Chapter 37 GENERATOR GROUP

MANUFACTURER/DISTRIBUTOR:

Génératrice Drummond
A/S Guy St-Onge
2997 RUE WATT
STE-FOY, P.Q., G1X 3W1
Email:
GSTOnge@generatricedrummond.com
Tel:(418) 780-3535
Fax:(418) 780-3435

37.1 **GENERATOR GROUP**

37.2 **TRANSFER SWITCH**

SHOP DRAWING FOR APPROVAL

Date : 17/06/2016

To:
Arktis Solutions
Chiarelli Engineering Management Ltd.
M.M. Mallet
P.O. Box 242
Gjoa Haven, NU, K0B 1J0
T: 867-446-0036
F: 866-475-1147

From :
Kudlik Construction Ltd.
C/O Jean-Sébastien Demers ing.
P.O. 727, 1519 Federal Road
Iqaluit, X0A 0H0
Tel.: 867-979-1166
F: 867-979-1169

SIFEC NORTH inc.
Electro Mechanical Contractor
P.O. Box 556
Rankin Inlet, NU, X0C 0G0
T: 866-437-4001
F: 206-338-2249

Project : 2016-061 **Igloolik Water Supply Upgrade - YGT12**

	Owner Tag Number	Section	DESCRIPTION	MODEL	Status	Initial Date of submital
1	N/A	26 36 23	Generator and transfer switch		Initial	17/06/2016

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 17 juin 2016

Reviewed [X]
Reviewed as noted [ ]
Resubmit [ ]

Out for approval

SIFEC NORTH INC.

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed pages 1 to 52
Reviewed By: N.K. Reviewed [X]
Reviewed as noted [ ]
Date: June 21, 2016 Resubmit [ ]

CHIARELLI ENGINEERING LTD.

GÉNÉRATRICE DRUMMOND
WAJAX POWER SYSTEMS

GENERATOR SET
SHOP DRAWINGS

PROJECT
IGLOOLIK WATER SUPPLY SYSTEM

REF: GDM-1915

CUSTOMER : Kudlik Construction LTD
1519 Federal Road PO Box 727
Iqaluit, NY
X0A 0H0

ENGINEER : CEML
203-100, Craig Henry Dr.
Nepean, ON
K2G 5W3

PREPARED BY : GÉNÉRATRICE DRUMMOND
243, RUE DES ARTISANS
ST-GERMAIN DE GRANTHAM, QUÉBEC
J0C 1K0

DATE : June, 15 2016

SHOP DRAWING
Reviewed by: Samuel Charbonneau
Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

SALES REPRESENTATIVE : Yvan Brouillette
TECHNICAL SUPPORT : Michelle Roy
SALES COORDINATOR : Éméline Gagnon

Phone : 819-472-4076 · Montreal : 514-875-0554 · Toll free : 1-800-567-3835
Fax : 819-395-5517 · www.generatricedrummond.com

ISO CERTIFIED ORGANIZATION 9001 2008

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Accessories	**SECTION 2**
Automatic Transfer Switch	**SECTION 3**
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SECTION 1

Generator set

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

DIESEL GENERATOR SET
MTU 4R0120 DS80

80 kWe / 60 Hz / Standby
208 - 600V

Reference MTU 4R0120 DS80 (72 kWe) for Prime Rating Technical Data

SYSTEM RATINGS

Standby

Voltage (L-L)	240V	240V	208V	240V	380V	480V	600V
Phase	1	1	3	3	3	3	3
PF	1	1	0.8	0.8	0.8	0.8	0.8
Hz	60	60	60	60	60	60	60
kW	80	80	80	80	80	80	80
kVA	80	80	100	100	100	100	100
Amps	333	333	278	241	151	120	96
skVA@30% Voltage Dip	145	311	216	216	165	288	236
Generator Model*	363CSL1607	363CSL1617	362CSL1604	362CSL1604	362CSL1606	362CSL1604	362PSL1635
Temp Rise	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C
Connection	12 LEAD ZIG-ZAG	4 LEAD	12 LEAD LOW WYE	12 LEAD HI DELTA	12 LEAD HI WYE	12 LEAD HI WYE	4 LEAD WYE

CERTIFICATIONS AND STANDARDS

// **Emissions –** EPA Tier 3 Certified

// **Generator set is designed and manufactured in facilities certified to standards ISO 9001:2008 and ISO 14001:2004**

// **UL 2200 / CSA – Optional**
- UL 2200 Listed
- CSA Certified
- CE Marking Provided

// **Performance Assurance Certification (PAC)**
- Generator Set Tested to ISO 8528-5 for Transient Response
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

// **Power Rating**
- Accepts Rated Load in One Step Per NFPA 110

STANDARD FEATURES*

// MTU Onsite Energy is a single source supplier
// Global Product Support
// 2 Year Standard Warranty
// OM924LA Diesel Engine
- 4.8 Liter Displacement
- 4-Cycle
// Engine-generator resilient mounted
// Complete Range of Accessories
// Generator
- Brushless, Rotating Field Generator
- 2/3 Pitch Windings
- 300% Short Circuit Capability with Optional PMG
// Digital Control Panel(s)
- UL Recognized, CSA Certified, NFPA 110
- Complete System Metering
- LCD Display
// Cooling System
- Integral Set-Mounted
- Engine Driven Fan

STANDARD EQUIPMENT*

// Engine

Air Cleaners
Oil Pump
Oil Drain Extension & S/O Valve
Full Flow Oil Filter
Fuel Filter with Water Separator
Jacket Water Pump
Thermostat
Blower Fan & Fan Drive
Radiator - Unit Mounted
Electric Starting Motor - 12V
Governor – Electronic Isochronous
Base - Formed Steel
SAE Flywheel & Bell Housing
Charging Alternator - 12V
Battery Box & Cables
Flexible Fuel Connectors
Flexible Exhaust Connection
EPA Certified Engine

// Generator

NEMA MG1, IEEE and ANSI standards compliance for temperature rise and motor starting
Self-Ventilated and Drip-Proof
Superior Voltage Waveform
Solid State, Volts-per-Hertz Regulator
±1% Voltage Regulation No Load to Full Load
Brushless Alternator with Brushless Pilot Exciter
4 Pole, Rotating Field
130 °C Maximum Standby Temperature Rise
1 Bearing, Sealed
Flexible Coupling
Full Amortisseur Windings
125% Rotor Balancing
3-Phase Voltage Sensing
100% of Rated Load - One Step
5% Maximum Total Harmonic Distortion

// Digital Control Panel(s)

Digital Metering
Engine Parameters
Generator Protection Functions
Engine Protection
SAE J1939 Engine ECU Communications
Windows®-Based Software
Multilingual Capability
Remote Communications to RDP-110 Remote Annunciator
Programmable Input and Output Contacts
UL Recognized, CSA Certified, CE Approved
Event Recording
IP 54 Front Panel Rating with Integrated Gasket
NFPA 110 Compatible

* Represents standard product only. Consult Factory/MTU Onsite Energy Distributor for additional configurations.

APPLICATION DATA

// Engine

Manufacturer	Mercedes-Benz
Model	OM924LA
Type	4-Cycle
Arrangement	4-Inline
Displacement: L (in^3)	4.8 (293)
Bore: cm (in)	10.6 (4.17)
Stroke: cm (in)	13.6 (5.35)
Compression Ratio	17.5:1
Rated RPM	1,800
Engine Governor	MR2 / ADM3
Maximum Power: kWm (bhp)	147 (197)
Speed Regulation	±0.25%
Air Cleaner	Dry

// Liquid Capacity (Lubrication)

Total Oil System: L (gal)	15.8 (4.2)
Engine Jacket Water Capacity: L (gal)	7 (1.8)
System Coolant Capacity: L (gal)	20.8 (5.5)

// Electrical

Electric Volts DC	12
Cold Cranking Amps Under -17.8 °C (0 °F)	950

// Fuel System

Fuel Supply Connection Size	-6 JIC
Fuel Supply Hose Size	3/8“ ID
Fuel Return Connection Size	-6 JIC
Fuel Return Hose Size	3/8“ ID
Maximum Fuel Lift: m (ft)	2.7 (9)
Recommended Fuel	Diesel #2
Total Fuel Flow: L/hr (gal/hr)	328.2 (86.7)

// Fuel Consumption *

At 100% of Power Rating: L/hr (gal/hr)	19.3 (5.1)
At 75% of Power Rating: L/hr (gal/hr)	14 (3.7)
At 50% of Power Rating: L/hr (gal/hr)	9.8 (2.6)

* Based on 362CSL1604 480 Volt generator set

// Cooling - Radiator System

Ambient Capacity of Radiator: °C (°F)	50 (122)
Maximum Allowable Static Pressure on Rad. Exhaust: kPa (in. H_20)	0.12 (0.5)
Water Pump Capacity: L/min (gpm)	143 (37)
Heat Rejection to Coolant: kW (BTUM)	37.5 (2,133)
Heat Rejection to Air to Air: kW (BTUM)	23.6 (1,342)
Heat Radiated to Ambient: kW (BTUM)	24.8 (1,410)
Fan Power: kW (hp)	3.3 (4.4)

// Air Requirements

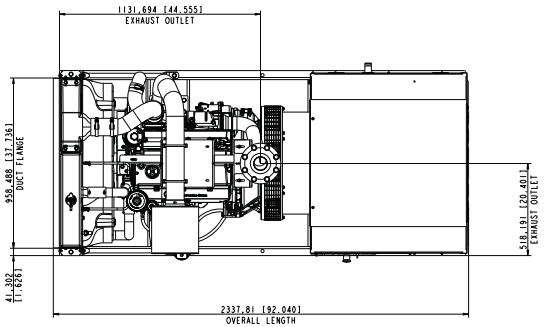
Aspirating: *m^3/min (SCFM)	8.6 (304)
Air Flow Required for Rad. Cooled Unit: *m^3/min (SCFM)	209 (7,381)
Remote Cooled Applications; Air Flow Required for Dissipation of Radiated Gen-set Heat for a Max of 25 °F Rise: *m^3/min (SCFM)	90.7 (3,203)

* Air density = 1.184 kg/m^3 (0.0739 lbm/ft^3)

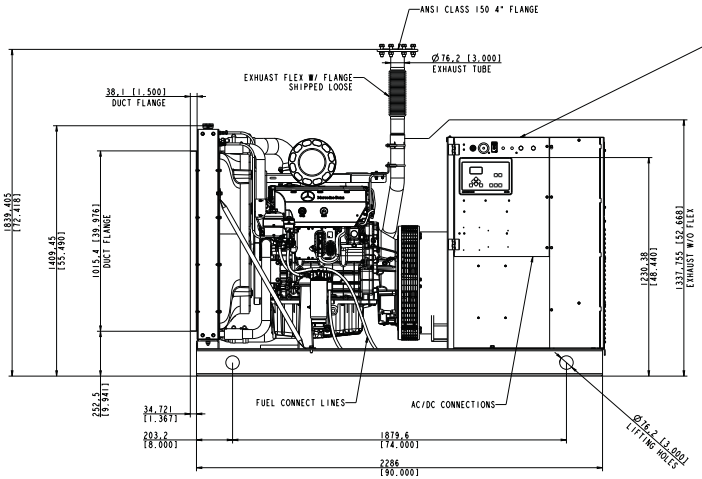
// Exhaust System

Gas Temp. (Stack): °C (°F)	354 (669)
Gas Volume at Stack Temp: m^3/min (CFM)	21.6 (763)
Maximum Allowable Back Pressure: kPa (in. H_20)	6.5 (26)

		Stand-By	Prime
60 Hz Models (kWe)	DG04RM120A1N	80	72
	DG04RM120A2N	100	90
	DG04RM120A3N	125	111
50 Hz Models (kVA)	DG04RM120A1L	89	80
	DG04RM120A2L	111	100
	DG04RM120A3L	139	125

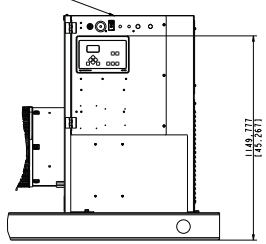


TOP VIEW



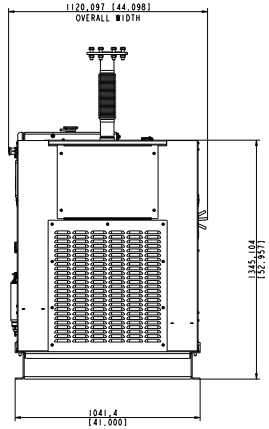
LEFT VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATIONS:
1. 430 GEN, ALL BREAKER SIZES
2. 360 GEN, P-FRAME BREAKER



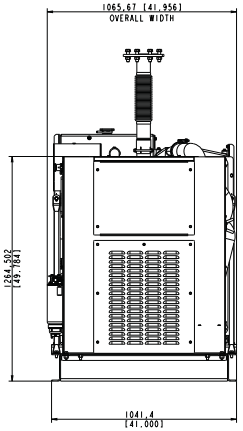
LEFT VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATION:
1. 360 GEN, H, J OR L-FRAME BREAKERS



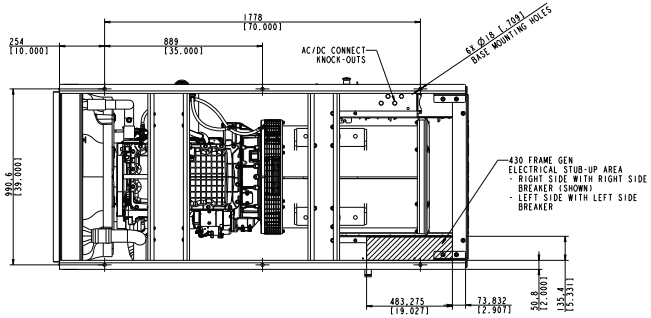
BACK VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATIONS:
1. 430 GEN, ALL BREAKER SIZES
2. 360 GEN, P-FRAME BREAKER

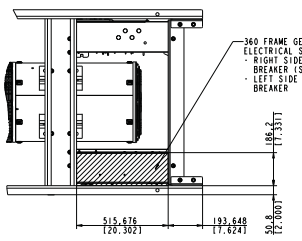


BACK VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATION:
1. 360 GEN, H, J & L-FRAME BREAKERS



BOTTOM VIEW



BOTTOM VIEW

STANDARD SCOPE OF SUPPLY

WITH NON-HOUSED/NON-TANKED BASE

GENSET DIMENSIONAL

| | | |

		Stand-By	Prime
60 Hz Models (kWe)	DG04RM120A1N	80	72
	DG04RM120A2N	100	90
	DG04RM120A3N	125	111
50 Hz Models (kVA)	DG04RM120A1L	89	80
	DG04RM120A2L	111	100
	DG04RM120A3L	139	125

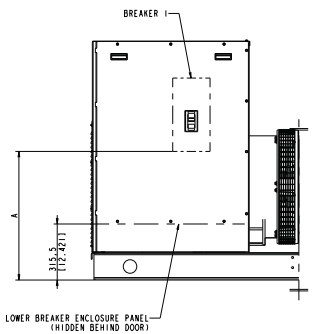
SINGLE BREAKER

BREAKER 1: UP TO 1200 AMP

MAXIMUM TOP ENTRY CONDUIT FITTING ACCOMMODATIONS:
QTY 2, 3.00" FITTINGS

MAXIMUM BOTTOM ENTRY CONDUIT FITTING ACCOMMODATIONS:
QTY 4, 3.50" FITTINGS, OR
QTY 3, 4.00" FITTINGS

RIGHT SIDE BREAKER SHOWN.
LEFT SIDE BREAKER OPTIONAL.



RIGHT VIEW

MARATHON GENERATOR	SQUARE-D BREAKER	
GENERATOR FRAME SIZE	BREAKER FRAME SIZE	DIMENSION "A"
360-FRAME	H-FRAME	768.64 [30.261]
	J-FRAME	754.41 [29.701]
	L-FRAME	673.88 [26.531]
	M/P-FRAME	724.03 [28.511]
430-FRAME	H-FRAME	849.24 [33.431]
	J-FRAME	835.02 [32.871]
	L-FRAME	760.48 [29.941]
	M/P-FRAME	724.03 [28.511]

BREAKER OPTIONS

Maßstab / Scale	Masse/Mass [g]	Format/Size
1:10	2650.795	A0

Werkstoff / Material

Benennung/Title: ABMASSZEICHNUNG / OPU BASE / DIMENSIONAL DRAWING / CM924 GENSET

Zeichnungs-Nr./Drawing No.: XZG2100100021

Blatt/Sheet: Nr.3

Prüf	Datum/Date	Name
Check	09.04.2015	Gast
Norm	09.04.2015	Anderson
Gezeichnet	09.04.2015	Carsten
Gepr.	09.04.2015	Carsten
Appr.	2009	Carsten

Oberflächenangaben nach/ISO1302 / Surface Specification per/ISO1302

Allgemeine Fertigungsvorschriften nach/MAN 332 / Production Specification per/MAN 332

Ersatz für/Replacement for

Ersetzt durch/Superseded by

Nachfolger/Successor

Verwendet für/Applicable to Model

Projekt/Auftrags-Nr./Project/Order No.

Referenz-Nr./Reference No.

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Aufgefährte Normen / Relevant Standards

Zeichnungsänderungen / Drawing Revision

Änderungs-Nr. / Revision Notice No.

Datum / Date

Name

Ersatz für / Replacement for

Ersetzt durch / Superseded by

Nachfolger / Successor

Prüfmaß / Check Dim.

Maßstab / Scale

Masse / Mass

Werkstoff / Material

Oberflächenangaben / Surface Specification

Allgemeine Fertigungsvorschriften / Production Specifications

Benennung / Title

Zeichnungs-Nr. / Drawing No.

Blatt / Sheet

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DIGITAL GENERATOR SET CONTROLLER
MGC-1500 Series Data Sheet

MTU Onsite Energy's Generator Set Controllers (MGC Series) are rugged, reliable, and easy-to-use digital generator set control systems. The MGC-1500 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that will hold up to almost any environment and is flexible enough to meet your application's needs.

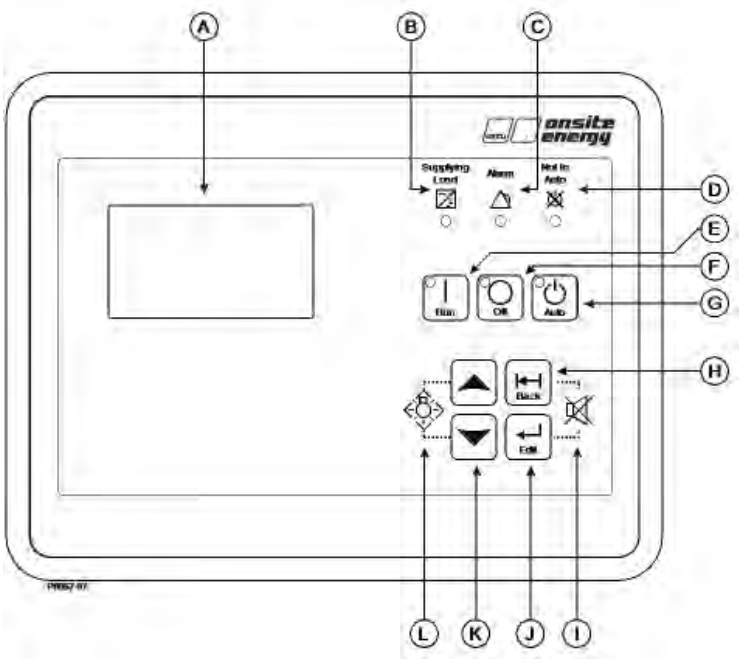


PRODUCT HIGHLIGHTS

- Three-phase generator metering
- Engine metering
- Generator set control
- Engine protection
- Generator protection
- BESTCOMS*Plus*®
  - Windows®-based software for optional remote operation (Software can be downloaded at www.mtuonsiteenergy.com)
  - Programming and setup software
  - Intuitive and powerful
  - Remote control and monitoring
  - Programmable logic
  - USB communications
- Suitable for rental generator sets with high/low sensing, single or three phase override, wye/delta/grounded delta configurable, and alternate frequency override (50/60 Hz)
- SAE J1939 Engine Control Unit (ECU) communications (optional)
- Resistive sender inputs for oil pressure and coolant temperature
- Multilingual capability
- Remote annunciation with RDP-110
- Event recording (up to 30 events in non-volatile memory)
- Extremely rugged, fully potted design
- Seven programmable contact inputs with Input 1 programmed to recognize an emergency stop
- Start, run, and prestart relays with four programmable outputs
- UL recognized, CSA certified, CE approved
- IP56 rating per IEC 60529
- NFPA-110 compatible
- Microprocessor based
- Complete system metering
- Expandable to meet customer needs

DIGITAL GENERATOR SET CONTROLLER
MGC-1500 Series Data Sheet

DIAGRAM



Front Panel Descriptions

- Liquid Crystal Display (A)
- Supplying Load Indicator (B)
- Alarm Indicator (C)
- Not in Auto Indicator (D)
- Run Pushbutton and Mode Indicator (E)
- Off Pushbutton and Mode Indicator (F)
- Auto Pushbutton and Mode Indicator (G)
- Back Pushbutton (H)
- Alarm Silence Pushbutton Combination (I)
- Edit Pushbutton (J)
- Arrow Pushbuttons (K)
- Lamp Test Pushbutton Combination (L)

FUNCTIONS

Generator Set Protection

Generator ANSI Codes

- Overvoltage (59)
- Overfrequency (81O)
- Voltage Phase Imbalance (47)
- Undervoltage (27)
- Underfrequency (81U)
- Overcurrent (50)

All generator set protection features are programmable as alarms, pre-alarms, status, or not used.

Alarms (Shutdowns)

- Automatic Restart Failure
- High Coolant Temperature
- Low Coolant Temperature
- Overspeed
- Overcrank
- Fuel Leak/Fuel Sender Failure
- Engine Sender
- Emergency Stop
- Battery Charger Failure
- Critical Low Fuel Level (optional)

FUNCTIONS, Generator Set Protection, continued:

Pre-Alarms (Warnings)

- Low Oil Pressure
- Low Coolant Temperature
- Weak Battery Voltage
- Engine Sender Unit Failure
- Maintenance Interval Timer
- Low Fuel Level
- High Fuel Level (optional)
- High Coolant Temperature
- Battery Overvoltage
- Battery Charger Fail
- Engine kW Overload (three levels)
- Low Coolant Level
- Fuel Leak Detect

All alarms and pre-alarms can be enabled or disabled via the BESTCOMS*Plus*® PC software or the front panel. Additional custom alarms and pre-alarms are available upon request.

Generator Set Metering

- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor. The view can be programmed to display up to 20 parameters using the scrolling and time delay feature.

- Engine parameters include oil pressure, coolant temperature, RPM, battery voltage, fuel level, engine runtime, and various SAE J1939 supported parameters.

Engine Control

- Cranking Control: Cycle or Continuous (Quantity and Duration fully programmable)
- Engine Cooldown: Smart Cooldown function saves time and fuel
- Successful Start Counter: Counts and records successful engine starts
- Timers:
  - Engine Cooldown Timer
  - Engine Maintenance Timer
  - Pre-Alarm Time Delays for Weak/Low Battery Voltage
  - Alarm Time Delay for Overspeed
  - Alarm Time Delay for Sender Failure
  - Arming Time Delays after Crank Disconnect:
    - Low Oil Pressure
    - High Coolant Temperature
  - Pre-Crank Delay
  - Continuous or Cycle Cranking Time Delay
  - Programmable Logic Timers

Event Recording

The MGC-1500 Series has an event recorder that provides a record of alarms, pre-alarms, engine starts, engine runtime loaded, engine runtime unloaded, last run date, and many other events that are all date and time stamped to help the user determine the cause and effect of issues related to the generator set. Contains up to 30 event records each retaining numerous occurrences in memory. Time, date, and engine hour detail are available for the most current 30 occurrences within each event record.

FUNCTIONS, continued:

Transfer Switch Control (Mains Failure) (optional)

The MGC-1500 Series has the ability to detect a mains failure via a single- or three-phase bus input. A mains failure is established when any one of the following conditions are met:

- Any phase of bus voltage falls below the dead bus threshold
- Any phase of bus voltage is unstable due to overvoltage or undervoltage
- Any phase of bus voltage is unstable due to overfrequency or underfrequency

When conditions are met, the MGC-1500 Series will start the generator set and, when ready, will send generator and mains breaker commands to apply power to the load from the generator set. The MGC-1500 Series implements open or closed breaker transitions to and from the mains. When the mains returns and is considered stable, the MGC-1500 Series will transfer the load back to the mains and stop the engine.

USB Port

The USB communication port can be used with BESTCOMS*Plus*® software to quickly configure a MGC-1500 Series with the desired settings or retrieve metering values and event log records.

Programmable Logic

The MGC-1500 Series offers a very powerful, yet easy-to-use, programmable logic scheme, BESTlogic™*Plus*, for custom programming of the various inputs, outputs, alarms, and pre-alarms. It allows these elements to be integrated into a complete logic scheme so that the user can meet even the most complex specification. The Programmable logic control includes the selection of logic gates and timers with drag-and-drop technology to make it fast and simple.

Remote Display Panel Annunciation (optional)

The MGC-1500 Series can communicate to a remote display panel, Model RDP-110. This requires only two wires to annunciate many of the alarms and pre-alarms required by NFPA-110 Level I and II. External power is required.

SAE J1939 Communications (optional)

SAE J1939 CANBus communications allows the MGC-1500 Series to communicate with the ECU to gather critical engine information like oil pressure, engine coolant temperature, RPM, battery voltage, and much more. By utilizing the ECU, the addition of analog engine senders is no longer required. This can save substantial money for the installer. It also eliminates any errors or discrepancies between the ECU data and the data displayed on the MGC-1500 Series that may be present due to analog sender inaccuracies or incompatibility. An additional benefit is access to the ECU's diagnostic troubleshooting codes (DTCs). The DTCs provide information about the engine's operating conditions and communicate these via SAE J1939 to the MGC-1500 Series, eliminating the need for hand-held service tools to diagnose simple engine issues.

SPECIFICATIONS

Operating Power

- Nominal: 12 or 24 VDC
- Range: 6 to 32 VDC
- Power Consumption:
  - Sleep Mode: 4.5 W
  - Normal Operational Mode: 6.5 W - Run mode, LCD heater off, three relays energized
  - Maximum Operational Mode: 14 W - Run mode, LCD heater on, seven relays energized
  - Battery Ride-Through: Withstands cranking ride-through down to 0 V for 50 ms (typical)

SPECIFICATIONS, continued:

Current Sensing (5 Amp CT Inputs)

- Continuous Rating: 0.1 to 5.0 Aac
- One Second Rating: 25 Aac
- Burden: 1 VA

Voltage Sensing

- Range: 12 to 576 V rms, line-to-line
- Frequency Range: 10 to 72 Hz
- Burden: 1 VA
- One Second Rating: 720 V rms

Contact Sensing/Input Contacts

- Contact sensing inputs include one emergency stop input and seven programmable inputs. The emergency stop input accepts normally closed, dry contacts. The remote emergency stop is limited to 75 ft. standard. Extended runs are available with an optional relay. All programmable inputs accept normally open, dry contacts. The factory may utilize up to three of these inputs.

Engine System Inputs

- Fuel Level Sensing Resistance Range: 5 to 250 Ω nominal
- Coolant Temperature Sensing Resistance Range: 5 to 2,750 Ω nominal
- Oil Pressure Sensing Resistance Range: 5 to 250 Ω nominal
- Engine Speed Sensing:
  - Magnetic Pickup or CANBus
    - Magnetic Pickup Voltage Range: 3 to 35 V peak (6 to 70 V peak to peak)
    - Magnetic Pickup Frequency Range: 32 to 10,000 Hz

Output Contacts

- (7) Total Outputs: (3) 5 A @ 28 VDC and (4) 2 A @ 28 VDC

- The factory utilizes the following on each generator set which can be reprogrammed as needed:
  - (3) 5 A @ 28 VDC for Pre-start, Start, and Run
  - (4) 2 A @ 28 VDC for general purpose

Metering

- Generator Voltage (rms)
  - Metering Range: 12 to 576 VAC (direct measurement), up to 9,999 VAC (with appropriate voltage transformer)
  - Accuracy: ±1% of programmed rated voltage or ±2 VAC (subject to accuracy of voltage transformer when used)
- Generator Current (rms)
  - Generator current is measured at the secondary windings of 5 A CTs.
  - Metering Range: 0 to 5,000 Aac
  - CT Primary Range: 1-5,000 Aac, in primary increments of 1 Aac
  - Accuracy: ±3% of programmed rated current or ±3 Aac (subject to accuracy of CTs)

SPECIFICATIONS, Metering, continued:

- Generator Frequency
  - Metering Range: 10 to 72 Hz
  - Accuracy: ±0.25% or 0.05 Hz
- Apparent Power
  - Indicates total kVA and individual line kVA (four-wire, line-to-neutral or three-wire, line-to-line).
  - Accuracy: ±5% of the full-scale indication or ±4 kVA
- Power Factor
  - Metering Range: 0.2 leading to 0.2 lagging
  - Accuracy: ±0.02
- Real Power
  - Indicates total kW and individual line kW (four-wire, line-to-neutral or three-wire, line-to-line)
  - Accuracy: ±5% of the full-scale indication or ±4 kW
- Oil Pressure
  - Metering Range: 0 to 150 psi or 0 to 1,034 kPa
  - Accuracy: ±3% of actual indication or ±2 psi or ±12 kPa (subject to accuracy of sender)
- Coolant Temperature
  - Metering Range: 0 °C to 204 °C (32 °F to 410 °F)
  - Accuracy: ±3% or actual indication or ±2° (subject to accuracy of sender)Fuel Level
  - Metering Range: 0 to 100%
  - Accuracy: ±3% (subject to accuracy of sender)
- Battery Voltage
  - Metering Range: 6 to 32 VDC
  - Accuracy: ±3% of actual indication or ±0.2 VDC
- Engine RPM
  - Metering Range: 0 to 4,500 rpm
  - Accuracy: ±2% of actual indication or ±2 rpm
- Engine Run Time
  - Engine run time is retained in non-volatile memory.
  - Metering Range: 0 to 99,999 h; Update Interval: 6 min
  - Accuracy: ±1% of actual indication or ±12 min
- Maintenance Timer
  - Maintenance timer indicates the time remaining until generator set service is due. Value is retained in non-volatile memory.
  - Metering Range: 0 to 5,000 h; Update Interval: 6 min
  - Accuracy: ±1% or actual indication or ±12 min

Generator Protection Functions

- Overvoltage (59) and Undervoltage (27)
  - Pickup Range: 70 to 576 VAC
  - Activation Delay Range: 0 to 30 s
- Overfrequency (81O) and Underfrequency (81U)
  - Pickup Range: 45 to 66 Hz
  - Pickup Increment: 0.1 Hz
  - Activation Delay Range: 0 to 30 s

SPECIFICATIONS, Generator Protection Functions, continued:

- Phase Imbalance (47)
  - Pickup Range: 5 to 100 VAC
  - Pickup Increment: 1 VAC
  - Activation Delay Range: 0 to 30 s
  - Activation Delay Increment: 0.1 s
- Overcurrent (51)
  - Pickup Range: 0.18 to 1.18 Aac (1 A current sensing)
  - Time Dial Range: 0 to 7,200 s (fixed time curve)

Environmental

- Temperature
  - Operating: -40 °C to 70 °C (-40 °F to 158 °F)
  - Storage: -40 °C to 85 °C (-40 °F to 185 °F)
- Humidity: IEC 68-2-38
- Salt Fog: ASTM B 17-73, IEC 68-2-11 (tested while operational)
- Ingress Protection: IEC IP54 for front panel
- Shock: 15 G in three perpendicular planes
- Vibration: 5 to 29 to 5 Hz at 1.5 G peak for 5 min
  29 to 52 to 29 Hz at 0.036" DECS-A for 2.5 min
  52 to 500 to 52 Hz at 5 G peak for 7.5 min
  - Swept over the above ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep.

Agency Approvals

- UL/CSA Approvals: "cURus" approved to UL 6200 and CSA C22.2 No.14
- NFPA Compliance: Complies with NFPA Standard 110, Standard for Emergency and Standby Power
- CE Marked: Complies with applicable EC Directives

ADDITIONAL SPECIFICATIONS

Battery Backup for Real Time Clock

The MGC-1500 Series provides a real-time clock with capacitor backup that is capable of operating the clock for up to 24 hours after power is removed from the controller. As the capacitor nears depletion, an internal backup battery takes over and maintains timekeeping. The battery will maintain the clock for approximately 10 years, depending on conditions. The battery is not replaceable. The clock is used by the events recorder function to timestamp events, and the exercise timer is used to start and stop the generator set when the exercise feature is utilized.

Breaker Management

The MGC-1500 Series is capable of controlling the generator breaker and the mains breaker. The status of the breakers is determined by using BESTlogic™*Plus* programmable logic to set up the GENBRK and MAINSBRK logic blocks. These logic blocks have outputs that can be configured to energize an output contact and control a breaker, as well as inputs for breaker control and status. The MGC-1500 Series will attempt to close a breaker only after verifying that it can be closed. If the breaker cannot be closed, the close request will be ignored. Only one breaker can be closed at a time. Synchronization is required before closing the breaker to a live bus. Closure to a dead bus can be performed after meeting dead bus threshold and timing requirements set by the user.

MAGNAPLUS®

MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL SUBMITTAL DATA

Basic Model 362CSL1604 **Date: 4-27-05**

Kilowatt ratings at	**1800** RPM	**60** Hertz					**12** Leads		
kW (kVA)	**3** Phase	**0.8** Power Factor					**Dripproof or Open** Enclosure		
	Class B	**Class F**					**→ Class H**		
Voltage*	**80° C ① Continuous**	**90° C ① Lloyds**	**95° C ① ABS**	**105° C † British Standard**	**105° C ① Continuous**	**130° C ① Standby**	**125° C † British Standard**	**125° C ① Continuous**	**150° C ① Standby**
240/480	**75 (94)**	**77 (96)**	**77 (96)**	**84 (105)**	**84 (105)**	**90 (113)**	**90 (113)**	**90 (113)**	**95 (119)**
230/460	**71 (89)**	**73 (91)**	**73 (91)**	**80 (100)**	**80 (100)**	**86 (107)**	**86 (107)**	**86 (107)**	**90 (113)**
220/440	**68 (85)**	**70 (88)**	**70 (88)**	**76 (95)**	**76 (95)**	**84 (105)**	**84 (105)**	**84 (105)**	**89 (112)**
→ **208/416**	**65 (81)**	**67 (84)**	**67 (84)**	**72 (90)**	**72 (90)**	**80 (100)**	**80 (100)**	**80 (100)**	**85 (106)**
190/380	**60 (75)**	**60 (75)**	**60 (75)**	**65 (81)**	**65 (81)**	**72 (90)**	**72 (90)**	**72 (90)**	**77 (96)**

① *Rise by resistance method, Mil-Std-705, Method 680.1b.* † *Rating per BS 5000.*

Submittal Data: 480 Volts, 100 kVA, 1800 RPM, 60 Hz, 3 Phase

Mil-Std-705B		
Method	**Description**	**Value**
301.1b	Insulation Resistance	> 1.5 Meg
302.1a	High Potential Test	
	Main Stator	2000 Volts
	Main Rotor	1500 Volts
	Exciter Stator	1500 Volts
	Exciter Rotor	1500 Volts
401.1a	Stator Resistance, Line to Line	
	High Wye Connection	0.138 Ohms
	Rotor Resistance	1.05 Ohms
	Exciter Stator	23.5 Ohms
	Exciter Rotor	0.12 Ohms
410.1a	No Load Exciter Field Amps	
	at 480 Volts Line to Line	0.52 A DC
420.1a	Short Circuit Ratio	0.634
421.1a	Xd Synchronous Reactance	1.864 pu
422.1a	X2 Negative Sequence	
	Reactance	0.148 pu
423.1a	X0 Zero Sequence Reactance	0.038 pu
425.1a	X'd Transient Reactance	0.127 pu
426.1a	X"d Subtransient Reactance	0.098 pu
427.1a	T'd Transient Short Circuit	
	Time Constant	0.05 sec.
428.1a	T"d Subtransient Short Circuit	
	Time Constant	0.007 sec.
430.1a	T'do Transient Open Circuit	
	Time Constant	0.8 sec.
432.1a	Ta Short Circuit Time	
	Constant of Armature Winding	0.01 sec.

Mil-Std-705B		
Method	**Description**	**Value**
505.3b	Overspeed	2250 RPM
507.1c	Phase Sequence CCW-ODE	ABC
601.4a	L-L Harmonic Maximum - Total	3.5%
	(Distortion Factor)	
601.4a	L-L Harmonic Maximum - Single	2.5%
601.1c	Deviation Factor	7.0%
---	TIF (1960 Weightings)	<50
	Additional Prototype Mil-Std Methods are Available on Request.	
--	Generator Frame	360
--	Type	Ext. Voltage Regulated, Brushless
--	Insulation	Class H
--	Coupling - Single Bearing	Flexible
--	Amortisseur Windings	Full
--	Cooling Air Volume	700 CFM
--	Exciter	Rotating
--	Voltage Regulator	SE350
--	Voltage Regulation	1%

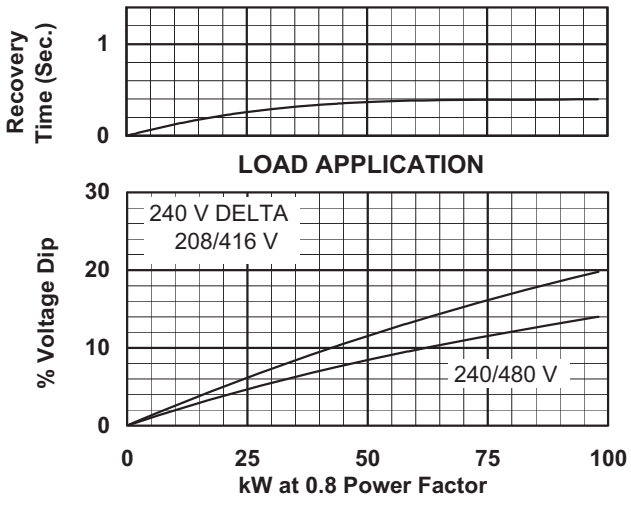
* Voltage refers to wye (star) connection, unless otherwise specified.

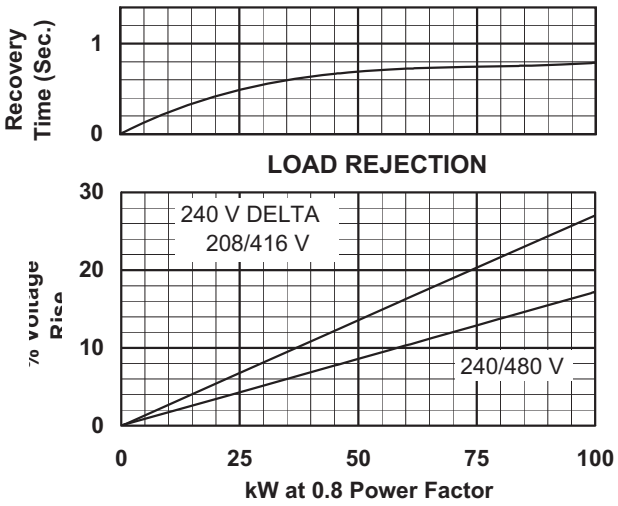
MAGNAPLUS®

MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL DYNAMIC CHARACTERISTICS

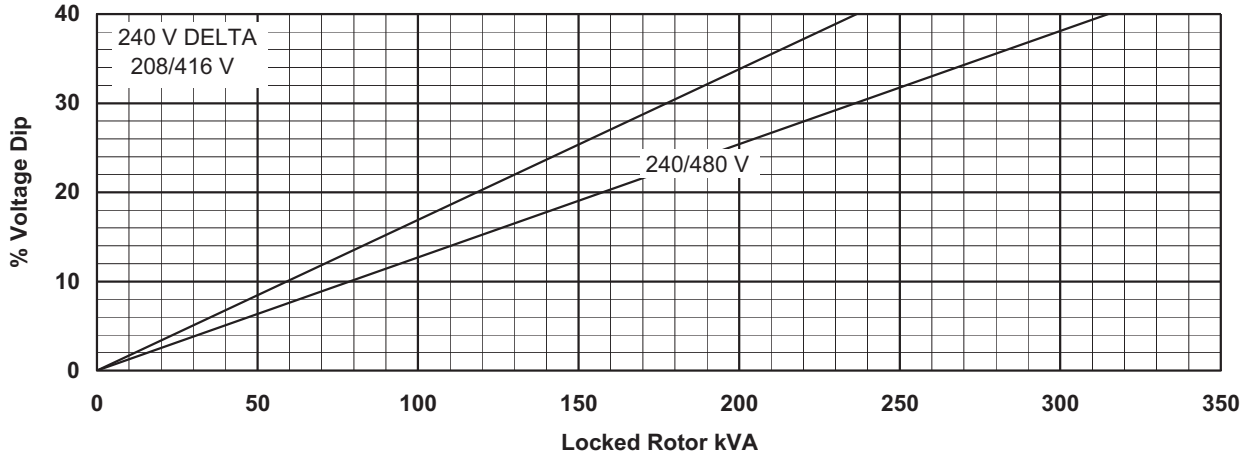
Basic Model 362CSL1604 **Date: 6-1-00**

60 HERTZ

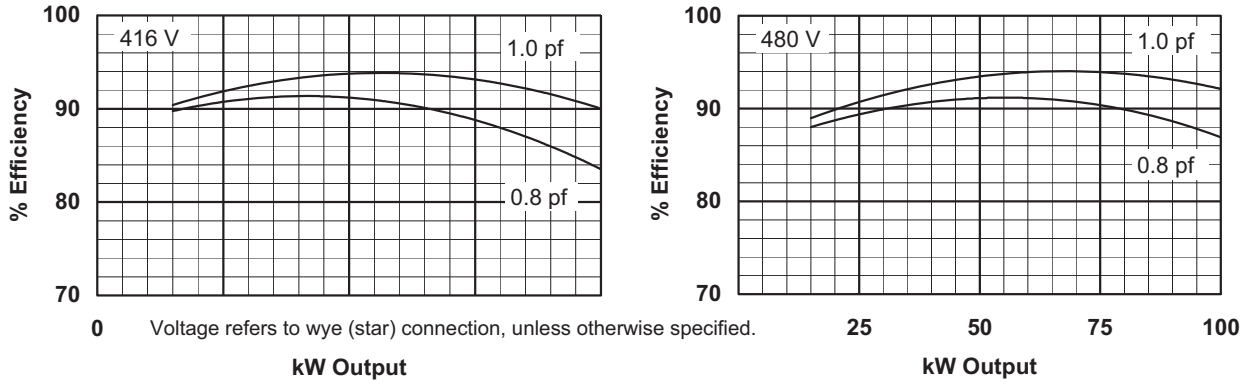




TYPICAL MOTOR STARTING CHARACTERISTICS



TYPICAL GENERATOR EFFICIENCY



Voltage refers to wye (star) connection, unless otherwise specified.

SECTION 2

Accessories

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

List of material

GÉNÉRATRICE DRUMMOND

Project no 2016-05-0758A

File 1915GDM

Project IGLOOLIK WATER SUPPLY SYSTEM

Group DS80D6S, 362CSL1604, 80kW/100kVA, A, 120/208V

Part no	Description	Quantity
	ATS	
ATH3KDA30300BSC	Automatic Transfer Switch, CH , 300A, 120/208V, 3Ph, 3P TS-	1.00
	Cooling system	
	Block Heater Kim Hotstart 1500W/120V	1.00
	Electrical system	
DD31P925	Battery EAST PENN 925CCA 12V (EPM)	1.00
79100	Battery Charger Guest compact 12 Vcc, 6 A	1.00
MGC-1520	Controler MTU MGC-1520	1.00
JDL36250	Breaker Square D 3 poles, 600V,250A (3/0-350MCM) (85686)	1.00
CRM012DC4LSS42H	Relays 12Vdc ABB 4P2D	2.00
	Exhaust system	
JIS-04	Silencer industrial grade	1.00
	Exhaust flex	1.00
	Fuel system	
B200-F	Fuse Valve ½" 165F ULC	1.00
	Miscellaneous	
MANUEL ATS	Owner's Manual - Automatic Transfer Switch	1.00
MANUEL GENE	Owner's Manual - Genset Group	1.00
	USB Key GD	2.00
GARANTIE ATS	Warranty 1 year - Automatic Transfer Switch	1.00
GARANTIE GENE	Warranty 2 years (3000 hours) - Genset Group	1.00
	Factory test	
	Standard Test	1.00

GENUINE DETROIT DIESEL MAINTENANCE FREE STARTING BATTERIES

Reliable starting power for any commercial service vehicle. Heavy-duty construction reduces damaging effect of vibration for long service life.



Genuine Detroit Diesel Maintenance-Free Starting Batteries assure quick, reliable starting power for any commercial service vehicle. Anchorlocked elements, radial grids and tight-pack, heavy-duty construction significantly reduce the damaging effects of vibration, resulting in maximum power-per-pound and long service life.

Genuine Detroit Diesel Starting Batteries are completely maintenance-free and never need watering, dramatically reducing maintenance costs. And the popular Group 31 size fits most types of commercial equipment for easy replacement. All our batteries pass more than 250 quality checks during manufacture, ensuring superior performance and long life. And Genuine Detroit Diesel Batteries are made in the U.S.A., your assurance of quality!

PERFORMANCE LEVEL								DIMENSIONS INCHES/(mm)		
BCI Group Size	Detroit Diesel Part Number	Footnotes	Cranking Amps @ 32°F	Cold Cranking Amps @ 0°F	Reserve Capacity Mins @ 80°F	Volts	Approx. Wt. Lbs. Wet	L	W	H
MAINTENANCE-FREE STARTING SERVICE										
31	EPM/DD931MF	JLMX	810	650	145	12	51	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD931PMF	JLMS	810	650	145	12	51	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1031MF	JLMX	910	760	170	12	54 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1031PMF	JLMS	910	760	170	12	54 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD31P925	JLMX	1110	925	170	12	56 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131PMF	JLMS	1110	925	170	12	56 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131XMF	JLMX	1190	1000	185	12	58	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1131XPMF	JLMS	1190	1000	185	12	58	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1231MF	JLMX~	1260	1125	195	12	61	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD1231PMF	JLMS~	1260	1125	195	12	61	13 (330)	6 3/4 (171)	9 1/2 (241)
FLOODED HEAVY-DUTY MAINTENANCE-FREE DUAL PURPOSE CYCLING/STARTING SERVICE										
31	EPM/DDDP31CS	JLMS§	875	700	180	12	57	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DDDP31PCS	JLMS§	875	700	180	12	57	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD7T31	JLMS§	940	730	190	12	62 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
31	EPM/DD7T31P	JLMS§	940	730	190	12	62 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)
ABSORBED GLASS MAT MAINTENANCE-FREE DUAL PURPOSE CYCLING/STARTING SERVICE										
31	EPM/DD8A31	HX1	**1000	**800	190	12	69	13 (330)	6 3/4 (171)	9 3/8 (238)
31	EPM/DD9A31	HX1	**1150	**925	190	12	68 1/2	13 (330)	6 3/4 (171)	9 1/2 (241)

H – Includes handles
J – Includes lifting ledges
L – Anchor lock elements
M – Flush manifold vented cover
N – Flush manifold vented cover when shipped wet, standard cover when shipped dry or FP
S – SAE "Automotive Type" post
X – 3/8" x 16 stainless steel stud posts

1 – "Non-Spillable" by DOT (Department of Transportation) definition
~ – Deduct 4% from CCA & CA rating to allow for special electrolyte additive
§ – Deduct 15% from CCA and CA rating shown to allow for double insulation (glass mat)
** – Pre-production estimate

California Proposition 65 Warning:
Batteries, battery posts, terminals and related accessories contain lead and lead compounds and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
Wash Hands after handling!

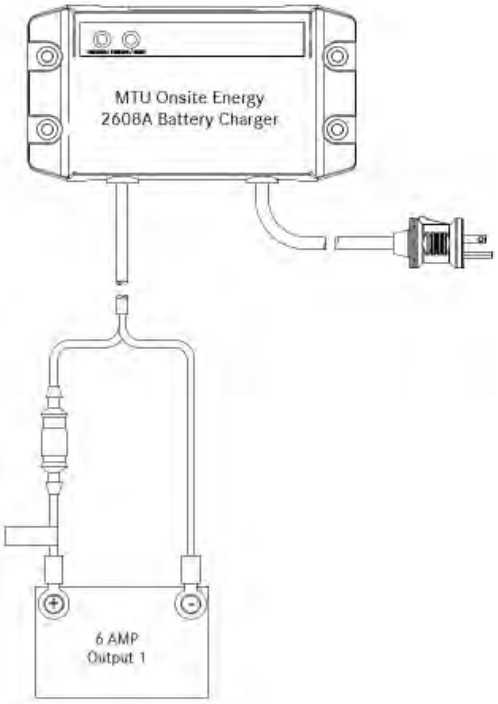
BATTERY CHARGER
2608A Data Sheet

FEATURES
- Watertight, shock and corrosion resistant
- Short circuit and thermal protection
- LED status indicator
- Reverse polarity protection



DESCRIPTION
The 2608A battery charger is designed to recharge batteries as well as extend the battery's life in applications where it is stored for long periods of time. This charger is "3-stage" electronic, completely automatic, and lightweight. Unlike automotive trickle chargers, the 2608A will not overcharge batteries. The visible red and green LED lights on the charger faceplate allow for easy operation.

SPECIFICATIONS
- MTU Onsite Energy Part #: SUA79100
- Output Volts: 12 Volts
- Output Amps: 6 Amps
- Load Banks: 1 Bank
- DC Cable Length: 1219.2 mm (48 in)
- Dimensions (L x W x H): 88.9 mm (3.5 in) x 162.56 mm (6.4 in) x 57.15 mm (2.25 in)
- Input Volts: 115 VAC - 50/60 Hz
- Input Amps Max: 2 Amps



2608A Battery Charger Schematic

© MTU Onsite Energy. Subject to alteration due to technological advances. 2014-08

Product Data Sheet

JDL36250

Molded Case Circuit Breaker , 600VAC/250VDC, 250A



SQUARE D by Schneider Electric

Technical Characteristics

Approvals	UL Listed - CSA Certified - IEC Rated
Circuit Breaker Type	Standard
Catalog Reference Number	0611CT0401
For Use With	Industrial Enclosures and Switchboards
Ampere Rating	250A
General Application	Provides overload and short circuit protection
AC Magnetic Trip Setting	1250A - 2500A Adjustable Trip
Frame Type	J-Frame
HACR Rated	Yes
Marketing Trade Name	Powerpact
Voltage Rating	600VAC/250VDC
Mounting Type	Unit Mount
Number of Poles	3-Pole
Weight	5 Pounds
Short Circuit Current Rating	25kA@240VAC - 18kA@480VAC - 14kA@600VAC
Terminal Type	Line: Lug - Load: Lug
Type	JD
Wire Size	#3/0-350 AWG/kcmil(Al/Cu)
Height	7.52 Inches
Width	4.12 Inches
Depth	5.00 Inches

Shipping and Ordering

Category	01110 -
Discount Schedule	DE2
Article Number	785901839941
Package Quantity	1
Weight	4.79 lbs.
Availability Code	Non-Stock Item: This item is not normally stocked in our distribution facility.
Returnability	Y

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

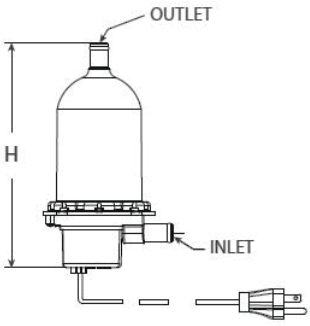
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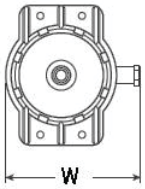
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WATER HEATER
TPS Series Data Sheet

The TPS engine preheater is designed to preheat diesel and gas engines in generator set applications. Simple to install and very lightweight, the TPS engine preheater features a built-in thermostat and heats engines up to 12 liter displacement. Thermosiphon circulation of the coolant delivers heat throughout the entire engine.







CERTIFICATIONS AND STANDARDS

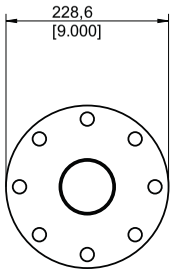
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- CSA Certified

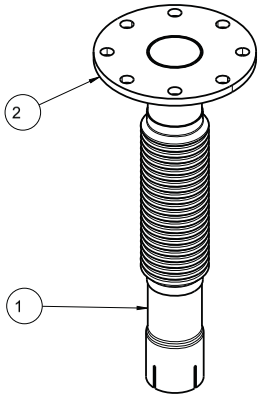
SPECIFICATIONS

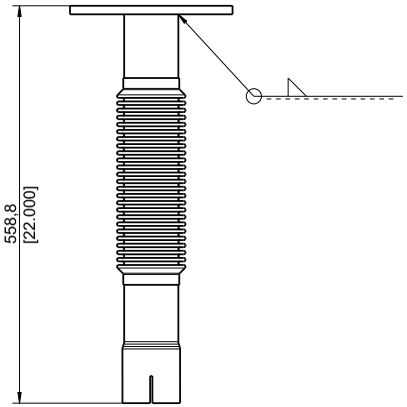
Height:	200 mm (7.9 in)
Width:	117 mm (4.6 in)
Weight:	771 g (1.7 lb)
Heating Fluid:	Engine coolant (50% glycol/50% water)
Power:	0.5, 1, 1.5, 1.8 and 2 kW
Rated Voltage:	1 Phase – 120 and 240 VAC
Tank Material:	Polyphenylene Sulfide (PPS)
Heating Element:	Incoloy 800
Enclosure:	IP41
Fluid Capacity:	416 cm^3 (0.11 gal)
Max Pressure:	6.2 bar (90 psi)
Inlet / Outlet:	15.9 mm (0.625 in)
Thermostat Range:	
On	38 °C (100 °F)
Off	49 °C (120 °F)

Model Number	MTU Onsite Energy Part Number	Watts	Volts	Phase	Hz	Amps
TPS101GT10-000	SUA52746	1,000	120	1	60	8.4
→ TPS151GT10-000	SUA52748	1,500	120	1	60	12.5
TPS181GT10-000	SUA52750	1,800	120	1	60	15

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Rz 100

MTN5168

Beschichtung nach MTV5010; Aluminiumlack,
Farbton ca. RAL9006 weissaluminium

Coating acc. to MTV5010; Aluminium paint,
color approx. RAL9006 aluminium-white

Es gilt zusaetzlich die 3D-Geometrie
The 3D geometry is also applicable

Schweissverfahren WIG/MAG
Welding method

Bewertungsgruppe C
nach ISO 5817
Evaluation group
as per ISO 5817

Zusatzwerkstoff W3Si1/G3Si1
nach MMN 402
Filler material
as per MMN 402

Nahtdicke bei a = 2 mm
Kehlnaehten
Seam thickness for
fillet welds

NOTES:
1) FINISH: ALUMINIZED
2) DIMENSIONS: MM[IN]

Pos.	Menge Qty	Benennung/Title	Material-Nr./Material No. Halbzeug,Modell usw. Semi-finished product,Pattern...	Norm Standard	Abmessung/Dimensions Behandlungszustand Treatment condition	Werkstoff/Material Oberflächenschutz Surface protection	Kl/Kl. Sel/No.	Masse Mass kg
2	1	4" FLANGE	SUA107547-02			S235JR	2	3.199
1	1	FLEX TUBE	SUA107547-01			S235JR	1	4.551

Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033		Massstab Scale 1:5	Masse/Mass kg 7.75	Format/Size A2	
Oberflaechenschutz Surface Protection			Werkstoff Material			
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 332		Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die			
Projekt-/Auftrags-Nr. Project/Order No.			Benennung/Title ROHR TUBE			
Referenz-Nr./Reference No.						

	Pro/E	Datum/Date	Name
Bearb. Drawn		06.06.2014	Kost
Gepr. Checked		06.06.2014	Anderson
Norm. Stndr.		06.06.2014	Carsten
Abt. Dept.	EDMM		Carsten

Bei Fremdteil/Kaufteil duerfen alle technischen Aenderungen am Lieferumfang nur nach unserer vorherigen Genehmigung vorgenommen werden.
Technical modifications to third party or purchased parts require our prior permission.

onsite energy

Zeichnungs-Nr./Drawing No. SUA107547

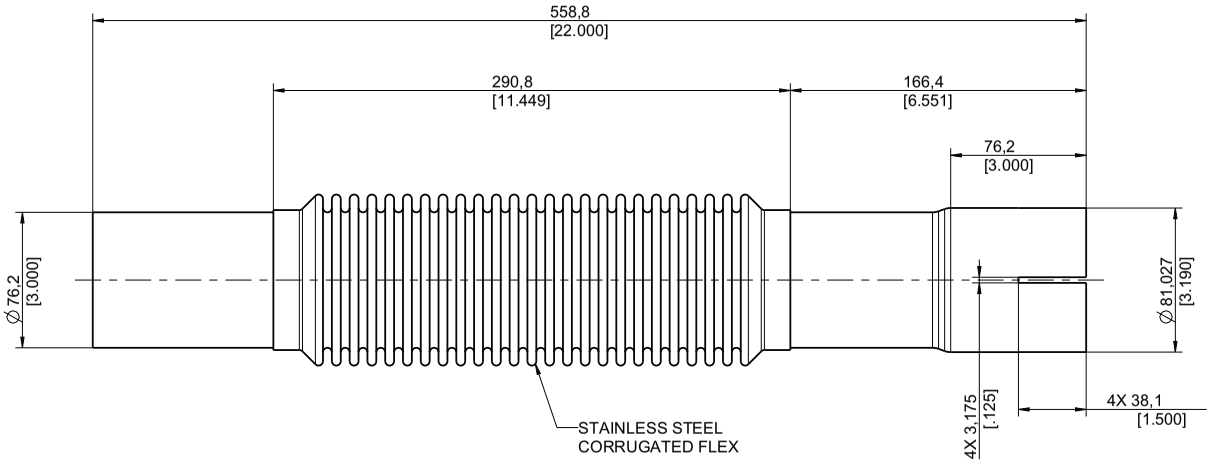
Blatt Sheet 1v.4

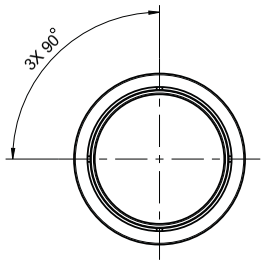
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Aufgeführte Normen Relevant Standards	Passmass Fit	Abmass in Deviation Lim	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
MMN402	0	0 0							
MTN5168	0	0 0							
MTV5010	0	0 0							
ISO5817	0	0 0					06.06.2014	kost	

lfd.Nr./Ser.No. 1

SCALE 1:5







NOTES:
1. MATERIAL, TUBE: 3.00 OD X .065; 16 GA. STEEL TUBING
2. MATERIAL, FLEX: STAINLESS STEEL CORRUGATED
3. FINISH: ALUMINIZED
4. DIMENSIONS: MM[IN]

Aufgeführte Normen Relevant Standards	Passmass Fit	Abmass in Deviation Lim	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0					06.06.2014	kost	

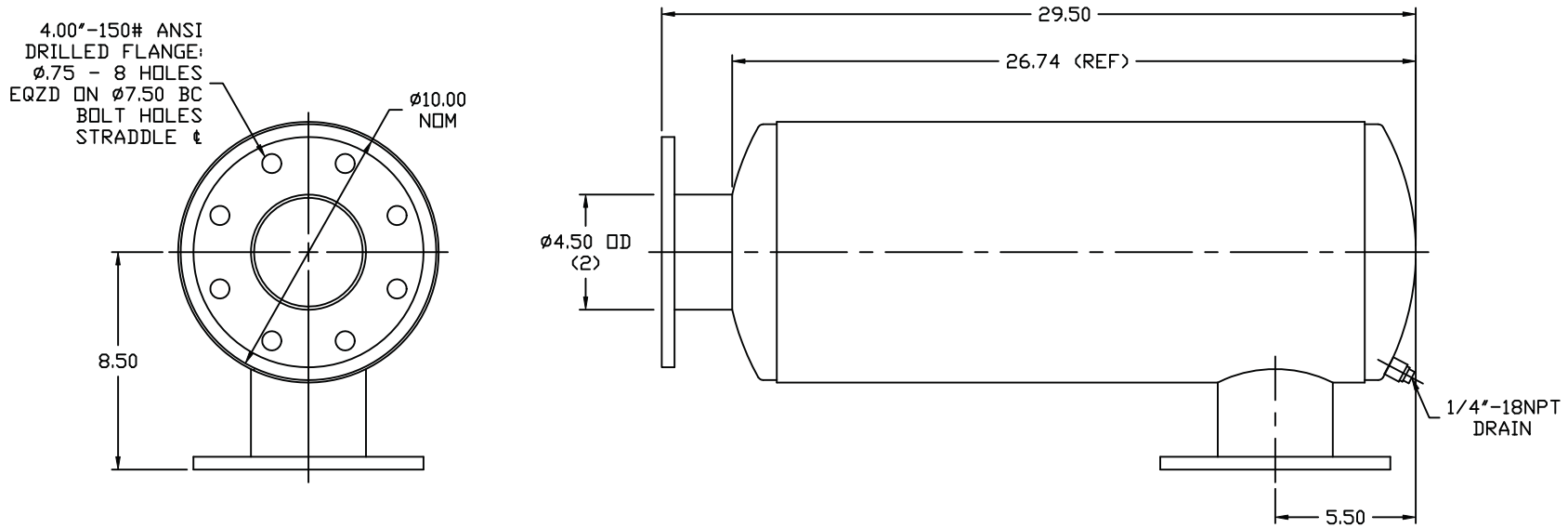
Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:2	Masse/Mass kg 7.75	Format/Size A2
Oberflaechenschutz Surface Protection		Werkstoff Material		
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungsvorschriften nach MMN 332 Production Specification per MMN 332	Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die		
Projekt-/Auftrags-Nr. Project/Order No.		Benennung/Title		
Referenz-Nr./Reference No.		ROHR		
Bei Fremdteil/Kaufteil duerfen alle technischen Aenderungen am Lieferumfang nur nach unserer vorherigen Genehmigung vorgenommen werden. Technical modifications to third party or purchased parts require our prior permission.	Pro/E Datum/Date Name Bearb. Drawn 06.06.2014 Kost Gepr. Checked 06.06.2014 Anderson Norm. Stndr. 06.06.2014 Carsten Abt. Dept. EDMM Carsten	TUBE		
		Zeichnungs-Nr./Drawing No. SUA107547		Blatt Sheet 2v.4

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REVISION HISTORY				
No.	DATE	BY	ZONE	COMMENTS
C	5/19/00	BAW	*	OUTLINE UPDATED

400094 | C

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GAS FLOW

EM PRODUCTS™

PHILLIPS & TEMRO *industries*
A Thyssen Budd Automotive Company

THIRD ANGLE PROJECTION	DRAWN BY INS	DATE 5/1/87	DESCRIPTION: JIS-04: S/E 4.00" FLG CONN *
	APPR. BY *	DATE *	
DIMENSIONS ARE IN: X IN , MM , INDMO	DRAWING ORIGIN PRIOR LAKE		REF: * / MATERIAL: CARBON STEEL / SHEET 1 OF 1

UNLESS SPECIFIED DIMENSION TOLERANCES ARE:

ANGLES	INCHES	MILLIMETERS
∠ ± 2°	.00 ± .13	00. ± *
	.000 ± *	0.0 ± *

SCALE:	DUT.	FAB.	DRAWING No.	REV.
1:4	B	B	400094	C

CUSTOMER * | WORK ORDER * | FINISH HIGH TEMP. BLACK | WEIGHT *

SECTION 3

Automatic Transfer Switch(es)

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

Cutler-Hammer

ATC-300
Automatic Transfer Switch Controller

Technical Data

New Information

ATH3KDA30300BSC



Introduction

The Cutler-Hammer® ATC-300 Automatic Transfer Switch Controller from Eaton's Electrical business is a comprehensive, multi-function, microprocessor-based automatic transfer switch controller. It is a compact, self-contained, panel-mounted controller that is designed to accurately monitor power sources and provide the necessary intelligence to reliably operate a transfer switch through a series of programmed sensing and timing functions. The ATC-300 provides an unmatched degree of programming flexibility to address the needs of any system.

Primary Functions

As standard, the ATC-300 Automatic Transfer Controller will:

- Monitor normal and emergency source voltages and frequencies.
- Provide transfer and re-transfer control signals.
- Provide engine/generator starting and shutdown signals.
- Permit customer programming of operational set points.
- Display real-time and historical information.
- Permit system testing.
- Store customer and factory established parameters in nonvolatile memory.
- Provide faceplate source status indication.
- Provides an LCD-based display for programming and status readouts.

Operational Simplicity

From installation to programming to usage, the ATC-300 Controller was designed with operational simplicity in mind. Only one style needs to be considered regardless of input/output requirements or system voltages and frequencies. The intuitive front panel interface simplifies routine operation, programming, and data presentation and set point adjustment. An LCD-based display is backlit for enhanced visibility. The front panel membrane pushbuttons with positive-feedback move the ATC-300 Controller display from function-to-function or step-to-step within a function. The ATC-300 Controller provides the functionality of multiple devices combined in one package and mounts in less than 5.75 inches (146.1 mm) x 7.75 inches (196.8 mm) of panel space.

Industrial Design Highlights

- True rms voltage sensing of normal and emergency sources.
- Frequency sensing of normal and emergency sources.
- Voltage unbalance and phase rotation sensing.
- Programmable set points stored in nonvolatile memory.
- PowerNet™ communications capable.
- System monitoring with historical data storage and display.
- Gold-plated engine start contact.
- Digital set points for accurate and consistent performance.
- Automatic plant exerciser.
- UV-resistant faceplate with Mimic Diagram and LED status indicators.
- LCD-based, backlit, two-line display.
- Suitable for application over a wide range of environmental conditions.
- Self-diagnostic and system diagnostic functions with LED indication.
- Help function for detailed description of displayed message.
- System Test pushbutton.
- Positive feedback membrane pushbuttons for application in harsh environments.
- Password protected access to programming mode.
- Pretransfer contacts.
- Bypass Time Delay pushbutton.
- Control input for remote testing or peak shaving applications.
- Five different control input functions for maximum operational flexibility.
- In-phase and Time Delay Neutral transfer modes for systems with inductive loads.

Standards

The Cutler-Hammer ATC-300 Automatic Transfer Switch Controller meets or exceeds all industry standards for endurance, reliability and performance. It is designed to meet the needs of markets worldwide.

The ATC-300 Automatic Transfer Switch Controller is designed and built as standard in accordance with the following standards where applicable.

Table 1. Standards

UL® 1008	UL Standard for Safety for Transfer Switch Equipment
UL 991	Tests for Safety-Related Controls Employing Solid-State Devices
CSA® 22.2 No.178	Canadian Standards Association
IEC 61000-4-2, 61000-4-3, 61000-4-4 61000-4-5 61000-4-6 61000-4-11	International Electrotechnical Commission EMC Standards
FCC Part 15, Class A	Federal Communication Commission RF Emissions
CISPR 11	International Electrotechnical Commission Standard for RF Emissions
UBC®, BOCA® Seismic Zone 4	California Building Code
CE	European Standards Conformance

ATC-300 Automatic Transfer Switch Controller Product Overview





ATC-300 Automatic Transfer Switch Controller

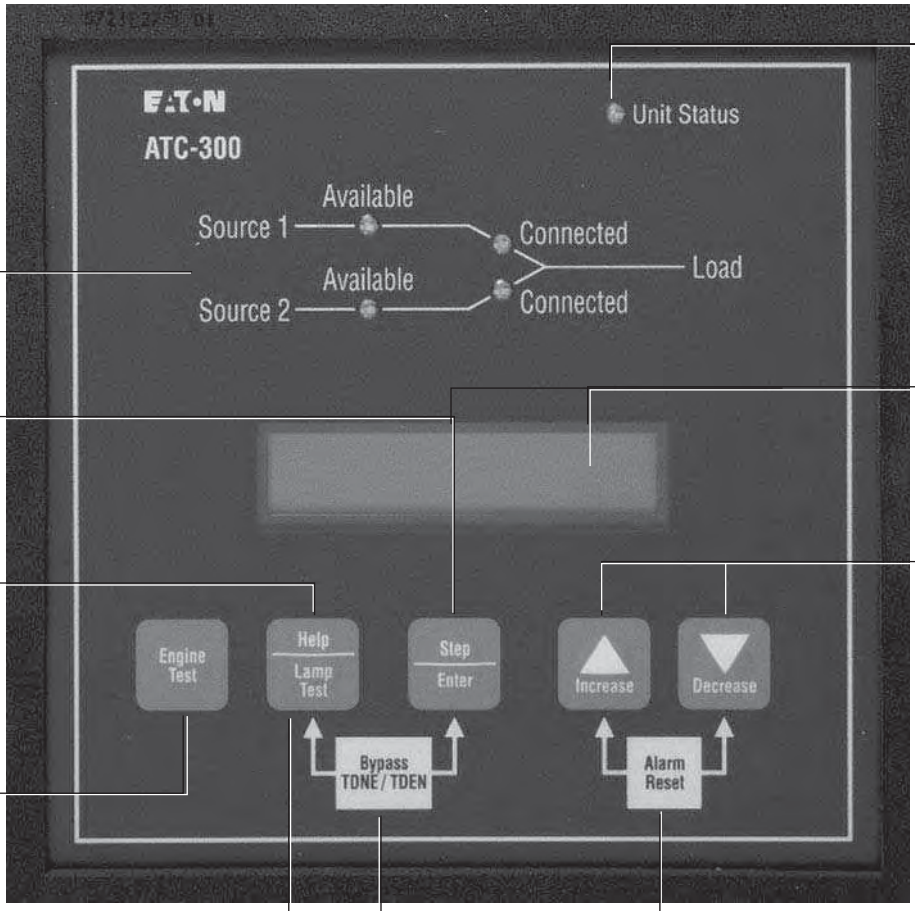
Table 2. Product Overview

Specifications	Value
Voltage	
Voltage Measurements of: Voltage Measurement Range Voltage Measurement Accuracy	Source 1 and 2: VAB, VBC and VCA 0 – 790 Vac rms ±1% of Full Scale
Frequency	
Frequency Measurements of: Frequency Measurement Range Frequency Measurement Accuracy	Source 1 and 2 40 – 70 Hz ±0.3 Hz
Control Power	
Input Range	65 Vac – 145 Vac rms, 50/60 Hz
System Inputs	
Source 1 Closed Source 2 Closed Lockout	Yes Yes Yes
Go to Source 2 Monitor Mode	Yes Yes
Output Contacts	
Form “A” for Generator Start Form “A” for Control	(1) 5 A, 250 Vac/30 Vdc (2) 10 A, 250 Vac/30 Vdc
Form “C” for Alarm Form “C” for Pre-Transfer	(1) 10 A, 250 Vac/30 Vdc (1) 10 A, 250 Vac/30 Vdc
Front Panel	
LED Indication	Unit Status. Source 1 and 2: Available and Connected (5 Total)
Main Display	LCD-Based Display
Parameters Displayed	Voltage, Frequency, Status, History, Time, Date, Set Points, Help Information
Stored Historical Data Includes:	Engine Run Time, Source 1 Available Time, Source 2 Available Time, Source 1 Connect Time, Source 2 Connect Time, Load Energized Time, Number of Transfers; Date, Time and Reason for Last 16 Transfers; Monitor Mode Event, Fail-Safe Event, Aborted Test

Table 2. Product Overview (Continued)

Specifications	Value
Front Panel	
Display Language Enclosure Compatibility	English, French NEMA® 1, 12 and 3R, UV-Resistant Faceplate
Operating Environmental Range	Operation -20°C – +70°C, Storage -30°C – +85°C, Humidity 0% – 95% Relative (Non-condensing)
Applicable Standards	UL 1008, UL 991, FCC Part 15, CISPR 11, IEC 1000-2,3,4,5, CSA, UBC and BOCA for Seismic Zone 4
Programming Access	Password
Front Panel Input Pushbuttons	Engine Test, Step, Help, Lamp Test, Increase, Decrease, Alarm Reset, Bypass Time Delays, Enter
Programming Selections	
Time Delay Normal to Emergency Time Delay Emergency to Normal Time Delay Engine Cooldown	0 – 1800 Seconds 0 – 1800 Seconds 0 – 1800 Seconds
Time Delay Engine Start Time Delay Neutral Time Delay Emergency Fail	0 – 120 Seconds 0 – 120 Seconds 0 – 6 Seconds
In-Phase In-Phase Frequency Difference Synchronization Time Allowance	Enabled or Disabled 0 – 3 Hz 1 – 60 Minutes
Pre-Transfer Signal Plant Exerciser	1 – 120 Seconds (Form “C” Contact) Selectable: Disabled, Daily or 7, 14, 28-Day Intervals, 0 – 600 Minutes, Load or No Load
System Sensing Voltage Unbalance Phase Reversal	3-Phase or Single-Phase 5% – 20% ABC – CBA
Test Pushbutton Mode	Disabled, Load, No Load
Undervoltage Dropout Range Undervoltage Pickup Range Overvoltage Dropout Range Overvoltage Pickup Range	50% – 97% of Nominal Dropout +2% – 99% of Nominal 105% – 120% of Nominal 103% of Nominal to Dropout -2%
Underfrequency Dropout Range Underfrequency Pickup Range	90% – 97% of Nominal Dropout +1 Hz – 99% of Nominal
Overfrequency Dropout Range Overfrequency Pickup Range	103% – 110% of Nominal 101% of Nominal to Dropout -1 Hz

ATC-300 Automatic Transfer Switch Controller Front Panel Display and Operator Functions



Unit Status
The Unit Status LED is a blinking indicator for self and system diagnostics.

Mimic Diagram
Source 1 and Source 2 color-coded LEDs provide Available and Connected status indication.

LCD-Based Display
The LCD-based display is a backlit, 2-line, 16-character display. Displayed information includes:

- Source voltages and frequency
- Time/date stamp
- Historical data
- Programming and set point information
- Password entry

Step/Enter
Pressing the Step/Enter pushbutton advances the information through the programming or display cycle.

Help
Pressing the Help pushbutton in any function mode will bring up display messages, explanations and prompts to assist the operator.

Increase and Decrease
Pressing the Increase or Decrease pushbuttons effect the value of the function presently active on the LCD-based display.

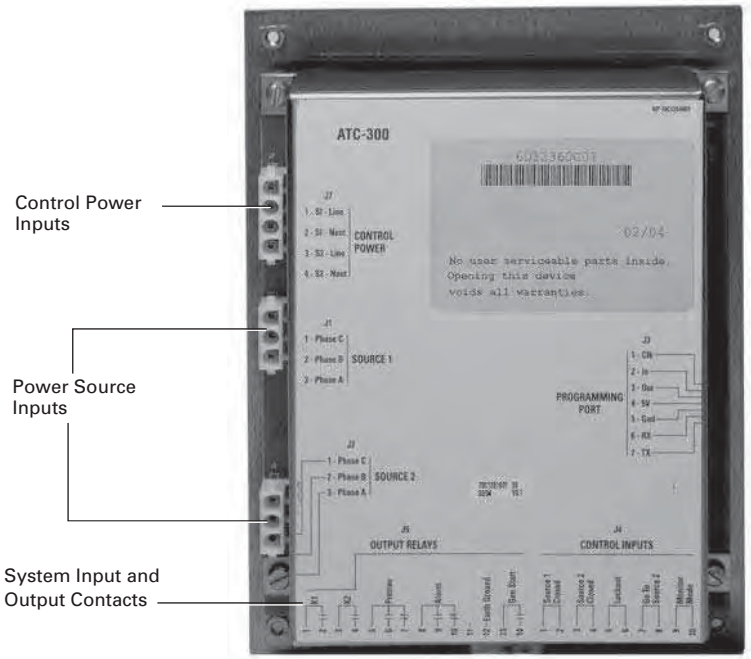
Engine Test
Pressing the Engine Test pushbutton twice initiates engine test cycle.

Alarm Reset
Pressing the Increase and Decrease pushbuttons simultaneously restores automatic operation in the event of an alarm condition).

Lamp Test
Pressing the Lamp Test pushbutton lights all LEDs and then displays ATC-300 controller information.

Bypass TDNE/TDEN
Pressing Step and Help/Lamp Test pushbuttons simultaneously reduces programmed time delays to zero to simplify test procedures.

ATC-300 Automatic Transfer Switch Controller



Rear View of ATC-300 Automatic Transfer Switch Controller

Output Contacts: The output contacts are dry relay contacts. The GEN START contact is rated 5 amperes at 250 Vac/ 30 Vdc. All other contacts are rated 10 amperes at 250 Vac/30 Vdc.

- K1, K2: These Form "A" output contacts are utilized to control single power switching mechanisms. They operate in conjunction with the SOURCE 1 and 2 CLOSED inputs.
- ALARM: Form "C" contact. This relay is energized during any of the following alarm conditions: failure of the power switching device to open or close, motor operator failure, unsuccessful in-phase transition, lockout condition, failed engine test, failed plant exerciser operation.
- PRE-TRAN: This relay operates on a timed basis (adjustable 0 – 120 seconds) prior to any transfer operation. Timing begins after TDNE or TDEN times out.
- GEN START: This is a latching relay utilized to initiate startup and shutdown cycles of the engine/ generator set.

Control Power Inputs (Source 1 and Source 2): The Control Power Input range is 65 Vac – 145 Vac, 50/60 Hz.

System Inputs: System Inputs are "wetted" contacts. Some system inputs are optional and must be enabled via factory control.

- SOURCE 1 CLOSED: This input is connected to the Source 1 power switching device position indication contact.
- SOURCE 2 CLOSED: This input is connected to the Source 2 power switching device position indication contact.
- LOCKOUT: This input is connected to an alarm contact. During an alarm condition, automatic operation is inhibited.
- GO TO SOURCE 2: This input provides the means to remotely initiate a startup and transfer cycle or retransfer and shutdown cycle.
- MONITOR MODE: This input allows the controller to be placed in a "non-automatic mode" while continuing to monitor source voltages and frequencies.
- EARTH GROUND: Provides a connection point for the common system ground.

Power Source Inputs (SOURCE 1 and SOURCE 2): The Power Source Inputs are the connection points for the power sources that are to be monitored. Three-phase systems are connected to Phase A, B and C. Single-phase systems are connected to points Phase A and Phase B.

Standard and Optional Features

All ATC-300 standard and optional features are listed in **Table 3**. All standard features are included and provided on all ATC-300 units.

Optional features must be specified with order entry and factory programmed. Only features that are originally ordered and factory programmed will appear on the LCD-based display. The ATC-300 Upgrade Module may be ordered to add optional features in the field.

Table 3. ATC-300 Automatic Transfer Controller — Standard and Optional Features

ATC-300 Features	Cutler-Hammer Feature Number	Field Programmable Set Point Range
Standard		
Time Delay Source 1 to Source 2 (TDNE) Time Delay Engine Start (TDES) Time Delay Source 2 to Source 1(TDEN) Time Delay Engine Cooldown (TDEC)	1 2 3 4	0 – 1800 Seconds 0 – 120 Seconds 0 – 1800 Seconds 0 – 1800 Seconds
Source 2 Single-Phase Undervoltage and Underfrequency Sensing	5B	UV Dropout: 50% – 97% of Nominal UV Pickup: (Dropout +2%) – 99% of Nominal UF Dropout: 90% – 97% of Nominal UF Pickup: (Dropout +1 Hz) – 99% of Nominal
Source 2 (Emergency) 3-Phase Undervoltage and Underfrequency Sensing	5J	UV Dropout: 50% – 97% of Nominal UV Pickup: (Dropout +2%) – 99% of Nominal UF Dropout: 90% – 97% of Nominal UF Pickup: (Dropout +1 Hz) – 99% of Nominal
Test Pushbutton Time Delay Emergency Fail (TDEF) Bypass TDEN Time Delay Bypass TDNE Time Delay	6B 7 8C 8D	No Load, Load or Disabled 0 – 6 Seconds Pushbutton Pushbutton
Source 1 Connected LED Indication Source 2 Connected LED Indication	12C 12D	N/A N/A
Source 1 Available LED Indication Source 2 Available LED Indication	12G 12H	N/A N/A
Plant Exerciser (Fail-Safe) with Selectable: (Daily, 7, 14 or 28-Day Cycle), (Load or No Load), (Day, Hour, Minute for Test Event) (0 – 600 Minutes Test Length)	23K	(Daily, 7, 14 or 28-Day Cycle), (No Load or Load) (Day, Hour, Minute) (0 – 600 Minutes Test Length)
Source 1 (All Phase) Undervoltage Sensing	26A	UV Dropout: 50% – 97% of Nominal UV Pickup: (Dropout +2%) – 99% of Nominal
Automatic Operation	29A	N/A
Seismic Zone 4 Qualification	42	N/A
Nominal Frequency Nominal Voltage	N/A N/A	50 or 60 Hz 120 – 600 Vac
System Phases Engine Test Run Duration for Engine Test Pushbutton and Plant Exerciser Duration	N/A N/A	1 or 3 0 – 600 Minutes
Optional		
Source 2 Single-Phase Overvoltage and Overfrequency Sensing	5C	OV Dropout: 105% – 120% of Nominal OV Pickup: 103% of Nominal to (Dropout -2%) OF Dropout: 103% – 110% of Nominal OF Pickup: 101% of Nominal to (Dropout -1 Hz)
Source 2 Single-Phase Undervoltage	5D	UV Dropout: 50% – 97% of Nominal UV Pickup: (Dropout +2%) – 99% of Nominal
Source 2 Single-Phase Overvoltage	5E	OV Dropout: 105% – 120% of Nominal OV Pickup: 103% of Nominal to (Dropout -2%)
Source 2 3-Phase Undervoltage	5F	UV Dropout: 50% – 97% of Nominal UV Pickup: (Dropout +2% – 99% of Nominal)
Source 2 3-Phase Overvoltage	5G	OV Dropout: 105% – 120% of Nominal OV Pickup: 103% of Nominal to (Dropout -2%)
Source 2 Phase Reversal	5H	0 = Disabled, 1 = ABC, 2 = CBA
Source 2 3-Phase Overvoltage and Overfrequency Sensing	5K	OV Dropout: 105% – 120% of Nominal OV Pickup: 103% of Nominal to (Dropout -2%) OF Dropout: 103% – 110% of Nominal OF Pickup: 101% of Nominal to (Dropout -1 Hz)
Source 2 3-Phase Voltage Unbalance	5L	(0 = Disabled, 1 = Active), (Dropout = 5% – 20%) (Pickup = 3% – (Dropout -2%)
Source 1 Overvoltage Sensing	26C	OV Dropout: 105% – 120% of Nominal OV Pickup: 103% of Nominal to (Dropout -2%)
Go to Source 2	26D	N/A
Source 1 Underfrequency Sensing	26E	UF Dropout: 90% – 97% of Nominal UF Pickup: (Dropout +1 Hz) – 99% of Nominal
Source 1 Overfrequency Sensing	26F	OF Dropout: 103% – 110% of Nominal OF Pickup: 101% of Nominal to (Dropout -1 Hz)
Source 1 Phase Reversal	26H	0 = Disabled, 1 = ABC, 2 = CBA
Source 1 3-Phase Voltage Unbalance	26L	(0 = Disabled, 1 = Active), (Dropout = 5% – 20%) (Pickup = 3% – (Dropout -2%)
Time Delay Neutral (TDN)	32A	0 – 120 Seconds
In-Phase Transition with Selectable (Enable or Disable), (Frequency Difference 0 – 3 Hz), (Synchronization Time 1 – 60 Minutes) and Default to Time Delay Neutral	32E	(Enable or Disable) (Frequency Difference 0 – 3 Hz) (Synchronization Time 1 – 60 Minutes)
Pretransfer Contacts (1NO/1NC)	35A	N/A

ATC-300 Upgrade Module

If an optional feature needs to be added after a transfer switch is in the field, contact the factory for availability of field upgrades with the ATC-300 Upgrade Module. This module can download new programs into the Automatic Transfer Controller (ATC-300) via connection to the communication module connector on the rear of the Automatic Transfer Controller device.

Dimensions in Inches (mm)

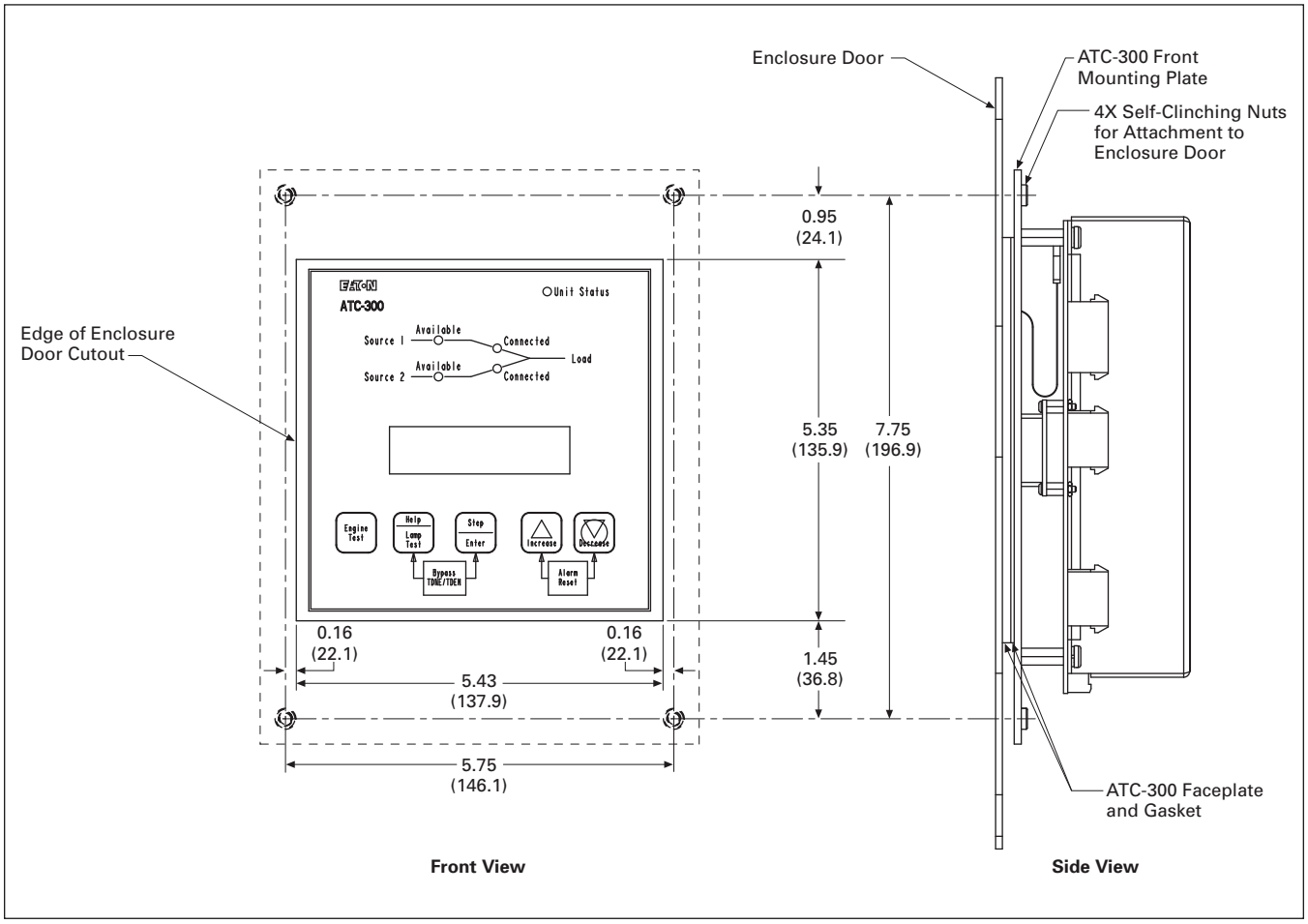


Figure 1. Automatic Transfer Controller (ATC-300)

UL is a federally registered trademark of Underwriters Laboratories Inc. CSA is a registered trademark of the Canadian Standards Association. UBC is a trademark of the International Conference of Building Officials (ICBO). BOCA is a registered trademark of Building Officials and Code Administrators International, Inc. Cutler-Hammer is a federally registered trademark of Eaton Corporation. NEMA is the registered trademark and service mark of the National Electrical Manufacturers Association.

Dimensions are approximate and should not be used for construction purposes (1 inch = 25.4 mm).

Commutateurs de transfert à disjoncteur

Type de commutateur - Fonctionnement automatique, manuel et électrique
30 A à 1000 A



Commutateur de transfert automatique ATHM



Description du produit

Une gamme économique de commutateurs de transfert avec automate informatisé offrant des caractéristiques de base pour les utilisations d'alimentation de base de systèmes de 30 à 1000 A jusqu'à 600 V, à 2, 3 ou 4 pôles.

Caractéristiques électriques

- 40, 100, 150, 200, 225, 260, 400, 600, 800 et 1000 ampères
- 2, 3 ou 4 pôles
- Jusqu'à 600 V c.a., 50/60 Hz.
- NEMA® 1, 3R, ouvert, 12, 4, 4x
- Approuvé UL 1008
- Homologué CSA® C22.2 n° 178

Caractéristiques standard (ATC300)

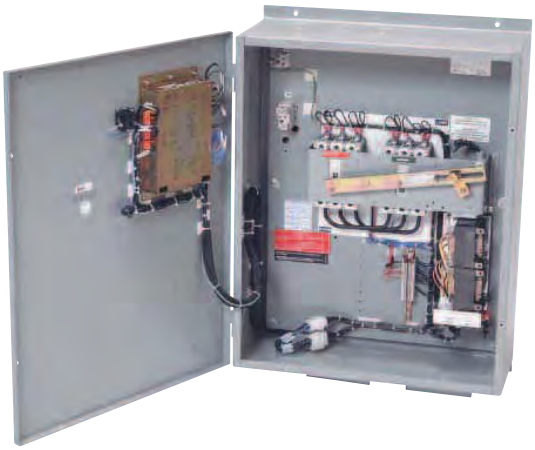
- Positions des contacts de commutateur
  - Source 1 Position 1NO et 1NF
  - Source 2 Position 1NO et 1NF
- Commande programmable à microprocesseur
- Surveillance du système d'alimentation normale et d'urgence
- Simulation des sources d'énergie à sécurité intégrée (programmable)
- Valeurs de tenue, de pouvoir de coupure et de fermeture élevées
- Transfert manuel sous charge
- Contacts de démarrage du moteur
- Délai temporisé entre le mode normal et le mode d'urgence
- Délai temporisé de démarrage du moteur
- Délai temporisé urgence à normal
- Délai temporisé de refroidissement du moteur
- Indicateurs DEL – position du commutateur
- Indicateurs DEL – source disponible
- Détection de sous-tension/sous-fréquence de la source d'urgence
- Détection de sous-tension de la source normale
- Délai temporisé de charge neutre
- Passer au contact d'urgence (protection de zone)
- Contacts de signal de prétransfert
- Délais temporisés de dérivation à bouton-poussoir

Caractéristiques en option

- Suppresseur de surtension disponible pour commande/alimentation, circuit de démarrage de moteur, connexions de téléphone et de câble
- Chaufferette avec thermostat
- Ampèremètre - du côté de la charge
- Surveillance de la qualité du courant
- Couvercle de commande en acier inoxydable

Caractéristiques en option (ATC 600)

- Communication à distance
- Délestage de la charge d'urgence
- Fonctionnement automatique ou non automatique sélectionnable





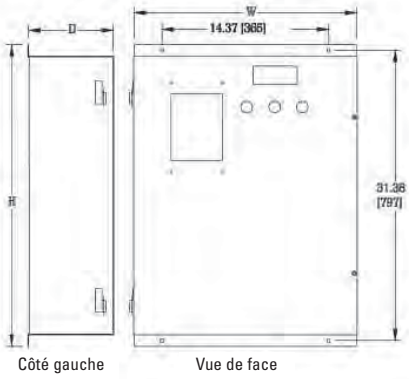


Figure A

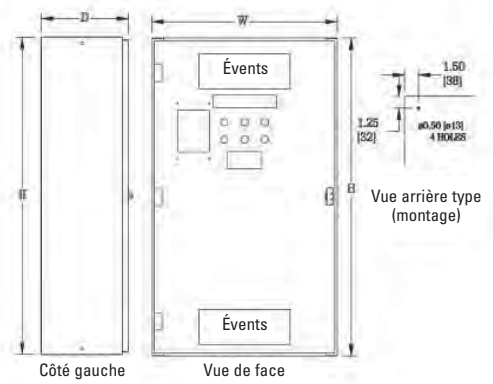


Figure B

DIMENSIONS DU BOÎTIER DE COMMUTATEUR DE TRANSFERT

Dimension du châssis	Nominale	Figure	Hauteur	Largeur	Profondeur
F	30A - 150A, 600V 30A - 200A, 240V	A	32,63 po (829)	24 po (610)	9 po (229)
→ K, L, M	225A - 600A	B	55 po (1397)	32 po (813)	15 po (381)
N	800A - 1200A	B	65 po (1651)	38 po (965)	16 po (406)

AT H 3 KD A 3 0300 B S C

Type
- **AT** = Automatique
- **MT** = Non automatique Manuel
- **NT** = Non automatique - Électrique

Automate programmable
- **3** = ATC-300
- **I** = ATC-600
- **X** = Sans logique

Montage
- **A** = Source1 (MCS), Source 2 (MCS)
- **B** = Source1 (MCCB), Source 2 (MCCB)
- **C** = Source1 (MCCB), Source 2 (MCS)
- **D** = Source1 (MCS), Source 2 (MCCB)

Nombre de pôles
- **2** = 2 pôles
- **3** = 3 pôles
- **4** = 4 pôles

Ampères
- **0030** = 30 A
- **0070** = 70 A
- **0100** = 100 A
- **0150** = 150 A
- **0200** = 200 A
- **0300** = 300 A
- **0400** = 400 A
- **0600** = 600 A
- **0800** = 800 A
- **1000** = 1000 A

Tension
- **A** = 120 V, 60 Hz
- **B** = 208 V, 60 Hz
- **E** = 600 V, 60 Hz
- **G** = 220 V, 50 Hz
- **H** = 380 V, 50 Hz
- **K** = 600 V, 50 Hz
- **M** = 230 V, 50 Hz
- **N** = 401 V, 50 Hz
- **O** = 415 V, 50 Hz
- **W** = 240 V, 60 Hz
- **X** = 480 V, 60 Hz
- **Z** = 365 V, 50 Hz

Boîtier
- **S** = NEMA 1
- **R** = NEMA 3R
- **J** = NEMA 12
- **L** = NEMA 4
- **D** = NEMA 4X
- **K** = Ouvert
- **P** = À l'épreuve des gicleurs

Orientation
- **H** = Horizontal

Bâti du commutateur

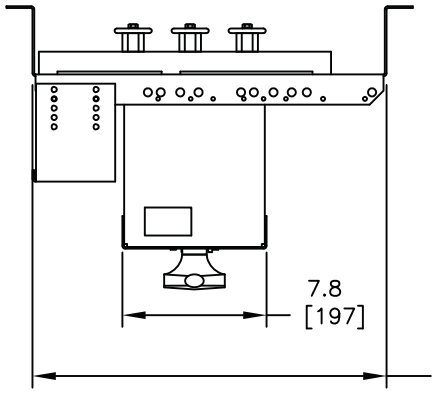
Type	240 V c.a.	480 V c.a.	600 V c.a.
FD = Bâti F	30-225A*	30-150A	30-150A
→ **KD** = Bâti K	400A	200-300A	200-300A
LD = Bâti L	600A	400A	400A
MD = Bâti M	800A	600A**	600A**
NB = Bâti N	800-1000A	800-1000A	800-1000A

Homologations
- **U** = Classifié UL
- → **C** = Certifié CSA

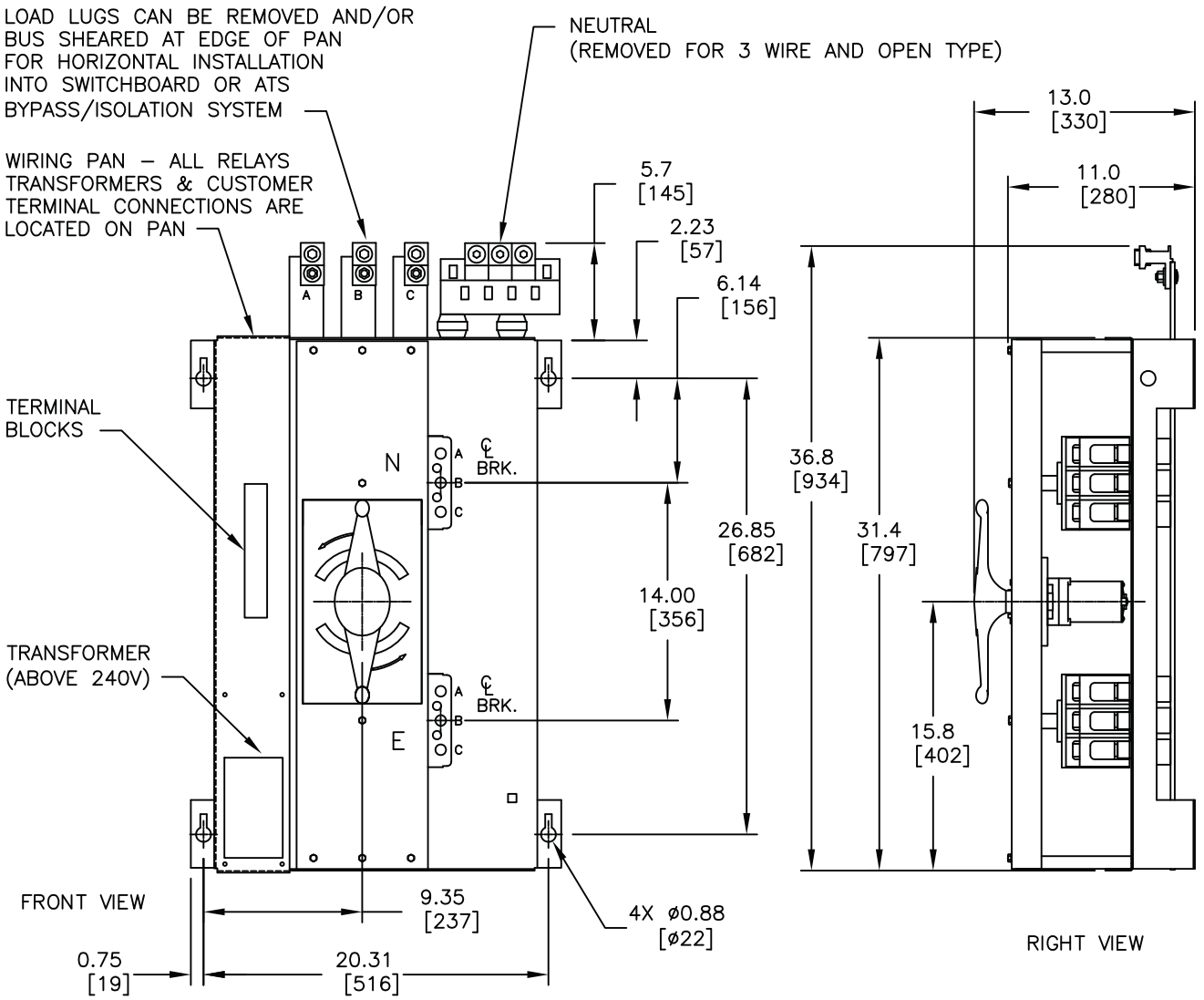
Remarques : * Applications monophasées 225 A seulement
** 4 pôles, 600 V c.a., 600 A et bâti N

Système de numérotation du catalogue de commutateurs de transfert automatique à disjoncteur

REVISION	
2	ADDED 150A RATING GG 5/9/06
01	



DIMENSIONS FOR OPEN–TYPE APPLICATION



WIRE SIZE FOR STANDARD TERMINALS PER PHASE

AMP. RATING	SWITCHING DEVICE	LINE	LOAD	NEUTRAL
150, 200, 225, 250	K	(1) #3–350 MCM AL/CU	(1) 3/0–750 MCM AL/CU OR (2) 3/0–250MCM	(3) 3/0–750 MCM AL/CU OR (6) 3/0–250MCM
300,350 400 (240V MAX.) 400 (TYPE B)	K	(1) 2/0–500 MCM AL/CU OR (2) 2/0–250MCM	(1) 3/0–750 MCM AL/CU OR (2) 3/0–250MCM	(3) 3/0–750 MCM AL/CU OR (6) 3/0–250MCM

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DFTR	DATE
RGC	15 MARCH 2006
APPD	DATE
RSA	20 APRIL 2006
S.O.	

EATON | Cutler-Hammer MILTON, ON

TITLE: WALL MOUNT AUTOMATIC TRANSFER SWITCH K–FRAME (150A – 400A)

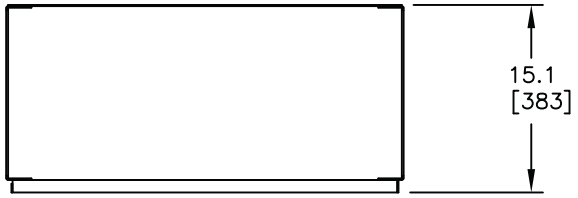
TYPE: ATH_K, NTHXK, MTHXK

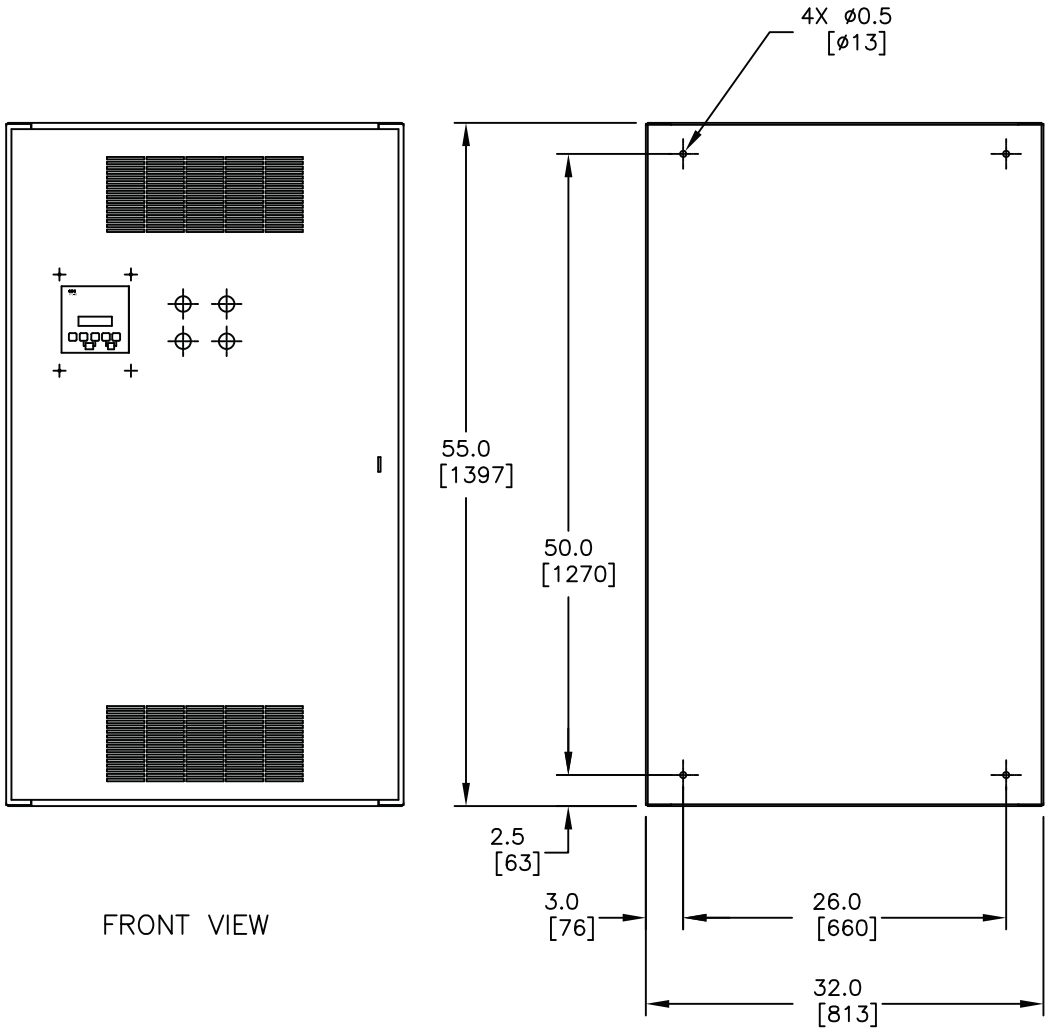
CE23115_SH1.DWG

FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE	G.O.	DWG	SHEET
80429	PG 230	2	A		CE23115	1 OF 2

REVISION
01

ENCLOSURE DIMENSIONS





FRONT VIEW

REAR MOUNTING HOLES

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DFTR	DATE
RGC	15 MARCH 2006
APPD	DATE
RSA	20 APRIL 2006
S.O.	

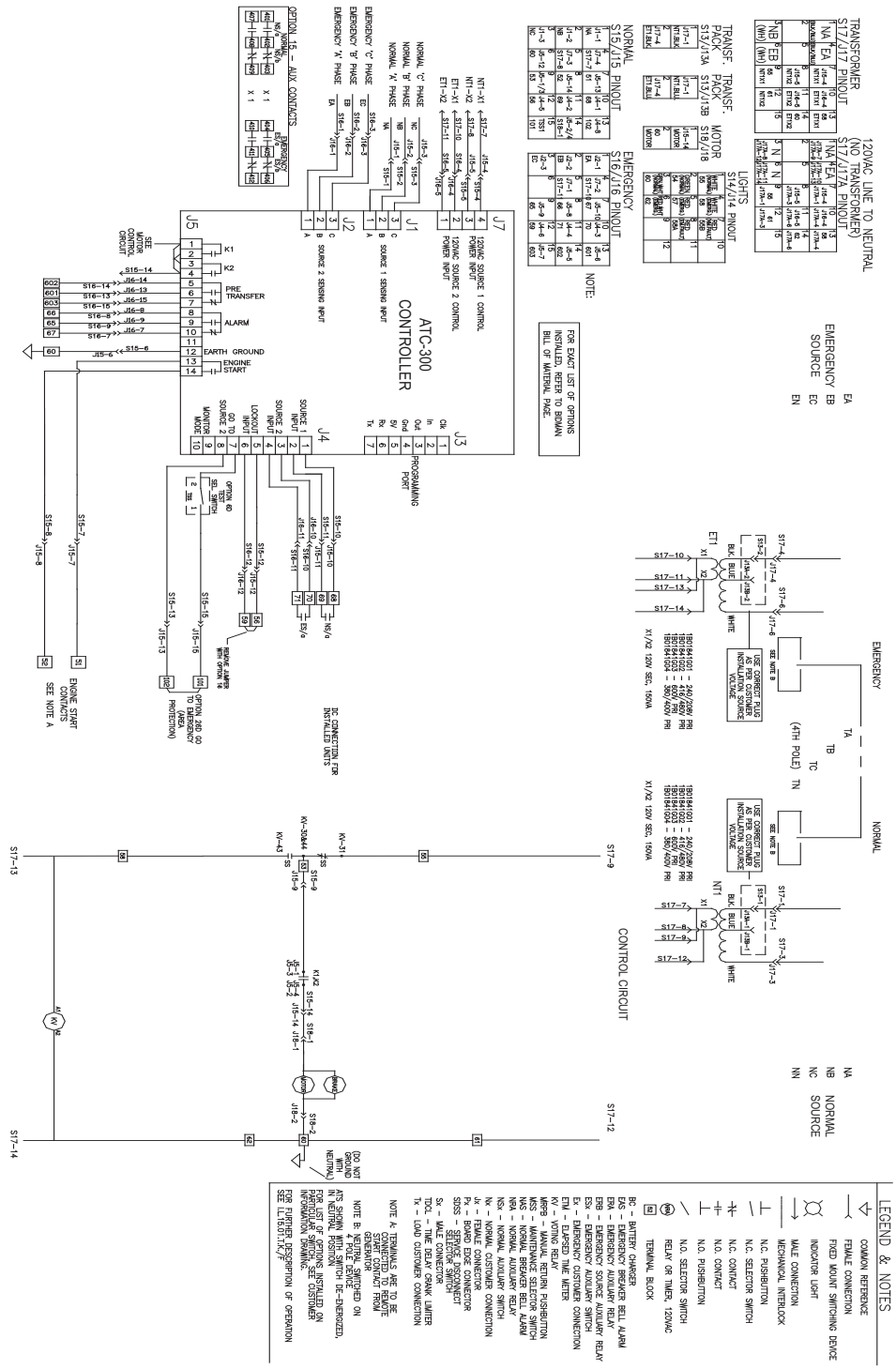
EATON | Cutler-Hammer MILTON, ON

TITLE: WALL MOUNT AUTOMATIC TRANSFER SWITCH K-FRAME ENCLOSURE

TYPE: ATH_K, NTHXK, MTHXK

CE23115_SH2.DWG

FEDERAL ID NO.	PRODUCT CODE	REVISION	DWG SIZE	G.O.	DWG	SHEET
80429	PG 230	1	A		CE23115	2 OF 2



The information on this document is created by Eaton Corporation. It is disclosed in confidence and it is only to be used for the purpose in which it is supplied.	PREPARED BY **PHILIPPEMONTPETIT**	DATE **04/21/11**	**Eaton Corporation**		
	APPROVED BY	DATE	JOB NAME **ATH3FDA30150ESC**		
			DESIGNATION		
	VERSION **7.5**		TYPE	DRAWING TYPE **Customer Appr.**	
NEG-ALT NUMBER **SO750421C104-0000**	REVISION	DWG SIZE **A**	G.O.	ITEM	SHEET **3 OF 3**

Cutler- Hammer "Contactor Type" Transfer Switches (Wallmount and Bypass Transfer Switches) "Specific Breaker" Withstand / Closing Ratings

When protected by a specific upstream circuit breaker as shown, the transfer switch is rated for use on a circuit capable of delivering not more than the RMS Symmetrical amps at the voltage shown below.

Voltage	Transfer Switch Ampere Rating	Number of Poles Switched	Maximum fault level available at upstream device (kA symmetrical)						
			Upstream Specific*						
			10kA	22kA	30kA	35kA	42kA	50kA	65kA
120/240 and 240, 208Y/120	30-100A	2,3,4	Specific*	Specific*	Specific*	---	---	---	---
	125 - 200	2,3,4	Specific*	Specific*	Specific*	---	---	---	---
	300-400	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	---
	600	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*
	800 - 1200	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*
480Y/277 and 480	30-100A	2,3,4	Specific*	Specific*	Specific*	---	---	---	---
	125 - 200	2,3,4	Specific*	Specific*	Specific*	---	---	---	---
	300-400	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	---
	600	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*
	800 - 1200	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*
600Y/347 and 600	30-100A	2,3,4	Specific*	Specific*	---	---	---	---	---
	125 - 200	2,3,4	Specific*	Specific*	---	---	---	---	---
	300-400	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	---	---
	600	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*
	800 - 1200	2,3,4	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*	Specific*

* Contact Cutler Hammer

04/05/09

Cutler-Hammer "Breaker Type" Transfer Switch Withstand / Closing Ratings

When protected by any manufacturers' breaker or Cutler-Hammer circuit breaker upstream as shown, the transfer switch is rated for use on a circuit capable of delivering not more than the RMS Symmetrical amps at the voltage shown below.

Voltage	Transfer Switch Ampere Rating	Number of Poles Switched	Maximum fault level available at upstream device (kA symmetrical)						
			Upstream any manufacturers' breaker or Cutler-Hammer circuit breaker type						
			25kA	35kA	42kA	50kA	65kA	100kA	200kA
120/240 and 240, 208Y/120	30 - 200	2,3,4	Any*	Any*	Any*	Any*	Any*	Any*	FDC,JDC,KDC
	225	2	Any*	Any*	Any*	Any*	Any*	Any*	FDC,JDC,KDC
	300	2,3,4	Any*	Any*	Any*	Any*	Any*	Any*	KDC
	400	2,3,4	Any*	Any*	Any*	Any*	Any*	Any*	KDC
	600	2,3,4	Any*	Any*	Any*	Any*	Any*	Any*	LDC
	800 - 1000	2,3,4	Any*	Any*	Any*	Any*	Any*	Any*	---
480Y/277 and 480	30 - 150	2,3,4	Any*	Any*	Any*	Any*	Any*	(FDB/FD)+LFD FDC,JDC,KDC	150kA FCL***,LCL***
	200 - 300	2,3,4	Any*	Any*	Any*	Any*	Any*	KDC,NB-TP**	LCL***
	400	2,3,4	Any*	Any*	Any*	Any*	Any*	---	---
	600	2,3	Any*	Any*	Any*	Any*	Any*	NB-TP	---
	800	2,3	Any*	Any*	Any*	Any*	---	NB-TP	---
	600 - 1000	4	Any*	Any*	Any*	Any*	---	---	---
	1000	2,3	Any*	Any*	Any*	Any*	---	---	---
600Y/347 and 600	30 - 150	2,3,4	Any*	Any*	(FD/FDB)+LFD KDC	(FD/FDB)+LFD KDC	(FD/FDB)+LFD KDC	(FD/FDB)+LFD LCL	---
	200 - 300	2,3,4	Any*	Any*	Any*	KDC	KDC	LCL	---
	400	2,3,4	Any*	Any*	Any*	KDC	KDC	---	---
	600	2,3	Any*	Any*	Any*	LDC	---	---	---
	600	4	Any*	---	---	---	---	---	---
	800 - 1000	2,3,4	Any*	---	---	---	---	---	---

*Any manufacturers' breaker ** with P12 limiter *** 150kA maximum

Cutler-Hammer "Breaker Type" Transfer Switch Withstand / Closing Ratings

When protected by an upstream fuse type shown, the transfer switch is rated for use on a circuit capable of delivering not more than the RMS Symmetrical amps at the voltage shown below.

Voltage	Transfer Switch Ampere Rating	Number of Poles Switched	Maximum fault level available at upstream device (kA symmetrical)		
			Upstream Fuse Type		Max Fuse Amperes
			100kA	200kA	
120/240 and 240, 208Y/120	30 - 225	2,3,4	---	J, T	200A
			J, T	---	400A
	300	2,3,4	R	J, T	400A
			J, T	---	600A
	400	2,3,4	J, T	R	600A
			L	---	1200A
	600	2,3,4	L	---	800A
			---	L	1600A
	800 - 1000	2,3,4	---	L	1600A
480Y/277, 480, 600Y/347 and 600	30 - 150	2,3,4	---	J, T	200A
			J, T	---	400A
	200 - 300	2,3,4	R	J, T	400A
			J, T	---	600A
	400	2,3,4	J, T	R	600A
			L	---	1200A
	600	2,3	L	---	800A
			---	L	1600A
	600	4	---	L	1600A
	800 - 1000	2,3,4	---	L	1600A

SECTION 4

Customer Interconnection

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

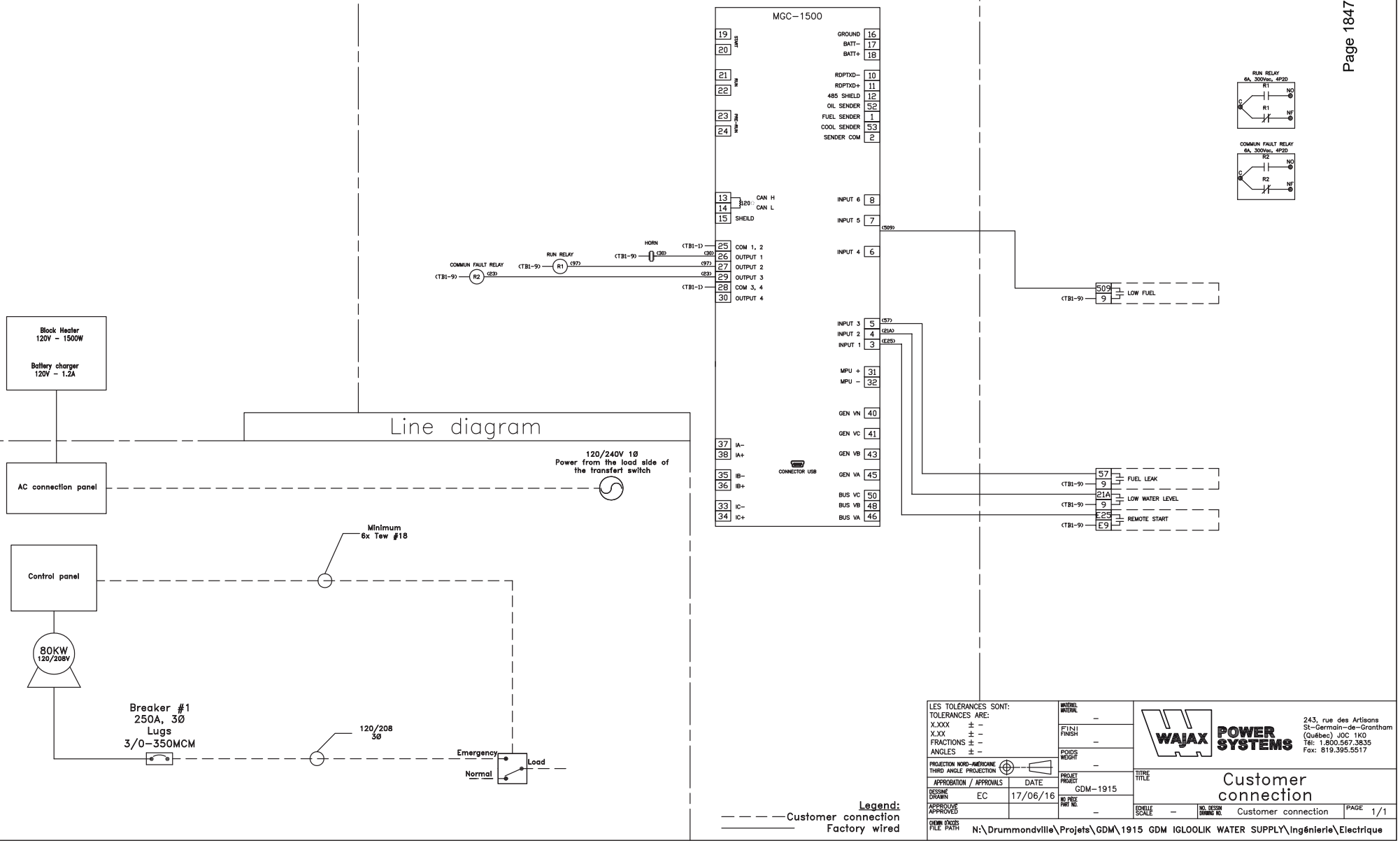
Out for approval

SIFEC NORTH INC.

AC Distribution

Customer connection

Line diagram



Legend:

- — — — Customer connection
- ——— Factory wired

LES TOLÉRANCES SONT: TOLERANCES ARE: X.XXX ± – X.XX ± – FRACTIONS ± – ANGLES ± –	MATÉRIEL MATERIAL –	WAJAX POWER SYSTEMS 243, rue des Artisans St-Germain-de-Grantham (Québec) J0C 1K0 Tél: 1.800.567.3835 Fax: 819.395.5517
PROJECTION NORD-AMÉRICAINE THIRD ANGLE PROJECTION	FINI FINISH –	
APPROBATION / APPROVALS DATE	POIDS WEIGHT –	TITRE TITLE: Customer connection
DESSINÉ DRAWN EC 17/06/16	PROJET PROJECT GDM-1915	
APPROUVÉ APPROVED	NO. PIÈCE PART NO. –	ÉCHELLE SCALE – NO. DESSIN DRAWING NO. Customer connection PAGE 1/1
CHEMIN D'ACCÈS FILE PATH N:\Drummondville\Projets\GDM\1915 GDM IGLOOLIK WATER SUPPLY\Ingénierie\Electrique		

SECTION 5

Warranties, Certifications & Procedures

SHOP DRAWING

Reviewed by: Samuel Charbonneau

Date: 17 juin 2016

Reviewed	X
Reviewed as noted	
Resubmit	

Out for approval

SIFEC NORTH INC.

MTU ONSITE ENERGY– STANDBY LIMITED WARRANTY
TWO (2) YEARS / 3,000 HOUR BASIC

LIMITED WARRANTY: Your MTU Onsite Energy product has been manufactured and inspected with care by experienced craftspeople. If you are the original consumer, MTU Onsite Energy warrants, for the limited warranty period indicated below, each product to be free from defects in materials and workmanship, and will perform under normal use and service from valid startup performed by MTU Onsite Energy. This Limited Warranty shall apply only when the product has been property installed, serviced, and operated in accordance with the applicable MTU Onsite Energy instruction manuals. If this Limited Warranty applies, the liability of MTU Onsite Energy shall be limited to the replacement, repair, or appropriate adjustment of the product, at MTU Onsite Energy's option. This Limited Warranty does not apply to malfunctions caused by normal wear and tear, or by damage, unreasonable use, misuse, repair, or service by unauthorized persons.

LIMITED WARRANTY PERIOD: Engine Generator Set: Parts and labor for 24 (twenty-four) months will begin with the first commissioning of the product(s). In all cases, the warranty period will expire not later than 36 (thirty-six) months from the date of shipment ex-works MTU Onsite Energy or after 3,000 operation hours, whichever occurs first. Accessories: Parts and labor for one (1) year from date of shipment. For a description of accessories and items excluded from this Limited Warranty, review the listings on the reverse side of this document.

LIMITED WARRANTY CONDITIONS: Before there is any protection under this Limited Warranty, the distributor must: (1) complete the MTU Onsite Energy Warranty, Start-Up Validation and Pre - Inspection form and return it to MTU Onsite Energy within 60 days of the start-up date, and (2) complete the engine registration form and return it to the manufacturer as stated in the instructions with engine registration form (when applicable). In addition, this Limited Warranty is not valid or enforceable unless: (1) all supporting maintenance records is to be kept on file with the end user and made available upon request from factory, (2) the generator set is routinely exercised in accordance with operating instructions, and (3) the installation meets the general guidelines, standards, and recommendations as laid out in the Installation Guide provided with the product and all local standards and codes applicable in the location of installation.

Engine generator sets that are stored by Owner / Buyer longer than 180 days from date of shipment are subject to special requirements. Contact MTU Onsite Energy's Service Center for instructions.

TO OBTAIN WARRANTY SERVICE: Warranty service may only be performed by MTU Onsite Energy authorized service providers. **Service provided by unauthorized persons will void this Limited Warranty. Non-MTU Onsite Energy replacement part(s) will void this Limited Warranty.**
Contact your nearest MTU Onsite Energy Service Representative to obtain warranty service. For assistance in locating your nearest authorized service representative, see contact information at the bottom of this page.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED. NO WARRANTIES SHALL BE IMPLIED OR OTHERWISE CREATED UNDER THE UNIFORM COMMERCIAL CODE, INCLUDING BUT NOT LIMITED TO A WARRANTY OF MERCHANTABILITY OR A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

MTU ONSITE ENERGY SHALL NOT BE LIABLE FOR ANY CLAIM GREATER IN AMOUNT THAN THE PURCHASE PRICE OF THE PRODUCT AT ISSUE, AND IN NO EVENT SHALL MTU ONSITE ENERGY BE LIABLE FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES. STATE LAWS REGARDING THE RIGHTS OF CONSUMERS MAY VARY FROM STATE TO STATE.

1. The following items are not considered nor will they be covered under this Limited Warranty. If there are questions as to coverage under this Limited Warranty, it is advisable to contact the factory in advance of filing a claim.
   a. Battery or batteries of any type or kind. The battery manufacturer's warranty, if any, is the only warranty that applies to batteries. Any warranty claim should be handled with the manufacturer according to its policies.
   b. Adjustments to fuel systems or governor system at time of start-up or any time after. A warranty claim for such adjustments is acceptable only when a defective part has been replaced, returned to the factory, and approved as defective.
   c. Normal maintenance costs, including but not limited to adjustments, loose and/or leaking fittings or clamps, and tune-ups performed during start-up or anytime thereafter.
   d. Due to shipping, manufacturer is not responsible for loose connections. All connections must be checked at time of start-up.
   e. Non-MTU Onsite Energy replacement part(s) will void this Limited Warranty.

TOGNUM GROUP COMPANIES

Europe / Middle East / Africa / Latin America / MTU Onsite Energy / 88040 Friedrichshafen / Germany / Phone + 49 7541 90 7060 / Fax +49 7541 90 7084 / powergenregion1@mtu-online.com // **Asia / Australia / Pacific /** MTU Onsite Energy / 1, Benoi Place / Singapore 629923 / Republic of Singapore / Phone + 65 6861 5922 / Fax + 65 6861 3615 / powergenregion2@mtu-online.com // **USA / Canada / Mexico /** MTU Onsite Energy Corporation/ 100 Power Drive / Mankato, Minnesota 56002 / USA / Phone + 1 507 625 7973 / Fax + 1 507 625 2968 / powergenregion3@mtu-online.com // **Worldwide for HotModule /** MTU Onsite Energy GmbH/ 81663 Munich / Germany / Phone + 49 89 203042 800 / Fax +49 89 203042 900 / hotmodule@mtu-online.com //www.mtu-online.com

MTU ONSITE ENERGY– STANDBY LIMITED WARRANTY
TWO (2) YEARS / 3,000 HOUR BASIC

f. Products that are modified in any form without the written consent of MTU Onsite Energy will void this Limited Warranty.
g. Shipping damage of any type.
h. Any installation errors or damage of the equipment when shipped as ordered.
i. Any overtime travel or labor to make repairs under warranty.
j. Any special access fees required to gain access to MTU Onsite Energy equipment, including but not limited to any training or safety policy requirements to gain access.
k. Additional costs associated with inaccessible installations, including but not limited to removal and reinstallation of the generator set.
l. Rental equipment used during warranty work including but not limited to generators, rigging equipment such as a crane or boom truck, load banks and special test equipment above factory requirements.
m. Excess mileage charges. Any authorized service provider may perform warranty service anywhere, but will only be paid for mileage expenses from the nearest service center and limited to 400 miles / 644 Kilometers roundtrip.
n. Any equipment not factory approved and engineered for use on MTU Onsite Energy products. This includes but is not limited to aftermarket items such as special fuel systems, enclosures, exhaust systems, or switch gear that had been sought out and quoted by a third party to be included in billing of the MTU Onsite Energy equipment.
o. Misuse or abuse during installation and thereafter.
p. Normal wear and tear, maintenance, and consumable items that are not required as part of a warranty repair.
Consumable items include but are not limited to belts, hoses, coolant, oil, filters, and fuses.
q. Acts of nature or acts of God such as lightning, wind, flood, tornado, hurricane or earthquake.
r. Any damage due to situations beyond the control of the manufacturing of the product or workmanship of the product.
s. Installation or operation outside the guidelines as stated in the Installation Guide and Owner's Manual.
t. Diesel engine "Wet Stacking" due to lightly loaded diesel engines.
u. Misapplication of the equipment such as usage outside the original design parameters as stated on the nameplate of the equipment.
v. Travel expense on portable equipment.
w. Trailer lights, wiring, and brakes.
x. More than one trip to the job site because a service vehicle was not stocked with normal service parts.
y. Lodging expense of person(s) performing service, unless approved in advance by factory.
z. Engine fluids.
aa. Units purchased at the Standby Power rating that are being used in a prime power application.
bb. Any repair labor time that is determined to be excessive, e.g., two or more people performing a one-person job.
cc. Any expenses associated with investigating performance complaints in which no defect is found.
dd. Any associated costs for replacing components that are found not to be defective.
ee. Any adjustments covered in the start-up and inspection forms that are to be completed during start-up.

2. The accessories that are limited to one (1) year parts and labor from date of shipment include but are not limited to:
   a. Cords, receptacles, and cord reels
   b. Gas flex pipes
   c. Housing lights, space heaters, and associated equipment

Rev. 20100420

TOGNUM GROUP COMPANIES

Europe / Middle East / Africa / Latin America / MTU Onsite Energy / 88040 Friedrichshafen / Germany / Phone + 49 7541 90 7060 / Fax +49 7541 90 7084 / powergenregion1@mtu-online.com // **Asia / Australia / Pacific /** MTU Onsite Energy / 1, Benoi Place / Singapore 629923 / Republic of Singapore / Phone + 65 6861 5922 / Fax + 65 6861 3615 / powergenregion2@mtu-online.com // **USA / Canada / Mexico /** MTU Onsite Energy Corporation/ 100 Power Drive / Mankato, Minnesota 56002 / USA / Phone + 1 507 625 7973 / Fax + 1 507 625 2968 / powergenregion3@mtu-online.com // **Worldwide for HotModule /** MTU Onsite Energy GmbH/ 81663 Munich / Germany / Phone + 49 89 203042 800 / Fax +49 89 203042 900 / hotmodule@mtu-online.com //www.mtu-online.com

Selling Policy, Distribution and Control Products, and Service Solutions General Terms and Conditions of Sale

Terms and Conditions of Sale
The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services (hereinafter referred to as Product(s) or Services by Eaton Industries (Canada) Company (hereinafter referred to as Seller) to the Buyer, and supersedes all prior quotations, purchase orders, correspondence or communications whether written or oral between the Seller and the Buyer. Notwithstanding any contrary language in the Buyer's purchase order, correspondence or other form of acknowledgment, Buyer shall be bound by these Terms and Conditions of Sale when it sends a purchase order or otherwise indicates acceptance of this contract, or when it accepts delivery from Seller of the Products or Services. THE CONTRACT FOR SALE OF THE PRODUCTS OR SERVICES IS EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS OF SALE STATED HEREIN. ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER ARE REJECTED UNLESS EXPRESSLY AGREED TO IN WRITING BY SELLER. No contract shall exist except as herein provided.

Complete Agreement
No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on the Seller unless made in writing by an authorized representative of the Seller. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this contract even though the accepting or acquiescing party had knowledge of the nature of the performance and opportunity for objection.

Quotations
Written quotations are valid for 30 days from its date unless otherwise stated in the quotation or terminated sooner by notice.

Verbal quotations, unless accepted, expire the same day they are made.

A complete signed order must be received by Seller within 20 calendar days of notification of award; otherwise the price and shipment will be subject to re-negotiation.

Termination and Cancellation
Any order may be terminated by the Buyer only by written notice and upon payment of reasonable termination charges, including all costs plus profit.

Seller shall have the right to cancel any order at any time by written notice if Buyer breaches any of the terms hereof, becomes the subject of any proceeding under provincial or federal law for the relief of debtors, or otherwise becomes insolvent or bankrupt, generally does not pay its debts as they become due or makes an assignment for the benefit of creditors.

Prices
All prices are subject to change without notice. In the event of a price change, the effective date of the change will be the date of the new price or discount sheet, letter or telegram. All quotations made or orders accepted after the effective date will be on the new basis. For existing orders, the price of the unshipped portion of post price increase dated orders will be the price in effect at time of order entry. We reserve the right to limit order quantities and requested ship dates pre price increase.

Price Policy – Products and Services
When prices are quoted as firm for quoted shipment, they are firm provided the following conditions are met:

1. The order is released with complete engineering details.
2. Shipment of Products is made, and Services purchased are provided within the quoted lead-time.
3. When drawings for approval are required for any Products, the drawings applicable to those Products must be returned within 30 calendar days from the date of the original mailing of the drawings by Seller (60 days where a Contractor is involved). The return drawings must be released for manufacture and shipment and must be marked "APPROVED" or "APPROVED AS NOTED". Drawing re-submittals, which are required for any other reason than to correct Seller errors, will not extend the 30-day period.

If the Buyer initiates or in any way causes delays in shipment, provision of Services or return of approval drawings beyond the periods stated above, the price of the Products or Services will be increased 1% per month or fraction thereof up to a maximum of 18 months from the date of the Buyer's order. For delays resulting in shipment or provision of Services beyond 18 months from the date of the Buyer's order, the price must be renegotiated.

Minimum Billing
Shelf goods individual purchase orders less than $100.00 will be billed $100.00.

Rush Shipments
Fee applies to shelf product orders where the customer requests "guaranteed" same day rush treatment of available product.

Taxes
The price does not include any taxes. Buyer shall be responsible for the payment of all taxes applicable to, or arising from the transaction, the Products, its sale, value, or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

TERMS OF PAYMENT
Product
At option of Seller one of the following will be quoted:

Terms of Payment - Net 25th Prox.
Terms of payment are Net 25th of the month following shipment.

Cash Discount
A cash discount can be applied to orders for predefined Products designated by Seller from time to time, whether shipped to a Distributor or drop shipped. The discount will be earned on orders for such Products when payment is received on or before the 10th day of the month following shipment by Seller **and where the account is not in arrears.**

Terms of Payment - Net 30
Terms of payment are net within 30 days from the date of invoice.

Progress Billings: we reserve the right to require progress payment terms on orders over $500,000 Canadian.

Services
Terms of payment are net within 30 days from date of invoice for orders amounting to less that $50,000.00.

Terms of payment for orders exceeding $50,000.00 shall be made according to the following:
1. Twenty percent (20%) of order value with the purchase order payable 30 days from date of invoice.
2. Eighty percent (80%) of order value in equal monthly payments over the performance period payable 30 days from date of invoice.

Except for work performed (i) under a firm fixed price basis or (ii) pursuant to terms of a previously priced existing contract between Seller and Buyer, invoices for work performed by Seller shall have added and noted on each invoice a charge of 3% (over and above the price of the work) which is related to Seller compliance with present and proposed environmental, health, and safety regulations associated with prescribed requirements covering hazardous materials management and employee training, communications, personal protective equipment, documentation and record keeping associated therewith.

Adequate Assurances
If, in the judgment of Seller, the financial condition of the Buyer, at any time during the period of the contract, does not justify the terms of payment specified, Seller may require full or partial payment in advance.

Delayed Payment
If payments are not made in accordance with these terms, a service charge will, without prejudice to the right of Seller to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance. In addition, any special remuneration will be forfeited until payment is made.

FREIGHT
Freight policy will be listed on the Product discount sheets, or at option of Seller one of the following will be quoted:

F.O.B. - P/S - Frt./Ppd. and Allowed
Product is sold F.O.B. point of shipment, freight prepaid and included to the Buyer for purchase orders valued at $1,000.00 or more, pre-tax. Freight is charged at 5% of invoice value or $25.00 whichever is greater, for orders less than $1,000.00. The 5% fee will be waived on 'collect', premium freight (charged) minimum billing or 'rush fee' applied shipments.

Seller reserves the right to charge freight on small project 'staged' shipments post the initial shipment, when the staged shipments are at customer request.

F.O.B. - P/S - Frt./Charged
Product is sold F.O.B. point of shipment and freight charged to the Buyer.

F.O.B. Destination - Frt./Ppd. and Allowed
At Buyer's option, Seller will deliver the Products F.O.B. destination freight prepaid and 2% will be added to the net price. The term "freight prepaid" means that freight charges will be prepaid to the accessible common carrier delivery point nearest the destination for shipments within Canada unless noted differently on the Product discount sheets. For any other destination contact Seller's representative.

Shipment and Routing
Seller shall select the point of origin of shipment, the method of transportation, the type of carrier equipment, and the routing of the shipment.

If the Buyer specifies a special mode of transportation, type of carrier equipment, routing, or delivery requirement, Buyer shall pay all special freight and handling charges.

When freight is included in the price, no allowance will be made in lieu of transportation if the Buyer accepts shipment at factory, warehouse, or freight station or otherwise supplies its own transportation.

Risk of Loss
Risk of loss or damage to the Products shall pass to Buyer at the F.O.B. point. The Buyer is responsible to procure adequate insurance for loss or damage during shipment.

Concealed Damage & Short Shipments
Except in the event of F.O.B. destination shipments, Seller will not participate in any settlement of claims for concealed damage.

When shipment has been made on an F.O.B. destination basis, the Buyer must unpack immediately and, if damage is discovered must:

1. Not move the Products from the point of examination.
2. Retain shipping container and packing material.
3. Notify the carrier in writing of any apparent damage.
4. Notify Seller representative within 72 hours of delivery.
5. Send Seller a copy of the carrie inspection report.
6. Shortages in quantity must be reported in writing to Seller within 72 hours from receipt.

Witnessed Tests/Customer Inspection
Standard factory tests may be witnessed by the Buyer at Seller's factory for an additional charge calculated at the rate of $2,500 per day (not to exceed eight (8) hours) per Product type. Buyer may final inspect Products at Seller's factory for $700 per day per Product type.

Witness tests will add one (1) week to the scheduled shipping date. Seller will notify Buyer fourteen (14) calendar days prior to schedule witness testing or inspection. In the event Buyer is unable to attend, the Parties shall mutually agree on a rescheduled date. However, Seller reserves the right to deem the witness tests waived with the right to ship and invoice the Products.

Held Orders
For any order held, delayed or rescheduled at the request of the Buyer, Seller may, at its sole option (1) require payment to be based on any reasonable basis, including but not limited to the contract price, and any additional expenses, or cost resulting from such a delay; (2) store Products at the sole cost and risk of loss to the Buyer; and/or (3) charge to the Buyer those prices under the applicable price policy. Payment for such price, expenses and costs, in any such event, shall be due by Buyer within thirty (30) days from date of Seller's invoice. Any order so held delayed or rescheduled beyond three (3) months will be treated as a Buy termination.

Drawing Approval
Seller will design the Products in line with, in Seller's judgment, good commercial practice. If at drawing approval Buyer makes changes outside of the design as covered in their specifications, Seller will then be paid reasonable charges and allowed a commensurate delay in shipping date based on the changes made.

Drawing Re-Submittal
When Seller agrees to do so in its quotation, Seller shall provide Buyer with the first set of factory customer approval drawing(s) at Seller's expense. The customer approval drawing(s) will be delivered at the quoted delivery date. If Buyer requests drawing changes or additions after the initial factory customer approval drawing(s) have been submitted by Seller, the Seller, at its option, may assess Buyer drawing charges. Factory customer approval drawing changes required due to misinterpretation by Seller will be at Seller's expense. Approval drawings generated by Bid-Manager are excluded from this provision.

WARRANTY
Warranty For Products
Seller warrants that the Products manufactured by it will conform to Seller's applicable specifications and be free from failure due to defects in workmanship and material for one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

In the event any Product fails to comply with the foregoing warranty Seller will, at its option, either (a) repair or replace the defective Product, or defective part or component thereof, F.O.B. Seller's facility freight prepaid, or (b) credit Buyer for the purchase price of the Product. All warranty claims shall be made in writing. Seller requires all non-conforming Products be returned at Seller's expense for evaluation unless specifically stated otherwise in writing by Seller.

This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with Seller's recommendations and industry standard practice or due to accident, misuse, abuse or negligence. This warranty does not cover reimbursement for labour, gaining access, removal, installation, temporary power or any other expenses, which may be incurred in connection with repair or replacement.

This warranty does not apply to equipment not manufactured by Seller. Seller limits itself to extending the same warranty it receives from the supplier.

Extended Warranty for Products
If requested by the Buyer and specifically accepted in writing by Seller, the foregoing standard warranty for Products will be extended from the date of shipment for the period and price indicated below:

24 months – 2% of Contract Price
30 months – 3% of Contract Price
36 months – 4% of Contract Price

Special Warranty (In and Out) for Products
If requested by the Buyer and specifically accepted in writing by Seller, Seller will, during the warranty period for Products, at an additional cost of 2% of the contract price, be responsible for the direct cost of:

1. Removing the Product from the installed location.
2. Transportation to the repair facility and return to the site.
3. Reinstallation on site.

The total liability of Seller for this Special Warranty for Products is limited to 50% of the contract price of the particular Product being repaired and excludes expenses for removing adjacent apparatus, walls, piping, structures, temporary service, etc.

Warranty For Services
Seller warrants that the Services performed by it hereunder will be performed in accordance with generally accepted professional standards.

The Services, which do not so conform, shall be corrected by Seller upon notification in writing by the Buyer within one (1) year after completion of the Services.

Unless otherwise agreed to in writing by Seller, Seller assumes no responsibility with respect to the suitability of the Buyer's, or its customers, equipment or with respect to any latent defects in the same. This warranty does not cover damage to Buyer's, or its customers, equipment, components or parts resulting in whole or in part from improper maintenance or operation or from their deteriorated condition. Buyer will, at its cost, provide Seller with unobstructed access to the defective Services, as well as adequate free working space in the immediate vicinity of the defective Services and such facilities and systems, including, without limitation, docks, cranes and utility disconnects and connects, as may be necessary in order that Seller may perform its warranty obligations. The conducting of any tests shall be mutually agreed upon and Seller shall be notified of, and may be present at, all tests that may be made.

Warranty for Power Systems Studies
Seller warrants that any power systems studies performed by it will conform to generally accepted professional standards. Any portion of the study, which does not so conform shall be corrected by Seller upon notification in writing by the Buyer within six (6) months after completion of the study. All warranty work shall be performed in a single shift straight time basis Monday through Friday. In the event that the study requires correction of warranty items on an overtime schedule, the premium portion of such overtime shall be for the Buyer's account.

Limitation on Warranties for Products, Services and Power Systems Studies
THE FOREGOING WARRANTIES ARE EXCLUSIVE EXCEPT FOR WARRANTIES OF TITLE. SELLER DISCLAIMS ALL OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROVIDED ABOVE SHALL CONSTITUTE SELLER'S SOLE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR FAILURE OF SELLER TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF THE BUYER ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY), EXTRA-CONTRACTUALLY, OR OTHERWISE.

Asbestos
Provincial Law requires that building or facility owners identify the presence, location and quantity of asbestos containing material (hereinafter "ACM") at work sites. Seller is not licensed to abate ACM. Accordingly, for any contract which includes the provision of Services, prior to (i) commencement of work at any site under a specific Purchase Order, (ii) a change in the work scope of any Purchase Order, the Buyer will certify that the work area associated with the Seller's scope of work includes the handling of Class II ACM, including but not limited to generator wedges and high temperature gaskets which include asbestos materials. The Buyer shall, at its expense, conduct abatement should the removal, handling, modification or reinstallation, or some or all of them, of said Class II ACM be likely to generate airborne asbestos fibers; and should such abatement affect the cost of or time of performance of the work then Seller shall be entitled to an equitable adjustment in the schedule, price and other pertinent affected provisions of the contract.

Compliance with Nuclear Regulation
Seller's Products are sold as commercial grade Products not intended for application in facilities or activities licensed by the Atomic Energy Control Board of Canada for atomic purposes. Further certification will be required for use of the Products in any safety-related application in any nuclear facility licensed by the AECB.

Returning Products
Authorization and shipping instructions for the return of any Products must be obtained from Seller before returning the Products. Re-stocking charge applies to excess and Customer error returns.

When return is occasioned due to Seller error, full credit including all transportation charges will be allowed.

Product Notices
Buyer shall provide the user (including its employees) of the Products with all Seller supplied Product notices, warnings, instructions, recommendations, and similar materials.

Force Majeure
Seller shall not be liable for failure to perform or delay in performance due to fire, flood, strike or other labor difficulty, act of God, act of any governmental authority or of the Buyer, acts of terrorism, riot, embargo, fuel or energy shortage, car shortage, wrecks or delays in transportation, or due to any other cause beyond Seller's reasonable control. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended by a period of time reasonably necessary to overcome the effect of such delay.

Liquidated Damages
Contracts which include liquidated damage clauses for failure to meet shipping or job completion promises are not acceptable or binding on Seller, unless such clauses are specifically accepted in writing by an authorized representative of the Seller at its headquarters office.

Patent Infringement
Seller will defend or, at its option, settle any suit or proceeding brought against Buyer, or Buyer's customers, to the extent it is based upon a claim that any Product or part thereof, manufactured by Seller or its subsidiaries and furnished hereunder infringes any Canadian or United States patent, other than a claim of infringement based upon use of a Product or part thereof in a process, provided Seller is notified in reasonable time and given authority, information and assistance (at Seller's expense) for the defense of same. Seller shall pay all legal and court costs and expenses and court-assessed damages awarded therein against Buyer and resulting from or incident to such suit or proceeding. In addition to the foregoing, if at any time Seller determines there is a substantial question of infringement of any Canadian or United States patent, and the use of such Product is or may be enjoined, Seller may, at its option and expense, either (a) procure for Buyer the right to continue using and selling the Product; (b) replace the Product with non-infringing apparatus; (c) modify the Product so it becomes non-infringing; or (d) as a last resort, remove the Product and refund the purchase price, equitably adjusted for use and obsolescence. In no case does Seller agree to pay any recovery based upon its Buyer's savings or profit through use of Seller's Products whether the use be special or ordinary. The foregoing states the entire liability of Seller for patent infringement.

The preceding paragraph does not apply to any claim of infringement based upon: (a) any modification made to a Product other than by Seller; (b) any design and/or

specifications of Buyer to which a Product was manufactured; or (c) the use or combination of Product with other products where the Product does not itself infringe. As to the above-identified claim situations where the preceding paragraph does not apply Buyer shall defend and hold Seller harmless in the same manner and to the extent as Seller's obligation described in the preceding paragraph. Buyer shall be responsible for obtaining (at Buyer's expense) all license rights required for Seller to be able to use software products in the possession of Buyer where such use is required in order to perform any Service for Buyer.

With respect to a Product or part thereof not manufactured by Seller or its subsidiaries, Seller will attempt to obtain for Buyer, from the supplier(s), the patent indemnification protection normally provided by the supplier(s) to customers.

Compliance with OSHA
Seller offers no warranty and makes no representation that its Products comply with the provisions or standards of the Occupational Safety and Health Act of 1998, or any regulation issued there under. In no event shall Seller be liable for any loss, damage, fines, penalty or expenses arising under said Act.

Limitation of Liability
THE REMEDIES OF THE BUYER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR ANY FAILURE OF SELLER TO COMPLY WITH ITS OBLIGATIONS HEREUNDER.

NOTWITHSTANDING ANY PROVISION IN THIS CONTRACT TO THE CONTRARY, IN NO EVENT SHALL SELLER BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) EXTRA-CONTRACTUALLY, OR OTHERWISE FOR DAMAGE TO PROPERTY OR EQUIPMENT OTHER THAN PRODUCTS SOLD HEREUNDER, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF PRODUCTS, COST OF CAPITAL, CLAIMS OF CUSTOMERS OF THE BUYER OR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, REGARDLESS OF WHETHER SUCH POTENTIAL DAMAGES ARE FORESEEABLE OR IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

THE TOTAL CUMULATIVE LIABILITY OF SELLER ARISING FROM OR RELATED TO THIS CONTRACT WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) EXTRA-CONTRACTUALLY OR OTHERWISE, SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED.

Governing Law
This contract shall be governed, interpreted and construed by and in accordance with the laws of the Province of Ontario.

Election of Language
It is the express wish of the parties that this document and all documents related to it be drawn up in English. Les parties aux présentes ont expressément exigé que ce document soit rédigé en langue anglaise ainsi que tous document y afférent.

Eaton Industries (Canada) Company
P.O. Box 5040, Station "A"
5050 Mainway
Burlington, Ontario L7R 3Y8

Printed in Canada
Rev **# 10F**, December 1, 2012

Certificate of Registration

nqa global assurance

This is to certify that the Quality Management System of:

Génératrice Drummond

243 Avenue des artisans
St-Germain (Québec)
J0C 1K0 Canada

applicable to:

Selling, installation, renting and servicing of generator sets and their related systems. Selling of parts for the same activities.

has been assessed and approved by
National Quality Assurance against the provisions of:

ISO 9001: 2008

Certificate Number :	12318
Code EAC :	29
First Issued :	July 7, 2010
Valid Until :	July 1, 2016
Reissued :	July 1, 2013

For and on behalf of NQA
NQA, USA,
4 Post Office Square,
Acton, MA 01720

ANAB ACCREDITED

Page 1 of 1

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, Acton, MA 01720, an accredited organization under the ANSI-ASQ National Accreditation Board.

LIST OF WORK TO BE

1- *Wiring of the:
- block heater
- transfer switch engine start contact
- battery charger by load side of the transfer switch
- power cables
- fuel lines (if required)
- transfer switch position contacts (if required)

*see «Connections diagram» drawing for more details

2- Finish the ventilation system;

3- Fill tank(s);

4- Check phase sequence;

5- Make sure the exhaust system outlet is protected against birds, snow and rain;

6- Check presence of normal power at the transfer switch;

7- Keep one (1) meter clearance on back and both side of the generator.

Operation and Maintenance Manual

Diesel engine-generator sets
with Mercedes-Benz (0120) OM924LA and OM926LA engines
Application group 3B, 3D
60 Hz, 50 Hz
Built in North America

131658944E

Order No.	131658944
Serial No.	95130600197

System designation		Engine model	Power node	kW/cyl	Application group
Product name	Model number				
MTU 4R0120 DS80	DG04RM120A1N	OM924LA	72 kW	22	Prime Power (3B)
MTU 4R0120 DS80	DG04RM120A1N	OM924LA	80 kW	25	Emergency Standby (3D)
MTU 4R0120 DS100	DG04RM120A2N	OM924LA	90 kW	27	Prime Power (3B)
MTU 4R0120 DS100	DG04RM120A2N	OM924LA	100 kW	31	Emergency Standby (3D)
MTU 4R0120 DS125	DG04RM120A3N	OM924LA	111 kW	31	Prime Power (3B)
MTU 4R0120 DS125	DG04RM120A3N	OM924LA	125 kW	36	Emergency Standby (3D)
MTU 6R0120 DS150	DG06RM120A1N	OM926LA	135 kW	28	Prime Power (3B)
MTU 6R0120 DS150	DG06RM120A1N	OM926LA	150 kW	31	Emergency Standby (3D)
MTU 6R0120 DS180	DG06RM120A2N	OM926LA	163 kW	33	Prime Power (3B)
MTU 6R0120 DS180	DG06RM120A2N	OM926LA	180 kW	37	Emergency Standby (3D)
MTU 6R0120 DS200	DG06RM120A3N	OM926LA	180 kW	36	Prime Power (3B)
MTU 6R0120 DS200	DG06RM120A3N	OM926LA	200 kW	41	Emergency Standby (3D)
MTU 4R0120 DS89	DG04RM120A1L	OM924LA	80 kVA	19	Prime Power (3B)
MTU 4R0120 DS89	DG04RM120A1L	OM924LA	89 kVA	21	Emergency Standby (3D)
MTU 4R0120 DS111	DG04RM120A2L	OM924LA	100 kVA	24	Prime Power (3B)
MTU 4R0120 DS111	DG04RM120A2L	OM924LA	111 kVA	27	Emergency Standby (3D)
MTU 4R0120 DS139	DG04RM120A3L	OM924LA	125 kVA	29	Prime Power (3B)
MTU 4R0120 DS139	DG04RM120A3L	OM924LA	139 kVA	31	Emergency Standby (3D)
MTU 6R0120 DS167	DG06RM120A1L	OM926LA	150 kVA	26	Prime Power (3B)
MTU 6R0120 DS167	DG06RM120A1L	OM926LA	167 kVA	29	Emergency Standby (3D)
MTU 6R0120 DS200	DG06RM120A2L	OM926LA	180 kVA	31	Prime Power (3B)
MTU 6R0120 DS200	DG06RM120A2L	OM926LA	200 kVA	32	Emergency Standby (3D)
MTU 6R0120 DS222	DG06RM120A3L	OM926LA	200 kVA	32	Prime Power (3B)
MTU 6R0120 DS222	DG06RM120A3L	OM926LA	222 kVA	36	Emergency Standby (3D)

Table 1: Applicability

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

Preface

This Operation & Maintenance Manual provides general instructions for operating your MTU Onsite Energy engine-generator set properly. Every person who works on or with the engine-generator set must be completely familiar with the contents of this manual and carefully follow the instructions contained herein.

Each operation and maintenance task may require some modification of the suggested guidelines in this manual. These modifications must be consistent with locally applicable standards and follow safety guidelines and measures.

Following this guide will result in an efficient and reliable installation.

Carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety section at the beginning of this manual.

For information about where to find additional supporting resources, see the table.(→ Page 46)

All instructions and diagrams have been checked for accuracy and simplicity of application, however, the skills of the operator are most important. MTU Onsite Energy does not guarantee the result of any operation contained in this manual nor can MTU Onsite Energy assume responsibility for any injury or damage to property. Persons engaging in operating do so entirely at their own risk.

In this publication, the manufacturer of the engine-generator set is known as MTU Onsite Energy.

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DCL-ID: 0000043296 - 001

1 Safety

1.1 MTU System Safety Section

System Safety Considerations

MTU systems or systems utilizing MTU equipment are integrated in a specific application to provide a capability to satisfy a stated need or objective.

In many cases, the system includes components from multiple product manufacturers, facility design considerations and the use of outside contractors. Complete safety information for the system can include multiple sources in addition to information provided by MTU. It is recommended you obtain and review the latest product application manuals from each manufacturer before design, installation or commissioning. It is the responsibility of the installation contractor and owner of the system installation site to ensure all local laws, ordinances and regulations are followed.

Given variations in system requirements, facility design and equipment, incompatibilities may result in potential hazards. If a system design, procedure or process that is not specifically recommended by MTU is used, you must satisfy yourself that it is safe for your application and facility.

System Installation and Commissioning

The safety guidelines and recommendations for the installation and commissioning of the MTU system are described in this manual and the Installation and Commissioning Validation Forms [for your application]. These materials contain specifications and procedures that must be considered by qualified technicians, project planners and outside contractors when installing and commissioning an MTU system and supporting equipment. Categories include:

- Transport, handling and lifting
- System identification
- System room, enclosure and open unit requirements
- Air inlet system
- Cooling system
- Mounting and foundation
- Fuel system
- Lube oil system
- Exhaust system
- Starting and battery charging system
- Electronic controls
- Electrical connections

TIM-ID: 0000035185 - 003

1.2 Use of MTU Technical Documentation

Access to MTU technical documentation is restricted, due to the highly technical nature of the information. Maintenance and workshop documentation is structured based on Qualification Levels (QLs). Personnel are to be qualified at the appropriate level to carry out specific tasks. The QLs are matched to MTU training courses and a demonstrated proficiency related to various tool kits.

QL1 - Operational monitoring and maintenance tasks that can be done during breaks in operation, and do not require disassembly of the system, engine or any components.

QL2 - Maintenance procedures requiring the exchange of assemblies.

QL3 - Maintenance procedures requiring overhaul of assemblies.

Do not use MTU Technical Documentation or attempt to perform the activities described in this manual if you have not been properly qualified by an MTU-authorized distributor for this QL level.

The information, specifications and illustrations in this manual are based upon information available at the time it was written. The information, specifications and illustrations can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before you start any work on the system, engine or any components.

If you did not receive this manual through MTU, stop all work and contact MTU to make sure you have the appropriate training and qualifications to follow the procedures within.

Keep this Manual near Engine for Personnel [QL1]

This publication must be provided to all MTU-certified personnel involved in any work being done on the engine and a copy must be located in the vicinity of the engine, accessible at all times.

General Responsibilities of Owners and Operators and MTU Technicians [QL1]

Owner and operator responsibilities

In preparation for service of an engine, owners and operators must:

- Keep unauthorized personnel clear of engine service areas.
- Provide a clear path for transport of the engine.
- Provide a service area for the engine.
- Provide proper equipment to transport the engine.
- Provide that lifting and handling of heavy objects are performed or supervised by personal knowledgeable with lifting procedures.
- Provide certified forklift and crane operators.
- Provide proper tools for working on an engine that are properly maintained and calibrated.
- Provide necessary add-on heat generating devices, such as a fuel heater.
- Make sure that servicing of batteries is performed or supervised by personnel knowledgeable with batteries and required battery service procedures.

TIM-ID: 0000035182 - 006

1.3 MTU Engine Safety Section

Preparing to Service Engine

Shut off equipment

You could be seriously injured or killed when working on running equipment. A release or spill of coolant, oil, fuel or hydraulic fluid while the engine is running can cause a fire or explosion. Do not fill coolant or fuel tanks while the engine is running. To reduce the risk of exposure to compressed air, fluids or moving parts, never carry out maintenance and repair work with the engine running and:

- Make sure that nobody is standing in the path of moving parts before barring over or starting the engine.
- Use care when working around moving belts and rotating parts.
- Remove safety guards only to complete service procedures that can only be completed with the guard removed and replace safety guards as soon as possible once the service is completed. Do not crank or start the engine with the safety guards removed unless specifically required in the procedure.

The engine may need to be running for some types of diagnostic activities.

Let engine and exhaust cool down

All exhaust components are hot when the engine is running and remain hot for an extended period after the engine is shut off. Other components and fluids are hot when the engine is running and remain hot for an extended period after the engine is shut off. Allow all components and fluids to cool before working on or near the unit, or use proper precautions to reduce the risk of being burned.

Engine placement [QL3]

When placing an engine in an area to be serviced, remember the following to reduce your risk of injury or death:

- Place the engine on a firm, flat and stable surface capable of supporting the units weight. Unless authorized by an MTU dealer or distributor, never set an engine down on the oil pan.
- Before servicing anything raised by hydraulics, make sure that it is mechanically supported by stands, blocks or a mechanical lock. Never rely on a hydraulic circuit alone when working underneath raised equipment.

Safe Engine Servicing

Following safe work practices can help reduce the risk of serious injury or death to yourself or bystanders when servicing an engine.

Use proper emergency shutdown procedures

If you have an emergency shutdown situation, use the hot shutdown procedure. You may damage the engine. Each emergency situation is unique. Follow the restart procedures in the manual.

Use lockout and tagout procedures

To reduce the risk of severe injury or death from electric shock or unintentional startup, disconnect all electrical power sources and batteries. Additionally, lockout and tagout the equipment before removing protective shields for service or maintenance. Do not remove a lockout tag unless proper authorization is obtained.

Provide proper ventilation

Do not operate this engine in an area where combustible chemicals or vapors may be present. Combustible vapors near the air intake system could be ingested into the engine, causing the engine to suddenly accelerate and overspeed or explode. This condition could cause an unexpected increase in engine rpm or fire. When changing the engine oil or working on the fuel system, make sure that the service area is properly ventilated.

Avoid carbon monoxide poisoning

All engine exhaust contains carbon monoxide, a deadly gas. Breathing carbon monoxide can cause headaches, dizziness, nausea, confusion and eventually death.

TIM-ID: 0000033371 - 005

Carbon monoxide is a colorless, odorless, tasteless gas that may be present even if you do not see or smell any engine exhaust. Deadly levels of carbon monoxide can collect rapidly and you can be quickly overcome and unable to save yourself. Also, deadly levels of carbon monoxide can linger for hours or days in enclosed or poorly ventilated areas. If you experience any symptoms of carbon monoxide poisoning, leave the area immediately, get fresh air and seek medical treatment.

To prevent serious injury or death from carbon monoxide:

- Never run engine in poorly ventilated or partially enclosed areas such as barns, garages, basements, carports, under dwellings, or in pits.
- Never run engine outdoors where engine exhaust can be drawn into a building through openings such as windows and doors.
- Make sure that the exhaust pipework is free of leaks and that the gases are discharged into the atmosphere.

Compressed gases and liquids hazards

Remember that you may be exposed to a variety of systems containing gases or fluids under pressure while working on an engine. Equipment does not necessarily have to be running to produce high fluid pressure-residual pressures in stationary circuits can represent a serious safety hazard.

Fluids in both liquid and gaseous states can be dangerous when proper safety precautions are not observed. Pressurized systems may cause fires, flying debris, or burns, and escaping fluid under high pressure, even a pin-hole sized leak, can penetrate body tissue, causing serious injury or death.

Electrical hazards

Hazardous voltages are present within this system. Contact with electrical components can result in electric shock. Disconnect all electrical power, and lockout and tagout the equipment before removing protective shields for service or maintenance.

Battery hazards

Refer to battery manufacturers warnings and instructions when interacting with batteries to reduce the risk of injury or death from electric shock, battery fire or explosion. Remember to:

- Use care when disconnecting battery cables. Always remove the negative side of the battery first.
- Charge batteries in a well-ventilated area and do not smoke in battery charging areas.

Using jumper cables

When starting the engine with an auxiliary or external power source, ground leads must be connected last and removed first. Improper jumper cable connections can cause an explosion that can result in injury. Connect the ground lead from the power source to the ground lead of the engine or to the ground terminal of the starter to avoid sparks in the vicinity of the battery.

Post-Service, Preparing to put Engine back in Service and to Start Engine

Complete all procedures when preparing to put an engine back into service to reduce the risk of serious injury or death to you and bystanders. Keep in mind the following steps to avoid incomplete procedures:

- Make sure all safety guards are in place and secured.
- Check that all protective devices have been reinstalled and all tools removed from the engine.
- Connect and secure all cables that may have become loose.
- Remove all loose components from the engine vicinity.
- Check battery polarity before connecting the cables to the battery.
- Ground the engine in accordance with the requirements in applicable national, state or local codes.
- Clear the area of bystanders before starting the engine.
- Start the engine from the operator station. Never short across the starting motor terminals or the batteries. This could bypass the engine neutral start system or damage the electrical system.
- Complete a successful commissioning inspection.

TIM-ID: 0000033371 - 005

1.4 MTU General Shop Safety Section

Personal Protective Equipment

Remember, there are many hazards that you may encounter in the workplace, such as falling objects, flying debris, loud noises, chemical exposure and sharp edges. To reduce your risk of injury when servicing the engine, always consider your activity and remember to wear appropriate protective gear:

- Feet – approved safety shoes (not bare feet, sandals or sneakers)
- Face – approved face shield
- Eyes – protective glasses or goggles
- Ears – hearing protection
- Lungs – respiratory protection
- Head – safety helmet, tied back hair
- Hand – gloves (for example, sleeved heat protective gloves)
- Body – protective clothing – apron, cotton work clothing (no rings, watches, jewelry or loose clothing)

Use of Compressed Air

Follow general shop safety procedures when utilizing compressed air and follow these common rules to reduce your risk of injury:

- Always use a pressure reducing valve and a safety valve and do not exceed 376 kPa (40 psi) air pressure. Make sure that the connected devices and equipment are appropriate for this pressure.
- Make sure that the hose coupling and connections are securely attached together.
- Make sure that the snout of the air nozzle has a protective disc (for example, rubber disc) to prevent airborne particles from being deflected.
- Always shut off compressed air lines before compressed air equipment is disconnected from the supply line or before equipment or tools are exchanged.
- Never use compressed air to force flammable liquids out of containers.
- Never force compressed air into thin-walled containers (for example, containers made of tin, plastic or glass) for drying purposes or to check for leaks as the container may shatter.
- Do not direct a compressed-air jet at someone and never use compressed air to clean contaminated clothing while it is worn.

Safe Use of Tools and Equipment

Make sure you understand how to use the tools before performing any service work. Always use tools that are in good conditions and follow manufacturers instructions. Improper use of tools or use of tools in poor condition can increase your risk of injury.

Working from Heights

When working from heights on the engine, always use proper procedures for working at height and follow equipment manufacturers instructions. To reduce your risk of injuries from falls while working on MTU engines, remember to:

- Use suitable ladders and work platforms.
- Make sure components are placed on stable surfaces.
- Never use pressurized lines for climbing or support.

Welding

When welding, always use proper welding techniques and follow the manufacturers instructions and warning. To reduce your risk of injuries from welding, also keep in mind:

- If components (for example, exhaust manifold) are to be welded, they must be removed from the engine.
- Do not use the assembly or system as ground terminal.
- It is not necessary to remove the connector and the connections when carrying out welding operations on the manufacturers electronics if the master switch for power supply is switched from "ON" to "OFF" and the wire is disconnected from the negative and positive poles on the battery.

TIM-ID: 0000035184 - 006

Safe Work Space

As with other industrial work, it is important to maintain an area surrounding the engine that is dry, well lit, ventilated and free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist. Make sure a First Aid Kit is available.

Fluids and lubricants must be kept in suitable, properly designated containers. Never put maintenance fluids into glass containers – glass containers can break.

Cleanup

After completion of maintenance and repair work, make sure that no loose objects are in or on the assembly or system. Try to organize parts in bins and on benches when you are disassembling components.

To reduce the risk of injury from slipping and falling, clean up spilled liquids with suitable cleaning agents or as defined by the manufacturers specifications. Clean up oil spills quickly. You can do this by applying absorbent grit: this not only absorbs oil but makes it less likely that a person may slip and fall on an oil slick.

Proper Disposal

Always dispose of all lubricants (motor oil, coolant, gear box oils, and so on.) and filters according to federal or local regulations. Used oil disposed of in nature or waterways contaminates drinking water and kills wildlife.

Fire Prevention

Ignition sources

As in other industrial contexts, there are various potential sources of fire or explosion hazards when working on an engine. To reduce the risk of injury from fire or explosion, be aware of potential ignition sources. Some examples of ignition sources include:

- Electrical sparks or arcs
- Cutting, welding or grinding sparks
- Open flame
- Hot surfaces
- Incandescent lights
- Smoking

Flammable materials and vapors

Avoid exposing potential ignition sources to flammable materials and vapors. Some examples of flammable materials and vapors include:

- Paint
- Batteries or battery charging areas
- Oxygen and acetylene fuel cylinders
- Diesel fuel
- Fuel gases or vapors
- Engine oil
- Grease
- Textiles soaked in fuels and lubricants
- Most lubricants
- Some coolant mixtures
- Oil and fluid leaks

Clean up spills immediately. Substances spilled onto hot surfaces or electrical components can cause a fire.

To help reduce the severity of a fire, remember to keep appropriate fire extinguishers on hand. Know how to use them according to manufacturers instructions and inspect them regularly.

TIM-ID: 0000035184 - 006

Noise

Recall that there is a risk of hearing damage, including permanent hearing loss, from exposure to high noise levels (above 85dB). Although this can be the result of a single exposure to a high level of noise, it often results from years of exposure to excessive and repetitive noise levels. Noise can also lead to an increased risk of accident if instructions or sounds indicating danger cannot be heard.

To reduce the risk of injury from hazardous noise levels, remember to wear hearing protection or protective devices for ears when the engine is in operation.

Chemical Safety

When working with fluids, lubricants and other chemical substances, remember to follow the instructions that are provided by other manufacturers or chemical producers and to review/have available material Safety Data Sheets for the products that you are using or coming into contact with.

To reduce the risk of injury from chemical contact, be cautious when handling acids, alkaline solutions, coolant, fuel, paint and preservatives. Follow the chemical manufacturers usage, handling, storage and disposal instructions. To reduce the risk of injury from chemicals, remember the following precautions:

- Make sure that the work area is well-ventilated and wear proper protective equipment (for example, gloves, respiratory protection, goggles) as necessary.
- Protect skin from contact with battery acid or alkaline electrolytes or caustic byproducts.
- Avoid contact with skin.
- Do not fill coolant or fuel tanks while the engine is running.

Dispose of used fluids, lubricants, materials and filters in accordance with local regulations. Used oil may contain combustion residues hazardous to health.

General precautions for chemical contact

If chemicals contact the skin with, wash skin immediately with water for at least 15 minutes.

Precautions for contact with battery acid or electrolyte

If you come in contact with battery acid, flush your skin with water, apply baking soda to help neutralize the acid and get medical attention immediately. Immediately seek medical attention after contact with electrolyte or byproduct.

Liquid nitrogen precautions

Liquid nitrogen is a clear, colorless liquid that is exceptionally cold, approximately -200 °C (-328 °F). Generally it is stored in containers at high pressure, and can cause rapid freezing on contact with living tissue, which may lead to frostbite. To reduce the risk of injury and damage to equipment when using liquid nitrogen, remember the following precautions:

- Store liquid nitrogen only in small quantities in regulation containers without fixed covers, and make sure that all liquid nitrogen containers are handled properly.
- Use proper protective clothing, eye and hand protection, and a face shield.
- Make sure that the work area is well-ventilated. High concentrations of liquid nitrogen fumes may lead to suffocation.

Coolant precautions

Coolant is toxic and carries the risk of poisoning. Remember the following precautions, which can reduce your risk of severe illness or death, when working with coolants:

- Use proper hand protection when handling coolant.
- After coming into contact with any antifreeze or coolant solution, wash the affected skin areas.
- If coolant is accidentally ingested, contact a Poison Control Center immediately
- Keep coolant out of reach of children and animals.

Fluoroelastomer (for example, Viton®) precautions

TIM-ID: 0000035184 - 006

Fluoroelastomer parts, such as O-rings and seals, are safe to handle under normal environmental conditions. However, they may present a potential hazard if raised to a temperature above 316 °C (600 °F). At this temperature, fluoroelastomers decompose (indicated by charring or the appearance of a black, sticky mass) and produce hydrofluoric acid. This acid is corrosive and may cause severe burns to bare skin if touched; however, the symptoms may not appear for several hours. To reduce your risk of injury or death, remember the following precautions when working with degraded fluoroelastomer parts:

- Wear eye protection (for example, goggles or face shield) and neoprene or PVC gloves.
- Discard protective clothing after handling degraded fluoroelastomer parts.

Viton® is a registered trademark of Dupont Performance Elastomers L.L.C.

TIM-ID: 0000035184 - 006

1.5 General Service Safety

Contact Authorized Service for Additional Help

If you have any questions about a procedure or safety message related to servicing this engine, contact an authorized service outlet for assistance. Repair or engine overhaul must be carried out in an MTU authorized workshop.

Trained and Authorized Personnel only

Maintenance and repair work is to be carried out by trained and authorized personnel only. Do not allow unauthorized personnel on or near the engine when the engine is serviced. Work on or around this engine must be performed by people who have the necessary training, skills and tools to do the work. Improper maintenance or repair work can cause severe injury or death for yourself or bystanders.

Using this Manual

Read and understand this safety section before working on this product. This section contains general safety messages. Additional safety messages are included in the specific task procedures.

Signal Words Used in this Manual

Failure to follow the signal words and safety alert symbols contained in this manual can result in serious injury or death. Important safety information is distinguished in this manual by the following notations:

DANGER 	In the event of immediate danger. **Consequences: Death or serious injury** • Remedial action
WARNING 	In the event of potentially dangerous situations. **Consequences: Death or serious injury** • Remedial action
CAUTION 	In the event of hazardous situations. **Consequences: Minor or moderate injuries** • Remedial action
NOTICE 	In the event of a situation involving potentially adverse effects on the product. **Consequences: Material damage!** • Remedial action. • Additional product information.

Consider the Safety of Procedures You Choose

The manufacturer cannot anticipate every possible circumstance that might involve a potential hazard. If a tool, procedure, work method or operating technique that is not specifically recommended by the manufacturer is used, you must consider possible hazards and satisfy yourself that it is safe for you and for others. Ensure the product will not be damaged or made unsafe by the transport, installation, commissioning, operation, lubrication, maintenance, repair or storage procedures that you choose.

TIM-ID: 0000033337 - 006

Use Genuine Parts and do not make Unauthorized Modifications

Unauthorized modifications, third-party add-on devices and replacement parts may compromise the integrity of the equipment, and may present a safety risk. Only genuine MTU parts are allowed to be used to replace components or assemblies. Failure to heed this warning can lead to product damage, serious injury or death and may cause non-compliance with environmental regulations.

Follow Applicable Standards and Regulations

MTU recommends owners, operators and certified technicians become familiar with applicable national safety standards. To reduce the risk of severe injury or death, follow all codes, standards, regulations and laws pertaining to the products installation and application.

Maintain Product Labels

Safety labels should be legible and not covered. If any safety labels are damaged, missing or illegible, contact an MTU-authorized distributor or dealer to obtain replacement labels.

TIM-ID: 0000033337 - 006

1.6 Engine-Generator Set – Lockout/Tagout and Unlocking Procedures

1.6.1 Lockout/tagout procedure

Preconditions

☑ Engine is not running and controls are in "OFF" position.

☑ Engine starting circuit is disabled.

DANGER 	Not completely de-energized systems can contain parts under high voltage. Live components and connections. **Risk of burns or death from electric shock!** • Disconnect all electrical power. • Lockout and tagout the equipment before removing protective shields for service or maintenance.
DANGER 	Manipulation of interlocks on parts under high voltage. Live components and connections. **Risk of burns or death from electric shock!** • Do not tamper with any interlocks in the system.
DANGER 	High voltage. Live components and connections. **Risk of burns or death from electric shock!** • Disable the engine start contact leads from the engine-generator set control panel. • Do not disconnect the engine start contact leads from the transfer switch enclosure.
DANGER 	Circuit breakers are live components. **Risk of burns or death from electric shock!** • Ensure all circuit breakers are placed in the "OPEN" position prior to and while servicing the engine-generator set.
DANGER 	Battery charger is a live component. **Risk of burns or death from electric shock!** • Wait at least 30 seconds after removing power source from the battery charger prior to servicing the engine-generator set.
WARNING 	Rotating and moving parts and high level of engine noise in the event of unexpected engine-generator set start during service. **Risk of crushing, danger of parts of the body being caught or pulled in!** **Risk of damage to hearing!** • Ensure the engine-generator set has been stopped. • Ensure the control panel is in "OFF" position to disable starting during service. • Disconnect the battery charger prior to service.
WARNING 	Hot components/surfaces. **Risk of burns!** • Allow the engine to cool down to below 50 °C before beginning work. • Wear suitable protective equipment/thermal gloves. • Avoid unprotected contact with hot surfaces.

TIM-ID: 0000000257 - 016

WARNING

Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

WARNING

Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING

Batteries are live parts.
Risk of electric shock!
- Take care when disconnecting battery cables.
- Remove the negative side of the battery first.

NOTICE

Surge when using insufficient fuses.
Damage to engine-generator set!
- Make notes from where each fuse is removed, and keep these notes until reinstallation.
- Ensure to install the correct fuses in each slot of the control panel and the battery charger.

Note: The instructions in this section are general and cannot reflect all possible control and electrical configurations (control panel, circuit breaker, etc.).

General recommendations

- MTU Onsite Energy strongly recommends documenting the particular starting procedure applicable to your system during commissioning.
- All commissioning personnel should attend the commissioning training for operators offered at the authorized training center for their specific region.

Facility battery charger

1. Remove AC power source from battery charger.
2. Remove the battery charger fuses.
3. Open the circuit breaker supplying AC power to the battery charger.

Battery

1. Disconnect the negative lead from battery terminal.
2. Tag "DO NOT OPERATE" or similar warning label, and secure lock.

Automatic transfer switch (if fitted)

1. Open the engine-generator set control panel door.
2. Remove the panel fuses.
3. Remove the generator start contact leads supplied from remote start.
4. Install protective cover to exposed lead ends.
5. Secure loose leads away from circuit boards and other electronic devices.
6. Close the engine-generator set control panel door.
7. Add lock and tag to panel door to indicate Lockout/Tagout condition.

TIM-ID: 0000000257 - 016

Engine-generator set controls

1. Push the EMERGENCY STOP button to lockout the engine-generator set.

Note: This causes the alarm to sound. There is another button which functions to silence the alarm. Depending on your panel configuration, this button is called ALARM SILENCE, ACK, etc.

2. Press this button to silence the alarm.
3. Add lock and tag to panel door to indicate Lockout/Tagout condition, if not in place.

Main circuit breaker(s)

1. Move circuit breaker handle into the "OPEN" position.
2. Tag "DO NOT OPERATE" or similar warning label.
3. For multiple breakers, repeat the two previous steps.

TIM-ID: 0000000257 - 016

2 Transport

2.1 Transport

Lifting instructions

DANGER



Suspended load.
Danger to life!
- Use appropriate lifting devices and appliances.
- Never stand beneath a suspended load.

Note the following:
- The engine-generator set may only be lifted with empty fuel tank.
- If the fuel tank extends beyond the base of the engine-generator set, it must be lifted separately.
- The engine-generator set may only be lifted at the points intended for this purpose (see decals).
- Pay attention to the center of gravity of the engine-generator set.
- Use appropriate handling equipment and lifting gear only.
- Remove any loose parts on the engine-generator set.
- Lift the engine-generator set slowly. The hoisting cables or chains must not touch the engine-generator set.

Transport locking devices

Always fit transport locking devices (if available) on the resilient engine and generator mounts before transportation.

Remove all transport locking devices before startup.

Transport

The engine-generator set may be transported in its intended installation position only.

Secure the engine-generator set such that it cannot conceivably tip over during transport. Eliminate any possibility of slipping and toppling when negotiating inclines and ramps.

TIM-ID: 0000064125 - 001

3 Product Information

3.1 Spec Sheet MTU 4R0120 DS80 (80 kW Standby) 25
3.2 Parts List - Shop Order 95130600197 29

DIESEL GENERATOR SET
MTU 4R0120 DS80

80 kWe / 60 Hz / Standby
208 - 600V

Reference MTU 4R0120 DS80 (72 kWe) for Prime Rating Technical Data

SYSTEM RATINGS

Standby

Voltage (L-L)	240V	240V	208V	240V	380V	480V	600V
Phase	1	1	3	3	3	3	3
PF	1	1	0.8	0.8	0.8	0.8	0.8
Hz	60	60	60	60	60	60	60
kW	80	80	80	80	80	80	80
kVA	80	80	100	100	100	100	100
Amps	333	333	278	241	151	120	96
skVA@30% Voltage Dip	145	311	216	216	165	288	236
Generator Model	363CSL1607	363CSL1617	362CSL1604	362CSL1604	362CSL1606	362CSL1604	362PSL1635
Temp Rise	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C	130 °C/40 °C
Connection	12 LEAD DOUBLE DELTA	4 LEAD	12 LEAD WYE	12 LEAD DELTA	12 LEAD WYE	12 LEAD WYE	4 LEAD WYE

CERTIFICATIONS AND STANDARDS

// **Emissions –** EPA Tier 3 Certified

// **Generator set is designed and manufactured in facilities certified to standards ISO 9001:2008 and ISO 14001:2004**

// **Seismic Certification – Optional**
- IBC Certification
- OSHPD Pre-Approval

// **Power Rating**
- Accepts Rated Load in One Step Per NFPA 110

// **UL 2200 / CSA – Optional**
- UL 2200 Listed
- CSA Certified
- CE Marking Provided

// **Performance Assurance Certification (PAC)**
- Generator Set Tested to ISO 8528-5 for Transient Response
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

TIM-ID: 0000098745 - 004

STANDARD FEATURES*

// MTU Onsite Energy is a single source supplier
// Global Product Support
// 2 Year Standard Warranty
// OM924LA Diesel Engine
- 4.8 Liter Displacement
- 4-Cycle
// Engine-generator resilient mounted
// Complete Range of Accessories
// Generator
- Brushless, Rotating Field Generator
- 2/3 Pitch Windings
- 300% Short Circuit Capability with Optional Permanent Magnet Generator (PMG)
// Digital Control Panel(s)
- UL Recognized, CSA Certified, NFPA 110
- Complete System Metering
- LCD Display
// Cooling System
- Integral Set-Mounted
- Engine-Driven Fan

STANDARD EQUIPMENT*

// Engine

Air Cleaners
Oil Pump
Oil Drain Extension and S/O Valve
Full Flow Oil Filter
Fuel Filter with Water Separator
Jacket Water Pump
Thermostat
Blower Fan and Fan Drive
Radiator - Unit Mounted
Electric Starting Motor - 12V
Governor – Electronic Isochronous
Base - Formed Steel
SAE Flywheel and Bell Housing
Charging Alternator - 12V
Battery Box and Cables
Flexible Fuel Connectors
Flexible Exhaust Connection
EPA Certified Engine

// Generator

NEMA MG1, IEEE and ANSI standards compliance for temperature rise and motor starting
Self-Ventilated and Drip-Proof
Superior Voltage Waveform
Solid State, Volts-per-Hertz Regulator
±1% Voltage Regulation No Load to Full Load
Brushless Alternator with Brushless Pilot Exciter
4 Pole, Rotating Field
130 °C Max. Standby Temperature Rise
1 Bearing, Sealed
Flexible Coupling
Full Amortisseur Windings
125% Rotor Balancing
3-Phase Voltage Sensing
100% of Rated Load - One Step
5% Max. Total Harmonic Distortion

// Digital Control Panel(s)

Digital Metering
Engine Parameters
Generator Protection Functions
Engine Protection
SAE J1939 Engine ECU Communications
Windows®-Based Software
Multilingual Capability
Remote Communications to RDP-110 Remote Annunciator
Programmable Input and Output Contacts
UL Recognized, CSA Certified, CE Approved
Event Recording
IP 54 Front Panel Rating with Integrated Gasket
NFPA110 Compatible

TIM-ID: 0000098745 - 004

* Represents standard product only. Consult Factory/MTU Onsite Energy Distributor for additional configurations.

APPLICATION DATA

// Engine

Manufacturer	Mercedes-Benz
Model	OM924LA
Type	4-Cycle
Arrangement	4-Inline
Displacement: L (in³)	4.8 (293)
Bore: cm (in)	10.6 (4.17)
Stroke: cm (in)	13.6 (5.35)
Compression Ratio	17.5:1
Rated RPM	1,800
Engine Governor	MR2 / ADM3
Max. Power: kWm (bhp)	147 (197)
Speed Regulation	±0.25%
Air Cleaner	Dry

// Liquid Capacity (Lubrication)

Total Oil System: L (gal)	15.8 (4.2)
Engine Jacket Water Capacity: L (gal)	7 (1.8)
System Coolant Capacity: L (gal)	20.8 (5.5)

// Electrical

Electric Volts DC	12
Cold Cranking Amps Under -17.8 °C (0 °F)	950

// Fuel System

Fuel Supply Connection Size	-6 JIC
Fuel Supply Hose Size	3/8" ID
Fuel Return Connection Size	-6 JIC
Fuel Return Hose Size	3/8" ID
Max. Fuel Lift: m (ft)	2.7 (9)
Recommended Fuel	Diesel #2
Total Fuel Flow: L/hr (gal/hr)	328.2 (86.7)

// Fuel Consumption *

At 100% of Power Rating: L/hr (gal/hr)	19.3 (5.1)
At 75% of Power Rating: L/hr (gal/hr)	14 (3.7)
At 50% of Power Rating: L/hr (gal/hr)	9.8 (2.6)

* Based on 362CSL1604 480 Volt generator set

// Cooling - Radiator System

Ambient Capacity of Radiator: °C (°F)	50 (122)
Max. Restriction of Cooling Air: Intake and Discharge Side of Rad.: kPa (in. H_20)	0.12 (0.5)
Water Pump Capacity: L/min (gpm)	143 (37)
Heat Rejection to Coolant: kW (BTUM)	37.5 (2,133)
Heat Rejection to Air to Air: kW (BTUM)	23.6 (1,342)
Heat Radiated to Ambient: kW (BTUM)	24.8 (1,410)
Fan Power: kW (hp)	3.3 (4.4)

// Air Requirements

Aspirating: *m³/min (SCFM)	8.6 (304)
Air Flow Required for Rad. Cooled Unit: *m³/min (SCFM)	209 (7,381)
Remote Cooled Applications; Air Flow Required for Dissipation of Radiated Generator Set Heat for a Max. of 25 °F Rise: *m³/min (SCFM)	90.7 (3,203)

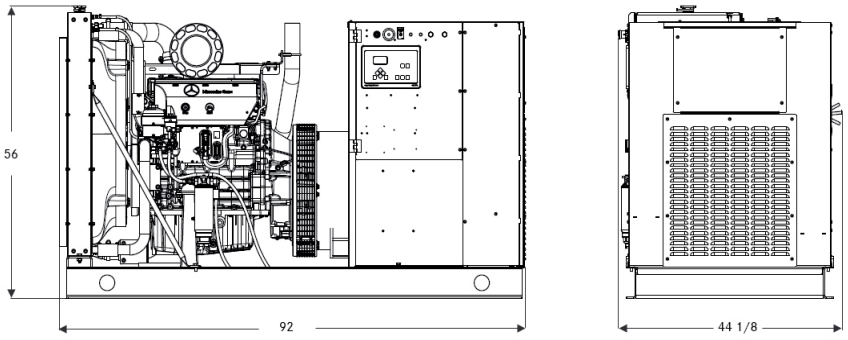
* Air density = 1.184 kg/m³ (0.0739 lbm/ft³)

// Exhaust System

Gas Temp. (Stack): °C (°F)	354 (669)
Gas Volume at Stack Temp: m³/min (CFM)	21.6 (763)
Max. Allowable Back Pressure: kPa (in. H_20)	6.5 (26)

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WEIGHTS AND DIMENSIONS



Drawing above for illustration purposes only, based on standard open power 480 volt generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (L x W x H)	Weight (less tank)
Open Power Unit (OPU)	2,336 x 1,121 x 1,422 mm (92 x 44.13 x 56 in)	1,769 kg (3,900 lb)

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific generator set.

SOUND DATA

Unit Type	Standby Full Load
Level 0: Open Power Unit dB(A)	83

Sound data is provided at 7 m (23 ft). Generator set tested in accordance with ISO 8528-10 and with infinite exhaust.

EMISSIONS DATA

NO_x + NMHC	CO	PM
3.61	1.42	0.08

All units are in g/hp-hr and shown at 100% load (not comparable to EPA weighted cycle values).
Emission levels of the engine may vary with ambient temperature, barometric pressure, humidity, fuel type and quality, installation parameters, measuring instrumentation, etc. The data was obtained in compliance with US EPA regulations. The weighted cycle value (not shown) from each engine is guaranteed to be within the US EPA Standards.

RATING DEFINITIONS AND CONDITIONS

// Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 3046-1, BS 5514, and AS 2789. Average load factor: ≤ 85%.

// Deration Factor:
Altitude: Consult your local MTU Onsite Energy Power Generation Distributor for altitude derations.
Temperature: Consult your local MTU Onsite Energy Power Generation Distributor for temperature derations.

C/F = Consult Factory/MTU Onsite Energy Distributor
N/A = Not Available

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3.2 Parts List - Shop Order 95130600197

ORDER SUMMARY

BASIC INFORMATION			
SALES ORDER #: (1 per Sales Order)	131658944		
MATERIAL/SLU #: (1 per Sales Order)	DG04RM120A1N	**MODEL #:** (1 per Sales Order)	MTU 4R0120 DS80
APPLICATION:	☒ Standby ☐ Prime	**kW:** (1 per Sales Order)	80
DOC TYPE / QTY	With Unit: _____ HARDCOPY 1 CD 1 USB Separate: _____ HARDCOPY _____ CD _____ USB		

UNIT SPECIFIC INFORMATION		
PROD ORDER #: (1 or more per Sales Order)	**SERIAL #:** (1 per Production Order)	**FINISH DATE:** (1 per Production Order / Serial Number)
1. 403007419	1. 95130600197	1. 08/01/2016

Configuration Summary

```
MTU 4R0120 DS80
DG04RM120A1N


Customer:           WAJAX Systemes du Puissance-Power

Project:            307210367
MTU Order:          1316589
                    20.07.2016

II.                 Selection Criteria for the Scope of Supply

Criteria
                    Selection          for Product No.
Frequency           60 Hz              1,
Voltage for starters                   208 V              1,
```

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Phase	3 Phase	1,		
Unit Specification	CSA	1,		
IBC Certification	Without IBC	1,		
OSHPD Certification	Without OSHPD	1,		
Engine Model	4R 4.8L OM924LA	1,		
Exhaust Emissions (EPA)		EPA "Nonroad" T. 3 Stationary (40 CFR 60)		
	1,			
Radiator Design Temperature		50°C	1,	
Temp Rise	130°	1,		
Power Output	80 kW	1,		
Generator Frame and Wire Qty		362/1604 (12 Wire)	1,	
Generator Wire Configuration		Wye	1,	
OPU/HSD	Level 0 - Open Power Unit		1,	
Fuel Tank	Without Tank	1,		
Control Panel	With Control Panel	1,		
Circuit Breaker Options		Single Circuit Breaker		1,
Breaker Wire Color Scheme		CEC Breaker Wire Color Scheme		1,
Paralleling	No Paralleling Operation		1,	
Acceptance testing	Factory acceptance	1,		
Country of Operation		USA/Canada	1,	
Emission cert. authority		18 US EPA Agency	1,	

Electrical: XZG2100100045

Dimensional: XZG2100100021

III. Scope of Supply

		valid for engine No.	
1	SYSTEM CONFIGURATION		1,
1.1	System Description	1,	
	Model: DG04RM120A1N		
	1,		
1.2	Cooling Package	1,	
	50 Deg C Cooling System		
•	Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump		
	1,		
1.3	Circuit Breaker	1,	

Circuit Breaker: Option 1

*For technical data refer to the circuit breaker enclosure data sheets located on the business portal.
1,

Circuit Breaker: Position 1

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*For technical data refer to the circuit breaker enclosure data sheets located on the business portal.

1,
Single Circuit Breaker
1,
Circuit Breaker Position 1:
1,
250 Amp 3 Pole 80% CB SQ-D JDL36250
1,
Circuit Breaker #1 Accessories:
1,
Canadian Electrical Code (CEC) breaker wire scheme
- Phase 1 (A) is Red label "CEC L1"
- Phase 2 (B) is Black label "CEC L2"
- Phase 3 (C) is Blue label "CEC L3"
- Neutral is White label "CEC NEU"

1,
LI Trip Breaker:

- LI breakers provide protection from long time overload and instantaneous short circuit events. Specific overload current values and time delays vary with breaker type and trip unit.

1,
1.4 Starting Aids 1,
Battery Rack Only
- Shipped with Battery Rack only (no battery included) 1,

Battery Charger: Guest 12-6A
1,
Battery Charger Mounted & AC/DC Wired
1,
With Coolant Preheating
1,
Block Heater
- -20 Deg F (120V 1PH 1500W)
- Model: TPS151GT10-005 1,

Block Heater Mounted & AC Wired
1,
1.5 Genset Enclosure 1,
OPU
- Engine Generator Set mounted on base with no enclosure 1,

1.6 Vibration Isolation 1,
Pad Isolators (Std)
- ¼ inch thick elastomeric pad in square shape placed under the base frame at each of the pre-drilled isolator mounting holes

1,
2 ENGINE CONFIGURATION 1,

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2.1 Engine System 1,
4R 4.8L OM924LA Charged Air Cooling
1,
Note Emission Compliance
- Please note that the engines and systems (only) comply with the country or region specific emission requirements and have appropriate emission certification(s) which are explicitly stated in respective RRPS/MTU defined technical specifications. Any Export / Import / Operation of the engine in countries or regions with different applicable emission law requirements is therefore at your own responsibility
1,
2.2 Exhaust System 1,
Shipped Loose Exhaust Silencer
• Muffler Model Number - JIS-04 1,
2.3 FUEL SYSTEM 1,
2.4 Air Intake System 1,
Air Filter (Standard)
1,
3 GENERATOR CONFIGURATION 1,
3.1 Generator Specification 1,
Generator Model Number: 362/1604
1,
3.2 Generator accessories 1,
MVC63-4 Regulator
1,
4 CONTROL PANEL CONFIGURATION 1,
4.1 Control panel 1,

Control Panel: Option 1

*For technical data refer to the circuit breaker enclosure data sheets located on the business portal.

1,

Control Panel: LH Mounted

*For technical data refer to the circuit breaker enclosure data sheets located on the business portal.

1,
MGC-1520
• MTU Onsite Energy's Generator Set Controllers are rugged, reliable, and easy-to-use digital generator set control systems. The MGC-1500 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that will hold up to almost any environment and is flexible enough to meet your application's needs.

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```
                    1,
                    No Parallel Operation
                    1,
5                   SERVICES AND AFTER SALES SUPPLY         1,
5.1                 Warranty            1,
                    2 Year/3000 Hour Basic Standby Limited Warranty (Standard)
                    1,
6                   MISCELLANEOUS       1,
6.2                 Documentation       1,
                    English
                    1,
                    1 CD Format
                    1,
                    1 Flash Drive
                    1,
                    French
                    1,
                    Spanish
                    1,
6.3                 Additional Options  1,
7                   FUNCTIONAL TESTING  1,
7.1                 Acceptance Testing  1,
                    Standard Commercial Test
                    1,
8                   SHIPPING CONDITIONS 1,
8.1                 Shipment            1,
                    Ship Unit Wet - Fluids Installed
                    1,
```

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Raw Material Components

Material	Material Description	Requirement quantity	Base Unit of Measure
XSG21200.00007	RADIATOR FOR GENSET	1	PC
XD0341100001	RADIATOR FOR GENSET	1	PC
XG2162500001	FAN COUPLING	1	PC
SUA103046	SENSOR LOW WATER LEVEL "ROCHESTER GAUGE"	1	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	4	PC
SUA95905	CAP SCREW M12-1.75 X 35MM 8.8 DIN 933 FU	2	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	2	PC
SUA106934	TUBE JW UPPER - 150-225KW OM926	1	PC
SUA100444	HOSE 2"ID X 4"L 4PLY SILICONE POLYESTER	4	PC
SUA43329	CLAMP HOSE 1 9/16" - 2 1/2" OD HEX HEAD	8	PC
SUA106935	TUBE JW LOWER - 150-225KW OM926	1	PC
XG2106100037	STEEL TUBE	1	PC
XG2120200003	HOSE	1	PC
SUA97555	CLAMP HOSE CONSTANT TENSION BREEZE CT-35	4	PC
XG2120200002	HOSE	1	PC
XG2141100013	STEEL TUBE	1	PC
SUA71154	HOSE 3 1/2"ID X 6"L SILICONE CUT FROM 71	2	PC
SUA97556	CLAMP HOSE CONSTANT TENSION BREEZE CT-40	4	PC
SUA47505	FITTING HOSE 1/4-18 MALE PIPE TO 3/8" ID	1	PC
SUA43350	CLAMP HOSE SIZE 1	4	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	2	FT
SUA47506	FITTING HOSE 3/8-18 MALE PIPE TO 3/8" ID	1	PC
XG2122700004	FAN	1	PC
SUA95313	WASHER, FLAT HARDENED, M8 X 8.4MM ID X 1	8	PC
SUA89200	WASHER M8 DIN 127 ZINC PLATED SPLIT LOCK	4	PC
SUA88932	HEX CAP SCREW M8-1.25 X 25MM 8.8 DIN 933	6	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	2	FT
XG2120500002	BANJO UNION FOR GENSET	1	PC
XG2162500002	DUCT	1	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	8	PC
SUA57040	PETCOCK 1/4" NPT MCMASTER-CARR 4921K16	1	PC
SUA107086	BRACKET LOWER CAC - 150-225KW OM926	1	PC
SUA44319	CLAMP MUFFLER 2 3/4"	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA102088	8X1.25X40MM HEX HEAD 10.9 ZINC	4	PC
SUA72679	CLAMP SUPPORT PLASTIC COATED	3	PC
SUA71172	HOSE 9/32" OVERFLOW HOSE	5	FT
SUA102014	6 WORM DRIVE CLAMP 7/16 TO 25/32	1	PC
XSG21000.00021	ARRANGEMENT DRAWING FOR GENSET	1	PC
XZG2100100045	ARRANGEMENT DRAWING FOR GENSET	1	PC
XSG21300.00046	COMPONENTS FOR GENSET	1	PC
XG2141100011	BRACE	2	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	2	PC
SUA49473	CAP SCREW M12-1.75 X 30MM 8.8 DIN 933 FU	2	PC
SUA88914	HEX CAP SCREW M10-1.5 X 30MM 8.8 DIN 933	2	PC
SUA89102	LOCK NUT M10-1.5 DIN 985 NYLON INSERT ZI	2	PC
SUA95543	WASHER, FLAT HARDENED, M10 X 10.5MM ID X	4	PC
XSG21300.00092	FLUIDS + LUBRICANTS	1	PC
SUA100490	COOLANT	17	GAL
XSG21300.00124	ADHESIVE LABEL FOR GENSET	1	PC
SUA88485	DECAL "MTU/ONSITE" (SMALL)	4	PC
XSG30500.00056	SWITCH	1	PC
SUA95536	MACHINE SCREW, M5-0.8 X 25MM, DIN 7985 P	3	PC
SUA97910	BLOCK NEUTRAL KIT 250-400A TNIA400UR GE	1	PC
XZG3150000010	BLOCK WITH SWITCH	1	PC
XSG21300.00064	BATTERY TRAY FOR GENSET	1	PC
SUA97234	CABLE BATTERY 2/0 AWG X 24"L W/ AUX. WIR	1	PC
SUA76018	CABLE BATTERY 2/0 AWG X 24"L W/ AUX WIRE	1	PC
SUA96114	NUT FLANGE M10-1.5 DIN6923	4	PC
SUA88914	HEX CAP SCREW M10-1.5 X 30MM 8.8 DIN 933	4	PC
SUA88935	HEX FULL NUT M10-1.5 DIN 934 Z CL8 COARS	4	PC
SUA95543	WASHER, FLAT HARDENED, M10 X 10.5MM ID X	4	PC
SUA94350	BOLT BATTERY HOLD DOWN, 10MM ROD	2	PC
SUA107520	BRACKET BATTERY HOLD DOWN BAR TEXTURED B	1	PC
SUA107521	BATTERY RACK TEXTURED BLACK	1	PC
SUA95543	WASHER, FLAT HARDENED, M10 X 10.5MM ID X	2	PC
XSG30340.00085	BATTERY CHARGER	1	PC
SUA79100	12V 6A 120VAC 2-STAGE (GUEST) ONSITE ENE	1	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	4	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
XZG3136000002	BATTERY CHARGER	1	PC
XSG21300.00030	HEATER FOR GENSET	1	PC
SUA106825	ADAPTER FLANGE TO 1/2" NPT - OM900	1	PC
XG2130100036	THREADED FITTING	3	PC
SUA47425	ELBOW PIPE SCHED 40 BLK	1	PC
SUA52057	BALL 1/2" NPT BRASS USE AS STANDARD	2	PC
SUA57057	FITTING HOSE 5/8 HOSE BARB TO 1/2" NPT	2	PC
SUA52748	HEATER TANK 1500W 120V 1PH KIM HOTSTART	1	PC
SUA43320	CLAMP HOSE HEX HEAD WOR	4	PC
SUA80452	HOSE 5/8" ID 2 PLY GREEN STRIPE (300' SP	1.6	FT
SUA80452	HOSE 5/8" ID 2 PLY GREEN STRIPE (300' SP	3.4	FT
SUA95568	CAP SCREW M6-1.0 X 20MM 8.8 DIN 933 FULL	4	PC
SUA101348	NUT FLANGE LOCK HEX NYLON-INSERT M6-1.0	4	PC
XG2120200004	GASKET	1	PC
SUA95313	WASHER, FLAT HARDENED, M8 X 8.4MM ID X 1	4	PC
SUA88932	HEX CAP SCREW M8-1.25 X 25MM 8.8 DIN 933	3	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	1	PC
SUA43344	CLAMP SUPPORT 1" PLASTIC COATED	1	PC
XSG21230.00003	BASE FOR GENSET	1	PC
XG2123300006	BASE	1	PC
SUA102667	BRACKET FRONT ENGINE FEET OM926	2	PC
SUA88919	HEX CAP SCREW M12-1.75 X 60MM 8.8 DIN 93	2	PC
SUA88918	HEX CAP SCREW M12-1.75 X 45MM 8.8 DIN 93	2	PC
SUA47719	WASHER FLAT1/2" ZINC PLATED USS	4	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	4	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	26	PC
SUA95905	CAP SCREW M12-1.75 X 35MM 8.8 DIN 933 FU	22	PC
XG2123300007	BRACKET	1	PC
SUA107504	BRACKET GENERATOR RISER 430FR TO 360FR -	1	PC
SUA77045	MOUNT VIBE RUBBER CONE K-61 50 DUROMETER	4	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	4	PC
XG2101500003	COLLARED BUSHING	2	PC
XSG30300.00015	ASSEMBLY KIT	1	PC
SUA63015	MOUNT VIBE PAD 3 X 8 X 1/4 SP NEOPRENE	6	PC
XSG21180.00001	OIL DRAIN VALVE FOR GENSET	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA106440	QUICK RELEASE OIL DRAIN VALVE WITH 90 DE	1	PC
XSG21180.00002	OIL DRAIN LINE FOR GENSET	1	PC
SUA43316	HOSE 4PLY 250 PSI GATES 4219G	4	FT
XSG21300.00001	COUPLING FOR GENSET	1	PC
SUA88914	HEX CAP SCREW M10-1.5 X 30MM 8.8 DIN 933	12	PC
SUA95543	WASHER, FLAT HARDENED, M10 X 10.5MM ID X	20	PC
SUA89157	SOCKET HEAD CAP SCREW M10-1.5 X 30MM CL	8	PC
XSG21300.00073	WIRING HARNESS FOR GENSET	1	PC
XD0342400005	WIRING HARNESS FOR GENSET	1	PC
XSG21300.00075	WIRING HARNESS FOR GENSET	1	PC
SUA107208	HARNESS ENGINE ALTERNATOR OM924	1	PC
XSG21240.00004	ENGINE FOR GENSET	1	PC
SUA107006	ENGINE MERCEDES-BENZ OM924 1800RPM SAE 2	1	PC
XG2100400003	ADHESIVE LABEL	1	PC
XSG21140.00014	EXHAUST PIPE FOR GENSET	1	PC
XG2141700002	BRACKET	1	PC
SUA107107	TUBE EXHAUST TURBO - OM924	1	PC
SUA44320	CLAMP MUFFLER	1	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	4	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	2	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	2	PC
XSG21140.00015	EXHAUST PIPE FOR GENSET	1	PC
SUA107547	FLEX EXHAUST SS OAL 22" - 3" SLEEVE TO 5	1	PC
SUA44320	CLAMP MUFFLER	1	PC
SUA86745	GASKET 4" PIPE FLANGE 150 ASA FLANGE RI	1	PC
SUA94436	WASHER, FLAT HARDENED, M16 X 17MM ID X 3	16	PC
SUA88803	CAP SCREW M16-2.0 X 60MM 10.9 DIN 933 FU	8	PC
SUA89075	NUT M16-2.0 DIN 934 Z CL8 COARSE THREAD	8	PC
XSG21140.00017	EXHAUST SILENCER FOR GENSET	1	PC
SUA61016	MUFFLER 4" INDUSTRIAL SI F=5.5 MIN	1	PC
XSG21070.00001	FUEL SYSTEM FOR GENSET	1	PC
XG2108300001	BRACKET	1	PC
SUA107555	FUEL FILTER	1	PC
SUA78974	CLAMP SUPPORT PLASTIC COATED (SP	1	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	6	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA88931	HEX CAP SCREW M8-1.25 X 20MM 8.8 DIN 933	2	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	2	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	3	PC
SUA105984	FITTING 6 FEMALE JIC SWIVEL TO 3/8" ID	1	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	1.04	FT
SUA107533	ADAPTER M16X1.5 MALE X 6 MALE 37DEG FLA	1	PC
SUA73698	CLAMP HOSE 2 EAR UL SP FOR 5/8" FUEL HO	2	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	2	PC
SUA88931	HEX CAP SCREW M8-1.25 X 20MM 8.8 DIN 933	1	PC
XSG21070.00003	FUEL SYSTEM FOR GENSET	1	PC
SUA105984	FITTING 6 FEMALE JIC SWIVEL TO 3/8" ID	2	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	2.05	FT
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	3.83	FT
SUA92507	PLUG PLASTIC 9/16-18 MALE PD-60	2	PC
XG21K4700006	BANJO UNION	1	PC
XG21K4700007	WASHER	2	PC
XG21K4700005	BANJO SCREW	1	PC
SUA73698	CLAMP HOSE 2 EAR UL SP FOR 5/8" FUEL HO	4	PC
XSG21180.00005	ENGINE OIL	1	PC
SUA101639	15W-40 DIESEL ENGINE	1	GAL
XSG21180.00006	ENGINE OIL	1	PC
SUA89619	OIL FOR WEIGHT CALCULATION ONLY	12	PC
XSG21120.00003	AIR FILTRATION SYST FOR GENSET	1	PC
SUA107094	ELBOW HOSE RUBBER REDUCING 90 DEG 4.00"-	1	PC
XG2112300001	AIR INTAKE PIPE	1	PC
SUA44323	CLAMP MUFFLER 4"	2	PC
XG2112100001	AIR FILTER	1	PC
SUA43339	CLAMP HOSE 3" TO 5 1/2" OD HEX HEAD WORM	1	PC
SUA43335	CLAMP HOSE 2 1/8" TO 4" OD HEX HEAD WORM	1	PC
SUA106994	BRACKET MOUNTING MUFFLER REAR - OM924 OM	1	PC
SUA106993	BRACKET MOUNTING MUFFLER TOP - OM924	1	PC
SUA107002	SPACER MOUNTING MUFFLER - OM924 OM926	1	PC
SUA106995	BRACKET MOUNTING MUFFLER FRONT - OM924 O	2	PC
SUA107671	BOLT FLANGE M10-1.5 X 25MM CLASS 10.9 DI	4	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	2	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA95531	CAP SCREW, HEX, M12-1.75 X 65MM 8.8 DIN	1	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	1	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	8	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	4	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	4	PC
SUA43339	CLAMP HOSE 3" TO 5 1/2" OD HEX HEAD WORM	1	PC
XSG21340.00045	GENERATOR	1	PC
SUA107475	GENERATOR 362/1604 SAE 2 FLYWHEEL 11 1/2	1	PC
XSG31500.00012	CABLING	1	PC
SUAMF140017	SUB ASSEMBLY	1	PC
XSG21500.00032	OUTLET HOUSING FOR GENSET	1	PC
SUA107377	OUTLET BOX 360 FRAME, RH PRIMARY BREAKER	1	PC
SUA107453	PANEL VENT 360 GEN - OM924	1	PC
SUA107451	PANEL BREAKER LOWER 360 FRAME	1	PC
SUA107452	PANEL OUTLET BOX TOP 360 FRAME	1	PC
SUA96031	BOLT ON (BLIND) POWDER BLACK STAINLESS P	2	PC
SUA82554	FOAM INSULATION 3/4" WIDE X 1/16" THICK	5.525	FT
SUA88879	WASHER FLAT 1/2" GRADE 9 SAE YELLOW ZINC	4	PC
SUA47728	LOCK WASHER ZINC PLATED MEDIUM SPLI	4	PC
SUA88918	HEX CAP SCREW M12-1.75 X 45MM 8.8 DIN 93	4	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	8	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	10	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	6	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	9	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	9	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	7	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	7	PC
XSG21500.00034	OUTLET HOUSING FOR GENSET	1	PC
SUA107818	PANEL BREAKER J-H-FRAME 360 GEN - OM924	1	PC
SUA107257	HANDLE SNAP-IN POCKET PULL, .070-.085 PA	2	PC
SUA34137	TRIM VINYL PROTECTIVE	2	FT
XSG21500.00014	OUTLET HOUSING FOR GENSET	1	PC
SUA107260	BRACKET H-J-FRAME BREAKER STAND-OFF 430	1	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	4	PC
XSG21500.00023	CONTROL PANEL FOR GENSET	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA107230	PANEL DOOR CONTROL MGC-1500 - OM924 OM92	1	PC
SUA74221	CLAMP SUPPORT 1 1/4" ID PLASTIC COATED	3	PC
SUA80505	CLAMP SUPPORT PLASTIC COATED W/	2	PC
SUA72679	CLAMP SUPPORT PLASTIC COATED	1	PC
SUA90393	WASHER FLAT .25 .281ID X .875OD X .090 T	3	PC
SUA101348	NUT FLANGE LOCK HEX NYLON-INSERT M6-1.0	6	PC
XSG21500.00031	CONTROL PANEL FOR GENSET	1	PC
XG2168500006	CONTROL PANEL	1	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	4	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	4	PC
XSG31300.00125	WIRING HARNESS	1	PC
SUAMF140008	HARNESS VOLTAGE REGULATOR SE350/KAVC63-	1	PC
XSG21500.00051	VOLTAGE REGULATOR	1	PC
SUA77199	REGULATOR VOLTAGE MAVC63-4D UL (SE350)	1	PC
SUA70782	LABEL VOLTAGE REGULATOR ADJUST BLACK ON	1	PC
SUA95527	K-LOCK NUT, M4-0.7 KEP ZINC PLATED	2	PC
XG21K5300005	PANEL	1	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	6	PC
XSG21500.00055	GENSET COMPONENTS	1	PC
XG2142400001	GENSET COMPONENTS	1	PC
SUA88879	WASHER FLAT 1/2" GRADE 9 SAE YELLOW ZINC	1	PC
SUA89004	LOCK WASHER ZINC PLATED SPLI	1	PC
SUA88918	HEX CAP SCREW M12-1.75 X 45MM 8.8 DIN 93	1	PC
SUA49430	STUD GROUND LUG CSA TD COMPRESSION --SP-	1	PC
SUA88865	BOLT FLANGE 3/8-16 X 3/4" CASE HARDENED	1	PC
XSG21500.00059	CONTROL PANEL	1	PC
SUA105389	MGC-1520 (MICROPROCESSOR DGC-2020ES LEVE	1	PC
XSG21300.00070	WIRING HARNESS FOR GENSET	1	PC
XD0430900002	WIRING HARNESS	1	PC
XSG30500.00069	CONNECTION	1	PC
SUA100595	BLOCK TERMINAL 4-QUATTRO PE 3031461	1	PC
SUA39156	COVER DUPLEX RECEPTACLE STANDARD	1	PC
SUA90460	TERMINAL BLOCK MARKER BLANK	5	PC
SUA95537	MACHINE SCREW, M4-0.7 X 12MM, DIN 7985 P	2	PC
SUA95852	HARNESS WIRING DUPLEX RECEPTACLE SPECIAL	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA96594	TERMINAL BLOCK DOUBLE DOUBLE 30A MAX ST	4	PC
SUAMF96981	RECEPTACLE DUPLEX 120V 20A NEMA 5-20R 2P	1	PC
SUA93505	TERMINAL BLOCK, END BLOCK	2	PC
SUA96738	TERMINAL BLOCK END CAP QUATTRO (USED WIT	1	PC
XSG21500.00056	MOUNTING BRACKET	1	PC
SUA106651	BRACKET ADM3 MOUNTING - OM900	1	PC
SUA105204	MOUNT VIBE 5/8" NEOPRENE WITH M6-1.0 FEM	4	PC
SUA95542	WASHER, FLAT HARDENED, M6 X 6.4MM ID X 1	4	PC
SUA95540	LOCK NUT, M6-1.0 DIN 985, NYLON INSERT Z	4	PC
SUA95534	FLAT WASHER, M5, DIN 125 TYPE A ZINC	4	PC
SUA88924	HEX CAP SCREW M5-0.8 X 12MM 8.8 DIN 933	4	PC
SUA95528	K-LOCK NUT, M5-0.8 KEP ZINC PLATED	4	PC
XSG21500.00062	ELECTRICAL EQUIPMENT	1	PC
SUA102705	ALARM BUZZER 12-24VDC STD PANEL ALARM SO	1	PC
SUA77880	SWITCH TOGGLE SPST 10AMP OFF-(ON) (SPRIN	1	PC
XG2130100005	LABEL FOR CONTROL PANEL	1	PC
SUA74221	CLAMP SUPPORT 1 1/4" ID PLASTIC COATED	2	PC
SUA90393	WASHER FLAT .25 .281ID X .875OD X .090 T	2	PC
SUA101348	NUT FLANGE LOCK HEX NYLON-INSERT M6-1.0	2	PC
SUA105964	PLUG DOME 1/2" DIAMETER HOLE CONVEX MATT	2	PC
SUA86539	COVER TERMINAL BLOCK D-STS 4 (USE WITH P	1	PC
SUA86540	TERMINAL BLOCK D-STS 4 (USE WITH PN 8653	3	PC
SUA93505	TERMINAL BLOCK, END BLOCK	2	PC
SUA95528	K-LOCK NUT, M5-0.8 KEP ZINC PLATED	6	PC
SUA90460	TERMINAL BLOCK MARKER BLANK	3	PC
SUAMF95279	RAIL MOUNTING DIN 35MM X 7.5MM X 7-1/8"	1	PC
SUA106794	GROUND LUG MECHANICAL - ALUM SINGLE COND	1	PC
SUA95905	CAP SCREW M12-1.75 X 35MM 8.8 DIN 933 FU	2	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	2	PC
SUA97421	WASHER FLAT M12 X 13MM ID X 24MM OD ZINC	4	PC
SUA34137	TRIM VINYL PROTECTIVE	0.9	FT
XG2150700002	WIRING HARNESS	1	PC
SUA105604	RIVET 3/16" DIA 0.188 - 0.250 GRIP RANG	11	PC
SUA102765	LABEL EQUIPMENT GROUNDING TERMINAL	1	PC
SUA86666	SWITCH E-STOP MAINTAINED YELLOW ISO LEGE	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
XG3130900013	ADHESIVE LABEL	1	PC
XSG31300.00054	ADHESIVE LABEL FOR GENSET	1	PC
SUA39008	LABEL CAUTION FOR STANDBY SERVICE CSA EN	1	PC
XSG31300.00056	ADHESIVE LABEL FOR GENSET	1	PC
SUA44540	PLATE "CAUTION" (UL) "FOR USE IN WEATHER	1	PC
XSG31300.00048	ADHESIVE LABEL FOR GENSET	1	PC
SUA92623	LABEL CAUTION RISK OF ELECTRIC SHOCK REC	1	PC
XSG31300.00030	ADHESIVE LABEL FOR GENSET	1	PC
SUA92608	LABEL CONTROL PANEL MODEL 1.75L X 4.25W	1	PC
XSG31300.00042	ADHESIVE LABEL FOR GENSET	1	PC
SUA79477	LABEL HEATER 120VAC CHARGER 120VAC WHITE	1	PC
XSG31300.00028	ADHESIVE LABEL FOR GENSET	1	PC
SUA100530	ADHESIVE LABEL	1	PC
XSG30000.00002	ADHESIVE LABEL	1	PC
SUA105981	LABEL LIFTING INSTRUCTION LIFTING HOLES	1	PC
XSG31300.00031	ADHESIVE LABEL FOR GENSET	1	PC
SUA77906	LABEL NOTICE NOT RESPONSIBLE FOR LOOSE C	1	PC
XSG31300.00033	ADHESIVE LABEL FOR GENSET	1	PC
SUA105201	LABEL STRANDED WIRE ONLY	1	PC
XSG31300.00027	TAG FOR GENSET	1	PC
SUA72045	TAG CAUTION EXHAUST SYSTEM HAS BEEN SEAL	1	PC
XSG31300.00046	TAG FOR GENSET	1	PC
SUA96612	TAG-CONNECT BATTERIES BEFORE ENERGIZIING	1	PC
XSG31300.00040	TAG FOR GENSET	1	PC
SUA100426	TAG TAG NFPA 37 EXHAUST	1	PC
XSG31300.00050	ADHESIVE LABEL FOR GENSET	1	PC
SUA39003	PLATE "PAC" W/ ADHESIVE BACKING BLK PRIN	1	PC
SUA39015	PLATE "WARNING" (UL) (UNIT MAY	1	PC
SUA39016	PLATE "DANGER" (UL)	1	PC
SUA47938	PLATE "ISOLATED NEUTRAL N0T BONDED.."	1	PC
SUA71558	PLATE - GROUND (UL)	1	PC
SUA72036	TAG FUEL RETURN DO NOT BEND FLEX WHEN IN	1	PC
SUA72037	TAG PRIME FUEL SYSTEM + BLEED LINE BEFOR	1	PC
SUA72038	TAG FUEL INLET - DO NOT BEND FLEX WHEN I	1	PC
SUA72039	TAG N0TICE: COOLING SYSTEM HAS BEEN FILL	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA72044	TAG CAUTION CHECK OIL LEVEL BEFORE START	1	PC
SUA72047	TAG DO NOT REMOVE TAG UNTIL WARRANTY REG	1	PC
SUA72709	LABEL "CAUTION" FOR LOW WATER LEVEL SHUT	1	PC
SUA73369	PLATE "NOTICE" DISCONNECT BATTERY CABLES	1	PC
SUA73791	PLATE "CAUTION" RISK OF ELECTRICAL SHOCK	1	PC
SUA73799	PLATE "NOTICE" SERVICE ACCESS DO N0T BLO	1	PC
SUA73800	PLATE "NOTICE" AC+DC CIRCUITS MUST BE RU	1	PC
SUA75985	TAG WARNING!!! BATTERY MUST BE FULLY CHA	1	PC
SUA76197	PLATE "WARNING" 2" X 3" (UL) "UNIT STAR	2	PC
SUA77823	DECAL "MADE IN THE USA"	1	PC
SUA83389	TAG "IMPORTANT" REFER TO INSTALLTION GUI	1	PC
XG3000400004	LABEL	1	PC
XSG21300.00099	CARRIER BAG	1	PC
SUA101374	BAG	1	PC
XSG21300.00098	GUARD FOR GENSET	1	PC
SUA107661	BRACKET GUARD BELT RIGHT - OM924 OM926	1	PC
SUA107659	GUARD BELT RIGHT - OM924 OM926	1	PC
SUA107660	GUARD BELT LEFT - OM924 OM926	1	PC
SUA93424	FLANGE BOLT PLATED	4	PC
SUA96084	FLANGE BOLT M8-1.25 X16MM 8.8 DIN6921 ZI	2	PC
XSG21300.00107	BRACKET	1	PC
XG2100400001	BRACKET	1	PC
SUA101370	UL2200 "CAUTION HOT SURFACES DO NOT TOUC	1	PC
SUA101398	1/8" DIA 0.039"- 0.187"" GRIP RANGE ALU	2	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	4	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	2	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	2	PC
XSG21500.00083	CURRENT TRANSFORMER	1	PC
SUA41708	TRANSFORMER CURRENT 400:5 600V 10.0VA SE	3	PC
XSG21500.00070	FUSE HOLDER	1	PC
XG21K5300003	PANEL	1	PC
SUA96031	BOLT ON (BLIND) POWDER BLACK STAINLESS P	1	PC
XG21K5300004	ADAPTER PLATE	1	PC
SUA42820	BLOCK FUSE	1	PC
SUA42828	FUSE	3	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA95527	K-LOCK NUT, M4-0.7 KEP ZINC PLATED	2	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	4	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	2	PC
XG2130100014	ADHESIVE LABEL	1	PC
XSG32300.00281	WORK SCHEDULE	1	EA
TXT00016703	DUMMY FOR IPAS PM GASSYSTEM DEVELOPMENT	1	PC
XS575500.00568	CIRCUIT BREAKER	1	PC
SUA47123	WIRE 1 AWG 150 DEG C BLACK TYPE EPDM LEA	18	FT
SUA74263	CONNECTOR WIRE RING LUG 1/2" 0N-INSULATE	4	PC
SUA98209	BREAKER 250A 600V 3P SQUARE-D J-FRAME 80	1	PC
SUA105543	SCREW SOCKET HEAD CAP M5-.8 X 70MM CL 12	2	PC
XSG21300.00113	ADHESIVE LABELS	1	PC
SUA106111	LABEL SERVICE EQUIPMENT UL	1	PC
SUA102766	LABEL SERVICE DISCONNECT	1	PC
XSG21000.00001	DIMENSIONAL DRAWING FOR BASE FRAME	1	PC
XZG2100100021	DIMENSIONAL DRAWING	1	PC
XS00D000.06593	USB-STICK FOR DOCUMENTATION	1	PC
USB00001/00E	USB-STICK ENGLISH	1	PC
XS00D000.06590	CD-ROM GENSET FOR DOCUMENTATION	1	PC
CDZ01753/00E	CD-ROM GENSET ENGLISH	1	PC
XSG25300.00294	WIRE FOR GENSET	1	PC
SUA121110	HARNESS EXCITER WIRE EXTENSION VERIZON	1	PC

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4 Product Summary

4.1 Chapter overview

This chapter provides general information about the engine-generator set and its component parts, including a functional description, technical data, and details of benefits. A listing of where to find additional resources for support is also provided here.

Engine-generator sets can be delivered with a range of standard and optional components.

Note: This publication describes all available engine-generator set components. Disregard any components which are not included in the scope of delivery of your particular engine-generator set.

Consult your local MTU Onsite Energy distributor or dealer should you require more detailed information about a specific component.

TIM-ID: 0000064667 - 001

4.2 Additional Resources for Support

Additional resources providing information about your specific engine-generator set are available. The following documents can be accessed as needed.

Document	Description	Location
Bill of Materials	Complete listing of all components selected for your specific engine-generator set	Provided by your MTU Onsite Energy dealer or distributor
Spec Sheet	Additional data pertaining to individual engine-generator set models	Visit www.mtuonsiteenergy.com or contact your MTU Onsite Energy dealer or distributor.
Template Drawings	Dimensional and electrical template drawings of individual engine-generator set models	Visit www.mtuonsiteenergy.com or contact your MTU Onsite Energy dealer or distributor.
Spare Parts Catalog	Complete listing of parts and part numbers for your specific unit	Provided by your MTU Onsite Energy dealer or distributor
Warranty	Warranty agreement purchased with your specific unit	Provided by your MTU Onsite Energy dealer or distributor
Specifications for Operating Fluids	Overview of requirements for operating fluids and specific product recommendations that are approved for use with your engine-generator set	Refer to Mercedes-Benz Specifications for Operating Fluids at https://bevo.mercedes-benz.com.
Maintenance Schedule	Overview of maintenance work for your engine-generator set, including a list of tasks to be performed with applicable time intervals	Provided by your MTU Onsite Energy dealer or distributor

For questions about supplementary documents, contact your MTU Onsite Energy dealer or distributor.

TIM-ID: 0000064637 - 001

4.3 Engine-Generator Set

4.3.1 Engine-generator set – General information

The engine-generator set consists mainly of a diesel engine and a generator mounted on a common base frame. Upon demand, the engine starts and drives the generator to produce electrical power.

Engine-generator sets are available in two application groups: prime power and standby power.

Application group 3B – Prime power

Prime power is continuous electric power generation for long periods of time. Engine-generator sets for prime power are used in the following conditions:

- When no utility service is available, for example in remote or developing areas
- When existing utility service is very expensive or not reliable

Continuous operation	Application group 3B
Operating mode	Continuous operation, variable
Rating definition	10% overload capacity (ICXN)
Load factor	< 75%
Operating hours	Unrestricted

Application group 3D – Standby power

Standby power systems are a type of system used to provide backup resources in a crisis or when regular systems (for example, a power grid) fail. They find uses in a wide variety of settings:

- Residential homes
- Hospitals
- Airports
- Scientific laboratories
- Data centers

Standby operation	Application group 3D
Operating mode	Short-time operation, variable
Rating definition	ISO fuel stop power (IFN)
Load factor	< 85%
Operating hours	Maximum 500 hours per year

Model designation of engine-generator sets

Key to the engine-generator set model designation – Example: MTU 4R0120 DS80	
MTU	Equipment Brand Identifier: MTU – MTU Onsite Energy
4	Number of engine cylinders
R	Cylinder arrangement: • R – Inline • V – V-block
0120	Engine series or nominal displacement per cylinder (liters x 100): • Example: 1.2 liters per cylinder displacement x 100 = 120 • Leading zero added when calculation results in three digits
D	Engine type: • D – Diesel • G – Gas

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Key to the engine-generator set model designation – Example: MTU 4R0120 DS80	
S	Project type: Standard product
80	Nominal power node (based on standby application) kW for 60 Hz (kVA for 50 Hz)

Benefits

- Wide range of standardized engine-generator sets to meet customer requirements regarding power, emission, and other characteristics
- Opportunity to choose from different component designs and to select options
- Latest diesel engine technology
- State-of-the-art main components for high efficiency and long service life

TIM-ID: 0000055270 - 001

4.3.2 Engine-generator set – Standard scope of delivery

The illustrations show an engine-generator set with a Mercedes-Benz OM924LA engine. The illustrations are also valid for engine-generator sets featuring a Mercedes-Benz OM926LA engine. Visual appearance and configuration may vary depending on the unit.

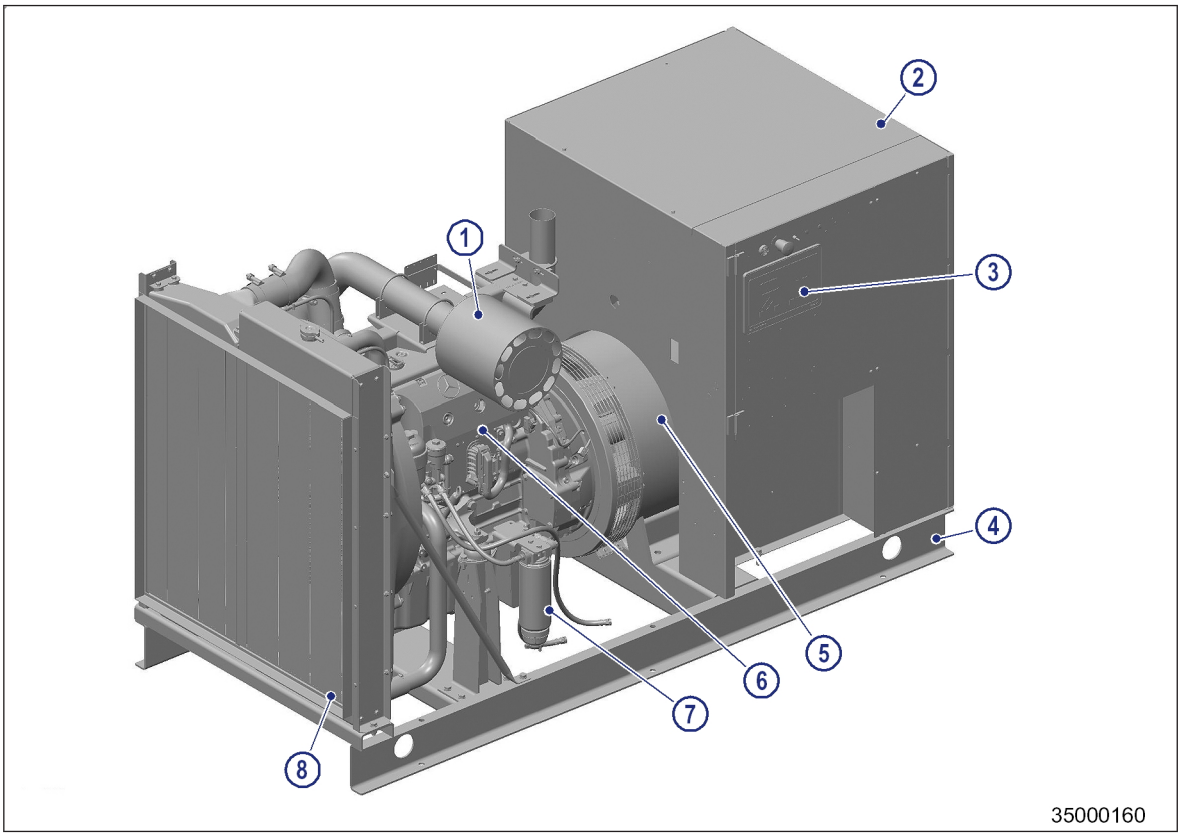


Figure 1: Engine-generator set with Mercedes-Benz OM924LA engine – Engine side

1 Air filter
2 Outlet box
3 Control panel
4 Base frame
5 Generator
6 Engine
7 Fuel prefilter with water separator
8 Unit-mounted radiator

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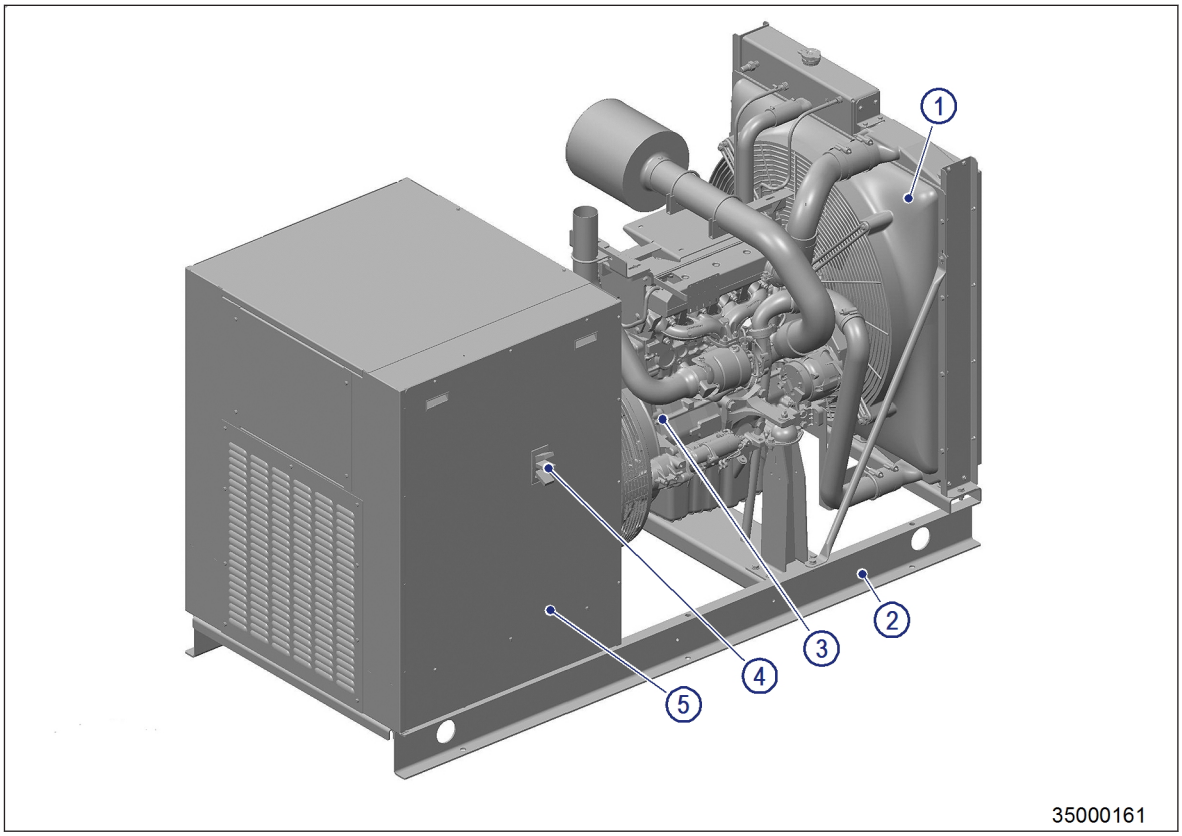


Figure 2: Engine-generator set with Mercedes-Benz OM924LA engine – Generator side

1 Unit-mounted radiator
2 Base frame
3 Engine
4 Circuit breaker
5 Outlet box

Standard scope of delivery

- Mercedes-Benz OM924LA engine, Mercedes-Benz OM926LA engine:
  - Rated speed 1,800 rpm (60 Hz), 1,500 rpm (50 Hz)
  - Electronic engine management system
  - 12 VDC Electric starter
- Generator:
  - Three measuring current transformers
  - Digital voltage regulator
- Control cabinet without control function
- Connections for fuel supply and return to the fuel tank
- Air filter
- Safety guards for all rotating parts
- Base frame with resilient mounts
- Radiator 50 °C
- Fuel prefilter with water separator

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Available options

- Sub base fuel tank
- Enclosure
- Jacket water heater -28.89 °C (-20 °F)
- Exhaust system – Open Power Unit (OPU)
  - Silencer (Industrial)
  - Silencer (Critical)
  - Silencer (Hospital)
- Charging/starting
  - Battery, rack, box, and cables
  - Battery charger
    - Guest 6 Amp
    - MicroGenius 6 Amp
    - MicroGenius 10 Amp
    - NRG 10 Amp
- Generator accessories:
  - Anti-condensation heater
  - Enhanced model of voltage regulator
- Generator temperature rise (60 Hz)
  - 80 °C (176 °F)
  - 105 °C (221 °F)
  - 130 °C (266 °F)
  - 150 °C (302 °F)
- Generator temperature rise (50 Hz)
  - 80 °C (176 °F)
  - 105 °C (221 °F)
  - 125 °C (257 °F)
  - 150 °C (302 °F)
- Single phase voltages (60 Hz)
  - 240 V, 4 wire
  - 240 V, 12 wire
- Three phase voltages (60 Hz)
  - 208 V
  - 240 V
  - 380 V
  - 480 V
  - 600 V
- Single phase voltages (50 Hz)
  - 220 V, 4 wire
  - 220 V, 12 wire
- Three phase voltages (50 Hz)
  - 220 V
  - 380 V
  - 400 V
  - 415 V
- Controller
  - MGC Series Digital Generator Set Controller
    - MGC-1500 Series
    - MGC-2000 Series
    - MGC-3000 Series
  - Contact Expansion Module (CEM)
  - Analog Expansion Module (AEM)
  - Remote annunciator
  - Safety override switch
  - Analog meter package
- Circuit breakers
  - 80% rated
  - 100% rated

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  - Electric trip
  - Up to two breakers
- Vibration isolation
  - Spring vibration isolation
  - Seismic spring isolation
- Literature
  - Quality/test documents
  - Prototype test report, test sheet

Technical data

- Application groups: 3D, standby power operation, fuel stop power, and 3B, prime power operation
- Mercedes-Benz OM924LA/OM926LA engine with:
  - 1,800 rpm (60 Hz), 1,500 rpm (50 Hz)
  - Charge-air cooling
- For engine-generator set dimensions, refer to the drawings.

For further technical data, refer to the Spec Sheet.

For an explanation of the model number classification, refer to the key code description(→ Page 49).

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4.4 Engine

4.4.1 Mercedes-Benz OM924LA/OM926LA Engines

Mercedes-Benz OM924LA/OM926LA engines with air-to-air charge-air cooling

These engines are compact, powerful, reliable, maintenance-friendly, and economical.

Their injection system unites optimum fuel utilization with compliance to the requirements of all relevant environmental protection regulations.

For more information about the engine, refer to the Mercedes-Benz engine manual (→ Page 277).

Technical data

- Four-stroke diesel engine with two intake valves and one exhaust valve per cylinder, direct injection
- Four or six cylinders, in-line arrangement
- Displacement:
  - Per cylinder = 1.2 liters (73 in^3)
  - Total for four cylinders = 4.8 liters (293 in^3)
  - Total for six cylinders = 7.2 liters (493 in^3)
- Counterclockwise rotation
- High-pressure fuel-injection system with centrally positioned injection nozzles
- Electronically controlled fuel injection
- Exhaust turbocharger and air-to-air charge-air cooling
- Engine cooling system with coolant circulation pump and thermostat
- Piston cooling
- Electric starter
- Resilient engine mounting
- Efficient internal oil cooler

Engine model designation

Key to the engine model designation	
OM	Oil engine (diesel)
9XX	Engine type
L	Intercooler
A	Exhaust gas turbocharger

Benefits

- Long service life
- High running capacity
- Low fuel consumption
- Engines meet all relevant exhaust emission standards

TIM-ID: 0000054005 - 001

4.5 Generator

4.5.1 Generator – General information

The electrical generator converts mechanical energy produced by the engine to electrical energy using electromagnetic induction.

Generators can differ from type to type in their appearance but not in their main functions. The figure (→ Figure 3) shows a typical generator with its components.

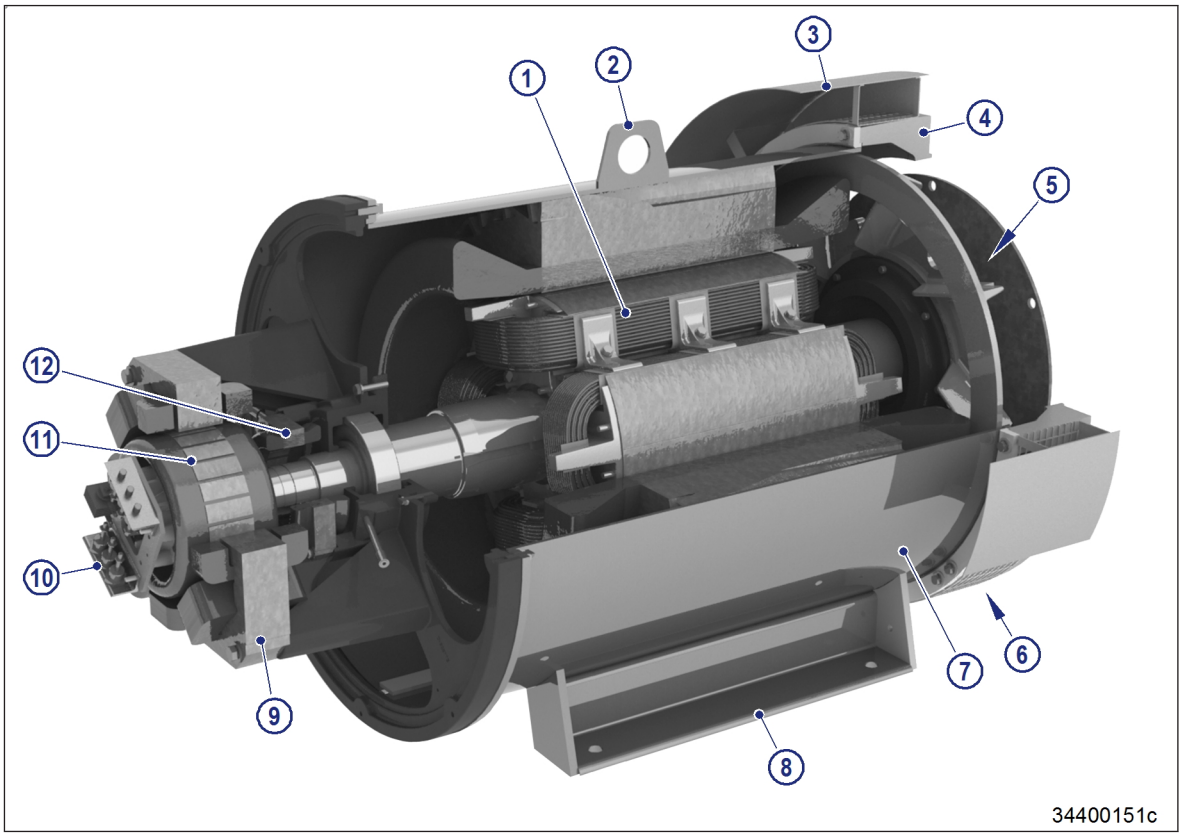


Figure 3: Generator interior view

1 Main rotor assembly
2 Generator lifting point
3 Drip cover
4 SAE adapter
5 Fan
6 Screen (air outlet)
7 Main body with main stator assembly
8 Mounting bracket
9 Exciter stator
10 Exciter rectifier assembly
11 Exciter rotor assembly
12 PMG rotor and stator

Note: Do not use the lifting points (2) to lift the entire engine-generator set.

Note: The PMG (12) may be optional, depending on the generator type.

Benefits

- Exclusive uni-rotor construction
- Superior class H insulation
- Long-life bearing
- Easy access and serviceability
- Extended life applications
- Robust voltage regulation in the presence of harmonic distortion caused by non-linear loads
- Low reactance design to minimize the harmonic voltage distortion caused by non-linear loads
- On-top-mounted outlet box to provide ample space for easy connection

TIM-ID: 0000057993 - 001

Function

The figure (→ Figure 3) shows the two main parts of a generator: the rotor (1) and the stator (in 7) which are integrated in the generator main body (7). An outlet box allows good load access from all sides.

This system supplies a minimum short circuit support current of 300% of rating for 60 Hz operation (250% for 50 Hz operation) for 10 seconds when the optional PMG is selected.

Controlling

The generator output voltage is controlled by a voltage regulator. For further information, see the description of the voltage regulator (→ Page 57).

Cooling

Generators are forced air-cooled. Air enters the lower part of the outlet box at the louvered cover. It passes through the stator and rotor coils and is exhausted as hot air at the adapter ring screened openings (6). The cast uni-directional aluminum alloy ventilation fan (5), driven by the main rotor (1), provides even air flow to maximize cooling of the generator.

Outlet box

The outlet box includes various equipment, such as a voltage regulator, CTs, and fuses. Load connections pass through cable grommets into the circuit breaker enclosure.

The figure (→ Figure 4) shows the interior of the outlet box, which can be equipped in slightly different variants.

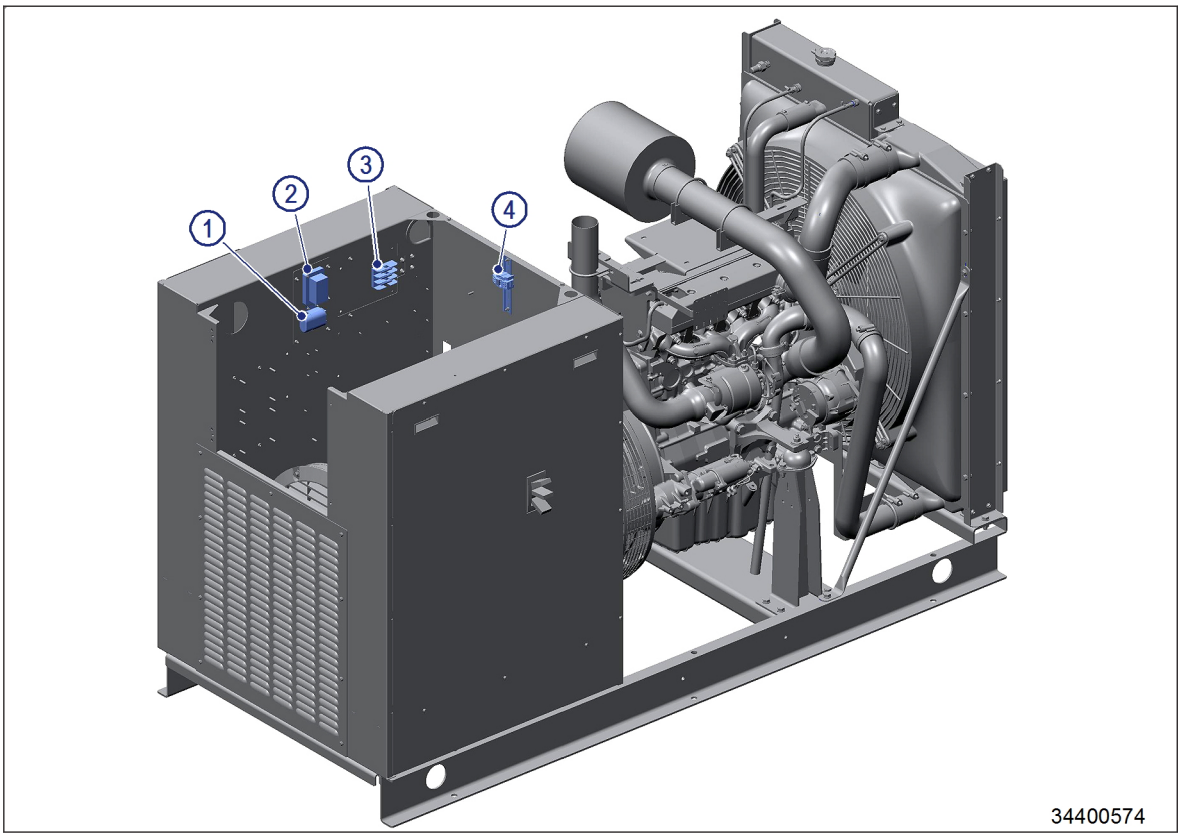


Figure 4: Generator outlet box

1 Capacitor (optional)
2 Voltage regulator (analog shown, digital optional)
3 Fuses
4 Terminal block

The mounted outlet box is shown without the cover to locate the equipment.

TIM-ID: 0000057993 - 001

The hinged control panel enables access to the voltage regulator. The adjusting points for the analog voltage regulator or the digital voltage regulator panel (if applicable) are handled from behind the control panel. The analog voltage regulator is a standard feature. The digital voltage regulator and the capacitor (1) are optional features. For further information, see the description of the voltage regulator (→ Page 57).

The current transformers (not shown in figure) are located on the cables that are connected to the studs on the link board. Fuses (3) are also located inside the outlet box.

Diodes perform the function of an "electrical check valve". They conduct in one direction only and are used to rectify AC current into DC current. Three forward polarity diodes and three reverse polarity diodes are used. The surge suppressor is polarized. Diodes and surge suppressor are located on the exciter rectifier assembly.

Technical data

- Single bearing generator of type:
  - MagnaPlus 360 frame
  - MagnaPlus 430 frame
- 1,800 rpm (60 Hz), 1,500 rpm (50 Hz)
- Voltage range: up to 600 V; 3-phase
- Windings with brushless exciter
- Meets NEMA MG 1 Part 32, BS 5000 and IEC 60034-1 requirements; CE marking provided
- UL recognized component and CSA certified; conforms to UL 1004-1 and CSA C22.2 No. 100

Identification number

Each model of a generator is characterized by an identification number composed of several sections. The identification number is defined by the technical specification of the model and located on the nameplate of the generator.

Exemplary composition of the identification number

433	Frame number
P	Construction: MagnaPlus
S	Bearing: Single (1 bearing)
L	Voltage: Up to 480 V
6216	Model in Series

Key to codes in generator identification numbers

Codes for Construction:	P – MagnaPlus (430 frame)
Codes for Bearing:	S – Single (1 bearing)
Codes for Voltage:	L – Up to 480 V S – 600 V
Codes for Model in Series:	Diverse types and codes

TIM-ID: 0000057993 - 001

4.5.2 Analog voltage regulator

The analog voltage regulator adjusts the generator output voltage by regulating the current into the exciter field. It is mounted behind the control panel inside the outlet box.

The figure (→ Figure 5) shows the location of the analog voltage regulator and its setting controls.

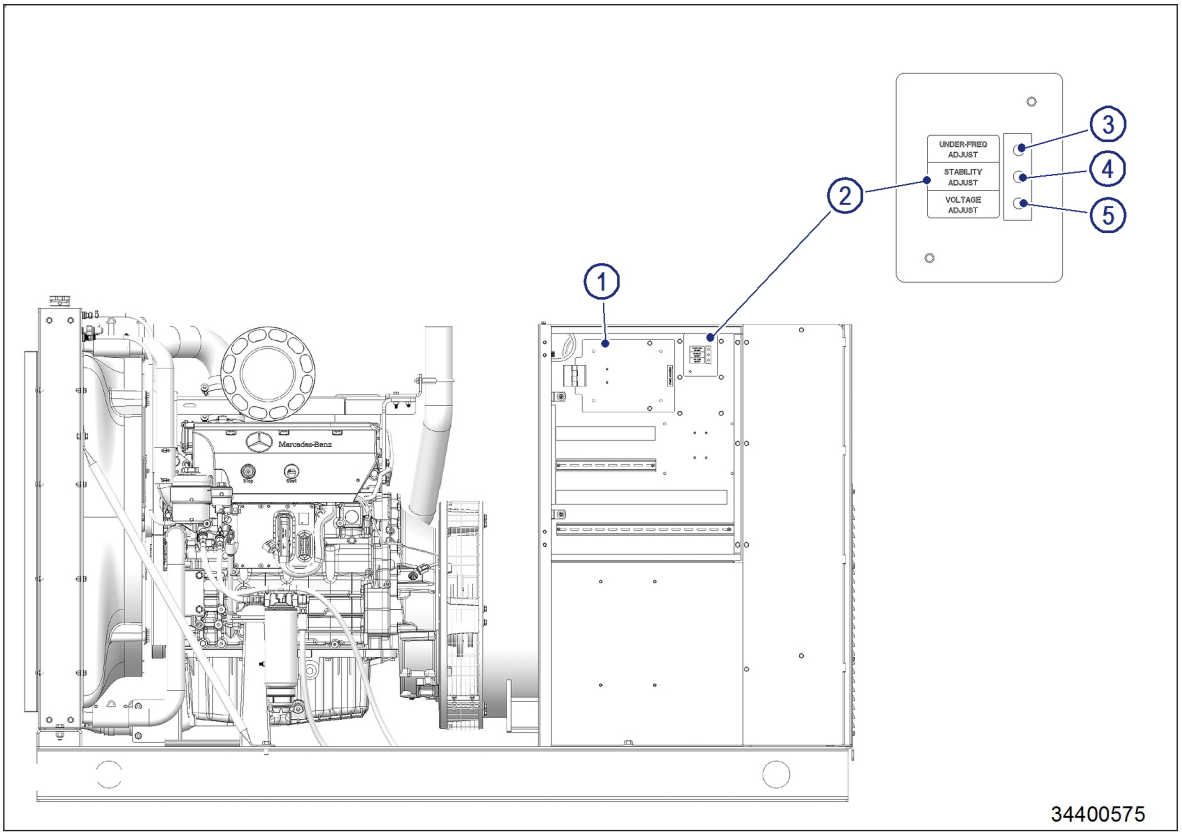


Figure 5: Analog voltage regulator (controls door removed for visibility)

1 Fuse access panel
2 Analog voltage regulator
3 Access point for underfrequency adjust
4 Access point for stability adjust
5 Access point for voltage adjust

Technical data

- Voltage regulation: 1% from no load to full load (with 5% frequency variation)
- Regulator drift: < 1% per 40 °C (72 °F) ambient temperature change
- Sensing and power input: 190 to 240 VAC
- 50 Hz or 60 Hz operation
- Overexcitation and underspeed protection
- Static-type using non-aging silicon controlled rectifiers
- Electromagnetic interference suppression to commercial standards with internal EMI filter
- Encapsulated design for humidity and abrasion protection

Function

In the standard configuration (shunt excited), the voltage regulator receives both its input power and voltage sensing from the generator's output terminals.

TIM-ID: 0000057994 - 001

At rated speed, the main stator's voltage produced by the residual magnetism of the exciter allows the automatic voltage regulator to function. The regulator provides voltage to the exciter field resulting in a build-up of generator terminal voltage. This system of using residual magnetism eliminates the need for a special field flashing circuit in the regulator. After the generator has established the initial residual voltage, the regulator provides a controlled DC field voltage to the exciter stator resulting in a controlled generator terminal voltage.

The requested frequency (50 Hz or 60 Hz) is set by means of a moveable jumper.

Voltage adjust

The screwdriver adjustable potentiometer labeled "VOLT" adjusts the generator output voltage.

- Adjustment clockwise increases the generator output voltage.
- Adjustment counterclockwise decreases the generator output voltage.

When using a remote voltage adjust rheostat, and if the jumper wire across terminals 6 and 7 is removed and a 2,000 Ω 0.5 W (minimum) rheostat is installed, a ±10% voltage variation from the nominal can be reached. By using a 1,000 Ω 0.5 W rheostat, a ±5% voltage variation is possible.

Stability adjust

The screwdriver adjustable potentiometer labeled "STAB" adjusts the system stability.

- Adjustment clockwise increases the stability and, therefore, increases the response time of the generator.
- Adjustment counterclockwise decreases the stability and, therefore, decreases the response time of the generator.

System stability is the ability of the generator to respond to load transients. Decreasing the stability makes the generator less sluggish and faster to respond to load transients. If the stability of the regulator is decreased too much, the generator will tend to hunt under steady state conditions.

V/Hz roll-off frequency selection

The roll-off point is the frequency where the generator voltage starts to decrease. This reduces the kilowatt load to the engine, which allows the engine to recover in speed under any load transient condition.

The screwdriver adjustable potentiometer labeled "U/F" sets the roll-off frequency from 54 to 61 Hz in the 60 Hz setting (45 to 51 Hz in the 50 Hz setting).

The analog voltage regulator has the roll-off point preset to:

- 58 Hz in the 60 Hz mode
- 48 Hz in the 50 Hz mode

To change the roll-off point:

1. Set the engine speed to the desired rated speed (50 Hz or 60 Hz).
2. Set the voltage to the desired setting at rated speed.
3. Set the engine speed to the desired roll-off point.
4. Adjust the potentiometer counterclockwise until the voltage starts to drop off.
5. Adjust the potentiometer clockwise until the voltage returns to rated voltage.
6. Reset engine speed to rated speed.

TIM-ID: 0000057994 - 001

4.5.3 Digital voltage regulator DVR2000E+

The digital voltage regulator is an encapsulated, microprocessor-based control device that regulates the output voltage of a brushless, AC generator by controlling the current into the generator exciter field. It is powered by a permanent magnet generator (PMG) and designed for behind-the-panel mounting.

All regulator adjustments are located on the front panel for easy use. The display annunciates regulator status and system conditions. Push buttons allow adjustment of the various regulator functions. Normally, the display is covered with a protection plate. The rear panel is accessible through a removable regulator panel located behind the hinged control panel in the outlet box.

The figure (→ Figure 6) shows the front panel and the rear panel of the digital voltage regulator.

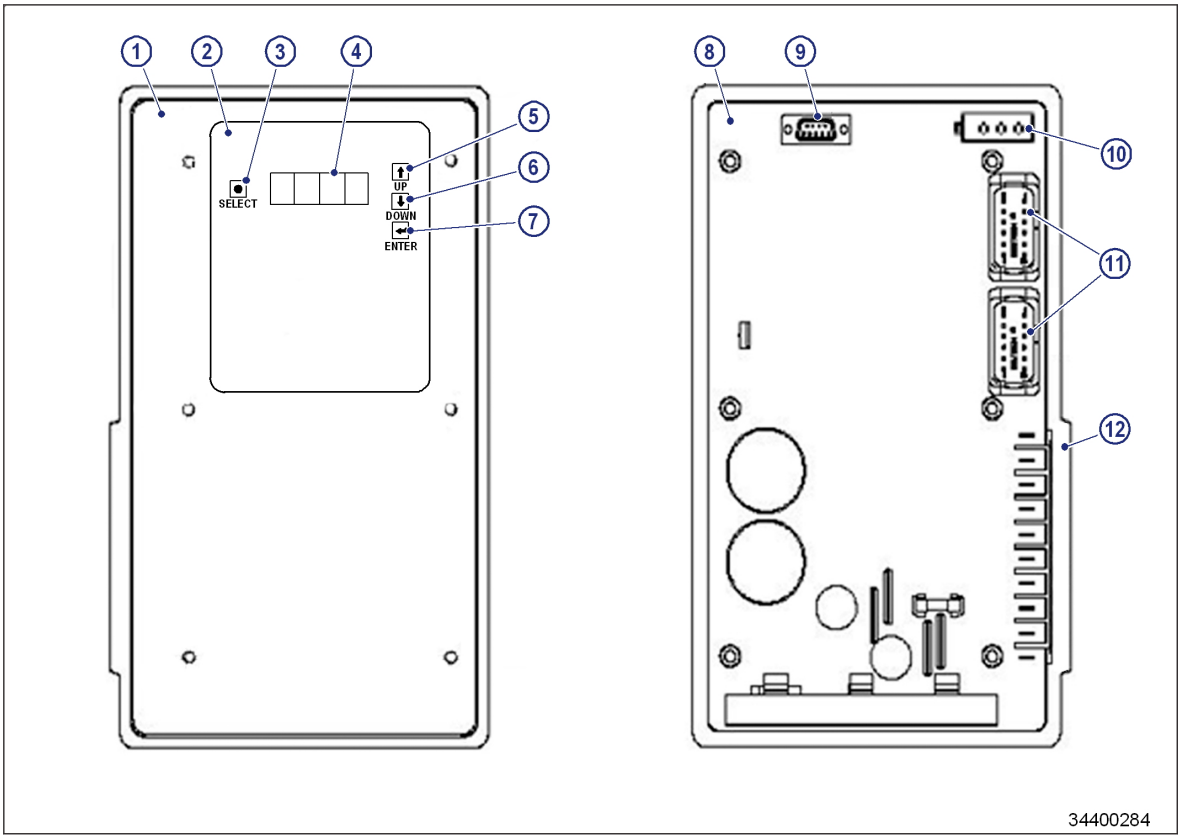


Figure 6: Digital voltage regulator panels

1 Front panel
2 Operating interface
3 SELECT button
4 Display
5 UP button
6 DOWN button
7 ENTER button
8 Rear panel
9 Serial port
10 CAN J1939 port
11 J1 and J2 connection points
12 Quick disconnect terminals

TIM-ID: 0000057995 - 001

Features

Operating features

- Voltage regulation to 0.25%
- Three regulation modes:
  - Single phase automatic voltage regulation (AVR1)
  - Three-phase automatic voltage regulation (AVR3)
  - Field current regulation (FCR)
- 50 or 60 Hz operation
- Preset stability settings
- Adjustable soft start in AVR1 or AVR3 regulation modes
- Underfrequency (volts/hertz) regulation
- Three-phase or single phase generator voltage (RMS) sensing
- Three-phase or single phase generator current (RMS) sensing
- True three-phase power metering
- Field current sensing
- Field voltage monitoring
- Contact inputs for system interface capability
- Contact output for fault indication
- Generator paralleling with reactive droop compensation and reactive differential compensation
- Front-panel human-machine interface (HMI) for status and configuration
- Modbus protocol via RS232 for external communication
- DVR2000E+ Windows ®-based software for configuration and monitoring
- Controller Area Network (CAN) interface with CAN 2.0B J1939 protocol for metering and control
- “Power on” LED indicator
- Configurable auxiliary input for metering and control
- CAN capability

Protection features

- Shutdown:
  - Field overexcitation shutdown
  - Generator overvoltage shutdown
  - Generator undervoltage shutdown
  - Generator voltage imbalance shutdown
  - Loss of generator sensing shutdown
  - Field current limiting shutdown
  - Regulator overtemperature shutdown
  - Instantaneous field overcurrent shutdown
- Alarm:
  - Generator underfrequency alarm
  - Generator reverse power flow alarm
  - Loss of CAN communication alarm

Front panel – Display and operation

The front panel of the digital voltage regulator consists of four push buttons and a 4-digit-display. The display gives out status conditions and failure messages. The push buttons were used to select adjustments during generator installation or service.

TIM-ID: 0000057995 - 001

The display works in three modes:

- STATUS mode
  The display shows the non-editable operating state of the digital voltage regulator.
  The display flashes while in STATUS mode.
- EDIT mode
  The display shows a multi-layer menu for reading and editing operating parameters of the digital voltage regulator.
  The display is steady-on while in EDIT mode.
- SLEEP mode
  The display is turned-off after a period of button-press inactivity.

Adjustments are chosen by means of the push buttons.

Panel push buttons

No. *	Button	Result
3	SELECT	Selects a function for adjustment. Successive pressing scrolls through the menu. Serves also as an escape key in EDIT mode.
5	UP	Increases the setting level of the function being adjusted in steps from the current value to a defined maximum.
6	DOWN	Decreases the setting level of the function being adjusted in steps from the current value to a defined minimum.
7	ENTER	Stores the current value of the parameter being adjusted and returns the user to the main menu list.
* Numbers correspond to (→ Figure 6).		

If regulator power is interrupted before the automatic save feature is commanded, that level of adjustment will be lost.

If no button is pressed for one minute, the regulator saves the settings and exits the adjustment mode.

Notes:

- To change settings, appropriate training by the user is required to avoid malfunctions!
- The engine-generator set must be running before conducting adjustments or settings must be adjusted while engine-generator set is operational.

Rear panel – Communication ports and terminals

Communication ports and terminals on the rear panel consists of four types of connectors:

- Ten quarter-inch, quick-connect terminals for generator connections
- Two 12-pin Deutsch (DTC style) connectors for current transformer (CTs) and system interface connections
- One 3-pin Amp/Tyco Mini Mate-N-Lok receptacle for CAN bus interface
- One 9-pin DB-9 type connector for serial communication between the digital voltage regulator and a Windows ® compatible PC (programming setup)

TIM-ID: 0000057995 - 001

Operating modes

The digital voltage regulator provides three modes of operation selectable through Windows ® or Palm OS ® communication software. Standard features are:

- Automatic voltage regulation mode – Single phase (AVR1)
  In AVR mode, the digital voltage regulator regulates the RMS generator output voltage. This is accomplished by sensing generator output voltage and adjusting DC output excitation current to maintain voltage at the regulation setpoint.
- Automatic voltage regulation mode – Three-phase (AVR3)
  In AVR mode, the digital voltage regulator regulates the RMS generator output voltage. This is accomplished by sensing generator output voltage and adjusting DC output excitation current to maintain voltage at the regulation setpoint.
- Manual mode (FCR)
  In manual mode, also known as field current regulation (FCR) mode, the digital voltage regulator maintains DC excitation current at a set level.

Digital voltage regulator communications software

DVR2000E+ is a Windows ®-based digital voltage regulator communication software package which is supplied with the digital voltage regulator.

The software provides a communication link between the digital voltage regulator and the user. The software enables the user to enter all digital voltage regulator settings and read all system metering values through an easy to use graphical interface.

For a detailed description of the DVR2000E+ software, contact your MTU Onsite Energy distributor or dealer.

Registered trademarks

Windows is a registered trademark of Microsoft Corporation.

Palm OS is a registered trademark of Palm, Inc.

TIM-ID: 0000057995 - 001

4.6 Engine-Generator Set MGC-1500 Series Control Panel

4.6.1 Control panel enclosure with MGC-1500 Series - General information

The control panel is the local control console and emergency control station for the engine-generator set. Its control and display elements provide status and alarm information and allow quick start/stop/emergency stop operations. The screen display is controlled by a key pad beneath the display panel. Command input for engine-generator set operation and alarm handling is provided by additional control keys on the display panel.

The control panel communication software allows units to be easily customized for each application.

Digital Generator Set Controller MGC-1500 Series

The MGC-1500 Series installed in MTU Onsite Energy engine-generator sets is a highly advanced, integrated engine-generator set control system. The MGC-1500 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that holds up to almost any environment. The MGC-1500 is flexible enough to meet the needs of your application. This device provides engine-generator set control, metering, protection, and programmable logic in a simple, easy-to-use, reliable, and cost effective package.

A control panel with MGC-1500 Series is installed on engine-generator sets with management and monitoring in:

- Engine-generator set without mains, with standard generator protection
- Engine-generator set with third-party ATS, with enhanced generator protection

(→ Figure 7) shows the control panel enclosure with MGC-1500 Series.

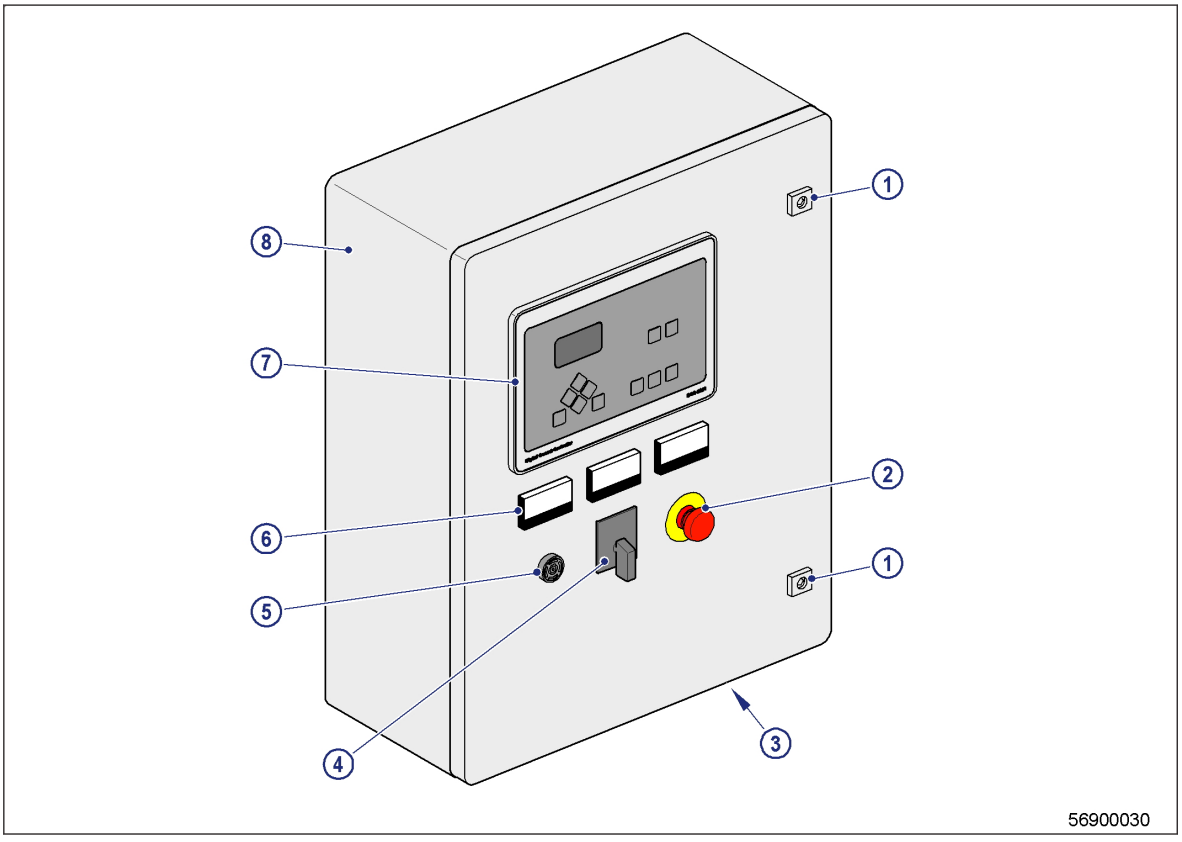


Figure 7: Control panel enclosure with MGC-1500 Series and meters – Exterior

1 Latch
2 Emergency stop button
3 Cable entries point
4 Phase selector switch (optional)
5 Audible alarm
6 Meters (optional)
7 Microprocessor MGC-1500 Series display (optional)
8 Control panel enclosure

TIM-ID: 0000054660 - 002

NOTE: (→ Figure 7) is a generic representation of the controller. The appearance of the front panel and enclosure varies depending on the controller type and engine-generator set. The location of enclosure buttons, switches, and other options may change but their functionality remains consistent.

The meters (6) show the present voltage and current per phase and the frequency. The phase selector switch (4) is used with the analog meters and has a position for each of the three phases. Turning the switch determines the phase. The values according to this phase are shown on the meters.

Features

- Engine metering and protection
- Emergency stop
- Current sensing (5 A CT inputs)
- System protection and supervision:
  - Under/Overvoltage
  - Under/Overfrequency
  - Overcurrent
  - Voltage phase imbalance
  - Loss of mains protection
  - Engine kW overload (three levels)
  - Bus under/overvoltage
  - Bus under/overfrequency
- 7 contact outputs:
  - Factory utilized: three 5 A at 28 VDC for Pre-start, Start, and Run and four 2 A at 28 VDC for general purpose
- 16 inputs
- Battery backup for Real Time Clock (RTC)
- LCD heater
- SAE J1939 CAN bus engine ECU communications
- Rugged, fully potted design
- Wide ambient temperature range
- UL/CSA approvals: cURus approved to UL 6200 and CSA C22.2 No. 14
- HALT (Highly Accelerated Life Tests) tested
- IP54 front panel rating with integrated gasket
- NFPA 110 level compliant
- Windows ®-based control panel communication software
  - Programming and setup software – intuitive and powerful
  - Programmable logic
  - USB communications
- Multilingual capability (English, Spanish, Chinese)
- Event recording

Accessories

- Contact expansion module for additional contact inputs and outputs

Contact expansion module (not available with all controllers)

The contact expansion module is programmed to display operating conditions (potential-free contacts):

TIM-ID: 0000054660 - 002

- Global (Pre-alarm)
- Global (Alarm)
- Not in AUTO
- Low fuel level (Pre-alarm)
- Fuel leak
- Low coolant level (Alarm)
- Low oil pressure (Pre-alarm)
- Low oil pressure (Alarm)
- High engine temperature (Pre-alarm)
- High engine temperature (Alarm)
- Low engine temperature (Pre-alarm)
- Engine running
- Overcrank (Alarm)
- Overspeed (Alarm)
- Battery overvoltage (Pre-alarm)
- Low battery voltage (Pre-alarm)
- Emergency system supplying load

The communications to the MGC-1500 Series takes place via CAN bus.

Functions

Engine-generator set protection

- Generator protection
  - Undervoltage
  - Overvoltage
  - Underfrequency
  - Overfrequency
  - Overcurrent
  - Phase imbalance
- Engine-generator set alarms, protected by MGC-1500 Series
  - Low oil pressure
  - Engine sender
  - Overcrank
  - Overspeed
  - Low coolant level
  - High coolant temperature
  - Fuel leak/fuel sender failure
  - Emergency stop
- Engine-generator set pre-alarms, protected by MGC-1500 Series
  - Low oil pressure
  - High coolant temperature
  - Low coolant temperature
  - Battery overvoltage
  - Battery charger failure
  - Weak battery voltage
  - Engine sender unit failure
  - Engine kW overload low (three levels)
  - Maintenance interval timer
  - Fuel leaks detect
  - Low fuel level
  - Low coolant level
  - High fuel level (optional)

TIM-ID: 0000054660 - 002

Engine-generator set metering

- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor (PF).
- Engine parameters include oil pressure, coolant temperature, RPM, battery voltage, fuel level, engine run-time, and various CAN bus supported parameters.

Engine control

- Cranking control: cycle or continuous (quantity and duration fully programmable)
- Engines cool-down: smart cool-down function saves time and fuel
- Successful starts counter: counts and records successful engine starts
- Timers:
  - Engine cool-down timer
  - Pre-alarm time delays for weak/low battery voltage
  - Alarm time delay for overspeed
  - Alarm time delay for sender failure
  - Continuous or cycle cranking time delay
  - Arming time delays after crank disconnect for:
    Low oil pressure
    High coolant temperature
  - Engine maintenance timer
  - Pre-crank delay
  - Programmable logic timer

Event recording

The MGC-1500 Series has an event recorder. The event recorder provides a record of alarms, pre-alarms, engine starts, engine runtime loaded, engine runtime unloaded, last run date, and many other events. These events are all date and time stamped to help the user determine the cause and effect of issues related to the engine-generator set. It contains 30 event records each retaining numerous occurrences in memory. Time, date and engine hour detail is available for the most current 30 occurrences within each event record.

Technical data

Operating power	Values
Nominal	12 or 24 V DC
Range	6 to 32 V DC
Power consumption in sleep mode	5 W with all relays non-energized
Power consumption in typical operation mode	6.5 W in RUN mode, with LCD heater off and three relays energized
Battery ride through	Withstands cranking ride-through down to 0 V for 50 ms (typical)

Environmental condition	Values	
Temperature	Operating:	-40 to 70 °C (-40 to 158 °F)
	Storage:	-40 to 85 °C (-40 to 185 °F)
Humidity	IEC 68-2-38	
Salt Fog	ASTM B 17-73 IEC 68-2-11 (tested while operational)	
Ingress Protection	IEC IP54 for front panel	
Shock	15 G in three perpendicular planes	

TIM-ID: 0000054660 - 002

Environmental condition	Values	
Vibration	5 to 29 to 5 Hz:	1.5 G peak for 5 min.
	29 to 52 to 29 Hz:	0.036" double amplitude for 2.5 min.
	52 to 500 to 52 Hz:	5 G peak for 7.5 min.
	Swept over these ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep	

Display operations

The front panel display is used to make settings changes and to display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions.

For further information to the main display operations, refer to (→ Page 68).

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

Registered trademark

Windows is a registered trademark of Microsoft Corporation.

TIM-ID: 0000054660 - 002

4.6.2 Control panel MGC-1500 Series – Display operations

Front panel display

The front panel display is used to change settings and display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions. The figure (→ Figure 8)shows the display of the MGC-1500 Series in detail.

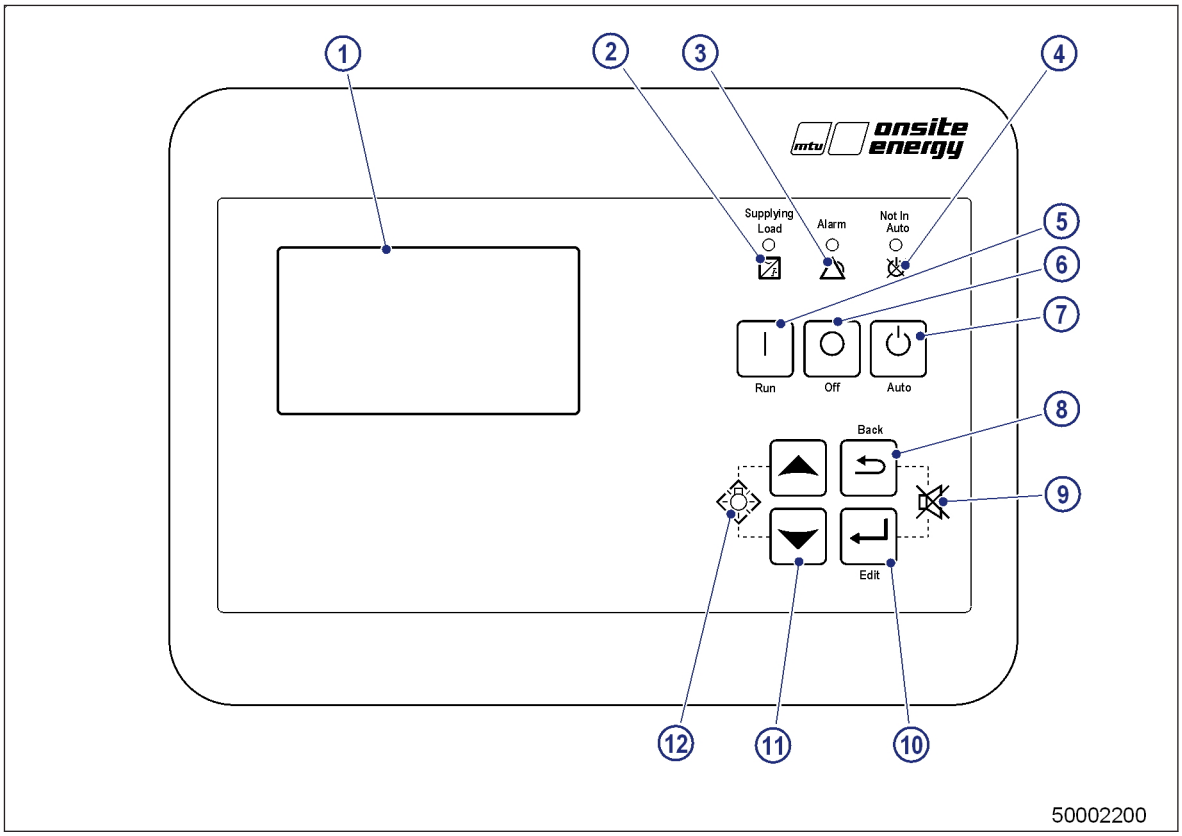


Figure 8: Control panel with MGC-1500 Series – Controls and indicators

1 Liquid Crystal Display (LCD)
2 Supplying load indicator
3 Alarm indicator
4 "Not in auto" indicator
5 RUN pushbutton and mode indicator
6 OFF pushbutton and mode indicator
7 AUTO pushbutton and mode indicator
8 Back pushbutton
9 Alarm silence pushbutton combination
10 EDIT pushbutton
11 Arrow pushbuttons
12 LAMP TEST pushbutton combination

Panel LED indicators

No.*	LED	Indication
2	Supplying Load	Green – Indicates the system is supplying current to a connected load.
3	Alarm	Red – Indicates an alarm situation by continuous illumination. Indicates a pre-alarm by flashing.
4	Not in Auto	Red – Indicates unit is not in the AUTO mode.
5	Run	Green – Indicates the MGC is in the RUN mode.
* Numbers correspond to (→ Figure 8).		

TIM-ID: 0000055005 - 002

No.*	LED	Indication
6	Off	Red – Indicates the MGC is in the OFF mode.
7	Auto	Green – Indicates the unit is in the AUTO mode of operation.
* Numbers correspond to (→ Figure 8).		

Panel pushbuttons

No.*	Pushbutton	Result
5	RUN	Places the MGC-1500 Series in RUN mode. The green LED lights when RUN mode is active.
6	OFF	Places the MGC-1500 Series in OFF mode. The red LED lights when OFF mode is active.
7	AUTO	Places the MGC-1500 Series in AUTO mode. The green LED lights when AUTO mode is active.
8	BACK	Cancels an editing session and discards any settings changed. When pressed, this pushbutton also resets the Breaker Management Pre-alarms.
9	ALARM SILENCE	Stops the currently occurring audible alarm.
10	EDIT	Starts an editing session and enables changes to MGC-1500 Series settings. At the conclusion of an editing session, the EDIT pushbutton is pressed again to save the setting chances.
11	(arrows)	Navigates through the front panel display menus and modifies settings. The left- and right-arrow pushbuttons are used to navigate through the menu levels. • The right-arrow pushbutton is pressed to move downward through the menu levels. • The left-arrow pushbutton is pressed to move upward. Within a level, the up- and down-arrow pushbuttons are used to move among items within the menu level. • Pressing the down-arrow pushbutton moves to items lower in the list. • Pressing the up-arrow pushbutton moves to items higher in the list. During an editing session, the up- and down-arrow pushbuttons are used to raise and lower the value of the selected setting.
12	LAMP TEST	Tests the MGC-1500 Series indicators by exercising all LCD pixels and lighting all LEDs.
* Numbers correspond to (→ Figure 8).		

Login/logout and permissions

Note: To change settings, appropriate user training is required to avoid malfunctions.

TIM-ID: 0000055005 - 002

1. To log in, navigate to the SETTINGS → ENTER PASSWORD screen and press the EDIT pushbutton.
2. Enter the password.
   - Use the up- and down-arrow pushbuttons to scroll through the characters.
   - Use the edit pushbutton to accept a character and move to the next space.
3. Press the EDIT pushbutton to log in.
   The LOGOUT selection now appears in the list of SETTINGS.
4. ... select your further operations ...
5. To log out, navigate to SETTINGS → LOGOUT and press the EDIT pushbutton.
   The LOGOUT selection is removed from the list of SETTINGS.

Summary screen

Note: To change settings, appropriate user training is required to avoid malfunctions.

The summary screen can be set to standard or scrolling.

Set the summary screen

1. Press the right arrow to select a standard or scrolling summary.
2. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
3. Press the EDIT pushbutton. Enter user ID and password as needed.
4. Edit the SUMMARY VIEW.
   The SCROLL DELAY setting is also found on the screen.

When set to standard, the following values are displayed:

VOLT*	AMP*	PH*	Hz	OIL	FUEL	TEMP	BATT

* Information for each phase is obtained by pressing the up- and down-arrow pushbuttons on the front panel.

When the summary screen is set to scrolling, you can select/configure the metering values that are displayed. Up to 20 values can be displayed and these values scroll at a delay time specified by the user.

Select the scrolling values

1. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
2. Edit the CONFIGURABLE METERING.

The following values may be selected by the user to be placed in the scrolling summary:

NONE*	BATT V	GEN VAB	GEN VAN	KW A	KVA A	GEN Hz	GEN IA
BLANK**	RPM	GEN VBC	GEN VBN	KW B	KVA B	GEN PF	GEN IB
OIL P	RPM SRC	GEN VCA	GEN VCN	KW C	KVA C	BUS Hz	GEN IC
TEMP	FUEL	RUN HRS	KWH	KW TOT	KVA TOT	BUS V	

* Removes a line from the scrolling list.
** Shows nothing on this line.

Remote access

If communications access is active through the modem or USB, the front panel displays "REMOTE COMMS, FRONT PANEL IS READ ONLY" and the summary screen. This informs that the front panel can only be used for viewing metering data and settings information. Remote access must be ended before modifying settings through the front panel.

Sleep mode

The sleep mode serves as a power-saving feature. A number of conditions must be met for the MGC-1500 Series to be in sleep mode. These conditions include being in OFF mode or AUTO mode not running. Also, if a pushbutton is not pressed for more than 15 minutes, the front panel LCD backlight and LCD heater are turned off. The MGC-1500 Series resumes normal display operation when any front panel pushbutton is pressed or the engine-generator set is started remotely via the ATS input.

TIM-ID: 0000055005 - 002

The MGC-1500 Series will not go to sleep while in an alarm state. If needed, the sleep mode can be permanently disabled via the control panel communication software or the front panel menu.

As a default, the sleep mode is disabled at the factory, however, it can be reinitiated.

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

TIM-ID: 0000055005 - 002

4.6.3 Remote annunciator for MGC Series

The remote annunciator is used with the MGC Series (→ Page 63) to provide electrical signaling for the engine-generator set. The MGC Series detects alarm, pre-alarm, and operating conditions and communicates via Modbus communications with RS-485 to the remote annunciator.

The figure(→ Figure 9) shows the remote annunciator front panel.

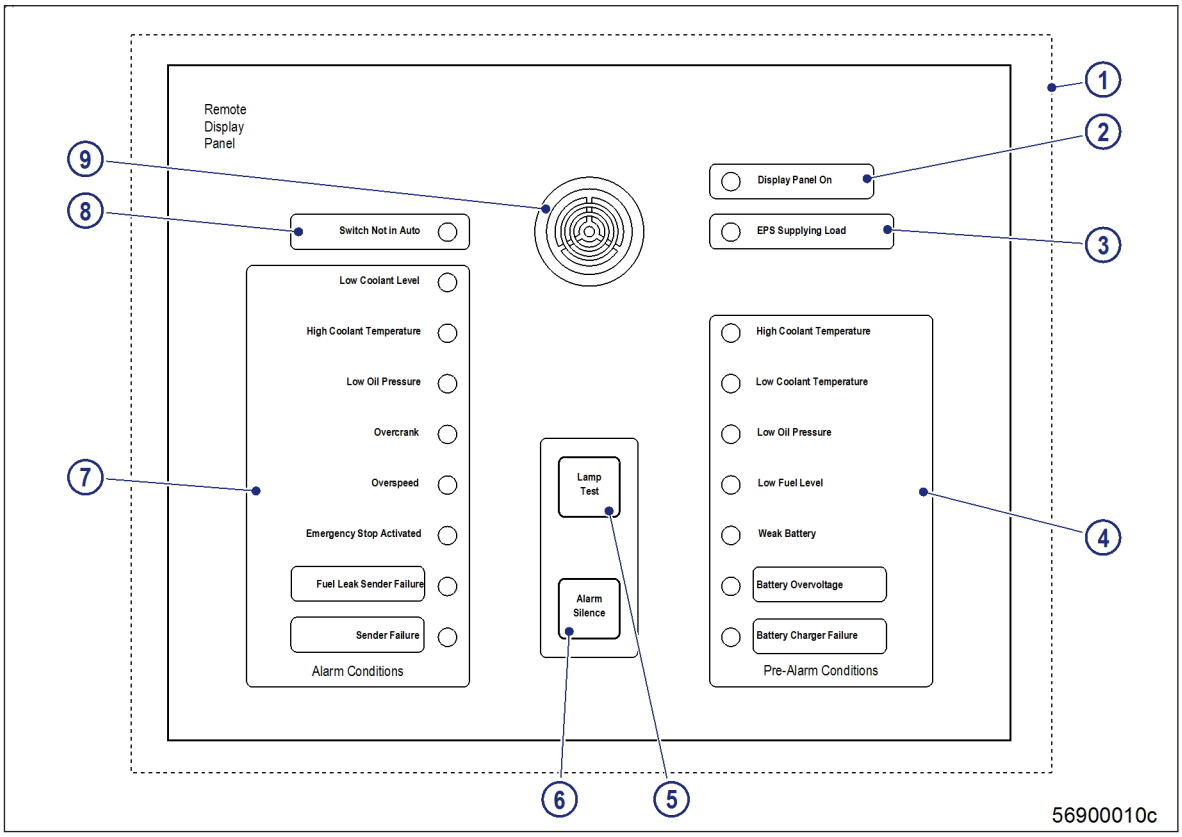


Figure 9: Remote annunciator for MGC Series – Front panel

1 Front panel *
2 LED "Power on"
3 LED "Supplying load"
4 LEDs for pre-alarms
5 LAMP TEST pushbutton
6 ALARM SILENCE pushbutton
7 LEDs for alarms
8 LED "Not in AUTO"
9 Audible alarm

* The dashed line indicates the outside edges when flush mounted. Otherwise, the full line denotes the edges.

Functions

The remote annunciator has 18 LEDs. These LEDs indicate alarms (7), pre-alarms (4), and operating conditions (2, 3, 8) of the engine-generator set as detected by the MGC Series.

If an alarm or pre-alarm is indicated, an audible alarm (9) sounds.

Panel LED indicators

No.*	LED	Indication
2	Display Panel On	Green – Indicates that power is applied to the remote annunciator.
3	EPS Supplying Load	Green – Indicates that the system is supplying more than two percent of rated current to a connected load.
Numbers correspond to the figure (→ Figure 9).		

TIM-ID: 0000055008 - 002

No.*	LED	Indication
4	Pre-alarm Conditions	Yellow – Indicates: • High coolant temperature • Low coolant Temperature • Low oil pressure • Low fuel level • Weak battery • Battery overvoltage • Battery charger failure
7	Alarm Conditions	Red – Indicates: • Low coolant level • High coolant temperature • Low oil pressure • Overcrank • Overspeed • Emergency stop activated • Fuel leak/Fuel sender failure • Sender failure
8	Switch Not in Auto	Red – Indicates that the unit is not in AUTO mode.
Numbers correspond to the figure (→ Figure 9).		

Panel pushbuttons

No.*	Pushbutton	Result
5	LAMP TEST	Tests the indicators by lighting all LEDs and exercises the audible alarm.
6	ALARM SILENCE	Stops the currently occurring audible alarm.
Numbers correspond to the figure (→ Figure 9).		

Benefits

- Monitoring main operating conditions and (pre-)alarms from a distance, for example from an office
- RS-485 communications
- Conduit box is included for easy installation
- Independent of environmental needs for operating the engine-generator set, the remote annunciator itself is designed for use in harsh environments

Technical data

- Power input from the starter batteries at 24 VDC or with an AC source at 120 VAC
- Port RS-485 interface
- Distance between annunciator and MGC Series: up to 1,200 m (4,000 ft)
- Meets the requirements of NFPA-110
- UL recognized, File E97035, and CSA certified, File LR23-23131
- Two mounting configurations: surface and flush mount

Environmental condition	Values
Operating temperature	-40 to 70 °C (-40 to 158 °F)
Storage temperature	-40 to 85 °C (-40 to 185 °F)
Salt Fog	Qualified to ASTM 117B-1989
Shock	15 G
Vibration	Withstands 2 G in each of three mutually perpendicular planes*
Sound	Alarm horn rated at 80 dB [from a distance of 60 cm (2 ft)]

TIM-ID: 0000055008 - 002

* Swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance

TIM-ID: 0000055008 - 002

4.7 Engine-Generator Set MGC-2000 Series Control Panel

4.7.1 Control panel enclosure with MGC-2000 Series - General information

The control panel is the local control console and emergency control station for the engine-generator set. Its control and display elements provide status and alarm information and allow quick start/stop/emergency stop operations. The screen display is controlled by a key pad beneath the display panel. Command input for engine-generator set operation and alarm handling is provided by additional control keys on the display panel.

The control panel communication software allows units to be easily customized for each application.

Digital Generator Set Controller MGC-2000 Series

The MGC-2000 Series installed in MTU Onsite Energy engine-generator sets is a highly advanced, integrated engine-generator set control system. The MGC-2000 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that holds up to almost any environment. The MGC-2000 is flexible enough to meet the needs of your application. This device provides engine-generator set control, metering, protection, and programmable logic in a simple, easy-to-use, reliable, and cost effective package.

A control panel with MGC-2000 Series installed on engine-generator sets with management and monitoring in:

- Engine-generator set without mains, with standard generator protection
- Engine-generator set without mains, with enhanced generator protection
- Engine-generator set with third-party ATS, with enhanced generator protection

(→ Figure 10) shows the control panel enclosure with MGC-2000 Series.

TIM-ID: 0000055364 - 002

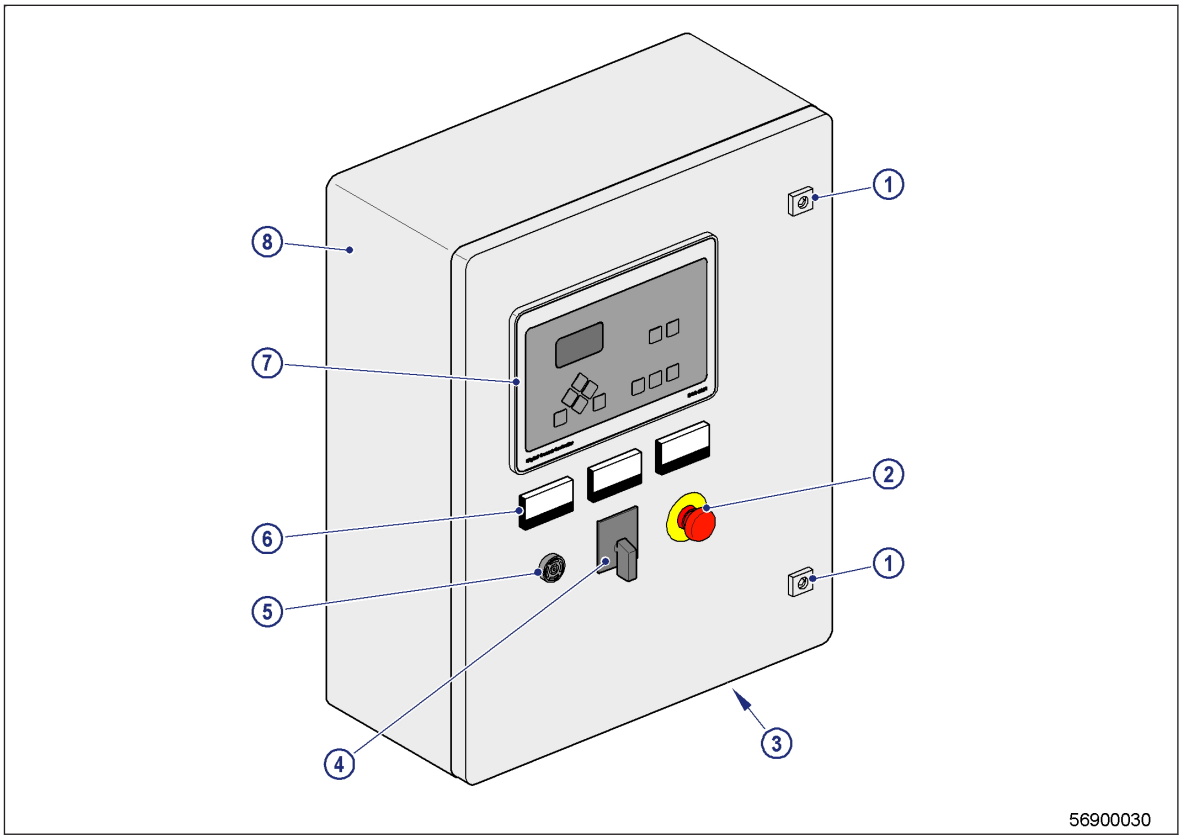


Figure 10: Control panel enclosure with MGC-2000 Series and meters – Exterior

1 Latch
2 Emergency stop button
3 Cable entries point
4 Phase selector switch (optional)
5 Audible alarm
6 Meters (optional)
7 Microprocessor MGC-2000 Series display (optional)
8 Control panel enclosure

NOTE: (→ Figure 10) is a generic representation of the controller. The appearance of the front panel and enclosure varies depending on the controller type and engine-generator set. The location of enclosure buttons, switches, and other options may change but their functionality remains consistent.

The meters (6) show the present voltage and current per phase and the frequency. The phase selector switch (4) is used with the analog meters and has a position for each of the three phases. Turning the switch determines the phase. The values according to this phase are shown on the meters.

TIM-ID: 0000055364 - 002

Features

- Engine metering and protection
- Emergency stop
- Current sensing (5 A CT inputs)
- System protection and supervision:
  - Under/Overvoltage
  - Under/Overfrequency
  - Overcurrent
  - Phase imbalance
  - Loss of mains protection
  - Loss of excitation
  - Reverse power
  - Engine kW overload
  - Bus under/overvoltage
  - Bus under/overfrequency
- 15 contact outputs:
  - Factory utilized: three 30 A DC and twelve 2 A DC rated contacts
  - User-defined: ten 2 A DC rated contacts
- 16 inputs
- Battery backup for Real Time Clock (RTC)
- LCD heater
- Modbus communications (via RS-485 communications port and Modbus RTU protocol)
- SAE J1939 CAN bus engine ECU communications
- Rugged, fully potted design
- Wide ambient temperature range
- UL/CSA approvals: cURus approved to UL 6200 and CSA C22.2 No. 14
- HALT (Highly Accelerated Life Tests) tested
- IP54 front panel rating with integrated gasket
- NFPA 110 level compatible
- Windows ®-based control panel communication software
  - Programming and setup software – intuitive and powerful
  - Programmable logic
  - USB communications
- Multilingual capability (English, Spanish, Chinese)
- Event recording

Accessories

- Analog expansion module for winding and bearing RTD (generator accessories)
- Contact expansion module for potential-free contacts

Analog expansion module

The analog expansion module is a remote auxiliary device that provides additional MGC-2000 Series analog inputs and outputs. Its features include:

- Eight RTD inputs (six for winding, one for bearing); for monitoring engine-generator set temperature (protect against high temperature conditions)
- Communications to the MGC-2000 Series via CAN bus

Contact expansion module

The contact expansion module is programmed to display operating conditions (potential-free contacts):

TIM-ID: 0000055364 - 002

- Global (Pre-alarm)
- Global (Alarm)
- Not in AUTO
- Low fuel level (Pre-alarm)
- Fuel leak
- Low coolant level (Alarm)
- Low oil pressure (Pre-alarm)
- Low oil pressure (Alarm)
- High engine temperature (Pre-alarm)
- High engine temperature (Alarm)
- Low engine temperature (Pre-alarm)
- Engine running
- Overcrank (Alarm)
- Overspeed (Alarm)
- Battery overvoltage (Pre-alarm)
- Low battery voltage (Pre-alarm)
- Emergency system supplying load

The communications to the MGC-2000 Series takes place via CAN bus.

TIM-ID: 0000055364 - 002

Functions

Engine-generator set protection

- Generator protection
  - Undervoltage
  - Overvoltage
  - Underfrequency
  - Overfrequency
  - Reverse power
  - Loss of excitation
  - Overcurrent
  - Phase imbalance (only available on MGC-2020 and MGC-2050)
  - Rate of change of frequency (only available on MGC-2020 and MGC-2050)
  - Vector shift (only available on MGC-2020 and MGC-2050)
- Engine-generator set alarms, protected by MGC-2000 Series
  - Low oil pressure
  - Engine sender unit failure
  - Overcrank
  - Overspeed
  - Low coolant level
  - High coolant temperature
  - Fuel leak/fuel sender failure
  - Emergency stop
- Engine-generator set pre-alarms, protected by MGC-2000 Series
  - Low oil pressure
  - High coolant temperature
  - Low coolant temperature
  - Battery overvoltage
  - Low battery voltage
  - Weak battery
  - Engine kW overload low
  - Maintenance interval timer
  - Low fuel level
  - High fuel level
  - AEM comms failure
  - Breaker open failure
  - CEM comms failure
  - Reverse rotation
  - Low coolant level
  - Active DTC
  - Breaker close failure
  - ECU comms failure
  - Checksum failure

Engine-generator set metering

- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor (PF).
- Engine parameters include oil pressure, coolant temperature, RPM, battery voltage, fuel level, engine run-time, ECU-specific parameters, and runtime statistics.

TIM-ID: 0000055364 - 002

Engine control

- Cranking control: cycle or continuous (quantity and duration fully programmable)
- Engines cool-down: smart cool-down function saves fuel and engine life
- Successful starts counter: counts and records successful engine starts
- Timers:
  - Engine cool-down timer
  - Pre-alarm time delays for weak/low battery voltage
  - Alarm time delay for overspeed
  - Alarm time delay for sender failure
  - Continuous or cycle cranking time delay
  - Arming time delays after crank disconnect for:
    Low oil pressure
    High coolant temperature
  - Engine maintenance timer
  - Pre-crank delay
  - Programmable logic timers

Event recording

The MGC-2000 Series has an event recorder. The event recorder provides a record of alarms, pre-alarms, engine starts, engine runtime loaded, engine runtime unloaded, last run date, and many other events. These events are all date and time-stamped to help the user determine the cause and effect of issues related to the engine-generator set. It contains 30 event records each retaining up to 99 occurrences in memory. Time, date and engine hour detail is available for the most current 30 occurrences within each event record.

Technical data

Operating power	Values
Nominal	12 or 24 V DC
Range	6 to 32 V DC
Power consumption in sleep mode	5 W with all relays non-energized
Power consumption in typical operation mode	7.9 W in RUN mode, with LCD heater off and six relays energized
Battery ride through	Withstands cranking ride-through down to 0 V for 50 ms (starting at 10 VDC)

Environmental condition	Values	
Temperature	Operating:	-40 to 70 °C (-40 to 158 °F)
	Storage:	-40 to 85 °C (-40 to 185 °F)
Humidity	IEC 68-2-38	
Salt Fog	ASTM B 17-73, IEC 68-2-11 (tested while operational)	
Ingress Protection	IEC IP54 for front panel	
Shock	15 G in three perpendicular planes	
Vibration	5 to 29 to 5 Hz:	1.5 G peak for 5 min.
	29 to 52 to 29 Hz:	0.036" double amplitude for 2.5 min.
	52 to 500 to 52 Hz:	5 G peak for 7.5 min.
	Swept over the following ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep	

TIM-ID: 0000055364 - 002

Display operations

The front panel display is used to make settings changes and to display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions.

For further information to the main display operations, refer to (→ Page 68).

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

Registered trademark

Windows is a registered trademark of Microsoft Corporation.

TIM-ID: 0000055364 - 002

4.7.2 Control panel MGC-2000 Series – Display operations

Front panel display

The front panel display is used to make settings changes and display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions. The figure (→ Figure 11)shows the display of the MGC-2000 Series in detail.

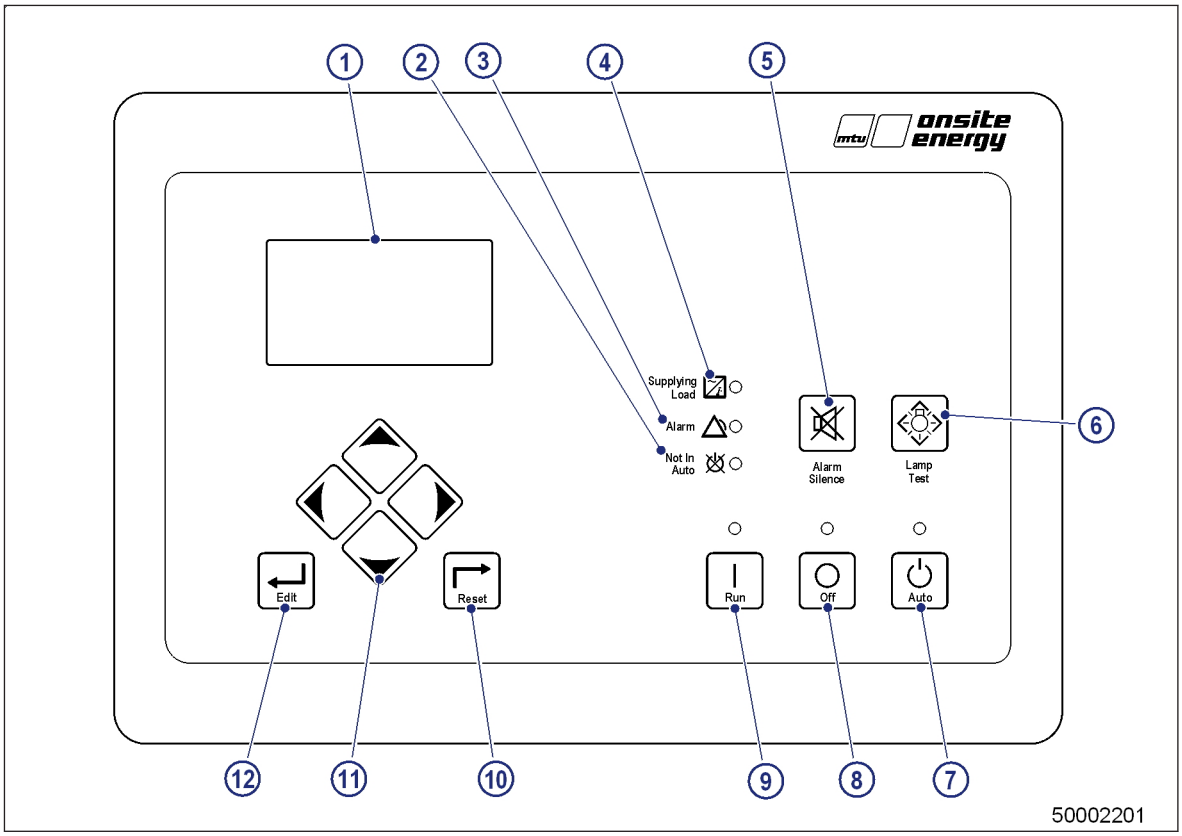


Figure 11: Control panel with MGC-2000 Series – Controls and indicators

1 Liquid Crystal Display (LCD)
2 "Not in auto" indicator
3 Alarm indicator
4 Supplying load indicator
5 Alarm Silence pushbutton
6 LAMP TEST pushbutton
7 AUTO pushbutton and mode indicator
8 OFF pushbutton and mode indicator
9 RUN pushbutton and mode indicator
10 RESET pushbutton
11 Arrow pushbuttons
12 EDIT pushbutton

Panel LED indicators

No.*	LED	Indication
2	Not in auto	Red – Indicates unit is not in the AUTO mode.
3	Alarm	Red – Indicates an alarm situation by continuous illumination. Indicates a pre-alarm by flashing.
4	Supplying Load	Green – Indicates the system is supplying current to a connected load.
7	Auto	Green – Indicates the unit is in the AUTO mode of operation.
8	Off	Red – Indicates the MGC is in the OFF mode.
9	Run	Green – Indicates the MGC is in the RUN mode.
* Numbers correspond to (→ Figure 11).		

TIM-ID: 0000055544 - 002

Panel pushbuttons

No.*	Pushbutton	Result
5	ALARM SILENCE	Stops the currently occurring audible alarm.
6	LAMP TEST	Tests the MGC-2000 Series indicators by exercising all LCD pixels and lighting all LEDs.
7	AUTO	Places the MGC-2000 Series in AUTO mode. The green LED lights when AUTO mode is active.
8	OFF	Places the MGC-2000 Series in OFF mode. The red LED lights when OFF mode is active.
9	RUN	Places the MGC-2000 Series in RUN mode. The green LED lights when RUN mode is active.
10	RESET	Cancels an editing session and discards any settings changed. When pressed, this pushbutton also resets the Breaker Management Pre-alarms.
11	(arrows)	Navigates through the front panel display menus and modifies settings. The left- and right-arrow pushbuttons are used to navigate through the menu levels. • The right-arrow pushbutton is pressed to move downward through the menu levels. • The left-arrow pushbutton is pressed to move upward. Within a level, the up-and down-arrow buttons are used to move among items within the menu level. • Pressing the down-arrow pushbutton moves to items lower in the list. • Pressing the up-arrow pushbutton moves to items higher in the list. During an editing session, the up- and down-arrow pushbuttons are used to raise and lower the value of the selected setting.
12	EDIT	Starts an editing session and enables changes to MGC-2000 Series settings. At the conclusion of an editing session, the EDIT pushbutton is pressed again to save the setting chances.
* Numbers correspond to (→ Figure 11).		

Login/logout and permissions

Note: To change settings, appropriate user training is required to avoid malfunctions.

1. To log in, navigate to the SETTINGS → ENTER PASSWORD screen and press the EDIT pushbutton.
2. Enter the password.
   - Use the up- and down-arrow pushbuttons to scroll through the characters.
   - Use the left- and right-arrow pushbuttons to enter more characters.
3. Press the EDIT pushbutton to log in.
   The LOGOUT selection now appears in the list of SETTINGS.
4. ... select your further operations ...
5. To log out, navigate to SETTINGS → LOGOUT and press the EDIT pushbutton.
   The LOGOUT selection is removed from the list of SETTINGS.

Summary screen

Note: To change settings, appropriate user training is required to avoid malfunctions.

TIM-ID: 0000055544 - 002

The summary screen can be set to standard or scrolling.

Set the summary screen

1. Press the right arrow to select a standard or scrolling summary.
2. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
3. Press the EDIT pushbutton. Enter user ID and password as needed.
4. Edit the SUMMARY VIEW.
   The SCROLL DELAY setting is also found on the screen.

When set to standard, the following values are displayed:

VOLT*	AMP*	PH*	Hz	OIL	FUEL	TEMP	BATT

* Information for each phase is obtained by pressing the up- and down-arrow pushbuttons on the front panel.

When the summary screen is set to scrolling, you can select/configure the metering values that are displayed. Up to 20 values can be displayed and these values scroll at a delay time specified by the user.

Select the scrolling values

1. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
2. Edit the CONFIGURABLE METERING.

The following values may be selected by the user to be placed in the scrolling summary:

NONE*	BATT V	GEN VAB	GEN VAN	KW A	KVA A	GEN Hz	GEN IA
BLANK**	RPM	GEN VBC	GEN VBN	KW B	KVA B	GEN PF	GEN IB
OIL P	RPM SRC	GEN VCA	GEN VCN	KW C	KVA C	BUS Hz	GEN IC
TEMP	FUEL	RUN HRS	KWH	KW TOT	KVA TOT	BUS V	FUEL DELV P
kvar A	kvar B	kvar C	kvar TOTAL	INJ RAIL PRS	TOTAL FUEL USED	FUEL TEMP	ENG OIL TEMP
ENG INTCLR TEMP	COOLANT PRESS	FUEL RATE	BOOST PRESS	INTAKE MNFLD TMP			

* Removes a line from the scrolling list.
** Shows nothing on this line.

Remote access

If communications access is active through the modem or USB, the front panel displays "REMOTE COMMS, FRONT PANEL IS READ ONLY" and the summary screen. This informs that the front panel can only be used for viewing metering data and settings information. Remote access must be ended before modifying settings through the front panel.

Sleep mode

The sleep mode serves as a power-saving feature. A number of conditions must be met for the MGC-2000 Series to be in sleep mode. These conditions include being in OFF mode or AUTO mode not running. Also, if a pushbutton is not pressed for more than 15 minutes, the front panel LCD backlight and LCD heater are turned off. The MGC-2000 Series resumes normal display operation when any front panel pushbutton is pressed or the engine-generator set is started remotely via the ATS input.

The MGC-2000 Series will not go to sleep while in an alarm state. If needed, the sleep mode can be permanently disabled via the control panel communication software or the front panel menu.

As a default, the sleep mode is disabled at the factory, however, it can be reinitiated.

TIM-ID: 0000055544 - 002

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

TIM-ID: 0000055544 - 002

4.7.3 Remote annunciator for MGC Series

The remote annunciator is used with the MGC Series (→ Page 63) to provide electrical signaling for the engine-generator set. The MGC Series detects alarm, pre-alarm, and operating conditions and communicates via Modbus communications with RS-485 to the remote annunciator.

The figure(→ Figure 12) shows the remote annunciator front panel.

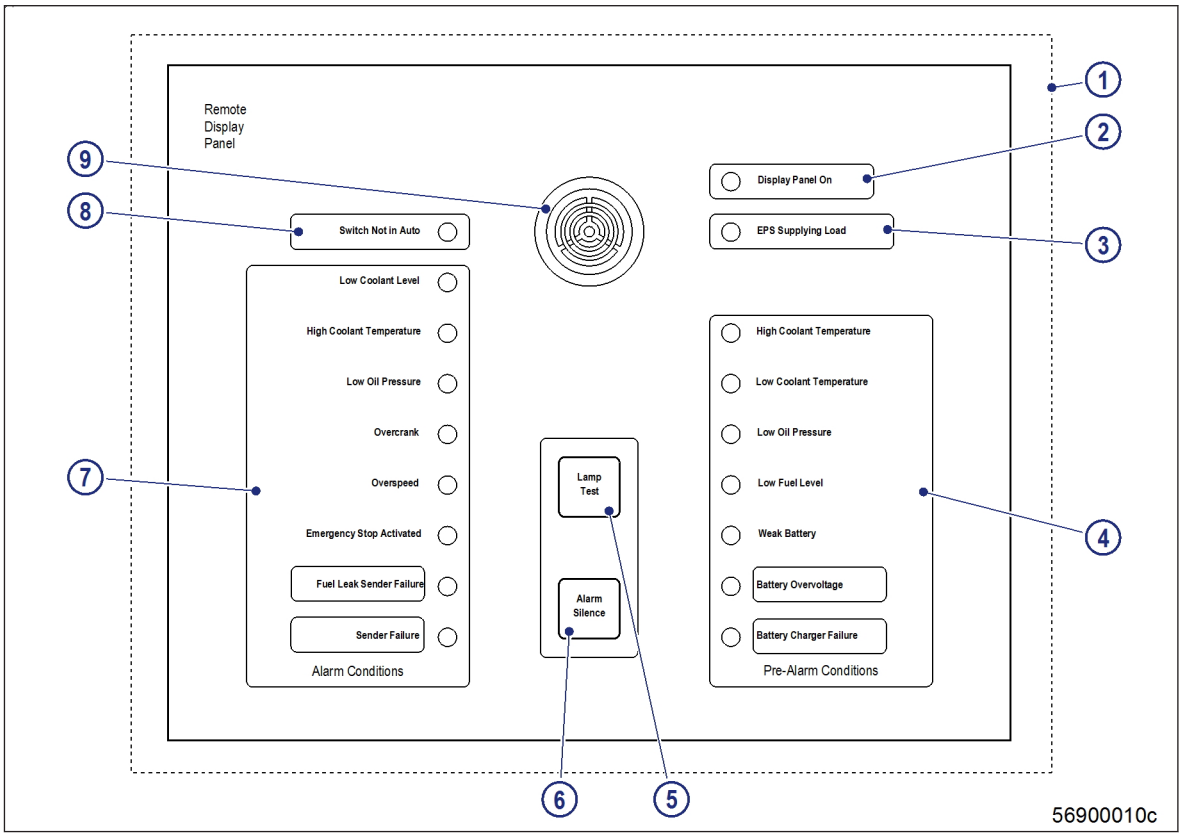


Figure 12: Remote annunciator for MGC Series – Front panel

1 Front panel *
2 LED "Power on"
3 LED "Supplying load"
4 LEDs for pre-alarms
5 LAMP TEST pushbutton
6 ALARM SILENCE pushbutton
7 LEDs for alarms
8 LED "Not in AUTO"
9 Audible alarm

* The dashed line indicates the outside edges when flush mounted. Otherwise, the full line denotes the edges.

Functions

The remote annunciator has 18 LEDs. These LEDs indicate alarms (7), pre-alarms (4), and operating conditions (2, 3, 8) of the engine-generator set as detected by the MGC Series.

If an alarm or pre-alarm is indicated, an audible alarm (9) sounds.

Panel LED indicators

No.*	LED	Indication
2	Display Panel On	Green – Indicates that power is applied to the remote annunciator.
3	EPS Supplying Load	Green – Indicates that the system is supplying more than two percent of rated current to a connected load.
Numbers correspond to the figure (→ Figure 12).		

TIM-ID: 0000055008 - 002

No.*	LED	Indication
4	Pre-alarm Conditions	Yellow – Indicates: • High coolant temperature • Low coolant Temperature • Low oil pressure • Low fuel level • Weak battery • Battery overvoltage • Battery charger failure
7	Alarm Conditions	Red – Indicates: • Low coolant level • High coolant temperature • Low oil pressure • Overcrank • Overspeed • Emergency stop activated • Fuel leak/Fuel sender failure • Sender failure
8	Switch Not in Auto	Red – Indicates that the unit is not in AUTO mode.
Numbers correspond to the figure (→ Figure 12).		

Panel pushbuttons

No.*	Pushbutton	Result
5	LAMP TEST	Tests the indicators by lighting all LEDs and exercises the audible alarm.
6	ALARM SILENCE	Stops the currently occurring audible alarm.
Numbers correspond to the figure (→ Figure 12).		

Benefits

- Monitoring main operating conditions and (pre-)alarms from a distance, for example from an office
- RS-485 communications
- Conduit box is included for easy installation
- Independent of environmental needs for operating the engine-generator set, the remote annunciator itself is designed for use in harsh environments

Technical data

- Power input from the starter batteries at 24 VDC or with an AC source at 120 VAC
- Port RS-485 interface
- Distance between annunciator and MGC Series: up to 1,200 m (4,000 ft)
- Meets the requirements of NFPA-110
- UL recognized, File E97035, and CSA certified, File LR23-23131
- Two mounting configurations: surface and flush mount

Environmental condition	Values
Operating temperature	-40 to 70 °C (-40 to 158 °F)
Storage temperature	-40 to 85 °C (-40 to 185 °F)
Salt Fog	Qualified to ASTM 117B-1989
Shock	15 G
Vibration	Withstands 2 G in each of three mutually perpendicular planes*
Sound	Alarm horn rated at 80 dB [from a distance of 60 cm (2 ft)]

TIM-ID: 0000055008 - 002

* Swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance

TIM-ID: 0000055008 - 002

4.8 Engine-Generator Set MGC-3000 Series Control Panel

4.8.1 Control panel enclosure with MGC-3000 Series - General information

The control panel is the local control console and emergency control station for the engine-generator set. Its control and display elements provide status and alarm information and allow quick start/stop/emergency stop operations. The screen display is controlled by a key pad beneath the display panel. Command input for engine-generator set operation and alarm handling is provided by additional control keys on the display panel.

The control panel communication software allows units to be easily customized for each application.

Digital Generator Set Controller MGC-3000 Series

The MGC-3000 Series installed in MTU Onsite Energy engine-generator sets is a highly advanced, integrated engine-generator set control system. The MGC-3000 Series is perfectly focused, combining rugged construction and microprocessor technology to offer a product that holds up to almost any environment. The MGC-3000 is flexible enough to meet the needs of your application. This device provides engine-generator set control, metering, protection, and programmable logic in a simple, easy-to-use, reliable, and cost-effective package.

A control panel with MGC-3000 Series is installed on engine-generator sets with management and monitoring in:

- Engine-generator set without mains, with standard generator protection
- Engine-generator set without mains, with enhanced generator protection
- Engine-generator set with third-party ATS, with enhanced generator protection
- Engine-generator set with electrical interlock circuit breakers, with enhanced generator protection
- Engine-generator set in parallel operation (island mode), with enhanced generator protection and automatic synchronizer

(→ Figure 13) shows the control panel enclosure with MGC-3000 Series.

TIM-ID: 0000055546 - 002

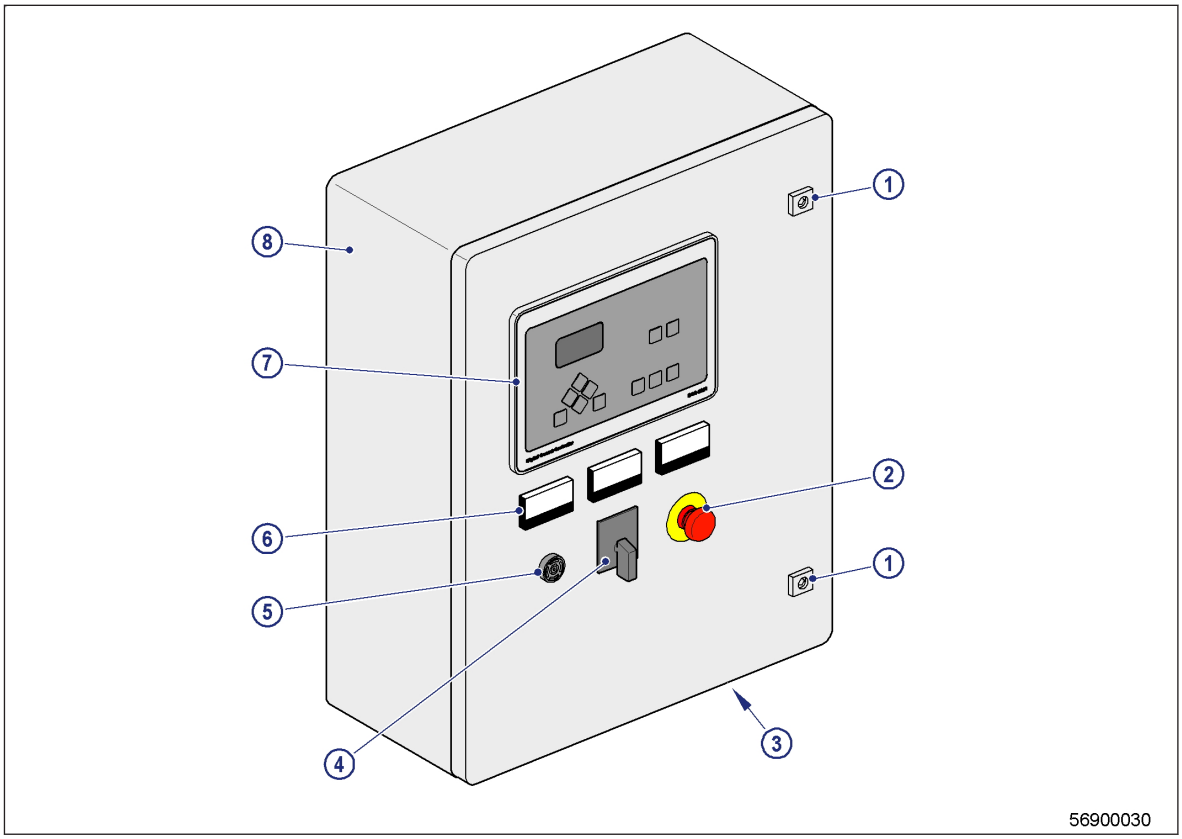


Figure 13: Control panel enclosure with MGC-3000 Series and meters – Exterior

1 Latch
2 Emergency stop button
3 Cable entries point
4 Phase selector switch (optional)
5 Audible alarm
6 Meters (optional)
7 Microprocessor MGC-3000 Series display (optional)
8 Control panel enclosure

NOTE: (→ Figure 13) is a generic representation of the controller. The appearance of the front panel and enclosure varies depending on the controller type and engine-generator set. The location of enclosure buttons, switches, and other options may change, but their functionality remains consistent.

The meters (6) show the present voltage and current per phase and the frequency. The phase selector switch (4) is used with the analog meters and has a position for each of the three phases. Turning the switch determines the phase. The values according to this phase are shown on the meters.

TIM-ID: 0000055546 - 002

Features

- Engine metering and protection
- Emergency stop
- Current sensing (5 A CT inputs)
- System protection and supervision:
  - Under/Overvoltage
  - Under/Overfrequency
  - Overcurrent
  - Phase imbalance
  - Loss of mains protection (optional)
  - Loss of excitation
  - Reverse power
  - Engine kW overload (three levels)
  - Bus under/overvoltage
  - Bus under/overfrequency
- 17 contact outputs:
  - Factory utilized: three 30 A DC and twelve 2 A DC rated contacts
  - User-defined: ten 2 A DC rated contacts
- 16 inputs
- Battery backup for Real Time Clock (RTC)
- LCD heater
- Modbus communications (via RS-485 communications port and Modbus RTU protocol)
- SAE J1939 CAN bus engine ECU communications
- Rugged, fully encapsulated design
- Wide ambient temperature range
- UL/CSA approvals: cURus approved to UL 6200 and CSA C22.2 No. 14
- HALT (Highly Accelerated Life Tests) tested
- NFPA 110 level compatible
- Windows ®-based control panel communication software
  - Programming and setup software – intuitive and powerful
  - Programmable logic
  - USB communications
- Multilingual capability (English, Spanish, Chinese)
- Event recording

Accessories

- Analog expansion module for winding and bearing RTD (generator accessories)
- Contact expansion module for potential-free contacts
- Automatic synchronizer for engine-generator set in parallel operations

Analog expansion module

The analog expansion module is a remote auxiliary device that provides additional MGC-3000 Series analog inputs and outputs. Its features include:

- Eight RTD inputs (six for winding, one for bearing); for monitoring engine-generator set temperature (protect against high temperature conditions)
- Communications to the MGC-3000 Series via CAN bus

Contact expansion module

The contact expansion module is programmed to display operating conditions (potential-free contacts):

TIM-ID: 0000055546 - 002

- Global (Pre-alarm)
- Global (Alarm)
- Not in AUTO
- Low fuel level (Pre-alarm)
- Fuel leak
- Low coolant level (Alarm)
- Low oil pressure (Pre-alarm)
- Low oil pressure (Alarm)
- High engine temperature (Pre-alarm)
- High engine temperature (Alarm)
- Low engine temperature (Pre-alarm)
- Engine running
- Overcrank (Alarm)
- Overspeed (Alarm)
- Battery overvoltage (Pre-alarm)
- Low battery voltage (Pre-alarm)
- Emergency system supplying load

The communications to the MGC-3000 Series takes place via CAN bus.

Automatic synchronizer

When the MGC-3000 Series is configured with this option, it can be selected between two types of auto-synchronizers: phase lock or anticipatory style.

In both methods, the MGC-3000 Series adjusts generator frequency and voltage to match that of the bus (mains) via analog outputs. Then, the MGC-3000 connects the generator to the bus by closing the connecting breaker.

TIM-ID: 0000055546 - 002

Functions

Engine-generator set protection

- Generator protection
  - Undervoltage
  - Overvoltage
  - Underfrequency
  - Overfrequency
  - Reverse power
  - Loss of excitation
  - Overcurrent
  - Phase voltage imbalance
  - Rate of change of frequency
  - Vector shift
- Engine-generator set alarms
  - Low oil pressure
  - Engine sender unit failure
  - Battery charger failure
  - Overspeed
  - Low coolant level
  - High coolant temperature
  - Low fuel level
  - Fuel leak/fuel sender failure
  - Emergency stop
- Engine-generator set pre-alarms
  - Low oil pressure
  - High coolant temperature
  - Low coolant temperature
  - Battery overvoltage
  - Battery charger failure
  - Weak battery
  - Engine sender unit failure
  - Engine kW overload (three levels)
  - Maintenance interval timer
  - Fuel leaks detect
  - Low fuel level
  - High fuel level (optional)
  - Low coolant level
  - AEM 1 through AEM 4 comms failure
  - Breaker open failure
  - CEM 1 and CEM2 comms failure
  - Generator reverse rotation
  - ID missing
  - Intergenset communication failure
  - Rated data and per unit values
  - Active Diagnostic Trouble Codes (DTC)
  - Breaker close failure
  - Bus 1 and Bus 2 reverse rotation
  - Ethernet 1 and Ethernet 2 link lost
  - Low battery voltage
  - High battery voltage
  - ID repeat
  - Synchronizer failure

TIM-ID: 0000055546 - 002

Engine-generator set metering

- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor (PF).
- Engine parameters include oil pressure, coolant temperature, battery voltage, fuel level, speed, engine runtime, ECU-specific parameters, and runtime statistics.

Engine control

- Cranking control: cycle or continuous (quantity and duration fully programmable)
- Engines cool-down: smart cool-down function saves fuel and engine life
- Successful starts counter: counts and records successful engine starts
- Timers:
  - Engine cool-down timer
  - Pre-alarm time delays for weak/low battery voltage
  - Alarm time delay for overspeed
  - Alarm time delay for sender failure
  - Continuous or cycle cranking time delay
  - Pre-crank delay
  - Programmable logic timers
  - Arming time delays after crank disconnect for:
    Low oil pressure
    High coolant temperature

Event recording

The MGC-3000 Series has an event recorder. The event recorder provides a record of alarms, pre-alarms, engine starts, engine runtime loaded, engine runtime unloaded, last run date, and many other events. These events are all date and time stamped to help the user determine the cause and effect of issues related to the engine-generator set. It contains 30 event records each retaining up to 99 occurrences in memory. Time, date and engine hour detail is available for the most current 30 occurrences within each event record.

Technical data

Operating power	Values
Nominal	12 or 24 V DC
Range	6 to 32 V DC
Power consumption in sleep mode	12.7 W - LCD heater off, all relays deenergized, and all analog outputs disabled
Power consumption in typical operation mode	18.1 W in RUN mode, with LCD heater off, start and run relays energized, analog outputs enabled, and six relays energized
Battery ride through	Withstands cranking ride-through down to 0 V for 50 ms (typical)

Environmental condition	Values	
Temperature	Operating:	-40 to 70 °C (-40 to 58 °F)
	Storage:	-40 to 85 °C (-40 to 185 °F)
Humidity	IEC 68-2-38	
Salt Fog	IEC 60068	
Ingress Protection	IEC IP56 for front panel	
Shock	15 G in three perpendicular planes	

TIM-ID: 0000055546 - 002

Environmental condition	Values	
Vibration	5 to 29 to 5 Hz:	1.5 G peak for 5 min.
	29 to 52 to 29 Hz:	0.036" double amplitude for 2.5 min.
	52 to 500 to 52 Hz:	5 G peak for 7.5 min.
	Swept over the following ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep	

Display operations

The front panel display is used to make settings changes and to display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions.

For further information to the main display operations, refer to (→ Page 68).

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

Registered trademark

Windows is a registered trademark of Microsoft Corporation.

TIM-ID: 0000055546 - 002

4.8.2 Control panel MGC-3000 series – Display operations

Front panel display

The front panel display is used to make settings changes and display metering values.

The wide temperature-range LCD with backlighting can be viewed under a wide range of ambient light and temperature conditions. The figure (→ Figure 14) shows the display of the MGC-3000 Series in detail.

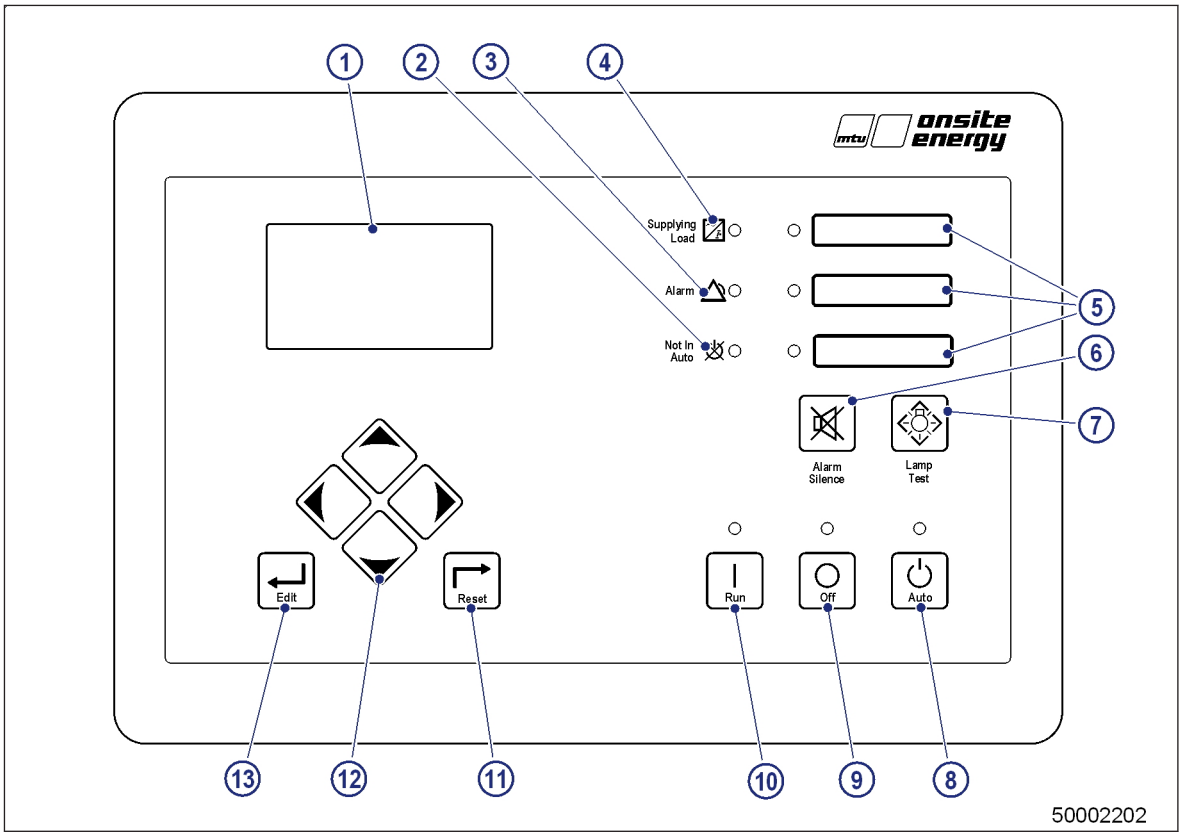


Figure 14: Control panel with MGC-3000 Series – Controls and indicators

1 Liquid Crystal Display (LCD)
2 "Not in auto" indicator
3 Alarm indicator
4 Supplying load indicator
5 Programmable indicators
6 Alarm silence pushbutton
7 LAMP TEST pushbutton
8 AUTO pushbutton and mode indicator
9 OFF pushbutton and mode indicator
10 RUN pushbutton and mode indicator
11 RESET pushbutton
12 Arrow pushbuttons
13 EDIT pushbutton

Panel LED indicators

No.*	LED	Indication
2	Not in Auto	Red – Indicates unit is not in the AUTO mode.
3	Alarm	Red – Indicates an alarm situation by continuous illumination. Indicates a pre-alarm by flashing.
4	Supplying Load	Green – Indicates the system is supplying current to a connected load.
8	Auto	Green – Indicates the unit is in the AUTO mode of operation.
* Numbers correspond to (→ Figure 14).		

TIM-ID: 0000055549 - 002

No.*	LED	Indication
9	Off	Red – Indicates the MGC is in the OFF mode.
10	Run	Green – Indicates the MGC is in the RUN mode.
* Numbers correspond to (→ Figure 14).		

Panel pushbuttons

No.*	Pushbutton	Result
6	ALARM SILENCE	Stops the currently occurring audible alarm.
7	LAMP TEST	Tests the MGC-3000 Series indicators by exercising all LCD pixels and lighting all LEDs.
8	AUTO	Places the MGC-3000 Series in AUTO mode. The green LED lights when AUTO mode is active.
9	OFF	Places the MGC-3000 Series in OFF mode. The red LED lights when OFF mode is active.
10	RUN	Places the MGC-3000 Series in RUN mode. The green LED lights when RUN mode is active.
11	RESET	Cancels an editing session and discards any settings changed. When pressed, this pushbutton also resets the Breaker Management Pre-alarms.
12	(arrows)	Navigates through the front panel display menus and modifies settings. The left- and right-arrow pushbuttons are used to navigate through the menu levels. • The right-arrow pushbutton is pressed to move downward through the menu levels. • The left-arrow pushbutton is pressed to move upward. Within a level, the up- and down-arrow pushbuttons are used to move among items within the menu level. • Pressing the down-arrow pushbutton moves to items lower in the list. • Pressing the up-arrow pushbutton moves to items higher in the list. During an editing session, the up- and down-arrow pushbuttons are used to raise and lower the value of the selected setting.
13	EDIT	Starts an editing session and enables changes to MGC-3000 Series settings. At the conclusion of an editing session, the EDIT pushbutton is pressed again to save the setting chances.
* Numbers correspond to (→ Figure 14).		

Login/logout and permissions

Note: To change settings, appropriate user training is required to avoid malfunctions.

TIM-ID: 0000055549 - 002

1. To log in, navigate to the SETTINGS → ENTER PASSWORD screen and press the EDIT pushbutton.
2. Enter the password.
   - Use the up- and down-arrow pushbuttons to scroll through the characters.
   - Use the left- and right-arrow pushbuttons to enter more characters.
3. Press the EDIT pushbutton to log in.
   The LOGOUT selection now appears in the list of SETTINGS.
4. ... select your further operations ...
5. To log out, press the RESET pushbutton while viewing any screen other than the overview screen.

Summary screen

Note: To change settings, appropriate user training is required to avoid malfunctions.

The summary screen can be set to standard or scrolling.

Set the summary screen

1. Press the right arrow pushbutton to select a standard or scrolling summary.
2. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
3. Press the EDIT pushbutton. Enter user ID and password as needed.
4. Edit the SUMMARY VIEW.
   The SCROLL DELAY setting is also found on the screen.

When set to standard, the following values are displayed:

VOLT*	AMP*	PH*	Hz	OIL	FUEL/DEF	TEMP	BATT

* Information for each phase is obtained by pressing the up- and down-arrow pushbuttons on the front panel.

When the summary screen is set to scrolling, you can select/configure the metering values that are displayed. Up to 20 values can be displayed and these values scroll at a delay time specified by the user.

Select the scrolling values

1. Navigate to the SETTINGS → GENERAL SETTINGS → FRONT PANEL HMI screen.
2. Edit the CONFIGURABLE METERING.

The following values may be selected by the user to be placed in the scrolling summary:

NONE*	BATT V	GEN VAB	GEN VAN	KW A	KVA A	GEN Hz	GEN IA
BLANK**	RPM	GEN VBC	GEN VBN	KW B	KVA B	GEN PF	GEN IB
OIL P	RPM SRC	GEN VCA	GEN VCN	KW C	KVA C	BUS Hz	GEN IC
TEMP	FUEL	RUN HRS	KWH	KW TOT	KVA TOT	BUS V	

* Removes a line from the scrolling list.
** Shows nothing on this line.

Remote access

If communications access is active through the modem or USB, the front panel displays "REMOTE COMMS, FRONT PANEL IS READ ONLY" and the summary screen. This informs that the front panel can only be used for viewing metering data and settings information. Remote access must be ended before modifying settings through the front panel.

Sleep mode

The sleep mode serves as a power-saving feature. A number of conditions must be met for the MGC-3000 Series to be in sleep mode. These conditions include being in OFF mode or AUTO mode not running. Also, if a pushbutton is not pressed for more than 15 minutes, the front panel LCD backlight and LCD heater are turned off. The MGC-3000 Series resumes normal display operation when any front panel pushbutton is pressed or the engine-generator set is started remotely via the ATS input.

TIM-ID: 0000055549 - 002

The MGC-3000 Series will not go to sleep while in an alarm state. If needed, the sleep mode can be permanently disabled via the control panel communication software or the front panel menu.

As a default, the sleep mode is disabled at the factory, however, it can be reinitiated.

Control panel communication software

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

TIM-ID: 0000055549 - 002

4.8.3 Remote annunciator for MGC Series

The remote annunciator is used with the MGC Series (→ Page 63) to provide electrical signaling for the engine-generator set. The MGC Series detects alarm, pre-alarm, and operating conditions and communicates via Modbus communications with RS-485 to the remote annunciator.

The figure(→ Figure 15) shows the remote annunciator front panel.

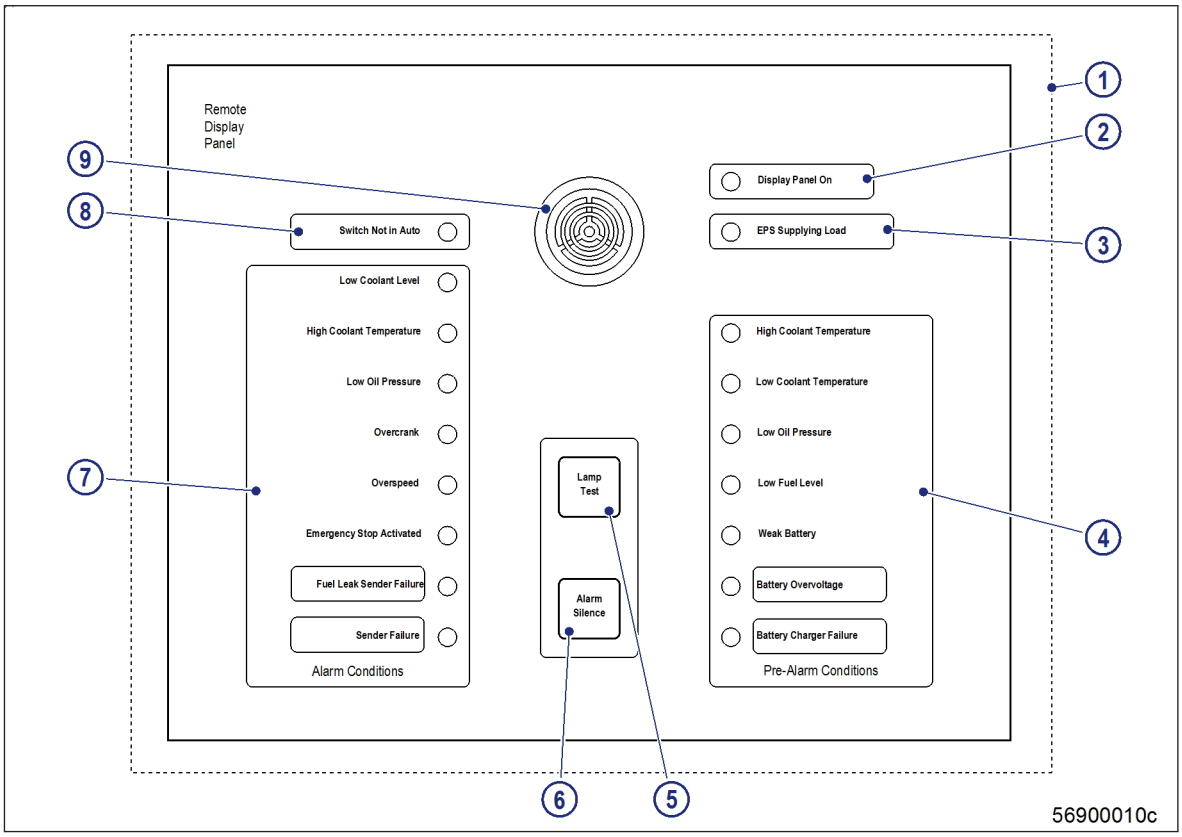


Figure 15: Remote annunciator for MGC Series – Front panel

1 Front panel *
2 LED "Power on"
3 LED "Supplying load"
4 LEDs for pre-alarms
5 LAMP TEST pushbutton
6 ALARM SILENCE pushbutton
7 LEDs for alarms
8 LED "Not in AUTO"
9 Audible alarm

* The dashed line indicates the outside edges when flush mounted. Otherwise, the full line denotes the edges.

Functions

The remote annunciator has 18 LEDs. These LEDs indicate alarms (7), pre-alarms (4), and operating conditions (2, 3, 8) of the engine-generator set as detected by the MGC Series.

If an alarm or pre-alarm is indicated, an audible alarm (9) sounds.

Panel LED indicators

No.*	LED	Indication
2	Display Panel On	Green – Indicates that power is applied to the remote annunciator.
3	EPS Supplying Load	Green – Indicates that the system is supplying more than two percent of rated current to a connected load.
Numbers correspond to the figure (→ Figure 15).		

TIM-ID: 0000055008 - 002

No.*	LED	Indication
4	Pre-alarm Conditions	Yellow – Indicates: • High coolant temperature • Low coolant Temperature • Low oil pressure • Low fuel level • Weak battery • Battery overvoltage • Battery charger failure
7	Alarm Conditions	Red – Indicates: • Low coolant level • High coolant temperature • Low oil pressure • Overcrank • Overspeed • Emergency stop activated • Fuel leak/Fuel sender failure • Sender failure
8	Switch Not in Auto	Red – Indicates that the unit is not in AUTO mode.
Numbers correspond to the figure (→ Figure 15).		

Panel pushbuttons

No.*	Pushbutton	Result
5	LAMP TEST	Tests the indicators by lighting all LEDs and exercises the audible alarm.
6	ALARM SILENCE	Stops the currently occurring audible alarm.
Numbers correspond to the figure (→ Figure 15).		

Benefits

- Monitoring main operating conditions and (pre-)alarms from a distance, for example from an office
- RS-485 communications
- Conduit box is included for easy installation
- Independent of environmental needs for operating the engine-generator set, the remote annunciator itself is designed for use in harsh environments

Technical data

- Power input from the starter batteries at 24 VDC or with an AC source at 120 VAC
- Port RS-485 interface
- Distance between annunciator and MGC Series: up to 1,200 m (4,000 ft)
- Meets the requirements of NFPA-110
- UL recognized, File E97035, and CSA certified, File LR23-23131
- Two mounting configurations: surface and flush mount

Environmental condition	Values
Operating temperature	-40 to 70 °C (-40 to 158 °F)
Storage temperature	-40 to 85 °C (-40 to 185 °F)
Salt Fog	Qualified to ASTM 117B-1989
Shock	15 G
Vibration	Withstands 2 G in each of three mutually perpendicular planes*
Sound	Alarm horn rated at 80 dB [from a distance of 60 cm (2 ft)]

TIM-ID: 0000055008 - 002

* Swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance

TIM-ID: 0000055008 - 002

4.9 Charge-Air System and Exhaust System

4.9.1 Air system - Overview

The air system provides the engine with filtered, cooled air for the combustion process.

The figure(→ Figure 16) shows the air system of an engine-generator set with a Mercedes-Benz OM924LA engine. It is also valid for an engine-generator set with a Mercedes-Benz OM926LA engine.

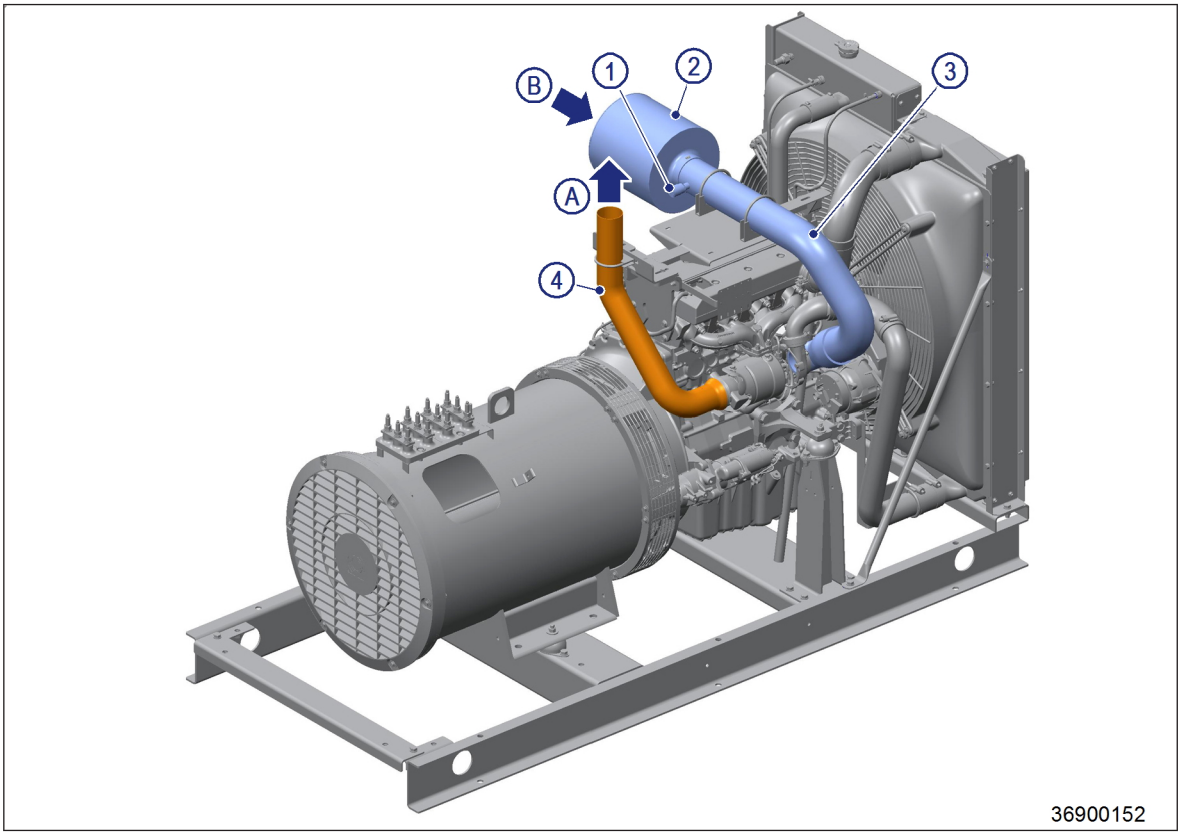


Figure 16: Air system

1 Air filter service indicator
2 Air intake filter
3 Air intake tube
4 Air exhaust tube
a Exhaust gas
b Air intake

Technical data

- Air-to-air charge-air cooling
- Unit-mounted radiator with intercooler core
- Single-stage air filter

Benefits

- Optimum load application characteristics
- Low fuel consumption

Function

The turbine wheel and the compressor wheel of the turbocharger are positioned on one shaft. The compressor wheel in the compressor housing draws air over an intake pipe (3) from the air filter (2) and compresses it. The compressed air flows from the compressor housing outlet through the charge-air pipe to the unit-mounted radiator.

TIM-ID: 0000057947 - 001

The radiator(→ Page 112) cools the charge-air in load operation, allowing optimum operational behavior of the engine to be achieved. The cooled charge-air flows through the charge-air pipe from the radiator via the charge-air intake neck to the inlet ducts of the cylinder head. It is consumed there during the combustion process.

TIM-ID: 0000057947 - 001

4.9.2 Air filter

The dry-type air filter cleans the incoming air used for combustion to prevent internal damage to major components.

The air filter features a single-stage, easy-to-service filter.

The figure (→ Figure 17)shows a standard air filter, with the air inlet on one end and the outlet on the other end.

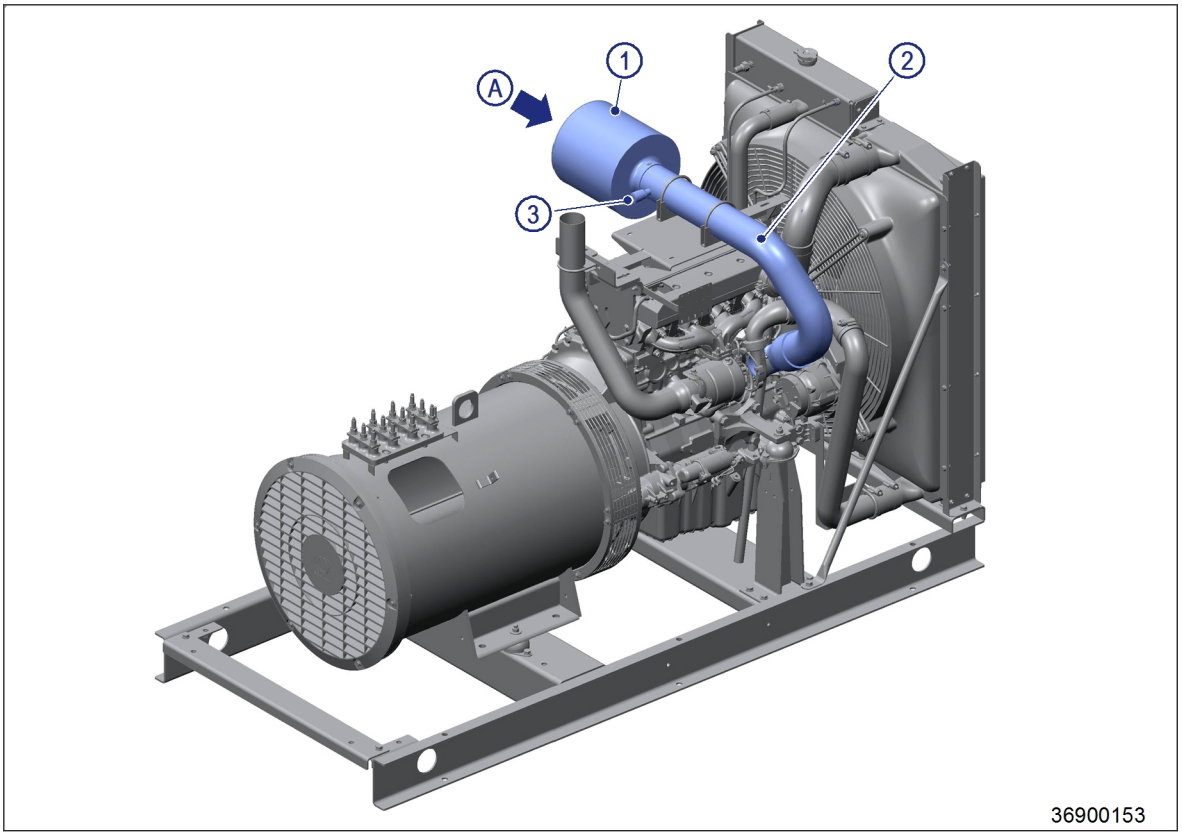


Figure 17: Air filter

1 Air intake filter
2 Air intake tube
3 Air filter service indicator
A Air

Technical data

- Single-stage engine air filter operating in light to medium dust conditions
- Airflow throughput: 162 to 524 CFM (4.5 to 15 m^3/min) at 1.2 to 8 in H_2O (3 to 20 mbar)
- Non-metallic, non-corrosive, tough materials
- Air filter housing and filter media are constructed as one unit
- Direct installation
- Horizontal installation

Benefits

- PermaPleat® embossing process forms dividers between pleats, preventing bunching and ensuring uniform air flow
- Compact design, vibration-resistant
- Improved reliability and durability with reduced weight and cost
- Mounted filter service indicator
- Flexible, easy installation
- Easy and fast service
- Completely disposable

TIM-ID: 0000057948 - 001

Function

Through the inlet, air is inducted into the air filter housing (1). The air flows through the filter media from outside to inside and then flows to the engine via the intake tube (2). Dust particles suspended in the air are retained by the filter media.

Replaced air filters can be disposed of in normal trash.

Filter service indicator

The engine-generator set shown is equipped with an optional filter service indicator (3) on the intake tube.

The filter service indicator signals when the filter should be replaced. This restriction measurement tool provides a dependable assessment of filter service life that is not possible by visual inspection alone. Although a filter may look "dirty," in most cases it can be used for several more hours. Attaching a filter service indicator to an air filter in the ducting ensures the longest possible filter life and provides the best engine protection.

TIM-ID: 0000057948 - 001

4.9.3 Exhaust system – Overview

The figure (→ Figure 18)shows the exhaust system of an engine-generator set with a Mercedes-Benz OM924LA engine. It is also valid for an engine-generator set with a Mercedes-Benz OM926LA engine.

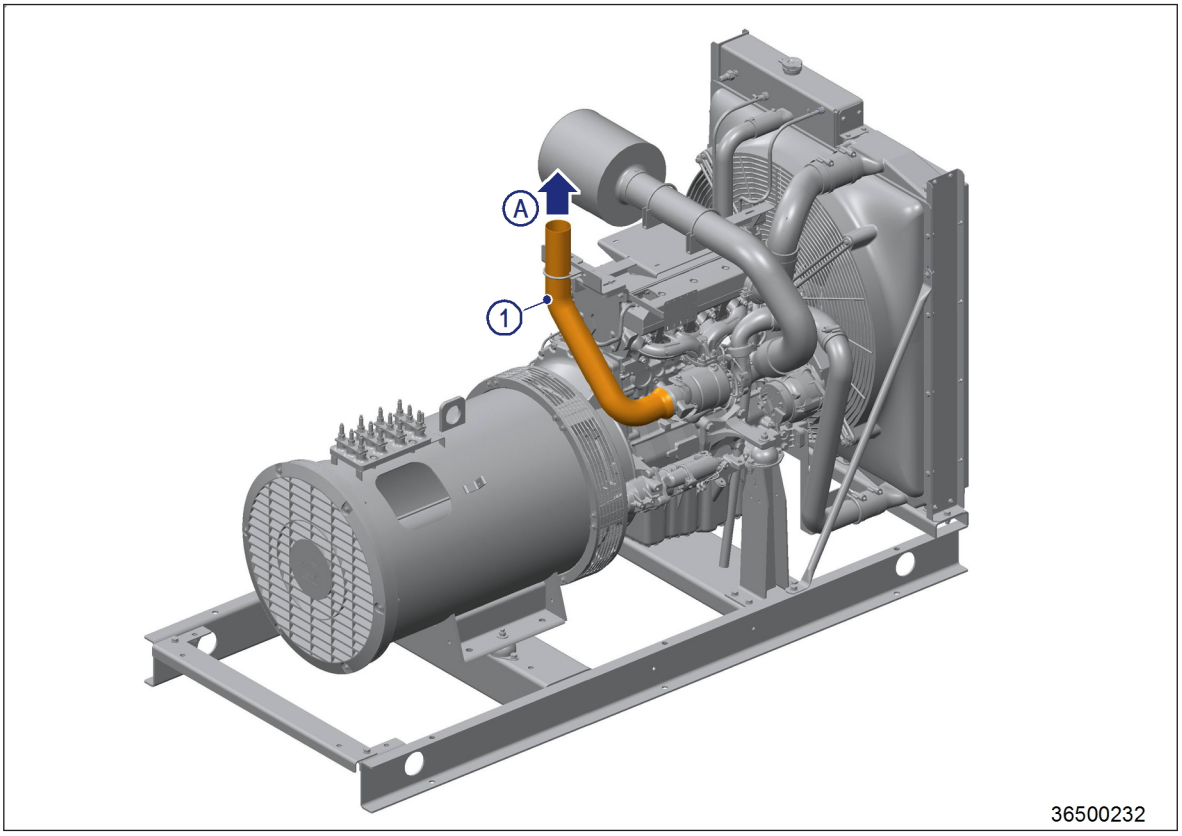


Figure 18: Exhaust system

1 Air exhaust tube A Exhaust gas

Technical data

- Single-stage exhaust with turbocharger

Benefits

- Low exhaust emissions
- Straightforward connection to external exhaust gas system
- High torque at low speeds
- Optimum load application characteristics
- Low fuel consumption

Function

The exhaust gases flow from the combustion chambers via exhaust manifolds to the exhaust turbocharger.

The exhaust gas rushing into the turbine housing drives the turbine wheel of the rotor assembly of the exhaust turbocharger, which consists of the turbine wheel and the compressor wheel mounted on one common shaft. In doing so, the exhaust flow provides the mechanical power to compress the combustion air. The exhaust gas (A) is routed from the turbocharger outlet via the exhaust pipework (1) to the atmosphere.

TIM-ID: 0000057949 - 001

4.9.4 Exhaust silencer

The function of an exhaust silencer is to reduce the diesel engine exhaust gas noise level. The figure(→ Figure 19) shows a typical exhaust silencer.

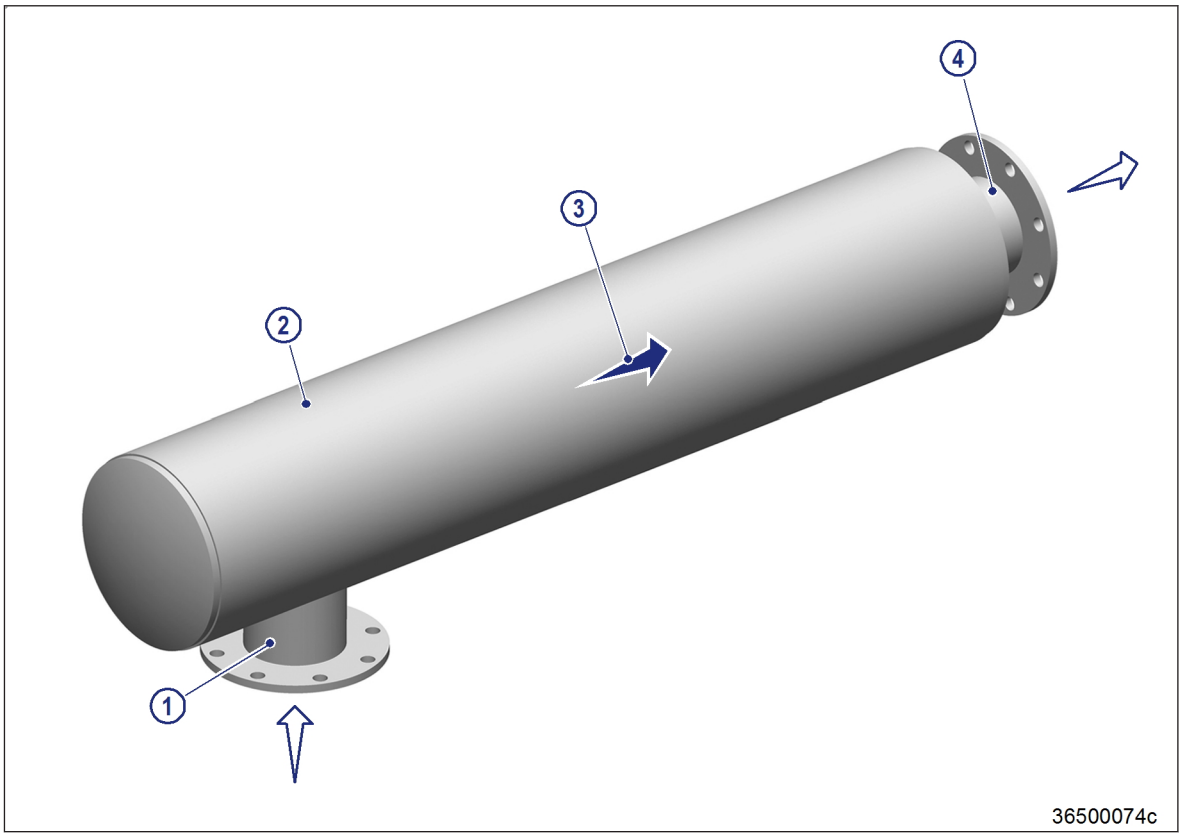


Figure 19: Exhaust Silencer

1 Inlet with flange
2 Enclosure
3 Flow direction
4 Outlet with flange

Technical data

- Material: Aluminized carbon steel construction, welded
- Vertical inlet and axial outlet direction
- Noise reduction: 35 to 40 dB(A)
- Exhaust gas volume: 0.3 to 0.7 m^3/s
- Maximum exhaust flow velocity: 30 m/sec
- Vertical installation
- Welded flanges with gaskets
- Counterflanges for connection provided
- Painted with high temperature resistant color

Benefit

- Low exhaust gas noise emissions

Function

The silencer is mounted in the exhaust pipework of the engine.

The exhaust gas is routed from the turbocharger outlet via the exhaust pipework flows through the intake (1) into the silencer (2). The reduction of convection heat is ensured by internal insulation of the silencers.

TIM-ID: 0000057950 - 001

To muffle the noise, diverse techniques are applied for different purposes:

- 10 dB(A): pure absorptive system made of specially designed rock wool
- 30 dB(A): combination of simple reactive chamber and absorptive system
- 40 dB(A): combination of double interconnected reactive chambers and absorptive system

The muffled exhaust gas leaves the silencers through the outlet (4) and is piped to the atmosphere.

TIM-ID: 0000057950 - 001

4.10 Cooling System

4.10.1 Cooling system – Overview

The cooling system on an engine-generator set with an air-to-air charge-air cooled engine consists of:
- Cooling circuit for engine coolant (radiator jacket water circuit)
- Cooling circuit for charge-air (radiator intercooler circuit)
- Generator cooling

The cooling circuits on the engine work by means of an external tube and fin type unit-mounted radiator(→ Page 112). The generator ventilation does not need an additional device.

Technical data

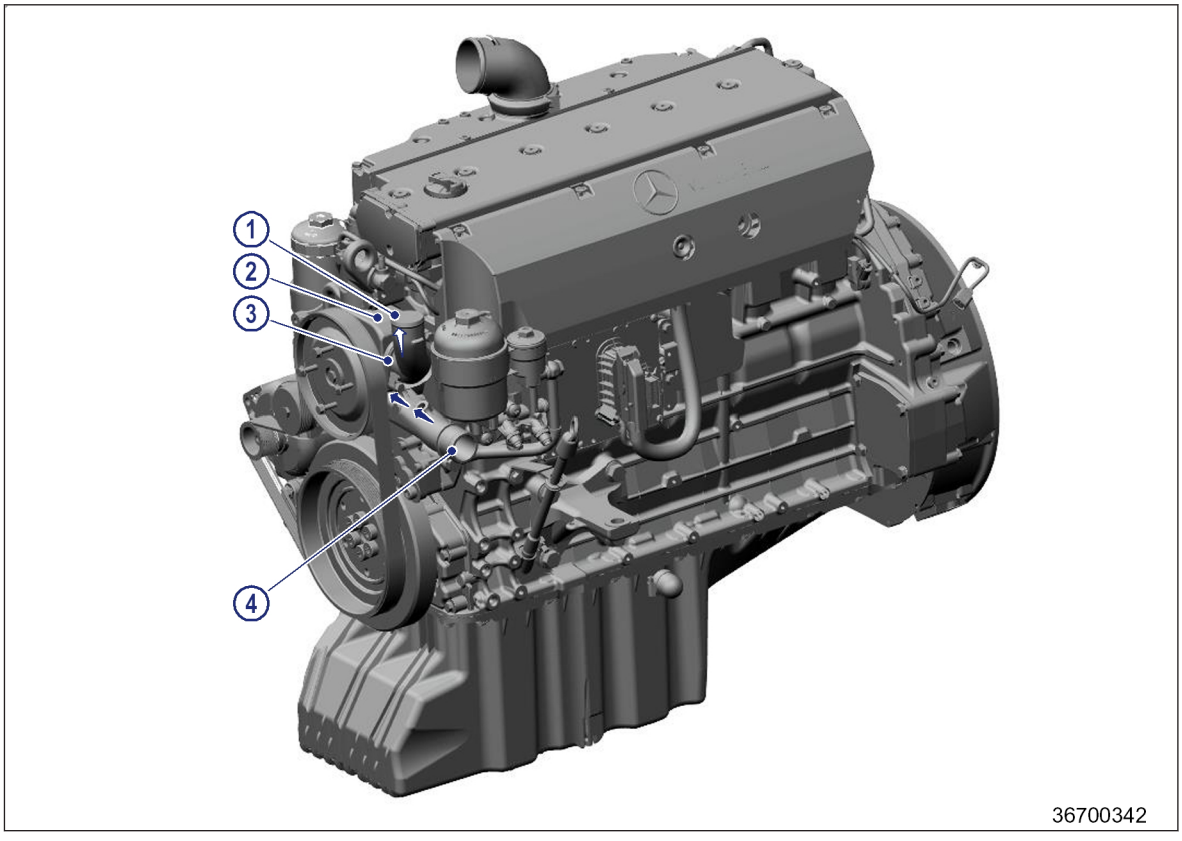
- Single-circuit cooling system with air-to-air charge-air cooling
- Complete system solution with unit-mounted radiator, including fan drive, fan, and piping
- Thermostat-controlled jacket water circuit

Benefits

- All-in-one solution
- Cooling package designed to perform in very high ambient conditions (122 °F)

Cooling circuit for engine coolant – Jacket water circuit

The figure(→ Figure 20) shows the engine coolant flow (engine side) of an engine-generator set with a Mercedes-Benz OM924LA engine. The figure is also valid for an engine-generator set with a Mercedes-Benz OM926LA engine.



TIM-ID: 0000057996 - 001

Figure 20: Engine coolant circuit

1 Outlet to radiator coolant pipe
2 Coolant pump
3 Thermostat
4 Inlet from radiator coolant pipe

The engine coolant circuit is a high-temperature circuit (HT).

The engine coolant is cooled in the jacket water core of the unit-mounted radiator(→ Page 112).

The coolant pump (2) is assembled on the engine. It pumps the cooled coolant from the jacket water core of the radiator via the coolant pipe to the inlet (4) through the engine. There, one part of the coolant is routed through the oil cooler, and a second part bypasses the oil cooler. The coolant flows into the coolant duct of the crankcase. In the crankcase, the coolant flows to the cylinders in the cylinder head, around the cylinder liners from bottom to top, and overflows into the cylinder head. There, it flows through the coolant spaces and coolant ducts of the cylinder head and arrives at the thermostat (3).

The thermostat (3) leads the engine coolant directly to the engine coolant pump (2) when the engine is cold.

Bypassing the radiator allows the engine, lube oil, and engine coolant to reach operating temperature quickly.

The thermostat (3) diverts the engine coolant via the outlet (1) and the coolant pipe to the radiator when the engine is under load (warm engine). Recooled engine coolant coming from the radiator (jacket water core) then returns to the engine coolant pump (2).

Drain plugs are provided at the lowest points of the engine coolant circuit.

Coolant preheating

Coolant preheating is provided by an optional coolant preheating unit [jacket water heater(→ Page 114)].

Cooling circuit for charge-air – Intercooler circuit

Fresh, compressed, heated air (coming via air filters and turbocharger) flows through the intake charge-air pipes of the unit-mounted radiator (→ Page 112) to the intercooler core. There, the charge-air is air-cooled by means of fan circulation during load operation.

The cooled charge-air flows through the outlet charge-air pipes of the radiator to the engine, where it is consumed during fuel combustion.

For a figure of the charge-air flow, refer to (→ Page 103).

Generator cooling

Generators are air-cooled. The air enters the lower part of the outlet box through the louvered cover (air gaps).

The shape of the outlet box properly directs outside ventilating air through the generator. The generator "hot air" passes through the stator and rotor coils and out the adapter ring screened openings.

The cast unidirectional aluminum alloy ventilation fan (driven by the main rotor) provides even air flow to maximize cooling of the generator.

For a figure of the generator parts, refer to (→ Page 54).

TIM-ID: 0000057996 - 001

4.10.2 Unit-mounted radiator

The unit-mounted radiator is a combined cooler for the engine coolant (in the jacket water circuit) and the charge-air coolant (in the intercooler circuit).

The figure shows a typical unit-mounted radiator.

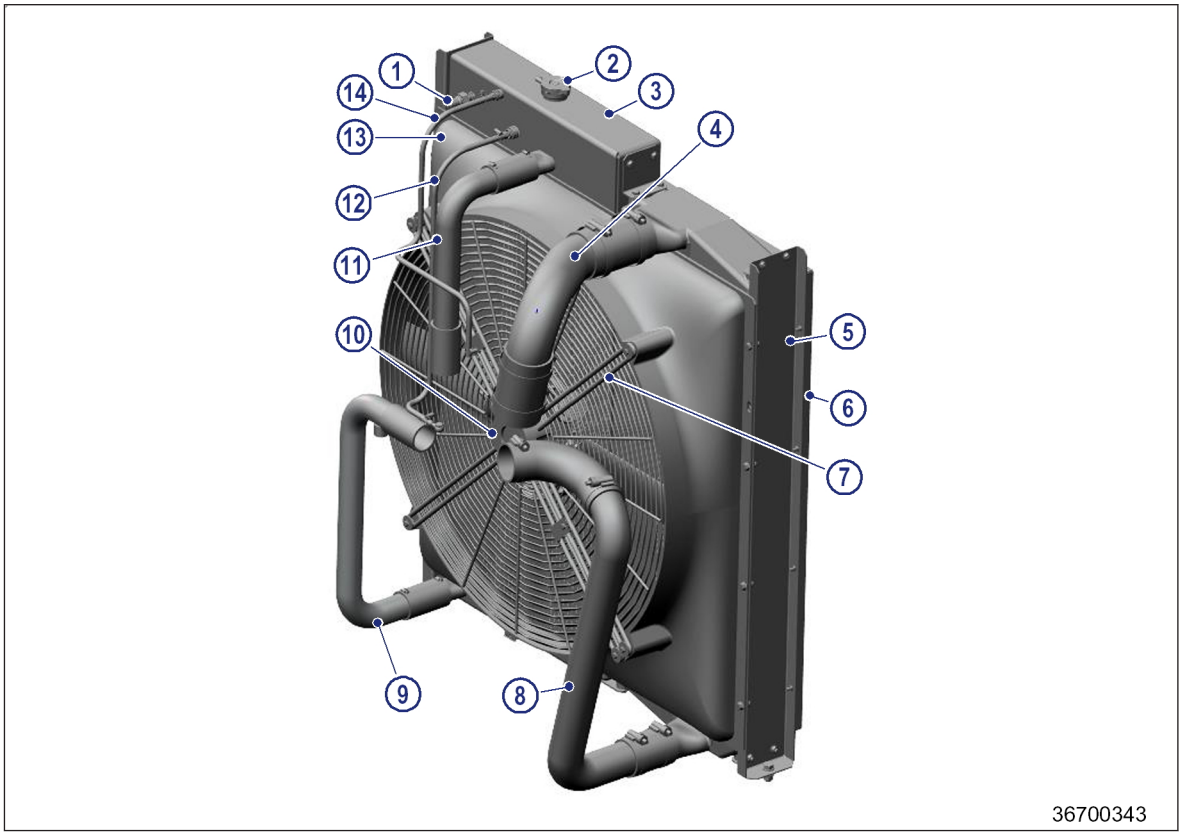


Figure 21: Unit-mounted radiator

1 Level sensor connection (jacket water circuit)
2 Pressure cap (jacket water circuit)
3 Expansion tank (jacket water circuit)
4 Charge-air pipe from radiator to engine (intercooler circuit)
5 Core (intercooler circuit)
6 Core face guard
7 Complete fan guard
8 Charge-air pipe from engine to radiator (intercooler circuit)
9 Coolant pipe from radiator to engine (jacket water circuit)
10 Fan
11 Coolant pipe from engine to radiator (jacket water circuit)
12 Expansion hose (jacket water circuit)
13 Core (jacket water circuit)
14 Connection vent line (jacket water circuit)

Technical data

- Single-circuit cooling system with air-to-air charge-air cooling
- Complete system solution with unit-mounted radiator, including fan drive, fan, and piping

Benefits

- Thermostat control ensures that optimum coolant and engine temperatures are reached quickly
- Charge-air cooling during load operation

Function

Jacket water circuit

The engine coolant is cooled in the jacket water core (13) of the radiator by means of fan (10) circulation.

TIM-ID: 0000057997 - 001

From the jacket water core (13), the coolant is pumped via the coolant pipe (9) to the engine and cools the cylinders during work. Depending on coolant temperature after passing the cylinders, an engine-mounted thermostat routes a part of the coolant via the coolant pipe (11) back to the jacket water core (13) where the coolant is recooled.

The coolant expansion tank (3) is installed at the highest point of the cooling system, usually on the radiator. It allows compensation of coolant quantity and pressure variations. As the coolant expands with increasing temperature, its pressure in the closed system increases also. The coolant expansion tank is equipped with pressure overflow devices, vent line connections (14), and level sensor connection (1).

Intercooler circuit

Fresh, compressed, heated air (coming via air filters and turbocharger) flows through the intake charge-air pipes (8) to the intercooler core (5). There, the charge-air is cooled by means of fan (10) circulation during load operation.

The cooled charge-air flows through outlet charge-air pipe (4) to the engine where it is consumed during fuel combustion.

TIM-ID: 0000057997 - 001

4.10.3 Jacket water heater

The jacket water heater is a convection coolant heating system designed to efficiently maintain an engine at optimum starting temperatures. Maintaining jacket water temperatures ensures easy starting, reduces harmful emissions at start-up, and allows engines to go to full power without unnecessary idling.

The figure (→ Figure 22)shows a standard convection jacket water heating system.

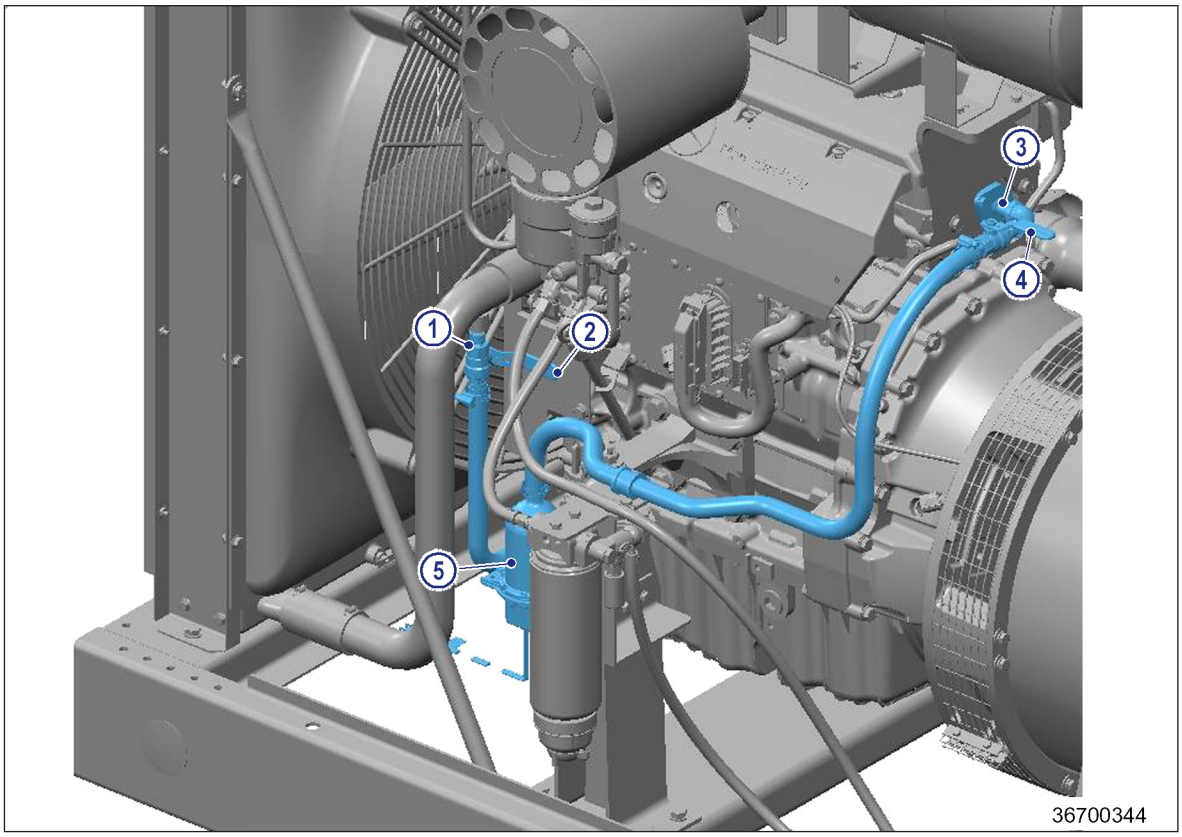


Figure 22: Preheater installation location

1 Coolant return from engine
2 Shut-off valve
3 Coolant supply to engine
4 Shut-off valve
5 Preheater

Technical data

- Single-phase system:
  - 120/240 V, 60 Hz model
- c-UL-us Listed; conforms to UL 499 and CSA C22.2 No. 191
- CE marking provided
- Available for engines ranging in size from 2.5 to 12 liters (153 to 732 in^3)
- Power of 0.4 to 2 kW
- Adjustable thermostat from 32 to 54 °C (90 to 130 °F)

Benefits

- Reduced outlet temperature extends hose life and reduces heater maintenance
- Reduced electrical consumption on engine startup
- Includes all required controls for automatic operation
- Compact design requires minimal material, space, and time for mounting
- Simple to install
- High-impact plastic tank heater offers exceptional tensile strength and resists corrosion

TIM-ID: 0000057998 - 001

Function

The jacket water heater is powered by an external power supply. It works during the out-of-operation time of the engine-generator set. It turns on and off depending on the temperature measured with the sensor on the thermostat.

Upon energizing the system, engine coolant circulates from the engine through the heating tank and back to the engine. An adjustable thermostat cycles the heating element on and off based on coolant temperature.

The coolant flows through the return line from the engine (1) to the jacket water heater (5). The circulating heating system consists of a coolant heating tank, with a low-watt density heating element inside, an adjustable thermostat, an electrical box, electrical connections, and mounting elements. The coolant leaves the jacket water heater through the fill line to the engine (3).

If the heating system is configured with user supplied, non-restrictive shut-off valves (isolation valves) in the coolant lines between jacket water heater and engine (2,4), maintenance on the heating system is allowed without draining the complete engine coolant.

TIM-ID: 0000057998 - 001

4.11 Fuel System

4.11.1 Fuel system - Overview

The fuel system provides the engine with fuel. The fuel source is a fuel tank which can be located below or beside the engine-generator set or outside the engine-generator set room. The fuel tank is connected to the fuel delivery pump via fuel hoses.

The fuel system electronics are controlled by the engine electronics and guarantee an optimal fuel supply for each application.

Technical data

Low pressure (LP) fuel system:

- Fuel delivery pump
- Fuel hand pump
- Fuel filter
- Fuel prefilter
- Fuel prefilter with water separator

High pressure (HP) fuel system:

- HP unit pumps
- Single-wall HP fuel lines
- Injection nozzles
- Pressure retaining valve

Fuel return system:

- Return line from the injection nozzles
- Return line from the unit pumps

Fuel control system:

- Control by electronic engine management system
- Electronically controllable (variable) injection start and injection end

Benefits

- Low exhaust emissions and low fuel consumption over the entire power range
- Excellent acceleration and load acceptance performance
- Injection time and amount of injected fuel electronically controlled
- Exemplary smooth running and high-speed stability
- No power loss at high fuel temperatures

Function

The fuel delivery pump draws fuel via the fuel prefilter with water separator from the fuel tank and delivers it through the hand pump, fuel prefilter, and fuel filter to the HP unit pumps. The HP unit pumps increase fuel pressure and deliver fuel via the fuel lines to the injection nozzles. Fuel injected by the nozzles is distributed evenly in the combustion chamber. Surplus fuel is led from the nozzles via return lines back to the fuel tank. The hand pump supports the manual filling and venting of the fuel system. The start of injection and the injection quantity are electronically controlled by the engine governor.

TIM-ID: 0000062124 - 001

4.11.2 Fuel prefilter with water separator

The fuel prefilter with water separator is installed in the intake line of the fuel delivery pump. It removes solid and liquid contaminants found in the fuel.

The figure (→ Figure 23) shows a fuel prefilter with water separator.

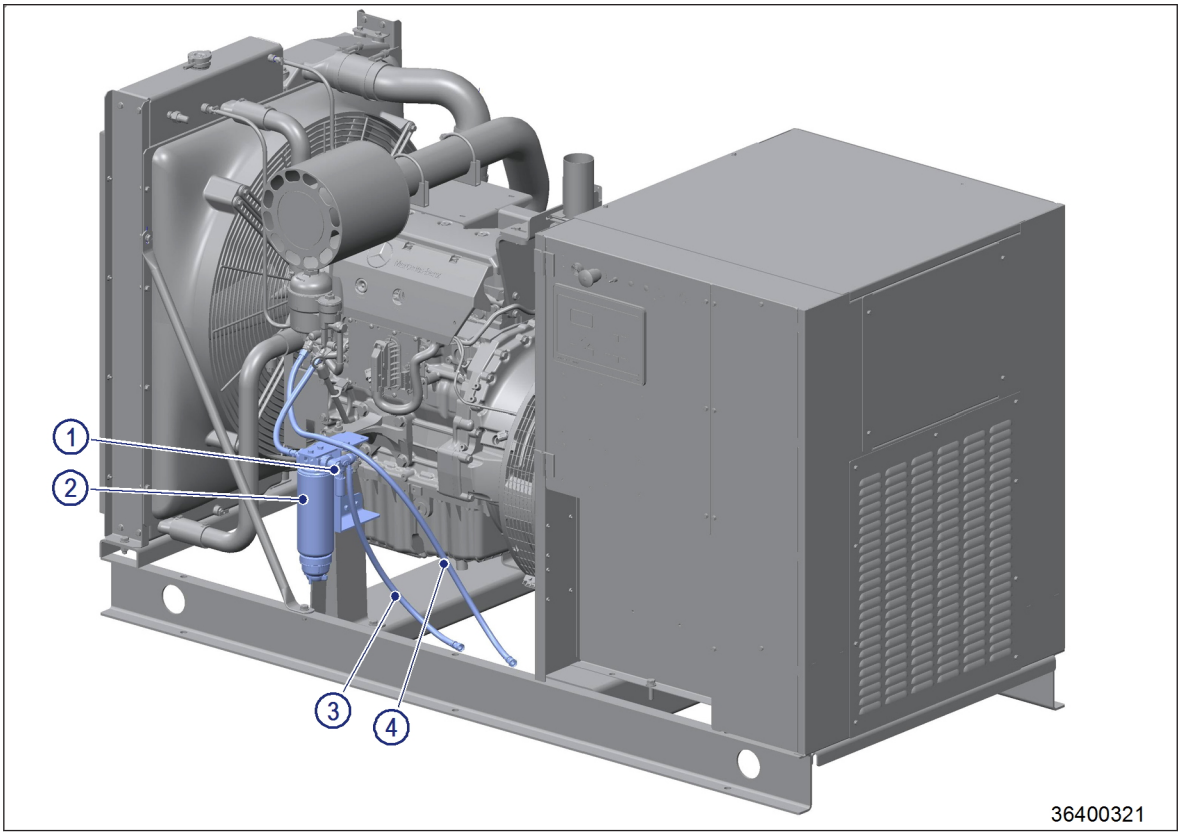


Figure 23: Fuel prefilter with water separator

1 Fuel primer pump
2 Fuel prefilter with water separator
3 Fuel supply to engine
4 Fuel return

Technical data

- Water separator and fuel filter for standard diesel fuel
- 3-stage filtration (multi-stage centrifugal system)

Benefits

- Most compact design
- High efficiency
- Low flow restriction
- Long life filter element
- Easy installation and simple maintenance

Function

The fuel prefilter with water separator (2) consists of one filter housing. The fuel passes through an inlet connection, flows through the filter housing, centrifugal filter, and bowl to the filter element. There, the fuel flows from outside to inside and is filtered in three stages.

TIM-ID: 0000063246 - 001

Filter stages	Meaning
1st stage	Separation: Using the fuel flow, the turbine separates large solids and free water through enhanced centrifugal force.
2nd stage	Coalescing: Smaller water droplets and solids coalesce on the conical baffle and fall to the collection bowl.
3rd stage	Filtration: Engines benefit from near 100% water separation and fuel filtration with water-repelling media. The replaceable filter elements are available in 10 micron ratings.

The cleaned fuel then passes through the outlet connection.

By venting the filter and draining the contaminants and water from the bowl at the drain valve, the filter element is flushed in the opposite flow direction and cleaned again.

TIM-ID: 0000063246 - 001

4.11.3 Sub-base tank

The sub-base tank is located beneath the base and stores the fuel that is delivered to the engine.

The double wall secondary containment fuel tank contains fuel leakage from the inner tank. Thus, it is an extra protection against fuel leakage to the surrounding environment. The secondary containment fuel tank is also sealed to prevent the entrance of rain and debris.

The figure (→ Figure 24) shows a typical sub-base tank. The location of each of these fittings may vary from system to system, but a typical sub-base tank always includes these items.

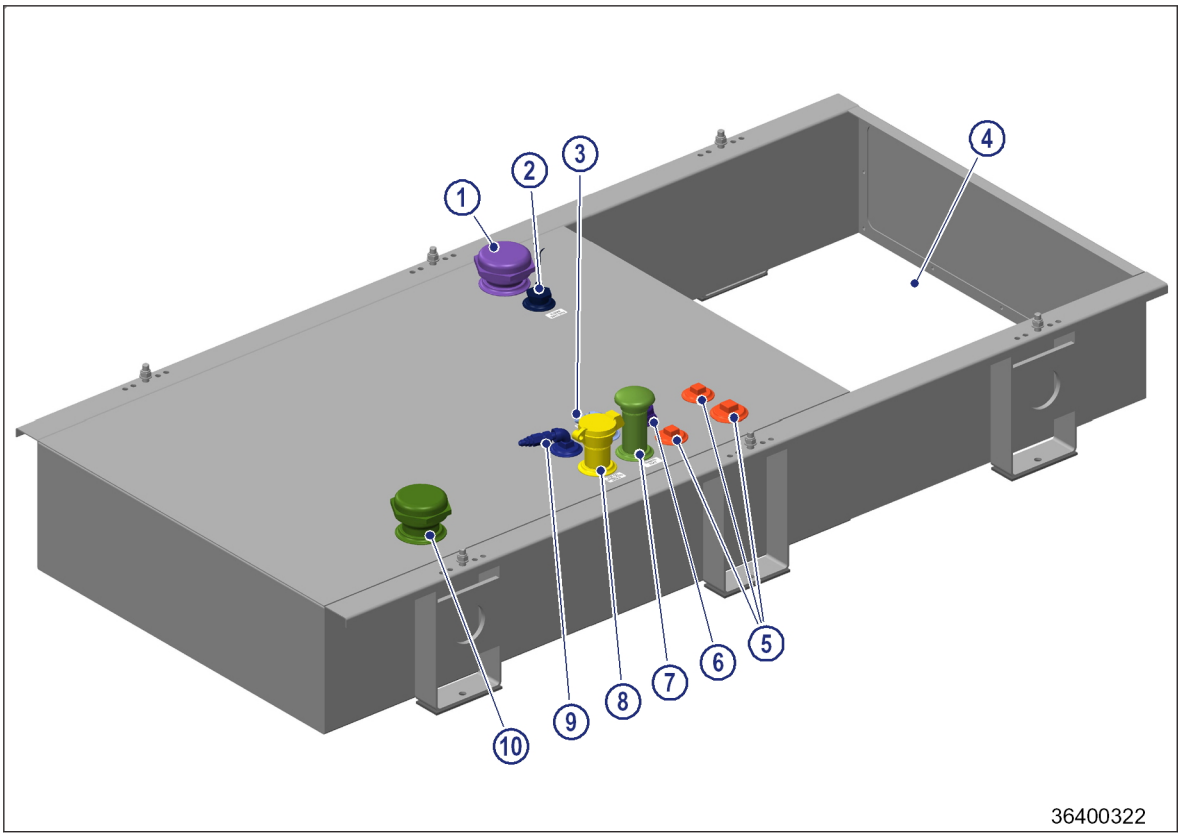


Figure 24: Sub-base tank

1 Emergency vent (secondary containment)
2 Leak detection switch
3 Fuel return to tank
4 Stub-up area
5 Extra fittings
6 Fuel gauge
7 Normal vent
8 Fuel fill
9 Fuel supply to engine
10 Emergency vent (primary containment)

Technical data

- Different sizes of sub-base tanks available with fuel capacities of 12, 24, 48, or 72 hours
- Steel construction
- Double wall with rupture basin
- Secondary containment system
- Normal and emergency ventilation for primary and secondary containment
- (National Pipe Thread) NPT fittings

Benefits

- Retains hazardous materials inside the container
- Switch indicates internal tank issues or leakages
- Leakages from inner tank are caught in the rupture basin

TIM-ID: 0000063247 - 001

Function

The sub-base tank delivers fuel to the diesel engine. Fuel is inserted into the tank via the fuel fill (8) and is stored there until consumption by the engine via the fuel supply (9). Excess fuel not used by the engine is returned to the tank via the fuel return (3). Any resulting gases produced during fuel containment are exhausted through the normal vent (7) and the emergency vents (1 and 10) as needed.

Optionally, the sub-base tank can be equipped with a spill fill box. The spill fix box is a container that holds approximately 19 liters (5 gallons) and is used to collect fuel from overfill and drips during tank filling. With a lockable fill cap inside and a drain port in the bottom, it is mounted on the fuel fill (8).

TIM-ID: 0000063247 - 001

4.12 Electrical System

4.12.1 Starter battery

A starter battery is necessary to start the engine-generator set.

The figure (→ Figure 25) shows the installation location of the starter battery.

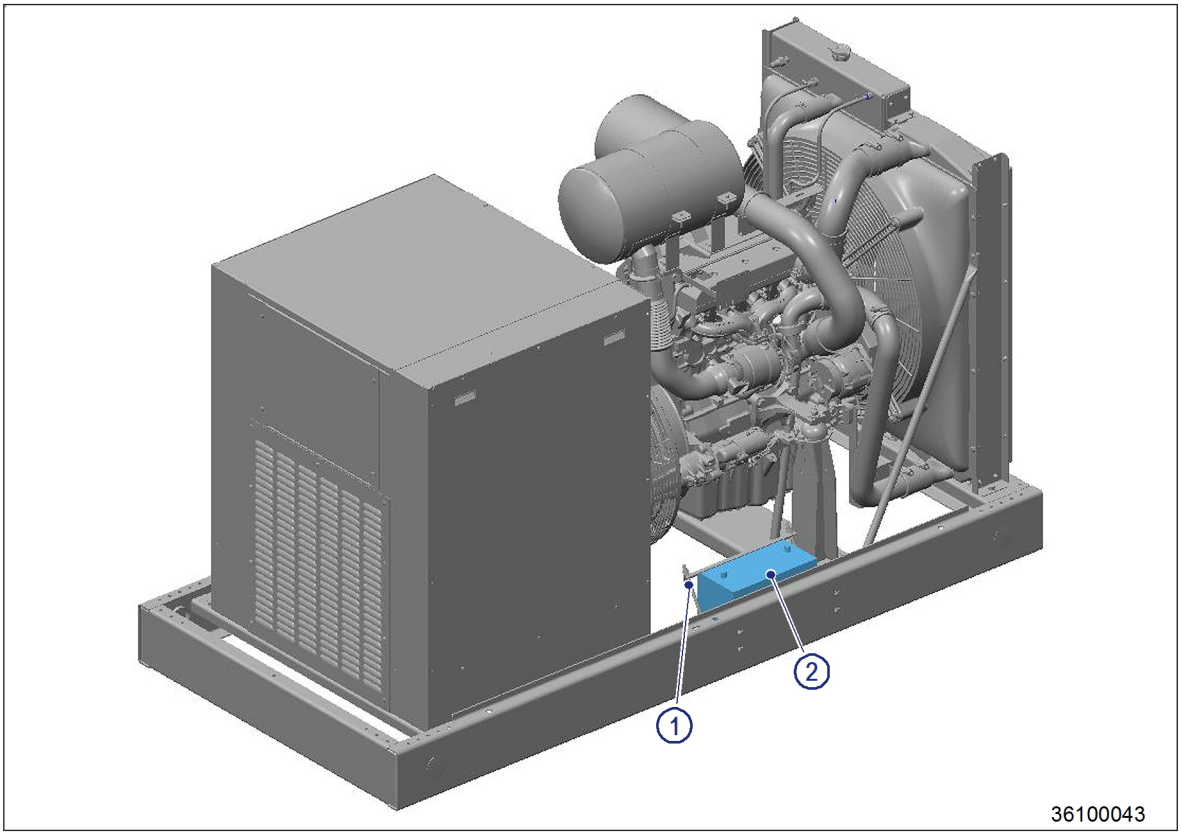


Figure 25: Starter battery installation location

1 Retainer 2 Starter battery

Technical data

NOTE: Technical data is based on one 12 V battery group number 31, lead-acid.

- Cold cranking amperes at -18 °C (0 °F): 950 A
- Cranking amperes at 0 °C (32 °F): 1,140 A
- Reserve capacity minutes at 25 A: 170 minutes
- Very low self-discharge rate

Benefits

- Immediate start of the engine-generator set due to high-quality battery
- Large tolerance for low ambient temperatures
- Automatic recharge by the engine-driven charging system
- Best battery performance and longest battery life with optional battery charger control system
- Easy installation and maintenance
- Rechargeable

Function

The battery (2) is connected to the starter. If the start of the engine-generator set is requested, the control panel tells the starter to operate. The starter itself engages the battery for DC electricity to supply power to start the engine-generator set.

TIM-ID: 0000062112 - 001

After the engine is running, the power supply by the battery stops. The lost capacity (discharge amount) is filled by an automatic recharge by the engine-driven alternator during engine operation.

Starting Lighting Ignition (SLI) batteries have a relatively low degree of discharge on each use. Once the engine is started, the battery is recharged by the engine-driven generator.

TIM-ID: 0000062112 - 001

4.12.2 Battery charger

A battery charger monitors and charges the batteries and displays the battery status. Precise charging and temperature compensation assure the correct battery charge under all conditions.

The figure shows a typical battery charger with details of the diagnostic display.

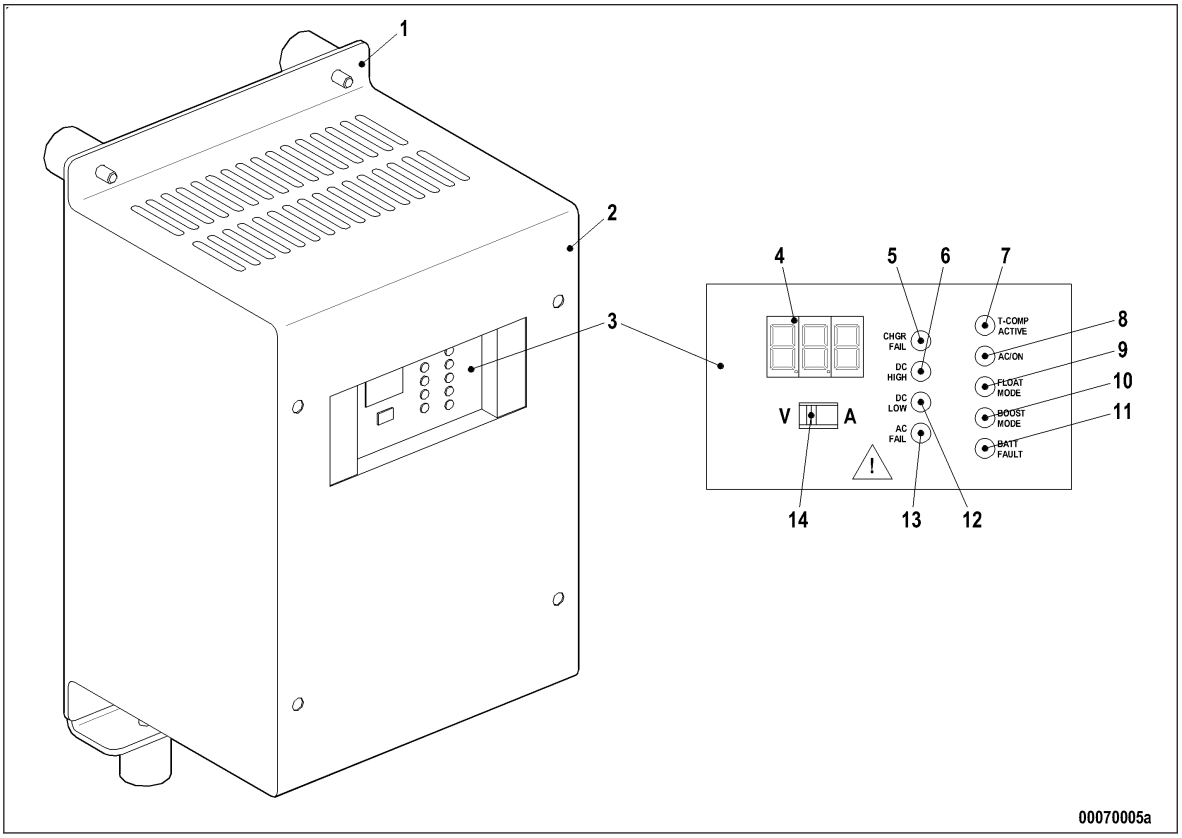


Figure 26: Battery charger

1 Mounting bracket
2 Battery charger box
3 Diagnostic display
4 DC Volt/Ampere meter display
5 RED for internal charge failure
6 RED for excessive battery voltage
7 GREEN for temperature-corrected charge voltage
8 GREEN for normal AC input
9 GREEN for normal voltage (float charge)
10 YELLOW for boost voltage (fast charge)
11 RED for open, wrong voltage, or reversed battery
12 RED for low battery voltage
13 RED for low or missing AC input
14 Meter mode selector

Technical data

- c-UL-us listed to UL 1236
- CSA standard 22.2 no. 107.2
- CE marked (50/60 Hz units) to EN 60335
- Single phase input: 110/120, 208/240 VAC
- DC output: 24 V nominal
- Operating temperature: -20 to 60 °C (-40 to 140 °F); meets full specification from -20 to 45 °C (-4 to 113 °F)
- Humidity 5 to 95%, non-condensing
- Vibration resistance to UL 991, Class B
- Lightning transient immunity to ANSI/IEEE C62.41 Cat. Band EN 50082-2 heavy industrial
- EN 61000-6-2 Seismic Certification IBC 2000, 2003, 2006, 2009

TIM-ID: 0000000150 - 010

Benefits

- Easy field adjustments for any battery
- Complete system status and diagnostics
- Enabled or disabled automatic fast charging
- Enabled or disabled automatic temperature compensation, or installation of optional remote temperature sensor
- Dead battery charge feature
- Worldwide operating voltage and frequency ranges
- Float and boost voltage electronically controlled with a fast charge program

Function

Float and boost voltage are selectable at install per specific battery vendor recommendations. Remote temperature compensation is responsible for accurate float and boost voltage control and to match the negative temperature coefficient of the battery. The output voltage increases slightly as the temperature decreases and vice versa.

The output voltage is clamped at 0 and 40 °C (32 and 104 °F) to protect against high or low output voltage. The battery charger can operate in automatic 4-rate fast charge program, so float and boost voltage are electronically controlled.

Display and alarm system

The display and alarm system gives the complete system status and diagnostics available. Optional alarm system "C" exceeds NFPA-110 requirements. The digital meter works accurately to +2% voltage and +5% amperes.

The battery charger issues a battery fault alarm if one of the following errors occur:
- Battery disconnected
- Polarity reversed
- Mismatched charger/battery voltage
- Open charger to battery connection
- Open battery cell
- Excessive internal resistance

Charger protection

The charger is protected from the following faults and installation errors:
- Reverse battery connection
- Powering up into a shorted battery
- Powering up with the wrong voltage setting (24 V charger with 12 V battery)
- Powering up into an open battery (battery not connected)
- Internal power component failures
- Overheating (over temperature output power reduction)
- Protected against power line transients and surges

TIM-ID: 0000000150 - 010

4.12.3 Circuit breakers

Circuit breakers are electrical switches designed to protect electrical systems from damage caused by overloads, short circuits, and ground faults. All circuit breakers open (break) and close a circuit by nonautomatic means and open (break) the circuit automatically on a predetermined overcurrent. Electronic trip case circuit breakers use an electronic trip system to signal the circuit breaker to open automatically.

The figure (→ Figure 27) shows a P-frame circuit breaker. Visual appearance and configuration may vary depending on the unit.

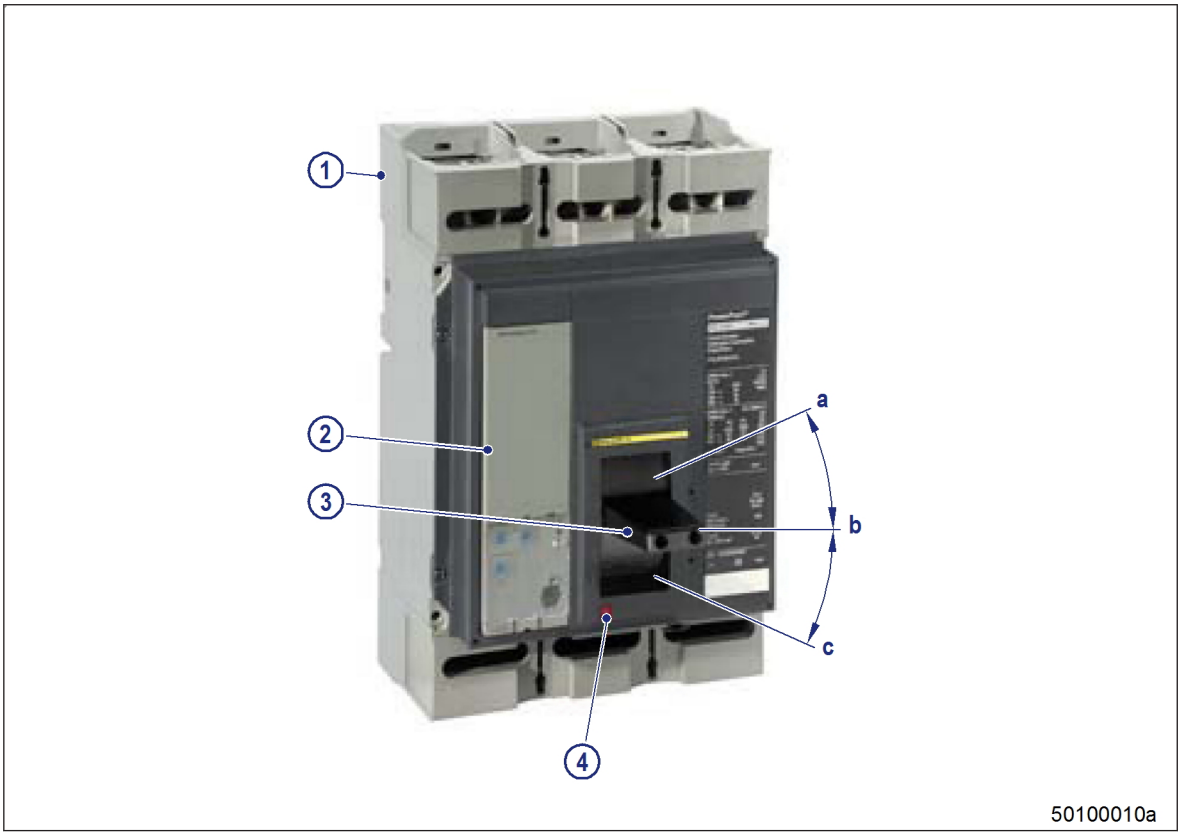


Figure 27: Circuit breaker P-frame

1 Case and mounting support
2 Trip unit
3 Handle
4 Release key
a I (ON) position
b Tripped position
c O (OFF) position

Technical data

- Brand: Square-D, 80% and 100% rated; 600 V, electronic trip circuit breakers
- Breaker models from 20 to 2,000 A with diverse frames and trip units
- Manually operated circuit breakers
- 3-pole
- Trip units:
  - Basic magnetic trip elements
  - Built-in electronic trip units
  - Micrologic trip units
- Molded case made of a glass-reinforced insulating material (thermal set composite resin) provides high dielectric strength
- UL Listed and CSA Certified; conforms to UL 489 and CSA C22.2 No. 5
- Meets IEC 60947-2 requirements; CE marking provided
- True RMS sensing devices

There are many different circuit breaker models available. For detailed information about circuit breakers for your system, contact your local MTU Onsite Energy distributor or dealer.

TIM-ID: 0000064774 - 001

Benefits

- Flexible connection capabilities
- High interrupting ratings and field-installable accessories in a small package

Function

Manually operated circuit breakers

Manually operated circuit breakers have a single operating handle (3) that acts directly through the operating mechanism against the contact blades. Multi-pole circuit breakers have a common trip bar for positive action of all poles on manual and automatic operation. These circuit breakers have a trip-free mechanism that allows them to trip even though the operating handle may be restricted (by a handle operating mechanism or padlock attachment) in the I (ON) position.

If not restricted, the operating handle moves to a position between I (ON) and O (OFF) when the circuit breaker is tripped (see handle positions a, b, and c in the figure).

The face of the manually operated circuit breakers is marked with standard ON/OFF and international I/O markings to indicate handle position. In addition, the I (ON) portion of the circuit breaker handle is color coded green.

Push-to-trip button

The push-to-trip button located on the face of each manually operated circuit breaker is a standard feature. It provides the ability to manually trip the circuit breaker without risking exposure to live parts. During normal ON-OFF operation, the handle opens and closes the circuit breaker contact, but does not exercise the tripping mechanism. The push-to-trip button can be used to exercise the circuit breaker mechanism and to check the auxiliary and alarm switch circuits.

Trip system

Trip units are designed to protect power circuits and loads.

The trip system causes the circuit breaker to open automatically under overload, short-circuit, or equipment ground-fault conditions. Electronic trip circuit breakers give the customer more versatility to achieve coordination with features such as adjustable instantaneous pickup and high withstand ratings.

The trip system consists of a set of current transformers (CTs or sensors) to sense current, a trip unit to evaluate the current, and a tripping solenoid (tripping coil) to trip the circuit breaker. The tripping coil is a flux transfer solenoid that requires no external power source. All protective functions are completely fault powered.

Magnetic trip element (available with H and J frames)

Magnetic trip elements provide short circuit protection. The circuit breakers use a magnetic actuator to trip the circuit. The current flow through the electrical device passes through an electromagnetic actuator. When the current flow reaches a preset level (determined by the current rating of the circuit breaker), the magnetic field in the electromagnet is strong enough to trip the breaker and allow the contacts to open. The current flow stops. This type of breaker generally has to be manually reset.

ET electronic trip system (available with H, J, L, and P frames)

The built-in electronic trip unit provides better accuracy than standard thermal-magnetic trip units. It is handled via calculations instead of bending metal, cannot be field replaced, and does not allow adjustment of the trip point setting.

Electronic trip circuit breakers provide:

- Overload and short-circuit protection
- Means to manually disconnect power to the circuit
- Enhanced coordination by their adjustability
- High interrupting ratings and withstand ratings

TIM-ID: 0000064774 - 001

Micrologic electronic trip system (available with H, J, L, and P frames)

Different models are available. The figure (→ Figure 28) shows a 6.0P model as an example.

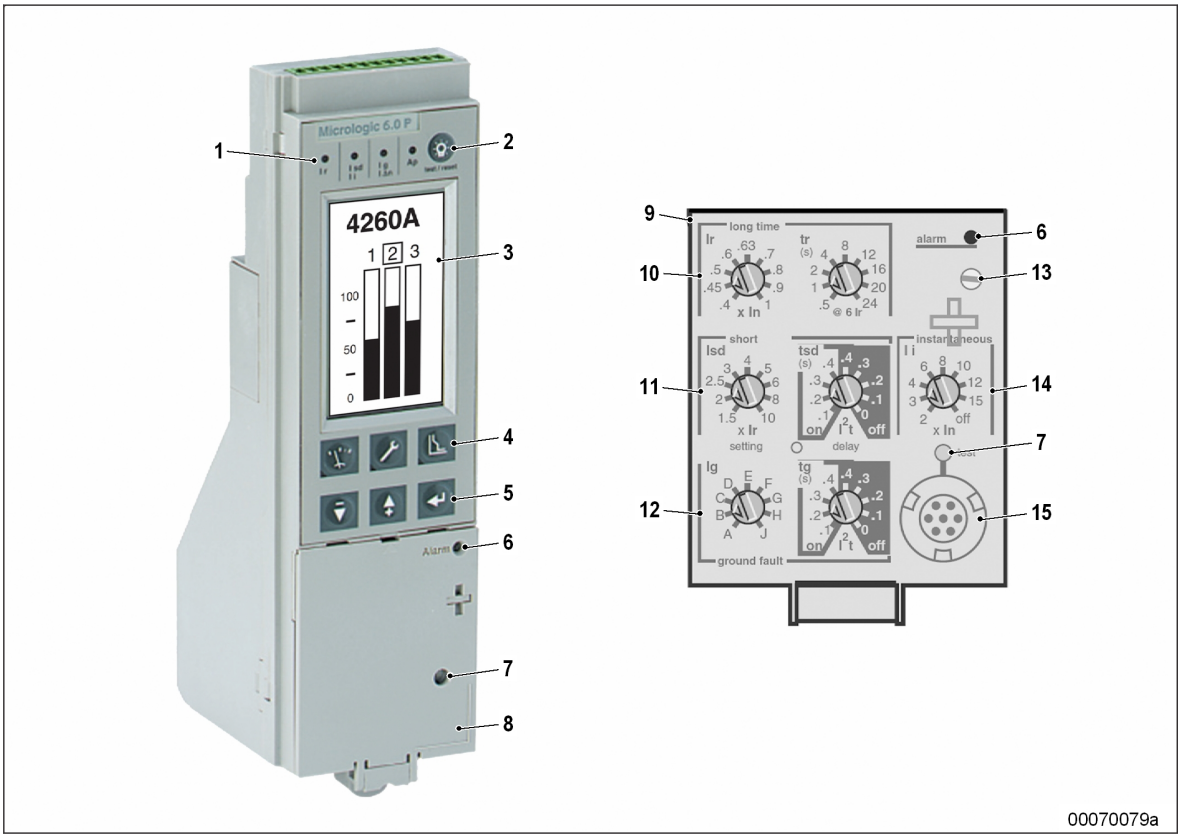


Figure 28: Circuit breakers – Trip unit Micrologic 6.0P

1 Indications of tripping cause (LED)
2 Test lamp (LED) and reset
3 Graphics display
4 Menu access buttons
5 Navigation/value set and confirm buttons
6 Alarm indicator "Overload" (LED)
7 Electronic push-to-trip button
8 Cover for adjustment dials
9 Adjustment dials
10 Long-time current setting and tripping delay
11 Short-time pickup and tripping delay
12 Ground-fault pickup and tripping delay
13 Long-time rating plug screw
14 Instantaneous pickup
15 Test connector

Features found in Micrologic electronic trip circuit breakers, such as adjustable rating plugs, adjustable long-time pickups, and 100% ratings also provide capacity for future growth.

The integral equipment ground fault sensing capabilities available with Micrologic trip systems mean that there are fewer parts and pieces to purchase, mount, and wire. These capabilities include integral ground-fault protection for equipment (which causes the circuit breaker to trip when a ground fault is detected) as well as integral ground-fault alarm (which does not trip the circuit breaker, but sends an alarm when a ground fault is detected).

Adjustable rotary switches on the trip unit allow the user to set the proper overcurrent or equipment ground-fault current protection required in the electrical system. If current exceeds a set value for longer than its set time delay, the trip system opens the circuit breaker. Alarms may be programmed for remote indications. Measurements of current, voltage, frequency, power, and power quality optimize continuity of service and energy management.

Different models are available with progressively increasing levels of functionality, from basic overcurrent protection to advanced protection, communications, and power metering/monitoring.

The table shows a choice of available Micrologic trip units and its characteristics:

TIM-ID: 0000064774 - 001

Features of Micrologic trip unit	3.0	5.0	5.0P	6.0P
Overload and short-circuit protection	✔	✔	✔	✔
Thermal imaging (active thermal imaging before and after tripping)	✔	✔	✔	✔
Means to manually disconnect power to the circuit	✔	✔	✔	✔
LED for long-time pickup	✔	✔	✔	✔
LED for trip indication	–	–	✔	✔
Support of an optional communication network with four wire Modbus, RTU, RS485; including event recording	–	–	✔	✔
Short time protection	–	✔	✔	✔
Long time and instantaneous protection	✔	✔	✔	✔
Ground fault protection for equipment: • Residual ground fault protection • Source ground-return ground fault protection • Modified differential ground fault protection	–	–	–	✔
Neutral protection	–	–	✔	✔
Enhanced coordination for adjustability, fine-tuning of settings	–	–	✔	✔
Ammeter for metering the true RMS value of currents	–	–	✔	✔
Phase loading bar graph	–	–	✔	✔
Power metering and monitoring • calculates in real time all electrical values: V, A, W, VAR, VA, Wh, VARh, VAh, Hz, power factor, and crest factor • calculates demand current and demand power over an adjustable time period	–	–	✔	✔
Zone-selective interlocking (ZSI) which can reduce damage in the event of a fault	–	–	✔	✔
Protective relaying functions	–	–	✔	✔
Contact wear indication	–	–	✔	✔
Trip and alarm histories of the last ten trips and ten alarms; recorded in two separate history files; can be displayed on the screen	–	–	✔	✔

TIM-ID: 0000064774 - 001

4.13 Base and Mounting System

4.13.1 Base and mounting system

The base frame provides support for all components of the engine-generator set.

The figure (→ Figure 29)shows a typical open power unit (OPU) base frame with mounts. Depending on the size of engine, generator, and radiator, the base frame can differ in its dimensions and number and location of cross members and resilient mounts. A base frame for a housed power unit (HPU) differs in its appearance but not in its function.

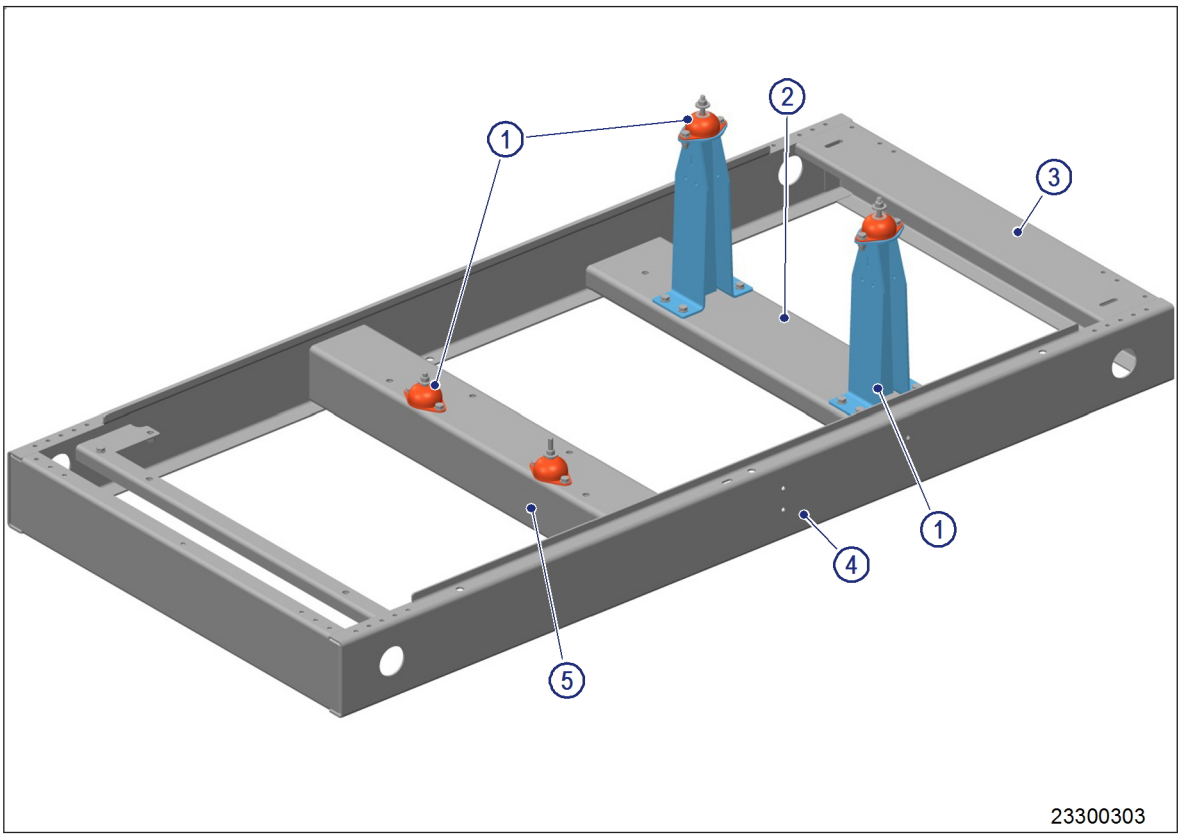


Figure 29: Base frame with mounts

1 Resilient mounts – engine and generator
2 Engine cross member
3 Radiator cross member
4 Side channel – left and right
5 Generator cross member

The base frame is a steel structure and consists of two side channels (4) and several cross members (2, 3, 5). The cross member for the generator (5) is fitted with resilient mounting elements (1). The cross member for the diesel engine (2) is fitted with engine mounts and resilient mounting elements (1). The unit-mounted radiator is mounted directly on the radiator cross member (3).

Technical data

- Welded steel structure
- Resilient mounting elements for diesel engine and generator

Benefits

- One common base to facilitate engine-generator set transportation
- Easy access to all major components
- Optimization of vibrational characteristics

TIM-ID: 0000062110 - 001

4.14 Enclosure

4.14.1 Enclosure

The engine-generator set enclosure consists mainly of a steel or aluminum housing that provides protection from the elements and/or sound attenuation.

The figures (→ Figure 30) (→ Figure 31)show in overview the components of an engine-generator set enclosure.

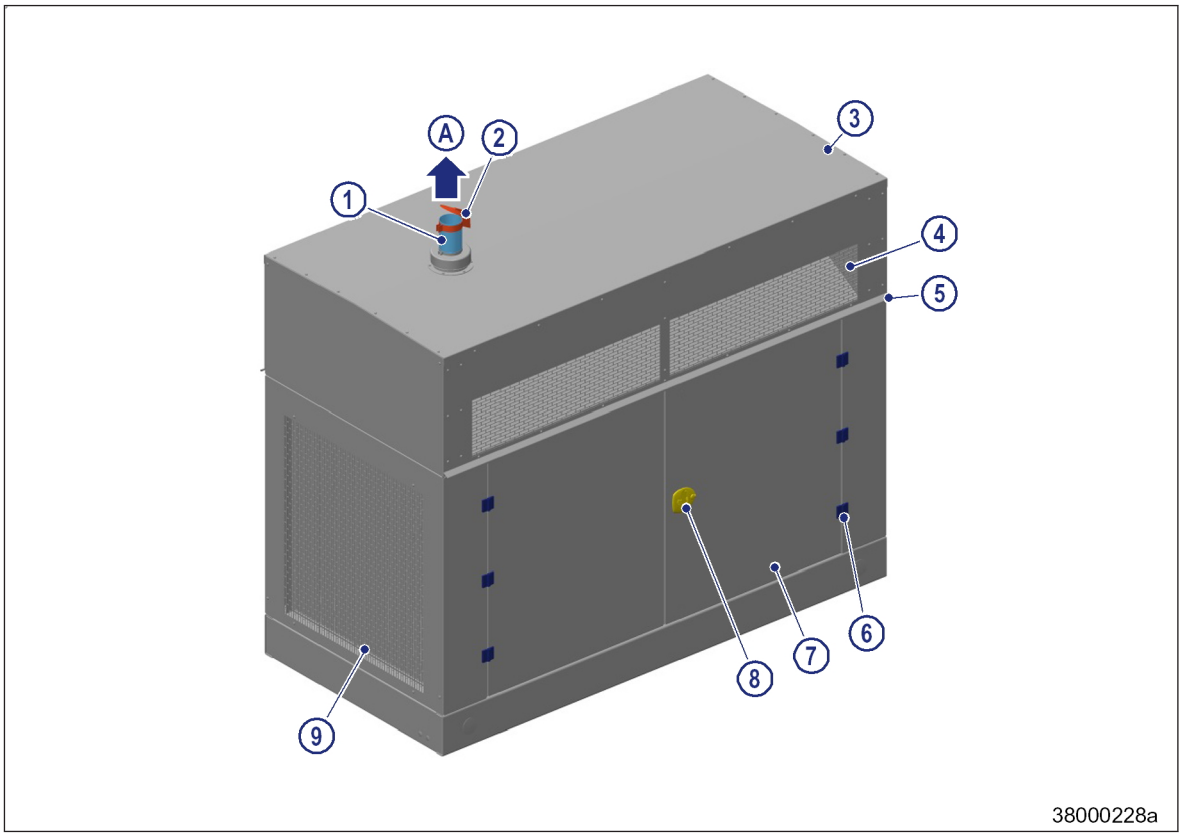


Figure 30: Enclosure

1 Exhaust pipe
2 Flapper rain cap
3 Pitched enclosure roof
4 Air intake
5 Drip rail
6 Aluminum hinge
7 Rubber sealed door
8 Lockable door handle
9 Air outlet grid
A Exhaust gas

TIM-ID: 0000062111 - 001

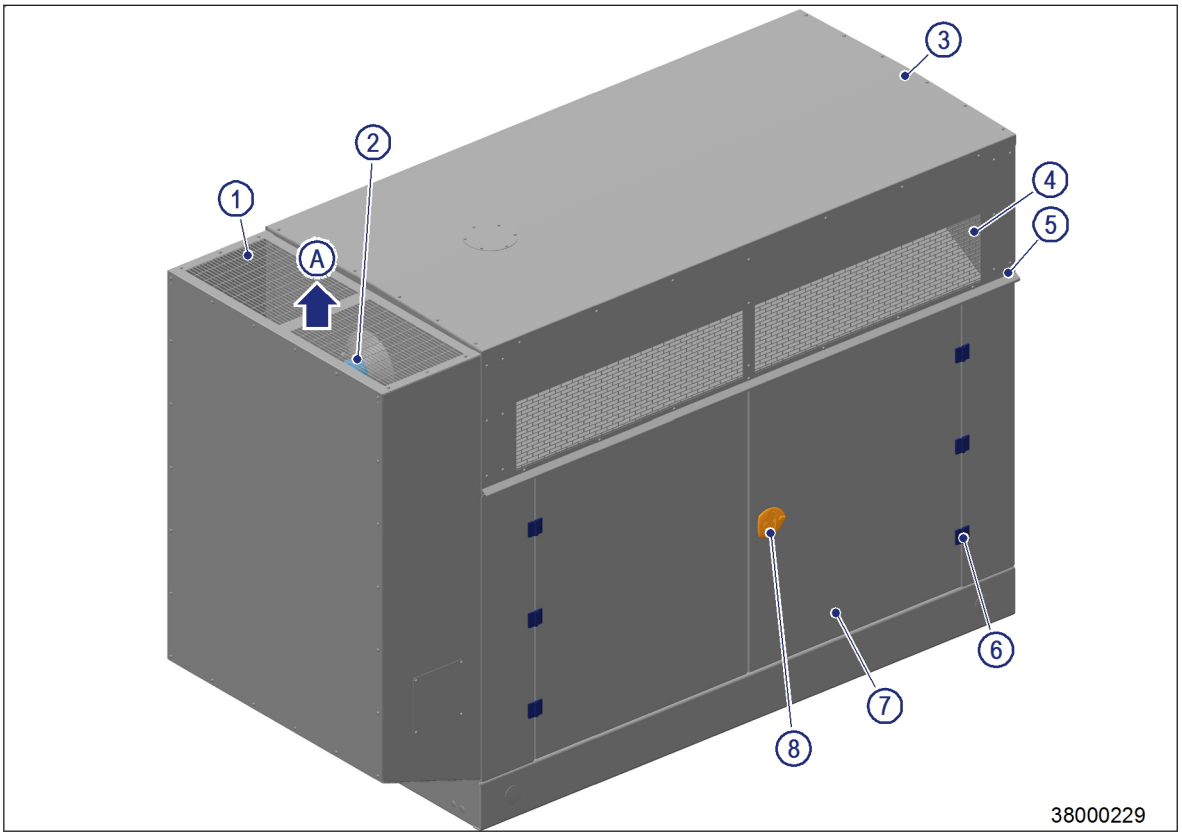


Figure 31: Enclosure with scoop

1 Air outlet grid
2 Exhaust pipe
3 Pitched enclosure roof
4 Air intake baffles
5 Drip rail
6 Aluminum hinge
7 Rubber sealed door
8 Lockable door handle
A Exhaust gas

Standard features

- Modular construction
- Bolted panels
- Fixed air intake baffles
- Punched air outlet grid
- Radiator ducted to enclosure air outlet
- Pitched enclosure roof
- Heavy-gauge steel construction
- Powder-baked primer
- Aluminum hinges and latches
- Recessed and lockable door handles
- Rubber sealed doors

Available options

- Aluminum
- LED light package
- Exhaust scoop
- Sub-base and cross member for engine-generator set
- Door restraints

Technical data

- Steel construction
- Aluminum construction (optional)

TIM-ID: 0000062111 - 001

Enclosure level identification	
Level 1:	Skid-mounted weather-protective enclosure constructed of heavy gauge steel or aluminum with fixed stormproof panels designed for 190 mph wind load rating. Enclosure consists of a bolted and welded construction with unit-mounted internal muffler. Hinged, lockable double-door access on both sides of the enclosure.
Level 2:	Level 1 enclosure with UL 94 HF-1 compliant, 1.5" thick sound attenuated foam insulation installed inside enclosure walls.
Level 3:	Level 2 enclosure with air exhaust scoop. UL 94 HF-1 compliant, 1.5" thick sound attenuated foam insulation installed in scoop.

Table 2: Enclosure levels

Benefits

- Modular construction allows design flexibility to meet different field conditions.
- Bolted panels may be easily removed for service, field replacement, and even modifications.
- Steel construction provides a durable, resilient structure.
- The pitched roof prevents water accumulation.
- Powder coating provides a durable weather-resistant finish, assuring years of corrosion-free service.
- Aluminum hinges and latches are corrosion-resistant and endure through harsh weather conditions.
- Lockable door handles provide security by preventing unauthorized access.
- Door gaskets prevent water and moisture from entering the enclosure and simultaneously minimize noise.
- Optional aluminum construction provides a superior corrosion resistance in salt spray or alkaline environment.

Function

Air enters through the air intake baffles (4) and flows to the engine for both intake and cooling. Air exits from the air outlet grid (1) and exhausts gas (A

) through the exhaust pipe (2). The pitched enclosure roof (3), the flapper rain caps (if applicable), drip rails (5), and sealed doors (7) keep water and other elements from entering the enclosure. The doors on both sides allow access to each component of the engine-generator set. To protect the engine-generator set from unauthorized access, the doors can be locked.

TIM-ID: 0000062111 - 001

5 Engine Generator Set Basic Operations

5.1 Lockout/tagout procedure

Preconditions

☑ Engine is not running and controls are in "OFF" position.

☑ Engine starting circuit is disabled.

DANGER

Not completely de-energized systems can contain parts under high voltage. Live components and connections.
Risk of burns or death from electric shock!
- Disconnect all electrical power.
- Lockout and tagout the equipment before removing protective shields for service or maintenance.

DANGER

Manipulation of interlocks on parts under high voltage. Live components and connections.
Risk of burns or death from electric shock!
- Do not tamper with any interlocks in the system.

DANGER

High voltage. Live components and connections.
Risk of burns or death from electric shock!
- Disable the engine start contact leads from the engine-generator set control panel.
- Do not disconnect the engine start contact leads from the transfer switch enclosure.

DANGER

Circuit breakers are live components.
Risk of burns or death from electric shock!
- Ensure all circuit breakers are placed in the "OPEN" position prior to and while servicing the engine-generator set.

DANGER

Battery charger is a live component.
Risk of burns or death from electric shock!
- Wait at least 30 seconds after removing power source from the battery charger prior to servicing the engine-generator set.

WARNING

Rotating and moving parts and high level of engine noise in the event of unexpected engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped.
- Ensure the control panel is in "OFF" position to disable starting during service.
- Disconnect the battery charger prior to service.

WARNING

Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

TIM-ID: 0000000257 - 016

WARNING

Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

WARNING

Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING

Batteries are live parts.
Risk of electric shock!
- Take care when disconnecting battery cables.
- Remove the negative side of the battery first.

NOTICE

Surge when using insufficient fuses.
Damage to engine-generator set!
- Make notes from where each fuse is removed, and keep these notes until reinstallation.
- Ensure to install the correct fuses in each slot of the control panel and the battery charger.

Note: The instructions in this section are general and cannot reflect all possible control and electrical configurations (control panel, circuit breaker, etc.).

General recommendations

- MTU Onsite Energy strongly recommends documenting the particular starting procedure applicable to your system during commissioning.
- All commissioning personnel should attend the commissioning training for operators offered at the authorized training center for their specific region.

Facility battery charger

1. Remove AC power source from battery charger.
2. Remove the battery charger fuses.
3. Open the circuit breaker supplying AC power to the battery charger.

Battery

1. Disconnect the negative lead from battery terminal.
2. Tag "DO NOT OPERATE" or similar warning label, and secure lock.

Automatic transfer switch (if fitted)

1. Open the engine-generator set control panel door.
2. Remove the panel fuses.
3. Remove the generator start contact leads supplied from remote start.
4. Install protective cover to exposed lead ends.
5. Secure loose leads away from circuit boards and other electronic devices.
6. Close the engine-generator set control panel door.
7. Add lock and tag to panel door to indicate Lockout/Tagout condition.

TIM-ID: 0000000257 - 016

Engine-generator set controls

1. Push the EMERGENCY STOP button to lockout the engine-generator set.

Note: This causes the alarm to sound. There is another button which functions to silence the alarm. Depending on your panel configuration, this button is called ALARM SILENCE, ACK, etc.

2. Press this button to silence the alarm.
3. Add lock and tag to panel door to indicate Lockout/Tagout condition, if not in place.

Main circuit breaker(s)

1. Move circuit breaker handle into the "OPEN" position.
2. Tag "DO NOT OPERATE" or similar warning label.
3. For multiple breakers, repeat the two previous steps.

TIM-ID: 0000000257 - 016

5.2 Unlocking procedure

Preconditions

☑ Engine is not running and controls are in "OFF" position.

☑ Engine starting circuit is disabled.

DANGER



High voltage. Live components and connections.
Risk of burns or death from electric shock!
- Disable the engine start contact leads from the engine-generator set control panel.
- Do not disconnect the engine start contact leads from the transfer switch enclosure.

DANGER



Circuit breakers are live components.
Risk of burns or death from electric shock!
- Ensure all circuit breakers are placed in the "OPEN" position prior to and while servicing the engine-generator set.

DANGER



Battery charger is a live component.
Risk of burns or death from electric shock!
- Wait at least 30 seconds after removing power source from the battery charger prior to servicing the engine-generator set.

WARNING



Rotating and moving parts and high level of engine noise in the event of unexpected engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped.
- Ensure the control panel is in "OFF" position to disable starting during service.
- Disconnect the battery charger prior to service.

WARNING



Rotating and moving parts and high level of engine noise in the event of unexpected engine-generator set start after service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the control panel is in "OFF" position prior to reconnecting the negative terminal of the battery.

WARNING



Batteries are live parts.
Risk of electric shock!
- Take care when disconnecting battery cables.
- Remove the negative side of the battery first.

NOTICE



Surge when using insufficient fuses.
Damage to engine-generator set!
- Make notes from where each fuse is removed, and keep these notes until reinstallation.
- Ensure to install the correct fuses in each slot of the control panel and the battery charger.

Note: The instructions in this section are general and cannot reflect all possible control and electrical configurations (control panel, circuit breaker, and so on).

TIM-ID: 0000000270 - 014

General recommendations

- MTU Onsite Energy strongly recommends to document the particular starting procedure applicable to your system during commissioning.
- All commissioning personnel should attend the commissioning training for operators offered at the authorized training center for their specific region.

Automatic transfer switch (if fitted)

1. Remove lockout tag and lock.
2. Open the engine-generator set control panel door.
3. Remove protective cover to exposed lead ends.
4. Reinstall the generator start contact leads supplied from remote start.
5. Reinstall the panel fuses.
6. Close the engine-generator set control panel door.

Engine-generator set controls

1. Twist and pull the EMERGENCY STOP button to reset.
2. Remove lock and tag.
3. Set the control panel to the requested operating mode.

Battery

1. Remove lock and lockout warning label.
2. Remove lead cap from negative lead.
3. Connect negative lead to negative battery terminal.

Result: This starts the panel boot process which causes the alarm to sound.

Note: There is a button which functions to silence the alarm. Depending on your panel configuration, this button will be called ALARM SILENCE, ACK, and so on.

4. Press this button to silence the alarm.

Facility battery charger

1. Close the circuit breaker supplying AC power to the battery charger.
2. Reinstall the battery charger fuses.
3. Reinstall AC power source from the battery charger.

Main circuit breaker(s)

1. Remove tag "DO NOT OPERATE" or similar warning label, and secure lock.
2. Set the circuit breaker(s) according to the applicable configuration. Note the "General recommendations" above.

Final step

▶ Test the engine-generator set through normal exercise procedure (→ Page 224).

TIM-ID: 0000000270 - 014

5.3 Putting the engine-generator set into operation after extended out-of-service-period

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

☑ Ensure that the Mercedes-Benz OM924-926LA engine manual is available.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000064937 - 001

Additional tasks to be carried out before operation after extended out-of-service-period (> 3 months)

Item	Task
Engine	Refer to recommissioning instructions in the Mercedes-Benz OM924-926LA engine manual(→ Page 531)
Cooling system	If engine is out of service for more than one year, change engine coolant (→ Page 531) (→ Page 533).

Checks to be carried out before operation

Item	Task
Engine-generator set location	Ensure that the location is clean of all debris and flammable or combustible material.
Engine-generator set	Check for dirt, leaks, and loose or contaminated wire connections. Carry out visual inspection for loose / missing fasteners and leaks. Clean, repair, and tighten, if necessary. Ensure that inlets and outlets, screens, and protection guards are clean and free of obstructions. Ensure that all needed fuel and cooling line valves are open, and drain valves are closed.
Engine	Check drive belt (→ Page 277). Check engine wiring (→ Page 277) . Check engine governor plug-in connection (→ Page 277).
Fuel system	Check fuel level in tank. If equipped with day tank, check for proper annunciator and alarm operation. Check tank fuel line connection, tank gauges, and alarms. Check tank for signs of rust. Check fuel lines for leaks, chafing, or dry rotting. Drain fuel prefilter with water separator (→ Page 220). Check fuel filter housing for leaks. Vent fuel system (→ Page 277).
Air system	Check air filters (signal ring position of service indicator)(→ Page 223). Check air filter assembly for dirt and debris. Check intake manifold for cracks and missing hardware.
Exhaust system	Check for leaks and missing hardware. If equipped with heat shields, check for missing / damaged heat shields.
Exhaust silencer, if fitted	Check flex pipe for crack and signs of leakage. Check for corrosion and leaks. Check rain cap for damage and proper fit.
Lube oil system	Check oil level (→ Page 429). Check for oil leaks.
Cooling system	Check engine coolant level (→ Page 529). Take coolant sample and analyze (pH value, antifreeze concentration, corrosion inhibitor concentration). Check coolant lines and connections for traces of coolant leaks. Check radiator expansion tank and pressure cap. Check radiator inlet / outlet lines and hoses. Check radiator cooling fins for debris, leaks, and corrosion. Ensure that no more than 20% of radiator cooling fins are blocked or clogged. Check preheater (jacket water heater) for leaks.
Starter batteries	Check and clean battery terminals and post. Check battery electrolyte level. Check batteries state of charge (perform load test) and charge, if necessary.

TIM-ID: 0000064937 - 001

Item	Task
Battery charger	Check shore power / incoming voltage to battery charger. Check annunciation terminal wires. Check charge flow rate, charging amps, and battery voltage.
Customer control system	Carry out a lamp test or similar test for general functionality, refer to the customer control system documentation. Test switches for operation. Check wiring for chafing and frayed wires inside panel. Check vibration dampers for cracks and dry rotting. Ensure that control panel is clean from debris. Verify that there are no fault messages.
Engine-generator set control panel	Press LAMP TEST push button to carry out a lamp test. Test switches for operation. Check wiring for chafing and frayed wires inside panel. Check vibration dampers for cracks and dry rotting. Ensure that control cabinet is clean from debris.
Remote annunciator, if fitted	Test alarm lights. Check wiring to annunciator. Check shore power wiring to annunciator.
Circuit breaker(s), if fitted	Check proper operation of breaker(s) and trip mechanism. Check lug terminals and load cables.
Generator anti-condensation heaters, if fitted	Ensure that engine-generator sets operating in a high humidity region are equipped with anti-condensation heaters (600 VAC and above - standard). Ensure that wiring on heaters is not chafed or frayed and that the voltage supplied to the heaters is correct. If the engine-generator set has been out of service for an extended time, allow heaters to operate 24 to 48 hours before operating the engine-generator set.
Rotating rectifier / main rotor assembly	Check diodes to ensure they are secure. Check that rotating exciter wiring and shaft wiring are not chafed or frayed. Check stator windings and field wires F1/F2. Check main stator and rotor winding insulation coating. Check generator housing for debris and clean as needed. Check generator terminals, e.g. T0, T1, T2, and T3.
Phase bar / isolators (if fitted)	Check bars and isolator terminal connections. Check isolators for loose fitting and cracks.
Voltage regulator	Check sensing leads and field leads for frayed or loose connection. Check wiring for PMG for loose or frayed connection (→ Page 243). Check vibration damper.
Automatic transfer switch, if fitted	Check utility / emergency load connection cable. Check transfer switch control wiring. Check controller lights for proper annunciation. If transfer switch is outdoor type: Ensure that heat strips are working correctly and check wiring. Ensure that transfer switch cabinet is clean of debris.
Engine governor, if fitted	Verify that there are no fault messages.

Putting the engine-generator set into operation

Item	Task
Engine-generator set	Perform unlocking procedure (→ Page 136).
Engine-generator set location	Start ventilation fan or open the doors / windows if engine-generator set is located in a closed space. Ensure room ventilation functions properly.

TIM-ID: 0000064937 - 001

Item	Task
Cooling system	Preheat coolant with preheater (jacket water heater). Ensure proper coolant operating temperature.
Customer control system	Select operating mode, e.g. automatic, manual mode, refer to the customer control system documentation.
Engine-generator set control panel	Select operating mode: • Press AUTO push button to select automatic operation (AUTO mode). • For manual operation, no further activity is required.

TIM-ID: 0000064937 - 001

5.4 Automatic start and stop

Preconditions

☑ Engine-generator set is in AUTO mode.

☑ A remote control is enabled.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

Automatic start

1. The engine-generator set is in standby (AUTO mode) and starts on request only (remote control).
2. If an electrically operated (motorized) circuit breaker is fitted, the digital generator set control panel delivers a pulse or a continuous signal to close the circuit breaker automatically under certain conditions. These conditions include the generator being stable, and no fault conditions are active (failed or a global alarm).

Note: Manual operation is only required if a manually operated circuit breaker is fitted.

3. If a manually operated circuit breaker is fitted, switch on the circuit breaker manually using the appropriate push button under certain conditions. These conditions include the generator being stable, and no fault conditions are active (failed or a global alarm).

Result: The circuit breaker is in ON position (closed). From this point on, the engine-generator set supplies power to the load until automatic stop is executed or a failure occurs.

Note:
- The generator circuit breaker (GCB) is used only for protection and is not used for control.
- For any information about the third-party ATS, refer to the manufacturer's documentation.

Automatic start with electrically operated (motorized) GCB

1. Ensure that the GCB is in OFF position (open).
2. The engine-generator set is in standby (AUTO mode). The ATS starts the engine-generator set automatically if one of the programmed events occur:
   - A power outage occurs.
   - A test run is started.
3. The digital generator set control panel delivers a pulse or a continuous signal to close the GCB automatically under certain conditions. These conditions include the generator being stable, and no fault conditions are active (failed or a global alarm).

Result: The GCB is in ON position (closed). From this point on, the engine-generator set supplies power to the load until automatic stop is executed or an engine failure occurs.

Automatic start with manually operated GCB or without GCB

1. Ensure that the manually operated GCB is in ON position (closed).
2. The engine-generator set is in standby (AUTO mode). The ATS starts the engine-generator set automatically if one of the programmed events occur:
   - The normal voltage does not meet specified requirements.
   - A test run is started.

Result: After the generator became stable, the ATS control system switches over the transfer switch. The engine-generator set supplies power to the load until automatic stop is executed or an engine failure occurs.

TIM-ID: 0000056800 - 001

Automatic stop

1. If the engine-generator set started via remote control, it will automatically stop after the remote control contact is open.
   a) If the engine has run with load, it should cool down before shutdown: The engine runs unloaded until the cool-down timer has expired.
   b) If during this time the remote control contact is reclosed, the circuit breaker closes and the cool down timer is reset.
2. If an electrically operated (motorized) circuit breaker is fitted, it switches open automatically.
3. If a manually operated circuit breaker is fitted, switch off the circuit breaker manually using the appropriate push button on the circuit breaker.

Result: The circuit breaker is in OFF position (open). After stopping, the engine-generator set is in standby (AUTO mode) again.

Automatic stop with ATS

▶ If an ATS started the engine-generator set, the engine-generator set will automatically stop after the normal voltage or power source returns. Also, the engine-generator set will automatically stop after a test run ends and time delays has been satisfied.

Result:
- If fitted: The electrically operated (motorized) GCB is in OFF position (open).
- After retransfer to the normal power source, a time delay begins to keep the engine running for a cool-down period. After the cool-down period, the ATS signals the engine-generator set to shut down. All circuits are reset for any future normal power source failure.
- After stopping, the engine-generator set is in standby (AUTO mode) again.

TIM-ID: 0000056800 - 001

5.5 Manual start

Preconditions

☑ Engine-generator set is ready for operation.

☑ Load leads are properly connected to the network.

☑ Load to transfer is available.

☑ Circuit breaker is in OFF position (open).

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Note: The start procedure is to be controlled by an external controller (customer control system). Observe strictly the instructions of the customer control system documentation.

Start

▶ For the start procedure, refer to the customer control system documentation.

Note: The generator circuit breaker (GCB) is used only for protection, and is not used for control.

Starting the engine-generator set manually

1. Switch the generator circuit breaker (GCB) to OFF position.
2. Press the RUN push button to activate the system and start the engine.

Result:
- After a few seconds, the engine starts. The starter motor disengages when the engine reaches a sufficient speed.
- After another few seconds, the engine-generator set will reach the rated speed.

3. When the generator becomes stable and no fault conditions are active (failed or a global alarm), switch on the GCB by pressing the appropriate push button.

Result:
- The generator circuit breaker is in ON position (closed).

4. If using a third-party ATS, execute the appropriate steps to transfer the load from the main to the generator. Refer to the manufacturer's documentation of the ATS for further information.

Result:
- The switch transfers the load from the main (normal) to the generator (emergency).

5. The engine-generator set supplies power to the load until manual stop is executed or an engine failure occurs.

TIM-ID: 0000056801 - 001

5.6 Manual stop

Preconditions

☑ Engine-generator set is operating and supplies power to the load.

☑ Engine-generator set is not in AUTO mode.

☑ Engine-generator set circuit breaker is in ON position.

☑ Automatic transfer switch has switch to the emergency (generator side).

WARNING



Rotating and moving parts during operation.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Ensure that all protective guards and covers are installed.
- Take care when working around moving belts and rotating parts near or on an operating engine-generator set.
- Do not tamper with moving or rotating parts.
- Wear close-fitting clothes and hairnet.
- Remove watches, rings and other metal objects.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE



Stopping the engine when it is running at full load subjects it to extreme thermal and mechanical stresses.
Overheating of and, therefore, damage to components is possible!
- Before shutting down the engine, allow it to idle until the engine temperatures decrease and constant levels are indicated.

Stopping the engine-generator set manually

1. If an ATS is controlling the generator, retransfer the load from the generator to the main, and execute the appropriate steps on the ATS. Refer to the manufacturer's documentation of the ATS for further information.

Result: The switch transfers the load from the generator (emergency) to the mains (normal).

2. Press the OFF push button on the digital generator set control panel.

Result: The engine stops.

3. If an electrically operated (motorized) circuit breaker is fitted, it switches off automatically.
4. If a manually operated circuit breaker is fitted, switch off the circuit breaker manually by pressing the appropriate push button.

Result: The circuit breaker is in OFF position. The engine-generator set is in OFF mode.

TIM-ID: 0000056832 - 001

5.7 Emergency stop

Preconditions

☑ Engine-generator set is running in AUTO or RUN mode.

NOTICE

An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to engine-generator set!
- Stop the engine according to the instructions in this manual.
- Initiate emergency stop only in emergency situations.

Note: The emergency stop procedure is to be controlled by an external controller (customer control system). Observe strictly the instructions of the customer control system documentation.

Emergency stop with third-party controller

▶ For the emergency stop procedure, refer to the customer control system documentation.

Emergency stop

▶ Press EMERGENCY STOP button.
Result: The engine is stopped and the alarm sounds.

After emergency stop

1. Reset the EMERGENCY STOP push button.
Result: Audible signalization stops.
2. Press ALARM SILENCE push button.
Result: Engine-generator set is in OFF mode and cannot switch on again automatically.
3. Press OFF push button.
Result: The signalization stops. The control panel is reset.
4. Execute troubleshooting.
Result: Faults which were reasons for the emergency stop must be resolved. If faults cannot be resolved, contact MTU Onsite Energy authorized Service outlet for assistance.
5. After faults are resolved, press AUTO or RUN push button, depending on desired operating mode.
Result: The engine-generator set is in standby (AUTO mode) or starts to run immediately (RUN mode).

TIM-ID: 0000056802 - 001

5.8 Exercising checks

Preconditions

☑ Engine-generator set is running and engine has reached operating temperature.

☑ Engine runs under load and at nominal speed.

DANGER



High voltage. Live components and connections.
Risk of burns or death from electric shock!
- Use extreme care when performing operational checks.

WARNING



Rotating and moving parts during operation.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Ensure that all protective guards and covers are installed.
- Take care when working around moving belts and rotating parts near or on an operating engine-generator set.
- Do not tamper with moving or rotating parts.
- Wear close-fitting clothes and hairnet.
- Remove watches, rings and other metal objects.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Note: The procedure for operational checks depends on the requirements of the particular installation and application of the engine-generator set.

Operational checks during engine-generator set operation

Item	Task
Engine-generator set	Check for abnormal running noises and vibration.
Engine-generator set control panel	Check whether the displayed operating parameters are within the limit: • For engine: oil pressure, coolant temperature, RPM, battery voltage, fuel / coolant levels, engine run time, speed • For generator: AC output voltage, current, frequency, real power (W), apparent power (VA), power factor
Air filter	Check signal ring position of service indicator (→ Page 223).
Exhaust pipework	Check exhaust color (→ Page 150).
Lube oil system	Check for oil leaks.

TIM-ID: 0000064938 - 001

Item	Task
Fuel system	Check fuel level in tank. If equipped with day tank, check for proper annunciator and alarm operation. Check pump operation. Check tank fuel line connection, tank gauges, and alarms. Check fuel lines for leaks, chafing or dry rotting.
Cooling system	Check coolant lines and connections for traces of coolant leaks. If equipped with preheater/jacket water heater, check preheater hose (→ Page 246).

TIM-ID: 0000064938 - 001

5.9 Putting the engine-generator set out of operation

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

☑ Ensure that the Mercedes-Benz OM924-926LA engine manual is available

After stopping the engine-generator set

Item	Task
Engine-generator set	Perform lockout/tagout procedure. (→ Page 18)
Cooling system	Drain engine coolant(→ Page 507) if any of the following conditions apply: • Freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive. • The engine room is not heated. • The coolant is not maintained at a suitable temperature. • The antifreeze concentration is insufficient for the engine-room temperature. • Antifreeze concentration is 50% and engine-room temperature is below -40 °C (-40 °F).
Air intake and exhaust system	Seal air and exhaust sides if the engine-generator set is to remain out of service for more than one week.
Engine-generator set	Decommission(→ Page 277) if the engine-generator set is to remain out of service for more than one month.

TIM-ID: 0000064939 - 001

6 Troubleshooting

6.1 Troubleshooting by symptoms

Engine-generator set does not start automatically / ATS will not transfer to Emergency

Component	Probable Cause	Task
ATS	Internal fault	If applicable, check ATS wiring and run ATS functional test. Refer to manufacturer documentation of the ATS.
	Timing cycle is not complete	Check "transfer to emergency" timer setting. Refer to manufacturer documentation of the ATS.
Engine	Engine start wires not correctly terminated	Contact Service.
Engine-generator set	Power supply harness unplugged	Plug in power supply harness.
	Limit switch harness unplugged	Plug in limit switch harness.
	In OFF mode	• Investigate why mode switch was set to OFF. • Switch to AUTO mode.
Engine-generator set control system	Alarm status	• If applicable, check alarm status on the customer control panel and correct fault conditions. Refer to manufacturer documentation of the customer control system. • If applicable, check alarm status on the controller and correct fault conditions. (→ Page 156)

Engine-generator set does not stop automatically / ATS will not transfer to Normal

Component	Probable Cause	Task
ATS	Internal fault	If applicable, check ATS wiring and run ATS functional test, refer to manufacturer documentation of the ATS.
	"Retransfer to normal" timing cycle not complete	Check "retransfer to normal" timer setting, refer to the manufacturer documentation of the ATS.
Engine	Engine start wires not correctly terminated	Contact Service.
Engine-generator set	In RUN mode	Investigate why mode switch was set to RUN. Switch to OFF to stop manually, unless there is a reason for not doing so.
	Normal voltage or frequency not within parameters	Check utility and utility breakers.
	Power supply harness unplugged	Plug in power supply harness.
	Limit switch harness unplugged	Plug in limit switch harness.

TIM-ID: 0000065485 - 001

Component	Probable Cause	Task
Engine-generator set control system	Internal fault	Check control system.
	Cool-down cycle	Check control system.

Engine does not turn when starter is actuated

Component	Probable Cause	Task
Starter battery	Low or damaged	Charge or replace.
	Cable connections damaged, loose, or corroded	Check cable connections for secure seating. Repair and clean, if necessary.
Engine starter	Engine wiring to starter loose	Check cable connections for secure seating.
	Starter damaged	Contact Service.
Engine wiring	Loose or damaged	Contact Service.
Engine-generator set control system	Secure seating of assemblies or connectors not provided	Check visually. Tighten, if necessary.
	Alarm status	• If applicable, check alarm status on the customer control panel and correct fault conditions. Refer to manufacturer documentation of the customer control system. • If applicable, check alarm status on the controller and correct fault conditions. (→ Page 156)
	Blown fuse	Replace blown fuse.
Engine governor	Plug-in connections are loose	Check plug-in connections. (→ Page 277)
	Damaged	Contact Service.
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Probable Cause	Task
Starter battery	Low voltage	Charge or replace.
Engine starter	Damaged	Contact Service.
Engine wiring	Loose or damaged	Contact Service.
Fuel system	Low fuel	Fill fuel tank.
	Not vented	Vent fuel system. See page 82 in Mercedes-Benz OM 904-926 LA Engine Manual.(→ Page 277)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 227) Clean filter element of fuel prefilter. (→ Page 467) Replace fuel filter.(→ Page 475)
Engine governor	Damaged	Contact Service.

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Engine fires unevenly

Component	Probable Cause	Task
Fuel injection equipment	Injector damaged	Contact Service.
Engine wiring	Loose or damaged	Contact Service.
Fuel system	Low fuel	Fill fuel tank.
	Not vented	Vent fuel system. See page 82 in Mercedes-Benz OM 904-926 LA Engine Manual. (→ Page 277)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 227) Clean filter element of fuel prefilter. (→ Page 467) Replace fuel filter.(→ Page 475)
Engine governor	Damaged	Contact Service.

Engine does not reach nominal speed

Component	Probable Cause	Task
Fuel supply	Fuel prefilter with water separator clogged	Replace filter element.(→ Page 227)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 227) Clean filter element of fuel prefilter. (→ Page 467) Replace fuel filter.(→ Page 475)
	Low fuel	Fill fuel tank.
Air supply	Air filter clogged	Check signal ring position of service indicator. (→ Page 223)
Fuel injection equipment	Injector damaged	Contact Service.
Engine wiring	Loose or damaged	Contact Service.
Engine	Overloaded	Reduce load. Contact Service.

Engine speed not steady

Component	Probable Cause	Task
Generator	Load fluctuation / imbalanced load	Rebalance system loads.
	Voltage regulator improperly calibrated or damaged	Contact Service.
Fuel injection equipment	Injector damaged	Contact Service.
Speed sensor	Damaged	Contact Service.

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Component	Probable Cause	Task
Fuel system	Not vented	Vent fuel system. See page 82 in Mercedes-Benz OM 904-926 LA Engine Manual. (→ Page 277)
	Incorrect fuel	Verify correct fuel and change, if necessary. Refer to Mercedes-Benz Specifications for Operating Fluids at https://bevo.mercedes-benz.com.
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 227) Clean filter element of fuel prefilter. (→ Page 467) Replace fuel filter.(→ Page 475)
Engine governor	Damaged	Contact Service.

Charge-air temperature too high

Component	Probable Cause	Task
Engine room	Air intake temperature too high	Check fans, air supply, ventilation ducts, and louvers.
	Air intake and outlet louvers not open	Open louvers.

Charge-air pressure too low

Component	Probable Cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator.(→ Page 223)
Exhaust turbocharger	Damaged	Contact Service.

Exhaust gas black

Component	Probable Cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator. (→ Page 223)
Fuel injection equipment	Injector damaged	Contact Service.
Fuel system	Low fuel	Fill fuel tank.
	Not vented	Vent fuel system. See page 82 in Mercedes-Benz OM 904-926 LA Engine Manual.(→ Page 277)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 227) Clean filter element of fuel prefilter. (→ Page 467) Replace fuel filter.(→ Page 475)
	Incorrect fuel	Verify correct fuel and change, if necessary. Refer to Mercedes-Benz Specifications for Operating Fluids at https://bevo.mercedes-benz.com.
Engine	Overloaded	Reduce load. Contact Service.

TIM-ID: 0000065485 - 001

Exhaust gas blue

Component	Probable Cause	Task
Engine oil	Too much oil in engine	Drain engine oil. (→ Page 429)
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Damaged	Contact Service.

Exhaust gas white

Component	Probable Cause	Task
Engine	Not at operating temperature	Run engine for 10 to 15 minutes with at least 30% load to reach operating temperature.
Fuel system	Water in fuel	Drain fuel prefilter with water separator. (→ Page 220)

No AC output voltage

Component	Probable Cause	Task
Engine-generator set control system	Voltmeter damaged	Verify output with another meter. Check meter fuses and meter. Replace meter fuses/meter, if necessary.
	Blown fuses	Check fuses and replace blown fuses.
	Secure seating of assemblies or connectors not provided	Check visually. Tighten, if necessary.
Generator	Regulator fuse blown or defective	Check fuses and replace. If voltage build-up causes fuse to blow, contact Service.
	Wiring loose or damaged	Check. (→ Page 241)
	Diodes damaged	Check rotating rectifier for damaged diodes. Contact Service.
	Regulator damaged	Contact Service.

Leakage

Component	Probable Cause	Task
Coolant system	Hoses, piping, or seals damaged Fittings damaged or loose	Identify damaged component and replace. Tighten fittings.
Fuel system	Hoses, piping, or seals damaged Fittings damaged or loose	Identify damaged component and replace. Tighten fittings.
Oil system	Hoses, piping, or seals damaged Fittings damaged or loose	Identify damaged component and replace. Tighten fittings.

Noise

Component	Probable Cause	Task
Engine-generator set	Varies	Contact Service.

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Vibration

Component	Probable Cause	Task
Engine-generator set	Varies	Contact Service.

TIM-ID: 0000065485 - 001

6.2 Fault Codes and Events on MGC Series Panels

6.2.1 Recording of fault codes on MGC Series digital control panels

The MGC Series digital control panels (referred to as the controller) monitor signals, detect status, and receive reports from all over the engine-generator set.

There are two types of messages:
- Messages created by the controller (controller events)
- Messages created in the engine governor originally and sent to the controller (engine fault codes)

MGC Series events

System events to be recorded are alarms, pre-alarms (warnings), and status messages. Depending on defined thresholds (limits), an event is classified as alarm or pre-alarm.

A pre-alarm may not require any action if the settings return to normal ranges.

Event log

An event log retains history of system events in nonvolatile memory.

30 event records are retained and each record contains a time stamp of the first and last event occurrence. The record also contains the number of occurrences for each event. In addition, each record contains details of the time, date, and engine hours for the most recent 30 occurrences of the event. The number of occurrences stops incrementing at 99.

If an event occurs which is of a type that differs from those in the 30 records in memory, the record that has the oldest "last" event occurrence is removed from the log. The new category takes its place. Since 30 event records with up to 99 occurrences each are retained in memory, a history of nearly 3,000 specific events is retained in the controller.

Detailed occurrence information is retained for the most recent 30 occurrences of each event record, and there are 30 event records; thus, the time, date, and engine hours details for up to 900 specific event occurrences are retained in the event log.

How to access the event log

The event log can be accessed in two ways:

- Use the control panel communication software to view and/or download the event log: Use the Metering Explorer, and select "Event log" to get a list of all recently occurred events.
- Navigate in the front panel display to Metering → Alarms-Status → Event Log.
  1. Use the up/down arrow buttons to highlight an event.
  2. Press the right-arrow button to view the summary of that event record.
     The summary contains the description of the event, date, time, and engine hours of the first occurrence of the event, along with date, time, and engine hours of the most recent occurrence of the event.
  3. Press the down-arrow button until DETAILS is highlighted and then press the right-arrow button to view details of specific event occurrences.
  4. The occurrence number can be changed by pressing the Edit button, up/down arrow buttons to select the number, and pressing the Edit button again to exit.

List of events in alphabetical order

The event list shows possible events in alphabetical order. (→ Page 158)

In the list, each event description is built of the following parts:

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- Short display text
- Long display text
- Event type and fault result
- Appearance in the event log
- Cause
- Corrective action

Note: The letter "x" in some texts is a placeholder for a number between 1 and a maximum value. The section "Cause" of each concerned event description contains that maximum value, e.g. "8" in the term "x = 1 to 8".

Engine fault codes

The controller displays the active engine fault codes issued by the engine governor. Each fault code appears on the controller display with fault number and short fault text.

If the controller does not have descriptive information about a fault code that was received from the engine governor, the fault text displays "NO TEXT AVAILABLE."

How to access the fault codes list

Engine fault codes can be accessed in two ways:

- Use the control panel communication software to view and/or download the J1939 fault codes list: Use the Metering Explorer to expand the "J1939" tree.
- Navigate in the front panel display to Metering → Alarms-Status → J1939 Fault Codes

List of J1939 engine fault codes in numerical order

The J1939 fault codes list shows possible fault codes in numerical order. (→ Page 255)

Each item in the list is built of the following parts:

- Fault code
- Fault location
- Fault description
- Remedial action
- Pin

Detailed information

For a detailed description of the communication software, contact your local MTU Onsite Energy distributor or dealer.

For a detailed description of the controller display operations, refer to (→ Page 68).

General note

In the description of fault codes and messages, the terms "sender" and "sensor" are used as synonyms.

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6.2.2 List of fault codes on MGC Series digital control panels in alphabetical order

27-1 UNDVOLT TRP

27-1 Undervoltage trip

Pre-Alarm

Appearance in event log: 27-1 UNDVOLT TRP P

Cause	Corrective action
Generator voltage is lower than the 27-1 Undervoltage limit in at least one phase, and 27-1 Undervoltage element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause low voltage conditions.

27-1 UNDVOLT TRP

27-1 Undervoltage trip

Alarm – causes machine shutdown

Appearance in event log: 27-1 UNDVOLT TRP A

Cause	Corrective action
Generator voltage is lower than the 27-1 Undervoltage limit in at least one phase, and 27-1 Undervoltage element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause low voltage conditions.

27-2 UNDVOLT TRP

27-2 Undervoltage trip

Pre-Alarm

Appearance in event log: 27-2 UNDVOLT TRP P

Cause	Corrective action
Generator voltage is lower than the 27-2 Undervoltage limit in at least one phase, and 27-2 Undervoltage element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause low voltage conditions.

27-2 UNDVOLT TRP

27-2 Undervoltage trip

Alarm – causes machine shutdown

Appearance in event log: 27-2 UNDVOLT TRP A

Cause	Corrective action
Generator voltage is lower than the 27-2 Undervoltage limit in at least one phase, and 27-2 Undervoltage element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause low voltage conditions.

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32 RVS PWR TRP

32 Reverse power protection trip

Pre-Alarm

Appearance in event log: 32 RVS PWR TRP P

Cause	Corrective action
Generator is absorbing power at a level higher than the 32 Reverse power protection limit, and 32 Reverse power protection element has been configured as pre-alarm.	1. Check the polarity of all potential transformers and current transformers used on the machine. 2. Check load sharing circuitry and components, and verify all machines in a load share system correctly receive generator breaker status. 3. If the machine is paralleled to the utility, make sure the Parallel to Mains Logic element is driven correctly.

32 RVS PWR TRP

32 Reverse power protection trip

Alarm – causes machine shutdown

Appearance in event log: 32 RVS PWR TRP A

Cause	Corrective action
Generator is absorbing power at a level higher than the 32 Reverse power protection limit, and 32 Reverse power protection element has been configured as alarm.	1. Check the polarity of all potential transformers and current transformers used on the machine. 2. Check load sharing circuitry and components, and verify all machines in a load share system correctly receive generator breaker status. 3. If the machine is paralleled to the utility, make sure the Parallel to Mains Logic element is driven correctly.

40 EXC LOSS TRP

40 Loss of excitation (reverse VAr) protection trip

Pre-Alarm

Appearance in event log: 40 EXC LOSS TRP P

Cause	Corrective action
Generator is absorbing power at a level higher than the 40 Loss of excitation protection limit, and 40 Loss of excitation protection element has been configured as pre-alarm.	1. Check the system wiring and the system voltage regulator. 2. Verify the voltage regulator is in droop or cross-current mode for VAr sharing on island systems. 3. Verify all the contact inputs to the voltage regulator are correctly received. 4. Check the voltage regulator settings and programming.

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40 EXC LOSS TRP

40 Loss of excitation (reverse VAr) protection trip

Alarm – causes machine shutdown

Appearance in event log: 40 EXC LOSS TRP A

Cause	Corrective action
Generator is absorbing power at a level higher than the 40 Loss of excitation protection limit, and 40 Loss of excitation protection element has been configured as alarm.	1. Check the system wiring and the system voltage regulator. 2. Verify the voltage regulator is in droop or crosscurrent mode for VAr sharing on island systems. 3. Verify all the contact inputs to the voltage regulator are correctly received. 4. Check the voltage regulator settings and programming.

47 PHS IMBAL TRP

47 Phase imbalance protection trip

Pre-Alarm

Appearance in event log: 47 PHS IMBAL TRP P

Cause	Corrective action
Generator in generator line to line voltages between phases is greater than the 47 Phase imbalance protection limit, and 47 Phase imbalance protection element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check load for the cause of phase imbalance. Loss of one leg of the wiring from machine to load could cause this situation.

47 PHS IMBAL TRP

47 Phase imbalance protection trip

Alarm – causes machine shutdown

Appearance in event log: 47 PHS IMBAL TRP A

Cause	Corrective action
Generator in generator line to line voltages between phases is greater than the 47 Phase imbalance protection limit, and 47 Phase imbalance protection element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check load for the cause of phase imbalance. Loss of one leg of the wiring from machine to load could cause this situation.

TIM-ID: 0000065425 - 001

51-1 OVRCURR TRP

51-1 Overcurrent protection trip

Pre-Alarm

Appearance in event log: 51-1 OVRCURR TRP P

Cause	Corrective action
Generator current is higher than the 51-1 overcurrent limit in at least one phase, and 51-1 overcurrent element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check load sharing devices in multiple generator applications. 4. Check load for source of overcurrent condition.

51-1 OVRCURR TRP

51-1 Overcurrent protection trip

Alarm – causes machine shutdown

Appearance in event log: 51-1 OVRCURR TRP A

Cause	Corrective action
Generator current is higher than the 51-1 Overcurrent limit in at least one phase, and 51-1 Overcurrent element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check load sharing devices in multiple generator applications. 4. Check load for source of overcurrent condition.

51-2 OVRCURR TRP

51-2 Overcurrent protection trip

Pre-Alarm

Appearance in event log: 51-2 OVRCURR TRP P

Cause	Corrective action
Generator current is higher than the 51-2 Overcurrent limit in at least one phase, and 51-2 Overcurrent element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check load sharing devices in multiple generator applications. 4. Check load for source of overcurrent condition.

51-2 OVRCURR TRP

51-2 Overcurrent protection trip

Alarm – causes machine shutdown

Appearance in event log: 51-2 OVRCURR TRP A

Cause	Corrective action
Generator current is higher than the 51-2 Overcurrent limit in at least one phase, and 51-2 Overcurrent element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check load sharing devices in multiple generator applications. 4. Check load for source of overcurrent condition.

TIM-ID: 0000065425 - 001

59-1 OVRVOLT TRP

59-1 Overvoltage trip

Pre-Alarm

Appearance in event log: 59-1 OVERVOLT TRP P

Cause	Corrective action
Generator voltage is higher than the 59-1 Overvoltage limit in at least one phase, and 59-1 Overvoltage element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause high voltage conditions.

59-1 OVRVOLT TRP

59-1 Overvoltage trip

Alarm – causes machine shutdown

Appearance in event log: 59-1 OVERVOLT TRP A

Cause	Corrective action
Generator voltage is higher than the 59-1 Overvoltage limit in at least one phase, and 59-1 Overvoltage element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause high voltage conditions.

59-2 OVRVOLT TRP

59-2 Overvoltage trip

Pre-Alarm

Appearance in event log: 59-2 OVERVOLT TRP P

Cause	Corrective action
Generator voltage is higher than the 59-2 Overvoltage limit in at least one phase, and 59-2 Overvoltage element has been configured as pre-alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause high voltage conditions.

59-2 OVRVOLT TRP

59-2 Overvoltage trip

Alarm – causes machine shutdown

Appearance in event log: 59-2 OVERVOLT TRP A

Cause	Corrective action
Generator voltage is higher than the 59-2 Overvoltage limit in at least one phase, and 59-2 Overvoltage element has been configured as alarm.	1. Check generator wiring (→ Page 241). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause high voltage conditions.

TIM-ID: 0000065425 - 001

78 VECTOR SHIFT TRIP

78 Vector shift protection trip

Pre-Alarm

Appearance in event log: 78 VECTOR SHIFT TRIP P

Cause	Corrective action
A phase shift in the generator voltage is detected (this often occurs when the grid is lost), and 78 Vector shift element has been configured as alarm.	1. Check vector shift setting. 2. Check mains voltage. 3. Check engine governor.

78 VECTOR SHIFT TRIP

78 Vector shift protection trip

Alarm – causes machine shutdown

Appearance in event log: 78 VECTOR SHIFT TRIP A

Cause	Corrective action
A phase shift in the generator voltage is detected (this often occurs when the grid is lost), and 78 Vector shift element has been configured as pre-alarm.	1. Check vector shift setting. 2. Check mains voltage. 3. Check engine governor.

81 ROC DF/DT TRIP

81 Rate of change of frequency protection trip

Pre-Alarm

Appearance in event log: 81ROC DF/DT TRIP P

Cause	Corrective action
A sudden change of load occurs, the pickup setting is reached and the activation delay has expired, and 81 ROC DF/DT has been configured as pre-alarm.	1. Check ROCOF setting. 2. Check engine governor.

81 ROC DF/DT TRIP

81 Rate of change of frequency protection trip

Alarm – causes machine shutdown

Appearance in event log: 81 ROC DF/DT TRIP P A

Cause	Corrective action
A sudden change of load occurs, the pickup setting is reached and the activation delay has expired, and 81 ROC DF/DT has been configured as alarm.	1. Check ROCOF setting. 2. Check engine governor.

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81O OVRFREQ TRP

81-O Overfrequency trip

Pre-Alarm

Appearance in event log: 81O OVRFREQ TRP P

Cause	Corrective action
Generator frequency is higher than the 81-O Overfrequency limit, and 81-O Overfrequency element has been configured as pre-alarm.	1. Check the rated frequency setting. 2. Check speed bias into the engine governor. 3. Check engine governor. 4. Check any load sharing devices in multiple generator applications.

81O OVRFREQ TRP

81-O Overfrequency trip

Alarm – causes machine shutdown

Appearance in event log: 81O OVRFREQ TRP A

Cause	Corrective action
Generator frequency is higher than the 81-O Overfrequency limit, and 81-O Overfrequency element has been configured as alarm.	1. Check the rated frequency setting. 2. Check speed bias into the engine governor. 3. Check engine governor. 4. Check any load sharing devices in multiple generator applications.

81U UNDFREQ TRP

81-U Underfrequency trip

Pre-Alarm

Appearance in event log: 81U UNDFREQ TRP P

Cause	Corrective action
Generator frequency is lower than the 81-U Underfrequency limit, and 81-U Underfrequency element has been configured as pre-alarm	1. Check the rated frequency setting. 2. Check speed bias into the engine governor. 3. Check engine governor. 4. Check any load sharing devices in multiple generator applications.

81U UNDFREQ TRP

81-U Underfrequency trip

Alarm – causes machine shutdown

Appearance in event log: 81U UNDFREQ TRP A

Cause	Corrective action
Generator frequency is lower than the 81-U Underfrequency limit, and 81-U Underfrequency element has been configured as alarm.	1. Check the rated frequency setting. 2. Check speed bias into the engine governor. 3. Check engine governor. 4. Check any load sharing devices in multiple generator applications.

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AEM COMM FAIL

Analog Expansion Module communications failure

Pre-Alarm

Appearance in event log: AEM COMM FAIL P

Cause	Corrective action
Analog Expansion Module (AEM) communications failure	1. Check that the AEM is powered when communication is expected. 2. Check CAN bus wiring from AEM to the controller-2020. 3. Check that a 120 Ω termination resistors (one on each end if the main wire, two total) are in place.

AEM OUTx OUT RNG

Analog Expansion Module output x is out of range

Status

Programmable string; default appearance in event log: AEM OUTx OUT RNG

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Analog Expansion Module (AEM) output x (x = 1 to 4) is out of range.	1. Check the parameter which drives the analog output, and verify that the parameter is within its valid range. 2. Check that the range used in mapping the parameter range to the analog output range is correct.

AEM OUTx OUT RNG

Analog Expansion Module output x is out of range

Pre-Alarm

Programmable string; default appearance in event log: AEM OUTx OUT RNG P

Cause	Corrective action
Analog Expansion Module (AEM) output x (x = 1 to 4) is out of range.	1. Check the parameter which drives the analog output, and verify that the parameter is within its valid range. 2. Check that the range used in mapping the parameter range to the analog output range is correct.

AEM OUTx OUT RNG

Analog Expansion Module output x is out of range

Alarm – causes machine shutdown

Programmable string; default appearance in event log: AEM OUTx OUT RNG A

Cause	Corrective action
Analog Expansion Module (AEM) output x (x = 1 to 4) is out of range.	1. Check the parameter which drives the analog output, and verify that the parameter is within its valid range. 2. Check that the range used in mapping the parameter range to the analog output range is correct.

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ALG IN x O1

Analog input x over limit 1

Status

Programmable string; default appearance in event log: ALG IN x_O1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for analog input x (x = 1 to 8) is over limit 1.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

ALG IN x O1

Analog input x over limit 1

Pre-Alarm

Programmable string; default appearance in event log: ALG IN x_O1 P

Cause	Corrective action
Analog input x (x = 1 to 8) over limit 1 has been programmed as a pre-alarm, and limit 1 has been exceeded.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

ALG IN x O1

Analog input x over limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: ALG IN x_O1 A

Cause	Corrective action
Analog input x (x = 1 to 8) over limit 1 has been programmed as an alarm, and limit 1 has been exceeded.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

ALG IN x O2

Analog input x over limit 2

Status

Programmable string; default appearance in event log: ALG IN x_O2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for analog input x (x = 1 to 8) is over limit 2.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

ALG IN x O2

Analog input x over limit 2

Pre-Alarm

Programmable string; default appearance in event log: ALG IN x_O2 P

Cause	Corrective action
Analog input x (x = 1 to 8) over limit 2 has been programmed as a pre-alarm, and limit 2 has been exceeded.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

ALG IN x O2

Analog input x over limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: ALG IN x_O2 A

Cause	Corrective action
Analog input x (x = 1 to 8) over limit 2 has been programmed as an alarm, and limit 2 has been exceeded.	1. Check the external device which drives the analog input and caused the limit to be exceeded. 2. Take any necessary action.

ALG IN x OOR

Analog input x out of range

Status

Programmable string; default appearance in event log: ALG IN x_OOR

Cause	Corrective action
Status indication on the front panel, and control panel communication software for analog input x (x = 1 to 8) is out of range.	1. Check the external device which drives the analog input and went outside the valid range. 2. Take any necessary action. 3. Verify the range programmed for the external device is correct for the application.

ALG IN x OOR

Analog input x out of range

Pre-Alarm

Programmable string; default appearance in event log: ALG IN x_OOR P

Cause	Corrective action
Analog input x (x = 1 to 8) out of range has been programmed as a pre-alarm, and the input is outside the valid range.	1. Check the external device which drives the analog input and went outside the valid range. 2. Take any necessary action. 3. Verify the range programmed for the external device is correct for the application.

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ALG IN x OOR

Analog input x out of range

Alarm – causes machine shutdown

Programmable string; default appearance in event log: ALG IN x_OOR A

Cause	Corrective action
Analog input x (x = 1 to 8) out of range has been programmed as an alarm, and the input is less than the limit.	1. Check the external device which drives the analog input and went outside the valid range. 2. Take any necessary action. 3. Verify the range programmed for the external device is correct for the application.

ALG IN x U1

Analog input x under limit 1

Status

Programmable string; default appearance in event log: ALG IN x_U1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for analog input x (x = 1 to 8) is under limit 1.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

ALG IN x U1

Analog input x under limit 1

Pre-Alarm

Programmable string; default appearance in event log: ALG IN x_U1 P

Cause	Corrective action
Analog input x (x = 1 to 8) under limit 1 has been programmed as a pre-alarm, and the input is less than limit 1.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

ALG IN x U1

Analog input x under limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: ALG IN x_U1 A

Cause	Corrective action
Analog input x (x = 1 to 8) under limit 1 has been programmed as an alarm, and the input is less than limit 1.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

ALG IN x U2

Analog input x under limit 2

Status

Programmable string; default appearance in event log: ALG IN x_U2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for analog input x (x = 1 to 8) is under limit 2.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

ALG IN x U2

Analog input x under limit 2

Pre-Alarm

Programmable string; default appearance in event log: ALG IN x_U2 P

Cause	Corrective action
Analog input x (x = 1 to 8) under limit 2 has been programmed as a pre-alarm, and the input is less than limit 2.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

ALG IN x U2

Analog input x under limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: ALG IN x_U2 A

Cause	Corrective action
Analog input x (x = 1 to 8) under limit 2 has been programmed as an alarm, and the input is less than limit 2.	1. Check the external device which drives the analog input and went below the underlimit setting. 2. Take any necessary action.

ATS INPUT CLOSED

ATS input closed

Status

Appearance in event log: ATS INPUT CLOSED

Cause	Corrective action
The contact used for the Automatic Transfer Switch (ATS) input has closed.	▶ (none)

TIM-ID: 0000065425 - 001

AUTO RESTART

Automatic restart in progress

Status

Appearance in event log: AUTO RESTART

Cause	Corrective action
Automatic restart in progress	▶ (none)

AUTO RESTART FAIL

Automatic restart failure

Alarm – causes machine shutdown

Appearance in event log: AUTO RESTART FAIL A

Cause	Corrective action
The automatic restart feature is enabled. The controller cleared the generator faults and tried to restart the programmed number of times, but could not restart. Most likely there are other alarms active at the same time.	1. Check the alarm list and the event log to find what alarms are preventing the unit from restarting. 2. Correct the conditions indicated by those alarms.

BATT CHRG FAIL

Battery charger failure

Pre-Alarm

Appearance in event log: BATT CHRG FAIL P

Cause	Corrective action
The contact input to which the battery charger failure programmable function has been assigned has been turned on, and battery charger failure has been configured as pre-alarm.	▶ Check the battery charger and battery charger fail detection devices and wiring.

BATT CHRG FAIL

Battery charger failure

Alarm – causes machine shutdown

Appearance in event log: BATT CHRG FAIL A

Cause	Corrective action
The contact input to which the battery charger failure programmable function has been assigned has been turned on, and battery charger failure has been configured as alarm.	▶ Check the battery charger and battery charger fail detection devices and wiring.

TIM-ID: 0000065425 - 001

BATT OVERVOLT

Battery overvoltage

Pre-Alarm

Appearance in event log: BATT OVERVOLT P

Cause	Corrective action
The battery voltage is above the limit set for the battery overvoltage pre-alarm.	1. Check the battery charging circuit and correct any conditions which could cause overcharging. 2. Check the battery voltage level setting for rated battery voltage in the controller. Ensure it matches a range appropriate for the nominal battery voltage.

BATTLE OVERRIDE

Battle override

Pre-Alarm

Appearance in event log: BATTLE OVERRIDE P

Cause	Corrective action
Battle override (shutdown override) – all engine and generator protection is bypassed.	▶ Remove the battle override to resume normal operation of engine and generator protection.

CEM COMM FAIL

Contact Expansion Module (CEM) communications failure

Pre-Alarm

Appearance in event log: CEM COMM FAIL P

Cause	Corrective action
Contact Expansion Module (CEM) communications failure	1. Check that the CEM is powered when communication is expected. 2. Check CAN bus wiring from CEM to controller. 3. Check that a 120 Ω termination resistors (one on each end if the main wire, two total) are in place.

CEM HW MISMATCH

CEM hardware mismatch

Pre-Alarm

Appearance in event log: CEM HW MISMATCH P

Cause	Corrective action
The number of outputs on the Contact Expansion Module (CEM) communicating with the controller does not match the number of CEM outputs programmed as a setting in the controller.	1. Check the number of outputs on the CEM. 2. Correct the setting for the number of CEM outputs.

TIM-ID: 0000065425 - 001

CHECKSUM FAIL

Checksum failure

Pre-Alarm

Appearance in event log: CHECKSUM FAIL P

Cause	Corrective action
The controller has detected a checksum error in internal memory. This can happen after flashing new firmware and/or language files into a controller, for example.	1. Push the RESET button on the front panel, or power cycle the controller. 2. If the pre-alarm occurs each time the controller is powered up, contact Service.

CONF PROT x

Configurable protection element x

Status

Programmable string; default appearance in event log: CONF PROT x

Cause	Corrective action
Status indication on the front panel, and control panel communication software for configurable protection element x (x = 1 to 8) is out of programmed range.	1. Check the parameter which caused the limit to be exceeded. 2. Take any necessary action.

CONF PROT x

Configurable protection element x

Pre-Alarm

Programmable string; default appearance in event log: CONF PROT x P

Cause	Corrective action
Configurable Protection element x (x = 1 to 8) has been programmed as a pre-alarm, and the programmed range has been exceeded.	1. Check the parameter which caused the limit to be exceeded. 2. Take any necessary action.

CONF PROT x

Configurable protection element x

Alarm – causes machine shutdown

Programmable string; default appearance in event log: CONF PROT x A

Cause	Corrective action
Configurable Protection element x (x = 1 to 8) has been programmed as a pre-alarm, and the programmed range has been exceeded.	1. Check the parameter which caused the limit to be exceeded. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

CONFIG ELEMENT x

Configurable element x

Pre-Alarm

Programmable string; default appearance in event log: CONF ELEMENT x P

Cause	Corrective action
Configurable element x (x = 1 to 8) has been programmed as a pre-alarm, and the input to the element in the PLC logic is true.	1. Check the logic in the PLC logic which is driving the input of the configurable element. 2. Take any necessary corrective action.

CONFIG ELEMENT x

Configurable element x

Alarm – causes machine shutdown

Programmable string; default appearance in event log: CONF ELEMENT x A

Cause	Corrective action
Configurable element x (x = 1 to 8) has been programmed as an alarm, and the input to the element in the PLC logic is true.	1. Check the logic in the PLC logic which is driving the input of the configurable element. 2. Take any necessary corrective action.

COOL LVL SNDR FL

Coolant level sender fail

Alarm – causes machine shutdown

Appearance in event log: COOL LVL SNDR FL A

Cause	Corrective action
The coolant level sender has failed.	▶ Check coolant level sender and replace, if necessary.

COOL SNDR FAIL

Coolant temperature sender fail

Status

Appearance in event log: COOL SNDR FAIL

Cause	Corrective action
The input from the sender is outside the valid range for the device.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

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COOL SNDR FAIL

Coolant temperature sender fail

Pre-Alarm

Appearance in event log: COOL SNDR FAIL P

Cause	Corrective action
The input from the sender is outside the valid range for the device, and the coolant temperature sender fail is configured as pre-alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

COOL SNDR FAIL

Coolant temperature sender fail

Alarm – causes machine shutdown

Appearance in event log: COOL SNDR FAIL A

Cause	Corrective action
The input from the sender is outside the valid range for the device, and the coolant temperature sender fail is configured as alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

DEMAND START

Demand Start request

Status

Appearance in event log: DEMAND START

Cause	Corrective action
An automatic machine start due to system demand has occurred.	▶ (none)

DEMAND STOP

Demand Stop request

Status

Appearance in event log: DEMAND STOP

Cause	Corrective action
An automatic machine stop due to system demand has occurred.	▶ (none)

TIM-ID: 0000065425 - 001

MGC HEARTBEAT FAIL

MGC heartbeat failure

Pre-Alarm

Appearance in event log: MGC HEARTBEAT FAIL P

Cause	Corrective action
An I/O module has lost the heartbeat from the controller.	1. Verify all CAN bus communications cables are in place, properly wired, and properly terminated. 2. Check that the I/O modules that are present in the system are enabled in the controller Settings. 3. Check the I/O modules to be sure they are powered up and functioning.

DIAG TRBL CODE

Diagnostic trouble codes

Pre-Alarm

Appearance in event log: DIAG TRBL CODE P

Cause	Corrective action
Diagnostic trouble codes have been received from the engine governor.	1. Check the meaning of the reported diagnostic codes in the engine documentation, or contact Service. 2. Remedy the issues reported by the diagnostic codes.

DIAL OUT FAILED

Modem dial out Failure

Status

Appearance in event log: DIAL OUT FAILED

Cause	Corrective action
Modem dial out has failed.	1. Check phone lines and phone connection. 2. Verify dial out phone numbers are correct. 3. Check that the pager ID is correct.

DIAL OUT SUCCESS

Modem dial out success

Status

Appearance in event log: DIAL OUT SUCCESS

Cause	Corrective action
Modem dial out has successfully accomplished.	1. Check phone lines and phone connection. 2. Verify dial out phone numbers are correct. 3. Check that the pager ID is correct.

TIM-ID: 0000065425 - 001

ECU SHUTDOWN

Shutdown by ECU

Alarm – causes machine shutdown, but presumably, it has shut down due to an unknown cause before this is announced

Appearance in event log: ECU SHUTDOWN A

Cause	Corrective action
The engine stopped, but the controller did not knowingly cause the stop. The assumed source of the stop is the engine governor, so, an engine governor shutdown alarm is announced.	▶ Check the engine governor for data indicating the cause of the shutdown.

EMERGENCY STOP

Emergency stop

Alarm – causes machine shutdown

Appearance in event log: EMERGENCY STOP A

Cause	Corrective action
The emergency stop input has opened.	1. Release the EMERGENCY STOP button. 2. If the alarm will not clear when the OFF button is pressed, check the wiring of the emergency stop circuit and verify that when the switch is not pushed or closed, there is a short circuit between terminals 46 and 47. There should be an open circuit between terminals 46 and 47 when the EMERGENCY STOP switch is pushed or is open.

ENG KW OVRLD-1

Engine kW overload 1

Pre-Alarm

Appearance in event log: ENG KW OVRLD-1 P

Cause	Corrective action
The kW output of the generator is above the limit for the kW overload 1 protection element.	1. Check generator wiring, machine configuration, load sharing devices in multiple generator applications and the load. 2. Shed some load, if necessary.

ENG KW OVRLD-2

Engine kW overload 2

Pre-Alarm

Appearance in event log: ENG KW OVRLD-2 P

Cause	Corrective action
The kW output of the generator is above the limit for the kW overload 2 protection element.	1. Check generator wiring, machine configuration, load sharing devices in multiple generator applications and the load. 2. Shed some load, if necessary.

TIM-ID: 0000065425 - 001

ENG KW OVRLD-3

Engine kW overload 3

Pre-Alarm

Appearance in event log: ENG KW OVRLD-3 P

Cause	Corrective action
The kW output of the generator is above the limit for the kW overload 3 protection element.	1. Check generator wiring, machine configuration, load sharing devices in multiple generator applications and the load. 2. Shed some load, if necessary.

ENGINE RUNNING

Engine running

Status

Appearance in event log: ENGINE RUNNING

Cause	Corrective action
The engine governor has determined the engine is running and sends the status to the controller.	▶ (none)

FUEL LEAK 1

Fuel leak 1

Pre-Alarm

Appearance in event log: FUEL LEAK 1

Cause	Corrective action
The engine governor has sent a FUEL LEAK 1 indication to the controller.	1. Check the fuel tanks and fuel lines for leakage. 2. Check the fuel leak detect sensor, and verify if fuel is actually present on the sensor.

FUEL LEAK 2

Fuel leak 2

Pre-Alarm

Appearance in event log: FUEL LEAK 2

Cause	Corrective action
The engine governor has sent a FUEL LEAK 2 indication to the controller.	1. Check the fuel tanks and fuel lines for leakage. 2. Check the fuel leak detect sensor, and verify if fuel is actually present on the sensor.

TIM-ID: 0000065425 - 001

FUEL LEAK DETECT

Fuel leak detect

Pre-Alarm

Appearance in event log: FUEL LEAK DETECT P

Cause	Corrective action
The contact input to which the fuel leak detect programmable function has been assigned has been turned on, and fuel leak detect has been configured as a pre-alarm.	1. Check the fuel tanks and fuel lines for leakage. 2. Check the fuel leak detect sensor, and verify if fuel is actually present on the sensor.

FUEL LEAK DETECT

Fuel leak detect

Alarm – causes machine shutdown

Appearance in event log: FUEL LEAK DETECT A

Cause	Corrective action
The contact input to which the fuel leak detect programmable function has been assigned has been turned on, and fuel leak detect has been configured as alarm.	1. Check the fuel tanks and fuel lines for leakage. 2. Check the fuel leak detect sensor, and verify if fuel is actually present on the sensor.

FUEL LEVL SENDR

Fuel level sender fail

Pre-Alarm

Appearance in event log: FUEL LEVL SENDR P

Cause	Corrective action
The input from the sender is outside the valid range for the device, and the fuel level sender fail is configured as pre-alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

FUEL LEVL SENDR

Fuel level sender fail

Alarm – causes machine shutdown

Appearance in event log: FUEL LEVL SENDR A

Cause	Corrective action
The input from the sender is outside the valid range for the device and the fuel level sender fail is configured as alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

TIM-ID: 0000065425 - 001

FUEL LEVL SENDR FAIL

Fuel level sender fail

Status

Appearance in event log: FUEL LEVL SENDR

Cause	Corrective action
The input from the sender is outside the valid range for the device.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

GEN TEST LOADED

Generator exerciser test with load

Status

Appearance in event log: GEN TEST LOADED

Cause	Corrective action
The generator exerciser has started a test run session with the breaker closed.	▶ (none)

GEN TEST UNLOADED

Generator exerciser test without load

Status

Appearance in event log: GEN TEST UNLOADED

Cause	Corrective action
The generator exerciser has started a test run session with the breaker open.	▶ (none)

GLBL SNDR FAIL

Global sender fail

Alarm – causes machine shutdown

Appearance in event log: GLBL SNDR FAIL A

Cause	Corrective action
A sender has failed, and the sender fail detection for the failed sender is configured as alarm.	1. Consult the alarms status to determine which sender has failed. 2. Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

TIM-ID: 0000065425 - 001

GN BKR CL FL

Generator breaker close failure

Pre-Alarm

Appearance in event log: GN BKR CL FL P

Cause	Corrective action
The controller has issued a breaker close output, but the breaker status has not reported the breaker closed within the time allowed by the Breaker Close Wait time.	1. This is a latched pre-alarm and can be cleared only by pushing the RESET button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. 4. Verify the breaker is receiving open and close commands from the controller. 5. If pulsed breaker commands are employed, make sure the pulse is long enough for the breaker to change states. Consider lengthening the Breaker Close Wait time.

GN BKR OP FL

Generator breaker open failure

Pre-Alarm

Appearance in event log: GN BKR OP FL P

Cause	Corrective action
The controller has issued a breaker open output, but the breaker status has not reported the breaker open within the time allowed by the Breaker Close Wait time.	1. This is a latched pre-alarm and can be cleared only by pushing the RESET button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. 4. Verify the breaker is receiving open and close commands from the controller. 5. If pulsed breaker commands are employed, make sure the pulse is long enough for the breaker to change states. Consider lengthening the Breaker Close Wait time.

GN BKR SYN FL

Generator breaker synchronization failure

Pre-Alarm

Appearance in event log: GN BKR SYN FL P

Cause	Corrective action
The Synchronizer Fail Activation Delay timer expired while the generator was trying to synchronizer and close the generator breaker.	1. This is a latched pre-alarm and can be cleared only by pushing the RESET button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. 4. Consider lengthening the Synchronizer Fail Activation Delay. 5. Check speed controller tuning, re-tune to make it more aggressive, if possible.

TIM-ID: 0000065425 - 001

HI COOLANT TMP

High coolant temperature

Pre-Alarm

Appearance in event log: HI COOLANT TMP P

Cause	Corrective action
The engine coolant temperature is above the limit set for the high coolant temperature pre-alarm.	1. Check engine thermostat. 2. Check engine coolant level. 3. Check that coolant pump is operating properly. 4. Check radiator and coolant passages for obstructions.

HI COOLANT TMP

High coolant temperature

Alarm – causes machine shutdown

Appearance in event log: HI COOLANT TMP A

Cause	Corrective action
The engine coolant temperature is above the limit set for the High coolant temperature alarm.	1. Check engine thermostat. 2. Check engine coolant level. 3. Check that coolant pump is operating properly. 4. Check radiator and coolant passages for obstructions.

HIGH FUEL LEVEL

High fuel level

Pre-Alarm

Appearance in event log: HIGH FUEL LEVEL P

Cause	Corrective action
The fuel level reading is above the level specified in the High fuel level pre-alarm element.	1. Avoid overfilling tank. 2. If an automatic fuel pump is used to fill the tank, check the fuel pump and associated wiring and verify pump shuts off when it should.

ID MISSING

LSM-2020 ID missing

Pre-Alarm

Appearance in event log: ID MISSING P

Cause	Corrective action
The controller is not detecting one or more machines that have been specified to be present on the inter-genset communications network.	1. Verify other generators are on line. 2. Check network cabling and components for network issues. 3. Verify that all devices on the network are industrially rated designed to comply with IEC 61000-4 series of specifications. 4. As a last resort, power cycle the LSM, and the network devices to see if communications is restored. 5. Check the I/O modules to be sure they are powered up and functioning. 6. Check the settings for the expected generator sequencing IDs and check it against the sequencing IDs of the actual machines.

TIM-ID: 0000065425 - 001

ID REPEAT

LSM-2020 ID repeated

Pre-Alarm

Appearance in event log: ID REPEAT P

Cause	Corrective action
The controller detects more than on machine with the same sequencing ID.	1. Verify other generators are on line. 2. Check the sequencing ID in each unit, and verify all are unique. This is necessary for network integrity even if sequencing is not enabled. 3. Check network cabling and components for network issues. 4. Verify that all devices on the network are industrially rated designed to comply with IEC 61000-4 series of specifications.

INPUT x

Contact input x (programmable)

Pre-Alarm

Programmable string; default appearance in event log: INPUT x P

Cause	Corrective action
Contact input x (x = 1 to 40) has been programmed as a pre-alarm, and the input has been triggered.	1. Check the external device which triggered the input. 2. Take any necessary action.

INPUT x

Contact input x (programmable)

Alarm – causes machine shutdown

Programmable string; default appearance in event log: INPUT x A

Cause	Corrective action
Contact input x (x = 1 to 40) has been programmed as an alarm, and the input has been triggered.	1. Check the external device which triggered the input. 2. Take any necessary action.

LOGIC OUTPUT

Logic output pre-alarm

Pre-Alarm

Appearance in event log: LOGIC OUTPUT P

Cause	Corrective action
The PLC logic in the controller is setting the logic pre-alarm PLC logic element to true.	1. Check the logic in the controller that drives the logic pre-alarm PLC logic element. 2. Correct the conditions that caused the logic pre-alarm PLC logic element to be triggered.

TIM-ID: 0000065425 - 001

LOGIC OUTPUT

Logic output alarm

Alarm – causes machine shutdown

Appearance in event log: LOGIC OUTPUT A

Cause	Corrective action
The PLC logic in the controller is setting the logic alarm PLC logic element to true.	1. Check the logic in the controller that drives the logic alarm PLC logic element. 2. Correct the conditions that caused the logic alarm PLC logic element to be triggered.

LOSS OF VOLT

Voltage sensing failure

Status

Appearance in event log: LOSS OF VOLT

Cause	Corrective action
The generator is not sensing voltage on at least one phase where voltage should be present.	1. Check machine wiring and potential transformer wired. 2. Check the load for conditions which would cause a low voltage reading on one or more phases.

LOSS OF VOLT

Voltage sensing failure

Pre-Alarm

Appearance in event log: LOSS OF VOLT P

Cause	Corrective action
The generator is not sensing voltage on at least one phase where voltage should be present and the voltage sensing failure element is configured as pre-alarm.	1. Check machine wiring and potential transformer wired. 2. Check the load for conditions which would cause a low voltage reading on one or more phases.

LOSS OF VOLT

Voltage sensing failure

Alarm – causes machine shutdown

Appearance in event log: LOSS OF VOLT A

Cause	Corrective action
The generator is not sensing voltage on at least one phase where voltage should be present and the voltage sensing failure element is configured as alarm.	1. Check machine wiring and potential transformer wired. 2. Check the load for conditions which would cause a low voltage reading on one or more phases.

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LOSS REM COMS

Loss of module communication fail

Pre-Alarm

Appearance in event log: LOSS REM COMS P

Cause	Corrective action
Loss of remote module communications string used in event log and/or alarm and pre-alarm annunciation (not used at this time).	▶ (none)

LOST ECU COMM

Loss of ECU communications

Pre-Alarm

Appearance in event log: LOST ECU COMM P

Cause	Corrective action
Communications with the engine governor is lost when it is pulsed or while communicating when the engine is not running or starting.	1. Check that the engine governor is powered when communications is expected. 2. Check CAN bus wiring from engine governor to controller. 3. Check that a 120 Ω termination resistors (one on each end if the main wire, two total) are in place.

LOST ECU COMM

Loss of ECU communications

Alarm – causes machine shutdown

Appearance in event log: LOST ECU COMM A

Cause	Corrective action
Communications with the engine governor is lost when the engine is running or trying to start.	1. Check that the engine governor is powered when communications is expected. 2. Check CAN bus wiring from engine governor to controller. 3. Check that a 120 Ω termination resistors (one on each end if the main wire, two total) are in place.

LOW BATT VOLT

Low battery voltage

Pre-Alarm

Appearance in event log: LOW BATT VOLT P

Cause	Corrective action
The battery voltage is below the limit set for the low battery voltage pre-alarm.	1. Check the battery voltage level, the battery charging circuits, and connections from the battery to the engine. 2. Charge battery, if necessary.

TIM-ID: 0000065425 - 001

LOW COOL LEVEL

Low coolant level

Pre-Alarm

Appearance in event log: LOW COOL LEVEL P

Cause	Corrective action
The engine coolant level is below the limit set for the low coolant level pre-alarm.	1. Check engine coolant level and add some, if necessary. 2. Check and correct any coolant leaks if the level is low.

LOW COOL LEVEL

Low coolant level

Alarm – causes machine shutdown

Appearance in event log: LOW COOL LEVEL A

Cause	Corrective action
The engine coolant level is below the limit set for the low coolant level alarm.	1. Check engine coolant level and add some, if necessary. 2. Check and correct any coolant leaks if the level is low.

LOW COOL TMP

Low coolant temperature

Pre-Alarm

Appearance in event log: LOW COOL TMP P

Cause	Corrective action
The engine coolant temperature is below the limit set for the low coolant temperature pre-alarm.	▶ Check engine block heater or any other devices which maintain minimum coolant temperatures when the engine is not running.

LOW COOL TMP

Low coolant temperature

Alarm – causes machine shutdown

Appearance in event log: LOW COOL TMP A

Cause	Corrective action
The engine coolant temperature is below the limit set for the low coolant temperature alarm.	▶ Check engine block heater or any other devices which maintain minimum coolant temperatures when the engine is not running.

TIM-ID: 0000065425 - 001

LOW FUEL LEVEL

Low fuel level

Pre-Alarm

Appearance in event log: LOW FUEL LEVEL P

Cause	Corrective action
The fuel level is below the level set in the low fuel level pre-alarm element.	1. Add fuel. 2. If an automatic fuel pump is employed to fill the tank, verify pump turns on when it should.

LOW FUEL LEVEL

Low fuel level

Alarm – causes machine shutdown

Appearance in event log: LOW FUEL LEVEL A

Cause	Corrective action
The fuel level is below the level set in the low fuel level alarm element.	1. Add fuel. 2. If an automatic fuel pump is employed to fill the tank, verify pump turns on when it should.

LOW OIL PRES

Low oil pressure

Pre-Alarm

Appearance in event log: LOW OIL PRES P

Cause	Corrective action
The engine oil pressure is below the limit set for the low oil pressure pre-alarm.	1. Check the engine oil level and add oil, if necessary. 2. Check oil pump. 3. Check for obstructions in the oil lubrication passages.

LOW OIL PRES

Low oil pressure

Alarm – causes machine shutdown

Appearance in event log: LOW OIL PRES A

Cause	Corrective action
The engine oil pressure is below the limit set for the low oil pressure alarm.	1. Check the engine oil level and add oil, if necessary. 2. Check oil pump. 3. Check for obstructions in the oil lubrication passages.

TIM-ID: 0000065425 - 001

LSM AVR OUT LMT

Load Share Module AVR output limit

Pre-Alarm

Appearance in event log: LSM AVR OUT LMT P

Cause	Corrective action
The Analog Voltage Regulator (AVR) bias signal has hit the low or high limit of its range. Usually this indicates some sort of wiring error or settings error which causes the bias output to be incompatible with the bias range on the AVR.	1. Check wiring and external devices to make sure the bias output and load share lines are not driven by an external device. 2. Verify the selected range for the bias output is compatible with the AVR bias input range. 3. Perform tests in the troubleshooting section of the manual to verify that changing bias output voltage or current values will change the generator's output voltage in the desired manner.

LSM COMMS FAIL

Load Share Module communications failure

Pre-Alarm

Appearance in event log: LSM COMMS FAIL P

Cause	Corrective action
The controller is not receiving a heartbeat from the Load Share Module (LSM).	1. Verify all CAN bus communications cables are in place, properly wired, and properly terminated. 2. Check that the I/O modules that are present in the system are enabled in the controller settings. 3. Check the I/O modules to be sure they are powered up and functioning.

LSM GOV OUT LMT

Load Share Module GOV output limit

Pre-Alarm

Appearance in event log: LSM GOV OUT LMT P

Cause	Corrective action
The Load Share Module (LSM) governor bias signal has hit the low or high limit of its range. Usually this indicates some sort of wiring error or settings error which causes the bias output to be incompatible with the bias range on the governor.	1. Check wiring and external devices to make sure the bias output and load share lines are not driven by an external device. 2. Verify the selected range for the bias output is compatible with the governor bias input range. 3. Perform tests in the troubleshooting section of the manual to verify that changing bias output voltage or current values will change the generator's RPM in the desired manner.

TIM-ID: 0000065425 - 001

LSM HEARTBEAT FAIL

Load Share Module heartbeat failed

Pre-Alarm

Appearance in event log: LSM HEARTBEAT FAIL P

Cause	Corrective action
The controller is not receiving a heartbeat from the Load Share Module (LSM).	1. Verify all CAN bus communications cables are in place, properly wired, and properly terminated. 2. Check that the I/O modules that are present in the system are enabled in the controller settings. 3. Check the I/O modules to be sure they are powered up and functioning.

LSM INTERGEN COM FAIL

Load Share Module intergen communications failure

Pre-Alarm

Appearance in event log: LSM INTERGEN COM FAIL P

Cause	Corrective action
The controller lost communications with the other generators on the Inter-Genset communications network. Typically, this indicates some sort of network issue is blocking communications between the generators.	1. Verify other generators are on line. 2. Check network cabling and components for network issues. 3. Verify that all devices on the network are industrially rated and designed to comply with IEC 61000-4 series of specifications. 4. As a last resort, power cycle the Load Share Module (LSM) and the network devices to see if communications is restored.

MAINT INTERVAL

Maintenance interval

Pre-Alarm

Appearance in event log: MAINT INTERVAL P

Cause	Corrective action
The maintenance interval has expired indicating it is time to service the unit.	1. Service the machine. 2. Reset the pre-alarm on the front panel under SETTINGS → SYSTEM SETTINGS → MAINT RESET by setting MAINT RESET to YES. It will reset the pre-alarm and change its value back to NO.

MF TRANSFER

Mains fail transfer complete

Status

Appearance in event log: MF TRANSFER

Cause	Corrective action
A transfer of the load from the utility to the generator after a mains failure has been successfully completed.	▶ (none)

TIM-ID: 0000065425 - 001

MF TRANSFER FAIL

Mains fail transfer fail

Status

Appearance in event log: MF TRANSFER FAIL P

Cause	Corrective action
A transfer of the load from the mains to the generator has not been accomplished in the time allowed by the Mains Fail Max Transfer time setting.	1. Check that bus sensing indicates a failed or dead bus status when the bus is not stable. 2. Verify that the breaker status for the generator breaker and mains breaker are received by the controller. 3. Check the time required for a transfer to occur and that enough time is allowed by the Mains Fail Max Transfer time setting.

MN BKR CL FL

Main breaker close failure

Pre-Alarm

Appearance in event log: MN BKR CL FL P

Cause	Corrective action
The controller has issued a mains breaker close output, but the breaker status has not reported the breaker closed within the time allowed by the Breaker Close Wait time.	1. This is a latched pre-alarm and can be cleared only by pushing the reset button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. 4. Verify the breaker is receiving open and close commands from the controller. 5. If pulsed breaker commands are employed, make sure the pulse is long enough for the breaker to change states. Consider lengthening the Breaker Close Wait time.

MN BKR OP FL

Main breaker open failure

Pre-Alarm

Appearance in event log: MN BKR OP FL P

Cause	Corrective action
The controller has issued a breaker open output, but the breaker status has not reported the breaker open within the time allowed by the Breaker Close Wait time.	1. This is a latched pre-alarm and can be cleared only by pushing the reset button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. 4. Verify the breaker is receiving open and close commands from the controller. 5. If pulsed breaker commands are employed, make sure the pulse is long enough for the breaker to change states. Consider lengthening the Breaker Close Wait time.

TIM-ID: 0000065425 - 001

MN BKR SYN FL

Main breaker synchronization failure

Pre-Alarm

Appearance in event log: MN BKR SYN FL P

Cause	Corrective action
The Synchronizer Fail Activation Delay timer expired while the generator was trying to synchronizer and close the mains breaker.	1. This is a latched pre-alarm and can be cleared only by pushing the reset button on the front of the controller or putting the machine into OFF mode. 2. Check the wiring from the controller to the breaker. 3. Verify the controller is receiving correct open-closed status from the breaker. Consider lengthening the Synchronizer Fail Activation Delay. 4. Check speed controller tuning and re-tune to make it more aggressive if possible.

MPU FAIL

Magnetic Pickup failure

Pre-Alarm

Appearance in event log: MPU FAIL P

Cause	Corrective action
The Magnetic Pickup (MPU) that senses flywheel teeth for speed sensing is not being monitored by the controller and the speed source is set for MPU or GEN (generator frequency). Loss of MPU causes a pre-alarm, and the controller uses generator frequency as the speed source to continue running.	1. Check the MPU sensor, and verify that it is creating pulses. 2. Check the wiring from the MPU sensor to the controller, and correct any issues.

MPU FAIL

Magnetic Pickup failure

Alarm – causes machine shutdown

Appearance in event log: MPU FAIL A

Cause	Corrective action
The Magnetic Pickup (MPU) that senses flywheel teeth for speed sensing is not being monitored by the controller, and the speed source is set for MPU. Loss of MPU causes an alarm.	1. Check the MPU sensor, and verify that is creating pulses. 2. Check the wiring from the MPU sensor to the controller, and correct any issues.

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MULTIPLE AEM

Multiple Analog Expansion Modules detected

Pre-Alarm

Appearance in event log: MULTIPLE AEM P

Cause	Corrective action
More than one Analog Expansion Module (AEM) has been detected on the CAN bus I/O network.	1. Remove all but one AEM if more than one is present. 2. Check CAN bus connections, terminations, etc. and verify good CAN bus communications are occurring.

MULTIPLE CEM

Multiple Contact Expansion Modules detected

Pre-Alarm

Appearance in event log: MULTIPLE CEM P

Cause	Corrective action
More than one Contact Expansion Modules (CEM) has been detected on the CAN bus I/O network.	1. Remove all but one CEM if more than one is present. 2. Check CAN bus connections, terminations, etc., and verify good CAN bus communications are occurring.

MULTIPLE LSM

Multiple Load Share Modules detected

Pre-Alarm

Appearance in event log: MULTIPLE LSM P

Cause	Corrective action
More than one Load Share Modules (LSM) has been detected on the CAN bus I/O network.	1. Remove all but one LSM if more than one is present. 2. Check CAN bus connections, terminations, etc., and verify good CAN bus communications are occurring.

NORM SHUTDOWN

Normal shutdown

Status

Appearance in event log: Normal Shutdown

Cause	Corrective action
The engine has shut down since all sources of run request have been removed.	▶ (none)

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OIL SNDR FAIL

Oil pressure sender fail

Status

Appearance in event log: OIL SNDR FAIL

Cause	Corrective action
The input from the sender is outside the valid range for the device.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

OIL SNDR FAIL

Oil pressure sender fail

Pre-Alarm

Appearance in event log: OIL SNDR FAIL P

Cause	Corrective action
The input from the sender is outside the valid range for the device, and the Oil Pressure sender fail is configured as pre-alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

OIL SNDR FAIL

Oil pressure sender fail

Alarm – causes machine shutdown

Appearance in event log: OIL SNDR FAIL A

Cause	Corrective action
The input from the sender is outside the valid range for the device, and the Oil Pressure sender fail is configured as alarm.	▶ Check the sender, the sender wiring, and the sender common wiring from the engine block to the controller.

OVERCRANK

Overcrank

Alarm – causes machine shutdown

Appearance in event log: OVERCRANK A

Cause	Corrective action
The engine has exceeded the allowed cranking time or number of crank cycles, and engine still has not started.	1. Check that the engine is receiving fuel and that the starter is rotating the engine adequately for engine cranking. 2. Investigate and correct issues that could prevent the engine from starting.

TIM-ID: 0000065425 - 001

OVERSPEED

Overspeed

Alarm – causes machine shutdown

Appearance in event log: OVERSPEED A

Cause	Corrective action
The engine RPM has exceeded the overspeed alarm limit.	1. Check the rated RPM setting, the speed bias into the engine governor, and the engine governor. 2. Check any load sharing devices in multiple generator applications.

PROT SHUTDOWN

Protective shutdown

Status

Appearance in event log: Protective Shutdown

Cause	Corrective action
The engine has shut down to a protective shut down.	1. Determine the source of the shut down. 2. Take action to correct the cause of the shutdown.

RTD IN x O1

Resistive Temperature Device input x over limit 1

Status

Programmable string; default appearance in event log: RTD IN x_O1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Resistive Temperature Device (RTD) input x (x = 1 to 8) is over limit 1.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

RTD IN x O1

Resistive Temperature Device input x over limit 1

Pre-Alarm

Programmable string; default appearance in event log: RTD IN x_O1 P

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) over limit 1 has been programmed as a pre-alarm, and limit 1 has been exceeded.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

RTD IN x O1

Resistive Temperature Device input x over limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: RTD IN x_O1 A

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) over limit 1 has been programmed as an alarm, and limit 1 has been exceeded.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

RTD IN x O2

Resistive Temperature Device input x over limit 2

Status

Programmable string; default appearance in event log: RTD IN x_O2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Resistive Temperature Device (RTD) input x (x = 1 to 8) is over limit 2.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

RTD IN x O2

Resistive Temperature Device input x over limit 2

Pre-Alarm

Programmable string; default appearance in event log: RTD IN x_O2 P

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) over limit 2 has been programmed as a pre-alarm, and limit 2 has been exceeded.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

RTD IN x O2

Resistive Temperature Device input x over limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: RTD IN x_O2 A

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) over limit 2 has been programmed as an alarm, and limit 2 has been exceeded.	1. Check the external device which drives the RTD input and caused the limit to be exceeded. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

RTD IN x OOR

Resistive Temperature Device input x out of range

Status

Programmable string; default appearance in event log: RTD IN x_OOR

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Resistive Temperature Device (RTD) input x (x = 1 to 8) is out of range.	1. Check the external device which drives the RTD input and went outside the valid range. 2. Take any necessary action.

RTD IN x OOR

Resistive Temperature Device input x out of range

Pre-Alarm

Programmable string; default appearance in event log: RTD IN x_OOR P

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) out of range has been programmed as a pre-alarm, and the input is outside the valid range.	1. Check the external device which drives the RTD input and went outside the valid range. 2. Take any necessary action.

RTD IN x OOR

Resistive Temperature Device input x out of range

Alarm – causes machine shutdown

Programmable string; default appearance in event log: RTD IN x_OOR A

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) out of range has been programmed as an alarm, and the input is less than the limit.	1. Check the external device which drives the RTD input and went outside the valid range. 2. Take any necessary action.

RTD IN x U1

Resistive Temperature Device input x under limit 1

Status

Programmable string; default appearance in event log: RTD IN x_U1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Resistive Temperature Device (RTD) input x (x = 1 to 8) is under limit 1.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

RTD IN x U1

Resistive Temperature Device input x under limit 1

Pre-Alarm

Programmable string; default appearance in event log: RTD IN x_U1 P

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) under limit 1 has been programmed as a pre-alarm, and the input is less than limit 1.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

RTD IN x U1

Resistive Temperature Device input x under limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: RTD IN x_U1 A

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) under limit 1 has been programmed as an alarm, and the input is less than limit 1.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

RTD IN x U2

Resistive Temperature Device input x under limit 2

Status

Programmable string; default appearance in event log: RTD IN x_U2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for Resistive Temperature Device (RTD) input x (x = 1 to 8) is under limit 2.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

RTD IN x U2

Resistive Temperature Device input x under limit 2

Pre-Alarm

Programmable string; default appearance in event log: RTD IN x_U2 P

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) under limit 2 has been programmed as a pre-alarm, and the input is less than limit 2.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

TIM-ID: 0000065425 - 001

RTD IN x U2

Resistive Temperature Device input x under limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: RTD IN x_U2 A

Cause	Corrective action
Resistive Temperature Device (RTD) input x (x = 1 to 8) under limit 2 has been programmed as an alarm, and the input is less than limit 2.	1. Check the external device which drives the RTD input and went below the underlimit setting. 2. Take any necessary action.

SCREEN ERROR

Screen error

Status

Appearance in event log: SCREEN ERROR

Cause	Corrective action
The processor tried to display something on the front panel but data missing or corrupt data prevented it. This message will not affect the operation of the unit, but it may affect viewing of some of the front panel screens.	1. Power cycle the controller. 2. If the error still occurs, re-program the controller Firmware and Language Module.

SPD SNDR FAIL

Speed sender failed

Status

Appearance in event log: SPD SNDR FAIL

Cause	Corrective action
The engine is running, the speed source is set to use MPU or GEN (generator frequency) as the speed source, and no input is detected from the Magnetic Pickup Unit (MPU).	1. Check the MPU speed source, if an MPU is a speed source. 2. Check the wiring from the MPU to the controller.

TIM-ID: 0000065425 - 001

SPD SNDR FAIL

Speed sender failed

Alarm – causes machine shutdown

Appearance in event log: SPD SNDR FAIL A

Cause	Corrective action
The engine is running or trying to start, and no engine speed source is detected. Speed source selections are MPU, GEN (generator frequency), or MPU-GEN in which case MPU is used if it is detected. Otherwise, it will revert to generator frequency as the speed source and report an MPU FAIL pre-alarm.	1. Check the Magnetic Pickup Unit (MPU) speed source if an MPU is a speed source. 2. Check that generator frequency is being monitored by the controller if generator frequency is a valid speed source.

SS OVERRIDE ON

Shutdown override active

Pre-Alarm

Appearance in event log: SS OVERRIDE ON P

Cause	Corrective action
The engine governor has determined the Safety System Shutdown Override is in effect and sent the pre-alarm to the controller.	▶ Remove the Safety System Shutdown Override to clear the pre-alarm.

THRM CPL x O1

Thermocouple input x over limit 1

Status

Programmable string; default appearance in event log: THRM CPL x_O1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for thermocouple input x (x = 1 to 2) is over limit 1.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

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THRM CPL x O1

Thermocouple input x over limit 1

Pre-Alarm

Programmable string; default appearance in event log: THRM CPL x_O1 P

Cause	Corrective action
Thermocouple input x (x = 1 to 2) over limit 1 has been programmed as a pre-alarm, and limit 1 has been exceeded.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

THRM CPL x O1

Thermocouple input x over limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: THRM CPL x_O1 A

Cause	Corrective action
Thermocouple input x (x = 1 to 2) over limit 1 has been programmed as an alarm, and limit 1 has been exceeded.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

THRM CPL x O2

Thermocouple input x over limit 2

Status

Programmable string; default appearance in event log: THRM CPL x_O2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for thermocouple input x (x = 1 to 2) is over limit 2.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

THRM CPL x O2

Thermocouple input x over limit 2

Pre-Alarm

Programmable string; default appearance in event log: THRM CPL x_O2 P

Cause	Corrective action
Thermocouple input x (x = 1 to 2) over limit 2 has been programmed as a pre-alarm, and limit 2 has been exceeded.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

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THRM CPL x O2

Thermocouple input x over limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: THRM CPL x_O2 A

Cause	Corrective action
Thermocouple input x (x = 1 to 2) over limit 2 has been programmed as an alarm, and limit 2 has been exceeded.	1. Check the external device which drives the thermocouple input and caused the limit to be exceeded. 2. Take any necessary action.

THRM CPL x OOR

Thermocouple input x out of range

Status

Programmable string; default appearance in event log: THRM CPL x_OOR

Cause	Corrective action
Status indication on the front panel, and control panel communication software for thermocouple input x (x = 1 to 2) is out of range.	1. Check the external device which drives the thermocouple input and went outside the valid range. 2. Take any necessary action.

THRM CPL x OOR

Thermocouple input x out of range

Pre-Alarm

Programmable string; default appearance in event log: THRM CPL x_OOR P

Cause	Corrective action
Thermocouple input x (x = 1 to 2) out of range has been programmed as a pre-alarm, and the input is outside the valid range.	1. Check the external device which drives the thermocouple input and went outside the valid range. 2. Take any necessary action.

THRM CPL x OOR

Thermocouple input x out of range

Alarm – causes machine shutdown

Programmable string; default appearance in event log: THRM CPL x_OOR A

Cause	Corrective action
Thermocouple input x (x = 1 to 2) out of range has been programmed as an alarm, and the input is less than the limit.	1. Check the external device which drives the thermocouple input and went outside the valid range. 2. Take any necessary action.

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THRM CPL x U1

Thermocouple input x under limit 1

Status

Programmable string; default appearance in event log: THRM CPL x_U1

Cause	Corrective action
Status indication on the front panel, and control panel communication software for thermocouple input x (x = 1 to 2) is under limit 1.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

THRM CPL x U1

Thermocouple input x under limit 1

Pre-Alarm

Programmable string; default appearance in event log: THRM CPL x_U1 P

Cause	Corrective action
Thermocouple input x (x = 1 to 2) under limit 1 has been programmed as a pre-alarm, and the input is less than limit 1.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

THRM CPL x U1

Thermocouple input x under limit 1

Alarm – causes machine shutdown

Programmable string; default appearance in event log: THRM CPL x_U1 A

Cause	Corrective action
Thermocouple input x (x = 1 to 2) under limit 1 has been programmed as an alarm, and the input is less than limit 1.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

THRM CPL x U2

Thermocouple input x under limit 2

Status

Programmable string; default appearance in event log: THRM CPL x_U2

Cause	Corrective action
Status indication on the front panel, and control panel communication software for thermocouple input x (x = 1 to 2) is under limit 2.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

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THRM CPL x U2

Thermocouple input x under limit 2

Pre-Alarm

Programmable string; default appearance in event log: THRM CPL x_U2 P

Cause	Corrective action
Thermocouple input x (x = 1 to 2) under limit 2 has been programmed as a pre-alarm, and the input is less than limit 2.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

THRM CPL x U2

Thermocouple input x under limit 2

Alarm – causes machine shutdown

Programmable string; default appearance in event log: THRM CPL x_U2 A

Cause	Corrective action
Thermocouple input x (x = 1 to 2) under limit 2 has been programmed as an alarm, and the input is less than limit 2.	1. Check the external device which drives the thermocouple input and went below the underlimit setting. 2. Take any necessary action.

WEAK BATTERY

Weak battery voltage

Pre-Alarm

Appearance in event log: WEAK BATTERY P

Cause	Corrective action
The battery voltage measured while the engine is cranking is below the limit set for the weak battery voltage pre-alarm.	1. Check the battery voltage level, the battery charging circuits, and connections from the battery to the engine. 2. Charge battery, if necessary. (The pre-alarm will not clear until a crank cycle occurs where the battery voltage is above the limit set for the weak battery voltage pre-alarm.)

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6.2.3 ADM3 Fault Codes for Mercedes-Benz Engines

A list of fault codes on the ADM3 for Mercedes-Benz engines can be accessed here: (→ Page 255).

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7 Ground Fault Protection - Field Testing

7.1 Field Testing of Residual Equipment Ground Fault Protection Systems 207

7.1 Field Testing of Residual Equipment Ground Fault Protection Systems

FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

SCOPE 1

DEFINITION(S) 1

SYSTEM OPERATION 3

SYSTEM TESTING 4

SCOPE

The purpose of this document is to provide instructions for testing a residual Equipment Ground Fault Protection (EGFP) system utilizing an MGC-3000 Series controller and a shunt trip-equipped disconnect device or circuit breaker (if tripping is required).

NFPA 70, National Electric Code (NEC) 215.10 specifies that each feeder disconnect rated 1,000 amperes or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase, shall be provided with ground fault protection of equipment in accordance with the provisions of NEC 230.95. NEC 230.95(C) specifies performance testing of the ground fault protection system when first installed onsite.

In certain installations, such as emergency systems (NEC Article 700) and legally required standby systems (NEC Article 701), indication of ground fault conditions is required.

To maintain UL2200 Listing of the engine generator assembly provided with equipment ground fault protection, use current transformer catalog number 115-601MR manufactured by Instrument Transformers Inc. in accordance with these instructions.

DEFINITION(S)

Residual Equipment Ground Fault Protection System

A residual or ground-strap form equipment ground fault protection system that typically utilizes a current transformer, protective relay, and a shunt trip-equipped disconnect device (if tripping is required). The system is configured with a main bonding jumper that connects the equipment ground bus to the generator neutral which passes through the center of the ground current transformer. The current transformer is connected to a protective relay that will sense ground fault currents and either indicate the condition or trip the main disconnect device by means of a shunt trip device. According to the placement of the main bonding jumper in Figure 1, the majority of the ground fault current will flow through the main bonding jumper and will be detected by the protective relay through means of the current transformer.

Ground Current Transformer

An instrument transformer used for measuring alternating electric currents. Specifically in EGFP systems, the current transformer detects any abnormal, damaging currents that may flow in the equipment ground back to the generator source when a phase-to-ground fault occurs.

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FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

MGC-3000 Series Controller
A microprocessor-based generator set controller with comprehensive control, metering, and protection capabilities. The MGC-3000 Series controller is responsible for starting and stopping the generator set, monitoring power quality and performance, and protecting equipment in the event of faults. In an EGFP system, the MGC-3000 Series controller serves as a protective relay, detecting ground faults by means of the current transformer, annunciating the fault condition, and tripping the disconnect device by means of a shunt trip device (if tripping is required). The MGC-3000 Series controller ground fault protection circuit complies with the applicable requirements of UL1053, as required by UL6200, and is also listed under MTU Onsite Energy's file AU3559.

Disconnect Device
A disconnect device (usually a circuit breaker) is the means by which the conductors of a circuit can be disconnected from its source of supply. This is controlled by the protective relay and protects equipment from damaging line-to-ground faults by simultaneously opening all ungrounded conductors of the faulted circuit.

Shunt Trip
A device commonly found on circuit breakers that allows a remote device, such as a protective relay, to trip the circuit breaker open mechanism, thereby disconnecting the power source and the load.

Ground Fault Indication (GFI)
Ground faults are indicated but the disconnect device remains closed.

Ground Fault Indication and Trip (GFIT)
Ground faults are indicated and the disconnect device is tripped open.

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FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

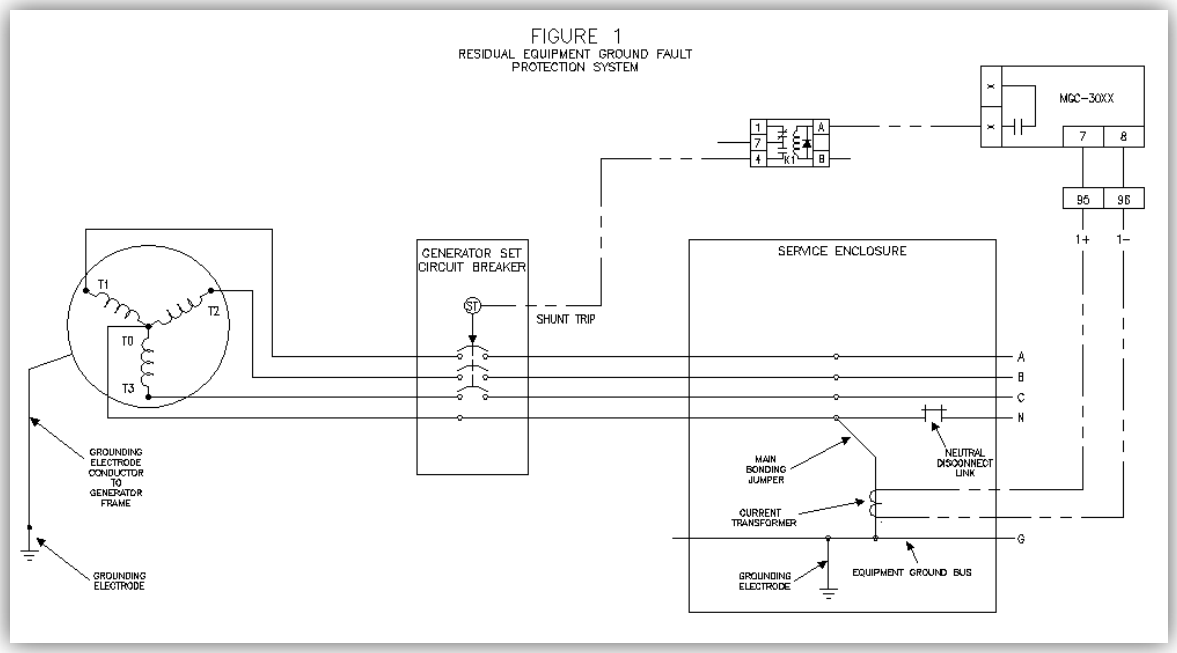


Figure 1: Residual Equipment Ground Fault Protection System

SYSTEM OPERATION

During normal operating conditions, there should be little to no ground return current flowing from the equipment ground bus, through the main bonding jumper, and back to the generator set neutral. The generator set circuit breaker will be closed, and actual ground return current should be below the trip/indication threshold in the MGC-3000 Series controller. Therefore, the controller will not activate the shunt trip.

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FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

SYSTEM TESTING

⚠ DANGER

ELECTRICAL SHOCK, EXPLOSION AND ARC FLASH HAZARD

- This equipment must be installed and serviced only by qualified electrical personnel.
- Do NOT attempt to test this equipment while it is energized. Death or severe personal injury could result.
- Turn off all power sources and use properly rated devices to confirm that power is off before testing.
- Replace all devices, doors, and covers before re-energizing equipment.

Preparation and Verification

1. Disconnect all sources supplying this equipment with power using approved lock-out, tag-out procedures.
2. Confirm that power is off using properly rated devices before testing.
3. Verify that all ground bus bar splices and straps are solidly connected at the generator set and in the service enclosure.
4. Verify that the main bonding jumper is installed between the generator set neutral bus and the equipment grounding bus in the service enclosure.
5. Verify that the ground current transformer is installed on the main bonding jumper with line side facing the equipment grounding bus.
6. Verify that there are no ground to neutral bonds on the line side of the main bonding jumper in the service enclosure (towards generator set).
7. Temporarily remove the neutral disconnect link in the service enclosure to isolate the load side of the neutral from the generator set source and the equipment grounding bus.
8. Measure and record the neutral-to-ground resistance to ensure that there are no connections on the load side of the EGFP system. The resistance should be greater than 1 mega ohm. Accidental or intentional grounding of the neutral anywhere else on the load side of the main bonding jumper will desensitize the EGFP system or render it ineffective.
9. Reinstall the neutral disconnect link.

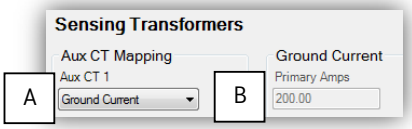
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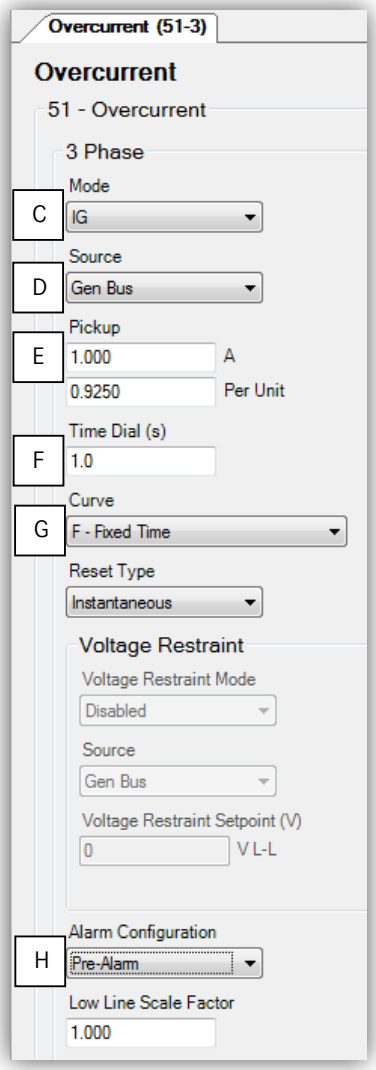
FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

Settings and Programming

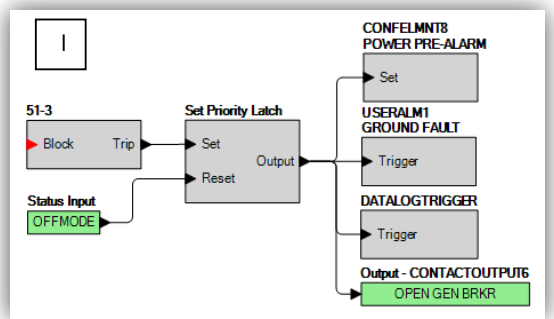
1. Verify the following settings and logic in the MGC-3000 Series controller:
   A. Aux CT 1set to “Ground Current”
   B. Ground Current “Primary Amps” based on current transformer used in application
   C. Overcurrent Mode set to “IG”
   D. Overcurrent Source set to “Gen Bus”
   E. Overcurrent Pickup set to “1.000” A (reduced for testing)
   F. Overcurrent Time Dial set to “1.0” (s)
   G. Overcurrent Curve set to “F – Fixed Time”
   H. Overcurrent Alarm Configuration based on application:
      i. Ground Fault Indication (GFI) → Pre-alarm
      ii. Ground Fault Trip (GFIT) → Alarm
   I. Verify logic is appropriate for application (i.e. breaker tripping, indication, data logging trigger, etc…)





Ground fault protection pickup and time delay settings must be determined through means of a coordination study of other protection devices and equipment in the power system on a per-application basis. The fixed time, definite time, and all inverse time curves have been investigated for ground fault protection. Do not use negative-sequence (46) or user programmable (P) curves.

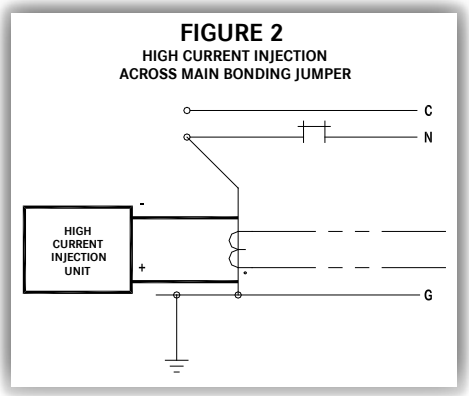
NEC 230.95(C) stipulates that the maximum setting of the EGFP system may not exceed 1200 amperes and a maximum time delay of 1 second for fault currents equal to or greater than 3000 amperes.

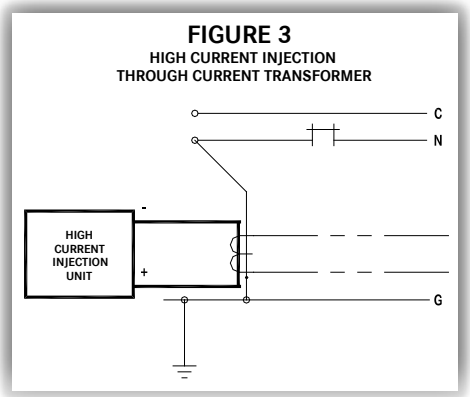


TIM-ID: 0000097094 - 001

Testing

1. Close the generator set circuit breaker.
2. Connect a high current injection unit by either method:
    a. Across the main bonding jumper; or
    b. By running a conductor through the ground current transformer.





3. Place the MGC-3000 series controller in 'Auto' mode.
4. Inject current in excess of the pickup threshold set in the MGC-3000 Series controller.
5. The MGC-3000 Series controller should:
    a. Provide ground fault indication condition by text, audible alarm, and indicator light; or
    b. Provide ground fault indication condition by text, audible alarm, and indicator light and trip the circuit breaker by means of the shunt trip device [if trip is required and tripping devices are present].
6. Reset the MGC-3000 Series controller.
7. Disconnect the high current injection unit.
8. Record the testing results in the EGFP System Test Record Table.

TIM-ID: 0000097094 - 001

FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

EGFP System Test Record Table			
Location			
Technician			
Tested EGFP Settings			
Ground Current Transformer Ratio		Overcurrent Time Dial	
Overcurrent Mode		Overcurrent Curve	
Overcurrent Source		Alarm Configuration	
Overcurrent Pickup			
Test Results			
Notes			
Coordinated EGFP Settings			
Ground Current Transformer Ratio		Overcurrent Time Dial	
Overcurrent Mode		Overcurrent Curve	
Overcurrent Source		Alarm Configuration	
Overcurrent Pickup			
Notes			
Signature		Date	

A copy of this table shall be retained by parties responsible for the building's electrical installation and shall be available to the authority having jurisdiction.

TIM-ID: 0000097094 - 001

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8 Maintenance

8.1 Preface

The maintenance schedule is applicable to products certified in accordance with U.S. emissions regulations and operated in the area of applicability of these regulations.

Information about the latest maintenance schedule is available at: http://www.mtu-online.com.

The following instructions must be observed for these products:

The maintenance schedule is an integral part of the emissions certification. Nonobservance of the maintenance instructions can result in violation of the statutory emission specifications. Modification or removal of mechanical or electronic components or the installation of additional components as well as the execution of calibration processes that might affect the emission characteristics of the product are prohibited by emission regulations. Emission-relevant components may only be maintained, exchanged or repaired if the components used for this purpose are approved by MTU or equivalent components. Emission-relevant components are for instance control units, data records, sensors, injectors, exhaust flaps ands all components of exhaust aftertreatment systems.

The maintenance system for MTU products is based on a preventive maintenance concept. Preventive maintenance facilitates advance operational planning and ensures a high level of equipment availability.The maintenance intervals and the scope of required maintenance activities are the result of operational experience and therefore represent recommendations. Severe operating and ambient conditions may require additional maintenance work and/or modification of the maintenance intervals.

Maintenance activities are specified with intervals based on hours in operation and time limits. Whichever value is reached first shall apply.

The individual maintenance intervals are classified in accordance with the qualification levels QL1 to QL4.

QL1: Operational monitoring and maintenance work which does not require disassembly of the product.
QL2: Exchange of components and parts (corrective only, not part of the maintenance schedule).
QL3: Maintenance work which requires partial disassembly of the product.
QL4: Maintenance work which requires complete disassembly of the product.

Additional notes on maintenance and preservation:

For change intervals for fluids and lubricants as well as for preservation specifications, refer to the relevant instructions of the component manufacturers and the MTU Fluids and Lubricants Specifications. The latest version for drive systems is available online at: http://www.mtu-online.com, and for power generation systems at: http://www.mtuonsiteenergy.com.

Components which are not listed in this maintenance schedule must be serviced in accordance with Manufacturer's Instructions.

TIM-ID: 0000046248 - 005

8.2 Maintenance schedule matrix

0 to 500 Operating hours

Task	Limit	Operating hours [h]	
		Daily	500
Engine-generator set monitoring			
W0109	-	X	
W0115	-	X	
W0110	-	X	
W0112	-	X	
W0134	1 m		
W6506	6 m		X
W1675	2 a		X
Engine			
W6536	-		
Generator			
W6535	1 m		X
X6065	1 a		X
W8654	1 a		X
W6534	1 a		X
X7900	1 a		X
Preheater / Jacket water heater			
W6521	1 a		X
Engine-generator set control panel			
W6511	6 m		X
X3041	10 a		
Radiator			
W1510	6 m		X
W8655	1 a		
w = weeks m = months a = years			

TIM-ID: 0000064808 - 001

8.3 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Note: For engine maintenance information, refer to the Mercedes-Benz OM924-926LA engine documentation contained within this manual. To ensure you have the most current version of the engine manual, contact the engine manufacturer or your MTU Onsite Energy distributor or dealer.

Task	Option	Maintenance Task	Reference
W0109		Check engine oil level.	(→ Page 219)
W0115		Drain off water and contamination from fuel prefilter with water separator.	(→ Page 220)
W0110		Check general condition of engine-generator set and inspect for leaks.	(→ Page 221)
W0112		Inspect service indicator of air filter.	(→ Page 223)
W0134		Test run at not below 1/3 load and at least until steady-state temperature is reached (monthly).	(→ Page 224)
W6506		Test status lights and gauges.	(→ Page 225)
W1675		Fit new fuel prefilter or new fuel prefilter insert.	(→ Page 227)
W6536		Check air flow into and out of unit, remove debris from ventialtion system.	(→ Page 240)
X6065		Check generator wiring visually for damage.	(→ Page 241)
W8654		Check antifriction bearings, replace if necessary.	(→ Page 242)
W6534		Check and adjust voltage regulator if needed.	(→ Page 243)
X7900		Check circuit breaker condition visually and carry out function tests.	(→ Page 245)
W6521		Test preheating functionality.	(→ Page 246)
W6511		Test controller displays for functionality.	(→ Page 247)
X3041		Replace backup battery in controller.	(→ Page 248)
W1510		Check cooler / radiator elements externally for contamination and leaks.	(→ Page 249)
W8655		Cooler / radiator core face cleaning.	(→ Page 250)

TIM-ID: 0000065770 - 001

9 Task Description

9.1 Chapter overview

This chapter provides instructions on performing the necessary maintenance work on the engine-generator set.

Note: This publication describes all available engine-generator set components. Disregard any components which are not included in the scope of delivery of your particular engine-generator set. For engine maintenance tasks, refer to the Engine Manual OM924-926 LA. (→ Page 277)

Before starting work

- Ensure that the prerequisites listed in the descriptions have been fulfilled.
- Ensure that all necessary special tools, consumables, and spare parts are available.
- Ensure that fluids and lubricants used for work have been approved for the engine-generator set.

Spare part designations and the quantities required are listed in the task descriptions. Spare part order numbers are listed in the Spare Parts Catalog.

Contact Service if a maintenance task cannot be successfully completed.

TIM-ID: 0000061864 - 001

9.2 Engine-Generator Set

9.2.1 Check engine oil level

The engine oil level must be checked daily. See the Mercedes-Benz OM924-926LA Operating Instructions, page 40. (→ Page 277)

TIM-ID: 0000065670 - 001

9.2.2 Fuel prefilter - Draining

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Draining

1. Provide a suitable container to collect the water.
2. Open drain valve (2).
3. Drain water and contaminants from the filter bowl (1) until pure fuel emerges.
4. Close drain screw.

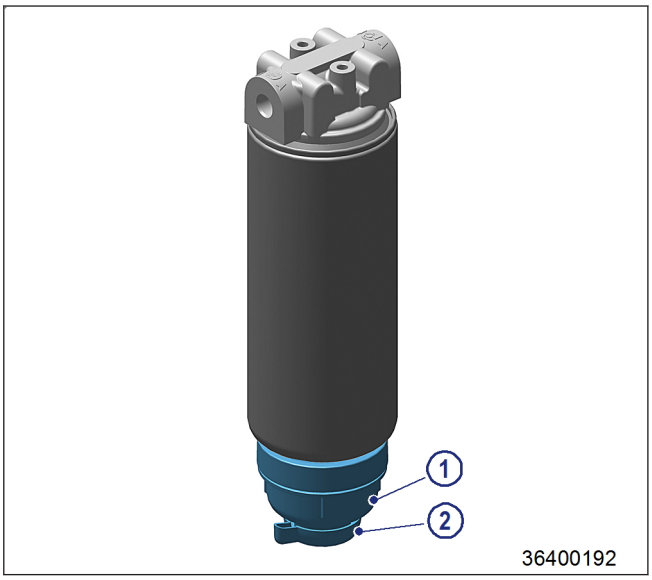


Figure 32: Fuel prefilter – Draining

TIM-ID: 0000057747 - 001

9.2.3 Engine-generator set – Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000060384 - 001

Maintenance checks to be carried out on engine-generator set

Item	Findings	Action
Check the engine-generator set location.	Debris or flammable/combustible material found.	Clear away debris and clean area as needed.
Inspect engine-generator set.	Dirt or contamination found. Loose/missing wires or fasteners found. Leaks or evidence of leakage found.	Clean as needed. Tighten or replace as needed. Repair or replace as needed.
Check inlets, outlets, screens, and protection guards.	Obstructions or debris found.	Clear and clean as needed.

TIM-ID: 0000060384 - 001

9.2.4 Service indicator – Signal ring position check

Preconditions

☑ Engine is stopped and starting disabled.

Checking signal ring position

1. If the signal ring is completely visible in the observation window (2), replace air filter.
2. After installation of new filter, press reset button (1).

Result: Engaged piston with signal ring moves back to initial position.

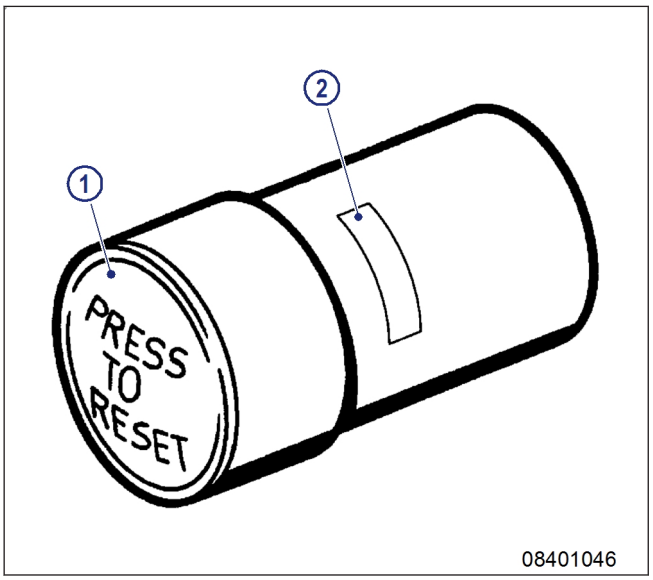


Figure 33: Service indicator

TIM-ID: 0000005483 - 003

9.2.5 Engine-generator set - Test run

Preconditions

☑ Engine-generator set is stopped.

☑ Engine-generator set is ready for operation and is in AUTO mode.

WARNING



Live parts, rotating and moving parts and a high level of engine noise.
Risk of electric shock, crushing, parts of the body being caught or pulled in or damage to hearing!
- Before starting, ensure that no other persons are in or near the danger zone.
- Carry out safety precautions to prevent persons entering the danger zone.
- Ensure that all protective guards and covers are installed, if the engine has been started in order to perform maintenance tasks
- Always start the engine according to the procedure described in the Operation and Maintenance Manual.

WARNING



Rotating and moving parts during operation.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Ensure that all protective guards and covers are installed.
- Take care when working around moving belts and rotating parts near or on an operating engine-generator set.
- Do not tamper with moving or rotating parts.
- Wear close-fitting clothes and hairnet.
- Remove watches, rings and other metal objects.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Test run

1. Start the engine-generator set using manual start procedure (→ Page 144). If the engine-generator set doesn't start, refer to troubleshooting (→ Page 150).
2. Carry out test run at a minimum of 30 % load and at least until steady-state temperature is reached (approximately for 10 to 15 minutes).
3. Carry out exercising checks (→ Page 147).
4. Stop the engine-generator set (→ Page 145).

TIM-ID: 0000001021 - 011

9.2.6 Engine-generator set – Test status lights and gauges

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000060420 - 001

Test status lights and gauges

Item	Findings	Action
Carry out lamp test on engine-generator set control panel.	Improper function.	Contact Service.
Test switches on engine-generator set control panel.	Improper function.	Contact Service.
Check for fault messages on engine-generator set control panel.	Fault messages found.	Contact Service.
Test alarm lights on remote annunciator, if fitted.	Improper function.	Contact Service.
Test controller lights and display on automatic transfer switch, if fitted.	Improper annunciation	Contact Service.

TIM-ID: 0000060420 - 001

9.2.7 Fuel prefilter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ System is not under pressure.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	1

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Tank is pressurized.
Risk of eye injuries resulting from fluid escaping under high pressure!
- Open tank slowly.
- Wear goggles or safety mask.

NOTICE

Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanliness.

Replacing fuel prefilter

1. Remove easy-change filter (2) with filter wrench.
2. Clean sealing surface on filter head (1).
3. Lightly lubricate seal on the easy-change filter (2).
4. Screw on easy-change filter (2) by hand until the seal makes contact with the filter head and tighten manually.

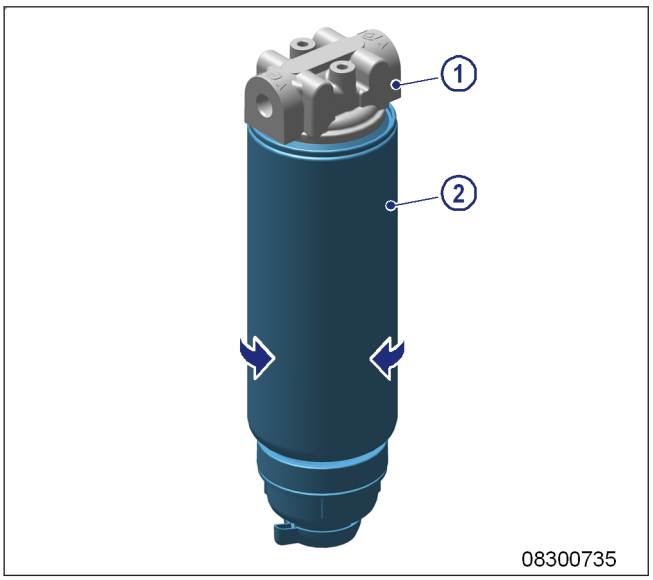


Figure 34: Replacing fuel prefilter

TIM-ID: 0000036955 - 003

9.3 Engine

9.3.1 Engine Maintenance for Mercedes-Benz OM924LA/OM926LA Engines

For engine maintenance information, refer to the Mercedes-Benz OM924LA/OM926LA engine documentation contained within this manual. To ensure you have the most current version of the engine manual, contact the engine manufacturer or MTU Onsite Energy(→ Page 381).

TIM-ID: 0000065669 - 001

9.3.2 Fuel system - Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000060428 - 001

Checks to be carried out on the fuel system

Item	Findings	Action
Inspect fuel tank if supplied.	Signs of rust found.	Repair or replace as needed.
Inspect fuel lines.	Leaks, chafing, or dry rot found.	Repair or replace as needed.
Check fuel prefilter with water separator.	Fluid in collection bowl found.	Drain (→ Page 220).
Inspect fuel filter housing.	Signs of leakage found.	Replace.
Check to ensure that fuel system is vented.	Fuel system is not vented.	Contact Service.

TIM-ID: 0000060428 - 001

9.3.3 Taking fuel samples

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

Note:
- Fluid analysis is most effective when samples are representative of the typical environmental conditions under which they operate. Dirt, system debris, water, and light fuels tend to separate from lubricants and coolants when system temperatures cool. Samples must be taken while the systems are operating under normal conditions or immediately after shutdown while they are still at operating temperature.

TIM-ID: 0000062623 - 001

- Samples must also be taken at regularly scheduled intervals and from the same sampling point each time. Although an equipment manufacturer's recommendations provide a good starting point for developing preventive maintenance practices, sampling intervals can vary. A major consideration for determining sampling frequency is how critical a piece of equipment is to production. Environmental factors are also important, such as hot, dirty operating conditions, short trips with heavy loads, and excessive idle times.
- For any engine or component failure that will generate a warranty claim, MTU Onsite Energy requires that samples of the appropriate fluids (such as oil, coolant, and/or fuel) are retained for analysis until the warranty claim is closed, unless otherwise instructed.

Collecting Fuel Samples



Use only new, clean, dry, and tightly sealable sample vessels. Do not use beverage bottles.
Fuel test kits can also be ordered from MTU Onsite Energy.The following kits are available:

- Basic Test (Part # F-PDFM1) This kit is used for checking the contamination level of diesel fuel. The test checks for metals, water, bacteria, and particle contaminates.
- Advanced Test (Part # F-PDFM2) This kit includes Basic Test plus analysis to determine contamination levels, possible filter plugging characteristics, and ignition performance in an engine.
- Advanced Test Plus (Part # F-PDFM3) This kit includes Advanced Test and lubricity analysis. Maintaining correct lubricity level is beneficial for ensuring long-term performance of engine fuel system components.

1. Clean the sampling point as well as possible with a clean, lint-free cloth before collecting the sample.
2. Discard the first liter of fuel collected. This prevents contaminants at the sampling point from reaching the sample vessel.
3. Collect the sample directly into the sample vessel. **Note**: Sample volumes depend on scope of examination. For standard analysis, 2000 ml must be provided.
4. Seal the sample immediately after collection.
5. Label the sample with the following information:
   - Fuel type
   - Engine
   - Sampling point
   - Date
   - Notes
6. Send the sample to one of the addresses below for analysis.

USA: Polaris Laboratories 7451 Winton Drive Indianapolis, IN 46268 Phone: 877.808.3750
Polaris Laboratories 10910 W. Sam Houston Parkway N., Suite 700 Houston, TX 77064-6314 Phone: 877.808.3750
Polaris Laboratories 3060 W. California Avenue, Suite B Salt Lake City, UT 84104 Phone: 877.808.3750
CANADA: Polaris Laboratories 5140 75th Street Edmonton, Alberta Canada T6E 6W2 Phone: 877.808.3750

Table 3: Delivery addresses for fuel samples

TIM-ID: 0000062623 - 001

9.3.4 Removing and installing air filter

Preconditions

☑ Engine-generator set is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Note: Filter may differ in appearance from image shown, but the procedure is the same.

Removing and installing air filter

1. Undo clamp (2).
2. Remove air filter (1) and clamp (2) from connecting flange of intake (3).
3. Clean the connecting flange of the intake (3) and check for obstruction.
4. Secure new air filter (1) on intake (3) with clamp (2).
5. Tighten clamp (2).

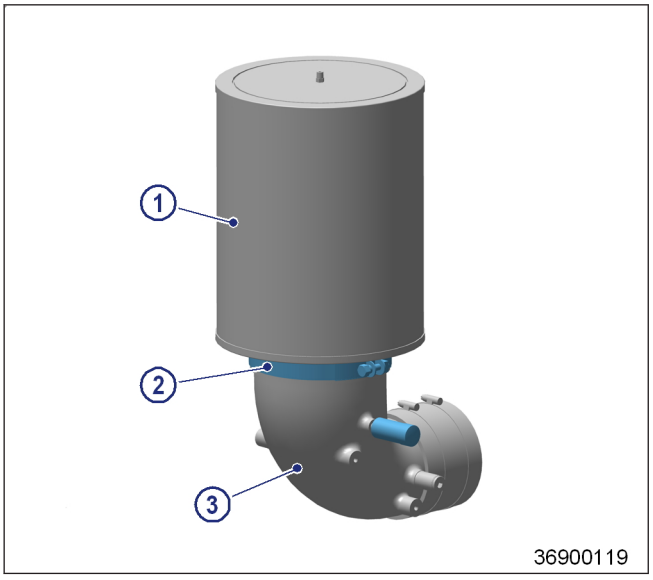


Figure 35: Air filter with intake

Final steps

▶ Press reset button (1) to return the signal ring in observation window (2) to its initial position.

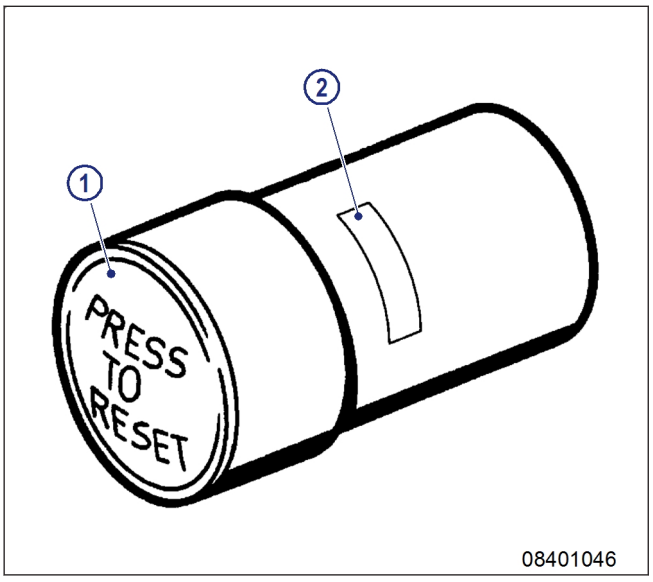


Figure 36: Filter restriction indicator

TIM-ID: 0000060424 - 001

9.3.5 Exhaust system - Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000060429 - 001

WARNING



Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

Checks to be carried out on the exhaust system

Item	Findings	Action
Inspect exhaust system.	Leaks are found or hardware is missing.	Repair or replace as needed.
Inpsect heat shields if applicable.	Heat shields are missing or damaged.	Contact Service.
Inspect flex pipe on exhaust silencer.	Cracks, corrosion, or signs of leakage are found.	Contact Service.
Check rain cap.	Rain cap is damaged or fits improperly.	Contact Service.

TIM-ID: 0000060429 - 001

9.3.6 Engine battery - Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000061526 - 001

Checks to be carried out on the battery

Item	Findings	Action
Check battery terminals and posts.	Dirt or debris found.	Clean terminals and posts.
Check battery electrolyte level.	Low fluid level found.	Add distilled water.
Perform load test to check level of charge in battery.	Low battery charge found.	Charge battery.

TIM-ID: 0000061526 - 001

9.3.7 Battery charger - Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000061527 - 001

Checks to be carried out on the battery charger

Item	Findings	Action
Check shore power / incoming voltage to battery charger.	Readings found are not within 10% of nameplate rating.	Contact Service.
Check annunciation terminal wires, if applicable.	Damaged wires or broken connections.	Contact Service.
Check battery voltage.	Readings found are not between 12 and 14 volts.	Contact Service.

TIM-ID: 0000061527 - 001

9.4 Generator

9.4.1 Generator – Check

Preconditions

☑ Engine-generator set is stopped and starting disabled.

☑ Circuits are disconnected.

☑ Lockout/tagout procedure is completed.

☑ Auxiliary equipment (if supplied, e.g. battery charger, water heater) is de-energized.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

Preparatory step

▶ Remove the cover of the outlet box.

Checking the generator

Item	Findings	Action
Inspect generator for external contamination.	Dirt or debris found.	Remove any dirt or debris with vacuum cleaner or brush.
Inspect all parts for wear and damage.	Wear or damage visible.	Contact Service.
Check that heat strips (if fitted) are operational.	Heat strips are not warm.	Contact Service.
Inspect air intake and outlet openings.	Dirt or blockages visible.	Remove any dirt with vacuum cleaner or brush. Remove foreign material to keep the openings unobstructed.

TIM-ID: 0000000179 - 008

Final step

▶ Install the cover of the outlet box.

9.4.2 Generator – Wiring check

Preconditions

☑ Engine-generator set is stopped and starting disabled.

☑ Circuits are disconnected.

☑ Lockout/tagout procedure is completed.

☑ Auxiliary equipment (if supplied, such as battery charger, water heater) is de-energized.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

Preparatory step

▶ Remove the cover of the outlet box.

Checking the generator wiring

Item	Findings	Action
Check all electrical connections.	Connections loose. Contacts corroded.	Tighten connections. Contact Service.
Check wiring for damage to the insulation.	Insulation damaged or oil-soaked.	Contact Service.
Inspect varnish coatings on the windings.	Coating deteriorated.	Contact Service.

Final step

▶ Install the cover of the outlet box.

TIM-ID: 0000064624 - 001

9.4.3 Generator - Check antifriction bearing

Preconditions

☑ Engine-generator set is stopped and starting disabled.

☑ Circuits are disconnected.

☑ Lockout/tagout procedure is completed.

☑ Auxiliary equipment (if supplied, for example, battery charger, water heater) is de-energized.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

Note: The generator is equipped with double-shielded ball bearings lubricated for the life of the bearing. Recommended practice is to replace bearing(s) during major overhaul of the engine.

Checks to be carried out on the generator bearings

Item	Findings	Action
Check anti-friction bearings for smooth and quiet operation.	Grinding, noisy, or rough operation observed.	Replace bearing.

TIM-ID: 0000061524 - 001

9.4.4 Voltage regulator - Check

Preconditions

☑ Engine-generator set is locked out.

☑ Engine-generator set is not in AUTO mode.

☑ Generator is not connected to network.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

WARNING



Rotating and moving parts and high level of engine noise in the event of accidental engine-generator set start during service.
Risk of crushing, danger of parts of the body being caught or pulled in!
Risk of damage to hearing!
- Ensure the engine-generator set has been stopped and starting is disabled during service.

WARNING



An engine-generator set in AUTO mode can start at any moment: Rotating and moving parts and high level of engine noise.
Risk of crushing, danger of parts of the body being caught or pulled in if started!
Risk of damage to hearing if started!
- Always remain clear of the engine-generator set when in AUTO mode.
- Keep ear protection on hand during the stay in the engine-generator set room.
- Disconnect/disable the starting system while servicing the engine-generator set.

WARNING



Exhaust gas is harmful to health.
Risk of poisoning!
- Repair leaking exhaust pipes prior to starting and operating the engine.
- Do not modify or tamper with the exhaust or emission control system.
- Always start and operate the engine in a well-ventilated area.
- If operating the engine in an enclosed area, properly vent the exhaust to the atmosphere.

WARNING



Batteries contain very caustic acid.
Risk of serious injury from chemical burn!
- Wear protective clothing, gloves and goggles/safety mask.
- If contact with battery acid occurs, flush skin with water, apply baking soda or lime to neutralize the acid, flush eyes with water and get medical attention immediately.

WARNING



Batteries develop explosive gases during charging.
Risk of serious injury from explosion and burning!
- Work in a well-ventilated area.
- Avoid open flames, electrical sparks and ignition sources near the battery.
- Do not smoke.
- Ensure only the negative lead is removed from the battery.
- Ensure correct polarity of battery connections.

TIM-ID: 0000060430 - 001

Preparatory step

▶ Remove the cover of the outlet box.

Checks to be carried out on the voltage regulator

Item	Findings	Action
Check sensing leads and field leads.	Frayed wires or loose connections found.	Contact Service.
Check PMG wiring if applicable.	Frayed wires or loose connections found.	Contact Service.

Final step

▶ Install the cover of the outlet box.

TIM-ID: 0000060430 - 001

9.4.5 Power circuit breaker – Functional check

Preconditions

☑ Engine-generator set at standstill.

☑ All sources de-energized.

☑ Control panel must be switched OFF.

☑ Battery charger isolated from power supply.

☑ Battery disconnected.

☑ Engine Control Unit deactivated (plug disconnected).

☑ Lockout/tagout procedure completed.

☑ Mains power switched off.

☑ Power circuit breaker open.

DANGER



High voltage. Live components and connections.
Risk of death or serious injury from electric shock!
- Disconnect the engine-generator set from all power sources (mains, batteries, other external power supplies) before starting to work.

DANGER



Circuit breakers are live components.
Risk of burns or death from electric shock!
- Ensure all circuit breakers are placed in the "OPEN" position prior to and while servicing the engine-generator set.

NOTICE



Oil contaminants in shop or onboard air causes circuitry damage.
Damage to engine-generator set!
- Use only clean, dry compressed air to clean excess dirt.

Cleaning power circuit breaker

▶ Clean the outer surfaces of the power circuit breaker with dry compressed air.

Checking mechanical operation of power circuit breaker

1. Actuate the ON and OFF switches on the power circuit breaker manually and by remote tripping (if applicable).
2. Check tripping by tripping unit.
3. Check all indicators and function.
4. Check number of switching operations at the operation counter.

Checking main connections

1. Check insulation for cracking.
2. Tighten screws and nuts.
3. Check connections for signs of overheating or oxidation.

TIM-ID: 0000048471 - 002

9.5 Jacket Water Heater

9.5.1 Jacket water heater - Hoses check

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

☑ All power sources for the heater are disconnected.

WARNING



Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

WARNING



Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Visual inspection of hoses

1. Verify that the heater is operable (hose from jacket water heater to the engine is warmer than others).
2. Inspect heater and hoses for leaks. Contact Service if leaks found.
3. Check for hard, brittle hoses. Contact Service if such hoses found.

TIM-ID: 0000000191 - 007

9.6 Engine-Generator Set Control Panel

9.6.1 Engine-generator set controller – Check

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

☑ Operating voltage is not present.

Checking electrical connections

1. Unlock and open the door of the control cabinet.
2. Visually inspect the interior as follows:

Item	Findings	Action
Check all parts for wear and damage.	Wear or damage found, for example, corrosion and scorch or burn marks.	Contact Service.
Check wiring.	Connections loose.	Tighten connections.
Check screw and clip mountings.	Connections loose.	Tighten connections.
Check fuses.	Blown fuse.	Replace fuse.

3. Close the door of the control cabinet and lock it.

TIM-ID: 0000060425 - 001

9.6.2 Control panel MGC Series – Backup battery replacement

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

☑ Operating voltage is not present.

Replacing the backup battery

Note: Battery location differs between various control panels.

1. Unlock and open the front door of the control panel. The backup battery is located on the rear side of the display (1).
2. Remove the backup battery (3) with flat nose pliers, or use a screwdriver to pry it out of the socket (2).

Note: The replacement battery must be the same size as the old battery.

3. Insert the new battery with correct polarity.
4. Close the front door of the control panel, and lock it.
5. Return the control panel to service.

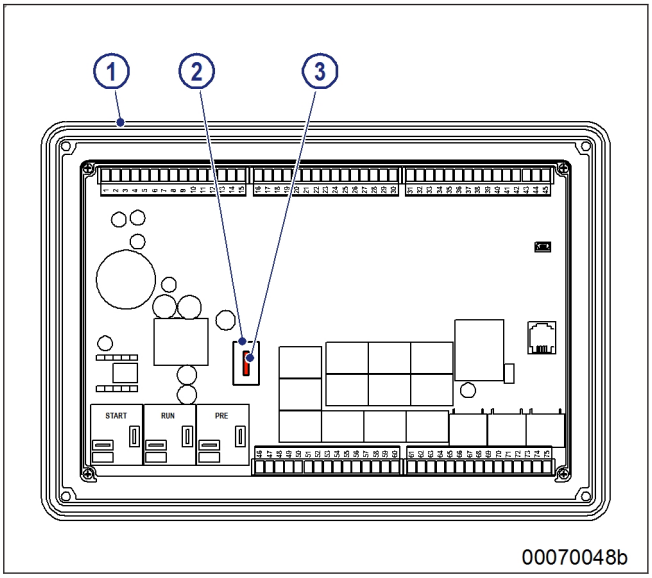


Figure 37: Backup battery location in control panel

TIM-ID: 0000057861 - 001

9.7 Radiator

9.7.1 Radiator - Check the core for leaks and contamination

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

☑ For remote radiator: All power sources for the radiator are disconnected.

DANGER



Not completely de-energized systems can contain parts under high voltage. Live components and connections.
Risk of burns or death from electric shock!
- Disconnect all electrical power.
- Lockout and tagout the equipment before removing protective shields for service or maintenance.

WARNING



Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking radiator core for leaks and contamination

Item	Findings	Action
Check the core for coolant leaks.	Leaks	Contact Service.
Check the front core face (on fan side) for contamination.	Dust, or foreign matters	Clean the clogged core (→ Page 250). Contact Service if any major cleaning is required.
Check all other components externally for dirt.	Dust and/or debris	Vacuum or brush off.

TIM-ID: 0000000193 - 010

9.7.2 Radiator - Core face cleaning

Preconditions

☑ Engine-generator set is stopped and starting is disabled.

DANGER



Not completely de-energized systems can contain parts under high voltage. Live components and connections.
Risk of burns or death from electric shock!
- Disconnect all electrical power.
- Lockout and tagout the equipment before removing protective shields for service or maintenance.

WARNING



Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

WARNING



Chemical substances in cleaners.
Risk of irritation and chemical burns!
- Always obey manufacturer's instructions for use.

NOTICE



Cleaning agents should not be left to take effect for too long.
Damage to components is possible!
- Observe manufacturer's instructions.

NOTICE



Inappropriate cleaning tool.
Risk of damage to component!
- Observe manufacturer's instructions.
- Use appropriate cleaning tool.

Cleaning with industrial vacuum cleaner

Note: An industrial vacuum cleaner may only be used from the fan side of the radiator.

1. Remove complete fan guard to access to the fan side.
2. Vacuum away the dirt.
3. Remount the complete fan guard.

TIM-ID: 0000000192 - 013

Cleaning with air gun and, if required, with industrial pressure washer

1. From the rear core face (1), blow out the fins with a jet of compressed air working in the opposite direction of the cooling air flow.

Note: The air gun nozzle (2) must maintain the air jet only in a right angle (90°) to the core face (1). Non-compliance results in damage to the fins and loss of cooling.

2. Remove and dispose of any debris blown from the core before engine-generator set start-up.
3. If cooling elements are still badly soiled, clean the core face with an industrial pressure washer from the rear core (1). A hot-water washer should preferably be used. A suitable proprietary degreasing agent (as recommended by the manufacturer of the pressure washer) should be added to the water, but this must not contain ammonia as it will corrode the core.

Note: Ensure the following targets. Non-compliance results in damage to the fins and loss of cooling.

- Apply the water jet in the opposite direction to the cooling air flow.
- Keep the nozzle (2) of the water jet at a right angle (90°) to the core face (1).
- The distance (d) between the core face and the nozzle must not be less than 450 mm (18 inches) for pressures up to 206 bar (3,000 PSI). For pressures above this limit, the distance must be increased accordingly.
- The diameter (Ø) of the water jet must not be less than 200 mm (8 inches).

4. Dry the core and the surrounding area thoroughly before engine-generator set start-up.

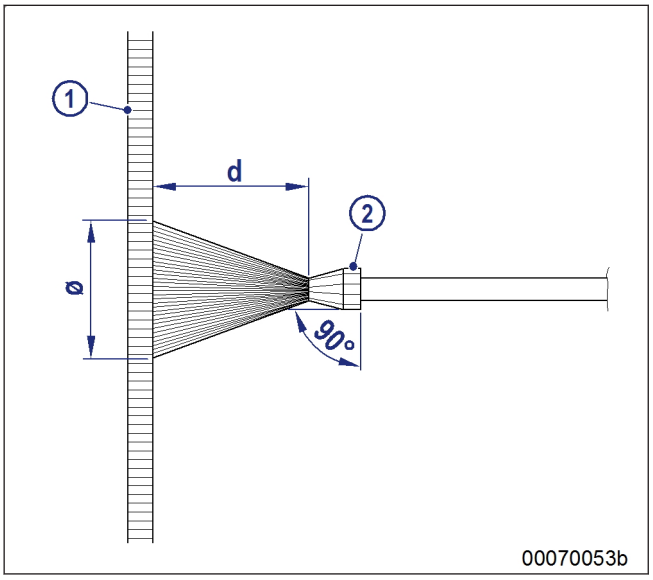


Figure 38: Radiator cleaning specifications

TIM-ID: 0000000192 - 013

10 Engine

10.1 ADM3 Fault Codes 255
10.2 Engine Manual OM 904-926 LA 277
10.3 Maintenance Booklet OM 904-926 LA 381
10.4 OM900 Engine oil and filter change 429
10.5 OM900 Inspect poly v-belt for wear and damage 441
10.6 OM900 Remove and install poly v-belt 455
10.7 OM900 Clean filter element of fuel prefilter 467
10.8 OM900 Replace fuel filter 475
10.9 OM900 Set valve clearance 485
10.10 OM900 Engine cooling system check fluid level 507
10.11 Engine Coolant - Level check 529
10.12 Engine Coolant - Draining 531
10.13 Engine Coolant - Filling 533

9. Fault codes

9.1. Fault codes diagnosis version 210

The background colour is used to indicate the newly supported or changed fault codes since diagnosis version 207.
The background colour is used to indicate the newly supported or changed fault codes since diagnosis version 210.
The background colour is used to indicate the newly supported or changed fault codes since diagnosis version 211.
The background colour indicates PLD/MR2 fault codes which are received from the PLD/MR2 control unit and are broadcasted by the ADM over J1939.

ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
51 / 0	-	12419	Engine Throttle Position	Above Measuring Range		LSCAN-MR
51 / 1	-	12420	Engine Throttle Position	Below Measuring Range		LSCAN-MR
51 / 2	-	12424	Engine Throttle Position	Measuring Range Not Plausible		LSCAN-MR
51 / 2	-	14217	Engine Throttle Position	Performance		LSCAN-MR
51 / 3	-	14205	Engine Throttle Position Sensor	Circuit High		LSCAN-MR
51 / 4	-	14206	Engine Throttle Position Sensor	Circuit Low		LSCAN-MR
51 / 7	-	12431	Engine Throttle Position	Defective		LSCAN-MR
51 / 13	-	14218	Engine Throttle Position	Position Not Learned		LSCAN-MR
69 / 9	17309	-	Two Speed Axle Switch	Abnormal Update Rate		CAN-J1939
69 / 19	17319	-	Two Speed Axle Switch	Received Network Data in Error		CAN-J1939
70 / 9	17409	-	Parking Brake Switch	Abnormal Update Rate		CAN-J1939
70 / 19	17419	-	Parking Brake Switch	Received Network Data in Error		CAN-J1939
84 / 3	10103	-	Vehicle Speed (C3 or J1939)	Open Circuit	- Check wiring	15/03
84 / 9	10109	-	Vehicle Speed (C3 or J1939)	Abnormal Update Rate		CAN-J1939
84 / 14	10114	-	Vehicle Speed (C3 or J1939)	Signal Not Plausible	- Check wiring	15/03
84 / 19	10119	-	Vehicle Speed (C3 or J1939)	Received Network Data in Error		CAN-J1939
91 / 0	10200	-	Accelerator Pedal (AFPS or J1939)	Not Adjusted	- Restart accelerator pedal adjustment routine - Check wiring - Limit value idle operation position: 5,0 V - Limit value kickdown position: 4,9 V	21/11
91 / 3	10203	-	Accelerator Pedal (AFPS or J1939)	Voltage too High	- Pedal unit exchange, if defective - check wiring - Limit value idle operation position: 5,0 V - Limit value kickdown position: 4,9 V	21/11

TIM-ID: 0000101050 - 001

ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
91 / 4	10204	-	Accelerator Pedal (AFPS or J1939)	Voltage too Low	- Pedal unit exchange, if defective - Check wiring - Limit value idle operation position: 5,0 V - Limit value kickdown position: 4,9 V	21/11
91 / 9	10209	-	Accelerator Pedal (AFPS or J1939)	Abnormal Update Rate		CAN-J1939
91 / 19	10219	-	Accelerator Pedal (AFPS or J1939)	Received Network Data in Error		CAN-J1939
94 / 0	-	11715	Fuel Pressure	Circuit High Input		LSCAN-MR
94 / 1	-	11716	Fuel Pressure	Circuit Low Input		LSCAN-MR
94 / 2	-	11717	Fuel Pressure	Range/Performance		LSCAN-MR
94 / 3	-	13015	Fuel Pressure	Open Circuit		LSCAN-MR
94 / 4	-	13016	Fuel Pressure	Shorted To Ground		LSCAN-MR
94 / 14	-	11917	Fuel Pressure	Pressure Too High/Too Low		LSCAN-MR
96 / 9	17509	-	Fuel Level	Abnormal Update Rate		CAN-J1939
96 / 19	17519	-	Fuel Level	Received Network Data in Error		CAN-J1939
98 / 0	10400	-	Oil Level (from PLD/MR2)	Oil Level too High	- Oil discharge with to strong overstocking. - Remark: This problem can occur also if in PLD/MR2 the false type of oil pan were programmed.	PLD/MR2
98 / 1	10401	-	Oil Level (from PLD/MR2)	Low Oil Level	- Refill oil	PLD/MR2
98 / 2	-	12026	Oil Level (from PLD/MR2)	Oil Level too High or too Low		LSCAN-MR
98 / 2	-	12403	Oil Level (from PLD/MR2)	Oil Level Not Plausible		LSCAN-MR
98 / 2	-	12517	Oil Level (from PLD/MR2)	Data Erratic, Not Plausible		LSCAN-MR
98 / 3	-	12516	Oil Level (from PLD/MR2)	Voltage Below		LSCAN-MR
98 / 4	-	12515	Oil Level (from PLD/MR2)	Voltage Above		LSCAN-MR
98 / 5	-	12509	Oil Level (from PLD/MR2)	Open Circuit		LSCAN-MR
98 / 14	10414	-	Oil Level (from PLD/MR2)	Oil Level too Low	- Refill oil - Remark: This problem can occur also if in PLD/MR2 the false type of oil pan were programmed.	PLD/MR2
100 / 1	10501	-	Oil Pressure (from PLD/MR2)	Low Oil Pressure	- Check oil pump and oil circuit	PLD/MR2
100 / 1	-	12021	Oil Pressure (from PLD/MR2)	Oil Pressure too Low		LSCAN-MR
100 / 2	-	11617	Oil Pressure (from PLD/MR2)	Range/Performance		LSCAN-MR
100 / 3	-	11615	Oil Pressure (from PLD/MR2)	High Voltage		LSCAN-MR
100 / 4	-	11616	Oil Pressure (from PLD/MR2)	Low Voltage		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
100 / 14	10514	-	Oil Pressure (from PLD/MR2)	Oil Pressure too Low	- Check oil pump and oil circuit.	PLD/MR2
100 / 14	-	12020	Oil Pressure (from PLD/MR2)	Oil Pressure too Low		LSCAN-MR
102 / 0	-	11820	Turbo Charger/ Supercharger	Overboost Condition		LSCAN-MR
102 / 1	-	11818	Turbo Charger/ Supercharger	Boost System Performance		LSCAN-MR
102 / 2	-	11417	Turbo Charger/ Supercharger	Boost Sensor “A” Circuit Range/Performance		LSCAN-MR
102 / 3	-	11415	Turbo Charger/ Supercharger	Boost Sensor “A” Circuit High		LSCAN-MR
102 / 4	-	11416	Turbo Charger/ Supercharger	Boost Sensor “A” Circuit Low		LSCAN-MR
102 / 7	-	11876	Turbo Charger/ Supercharger	Boost System Performance		LSCAN-MR
102 / 7	-	11878	Turbo Charger/ Supercharger	Bypass Valve – Mechanical		LSCAN-MR
102 / 13	-	11873	Turbo Charger/ Supercharger	Underboost, Control at Limit		LSCAN-MR
102 / 13	-	11874	Turbo Charger/ Supercharger	Underboost, Control Deviation too High		LSCAN-MR
102 / 13	-	11875	Turbo Charger/ Supercharger	Boost System Performance		LSCAN-MR
103 / 3	-	12616	Turbo Charger Speed Sensor	Circuit Low		LSCAN-MR
103 / 4	-	12615	Turbo Charger Speed Sensor	Circuit High		LSCAN-MR
103 / 7	-	12612	Turbo Charger Speed Sensor	Signal Timeout, no revolution on charger 1		LSCAN-MR
105 / 0	-	11822	Intake Air Temperature	Temperature Too high		LSCAN-MR
105 / 3	-	11215	Intake Air Temperature Sensor 1	Circuit High		LSCAN-MR
105 / 4	-	11216	Intake Air Temperature Sensor 1	Circuit Low		LSCAN-MR
107 / 0	10800	-	Air Filter Sensor (LF_SE)	Differential Pressure too High	- Check wiring.	15/08
107 / 3	10803	-	Air Filter Sensor (LF_SE)	Open Circuit	- Check wiring.	15/08
107 / 4	10804	-	Air Filter Sensor (LF_SE)	Short Circuit to Ground	- Check wiring.	15/08
110 / 0	-	12122	Coolant Temperature (from PLD/MR2)	High Coolant Temperature	- Cooling-water level and cooling circuit check.	LSCAN-MR
110 / 3	-	11515	Coolant Temperature (from PLD/MR2)	Sensor 1 Circuit High		LSCAN-MR
110 / 4	-	11516	Coolant Temperature (from PLD/MR2)	Sensor 1 Circuit Low		LSCAN-MR
110 / 14	10914	-	Coolant Temperature (from PLD/MR2)	Coolant Temperature too High	- Cooling-water level and cooling circuit check.	PLD/MR2
111 / 1	11001	-	Coolant Level Sensor (KW_SE)	Low Coolant Level	- Refill coolant - Check wiring	15/07
111 / 3	11003	-	Coolant Level Sensor (KW_SE)	Open Circuit	- Check wiring - Voltage must be larger than 2,0 V.	15/07
111 / 4	11004	-	Coolant Level Sensor (KW_SE)	Short Circuit to Ground	- Check wiring.	15/07
111 / 14	11014	-	Coolant Level Sensor (KW_SE)	Coolant Level too Low	- Refill coolant - Check wiring	15/07

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
158 / 0	11100	-	Battery Voltage Switched (Terminal 15)	Over Voltage	- Check battery voltage - Check parameter 2/08 (24V/12V selection)	21/02
158 / 1	11101	-	Battery Voltage Switched (Terminal 15)	Under Voltage	- Check battery voltage - Check parameter 2/08 (24V/12V selection)	21/02
158 / 2	-	12219	Battery Voltage Switched (Terminal 15)	Inconsistent		LSCAN-MR
158 / 14	-	12319	Battery Voltage Switched (Terminal 15)	Starter Switch Inconsistent		LSCAN-MR
161 / 9	17609	-	Transmission Input Shaft Speed	Abnormal Update Rate		CAN-J1939
161 / 19	17619	-	Transmission Input Shaft Speed	Received Network Data in Error		CAN-J1939
168 / 3	-	17542	System Voltage	Voltage High		LSCAN-MR
168 / 4	-	17543	System Voltage	Voltage Low		LSCAN-MR
171 / 2	-	13617	Ambient Air Temperature	Sensor Circuit Range/Performance		LSCAN-MR
171 / 3	16603	-	Ambient Air Temperature	Voltage too High	- Check wiring - Input Pin depending on configuration of parameter 13/39	21/11, 18/18, 15/08
171 / 4	16604	-	Ambient Air Temperature	Voltage too Low	- Check wiring - Input Pin depending on configuration of parameter 13/39	21/11, 18/18, 15/08
171 / 9	16609	-	Ambient Air Temperature	Abnormal Update Rate		CAN-J1939
171 / 9	-	13604	Ambient Air Temperature	Lost Message		LSCAN-MR
171 / 19	16619	-	Ambient Air Temperature	Received Network Data in Error		CAN-J1939
173 / 0	-	12406	Engine Exhaust Gas Temperature	Above Nominal Value		LSCAN-MR
173 / 15	-	12429	Engine Exhaust Gas Temperature	Too High		LSCAN-MR
174 / 3	-	11115	Fuel Temperature Sensor “A”	Circuit High Input		LSCAN-MR
174 / 4	-	11116	Fuel Temperature Sensor “A”	Circuit Low Input		LSCAN-MR
175 / 3	-	11015	Engine Oil Temperature Sensor	Circuit High		LSCAN-MR
175 / 4	-	11016	Engine Oil Temperature Sensor	Ciruit Low		LSCAN-MR
190 / 0	-	10530	Engine Speed	Engine Overspeed Condition		LSCAN-MR
191 / 9	17709	-	Transmission Output Shaft Speed	Abnormal Update Rate		CAN-J1939
191 / 19	17719	-	Transmission Output Shaft Speed	Received Network Data in Error		CAN-J1939
354 / 3	-	13415	Ambient Air Combi Sensor, Part Humidity	Circuit High		LSCAN-MR
354 / 4	-	13416	Ambient Air Combi Sensor, Part Humidity	Circuit Low		LSCAN-MR
523 / 9	17809	-	Transmission Current Gear	Abnormal Update Rate		CAN-J1939
523 / 19	17819	-	Transmission Current Gear	Received Network Data in Error		CAN-J1939

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
524 / 9	17909	-	Transmission Selected Gear	Abnormal Update Rate		CAN-J1939
524 / 19	17919	-	Transmission Selected Gear	Received Network Data in Error		CAN-J1939
558 / 1	11701	-	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Signals Equal but Should Not	- Check wiring	21/12 and 21/13
558 / 5	11705	-	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Switches Open Circuit	- Check wiring - Pedal unit exchange, if defective	21/12 and 21/13
558 / 9	11709	-	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Abnormal Update Rate		CAN-J1939
558 / 12	11712	-	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Switches Closed	- check wiring - Pedal unit exchange, if defective	21/12 and 21/13
558 / 19	11719	-	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Received Network Data in Error		CAN-J1939
559 / 9	18009	-	Accelerator Pedal Kickdown Switch	Abnormal Update Rate		CAN-J1939
559 / 19	18019	-	Accelerator Pedal Kickdown Switch	Received Network Data in Error		CAN-J1939
573 / 9	18109	-	Transmission Torque Converter Lockup Engaged	Abnormal Update Rate		CAN-J1939
573 / 19	18119	-	Transmission Torque Converter Lockup Engaged	Received Network Data in Error		CAN-J1939
574 / 9	18209	-	Transmission Shift In Process	Abnormal Update Rate		CAN-J1939
574 / 19	18219	-	Transmission Shift In Process	Received Network Data in Error		CAN-J1939
596 / 9	18309	-	Cruise Control Enable Switch	Abnormal Update Rate		CAN-J1939
596 / 19	18319	-	Cruise Control Enable Switch	Received Network Data in Error		CAN-J1939
597 / 9	18409	-	Brake Switch	Abnormal Update Rate		CAN-J1939
597 / 19	18419	-	Brake Switch	Received Network Data in Error		CAN-J1939
598 / 9	18509	-	Clutch Switch	Abnormal Update Rate		CAN-J1939
598 / 19	18519	-	Clutch Switch	Received Network Data in Error		CAN-J1939
599 / 9	11809	-	Cruise Control Switch CC- (Set + Coast)	Abnormal Update Rate (Set Switch)		CAN-J1939
599 / 12	11812	-	Cruise Control Switch CC- (Set + Coast)	Both Switches CC- and CC+ Closed	- Check wiring - Check cruise control switch	18/04 and 18/05
599 / 14	11814	-	Cruise Control Switch CC- (Set + Coast)	Plausibility Check Failed (Check Stalk Switch Wiring)	- Check wiring of stalk switch - Check parameter 13/37	18/04 and 12/07
599 / 19	11819	-	Cruise Control Switch CC- (Set + Coast)	Received Network Data in Error		CAN-J1939
600 / 9	18609	-	Cruise Control Coast (Decelerate) Switch	Abnormal Update Rate		CAN-J1939
600 / 19	18619	-	Cruise Control Coast (Decelerate) Switch	Received Network Data in Error		CAN-J1939
601 / 9	11909	-	Cruise Control Switch CC+ (Res + Acc)	Abnormal Update Rate (Resume Switch)		CAN-J1939

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
601 / 12	11912	-	Cruise Control Switch CC+ (Res + Acc)	Both Switches CC+ and CC- Closed	- Check wiring - Check cruise control switch	18/04 and 18/05
601 / 14	11914	-	Cruise Control Switch CC+ (Res + Acc)	Plausibility Check Failed (Check Stalk Switch Wiring)	- Check wiring of stalk switch - Check parameter 13/37	18/05 and 12/07
601 / 19	11919	-	Cruise Control Switch CC+ (Res + Acc)	Received Network Data in Error		CAN-J1939
602 / 9	18709	-	CCVS1 Cruise Control Accelerate Switch	Abnormal Update Rate or Signal Not Available		CAN-J1939
602 / 19	18719	-	CCVS1 Cruise Control Accelerate Switch	Received Network Data in Error		CAN-J1939
609 / 0	-	19960	Anti Theft Device	Immobilizer Number of Keys Limited to 8		LSCAN-MR
609 / 2	12002		PLD/MR2 Error	Unknown Cause	- Check PLD/MR2 Error Codes	PLD/MR2
609 / 2	-	19963	Anti Theft Device	Immobilizer TPC Signal Error CAN		LSCAN-MR
609 / 2	-	19965	Anti Theft Device	Incorrect Immobilizer Key		LSCAN-MR
609 / 9	-	19964	Anti Theft Device	Immobilizer TPC Signal Error Starter Line		LSCAN-MR
609 / 11	-	14056	PLD/MR2	Data Map Manipulated, Control Module Performance		LSCAN-MR
609 / 11	-	14058	PLD/MR2	Data Map Manipulated, Control Module Programming Error		LSCAN-MR
609 / 11	-	19962	Anti Theft Device	Immobilizer Automatically Activated		LSCAN-MR
609 / 12	-	11315	PLD/MR2 Barometric Pressure Circuit	Open Circuit		LSCAN-MR
609 / 12	-	11316	PLD/MR2 Barometric Pressure Circuit	Shorted to Ground		LSCAN-MR
609 / 12	-	12401	PLD/MR2	Auxiliary Voltage 8,5V Defective		LSCAN-MR
609 / 12	-	12402	PLD/MR2	Common Internal Error		LSCAN-MR
609 / 12	-	14024	PLD/MR2	Limp Home Controller / Controller #2 Defective		LSCAN-MR
609 / 12	-	14034	PLD/MR2	High Side Driver PVB1 Defective		LSCAN-MR
609 / 12	-	14035	PLD/MR2	High Side Driver PVB2 Defective		LSCAN-MR
609 / 12	-	14036	PLD/MR2	High Side Driver PV5 Defective		LSCAN-MR
609 / 12	-	14038	PLD/MR2	Starter Driver Defective (Redundant)		LSCAN-MR
609 / 12	-	14039	PLD/MR2	Starter Driver Defective (Main)		LSCAN-MR
609 / 12	-	14040	PLD/MR2	Diagnosis Starter Error		LSCAN-MR
609 / 12	-	14041	PLD/MR2	Diagnosis Starter Error		LSCAN-MR
609 / 12	-	14054	PLD/MR2	Low Speed CAN Data Error		LSCAN-MR
609 / 12	-	14262	PLD/MR2	Wrong Boot Block		LSCAN-MR
609 / 12	-	14296	PLD/MR2 Bootloader	Application Software Defective		LSCAN-MR
609 / 12	-	14297	PLD/MR2 Bootloader	Flash Memory Defective		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
609 / 12	-	14298	PLD/MR2 Bootloader	Flash Not Erasable		LSCAN-MR
609 / 12	-	14299	PLD/MR2 Bootloader	No Application Software In Flash		LSCAN-MR
609 / 12	-	18039	PLD/MR2 Starter Relay Circuit	Shorted (Main or Redundant)		LSCAN-MR
609 / 13	-	12400	PLD/MR2	No. Of Cylinders Not Corresponding To Engine Type		LSCAN-MR
609 / 14	-	14037	PLD/MR2 Program	Wrong No. of Cylinders		LSCAN-MR
609 / 14	-	14047	PLD/MR2 Program	Set of Maps Error		LSCAN-MR
609 / 14	-	14048	PLD/MR2 Program	Wrong No. of Cylinders		LSCAN-MR
609 / 14	-	14049	PLD/MR2 Program	PWM Calibration		LSCAN-MR
609 / 14	-	14050	PLD/MR2 Program	Wrong Hardware		LSCAN-MR
609 / 14	-	14051	PLD/MR2 Program	EEPROM Checksum 1		LSCAN-MR
609 / 14	-	14052	PLD/MR2 Program	EEPROM Checksum 2		LSCAN-MR
609 / 14	-	14053	PLD/MR2 Program	EEPROM Checksum 3		LSCAN-MR
609 / 14	-	14269	Euromot3b / Tier4i Engine Control Module	Chassis Control Module Mismatch	New Since Version 10.00	LSCAN-MR
609 / 14	-	19961	Anti Theft Device	Immobilizer Response Counter Flow		LSCAN-MR
611 / 4	-	16506	Oil Separator	Circuit Low		LSCAN-MR
611 / 12	-	16564	Oil Separator	Circuit High		LSCAN-MR
620 / 3	12103	-	Supply Analog Accelerator Pedal (AFP+)	Voltage too High	- Supply voltage > 5,2 V.	21/09
620 / 4	12104	-	Supply Analog Accelerator Pedal (AFP+)	Voltage too Low	- Supply voltage < 4,8 V.	21/09
625 / 2	12202	-	CAN Link ADM3 – PLD/MR2	No Communication with PLD/MR2	- Check wiring (engine CAN) - Check configuration: PLD/MR2 parameter (../..) and ADM3 parameter 01/01 to be set to equal functionality (One wire capability)	-
625 / 2	-	10102	CAN Link ADM3 – PLD/MR2	Invalid Data Received	- Check wiring (engine CAN)	LSCAN-MR
625 / 2	-	10104	CAN Link ADM3 – PLD/MR2	No Communication	- Check wiring (engine CAN)	LSCAN-MR
625 / 14	-	10100	CAN Link ADM3 – PLD/MR2	CAN B Bus (+) Circuit	- Check wiring (engine CAN)	LSCAN-MR
625 / 14	-	10101	CAN Link ADM3 – PLD/MR2	CAN B Bus (-) Circuit	- Check wiring (engine CAN)	LSCAN-MR
625 / 14	-	10149	PLD/MR2	Control Module Vehicle Options Error		LSCAN-MR
630 / 2	-	14092	Control Module	Module Performance		LSCAN-MR
630 / 9	-	14149	Control Module	Vehicle Options Error	- Check Engine Brake Parameters	LSCAN-MR
632 / 5	-	12430	Fuel Shutoff Valve "A" Control	Circuit Open		LSCAN-MR
636 / 1	-	10310	Crankshaft Position Sensor “A”	Circuit Range/Perforamnce		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
636 / 3	-	10309	Crankshaft Position Sensor “A”	Open Circuit		LSCAN-MR
636 / 4	-	10308	Crankshaft Position Sensor “A”	Low Input		LSCAN-MR
636 / 7	-	10311	Crankshaft Position	Camshaft Position Correlation (Bank 1 Sensor)		LSCAN-MR
636 / 8	-	10312	Crankshaft Position Sensor “A” Circuit	Time Out		LSCAN-MR
636 / 14	-	10313	Crankshaft Position Sensor “A”	Polarity Error		LSCAN-MR
639 / 2	14902	-	SAE J1939 Interface	At Least One J1939 Message is Missing	- Check wiring - Check other Control Units on J1939	CAN-J1939
651 / 5	-	15027	Injector Cylinder 1	Open Ciruit		LSCAN-MR
651 / 6	-	15028	Injector Cylinder 1	Shorted Circuit		LSCAN-MR
651 / 7	-	15026	Injector Cylinder 1	Injection Timing, No Plunger		LSCAN-MR
651 / 12	-	19044	Injector Cylinder 1	Idle Control At Limit		LSCAN-MR
651 / 14	-	19045	Injector Cylinder 1	Cylinder Correction At Limit		LSCAN-MR
652 / 5	-	15127	Injector Cylinder 2	Open Circuit		LSCAN-MR
652 / 6	-	15128	Injector Cylinder 2	Shorted Circuit		LSCAN-MR
652 / 7	-	15126	Injector Cylinder 2	Injection Timing, No Plunger		LSCAN-MR
652 / 12	-	19144	Injector Cylinder 2	Idle Control At Limit		LSCAN-MR
652 / 14	-	19145	Injector Cylinder 2	Cylinder Correction At Limit		LSCAN-MR
653 / 5	-	15227	Injector Cylinder 3	Open Circuit		LSCAN-MR
653 / 6	-	15228	Injector Cylinder 3	Shorted Circuit		LSCAN-MR
653 / 7	-	15226	Injector Cylinder 3	Injection Timing, No Plunger		LSCAN-MR
653 / 12	-	19244	Injector Cylinder 3	Idle Control At Limit		LSCAN-MR
653 / 14	-	19245	Injector Cylinder 3	Cylinder Correction At Limit		LSCAN-MR
654 / 5	-	15327	Injector Cylinder 4	Open Circuit		LSCAN-MR
654 / 6	-	15328	Injector Cylinder 4	Shorted Circuit		LSCAN-MR
654 / 7	-	15326	Injector Cylinder 4	Injection Timing, No Plunger		LSCAN-MR
654 / 12	-	19344	Injector Cylinder 4	Idle Control At Limit		LSCAN-MR
654 / 14	-	19345	Injector Cylinder 4	Cylinder Correction At Limit		LSCAN-MR
655 / 5	-	15427	Injector Cylinder 5	Open Circuit		LSCAN-MR
655 / 6	-	15428	Injector Cylinder 5	Shorted Circuit		LSCAN-MR
655 / 7	-	15426	Injector Cylinder 5	Injection Timing, No Plunger		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
655 / 12	-	19444	Injector Cylinder 5	Idle Control At Limit		LSCAN-MR
655 / 14	-	19445	Injector Cylinder 5	Cylinder Correction At Limit		LSCAN-MR
656 / 5	-	15527	Injector Cylinder 6	Open Circuit		LSCAN-MR
656 / 6	-	15528	Injector Cylinder 6	Shorted Circuit		LSCAN-MR
656 / 7	-	15526	Injector Cylinder 6	Injection Timing, No Plunger		LSCAN-MR
656 / 12	-	19544	Injector Cylinder 6	Idle Control At Limit		LSCAN-MR
656 / 14	-	19545	Injector Cylinder 6	Cylinder Correction At Limit		LSCAN-MR
657 / 5	-	15627	Injector Cylinder 7	Open Circuit		LSCAN-MR
657 / 6	-	15628	Injector Cylinder 7	Shorted Circuit		LSCAN-MR
657 / 7	-	15626	Injector Cylinder 7	Injection Timing, No Plunger		LSCAN-MR
657 / 12	-	19644	Injector Cylinder 7	Idle Control At Limit		LSCAN-MR
657 / 14	-	19645	Injector Cylinder 7	Cylinder Correction At Limit		LSCAN-MR
658 / 5	-	15727	Injector Cylinder 8	Open Circuit		LSCAN-MR
658 / 6	-	15728	Injector Cylinder 8	Shorted Circuit		LSCAN-MR
658 / 7	-	15726	Injector Cylinder 8	Injection Timing, No Plunger		LSCAN-MR
658 / 12	-	19744	Injector Cylinder 8	Idle Control At Limit		LSCAN-MR
658 / 14	-	19745	Injector Cylinder 8	Cylinder Correction At Limit		LSCAN-MR
677 / 3	-	18005	Output Relay 1 (PLD/MR2)	Starter Relay Shorted To High		LSCAN-MR
677 / 3	13303	-	Output Relay 1 (REL 1)	Open Circuit	- Check wiring - Check relay 1	15/12
677 / 4	13304	-	Output Relay 1 (REL 1)	Short Circuit to Ground	- Check wiring - Check relay 1	15/12
677 / 5	-	18009	Output Relay 1 (PLD/MR2)	Starter Relay Open Circuit		LSCAN-MR
677 / 6	-	18008	Output Relay 1 (PLD/MR2)	Starter Relay Shorted To Ground		LSCAN-MR
677 / 7	-	18086	Output Relay 1 (PLD/MR2)	Starter Stick, Does not Engage		LSCAN-MR
677 / 14	-	18033	Output Relay 1 (PLD/MR2)	Starter Relay Stick		LSCAN-MR
697 / 3	-	17007	Proportional Valve 1	Circuit High		LSCAN-MR
697 / 3	-	17705	Proportional Valve Bank 1	Shorted To Battery Voltage Bank 1		LSCAN-MR
697 / 4	-	17708	Proportional Valve Bank 1	Shorted To Ground Bank 1		LSCAN-MR
697 / 5	-	12425	Proportional Valve Bank 1	Open Circuit		LSCAN-MR
697 / 5	-	17009	Proportional Valve 1	Open Circuit		LSCAN-MR
697 / 6	-	17006	Proportional Valve 1	Shorted To Ground		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
698 / 3	-	17305	Proportional Valve 2	Shorted To Battery Voltage		LSCAN-MR
698 / 3	-	17307	Proportional Valve 2	Shorted To Battery Voltage		LSCAN-MR
698 / 5	-	12426	Proportional Valve Bank 2	Open Circuit		LSCAN-MR
698 / 5	-	17309	Proportional Valve 2	Open Circuit		LSCAN-MR
698 / 5	-	17317	Proportional Valve 2	Open Circuit		LSCAN-MR
698 / 6	-	17306	Proportional Valve 2	Shorted To Ground		LSCAN-MR
699 / 3	-	17107	Proportional Valve 3	Shorted To Battery Voltage		LSCAN-MR
699 / 5	-	17109	Proportional Valve 3	Open Circuit		LSCAN-MR
699 / 6	-	17106	Proportional Valve 3	Shorted To Ground		LSCAN-MR
700 / 3	-	17207	Proportional Valve 4	Shorted To Battery Voltage		LSCAN-MR
700 / 5	-	17209	Proportional Valve 4	Open Circuit		LSCAN-MR
700 / 6	-	17206	Proportional Valve 4	Shorted To Ground		LSCAN-MR
705 / 3	-	12411	Proportional Valve 5	CNG Lock Valve Shorted To Battery Voltage		LSCAN-MR
705 / 3	-	17405	Proportional Valve 5	Shorted To Battery Voltage		LSCAN-MR
705 / 3	-	17805	Proportional Valve Bank 2	Shorted To Battery Voltage		LSCAN-MR
705 / 4	-	12412	Proportional Valve 5	CNG Lock Valve Shorted To Ground		LSCAN-MR
705 / 4	-	17408	Proportional Valve 5	Shorted To Ground		LSCAN-MR
705 / 4	-	17808	Proportional Valve Bank 2	Shorted To Ground		LSCAN-MR
706 / 3	-	17609	Proportional Valve 6	Open Circuit		LSCAN-MR
706 / 5	-	17607	Proportional Valve 6	Shorted To Battery Voltage		LSCAN-MR
706 / 6	-	17606	Proportional Valve 6	Shorted To Ground		LSCAN-MR
723 / 3	-	10409	Camshaft Position Sensor “A” (Bank 1 or Single Sensor)	Open Circuit		LSCAN-MR
723 / 4	-	10408	Camshaft Position Sensor “A” (Bank 1 or Single Sensor)	Shorted To Ground		LSCAN-MR
723 / 8	-	10412	Camshaft Position Sensor “A” (Bank 1 or Single Sensor)	Time Out		LSCAN-MR
723 / 14	-	10413	Camshaft Position Sensor “A” (Bank 1 or Single Sensor)	Polarity Error, Pins Swapped		LSCAN-MR
729 / 3	14003	-	Intake Air Heater (MBR_KD)	Open Circuit	- Check wiring - Check solenoid valve	15/10
729 / 4	14004	-	Intake Air Heater (MBR_KD)	Short Circuit to Ground	- Check wiring - Check solenoid valve	15/10
729 / 5	-	16409	Intake Air Heater (PLD/MR2)	Circuit Open		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
729 / 12	-	16432	Intake Air Heater (PLD/MR2)	Circuit Universal Troubles		LSCAN-MR
730 / 0	13900	-	Output Relay 2 (REL 2)	Grid Heater: No Increasing Boost Temperature After Activation	- Check wiring - Check relay 2 - Check grid heater	15/09
730 / 1	13901	-	Output Relay 2 (REL 2)	Relay Permanently Closed (Grid Heater)	- Check wiring - Check relay 2	15/09
730 / 2	13902	-	Output Relay 2 (REL 2)	Relay Permanently Open (Grid Heater)	- Check wiring - Check relay 2	15/09
730 / 3	13903	-	Output Relay 2 (REL 2)	Voltage too High when Activated	- Check wiring	15/09
730 / 4	13904	-	Output Relay 2 (REL 2)	Voltage too Low when Activated	- Check wiring - Check relay 2	15/09
870 / 3	-	14223	SCR Diffusor Heating	Circuit High		LSCAN-MR
870 / 3	-	14270	Heater Regeneration System	Circuit High		LSCAN-MR
870 / 4	-	14222	SCR Diffusor Heating	Circuit Low		LSCAN-MR
870 / 4	-	14269	Heater Regeneration System	Circuit Low		LSCAN-MR
870 / 5	-	14221	SCR Diffusor Heating	Circuit Open		LSCAN-MR
904 / 9	18809	-	Front Axle Speed	Abnormal Update Rate		CAN-J1939
904 / 19	18819	-	Front Axle Speed	Received Network Data in Error		CAN-J1939
925 / 3	-	17905	SCR Module Proportional Valve Bank	Circuit High		LSCAN-MR
925 / 4	-	17908	SCR Module Proportional Valve Bank	Circuit Low		LSCAN-MR
973 / 9	18909	-	Engine Retarder Selection	Abnormal Update Rate		CAN-J1939
973 / 19	18919	-	Engine Retarder Selection	Received Network Data in Error		CAN-J1939
974 / 2	14202	-	Remote Throttle Pedal (HFG)	Supply Voltage Out of Range (Pin HFG+)	- Limit values for the supply voltage of the HFG: Minimum value: 4,8 V and maximum value: 5,2 V.	18/17
974 / 3	14203	-	Remote Throttle Pedal (HFG)	Voltage too High	- Check wiring - Check remote pedal	18/18
974 / 4	14204	-	Remote Throttle Pedal (HFG)	Voltage too Low	- Check wiring - Check remote pedal	18/18
986 / 1	-	10631	Fan Speed	Speed Too Low		LSCAN-MR
986 / 9	-	10612	Fan Speed	Time Out		LSCAN-MR
986 / 9	-	17112	Fan Speed	Time Out		LSCAN-MR
1004 / 3	14403	-	Output Relay 4 (REL 4)	Open Circuit	- Check wiring - Check relay 4	18/01
1004 / 4	14404	-	Output Relay 4 (REL 4)	Short Circuit to Ground	- Check wiring - Check relay	18/01
1005 / 3	14503	-	Output PWM Pedal Supply or Transmission (FP+)	Open Circuit	- Check wiring.	15/05
1005 / 4	14504	-	Output PWM Pedal Supply or Transmission (FP+)	Short Circuit to Ground	- Check wiring.	15/05

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1015 / 1	15001	-	PWM Accelerator Pedal (PWM FFG)	No Supply Voltage at Pin FP+	- Check wiring	15/05
1015 / 3	15003	-	PWM Accelerator Pedal (PWM FFG)	No Signal at Path 2 (GAS2)	- Check wiring - Pins 21/13, 15/05 , 21/14.	
1015 / 4	15004	-	PWM Accelerator Pedal (PWM FFG)	No Signal at Path 1 (GAS1)	- Check wiring - Pins 21/12, 15/05 , 21/14	
1015 / 5	15005	-	PWM Accelerator Pedal (PWM FFG)	Not Adjusted	- Restart accelerator pedal adjustment routine	-
1015 / 6	15006	-	PWM Accelerator Pedal (PWM FFG)	Idle Position Out of Adjusted Range	- Restart accelerator pedal adjustment routine	-
1015 / 7	15007	-	PWM Accelerator Pedal (PWM FFG)	Out of Adjusted Range	- Restart accelerator pedal adjustment routine	-
1072 / 3	10003	-	Decompression Brake Valve (MBR_KD)	Open Circuit	- Check wiring - Check solenoid valve	15/10
1072 / 4	10004	-	Decompression Brake Valve (MBR_KD)	Short Circuit to Ground	- Check wiring - Check solenoid valve	15/10
1074 / 3	14603	-	Exhaust Brake Valve (MBR_BK)	Open Circuit	- Check wiring - Check exhaust brake valve	15/06
1074 / 3	-	14256	Exhaust Brake Valve (PLD/MR2)	Circuit High		LSCAN-MR
1074 / 4	14604	-	Exhaust Brake Valve (MBR_BK)	Short Circuit to Ground	- Check wiring - Check exhaust brake valve	15/06
1074 / 4	-	14255	Exhaust Brake Valve (PLD/MR2)	Circuit Low		LSCAN-MR
1074 / 5	-	14257	Exhaust Brake Valve (PLD/MR2)	Circuit Open		LSCAN-MR
1074 / 12	-	14254	Exhaust Brake Valve (PLD/MR2)	Performance		LSCAN-MR
1127 / 1	-	14259	Intake Throttle Turbocharger	Underboost		LSCAN-MR
1132 / 3	-	13115	Intake Air Temperature Sensor 2	Circuit High		LSCAN-MR
1132 / 4	-	13116	Intake Air Temperature Sensor 2	Circuit Low		LSCAN-MR
1136 / 0	-	14273	Engine ECU Temperature	Temperature too High		LSCAN-MR
1136 / 1	-	14274	Engine ECU Temperature	Temperature too Low		LSCAN-MR
1184 / 0	-	14422	Engine Turbocharger 1 Turbine Outlet Tempeature	Temperature Too High		LSCAN-MR
1184 / 2	-	14263	Engine Turbocharger 1 Turbine Outlet Tempeature	Not Plausible		LSCAN-MR
1184 / 3	-	14415	Engine Turbocharger 1 Turbine Outlet Tempeature	Circuit High		LSCAN-MR
1184 / 4	-	14416	Engine Turbocharger 1 Turbine Outlet Tempeature	Circuit Low		LSCAN-MR
1213 / 12	-	16327	Malfunction Indicator Lamp (MIL)	Control Circuit		LSCAN-MR
1227 / 7	-	14261	Constant Throttle System	System Performance		LSCAN-MR
1231 / 9	-	10204	High Speed CAN Communication Bus	Lost Communication		LSCAN-MR
1237 / 9	19509	-	Engine Shutdown Override	Abnormal Update Rate		CAN-J1939

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
1237 / 19	19519	-	Engine Shutdown Override	Received Network Data in Error		CAN-J1939
1268 / 3	-	12432	Engine Ignition Coil #1	Circuit High		LSCAN-MR
1268 / 4	-	12433	Engine Ignition Coil #1	Circuit Low		LSCAN-MR
1268 / 5	-	12434	Engine Ignition Coil #1	Open Circuit		LSCAN-MR
1269 / 3	-	12435	Engine Ignition Coil #2	Circuit High		LSCAN-MR
1269 / 4	-	12436	Engine Ignition Coil #2	Circuit Low		LSCAN-MR
1269 / 5	-	12437	Engine Ignition Coil #2	Open Circuit		LSCAN-MR
1270 / 3	-	12438	Engine Ignition Coil #3	Circuit High		LSCAN-MR
1270 / 4	-	12439	Engine Ignition Coil #3	Circuit Low		LSCAN-MR
1270 / 5	-	12440	Engine Ignition Coil #3	Open Circuit		LSCAN-MR
1271 / 3	-	12441	Engine Ignition Coil #4	Circuit High		LSCAN-MR
1271 / 4	-	12442	Engine Ignition Coil #4	Circuit Low		LSCAN-MR
1271 / 5	-	12443	Engine Ignition Coil #4	Open Circuit		LSCAN-MR
1272 / 3	-	12444	Engine Ignition Coil #5	Circuit High		LSCAN-MR
1272 / 4	-	12445	Engine Ignition Coil #5	Circuit Low		LSCAN-MR
1272 / 5	-	12446	Engine Ignition Coil #5	Open Circuit		LSCAN-MR
1273 / 3	-	12447	Engine Ignition Coil #6	Circuit High		LSCAN-MR
1273 / 4	-	12448	Engine Ignition Coil #6	Circuit Low		LSCAN-MR
1273 / 5	-	12449	Engine Ignition Coil #6	Open Circuit		LSCAN-MR
1387 / 2	-	18417	Reductant Pressure Sensor	Circuit Range/Performance		LSCAN-MR
1387 / 3	-	18415	Reductant Pressure Sensor	Circuit High		LSCAN-MR
1387 / 4	-	18416	Reductant Pressure Sensor	Circuit Low		LSCAN-MR
1390 / 0	-	12409	Engine Fuel Valve 1 Inlet Absolute Pressure	Above Measuring Range		LSCAN-MR
1390 / 1	-	12410	Engine Fuel Valve 1 Inlet Absolute Pressure	Below Measuring Range		LSCAN-MR
1390 / 17	-	12408	Engine Fuel Valve 1 Inlet Absolute Pressure	Too Low		LSCAN-MR
1623 / 9	19009	-	Tachograph Output Shaft Speed	Abnormal Update Rate		CAN-J1939
1623 / 19	19019	-	Tachograph Output Shaft Speed	Received Network Data in Error		CAN-J1939
1624 / 9	19109	-	Tachograph Vehicle Speed	Abnormal Update Rate		CAN-J1939
1624 / 19	19119	-	Tachograph Vehicle Speed	Received Network Data in Error		CAN-J1939
1633 / 9	19209	-	Cruise Control Pause Switch	Abnormal Update Rate		CAN-J1939

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
1633 / 14	19214	-	Cruise Control Pause Switch	Plausibility Check Failed (Check Stalk Switch Wiring)	- Check wiring of stalk switch - Check parameter 13/37	18/06 and 12/07
1633 / 19	19219	-	Cruise Control Pause Switch	Received Network Data in Error		CAN-J1939
1636 / 3	-	13515	Ambient Air Combi Sensor, Part Temperature	Circuit High		LSCAN-MR
1636 / 4	-	13516	Ambient Air Combi Sensor, Part Temperature	Circuit Low		LSCAN-MR
1695 / 0	-	12413	Engine Exhaust Gas Oxygen Sensor (Lambda Sensor) Fueling Correction	Control Deviation Too High		LSCAN-MR
1695 / 2	-	12450	Engine Exhaust Gas Oxygen Sensor (Lambda Sensor) Fueling Correction	Drift Not Plausible		LSCAN-MR
1716 / 9	19309	-	Retarder Selection, non-engine	Abnormal Update Rate		CAN-J1939
1716 / 19	19319	-	Retarder Selection, non-engine	Received Network Data in Error		CAN-J1939
1761 / 1	-	16029	Reductant Level	Level Low		LSCAN-MR
1761 / 18	-	14270	Tier4i Reductant Level Sensor	Level Too Low		LSCAN-MR
1761 / 3	-	16015	Reductant Level Sensor	Circuit High		LSCAN-MR
1761 / 4	-	16016	Reductant Level Sensor	Circuit Low		LSCAN-MR
1908 / 3	-	18107	SCR Air Pressure Shut-Off Valve Solenoid	Circuit High		LSCAN-MR
1908 / 4	-	18106	SCR Air Pressure Shut-Off Valve Solenoid	Circuit Low		LSCAN-MR
1908 / 5	-	18109	SCR Air Pressure Shut-Off Valve Solenoid	Circuit Open		LSCAN-MR
2436 / 9	-	12712	Generator Speed Sensing	Signal-Timeout		LSCAN-MR
2791 / 0	-	13215	Exhaust Gas Recirculation	Temperature Sensor Circuit High		LSCAN-MR
2791 / 1	-	13216	Exhaust Gas Recirculation	Temperature Sensor Circuit Low		LSCAN-MR
2791 / 2	-	16679	Exhaust Gas Recirculation	System Performance, Temperature Diagnosis		LSCAN-MR
2791 / 7	-	16678	Exhaust Gas Recirculation	System Performance, Universal Control Error		LSCAN-MR
2791 / 12	-	13332	Exhaust Gas Recirculation	Temperature Too High/Too Low		LSCAN-MR
2797 / 3	-	14805	Engine Injector Group 1	Circuit High		LSCAN-MR
2797 / 4	-	14806	Engine Injector Group 1	Circuit Low		LSCAN-MR
2797 / 5	-	12427	Engine Injector Group 1	Open Circuit		LSCAN-MR
2797 / 9	-	19846	Engine Injector Group 1, Cylinder Contribution/Balance	Timeout		LSCAN-MR
2798 / 3	-	14905	Engine Injector Group 2	Circuit High		LSCAN-MR
2798 / 4	-	14906	Engine Injector Group 2	Circuit Low		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
2798 / 5	-	12428	Engine Injector Group 2	Open Circuit		LSCAN-MR
3031 / 3	-	16115	Reductant Tank Temperature Sensor	Circuit High		LSCAN-MR
3031 / 4	-	16116	Reductant Tank Temperature Sensor	Circuit Low		LSCAN-MR
3031 / 7	-	16169	Reductant Tank Temperature Sensor	Circuit		LSCAN-MR
3050 / 7	-	14247	NOx Emission SCR Catalyst	SCR Catalyst Error		LSCAN-MR
3050 / 13	-	16949	SCR System Calibration	Calibration Error		LSCAN-MR
3217 / 0	-	12414	Aftertreatment 1 Intake %O2 (Lambda Sensor)	Above Measuring Range		LSCAN-MR
3217 / 1	-	12415	Aftertreatment 1 Intake %O2 (Lambda Sensor)	Below Measuring Range		LSCAN-MR
3217 / 2	-	12451	Aftertreatment 1 Intake %O2 (Lambda Sensor)	Not Plausible		LSCAN-MR
3219 / 1	-	12823	NOx Sensor	Operation Temperature Not Reached		LSCAN-MR
3220 / 9	-	12804	NOx Concentration	Lost Message		LSCAN-MR
3222 / 0	-	12416	Aftertreatment 1 Intake Gas Sensor (Lambda Sensor) Heater Preliminary FMI	Above Measuring Range		LSCAN-MR
3222 / 1	-	12417	Aftertreatment 1 Intake Gas Sensor (Lambda Sensor) Heater Preliminary FMI	Below Measuring Range		LSCAN-MR
3222 / 2	-	12418	Aftertreatment 1 Intake Gas Sensor (Lambda Sensor) Heater Preliminary FMI	Measuring Range Not Plausible		LSCAN-MR
3224 / 3	-	12815	NOx Sensor	Circuit High (Bank 1)		LSCAN-MR
3224 / 4	-	12816	NOx Sensor	Circuit Low (Bank 1)		LSCAN-MR
3224 / 16	-	14234	NOx Emission	Level 2 Exceeded		LSCAN-MR
3226 / 15	-	14246	NOx Emission	Increased Raw Emission		LSCAN-MR
3234 / 2	-	14237	NOx Sensor (Bank 1)	Circuit Range/Performance		LSCAN-MR
3234 / 12	-	14245	NOx Emission NOx Sensor	Sensor Error		LSCAN-MR
3234 / 13	-	14244	NOx Sensor	Sensor Readiness Error		LSCAN-MR
3242 / 3	-	14207	Diesel Oxidation Catalyst Inlet Temperature Sensor	Circuit High		LSCAN-MR
3242 / 4	-	14208	Diesel Oxidation Catalyst Inlet Temperature Sensor	Circuit Low		LSCAN-MR
3246 / 1	-	14238	Diesel Particulate Filter Operation Temperature	Temperature Not Reached		LSCAN-MR
3250 / 3	-	14209	Diesel Oxidation Catalyst Outlet Temperature Sensor	Circuit High		LSCAN-MR
3250 / 4	-	14210	Diesel Oxidation Catalyst Outlet Temperature Sensor	Circuit Low		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
3251 / 0	-	14215	Diesel Particulate Filter Differential Pressure	Pressure Too High		LSCAN-MR
3251 / 1	-	14216	Diesel Particulate Filter Differential Pressure	Pressure Too Low		LSCAN-MR
3251 / 7	-	14231	Diesel Particulate Filter	Component Not Present		LSCAN-MR
3251 / 15	-	14258	Diesel Particulate Filter Regeneration	Regeneration Insuffcient		LSCAN-MR
3361 / 3	-	18207	Prop. Valve 7, Reductant Injector (Bank 1 Unit 1)	Circuit High		LSCAN-MR
3361 / 3	-	18907	Reductant Injector (Bank 1 Unit 1)	Circuit High		LSCAN-MR
3361 / 4	-	18206	Prop. Valve 7, Reductant Injector (Bank 1 Unit 1)	Circuit Low		LSCAN-MR
3361 / 4	-	18208	Prop. Valve 7, Reductant Injector (Bank 1 Unit 1)	Circuit Low		LSCAN-MR
3361 / 4	-	18906	Reductant Injector (Bank 1 Unit 1)	Circuit Low		LSCAN-MR
3361 / 5	-	18209	Prop. Valve 7, Reductant Injector (Bank 1 Unit 1)	Circuit / Open		LSCAN-MR
3361 / 5	-	18909	Reductant Injector (Bank 1 Unit 1)	Circuit / Open		LSCAN-MR
3363 / 3	-	14266	Reductant Tank Heating Solenoid Valve	Circuit High		LSCAN-MR
3363 / 3	-	15907	Prop. Valve 8, Reductant Tank Heating Solenoid Valve	Circuit High		LSCAN-MR
3363 / 4	-	14265	Reductant Tank Heating Solenoid Valve	Circuit Low		LSCAN-MR
3363 / 4	-	15906	Prop. Valve 8, Reductant Tank Heating Solenoid Valve	Circuit Low		LSCAN-MR
3363 / 5	-	14267	Reductant Tank Heating Solenoid Valve	Circuit Open		LSCAN-MR
3363 / 5	-	15909	Prop. Valve 8, Reductant Tank Heating Solenoid Valve	Circuit Open		LSCAN-MR
3363 / 7	-	14268	Reductant Tank Heating Solenoid Valve	Circuit, Component Defective		LSCAN-MR
3363 / 7	-	15969	Prop. Valve 8, Reductant Tank Heating Solenoid Valve	Circuit, Component Defective		LSCAN-MR
3363 / 14	-	14276	Euromot3b / Tier4i Engine Cold Operation	Invalid Engine Cold Operation		LSCAN-MR
3464 / 2	-	14224	Intake Throttle Highside Transistor	Control Module Performance		LSCAN-MR
3464 / 3	-	14200	Intake Throttle Direction Signal	Circuit High		LSCAN-MR
3464 / 4	-	14201	Intake Throttle Direction Signal	Circuit Low		LSCAN-MR
3464 / 6	-	12407	Intake Throttle Direction Signal	Command Current Too High		LSCAN-MR
3465 / 3	-	14204	Intake Throttle	Circuit Open		LSCAN-MR
3465 / 4	-	14202	Intake Throttle	Circuit Low		LSCAN-MR
3465 / 5	-	14203	Intake Throttle	Circuit High		LSCAN-MR
3485 / 2	-	18517	Reductant Injection Air Pressure Sensor	Circuit Range/Performance		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
3485 / 3	-	18515	Reductant Injection Air Pressure Sensor	Circuit High		LSCAN-MR
3485 / 4	-	18516	Reductant Injection Air Pressure Sensor	Circuit Low		LSCAN-MR
3509 / 2	-	14239	5V Output Reference Voltage 1	Voltage Too High/Too Low		LSCAN-MR
3510 / 2	-	14240	5V Output Reference Voltage 2	Voltage Too High/Too Low		LSCAN-MR
3511 / 5	-	14241	Sensor Reference Voltage “A”	Circuit Open		LSCAN-MR
3512 / 5	-	14242	Sensor Reference Voltage “B”	Circuit Open		LSCAN-MR
3513 / 5	-	14243	Sensor Reference Voltage “C”	Circuit Open		LSCAN-MR
3516 / 1	-	14236	NOx Emission Reducant Dosing	Unsufficient Reductant Dosing		LSCAN-MR
3516 / 14	-	14249	NOx Emission Reductant Dosing	Reductant Quality/Unsufficient Reductant Dosing/SCR Catalyst Error		LSCAN-MR
3516 / 18	-	14248	NOx Emission Reductant Dosing	Reductant Quality/Unsufficient Reductant Dosing		LSCAN-MR
3520 / 18	-	14235	NOx Emission Reductant	Reductant Quality		LSCAN-MR
3597 / 2	-	14227	Proportional Valve Bank 1	Control Module Performance		LSCAN-MR
3597 / 3	-	14225	Proportional Valve Bank 1	Circuit High		LSCAN-MR
3597 / 4	-	14226	Proportional Valve Bank 1	Circuit Low		LSCAN-MR
3605 / 3	-	14252	Coolant Pump Control	Circuit High		LSCAN-MR
3605 / 4	-	14250	Coolant Pump Control	Circuit Low		LSCAN-MR
3605 / 5	-	14251	Coolant Pump Control	Circuit Open		LSCAN-MR
3609 / 2	-	14232	Diesel Particulate Filter Inlet Pressure Sensor	Circuit Range/Performance		LSCAN-MR
3609 / 3	-	14211	Diesel Particulate Filter Inlet Pressure Sensor	Circuit High		LSCAN-MR
3609 / 4	-	14212	Diesel Particulate Filter Inlet Pressure Sensor	Circuit Low		LSCAN-MR
3610 / 2	-	14233	Diesel Particulate Filter Outlet Pressure Sensor	Circuit Range/Performance		LSCAN-MR
3610 / 3	-	14213	Diesel Particulate Filter Outlet Pressure Sensor	Circuit High		LSCAN-MR
3610 / 4	-	14214	Diesel Particulate Filter Outlet Pressure Sensor	Circuit Low		LSCAN-MR
3673 / 0	-	12421	Engine Throttle Position 2	Above Measuring Range		LSCAN-MR
3673 / 1	-	12422	Engine Throttle Position 2	Below Measuring Range		LSCAN-MR
3673 / 2	-	12423	Engine Throttle Position 2	Measuring Range Not Plausible		LSCAN-MR
3826 / 0	-	18790	Average Reductant Consumption	Consumption Too High		LSCAN-MR
3826 / 1	-	18791	Average Reductant Consumption	Consumption Too Low		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
3828 / 0	-	18690	Current Reductant Consumption	Consumption Too High		LSCAN-MR
3828 / 1	-	18691	Current Reductant Consumption	Consumption Too Low		LSCAN-MR
4213 / 7	-	14275	Diagnostic Function Engine Cranking	Engine Cranking Without Fuel Injection		LSCAN-MR
4332 / 12	-	16293	Aftertreatment 1 SCR System State	Control Module Performance		LSCAN-MR
4334 / 1	-	16770	Reductant Pressure System	Pressure Decrease Too Low (Shut Off Sequence)		LSCAN-MR
4334 / 7	-	14219	SCR Dosing Unit	Air Route Plugged		LSCAN-MR
4334 / 12	-	14220	SCR Dosing Unit	Pressure Route Plugged		LSCAN-MR
4334 / 18	-	16721	Reductant Pressure System	Reductant Pressure Too Low		LSCAN-MR
4335 / 0	-	16820	SCR Air Pressure System	Pressure Too High		LSCAN-MR
4335 / 1	-	16821	SCR Air Pressure System	Pressure Too Low		LSCAN-MR
4335 / 7	-	16883	SCR Air Pressure System	Missing Air Supply		LSCAN-MR
4335 / 14	-	14264	SCR Air Pressure System	Draining Pressure Pipe Not Performed		LSCAN-MR
4336 / 3	-	13707	SCR Air Pressure Control Valve Solenoid	Circuit Low		LSCAN-MR
4336 / 4	-	13706	SCR Air Pressure Control Valve Solenoid	Circuit High		LSCAN-MR
4336 / 5	-	13709	SCR Air Pressure Control Valve Solenoid	Circuit Open		LSCAN-MR
4337 / 3	-	18315	Reductant Temperature Sensor	Circuit High Input		LSCAN-MR
4337 / 4	-	18316	Reductant Temperature Sensor	Circuit Low Input		LSCAN-MR
4354 / 3	-	15807	SCR Reductant Pipe Heating	Circuit High		LSCAN-MR
4354 / 4	-	15806	SCR Reductant Pipe Heating	Circuit Low		LSCAN-MR
4354 / 5	-	15809	SCR Reductant Pipe Heating	Circuit Open		LSCAN-MR
4354 / 7	-	15869	SCR Reductant Pipe Heating	Circuit		LSCAN-MR
4360 / 0	-	10797	SCR Catalyst Temperature Before Catalyst	Temperature Too High		LSCAN-MR
4360 / 2	-	13817	Catalyst Temperature Sensors	Range/Performance		LSCAN-MR
4360 / 15	-	10788	SCR Catalyst Temperature	Level 1 Exceeded		LSCAN-MR
4360 / 16	-	10789	SCR Catalyst Temperature	Level 2 Exceeded		LSCAN-MR
4363 / 0	-	10722	SCR Catalyst Temperature Behind Catalyst	Temperature Too High		LSCAN-MR
4364 / 15	-	12971	NOx Emission	Level 1 Exceeded		LSCAN-MR
4364 / 16	-	12972	NOx Emission	Level 2 Exceeded		LSCAN-MR
4375 / 0	-	16777	Reductant Pressure System Pump	Current Too High		LSCAN-MR

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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
4375 / 3	-	13907	Reductant Supply Control	Curcuit High		LSCAN-MR
4375 / 4	-	13906	Reductant Supply Control	Curcuit Low		LSCAN-MR
4375 / 5	-	13909	Reductant Supply Control	Curcuit Open		LSCAN-MR
4794 / 14	-	10782	Aftertreatment 1 SCR Catalyst System	Component Not Present		LSCAN-MR
4809 / 3	-	10815	Catalyst Temperature Sensor (Bank 1 Sensor 1)	Circuit High Input		LSCAN-MR
4809 / 3	-	12404	Catalyst Temperature Sensor (Bank 1 Sensor 1)	Circuit High Input		LSCAN-MR
4809 / 4	-	10816	Catalyst Temperature Sensor (Bank 1 Sensor 1)	Circuit Low Input		LSCAN-MR
4809 / 4	-	12405	Catalyst Temperature Sensor (Bank 1 Sensor 1)	Circuit Low Input		LSCAN-MR
4810 / 3	-	10915	Catalyst Temperature Sensor (Bank 1 Sensor 2)	Circuit High		LSCAN-MR
4810 / 4	-	10916	Catalyst Temperature Sensor (Bank 1 Sensor 2)	Circuit Low		LSCAN-MR
520192 / 9	19409	-	Engine Start Stop Signals	Abnormal Update Rate		CAN-J1939
520192 / 19	19419	-	Engine Start Stop Signals	Received Network Data in Error		CAN-J1939
520230 / 0	-	18820	SCR Pressure Accumulator Bubble Pressure	Pressure Too High		LSCAN-MR
520230 / 2	-	14253	SCR Pressure Accumulator Bubble Pressure	Pressure Outside Range		LSCAN-MR
520258 / 7	-	14228	SCRT System Component	Component Not Present		LSCAN-MR
520259 / 2	-	14229	SCRT Temperature Sensors Pair A	Circuit Range/Performance		LSCAN-MR
520260 / 2	-	14230	SCRT Temperature Sensors Pair B	Circuit Range/Performance		LSCAN-MR
520262 / 14	-	16994	SCR System EGA	Disabled Mannheim-Function		LSCAN-MR
520262 / 14	-	16995	SCR System EGA	Disabled Wörth-Function		LSCAN-MR
520263 / 9	-	14272	Automatic Compression Detection Function	Timeout		LSCAN-MR
520263 / 14	-	14271	Automatic Compression Detection Function	Cancelling		LSCAN-MR

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9.2. Fault codes listed by K-line code

ADM3 fault code (K-line)	ADM3 fault code (J1939) SPN / FMI	Fault location	Fault description
10003	1072 / 3	Decompression Brake Valve (MBR_KD)	Open Circuit
10004	1072 / 4	Decompression Brake Valve (MBR_KD)	Short Circuit to Ground
10103	84 / 3	Vehicle Speed (C3 or J1939)	Open Circuit
10109	84 / 9	Vehicle Speed (C3 or J1939)	Abnormal Update Rate
10114	84 / 14	Vehicle Speed (C3 or J1939)	Signal Not Plausible
10119	84 / 19	Vehicle Speed (C3 or J1939)	Received Network Data in Error
10200	91 / 0	Accelerator Pedal (AFPS or J1939)	Not Adjusted
10203	91 / 3	Accelerator Pedal (AFPS or J1939)	Voltage too High
10204	91 / 4	Accelerator Pedal (AFPS or J1939)	Voltage too Low
10209	91 / 9	Accelerator Pedal (AFPS or J1939)	Abnormal Update Rate
10219	91 / 19	Accelerator Pedal (AFPS or J1939)	Received Network Data in Error
10400	98 / 0	Oil Level (from PLD/MR2)	Oil Level too High
10401	98 / 1	Oil Level (from PLD/MR2)	Low Oil Level
10414	98 / 14	Oil Level (from PLD/MR2)	Oil Level too Low
10501	100 / 1	Oil Pressure (from PLD/MR2)	Low Oil Pressure
10514	100 / 14	Oil Pressure (from PLD/MR2)	Oil Pressure too Low
10800	107 / 0	Air Filter Sensor (LF_SE)	Differential Pressure too High
10803	107 / 3	Air Filter Sensor (LF_SE)	Open Circuit
10804	107 / 4	Air Filter Sensor (LF_SE)	Short Circuit to Ground
10914	110 / 14	Coolant Temperature (from PLD/MR2)	Coolant Temperature too High
11001	111 / 1	Coolant Level Sensor (KW_SE)	Low Coolant Level
11003	111 / 3	Coolant Level Sensor (KW_SE)	Open Circuit
11004	111 / 4	Coolant Level Sensor (KW_SE)	Short Circuit to Ground
11014	111 / 14	Coolant Level Sensor (KW_SE)	Coolant Level too Low
11100	158 / 0	Battery Voltage Switched (Terminal 15)	Over Voltage
11101	158 / 1	Battery Voltage Switched (Terminal 15)	Under Voltage
11701	558 / 1	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Signals Equal but Should not
11705	558 / 5	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Switches Open Circuit
11709	558 / 9	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Abnormal Update Rate
11712	558 / 12	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Both Switches Closed
11719	558 / 19	Accelerator Pedal Idle Switch (GAS1 + GAS2 or J1939)	Received Network Data in Error
11809	599 / 9	Cruise Control Switch CC- (Set + Coast)	Abnormal Update Rate (Set Switch)
11812	599 / 12	Cruise Control Switch CC- (Set + Coast)	Both Switches CC- and CC+ Closed
11814	599 / 14	Cruise Control Switch CC- (Set + Coast)	Plausibility Check Failed (Check Stalk Switch Wiring)
11819	599 / 19	Cruise Control Switch CC- (Set + Coast)	Received Network Data in Error
11909	601 / 9	Cruise Control Switch CC+ (Res + Acc)	Abnormal Update Rate (Resume Switch)
11912	601 / 12	Cruise Control Switch CC+ (Res + Acc)	Both Switches CC+ and CC- closed
11914	601 / 14	Cruise Control Switch CC+ (Res + Acc)	Plausibility Check Failed (Check Stalk Switch Wiring)
11919	601 / 19	Cruise Control Switch CC+ (Res + Acc)	Received Network Data in Error
12002	609 / 2	PLD/MR2 Error	Unknown Cause
12103	620 / 3	Supply Analog Accelerator Pedal (AFP+)	Voltage too High
12104	620 / 4	Supply Analog Accelerator Pedal (AFP+)	Voltage too Low
12202	625 / 2	CAN Link ADM3 – PLD/MR2	No Communication with PLD/MR2
13303	677 / 3	Output Relay 1 (REL 1)	Open Circuit
13304	677 / 4	Output Relay 1 (REL 1)	Short Circuit to Ground

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ADM3 fault code (K-line)	ADM3 fault code (J1939) SPN / FMI	Fault location	Fault description
13900	730 / 0	Output Relay 2 (REL 2)	Grid Heater: No Increasing Boost Temperature After Activation
13901	730 / 1	Output Relay 2 (REL 2)	Relay Permanently Closed (Grid Heater)
13902	730 / 2	Output Relay 2 (REL 2)	Relay Permanently Open (Grid Heater)
13903	730 / 3	Output Relay 2 (REL 2)	Voltage too High when Activated
13904	730 / 4	Output Relay 2 (REL 2)	Voltage too Low when Activated
14003	729 / 3	Intake Air Heater (MBR_KD)	Open Circuit
14004	729 / 4	Intake Air Heater (MBR_KD)	Short Circuit to Ground
14202	974 / 2	Remote Throttle Pedal (HFG)	Supply Voltage Out of Range (Pin HFG+)
14203	974 / 3	Remote Throttle Pedal (HFG)	Voltage too High
14204	974 / 4	Remote Throttle Pedal (HFG)	Voltage too Low
14403	1004 / 3	Output Relay 4 (REL 4)	Open circuit
14404	1004 / 4	Output Relay 4 (REL 4)	Short Circuit to Ground
14503	1005 / 3	Output PWM Pedal Supply or Transmission (FP+)	Open Circuit
14504	1005 / 4	Output PWM Pedal Supply or Transmission (FP+)	Short Circuit to Ground
14603	1074 / 3	Exhaust Brake Valve (MBR_BK)	Open Circuit
14604	1074 / 4	Exhaust Brake Valve (MBR_BK)	Short Circuit to Ground
14902	639 / 2	SAE J1939 Interface	At Least One J1939 Message is Missing
15001	1015 / 1	PWM Accelerator Pedal (PWM FFG)	No Supply Voltage at Pin FP+
15003	1015 / 3	PWM Accelerator Pedal (PWM FFG)	No Signal at Path 1 (GAS1)
15004	1015 / 4	PWM Accelerator Pedal (PWM FFG)	No Signal at Path 2 (GAS2)
15005	1015 / 5	PWM Accelerator Pedal (PWM FFG)	Not Adjusted
15006	1015 / 6	PWM Accelerator Pedal (PWM FFG)	Idle Position Out of Adjusted Range
15007	1015 / 7	PWM Accelerator Pedal (PWM FFG)	Out of Adjusted Range
16603	171 / 3	Ambient Air Temperature	Voltage too High
16604	171 / 4	Ambient Air Temperature	Voltage too Low
16609	171 / 9	Ambient Air Temperature	Abnormal Update Rate
16619	171 / 19	Ambient Air Temperature	Received Network Data in Error
17309	69 / 9	Two Speed Axle Switch	Abnormal Update Rate
17319	69 / 19	Two Speed Axle Switch	Received Network Data in Error
17409	70 / 9	Parking Brake Switch	Abnormal Update Rate
17419	70 / 19	Parking Brake Switch	Received Network Data in Error
17509	96 / 9	Fuel Level	Abnormal Update Rate
17519	96 / 19	Fuel Level	Received Network Data in Error
17609	161 / 9	Transmission Input Shaft Speed	Abnormal Update Rate
17619	161 / 19	Transmission Input Shaft Speed	Received Network Data in Error
17709	191 / 9	Transmission Output Shaft Speed	Abnormal Update Rate
17719	191 / 19	Transmission Output Shaft Speed	Received Network Data in Error
17809	523 / 9	Transmission Current Gear	Abnormal Update Rate
17819	523 / 19	Transmission Current Gear	Received Network Data in Error
17909	524 / 9	Transmission Selected Gear	Abnormal Update Rate
17919	524 / 19	Transmission Selected Gear	Received Network Data in Error
18009	559 / 9	Accelerator Pedal Kickdown Switch	Abnormal Update Rate
18019	559 / 19	Accelerator Pedal Kickdown Switch	Received Network Data in Error
18109	573 / 9	Transmission Torque Converter Lockup Engaged	Abnormal Update Rate
18119	573 / 19	Transmission Torque Converter Lockup Engaged	Received Network Data in Error
18209	574 / 9	Transmission Shift in Process	Abnormal Update Rate
18219	574 / 19	Transmission Shift in Process	Received Network Data in Error
18309	596 / 9	Cruise Control Enable Switch	Abnormal Update Rate
18319	596 / 19	Cruise Control Enable Switch	Received Network Data in Error

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ADM3 fault code (K-line)	ADM3 fault code (J1939) SPN / FMI	Fault location	Fault description
18409	597 / 9	Brake Switch	Abnormal Update Rate
18419	597 / 19	Brake Switch	Received Network Data in Error
18509	598 / 9	Clutch Switch	Abnormal Update Rate
18519	598 / 19	Clutch Switch	Received Network Data in Error
18609	600 / 9	Cruise Control Coast (Decelerate) Switch	Abnormal Update Rate
18619	600 / 19	Cruise Control Coast (Decelerate) Switch	Received Network Data in Error
18709	602 / 9	Cruise Control Accelerate Switch	Abnormal Update Rate
18719	602 / 19	Cruise Control Accelerate Switch	Received Network Data in Error
18809	904 / 9	Front Axle Speed	Abnormal Update Rate
18819	904 / 19	Front Axle Speed	Received Network Data in Error
18909	973 / 9	Engine Retarder Selection	Abnormal Update Rate
18919	973 / 19	Engine Retarder Selection	Received Network Data in Error
19009	1623 / 9	Tachograph Output Shaft Speed	Abnormal Update Rate
19019	1623 / 19	Tachograph Output Shaft Speed	Received Network Data in Error
19109	1624 / 9	Tachograph Vehicle Speed	Abnormal Update Rate
19119	1624 / 19	Tachograph Vehicle Speed	Received Network Data in Error
19209	1633 / 9	Cruise Control Pause Switch	Abnormal Update Rate
19214	1633 / 14	Cruise Control Pause Switch	Plausibility Check Failed (Check Stalk Switch Wiring)
19219	1633 / 19	Cruise Control Pause Switch	Received Network Data in Error
19309	1716 / 9	Retarder Selection, non-engine	Abnormal Update Rate
19319	1716 / 19	Retarder Selection, non-engine	Received Network Data in Error
19409	520192 / 9	Engine Start Stop Signals	Abnormal Update Rate
19419	520192 / 19	Engine Start Stop Signals	Received Network Data in Error
19509	1237 / 9	Engine Shutdown Override	Abnormal Update Rate
19519	1237 / 19	Engine Shutdown Override	Received Network Data in Error

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OM 904-926 LA BlueTec®, OM 904-926 LA

Operating Instructions

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Mercedes-Benz

Symbols

⚠ WARNING

Warning notes make you aware of dangers which could pose a threat to your health or life, or to the health and life of others.

Environmental note

Environmental notes provide you with information on environmentally aware actions or disposal.

❗ Notes on material damage alert you to dangers that could lead to damage to your vehicle.

ⓘ These symbols indicate useful instructions or further information that could be helpful to you.

▶ This symbol designates an instruction you must follow.

▶ Several consecutive symbols indicate an instruction with several steps.

(▷ page) This symbol tells you where you can find further information on a topic.

▷ ▷ This symbol indicates a warning or an instruction that is continued on the next page.

`Display` This text indicates an indicator in the display.

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Welcome

Familiarise yourself with your engine system and read the operating instructions before you use the engine system. This will help you to avoid endangering yourself or others.

The standard equipment and product description of your engine system may vary, depending on individual specifications. This is described on the data card.

The engine systems are constantly updated to be state of the art.

Mercedes-Benz reserves the right to make changes to the following:

- design
- equipment
- technical features

Descriptions may therefore differ in individual cases from your engine system.

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Engine system

The OM 904-926 LA BlueTec® series of engines only function as intended when used in conjunction with the corresponding exhaust gas aftertreatment unit. Therefore, in these Operating Instructions, the term "engine system" refers to the engine and the exhaust gas aftertreatment unit.

Protection of the environment

Environmental note

Daimler AG has a declared policy of comprehensive environmental protection.

The objectives are to use the natural resources which form the basis of our existence on this planet sparingly and in a manner which takes the requirements of both nature and humanity into account.

You too can help to protect the environment by operating your vehicle in an environmentally responsible manner.

Information and notes on driving in an environmentally responsible and fuel-saving manner can be found in the "Operating notes" section (▷ page 57).

Assembly equipment

These Operating Instructions describe all models and all standard and optional equipment available for your engine system at the time of publication of the Operating Instructions. Country-specific deviations are possible. Note that your engine system may not be fitted with all features described. This also applies to safety-relevant systems and functions. Therefore, the equipment on your engine system may differ from certain descriptions and illustrations.

All of the components in your engine system are listed in the data card of your engine system. Data card (▷ page 94).

Please contact a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre if you have any questions about equipment or operation (see addresses in the publication details on the rear inside cover).

- Mercedes-Benz recommends, for on-highway applications, that you use a Mercedes-Benz Service Centre.
- MTU recommends, for off-highway applications, an MTU partner or MTU-authorised Mercedes-Benz partner.

Genuine Mercedes-Benz parts

Environmental note

Daimler AG also supplies reconditioned assemblies and parts which are of the same quality as new parts. For these, the same warranty applies as for new parts.

If you use parts which have not been approved by Mercedes-Benz, the operational safety of the engine system may be jeopardised. This could lead to malfunctions in safety-relevant systems. Use only genuine Mercedes-Benz parts or parts of equal quality. Only use parts that have been approved for your engine type.

Mercedes-Benz checks genuine Mercedes-Benz parts for:

- reliability
- safety
- suitability

Despite ongoing market research, Mercedes-Benz is unable to assess other parts. Mercedes-Benz therefore accepts no responsibility for the use of such parts in Mercedes-Benz vehicles, even if they have been officially approved or independently approved by a testing centre.

In Germany, certain parts are only officially approved for installation or modification if they comply with legal requirements. This also applies to some other countries. All genuine Mercedes-Benz parts meet the approval

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requirements. The use of non-approved parts may invalidate the vehicle's general operating permit.

This is the case if:

- they result in a change to the vehicle type from that for which the vehicle's general operating permit was granted
- they pose a possible risk for road users
- they adversely affect the emission or noise levels

You can find more information on recommended conversion parts and accessories, as well as permitted technical modifications at a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10).

Always state the engine number when ordering genuine Mercedes-Benz parts. You can find the engine number on the identification plate of your engine. You can also find the numbers on the data card (▷ page 94).

Modifying the engine output

! Increased power could:

- change emission levels
- cause malfunctions
- lead to consequential damage

The operating safety of the engine cannot be guaranteed in all situations.

Any tampering with the engine management system in order to increase the engine power output will lead to a loss of warranty entitlements.

Safety/emergency running program

The engine is equipped with an electronic engine management system that monitors the engine and has a self-diagnostic system.

If the electronic control system detects a malfunction, one of the following measures is automatically implemented after an appraisal of the malfunction:

- faults during operation are indicated by the corresponding warning lamp (▷ page 48).
- in conjunction with the electronic engine management system, fault codes with additional information can be shown on a display.
- the system switches to a suitable backup function for the continued, albeit restricted, operation of the engine. This includes torque and engine speed limitation, for example, as well as road speed limitation or constant emergency running speed.

Correct use

The engine system may only be installed as contractually specified.

The manufacturer of the end product is responsible for the correct installation of the engine and the exhaust gas aftertreatment system in the overall system.

The engine and the exhaust gas aftertreatment system may not be modified. If the engine is modified, Mercedes-Benz and MTU do not accept responsibility for any damage arising as a result.

Correct use of the engine system also requires adherence to the instructions in these Operating Instructions. This also requires compliance with the maintenance intervals and the professional execution of maintenance work. Please observe the Workshop Information System (WIS) (▷ page 10).

Implied warranty

A well-developed network of Mercedes-Benz, MTU and MTU-authorised Mercedes-Benz Service Centres is available to carry out maintenance work.

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These Mercedes-Benz and MTU or MTU-authorised Mercedes-Benz Service Centres:

- have special equipment and tools as well as specialists who receive continuous training
- guarantee that your engine system is repaired and maintained thoroughly and expertly
- carry out all repairs related to implied warranty
- carry out all maintenance work expertly
- confirm in the Maintenance Booklet that the maintenance work has been carried out at the required time
- handle implied warranty claims that are admissible according to the sales contract

Please observe the instructions and recommendations as well as the maintenance services in the Maintenance Booklet. Please observe these instructions even if you let a third party use and care for your vehicle. This is the only way to ensure that you do not lose your entitlements.

If the prescribed maintenance work is not carried out, claims can only be decided after the manufacturer has inspected the claim.

During the implied warranty period, have the prescribed maintenance service for your engine system carried out as follows:

- regularly
- punctually
- at a qualified specialist workshop which has the necessary specialist knowledge and tools to carry out the work required

  Mercedes-Benz recommends that you use a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre. In particular, work relevant to safety or on safety-related systems must be carried out by a qualified specialist workshop.

If there are legal requirements on emission control, please note that:

- maintenance on the engines must be carried out according to specific regulations and using special measuring devices
- it is prohibited to modify or tamper with components relevant to emissions

All Mercedes-Benz and MTU or MTU-authorised Mercedes-Benz Service Centres are familiar with the relevant regulations.

Maintenance work does not include repair work. Issue a separate order for repair work.

You can obtain further information on the maintenance of your engine system from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre.

Stored data

Several of the electronic components in your engine system contain data memories.

These data memories temporarily or permanently store technical information about:

- the engine system state
- events
- malfunctions

In general, this technical information documents the state of a component, a module, a system or the surroundings.

This includes, for example:

- operating conditions of system components, e.g. fluid levels
- the vehicle's status messages and those of its individual components, e.g. speed, deceleration in movement, accelerator position
- malfunctions and defects in important system components
- the vehicle's reactions and operating statuses in special driving situations
- ambient conditions, e.g. outside temperature

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This data is exclusively technical in nature and can be used to:

- assist in the detection and rectification of faults and defects
- analyse vehicle functions, e.g. after an accident

The data cannot be used to trace the vehicle's movements.

When you use one of the available services, technical information may be read from the event data memory and fault data memory.

Services include, for example:

- repair services
- service processes
- implied warranty and guarantee cases
- quality assurance

The information is read out by employees of the service network (including manufacturers) using special diagnostic testers. Further information is available there if required.

After a fault has been rectified, the information is deleted from the fault memory or is continually overwritten.

Qualified specialist workshop

A qualified specialist workshop has the necessary specialist knowledge, tools and qualifications to carry out the work required on the engine to a professional standard. This is particularly applicable to work relevant to safety.

Observe the notes in the Maintenance Booklet.

Always have the following maintenance work carried out at a qualified specialist workshop:

- work relevant to safety
- service and maintenance work
- repair work
- modifications as well as installations and conversions
- work on electronic components
- Mercedes-Benz recommends, for on-highway applications, that you use a Mercedes-Benz Service Centre.
- MTU recommends, for off-highway applications, an MTU partner or MTU-authorised Mercedes-Benz partner.

Further applicable documents

These Operating Instructions describe all models, as well as all standard and optional equipment of your engine system which are part of the scope of delivery of Daimler AG. The installation of the engine system into the vehicle/device may require additional operating instructions adapted to the vehicle/device and the appropriate use thereof. These additional operating instructions will be provided by the vehicle/device manufacturer. The additional operating instructions will describe, in particular, the functions specific to the installation and operation, the use of such functions as well as warning and control mechanisms.

To use the engine correctly, you also require the Maintenance Booklet.

For US-certified off-highway engines you also require the "Emission Warranty" supplement.

Please also observe the information contained in the vehicle or the equipment operating instructions (manufacturer of the end product). Always keep these documents together with the engine, vehicle or equipment. These documents should be passed on to the new owner if you sell the engine, vehicle or equipment.

When carrying out maintenance work, you require access to the Workshop Information System (WIS) via the Internet. This access is subject to a fee.

Current information on the system and prices can be found at this web address: http://service-parts.mercedes-benz.com. Click on "EPC, WIS/ASRA" in the "Service and parts information" tab and then on "WIS".

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You can log in by clicking on "Register" on the right-hand side.

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General information

The engine is a four-stroke, water-cooled diesel engine with direct injection.

The cylinders are arranged in a row. Each cylinder has two inlet valves and one outlet valve.

Each cylinder has its own fuel injection pump (unit pump) with a short high-pressure fuel injection line to the multi-hole nozzle at the centre of the combustion chamber. The unit pumps sit directly in the crankcase and are driven by the camshaft.

The engine is equipped with exhaust gas turbocharger and intercooler as standard. The engine may include an engine brake (airbrake and constantly open throttle) as optional equipment.

It is a low-emission engine. Start of injection, injection duration and injection quantity are controlled entirely electronically.

BlueTEC® exhaust gas aftertreatment

The engines meet the requirements of the relevant emissions level and are correspondingly certified. Compliance with emissions laws and regulations is a condition of the operating permit for the vehicle/equipment.

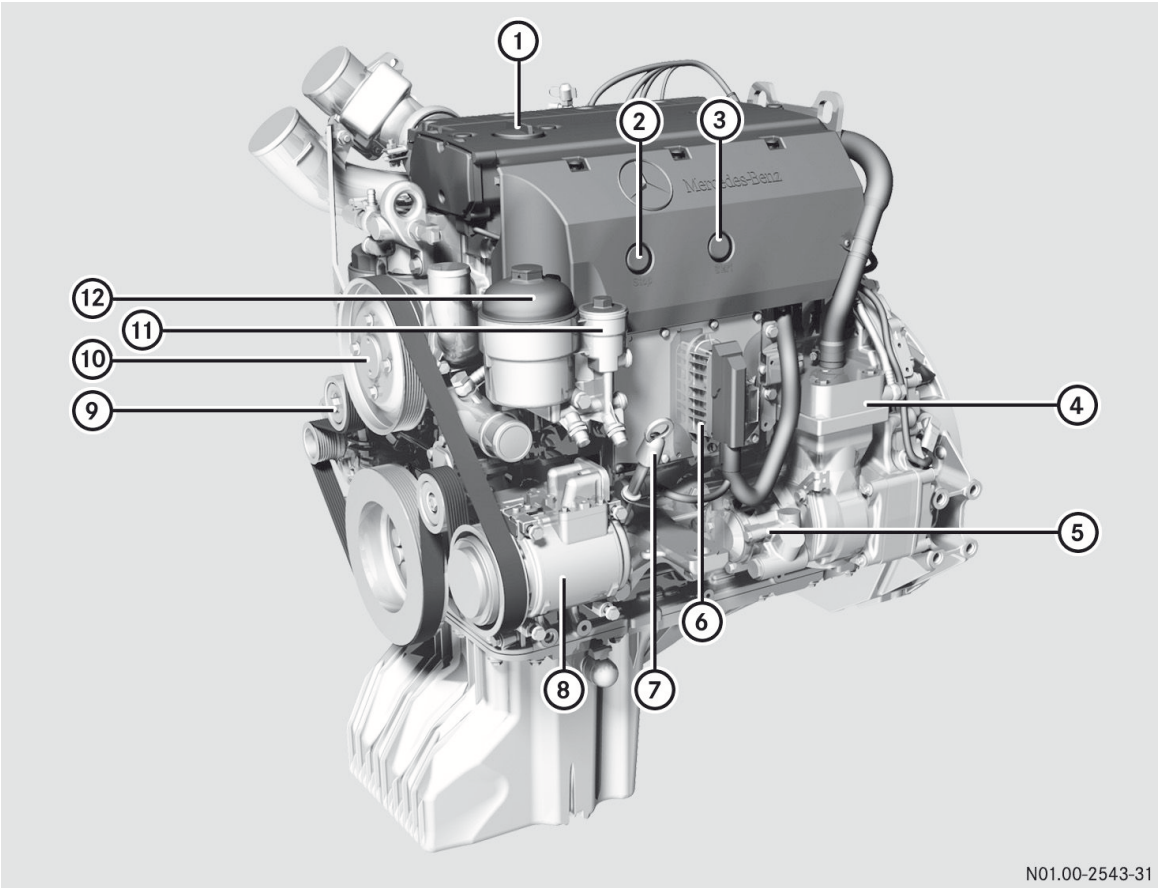
The BlueTEC® exhaust gas aftertreatment unit is characterised by the following technologies:

- selective catalytic reduction (SCR) with ammonia slip catalytic converter
- the diesel oxidation catalytic converter (DOC)

Engines with BlueTEC® exhaust gas aftertreatment must be operated with AdBlue® or DEF in order to meet the emissions laws and regulations. The operating permit is invalidated if the vehicle/equipment is operated without AdBlue®/DEF. Failure to use AdBlue® or DEF during operation may be a statutory or regulatory offence in certain countries. Special concessions granted either at the time of purchase or to reduce operating costs of the vehicle/equipment, e.g. reduced taxes or tolls, may also be rendered retroactively invalid. This may be the case in the country of registration. Or also in another country where you operate the vehicle/equipment.

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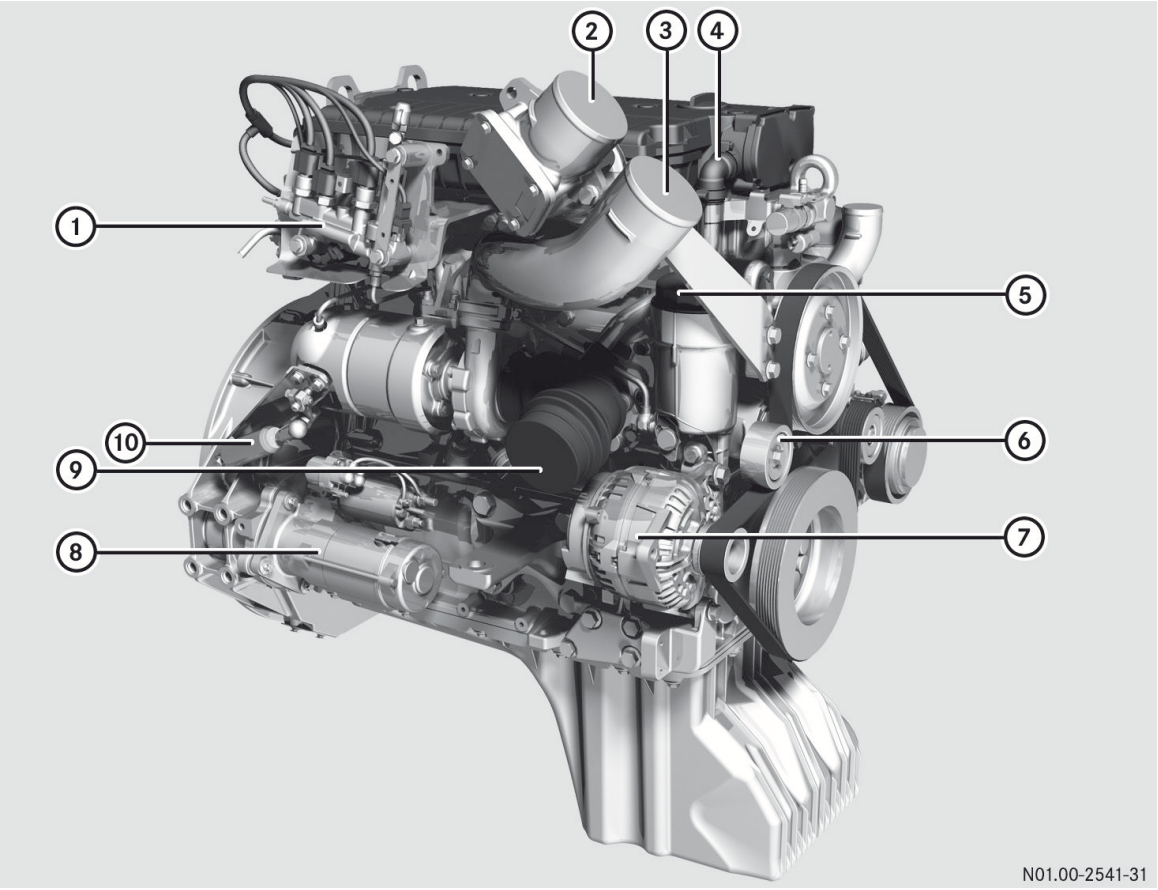
Engine overview



Engine overview: OM 904 LA

① Engine oil filler neck
② Stop button
③ Start button
④ Air compressor
⑤ Power-steering pump
⑥ Engine control unit (MR)
⑦ Dipstick
⑧ Refrigerant compressor
⑨ Poly V-belt tensioning device
⑩ Coolant pump
⑪ Fuel prefilter
⑫ Fuel filter

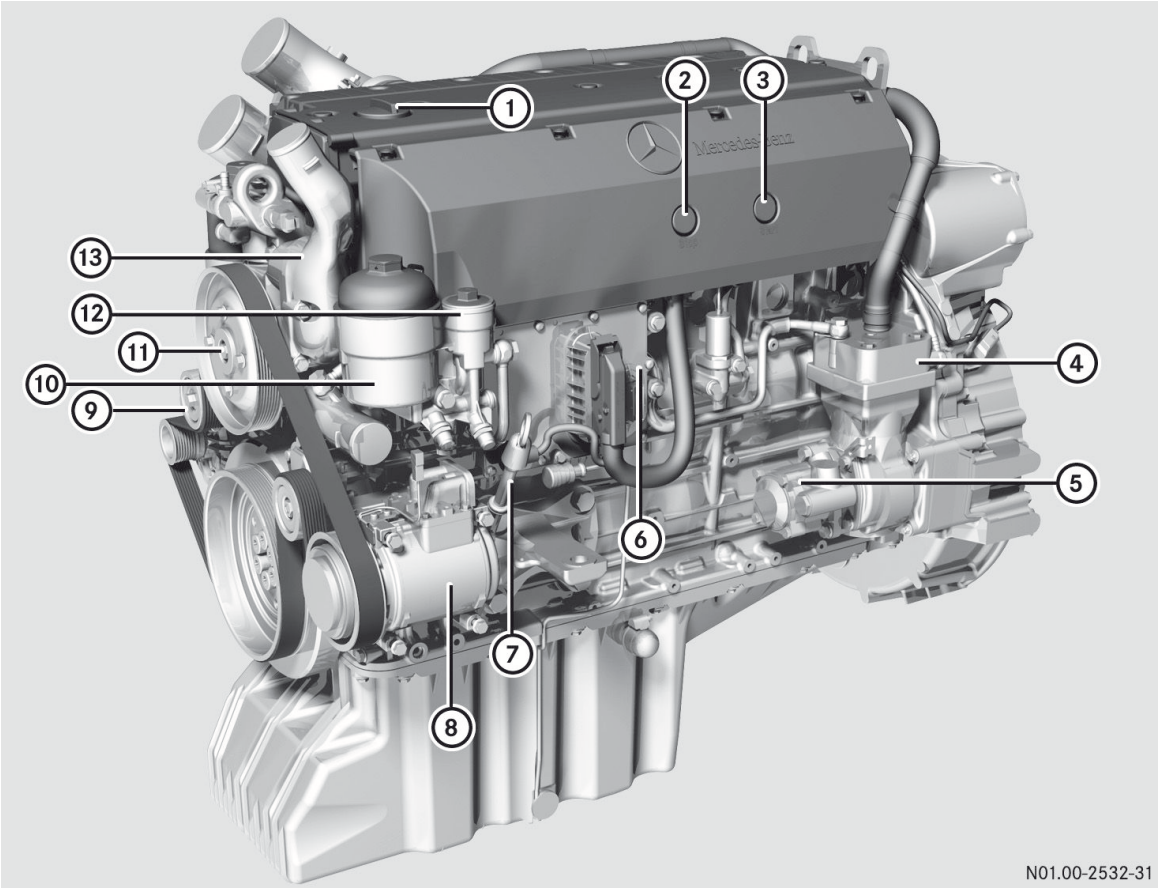
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Engine overview: OM 904 LA

① AdBlue®/DEF metering unit
② Charge-air pipe from the charge-air cooler
③ Charge-air pipe to the charge-air cooler
④ Engine ventilation hose
⑤ Oil filter
⑥ Poly V-belt tensioning device
⑦ Alternator
⑧ Starter motor
⑨ Intake air inlet
⑩ Engine brake

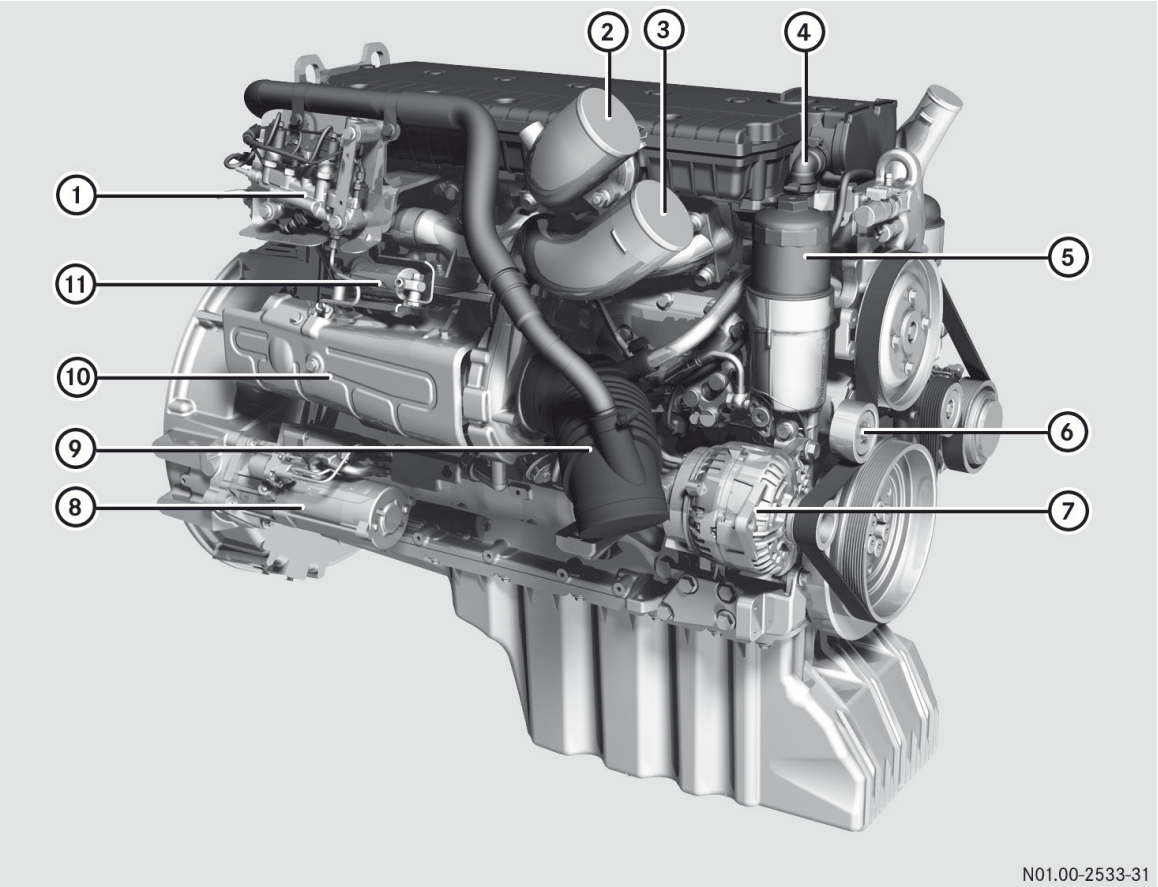
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Engine overview: OM 906 LA

① Engine oil filler neck
② Stop button
③ Start button
④ Air compressor
⑤ Power-steering pump
⑥ Engine control unit (MR)
⑦ Dipstick
⑧ Refrigerant compressor
⑨ Poly V-belt tensioning device
⑩ Fuel filter
⑪ Coolant pump
⑫ Fuel prefilter
⑬ Coolant outlet to the radiator

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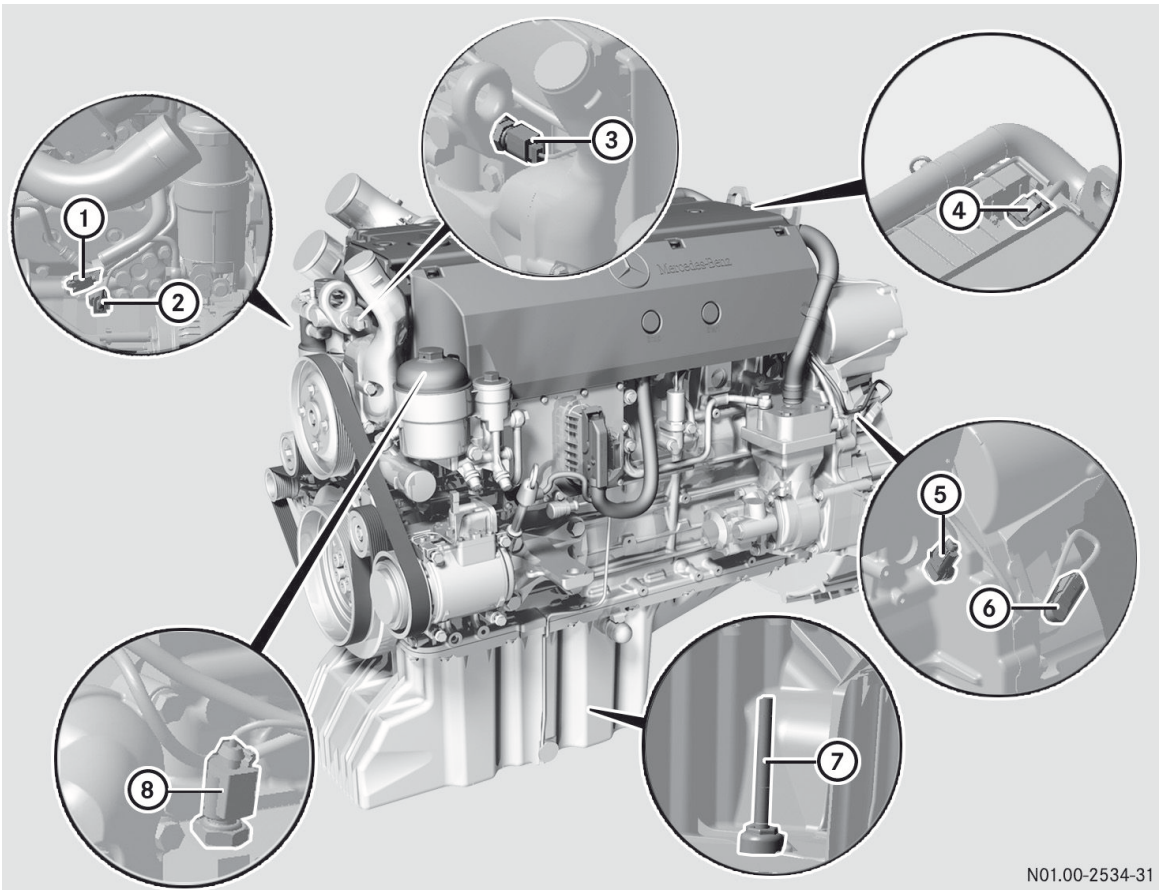
Engine overview: OM 906 LA

① AdBlue®/DEF metering unit
② Charge-air pipe from the charge-air cooler
③ Charge-air pipe to the charge-air cooler
④ Engine ventilation hose
⑤ Oil filter
⑥ Poly V-belt tensioning device
⑦ Alternator
⑧ Starter motor
⑨ Intake air inlet
⑩ Exhaust gas turbocharger
⑪ Engine brake

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Sensors overview

Sensors, general

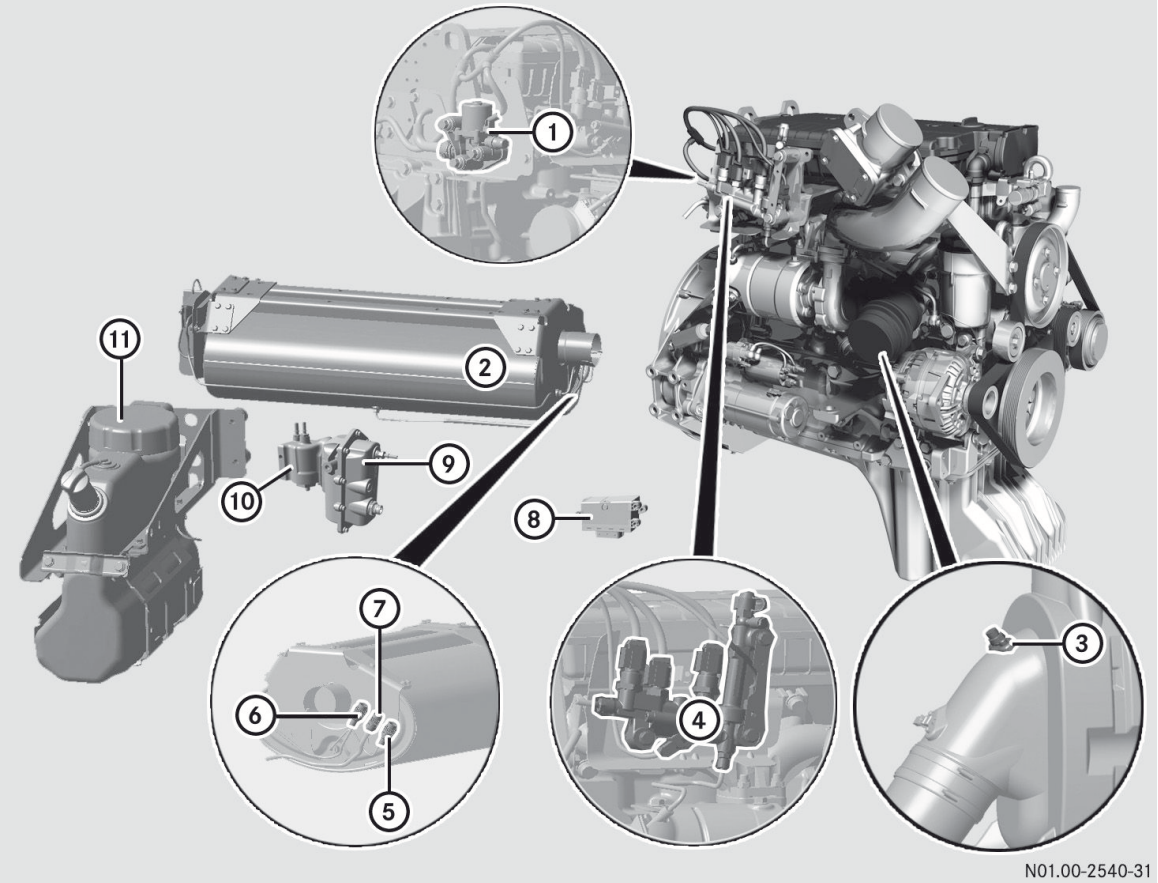


Example: OM 926 LA

① Oil temperature
② Oil pressure
③ Coolant temperature
④ Charge-air temperature/charge-air pressure
⑤ Camshaft position sensor (on camshaft gear)
⑥ Crankshaft position sensor (on flywheel)
⑦ Oil level
⑧ Fuel temperature

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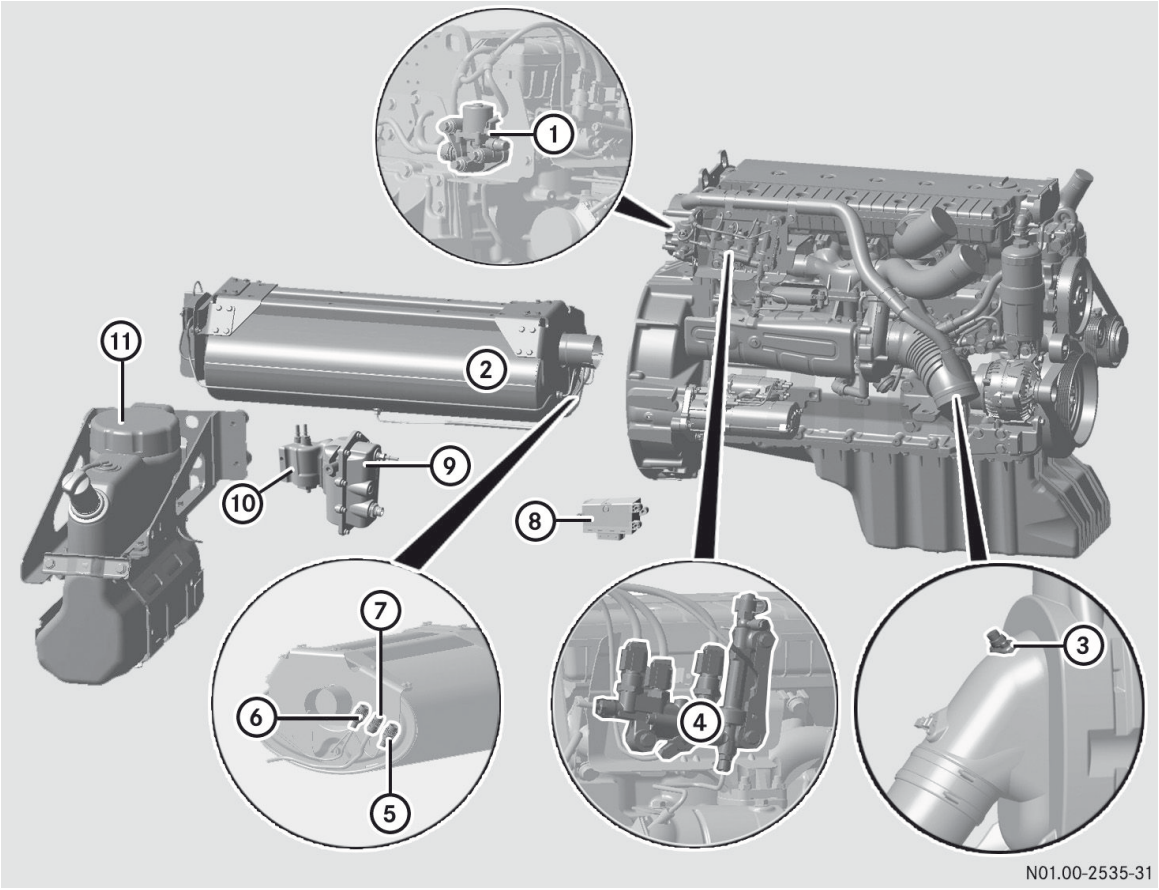
AdBlue®/DEF components



BlueTec® sensors, overview: OM 924 LA

① Valve preheating, AdBlue®/DEF system
② Exhaust aftertreatment unit
③ Temperature and humidity sensor (air filter, clean air side)
④ Metering unit
⑤ Temperature sensor downstream of catalytic converter
⑥ NOx sensor
⑦ Temperature sensor upstream of catalytic converter
⑧ Exhaust gas aftertreatment control unit
⑨ Supply unit
⑩ AdBlue®/DEF filter
⑪ AdBlue®/DEF tank

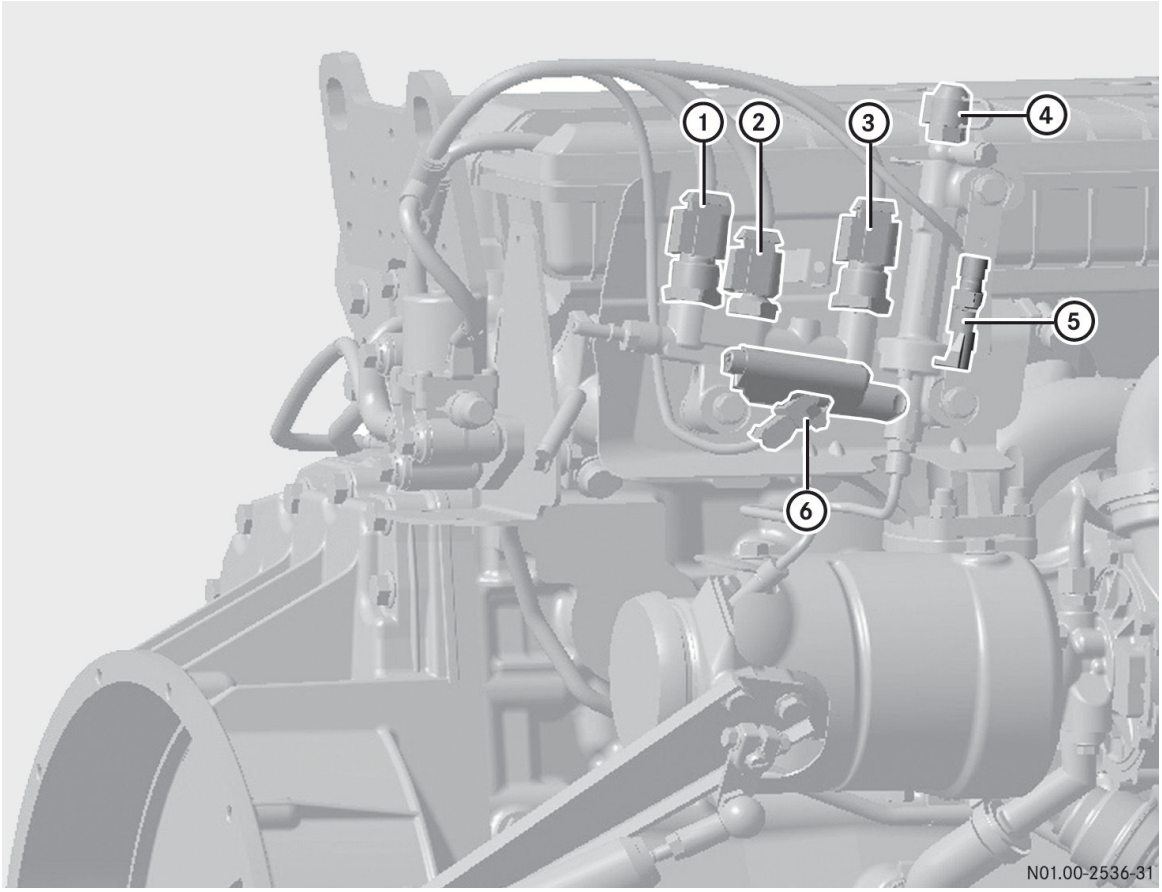
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BlueTec® sensors, overview: OM 926 LA

① Valve preheating, AdBlue®/DEF system
② Exhaust aftertreatment unit
③ Temperature and humidity sensor (air filter, clean air side)
④ Metering unit
⑤ Temperature sensor downstream of catalytic converter
⑥ NOx sensor
⑦ Temperature sensor upstream of catalytic converter
⑧ Exhaust gas aftertreatment control unit
⑨ Supply unit
⑩ AdBlue®/DEF filter
⑪ AdBlue®/DEF tank

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Example: BlueTec® sensors and test connection on the metering unit

① AdBlue®/DEF pressure sensor
② AdBlue®/DEF temperature sensor
③ Pressure sensor for compressed air
④ Metering unit test connection
⑤ Metering unit heater
⑥ Metering valve

Electronic engine management

The engine system is equipped with an electronic engine management system which comprises the following control units:

- engine control unit (MR)
- drive control unit (ADM)
- exhaust gas aftertreatment control unit (only for engines with BlueTec® exhaust gas aftertreatment)

The electronic engine management system monitors:

- the engine
- the exhaust gas aftertreatment in the case of BlueTec®
- and, as well as the connection to the vehicle or the device, it also monitors itself.

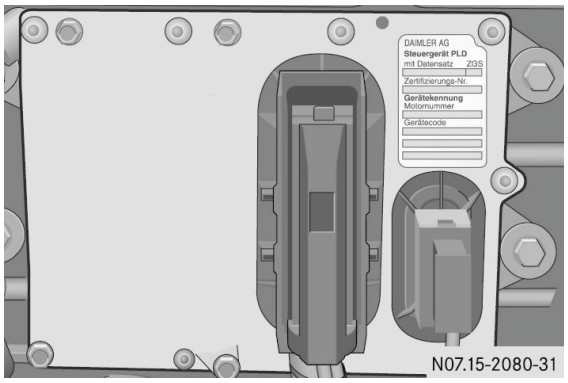
Depending on the malfunctions or failures which occur, warning and information displays are activated (▷ page 26). The malfunction is stored in the fault memory and if necessary a safety and emergency mode is automatically selected (▷ page 44). If the electronic engine management control

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detects a fault, the fault code is stored in the control units. It can then be read by a qualified specialist workshop (▷ page 10) using a diagnostic tester.

Engine management control unit (MR) (engine-mounted)

The engine management control unit (MR) is on the side of the engine.



Example: OM 926 LA engine management control unit (MR)

The engine management control unit (MR) processes values from the drive control unit (ADM). These are, for example, the position of the accelerator pedal sensor, the engine brake or engine start/stop, etc.

These values are analysed together with data from the engine sensors. They are compared with the charts or characteristic curves stored in the engine management control unit (MR).

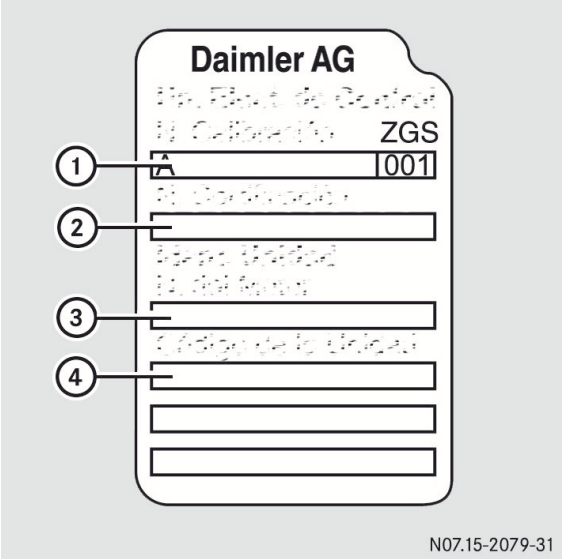
Data from the sensors derives from information such as:

- charge-air pressure and charge-air temperature
- coolant temperature
- fuel temperature
- oil pressure

Start of injection, injection duration and injection quantity are calculated on this basis and the unit pumps are controlled via the solenoid valve accordingly.

If BlueTec® exhaust gas aftertreatment is available, the associated sensors are also analysed and the AdBlue®/DEF dosage is controlled.

ⓘ To obtain a replacement engine management control unit (MR), you will require all the data on the control unit type plate.



Control unit type plate

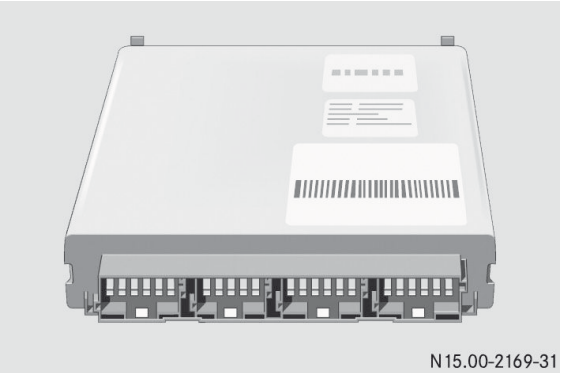
① Data record
② Certification no.
③ Engine number
④ Equipment code

Drive control unit (ADM)

The drive control unit (ADM) is installed in a protected location in the vehicle/device by the vehicle/device manufacturer. It acts as an interface between the electric and electronic components on the vehicle/device side and the engine management control module (MR) on the engine side.

The engine can be adapted to the various operation-specific requirements using the drive control unit (ADM).

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Example: drive control unit (ADM)

The drive control unit (ADM) has many functions:

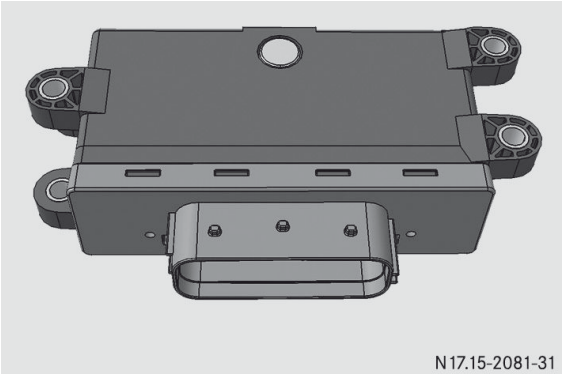
- Calculation of torque demand

  The drive control unit (ADM) registers the driver's requirements. For example, the position of the accelerator is detected by the drive control unit (ADM). A torque requirement is calculated from that and sent to the engine management control module (MR) via the CAN connection.

  In doing so, information and limitations from optionally connected control units such as the gearbox control, retarder control, ABS and ASR are taken into account.
- Output of displays and indicator signals which are displayed in the instrument cluster.
- Monitoring of coolant level, charge current and air filter, for example
- Legal speed limitation
- Evaluation of start request

  The engine starting process is initiated once a corresponding start request is present (ignition lock or external engine start/engine stop button).

Exhaust gas aftertreatment control unit (on the frame)



Exhaust gas aftertreatment control unit

The exhaust gas aftertreatment control unit reads signals and transmits them via the CAN line to the engine management (MR) control unit.

The following signals are read:

- temperature sensor upstream of the SCR catalytic converter
- temperature sensor downstream of the SCR catalytic converter
- NOx sensor downstream of the SCR catalytic converter
- pressure and temperature sensor for the fluid level and temperature in the AdBlue®/DEF tank
- sensor for humidity and intake air temperature

If the electronic engine management control detects a fault, the fault code is stored in the control units.

BlueTec® exhaust gas aftertreatment

The exhaust gas aftertreatment system is activated immediately after the engine is started and remains activated during engine operation. It ensures that the pollutant emissions in the exhaust gas are reduced to the limits stipulated in the emissions standard.

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Exhaust gas treatment is carried out by:

- selective catalytic reduction (SCR) with ammonia slip catalytic converter
- the diesel oxidation catalytic converter (DOC)

In order to ensure correct operation of the BlueTec® exhaust gas aftertreatment system, only operate the engine, vehicle or device with AdBlue®/DEF reducing agent. AdBlue®/DEF is not refilled as part of the maintenance work. You should therefore top up the AdBlue®/DEF tank regularly.

BlueTec® technology is one part of the engine homologation that requires certification. Operating the engine, vehicle or device without AdBlue®/DEF or with another medium that has not been approved by Daimler invalidates the engine's operating permit or certification.

Continuous brake

If increased braking power is required, the engine can be equipped with a brake valve downstream from the exhaust gas turbocharger in conjunction with constant throttle valves. The brake valve uses exhaust back pressure to increase braking power. The constant throttle valves bring about a reduction of the compression pressure in the power stroke (third stroke), whilst the compression (second stroke) is not significantly affected. The constant throttle valve is an additional valve in the cylinder head. When open, the constant throttle valve establishes a connection between the combustion chamber and exhaust port.

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Warning and indicator lamps

Important safety notes

Important safety notes

If you ignore warning and indicator lamps, you will not be able to recognise failures and malfunctions in components or systems. The driving and braking characteristics may change and the road and operating safety of your vehicle or equipment may be restricted. Have the affected system checked and repaired at a qualified specialist workshop. Always observe the warning and indicator lamps and follow the corresponding corrective actions (▷ page 48).

Overview

The indicator and warning lamp display is designed for the specific vehicle or equipment. Please also observe the information in the additional operating instructions. These will be provided by the vehicle/device manufacturer. The symbols listed below are examples only and their appearance may differ in the vehicle or on the equipment. In the event of a fault or warning, a warning lamp or indicator lamp lights up automatically. Depending on the priority of the fault or warning, the warning and indicator lamps light up in different combinations. The following warning and indicator lamps may be available on the instrument panel:

On-highway version without BlueTec®[1]

The following warning and indicator lamps may be available on the instrument panel:

Indicator lamp	Description
red[2]	Engine stop
	Engine system malfunction
	Charge current
(optional)	Cold-start aid
(optional)	Oil pressure too low (engine)
(optional)	Oil level too low (engine)
(optional)	Coolant level too low
(optional)	Coolant temperature too high

1 On-highway: vehicles with operating permit

2 In addition, an acoustic warning signal may sound.

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Indicator lamp	Description
(optional)	Continuous brake active
(optional)	Cruise control
LIM (optional)	Speed limiter
(optional)	Power take-off engaged

On-highway version[1] with BlueTec®

The following warning and indicator lamps may be available on the instrument panel:

Indicator lamp	Description
red[2]	Engine stop
	Engine system malfunction
	Engine diagnostics MIL
LIMIT (lit constantly)	Torque operating restriction
	Charge current
(optional)	Cold-start aid
(optional)	AdBlue®/DEF reserve level
(optional)	Oil pressure too low (engine)
(optional)	Oil level too low (engine)
(optional)	Coolant level too low
(optional)	Coolant temperature too high

1 On-highway: vehicles with operating permit

2 In addition, an acoustic warning signal may sound.

TIM-ID: 0000094786 - 003

Indicator lamp	Description
 (optional)	Continuous brake active
 (optional)	Cruise control
LIM (optional)	Speed limiter
 (optional)	Power take-off engaged

Off-highway version[3] without BlueTec®

The following warning and indicator lamps may be available on the instrument panel:

Indicator lamp	Description
 red[2]	Engine stop
	Engine system malfunction
	Charge current
 (optional)	Cold-start aid
 (optional)	Oil pressure too low (engine)
 (optional)	Oil level too low (engine)
 (optional)	Coolant level too low
 (optional)	Coolant temperature too high
 (optional)	Continuous brake active
 (optional)	Cruise control

3 Off-highway: devices/vehicles

2 In addition, an acoustic warning signal may sound.

TIM-ID: 0000094786 - 003

Indicator lamp	Description
LIM (optional)	Speed limiter
(optional)	Power take-off engaged

Off-highway version[3] with BlueTec®

The following warning and indicator lamps may be available on the instrument panel:

Indicator lamp	Description
red[2]	Engine stop
	Engine system malfunction
	Emissions-relevant malfunction of the exhaust gas aftertreatment system or AdBlue®/DEF supply
LIMIT (lit constantly)	Torque operating restriction
LIMIT (flashing)	Torque and engine speed operating restriction
	Charge current
(optional)	Cold-start aid
(optional)	AdBlue®/DEF reserve level
(optional)	Oil pressure too low (engine)
(optional)	Oil level too low (engine)
(optional)	Coolant level too low
(optional)	Coolant temperature too high
(optional)	Continuous brake active

3 Off-highway: devices/vehicles

2 In addition, an acoustic warning signal may sound.

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Indicator lamp	Description
(optional)	Cruise control
LIM (optional)	Speed limiter
(optional)	Power take-off engaged

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Operating safety

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

The operating safety of an engine system depends on its professional installation in the overall system (e.g. the vehicle or working machinery). As the operator of the engine, you also affect its safe operation.

Through compliance with the prescribed maintenance intervals, you fulfil part of the requirements for safe operation of the engine.

However, safe operation of the engine also depends upon its proper use and care. This includes, for example, regularly checking the oil level.

Safety precautions

Damage to the engine can also lead to personal injury. In order to avoid engine damage, the following safety precautions must be adhered to.

- Only start the engine when the batteries are firmly attached.
- Do not disconnect the batteries when the engine is running.
- Do not use a rapid charger to start the engine.
- Only perform the jump-starting procedure with separate batteries.
- Note, the battery terminals must be disconnected when rapid charging the batteries.
- Observe the operating instructions of the rapid battery charger.
- Please note that the "+" and "-" terminals on the batteries must be disconnected when carrying out electric welding work.
- The control unit connectors may only be connected/disconnected when the electrical system is switched off.
- Incorrect control unit-power supply polarity (e.g. by connecting up the batteries incorrectly) can cause irreparable damage to the control units.
- Tighten diesel injection system connections to the prescribed tightening torque.
- If temperatures above 80 °C are to be expected (e.g. in a drying oven), the control unit on the engine must be removed.
- Only use the appropriate testing probes when taking measurements from electrical connectors (e.g. a Mercedes-Benz connection set). Telephones and two-way radio devices that are not connected to an external aerial can cause malfunctions in the electronics and thus endanger the operating safety of the engine.

Warning stickers

If you remove any warning stickers, you or others could fail to recognise certain dangers.

Various warning stickers are attached to the engine system. Their purpose is to make you and others aware of various risks.

Notes on electronic systems

Important safety notes

⚠ WARNING

Modifications to electronic components, their software as well as wiring could affect their function and/or the operation of other networked components. This could in particular also be the case for systems relevant to safety. They might not function properly anymore and/or jeopardise the operational

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safety of the vehicle. There is an increased risk of an accident and injury.

Do not attempt to modify the wiring as well as electronic components or their software. Always have work on electrical and electronic components carried out at a qualified specialist workshop.

The general operating permit for your vehicle/equipment could be rendered invalid if you carry out modifications to electronic components, their software or their wiring.

Electromagnetic compatibility

The electromagnetic compatibility of the engine system's components has been checked and certified according to the currently valid version of Directive ECE-R 10.

Diagnostics connection

The diagnostics connection is used for connecting diagnostic equipment at a qualified specialist workshop.

⚠ WARNING

If you connect equipment to a diagnostics connection in the vehicle, it can affect the operation of the vehicle systems. This may affect the operating safety of the vehicle. There is a risk of an accident.

Do not connect any equipment to a diagnostics connection in the vehicle.

If the engine is switched off and devices connected to the diagnostics connection are being used, the starter battery can become discharged.

Staff qualifications

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

The engine should only be operated, maintained and repaired by trained personnel who have been briefed and authorised by the operator. The prescribed minimum legal age for personnel carrying out maintenance and repair work must be observed.

Organisational measures

The operator must determine the responsibilities for operation, maintenance and repairs. Give the Operating Instructions and the Maintenance Booklet to the personnel that are charged with operating or carrying out work on the engine.

Instruct personnel on how to operate the engine using the Operating Instructions. When doing so, put special emphasis on safety-relevant information. This is particularly important for personnel that only work occasionally on the engine.

Always keep the Operating Instructions and the Maintenance Booklet readily accessible, in the area of engine operation.

In addition to the Operating Instructions, other general, country-specific, legal and other binding regulations on accident prevention and environmental protection must be adhered to.

Please also observe the information in the additional operating instructions. These will be provided by the device/vehicle manufacturer.

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Transport

⚠ WARNING

If you do not lift the engine as described, the lugs intended for the purpose may be torn out or snap. This may be the case especially if the maximum permissible lug load is exceeded. The engine could then drop uncontrolled, causing serious or even fatal injury.

Always make sure that:

- the engine is only lifted at the intended lifting points/lifting lugs.
- the engine is only lifted and transported in the fitting position.
- ropes/chains are always routed vertically.
- only parts which are typically in the original scope of delivery are attached to the engine.

⚠ WARNING

If you lift the engine at unsuitable points and/or using unsuitable lifting gear, it may:

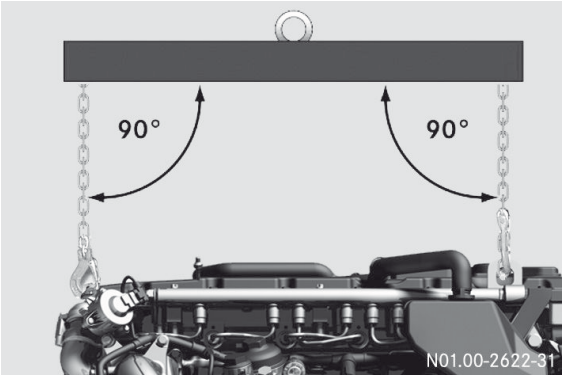
- work loose and fall off
- swing uncontrollably as a result of a change in the centre of gravity.

There is a risk of injury.

Lift the engine only at the lifting points provided using suitable lifting gear. Make sure that there is nobody in the danger zone when raising and lowering the engine.

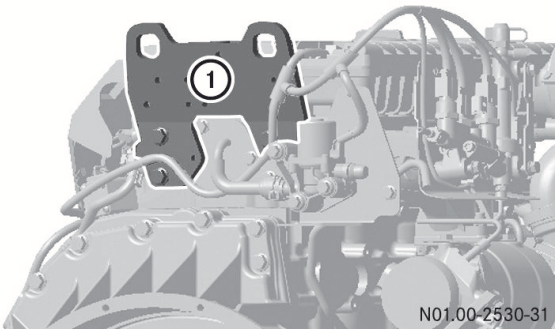
! The engines are by default delivered filled with oil. If the engine is transported at an angle or on its side, oil could leak out. Only transport the engine in the installation position.

! Do not stand on the engine or the exhaust gas aftertreatment unit. They may otherwise be damaged.

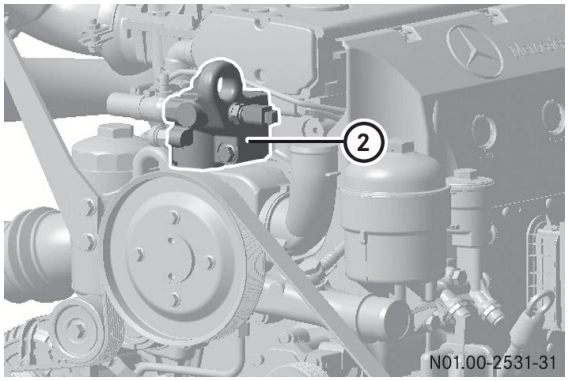


Example: using a cross member

The engine may only be lifted using a cross member with the chain/rope at 90° relative to the horizontal engine.



① Example: flywheel-side lifting point



② Example: belt-side lifting point

Installation

The engine system may only be installed as contractually specified.

Observe the sections "Correct use" (▷ page 8) and "Modifying the engine output" (▷ page 8).

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Daimler AG provides the vehicle manufacturer with comprehensive material, e.g. the installation guideline, for initial installation. The vehicle manufacturer must take this into account. If the engine is fitted after repair work, for example, the information in the Workshop Information System (WIS) must be observed (▷ page 10).

Observe the sections "Qualified specialist workshop" (▷ page 10) and "Further applicable documents" (▷ page 10).

Please consult a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre if you have any questions.

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Preparation for operation

Engine with initial operation oil from the factory

The engine is filled at the factory with an initial operation oil.

These high-quality engine oils are beneficial to the running-in process. They also allow you to make the first oil change in accordance with the applicable oil change intervals. This eliminates the need for special break-in oils and the additional oil change otherwise required.

Checking the engine oil level

The engine is equipped with an electronic oil level detection system.

If the engine is also equipped with a dipstick, this is subsidiary to the electronic oil level measurement system. It is merely used for a general check to determine if there is oil in the engine.

Electronic oil level measurement – system description

The engine oil level sensor is installed in the oil pan for oil level measurement. The electrical signals are detected in the engine control (MR) control unit and transmitted to the adaptation module (ADM) via the engine CAN.

Output can be displayed on a matrix display when the engine is not running.

The engine oil level is not displayed while the engine is running.

Checking the oil level electronically

Check the engine oil level on a regular basis, e.g. every week or each time you refuel.

The current oil level in the engine is only displayed once the engine is switched off and with the ignition switched on. An accurate display of the engine oil level is therefore only possible with the engine switched off and the ignition switched on.

- ▶ Park the vehicle/device on a level surface.
- ▶ Engage the parking brake.
- ▶ Switch off the engine.
- ▶ Wait approximately five to ten minutes. If you call up the oil level in the engine too early or while the engine is running, it is not available.

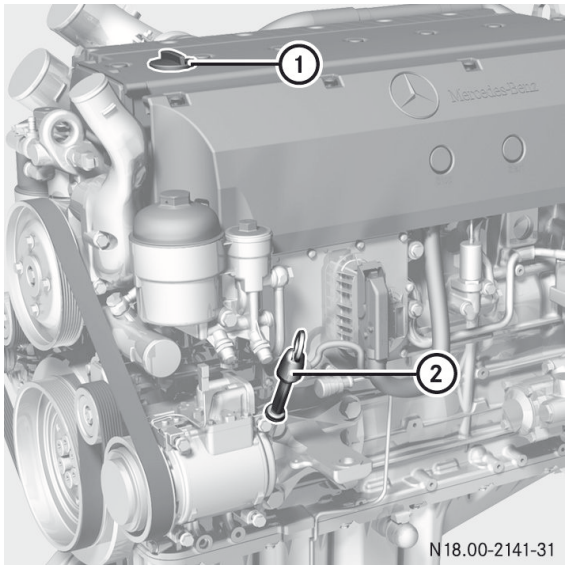
Only use engine oil which has been approved for the engine and which meets the specified SAE classification (▷ page 65).

Checking the oil level with the dipstick

❗ Do not add too much oil. If you add too much oil, the engine or the exhaust aftertreatment unit could be damaged. Drain or siphon off any excess oil.

Check the engine oil level on a regular basis, e.g. every week or each time you refuel.

- ▶ Park the vehicle/device on a level surface.
- ▶ Engage the parking brake.
- ▶ Switch off the engine.
- ▶ Wait approximately five to ten minutes.



Example: OM 926 LA

- ▶ Check the engine oil level with dipstick ②. The oil level should be between the upper and lower marks on dipstick ②.
- ▶ If necessary, use filler neck ① to top up the oil.

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Only use engine oil which has been approved for the engine and which meets the specified SAE classification (▷ page 65).

Checking the coolant level

- ▶ Check the coolant level as stated in the vehicle's/device's operating instructions.
- ▶ Fill the cooling system if necessary. Only use coolant that has been approved for the engine (▷ page 68).

Checking the fuel level

For checking the fuel level on the fuel gauge, see the vehicle's operating instructions. Refuel if necessary (▷ page 68).

Checking the AdBlue®/DEF supply

For checking the AdBlue®/DEF supply on the AdBlue®/DEF gauge, see the vehicle's operating instructions. Refuel if necessary (▷ page 59).

Starting and stopping the engine

Starting the engine

⚠ WARNING

Combustion engines emit poisonous exhaust gases such as carbon monoxide. Inhaling these exhaust gases leads to poisoning. There is a risk of fatal injury. Therefore never leave the engine running in enclosed spaces without sufficient ventilation.

! If the oil pressure in the engine is too low, a warning light lights up on the instrument panel. The warning buzzer also sounds.

The operating safety of the engine is jeopardised. Switch off the engine immediately.

! Do not pull away as soon as the engine starts. Let the engine run in neutral for a short time after starting, until there is sufficient engine oil pressure. Do not drive at high engine speeds when the engine is cold.

This will prevent excessive wear and possible engine failure.

Warm up the engine quickly by driving at moderate engine speeds. Depending on the outside temperature, the engine will reach its operating temperature after approximately 10 to 20 minutes (▷ page 98).

You can utilise the full engine power output once the engine has reached its normal operating temperature.

The display format for indicator and warning lights is vehicle-specific/device-specific. Please also observe the information in the additional operating instructions. These will be provided by the vehicle/device manufacturer.

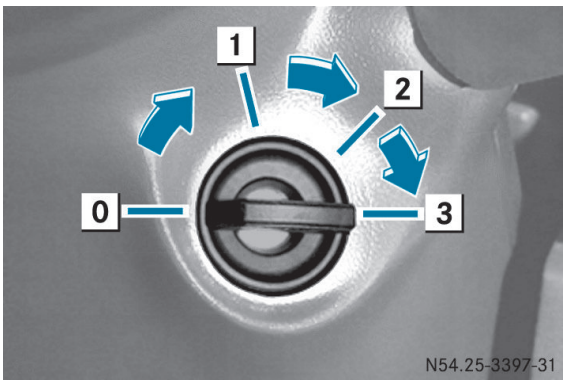
- ▶ Start the engine using the key in the ignition lock or the external engine start/engine stop button on the engine. Do not depress the accelerator or clutch pedal while doing so.

For additional safety, the electronic engine management system is equipped with a function that only allows the engine to be started when the transmission is in neutral (vehicle-specific/device-specific).

Starting the engine with the key

! After starting the engine, let it run at engine idling speed until the oil pressure is displayed. If no oil pressure is displayed after approximately 10 seconds, switch off the engine. Determine the cause. The operating safety of the engine is jeopardised.

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Example: ignition lock

0 To insert/remove the vehicle key
1 Steering wheel unlocked/radio position
2 Drive position (ignition)
3 Start position

- ▶ Secure the vehicle/equipment against rolling away.
- ▶ Deactivate power take-off.
- ▶ Shift the transmission to neutral or engage neutral on the equipment.
- ▶ **To start the engine:** turn the key in the ignition lock to drive position 2.
- ▶ Vehicles/equipment with a hot-water auxiliary heater: preheat the engine at outside temperatures below −20 °C before starting.
- ▶ Vehicles/equipment with cold-start aid: wait until the indicator lamp in the instrument cluster goes out.
- ▶ Turn the key to start position 3 in the ignition lock. Do not depress the accelerator pedal whilst doing so. For equipment, keep the idling function active.
- ▶ When the engine has started, release the key.
  The idling speed is controlled automatically.

ⓘ The engine idling speed is raised at very low outside temperatures.

- ▶ **If the engine does not start immediately:** interrupt the starting procedure after no more than 30 seconds.
- ▶ Turn the key in the ignition lock back to the stop at key position 0.
- ▶ Repeat the starting procedure after a waiting period of approximately 1 minute.
- ▶ If the engine fails to start: rectify the cause of the poor starting characteristics (▷ page 85).
- ▶ Observe the oil pressure gauge immediately after having started the engine.

Starting the engine with the external engine start/engine stop button

- ▶ **To start the engine with the external engine start/engine stop button:** (▷ page 80).

Stopping the engine

⚠ WARNING

When switching off the equipment or parking the vehicle, make sure that the exhaust system does not come into contact with combustible objects, e.g. dry leaves, grass or other highly flammable materials.

⚠ WARNING

If you switch off the ignition while the vehicle is in motion, safety-relevant functions are restricted or not available. This can affect the power steering function and the brake boosting effect, for example. You will then require considerably more force to steer and brake. There is a risk of an accident.

Do not switch off the ignition while the vehicle is in motion.

❗ Stop the engine immediately, paying attention to the road and traffic conditions if:

- the oil pressure falls or fluctuates significantly.
- the power output or engine speed decreases and the position of the position sensor (accelerator) remains constant.
- heavy smoke is emitted from the exhaust.

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- the coolant or engine oil temperature rises steeply.
- abnormal noises suddenly come from the engine or exhaust gas turbocharger.

▶ Park the vehicle/equipment.

▶ Secure the vehicle/equipment against rolling away.

▶ Shift the transmission into neutral/decouple the drive system.

Let the engine idle for approximately two minutes before switching off the engine if:

- the coolant temperature is very high (over 90 ℃).
- the engine has been operated at full output.

▶ **To switch off the engine:** turn the vehicle key in the ignition lock back to the stop at position 0.

ⓘ When you switch off the engine, BlueTec® exhaust gas aftertreatment automatically flushes the exhaust system with fresh air. Residues of AdBlue®/DEF on the metering unit or the injection nozzle might otherwise impair the function of BlueTec® exhaust gas aftertreatment. Depending on the engine's previous operating load, BlueTec® exhaust gas aftertreatment may flush the exhaust system several times.

When BlueTec® exhaust gas aftertreatment flushes the exhaust system, an air valve is activated. You may then hear a hissing sound. This hissing sound does not indicate a leak in the compressed-air system.

Switching off the engine with the external engine start/engine stop button

▶ **Switch off the engine with the external engine start/engine stop button:** (▷ page 80).

Switching the continuous brake on and off

⚠ WARNING

If you activate the continuous brake or shift to a lower gear on a slippery road surface in order to increase the engine's braking effect, the drive wheels may lose traction. There is an increased risk of skidding and an accident.

Do not activate the continuous brake and do not shift to a lower gear in order to increase the engine's braking effect on a slippery road surface.

! If the continuous brake is deactivated and the indicator lamp in the instrument cluster does not go out, have the continuous brake checked at a qualified specialist workshop.

The engine brake and retarder are used as a continuous brake.

You can utilise the engine's braking effect, particularly on long downhill gradients if you:

- activate the continuous brake
- shift to a lower gear in good time

Slowly depress the brake pedal if the engine's braking effect is insufficient when driving downhill.

Vehicles without a retarder are equipped with only two brake stages.

Operation of the continuous brake (see the vehicle/device operating instructions).

The indicator lamp in the instrument cluster is lit when the continuous brake is active.

When ABS (Anti-lock Braking System) intervenes, the continuous brake is switched off. The indicator lamp in the instrument cluster remains on.

Engine brake

The effectiveness of the engine brake depends on the engine speed. A high engine

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speed results in more effective engine braking.

Observe the effective engine braking range marked on the rev counter (▷ page 46).

The maximum permissible engine speed is restricted if necessary, depending on the vehicle/device application.

Observe the vehicle/device Operating Instructions.

At very low outside temperatures, the engine brake has limited or no effect after the engine has been started.

Operation of the engine brake (see the vehicle/device Operating Instructions).

Retarder

Operation of the retarder; see the vehicle/device Operating Instructions.

Idling speed

After the engine has been started, idling speed is regulated automatically. The engine idling speed may differ in certain operating conditions depending on the engine or on vehicles with power take-off.

The engine idling speed is raised at very low outside temperatures.

You can set the speed to the working speed via the electronic engine management system. This makes it possible to drive auxiliary equipment such as pumps at their working speed. For setting the working speed, see the vehicle's operating instructions.

Operational monitoring

Charge current

The charge current indicator lamp must go out after the engine has started.

If the  indicator lamp does not go off or lights up when the engine is running, switch off the engine. Searching for and eliminating the cause of the malfunction (▷ page 85).

Electronic engine management

The indicator and warning lamps must go out after the engine has started.

If an indicator lamp or warning lamp does not go out, or if it lights up while the engine is running, there is a malfunction in the electronic engine management system.

Searching for and eliminating the cause of the malfunction (▷ page 85).

Each malfunction is stored in the system with its own fault code. Temporary faults are also stored.

Fault codes can be read by a qualified specialist workshop using a diagnostic tester (▷ page 8).

Oil pressure

If the  indicator lamp does not go out or if it lights up when the engine is running, switch off the engine. Searching for and eliminating the cause of the malfunction (▷ page 85).

Operating restrictions for on-highway applications with BlueTec®

The electronic engine management system monitors:

- emissions-relevant malfunctions in the exhaust gas aftertreatment
- malfunctions in the electronic monitoring of the exhaust gas aftertreatment system
- consumption, level and quality of the AdBlue®/DEF reducing agent
- the efficiency of the catalytic converter in accordance with the permitted thresholds for nitric oxide emissions (NOx)

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Operating restrictions may occur in the form of torque reduction, thus also limiting output and speed.

The degree of torque reduction depends on the vehicle category:

- vehicles above 7.5 t: torque reduction by approximately 40%
- vehicles below 7.5 t: torque reduction by approximately 25%

Operating restrictions for off-highway engines with BlueTec®

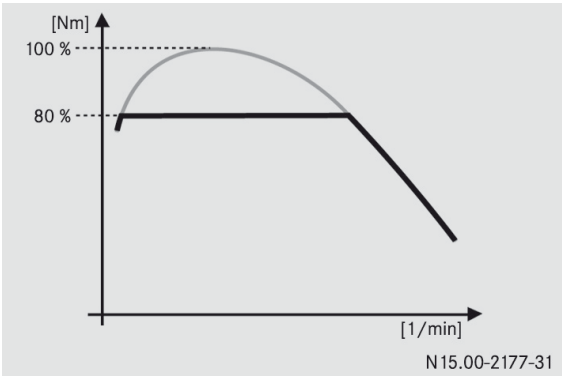
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- emissions-relevant malfunctions in the exhaust gas aftertreatment
- malfunctions in the electronic monitoring of the exhaust gas aftertreatment system
- consumption, level and quality of the AdBlue®/DEF reducing agent
- the efficiency of the catalytic converter in accordance with the permitted thresholds for nitric oxide emissions (NOx)

Operating restrictions in the form of torque reduction and thus output and speed limitation may occur.

Minor operating restriction

The available torque is reduced to roughly 80% of the maximum torque.



Reduction in output during minor operating restriction

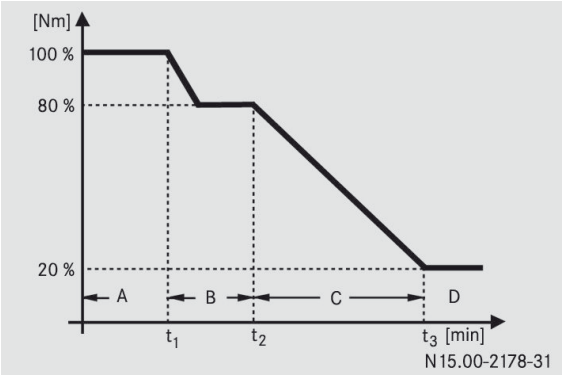
Major operating restriction

The transition between a minor and a major operating restriction is achieved by a gradual reduction in engine speed and torque.

- The engine torque is linearly reduced to 20% of the nominal value.
- At the same time, the engine speed is slowly reduced to 1000 rpm.

Types of operating restriction

AdBlue®/DEF level low



Insufficient AdBlue®/DEF remaining; warning and length of operating restriction period (example display)

A Acknowledged fault

B Minor operating restriction

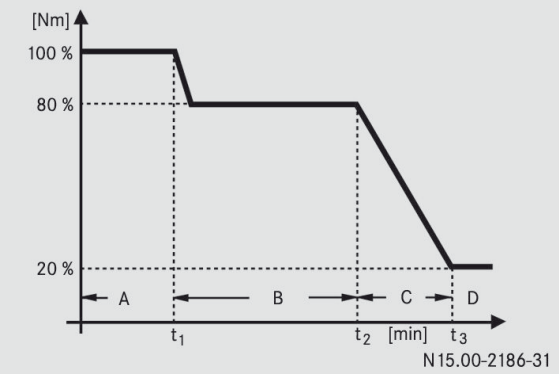
C Speed/torque reduction

D Major operating restriction

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AdBlue®/DEF quality not OK/fault in the monitoring system



Poor AdBlue®/DEF quality and misuse; warning and length of operating restriction period (example display)

A Acknowledged fault

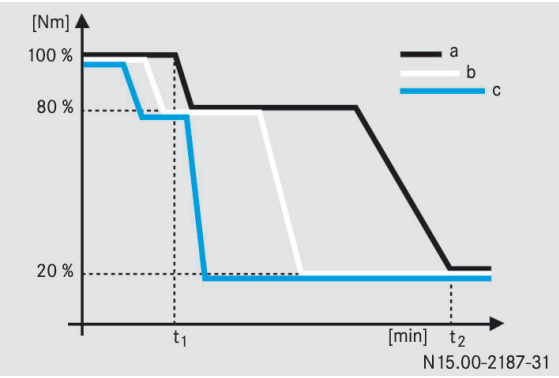
B Minor operating restriction

C Speed/torque reduction

D Major operating restriction

Repeated violations

In the event of repeated violations, the periods for the operating restriction system are shortened. When a fault is eliminated (for example the NOx sensor is replaced or reconnected), the operating restrictions are reset. Normal operation can be resumed.



Recurring fault (example display)

a Regular operating restriction

b Operating restriction after first recurrence of fault

c Operating restriction after second recurrence of fault

Emergency switch for overriding operating restrictions

If an emissions-relevant malfunction in the exhaust gas aftertreatment or the AdBlue®/DEF supply is detected, this can cause an operating restriction (limitation of engine torque and engine speed).

In case of emergency a push-button switch can be operated to override the operating restriction. This means that full engine power is available for a maximum of 30 minutes. This emergency function by operating the switch can be activated a maximum of three times.

When the final operating restriction (idling speed and 20% of torque) has been reached, the push-button switch is deactivated.

Deleting the fault memory

A fault stored in the fault memory because of the operating restriction system cannot be deleted with a conventional reading device. Faults can only be deleted using the Daimler/MTU maintenance system.

Displays

Rev counter

! If you exceed the maximum permissible engine speed, the warning tone sounds.

You should not drive and change gear by the sound of the engine, but according to the engine speed shown in the rev counter.

Avoid driving in the red overrevving range. This could lead to engine damage.

The engine speed display is the responsibility of the vehicle manufacturer and is not necessarily supplied by Mercedes-Benz. Daimler AG recommends that the vehicle manufacturer uses a rev counter divided by:

- operational efficiency
- engine braking range
- engine overrevving range

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General notes on the rev counter:

- Keep an eye on the rev counter while driving and stay within the economical operating range.

  In some situations it may make sense to operate the engine outside the economical engine speed range, e.g. on uphill gradients or when overtaking.
- If you run the engine within the economical engine speed range, you achieve low fuel consumption and reduced wear.
- In engine braking mode, drive in the middle engine speed range. The highest engine braking effect will be achieved just before the red overrevving range.
- When driving downhill, make sure that the engine speed does not enter the overrevving range (marked red).
- Idling speed is set automatically depending on the coolant temperature.
- When the vehicle is stationary, the engine is running and the transmission is in neutral, the engine increases throttle only slowly.

AdBlue®/DEF level

The AdBlue®/DEF gauge is the responsibility of the vehicle manufacturer. It is not necessarily supplied by Mercedes-Benz. Daimler AG recommends that the vehicle manufacturer uses an AdBlue®/DEF gauge and an AdBlue®/DEF indicator lamp for the AdBlue®/DEF reserve level .

The AdBlue®/DEF reducing agent is required for reduction of engine emissions.

The MOT approval/operating permit is invalidated if the vehicle/equipment is operated without AdBlue®/DEF. The legal consequence of this is that the vehicle/equipment may no longer be operated on public roads.

If the AdBlue®/DEF level has sunk to approximately 10%, a warning lamp for the AdBlue®/DEF reserve level lights up on the instrument panel. Top up the AdBlue®/DEF tank in good time (▷ page 59).

If the display is ignored and the AdBlue®/DEF level drops further, engine torque and engine speed may be reduced (▷ page 44).

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Warning and indicator lamps

Warning and indicator lamps – causes/consequences and solutions

Warning and indicator lamps for on-highway applications

Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp flashes red.	A serious fault in the engine system has been detected. ▶ Immediately stop the vehicle/device while paying attention to the traffic conditions and contact a qualified specialist workshop.
The indicator lamp lights up.	Impermissible operating conditions have been detected in the engine system. One of the following systems is malfunctioning: • Engine • Engine cooling • Engine management • Diesel injection system ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause. ▶ Have the systems checked at a qualified specialist workshop.
The indicator lamp lights up.	A malfunction has been detected in the electric power supply. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go out or if it lights up when the engine is running, search for the cause of the malfunction and have it repaired at a qualified specialist workshop.
The indicator lamp lights up.	After you have switched the ignition lock to the drive position, the indicator lamp indicates the status of the cold-start aid (▷ page 60). ▶ If there are no malfunctions, the indicator lamp goes out after the cold start aid has been switched off.
The indicator lamp lights up.	A malfunction was detected in the supply of engine lubricating oil. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check the engine oil level (▷ page 40). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp lights up.	A malfunction was detected in the supply of engine lubricating oil. The engine oil level is too low. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check the engine oil level (▷ page 40). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
The indicator lamp lights up.	A malfunction in the coolant circuit has been detected. The coolant level is too low. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check coolant level. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
The indicator lamp lights up.	A malfunction in the coolant circuit has been detected. The coolant temperature is too high. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check coolant level. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop. If you do not observe the instructions, engine performance and torque may be limited.
The indicator lamp lights up.	The indicator lamp shows the status of the continuous brake. ▶ The indicator lamp lights up after activation of the continuous brake. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions. ▶ If the indicator lamp does not go out after deactivation or if it lights up permanently, there is a malfunction. ▶ Have the malfunction rectified immediately at a specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The [cruise control] indicator lamp lights up.	The indicator lamp shows the status of the cruise control function. ▶ The indicator lamp lights up after activation of cruise control. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.
The [LIM] indicator lamp lights up.	The indicator lamp shows the status of the variable speed limiter. ▶ The indicator lamp lights up after a speed limit was activated by the speed limiter. ▶ The active speed limit is shown in the vehicle/equipment display. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.
The [LIM] indicator lamp flashes.	The indicator lamp shows that the speed set by the speed limiter has been exceeded. ▶ The maximum speed (speed limit) set by the speed limiter is being exceeded by more than 3 km/h. If necessary, reduce speed by adaptive braking. ▶ The speed limit set by the speed limiter was temporarily deactivated by kickdown and may be exceeded. By briefly switching to idle throttle position, the set speed limit is reactivated. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.
The [power take-off] indicator lamp lights up.	The indicator lamp shows the status of the power take-off. ▶ The indicator lamp lights up after engaging power take-off. ▶ If there are no malfunctions, the indicator lamp goes out after the power take-off is switched off. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.

Additional tips for vehicles/devices with BlueTec®/DEF

Problem	Possible causes/consequences and ▶ Solutions
The [AdBlue] indicator lamp lights up.	The AdBlue®/DEF reserve level has been reached. ▶ Top up the AdBlue®/DEF tank.
The [engine] indicator lamp flashes when the ignition is ON.	After you have switched the ignition lock into the drive position, the indicator lamp indicates the status of the European On-Board Diagnosis (OBD) by means of a sequence of flashes . ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started.

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Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp lights up.	An emissions-relevant fault has been detected. ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause. ▶ Have the exhaust gas aftertreatment system checked at a qualified specialist workshop. The operating permit is invalidated if you continue to use the vehicle. If there are no malfunctions, the indicator lamp only goes out after further test routines. The system check may involve several engine starts, several hours or several journeys without a malfunction.
The LIMIT indicator lamp lights up.	An emissions-relevant fault has been detected. ▶ An operating restriction is active. The engine torque is temporarily limited. ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause.

When the AdBlue®/DEF tank is filled or the fault is rectified, full engine power will be available again. If the system check does not detect any other faults, the indicator lamps go out after the system's status indicator. The system check may involve several engine starts, several hours or several journeys without a malfunction.

Warning and indicator lamps for off-highway engines

Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp flashes red.	A serious fault in the engine system has been detected. ▶ Immediately stop the vehicle/device while paying attention to the traffic conditions and contact a qualified specialist workshop.
The CHECK indicator lamp lights up.	Impermissible operating conditions have been detected in the engine system. One of the following systems is malfunctioning: • Engine • Engine cooling • Engine management • Diesel injection system ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause. ▶ Have the systems checked at a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp lights up.	A malfunction has been detected in the electric power supply. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go out or if it lights up when the engine is running, search for the cause of the malfunction and have it repaired at a qualified specialist workshop.
The indicator lamp lights up.	After you have switched the ignition lock to the drive position, the indicator lamp indicates the status of the cold-start aid (▷ page 60). ▶ If there are no malfunctions, the indicator lamp goes out after the cold start aid has been switched off.
The indicator lamp lights up.	A malfunction was detected in the supply of engine lubricating oil. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check the engine oil level (▷ page 40). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
The indicator lamp lights up.	A malfunction was detected in the supply of engine lubricating oil. The engine oil level is too low. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check the engine oil level (▷ page 40). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
The indicator lamp lights up.	A malfunction in the coolant circuit has been detected. The coolant level is too low. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check coolant level. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The [coolant] indicator lamp lights up.	A malfunction in the coolant circuit has been detected. The coolant temperature is too high. ▶ If there are no malfunctions, the indicator lamp goes out after the engine is started. ▶ If the indicator lamp does not go off or lights up when the engine is running, switch off the engine. ▶ Check coolant level. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop. If you do not observe the instructions, engine performance and torque may be limited.
The [brake] indicator lamp lights up.	The indicator lamp shows the status of the continuous brake. ▶ The indicator lamp lights up after activation of the continuous brake. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions. ▶ If the indicator lamp does not go out after deactivation or if it lights up permanently, there is a malfunction. ▶ Have the malfunction rectified immediately at a specialist workshop.
The [cruise] indicator lamp lights up.	The indicator lamp shows the status of the cruise control function. ▶ The indicator lamp lights up after activation of cruise control. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.
The [LIM] indicator lamp lights up.	The indicator lamp shows the status of the variable speed limiter. ▶ The indicator lamp lights up after a speed limit was activated by the speed limiter. ▶ The active speed limit is shown in the vehicle/equipment display. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.

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Problem	Possible causes/consequences and ▶ Solutions
The LIM indicator lamp flashes.	The indicator lamp shows that the speed set by the speed limiter has been exceeded. ▶ The maximum speed (speed limit) set by the speed limiter is being exceeded by more than 3 km/h. If necessary, reduce speed by adaptive braking. ▶ The speed limit set by the speed limiter was temporarily deactivated by kickdown and may be exceeded. By briefly switching to idle throttle position, the set speed limit is reactivated. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.
The indicator lamp lights up.	The indicator lamp shows the status of the power take-off. ▶ The indicator lamp lights up after engaging power take-off. ▶ If there are no malfunctions, the indicator lamp goes out after the power take-off is switched off. ▶ Observe the information contained in the equipment's/vehicle's Operating Instructions.

More tips for vehicles/equipment with BlueTec®

Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp lights up.	The AdBlue®/DEF reserve level has been reached. ▶ Top up the AdBlue®/DEF tank.
The LIMIT indicator lamp lights up.	An emissions-relevant fault has been detected. ▶ An operating restriction is active. The engine torque is temporarily limited. ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause.
The LIMIT indicator lamp flashes.	An emissions-relevant fault has been detected. ▶ An operating restriction is active. The engine torque is temporarily limited. ▶ If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause.

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Problem	Possible causes/consequences and ▶ Solutions
The [⚠] indicator lamp lights up.	An emissions-relevant malfunction in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply has been detected. ▶ Top up the AdBlue®/DEF tank immediately. ▶ If this does not help: have the exhaust gas aftertreatment system checked at a qualified specialist workshop. Have the malfunction rectified immediately. If you do not, engine output may be reduced and engine speed may be limited. If there are no malfunctions, the indicator lamp only goes out after further test routines. The system check may involve several engine starts, several hours or several journeys without a malfunction. If further indicator lamps are displayed, take the combination of lamps (see below) into account when evaluating the cause.
The [⚠] indicator lamp flashes, the [LIMIT] indicator lamp lights up.	You have not rectified an emissions-relevant malfunction that has been detected in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply. Reduced engine output is active. The engine torque is temporarily limited to a maximum of 80% across the entire engine speed range. The effect of the limitation is linear. If you do not observe the instructions, engine torque may be further limited to a maximum of 50%. ▶ Adapt your driving/operating style. ▶ Top up the AdBlue®/DEF tank immediately. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop. If you do not observe the instructions, engine performance and also engine speed may be limited.
The [⚠] and [LIMIT] indicator lamps are flashing.	You have not rectified an emissions-relevant malfunction that has been detected in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply. The reduction in engine output and limitation of the engine torque are activated. The engine torque is limited to a maximum of 20% across the whole engine speed range. The engine speed is limited to a maximum of 1000 rpm. ▶ Adapt your driving/operating style. ▶ Top up the AdBlue®/DEF tank immediately. ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The [⚠] and [CHECK] indicator lamps are lit.	An emissions-relevant malfunction in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply has been detected. ▶ Have the exhaust gas aftertreatment system checked at a qualified specialist workshop. Have the malfunction rectified immediately. If you do not, engine output may be reduced and engine speed may be limited. If there are no malfunctions, the indicator lamp only goes out after further test routines. The system check may involve several engine starts, several hours or several journeys without a malfunction.
The [⚠] indicator lamp flashes, the [CHECK] and [LIMIT] indicator lamps light up.	You have not rectified an emissions-relevant malfunction that has been detected in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply. The reduction in engine output and limitation of the engine torque are activated. The engine torque is temporarily limited to a maximum of 80% across the entire engine speed range. The effect of the limitation is linear. If you do not observe the instructions, engine torque may be further limited to a maximum of 50%. ▶ Adapt your driving/operating style. ▶ Have the malfunction rectified immediately at a specialist workshop. If you do not observe the instructions, engine performance and also engine speed may be limited.
The [⚠] and [LIMIT] indicator lamps flash, the [CHECK] indicator lamp lights up.	You have not rectified an emissions-relevant malfunction that has been detected in the exhaust gas aftertreatment system or in the AdBlue®/DEF supply. The reduction in engine output and limitation of the engine torque are activated. The engine torque is limited to a maximum of 20% across the whole engine speed range. The engine speed is limited to a maximum of 1000 rpm. ▶ Adapt your driving/operating style. ▶ Have the malfunction rectified immediately at a specialist workshop.

In the event of an emergency, operating restrictions (limitation of the engine torque and engine speed) can be temporarily overridden with the emergency switch (▷ page 46). When the AdBlue®/DEF tank is filled or the fault is rectified, full engine power will be available again. If the system check does not detect any other faults, the indicator lamps go out after the system's status indicator. The system check may involve several engine starts, several hours or several journeys without a malfunction.

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Operating instructions

Running-in

Vehicles/devices

Observe the vehicle/device manufacturer's running-in notes.

The running-in period of the engine has a significant effect on the vehicle, especially with regard to:

- service life
- operating safety
- economy

Observe the following notes during the running-in period up to 2,000 km (30 operating hours):

- avoid subjecting the engine to full load.
- run in the engine with care, using differing speeds and engine revs.
- avoid high engine speeds.
- do not drive at more than ¾ of the maximum road speed for each gear.
- change gear in good time.
- do not shift down to brake the vehicle.
- for vehicles with automatic transmission, do not depress the accelerator pedal beyond the point of resistance (kickdown).

After 2,000 km (30 operating hours), you can gradually bring the vehicle up to full road speed and increase engine speeds.

Fuel consumption

General notes

Fuel consumption depends on:

- the type of fuel used (diesel fuel, fatty acid methyl ester FAME fuel)
- the machine version/vehicle version
- the operating mode
- the operating conditions
- the attached equipment (e.g. hydraulic pumps, mowers, etc.)
- maintenance
- driving resistance
- your driving style

For these reasons, exact details about any single engine's fuel consumption cannot be provided.

Machine version/vehicle version

The following components affect fuel consumption:

- tyres (e.g. tyre pressure, tyre condition)
- body type
- drive train (e.g. transmission ratio)
- additional equipment (e.g. automatic climate control, auxiliary heating)

Maintenance

Fuel consumption and assembly wear depend on how often maintenance is carried out. Regular maintenance increases safety and lowers fuel consumption. Keep to the maintenance intervals. Always have maintenance work carried out at a qualified specialist workshop.

Fuel type

The fuel grade also affects fuel consumption. Use of lower fuel grades and/or non-approved fuel additives will increase fuel consumption. When refuelling, ensure that you are filling the appropriate fuel grade (▷ page 68).

AdBlue®/DEF consumption

AdBlue®/DEF consumption is between 3 and 6% of the fuel consumption, depending on engine use.

Engine oil consumption

After running-in the engine, oil consumption may reach 0.5% of the vehicle's fuel consumption.

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More arduous operating conditions and increased distance covered could result in engines exceeding this oil consumption value.

Warning buzzer

If the warning buzzer sounds and the symbol on the instrument panel is displayed, the engine's operating safety is jeopardised. Do not pull away, or stop the vehicle as soon as possible, paying attention to road and traffic conditions. You could otherwise damage the engine. The warning buzzer sounds depending on the vehicle if:

- you exceed the maximum permissible engine speed.
- the engine speed or vehicle speed is too high when changing gears.
- the coolant level is too low or the maximum permissible coolant temperature (about 100 °C) is exceeded. The operating safety of the engine is jeopardised.
- an emissions-relevant fault is detected or there is an operating restriction due to an emissions-relevant malfunction.

Refuelling

Fuels

Important safety notes

⚠ WARNING

Fuels are poisonous and hazardous to health. There is a danger of injury.

Do not swallow fuel or let it come into contact with skin, eyes or clothing. Do not inhale fuel vapours. Keep fuels out of the reach of children.

If you or others come into contact with fuel, observe the following:

- Wash the fuel off any affected areas of skin with water and soap immediately.
- If you get fuel in your eyes, rinse them thoroughly with clean water immediately. Seek immediate medical attention.
- If fuel is swallowed, seek immediate medical attention. Do not induce vomiting.
- Change any clothing that has come into contact with fuel immediately.

⚠ WARNING

Fuel is highly flammable. Improper handing of fuel creates a risk of fire and explosion.

Avoid fire, naked flames, smoking and creating sparks under all circumstances. Switch off the ignition and auxiliary heating before carrying out work to the fuel system. Always wear protective gloves.

⚠ WARNING

If you mix diesel fuel with petrol, the flash point of this fuel mixture is lower than that of pure diesel fuel. When the engine is running, components in the exhaust system may overheat unnoticed. There is a risk of fire.

Never refuel with petrol. Never add petrol to diesel fuel.

! Do not use petrol to refuel vehicles with a diesel engine. Even small amounts of petrol result in damage to the fuel system and engine.

! Do not switch on the ignition if you accidentally refuel with the wrong fuel. Otherwise, the fuel will enter the fuel lines. Notify a qualified specialist workshop and have the fuel tank and fuel lines drained completely.

! Do not add any special fuel additives to the diesel fuel.

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Special fuel additives can lead to:

- malfunctions
- damage to the catalytic converter
- engine damage

! AdBlue®/DEF is not a fuel additive and must not be added to the diesel tank. If AdBlue®/DEF gets into the diesel tank, this could lead to engine damage.

! A higher fuel sulphur content accelerates the ageing process of the engine oil and can damage the engine and exhaust system.

Environmental note

If fuels are handled improperly, they pose a danger to persons and the environment. Do not allow fuels to run into the sewage system, the surface waters, the ground water or into the ground.

Only refuel using approved fuels which are commercially available. Please note the approved fuel grade in the "Service products" section (▷ page 68). Using fuels which have not been approved causes irreversible damage to the engine and the exhaust gas aftertreatment system, as well as also significantly reducing the expected service life.

Before filling the tank

! If you are using drums or canisters to refuel the vehicle, you should filter the fuel before adding it.

This will prevent malfunctions in the fuel system due to contaminated fuel.

▶ Switch off the engine.

▶ Secure the vehicle/equipment against rolling away.

▶ Switch off the auxiliary heating.

▶ Observe the fuel grade (▷ page 68).

Regularly check the fuel prefilter with heated water separator for condensation.

AdBlue®/DEF

Important safety notes

! Do not allow diesel fuel to run into the AdBlue®/DEF tank. You could otherwise damage the exhaust gas aftertreatment system.

! Only use AdBlue®/DEF in accordance with DIN 70070/ISO 22241. Do not use any additives.

If AdBlue®/DEF comes into contact with painted or aluminium surfaces when filling the tank, rinse the affected area immediately with plenty of water.

! Do not mix additives to AdBlue®/DEF. Do not dilute AdBlue®/DEF with tap water. This could destroy the exhaust gas aftertreatment system.

! Always close the AdBlue®/DEF tank properly. Otherwise impurities may get into the exhaust gas aftertreatment system and damage it.

! Make sure that you do not overfill the AdBlue®/DEF tank. Otherwise, the AdBlue®/DEF tank could be damaged at very low temperatures.

Environmental note

Dispose of AdBlue®/DEF in an environmentally responsible manner.

When opening the AdBlue®/DEF tank, small amounts of ammonia vapours could escape.

Ammonia vapours have a pungent smell and are particularly irritating to:

- skin
- mucous membranes
- eyes

The vapours may cause a burning sensation in the eyes, nose and throat as well as irritation of the throat and watering eyes.

Avoid inhaling ammonia vapours. Only fill the AdBlue®/DEF tank in well-ventilated areas.

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AdBlue®/DEF should not come into contact with skin, eyes or clothing, and should not be swallowed. Keep AdBlue®/DEF out of the reach of children.

If you come into contact with AdBlue®/DEF, observe the following:

- immediately wash AdBlue®/DEF from your skin with water and soap.
- if AdBlue®/DEF comes into contact with your eyes, rinse your eyes with clean water immediately. Seek medical attention immediately.
- if you have swallowed AdBlue®/DEF, immediately rinse your mouth with water and drink plenty of water. Seek medical attention immediately.
- change clothing that has come into contact with AdBlue®/DEF immediately.

AdBlue®/DEF is not refilled as part of the maintenance work. Top up the tank regularly during vehicle operation or at the latest when the first event message is displayed on the electronic engine management system.

You will find further information on AdBlue®/DEF in the "Service products" section (▷ page 71).

Before filling the tank

▶ Switch off the engine.

▶ Secure the vehicle/equipment against rolling away.

Always fill the tank with at least 5 litres, as smaller amounts could cause malfunctions.

Winter operation

Notes for winter operation

! At very low outside temperatures, make sure that the engine oil added is of an appropriate SAE classification. Using engine oils that are not suitable for very low outside temperatures may result in engine damage.

Before the start of the cold season, make sure that:

- the coolant contains sufficient antifreeze (▷ page 68)
- the fuel used is suitable for winter use (▷ page 68)
- the SAE class of the engine oil used is in accordance with outside temperatures (▷ page 65).

Jump-starting

⚠ WARNING

The use of liquid or gaseous starting aids can cause explosions. This may result in severe injuries.

Do not use liquid or gaseous starting aids such as ether or Startpilot to start the engine.

Batteries

Always aim to achieve the full charge status. You can do this by means of careful maintenance and low electrical consumption. The cold start capacity is reduced when it is very cold. For example, at -10 °C it is only around 60% of the normal capacity.

Diesel fuels

Notes on diesel fuel at low temperatures (▷ page 70).

Cold-start aid

The cold-start aid makes it easier to start the engine at low outside temperatures (below –15 °C). It is activated when the outside temperature falls below –4 °C.

Environmental note

At outside temperatures below approximately -4 °C, the cold-start aid minimises pollutant emissions (after the engine is started). In addition, it reduces the load on the starter motor and batteries and enables the engine to be started more rapidly. For this reason, only

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start the engine once the indicator lamp in the status area of the on-board computer has gone out.

▶ **To activate the cold-start aid:** turn the vehicle key to the drive position in the ignition lock.
The indicator lamp lights up in the instrument panel.

▶ After the indicator lamp goes out, start the engine within 30 seconds.

The cold-start aid is automatically deactivated if:

- the engine is not started within 30 seconds of the indicator lamp going out.
- the engine is started when the indicator lamp is lit.
- the coolant temperature reaches around 0 °C while the engine is running.

At a coolant temperature above approximately -4 °C, the indicator lamp goes out after approximately 2 seconds (function check). At a coolant temperature below approximately -4 °C, the indicator lamp goes out after approximately 20 seconds.

Have the cold-start aid checked and repaired only at a qualified specialist workshop. Mercedes-Benz recommends that you use a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10). Work relevant to safety or on safety-related systems must be carried out at a qualified specialist workshop.

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General notes

⚠ WARNING

Before carrying out maintenance or repair work, you must read the relevant sections of the technical documentation relating to maintenance and repair measures, e.g. the Operating Instructions and workshop information.

In particular, first familiarise yourself with the legal regulations, e.g. work safety and accident prevention regulations.

You could otherwise fail to recognise dangers and injure yourself or others.

Always have maintenance work carried out at a qualified specialist workshop.

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

⚠ WARNING

Limbs could be crushed or trapped if the engine is started unintentionally during service or maintenance work. There is a risk of injury.

Always secure the engine against unintentional starting before carrying out maintenance or repair work.

⚠ WARNING

Cloths or other flammable materials left in the engine compartment can ignite if they come into contact with the exhaust system or parts of the engine that heat up. There is a risk of fire. After carrying out maintenance work, make sure that no extraneous flammable material is left in the engine compartment or on the exhaust system.

Environmental note

If circumstances require you to do some maintenance work yourself, you must observe the environmental protection requirements. When disposing of service products, e.g. engine oil, you must comply with the legal requirements. This also concerns all parts, e.g. filters, that have been in contact with service products.

Dispose of empty containers, cleaning cloths and care products in an environmentally responsible manner.

Observe the instructions for care products.

Do not let the engine run longer than necessary when stationary.

Like all technical equipment, the engine system requires care and maintenance.

The scope and frequency of maintenance work depends mainly on:

- the widely varying operating conditions.
- the service products used.

ⓘ All maintenance intervals and work refer to genuine Mercedes-Benz parts. They also refer to accessory parts and service products that have been expressly approved by Mercedes-Benz for the engine.

Inspection and maintenance work requires special skills that cannot be acquired by reading these Operating Instructions. Always have this work and maintenance work carried out by a qualified specialist workshop.

Have any work that is carried out confirmed with an entry in the Maintenance Booklet. This proof of regular maintenance is always required for any warranty claims.

Instructions and important information on carrying out maintenance work can be found in the Workshop Information System (WIS) on the Internet. Make sure that you have access to this information when carrying out maintenance work. Information on WIS (▷ page 10).

Please also observe the maintenance instructions for special accessories.

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When working on the vehicle, comply with all safety regulations, such as operating instructions, regulations concerning hazardous materials, environmental protection measures, work safety and accident prevention regulations.

Service products

Important safety notes

⚠ WARNING

Service product can be poisonous and hazardous to health. There is a risk of injury.

Observe the instructions on the respective original container when using, storing and disposing off service products. Always store service products in the sealed original container. Always keep service products out of the reach of children.

! Special additives (except approved fuel additives) are neither required nor approved for use with approved service products. Additives may cause damage to major assemblies. Therefore, do not mix any additives with service products. You are responsible for the results of using fuel additives.

Environmental note

Dispose of service products in an environmentally-responsible manner.

Service products are:

- fuels (e.g. diesel)
- lubricants (e.g. engine oil, transmission oil, grease)
- coolant, antifreeze
- AdBlue®/DEF, reducing agent in the exhaust gas aftertreatment system

Approved service products fulfil the highest quality standards and are documented in the Mercedes-Benz Specifications for Service Products. For this reason, only use approved service products for your vehicle. Information about approved service products is available from any Mercedes-Benz Service Centre (▷ page 10).

You can recognise service products approved by Mercedes-Benz by the following inscription on the container:

- MB-Freigabe (e.g. MB-Freigabe 228.51)

  or
- MB-Approval (z. B. MB-Approval 228.51)

Other labels and recommendations relating to the quality or indicating that the product meets a certain specification are not necessarily approved by Mercedes-Benz. Further information is available from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10).

ⓘ Information about service products which have been tested by Mercedes-Benz and approved for your engine system can be found in the Mercedes-Benz Specifications for Service products on the Internet at: **http://bevo.mercedes-benz.com/**.

ⓘ The specification and availability of lubricants may vary. Individual lubricants may no longer be available, especially for older engines. Information is available from any Mercedes-Benz, MTU or MTU-authorised Service Centre (▷ page 10).

Engine oils

Notes on engine oils

! Engine oils other than those of the quality specified in this Operator's Manual are not permitted.

Only use engine oils that comply with the Mercedes-Benz Specifications for Service Products.

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The following engine oils are approved:

- Sheet No. 228.5 / 228.3 / 228.1 standard quality multi-grade engine oils
- Sheet No. 228.51 / 228.31 low-ash multi-grade engine oils
- Sheet No. 228.0 / 228.2 standard quality single-grade engine oils (exceptional circumstances)

Mercedes-Benz particularly recommends engine oils that comply with Sheet no. 228.5 of the Mercedes-Benz Specifications for Service Products.

These engine oils are of a high standard of quality and have a beneficial effect on:

- length of oil change intervals
- engine wear
- fuel consumption
- exhaust emissions

The maximum interval for oil change is only achieved with engine oils of a particularly high quality grade.

Check the vehicle assemblies for leaks regularly. If fluid loss is identified, e.g. by oil drops on the parking area, have the cause of the fluid loss rectified at a qualified specialist workshop.

Scope of application

For engines with BlueTec® exhaust gas aftertreatment and operation with diesel fuel, only use multi-grade engine oils compliant with Sheet Nos. 228.5, 228.51, 228.3 and 228.31 or, in exceptional cases, single-grade engine oils compliant with Sheet No. 228.2.

For engines without BlueTec® exhaust gas aftertreatment, multi-grade oils compliant with Sheet No. 228.1 and, in exceptional cases, single-grade oils compliant with Sheet No. 228.0 / 228.2 can also be used.

For operation with FAME fatty acid methyl ester fuel (bio-diesel fuel), use only engine oils compliant with Sheet Nos. 228.5, 228.51, 228.3 and 228.31 (▷ page 70).

This is also required for a mixture of conventional diesel fuels and FAME fatty acid methyl ester fuels (bio-diesel fuel).

Multi-grade engine oils compliant with Sheet Nos. 228.5, 228.51, 228.3, 228.31 and 228.1 can be used all year round. Depending on the fuel quality (fuel sulphur content or FAME fatty acid methyl ester fuel), the oil change intervals may be shortened. For details, see the Maintenance Booklet.

Single-grade engine oils only cover an SAE (viscosity) classification for certain temperature ranges. Change the engine oil to an SAE class suitable for the time of year and the respective outside temperatures.

The use of low-ash engine oils is permitted but only necessary on engines with a diesel particle filter. The use of low-ash engine oils compliant with Sheet No. 228.51 and 228.31 is however only approved in conjunction with low-sulphur diesel fuel (less than 50 ppm, 0.005% by weight) (▷ page 69).

Oil change

! If you mix engine oils with differing oil grades, the change interval for the engine oil is reduced in comparison to mixtures of engine oil of identical grade.

Therefore, only mix engine oils of differing grade in exceptional circumstances. To prevent damage to the engine, the maintenance intervals must be adjusted accordingly.

! If the SAE class (viscosity) of the engine oil used is not suitable for continually low outside temperatures below -20 °C, this could cause engine damage.

The specified temperatures of the SAE class always refer to freshly added oil. Engine oil ages during driving due to soot and fuel residue. This impairs the characteristics of the engine oil, particularly at low outside temperatures.

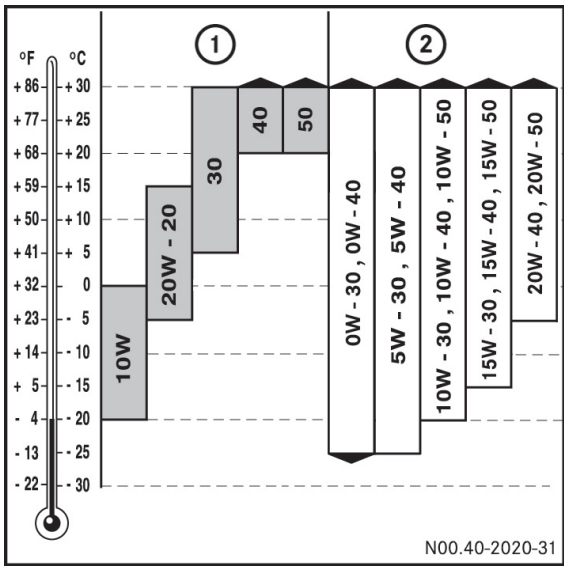
If the outside temperature is under -20 °C, Mercedes-Benz strongly recommends

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using engine oils of SAE class 5W-30 or 0W-30.

Use only all-season oils.

! If you do not use oil for all-year-round operation in your engine, change the engine oil right at the beginning of the cold season. Use only an approved engine oil in the specified SAE classification.



Engine oil SAE classes (viscosity)

① Single-grade engine oils

② Multi-grade engine oils

Oil change intervals are dependent on the following:

- the operating conditions of the vehicle
- the grade of the engine oil used
- the fuel grade (sulphur content)
- the fuel type, e.g. FAME fatty acid methyl ester fuel

For more details, see the Maintenance Booklet.

The maximum oil change interval can only be achieved by using engine oils of particularly high quality in accordance with Sheet No. 228.51 and 228.5 of the Mercedes-Benz Specifications for Service Products. The classification of oil change intervals is specified in the Maintenance Booklet.

Environmental note

If you operate your vehicle using FAME fatty acid methyl ester fuel (bio-diesel), special precautions must be taken and national specifications complied with when disposing of engine oils. Information is available from any Mercedes-Benz or MTU Service Centre.

Adding/topping up the engine oil

! There is a risk of damage to the catalytic converter or to the engine if too much oil is added. Have excess oil drained off.

When topping up, Mercedes-Benz recommends that you only use engine oil of the same grade and SAE class as the oil filled at the last oil change.

Check the oil level before topping up the engine oil (▷ page 40).

Miscibility of engine oils

The benefits of high-quality engine oils are diminished if you mix them.

Engine oils are differentiated according to:

- engine oil brand
- quality grade (Sheet No.)
- SAE viscosity class

If, in exceptional circumstances, the type of engine oil currently used in the engine is not available, another mineral or synthetic engine oil may be used. Make sure it is approved for Mercedes-Benz.

Please observe the following: if you top up with an engine oil of a lower quality, the maintenance interval corresponding to the lower quality (Sheet No.) must be used. The maintenance interval is reduced. If you top up with an engine oil of a higher quality, the maintenance interval is not altered.

Observe the notes in the Maintenance Booklet.

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Coolant

⚠ WARNING

The engine cooling system is under pressure, particularly if the engine is warm. You could be scalded by hot coolant spraying out when opening the cap. There is a danger of injury.

Allow the engine to cool before opening the cap. Wear gloves and protective eyewear when opening. Slowly turn the cap half a turn to allow pressure to escape.

⚠ WARNING

If antifreeze comes into contact with hot components in the engine compartment, it may ignite. There is a risk of fire and injury.

Let the engine cool down before you top up the antifreeze. Make sure that antifreeze is not spilled next to the filler neck. Thoroughly clean the antifreeze from components before starting the engine.

A coolant that ensures anti-corrosion/antifreeze protection and other important protective effects is filled at the factory.

The coolant is a mixture of water and corrosion inhibitor/antifreeze.

The corrosion inhibitor/antifreeze in the coolant has the following properties:

- heat transfer
- anti-corrosion protection
- cavitation protection (protection against pitting)
- antifreeze protection
- raising the boiling point

Leave the coolant in the engine cooling system all year round – even in countries with high outside temperatures.

Check the corrosion inhibitor/antifreeze concentration in the coolant every six months.

Renew the coolant at the interval specified in the Maintenance Booklet.

Only use approved corrosion inhibitor/antifreeze agents. Please note the Mercedes-Benz Specifications for Service Products (▷ page 65). This prevents damage to the engine cooling system and engine.

When renewing the coolant, ensure that it contains 50% corrosion inhibitor/antifreeze by volume. This corresponds to antifreeze protection down to -37 ℃.

Do not exceed 55% by volume (antifreeze down to approximately -45 ℃). The heat dissipation and antifreeze may otherwise be negatively affected.

If there is a loss of coolant, do not top it up by using only water, but also add an approved corrosion inhibitor/antifreeze agent.

The water in the coolant must meet certain requirements, which are often fulfilled by the use of drinking water. The water must be treated if its quality does not meet the required standards.

Please note the Mercedes-Benz Specifications for Service Products, Sheet No. 310.1.

Mixtures with other corrosion inhibitors/antifreeze agents are not permitted.

Diesel fuels

Important safety notes

⚠ WARNING

Fuel is highly flammable. Improper handing of fuel creates a risk of fire and explosion.

Avoid fire, naked flames, smoking and creating sparks under all circumstances. Switch off the engine and, if applicable, the auxiliary heating before refuelling.

⚠ WARNING

Fuels are poisonous and hazardous to health. There is a danger of injury.

Do not swallow fuel or let it come into contact with skin, eyes or clothing. Do not inhale fuel vapours. Keep fuels out of the reach of children.

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If you or others come into contact with fuel, observe the following:

- Wash the fuel off any affected areas of skin with water and soap immediately.
- If you get fuel in your eyes, rinse them thoroughly with clean water immediately. Seek immediate medical attention.
- If fuel is swallowed, seek immediate medical attention. Do not induce vomiting.
- Change any clothing that has come into contact with fuel immediately.

! If you are using drums or canisters to refuel the engine/vehicle/equipment, you should filter the fuel before filling.

This prevents malfunctions in the fuel system caused by contaminated fuel.

The following fuel types are not permitted:

- marine diesel fuel
- aviation turbine fuel
- heating oils

Fuel grade

i Certain countries have diesel fuel with varying sulphur content. Diesel fuel with low sulphur content is sold in certain countries under the name "Euro diesel".

Fuel sulphur content

! A higher fuel sulphur content accelerates the ageing process of the engine oil and can damage the engine and exhaust system.

! **Vehicles with BlueTec® exhaust gas aftertreatment:**

Only standardised fuels with a maximum sulphur content of 0.05% (500 ppm) by weight are permissible. However, Mercedes-Benz only recommends fuel that complies with the European standard EN 590 as of 2005, et seq. (max. 0.005% (50 ppm) sulphur by weight). The use of fuels with a sulphur content higher than 0.005% (50 ppm) by weight reduces the life expectancy of the engine and exhaust system.

! **Vehicles without BlueTec® exhaust gas aftertreatment:**

Only commercially available fuels which comply with the European standard EN 590 or comparable national fuel standards are permitted. Mercedes-Benz recommends fuels with a low sulphur content. The use of fuels with a high sulphur content reduces the lifespan of the engine and the exhaust system. For operation with a high sulphur content > 0.05% by weight (500 ppm), the maintenance intervals for the engine oil and filter must be reduced.

For details, see the Maintenance Booklet.

i Even if the maintenance intervals are reduced, operation with fuel with a higher sulphur content will lead to increased engine wear, especially on the fuel injectors.

Information about current country-specific fuel sulphur contents can be obtained from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10).

You can find a table of fuel sulphur contents in specific countries in the Mercedes-Benz Specifications for Service Products, Sheet 136.2 at http://bevo.mercedes-benz.com.

The maintenance intervals for engine oil and filter replacement must be adapted depending on the fuel grade used. The higher the sulphur content in diesel fuel, the shorter the maintenance intervals for engine oil and filter replacement. Observe the notes in the Maintenance Booklet.

Water content

If the engine is operated with increased amounts of dirt and water, an additional fuel prefilter with a water separator must be fitted on the chassis.

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Diesel fuels at low temperatures

⚠ WARNING

If you heat fuel system components, e.g. with a hot-air gun or naked flame, these components could be damaged. This can cause fuel to escape and ignite. Depending on the type of damage, fuel may also not escape until the engine is running. There is a risk of fire and explosion.

Never heat fuel system components. Contact a qualified specialist workshop to rectify the malfunction.

At low outside temperatures, paraffin separation may cause the flow properties of the diesel fuel to be insufficient.

To prevent operating problems, diesel fuel with improved flow properties is available in the winter months.

Winter diesel fuels are reliable down to outside temperatures of −22 °C in Germany and other Central European countries. You can normally use winter diesel fuel without problems at the outside temperatures expected in the country where it is on sale.

Fuel additives

! When necessary, use only approved fuel additives.

There is otherwise a risk of impaired engine performance or engine and catalytic converter damage. The use of appropriate fuel additives is your responsibility.

! Do not add any petrol or kerosene to diesel fuel to improve its flow characteristics. Petrol or kerosene impairs the lubricity of the diesel fuel. This can cause damage to the injection system, for example.

For lower temperatures, the engine can be equipped with a fuel preheating system. This improves the flow characteristics of the diesel fuel according to the output of the installed heater.

Fuel additives used to improve flow characteristics are flow improvers.

Do not add flow improvers to winter diesel fuel guaranteed to operate down to −22 °C. The cold flow properties of the fuel may deteriorate as a consequence of the flow improver.

Fatty acid methyl ester (FAME) fuel (bio-diesel)

General notes

Operate your engine using pure FAME fatty acid methyl ester fuel in compliance with DIN EN 14214. You can also operate your engine using a mixture of conventional diesel fuel and FAME fatty acid methyl ester fuel. This also applies to engines with exhaust gas aftertreatment.

Observe the specifications in accordance with Sheet no. 135.0 of the Mercedes-Benz Specifications for Service Products for operation with FAME fatty acid methyl ester fuel.

Operating the vehicle with FAME fatty acid methyl ester fuel results in:

- higher fuel consumption
- reduced engine power output
- increased white smoke after a cold start
- reduced maintenance intervals

Low outside temperatures

FAME fatty acid methyl ester fuel compliant with DIN EN 14214 can be used reliably at outside temperatures down to −20 °C.

If you add a flow improver to the FAME fatty acid methyl ester fuel, the fuel's resistance to low temperatures does not change.

For lower temperatures, the engine can be equipped with a fuel preheating system. This improves the flow characteristics of the FAME fatty acid methyl ester fuel according to the heat output installed.

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AdBlue®/DEF

Important safety notes

⚠ WARNING

AdBlue®/DEF must not come into contact with skin, eyes or clothing.

- If AdBlue®/DEF comes into contact with your eyes or skin, rinse affected areas with clean water immediately.
- If AdBlue®/DEF is swallowed, immediately rinse your mouth out with a lot of clean water and drink plenty of water.
- Change clothing that is soiled with AdBlue®/DEF immediately.
- If allergic reactions occur, consult a doctor immediately.

Keep AdBlue®/DEF out of the reach of children.

! Only use AdBlue®/DEF in accordance with DIN 70070/ISO 22241. Do not use any additives.

If AdBlue®/DEF comes into contact with painted or aluminium surfaces when filling the tank, rinse the affected area immediately with plenty of water.

The terms "Urea" and "DEF" (Diesel Exhaust Fluid) are also used for "AdBlue®".

If the AdBlue®/DEF tank is full of AdBlue®/DEF, pressure compensation may occur when the tank lid is unscrewed. AdBlue®/DEF may spill out. Therefore, open the AdBlue®/DEF tank lid carefully. If AdBlue®/DEF spills out, immediately wash the affected area with plenty of water.

When opening the AdBlue®/DEF tank, small amounts of ammonia vapours could escape.

Ammonia vapours have a pungent smell and are particularly irritating to:

- skin
- mucous membranes
- eyes

The vapours may cause a burning sensation in the eyes, nose and throat as well as irritation of the throat and watering eyes.

Avoid inhaling ammonia vapours. Only fill the AdBlue®/DEF tank in well-ventilated areas.

AdBlue®/DEF should not come into contact with skin, eyes or clothing, and should not be swallowed. Keep AdBlue® out of the reach of children.

If you come into contact with AdBlue®/DEF, observe the following:

- immediately wash AdBlue®/DEF from your skin with water and soap.
- if AdBlue®/DEF comes into contact with your eyes, rinse your eyes with clean water immediately. Seek medical attention immediately.
- if you have swallowed AdBlue®/DEF, immediately rinse your mouth with water and drink plenty of water. Seek medical attention immediately.
- change clothing that has come into contact with AdBlue®/DEF immediately.

High outside temperatures

⚠ WARNING

If the AdBlue®/DEF tank cap is opened at high temperatures, ammonia vapours may escape.

Ammonia vapours have a pungent odour and particularly irritate:

- skin
- mucous membranes
- eyes

The vapours may cause a burning sensation in the eyes, nose and throat as well as irritation of the throat and watering eyes.

Avoid inhaling ammonia vapours.

The chemical composition of AdBlue®/DEF can break down if it heats up to 50 °C over a long period (e.g. as a result of direct sunlight on the tank). This creates ammonia vapour.

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Low outside temperatures

AdBlue®/DEF freezes at a temperature of approximately −11 °C .

Depending on equipment and country, the AdBlue®/DEF supply system of the vehicle may be heated; see the vehicle's Operating Instructions. Winter operation is thus guaranteed at temperatures below −11 °C .

Additives, tap water

! Do not mix additives to AdBlue®/DEF. Do not dilute AdBlue®/DEF with tap water. This could destroy the exhaust gas aftertreatment system.

Storage

! Containers made of the following materials are not suitable for the storage of AdBlue®/DEF:

- aluminium
- copper
- copper alloys
- unalloyed steel
- galvanised steel

If AdBlue® is stored in these types of container, constituents of these metals may dissolve and damage the exhaust gas aftertreatment beyond repair.

Only use containers made of the following materials to store AdBlue®:

- Cr-Ni steel in accordance with DIN EN 10 088-1/2/3
- Mo-Cr-Ni steel in accordance with DIN EN 10 088-1/2/3
- Polypropylene
- Polyethylene

Disposal

Environmental note

Dispose of AdBlue®/DEF in an environmentally responsible manner.

Observe laws and regulations on the disposal of AdBlue®/DEF in the country concerned.

Purity

! Impurities in AdBlue®/DEF, e.g. due to other service products, cleaning products or dust, may lead to:

- increased emission values
- damage to the catalytic converter
- engine damage
- malfunctions in the exhaust gas aftertreatment system.

Ensure that AdBlue®/DEF is always pure to avoid malfunctions in the exhaust gas aftertreatment system.

If AdBlue®/DEF is pumped from the tank, e.g. during repairs, do not use this fluid to refill the tank. Otherwise the purity of the fluid would no longer be guaranteed.

Cleaning and care

Notes on care

Regular care helps to maintain the value of the engine.

Mercedes-Benz recommends that you only use care products that have been approved for Mercedes-Benz. You can obtain these care products from any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10).

High-pressure cleaning

Environmental note

Only wash your vehicle at a wash bay designed for this purpose. Dispose of empty containers and used cleaning products in an environmentally responsible manner.

! The exhaust gas aftertreatment system may only be cleaned when it is cool. The sensors can otherwise be damaged.

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! When cleaning, never point the water jet at the exhaust pipe. The system may otherwise be damaged.

! When using a high-pressure cleaner, keep a minimum distance between the high-pressure nozzle and the engine parts. Otherwise, parts of the engine may be damaged.

Observe the following minimum distances:

- about 70 cm with round-spray jets
- about 30 cm with 25° flat-spray jets
- about 30 cm with concentrated-power jets

! Keep the water jet moving constantly while cleaning. In this way, you will avoid causing damage.

Do not point the water jet at:

- electrical components
- plug connectors
- seals
- hoses

Cleaning the engine

! Observe the following notes when cleaning the engine. This avoids malfunctions and damage to the engine.

- When using high-pressure or steam cleaners, do not point the spray directly at electrical components and electric cables.
- Make sure that no water enters the air intake and ventilation openings.
- Treat the engine with preservative agents after it has been cleaned. When doing so, protect the belt drive system from the preservative agent.
- Only use wax-based protective agents for engines that comply with Sheet No. 385.4 of the Mercedes-Benz Specifications for Service Products.

In addition, observe the notes in the "High-pressure cleaning" section (▷ page 72).

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General notes

Decommissioned engines are engines that are not operated for over a month.

Special measures are required to decommission the engine/vehicle.

Information about batteries: if the engine/vehicle is to be out of use for longer than three weeks, disconnect the negative terminal on the battery. This prevents the batteries from being discharged by no-load current consumers.

If the engine/vehicle is to be out of use for a longer period, remove the batteries and store them in a dry and well-ventilated area.

Recharge batteries every 3 months at the latest.

Ensure that there is adequate ventilation when recharging. Check the battery fluid levels before and after charging and if necessary correct them. For further information (▷ page 60).

Decommissioning for up to 6 months

When decommissioning an engine/vehicle, keep it in a covered, dry and well-ventilated area. The room temperature should not fall below -10 ℃.

Measures prior to decommissioning:

- Clean the engine/vehicle thoroughly.
- Remove any patches of corrosion from the engine.
- Change the engine oil and oil filter if the last oil change was carried out more than 20,000 km (or around 300 operating hours) ago.

  Also change the engine oil and filter if the oil is more than 12 months old.
- Check and adjust the level of coolant or renew coolant.
- Check and adjust the concentration of anti-corrosion/antifreeze additives in the coolant.
- Top up the AdBlue®/DEF tank until it is full, to prevent AdBlue®/DEF from crystallising.
- Drain the water separator for the fuel system.

Engine/vehicle/equipment run on FAME (Fatty Acid Methyl Ester) bio-diesel fuel

Before decommissioning, operate the engine with at least two fuel tanks of diesel fuel. Decommissioning with FAME fatty acid methyl ester (bio-diesel fuel) is not permitted.

Measures prior to recommissioning:

- Fit and connect the battery.
- Check that the electrical system is functioning correctly.
- Check cables, hoses and lines for tears and leaks.
- Check the engine oil level.
- Check the oil level in the steering and hydrostatic fan drive.
- Check the coolant level and correct it, if necessary.
- Check AdBlue®/DEF level.
- Check the fuel level.
- Start the engine and leave it running at medium engine speeds until it is at operating temperature (coolant temperature). While doing so, observe the indicators for oil pressure, coolant temperature and oil temperature.
- Vehicles with auxiliary heating: activate the auxiliary heating and check operation.
- Check operation of the steering and brakes.
- Check whether maintenance is due and if necessary carry it out.

Decommissioning for up to 12 months

Carry out all measures in "Decommissioning for up to 6 months". In addition, the engine must be started at least every three months. Warm up the engine at medium engine

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speeds and allow it to run for approximately 30 minutes at operating temperature.

Before recommissioning, carry out the prescribed maintenance work, see the Maintenance Booklet.

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Important safety notes

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

⚠ WARNING

There are moving components in the engine compartment. Certain components may continue to move or suddenly move again even after the ignition has been switched off, e.g. the radiator fan. There is a risk of injury.

If you have to carry out work in the engine compartment:

- switch off the ignition
- never touch the dangerous areas surrounding moving components, e.g. the rotation area of the fan
- remove jewellery and watches
- keep items of clothing and hair, for example, away from moving parts.

⚠ WARNING

Certain engine components can become very hot. There is a risk of injury when carrying out work at the engine.

Where possible, allow the engine to cool down and only touch the components described below.

When working on the vehicle, comply with all safety regulations, such as operating instructions, regulations concerning hazardous materials, environmental protection measures, work safety and accident prevention regulations.

Be aware of the road and traffic situation when working on public roads and secure your position accordingly.

Apart from careful operation and maintenance of the engine it is also important that malfunctions be rectified in good time.

You can rectify certain malfunctions yourself, (▷ page 85).

Have malfunctions that you cannot eliminate yourself rectified at a qualified specialist workshop.

External engine start/engine stop button

Switch off the engine with the external engine start/engine stop button:

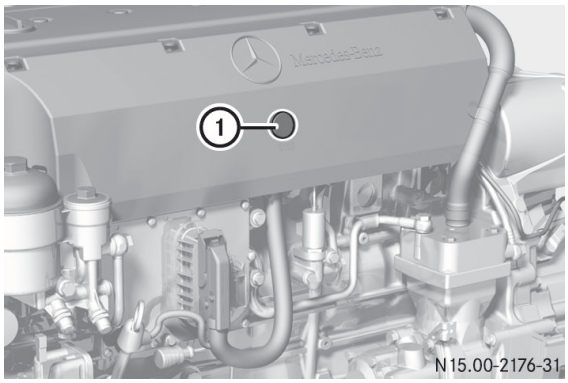
The safety functions of the electronic engine management system only allow the engine to be started when the transmission is in neutral or equipment is not being driven (disengaged).

Observe the information contained in the equipment's/vehicle's Operating Instructions.

Before starting the engine

- ▶ Switch the ignition lock to the drive position.
- ▶ Shift into neutral.
- ▶ Secure the vehicle against rolling away.
- ▶ Deactivate power take-off.

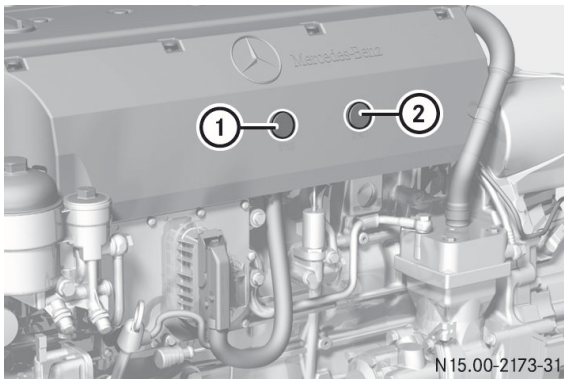
Engine with one button



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- ▶ **To start the engine:** press Start/Stop button ①.
  The engine starts and runs at engine idling speed.
- ▶ **To start the engine and increase the engine speed:** press and hold Start/Stop button ①.
  The engine starts and runs at engine idling speed. After about three seconds, the engine speed increases.
- ▶ Hold down Start/Stop button ① until the desired engine speed is reached.
  After releasing Start/Stop button ①, the engine continues to run at the currently set speed. The engine speed can be increased up to the limiting speed.
- ▶ **To stop the engine:** press Start/Stop button ① again.
  The engine switches off.

Engine with two buttons



- ▶ **To start the engine:** press start button ②.
  The engine starts and runs at engine idling speed.
- ▶ **To increase the engine speed:** while the engine is running, press start button ② again and hold it down until the desired engine speed is reached.
  After releasing start button ②, the engine continues to run at the currently set speed. The engine speed can be increased up to the limiting speed.
- ▶ **To stop the engine:** while the engine is running, press stop button ①.
  The engine switches off.
- ▶ **To turn the engine over without starting it:** press and hold start button ② and stop button ① at the same time.
  The engine turns over without starting.
- ▶ Release start button ② and stop button ①.
  The engine remains at a standstill.

Bleeding and draining the fuel system

When the engine is started, the battery must have sufficient charge to bleed the fuel system.

Bleeding with a heated fuel prefilter with a water separator fitted on the chassis:

- ▶ Bleed the fuel prefilter with water separator on the chassis before bleeding the fuel circuit on the engine side (▷ page 82).

Bleeding the fuel system without a fuel prefilter on the chassis frame

! Do not bleed the fuel system by operating the starter motor for an extended period of time. You could otherwise damage the starter motor.

- ▶ Turn the key to the start position in the ignition lock and hold it. Do not depress the accelerator pedal whilst doing so.

i Stop the starting procedure after approximately 30 seconds.

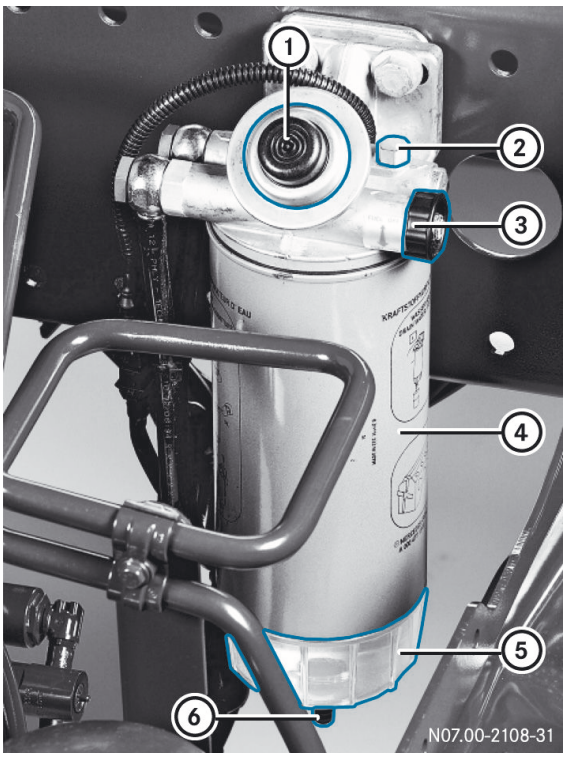
- ▶ Repeat the starting procedure after a waiting period of approximately 1 minute.

The fuel system is bled automatically.

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Bleeding the fuel system with a fuel prefilter on the chassis frame

Fuel prefilter overview



Example: fuel prefilter

① Manual fuel pump
② Vent valve
③ Shutoff valve
④ Filter housing
⑤ Water separator with inspection window
⑥ Water release valve

If water has collected in inspection window ⑤, drain the fuel prefilter before bleeding.

Draining the fuel prefilter

Environmental note

Dispose of the water-fuel mixture in an environmentally responsible manner.

Drain the fuel prefilter regularly.

- ▶ Place a collector under water release valve ⑥.
- ▶ On vehicles with fuel prefilter at tank level: close shutoff valve ③.
- ▶ Open water release valve ⑥.
- ▶ Press manual fuel pump ① and collect the fuel/water mixture.
- ▶ Close water release valve ⑥.
- ▶ On vehicles with fuel prefilter at tank level: open shutoff valve ③.
- ▶ Start the engine and allow it to run for about one minute.
  The fuel system is bled automatically.
- ▶ Check the fuel system for leaks.

Bleeding the fuel prefilter with the manual fuel pump

The fuel prefilter must only be bled when:

- the fuel tank is empty or
- the fuel filter has been replaced.

- ▶ Unscrew the fuel tank filler cap.
- ▶ Place the collector underneath the fuel prefilter.
- ▶ Open shutoff valve ③ fully.
- ▶ Open bleed nipple ②.
- ▶ Press manual fuel pump ① repeatedly until the escaping fuel is free of bubbles ②. Do not continue to pump.
- ▶ Close bleed nipple ②.
- ▶ Close the fuel tank filler cap.
- ▶ Start the engine.

The fuel system is bled automatically.

! Do not continue to press the fuel hand pump after the engine has started. This could otherwise damage the hand pump.

Electrical fuses

Important safety notes

⚠ WARNING

If you manipulate, bridge or replace a faulty fuse with a fuse of a higher amperage, the electric cables could be overloaded. This may result in a fire. There is a risk of an accident and injury.

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Always replace faulty fuses with specified new fuses of the correct amperage.

The individual electrical circuits are protected by safety fuses or automatic circuit-breakers.

Blown fuses or defective automatic circuit-breakers must be replaced by equivalent fuses with the fuse ratings recommended in the fuse allocation chart. Fuses with the same fuse rating are the same colour.

Further information is available from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 10).

The vehicle-specific fuse allocation chart is provided by the vehicle manufacturer.

If the newly inserted fuse also blows, have the cause traced and rectified at a qualified specialist workshop, e.g. a Mercedes-Benz Service Centre.

▶ If a circuit fails, switch off the consumer equipment and switch the ignition lock to position **0**.

Checking and replacing a safety fuse

▶ Pull the fuse out of the module using the pliers and carry out a visual inspection.
▶ If the fuse wire has melted, replace the blown fuse with a spare fuse.
▶ Switch on consumers and check that they function correctly.

If the safety fuse burns out again, have the electrical system checked at a qualified specialist workshop.

Jump-starting

Important safety notes

⚠ **WARNING**

Comply with safety precautions and take protective measures when handling batteries.



Risk of explosion



Fire, naked flames and smoking are prohibited when handling the battery. Avoid creating sparks.



Battery acid is caustic. Avoid contact with the skin, eyes or clothing.

Wear suitable protective clothing, in particular gloves, an apron and a face mask.

Immediately rinse acid splashes off with clean water. Consult a doctor if necessary.



Wear eye protection.



Keep children away.



Observe this Owner's Manual.

! Observe the following notes. You could otherwise damage the battery or electronic components in the vehicle:

- do not use a battery quick-charge unit for jump-starting.
- if you use a mobile battery charger (battery device with mains power stage), remove the mains plug before jump-starting.
- only have jump-starting provided by vehicles with a 24 V system.
- use jump leads which are protected against polarity reversal and with a wire

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cross section of approximately 35–50 mm² and insulated terminal clamps.

- if the outside temperature drops below -10 °C, a discharged battery could freeze. Do not start the engine under these circumstances. Let the battery thaw out first.

! Do not connect the negative terminal clamp of the jump lead to the chassis frame. Otherwise, engine or transmission components can be damaged.

! When you remove the jump leads, let the engine of the vehicle being jump-started idle. This avoids damage being caused to the vehicle electronics.

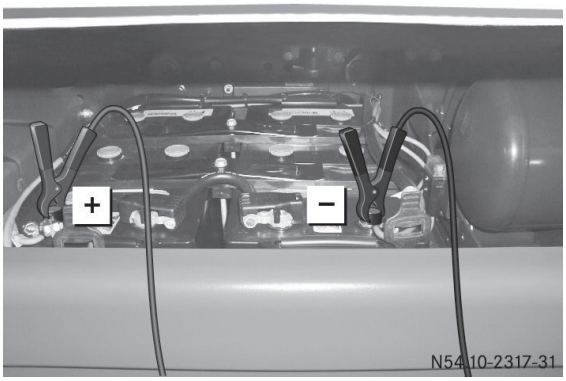
General notes

Observe the instructions relevant to safety and protective measures when handling the battery.

After jump-starting, have the batteries checked at a qualified specialist workshop.

- ▶ Make sure that the vehicles are not touching.
- ▶ Engage the parking brake.
- ▶ Switch off all electrical consumers.
- ▶ Turn the key to position **0** in the ignition lock.

Vehicles without a jump-starting connection point



Connecting the jump lead

- ▶ Remove the battery compartment cover.
- ▶ First, connect the positive terminal clamp of the jump lead to the positive terminal of the other vehicle's battery and then to the + positive terminal of the starter battery.
- ▶ First, connect the negative terminal clamp of the jump lead to the negative terminal of the other vehicle's battery and then to the – negative terminal of the starter battery.
- ▶ Assisting vehicle: run the engine at a high speed.
- ▶ Start the engine and allow it to idle.

Disconnecting the jump lead

- ▶ First, disconnect the negative terminal clamps of the jump lead from the negative terminals.
- ▶ Remove the positive terminal clamps of the jump lead from the positive terminals.

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Troubleshooting

Engine problems

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

Apart from careful operation and maintenance of the engine it is also important that malfunctions be rectified in good time. You can rectify certain faults yourself.

Have malfunctions that you cannot eliminate yourself rectified at a qualified specialist workshop (▷ page 10).

Problem	Possible causes/consequences and ▶ Solutions
The drive pinion does not turn or turns too slowly.	The battery is not sufficiently charged. ▶ Charge the battery.
	The connecting cable to the starter motor is loose. ▶ Tighten the cable on the terminal. If necessary, solder on a new terminal.
	The earth connection to the battery is loose. ▶ Tighten the cable on the terminal. If necessary, solder on a new terminal.
	The starter motor solenoid switch is faulty or the starter motor is faulty. ▶ Have it checked at a qualified specialist workshop.
The engine does not start or stalls again immediately.	The fuel tank is empty. ▶ Refill the fuel tank (▷ page 58).
	The fuel filter is blocked. ▶ Replace the fuel filter element.
	The fuel prefilter contains water. ▶ Drain the fuel prefilter.
	The fuel prefilter is blocked. ▶ Replace the fuel filter element.

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Problem	Possible causes/consequences and ▶ Solutions
	Leaks or insufficient pressure in the low-pressure fuel circuit ▶ Check for leaks (visual check), replace the seals if necessary. ▶ Have the fuel pressure tested at a qualified specialist workshop. Replace the seals.
The engine does not start correctly.	There is a malfunction in the engine control unit. ▶ Read out the MR (engine control) unit; have it checked at a qualified specialist workshop.
	There are leaks or there is insufficient pressure in the low-pressure fuel circuit. ▶ Carry out a check for leaks (visual check). ▶ Have the pressure tested at a qualified specialist workshop.
The engine stops inadvertently.	The MR (engine control) unit is faulty (total failure). ▶ Consult a qualified specialist workshop.
	The power supply to the MR and ADM control units is interrupted or there is a short circuit in the wiring. ▶ Have the power supply checked at a qualified specialist workshop.
	There are leaks or there is insufficient pressure in the low-pressure fuel circuit or the fuel pump drive is faulty. ▶ Check for leaks (visual check). ▶ Have the fuel pressure tested at a qualified specialist workshop.
The engine is in emergency running mode.	There is an interruption in the data flow of the MR and ADM control units. ▶ Read out the control unit's fault memory. ▶ Have it checked at a qualified specialist workshop.
The engine surges, vibrates or runs irregularly.	There is a malfunction in the fuel system. ▶ Carry out a check for leaks (visual check). ▶ Read out the control unit's fault memory. ▶ Have it checked at a qualified specialist workshop.
The engine's output is poor (lack of power).	The air filter is dirty or blocked. ▶ Replace the air filter element.
	The charge-air temperature is too high; the charge-air cooler or coolant radiator is dirty on the exterior. ▶ Clean the exterior of the charge-air cooler and coolant radiator.

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Problem	Possible causes/consequences and ▶ Solutions
	The coolant temperature is too high. ▶ Check the temperature sensor; replace if necessary. Check the fan speed. ▶ Check the thermostat and replace as necessary. Consult a qualified specialist workshop.
	Malfunction in the fuel system (blocked, leaking). ▶ Visual inspection for leaks. ▶ Consult a qualified specialist workshop.
	Poor fuel grade ▶ Use the specified type of fuel and fuel grade (▷ page 68).
	The charge-air system is leaking; the hose clip on the charge-air hose is loose or damaged. ▶ Check the charge-air system for leaks. ▶ Check the charge-air pressure sensor and, if necessary, replace. ▶ Consult a qualified specialist workshop.
	An operating restriction is activated due to an emissions-relevant malfunction. ▶ Observe the notes on warning and indicator lamps (▷ page 26).
There is an interruption in the tractive power.	There is an increased voltage drop to the MR and ADM control unit (loose contact). ▶ Check the battery terminals and the connectors on the MR and ADM control unit for secure seating and corrosion.
The engine braking effect is poor.	The cause must be established in a qualified specialist workshop. ▶ Consult a qualified specialist workshop.
Fuel consumption is too high.	The cause must be established in a qualified specialist workshop. ▶ Consult a qualified specialist workshop.
The engine cuts off too early (maximum engine speed cannot be reached).	The engine management (MR) control unit is faulty or parameterised incorrectly. ▶ Consult a qualified specialist workshop.
The engine gets too hot (according to the coolant temperature gauge).	There is not enough coolant in the coolant circuit. ▶ Add coolant and bleed the system.
	The coolant temperature sensor or display is faulty. ▶ Replace the sensor or display.

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Problem	Possible causes/consequences and ▶ Solutions
	The poly-V-belt is damaged. ▶ Replace the poly-V-belt.
	The fan does not switch on correctly. ▶ Consult a qualified specialist workshop.
	The coolant radiator is dirty on the inside; the coolant radiator is very dirty on the outside. ▶ Clean the coolant radiator.
	The thermostat is faulty. ▶ Check and replace as necessary. ▶ Consult a qualified specialist workshop.
Indicator lamps do not light up at IGNITION ON.	The lamps are faulty or the electrical cables are interrupted. ▶ Consult a qualified specialist workshop.
The charge current indicator lamp lights up when the engine is running.	The poly-V-belt is slipping. ▶ Check the belt tensioner function. ▶ Check that the poly-V-belt contact surfaces are not torn, damaged, oily or glazed. Replace the poly-V-belt if necessary.
	The poly-V-belt is torn. ▶ Replace the poly-V-belt.
	The alternator or sensor is faulty. ▶ Check the alternator or sensor. ▶ Consult a qualified specialist workshop.
The engine emits black smoke.	The air filter is heavily contaminated. ▶ Replace the air filter element.
	The engine brake is faulty. ▶ Consult a qualified specialist workshop.
	The exhaust gas turbocharger is faulty. ▶ Carry out a visual inspection. ▶ Consult a qualified specialist workshop.
	Misfiring; the fuel injector is faulty. ▶ Consult a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
The exhaust fumes are blue.	The oil level in the engine is too high; the crankcase ventilation system is faulty; engine oil has entered the combustion chamber. ▶ Adjust the oil level correctly. ▶ Have the crankcase ventilation system checked at a qualified specialist workshop.
The exhaust fumes are white.	Coolant is entering the combustion chamber. ▶ Have a pressure loss test carried out at a qualified specialist workshop.
The engine is "knocking".	The engine is misfiring. ▶ Consult a qualified specialist workshop.
The engine is "knocking".	There is bearing damage. ▶ Consult a qualified specialist workshop.
There are abnormal sounds.	The air intake pipe and exhaust gas pipe are leaking, causing a whistling noise. ▶ Rectify the cause of the leak and, if necessary, replace gaskets.
	The turbine or compressor wheel is scraping the housing; there are foreign objects in the compressor or turbine housing; bearings have seized on the rotating parts. ▶ Have the exhaust gas turbocharger checked at a qualified specialist workshop.
	The valve clearance is excessive. ▶ Check and adjust the valve clearance.
	The poly-V-belt is slipping. ▶ Check that the poly-V-belt contact surfaces are not torn, damaged, oily or glazed. Replace the poly-V-belt if necessary.
Indicator lamp for charge current lights up.	The poly-V-belt is slipping. ▶ Check that the poly-V-belt contact surfaces are not torn, damaged, oily or glazed. Replace the poly-V-belt if necessary.

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Replacing the poly-V-belt

If the poly-V-belt is torn or shows damage patterns , it must be replaced.

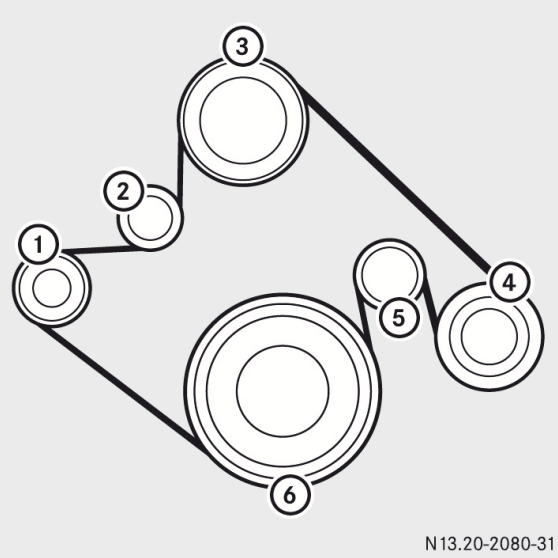
⚠ WARNING

The tensioning device is spring-tensioned. When it is loosened or tightened, there is a risk of injury from crushing or entrapment in pretensioned parts.

▷▷

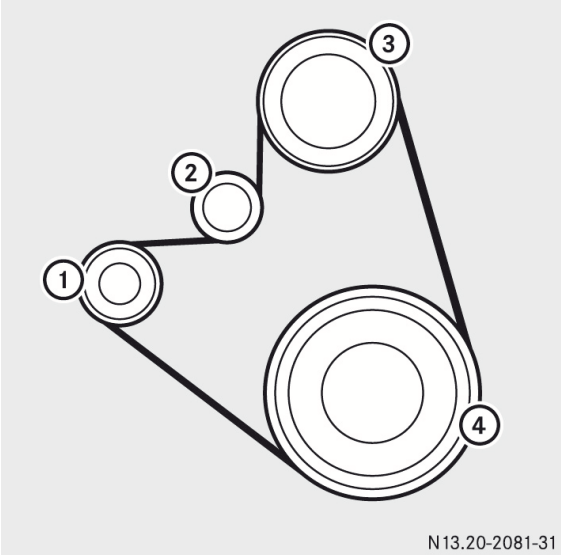
- Always carry out work on the tensioning device with extreme care.
- Make sure that the tool is handled correctly.

Belt profile



Poly-V-belt routing (engine with refrigerant compressor)

① Alternator
② Tensioning pulley
③ Coolant pump
④ Refrigerant compressor
⑤ Guide pulley
⑥ Crankshaft

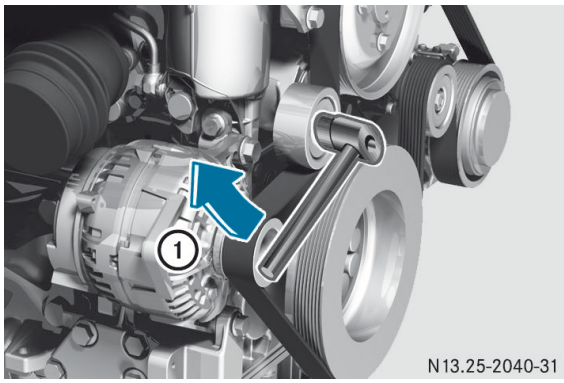


Poly-V-belt routing (engine without refrigerant compressor)

① Alternator
② Tensioning pulley
③ Coolant pump
④ Crankshaft

Routing

Fitting/removing poly-V-belts



① Example: releasing the poly-V-belt

▶ Insert the 15 mm socket, with the handle and extension attached, into the tensioner.
▶ Swing the tensioning pulley up and remove the poly-V-belt.
▶ Swing back the tensioner.
▶ Check that both the tensioner and the belt pulley are in fault-free condition. Check for such defects as worn bearings in the tensioner, tensioning pulley and guide pulleys

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and for wear of the tooth profile on the belt pulleys.

- ▶ Replace faulty parts.
- ▶ Route the new poly-V-belt over all belt pulleys except the tensioning pulley (observe the poly-V-belt routing shown in the illustration).
- ▶ Swing the tensioning pulley up using the lever, lay the poly-V-belt over the tensioning pulley and allow the tensioning pulley to swing back.
- ▶ Remove the spanner and check for correct seating of the poly-V-belt on the belt pulleys.

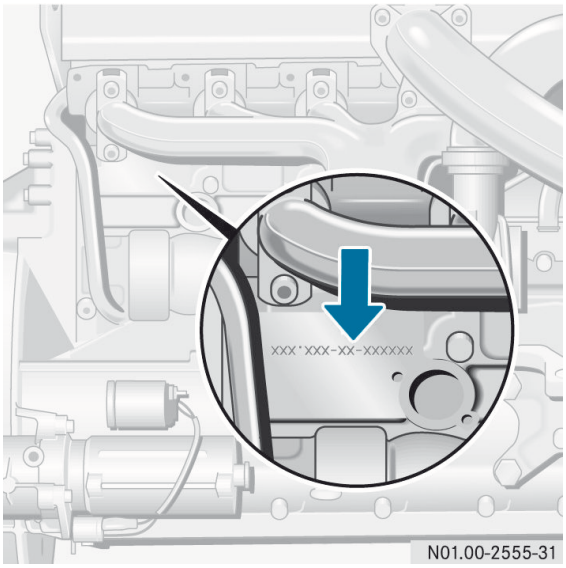
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Engine data plate 94
Information on the engine data plate 94
Engine model designation 94
Data card 94
Engine data 95

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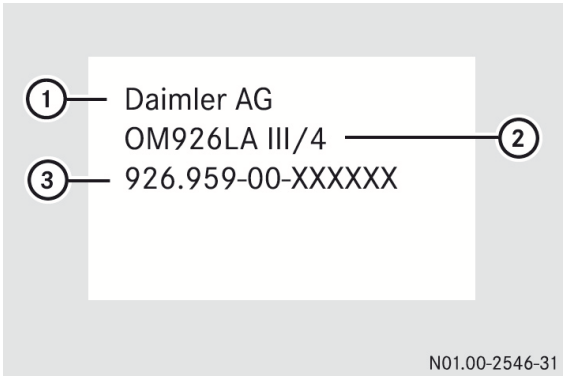
Engine data plate

The engine data plate is located on the right-hand side of the engine below the exhaust manifold. The engine data plate data is stamped into the crankcase.



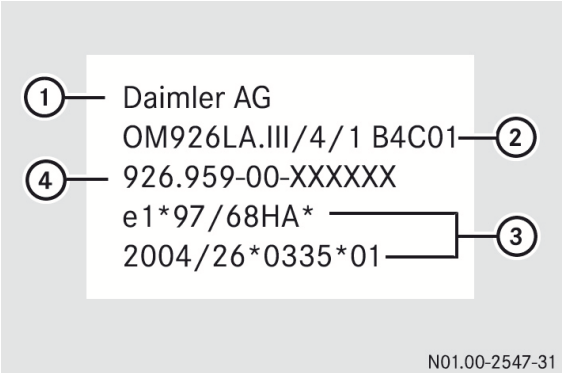
Information on the engine data plate

The following data is contained on the engine data plate in the form of numbers stamped directly onto the crankcase:



Example: engine data plate for road vehicles (on-highway engine)

① Manufacturer's name
② Engine model designation
③ Engine number



Example: engine data plate for non-road vehicles (off-highway engine)

① Manufacturer's name
② Engine model designation
③ Type approval number
④ Engine number

Engine model designation

Example: engine model designation

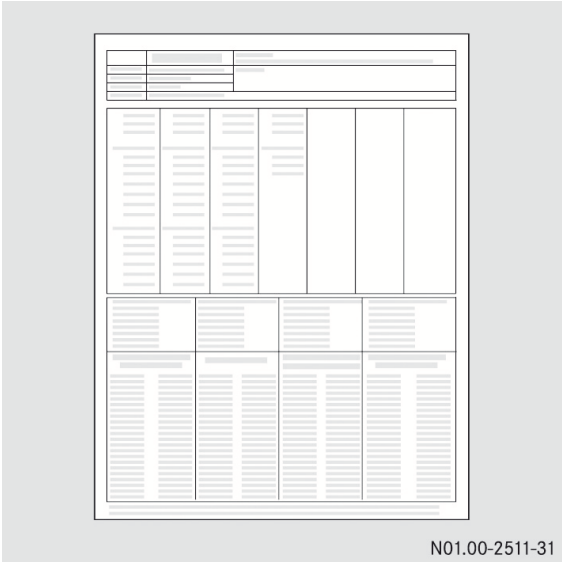
OM	9XX	L	E	
OM				Oil engine (diesel)
	9XX			Engine type
		L		Intercooler
			E	Exhaust gas turbocharger

Data card

The engine data card forms an integral part of the documents belonging to the engine and should always be kept together with the Maintenance Booklet. It contains details about the design of the engine, including special features.

The engine data card must be presented or the complete engine number must be specified for the procurement of genuine Mercedes-Benz parts.

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N01.00-2511-31

Engine data card

The engine data card describes the scope of delivery from the Mercedes-Benz factory.

Conversion parts on the engine system which change the scope of the engine delivered by Mercedes-Benz should be reported to Mercedes-Benz. Once the documentation (VeDoc) has been updated, an updated data card is supplied. This helps to prevent incorrect ordering of replacement parts.

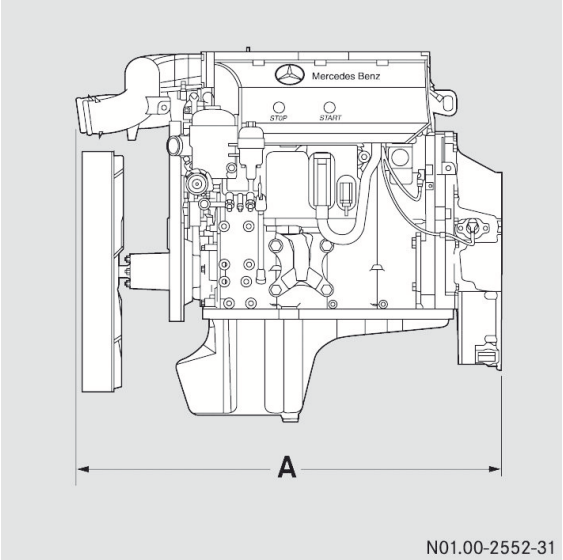
In order to prevent incorrect ordering of replacement parts, the Mercedes-Benz replacement parts service must also be informed.

Engine data

Dimensions and weights

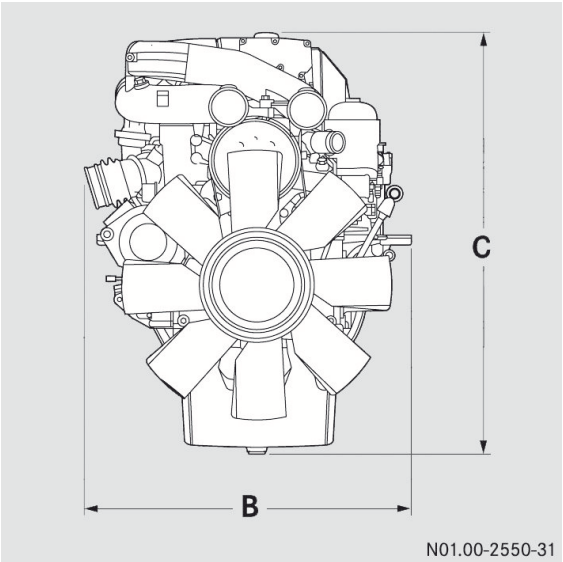
All data refers to the standard version of the respective engine type. Deviations may occur, depending on the engine equipment and installation situation in the vehicle/device.

Dimensions



N01.00-2552-31

Example: engine length



N01.00-2550-31

Example: engine width and height

	OM 904 LA OM 924 LA	OM 906 LA OM 926 LA
A = engine length	830 mm	1078 mm
B = engine width	645 mm	645 mm
C = engine height	925 mm	940 mm

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Weights

	OM 904 LA OM 924 LA	OM 906 LA OM 926 LA
Dry engine maximum	405 kg	540 kg
Wet engine maximum	425 kg	575 kg

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General data

All data refers to the standard version of the respective engine type. Data for other versions is available on request.

Engine	Engine type	OM 904 LA OM 924 LA	OM 906 LA OM 926 LA
	Assembly model series	904.9 924.9	906.9 926.9
	Type	Turbocharged in-line engine with intercooler	
	Combustion principle	4-stroke direct injection diesel	
	Number of cylinders	4	6
	Bore	102 mm 106 mm	102 mm 106 mm
	Stroke	130 mm 136 mm	130 mm 136 mm
	Engine capacity	4250 cm^3 4800 cm^3	6370 cm^3 7200 cm^3
	Type of cooling system	Forced circulation cooling	
	Engine, direction of rotation	Anti-clockwise (when looking at the flywheel)	
Valve clearance	Intake valve	0.40 mm	0.40 mm
	Exhaust valve	0.60 mm	0.60 mm
Starter motor	Starter	Electric	Electric
	Voltage	24 V	24 V
	Output	4.0 kW	4.0 kW
Battery	Voltage	12 V/24 V	12 V/24 V
	Cold-discharge test current	Maximum 450 A	Maximum 450 A
	Cold start ability (battery charge level 75 %) (▷ page 60)	OM 904 LA, E5: -10 °C	OM 906 LA, E5: -10 °C
		OM 924 LA, 3B: -18 °C	OM 926 LA, 3B: -18 °C
		OM 924 LA, E5: -15 °C	OM 926 LA, E5: -15 °C

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Alternator	Voltage	28 V	28 V
	Amperage	80 A	80 A

Operating data

Engine type		OM 904 LA/OM 924 LA	OM 906 LA/OM 926 LA
Rated engine speed		2200 rpm	2200 rpm
Effective engine speed range		2500 rpm	2500 rpm
Idling speed		Approximately 600 rpm	Approximately 600 rpm
Engine brake permissible up to		2700 rpm	2700 rpm
Engine speed limiter (emergency running mode)		1300 rpm	1300 rpm
Oil pressure	At idling speed	Minimum 0.5 bar	Minimum 0.5 bar
	At nominal engine speed	Minimum 2.5 bar	Minimum 2.5 bar
Coolant temperature	Normal operation	Approximately 80-95 °C	Approximately 80-95 °C
	Maximum permissible coolant temperature	100 °C	100 °C

Capacities and service products

		Capacity approximately	Service product (Sheet No.[4])
Engine with oil filter (with standard truck oil pan)	OM 904 LA/OM924 LA	13 l - 16 l	For all engines: Engine oil (Sheet No. 228.2/.3/.31/.5/.51) For engines without BlueTec®, also: Engine oil (Sheet No. 228.0, 228.1)
	OM 906 LA/OM 926 LA	24 l - 29 l	

4 Mercedes-Benz Specifications for Service Products

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			Capacity approximately	Service product (Sheet No.[4])
Fuel system	Diesel fuel tank[5]		-	Diesel fuels in accordance with EN 590 or ASTM D975 (Sheet No. 131.0)
	Vehicle operation with fatty acid methyl ester		-	Fatty acid methyl ester fuel in accordance with DIN EN 14214 (Sheet No. 135.0)
Exhaust gas aftertreatment system	AdBlue®/DEF tank[5]		-	AdBlue®/DEF in accordance with ISO 22241 (Sheet No. 352.1)
	AdBlue®/DEF filter sealing rings		-	MB silicon grease
Cooling system	Amount of coolant in the engine	OM 904/924 LA OM 906/926 LA	7 l 10 l	Antifreeze/corrosion inhibitor (Sheet No. 325.0/2/3/5) and water quality (Sheet No. 310.1) or premixed coolant (Sheet No. 326.0/2/3/5).
	Corrosion inhibitor/antifreeze agent volume down to –37 °C		Approx. 50% by volume	
	Corrosion inhibitor/antifreeze volume down to –45 °C		Approx. 55% by volume	
	Coolant additive (coolant without antifreeze protection)		-	Coolant additive and water quality (Sheet No. 310.1, 312.0)
Engine compartment	Protective wax		-	Wax preservative (Sheet No. 385.4)
Engine brake	Heat-resistant lubricant		-	Heat-resistant lubricant (part number A000 989 76 51)

4 Mercedes-Benz Specifications for Service Products

5 Installation on the vehicle side; designed by the vehicle manufacturer.

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Tightening torques

All threads on mechanical components and the corresponding contact surfaces must be clean, smooth and coated with engine oil. Other lubricants lead to substantially different tightening torques.

Engine	Cylinder head cover	Light alloy (with oil filler cap)	25 Nm
		Plastic (without oil filler cap)	20 Nm
	Valve clearance setting	Counternut on the rocker arm adjustment screw	50 Nm
	Inspection hole cap on the timing case		25 Nm
	Flywheel housing rotation device		25 Nm
	Charge-air distributor at cylinder head		30 Nm
Fuel system	Cap on the fuel filter housing		25 Nm
Oil circuit	Drain plug on the oil pan	M 20 x 1.5	70 Nm
		M 26 x 1.5	90 Nm
	Oil filter cap on the oil filter housing		40 Nm
Cooling system	Coolant drain screw	On the crankcase	60 Nm
		On the radiator	2 Nm
Exhaust gas aftertreatment	Filter bowl on the AdBlue®/DEF pump module		32 Nm

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Imprint

Internet

Further information about MTU, Mercedes-Benz and Daimler AG can be found on the Internet at:

www.mtu-online.com

www.mercedes-benz.com

www.daimler.com

Documentation team

Should you have any questions or suggestions regarding this manual, you can reach the technical documentation team at the following address:

Daimler AG, HPC: CAC, Customer Service, 70546 Stuttgart, Germany

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Equipment manufacturer

Daimler AG
Mercedesstraße 137
70327 Stuttgart
Germany

TIM-ID: 0000094786 - 003

As at 02.09.2014



Order no. 6462 9851 02 Part no. 926 584 29 81 Edition 01-15

TIM-ID: 0000094786 - 003



OM 904-926 LA BlueTec® / OM 904-926 LA
OM 906 hLA BlueTec® / OM 906 hLA

Wartungsheft | Maintenance Booklet | Carnet de maintenance | Cuaderno de mantenimiento | Libretto di manutenzione | Сервисная книжка

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Vehicle/equipment/assembly data/symbols

Vehicle/equipment data

Manufacturer	▶
Vehicle/equipment identification number	▶
Type	▶
Date of first registration/initial operation	▶
Licence plate	▶
Licence plate	▶
Licence plate	▶

Assembly data

Major assembly ID number (AGS ID)	▶
Engine number	▶
Exhaust gas aftertreatment system ID number (AGN ID)	▶

Symbols

⚠ Warning

Environmental note

General information

Introduction

This Maintenance Booklet should serve as a guideline for the maintenance of your engine system.

The prescribed tasks must be carried out regularly and in good time to ensure the operating safety of your engine and exhaust gas aftertreatment system.

Work relevant to safety or on safety-related systems must be carried out at a qualified specialist workshop.

Mercedes-Benz is constantly updating its engines to the state of the art. Please be aware that these changes could also affect the scope of maintenance work.

Qualified specialist workshop

A qualified specialist workshop has the necessary specialist knowledge, tools and qualifications to carry out the work required on the engine to a professional standard. This is particularly applicable to work relevant to safety.

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Observe the notes in the Maintenance Booklet.

Always have the following maintenance work carried out at a qualified specialist workshop:

- work relevant to safety
- service and maintenance work
- repair work
- modifications as well as installations and conversions
- work on electronic components
- Mercedes-Benz recommends, for on-highway applications, that you use a Mercedes-Benz Service Centre.
- MTU recommends, for off-highway applications, an MTU partner or MTU-authorised Mercedes-Benz partner.

Implied warranty

A well-developed network of Mercedes-Benz, MTU and MTU-authorised Mercedes-Benz Service Centres is available to carry out maintenance work.

These Mercedes-Benz and MTU or MTU-authorised Mercedes-Benz Service Centres:

- have special equipment and tools as well as specialists who receive continuous training
- guarantee that your engine system is repaired and maintained thoroughly and expertly
- carry out all repairs related to implied warranty
- carry out all maintenance work expertly
- confirm in the Maintenance Booklet that the maintenance work has been carried out at the required time
- handle implied warranty claims that are admissible according to the sales contract

Please observe the instructions and recommendations as well as the maintenance services in the Maintenance Booklet. Please observe these instructions even if you let a third party use and care for your vehicle. This is the only way to ensure that you do not lose your entitlements.

If the prescribed maintenance work is not carried out, claims can only be decided after the manufacturer has inspected the claim.

During the implied warranty period, have the prescribed maintenance service for your engine system carried out as follows:

- regularly
- punctually
- at a qualified specialist workshop which has the necessary specialist knowledge and tools to carry out the work required

  Mercedes-Benz recommends that you use a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre. In particular, work relevant to safety or on safety-related systems must be carried out by a qualified specialist workshop.

If there are legal requirements on emission control, please note that:

- maintenance on the engines must be carried out according to specific regulations and using special measuring devices
- it is prohibited to modify or tamper with components relevant to emissions

All Mercedes-Benz and MTU or MTU-authorised Mercedes-Benz Service Centres are familiar with the relevant regulations.

Maintenance work does not include repair work. Issue a separate order for repair work.

You can obtain further information on the maintenance of your engine system from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre.

Important safety notes

⚠ WARNING

Before carrying out maintenance or repair work, you must read the relevant sections of the technical documentation relating to maintenance and repair measures, e.g. the Operating Instructions and workshop information.

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In particular, first familiarise yourself with the legal regulations, e.g. work safety and accident prevention regulations.

You could otherwise fail to recognise dangers and injure yourself or others.

Always have maintenance work carried out at a qualified specialist workshop.

⚠ WARNING

If you do not have the prescribed service/maintenance work or necessary repairs carried out, this could result in malfunctions or system failures. There is a risk of an accident.

Always have the prescribed service/maintenance work as well as necessary repairs carried out at a qualified specialist workshop.

⚠ WARNING

Limbs could be crushed or trapped if the engine is started unintentionally during service or maintenance work. There is a risk of injury.

Always secure the engine against unintentional starting before carrying out maintenance or repair work.

⚠ WARNING

Cloths or other flammable materials left in the engine compartment can ignite if they come into contact with the exhaust system or parts of the engine that heat up. There is a risk of fire. After carrying out maintenance work, make sure that no extraneous flammable material is left in the engine compartment or on the exhaust system.

When carrying out maintenance work, you require access to the Workshop Information System (WIS) via the Internet. This access is subject to a fee.

Current information on the system and prices can be found at this web address: http://service-parts.mercedes-benz.com. Click on "EPC, WIS/ASRA" in the "Service and parts information" tab and then on "WIS".

You can log in by clicking on "Register" on the right-hand side.

Service products

⚠ WARNING

Service product can be poisonous and hazardous to health. There is a risk of injury.

Observe the instructions on the respective original container when using, storing and disposing off service products. Always store service products in the sealed original container. Always keep service products out of the reach of children.

Environmental note

Dispose of service products in an environmentally-responsible manner.

Service products include:

- fuels (e.g. diesel)
- lubricants (e.g. engine oil, transmission oil, hydraulic fluid, greases)
- antifreeze protection, coolant
- AdBlue®/DEF (reducing agent of the exhaust gas aftertreatment system)[3]

The approved service products are summarised in the Mercedes-Benz Specifications for Service Products. Information about these specifications can be obtained from any Mercedes-Benz or MTU Service Centre or at http://bevo.mercedes-benz.com.

For filling capacities, see the "Technical data" section of the Operating Instructions.

Changing the engine oil and replacing the filter

The interval for changing the engine oil and replacing the filter depends on the following:

- engine oil grade
- fuel type: diesel/fatty acid methyl ester FAME (bio-diesel) and sulphur content

[3] As alternatives to "AdBlue®", the terms "Urea" and "DEF" (Diesel Exhaust Fluid) are also used.

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- engine load (observe maintenance category)
- time: at least every **2 years** for diesel fuel operation

  at least **once a year** if operated using acid methyl ester FAME (bio-diesel)

Engine oil

Select the SAE class (viscosity) of the engine oil to suit the average outside temperatures for the time of year.

Only use engine oils that comply with the Mercedes-Benz Specifications for Service Products.

The following engine oils are approved:

- For engines with BlueTec® exhaust gas aftertreatment and which are operated with diesel fuel, only use multi-grade oils compliant with Sheet No. 228.3/.31/.5/.51 or, in exceptional cases, single-grade oils compliant with Sheet No. 228.2.
- For engines without BlueTec® exhaust gas aftertreatment, multi-grade oils compliant with Sheet No. 228.1 and, in exceptional cases, single-grade oils compliant with Sheet No. 228.0/.2 can also be used.
- For operation with FAME fatty acid methyl ester fuel (bio-diesel fuel), only use engine oil compliant with Sheet No. 228.3/.31/.5/.51.

  This is also required for a mixture of conventional diesel fuels and FAME fatty acid methyl ester fuels (bio-diesel fuel).

Depending on the fuel quality (sulphur content or FAME fatty acid methyl ester fuel), the oil change intervals may be shortened.

Multi-grade oils which comply with Sheet No. 228.1/.3/.31/.5/.51 can be used all year round. Single-grade oils which comply with Sheet No. 228.0/.2 are only designed for one SAE viscosity class for specific temperature ranges. Change the engine oil to an SAE class suitable for the time of year and the respective outside temperatures.

Using engine oils that have not been approved could restrict your warranty entitlements.

Information is available from any Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre.

The maximum oil change interval can only be achieved by using engine oils of particularly high quality in accordance with Sheet No. 228.5/.51 of the Mercedes-Benz Specifications for Service Products. If you use a lower grade engine oil (e.g. in accordance with Sheet No. 228.31) when the engine oil is changed or topped up, the maximum oil change interval is reduced. Then use the maintenance interval according to the lower oil quality.

Fuels

Fuel sulphur content

! A higher fuel sulphur content accelerates the ageing process of the engine oil and can damage the engine and exhaust system.

! Vehicles with BlueTec® exhaust gas aftertreatment:

Only standardised fuels with a maximum sulphur content of 0.05% (500 ppm) by weight are permissible. However, Mercedes-Benz only recommends fuel that complies with the European standard EN 590 as of 2005, et seq. (max. 0.005% (50 ppm) sulphur by weight). The use of fuels with a sulphur content higher than 0.005% (50 ppm) by weight reduces the life expectancy of the engine and exhaust system.

! Vehicles without BlueTec® exhaust gas aftertreatment:

Only commercially available fuels which comply with the European standard EN 590 or comparable national fuel standards are permitted. Mercedes-Benz recommends fuels with a low sulphur content. The use of fuels with a high sulphur content reduces the lifespan of the engine and the exhaust

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system. For operation with a high sulphur content > 0.05% by weight (500 ppm), the maintenance intervals for the engine oil and filter must be reduced.

ⓘ Even if the maintenance intervals are reduced, operation with a higher sulphur content will lead to increased engine wear, especially on the fuel injectors.

Sulphur content in diesel fuel	Interval for changing engine oil and filter
up to 0.05 % by weight (500 ppm)	100%
from 0.05% by weight (500 ppm) to 0.1% by weight (1000 ppm)	50%
over 0.1 % by weight (1000 ppm)	25 %

You can find a table of fuel sulphur contents in specific countries in the Mercedes-Benz Specifications for Service Products, Sheet No. 136.1/.2 at http://bevo.mercedes-benz.com.

! When necessary, use only approved fuel additives.

There is otherwise a risk of impaired engine performance or engine and catalytic converter damage. The use of appropriate fuel additives is your responsibility.

Operation with FAME fuels (bio-diesel)

The fuel must comply with DIN EN 14214. Operating with a fuel of lower quality can lead to damage and malfunctions.

The intervals for renewing engine oil and filter changes are significantly shorter. An engine oil and filter change must be carried out at least once a year. When the oil and the oil filter are changed, the fuel filter must also be replaced.

Before operation on FAME fuels, the replacement intervals must be individually determined. For this, consultation with a Mercedes-Benz or MTU Service Centre is necessary.

Only use engine oils which have been approved for operation with fatty acid methyl ester FAME (bio-diesel) (▷ page 53).

AdBlue®/DEF

Only use AdBlue®/DEF in accordance with DIN 70070/ISO 22241.

Coolant

⚠ WARNING

The engine cooling system is under pressure, particularly if the engine is warm. You could be scalded by hot coolant spraying out when opening the cap. There is a danger of injury.

Allow the engine to cool before opening the cap. Wear gloves and protective eyewear when opening. Slowly turn the cap half a turn to allow pressure to escape.

⚠ WARNING

If antifreeze comes into contact with hot components in the engine compartment, it may ignite. There is a risk of fire and injury.

Let the engine cool down before you top up the antifreeze. Make sure that antifreeze is not spilled next to the filler neck. Thoroughly clean the antifreeze from components before starting the engine.

A coolant that ensures anti-corrosion/antifreeze protection and other important protective effects is filled at the factory.

The coolant is a mixture of water and corrosion inhibitor/antifreeze.

The corrosion inhibitor/antifreeze in the coolant has the following properties:

- heat transfer
- anti-corrosion protection

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- cavitation protection (protection against pitting)
- antifreeze protection
- raising the boiling point

Leave the coolant in the engine cooling system all year round – even in countries with high outside temperatures.

Check the corrosion inhibitor/antifreeze concentration in the coolant every six months.

Renew the coolant every 3 years.

Only use antifreeze and corrosion inhibitor which has been approved according to Sheet No. 325.0/2/3/5 and water quality according to Sheet No. 310.1 or premixed coolant according to Sheet No. 326.0/2/3/5. In this way, you will avoid damaging the engine cooling system and the engine itself.

When renewing the coolant, ensure that it contains 50% corrosion inhibitor/antifreeze by volume. This corresponds to antifreeze protection down to -37 °C.

Do not exceed 55% by volume (antifreeze down to approximately -45 °C). The heat dissipation and antifreeze may otherwise be negatively affected.

If there is a loss of coolant, do not top it up by using only water, but also add an approved corrosion inhibitor/antifreeze agent.

The water in the coolant must meet certain requirements, which are often fulfilled by the use of drinking water. The water must be treated if its quality does not meet the required standards.

Please note the Mercedes-Benz Specifications for Service Products, Sheet No. 310.1.

Mixtures with other corrosion inhibitors/antifreeze agents are not permitted.

Maintenance work

Engine usage

The scope and frequency of maintenance work depends mainly on the different vehicle applications and operating conditions. The maintenance intervals are also dependent upon the grade of the engine oil and fuel used as well as the sulphur content of the fuel. Depending on the load, the assemblies are divided into three maintenance categories with varying maintenance intervals.

If in doubt, especially in the case of unusual operating conditions, contact a Mercedes-Benz, MTU or MTU-authorised Mercedes-Benz Service Centre.

Maintenance categories

Maintenance category A

Intermittent use with light load. Average speed of above 50 km/h.

Distance-based maintenance

Usage examples:

- Vehicles:

  Tourist coaches/intercity buses (European road conditions), commercial long-distance vehicles

Maintenance category B

Intermittent use predominantly at medium engine speeds and load range.

Distance-based maintenance

Usage examples:

- Tourist coaches/intercity buses (non-European road conditions)
- City buses (gentle topography)
- Short-radius distribution vehicles
- Trucks used as construction site vehicles (for road use)

When using the engines in vehicles (e.g. city buses) with a fuel consumption of more than 7 l/h in urban traffic or speeds less than 15 km/h, maintenance category C should generally be used.

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Maintenance by operating hours

Usage examples:

- Vehicles:

  Airport shuttle buses, hybrid vehicles, refuse collection vehicles
- Agricultural machinery:

  Agricultural tractors, vineyard tractors, grape pickers, car loaders, mixing and grinding machines, bark peeling machines, logging tractors
- Materials handling equipment and lifting gear:

  Industrial tractors, fork-lift trucks, charging trolleys, aircraft towing vehicles, container loaders, container handling gantries, harbour cranes, mobile cranes – vehicle engine and special purpose body engine
- Construction machinery:

  Wheel loaders, road graders, face shovel excavators, bucket excavators, road rollers, vibratory rollers, cement mixer vehicles – vehicle engine and special purpose body engine, cement mixer vehicle – special purpose body engine, concrete pumps, road pavers, soil compactors, track tamping machines
- Working machinery:

  Road sweepers – vehicle engine and special purpose body engine, snow cats, high-pressure flushing pumps, fire engine pumps, grain blowers, refuse compressors, snow blowers – vehicle engine and special purpose body engine

Maintenance category C

Operation mainly:

- in the high engine speed and load range
- with frequent idling
- extreme short-term operation
- frequent cold starts
- difficult topography

Fuel consumption greater than 7 l/h or an average speed of less than 15 km/h. This corresponds to total fuel consumption of 50 l/100 km, for example, for a city bus with an average speed of 15 km/h.

Distance-based maintenance

Usage examples:

- Vehicles:

  Heavy trucks, city buses, fire engines, trucks used as construction-site vehicles (for operation on construction sites), cement mixer vehicles (vehicle engine and special purpose body engine), cement pump vehicles (vehicle engine and special purpose body engine), sightseeing buses.

Maintenance by operating hours

Usage examples:

- Agricultural machinery:

  Combine harvesters, corn threshers, field choppers, sugar cane harvesters, beet lifters, potato lifters
- Construction machinery:

  Bulldozers, trench diggers, dumpers, road milling machines
- Working machinery:

  Drills, compressor assemblies, crushers, snow cutters – engine of special-purpose body, stone crushers, road sweepers – engine of special-purpose body
- Generators:

  Emergency power operation, continuous operation

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Maintenance intervals

Engine with BlueTec®

The maximum engine oil retention time in the engine must be observed (▷ page 53).

The following tables are valid for the following emission levels:

- Euro 4/5
- EUROMOT 3B
- Tier 4i

Engine use according to the specifications in the maintenance category overview.

Maintenance according to distance covered (km)

Oil grade according to Sheet Number	Maintenance category A	Maintenance category B	Maintenance category C
228.5/51	100000 km	50000 km	25000 km
228.2[4]/3/31	50000 km	30000 km	15000 km

Maintenance according to operating hours (h)

Oil grade according to Sheet Number	Maintenance category A	Maintenance category B	Maintenance category C
228.5/51	1400 h	900 h	500 h
228.2[24681012]/3/31	1100 h	700 h	400 h

Engine without BlueTec®

When using fuel with a higher sulphur content, the maintenance intervals must be reduced (▷ page 54).

The following tables are valid for the following emission levels:

- Euro 3
- EUROMOT 2/3A
- Tier 2/3

Engine use according to the specifications in the maintenance category overview.

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4 Only use single-grade oil in exceptional circumstances.
2 Einbereichsöl nur in Ausnahmefällen verwenden
6 N'utilisez une huile monograde que dans des cas exceptionnels.
8 Utilice aceites de motor monogrado solo en casos excepcionales
10 Utilizzare oli unigrado solo in casi eccezionali
12 Используйте сезонное моторное масло только в исключительных случаях.

Maintenance according to distance covered (km)

Oil grade according to Sheet Number	Maintenance category A	Maintenance category B	Maintenance category C
228.5/51	100000 km	50000 km	25000 km
228.2[24681012]/3/31	50000 km	30000 km	15000 km
228.0[24681012]/1	30000 km	20000 km	12000 km

Maintenance according to operating hours (h)

Oil grade according to Sheet Number	Maintenance category A	Maintenance category B	Maintenance category C
228.5/51	1400 h	900 h	500 h
228.2[24681012]/3/31	1100 h	700 h	400 h
228.0[24681012]/1	800 h	500 h	300 h

Maintenance

Maintenance

Maintenance due dates

Abbre-viation	Maintenance due date
M	Engine maintenance (depending on the distance/operating hours according to maintenance category, at least every 2 years)
J3	Time-based maintenance - Maintenance work should be carried out every 3 years
V2	Adjust the valve clearance (every 1st, 3rd, 5th, 7th etc. engine maintenance)
X	Vehicle scope - Maintenance due date is set by the vehicle manufacturer
Z	Additional scope for engine maintenance
Z2	Additional work (every 2nd, 4th, 6th, 8th etc. engine maintenance)
Z3	Additional work (every 3rd, 6th, 9th etc. engine maintenance)

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6 N'utilisez une huile monograde que dans des cas exceptionnels.
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12 Используйте сезонное моторное масло только в исключительных случаях.

Maintenance	J3	M	V2	X	Z	Z2	Z3
Engine maintenance							
Oil and filter change		•					
Check the poly-V-belt for wear and damage		•					
Fuel prefilter: clean the filter element		•					
Fuel filter: replace filter element.		•					
Fuel prefilter with water separator: replace fuel filter element (fixed to the chassis)		•					
Additional engine maintenance work							
Check and adjust the valve clearance of the engine.			•				
Engine brake: check condition and setting.							•
Indicator lamps and warning systems: function check					•		
Check all equipment for leaks and condition. In the event of fluid loss, find the cause and remedy it.					•		
Check the air intake duct between the air filter, charge-air cooler and the engine for leaks and condition. In the event of leaks, find and rectify the cause. Vehicle scope: task descriptions are provided by the vehicle manufacturer.					•		
Cooling and heating system: check radiator, cables and hoses for leaks and condition. In the event of fluid loss or damage, find and rectify the cause. Vehicle scope: task descriptions are provided by the vehicle manufacturer.					•		
Check the exhaust system for leaks and condition. In the event of damage or leaks, find and rectify the cause. Vehicle scope: task descriptions are provided by the vehicle manufacturer.					•		
Check all reservoirs, units, covers, bellows and protective caps for leaks and condition. In the event of damage or fluid loss, find and rectify the cause. Vehicle scope: task descriptions are provided by the vehicle manufacturer.					•		
Check all lines, hoses and electrical cables for areas of abrasion and correct routing.					•		
Engine cooling system: check and adjust corrosion/antifreeze protection. Vehicle scope: task descriptions are provided by the vehicle manufacturer.					•		

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	J3	M	V2	X	Z	Z2	Z3
Charging the AdBlue® pressure reservoir					•		
Replace AdBlue® filter						•	
Time-based maintenance							
Renew coolant. Vehicle scope: task descriptions are provided by the vehicle manufacturer. Observe the coolant mixture ratio (interval between changes depends on the Sheet No. of the corrosion inhibitor/antifreeze in the Mercedes-Benz Specifications.	•						
Compressed-air dryer: replace granulate cartridge. Vehicle scope: task descriptions are provided by the vehicle manufacturer.				•			
Replace the air filter element. Vehicle scope: task descriptions are provided by the vehicle manufacturer.				•			

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Confirmations

Maintenance service/additional maintenance work

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

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Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

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- ☐ Coolant
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Date	
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Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

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Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

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Maintenance/time-based maintenance/additional maintenance work

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☐ Z ☐ Z2 ☐ Z3

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Maintenance/time-based maintenance/additional maintenance work

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- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/additional maintenance work

☐ M ☐ J3 ☐ V2 ☐ X

☐ Z ☐ Z2 ☐ Z3

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Fuel filter element
- ☐ Fuel prefilter with water separator: fuel filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter

Signature/stamp of the Mercedes-Benz or MTU Service Centre

TIM-ID: 0000096123 - 001

Imprint

Internet

Further information about MTU, Mercedes-Benz and Daimler AG can be found on the Internet at:

www.mtu-online.com

www.mercedes-benz.com

www.daimler.com

Documentation team

Should you have any questions or suggestions regarding this manual, you can reach the technical documentation team at the following address:

Daimler AG, HPC: CAC, Customer Service, 70546 Stuttgart, Germany

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Equipment manufacturer

Daimler AG

Mercedesstraße 137

70327 Stuttgart

Germany

TIM-ID: 0000096123 - 001

Engine-Oil and filter change

TIM-ID: 0000099517 - 001

Dokumenttitel	Engine oil and filter change
Dokumentnummer	ap1800g0101dd

TIM-ID: 0000099517 - 001

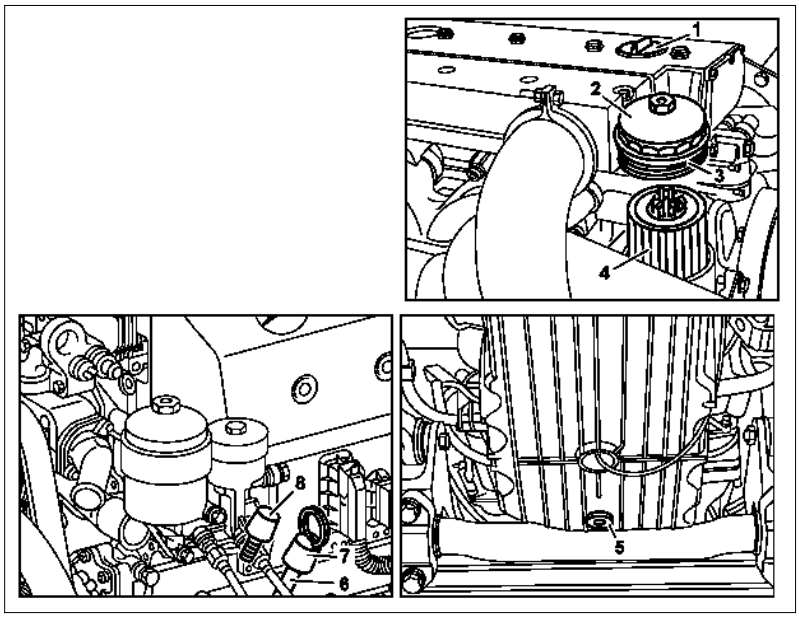
AP18.00-G-0101DD	Engine oil and filter change	11.6.15

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Modification notes

24.11.14	Contents completely revised.		

1 Cap
2 Threaded cap
3 Sealing ring
4 Oil filter element
5 Drain screw
6 Guide tube
7 Oil dipstick
8 Plug



G18.00-3172-06

⚠ **Danger !**	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
i	Notes on engine oil		AH18.00-N-0101-01B
	Lowering		
1	Replace oil filter element (4)	Nm Oil filter cover to oil filter housing	AP18.20-G-0100-04DD *BA18.20-N-1003-01L
2	Detach end cover (1)		
3	Pull oil dipstick (7) or stop plug (8) out of guide tube (6)	If the oil is extracted using the oil suction unit.	
4.1	Extract oil through guide tube (6)	If the oil is extracted using the oil suction unit. i Extract the oil only when the engine is at normal operating temperature. Engine oil suction unit - mobile gotis://S_18.1_02.0	
4.2	Remove drain screw (5) and drain oil	If the oil is drained from the oil pan. i Drain the oil only when the engine is at normal operating temperature. Used oil collector - mobile gotis://S_18.1_05.0	
5.1	Insert oil dipstick (7) or stop plug (8) into guide tube (6)	If the oil was extracted using the oil suction unit.	
5.2	Screw in drain screw (5) securely with a new sealing ring	If the oil was drained from the oil pan. Nm Oil drain screw to oil pan	*BA01.45-N-1002-01K

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TIM-ID: 0000099517 - 001

	Filling		
6	Pour in engine oil	Refer to the owner's manual for the specified filling capacity as well as the quality of the engine oil.	
7	Attach end cover (1)		
	Check		
8	Start engine and observe oil pressure indicator with the engine running at idle speed	Do not rev up the engine while there is no oil pressure. The engine can otherwise be damaged. An oil pressure must be indicated after about 10 seconds. Engine oil pressure	*BE18.00-N-1001-01I
9	Switch off engine and check and correct oil level after a waiting time of approx. 5 min	See information provided by vehicle manufacturer or engine supplier.	
10	Check threaded cap (2) and, if necessary, drain screw (5) of oil pan for leaks	Visual inspection.	

Check values of engine oil pressure

Number	Designation			ENGINE 900.9, 902.9, 904.9, 906.9	ENGINE 924.9, 926.9
BE18.00-N-1001-01I	Engine oil pressure	idle speed	bar	≥0,5	≥0,5
		maximum speed	bar	≥2,5	≥2,5

Nm **Oil pan**

Number	Designation			ENGINE 900.9, 902.9, 904.9, 906.9, 924.9	ENGINE 926.9
BA01.45-N-1002-01K	Oil drain screw to oil pan	M20×1.5	Nm	65	65
		M26×1.5	Nm	85	–

Nm **Oil filter**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9	ENGINE 924.9, 926.9
BA18.20-N-1003-01L	Oil filter cover to oil filter housing	Nm	25	25

TIM-ID: 0000099517 - 001

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099517 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099517 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work
MODEL ALL

Dokumenttitel Notes on engine oil

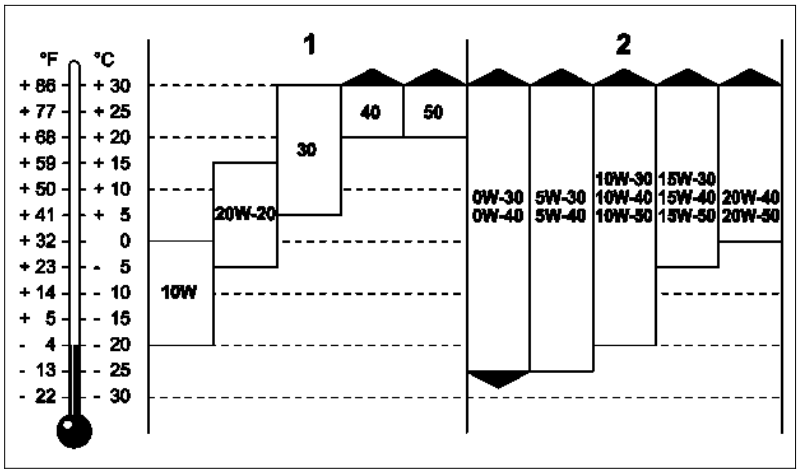
Dokumentnummer ah1800n010101b

TIM-ID: 0000099517 - 001

AH18.00-N-0101-01B	Notes on engine oil		i

ENGINE 457.9 in MODEL 374, 375, 695, 940, 942, 943, 944, 949, 958
ENGINE 541.9 in MODEL 930, 932, 933, 934, 950, 952, 953, 954
ENGINE 542.9 in MODEL 930, 932, 934, 950, 952, 954
ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9

SAE viscosity class
The SAE viscosity class must be selected in accordance with the average air temperature for the specific season.
Strict application of SAE viscosity classes based on ambient air temperatures would require more frequent-oil changes. The temperature ranges for the SAE viscosity classes should therefore be regarded as a guide and the particular temperature may be higher or lower than that stated.



P00.40-2029-05

Specified engine oil quality
Certified engine oils are ones that have been named and approved in the valid version of the MB-Specifications for Operating Fluids.

Oil types for the different engine oil qualities are listed under the respective sheet number.

Vehicles without maintenance system
Refer to the maintenance booklet valid for the vehicle for the engine oil and oil filter change interval.
The intervals listed in the maintenance booklet depend on:
- Engine oil quality (sheet no. of the MB-Specifications for Operating Fluids)
- Fuel type (diesel or FAME)
- Sulfur content of fuel
- Vehicle usage

Vehicles with maintenance system
The point in time for an engine oil and oil filter change is calculated by the maintenance system and shown on the multifunction display. To this end, the following details must be entered into the maintenance system:
- Engine oil quality (sheet no. of the MB-Specifications for Operating Fluids)
- Used SAE viscosity class
- Fuel type (diesel or FAME)
- Sulfur content of fuel

TIM-ID: 0000099517 - 001

© Daimler AG, 10.08.15, G/08/15, ah18.00-n-0101-01b, Notes on engine oil

Dokumenttitel Replace oil filter element

Dokumentnummer ap1820g010004dd

TIM-ID: 0000099517 - 001

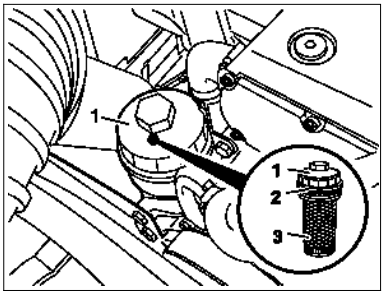
AP18.20-G-0100-04DD	Replace oil filter element		

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Nm **Oil filter**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9	ENGINE 924.9, 926.9
BA18.20-N-1003-01L	Oil filter cover to oil filter housing	Nm	25	25

1 Threaded cap
2 Sealing ring
3 Oil filter element



N18.20-0252-01

1 Unscrew threaded cap (1) of oil filter using socket wrench bit and allow oil to flow out of filter housing.

2 Remove threaded cap (1) with oil filter element (3) and unclip oil filter element (3) by pressing at side.

i Ensure that no foreign matter gets into the oil filter housing. Never wipe out the oil filter housing.

3 Replace sealing ring (2).

i Grease sealing ring (2) slightly.

4 Clip new oil filter element (3) into the threaded cap (1).

5 Screw on threaded cap (1) with oil filter element (3) and tighten Nm.

TIM-ID: 0000099517 - 001

© Daimler AG, 10.08.15, G/08/15, ap18.20-g-0100-04dd, Replace oil filter element

Inspect poly-V-belt for wear and damage

TIM-ID: 0000099519 - 001

Dokumenttitel	Inspect poly-V-belt for wear and damage
Dokumentnummer	ap1322g1351dd

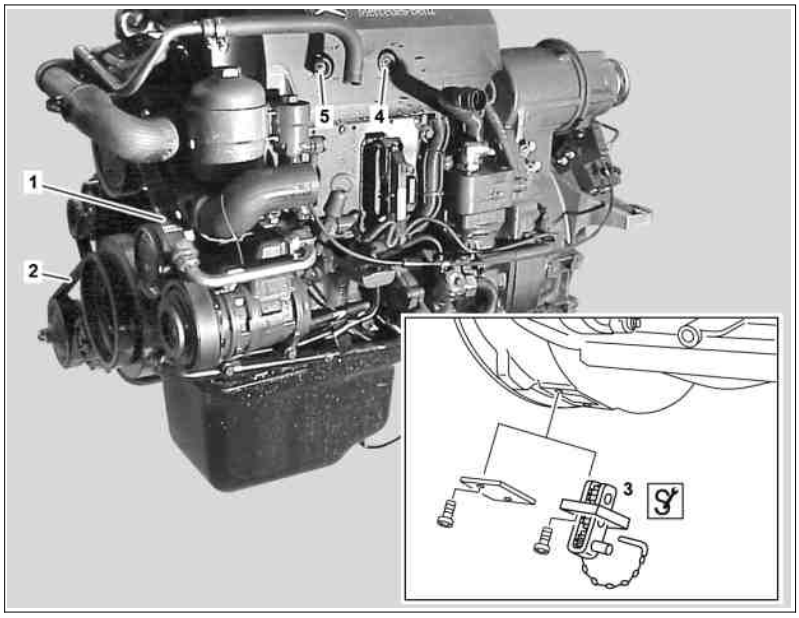
TIM-ID: 0000099519 - 001

AP13.22-G-1351DD	Inspect poly-V-belt for wear and damage	8.5.15

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Shown on engine 904

1 Poly-V-belt
2 Poly-V-belt
3 Turning device
4 Engine start button
5 Engine stop button



G13.22-3113-06

⚠ **Danger !**	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
	Check		
1 AR	Attach cranking device (3) to engine	Only when for test purposes the engine is cranked using the turning device (3). When the cranking device (3) is installed, the engine start button (4) must not be pressed. Otherwise the flywheel or the cranking device (3) may be damaged. Nm Bolt, turning device to timing case Turning device	AR03.30-G-1600-03DD *BA01.60-N-1003-01I *904589046300
2.1 AR	Crank engine using cranking device (3) while checking entire length of poly-V belts (1, 2) in sections for signs of wear and damage	Only when cranking the engine using the cranking device (3). Damage profiles for a poly-V belt If wear or damage is present: ↓ Replace the affected poly-V belts (1, 2).	AP13.22-D-1351-01A AR13.22-G-1202DD
2.2 AR	Crank engine gradually using engine start button (4) and engine stop button (5) while checking entire length of poly-V belts (1, 2) in sections for signs of wear and damage	Only when cranking engine with starter. Damage profiles for a poly-V belt If wear or damage is present: ↓ Replace the affected poly-V belts (1, 2).	AP13.22-D-1351-01A AR13.22-G-1202DD

TIM-ID: 0000099519 - 001

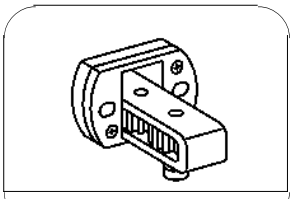
3 AR	Remove cranking device (3) from engine	Only when for test purposes the engine was cranked using the turning device (3). Nm Inspection hole cap to timing case Turning device	 AR03.30-G-1600-03DD *BA01.60-N-1002-01I *904589046300

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1002-01I	Inspection hole cap to timing case	Nm	25

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1003-01I	Bolt, turning device to timing case	Nm	25



904 589 04 63 00

Turning device

TIM-ID: 0000099519 - 001

© Daimler AG, 10.08.15, G/08/15, ap13.22-g-1351dd, Inspect poly-V-belt for wear and damage

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099519 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099519 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work

Dokumenttitel Attach/detach cranking/blocking device for engine

Dokumentnummer ar0330g160003dd

TIM-ID: 0000099519 - 001

AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine		

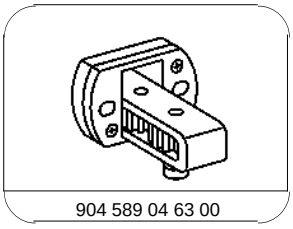
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1002-01I	Inspection hole cap to timing case	Nm	25

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1003-01I	Bolt, turning device to timing case	Nm	25



904 589 04 63 00

Turning device

Installing

1 Remove cap (1) at flywheel housing.

2 Attach turning device (2) with screw/bolts (4) to the flywheel housing Nm.

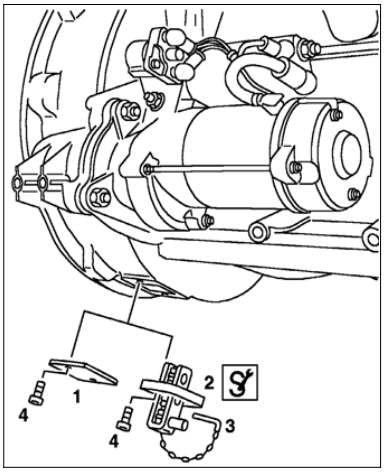
The cranking device (2) must be removed before starting the engine. The flywheel or the cranking device (2) will be damaged otherwise.

The cranking device (2) can be blocked by inserting the pin (3).

Remove

3 Remove turning device (2) from the flywheel housing.

4 Attach cap (1) with screw/bolts (4) on flywheel housing Nm.



W03.30-0001-02

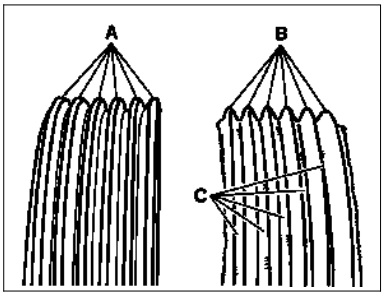
TIM-ID: 0000099519 - 001

© Daimler AG, 10.08.15, G/08/15, ar03.30-g-1600-03dd, Attach/detach cranking/blocking device for engine

Dokumenttitel	Damage patterns for poly V-belt
Dokumentnummer	ap1322d135101a

TIM-ID: 0000099519 - 001

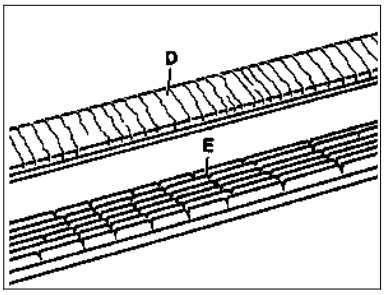
AP13.22-D-1351-01A	Damage patterns for poly V-belt		



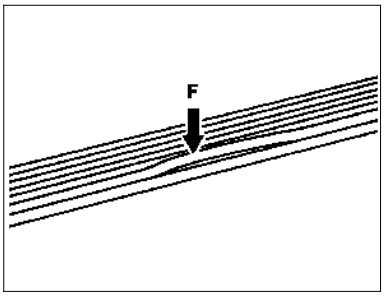
N13.22-2068-01

Wear to flank - ribs wedge-shaped (B) and cord visible in base of rib (C),
condition of ribs when new is trapezoidal in shape (A)

Splits across the back (D)
Splits across several ribs (E)



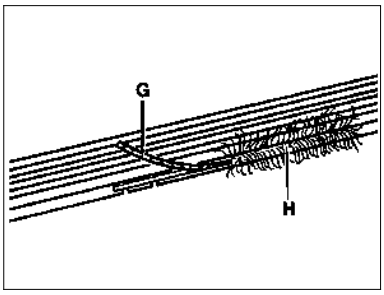
N13.22-2066-01



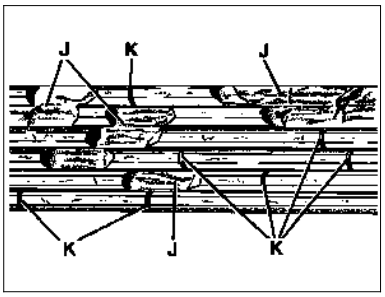
N13.22-2071-01

Rib detached from base of belt (F)

Strand torn out at the side (G), fraying (H) of outer strands



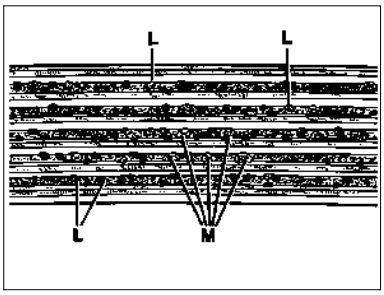
N13.22-2067-01



N13.22-2069-01

Sections of ribs broken out (J)
Splits across ribs (K),

Rubber lumps in base of rib (L)
Dirt or grit embedded (M)



N13.22-2070-01

TIM-ID: 0000099519 - 001

© Daimler AG, 10.08.15, G/08/15, ap13.22-d-1351-01a, Damage patterns for poly V-belt
ENGINE all

Dokumenttitel	Routing diagram for poly-V belt
Dokumentnummer	ar1322g390202dd

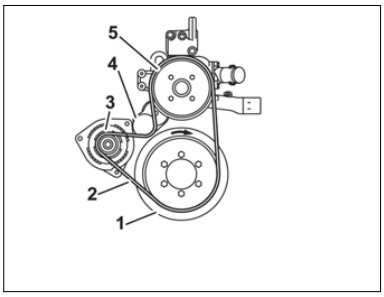
TIM-ID: 0000099519 - 001

AR13.22-G-3902-02DD	Routing diagram for poly-V belt		

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Modification notes

24.11.14	Contents completely revised.		



W13.22-1029-01

1 *Belt pulley or vibration damper*
2 *Poly-V belt*
3 *Alternator belt pulley (if installed)*
4 *Tensioning device*
5 *Coolant pump belt pulley*
Pfeil *Direction of engine rotation*

TIM-ID: 0000099519 - 001

© Daimler AG, 10.08.15, G/08/15, ar13.22-g-3902-02dd, Routing diagram for poly-V belt

Engine 900.91/92 in model 000.001 Engine 902.91/93 in model 000.001 Engine 904.94/95/96/97 in model 000.001 Engine 906.90/93/94/95/96/98/99 in model 000.001 Engine 924.91/93/94 in mo

Remove/install poly-V-belt

TIM-ID: 0000099520 - 001

Dokumenttitel Remove/install poly-V belt

Dokumentnummer ar1322g1202dd

TIM-ID: 0000099520 - 001

AR13.22-G-1202DD	Remove/install poly-V belt	28.5.15

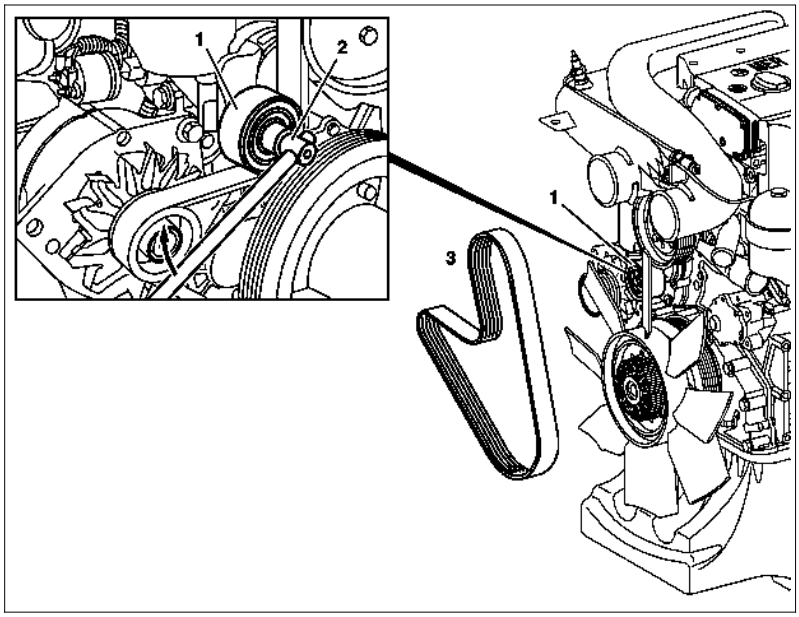
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Modification notes

24.11.14	Contents completely revised.		
24.11.14	Contents completely revised.		AR13.22-G-3902-02DD

Shown on ENGINE 904.9

1 Tensioner pulley
2 Breaker bar and socket
3 Poly-V belt



W13.22-0004-06

	Remove		
1	Swivel and hold tensioner pulley (1) with breaker bar and socket (2) upwards (direction of arrow)	Only swivel clamping device against the spring tension of the tensioner pulley (1). The screw/bolt can loosen otherwise.	
2	Remove poly-V belt (3) from tensioner pulley (1)		
3	Swivel the tensioning device back and remove the poly-V belt (3)	Do not kink poly-V belt (3). Otherwise it may be damaged.	
	Check		
4	Check condition of poly-V belt (3)	If necessary: ↓ Replace poly-V belts (3). Damage profiles	 AP13.22-D-1351-01A
5	Check vibration damper, belt pulley of alternator and coolant pump and tensioning device with tensioner pulley (1)	If necessary: ↓ Replace damaged or worn parts. Belt pulley/vibration damper Poly-V belt tensioning device	 AR03.30-G-1600DD AR13.25-G-3200DD

TIM-ID: 0000099520 - 001

		Coolant pump	AR20.10-G-1271DD
	Install		
6	Fit poly-V belt (3) onto the belt pulley and the vibration damper	Routing diagram Do not fit the poly-V belt (3) onto the tensioner pulley (1) at this stage. Observe the routing diagram.	AR13.22-G-3902-02DD
7	Swivel and hold tensioner pulley (1) with breaker bar and socket (2) upwards (direction of arrow)	Only swivel clamping device against the spring tension of the tensioner pulley (1). The screw/bolt can loosen otherwise.	
8	Fit poly-V belt (3) onto tensioner pulley of tensioning device (1) and swivel tensioning device back, remove breaker bar and socket (2)		
	Check		
9	Check for correct seating of poly-V belt (3).	If necessary: ↓ Align poly-V belt (3).	

TIM-ID: 0000099520 - 001

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099520 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

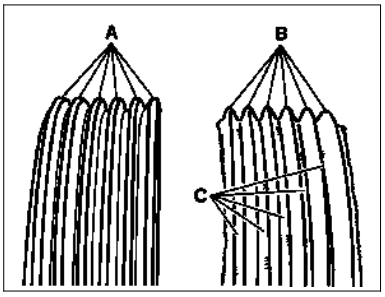
TIM-ID: 0000099520 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work

Dokumenttitel	Damage patterns for poly V-belt
Dokumentnummer	ap1322d135101a

TIM-ID: 0000099520 - 001

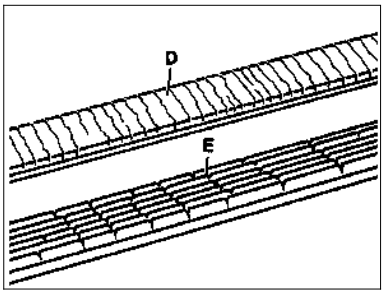
AP13.22-D-1351-01A	Damage patterns for poly V-belt		



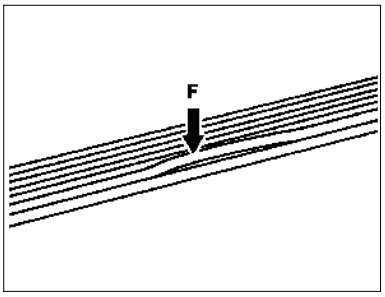
N13.22-2068-01

Wear to flank - ribs wedge-shaped (B) and cord visible in base of rib (C),
condition of ribs when new is trapezoidal in shape (A)

Splits across the back (D)
Splits across several ribs (E)



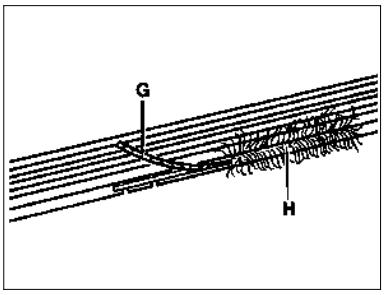
N13.22-2066-01



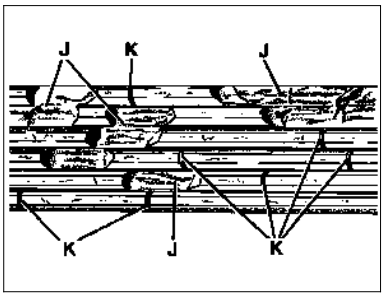
N13.22-2071-01

Rib detached from base of belt (F)

Strand torn out at the side (G), fraying (H) of outer strands



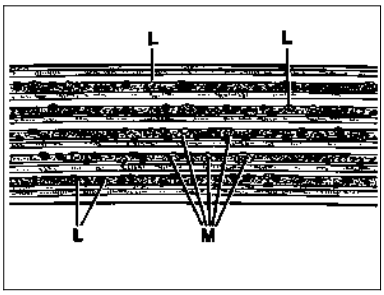
N13.22-2067-01



N13.22-2069-01

Sections of ribs broken out (J)
Splits across ribs (K),

Rubber lumps in base of rib (L)
Dirt or grit embedded (M)



N13.22-2070-01

TIM-ID: 0000099520 - 001

© Daimler AG, 10.08.15, G/08/15, ap13.22-d-1351-01a, Damage patterns for poly V-belt
ENGINE all

Dokumenttitel Routing diagram for poly-V belt

Dokumentnummer ar1322g390202dd

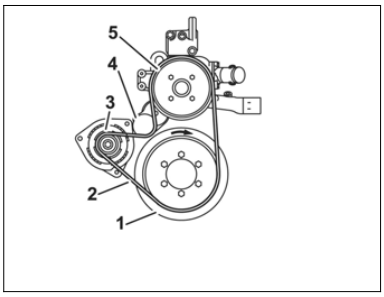
TIM-ID: 0000099520 - 001

AR13.22-G-3902-02DD	Routing diagram for poly-V belt		

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Modification notes

24.11.14	Contents completely revised.		



W13.22-1029-01

1 *Belt pulley or vibration damper*
2 *Poly-V belt*
3 *Alternator belt pulley (if installed)*
4 *Tensioning device*
5 *Coolant pump belt pulley*
Pfeil *Direction of engine rotation*

TIM-ID: 0000099520 - 001

Clean filter element of fuel prefilter

TIM-ID: 0000099521 - 001

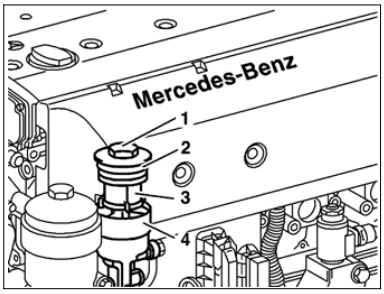
Dokumenttitel	Clean filter element of fuel prefilter
Dokumentnummer	ap4720g0730dd

TIM-ID: 0000099521 - 001

AP47.20-G-0730DD	Clean filter element of fuel prefilter	11.5.15

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

1 Cap
2 Sealing ring
3 Filter element
4 Filter housing



G47.20-3114-01

⚠ **Danger !**	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
⚠ **Danger !**	**Risk of explosion** caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.	No fires, sparks, open flames or smoking. Pour fuels into suitable and appropriately marked containers only. Wear protective clothing when handling fuel.	AS47.00-Z-0001-01A
	Clean		
1	Open lid on fuel tank	i In order to reduce the overpressure in the fuel system.	
2	Clean exterior of filter housing (4)		
3	Unscrew screw cap (1) and pull out of filter housing (4) together with filter element (3)	i Ensure that no foreign bodies enter the filter housing (4). Do not wipe the filter housing (4) under any circumstances.	
4	Clean screw cap (1) and filter element (3)	With severely clogged or damaged filter element (3): ↓ Replace filter element (3).	
5	Replace seal (2)		
6	Apply a thin coating of grease to sealing ring (2)		
7	Screw on screw cap (1) with filter element (3) and tighten	Nm Cover to fuel prefilter housing	*BA47.20-N-1003-02I
8	Start the engine and bleed the fuel system	i Run engine for approx. 1 minute. The fuel system is bled automatically.	
9	Check leaktightness of filter housing (4) when the engine is running	i Visual inspection.	
10	Turn off engine		

Nm **Fuel filter**

Number	Designation		Engine 900.9 in model 000.001 Engine 902.9 in model 000.001 Engine 904.9 in model 000.001 Engine 906.903/91/92/93/94/95/96/97/98/99 in model 000.001	Engine 924.9 in model 000.001 Engine 926.9 in model 000.001
BA47.20-N-1003-02I	Cover to fuel prefilter housing	Nm	25	25

TIM-ID: 0000099521 - 001

© Daimler AG, 10.08.15, G/08/15, ap47.20-g-0730dd, Clean filter element of fuel prefilter

Engine 900.91/92 in model 000.001 Engine 902.91/93 in model 000.001 Engine 904.94/95/96/97 in model 000.001 Engine 906.93/94/95/96/98/99 in model 000.001 Engine 924.91/93/94 in model 000.

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099521 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099521 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work

Dokumenttitel	Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.
Dokumentnummer	as4700z000101a

TIM-ID: 0000099521 - 001

AS47.00-Z-0001-01A	**Risk of explosion** caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.	No fires, sparks, open flames or smoking. Pour fuels into suitable and appropriately marked containers only. Wear protective clothing when handling fuel.	⚠ **Danger !**

ENGINE ALL
ENGINE ALL
except natural gas engine

Potential risks
Risk of explosion, poisoning and injury
Fuels are highly inflammable and toxic if taken. Fuel may cause damage to skin. For example, skin is degreased when it comes into contact with gasoline fuel. Fuel vapors are explosive, invisible and spread out across the floor. They are poisonous when inhaled and have an anesthetizing effect in high concentrations.
Safety precautions/instructions
- Pay attention to national safety precautions and regulations.
- No fires, sparks, open flames or smoking.
- Ensure the work place is adequately ventilated.
- Never drain or pour in fuels over maintenance pits.
- Store drained fuel in suitable and sealed containers.
- Immediately clean up any fuel which has leaked.

Performing work on a vehicle with open flame
(e.g. welding or similar)
- Remove the relevant parts of the fuel system before performing this type of work and seal open fuel lines with stop plugs.

First-aid measures
- Clean skin coated with fuel using water and soap.
- Change clothing coated with fuel as quickly as possible.
- If fuel gets into the eyes, rinse eyes with water immediately and consult a physician if necessary.

TIM-ID: 0000099521 - 001

© Daimler AG, 10.08.15, G/08/15, as47.00-z-0001-01a, Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to ENGINE ALL ENGINE ALL except natural gas engine

Replace fuel filter

TIM-ID: 0000099522 - 001

Dokumenttitel	Replace fuel filter
Dokumentnummer	ap4720g0780dd

TIM-ID: 0000099522 - 001

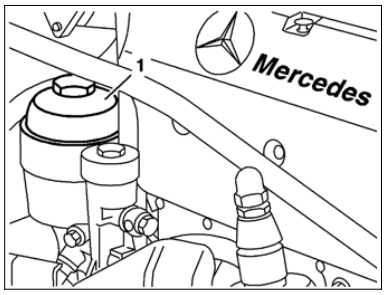
AP47.20-G-0780DD	Replace fuel filter	11.5.15

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

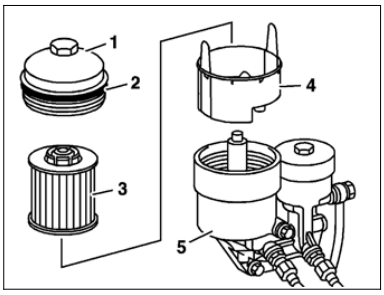
Modification notes

24.11.14	Contents completely revised.		

1 Threaded cap
2 Sealing ring
3 Filter element
4 Dirt collecting tank
5 Fuel filter housing



N07.57-0226-01



N07.57-0225-01

⚠ **Danger !**	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
⚠ **Danger !**	**Risk of explosion** caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.	No fires, sparks, open flames or smoking. Pour fuels into suitable and appropriately marked containers only. Wear protective clothing when handling fuel.	AS47.00-Z-0001-01A
	Remove		
1	Open lid on fuel tank	ℹ In order to reduce the overpressure in the fuel system.	
2	Remove threaded cap (1) from fuel filter housing (5)	ℹ Remove the screw cap (1) with the filter element (3) only after the fuel has drained out of the fuel filter housing (5).	
3	Remove threaded cap (1) with filter element (3) and unclip filter element (3) by pressing at side	ℹ Ensure that no foreign bodies get into the fuel filter housing (5) Under no circumstances rinse out the fuel filter housing (5).	
4	Pull out the dirt collecting tank (4) at the fishplate from the fuel filter housing (5)	Do not empty the dirt collecting tank (4) into the fuel filter housing (5), never wipe out the fuel filter housing (5) and make sure that the deposited dirt does not enter the fuel filter housing (5). The fuel system can otherwise be damaged.	
5	Clean threaded cap (1) and dirt collecting tank (4)		
	Install		
6	Replace seal (2)		
7	Apply a thin coating of grease to sealing ring (2)		
8	Insert new filter element (3) into the screw cap (1)		
9	Insert the dirt collecting tank (4) into the fuel filter housing (5)	ℹ Install components in correct positions.	
10	Screw on screw cap (1) with filter element (3) and tighten	Nm Cover on fuel filter housing	*BA47.20-N-1001-02I
11	Close cap on fuel tank		
12	Start the engine and bleed the fuel system	ℹ Run the engine for approx. 1 minute. The fuel system is ventilated automatically.	

TIM-ID: 0000099522 - 001

13	Check the fuel filter housing (5) for leaks when the engine is running		
14	Turn off engine		

Nm **Fuel filter**

Number	Designation		Engine 900.9 in model 000.001 Engine 902.9 in model 000.001 Engine 904.9 in model 000.001 Engine 906.903/91/92/93/94/95/96/97/98/99 in model 000.001	Engine 924.9 in model 000.001 Engine 926.9 in model 000.001
BA47.20-N-1001-02I	Cover on fuel filter housing	Nm	25	25

TIM-ID: 0000099522 - 001

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099522 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099522 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work
MODEL ALL

Dokumenttitel	Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.
Dokumentnummer	as4700z000101a

TIM-ID: 0000099522 - 001

AS47.00-Z-0001-01A	**Risk of explosion** caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to eyes and skin caused by contactwith fuel.	No fires, sparks, open flames or smoking. Pour fuels into suitable and appropriately marked containers only. Wear protective clothing when handling fuel.	⚠ **Danger !**

ENGINE ALL
ENGINE ALL
except natural gas engine

Potential risks
Risk of explosion, poisoning and injury
Fuels are highly inflammable and toxic if taken. Fuel may cause damage to skin. For example, skin is degreased when it comes into contact with gasoline fuel. Fuel vapors are explosive, invisible and spread out across the floor. They are poisonous when inhaled and have an anesthetizing effect in high concentrations.
Safety precautions/instructions
- Pay attention to national safety precautions and regulations.
- No fires, sparks, open flames or smoking.
- Ensure the work place is adequately ventilated.
- Never drain or pour in fuels over maintenance pits.
- Store drained fuel in suitable and sealed containers.
- Immediately clean up any fuel which has leaked.

Performing work on a vehicle with open flame
(e.g. welding or similar)
- Remove the relevant parts of the fuel system before performing this type of work and seal open fuel lines with stop plugs.

First-aid measures
- Clean skin coated with fuel using water and soap.
- Change clothing coated with fuel as quickly as possible.
- If fuel gets into the eyes, rinse eyes with water immediately and consult a physician if necessary.

TIM-ID: 0000099522 - 001

© Daimler AG, 10.08.15, G/08/15, as47.00-z-0001-01a, Risk of explosion caused by fuel igniting, risk of poisoning caused by inhaling and swallowing fuel as well as risk of injury to ENGINE ALL ENGINE ALL except natural gas engine

Set valve clearance

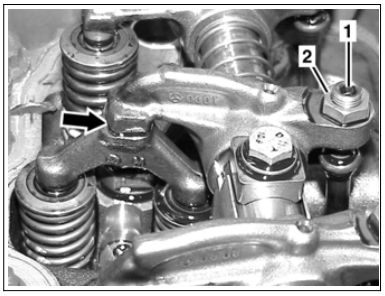
TIM-ID: 0000099523 - 001

Dokumenttitel	Set valve clearance
Dokumentnummer	ap0530g0560dd

TIM-ID: 0000099523 - 001

AP05.30-G-0560DD	Set valve clearance	18.1.11

ENGINE 900.91 /92, 902.91 /93, 904.94 /95 /96 /97, 906.90 /93 /94 /95 /96 /98 /99, 924.91 /93, 926.91 /92 /93 /95 /97 in MODEL 000.001



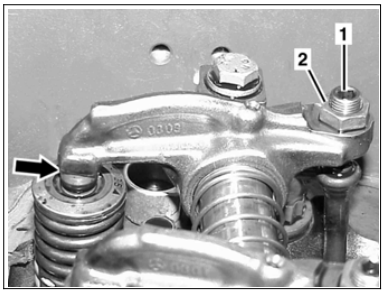
G05.30-3102-01

Inlet valve

1 Adjustment screw
2 Jam nut

Exhaust valve

1 Adjustment screw
2 Jam nut



G05.30-3103-01

	Remove/install		
1	Remove cylinder head cover Remove/install cylinder head cover	 Except engine 906.90 with code (MS8) Natural gas engine, Engine 906.90 with code (MS8) Natural gas engine	 AR01.20-G-5014DD AR01.20-G-5014DE
2 i i	Select adjustment method for valve clearance General information on adjustment valve clearance General information on adjustment valve clearance	Setting according to injection order: ↓ Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 1 Setting at two crankshaft positions: ↓ Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 2	 AH05.30-N-1000-01C AH05.30-N-1000-01D
3	Attach turning device for engine Attach/detach cranking/blocking device for engine	 Nm 	 AR03.30-G-1600-03DD *BA01.60-N-1003-01I *904589046300
4	Move engine into the crankshaft position of the selected setting method		
	Checking		
5	Inspect valve clearance (arrow) and adjust	i Check or adjust valve clearance when engine is cold only, at the earliest 30 min. following adjustment of the engine, to ensure uniform warming up. The same also applies for short-term operation. i The inspection tolerance of the valve clearance applies only to the inspection, not to the setting. Nm	AP05.30-G-0560-01DD *BE05.30-N-1012-01K *BE05.30-N-1013-01K *BA05.00-N-1002-01H
6	Detach turning device for engine Attach/detach cranking/blocking device for engine	 Nm 	 AR03.30-G-1600-03DD *BA01.60-N-1002-01I *904589046300
7	Install cylinder head cover Remove/install cylinder head cover	 Except engine 906.90 with code (MS8) Natural gas engine, Engine 906.90 with code (MS8) Natural gas engine	 AR01.20-G-5014DD AR01.20-G-5014DE
⚠ **Danger!** 8	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the engine as it is running Start engine and inspect cylinder head cover for leaks	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A

TIM-ID: 0000099523 - 001

Check values for valves

Number	Designation			Engine 900.9 except 900.910, Engine 902.9 except 902.910/919, Engine 924.9, 926.9	Engine 900.910, Engine 902.910/919	Engine 906.901/902
BE05.30-N-1012-01K	Valve clearance	Inlet	mm	0.40	0.40	0.40
		Outlet	mm	0.60	0.60	0.60
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	-0.05/+0.05	-0.05/+0.05	-0.05/+0.05
		Outlet	mm	-0.10/+0.10	-0.10/+0.10	-0.10/+0.10

Check values for valves

Number	Designation			Engine 904.9 up to end no. 039739, Engine 906.9 up to end no. 041955 except 906.901/902	Engine 904.9 up to end no. 039740, Engine 906.9 up to end no. 041956 except 906.901/902
BE05.30-N-1012-01K	Valve clearance	Inlet	mm	0.40	0.40
		Outlet	mm	0.60	0.60
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	-0.05/+0.05	-0.05/+0.05
		Outlet	mm	-0.10/+0.10	-0.10/+0.10

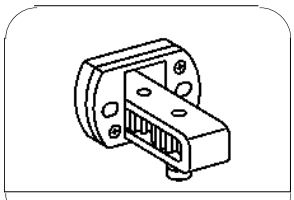
Nm Timing case

Number	Designation		Engine 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1002-01I	Inspection hole closure cover to timing case	Nm	25
BA01.60-N-1003-01I	Bolt, turning device to timing case	Nm	25

Nm Engine timing - general

TIM-ID: 0000099523 - 001

Number	Designation	Engines 900.9, 902.9	Engine 904.9, 906.9	Engines 924.9, 926.9
BA05.00-N-1002-01H	Jam nut on rocker arm adjustment screw Nm	25	25	25



904 589 04 63 00

Cranking device

TIM-ID: 0000099523 - 001

Dokumenttitel Remove/install cylinder head cover

Dokumentnummer ar0120g5014dd

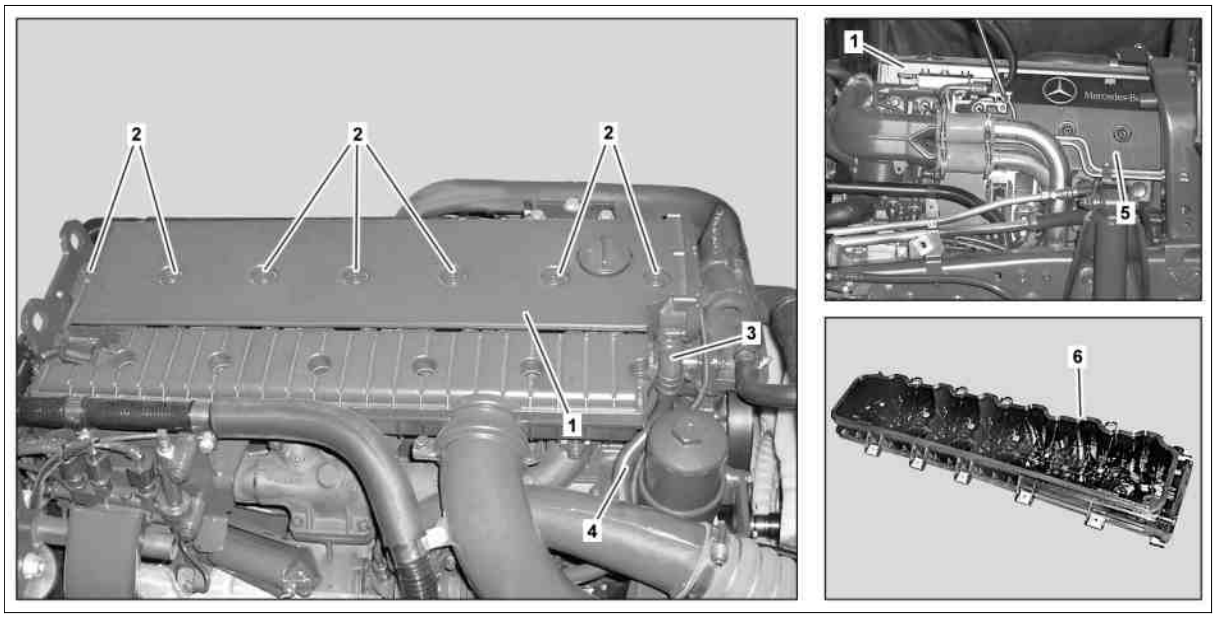
TIM-ID: 0000099523 - 001

AR01.20-G-5014DD	Remove/install cylinder head cover	12.5.15

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Modification notes

6.11.14	Contents completely revised.		



G01.20-3119-09

1 Cylinder head cover
2 Screw/bolts
3 Vent hose
4 Vent line
5 Engine cover
6 Seal

⚠ **Danger !**	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
	Remove/install		
1	Remove engine cover (5)	**Installation:** Only re-install the engine cover (5) after the leak test.	
2	Remove vent hose (3) on vent line (4)		
3	Check bleed hose (3) for damage	If damage is present: ↓ Replace vent hose (3).	
4	Remove cylinder head cover (1)	**Installation:** Clean the sealing surfaces of cylinder head cover (1) and the cylinder head. Replace sealing washers on screw/bolts (2) and seal (6). Nm Screw/bolt, cylinder head cover to cylinder head	*BA01.20-N-1001-01J
5	Install in the reverse order		

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TIM-ID: 0000099523 - 001

6	Start engine and perform an engine test run	i Allow engine to run at a higher rotational speed.	
7	Stop engine and check in the area of cylinder head cover (1) for leaktightness		

Nm **Crankcase ventilation, cylinder head cover**

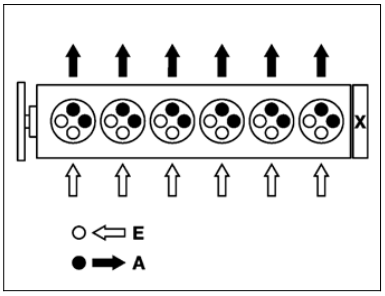
Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9	ENGINE 924.9, 926.9
BA01.20-N-1001-01J	Screw/bolt, cylinder head cover to cylinder head	Nm	30	30

TIM-ID: 0000099523 - 001

Dokumenttitel	General information on adjusting valve clearance
Dokumentnummer	ah0530n100001c

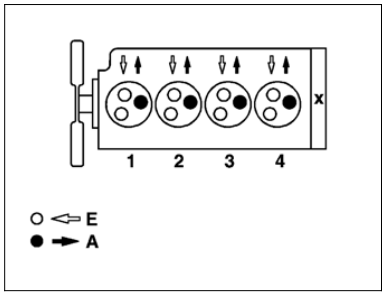
TIM-ID: 0000099523 - 001

AH05.30-N-1000-01C	General information on adjusting valve clearance	Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9 Method 1	i



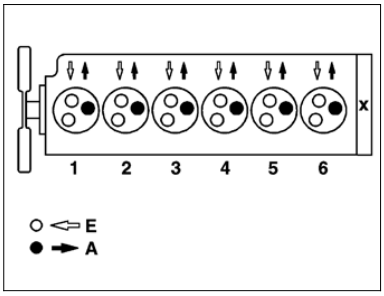
A01.00-0001-01

Engine 457.9, 458.9
A Outlet valve
E Inlet valve
X Flywheel side



N01.00-0347-01

Engine 900.9, 904.9, 924.9
A Outlet valve
E Inlet valve
X Flywheel side



N01.00-0348-01

Engines 902.9, 906.9, 925.9, 926.9
A Outlet valve
E Inlet valve
X Flywheel side

Method 1:
Set inlet and exhaust valves for each cylinder, according to firing order.

The cylinder to be set must be at ignition TDC, the synchronized cylinder at overlap TDC.

Engine	Crankshaft position	Cylinder/injection order
4-cylinder	Ignition TDC	1 3 4 2
	Overlap TDC	4 2 1 3
6-cylinder	Ignition TDC	1 5 3 6 2 4
	Overlap TDC	6 2 4 1 5 3

TIM-ID: 0000099523 - 001

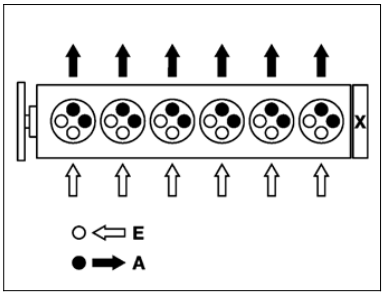
© Daimler AG, 10.08.15, G/08/15, ah05.30-n-1000-01c, General information on adjusting valve clearance
ENGINE 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9 Methode 1

Dokumenttitel General information on adjusting valve clearance

Dokumentnummer ah0530n100001d

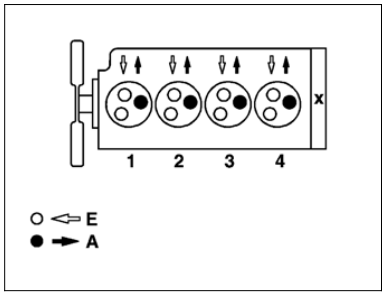
TIM-ID: 0000099523 - 001

AH05.30-N-1000-01D	General information on adjusting valve clearance	Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9 Method 2	i



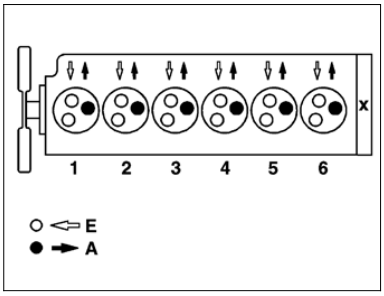
A01.00-0001-01

Engine 457.9, 458.9
A Outlet valve
E Inlet valve
X Flywheel side



N01.00-0347-01

Engine 900.9, 904.9, 924.9
A Outlet valve
E Inlet valve
X Flywheel side



N01.00-0348-01

Engines 902.9, 906.9, 925.9, 926.9
A Outlet valve
E Inlet valve
X Flywheel side

Method 2:
Set inlet and exhaust valves at two crankshaft positions, as shown in the table.

4-cylinder
Position cylinder 4 in the valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 4 in ignition TDC).

6-cylinder
Position cylinder 6 in the valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 6 in ignition TDC).

Engine	Crankshaft position	Cylinder/valves to be set					
		1	2	3	4	5	6
4-cylinder	Cylinder 4 valve overlap TDC	E/A	R	A	-		
	Cylinder 1 valve overlap TDC	-	A	R	E/A		
6-cylinder	Cylinder 6 valve overlap TDC	E/A	R	A	R	A	-
	Cylinder 1 valve overlap TDC	-	A	R	A	R	E/A

TIM-ID: 0000099523 - 001

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ENGINE 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9 Methode 2

Dokumenttitel	Attach/detach cranking/blocking device for engine
Dokumentnummer	ar0330g160003dd

TIM-ID: 0000099923 - 001

AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine		

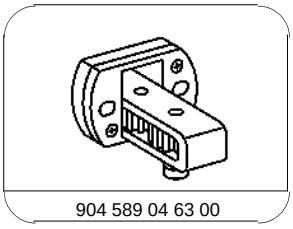
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1002-01I	Inspection hole cap to timing case	Nm	25

Nm **Timing case**

Number	Designation		ENGINE 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1003-01I	Bolt, turning device to timing case	Nm	25



904 589 04 63 00

Turning device

Installing

1 Remove cap (1) at flywheel housing.

2 Attach turning device (2) with screw/bolts (4) to the flywheel housing Nm.

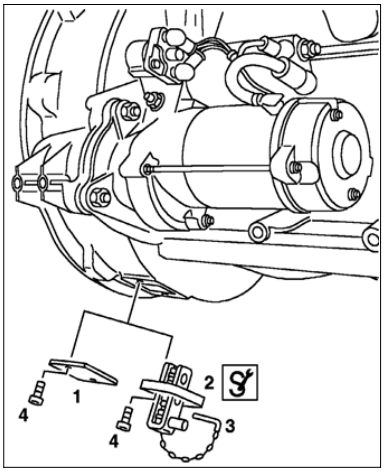
The cranking device (2) must be removed before starting the engine. The flywheel or the cranking device (2) will be damaged otherwise.

The cranking device (2) can be blocked by inserting the pin (3).

Remove

3 Remove turning device (2) from the flywheel housing.

4 Attach cap (1) with screw/bolts (4) on flywheel housing Nm.



W03.30-0001-02

TIM-ID: 0000099523 - 001

© Daimler AG, 10.08.15, G/08/15, ar03.30-g-1600-03dd, Attach/detach cranking/blocking device for engine

Engine 900.91/92 in model 000.001 Engine 902.91/93 in model 000.001 Engine 904.94/95/96/97 in model 000.001 Engine 906.90/93/94/95/96/98/99 in model 000.001 Engine 924.91/93/94 in mo

Dokumenttitel	Check and adjust valve clearance
Dokumentnummer	ap0530g056001dd

TIM-ID: 0000099523 - 001

AP05.30-G-0560-01DD	Check and adjust valve clearance		

Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

Check values for valves

Number	Designation			ENGINE 900.9 (except 900.910), ENGINE 902.9 (except 902.910/919), ENGINE 924.9, 926.9	ENGINE 900.910 ENGINE 902.910/919
BE05.30-N-1012-01K	Valve clearance	Inlet	mm	0,40	0,40
		Outlet	mm	0,60	0,60

Check values for valves

Number	Designation			ENGINE 906.901/902	ENGINE 904.9## ## up to 039739, ENGINE 906.9## (except 906.901/902) ## up to 041955
BE05.30-N-1012-01K	Valve clearance	Inlet	mm	0,40	0,40
		Outlet	mm	0,60	0,60

Check values for valves

Number	Designation			ENGINE 904.9## ## as of 039740, ENGINE 906.9## (except 906.901/902) ## as of 041956
BE05.30-N-1012-01K	Valve clearance	Inlet	mm	0,40
		Outlet	mm	0,60

Check values for valves

Number	Designation			ENGINE 900.9 (except 900.910), ENGINE 902.9 (except 902.910/919), ENGINE 924.9, 926.9	ENGINE 900.910 ENGINE 902.910/919
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	–0,05/+0,05	–0,05/+0,05
		Outlet	mm	–0,10/+0,10	–0,10/+0,10

TIM-ID: 0000099523 - 001

Check values for valves

Number	Designation			ENGINE 906.901/902	ENGINE 904.9## ## up to 039739, ENGINE 906.9## (except 906.901/902) ## up to 041955
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	–0,05/+0,05	–0,05/+0,05
		Outlet	mm	–0,10/+0,10	–0,10/+0,10

Check values for valves

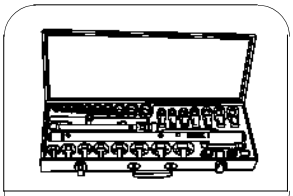
Number	Designation			ENGINE 904.9## ## as of 039740, ENGINE 906.9## (except 906.901/902) ## as of 041956
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	–0,05/+0,05
		Outlet	mm	–0,10/+0,10

Nm **Engine timing - general**

Number	Designation		Engine 900.9, 902.9 in model 000.001	Engine 904.9, 906.9 in model 000.001
BA05.00-N-1002-01H	Jam nut on rocker arm adjustment screw	Nm	25	25

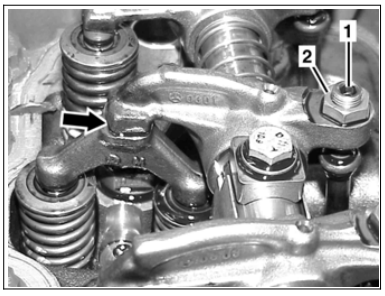
Nm **Engine timing - general**

Number	Designation		Engine 924.9, 926.9 in model 000.001
BA05.00-N-1002-01H	Jam nut on rocker arm adjustment screw	Nm	25



000 589 10 99 00

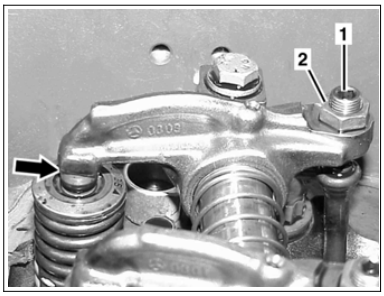
Tool kit



G05.30-3102-01

Inlet valve
1 Adjustment screw
2 Jam nut

Outlet valve
1 Adjustment screw
2 Jam nut



G05.30-3103-01

1 Use feeler gauge to check valve clearance (arrow) between rocker arm and valve bridge (intake valves)or valve stem (exhaust valves).

i The valve clearance (arrow) must be adjusted if it is outside the test tolerance.

i Use the "14 mm" open end wrench bit from the tool kit.

4 Check the valve clearance (arrow) again.

TIM-ID: 0000099923 - 001

If the valve clearance (arrow) is outside the tolerance:

2 Loosen jam nut (2) and set valve clearance (arrow) on adjustment screw (1).

Correct valve clearance (arrow).

i The valve clearance (arrow) is correctly set, if it is possible to pull the feeler gauge through with a slight resistance.

3 Counterhold adjustment screw (1) and tighten jam nut (2) Nm.

TIM-ID: 0000099523 - 001

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099523 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099523 - 001

© Daimler AG, 10.08.15, G/08/15, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from work

Engine cooling system-check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct concentration

TIM-ID: 0000099524 - 001

Dokumenttitel	Engine cooling system - check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct concentration
Dokumentnummer	ap2000g2010mt

TIM-ID: 0000099524 - 001

AP20.00-G-2010MT	Engine cooling system - check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct concentration	30.3.09

MODEL 000.001 with ENGINE 444.9, 447.9, 457.9, 458.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 907.9, 909.9, 924.9, 926.9, 941.9, 942.9

	Check		
⚠ **Danger!**	**Risk of injury** to skin and eyes caused by scalding from contact with hot coolant spray. **Risk of poisoning** caused by swallowing coolant.	Do not open cooling system unless coolant temperature is below 90°C. Open cap slowly and release the pressure. Do not pour coolant into beverage containers. Wear protective gloves, protective clothing and safety glasses.	AS20.00-Z-0001-01A
1	Open filler neck for coolant	ℹ See Operator's Manual	
2	Check anticorrosion agent and antifreeze concentration, correct if necessary	ℹ See Operator's Manual ℹ If there is insufficient anticorrosion agent and antifreeze in the coolant, the concentration of anticorrosion agent and antifreeze must be corrected: ↓ Correct the corrosion protection or antifreeze protection	AP20.00-G-2010-01MT
BB	Coolant specifications	Sheet 310.1	BB00.40-P-0310-01A
BB	Anticorrosion/antifreeze agents (Sheet 325.2)	Sheet 325.2 Antifreeze tester gotis://D_13/20_03.0	BB00.40-P-0325-02A
3	Check coolant level, correct if necessary	ℹ See Operator's Manual ℹ The coolant temperature must be below 50 °C. The specified composition of the coolant must be guaranteed.	
	Notes on coolant	All engines	AH20.00-N-2080-01A
4	Close filler neck for coolant	ℹ See Operator's Manual	

TIM-ID: 0000099524 - 001

© Daimler AG, 10.08.15, G/08/15, ap20.00-g-2010mt, Engine cooling system - check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct .

Dokumenttitel	Notes on coolant
Dokumentnummer	ah2000n208001a

TIM-ID: 0000099524 - 001

AH20.00-N-2080-01A	Notes on coolant		(!)

ENGINE 100, 102, 103, 104, 110, 111, 112, 113, 114, 115, 116, 117, 119, 120, 121, 123, 127, 129, 130, 133, 137, 152, 155, 156, 157, 159, 166, 177, 178, 180, 266, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 285, 601, 602, 603, 604, 605, 606, 607, 611, 612, 613, 615, 616, 617, 621, 626, 628, 629, 640, 642, 646, 647, 648, 651, 668, 780 (except 780.991)

ENGINE ALL

Coolant composition

Car and commercial vehicle engines (normal case):

50% water and 50% anticorrosion or antifreeze.

For different coolant composition for CV engines, refer to **MB Specifications for Operating Fluids**.

Coolant composition OM 607 or M 200 in model 415

Hot countries:

60% water and 40% anticorrosion or antifreeze.

Cold countries:

50% water and 50% anticorrosion or antifreeze.

In the model series 415 the anticorrosion/antifreeze "Arteco ETX 9536 B" (yellow fluorescent) is used at the factory. With this anticorrosion/antifreeze, the antifreeze protection configured at the factory will change in comparison to previous Mercedes-Benz van model series. The antifreeze protection is set between -25 °C and -37 °C ex factory and does not need to be adjusted. This results in a different coolant composition. Observe **MB-Specifications for Operating Fluids**.

Tasks of anticorrosion/antifreeze agent

- Corrosion and cavitation protection for all components in the engine cooling system
- Antifreeze
- Increasing the boiling point so that coolant does not evaporate so rapidly. Avoiding ejection of coolant at high coolant temperatures.

Antifreeze

50% anticorrosion or antifreeze by volume provides antifreeze protection for up to approx. **-37 °C**. A higher concentration is only necessary if the ambient temperatures are even lower. 55% anticorrosion or antifreeze agent by volume provides antifreeze protection for up to approx. **-45 °C**.

For model series 415 with OM 607 or M 200, the factory-adjusted anticorrosion or antifreeze agent by volume is 40_% (hot countries) or 50_% (cold countries). This provides up to **-25 °C** or up to **-37 °C**.

(!) A concentration of more than 55% anticorrosion/antifreeze agent by volume should not be used as the maximum antifreeze protection is already reached at this concentration.

An even higher concentration reduces the anti-freeze protection and impairs heat dissipation. Reduced heat dissipation can result in damage to components of the engine cooling system and to the engine.

Water

Use water which is clean and not too hard. Drinking water often satisfies the requirements, but not always. The amount of dissolved substances in the water may be of significance for the occurrence of corrosion. If doubt exists, analyze the water.

For fresh water specifications refer to **MB Specifications for Operating Fluids** .

Operational monitoring of coolant

Inspect the coolant for resistance to low temperatures before the start of the cold season.

In countries with high ambient temperatures, check concentration of anticorrosion/antifreeze agent once a year.

The corrosion protection in the coolant is depleted during operation. Old coolant, in which the corrosion protection is mainly depleted, is extremely corrosive.

Period of use

The maximum permissible period of use of the coolant is given in the maintenance booklet, the applicable "Service/Maintenance Sheet" or the **MB-Specifications for Operating Fluids**.

For the period of use for a deviating coolant composition for CV engines, refer to **MB Specifications for Operating Fluids**.

(i) Before pouring in fresh coolant, flush the used coolant out of the engine cooling system.

(!) In case of severe soiling or oil streaks, clean engine cooling system.

Otherwise engine cooling system components may be damaged.

(i) If the drained coolant is used again, it is essential that the coolant is filtered before being filled into the engine cooling system.

(!) Dust particles must not enter into the engine cooling system.

Otherwise engine cooling system components may be damaged.

Disposing of coolants

Observe the legal provisions and local waste water regulations.

The following brochure is available about disposing of waste products in auto repair trade for the location Federal Republic of Germany:

"Environmental protection manual for motor vehicle repair operations"

Publisher: German Association of the Automotive Industry e. V. (VDA)

60325 Frankfurt am Main, Westendstraße 61

TIM-ID: 0000099524 - 001

© Daimler AG, 10.08.15, G/08/15, ah20.00-n-2080-01a, Notes on coolant

Dokumenttitel	Risk of injury to skin and eyes suffering scalding from contact with hot coolantspray. Risk of poisoning from swallowing coolant.
Dokumentnummer	as2000z000101a

TIM-ID: 0000099524 - 001

AS20.00-Z-0001-01A	**Risk of injury** to skin and eyes suffering scalding from contact with hot coolantspray. **Risk of poisoning** from swallowing coolant.	Do not open cooling system unless coolant temperature is below 90 °C. Open cap slowly and release the pressure. Do not pour coolant into beverage containers. Wear protective gloves, protective clothing and safety glasses.	⚠ **Danger !**

ENGINE ALL

Potential risks

Risk of injury

When the engine is warm, the cooling system is pressurized. If the cooling system is opened suddenly, there is a **risk of scalding** from hot coolant which splashes out.

Risk of poisoning

If coolant is swallowed, this can result in symptoms of poisoning such as headaches, dizziness, stomach ache, respiratory paralysis, unconsciousness, vomiting and cramps.

Safety precautions/instructions

- Allow cooling system to cool down to a coolant temperature of less than 90 °C.
- Open coolant cap slowly; in the case of a conventional coolant cap, turn it as far as the first detent and in the case of a screwed coolant cap, turn approx. $^1/_2$ turn and release the pressure.
- Wear protective gloves, protective clothing and safety glasses.
- Do not pour coolant into beverage containers.

First aid measures

- Rinse affected skin with large quantities of cold water and cover with sterile dressing.
- Drink plenty of water with medicinal charcoal additive.
- If the person has suffered severe burns or has swallowed coolant, contact a physician.

TIM-ID: 0000099524 - 001

© Daimler AG, 10.08.15, G/08/15, as20.00-z-0001-01a, Risk of injury to skin and eyes suffering scalding from contact with hot coolantspray. Risk of poisoning from swallowing cool

Dokumenttitel Correcting anticorrosion/antifreeze concentration

Dokumentnummer ap2000g201001mt

TIM-ID: 0000099524 - 001

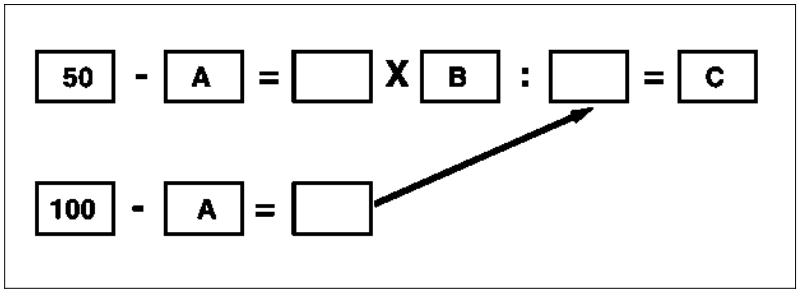
AP20.00-G-2010-01MT	Correcting anticorrosion/antifreeze concentration		
⚠ **Danger!**	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the engine as it is running	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	AS00.00-Z-0005-01A
⚠ **Danger!**	**Risk of injury** to skin and eyes caused by scalding from contact with hot coolant spray. **Risk of poisoning** caused by swallowing coolant.	Do not open cooling system unless coolant temperature is below 90°C. Open cap slowly and release the pressure. Do not pour coolant into beverage containers. Wear protective gloves, protective clothing and safety glasses.	AS20.00-Z-0001-01A

Comparison table (specifications "approx.")
Antifreeze protection in [°C] and anticorrosion agent and antifreeze concentration in [vol %]

°C	vol %	°C	vol %	°C	vol %
–10	20	–20	32	–30	42
–15	26	–25	37	–33	45
–18	30	–27	40	–37	50

Calculation table of refill quantity of anticorrosion agent and antifreeze

A *Determined anticorrosion agent and antifreeze concentration (in % by volume)*
B *Total coolant filling capacity (in liters)*
C *Replenishment quantity of anticorrosion agent and antifreeze (in liters)*



N20.00-0377-04

1 Enter determined anticorrosion agent and antifreeze concentration (A) in the calculation table.

2 Obtain the total coolant filling quantity (B) from the manufacturer's operator's manual and enter in the calculation table.

3 Calculate refill quantity of anticorrosion agent and antifreeze (C).

4 Remove drain screw on radiator and drain as much coolant as is to be poured in again as refill quantity of anticorrosion agent and antifreeze (C).
i Installation location of drain screw: See operator's manual.

5 Screw drain screw into the radiator again.

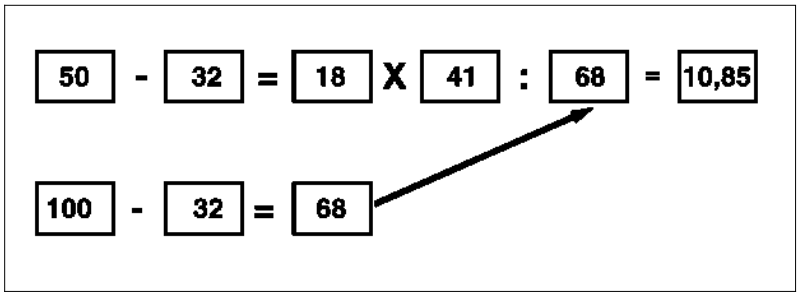
6 Pour the calculated refill quantity of anticorrosion agent and antifreeze (C) into the cooling system.

7 Start engine and run for about one minute at varying revs.

8 Switch off engine.

Example

- Determined anticorrosion agent and antifreeze concentration (A): 32 % by volume (corresponds to antifreeze protection down to –20 °C)
- Complete coolant filling capacity (B): 41 liters
- Refill quantity of anticorrosion agent and antifreeze (C): 10.85 liters



N20.00-0376-04

TIM-ID: 0000099524 - 001

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MODEL 000.001 with ENGINE 444.9, 447.9, 457.9, 458.9, 470.9, 471.9, 541.9, 542.9, 900.9, 902.9, 904.9, 906.9, 907.9, 909.9, 924.9, 926.9, 941.9, 942.9

Dokumenttitel	Risk of injury to skin and eyes suffering scalding from contact with hot coolantspray. Risk of poisoning from swallowing coolant.
Dokumentnummer	as2000z000101a

TIM-ID: 0000099524 - 001

AS20.00-Z-0001-01A	**Risk of injury** to skin and eyes suffering scalding from contact with hot coolantspray. **Risk of poisoning** from swallowing coolant.	Do not open cooling system unless coolant temperature is below 90 °C. Open cap slowly and release the pressure. Do not pour coolant into beverage containers. Wear protective gloves, protective clothing and safety glasses.	⚠ **Danger !**

ENGINE ALL

Potential risks

Risk of injury

When the engine is warm, the cooling system is pressurized. If the cooling system is opened suddenly, there is a **risk of scalding** from hot coolant which splashes out.

Risk of poisoning

If coolant is swallowed, this can result in symptoms of poisoning such as headaches, dizziness, stomach ache, respiratory paralysis, unconsciousness, vomiting and cramps.

Safety precautions/instructions

- Allow cooling system to cool down to a coolant temperature of less than 90 °C.
- Open coolant cap slowly; in the case of a conventional coolant cap, turn it as far as the first detent and in the case of a screwed coolant cap, turn approx. $^1/_2$ turn and release the pressure.
- Wear protective gloves, protective clothing and safety glasses.
- Do not pour coolant into beverage containers.

First aid measures

- Rinse affected skin with large quantities of cold water and cover with sterile dressing.
- Drink plenty of water with medicinal charcoal additive.
- If the person has suffered severe burns or has swallowed coolant, contact a physician.

TIM-ID: 0000099524 - 001

© Daimler AG, 10.08.15, G/08/15, as20.00-z-0001-01a, Risk of injury to skin and eyes suffering scalding from contact with hot coolantspray. Risk of poisoning from swallowing cool

Dokumenttitel	Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from working on the engine while it is being started or when it is running.
Dokumentnummer	as0000z000501a

TIM-ID: 0000099524 - 001

AS00.00-Z-0005-01A	**Risk of accident** from vehicle starting off by itself when engine running. **Risk of injury** (bruises and burns) resulting from working on the engine while it is being started or when it is running.	Secure vehicle to prevent it from starting off by itself. Wear closed and snug-fitting work clothes. Do not touch hot or rotating parts.	⚠ **Danger !**

MODEL ALL

Potential risks

Risk of accident

Caused by the vehicle driving off by itself while being started (e.g. during compression test) **due to engaged gear** or with the engine running and vehicles with automatic transmission **due to selector lever position "P" or "N"** not being engaged (except for vehicles that do not have selector lever position "P").

Risk of injury

Severe injuries can occur near a running engine caused by its rotating parts.

Because the engine heats up when operating, serious burns can be caused by touching unshielded parts.

Safety instructions/precautions

- In general, only work on a running engine when it is absolutely necessary.
- **Apply parking brake** before starting the engine.
- The vehicle is to be secured against moving forwards or backwards.
- The person performing tests on vehicles with engines running must sit in the driver seat to be able to prevent the vehicle from moving.
- It is not permitted for persons to be in the hazard area in front of and behind the vehicle while performing tests.
- **Shift the gearshift lever to neutral** on vehicles with manual transmission.
- On vehicles with automatic transmission, move **selector lever into position "P" or "N"** (exception for vehicles that do not have selector lever position "P").
- On vehicles that do not have selector lever position "P", the **selector lever** is to be **secured against unauthorized access** .
- Wear closed and snug-fitting work clothes.
- Remove all jewelry such as chains, rings, etc.
- Wear suitable head wear to cover long hair.
- Before commencing any work on the running engine, familiarize yourself with the location of potentially hot parts.
- When carrying out work when starting the engine or when engine is running **do not touch any hot and rotating parts.**

First aid measures in the event of burns

- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099524 - 001

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MODEL ALL

Dokumenttitel	Coolant specifications
Dokumentnummer	bb0040p031001a

TIM-ID: 0000099524 - 001

MODEL ALL

Note: These regulations apply to the Mercedes-Benz, Maybach, smart and Setra brands.

1. Terms used

Antifreeze with corrosion inhibitor, KFM:
Component of the coolant for combustion engines as corrosion and antifreeze protection, for lowering the freezing point as well as raising the boiling point.

Coolant, KM:
Mixture of antifreeze with corrosion inhibitor and water for cooling engines. Normally coolants consists of antifreeze with corrosion inhibitor and water. The coolants must exhibit the following properties:
- Guarantee of heat transfer
- Long-term corrosion and cavitation protection for all components in cooling system
- Guarantee of antifreeze protection
- Increase of boiling point
- Resistance to microorganisms
- Effective foaming suppression

Coolant additives:
Anticorrosion agent that can be used for special applications mixed with water. The mixture has no antifreeze protection!

MB approval:
Marking of the coolants or antifreezes with corrosion inhibitor that are tested by Daimler AG and approved for the corresponding use, see table 1 and 2. On the containers with tested brand-name products, you will find **MB approval 325.0** , for example, as a note.

2. Overview

Tables 1 and 2 give an overview for the application of the tested antifreezes with corrosion inhibitor and the maximum change intervals. Pay attention to the MB approval before using a coolant. With the correct use of tested coolant qualities with MB approval, you ensure the full protection of the cooling system. The vehicles with combustion engine are defined in the assignment across the engine model series. Table 1 therefore applies for all vehicles with an OM642 engine, for example.

Table 1: For passenger cars and vehicles with passenger car combustion engines

Sheet No.	Major assembly model series			Change interval years/km
	M1xx/M2xx	OM6xx		
325.0 and 326.0	●	●	For all vehicles with a manufacture date up to and including April 2014	15/250.000 i Whichever occurs first must be observed; exception: in the vehicle's maintenance manual, shorter change intervals are stipulated.
325.6 and 326.6	●	●	Usable for all vehicles	15/250.000 i Whichever occurs first must be observed; exception: in the vehicle's maintenance manual, shorter change intervals are stipulated.

Table 2: For vehicles with commercial vehicle engines

Sheet No.	Major assembly model series							Change interval in years
	OM300	OM400	OM904 up to 926	OM934, 936	OM457, 460	OM500	OM470 up to 473	
311.0	●	●						0.5
312.0	●	●	●		●	●		1
325.0 or 326.0	●	●	●		●	●		3
325.2 or 326.2	●	●	●		●	●		3
325.3 or 326.3	●	●	●		●	●		5
325.5 or 326.5			●	●	●	●	●	3

Coolants or antifreezes with corrosion inhibitor that are listed on different sheet numbers in tables 1 and 2 must not be mixed, as a considerably reduced corrosion protection may damage the cooling system. In general, mixtures of different antifreezes with corrosion inhibitor offer a lesser performance than the specially adapted active components of a formulation.
The sheet numbers: 325.x show the antifreezes with corrosion inhibitor and the corresponding sheet number 326.x shows the finally mixed coolant. The antifreezes with corrosion inhibitor must be mixed with water before use.

Vehicles with a fuel cell require a special coolant for cooling the fuel cell. Coolants for fuel cell vehicles must only be refilled in an F-Cell support point.

3. Coolant

The coolants and antifreezes with corrosion inhibitor are based on ethylene glycol as the antifreeze component but differ with regard to the remaining ingredients, e.g. for corrosion protection, table 3.

TIM-ID: 0000099524 - 001

Table 3: Specifications for Operating Fluids sheet number and coolant type				
Coolantsheet no.	**Anticorrosion/ antifreezesheet no.**	**Inhibitors**		**Free of**
		inorganic	**organic**	
326.0	325.0	Si, B	X	amine, phosphate
326.2	325.2	Si, B	X	amine, phosphate
326.3	325.3		X	nitrite, amine, phosphate, borat, silicon
326.5	325.5	SI	X	nitrite, amine, phosphate, borat, 2-ethylhexanoic acid
326.6	325.6	SI	X	nitrite, amine, phosphate, borat, 2-ethylhexanoic acid

The coolant must remain in the cooling system year round to protect against corrosion under all operating conditions. Corrosion may lead to poor heat output and engine overheating!

3.1. Mixing ratio

Generally a coolant must be used with approx. 50 % by volume of antifreeze with corrosion inhibitor and 50 % by volume of water. The water quality must satisfy the requirements in the following chapter. The antifreeze protection of this mixture is sufficient up to approx. -37 °C. Even with extremely low ambient temperatures, not more than 55 % by volume of antifreeze with corrosion inhibitor should be used. With 55 % antifreeze with corrosion inhibitor, the maximum antifreeze protection, approx. -45 °C, of a water-based ethylene glycol solution is reached; a higher KFM portion lowers the antifreeze protection and the heat dissipation in the engine worsens.

Table 4: Target concentration of antifreeze with corrosion inhibitor and water		
Sheet No.	**Mixing ratio**	
	KFM vol %	**Water % by vol.**
325.0	50	50
325.2	50	50
325.3	50	50
325.5	50	50
325.6	50	50
311.0	1	99
312.0	10	90

The boiling point of the coolant increases with the portion of the antifreeze with corrosion inhibitor. In the vehicle, the coolant is additionally protected against boiling by the pressure in the cooling system. By raising the pressure, the boiling temperature of the coolant is increased further.

Only approved products offer reliable protection of the cooling system. In special cases (commercial-vehicle engines, no antifreeze specification) coolant additives can be used that are primarily corrosion protection additives.

4. Water quality

Clean and the softest possible water should be used for processing the coolant. Drinking water often satisfies the requirements. Information concerning the water quality of drinking water is available from the local water-plant authorities or the official water utilities on request.

If there is no available information regarding the water quality or if no suitable water is available, then distilled or deionized water should be used to prepare the coolant. Sea water, brackish water, brine and industrial waters are not suitable. Salts may promote corrosion or form disruptive deposits.

The analysis values of the water for mixing coolants must be within the limits of table 5.

Table 5: Water quality			
Water quality		**min**	**max.**
Earth alkali ions	mmol/l		2.7
Hardness	°dH		15
Chloride	mg/l		80
Chloride + sulfate	mg/l		160
pH-value	-	6.5	8.0

1° dH = 1.783 mmol/l alkaline earth ions = 7.147 mg/l Ca^{2+} or 4.336 mg/l Mg^{2+}

With the use of premixed coolant, compliance with the concentration (50/50) must also be observed in addition to the MB approval.

TIM-ID: 0000099524 - 001

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MODEL ALL

4.1. Coolant additives for commercial vehicle engines without antifreeze specification

In climate zones free of frost year round, no antifreeze protection is required as the cooling systems are adapted to coolant according to sheet 325.x and 326.x. However in justified exceptional cases an aqueous solution with corrosion protection should be used. The use of anticorrosion agents in water is limited to the engines named in table 2. The use of anticorrosion oil emulsion according to sheet 311.0 is limited thermally. The emulsion must therefore not be used in efficient modern engines.

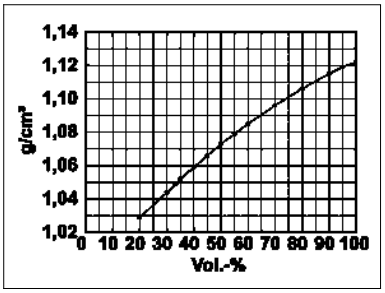
Mixtures of different products as stated in sheet 311.0 and 312.0 are not permitted.

When producing the anticorrosion oil emulsion in accordance with sheet 311.0, the following must be noted: When carrying out a new filling (initial filling or filling after a cleansing operation), an emulsion of 1.0 - 1.5 % by volume must be used. When refilling, an emulsion of 0.5 - 1.0 % by volume should be used. Concentrations that are too high (>1.5 % by volume) do not improve the corrosion protection, but rather exert a negative influence on seals and hoses.

5. Monitoring coolant operation

During operation the corrosion inhibitors of the coolant are consumed and the mixing ratio may be changed due to the evaporation of water. It is therefore very important to regularly monitor the coolant if the engine is to run trouble free.

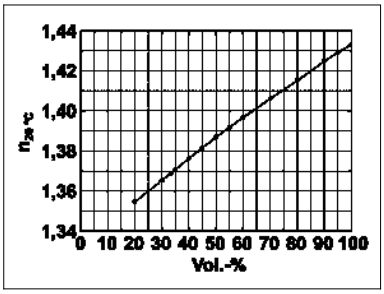
The inspection of the mixing ratio should be conducted with suitable apparatus. To do so, the density can be used to determine this in accordance with picture 1 or the refractive index in accordance with picture 2. The specifications on the mixing ratio may vary slightly for individual coolants from the values in pictures 1 and 2.



P00.40-2032-01

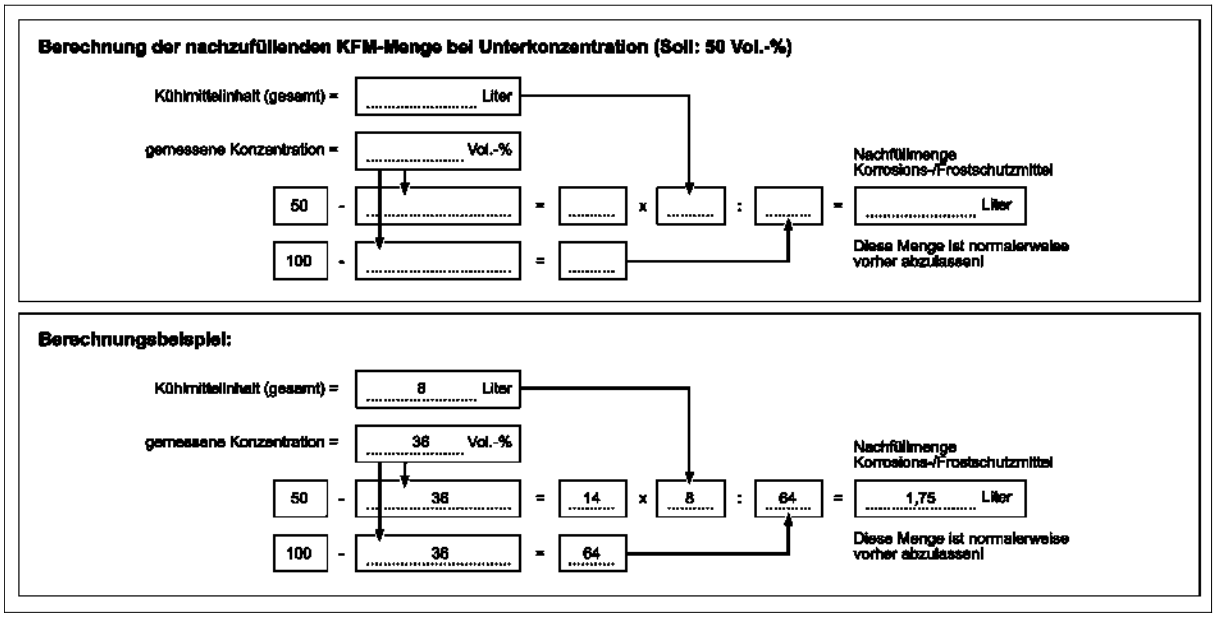
Bild 1: Density of KFM/water mixtures

Bild 2: Refractive index of KFM/water mixtures



P00.40-2033-01

Should the coolant contain only 40 % by volume or greater than 55 % by volume of antifreeze with corrosion inhibitor, the mixing ratio must be corrected immediately. To calculate the refill quantity, the following calculation aid can be used:



P00.40-2038-09

Refrigerant protection/concentration table (approx.)												
°C	–10	–14	–15	–18	–20	–23	–25	–27	–30	–33	–35	–40
vol %	20	25	26	30	32	35	37	40	42	45	47	50

6. Disposal of coolants

TIM-ID: 0000099524 - 001

The coolants are biologically-degradable material. The statutory regulations or waste water ordinances in each individual country must be observed when disposing of used coolant. It is recommended to have the possibilities available for disposing of materials explained by the local responsible water authorities.

TIM-ID: 0000099524 - 001

© Daimler AG, 10.08.15, G/08/15, bb00.40-p-0310-01a, Coolant specifications
MODEL ALL

Dokumenttitel	Anticorrosion/antifreeze agents (Sheet 325.2)
Dokumentnummer	bb0040p032502a

TIM-ID: 0000099524 - 001

BB00.40-P-0325-02A	Anticorrosion/antifreeze agents (Sheet 325.2)	Commercial vehicles and industrial engines: usable in all engines **Except** model series OM 600, M 100 and M200	

MODEL ALL

Product name	**Customer, town/country**
Anticongelante Lubral HD M5.2	Lubricantes de América, S.A. de C.V., Santa Catarina/Mexico

TIM-ID: 0000099524 - 001

OM900 Series (0120)
Engine coolant – Level check

Preconditions:

- ✓ Engine is stopped and starting is disabled.
- ✓ Mercedes-Benz Specifications for Operating Fluids are accessible at https://bevo.mercedes-benz.com.

WARNING	
	Coolant is hot and under pressure. **Risk of injury and scalding!** • Let the engine cool down. • Wear protective clothing, gloves, safety mask, and goggles.

Preparatory steps:

1. Turn radiator cap counterclockwise to first stop and allow pressure to escape (see Figure 1).
2. Continue to turn radiator cap counterclockwise and remove.

□

Engine coolant – Level check

1. Check coolant level. Coolant must be visible at the lower edge of the filler neck on the radiator (Figure 1).
2. Top up with treated coolant as needed. Refer to Mercedes-Benz Specifications for Operating Fluids at https://bevo.mercedes-benz.com.
3. Check radiator cap (visual inspection) and clean, if necessary.
4. Position radiator cap on filler neck and turn clockwise to close.

□

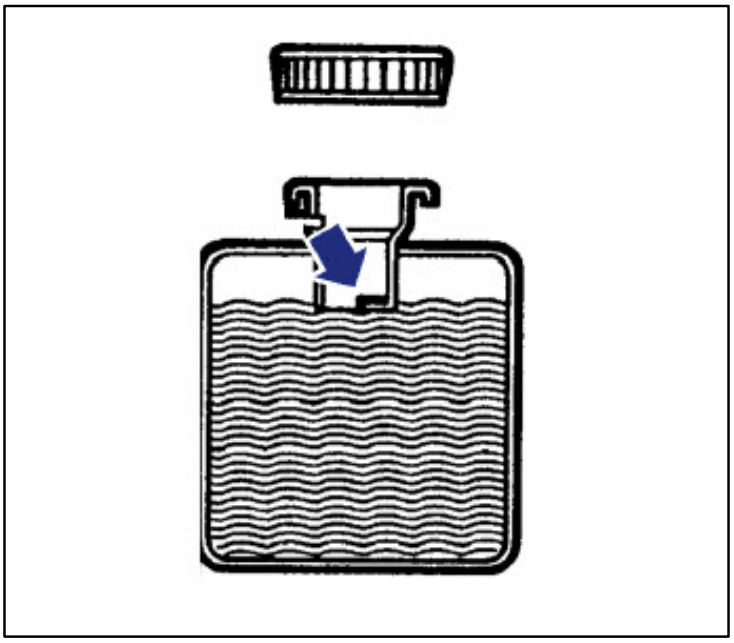


Figure 1: Engine coolant – Level check

TIM-ID: 0000103741 - 001

OM900 Series (0120)
Engine coolant – Level check

Checking engine coolant level by means of level sensor

1. Switch on engine control system and check readings on display.
2. Check coolant level and top up with coolant as necessary. Refer to Mercedes-Benz Specifications for Operating Fluids at https://bevo.mercedes-benz.com.

□

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OM900 Series (0120)
Engine coolant – Draining

Preconditions:

✓ Engine is stopped and starting is disabled.

WARNING	
	Coolant is hot and under pressure. **Risk of injury and scalding!** • Let the engine cool down. • Wear protective clothing, gloves, safety mask, and goggles.

Preparatory steps:

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheater, if installed.

Engine coolant – Draining

1. Turn radiator cap on filler neck counterclockwise to first stop and allow pressure to escape.
2. Continue to turn radiator cap counterclockwise and remove.
3. Attach drain hose onto coolant drain plug on the crankcase (see Figure 1).
4. Place a suitably-sized container underneath the drain hose to catch the coolant.
5. Release drain plug and collect coolant.
6. Clear blocked drainage openings of deposits.
7. Tighten coolant drain plug on engine with a new seal.

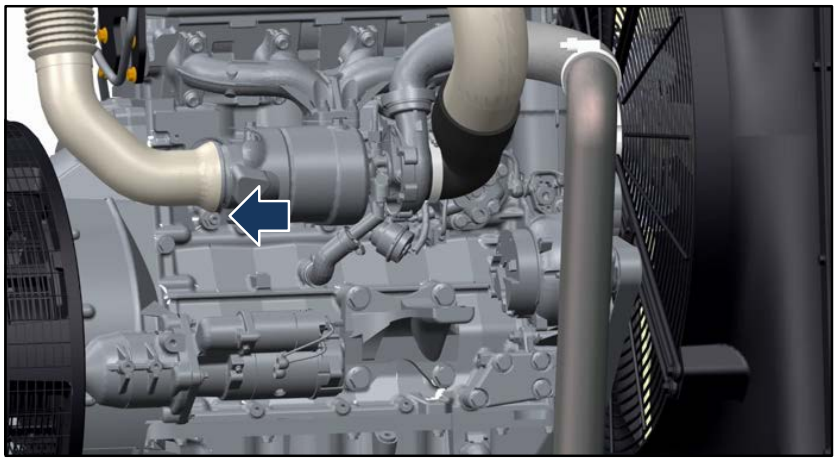


Figure 1: Engine coolant – Draining

TIM-ID: 0000103742 - 001

8. Place a suitably-sized container underneath the radiator to catch the coolant.
9. Turn radiator drain valve counterclockwise to drain coolant from radiator (see Figure 2).
10. Turn radiator drain valve clockwise to tighten.
11. Position radiator cap on filler neck and turn clockwise to close.
12. If performing coolant change, proceed to instructions for *Engine coolant – Filling*.



Figure 2: Engine coolant – Draining

TIM-ID: 0000103742 - 001

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OM900 Series (0120)
Engine coolant – Filling

Preconditions:

- ✓ Engine is stopped and starting is disabled.
- ✓ Mercedes-Benz Specifications for Operating Fluids are accessible at https://bevo.mercedes-benz.com

WARNING	
	Coolant is hot and under pressure. **Risk of injury and scalding!** • Let the engine cool down. • Wear protective clothing, gloves, safety mask, and goggles.

WARNING	
	High level of noise when the engine is running. **Risk of damage to hearing!** • Wear ear protection.

NOTICE	
	Cold coolant in hot engine can cause thermal stress. **Possible formation of cracks in the engine!** • Fill / top up coolant only into cold engine.

Preparatory steps:

1. Turn radiator cap counterclockwise to first stop and allow pressure to escape (see Figure 1).
2. Continue to turn radiator cap counterclockwise and remove.

□

TIM-ID: 0000103743 - 001

Engine coolant – Filling

1. Fill coolant through filler neck on radiator (see Figure 1) until coolant level reaches lower edge of filler neck.
2. Check proper condition of radiator cap and clean sealing faces, if required.
3. Position radiator cap on filler neck and turn clockwise to close.



Figure 1: Engine coolant – Filling

Final steps:

1. Start the engine and operate it at idle speed for five minutes.
2. Check coolant level (see *Engine coolant – Level check*) and top up with coolant, if required.

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11 Fluids and Lubricants Specifications

11.1 Fluids and Lubricants for Mercedes-Benz Engines

Fluids and lubricants specifications for Mercedes-Benz engines can be accessed at the following location: https://bevo.mercedes-benz.com.

This site provides an overview of requirements for operating fluids and specific product recommendations that are approved for use with your engine-generator set. Because further developments to operating fluids and lubricants are constantly being made, this website is continually updated. For this reason, only the online version of the Mercedes-Benz Specifications for Operating Fluids found here is valid.

For questions about fluids and lubricants specifications, contact your MTU Onsite Energy distributor or dealer.

TIM-ID: 0000064636 - 001

12 Appendix A

12.1 Abbreviations

Abbreviation	Meaning	Explanation
A/AC	Air-to-Air Charge Cooling	Type of diesel engine cooling configuration
AC	Alternating Current	The movement or flow of electric charge that periodically reverses direction
ADEC	Advanced Diesel Engine Control	Engine governor
AEM	Analog Expansion Module	Option for Digital Genset Controller
AGA	American Gas Association	
AL	Alarm	Alarm (general)
ANSI	American National Standards Institute	
ASTM	American Society for Testing and Materials	
ATS	Automatic Transfer Switch	
AVR	Automatic Voltage Regulation	
AWG	American Wire Gauge	Unit of the cross-sectional size of a wire
BDC	Bottom Dead Center	
BCI	Battery Council International	
BHP	Brake Horse Power	
BMEP	Brake Mean Effective Pressure	
BTU	British Thermal Unit	
CA	Cranking Amperes	Unit of current provided by an battery at 0 °C (32 °F)
CAD	Computer-Aided Design	
CAN	Controller Area Network	Data bus system, bus standard
CCA	Cold Cranking Amperes	Unit of current provided by an battery at -18 °C (0 °F)
CCB	CAN Connection Board	Plug-in board for CAN bus communication
CE	Conformité Européenne	Mandatory conformity mark on many products placed on the single market in the European Economic Area
CEM	Contact Expansion Module	Option for Digital Genset Controller
CFH	Cubic Feet per Hour	Unit for volumetric flow rate
CFM	Cubic Feet per Minute	Unit for volumetric flow rate
COM	Communication equipment	Hardware interface (serial port)
CSA	Canadian Standards Association	Not-for-profit association for safety and performance standards, including those for electrical/electronic/industrial equipment, boilers and pressure vessels, environmental protection, and more
CT	Current Transformer	
dB(A)	A-weighted decibel	One-tenth of a bel; unit for noise level
DC	Direct Current	
DGC	Digital Genset Controller	

TIM-ID: 0000000159 - 012

Abbreviation	Meaning	Explanation
DIN	Deutsches Institut für Normung e. V.	German Standardization Organization, at the same time identifier of German standards ("Deutsche Industrie-Norm")
DL	Default Lost	Alarm: Default CAN bus failure
DN	Diameter Nominal	A designated or theoretical diameter that may vary from the actual size, usually within an allowable tolerance band
DVR	Digital Voltage Regulator	
ECM	Electronic Control Module	
ECMS	Engine Side Control Management System	
ECU	Engine Control Unit	
EPA	Environmental Protection Agency	U.S. regulatory agency for implementation of federal laws for environment protection; establishes standards that will help meet those laws.
FCR	Field Current Regulation	
GPM	Gallons Per Minute	Unit for volumetric flow rate
HALT	Highly Accelerated Life Tests	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	
HMI	Human Machine Interface	Alarm: Measured value exceeds 2nd maximum limit
HP	High Pressure	
HP	Horse Power	
HT	High Temperature	
IEC	International Electrotechnical Committee	International standards organization for all electrical, electronic and related technologies
IEEE	Institute of Electrical and Electronic Engineers	International organization for the advancement of technology related to electricity
IP	Ingress Protection	Classification for environmental protection for electrical/electronic devices
ISO	International Organization for Standardization	International organization for publishing worldwide proprietary industrial and commercial standards
ITS	Integral Test System	
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LCD	Liquid Crystal Display	
LED	Light Emitting Diode	
L.L.C.	Limited Liability Company	
LO	LOW	Alarm: Measured value lower than 1st minimum limit
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit
LP	Low Pressure	
LSM	Load Sharing Module	Option for Digital Genset Controller
LT	Low Temperature	
MAU	Medium Attachment Unit	Interface
MCS	Monitoring and Control System	

TIM-ID: 0000000159 - 012

Abbreviation	Meaning	Explanation
MIL-STD	Mlitary Standard	
NEC	National Electrical Code	U.S. association for standards
NEMA	National Electrical Manufacturer's Association	U.S. association for standards for electrical products
NFPA	National Fire Protection Association	U.S. association for standards
NPT	National Pipe Thread	U.S. standard for tapered threads
QL	Qualification Level	
OEM	Original Equipment Manufacturer	A company that uses a component made by a second company in its own product, or sells the product of the second company under its own brand.
OPU	Open Power Unit	An engine-generator set with no enclosure
OSHA	Occupational Safety and Health Administration	A US federal agency
PAC	Performance Assurance Certificate	MTU Onsite Energy statement of assurance
PAN	Panel	
PF	Power Factor	
PH	Phase	
PM	Permanent Magnet	
PMG	Permanent Magnetic Generator	
PSI	Pounds per Square Inch	
PTO	Power Take-Off	
PVC	Polyvinyl Chloride	
RCM	Reserve Capacity Minutes	Unit for battery discharge
RDP	Remote Desktop Protocol	
RFOB	Rear Face of Block	
RMS	Root Mean Square	Mathematics: Effective value
RPM	Revolutions Per Minute	Unit of frequency (1 RPM = 1/60 Hz); number of rotations completed in one minute around a fixed shaft
RTC	Real Time Clock	
RTD	Resistive Temperature Device	
RTU	Remote Terminal Unit	Interface for Modbus
SAE	Society of Automotive Engineers	U.S. standardization organization
SAM	Service and Application Module	Diagnostic interface
SCA	Supplemental Coolant Additive	
SCCC	Seperate Charge Cooling Circuit	
SD	Sensor Defect	Alarm: Sensor failure
SLI	Starting, Lighting, Ignition	Type of starter battery
SS	Safety System	
TA-Luft	Technische Anleitung zur Reinhaltung der Luft	German technical regulation for protection of the air (emission limits for stationary engines in Germany)
TB	Terminal Block	
TB	–	Synonym for: water-to-air charge-air cooling

TIM-ID: 0000000159 - 012

Abbre-viation	Meaning	Explanation
TCP	Transmission Control Protocol	Interface for Modbus
TD	–	Synonym for: air-to-air charge-air cooling
TDC	Top Dead Center	
TEN	Technical Evolution Network	Technical sales documentation
TS	Transfer Switch	
TVU	Technische Verkaufs Unterlagen	German terminology for Technical Sales Documentation; a Business Portal-based MTU computer database which provides engine technical information for application and sales engineering purposes
UDP	User Datagram Protocol	Network protocol for Ethernet communication
UL	Underwriters Laboratories	Global not-for-profit organization for product safety testing and certification
UPS	Un-interrupted Power Source	
VAR	Volt-Amperes Reactive	Reactive power control
VAwS	Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen	German degree on the protection against water hazard substances
VDE	Verband Deutscher Elektrotechniker	German organization for electrical engineers
ZSI	Zone-Selective Interlocking	

TIM-ID: 0000000159 - 012

12.2 Conversion tables

Length

Unit A	multiplied by factor	= Unit B
in	25.4	= mm
ft	0.3048	= m
yd	0.9144	= m
stat. mile	1.609	= km
Nm	1.852	= km
yd	3	= ft
yd	36	= in

Unit B	multiplied by factor	= Unit A
mm	0.03937	= in
m	3.281	= ft
km	0.6215	= stat. mile

Area

Unit A	multiplied by factor	= Unit B
in^2	645.16	= mm^2
ft^2	0.0929	= m^2
yd^2	0.8361	= m^2
stat. $mile^2$	2.59	= km^2

Unit B	multiplied by factor	Unit A
mm^2	0.00155	= in^2
m^2	10.764	= ft^2
m^2	1.1960	= yd^2
km^2	0.3861	= stat. $mile^2$

Volume

Unit A	multiplied by factor	= Unit B
in^3	16387	= mm^3
ft^3	0.02832	= m^3
yd^3	0.7646	= m^3
gallon (U.S.)	3.785	= dm^3
gallon (UK)	4.546	= dm^3

Unit B	multiplied by factor	= Unit A
cm^3	0.06102	= in^3
m^3	35.31	= ft^3
dm^3	0.2642	= gallon (U.S.)
dm^3	0.22	= gallon (UK)

TIM-ID: 0000002173 - 016

Volumetric flow

Unit A	multiplied by factor	= Unit B
gal/min (GPM, U.S.)	3.79	= l/min
gal/min (GPM, U.S.)	0.134	= ft^3/min (cfm)
ft^3/min (cfm)	1.70	= m^3/h

Unit B	multiplied by factor	= Unit A
l/min	0.264	= gal/min (U.S.)
ft^3/min (cfm)	7.48	= gal/min (U.S.)
m^3/h	0.589	= ft^3/min (cfm)

Velocity

Unit A	multiplied by factor	= Unit B
ft/s	0.3048	= m/s
stat. mile/h (mph)	1.609	= km/h
knot (UK)	1.852	= km/h

Unit B	multiplied by factor	= Unit B
m/s	3.281	= ft/s
km/h	0.6214	= stat. mile/h (mph)
km/h	0.54	= knot (UK)

Mass

Unit A	multiplied by factor	= Unit B
lb	0.4536	= kg
oz	28.35	= g
ton (imp.)	1.016	= t

Unit B	multiplied by factor	= Unit A
g	0.03527	= oz
kg	2.205	= lb
t	0.9842	= ton (imp.)

Force

Unit A	multiplied by factor	= Unit B
lbf	0.4536	= kp
lbf	4.4482	= N
kp	9.80665	= N

Unit B	multiplied by factor	= Unit A
kp	2.205	= lbf
N	0.10197	= kp
N	0.2248	= lbf

TIM-ID: 0000002173 - 016

Density

Unit A	multiplied by factor	= Unit B
slug/ft^3	515.4	= kg/m^3

Unit B	multiplied by factor	= Unit A
kg/m^3	0.00194	= slug/ft^3

Torque

Unit A	multiplied by factor	= Unit B
lbf ft	1.3558	= Nm

Unit B	multiplied by factor	= Unit A
Nm	0.7376	= lbf ft

Pressure

Unit A	multiplied by factor	= Unit B
lbf/in^2 (psi)	703.1	= kp/m^2 (mmH_2O)
lbf/in^2 (psi)	0.06895	= bar
lbf/ft^2 (psf)	47.88	= Pa
inHg	0.03386	= bar
inHg	345.3	= kp/m^2 (mmH_2O)

Unit B	multiplied by factor	= Unit A
atm	760	= mmHg
atm	1.0133	= bar
atm	10332	= kp/m^2 (mmH_2O)
atm	1.0332	= kp/cm^2 (at)
atm	14.696	= lbf/in^2 (psi)
bar	14.504	= lbf/in^2 (psi)
Pa	0.0209	= lbf/ft^2 (psf)

2nd moment of mass

Unit A	multiplied by factor	= Unit B
slug ft^2	1.3558	= kg m^2

Unit B	multiplied by factor	= Unit A
kg m^2	0.7376	= slug ft^2

Energy

Unit A	multiplied by factor	= Unit B
lbf ft	1.356	= J
kcal	4186.8	= J
BTU	1055	= J
CHU	1899	= J

TIM-ID: 0000002173 - 016

Unit B	multiplied by factor	= Unit A
J	0.7376	= lbf ft
J	0.0002388	= kcal
J	0.0009478	= BTU
J	0.00052656	= CHU

Power

Unit A	multiplied by factor	= Unit B
PS	0.7355	= kW
HP	0.7457	= kW
BTU/s	1.054	= kW
kcal/h	1.163	= W
HP	550	= lbf ft/s

Unit B	multiplied by factor	= Unit A
kW	1.36	= PS
kW	1.341	= HP
kW	0.9487	= BTU/s
W	0.8598	= kcal/h
lbf ft/s	0.0018	= HP

Temperature

	Celsius	Kelvin
x °C	-	= x + 273.15 K
x K	= x − 273.15 °C	-
x °F	= 5/9(x − 32) °C	= 5/9(x − 32) + 273.15 K
x °R	= 5/4x °C	= (5/4x) + 273.15 K

	Fahrenheit	Réaumur
x °C	= 9/5x + 32 °F	= (4/5x) °R
x K	= 9/5(x − 273.15) + 32 °F	= 4/5(x − 273.15) °R
x °F	-	= 4/9(x − 32) °R
x °R	= (9/4x) + 32 °F	-

Fuel consumption

Unit A	multiplied by factor	= Unit B
mile/gal (US)	0.4251	= km/l
gal/mile (US)	2.3527	= l/km

Unit B	multiplied by factor	= Unit A
km/l	2.3527	= mile/gal (US)
l/km	0.4251	= gal/mile (US)

TIM-ID: 0000002173 - 016

12.3 Glossary

Aeration	Ventilation (progressive or otherwise) of air or combustion gases in the engine coolant
After boil	Boiling of the coolant after engine shutdown due to residual heat in the engine
After boil volume	Quantity of coolant discharged from the pressure relief overflow tube following engine shutdown
Air bind	A condition where a pocket of air has been trapped in the water pump causing it to lose its prime and ability to pump coolant
Air cleaner	A device to filter combustion air at the entrance to the combustion air circuit
Air handling	The cooling system's ability to purge air when injected at a given rate determined by the engine manufacturer and meeting specified criteria
Air re-circulation	A condition either occurring around the tips of the fan blades or where discharged air from a radiator core is returned to the front of the core; Either condition hinders cooling capability.
Alternator	A device for converting mechanical energy into alternating current electrical energy; In this documentation, the term "generator" (AC or synchronous generator) is used instead.
Altitude	The vertical relative to sea level at which the generating system is operating
Altitude rating	The maximum power recommended by the manufacturer for satisfactory operating at a given altitude
Ambient temperature	The air temperature of the surroundings in which the generating system or other applicable electrical equipment operates; The ambient temperature for optimum rating of components of the system may vary from device to device.
Ammeter	An instrument for measuring the magnitude of an electric current
Amperage	The strength of an electric current measured in Amperes
Analog control panel	A control panel that represents data by measurement of a continuous physical variable, as voltage or pressure
Annunciator	A signaling apparatus, generally used in conjunction with a buzzer, that displays a visual indication when energized by electric current; typically mounted on the unit
Annunciator panel	Groupings of annunciator lights
Antimony	A blue-white metalloid used in electrical batteries to increase the hardness of lead
Aspiration	A drawing of something in, out, up or through by or as if by suction
Audible alarm	Horn, siren, bell or buzzer which is used to attract the attention of the operator when a fault occurs in the electric power generating system
Automatic transfer switch	A switch designed to sense the loss of one power source and automatically transfer the load to another source of power
Auxiliary contact	Contacts, in a switching device, in addition to the main circuit contacts, which function with the movement of the latter
Base frame	The bottom support of an engine-generator set
Battery	A device that transforms chemical energy into electric energy in a cell with positive and negative electrodes in an electrolyte; Technically two or more cells connected in series, but in common usage often applied to single cells
Battery (lead-acid)	A battery that uses lead as a negative electrode, lead dioxide as a positive electrode and sulfuric acid as an electrolyte; nominal voltage 1.2 V per cell
Battery (nickel cadmium)	A battery that uses nickel oxide for a positive electrode and cadmium for a negative electrode with an alkaline electrolyte; nominal voltage 1.2 V per cell
Battery charger	Equipment used to restore the charge in storage batteries

TIM-ID: 0000000160 - 009

Battery rack	A framework of bars designed to support a battery
Battery warmer	Heater used in cold climates to maintain battery electrolyte temperature
Battery warmer plate	Heater mounted under the battery; Ensures battery will hold a charge in sub-zero conditions
Bell alarm	Audible alarm that electronically sounds from an input signal on a circuit breaker
Bio diesel	A type of diesel fuel derived from biological sources (such as vegetable oils), as opposed to petroleum
Bleed line	Line strategically placed on the cooling system to vent air/gases from the system both during fill and engine running mode; also known as deaeration or vent line.
Block heater	Coolant heating device which may be mounted in the engine block and immersed in engine coolant, (immersion type heater) or mounted externally and connected to the engine's coolant passages by means of piping or hoses (tank type heater)
Blocked open	Thermostats mechanically blocked open to required position; Used for cooling tests only.
Blower fan	A fan that pushes the air through the radiator core.
Bore (engine)	A measurement of the diameter of the holes bored into the engine block for use as cylinders
Bottom tank	Refers to the down stream radiator tank temperature that is usually the lowest temperature
Break horsepower	The power available at the flywheel, or other output member(s) for doing useful work
Brake mean effective pressure	The average (mean) pressure which, if imposed on the pistons uniformly from the top to the bottom of each power stroke, would produce the measured (brake) power output
Bus	A conductor, or group of conductors, that serve as a common connection for two or more circuits
Business portal	A web-based sales and technical information portal that is accessible to authorized MTU Onsite Energy personnel, distributors and dealers
Bypass switch	A specific device or combination of devices designed to bypass a control device
Bypass-isolation switch	A manually operated device used in conjunction with a transfer switch to provide a means of directly connecting load conductors to a power source and isolating the transfer switch to permit maintenance and testing of the transfer switch with no interruption to the load
Catalytic converter	A device used to reduce the toxicity of emissions from an internal combustion engine
Cavitation	A localized event where a vapor pressure/temperature phenomenon of the cooling liquid allows partial vaporization of the coolant; These cavities of vapor are carried downstream to a region of higher pressure, causing them to collapse. Cavitation reduces coolant flow and increases pump wear.
Cetane number	A relative measure of the time delay between the beginning of fuel injection and the start of combustion
Circuit	The portion of a circuit breaker mechanism that opens the circuit under sustained overload but does not protect against short-circuit currents
Circuit breaker	A mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specific time and automatically breaking currents under specified abnormal circuit conditions, such as those of short circuit
Circuit breaker, magnetic trip	The portion of a circuit breaker mechanism that opens the circuit under specified abnormal current

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Circuit breaker, thermal trip	The portion of a circuit breaker mechanism that opens the circuit under sustained overload but does not protect against short-circuit currents
Circuit breaker, thermal/magnetic trip	Thermal/magnetic trips employ a thermal bi-metallic element having an inverse time/current characteristic for protection against sustained overloads. In addition, the breaker contains an instantaneous magnetic trip element for short-circuit protection.
Cold cranking amperes	A standard rating for lead-acid batteries; established by the BCI; The cold cranking ampere rating is the current, in amperes, that a battery will deliver for 30 seconds, at -18 °C (0 °F), before the battery terminal voltage drops to 1.2 V per cell (7.2 V for a 12 V system and 14.4 V for a 24 V system). Lead-acid batteries are generally specified in terms of cold cranking amperes and reserve capacity (see Reserve capacity minutes).
Commercial power	A term applied to power furnished by an electric power utility
Compression ratio	The ratio of a cylinder volume enclosed by the piston at its outermost position to the volume enclosed by it at its innermost position
Connector	A coupling device employed to connect conductors of one circuit element with those of another circuit element
Continuous power	Power recommended by the manufacturer for satisfactory operation under the manufacturer's specified continuous duty conditions (defined as operating with a constant, non-varying load)
Control panel	A flat, often vertical, area where control or monitoring instruments are displayed
Controller	A device used to operate an electronic device
Coolant	A liquid medium used to transport heat from one area to another.
Coolant flow rate	The rate of coolant flow through the cooling system and/or radiator.
Coolant level	The amount of coolant to completely fill the cooling system to its designed capacity (volume) cold full level
Coolant recovery	An add-on coolant reserve tank that is used when radiator top tank and/or bottle remote deaeration tank cannot be sized large enough to meet cooling system drawdown requirements; Also known as an overflow bottle.
Cooling	The transfer of thermal energy via thermal radiation, heat conduction or convection
Cooling potential	The temperature difference between air entering the radiator core and the average temperature of the coolant in the radiator core
Cooling capability	The ambient in which a cooling system can perform without exceeding maximum engine coolant out temperature approved by the engine manufacturer
Cooling system	A group of inter-related components used in the transfer of heat
Cooling system air	The pressure drop across the radiator core and other up and down stream restriction components that offer resistance to the airflow
Crankcase oil heater	120 V probes that are inserted in the oil in the oil pan, designed to heat motor oil when the oil is idle
Cranking	The act of turning an engine crankshaft over through the use of a DC starter
Cranking amperes	A standard rating for lead-acid batteries; established by the BCI; (also referred to as marine cranking amperes); The cranking ampere rating is the current, in amperes, that a battery will deliver for 30 seconds, at 0 °C (32 °F), before the battery terminal voltage drops to 1.2 V per cell (7.2 V for a 12 V system and 14.4 V for a 24 V system).
Critical silencer	An exhaust silencer that is applied in sensitive noise control areas
Current	The rate of flow of electricity; The unit of current is Ampere (A).
Cycle	Any set of operations that are repeated regularly in the same sequence
Cylinder arrangement	The pattern an engine's cylinder are arranged in

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Darcy-Weisbach	In fluid dynamics, the Darcy-Weisbach equation is a phenomenological equation, which relates pressure loss due to friction along a given length of pipe to the average velocity of the fluid flow. The equation is named after Henry Darcy and Julius Weisbach. In fluid dynamics, the equivalent length is the associated length of straight pipe of the same diameter as an accessory (for example elbow), which will incur the same pressure loss.
Day tank	A small fuel tank usually adjacent or in close proximity to the engine driven fuel pump which stores a ready fuel supply near the engine; Also called a transfer tank.
Deaeration	The cooling systems ability to purge trapped gases from the cooling system after an initial fill
Deaeration capability	The running time required to expel all the trapped gases from the cooling system after an initial fill
Deaeration tank	A tank used to separate air/gases from the circulating coolant and return unaerated coolant to the system; Also used for filling, expansion of the coolant, reserve capacity, etc. Sometimes called a surge tank or top tank.
Deaeration volume	The volume of space designed into the deaeration tank and located above the expansion volume for collecting the trapped gases as they are expelled into the tank
Decibel (dB)	One-tenth of a bel; The number of decibels denoting the ratio of the two amounts of power being ten times the logarithm to the base 10 of this ratio. A unit of measure of noise level in which the faintest sound we can hear, called the threshold of hearing, is 0 dB, and the loudest sound the human ear can tolerate, called the threshold of pain, is 140 dB.
Delay transition	A timed load disconnect during transfer between power sources, primarily to allow for the decay of motor residual voltage
DiaSys	DiaSys (Diagnostic System) is a diagnostic tool consisting of a software CD, dongle and RS232 cable. This tool is used for the following to transfer data to and from the engine controller, monitor all sensors installed on the engine and record snapshots of engine operation.
Diesel fuel	Fuel used in a diesel engine; Usually refers to diesel fuel processed from petroleum (petro diesel), but may also refer to bio diesel or any number of other alternative diesel fuel.
Diode	A device that allows current to pass in one direction only; It may be used as a rectifying element.
Displacement	The swept volume of an engine cylinder, referring to the volume displaced by the cyclic travel of the piston
Dongle	A hardware key required to communicate with ADEC via DiaSys
D-rate	A change in the kW rating usually occurs when fuels are switched (usually applied when LP is substituted for natural gas)
Drawdown	The quantity of coolant that can be removed from a full cooling system before aeration occurs
Drawing	A visual representation of a unit or component of which it is made; Usually created using a CAD program.
Driving end	The driving end of the engine is the end that has the flywheel installed.
Dual fuel	The ability to use two different types of fuels in the same unit
Duct flange	Radiator mounted shroud of metal, used to fill the air gap from the radiator to the duct work or louver. It prevents re-circulation and overheating
Duration	An amount of time or a particular time interval
Electric starting system	Utilizes a series of wound DC electric motor to crank the engine for starting; The DC power is usually supplied by a battery pack.

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Electronic control unit (ECU)	The most important component of ADEC/MDEC, as it controls the engine operation and acts as an interface with the other subsystems and devices
Elevation	The height to which something is elevated or to which it rises
Emergency-stop button	Typically located on the panel and possibly in several other areas of the machine; It provides a rapid means to disconnect the energy source of the device to protect workers.
Enclosure	A structure that can be added to enclose an engine-generator set to protect against the environment and reduce sound
Engine	A machine for converting thermal energy into mechanical energy or power to produce force and motion
Engine coolant out	Usually the hottest coolant and measured at the thermostat housing; Also called radiator inlet or top tank temperature.
Engine gauges	Gauges mounted on the engines typically used to measure oil pressure and engine temperature
Engine-generator set	A power generation system comprised of a combustion engine driving an electrical generator
Engine safety controls	Devices that protect against catastrophic damage by shutting the engine down in the event of abnormal operating conditions
Excitation	The DC power supplied to the field coils of a synchronous generator, producing the magnetic flux required for inducing voltages in the opposing member
Exciter	A device for supplying excitation to the generator field; It may be rotating DC, AC with rectifiers, or a static device converting AC to DC.
Exerciser	A timer is mounted in the control panel that will trigger a run command to exercise the unit. This preventative maintenance practice ensures the engine-generator set will function properly when it is actually needed.
Exhaust emissions	The constituents of the waste gas that leaves the prime mover through its exhaust system
Exhaust louver	A slanted opening on the end of an enclosed engine-generator set for the expulsion of exhaust and ventilation
Exhaust manifold	Generally simple cast iron units which collect engine exhaust from multiple cylinders and deliver it to the exhaust pipe
Expansion volume	The volume of space designed into the deaeration tank to permit the coolant to expand as it is heated without being lost to the environment
Failure light	Light that indicates an engine-generator set malfunction
Fan airflow	The rate of airflow a fan can deliver at a given speed and static pressure
Field	A region of magnetic lines of flux; The field may be produced by electrical current or permanent magnet.
Field coil	A suitably insulated electric winding to be mounted on a field pole
Field pole	The part of a magnetic structure of an electric machine on which the field coils are located
Fill line	A line used to route coolant from the deaeration tank to the inlet of the water pump; It is also called a shunt or make up line.
Fill rate	The coolant flow rate at which an empty cooling system can be completely filled without overflowing
Filter	In engine systems, a device having a porous medium, whose primary function is the separation and retention of particular contaminants from a fluid; In electrical systems, a device used to reduce unwanted alternating currents
Flange	An external or internal rib or rim (lip) used for strengthening

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Flexible exhaust connection	A flexible section in the exhaust system used to reduce stresses which can result from relative motion between the engine and fixed exhaust piping, or from thermal expansion and contraction
Flux	Magnetic lines of force
Flywheel	A heavy disk or wheel rotating on a shaft so that its momentum gives almost uniform rational speed to the shaft and to all connected machinery
Foam insulation	Foam mounted on the inside of an enclosure, used to decrease the decibel level of an engine-generator set
Free end	The free end is the non-drive end of the engine. For example, if a cooling system fan drive is required for an application it would be mounted on this end of the engine.
Frequency	The number of complete cycles of an alternating voltage or current per unit of time, expressed in Hertz (Hz), cycles per second
Frequency meter	An instrument that indicates frequency of the generator output in Hertz
Fuel	An energy source for engine-generator sets; typically diesel, natural gas, or liquid propane
Fuel cell	A device that produces a continuous electric current directly from the oxidation of a fuel, as that of hydrogen and oxygen
Fuel solenoid	Electric valve used on fuel lines to prevent accidental ignition of fuel in the line
Fuel tank	A safe container for a flammable liquid or fuel gas and typically part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an internal combustion engine or fuel cell
Fuel tank cooler	Cooler that maintains fuel temperature in a tank at an optimal level
Fuel tank heater	Heater that maintains fuel temperature in a tank at an optimal level
Fuel water separator	Component that removes water from fuel; This raises the quality of the fuel used in the engine-generator set.
Fuse	An overcurrent protective device which consists of a conductor that melts and opens the circuit when current exceeds rated values for a predetermined time
Gas temperature	Temperature of exhaust gases coming out of the muffler
Gas volume	The amount (volume) of exhaust gas coming out of the muffler
Gaseous	Existing in the state of gas; not solid or liquid
Generator	A machine for converting mechanical energy into electrical energy; The energy may be direct current (DC) or alternating current (AC).
Generator drive engine	An engine specifically developed to drive and engine generator
Generator set	See Engine-generator set.
Genset	See Engine-generator set.
Governor	A device that regulates prime mover speed by adjusting the fuel input to maintain constant speed
Ground fault protection	A function that trips (opens) a circuit breaker or sounds an alarm in the event that there is an electrical fault between one or more of the phase conductors and ground (earth); This ground fault protection function may be incorporated into a circuit breaker.
Harmonics	Voltage or current components which operate at integral multiples of the fundamental frequency of a power system (50 or 60 Hz); Harmonic currents have the effect of distorting the shape of the voltage wave form from that of a pure sine wave.
Heat dissipation	The amount of heat engine (BTU) that a heat transfer component can dissipate to the environment at specified conditions

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Heat exchanger cooling	Engine coolant heat dissipated to water through a liquid to liquid heat exchanger
Heat rejection to ambient	Engine and generator heat radiated to ambient (surrounding engine-generator set)
Heat rejection to coolant	Engine heat dissipated to engine coolant
Hertz (Hz)	A unit of frequency equal to one cycle per second; Engine-generator sets in North America operate at 60 Hz, while most of Europe operates at 50 Hz.
Horse power (HP)	A measure of engine power output, equivalent to 550 ft-lbs/second. (1 HP = 0.986 BHP = 0.7457 kW)
Hydrometer	An instrument used to measure the specific gravity (or relative density) of liquids; that is, the ratio of the density of the liquid to the density of water
Installation	To place, position, or fit into a position and then to connect, change, or modify in such a manner as to bring (the equipment) into service
Intake louver	A slanted opening on the end of an enclosed engine-generator set for the intake of air and ventilation
Interlock	A device to help prevent a machine from harming an operator or damaging itself when tripped
Kilovolt-Amperes (kVA)	An electrical unit, equal to 1000 Volt-Amperes
Kilowatts (kW)	A unit of power equal to 1000 Watts (1 kW = 1.360 HP = 1.341 BHP)
Liquid crystal display	An electro-optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector
Limited warranty	A guarantee: a written assurance by MTU Onsite Energy that our product or service will be provided and will meet certain specifications. Warranties are typically limited by time since the purchase of the warranty and hours of product use.
Liquid capacity	The total capacity of the different liquids needed for operation of the engine-generator set
Liquid petroleum gas (LP)	A mixture of hydrocarbon gases used as a fuel
Liquid withdrawal	Used to describe fuel systems where the fuel is drawn from the liquid section of the storage tank
Load	The power consumed by a circuit
Load factor	The ratio of the average load imposed on the prime mover to the prime mover's load rating
Lubrication	Lubrication is the process or technique employed to reduce wear of one or both surfaces in close proximity, and moving relative to each another, by interposing a substance called lubricant between the surfaces to carry or to help carry the load (pressure generated) between the opposing surfaces.
Maintenance	Fixing any sort of mechanical or electrical device should it become out of order or broken (repair) as well as performing the routine actions which keep the device in working order (maintenance) or prevent trouble from arising (preventive maintenance)
Mankato	Minnesota city (approximately 80 miles southwest of Minneapolis) where MTU Onsite Energy Corporation is headquartered
Maximum power	The largest amount of kW an engine-generator set can output

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MTU Onsite Energy	An umbrella brand created by the Tognum Group in September 2008, consisting of decentralized power generation operations; The product range includes standardized and customized diesel engine-generator sets for emergency stand-by, base and peak load applications as well as compact cogeneration modules powered by gas engines, fuel cells or gas turbines for the generation of both heat and power.
MTU Onsite Energy, Gen I Training	A three day training course offered by MTU Onsite Energy Corporation tailored to new and experienced technicians, sales staff, spec writers and engineering support; This class covers installation, troubleshooting, general maintenance and start-ups.
MTU Onsite Energy, Gen II Training	A four day training course offered by MTU Onsite Energy Corporation designed for experienced technicians and engineering support; This class covers in-depth troubleshooting, control panels and start-ups. GEN II attendees are required to have completed GEN I and pass the GEN II class with an 85 % or higher score. Training offered byMTU Onsite Energy Corporation for salespeople.
Muffler	Any of various devices of deadening sound, as the sound of escaping gases of an internal-combustion engine
Natural gas	A combustible mixture of gaseous hydrocarbons that accumulates in porous sedimentary rocks, esp. those yielding petroleum, consisting of usually over 80 % methane together with minor amounts of ethane, propane, butane, nitrogen and sometimes helium; It is used as a fuel to make synthesis gas.
NEMA 1 enclosure	An enclosure designation for indoor use only – where dirt, dust and water are not a consideration; Personnel protection is the primary purpose of this type of enclosure.
Neutral	The common point of a Y-connected AC generator, a conductor connected to that point or to the mid-winding point of a single-phase AC generator
Nominal value	An accepted condition which is a goal or an approximation as opposed to the real value
OEM manuals	Manuals (written instructions) created by an OEM
Oil pump	A gear pump driven by the camshaft or crankshaft; The oil pump usually sucks the oil out of the engine's oil pan through a wire mesh strainer and pumps the oil through an oil filter before it goes to the bearings.
Oil sampling kit	A parts package used to determine the quality of engine oil
Operating instructions	Directions included with an engine-generator set that provide information on how to operate the unit
Overcooling	A condition where the coolant temperature will not approach the start to open temperature value of the thermostat under normal engine operation
Overheating	An operating condition where coolant temperature exceeds design intent; This may be caused by a deficiency in the cooling system of by abnormal operating conditions.
Overload power	Overload power is that load in excess of rated load which the engine-generator set is capable of delivering for a specified period of time. It should be recognized that the voltage, frequency and operating temperature may differ from normal rated values.
Parallel connection	An electrical connection in which the input terminal of one element is connected to the input terminal of another element and the output terminals are similarly connected together, thereby providing two paths for current flow
Parallel operation	Two or more generators, or other power sources, of the same phase, voltage and frequency characteristics supplying the same load
Paralleling	The procedure used to connect two or more generators to a common load
Peak shaving	Process by which utility customer minimizes utility charges by either generating power and eliminating excessive demand charges or by shedding load

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Permanent magnet	A ferromagnetic body that maintains a magnetic field without the aid of external electric current; The most practical material types are alnico, ceramic and rare earth.
Permanent magnet generator	A generator that has a permanent magnet field, usually rotating; The generator is usually synchronous.
Phase	The winding of a generator that determines the number of complete voltage and/or current sine waves generated per 360 electrical degrees, as in three-phase
Pole, magnetic	A part of a magnetic structure; There being two such parts, called a north pole and a south pole. Since neither pole can exist without the corresponding opposite, they always are present in pairs. Hence, a generator always has an even number of poles.
Power	The rate of performing work or of expending energy; Typically, mechanical power is expressed in terms of horse power and electrical power in terms of kilowatts. 1 kW equals 1.34 HP.
Power factor (PF)	(also cos θ); In AC circuits, the inductances and capacitances may cause the point at which the voltage wave passes through zero to differ from he point at which the current wave passes through zero. When the current wave precedes the voltage wave, a leading power factor results, as in the case of a capacitive load or over-excited synchronous motors. When the voltage wave precedes the current wave, a lagging power factor results. The power factor expresses the extent to which voltage zero differs from the current zero. Considering one full cycle to be 360 electrical degrees, the difference between the zero points can be expressed as an angle, θ. Power factor is calculated as the cosine of θ between zero points and expressed as a decimal fraction (0.8) or as a percentage (80 %). It can also be shown to be the ratio of apparent power (kW or VA), divided by the real power (kVA or W).
Power factor meter	An instrument that measures the power factor of the system
Pre-alarm	Warning prior to actually actuating the automatic engine safeties to indicate impending shutdown
Prime power	An application where the engine-generator set(s) must supply power on a continuous basis and for long periods of time between shutdowns; No utility service is present in typical prime power applications.
Radiator	A type of heat exchangers designed to transfer thermal energy from one medium to another for the purpose of cooling and heating
Radiator fan	Fan on end of the radiator used to push air through the radiator for engine cooling
Radiator shutters	A device placed either in front of or behind the radiator to block air flow when not required
Rain cap	A device mounted on the exhaust system with the purpose to preventing rain from entering the system
Rated power	The net electric output a generator can provide continuously when functioning is designed
Reactive load sharing	The process of regulating excitation which causes the reactive load to be shared proportionally between engine-generator sets
Reactive power control	This value is the calculated product of the metered generator voltage (VAVG), metered generator current (IB) square root of 3 and the sine of the metered phase angle.
Real load sharing	The process of governing which causes the real load (in Watts) to be shared proportionally between engine-generator sets
Regulator	Any of various controls or devices for regulating or controlling fluid flow, pressure, temperature, etc.

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Relay	An electrical switch that opens and closes under the control of another electrical circuit
Remote annunciator	A signaling apparatus not mounted on the engine-generator set, generally used in conjunction with a buzzer, that displays a visual indication when energized by electric current
Remote radiator	Radiator and fan that is mounted at some distance from the engine; The fan is generally not directly driven by the engine.
Reserve capacity minutes	A standard rating for lead-acid batteries; established by the BCI; (also referred to as reserve capacity); Battery's ability to sustain a minimum stated electrical load; It is defined as the time, in minutes, that a lead-acid battery will continuously deliver 25 A at 27 °C (80 °F) before its voltage drops below 10.5 V.
Reserve volume	A volume designed into the deaeration tank to provide a surplus of coolant to offset losses that might occur
Resistance	The non-reactive opposition which a device or material offers to the flow of direct or alternating current
Resistive temperature device	A solid state temperature sensor
Rotor	The rotating element of a motor or generator
Running time meter	Meter that keeps track of the total amount of time an engine-generator set has operated
Selector switch	A switch that is used to select among alternatives
Shunt trip	A feature added to a circuit breaker or fusible switch to permit the remote opening of the breaker or switch by an electrical signal
Shutdown	To stop operation
Silencer	See Muffler.
Software	A collection of computer programs, procedures and documentation that perform some tasks on a computer system
Sound	Can be considered both in terms of the sound pressure waves traveling in air (pressures superimposed on the atmospheric pressure) and the corresponding aural sensation; Sound can be "structure-borne", that is, transmitted through any solid elastic medium, but is audible only at points where the solid medium "radiates" the pressure waves into the air.
Sound attenuation	Reduction of sound level
Space heater	Integral heater used to prevent condensation in electrical equipment
Spec sheet	Term referring to MTU Onsite Energy's Engine Data Spec Sheets; These spec sheets provide specific technical information on different engine-generator sets (arranged by kW). They can be found online or in engineering guidebooks.
Stabilization	A condition where under a controlled operating environment, the coolant, oil, air and exhaust temperatures will not change regardless of the length of time the unit is run.
Standby power supply	The power supply that is selected to furnish electric energy when the normal power supply is not available
Standpipe	Deaeration tube located in the integral radiator deaeration tank to vent the radiator core of gases. Also called “J” tube.
Start-up request form	Form that is submitted by the end user of the engine-generator set to the distributor to initiate the units start up
Start-up validation and inspection form	Form that is completed by a qualified MTU Onsite Energy technician at the time of a unit start up

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Starter	An electric motor that initiates rotational motion in an internal combustion engine before it can power itself
Static	Inactive: not in physical motion
Static head	A term used in fluid mechanics to represent the internal energy of a fluid due to the pressure exerted on its container
Stroke	A single action of certain engines; Can also refer to the distance the piston travels.
Suction fan	A fan that pulls air through the core
Surge tank	See Deaeration tank.
Synchronous generator	A synchronous alternating-current machine that transforms mechanical power into electrical power; Note: • A synchronous machine is one in which the speed of normal operation is exactly proportional to the frequency of the system to which it is connected. • Unless otherwise stated, it is generally understood that a synchronous generator (or motor) has field poles excited with direct current or permanent magnets.
TB engine	Engine with water-to-air charge-air cooling circuit
TD engine	Engine with air-to-air charge-air cooling circuit
Temperature rise	The temperature increase over ambient due to load
Temperature stability	The ability of the cooling system to maintain coolant temperature at light loads or drift and/or engine speed or long vehicle drift (coasting); It is an important system characteristic for good heater operation during cold ambient conditions.
Thermo-regulating valve	Heat actuated valve that limits amount of city or raw cooling water into the system to conserve water and regulate cooling
Thermostat	A device that is heat actuated to maintain the circulating water temperature at a pre-determined level
Thermostatic valve	A pressure-balancing shower mixing valve with automatic temperature control; When temperature or pressure fluctuations occur at the water inlets, a thermal actuator adjusts the hot and cold ratio to maintain the original temperature setting.
Tier level	EPA emission standards and diesel fuel rules for non-road diesel engines in the United States
Top tank	See Deaeration tank.
Torque	Force required to move a shaft around its axis; It is measured in pounds-feet.
Tractor-driven generator	An electric generator so constructed that its rotor is driven by a power take-off on a farm tractor; Typically referred to as a PTO generator.
Trailer	An unpowered vehicle pulled by a powered vehicle
Transient curve	The measurement characteristics of a generator's electrical output when placed under changing loads
Transient response	The amount of time required for a generator to return to steady-state electrical output after applying or removing a load
Transient tolerances	A window of accepted deviation between theoretical and actual transient curves
Troubleshooting	The identification and resolution of problems, especially problems of a technical nature
UL 2200	A UL safety standard for stationary engine generator assemblies
Unidirectional current	A current which flows in one direction only; Is also called direct current (DC).
Unit mounted radiator	A radiator mounted on the engine-generator set
Valve	A device that regulates the flow of fluid (gases, fluidized solids, slurries, or liquids) by opening, closing, or partially obstructing various passageways
Ventilation	The circulation air

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Vibration isolator	A resilient support that tends to isolate the engine-generator set from steady state excitation
Voltage	The difference of electrical potential between any two conductors; The unit of voltage is Volt (V).
Voltage dip	The reduction in voltage resulting from a sudden application of load, usually expressed as a percentage
Voltage range	The span of voltage through which the engine-generator set is capable of being connected
Voltage regulation	The voltage regulation of an engine-generator set is the difference between steady state no load and steady state full load output voltage expressed as a percentage of the full load voltage.
Voltage regulator	A device which automatically controls the voltage output of a generator at its specific value
Voltage transient	The maximum change in voltage when a specified load is suddenly applied or removed
Warning	A signal of danger
Water heater	Also tank heater; An appliance for heating water above its ambient temperature
Water pump	The pump, driven by the engine crankshaft, that circulates coolant through the engine block, cylinder head and radiator
Water pump inlet	The pressure (suction) at the inlet to the water pump when the pressure cap is removed, which represents up-stream restriction
Weatherproof	Capable of resisting damage caused by the weather
Wet stack	A field term used to describe the condition when unburned hydrocarbons in the exhaust gases condense in the exhaust system; This is a result of under utilized power (typically < 30 % load) on a diesel engine. Unchecked, this condition can lead to degradation of performance and compromise the integrity of the diesel engine.
Winding	An assembly of coils that acts to produce a magnetic flux field or to link a flux field
Wiring harness	A pre-assembled group of wires arranged to facilitate interconnection of electrical circuits

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13 Appendix B

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14 Preparation and Startup Information

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14.1 Form A - Engine Generator Set Request for Start-Up OE-G-GEN-A-001

MTU ONSITE ENERGY
Form A - Engine Generator Set Request for Start-Up

Requested Date: _____

☐ First Visit ☐ Follow-Up Visit

Instructions
This form must be completed and signed by the customer/client to ensure proper installation of the generator set prior to scheduling a start-up date and to request start-up service from an authorized MTU Onsite Energy distributor or regional service center.

Applicant Contact Details

Company: _____

Name: _____

Telephone: _____

Email: _____

Project Details

Project Name: _____

Project Number: _____

Site Address: _____

_____

Engine Generator Set Nameplate

Model Number: _____

Serial Number: _____

Rating: _____

Hz: _____ kW: _____

kVA: _____ Volts: _____

Phase: _____ Amps: _____

Engine

Model Number: _____

Serial Number: _____

Power: _____ RPM: _____

Fuel Type
☐ Diesel ☐ NG ☐ LP Vapor ☐ Liquid LP ☐ Other

ATS (☐ Yes ☐ No)

Manufacturer: _____

Model Number: _____

Serial Number: _____

Voltage: _____ Current: _____

Poles: _____

Utility Service

Volts: _____ Phase: _____

Phase Rotation: _____

Load Bank (☐ Yes ☐ No)

Capacity: _____

Pre-Start-Up Validation Checklist

	Yes	No	N/A
Unit set in final location	☐	☐	☐
Radiator ducted to air discharge louvers	☐	☐	☐
Intake and discharge air louvers installed and wired	☐	☐	☐
Unit filled with oil to proper level	☐	☐	☐
Unit filled with coolant to proper level	☐	☐	☐
Battery filled and fully charged	☐	☐	☐
Battery charger mounted with AC and DC wiring	☐	☐	☐
Block heater wired to correct AC power supply	☐	☐	☐
Switch gear/transfer switch connections made	☐	☐	☐
All other AC and DC electrical connections made	☐	☐	☐
Fuel inlet and return lines run between the unit and fuel storage system	☐	☐	☐
Fuel storage system filled with sufficient quantity for commissioning	☐	☐	☐
Exhaust system properly installed and supported	☐	☐	☐
Radiator and engine generator set room is free of debris	☐	☐	☐
Permission for use of site load or request load bank	☐	☐	☐
Other: _____	☐	☐	☐

NOTE: If the tasks on this checklist are not adequately completed upon arrival of the authorized MTU Onsite Energy technician or for reasons beyond MTU Onsite Energy's control, an additional start-up charge may be incurred. Please resubmit this form when items are addressed.

Additional Comments/Notes:

_____

_____

_____

_____

Completed by (signature): _____

Print Name: _____

Company: _____

Date: _____

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14.2 Form B - Engine Generator Set Installation and Commissioning OE-G-GEN-A-002

MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Instructions
This report must be completed and signed by an MTU Onsite Energy certified commissioning technician in order to accomplish all requirements of the MTU Onsite Energy Limited Warranty. This report includes the physical installation checkups and commissioning procedures for all control versions as well as open and enclosed generator sets.

After completion, a signed copy must be provided to each of the following:

1. Distributor/Dealer
2. Owner
3. MTU Onsite Energy Regional Warranty Department

Applicant Contact Details

Distributor/Company: _____
Name: _____
Telephone: _____
Email: _____

Project Details

Project Name: _____
Project Number: _____
Site Address: _____
_____
Start-Up and Commissioning Start Date: _____
Start-Up and Commissioning Completion Date: _____

Engine Generator Set Nameplate

Model Number: _____
Serial Number: _____
Rating: _____
Hz: _____ kW: _____
kVA: _____ Volts: _____
Phase: _____ Amps: _____

Engine

Model Number: _____
Serial Number: _____
Power: _____ RPM: _____
Fuel Type:
☐ Diesel ☐ NG ☐ LP Vapor ☐ Liquid LP ☐ Other

Generator

Manufacturer: _____
Model Number: _____
Serial Number: _____
AVR Type: _____
kVA: _____ Hz: _____
Voltage: _____ Current: _____
Phase Rotation: _____

Breaker (MTU Delivery ☐ Yes ☐ No)

Manufacturer: _____
Model Number: _____
Serial Number: _____
Voltage: _____ Current: _____
Poles: _____

ATS (☐ Yes ☐ No)

Manufacturer: _____
Model Number: _____
Serial Number: _____
Voltage: _____ Current: _____
Poles: _____

Controller

Manufacturer: _____
Model Number: _____
Serial Number: _____
Firmware Version: _____

General

Application: ☐ 3A Continuous ☐ 3B Prime ☐ 3D Standby ☐ 3F DCCP ☐ _____
Load test type on site: ☐ Building load ☐ Load bank ☐ Grid parallel ☐ None
Load test not possible because:
_____
_____

Engine Generator Set Application

☐ Installed in building
☐ Containerized
☐ Enclosed

TIM-ID: 0000107030 - 001

MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Prestart Safety Checks/Environmental Check

	Yes	No	N/A
Commissioning performed by an MTU Onsite Energy certified commissioning technician	☐	☐	☐
Personal protection equipment is available and functional	☐	☐	☐
Access only for authorized personnel	☐	☐	☐
Emergency escape routes are unobstructed (no loose materials, parts, or tools) and labeled	☐	☐	☐
Danger spots are indicated (e.g. trip hazards, beams, pipes)	☐	☐	☐
Control panel/engine area is unobstructed	☐	☐	☐
All warning plates and instruction labels are properly in place	☐	☐	☐
Genset room is free of debris, dirt, dust, loose materials, parts, and tools	☐	☐	☐
Air ducts are free and clean	☐	☐	☐
Engine generator set is leveled; mounting bolts secure	☐	☐	☐
Shipping blocks are removed	☐	☐	☐
For two-bearing generators, check for proper alignment	☐	☐	☐
Heat protection covers are installed	☐	☐	☐

Engine Generator Set Room (Equipment)

	Yes	No	N/A
Battery powered emergency light is installed	☐	☐	☐
Fire extinguishers are in place	☐	☐	☐
First aid kit is in place	☐	☐	☐
Oil resistant floor coating	☐	☐	☐
Spill containment system in place	☐	☐	☐

Fire extinguishing system

☐ Water ☐ CO_2 ☐ Chemical ☐ None

Engine Room Requirements (Open Power Units)

	Yes	No	N/A
Engine room is located as close as practical to the main consumer	☐	☐	☐
Space for maintenance is left around the engine generator set	☐	☐	☐
Battery powered back-up lights available	☐	☐	☐

Engine Generator Set Room Ventilation

	Yes	No	N/A
Intake and exhaust opening properly sized and louvers installed	☐	☐	☐
Flexible duct section installed	☐	☐	☐
Radiator duct properly sized to louver	☐	☐	☐
Proper air flow direction past alternator and then the engine	☐	☐	☐
Engine room inlet air filter in place	☐	☐	☐
Weather/animal guard is fitted to intake and outlet	☐	☐	☐

Self-Contained Engine Generator Set Ventilation

	Yes	No	N/A
Engine generator set intake positioned away from obstruction to airflow	☐	☐	☐
Radiator discharge positioned away from prevailing winds	☐	☐	☐
Sufficient clearance around self-contained engine generator set for airflow	☐	☐	☐

Air Inlet and Outlet

	Yes	No	N/A
Air ducts are clean and clear	☐	☐	☐
Ducts are installed properly	☐	☐	☐
Weather protection guards are installed	☐	☐	☐
Silencers are installed properly	☐	☐	☐
Louvers open and close automatically	☐	☐	☐
Manual operation of louvers is possible	☐	☐	☐
Structure air flows are correct (no thermal short circuit)	☐	☐	☐
Unrestricted airflow over the engine	☐	☐	☐

Cooling System

	Yes	No	N/A
Cooling system is free of leakages	☐	☐	☐
Pipelines and connections undamaged	☐	☐	☐
Radiator fan(s) are clear and clean	☐	☐	☐
Venting pipes have gradient toward expansion tank	☐	☐	☐
Overflow is free and spillage is avoided	☐	☐	☐
System is filled to proper level	☐	☐	☐
Filling cap is freely accessible	☐	☐	☐
Coolant-preheater is functional	☐	☐	☐
Coolant type and concentration as specified in MTU manual: _____	☐	☐	☐

Frame-Mounted Radiator

	Yes	No	N/A
Check belt tension and alignment	☐	☐	☐
Radiator clean and free from obstruction	☐	☐	☐
Radiator air outlet connected to outlet duct	☐	☐	☐
Check for possibility of hot air recirculation	☐	☐	☐
Engine generator set vent pipes routed upward toward radiator expansion tank	☐	☐	☐
Pipelines secure and undamaged	☐	☐	☐
Overflow clear and routed to avoid spillage	☐	☐	☐

Remote-Mounted Cooling System

	Yes	No	N/A
Pipelines cleaned and painted	☐	☐	☐
Device(s) aligned and fixed properly	☐	☐	☐
Pipelines fixed properly	☐	☐	☐
Expansion tank is of adequate size	☐	☐	☐
Pipelines isolated from generator set vibration	☐	☐	☐
Static head pressure is within system capability	☐	☐	☐
Auxiliary power supply is installed correctly	☐	☐	☐
Potential equalization is installed properly	☐	☐	☐
Fan rotational direction correct	☐	☐	☐
Overflow clear and routed to avoid spillage	☐	☐	☐
Engine generator set vent pipes routed upward toward radiator expansion tank	☐	☐	☐
Avoid air locks in pipelines – air bleed valves provided	☐	☐	☐
All proper electrical connections made	☐	☐	☐

Heat Exchanger and Cooling Tower

	Yes	No	N/A
Pipelines cleaned and painted	☐	☐	☐
Device(s) aligned and fixed properly	☐	☐	☐
Pipelines fixed properly	☐	☐	☐

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MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Heat Exchanger and Cooling Tower (continued)

	Yes	No	N/A
Expansion tank is of adequate size	☐	☐	☐
Pipelines isolated from generator set vibration	☐	☐	☐
Vent valves installed	☐	☐	☐
Static head pressure is within system capability	☐	☐	☐
Secondary circuit pump direction is accurate	☐	☐	☐
Secondary circuit pump is functional	☐	☐	☐
Potential equalization is functioning properly	☐	☐	☐
Overflow lines are clear and routed to avoid spillage	☐	☐	☐
Engine generator set vent pipes routed upward toward expansion tank	☐	☐	☐
Air bleed valves installed	☐	☐	☐
Cooling tower make up supply is complete	☐	☐	☐
Auxiliary power supply to fans is correctly installed	☐	☐	☐
All proper electrical connections made	☐	☐	☐

Mounting/Foundation

	Yes	No	N/A
Engine generator set is installed on proper mounts	☐	☐	☐
Static deflection area of mounts not blocked by components	☐	☐	☐
Surface is level	☐	☐	☐
Support structure is adequate to support engine generator set weight	☐	☐	☐
Engine generator set is supported at each mounting location	☐	☐	☐

Lube Oil System

	Yes	No	N/A
Engine is filled with oil to proper level	☐	☐	☐
No oil leaks present	☐	☐	☐
Flexible lines installed in make-up lube-oil system	☐	☐	☐
Oil type as specified in MTU manual (record type):	☐	☐	☐

_____

Starting System

	Yes	No	N/A
Battery and cables are free from damage	☐	☐	☐
Battery and cables installed, mounted, and wired properly	☐	☐	☐
Batteries filled up to appropriate level	☐	☐	☐
Idle charging voltage min. 27.6 VDC for 24 V system or 13.7 VDC for 12 V system	☐	☐	☐
Battery charger properly installed and wired	☐	☐	☐
Battery is located near starter with shortest cable run as possible	☐	☐	☐

Diesel Fuel System

	Yes	No	N/A
Fuel system is free of leakages	☐	☐	☐
Flexible lines installed at engine	☐	☐	☐
Pipeline size adequate to system	☐	☐	☐
Pipelines and connections undamaged	☐	☐	☐
Flow and return lines connected correctly	☐	☐	☐
Fuel lines free of tension, scuffing, or kinks	☐	☐	☐
Potential equalization is installed properly	☐	☐	☐
Adequate room is left for fuel tank inspections	☐	☐	☐

Diesel Fuel System (continued)

	Yes	No	N/A
Tank is not overfilled	☐	☐	☐
Tank is not in the vicinity of exhaust or other heat sources	☐	☐	☐
For electric fan driven fuel coolers: Fuel cooler plumbed and wired correctly	☐	☐	☐
Fuel returns to fuel tank without restriction, proper sized pipe	☐	☐	☐
Fuel prefilter installed before engine inlet	☐	☐	☐
Electronic day tank pump used from main storage to day tank	☐	☐	☐
Day tank controls/pumps installed	☐	☐	☐
Fuel transfer pump connected to emergency power	☐	☐	☐
Level indicator used for checking tank contents	☐	☐	☐
Leak sensors are in place	☐	☐	☐
All proper control and sensor connections are made	☐	☐	☐
Spill containment procedure in place per code	☐	☐	☐

Diesel Fuel System (Main Storage Tank)

	Yes	No	N/A
Isolating valves correctly positioned	☐	☐	☐
Transfer pump and controls operational	☐	☐	☐
Pipeline/tank heating system operational	☐	☐	☐
Fuel level monitoring system operational	☐	☐	☐
Check for leaks	☐	☐	☐

Day Tank

	Yes	No	N/A
Tank is fixed properly and mounted to substructure	☐	☐	☐
Tank vent line is plumbed to safe area	☐	☐	☐
Tank filling line is of adequate size	☐	☐	☐
All unused fittings are plugged	☐	☐	☐
Mechanical fuel level indicator installed	☐	☐	☐
Electrical fuel level indicator installed and tested	☐	☐	☐
Fuel level switches installed and adjusted	☐	☐	☐
System pump(s) connected to emergency power	☐	☐	☐
Potential equalization is installed properly	☐	☐	☐
System pump(s) installed correctly (flow direction)	☐	☐	☐
Refill function checked	☐	☐	☐
Leakage sensor in place	☐	☐	☐
Adequate space available for inspections	☐	☐	☐
Isolating and solenoid valves checked	☐	☐	☐
Tank filled	☐	☐	☐
Check for leaks	☐	☐	☐
Fire valves present	☐	☐	☐

Gas Fuel System (Americas Only)

	Yes	No	N/A
Dedicated gas supply line of proper size and material	☐	☐	☐
Check for gas filter/screen	☐	☐	☐
Check gas solenoid valve operation	☐	☐	☐
Check supply lines for leaks	☐	☐	☐
Check manual shut-off valve operation	☐	☐	☐
Solenoid valves correctly positioned	☐	☐	☐
Regulator set to correct pressure	☐	☐	☐
Gas leak detection equipment operational	☐	☐	☐
Shut-off devices operational	☐	☐	☐
Specified gas pressure is available at fuel inlet	☐	☐	☐

MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Exhaust System

	Yes	No	N/A
Piping is installed and secured properly	☐	☐	☐
Flexible connectors installed at engine exhaust outlet	☐	☐	☐
Flexible connectors installed correctly	☐	☐	☐
Exhaust line condensate trap with drain installed	☐	☐	☐
Silencer is installed and secure	☐	☐	☐
Exhaust thimble installed per local codes	☐	☐	☐
Exhaust system below back pressure limit	☐	☐	☐
Exhaust piping diameter properly sized for length of run	☐	☐	☐
No diameter reductions downstream on exhaust pipes	☐	☐	☐
All exhaust system weight is properly supported	☐	☐	☐
Proper pipe wall thickness is maintained	☐	☐	☐
Exhaust lines are properly insulated	☐	☐	☐
Exhaust installed with a downward pitch to outlet	☐	☐	☐
Exhaust line protected from natural elements (rain cap installed)	☐	☐	☐
Exhaust gas prevented from re-entry to building	☐	☐	☐
Hot parts safety decals/guards are present	☐	☐	☐

Fire Alarm/Suppression System

	Yes	No	N/A
Fire alarm/suppression system present	☐	☐	☐

Engine Management System (Engine Governor)

	Yes	No	N/A
Engine Control Unit box is free of damage	☐	☐	☐
Engine Control Unit box is securely mounted to engine	☐	☐	☐
Electrical connections securely fastened	☐	☐	☐

Grounding

	Yes	No	N/A
Engine and generator are properly grounded	☐	☐	☐

Electrical and Control System

	Yes	No	N/A
Remote wiring connected correctly	☐	☐	☐
Cables free of tension, scuffing, or kinks	☐	☐	☐
All connections clean and secure	☐	☐	☐
Bus bar phase sequence, voltage, and frequency checked	☐	☐	☐
Control cables routed in separate conduits from phase leads	☐	☐	☐
Engine generator set controls energized and functional	☐	☐	☐
Software version of engine generator set controller recorded	☐	☐	☐
All LEDs on panel illuminate when LED test is pressed	☐	☐	☐
Emergency stop control operational	☐	☐	☐
Test certificates available for all cables	☐	☐	☐
Utility service breaker capacity verified	☐	☐	☐
Small power and lighting circuits operational	☐	☐	☐

Switchgear/Transfer Switch

	Yes	No	N/A
Cables installed to correct torque specification	☐	☐	☐
Phase cables to switchgear/transfer switch are correctly sized and clearly identified	☐	☐	☐
Switchgear protection settings checked	☐	☐	☐
All other connections are clean and secure	☐	☐	☐

Generator Circuit Breaker

	Yes	No	N/A
ON/OFF function	☐	☐	☐
Auxiliary contact	☐	☐	☐
Adjust over-current protection	☐	☐	☐
Adjust the trip unit	☐	☐	☐
Phase rotation checked	☐	☐	☐

Preparation for Running Checks

☐ Follow appropriate lockout/tagout procedure

Running Checks

	Yes	No	N/A
Engine generator set engine control switch in the RUN position. Start engine and verify whether there is sufficient oil pressure	☐	☐	☐
Allow engine to run for five minutes	☐	☐	☐
Check coolant level, add as necessary, and reinstall cap	☐	☐	☐
Allow engine to run for at least 20 minutes and check engine operating temperature	☐	☐	☐
Check the battery charger for proper operation	☐	☐	☐
If the speed is unstable, adjust to specifications	☐	☐	☐
Adjust the AC output voltage to match the utility voltage using the voltage adjusting control	☐	☐	☐
Check for oil, coolant, and exhaust leaks/recirculation	☐	☐	☐
Check temperature on city water-cooled models and adjust the thermostatic valve as necessary	☐	☐	☐
Engine generator set engine control switch in the OFF position	☐	☐	☐
Permission must be obtained from the building authority before transfer switch test is performed	☐	☐	☐
Test transfer switch	☐	☐	☐
Record the current phase for the three phase systems A _____ B _____ C _____			
Set the engine generator set exerciser with load to the customer's required exercise period	☐	☐	☐
Verify that all options on the transfer switch are adjusted and functional to the customer's requirements	☐	☐	☐

Record transfer switch delay settings:

TDES (Time Delay to Engine Start)	_____ sec.
TNE (Time Delay Normal to Emergency)	_____ sec.
TDN (Time Delay to Normal)	_____ min.
TDEC (Time Delay Engine Cooldown)	_____ min.

Mains Failure Test

Number of start trials: _____

Duration between mains failure and generator circuit breaker (GCB) closed (until emergency power source supplies load) _____ sec.

	Yes	No	N/A
Dyn. Frequency drift within limit of ISO 8528-5	☐	☐	☐
Static voltage drift during operation within limit of ISO 8528-5	☐	☐	☐
Static frequency drift during operation within limit of ISO 8528-5	☐	☐	☐

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MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Running Checks (record on chart)

Unless otherwise specified by local or state regulations, run the engine-generator set at full expected system load in excess of 30% of the nameplate rating). Record data at 15 minute intervals.

Time of Day	Generator Voltage, Volts	Generator Output A Phase, Amps	Generator Output B Phase, Amps	Generator Output C Phase, Amps	Generator Output Frequency, Hz	Ambient Room Temperature	Engine Oil Pressure	Battery Charger Volts (DC)	Coolant Temperature	Run Time, Minutes	Notes

Shutdowns

	Yes	No	N/A
Emergency stop (also external)	☐	☐	☐
Over-frequency/over speed	☐	☐	☐
Under-frequency	☐	☐	☐
Over-voltage	☐	☐	☐
Under-voltage	☐	☐	☐
Oil pressure Lo Lo	☐	☐	☐
Engine temperature Hi Hi	☐	☐	☐

Check and verify any additional protective devices and list:

_____

_____

_____

Additional Comments/Notes:

_____

_____

_____

_____

_____

_____

_____

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MTU ONSITE ENERGY
Form B - Engine Generator Set Installation and Commissioning

Customer Acknowledgement (Literature and Instructions)

☐ Verify that the customer has the appropriate engine/engine-generator set and transfer switch (if provided by MTU Onsite Energy) literature. Instruct the customer in the operation and maintenance of the power system.

I _____ received instructions on _____
Please print name of person receiving instructions. Date

_____ (signature)

To be filled out by the commissioning technician only.

Completed by (signature): _____

Print Name: _____

Company: _____

Date: _____

Note: Completion of this checklist does not relieve the installer of contract obligations.

To be filled out by the customer/client.

Witnessed by (signature): _____

Print Name: _____

Company: _____

Location: _____

Date: _____

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14.3 Two (2) Year 3000 Hour Basic Standby Limited Warranty_OE-M-GEN-S-006

STANDBY LIMITED WARRANTY
Two (2) Year / 3,000 Hour Basic

LIMITED WARRANTY

Your MTU Onsite Energy product has been manufactured and inspected with care by experienced craftspeople. If you are the original consumer, MTU Onsite Energy warrants, for the limited warranty period indicated below, each product will be free from defects in materials and workmanship, and will perform under normal use and service from valid start-up performed by MTU Onsite Energy. This Limited Warranty shall apply only when the product has been properly installed, serviced, and operated in accordance with the applicable MTU Onsite Energy instruction manuals. If this Limited Warranty applies, the liability of MTU Onsite Energy shall be limited to the replacement, repair, or appropriate adjustment of the product, at MTU Onsite Energy's option. This Limited Warranty does not apply to malfunctions caused by normal wear and tear, or by damage, unreasonable use, misuse, repair, or service by unauthorized persons.

LIMITED WARRANTY PERIOD

Engine Generator Set: Parts and labor for twenty-four (24) months will begin with the first commissioning of the product(s). In all cases, the warranty period will expire not later than thirty-six (36) months from the date of shipment ex-works MTU Onsite Energy or after 3,000 operation hours, whichever occurs first. Accessories: Parts and labor for one (1) year from date of shipment. For a description of accessories and items excluded from this Limited Warranty, review the listings below.

LIMITED WARRANTY CONDITIONS

Before there is any protection under this Limited Warranty, the distributor must: (1) complete the MTU Onsite Energy Warranty and the Start-Up Validation and Pre-Inspection form, and return them to MTU Onsite Energy within 60 days of the start-up date, and (2) complete the engine registration form and return it to the manufacturer as stated in the instructions with engine registration form (when applicable). In addition, this Limited Warranty is not valid or enforceable unless: (1) all supporting maintenance records are kept on file with the end user and made available upon request from factory, (2) the generator set is routinely exercised in accordance with operating instructions, and (3) the installation meets the general guidelines, standards, recommendations (as laid out in the Installation Guide provided with the product), and all local standards and codes applicable in the location of installation.

Engine generator sets that are stored by Owner / Buyer longer than 180 days from date of shipment are subject to special requirements. Contact MTU Onsite Energy's Service Center for instructions.

TO OBTAIN WARRANTY SERVICE

Warranty service may only be performed by MTU Onsite Energy authorized service providers. **Service provided by unauthorized persons will void this Limited Warranty. Non-MTU Onsite Energy replacement part(s) will void this Limited Warranty.** Contact your nearest MTU Onsite Energy Service Representative to obtain warranty service. For assistance in locating your nearest authorized service representative, see contact information at the bottom of this page.

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THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED. NO WARRANTIES SHALL BE IMPLIED OR OTHERWISE CREATED UNDER THE UNIFORM COMMERCIAL CODE, INCLUDING BUT NOT LIMITED TO A WARRANTY OF MERCHANTABILITY OR A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.
MTU ONSITE ENERGY SHALL NOT BE LIABLE FOR ANY CLAIM GREATER IN AMOUNT THAN THE PURCHASE PRICE OF THE PRODUCT AT ISSUE, AND IN NO EVENT SHALL MTU ONSITE ENERGY BE LIABLE

STANDBY LIMITED WARRANTY
Two (2) Year / 3,000 Hour Basic

FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES. STATE LAWS REGARDING THE RIGHTS OF CONSUMERS MAY VARY FROM STATE TO STATE.

1. The following items are not considered nor will they be covered under this Limited Warranty. If there are questions as to coverage under this Limited Warranty, it is advisable to contact the factory in advance of filing a claim.
   a. Battery or batteries of any type or kind. The battery manufacturer's warranty, if any, is the only warranty that applies to batteries. Any warranty claim should be handled with the manufacturer according to its policies.
   b. Adjustments to fuel systems or governor system at time of start-up or any time after. A warranty claim for such adjustments is acceptable only when a defective part has been replaced, returned to the factory, and approved as defective.
   c. Normal maintenance costs, including but not limited to adjustments, loose and/or leaking fittings or clamps, and tune-ups performed during start-up or anytime thereafter.
   d. Due to shipping, manufacturer is not responsible for loose connections. All connections must be checked at time of start-up.
   e. Non-MTU Onsite Energy replacement part(s) will void this Limited Warranty.
   f. Products that are modified in any form without the written consent of MTU Onsite Energy will void this Limited Warranty.
   g. Shipping damage of any type.
   h. Any installation errors or damage of the equipment when shipped as ordered.
   i. Any overtime travel or labor to make repairs under warranty.
   j. Any special access fees required to gain access to MTU Onsite Energy equipment, including but not limited to any training or safety policy requirements to gain access.
   k. Additional costs associated with inaccessible installations, including but not limited to removal and reinstallation of the generator set.
   l. Rental equipment used during warranty work including but not limited to generators, rigging equipment such as a crane or boom truck, load banks, and special test equipment above factory requirements.
   m. Excess mileage charges. Any authorized service provider may perform warranty service anywhere, but will only be paid for mileage expenses from the nearest service center and limited to 400 miles / 644 Kilometers round-trip.
   n. Any equipment not factory approved and engineered for use on MTU Onsite Energy products. This includes but is not limited to aftermarket items such as special fuel systems, enclosures, exhaust systems, or switch gear that had been sought out and quoted by a third party to be included in billing of the MTU Onsite Energy equipment.
   o. Misuse or abuse during installation and thereafter.
   p. Normal wear and tear, maintenance, and consumable items that are not required as part of a warranty repair. Consumable items include but are not limited to belts, hoses, coolant, oil, filters, and fuses.
   q. Acts of nature or acts of God such as lightning, wind, flood, tornado, hurricane, or earthquake.
   r. Any damage due to situations beyond the control of the manufacturing of the product or workmanship of the product.
   s. Installation or operation outside the guidelines as stated in the Installation Guide and Owner's Manual.
   t. Diesel engine "Wet Stacking" due to lightly loaded diesel engines.
   u. Misapplication of the equipment such as usage outside the original design parameters as stated on the nameplate of the equipment.
   v. Travel expense on portable equipment.
   w. Trailer lights, wiring, and brakes.

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x. More than one trip to the job site because a service vehicle was not stocked with normal service parts.
y. Lodging expense of person(s) performing service, unless approved in advance by factory.
z. Engine fluids.
aa. Units purchased at the standby power rating that are being used in a prime power application.
ab. Any repair labor time that is determined to be excessive, e.g., two or more people performing a one-person job.
ac. Any expenses associated with investigating performance complaints in which no defect is found.
ad. Any associated costs for replacing components that are found not to be defective.
ae. Any adjustments covered in the start-up and inspection forms that are to be completed during start-up.

2. The accessories that are limited to one (1) year parts and labor from date of shipment include but are not limited to:
   a. Cords, receptacles, and cord reels
   b. Gas flex pipes
   c. Housing lights, space heaters, and associated equipment

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100 Power Drive / Mankato, MN 56001 / 800-325-5450

14.4 MTU Onsite Energy Registration

Important MTU Onsite Energy Registration

Please complete the MTU Onsite Energy registration using one of the following methods:

Please complete the MTU Onsite Energy product registration at: http://registration.mtuonsiteenergy.com

Or

Please complete and return the MTU Onsite Energy product registration card found below to MTU Onsite Energy.

The product registration details are used to communicate after sales and logistics support (spare parts, documentation updates, etc.)

(Complete and detach the Product Registration Card below)

_____
_____
_____

Postcard

MTU Onsite Energy Corporation
P.O. Box
100 Power Drive
Mankato, MN 56002

TIM-ID: 0000001680 - 001

Important MTU Onsite Energy Registration

(Complete and detach the Product Registration Card below)

Quality is extremely important to MTU Onsite Energy and we want to hear from you. Please take the time to tell us what you think about MTU Onsite Energy products.
Generator Set Serial Number: _____Date generator set was received:_____ Date installed:_____

Contact Name:_____Contact Number:_____E-mail :_____

Describe your level of satisfaction with each of the following:

	Excellent	Very Good	Good	Satisfactory	Unsatisfactory	N/A
Timely Receipt of Product:	O	O	O	O	O	O
Product Installation:	O	O	O	O	O	O
Start-up:	O	O	O	O	O	O
Ease of Operation:	O	O	O	O	O	O
Overall Product Quality:	O	O	O	O	O	O

Did you receive the following?

	Yes	No
Warranty Validation Form:	O	O
Product Installation:	O	O
Start-up:	O	O
Ease of Operation:	O	O
Overall Product Quality:	O	O

Describe the quality of the following:

	Excellent	Very Good	Good	Satisfactory	Unsatisfactory	N/A
Operation & Maintenance Manual:	O	O	O	O	O	O
Installation & Operation: Guide:	O	O	O	O	O	O

Will you purchase MTU Onsite Energy products in the future? **Yes / No**
Will you recommend MTU Onsite Energy products in the future? **Yes / No**
What MTU Onsite Energy product changes would you recommend?_____
What value-added products and services would you like to see MTU Onsite Energy Offer?_____
Additional Comments:_____

Please contact MTU Onsite Energy at 800.325.5450 with any questions or concerns.
Thank you for taking the time to complete the Product Registration & Customer Satisfaction Survey.

TIM-ID: 0000001680 - 001

CIRCUIT BREAKER ENCLOSURE - DIESEL
80-125 kW Standby / 72-111 kW Prime Data Sheet

CIRCUIT BREAKER ENCLOSURE

This circuit breaker enclosure data sheet is used in conjunction with dimensional drawings to assist with submittal documentation and specification requirements. This document summarizes the enclosure dimensions and mounting positions for the MTU 4R0120 DS80, MTU 4R0120 DS100, and MTU 4R0120 DS125 circuit breakers, including small and large size enclosures. The dimensional drawings will govern and should be referenced for installation.

SMALL ENCLOSURE

- Small enclosure supplied with select 360 frame alternator applications.
- Right side breakers shown. Left side breakers optional.
- Reference Figure 1.1 and Table 1.1 for breaker mounting positions.

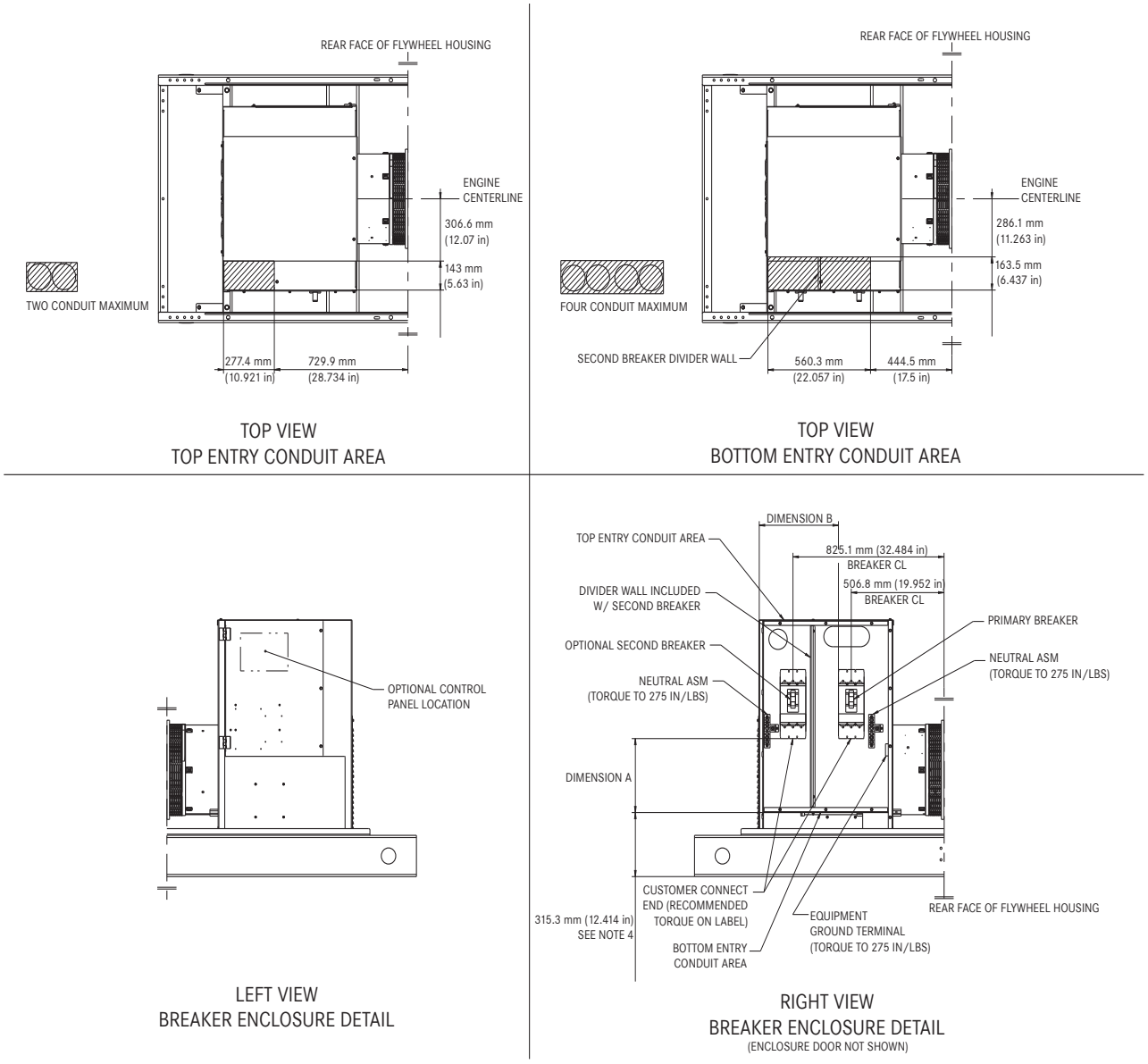


Figure 1: Small Enclosure (Drawing ID: XZG2100100031)

TIM-ID: 0000100959 - 006

CIRCUIT BREAKER ENCLOSURE - DIESEL
80-125 kW Standby / 72-111 kW Prime Data Sheet

Available Circuit Breakers		Enclosure Data				
Breaker Frame	Amperage	Output Wire Range 90 °C Cu (wires per lug)	Wire Bending Space[1] Dimension A mm (in)	Wire Gutter Space[1,2] Dimension B mm (in)	Conduit Quantity	Conduit Size[3] in
H-Frame	15 - 150	(1) 4 - 3/0	459 (18.08)	450 (17.72)	1	2.5
J-Frame	175	(1) 4 - 3/0	445 (17.52)	450 (17.72)	1	2.5
J-Frame	200 - 250	(1) 3/0 - 350	445 (17.52)	450 (17.72)	1	3
L-Frame 100%	300 - 400	(2) 2/0 - 500	364 (14.35)	433 (17.03)	2	3.5
L-Frame 80%	300 - 600	(2) 2/0 - 500	364 (14.35)	433 (17.03)	2	3.5

Table 1: Small Enclosure Data

1. Meets or exceeds NFPA 70, NEC 312.6(A), and NEC 312.6(B).
2. Top entry only available for single breaker applications.
3. Based on flexible metal conduit at 40% fill using THHN wire.
4. Add 205 mm (8.08 in) for bases with integrated single wall fuel tank (see Figure 1).

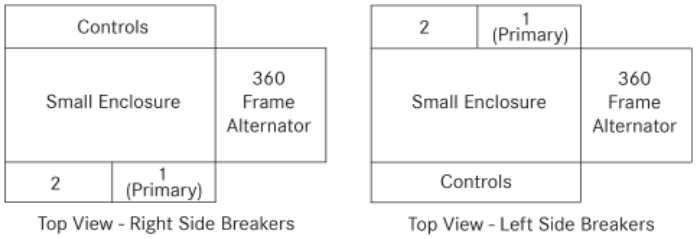


Figure 1.1: Small Enclosure Breaker Mounting Positions

Breaker Frame	
Position 1 (Primary)	Position 2
H / J / L	-
H / J / L	H / J / L

Table 1.1: Small Enclosure Breaker Mounting Positions

TIM-ID: 0000100959 - 006

CIRCUIT BREAKER ENCLOSURE - DIESEL
80-125 kW Standby / 72-111 kW Prime Data Sheet

LARGE ENCLOSURE

- Large enclosure supplied with all 430 frame alternator applications and select 360 frame alternator applications.
- Right side primary breaker shown. Left side primary breaker optional.
- Reference Figure 2.1 and Table 2.1 for breaker mounting positions.

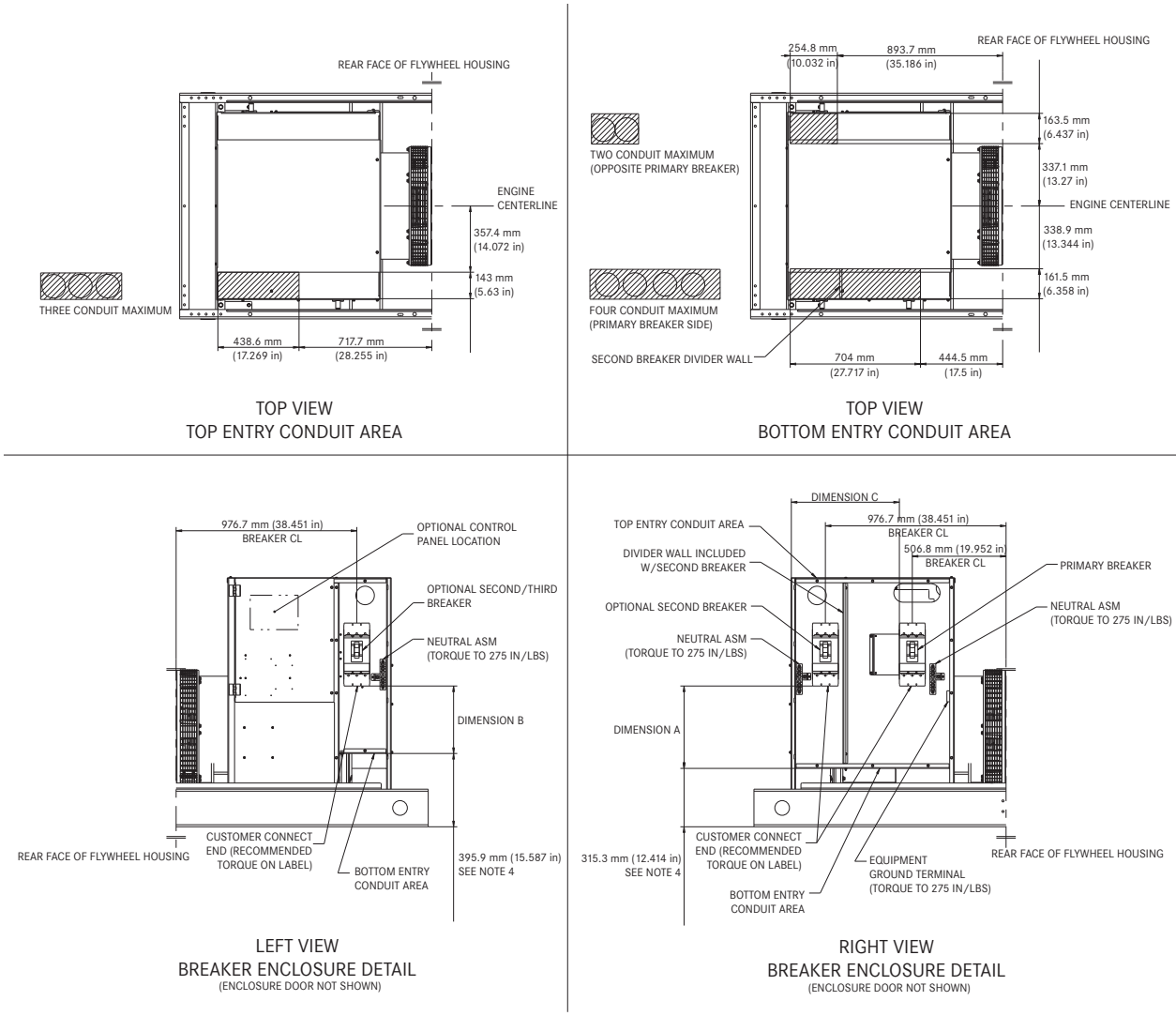


Figure 2: Large Enclosure (Drawing ID: XZG2100100031)

TIM-ID: 0000100959 - 006

Available Circuit Breakers		Enclosure Data					
Breaker Frame	Amperage	Output Wire Range 90 °C Cu (wires per lug)	Wire Bending Space[1] Dimension A mm (in)	Wire Bending Space[1] Dimension B mm (in)	Wire Gutter Space[1,2] Dimension C mm (in)	Conduit Quantity	Conduit Size[3] in
H-Frame	15 - 150	(1) 4 - 3/0	532 (20.93)	451 (17.76)	602 (23.69)	1	2.5
J-Frame	175	(1) 4 - 4/0	518 (20.37)	437 (17.2)	602 (23.69)	1	2.5
J-Frame	200 - 250	(1) 3/0 - 350	518 (20.37)	437 (17.2)	602 (23.69)	1	3
L-Frame 100%	300 - 400	(2) 2/0 - 500	443 (17.44)	362 (14.27)	584 (23)	2	3.5
L-Frame 80%	300 - 600	(2) 2/0 - 500	443 (17.44)	362 (14.27)	584 (23)	2	3.5
M-, P-Frame	250 - 800	(3) 250 - 500	407 (16.01)	n/a	451 (17.74)	3	3.5

Table 2: Large Enclosure Data

1. Meets or exceeds NFPA 70, NEC 312.6(A), and NEC 312.6(B).
2. Top entry only available for single breaker applications.
3. Based on flexible metal conduit at 40% fill using THHN wire.
4. Add 205 mm (8.08 in) for bases with integrated single wall fuel tank (see Figure 2).

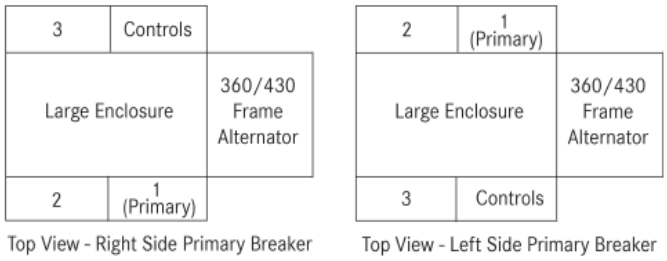


Figure 2.1: Large Enclosure Breaker Mounting Positions

Breaker Frame		
Position 1 (Primary)	Position 2	Position 3
H / J / L	-	-
H / J / L	H / J / L	-
H / J / L	H / J / L	H / J / L
P/M	-	-
P/M	H/J	-
P/M	H/J	H / J / L
P/M		L

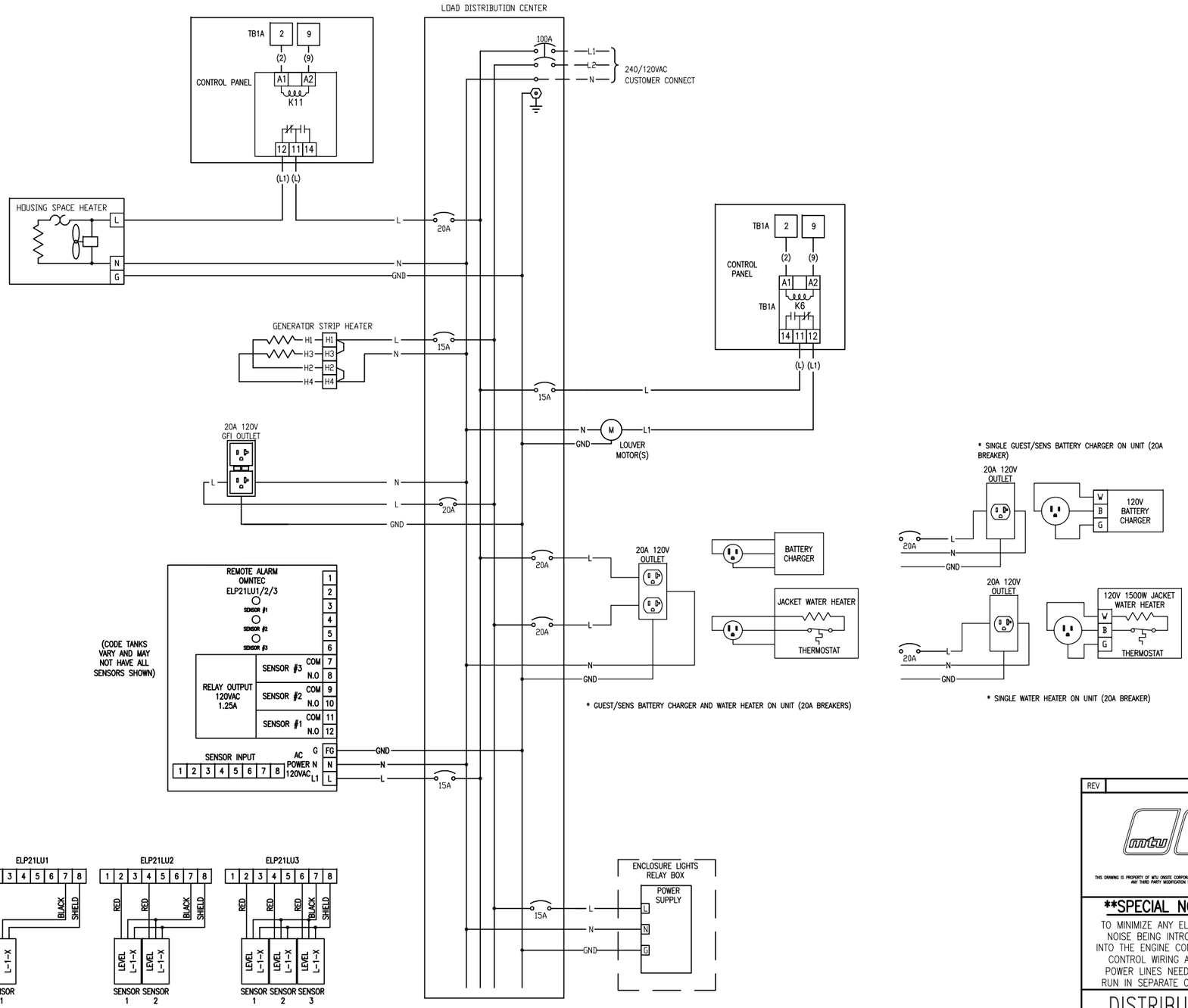
Table 2.1: Large Enclosure Breaker Mounting Positions

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15 80-200 kW Electrical Drawings

15.1 Mercedes-Benz (OM924/926) 80-200 kW Distribution Panel Options - XZG2100100045 581
15.2 Mercedes-Benz (OM924/926) 80-200 kW Breaker Diagram - XZG2100100045 583
15.3 Mercedes-Benz (OM924/926) 80-200 kW Engine Diagram - XZG2100100045 585
15.4 Mercedes-Benz (OM924/926) 80-200 kW Generator Diagram - XZG2100100045 587
15.5 Mercedes-Benz (OM924/926) 80-200 kW MGC-1500 Face Panel - XZG2100100045 589
15.6 Mercedes-Benz (OM924/926) 80-200 kW Options - XZG2100100045 593

15.1 Mercedes-Benz (OM924/926) 80-200 kW Distribution Panel Options - XZG2100100045



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****SPECIAL NOTE****

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GENERATOR: NA	
REGULATOR: NA	
CONTROL PANEL: NA	
VOLTAGE: NA	
GOVERNOR: NA	

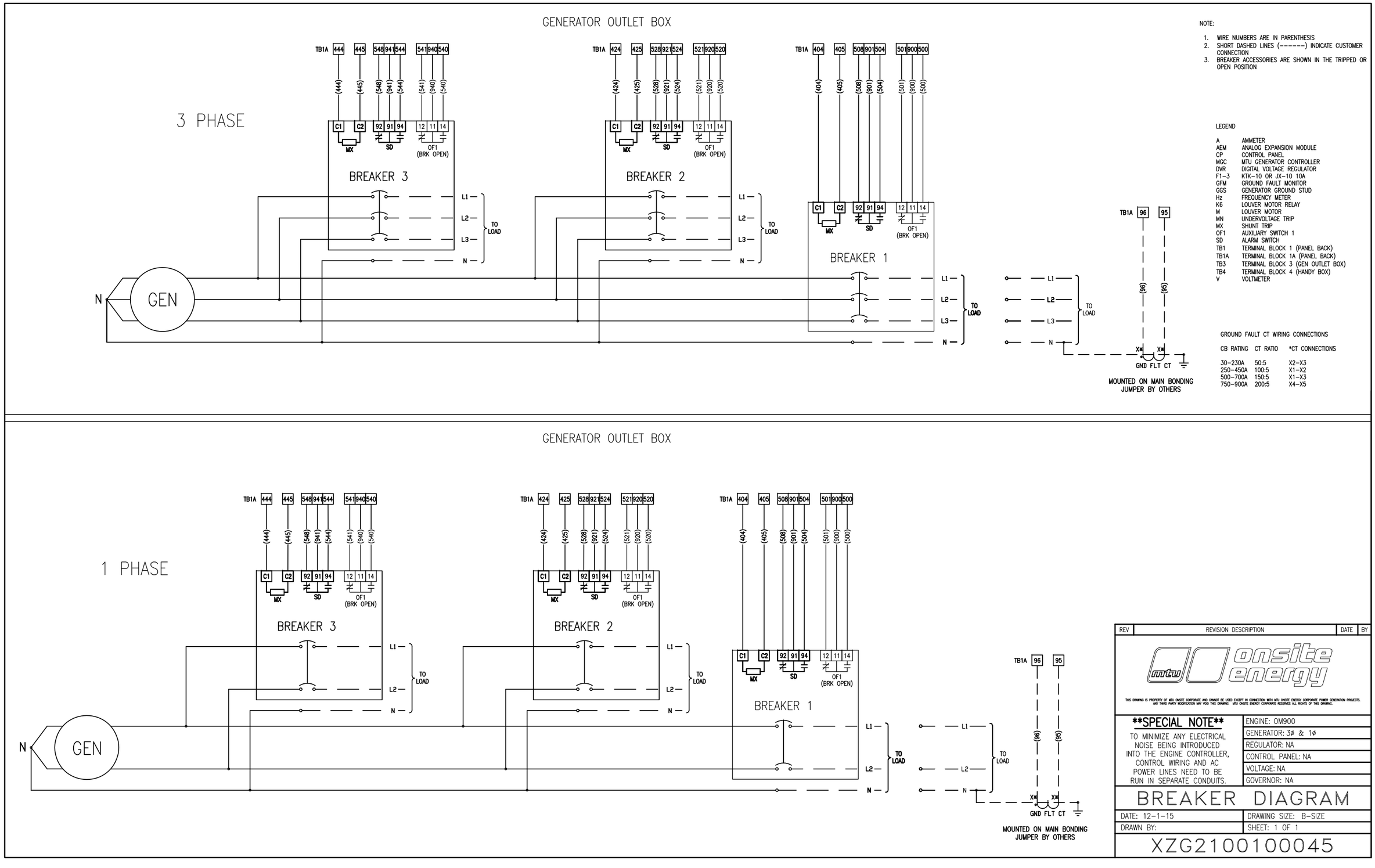
DISTRIBUTION PANEL OPTIONS

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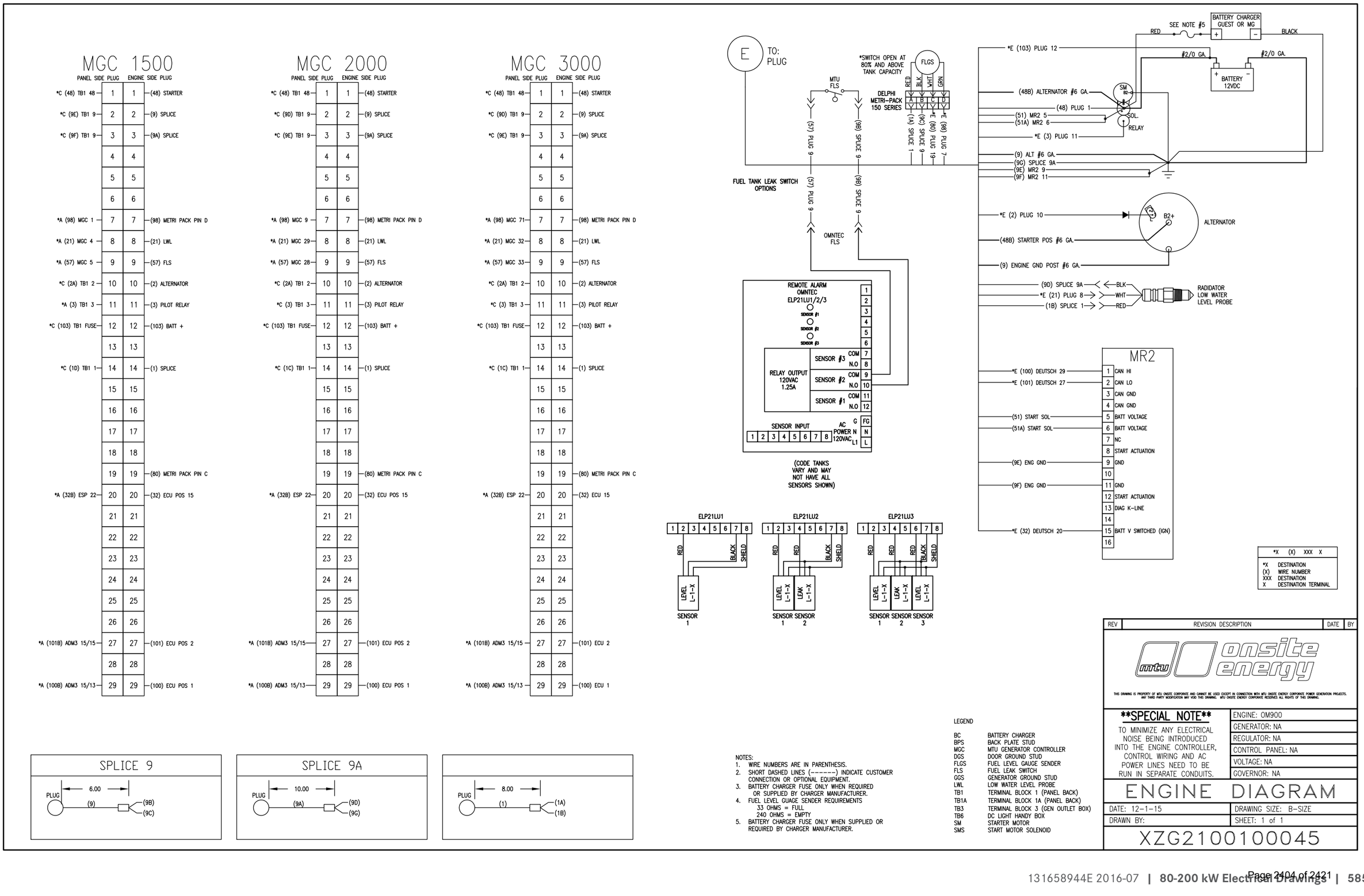
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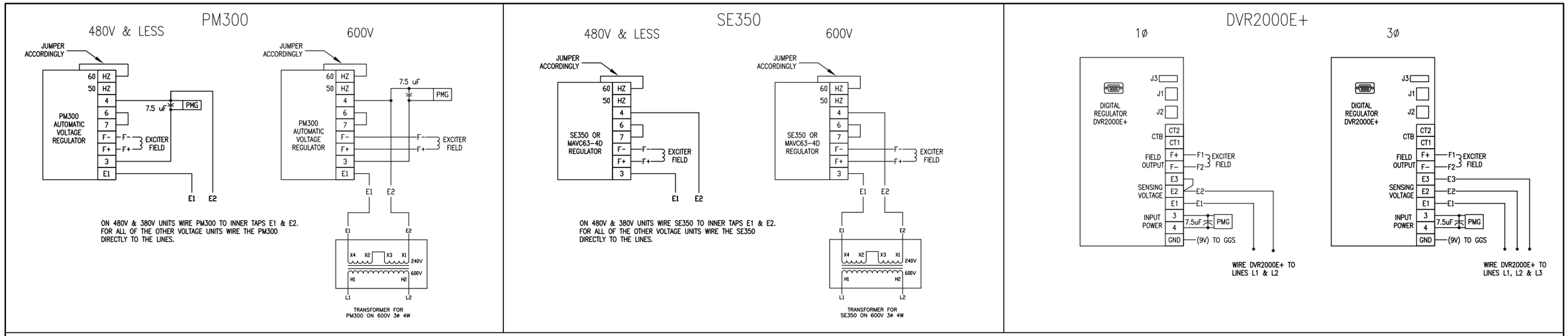
15.2 Mercedes-Benz (OM924/926) 80-200 kW Breaker Diagram - XZG2100100045



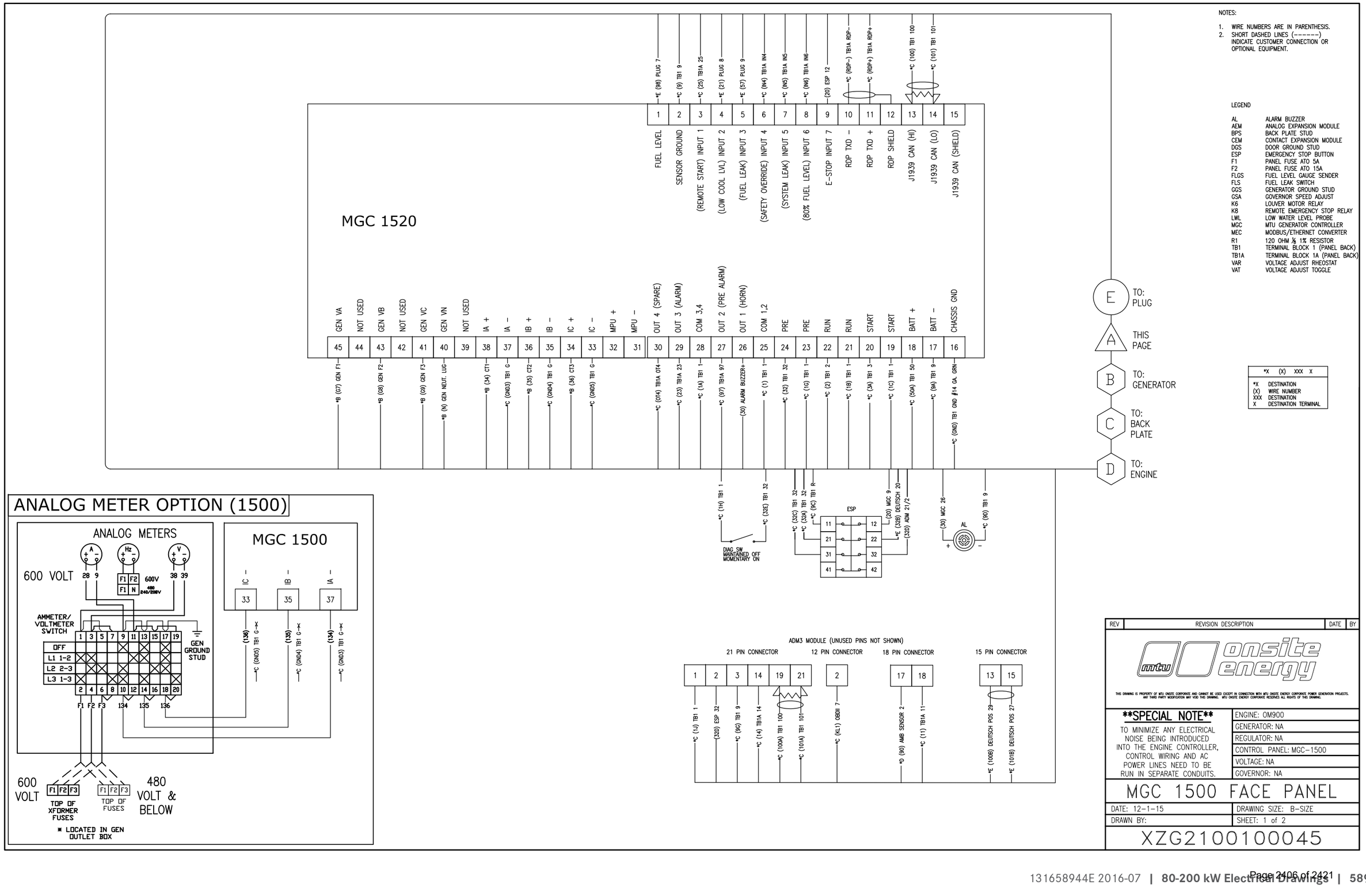
15.3 Mercedes-Benz (OM924/926) 80-200 kW Engine Diagram - XZG2100100045

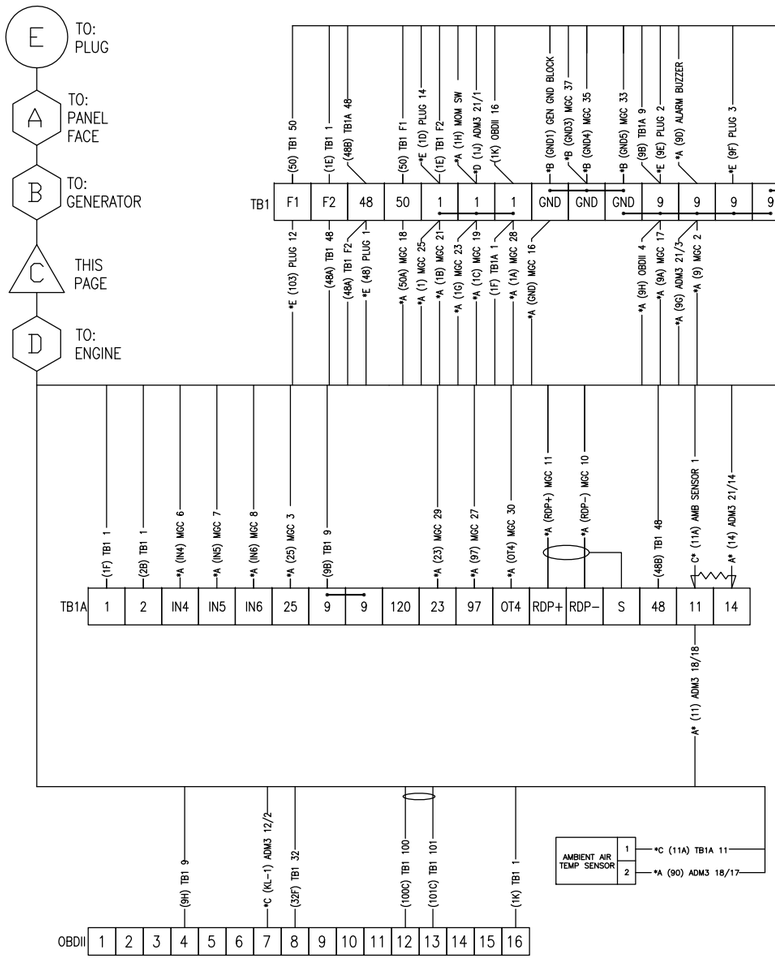


15.4 Mercedes-Benz (OM924/926) 80-200 kW Generator Diagram - XZG2100100045



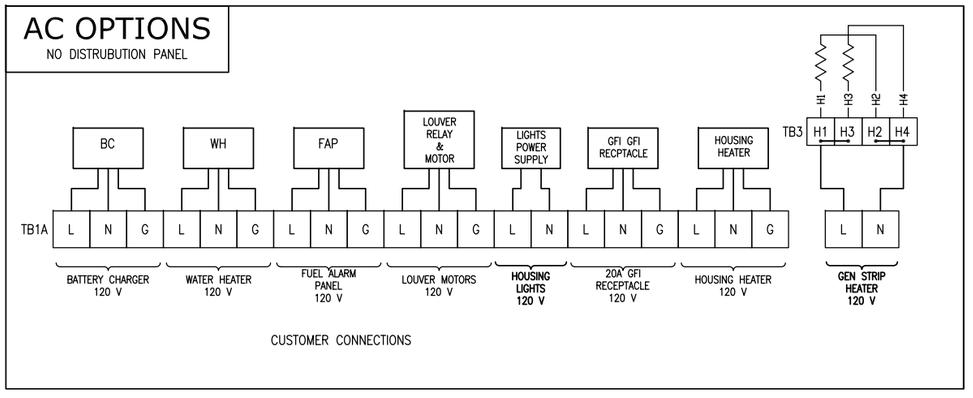
15.5 Mercedes-Benz (OM924/926) 80-200 kW MGC-1500 Face Panel - XZG2100100045





AC OPTIONS

NO DISTRUBUTION PANEL



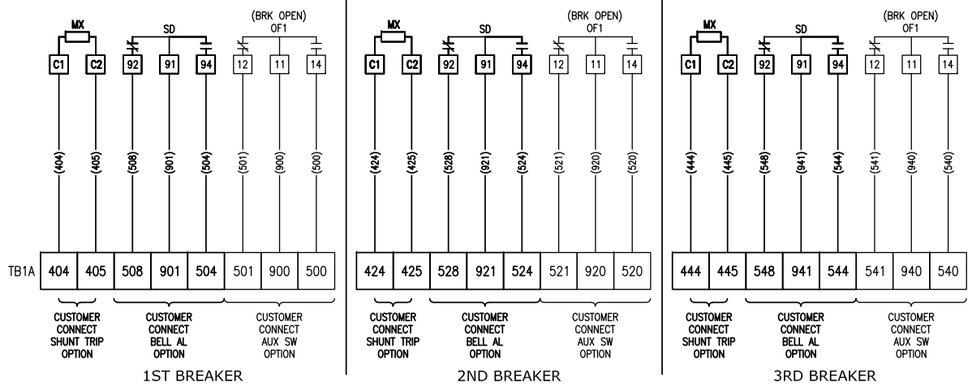
CUSTOMER CONNECTIONS

AC CUSTOMER CONNECT

SEE PAGE 3 FOR TERMINAL DESIGNATION

BREAKER OPTIONS

MX = SHUNT TRIP
SD = BELL ALARM
OF1 = AUX SWITCH



NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (-------) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

LEGEND:

AEM	ANALOG EXPANSION MODULE
BPS	BACK PLATE STUD
CEM	CONTACT EXPANSION MODULE
MGC	MTU GENERATOR CONRTOLLER
DGS	DOOR GROUND STUD
F1	PANEL FUSE ATO 5A
F2	PANEL FUSE ATO 15A
K1	ENGINE RUN RELAY
K2	ENGINE FAIL RELAY
K3	MINOR ALARM RELAY
K6	LOUVER MOTOR RELAY
K8	REMOTE ESTOP RELAY
K10	ENGINE RUN RELAY
LVR	LOUVER MOTOR RELAY
MEC	MODBUS/ETHERNET CONVERTER
R2	RESISTOR 12K OHM 1/4W
TB1	TERMINAL BLOCK 1 (PANEL BACK)
TB1A	TERMINAL BLOCK 1 (PANEL BACK)

*X	(X)	XXX	X
*X	DESTINATION		
(X)	WIRE NUMBER		
XXX	DESTINATION		
X	DESTINATION TERMINAL		

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GENERATOR: NA	
REGULATOR: NA	
CONTROL PANEL: MGC-1500	
VOLTAGE: NA	
GOVERNOR: NA	

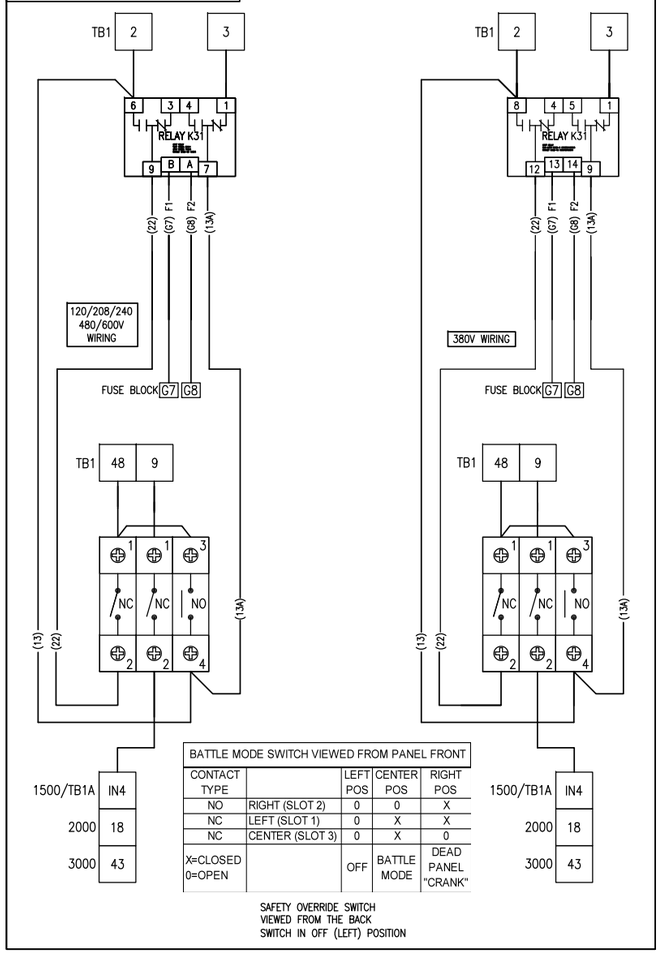
1500 BACK PLATE

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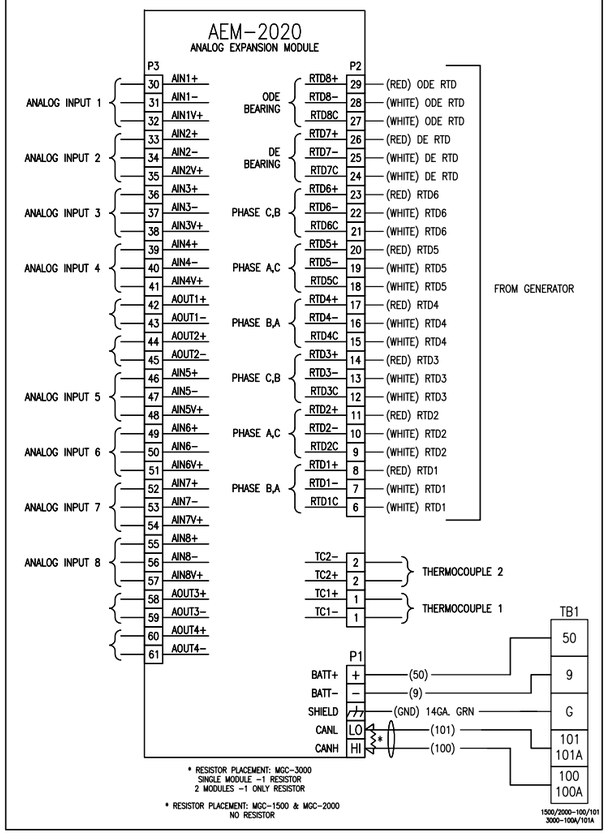
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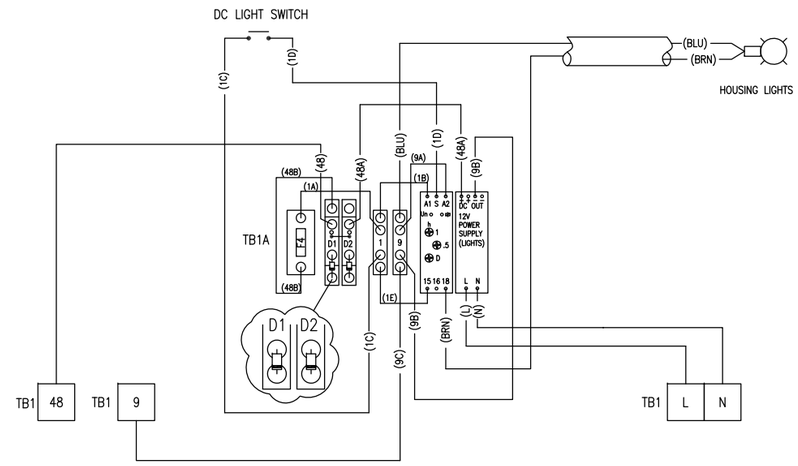
SAFETY OVERRIDE SWITCH



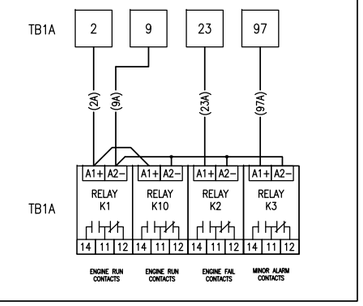
AEM OPTION



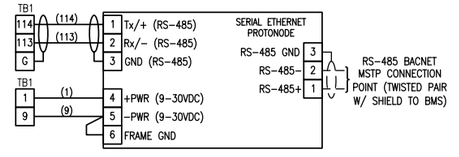
HOUSING LIGHT OPTION



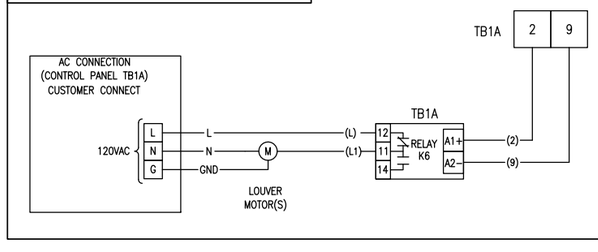
4 RELAY OPTION



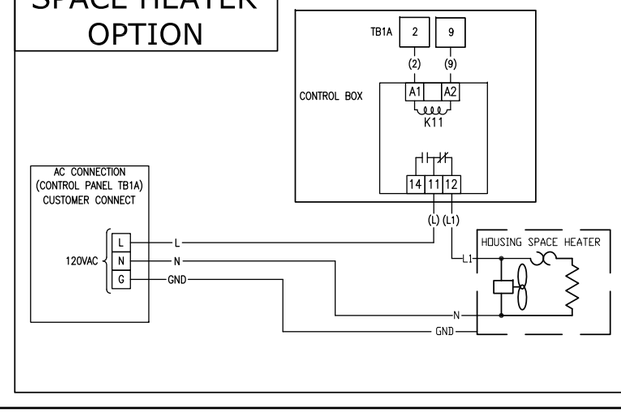
BACKNET CONVERTOR



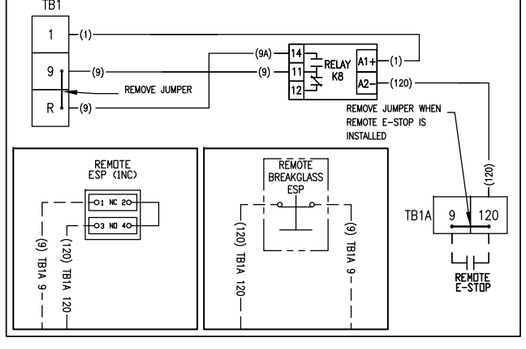
LOUVER MOTOR(S) OPTION



SPACE HEATER OPTION



REMOTE E-STOP OPTION



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GENERATOR:	NA
REGULATOR:	NA
CONTROL PANEL:	NA
VOLTAGE:	NA
GOVERNOR:	NA

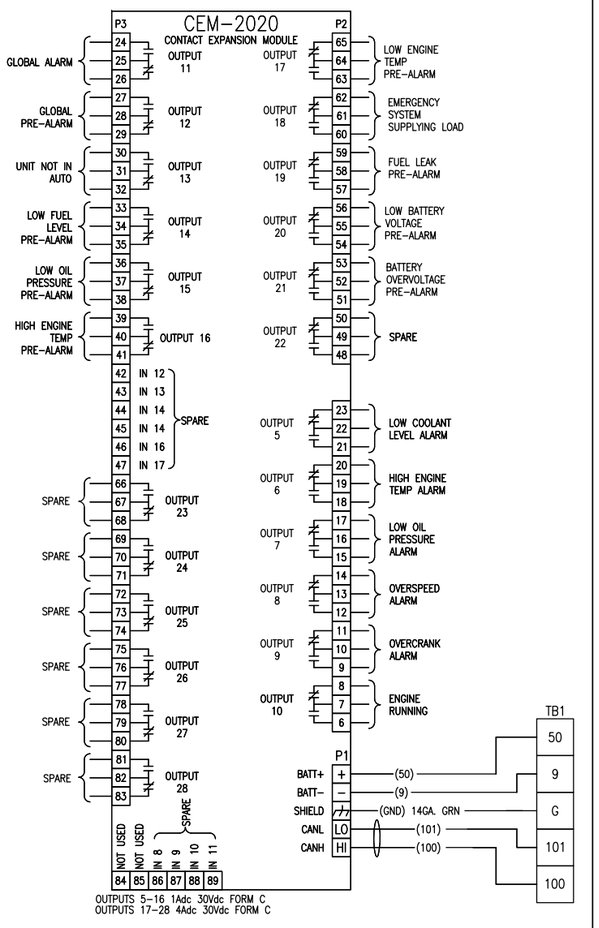
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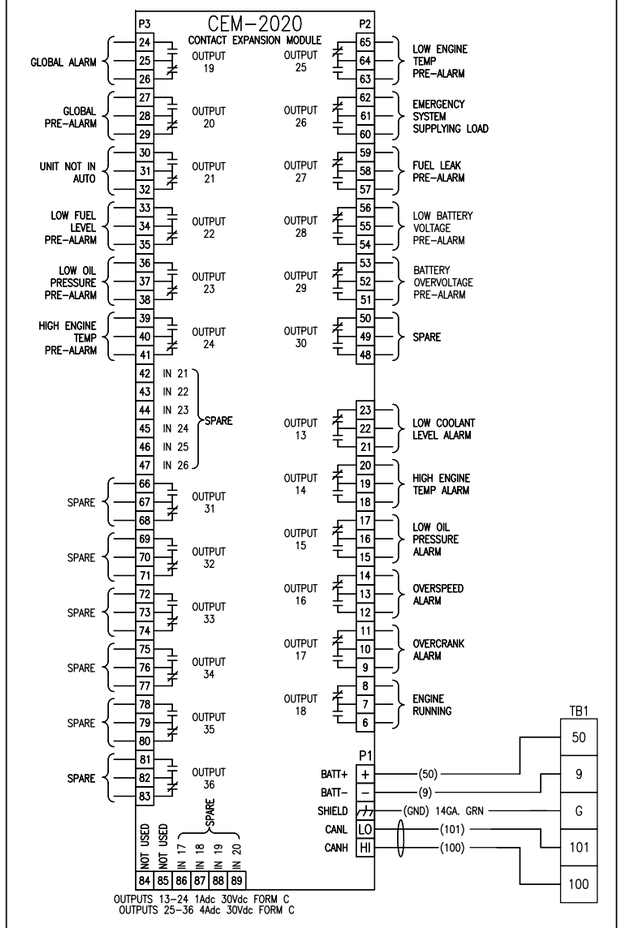
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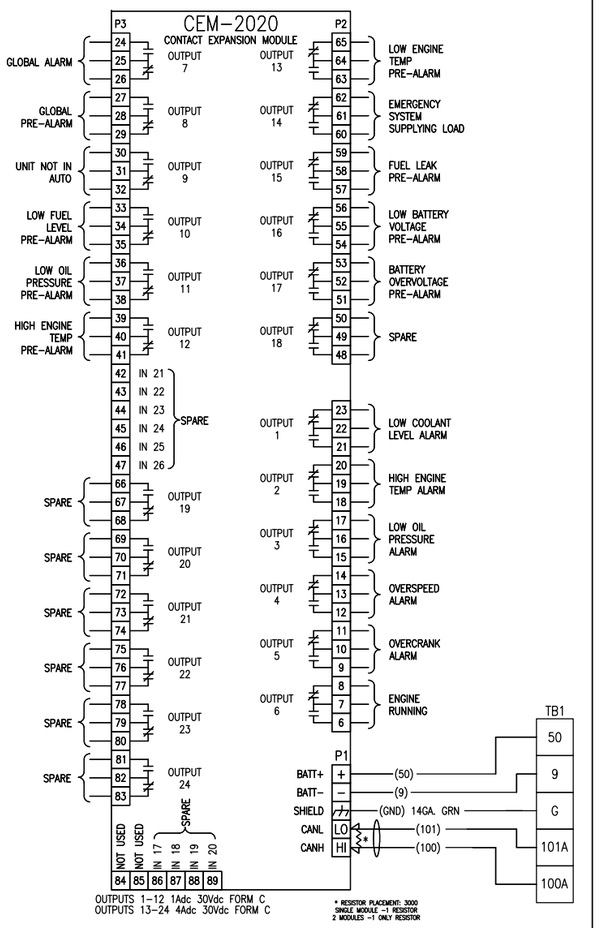
CEM OPTION 1500



CEM OPTION 2000



CEM OPTION 3000



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ENGINE: OM924/OM926	
GENERATOR: NA	
REGULATOR: NA	
CONTROL PANEL: NA	
VOLTAGE: NA	
GOVERNOR: NA	

OPTION PAGE

DATE: 12-1-15	DRAWING SIZE: B-SIZE
DRAWN BY:	SHEET: 2 OF 2

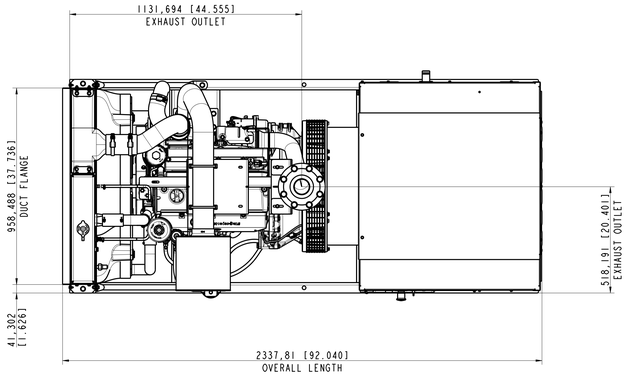
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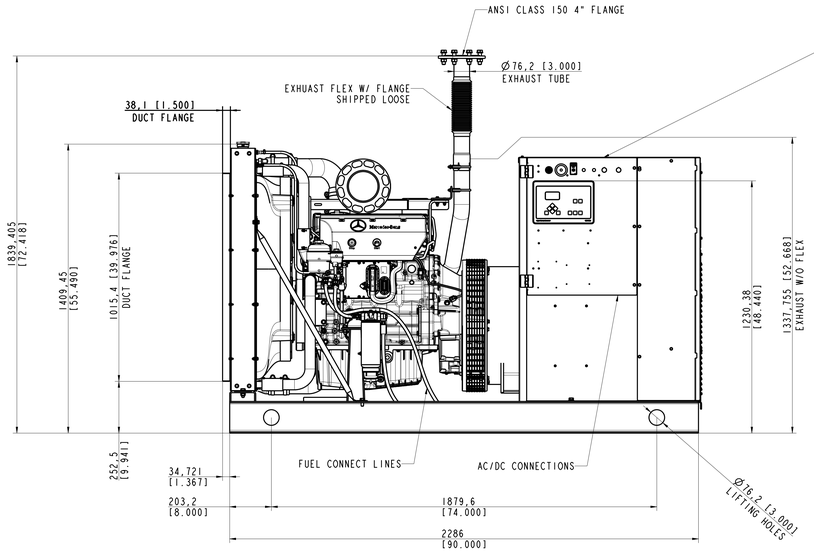
16 Drawings

16.1 XZG2100100021 599

		Stand-By	Prime
60 Hz Models (kWe)	DG04RMI20A1N	80	72
	DG04RMI20A2N	100	90
	DG04RMI20A3N	125	111
50 Hz Models (kVA)	DG04RMI20A1L	89	80
	DG04RMI20A2L	111	100
	DG04RMI20A3L	139	125

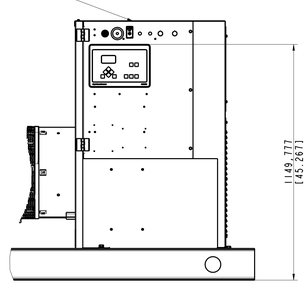


TOP VIEW



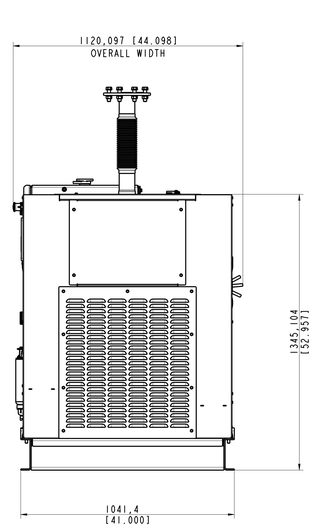
LEFT VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATIONS:
1. 430 GEN, ALL BREAKER SIZES
2. 360 GEN, P-FRAME BREAKER



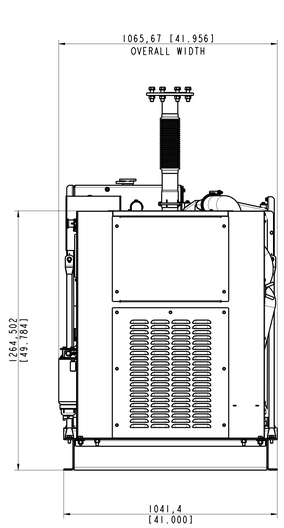
LEFT VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATION:
1. 360 GEN, H, J OR L-FRAME BREAKERS



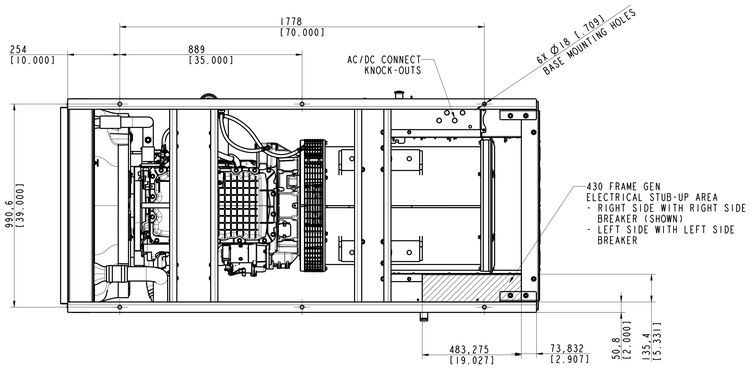
BACK VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATIONS:
1. 430 GEN, ALL BREAKER SIZES
2. 360 GEN, P-FRAME BREAKER

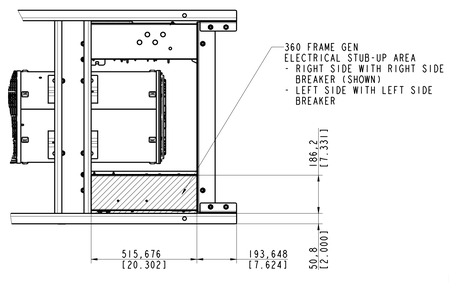


BACK VIEW

OUTLET BOX SHOWN USED WITH CONFIGURATION:
1. 360 GEN, H, J & L-FRAME BREAKERS



BOTTOM VIEW



BOTTOM VIEW

STANDARD SCOPE OF SUPPLY

WITH NON-HOUSED/NON-TANKED BASE

GENSET DIMENSIONAL

Aufgeführte Normen Relevant Standards	Pos.-Nr. Ref.	Änderg. in Revision Chg.	Ausgl. Rev.Ltr.	Name var. Frequency	Änderung/Revision	Änderungs-Nr. Revision Notice No.	Datum Date	Name Sign
							09.04.2015	kost

Beschaffung u.Lieferung tech. Charakteristics	Oberflächenangaben nach MTM0033 Surface Specification per MTM0033	Maßstab Scale 1:10	Masse/Mass kg 2650.795	Format/Size A0
Oberflächenschutz Surface Protection		Werkstoff Material		
Verwendbar für: Typ Applicable to Model	Allgemeine Fertigungsvorschriften nach MMM 332 Production Specification per MMM 332			
Projekt-/Auftrags-Nr. Project/Order No.		Halbzeug,Modell,Gesenk Semi-finished Product, Pattern,Die		
Referenz-Nr./Reference No.		Benennung/title /		

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	Prüf.	Datum/Date	Name
Gezeichnet Drawn		09.04.2015	Kost
Geprüft Checked		09.04.2015	Anderson
Norm. Appd.		09.04.2015	Carsten
Ers. für Repl. for	EDMN		Carsten

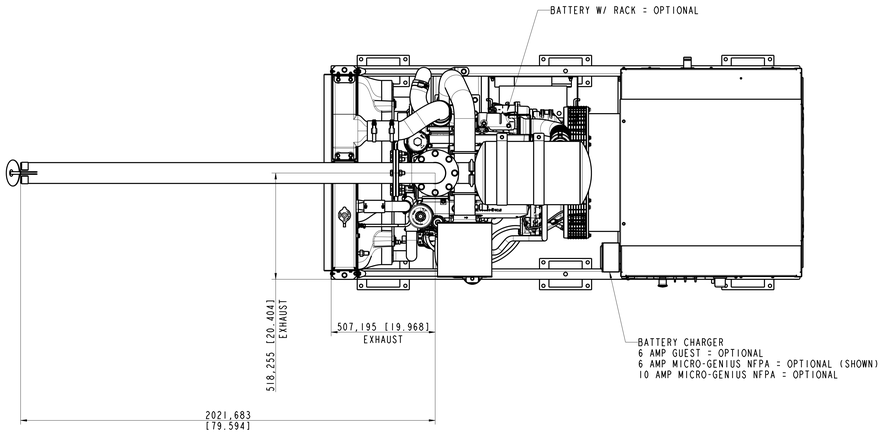
ABMASSZEICHNUNG
OPU BASE
DIMENSIONAL DRAWING
OM924 GENSET

Zeichnungs-Nr./Drawing No. XZG2100100021

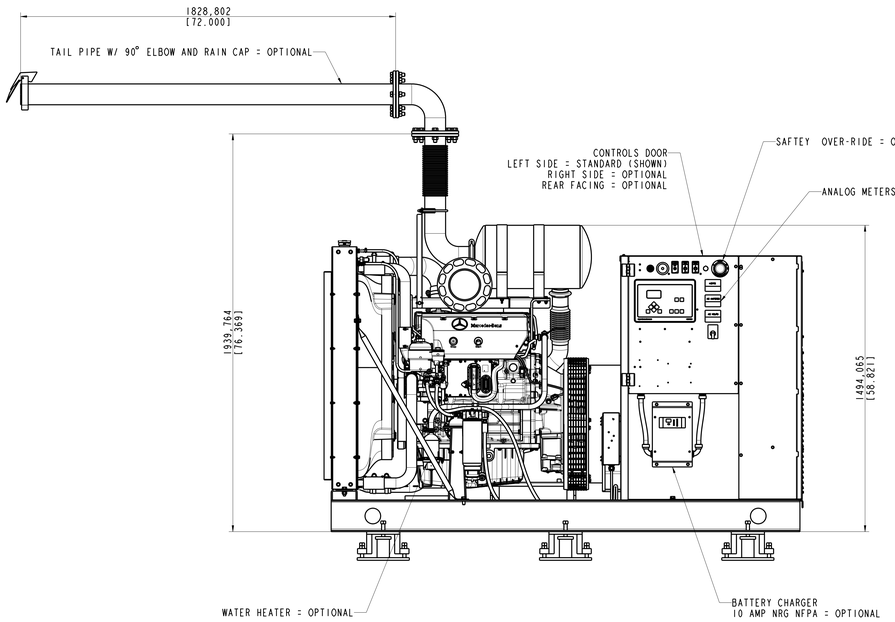
Blatt/Sheet Ix.3

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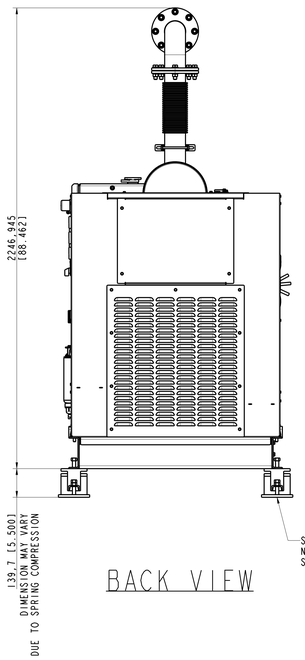
		Stand-By	Prime
60 Hz Models (kWe)	DG04RMI20A1N	80	72
	DG04RMI20A2N	100	90
	DG04RMI20A3N	125	111
50 Hz Models (kVA)	DG04RMI20A1L	89	80
	DG04RMI20A2L	111	100
	DG04RMI20A3L	139	125



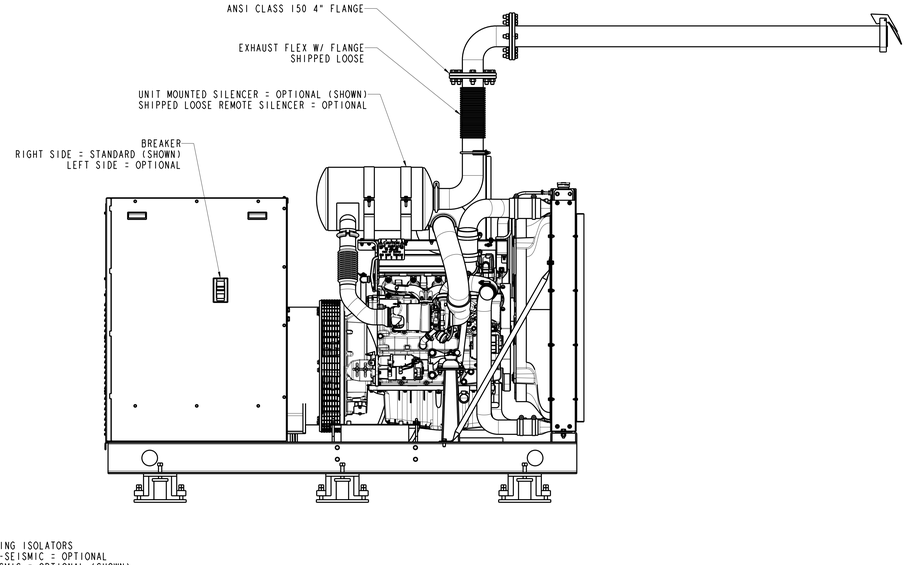
TOP VIEW



LEFT VIEW



BACK VIEW



RIGHT VIEW

OPTIONAL SCOPE OF SUPPLY

WITH NON-HOUSED/NON-TANKED BASE

GENSET DIMENSIONAL

Aufgeführte Normen Relevant Standards	Passiviert (y)	Ersetzt durch Replaced by	Ersetzt für Repl.for	Ersatz für Repl.by	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check

Oberflächenangaben nach WN5030
Surface Specification per WN5033
Allgemeine Fertigungsvorschriften nach WNN 332
Production Specification per WNN 332

Bei Fremdteil/Kaufteil duerfen alle technischen Aenderungen am Lieferumfang nur nach unserer vorherigen Genehmigung vorgenommen werden.
Technical modifications to third party or purchased parts require our prior permission.

Prueft	Datum/Date	Name
Bearb.	09.04.2015	Kost
Gepr.	09.04.2015	Anderson
Norm.	09.04.2015	Carsten
Ers. durch		
Ers. für		
Gen.	09.04.2015	Carsten

Massstab Scale 1:10 | Masse/Mass 2650.795 kg | Formatfürer A0

Werkstoff Material

Zeichnung, Modell, Gesamt Semifinished Product, Pattern, Die

Benennung/Title /

ABMASSZEICHNUNG
OPU BASE
DIMENSIONAL DRAWING
CM924 GENSET

Zeichnungs-Nr./Drawing No. XZG2100100021

Blatt Sheet 2v.3

Power Generation

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		Stand-By	Prime
60 Hz Models (kWe)	DG04RM120A1N	80	72
	DG04RM120A2N	100	90
	DG04RM120A3N	125	111
50 Hz Models (kVA)	DG04RM120A1L	89	80
	DG04RM120A2L	111	100
	DG04RM120A3L	139	125

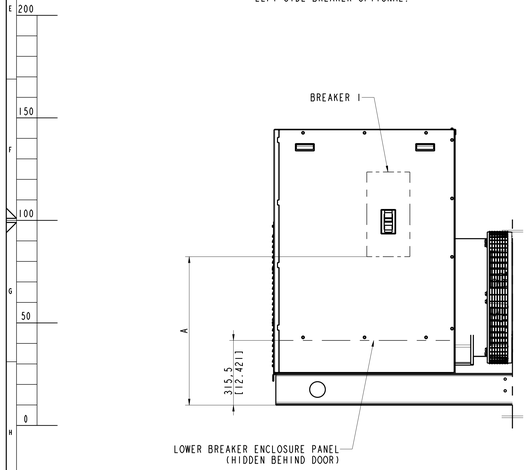
SINGLE BREAKER

BREAKER 1: UP TO 1200 AMP

MAXIMUM TOP ENTRY CONDUIT FITTING ACCOMMODATIONS:
QTY 2, 3.00" FITTINGS

MAXIMUM BOTTOM ENTRY CONDUIT FITTING ACCOMMODATIONS:
QTY 4, 3.50" FITTINGS, OR
QTY 3, 4.00" FITTINGS

RIGHT SIDE BREAKER SHOWN.
LEFT SIDE BREAKER OPTIONAL.



RIGHT VIEW

MARATHON GENERATOR	SQUARE-D BREAKER	
GENERATOR FRAME SIZE	BREAKER FRAME SIZE	DIMENSION "A"
360-FRAME	H-FRAME	768.64 [30.26]
	J-FRAME	754.41 [29.70]
	L-FRAME	673.88 [26.53]
	M/P-FRAME	724.03 [28.51]
430-FRAME	H-FRAME	849.24 [33.43]
	J-FRAME	835.02 [32.87]
	L-FRAME	760.48 [29.94]
	M/P-FRAME	724.03 [28.51]

DUAL BREAKER

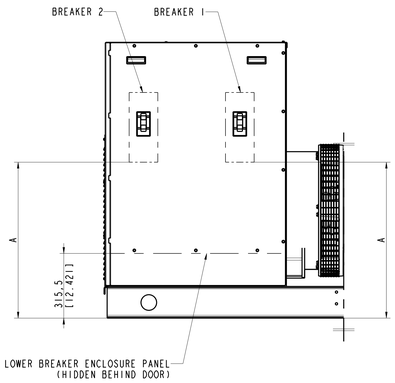
BREAKER 1: UP TO 600 AMP 80% RATED
OR 400 AMP @100% RATED

MAXIMUM CONDUIT FITTING ACCOMMODATIONS:
QTY 2, 3.00" FITTINGS
BOTTOM ENTRY ONLY

BREAKER 2: UP TO 600 AMP 80% RATED
OR 400 AMP @100% RATED

MAXIMUM CONDUIT FITTING ACCOMMODATIONS:
QTY 2, 3.00" FITTINGS
BOTTOM ENTRY ONLY

RIGHT SIDE BREAKERS SHOWN.
LEFT SIDE BREAKERS OPTIONAL.



RIGHT VIEW

MARATHON GENERATOR	SQUARE-D BREAKER	
GENERATOR FRAME SIZE	BREAKER FRAME SIZE	DIMENSION "A"
360-FRAME	H-FRAME	768.64 [30.26]
	J-FRAME	754.41 [29.70]
	L-FRAME	673.88 [26.53]
	M/P-FRAME	-
430-FRAME	H-FRAME	849.24 [33.43]
	J-FRAME	835.02 [32.87]
	L-FRAME	760.48 [29.94]
	M/P-FRAME	-

DUAL BREAKER

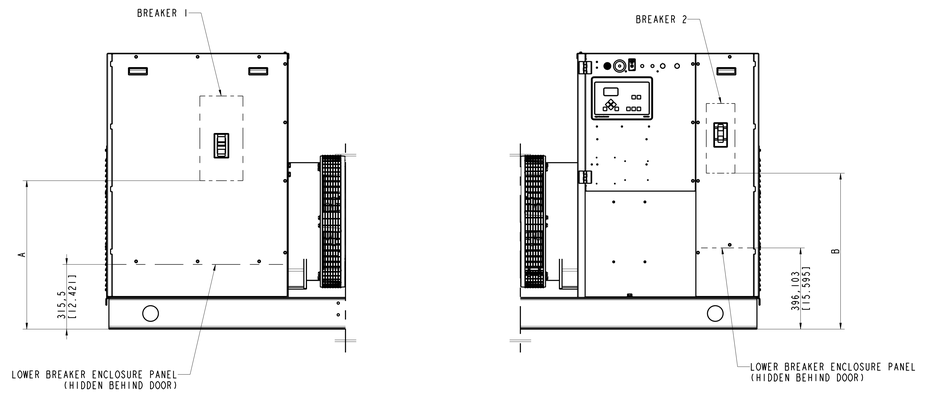
BREAKER 1: UP TO 1200 AMP

MAXIMUM CONDUIT FITTING ACCOMMODATIONS:
QTY 4, 3.50" FITTINGS, OR
QTY 3, 4.00" FITTINGS
BOTTOM ENTRY ONLY

BREAKER 2: UP TO 600 AMP 80% RATED
OR 400 AMP @100% RATED

MAXIMUM CONDUIT FITTING ACCOMMODATIONS:
QTY 2, 3.00" FITTINGS
BOTTOM ENTRY ONLY

RIGHT SIDE BREAKER 1, LEFT SIDE BREAKER 2 SHOWN.
LEFT SIDE BREAKER 1, RIGHT SIDE BREAKER 2 OPTIONAL.



RIGHT VIEW

LEFT VIEW

MARATHON GENERATOR	SQUARE-D BREAKER		
GENERATOR FRAME SIZE	BREAKER FRAME SIZE	DIMENSION "A"	DIMENSION "B"
360-FRAME	H-FRAME	-	849.24 [33.43]
	J-FRAME	-	835.02 [32.87]
	L-FRAME	-	760.48 [29.94]
	M/P-FRAME	724.03 [28.51]	-
430-FRAME	H-FRAME	-	849.24 [33.43]
	J-FRAME	-	835.02 [32.87]
	L-FRAME	-	760.48 [29.94]
	M/P-FRAME	724.03 [28.51]	-

BREAKER OPTIONS

Aufgeführte Normen
Relevant Standards

Pos.	Anmerkung	Änderungs-Nr.	Datum	Name
Pos.	Abmass in Millimeter (mm)	Änderungs-Nr. Revision Notice No.	Datum Date	Name

Änderung/Revision

Auslieferung u. Lieferung
tech. Characteristics
Oberflächenschutz
Surface Protection
Voraussichtlich gültig für
Applicable to Model
Projekt-/Auftrags-Nr.
Project/Order No.
Referenz-Nr./Reference No.

Oberflächenangaben nach MTM033
Surface Specification per MTM033
Allgemeine Fertigungsvorschriften nach MAN 332
Production Specification per MAN 332

Prod. Datum/Date Name
Erstellt/Drawn 09.04.2015 Host
Geprüft/Checked 09.04.2015 Anderson
Norm. Dept. 09.04.2015 Carsten
Gen. Dept. EGMN Carsten

Massstab / Scale 1:10
Masse/Mass kg 2650.795
Format/Size A0
Werkstoff / Material
Rohbezeichnung, Modell, Gesenk / Semi-finished Product, Pattern, Die
Benennung/Title /

ABMASSZEICHNUNG
OPU BASE
DIMENSIONAL DRAWING
OM924 GENSET

Zeichnungs-Nr./Drawing No. XZG2100100021
Blatt/Sheet 3v.3

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