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

132033444E

Order No.	132033444
Serial No.	95130600566

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 52)

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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1 Safety

1.1 MTU System Safety Section

Important Safety Instructions

Save these Instructions!

This manual contains important instructions for MTU systems and MTU Onsite Energy engine-generator sets that should be followed during the installation and maintenance of the system.

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 take responsibility to ensure that it is safe for your application and facility.

UL 2200 Certified

MTU systems, particularly generator-set installations, use UL 2200 as a standard when writing detailed specifications. UL 2200 sets minimum requirements for health and safety of personnel when operating equipment.

As an accepted standard, UL 2200 certification is specified or used by the following:

- Qualified technicians and project planners
- Contractors and specifying engineers
- State and local inspectors
- Federal agencies

UL 2200 addresses the entire generator-set and is primarily concerned with reducing the risk of shock, fire, and machinery-related injuries. This standard also addresses matters such as the routing of fuel lines and safety measures for rotating parts. UL 2200 also requires manufacturers to load-test their generator sets to verify that they can produce nameplate-rated power levels.

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:

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

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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.

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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.

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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.

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1.4 MTU General Shop Safety Section

Personnel requirements

Work on the equipment must only be carried out by appropriately qualified and instructed personnel.

Observe the minimum legal age.

Responsibilities of the operating, maintenance and repair personnel must be specified by the operating company.

Personal Protective Equipment

Personal Protective Equipment (PPE) is required when performing all maintenance work. 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 equipment, 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.

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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.

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:

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- 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.

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:

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- 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

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 - 007

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 take responsibility to ensure 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 - 007

Hazardous Environment Operation

MTU equipment is not approved for hazardous environment operation. It is the responsibility of the operator to ensure the engine-system is not operated in a hazardous environment. A hazardous environment is defined as a mixture of volatile substances with air, in the form of gases, vapors, mist, or dust in which, ignition can occur.

ATEX in the EU and OSHA in the U.S., define and classifies hazardous environments.

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 - 007

1.6 Battery Safety Instructions

Battery

For proper unit operation, battery minus (-) terminal must always be connected to ground. Reverse connection of the battery will severely damage or destroy the battery charging alternator, regulator, and other polarity sensitive devices.

Wear protective safety eyeglasses and gloves when handling starting batteries and electrolyte. Battery acid can cause serious burns if it contacts eyes or skin.

Servicing of batteries is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

Do not smoke or use an open flame when servicing batteries. Batteries generate an explosive gas during charging.

The replacement starting battery or batteries must be of equal size and cold cranking amps.

The generator controls must be in the off position when replacing the batteries.

Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

Do not open or mutilate the battery. Released electrolyte has been known to be harmful to the skin and eyes and to be toxic.

A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

1. Remove watches, rings, or other metal objects
2. Use tools with insulated handles

Vented Batteries

The installation of the engine generator shall provide enough ventilation to ensure that gases generated by vented batteries during charging or caused by equipment malfunction are removed.

The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. It is electrically conductive and corrosive. The following procedures are to be observed:

1. Wear full eye protection and protective clothing
2. Where electrolyte contacts the skin, wash it off immediately with water
3. Where electrolyte contacts the eyes, flush thoroughly and immediately with water
4. Spilled electrolyte is to be washed down with an acid-neutralizing agent. A common practice is to use a solution of 500 g (1 lb) bicarbonate of soda solution to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.

Lead acid batteries present a risk of fire because they generate hydrogen gas. The following procedures are to be followed:

1. DO NOT SMOKE when near batteries
2. DO NOT cause flame or spark in battery area
3. Discharge static electricity from body before touching batteries by first touching a grounded metal surface

TIM-ID: 0000072836 - 001

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

1.7.1 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 6R0120 DS180 (180 kW Standby) 27
3.2 Parts List - Shop Order 95130600566 31

DIESEL GENERATOR SET
MTU 6R0120 DS180

180 kWe / 60 Hz / Standby
208 - 600V

Reference MTU 6R0120 DS180 (163 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	180	180	180	180	180	180	180
kVA	180	180	225	225	225	225	225
Amps	750	750	625	541	342	271	217
skVA@30% Voltage Dip	268	366	433	433	362	451	375
Generator Model	432CSL6210	432PSL6228	431CSL6206	431CSL6206	431CSL6206	431CSL6204	431PSL6242
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: 0000098761 - 005

STANDARD FEATURES*

// MTU Onsite Energy is a single source supplier
// Global Product Support
// 2 Year Standard Warranty
// OM926LA Diesel Engine
- 7.2 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: 0000098761 - 005

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

APPLICATION DATA

// Engine

Manufacturer	Mercedes-Benz
Model	OM926LA
Type	4-Cycle
Arrangement	6-Inline
Displacement: L (in^3)	7.2 (439)
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)	247 (331)
Speed Regulation	±0.25%
Air Cleaner	Dry

// Liquid Capacity (Lubrication)

Total Oil System: L (gal)	29 (7.7)
Engine Jacket Water Capacity: L (gal)	10 (2.6)
System Coolant Capacity: L (gal)	24.1 (6.4)

// 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)	2.6 (8.5)
Recommended Fuel	Diesel #2
Total Fuel Flow: L/hr (gal/hr)	330.5 (87.3)

// Fuel Consumption *

At 100% of Power Rating: L/hr (gal/hr)	50 (13.2)
At 75% of Power Rating: L/hr (gal/hr)	36 (9.5)
At 50% of Power Rating: L/hr (gal/hr)	23.9 (6.3)

* Based on 431CSL6204 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)	88.8 (5,430)
Heat Rejection to Air to Air: kW (BTUM)	54 (3,071)
Heat Radiated to Ambient: kW (BTUM)	38.3 (2,178)
Fan Power: kW (hp)	15.6 (22.1)

// Air Requirements

Aspirating: *m^3/min (SCFM)	14.3 (505)
Air Flow Required for Rad. Cooled Unit: *m^3/min (SCFM)	408 (14,408)
Remote Cooled Applications; Air Flow Required for Dissipation of Radiated Generator Set Heat for a Max. of 25 °F Rise: *m^3/min (SCFM)	139.9 (4,941)

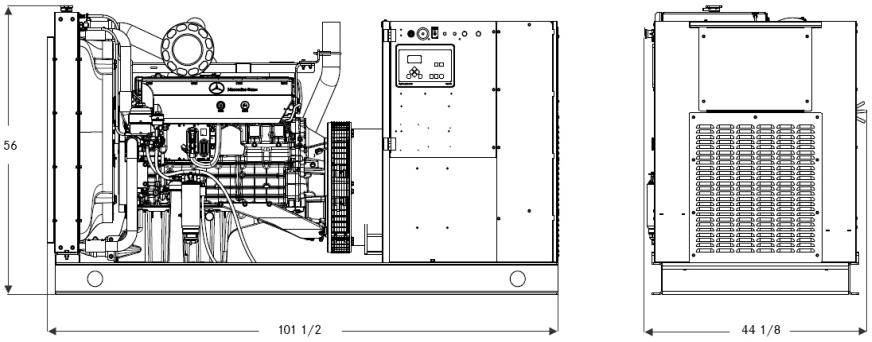
* Air density = 1.184 kg/m^3 (0.0739 lbm/ft^3)

// Exhaust System

Gas Temp. (Stack): °C (°F)	491 (916)
Gas Volume at Stack Temp: m^3/min (CFM)	43 (1,519)
Max. Allowable Back Pressure: kPa (in. H_20)	10.5 (42)

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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)	2,580 x 1,121 x 1,422 mm (101.57 x 44.13 x 56 in)	1,632-2,120 kg (3,598-4,674 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)	88.8

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
3.93	1.2	0.06

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 95130600566

ORDER SUMMARY

BASIC INFORMATION			
SALES ORDER #: (1 per Sales Order)	132033444		
MATERIAL/SLU #: (1 per Sales Order)	DG06RM120A2N	**MODEL #:** (1 per Sales Order)	MTU 6R0120 DS180
APPLICATION:	☒ Standby ☐ Prime	**kW:** (1 per Sales Order)	180
DOC TYPE / QTY	With Unit: 2 HARDCOPY 1 CD _____ 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. 403010961	1. 95130600566	1. 06/09/2017

Configuration Summary

MTU 6R0120 DS180
DG06RM120A2N

```
Customer:           Central Power Systems & Services,

Project:            303210697
MTU Order:          1320334
                    15.05.2017

II.                 Selection Criteria for the Scope of Supply

Criteria
                    Selection          for Product No.
Frequency           60 Hz              1-4,
Voltage for starters                   480 V              1-4,
Phase               3 Phase            1-4,
Unit Specification  UL2200             1-4,
IBC Certification   Without IBC        1-4,
```

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OSHPD Certification	Without OSHPD	1-4,	
Engine Model	6R 7.2L OM926LA (12volts)		1-4,
Exhaust Emissions (EPA)		EPA "Nonroad" T. 3 Stationary (40 CFR 60)	
	1-4,		
Radiator Design Temperature		50°C	1-4,
Temp Rise	105°	1-4,	
Power Output	180 kW	1-4,	
Generator Frame and Wire Qty		431/6206 (12 Wire)	1-4,
Generator Wire Configuration		Wye	1-4,
OPU/HSD	Level 3 - Maximum Sound Attenuation		1-4,
Fuel Tank	with tank	1-4,	
Control Panel	With Control Panel	1-4,	
Circuit Breaker Options		Single Circuit Breaker	1-4,
Breaker Wire Color Scheme		Standard Breaker Wire Color Scheme	1-4,
Paralleling	No Paralleling Operation		1-4,
Acceptance testing	Factory acceptance	1-4,	
Country of Operation		USA/Canada	1-4,
Emission cert. authority		18 US EPA Agency	1-4,

electrical
XZG21K0000002
XZG21K0000003
XZG21K0000004
XZG21K0000005
XZG21K0000009

dimensional
XZG2100100038
XZG2100100040
XZG2100100042

III. Scope of Supply

		valid for engine No.	
1	SYSTEM CONFIGURATION		1-4,
1.1	System Description	1-4,	
	Model: DG06RM120A2N		

DGC Program: 1320334

	1-4,		
1.2	Cooling Package	1-4,	
	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

	1-4,		
1.3	Circuit Breaker	1-4,	

Circuit Breaker: Option 1

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*For technical data refer to the circuit breaker enclosure data sheets located on the business portal.
1-4,

Circuit Breaker: Position 1

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

1-4,
Single Circuit Breaker
1-4,
Circuit Breaker Position 1:
1-4,
225 Amp 3 Pole 100% CB SQ-D JDL36225CLC
1-4,
Circuit Breaker #1 Accessories:
1-4,
Auxillary Contact
1-4,
Standard Breaker Wire Scheme:
- Phase 1 (A) is Black label "L1"
- Phase 2 (B) is Red label "L2"
- Phase 3 (C) is Blue label "L3"
- Neutral is White label "NEU"

1-4,
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.

1-4,
1.4 Starting Aids 1-4,
Starting Battery (Group 31), Cables & Battery Rack
- Battery Rack mounted and installed
- Battery Group 31 Starting Battery filled with acid
- Qty 1 1-4,

Battery Charger: MicroGenius 10A
- 150W
- 10 Amp
- 12V
- NFPA 110 1-4,

Battery Charger Mounted & AC/DC Wired
1-4,
With Coolant Preheating
1-4,
Block Heater
- -20 Deg F Block Heater (120V 1PH - 1500W)

TIM-ID: 0000112183 - 001

• Model: TPS151GT10-005
• Qty 1 1-4,
Block Heater Mounted & AC Wired
1-4,
1.5 Genset Enclosure 1-4,
Level 3
• Weather proof enclosure constructed of heavy gauge steel or aluminum with fixed storm proof panels. Enclosure consists of a bolted and welded construction. Hinged, lockable double-door access on both sides of the enclosure. Includes UL 94 HF-1 compliant, 1.5" thick sound attenuated foam insulation installed where applicable.
1-4,
Weather Proof Enclosure - Steel
1-4,
130mph Wind Rated
1-4,
Sound Attenuation Kit
1-4,
Sound Attenuation Kit
1-4,
Exhaust Scoop - Steel
1-4,
1.6 Vibration Isolation 1-4,
SUA63015 Pad Isolators
• ¼ inch thick elastomeric pad in rectangular shape placed under the base frame at each of the pre-drilled isolator mounting holes
1-4,
2 ENGINE CONFIGURATION 1-4,
2.1 Engine System 1-4,
6R 7.2L OM926LA Charged Air Cooling
1-4,
Note Emission Compliance
The engines and/or systems, if certified, may only be certified to comply with the required country or region specific emission regulations. Where applicable, the engines and/or systems are only certified to those specific emission regulations/standards which are clearly stated in the respective RRPS/MTU defined technical specifications. IT IS THE CUSTOMER'S SOLE RESPONSIBILITY TO ENSURE THAT THE EXPORT/IMPORT, INSTALLATION AND USE OF THE ENGINE AND/OR SYSTEM COMPLIES WITH THE APPLICABLE EMISSION REGULATIONS IN THE COUNTRY OR REGION WHERE THE ENGINE AND/OR SYSTEM WILL BE USED.
1-4,
2.2 Exhaust System 1-4,
Unit-Mounted Hospital Grade Silencer 5"
• Provides 35-40dB of sound attenuation
• Silencer Model Number: CPJS-05X-90040066
• Qty 1 1-4,
2.3 FUEL SYSTEM 1-4,
TANK FUEL SUB BASE 24HR 400 GALLON
1-4,

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2.4 Air Intake System 1-4,
Air Filter (Standard)
1-4,
3 GENERATOR CONFIGURATION 1-4,
3.1 Generator Specification 1-4,
Generator Model Number: 431/6206
1-4,
3.2 Generator accessories 1-4,
PMG with DVR 2000E+
• True RMS Sensing – One or Three Phase Connect. Senses 95 to 600 volts ±10% at 50/60 Hertz. Patented circuitry senses true RMS voltage rather than average for superior load regulation.
1-4,
4 CONTROL PANEL CONFIGURATION 1-4,
4.1 Control panel 1-4,

Control Panel: Option 1

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

1-4,

Control Panel: LH Mounted

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

1-4,
(4) Relay Option
The 4-relay board includes (4) 10 amp form C relays customizable for user defined functionality requirements. Standard outputs are as follows:
1. Engine Run
2. Engine Run
3. Engine Fail
4. Minor Alarm
1-4,
High Fuel Level Pre-Alarm
1-4,
Critical Low Fuel Level Alarm
1-4,
MGC-1500 Series
• 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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	1-4,	
	No Parallel Operation	
	1-4,	
5	SERVICES AND AFTER SALES SUPPLY	1-4,
5.1	Warranty	1-4,
	5 Year/3000 Hour Comp Extended Standby Limited Warranty	
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6	MISCELLANEOUS	1-4,
6.1	Painting	1-4,
	Paint Color: RAL 7001 Grey	
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6.2	Documentation	1-4,
	1 CD Format	
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	English	
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	English	
	1-4,	
	2 Hard Copy	
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	Spanish	
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	Standard Commercial Test	
	1-4,	
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	Ship Unit Wet - Fluids Installed	
	1-4,	
	Genset Unit is enclosed in a Shipping Bag	
	1-4,	

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Raw Material Components

Material	Material Description	Requirement quantity	Base Unit of Measure
XSG21200.00003	RADIATOR FOR GENSET	1	PC
XG2162500001	FAN COUPLING	1	PC
XD0341100001	RADIATOR FOR GENSET	1	PC
XG2122700002	FAN	1	PC
SUA103046	SENSOR LOW WATER LEVEL "ROCHESTER GAUGE"	1	PC
SUA95313	WASHER, FLAT HARDENED, M8 X 8.4MM ID X 1	8	PC
SUA88932	HEX CAP SCREW M8-1.25 X 25MM 8.8 DIN 933	6	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
SUA106935	TUBE JW LOWER - 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
SUA106934	TUBE JW UPPER - 150-225KW OM926	1	PC
SUA106932	TUBE CAC LOWER - 150-225KW OM926	1	PC
XG2120200002	HOSE	1	PC
SUA97555	CLAMP HOSE CONSTANT TENSION BREEZE CT-35	4	PC
XG2120200003	HOSE	1	PC
SUA106931	TUBE CAC UPPER - 150-225KW OM926	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
XG2162500002	DUCT	1	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	8	PC
SUA47505	FITTING HOSE 1/4-18 MALE PIPE TO 3/8" ID	1	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	2	FT
SUA43350	CLAMP HOSE SIZE 1	4	PC
SUA47506	FITTING HOSE 3/8-18 MALE PIPE TO 3/8" ID	1	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	2	FT
XG2120500002	BANJO UNION FOR GENSET	1	PC
SUA57040	PETCOCK 1/4" NPT MCMASTER-CARR 4921K16	1	PC
SUA89200	WASHER M8 DIN 127 ZINC PLATED SPLIT LOCK	4	PC
SUA107086	BRACKET LOWER CAC - 150-225KW OM926	1	PC

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ORDER SUMMARY

Material	Material Description	Requirement quantity	Base Unit of Measure
SUA44319	CLAMP MUFFLER 2 3/4"	1	PC
SUA102088	8X1.25X40MM HEX HEAD 10.9 ZINC	4	PC
SUA72679	CLAMP SUPPORT PLASTIC COATED	3	PC
SUA102014	6 WORM DRIVE CLAMP 7/16 TO 25/32	1	PC
XG2141100018	HOSE	3	FT
XSG21200.00002	RADIATOR FOR GENSET	1	PC
XG2141100003	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
XSG21300.00108	COOLANT	1	PC
SUA100490	COOLANT	19	GAL
XSG21300.00109	CIRCUIT BREAKER	1	PC
SUA90090	1A 1B + ALARM SWITCH (BELL ALARM) SQ-D	1	PC
SUA93571	TERMINAL BLOCK, MARKERS BLANK	3	PC
SUA93573	DOUBLE DOUBLE 20A MAX ST 2.5-QUATTRO	3	PC
XD0442400003	WIRING HARNESS FOR GENSET	1	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

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Material	Material Description	Requirement quantity	Base Unit of Measure
XSG30340.00087	BATTERY	1	PC
SUA120299	BATTERY 12V HP-31 ENGINE STARTING BATTER	1	PC
XSG21300.00032	HEATER FOR GENSET	1	PC
SUA106825	ADAPTER FLANGE TO 1/2" NPT - OM900	1	PC
XG3030100537	PIPE	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	3.4	FT
SUA80452	HOSE 5/8" ID 2 PLY GREEN STRIPE (300' SP	1.6	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
SUA43344	CLAMP SUPPORT 1" PLASTIC COATED	1	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	1	PC
XSG21230.00005	BASE FOR GENSET	1	PC
SUA88919	HEX CAP SCREW M12-1.75 X 60MM 8.8 DIN 93	2	PC
SUA91896	MOUNT VIBE UNIT TO BASE EBCO 4610-060 (K	2	PC
SUA102667	BRACKET FRONT ENGINE FEET OM926	2	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	4	PC
SUA47719	WASHER FLAT1/2" ZINC PLATED USS	4	PC
SUA88918	HEX CAP SCREW M12-1.75 X 45MM 8.8 DIN 93	2	PC
SUA95905	CAP SCREW M12-1.75 X 35MM 8.8 DIN 933 FU	16	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	20	PC
SUA77289	MOUNT VIBE RUBBER CONE K-61 70 DUROMETER	2	PC
SUA95977	PLUG DOME 3" DIAMETER HOLE CONVEX MATTE	4	PC
SUA104983	PLUG	2	PC
SUA106902	BASE HOUSED HSD 112L X 48W X 8H - 150-22	1	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	4	PC
XG2101500003	COLLARED BUSHING	2	PC
XSG21180.00003	OIL DRAIN VALVE FOR GENSET	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA106595	QUICK RELEASE OIL DRAIN VALVE WITH 90 DE	1	PC
SUA107858	OIL DRAIN EXTENSION ADAPTER 20MM-1.5	1	PC
XSG21180.00004	OIL DRAIN LINE FOR GENSET	1	PC
SUA43314	HOSE 3/8" ID 50 PSI (FUEL) (UL) GATES 42	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
XSD03990.00001	WIRING HARNESS	1	PC
XD0342400006	WIRING HARNESS FOR GENSET	1	PC
XSD04990.00001	WIRING HARNESS	1	PC
SUA107220	HARNESS ENGINE ALTERNATOR OM926	1	PC
XSG21240.00005	ENGINE FOR GENSET	1	PC
SUA107007	ENGINE MERCEDES-BENZ OM926 1800RPM SAE 2	1	PC
XG2100400004	ADHESIVE LABEL	1	PC
XSG21140.00001	EXHAUST SILENCER FOR GENSET	1	PC
SUA107852	TUBE FLEX EXHAUST TURBO - OM926 (W/ MTU	1	PC
SUA96347	CLAMP V-BAND 3-1/2 INCH DIAMETER	1	PC
XG2114500002	SILENCER	1	PC
SUA106996	CLAMP MOUNTING MUFFLER 14" DIA	2	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	12	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	4	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	6	PC
SUA95530	CAP SCREW HEX M8-1.25 X 45MM 8.8 DIN 933	2	PC
XSG21880.00037	FUEL TANK	1	PC
XG2141200021	DIESEL FUEL TANK FOR GENSET	1	PC
SUA89700	CAP VENT EMERGENCY 4" NPT UL LISTED FOR	2	PC
SUA48670	NIPPLE PIPE 2" NPT X 4" LG SCHED 40 THRE	1	PC
SUA42239	CAP FUEL FILL 2" NPT FEMALE LOCKING STD	1	PC
SUA82415	NIPPLE PIPE 2" NPT X 6" LG SCHED 40 THRE	1	PC
SUA78989	VENT TANK 2" MUSHROOM STYLE USED AS N0RM	1	PC
SUA79028	SWITCH FLOAT FULLY ASSEMBLED 35" W/ 1 1/	1	PC
SUA44640	PLATE FUEL LEAK SWITCH	1	PC
SUA74456	PLATE FUEL TANK NORMAL VENT	1	PC
SUA74458	PLATE FUEL FILL DIESEL FUEL ONLY	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA74459	PLATE FUEL SUPPLY TO ENGINE	1	PC
SUA74457	PLATE FUEL RETURN TO TANK	1	PC
SUA94436	WASHER, FLAT HARDENED, M16 X 17MM ID X 3	16	PC
SUA89103	LOCK NUT M16 X 2.0 DIN 985 NYLON INSERT	8	PC
SUA88802	CAP SCREW M16-2.0 X 50MM 8.8 DIN 933 FUL	8	PC
XG2188100015	LEVEL GAUGE FOR FUEL TANK	1	PC
SUA107859	STEP 36 INCHES REMOVABLE OM920	1	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	12	PC
SUA88918	HEX CAP SCREW M12-1.75 X 45MM 8.8 DIN 93	6	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	6	PC
SUA63015	MOUNT VIBE PAD 3 X 8 X 1/4 SP NEOPRENE	8	PC
SUA33107	TAPE FOAM INSULATION 3/8" X 1 1/2"W	28	FT
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
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
XSG21070.00002	FUEL SYSTEM FOR GENSET	1	PC
SUA47414	NIPPLE PIPE SCHED 40 BLK	1	PC
SUA105647	CHECK VALVE 1/2" FNPT NICKEL	1	PC
SUA47441	BUSHING PIPE 1/2" X 3/8" BLACK STEEL HEX	2	PC
SUA100962	ADAPTER 3/8" NPT (MALE) TO 6 JIC 37DEG	2	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
XG21K4700006	BANJO UNION	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
XG21K4700007	WASHER	2	PC
XG21K4700005	BANJO SCREW	1	PC
SUA73698	CLAMP HOSE 2 EAR UL SP FOR 5/8" FUEL HO	4	PC
XSG21180.00008	ENGINE OIL	1	PC
SUA89619	OIL FOR WEIGHT CALCULATION ONLY	14	PC
XSG21120.00001	AIR FILTRATION SYST FOR GENSET	1	PC
SUA43303	ELBOW HOSE RUBBER 4" 90 DEG USED ON AIR	1	PC
XG2112300003	AIR INTAKE PIPE	1	PC
XG2112100001	AIR FILTER	1	PC
SUA106994	BRACKET MOUNTING MUFFLER REAR - OM924 OM	1	PC
SUA107002	SPACER MOUNTING MUFFLER - OM924 OM926	1	PC
SUA106992	BRACKET MOUNTING MUFFLER TOP - OM926	1	PC
SUA106995	BRACKET MOUNTING MUFFLER FRONT - OM924 O	2	PC
SUA95544	WASHER, FLAT HARDENED, M12 X 13MM ID X 2	2	PC
SUA96710	LOCK NUT M12-1.75 DIN 985 ZINC PLATED NY	1	PC
SUA95531	CAP SCREW, HEX, M12-1.75 X 65MM 8.8 DIN	1	PC
SUA107671	BOLT FLANGE M10-1.5 X 25MM CLASS 10.9 DI	4	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	8	PC
SUA44323	CLAMP MUFFLER 4"	2	PC
SUA88933	HEX CAP SCREW M8-1.25 X 30MM 8.8 DIN 933	4	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	4	PC
SUA43339	CLAMP HOSE 3" TO 5 1/2" OD HEX HEAD WORM	2	PC
SUA43339	CLAMP HOSE 3" TO 5 1/2" OD HEX HEAD WORM	1	PC
XSG21340.00024	GENERATOR	1	PC
SUA107715	GENERATOR 431/6206 SAE 2 FLYWHEEL 11 1/2	1	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
XSG21500.00050	VOLTAGE REGULATOR	1	PC
SUA102880	VOLTAGE REGULATOR	1	PC
SUA95527	K-LOCK NUT, M4-0.7 KEP ZINC PLATED	4	PC
XSG21340.00001	GENSET COMPONENTS	1	PC
SUA102878	GENERATOR ACCESSOR	1	PC
XSG21500.00059	CONTROL PANEL	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA105389	MGC-1520 (MICROPROCESSOR DGC-2020ES LEVE	1	PC
XSG21300.00070	WIRING HARNESS FOR GENSET	1	PC
XD0430900002	WIRING HARNESS	1	PC
XSG31500.00019	CABLING	1	PC
SUA100225	RELAY SOCKET 12V DC 14MM PLC BASIC TERMI	4	PC
SUA106063	HARNESS WIRING W/4 RELAY - 30-225KW	1	PC
SUA106165	RELAY SOCKET CONTINUOUS PLUG-IN BRIDGE P	2.25	"
SUA106165	RELAY SOCKET CONTINUOUS PLUG-IN BRIDGE P	1	"
SUA90460	TERMINAL BLOCK MARKER BLANK	4	PC
SUA98838	RELAY 1PDT 12VDC/21HC AU 2961532	4	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
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
XSG21300.00016	HOUSING FOR GENSET	1	PC
SUA106876	ENCLOSURE KIT 150MPH STEEL	1	PC
SUA45222	FLANGE ANGLE RING 7" I.D. --SP	1	PC
SUA77163	STRAP DOOR GROUNDING 12.5L 5/16 RING LUG	4	PC
SUA77784	LATCH FLUSH MOUNTED FOLDING T-HAND ADJUS	4	PC
SUA82538	FOAM INSULATION 5/8" X 3/8" DOMED W.STRI	44	FT
SUA82554	FOAM INSULATION 3/4" WIDE X 1/16" THICK	16	FT

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA88978	LOCK NUT 10-24 18-8 STAINLESS STEEL NYLO	16	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	48	PC
SUA89001	WASHER LOCK 5/16" ZINC PLATED EXTERNAL T	8	PC
SUA93424	FLANGE BOLT PLATED	33	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	174	PC
SUA96031	BOLT ON (BLIND) POWDER BLACK STAINLESS P	12	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	146	PC
SUA96114	NUT FLANGE M10-1.5 DIN6923	27	PC
SUA101348	NUT FLANGE LOCK HEX NYLON-INSERT M6-1.0	52	PC
SUA107257	HANDLE SNAP-IN POCKET PULL, .070-.085 PA	2	PC
XSG21300.00043	HOUSING FOR GENSET	1	PC
SUA106886	SCOOP KIT HOUSING STEEL - 1	1	PC
SUA49563	14X3/4 WASHER TEK3	16	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	50	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	50	PC
XSG21300.00028	INSULATION FOR GENSET	1	PC
SUA107052	FOAM INSULATION KIT FOR HSG - 150-225KW	1	PC
XSG21300.00029	INSULATION FOR GENSET	1	PC
SUA107053	FOAM KIT SOUND ATTENUATION FOR SCOOP INS	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
XSG31300.00031	ADHESIVE LABEL FOR GENSET	1	PC
SUA77906	LABEL NOTICE NOT RESPONSIBLE FOR LOOSE C	1	PC
XSG31300.00052	ADHESIVE LABEL FOR GENSET	1	PC
SUA75981	PLATE RAINPROOF ENCLOSURE 1" X 2" BLACK	1	PC
XSG31300.00033	ADHESIVE LABEL FOR GENSET	1	PC
X00A00400015	LABEL	1	PC
XSG31300.00027	TAG FOR GENSET	1	PC
SUA72045	TAG CAUTION EXHAUST SYSTEM HAS BEEN SEAL	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
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
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
XSG21300.00100	CARRIER BAG	1	PC
SUA101375	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

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Material	Material Description	Requirement quantity	Base Unit of Measure
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
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
XSG32300.00282	WORK SCHEDULE	1	EA
TXT00016703	DUMMY FOR IPAS PM GASSYSTEM DEVELOPMENT	1	PC
XS575500.00553	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
SUA98208	BREAKER 225A 600V 3P SQUARE-D J-FRAME 10	1	PC
SUA105543	SCREW SOCKET HEAD CAP M5-.8 X 70MM CL 12	2	PC
XSG30300.02206	BATTERY CHARGER	1	PC
SUA77114	RELIEF STRAIN .17-.45 DIA (PLASTIC) LIQU	2	PC
XG3030100057	BATTERY CHARGER	1	PC
SUA101348	NUT FLANGE LOCK HEX NYLON-INSERT M6-1.0	4	PC
SUA95568	CAP SCREW M6-1.0 X 20MM 8.8 DIN 933 FULL	4	PC
XD0330100005	WIRING HARNESS	1	PC
SUA64005	LOOM WIRING 3/8" DIAMETER CONVOLUTED VIN	7	FT
XG3030100053	CORD	1	PC
X0KD00100009	TAG	1	PC
XSG21300.00085	WIRING HARNESS	1	PC
SUAMF140019	SUB ASSEMBLY	1	PC
XSG21500.00001	OUTLET HOUSING FOR GENSET	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
SUA107197	OUTLET BOX 430 FRAME, RH PRIMARY BREAKER	1	PC
SUA107198	PANEL BREAKER LOWER FULL 430 FRAME	1	PC
SUA107199	PANEL BREAKER LOWER SHORT - 430 FRAME	1	PC
SUA107276	PANEL VENT 430 GEN - OM924 OM926	1	PC
SUA107201	PANEL OUTLET BOX TOP 430 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
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	8	PC
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
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	15	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	7	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	11	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	11	PC
SUA95538	FLANGE BOLT, M6-1.0 X 16MM, DIN 6921 CLA	12	PC
SUA96086	WASHER FLAT NYLON 1/4 X 1/16 THICK	12	PC
XSG21500.00004	OUTLET HOUSING FOR GENSET	1	PC
SUA107249	PANEL BREAKER J-H-FRAME 430 GEN - OM924	1	PC
SUA107257	HANDLE SNAP-IN POCKET PULL, .070-.085 PA	2	PC
SUA34137	TRIM VINYL PROTECTIVE	2	FT
XSG21500.00012	OUTLET HOUSING FOR GENSET	1	PC
SUA107246	PANEL BREAKER BLANK CONTROLS SIDE 430 GE	1	PC
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
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
XSG21500.00062	ELECTRICAL EQUIPMENT	1	PC
SUA102705	ALARM BUZZER 12-24VDC STD PANEL ALARM SO	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
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
XG3130900013	ADHESIVE LABEL	1	PC
XSG21300.00113	ADHESIVE LABELS	1	PC
X00D30900004	ADHESIVE LABEL FOR GENSET	1	PC
SUA102766	LABEL SERVICE DISCONNECT	1	PC
XSG21140.00024	EXHAUST PIPE	1	PC
XG2114500006	EXHAUST PIPE	1	PC
XG2114100005	EXHAUST PIPE	1	PC
XG2141700003	BRACKET	1	PC
SUA44324	CLAMP MUFFLER 5"	2	PC
SUA94725	WASHER FLAT HARDENED M8 X 16MM	6	PC
SUA88931	HEX CAP SCREW M8-1.25 X 20MM 8.8 DIN 933	3	PC
SUA88992	LOCK NUT M8-1.25 DIN 985 ZINC PLATED NYL	3	PC
SUA45215	COLLAR STORM 5" SNAPPY --SP	1	PC
SUA44324	CLAMP MUFFLER 5"	1	PC

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ORDER SUMMARY

Material	Material Description	Requirement quantity	Base Unit of Measure
XSG21180.00007	ENGINE OIL	1	PC
SUA101639	15W-40 DIESEL ENGINE	1	GAL
XS00D000.06587	GENSET DOCUMENTATION ENGLISH	2	PC
SS180044/00E	SYSTEM DOCUMENTATION FOR GENSET	2	PC
XS00D000.06590	CD-ROM GENSET FOR DOCUMENTATION	1	PC
CDZ01753/00E	CD-ROM GENSET ENGLISH	1	PC
XSG21500.00091	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
SUA92611	LUG GROUND MECHANICAL COPPER SINGLE COND	1	PC
SUA90296	BOLT FLANGE 1/2-13 X 3/4" CASE HARDENED	1	PC
XSG21300.00125	ADHESIVE LABEL FOR GENSET	1	PC
SUA88487	DECAL "MTU/ONSITE" (X-LARGE) .	4	PC
XSG25300.00294	WIRE FOR GENSET	1	PC
SUA121110	HARNESS EXCITER WIRE EXTENSION VERIZON	1	PC
XSG21000.00028	ARRANGEMENT DRAWING F.CIRCUIT BREAKER	1	PC
XZG21K0000002	SYSTEM F.CIRCUIT BREAKER	1	PC
XSG21000.00029	ARRANGEMENT DRAWING FOR ENGINE	1	PC
XZG21K0000003	SYSTEM FOR DIESEL ENGINE	1	PC
XSG21000.00030	ARRANGEMENT DRAWING FOR GENERATOR	1	PC
XZG21K0000004	SYSTEM F.GENERATOR SYSTEM	1	PC
XSG21000.00031	ARRANGEMENT DRAWING FOR CONTROL PANEL	1	PC
XZG21K0000005	SYSTEM FOR CONTROL SYSTEM	1	PC
XSG21000.00035	ARRANGEMENT DRAWING OPTIONAL VERSIONS	1	PC
XZG21K0000009	SYSTEM OPTIONAL VERSIONS	1	PC
XSG30300.02396	LABEL	1	PC
XG3000100125	ADHESIVE LABEL	2	PC
SUA97884	DECAL LIFT POINT 2L X 2W ISO STANDARD	4	PC
XSG21000.00017	DIMENSIONAL DRAWING	1	PC
XZG2100100038	DIMENSIONAL DRAWING	1	PC
XSG21000.00019	DIMENSIONAL DRAWING	1	PC
XZG2100100040	DIMENSIONAL DRAWING	1	PC

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Material	Material Description	Requirement quantity	Base Unit of Measure
XSG21000.00020	DIMENSIONAL DRAWING	1	PC
XZG2100100042	DIMENSIONAL DRAWING	1	PC

TIM-ID: 0000112183 - 001

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. Additional data pertaining to fuel connection type is located on the mechanical drawings.	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
System Nameplate	Model number and serial number, complete electrical ratings, generator temperature rise and ambient ratings, and fuel pressure or flow ratings.	Refer to system nameplate on generator set

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

TIM-ID: 0000064637 - 002

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

TIM-ID: 0000055270 - 001

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.

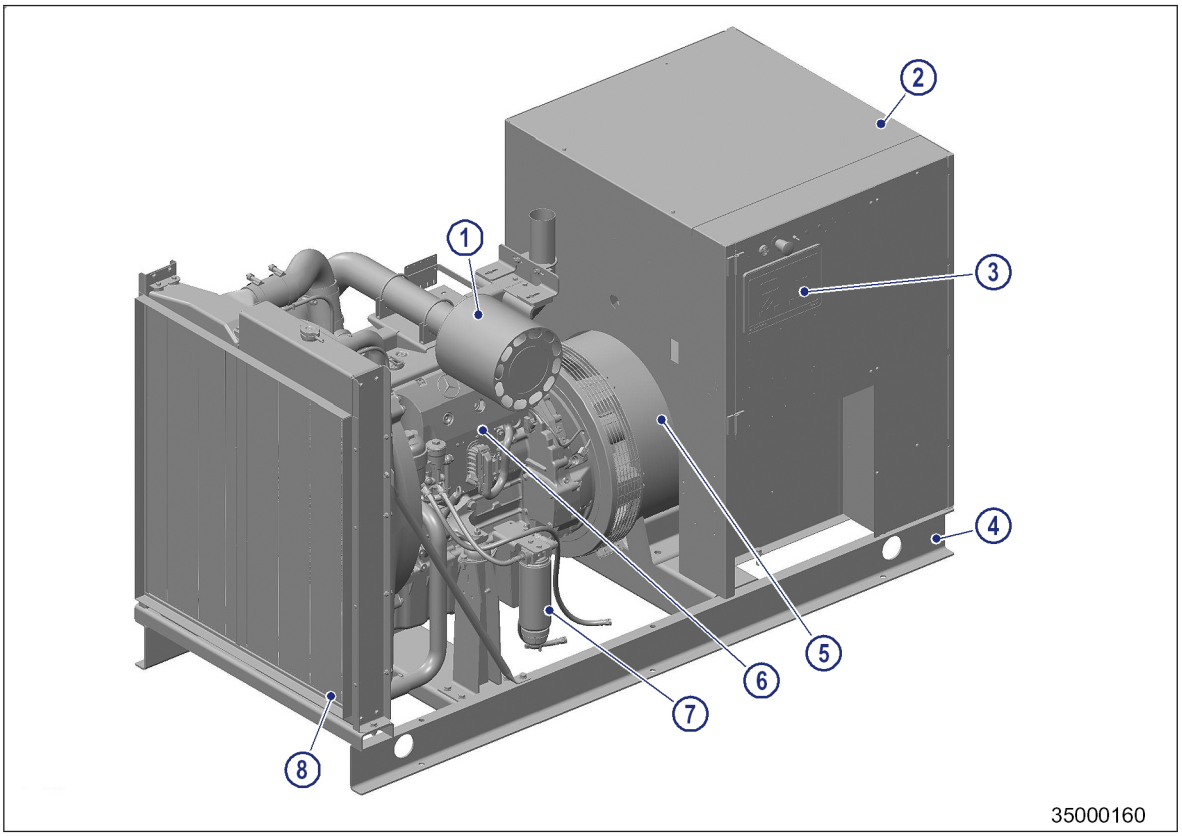


Figure 1: Engine-generator set with Mercedes-Benz OM924LA engine – Engine side

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

TIM-ID: 0000061850 - 001

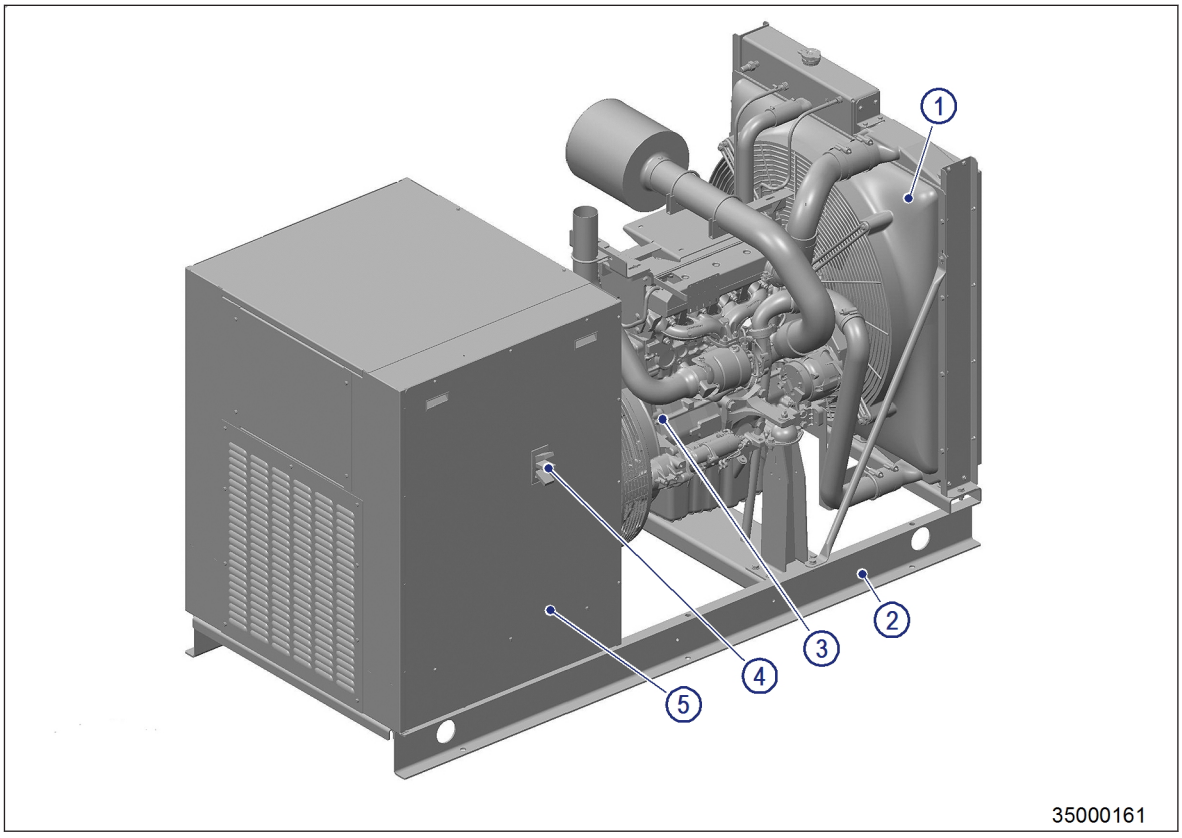


Figure 2: Engine-generator set with Mercedes-Benz OM924LA engine – Generator side

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

TIM-ID: 0000061850 - 001

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

TIM-ID: 0000061850 - 001

  - 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 53).

TIM-ID: 0000061850 - 001

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 267).

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.

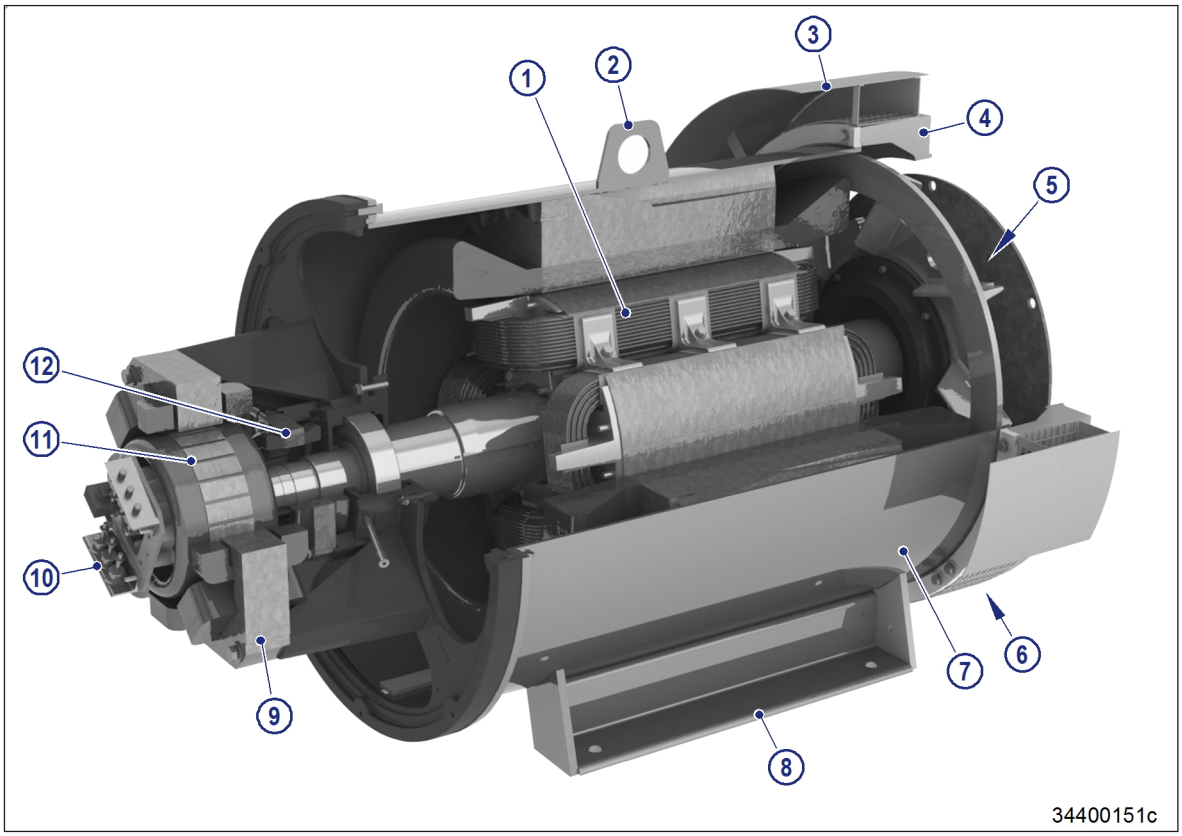


Figure 3: Generator interior view

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 63).

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.

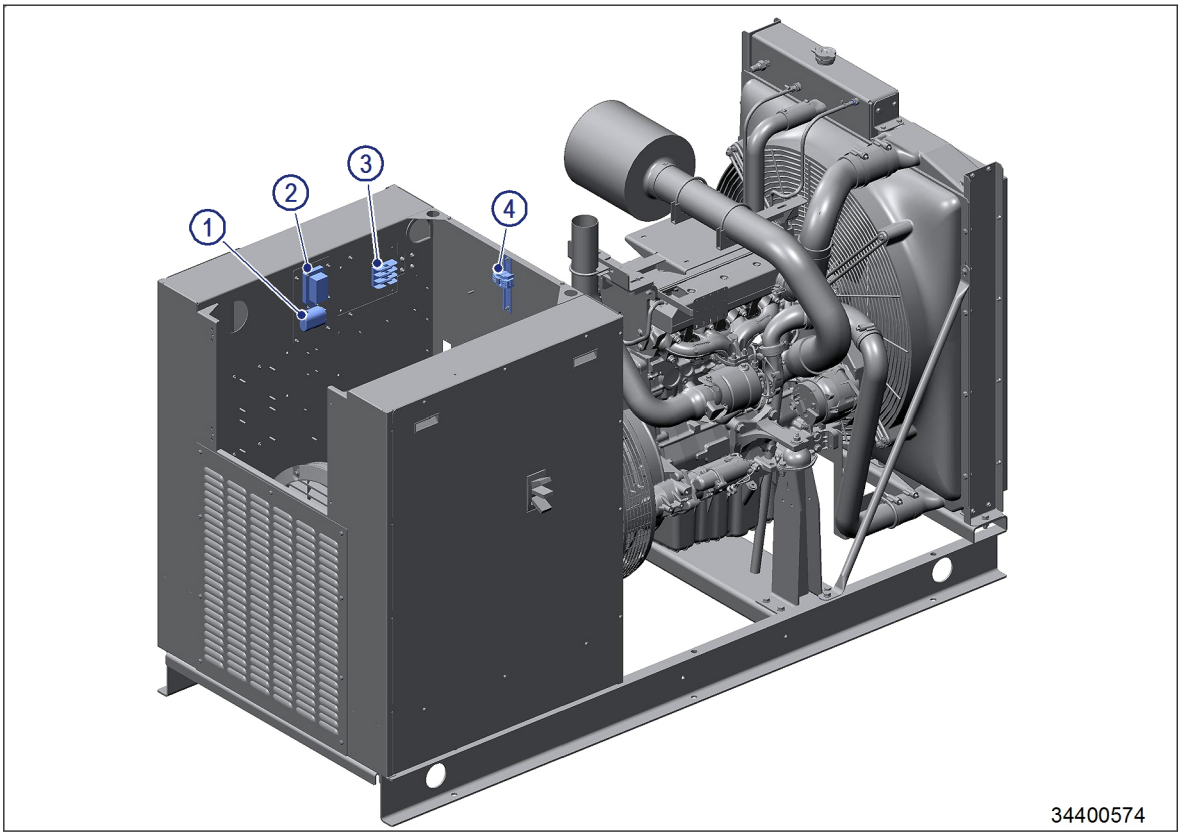


Figure 4: Generator outlet box

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 63).

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.

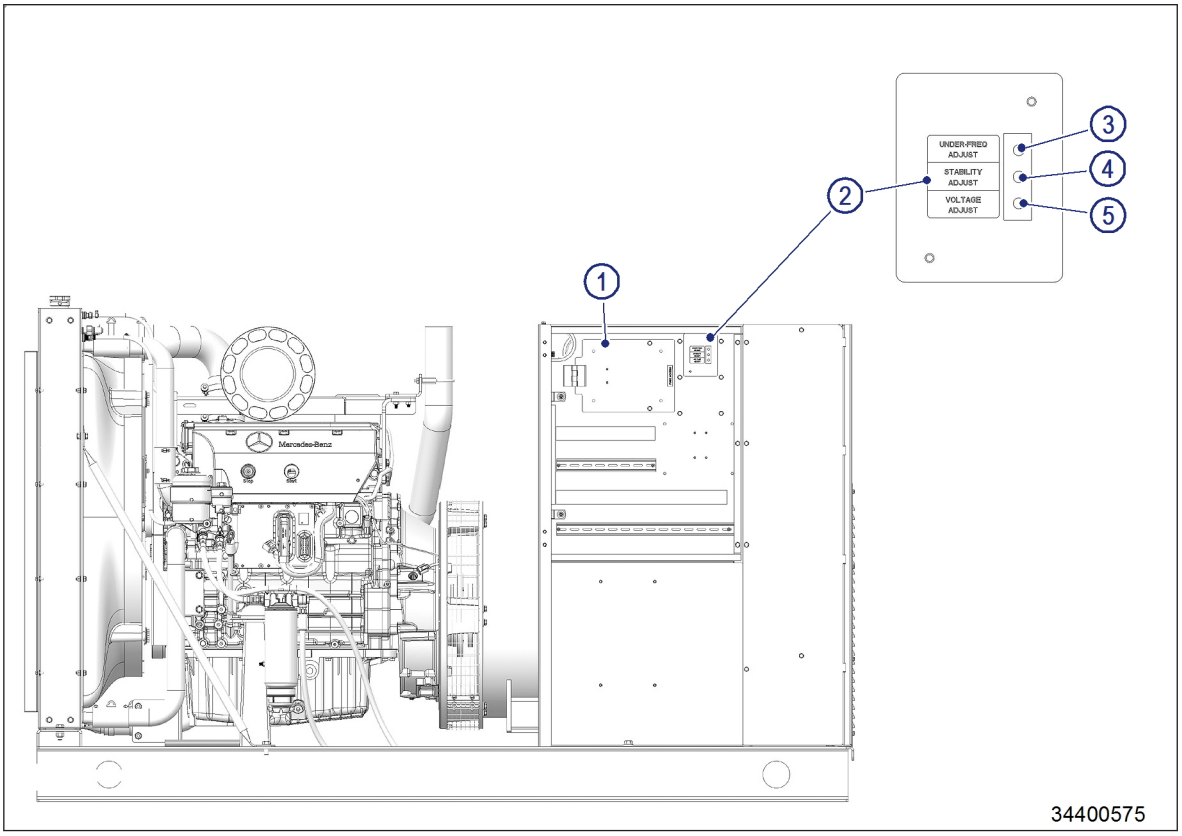


Figure 5: Analog voltage regulator (controls door removed for visibility)

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.

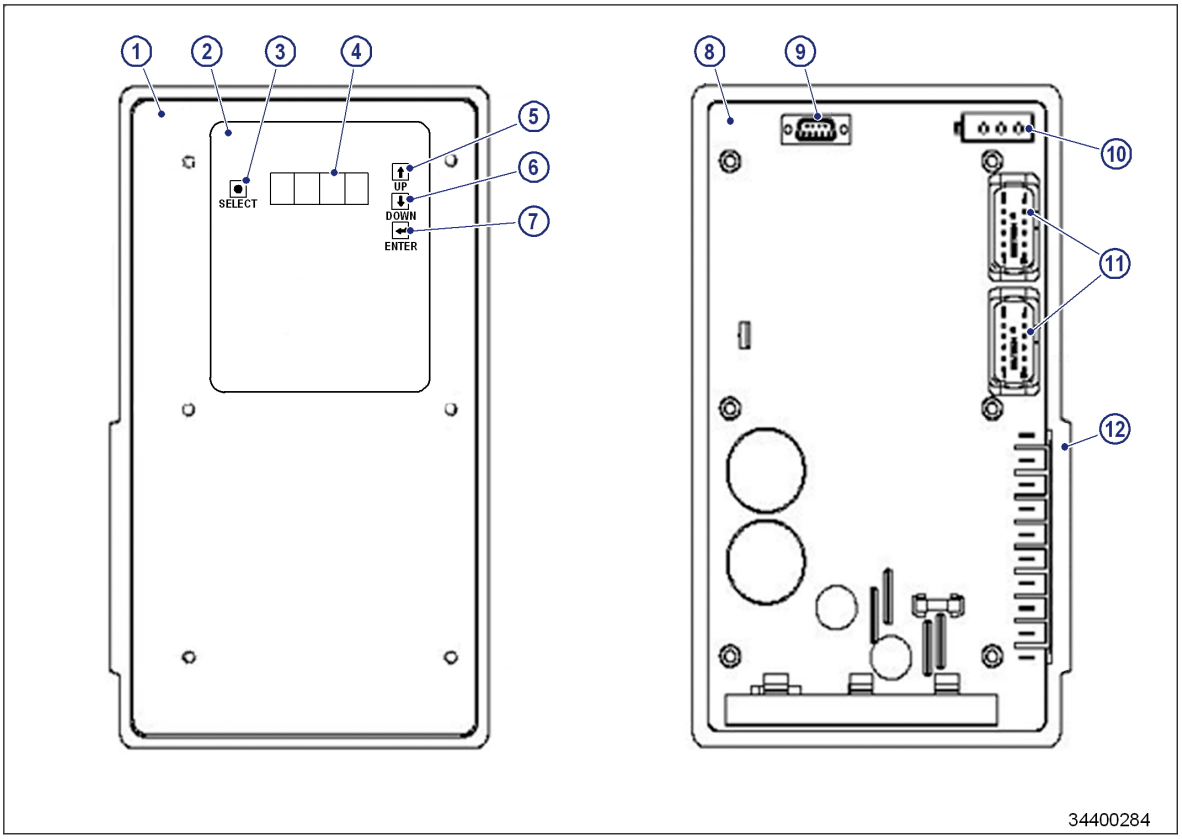


Figure 6: Digital voltage regulator panels

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.

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4.6 Engine-Generator Set Control Panel

4.6.1 Control panel enclosure with MGC Series Controller – 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 near 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.

MGC Series Digital Generator Set Controller

The MGC Series controller installed on MTU Onsite Energy engine-generator sets is a highly advanced, integrated engine-generator set control system. The MGC Series controller is perfectly focused, combining rugged construction and microprocessor technology to offer a product that holds up to almost any environment. The MGC Series controller 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.

MTU Onsite Energy offers three MGC Series controllers to meet the needs of your specific application. The MGC Series control panel is installed on engine-generator sets with management and monitoring in:

Description	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
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 7) shows the control panel enclosure with an MGC Series controller.

TIM-ID: 0000072832 - 001

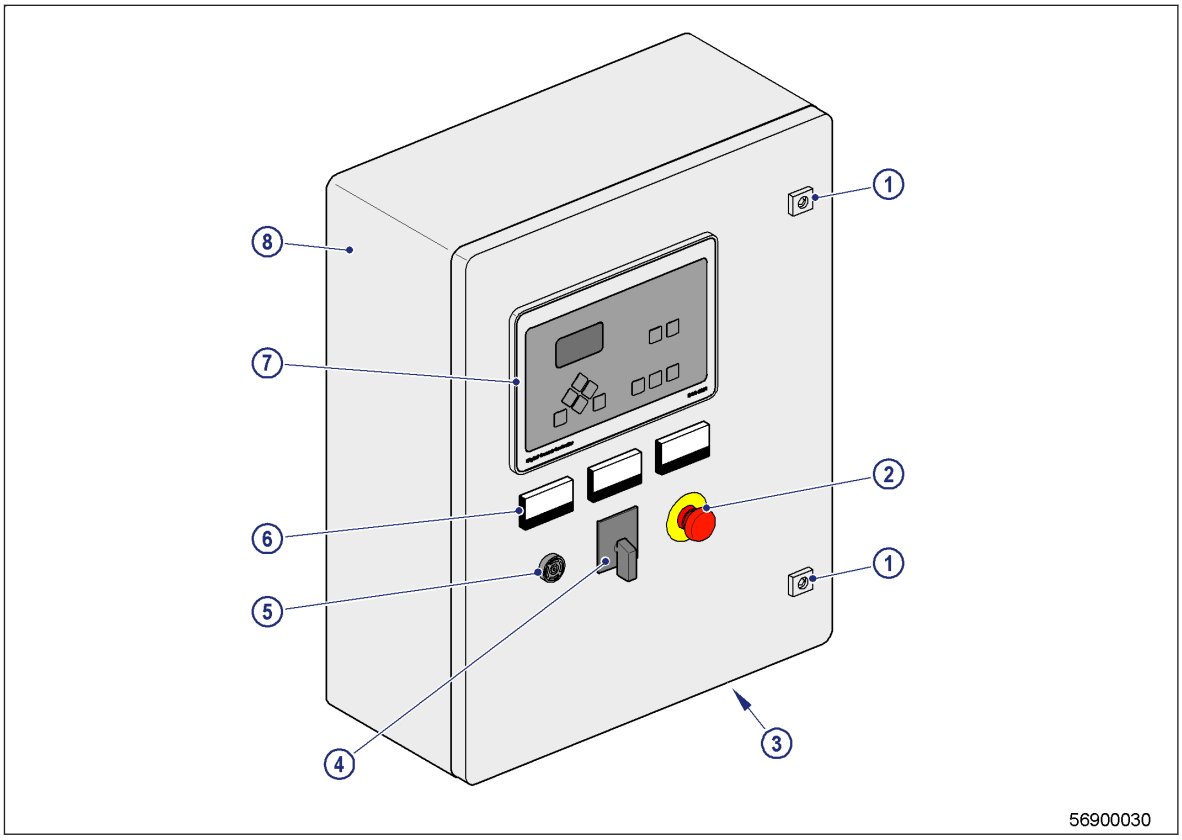


Figure 7: Control panel enclosure with MGC Series and meters – Exterior

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

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

Description	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
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		√	√

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Description	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
- Engine kW overload (three levels)	√	√	√
- Bus under/overvoltage	√	√	√
- Bus under/overfrequency	√	√	√
Contact outputs:	7	15	17
- Factory utilized: three 5 A at 28 VDC for Pre-start, Start, and Run, and four 2 A at 28 VDC for general purpose	√		
- 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	√	√	√
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

Description	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
Contact expansion module for additional contact inputs and outputs	√		
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			√

Contact expansion module (not available with all controllers)

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

TIM-ID: 0000072832 - 001

- 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 Series controller takes place via CAN bus.

Analog expansion module

The analog expansion module is a remote auxiliary device that provides additional analog inputs and outputs for MGC-2000 and MGC-3000. 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

Automatic synchronizer (MGC-3000 only)

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.

Functions

Engine-generator set protection	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
Generator protection:			
- Undervoltage	√	√	√
- Overvoltage	√	√	√
- Underfrequency	√	√	√
- Overfrequency	√	√	√
- Reverse power		√	√
- Loss of excitation		√	√
- Overcurrent	√	√	√
- Phase imbalance	√	MGC-2020, MGC-2050	√
- Rate of change of frequency		MGC-2020, MGC-2050	√
- Vector shift		MGC-2020, MGC-2050	√

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Engine-generator set protection	MGC-1500 Series	MGC-2000 Series	MGC-3000 Series
Engine-generator set alarms:			
- Low oil pressure	√	√	√
- Engine sender unit failure	√	√	√
- Battery charger failure			√
- Overcrank	√	√	
- 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 comms failure		√	√
- Breaker open failure		√	√
- CEM comms failure		√	√
- Generator reverse rotation		√	√
- Active Diagnostic Trouble Codes (DTC)		√	√
- Breaker close failure		√	√
- ECU Comms failure		√	
- Checksum failure		√	
- ID missing			√
- Intergenset communication failure			√
- Rated data and per unit values			√
- 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: 0000072832 - 001

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, 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 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
  - Engine maintenance timer
  - Pre-crank delay
  - Programmable logic timers
  - Arming time delays after crank disconnect for:
    Low oil pressure
    High coolant temperature

Event recording

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 VDC
Range	6 to 32 VDC
Power consumption in sleep mode	MGC-1500, MGC-2000: 5 W with all relays non-energized MGC-3000: 12.7 W - LCD heater off, all relays deenergized, and all analog outputs disabled
Power consumption in typical operation mode	MGC-1500: 6.5 W in RUN mode, with LCD heater off and three relays energized MGC-2000: 7.9 W in RUN mode, with LCD heater off and six relays energized MGC-3000: 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 158 °F)
	Storage:	-40 to 85 °C (-40 to 185 °F)
Humidity	IEC 68-2-38	
Salt Fog	MGC-1500, MGC-2000: ASTM B 17-73, IEC 68-2-11 (tested while operational) MGC-3000: IEC 60068	

TIM-ID: 0000072832 - 001

Environmental condition	Values	
Ingress Protection	IEC IP56 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	

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 on the main display operations, refer to the Display Operations section in this chapter that pertains to your MGC-Series controller.

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: 0000072832 - 001

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.

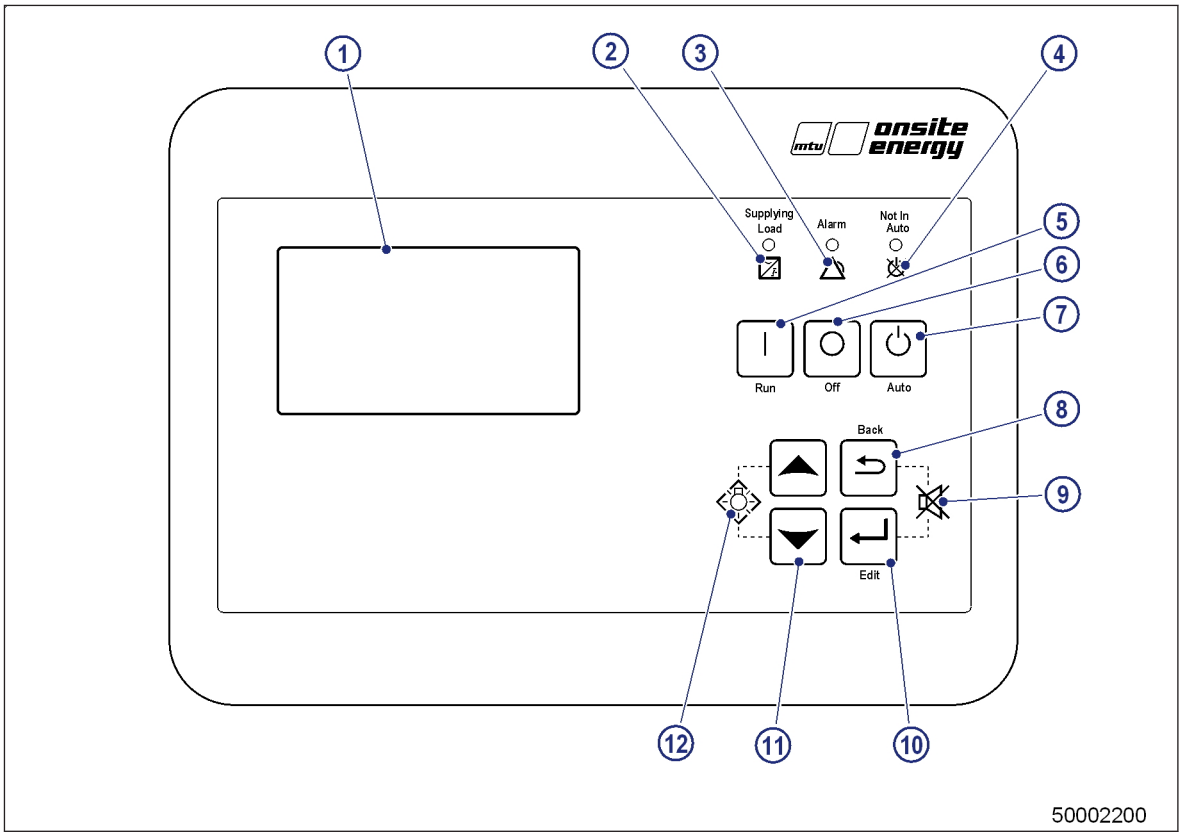


Figure 8: Control panel with MGC-1500 Series – Controls and indicators

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 - 003

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	Simultaneously pressing both the Back and Edit buttons 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. 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.

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.

TIM-ID: 0000055005 - 003

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.

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 - 003

4.6.3 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 9)shows the display of the MGC-2000 Series in detail.

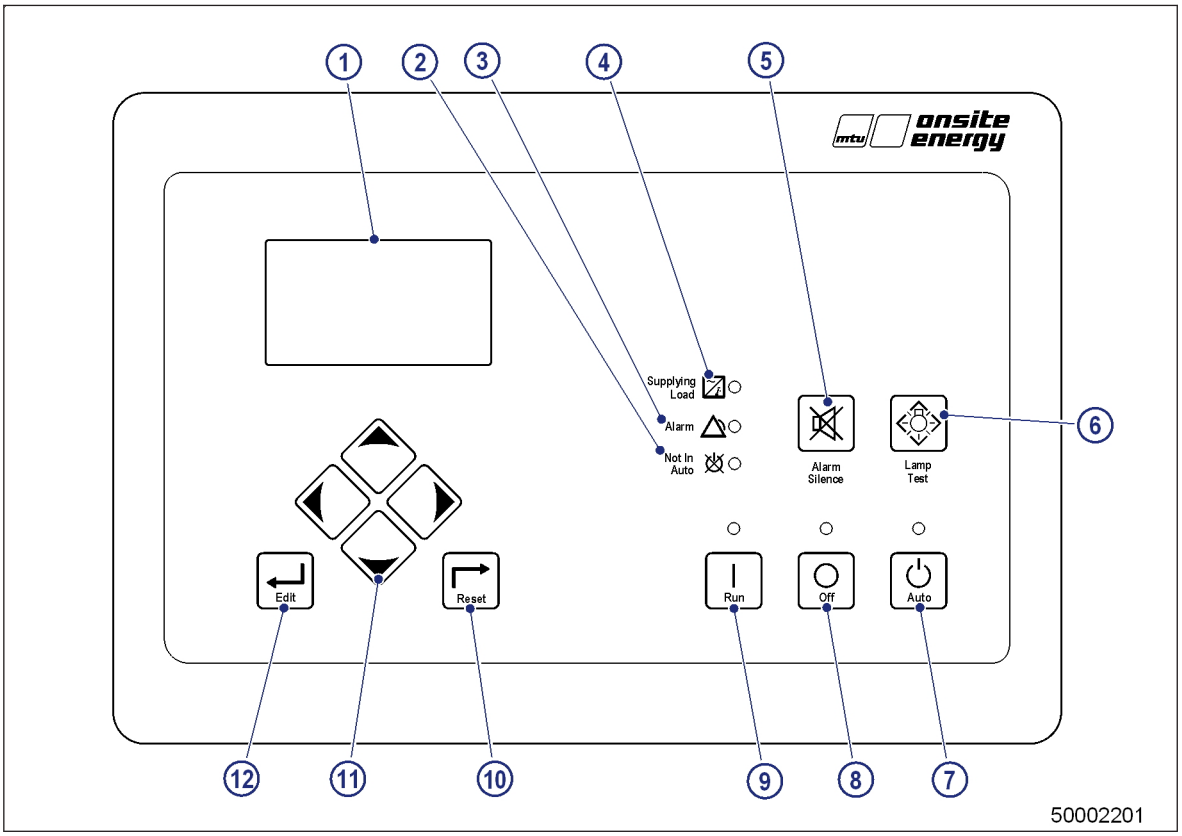


Figure 9: Control panel with MGC-2000 Series – Controls and indicators

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 9).		

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 9).		

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

4.6.4 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 10) shows the display of the MGC-3000 Series in detail.

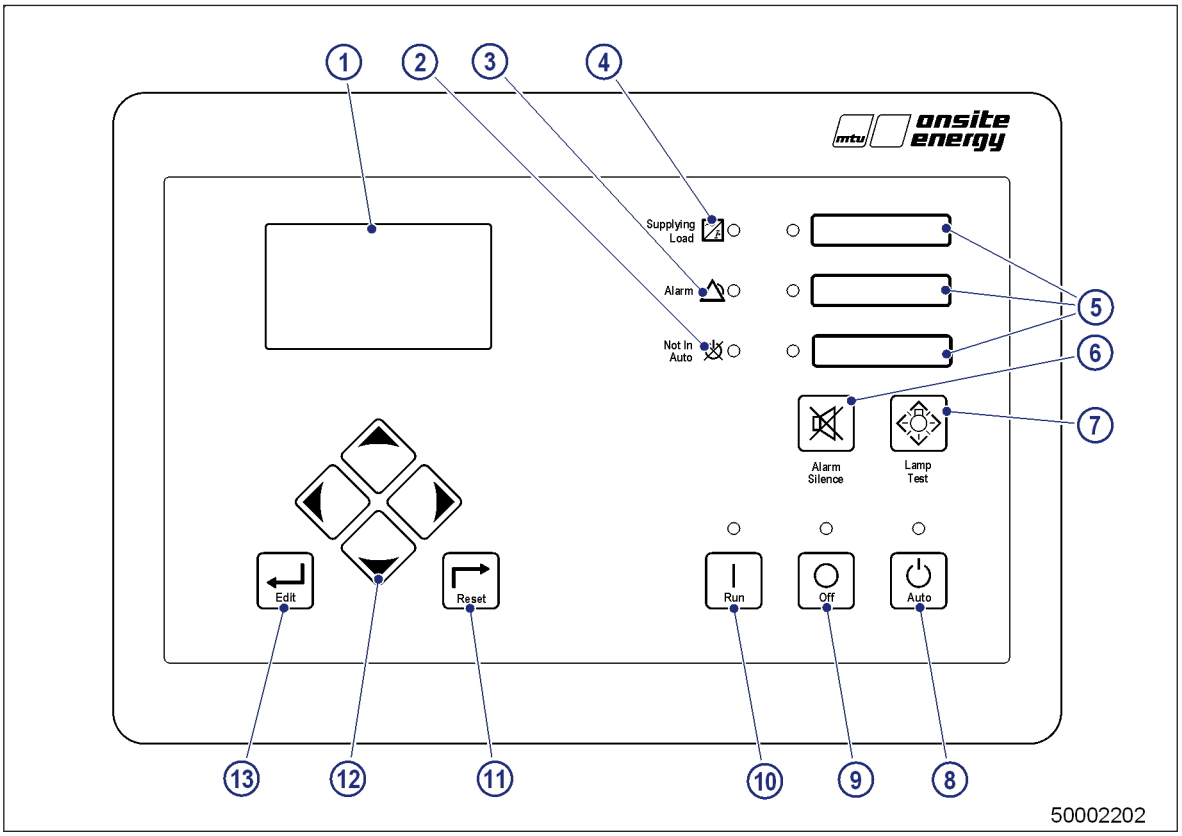


Figure 10: Control panel with MGC-3000 Series – Controls and indicators

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 10).		

TIM-ID: 0000055549 - 003

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 10).		

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 10).		

Login/logout and permissions

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

TIM-ID: 0000055549 - 003

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, USB port, or Ethernet port, 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 - 003

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 - 003

4.6.5 Remote annunciator for MGC Series

The remote annunciator is used with the MGC Series (→ Page 69) 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 11) shows the remote annunciator front panel.

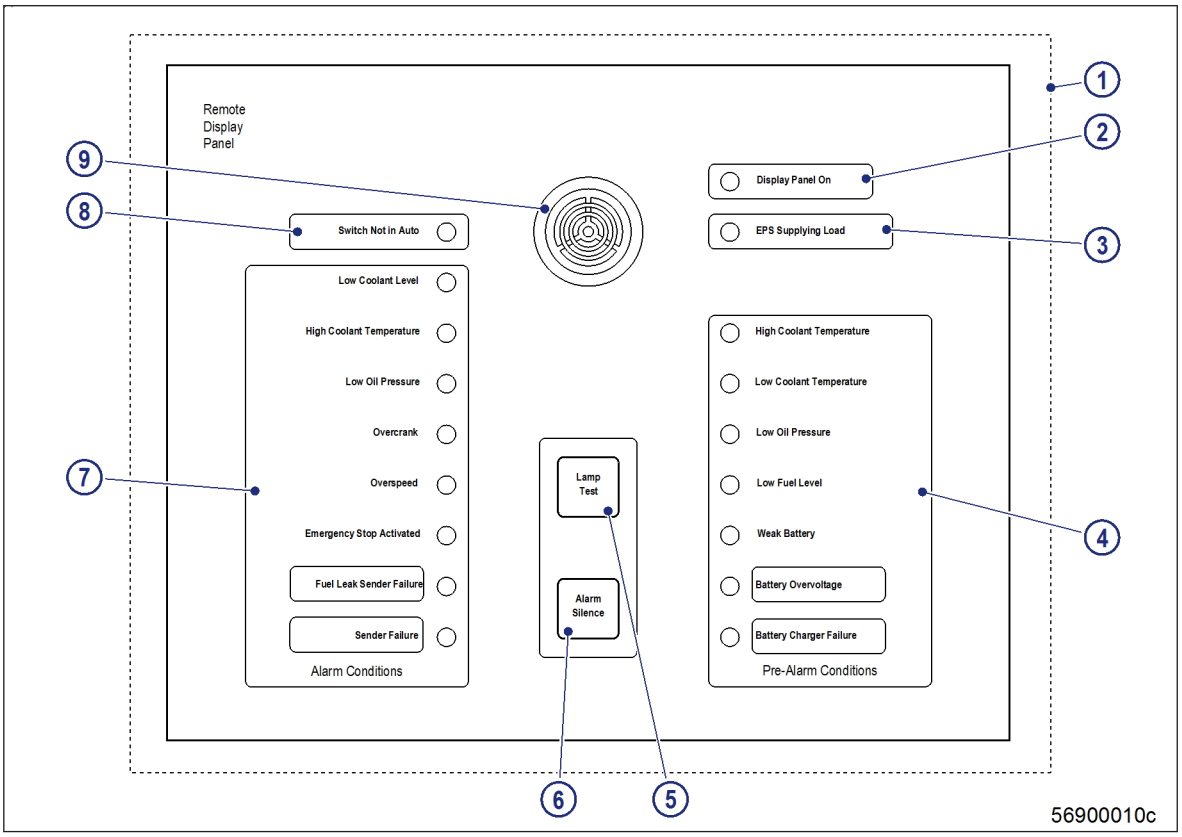


Figure 11: Remote annunciator for MGC Series – Front panel

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 11).		

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 11).		

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 11).		

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 Charge-Air System and Exhaust System

4.7.1 Air system - Overview

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

The figure(→ Figure 12) 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.

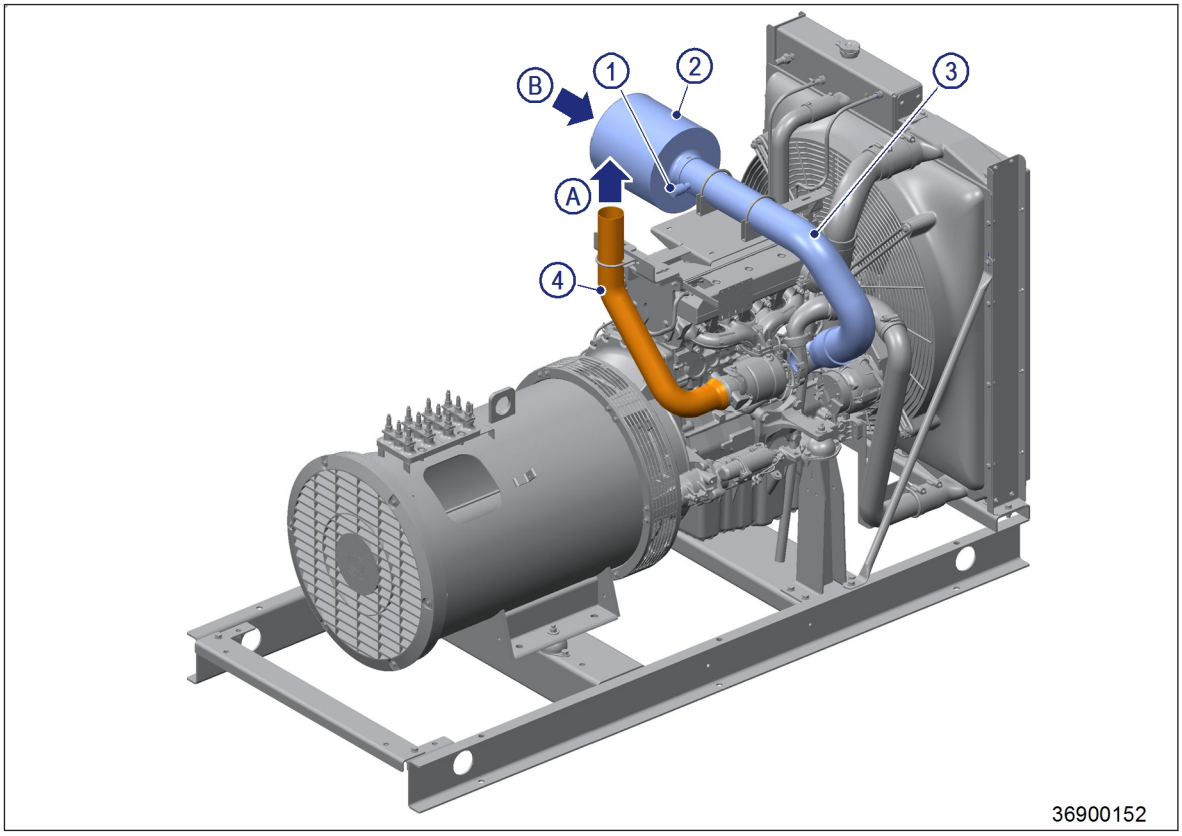


Figure 12: Air system

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 99) 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

4.7.2 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 13)shows a standard air filter, with the air inlet on one end and the outlet on the other end.

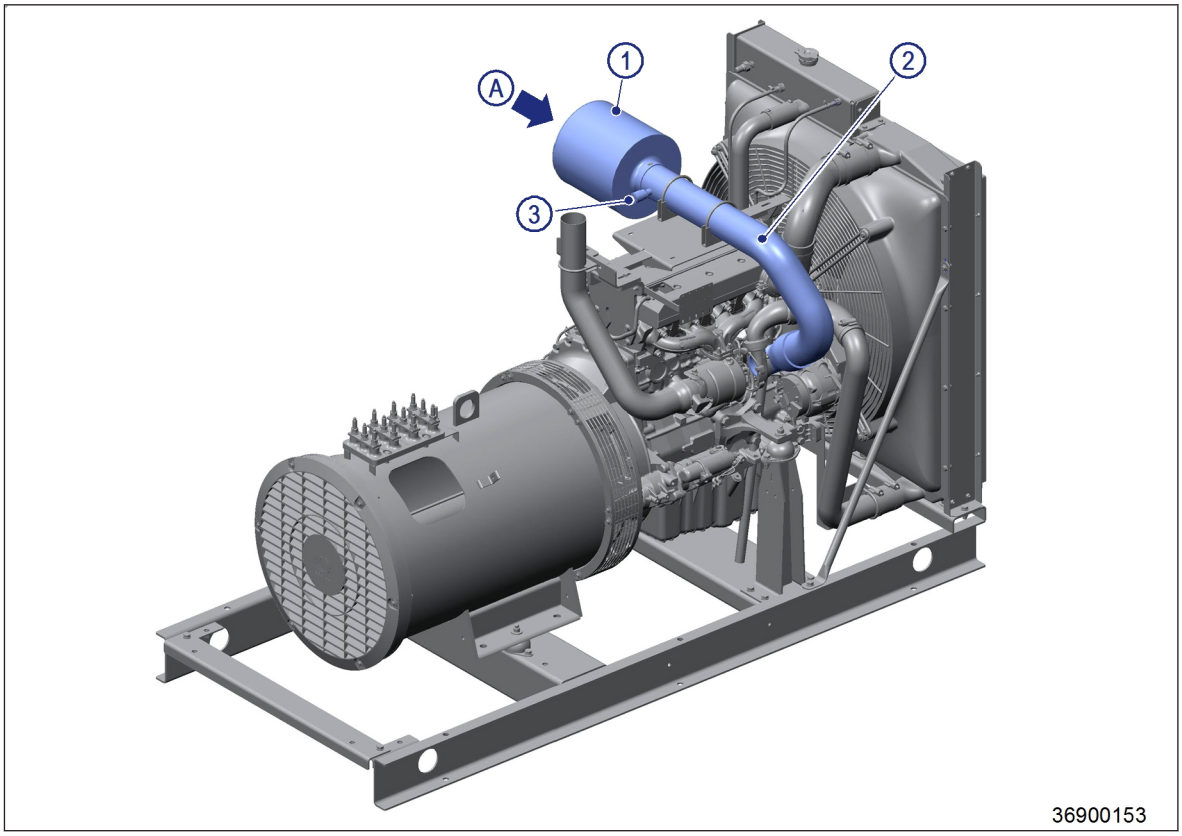


Figure 13: Air filter

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

4.7.3 Exhaust system - Overview

The figure (→ Figure 14)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.

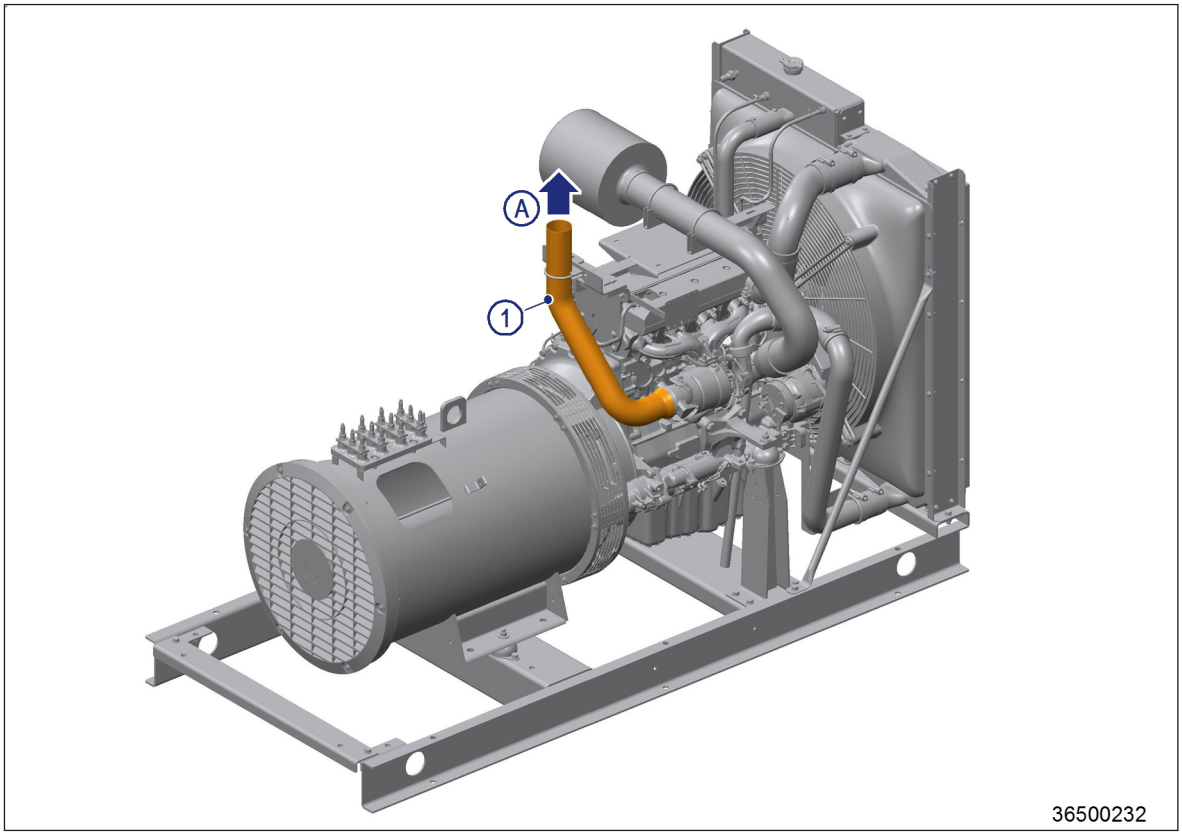


Figure 14: Exhaust system

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

4.7.4 Exhaust silencer

The function of an exhaust silencer is to reduce the diesel engine exhaust gas noise level. The figure(→ Figure 15) shows a typical exhaust silencer.

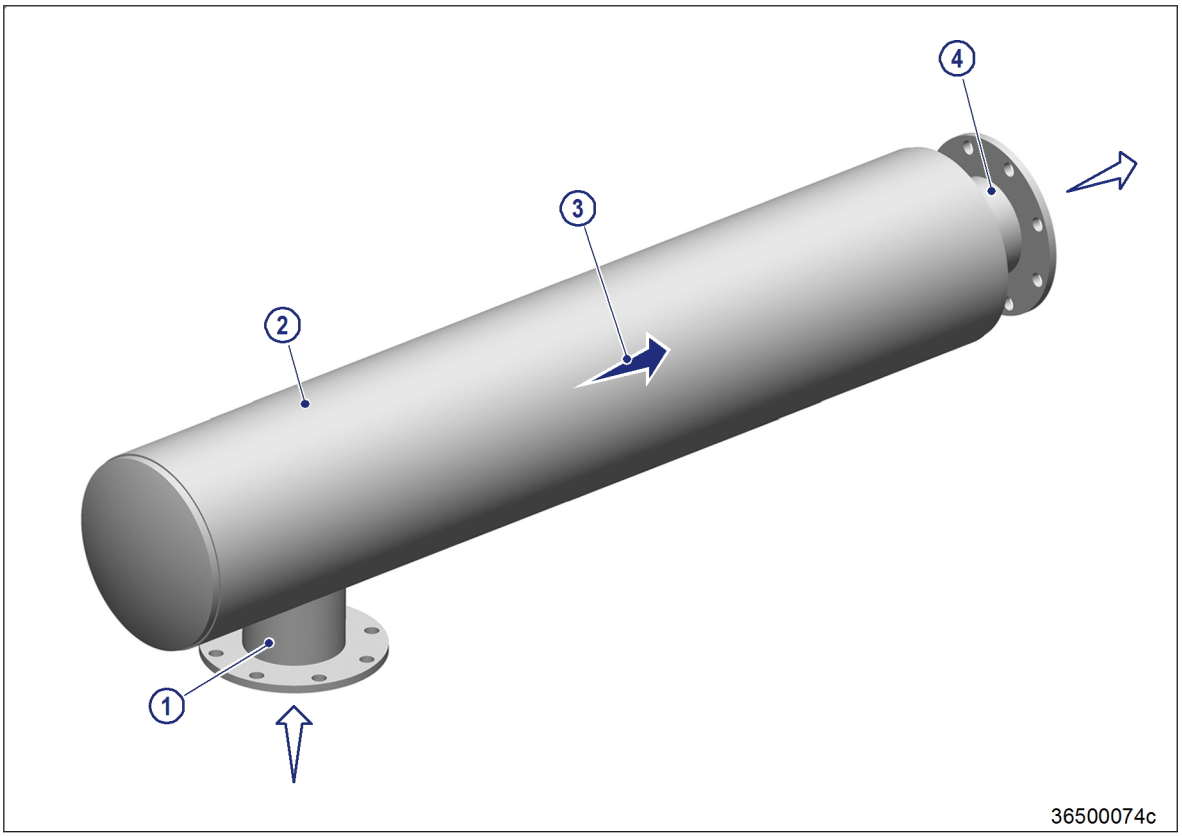


Figure 15: Exhaust Silencer

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

4.8 Cooling System

4.8.1 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 99). 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 16) 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.

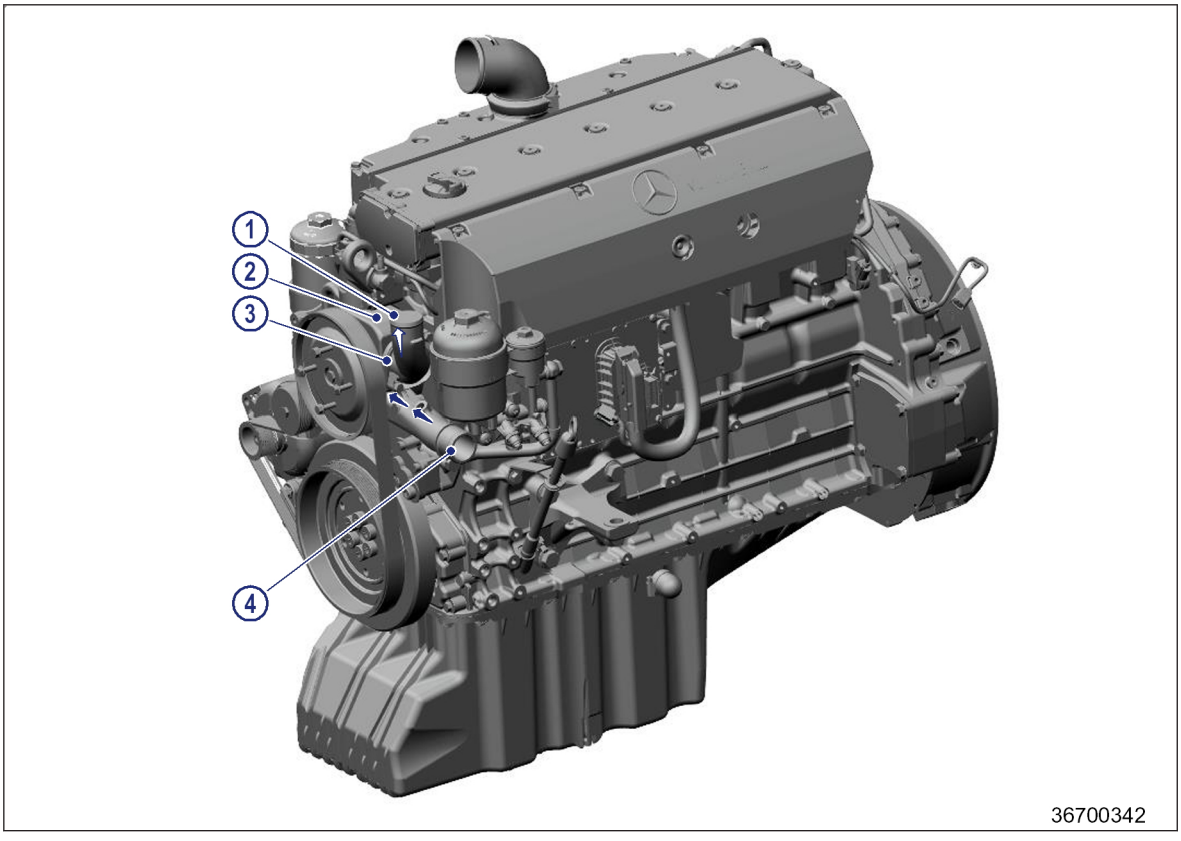


Figure 16: Engine coolant circuit

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

TIM-ID: 0000057996 - 001

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 99).

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 101)].

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 99) 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 90).

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 60).

TIM-ID: 0000057996 - 001

4.8.2 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.

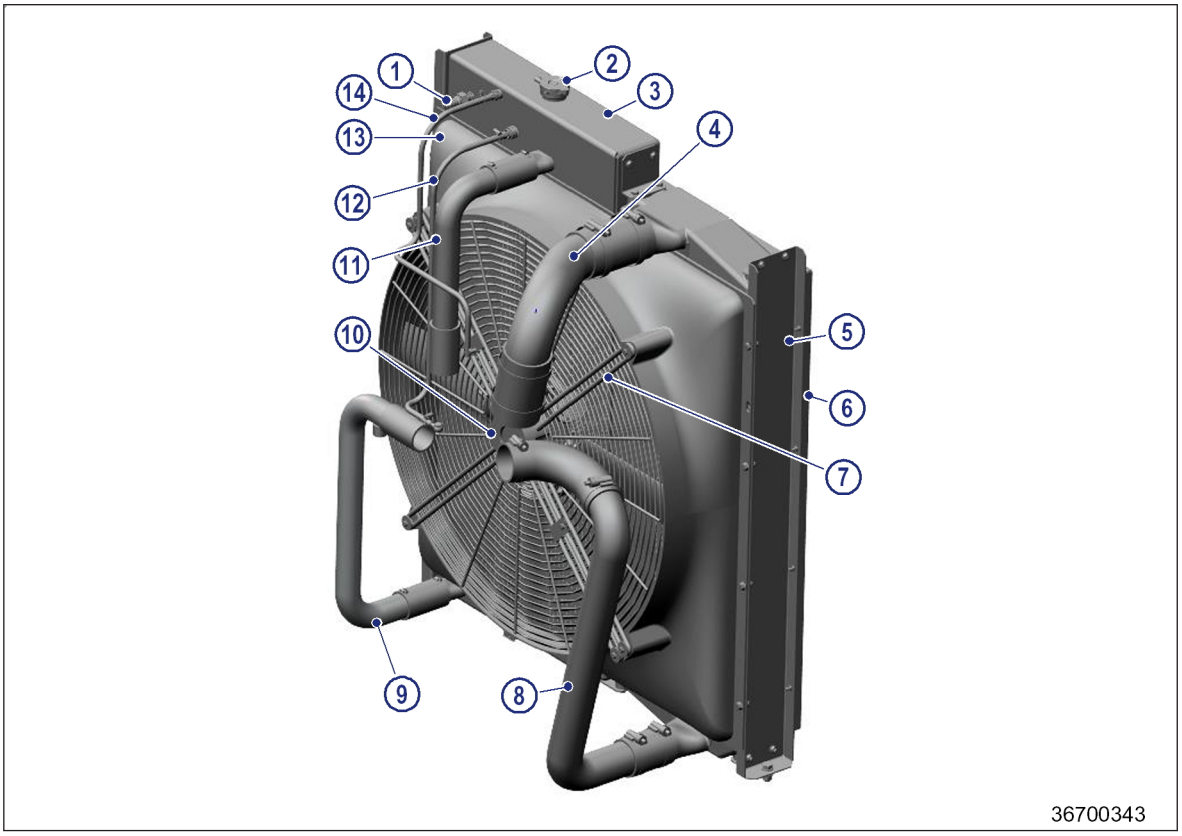


Figure 17: Unit-mounted radiator

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

4.8.3 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 18)shows a standard convection jacket water heating system.

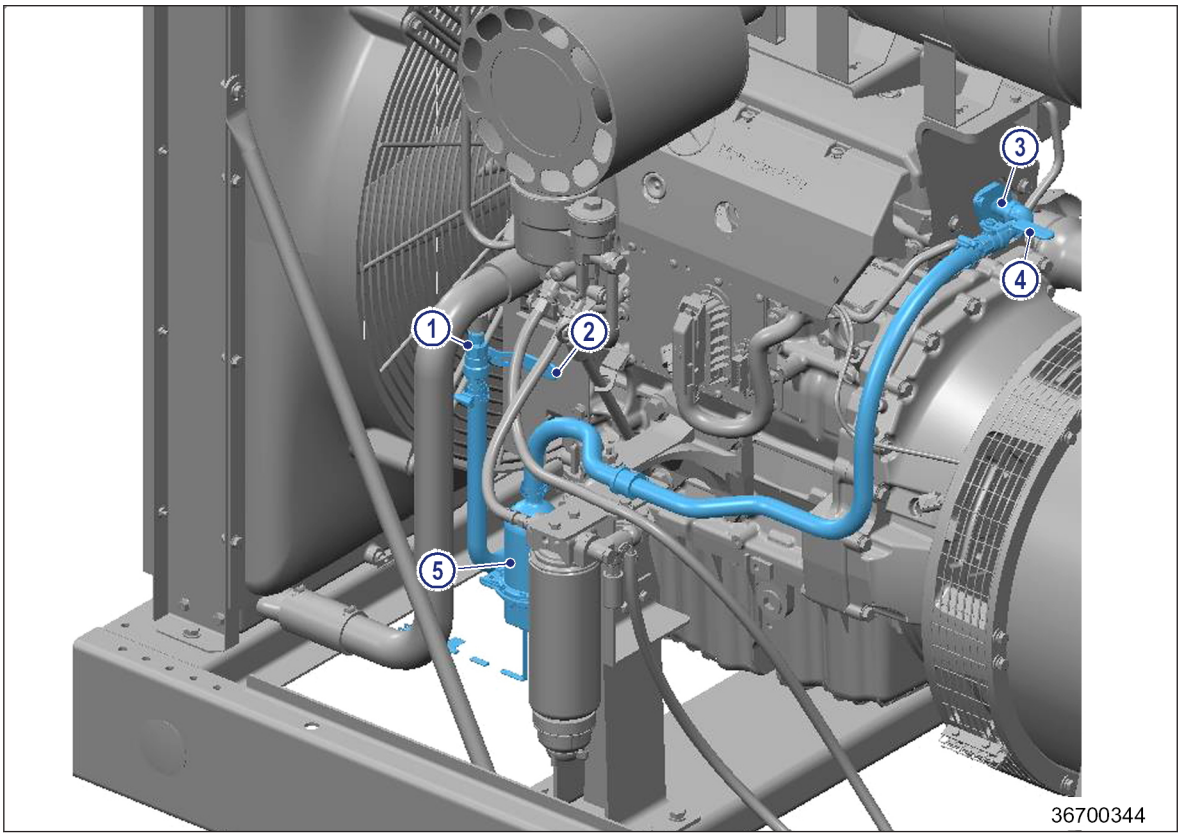


Figure 18: Preheater installation location

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

4.9 Fuel System

4.9.1 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

4.9.2 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 19) shows a fuel prefilter with water separator.

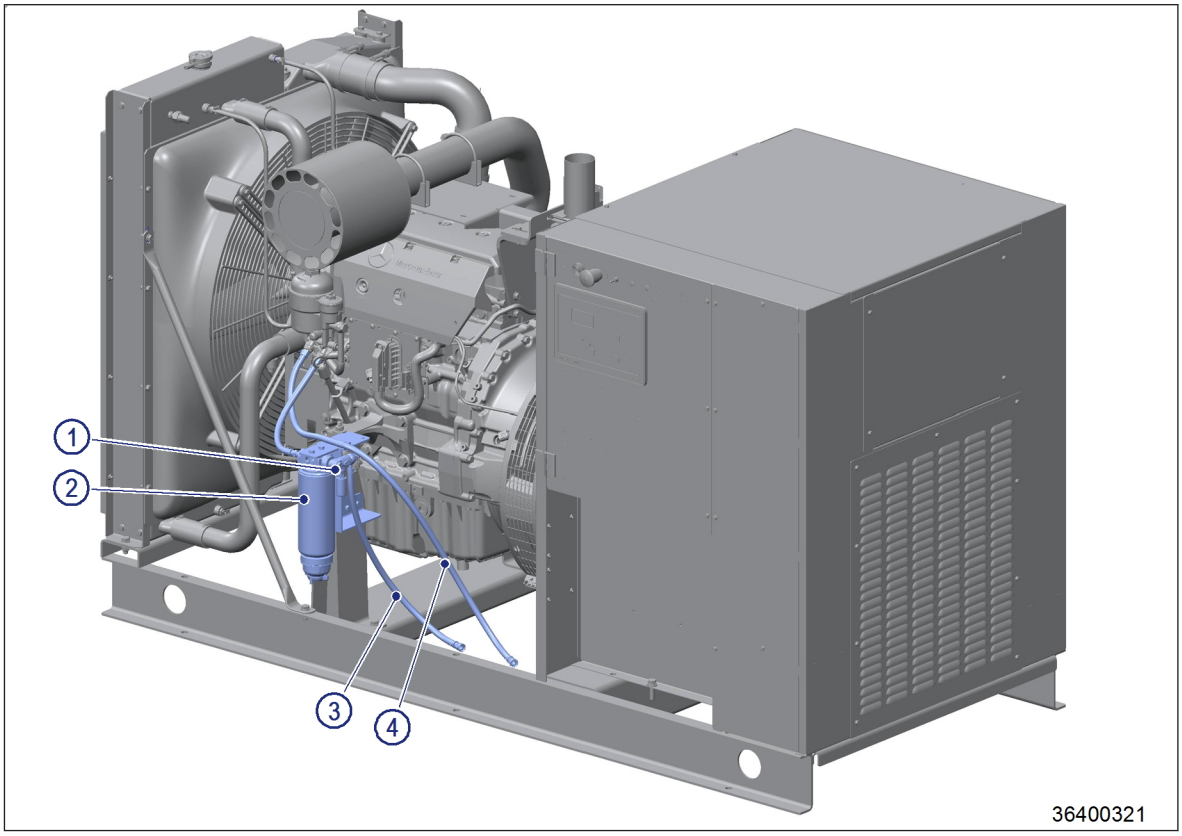


Figure 19: Fuel prefilter with water separator

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

4.9.3 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 20) 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.

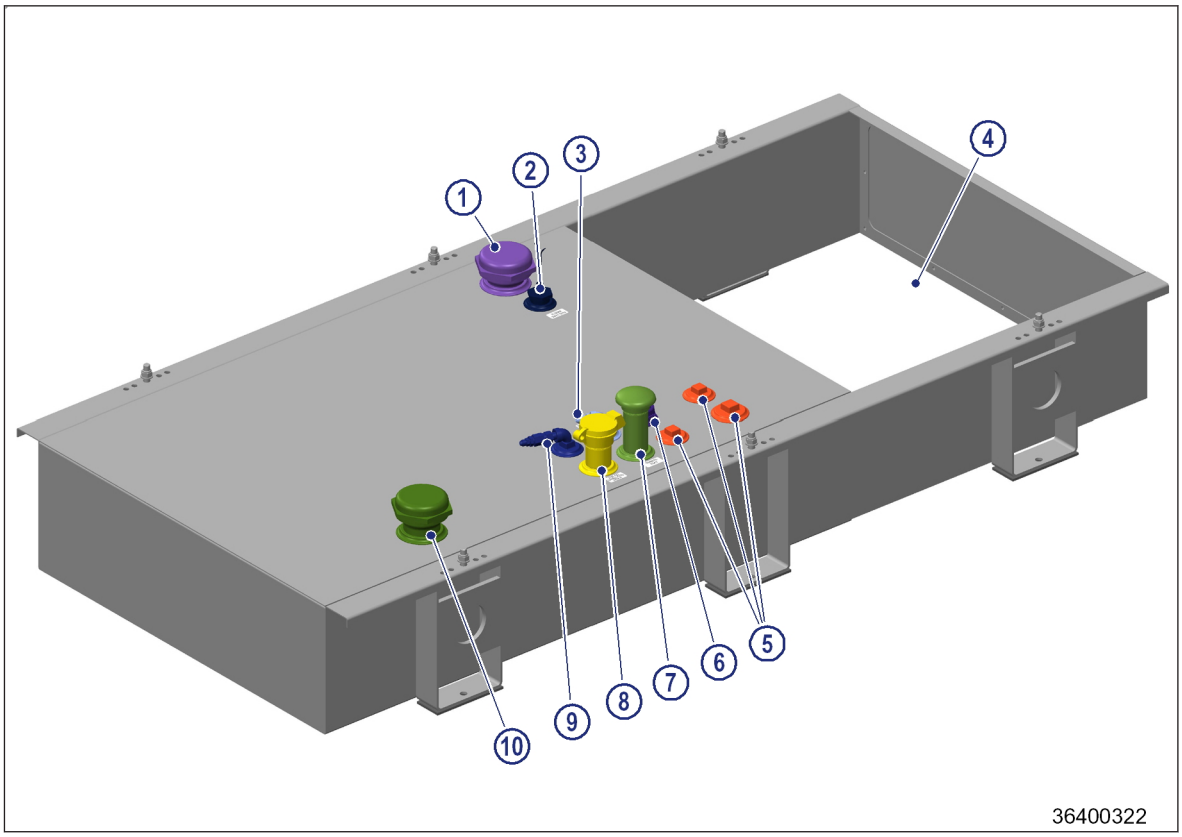


Figure 20: Sub-base tank

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

4.10 Electrical System

4.10.1 Starter battery

A starter battery is necessary to start the engine-generator set.

The figure (→ Figure 21) shows the installation location of the starter battery.

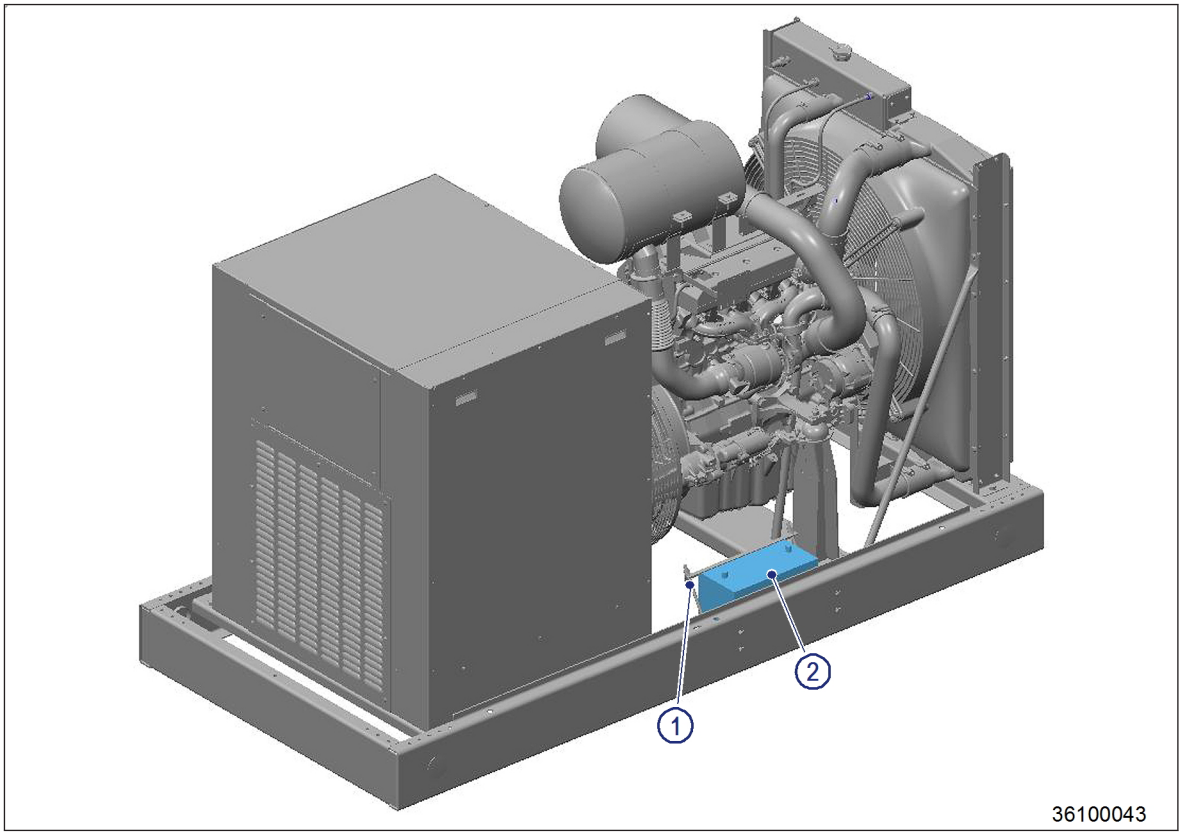


Figure 21: Starter battery installation location

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

4.10.2 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.

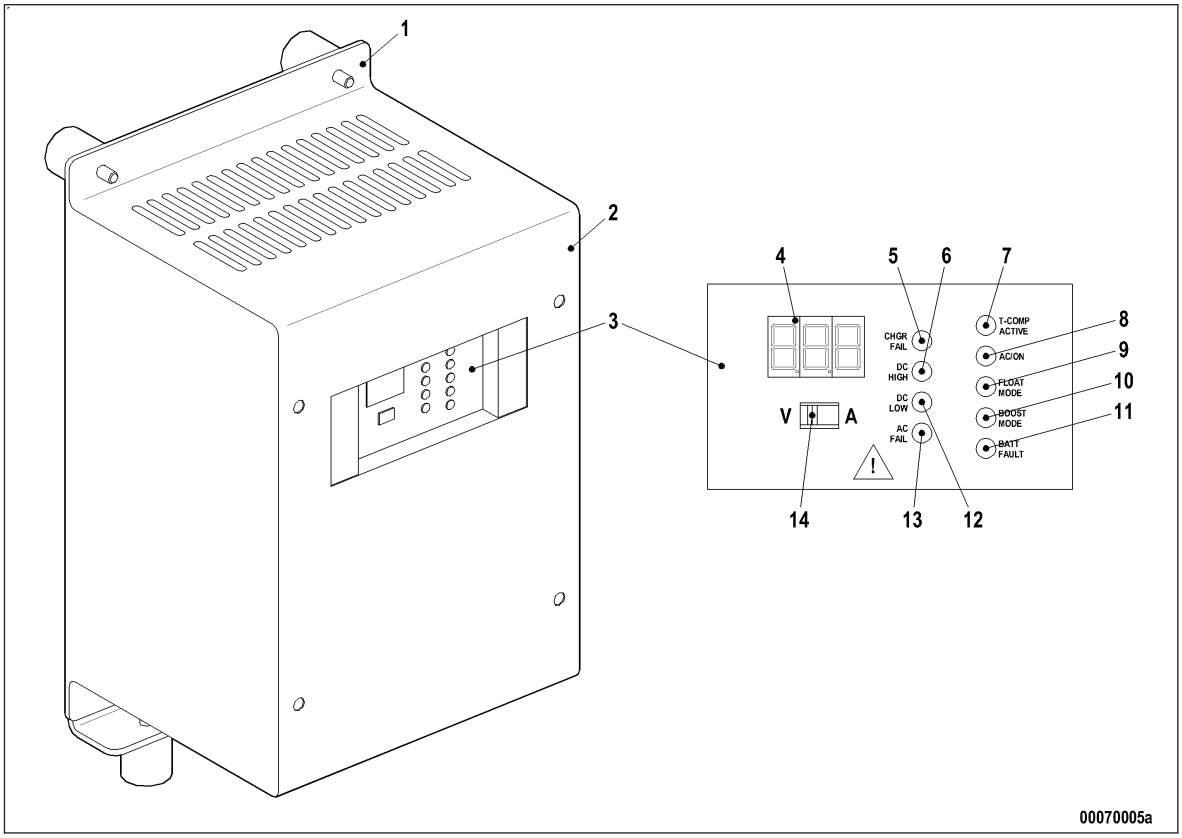


Figure 22: Battery charger

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

4.10.3 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 23) shows a P-frame circuit breaker. Visual appearance and configuration may vary depending on the unit.

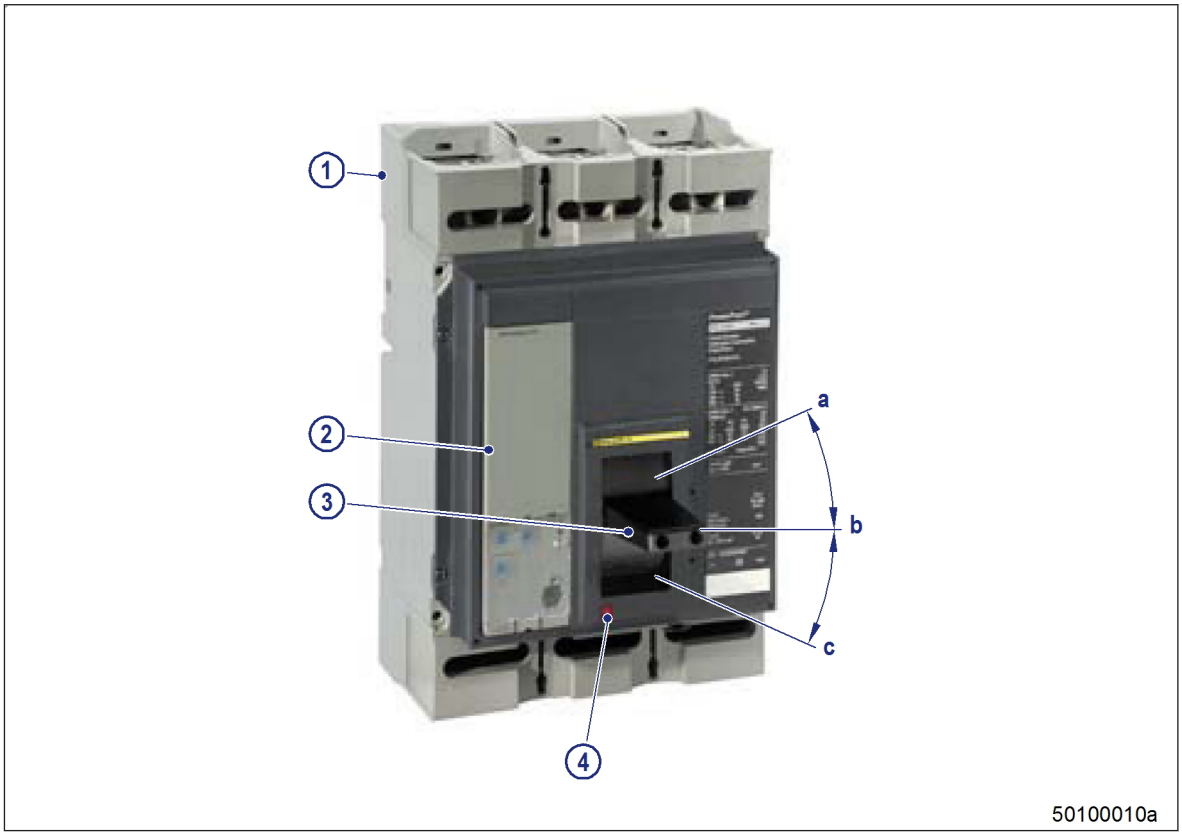


Figure 23: Circuit breaker P-frame

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.

TIM-ID: 0000064774 - 001

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

Micrologic electronic trip system (available with H, J, L, and P frames)

Different models are available. The figure (→ Figure 24) shows a 6.0P model as an example.

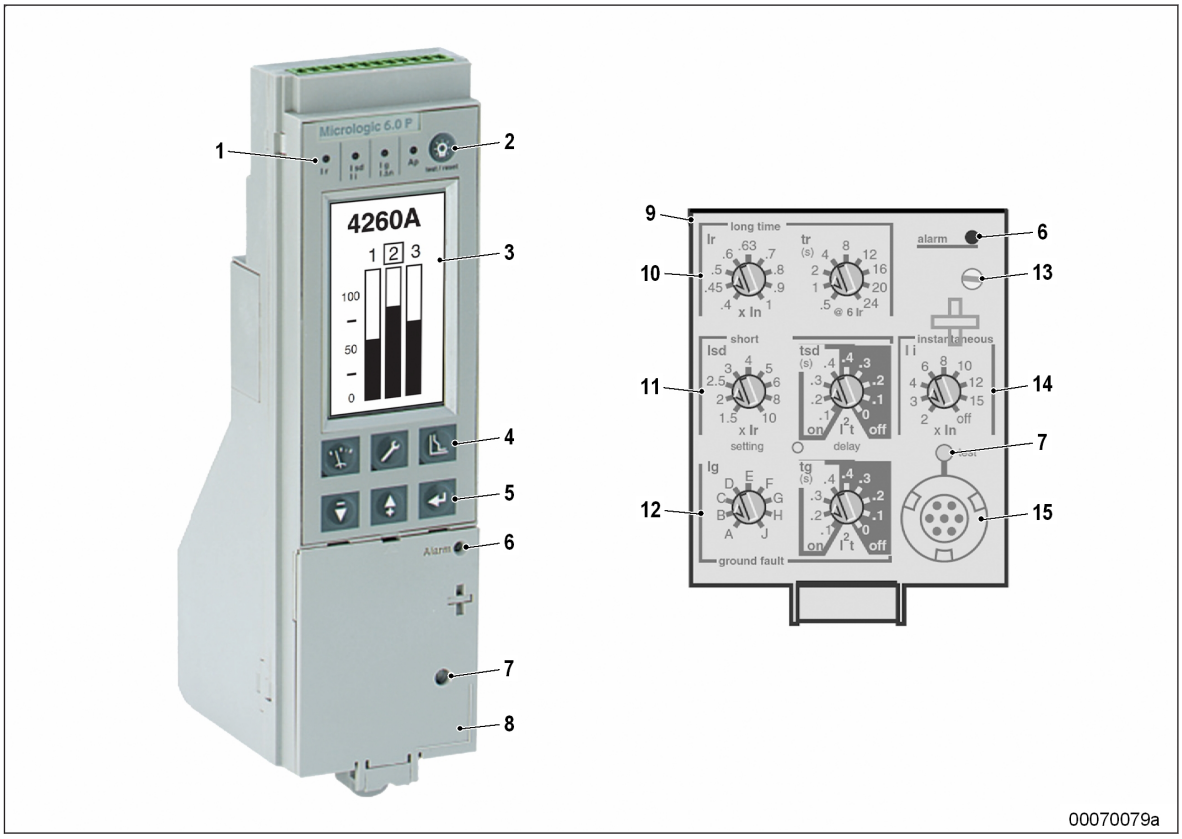


Figure 24: Circuit breakers – Trip unit Micrologic 6.0P

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

4.11 Base and Mounting System

4.11.1 Base and mounting system

The base frame provides support for all components of the engine-generator set.

The figure (→ Figure 25)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.

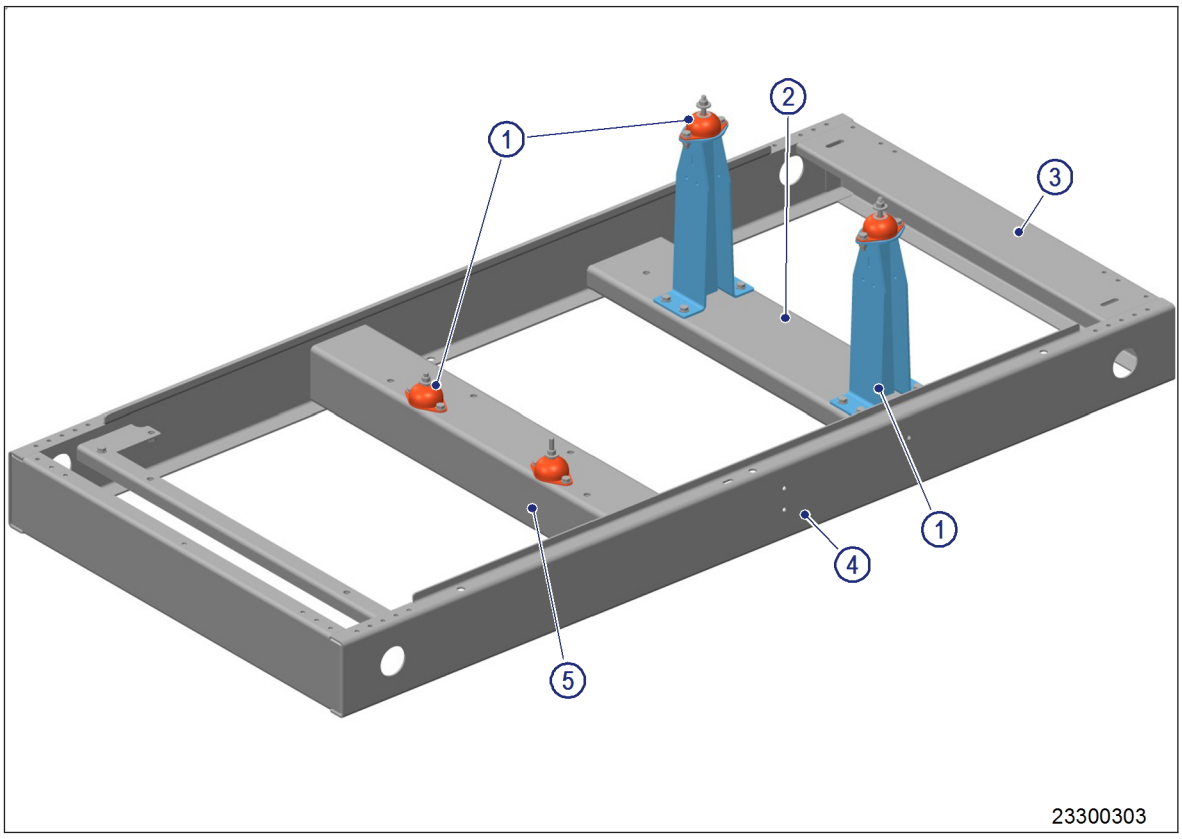


Figure 25: Base frame with mounts

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

4.12 Enclosure

4.12.1 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 26) (→ Figure 27)show in overview the components of an engine-generator set enclosure.

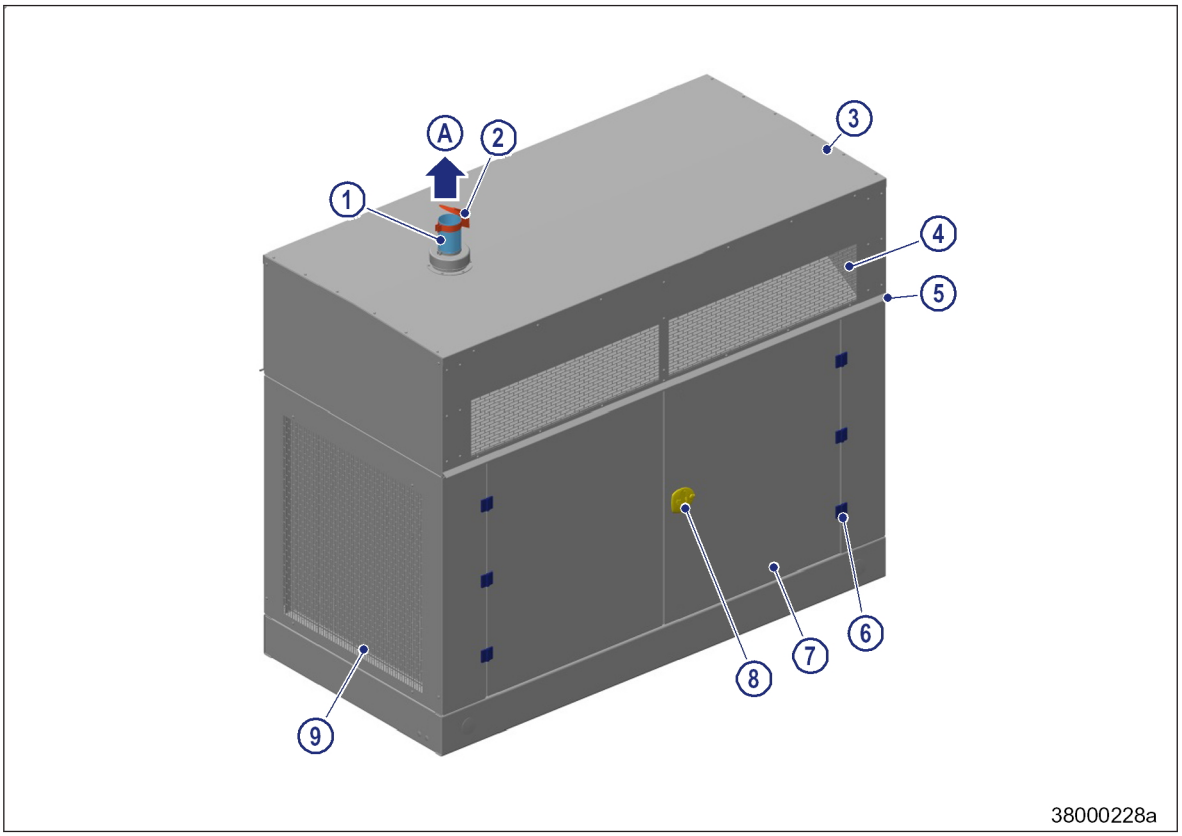


Figure 26: Enclosure

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

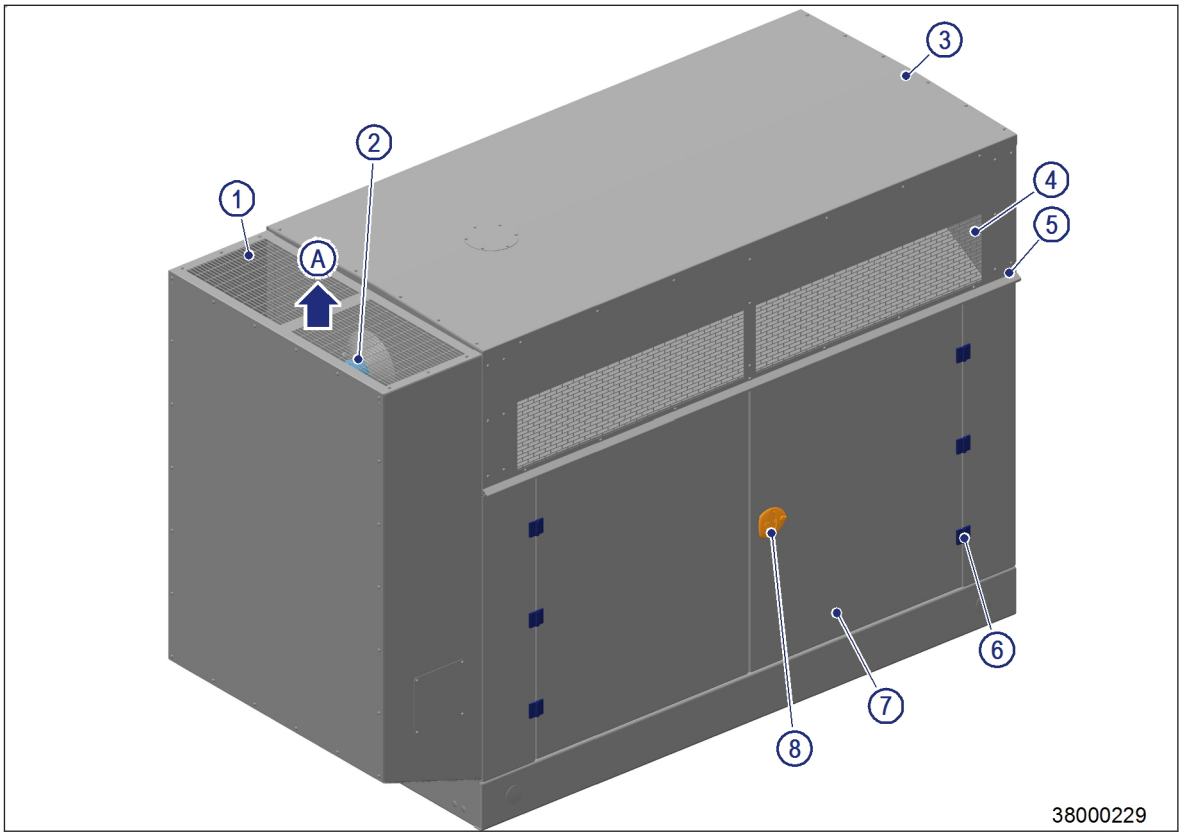


Figure 27: Enclosure with scoop

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 213).

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.

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.

TIM-ID: 0000064937 - 003

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 267)
Cooling system	If engine is out of service for more than one year, change engine coolant (→ Page 427) (→ Page 429).

Checks to be carried out before operation

Item	Task
Engine-generator set location	Check to see 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. Check that inlets and outlets, screens, and protection guards are clean and free of obstructions. Check to see that all needed fuel and cooling line valves are open, and drain valves are closed.
Engine	Check drive belt (→ Page 267). Check engine wiring (→ Page 267) . Check engine governor plug-in connection (→ Page 267).
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 209). Check fuel filter housing for leaks. Vent fuel system (→ Page 267).
Air system	Check air filters (signal ring position of service indicator)(→ Page 212). 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 373). Check for oil leaks.
Cooling system	Check engine coolant level (→ Page 425). 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 - 003

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	Engine-generator sets operating in a high humidity region must be equipped with anti-condensation heaters (600 VAC and above - standard). Check 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, for example 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 232). 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. Check to see that transfer switch cabinet is clean of debris.
Engine governor, if fitted	Verify that there are no fault messages.

TIM-ID: 0000064937 - 003

Putting the engine-generator set into operation

Item	Task
Engine-generator set	Perform unlocking procedure (→ Installation and Commissioning Instructions).
Engine-generator set location	Start ventilation fan or open the doors / windows if engine-generator set is located in a closed space. Check to see that room ventilation functions properly.
Cooling system	Preheat coolant with preheater (jacket water heater). Ensure proper coolant operating temperature.
Customer control system	Select operating mode, for example automatic or 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 - 003

5.4 Automatic start and stop

Preconditions

☑ For units that are paralleled, refer to the **Automatic start and stop with paralleling** section.

☑ 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

Note: For units that are paralleled, refer to the **Automatic start and stop with paralleling** section (This is not applicable to your system.).

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 - 002

Automatic stop

Note: For units that are paralleled, refer to the **Automatic start and stop with paralleling**section (This is not applicable to your system.).

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 - 002

5.5 Manual start

Preconditions

☑ For units that are paralleled, refer to the **Manual start with paralleling** section.

☑ 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.

TIM-ID: 0000056801 - 002

Note: The generator circuit breaker (GCB) is used only for protection, and is not used for control.

Starting the engine-generator set manually

Note: For units that are paralleled, refer to the **Manual start with paralleling** section (This is not applicable to your system.).

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 - 002

5.6 Manual stop

Preconditions

☑ For units that are paralleled, refer to the **Manual stop with paralleling** section.

☑ 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

Note: For units that are paralleled, refer to the **Manual stop with paralleling** section (This is not applicable to your system.).

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 - 002

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 212).
Exhaust pipework	Check exhaust color (→ Page 138).
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 235).

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 20)
Cooling system	Drain engine coolant(→ Page 427) 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 267) if the engine-generator set is to remain out of service for more than one month.

TIM-ID: 0000064939 - 002

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 144)

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 - 002

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 144)
	Blown fuse	Replace blown fuse.
Engine governor	Plug-in connections are loose	Check plug-in connections. (→ Page 267)
	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 267)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 216) Clean filter element of fuel prefilter. (→ Page 391) Replace fuel filter.(→ Page 395)
Engine governor	Damaged	Contact Service.

TIM-ID: 0000065485 - 002

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 267)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 216) Clean filter element of fuel prefilter. (→ Page 391) Replace fuel filter.(→ Page 395)
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 216)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 216) Clean filter element of fuel prefilter. (→ Page 391) Replace fuel filter.(→ Page 395)
	Low fuel	Fill fuel tank.
Air supply	Air filter clogged	Check signal ring position of service indicator. (→ Page 212)
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.

TIM-ID: 0000065485 - 002

Component	Probable Cause	Task
Fuel system	Not vented	Vent fuel system. See page 82 in Mercedes-Benz OM 904-926 LA Engine Manual. (→ Page 267)
	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 216) Clean filter element of fuel prefilter. (→ Page 391) Replace fuel filter.(→ Page 395)
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 212)
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 212)
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 267)
	Fuel filter clogged	Replace filter in fuel prefilter with water separator.(→ Page 216) Clean filter element of fuel prefilter. (→ Page 391) Replace fuel filter.(→ Page 395)
	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 - 002

Exhaust gas blue

Component	Probable Cause	Task
Engine oil	Too much oil in engine	Drain engine oil. (→ Page 373)
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 209)

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 230)
	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.

TIM-ID: 0000065485 - 002

Vibration

Component	Probable Cause	Task
Engine-generator set	Varies	Contact Service.

TIM-ID: 0000065485 - 002

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 146)

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 245)

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 76).

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 230). 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 230). 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 230). 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 230). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause low voltage conditions.

TIM-ID: 0000065425 - 001

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.

TIM-ID: 0000065425 - 001

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 230). 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 230). 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 230). 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 230). 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 230). 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 230). 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.

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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 230). 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 230). 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 230). 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 230). 2. Check machine configuration (refer to spec sheet). 3. Check generator voltage regulator. 4. Check load for faults that could cause high voltage conditions.

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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.

TIM-ID: 0000065425 - 001

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.

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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.

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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)

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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)

TIM-ID: 0000065425 - 001

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.

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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.

TIM-ID: 0000065425 - 001

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.

TIM-ID: 0000065425 - 001

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.)

TIM-ID: 0000065425 - 001

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 245).

TIM-ID: 0000065643 - 001

7 Ground Fault Protection - Field Testing

7.1 Field Testing of Residual Equipment Ground Fault Protection Systems 195

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.

TIM-ID: 0000097094 - 001

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.

TIM-ID: 0000097094 - 001

FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

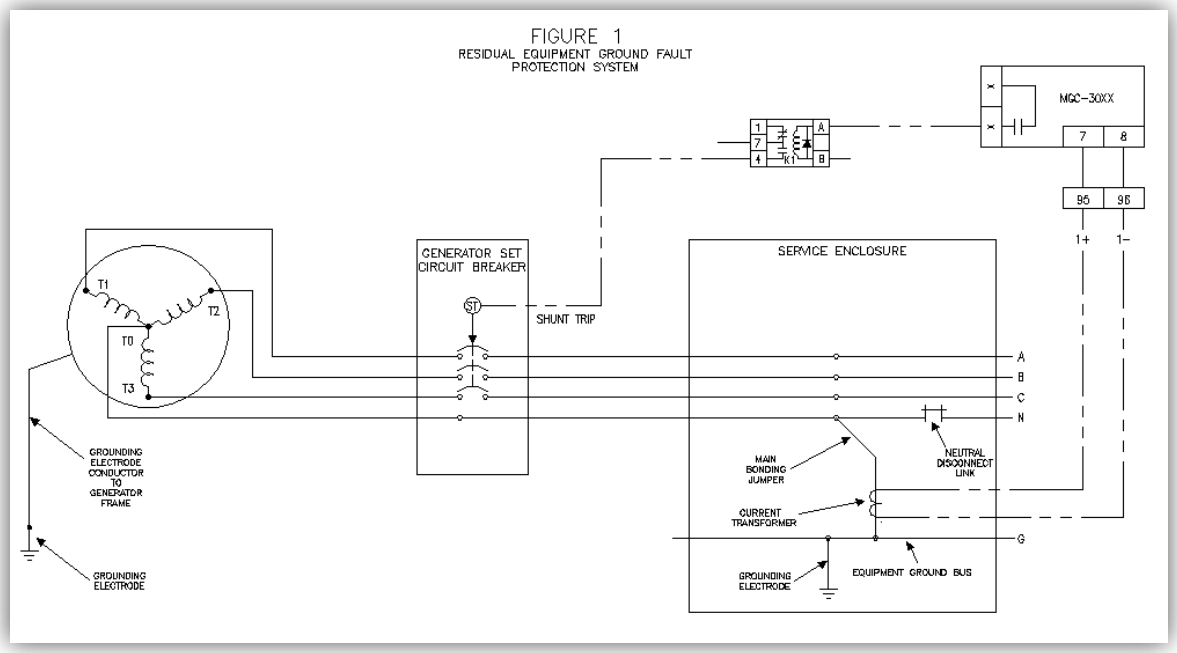


Figure 1: Residual Equipment Ground Fault Protection System

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.

TIM-ID: 0000097094 - 001

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.

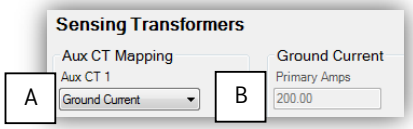
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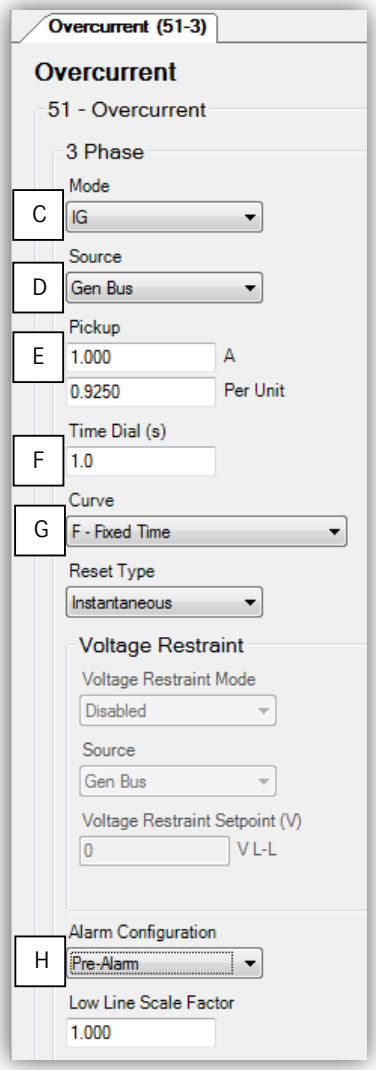
FIELD TESTING OF RESIDUAL EQUIPMENT GROUND FAULT PROTECTION SYSTEMS

Utilizing MGC-3000 Series Controllers and Shunt Trip-Equipped Circuit Breakers

Settings and Programming

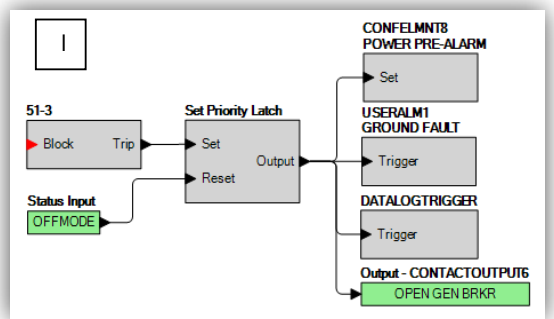
1. Verify the following settings and logic in the MGC-3000 Series controller:
   - A. Aux CT 1set to “Ground Current”
   - B. Ground Current “Primary Amps” based on current transformer used in application
   - C. Overcurrent Mode set to “IG”
   - D. Overcurrent Source set to “Gen Bus”
   - E. Overcurrent 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.

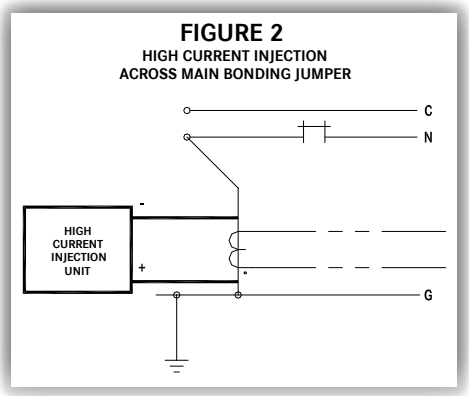
NEC 230.95(C) stipulates that the maximum setting of the EGFP system may not exceed 1200 amperes and a maximum time delay of 1 second for fault currents equal to or greater than 3000 amperes.

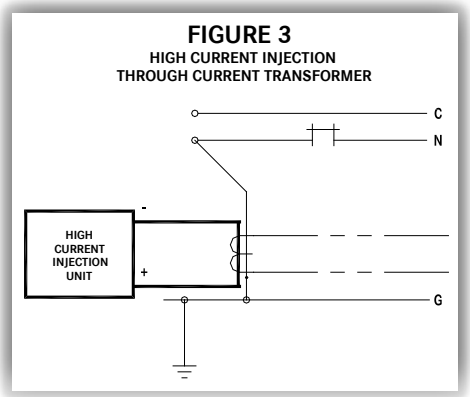


TIM-ID: 0000097094 - 001

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.

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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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TIM-ID: 0000097094 - 001

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 serviced, replaced or repaired if components approved by MTU are used. 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.

Adherence to the specified maintenance intervals is essential to maintain product safety.

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 - 006

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. (→ Page 267)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 207)
W0115		Drain off water and contamination from fuel prefilter with water separator.	(→ Page 209)
W0110		Check general condition of engine-generator set and inspect for leaks.	(→ Page 210)
W0112		Inspect service indicator of air filter.	(→ Page 212)
W0134		Test run at not below 1/3 load and at least until steady-state temperature is reached (monthly).	(→ Page 213)
W6506		Test status lights and gauges.	(→ Page 214)
W1675		Fit new fuel prefilter or new fuel prefilter insert.	(→ Page 216)
W6536		Check air flow into and out of unit, remove debris from ventialtion system.	(→ Page 229)
X6065		Check generator wiring visually for damage.	(→ Page 230)
W8654		Check antifriction bearings, replace if necessary.	(→ Page 231)
W6534		Check and adjust voltage regulator if needed.	(→ Page 232)
X7900		Check circuit breaker condition visually and carry out function tests.	(→ Page 234)
W6521		Test preheating functionality.	(→ Page 235)
W6511		Test controller displays for functionality.	(→ Page 236)
X3041		Replace backup battery in controller.	(→ Page 237)
W1510		Check cooler / radiator elements externally for contamination and leaks.	(→ Page 238)
W8655		Cooler / radiator core face cleaning.	(→ Page 239)

Mercedes-Benz Engine Maintenance

Engine Maintenance Task	Reference
Engine maintenance booklet	(→ Page 335)
Engine oil and filter change	(→ Page 373)
Inspect / replace poly v-belt	(→ Page 379)
Clean filter element of fuel prefilter	(→ Page 391)
Replace fuel filter	(→ Page 395)
Set valve clearance	(→ Page 401)
Engine cooling system check fluid level	(→ Page 415)
Engine coolant level check	(→ Page 425)
Engine coolant draining	(→ Page 427)
Engine coolant filling	(→ Page 429)

TIM-ID: 0000065770 - 003

TIM-ID: 0000065770 - 003

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 267)

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 267)

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.

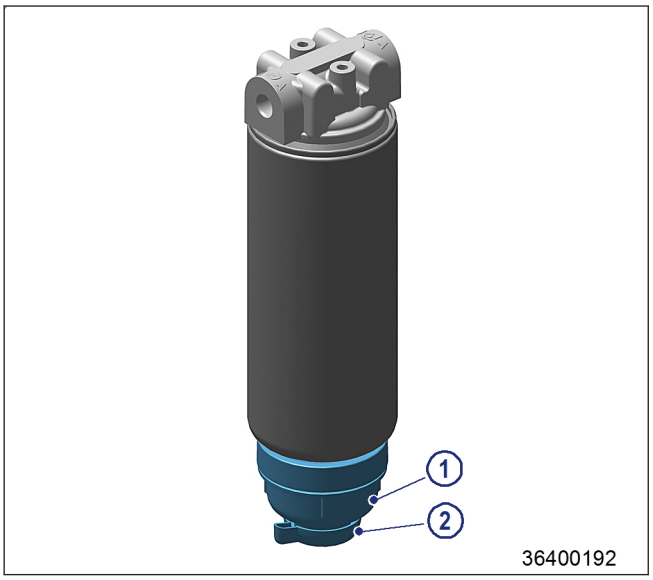


Figure 28: Fuel prefilter – Draining

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.

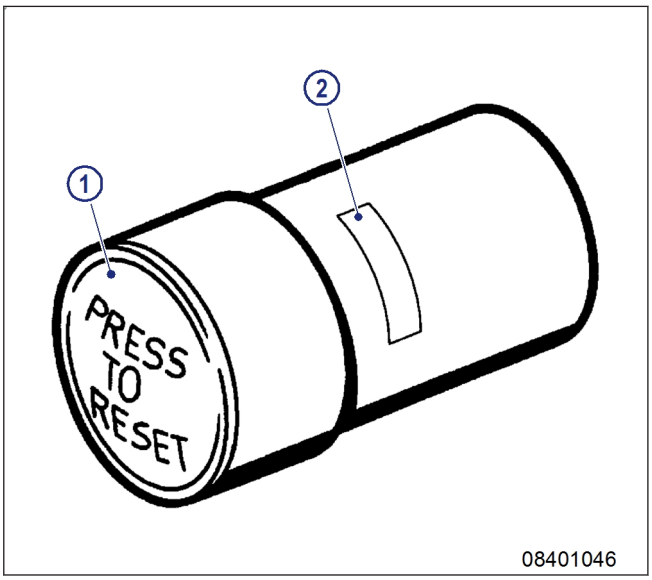


Figure 29: Service indicator

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 131). If the engine-generator set doesn't start, refer to troubleshooting (→ Page 138).
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 135).
4. Stop the engine-generator set (→ Page 133).

TIM-ID: 0000001021 - 012

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.

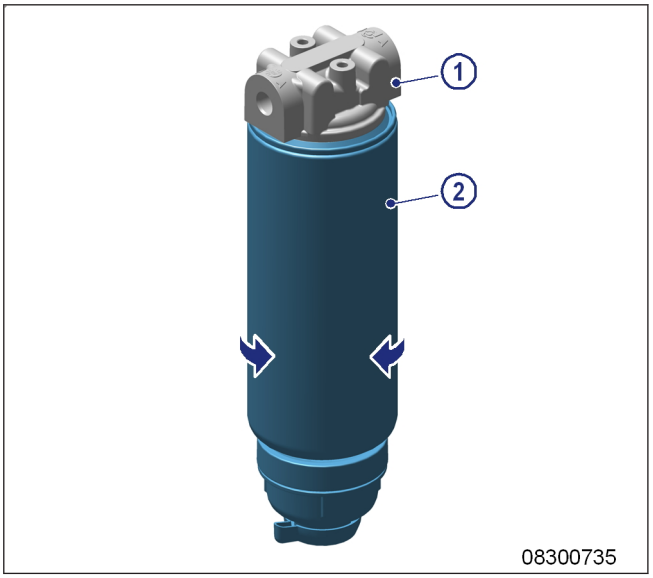


Figure 30: Replacing fuel prefilter

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.

Document	Reference
Additional Engine Documentation Overview	(→ Page 243)
ADM3 Fault Codes	(→ Page 245)
Engine Manual OM 904-926 LA	(→ Page 267)
Maintenance Booklet OM 904-926 LA	(→ Page 335)
OM900 Engine oil and filter change	(→ Page 373)
OM900 Inspect / replace poly v-belt	(→ Page 379)
OM900 Clean filter element of fuel prefilter	(→ Page 391)
OM900 Replace fuel filter	(→ Page 395)
OM900 Set valve clearance	(→ Page 401)
OM900 Engine cooling system check fluid level	(→ Page 415)
Engine Coolant - Level check	(→ Page 425)
Engine Coolant - Draining	(→ Page 427)
Engine Coolant - Filling	(→ Page 429)

TIM-ID: 0000065669 - 003

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 - 002

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 209).
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 - 002

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.

TIM-ID: 0000062623 - 001

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.

- 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).

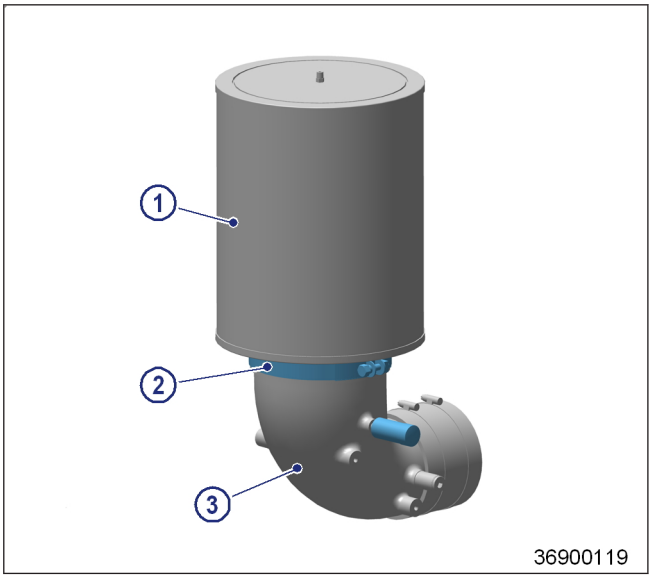


Figure 31: Air filter with intake

Final steps

▶ Press reset button (1) to return the signal ring in observation window (2) to its initial position.

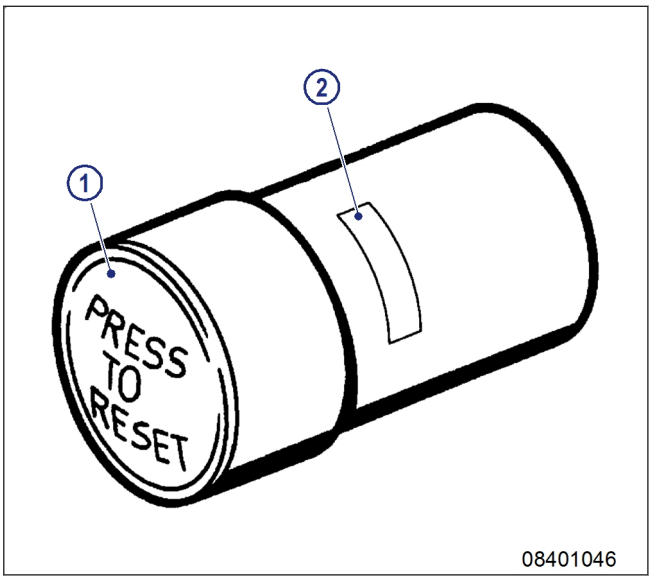


Figure 32: Filter restriction indicator

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.

Final step

▶ Install the cover of the outlet box.

TIM-ID: 0000000179 - 008

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.

Preparatory step

▶ Remove the cover of the outlet box.

TIM-ID: 0000060430 - 001

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 is stopped.

☑ 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 operations of undervoltage circuit breaker (if fitted).
3. Check all indicators and function.
4. Check number of switching operations at the operation counter (if fitted).

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 - 003

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.

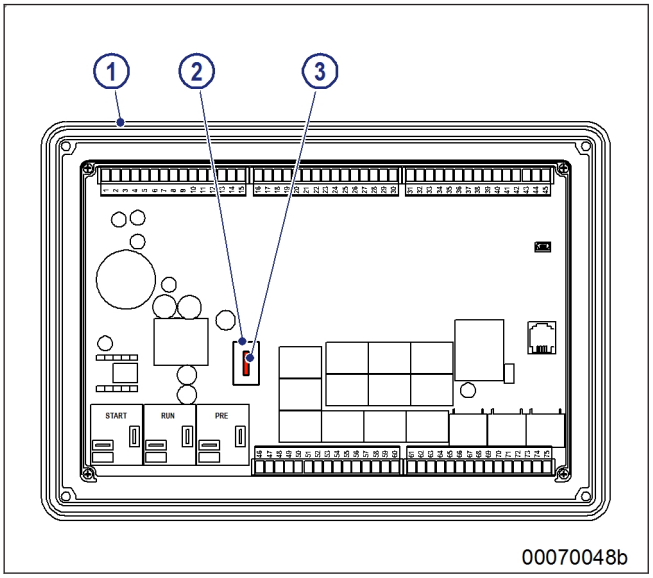


Figure 33: Backup battery location in control panel

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 239). 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.

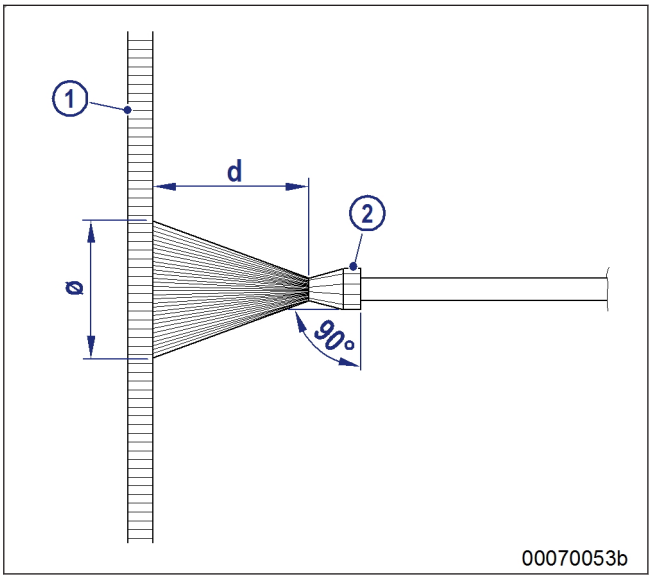


Figure 34: Radiator cleaning specifications

TIM-ID: 0000000192 - 013

10 Engine

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Additional Engine Documentation

Overview

This chapter provides instructions from the engine manufacturer on performing necessary maintenance tasks on the engine. For additional necessary engine maintenance tasks, refer to the Engine section of the Maintenance Task Description.

For required maintenance on the the engine-generator set, refer to the Maintenance chapter.

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: 0000109198 - 001

TIM-ID: 0000061864 - 001

TIM-ID: 0000109198 - 001

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

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
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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ADM3 fault code (J1939) SPN / FMI	ADM3 fault code (K-line)	MR2 fault code (K-line)	Fault location	Fault description	Remedial action	Pin
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

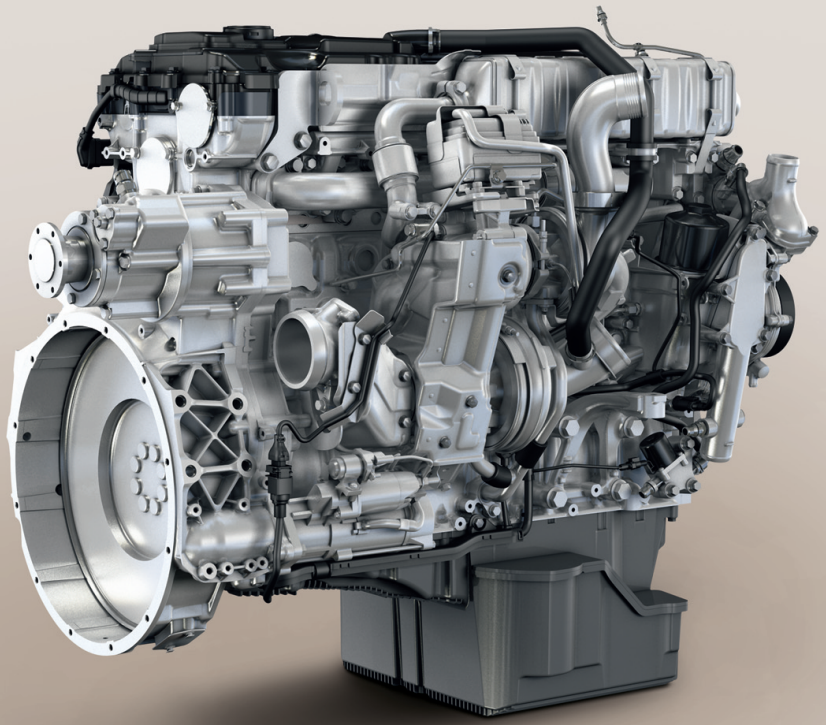
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ADM3 fault code (K-line)	ADM3 fault code (J1939) SPN / FMI	Fault location	Fault description
13900	730 / 0	Output Relay 2 (REL 2)	Grid Heater: No Increasing Boost Temperature After Activation
13901	730 / 1	Output Relay 2 (REL 2)	Relay Permanently Closed (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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4R/6R 1000

Operating Instructions

TIM-ID: 0000094786 - 004

Power. Passion. Partnership.

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.

! The purpose of material damage warnings is to draw your attention to risks which could lead to damage to your engine system.

i 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.

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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.

MTU/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 without exhaust gas aftertreatment system

The engines without an exhaust gas aftertreatment system described in the document comply with the "EU Stage IIIA" emissions level.

These are certified in accordance with directive "ECE-R 96 Chapter 5.2.1 for power bands H or I".

The term "EU Stage IIIA" was taken from EU Directive 97/68, is still used in general parlance and is used in this document.

"EU Stage IIIA" emissions level is certified without an associated exhaust gas aftertreatment unit. An exhaust muffler with a silencer is used instead of an exhaust gas aftertreatment unit.

This means that the exhaust muffler used is determined by the vehicle or device and is covered in the operating instructions provided by the vehicle/device manufacturer.

Engine system

In these Operating Instructions, the term "engine system" refers to the combination of the engine and exhaust gas aftertreatment unit. The engine and the emission control system are parts that require certification. The engine system is certified as one unit with the engine and exhaust gas aftertreatment unit assembly with the AdBlue® treatment reactor and the AdBlue® supply system.

Engine systems with exhaust gas aftertreatment can comply with the following emission levels depending on the version:

- EU Stage IV
- US Tier 4
- Japan 2014 - Heisei 26
- Korea Tier 4

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 37).

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 60).

Please contact any MTU or MTU-authorised Mercedes-Benz Service Centre if you have any questions about equipment and operation (see addresses in the publication details on the inside of the back cover).

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.

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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 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 any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

Always specify the assembly system ID number (AGS ID), the engine number and the number of the exhaust gas aftertreatment unit when ordering genuine Mercedes-Benz parts. You can find the engine number on the identification plate of your engine. You can find the number of the exhaust gas aftertreatment unit on the identification plate of the exhaust gas aftertreatment control module (ACM) (▷ page 60). You can also find the two numbers on the data card (▷ page 60).

The exhaust gas aftertreatment unit and the exhaust gas aftertreatment control unit (ACM) are not used for emissions certificate EU Stage IIIA.

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 not only the engine and the exhaust gas aftertreatment unit (not for EU Stage IIIA) but also itself (self-diagnosis).

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 29).
- 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 (not for EU Stage IIIA) in the overall system.

The engine and the exhaust gas aftertreatment system may not be modified. In the event of modification, Mercedes-Benz and MTU do not

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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 8).

Implied warranty

A well-developed network of MTU or MTU-authorised Mercedes-Benz Service Centres is available to carry out maintenance work.

These 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 follow the instructions in this Service Booklet, even if you hand the vehicle/device over to a third party for use or care.

If the specified service/maintenance work is not carried out, the decision as to whether a warranty claim can be accepted or not can be made only 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

  Confirmation that all service/maintenance work has been carried out at a qualified specialist workshop will be entered in this Maintenance Booklet.

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

Confirmation that all service/maintenance work has been carried out at a qualified specialist workshop will be entered in this Maintenance Booklet.

Maintenance work does not include repair work. Repair work will be invoiced separately.

You can obtain further information on the maintenance of your engine system from any 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/device 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/device reactions and operating statuses in special driving situations
- ambient conditions, e.g. outside temperature

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

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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

Please consult an MTU or MTU-authorised Mercedes-Benz partner.

Further applicable documents

These operating instructions describe all models and all standard and optional equipment available for your engine system within 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 (manufacturer of the end product). 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.

Always keep these documents together with the engine, vehicle or device. These documents should be passed on to the new owner if you sell the engine, vehicle or device.

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.

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General information

The engine is a four-stroke, water-cooled diesel engine with direct injection.

The engine is equipped with a common rail diesel injection system, cooled and regulated exhaust gas recirculation and exhaust gas turbocharging with charge-air pressure control.

Depending on the engine output, engine turbocharging is either by means of single-stage exhaust turbocharging or two stage exhaust gas turbocharging with two sequential exhaust gas turbochargers of differing dimensions.

The valve gear has two camshafts at the top, which are driven via a gearwheel drive.

The engine features a single-piece cylinder head. In the cylinder head there are two inlet valves and two exhaust valves per cylinder. The valves are arranged symmetrically. The symmetrical valve arrangement is optimal for combustion.

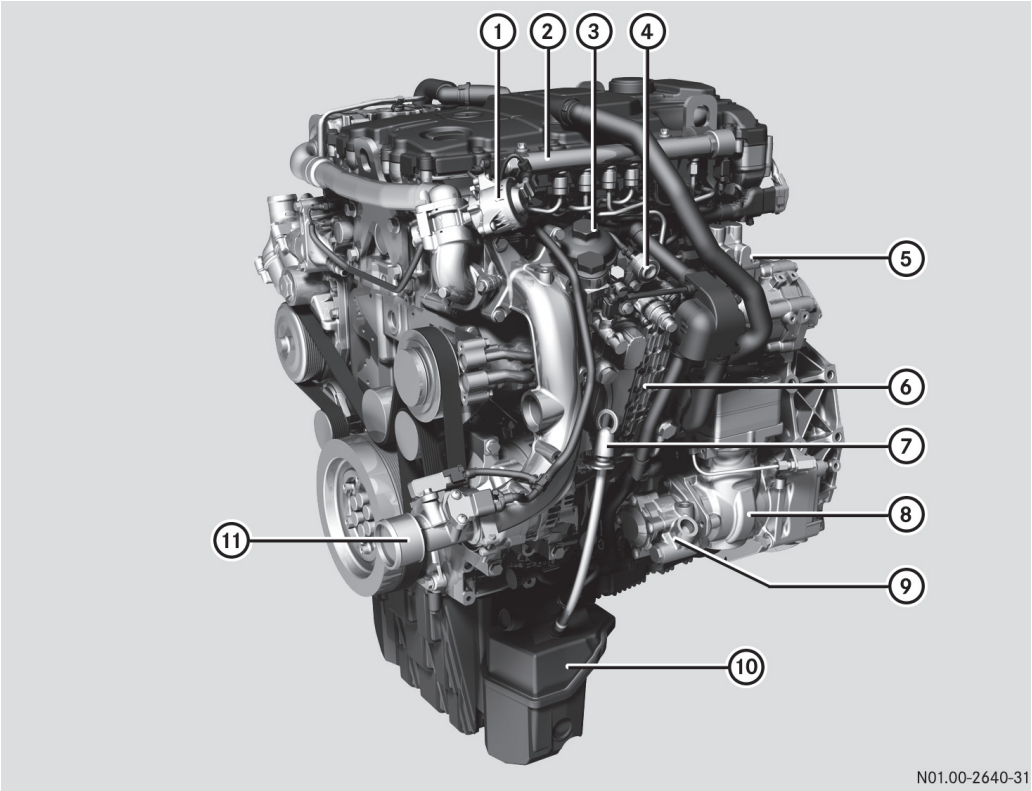
The exhaust gas aftertreatment unit is characterised by the following technologies (not for EU Stage IIIA):

- selective catalytic reduction (SCR) with ammonia slip catalytic converter
- diesel oxidation catalytic converter (DOC)

The engine brake is a decompression brake. It has a controlled exhaust valve which gives it high braking power. The engine brake is controllable in steps or modulated.

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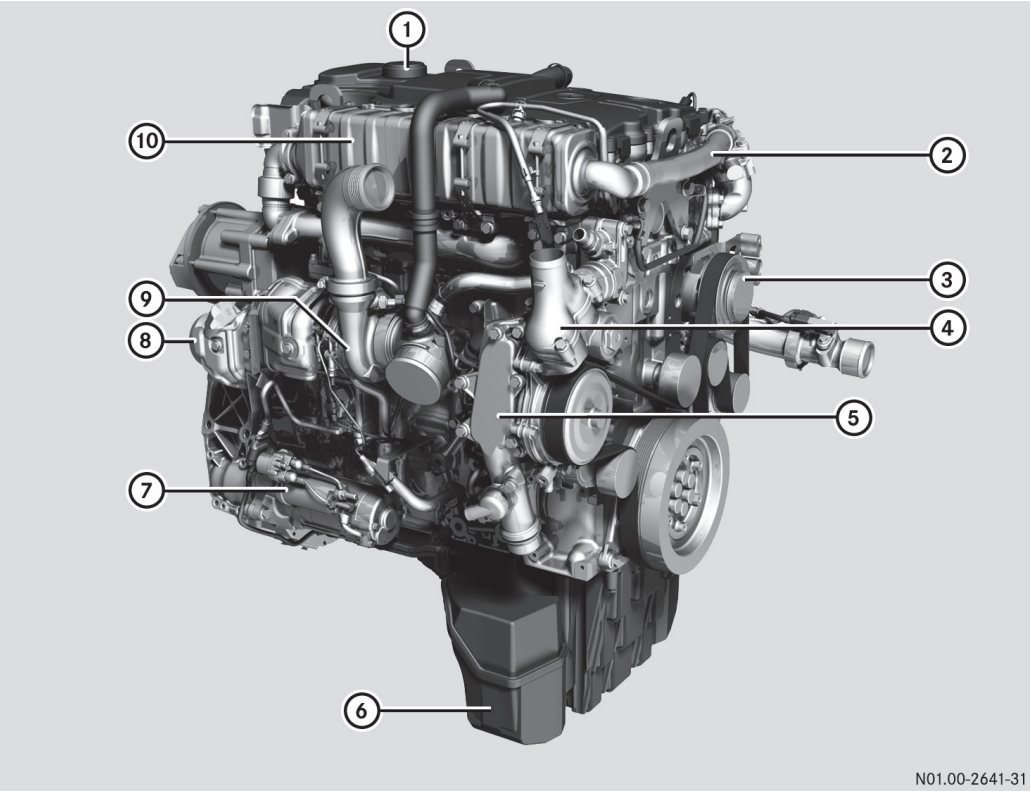
Engine overview



Engine overview: 4R 1000 with single-stage charging

① Exhaust gas recirculation positioner
② Rail
③ Fuel filter
④ External engine start/engine stop button
⑤ High-pressure fuel pump
⑥ Engine management control module (MCM)
⑦ Dipstick
⑧ Air compressor
⑨ Power-steering pump
⑩ Oil pan
⑪ Charge-air pipe (cold)

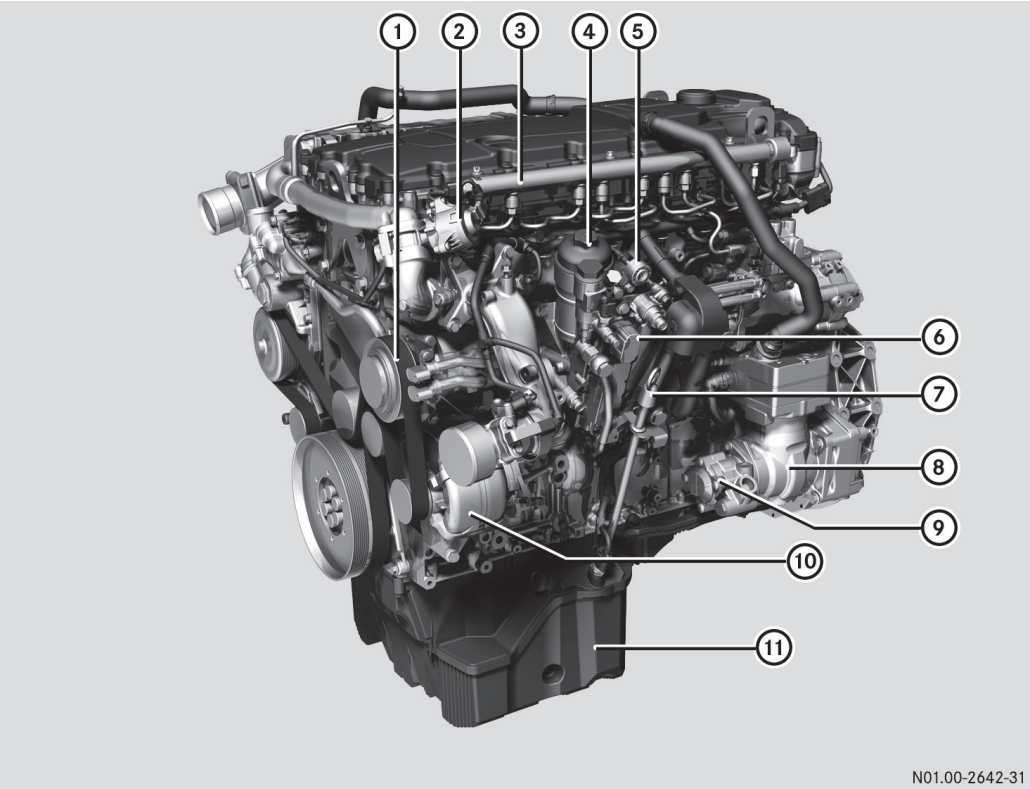
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Engine overview: 4R 1000 with single-stage charging

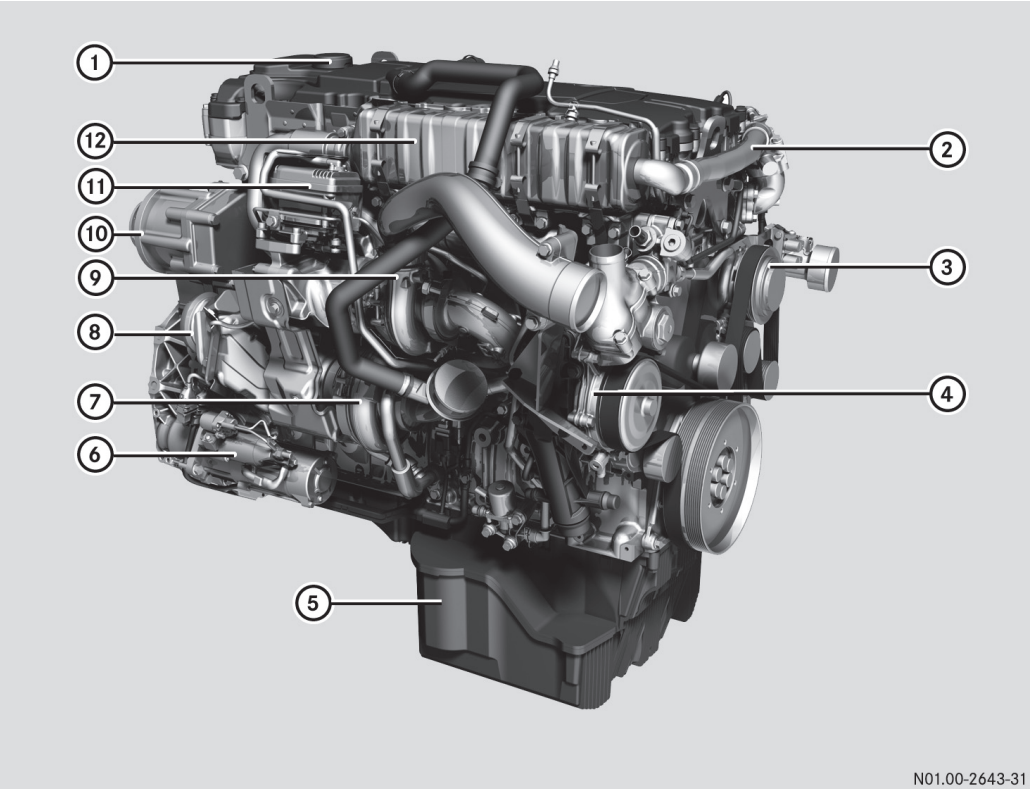
① Crankcase ventilation system
② Exhaust gas recirculation pipe (cold)
③ Refrigerant compressor
④ Coolant thermostat
⑤ Combined oil filter/oil cooler module with coolant pump
⑥ Oil pan
⑦ Starter motor
⑧ Exhaust pipe to exhaust gas aftertreatment unit
⑨ Exhaust gas turbocharger
⑩ Exhaust gas recirculation cooler

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Engine overview: 6R 1000 with two-stage charging
① Refrigerant compressor
② Exhaust gas recirculation positioner
③ Rail
④ Fuel filter
⑤ External engine start/engine stop button
⑥ Engine management control module (MCM)
⑦ Dipstick
⑧ Air compressor
⑨ Power-steering pump
⑩ Alternator
⑪ Oil pan

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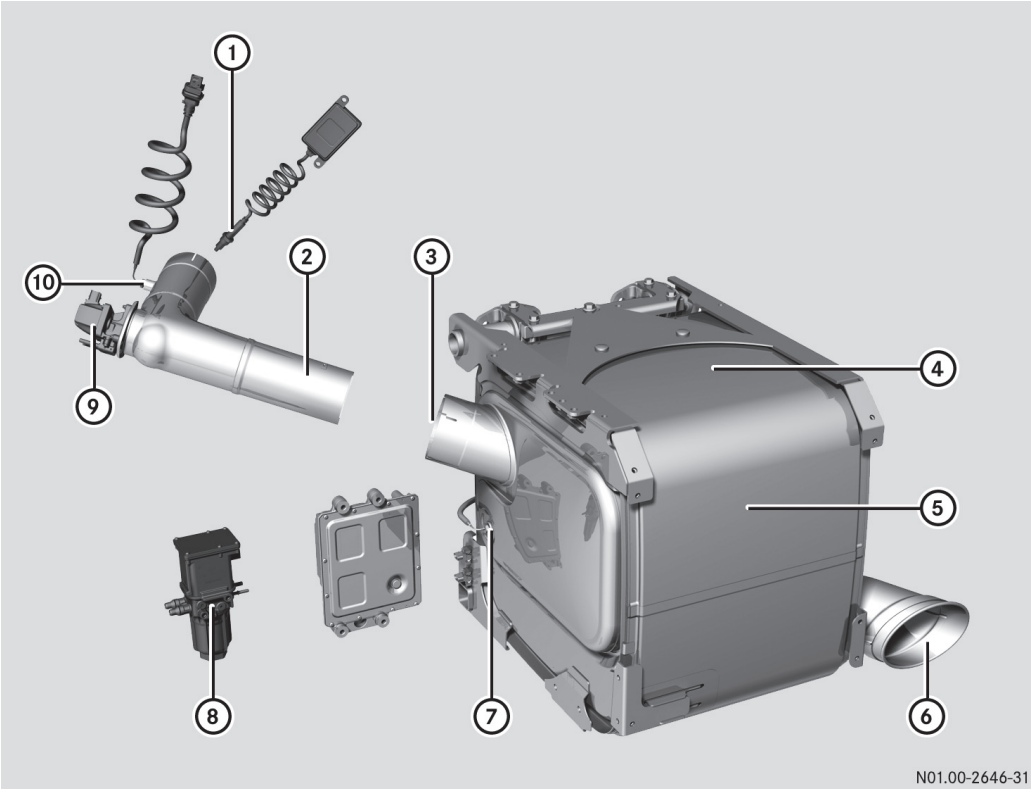


Engine overview: 6R 1000 with two-stage charging

① Crankcase ventilation system
② Exhaust gas recirculation pipe (cold)
③ Refrigerant compressor
④ Combined oil filter/oil cooler module with coolant pump
⑤ Oil pan
⑥ Starter motor
⑦ Low pressure exhaust gas turbocharger
⑧ Exhaust pipe to exhaust gas aftertreatment unit
⑨ High pressure exhaust gas turbocharger
⑩ Power take-off (PTO)
⑪ Boost pressure positioner
⑫ Exhaust gas recirculation cooler

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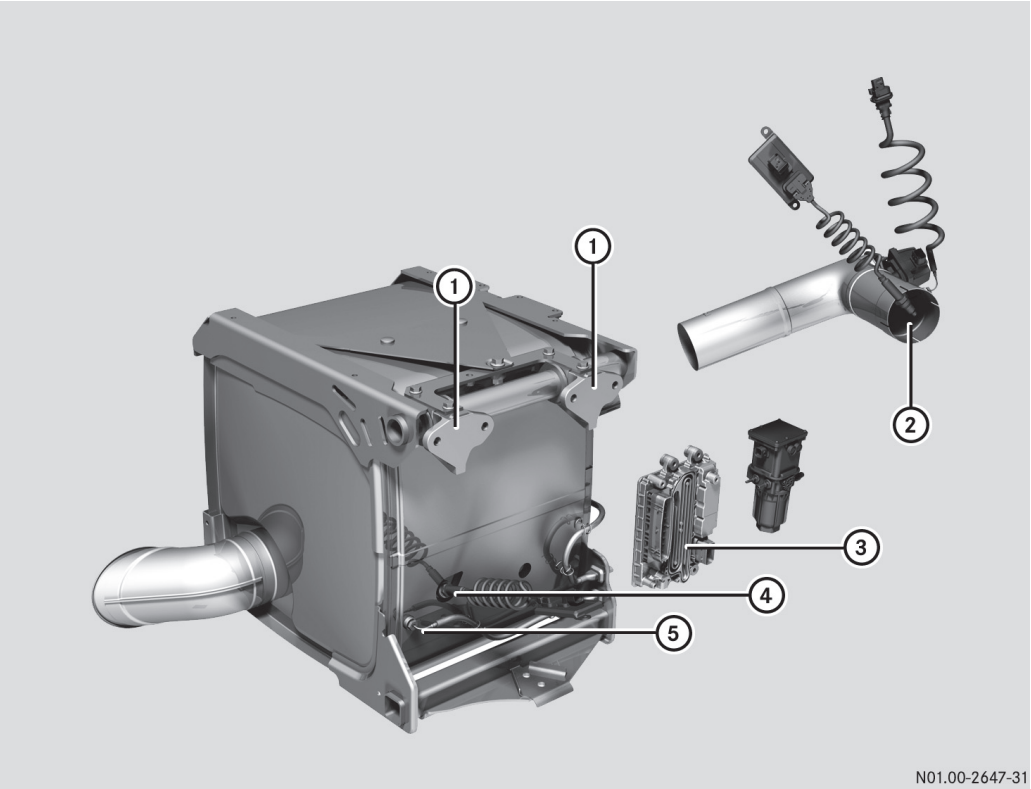
Exhaust gas aftertreatment overview



Exhaust gas aftertreatment unit (not for EU Stage IIIA)

① NOx sensor on exhaust gas aftertreatment unit inlet
② AdBlue® mixing tube
③ Exhaust gas inlet from AdBlue® mixing tube
④ Position of exhaust gas aftertreatment identification plate
⑤ Exhaust gas aftertreatment box
⑥ Exhaust gas outlet
⑦ Exhaust gas temperature sensor upstream of the SCR catalytic converter
⑧ Pump module
⑨ AdBlue® or DEF metering unit
⑩ Exhaust gas temperature sensor upstream of the AdBlue® metering unit

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Exhaust gas aftertreatment unit (not for EU Stage IIIA)
① Mounting brackets
② Exhaust gas inlet from engine
③ Exhaust gas aftertreatment control unit (ACM)
④ NOx sensor on exhaust gas aftertreatment unit outlet
⑤ Exhaust gas temperature sensor downstream of the SCR catalytic converter

Electronic engine management

The engine system is equipped with an electronic engine management system which comprises the following control units:

- Engine management control module (MCM)
- Drive control system unit (CPC)
- Exhaust gas aftertreatment control module (ACM) (not for EU Stage IIIA)

The control units are connected in an electronic network. Data is exchanged via CAN (Controller Area Network).

In addition to the engine, the exhaust gas aftertreatment and the connection on the vehicle/device, the electronic engine management system also monitors itself.

Depending on the malfunctions or failures which occur, warning and indicator lamps are activated (▷ page 17). The malfunction is stored in the fault memory and if necessary a safety and emergency mode is automatically selected (▷ page 28). If the electronic engine management control detects a fault, the fault code is stored in the control units. It can then be read by a qualified specialist workshop (▷ page 8) using a diagnostic tester.

Engine management control module (MCM)

The engine management control module (MCM) is located on the side of the engine. It acts as an

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interface between the electric and electronic components on the engine and the drive control system unit (CPC) on the vehicle.

The engine management control module (MCM) has many functions:

- Injection control of the common rail diesel injection system

  The engine management control module (MCM) calculates the optimum start and quantity of injection, taking the torque demand from the drive control system unit (CPC) into account.

  All of the data required for this, e.g. power output or data which serves to protect the engine, is stored in the engine management control module (MCM).
- Regulation of exhaust gas recirculation (EGR)

  The ratio between the mass of recirculated exhaust gas and the fresh air mass is precisely regulated over the entire engine speed range.
- Charge-air pressure control
- Control of the engine brake

  The engine management control module (MCM) controls the engine brake as required by the drive control system unit (CPC).
- Fan regulation

  In optional fan regulation, the solenoid valve on the fan clutch is activated according to coolant temperature.
- Instrument cluster display

  For the displays in the instrument cluster, the engine management control module (MCM) detects the following:
- Engine oil level
- Engine oil temperature
- Oil pressure
- Coolant temperature
- Engine speed

Drive control system unit (CPC)

The drive control system unit (CPC) 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 and the engine management control module (MCM) on the engine.

The drive control system unit (CPC) has many functions:

- Calculation of torque demand

  The drive control system unit (CPC) registers the driver's requirements. For example, the position of the accelerator is detected by the drive control system unit (CPC). A torque requirement is calculated from that and sent to the engine management control module (MCM) 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 module (ACM) (not for EU Stage IIIA)

The exhaust gas aftertreatment control module (ACM) is installed in a protected location in the vehicle/device by the vehicle/device manufacturer. It regulates and controls the exhaust gas aftertreatment system.

Functions of the exhaust gas aftertreatment control module (ACM):

- Evaluation of sensor signals

  The sensor signals of the directly connected sensors are evaluated. Data provided via the CAN by the engine management control module (MCM) and the control units for the NOx sensors is also evaluated.
- AdBlue®/DEF injection

  Calculation of the required amount of AdBlue®/DEF and supply of AdBlue®/DEF by actuation of the SCR delivery pump.

  Injection by actuation of the AdBlue®/DEF metering unit.

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BlueTec® exhaust gas aftertreatment (not for EU Stage IIIA)

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.

Exhaust gas treatment is carried out by:

- selective catalytic reduction (SCR) with ammonia slip catalytic converter
- diesel oxidation catalytic converter (DOC)

In order to ensure correct operation of the exhaust gas aftertreatment system, only operate the engine/vehicle with the AdBlue® reducing agent. AdBlue®/DEF is not refilled as part of the maintenance work. You should therefore top up the AdBlue®/DEF tank regularly.

Operating the vehicle or device without AdBlue®/DEF or with another medium that has not been approved by Mercedes-Benz or MTU invalidates the engine's operating permit or certification.

Exhaust gas recirculation

Exhaust gas recirculation (EGR) serves primarily to reduce the amount of nitrogen oxide prior to exhaust gas aftertreatment. This serves to comply with emissions limits.

Exhaust gas is added to the fresh air being drawn in or charged so that the concentration of oxygen in the combustion mixture is reduced. Combustion deteriorates if the concentration of exhaust gas in the combustion mixture is too high.

The emission of soot particles, carbon monoxide (CO) and hydrocarbons (HC) increases.

Conversely, the emission of nitrogen oxides (NOx) would increase if the concentration of fresh or charged air were too high.

Warning and indicator lamps

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 29).

Overview

The indicator and warning lamp display is designed for the specific vehicle or equipment. Observe the information contained in the operating instructions of the vehicle or device. 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:

Indicator lamp	Description
red	Engine stop
	Engine system malfunction
[1]	Emissions-relevant malfunction of the exhaust gas aftertreatment system or AdBlue®/DEF supply
LIMIT[1] (lit constantly)	Torque operating restriction
LIMIT[1] (flashing)	Torque and engine speed operating restriction
	Charge current

1 Not for EU Stage IIIA

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Indicator lamp	Description
[1] (optional)	AdBlue®/DEF reserve level
(optional)	Oil pressure too low (engine)
(lit constantly)	Engine oil level low
(flashing)	Engine oil level too low
(optional)	Coolant level too low
(optional)	Coolant temperature too high
(optional)	Continuous brake active
(optional)	Cruise control
LIM (optional)	Speed limiter
(optional)	Power take-off engaged

[1] Not for EU Stage IIIA

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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 measures

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.
- When drying paintwork, do not exceed a temperature of 80 °C (e.g. in the drying oven).
- 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 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

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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 may affect the operation of vehicle systems. As a result, the operating safety of the vehicle could be affected. There is a risk of an accident.

Only connect equipment to a diagnostics connection in the vehicle, which is approved for your vehicle by Mercedes-Benz.

If the engine is switched off and devices connected to the diagnostics connection are being used, the starter battery can become discharged.

Connecting devices to the diagnostics connection can, for example, cause the emissions monitoring information to be reset. As a result, there is a possibility that the vehicle/equipment will not fulfil the requirements of the next legally prescribed emissions test.

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.

ⓘ Further measures may be required for personnel, depending on national regulations. Comply with the relevant applicable regulations in your country.

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:

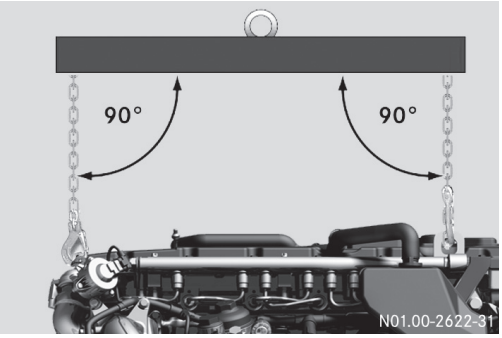
- work loose and fall off
- swing uncontrollably as a result of a change in the centre of gravity.

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.

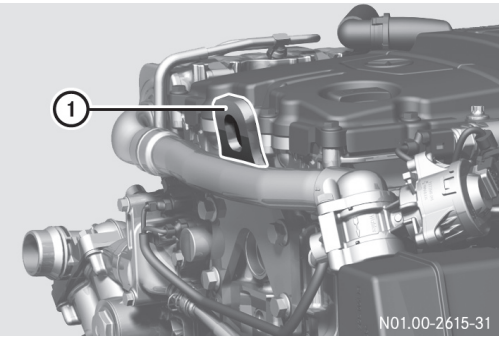
! The engines are by default delivered filled with oil. If the engine is transported at an angle or on its side, oil could leak out. Only transport the engine in the installation position.

! Do not tread on the engine or the exhaust gas aftertreatment unit (not for EU Stage IIIA). They may otherwise become damaged.

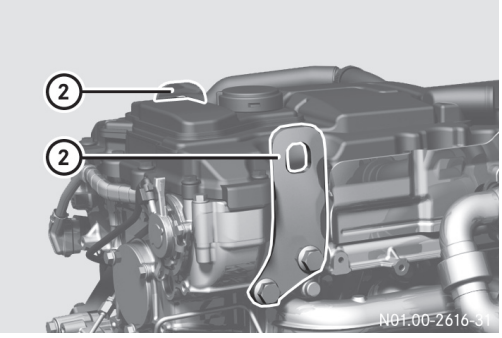


Example: using a cross member

The engine may only be lifted using a cross member with the chain/rope at 90° relative to the horizontal engine.



① Example: belt-side lifting point



② Example: flywheel-side lifting point

Installation

The engine system may only be installed as contractually specified.

Observe the sections "Correct use" (▷ page 6) and "Modifying the engine output" (▷ page 6).

Daimler AG provides the vehicle manufacturer with comprehensive material, e.g. the installa-

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tion 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 taken into account (▷ page 8).

Observe the sections "Qualified specialist workshop" (▷ page 8) and "Further applicable documents" (▷ page 8).

Please consult an 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.

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 management control module (MCM) and transmitted to the drive control system control unit (CPC).

Output can be displayed by indicator lamps or on a matrix display when the engine is not running and the ignition is switched on.

The engine oil level is not displayed while driving.

Checking the oil level electronically

! 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. daily before driving or each time you refuel.

Please also observe the information in the Operating Instructions provided by the vehicle/device manufacturer.

- ▶ Park the vehicle/device on a level surface.
- ▶ Apply the parking brake.
- ▶ Switch off the engine
- ▶ Switch the ignition lock to the drive position.
- ▶ Wait for at least five minutes after switching off the engine.

i The current oil level information can only be called up when the vehicle is stationary and at least 5 minutes after the engine was switched off. Then switch on the ignition and wait for the lamp failure indicator.

! To measure the oil level, the vehicle or device must be on a level surface. If the oil level is measured while the vehicle is on a slope, false readings will be displayed

If the oil level is low, the indicator lamp lights up

If the oil level is too low and the engine should not be started, the indicator lamp flashes

- ▶ If necessary, use filler neck ① to top up the oil.

Only use engine oil which has been approved for the engine and which meets the specified SAE classification (▷ page 42).

Oil level messages via indicator lamp

If the oil level is low the indicator lamp lights up. The oil level is low. Add oil. Use the dipstick to determine the quantity to be added.

i The missing amount should be refilled immediately. If the engine oil level is too low, the indicator lamp flashes and the warning buzzer sounds. The oil level is **too** low; do not start the engine and refill oil immediately. Use the dipstick to determine the quantity to be added.

! The oil level must be corrected immediately; there is a risk of engine failure.

Oil level messages via matrix display

The display of oil level messages is determined by the vehicle or device manufacturer. Please observe the information in the operating instructions provided by the vehicle/device manufacturer.

If the engine oil level is low, refill the quantity of missing oil shown in the display.

If the engine oil level is **too** low, do not start the engine and refill the quantity of missing oil shown in the display.

Operation

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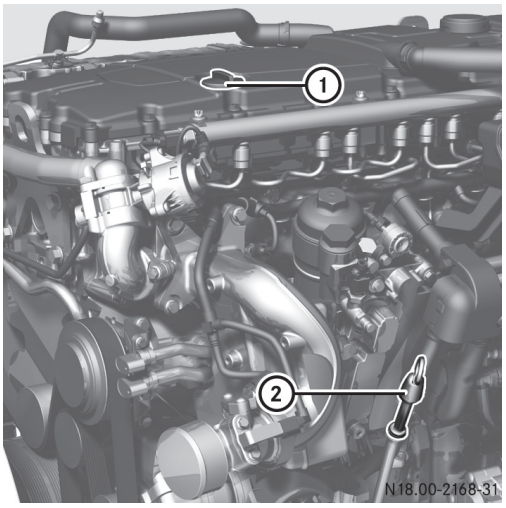
! The oil level must be corrected immediately; there is a risk of engine failure.

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. before each journey or each time you refuel.

- ▶ Park the vehicle/device on a level surface.
- ▶ Apply the parking brake.
- ▶ Switch off the engine.
- ▶ Wait for approximately 5 minutes.



- ▶ 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.

Only use engine oil which has been approved for the engine and which meets the specified SAE classification (▷ page 42).

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 43).

Checking the fuel level

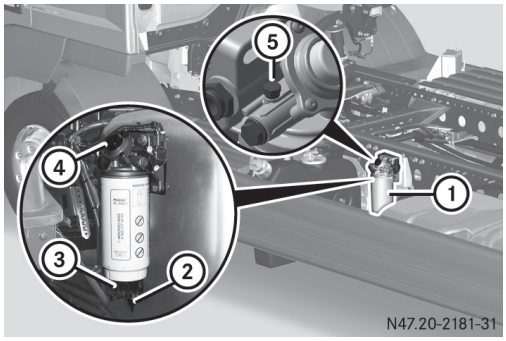
For checking the fuel level on the fuel gauge, see the vehicle Owner's Manual. Refuel if necessary (▷ page 44).

Checking the water level in the fuel prefilter on the chassis frame

Environmental note

Dispose of the water-fuel mixture in an environmentally responsible manner.

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Example: fuel prefilter on the chassis frame

	Function	Page
1	Fuel prefilter	
2	Drain plug	
3	Inspection window	
4	Manual fuel pump	
5	Bleed screw	

If water has collected in inspection window ③, drain fuel prefilter ① on the chassis frame.

Drain fuel prefilter ① on the chassis frame when necessary; if there is a danger of frost, do this on a regular basis.

Draining the fuel prefilter on the chassis frame

- Place a collecting pan under drain plug ②.
- Turn drain plug ② open.
- Press manual fuel pump ④ and collect the fuel/water mixture.
- Turn drain plug ② closed.

Check the AdBlue®/DEF level (not for EU Stage IIIA)

For checking the AdBlue®/DEF supply on the AdBlue®/DEF gauge, see the vehicle Owner's Manual. Refuel if necessary (▷ page 39).

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 62).

You can utilise the full engine power output once the engine has reached its normal operating temperature.

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 supplemental operating instructions are provided by the vehicle/device manufacturer.

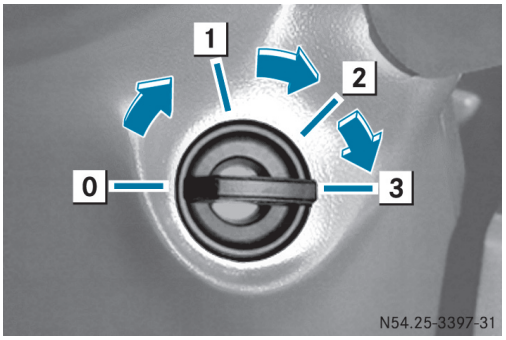
For additional safety, the electronic engine management system is equipped with a function that only allows the engine to be started when the transmission is in neutral (vehicle-specific/device-specific).

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.

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Determine the cause. The operating safety of the engine is jeopardised.



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/device against rolling away.
- ▶ Deactivate power take-off.
- ▶ Shift into neutral.
- ▶ **To start the engine:** turn the key in the ignition lock to drive position 2.
- ▶ Turn the key to start position 3 in the ignition lock. Do not depress the accelerator pedal whilst doing so.
- ▶ 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 55).
- ▶ 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 51).

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.
- 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/device against rolling away.
- ▶ Shift the transmission into neutral/decouple the drive system.

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Let the engine idle for approximately two minutes before switching off the engine if:

- the coolant temperature is very high (over 100 °C).
- 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 (not for EU Stage IIIA emissions certification) the system may continue to run for a short while. Depending on the installation position, operating state and ambient temperature, circulation of AdBlue®/DEF is necessary to ensure cooling. To do this the AdBlue®/DEF delivery pump is actuated during this period.

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 51).

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.

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 speed results in more effective engine braking.

Note the effective engine braking range marked on the rev counter (▷ page 28).

The maximum permissible engine speed may be restricted, depending on the vehicle/device application.

Observe the information contained in the operating instructions of the vehicle or device.

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 or device operating instructions).

Retarder

Operation of the retarder; see the vehicle or 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.

You can set the idling speed to between approximately 600 and 800 rpm.

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 set-

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ting the working speed, see the vehicle operating instructions.

Climate control

Air-conditioning system

! Turn on the air-conditioning system at least once a month for approximately ten minutes. The refrigerant compressor may otherwise be damaged.

Environmental note

Only switch on the air-conditioning system when necessary. Fuel consumption increases when the air-conditioning system is switched on.

The air-conditioning system can only be operated when the engine is running. Operation of the air-conditioning system (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 55).

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 55).

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 6).

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 55).

Operating restrictions (not for EU Stage IIIA)

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)

Operating restrictions in the form of torque reduction and thus output and speed limitation may occur.

Emergency switch for overriding operating restrictions (not for EU Stage IIIA)

A detected emissions-related malfunction in the exhaust gas aftertreatment system or the AdBlue®/DEF supply can result in restricted operation (limitation of engine torque and engine speed).

In case of emergency a button can be pressed 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 button is disabled.

Displays

Rev counter

! If you exceed the maximum permissible engine speed, the warning tone sounds.

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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

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 (not for EU Stage IIIA)

The AdBlue®/DEF display is the responsibility of the vehicle manufacturer and 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 is operated without AdBlue®/DEF. The legal consequence of this is that the vehicle 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 39).

If the display is ignored and the AdBlue®/DEF level drops further, engine torque and engine speed may be reduced (▷ page 28).

The engine torque can be limited to a maximum of 20% across the whole engine speed range. The engine speed can be limited to idling speed.

Warning and indicator lamps

Warning and indicator lamps – causes/consequences and solutions

The display format for indicator and warning lights is vehicle-specific/device-specific. Please observe the information contained in the device/vehicle operating instructions. The symbols listed below are examples and may differ from those symbols displayed in the vehicle/device. Depending on the priority of the fault or warning, the warning and indicator lamps light up in different combinations.

If you ignore warning and indicator lamps, you will not be able to recognise failures and malfunctions in components or systems. Have the affected system checked and repaired at a qualified specialist workshop.

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Warning and indicator lamps

Problem	Possible causes/consequences and ▶ Solutions
The indicator lamp lights up 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, have the cause of the malfunction repaired at a qualified specialist workshop.
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 23). ▶ 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 (▷ page 24). ▶ 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 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 engine oil level. The engine oil level is low. ▶ The indicator lamp lights up after the electronic oil level measurement has been completed and a "low oil level" has been determined. ▶ Correct the engine oil level (▷ page 23). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
The indicator lamp flashes.	The indicator lamp shows the status of the engine oil level. The engine oil level is too low. ▶ The indicator lamp lights up after the electronic oil level measurement has been completed and "oil level too low" has been determined. ▶ Do not start the engine. ▶ Correct the engine oil level (▷ page 23). ▶ If this does not help, have the malfunction rectified at a qualified specialist workshop.
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 operating instructions of the device/vehicle. ▶ 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 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 operating instructions of the device/vehicle.

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Problem	Possible causes/consequences and ▶ Solutions
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/device display. ▶ Observe the information contained in the operating instructions of the device/vehicle.
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 idling position, the set speed limit is reactivated. ▶ Observe the information contained in the operating instructions of the device/vehicle.
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 operating instructions of the device/vehicle.

Only for vehicles/devices with AdBlue®/DEF reserve level warning lamp (not for EU Stage IIIA)

If a malfunction is detected and the listed indicator lamps light up, a warning buzzer sounds for approximately 5 seconds. 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 28).

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Problem	Possible causes/consequences and ▶ Solutions
Indicator lamps and LIMIT are lit and flashes.	The AdBlue®/DEF level has dropped to approximately 7.5%. Reduced engine output is active. The engine torque is limited to a maximum of 75% across the whole engine speed range. The limitation takes effect by means of a ramp function. ▶ Adapt your driving/operating style. ▶ Top up the AdBlue®/DEF tank immediately. If you do not follow the instructions, an engine speed limitation may be imposed.
The indicator lamp is lit and and LIMIT are flashing.	The AdBlue®/DEF level has dropped to approximately 5%. The reduction in engine output and limitation of the engine torque are activated. The engine torque is limited to a maximum of 50% across the whole engine speed range. The engine speed is limited to a maximum of 60%. The limitation takes effect by means of a ramp function. ▶ Adapt your driving/operating style. ▶ Top up the AdBlue®/DEF tank immediately. If you do not observe the instructions, engine torque and engine speed may be further reduced.
The and indicator lamps are lit and and LIMIT are flashing.	The AdBlue®/DEF level has dropped to approximately 2.5%. 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 idling speed. The limitation takes effect by means of a ramp function. ▶ Adapt your driving/operating style. ▶ Top up the AdBlue®/DEF tank immediately.
The , , and LIMIT indicator lamps are flashing.	The AdBlue®/DEF level has dropped to approximately 0%. 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 idling speed. The limitation takes effect by means of a ramp function. ▶ Stop the vehicle/device, paying attention to road and traffic conditions. ▶ Top up the AdBlue®/DEF tank immediately.
The indicator lamp lights up.	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, hours or journeys without a malfunction.

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Problem	Possible causes/consequences and ▶ Solutions
The LIMIT indicator lamp lights up and ⇦ is 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. Reduced engine output is active. The engine torque is limited to a maximum of 75% across the whole engine speed range. The limitation takes effect by means of a ramp function. ▶ Adapt your driving/operating style. ▶ Drive carefully to the nearest qualified specialist workshop and have the malfunction rectified immediately. If you do not follow the instructions, an engine speed limitation may be imposed.
The LIMIT and ⇦ 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 50% across the whole engine speed range. The engine speed is limited to a maximum of 60%. The limitation takes effect by means of a ramp function. ▶ Adapt your driving/operating style. ▶ Drive carefully to the nearest qualified specialist workshop and have the malfunction rectified immediately. If you do not follow the instructions, an engine speed limitation may be imposed.
The LIMIT and ⇦ indicator lamps are flashing and ⚙ 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 idling speed. ▶ Adapt your driving/operating style. ▶ Have the malfunction rectified immediately at a specialist workshop.
The LIMIT, ⇦ and ⚙ 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. Reduced engine output is active. The engine torque is limited to a maximum of 20% across the whole engine speed range. The engine speed is limited to idling speed. ▶ Stop the vehicle/device, paying attention to road and traffic conditions. ▶ Have the malfunction rectified immediately at a specialist workshop.

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

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status indicator. The system check may involve several engine starts, several hours or several journeys without a malfunction.

Only for vehicles/devices without AdBlue®/DEF reserve level warning lamp (not for EU Stage IIIA)

If a malfunction is detected and the listed indicator lamps light up, a warning buzzer sounds for approximately 5 seconds. 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 28).

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, hours or journeys without a malfunction.
The indicator lamp is flashing and LIMIT 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 limited to a maximum of 75% across the whole engine speed range. The limitation will take effect the next time the engine is started. ▶ 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 follow the instructions, an engine speed limitation may be imposed.
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 50% across the whole engine speed range. The engine speed is limited to a maximum of 60%. The limitation takes effect by means of a ramp function. ▶ 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 follow the instructions, an engine speed limitation may be imposed.

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Problem	Possible causes/consequences and ▶ Solutions
The [engine] and LIMIT indicator lamps are flashing and [engine] 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 idling speed. ▶ 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.
The [engine], LIMIT and [engine] 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 idling speed. ▶ Stop the vehicle/device, paying attention to road and traffic conditions. ▶ Have the malfunction rectified immediately at a specialist workshop.

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.

If the system check does not detect any other faults, the indicator lamps go out after the system's status indicator.

Operating instructions

Running-in

Observe the vehicle/device manufacturer's running-in notes. The running-in period of the engine has a significant effect on the vehicle/device, 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/device up to full output and increased engine speeds.

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Fuel consumption

General notes

Fuel consumption depends on:

- the machine version/vehicle version
- 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 44).

AdBlue®/DEF consumption (not for EU Stage IIIA)

AdBlue® consumption is between 2 and 4% of the fuel consumption, depending on engine use.

Engine oil consumption

After running-in the engine, oil consumption may reach 0.2% of the vehicle's actual fuel consumption.

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 (▷ page 62) is exceeded. The operating safety of the engine is jeopardised.
- an emissions-relevant malfunction is detected (not for engines with emissions certification according to EU Stage IIIA) or there is an operating restriction due to an emissions-relevant malfunction.
- the oil level is too low.

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.

▷▷

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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.

⚠ 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.

! Only refuel using commercially available, sulphur-free diesel fuel that complies with the following standards:

- EN 590 as of 2010, et seq. (max. 0.001% sulphur by weight) (10 ppm) or
- ASTM D975 (max. 0.0015% sulphur by weight) (15 ppm)

The following fuel types are not permitted:

- sulphurous fuel with a sulphur content greater than 0.005% by weight (50 ppm)
- marine diesel fuel
- aviation turbine fuel
- heating oils
- fatty acid methyl ester FAME (bio-diesel fuel)

These fuel types cause irreversible damage to the engine and the exhaust gas aftertreatment system (not for EU Stage IIIA) and significantly reduce the expected service life.

! 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.

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.

Please observe further information on diesel fuel in the "Service products" section (▷ page 44). 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.

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- ▶ Switch off the engine.
- ▶ Secure the vehicle/device against rolling away.
- ▶ Observe the fuel grade (▷ page 44).

Regularly check the fuel prefilter with heated water separator for condensation.

AdBlue®/DEF (not for EU Stage IIIA)

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.

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 45).

Before filling the tank

- ▶ Switch off the engine.
- ▶ Secure the vehicle/device 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.

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Before the start of the cold season, make sure that:

- the coolant contains sufficient antifreeze (▷ page 43)
- the fuel used is suitable for winter use (▷ page 44)
- the SAE class of the engine oil used is in accordance with outside temperatures (▷ page 42).

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.

Coolant preheating

⚠ DANGER

There is high voltage in the 230 V power socket if:

- the 230 V power supply is being established
- the residual current circuit breaker is switched on

If you or another person, particularly a child, reach into the power socket, you could receive an electric shock. There is a risk of fatal injuries.

Do not reach into the power socket and keep children away from it. After connecting to the 230 V power supply, make sure that the residual current circuit breaker is functioning correctly.

There is an electrical heating element fitted to the engine for coolant preheating. Coolant preheating serves to help the engine reach operating temperature sooner.

Thanks to a shorter cold-start phase, the engine is operational sooner and engine wear and tear is reduced.

The electrical heating element has power consumption of up to 1.5kW at 230V power supply.

The supply of electrical power is provided by an external (230V) power socket.

Please also observe the information in the Operating Instructions provided by the vehicle/device manufacturer.

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 45).

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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 8).

Please also observe the maintenance instructions for special accessories.

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.

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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 (not for EU Stage IIIA)

Approved operating fluids fulfil the highest quality standards and are documented in the Mercedes-Benz Specifications for Service Products. Therefore, only use service products approved for the vehicle. Information about approved service products is available from any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

You can recognise operating fluids approved by Mercedes-Benz by the following inscription on the container:

- MB-Freigabe (e.g. MB-Freigabe 229.51)

  or
- MB-Approval (z. B. MB-Approval 229.51)

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 at any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

ⓘ 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 MTU or MTU-authorised Service Centre (▷ page 8).

Engine oils

Notes on engine oils

! Engine oils other than those of the quality specified in this Operator's Manual are not permitted.

The oil quality is crucial for the function and service life of an engine. Based on highly exacting tests, Mercedes-Benz regularly approves engine oils which fulfil the current technical standards.

Only use engine oils in accordance with Sheet No. 228.51, 228.31, 228.5 or 228.3 of the Mercedes-Benz Specifications for Service Products.

Engine oils according to Sheet No. 228.51 and 228.5 have a higher quality standard and have a favourable effect on:

- length of oil change intervals
- engine wear
- fuel consumption
- exhaust emissions

Before delivery, the engine is filled with oil in SAE class 5W-30 (▷ page 23).

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

Multi-grade engine oils compliant with Sheet No. 228.51, 228.31, 228.5 or 228.3 can be used all year round.

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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.

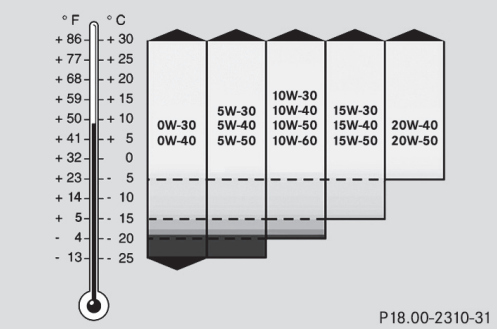
Therefore, only mix engine oils of differing grade in exceptional circumstances. To prevent damage to the engine, the maintenance intervals must be adjusted accordingly.

! If the SAE class (viscosity) of the engine oil used is not suitable for continually low outside temperatures below -20 ℃, 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 ℃, Mercedes-Benz strongly recommends using engine oils of SAE class 5W-30 or 0W-30.

Use only all-season oils.



Engine oil SAE classes (viscosity)

▶ Select the SAE class (viscosity) of the engine oil to suit the average outside temperatures for the time of year.

Oil change intervals are dependent on the following:

- the operating conditions of the vehicle
- the grade of the engine oil used

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.

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 23).

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.

Coolant

⚠ WARNING

The cooling system is pressurised, particularly when the engine is warm. If you open the cap, you could be scalded if hot coolant sprays out. There is a risk of injury.

Let the engine cool down before you open the cap. Wear gloves and eye protection. Open the cap slowly to release the pressure.

⚠ WARNING

If antifreeze comes into contact with hot components in the engine compartment, it may ignite. There is a risk of fire and injury.

▷▷

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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 (▷ page 63). Please note the Mercedes-Benz Specifications for Service Products (▷ page 42). 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.

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 vehicle, you should filter the fuel before filling.

This prevents malfunctions in the fuel system caused by contaminated fuel.

! Only refuel using commercially available, sulphur-free diesel fuel that complies with the following standards:

- EN 590 as of 2010, et seq. (max. 0.001% sulphur by weight) (10 ppm) or
- ASTM D975 (max. 0.0015% sulphur by weight) (15 ppm)

The following fuel types are not permitted:

- sulphurous fuel with a sulphur content greater than 0.005% by weight (50 ppm)
- marine diesel fuel

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- aviation turbine fuel
- heating oils
- fatty acid methyl ester FAME (bio-diesel fuel)

These fuel types cause irreversible damage to the engine and the exhaust gas aftertreatment system (not for EU Stage IIIA) and significantly reduce the expected service life.

! A higher fuel sulphur content accelerates the ageing process of the engine oil and can damage the engine and exhaust system.

Fuel grade

i Certain countries have diesel fuel with varying sulphur contents. Diesel fuel with low fuel-sulphur content is sold in certain countries under the name "Euro diesel".

Information about current country-specific sulphur contents can be obtained from any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

Water content

The maximum permissible water content at the point of transfer between vehicle and engine must not be greater than 200 mg/kg. If the water content is higher, an additional water separator must be fitted on the chassis.

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.

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.

AdBlue®/DEF (not for EU Stage IIIA)

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.

▷▷

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- 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.

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 Owner's Manual. 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 suited to storing AdBlue®:

- aluminium
- copper
- copper alloys

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- unalloyed steel
- galvanised steel

If stored in these types of containers, constituents of these metals may dissolve and cause irreparable damage to the exhaust gas aftertreatment.

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 tested and approved for Mercedes-Benz. You can obtain these care products from any MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

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.

! 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,

Maintenance

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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 47).

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General notes

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 39).

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 °C.

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 oil filter if the oil is more than 12 months old.
- Check and adjust the level of coolant or renew coolant.
- Check and correct the corrosion inhibitor/antifreeze agent content in the coolant.
- Add AdBlue®/DEF until the tank is full, to prevent AdBlue®/DEF from crystallising (not for EU Stage IIIA).
- Drain the water separator for the fuel system.

Measures during decommissioning:

Start the engine at least once a month and leave it running for 15 - 30 minutes at around 900 rpm.

Depending on the vehicle's equipment:

- with the air-conditioning system switched on
- with the heating activated
- with the auxiliary heating switched on

The monthly engine start can be omitted if the engine was operated with FAME-free fuel (B0 diesel fuel/with no biodiesel content [2]) and subsequently decommissioned.

The engine oil level and the coolant level must be checked before every engine start. On vehicles/devices with a water separator on the fuel filter or fuel prefilter, additionally drain the water separator, if necessary. Upon starting and while the engine is running, observe the oil pressure as well as the coolant temperature.

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 the AdBlue®/DEF level (not for EU Stage IIIA).
- 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 longer than 6 months

If the vehicle is to be decommissioned for longer than 6 months, further measures are required. For more details, consult your MTU or MTU-

2 Further information can be obtained from any Mercedes-Benz Service Centre

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authorised Mercedes-Benz Service Centre
(▷ page 8).

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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

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

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, always comply with all safety regulations, such as operating instructions, regulations concerning hazardous materials, environmental protection measures, work safety and accident prevention regulations.

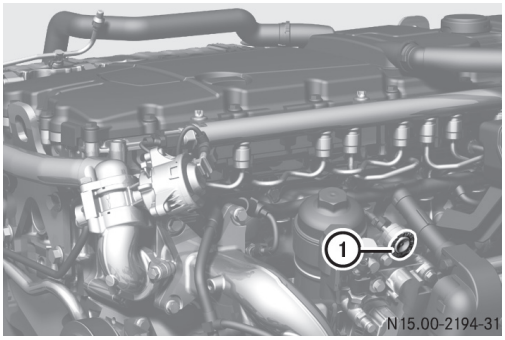
Be aware of the road and traffic situation when working on public roads and secure your position accordingly.

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 55).

Have malfunctions that you cannot eliminate yourself rectified at a qualified specialist workshop.

External engine start/engine stop button



You can start and switch off the engine using the external engine start/engine stop button.

Before starting the engine

- ▶ Turn the key to the drive position in the ignition lock.
- ▶ Shift into neutral.
- ▶ Secure the vehicle against rolling away.
- ▶ Deactivate power take-off.

Starting the engine

- ▶ Press external engine start/engine stop button ① until the engine starts.

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Starting the engine and increasing the engine speed

- Hold down external engine start/engine stop button ① until the desired engine speed is achieved.
  The engine starts and runs at engine idling speed.
  After about 3 seconds, the engine speed increases. After releasing external engine start/engine stop button ①, the engine continues to run at the currently set speed.
  The engine speed can be increased up to the limiting speed.
- **If the engine does not start immediately:** interrupt the starting procedure after no more than 30 seconds.
- 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 55).
- Observe the oil pressure gauge immediately after having started the engine.

Stopping the engine

- Press external engine start/engine stop button ① again.

ⓘ When the engine is switched off (not for EU Stage IIIA), the system may continue to run for a short while. Depending on the installation position, operating state and ambient temperature, circulation of AdBlue®/DEF is necessary for ensuring cooling. To do this the AdBlue®/DEF delivery pump is actuated during this period.

Bleeding and draining the fuel system

Bleeding, after refuelling a fuel system which has been run dry, is performed the next time the engine is started. Automatic continuous bleeding takes place in the filter.

When the engine is started, the battery must have sufficient charge to bleed the fuel system.

Bleed the heated fuel prefilter with water separator on the vehicle before the fuel circuit on the engine is bled by the starter motor. Use the manual fuel pump integrated in the fuel prefilter to do so.

Bleeding the fuel system without a fuel prefilter on the chassis frame

- Turn the key to the start position in the ignition lock and hold it. Do not depress the accelerator pedal whilst doing so.

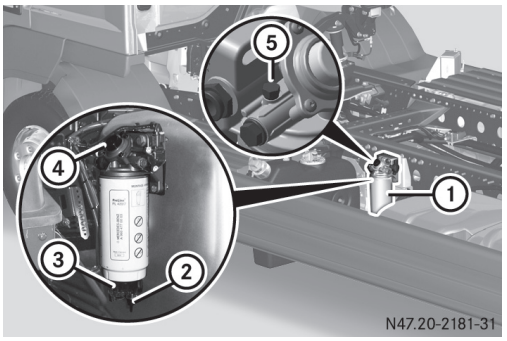
ⓘ The starting procedure is automatically cancelled after approximately 60 seconds.

- Repeat the starting procedure after a waiting period of approximately 1 minute.
- If the engine starts normally, depress the accelerator pedal several times.
  The fuel system is completely bled.

Bleeding the fuel system with a fuel prefilter on the chassis frame

Environmental note

Dispose of the water-fuel mixture in an environmentally responsible manner.



Example: fuel prefilter on the chassis frame

If water has collected in inspection window ③, drain fuel prefilter on chassis frame ① before bleeding. Drain fuel prefilter on chassis frame ① regularly.

Draining the fuel prefilter on the chassis frame

- Place a collector under drain plug ②.
- Turn drain plug ② open.
- Press manual fuel pump ④ and collect the fuel/water mixture.
- Turn drain plug ② closed.

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Bleeding using the manual fuel pump of the fuel prefilter on the chassis frame

- ▶ Unscrew the fuel tank filler cap.
- ▶ Place the collector underneath fuel prefilter ①.
- ▶ Unscrew bleed screw ⑤.
- ▶ Press manual fuel pump ④ repeatedly until the fuel escaping at bleed screw ⑤ is free of bubbles.
- ▶ Tighten bleed screw ⑤.

ⓘ If there was no fuel in the fuel tank, press manual fuel pump ④ again until there is noticeable resistance.

ⓘ Then bleed the fuel circuit on the engine as described under "Bleeding the fuel system without a fuel prefilter on the chassis frame".

- ▶ Tighten the fuel tank filler cap.
- ▶ Turn the key to the start position in the ignition lock and hold it. Do not depress the accelerator pedal whilst doing so.

ⓘ The starting procedure is automatically cancelled after approximately 60 seconds.

- ▶ Repeat the starting procedure after a waiting period of approximately 1 minute.
- ▶ If the engine starts normally, depress the accelerator pedal several times. The fuel system is completely bled.

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.

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 MTU or MTU-authorised Mercedes-Benz Service Centre (▷ page 8).

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.

▷▷

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Immediately rinse acid splashes off with clean water. Consult a doctor if necessary.



Wear eye protection.



Keep children away.



Observe this Owner's Manual.

! Only perform the jump-starting procedure when the engine and catalytic converter are cold. Otherwise, the gas system or the catalytic converter could be damaged.

! 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 cross section of approximately 35–50 mm^2 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.

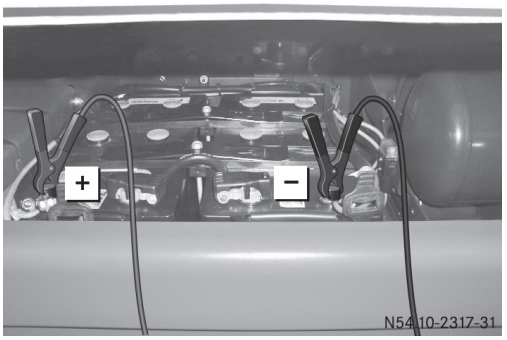
General notes

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 8).

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 37).
	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.
	There are leaks or there is 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.

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Problem	Possible causes/consequences and ▶ Solutions
Engine fails to start when the ambient temperature is low.	The fuel is not resistant to cold. The flow properties of the diesel fuel are inadequate due to paraffin separation. ▶ Malfunctions resulting from paraffin separation can be corrected by warming the entire fuel system, e.g. by parking the vehicle in a heated area. ▶ Refuel with winter fuel (▷ page 45).
	The engine oil viscosity is incorrect. ▶ Alter the engine oil viscosity to the conditions of use (▷ page 42). ▶ If the engine does not start after another attempt, have the cause traced and rectified at a qualified specialist workshop.
The engine stops inadvertently.	The power supply to the engine management (MCM) or the exhaust gas aftertreatment (ACM) (not for EU Stage IIIA) control modules is interrupted or there is a short circuit in the wiring. ▶ Check the electrical fuses ▶ Have the power supply 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 fuel pressure tested at a qualified specialist workshop.
The engine is in emergency running mode.	There is an interruption in the engine management (NGT) control cluster data flow. ▶ Check the battery terminals on the battery and the connectors on the control units for secure seating and corrosion. ▶ 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 gas 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 exterior of the charge-air cooler or engine radiator is dirty. ▶ Clean the exterior of the charge-air cooler and engine radiator.
	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.

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Problem	Possible causes/consequences and ▶ Solutions
	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 44).
	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 (not for EU Stage IIIA). ▶ Observe the notes on warning and indicator lamps (▷ page 29).
There is an interruption in the tractive power.	There is an increased voltage drop to the engine management (MCM) and exhaust gas aftertreatment (ACM) control modules (loose contact). ▶ Check the battery terminals on the battery and the connectors on the engine management (MCM) and exhaust gas aftertreatment (ACM) control modules 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 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.
	The poly-V-belt is damaged. ▶ Replace the poly-V-belt.
	The fan does not switch on correctly. ▶ Consult a qualified specialist workshop.
	The engine radiator is dirty on the inside; the engine radiator is very dirty on the outside. ▶ Clean the engine radiator.
	The thermostat is faulty. ▶ Check and replace as necessary. ▶ Consult a qualified specialist workshop.

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Problem	Possible causes/consequences and ▶ Solutions
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 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.

Replacing the poly-V-belt

If the poly-V-belt is torn or shows patterns of damage, it must be replaced.

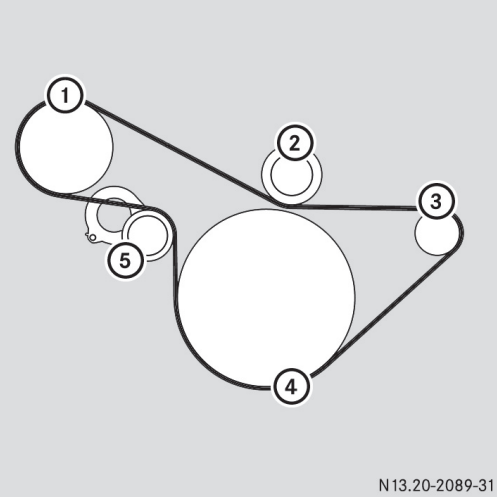
⚠ WARNING

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.

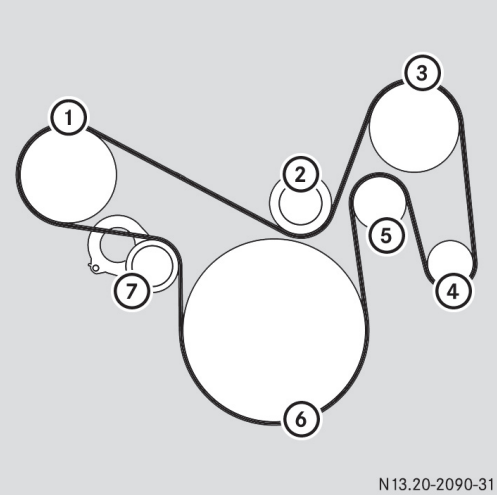
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Belt profile



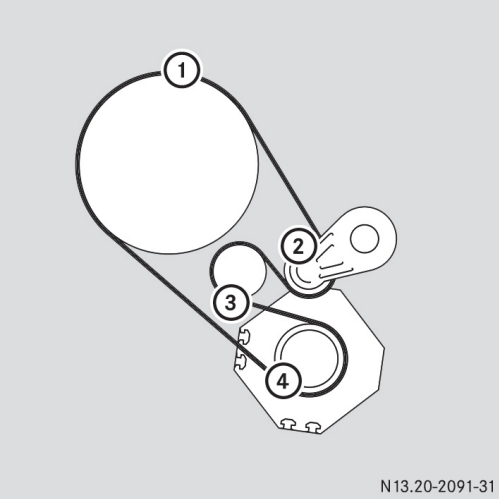
Poly-V-belt routing (engine without refrigerant compressor)

① Coolant pump
② Guide pulley
③ Alternator
④ Crankshaft
⑤ Tensioning pulley



Poly-V-belt routing (engine with refrigerant compressor)

① Coolant pump
② Guide pulley
③ Refrigerant compressor
④ Alternator
⑤ Guide pulley
⑥ Crankshaft
⑦ Tensioning pulley



Poly-V-belt routing (engine with cooling system)

① Crankshaft
② Tensioning pulley
③ Guide pulley
④ Cooling system generator

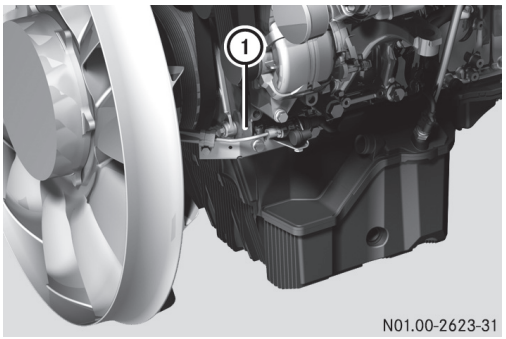
Fitting/removing poly-V-belts

- ▶ Insert the spanner, with the handle and extension attached, 15 mm into the tensioner.
- ▶ 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 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).
- ▶ Remove the spanner and check for correct seating of the poly-V-belt on the belt pulleys.

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Identification plates

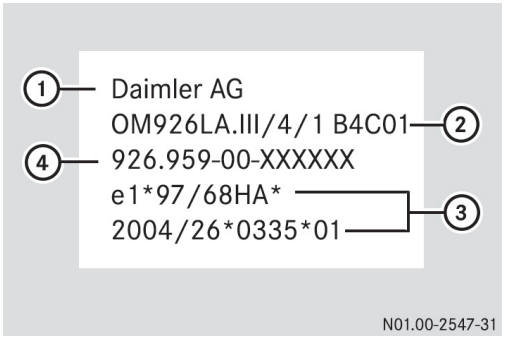
Engine data plate



① Position of engine data plate (example)

Information on the engine data plate

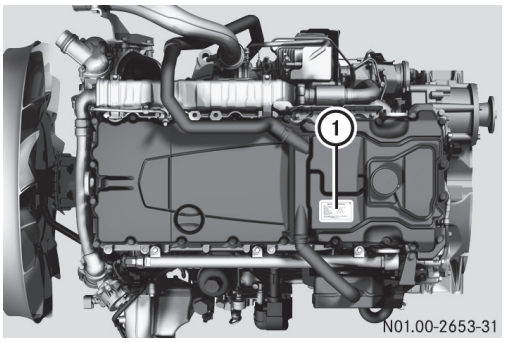
The following data is contained on the engine data plate in the form of numbers stamped directly onto the crankcase:



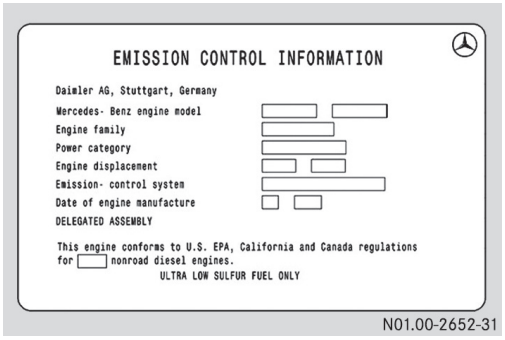
Example: engine data plate
① Manufacturer's name
② Engine model designation
③ Type approval number
④ Engine number

Emission certification label

In engines with the US TIER 4 emissions certificate, the emission certification label (EPA Certification) is located on the cylinder head cover.



① Position Emission certification label (EPA Certification)



Exhaust gas aftertreatment identification plate (not for EU Stage IIIA)

The exhaust gas aftertreatment identification plate is located on the exhaust gas aftertreatment control module (ACM).

Information on the exhaust gas aftertreatment identification plate

The identification plate for the exhaust gas aftertreatment unit contains the 14-digit identification number (AGN ID number) of the exhaust gas aftertreatment unit.

Data card

The data card forms an integral part of the documents belonging to the engine and should always be kept with the Maintenance Booklet. It contains details about the design of the engine and the exhaust gas aftertreatment system, including special features.

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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 has been updated in VeDoc, an updated data card is supplied. This helps to prevent incorrect ordering of replacement parts.

The following is absolutely necessary when procuring genuine Mercedes-Benz parts:

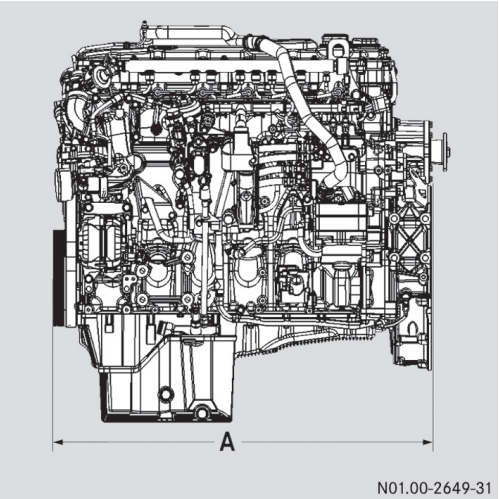
- the data card or
- the complete engine number and the number of the exhaust gas aftertreatment unit.

Engine data

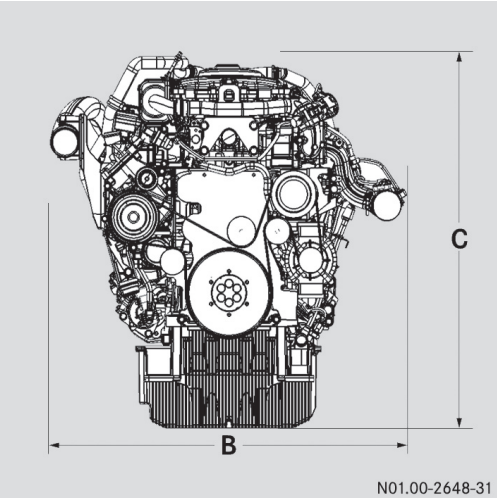
Dimensions and weights

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



Example: engine length



Example: engine width and height

	R4 1000	R6 1000
A = engine length with fan	948 mm	1059 mm
B = engine width	817 mm	924 mm
C = engine height	1033 mm	1068 mm

Weights

Engine weight DIN 70020 - GZ

	4R 1000	6R 1000
Single-stage charging	499 kg	655 kg
Dual-stage charging	510 kg	669 kg

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	4R 1000	6R 1000
	Assembly model series	933.91	935.91

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	Type	In-line engine with exhaust gas recirculation and charge-air pressure control	
	Combustion principle	4-stroke direct injection diesel	
	Number of cylinders	4	6
	Bore	110 mm	110 mm
	Stroke	135 mm	135 mm
	Engine capacity	5130 cm^3	7700 cm^3
	Firing order	1 -3 -4 -2	1 - 5 - 3 - 6 - 2 - 4
	Type of cooling system	Forced circulation cooling	
	Engine, direction of rotation	Anti-clockwise (when looking at the flywheel)	
Valve clearance	Intake valve	0.30 mm +/- 0.05 mm	0.30 mm +/- 0.05 mm
	Exhaust valve	0.60 mm +/- 0.1 mm	0.60 mm +/- 0.1 mm
	Engine brake when using adjusting gauges (0.6 mm) on both exhaust valves	0.15 mm	0.15 mm
Starter motor	Starter	Electric	Electric
	Voltage	24 V	24 V
	Output	3.9 kW	3.9 kW
	Cold-start limit	-30 °C (battery capacity 75 %)	
Alternator	Voltage	24 V	24 V
	Amperage	100 A	100 A

Operating data

Operating range of engine brake		Approx. 1000 - 3000 rpm
Engine speed range of maximum engine torque		Approx. 1200 - 1600 rpm
Engine speed of maximum power output		Approx. 2200 rpm
Idling speed		Approx. 600 rpm
Oil pressure at idling speed		Minimum 0.5 bar
Coolant temperature	Normal operation	Approx. 85 - 100 °C
	Maximum permissible temperature of coolant (automatic torque limitation up to 50 % from 103 °C)	105 °C

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Capacities and service products

			Capacity approximately	Service product (Sheet No. [3])
Engine with oil filter (with standard truck oil pan)	4R 1000		17.5 l - 20.5 l	Engine oil (Sheet No. 228.3/.31/.5/.51)
	6R 1000		24.5 l - 29.5 l	
Fuel system	Fuel tank[4]			Diesel fuels in accordance with DIN EN 590 as of 2010 ff or ASTM D975 (Sheet No. 131.0)
Exhaust gas aftertreatment system[5]	AdBlue®/DEF tank[4]			AdBlue®/DEF in accordance with ISO 22241 -1 (Sheet No. 352.1)
	AdBlue®/DEF filter sealing rings		-	MB silicon grease
Cooling system	Amount of coolant in the engine	4R 1000	Approx. 11 l	Corrosion inhibitor/antifreeze (Sheet No. 325.5) or premixed coolant (Sheet No. 326.5). Water quality (Sheet No. 310.1)
		6R 1000	Approx. 14 l	
	Corrosion inhibitor/antifreeze agent volume down to - 37 °C		Approx. 50% by volume	
	Corrosion inhibitor/antifreeze agent volume down to - 45 °C		Max. 55% by volume	
Engine compartment	Protective wax		-	Wax preservative (Sheet No. 385.4)

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.

The tightening torques are the same for 4R 1000 and 6R 1000.

Engine	Cylinder head cover screw on the rocker arm frame (observe the tightening sequence for the cylinder head cover)	Light alloy	20 Nm
		Thermoplastic	25 Nm
	Valve clearance setting	Counternut on the rocker arm adjustment screw	30 Nm
	Engine brake setting	Counternut on the rocker arm adjustment screw	27 Nm
	Screw of TDC inspection hole cap on the flywheel housing		30 Nm

[3] Mercedes-Benz Specifications for Service Products

[4] Installation on the vehicle. Designed by the vehicle manufacturer.

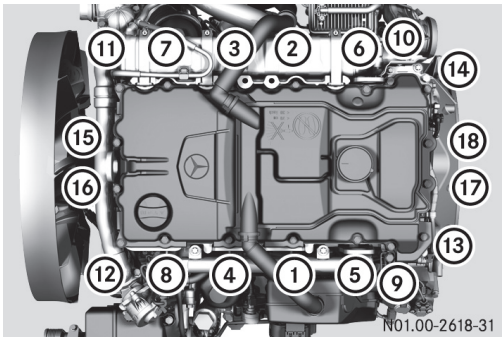
[5] Not for EU Stage IIIA.

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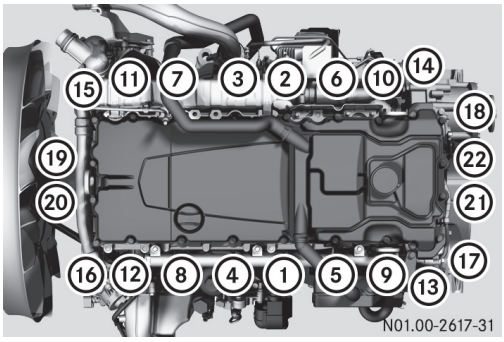
	Cranking device screw on the timing case		30 Nm
Fuel system	Fuel filter cap on the fuel filter module		25 Nm
	Fuel prefilter cap on the fuel filter module		25 Nm
Oil circuit	Drain plug on the oil pan (thermoplastic and light alloy)	M16 x 1.5	35 Nm
	Oil filter cap on the oil/coolant module		50 Nm
Cooling system	Silicate gel cartridge on the coolant pump		50 Nm
Exhaust gas aftertreatment[6]	Filter housing on the pump module		80 Nm
Air dryer	Granulate cartridge on the air dryer		15 Nm

Tightening sequence for the cylinder head cover

The cylinder head cover screws must be tightened in the correct tightening sequence in the same order as described below.



Tightening sequence for 4R 1000



Tightening sequence for 6R 1000

6 Not for EU Stage IIIA

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Publication details

Internet

Further information about MTU, Mercedes-Benz and Daimler AG can be found online 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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Assembly manufacturer

Daimler AG

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Germany

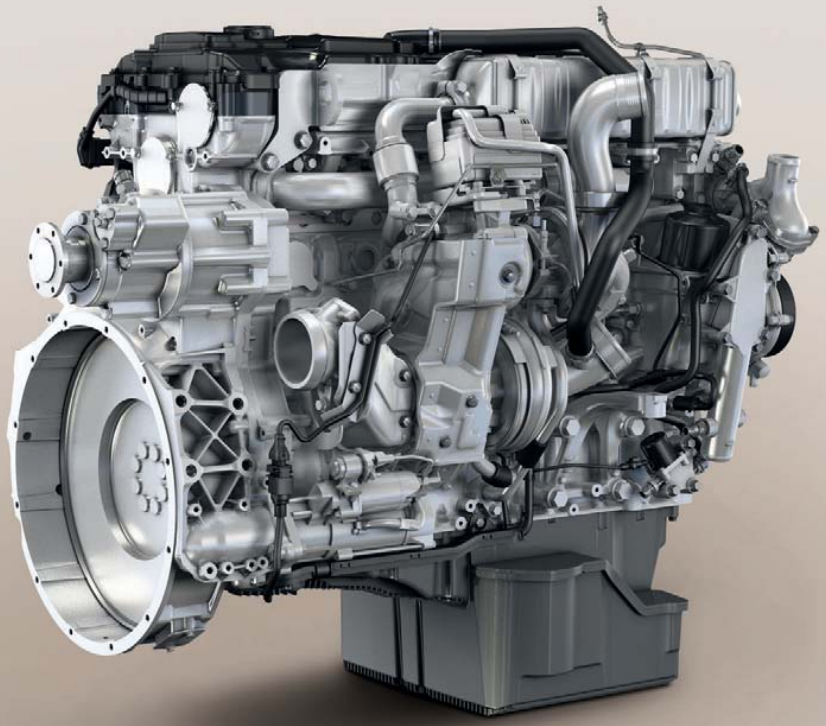
TIM-ID: 0000094786 - 004

As at 08.03.2016

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Order no. 6462 9886 02 Part no. 934 584 20 81 Edition 07-16

TIM-ID: 0000094786 - 004



4R/6R 1000 EU Stufe IIIA/IV/US TIER 4

Wartungsheft | Maintenance Booklet | Carnet de maintenance | Cuaderno de mantenimiento | Libretto di manutenzione | Сервисная книжка

Power. Passion. Partnership.

TIM-ID: 0000096123 - 002

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English

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 ID number (AGN-ID) (not for EU Stage IIIA)	▶

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 (not for EU Stage IIIA).

If the prescribed maintenance work is not carried out according to the instructions and recommendations in the Maintenance Booklet, this can lead to a warranty claim refusal once the manufacturer has inspected the claim.

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.

Engines subsequent to EU Stage IIIA

The engines described in this document with "EU Stage IIIA" emissions level are certified in accordance with Directive "ECE-R 96 Section 5.2.1 depending on engine output range H or I". Engine performance ranges H and I in Directive ECE-R 96 are identical to performance ranges H and I in EU Directive 97/68. For this reason, the term "EU Stage IIIA" was adopted from EU Directive 97/68, and is still used in common parlance, so is used in the same form in this document.

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Information on the implied warranty

A well-developed network of MTU or MTU-authorised Mercedes-Benz Service Centres is available to carry out maintenance work.

These 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 follow the instructions in this Service Booklet, even if you hand the vehicle/device over to a third party for use or care.

If the specified service/maintenance work is not carried out, the decision as to whether a warranty claim can be accepted or not can be made only 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

  Confirmation that all service/maintenance work has been carried out at a qualified specialist workshop will be entered in this Maintenance Booklet.

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

Confirmation that all service/maintenance work has been carried out at a qualified specialist workshop will be entered in this Maintenance Booklet.

Maintenance work does not include repair work. Repair work will be invoiced separately.

You can obtain further information on the maintenance of your engine system from any MTU or MTU-authorised Mercedes-Benz Service Centre.

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

Please consult an MTU or MTU-authorised Mercedes-Benz partner.

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.

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.

▷▷

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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 working on the vehicle/device, always comply with all safety regulations, such as operating instructions, regulations concerning hazardous materials, environmental protection measures, work safety and accident prevention regulations.

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)[2] (not for EU Stage IIIA)

The approved service products are summarised in the Mercedes-Benz Specifications for Service Products. Information about these specifications can be obtained from any MTU or MTU-authorised Mercedes-Benz Service Centre or at http://bevo.mercedes-benz.com.

For further information on individual service products, see the "Maintenance" section of the Operating Instructions.

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 quality and sulphur content
- engine load (observe maintenance category (▷ page 41))
- time: at least every **2 years** for diesel fuel operation

Engine oil

Using engine oils that have not been approved could restrict your warranty entitlements.

[2] As alternatives to "AdBlue®", the terms "Urea" or "DEF" (Diesel Exhaust Fluid) are also used.

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Information is available from any MTU or MTU-authorised Mercedes-Benz Service Centre.

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 an MTU or MTU-authorised Mercedes-Benz Service Centre.

Maintenance categories

Maintenance category A

Maintenance category A is not applicable.

Maintenance category B

Intermittent use predominantly at medium engine speeds and load range.

Maintenance by operating hours

Usage examples

Vehicles: airport shuttle buses

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, road rollers, vibratory rollers, road pavers, soil compactors, track tamping machines

Working machinery: snow cats, high-pressure flushing pumps, fire engine pumps, grain blowers, refuse compressors

Maintenance category C

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, face shovel excavators, bucket excavators

Working machinery: drills, compressor assemblies, crushers, stone crushers, road sweepers (vehicle engine and special purpose body engine), snow-clearing equipment (vehicle engine and special purpose body engine), cement mixer vehicles (vehicle engine and special purpose body engine), cement pump vehicles (vehicle engine and special purpose body engine), fire engines

Generators: mobile gensets

Maintenance intervals

Maintenance according to operating hours (h)

Oil quality	Maintenance category A	Maintenance category B	Maintenance category C
228.5/.51	-	750 h	500 h
228.3/.31	-	500 h	300 h

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English

Maintenance

Maintenance

Abbre-viation	Maintenance due date
J1	Time-based maintenance - Maintenance work should be carried out annually
J2	Time-based maintenance - Maintenance work should be carried out every 2 years
J3	Time-based maintenance - Maintenance work should be carried out every 3 years
M	Engine maintenance (depending on the distance/operating hours according to maintenance category, at least every 2 years)
V2	Adjust the valve clearance (every 2nd, 4th, 6th, 8th etc. engine maintenance)
X	Vehicle scope - Maintenance due date is set by the vehicle manufacturer

	J1	J2	J3	M	V2	X
Maintenance						
Engine maintenance						
Oil and filter change				•		
Check the poly-V-belt for wear and damage				•		
Replace V-belt. Only with engine power take-off at the front, refrigeration unit.				•		
Fuel prefilter and fuel filter: replace filter elements				•		
Fuel prefilter with water separator: replace fuel filter element (fixed to the chassis)				•		
Additional engine maintenance work						
Check and adjust engine and engine brake valve clearance					•	
Time-based maintenance						
Engine cooling system: check and correct the fluid level and the antifreeze/corrosion inhibitor. Vehicle scope: task descriptions are provided by the vehicle manufacturer.	•					
Renew coolant. Vehicle scope: task descriptions are provided by the vehicle manufacturer. Observe the coolant mixture ratio.			•			
Replace the AdBlue®/DEF filter (not for EU stage IIIA)		•				
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.						•
Indicator lamps and warning systems: function check	•					

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	J1	J2	J3	M	V2	X
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.	•					

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English

Confirmations

Maintenance service/additional maintenance work

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

☐ Air filter element

☐ Compressed-air dryer: granulate cartridge(s)

☐ Coolant

☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

☐ Air filter element

☐ Compressed-air dryer: granulate cartridge(s)

☐ Coolant

☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

☐ Air filter element

☐ Compressed-air dryer: granulate cartridge(s)

☐ Coolant

☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

English

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

Maintenance carried out in accordance with Daimler AG specifications:

Yes/No	

Replaced/renewed:

- ☐ Air filter element
- ☐ Compressed-air dryer: granulate cartridge(s)
- ☐ Coolant
- ☐ AdBlue®/DEF filter (not for EU stage IIIA)

Signature/stamp of the Mercedes-Benz Service Centre

TIM-ID: 0000096123 - 002

Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance/time-based maintenance/ additional maintenance work

☐ J1 ☐ J2 ☐ J3 ☐ M

☐ V2 ☐ X

Oil change

Engine

Viscosity	
Sheet No.	

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English

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Maintenance/time-based maintenance/ additional maintenance work

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Oil change

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Publication details

Internet

Further information about MTU, Mercedes-Benz and Daimler AG can be found online 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:

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Assembly manufacturer

Daimler AG

Mercedesstraße 137

70327 Stuttgart

Germany

TIM-ID: 0000096123 - 002

TIM-ID: 0000096123 - 002

OM900 Series (0120)
Engine oil and filter change

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

Daimler Document ID Number	Document Title
AP18.00-G-0101DD	Engine oil and filter change
AS00.00-Z-0005-01A	Risk of accident/Risk of injury
AH18.00-N-0101-01B	Notes on engine oil
AP18.20-G-0100-04DD	Replace oil filter element

TIM-ID: 0000099517 - 002

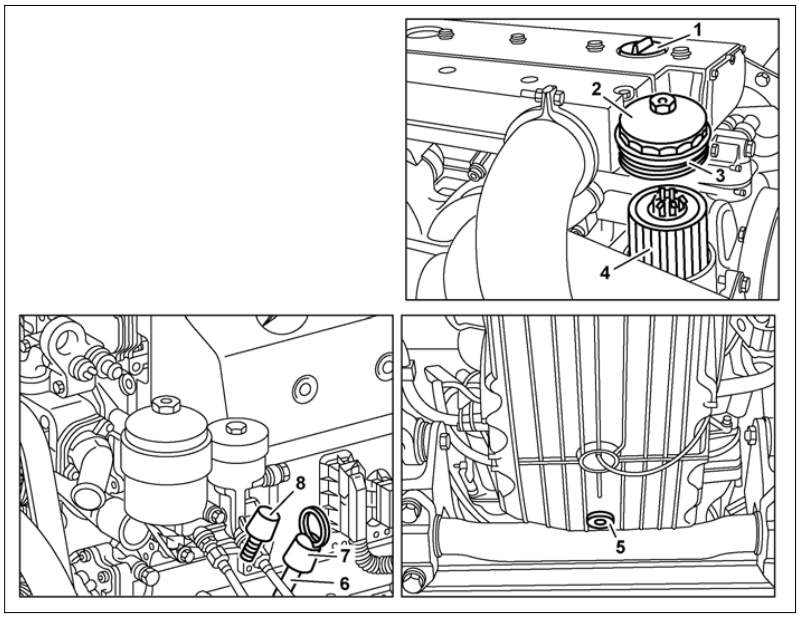
AP18.00-G-0101DD	Engine oil and filter change	31.05.2016

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

24.11.2014	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
	Draining		
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.	
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.	
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
	Filling		
6	Add engine oil	i Refer to the owner's manual for the specified filling capacity as well as the quality of the engine oil.	

TIM-ID: 0000099517 - 002

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 - 002

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.

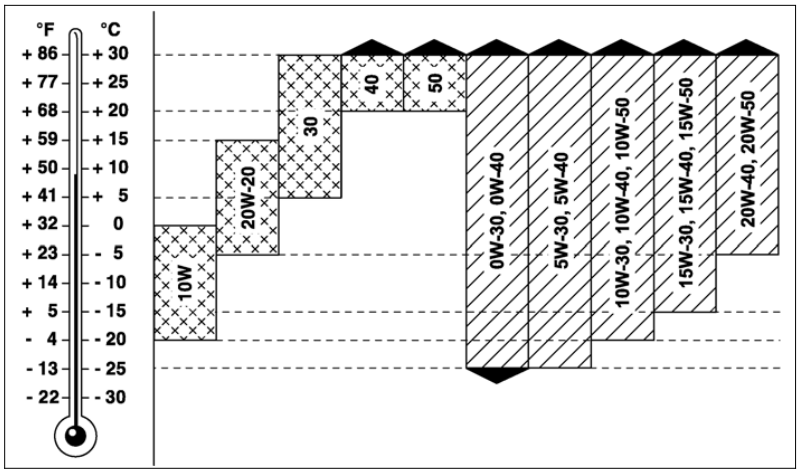
TIM-ID: 0000099517 - 002

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AH18.00-N-0101-01B	Notes on engine oil		i

Engine 457.9 in model 374, 375, 693, 695, 696, 934, 940, 942, 943, 944, 949, 958
Engine 541.9 in model 930, 932, 933, 934, 936, 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

Society of Automotive Engineers (SAE) viscosity classes
The SAE viscosity class must be selected in accordance with the average air temperature for the specific season.
Precise application of the SAE grades on the basis of the outside temperatures would require more frequent oil changes. The temperature ranges for the SAE grades should therefore be regarded as a guide and the particular temperature may be higher or lower than that stated.



N18.00-2074-05

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.

Oil change intervals

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 fatty acid methyl ester (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 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 fatty acid methyl ester (FAME))
- Sulfur content of fuel

TIM-ID: 0000099517 - 002

© Daimler AG, 1/17/17, B/01/17, ah18.00-n-0101-01b, Notes on engine oil

Engine 457.9 in model 374, 375, 693, 695, 696, 934, 940, 942, 943, 944, 949, 958 Engine 541.9 in model 930, 932, 933, 934, 936, 950, 952, 953, 954 Engine 542.9 in model 930, 932, 934, ...

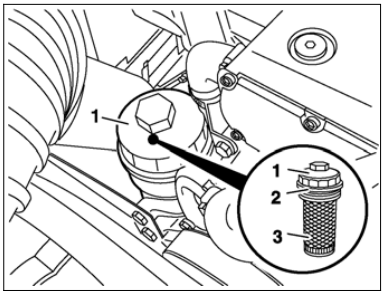
AP18.20-G-0100-04DD	Replace oil filter element		

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 - 002

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OM900 Series (0120)
Inspect/replace poly-V belt

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

Daimler Document ID Number	Document Title
AP13.22-G-1351DD	Inspect poly-V belt for wear and damage
AS00.00-Z-0005-01A	Risk of accident/Risk of injury
AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine
AP13.22-D-1351-01A	Damage profiles for a poly-V belt
AR13.22-G-1202DD	Remove/install poly-V belt
AR13.22-G-3902-02DD	Routing diagram for poly-V belt

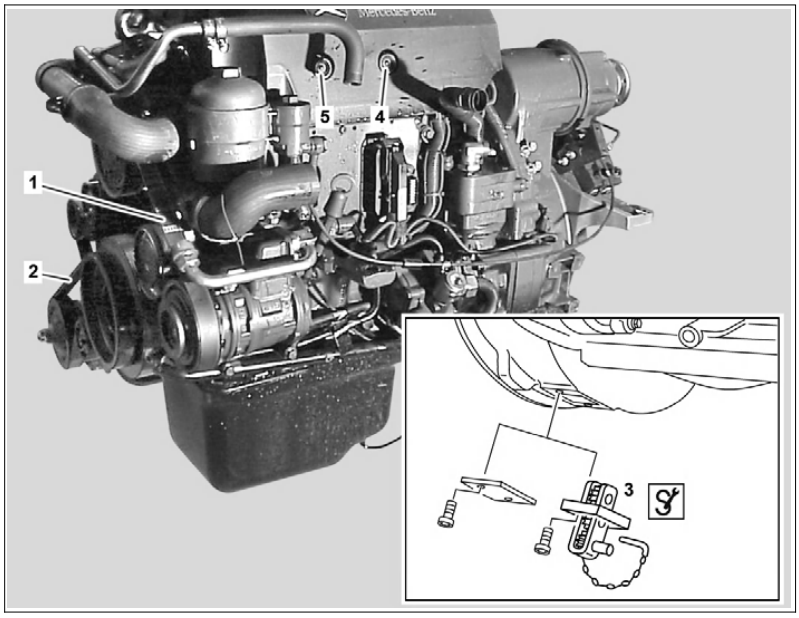
TIM-ID: 0000099519 - 002

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. 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

© Daimler AG, 1/26/17, B/01/17, ap13.22-g-1351dd, Inspect poly-V-belt for wear and damage

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 ...

TIM-ID: 0000099519 - 002

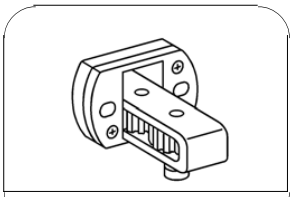
3 AR	Remove cranking device (3) from engine	Only when for test purposes the engine was cranked using the turning device (3). Nm Inspection hole cap to timing case Turning device	 AR03.30-G-1600-03DD *BA01.60-N-1002-01I *904589046300

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 - 002

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 - 002

© Daimler AG, 1/26/17, B/01/17, 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 workin

AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine		

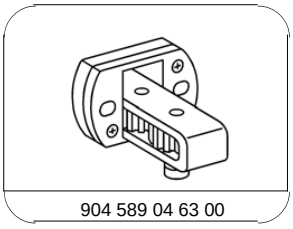
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

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 .

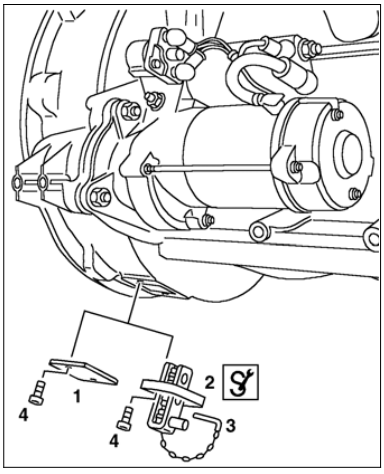
The cranking device (2) must be removed before starting the engine. The flywheel or the cranking device (2) will be damaged otherwise.

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 - 002

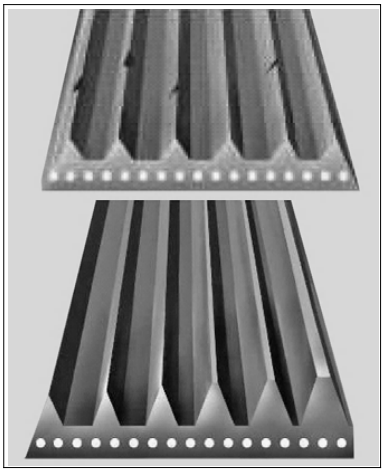
© Daimler AG, 1/26/17, B/01/17, ar03.30-g-1600-03dd, Attach/detach cranking/blocking device for engine

AP13.22-D-1351-01A	Damage profiles for a poly-V belt		

Engine all

Edges of poly-V belts worn, poly-V belts exhibit traces of wear or they are pointed instead of trapezoidal

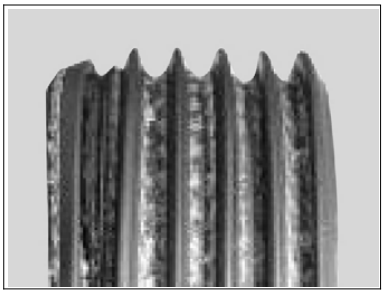
Check belt drive and replace any misaligned or damaged belt pulleys as well as poly-V belts.



P13.22-2174-02

Tensile cord (brighter points) visible in base of poly-V belt

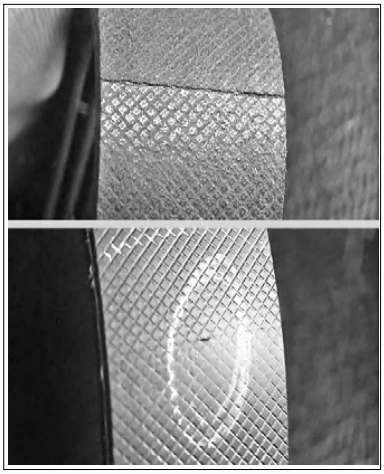
Replace poly-V-belt.



P13.22-2175-01

Backs of belts damaged, top layer exhibits transverse or longitudinal cracks

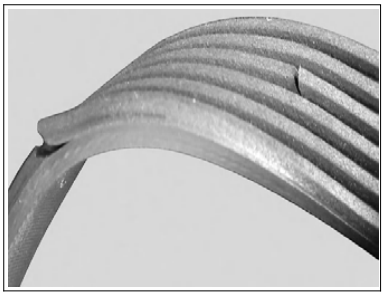
Check guide pulley, replace if necessary and replace poly-V belt.



P13.22-2176-02

Poly-V belt detached from poly-V belt base

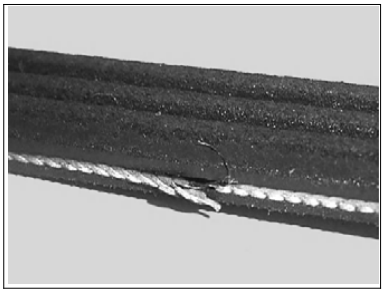
Replace poly-V-belt.



TIM-ID: 0000099519 - 002

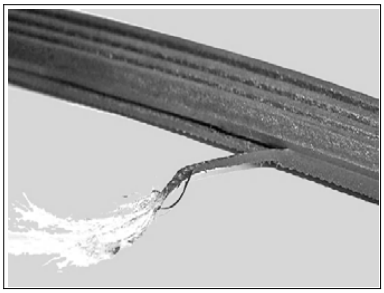
P13.22-2177-01

Fraying of outer cords
Replace poly-V-belt.



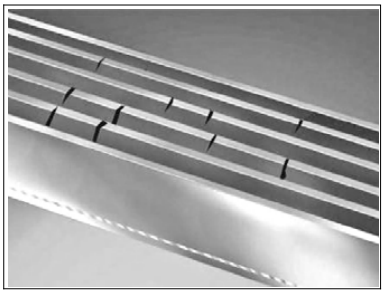
P13.22-2178-01

Cord torn out at the side
Replace poly-V-belt.



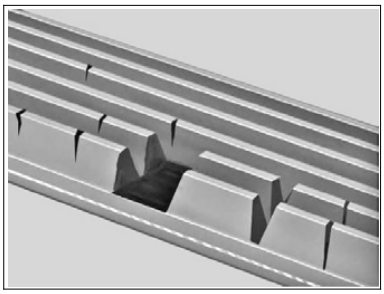
P13.22-2179-01

Transverse cracks in several poly-V
Replace poly-V-belt.



P13.22-2180-01

Chippings on poly-V belt
Replace poly-V-belt.

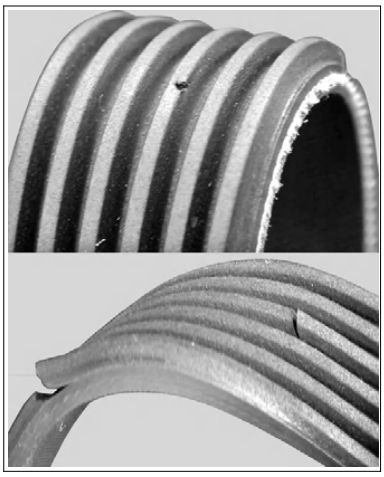


P13.22-2181-01

TIM-ID: 0000099519 - 002

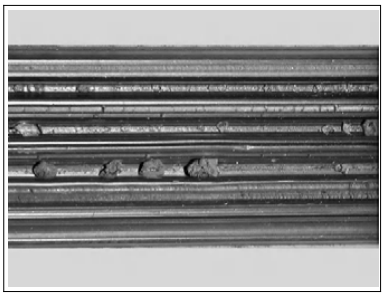
© Daimler AG, 1/26/17, B/01/17, ap13.22-d-1351-01a, Damage profiles for a poly-V belt
Engine all

Individual transverse cracks in the poly-V belt
Replace poly-V-belt.



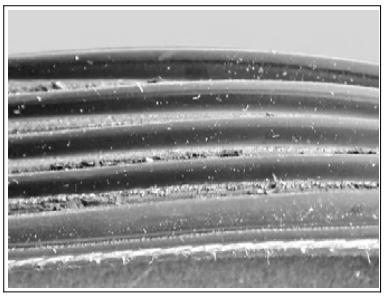
P13.22-2182-02

Dirt or stones embedded in ribs
Clean or replace belt pulleys or guide pulleys and replace poly-V belt.



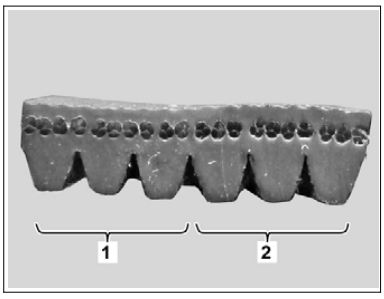
P13.22-2183-01

Heavy wear and deposits and lumps of rubber in base of rib
Clean or replace belt pulleys and replace poly-V belt.



P13.22-2184-01

Swelling through contact with engine oil, coolant, cold cleaning solvent etc., increase in width ≥ 0.7 mm.
Rectify leakage, clean or replace belt pulleys and guide pulleys and replace poly-V belt.
1 = Without exposure to engine oil, coolant, cold cleaning solvent etc.
2 = With exposure to engine oil, coolant, cold cleaning solvent etc.



P13.22-2185-01

TIM-ID: 0000099519 - 002

© Daimler AG, 1/26/17, B/01/17, ap13.22-d-1351-01a, Damage profiles for a poly-V belt
Engine all

AR13.22-G-1202DD	Remove/install poly-V belt	28.5.15

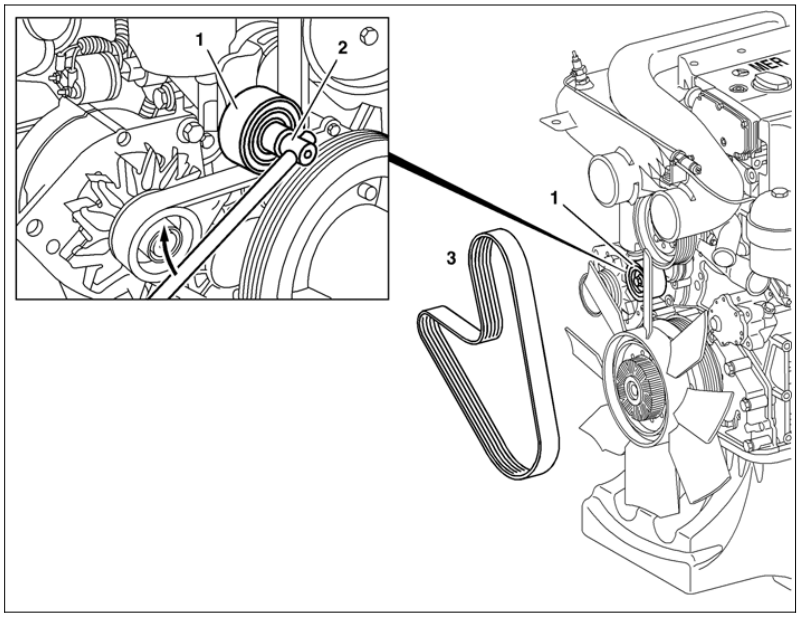
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

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 AP	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: 0000099519 - 002

		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: 0000099519 - 002

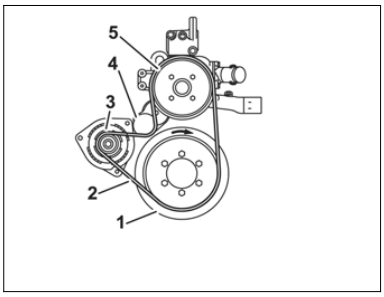
AR13.22-G-3902-02DD	Routing diagram for poly-V belt		

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.		

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*



W13.22-1029-01

TIM-ID: 0000099519 - 002

© Daimler AG, 1/26/17, B/01/17, 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 ...

TIM-ID: 0000099519 - 002

10.7 OM900 Clean filter element of fuel prefilter

OM900 Series (0120)
Clean filter element of fuel prefilter

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

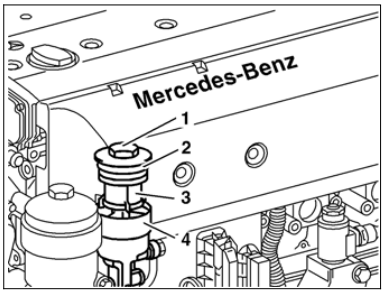
Daimler Document ID Number	Document Title
AP47.20-G-0730DD	Clean filter element of fuel prefilter
AS00.00-Z-0005-01A	Risk of accident/Risk of injury
AS47.00-Z-0001-01A	Risk of explosion

TIM-ID: 0000099521 - 002

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 - 002

© Daimler AG, 1/18/17, B/01/17, ap47.20-g-0730dd, Clean filter element of fuel prefilter

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 - 002

© Daimler AG, 1/18/17, B/01/17, 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 workin

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

Potential risks

Risk of explosion, poisoning and injury

Fuels are highly inflammable and toxic if inhaled. Fuel may cause damage to skin. For example, skin is degreased when it comes into contact with gasoline. 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

- Observe 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 work pits.
- Store drained fuel in a suitable and sealed vessel.
- Immediately eliminate any fuel that has flowed out.

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 moistened skin with water and soap.
- Change moistened clothing as quickly as possible.
- If fuel gets into the eyes, rinse eyes with water immediately and consult a physician if necessary.

TIM-ID: 0000099521 - 002

© Daimler AG, 1/18/17, B/01/17, 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 ... Page 1 of 1
Engine all

OM900 Series (0120)
Replace fuel filter

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

Daimler Document ID Number	Document Title
AP47.20-G-0780DD	Replace fuel filter
AS00.00-Z-0005-01A	Risk of accident/Risk of injury
AS47.00-Z-0001-01A	Risk of explosion

TIM-ID: 0000099522 - 002

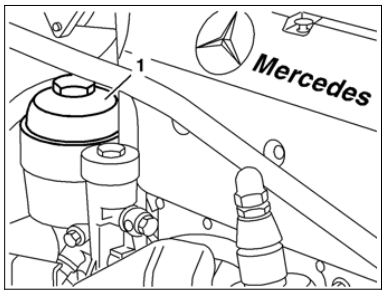
AP47.20-G-0780DD	Replace fuel filter	11.8.15

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

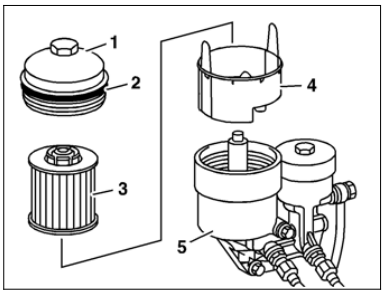
Modification notes

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 - 002

© Daimler AG, 1/9/17, B/01/17, ap47.20-g-0780dd, Replace fuel filter

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 - 002

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 - 002

© Daimler AG, 1/9/17, B/01/17, 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 MODEL ALL

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

Potential risks

Risk of explosion, poisoning and injury

Fuels are highly inflammable and toxic if inhaled. Fuel may cause damage to skin. For example, skin is degreased when it comes into contact with gasoline. 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

- Observe 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 work pits.
- Store drained fuel in a suitable and sealed vessel.
- Immediately eliminate any fuel that has flowed out.

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 moistened skin with water and soap.
- Change moistened clothing as quickly as possible.
- If fuel gets into the eyes, rinse eyes with water immediately and consult a physician if necessary.

TIM-ID: 0000099522 - 002

© Daimler AG, 1/9/17, B/01/17, 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 ...

TIM-ID: 0000099522 - 002

OM900 Series (0120)
Set valve clearance

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

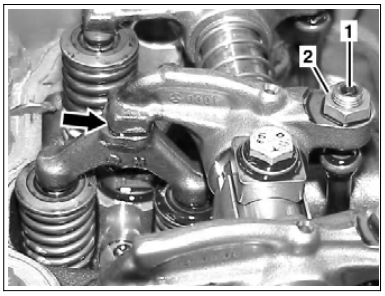
- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

Daimler Document ID Number	Document Title
AP05.30-G-0560DD	Set valve clearance
AR01.20-G-5014DD • AS00.00-Z-0005-01A	Remove/install cylinder head cover • Risk of accident/Risk of injury
AH05.30-N-1000-01C	General information on adjusting valve clearance (Method 1)
AH05.30-N-1000-01D	General information on adjusting valve clearance (Method 2)
AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine
AP05.30-G-0560-01DD	Check and adjust valve clearance

TIM-ID: 0000099523 - 002

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



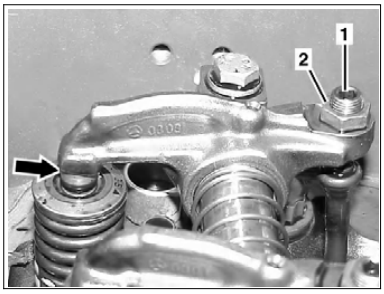
G05.30-3102-01

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	Select adjustment method for valve clearance	Setting according to injection order: ↓	
i	General information on adjusting valve clearance	Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 1	AH05.30-N-1000-01C
		Setting at two crankshaft positions: ↓	
i	General information on adjusting valve clearance	Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 926.9 Method 2	AH05.30-N-1000-01D
3	Attach turning device for engine Attach/detach cranking/blocking device for engine	 Nm SST	 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 SST	 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!**	**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
8	Start engine and inspect cylinder head cover for leaks		

TIM-ID: 0000099523 - 002

© Daimler AG, 1/18/17, B/01/17, ap05.30-g-0560dd, Set valve clearance
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

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

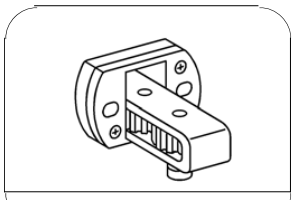
Number	Designation		Engine 900.9, 902.9, 904.9, 906.9, 924.9, 926.9
BA01.60-N-1002-01I	Inspection hole closure cover to timing case	Nm	25
BA01.60-N-1003-01I	Bolt, turning device to timing case	Nm	25

Nm Engine timing - general

TIM-ID: 0000099523 - 002

© Daimler AG, 1/18/17, B/01/17, ap05.30-g-0560dd, Set valve clearance

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

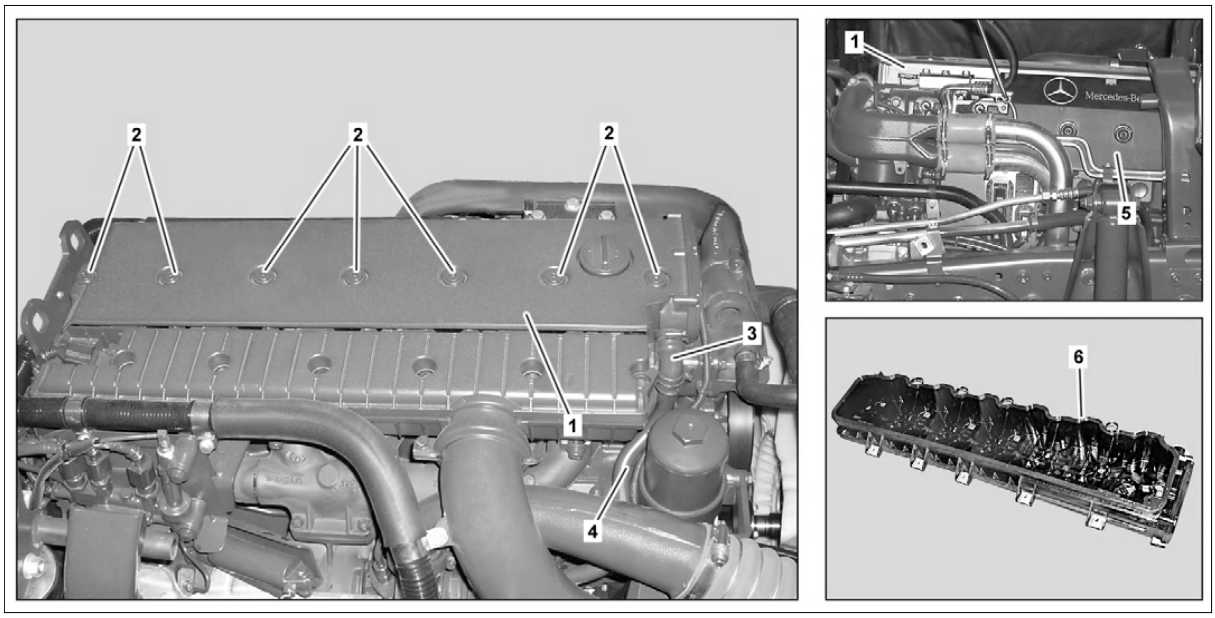
TIM-ID: 0000099523 - 002

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		

TIM-ID: 0000099523 - 002

6	Start engine and perform an engine test run	Allow engine to run at a higher rotational speed.	
7	Stop engine and check in the area of cylinder head cover (1) for leaktightness		

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 - 002

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

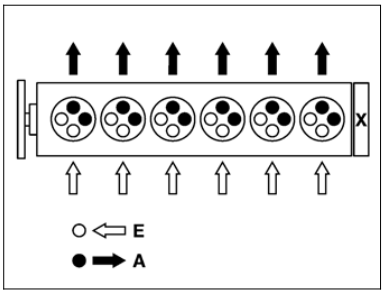
- Do not rub the skin areas affected; rinse with plenty of cold water and cover skin with sterile dressings.
- Consult a physician immediately.

TIM-ID: 0000099523 - 002

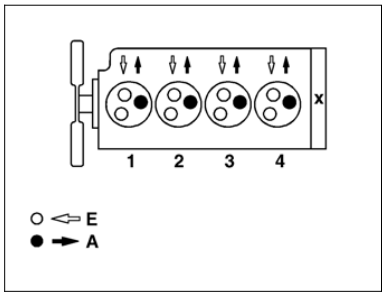
© Daimler AG, 1/18/17, B/01/17, as00.00-z-0005-01a, Risk of accident from vehicle starting off by itself when engine running. Risk of injury (bruises and burns) resulting from workin

AH05.30-N-1000-01C	General information on adjusting valve clearance		i

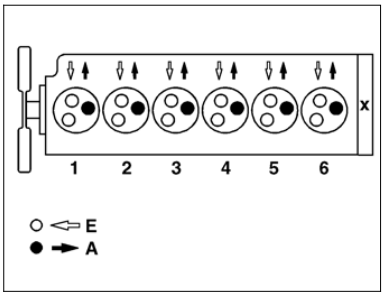
Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9
Method 1



A01.00-0001-01



N01.00-0347-01



N01.00-0348-01

Engine 457.9, 458.9

A Outlet valve
E Inlet valve
X Flywheel side

Engine 900.9, 904.9, 924.9

A Outlet valve
E Inlet valve
X Flywheel side

Engine 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 the injection sequence. The cylinder to be set must be at ignition TDC, the synchronized cylinder at overlap TDC.

4-cylinder engine

- *Ignition TDC:* Cylinders 1 - 3 - 4 - 2 to be set
- *Valve overlap-TDC:* Cylinders 4 - 2 - 1 - 3 to be set

6-cylinder engine

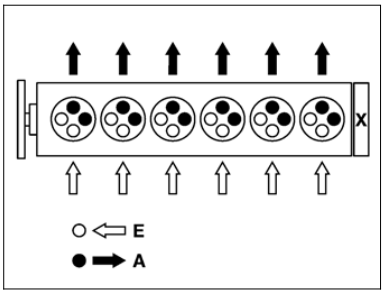
- *Ignition TDC:* Cylinders 1 - 5 - 3 - 6 - 2 - 4 to be set
- *Valve overlap-TDC:* Cylinders 6 - 2 - 4 - 1 - 5 - 3 to be set

TIM-ID: 0000099523 - 002

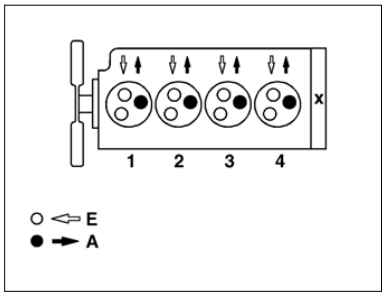
© Daimler AG, 1/18/17, B/01/17, ah05.30-n-1000-01c, General information on adjusting valve clearance
Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9 Method 1

AH05.30-N-1000-01D	General information on adjusting valve clearance		i

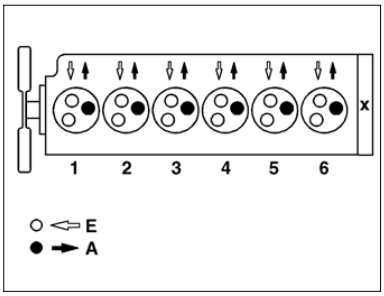
Engine 457.9, 458.9, 900.9, 902.9, 904.9, 906.9, 924.9, 925.9, 926.9
Method 2



A01.00-0001-01



N01.00-0347-01



N01.00-0348-01

Engine 457.9, 458.9

A Outlet valve
E Inlet valve
X Flywheel side

Engine 900.9, 904.9, 924.9

A Outlet valve
E Inlet valve
X Flywheel side

Engine 902.9, 906.9, 925.9, 926.9

A Outlet valve
E Inlet valve
X Flywheel side

Method 2:
Adjust intake and exhaust valve into two crankshaft positions.
4-cylinder engine
Position cylinder 4 in valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 4 in ignition TDC).

- *4th cylinder valve overlap-TDC:* Valves on cylinder 1 (I/O) - 2 (I) - 3 (O) to be set
- *1st cylinder valve overlap-TDC:* Valves on cylinder 2 (I/O) - 3 (I) - 4 (O) to be set

6-cylinder engine
Position cylinder 6 in valve overlap TDC (cylinder 1 in ignition TDC), then position cylinder 1 in valve overlap TDC (cylinder 6 in ignition TDC).

- *6th cylinder valve overlap-TDC:* Valves on cylinder 1 (I/O) - 2 (I) - 3 (O) - 4 (I) - 5 (O) to be set
- *1st cylinder valve overlap-TDC:* Valves on cylinder 2 (O) - 3 (I) - 4 (O) -5 (I) - 6 (I/O) to be set

TIM-ID: 0000099523 - 002

© Daimler AG, 1/18/17, B/01/17, 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

AR03.30-G-1600-03DD	Attach/detach cranking/blocking device for engine		

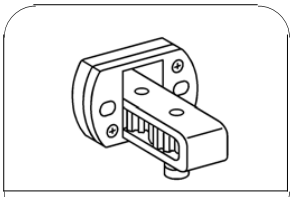
Engine 900.91/92 in model 000.001
Engine 902.91/93 in model 000.001
Engine 904.94/95/96/97 in model 000.001
Engine 906.90/93/94/95/96/98/99 in model 000.001
Engine 924.91/93/94 in model 000.001
Engine 926.91/92/93/95/97/98 in model 000.001

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 .

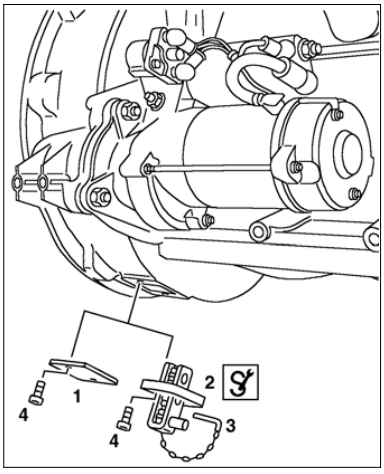
The cranking device (2) must be removed before starting the engine. The flywheel or the cranking device (2) will be damaged otherwise.

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 - 002

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 - 002

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

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Check values for valves

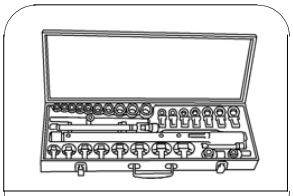
Number	Designation			ENGINE 904.9## ## as of 039740, ENGINE 906.9## (except 906.901/902) ## as of 041956
BE05.30-N-1013-01K	Test tolerance for valve clearance	Inlet	mm	–0,05/+0,05
		Outlet	mm	–0,10/+0,10

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

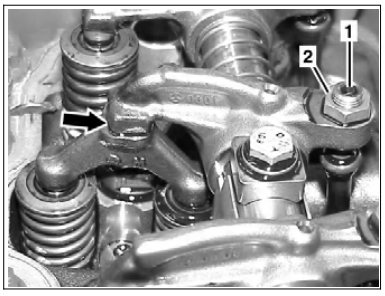
Nm **Engine timing - general**

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

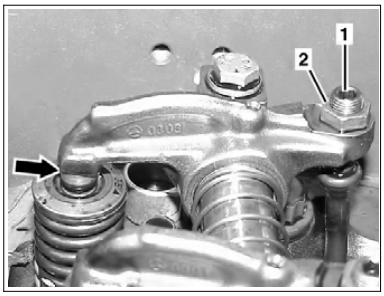
Tool kit



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: 0000099523 - 002

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 - 002

TIM-ID: 0000099923 - 002

OM900 Series (0120)
Engine cooling system – Check fluid level

The following task description has been supplied through the Daimler Workshop Information System (WISnet). Access to this information is available through Daimler by paid subscription.

- Before starting work, read through the entire task, including all safety information.
- All information pertaining to the task has been provided here, including linked documents.
- The documents included in this task are shown in the table below.

Daimler Document ID Number	Document Title
AP20.00-G-2010MT	Engine cooling system – check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct concentration
AS20.00-Z-0001-01A	Risk of injury/ Risk of poisoning
AH20.00-N-2080-01A	Notes on coolant
AP20.00-G-2010-01MT • AS00.00-Z-0005-01A • AS20.00-Z-0001-01A	Correcting anticorrosion/antifreeze concentration • Risk of accident/Risk of injury • Risk of injury/Risk of poisoning
BB00.40-P-0310-01A	Coolant specifications

TIM-ID: 0000099524 - 002

AP20.00-G-2010MT	Engine cooling system - check fluid level, adjust to correct level. Inspect anticorrosion/antifreeze protection, adjust to correct concentration	01.08.2016

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**

⚠ **Danger !**	**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.	AS20.00-Z-0001-01A
	Notes on coolant		AH20.00-N-2080-01A
	Check		
1	Open filler neck for coolant	See owner's manual.	
2 BB	Check anticorrosion agent and antifreeze concentration, correct if necessary Coolant specifications	 See owner's manual. If the coolant has an insufficient amount of corrosion and antifreeze in it. ↓ The corrosion and antifreeze level has to be corrected.	 BB00.40-P-0310-01A AP20.00-G-2010-01MT
3	Check coolant level, correct if necessary	See owner's manual. The coolant temperature must be less than 50 °C. The specified composition of the coolant must be guaranteed.	
4	Close filler neck for coolant	See owner's manual.	

TIM-ID: 0000099524 - 002

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 - 002

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ENGINE ALL

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, 176, 177, 178, 180, 256, 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, 654, 668, 780.001/990/996**

Engine **780.991 in model 169.090**

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
- Increase 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**.

Before pouring in fresh coolant, flush the used coolant out of the engine cooling system.

In case of severe soiling or oil fouling, clean engine cooling system.

Otherwise engine cooling system components may be damaged.

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 - 002

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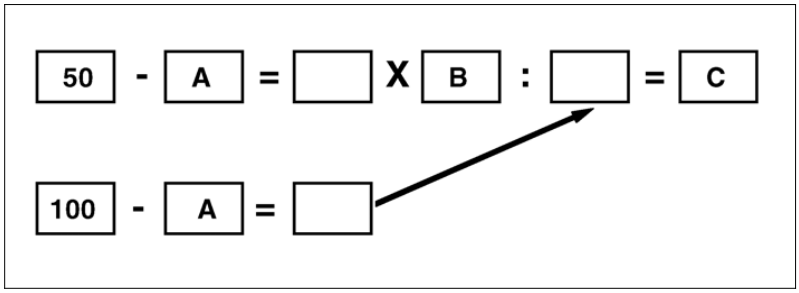
AP20.00-G-2010-01MT	Correcting anticorrosion/antifreeze concentration		
⚠ **Danger!**	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the engine as it is running	Secure 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).
ⓘ Installation location of drain screw: See operator's manual.

5 Screw drain screw into the radiator again.

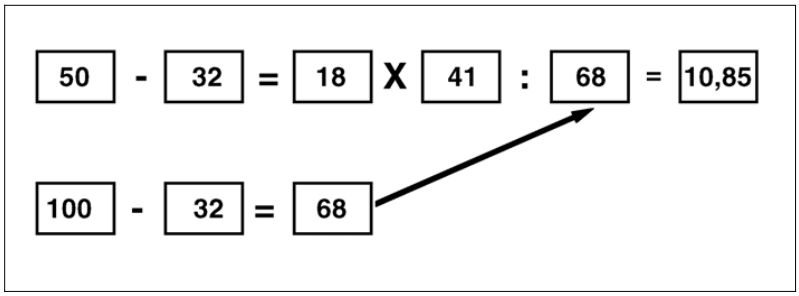
6 Pour the calculated refill quantity of anticorrosion agent and antifreeze (C) into the cooling system.

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 - 002

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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

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 - 002

© Daimler AG, 1/10/17, B/01/17, 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 workin

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 - 002

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ENGINE ALL

BB00.40-P-0310-01A	Coolant specifications		

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 comprise anticorrosion/antifreeze agent 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 ⓘ Whichever occurs first must be observed; exception: in the vehicle's maintenance manual, different change intervals are stipulated.
325.6 and 326.6	●	●	Usable for all vehicles	15/250,000 ⓘ Whichever occurs first must be observed; exception: in the vehicle's maintenance manual, different 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
325.3 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.

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.

Table 3: Specifications for Operating Fluids sheet number and coolant type

Coolantsheet no.	Antifreeze with corrosion inhibitor sheet no.	Inhibitors		Free of
		inorganic	organic	

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Model all

TIM-ID: 0000099524 - 002

326.0	325.0	Si, B	X	Nitrite, amine, phosphate
326.3	325.3		X	Nitrite, amine, phosphate, borat, silicate
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
325.3	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.

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. Only 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.

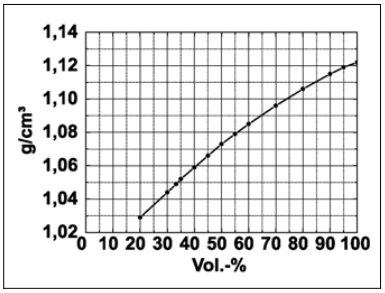
5. Monitoring coolant operation

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.

TIM-ID: 0000099524 - 002

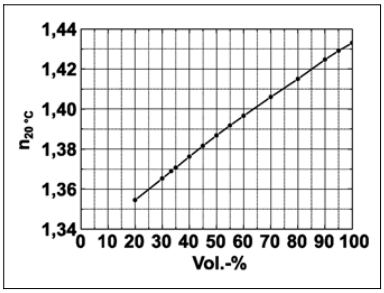
© Daimler AG, 1/10/17, B/01/17, bb00.40-p-0310-01a, Coolant specifications
Model all



P00.40-2032-01

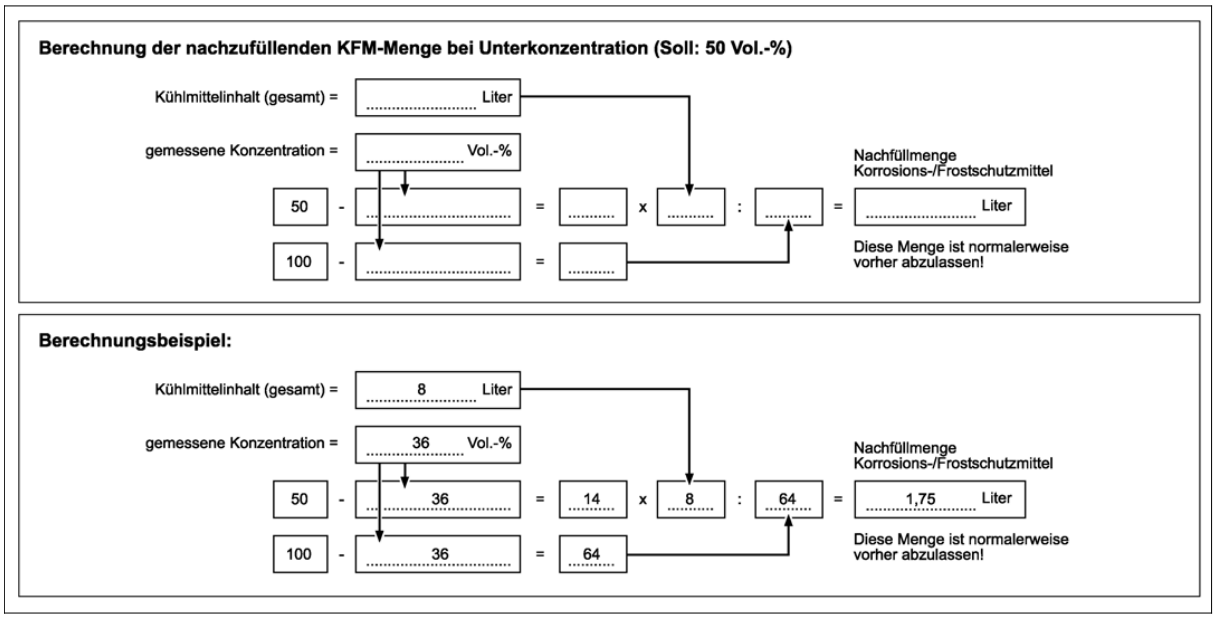
Bild 1: Density of KFM/water mixtures

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

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 - 002

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.

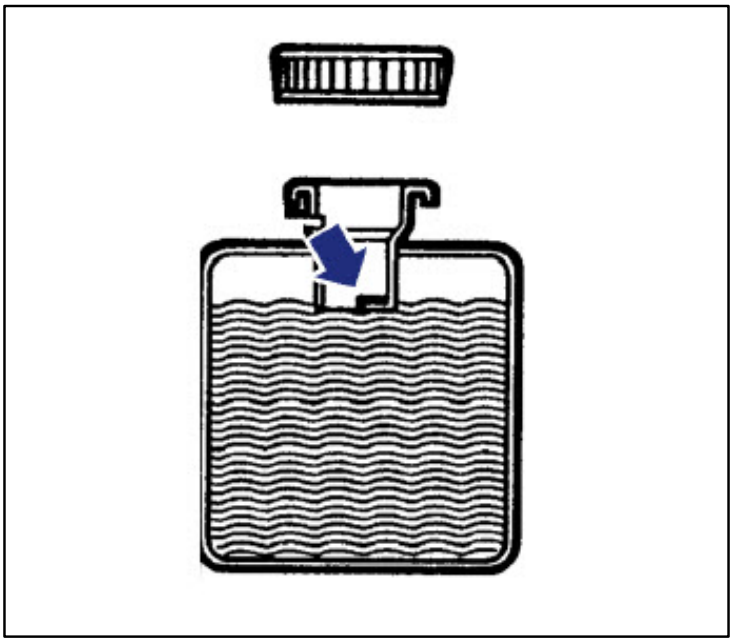


Figure 1: Engine coolant – Level check

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.

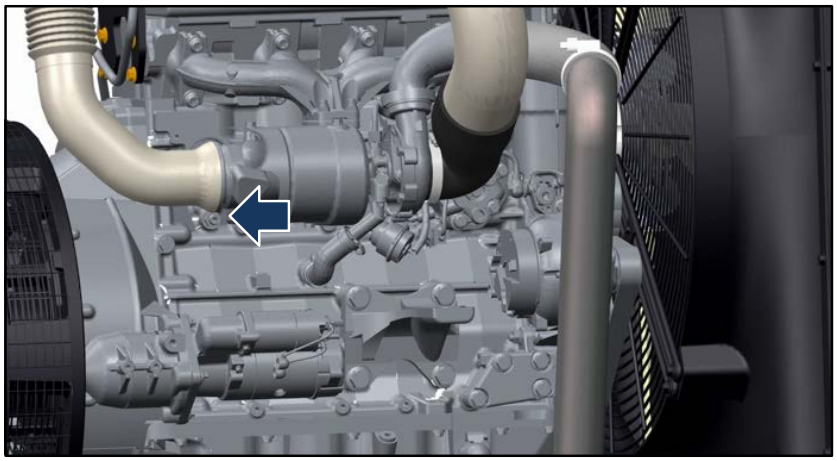


Figure 1: Engine coolant – Draining

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*.

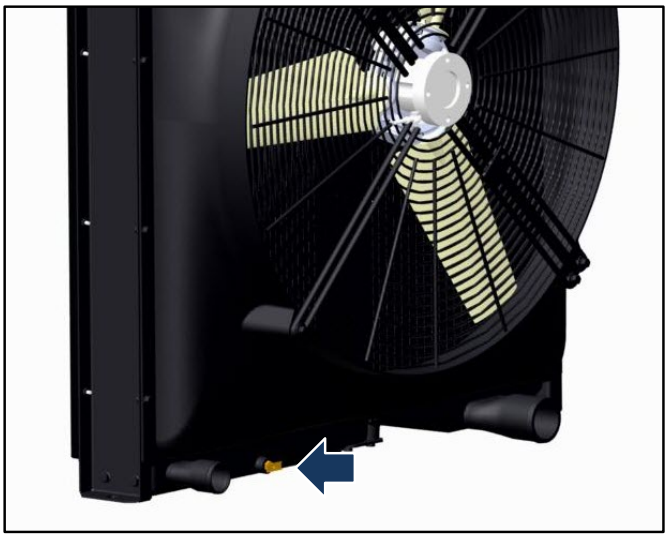


Figure 2: Engine coolant – Draining

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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

OM900 Series (0120)
Engine coolant - Filling

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

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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

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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

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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

13.1 Index

A

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Installation and Basic Operation Manual

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MTU Onsite Energy Corporation
100 Power Drive, Mankato, MN 56001
Phone 800-325-5450 **www.mtuonsiteenergy.com**
2016-06

CALIFORNIA PROPOSITION 65

WARNING

ENGINE EXHAUST FROM THIS PRODUCT CONTAINS CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS, AND OTHER REPRODUCTIVE HARM.

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Product Identification Information

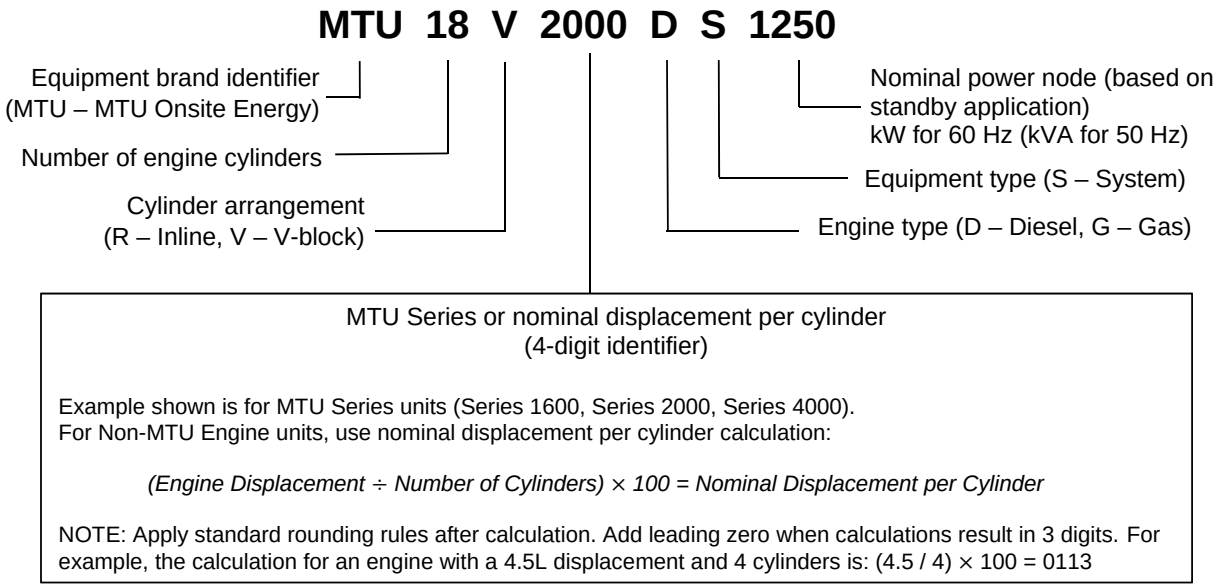
Locate and record numbers in the spaces below immediately after unpacking your generator set. This ensures that the numbers are readily available for future reference.

Model Designation: _____

Serial Number: _____

HOW TO READ MODEL NUMBERS

MTU Onsite Energy's model numbering format is composed of 7 sections:



Example shown is for MTU Series units (Series 1600, Series 2000, Series 4000).
For Non-MTU Engine units, use nominal displacement per cylinder calculation:

(Engine Displacement ÷ Number of Cylinders) × 100 = Nominal Displacement per Cylinder

NOTE: Apply standard rounding rules after calculation. Add leading zero when calculations result in 3 digits. For example, the calculation for an engine with a 4.5L displacement and 4 cylinders is: (4.5 / 4) × 100 = 0113

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Forward

This Installation Guide provides general instructions for installing your MTU Onsite Energy generator set properly. It is essential that every person who works on or with the generator set be completely familiar with the contents of this manual, and that he/she carefully follows the instructions contained herein.

Each installation may require some modification of the suggested guidelines in this manual. Installations must be consistent with locally applicable standards and take into consideration 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 Precautions section at the beginning of this manual.

IMPORTANT

Information in this publication represents data available at the time of print. MTU Onsite Energy reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

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

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Figures and Tables

The following is a list of all figures and tables contained in this manual.

Figure 1-1……Typical generator set installation
Figure 2-1……Lifting provisions
Figure 4-1……Typical pad type vibration
Figure 4-2……Spring mount vibration isolator
Figure 4-3……Recommended anchor bolt
Figure 5-1……Typical center top pivoted louver
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Figure 8-1……Suggested motorized louver wiring
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Figure 12-1……...Standard GAC Governor Control
Figure 12-2……...Standard Mechanical Governor (Diesel)
Figure 12-3……...Standard Mechanical Governor (Diesel)

Table 7-1……Gaseous Fuel Pipe Capacity (Imperial: ft^3/hr)
Table 7-2……Gaseous Fuel Pipe Capacity (Metric: m3/hr)

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Safety Precautions

IMPORTANT SAFETY INSTRUCTIONS

Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained.

Dangers, Warnings and Cautions are used in this manual to alert the operator to special instructions concerning a particular procedure that may be hazardous if performed incorrectly. These safety alerts alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions and common sense operation are major accident prevention measures. Observe all warnings found on the equipment. Ensure that warning labels are legible and not obstructed by dirt, grease or other equipment. MTU Onsite Energy cannot anticipate every possible circumstance that might involve a hazard. The warnings in this manual and on tags and decals affixed to equipment are, therefore, not all inclusive.



DANGER

Danger indicates the presence of a hazard that will cause severe personal injury, death, or substantial property damage.



WARNING

Warning indicates the presence of a hazard that can cause severe personal injury, death, or substantial property damage.



CAUTION

Caution indicates the presence of a hazard that will or can cause minor personal injury or property damage.



This symbol signifies high voltage.

The following safety rules should be strictly complied with:

ACCIDENTAL STARTING

Be aware that the generator set could start at any time in the "AUTO" mode. Keep clear of all moving parts and be sure to turn switch to the "OFF" position before servicing and disconnect the negative battery cable after disconnecting the battery charger circuit.

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BATTERY

For proper unit operation, battery minus (-) terminal must always be connected to ground. Reverse connection of the battery will severely damage or destroy the battery charging alternator, regulator and other polarity sensitive devices.

Wear protective safety eyeglasses and gloves when handling starting batteries and electrolyte. Battery acid can cause serious burns if it contacts eyes or skin.

Servicing of batteries is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

Do not smoke or use an open flame when servicing batteries. Batteries generate an explosive gas during charging.

The replacement starting battery or batteries must be of equal size and cold cranking amps.

The generator controls must be in the off position when replacing the batteries.

Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

Do not open or mutilate the battery. Released electrolyte has been known to be harmful to the skin and eyes and to be toxic.

A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

1. Remove watches, rings, or other metal objects
2. Use tools with insulated handles

VENTED BATTERIES

The installation of the engine generator shall provide enough ventilation to ensure that gases generated by vented batteries during charging or caused by equipment malfunction are removed.

The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. It is electrically conductive and corrosive. The following procedures are to be observed:

1. Wear full eye protection and protective clothing
2. Where electrolyte contacts the skin, wash it off immediately with water
3. Where electrolyte contacts the eyes, flush thoroughly and immediately with water
4. Spilled electrolyte is to be washed down with an acid-neutralizing agent. A common practice is to use a solution of 500 g (1 lb) bicarbonate of soda solution to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.

Lead acid batteries present a risk of fire because they generate hydrogen gas. The following procedures are to be followed:

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1. DO NOT SMOKE when near batteries
2. DO NOT cause flame or spark in battery area
3. Discharge static electricity from body before touching batteries by first touching a grounded metal surface

Fire Hazard

Keep fire extinguishers in accessible locations. Use appropriate fire extinguishers as recommended by NFPA.

Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage, which present a potential fire hazard.

When an open bottom base is used, the stationary engine generator assembly is to be installed over noncombustible materials. It should be located such that it prevents combustible materials or loose debris from accumulating under or inside the generator set.

Do not service the engine when any ignition source such as an open flame is present. "DANGER" signs must be placed to warn of the fire hazard. No work may be performed on the engine involving an ignition source such as open flames, cutting, welding, or grinding.

A fire extinguisher (dry chemical or carbon dioxide, CO2) must be immediately available to the mechanics while working. When liquefied or natural gas leaks or escapes, it can result in dangerous accumulations of gas, which might cause a serious flash or explosion. Careful ventilation of the area is mandatory in the event of a fuel leak.

The total electric load on this equipment must not exceed the nameplate rating. Overloading can cause fires, damage the generator set, and damage any equipment that is connected to it.

Exhaust System

Engine exhaust gases contain DEADLY carbon monoxide gas, which is colorless and odorless. If breathed in sufficient concentrations, this gas can cause severe nausea, fainting, or death. Provide adequate ventilation to prevent buildup of exhaust gases. When the generator is installed inside a room or enclosure, exhaust gases must be piped outdoors. Install the exhaust system so exhaust gas does not leak at joints or piping connections. Make certain that the extended exhaust piping is plumbed properly and that the exhaust is not near an intake ventilator.

Increase the exhaust pipe diameter as necessary to reduce back pressure. Use a minimum number of fittings and elbows to prevent back pressure in the engine exhaust system. Be sure the enclosure has proper ventilation to accommodate the engine cooling system.

Fuel System

Gaseous, Natural Gas and Liquid Propane Gas are extremely flammable, and vapors are EXPLOSIVE. Comply with all laws regulating the storage and handling of these fuels. Check for leaks frequently and correct such leakage immediately.

Do not fill fuel tanks while the engine is running.

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Do not smoke or use open flame at any time when fuel is being handled. Fuel vapors are both toxic and flammable.

Liquid petroleum gas (LPG) systems operate at tank pressures around 690 kPa (100 psi) or above. The tank pressures are regulated down. Vaporized LPG systems operate at pressures near 2.7 kPa (11 in H_2O), as do most natural gas systems.

Safety precautions when handling liquefied petroleum gas cannot be over-emphasized. There are state, county and city codes, and fire regulations covering the handling and storage of liquefied petroleum gas or natural gas. In addition to the safety suggestions in this manual, all local codes and fire regulations on this subject must be followed explicitly. Where local codes are more stringent than the suggestions in this manual, the local codes must be given priority.

Before proceeding with any service, be certain that all switches are in the OFF position, disconnect battery ground cable, remove fuses in DC systems and turn off the battery charger. These safety suggestions apply to service of any engine using liquefied petroleum gas or natural gas fuel regardless of the work to be performed. When servicing the engine, ensure that there is adequate ventilation. This is to avoid the accumulation of gas/air mixtures in and about the engine caused by undetected leaks.

Any service performed on the fuel system requires that:

- All threaded connections are sealed with proper pipe thread compound. Replace defective fittings and reseal all connections.
- Fuel system is checked for leaks. Leaks are not permissible. Odorants, which are strong smelling components (an odor similar to spoiled cabbage), are added to liquefied petroleum gas as a warning agent to indicate the leakage of even small quantities of gas.
- A soap solution applied with a soft brush will bubble to indicate leaks. Never use an open flame to check for leaks. All leaks must be sealed.
- All flexible fuel connections are checked, metallic and neoprene, with the soap solution.

It is important to remember that all gas fuel systems are pressurized. Be certain that the fuel valves are tightly closed and all fuel has been vented before starting any repair work on the fuel system.

HAZARDOUS NOISE

Prolonged unprotected exposure to hazardous noise levels may cause loss of hearing. Never operate the generator set without a muffler or with a faulty exhaust system. Ear protection may be required.

HAZARDOUS VOLTAGE/ELECTRICAL ENERGY

Safe practices MUST be followed while performing work on electrical equipment to prevent death or injury from electric shock, electrocution, arc flash, and arc blast hazards. The Standard for Electrical Safety in the Workplace, NFPA 70E, requires that the owner of this electrical equipment provide a field-applied label which includes incident energy level,

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minimum Personal Protective Equipment (PPE) required, safe working distance, and arc flash boundary. This information is determined through an arc flash hazard analysis performed by a licensed professional electrical engineer who is familiar with the electrical system design.

Dangerous voltages are present at power terminals of this equipment. Contact with such terminals will result in extremely dangerous and possibly lethal electric shock. Never allow any unqualified person to install, operate or service the equipment. The standby electric system must be installed, tested, and inspected per the manufacturer's recommendations. All codes, standards, regulations, and laws pertaining to the installation must be strictly complied with.

Accidental contact with electrical equipment can cause severe injury and death if the equipment is not properly grounded. The frame and external electrically conductive parts of this equipment must be properly connected to an approved earth ground, in accordance with applicable electrical codes. A grounding lug is provided on the generator and in other equipment for this purpose.

CAUTION: RISK OF ELECTRIC SHOCK!

The grounded conductor must be bonded to ground in accordance with the National Electrical Code, NFPA 70. The unit shall not be used in floating output applications.

Remove all electrical power before removing protective shields for service or maintenance. Exercise extreme caution when working on or around electrical components. Open or poorly insulated conductors are extremely dangerous during operation. Severe, possibly fatal, shock may result. Make certain that all conductors are properly insulated or guarded, all grounds are made and that the area is dry. Do not tamper with interlocks.

In the event of an accident from electrical shock, shut down the generator set immediately. If the set cannot be shut down, free the victim from contact with a dry nonconductor, avoiding direct contact with victim until free of the conductor. If the victim is unconscious, apply artificial respiration if qualified and get medical help immediately.

Verify that all power leads and control connections are properly insulated before starting the generator set. Neglecting this may result in extensive damage to equipment and personal injury. This problem arises if the unit is started before electrical installation is completed.

Make certain the area is well ventilated to dissipate any flammable vapors, which may collect from fuels. When servicing any part of the electrical system or making any connections, be sure the main switch is OFF and disconnect battery ground cable or remove fuse in DC system. Turn off the battery charger. Clean or service the generator set only when the engine is shut down. If the unit stops because of an engine safety device, do not attempt to restart until the cause for shutdown has been corrected.

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ELECTROMAGNETIC FIELD

When the generator is running, an electromagnetic field is present that can interfere with pacemakers or other active medical implants. Access to the generator area is prohibited for personnel wearing pacemakers or implanted defibrillators.

HOT PARTS

The exhaust manifold, turbocharger(s), and extended exhaust piping are HOT when the engine is running. These can remain hot for long periods of time after the engine shuts off. Avoid contact with these parts. Consider insulating the exhaust system if installation is such that unintentional contact with the exhaust system components is likely.

Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.

MOVING PARTS

Moving parts can cause severe personal injury or death. Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.

HANDLING

Do not use lifting devices with marginal capacities when lifting or moving the unit. Observe the center of gravity of the equipment to be lifted and do not allow the generator set to swing if suspended. Make certain the supporting structure is adequate to support the unit. Failure to observe this warning may result in equipment damage and serious or fatal injury.

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1 General

When installed properly and according to applicable codes, your MTU Onsite Energy generator set will perform safely and reliably. Incorrect installation can cause continuing problems. Figure 1-1 illustrates a typical installation. Your authorized generator set distributor/dealer can provide advice about or assistance with your installation.

This manual references organizations and their codes that govern generator set selection and installation for US installations. Installers must comply with national and local codes when applicable.

NFPA 37……Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 54……National Fuel Gas Code
NFPA 70……National Electrical Code®
NFPA 99……Health Care Facilities Code
NFPA 101……...Life Safety Code®
NFPA 110……...Emergency and Standby Power Systems
UL 2200……...Stationary Engine Generator Assemblies

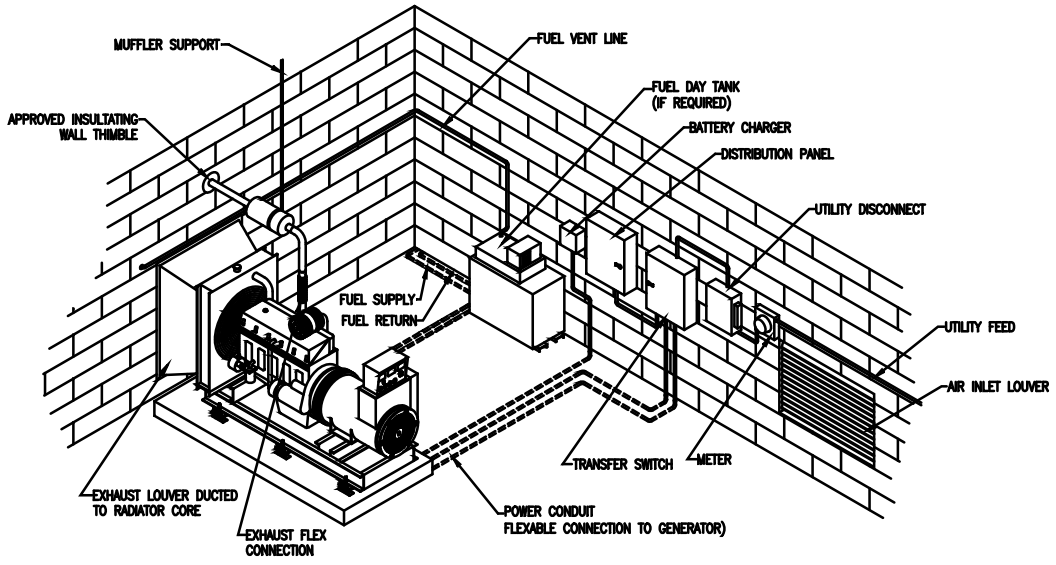


Figure 1-1: Typical generator set installation

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2 Lifting Provisions

To ensure personal safety and prevent damage to the product, we strongly recommend the guidelines in Figure 2-1 be observed when lifting MTU Onsite Energy generator sets. Due to the different designs, dimensions and weights of the generator sets, specific instructions for each model are not provided. It is the responsibility of the dealer/distributor to see that generator set lifting is performed within the framework of these guidelines.

DANGER

- **Never stand beneath a suspended load.**
- **Use appropriate lifting devices and appliances.**

CAUTION

Lifting brackets are for lifting purposes only. Do not use for any other purpose.

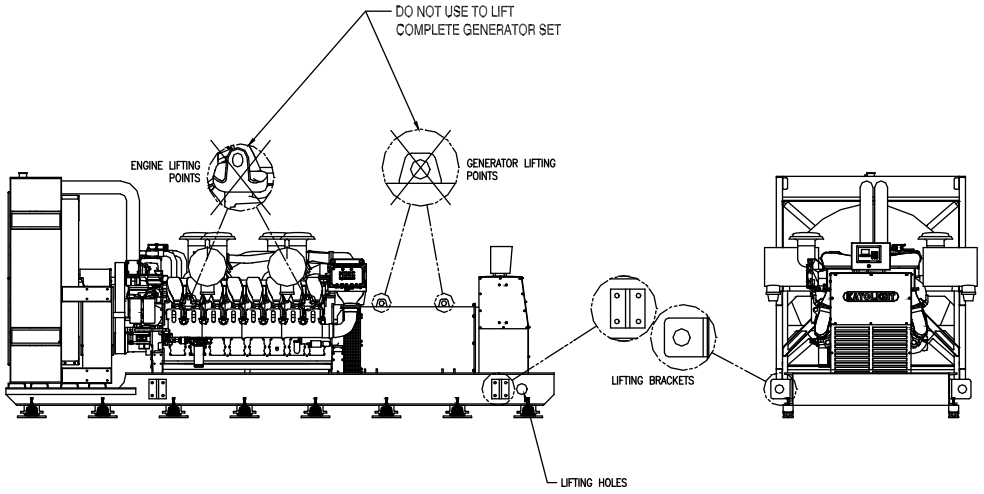


Figure 2-1: Lifting provisions

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3 Location

The location of the generator set is influenced by factors such as ventilation, exhaust piping, electrical service, fuel supply and accessibility for maintenance and service.

Before selecting the location for your generator set, consider the following:

- Supporting structure must be adequate for the generator set and accessories. For information on mounting on an inertia pad, see Section 4. For any other set-up, consult a structural engineer for an appropriate design.
- Area should be clean, dry and not subject to flooding.
- Ventilation should be available in the area with a minimum amount of duct work
- Exhaust gas must be piped away from the structure and any ventilation intakes. Piping must incorporate large radius, low restriction elbows.
- An adequate supply of fuel should be available at all times to sustain operation.
- The main diesel fuel supply should be as close as possible to the unit. If the main fuel tank is installed underground, an auxiliary pump and day tank are necessary to transfer fuel from the main tank to the day tank.
- Vibration should be effectively isolated and dampened to reduce transmission of vibration and prevent fatigue fractures of connected systems.
- Area should provide easy access for maintenance and repair. A minimum clearance of 0.91 m (3 ft) between an installed generator set and adjacent walls or other electrical equipment should be maintained on three sides of the generator set. Clearance of 1.52 m (5 ft) should be maintained at the rear of the generator set to facilitate removal, should it become necessary.
- Applicable fire rating codes and standards must be met.
- When an open bottom base is used, the stationary engine generator assembly is to be installed over noncombustible materials. It should be located such that it prevents combustible materials or loose debris from accumulating under or inside the generator set.

Local weather conditions will have a direct influence on location of the unit and the type of accessory equipment required to assure reliable operation. Extreme ambient temperature variations should be avoided. For ambient temperatures below 16 °C (60 °F), starting aids such as jacket water heaters and lubricating oil heaters will ensure dependable starting. Anti-condensation or strip heaters are available for control panels and generators to maintain a temperature above the dew point to prevent condensation of moisture.

Standard transfer switches located indoors in heated facilities are enclosed in NEMA 1 enclosures. Various other NEMA enclosures may be needed. If the generator set is located outside, heaters are needed below 0 °C (32 °F).

Consider preventive maintenance issues when selecting a generator set location. See Section 9 for a list of service points that should be accessible.

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4 Mounting

Your generator set should be installed in a location that is able to support the weight of the unit and accessories, resist dynamic loading, and does not transmit generator noise and vibration. See Section 3 for detailed information on selecting a location for your generator set.

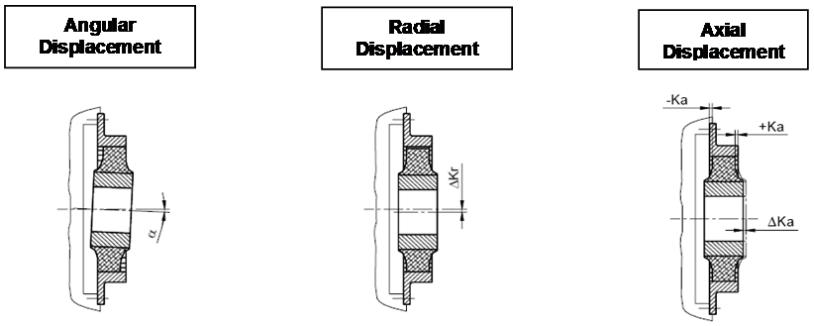
NOTE: Skid brackets are not to be used as mounting brackets. Make sure to follow proper installation instructions.

FIELD ALIGNMENT

Field alignment after the generator set is installed corrects any changes in the coupling alignment during transport and installation. This realignment ensures that the coupling will perform as needed and reduces the possibility of excess vibrations that decrease the useful life of the generator set.

After final installation, the following measurements must be checked to confirm proper alignment as noted in the table and illustration below:

Measurement	Specification
Angular Displacement	Less than or equal to 0.3°
Radial Displacement	Less than or equal to 1.49 mm (0.059 in)
Axial Displacement	Less than or equal to 3.99 mm (0.157 in)



Alignment can be validated by using dial indicators or a laser alignment tool.

NOTE: This applies only to models equipped with a two-bearing generator.

ENGINE LOCKS

All generator sets must be locked using the crankshaft locks provided with the engine by the engine manufacturer. If the generator sets are using vibration isolators, these must be blocked as well. Before installing the generator set, these engine locks and vibration isolator blocks must be removed.

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NOTE: This affects Series 4000 engine serial numbers beginning with 526, 527, and 528.

WEIGHT

The weight of the generator set and accessories will determine the type and design of the support structure. Generator set weight can be found in the specification sheet for your particular model. Be sure that the weight of accessory items and fuel (if a sub-base tank is used) are added to the total requirements.

INERTIA PAD/BASE

Your generator set must be mounted on a substantial inertia pad or base. The composition of the inertia pad should follow standard practice for the required loading. Common specifications call for 17 MPa (2,500 psi) concrete reinforced with 8-gauge wire mesh (4.06 mm or 0.16 in) or number 6 reinforcing bars on 30 cm (12 in) centers.

To determine the depth of the inertia pad, the following formula can be used:

$$\text{BASE DEPTH} = \frac{Wu}{d * w * l}$$

Where Wu = engine-generator set weight in kg (lb)
d = concrete density (usually 2,322.68 kg/m^3 or 145 lb/ft^3)
w = foundation width in m (ft)
l = foundation length in m (ft)

The inertia pad should be a minimum of 30.48 cm (12 in) wider and 30.48 cm (12 in) longer than the unit base. The inertia pad may be constructed higher than the floor level by 8 to 20 cm (3 to 8 in) for ease of maintenance.

To reduce the amount of unit vibration transmitted, you must isolate your inertia pad from the foundation. One method for isolating the inertia pad from the foundation is to use 20 to 25 cm (8 to 10 in) of wet gravel or sand as a bed in the inertia pad pit. For other methods, consult a qualified structural engineer.

To allow settlement of the inertia pad from the foundation, expansion joints should be incorporated between the inertia pad and the foundation.

VIBRATION ISOLATION

Vibration is a normal by-product of the operation of any generator set. Vibration transmitted to surrounding areas will increase the noise level and if severe, can cause structural damage. To minimize this risk, all generator sets should have vibration isolation between the generator base and inertia pad.

All fuel, coolant, exhaust and electrical connections must have flexible sections to isolate vibration. Leaks or fractures can develop rapidly without vibration isolation and there is a danger of eventual total failure.

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For generator sets enclosed within a building, where maximum vibration isolation is required, spring mounts provide vibration isolation between the generator base and the structure. Check state and local codes for such requirements.

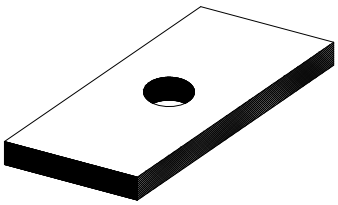


Figure 4-1: Typical pad type vibration

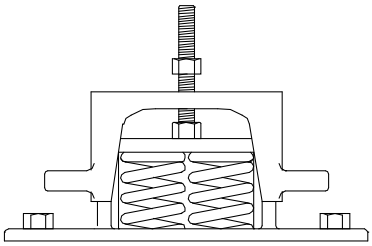
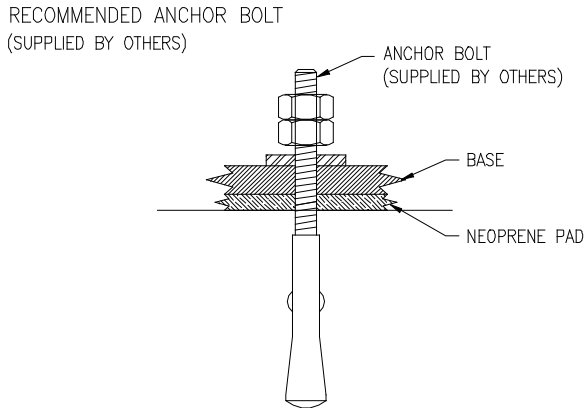


Figure 4-2: Spring mount vibration isolator

Anchor bolts should be loosened and double nutted after installation to avoid base distortion caused by unlevel inertia pads.



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Figure 4-3: Recommended anchor bolt

5 Air Requirements

GENERAL

When installing engine generator sets, great care must be taken to ensure adequate ventilation. Proper installations require enough ventilation to cool the engine generator set as well as supply adequate air for combustion.

When installing the ventilation system, the following factors should be considered:

- Location of intake and exhaust louvers
- Method of actuation of intake and exhaust louvers
- Ambient temperature
- Routing of exhaust air duct

The air intake and exhaust should be in line to provide engine room ventilation air flow which will parallel the generator set air flow over the engine, through the radiator and/or exhaust louver. The inlet and outlet openings must be large enough to provide the volume of air required by the engine generator.

NOTE

Exhaust louver effective opening should be at least 25% to 50% larger than engine radiator core. Intake louver should be 50% to 100% larger in effective opening than engine radiator core.

In most applications, intake and exhaust louvers should be used. Figure 5-1 indicates a typical louver.

Care should be taken to provide adequate open space outside the exhaust louver so as not to obstruct airflow.

Units with mounted radiators should be installed with ducting between the radiator and the exhaust louver to prevent recirculation of air.

CAUTION

Ensure that the exhaust ducting is installed so that no recirculation of radiator exhaust air occurs. Failure to prevent recirculation could cause the unit to overheat and shut down.

The exhaust louver should not be exposed to high prevailing winds, since wind pressure may reduce fan discharge and reduce cooling. The duct should be constructed with as few bends as possible. All units can be supplied with radiator duct flanges of the required size to meet the customer's application.

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WARNING

Prior to start-up, louver-securing hardware must be removed. For motorized louvers, louver blade assembly must be reattached.

If bends are required, they should be in the form of gradual sweeps to allow airflow with minimum restriction. Increase duct size one-fourth to one-half to compensate for bends.

Motorized and gravity louvers may be used to prevent entry of cold air which may cause difficulty in engine starting. (Refer to Chapter 8 for recommendations for wiring motorized louvers). Louvers also reduce the entry of rain, snow and insects into the building.

A gravity-operated louver can be used for the exhaust air. When the set operates, outlet airflow will open the louver and it will close automatically by gravity when the unit is shut down.

Generating sets with automatic start require the use of motor operated intake or fixed louvers or dampers. Motor operated louvers are held closed by spring tension and are driven to the open position by a motor operating through a mechanical linkage.

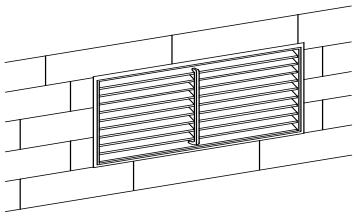


Figure 5-1: Typical center top pivoted louver

CAUTION

Care should be taken in wiring the system to ensure that the intake louver motor is supplied with power during all possible modes of unit operation, i.e. true power failure, simulated power failure due to incorporation of a system test switch, or automatic plant exercising. Incorrectly wired louver motors could result in the louvers closing prematurely during engine cool-down, which can cause overheating, engine shutdown, and possible damage to the unit.

In some extreme cold weather applications, the opening of intake louvers immediately upon starting may cause carburetor icing and vaporizing problems with engines utilizing gaseous fuels. Diesel engines may also be affected if lightly loaded. Thermostatically controlled louvers may be used to reduce the difficulties encountered with cold weather applications.

Figure 5-2 illustrates a typical generator set installation for units with unit-mounted radiators, indicating ducting and preferred locations of the louvers.

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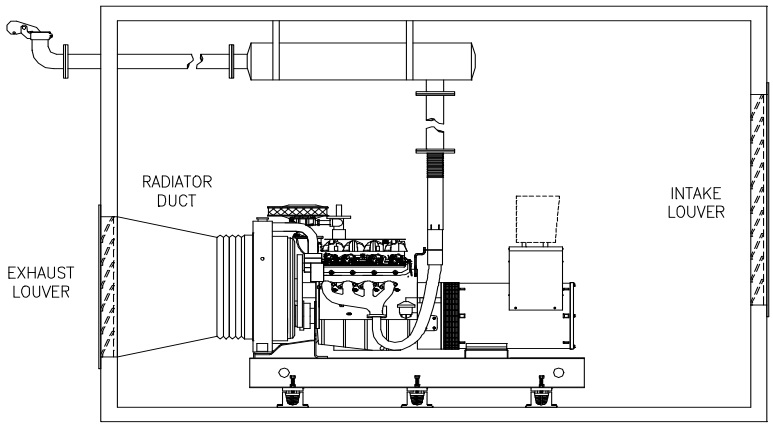


Figure 5-2: Typical installation with louvers

Engine-generator sets with remote cooling will not have an engine driven fan to move air through the generator room. As a result, a fan or some other means of moving air through the room must be considered. The fan must move the required amount of air against the allowable static friction.

The following formula may be used to estimate the amount of airflow required to remove engine and generator radiated heat and supply sufficient combustion air. The formula is based on air temperature of 38 °C (100 °F). Allowable room air temperature rise is 11 to 16 °C (20 to 30 °F).

$$V = \frac{Q}{F * \Delta T}$$

Where V = Air flow through the engine-generator room in m^3/min (ft^3/min)
Q = Engine-generator set radiated heat in kW (BTU/min)
F = 0.02 for metric units (0.018 for imperial units)
ΔT= Allowable room air temperature rise in °C (°F)

Higher elevation installations will require increased airflow. Add 10% for each increase of 762 m (2,500 ft). Also increase airflow for non-insulated exhaust silencer and other equipment that may add to the radiated heat in the room. Also keep in mind the required combustion airflow for the engine.

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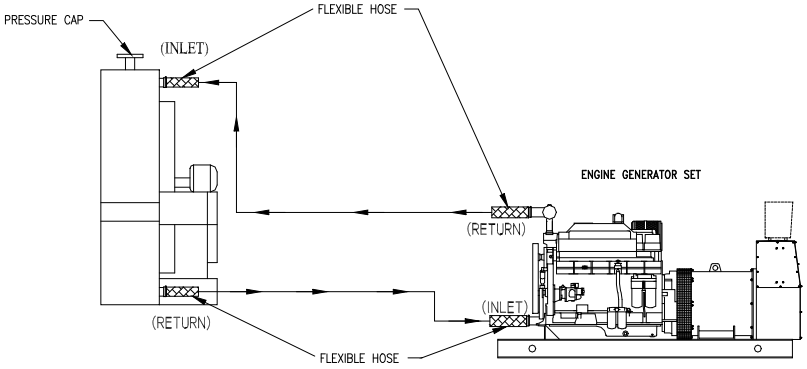


Figure 5-3: Typical remote radiator installation

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6 Exhaust System

Proper exhaust system installation is essential for maximum generator set engine efficiency. Because exhaust fumes are deadly, great care must be taken when installing the exhaust system. Consideration must be given to back pressure, piping, and placement. Figures 6-1 and 6-2 show the general arrangement of recommended exhaust systems.

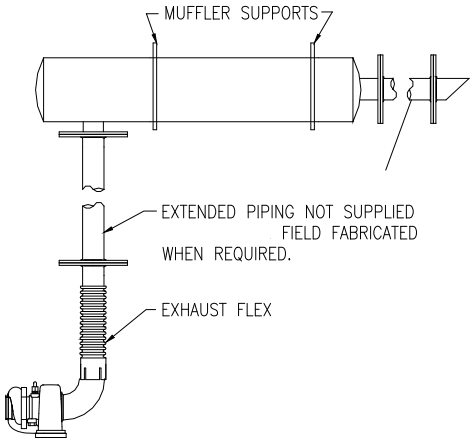


Figure 6-1: Typical side inlet exhaust

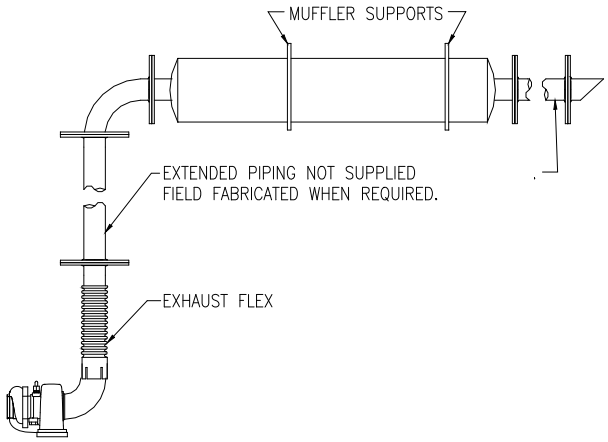


Figure 6-2: Typical end inlet exhaust

PLACEMENT

The exhaust pipe should terminate outdoors, away from doors, windows, or other building openings in an area where exhaust can dissipate. Placement of piping and exhaust silencer should take into account the location of combustible materials. If location cannot avoid these concerns, remove combustible materials on a regular basis. Keep dry grass, foliage, and combustible landscaping material a safe distance from the exhaust system.

WARNING

Inhalation of exhaust gases can cause death. Exhaust pipes must not terminate near fresh inlet vents of any type or near combustible materials. Avoid exhaust gas recirculation which could cause the engine-generator set to overheat. Generator sets installed outdoors inside enclosures should have their exhaust directed so that it will disperse away from buildings and building air intakes.

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Back Pressure

The installed exhaust system must not exceed the engine manufacturer's maximum exhaust back pressure limit. Damage may result from excessive back pressure. Causes may include:

- Insufficient exhaust pipe diameter
- Exhaust run too long
- Exhaust silencer too small or designed improperly
- Too many bends and/or constrictions in piping
- Obstruction in exhaust piping

Your generator set has been sized so that exhaust system back pressure is kept within the acceptable limits. However, in situations when extended piping or a flex connector other than the one supplied must be used, contact MTU Onsite Energy to ensure that back pressure will not exceed the engine manufacturer's specification.

Piping

Exhaust piping must conform to all applicable codes. Routing of exhaust piping should be as short and direct as possible. Exhaust piping should be of Schedule 40 black iron, steel or other suitable material having adequate strength and durability. The recommended material for exhaust piping is Schedule 40 black iron pipe. Where possible, sweep elbows with a radius of at least 3 times the pipe diameter should be used.

Exhaust pipes must be independently supported with no weight applied to the engine, turbocharger, exhaust manifold or flex connector. Where exhaust pipes attach to the engine, they must be connected with flexible connectors to minimize vibrations that can cause damage to the exhaust system.

CAUTION

Weight applied and vibration extended to the exhaust manifold or turbocharger could result in damage to these components. No exhaust piping weight may be carried by the engine, exhaust manifold or turbocharger.

The following applies to UL 2200 Listed engine-generator sets. When the complete exhaust system is not factory installed, exhaust piping and chimneys shall be designed, constructed, and installed in accordance with NFPA 37, Standard for the Installation and Use of Stationary combustion Engines and Gas Turbines.

Flexible Section

The supplied exhaust flex should be installed directly off the engine turbo elbow/manifold. This limits the stress on the engine exhaust manifold or turbocharger resulting from engine motion on its vibration mounts and temperature-induced changes in pipe dimensions. The flexible section should not be bent or used to make up for misalignment between the engine exhaust and the exhaust piping. Since typical exhaust temperatures range from 427 °C (800 °F) to over 649 °C (1,200 °F) for some engines, seamless stainless steel should be used for the flexible section.

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CAUTION

When installing a silencer, make certain flow direction is correct. Check inlet and outlet marking on the silencer nameplate.

EXTENDED PIPING

Engine exhaust piping can accumulate a considerable amount of condensed moisture after unit shutdown, particularly if the exhaust system is run through lengthy piping. To prevent condensed moisture from running back into the engine, exhaust piping should be sloped away from the engine and a condensate trap and drain should be incorporated at a low point ahead of engine manifolds. The trap should be drained periodically.

Horizontal extended exhaust pipe should terminate with a 45° tail pipe to prohibit rain from entering the system. A screen should be placed across the end of the tail pipe to keep birds and rodents from entering the system.

Where vertical exhaust stack is necessary, a rain cap should be fitted to exclude rain and snow from the exhaust pipe.

Where there is a danger of extending piping coming in contact with combustible material or personnel, the piping should be insulated or shielded.

PIPING INSULATION

The heat rejected by exhaust piping and the amount of ventilating air required can be substantially reduced by insulating exhaust piping with suitable high-temperature insulation. Exhaust temperatures are given on each generator model's specification sheet. DO NOT insulate piping for the turbocharger or manifold.

WALL OR ROOF THIMBLES

Exhaust piping passing through combustible walls or partitions must be guarded at the point of passage by an approved metal ventilated thimble to prevent exhaust pipe heat from being transmitted to the combustible material (Figure 6-3). Thimbles must be suitable for the application. Consider the type of exhaust system, construction materials used and local fire codes.

ROOF THIMBLES

Approved roof thimbles should be constructed so that they extend at least 23 cm (9 in) both ways from the surface of the roof. Ventilation holes are located on both ends for roof thimbles, therefore, a rain shield must be included above the thimble. Rain caps on the end of the exhaust pipe are recommended only in areas not subject to freezing temperatures. In an area where freezing is common, extend the exhaust piping well beyond the roof and use a gradual "U" bend at the end to direct the exhaust outlet downward which will keep rain, snow, etc., out of the pipe. The outlet of the pipe should be far enough away from the roof to prevent ignition of the roof material from hot exhaust.

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WALL THIMBLES

Approved wall thimbles should be constructed so that they extend at least 15 cm (6 in) both ways from the surface of the wall. Wall thimbles have ventilation holes on one end which should be oriented to the inside of the building.

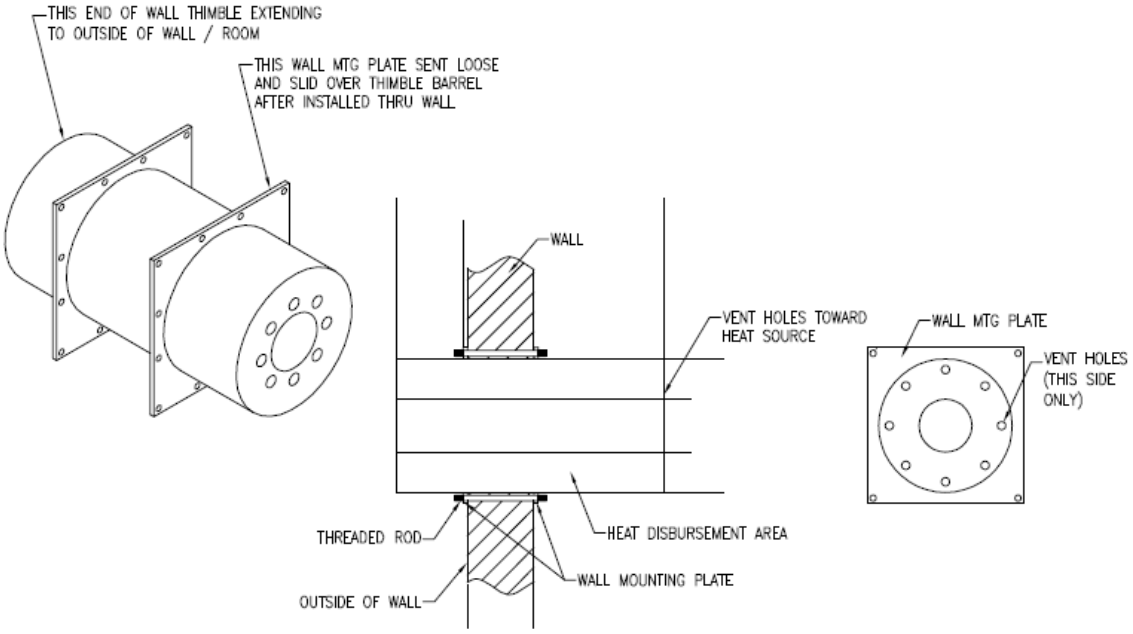


Figure 6-3: Wall thimble installation

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7

Fuel System

General

The fuel system must be installed properly to assure availability of fuel for starting and continuous running throughout the emergency. Before connecting the fuel lines to the engine, ensure that fuel connections are free from dirt, grease, water and other contaminants that could damage the engine.

The components comprising a fuel system will differ according to the generator set location, type of fuel and anticipated time of operation desired.

Diesel Applications

The following basic components comprise a representative diesel fuel system:

1. Main Fuel Tank Incorporating:
   a. Fill Line
   b. Vent Line
   c. Supply Line with Foot Valve
   d. Return Line

2. Day Tank (if required)
   a. Pump Control Switch

3. Electric Fuel Transfer Pump (if necessary)

Main Fuel Tank

The best location for the main fuel tank is as close to the engine as possible. If building codes and insurance regulations permit, the tank could be located in the same room as the generator set, or in an adjoining room. If this is not possible, the tank should be located in a convenient location compliant with local, regional and national codes.

The fuel level in the main tank should be level with the engine's fuel transfer pump inlet. If located in the room, the tank should be on the same general level as the engine's fuel injection pump but lower than the injectors. When the tank must be placed higher or lower than this, it often requires the usage of priming or float tanks. When the main tank can be located close to the set and where the vertical lift is 1.52 m (5 ft) or less, the fuel injection pump may be capable of supplying sufficient fuel. If the horizontal run is too great, or the vertical height exceeds 1.52 m (5 ft), a transfer pump is required. As a general rule, when static head and dynamic suction (horizontal head) exceed 20 kPA (6 inHg), an auxiliary pump and tank are required. A float tank or transfer tank is required with the auxiliary pump. The auxiliary pump should be of the positive displacement type, operated electrically from the load side of the transfer switch.

All tanks must be vented to a safe area in the event of an overflow and to allow air and other gases to escape to atmosphere. The vent must, however, prevent dust, dirt and moisture from entering the tank. Return lines are required. Keep the return space at least 30.48 cm (12 in)

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away from the pick-up or fuel supply in the day tank. If this is not done, air bubbles could be entrapped in the fuel and cause erratic operation. At least 5% of capacity should be allowed in a diesel main tank for expansion of the fuel. If the main tank is to be located overhead, an auxiliary fuel shut-off solenoid should be used.

The capacity of the fuel tank will be determined by the fuel consumption of the unit and the continuous operating time necessary. Minimum fuel supply must be sufficient to allow the set to operate for the prescribed number of hours. Before installing a fuel tank, review all local code requirements governing fuel tanks.

The number of lines connected to an underground fuel tank, whose depth of burial exceeds the below grade depth of the electric generating unit, will vary as a function of day tank positioning with regard to the engine and the number of ancillary devices utilized. However, all underground tanks must have the following:

- A vent line terminating above ground level in a screened or hooded type vent cap with unrestricted opening to atmosphere and a safe area, in the event of an overflow, that meets all necessary codes.
- A fuel fill line terminating above grade level, and fitted with an appropriate cap, and terminating in a fuel filler box with an appropriate cap plainly marked for the fuel utilized.
- A fuel supply line connected from the tank to an electric fuel transfer pump is needed when the fuel tank is located below the fuel lifting capacity of the set. The end of the fuel supply line within the tank must be fitted with a foot valve (permits flow in one direction only) to prevent loss of transfer pump prime when the transfer pump is not in operation.
- The day tank should be positioned so that the bottom of the day tank is above the level of the engine fuel filters in order to provide a positive head of pressure for the fuel injection pump. The mounting of the day tank in this manner will prevent loss of prime to the unit fuel injection pump and is recommended particularly in applications where the unit is utilized as a standby power source. In all applications, the return lines should returned to the main tank.

Local and national regulations governing fuel tank location must be checked before planning the installation. Fuel tanks must be adequately vented to prevent pressurization due to fuel expansion when heated.

CAUTION

The fuel system needs to be sized to handle the fuel flow required by the engine. Engine fuel flow is greater than engine fuel consumption and varies for different engine models. Engine fuel flow and consumption can be found on the model specification sheets located in the Operation and Maintenance manual.

The fill, supply and return lines as well as all diesel fuel system piping must be constructed of black iron pipe. Do not use galvanized pipe for diesel fuel applications.

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CAUTION

Galvanized tanks and piping must not be used since the diesel fuel and the galvanized coating react chemically to produce flaking which quickly clogs filters or causes failure of the fuel pump or injectors. Do not use Teflon tape on fuel fittings as it can clog the fuel injectors.

Cast iron and aluminum fittings and pipe should be avoided since they are porous and can leak fuel. Flexible fuel lines must be used to connect the unit to the fuel supply and return lines. Flexible lines must be of the type approved for diesel fuels.

WARNING!

Leaky fuel lines and fuel connections can introduce the possibility of explosion and fire, which can result in injury or death. Ensure fuel lines are properly connected and flexible lines are used between the engine and supply and return lines.

Fuel filters and drains must be located in easily accessible areas to promote regular and frequent service. Cleanliness of the fuel is critical for diesel engines that have easily damaged or clogged precision fuel injectors and pumps.

DAY TANK

The day tank provides a ready supply of fuel at the injector pump. Day tanks are used when the engine pump does not have the necessary lift to draw fuel from the main tank. If the main tank is above the level of the injectors, the day tank is used to remove the fuel head pressure that would otherwise be placed on the engine fuel system components.

A slight head of fuel can cause leakage through the injectors and result in hydraulic lock problems such as filling of the engine cylinder with liquid fuel. The injector return line must always be at or below the level of the fitting on the engine. The line must drain toward the day tank.

FUEL OIL TRANSFER PUMP

The fuel oil transfer pump (auxiliary pump) is used to supply fuel from the main tank to the day tank.

Single phase 120 VAC or 240 VAC, the AC power supply for the transfer pump should be taken from the load side of the transfer switch. The pump will operate when its circuit is closed by the action of the level switch.

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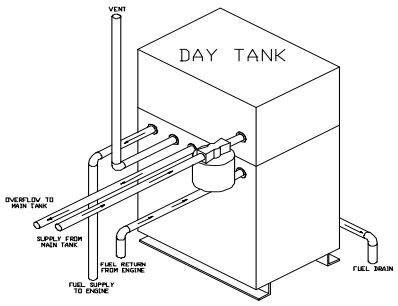


Figure 7-1: Fuel day tank

Fuel is then drawn from the main tank through a foot valve and is pumped into the day tank. Operation continues until the fuel level in the day tank rises causing the float to rise, opening the float switch and disconnecting the pump motor.

Diesel Fuel Recommendations

MTU Onsite Energy recommends the use of #2-D diesel fuel.

#2-D Diesel Fuel:
A good quality 40 cetane (min) #2-D diesel fuel is best for most MTU Onsite Energy diesel generator set installations. This must be a distillate fuel which meets the requirements for #2-D in the ASTM diesel fuel classification D-975-60T. Most major brands of fuel oils conform to ASTM specifications.

#1-D Diesel Fuel:
A #1-D grade 40 cetane (min) diesel fuel may be best if operating at altitudes above 1,524 m (5,000 ft) or in cold weather (below 4 °C or 40 °F) conditions. Kerosene is included in the #1-D class of fuel. This fuel has a lower flash point (more volatile) and is of lower viscosity (flows more freely) than #2-D.

#2 Domestic Type (Furnace) Oil:
#2 domestic or furnace oil may be used. The #2 domestic fuel should have properties as close as possible to that of #2 diesel fuel. Check ASTM D-396-60T. Particular attention must be given to the sulfur content – this must be less than 1% by weight. High sulfur content can lead to increased engine wear and shorter injector life, especially if intermittent operation or low operating temperatures exist.

#4-D Grade Fuel: (NOT RECOMMENDED)
The high sulfur content plus low cetane rating of this class of fuel makes it unsuitable for diesel generator set use.

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GASEOUS FUEL SYSTEMS

System Variations: The gaseous fuel systems used can be grouped in 4 general classifications. The systems are covered in the following sequence:

1. Natural Gas (including manufactured gas)
2. LP Vapor
3. Liquefied Withdrawal
4. Dual Fuel Systems (natural gas and LP gas)
5. Zero Pressure Regulation

1. & 2. NATURAL GAS AND VAPOR PROPANE (FIGURE 7-2A):

Natural, manufactured, sewage and most LP Vapor gas systems are vapor fuels as supplied by the utilities. These fuel system components are used in a similar manner. When the heating content of the fuel falls below 35,315 BTU/m^3 (1000 BTU/ft^3), as it does with manufactured sewage and some natural gas fuels, the set will have to be derated. Check with the factory for application details. The gas distribution companies will provide piping from the main transmission line to the building. The primary regulator should be furnished by the utility company. It is the responsibility of the utility company to ensure that sufficient pressure is present at all times to operate the primary regulator. Installation, repair and alteration to gas piping should be undertaken only by the utility company or personnel authorized by them. Piping should be rigidly mounted but protected against damage from vibration. Only UL or AGA approved flexible connection should be used.

3. LIQUID WITHDRAWAL

Most LPG systems are operated from vapor. The main tank is sized to vaporize the fuel volume needed for ambient temperature of the installation. Sizing the LPG tank must be the responsibility of the fuel supplier. Give the fuel supplier the fuel volume required.

Vaporizers: Vaporizers are devices used exclusively with LPG systems. LPG in liquid form is introduced under tank pressure into the vaporizer which uses engine coolant heat to convert the liquid into a vapor state. Vaporizers may be referred to as converters; both names describe its function. There are several types of vaporizers. One type is strictly a vaporizer and must be used in conjunction with other pressure regulators. This type of vaporizer may be required if tank size is limited; low ambient temperatures or high fuel volume are conditions affecting the installation. The type classified as vaporizer-regulators provide vaporization plus primary and secondary regulation of gas pressure.

Fire regulations in most localities prohibit liquid LP high-pressure fuel lines inside a building or enclosure. This automatically precludes high-pressure equipment on or near an engine installed inside a building. Under such regulations, the coolant lines can be extended and the vaporizer mounted outside the structure.

Gas at permissible pressure (usually about 140 kPa or 20 psi maximum) is allowed inside the building. The vaporizer must be mounted below the level of the engine water pump and within 7.62 m (25 ft) of the engine. If freezing temperatures are common, don't overlook the fact that water inside the vaporizer could freeze unless antifreeze is added to the system.

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4. Dual Fuel Systems (Natural or LP Vapor)

In many applications, natural gas is the main fuel and LPG is used as the emergency fuel when natural gas is not available. The dual fuel system (in common use) offers automatic changeover from one fuel to the other.

During operation on natural gas, pressure existing in the common line to the carburetor closes off the LP Vapor regulator. Cutting off the natural gas operates a pressure switch in the line which automatically opens the LP Vapor solenoid and closes the natural gas solenoid.

5. Zero Pressure Regulation

The Zero Pressure Regulator System works on Zero Pressure air and Zero Pressure gas, the engine vacuum is what mixes the fuel and air through the mixer on the carb.

The system still requires 1.74 to 2.74 kPa (7 to 11 in H_2O) on either Natural Gas or LP Vapor.

The flow control valve is left with the tower in the upright position on either fuel and with the spring left in. The Zero Pressure System only requires the installer to give the correct pressure and volume to the system. NOTE: A dog tag on the system shows the fuel consumption and pressures required for each system.

Gas Piping: Piping must never be used to ground electrical apparatus. Piping must be rigidly mounted but protected against vibration. Where flexible connections are required, use only approved connections. A flexible section should be used between the point where the gas leaves the rigid fuel line and enters the engine. Only connections capped off by a temporary plastic plug are intended to be connected to by the end user.

All gas lines and piping should be of black iron. Joints and connections must be sealed. The pipe should be of sufficient size to maintain the proper pressure level when operating at full load. In addition to the actual fuel consumption, the following factors must be considered:

- Pressure loss due to number of fittings
- Specific gravity of gas
- Pressure loss due to length of piping

At the end of the chapter is a list of steps to follow when calculating pipe capacities for gas flow rates.

This procedure is based on a pressure drop of 0.125 kPa (0.5 in H_2O) which allows for a normal amount of restriction from fittings.

Tables 7-1 and 7-2, Gaseous Fuel Pipe Capacity, list the capacity of various sizes and lengths of pipe. The capacity in m^3/hr (ft^3/hr) is calculated using the specific gravity of 0.6 as base. A pressure drop of 0.125 kPa (0.5 in H_2O) is used to account for a nominal number of fittings and metering equipment in this table.

Main Components: Solenoid valves used in a gaseous fuel system are designed to close and stop fuel the instant the engine stops. They should not be relied upon to completely seal the

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fuel system. A ruptured diaphragm or a piece of grit could prevent the valves from sealing resulting in gas continuing to flow through the carburetor into the engine and out into the surrounding air. Some gaseous fuels are heavier than air and tend to settle in low areas. This could present a serious hazard, especially in enclosed applications. Safeguards against this should be incorporated in each system.

The common components of a gas system are as follows:

Primary regulator: This regulator is used to provide pressure regulation of the gas from the high-pressure supply line or with LPG with the supply tank.

The primary regulator reduces line pressures to allowable inlet pressures for the secondary regulator. This regulator is supplied by the utility or fuel company.

Secondary regulator: The low-pressure type regulator admits fuel to the engine in response to engine demand similar to the float valve in a gasoline carburetor. The secondary regulator is not supplied and must be supplied by the purchaser. Natural gas and LPG vapor withdrawal inlet pressures must be from 1.74 to 2.74 kPa (7 to 11 in H_2O).

PRESSURE REDUCING VALVE

The pressure-reducing valve regulates the volume of fuel to the carburetor. The volume is proportional to the load on the engine.

This device is factory mounted for LP gas vapor withdrawal fuel systems, the valve is inverted and the internal spring removed. Consult factory for drawings showing modifications for propane fuel systems.

Fuel shut-off solenoid: This device automatically shuts off the fuel supply when the engine stops. All MTU Onsite Energy automatic fuel shut-off valves are electrically activated solenoids that seal off the fuel the instant the ignition switch is turned off.

Carburetor: Gas carburetors operate on gaseous fuels only.

*NFPA 37 requires the electric solenoid to be placed ahead of any flexible connector. This solenoid is not supplied by MTU Onsite Energy.

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Determining Pipe Size for Gaseous Fuel Systems

1. Obtain the fuel consumption in m^3/hr (ft^3/hr) at 100% load from the engine generator model specification sheet for the type of fuel used.
2. Refer to the correction chart below, and select the correction factor for the type of fuel used.

Fuel Specific Gravity	Fuel	Correction Factor
0.65	Natural Gas	0.962
1.00	Air	0.775
1.50	Propane	0.633
2.10	Butane	0.535

3. Divide the fuel consumption from step one by the correction factor to obtain adjusted flow rate.
4. Determine length of pipe between the fuel source and generator set.
5. From table 7-1 or 7-2, choose the column of the nearest pipe length.
6. Move down the column until the figure equal to or greater than the adjusted flow rate obtained in step three is encountered.
7. Move horizontally to the left column to determine the correct pipe size (NPS = Nominal Pipe Size).

NPS	Length of Pipe (ft)													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4	43	29	24	20	18	16	15	14	13	12	11	10	9	8
3/8	95	65	52	45	40	36	33	31	29	27	24	22	20	19
1/2	175	120	97	82	73	66	61	57	53	50	44	40	37	35
3/4	360	250	200	170	151	138	125	118	110	103	93	84	77	72
1	680	465	375	320	285	260	240	220	205	195	175	160	145	135
1-1/4	1400	950	770	660	580	490	460	460	430	400	360	325	300	280
1-1/2	2100	1460	1180	990	900	810	750	690	650	620	550	500	460	430
2	3950	2750	2200	1900	1680	1520	1400	1300	1220	1150	1020	950	850	800
2-1/2	6300	4350	3520	3000	2650	2400	2250	2050	1950	1850	1650	1500	1370	1280
3	11000	7700	6250	5300	4750	4300	3900	3700	3450	3250	2950	2650	2450	2280
4	23000	15800	12800	10900	9700	8800	8100	7500	7200	6700	6000	5500	5000	4600

Table 7-1: Gaseous Fuel Pipe Capacity (Imperial: ft^3/hr)

DN	Length of Pipe (m)													
	3	6	9	12	15	18	21	24	27	30	38	46	53	61
8	1.2	0.82	0.68	0.57	0.51	0.45	0.42	0.4	0.37	0.34	0.31	0.28	0.25	0.23
10	2.7	1.8	1.5	1.3	1.1	1	0.93	0.88	0.82	0.76	0.68	0.62	0.57	0.54
15	5	3.4	2.8	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.1	1	1
20	10	7.1	5.7	4.8	4.3	3.9	3.5	3.3	3.1	2.9	2.6	2.4	2.2	2
25	19	13	11	9.1	8.1	7.4	6.8	6.2	5.8	5.5	5	4.5	4.1	3.8
32	40	27	22	19	16	14	13	13	12	11	10	9.2	8.5	7.9
40	59	41	33	28	25	23	21	20	18	18	16	14	13	12
50	112	78	62	54	48	43	40	37	35	33	29	27	24	23
65	178	123	100	85	75	68	64	58	55	52	47	42	39	36
80	311	218	177	150	135	122	110	105	98	92	84	75	69	65
100	651	447	362	309	275	249	229	212	204	190	170	156	142	130

Table 7-2: Gaseous Fuel Pipe Capacity (Metric: m^3/hr)

TIM-ID: 0000002924 - 024

Example

- Engine – generator set operating with a fuel consumption of 700 cubic feet per hour and at a distance of 50 feet from the fuel supply

- Fuel used is propane and has a specific gravity of 1.5
- Dividing the flow rate of 700 CFH by the correction factor of 0.633 for propane gives the adjusted capacity of 1105 CFH
- Reading down the 50-foot pipe length column in table 7-1 until a figure equal to or greater than 1106 is encountered, we get a figure of 1680
- Reading directly across to the left column gives the required pipe size of 2 inches

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8 Electrical Requirements

General

The electrical system consists of the AC power supplied to the generator and the DC starting and control circuitry. These circuits must be enclosed in separate conduits.

Batteries

The batteries need to be provided with enough capacity to provide the cranking motor current specified on the unit specification sheet. The recommended batteries are lead-acid or nickel cadmium. They can be shipped wet or dry. If shipped dry, they can be stored indefinitely and when ready to use filled with electrolyte (acid) with a specific gravity of 1.250 to 1.265. It is recommended that batteries be placed on trickle charge for 12 hours after electrolyte is added.

Batteries should be located as close as possible to the generator set to eliminate line losses.

Nickel cadmium batteries are shipped wet. It is advisable that batteries be placed on trickle charge for 12 hours when received.

Coat battery terminal connections with grease to prevent corrosion. Check the electrolyte level periodically. Make certain all vent caps are in place and unobstructed.

Battery Racks and Cables

Where the battery installation requires remote battery location, the correct cross sectional area of battery cables is of importance in minimizing line drop. Battery racks or boxes are supplied by MTU Onsite Energy for lead-acid batteries.

AC Power Output Wiring

All wiring must be in accordance with applicable electrical codes. Wires must be of adequate size, properly insulated and supported in an approved manner. Wires should not be placed where they may interfere with plant operation. Figure 8-1 illustrates the various generator connections for MTU Onsite Energy generators.

The following applies to UL 2200 Listed engine-generator sets where installed in accordance with NFPA 70, National Electric Code. For the generator output wiring, use listed stranded copper wire with 90 °C rated insulation. If wire terminals are not factory provided, use UL Listed wire terminals which are suitable for the application and ratings. When an output circuit breaker is not factory provided, install an approved overcurrent protection device rated equal to or greater than the generator voltage with a current rating no more than 125% of the output current of the unit, located within 7.6 m (25 ft) of the generator output terminals.

WARNING

Accidental contact with electrical equipment can cause severe injury and death if the equipment is not properly grounded. Ensure that all equipment is properly grounded.

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Automatic Transfer Switch

Installing an automatic transfer switch is primarily an electrical operation and, therefore, should be handled by a licensed electrician. Instructions and detailed wiring diagrams will accompany the switch.

The transfer switch is designed to be mounted on a wall or other vertical surface free from vibration. The switch should be at the electrical service entrance and yet within 30.48 m (100 ft) with No. 12 AWG (3.31 mm^2) wire from the generator set control cabinet.

Remote/Audible Alarm

An external fault indicator or audible alarm can be wired to the generator set. Make certain external fault indicator or audible alarm is rated for 2 amperes maximum and 12 or 24 VDC depending on the DC voltage of the system. The indicator will become illuminated or the alarm will sound when an overcrank, low lube pressure, high coolant temperature or overspeed condition occurs.

Accessory Wiring

When motor operated louvers are required for a generator set installation, the louver motors must be wired to operate whenever the engine generator set runs, during emergency conditions, normal periodic exercising, or for maintenance.

MTU Onsite Energy suggests the louver motors be wired to a distribution panel on the load side of the automatic transfer switch. The louver motor control circuit is wired to “energized to run” contacts in the generator set control panel.

Voltage Selector Tap Switch (optional)

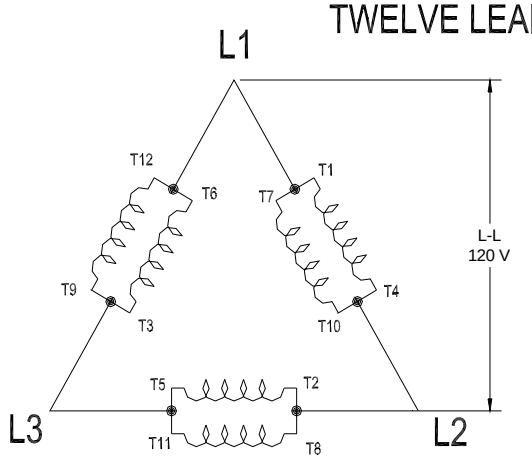
WARNING

Never attempt to change the voltage selector tap switch while the engine is running! This will cause severe arcing and damage to the switch and generator windings. Refer to the electrical drawings for your generator set for more detailed information.

The optional voltage selector tap switch mechanically changes the connection between the generator output leads and the connection lugs or optional cam lock connectors. Voltage range is selected by moving the tap switch to the corresponding position.

TIM-ID: 0000002924 - 024

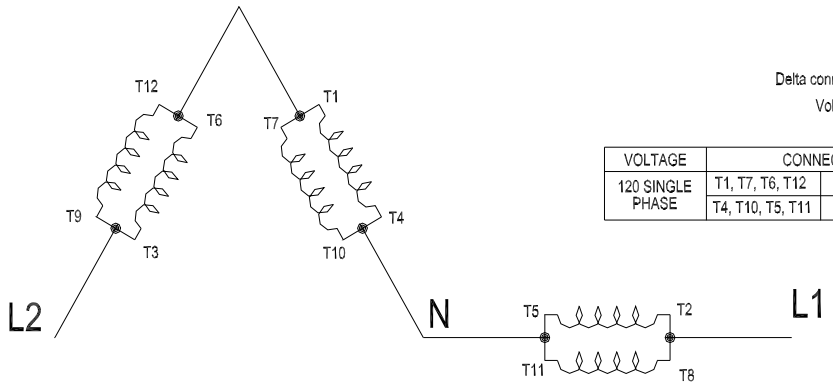
TWELVE LEAD PARALLEL DELTA



Delta connection with 12 lead generators only.
Voltages: 60 Hz 120v TO 139v
50 Hz 100v TO 120v

VOLTAGE	CONNECT		L1	L2	L3
120 DELTA	T1, T7, T6, T12	T2, T8, T4, T10	T1	T2	T3
	T3, T5, T9, T11				

TWELVE LEAD ZIG-ZAG OR OPEN DELTA

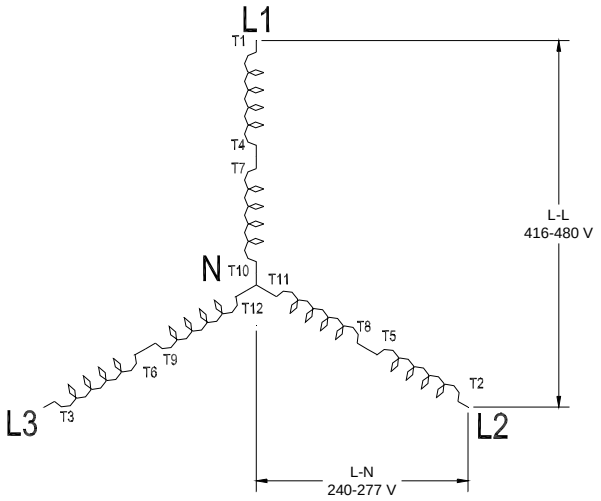


Delta connection with 12 lead generators only.
Voltages: 60 Hz 120/240v single phase
50 Hz 110/220v single phase

VOLTAGE	CONNECT		L1	L2
120 SINGLE PHASE	T1, T7, T6, T12	T3, T9	T2, T8	T3, T9
	T4, T10, T5, T11	T2, T8		

TIM-ID: 0000002924 - 024

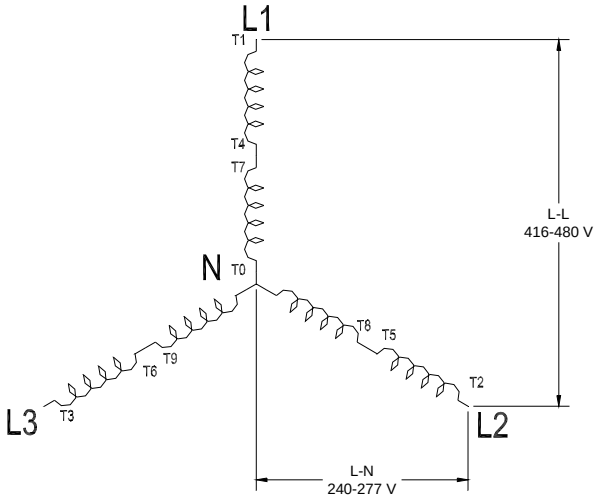
TWELVE LEAD SERIES WYE



Voltages: 60 Hz 240/416v TO 277/480v
50 Hz 220/380v TO 240/416v

VOLTAGE	CONNECT			L1	L2	L3	NEUTRAL
480-416 WYE	T10, T11, T12			T1	T2	T3	T10, T11, T12
	T4, T7	T5, T8	T6, T9				

TEN LEAD SERIES WYE

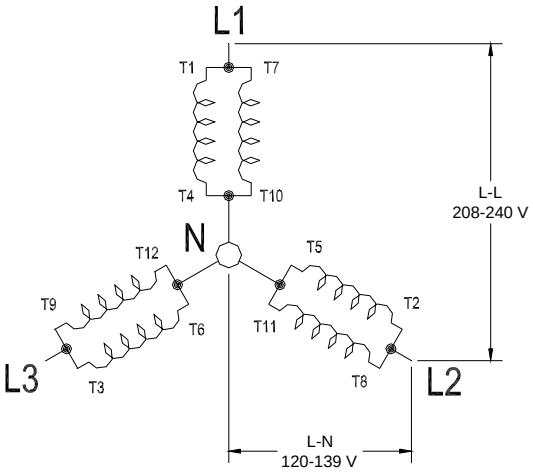


Voltages: 60 Hz 240/416v TO 277/480v
50 Hz 220/380v TO 240/416v

VOLTAGE	CONNECT			L1	L2	L3	NEUTRAL
480-416 WYE				T1	T2	T3	T0
	T4, T7	T5, T8	T6, T9				

TIM-ID: 0000002924 - 024

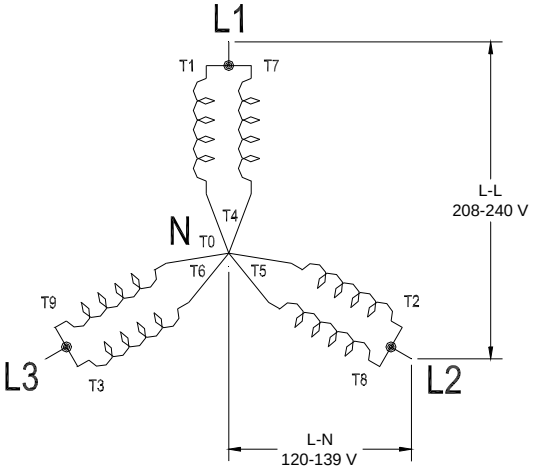
TWELVE LEAD PARALLEL WYE



Voltages: 60 Hz 120/208v TO 139/240v
50 Hz 110/190v TO 120/208v

VOLTAGE	CONNECT			L1	L2	L3	NEUTRAL
240-208 WYE	T10, T11, T12		T4, T5, T6	T1	T2	T3	T10, T11, T12
	T1, T7	T2, T8	T3, T9				T4, T5, T6

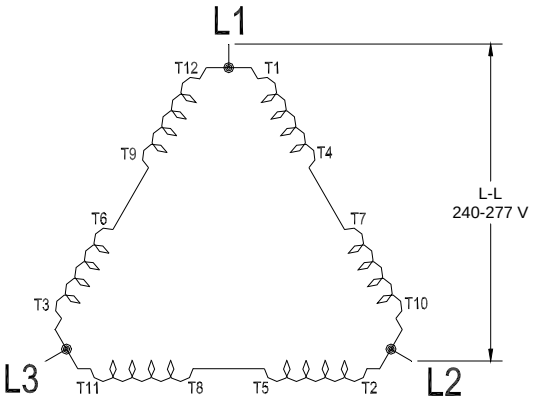
TEN LEAD PARALLEL WYE



Voltages: 60 Hz 120/208v TO 139/240v
50 Hz 110/190v TO 120/208v

VOLTAGE	CONNECT			L1	L2	L3	NEUTRAL
240-208 WYE	T4, T5, T6, T0			T1	T2	T3	T4, T5, T6
	T1, T7	T2, T8	T3, T9				

TWELVE LEAD SERIES DELTA



Voltages: 60 Hz 120/240v TO 138/277v
50 Hz 110/220v TO 120/240v

VOLTAGE	CONNECT			L1	L2	L3
240-277 DELTA	T4, T7	T5, T8	T6, T9	T1	T2	T3
	T1, T12	T2, T10	T3, T11			

TIM-ID: 0000002924 - 024

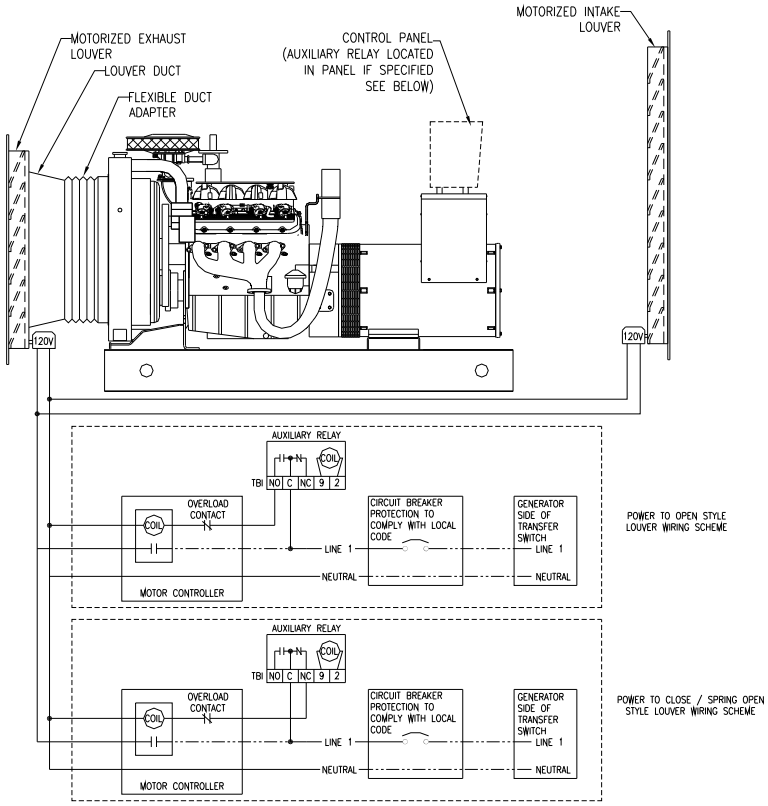


Figure 8-1: Suggested motorized louver wiring

As an alternate-wiring scheme, the louver motor may be wired directly to the generator output leads, prior to the mainline circuit breaker. The installation contractor must add any necessary wiring devices and circuit protection to comply with the local electrical code requirements.

There are many other wiring schemes which may be used to safely wire the louver motors and control circuits to ensure the louvers will open when the engine generator set runs. If there are any questions, consult your generator set supplier.

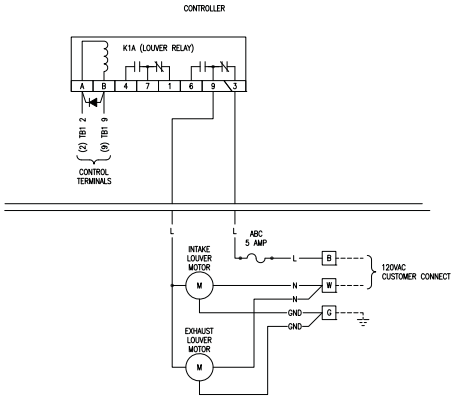


Figure 8-2: Optional motorized louver wiring

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9

Service

Install the generator set in an area that can be quickly reached for repair in case of malfunction. Service entrances should be large enough to permit service of components such as engine, radiator or generator in the event major overhaul or replacement is needed.

The location for items requiring service varies from model to model. All service items should be known and considered when planning the installation. An item requiring routine attention must, of course, be made more accessible.

In general, the following service points should be accessible:

- Air Cleaner
- Primary Fuel Filter
- Secondary Fuel Filter
- Lube Oil Dip Stick
- Oil Filter
- Starting Battery
- Starter
- Battery Charger & Voltage Regulator
- Generator & Control Systems

If your generator set requires service or repairs, simply contact an authorized MTU Onsite Energy dealer for assistance. Service technicians are factory-trained and are capable of handling all of your service needs.

When contacting a MTU Onsite Energy Authorized Dealer, always supply the complete model number and serial number of your unit, which are located on your generator set nameplate.

To locate the MTU Onsite Energy Authorized Dealer nearest you, call 800-325-5450.

NOTE

For standby units, it is important that servicing is performed on a calendar basis. Failure to do this may result in the generator set not starting or operating properly when the unit is most needed. Consult your Operation and Instruction Manual provided with the generator set for servicing information.

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10 Installation Checklist

Prior to initial start-up, refer to the following installation checklist to ensure that the generator set is installed properly.

CHECK	OK	CHECK	OK
1. Adequate clearance on all sides.		19. Exhaust nipple installed on manifold below flexible exhaust connection (condensate trap).	
2. Doors on unit must be in alignment.		20. Exhaust piping sloped away from engine.	
3. Remove engine locks and vibration isolator blocks.		21. Condensate trap or drain installed.	
4. Confirm proper alignment of angular displacement, radial displacement and axial displacement (applicable only to two-bearing generators only).		22. Muffler exhaust flow in right direction.	
5. Adequate incoming air flow.		23. Exhaust line free of excessive elbows and restrictions.	
6. Adequate outgoing air flow.		24. Exhaust line shielded/protected.	
7. Radiator duct flange connected.		25. Battery in cool location.	
8. Antifreeze required/installed.		26. Battery properly charged.	
9. Water heater properly connected and of proper voltage.		27. Battery of proper size and voltage.	
10. Proper size fuel line and connectors.		28. Battery cables correct size.	
11. Fuel lines protected.		29. Battery charger operating.	
12. Fuel pump lift adequate.		30. Generator properly connected.	
13. Flexible fuel connectors.		31. All controller contacts clean.	
14. Fuel return line.		32. Transfer switch operating correctly.	
15. Gas pressure acceptable.		33. Binding posts tight (all connections).	
16. Solenoid shut-off valve installed (gas).		34. Operator has instruction manual.	
17. Proper size exhaust line.		35. Maintenance schedule posted.	
18. Flexible exhaust connection installed.		36. No loose parts, belts, bolts, nuts, etc.	

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11

Start-Up Request Form

To provide an authorized factory start-up at the lowest possible prices, we must request that the following checklist and tasks be completed prior to an MTU Onsite Energy representative's arrival at the installation site to perform the start-up.

Unit Serial Number: _____ Contact Name: _____

Company Name: _____ Title: _____

Please attach a map or directions to the site. Phone Number: (_____)_____

- ☐ Unit set in place on vibration pads with floor anchor/studs to prevent movement.
- ☐ Doors on unit in alignment.
- ☐ Radiator ducted to properly sized air discharge louvers.
- ☐ Unit full of oil and water/anti-freeze mix.
- ☐ Battery filled with acid and fully charged.
- ☐ Battery charger mounted with AC and DC wired, if not supplied mounted by the factory.
- ☐ All AC and DC electrical connections made.
- ☐ Engine heater wired to normal AC power supply.
- ☐ Fuel inlet and return lines run between the unit and fuel storage system, system filled and primed to the engine with proper fuel.
- ☐ Exhaust system in place and supported so that the exhaust manifold does not carry weight of exhaust system.
- ☐ Air inlet louver motor wired to an emergency generator source point to open upon the start of an engine generator set.
- ☐ Generator room cleaned of construction debris including excess nails, bolts, nuts, panel knockouts, etc. It is very important that the radiator fan area is checked for debris, as damage to the equipment and personal injury can occur if loose items come in contact with the fan when the unit is initially started.

Consult your Installation Guide on any questions.

If, upon arrival at the installation site, our representative cannot perform the start-up as a result of defective MTU Onsite Energy equipment, the problems will be resolved and we will reschedule another start-up date at the earliest possible date at no additional charge.

If the start-up cannot be performed due to an incomplete installation or for reasons beyond MTU Onsite Energy's control, you may incur an additional start-up charge at a later date.

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Signature: _____ Date: _____

12

Operating Procedures

CAUTION

Be aware that the generator set could start at any time in the "AUTO" mode. Keep clear of all moving parts and be sure to turn the switch to "OFF" position before servicing and disconnect the negative battery cable after disconnecting the battery charger circuit.

The high engine temperature shutdown system will not operate if the coolant level is too low. The high engine temperature sensor monitors coolant temperature. Loss of coolant will prevent sensor operation and allow the engine to overheat causing severe damage to the engine. Therefore, maintain adequate coolant level for proper operation of the high engine temperature shutdown system.

Low Coolant Level Shutdown: A submerged sensor in the top portion of the radiator shuts down the engine and lights the Hi Engine Temp fault lamp when the coolant level falls below the level of the sensor. Top off coolant frequently.

Prior to starting or testing the generator set, refer to the engine manual for maintenance checkpoints. Items such as oil level, coolant level, belt tension, battery electrolyte level, wire connections, and air filter are some of those that should be checked frequently.

CAUTION

Stop engine before filling fuel tank. Never fill tank when engine is hot.

STARTING PROCEDURE

The following sections cover the three systems used to start the generator set.

Starting at Control Panel (Manual Start)

1. Press the "RUN" button to activate the engine control system and the starting system.
2. The engine will begin cranking, and after a few seconds, will start.

If the engine does not start:

3. MTU Onsite Energy generator sets will automatically attempt two more crank cycles then will produce an overcrank alarm.
4. To clear an overcrank alarm, press the "OFF" button.
5. Wait two minutes for the starter motor to cool and then repeat the starting procedure.
6. If the engine does not run after a second attempt at starting, refer to the **Troubleshooting** section.

Automatic Operations

For automatic operation, the generator set will be controlled by the automatic transfer switch and the automatic engine control.

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For detailed operations of the transfer switch, refer to the Operations Manual supplied with the transfer switch.

For detailed operations of the automatic engine control, refer to the Operations Manual supplied with the generator set.

1. Leave the engine in the "AUTO" position.
2. Leave the generator set circuit breaker in the "ON/CLOSED" position.
3. Automatic starting and stopping is controlled by the transfer switch.
4. If issues for starting or stopping occur, refer to the **Troubleshooting** section.

EMERGENCY STOP PUSH BUTTON

In case of emergency the operator may shut down the generator set by pushing the red E-Stop button. This will stop and disable the generator set. The E-Stop button must be reset to resume generator set operation. Press the "OFF" button on the controller to reset the engine control before restarting the unit.

STOPPING PROCEDURE

Before Stopping

Run the generator set at no load for 3 to 5 minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

To Stop

If the set was started at the set control panel or at a remote control panel, move the RUN/OFF/AUTO switch or remote starting switch to the OFF position. If an automatic transfer switch started the set, the set will automatically stop after the normal power source returns and time delays have been satisfied.

BREAK-IN

Drain and replace the crankcase oil and oil filter(s) after the first 30 to 50 hours of operation on new generator sets. Refer to the **MAINTENANCE** section of the Engine manual for the recommended procedures. It is recommended to achieve the break in during the first 2 months after installation is completed. This will familiarize the operator with the system.

NO-LOAD OPERATION

Periods of no load operation should be held to minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of Load Banks.

EXERCISE PERIOD

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts. Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide reliable engine starting.

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According to the NFPA 99-2005, NFPA 110-2010, and applicable national and local laws, ordinances, and regulations, exercise the generator set with load so the engine reaches normal operating exhaust gas temperatures. Generator sets must be tested 12 times a year, with testing intervals set at a minimum of 20 days and maximum of 40 days. For recommended minimum operating exhaust gas temperatures, refer to the engine manufacturer's documentation.

Testing the emergency power supply systems (EPSS) includes:

- using building load, as long as the load is in excess of 30% of the nameplate rating of the EPSS, or
- operating the engine maintaining a minimum exhaust gas temperature as recommended by the engine manufacturer to prevent "wet stacking" of the exhaust.

The Automatic Transfer switch has an optional exerciser that can be preset to provide regular exercise periods. Typically the exerciser can be set for time of start, length of run, and day of week. Consult the factory for additional guidance as needed.

Low Operating Temperatures

Use a coolant heater if a separate source of power is available. The optional heater will help provide reliable starting under adverse weather conditions.

Be sure the voltage of the separate power source is correct for the heater element rating. The heater should be in use year round. A heater is required on all automatic systems to prevent engine damage due to short warm up cycles.

AUTOMATIC TRANSFER SWITCH

DANGER

HAZARDOUS VOLTAGE will cause severe injury or death. Turn OFF all power before installation, adjustment or removal of transfer switch or any of its components.

Equipment Inspection

Immediately inspect the transfer switch when received to detect any damage, which may have occurred during transit. If damage is found or suspected, file claims as soon as possible with the carrier and notify the nearest MTU Onsite Energy representative. The switch cabinet should be opened at inspection to check for internal freight damage, even if the box and cabinet enclosure appear undamaged.

Final Equipment Inspection

Prior to energizing the transfer switch:

- Remove any debris incurred due to shipment or installation. DO NOT use a blower since debris may become lodged in the electrical and mechanical components and cause damage. Use of a vacuum is recommended.
- Verify that all cabled connections are correct. Verify phase rotation and position of the high leg at both sources on the delta system.
- Check engine start connections and verify the correct connection of all control wires.

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- Check settings of all timers and adjust as necessary. Also adjust any optional accessories as required.
- Check the integrity of power connections by verifying actual lug torque values as specified in the ATS manual.
- Make sure that all covers and barriers are installed and properly fastened.

FUNCTIONAL TEST

Since there are various transfer switch designs available, please refer to the operator manual provided with the transfer switch for specific details.

The functional testing of the transfer switch consists of electrical tests described in this section. Before proceeding, refer to the information package supplied with the transfer switch. Read and understand all instructions and review the operation of all accessories provided.

Before starting the operation test, check the equipment-rating nameplate on the transfer switch to **verify the correct system voltage**.

To begin the test, close the Normal source circuit breaker. The micro-controller will illuminate the Normal Available LED if proper voltage is sensed. Verify the phase-to-phase voltages at the Normal line terminals.

Next, close the Emergency source breaker and start the engine generator. The Emergency Available LED indicator will illuminate when preset voltage and frequency levels are achieved. Check the phase-to-phase voltages at the Emergency line terminals. Also, verify that the phase rotation of the Emergency source is the same as the phase rotation of the Normal source.

After the sources have been verified, shut down the engine generator, and put the starting control in the automatic position. Complete the visual inspection of the transfer switch, and close and lock the cabinet door.

Initiate the electrical transfer test by activating the test switch. **Hold the test switch until transfer to Emergency is accomplished**. After the engine start time delay, the micro-controller will send an engine start signal and sensing will determine when the auxiliary source reaches preset levels. The switch will transfer to the Emergency source after the time delay of the transfer to the Emergency timer.

Deactivating the test switch will start retransfer to the Normal source. The switch will retransfer to the Normal source after the time delay of the retransfer to Normal timer. The engine over-run timer allows the engine generator to run unloaded for a preset cool-down period.

For complete details of timer and voltage sensing operations, please refer to the Automatic Transfer Switch Operation Manual.

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Maintenance and Testing

A preventive maintenance program will ensure high reliability and long life for the transfer switch. The preventive maintenance program for the transfer switch should include the following items.

Inspection and Cleaning

DANGER

HAZARDOUS VOLTAGE. De-energize all sources of power before doing any work on the transfer switch. Note: If approved disconnects are not in place contact your Local Electric Utility or a qualified Electrician before proceeding.

The switch should be inspected for any accumulation of dust, dirt, or moisture, and should be cleaned by vacuuming or wiping with a dry cloth or soft brush. DO NOT use a blower since debris may become lodged in the electrical and mechanical components and cause damage.

Remove the transfer switch barriers and check the condition of the contacts. Any surface deposits must be removed with a clean cloth (DO NOT USE EMERY CLOTH OR A FILE). If the contacts are pitted or worn excessively, they should be replaced. A general inspection of mechanical integrity should be made to include loose, broken or badly worn parts.

Servicing

All worn or inoperative parts must be replaced using recommended replacement parts. Please contact your nearest Distributor for specific replacement part information and ordering procedures.

The operating mechanism of the transfer switch is lubricated. The lubricant applied at the factory provides adequate lubrication for the lifetime of the switch. Should debris contaminate the mechanism, clean and apply additional lubricant. (See Automatic Transfer Switch Manual for proper lubricant type).

Testing

A manual operator handle is provided with the transfer switch for maintenance purposes only. Manual operation of the switch must be checked before it is operated electrically. Both power sources MUST be disconnected before manual operation of the switch. Insert the handle and operate the transfer switch between the Normal and Emergency positions. The transfer switch should operate smoothly without binding. Return the switch to the Normal position, remove the handle, and return it to the holder provided.

After completing the inspection, cleaning and servicing of the transfer switch, reinstall the switch cover, and close and lock the cabinet door. Reclose the circuit breakers feeding the utility and generator sources to the switch.

Initiate the electrical transfer test by activating the test switch. Engine start timer will time out and the micro-controller will send an engine start signal. When the transfer to Emergency time has elapsed, the switch will complete its transfer by closing into the Emergency source.

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Deactivating the test switch will start retransfer to the Normal source. The switch will complete its retransfer to Normal after the time delay of the retransfer to Normal timer. The engine over-run timer allows the engine generator to run unloaded for a preset cool down period.

GOVERNORS

MECHANICAL GOVERNOR ADJUSTMENTS

All MTU Onsite Energy generator sets are tested at full load prior to shipment and the speed settings are adjusted. The typical settings will vary from 60 – 63 Hz at no load and are set to operate at 60 Hz when loaded to the nameplate rating. If the system load does not reach the nameplate rating the speed can be adjusted down to 60 Hz. Care must be taken to ensure that the MTU Onsite Energy generator set operates at no less than 60 Hz when the entire load to be on the unit is applied. See Figures 12-1 and 12-3 to find the typical speed adjust locations.

ELECTRONIC GOVERNOR DIESEL ADJUSTMENTS

Governor Speed Setting (Diesel)

The governed speed set point is increased by clockwise rotation of the Speed adjustment control. Remote speed adjustment can be obtained with an optional Speed Trim Control. See Figure 12-1.

Governor Performance (Diesel)

Once the engine is at operating speed and at no load, the following governor performance adjustments can be made: Rotate the Gain adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment 1/8 of a turn further counterclockwise to ensure stable performance.

Rotate the Stability adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment 1/8 of a turn further counterclockwise to ensure stable performance.

Gain and stability adjustment may require minor changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to optimize the adjustments further. If instability cannot be corrected or further performance improvements are required, contact the nearest distributor or Service Center.

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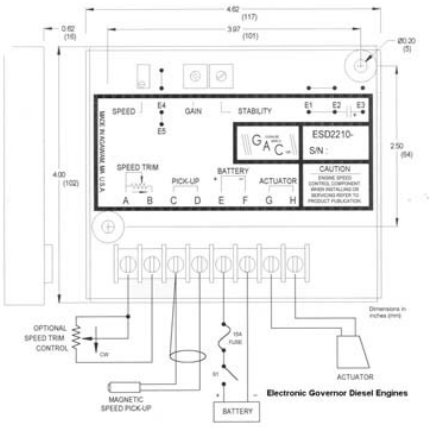


Figure 12-1: Standard GAC Governor Control

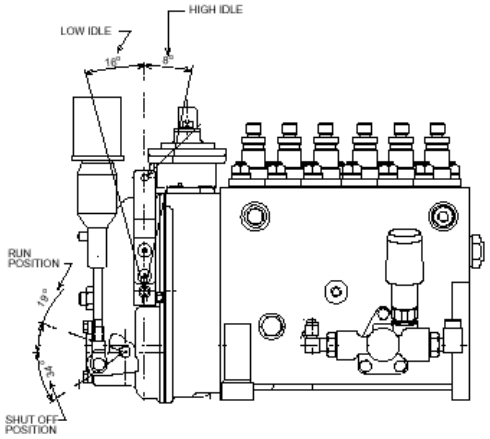


Figure 12-2: Standard Mechanical Governor for Diesel Engines

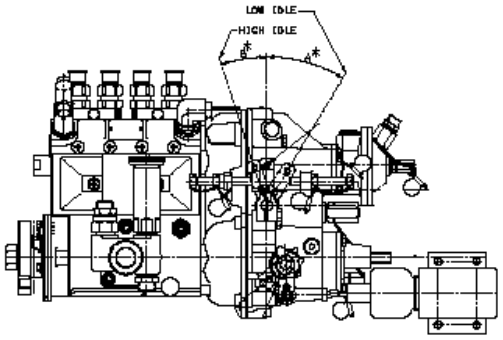


Figure 12-3: Standard Mechanical Governor for Diesel Engines

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GAS ENGINE GOVERNOR SYSTEM

The gaseous engines utilize an electronic governor as standard. The governors are microprocessor controlled and have no operator accessible adjustments. The speed is factory set to operate at 60.1 hertz.

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13

Troubleshooting

The generator set has a number of sensor units that continuously monitor the engine for abnormal conditions such as low oil pressure or high coolant temperature. If an abnormal condition does occur, the engine monitor will activate a fault lamp and may also stop the engine depending on the condition. If the generator set does shut down, the operator may be able to restart the set after making certain adjustments or corrections. This section describes the operation of the fault condition system and suggested troubleshooting procedures for the operator.

Depending on the model of the generator set, set points, pre-alarms and alarms may vary for oil pressure and coolant temperature. **Note:** These are generator control set points and **not** engine control set points.

Please consult your distributor for exact set point, pre-alarm and alarm values for your specific generator set.

Safety Considerations

High voltages are present within the control panel and generator outlet box when the generator is running.

WARNING

Contacting high voltage components can cause serious personal injury or death. Keep control and outlet box covers in place during troubleshooting.

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down make certain the generator set cannot be accidentally restarted. Press the OFF button on the controller and remove the negative battery cable from the starting battery. Also, be sure to turn battery charger disconnect off before servicing battery circuits.

WARNING

Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set before troubleshooting.

When a fault comes on during operation the type of fault will be displayed on the LCD panel. The control panel will also illuminate an indicator light to correspond with the display. The red LED light will indicate fault (shutdown alarm) or the yellow LED pre-alarm (approaching shut down point).

Display Mode Switch

This switch allows the operator to lock the display by moving the switch upward when in the scroll lock mode, the display will not update. By moving the toggle downward the display will show total run time. When the mode switch is in the mid position (normal mode), the display

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will scroll through all parameters. Follow the trouble shooting procedures to locate and correct the problem. For any symptom not listed, contact your Distributor for service. Voltage and amperage may display 3 phases, when operated single phase. The unused positions will display "0".

RESETTING THE CONTROL

Placing the RUN/OFF/AUTO switch in the OFF position and pressing the alarm silence switch can deactivate the external alarm and fault lamp. Locate the problem and make the necessary corrections before restarting the generator set.

MAIN LINE CIRCUIT BREAKER

The generator output mainline circuit breaker is mounted inside the generator outlet box. If the load exceeds the breaker current rating, the breaker will open to prevent the generator from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as required. Manually reset the breaker to reconnect the load to the generator, by pushing the handle down to the open OFF position, then up to the closed ON position.

WARNING

Many troubleshooting procedures present hazards, which can result in severe personal injury or death, as well as severe damage to the unit. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the Safety Precautions chapter and follow all local laws and regulations.

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SYMPTOM As Indicated on Display Screen	CORRECTIVE ACTION
1. PRE HI ENGINE TEMP. Engine continues to operate.	Indicates engine temperature has risen above the normal operating range, and unit may shut down if corrective action is not taken. If generator is powering non-critical and critical loads and cannot be shut down, use the following: • Reduce load, if possible, by turning off non-critical loads. • Check air inlets and outlets and remove any obstructions to airflow. • Open doors or windows in generator area to increase ventilation. If engine can be stopped, follow procedure in Step 2.
2. HI ENGINE TEMP LED. Engine shuts down.	Indicates engine temperature has exceeded allowable limit or coolant level is low (on sets with coolant level sensor). Allow engine to cool down completely before proceeding with the following checks: • Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. • Check for obstructions to cooling airflow and correct as necessary. • Check for a slipping fan belt and tighten if loose. • Reset control and restart after locating and correcting problem.
3. PRE LOW OIL PRESSURE. Engine continues to operate.	Indicates engine oil pressure has dropped below the normal operating range and unit may shut down if corrective action is not taken. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow Step 4 procedure. If engine can be stopped, follow procedures in Step 4.
4. LOW OIL PRESSURE. Engine shuts down. NOTE: Also see Step 5.	Indicates engine oil pressure has dropped below an acceptable level, and the unit has stopped. Check oil level, lines and filters. If oil system is stable, but oil level is low, replenish. Reset control and restart.

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SYMPTOM As Indicated on Display Screen	CORRECTIVE ACTION
5. OVERCRANK. Engine stops cranking. Or Engine runs, shuts down, and LOW OIL PRESSURE.	Indicates possible fuel system problem. • Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. • Check for dirty fuel filter and replace if necessary (See Maintenance section of Engine Manual). • Check for dirty or plugged air filter and replace if necessary (See Maintenance section of Engine Manual). • Refer to Step 4. • Reset the control and restart after correcting the problem. Contact your Dealer or Distributor for service if none of the above.
6. OVERSPEED. Engine runs and then shuts down.	Indicates engine has exceeded normal operating speed. Refer to governor adjust procedure. Contact your Dealer or Distributor for service.
7. UNIT NOT IN AUTO.	Indicates AUTO/OFF/RUN switch is in the OFF position which will prevent automatic starting if an automatic transfer switch is used. Move the AUTO/OFF/RUN switch to the AUTO position for automatic starting.
8. LOW FUEL. Engine continues to run.	Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.
9. LOW FUEL and LOW OIL.	Indicates engine has run out of fuel. Check fuel level and replenish as required. See Engine Manual for fuel system priming procedure.
10. LOW ENGINE TEMPERATURE. Set is in standby mode but not operating.	Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: • Coolant heater not connected to power supply. Check for blown fuse, open circuit breaker or disconnected heater cord and correct as required. • Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required.
11. Engine starts from generator control panel, but will not start automatically or from a remote panel. Note: The AUTO/OFF/RUN switch must be in the AUTO position. Automatic or remote starting.	Indicates possible fault with remote start circuit. Check the following: • Check wire to ATS. • See ATS section for further troubleshooting. • Contact your Dealer or Distributor for assistance.

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SYMPTOM As Indicated on Display Screen	CORRECTIVE ACTION
12. Engine will not crank.	Indicates possible fault with control or starting system. Check for the following conditions: • Fault lamp on. Correct fault and reset control. • Poor battery cable connections. Clean the battery cable terminals and tighten all connections. • Discharged or defective battery. Recharge or replace the battery. • Contact your Dealer or Distributor for assistance if none of the above.
13. No AC output voltage.	Indicates possible fault with voltage regulator. • Verify output with another meter. If OK, check meter. If OK, check meter fuses. • Regulator fuse is blown. Replace fuse. Contact your Dealer or Distributor if voltage build-up causes fuse to blow. • Check rotating rectifier for damaged diodes. Replace all diodes if any are failed.
14. No Engine Start.	Indicates Engine Start wires not terminated properly or Generator in OFF position. • Check Engine Start connections. • Investigate why Engine Control Switch was put in off. • Contact your Dealer or Distributor for assistance.
15. No Engine Stop.	Indicates Timing Cycle not complete, Engine Start wires not terminated correctly or Generator in RUN. • Check Engine Start Timer setting. • Check Engine Start Connections. • Investigate why the Engine Control Switch was put in Manual. • Contact your Dealer or Distributor for assistance.

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SYMPTOM As Indicated on Display Screen	CORRECTIVE ACTION
16. ATS will not transfer to Emergency.	Indicates Emergency voltage or frequency not within acceptable parameters, power supply harness unplugged, limit switch harness unplugged or timing cycle not complete. • Check Engine Start connections, generator output, and engine control switch. • Plug in power supply harness. • Plug in limit switch harness. • Check transfer to emergency timer setting. • Contact your Dealer or Distributor for assistance.
17. ATS will not transfer to Normal.	Indicates Normal voltage or frequency not within acceptable parameters, power supply harness unplugged, limit switch harness unplugged or retransfer to Normal timing cycle not complete. • Check utility and utility breakers. • Plug in power supply harness. • Plug in limit switch harness. • Check retransfer to Normal Timer setting. • Contact your Dealer or Distributor for assistance.

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13 Version History

Indicated below is a summary of the changes that have occurred in the Installation and Basic Operation Manual.

Version	Description of Change
2016-06	Added safety information.
2016-04	Updated **Air Requirements** section to include: **WARNING** Prior to start-up, louver-securing hardware must be removed. For motorized louvers, louver blade assembly must be reattached.
2015-03	Updated **Product Identification Information** section with new nomenclature.
2014-10	Added direction to install overcurrent protection device when needed in **AC Power Output Wiring** section under **Electrical Requirements**.
2014-06	Added metric units to all measurements. Removed Table 6-1 and added Table 7-2 in **Determining Pipe Size for Gaseous Fuel Systems** section.
2014-04	Updated **Starting at Control Panel** section and added **Automatic Operations** section.
2014-02	Corrected table references in **Determining Pipe Size for Gaseous Fuel Systems** section. Previously, Table 6-1 was incorrectly referenced. References were corrected to refer to Table 7-1.
2013-12	Added arc flash safety information to **Hazardous Voltage/External Energy** section.
2013-09	Added tap switch information to **Voltage Selector Tap Switch (Optional)** section.
2013-07	Added statements for proper lifting and mounting to **Lifting Provisions** and **Mounting** sections.
2013-06	Added statements to **Piping** and **AC Power Output Wiring** sections based on UL feedback
2013-01v2	Updated **Exercise Period** section and references to website.
2013-01	Updated to include min./max. testing periods in **Exercise Period** section.
2012-08	Updated graphic by removing reference to Katolight

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14.2 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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14.3 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

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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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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	☐	☐	☐

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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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14.4 Five (5) Year 3000 Hour Comprehensive Extended Standby Limited Warranty_OE-M-GEN-E-002

MTU ONSITE ENERGY CORPORATION
FIVE (5) YEAR / 3,000 HOUR
COMPREHENSIVE EXTENDED
STANDBY LIMITED WARRANTY

MTU Onsite Energy Corporation ("MTU Onsite Energy") issues the following express Limited Warranty subject to the following terms, conditions, and limitations:

An original consumer ("Owner") who purchases an MTU Onsite Energy engine generator set ("Product") is entitled to coverage under this Limited Warranty. MTU Onsite Energy warrants to the Owner that the Product is free of defects in material and workmanship and will perform under normal use and service from valid start-up performed by MTU Onsite Energy. Any nonconformity to the foregoing is defined as a Warrantable Defect. This Limited Warranty applies to Product shipped by MTU Onsite Energy after January 1, 2014.

1. **Limited Warranty Periods**

Limited Warranty Period. The Limited Warranty Period for a Warrantable Defect in the Product is sixty (60) months after the first commissioning of the Product. In all cases, the Limited Warranty period will expire not later than seventy-two (72) months from the date of shipment from MTU Onsite Energy's Mankato, MN facility or after 3,000 operation hours, whichever occurs first.

Accessories Coverage Period. The Accessories Coverage Period for a Warrantable Defect in cords, receptacles, cord reels, gas flex pipes, housing lights, space heaters, and associated equipment ("Accessories") is twelve (12) months from the date of shipment from MTU Onsite Energy's Mankato, MN facility.

MTU Onsite Energy's warranty obligations under this Limited Warranty are contingent upon distributor completing the following:

(a) The MTU Onsite Energy warranty and the *Start-Up Validation and Pre-Inspection Form.* Return both to MTU Onsite Energy within sixty (60) days of the start-up date; and
(b) The engine registration form (when applicable). Return to the manufacturer as stated in the engine registration form instructions.

2. **MTU Onsite Energy Responsibilities**

If a Warrantable Defect is found during the Limited Warranty Period and/or the Accessories Coverage Period, and provided the Owner has complied with its obligations under Section 3, MTU Onsite Energy will, during normal working hours, through MTU Onsite Energy's authorized distributor, dealer, or service outlet, perform some or all of the following:

(a) Repair or replace, at MTU Onsite Energy's sole election, the defective part with a new or remanufactured replacement part;
(b) Provide reasonable or customary labor needed to correct the Warrantable Defect;
(c) Provide technician travel time of 400 miles to and from the closest MTU Onsite Energy authorized distributor, dealer or service outlet to the Product location;
(d) Part removal and re-installation, if necessary and as solely determined by MTU Onsite Energy.

MTU Onsite Energy's obligation to repair or replace defective parts does not include responsibility for reimbursement of incidental or consequential costs. If MTU Onsite Energy repairs or replaces an Accessory, part, or Product under this Limited Warranty, the repaired or replaced Accessory, part, or Product assumes the unexpired portion of the warranty period remaining from the original Accessory, part, or Product. Repair or replacement of an Accessory, part, or Product will not extend the term of the original Limited Warranty Period or Accessories Coverage Period. Parts or Product replaced shall become the property of MTU Onsite Energy.

MTU Onsite Energy's failure to enforce any of the terms or conditions stated herein shall not be construed as a waiver of such provision or of any other terms and conditions of this Limited Warranty.

3. **Owner Responsibilities**

During the Limited Warranty Period and Accessories Coverage Period, the Owner is responsible for, and MTU Onsite Energy will not reimburse for the following:

(a) Battery;
(b) Premium or overtime labor costs;
(c) Labor and material costs for Product removal and reinstallation;
(d) Any special access fees required to gain access to MTU Onsite Energy equipment, without limitation, training or safety policy requirement to gain access;
(e) Transportation costs or travel expenses related to delivery of the Product to the designated distributor, dealer, or service outlet;
(f) Incidental and consequential costs, damages, or administrative expenses of whatever nature;
(g) Non-Product repairs, vehicle damage, "downtime" expenses, cargo damage, fines, lost income, any business costs of any kind, Owner's travel expenses, and other losses resulting from a Warrantable Defect;
(h) Shipping charges for replacement parts/Products in excess of those which are usual and customary; or
(i) Local taxes, if applicable.

In addition, Owner must:

(a) Operate, use, and maintain the Product in accordance with the applicable Owner's manual and/or any other manuals specified by MTU Onsite Energy, including without limitation handling, inspection, servicing, or operating instructions;
(b) Promptly notify MTU Onsite Energy or its authorized representative of a Warrantable Defect and make the Product available for repair;

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(c) Comply with MTU Onsite Energy's or MTU Onsite Energy's authorized representative's reasonable directions regarding the timing, sequence, and location of warranty repairs and make the Product available for inspection;
(d) Perform all required maintenance and maintain and provide proof that all required maintenance has been performed;
(e) Use MTU Onsite Energy specified parts, components, and consumables;
(f) Promptly return to MTU Onsite Energy all parts replaced under this Limited Warranty;
(g) Comply with MTU Onsite Energy's long term storage guidelines, if applicable, and maintain and provide proof of compliance;
(h) Routinely exercise the Product in accordance with operating instructions;
(i) Install the Product in accordance with the installation guide provided; and
(j) Reimburse MTU Onsite Energy for all costs incurred in providing warranty service where, following examination, the request or claim for warranty coverage proves to be unfounded or excluded, as well as all incidental costs including those incurred investigating the claim.

4. **Limitations**

MTU Onsite Energy is not responsible, and this Limited Warranty is not available under any circumstances, for any of the following:

(a) Failure of Owner to fulfill its obligations under Section 3;
(b) Failure of Owner to follow MTU Onsite Energy's instructions for Product stored by Owner longer than 180 days from date of shipment from MTU Onsite Energy's Mankato, MN facility;
(c) Defects caused by adjustments made by Owner to the fuel system or governor system;
(d) Defects which were obvious or capable of being identified by reasonable inspection and were not reported to MTU Onsite Energy within a reasonable time;
(e) Rental equipment used during warranty work;
(f) Defects caused or potentially caused by service work performed by non-MTU Onsite Energy authorized service providers and/or the use of non-genuine MTU Onsite Energy parts;
(g) Defects resulting from natural wear and tear, external action, negligence, natural disasters, accidents, incorrect use, improper handling or storage, inadequate corrosion-proofing, incorrect assembly or installation, or modification of the Product;
(h) Defects resulting from abuse or neglect, including unauthorized modifications to the Product;
(i) Repair or any use or installation which MTU Onsite Energy, in its sole discretion, determines to be improper;
(j) Defects caused by incorrect maintenance;
(k) Defects resulting from Owner's delay in making the Product available after being notified of a potential problem or Owner's failure to take immediate measures to avoid or mitigate damage;
(l) Damage caused by shipping;
(m) Repair of parts sold by MTU Onsite Energy that are warranted directly to the Owner by the respective part's manufacturer;
(n) Misapplication of the Product;
(o) Diesel engine "wet stacking" due to lightly loaded diesel engines;
(p) Acts of nature or acts of God;
(q) Any failure, other than those resulting from a defect in material or factory workmanship of the Product;
(r) Use of the Product for purposes other than those for which it was intended, including without limitation use of the Product under extraordinary operating conditions not made known to MTU Onsite Energy in writing at the time of the order; or
(s) Material provided by or a design specified by the Owner.

5. **Software Warranty.** Where software is included in the Product, MTU Onsite Energy warrants to the Owner that 1) the software will be substantially free from material program errors and material defects in material and workmanship and that 2) it shall function substantially in accordance with MTU Onsite Energy's specification at the time of dispatch from the MTU Onsite Energy manufacturing facility. MTU Onsite Energy does not warrant that the software is error-free or free from "bugs" as commonly categorized by the computer industry. MTU Onsite Energy shall, during the Limited Warranty Period, endeavor to remedy at its cost, in its sole discretion, by repair or replacement of any material program errors or material defects of which Owner has promptly notified MTU Onsite Energy. MTU Onsite Energy, at its option, may elect to provide the most current software at no cost, and in such case MTU Onsite Energy will not cover the cost to install the applicable updated software. MTU Onsite Energy shall have no obligation with respect to any nonconformities resulting from unauthorized modifications to the software or any Owner interfacing.

6. **Emissions Warranty.** The Product may be covered under an emissions warranty specified by the U.S. Environmental Protection Agency and/or the California Air Resources Board. The terms of the warranty, if applicable, may be accessed by following the link: http://www.mtuonsiteenergy.com/technical-info/emissions-warranty/. Any such Emissions Warranty is incorporated herein by reference in its entirety to the extent and with the same force as if fully set forth herein. The Product, if certified, may only be certified to comply with the required country or region specific emission regulations. Where applicable, the Product is only certified to those specific emission regulations/standards which are clearly stated in the respective RRPS/MTU Onsite Energy defined technical specifications. IT IS THE OWNER'S SOLE RESPONSIBILITY TO ENSURE THAT THE EXPORT/IMPORT, INSTALLATION, AND USE OF THE PRODUCT(S) COMPLIES WITH THE APPLICABLE EMISSION REGULATIONS IN THE COUNTRY OR REGION WHERE THE PRODUCT(S) WILL BE USED.

TIM-ID: 0000076810 - 003

MTU ONSITE ENERGY CORPORATION
FIVE (5) YEAR / 3,000 HOUR
COMPREHENSIVE EXTENDED
STANDBY LIMITED WARRANTY

7. **Disclaimers**

LIMITATION OF WARRANTIES: THIS LIMITED WARRANTY IS GIVEN EXPRESSLY AND IN PLACE OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, FREEDOM FROM INFRINGEMENT OR THIRD PARTY INTELLECTUAL PROPERTY RIGHTS, OR ARISING FROM COURSE OF DEALING, COURSE OF PERFORMANCE OR USAGE OF TRADE. THERE ARE NO UNDERSTANDINGS, AGREEMENTS, REPRESENTATIONS, OR WARRANTIES NOT SPECIFIED HEREIN.

THIS LIMITED WARRANTY, THE OBLIGATIONS OF MTU ONSITE ENERGY AND THE RIGHTS AND REMEDIES OF THE OWNER SET FORTH IN THIS LIMITED WARRANTY ARE EXCLUSIVE AND ARE EXPRESSLY IN LIEU OF, AND THE OWNER HEREBY WAIVES AND RELEASES ALL OTHER OBLIGATIONS, WARRANTIES (INCLUDING WARRANTY AGAINST REDHIBITORY DEFECTS), REPRESENTATIONS OR LIABILITIES, EXPRESS OR IMPLIED, ARISING BY LAW IN CONTRACT, TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE, INCLUDING BUT NOT LIMITED TO ANY CLAIMS ARISING OUT OF, CONNECTED WITH OR RESULTING FROM THE PERFORMANCE OF THIS LIMITED WARRANTY OR FROM THE DESIGN, MANUFACTURE, SALE, REPAIR, LEASE OR USE OF THE PRODUCT, ANY COMPONENT THEREOF AND SERVICES DELIVERED OR RENDERED HEREUNDER OR OTHERWISE.

IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT OR WARRANTY, ALLEGED NEGLIGENCE, OR OTHERWISE, SHALL MTU ONSITE ENERGY BE SUBJECT TO LIABILITY FOR INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING WITHOUT LIMITATION, DAMAGE TO THE PRODUCT, OR OTHER PROPERTY, COMMERCIAL LOSSES, LOST PROFITS, LOSS OF USE, INCONVENIENCE, LOSS OF TIME, COST OF CAPITAL, COST OF SUBSTITUTE EQUIPMENT, DOWNTIME, OR CLAIMS OF CUSTOMERS.

MTU ONSITE ENERGY SHALL NOT BE LIABLE FOR ANY CLAIM GREATER IN AMOUNT THAN THE PURCHASE PRICE OF THE PRODUCT.

8. The Owner is entitled to rectify the defect or to have it rectified by third parties only in urgent cases where operational safety is at risk or in order to prevent disproportionately extensive damage; provided that Owner has informed MTU Onsite Energy and obtained MTU Onsite Energy's prior written consent. In such cases, MTU Onsite Energy shall, in its sole discretion, reimburse the costs incurred by the Owner up to an amount equivalent to the costs MTU Onsite Energy would have incurred had it remedied the defect itself.

9. This Limited Warranty gives the Owner specific legal rights, and the Owner may also have other rights, which vary from state to state. Some states do not allow warranty duration limitations and/or certain exclusions or limitation of incidental or consequential damages. Therefore, the previously expressed exclusion(s) may not apply to Owner. If any one or more of the provisions contained in this Limited Warranty shall be invalid, illegal, or unenforceable in any respect, the validity, legality, or enforceability of the remaining provisions contained therein shall not in any way be affected or impaired thereby.

10. This Limited Warranty is governed by the laws of the State of Minnesota without regard to its conflicts of law principles and excluding the United Nations Convention for the International Sale of Goods.

11. In order to obtain performance of an MTU Onsite Energy warranty obligation, the Owner should contact the nearest MTU Onsite Energy authorized distributor, dealer, or service outlet for instructions. To find the location of the nearest MTU Onsite Energy authorized distributor, dealer, or service outlet call 800-325-5450 or write to: MTU Onsite Energy Onsite Energy Corporation Warranty Department, 100 Power Drive, Mankato, MN 56001.

TIM-ID: 0000076810 - 003

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CIRCUIT BREAKER ENCLOSURE - DIESEL
150-200 kW Standby / 135-180 kW Prime Data Sheet

DESCRIPTION

This circuit breaker enclosure data sheet is used in conjunction with dimensional drawings to assist with submittal documentation, specification requirements, and installation. This document summarizes the enclosure dimensions and mounting positions for the MTU 6R0120 DS150, MTU 6R0120 DS180, and MTU 6R0120 DS200 circuit breakers. The dimensional drawings will govern and should be referenced for installation.

430 FRAME ENCLOSURE

- Enclosure supplied with all 430 frame alternator applications.
- Right side primary breaker shown. Left side primary breaker optional.
- Reference Figure 2 and Table 2 for breaker mounting positions.

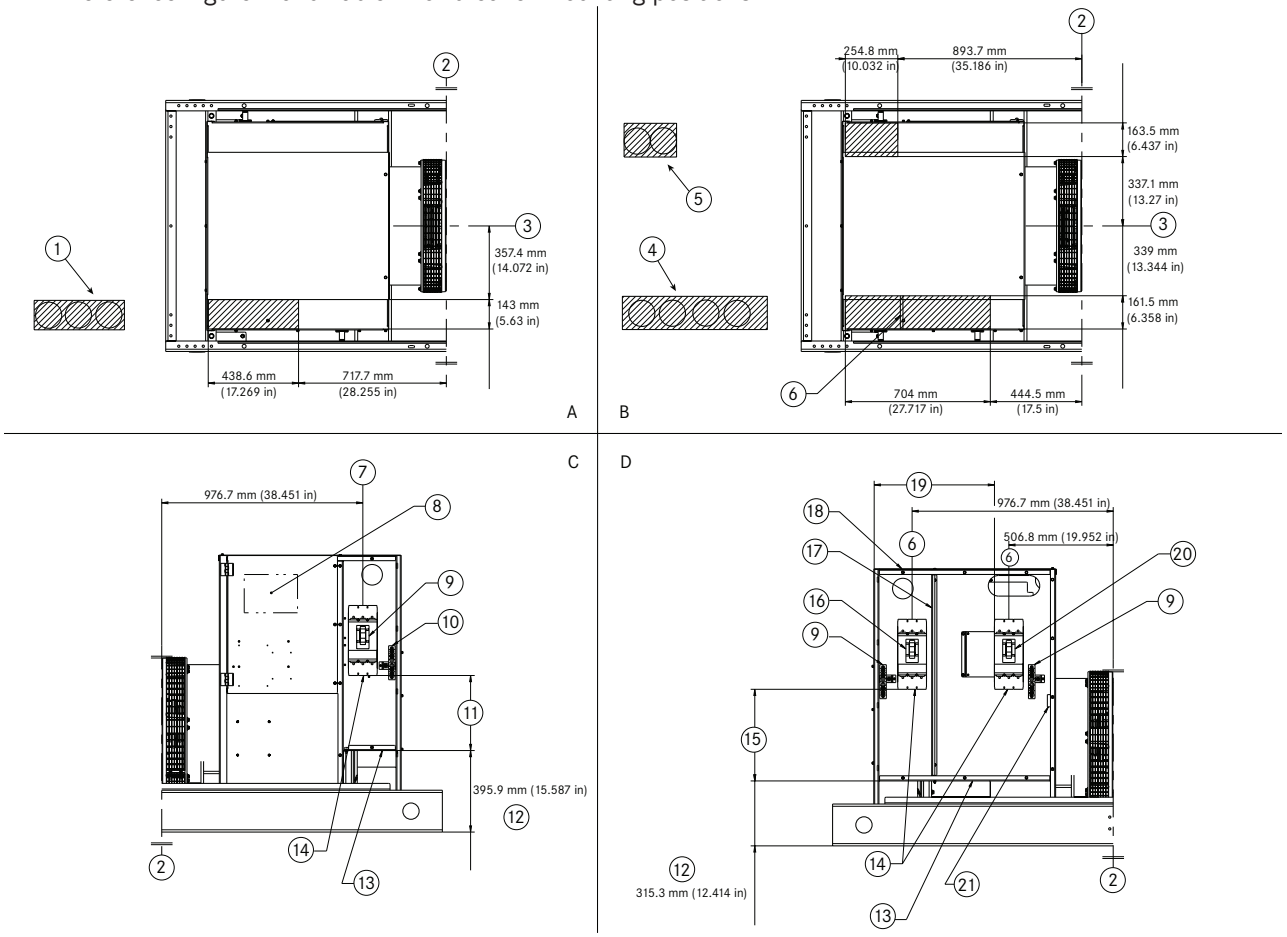


Figure 1: 430 Frame Enclosure

A. Top view, top entry conduit area
B. Top view, bottom entry conduit area
C. Left view, breaker enclosure detail (enclosure door not shown)
D. Right view, breaker enclosure detail (enclosure cover not shown)

1. Three conduit maximum
2. Rear face of flywheel housing
3. Generator centerline
4. Four conduit maximum (primary breaker side)
5. Two conduit maximum (opposite primary breaker)
6. Second breaker divider wall
7. Breaker centerline
8. Optional control panel location
9. Optional second/third breaker
10. Neutral ASM (torque to 275 in/lbs)
11. Dimension B
12. See note 4
13. Bottom entry conduit area
14. Customer connect end (recommended torque on label)
15. Dimension A
16. Optional second breaker
17. Divider wall included with second breaker
18. Top entry conduit area
19. Dimension C
20. Primary breaker
21. Equipment ground terminal (torque to 275 in/lbs)

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CIRCUIT BREAKER ENCLOSURE - DIESEL
150-200 kW Standby / 135-180 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 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

(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)

NOTE: Equipment grounding terminal wire range: 6 AWG - 350 kcmil

Table 1: 430 Frame Enclosure Data

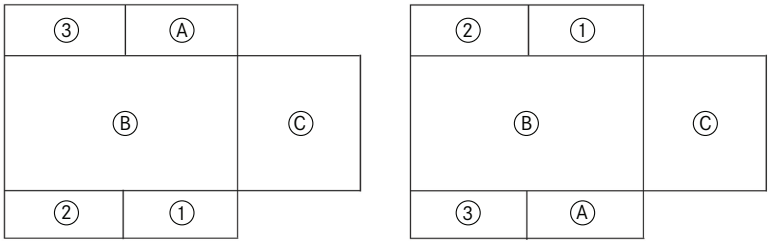


Figure 2: 430 Frame Enclosure Breaker Mounting Positions

A. Controls
B. Outlet box
C. Alternator
1. Position 1 (Primary)
2. Position 2
3. Position 3

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: 430 Frame Breaker Mounting Positions

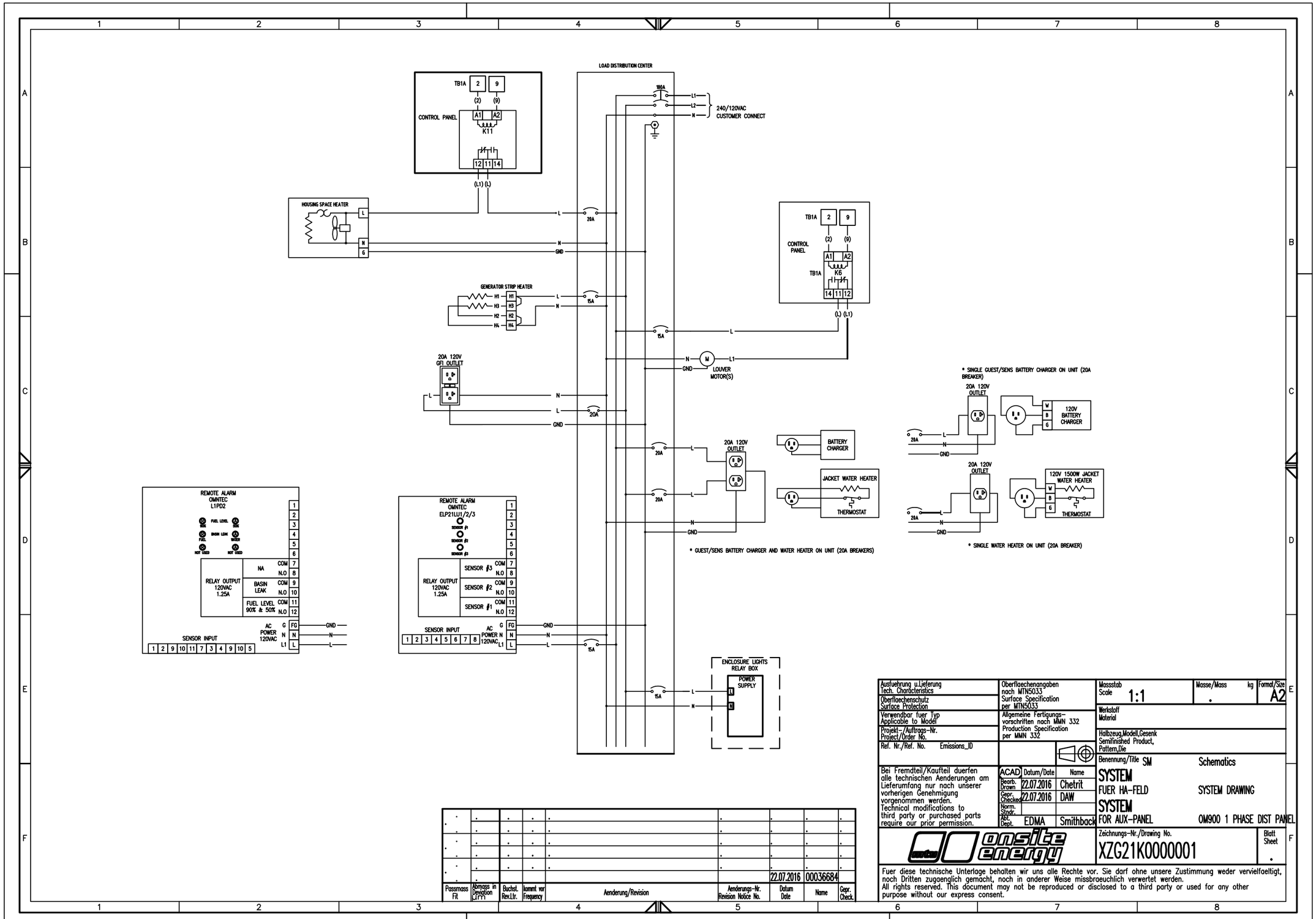
N/A = Not Available

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15 80-200 kW Electrical Drawings

15.1 Mercedes-Benz (OM924/926) 80-200 kW Distribution Panel Options - XZG21K0000001 533
15.2 Mercedes-Benz (OM924/926) 80-200 kW Breaker Diagram - XZG21K0000002 535
15.3 Mercedes-Benz (OM924/926) 80-200 kW Engine Diagram - XZG21K0000003 537
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15.5 Mercedes-Benz (OM924/926) 80-200 kW MGC-1500 Face Panel - XZG21K0000005 543
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15.1 Mercedes-Benz (OM924/926) 80-200 kW Distribution Panel Options - XZG21K0000001



Passmass Fit	Abmass in Deviation	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

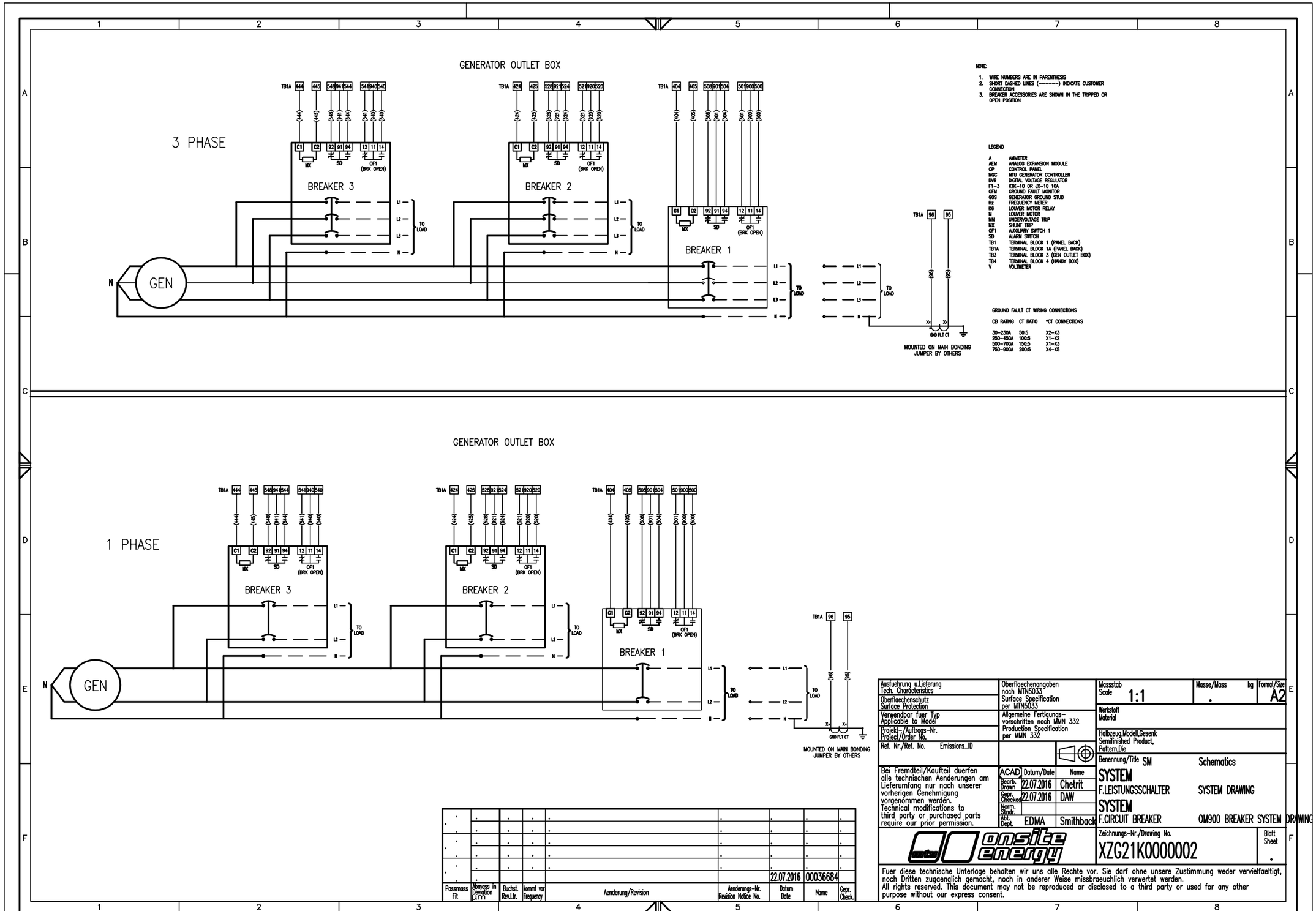
Ausfuehrung u.Lieferung Tech. Charakteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	Format/Size A2
Oberflaechenschutz Surface Protection		Werkstoff Material		
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 332	Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die		
Projekt-/Auftrags-Nr. Project/Order No.		Benennung/Title SM	Schematics	
Ref. Nr./Ref. No. Emissions_ID		SYSTEM FUER HA-FELD	SYSTEM DRAWING	
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.	ACAD Datum/Date Name Bearb. Drawn 22.07.2016 Chetrit Gepr. Checked 22.07.2016 DAW Norm. Stndr. Abt. Dept. EDMA Smithbock	SYSTEM FOR AUX-PANEL	OM900 1 PHASE DIST PANEL	
onsite energy		Zeichnungs-Nr./Drawing No. XZG21K0000001		Blatt Sheet .

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TIM-ID: 0000104099 - 002

TM-ID: 0000104099 - 002

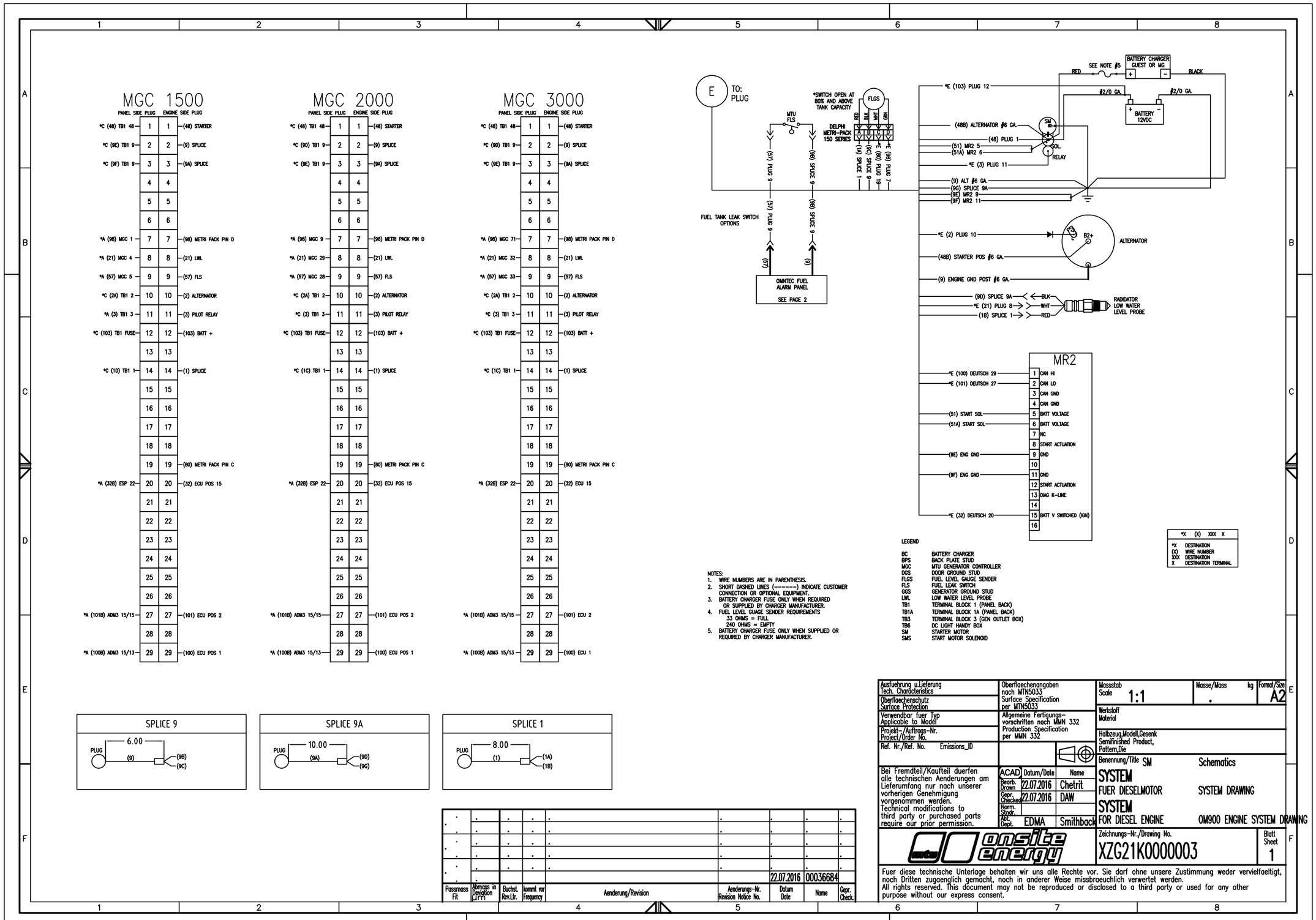
15.2 Mercedes-Benz (OM924/926) 80-200 kW Breaker Diagram - XZG21K0000002



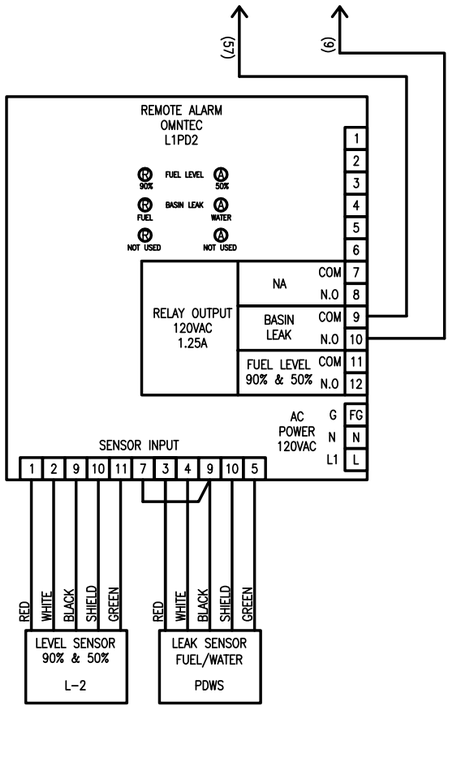
TIM-ID: 0000104100 - 002

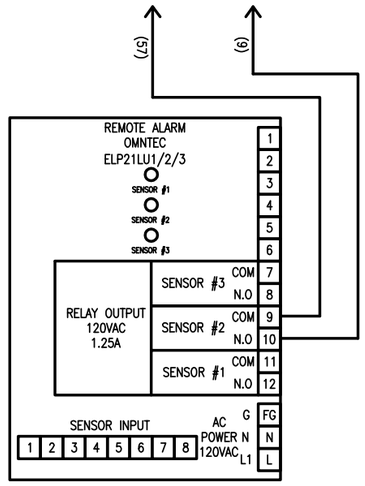
TM-ID: 0000104100 - 002

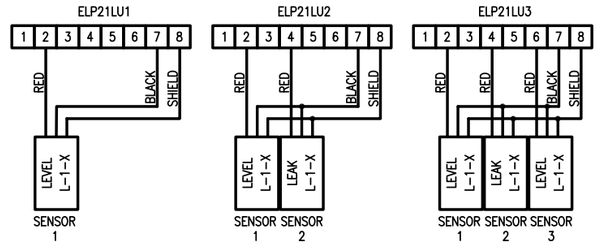
15.3 Mercedes-Benz (OM924/926) 80-200 kW Engine Diagram - XZG21K0000003

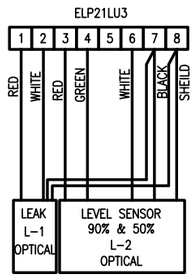


TIM-ID: 0000104101 - 002









Passmass Fit	Abmass in Deviation [mm]	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

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

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ACAD	Datum/Date	Name
Bearb. Drawn	22.07.2016	Chetrit
Gepr. Checked	22.07.2016	DAW
Norm. Stndr.		
Abt. Dept.	EDMA	Smithback

SYSTEM
FUER DIESELMOTOR SYSTEM DRAWING
SYSTEM
FOR DIESEL ENGINE OM900 ENGINE SYSTEM DRAWING

onsite energy

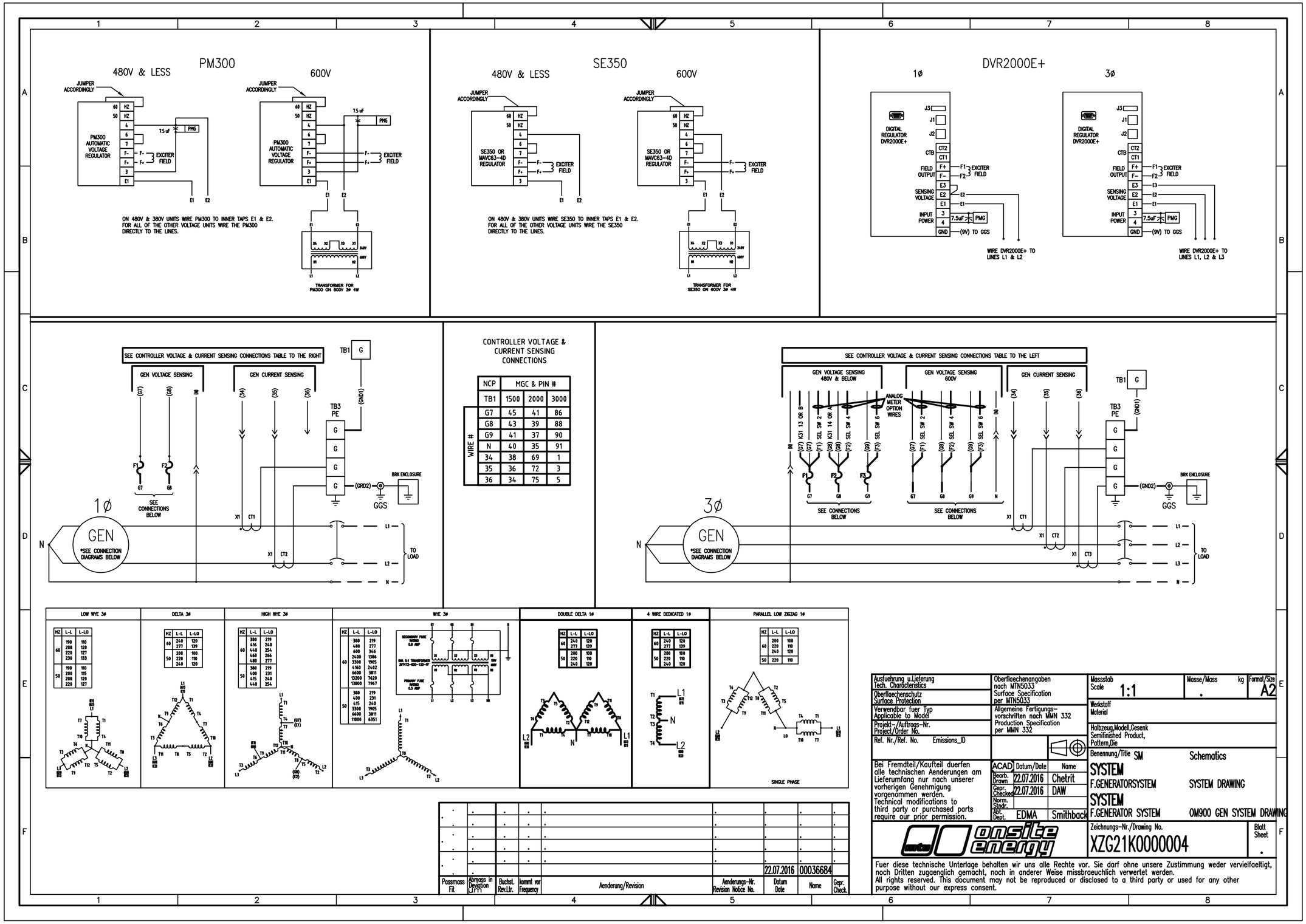
Zeichnungs-Nr./Drawing No. XZG21K0000003 | Blatt Sheet 2

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TIM-ID: 0000104101 - 002

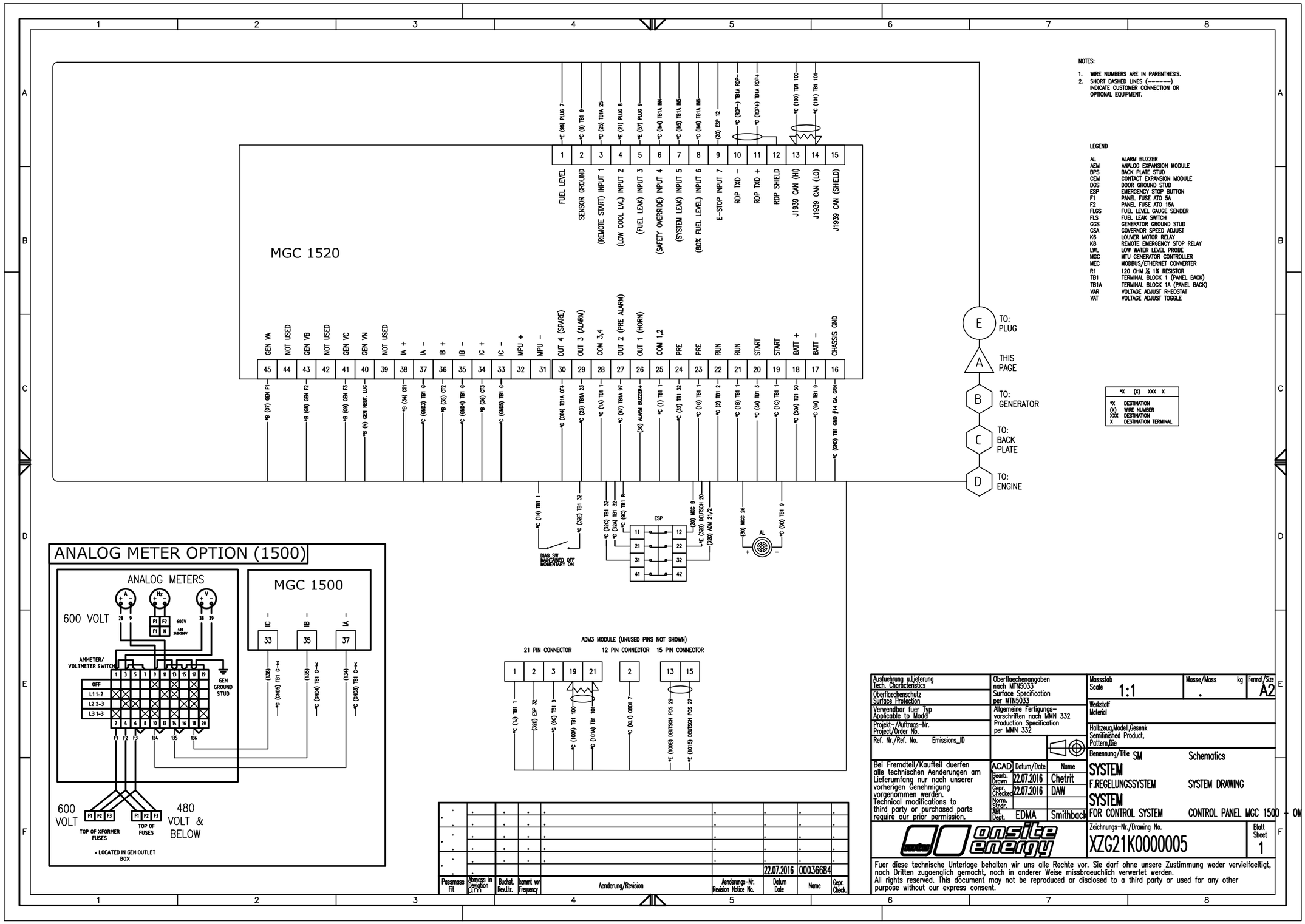
TIM-ID: 0000104101 - 002

15.4 Mercedes-Benz (OM924/926) 80-200 kW Generator Diagram - XZG21K0000004



TM-ID: 0000104102 - 003

15.5 Mercedes-Benz (OM924/926) 80-200 kW MGC-1500 Face Panel - XZG21K0000005



Passmass Fit	Abmass in Deviation	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

Ausfuehrung u.Lieferung Tech. Characteristics
Oberflaechenschutz Surface Protection
Verwendbar fuer Typ Applicable to Model
Projekt-/Auftrags-Nr. Project/Order No.
Ref. Nr./Ref. No. Emissions_ID

Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033
Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 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.

ACAD	Datum/Date	Name
Bearb. Drawn	22.07.2016	Chetrit
Gepr. Checked	22.07.2016	DAW
Norm. Stndr.		
Abt. Dept.	EDMA	Smithback

Massstab Scale 1:1 | Masse/Mass kg . | Format/Size A2

Werkstoff Material

Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die

Benennung/Title SM Schematics
SYSTEM
F.REGELUNGSSYSTEM SYSTEM DRAWING
SYSTEM
FOR CONTROL SYSTEM CONTROL PANEL MGC 1500 - OM

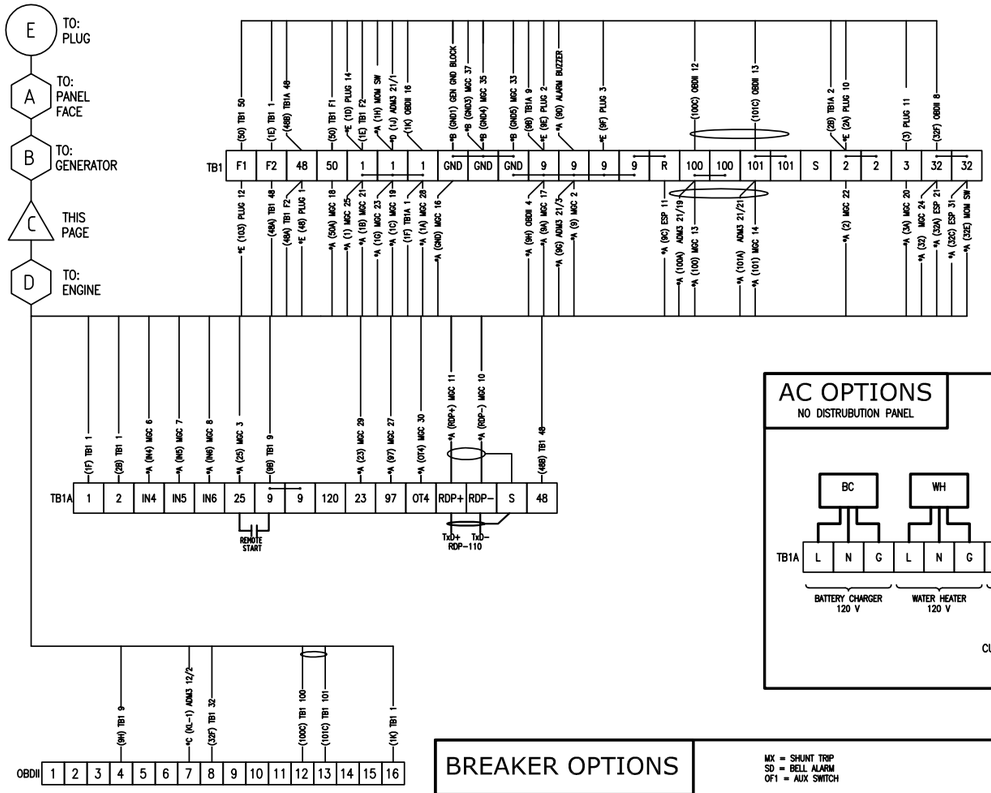
onsite energy

Zeichnungs-Nr./Drawing No. XZG21K0000005 | Blatt Sheet 1

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TIM-ID: 0000104103 - 002

TIM-ID: 0000104103 - 002



NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (--------) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

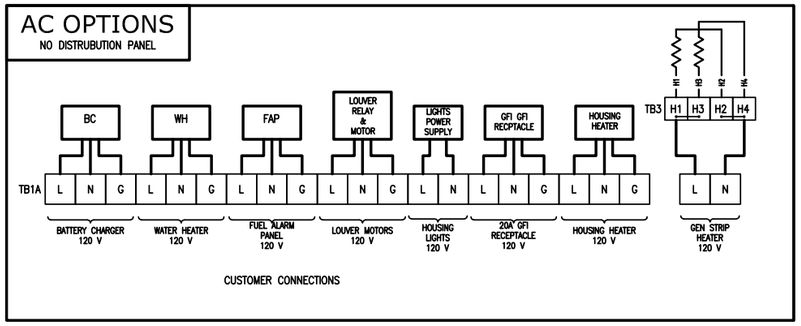
LEGEND:

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
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		

AC OPTIONS

NO DISTRUBUTION PANEL

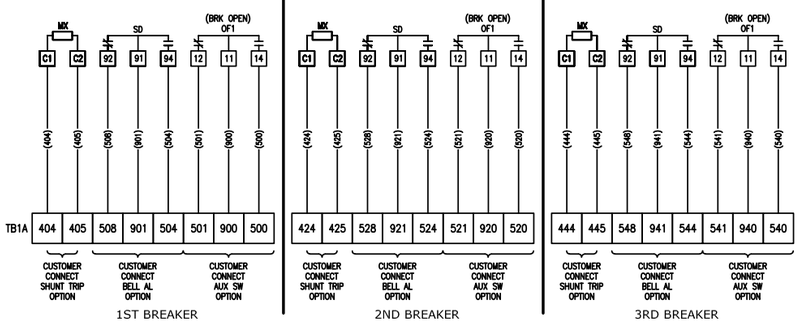


AC CUSTOMER CONNECT

SEE PAGE 3 FOR TERMINAL DESIGNATION

BREAKER OPTIONS

MX = SHUNT TRIP
SD = BELL ALARM
OF1 = AUX SWITCH



Passmass Fit	Abmass in Deviation [1/1]	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	22.07.2016 Datum Date	00036684 Name	Gepr. Check.	

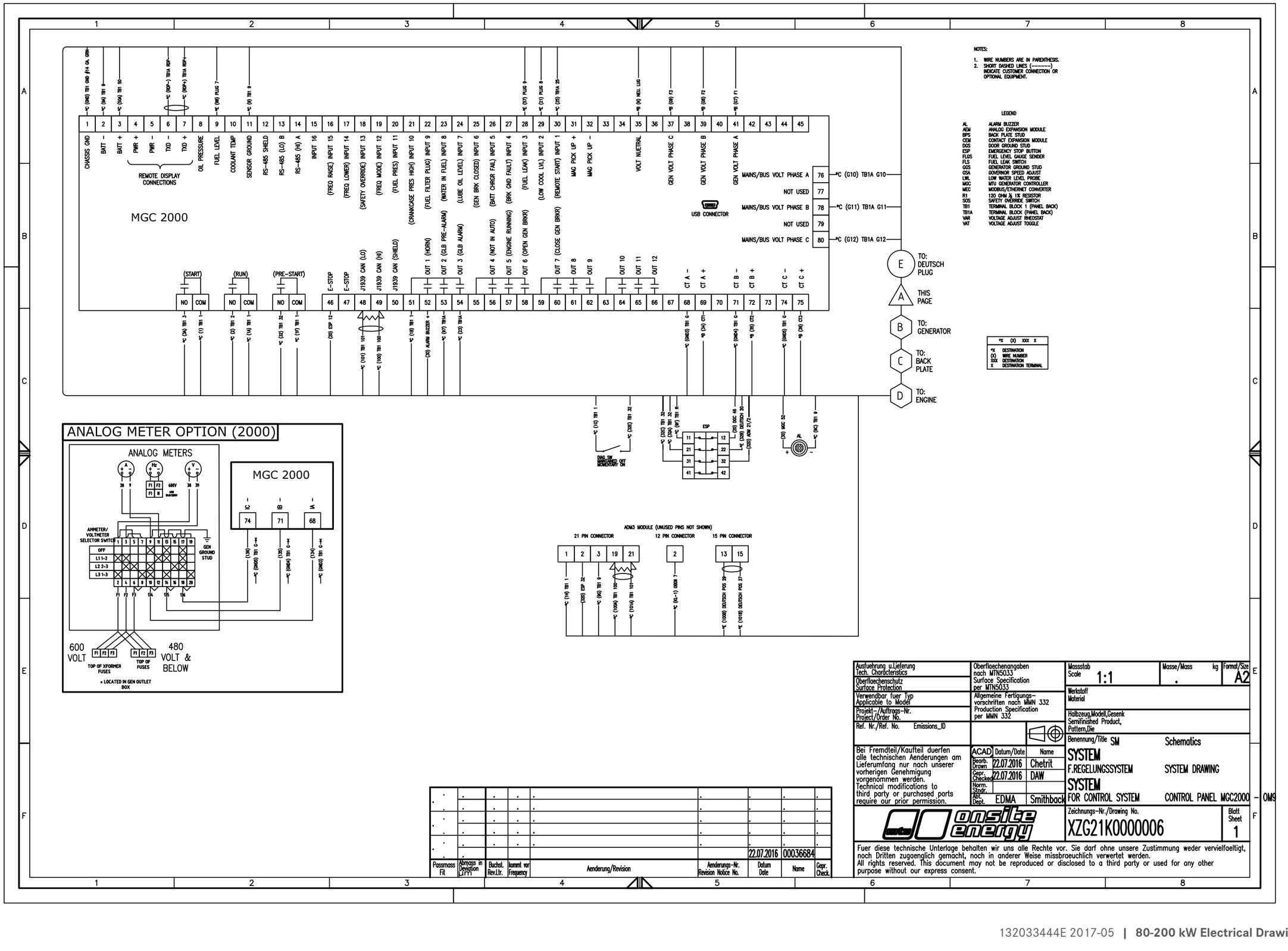
Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	Format/Size A2
Oberflaechenschutz Surface Protection		Werkstoff Material		
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 332	Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die		
Projekt-/Auftrags-Nr. Project/Order No.		Benennung/Title SM Schematics		
Ref. Nr./Ref. No. Emissions_ID		SYSTEM F.REGELUNGSSYSTEM SYSTEM DRAWING		
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.	ACAD Datum/Date Name Bearb. Drawn 22.07.2016 Chetrit Gepr. Checked 22.07.2016 DAW Norm. Stndr. Abt. Dept. EDMA Smithback	SYSTEM FOR CONTROL SYSTEM CONTROL PANEL MGC 1500 - OM		
onsite energy		Zeichnungs-Nr./Drawing No. XZG21K0000005		Blatt Sheet 2

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TIM-ID: 0000104103 - 002

15.6 Mercedes-Benz (OM924/926) 80-200 kW MGC-2000 Face Panel - XZG21K0000006



TIM-ID: 0000104104 - 002

TIM-ID: 0000104104 - 002

E TO: DEUTSCH PLUG

A TO: PANEL FACE

B TO: GENERATOR

C THIS PAGE

D TO: ENGINE

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
DGS	DOOR GROUND STUD
F1	FUSE 5 AMP
F2	FUSE 15 AMP
K1	ENGINE RUN RELAY
K10	SPARE RELAY
K2	ENGINE FAIL RELAY
K3	MINOR ALARM RELAY
K6	LOUVER MOTOR RELAY
K8	REMOTE ESP RELAY
MEC	MODBUS/ETHERNET CONVERTER
MGC	MTU GENERATOR CONTROLLER
SOS	SAFETY OVERRIDE SWITCH
TB1	TERMINAL BLOCK 1
TB1A	TERMINAL BLOCK 1A

*X (X) XXX X	
*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL

TB1: F1 | F2 | 48 | 50 | 1 | 1 | 1 | GND | GND | GND | 9 | 9 | 9 | 9 | R | 100 | 100 | 101 | 101 | S | 2 | 2 | 3 | 32 | 32

TB1A: 1 | 2 | 25 | 9 | 9 | 120 | 23 | 97 | RDP+ | RDP− | S | 48

OBDII: 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16

AC OPTIONS

NO DISTRUBUTION PANEL

TB1A: L N G | L N G | L N G | L N G | L N | L N G | L N G | L N G | L N

BC — BATTERY CHARGER 120 V

WH — WATER HEATER 120 V

FAP — FUEL ALARM PANEL 120 V

LOUVER RELAY & MOTOR — LOUVER MOTORS 120 V

LIGHTS POWER SUPPLY — HOUSING LIGHTS 120 V

GFI GFI RECPTACLE — 20A GFI RECEPTACLE 120 V

HOUSING HEATER — HOUSING HEATER 120 V

TB3: H1 H3 H2 H4 — GEN STRIP HEATER 120 V

CUSTOMER CONNECTIONS

*A (G10) MGC 76 — G10

*A (G11) MGC 78 — G11

*A (G12) MGC 80 — G12

AC CUSTOMER CONNECT

SEE PAGE 3 FOR TERMINAL DESIGNATION

BREAKER OPTIONS

MX = SHUNT TRIP
SD = BELL ALARM
OF1 = AUX SWITCH

1ST BREAKER: MX C1 C2 | SD 92 91 94 | (BRK OPEN) OF1 12 11 14 — TB1A 404 405 508 901 504 501 900 500

2ND BREAKER: MX C1 C2 | SD 92 91 94 | (BRK OPEN) OF1 12 11 14 — TB1A 424 425 528 921 524 521 920 520

3RD BREAKER: MX C1 C2 | SD 92 91 94 | (BRK OPEN) OF1 12 11 14 — TB1A 444 445 548 941 544 541 940 540

CUSTOMER CONNECT SHUNT TRIP OPTION

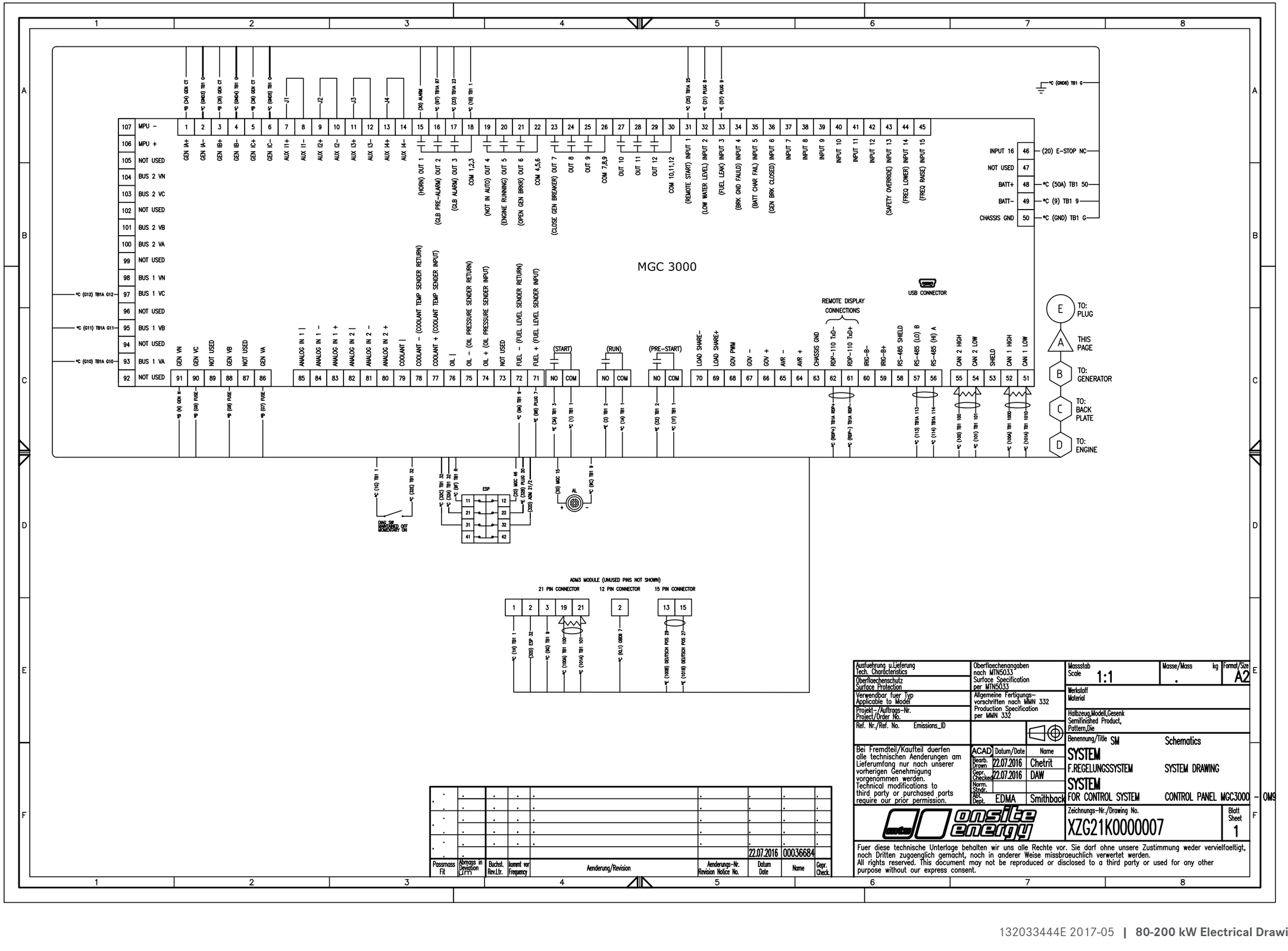
CUSTOMER CONNECT BELL AL OPTION

CUSTOMER CONNECT AUX SW OPTION

| | | |

TIM-ID: 0000104104 - 002

15.7 Mercedes-Benz (OM924/926) 80-200 kW MGC-3000 Face Panel - XZG21K0000007



Passmass Fit	Abmass in Deviation [mm]	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

Ausfuehrung u.Lieferung Tech. Characteristics
Oberflaechenschutz Surface Protection
Verwendbar fuer Typ Applicable to Model
Projekt–/Auftrags–Nr. Project/Order No.
Ref. Nr./Ref. No. Emissions_ID

Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033
Allgemeine Fertigungs–vorschriften nach MMN 332 Production Specification per MMN 332

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Bearb. Drawn	22.07.2016	Chetrit
Gepr. Checked	22.07.2016	DAW
Norm. Stndr.		
Abt. Dept.	EDMA	Smithback

Massstab Scale 1:1 | Masse/Mass kg . | Format/Size A2

Werkstoff Material

Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die

Benennung/Title SM Schematics

SYSTEM F.REGELUNGSSYSTEM SYSTEM DRAWING

SYSTEM FOR CONTROL SYSTEM CONTROL PANEL MGC3000 – OM9

Zeichnungs–Nr./Drawing No. XZG21K0000007

Blatt Sheet 1

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TIM-ID: 0000104105 - 002

TIM-ID: 0000104105 - 002

E TO: DEUTSCH PLUG

A TO: PANEL FACE

B TO: GENERATOR

C THIS PAGE

D TO: ENGINE

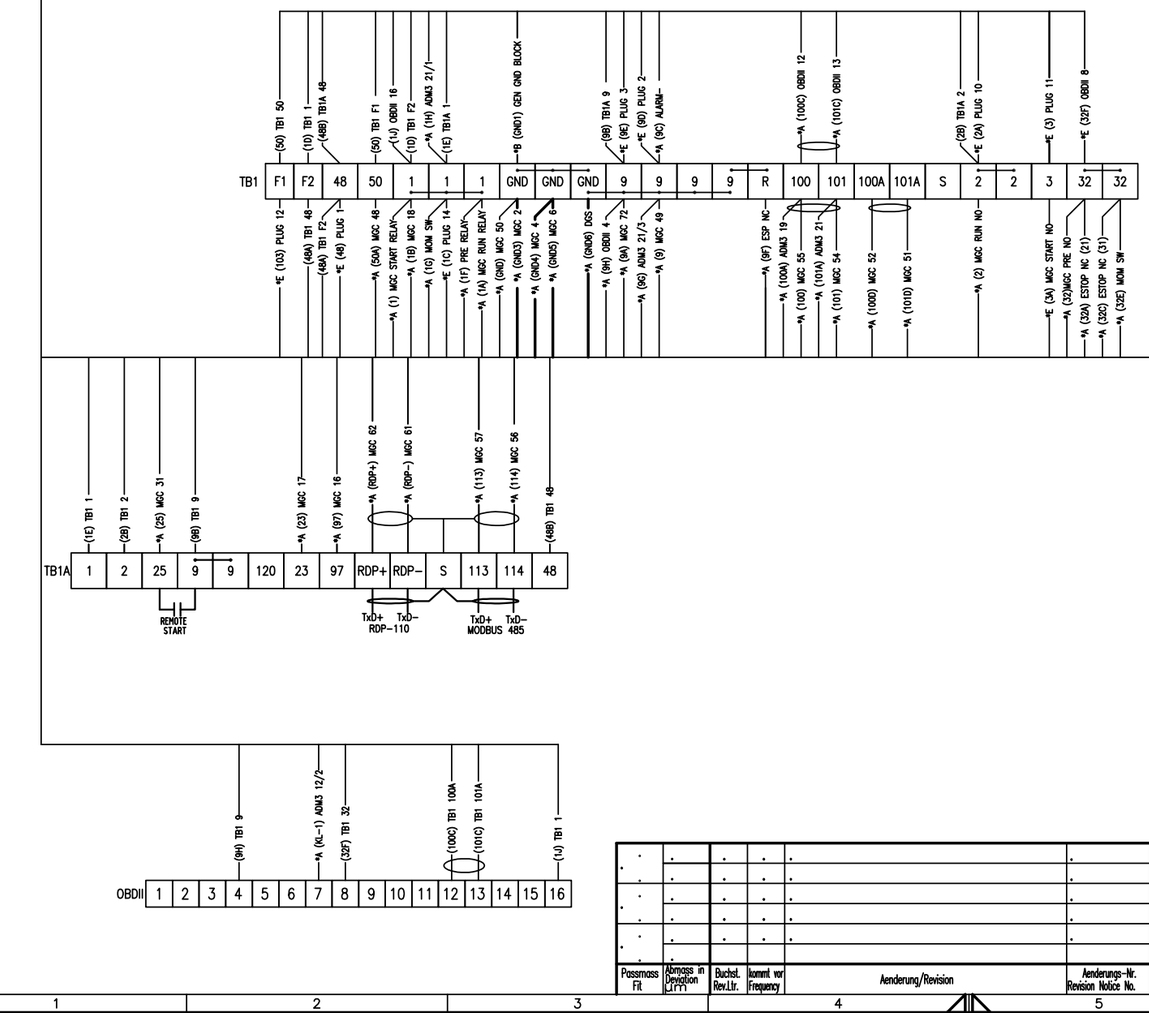
NOTES:

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
DGS	DOOR GROUND STUD
F1	FUSE 5 AMP
F2	FUSE 15 AMP
K1	ENGINE RUN RELAY
K10	SPARE RELAY
K2	ENGINE FAIL RELAY
K3	MINOR ALARM RELAY
K6	LOUVER MOTOR RELAY
K8	REMOTE ESP RELAY
MEC	MODBUS/ETHERNET CONVERTER
MGC	MTU GENERATOR CONTROLLER
SOS	SAFETY OVERRIDE SWITCH
TB1	TERMINAL BLOCK 1
TB1A	TERMINAL BLOCK 1A

*X (X) XXX X	
*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL



						22.07.2016	00036684	
Passmass Fit	Abmass in Deviation (JIT)	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.

Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	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 SM SYSTEM F.REGELUNGSSYSTEM FOR CONTROL SYSTEM	Schematics SYSTEM DRAWING CONTROL PANEL MGC3000	
Ref. Nr./Ref. No. Emissions_ID				

	ACAD	Datum/Date	Name
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	Gepr. Checked	22.07.2016	DAW
	Norm. Stndr.		
	Abt. Dept.	EDMA	Smithback

onsite energy

Zeichnungs-Nr./Drawing No. XZG21K0000007

Blatt Sheet 2

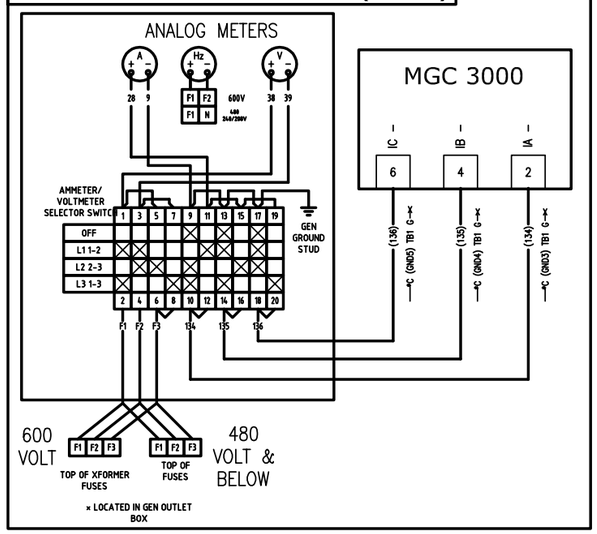
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TIM-ID: 0000104105 - 002

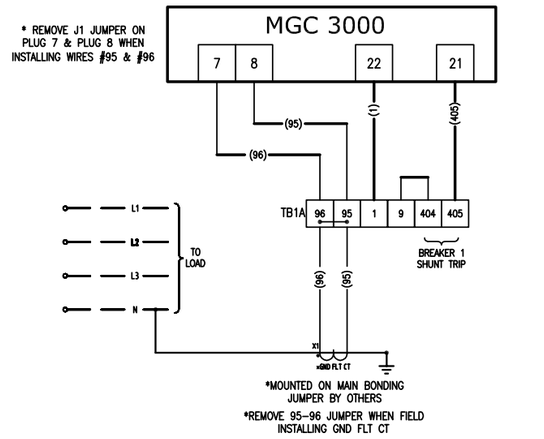
OM9

TIM-ID: 0000104105 - 002

ANALOG METER OPTION (3000)



GROUND FAULT OPTION (3000)



NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (- - - - - -) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

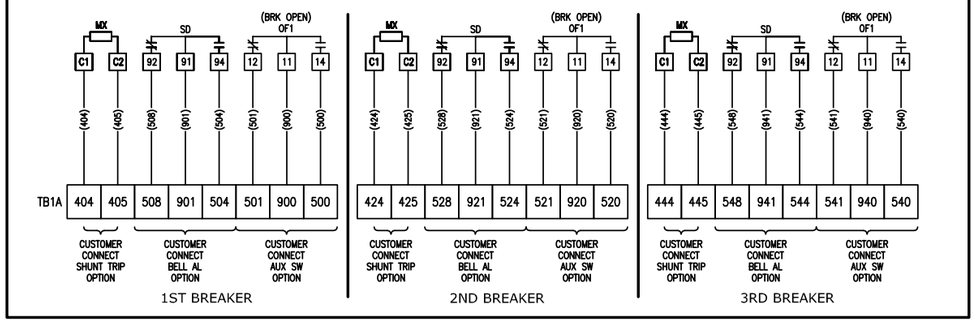
LEGEND:

AEM	ANALOG EXPANSION MODULE
BPS	BACK PLATE STUD
CEM	CONTACT EXPANSION MODULE
DGS	DOOR GROUND STUD
F1	FUSE 5 AMP
F2	FUSE 15 AMP
K1	ENGINE RUN RELAY
K10	SPARE RELAY
K2	ENGINE FAIL RELAY
K3	MINOR ALARM RELAY
K6	LOUVER MOTOR RELAY
K8	REMOTE ESP RELAY
MEC	MODBUS/ETHERNET CONVERTER
MGC	MTU GENERATOR CONTROLLER
R2	RESISTOR 12K OHM 1/4 W
SOS	SAFETY OVERRIDE SWITCH
TB1	TERMINAL BLOCK 1
TB1A	TERMINAL BLOCK 1A

*X	(X)	XXX	X
*X	DESTINATION		
(X)	WIRE NUMBER		
XXX	DESTINATION		
X	DESTINATION TERMINAL		

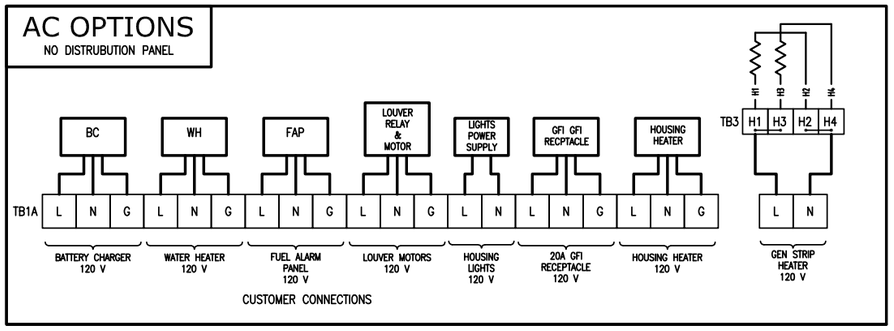
BREAKER OPTIONS

MX = SHUNT TRIP
SD = BELL ALARM
OF1 = AUX SWITCH



AC OPTIONS

NO DISTRUBUTION PANEL



						22.07.2016	00036684	
Passmass Fit	Abmass in Deviation	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.

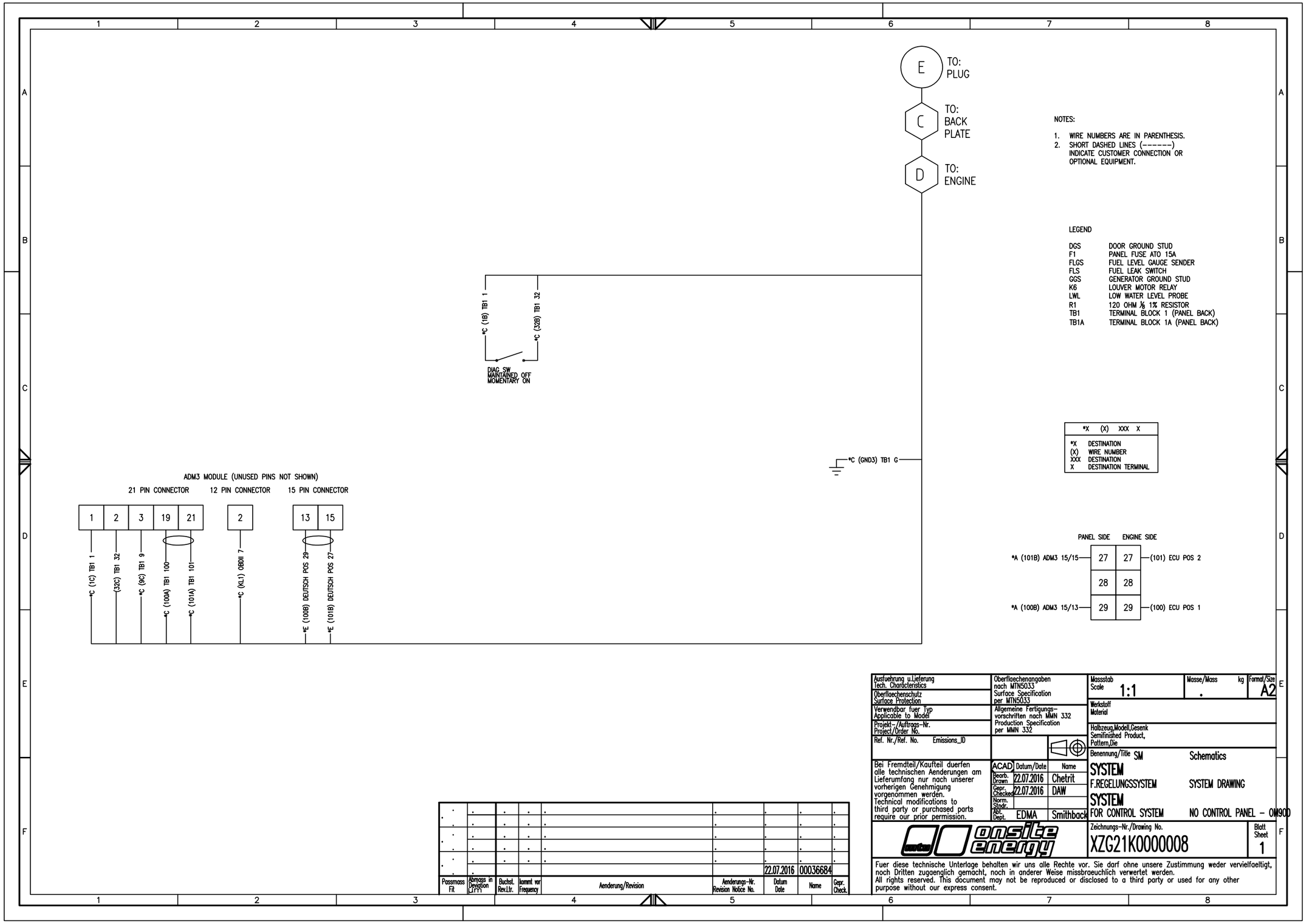
Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	Format/Size A2
Oberflaechenschutz Surface Protection		Werkstoff Material		
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs-vorschriften nach MNN 332 Production Specification per MNN 332			
Projekt-/Auftrags-Nr. Project/Order No.		Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die		
Ref. Nr./Ref. No. Emissions_ID		Benennung/Title SM	Schematics	
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.	ACAD Datum/Date Name Bearb. Drawn 22.07.2016 Chetrit Gepr. Checked 22.07.2016 DAW Norm. Stndr. Abt. Dept. EDMA Smithback	SYSTEM F.REGELUNGSSYSTEM SYSTEM FOR CONTROL SYSTEM	SYSTEM DRAWING CONTROL PANEL MGC3000 – 0M9	
onsite energy		Zeichnungs-Nr./Drawing No. XZG21K0000007		Blatt Sheet 3

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TIM-ID: 0000104105 - 002

TIM-ID: 0000104105 - 002

15.8 Mercedes-Benz (OM924/926) 80-200 kW No Control Panel - XZG21K0000008



							22.07.2016	00036684	
Passmass Fit	Abmass in Deviation LIT11	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.	

Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	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 SM	Schematics	
Ref. Nr./Ref. No. Emissions_ID		SYSTEM F.REGELUNGSSYSTEM	SYSTEM DRAWING	
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.	ACAD / Bearb. Drawn: Datum/Date 22.07.2016, Name Chetrit; Gepr. Checked: 22.07.2016, DAW; Norm. Stndr.; Abt. Dept. EDMA, Smithback	SYSTEM FOR CONTROL SYSTEM	NO CONTROL PANEL – OM900	
		Zeichnungs-Nr./Drawing No. XZG21K0000008		Blatt Sheet 1

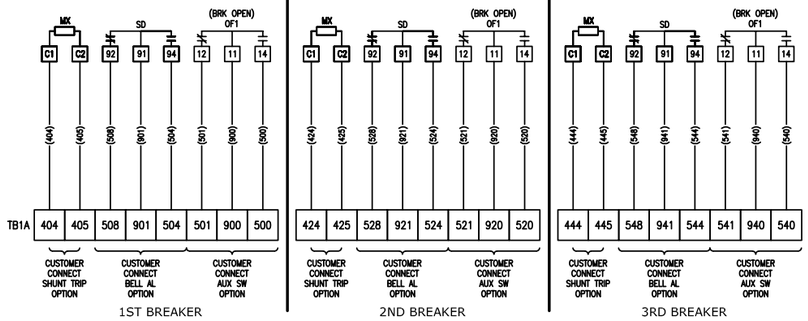
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TIM-ID: 0000109209 - 001

TIM-ID: 0000109209 - 001

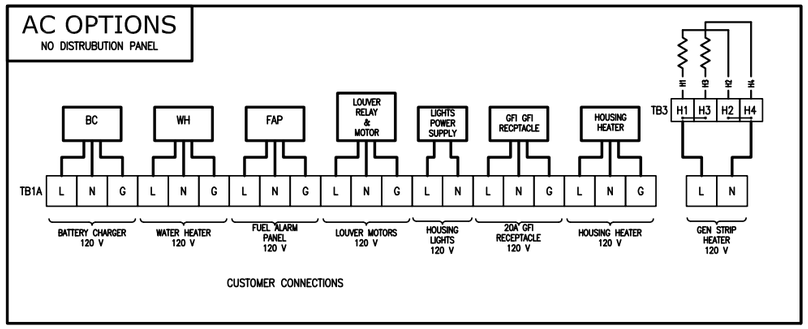
BREAKER OPTIONS

MX = SHUNT TRIP
SD = BELL ALARM
OF1 = AUX SWITCH



AC OPTIONS

NO DISTRUBUTION PANEL

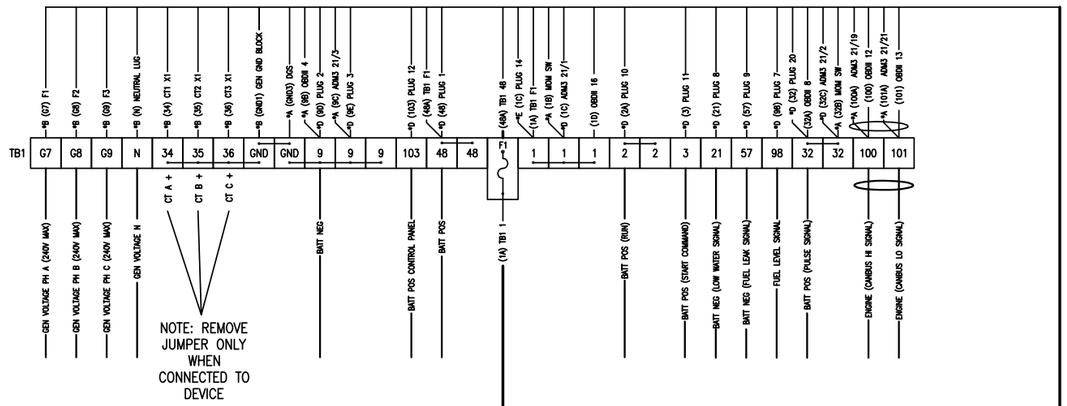


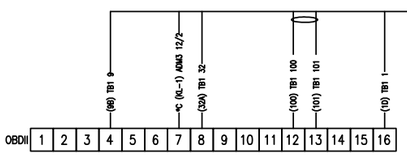
NOTES:

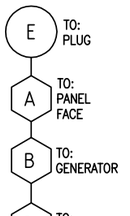
1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (------) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

LEGEND:

F1 PANEL FUSE ATO 15A
K6 LOUVER MOTOR RELAY
TB1 TERMINAL BLOCK 1 (PANEL BACK)
TB1A TERMINAL BLOCK 1 (PANEL BACK)







PANEL SIDE		ENGINE SIDE
*C (48) TB1 48	1	(48) STARTER
*C (90) TB1 9	2	(9) SPLICE
*C (9E) TB1 9	3	(9A) SPLICE
*A (98) TB1 98	7	(98) METRI PACK PIN D
*A (21) TB1 21	8	(21) LWL
*A (57) TB1 57	9	(57) FLS
*C (2A) TB1 2	10	(2) ALTERNATOR
*C (3) TB1 3	11	(3) PILOT RELAY
*C (103) TB1 103	12	(103) BATT +
*C (1C) TB1 1	14	(1) SPLICE

*X (X) XXX X	
*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL

Passmass Fit	Abmass in Deviation [mm]	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

Ausfuehrung u.Lieferung Tech. Characteristics
Oberflaechenschutz Surface Protection
Verwendbar fuer Typ Applicable to Model
Projekt-/Auftrags-Nr. Project/Order No.
Ref. Nr./Ref. No. Emissions_ID

Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033
Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 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.

ACAD	Datum/Date	Name
Bearb. Drawn	22.07.2016	Chetrit
Gepr. Checked	22.07.2016	DAW
Norm. Stndr.		
Abt. Dept.	EDMA	Smithback

Massstab Scale 1:1 | Masse/Mass kg . | Format/Size A2

Werkstoff Material

Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die

Benennung/Title SM Schematics

SYSTEM F.REGELUNGSSYSTEM SYSTEM DRAWING

SYSTEM FOR CONTROL SYSTEM NO CONTROL PANEL – OM900

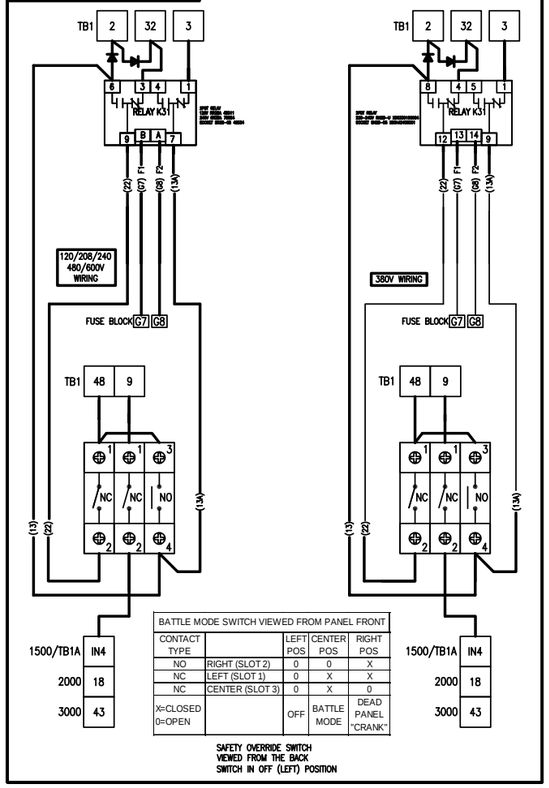
Zeichnungs-Nr./Drawing No. XZG21K0000008 | Blatt Sheet 2

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TM-ID: 0000109209 - 001

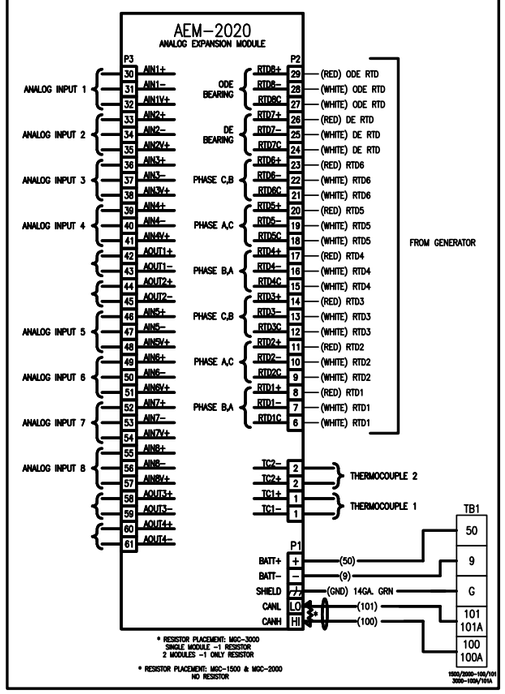
SAFETY OVERRIDE SWITCH



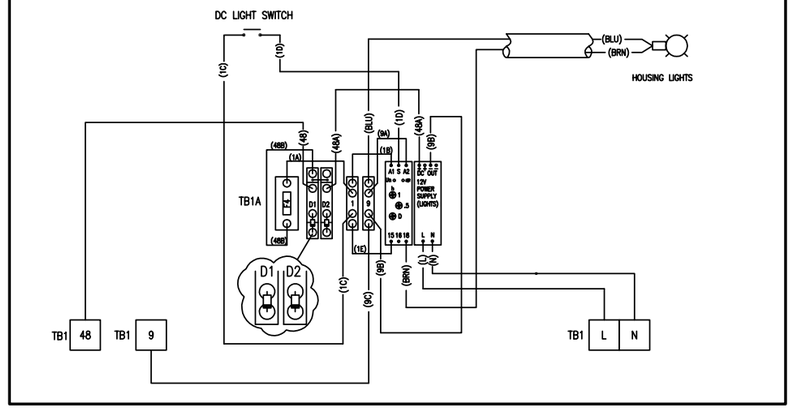
BATTLE MODE SWITCH VIEWED FROM PANEL FRONT				
CONTACT TYPE		LEFT POS	CENTER POS	RIGHT POS
NO	RIGHT (SLOT 2)	0	0	X
NC	LEFT (SLOT 1)	0	X	X
NC	CENTER (SLOT 3)	0	X	0
X=CLOSED 0=OPEN		OFF	BATTLE MODE	DEAD PANEL "CRANK"

SAFETY OVERRIDE SWITCH VIEWED FROM THE BACK SWITCH IN OFF (LEFT) POSITION

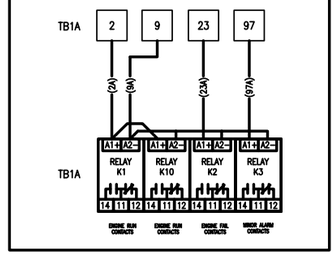
AEM OPTION



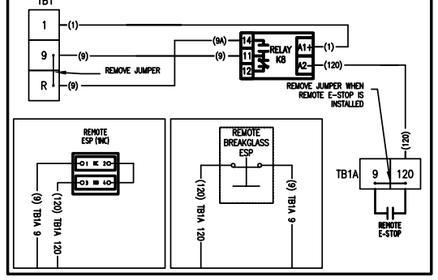
HOUSING LIGHT OPTION



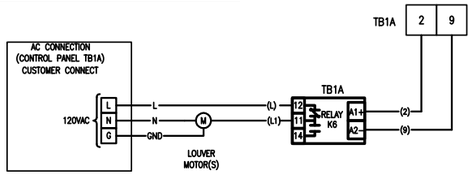
4 RELAY OPTION



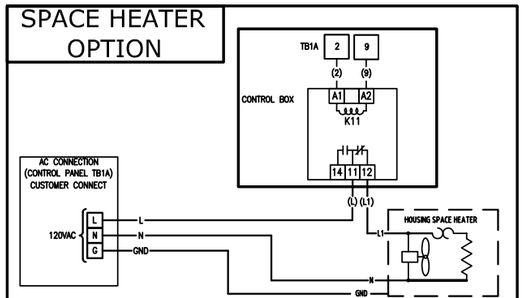
REMOTE E-STOP OPTION



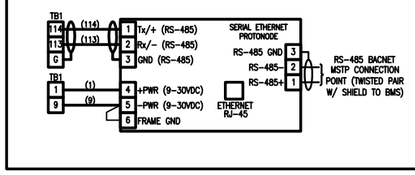
LOUVER MOTOR(S) OPTION



SPACE HEATER OPTION



BACnet CONVERTOR



Passmass Fit	Abmass in Deviation	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

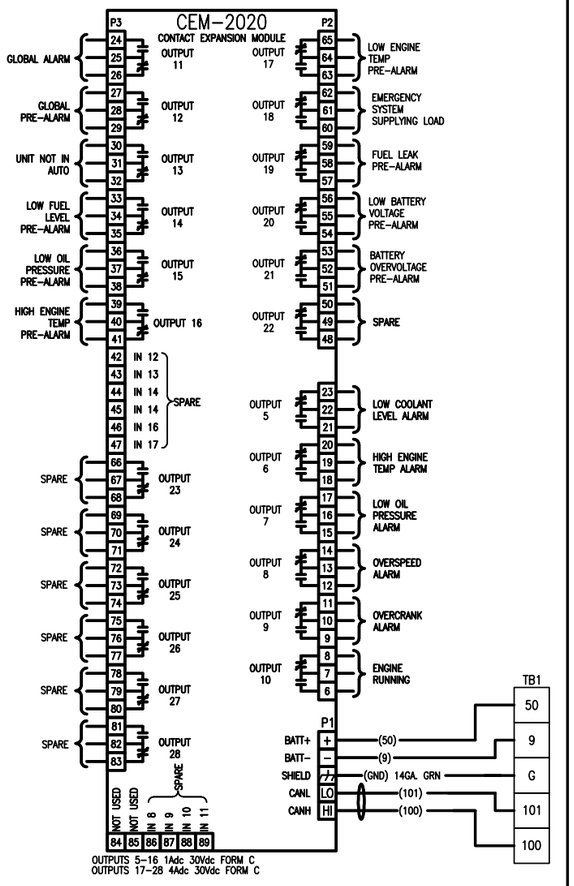
Ausfuehrung u.Lieferung Tech. Characteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .	Format/Size A2
Oberflaechenschutz Surface Protection		Werkstoff Material		
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs-vorschriften nach MMN 332 Production Specification per MMN 332	Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die		
Projekt-/Auftrags-Nr. Project/Order No.		Benennung/Title SM	Schematics	
Ref. Nr./Ref. No. Emissions_ID		SYSTEM WAHLW.AUSFUEHRUNGEN	SYSTEM DRAWING	
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onsite energy		Zeichnungs-Nr./Drawing No. XZG21K0000009		Blatt Sheet 1

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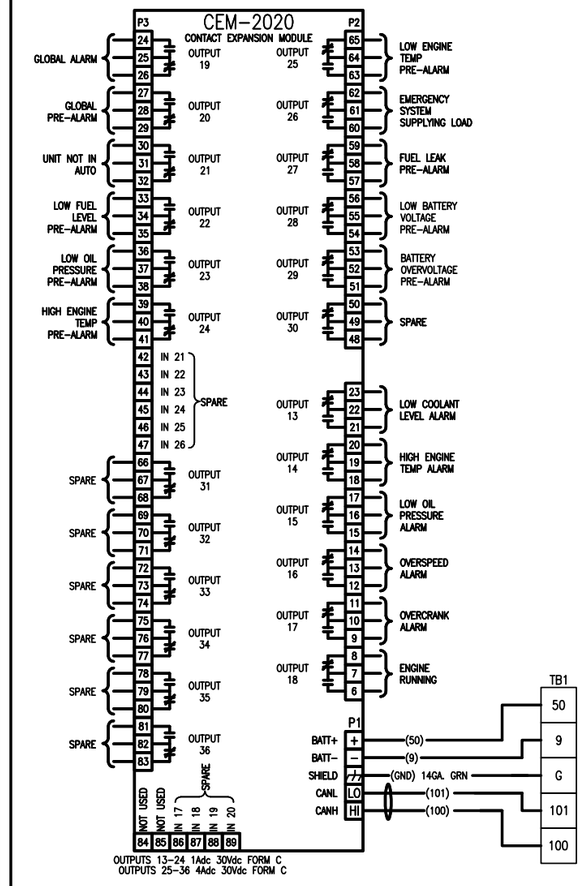
TIM-ID: 0000104106 - 002

TIM-ID: 0000104106 - 002

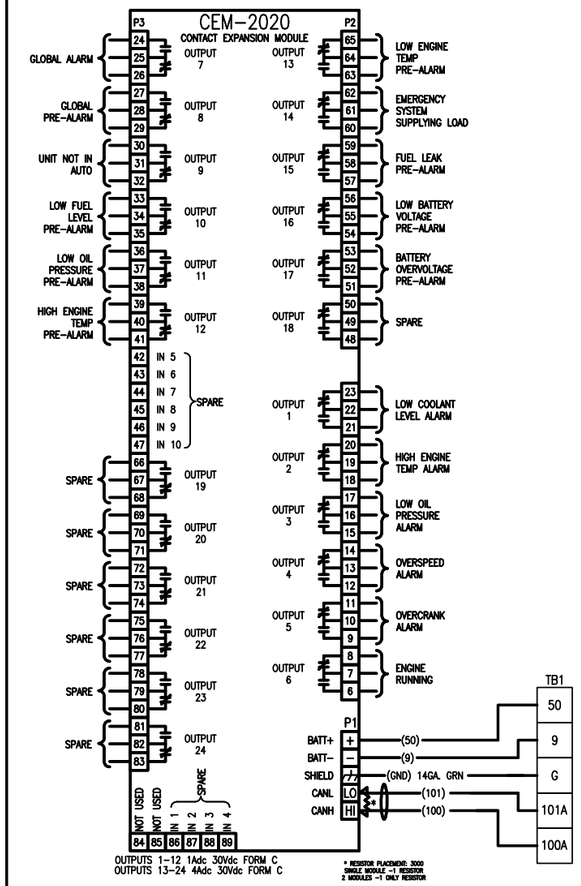
CEM OPTION 1500



CEM OPTION 2000



CEM OPTION 3000



Passmass Fit	Abmass in Deviation (.???)	Buchst. Rev.Ltr.	kommt vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
						22.07.2016	00036684	

Ausfuehrung u.Lieferung Tech. Charakteristics	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Massstab Scale 1:1	Masse/Mass kg .
Oberflaechenschutz Surface Protection			Format/Size A2
Verwendbar fuer Typ Applicable to Model	Allgemeine Fertigungs–vorschriften nach MMN 332 Production Specification per MMN 332	Werkstoff Material	
Projekt–/Auftrags–Nr. Project/Order No.		Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die	
Ref. Nr./Ref. No. Emissions_ID		Benennung/Title SM	Schematics
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.	ACAD Datum/Date Name Bearb. Drawn 22.07.2016 Chetrit Gepr. Checked 22.07.2016 DAW Norm. Stndr. Abt. Dept. EDMA Smithback	SYSTEM WAHLW.AUSFUEHRUNGEN	SYSTEM DRAWING
		SYSTEM OPTIONAL VERSIONS	OPTION SHEET – OM900
onsite energy		Zeichnungs–Nr./Drawing No. XZG21K0000009	Blatt Sheet 2

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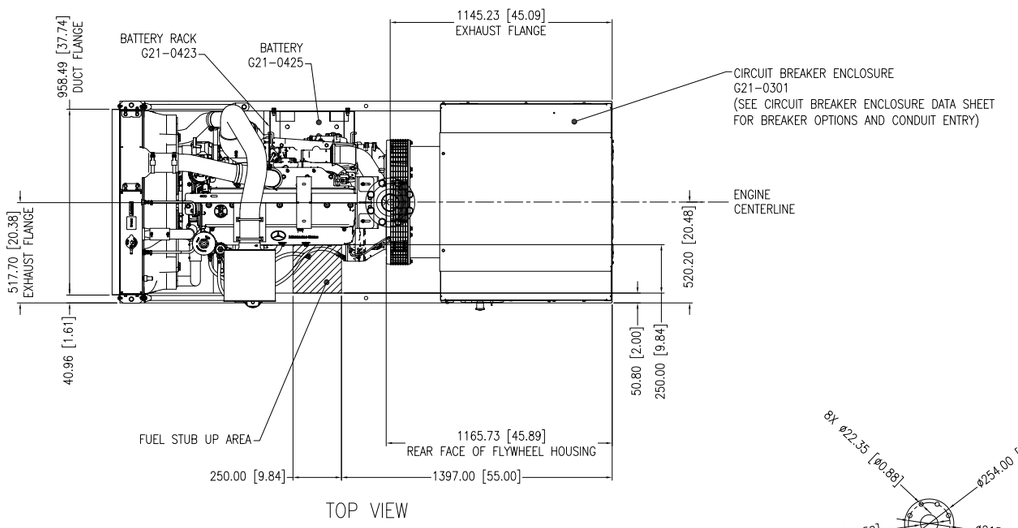
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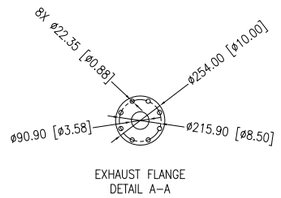
16 150-200 kW Mechanical Drawings

16.1 Mercedes-Benz (OM926) 150-200 kW OPU Base Dimensional Layout - XZG2100100037 567
16.2 Mercedes-Benz (OM926) 150-200 kW Housed Base Dimensional Layout - XZG2100100038 571
16.3 Mercedes-Benz (OM926) 150-200 kW Integrated Tank Dimensional Layout - XZG2100100039 575
16.4 Mercedes-Benz (OM926) 150-200 kW Level 1 and 2 Housing Dimensional Layout - XZG2100100040 579
16.5 Mercedes-Benz (OM926) 150-200 kW Level 3 Housing Dimensional Layout - XZG2100100040 581
16.6 Mercedes-Benz (OM926) 150-200 kW Tank Dimensional Layout - XZG2100100042 583

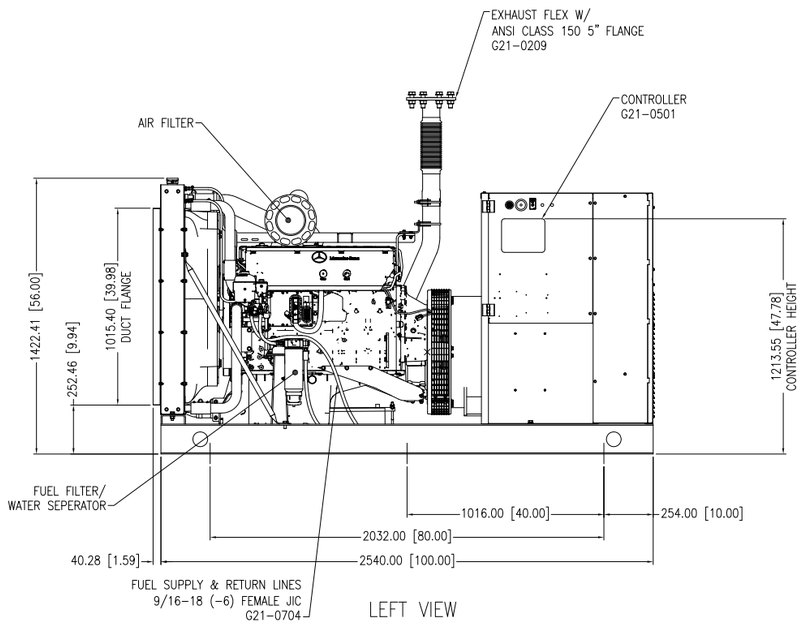
16.1 Mercedes-Benz (OM926) 150-200 kW OPU Base Dimensional Layout - XZG2100100037



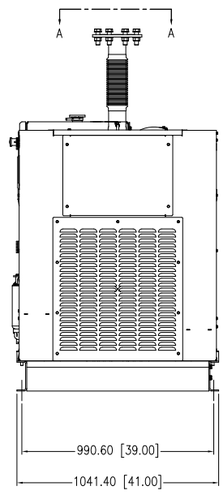
TOP VIEW



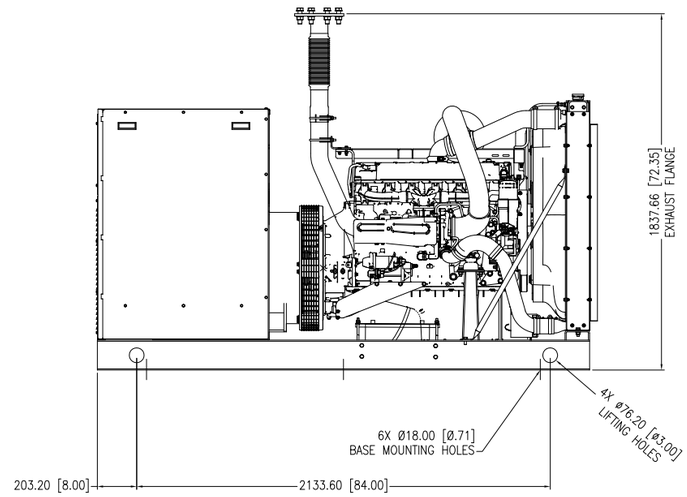
EXHAUST FLANGE
DETAIL A-A



LEFT VIEW



REAR VIEW



RIGHT VIEW

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-10-12

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200 kW Genset, OPU Base

ENGINE: Mercedes, OM926

WEIGHT (MIN-MAX): 1257-2090 KG 2770-4607 LB

DRAWING NUMBER: XZG2100100037

SHEET: 1 of 2

TIM-ID: 0000104065 - 001

TIM-ID: 0000104065 - 001

DRAWING CODE CONFIGURATION 150–200 kW OM926			
GENERATOR FRAME	BREAKER QTY	BREAKER SIDE (PRIMARY)	LOCATION
430	1–3	RIGHT	1
		LEFT	2

Step 1: Reference the Drawing Code Configuration table and determine your location number.

Step 2: Reference the Drawing Options tables and within the Layer Properties turn on/off the Drawing Codes that may or may not apply to your location number.

Note: Some options may not be referenced. Only options which visibly change the drawing are selectable.

DRAWING OPTIONS 150–200 kW OM926			LOCATION	
GROUP	DRAWING CODE	DESCRIPTION	1	2
Standard Unit	G21–0005	Standard Unit w/ OPU Base	X	X
Intake Air	G21–0102	Restriction Indicator	X	X
Exhaust Air	G21–0209	No Silencer	X	X
	G21–0212	Unit Mounted Silencer, OPU	X	X
Outlet Box & Breaker Enclosure	G21–0301	430 Frame Gen, Right Side Primary Breaker	X	
	G21–0302	430 Frame Gen, Left Side Primary Breaker		X
Starting Aids	G21–0405	Battery Charger, Guest, 6 amp	X	
	G21–0406	Battery Charger, Guest, 6 amp		X
	G21–0409	Battery Charger, Micro–Genius, 6 amp NFPA	X	
	G21–0410	Battery Charger, Micro–Genius, 6 amp NFPA		X
	G21–0413	Battery Charger, Micro–Genius, 10 amp NFPA	X	
	G21–0414	Battery Charger, Micro–Genius, 10 amp NFPA		X
	G21–0423	Battery Rack, OPU Base	X	X
	G21–0425	Battery, OPU Base	X	X
	G21–0427	Water Heater w/o Shut–Off Valves	X	X
	G21–0428	Water Heater with Shut–Off Valves	X	X
Controls	G21–0501	MGC–1500 Controller, Left Side Facing	X	
	G21–0503	MGC–1500 Controller, Right Side Facing		X
	G21–0505	MGC–1500 Controller, Rear Facing	X	X
	G21–0507	MGC–2000 Controller, Left Side Facing	X	
	G21–0509	MGC–2000 Controller, Right Side Facing		X
	G21–0511	MGC–2000 Controller, Rear Facing	X	X
	G21–0513	MGC–3000 Controller, Left Side Facing	X	
	G21–0515	MGC–3000 Controller, Right Side Facing		X
	G21–0517	MGC–3000 Controller, Rear Facing	X	X
	G21–0519	Analog Meters, Left Side Facing	X	
	G21–0521	Analog Meters, Right Side Facing		X
	G21–0523	Analog Meters, Rear Facing	X	X
	G21–0525	Safety Over–Ride Switch, Left Side Facing	X	
	G21–0527	Safety Over–Ride Switch, Right Side Facing		X
	G21–0529	Safety Over–Ride Switch, Rear Facing	X	X
Vibration Isolation	G21–0606	Non–Seismic Springs, OPU Base	X	X
	G21–0608	Seismic Springs, OPU Base	X	X
Additional Options	G21–1001	Crankcase Filter	X	X
	G21–1002	Convenience Receptacle	X	
	G21–1003	Convenience Receptacle		X
	G21–1006	Distribution Panel	X	
	G21–1007	Distribution Panel		X

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015–10–12

DIMENSIONAL LAYOUT

DESCRIPTION: 150–200 kW Genset, OPU Base

ENGINE: Mercedes, OM926

WEIGHT (MIN–MAX): 1257–2090 KG 2770–4607 LB

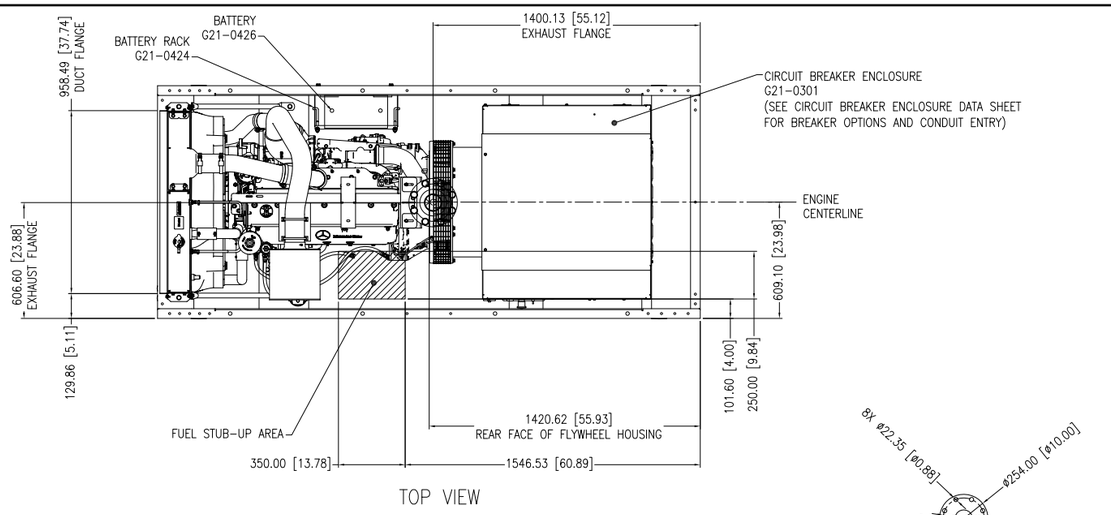
DRAWING NUMBER: XZG2100100037

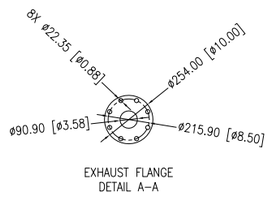
SHEET: 2 of 2

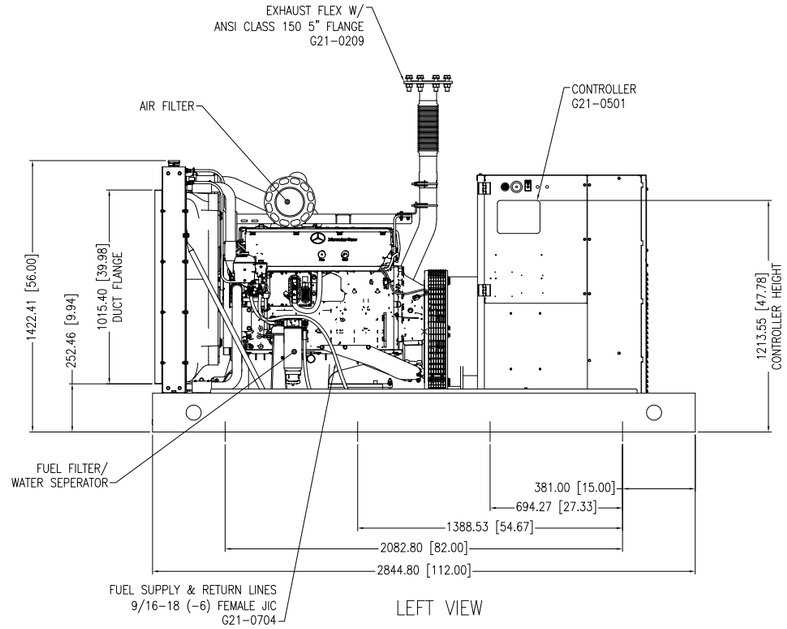
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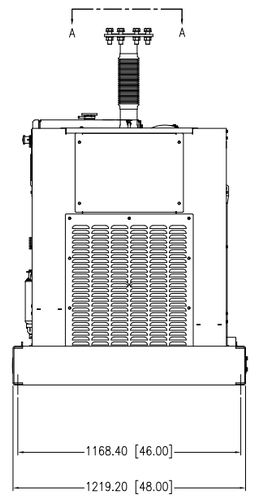
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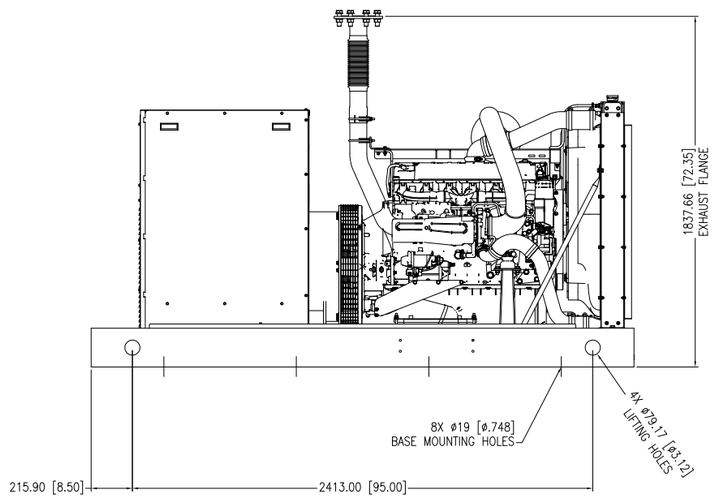
16.2 Mercedes-Benz (OM926) 150-200 kW Housed Base Dimensional Layout - XZG2100100038











REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-10-12

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200 kW Genset, Housed Base

ENGINE: Mercedes, OM926

WEIGHT (MIN-MAX): 1292-2125 KG 2848-4685 LB

DRAWING NUMBER: XZG2100100038

SHEET: 1 of 2

TIM-ID: 0000104066 - 001

TIM-ID: 0000104066 - 001

DRAWING CODE CONFIGURATION 150–200 kW OM926			
GENERATOR FRAME	BREAKER QTY	BREAKER SIDE (PRIMARY)	LOCATION
430	1–3	RIGHT	1
		LEFT	2

Step 1: Reference the Drawing Code Configuration table and determine your location number.

Step 2: Reference the Drawing Options tables and within the Layer Properties turn on/off the Drawing Codes that may or may not apply to your location number.

Note: Some options may not be referenced. Only options which visibly change the drawing are selectable.

DRAWING OPTIONS 150–200 kW OM926			LOCATION	
GROUP	DRAWING CODE	DESCRIPTION	1	2
Standard Unit	G21–0006	Standard Unit w/ Housed Base	X	X
Intake Air	G21–0102	Restriction Indicator	X	X
Exhaust Air	G21–0209	No Silencer	X	X
	G21–0212	Unit Mounted Silencer, OPU	X	X
	G21–0213	Unit Mounted Silencer, w/ Level 1 or 2 Housing	X	X
	G21–0214	Unit Mounted Silencer, w/ Level 3 Housing	X	X
Outlet Box & Breaker Enclosure	G21–0301	430 Frame Gen, Right Side Primary Breaker	X	
	G21–0302	430 Frame Gen, Left Side Primary Breaker		X
Starting Aids	G21–0405	Battery Charger, Guest, 6 amp	X	
	G21–0406	Battery Charger, Guest, 6 amp		X
	G21–0409	Battery Charger, Micro–Genius, 6 amp NFPA	X	
	G21–0410	Battery Charger, Micro–Genius, 6 amp NFPA		X
	G21–0413	Battery Charger, Micro–Genius, 10 amp NFPA	X	
	G21–0414	Battery Charger, Micro–Genius, 10 amp NFPA		X
	G21–0424	Battery Rack, Housed Base	X	X
	G21–0426	Battery, Housed Base	X	X
	G21–0427	Water Heater w/o Shut–Off Valves	X	X
	G21–0428	Water Heater with Shut–Off Valves	X	X
Controls	G21–0501	MGC–1500 Controller, Left Side Facing	X	
	G21–0503	MGC–1500 Controller, Right Side Facing		X
	G21–0505	MGC–1500 Controller, Rear Facing	X	X
	G21–0507	MGC–2000 Controller, Left Side Facing	X	
	G21–0509	MGC–2000 Controller, Right Side Facing		X
	G21–0511	MGC–2000 Controller, Rear Facing	X	X
	G21–0513	MGC–3000 Controller, Left Side Facing	X	
	G21–0515	MGC–3000 Controller, Right Side Facing		X
	G21–0517	MGC–3000 Controller, Rear Facing	X	X
	G21–0519	Analog Meters, Left Side Facing	X	
	G21–0521	Analog Meters, Right Side Facing		X
	G21–0523	Analog Meters, Rear Facing	X	X
	G21–0525	Safety Over–Ride Switch, Left Side Facing	X	
	G21–0527	Safety Over–Ride Switch, Right Side Facing		X
	G21–0529	Safety Over–Ride Switch, Rear Facing	X	X
Vibration Isolation	G21–0607	Non–Seismic Springs, Housed Base	X	X
	G21–0609	Seismic Springs, Housed Base	X	X
Fuel System	G21–0703	Fuel Lines for Sub–Base Tank	X	X
	G21–0704	Fuel Lines w/o Tank	X	X
Housing Options, Interior	G21–0904	Space Heater	X	
	G21–0905	Space Heater		X
Additional Options	G21–1001	Crankcase Filter	X	X
	G21–1002	Convenience Receptacle	X	
	G21–1003	Convenience Receptacle		X
	G21–1006	Distribution Panel	X	
	G21–1007	Distribution Panel		X

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015–10–12

DIMENSIONAL LAYOUT

DESCRIPTION: 150–200 kW Genset, Housed Base

ENGINE: Mercedes, OM926

WEIGHT (MIN–MAX): 1292–2125 KG 2848–4685 LB

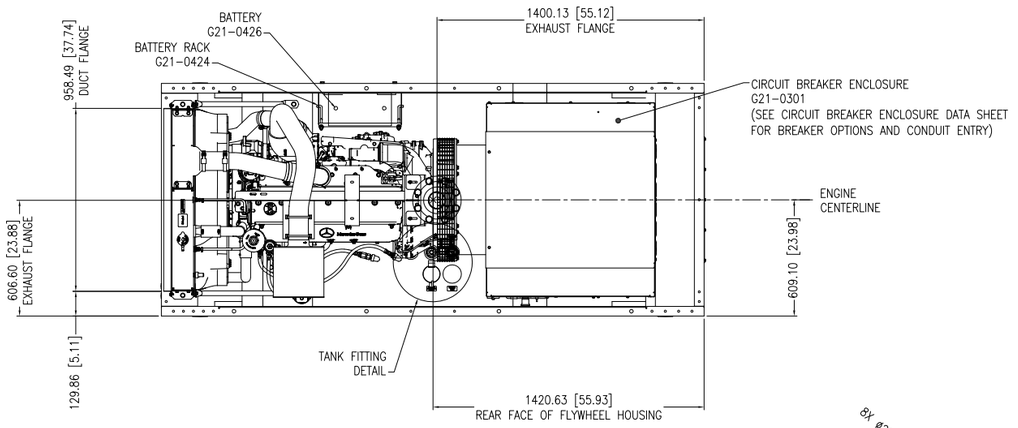
DRAWING NUMBER: XZG2100100038

SHEET: 2 of 2

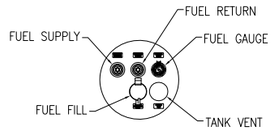
TIM-ID: 0000104066 - 001

TIM-ID: 0000104066 - 001

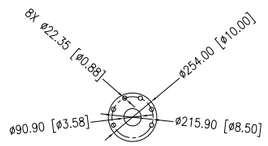
16.3 Mercedes-Benz (OM926) 150-200 kW Integrated Tank Dimensional Layout - XZG2100100039



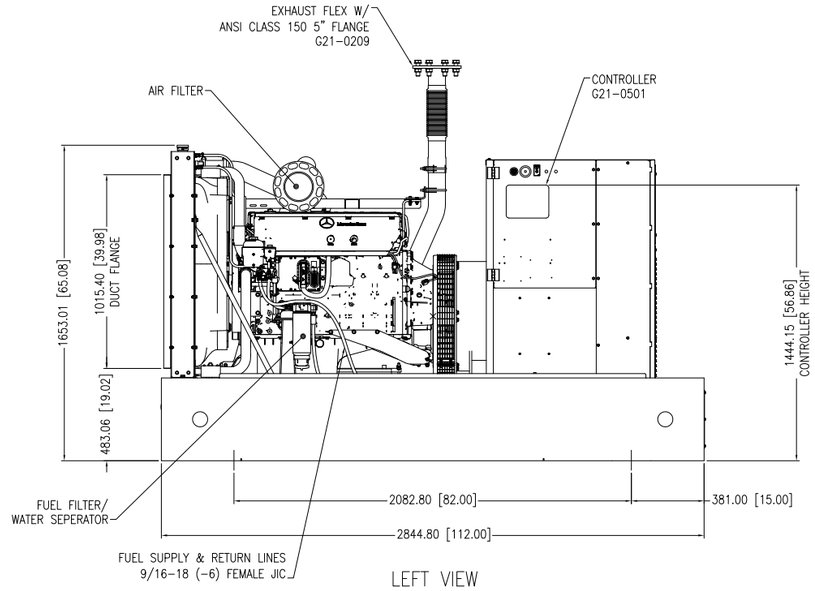
TOP VIEW



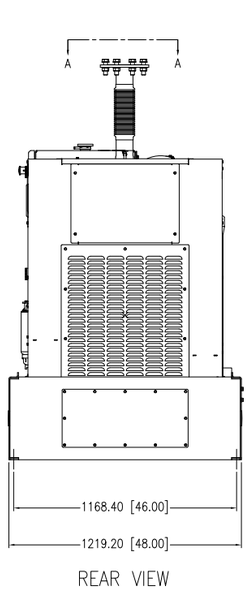
TANK FITTING DETAIL



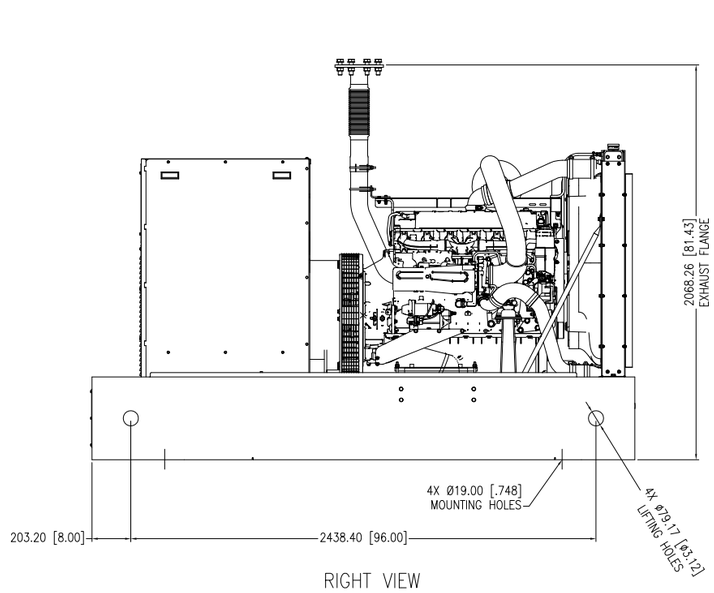
EXHAUST FLANGE
DETAIL A-A



LEFT VIEW



REAR VIEW



RIGHT VIEW

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-10-12

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200 kW Genset, Integrated Tank Base

ENGINE: Manufacturer, Model

WEIGHT (MIN-MAX): 1499-2333 KG 3305-5142 LB

DRAWING NUMBER: XZG2100100039

SHEET: 1 of 2

TIM-ID: 0000104067-001

TIM-ID: 0000104067 - 001

DRAWING CODE CONFIGURATION 150–200 kW OM926			
GENERATOR FRAME	BREAKER QTY	BREAKER SIDE (PRIMARY)	LOCATION
430	1–3	RIGHT	1
		LEFT	2

Step 1: Reference the Drawing Code Configuration table and determine your location number.

Step 2: Reference the Drawing Options tables and within the Layer Properties turn on/off the Drawing Codes that may or may not apply to your location number.

Note: Some options may not be referenced. Only options which visibly change the drawing are selectable.

DRAWING OPTIONS 150–200 kW OM926			LOCATION	
GROUP	DRAWING CODE	DESCRIPTION	1	2
Standard Unit	G21–0007	Standard Unit w/ Integrated Tank Base	X	X
Intake Air	G21–0102	Restriction Indicator	X	X
Exhaust Air	G21–0209	No Silencer	X	X
	G21–0212	Unit Mounted Silencer, OPU	X	X
	G21–0213	Unit Mounted Silencer, w/ Level 1 or 2 Housing	X	X
	G21–0214	Unit Mounted Silencer, w/ Level 3 Housing	X	X
Outlet Box & Breaker Enclosure	G21–0301	430 Frame Gen, Right Side Primary Breaker	X	
	G21–0302	430 Frame Gen, Left Side Primary Breaker		X
Starting Aids	G21–0405	Battery Charger, Guest, 6 amp	X	
	G21–0406	Battery Charger, Guest, 6 amp		X
	G21–0409	Battery Charger, Micro–Genius, 6 amp NFPA	X	
	G21–0410	Battery Charger, Micro–Genius, 6 amp NFPA		X
	G21–0413	Battery Charger, Micro–Genius, 10 amp NFPA	X	
	G21–0414	Battery Charger, Micro–Genius, 10 amp NFPA		X
	G21–0424	Battery Rack, Housed Base	X	X
	G21–0426	Battery, Housed Base	X	X
	G21–0427	Water Heater w/o Shut–Off Valves	X	X
	G21–0428	Water Heater with Shut–Off Valves	X	X
Controls	G21–0501	MGC–1500 Controller, Left Side Facing	X	
	G21–0503	MGC–1500 Controller, Right Side Facing		X
	G21–0505	MGC–1500 Controller, Rear Facing	X	X
	G21–0507	MGC–2000 Controller, Left Side Facing	X	
	G21–0509	MGC–2000 Controller, Right Side Facing		X
	G21–0511	MGC–2000 Controller, Rear Facing	X	X
	G21–0513	MGC–3000 Controller, Left Side Facing	X	
	G21–0515	MGC–3000 Controller, Right Side Facing		X
	G21–0517	MGC–3000 Controller, Rear Facing	X	X
	G21–0519	Analog Meters, Left Side Facing	X	
	G21–0521	Analog Meters, Right Side Facing		X
	G21–0523	Analog Meters, Rear Facing	X	X
	G21–0525	Safety Over–Ride Switch, Left Side Facing	X	
	G21–0527	Safety Over–Ride Switch, Right Side Facing		X
	G21–0529	Safety Over–Ride Switch, Rear Facing	X	X
Housing Options, Interior	G21–0904	Space Heater	X	
	G21–0905	Space Heater		X
Additional Options	G21–1001	Crankcase Filter	X	X
	G21–1002	Convenience Receptacle	X	
	G21–1003	Convenience Receptacle		X
	G21–1006	Distribution Panel	X	
	G21–1007	Distribution Panel		X

TIM-ID: 0000104067 - 001

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015–10–12

DIMENSIONAL LAYOUT

DESCRIPTION: 150–200 kW Genset, Integrated Tank Base

ENGINE: Manufacturer, Model

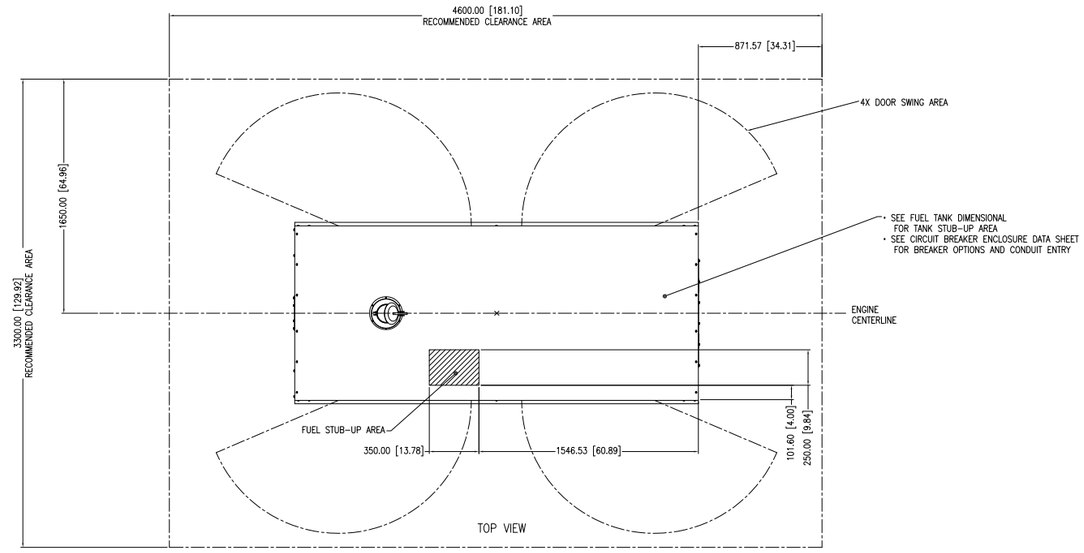
WEIGHT (MIN–MAX): 1499–2333 KG 3305–5142 LB

DRAWING NUMBER: XZG2100100039

SHEET: 2 of 2

TIM-ID: 0000104067 - 001

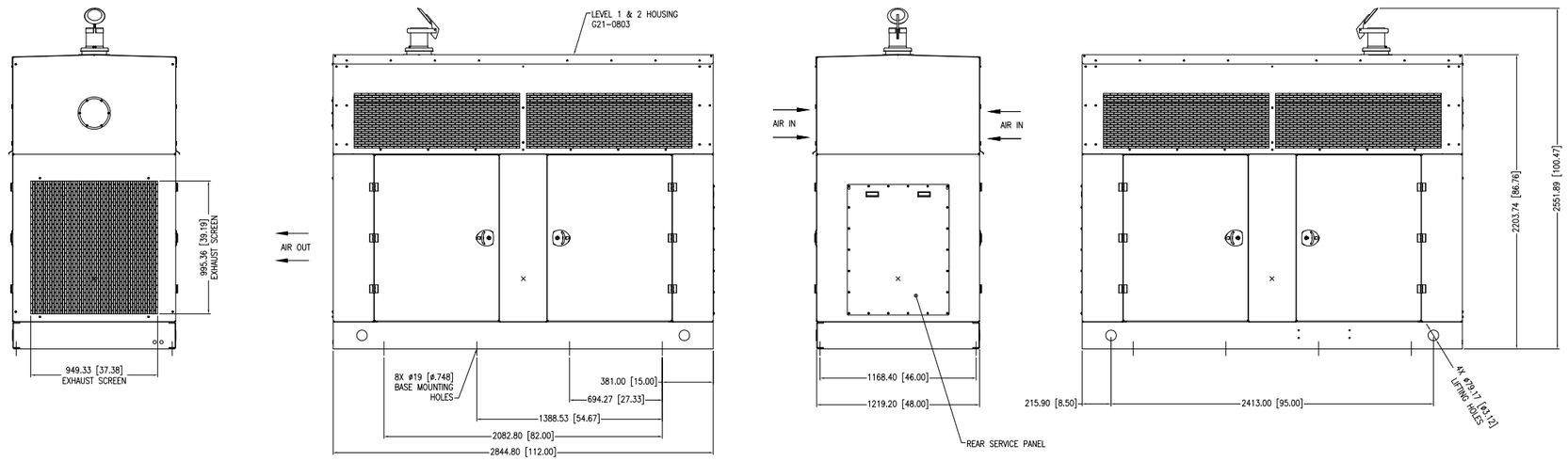
16.4 Mercedes-Benz (OM926) 150-200 kW Level 1 and 2 Housing Dimensional Layout - XZG2100100040



DRAWING OPTIONS 150–200 kW OM926		
Group	Drawing Code	Description
Housing Options, Exterior	G21–0803	Level 1 & 2 Housing
	G21–0804	Level 3 Housing w/ Exhaust Scoop
	G21–0806	Air Exhaust Gravity Louver
Housing Options, Interior	G21–0902	Air Intake Motorized Louver
	G21–0903	Interior Housing Lights

Reference the Drawing Options table and within the Layer Properties turn on/off the Drawing Codes that may or may not apply to your configuration.

Note: Some options may not be referenced. Only options which visibly change the drawing are selectable



REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015–10–13

DIMENSIONAL LAYOUT

DESCRIPTION: 150–200 kW Genset, Housing

ENGINE: Mercedes, OM926

WEIGHT (MIN–MAX): 204–602 KG 450–1327 LB

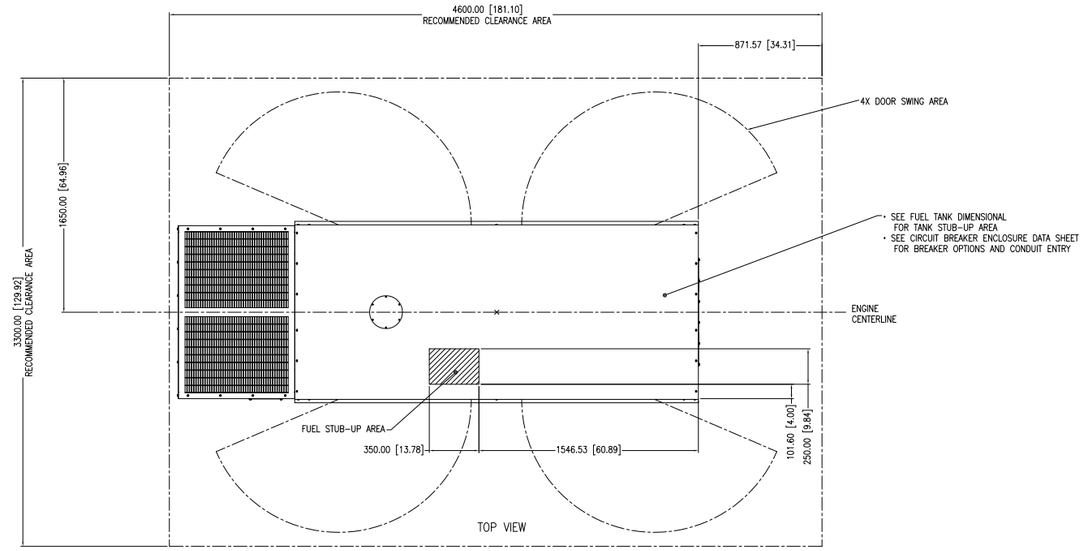
DRAWING NUMBER: XZG2100100040

SHEET: 1 of 1

TIM-ID: 0000104068 - 001

TIM-ID: 0000104068 - 001

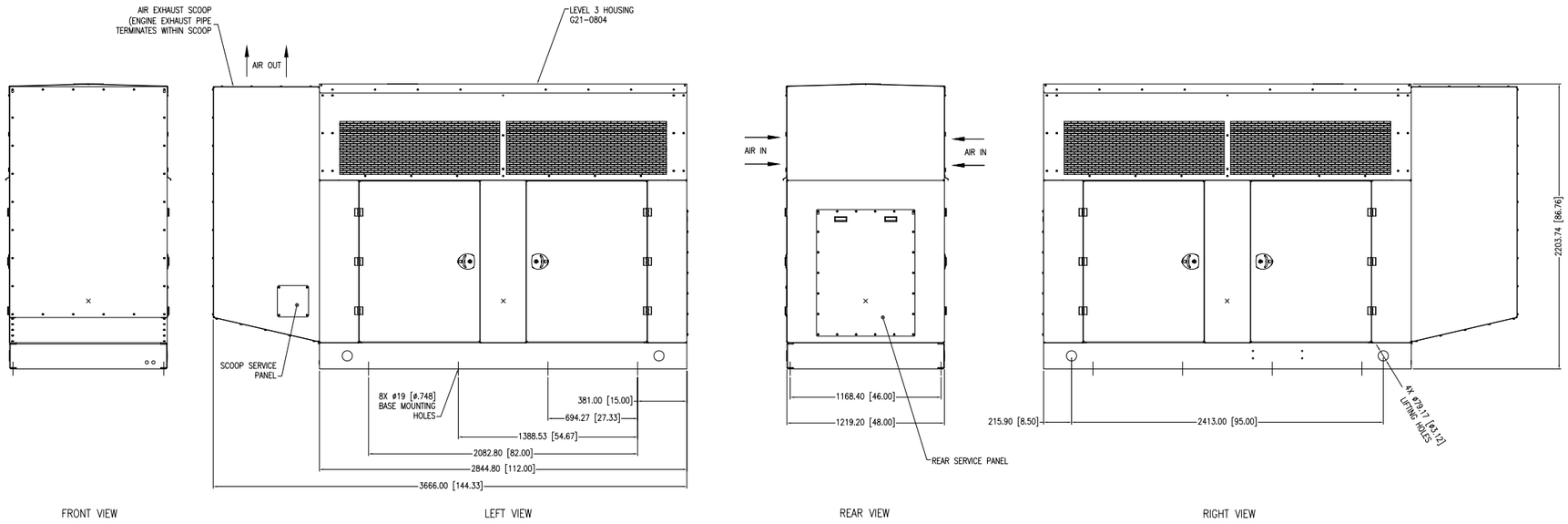
16.5 Mercedes-Benz (OM926) 150-200 kW Level 3 Housing Dimensional Layout - XZG2100100040



DRAWING OPTIONS 150–200 kW OM926		
Group	Drawing Code	Description
Housing Options, Exterior	G21–0803	Level 1 & 2 Housing
	G21–0804	Level 3 Housing w/ Exhaust Scoop
	G21–0806	Air Exhaust Gravity Louver
Housing Options, Interior	G21–0902	Air Intake Motorized Louver
	G21–0903	Interior Housing Lights

Reference the Drawing Options table and within the Layer Properties turn on/off the Drawing Codes that may or may not apply to your configuration.

Note: Some options may not be referenced. Only options which visibly change the drawing are selectable



REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015–10–13

DIMENSIONAL LAYOUT

DESCRIPTION: 150–200 kW Genset, Housing

ENGINE: Mercedes, OM926

WEIGHT (MIN–MAX): 204–602 KG 450–1327 LB

DRAWING NUMBER: XZG2100100040

SHEET: 1 of 1

TIM-ID: 0000104069 - 001

TM-ID: 0000104069 - 001

Group	Capacity (Hours)	Capacity (Gallons)	Drawing Page #
Standard Length	12	200	2
	24	400	3
Extended Length	24	400	4
	48	800	5
	72	1200	6
IBC Standard Length	12	200	7
	24	400	8
IBC Extended Length	24	400	9
	48	800	10
	72	1200	11

Notes:
1. Extended style tanks are required for spill fill containment.
2. Regional Code Kits may be added to extended tanks to meet certain local requirements.
3. Refer to "Sub-Base Tank Data Sheet" for more information.

TIM-ID: 0000104070 - 001

REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200 kW Tank Dimensional

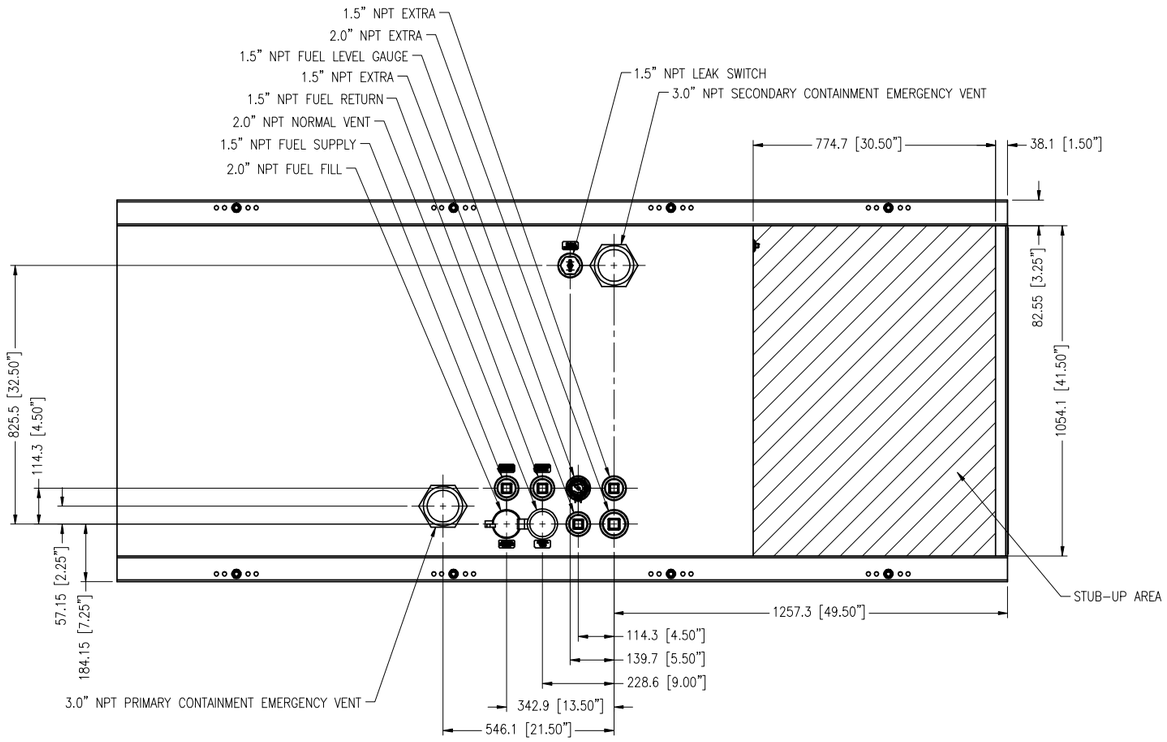
ENGINE: Mercedes, OM926

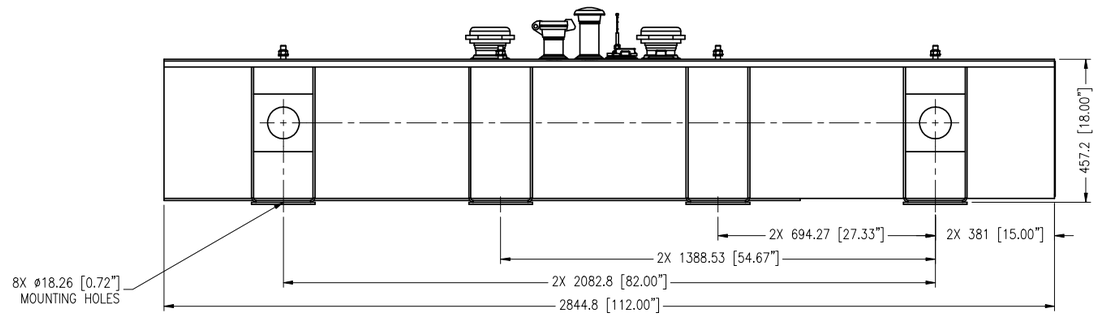
WEIGHT (MIN-MAX): See subsequent sheets

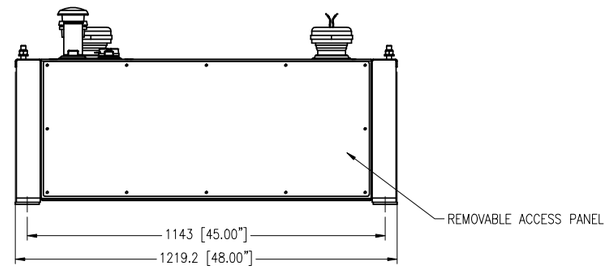
DRAWING NUMBER: XZG2100100042

SHEET: 1 of 11

TIM-ID: 0000104070 - 001







REVISION	DATE	DESCRIPTION

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 12Hr 200Gal Standard Tank

ENGINE: Mercedes, OM926

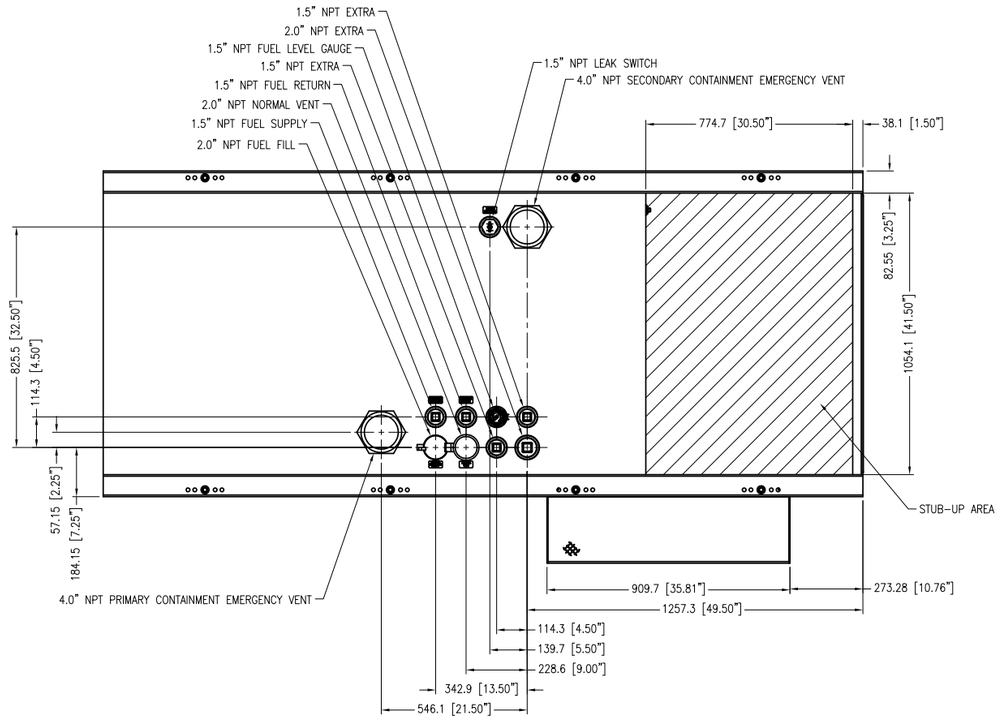
WEIGHT (MIN-MAX): 395 KG 871 LB

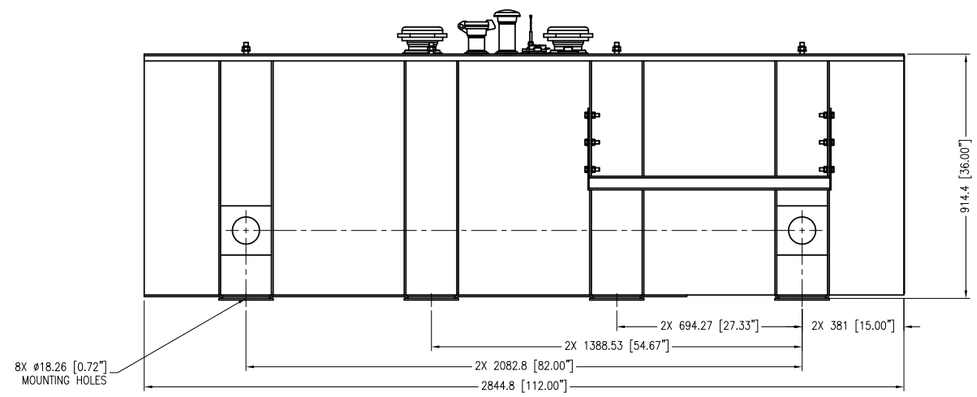
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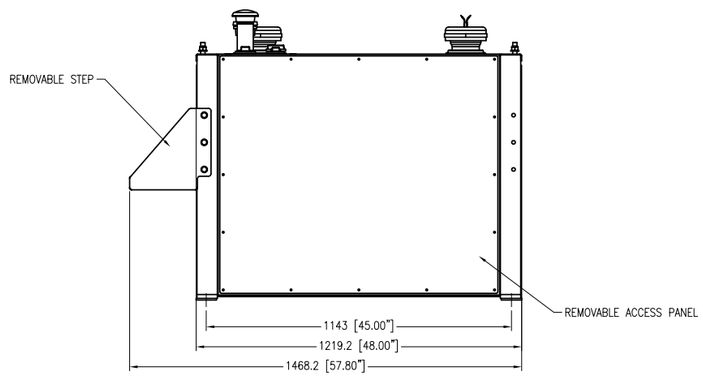
SHEET: 2 of 11

TIM-ID: 0000104070 - 001

TIM-ID: 0000104070 - 001







REVISION	DATE	DESCRIPTION

THIS DRAWING IS PROPERTY OF MTU ONSITE ENERGY CORPORATION AND CANNOT BE USED EXCEPT IN CONNECTION WITH MTU ONSITE ENERGY CORPORATION POWER GENERATION PROJECTS. ANY THIRD PARTY MODIFICATION MAY VOID THIS DRAWING. MTU ONSITE ENERGY CORPORATION RESERVES ALL RIGHTS OF THIS DRAWING.

APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 24Hr 400Gal Standard Tank

ENGINE: Mercedes, OM926

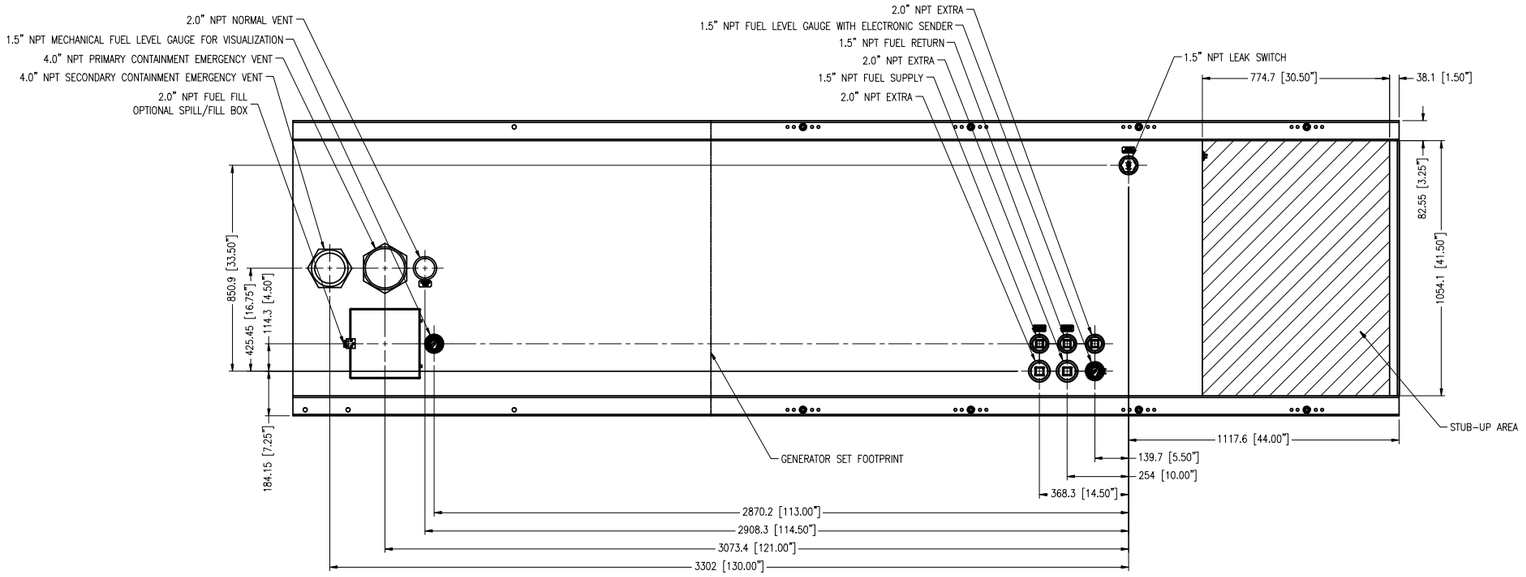
WEIGHT (MIN-MAX): 625 KG 1378 LB

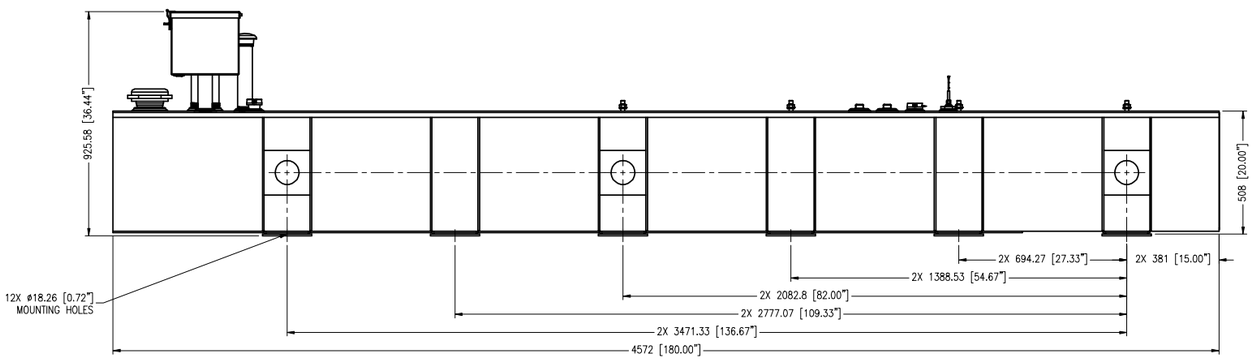
DRAWING NUMBER: XZG2100100042

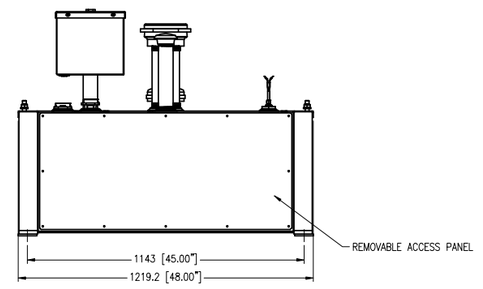
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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 24Hr 400Gal Extended Tank

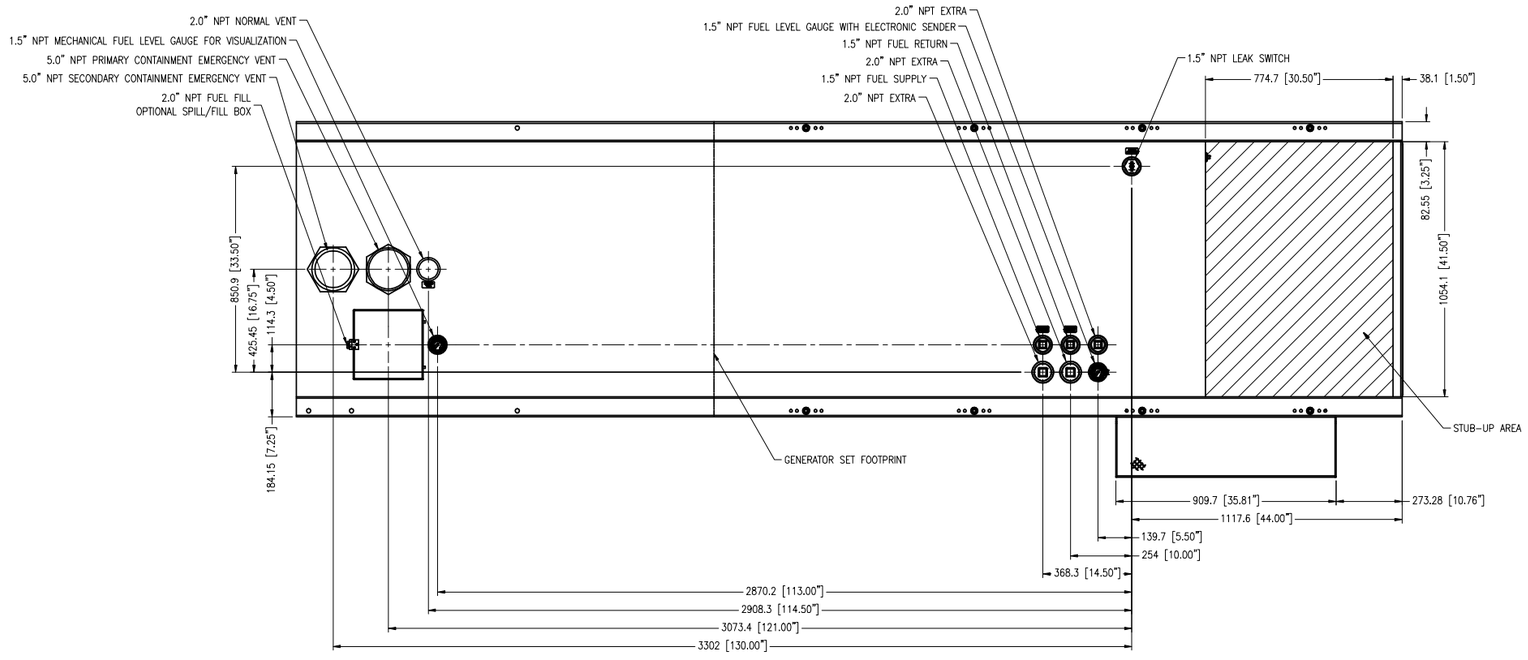
ENGINE: Mercedes, OM926

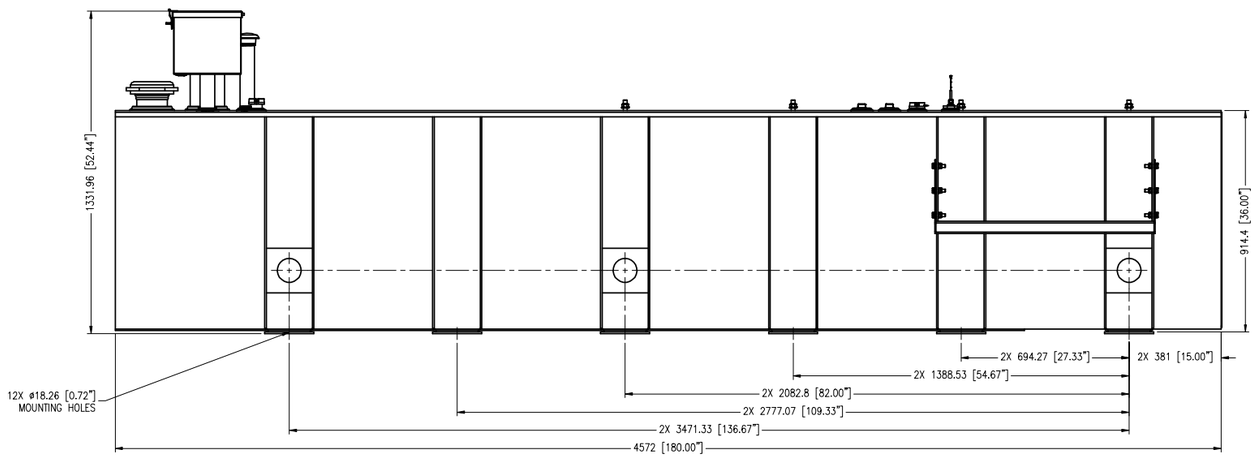
WEIGHT (MIN-MAX): 672 KG 1482 LB

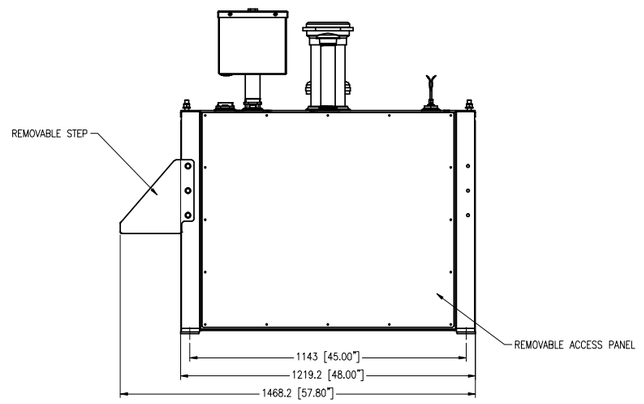
DRAWING NUMBER: XZG2100100042

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 48Hr 800Gal Extended Tank

ENGINE: Mercedes, OM926

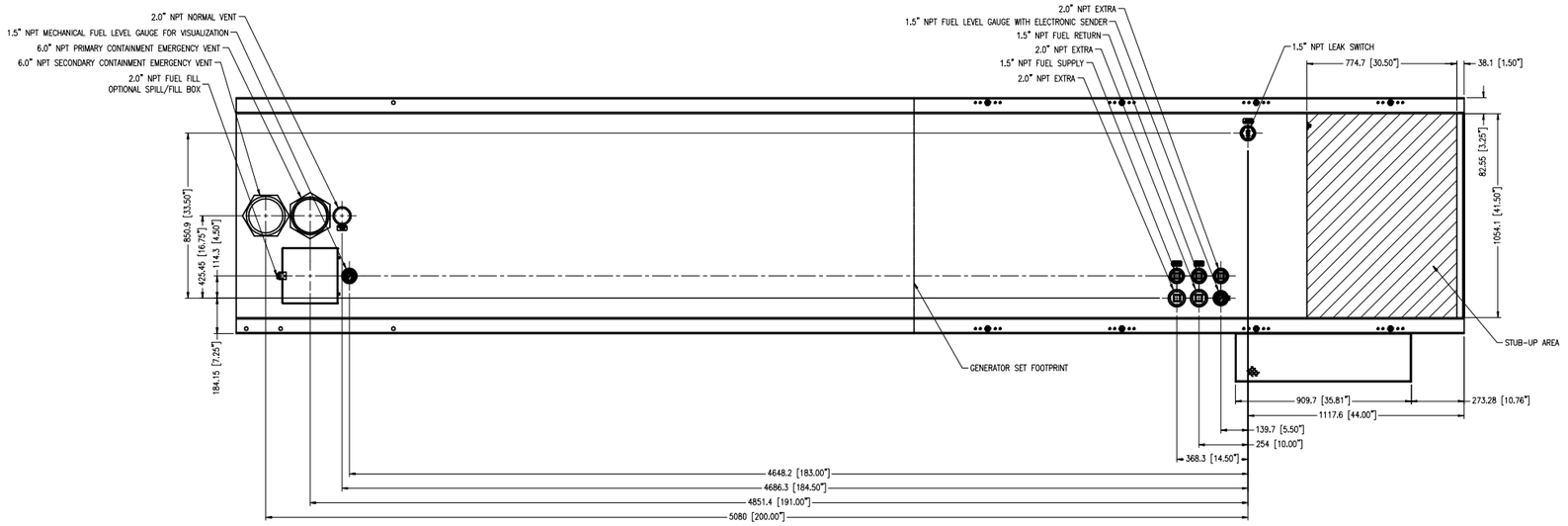
WEIGHT (MIN-MAX): 951 KG 2098 LB

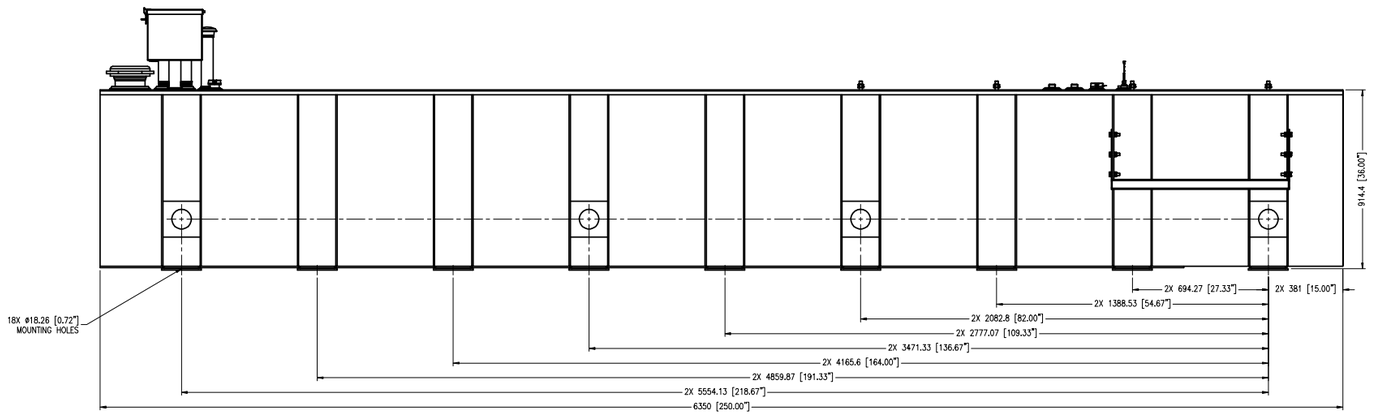
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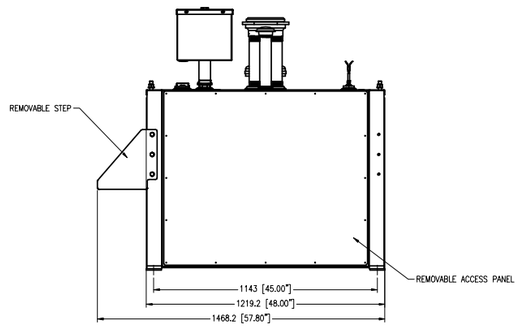
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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 72Hr 1200Gal Extended Tank

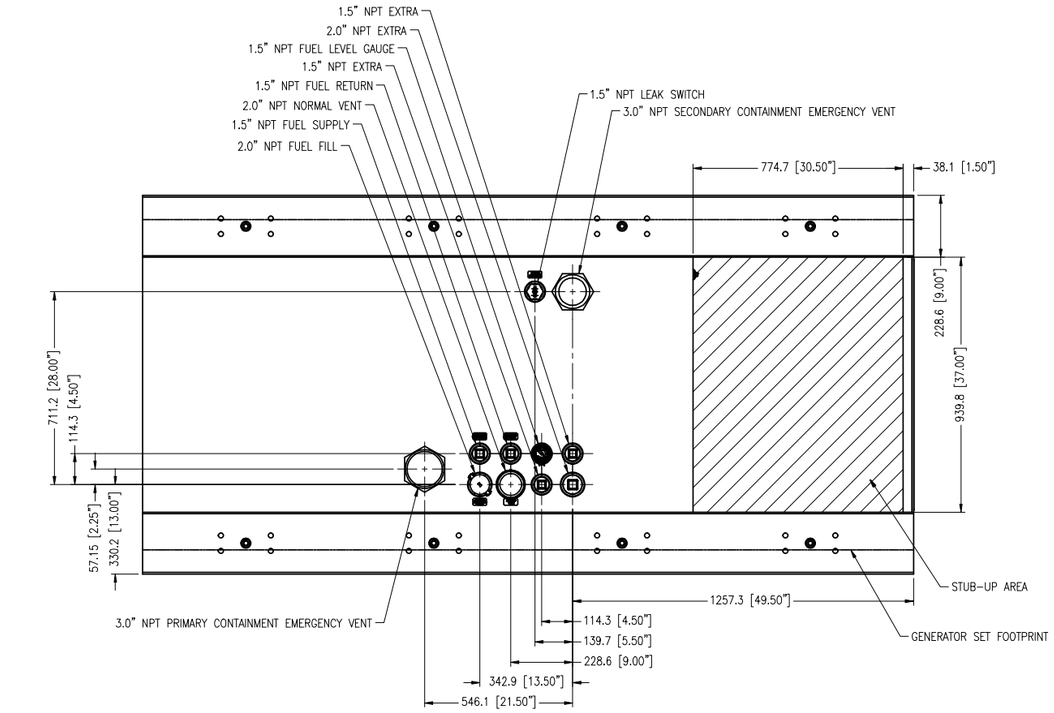
ENGINE: Mercedes, OM926

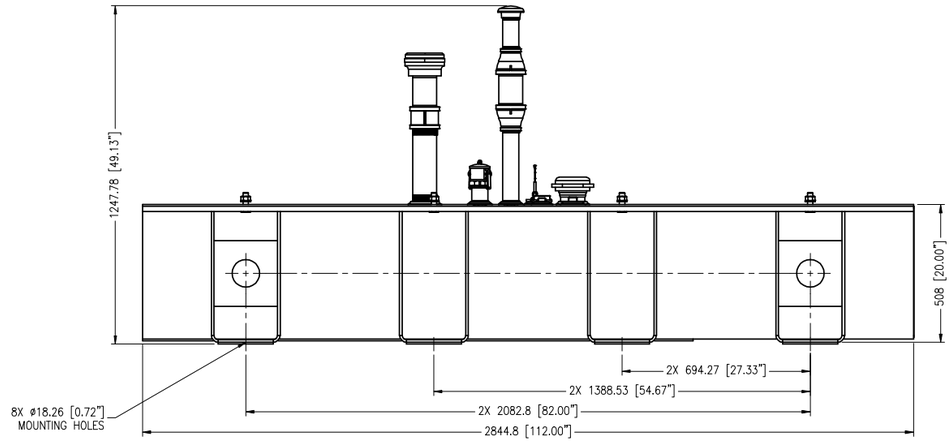
WEIGHT (MIN-MAX): 1314 KG 2897 LB

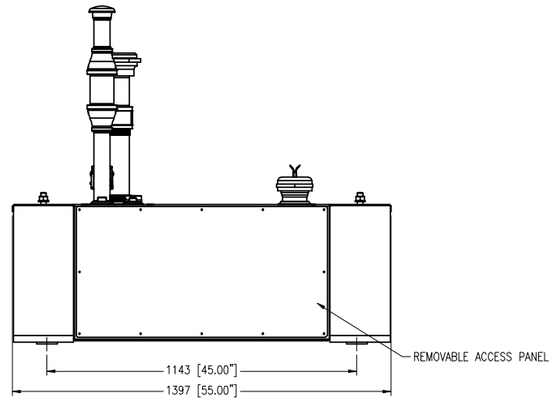
DRAWING NUMBER: XZG2100100042

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 12Hr 200Gal IBC Standard Tank

ENGINE: Mercedes, OM926

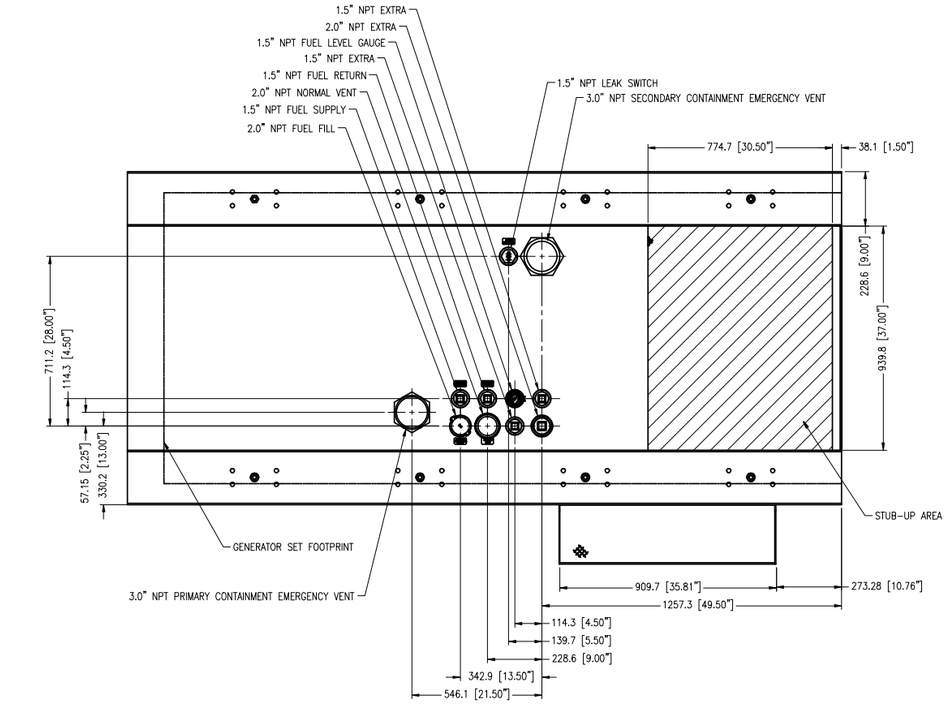
WEIGHT (MIN-MAX): 575 KG 1269 LB

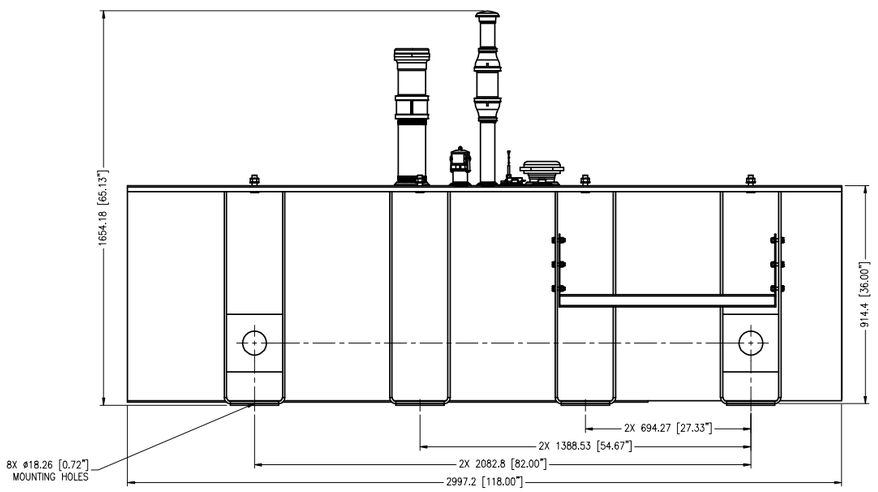
DRAWING NUMBER: XZG2100100042

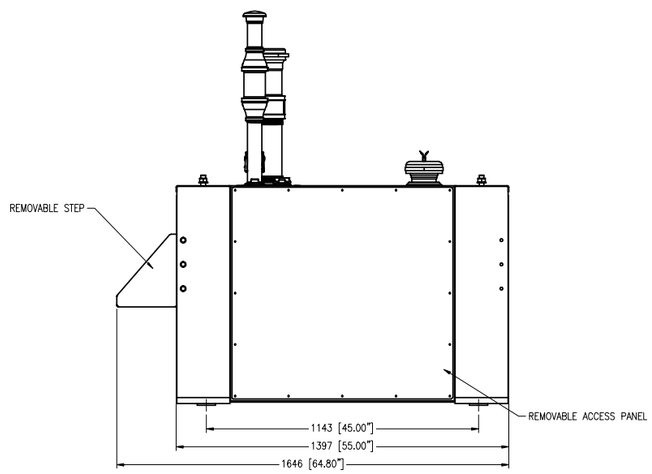
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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 24Hr 400Gal IBC Standard Tank

ENGINE: Mercedes, OM926

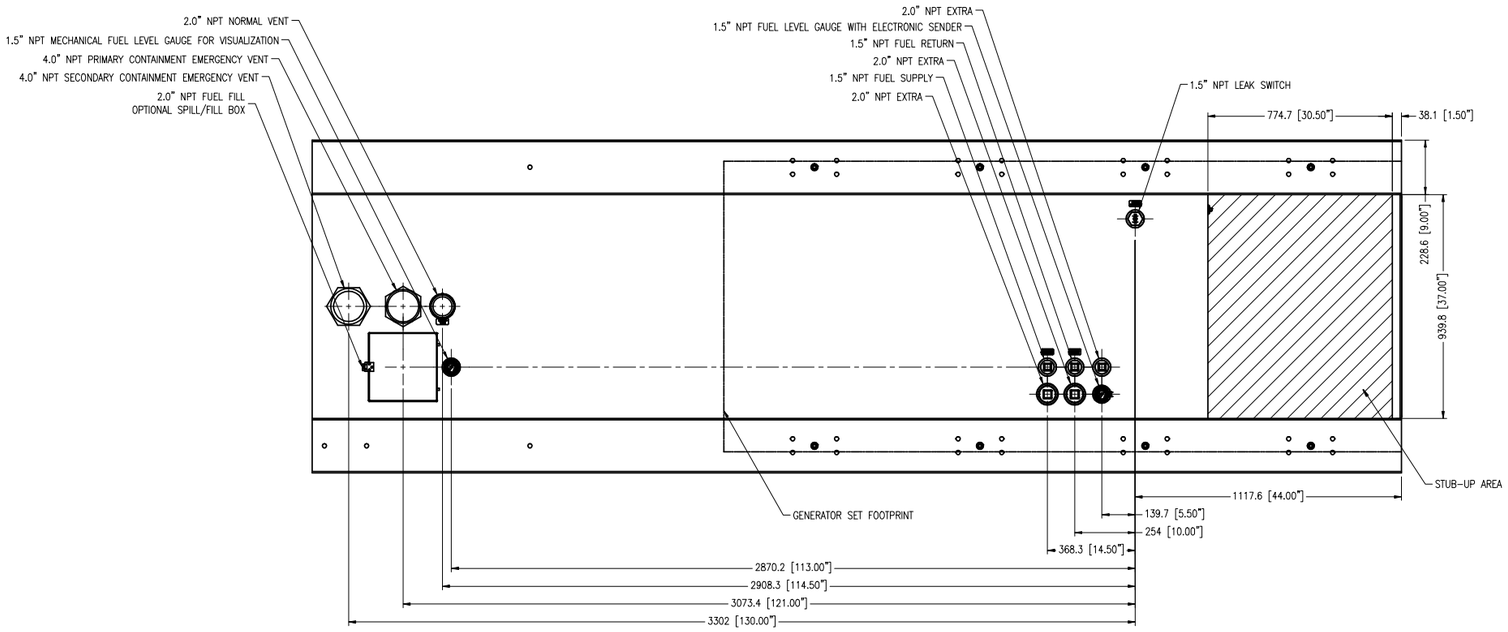
WEIGHT (MIN-MAX): 885 KG 1952 LB

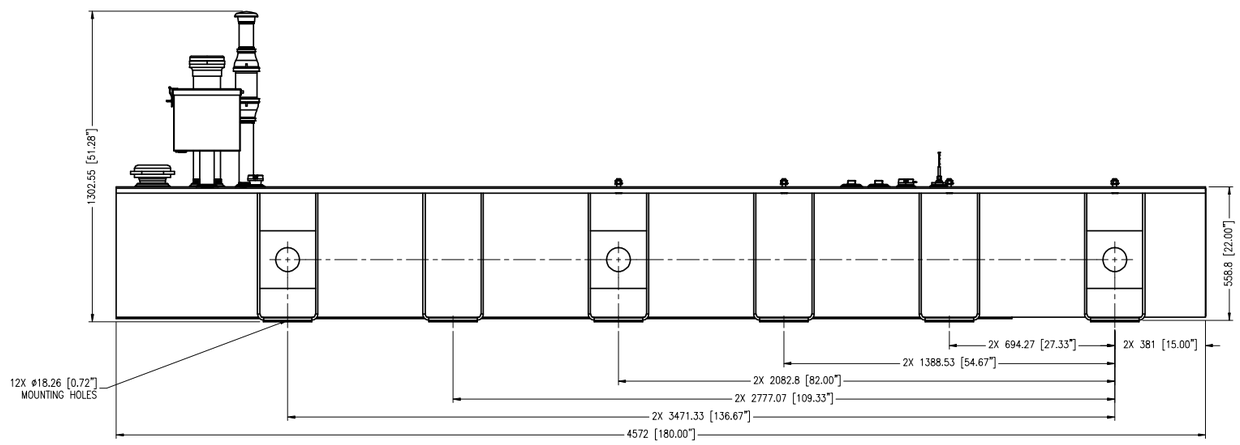
DRAWING NUMBER: XZG2100100042

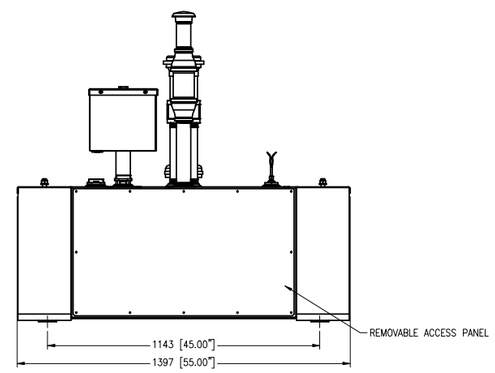
SHEET: 8 of 11

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TIM-ID: 0000104070 - 001







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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 24Hr 400Gal IBC Extended Tank

ENGINE: Mercedes, OM926

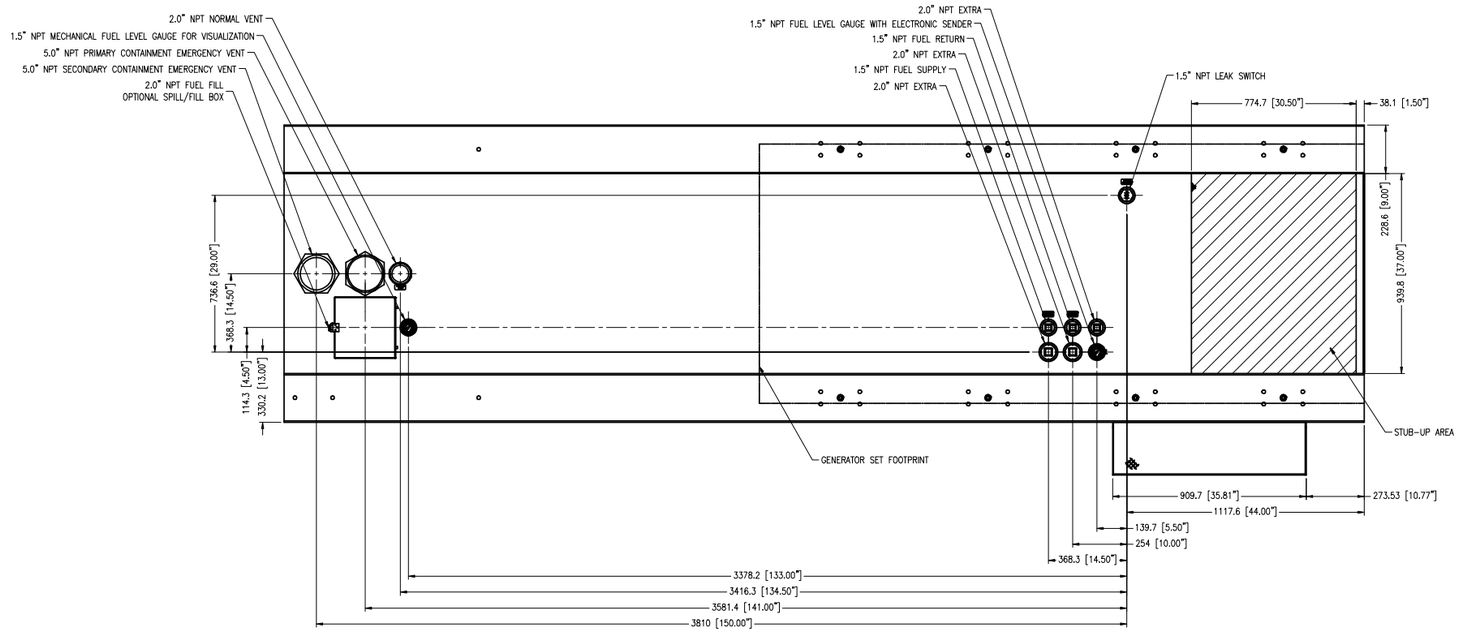
WEIGHT (MIN-MAX): 952 KG 2099 LB

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 48Hr 800Gal IBC Extended Tank

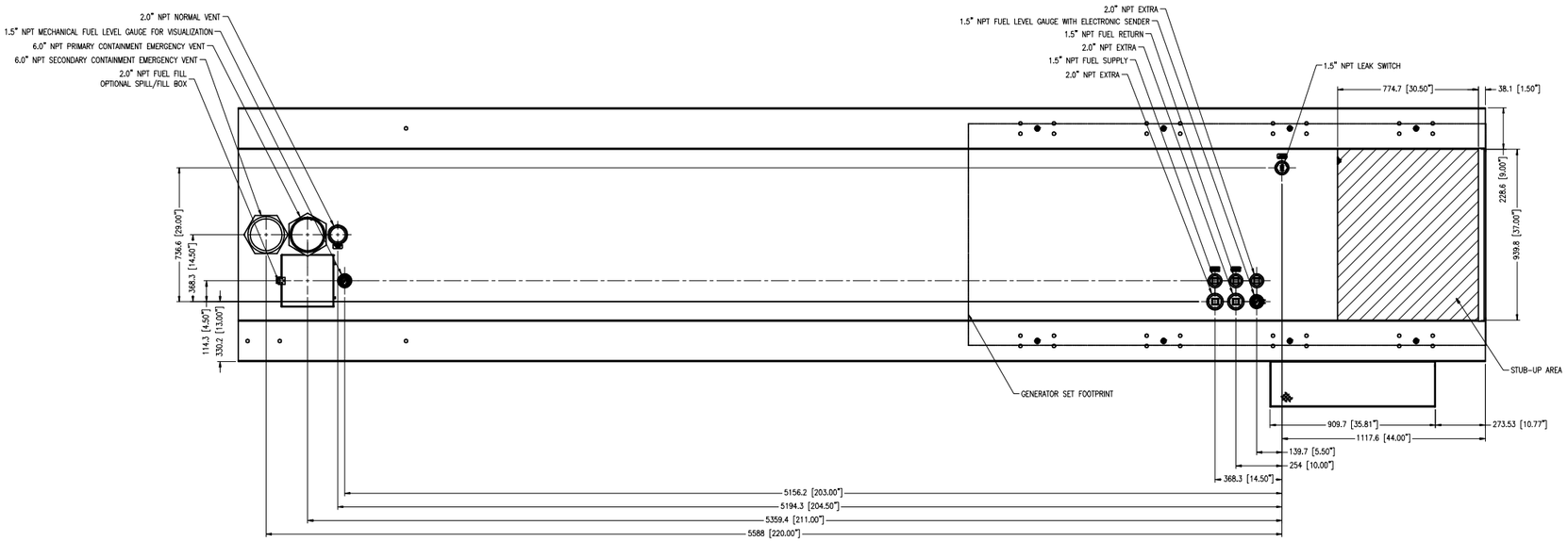
ENGINE: Mercedes, OM926

WEIGHT (MIN-MAX): 1417 KG 3125 LB

DRAWING NUMBER: XZG2100100042

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APPLICABLE MODELS:
MTU 6R0120 DS150
MTU 6R0120 DS180
MTU 6R0120 DS200

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2015-11-13

DIMENSIONAL LAYOUT

DESCRIPTION: 150-200kW 72Hr 1200Gal IBC Extended Tank

ENGINE: Mercedes, OM926

WEIGHT (MIN-MAX): 1940 KG 4278 LB

DRAWING NUMBER: XZG2100100042

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