DOCKETED	
Docket Number:	23-OPT-02
Project Title:	Darden Clean Energy Project
TN #:	260649
Document Title:	Supplemental Data Response Set 1 - Appendix A SUP DR AQ-2 and Appendix B SUP DR AQ-3
Description:	Supplemental Data Response Set 1 - Appendix A SUP DR AQ-2 Darden Operational Equipment Summary Includes equipment, criteria pollutant emissions, and greenhouse gas emissions summaries, for both the original project and the project without the green hydrogen facility, provided in response to SUP DR AQ-2 as Appendix A of Supplemental Response Set 1. Supplemental Data Response Set 1 - Appendix B SUP DR AQ-3 Supplemental SJVAPCD Permit Form and LPG Specifications Includes supplemental information provided to San Joaquin Valley Air Pollution Control District based on project updates, provided in response to SUP DR AQ-3 as Appendix B of Supplemental Response Set 1.
Filer:	Megan Knight
Organization:	Rincon Consultants, Inc.
Submitter Role:	Applicant Consultant
Submission Date:	12/13/2024 4:19:28 PM
Docketed Date:	12/13/2024

Appendix A

SUP DR AQ-2 Darden Operational Equipment Summary

Darden Clean Energy Project

Equipment Summary, Original Project

Engine Information

Engine No.	Make / Model	Location	# of Units	Size (ekW)	Size (bhp)	Fuel	Reference File Name
1A	Power Solutions Int'l (PSI) 8800CAC (LPG)	Step Up Substation Option 1	1	150	262	LPG	Oberon MTU GS150 submittal file Rev. 1.pdf
1B	Emergency Generator Set	Step Up Substation Option 2	1	150	262		
2		Step Down Substation	1	150	262		
3A	CAT C18 Fire Pump Engine	Option 1	2	400	536	Diesel	C18FP_EM0067 Perf Data.pdf
3B		Option 2	2	400	536		
3C		Option 3	2	400	536		
4A	CAT C18 Diesel Emergency Generator Set	Option 1	2	600	805	Diesel	600kw C18_LEHE1581-02.pdf
4B		Option 2	2	600	805		
4C		Option 3	2	600	805		

Notes: ekW = electrical kilowatts; bhp = brake horsepower; LPG = liquified petroleum gas

Emission Rates

				NOx Emission Factor (g/bhp-hr)		VOC Emission Factor (g/bhp-hr)		CO Emission Factor (g/bhp-hr)		SOx Emission Factor (g/bhp-hr)		PM Emission Factor (g/bhp-hr)		NH3	CO2	CH4	N2O
Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Controlled		g/bhp-hr	
1A, 1B, 2	Spec Sheets	1	100	n/a	1	n/a	0.7	n/a	2	n/a	n/a	n/a	n/a	n/a	*	*	*
3A, 3B, 3C	US EPA Tier 3	1	100	2.85	2.85	0.15	0.15	2.6	2.6	2.05E-03	2.05E-03	0.15	0.15	n/a	568	0.023	0.005
4A, 4B, 4C	US EPA Tier 2 / Tier 4	1	100	4.56	0.5	0.24	0.14	2.6	2.6	2.05E-03	2.05E-03	0.15	0.022	n/a	568	0.023	0.005

Notes: US EPA = United States Environmental Protection Agency; NOx = oxides of nitrogen; VOC = volatile organic compounds; CO = carbon monoxide; SOx = sulfur oxides; PM = particulate matter; NH3 = ammonia; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxides; g/bhp-hr = grams per brake horsepower-hour

* The LPG engine has emission factors based on fuel flow rates as provided by the US EPA's 2023 Emission Factor for Greenhouse Gas Inventories. The engine fuel consumption at 100% rating is 695 ft3/hr (or 19.7 m3/hr).

Per Table A of Appendix A of SCAQMD's *Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Threshold* s, for Electric Generation, PM10 is 96% of Total PM and PM2.5 is 93.7% of Total PM. For the Fire Pump Engines, PM10 is 97.6% of Total PM and PM2.5 is 96.7% of Total PM

SOx Factors from AP-42 Table 3.3-1

Stack Parameters

Engine No.	SJVAPCD Source ID	UTM X	UTM Y	Release Height (m)	Stack Diameter (m)	Temp (K)	Gas Velocity (m/s)	Gas Flow Rate (cfm)
1A	275_DE	749650	4040200	2.43	0.12	795.31	50.25	1204.2
1B	275_DE	746900	4036800	2.43	0.12	795.31	50.25	1204.2
2	275_DE	733300	4034400	2.43	0.12	795.31	50.25	1204.2
3A	600_DE	748500	4040200	3.71	0.16	793.56	92.45	3938.6
3B	600_DE	747100	4036100	3.71	0.16	793.56	92.45	3938.6
3C	600_DE	733300	4034100	3.71	0.16	793.56	92.45	3938.6
4A	825_DE	748500	4040200	6.07	0.19	784.00	87.68	5267.5
4B	825_DE	747100	4036100	6.07	0.19	784.00	87.68	5267.5
4C	825_DE	733300	4034100	6.07	0.19	784.00	87.68	5267.5

Notes: m = meters; m/s = meters per second; cfm = cubic feet per minute

SJVAPCD stack parameters provided via email on 2/15/2024.

UTM = Universal Transvers Mercator Coordinate; coordinate locations are based on assumed equipment locations.

Darden Clean Energy Project

Equipment Summary, Project Update w/o Green Hydrogen Facility

Engine Information

Engine No.	Make / Model	Location	# of Units	Size (ekW)	Size (bhp)	Fuel	Reference File Name
1	Power Solutions Int'l (PSI) 8800CAC (LPG) Emergency Generator Set	Step Up Substation	1	150	262	LPG	Oberon MTU GS150 submittal file Rev. 1.pdf
2			1	150	262		
3			1	150	262		

Notes: ekW = electrical kilowatts; bhp = brake horsepower; LPG = liquified petroleum gas

Emission Rates

				NOx Emission Factor (g/bhp-hr)		VOC Emission Factor (g/bhp-hr)		CO Emission Factor (g/bhp-hr)		SOx Emission Factor (g/bhp-hr)		PM Emission Factor (g/bhp-hr)		NH3	CO2	CH4	N2O
Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Controlled		g/bhp-hr	
3-Jan	Spec Sheets	1	100	n/a	1	n/a	0.7	n/a	2	n/a	n/a	n/a	n/a	n/a	*	*	*

Notes: US EPA = United States Environmental Protection Agency; NOx = oxides of nitrogen; VOC = volatile organic compounds; CO = carbon monoxide; SOx = sulfur oxides; PM = particulate matter; NH3 = ammonia; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxides; g/bhp-hr = grams per brake horsepower-hour

* The LPG engine has emission factors based on fuel flow rates as provided by the US EPA's 2023 Emission Factor for Greenhouse Gas Inventories. The engine fuel consumption at 100% rating is 695 ft3/hr (or 19.7 m3/hr).

Per Table A of Appendix A of SCAQMD's *Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Threshold* s, for Electric Generation, PM10 is 96% of Total PM and PM2.5 is 93.7% of Total PM. For the Fire Pump Engines, PM10 is 97.6% of Total PM and PM2.5 is 96.7% of Total PM

SOx Factors from AP-42 Table 3.3-1

Stack Parameters

Engine No.	SJVAPCD Source ID	UTM X	UTM Y	Release Height (m)	Stack Diameter (m)	Temp (K)	Gas Velocity (m/s)	Gas Flow Rate (cfm)
1	275_DE	749650	4040200	2.43	0.12	795.31	50.25	1204.2
2	275_DE			2.43	0.12	795.31	50.25	1204.2
3	275_DE			2.43	0.12	795.31	50.25	1204.2

Notes: m = meters; m/s = meters per second; cfm = cubic feet per minute

SJVAPCD stack parameters provided via email on 2/15/2024.

UTM = Universal Transvers Mercator Coordinate; coordinate locations are based on assumed equipment locations.

Darden Clean Energy Project

Criteria Pollutant Emissions Summary, Original Project

Emission Calculations, Hourly

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	NOx lb/hr	VOC lb/hr	CO lb/hr	SOx lb/hr	PM lb/hr
1A	Spec sheets	1	100	0.578	0.404	1.155	0	0
1B	Spec sheets	1	100	0.578	0.404	1.155	0	0
2	Spec sheets	1	100	0.578	0.404	1.155	0	0
3A	US EPA Tier 3	1	100	6.741	0.355	6.149	0.005	0.355
3B	US EPA Tier 3	1	100	6.741	0.355	6.149	0.005	0.355
3C	US EPA Tier 3	1	100	6.741	0.355	6.149	0.005	0.355
4A	US EPA Tier 2 / Tier 4	1	100	5.375	0.585	9.224	2.311	0.078
4B	US EPA Tier 2 / Tier 4	1	100	5.375	0.585	9.224	2.311	0.078
4C	US EPA Tier 2 / Tier 4	1	100	5.375	0.585	9.224	2.311	0.078

Note: Assuming 0.25 hr uncontrolled and 0.75 hr controlled for Tier 4 equipment. Except for PM, assuming no startup time required and 100% emissions controlled through DPF.

Emission Calculations, Annual

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	NOx lb/yr	VOC lb/yr	CO lb/yr	SOx lb/yr	PM lb/yr
1A	Spec sheets	1	100	57.8	40.4	115.5	0	0
1B	Spec sheets	1	100	57.8	40.4	115.5	0	0
2	Spec sheets	1	100	57.8	40.4	115.5	0	0
3A	US EPA Tier 3	1	100	674.1	35.5	614.9	0.5	35.5
3B	US EPA Tier 3	1	100	674.1	35.5	614.9	0.5	35.5
3C	US EPA Tier 3	1	100	674.1	35.5	614.9	0.5	35.5
4A	US EPA Tier 2 / Tier 4	1	100	207.0	35.9	627.2	56.2	7.8
4B	US EPA Tier 2 / Tier 4	1	100	207.0	35.9	627.2	56.2	7.8
4C	US EPA Tier 2 / Tier 4	1	100	207.0	35.9	627.2	56.2	7.8
		Total Emissions Per Project Option:		**996.6**	**152.2**	**1473.2**	**56.7**	**43.3**

Note: Assuming 12 startup events for T&M, the remaining 88 hours assumed controlled for the Tier 4 equipment.

Darden Clean Energy Project

Criteria Pollutant Emissions Summary, Project Update w/o Green Hydrogen Facility

Emission Calculations, Hourly

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	NOx lb/hr	VOC lb/hr	CO lb/hr	SOx lb/hr	PM lb/hr
LPG1	Spec sheets	1	100	0.578	0.404	1.155	0	0
LPG2	Spec sheets	1	100	0.578	0.404	1.155	0	0
LPG3	Spec sheets	1	100	0.578	0.404	1.155	0	0
			Max Hourly Project Emissions (Update):	0.578	0.404	1.155	0.000	0.000
			Max Hourly Emissions, Original Project:	6.741	0.585	9.224	2.311	0.355
			Difference in Emissions:	**-6.2**	**-0.2**	**-8.1**	**-2.3**	**-0.4**
			% Difference:	**-91%**	**-31%**	**-87%**	**-100%**	**-100%**

Note: Assuming 0.25 hr uncontrolled and 0.75 hr controlled for Tier 4 equipment. Except for PM, assuming no startup time required and 100% emissions controlled through DPF.

Emission Calculations, Annual

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	NOx lb/yr	VOC lb/yr	CO lb/yr	SOx lb/yr	PM lb/yr
LPG1	Spec sheets	1	100	57.8	40.4	115.5	0	0
LPG2	Spec sheets	1	100	57.8	40.4	115.5	0	0
LPG3	Spec sheets	1	100	57.8	40.4	115.5	0	0
			Total Project Emissions (Update):	**173.3**	**121.3**	**346.6**	**0.0**	**0.0**
			Total Emissions, Original Project:	**996.6**	**152.2**	**1473.2**	**56.7**	**43.3**
			Difference in Emissions:	**-823.4**	**-30.9**	**-1126.7**	**-56.7**	**-43.3**
			% Difference:	**-83%**	**-20%**	**-76%**	**-100%**	**-100%**

Note: Assuming 12 startup events for T&M, the remaining 88 hours assumed controlled for the Tier 4 equipment.

Darden Clean Energy Project

Greenhouse Gas Emissions Summary, Original Project

Emission Calculations, Hourly

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	CO2 lb/hr	CH4 lb/hr	N2O lb/hr	CO2e lb/hr
1A	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69
1B	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69
2	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69
3A	US EPA Tier 3	1	100	1343.4168	0.0544	0.0118	1348.30
3B	US EPA Tier 3	1	100	1343.4168	0.0544	0.0118	1348.30
3C	US EPA Tier 3	1	100	1343.4168	0.0544	0.0118	1348.30
4A	US EPA Tier 2 / Tier 4	1	100	2015.1252	0.0816	0.0177	2022.45
4B	US EPA Tier 2 / Tier 4	1	100	2015.1252	0.0816	0.0177	2022.45
4C	US EPA Tier 2 / Tier 4	1	100	2015.1252	0.0816	0.0177	2022.45

Notes: CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents

Emission Calculations, Annual

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	CO2 MT/yr	CH4 MT/yr	N2O MT/yr	CO2e MT/yr
1A	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
1B	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
2	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
3A	US EPA Tier 3	1	100	60.94	1.66E-02	1.90E-04	61.41
3B	US EPA Tier 3	1	100	60.94	1.66E-02	1.90E-04	61.41
3C	US EPA Tier 3	1	100	60.94	1.66E-02	1.90E-04	61.41
4A	US EPA Tier 2 / Tier 4	1	100	91.40	7.66E-03	2.89E-04	91.68
4B	US EPA Tier 2 / Tier 4	1	100	91.40	7.66E-03	2.89E-04	91.68
4C	US EPA Tier 2 / Tier 4	1	100	91.40	7.66E-03	2.89E-04	91.68
		Total Emissions Per Project Option:		**160.4**	**0.02**	**0.001**	**161.2**

Darden Clean Energy Project

Greenhouse Gas Emissions Summary, Project Update w/o Green Hydrogen Facility

Emission Calculations, Hourly

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	CO2 lb/hr	CH4 lb/hr	N2O lb/hr	CO2e lb/hr
LPG1	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69
LPG2	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69
LPG3	Spec sheets	1	100	89.3165	0.0044	0.0009	89.69

Notes: CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents

Emission Calculations, Annual

Engine No.	Emission Factors Source	Max Daily Hours	Max Annual Hours	CO2 MT/yr	CH4 MT/yr	N2O MT/yr	CO2e MT/yr
LPG1	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
LPG2	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
LPG3	Spec sheets	1	100	4.05	1.14E-04	1.60E-05	4.06
			Total Project Emissions (Update):	**12.2**	**3.43E-04**	**4.80E-05**	**12.2**
			Total Emissions, Original Project:	**160.4**	**0.0**	**0.0**	**161.2**
			Difference in Emissions:	**-148.3**	**0.0**	**0.0**	**-149.0**
			% Difference:	**-92%**	**-99%**	**-91%**	**-92%**

Appendix B

SUP DR AQ-3 Supplemental SJVAPCD Permit Form and LPG Specifications

San Joaquin Valley Air Pollution Control District

Supplemental Application Form

Emergency/Low-Use IC Engines

Please complete one form for each engine.

This form must be accompanied by a completed Authority to Construct/Permit to Operate Application form

Permit to be issued to: IP Darden I, LLC c/o Intersect Power, LLC
Location where the equipment will be operated: See Attachment
Installation date: tbd

EQUIPMENT DESCRIPTION

Engine Details

Engine Manufacturer: PSI		Engine Tier Rating: n/a
Engine Model: PSI 8.8L T CAC		Engine Year of Manufacture: tbd
Engine Serial Number: tbd		
EPA Certification Family Number: N P S I B 8 . **8** 0 E M T		
Engine's Type of Combustion: ☐ Rich-Burn ☐ Lean-Burn ☐ 4-Stroke ☐ 2-Stroke		
Maximum Intermittent Brake Horsepower Rating of the Engine (per the Engine Data Plate): _____ bhp		
Engine's Rated Power Output for the Process the Engine Serves: 230.12 bhp		

Process Data

Process the Engine Serves: Emergency Backup Power		
Electrical Power Generation Only	Generator Manufacturer: Marathon	Model: 431CSL6208
	Power Output: 150 kW	
Will this equipment be used in an electric utility rate reduction program? ☐ Yes ☒ No		

Fuel Data

Fuel Type: ☐ Diesel ☐ Natural Gas ☒ LPG/Propane ☐ Gasoline ☐ Other: _____
For "Other" fuels only: Higher Heating Value: _____ Btu/scf, or _____ Btu/gal, For "Other" fuels only: An Ultimate Fuel Analysis or the combustion F-Factor _____dscf/MMBtu
Sulfur Content: _____ gr/100 scf (gaseous fuel) or _____ % by weight (liquid fuel)
Fuel Consumption at Maximum Rated Output: _____ gal/hr, or 695 scf/hr

Rule 4702 Type of Use

☒ **Emergency Standby** - Limited exclusively to power primary mechanical or an electrical generator during periods of unscheduled power outages beyond the control of the operator, and limited to 20 - 100 hr/yr (depending on the engine's PM_{10} emission factor) for maintenance and testing operation.

- ☐ This engine is specifically used to power a pump for a municipal water supply.
  - ☐ I request the higher opacity limit of 40% with the corresponding operational limits of 30 minutes per week and 2 hours per month for maintenance and testing. (CH&SC 41701.6)
  - ☐ I request the lower opacity limit of 20%.
- ☐ This engine is specifically used to provide power at a health care facility. (CH&SC 1250)
  - ☐ This engine is subject to Office of Statewide Health Planning and Development (OSHPD) requirements.

☐ **Special Case Emergency** - Limited exclusively to preserve or protect property, human life, or public health during a disaster or a state emergency (e.g. fire or flood) and limited to 20 - 100 hr/yr (depending on the engine's PM_{10} emission factor) for maintenance and testing operation.

- ☐ This engine is specifically used to power a direct-drive firewater pump.
  - ☐ This firewater pump engine is subject to National Fire Protection Association (NFPA) requirements.

☐ **Low Use** - Limited to ≤ 200 hr/yr of operation for **ALL** purposes combined, including maintenance and testing.

Hour Meter

Note: All engines are required to have either a nonresettable elapsed time meter or an alternate device, method, or technique, approved by the APCO, for determining elapsed operating time.

☒ Equipped with a Nonresettable Elapsed Operating Time Meter

☐ Alternate Method (please provide details): _____

EMISSIONS CONTROL

Emissions Control Equipment (Check all that apply)	☐ Positive Crankcase Ventilation	☐ 90% Efficient crankcase emission control device
	☐ Turbocharger	☐ Intercooler/Aftercooler
	☐ Automatic Air/Fuel Ratio or O_2 Controller - Manufacturer: _____	
	☒ Non-Selective Catalytic Reduction: Manufacturer: EMIT Model: RE-1450-T Control Efficiencies: NO_X 50+ %, SO_X _____ %, PM_{10} n/a %, CO 50+ %, VOC 30+ %	
	☐ Particulate Filter - Manufacturer: _____ Model: _____ Control Efficiency: _____ %	
	☐ Other (please specify):	

EMISSIONS DATA

Note: See District BACT and District Rule 4702 requirements for applicability to proposed engine at http://www.valleyair.org/busind/pto/bact/chapter3.pdf and http://www.valleyair.org/rules/currntrules/r4702.pdf.

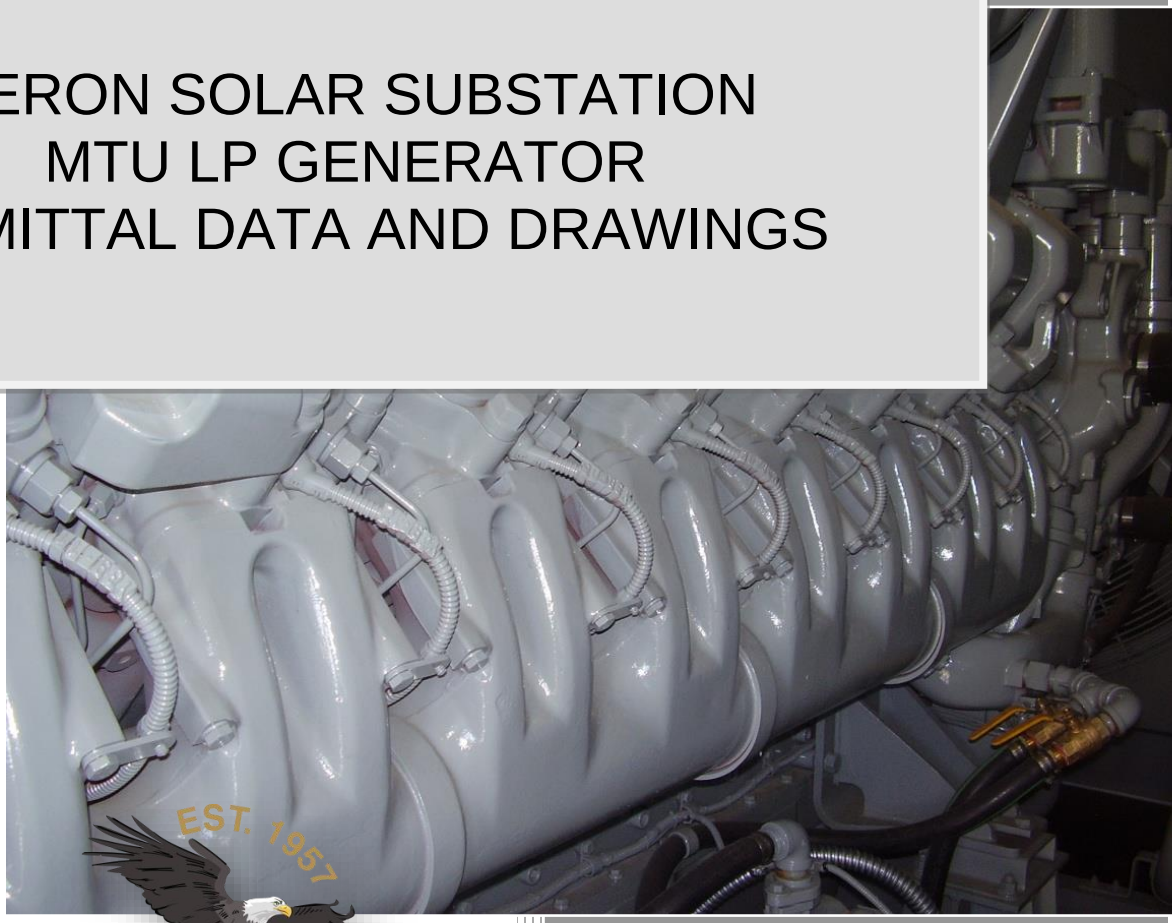
	Pollutant	(g/bhp-hr)	(g/kW-hr)	(ppmvd)
Emissions Data	Nitrogen Oxides (NO_x)	< 1.00		
	Volatile Organic Compounds (VOC)	< 0.70		
	NO_x + NMHC			
	Particulate Matter (PM_{10})	n/a		
	Carbon Monoxide	< 2.00		
	% O_2, dry basis, if corrected to other than 15%: _____ %			
Source of Data	☒ Manufacturer's Specifications ☐ Emissions Source Test ☐ CARB/EPA Certification ☐ Other _____ **Note: please provide copies of all sources of emissions data.**			

HEALTH RISK ASSESSMENT DATA

Operating Hours	Maximum Operating Schedule: _____ hours per day, and _____ hours per year		
Receptor Data	Distance to nearest Residence	_____ feet	Distance is measured from the proposed stack location to the nearest boundary of the nearest apartment house, dormitory, etc.
	Direction to nearest Residence	_____	Direction from the stack to the receptor, i.e. Northeast or South.
	Distance to nearest Business	_____ feet	Distance measured from the proposed stack location to the nearest boundary of the nearest office building, factory, store, etc.
	Direction to nearest Business	_____	Direction from the stack to the receptor, i.e. North or Southwest.
Stack Parameters **Note: Stack parameters may be listed on the permit as enforceable permit conditions*	Release Height *(See Note*)*	_____ feet above grade	
	Stack Diameter *(See Note*)*	_____ inches at point of release	
	Rain Cap *(See Note*)*	☐ Flapper-type ☐ Fixed-type ☐ None ☐ Other: _____	
	Stack Orientation *(See Note*)*	☐ Vertical ☐ Horizontal ☐ Other: _____ ° from vert. or _____ ° from horiz.	
Exhaust Data	Flowrate: _____ acfm	Temperature: _____ °F	
Transportable	Is this engine transportable? ☐ Yes ☒ No		
Facility Location	☐ Urban (area of dense population) ☒ Rural (area of sparse population)		

Please refer to attached modeling reference files.

OBERON SOLAR SUBSTATION
MTU LP GENERATOR
SUBMITTAL DATA AND DRAWINGS



INTERSTATE
Pride in Service

Provided by:

Interstate Power Systems

12568 Highview Avenue

Lakeville, MN 55044

Power Generation

PERFORMANCE ASSURANCE CERTIFICATION

A Rolls-Royce solution

TESTING PROCEDURES

Prototype

We have been producing superior generator sets for more than six decades. Understanding the importance of reliable, cost-effective products, we have developed industry-leading test procedures to ensure we exceed this criteria. Our testing program confirms that our customers will receive products of the highest quality.

Our Performance Assurance Certification (PAC) certifies that every MTU generator set undergoes rigorous prototype testing including the following:

Prototype Test Procedures

- **Rated Load (NFPA 110)**
  All generator set models will produce the nameplate-rated load within the design tolerance of the generator set.
- **Extended-run Testing**
  All generator set prototypes have been subjected to extended run-time testing.
- **Transient Response Analysis (ISO 8528-5)**
  All new generator set models have undergone transient response analysis per ISO 8528-5.
- **Torsional Analysis**
  All generator set models have undergone torsional stress analysis.
- **Engine Cooling System**
  All generator set models will cool sufficiently within the ambient design conditions per each model.
- **Anticipatory Alarms and Shutdowns**
  The pre-alarms and alarms function appropriately to protect the generator set from any foreseen unnecessary failures.
- **Vibrational Analysis (ISO 8528-9)**
  All new generator set models have undergone vibration analysis to ensure that each engine-generator coupling is balanced and that there is no destructive resonant vibration.
- **Noise Analysis (ISO 8528-10)**
  All generator sets undergo airborne noise analysis using the enveloping surface method.

Prototype Test Standards

MTU generator sets are compliant with many different codes and standards. Our validation philosophy and performance are regularly reviewed to ensure continuity with these codes and standards: *UL2200, CSA, EPA, NFPA 99—Health Care Facilities, NFPA 70—National Electrical Code, NFPA 110—Standard for Emergency and Standby Power Systems, Department of Labor and Industry, NEMA MG 1—Motors and Generators, and MIL-STD-705-c.*

Factory Acceptance

Our factory testing is performed with the same extreme diligence and attention to detail that is given to the prototype testing process. Every MTU generator set receives a complete factory acceptance test that certifies and ensures the system will function in accordance to every specific application.

Test metering has an accuracy of 1.3% or better. This metering is calibrated a minimum of once per year and is directly traceable to the Bureau of Standards.

Factory acceptance testing procedures

- **Insulation Resistance Inspection** (301.1c)*
- **High Potential Test** (302.1b)*
- **Alternator Overspeed** (1 min.)*
- **Engine Inspection**
- **Generator Inspection**
- **Resistances Inspection** (401.1b)
  - Exciter Field Stator
  - Alternator Armatures
- **Mounting and Coupling Inspection**
- **Engine Fuel Oil System Inspection**
- **Engine Lube Oil System Inspection**
- **Engine Cooling System Inspection**
- **DC Charging System Inspection**
- **Circuit Breaker Inspection**
- **Anticipatory Alarms and Shutdowns Inspection** (505.2b, 515.1b, 515.2b)
- **Optional Equipment Inspection** (513.2a)
- **Load Test Inspection**
  - Full Nameplate-Rated Load
  - No-Load Inspection
  - MAX Load @ 1.0 P.F. (640.1d)
  - MAX Load @ 0.8 P.F.
  - Block Loads @ 0–25%, 0–50%, 0–75%, 0–100%
- **Phase Balance and Sequence Inspection** (507.1d, 508.1d, 516.1a)

** Performed by Alternator OEM*

OPTIONAL TESTING

Factory Acceptance

Extended-run factory acceptance testing

In some cases, extended-run testing may be requested. Unless specified otherwise, extended-run testing will be performed in the following manner:

- Full nameplate-rated load
- Standard readings taken every 15 or 30 minutes

Standard readings recorded during load test inspection

- Run Time
- AC Voltage
- AC Amperage
- kVA
- kWe
- Power Factor
- Frequency
- Exciter Field Voltage
- Exciter Field Current
- Lube Oil Pressure
- Engine Coolant Temperature
- Ambient Temperature

Witnessed factory acceptance testing

Witnessed factory tests must be scheduled and approved at least four weeks prior to the generator set's scheduled shipping date. Any requests for witnessed factory testing after this four-week period must be approved by the Regional Sales Manager and are subject to additional fees.

Witnessed extended-run factory acceptance testing

Witnessed extended-run tests must be scheduled and approved at least four weeks prior to the generator set's scheduled ship date. Any requests for witnessed extended-run testing after this four-week period must be approved by the Regional Sales Manager and are subject to additional fees.

Additional factory acceptance testing

Additional testing is available upon request. The following is a list of supplementary tests which can be performed on MTU generator sets. Non-standard testing is subject to additional charges.

Additional testing procedures

- **Start and Stop Test** (MIL-STD-705c 503.1c)
- **Remote Start and Stop Test** (MIL-STD-705c 503.2c)
- **Overspeed Protective Device Test** (MIL-STD-705c 505.2b)
- **Insulation Resistance Test** (MIL-STD-705c 301.1c)*
- **Open Circuit Saturation Curve Test** (MIL-STD-705c 410.1b)
- **Temperature Rise Test** (MIL-STD-705c 680.1c)
- **Frequency Range Adjust Test** (MIL-STD-705c 511.2c)
- **Low Oil Pressure Protective Device Test** (MIL-STD-705c 515.1b)
- **Over-temperature Protective Device Test** (MIL-STD-705c 515.2b)
- **Controls, Direction, and Rotation Test** (MIL-STD-705c 516.1a)
- **Frequency and Voltage Regulation, Stability, and Transient Response** (MIL-STD-705c 608.1b)
- **Voltage and Frequency Regulation** (MIL-STD-705c 614.1b)
- **Voltage Dip and Rise for Rated Load Test** (MIL-STD-705c 619.2c)
- **Regulator Range Test** (511.1d)
- **Maximum Power Test** (MIL-STD-705c 640.1d)
- **Fuel Consumption Test**
- **Vibration and Mechanical Balance Test** (ISO 8528-9)
- **Sound Test** (ISO 8528-10)

** Testing conducted by generator OEM*

Rolls-Royce Group
www.mtu-solutions.com

Subject to change. | Edition 02/20 | ENC 2020-02

CERTIFICATE OF COMPLIANCE

Certificate Number	AU3559
Report Reference	AU3559-20110603
Issue Date	2020-JULY-13
Issued to:	MTU America Inc 100 Power Dr Mankato MN 56001-4790
This certificate confirms that representative samples of	ENGINE GENERATORS See Addendum Page
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 2200, Stationary Engine Generator Assemblies
Additional Information:	See the UL Online Certifications Directory at https://iq.ulprospector.com for additional information.

This *Certificate of Compliance* does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

CERTIFICATE OF COMPLIANCE

Certificate Number	AU3559
Report Reference	AU3559-20110603
Issue Date	2020-JULY-13

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Stationary engine generator assemblies for outdoor use and indoor use, Models:

Model Series G, followed by S or P, may be followed by two zeroes, followed by 130, 150, 175, 200, 235, 260, 300, 350, 355 or 400, followed by N, L, or V, followed by 6, followed by C or S, followed by R, P, J, N, G or D, followed by A, followed by S, followed by 0, followed by 98, followed by 3 or 4. May have additional prefix or suffix letters or numbers.

Models G, followed by G, followed by 06, 08, 10, or 12, followed by R or V, followed by K, followed by a three digit number. May have additional prefix or suffix letters or numbers.

Models 6, 8, 10, or 12, followed by R or V, followed by a four digit number, followed by G, followed by S, followed by a number ranging from 150 to 650. May have additional prefix or suffix letters or numbers.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

Prototype Test Summary (PTS)

A Rolls-Royce solution

Prototype testing is administered to validate the electrical and mechanical design integrity of the generator set. The results indicated below summarize testing performed on the prototype of the specified generator set model. This form of testing is only conducted on standard factory prototype generator sets. *Results may vary.*

GENERATOR SET MODEL(S):	***mtu*** 8V0110 GS150		
Rep. Prototype Model:	***mtu*** 8V0110 GS150	**Test Date:**	10/20/2020
kW:	150	**kVA:**	240
Voltage:	240	**Hz:**	60

ENGINE/GENERATOR

Engine Manufacturer:	PSI	**Engine Model:**	PSI 8.8L T CAC
Engine Fuel:	Natural Gas		
Generator Manufacturer:	Marathon	**Generator Model:**	431CSL6208
Voltage Regulator Model:	SE350	**PMG Equipped:**	☐ Yes ☒ No

OPTIONS

Enclosure Level:	Level 3	**Silencer:**	Unit Mounted – L3 system
Air Filtration:	Standard		

TEST SUMMARY

TEST	TEST RESULT
Transient Performance *Certifies that the engine generator-set model has undergone transient response analysis per ISO 8528-5*	**NFPA-110 One Step:** ☒ 100% ☐ Other. Specify: ____ % **Full Load Acceptance:** Voltage Dip: 42.1 % Recovery Time: 3.37 seconds Frequency Dip: 14.4 % Recovery Time: 3.69 seconds
Steady State Performance *Certifies that voltage deviation and harmonics are within acceptance tolerance range per ISO-8528-5 at full load*	**Frequency Regulation:** 0.22 +/- % Regulation Overall 60.27 Maximum Hz 60.01 Minimum Hz **Voltage Regulation:** 0.26 +/- % Regulation Overall 242.7 Maximum AC Volts 241.5 Minimum AC Volts
Torsional Analysis *Certifies that the generator set has undergone torsional stress analysis and is not subjected to torsional stresses that could be harmful to the unit*	☒ Complete
Cooling System *Certifies that all generator set models will cool sufficiently within the ambient design conditions per each model at referenced enclosure level*	48 °C (118.4 °F) Maximum Ambient Temperature 191 m^3/min (6.738 SCFM) Radiator Air Flow
Sound Data *Certifies that sound data is within the acceptable tolerance range per ISO 8528-10 at referenced enclosure level*	74.5 dBA @ 7 m (23 ft) at full rated load *The sound value is representative of the specified prototype at the time of testing and is subject to alteration due to technological advances. Please contact your **mtu** representative for the most recent enclosure and sound data.*
Vibrational Analysis *Certifies that new generator set models have undergone vibration analysis to ensure that each generator coupling is balanced and there is no destructive resonant vibration per ISO 8528-9*	☒ Complete

Subject to change. 2021-10

ROLLS-ROYCE SOLUTIONS AMERICA INC.

Two (2) Year / 3,000 Hour Basic Limited Warranty
Standby (3D) / Prime (3B) / Data Center Continuous Power (3F)

Rolls-Royce Solutions America Inc. ("RRSA") issues the following express Limited Warranty subject to the following terms, conditions, and limitations:

An original consumer ("Owner") who purchases an RRSA engine generator set ("Product") is entitled to coverage under this Limited Warranty. RRSA 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 RRSA. Any nonconformity to the foregoing is defined as a Warrantable Defect. This Limited Warranty applies to Product shipped by RRSA after January 1, 2014.

1. 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 RRSA 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 RRSA 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.

RRSA'S AGGREGATE TOTAL LIABILITY RELATING TO THE SYSTEM AND/OR PRODUCT UNDER THIS LIMITED WARRANTY OR UNDER ANY OTHER CLAIM (IN CONTRACT, TORT, OR OTHERWISE) MADE IN CONNECTION WITH THE SALE OR USAGE OF THE SYSTEM AND/OR PRODUCT IS LIMITED TO THE DOLLAR AMOUNT OF THE OWNER'S ORIGINAL PAYMENT MADE FOR THE SYSTEM AND/OR PRODUCT.

2. Limited Warranty Periods

Limited Warranty Period. The Limited Warranty Period for a Warrantable Defect in the Product is twenty-four (24) months after the first commissioning of the Product. In all cases, the Limited Warranty period will expire not later than thirty-six (36) months from the date of shipment from the RRSA 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 RRSA Mankato, MN facility.

RRSA warranty obligations under this Limited Warranty are contingent upon distributor completing the following:

(a) The RRSA warranty and the *Start-Up Validation and Pre-Inspection Form*. Return both to RRSA 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.

3. RRSA 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 4, RRSA will, during normal working hours, through an RRSA authorized distributor, dealer, or service outlet, perform some or all of the following:

(a) Repair or replace, at the sole election of RRSA, 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 RRSA authorized distributor, dealer, or service outlet to the Product location;
(d) Part removal and re-installation, if necessary and as solely determined by RRSA.

The obligation to repair or replace defective parts by RRSA does not include responsibility for reimbursement of incidental or consequential costs. If RRSA 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 RRSA.

Failure of RRSA 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.

4. Owner Responsibilities

During the Limited Warranty Period and Accessories Coverage Period, the Owner is responsible for, and RRSA 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 RRSA 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 RRSA, including without limitation handling, inspection, servicing, or operating instructions;

(b) Promptly notify RRSA or its authorized representative of a Warrantable Defect and make the Product available for repair;
(c) Comply with RRSA or its 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 RRSA specified parts, components, and consumables;
(f) Promptly return to RRSA all parts replaced under this Limited Warranty;
(g) Comply with RRSA 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 RRSA 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.

5. Limitations

RRSA 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 4;
(b) Failure of Owner to follow RRSA instructions for Product stored by Owner longer than 180 days from date of shipment from the RRSA 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 RRSA within a reasonable time;
(e) Rental equipment used during warranty work;
(f) Defects caused or potentially caused by service work performed by non-RRSA authorized service providers and/or the use of non-genuine RRSA 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 RRSA, 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 RRSA 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 RRSA in writing at the time of the order; or
(s) Material provided by or a design specified by the Owner.

6. Software Warranty. Where software is included in the Product, RRSA 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 RRSA specification at the time of dispatch from the RRSA manufacturing facility. RRSA does not warrant that the software is error-free or free from "bugs" as commonly categorized by the computer industry. RRSA 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 RRSA. RRSA, at its option, may elect to provide the most current software at no cost, and in such case RRSA will not cover the cost to install the applicable updated software. RRSA shall have no obligation with respect to any nonconformities resulting from unauthorized modifications to the software or any Owner interfacing.

7. **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: https://www.mtu-solutions.com/eu/en/technical-information/emissions-warranty.html. 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 RRSA 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.

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 RRSA and obtained prior written consent from RRSA. In such cases, RRSA shall, in its sole discretion, reimburse the costs incurred by the Owner up to an amount equivalent to the costs RRSA 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 Michigan without regard to its conflicts of law principles and excluding the United Nations Convention for the International Sale of Goods. Any and all disputes between the parties that may arise pursuant to the sale or use of the Product shall be heard and determined before an appropriate state of federal court located in Oakland County, Michigan. The Owner acknowledges that such court has the jurisdiction to interpret and enforce the provisions herein, and Owner waives any and all objections that it may have as to personal jurisdiction or venue in any of the above courts.

11. In order to obtain performance of an RRSA warranty obligation, the Owner should contact the nearest RRSA authorized distributor, dealer, or service outlet for instructions. To find the location of the nearest RRSA authorized distributor, dealer, or service outlet call +1 248-560-8000 or write to: Rolls-Royce Solutions America Inc. Warranty Department, 39525 MacKenzie Drive, Novi, MI 48377.

Power Solutions International, Inc.
201 Mittel Drive
Wood Dale, IL 60191
www.psiengines.com

0 Hour Non-Deteriorated Emissions Data for Permitting Customers

PSI EPA Engine Family XPSIB8.80EMT "X" denotes generic model year

PSI Engine Model Description PSI-8.8L Turbo Emergency Stationary

	8.8L Turbo LPG	8.8L Turbo NG
Displacement	8.8L	8.8L
Test Speed (rpm)	1800	1800
	g/KW-hr	**g/HP-hr**
BSCO	1.297	0.215
BSCO2	761.1	454.87
BSCH4	NA	0.048
BSTHC	0.028	NA
BSNMHC	NA	0.002
BSNOx	0.019	0.025
BSTHC+NOx	0.047	NA
BSNMHC+NOx	NA	NA
BSFC (kg/kw-hr)	0.253	0.211

Weighted compositie emissions from ISO 8178 D2 (LPG) & D1 (NG) test cycles
BSFC is the weighted composite fuel consumption over the emission test cycle
LPG Emission Data Units in g/KW-hr
NG Emission Data Units in g/HP-hr

SK36231A

For MTU GS150 LP

PREPARED FOR:
Interstate Power Systems

QUOTE: GCP-031121-1001

APPLICATION INFORMATION

Driver:	Engine
Make:	MTU
Model:	8.8L
Horsepower:	262
RPM:	1800
Compression Ratio:	10.0:1
Exhaust Flow Rate:	1176
Exhaust Temperature:	1200
Reference:	MTU Spec
Fuel:	Gas
Annual Operating Hours:	8760

EQUIPMENT

Housing	EAS-1450-0505F-2C4E
	14.5" Combo Housing, Critical Grade Silencer
	2 Element Capacity, Carbon Steel Construction
	5" Bottom Inlet, 5" End Outlet
Mounting	14.5" Wrap Around Bracket
Catalyst	RE-1450-T NSCR, Round 14.5"x3.5"
Elements Required	(2) Elements Required to meet Reductions
Minimum Exhaust Temp	1000*F

UNCONTROLLED EMISSIONS DATA

	g/bhp-hr
NOx:	N/A
CO:	N/A
THC:	N/A
NMHC:	N/A
NMNEHC:	N/A
HCHO:	N/A
Oxygen:	0.50%

POST CATALYST EMISSIONS DATA

	g/bhp-hr
NOx:	< 1.00
CO:	< 2.00
VOC:	< 0.70

Jason Martindale
Direct:505.592.1318
jmartindale@emittechnologies.com

PREPARED FOR:
Interstate Power Systems

QUOTE: GCP-031121-1001

ITEM #	*DESCRIPTION*	*QUANTITY*
1001-01	EAS-1450-0505F-2C4E Combo Housing	1
1001-02	14.5" Wrap Around Brackets	2
1001-03	RE-1450-T 14.5" NSCR Catalyst Element	2

WARRANTY

EMIT Technologies,Inc. warrants that the goods supplied will be free from defects in workmanship by EMIT Technologies, Inc. for a period of one (1) year from date of shipment. EMIT Technologies, Inc. will not be responsible for any defects which result from improper use, neglect, failure to properly maintain or which are attributable to defects, errors or omissions in any drawings, specifications, plans or descriptions, whether written or oral, supplied to EMIT Technologies, Inc. by Buyer.

Catalyst performance using an EMIT Air/Fuel ratio controller is dependent upon properly defined set-points, variable with engine and fuel gas composition. Air/fuel ratio controller performance is guaranteed, but not limited, to fuel gas with an HHV content of 1400 BTU/SCF.

Catalyst performance will be guaranteed for a period of 2 years from installation, or 17,000 operating hours, whichever comes first. The catalyst shall be operated with an automatic air/fuel ratio controller. The performance guarantee shall not cover the effects of excessive ash masking due to operation at low load, improper engine maintenance, or inappropriate lubrication oil. The performance guarantee shall not cover the effects of continuous engine misfires (cylinder or ignition) exposing the catalyst to excessive exothermic reaction temperatures.

Unless otherwise stated the exhaust temperature operating range at the converter inlet is 600°F minimum for oxidation catalyst and 750°F for NSCR catalyst and 1250°F maximum.

If a high temperature shut down switch is not installed, thermal deactivation of catalyst at temperatures above 1300 °F is not covered.

The catalyst conversion efficiencies (% reduction) will be guaranteed for engine loads of 50 to 100 percent.

Engine lubrication oil shall contain less than 0.6% ash (by weight) with a maximum allowable specific oil consumption of 0.01 gal/bhp-hr. The maximum ash loading on the catalyst shall be limited to 350 g/m3. Phosphorous and zinc additives are limited to 0.03% (by weight).

The catalyst must not be exposed to the following known poisoning agents, including: iron, nickel, sodium, chromium, arsenic, zinc, lead, phosphorous, silicon, potassium, magnesium, copper, tin, and mercury. Total poison concentrations in the gas are limited to 0.3 ppm.

Shipment - Promised shipping dates are approximate and are not guaranteed and are from the point of manufacture. EMIT Technologies,Inc. will not be liable for any loss, damage or delay in manufacture or delivery resulting from any cause beyond its control including, but not limited to a period equal to the time lost by reason of that delay. All products will be crated as per best practice to prevent any damage during shipment. Unless otherwise specified, Buyer will pay for any special packing and shipping requirements. Acceptance of goods by common carrier constitutes delivery to Buyer. EMIT Technologies,Inc. shall not be responsible for goods damaged or lost in transit.

PAYMENT TERMS AND ADVANCE PAYMENT REQUIREMENT

Terms: Credit is extended to purchaser for net 30 time period. If payment is not received in the net 30 timeframe, interest on the unpaid balance will accrue at a rate of 1.5% per month from the invoice date.

Advance Payment Requirement: Proposals with a project value of $100,000 or greater, and 60 days or greater time to completion, will require an advance payment of 30% of the total value. The advance payment will be invoiced to the customer upon receipt of the customer's purchase order. Advance payment is due 30 days after the date of the invoice. If payment is not received in the net 30 timeframe, interest on the unpaid balance will accrue at teh rate of 1.5% per month from the invoice date. Failure to pay this invoice may delay completion of the project outlined in this proposal.

Order Cancellation Terms: Upon cancellation of an order once submittal of a Purchase Order has occurred, the customer will pay a 25% restocking fee for Catalyst Housings, Catalyst Elements, and Air/Fuel Ratio Controllers; 50% restocking fee for Cooler Top Solutions,Exhaust System Accessories, and other Custom Built Products; 100% of all associated shipping costs incurred by EMIT; 100% of all project expenses incurred by EMIT for Field Services.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2022 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Power Solutions International, Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: NPSIB8.80EMT-009

Effective Date: 08/02/2021

Expiration Date: 12/31/2022

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 08/02/2021

Revision Date: N/A

Manufacturer: Power Solutions International, Inc.
Engine Family: NPSIB8.80EMT
Mobile/Stationary Certification Type: Stationary
Fuel : LPG/Propane
Natural Gas (CNG/LNG)
Emission Standards :
Stationary Part 1048
NMHC + NOx (g/kW-hr) : 2.7
HC + NOx (g/kW-hr) : 2.7
CO (g/kW-hr) : 4.4
Part 60 Subpart JJJJ Table 1
CO (g/Hp-hr) : 4.0
VOC (g/Hp-hr) : 1.0
NOx (g/Hp-hr) : 2.0
Emergency Use Only : Y

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR Part 60, 1065, 1068, and 60 (stationary only and combined stationary and mobile) and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following nonroad engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new nonroad spark-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60. This certificate of conformity does not cover nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover large nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

South Coast
Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

December 15, 2021

Mr. Mark Holt
Rolls-Royce Solutions America, Inc.
100 Power Dr.
Mankato, MN 56001

Dear Mark Holt,

The South Coast Air Quality Management District (South Coast AQMD) has extended Certified Equipment Permits (CEPs) to December 31, 2022 for the stationary emergency internal combustion (IC) engine models listed in the attached table. However, please be reminded that many of these certified diesel-fueled IC engines may not meet Rule 1470 requirements if installed at or near a sensitive receptor or near school grounds and, therefore, may require an aftertreatment system such as a diesel particulate filter in the exhaust stream.

Please note that the South Coast AQMD does not endorse or warrant any specific equipment or manufacturer. Modification of the equipment listed here will void this certification.

If you have additional questions or need further clarification on the CEP program, please feel free to contact CJ Chang at (909) 396-3293, cchang@aqmd.gov; or Susan Tsai at (909) 396-2529, stsai@aqmd.gov.

Sincerely,

David Ono
Senior Engineering Manager
Engineering and Permitting

DO:GI:ST:CC

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Certified ICE-Emergency Generators

Rolls-Royce Solutions America, Inc.

Engine Mfg.	Model	Engine Rating	Appl. No.
MTU America	10V1600G80S	752 BHP	578846
MTU America	18V2000G76S	1839 BHP	578847
Mercedes-Benz	OM 924 LA	197.1 BHP	580124
Mercedes-Benz	OM 926 LA	331.2 BHP	580125
MTU America	6R1600G70S	419 BHP	518630
MTU America	6R1600G80S	460 BHP	518631
MTU America	8V1600G70S	548 BHP	518632
MTU America	8V1600G80S	601 BHP	518633
MTU America	12V1600G70S	822 BHP	503822
MTU America	12V1600G80S	896 BHP	503820
MTU America	12V2000G45 TB/TD (R1238A37)	952 BHP	495350
MTU America	12V2000G85 TB/TD (R1238A37)	1086 BHP	495342
MTU America	16V2000G45 TB/TD (R1638A37)	1227 BHP	495344
MTU America	16V2000G85 TB/TD (R1638A37)	1354 BHP	495345
MTU America	G43D (20V-4000 G43 3D, 20V-4000 G83 3B)	3674 BHP	470538
MTU America	G83L (20V-4000 G83L)	4680 BHP	470536
MTU America	G83L (20V-4000 G83L, 20V-4000 G83 3D)	4036 BHP	470537
MTU America	T1238A36 (12V-4000 G83)	2561 BHP	470532
MTU America	T1238A36 (12V-4000 G83, 12V-4000 G43)	2328 BHP	470534
MTU America	T1638A36 (16V-4000 G83 3D)	3353 BHP	470533
MTU America	T1638A36 (16V-4000 G43 3D, 16V-4000 G83 3B)	3058 BHP	608239

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Certified ICE-Emergency Generators

Rolls-Royce Solutions America, Inc.

Engine Mfg.	Model	Engine Rating	Appl. No.
MTU America	12V2000G45TB	1045 BHP	551794
MTU America	12V2000G85TB	1194 BHP	608240
MTU America	16V2000G45TB	1354 BHP	551796
MTU America	16V2000G85TB	1495 BHP	551797
MTU America	16V4000G83L	3674 BHP	551792
MTU America	16V2000G86S	1839 BHP	608241
MTU America	10V1600G70S	685 BHP	602447
MTU America	12V4000G14S	2038 BHP	608244
MTU America	12V4000G24S	2328 BHP	608247
MTU America	12V4000G74S	2328 BHP	608248
MTU America	12V4000G84S	2561 BHP	608249
MTU America	16V4000G14S	2709 BHP	608250
MTU America	16V4000G24S	3058 BHP	608251
MTU America	20V4000G64S	3674 BHP	608253
MTU America	20V4000G44S	4036 BHP	608260
MTU America	16V4000G74S	3058 BHP	608263
MTU America	20V4000G94S	4680 BHP	608264
MTU America	20V4000G74S	4036 BHP	608265
MTU America	20V4000G24S	3674 BHP	608267
MTU America	20V4000G14S	3339 BHP	608268
MTU America	16V4000G84S	3353 BHP	608269
MTU America	16V4000G94S	3674 BHP	608270

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Certified ICE-Emergency Generators

Rolls-Royce Solutions America, Inc.

Engine Mfg.	Model	Engine Rating	Appl. No.
Power Solutions Int'l (PSI)	8800CAC (LPG)	230.12 BHP	629447
Power Solutions Int'l (PSI)	8800CAC (Nat Gas)	261.47 BHP	629474
Rolls-Royce	20V4000G94S	4680 BHP	630151
Rolls-Royce	20V4000G74S	4036 BHP	630155
Rolls-Royce	16V4000G74S	3058 BHP	630156
Rolls-Royce	20V4000G44S	4036 BHP	630157
Rolls-Royce	20V4000G24S	3674 BHP	630159
Rolls-Royce	20V4000G14S	3339 BHP	630162
Rolls-Royce	18V2000G76S	1839 BHP	630163
Rolls-Royce	16V4000G94S	3674 BHP	630164
Rolls-Royce	16V4000G84S	3353 BHP	630165
Rolls-Royce	16V4000G74S	3058 BHP	630166
Rolls-Royce	16V4000G24S	3058 BHP	630167
Rolls-Royce	16V4000G14S	2709 BHP	630168
Rolls-Royce	16V2000G86S	1839 BHP	630169
Rolls-Royce	12V4000G74S	2328 BHP	630170
Rolls-Royce	12V4000G24S	2328 BHP	630171
Rolls-Royce	12V4000G14S	2038 BHP	630172
Rolls-Royce	10V1600G80S	752 BHP	630215
Rolls-Royce	10V1600G70S	685 BHP	630216
Rolls-Royce	12V1600G80S	896 BHP	630223
Rolls-Royce	12V1600G70S	822 BHP	630225
Rolls-Royce	12V4000G84S	2561 BHP	608227

Rolls-Royce Solutions America Inc.

39525 MacKenzie Dr.
Novi, MI 48377, USA
T +1 248 560 8000

660 Bettis Academy Rd.
Graniteville, SC 29829, USA
T +1 803 663 8831

100 Power Dr.
Mankato, MN 56001, USA
T +1 507 625 7973

09/03/2021

The attached South Coast Air Quality Management District Certified Equipment Permits (CEP) are for the Power Solutions International (PSI) PSI 8.8 L TCAC engine used in the Rolls-Royce Solutions America Inc. Genset model No. 8V0110 GS150. The PSI engine model No. in the SCAQMD permits is 8800CAC. This is the 8.8 L TCAC engine; However, the PSI US EPA certificate of conformity application uses the model No. 8800CAC and therefore this is the model No. information which must be provided in the SCAQMD CEP.

SCAQMD now requires separate permits for the same engine if the power ratings are different therefore there are two permits for the PSI engine model No. 8800 CAC (8.8 L TCAC). One if for the engine using natural gas (NG) fuel and the other permit if for the engine running on liquid propane gas (LPG).

Mark Holt

Emissions Expert
Rolls-Royce Solutions America Inc..
100 Power Drive
Mankato, MN 56001

South Coast Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178

Application or CEP No.
629447
Page 1

CERTIFIED EQUIPMENT PERMIT (CEP)
(NOT A PERMIT TO CONSTRUCT OR OPERATE)

Granted on August 25, 2021

ID 180910

Legal Owner or Operator:
Rolls-Royce Solutions America, Inc.
39525 MacKenzie Dr.
Novi, MI 48377
Attn: Mark Holt

Equipment Location: SAME AS ABOVE

The equipment described below and as shown on the approved plans and specifications are subject to the special condition or conditions listed.

Equipment Description

Internal Combustion Engine, Power Solutions International (PSI), Model No. 8800CAC, LPG-Fueled, 8-Cylinder, Turbocharged and Aftercooled, Rated at 230.12 BHP, Equipped with Air/Fuel Ratio Controller and Three-Way Catalyst, Driving an Emergency Electrical Generator.

Manufacturer Condition

1. **This Certified Equipment Permit (CEP) is not a Permit to Construct or Operate.** The person constructing, installing or operating the equipment at each specific site shall obtain all necessary permit(s) to construct and permit(s) to operate and comply with any other District rules and regulations including the requirements of Regulation XIII.

End User Conditions

1. Operation of this equipment shall be in compliance with all data and specifications submitted with the application under which this permit was issued, unless otherwise noted below.

2. This equipment shall be properly maintained and kept in good operating condition at all times.

3. This engine shall be fired with LPG only.

ORIGINAL

CERTIFIED EQUIPMENT PERMIT (CEP)
(NOT A PERMIT TO CONSTRUCT OR OPERATE)

4. The engine shall not be operated unless its exhaust is vented to the non-selective catalytic reduction unit which is in full operation and which is in good operating condition at all times.

5. The engine shall not be operated without the use of an air-to-fuel ratio controller which shall be maintained and kept in proper operating condition at all times.

6. This engine shall not be operated more than 200 hours in any one year, which includes no more than 50 hours in any one year and no more than 4.2 hours in any one month for maintenance and testing purposes

7. An operational non-resettable totalizing timer shall be installed and maintained to indicate the engine elapsed operating time.

8. The operation of this engine beyond 50 hours per year allotted for engine maintenance and testing shall be allowed only during emergencies resulting in an interruption of service of the primary power supply or during stage II or III electrical emergencies declared by the electrical grid operator. This engine may be used as part of an interruptible electric service program.

9. The operator shall maintain accurate maintenance records of the date of catalyst cleaning or replacement, oxygen sensor replacement, and their associated total hour reading on the non-resettable totalizing time meter, to determine the engine elapsed operating time, and records of engine tune-ups.

10. The operator shall keep a log of engine operations documenting the total time the engine is operated each month and specific reason for operation as:

    A. Emergency use.
    B. Maintenance and testing.
    C. Other (describe the reason for operating).

    In addition, each time the engine is manually started, the log shall include the date of operation, the specific reason for operation, and the totalizing hour meter reading (in hours and tenths of hours) at the beginning and end of operation.

11. On or before January 15th of each year, the operator shall record in the engine operating log the following:

    A. The total hours of operation for the previous calendar year, and
    B. The total hours of engine operation for maintenance and testing for the previous calendar year.

CERTIFIED EQUIPMENT PERMIT (CEP)
(NOT A PERMIT TO CONSTRUCT OR OPERATE)

Engine operating log shall be retained on site for a minimum of five calendar years and shall be made available to the Executive Officer or representative upon request.

12. This engine shall comply with the NMHC, NOx, CO, and PM emission limits to be determined at the time of issuance of the end-user permit.

13. Sulfur content of LPG fuel supplied to the engine shall not exceed 40 ppm by volume measured over a 4-hour average period.

14. This engine shall be operated in compliance with all applicable requirements of the Code of Federal Regulations Title 40 Part 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engine.

Please notify CJ Chang at (909) 396-3293 (cchang@aqmd.gov) when South Coast AQMD information packets are needed or if you have any questions concerning the Certification/Registration Program.

This Certified Equipment Permit is based on the plans, specifications, and data submitted as it pertains to the release of air contaminants and control measures to reduce air contaminants. No approval or opinion concerning safety and other factors in design, construction or operation of the equipment is expressed or implied.

This Certified Equipment Permit will become invalid if this application is cancelled. THIS PERMIT SHALL EXPIRE ON December 31, 2021 unless an extension is granted by the Executive Officer.

By _____

GEORGE ILLES
Supervising Air Quality Engineer

ORIGINAL

CERTIFIED EQUIPMENT PERMIT (CEP)
(NOT A PERMIT TO CONSTRUCT OR OPERATE)

Engine operating log shall be retained on site for a minimum of five calendar years and shall be made available to the Executive Officer or representative upon request.

12. This engine shall comply with the NMHC, NOx, CO, and PM emission limits to be determined at the time of issuance of the end-user permit.

13. Sulfur content of natural gas fuel supplied to the engine shall not exceed 16 ppm by volume.

14. This engine shall be operated in compliance with all applicable requirements of the Code of Federal Regulations Title 40 Part 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engine.

Please notify CJ Chang at (909) 396-3293 (cchang@aqmd.gov) when South Coast AQMD information packets are needed or if you have any questions concerning the Certification/Registration Program.

This Certified Equipment Permit is based on the plans, specifications, and data submitted as it pertains to the release of air contaminants and control measures to reduce air contaminants. No approval or opinion concerning safety and other factors in design, construction or operation of the equipment is expressed or implied.

This Certified Equipment Permit will become invalid if this application is cancelled. THIS PERMIT SHALL EXPIRE ON December 31, 2021 unless an extension is granted by the Executive Officer.

By _____

GEORGE ILLES
Supervising Air Quality Engineer

ORIGINAL

MTU ONSITE ENERGY GS150 LP VAPOR GENERATOR
GENERATOR: 130 kW, 130kVA, 541 amps, 1800 RPM
VOLTAGE: 120/240v 1 phase
ENGINE: PSI 8.8, LP Vapor, EPA Certified

Selected Features Included:
Steel Sub Base, Battery Cables, Battery Rack, Flex Fuel Connector, Oil Drain Extension, Lube Oil and Anti-freeze
Electronic Isochronous Governor + / - .25%
UL2200 Listed, Prototype Tested, Factory Tested
130 Degree Rise Standby Alternator, Permanent Magnet
2 Year / 3,000 Hour Standby Limited Warranty

CONTROL PANEL: Basler DGC-1510 Control Panel
The expanded Digital Genset Controller utilizes microprocessor based technology to provide a versatile system for genset control, protection, monitoring and event logging. 4 Relay Board.

ENCLOSURE: Level 2 Sound Attenuated Weatherproof Enclosure includes bolt together sheet metal enclosure constructed with 14-gauge material, lockable hinged doors, keyed alike, a fixed storm proof air intake louver and expanded metal air discharge, muffler support brackets and exhaust piping allowing the muffler to be mounted internally, including rain cap. 79 dBA at 23'.

COOLING SYSTEM: Unit Mounted Radiator, 50 Degree Rise

CIRCUIT BREAKER: Square D, 80% rated, LSI, 2-400 Amps

BATTERY: Lead Acid Battery, Acid Resistant Steel Rack

BLOCK HEATER: 2,000 Watts, Mounted and Wired, Isolation Valves

VIBRATION ISOLATION: Neoprene Vibration Pads, Integral Vibration Isolation

BATTERY CHARGER: 12v, 6 Amps, mounted and wired

MUFFLER: Critical Grade Muffler Mounted Inside Enclosure

MISC: One Owner's Manual, Standard Color ANSI Gray

CONTROL EQUIPMENT

Catalyst Housing
Model: EAS-1200-0404F-2C4E
Manufacturer: EMIT Technologies, Inc
Element Size: Round 12" x 3.5"
Housing Type: 2 Element Capacity
Catalyst Installation: Accessible Housing
Construction: 10 gauge Carbon Steel
Sample Ports: 6 (0.5" NPT)
Inlet Connections: 4" Flat Face Flange
Outlet Connections: 4" Flat Face Flange
Configuration: Side In / End Out
Silencer: Integrated
Silencer Grade: Critical
Insertion Loss: 25-30 dBA
Catalyst Element
Model: RE-1200-T
Catalyst Type: NSCR, Standard Precious Group Metals
Substrate Type: BRAZED
Manufacturer: EMIT Technologies, Inc
Element Quantity: 1
Element Size: Round 12" x 3.5"

Gas Generator Set

mtu 8V0110 GS150

150 kWe/60 Hz/Standby/208 - 600V

System ratings

Voltage (L-L)	240V †	240V †	208V †	240V †	480V †	600V	380V †
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
Natural Gas (NG)							
Amps	625	625	520	451	226	180	285
kW/kVA	150/150	150/150	150/187.5	150/187.5	150/187.5	150/187.5	150/187.5
Liquid Propane (LP)							
Amps	542	542	451	391	195	156	247
kW/kVA	130/130	130/130	130/162.5	130/162.5	130/162.5	130/162.5	130/162.5
NG and LP							
skVA@30% voltage Dip	196	187	296	296	394	315	282
Generator model	431PSL6224	431CSL6206	431PSL6202	431PSL6202	431PSL6202	431CSL6240	431PSL6204
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	4 LEAD	12 LEAD DOUBLE DELTA	12 LEAD WYE	12 LEAD DELTA	12 LEAD WYE	4 LEAD WYE	12 LEAD WYE

† UL 2200 offered

Note: This unit is available with a dual fuel configuration.

Certifications and standards

- Generator set is designed and manufactured in facilities certified to standards ISO 9001:2008 and ISO 14001:2004
- Seismic certification – optional
  - 2018 IBC certification
  - OSHPD pre-approval
- UL 2200 – optional (refer to *System ratings* for availability)
- CSA – optional
  - CSA C22.2 No. 100
  - CSA C22.2 No. 14
- Performance Assurance Certification (PAC)
  - Generator set tested to ISO 8528-5 for transient response
  - Verified product design, quality and performance integrity
  - All engine systems are prototype and factory tested
- Power rating
  - Accepts rated load in one step per NFPA 110

A Rolls-Royce solution

Standard features*

- Single source supplier
- Global product support
- Two (2) Year/3,000 Hour Basic Limited Warranty
- PSI 8.8L TCAC engine
  - 8.8 liter displacement
  - 4-cycle
- 3-way catalyst
- Optional fuels: LP liquid and dual fuel
- Engine-generator resilient mounted
- Complete range of accessories
- Cooling system
  - Integral set-mounted
  - Engine-driven fan
- Generator
  - Brushless, rotating field generator
  - 2/3 pitch windings
  - 300% short circuit capability
- Digital control panel(s)
  - UL recognized, CSA Certified, NFPA 110
  - Complete system metering
  - LCD display

Standard equipment*

Engine

- Air cleaner
- Oil pump
- Oil drain extension and shut-off valve
- Full flow oil filter
- 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 rack and cables
- Flexible exhaust connection
- Liquid cooled, ball bearing turbcharger
- EPA certified engine

Generator

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting
- Sustained short circuit current of up to 300% of the rated current for up to 10 seconds
- Self-ventilated
- Superior voltage waveform
- Solid state, volts-per-hertz regulator
- ± 1% voltage regulation no load to full load
- Brushless alternator with brushless pilot exciter
- 4 pole, rotating field
- 130 °C maximum standby temperature rise
- 1-bearing, sealed
- Flexible coupling
- Full amortisseur windings
- 125% rotor balancing
- 3-phase voltage sensing
- 100% of rated load - one step
- 5% maximum total harmonic distortion

Digital control panel(s)

- Digital metering
- Engine parameters
- Generator protection functions
- Engine protection
- SAE J1939 engine ECU communications
- Windows®-based software
- Multilingual capability
- Communications to remote annunciator
- Programmable input and output contacts
- UL recognized, CSA certified, CE approved
- Event recording
- IP 54 front panel rating with integrated gasket
- NFPA 110 compatible

* Represents standard product only. Consult your local ***mtu*** Distributor for additional configurations.

Application data

Engine

Manufacturer	PSI
Model	8.8L TCAC
Type	4-cycle
Aspiration	turbocharged, intercooled
Arrangement	8-V
Displacement: L (in^3)	8.8 (535)
Bore: cm (in)	11.05 (4.35)
Stroke: cm (in)	11.43 (4.5)
Compression ratio	10:1
Rated rpm	1,800
Engine governor	Bosch
Maximum power (NG): kWm (bhp)	195.0 (261.5)
Maximum power (LP): kWm (bhp)	171.6 (230.1)
Steady state frequency band	± 0.75%
Air cleaner	dry

Liquid capacity

Total oil system: L (gal)	9.0 (2.38)
Engine jacket water capacity: L (gal)	13.4 (3.5)
System coolant capacity: L (gal)	25.5 (6.7)

Electrical

Electric volts DC	12
Cold cranking amps under -17.8 °C (0 °F)	925
Batteries: group size	31
Batteries: quantity	1

Fuel inlet - vaporous supply

Fuel supply connection size	2” NPT
Fuel supply pressure: mm H_20 (in. H_20)	178–279 (7–11)

Fuel inlet - liquid supply

Fuel supply connection size	#6 (3/8”) female SAE 45° flare
Maximum fuel supply pressure: kPa (PSI)	2,150 (312)

Fuel consumption (NG-1000 BTU/ft^3 / LP-2500 BTU/ft^3)

	NG	LPG
At 100% of power rating: m^3/hr (ft^3/hr)	56.2 (1,986)	19.7 (695)
At 75% of power rating: m^3/hr (ft^3/hr)	43.9 (1,549)	15.1 (534)
At 50% of power rating: m^3/hr (ft^3/hr)	31.8 (1,121)	11.0 (389)

Cooling - radiator system

	NG and LPG
Ambient capacity of radiator: °C (°F)	48 (118.4)*
Maximum restriction of cooling air: intake and discharge side of radiator: kPa (in. H_20)	0.12 (0.5)
Water pump capacity: L/min (gpm)	125 (33.0)
Heat rejection to coolant: kW (BTUM)	88.3 (5,021)
Heat radiated to ambient: kW (BTUM)	41.1 (2,337)
Heat rejected to charge air cooler: kW (BTUM)	13.8 (782)
Fan power: kW (hp)	11.9 (16.0)

* Installation of gravity exhaust louvers reduces the ambient capacity of the cooling system by an additional 3 °C (5.5 °F).

Air requirements

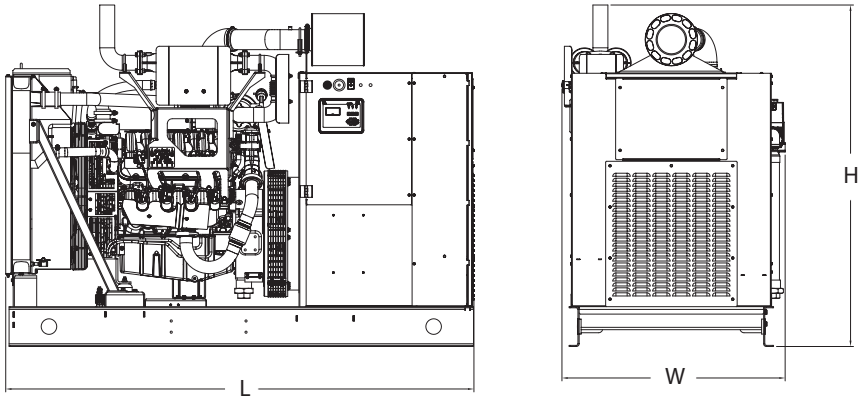
	NG and LPG
Aspirating: *m^3/min (SCFM)	10.33 (365)
Air flow required for radiator cooled unit: *m^3/min (SCFM)	229.8 (8,115)
Remote cooled applications; air flow required for dissipation of radiated generator set heat for a maximum of 25 °F rise: *m^3/min (SCFM)	211.6 (7,473)

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

Exhaust system

	NG and LPG
Gas temperature (stack): °C (°F)	649 (1,200)
Gas volume at stack temperature: m^3/min (CFM)	33.3 (1,176)
Maximum allowable back pressure at outlet of engine, before piping: kPa (in. H_20)	10.2 (41)

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
[redacted]		

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 (NG)	Standby full load (LP)
[redacted]		

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

Emissions data

Fuel type	THC + NO_x	CO
Natural gas	N/A	0.22
Liquid propane	0.035	0.95

— All units are in g/hp-hr and are 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.

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%.
— Nominal ratings at standard conditions: 25 °C and 300 meters (77 °F and 1,000 feet).
— Deration factor:
  - Consult your local ***mtu*** Distributor for altitude derations.
  - Consult your local ***mtu*** Distributor for temperature derations.

C/F = Consult Factory/***mtu*** Distributor

Digital Generator Set Controller Data Sheet

MGC-1500 Series

The MGC-1500 Series controllers include the following models which are described throughout this document.*

— MGC-1510
— MGC-1520

MGC Series 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.

PRODUCT HIGHLIGHTS

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

* Please refer to the last page of this data sheet for available MGC-1500 series configuration options. The MGC Series Controller Comparison Data Sheet is a available as a reference for all MGC series configuraton options..

DIAGRAM

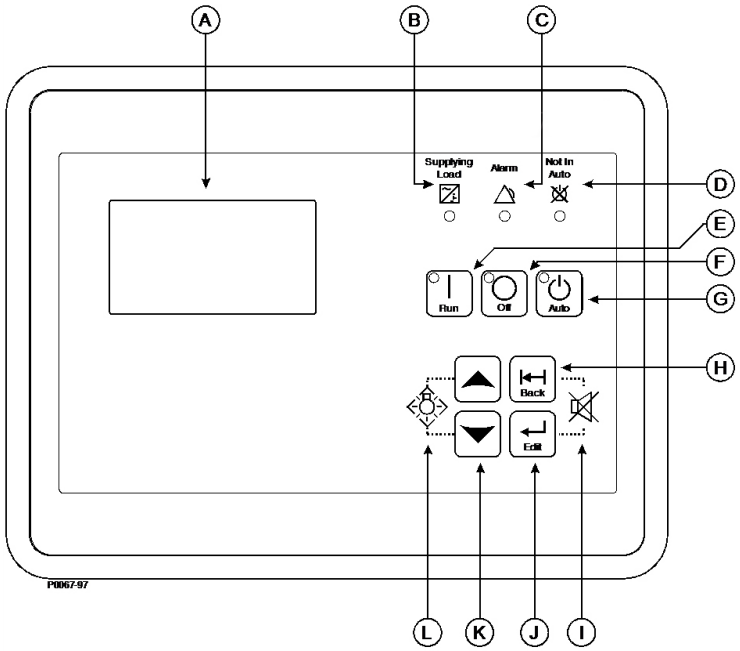


Figure 1: Front Panel Descriptions

A. Liquid crystal display
B. Supplying load indicator
C. Alarm indicator
D. Not in auto indicator
E. Run pushbutton and mode indicator
F. Off pushbutton and mode indicator
G. Auto pushbutton and mode indicator
H. Back pushbutton
I. Alarm silence pushbutton combination
J. Edit pushbutton
K. Arrow pushbuttons
L. Lamp test pushbutton combination

FUNCTIONS

Generator set protection

Generator ANSI codes
- Overvoltage (59)
- Overfrequency (81O)
- Voltage phase imbalance (47)
- Undervoltage (27)
- Underfrequency (81U)
- Overcurrent (50)

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

Alarms (shutdowns)
- Low oil pressure
- High coolant temperature
- Low coolant temperature
- Overspeed
- Overcrank
- Coolant temp sender fail (non-ECU engines)
- Oil pressure sender fail (non-ECU engines)
- Emergency stop
- Critical low fuel level (refer to *Configuration Options*)

Pre-alarms (warnings)
- Low oil pressure
- Low coolant temperature
- Weak battery voltage
- Low fuel level
- High fuel level
- High coolant temperature
- Battery overvoltage

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

FUNCTIONS, continued

Generator set metering
- Generator parameters include voltage, current, real power (watts), apparent power (VA), and power factor. The view can be programmed to display up to 20 parameters using the scrolling and time delay feature.
- Engine parameters include oil pressure, coolant temperature, RPM, battery voltage, fuel level, engine runtime, and various SAE J1939 supported parameters.

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

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

Transfer switch control (Mains failure)
(Refer to *Configuration Options*)

The MGC-1500 Series has the ability to detect a mains failure via a single- or three-phase bus input. A mains failure is established when any one of the following conditions are met:
- Any phase of bus voltage falls below the dead bus threshold
- Any phase of bus voltage is unstable due to overvoltage or undervoltage
- Any phase of bus voltage is unstable due to overfrequency or underfrequency

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

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

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

Remote display panel annunciation
(Refer to *Configuration Options*)

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

SAE J1939 communications
(Refer to *Configuration Options*)

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

SPECIFICATIONS

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

Current sensing (5 Amp CT inputs)
- Continuous rating: 0.1 to 5.0 Aac
- One second rating: 25 Aac
- Burden: 1 VA

Voltage sensing
- Range: 12 to 576 V rms, line-to-line
- Frequency range: 10 to 72 Hz
- Burden: 1 VA
- One second rating: 720 V rms

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

Engine system inputs
- Fuel level sensing resistance range: 5 to 250 Ω nominal
- Coolant temperature sensing resistance range: 5 to 2,750 Ω nominal
- Oil pressure sensing resistance range: 5 to 250 Ω nominal
- Engine speed sensing:
  - Magnetic pickup or CANBus
    - Magnetic pickup voltage range: 3 to 35 V peak (6 to 70 V peak to peak)
    - Magnetic pickup frequency range: 32 to 10,000 Hz

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

Metering
Generator voltage (rms)
- Metering range: 12 to 576 VAC (direct measurement), up to 9,999 VAC (with appropriate voltage transformer)
- Accuracy: ±1% of programmed rated voltage or ±2 VAC (subject to accuracy of voltage transformer when used)

Generator current (rms)
- Generator current is measured at the secondary windings of 5 A CTs.
- Metering range: 0 to 5,000 Aac
- CT primary range: 1-5,000 Aac, in primary increments of 1 Aac
- Accuracy: ±3% of programmed rated current or ±3 Aac (subject to accuracy of CTs)

Generator frequency
- Metering range: 10 to 72 Hz
- Accuracy: ±0.25% or 0.05 Hz

Apparent power
- Indicates total kVA and individual line kVA (four-wire, line-to-neutral or three-wire, line-to-line)
- Accuracy: ±5% of the full-scale indication or ±4 kVA

Power factor
- Metering range: 0.2 leading to 0.2 lagging
- Accuracy: ±0.02

Real power
- Indicates total kW and individual line kW (four-wire, line-to-neutral or three-wire, line-to-line)
- Accuracy: ±5% of the full-scale indication or ±4 kW

Oil pressure
- Metering range: 0 to 150 psi or 0 to 1,034 kPa
- Accuracy: ±3% of actual indication or ±2 psi or ±12 kPa (subject to accuracy of sender)

Coolant temperature
- Metering range: 0 °C to 204 °C (32 °F to 410 °F)
- Accuracy: ±3% or actual indication or ±2° (subject to accuracy of sender).

Fuel level
- Metering range: 0 to 100%
- Accuracy: ±3% (subject to accuracy of sender)

Battery voltage
- Metering range: 6 to 32 VDC
- Accuracy: ±3% of actual indication or ±0.2 VDC

Engine RPM
- Metering range: 0 to 4,500 rpm
- Accuracy: ±2% of actual indication or ±2 rpm

Engine run time
- Engine run time is retained in non-volatile memory
- Metering range: 0 to 99,999 h; update interval: 6 min
- Accuracy: ±1% of actual indication or ±12 min

SPECIFICATIONS, continued

Metering, continued

Maintenance timer
- Maintenance timer indicates the time remaining until generator set service is due. Value is retained in non-volatile memory.
- Metering range: 0 to 5,000 h; update interval: 6 min
- Accuracy: ±1% or actual indication or ±12 min

Generator protection functions

Overvoltage (59) and undervoltage (27)
- Pickup range: 70 to 576 VAC
- Activation delay range: 0 to 30 s

Overfrequency (81O) and underfrequency (81U)
- Pickup range: 45 to 66 Hz
- Pickup increment: 0.1 Hz
- Activation delay range: 0 to 30 s

Phase imbalance (47)
- Pickup range: 5 to 100 VAC
- Pickup increment: 1 VAC
- Activation delay range: 0 to 30 s
- Activation delay increment: 0.1 s

Overcurrent (51)
- Pickup range: 0.18 to 1.18 Aac (1 A current sensing)
- Time dial range: 0 to 7,200 s (fixed time curve)

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

Agency approvals
- UL/CSA approvals: “cURus” approved to UL 6200 and CSA C22.2 No.14
- NFPA Compliance: complies with NFPA Standard 110, standard for emergency and standby power
- CE Marked: complies with applicable EC directives

ADDITIONAL SPECIFICATIONS

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

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

OPTIONAL ACCESSORIES

(Refer to *Configuration Options*)

Contact Expansion Module 2020 (CEM-2020)

The CEM-2020 is a remote device that provides additional MGC-1500 Series contact inputs and outputs, giving the user flexibility to use the same model MGC-1500 Series generator set controller for simple functions or more complicated applications that require contact functionality or duplication of contacts for remote annunciation. Its features include:

- **10 Contact Inputs:** the CEM-2020 provides 10 programmable contact inputs with the same functionality as the contact inputs on the MGC-1500 Series.
- **24 Contact Outputs:** the CEM-2020 provides 24 Form C programmable output contacts with the same functionality as the output contacts on the MGC-1500 Series. The output ratings of the Form C contacts are:

Output No.	Rating (Cont.)	Additional Information
5-16	1 A @ 30 VDC	This is a gold flash contact for low current circuits.
17-28	4 A @ 30 VDC	

Table 1: Output Ratings Form C Contacts

- **Communications via CANBus:** the CEM-2020 communicates to the MGC-1500 Series via SAE J1939 CANBus communications and allows the user to program the functionality of these inputs and outputs in the BESTCOMSPlus® software.
- The user can add labels for the inputs and outputs that appear in BESTCOMS®Plus, on the front panel, and in programmable logic. All the functionality can be assigned to these inputs and outputs as if they were an integrated part of the MGC-1500 Series. The CEM-2020 module has all of the environmental ratings of the MGC-1500 Series, including a model for UL Class1 Div2 applications. The CEM-2020 terminals accept a maximum wire size of 12 AWG, while the chassis ground requires 12 AWG wire. Flexibility is one of the benefits of the MGC-1500 Series, and this add-on module enhances that benefit even further.

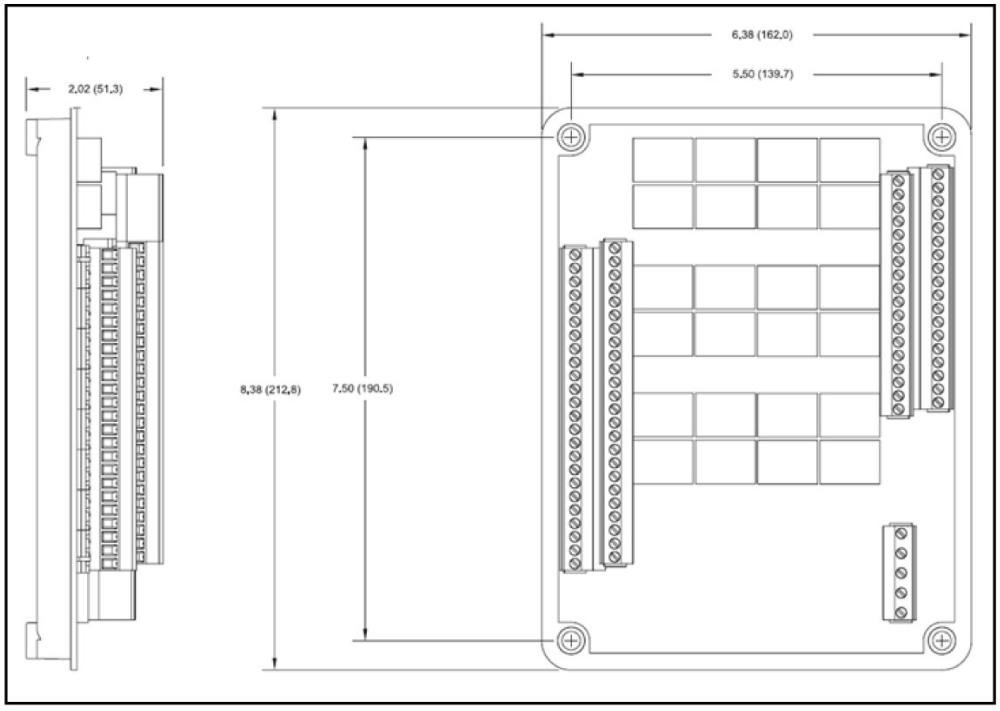


Figure 2: CEM-2020 Overall Dimensions

CONFIGURATION OPTIONS

Generator protection

	MGC-1510	MGC-1520
Standard		
Phase Imbalance (47)	X	X
Overcurrent (50)	X	X
Overvoltage (59)	X	X
Undervoltage (27)	X	X
Underfrequency (81U)	X	X
Overfrequency (81O)	X	X
Reverse Power (32)		
Loss of Excitation (40Q)		
Enhanced		
Overcurrent (51)		
Vector Shift (78)		
Rate of Change of Frequency (81R)		
Ground Fault		

Note: Numbers in parentheses above are ANSI standard device numbers denoting which features the controllers support.

Inputs

	MGC-1510	MGC-1520
Controller		
Digital	7	7
Analog (Dedicated)	3	-
Analog	-	-
CEM		
Digital	-	10
AEM		
Analog	-	-
TC	-	-
RTD	-	-

Outputs

	MGC-1510	MGC-1520
Controller		
Digital Form A, 30 Amp	-	-
Digital Form A, 5 Amp	3	3
Digital Form A, 2 Amp	4	4
Analog	-	-
CEM		
Digital Form C, 4 Amp	-	12
Digital Form C, 1 Amp	-	12
AEM		
Analog	-	-
External to Controllers (CEM)		
Digital Form C, 10 Amp (Interposing Relay)	-	10

Communication

	MGC-1510	MGC-1520
ModBus RTU (RS-485)		
ModBus TCP-IP		
RDP-110	X	X
CANBus		X
Modem Interface (RS-232)		
Ethernet		

Metering

	MGC-1510	MGC-1520
Bus 1 Voltage		
Single Phase	X	X
Three Phase	X	X
Bus 2 Voltage		
Single Phase		
Three Phase		
Current Transformers		
Generator	3	3
Auxiliary	-	-

LC-50

Integrated gas mixer, throttle body, and programmable speed control/ actuator

- Integrated, bi-directional actuator and programmable speed control
- Suitable for gaseous engines
- OEM configurable
- Venturi mixer has superior mixing with no moving parts
- Eliminates external linkages
- Reduces total engine assembly costs
- Optional positioner mode
- Five sizes available
- Optional air/fuel ratio trim valve
- Sealed ball-bearing throttle body design
- Optional external throttle position switch

APPLICATION

The LC-50 is designed for use on gaseous fueled industrial engines between 5 and 100 kW (7 and 134 hp). The throttle and venturi sizes are between 24 and 50 mm. Applications include power generation, refrigeration units, pumps, irrigation, and mobile industrial.

The mixer can be used with propane and natural gas and requires a zero pressure regulator. The throttle body incorporates the proven Woodward LCS speed control, which operates the throttle plate. The LC-50 can be programmed via the RS-232 port of a PC/laptop to a variety of configurations, as follows:

- isochronous speed control
- droop
- auxiliary input
- dual dynamics
- adjustable ramp time
- self-tuning
- overspeed/underspeed protection
- remote speed setting
- three speed select
- error relay driver

DESCRIPTION

The LC-50 provides a building block approach to total engine management. This modular design consists of a die-cast aluminum throttle body, mixer, plus a fully programmable integrated digital speed control and bi-directional actuator.

This unique design includes a venturi style annular ring mixer with no moving parts for superior mixing. The throttle body incorporates a corrosion-protected, plated steel shaft, plate, and a sealed ball-bearing design for durability and long life. An internal throttle return spring is standard to close the throttle in the event of power failure.

The LC-50 modular design reduces total engine assembly cost, eliminates external linkages, lowers inventory and part number proliferation. The programmable controller offers security to your configuration.

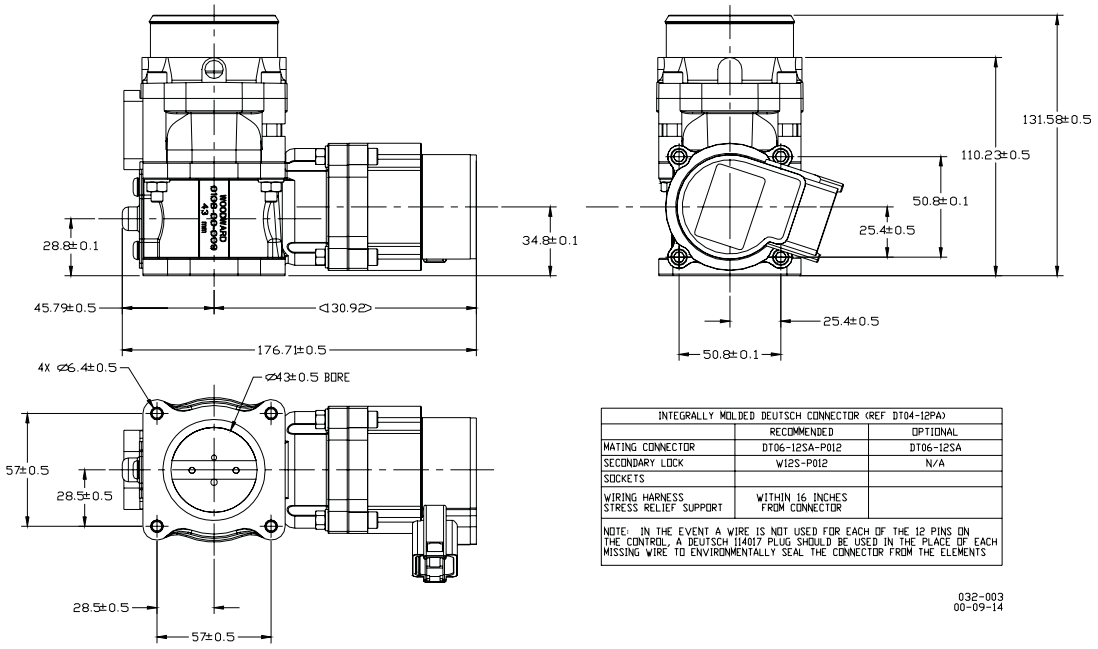
The LC-50 is compatible with Woodward's venturi-style mixer and other brands of gas mixers using suitable adapters (see LCS product specification 03225 for actuator details and operating parameters).

Woodward
Industrial Controls
PO Box 1519
Fort Collins CO, USA
80522-1519
1000 East Drake Road
Fort Collins CO 80525
Ph: +1 (970) 482-5811
Fax: +1 (970) 498-3058

Distributors & Service
Woodward has an international network of distributors and service facilities. For your nearest representative, call the Fort Collins plant or see the Worldwide Directory on our website.

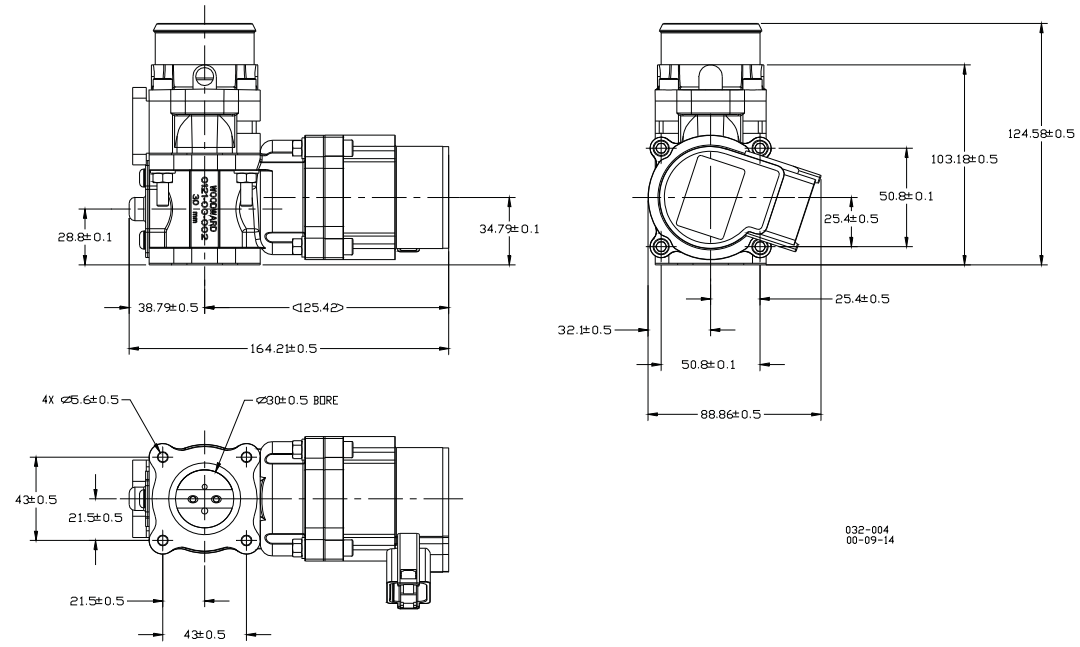
Corporate Headquarters
Rockford IL, USA
Ph: +1 (815) 877-7441

www.woodward.com



INTEGRALLY MOLDED DEUTSCH CONNECTOR (REF DT04-12PA)		
	RECOMMENDED	OPTIONAL
MATING CONNECTOR	DT06-12SA-P012	DT06-12SA
SECONDARY LOCK	W12S-P012	N/A
SOCKETS		
WIRING HARNESS STRESS RELIEF SUPPORT	WITHIN 16 INCHES FROM CONNECTOR	
NOTE: IN THE EVENT A WIRE IS NOT USED FOR EACH OF THE 12 PINS ON THE CONTROL, A DEUTSCH 114017 PLUG SHOULD BE USED IN THE PLACE OF EACH MISSING WIRE TO ENVIRONMENTALLY SEAL THE CONNECTOR FROM THE ELEMENTS		

Representative Drawing of 43 mm LC-50
(Do not use for construction)



Representative Drawing of 30 mm LC-50
(Do not use for construction)

Technical Manual 26135

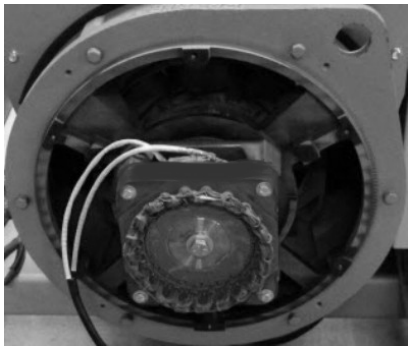
For more information contact:

Generator System Data Sheet

Permanent Magnet Generator (PMG)

DESCRIPTION

A permanent magnet generator (PMG) is standard on 450 kW and larger units and is available as an optional accessory on most units smaller than 450 kW. The PMG is an improved method of supplying power to the voltage regulator and adds distinct advantages over the alternative shunt type power supply.



FEATURES

Improved transient response

When a generator is subject to a large step load, the generator's terminal voltage experiences a sudden voltage dip. With a shunt style regulator, reduced voltage means the regulator's ability to increase excitation is reduced and voltage recovery will take longer. Power from a PMG is only dependent on the speed of rotation so voltage regulator power, and therefore excitation power, is not compromised during a load step.

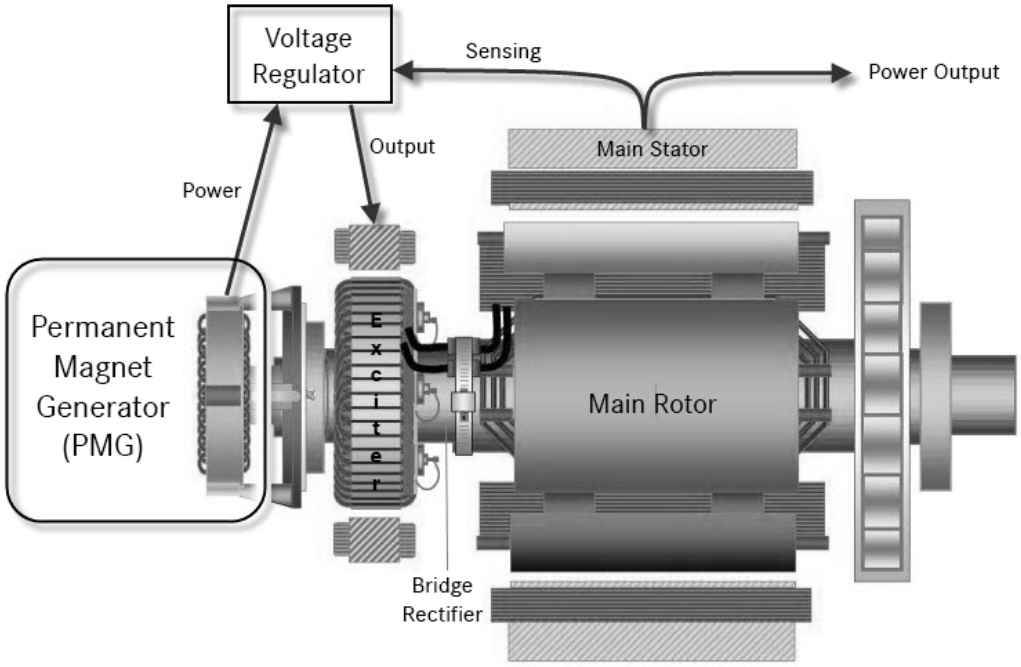
300% short circuit capability

The PMG enables the generator to provide up to 300% short circuit current for 10 seconds. This is important when a fault occurs to ensure current continues to flow long enough for downstream breakers to trip and clear the fault. When a fault occurs with a shunt type regulator, the sudden drop in voltage indicates the regulator has no power to increase excitation to keep current flowing. Without current flow, the downstream breakers may not trip.

Resistant to the effects of harmonics

A PMG is also beneficial in applications with harmonic producing loads. When rectifier-type loads are present and cause voltage wave form notching, the disrupted voltage wave form can affect voltage regulator operation on shunt powered regulators. Unlike a shunt regulator, the PMG supplies the regulator with a power source which is isolated from the electrical system.

Permanent Magnet Generator (PMG) Data Sheet



Generator Equipped with PMG

EXCITATION SYSTEM COMPARISON CHART

	AREP	Permanent Magnet Generator (PMG)
Motor starting capability	High	High
Short circuit current capability	300% at 60 Hz	300% at 60 Hz
Susceptibility to non-linear loads	Minimum	Minimum
Number of components	Minimum	Maximum
Retrofitability	No	Yes
Generator length	Minimum	Maximum
Stator design	Special	Standard with PM attachment
Voltage buildup	Uses residual magnetism and permanent magnet inserts on some frames	Positive from permanent magnets

Subject to change. | WT00037948 | 2020-07

marathon®
Generators

DVR® 2400
DIGITAL VOLTAGE REGULATOR

NEW FEATURES
- USB 2.0 access through front panel
- Euro style connector for low voltage connections
- Event Logging
- PMG voltage metering
- Polarity configuration for external inputs
- Configurable cut-in and cut-out frequencies
- Retain/reset configuration of remote adjust

FOUR DIGIT HMI DISPLAY
From intial setup to monitoring regulator status, this display provides innovative, fast and easy setup.

REGULATION MODES
Single and Three phase (AVR), Manual Field Current Regulation (FCR), Reactive Power Regulation (VAR) and Power Factor Regulation (PF). All modes compatible with control by external devices.

GENERATOR SOFT START
Controlled increase to rated voltage limits overshoot during voltage build-up in AVR modes.

TRUE RMS VOLTAGE SENSING - SINGLE OR THREE PHASE
Directly sense 100 to 600 Volts at 50/60 Hz. Circuitry senses true RMS voltage for superior regulation.

SINGLE PHASE POWER METERING

FRAME SIZE SPECIFIC PID SELECTION
Simply select the appropriate frame size and your gains are set.

ROBUST GENERATOR PROTECTION FEATURES
9 different Alarm and Shutdown protection features, many are customizable for your application including:
- Field Over & Under Excitation
- Instantaneous Field Over Current
- Generator Over & Under Voltage
- Generator Voltage Imbalance
- Generator Loss of Sensing

REGAL®

DVR®2400 DIGITAL VOLTAGE REGULATOR

SPECIFICATIONS

Voltage Regulation - 0.25% over load range at rated power factor and constant generator frequency.

Output Power - 100 Vdc, 4.0 Adc continuous rating and 190 Vdc, 7.5 Adc forcing capability for one minute.

Exciter Field DC Resistance - 18 to 25Ω Range

Remote Voltage Adjustment - ±30% of nominal via analog input, ±15% via external contacts.

Input Power - 180 to 240 Vac, 250 to 300 Hz PMG power supply

Regulator Sensing - 100 to 600 Vac, 50/60 Hz, 1-phase/3phase

Operating Temperature - From -40˚C to +70˚C (-40˚F to + 158˚F)

Storage Temperature - From -40˚ C to +85˚C (-40˚F to +185˚F)

Ingress Protection - IP52 (front side mounted in conduit box along with swing cover); IP10 (rear side with protective cover)

Shock - 20G in 3 perpendicular planes

Vibration - 2.5G at 5 to 26 Hz; 0.050" double amplitude (27 to 52 Hz); 7G at 53 to 500 Hz

Weight - 3.5 lb. (1361 g)

Humidity Testing - Per MIL-STD-705B, Method 711-D

Salt Fog Testing - Per MIL-STD-810E

EMI Compatibility

Immunity

Meets EN 61000-6-2: 2005 Electromagnetic compatibility (EMC) -Part 6-2: Generic standards- immunity for industrial environments.

Emission

- Meets EN 61000-6-4: 2007 Electromagnetic compatibility (EMC) - Part 6-4: Generic Standards - emmission standard for industrial environments

EMI Compatibility Tests

Immunity

- Electrostatic Discharge (ESD): IEC 61000-4-2
- Radiated RF: IEC 61000-4-3
- Electrical Fast Transient (EFT) /Burst: IEC 61000-4-4
- Conducted RF: IEC 61000-4-6
- Power Frequency and Magnetic Field: IEC 61000-4-8

Emission

- Radiated RF: EN 61000-6-4: 2007, 30 MHz to 1000 MHz

marathon® Generators

Regal Beloit America, Inc.
100 East Randolph Street
Wausau, WI 54402-8003
PH: 715-675-3359

www.marathonelectric.com

REGAL®

MAGNAPLUS®

MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL SUBMITTAL DATA

Basic Model: **431CSL6202/431PSL6202** Date: **6/15/17**

Kilowatt ratings at	**1800 RPM**		**60 Hertz**			**12 Leads**		
kW (kVA)	**3 Phase**		**0.8 Power Factor**			**Dripproof or Open Enclosure**		
	Class B	**Class F**				**Class H**		
Voltage*	**80º C ① Continuous**	**90º C ① Lloyds**	**95º C ① ABS**	**105º C † British Standard**	**105º C ① Continuous**	**130º C ① Standby**	**125º C † British Standard**	**125º C ① Continuous**	**150º C ① Standby**
240/480	125 (156)	131 (164)	135 (169)	142 (178)	142 (178)	155 (194)	145 (181)	151 (189)	160 (200)
230/460	125 (156)	132 (165)	136 (170)	143 (179)	143 (179)	155 (194)	145 (181)	152 (190)	160 (200)
220/440	125 (156)	132 (165)	136 (170)	143 (179)	143 (179)	153 (191)	145 (181)	151 (189)	160 (200)
208/416	125 (156)	130 (163)	133 (166)	140 (175)	140 (175)	151 (189)	141 (176)	147 (184)	155 (194)
190/380	115 (144)	120 (150)	123 (154)	130 (163)	130 (163)	140 (175)	132 (165)	135 (169)	145 (181)

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

Submittal Data: 240/480 Volts*, 194 kVA, 1800 RPM, 60 Hz, 3 Phase

Mil-Std-705B Method	**Description**	**Value**
301.1b	Insulation Resistance	> 1.5 Meg
302.1a	High Potential Test	
	Main Stator	2000 Volts
	Main Rotor	1500 Volts
	Exciter Stator	1500 Volts
	Exciter Rotor	1500 Volts
	PMG Stator	1500 Volts**
401.1a	Stator Resistance, Line to Line	
	High Wye Connection	0.0718 Ohms
	Rotor Resistance	0.598 Ohms
	Exciter Stator	18.5 Ohms
	Exciter Rotor	0.116 Ohms
	PMG Stator	2.1 Ohms**
410.1a	No Load Exciter Field Amps	
	at 480 Volts Line to Line	0.6 A DC
420.1a	Short Circuit Ratio	0.405
421.1a	Xd Synchronous Reactance	3.195 pu
422.1a	X2 Negative Sequence	
	Reactance	0.268 pu
423.1a	X0 Zero Sequence Reactance	0.05 pu
425.1a	X'd Transient Reactance	0.19 pu
426.1a	X"d Subtransient Reactance	0.182 pu
--	Xq Quadrature Synchronous	
	Reactance	1.478 pu
427.1a	T'd Transient Short Circuit	
	Time Constant	0.048 sec.
428.1a	T"d Subtransient Short Circuit	
	Time Constant	0.005 sec.
430.1a	T'do Transient Open Circuit	
	Time Constant	1.34 sec.
432.1a	Ta Short Circuit Time	
	Constant of Armature Winding	0.014 sec.

Mil-Std-705B Method	**Description**	**Value**
505.3b	Overspeed	2250 RPM
507.1c	Phase Sequence CCW-ODE	ABC
508.1c	Voltage Balance, L-L or L-N	0.2%
601.4a	L-L Harmonic Maximum - Total	5.0%
	(Distortion Factor)	
601.4a	L-L Harmonic Maximum - Single	3.0%
601.1c	Deviation Factor	5.0%
---	TIF (1960 Weightings)	<50
652.1a	Shaft Current	< 0.1 ma
652.1a	Main Stator Capacitance to	
	Ground	0.015 mfd
	Additional Prototype Mil-Std Methods are Available on Request.	
--	Generator Frame	431
--	Type‡, Brushless	
--	Insulation	Class H
--	Coupling - Single Bearing	Flexible
--	Amortisseur Windings	Full
--	Cooling Air Volume	1280 CFM
--	Exciter	Rotating
--	Voltage Regulator	SE350***
--	Voltage Regulation	1%***
--	Sensing	1 Phase***

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

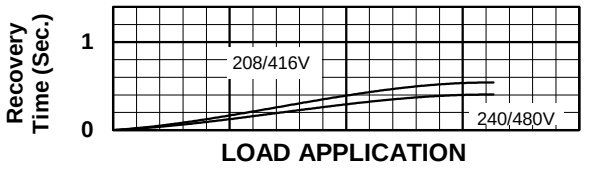
**Not supplied as standard equipment.

***DVR®2000E+ voltage regulator supplied with PMG option. DVR®2000E+ voltage regulation 1/4%, 1 or 3 Phase sensing.

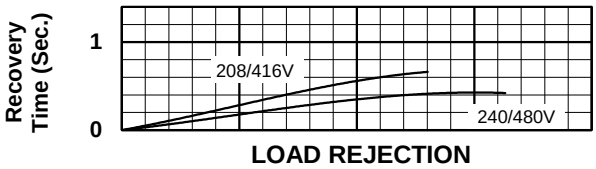
MARATHON ELECTRIC
SYNCHRONOUS AC GENERATOR
TYPICAL SUBMITTAL DATA

Basic Model: **431CSL6202/431PSL6202** Date: **6/27/17**

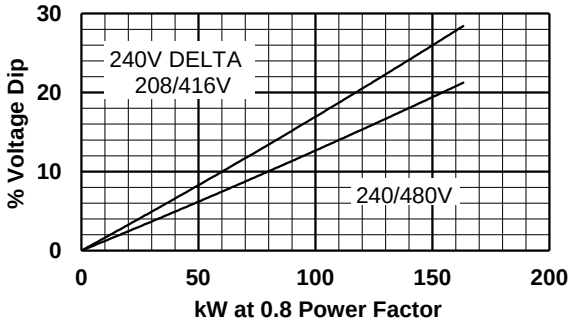
60 HERTZ

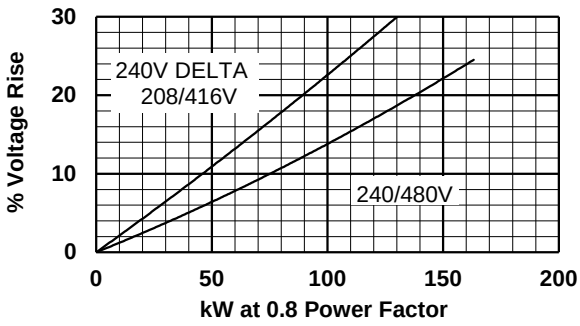


LOAD APPLICATION

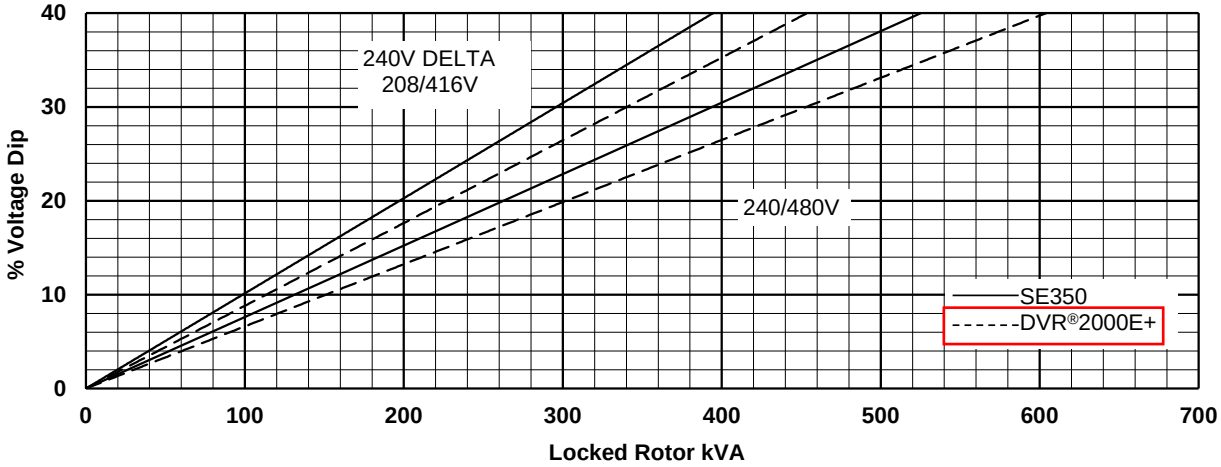


LOAD REJECTION

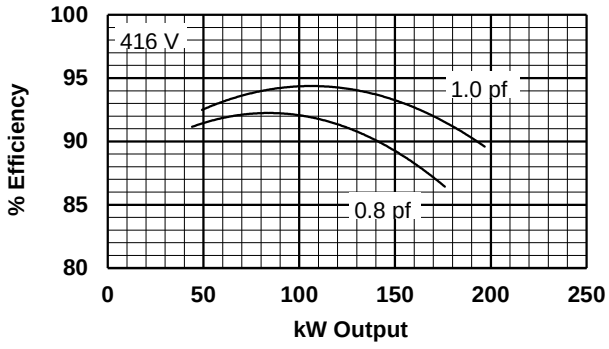


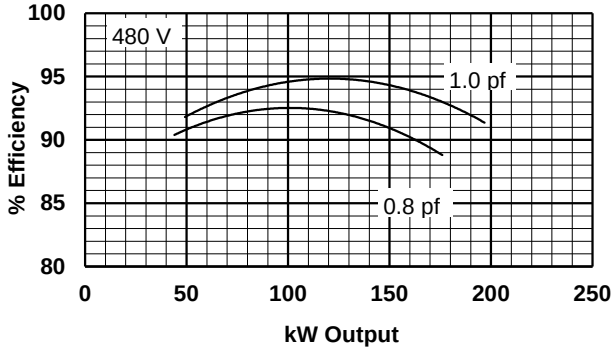


TYPICAL MOTOR STARTING CHARACTERISTICS



TYPICAL GENERATOR EFFICIENCY





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

Product data sheet
Characteristics

LDL36400U33X
PowerPact L Circuit Breaker,Micrologic3.3S,400A,3P,600V,14kA

Main

Product or component type	Circuit breaker
Range of product	PowerPact L
Trip unit technology	Electronic standard Micrologic 3.3 S LSI
Breaking capacity code	D

Complementary

Protection technology	Current limiter
Line Rated Current	400 A
Poles description	3P
Breaking capacity	18 kA at 480 V AC 25 kA at 240 V AC 14 kA at 600 V AC
System Voltage	600 V AC
[Ics] rated service short-circuit breaking capacity	80 %
Mounting mode	Unit mount
Electrical connection	Lugs load Lugs line
AWG gauge	AWG 2/0...500 kcmil (aluminium/copper) 2
Terminal identifier	AL600LS52K3
Height	11.3 in
Width	5.5 in
Depth	6.61 in

Environment

Product certifications	UL listed NMX

	CCC CSA CE

Ordering and shipping details

Category	01116 - L ELEC TRIP UNIT MOUNT BREAKER/SW
Discount Schedule	DE2
GTIN	00785901954354
Nbr. of units in pkg.	1
Package weight(Lbs)	15
Returnability	Y
Country of origin	US

Offer Sustainability

Sustainable offer status	Green Premium product
RoHS (date code: YYWW)	Compliant - since 1132 - Schneider Electric declaration of conformity Schneider Electric declaration of conformity
REACh	Reference not containing SVHC above the threshold Reference not containing SVHC above the threshold
Product environmental profile	Available
Product end of life instructions	Available

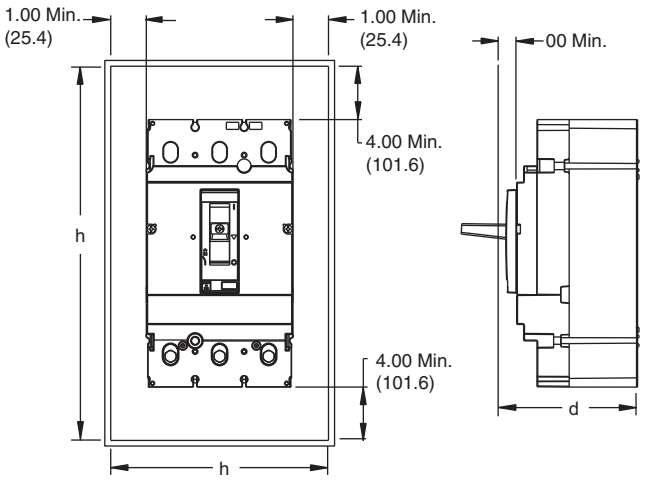
Contractual warranty

Warranty period	18 months

Circuit Breaker Enclosures and Enclosure Accessories

- Square D™ brand circuit breaker enclosures are UL Listed/CSA Certified and are suitable for use as service entrance equipment, except as footnoted.
- The short circuit rating of an enclosed circuit breaker is equal to the rating of the circuit breaker installed, except as footnoted.
- Circuit breakers are ordered and shipped separately for field installation.

Table 113: Minimum Enclosure Dimensions



Circuit Breaker	Amperage	Enclosure Dimensions (h x w x d)	
		Standard (80%)	100% Rated
HD/HG /HJ/HL	15–150 A	15.6 x 6.12 x 3.49 in. (396 x 155 x 89 mm)	15.6 x 6.12 x 3.49 in. (396 x 155 x 89 mm)
HR		18.13 x 8.63 x 4.13 in. (461 x 219 x 105 mm)	62 x 22.5 x 14 in. (1575 x 572 x 356 mm)
JD/JG/ JJ/JL[1]	150–250 A	18.72 x 6.12 x 3.49 in. (476 x 155 x 89 mm)	18.72 x 6.12 x 3.49 in. (476 x 155 x 89 mm)
JR		28.5 x 12.38 x 5.38 in. (724 x 314 x 137 mm)	62 x 22.5 x 14 in. (1575 x 572 x 356 mm)
LD/LG/ LJ/LL	250–600 A	35.48 x 12.00 x 4.45 in. 901 x 305 x 113 mm)	35.48 x 12.00 x 4.45 in. (901 x 305 x 113 mm)
LR		40.5 x 13.75 x 4.33 in. (1030 x 350 x 110 mm)	40.5 x 13.75 x 4.33 in. (1030 x 350 x 110 mm)

[1] Minimum enclosure insulation required if circuit breaker side < 4.13 in. (105 mm) from metal.

Table 114: Circuit Breaker Enclosure Catalog Numbers

Circuit Breaker			Enclosure Cat. No.				
Cat. No. Prefix	Rating	Poles	NEMA 1 Flush	NEMA 1 Surface	NEMA 3R[1]	NEMA 4, 4X, 5, 3, 3R Stainless Steel	NEMA 12/3R, 5 (Without Knockouts)[2]
HDL,HGL,HJL,HLL	15–150 A	2, 3	J250F	J250S	J250R	J250DS	J250AWK
JDL,JGL,JJL,JLL	150–250 A	2, 3					
HDL	15–100 A	3	—	HD100S[3, 4, 5]	—	—	—
JDL	150–250 A	3	—	JD250S[3, 5, 6]	—	—	—

[1] Enclosures with NRB or RB suffix have provisions for 3/4 in. through 2-1/2 in. bolt-on hubs in top endwall. Enclosures with R suffix have blank endwalls and require field cut opening.

[2] Suitable for rainproof NEMA 3R application by removing drain screw from bottom endwall.

[3] Copper wire only.

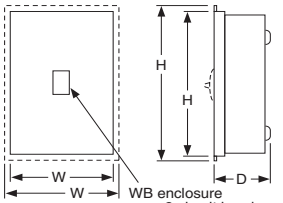
[4] Maximum short circuit current rating is 25 kA, 240 Vac.

[5] Order service ground kit PKOGTA2 if required.

[6] Maximum short circuit current rating is 18 kA, 480 Vac.

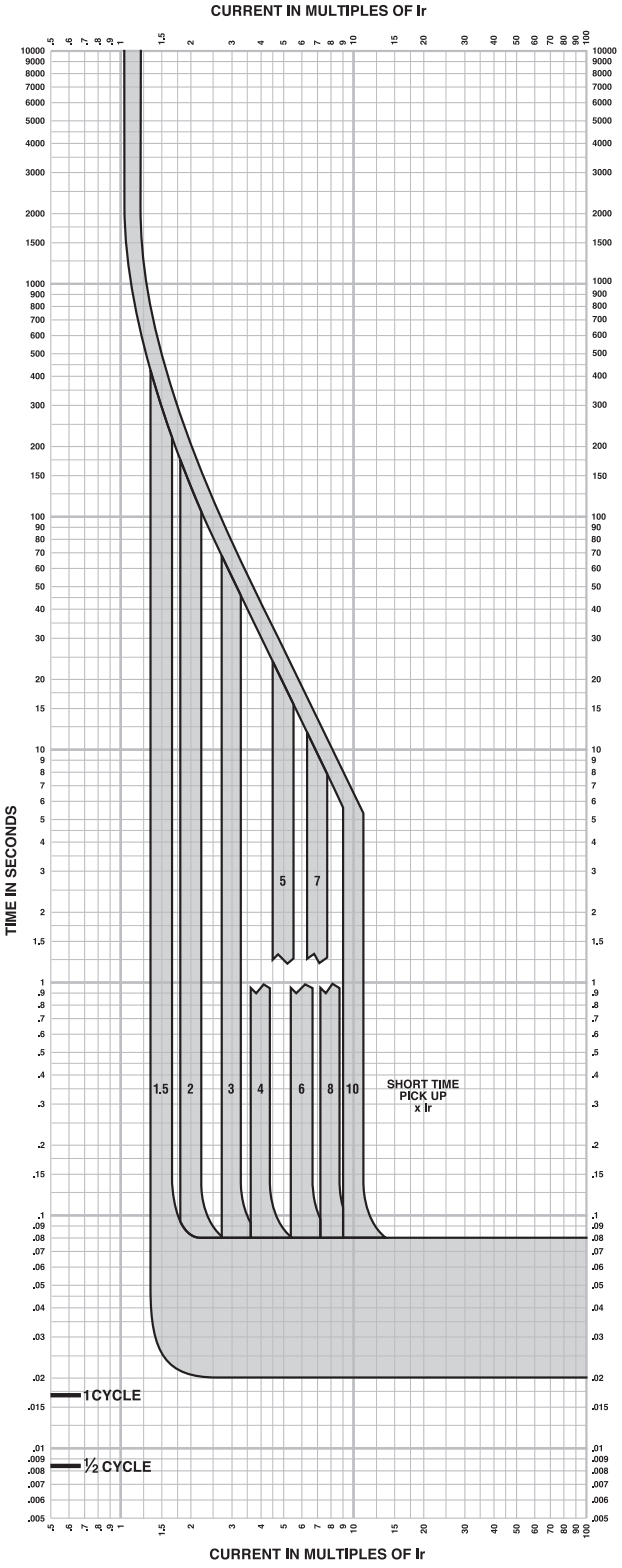
Table 115: Dimensions

Cat. No.	Approximate Dimension						
	Series	H		W		D	
HD100S	A01	17.00 in.	431.8 mm	7.90 in.	200.7 mm	4.75 in.	120.7 mm
J250F	A01	32.40 in.	823 mm	15.40 in.	391 mm	6.00 in.	152 mm
J250S	A01	31.36 in.	797 mm	14.36 in.	365 mm	6.00 in.	152 mm
J250R	A01	31.05 in.	789 mm	14.47 in.	368 mm	6.28 in.	160 mm
J250DS	A01	32.26 in.	819 mm	9.72 in.	247 mm	7.94 in.	202 mm
J250AWK	A01	32.26 in.	819 mm	9.72 in.	247 mm	7.94 in.	202 mm



NEMA Type 1

Figure 117: Micrologic 3.3S and 3.3S-W Electronic Trip Unit Long Time/Short Time Trip Curve



MICROLOGIC™ ELECTRONIC TRIP UNITS
Micrologic™ 3.3S and 3.3S-W
Long Time/Short Time Trip Curve
250A, 400A L-Frame

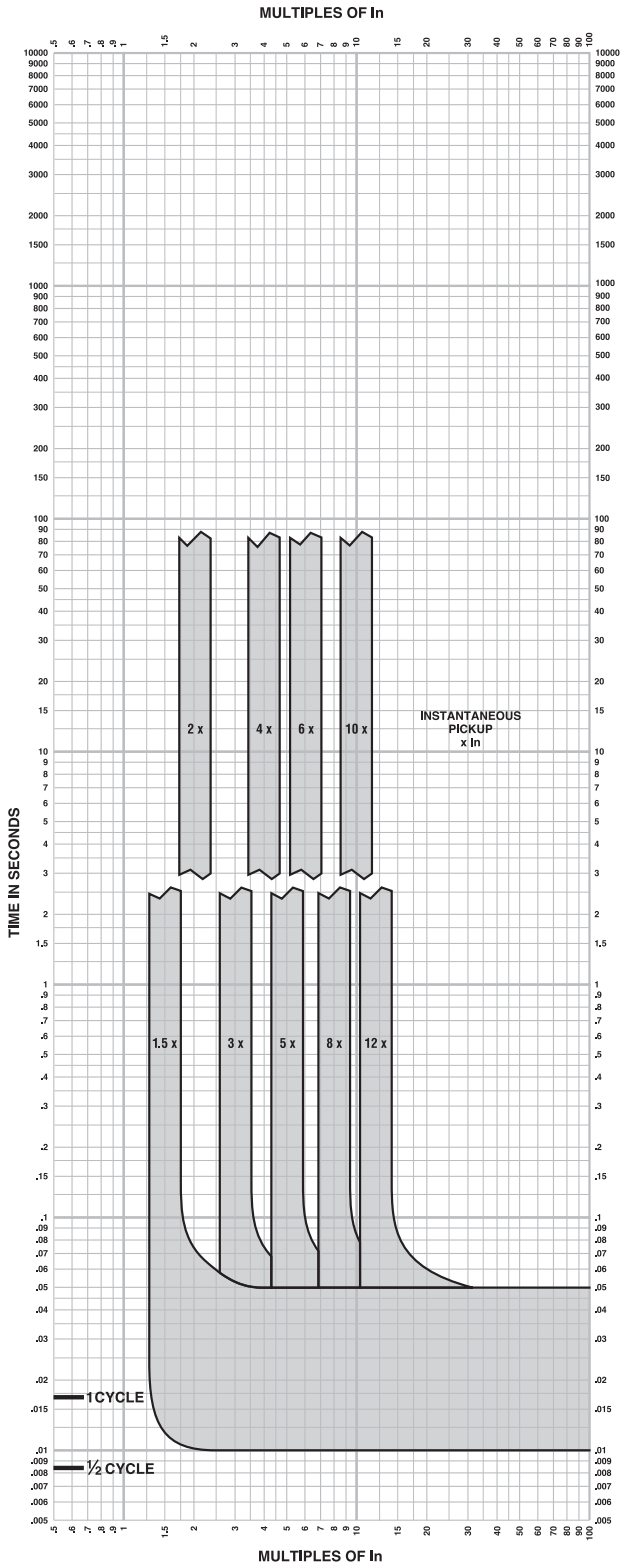
The time-current curve information is to be used for application and coordination purposes only.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.

Curves apply from -35ºC to +70ºC (-31ºF to +158ºF) ambient temperature.

Figure 119: Micrologic 3.3, 3.3-W, 3.3S, 3.3S-W, 5.3A, 5.3A-W, 5.3E, 5.3E-W, 6.3A, 6.3A-W, 6.3E, and 6.3E-W Electronic Trip Unit Instantaneous Trip Curve



MICROLOGIC™ ELECTRONIC TRIP UNITS
Micrologic™ 3.3, 3.3-W, 3.3S, 3.3S-W, 5.3A, 5.3A-W, 5.3E, 5.3E-W, 6.3A, 6.3A-W, 6.3E, and 6.3E-W
Instantaneous Trip Curve
400A L-Frame

The time-current curve information is to be used for application and coordination purposes only.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
3. In = Maximum dial setting of Ir.
   400A L-Frame: In = 400A = Max Ir setting

Curves apply from -35ºC to +70ºC (-31ºF to +158ºF) ambient temperature.

Circuit Breaker Enclosure Data Sheet - Gas

150 kW Standby

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*** 8V0110 GS150 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.

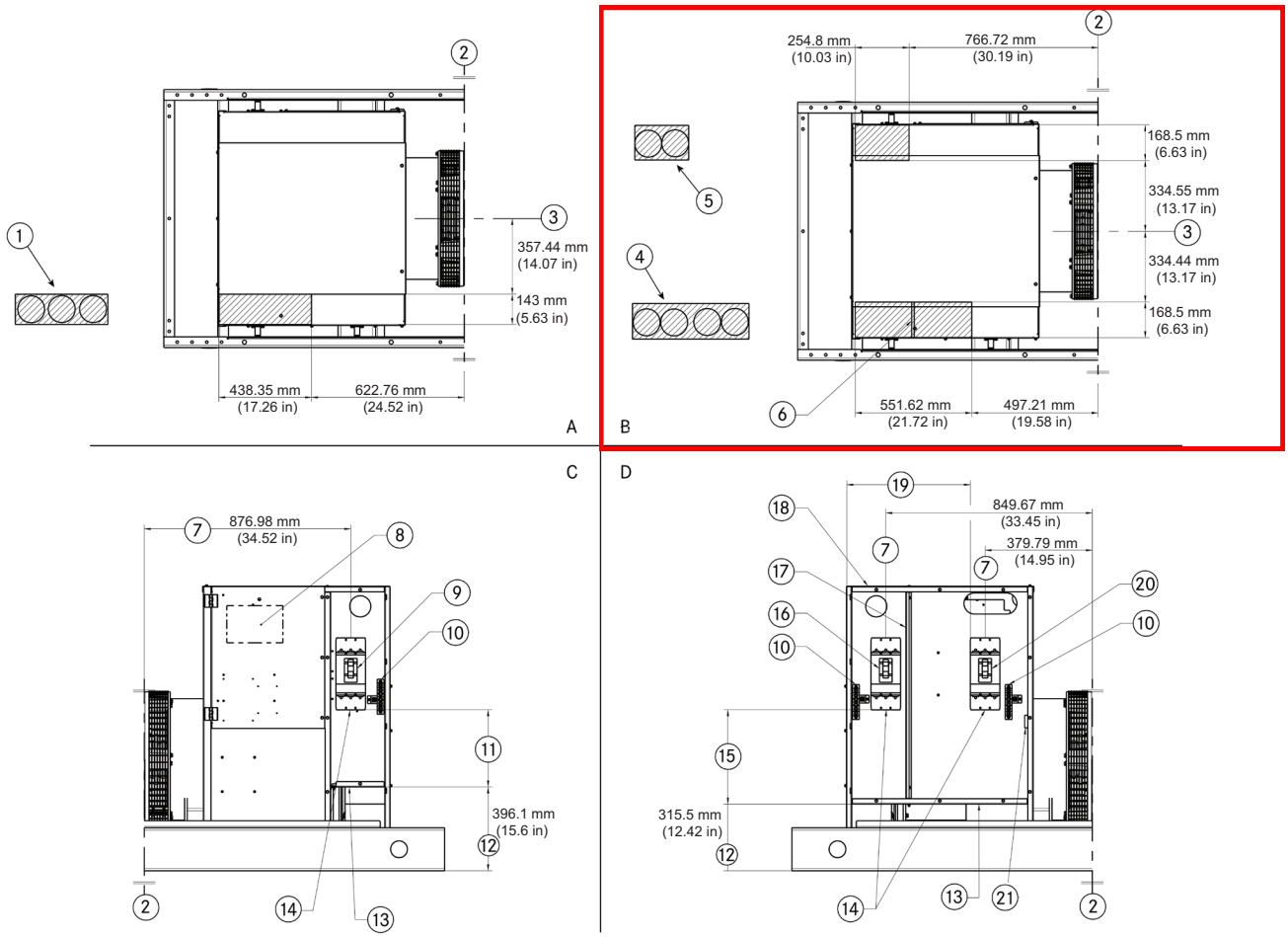


Figure 1: 430 Frame Enclosure

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. Add 205 mm (8.08 in) for bases with integrated single wall fuel tank
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)

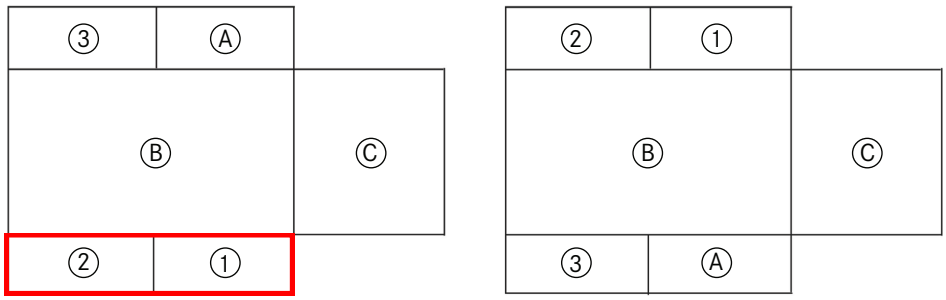
Circuit Breaker Enclosure Data Sheet - Gas
150 kW Standby

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	20-150	(1) 8-3/0	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

NOTE: Equipment grounding terminal wire range: 6 AWG - 350 kcmil.

Table 1: 430 Frame Enclosure Data



Top View - Right Side Breaker **Top View - Left Side Breaker**

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	-
PP/MM	H/J	H/J/L
P/M	P/M	L

Table 2: 430 Frame Breaker Mounting Positions

N/A = Not Available

Starting System Data Sheet

Commercial Battery

Extra ruggedness and resistance to vibration, heat, chemicals, and physical abuse are built into every commercial battery provided with an ***mtu*** generator set. The battery design features the latest in power storage technology for lead-acid batteries, as well as incorporates proven designs developed with the most experience in the business.

PRODUCT FEATURES

- **Case Design:** Tough, high-impact reinforced polypropylene case is heat sealed under extreme pressure to withstand heavy commercial service usage. This helps to prevent electrolyte leakage, improves reliability, and reduces breakage.
- **Internal Design:** Full-frame power path grids avoid sharp wires protruding through separators and directs the power straight to the lug for low resistance and higher cranking amps.
- **Terminals:** Standard terminals are solidly built preventing porosity, corrosion, black post, and harmful acid leaks.
- **Power Density:** Extra heavy-duty batteries deliver more cranking amps per pound.
- **Maintenance:** The battery uses pure de-mineralized electrolytes for reduced water loss, reduced gassing, longer battery life, and low maintenance.
- **Reliability:** Narrow ribs reduce separator corrosion to protect against shorts while deep-pocket envelopes dramatically improve reliability and extend service life.
- **Quality:** Over 250 quality control checks, combined with computer-aided design technology, provide a tough, durable battery in each commercial battery provided with an ***mtu*** generator set.

						Overall Dimension			
BCI Group Size	Terminal Type	*mtu* Part Number	Volt	Cranking Performance CCA (Cold Cranking Amps) -18° C / 0° F	Reserve Capacity	Length mm (in)	Width mm (in)	Height mm (in)	Weight (Wet) kg (lbs)
24	Post	SUA102538	12	650	115	273 (10.75)	171 (6.75)	229 (9)	18.1 (40)
31	Post	SUA120299	12	950	175	330 (13)	171 (6.75)	241 (9.5)	25.7 (56.5)
4D	Post	SUA102493	12	1,050	290	527 (20.75)	216 (8.5)	258 (10.125)	45.2 (99.5)
8D	Post	SUA102492	12	1,400	430	527 (20.75)	279 (11)	254 (10)	59.3 (130.5)

Water Heater Data Sheet

TPS Series

DESCRIPTION

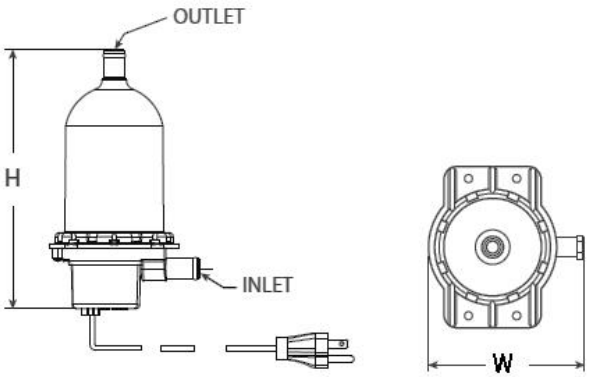
The TPS engine preheater is designed to preheat diesel and gas engines in generator set applications. Simple to install and very lightweight, the TPS engine preheater features a built-in thermostat and heats engines with up to 12 L displacement. Thermosiphon circulation of the coolant delivers heat throughout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

CERTIFICATIONS AND STANDARDS

— c-UL-us Listed
— CE Compliant

SPECIFICATIONS

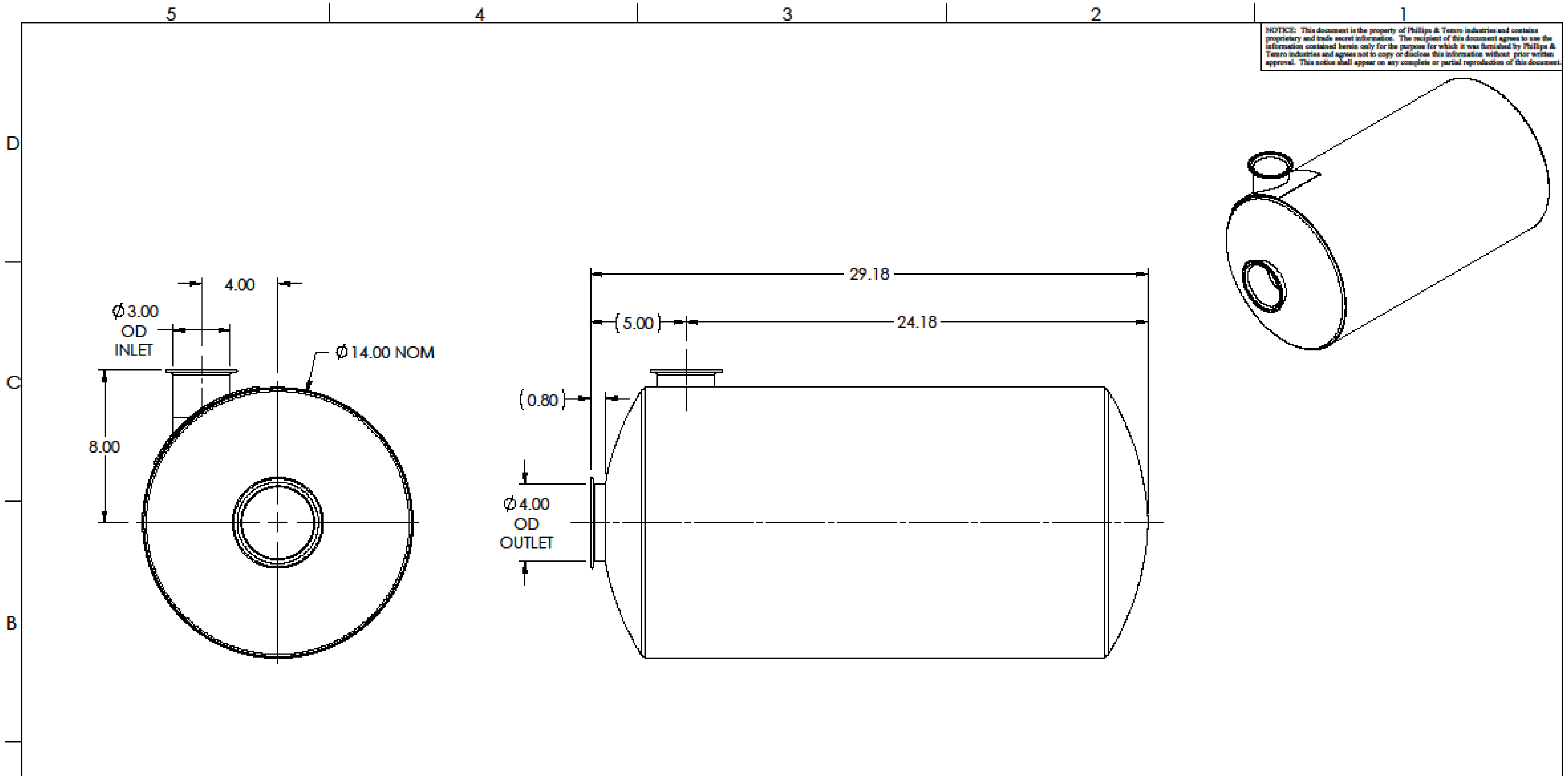
Height:	200 mm (7.9 in)
Width:	117 mm (4.6 in)
Weight:	771 g (1.7 lb)
Heating fluid:	Engine coolant (50% glycol/50% water)
Power:	0.5, 1, 1.5, 1.8, and 2 kW
Voltage range:	120 to 240 V
Tank material:	Polyphenylene sulfide (PPS)
Heating element:	Incoloy 800
Enclosure:	IP41
Fluid capacity:	416 cm^3 (0.11 gal)
Max pressure:	6.2 bar (90 psi)
Inlet / outlet:	15.9 mm (0.625 in)
Thermostat range:	
On	38 °C (100 °F)
Off	49 °C (120 °F)



Model Number	*mtu* Part Number	Watts	Volts	Phase	Hz	Amps
TPS051GT10-000	SUA90366	500	120	1	60	4.2
TPS101GT10-000	SUA52746	1,000	120	1	60	8.4
TPS151GT10-000	SUA52748	1,500	120	1	60	12.5
TPS181GT10-000	SUA52750	1,800	120	1	60	15
TPS202GT10-000	SUA52751	2,000	240	1	60	8.3

Subject to change. | WT00032343 | 2021-04

A Rolls-Royce solution



ENGINE SPECIFIC INFORMATION	
ENGINE:	FORD 6.8L NG/LPG
DISPLACEMENT (IN³):	415
FLOW (CFM):	785
TEMP (°F):	1200/1260
BACK PRESSURE (H2O):	81.5"

REV	DATE	BY	COMMENTS
1	12/14/2011	JVC	RELEASED FOR CUSTOMER APPROVAL
2	1/5/2012	JVC	REVISED INLET WAS 3.50 OD & OAL WAS 23.00

CUSTOMER MTU — FINISH HIGH TEMP BLACK PAINT — WEIGHT 69.50

PHILLIPS & TEMRO Industries

DRAWN BY: JVC — DRAWN DATE: 12/14/2011 — DESCRIPTION: S-E SB03-SB04 Ø14.00 29.18 OAL F:24.18 —

SIZE: B — SHEET: 3 OF 3 — DWG NO — SEE PO — REFERENCE: MTU - 101740 — MATERIAL: SEE BOM

MACH: ±1° BEND: ±2° — .00 ±.13 .000 ±.06 — 00. ±2 0.0 ±1 — SCALE: 1:5 — DRAWING/PART NUMBER: CPJS-04X-90013905 — REV: 2

Reference Information:

Manufacturer: Philips & Temro
Model: CPJS-04X-90013905

Dimensions and Weights on Drawings are in Inches/Pounds.

Buchst. Rev.Ltr.	Kommt vor Frequency	Änderung/Revision	Auftrags-Nr. Rev. Not. No.	Datum Date	Name	Gepr. Check
a	0x			12-01-13	Klassen	kost
----	--------	----------------------				---

Oberflächenangaben nach MTN5033 Surface Specification per MTN5033	Allgemeine Fertigungsvorschriften nach MMN 332 Production Specification per MMN 332	-- --	Masse/Mass kg 154.945 — Format/Size **A3**

	WORD	Datum Date	Name
Verwendbar für Typ / Applicable to Model			
Projekt-/Auftrags-Nr. / Project/Order No.	Bearb. Drawn	12-01-13	Klassen
Ref.-Nr./Ref.No. Emissions_ID	Gepr. Checked	12-01-13	Kost
Bei Fremdteil/Kaufteil dürfen alle techn. Änderungen am Lieferumfang nur nach unserer vorherigen Genehmigung vor-genommen werden. Techn. modifications to third party or purchased parts require our prior permission.	Norm Stndr.	12-01-13	Halbert
	Abt. Dept.	OAN	Halbert

Benennung/Title

ABGASSCHALLDAEMPFER

EXHAUST SILENCER

INSULATED FORD 6.8L

mtu onsite energy — MTU Friedrichshafen GmbH

Zeichnungs-Nr./Drawing No. **SUA101740**

Blatt/Sheet **1** von/of **1**

T-348-0108

Air Filter Data Sheet

DESCRIPTION

Air filters offer engine protection and minimal downtime during normal maintenance. The air filters on ***mtu*** generator sets are easy to install, durable, and reliable.

FEATURES

- Designed to withstand severe intake pulsation and high humidity
- Sturdy, self-supporting, one-piece construction
- Lightweight and compact

SPECIFICATIONS

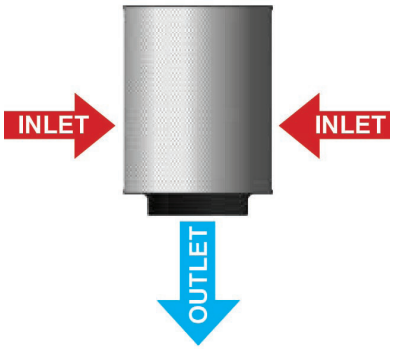
mtu Part #	Airflow @ Inches of Water Restriction (refer to *Airflow Diagrams* below)			Weight	Maximum Temp	
	m^3/min (SCFM) @ 4 in. H_2O	m^3/min (SCFM) @ 6 in. H_2O	m^3/min (SCFM) @ 8 in. H_2O	kg (lb)	Continuous °C (°F)	Intermittent °C (°F)
SUA106417	4.3 (150)	5.1 (180)	6.1 (215)	1 (2.2)	83 (180)	105 (220)
SUA90069	43.9 (1,550)	52 (1,836)	60 (2,118)	3.6 (8)	83 (180)	105 (220)
SUA86885	13.7 (485)	17.6 (620)	21.5 (760)	2.6 (5.8)	83 (180)	105 (220)
SUA77166	3.8 (135)	4.6 (163)	5.3 (190)	1.3 (2.9)	N/A	N/A
SUA40198	3.1 (112)	4.1 (145)	4.8 (170)	0.64 (1.4)	83 (180)	105 (220)
XG3012100019	23.5 (830)	31.43 (1,110)	36.67 (1,295)	1.45 (3.2)	83 (180)	105 (220)
XG2112100001 XG2512100002	9.63 (340)	13.03 (460)	15.85 (560)	1.59 (3.5)	N/A	N/A

mtu Part #	Dimensions (refer to *Dimension Diagrams* on next page)				Minimum Removal Clearance
	Body Length (D) mm (in)	Body Diameter (A) mm (in)	Outlet Length (F) mm (in)	Outlet Diameter (C) mm (in)	mm (in)
SUA106417	127 (5)	216 (8.5)	35 (1.38)	76 (3)	38.1 (1.5)
SUA90069	400 (15.75)	318 (12.5)	48 (1.89)	198 (7.8)	38.1 (1.5)
SUA86885	279 (11)	318 (12.5)	35 (1.38)	127 (5)	38.1 (1.5)
SUA77166	172 (6.75)	216 (8.5)	27 (1.08)	75 (2.96)	38.1 (1.5)
SUA40198	102 (4)	216 (8.5)	35 (1.38)	64 (2.5)	38.1 (1.5)
XG3012100019	381 (15)	318 (12.5)	35 (1.38)	152 (6)	38.1 (1.5)
XG2112100001 XG2512100002	267 (10.5)	267 (10.5)	35 (1.38)	102 (4)	38.1 (1.5)

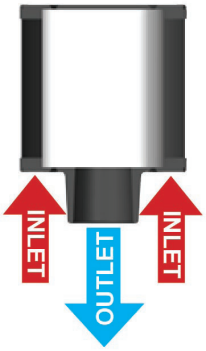
N/A = Not Available

A Rolls-Royce solution

AIRFLOW DIAGRAMS



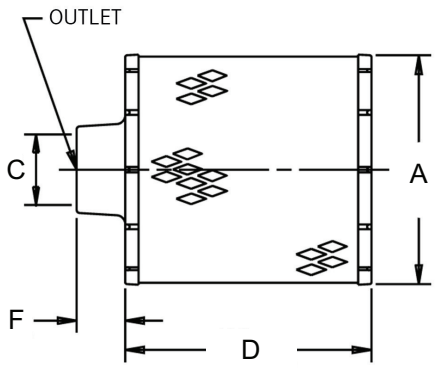
Airflow Diagram: SUA90069, XG3012100019



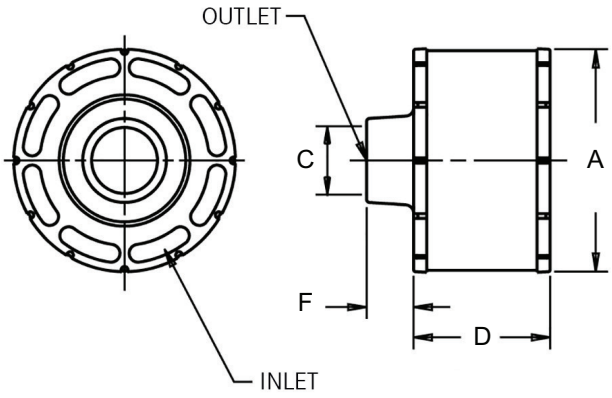
Airflow Diagram: SUA106417, SUA86885, SUA77166, SUA40198

Airflow Diagram: XG2112100001, XG2512100002

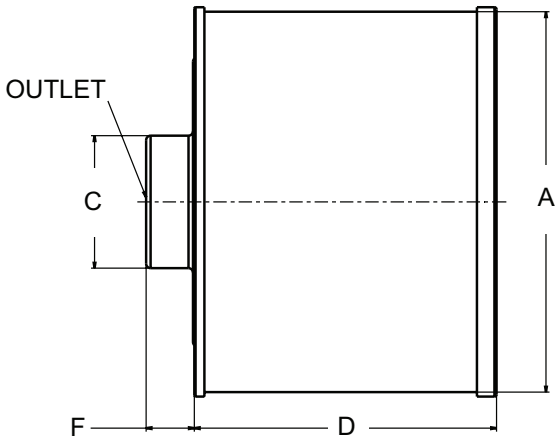
DIMENSION DIAGRAMS



Dimension Diagram: SUA90069, XG3012100019



Dimension Diagram: SUA106417, SUA86885, SUA40198



Dimension Diagram: SUA77166, XG2112100001, XG2512100002

Isolator Pad Data Sheet

DESCRIPTION

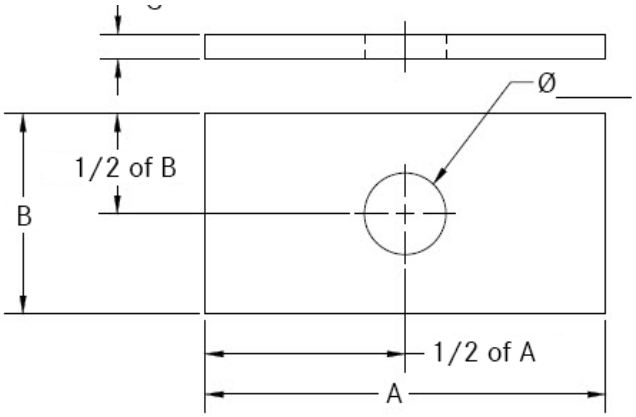
These square-molded, neoprene pads can be used to compensate for inconsistencies in the mounting surface between the generator set base frame and the installation surface, or between the sub-base fuel tank and the installation surface, if applicable. They can be easily cut to any desired shape and can be used in multiple layers to increase deflection.

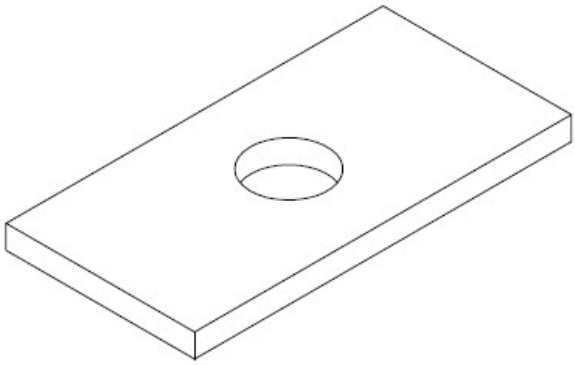
NEOPRENE TYPICAL PHYSICAL PROPERTIES

Hardness:	40A-90A
Tensile Strength:	500
Elongation:	200
Tear Value:	50
Thermal Conductivity (K Factor):	0.30

Heat Resistance @ 100 °C (212 °F) after 70 Hours:

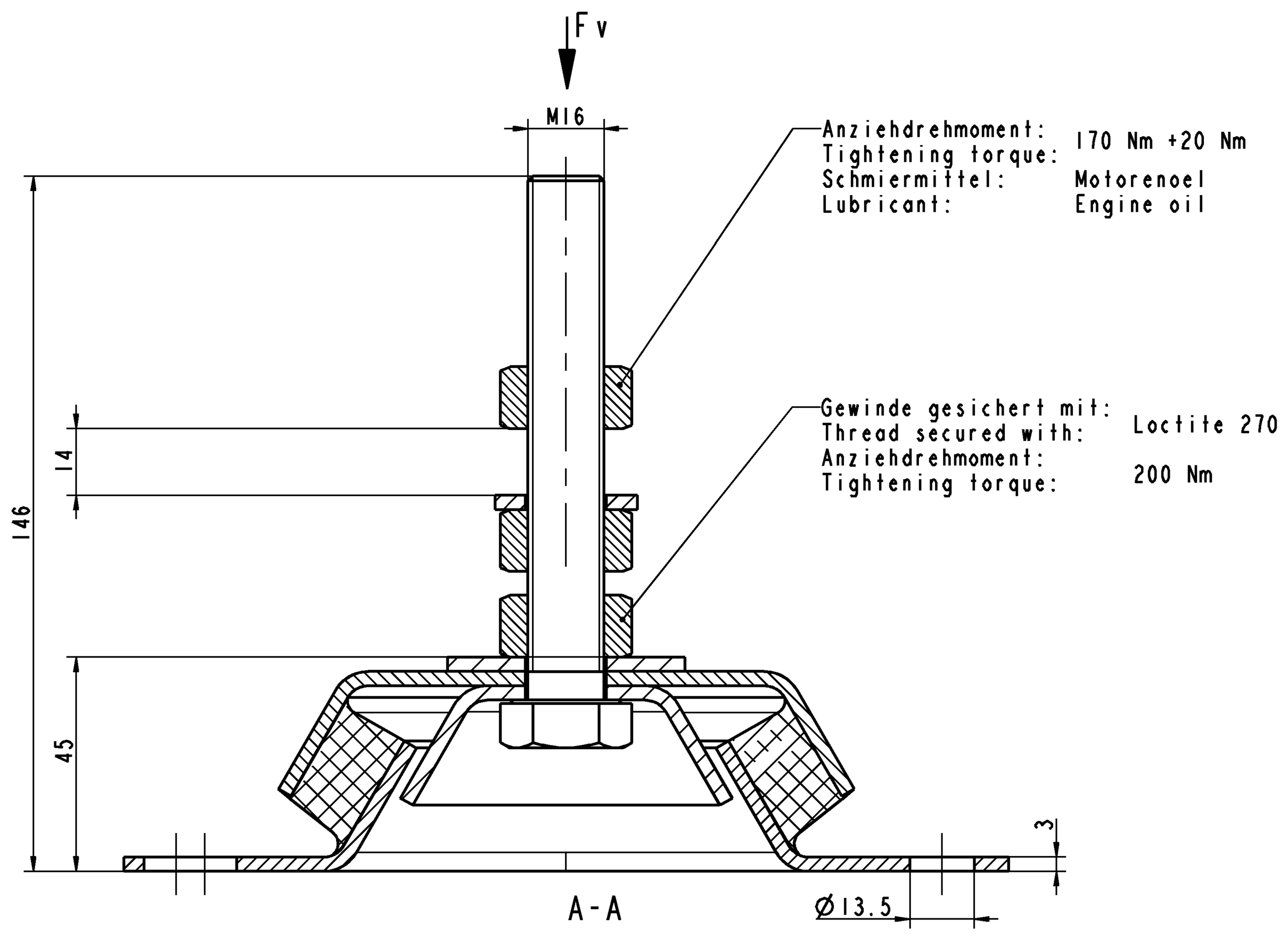
Change in Hardness:	10
Change in Tensile:	-16%
Change in Elongation:	-60%
Compression Set:	50%
Lowest Working Temperature:	-40 °C (-40 °F)
Highest Working Temperature:	90.6 °C (195 °F)

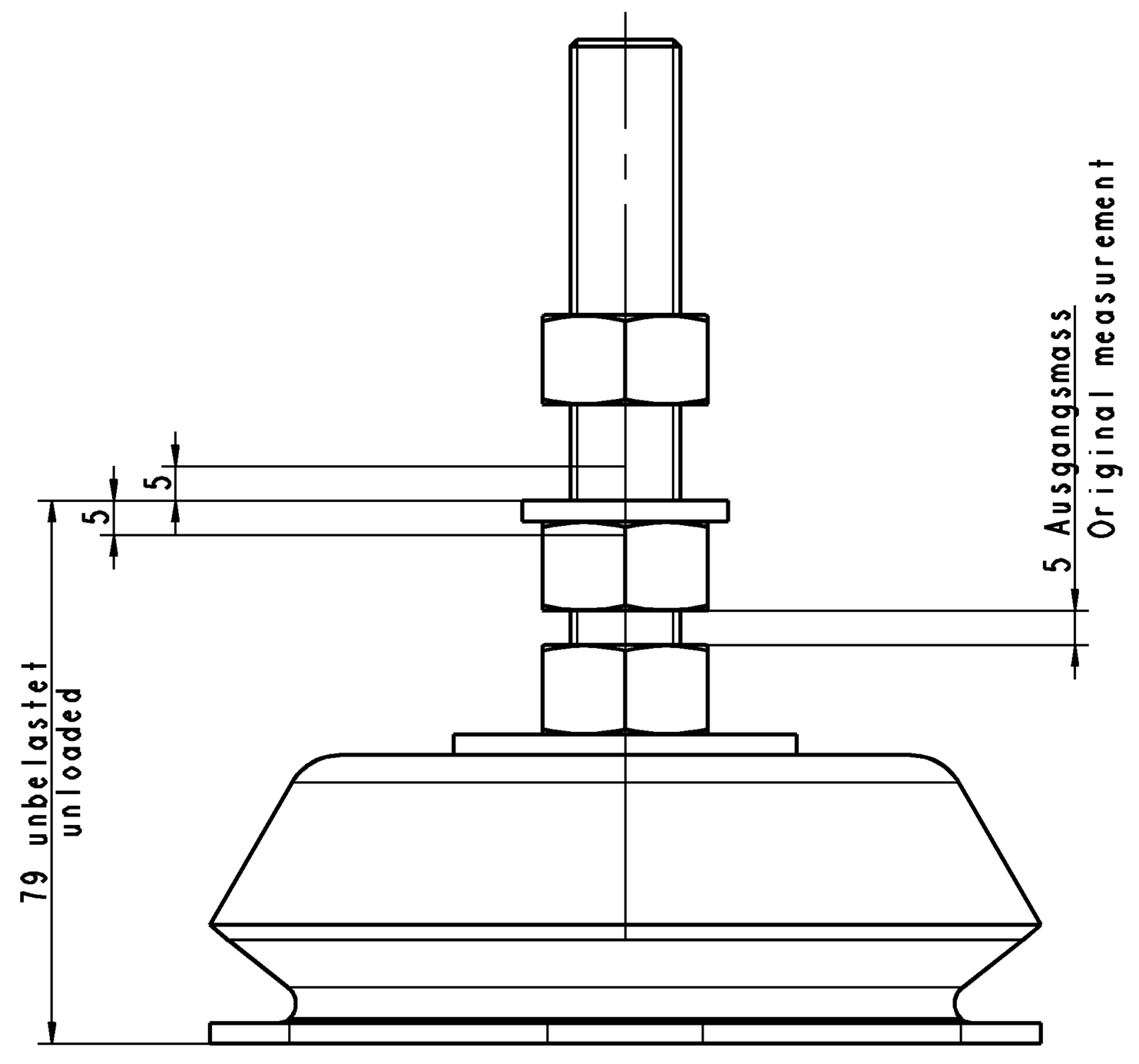


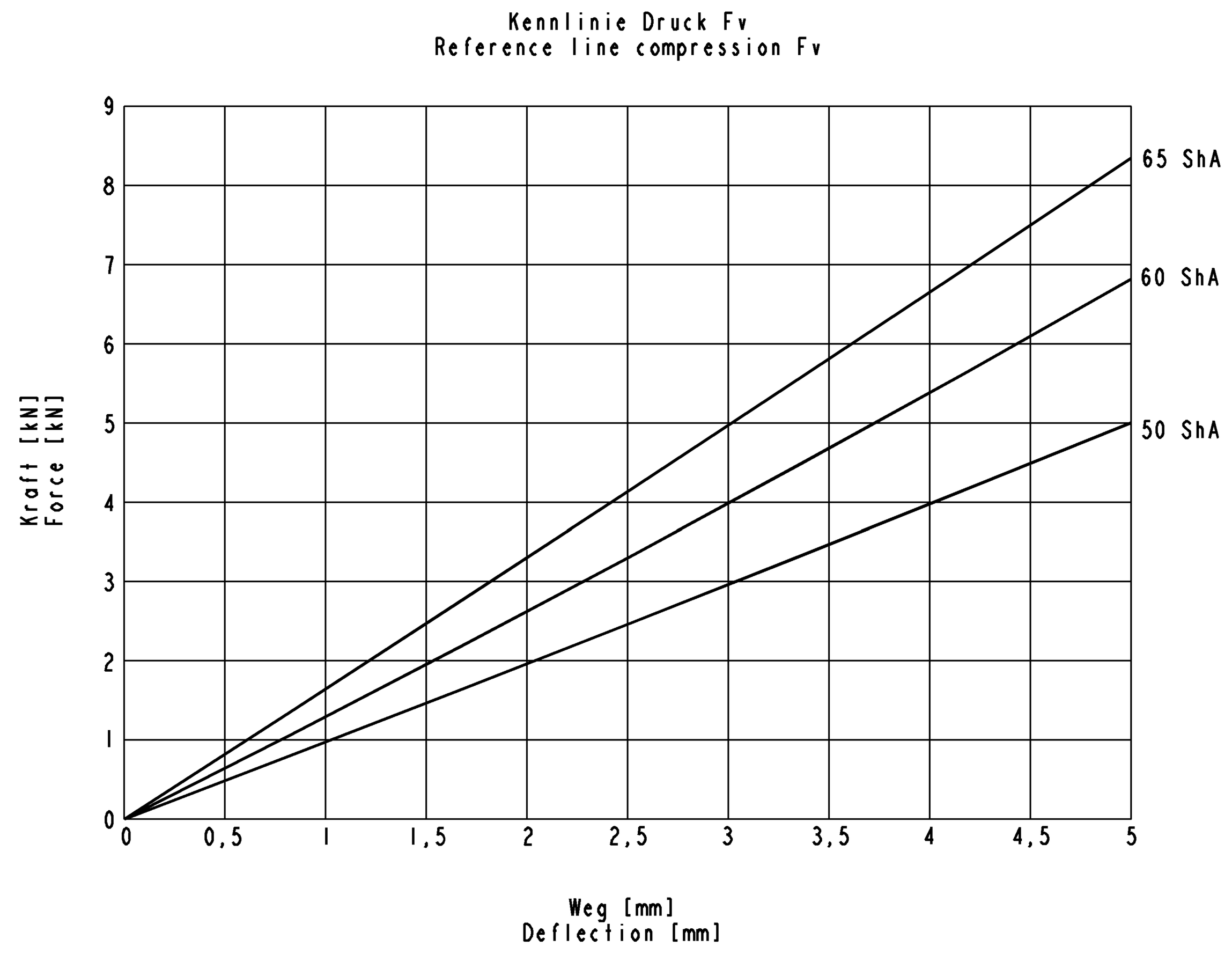


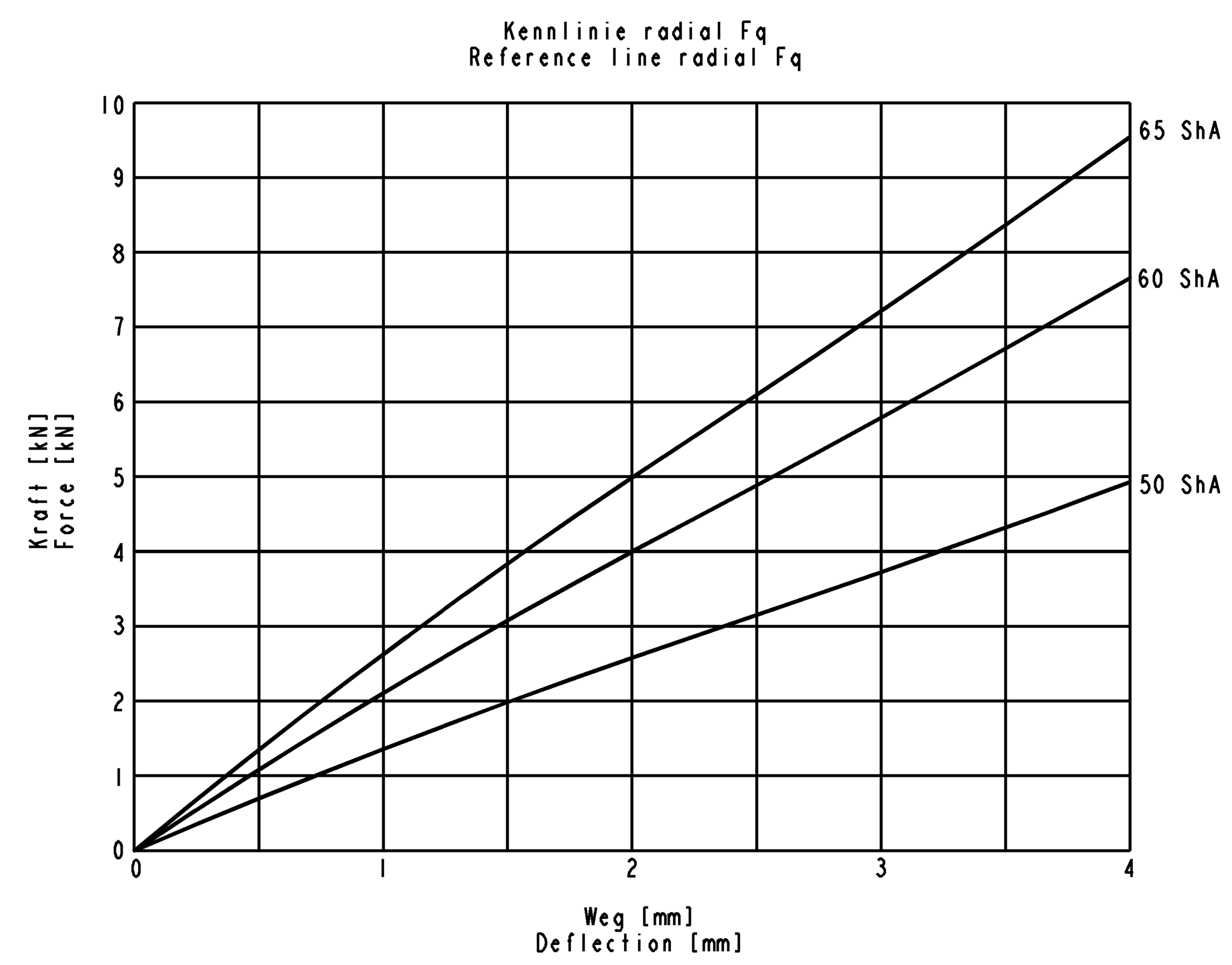
mtu Part Number	Dim. A mm (in)	Dim. B mm (in)	Dim. C mm (in)	Hole Diameter mm (in)	Durometer
SUA46904	101.6 (4)	50.8 (2)	6.35 (0.25)	20.638 (0.813)	50
SUA46905	152.4 (6)	50.8 (2)	6.35 (0.25)	20.638 (0.813)	50
SUA46906	254 (10)	50.8 (2)	6.35 (0.25)	20.638 (0.813)	50
SUA46907	457.2 (18)	63.5 (2.5)	6.35 (0.25)	20.638 (0.813)	50
SUA46908	457.2 (18)	76.2 (3)	6.35 (0.25)	20.638 (0.813)	50
SUA46909	457.2 (18)	457.2 (18)	6.35 (0.25)	Not Required	50
SUA63015	203.2 (8)	76.2 (3)	6.35 (0.25)	20.638 (0.813)	50
SUA77843	101.6 (4)	50.8 (2)	19.05 (0.75)	20.638 (0.813)	60
SUA86147	457.2 (18)	76.2 (3)	6.35 (0.25)	20.638 (0.813)	70
SUA95672	304.8 (12)	50.8 (2)	6.35 (0.25)	20.638 (0.813)	50
SUA102408	457.2 (18)	76.2 (3)	6.35 (0.25)	26 (1.024)	50
X54599100330	381 (15)	76.2 (3)	6.35 (0.25)	22.225 (0.875)	50

Subject to change. | WT00038043 | 2021-10







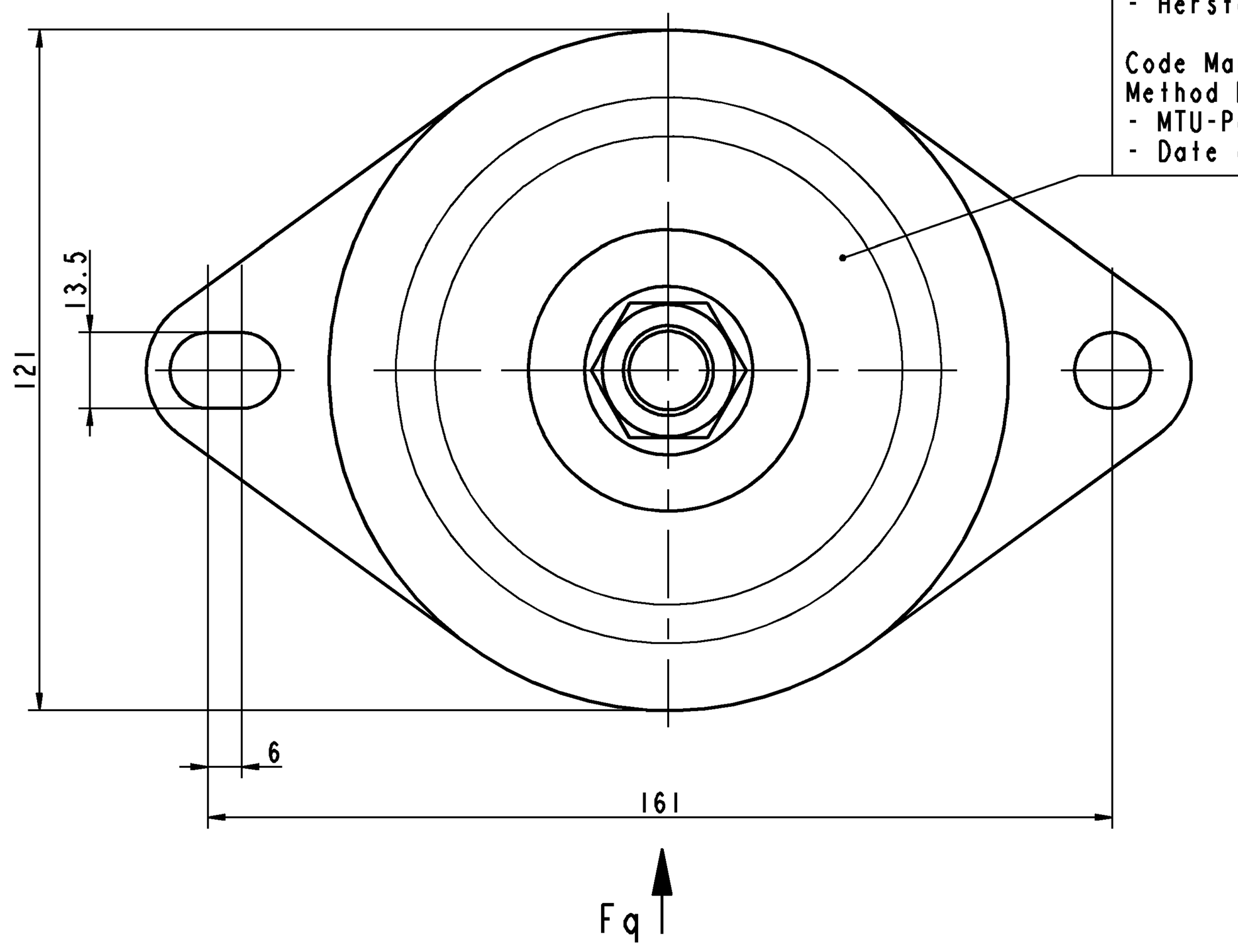


maximal zulaessiger Federweg: 4mm
Maximum permitted resilient tolerance:
maximal zulaessige Belastung: siehe Kennlinie
Maximum permitted load: see reference line

MTU-Sachnummer MTU-Part number	Sachnummer Lieferant Supplier Part No.	Shore Haerte Shore hardness	Daempfungsgrad Damping ratio	Federsteifigkeit Fv Resilient stiffness Fv
X57523100036	10004401	50 Sh A	0,04	1,0 kN/mm ±20%
X57523100037	10004402	60 Sh A	0,05	1,3 kN/mm ±20%
X57523100039	10004403	65 Sh A	0,06	1,6 kN/mm ±20%

Kennzeichnung siehe MTN5077
Verfahren B2 -
- MTU-Sachnummer
- Herstelldatum auf Gummielement

Code Marking, see MTN5077
Method B2 -
- MTU-Part Number
- Date of Manufacture on Rubber Element



MTU-Sachnummer MTU-Part number	Zylinderzahl No. of cylinders	Shore Haerte Shore hardness	statische Einfederung Static resilient deflection
X57523100039	12V	65 Sh A	2,5 [mm]
X57523100037	10V	60 Sh A	2,8 [mm]
X57523100037	8V	60 Sh A	2,4 [mm]
X57523100036	6R	50 Sh A	3,1 [mm]

X57523100036 (50 ShA)

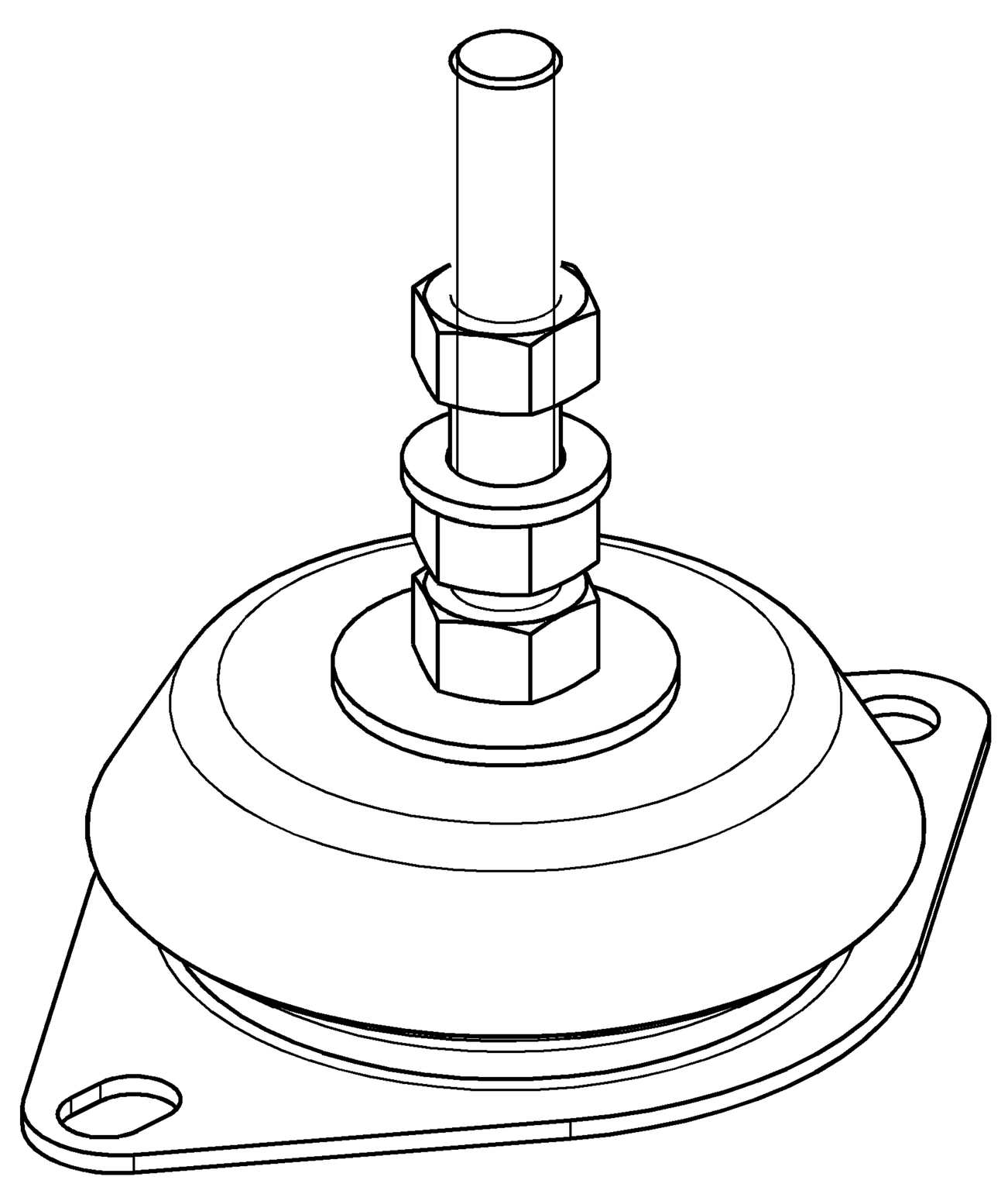
FEDERWEG-PRUEFVORSCHRIFT
Belastungsrichtung: Druck Fv
Pruefhaufigkeit: einmalig pro Charge
Pruefvorrichtung:
Messtemperatur: Raumtemperatur
Vorlast: 500 N
Anzahl Setzzyklen: 2
Setzgeschwindigkeit: 20mm/min
Setzbelastung bis: 4kN
Pruefgeschwindigkeit: 20mm/min
1. Kraftmessung:
2. Wegmessung:
3. Steifigkeitsmessung: C=0,8-1,2kN/mm zwischen 1-3mm

X57523100037 (60 ShA)

FEDERWEG-PRUEFVORSCHRIFT
Belastungsrichtung: Druck Fv
Pruefhaufigkeit: einmalig pro Charge
Pruefvorrichtung:
Messtemperatur: Raumtemperatur
Vorlast: 500 N
Anzahl Setzzyklen: 2
Setzgeschwindigkeit: 20mm/min
Setzbelastung bis: 5,5kN
Pruefgeschwindigkeit: 20mm/min
1. Kraftmessung:
2. Wegmessung:
3. Steifigkeitsmessung: C=1,05-1,6kN/mm zwischen 1-3mm

X57523100039 (65 ShA)

FEDERWEG-PRUEFVORSCHRIFT
Belastungsrichtung: Druck Fv
Pruefhaufigkeit: einmalig pro Charge
Pruefvorrichtung:
Messtemperatur: Raumtemperatur
Vorlast: 500 N
Anzahl Setzzyklen: 2
Setzgeschwindigkeit: 20mm/min
Setzbelastung bis: 6,5kN
Pruefgeschwindigkeit: 20mm/min
1. Kraftmessung:
2. Wegmessung:
3. Steifigkeitsmessung: C=1,3-1,9kN/mm zwischen 1-3mm



X57523100036 (50 ShA)

RESILIENT TOLERANCE - TEST SPECIFICATION
Load direction: pressure Fv
Test frequency: once per lot
Test device:
Measuring temperature: ambient temperature
Pre-load: 500 N
Number of creep cycles: 2
Creep rate: 20mm/min
Creep load up to: 4kN
Test rate: 20mm/min
1. Measurement - Force:
2. Measurement - Deflection:
3. Measurement - Rigidity: C=0,8-1,2kN/mm between 1-3mm

X57523100037 (60 ShA)

RESILIENT TOLERANCE - TEST SPECIFICATION
Load direction: pressure Fv
Test frequency: once per lot
Test device:
Measuring temperature: ambient temperature
Pre-load: 500 N
Number of creep cycles: 2
Creep rate: 20mm/min
Creep load up to: 5,5kN
Test rate: 20mm/min
1. Measurement - Force:
2. Measurement - Deflection:
3. Measurement - Rigidity: C=1,05-1,6kN/mm between 1-3mm

X57523100039 (65 ShA)

RESILIENT TOLERANCE - TEST SPECIFICATION
Load direction: pressure Fv
Test frequency: once per lot
Test device:
Measuring temperature: ambient temperature
Pre-load: 500 N
Number of creep cycles: 2
Creep rate: 20mm/min
Creep load up to: 6,5kN
Test rate: 20mm/min
1. Measurement - Force:
2. Measurement - Deflection:
3. Measurement - Rigidity: C=1,3-1,9kN/mm between 1-3mm

MTN5168

Oberflaechenschutz Stahlteile:
Surface Protection Steelparts:
MTV5025, Schichtdicke: / Layer thickness: 10 bis/to 12 µm Cr(VI) frei/free

Lieferung und Altersueberwachung nach MTV 5005
Shelf Life Monitoring in compliance with MTV 5005

Lieferant / Supplier: GMT GmbH

Aufgeführte Normen Relevant Standards	Passmass Fit	Abmass in Deviation µm	Buchst. Rev.Ltr.	kennl vor Frequency	Aenderung/Revision	Aenderungs-Nr. Revision Notice No.	Datum Date	Name	Gepr. Check.
MTV5025									
MTV5005									
MTN5168			a	1	Kennlinie radial hinzugefügt	57974	14.09.2009	sabala	
MTN5077						49043	04.12.2008	zimmerma	

Ausfuehrung u.Lieferung / Tech. Characteristics	Oberflaechenangaben nach MTN5033 / Surface Specification per MTN5033
Oberflaechenschutz / Surface Protection	
Verwendbar fuer Typ / Applicable to Model: BR 1600	Allgemeine Fertigungsvorschriften nach MMN 332 / Production Specification per MMN 332
Projekt-/Auftrags-Nr. / Project/Order No.	
Referenz-Nr./Reference No.	YKFT
Massstab / Scale	1:1
Masse/Mass kg	1.334
Format/Size	A0
Werkstoff / Material	
Halbzeug, Modell, Gesenk / Semifinished Product, Pattern, Die	

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

Pro/E	Datum/Date	Name
Bearb. Drawn	10.12.2008	Zimmerma
Gepr. Checked	12.12.2008	Zurell
Norm. Stndr.	11.12.2008	Haas
Abt. Dept.	TKA	Dr.Kurreck

Benennung/Title

DAEMPFUNGSLAGER
RUBBER MOUNT

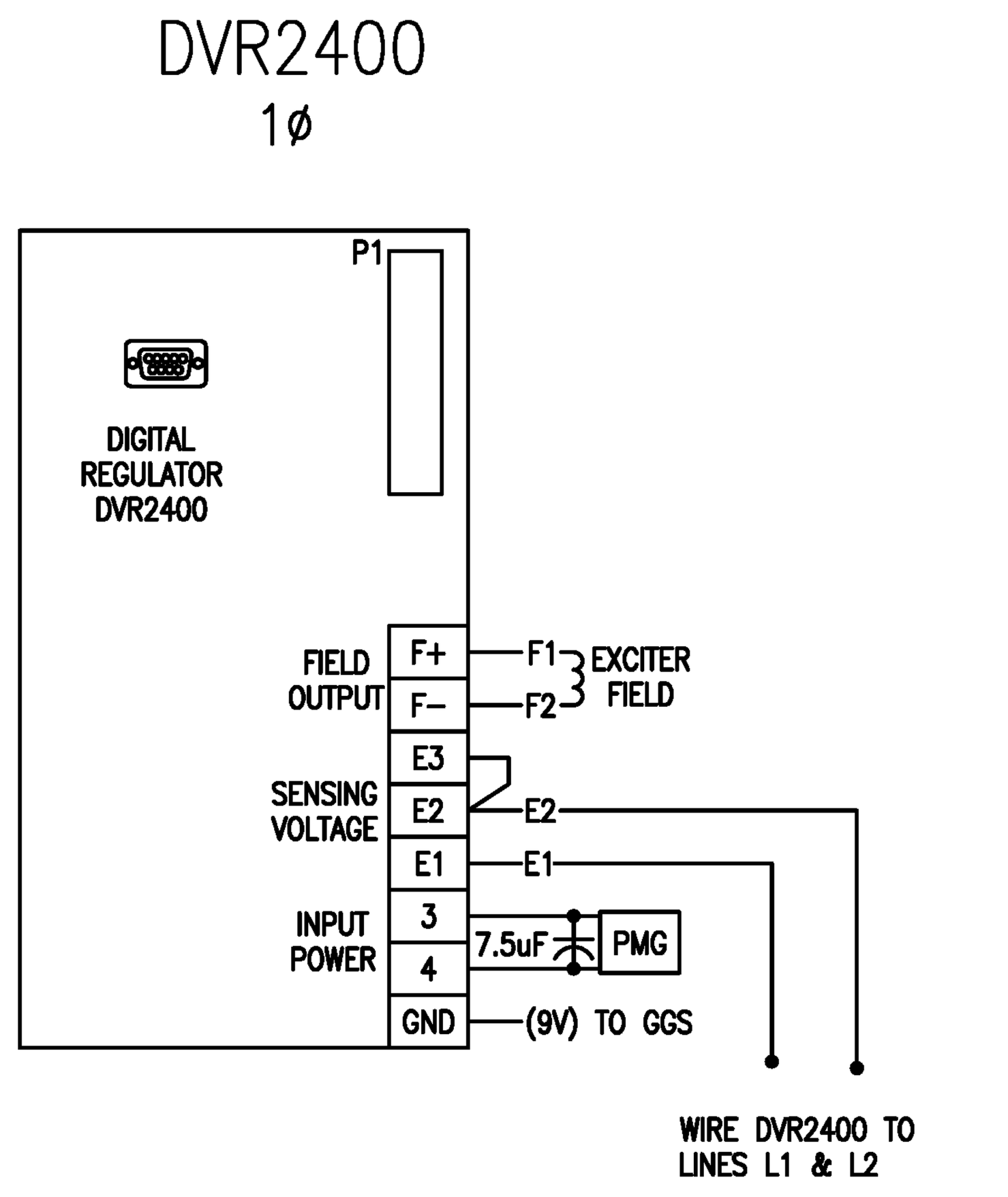
MTU Friedrichshafen GmbH

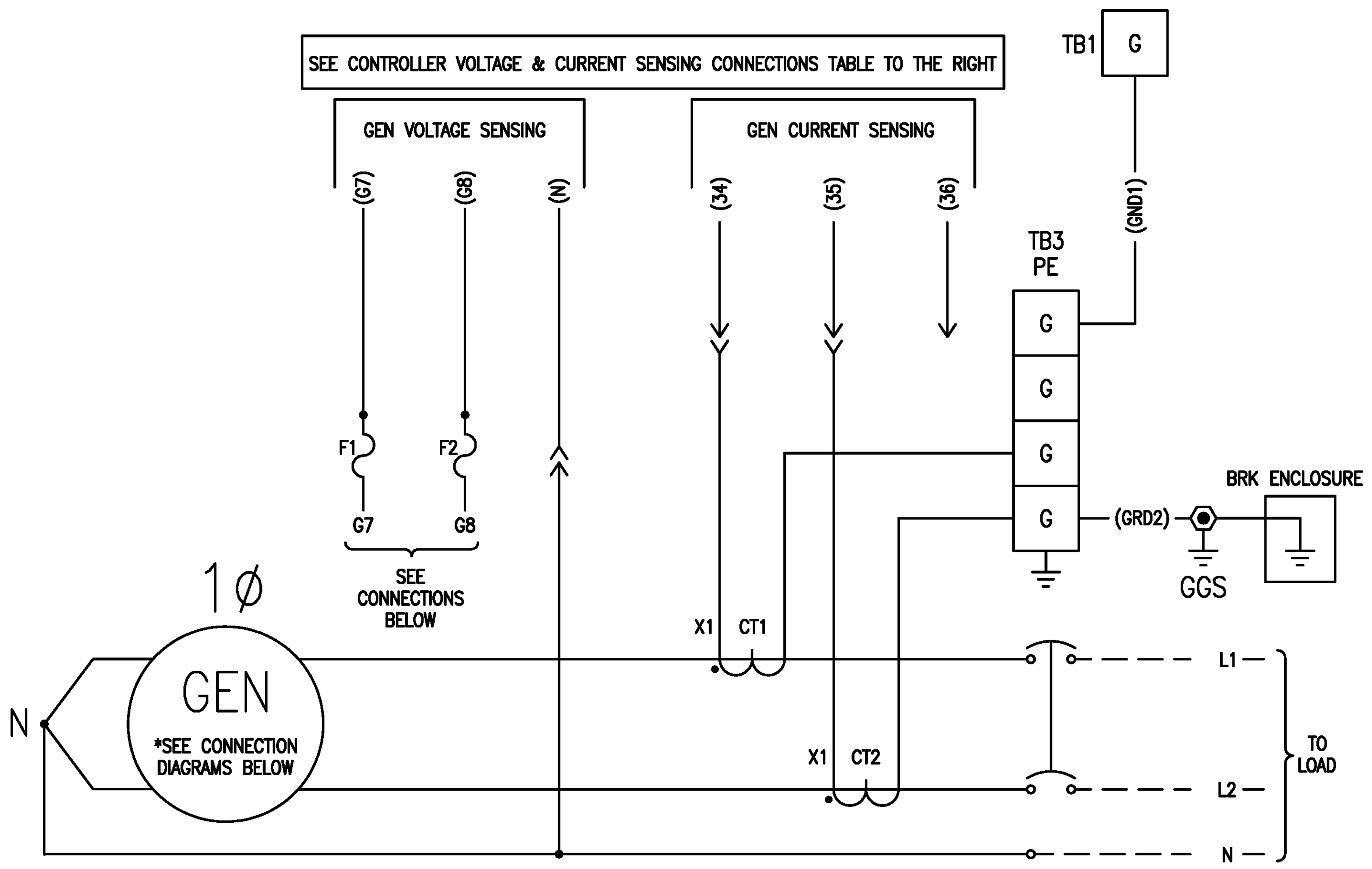
Zeichnungs-Nr./Drawing No.: XZ57523100035

Blatt / Sheet: 1v.1

DVR2400 P1 CONNECTOR

Terminal	Name	Description
P1-1	IB1	Generator Phase B CT - terminal 1
P1-2	IB2	Generator Phase B CT - terminal 2
P1-3	A_L	Auxiliary current loop (DVR2500 only)
P1-4	AU+	Auxiliary input positive
P1-5	AU-	Auxiliary input negative
P1-6	EXC	Excitation disable contact input (active closed)
P1-7	UP	UP contact input (active closed)
P1-8	DN	DOWN contact input (active closed)
P1-9	DRP	Droop disable contact input (active closed)
P1-10	QRP	VAR/PF mode disable (active closed)
P1-11	DG	Digital ground
P1-12	NO	Contact output normally open
P1-13	COM	Contact output common
P1-14	NC	Contact output normally closed





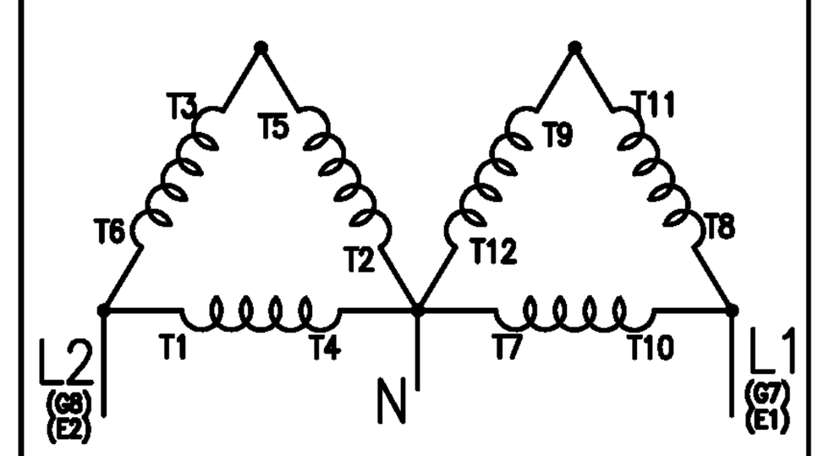
CONTROLLER VOLTAGE & CURRENT SENSING CONNECTIONS

NCP	MGC & PIN #		
TB1	1500	2000	3000
G7	45	41	86
G8	43	39	88
G9	41	37	90
N	40	35	91
34	38	69	1
35	36	72	3
36	34	75	5

WIRE #

DOUBLE DELTA 1ø

HZ	L-L	L-LO
60	240 277	120 139
50	200 220 240	100 110 120



Aenderungsbeschreibung/Description of revision: INITIAL RELEASE
Aenderungs-Nr./Revision Notice No.: PR062671
Buchst./Rev.Ltr.: --.1
Bearbeitungsstatus/Lifecycle: Released

XZG25K0000014

Benennung/Title: A0 Arrangement
ARRANGEMENT DRAWING
1GEN GENERATOR
ELECTRICAL SYSTEM DRAWING

Zeichnungs-Nr./Drawing No.: CAD06787700
Blatt/Sheet 1/1

Erstellt 08.10.2020 groenke
Gepr. 08.10.2020 groenke
Norm 12.10.2020 carsten
Freig. 12.10.2020 carsten

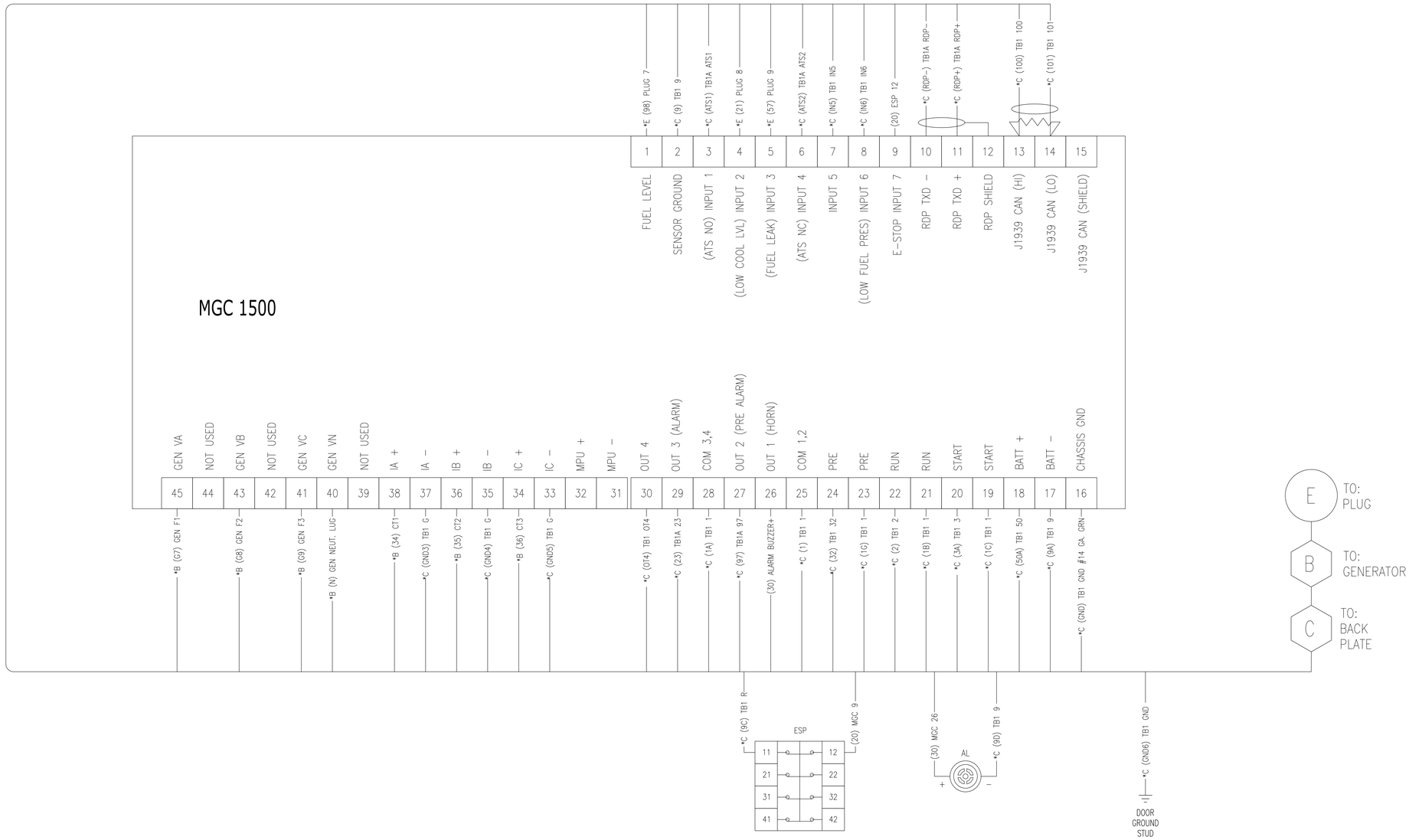
NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (- - - - - -) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

LEGEND

AL	ALARM BUZZER
BPS	BACK PLATE STUD
DGS	DOOR GROUND STUD
ESP	EMERGENCY STOP BUTTON
F1	5A ATO FUSE MGC CONTROLLER
F2	25A ATO FUSE PANEL
F3	20A ATO FUSE ECU
GGS	GENERATOR GROUND STUD
LWL	LOW WATER LEVEL PROBE
MGC	MTU GENERATOR CONTROLLER
R1	120 OHM ⅛ 1% RESISTOR
TB1	TERMINAL BLOCK 1 (PANEL BACK)
TB1A	TERMINAL BLOCK 1A (PANEL BACK)

*X (X) XXX X	
*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL



Aenderungsbeschreibung/Description of revision	kommt vor/Frequency
INITIAL RELEASE	

Buchst./Rev.Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
–.1	PR062671	Released

Passmass Fit / Abmass in Deviation µm

Allgemeintoleranzen / General Tolerances ISO 2768-mK
Tolerierung / Toleranzing ISO 8015
Auslieferung to Lieferung ----
Tech. Characteristics
Oberflächenschutz ----
Surface Protection
Verwendbar fuer TYP
Applicable to Model ----
Projekt-/Auftrags-Nr.
Project/Order NO. ----
Referenz-Nr./Ref.No. ----
Masse / Size ISO 14405
Oberflächenangaben nach MTN5033
Surface Specification per MTN5033
Allgemeine Fertigungsvorschriften nach MAN 332
Production Specification per MAN 332
Emission ID ----
block kevi 12.10.2020

Alle Rechte aus Schutzrechtsanmeldungen vorbehalten. Weitergabe, Vervielfältigung, sonstige Verwendung ohne Zustimmung nicht gestattet. Zuwiderhandlungen verpflichten zum Schadenersatz.
All industrial property rights reserved. Disclosure, reproduction or use for any other purpose is prohibited unless our written consent has been given. Any infringement results in liability to pay damages.

ACAD	Datum/Date	Name	
Ersteller Drawn	08.10.2020	groenke do	
Gepr. Check	08.10.2020	groenke do	
Norm. Appr.	12.10.2020	carsten jd	
Freigabe Released	12.10.2020	carsten jd	

Massstab/Scale
Masse/Mass ---- kg
Format/Size A
Werkstoff Material ----------
Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die ----
Material-Nr./Material-No. XZG25K0000015
Benennung/Title AO Arrangement ----
ARRANGEMENT DRAWING
1GEN MGC 1500 CONTROL PANEL
ELECTRICAL SYSTEM DRAWING
Zeichnungs-Nr./Drawing No. CAD06787711
Beschreibung/Description ----
Blatt Sheet 1/3

MGC 1500

PANEL SIDE PLUG

Wire / Destination	Pin
(48) TB1 F2	1
(9E) TB1 9	2
(9F) TB1 9	3
(GND7) TB1 GND	4
	5
	6
*A (98) MGC 1	7
*A (21) MGC 4	8
*A (57) MGC 5	9
(2A) TB1 2	10
(3) TB1 3	11
(103) TB1 F1	12
	13
(1D) TB1 1	14
	15
	16
	17
	18
(80) TB1 IN6	19
(32A) TB1 32	20
	21
	22
	23
(100A) TB1 100	24
(51A) TB1 51	25
	26
(101A) TB1 101	27
	28
CAN S	29

NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (------) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

LEGEND

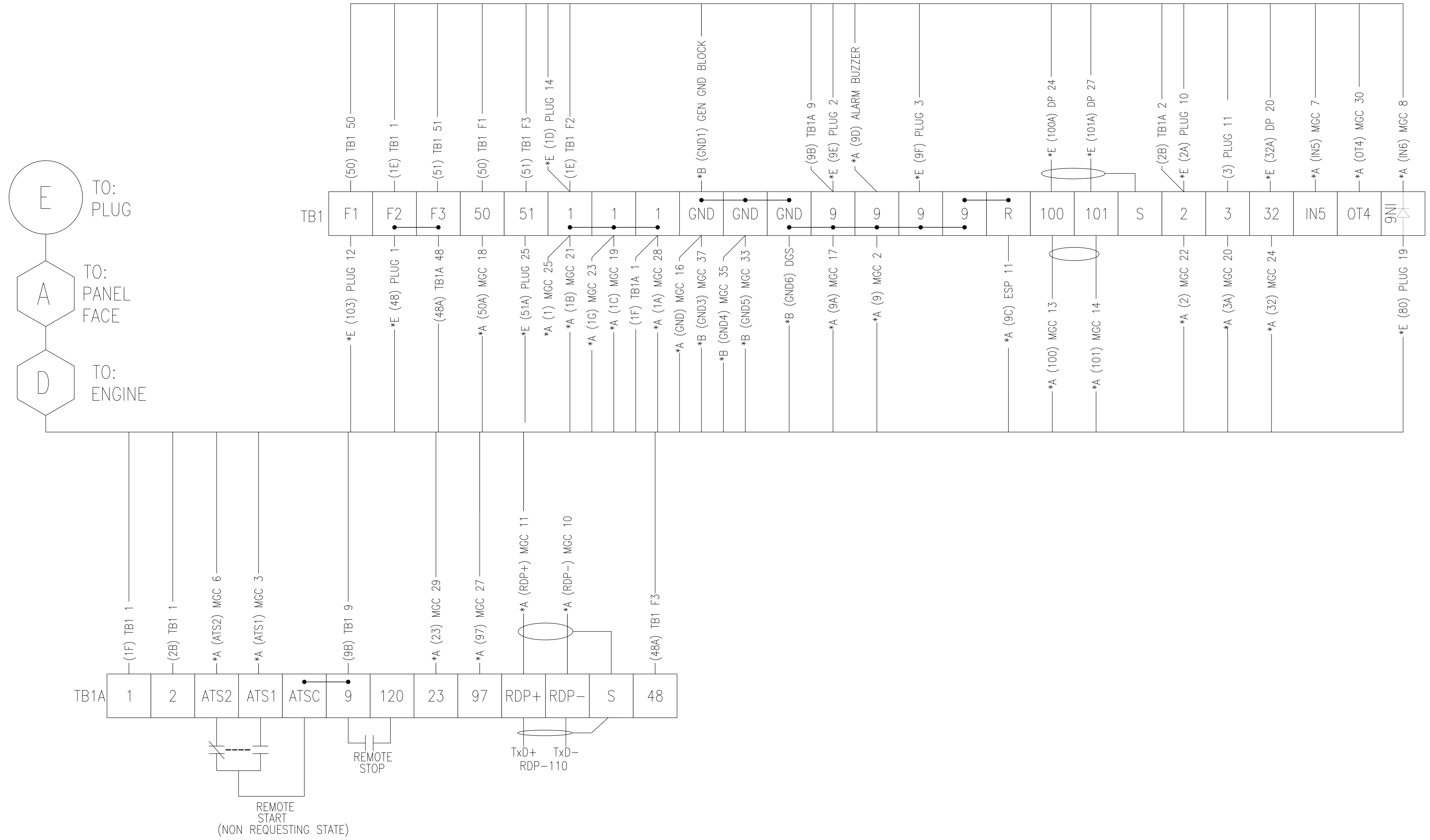
AL	ALARM BUZZER
BPS	BACK PLATE STUD
DGS	DOOR GROUND STUD
ESP	EMERGENCY STOP BUTTON
F1	5A ATO FUSE MGC CONTROLLER
F2	25A ATO FUSE PANEL
F3	20A ATO FUSE ECU
GGS	GENERATOR GROUND STUD
LWL	LOW WATER LEVEL PROBE
MGC	MTU GENERATOR CONTROLLER
R1	120 OHM ⅛ 1% RESISTOR
TB1	TERMINAL BLOCK 1 (PANEL BACK)
TB1A	TERMINAL BLOCK 1A (PANEL BACK)

*X (X) XXX X

*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL

AC CUSTOMER CONNECT

SEE PAGE 3 FOR TERMINAL DESIGNATION



Allgemeintoleranzen / General Tolerances ISO 2768-mK		Massstab/Scale	Masse/Mass kg ---- / Format/Size A
Tolerierung / Tolerancing ISO 8015	Masse / Size ISO 14405		
Ausfuehrung u. Lieferung Tech. Characteristics ----	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033	Werkstoff Material --------	
Oberflaechenschutz Surface Protection ----			
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. ----			
Referenz-Nr./Ref.No. ---- / Emission ID ----	black kevi 12.10.2020	Material-Nr./Material-No. XZG25K0000015	

Alle Rechte aus Schutzrechtsanmeldungen vorbehalten. Weitergabe, Vervielfältigung, oder sonstige Verwertung ohne Zustimmung nicht gestattet. Zuwiderhandlungen verpflichten zum Schadensersatz. All industrial property rights reserved. Disclosure, reproduction or use for any other purpose is prohibited unless our express permission has been given. Any infringement results in liability to pay damages.

ACAD	Datum/Date	Name
Ersteller Drawn	08.10.2020	groenke do
Bearb. Change	08.10.2020	groenke do
Norm. Std.	12.10.2020	carsten jd
Gepr. Checked	12.10.2020	carsten jd

Benennung/Title AO Arrangement

ARRANGEMENT DRAWING
1GEN MGC 1500 CONTROL PANEL
ELECTRICAL SYSTEM DRAWING

onsite energy

Zeichnungs-Nr./Drawing No. CAD06787712

Beschreibung/Description ----

Blatt Sheet 2/3

Aenderungsbeschreibung/Description of revision: INITIAL RELEASE

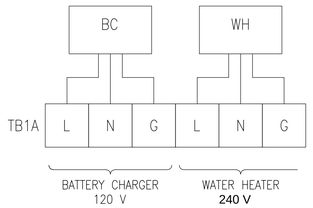
kommt vor/Frequency

Buchst./Rev.Ltr. -.1 | Aenderungs-Nr./Revision Notice No. PR062671 | Bearbeitungsstatus/Lifecycle Released

Passmass Fit | Abmass in Deviation µm

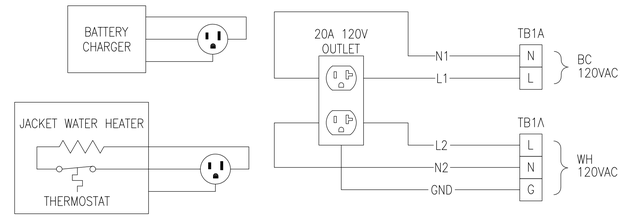
AC OPTIONS

NO DISTRUBUTION PANEL



CUSTOMER CONNECTION

RECEPTACLE OPTIONS



NOTES:

1. WIRE NUMBERS ARE IN PARENTHESIS.
2. SHORT DASHED LINES (------) INDICATE CUSTOMER CONNECTION OR OPTIONAL EQUIPMENT.

LEGEND

AL	ALARM BUZZER
BPS	BACK PLATE STUD
DGS	DOOR GROUND STUD
ESP	EMERGENCY STOP BUTTON
F1	5A ATO FUSE MGC CONTROLLER
F2	25A ATO FUSE PANEL
F3	20A ATO FUSE ECU
GGS	GENERATOR GROUND STUD
LWL	LOW WATER LEVEL PROBE
MGC	MTU GENERATOR CONTROLLER
R1	120 OHM ⅛ 1% RESISTOR
TB1	TERMINAL BLOCK 1 (PANEL BACK)
TB1A	TERMINAL BLOCK 1A (PANEL BACK)

*X	(X)	XXX	X

*X	DESTINATION
(X)	WIRE NUMBER
XXX	DESTINATION
X	DESTINATION TERMINAL

Aenderungsbeschreibung/Description of revision	kommt vor/Frequency
INITIAL RELEASE	

Buchst./Rev.Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.2	PR062671	Released

Passmass Fit | Abmass in Deviation µm

Massstab/Scale | Masse/Mass ---- kg | Format/Size A

Werkstoff Material ----------

Holzzeug,Model,Gesenk Semifinished Product, Pattern,Die ----

Material-Nr./Material-No. XZG25K0000015

	ACAD	Datum/Date	Name
Ersteller Drawn		08.10.2020	groenke do
Geprüft Checked		08.10.2020	groenke do
Norm Std.		12.10.2020	carsten jd
Gen. Checked		12.10.2020	carsten jd

Benennung/Title AO Arrangement ----

ARRANGEMENT DRAWING
1GEN MGC 1500 CONTROL PANEL
ELECTRICAL SYSTEM DRAWING

onsite energy

Zeichnungs-Nr./Drawing No. CAD06787713

Beschreibung/Description ----

Blatt Sheet 3/3

ENGINE SIDE PLUG

1 (48) #12 AWG
2 (9) #12 AWG
3 (9H) #12 AWG
4 (GND) #12 AWG
5
6
7
8 (21) #16 AWG
9
10 (2) #16 AWG
11 (3) #18 AWG
12 (103) #16 AWG
13
14 (1) #16 AWG
15
16
17
18
19 (80) #18 AWG
20 (32) #20 AWG
21 (SP1) #18 AWG
22 (SP2) #18 AWG
23 (SP3) #18 AWG
24 (100) #20 AWG
25
26
27 (101) #20 AWG
28
29 (S) #22 AWG

(21) WHT (9J) BLK RED

RADIATOR
LOW WATER
LEVEL PROBE

#16 AWG

SPARE 1
SPARE 2
SPARE 3

(1)

14-PIN FUEL HARNESS CONNECTOR

A (2A)
B (2B)
C (2C) (2C)
D (2D) (2D)
E (2E) (2E)
F (9A) (9A)
G (9B)
H (9C) (9C)
J (9D) (9D)
K (9E) (9E)
L (54)
M (55) (55)
N (56) (9A)
P (80) (80)

16-PIN ECU HARNESS CONNECTOR

A (32)
B (54)
C (55)
D
E
F (3)
G
H (56)
J
K
L
M
N (100)
P (101)
R
S (9G)

LP GAS RELAY

(2C) 86 LPR 85 (55)
(2D) 30 87 (155)

DUNGS VALVE
LP VAPOR

3 2
LPS1 LPS2
1

M: 3 GND 1 2

F: 3 GND 1 2 — LP VALVE DIN PLUG
(2E) (9D) (9C) (155)

FPS — DUNGS PRESSURE SWITCH

M: 3 GND 1 2

F: 3 GND 1 2 — PRESSURE SWITCH DIN PLUG
(80) (9E)

(EQ1)

SM
SOL
#12 AWG
(48) PLUG 1
(GND) PLUG 4

#2/0 GA. #2/0 GA.

BATTERY 12VDC

BATTERY CHARGER
SEE NOTE #5
RED BLACK

ENGINE GND

SINGLE FUEL LP GAS

Änderungsbeschreibung/Description of revision	kommt vor/Frequency
INITIAL RELEASE	

Buchst./Rev.Ltr.	Änderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
–.1	PR062671	Released

Passmass Fit / Nonpass in Deviation am

Allgemeintoleranzen / General Tolerances ISO 2768-mK
Toleranzng / Tolerancing ISO 8015
Ausführung u. Lieferung / Tech. Characteristics ----
Oberflächenschutz / Surface Protection ----
Verwendbar fuer Typ / Applicable to Model ----
Projekt-/Auftrags-Nr. / Project/Order No. ----
Referenz-Nr./Ref.No. ---- Emission ID ----

Masse / Size ISO 14405
Oberflächenangaben nach MTN5033 / Surface Specification per MTN5033
Allgemeine Fertigungsvorschriften nach MAN 332 / Production Specification per MAN 332

Massstab/Scale
Masse/Mass ---- kg
Format/Size A

Werkstoff / Material ----------
Halbzeug,Modell,Gesenk / Semifinished Product, Pattern,Die ----
Material-Nr./Material-No. ----

black kevi 12.10.2020

XZG25K0000020

Benennung/Title A0 Arrangement ----

ARRANGEMENT DRAWING
1GEN PSI 8.1L GAS ENGINE
ELECTRICAL SYSTEM DRAWING

	ACAD	Datum/Date	Name
Ersteller / Drawn		08.10.2020	groenke do
Prüfer / Checked		08.10.2020	groenke do
Norm. gep. / Standard		12.10.2020	carsten jd
Freigabe / Released		12.10.2020	carsten jd

Alle Rechte aus Schutzrechtsanmeldungen vorbehalten. Weitergabe, Vervielfältigung, oder sonstige Verwertung ohne Zustimmung nicht gestattet. Zuwiderhandlung verpflichten zum Schadenersatz.
All industrial property rights reserved. Disclosure, reproduction or use for any other purpose is prohibited unless our express permission has been given. Any infringement results in liability to pay damages.

onsite energy

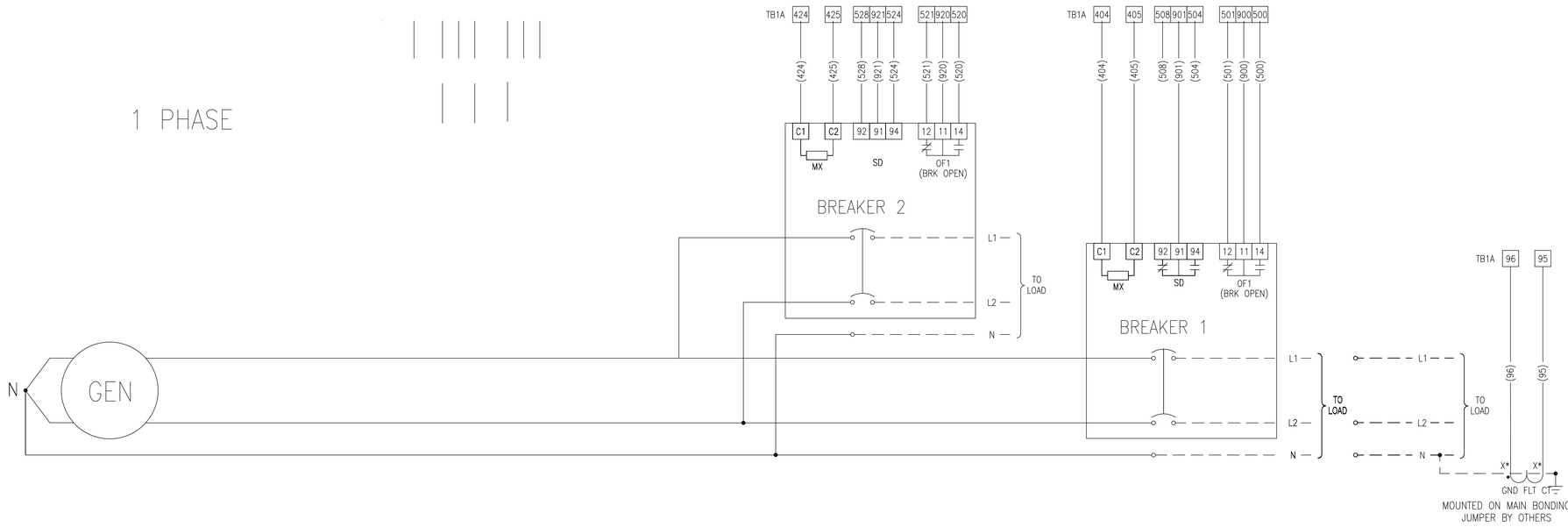
Zeichnungs-Nr./Drawing No. CAD06790337
Beschreibung/Description ----
Blatt / Sheet 2/5

NOTE:

X* X*

OUTLET BOX

1 PHASE



Allgemeintoleranzen / General Tolerances ISO 2768-mK		Massstab/Scale	Masse/Mass kg Format/Size
Tolerierung / Toleroncing ISO 8015	Masse / Size ISO 14405		---- A
Ausfuehrung u. Lieferung / Tech. Characteristics ----	Oberflaechenangaben nach MTND033	Werkstoff / Material ----------	
Oberflaechenschutz / Surface Protection ----	Surface Specification per MTND033		
Verwendbar fuer Typ / Applicable to Model ----	Allgemeine Fertigungsvorschriften nach MAN 332	Halbzeug,Modell,Gesenk / Semifinished Product, ----	
Projekt-/Auftrags-Nr. / Project/Order No. ----	Production Specification per MAN 332	Pattern,Die	
Referenz-Nr./Ref.No. ----	Emission ID ----	block kevi 17.10.2000 ---- ---	Material-Nr./Material-No. XZG25K0000013

	ACAD	Datum/Date	Name
	Ersteller Created	09.10.2020	groenke do
	Gepr. Checked	09.10.2020	groenke do
	Norm. Std.	12.10.2020	carsten jd
	Gen. Checked	12.10.2020	carsten jd

Benennung/Title AO Arrangement ----

ARRANGEMENT DRAWING
1GEN BREAKERS
ELECTRICAL SYSTEM DRAWING

Aenderungsbeschreibung/Description of revision	kommt vor/Frequency
INITIAL RELEASE	

Buchst./Rev.Ltr	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
-.1	PR062671	Released

Passmass Fit | Abmass in Deviation um

Zeichnungs-Nr./Drawing No. CAD06787676

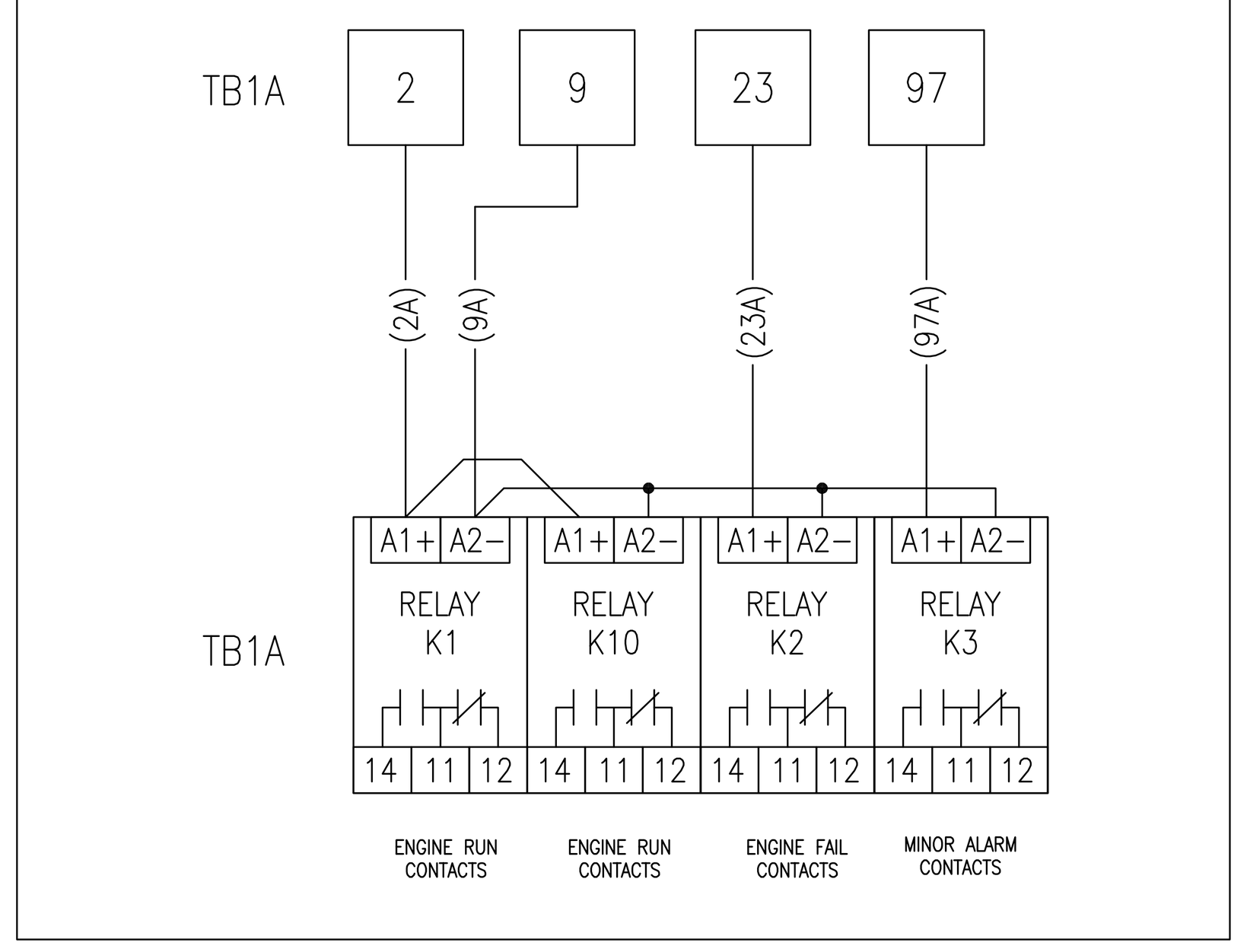
Beschreibung/Description ----

Blatt Sheet 1/1

LEGEND:

D1	DIODE
D2	DIODE
F4	FUSE ATO 3A
F5	FUSE ATO 3A
TB1	TERMINAL BLOCK 1
TB1A	TERMINAL BLOCK 1A

4 RELAY OPTION



Aenderungsbeschreibung/Description of revision	kommt vor/Frequency
INITIAL RELEASE	
Passmass Fit	Abmass in Deviation µm
Buchst./Rev.Ltr.	−.1
Aenderungs-Nr./Revision Notice No.	PR062671
Bearbeitungsstatus/Lifecycle	Released

Allgemeintoleranzen / General Tolerances ISO 2768-mK	
Tolerierung / Tolerancing ISO 8015	Masse / Size ISO 14405
Ausfuehrung u. Lieferung Tech. Characteristics ----	Oberflaechenangaben nach MTN5033 Surface Specification per MTN5033
Oberflaechenschutz Surface Protection ----	
Verwendbar fuer Typ Applicable to Model ----	Allgemeine Fertigungsvorschriften nach MMN 332 Production Specification per MMN 332
Projekt-/Auftrags-Nr. Project/Order No. ----	
Referenz-Nr./Ref.No. ----	Emission ID ----
black kevi 12.10.2020	---- ----
Massstab/Scale	
Masse/Mass kg	----
Format/Size	A
Werkstoff Material	---------
Halbzeug,Modell,Gesenk Semifinished Product, Pattern,Die	----
Material-Nr./Material-No.	XZG25K0000019

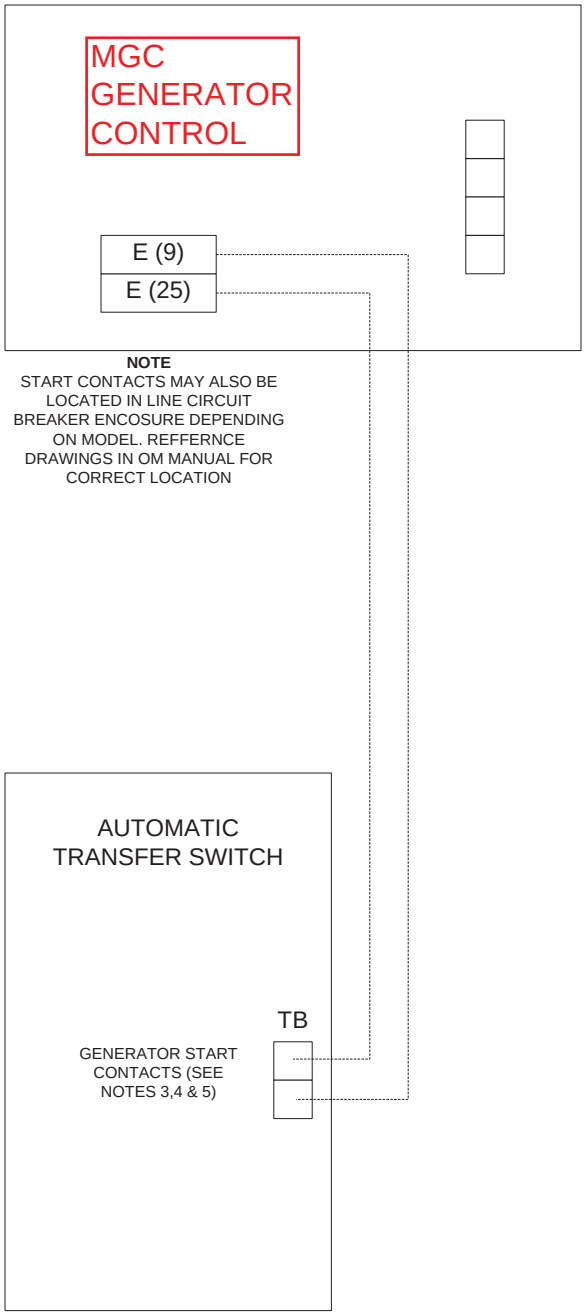
ACAD	Datum/Date	Name
Ersteller Drawn	08.10.2020	groenke do
Bearb. Change	08.10.2020	groenke do
Norm. Std.	12.10.2020	carsten jd
Gepr. Checked	12.10.2020	carsten jd

Benennung/Title AO Arrangement

ARRANGEMENT DRAWING
1GEN OPTIONS
ELECTRICAL SYSTEM DRAWING

onsite energy

Zeichnungs-Nr./Drawing No.	CAD06790329
Beschreibung/Description	----
Blatt Sheet	1/2



NOTES:

1. For multiple transfer switches, daisy chain the contact for generator start.

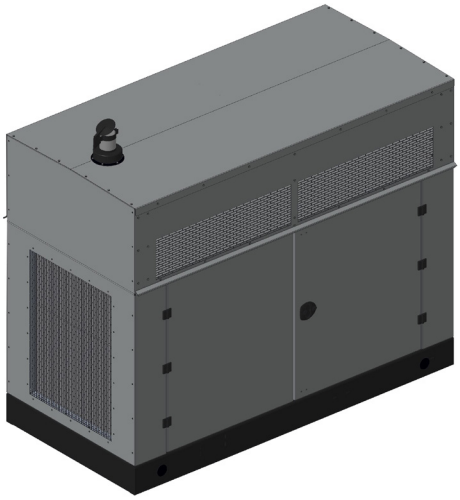
2. ATS control Interconnect wiring. Two stranded copper wires required:
0- 700 Feet -20 Gauge
700- 1125 Feet – 18 Gauge

3. For contact landing locations in transfer switch refer to the wiring drawing included with the transfer switch.

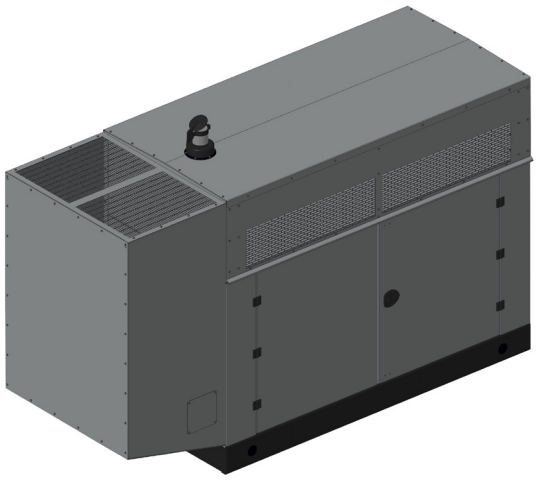
BASIC INTERCONNECT DRAWING FOR MGC CONTROL WITH TRANSFER SWITCH

Enclosure and Sound Data Sheet - Gas, Open Field

60 Hz: 150 kW Standby



Level 1 Enclosure (pictured)



Level 3 Enclosure (pictured)

Enclosure Level Identification	
Level 1	Skid-mounted weather-protective enclosure constructed of heavy gauge steel or aluminum with fixed stormproof panels designed for 130 mph wind load rating. Enclosure consists of a bolted and welded construction with unit-mounted internal silencer. 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 on enclosure walls.
Level 3	Level 2 enclosure with air exhaust scoop including UL 94 HF-1 compliant, 1.5" thick sound attenuated foam insulation.
Level 3 Plus	Level 3 enclosure with UL 94 HF-1 compliant, 1.5" thick sound attenuated foam on enclosure walls and ceiling.

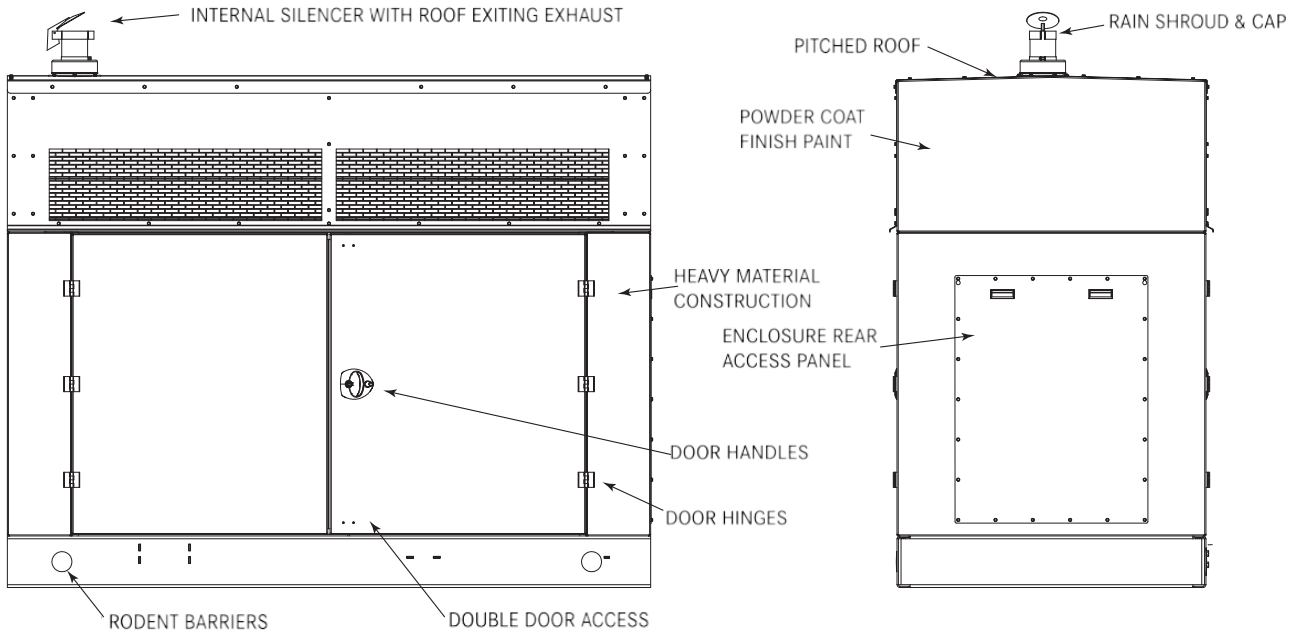
CERTIFICATIONS AND STANDARDS

- UL 2200
- CE Marking Provided
- CSA C22.2 No. 100
- CSA C22.2 No. 14

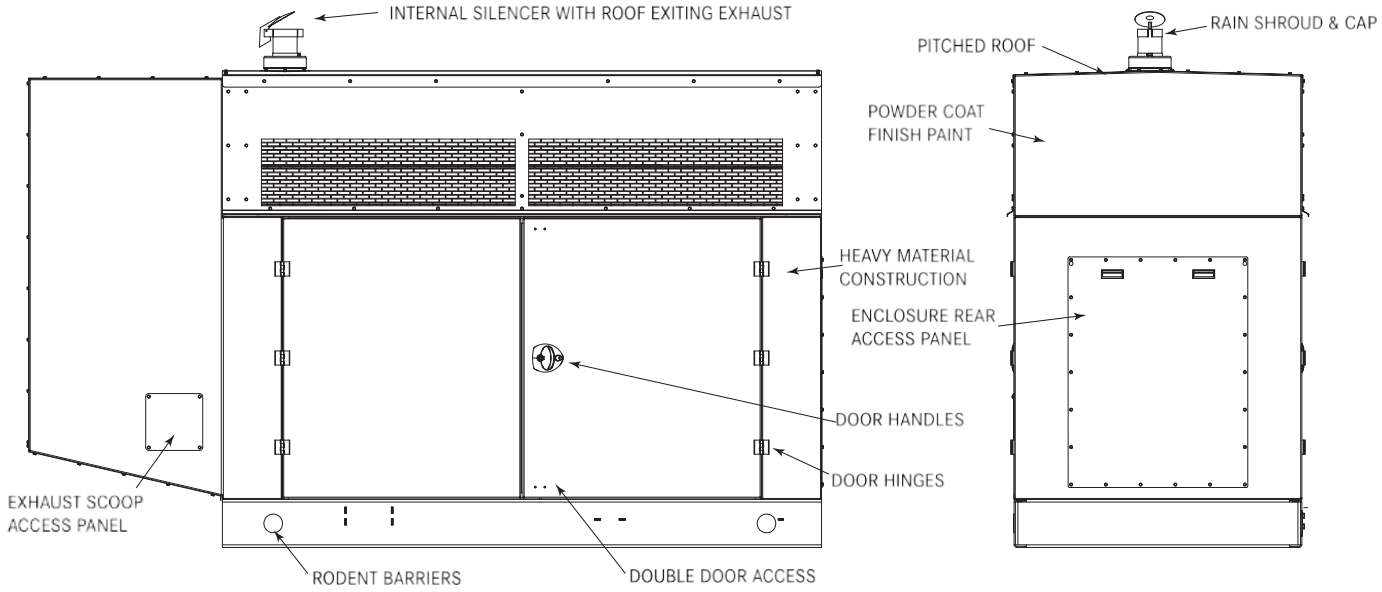
STANDARD FEATURES FOR ALL LEVELS

- Heavy material construction
  - Steel enclosure: 1.9 mm (0.075 in) - 14 gauge or greater thickness
  - Aluminum enclosure: 2.3 mm (0.09 in) or greater thickness
- 130 mph wind rating
- Service access
  - Double door access gives ease of service to all components
- Pitched roof
- Rain shroud
- Rain cap
- Rodent barriers
- Exhaust scoop access panel and drain
- Hardware
  - Powder coated hinges with stainless steel pins
  - Key-lockable and pad-lockable powder coated door handles
- Powder coat finish paint: RAL 7001 Silver Grey standard
  - Custom colors available upon request
- Internal silencer (Hospital Grade)
  - Insulated silencer
  - Stainless steel flexible exhaust connections (where applicable)

Enclosure and Sound Data Sheet - Gas, Open Field
60 Hz: 150 kW Standby



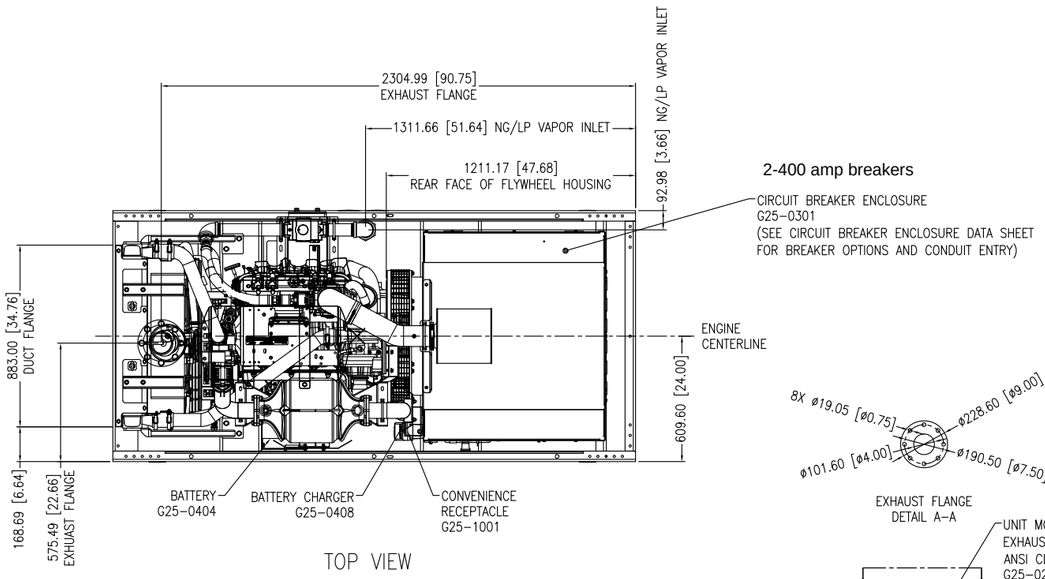
Level 1 Enclosure (pictured)



Level 3 Enclosure (pictured)

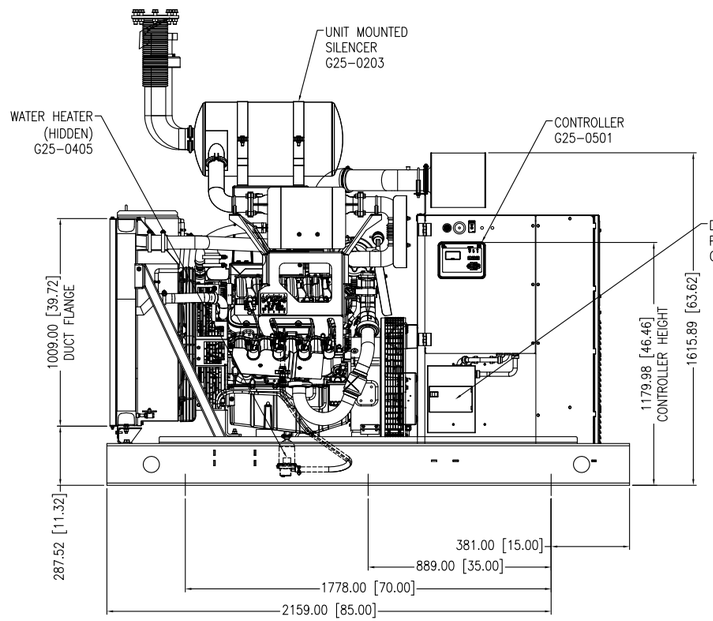
OPTIONAL FEATURES

- Door restraints
- LED light package
- Enclosure space heater
- Motorized intake louvers
- 190 mph wind rating
- Distribution panel
- Gravity exhaust louvers
- For other custom options, please consult factory.

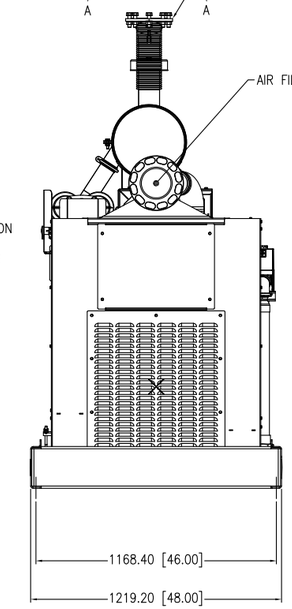


TOP VIEW

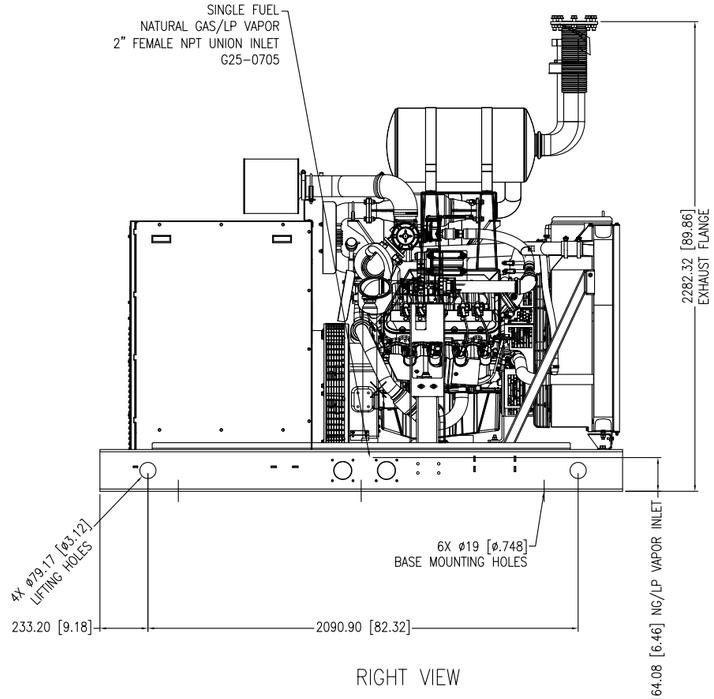
EXHAUST FLANGE
DETAIL A-A



LEFT VIEW



REAR VIEW



RIGHT VIEW

REVISION	DATE	DESCRIPTION

A Rolls-Royce solution

APPLICABLE MODELS:
MTU 8V0110 GS150

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2020-12-12

DIMENSIONAL LAYOUT

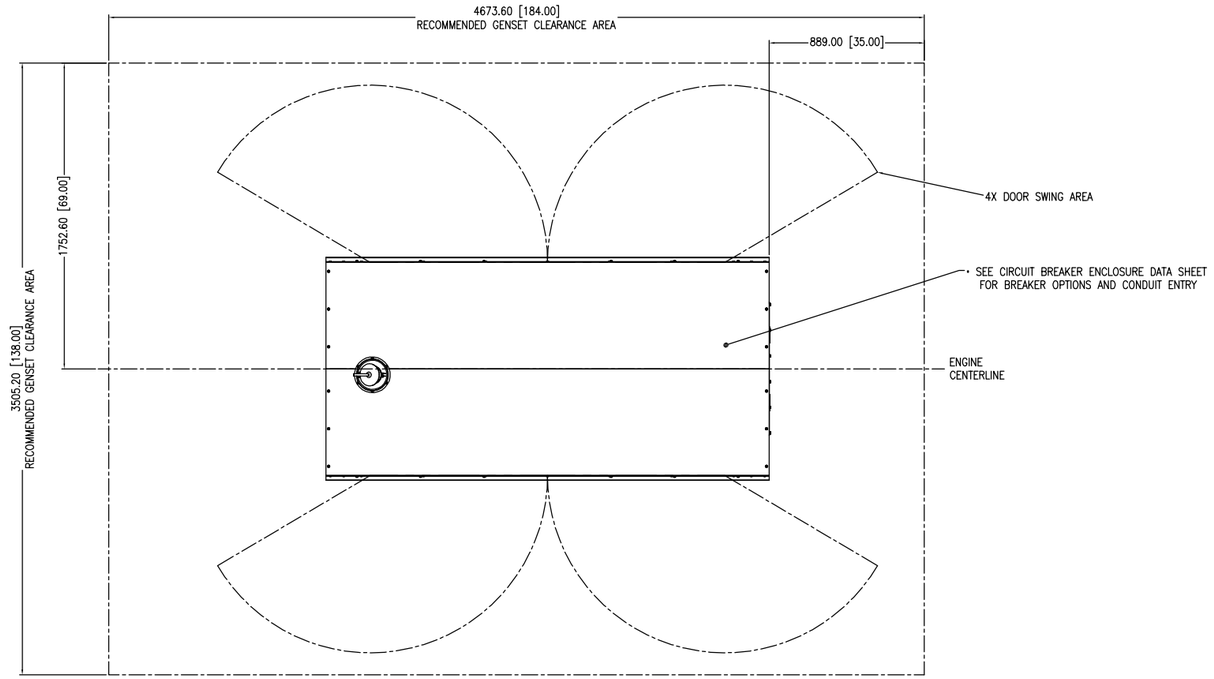
DESCRIPTION: 150 kW Genset, Housed Base

ENGINE: PSI 8.8LT CAC

WEIGHT (MIN-MAX): 1540-1820 KG 3400-4000 LB

DRAWING NUMBER: XZG2500100034

SHEET: 1 of 2

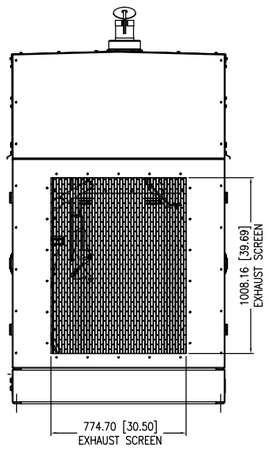


TOP VIEW

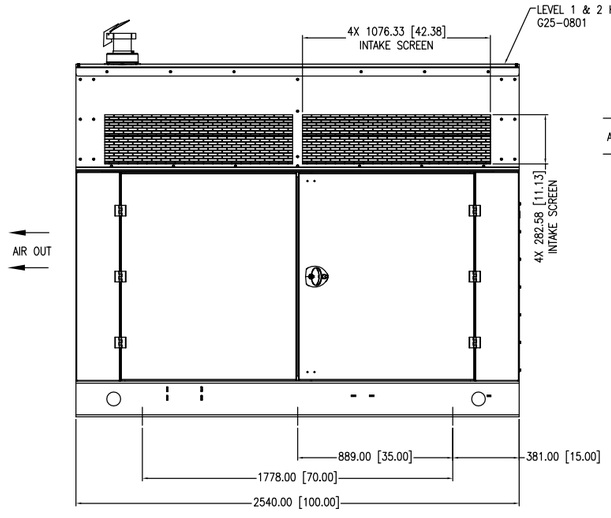
DRAWING OPTIONS 150kW PSI 8.8LT CAC			SELECTED OPTIONS
Group	Drawing Code	Description	
Housing Options, Exterior	G25-0801	Level 1 & 2 Housing	✓
	G25-0802	Level 3 Housing	
	G25-0803	Air Exhaust Gravity Louver	
Housing Options, Interior	G25-0901	Air Intake Motorized Louver	
	G25-0902	Interior Housing Lights	
	G25-0903	Space Heater	

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.

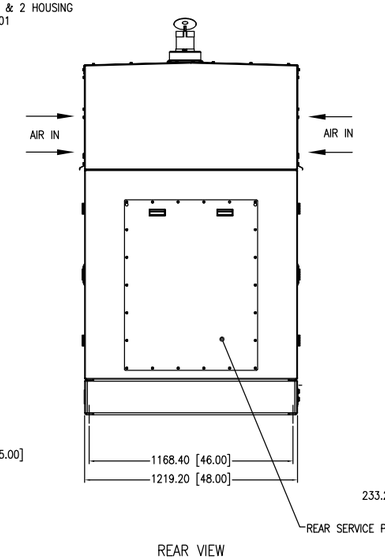
Note: Some options may not be referenced. Only options which visibly change the drawing are selectable



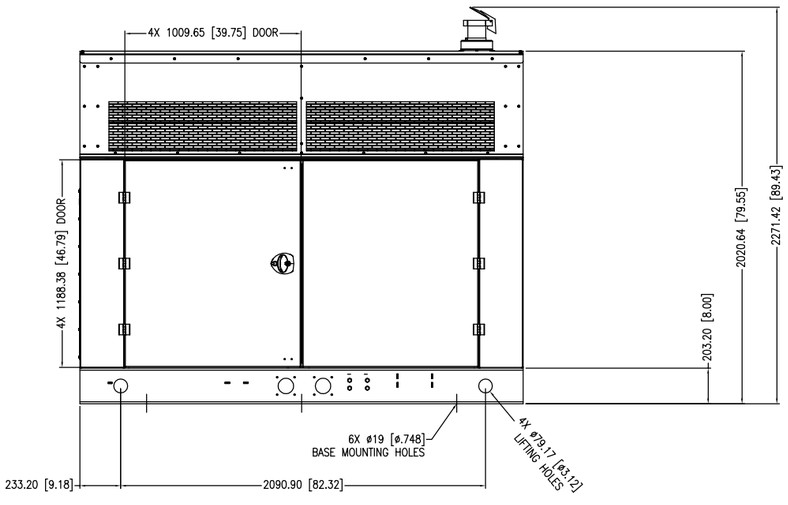
FRONT VIEW



LEFT VIEW



REAR VIEW



RIGHT VIEW

REVISION	DATE	DESCRIPTION

A Rolls-Royce solution

APPLICABLE MODELS:
MTU 8V0110 GS150

THIRD ANGLE PROJECTION

DRAWN TO SCALE
DIMENSIONS: MM [INCH]

DATE CREATED: 2021-02-26

DIMENSIONAL LAYOUT

DESCRIPTION: 150 kW Genset Housing

ENGINE: PSI 8.8LT CAC

WEIGHT (MIN-MAX): 2040-2500 KG 4500-5500 LB

DRAWING NUMBER: XZG2500100035

SHEET: 1 of 1