889
ARMATURE SHORT CIRCUIT T_a	0.0331

Short Circuit Ratio: 0.68 | Stator Resistance = 0.1725 Ohms | Field Resistance = 1.522 Ohms

Voltage Regulation

Voltage level adustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	3.0%
Telephone influence factor: less than	50

Generator Excitation

	No Load	Full Load, (rated) pf	
		Series	Parallel
Excitation voltage:	10.88 Volts	41.08 Volts	Volts
Excitation current	3.4 Amps	10.56 Amps	10.56 Amps

Selected Model

Engine: 3520 **Generator Frame:** 866 **Genset Rating (kW):** 1600.0 **Line Voltage:** 4160
Fuel: Gas **Generator Arrangement:** 1586432 **Genset Rating (kVA):** 2000.0 **Phase Voltage:** 2402
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 277.6
Duty: CONTINUOUS **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 39272 /38778 /38180 /9577

Generator Mechanical Information

Center of Gravity

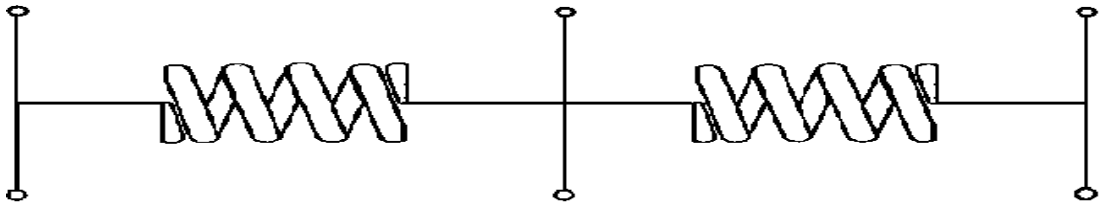
Dimension X	-1132.0 mm	-44.6 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 5413 kg * Rotor WT = 2156 kg * Stator WT = 3257 kg
11,934 LB 4,753 LB 7,180 LB

Rotor Balance = 0.0508 mm deflection PTP
Overspeed Capacity = 150% of synchronous speed

Generator Torsional Data



J1 = Coupling and Fan **J2 = Rotor** **J3 = Exciter End**
TOTAL J = J1 + J2 + J3

K1 = Shaft Stiffness between J1 + J2 (Diameter 1) **K2 = Shaft Stiffness between J2 + J3 (Diameter 2)**

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
62.0 LB IN. s^2	54.9 MLB IN./rad	5.0 IN.	924.6 LB IN. s^2	53.1 MLB IN./rad	3.8 IN.	3.9 LB IN. s^2
7.0 N m s^2	6.2 MN m/rad	127.0 mm	104.462 N m s^2	6.0 MN m/rad	96.5 mm	0.443 N m s^2

Total J
990.4 LB IN. s^2
111.905 N m s^2

Selected Model

Engine: 3520	**Generator Frame:** 866	**Genset Rating (kW):** 1600.0	**Line Voltage:** 4160
Fuel: Gas	**Generator Arrangement:** 1586432	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 2402
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 277.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 39272 /38778 /38180 /9577

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 ^{0}C)**	
Heat Dissipated:	75.4 kW	**Stator Rise:**	105.0 ^{0}C
Air Flow:	0.0 m^3/min	**Rotor Rise:**	105.0 ^{0}C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 ^{0}C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	4160 Volts
B BR 80/40	1660.0 kVA
F BR -105/40	2000.0 kVA
H BR - 125/40	2200.0 kVA
F PR - 130/40	2200.0 kVA

Selected Model

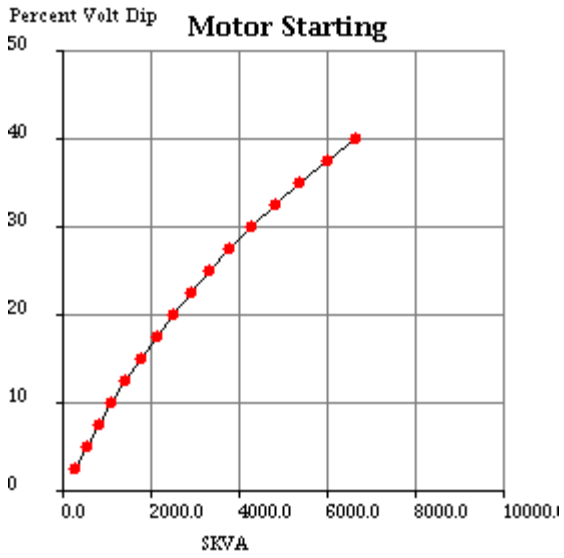
Engine: 3520	**Generator Frame:** 866	**Genset Rating (kW):** 1600.0	**Line Voltage:** 4160
Fuel: Gas	**Generator Arrangement:** 1586432	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 2402
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 277.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 39272 /38778 /38180 /9577

Starting Capability & Current Decrement

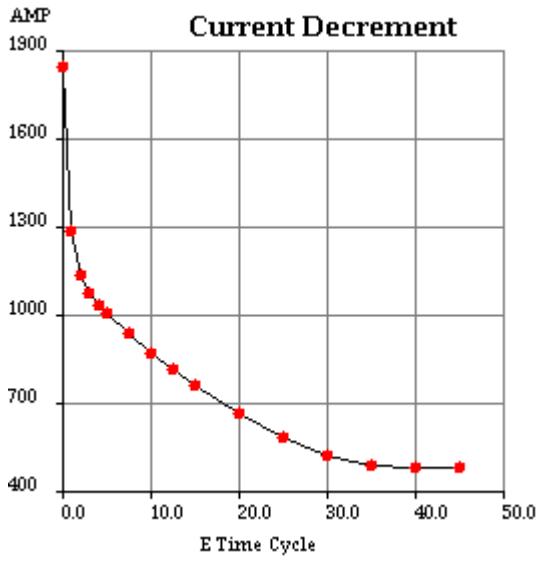
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
256	2.5
526	5.0
810	7.5
1,110	10.0
1,427	12.5
1,762	15.0
2,118	17.5
2,497	20.0
2,899	22.5
3,329	25.0
3,788	27.5
4,280	30.0
4,809	32.5
5,378	35.0
5,992	37.5
6,658	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	1,845
1.0	1,286
2.0	1,133
3.0	1,074
4.0	1,037
5.0	1,006
7.5	936
10.0	872
12.5	813
15.0	759
20.0	665
25.0	586
30.0	522
35.0	490
40.0	479
45.0	482



Instantaneous 3 Phase Fault Current: 1845 Amps **Instantaneous Line - Line Fault Current:** 1595 Amps

Instantaneous Line - Neutral Fault Current: 2680 Amps

Selected Model

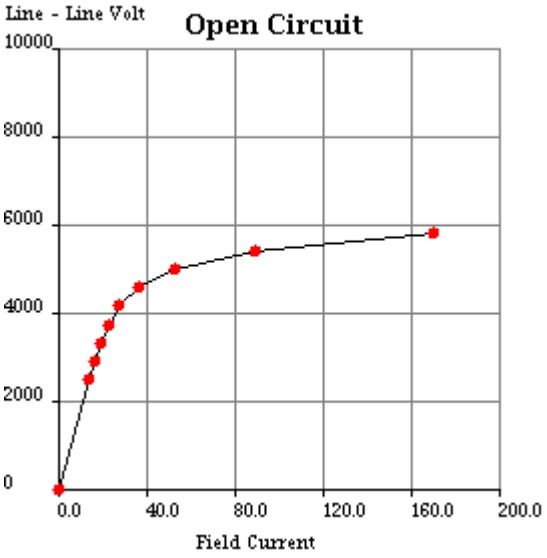
Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 4160
Fuel: Gas	**Generator Arrangement:** 1586432	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 2402
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 277.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 39272 /38778 /38180 /9577

Generator Output Characteristic Curves

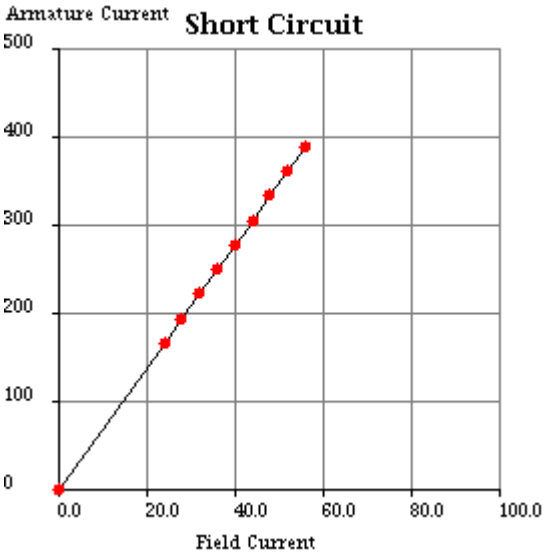
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
13.9	2,496
16.4	2,912
19.1	3,328
22.6	3,744
27.6	4,160
36.2	4,576
53.1	4,992
89.2	5,408
169.9	5,824



Short Circuit Curve

Field Current	Armature Current
0.0	0
24.0	167
27.9	194
31.9	222
35.9	250
39.9	278
43.9	305
47.9	333
51.9	361
55.9	389



Selected Model

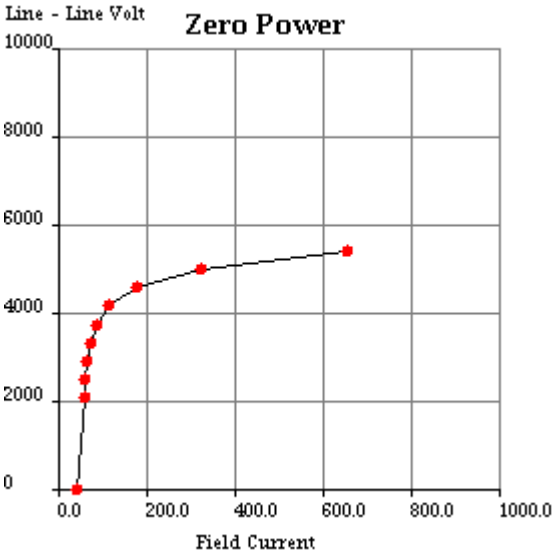
Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 4160
Fuel: Gas	**Generator Arrangement:** 1586432	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 2402
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 277.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 39272 /38778 /38180 /9577

Generator Output Characteristic Curves

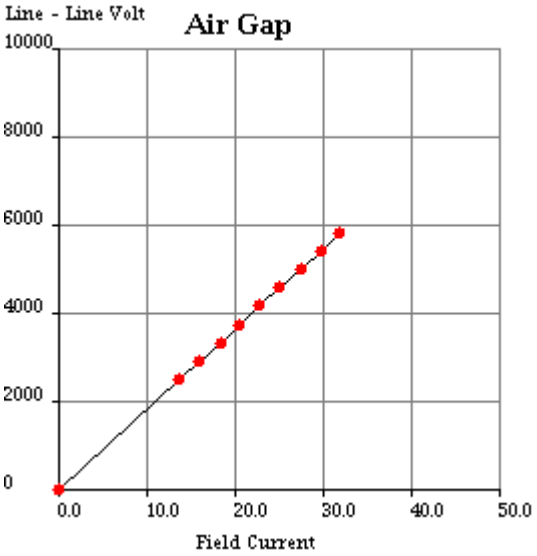
Zero Power Factor Curve

Field Current	Line - Line Volt
39.9	0
57.5	2,080
60.8	2,496
65.3	2,912
72.5	3,328
86.2	3,744
115.0	4,160
178.6	4,576
323.1	4,992
654.7	5,408



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
13.7	2,496
16.0	2,912
18.3	3,328
20.5	3,744
22.8	4,160
25.1	4,576
27.4	4,992
29.7	5,408
31.9	5,824

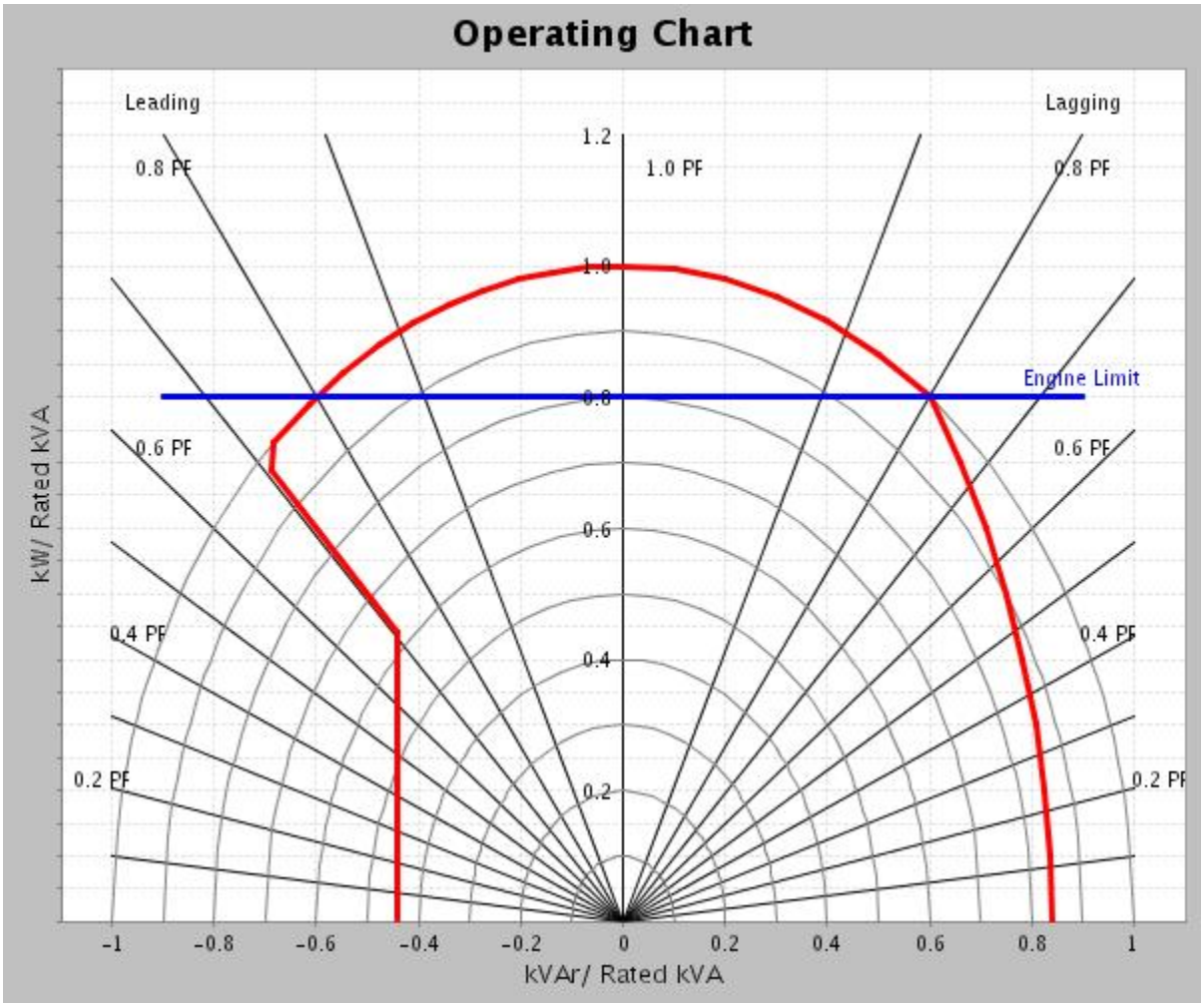


Selected Model

Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 4160
Fuel: Gas	**Generator Arrangement:** 1586432	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 2402
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 277.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 39272 /38778 /38180 /9577

Reactive Capability Curve



DIGITAL VOLTAGE REGULATOR

CATERPILLAR®

The Cat Digital Voltage Regulator is a microprocessor based control designed to provide precise voltage control, robust transient response, and generator protection with industry leading features and versatility.

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.

FEATURES

- Microprocessor based control featuring choice of three control modes standard:
  - Automatic Voltage Regulation (AVR)
  - Power Factor Regulation (PF)
  - Reactive Power Regulation (Var)
- Programmable stability settings
- Soft start control with an adjustable time setting in AVR control mode
- Dual Slope Underfrequency (volts/hertz) regulation
- Three-phase or single-phase generator voltage (RMS) sensing/regulation in AVR mode
- Single-phase generator current sensing for regulation purposes
- Field current and field voltage sensing
- Five contact sensing inputs for system interface
- One common LED for visual indication of Alarm and Shutdown fault conditions
- Fault Shutdown Driver and Alarm Output Driver for indication of Alarm and Shutdown fault conditions
- Generator paralleling with reactive droop compensation and reactive differential compensation
- Line drop compensation
- Remote communication interface via CAN 2.0B
- Ten generator protective functions
- UL 508A Recognized and CE certified

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Caterpillar dealer network
- Over 1,800 dealer branch stores operating in 166 countries.
- 99.7% of parts orders filled within 24 hours. The best product support record in the industry.
- Caterpillar dealer service technicians are trained to service every aspect of your electric power generation system.

COMPLETE SYSTEM INTEGRATION

Fully designed and factory tested to work seamlessly with Cat Generator using Shunt, PMG, or AREP excitation systems and EMCP controls.

LEHE3225

SPECIFICATIONS

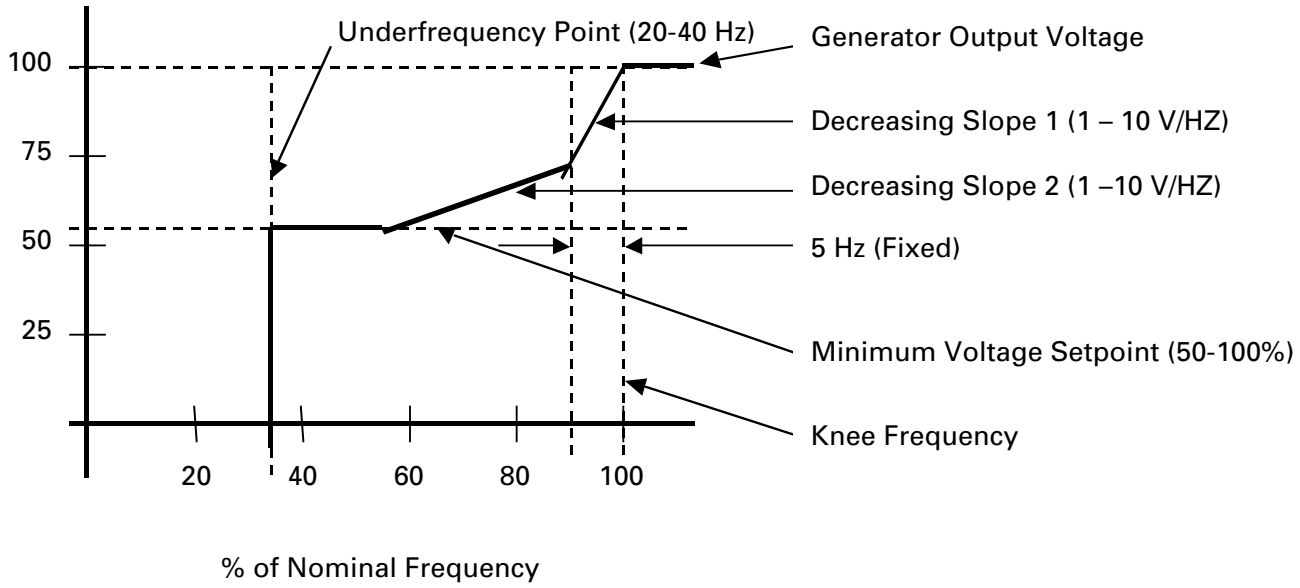
General Specifications	
Voltage Regulation	±0.25% no load to full load
Temperature Drift	±1.0% for a 40° C change
Response Time	Maximum of 10 milliseconds
Variable Sensing Range	90 to 600 Volts
Control Power	24 Vdc Supply (18 to 30 Vdc, 5VA)
Regulator Filtering	THF 3% per IEC34-1 TIF of 50 NEMA MG1-22.43
Harmonic Tolerance	0.5% Voltage regulation with 40% THD
Weight	1.47 kg (3.25 lb)
Environmental	
Operating Temperature	–40° C to 70° C (–40° F to 158° F)
Storage Temperature	–40° C to 85° C (–40° F to 185° F)
Relative Humidity	95% non-condensing 30° C to 60° C
Salt Spray	5% for 48 hrs at 38° C at 115% nominal operating voltage
Vibration	4.5G (peak) 18-2000 Hz in 3 perpendicular planes
Shock	20G
Certifications	
CE Approved	
UL Recognized	
CSA Listed	

PROTECTIVE FUNCTIONS

- Generator Overvoltage
- Generator Undervoltage
- Loss of Excitation
- Instantaneous Field Overcurrent
- Over Excitation
- Loss of Sensing
- Diode Fault Monitor
- Internal Watchdog Failure
- Internal Memory Failure
- Fault Reset Closed Too Long

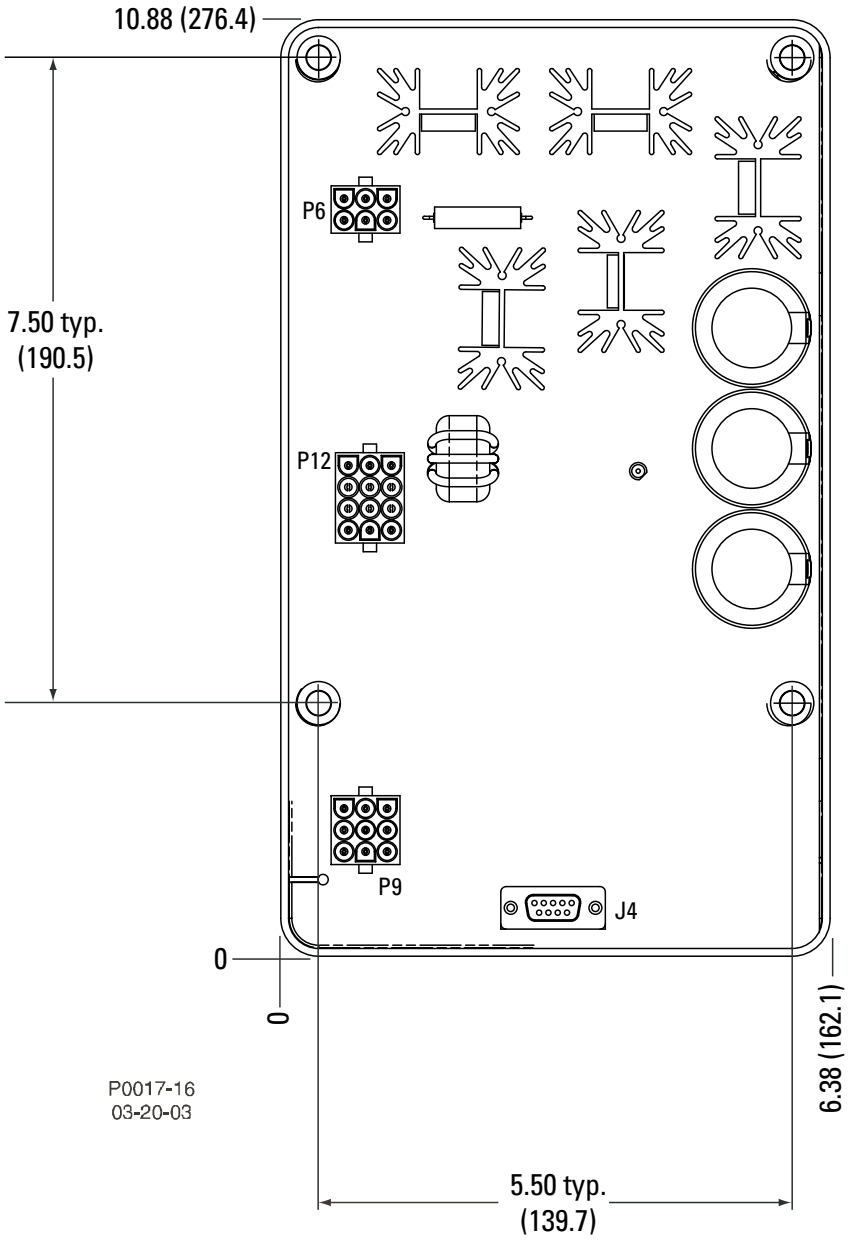
Programmable Variables	Range of Adjustment
Voltage vs Frequency Characteristic	Two slope ranges adjustable from 1 to 10 PU in 0.1 increments
Fine Voltage Level	–10% to +10% in 0.1% increment
Droop Adjustment	0 to 10% in 0.1% increment
Overvoltage Setpoint Overvoltage Time Delay	105 to 135% of rated voltage in 1.0% increment 2 to 30 seconds in 1 second increments
Undervoltage Setpoint Undervoltage Time Delay	60 to 95% of rated voltage in 1.0% increment 10 to 120 seconds in 1 second increments
Gain	1 to 20% in 0.1% increments
Single Phase or Three Phase Sensing	
Under Frequency Point	20 to 40 Hz
Knee Frequency	45 to 65 Hz in 0.1 Hz increments
Minimum Voltage Setpoint	50 to 100% of rated voltage
Var Operating Mode	100% to –100% in 0.001 increments
PF Operating Mode	0.6 lead to 0.6 lag in 0.01 increments
Line Drop (IR) Compensation	0 to 10% in 0.1% increment
Loss of Excitation Loss of Excitation Time Delay	0.1 to 1.0 PU leading vars 0.1 to 9.9 seconds in 0.1 second increments
Over Excitation Time Delay — Fixed Time Option	0 to 12 Adc in 0.1 Adc increments 0 to 10 sec in 0.1 sec increments
Loss of Sensing Time Delay	0 to 25 sec in 1 sec increments
Diode Fault Monitor	1 to 10A rms field ripple current
Soft Start Function	1 to 120 sec

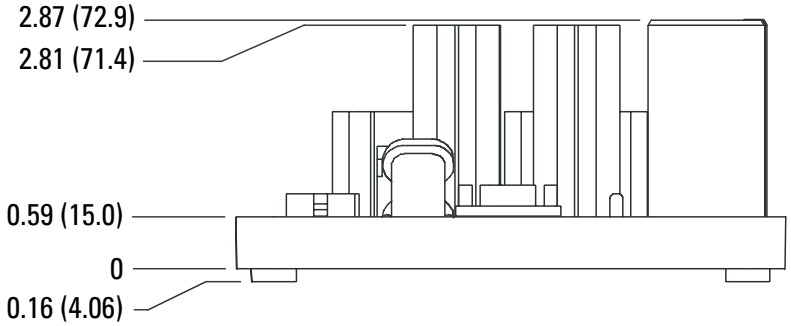
REGULATION CHARACTERISTIC — FIGURE 1



LEHE3225

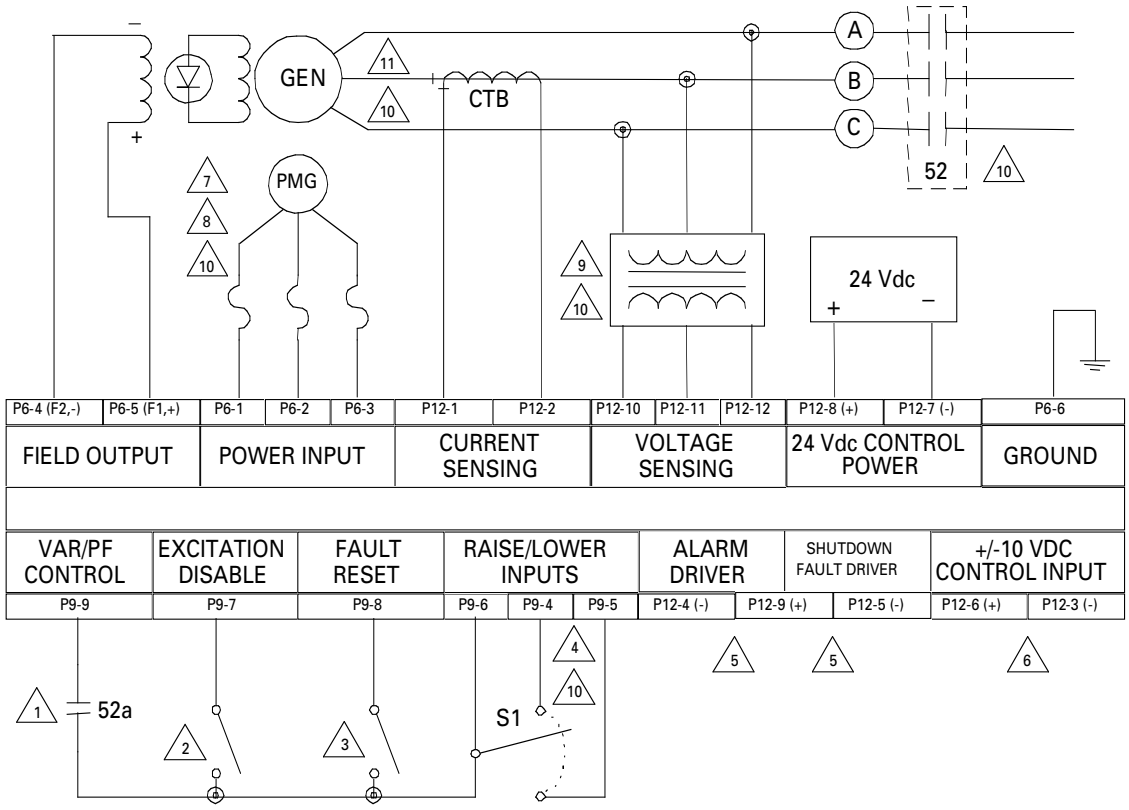
OUTLINE DRAWING — FIGURE 2





LEHE3225

EXAMPLE CONNECTION DIAGRAM — FIGURE 3



1. Required only for Var/PF control. Var/PF is active with 52a closed, inactive with 52a open.
2. Excitation is disabled when closed, enabled when open.
3. Momentary closure resets any shutdown fault.
4. S1 (SPDT, spring -return to center-off position) adjusts regulator setpoint.
5. Normally-off, turns on for user alarm or trip.
6. Analog input voltage between -10 and +10 Vdc provides adjustment of operating setpoint.
7. External fuses should be sized to match the PMG and protect the field. Maximum fuse size should be limited to Bussmann type KTK-12 or equivalent.
8. Three-phase PMG is shown. For single-phase PMG, omit P6-3 connection.
9. Sensing potential transformer is required if line voltage exceeds 660 Vac.
10. Item not supplied by Caterpillar.
11. When generator rotation is ACB, the connections shown for CTB should be reversed.

SPACE HEATER CONNECTIONS

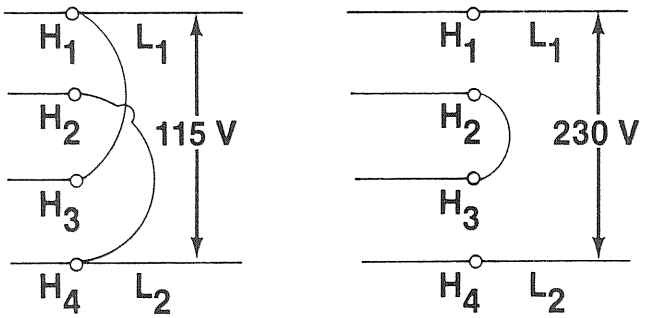


Figure 1

There are two basic methods of heater control:

1. Manual switching by reliable personnel on hand whenever the generator set is in a nonoperational mode.

2. Automatic switching to energize whenever the generator set is nonoperative and deenergize whenever operative. Auxiliary contacts on the generator main circuit breaker are frequently used to energize the heater circuit whenever the breaker is opened. Automatic switching with thermostatic and humidistat controls is not recommended. Coordination of proper temperature setting with humidity and seasonal temperature variations make this method undesirable unless energy conservation practices dictate otherwise.

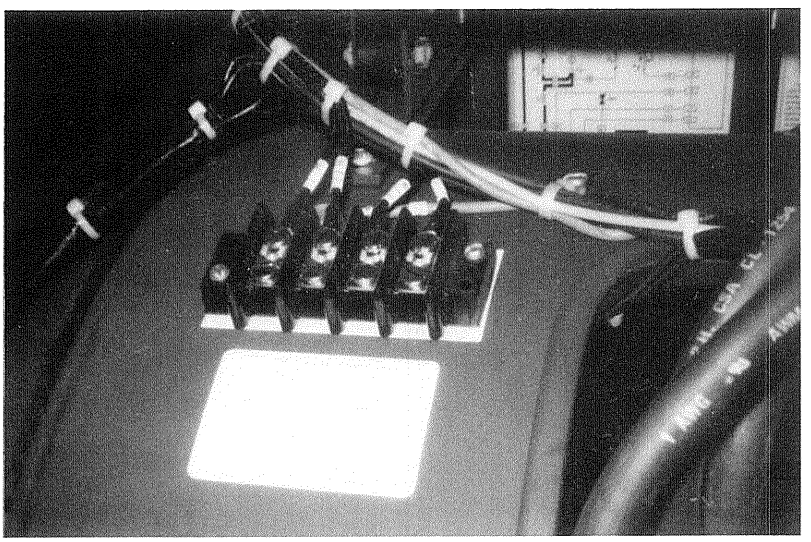
Space heaters are standard equipment on all marine generators and available as optional installed attachments on all other installed generators at time of order. Space heater kits may be "field installed" on SR 4 Generators which fall within the compatibility and adaptability listed in Figure 2:

Generator Frame Size*	Heater Kit No.	Power Consumption (Watts)
360	7C055	400
440	7C0555	500
580 (3400 Family 4 Pole)	7C0556	600
580 (3400 Family 6 Pole And All 3500 Family)	7W8877	600

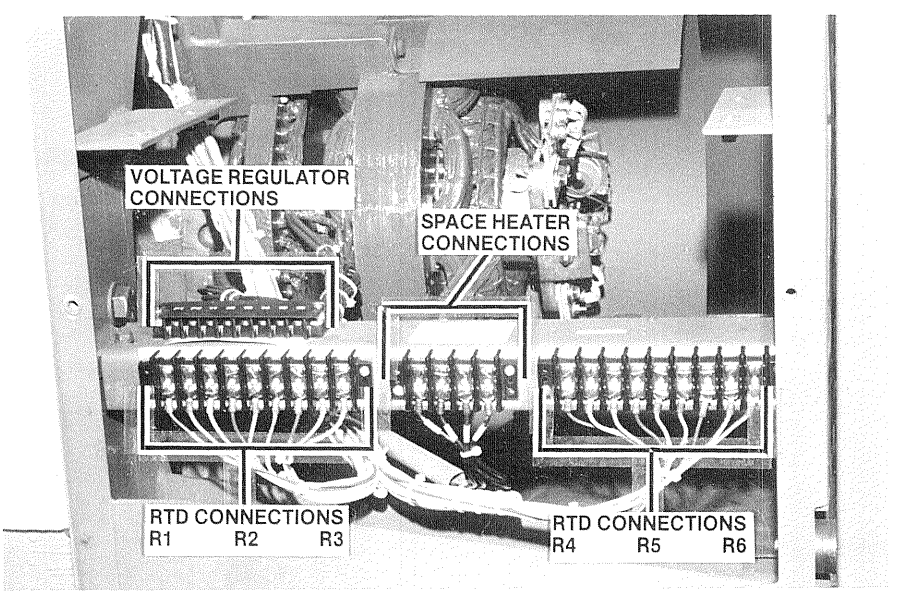
Generator Frame Size*	Heater Kit No.	Power Consumption (Watts)
680 (Low Voltage)**	7W9967	900
680 (Medium Voltage)**	7W8710	900
800 (Low Voltage)**	7W9986	1200
800 (Medium Voltage)**	7C2696	1200

*Refer to NPR for generator part number and serial number adaptability.

**Low voltage is 600 volts and below. Medium voltage is a Caterpillar Generator above 600 volts.



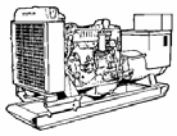
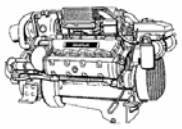
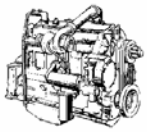
SPACE HEATER TERMINAL BLOCK
(Small Frame SR4)



SPACE HEATER TERMINAL BLOCK
(Large Frame SR4)

Figure 2

Blanchard CAT

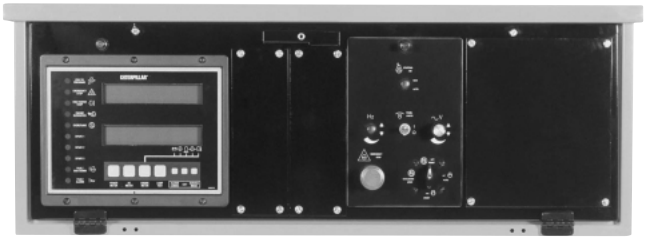





SUBMITTAL DATA

SECTION 4

ENGINE CONTROL PANEL

EMCPII+ CONTROL PANEL
NFPA 99 ALARM MODULE



EMCP II+

ELECTRONIC MODULAR CONTROL PANEL

The Caterpillar Electronic Modular Control Panel (EMCP II+) places full-featured power metering, protective relaying, simultaneous engine and generator parameter viewing, and expanded AC metering at your fingertips. Engine and generator control, diagnostics, and operating information is accessible via the control panel keypads or a remote, personal computer. The advanced microprocessor-based EMCP II+ combined with the Caterpillar Customer Communication Module (CCM) and Relay Driver Module (RDM) give you the flexibility to remotely manage the specific needs of your total system.

FEATURES

UL 508A

- UL 508A Listed

RELIABLE, DURABLE, AND ACCURATE

- Environmentally sealed, die-cast aluminum housing isolates and protects electrical components against failure caused by moisture and dirt contamination.
- Rigorous vibration testing ensures panel dependability.
- Maintains metering accuracy from –40° C (–40° F) to 70° C (158° F)
- Electrical noise immunity of 100 volts/meter
- True RMS sensing ensures AC metering accuracy is 0.5% for AC volts, amps, and power parameters.
- The digital, 32 bit microprocessor-based system eliminates the need for a number of switches, meters, transducers, relays, and sending units. That means less wiring and fewer opportunities for mechanical failures.

ADVANCED FEATURES THAT SUPPORT YOUR BUSINESS NEEDS

- Full-featured power metering, accessible with one keypad touch, allows you to view generator set kW, kVA, kVAR, kW hours, kVAR hours, percent rated power, and power factor.
- Customer programmable protective relaying, available as alarm and shutdown, protects against undervoltage, overvoltage, underfrequency, overfrequency, overcurrent, and reverse power.
- Load demand relay opens and closes based on generator kW output, programmable to activate at an adjustable setpoint.
- Simultaneous viewing of engine and generator parameters with toggle between auto parameter scrolling and individual parameter display.
- Simultaneous viewing of all AC L-L voltages, all AC L-N voltages, or all AC line currents.
- Expanded remote customer communication module supported by an open RS-232C architecture — easily interfaces with existing plant systems and equipment.

KEYPAD PROGRAMMABILITY

- User-friendly, convenient, customer programmability directs the customer to logical parameter groups — AC metering, protective relaying, engine monitoring — for quick keypad access.
- Programmable, spare control relay with remote control capability provides additional flexibility for customer control function.
- 10 LED alarms, five programmable for customer inputs, provide more information at a glance.

REGULATORY APPROVALS

- U.S. sourced control panels meet CSA requirements.
- Larne sourced control panels meet CE requirements.

LEHX9590-05

STANDARD/OPTIONAL FEATURES

EMCP II+	
STANDARD FEATURES	
Digital (LCD) Indication	AC voltage — 3 phase (L-L & L-N) AC amps (3 phase & total) kW (total & per phase) kVA (total) kVAR (total) kWhr (total) kVARhr (total) PF (average total & per phase) Percent of rated (total) Frequency DC voltage Coolant temperature Oil pressure rpm Hours run System diagnostic L/R exhaust manifold temperature (3500 only) Oil temperature (except 3300/3406)
Controls	Auto start/stop Purge cycle (gas packages only) Staged shutdown (gas packages only) Emergency stop Lamp test Cycle crank Voltage control Cooldown timer Phase selector switch Load demand relay Spare relay — programmable
Enclosure	NEMA 12, IP44 Vandal door (Not available on 3406, 3456)
Indicating Lights with Shutdown	Low oil pressure High coolant temperature Overspeed Overcrank Emergency stop High inlet air temp (gas TA engines only) Detonation sensitive timing (gas LE engines only) Fault shutdown Fault alarms 3 spare lights/4 spare inputs, customer programmable (shutdown or alarm) to spare alarm or fault LEDs
Protective Relaying	Programmable relays: Over/undervoltage Reverse power relay Over/underfrequency Overcurrent
OPTIONAL FEATURES	
Protective Devices	Low coolant level (standard on some packages)
Miscellaneous Controls	Electronic governor: Isochronous speed control Load share Alarm modules — local (with horn and silence switch) Frequency control Common alarm/shutdown volt free contact Generator running volt free contact Ether starting aid (not available on gas packages) Remote annunciator modules Computer communications data link Panel lights

PROTECTIVE RELAYING

Setpoint programming provides the flexibility to custom configure protective relays in a manner which best suits a customer's application. The customer determines the response type and timing of protective relay functions:

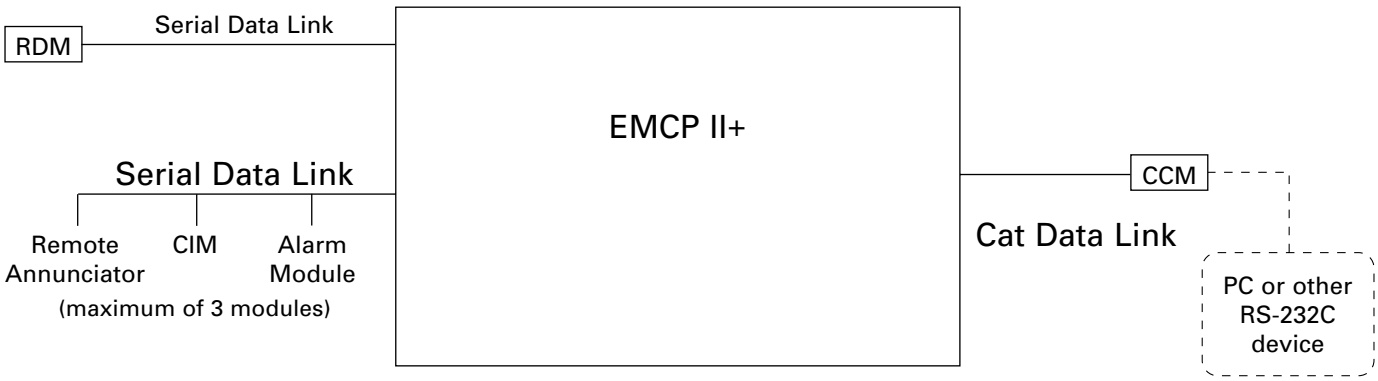
- Alarm enable/disable
- Alarm threshold level
- Alarm time delay
- Shutdown enable/disable
- Shutdown threshold level
- Shutdown time delay

Setpoints are factory set for optimum performance and generator protection. Setpoint values may be viewed with the engine running or stopped.

EMCP II+ SPECIFICATIONS

EMI Immunity
IEC 801-2, IEC 801-3, IEC 801-4, EN 5082-2
Enclosure
NEMA 12, IP44
Humidity
0 to 100% relative humidity
Impervious to:
salt spray, fuel, oil and oil additives, coolant, spray cleaners, chlorinated solvents, hydrogen sulfide and methane gas, and dust
Input and output protection
all inputs and outputs are protected against short circuits to (+/-) battery
Input voltage range (24 VDC nominal)
14 to 45 VDC
Power requirements
10 watts (with generator set in standby mode — no alarms)
Reverse polarity protected
Shock, withstands 20 g
Temperature range
Operating: –40° C to 70° C (–40° F to 158° F)
Storage: –55° C to 85° C (–67° F to 185° F)
Vibration
withstands 2.0 g @ 18 to 500 Hz

EMCP II+ SYSTEM HIERARCHY DRAWING



c UL us LISTED

FACILITIES ISO 9001 CERTIFIED

www.CAT-ElectricPower.com

U.S./European sourced

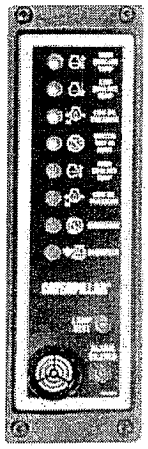
LEHX9590-05 (7-03)
Supersedes LEHX9590-04

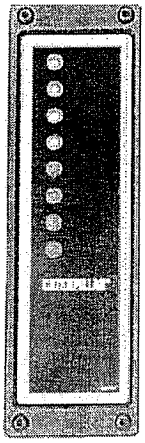
Materials and specifications are subject to change without notice.
The International System of Units (SI) is used in this publication.

CATERPILLAR®

Alarm Modules

NFPA 99 Alarm Module (Local or Remote)
NFPA 110 Alarm Module (Local or Remote)
Custom Alarm Module (CAM) (Local or Remote)





Shown with Optional Equipment

The alarm modules are designed to meet and exceed the standards of the National Fire Protection Association (NFPA).

Whether customer requirements are the NFPA 99, NFPA 110 (local or remote), or any application requiring local or remote annunciation of generator set or related parameters, Caterpillar has designed a match. If additional requirements are needed, the Custom Alarm Module (CAM) has been developed to be functionally compatible with all existing alarm modules to give customers greater flexibility in the field.

FEATURES

NFPA 99/110 Alarm Modules:

- Functionally designed to be compatible with all existing Caterpillar alarm modules
- Each module has eight LEDs: 4 amber for "pre-alarms," 4 red for "faults"
- Can be remotely mounted up to 1000 feet (350 m) away from control panel
- Lamp test and acknowledge/silence switches
- All inputs and outputs are protected against short circuits to (+/-) battery
- Reverse polarity protection
- Designed for operation from 15 to 45 VDC
- Environmentally sealed

Custom Alarm Module (CAM), in addition to the above, includes:

- 8 switch inputs
- Pre-defined labels so customer can customize CAM for each individual application
- Self-aligning template is supplied for labels
- Two versions available: One is fully equipped (version 1); second version is for use with other Cat Alarm Modules – Horn, Acknowledge/Silence Switch, and Lamp Test Switch, are not included (version 2)
- Available as an alarm module mounted on EMCP II or as a remote annunciator module available by itself or with other modules
- No limit on the number of modules used in an application

SPECIFICATIONS

Dimensions
3-3/8" W x 10-5/8" H x 3-3/8" D
13.31 mm W x 41.85 mm H x 13.31 mm D
EMI immunity
IEC 801-2, IEC 801-3, IEC 801-4, EN 5082-2
EEC Certification 89/392/EEC
Enclosure
single-membrane front face with integral test light and alarm silence switches
Horn output: 80 dB(A) nominal
Humidity
0 to 100% relative humidity
Impervious to
salt spray, fuel, oil and oil additives, coolant, spray cleaners, chlorinated solvents, hydrogen sulfide and methane gas, and dust
Input and output protection
all inputs and outputs are protected against short circuits to (+/-) battery
Input voltage (supply)
15 to 45 VDC
Power requirements
maximum wattage: 6 watts (all LEDs and horn on)
minimum wattage: 2.2 watts
Reverse polarity, protected
Shock, withstands 20 g
Temperature range
operating: -40° C to +70° C/-40° F to +158° F
storage: -55° C to +85° C/-67° F to +185° F
Vibration
withstands 2.0 g @ 18 to 500 Hz
Weight
2.50 lbs. (1.14 kgs.)

CAT ENGINE FACILITIES ISO 9001 CERTIFIED

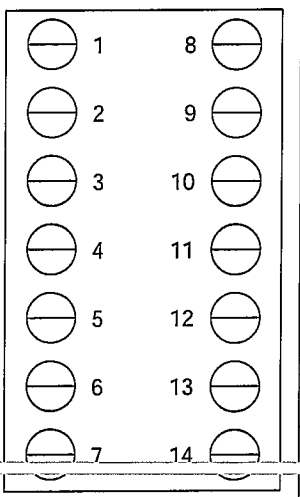
PREDEFINED ALARM MODULES (LED COLOR/SIGNAL SOURCE)

Function		Local[1]		Remote[1]	
		NFPA 99	NFPA 110	NFPA 99	NFPA 110[2]
High Coolant Temperature	Alarm	amber/data link	amber/data link	–	amber/data link
	Shutdown[3]	–	–	red/data link	red/data link
Low Coolant Temperature	Alarm	amber/data link	amber/data link	amber/data link	amber/data link
Low Oil Pressure	Alarm	amber/data link	amber/data link	–	amber/data link
	Shutdown[3]	–	–	red/data link	red/data link
Low Fuel Level	Alarm	amber/switch input	amber/switch input	amber/switch input	amber/switch input
Not in Auto	Alarm	red/data link	red/data link	–	amber/data link
Low DC Voltage	Alarm	red/internal source	red/internal source	–	–
Batt. Charger Malfunction	Alarm	–	red/switch input	amber/switch input	–
Air Damper Closed	Alarm	–	red/switch input	–	–
Generator on Load	Status	–	–	amber/switch input	–
Overcrank	Shutdown[3]	–	–	red/data link	red/data link
Overspeed	Shutdown[3]	–	–	red/data link	red/data link
Spare Faults	Alarm	2 red/switch inputs	–	–	4 red, 3 amber/ switch inputs

[1]Data Link signal is from EMCP II
[2]NFPA 110 provides 16 lights. CAM is used to provide low fuel level and spares.
[3]Local indication provided by ECMP II

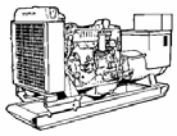
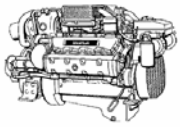
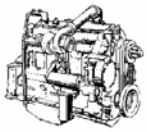
ALARM MODULE

Terminal Strip Connection Diagram



Screw Terminal	Local		Remote	
	NFPA 99	NFPA 110	NFPA 99	NFPA 110
1	B+	B+	B+	B+
2	Data In	Data In	Data In	Data In
3	Horn In 1	Horn In 1	Horn In 1	Horn In 1
4	Horn In 2	Horn In 2	Horn In 2	Horn In 2
5	Mode Sel 1 (NC)	Mode Sel 1 (NC)	Mode Sel 1 (B-)	Mode Sel 1 (NC)
6	Mode Sel 2 (NC)	Mode Sel 2 (B-)	Mode Sel 2 (NC)	Mode Sel 2 (B-)
7	B-	B-	B-	B-
8	S1 (low fuel level)	S1 (low fuel level)	S1 (low fuel level)	S1 (NC)
9	S2 (NC)	S2 (NC)	S2 (NC)	S2 (B-)
10	S3 (Spare)	S3 (batt chg mlfunct)	S3 (gen on load)	S3 (NC)
11	S4 (Spare)	S4 (air damper closed)	S3 (batt chg mlfunct)	S4 (NC)
12	Lamp Test	Lamp Test	Lamp Test	Lamp Test
13	Ack/Silence	Ack/Silence	Ack/Silence	Ack/Silence
14	Horn Output	Horn Output	Horn Output	Horn Output

Blanchard CAT


SUBMITTAL DATA

SECTION 5

AUXILIARY EQUIPMENT

STARTING BATTERIES
BATTERY CHARGER
VIBRATION ISOLATORS
ENGINE LUBE OIL
ENGINE COOLANT
WARRANTY INFORMATION

Cat® Batteries

Cat Batteries – Greater Starting Power – Lower Maintenance – Longer Life

Cat Premium High Output (PHO) batteries are used in all Caterpillar Machines and Engine Gen-Sets. They are designed to meet stringent Caterpillar design specifications, which provide industry leading cold cranking amp (CCA) capability and maximum vibration resistance.

Maintenance Free or low maintenance designs are available in wet and dry configurations.

General Service Line batteries are available in Maintenance Free or low maintenance designs and in wet or dry configurations. Wide selections of BCI group sizes are available for automotive, light truck, bus, industrial, agricultural, marine, recreational and valve regulated (VRLA-AGM & Gel) applications.

Caterpillar. The difference counts.™

Cat Dealers define world – class product support. We offer you the right parts and service solutions, when and where you need them.

The Cat Dealer network of highly trained experts keeps your entire fleet up and running to maximize your equipment investments.

CATERPILLAR®

World's Toughest Batteries

Premium High Output – Maximum Vibration Resistance

- Vibration Resistance...five times the Industry Standard
- Exclusive "flat top" BCI group 4D & 8D batteries are Maintenance Free and have the industries highest cold cranking amps (CCA)
- Popular BCI group 31 Maintenance Free batteries with industry leading cold cranking amps...up to 1000 (CCA), for electric power, machine or on-highway truck and bus applications. Deep cycle models available for truck, marine or recreational usage

Specifications for Cat Premium High Output Batteries – Available Worldwide

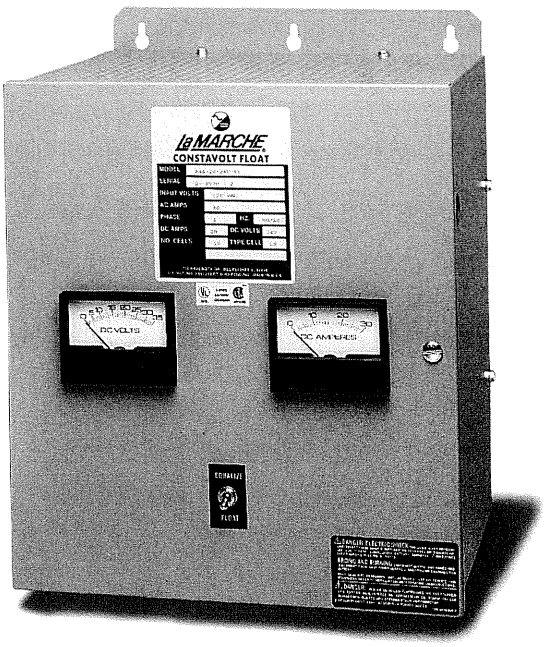
								BCI Overall Dimensions				Nominal Weight	
BCI Group Size	Part No.	Cold Cranking Amps"	Reserve Capacity Minutes'	Volts	Amp Hr. Capacity @ 20 Hrs.	Construction	Add Water Maintenance Check Hours	Length In (mm)	Width In (mm)	Height In (mm)	Wet Lb (kg)	Dry Lb (kg)	Nominal Acid to Fill Qt (liter)
8D	153-5720	1500	465	12	210	C	MF	20.47 (520)	10.8 (275)	9.76 (248)	132 (60)	–	–
8D	101-4000	1400	400	12	190	LAC+	1000	20.7 (526.5)	10.96 (278)	9.76 (248)	132 (60)	86 (39)	18.0 (17.0)
4D	153-5710	1400	425	12	200	C	MF	20.47 (520)	8.58 (218)	9.76 (248)	119 (54)	–	–
4D	153-5700	1125	305	12	145	C	MF	20.47 (520)	8.58 (218)	9.76 (248)	101 (46)	–	–
4D	9X-9730	1300	400	12	190	LAC+	1000	20.75 (527)	8.58 (218)	9.76 (248)	119 (54)	81 (37)	14.8 (14.0)
4D	9X-9720	1000	275	12	140	LAC+	1000	20.75 (527)	8.58 (218)	9.76 (248)	101 (46)	59 (27)	15.9 (15.0)
31	175-4390	1000	180	12	90	C/S	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	–	–
31	175-4370	825	190	12	100	C/S**	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	–	–
31	175-4360	710	185	12	100	C/S***	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	–	–
31	**250-0480**	710	185	12	100	C/SDT***	MF	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	–	–
31	115-2422	1000	170	12	90	C SAE	MFA	12.9 (328.4)	6.74 (171.2)	9.46 (240.3)	60 (27)	–	–
31	115-2421	950	170	12	90	C SAE +	MFA	12.9 (328.4)	6.74 (171.2)	9.46 (240.3)	60 (27)	44 (20)	6.6 (6.2)
31	9X-3404	950	165	12	100	C SAE	MF	13 (330.2)	6.77 (172)	9.46 (240.3)	58 (26)	–	–
31	3T-5760	750	165	12	100	C SAE	MF	13 (330.2)	6.77 (172)	9.46 (240.3)	55 (25)	–	–
24	153-5656	650	110	12	52	SC	MF	10.98 (278.9)	6.85 (174)	9.0 (229.1)	39 (18)	–	–
65	230-6368	880	140	12	80	SC	MF	11.9 (303.4)	7.5 (190.8)	7.5 (191.4)	45.5 (21)	–	–
74	153-5660	650	110	12	52	SC*	MF	10.98 (278.9)	7.0 (178.2)	8.15 (206.9)	39 (18)	–	–
58	175-4280	500	70	12	35	SC	MF	9.96 (253.1)	7.2 (182.5)	6.9 (176)	31 (14)	–	–
2	153-5690	765	210	6	90	LAC+	1000	10.24 (260)	6.8 (173)	8.72 (221.6)	37 (17)	22 (10)	4.8 (4.5)

Construction Notes:
LAC = Low Maintenance, Hybrid Construction
C = Calcium Lead Alloy Grid Design
MF = Maintenance Free
MFA = Maintenance Free with Accessible Vent Caps
S = Stud Terminals
+ = Shipped Dry Only
* = Side Terminals
** = Starting and Deep Cycle Battery
*** = Deep Cycle and Starting Battery
" = For 30 seconds at 0° F (-18° C)
' = Minimum of 25 amp output at 80° F (27° C)
SAE = Uses SAE Posts
SDT = Dual, Top mounted Terminals, Stud and SAE Post, Marine Deep Cycle/Starting Battery
SC = Silver (Ag) Calcium Alloy Grids for resistance to high underhood temperatures

Rugged Design – Built Tough – Reliable Starting

- Positive and Negative plates are anchored to container bottom and locked at the top of cell element for maximum vibration resistance.
- Heavy-duty forged terminal post bushings provide maximum strength and resistance to acid seepage.
- Hefty full-frame grids, no sharp edges, optimum acid/paste combination provides better charge acceptance after deep discharge.
- Manifold vented cover with built-in Flame Arrestor…a safety feature that directs corrosive gases away from the battery and hold-downs.
- Thick, robust container resists rugged treatment typical of heavy-duty commercial use. Embossed part number & descriptors for easy serviceability.

La Marche A46 Generator Set Float Battery Charger



The La Marche A46 is designed specially for maintaining and recharging starting batteries of engine sets.

The La Marche A46 float battery charger is designed specifically for maintaining and recharging the starting batteries of engine generator sets. It provides the high reliability necessary for the continued operation of emergency standby equipment and eliminates most starting problems by maintaining batteries at full charge, ensuring optimum battery performance and maximum life.*

The A46 features the proven dependability, and long life of Mag Amp transformer technology along with transistorized control circuitry. Sensing battery and load conditions, the A46 can determine when the batteries are low and will automatically provide the correct charge. The A46 also assures continued operation of emergency standby equipment and eliminates most starting problems by maintaining the batteries at full charge.

Call La Marche today for more details.

*The A46 is not recommended for use on sealed valve regulated batteries.

DESIGN FEATURES

- Proven Mag Amp Technology
- AC Line Compensation
- Automatic Operation — output is regulated by automatic sensing of battery voltage
- Separate Float and Equalize Voltage Ranges
- Current Limited — self protecting under all load conditions
- DC Ammeter Indicates Output Charge Rate
- DC Voltmeter Shows Battery Voltage
- AC Power Failure Will Not Cause Battery Discharge
- Complete isolation of AC Input from the DC Output — eliminates blown fuses from grounded equipment
- AC Power Failure Alarm Contacts
- Heavy Duty Case

5 Year Limited Warranty

Made In The USA

the powerful advantage™

LaMARCHE®

UL LISTED

La Marche A46 Battery Charger
Technical Data

Standard Features

Ammeter and Voltmeter
Fused AC Inputs and DC Output
Terminals for AC and DC Connections
Front Mounted Float/Equalize Switch

Finish

Base Material Pretreated with Grey Primer
ANSI 61 Grey Baked Enamel Finish Coat

Optional Accessories

16E-Combined Accessory Package

Includes: Digital Combination Meter, Multi-mode Equalize Timer and the Following Alarms and Indications — Low DC Volts 1, Low DC Volts 2, High DC Volts, High DC Voltage Shutdown, Low DC Current, Summary/Rectifier Failure, AC "ON", Equalize Lights.

Note: All Alarms have LED and two form "C" contacts, except Summary/Rectifier Failure (two form "C" contacts only).

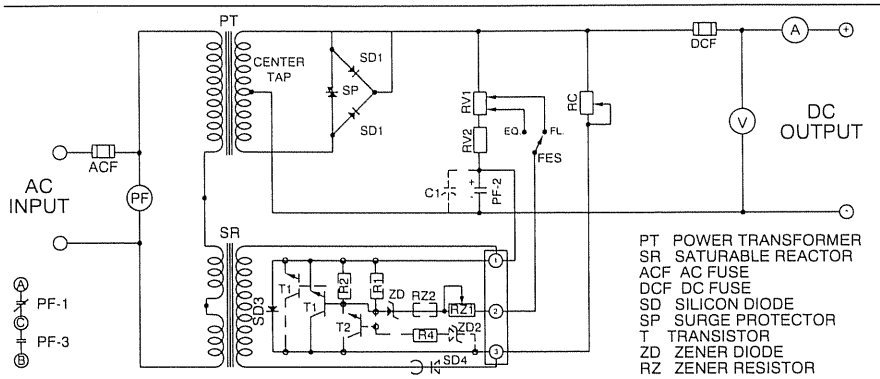
Individual Accessories

03A-DC Cranking Disconnect Relay
080-Drip Shield

NOTE: If more than two of the following accessories are required, use the 16E-Combined Accessory Package.

04J-Electronic Timer with Float and Equalize Lights
03M-Low/High DC Voltage Alarm Relay with Lights
055-Float Light *(with F/E Switch)*
056-Equalize Light *(with F/E Switch)*
060-AC Pilot Light

Schematic



PT POWER TRANSFORMER
SR SATURABLE REACTOR
ACF AC FUSE
DCF DC FUSE
SD SILICON DIODE
SP SURGE PROTECTOR
T TRANSISTOR
ZD ZENER DIODE
RZ ZENER RESISTOR

RV VOLTAGE DIVIDER RESISTOR
PF POWER FAILURE RELAY
RC COLLECTOR RESISTOR
FES FLOAT EQUALIZE SWITCH
A AMMETER
V VOLTMETER
C CAPACITOR
R RESISTOR

Ordering Information

Model Number	DC Output Amps	DC Output System Voltage	Width (inches)	Depth (inches)	Height (inches)	Weight (approx.)	Case Size
A46-6-12V	6	12	10 3/8	7 1/8	16 1/4	30	1
A46-10-12V	10	12	10 3/8	7 1/8	16 1/4	34	1
A46-20-12V	20	12	12 13/16	10	17 1/8	54	2
A46-30-12V	30	12	12 13/16	10	17 1/8	68	2
A46-6-24V	6	24	10 3/8	7 1/8	16 1/4	40	1
A46-10-24V	10	24	12 13/16	10	17 1/8	60	2
A46-20-24V	20	24	12 13/16	10	17 1/8	75	2
A46-30-24V	30	24	14 1/4	10 5/8	19 7/8	92	7
A46-40-24V	40	24	14 1/4	10 5/8	19 7/8	96	7
A46-6-32V	6	32	12 13/16	10	17 1/8	60	2
A46-10-32V	10	32	12 13/16	10	17 1/8	64	2
A46-20-32V	20	32	12 13/16	10	17 1/8	74	2
A46-30-32V	30	32	14 1/4	10 5/8	19 7/8	98	7

When Ordering Please Specify the Following

- La Marche model number A46
- AC input voltage
  (120, 208 Or 240 volts; 50/60 Hz; and, single phase)
- Number and type of battery cells
- Ampere hour capacity of battery
- Desired recharge time
- Options required

Model Number Format

A46 - 10 - 12V - ( ) A1 -- ( )

- Product No.
- DC Amps
- DC Volts
- Special Frequency *(when required)*
- Factory Assigned Accessory Code
- AC Phase Code
- AC Voltage Code

Frequency Code
50/60 Hz Standard

AC Voltage
A-120
B-240
D-208

AC Phase Code
1-Single Phase

the powerful advantage™

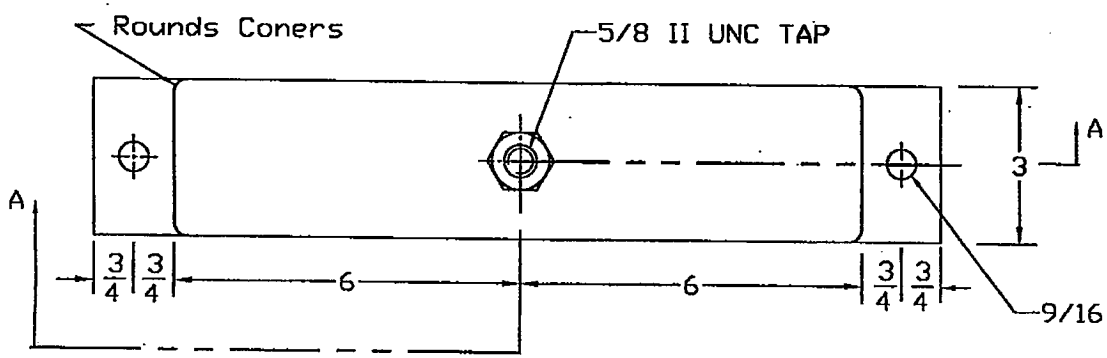
laMARCHE®

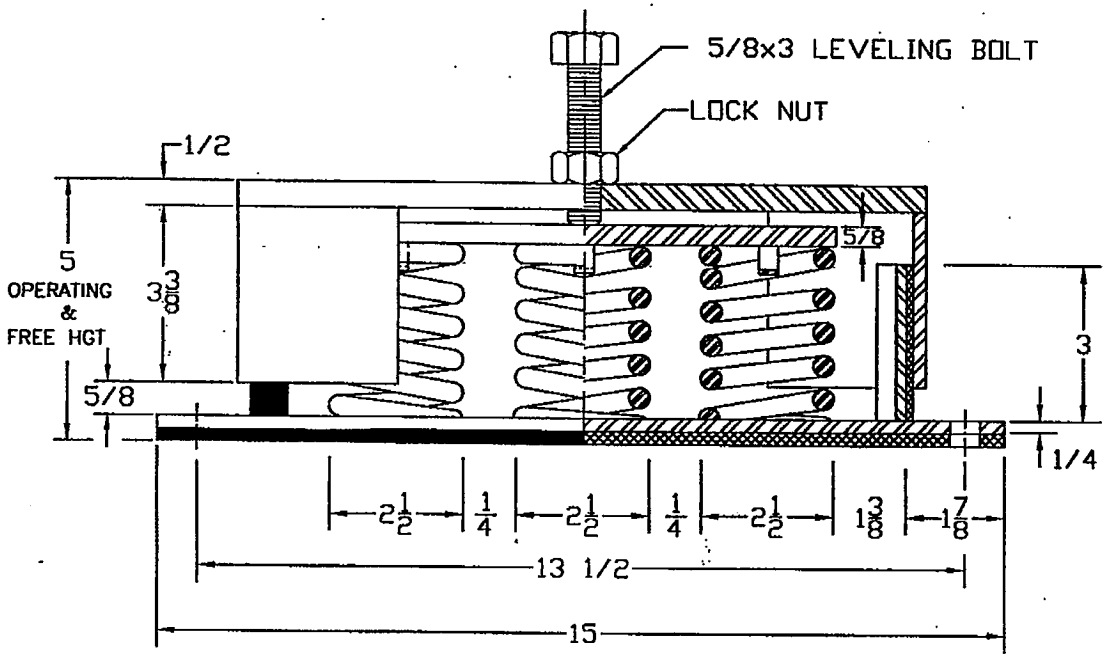
106 Bradrock Drive, Des Plaines, IL 60018 USA
Tel: (847) 299-1188, Fax: (847) 299-3061
http://www.lamarche-power.com

TYPE "EQ3" SPRING MOUNT

Caterpillar Part No.	V.E. Part No.	WGT.
1533865	1089-47R-8-6-8	3750#
1533864	1089-47R-8-8-8	4500#

RATED DEFLECTION - 0.75"





JOB : _____

CONTRACTOR : _____

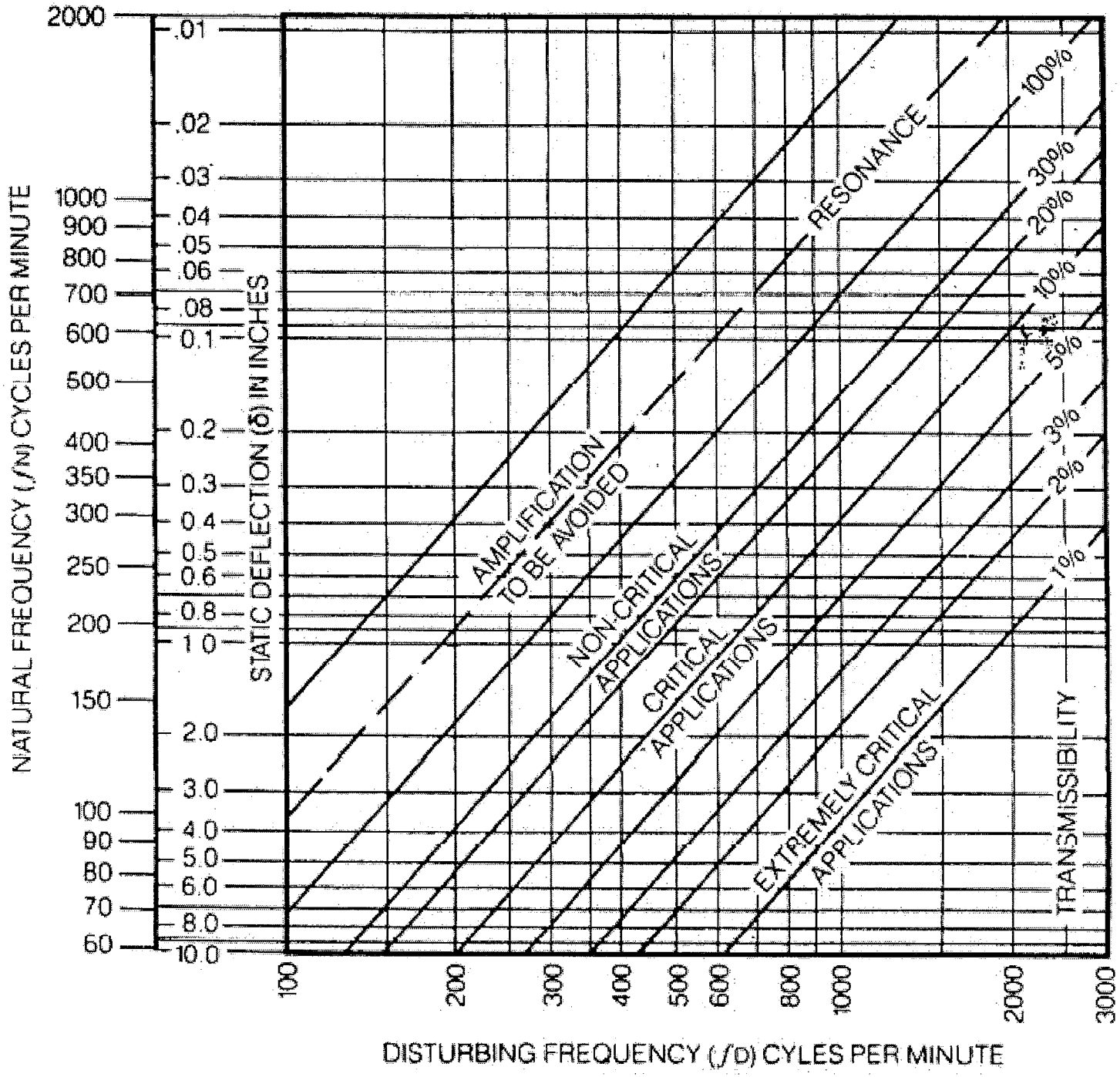
P.O. NO. : _____

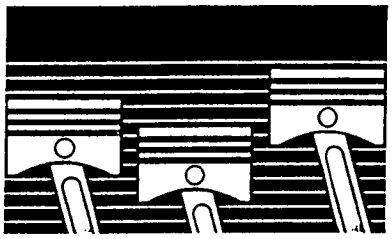
EQ3SUB1.DWG

VIBRATION ELIMINATOR CO. INC.
15 Dixon Avenue
Copiague, NY 11726
TEL. (631) 841-4000 FAX (631) 841-0020

Dwg. No.

Vibration transmissibility chart for $C/C_c = 0$





Diesel Engine Oil (CF-4)

15W-40
10W-30

PRODUCT DATA SHEET

Developed, tested and approved by Caterpillar® for primary use in Cat® on-highway truck and earthmoving diesel engines to achieve optimum engine life and performance.

Product Grades*

15W-40, 10W-30

API Service Classification

CF-4, CE/SG

Diesel Fuel Compatibility

Caterpillar's 20 times rule for TBN (Reference: Oil and Your Engine - SEBD0640) versus fuel sulfur is a general requirement which was developed in the early 1980's for Cat prechamber combustion system (PC) engines with the oil formulations of that era. The fuel sulfur neutralization of today's newer oil formulations along with direct injection combustion system (DI) engines are more effective. Field results indicate that DI engines and the oils now recommended for these engines will operate at an oil TBN equal to 10 times the fuel sulfur.

Recommended Use:

- Caterpillar diesel engines used in earthmoving, on-highway trucks, and industrial applications **(excluding 3600).**
- OEM heavy-duty diesel engines permitting the use of API CF-4, CE or CD classification oils. **Refer to your OEM machine/engine owner's manual for specific lubrication requirements.**
- Can be used in gasoline engines requiring API SG.
- Can be used in Cat lift truck diesel and gasoline engines.

Application

This oil has a strong dispersancy effectiveness along with sufficient alkalinity and sulfated ash level for the performance requirements of present day diesel engine designs. In addition, by meeting the CF-4 performance category, requirements are met for newly designed **low emission** and **hi-output diesel engines.**

Cat DEO (CF-4) is the **preferred** oil for earthmoving machines and on-highway truck engines. It is the **only** Cat oil recommended for use in low emission Cat 3406, 3116 and 3176 Truck Engines.

For Complete Lube Information About Caterpillar Engines	Please Refer to Form Number:
EARTHMOVING MACHINE	SEBU6250
ON-HIGHWAY TRUCK	SEBU6385
INDUSTRIAL AND MARINE	SEBU6251

Customer Benefits

- Strong dispersancy effectiveness to control soot buildup and reduce chance of plugging filters in off-highway and on-highway applications.
- Meets performance standards of Cat on-highway truck engines built to meet the U.S. EPA 1991 emission requirements.
- Reduces cylinder liner wear, resulting in longer engine life.
- Improved fuel economy and oil consumption compared to monograde oils (ie., SAE 30).
- Minimizes deposits in piston ring groove to help control oil consumption and optimize engine life.
- Field proven consistent performance.
- Exceeds requirements of API CF-4 and can be used in Cummins and Mack Truck Engines.
- Standard Caterpillar factory-fill oil.

General Requirements

This oil has been designed, tested and approved by Caterpillar engineers to meet the performance requirements of Cat diesel engines and the new API CF-4 service classification. This defines a new industry standard that now covers Caterpillar, Cummins and Mack requirements for oils to be used in heavy-duty diesel engines meeting the U.S. EPA 1991 emissions regulations.

Cat Diesel Engine Oil (CF-4)has been further tested and evaluated in Cat proprietary engine tests for ring sticking, oil control, and soot dispersancy. CF-4 oils can be used anywhere API CE or CD oils had been previously recommended. CF-4 supersedes the CE category.

* Cat Diesel Engine Oil (CD) is available in SAE 10W, 30 and 40. See Product Data Sheet PEHP1027 and your Caterpillar dealer for additional details.

The API CF-4 and CE classifications are more specifically defined by the following OEM engine tests:

CF-4 = Cat (1K test) + Cummins (NTC400)+ Mack T-6 and T-7 + L-38

CE = Cat (1G2)† + Cummins (NTC400)+ Mack T-6 and T-7 + L-38

CD = Cat (1G2) + L-38

The major difference between CF-4 and CE is that Caterpillar introduced the 1K single cylinder engine test to replace the former 1G2. This 1K test is now more representative of modern Cat heavy-duty diesel engines designed for low emissions, and /or hi-output.

Typical Characteristics*

SAE Visc Grade	15W-40	10W-30
API Classification**	CF-4, CE/SG, CDII	CF-4, CE/SG
Manufacturer's Tests		
CAT	1K	1K
Cummins	NTC 400	NTC 400
Mack	T-6, T-7	T-6, T-7
Detroit Diesel	6V-53T	—
API Gravity at 16°C (ASTM D287)	27.9	29.8
Color, ASTM (ASTM D1500)	5.5	5.5
Flash Point, °C (ASTM D92)	224	218
Pour Point, °C (ASTM D97)	-29	-32
Borderline Pumping Temp, °C	-25	-30
Viscosity, cST @ -15°C	3300	—
cST @ -20°C	—	3000
cST @ 40°C (ASTM D445)	115.2	65.3
cST @ 100°C (ASTM D445)	15.4	10.48
Viscosity Index (ASTM D567)	140	145
Sulfated Ash, % wt. (ASTM D874)	1.4	1.4
TBN (ASTM D2896)	12.5	12.5
Zinc, % wt. (ASTM D1549)	.121	.121

Health and Safety

Based on available toxicology information, when properly handled and used, these products have little or no adverse health effects. No special precautions are suggested, beyond attention to good personal hygiene, including avoiding prolonged, repeated skin contact. A Material Safety Data Sheet is available from your Caterpillar dealer.

* The values shown are typical values and should not be used as quality control parameters to either accept or reject product. These characteristics may not accurately describe DEO (CF-4) blended outside North America. Contact your Caterpillar dealer for details.

** This oil meets the API SG rating. This oil can be used in gasoline engines requiring the SG performance rating.

† Non-current test. 1K replaced 1G2.

Specifications subject to change without notice.

CATERPILLAR®

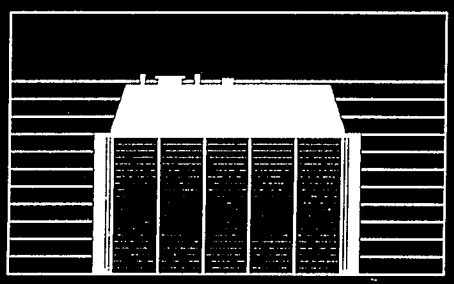
Printed in U.S.A

CATERPILLAR®

PREVENTIVE MAINTENANCE PRODUCTS

Extended Life Coolant

For all Caterpillar® diesel, gasoline, and natural gas engines



Developed, tested, and approved by Caterpillar, **Cat® Extended Life Coolant (ELC)** lasts *twice as long* as Cat Diesel Engine Antifreeze/Coolant (DEAC) *in Cat machines and commercial engines* and *three times as long in Cat truck engines.* It requires no supplemental coolant additives (SCAs); instead, Cat Extender is added once, when other coolants are replaced.

Recommended use

Cat ELC can be used in all Cat and most OEM diesel, gasoline, and natural gas engines, allowing you to inventory one coolant for your entire mixed fleet. It meets ASTM D4985 and ASTM D5345 standards for heavy-duty, low-silicate antifreeze/coolants and ASTM D3306 and ASTM D4656 for automotive applications.

Cat ELC Premixed contains 50% ELC and 50% deionized water and is intended for initial fill and top-off. This formula ensures that water quality does not compromise engine coolant life and performance; there is no guessing about correct antifreeze-to-water mix or worrying about hard water scale. **Cat ELC Concentrate** can be used to lower the coolant's freezing point temperature below that of Premixed, which is -34°F (-37°C).

Cat Extender should be added at 300,000 miles for truck engines and 3,000 hours for machines/commercial engines. The system should be drained and flushed with clean water at 600,000 miles for truck engines and 6,000 hours for machines/commercial engines (no cleaning agents are required if you are already using ELC).

We can help you determine the right coolant for your Cat machines and engines, or you can refer to your "Operation and Maintenance Manual" or Service Publications SEBU6250 (Caterpillar Machines), SEBU6251 (Caterpillar Commerical Engines), or SEBU6385 (Caterpillar On-Highway Trucks).

Typical Characteristics*

Appearance	Strawberry Red
Specific gravity, 60/60 F	1.110
pH (33% solution)	8.3
Reserve alkalinity	5.5
Ash, % max.	5.0
Boiling protection, °F (°C) 15 lb. pressure cap	
60% (Cat ELC Concentrate)	270 (132)
50% (Cat ELC Concentrate)	265 (129)
Freezing protection, °F (°C)	
60% (Cat ELC concentrate)	-65 (-54)
50% (Cat ELC concentrate)	-34 (-37)
Silicate, %	0
Phosphate, %	0
Amine, %	0
Borate, %	0
Nitrates, %	0
Molybdates, %	0

* The values shown are typical values and should not be used as quality control parameters to either accept or reject product. Specifications are subject to change without notice.

CATERPILLAR®

Extended Life Coolant

Cat ELC vs. Cat DEAC

Feature	Cat ELC	Cat DEAC
Coolant change interval	600,000 miles/6000 hours	200,000 miles/3000 hours
Inhibitor addition	Cat Extender at 300,000 miles/3000 hours	Cat SCA Every 15,000 miles/250 hours
Ethylene glycol base	Yes	Yes
Additive technology	Carboxylic Acid, Tolytriazole (some), Nitrites (some)	Nitrites, Silicates (some), Borates (some), Nitrates (some)
Meets Cat EC-1	Yes	No
Aluminum compatible	Yes	Yes
Mixed fleet use	Yes	Limited
SCA required	No	Yes
Color	Strawberry Red	Pink
SCA test kit required	No	Yes
Initial fill	No Cat Extender required	No Cat SCA required

Better protection for longer life

KLLM Transport Services, Inc. tested Cat ELC in its truck engines. The thermostat on the left is from an engine with 69,000 miles that used conventional coolant. The thermostat on the right is from an engine with 174,000 miles that used Cat ELC. KLLM's results demonstrate the longer life and better protection available with Cat ELC.

New chemical technology for long life

Cat Extended Life Coolant incorporates an advanced formula technology with organic acid corrosion inhibitors. It is free of nitrates, silicates, phosphates, borates, molybdates, and amines. Instead, Cat ELC uses mono- and dibasic organic acid salts to provide maximum protection of the six basic metal alloys—copper, solder, brass, steel, cast iron, and aluminum—found in most heat transfer systems. Some nitrites are added to help protect the cylinder liners from pitting.

Since Cat ELC doesn't contain any phosphates or silicates, hard water deposits in the cooling system are practically eliminated. The low level of total dissolved solids in Cat ELC improves water pump seal life. Plus, Cat ELC's **advanced technology** prevents gel formation and provides excellent protection against cylinder liner cavitation corrosion.

In addition, the additives used in Cat ELC don't deplete as fast as those used in conventional coolants. Coolant life in heavy-duty diesel engines is limited by the corrosion protection ability of the corrosion inhibitors. In conventional coolants, SCAs deplete, so heavy-duty diesel engine manufacturers require that you add SCAs at every oil change. With Cat ELC, however, additives deplete much more slowly—*so you don't need to add any SCAs.*

New standards for maximum performance

Cat ELC **exceeds** the new Cat EC-1 standard for cooling the engine and protecting the cooling system. **EC-1**, a new industry standard developed by Caterpillar, defines the performance requirements that an engine coolant must meet to be sold as an extended life coolant for Cat engines. One of these requirements is extensive field testing, and Cat ELC has successfully completed over 20 million miles of testing in Cat engines.

Note: Caterpillar does not monitor or approve any products that claim to meet Cat EC-1 standards. Individual suppliers are responsible for the quality and performance of their own products, including any associated liabilities.

Effective with sales to the first user on or after August 1, 2005

CATERPILLAR LIMITED WARRANTY

Industrial Engine Products and
Electric Power Generation Products
Worldwide*

(*excluding the Commonwealth of Independent States)

Caterpillar Inc. or any of its subsidiaries ("Caterpillar") warrants new and Remanufactured engines and electric power generation products sold by it (including any products of other manufacturers packaged and sold by Caterpillar) and operating outside the Commonwealth of Independent States (formerly USSR), to be free from defects in material and workmanship.

A different warranty statement applies to product operating in the Commonwealth of Independent States. Copies of this warranty may be obtained by writing Caterpillar Inc., 100 N.E. Adams St., Peoria, IL USA 61629.

This warranty does not apply to Caterpillar Motoren (CM) product, engines sold for use in on-highway vehicle or marine applications, engines in machines manufactured by or for Caterpillar, 3500 and 3600 Family engines used in locomotive applications, 3000 Family engines, C0.5 through C4.4 and ACERT (C6.6, C7, C9, C11, C13, C15, C18, C27, and C32) engines used in industrial applications, or Caterpillar brand batteries. These products are covered by other Caterpillar warranties.

This warranty is subject to the following:

Warranty Period

- For Uninterruptible Power Supply (UPS) systems, the warranty period is 12 months after date of delivery to the first user.
- For new industrial engines and electric power generation products (excluding UPS systems), the warranty period is 12 months (24 months for Automatic Transfer Switch (ATS) product, mobile agricultural and standby electric power generation applications) after date of delivery to the first user.
- For all Remanufactured engines, the warranty period is 6 months (12 months for mobile agricultural and standby electric power generation applications) after date of delivery to the first user.

Caterpillar Responsibilities

If a defect in material or workmanship is found during the warranty period, Caterpillar will, during normal working hours and through a place of business of a Caterpillar dealer or other source approved by Caterpillar:

- Provide (at Caterpillar's choice) new, Remanufactured or Caterpillar-approved repaired parts or assembled components needed to correct the defect.

Note: Items replaced under this warranty become the property of Caterpillar.

- Replace lubricating oil, filters, coolant and other service items made unusable by the defect.
- Provide reasonable or customary labor needed to correct the defect, including labor to disconnect the product from and reconnect the product to its attached equipment, mounting, and support systems, if required.

For new 3114, 3116 and 3126 engines and electric power generation products (including any new products of the other manufacturers packaged and sold by Caterpillar):

- Provide travel labor, up to four hours round trip if, in the opinion of Caterpillar, the product cannot reasonably be transported to a place of business of a Caterpillar dealer or other source approved by Caterpillar (travel labor in excess of four hours round trip, and any meals, mileage, lodging, etc. is the user's responsibility).

For all other products:

Provide reasonable travel expenses for authorized mechanics, including meals, mileage, and lodging, when Caterpillar chooses to make the repair on-site.

User Responsibilities

The user is responsible for:

- Providing proof of the delivery date to the first user.
- Labor costs, except as stated under "Caterpillar Responsibilities", including costs beyond those required to disconnect the product from and reconnect the product to its attached equipment, mounting and support systems.
- Travel expenses not covered under "Caterpillar Responsibilities".
- All costs associated with transporting the product to and from the place of business of a Caterpillar dealer or other source approved by Caterpillar.
- Premium or overtime labor costs.
- Parts shipping charges in excess of those which are usual and customary.
- Local taxes, if applicable.
- Costs to investigate complaints, unless the problem is caused by a defect in Caterpillar material or workmanship.
- Giving timely notice of a warrantable failure and promptly making the product available for repair.
- Performance of the required maintenance (including use of proper fuel, oil, lubricants and coolant) and items replaced due to normal wear and tear.
- Allowing Caterpillar access to all electronically stored data.

(continued on reverse side…)

Limitations

Caterpillar is not responsible for:

- Failures resulting from any use or installation which Caterpillar judges improper.
- Failures resulting from attachments, accessory items and parts not sold or approved by Caterpillar.
- Failures resulting from abuse, neglect and/or improper repair.
- Failures resulting from user's delay in making the product available after being notified of a potential product problem.
- Failures resulting from unauthorized repair or adjustments, and unauthorized fuel setting changes.
- Damage to parts, fixtures, housings, attachments, and accessory items that are not part of the engine or electric power generation product (including any products of other manufacturers packaged and sold by Caterpillar).
- Repair of components sold by Caterpillar that is warranted directly to the user by their respective manufacturer. Depending on type of application, certain exclusions may apply. Consult your Caterpillar dealer for more information.

For products operating outside of Australia, Fiji, Nauru, New Caledonia, New Zealand, Papua New Guinea, the Solomon Islands and Tahiti, the following is applicable:

NEITHER THE FOREGOING EXPRESS WARRANTY NOR ANY OTHER WARRANTY BY CATERPILLAR, EXPRESS OR IMPLIED, IS APPLICABLE TO ANY ITEM CATERPILLAR SELLS WHICH IS WARRANTED DIRECTLY TO THE USER BY ITS MANUFACTURER.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, EXCEPT CATERPILLAR EMISSION-RELATED COMPONENTS WARRANTIES FOR NEW ENGINES, WHERE APPLICABLE. REMEDIES UNDER THIS WARRANTY ARE LIMITED TO THE PROVISION OF MATERIAL AND SERVICES, AS SPECIFIED HEREIN.

CATERPILLAR IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

CATERPILLAR EXCLUDES ALL LIABILITY FOR OR ARISING FROM ANY NEGLIGENCE ON ITS PART OR ON THE PART OF ANY OF ITS EMPLOYEES, AGENTS OR REPRESENTATIVES IN RESPECT OF THE MANUFACTURE OR SUPPLY OF GOODS OR THE PROVISION OF SERVICES RELATING TO THE GOODS.

IF OTHERWISE APPLICABLE, THE VIENNA CONVENTION (CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS) IS EXCLUDED IN ITS ENTIRETY.

For personal or family use engines or electric power generation products, operating in the USA, its territories and possessions, some states do not allow limitations on how long an implied warranty may last nor allow the exclusion or limitation of incidental or consequential damages. Therefore, the previously expressed exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights, which vary by jurisdiction. To find the location of the nearest Caterpillar dealer or other authorized repair facility, call (800) 447-4986. If you have questions concerning this warranty or its applications, call or write:

In USA and Canada: Caterpillar Inc., Engine Division, P. O. Box 610, Mossville, IL 61552-0610, Attention: Customer Service Manager, Telephone (800) 447-4986. Outside the USA and Canada: Contact your Caterpillar dealer.

For products operating in Australia, Fiji, Nauru, New Caledonia, New Zealand, Papua New Guinea, the Solomon Islands and Tahiti, the following is applicable:

THIS WARRANTY IS IN ADDITION TO WARRANTIES AND CONDITIONS IMPLIED BY STATUTE AND OTHER STATUTORY RIGHTS AND OBLIGATIONS THAT BY ANY APPLICABLE LAW CANNOT BE EXCLUDED, RESTRICTED OR MODIFIED ("MANDATORY RIGHTS"). ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED (BY STATUTE OR OTHERWISE), ARE EXCLUDED.

NEITHER THIS WARRANTY NOR ANY OTHER CONDITION OR WARRANTY BY CATERPILLAR, EXPRESS OR IMPLIED (SUBJECT ONLY TO THE MANDATORY RIGHTS), IS APPLICABLE TO ANY ITEM CATERPILLAR SELLS WHICH IS WARRANTED DIRECTLY TO THE USER BY ITS MANUFACTURER.

TO THE EXTENT PERMITTED UNDER THE MANDATORY RIGHTS, IF CATERPILLAR IS THE SUPPLIER TO THE USER, CATERPILLAR'S LIABILITY SHALL BE LIMITED AT ITS OPTION TO (a) IN THE CASE OF SERVICES, THE SUPPLY OF THE SERVICES AGAIN OR THE PAYMENT OF THE COST OF HAVING THE SERVICES SUPPLIED AGAIN, AND (b) IN THE CASE OF GOODS, THE REPAIR OR REPLACEMENT OF THE GOODS, THE SUPPLY OF EQUIVALENT GOODS, THE PAYMENT OF THE COST OF SUCH REPAIR OR REPLACEMENT OR THE ACQUISITION OF EQUIVALENT GOODS.

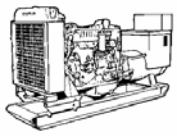
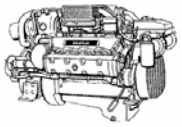
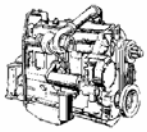
CATERPILLAR EXCLUDES ALL LIABILITY FOR OR ARISING FROM ANY NEGLIGENCE ON ITS PART OR ON THE PART OF ANY OF ITS EMPLOYEES, AGENTS OR REPRESENTATIVES IN RESPECT OF THE MANUFACTURE OR SUPPLY OF GOODS OR THE PROVISION OF SERVICES RELATING TO THE GOODS.

CATERPILLAR IS NOT LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES UNLESS IMPOSED UNDER MANDATORY RIGHTS.

IF OTHERWISE APPLICABLE, THE VIENNA CONVENTION (CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS) IS EXCLUDED IN ITS ENTIRETY.

This warranty covers every major component of the products. Claims under this warranty should be submitted to a place of business of a Caterpillar dealer or other source approved by Caterpillar. For further information concerning either the location to submit claims or Caterpillar as the issuer of this warranty, write Caterpillar Inc., 100 N. E. Adams St., Peoria, IL USA 61629.

Blanchard CAT


SUBMITTAL DATA

SECTION 6

GENERATOR ENCLOSURE

SOUND ATTENUATED
MOUNTED SWITCH GEAR
FIRE SUPPRESSION SYSTEM
ROOF MOUNTED RADIATOR

chillicothe metal co., inc.

4507 East Rome Road
Chillicothe, Illinois 61523-9071 USA

p 309.274.5421
f 309.274.4686
www.cmcousa.com

October 12, 2007

BLANCHARD POWER SYSTEMS
P.O. Box 7517
Columbia, SC, 29202

Attention: Brady Porth
James Adams

Reference: Our S.O. 07-16468
Quote 07-726 Revision D
Caterpillar G3520C 1600kW with Base /
14 Gauge Galvanized Steel Enclosure Package
Anderson Landfill

CMCO is pleased to revise our offer the following goods and services. The Caterpillar G3520C 1600kW, 4,160 volt generator set with a roof mounted radiator remains the same. We have updated our pricing to include the adders discussed.

1. Steel sub base complete with a full steel floor and four point lifting provisions. The approximate dimensions of the sub base are 120”W x 24”H x 505”L.

2. CMCO to install the following dealer supplied 4 inch gas train:
   - Manual ball valve.
   - Fast acting solenoid block valve.
   - Gas pressure switches.
   - Gas filter.

3. CMCO supplied steel braided flexible line for installation between the gas train and the generator.

4. CMCO supplied and installed 30 gallon lube oil reservoir tank and an oil level regulator.

5. Conduit sleeve with removable cover plate installed through the sub base floor for cable access to the floor standing breaker.

6. Install the dealer supplied battery racks and cables for use with the dealer supplied lead acid batteries.

7. Mounting pads and shipping restraints to install the dealer supplied spring type vibration isolators between the engine rails and the sub base floor.

8. Oil and water drain group plus fumes disposal lines are extended to the exterior of the enclosure.

9. 14 gauge galvanized steel, walk-in, enclosure (118”W x 128”H x 504”L) with gasketed strap hinged doors, stainless steel hinges and stainless steel padlock style door handles.

10. The four enclosure single doors are equipped with inside door operators.

11. The one enclosure double door is equipped with inside door operator.

12. Mineral fiber insulation and a perforated galvanized liner are applied to the interior walls and ceiling of the enclosure.

13. Galvanized construction motorized louvers for the air intake opening(s). The 120VAC louver motors are wired to motor close and spring open.

14. Birdscreens installed for the air intake and discharge openings.

15. Wall mounted exhaust fan with gravity damper.

16. Breaker type panelboard rated 480 volt three phase complete with branch circuit breakers for the wall mounted ventilator, remote radiator and the jacket water heaters.

17. CMCO supplied 480:120/208 Volt, 3 phase, step down transformer installed. The secondary is wired to the following load center. The primary is wired to the circuit breaker in the previous.

18. Breaker type load center rated 120/208 volt three phase complete with a main circuit breaker and branch circuit breakers for the engine and enclosure accessories.

19. All wiring is installed in EMT (Electrical Metallic Tubing) and liquid tight flexible conduit.

20. Six 120VAC, interior, fluorescent light fixtures complete with two wall switches and two GFI protected duplex receptacles.

21. One 5kW, 208 volt unit space heater complete with a thermostat. Includes a cutout to prevent operation while the engine is running.

22. Wall mounted summer exhaust fan complete with a gravity damper and a thermostat. Includes a cutout to prevent operation while the engine is running.

23. Wire the jacket water heater to the load center.

24. Wire the generator condensation heater to the load center.

25. Install a dealer supplied battery charger and wire the charger alarm relays to the control panel.

26. Divider wall with door operable from both sides to allow the switchgear its own room.

27. CMCO supplied exterior wall mounted 3 ton air conditioner complete with low ambient controls for the switchgear room.

28. Labor and materials to install the dealer supplied freestanding 350 Amp switchgear that measures approximately 72"wide x 100"high x 97"deep and wire the circuit breaker to the generator set.

29. CMCO will pull and tag the wire between the switchgear and the generator set.

30. CMCO supplied mounting brackets to install the two dealer supplied air filters. The filters will be removed from the ship loose filter housing and installed directly on the generator. The housing will be discarded.

31. One CMCO supplied and installed bridge crane with manual overhead chain hoist. The overhead chain hoist has a capacity of 2,200 lbs. and an 8 foot lift. The hoist will have the capability to travel the full length of the generator set with the exhaust flex and air filters removed.

32. CMCO supplied CO2 fire suppression system and Methane gas detection complete with agent cylinders, discharge nozzles, two (2) 225-degree heat detectors, fire control panel with battery backup, manual release station and weatherproof horn/strobe alarms. All electrical devices are to be interlocked with the fire detection equipment. For example the fans, heating cooling and devices etc are to shutoff when the fire detection alarms signal. Includes CMCO supplied logic schematic and end user start-up with function test.

33. Exhaust roof dress cap installed.

34. Flex and mounting brackets to install the CMCO supplied side inlet muffler on the enclosure roof.

35. CMCO supplied hospital grade spark arrestor cylindrical type, aluminized, side in, end out silencer for mounting on the enclosure roof and complete with petcock. **NOTE**: The muffler will ship loose and be installed at the job site by others.

36. One 90 degree exhaust extension with a rain cap.

37. Generator set pickup at the Caterpillar factory. **NOTE**: The dealer will deliver the radiator to CMCO.

38. Labor and material to extend the jacket water and after cooler circuits to the exterior of the enclosure. Each circuit includes a flexible engine connection and will terminate with a bolt flange.

39. CMCO supplied insulation blankets for the above jacket water and after cooler lines inside the enclosure.

40. CMCO supplied mounting provisions and piping to install the dealer supplied radiator on the roof of the enclosure. The radiator will come with the motor starters installed. **NOTE**: The radiator will require an additional truck for shipping to the job site.

41. Final assembly of the generator set and enclosure to the base

42. All enclosure seams are caulked.

43. Ameron, Dimetcote 9HS prime coat: Inorganic zinc silicate, self-cured, applied to a dry film thickness of 2.0 to 3.0 mils. Shall contain a minimum of 85% zinc in dry film.

44. Ameron, Amercoat 385 intermediate coat: High build polyamide epoxy applied to a dry film thickness of 4.0 to 6.0 mils. Shall contain minimum of 70% solids

45. Ameron, Amercoat 450OHS finish coat: Acrylic aliphatic polyurethane applied to a dry film thickness of 1.0 to 2.0 mils. Shall contain minimum of 70% solids. The color is to be selected from the Chillicothe Metal Co. color selector guide.

46. CMCO supplied bolt-on ladder assembly for access onto the enclosure roof. The roof mounted radiator will come with provisions for access from the roof. The ladder assembly will be removed for shipment.

47. Bolt handrails mounted on opposite sides of the roof in-between the silencer and the radiator. The handrails will ship loose to the job site for installation by others.

48. Install the dealer supplied Neutral Ground Resistor above the generator. Includes installing the dealer supplied current transformer.

49. Batteries and battery chargers installed in the switchgear room.

50. Change the CMCO supplied 225 amp, 480V panelboard to a 400AF, 300AT 480V panelboard to accommodate the 200 amp main in the roof mounted radiator.

51. Install and plumb the dealer supplied crankcase emission system. The bottom of the canister is to be at least 5 to 6 feet above the engine oil level. Includes a CMCO supplied sliding rack.

52. Two (2) hour natural gas load test at 1.0 power factor (Not .8PF). Includes visual recordings very 15-minutes of the following: amperage, voltage, frequency, RPM, coolant temperature, oil temperature, oil pressure, ambient temperature and time of day. **NOTE**: We are not testing thermal efficiency or exhaust gas emissions.

53. General outline drawing submitted for engineering approval.

NOTES / OPTIONS:

A. CMCO is an ISO 9001:2000 with design certified facility.

CHILLICOTHE METAL CO., INC.

GT Exhaust Systems, Inc.
Phone: 402-323-7272 Fax: 402-323-7270

202-6100 Series
Super Critical Grade Spark Arrestor

APPLICATION
A premium spark arresting silencer designed for use on exhaust of internal combustion engines, where fire hazards exist, and noise levels are extremely low. Centrifugal force separates the solids form the exhaust gas stream. Solids are then deposited in easily accessible cleanouts.

Typical Attenuation: 30 to 38 dB'A'

INSTALLATION
May be installed in any position

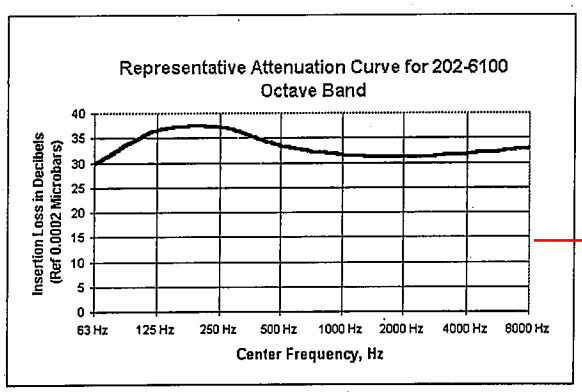
CONSTRUCTION
Silencers feature all welded heavy-duty double shell construction, with compressed acoustical fiberglass inserted between the shells. Packed shell can provide significant reduction in surface temperature depending on application and ambient conditions. Standard with ANSI steel plate flanges.

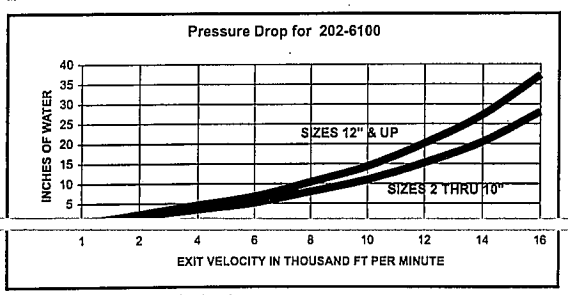
MATERIAL OPTIONS
A variety of material options are provided to satisfy most applications and budgets:

C	Carbon Steel
AS	Aluminized Shell
AH	Aluminized Shell and Heads
S	Stainless Steel

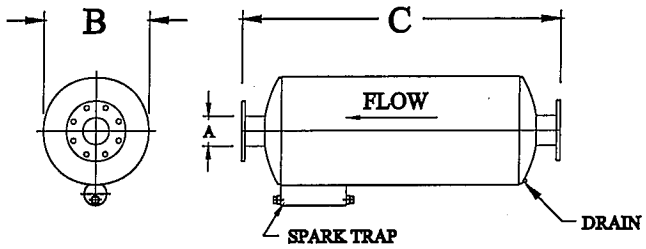
FINISH
Standard finish is high heat silicone black or aluminum, depending on material options. Consult factory for optional coatings.

STAINLESS STEEL OPTIONS: 304, 316, & 316L

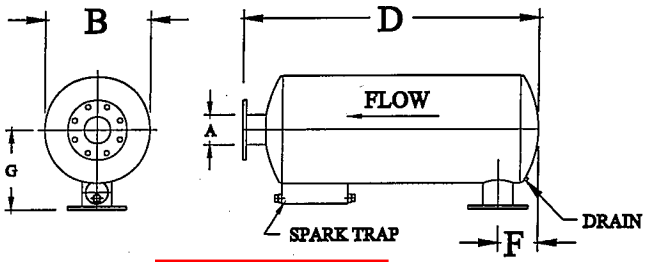




All dimensions are in inches.
Inlet sizes available up to 30"



~~STYLE 1~~



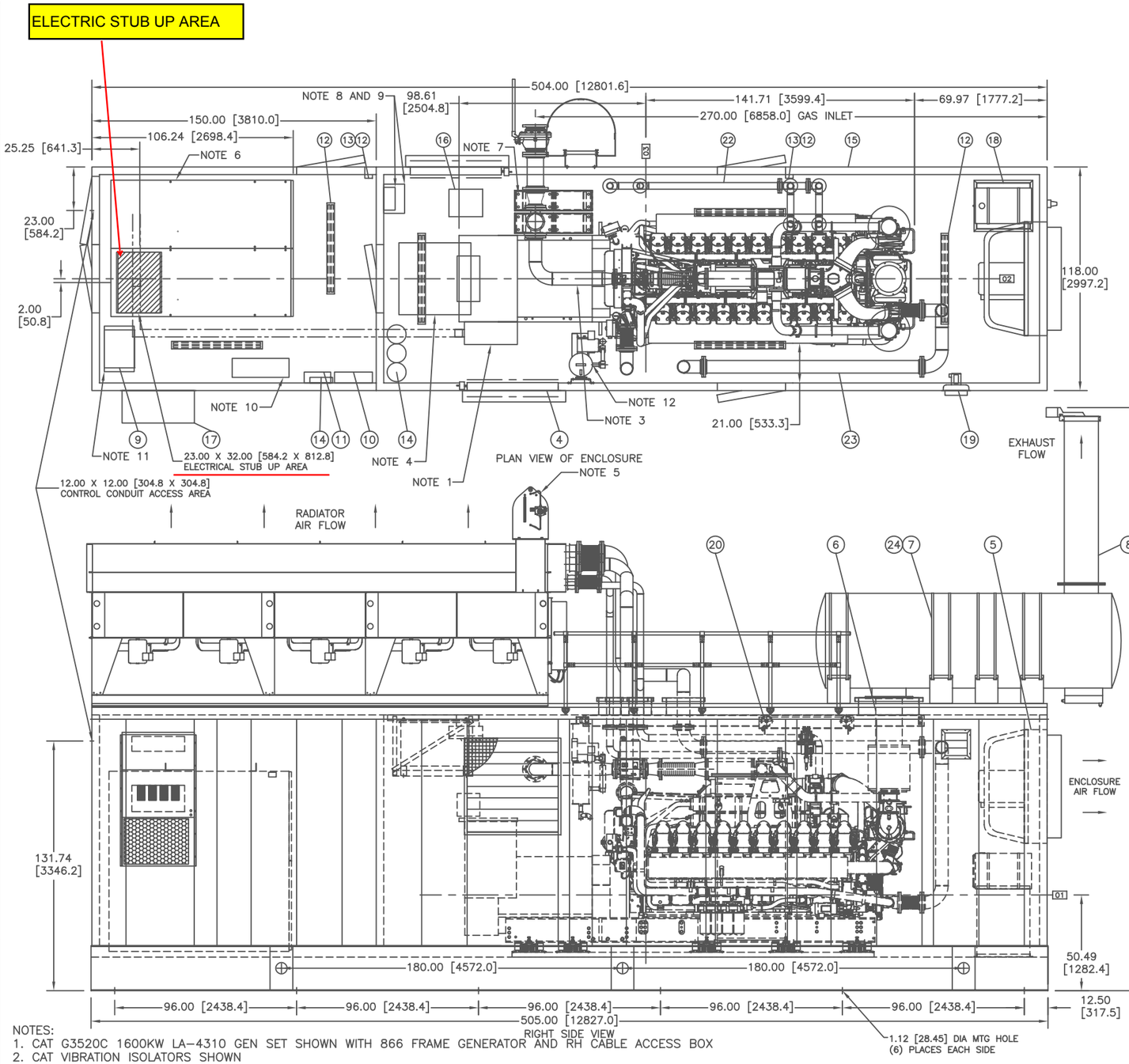
STYLE 2

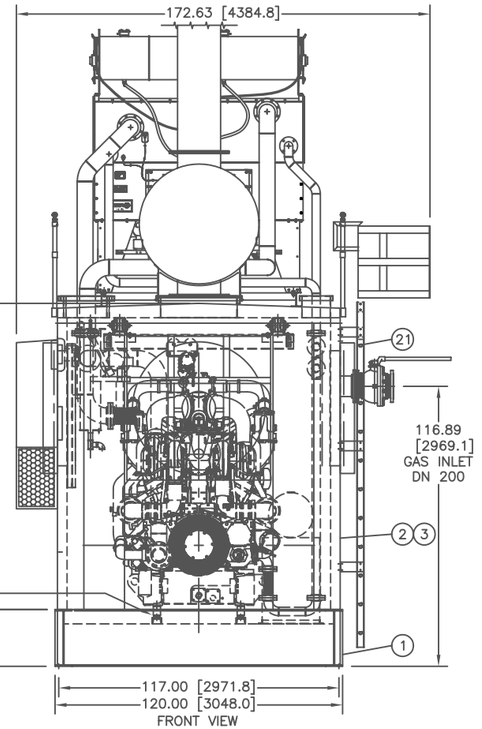
Model	A SIZE	B DIA	C OAL-1	D OAL-2	F MIN	F MAX	G	WT
202-6104	4	16	61	57	6	25	12	183
202-6105	5	20	74	70	8	30	14	256
202-6106	6	24	75	71	10	30	16	317
202-6108	8	26	99	95	12	40	17	470
202-6110	10	30	114	110	14	46	19	825
202-6112	12	36	138	134	16	45	22	1386
202-6114	14	42	158	154	16	46	25	2025
202-6116	16	45	165	162	18	57	27	2151
202-6118	18	48	180	176	20	57	29	2550
202-6120	20	54	184	180	22	57	32	3355
202-6122	22	60	206	202	24	69	35	3800
202-6124	24	62	206	202	26	67	36	4000

ORDERING INFORMATION

When ordering, please place Material and Style Options as illustrated in the examples below:

202-6104-2-S Carbon Steel Construction with Style 2 -- Side Inlet
202-6112-1-AS Aluminized Shell with Style 1 -- End Inlet
202-6108-2-S Stainless Steel with Style 2 -- Side Inlet





07–726		CDTB00ACC0IG42
COMP	QTY	DESCRIPTION
1	1	STRUCTURAL BASE WITH (6) POINT LIFT PROVISIONS AND FULL STEEL FLOOR
2	1	ENCLOSURE 118W X 504L X 128H WITH (4) GASKETED LOCKABLE ACCESS DOORS AND INSIDE OPERATORS
3	1	SOUND INSULATION WITH GALVANIZED PERFORATED LINER
4	2	MOTORIZED INTAKE LOUVER WITH SCREEN
5	1	VENTILATION FAN WITH INTAKE GUARD AND GRAVITY DAMPER
6	1	EXHAUST FLEX CONNECTION AND ROOF DRESS CAP
7	4	EXHAUST SILENCER MOUNTING BRACKETS
8	1	EXHAUST EXTENSION WITH RAINCAP
9	1	TRANSFORMER 480:208/120 THREE PHASE
10	1	PANELBOARD 480V THREE PHASE
11	1	PANELBOARD 208/120 THREE PHASE
12	6	FLUORESCENT LIGHTS 120VAC WITH (2) WALL SWITCHES
13	2	GFI PROTECTED DUPLEX RECEPTACLES
14	1	CO2 FIRE SUPPRESSION SYSTEM COMPLETE WITH AGENT TANKS DISCHARGE NOZZLES A MANUAL RELEASE STATION CONTROL PANEL HEAT DETECTORS AND ALARM STROBE
15	1	OIL WATER AND FUMES DISPOSAL GROUP
16	1	SPACE HEATER 5KW WITH A THERMOSTAT
17	1	3 TON AIR CONDITIONER WITH LOW AMBIENT CONTROLS *
18	1	30 GALLON LUBE OIL RESERVOIR TANK AND LEVEL REGULATOR
19	1	SUMMER EXHAUST FAN
20	1	MANUAL OVERHEAD CHAIN HOIST 2200LB CAPACITY
21	1	ROOF ACCESS LADDER WITH HANDRAILS (OPTIONAL EQUIPMENT) *
22	1	AFTERCOOLER PIPING *
23	1	JACKETWATER PIPING *
24	1	EXHAUST SILENCER 18" HOSPITAL GRADE SPARK ARRESTOR *

* ITEM SHIPS LOOSE TO BE SET AND INSTALLED BY CONTRACTOR ON SITE

NOTES:
1. CAT G3520C 1600KW LA–4310 GEN SET SHOWN WITH 866 FRAME GENERATOR AND RH CABLE ACCESS BOX
2. CAT VIBRATION ISOLATORS SHOWN
3. PRELIMINARY GAS TRAIN SHOWN FOR REFERENCE ONLY
4. MILWAUKEE RESISTOR NGR SHOWN PER DWG #NG0246 (OPTIONAL EQUIPMENT)
5. IEA HCR200S01 RADIATOR SHOWN
6. POWERLYNX SWITCHGEAR CUBICLE SHOWN PER DWG #35925 REV. 0.1
7. CAT BATTERIES RACKS AND CABLE GROUP
8. ENGINE STARTING BATTERY CHARGER SHOWN
9. BREAKER CONTROL BATTERY CHARGER SHOWN
10. BREAKER CONTROL 48VDC BATTERIES RACKS AND CABLES SHOWN
11. CONTROL 24VDC BATTERIES RACKS AND CABLES SHOWN
12. CAT CRANKCASE BLOWER SHOWN
13. APPROXIMATE WEIGHT OF ENCLOSURE PACKAGE = 103,000 LB
14. RECOMMEND MINIMUM OF 60.00 [1524.0] BETWEEN THE ENCLOSURE AND ANY OTHER STRUCTURE FOR PROPER VENTILATION. REFER TO LOCAL CODE AND/OR ORDINANCE FOR ANY FURTHER RESTRICTIONS.

EST. SHIPPING DIMENSIONS
WIDTH – 130.00 [3302.0]
HEIGHT – 157.00 [3987.8]
LENGTH – 514.00 [13055.6]

PRELIMINARY DRAWING

ENCLOSURE PACKAGE FOR CAT G3520 GEN SET

REV	DATE	BY	DESCRIPTION OF CHANGE
B	10/09/07	JB	OPTIONAL EQUIPMENT NOTED
A	10/03/07	CT	ADD DETAILS

REVISION RECORD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCH [MM] DIMENSIONS WITHOUT TOLERANCE ARE BASIC

Chillicothe Metal Co.
4507 E. ROME ROAD CHILLICOTHE, IL. 61523
PH. 309–274–5421 FAX 309–274–4686
WEBSITE: WWW.CMCOUSA.COM

W.O. #	07–726				
DATE					
DR. BAILLEY	DATE: 8/31/7	ENGR.	FILE: CD		
CHKD. BESSLER	DATE: 8/31/7	SCALE: 1=80	SHT 1 OF 1		

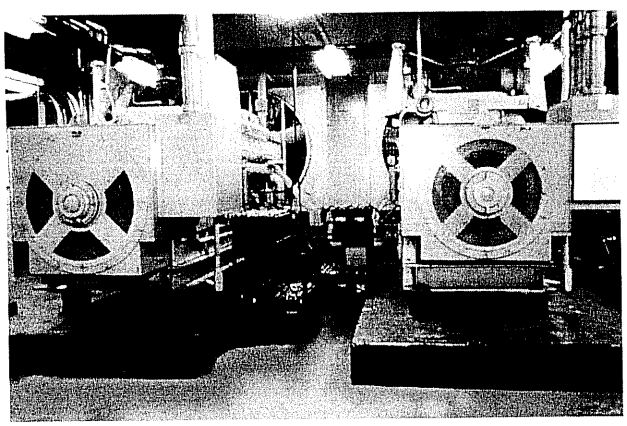
DWG. # CDTB00ACC0IG42

FOUNDATIONS

Several basic foundations are suitable for generator sets. The foundation chosen will depend on the unit selected, as well as limitations imposed by the specific location and application.

Generator set foundations must:

- **Support** total wet weight of generator set, which includes accessory equipment and liquids (coolant, oil, and fuel)



- **Maintain alignment** between engine, generator, and accessory equipment
- **Isolate vibrations** of generator set from surrounding structures

Support

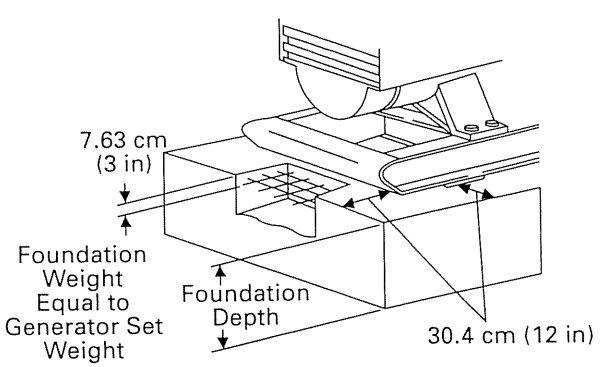
Mounting Surfaces

- Firm, level soil, gravel, or rock provides satisfactory support for single-bearing generator sets used in stationary or portable service. This support can be used where the weight-bearing capacity of the supporting material exceeds pressure exerted by the equipment package, and where alignment with external machinery is unimportant.
- Soil, such as fine clay, loose sand, or sand near the ground water level, is particularly unstable under dynamic loads and requires substantially larger foundations. Information concerning bearing capacity of soils at the site may be available from local sources and must comply with local building codes.
- Where support rails or mounting feet have insufficient bearing area, flotation pads can distribute the weight. The underside area and stiffness of the pad must be sufficient to support the equipment.
- Seasonal and weather changes adversely affect mounting surfaces. Soil changes considerably while freezing and thawing. To avoid movement from seasonal changes, extend foundations below the frost line.

Concrete Foundations

Massive concrete foundations are unnecessary for modern, multi-cylinder, medium-speed generator sets. Avoid excessively thick, heavy bases to minimize subfloor or soil loading. Bases should be only thick enough to prevent deflection and torque reaction, while retaining sufficient surface area for support.

CONCRETE FOUNDATION



FOUNDATIONS

Using Concrete Foundations

If a concrete foundation is required, minimum design guidelines are:

- Strength must support wet weight of units plus dynamic loads.
- Outside dimensions must exceed that of the generator set by a minimum of 1 ft (304.8 mm) on all sides.
- Depth must be sufficient to attain a minimum weight equal to generator set wet weight (if inertia block is specified for vibration control).

Foundation Design

- When effective vibration isolation equipment is used, floor concrete must only be deep enough to provide structural support of the static load.
- If isolators are not used, dynamic loads transmit to the facility floor and require it to support 125 percent of the generator wet weight.
- If generator sets are paralleled, possible out-of-phase paralleling and resulting torque reactions demand foundations that are able to withstand twice the wet weight of the generator set.

Estimate foundation depth that will accommodate generator set weight using the formula:

$$FD = \frac{W}{D \times B \times L}$$

FD = foundation depth in meters (feet)
W = total weight of generator set in kilograms (pounds)
D = density of concrete in kg/m^3 (lb/ft^3) (2402.8 kg/m^3, 150 lb/ft^3)
B = foundation width in meters (feet)
L = foundation length in meters (feet)

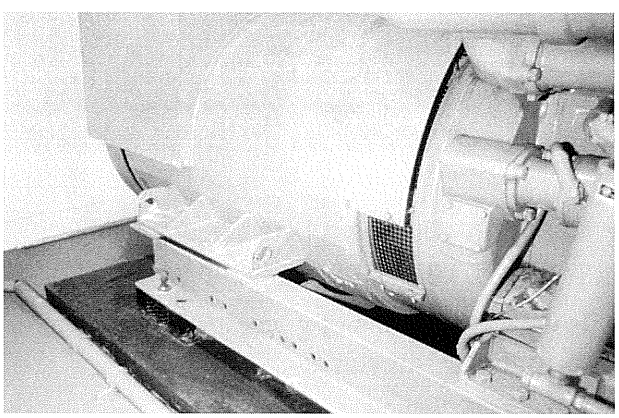
Bases

There are important factors to consider when selecting the type of base to be used because the different types of bases are designed to accommodate various needs.

Fabricated Bases

Engines with close-coupled, single-bearing generators maintain alignment by mounting rails or modest bases. They are commonly supported by fabricated bases. These bases are used to provide:

- Ease of relocation
- Ease of installation
- Isolation from a flexing foundation



Heavy-Duty Fabricated Base

Two-bearing generators, generators driven from either end of the engine, tandem generators, or tandem engines require substantial boxed bases. They must incorporate sufficient strength and rigidity to:

- Resist outside bending forces imposed on the engine block, couplings, and generator frame during transportation
- Limit torsional and bending movement caused by torque reactions
- Prevent resonant vibration
- Provide alignment

NOTES:

1. MINIMUM 1 ft. ON ALL SIDES.

2. FOUNDATION DEPTH SHALL BE CALCULATED BY:

$$FD = \frac{W}{D \times B \times L}$$

WHERE:

FD = FOUNDATION DEPTH IN m (ft)
W = TOTAL WEIGHT OF GENERATOR SET IN kg (lb).
D = DENSITY OF CONCRETE, (2403 FOR METRIC, 150 FOR ENGLISH)
B = FOUNDATION WIDTH IN m (ft).
L = FOUNDATION LENGTH IN m (ft).

SUGGESTED CONCRETE MIXTURE BY VOLUME IS 1:2:3 OF CEMENT, SAND, AGGREGATE, WITH MAXIMUM 100 mm (4 in.) SLUMP AND 28-DAY COMPRESSIVE STENGTH OF 20 MPa (3000 psi).

3. STUB UP CONDUIT FOR AUTOMATIC TRANSFER SWITCH CONTROLS, BLOCK HEATER, FEEDERS, ETC.

4. REINFORCE WITH No. 8 GAUGE STEEL WIRE MESH OR EQUIVALENT, HORIZONTALLY PLACE ON 150 mm (6 in.) CENTERS. AN ALTERNATIVE METHOD PLACES No. 6 REINFORCING BARS ON 300 mm (12 in.) CENTERS HORIZONTALLY. BARS SHOULD CLEAR FOUNDATION SURFACES 75 mm (3 IN.) MINIMUM.