



MGS-G-EU 1875-C OPEN SKID GAS GENERATING SET

TECHNICAL SPECIFICATION

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1 - GENERAL INFORMATION

This specification covers a package based on the Mitsubishi MGS-G-EU 1875-C gas generating set for indoor installation.

The gas generating set can be operated in parallel with the grid and / or with other same model of generating set.

If there are high harmonics current on the complex load, the customer or user is requested to reduce the high harmonic current to a percentage level not exceeding negative phase sequence currents of alternator.

The generating set performances are subject to proper maintenance works and to the use of recommended, lubricating oil and cooling water as specified in the enclosed specifications.

Scope of supply	–	Mitsubishi MGS-G-EU 1875-C gas generating set with auxiliaries as described in present technical specification.
Number of open skid genset	–	1
Duty	–	Continuous
Rating	–	Continuous
Annual running hours	–	No limitation except maintenance
Average output	%	From 50 to 100 of rated output
Maximum output	%	100
Overload	–	Not applicable
Alternator output	kWe	1 500
Frequency	Hz	50 Hz
Speed	Rpm	1 500
Power factor	–	0,8
Output voltage	kV	0,4 KV (6,3 KV as per alternative offer)
Design conditions	–	Ambient temperature: 35°C maxi / -15°C mini Altitude : 150 m a.s.l maxi Relative humidity: 85% maxi
Fuel gas	–	Natural gas
Fuel gas supply pressure (at gas line inlet)	kPa	350 – 600 maxi
Gas supply pressure available at site	bar	TBC by customer
Lower heating value	kJ/Nm ³	See generating set datasheet GS16R2 PTK
Fuel gas methane number	–	See generating set datasheet GS16R2 PTK
Lubricating oil specification	–	See § 3
Cooling water specification	–	See § 3
Applicable standards	–	I.S.O. : International Standard Organization C.E.N. : European Standard Committee I.E.C: International Electric Commission J.I.S : Japanese Industrial Standards J.E.C : Japanese Electrotechnical committee

		J.E.M: Japan Electrical Manufacturers Association Manufacturers standards
EU and CE compliance		2014/35/EU : low voltage 2006/42/EC : machinery
Units	–	SI metric system
Installation location	–	Indoor, without corrosive gas, explosive gas, salt damage, power dust
NOx emission level @ 5% O2	mg/Nm3	500
Other data not specified	–	See generating set datasheet GS16R2 PTK

2 - SCOPE OF SUPPLY – DESCRIPTION OF THE EQUIPMENTS

2.1 - MECHANICAL EQUIPMENT

2.1.1 - GENERATING SET

2.1.1.1. GAS ENGINE



Gas engine MITSUBISHI model GS16R2-PTK

- 4 cycles
- Water cooled
- Spark ignition pre-mixed fuel gas and air with exhaust turbine turbocharger and intake air cooler
- 16 cylinders in Vee configuration
- Total displacement 79,9 litres
- Bore 170 mm
- Stroke 220 mm
- Turbocharger : Exhaust gas turbine
- Governor : Electronic air-fuel mixture control type
- Speed regulation: (100 % load unloading or 30% loading)
 - Transient ----- 15% or below
 - Steady state ----- 5% or below
 - Recovery time --- 15 sec or below
- Lubricating oil capacity : 460 liters (oil pan 430 liters)
- Lubricating oil cooler: Jacket water cooled corrugated type
- Lubricating oil filter : Full flow paper element type
- Starting system : Electric motor starting

Starting motor capacity : 24 V – 7,5 kW x 2

Lead acid battery N-600 Ah (**see note 1**)

- Lubricating oil priming system: AC motor driven gear pump with periodical operating timer
(400 V - 3 ph – 1.5 kW)
- Forced lubricating by gear pump wet sump system
- Lubricating oil manual draining pump
- Cooling system: Closed loop circuit by remote radiator (**see Note 1**)
(Jacket water capacity for engine only : 200 liters))
- Water pumps: Centrifugal type driven by AC motor (**see Note 1**)
- Jacket water heater : 400 V – 3 ph - 6 kW (**see Note 1**)
- Stopping system: De-energize to Engine stop type solenoid on the fuel linkage
- Engine standard tools set (for routine maintenance)
- Lubricating oil and water flexible connections
- Automatic level control float switch valve fitted on engine sump.

Note 1: *The following equipments and not included in MTEE scope of supply but can be supplied in option :*

- *Starting batteries, cables and switch*
- *Cooling radiator and expansion tank*
- *HT & LT cooling water circulating pumps*
- *Water preheating system, circulator, resistance and piping to the engine*

2.1.1.2. ALTERNATOR (0.4 KV)

- Manufacturer LEROY SOMER (or equivalent)
- Model LSA 52.3 S7 / 4P (or equivalent)
- Type: Enclosed, self-ventilated, self-regulated, brushless
- Continuous rating: 1875 KVA (1 500 kWe)
- Insulation class H
- Temperature rise class F
- Voltage: 400 V – 3 ph - 4 W
- 4 poles
- Frequency: 50 Hz
- Speed: 1500 Rpm.
- Power factor: 0,8
- Method of cooling : Air IC01
- Single bearing lubricating type
- Protection: IP23
- Overspeed: 1 800 Rpm - 2 min
- Winding pitch: 2/3
- Total harmonic distortion DHT : < 4%
- Wave form: NEMA = TIF: < 50
- PT100 for bearing and stator winding
- Space heater 220 V
- Automatic voltage regulator (AVR) for single and parallel operation

- Voltage regulation: +/- 0.5 % of rated voltage at steady state
- Excitation system : AREP
- Set of CTs for measure and protection

2.1.1.3. ALTERNATOR (6,3 KV, option)

- Manufacturer LEROY SOMER (or equivalent)
- Model LSA 52.2 XL80 / 4P (or equivalent)
- Type: Enclosed, self-ventilated, self-regulated, brushless
- Continuous rating: 1875 KVA (1 500 kWe)
- Insulation class H
- Temperature rise class F
- Voltage: 6 300 V – 3 ph - 4 W
- 4 poles
- Frequency: 50 Hz
- Speed: 1500 Rpm.
- Power factor: 0,8
- Method of cooling : Air IC01
- Double bearing lubricating type
- Protection: IP23
- Overspeed: 1 800 Rpm - 2 min
- Winding pitch: 5/6
- Total harmonic distortion DHT : < 5%
- Wave form: NEMA = TIF: < 50
- PT100 for bearing and stator winding
- Space heater 220 V
- Automatic voltage regulator (AVR) for single and parallel operation
- Voltage regulation: +/- 0.5 % of rated voltage at steady state
- Excitation system : AREP + PMI
- Set of CTs for measure and protection
- Set of VTs

2.1.1.4. GENERATING SET ASSEMBLY

The engine and the alternator are fitted on a common rigid steel base frame.

The alternator in LV is single bearing type and is directly coupled to the engine through a SAE flange with semi rigid coupling disks.

For HV, the alternator is double bearing type and is coupled to the engine through a SAE flange via an elastic coupling.

The common base frame is equipped with a retention tank.

Anti-vibration pads are fitted between the base frame and the floor to prevent vibrations being transmitted to the building.

All generator electrical systems are wired on a box terminals fitted on the common base frame.

Before shipment standard tests are conducted on the generating set and include:

- Starting and stopping tests
- 10 min at 25% of load
- 10 min at 50% of load
- 10 min at 75% of load
- 1 hour at 100% of load
- Insulation resistance measurement
- Governor test
- Safety devices test

Will be registered during these tests:

- Temperatures
- Pressures
- Output, voltage and frequency

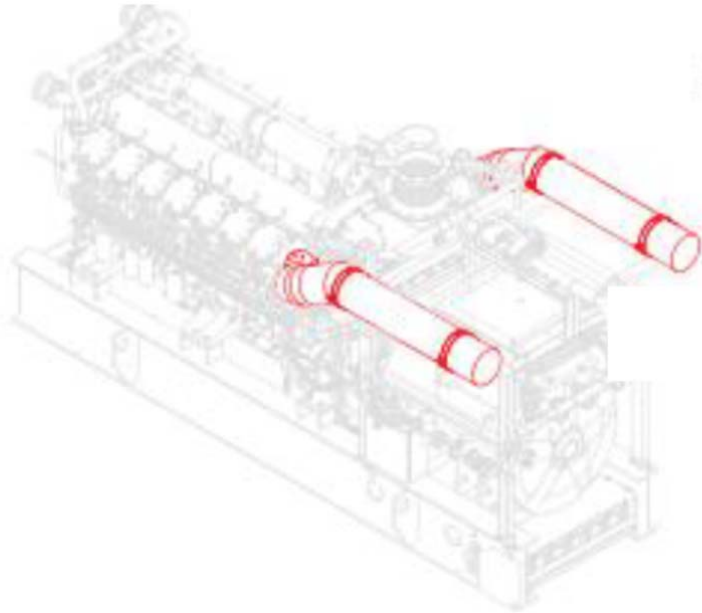
For main auxiliaries, routine tests at the manufacturer's workshop, will be carried out according to the manufacturer's standard.

Painting work before shipment shall be carried out on the procedure of one prime coat, one under coat and one finishing coat in accordance with manufacture's standard practice.

Equipment to be welded at site and raw materials shall be painted by one under coat or treated against corrosion.

Generating set finishing coat color is « Blue RAL 5010 ».

2.1.2 - COMBUSTION AIR FILTER SYSTEM

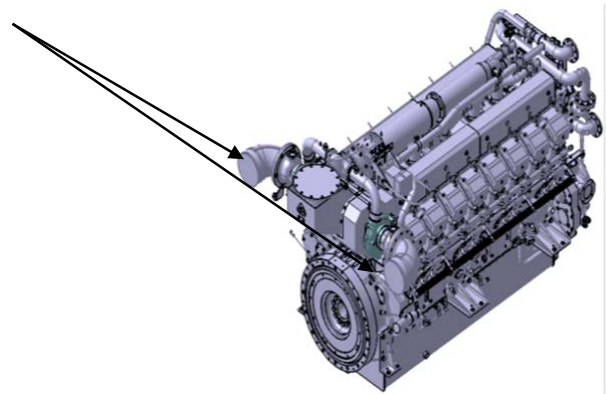


The combustion air system is based on 2 indoor air filtration casings (1 for each cylinder bank), consisting each one of:

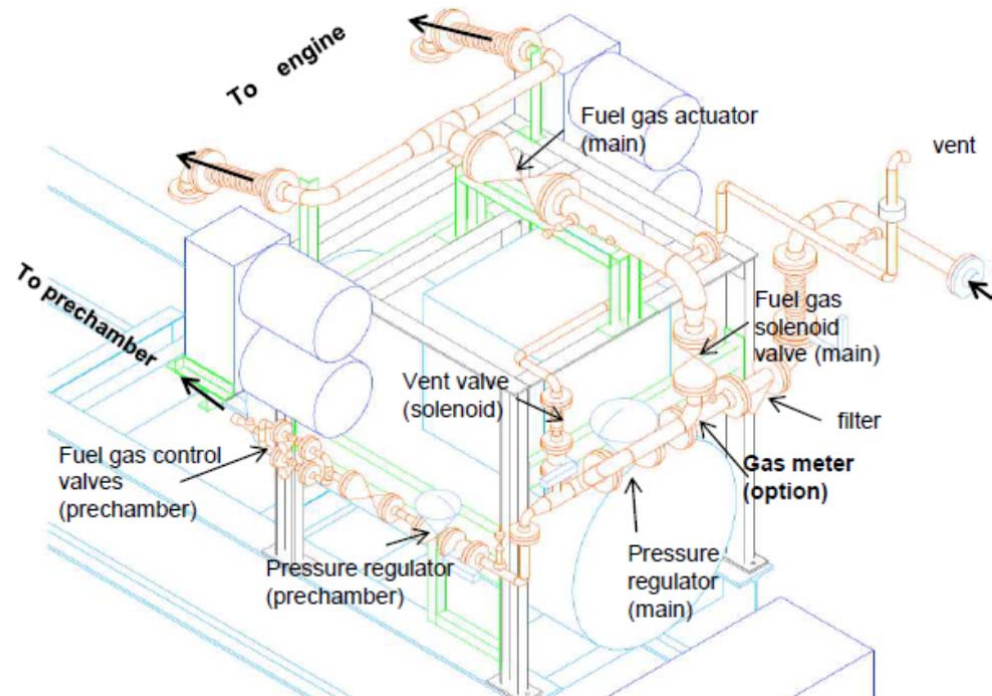
- 1 set of glass fiber paper filter, F9 filtration class (arrestance : 100% gravimetric, efficiency : >95% atmospheric) (**see note 1**)
- 1 clogging indicator with alarm
- 1 connection pipe between turbocharger and filtration casing
- 1 filtration casing

Note 1: The oil mist outlet of the engine mist separator is connected to the turbocharger inlet, to this purpose, the air filter casing will be supplied by MTEE, the air filters will be supplied and fitted on the generating set by the customer in accordance with MTEE specifications. Alternatively, they can be supplied by MTEE in option.

2 Turbocharger inlet



2.1.3 GAS LINE



The generating set package is equipped with a gas supply line installed on a steel structure over the alternator, this supply line is consisting of 2 parts:

Part 1: Main gas train including:

- Ball valve DN50
- Gas filter DN50
- Pressure gauge 0 – 10 bar
- Shut-off solenoid valve DN50
- Pressure regulator 4 – 6 bar --- 150 mbar with built in slam shut off valve DN50
- Pressure transmitter 0 – 400 mbar with min/max pressure detection
- Safety blow off valve (solenoid)
- Fuel gas regulating valve operated by engine controller
- Flexible couplings to engine inlets

Part 2: Pre chamber gas train including:

- Shutt-off solenoid valve DN25
- Pressure regulator 4 – 6 bar --- 3,5 bar DN25
- Pressure transmitter 0-10b
- 2 fuel gas regulating valves operated by engine controller
- Pressure gauge 0-10b
- Flexible coupling to engine inlet

Note : outdoor shut-off solenoid valves for safety (operated automatically on fuel gas detection or emergency push button) are out of scope. They are required to comply to CE regulation and are to be installed by the customer according to applicable standards for CE.

2.1.4 EXHAUST SYSTEM (OUT OF MTEE SCOPE)

The engine shall be equipped with an exhaust silencer, this is out of MTEE scope. It is required to comply with CE regulation about noise limitation and has to be designed based on below noise levels at engine exhaust outlet :

EXHAUST		GS16R2
Overall noise level - dB(A) at 1m distance, 1.5m height		123
Frequency (Hz)	31.5	-
	63	85
	125	111
	250	116
	500	117
	1000	114
	2000	115
	4000	115
	8000	109

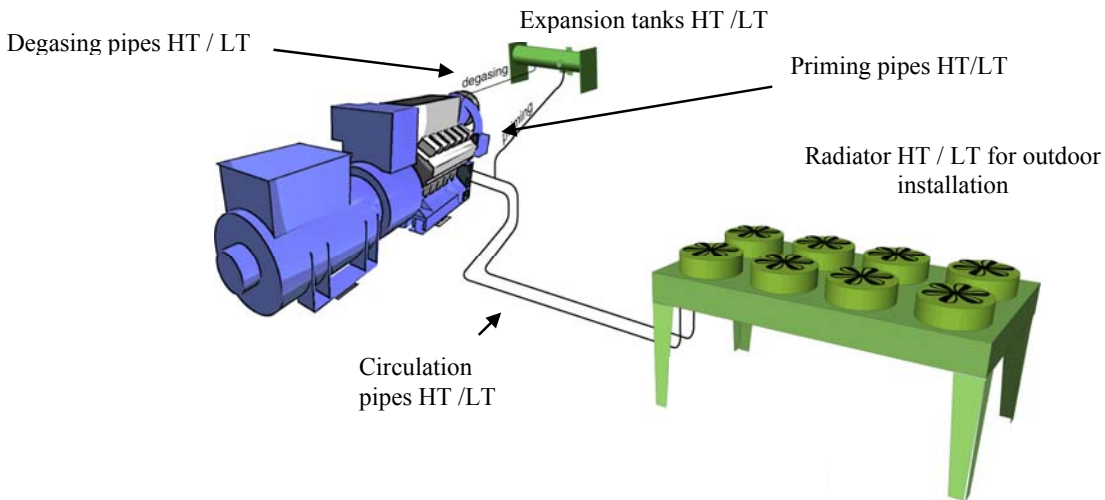
Concerning exhaust circuit, MTEE scope is limited to the loose supply of 1 exhaust bellow to be fitted at turbocharger outlet. All other items for connection to the exhaust stack shall be provided by the customer.

Heat insulation is out of scope. It is required to comply with CE regulation and is to be installed by the customer according to applicable standards for CE.

Nota : mechanical noise level of engine shall also be considered by the customer for the design of noise reduction system of the enclosure of the generator set. Following noise levels of engine shall be considered :

MECHANICAL		GS16R2
Overall noise level - dB(A) at 1m distance, 1.5m height		108
Frequency (Hz)	31.5	47
	63	75
	125	91
	250	98
	500	102
	1000	102
	2000	102
	4000	98
	8000	94

2.1.5 COOLING SYSTEM (OUT OF MTEE SCOPE, except note 1.)



The engine water circuits HT and LT shall be cooled via a dry air cooler which is not included in MTEE scope and which shall be supplied and installed by the customer.

The dry air cooler should be designed taking into consideration the engine heat balance, the recommended water temperature at engine inlet or outlet and the site conditions.

- The main specifications of the dry air cooler should be as follows:

- * Bundle made of appropriate material according to the site conditions (negative temperatures)
- * Double circuit HT/LT (High temperature circuit / Low temperature circuit)
- * Double expansion tank installed on the radiator with level indicator and low level contact
- * Air temperature : Mini and maxi at site
- * Engine heat balance : according to MTEE data sheet
- * Engine inlet and outlet temperatures : according to MTEE data sheet
- * Antifreeze with appropriate volume of Ethylen glycol
- * Low noise : according to customer request and site conditions
- * motor protection panel

Note 1: The HT and LT water temperature control valves are delivered together with genset , as loose supply parts. They have to be mounted in the cooling piping of both HT and LT circuits and connected to the control panel as per MTEE instructions.

Note 2: The HT and LT cooling water circulating pumps are out of MTEE scope and shall be supplied and installed by the customer. Alternatively, they can be supplied in option.

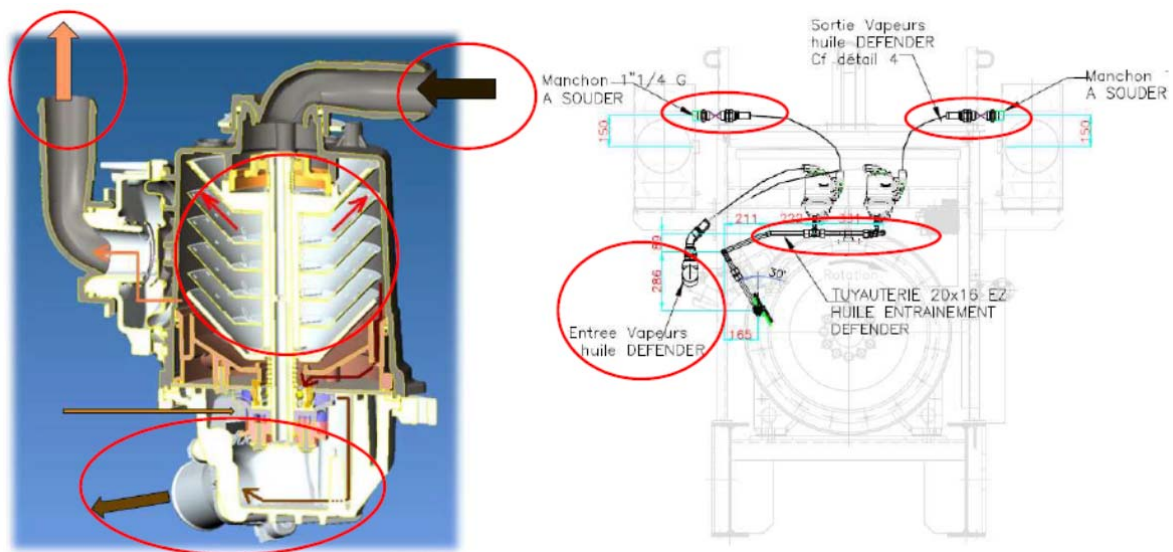
2.1.6 LUBRICATING OIL SYSTEM

The generating set is equipped with an automatic level control float switch valve fitted on engine sump dedicated to ensure automatic filling of the engine sump.

This valve should be connected to a service tank feeding the engine preferably by gravity.

The service tank and the connection pipe to the float switch valve are not included in MTEE scope and should be supplied and installed by the customer.

2.1.7 OIL MIST



The engine is equipped with an oil mist separator installed on the generating set. Oil mists are filtered before being re circulated to the turbocharger air inlet.

Therefore, oil mist is circulating in a closed loop circuit without any contamination of the atmosphere for better environmental protection.

The oil mist separator is centrifugal type “ALFA LAVAL” made driven by engine oil pressure.

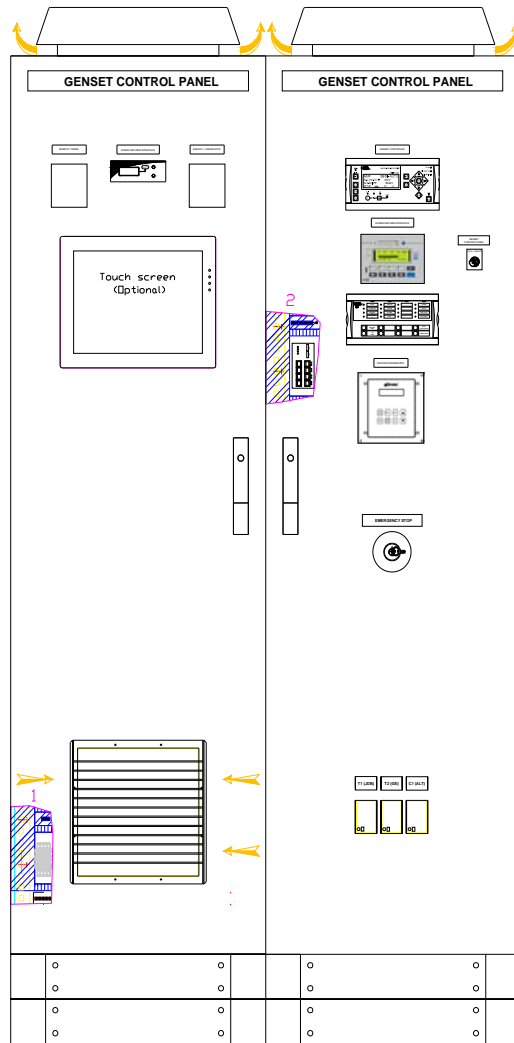
2.2 ELECTRICAL EQUIPEMENT

2.2.1 GENERATING SET CONTROL COMMAND AND AUXILIARIES PANEL

2.2.1.1 CONSTITUTION OF PANEL

Generating set control consists of followings:

- (1) 1 generating set Control Panel (GCP)



2.2.1.2 GENERAL SPECIFICATION FOR GCP

(1) Structure :	Indoor service, metal-enclosed, vertical floor mounting with double front doors cubicle type (IP55)
(2) Dimension	Width : 1200 mm (2 x 600 mm) Height : 2200 mm Depth : 600 mm
(3) Nameplate	Acryl name plates with black letters on white back grounded
(4) Painting color	Exterior RAL 7032 or 7035 Interior RAL 7032 or 7035
(5) Insulation and clearance of live parts	U.T.E., E.N., I.E.C. or manufacturer's standard
(6) Indication meters	Digital multiple meter
(7) Control power source	Auxiliary machine control voltage: AC 400/230V System : 3 phase, 4 wire Rated frequency : 50 Hz Control source voltage : DC 24V
(8) Maintenance place	Front of panel
(9) Thickness of enclosure	General : 15/10 mm Door : 20/10 mm
(10) Components and parts	All components and parts to be selected according to manufacturer's design criteria.

2.2.1.3 FUNCTION

(1) Start and stop operation

The generating set shall be started and stopped manually by specific push buttons on the Automatic Generating set Controller (AGC) located in front of the panel.

Following automatic operation systems shall be provided by the AGC :

- 1) Automatic starting and stop sequence
- 2) Automatic engine protection device

(2) Parallel operation

Synchronizing and parallel operation of generating sets shall be done both manually and automatically.

(3) Load sharing

Load sharing of the generators shall be done both manually and automatically.

(4) Optimal running unit control

The generating sets shall be started or stopped automatically according to the increase and decrease of the load demand.

(5) Engine Auxiliaries

The following auxiliary equipments shall be controlled both manually and automatically.

- 1) Jacket water pump
- 2) Inter cooler pump
- 3) Jacket water heater
- 4) Alternator heater
- 5) Lubricating oil priming pump
- 6) Radiator cooling fan
- 7) Temperature control valves for jacket water and inter cooler
- 8) Generating set ventilation fans

(6) 24V DC source

1 x 24V DC energy block is included to supply all PLC and panel equipment

1 x 24V DC charger is included to supply engine starting batteries which shall be charged automatically

(7) Monitoring and display items

The generating set control panel is equipped with Human Machine Interface (HMI) for display and monitoring of operating data, alarms and history logs. It is equipped with Ethernet TCP/IP communication port for remote access via Internet.

This HMI displays all information on a 7" LCD screen as standard.

The following monitoring devices shall be provided.

Monitoring and display items	Location				Remarks
	Automatic Generating set Controller	Energy monitoring	HMI	Touch Panel (OPTION)	
Generator					
Generator operating	X		X	X	
Generator voltage	X		X	X	
Generator current	X		X	X	
Generator frequency	X		X	X	
Generator power factor	X		X	X	
Generator active power	X		X	X	
Generator reactive power	X		X	X	
Stator winding temperature (3 phase)	X		X	X	
Generator bearing temperature	X		X	X	
Alarm (light trouble)	X		X	X	
Fault (heavy trouble)	X		X	X	
Active Energy Production (Generating set output)	X		X	X	
Reactive Energy Production (Generating set output)	X		X	X	
Active Energy Consumption (Generating set)		X	X	X	
Reactive Energy Consumption (Generating set output)		X	X	X	
Engine proper and fuel supply system					
Engine speed	X		X	X	
Fuel gas flow rate			X	X	
Fuel gas inlet pressure			X	X	
Pre-chamber gas pressure			X	X	
Intake manifold pressure			X	X	
Lubricating oil pressure			X	X	
Lubricating oil temperature			X	X	
Jacket coolant outlet temperature			X	X	
Intercooler coolant inlet temperature			X	X	
Air-fuel mixture temperature			X	X	
Air inlet temperature			X	X	
N°1 cylinder exhaust gas outlet temp			X	X	
N°2 cylinder exhaust gas outlet temp			X	X	

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N°3 cylinder exhaust gas outlet temp			X	X
N°4 cylinder exhaust gas outlet temp			X	X
N°5 cylinder exhaust gas outlet temp			X	X
N°6 cylinder exhaust gas outlet temp			X	X
N°7 cylinder exhaust gas outlet temp			X	X
N°8 cylinder exhaust gas outlet temp			X	X
N°9 cylinder exhaust gas outlet temp			X	X
N°10 cylinder exhaust gas outlet temp			X	X
N°11 cylinder exhaust gas outlet temp			X	X
N°12 cylinder exhaust gas outlet temp			X	X
N°13 cylinder exhaust gas outlet temp			X	X
N°14 cylinder exhaust gas outlet temp			X	X
N°15 cylinder exhaust gas outlet temp			X	X
N°16 cylinder exhaust gas outlet temp			X	X
Engine outlet exhaust gas temp			X	X
Crankcase pressure			X	X
Auxiliaries				
Priming pump operating	X		X	X
Jacket water heater	X		X	X
Alternator space heater			X	X
Lubricating oil tank level	X		X	X
Cooling water reserve tank level	X		X	X
Jacket water circulating pump operating	X		X	X
Intercooler water circulating pump operating	X		X	X
Generating set ventilation fans operating	X		X	X

(8) Protective equipments

To minimize troubles and damage to the gas generator set, protective and alarm devices are provided.

Alarm system and protective devices shall operate automatically in the events of the following abnormal conditions

Designation		Alarm	Trip	Instantaneous shutdown	Shutdown with cooling down	I. T. retard	Setpoint	Unit	Adjustable	Sensor type	Signal type
ALARMS AND SAFETY SWITCHES											
Lube Oil	Lubricating oil low pressure approach	x					4.0	bar	x	engine transmitter	4-20 mA
	Lubricating oil low pressure		x	x			3.0	bar	x		
	Lubricating oil low pressure		x	x			1.5	bar		Pressure switch	dry contact
	Lubricating oil high temperature approach	x					100	°C	x	engine thermocouple	type T
	Lubricating oil high temperature		x		x		105	°C	x		
	Lubricating oil level low		x	x					x	float switch	dry contact
Cooling water	Jacket coolant high temperature approach	x					85	°C	x	engine thermocouple	type T
	Jacket coolant high temperature		x		x		98	°C	x		
	Jacket coolant high temperature		x		x		98	°C		T° switch	dry contact
	Intercooler coolant high temperature approach	x					55	°C	x	engine thermocouple	type T
	Jacket coolant low level	x					70	%		floating switch	dry contact
	Jacket coolant low low level		x	x			50	%		floating switch	dry contact
	Intercooler coolant low level	x					70	%		floating switch	dry contact
	Intercooler coolant low low level	x					50	%		floating switch	dry contact
	Pre-heating failure	x					30	°C		engine switch	dry contact
	Pre-heating control						50	°C	x	thermoswitch	dry contact
Ignition	Igniter abnormal		x	x						CD200D	dry contact
	Fuel control abnormal approach	x								ECM3	dry contact
	Fuel control abnormal		x	x							
	Knocking approach	x				x				DET1600	dry contact
	Knocking		x	x							

Designation		Alarm	Trip	Instantaneous shutdown	Shutdown with cooling down	I.T. retard	Setpoint	Unit	Adjustable	Sensor type	Signal type
SAFETY PROTECTION SETTINGS - MECHANICAL											
Air intake - exhaust	crankcase high pressure approach	x					2.5	kPa	x	engine transmitter	4-20 mA
	crankcase high pressure		x	x			5	kPa	x		
	Exhaust gas high temperature approach	x					460	°C	x	engine thermocouple	type K
	Exhaust gas high temperature		x	x			500	°C	x		
	Misfiring - Exhaust gas low temperature (1 cyl)	x				x	AVG-30	°C	x	engine cylinder thermocouple	type K
	Exhaust gas high temperature (1 cylinder)	x				x	AVG+30	°C	x		
	Misfiring - Exh gas high temp approach(1 cyl)	x					610	°C	x		
	Misfiring - Exhaust gas high temperature (1 cyl)		x	x			630	°C	x		
	Misfiring - Exhaust gas low temperature (>1 cyl)		x	x			AVG-50	°C	x		
	Intake manifold high pressure approach	x					2.8	bar	x	engine transmitter	4-20 mA
	Intake manifold high pressure		x	x			2.95	bar	x		
	Air-fuel mixture high temperature approach	x					70	°C	x	engine thermocouple	type T
	Air-fuel mixture high temperature		x	x			75	°C	x		
	Fuel gas low pressure approach	x					0.08	bar	x	pressure transmitter	4-20 mA
	Fuel gas pressure low		x	x			0.06	bar	x		
Ambiant temperature high (air inlet)	x					40	°C	x	T° 0-100°C	4-20 mA	
Others	Overspeed		x	x			1725	rpm	x	engine pickup	internal (AGC)
	Start failure		x				3	--	x		
	Emergency stop		x	x			--	--			dry contact
	24Vdc battery charger low voltage	x					22	V			dry contact
	24Vdc battery charger failure	x					--	--			dry contact
	PLC battery low voltage	x					2	V			internal (AGC)
	Auxiliary supply failure	x					--	--			dry contact
	Auxiliary breaker failure	x					--	--			dry contact
	Generator windings high temperature approach	x					110	°C	x	PT100	PT100
	Generator windings high temperature				x		130	°C	x		
	Generator bearing high temperature approach	x					85	°C	x	PT100	PT100
	Generator bearing high temperature				x		90	°C	x		
	Fire detection		x	x			--	--		fire det. system	dry contact
	Gas leakage detection, 1st level	x					20%	LIE		gas det. system	dry contact
	Gas leakage detection, 2nd level		x	x			40%	LIE			

Designation	alarm	shutdown	excitation cut off	instantaneous shutdown	shutdown with cooling	setpoint	timer	adjustable	remark
<u>SAFETY PROTECTION SETTINGS - ELECTRICAL</u>									
overload (51)	x	x				2965 A	8 s	x	110%
over current (50)	x	x	x	x		6739 A	0,5 s	x	250%
reverse power (32)	x	x				-75 kW	10 s	x	5%
under voltage (27)	x	x				320 V	0,5 s	x	80%
over voltage (59)	x	x				480 V	0,5 s	x	120%
over frequency (81u)	x	x		x		57.5 Hz	0,2 s	x	115%
under frequency (81d)	x	x				47.5 Hz	15 s	x	95%
vector jump (78)	x	x				12°	-	x	Enable / disable
excitation loss (40)	x	x				-360 kVAr	0,1 s	x	20%
synchro check (25)	x	x				-	-	x	
earth fault (51N)	x	x			x	20kOhms	-	x	

(*) These settings apply to the safety protection system of the genset control panel which is to be connected to a suitable protection circuit breaker which is out of scope. This circuit breaker is required to comply to CE regulation and is to be installed by the customer according to applicable standards for CE.

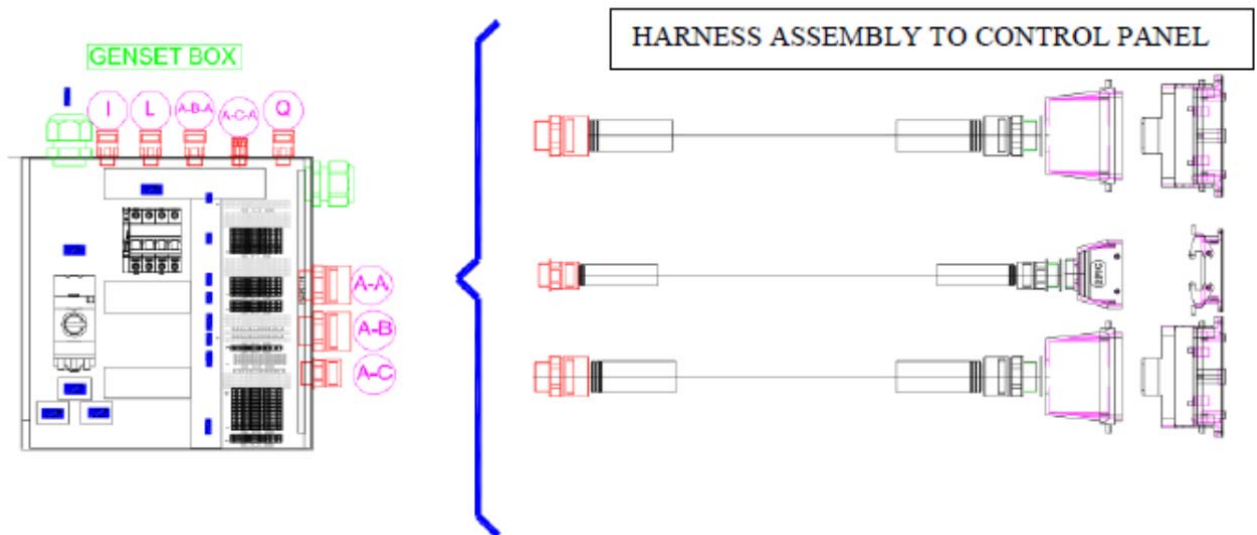
Nota : All wirings are out of MTEE scope :

- Command, control and signaling cables between generating set and GCP
- Command, control and signaling cables between auxiliaries and GCP
- Power supply auxiliary cables between auxiliaries and GCP
- Power supply cables between GCP and remote box of radiator fans

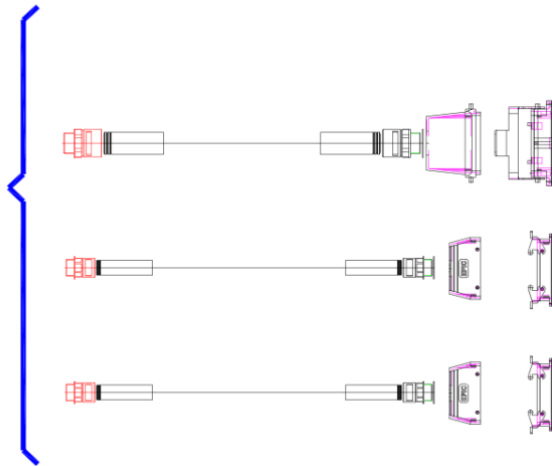
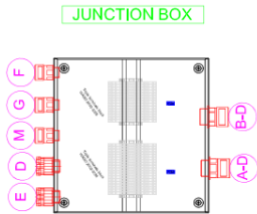
2.2.2 HARNESS ASSEMBLY CABLE BETWEEN GENERATING SET AND CONTROL PANEL

In addition to the generating set, we can supply:

- A Harness Assembly prefabricated cable (HA) made of full set of cables and industrial connectors between generating set base frame / box and Generating set Control Panel (GCP).

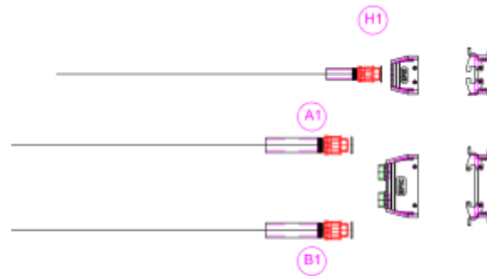
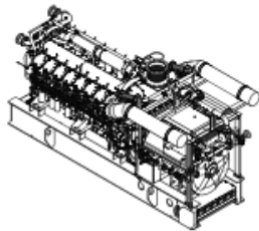


HARNESS ASSEMBLY TO CONTROL PANEL

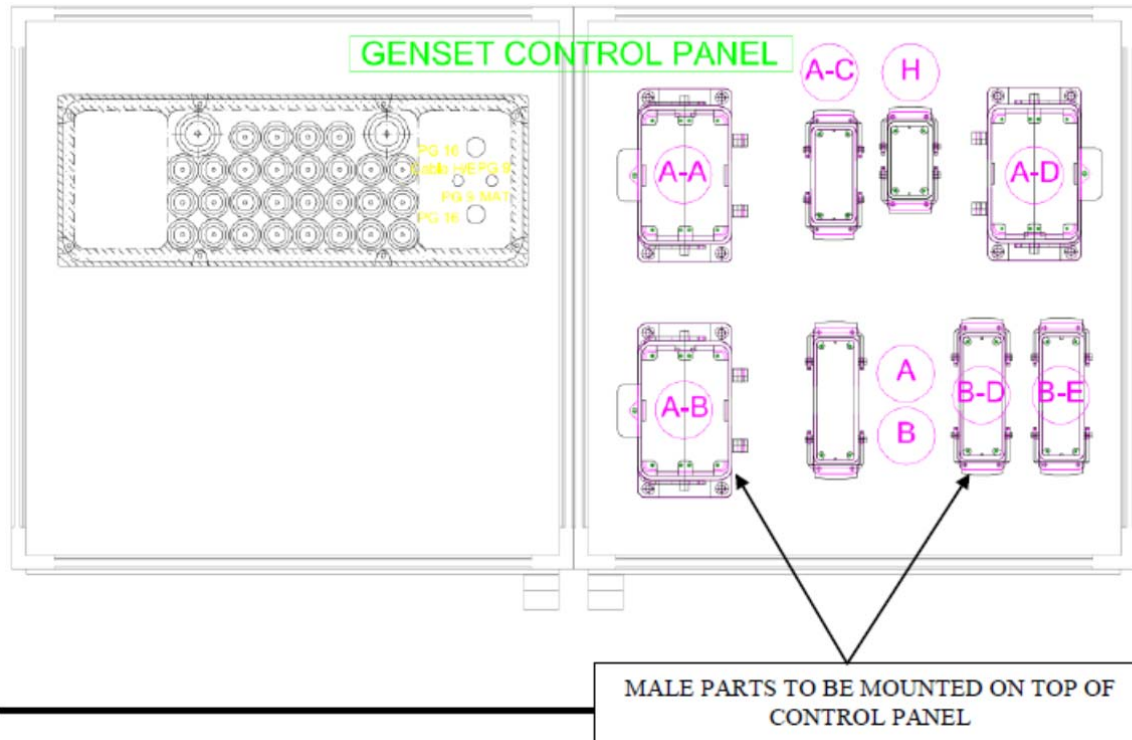


HARNESS ASSEMBLY TO CONTROL PANEL

GENSET



- Available length between end of generating set base frame and GCP = 10m.
- HA will be delivered pre-wired at generating set base frame side. Industrial connectors: female at cable end side, male on top of GCP.
- This HA reduce the cabling time at site to almost nothing because you have only to connect the HA to the top of the GCP
- It prevents any cabling mistake because there is no more wire to connect on terminals (requiring wire check) but only connectors with keyway. All cables of this HA are suitable for vibration level of generating set and protected against mechanical chocks and liquid projections by rigid sheath.



2.3 ENGINEERING - DOCUMENTATION

The following documentation will be supplied:

- Layout drawing of generating set
- Layout drawing of generating set control panel
- Civil works guidance drawing
- Generating set tests report
- Fluids schematics of included equipment
- Electrical schematics of included equipment
- Electrical cable list
- File of executed works
- 1 set of generating set operation manual
- 1 set of generating set spare parts book

Preliminary engineering documentation will be supplied in English language.
Final documentation will be supplied in Russian language.

3 GAS, LUBRICATING OIL AND COOLANT SPECIFICATION

3.2 FUEL GAS SPECIFICATION

The values in blue bolted characters have to be confirmed by the customer.

3.2.1 GAS ANALYSIS

Content of Fuel Gas	% Vol
CO ₂	0.025
N ₂	0.316
O ₂	0.005
H ₂	—
HE	0.009
CH ₄	99.543
C ₂ H ₆	0.102
C ₃ H ₈	—
Iso-C ₄ H ₁₀	—
Nor-C ₄ H ₁₀	—
Iso-C ₅ H ₁₂	—
Nor-C ₅ H ₁₂	—
Neo-C ₅ H ₁₂	—
C ₆ H ₁₄	—
C ₇ H ₁₆	—
C ₈ H ₁₈	—
C ₉ H ₂₀	—
C ₁₀ H ₂₂	—
C ₁₁ H ₂₄ +	—
% Vol Total	100

3.2.2 TEMPERATURE AND PRESSURE

The values in blue bolted characters have been confirmed by ITE.

	Unit	Limit	Data	Remark
Maximum temperature	°C	60	The Customer will install necessary gas heating system to match recommended gas temperature limits	
Minimum temperature	°C	10		
Maximum pressure	kPa	600	When gas pressure available at site is over 6 bar, the customer shall supply and install pressure regulating equipment down to 6 bar.	
Minimum pressure	kPa	350		
Fuel pressure fluctuation	kPa (+/-)	1.7		

3.2.3 FUEL GAS CALORIE

	Unit	Limit	Data	Remark
Calorie fluctuation	MJ / 5 min	+ / - 1.0		TBC by the customer

3.2.4 CONTAMINANTS

Contaminant	Unit	Limit	Data	Remark
Sulfur compounds as H ₂ s	ppm	10	TBC by the customer	Note 1
Halide compounds as Cl	mgCl / MJ	0		Note 2
Nitrogen compounds as NH ₃	mgNH ₃ / MJ	0		
Oil content	mg / MJ	1.19		
Particulates	mg / MJ	0.8		Note 3
Particulates size in fuel	micron	50		
Silicon compounds as Si	mgSI / MJ	0.1		
Water content	% (RH)	80		

Data received from ITE:

- Mass concentration of hydrogen sulfide < (less) 0,0001 g/m³**
- Mass concentration of mercaptan sulfur < (less) 0,0002 g/m³**
- Mass of of mechanical impurities in 1 m³ - absent**

Note 1:

Sulfur compounds are those which contain sulfur.

Total sulfur level should account for all sulfur and be expressed as hydrogen sulfide.

Note 2:

Halide compounds are those which contain chlorine, fluorine, iodide or bromine.

Total Halide level should account for all halides and be expressed as chlorine.

Note 3:

Total particulate level must include inorganic silicon.

Limit shown for silicon must account for the total organic (siloxanes, etc ...) and inorganic silicon content.

At low temperatures, hydrocarbon fuels may condense and enter the engine. Liquids are never permitted in the fuel.

3.3 COOLANT SPECIFICATIONS

Item	Chemical symbol	Unit	Recommended limit	Main malign effect	
				Corrosion And rust	Scale formation
PH(25 deg.C)	-----	-----	6.5 à 8.5	○	○
Electrical conductivity (25 deg.C)	-----	$\mu\Omega/cm$	< 400	○	○
Total hardness	$CaCO_3$	ppm	< 100	-----	○
M alkalinity	$CaCO_3$	ppm	< 150	-----	○
Chlorine ion	Cl^-	ppm	< 100	○	-----
Sulfuric acid ion	SO_4^{2-}	ppm	< 100	○	-----
Total iron	Fe	ppm	< 1.0	-----	○
Silica	SiO_2	ppm	< 50	-----	○
Résidue from evaporation	-----	ppm	< 400	-----	○

This specification indicates the limitation for the new water.

Never use raw water alone as coolant water treatment with rust inhibitor or ethylene glycol base antifreeze is required (Antifreeze is preferred).

Maintain the antifreeze concentration more than 30% against corrosion.

3.4 RECOMMENDED LUBRICATING OIL

Manufacturer	Type
Mobil	Pegasus 1 005

Remark:

Lubricating oil for gas engine shall be used according to our recommended list as above.
If other oils are used, we are not able to keep any guarantee.