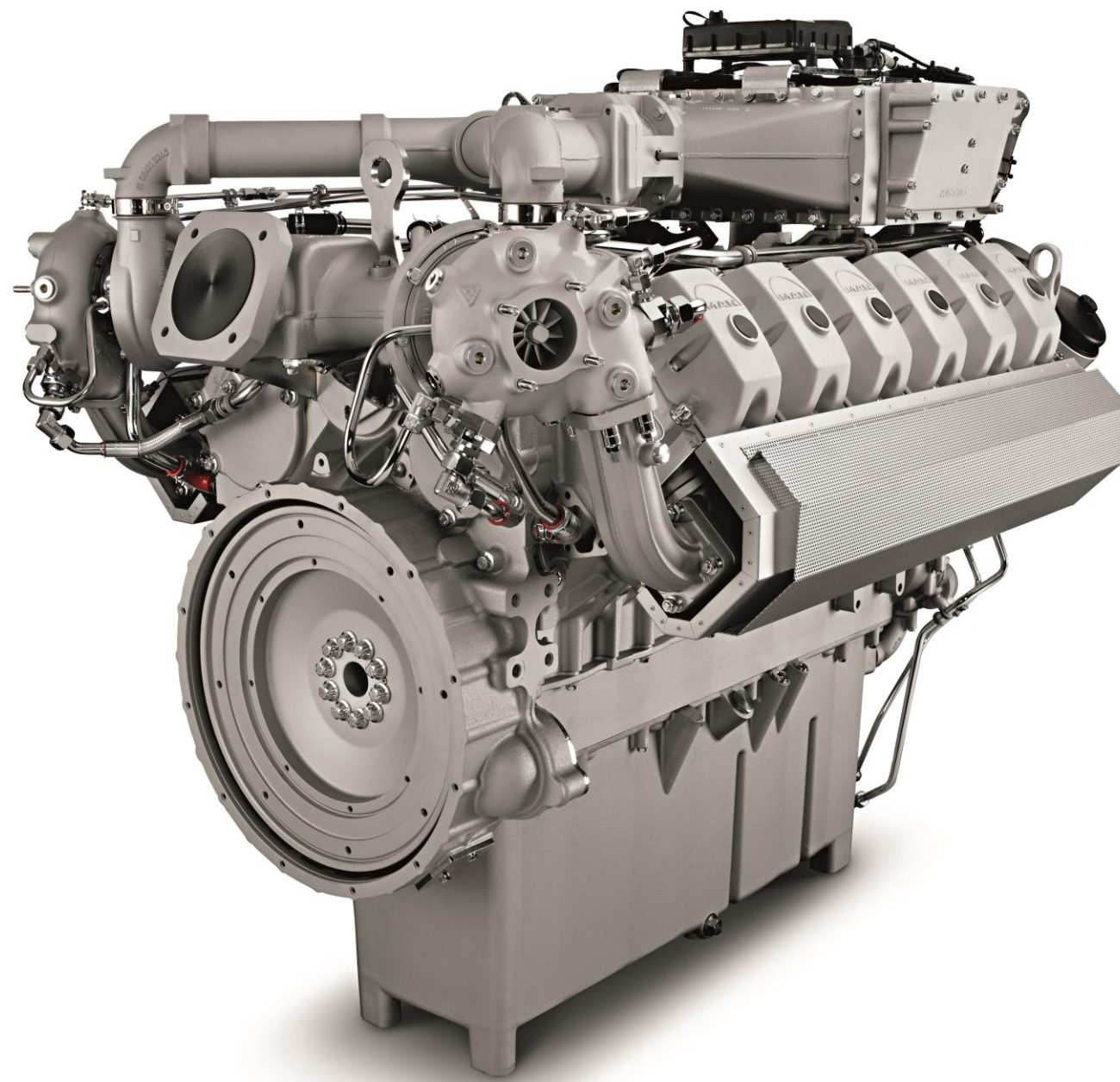


# Technical Data

## E3262 LE202



Since our products are in continuous development, we reserve the right to make technical modifications.

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### Technical Data - Variants of Operation Mode

Gastype	Speed	NOx - Emission		Mixture Temp.			
Natural Gas	1500 min <sup>-1</sup> (50 Hz)	500 mg/m <sub>N</sub> <sup>3</sup>	0,5 g/bhp-hr	50 °C	122 °F	Page	11
Natural Gas	1800 min <sup>-1</sup> (60 Hz)	500 mg/m <sub>N</sub> <sup>3</sup>	0,5 g/bhp-hr	50 °C	122 °F	Page	19
Natural Gas	1500 min <sup>-1</sup> (50 Hz)	250 mg/m <sub>N</sub> <sup>3</sup>	0,3 g/bhp-hr	50 °C	122 °F	Page	27
Natural Gas	1800 min <sup>-1</sup> (60 Hz)	250 mg/m <sub>N</sub> <sup>3</sup>	0,3 g/bhp-hr	50 °C	122 °F	Page	35
Special Gas	1500 min <sup>-1</sup> (50 Hz)	500 mg/m <sub>N</sub> <sup>3</sup>	0,4 g/bhp-hr	50 °C	122 °F	Page	43
Special Gas	1800 min <sup>-1</sup> (60 Hz)	500 mg/m <sub>N</sub> <sup>3</sup>	0,4 g/bhp-hr	50 °C	122 °F	Page	51

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Engine Specification

4 - Stroke Otto - Gas - Engine (lean burn operation)

Specification		metric		standard	
No. of cylinders / type of construction		12		12	V - type (90°)
Bore	mm	132	in	5,20	
Stroke	mm	157	in	6,18	
Displacement	l	25,78	cu in	1573	
No. of valves per cylinder		4		4	
Direction of rotation looking on		left		left	
Flywheel housing		SAE 1		SAE 1	
Ring gear with number of teeth	Z	137	Z	137	
Compression ratio	ε	12:1	ε	12:1	

Equipment

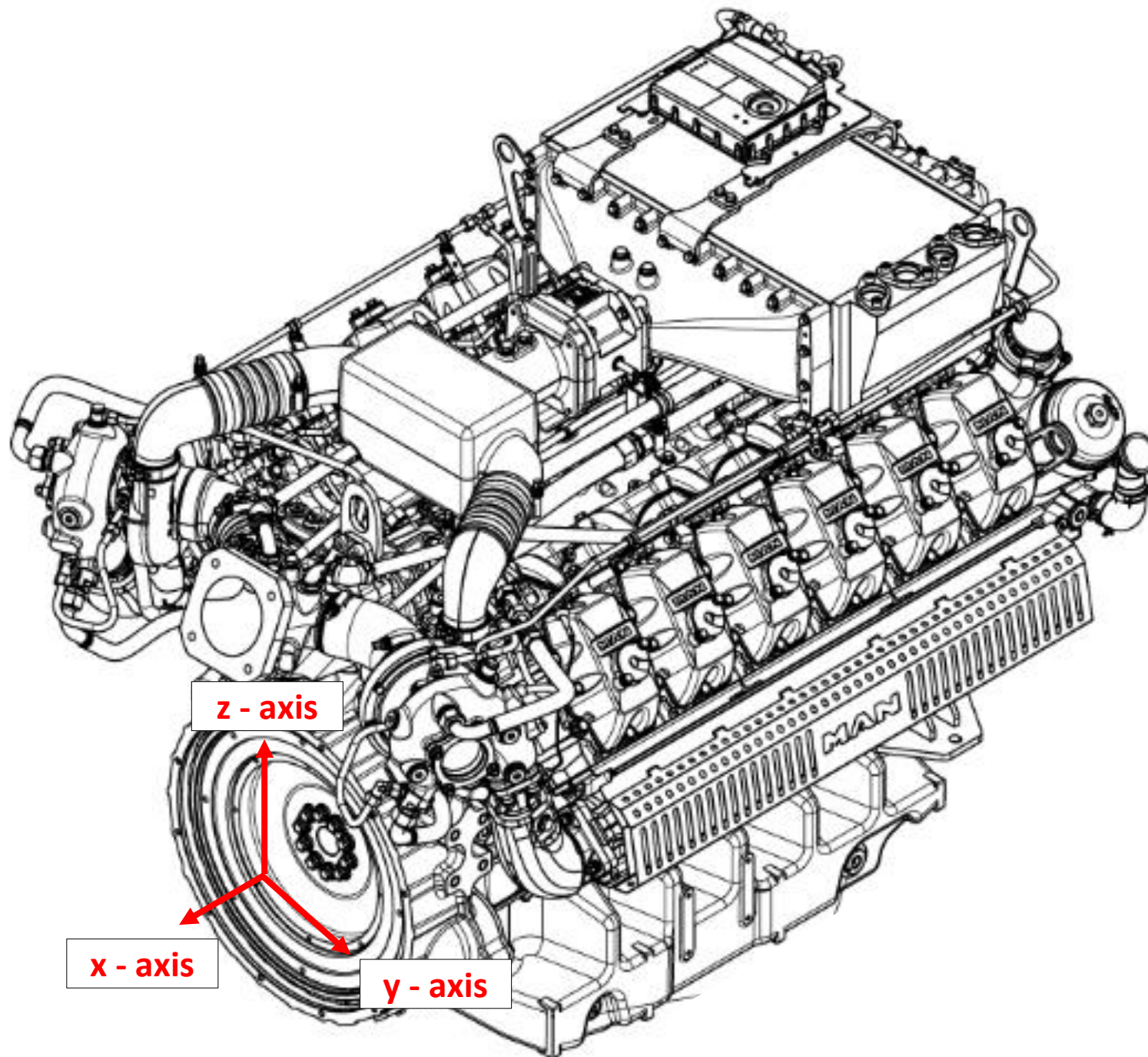
Piston:	Aluminium piston with compression ratio 12:1
Cylinder liners:	Wet cylinder liners
Camshaft:	Induction - hardened camshaft
Crankshaft:	Forged crankshaft with balancing weights
Exhaust pipes:	Dry exhaust pipes with heat insulation cover and cover against direct contact
Turbocharging:	Two pressure oil lubricated turbochargers with water cooled bearing block and water cooled turbine housing
Mixture cooling / engine cooling:	Double-stage mixture cooler without cooling water pump or engine water pump; for LT - coolant circuit and for HT- and engine coolant circuit each necessary a cooling water pump with mixture temperature regulation for 50 °C (122 °F)
Lubrication:	Forced oil lubrication with two oil pumps; two exchangeable lubrication filters in the main circuit and lubrication cooler in engine coolant circuit
Oil pan / Oil capacity:	Oil pan with capacity 90 l (24 Imp. gal.)
Spark plugs:	Spark plug M18 for industrial engines
Starter:	Electric starter 24 V - 7 kW
Required capacity of starter battery:	140 / 225 Ah (min./max.) / 24 V
Engine monitoring acc. to scope of delivery:	Intake air temperature Intake air suction pressure Coolant temperature inlet Coolant temperature outlet Oiltemperature Oilpressure Exhaust temperature  or optional: Dataloggerbox with CAN - Interface J1939
Documentation:	Installation instructions 51.99496-8236 Repair Manual 51.99598-8313 Operating instructions 51.99587-8006 Maintanace instructions 51.99597-8072 Assembly drawing 51.00512-7141

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**Geometric Data**

	metric		standard	
<b>Dimensions</b>				
Engine width	mm	1243	in	48,9
Engine length	mm	1748	in	68,8
Engine height	mm	1500	in	59,1
<b>Weight</b>				
Engine weight, dry	kg	1849	lb	4076
<b>Gravity data</b>				
Center of gravity, longitudinal axis Reference: Flywheel housing, rear edge	mm	-719	in	-28,3
Center of gravity, transversal axis Reference: Crankschaft axis in direction of flywheel housing	mm	-1	in	-0,04
Center of gravity, vertical axis Reference: Crankschaft axis in direction of flywheel housing	mm	368	in	14,5
<b>Mass moments of inertia</b>				
Mass moment of inertia, longitudinal axis	kgm <sup>2</sup>	162	lbin <sup>2</sup>	553581
Mass moment of inertia, transversal axis	kgm <sup>2</sup>	336	lbin <sup>2</sup>	1148168
Mass moment of inertia, vertical axis	kgm <sup>2</sup>	242	lbin <sup>2</sup>	826955

Origin of the coordinate system in the crankshaft / flywheel - housing - rear edge



**Torsional mass elastic system**

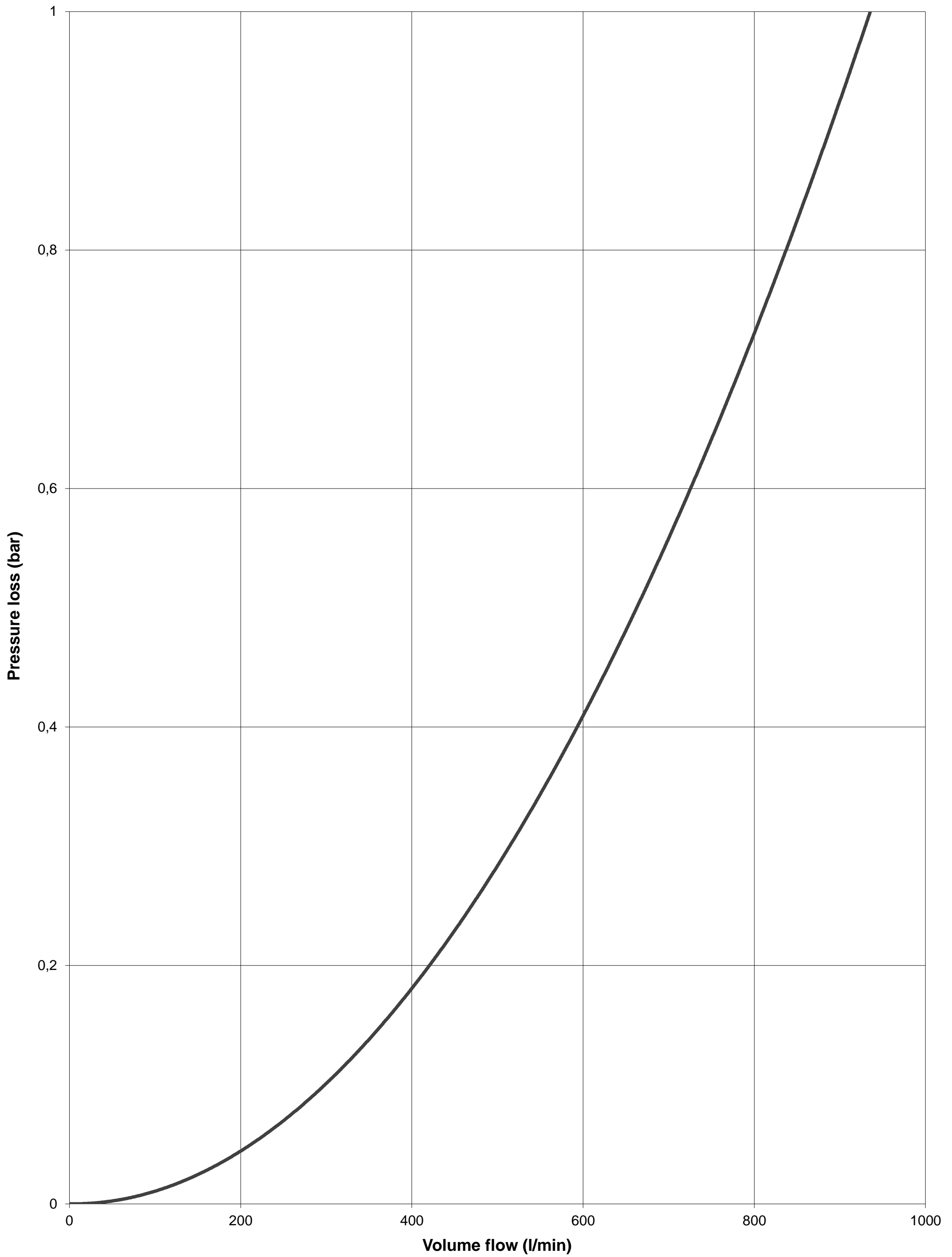
see data sheet 51.99431-8936

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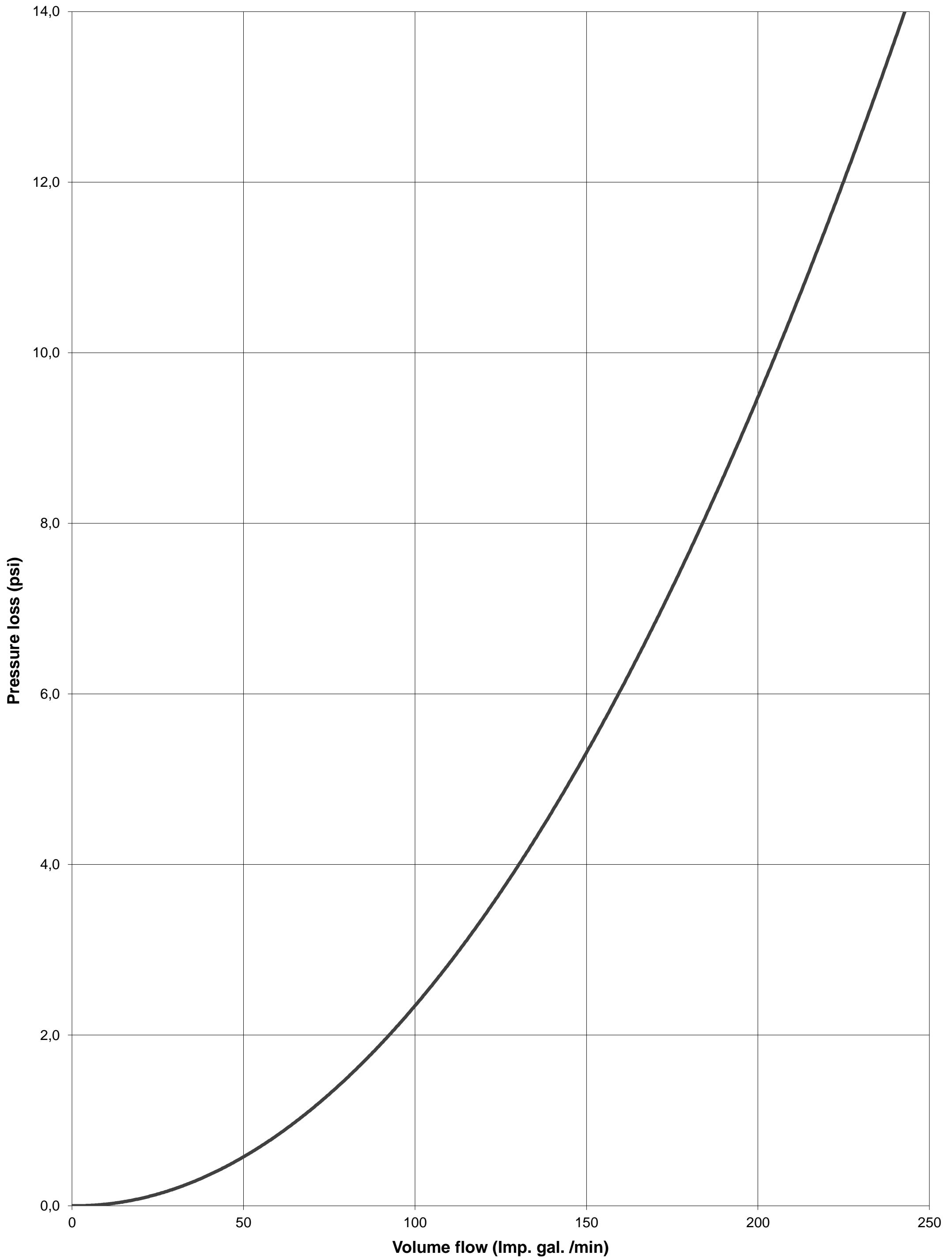
Resistance Level Engine  
metric



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Resistance Level Engine  
standard

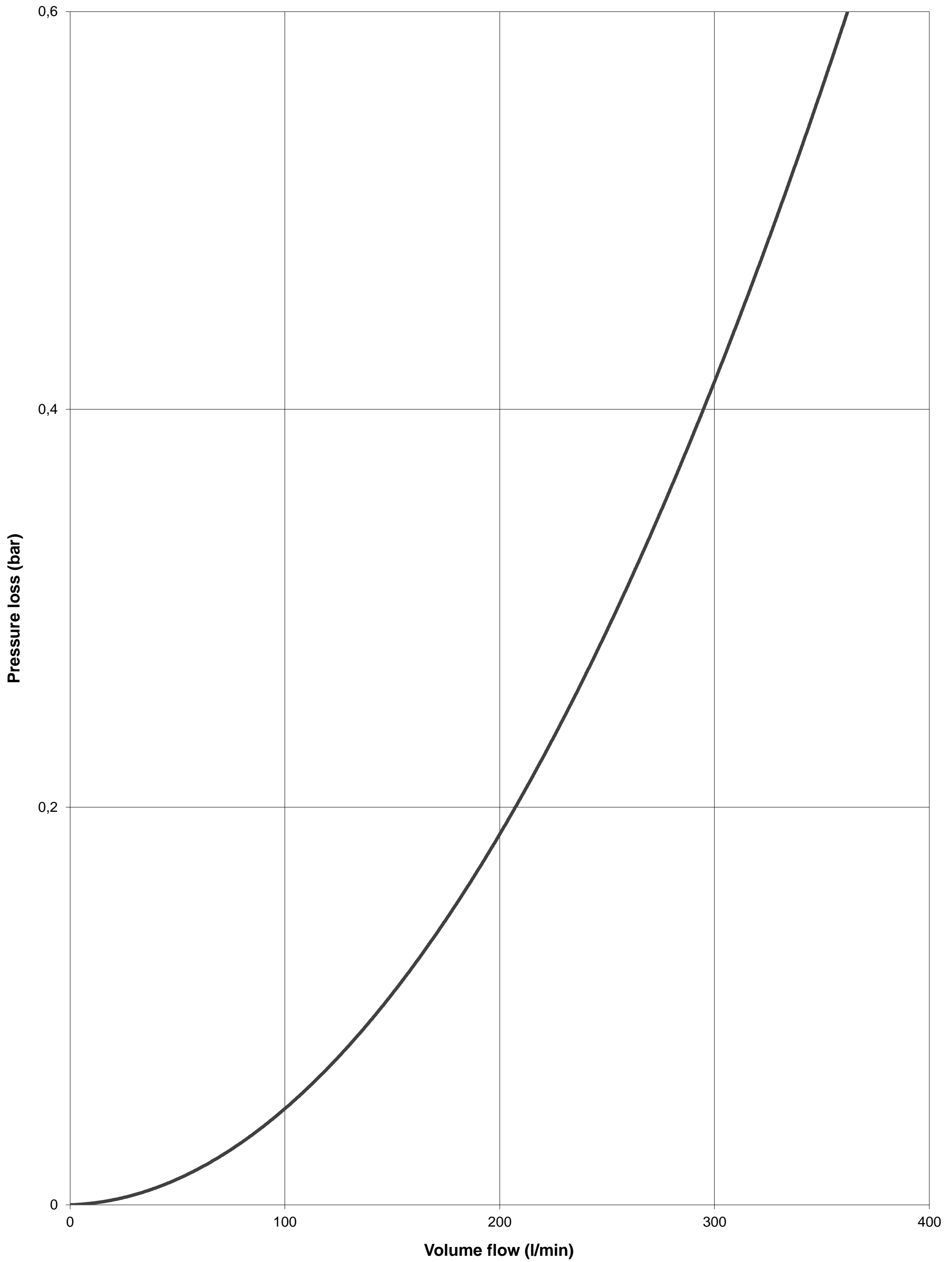


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**Resistance Curve of HT - Mixture Cooler**

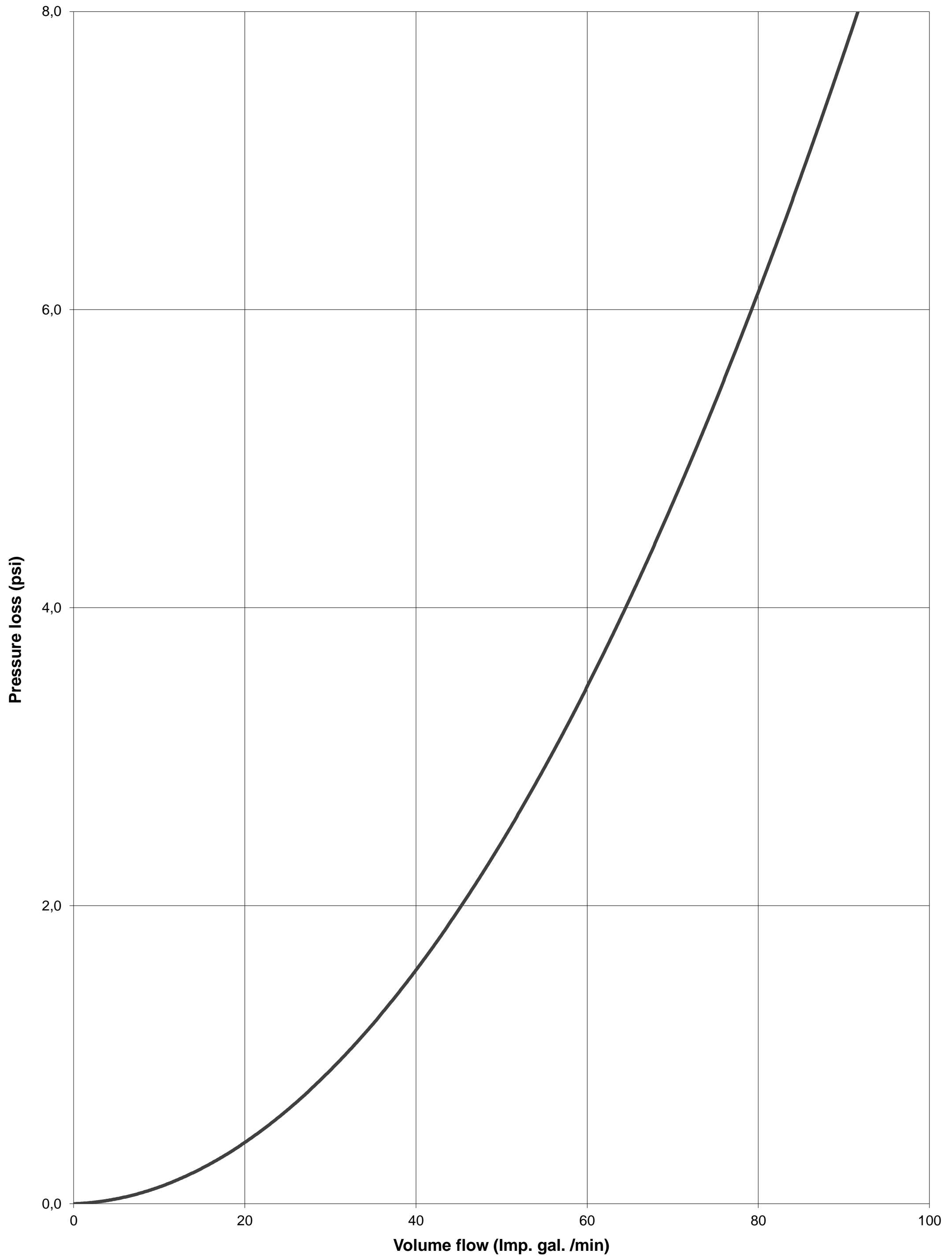
metric  
(Screwed socket, inner - Ø 34 mm)



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**Resistance Curve of HT - Mixture Cooler**  
standard  
(Screwed socket, inner - Ø 1,3 in)



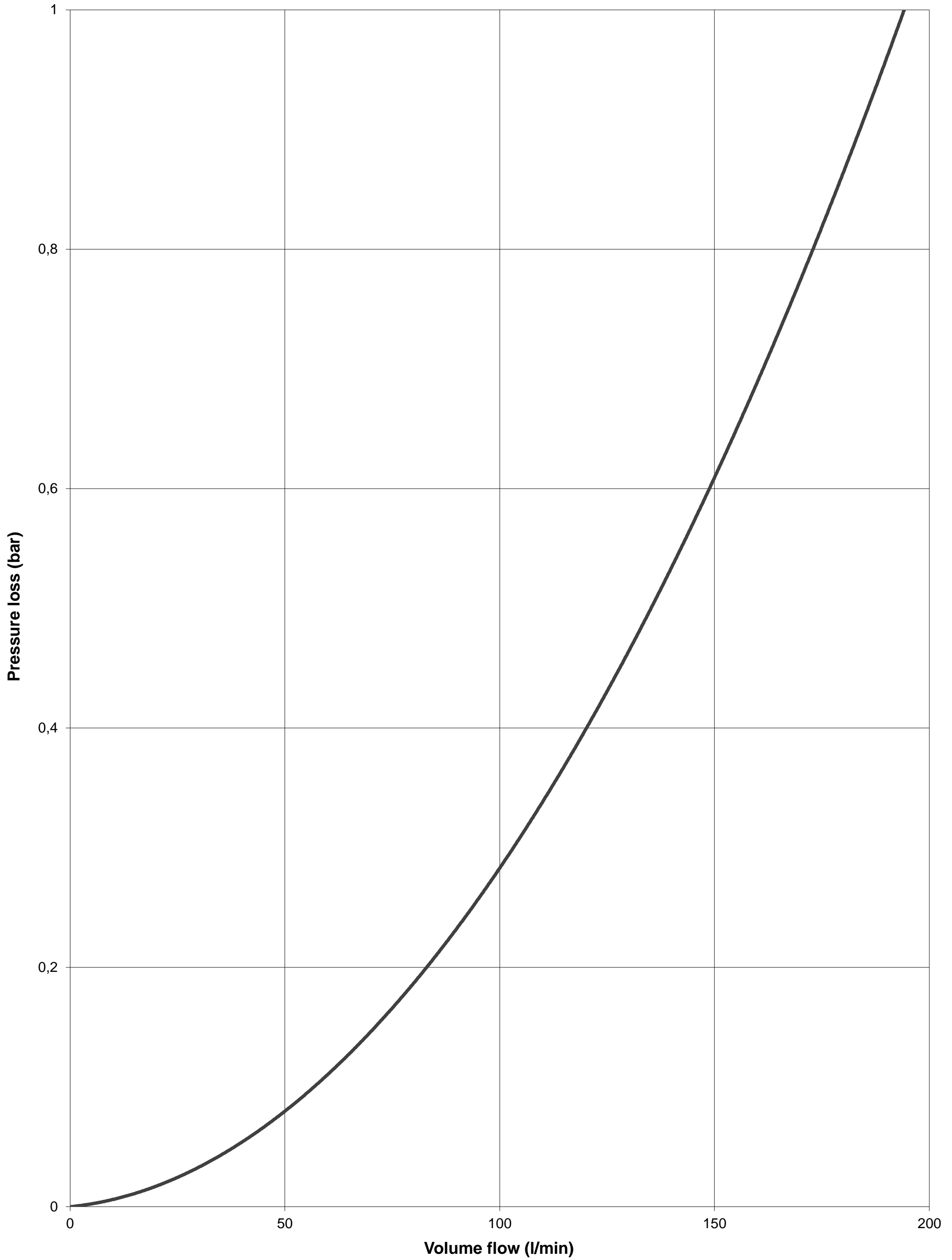
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**Resistance Curve of LT - Mixture Cooler**

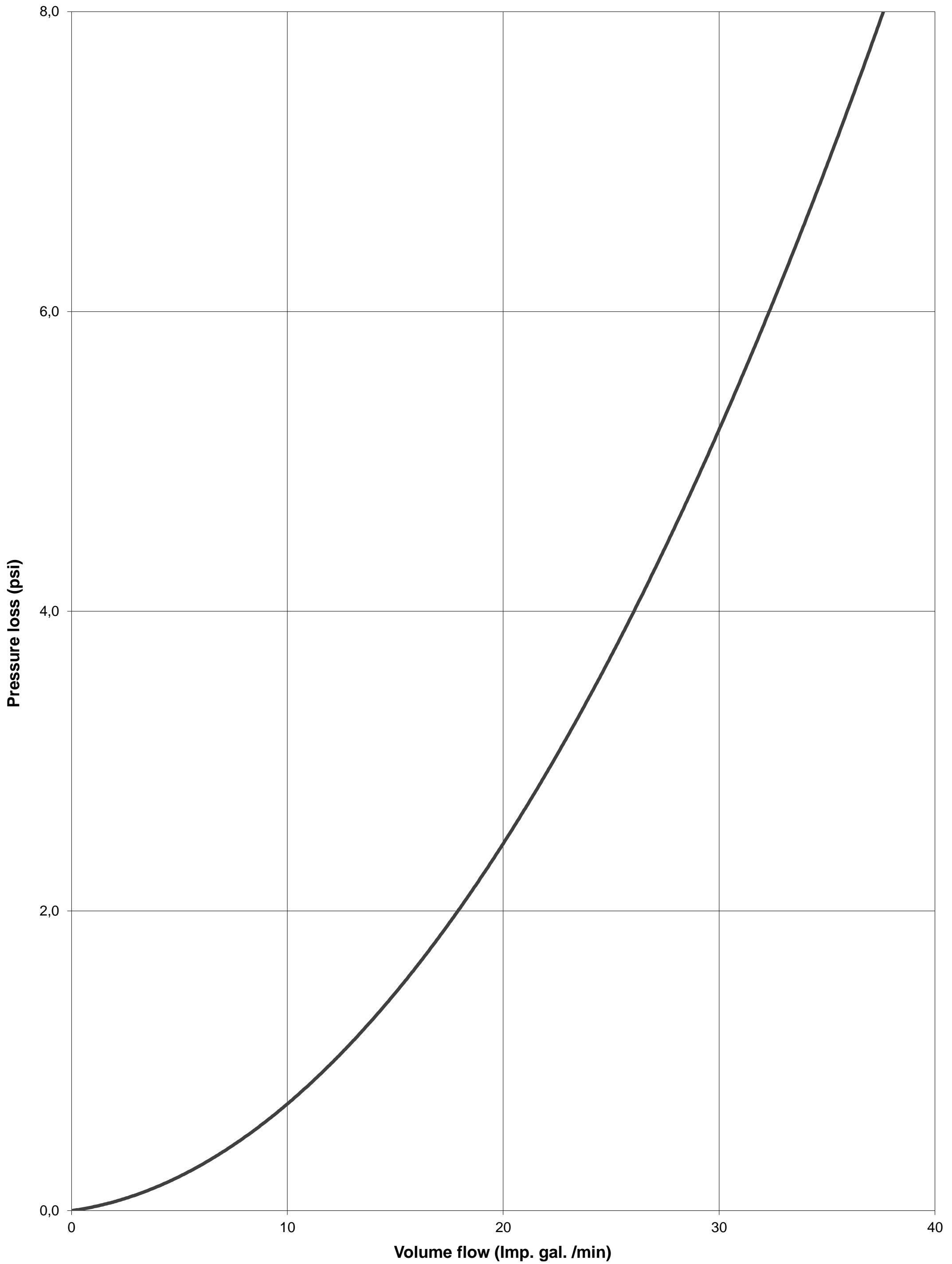
metric  
(Screwed socket, inner - Ø 34 mm)



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**Resistance Curve of LT - Mixture Cooler**  
standard  
(Screwed socket, inner - Ø 1,3 in)



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### Mode of Operation

**Natural Gas - 1500 min-1 (50 Hz) - NOx < 500 mg/mN<sup>3</sup> - 50 °C**

**Natural Gas - 1500 rpm (50 Hz) - NOx < 0,5 g/bhp - 122 °F**

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**Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/m<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F**

**Basic Data**

		metric		standard	
<b>Engine Data</b>					
Rated speed	min <sup>-1</sup>	1500		rpm	1500
ISO standard power (COP)	kW	550		bhp	738
Engine Torque max. (ISO 1585) at rated speed	Nm	3502		Nm	3502
Mean effective pressure	bar	17,1		psi	248,0
Mean piston speed	m/s	7,85		m/s	7,9
<b>Oil circuit</b>					
Mean oil consumption	g/h	80		lb/hr	0,176
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397
Lube oil filling quantity min. / max.	l	42 90		Imp.gal.	11 24
<b>Cooling circuit</b>					
Coolant filling quantity	l	55		Imp.gal.	14,5
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5
Engine cooling water circulation quantity min.	l/min	738		ft <sup>3</sup> /min	26,1
Coolant temperature min.	°C	80		°F	176
Coolant temperature max.	°C	88		°F	190
Difference inlet - outlet max.	K	6		K	6
Mixture temperature after throttle valve max.	°C	190		°F	374
Mixture temperature after mixture cooler max.	°C	50		°F	122
Mixture cooling water inlet temperature LT	°C	42		°F	108
Mixture cooling water circulation quantity LT	l/min	123		ft <sup>3</sup> /min	4,3
Difference inlet - outlet max. LT max.	K	5		K	5
Mixture cooling water inlet temperature HT	°C	82		°F	180
Mixture cooling water circulation quantity HT	l/min	236		ft <sup>3</sup> /min	8,3
Difference inlet - outlet HT max.	K	5		K	5
Coolant concentration min . / max.	%	40 50		%	40 50
<b>Pressure conditions</b>					
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100		psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	18		psi	0,26
Boost pressure before mixture cooler max.	bar	1,79		psi	25,96
over mixture cooler max.	mbar	25			0,36
Exhaust back pressure min. / max.	mbar	5 40		psi	0,07 0,58
<b>Emissions</b>					
NO <sub>x</sub>	mg/m <sub>N</sub> <sup>3</sup>	< 500 (5 % O <sub>2</sub> )		g/bhp	< 0,5 (15 % O <sub>2</sub> )
CO	mg/m <sub>N</sub> <sup>3</sup>	< 700 (5 % O <sub>2</sub> )		g/bhp	< 0,7 (15 % O <sub>2</sub> )
HCHO (measured by FTIR)	mg/m <sub>N</sub> <sup>3</sup>	< 60 (5 % O <sub>2</sub> )		g/bhp	< 0,1 (15 % O <sub>2</sub> )
HC	mg/m <sub>N</sub> <sup>3</sup>	< 600 (5 % O <sub>2</sub> )		g/bhp	< 0,7 (15 % O <sub>2</sub> )
NMHC	ppm	< 50		ppm	< 50
NMNEHC (VOC)	ppm	< 10		ppm	< 10
TOC (without Methan)	mg/m <sub>N</sub> <sup>3</sup>	< 100 (5 % O <sub>2</sub> )		g/bhp	< 0,1 (15 % O <sub>2</sub> )

Lube oil to MAN works standard M 3271-2 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

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Natural Gas - 1500 min<sup>-1</sup> (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> - 50 °C

Flow and Heat Balance

MZ > 80 / IT 18 °CA / 550 kW  
metric

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	18	18	18
ISO standard power <sup>1</sup>	kW	550	412	275
Coolant heat <sup>2</sup>	kW	278,11	235	191
Mixture heat HT <sup>2</sup>	kW	74	34	6
Mixture heat LT <sup>2</sup>	kW	42	30	20
Exhaust heat up to 120 °C	kW	251	201	148
Radiation heat max.	kW	30	25	21
Energy input	kW	1310	1000	705
Specific fuel consumption	MJ/kWh	8,6	8,7	9,2
Air ratio <sup>3</sup>		1,65	1,62	1,58

**Efficiency Data**

mechanical <sup>1</sup>	%	42,0	41,2	39,0
thermal	%	46,0	46,9	49,1
total	%	88,0	88,1	88,1

**Mass flows**

Combustion air	kg/h	2648	1986	1363
Fuel	kg/h	102	78	55
Exhaust gas mass flow rate, wet	kg/h	2750	2064	1418
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2200	1651	1135
Engine coolant mass flow rate	kg/h	45469		
Mixture cooling water mass flow rate LT	kg/h	7295		
Mixture cooling water mass flow rate HT	kg/h	14543		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	576
Measured exhaust gas temperature after turbocharger (average)	°C	402

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 23 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	40,5	39,6	37,6
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	96,2		
	Inlet air temperature	°C	26		
	Relative air humidity	%	23		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°C	0		
	Atmospheric pressure abs.	kPa	100		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Natural Gas - 1500 rpm (50 Hz) - NOx < 0,5 g/bhp - 122 °F

Flow and Heat Balance

MZ > 80 / IT 18 °CA / 738 bhp standard

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	18	18	18
ISO standard power <sup>1</sup>	bhp	738	553	369
Coolant heat <sup>2</sup>	bhp	373	315	256
Mixture heat HT <sup>2</sup>	bhp	99	45	9
Mixture heat LT <sup>2</sup>	bhp	57	40	26
Exhaust heat up to 248 °F	bhp	336	269	199
Radiation heat max.	bhp	40	34	27
Energy input	bhp	1756	1341	946
Specific fuel consumption	BTU/bhp-hr	6058	6176	6524
Air ratio <sup>3</sup>		1,65	1,62	1,58

**Efficiency Data**

mechanical <sup>1</sup>	%	42,0	41,2	39,0
thermal	%	46,0	46,9	49,1
total	%	88,0	88,1	88,1

**Mass flows**

Combustion air	lb/hr	5839	4377	3005
Fuel	lb/hr	225	172	121
Exhaust gas mass flow rate, wet	lb/hr	6064	4549	3126
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2200	1651	1135
Engine coolant mass flow rate	lb/hr	100243		
Mixture cooling water mass flow rate LT	lb/hr	16083		
Mixture cooling water mass flow rate HT	lb/hr	32062		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°F	1069
Measured exhaust gas temperature after turbocharger (average)	°F	756

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 0,9 in Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1. The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	40,5	39,6	37,6
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	14,0		
	Inlet air temperature	°F	79		
	Relative air humidity	%	23		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Values / limits for 100 % load\*

		metric		standard
<b>Methane number</b>		> 80		> 80
<b>Performance Data</b>				
Ignition timing (±2 °CA)	Hz	50	Hz	50
ISO standard power	°CA	18	°CA	18
O <sub>2</sub> - proportion in the exhaust gas min.	kW	550	bhp	738
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	8,6	Vol-%	8,6
	mg/Nm <sup>3</sup>	500	g/bhp	0,5
<b>Operating parameters</b>				
Coolant operating pressure max. (pump in pressure operation)	bar	3,0	psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15	psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100	psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	18	psi	0,26
Boost pressure before mixture cooler max.	bar	1,79	psi	26
Pressure loss over mixture cooler max.	mbar	25	psi	0,36
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

For alternative operating parameters please see chapter "Power reduction".

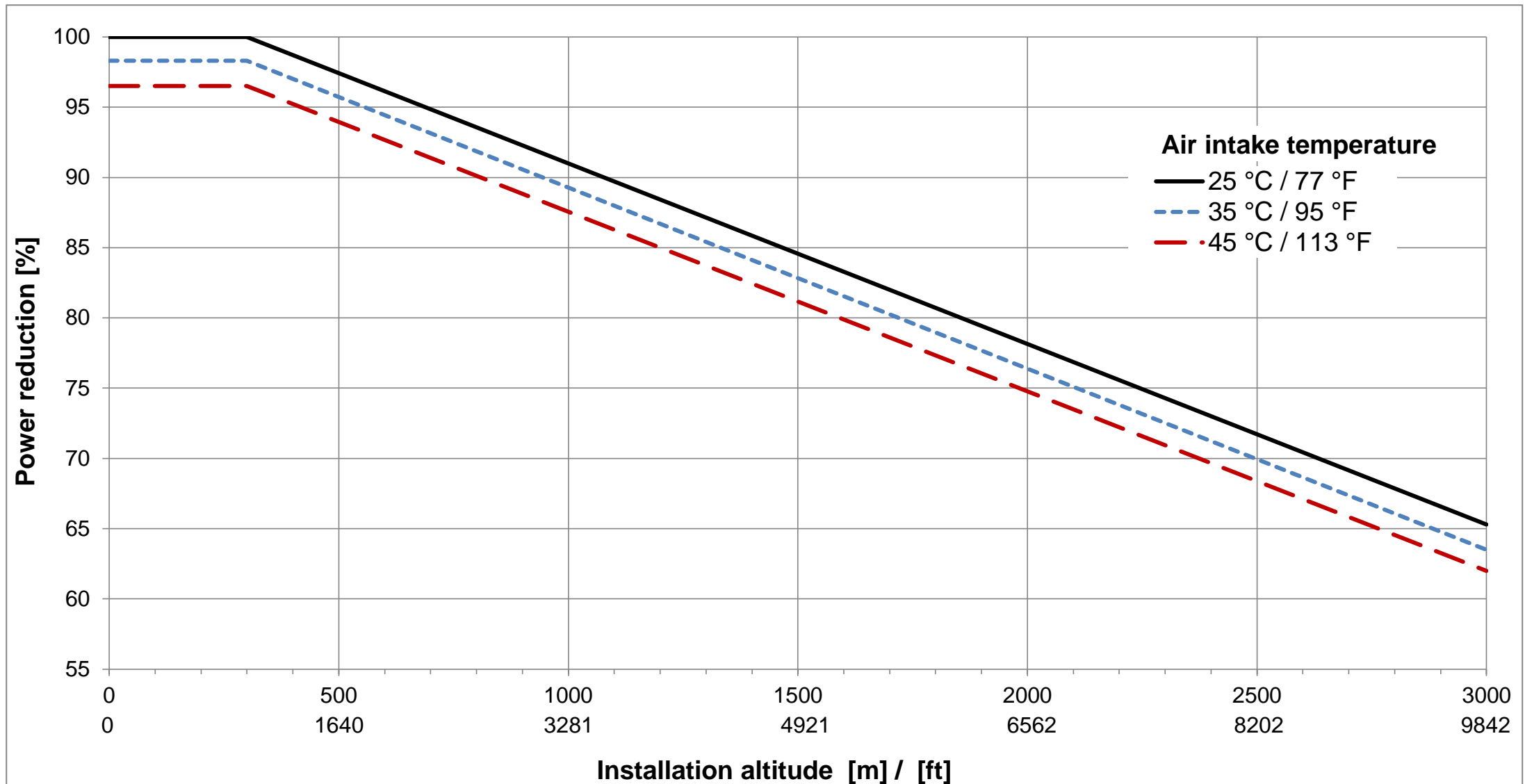
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Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 630	≥ 1166	2
≥ 640	≥ 1184	6
≥ 650	≥ 1202	Operation not permitted / Engine stop

Operation with methane numbers < 80

Operation with methane numbers < 80 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

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Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Acoustic Data

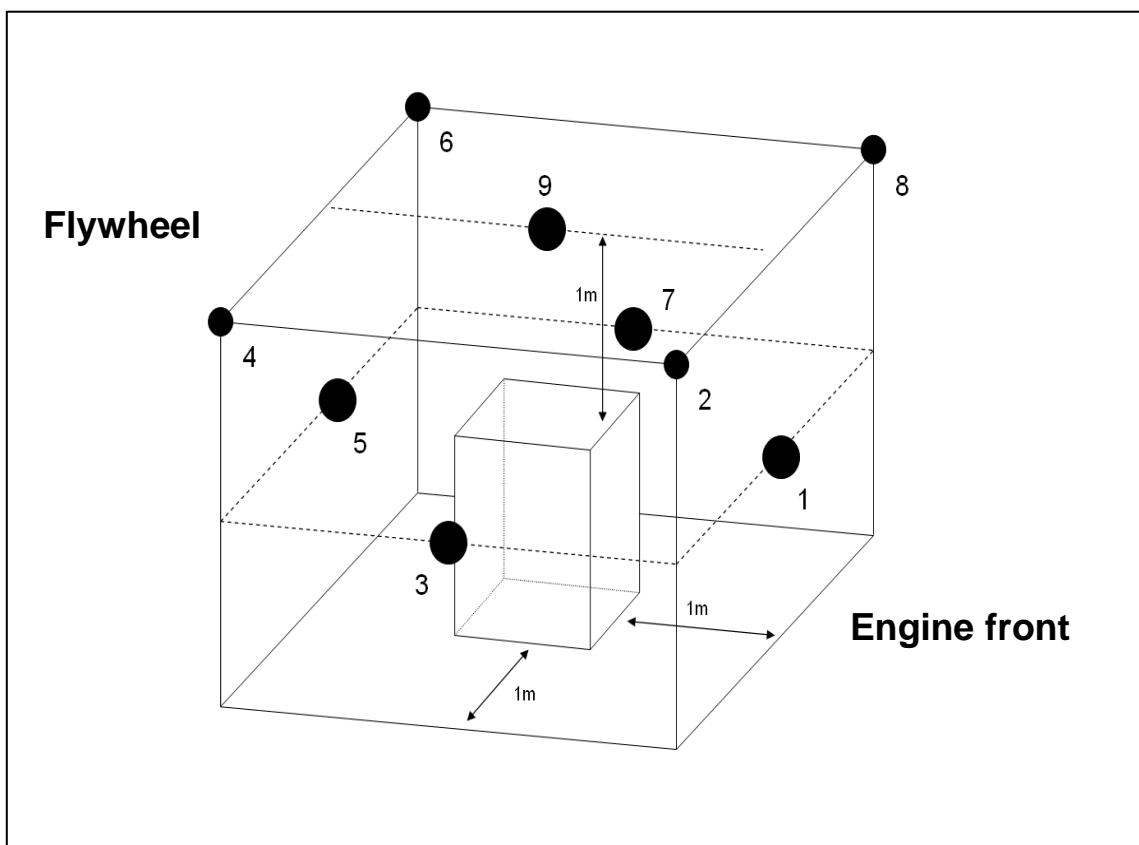
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	91,4
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	108,2
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	19,1	18,7	17,2	24,4	17,0	17,3	17,0	16,5	11,2	18,9
31,5	15,5	13,9	18,3	19,6	18,3	13,7	13,0	14,7	12,0	16,2
40	19,9	16,1	22,6	22,7	22,8	18,0	18,9	15,0	15,7	20,0
50	28,3	27,5	31,9	33,4	42,0	34,3	37,3	22,3	28,0	35,2
63	32,9	37,0	45,4	38,8	41,0	36,5	37,4	28,0	38,9	39,5
80	49,0	45,6	55,5	41,1	48,7	52,0	52,9	43,8	56,7	51,9
100	42,2	42,9	47,9	40,4	50,8	41,2	47,7	43,6	51,3	47,1
125	50,2	50,5	51,1	47,6	60,1	48,6	54,3	49,8	54,2	53,7
160	57,2	49,7	57,3	52,9	63,2	58,9	58,8	52,4	63,7	59,2
200	59,5	59,1	60,6	62,9	66,3	62,3	63,1	57,8	67,6	63,3
250	64,0	63,5	67,6	66,7	73,6	63,3	67,0	63,9	71,7	68,4
315	69,2	64,0	68,8	62,5	77,1	61,0	70,4	64,6	72,5	70,6
400	75,9	72,2	77,0	72,0	85,2	68,8	78,5	75,4	74,5	78,2
500	78,0	70,2	77,8	70,1	85,9	76,2	77,5	71,7	76,5	78,8
630	81,7	75,7	76,3	75,1	76,6	75,1	76,5	76,1	81,1	77,9
800	81,4	75,3	78,7	72,6	75,1	73,2	80,2	78,6	83,8	79,1
1000	78,3	75,9	79,2	75,1	74,9	74,9	79,9	76,0	79,7	77,6
1250	82,8	76,4	81,0	77,6	76,9	76,1	80,2	76,9	77,0	79,0
1600	88,0	78,9	81,8	78,1	81,1	77,8	81,3	77,6	82,5	82,2
2000	85,3	79,1	82,4	78,1	77,0	78,6	83,9	80,1	81,6	81,5
2500	83,6	77,5	81,3	76,0	74,8	76,5	81,3	76,9	81,5	79,8
3150	79,2	74,5	79,2	73,8	71,0	73,5	80,8	75,0	80,0	77,5
4000	79,3	75,4	80,8	74,2	73,0	73,9	81,1	74,6	79,9	78,0
5000	76,6	73,9	80,2	72,7	74,0	74,1	83,9	73,9	80,5	78,4
6300	74,0	73,6	81,7	73,1	74,8	72,7	84,1	73,5	78,5	78,3
8000	71,0	72,1	80,1	72,6	76,7	70,5	80,5	70,5	76,0	76,1
10000	71,6	77,0	80,7	77,3	84,0	76,6	81,0	73,3	82,0	79,7
12500	69,3	74,1	79,7	75,3	82,8	74,3	82,3	71,6	79,6	78,6
16000	68,9	71,4	80,3	74,2	81,7	73,0	81,6	69,8	74,1	77,5
20000	64,7	68,2	76,8	71,3	78,3	68,9	77,4	65,0	69,7	73,8
<b>Sum</b>	<b>93,3</b>	<b>88,0</b>	<b>92,6</b>	<b>87,6</b>	<b>92,9</b>	<b>87,5</b>	<b>93,8</b>	<b>88,0</b>	<b>92,5</b>	

Placement of measuring points of engine noise surface



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

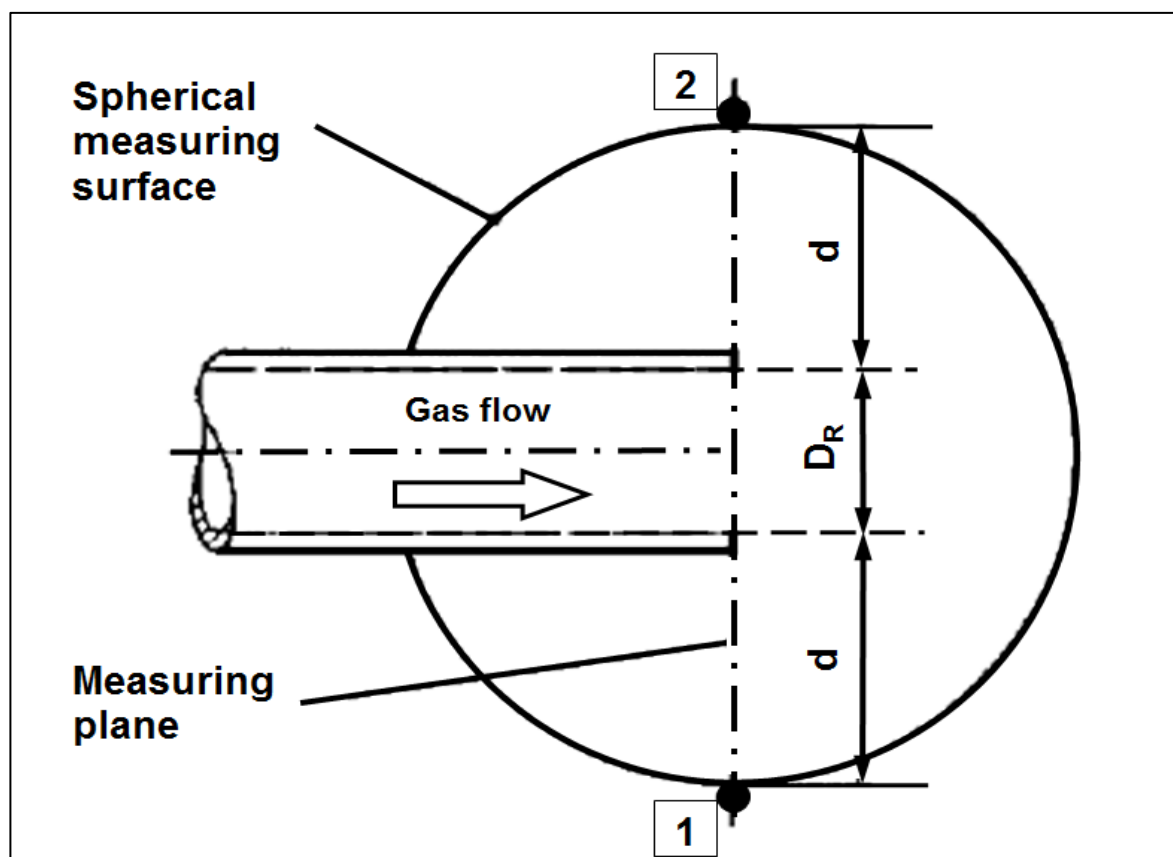
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      106,3  
 L<sub>WA</sub> (re 1 pW)      dB(A)      118,1  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	53,9	52,7	<b>53,3</b>
31,5	42,3	40,9	<b>41,7</b>
40	52,1	48,2	<b>50,6</b>
50	68,3	66,2	<b>67,4</b>
63	74,0	65,7	<b>71,6</b>
80	92,3	82,8	<b>89,8</b>
100	79,9	79,4	<b>79,7</b>
125	86,8	84,9	<b>86,0</b>
160	88,4	95,2	<b>93,0</b>
200	84,3	87,6	<b>86,3</b>
250	96,7	96,5	<b>96,6</b>
315	100,1	102,5	<b>101,5</b>
400	101,4	96,6	<b>99,6</b>
500	95,2	95,1	<b>95,2</b>
630	92,9	89,8	<b>91,6</b>
800	94,7	88,6	<b>92,6</b>
1000	87,3	83,8	<b>85,9</b>
1250	83,9	81,9	<b>83,0</b>
1600	88,2	86,1	<b>87,3</b>
2000	89,2	87,5	<b>88,4</b>
2500	91,8	86,6	<b>89,9</b>
3150	88,9	85,3	<b>87,5</b>
4000	88,0	85,4	<b>86,9</b>
5000	88,1	85,0	<b>86,8</b>
6300	86,6	83,4	<b>85,3</b>
8000	83,6	80,9	<b>82,5</b>
10000	77,5	73,8	<b>76,0</b>
12500	72,0	68,6	<b>70,6</b>
16000	61,4	59,1	<b>60,4</b>
20000	54,0	52,4	<b>53,3</b>
<b>Sum</b>	<b>106,7</b>	<b>106,0</b>	

Placement of measuring points of exhaust outlet noise



	Date	Signature	No. of data sheet	Index
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Released	04.12.2017	Kn		



### Mode of Operation

**Natural Gas - 1800 min<sup>-1</sup> (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> - 50 °C**

**Natural Gas - 1800 rpm (60 Hz) - NO<sub>x</sub> < 0,5 g/bhp - 122 °F**

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



**Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F**

**Basic Data**

		metric			standard	
<b>Engine Data</b>						
Rated speed	min <sup>-1</sup>	1800		rpm	1800	
ISO standard power (COP)	kW	580		bhp	778	
Engine Torque max. (ISO 1585) at rated speed	Nm	3077		Nm	3077	
Mean effective pressure	bar	15		psi	217,5	
Mean piston speed	m/s	9,42		m/s	9,4	
<b>Oil circuit</b>						
Mean oil consumption	g/h	90		lb/hr	0,198	
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lube oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
<b>Cooling circuit</b>						
Coolant filling quantity	l	55		Imp.gal.	14,5	
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3	
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8	
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5	
Engine cooling water circulation quantity min.	l/min	823		ft <sup>3</sup> /min	29,1	
Coolant temperature min.	°C	80		°F	176	
Coolant temperature max.	°C	88		°F	190	
Difference inlet - outlet max.	K	6		K	6	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature LT	°C	42		°F	108	
Mixture cooling water circulation quantity LT	l/min	144		ft <sup>3</sup> /min	5,1	
Difference inlet - outlet max. LT max.	K	5		K	5	
Mixture cooling water inlet temperature HT	°C	82		°F	180	
Mixture cooling water circulation quantity HT	l/min	302		ft <sup>3</sup> /min	10,7	
Difference inlet - outlet HT max.	K	5		K	5	
Coolant concentration min . / max.	%	40	50	%	40	50
<b>Pressure conditions</b>						
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22	
Gas flow pressure before zero pressure regulator min. / max.	mbar	30	100	psi	0,44	1,45
Pressure loss over gas mixer max.	mbar	22		psi	0,32	
Boost pressure before mixture cooler	bar	1,87		psi	27,12	
Pressure loss over mixture cooler	mbar	45			0,65	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58
<b>Emissions</b>						
NO <sub>x</sub>	mg/mN <sup>3</sup>	< 500	(5 % O <sub>2</sub> )	g/bhp	< 0,5	(15 % O <sub>2</sub> )
CO	mg/mN <sup>3</sup>	< 700	(5 % O <sub>2</sub> )	g/bhp	< 0,7	(15 % O <sub>2</sub> )
HCHO (measured by FTIR)	mg/mN <sup>3</sup>	< 60	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )
HC	mg/mN <sup>3</sup>	< 620	(5 % O <sub>2</sub> )	g/bhp	< 0,7	(15 % O <sub>2</sub> )
NMHC	ppm	< 60		ppm	< 60	
NMNEHC (VOC)	ppm	< 10		ppm	< 10	
TOC (without Methan)	mg/mN <sup>3</sup>	< 100	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )

Lube oil to MAN works standard M 3271-2 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

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Natural Gas - 1800 min<sup>-1</sup> (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> - 50 °C

Flow and Heat Balance

MZ > 80 / IT 22 °CA / 580 kW  
metric

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	22	22	22
ISO standard power <sup>1</sup>	kW	580	435	290
Coolant heat <sup>2</sup>	kW	310	267	219
Mixture heat HT <sup>2</sup>	kW	95	46	12
Mixture heat LT <sup>2</sup>	kW	50	36	25
Exhaust heat up to 120 °C	kW	271	220	163
Radiation heat max.	kW	34	30	22
Energy input	kW	1432	1104	780
Specific fuel consumption	MJ/kWh	8,9	9,1	9,7
Air ratio <sup>3</sup>		1,66	1,62	1,58

**Efficiency Data**

mechanical <sup>1</sup>	%	40,5	39,4	37,2
thermal	%	47,2	48,3	50,5
total	%	87,7	87,7	87,7

**Mass flows**

Combustion air	kg/h	2914	2192	1507
Fuel	kg/h	112	86	61
Exhaust gas mass flow rate, wet	kg/h	3025	2278	1568
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2419	1823	1255
Engine coolant mass flow rate	kg/h	50683		
Mixture cooling water mass flow rate LT	kg/h	8564		
Mixture cooling water mass flow rate HT	kg/h	18631		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	586
Measured exhaust gas temperature after turbocharger (average)	°C	398

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 23 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	0	0	0
	Efficiency mech.	%	38,8	37,9	35,7
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	96		
	Inlet air temperature	°C	28		
	Relative air humidity	%	19		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°C	0		
	Atmospheric pressure abs.	kPa	100		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Natural Gas - 1800 rpm (60 Hz) - NOx < 0,5 g/bhp - 122 °F

Flow and Heat Balance

MZ > 80 / IT 22 °CA / 778 bhp standard

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	22	22	22
ISO standard power <sup>1</sup>	bhp	778	583	389
Coolant heat <sup>2</sup>	bhp	416	358	294
Mixture heat HT <sup>2</sup>	bhp	127	62	16
Mixture heat LT <sup>2</sup>	bhp	67	48	34
Exhaust heat up to 248 °F	bhp	364	295	219
Radiation heat max.	bhp	45	41	29
Energy input	bhp	1920	1481	1045
Specific fuel consumption	BTU/bhp-hr	6283	6458	6840
Air ratio <sup>3</sup>		1,66	1,62	1,58

**Efficiency Data**

mechanical <sup>1</sup>	%	40,5	39,4	37,2
thermal	%	47,2	48,3	50,5
total	%	87,7	87,7	87,7

**Mass flows**

Combustion air	lb/hr	6424	4833	3322
Fuel	lb/hr	246	190	134
Exhaust gas mass flow rate, wet	lb/hr	6670	5023	3456
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2419	1823	1255
Engine coolant mass flow rate	lb/hr	111738		
Mixture cooling water mass flow rate LT	lb/hr	18881		
Mixture cooling water mass flow rate HT	lb/hr	41074		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°F	1087
Measured exhaust gas temperature after turbocharger (average)	°F	748

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 0,9 in Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1. The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	38,8	37,9	35,7
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	13,9		
	Inlet air temperature	°F	82		
	Relative air humidity	%	19		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Released	04.12.2017	Kn		





Natural Gas - 1800 min-1 / 1800 rpm (60 Hz) - NOx < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Values / limits for 100 % load\*

		metric		standard	
<b>Methane number</b>		> 80		> 80	
<b>Performance Data</b>					
Ignition timing (±2 °CA)	Hz	60		Hz	60
ISO standard power	°CA	22		°CA	22
O <sub>2</sub> - proportion in the exhaust gas min.	kW	580		bhp	778
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	8,6		Vol-%	8,6
	mg/Nm <sup>3</sup>	500		g/bhp	0,5
<b>Operating parameters</b>					
Coolant operating pressure max. (pump in pressure operation)	bar	3,0		psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100		psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	22		psi	0,32
Boost pressure before mixture cooler max.	bar	1,87		psi	27
Pressure loss over mixture cooler max.	mbar	45		psi	0,65
Exhaust back pressure min. / max.	mbar	5 40		psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

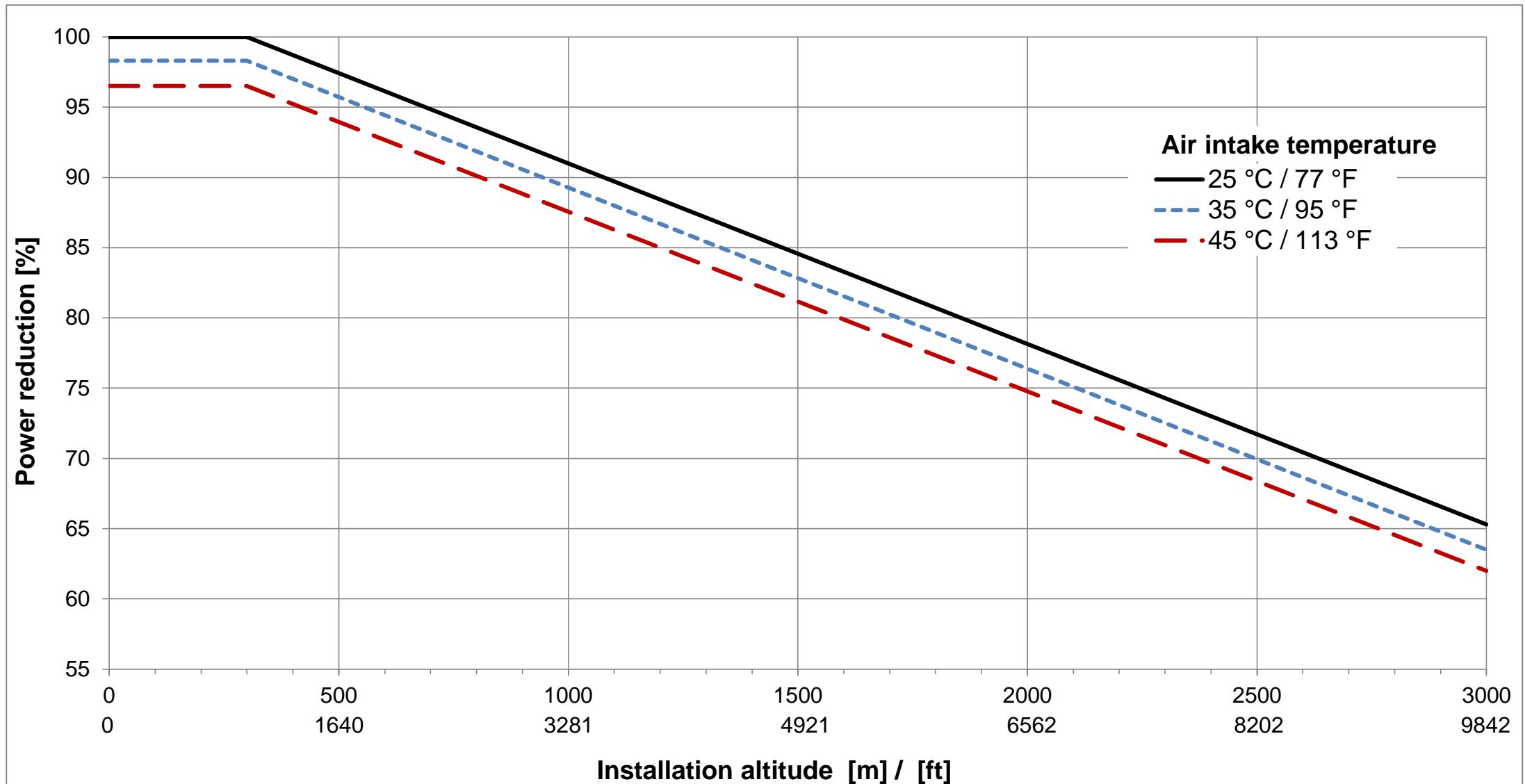
For alternative operating parameters please see chapter "Power reduction".

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Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 640	≥ 1184	2
≥ 650	≥ 1202	6
≥ 660	≥ 1220	Operation not permitted / Engine stop

Operation with methane numbers < 80

Operation with methane numbers < 80 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

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Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Acoustic Data

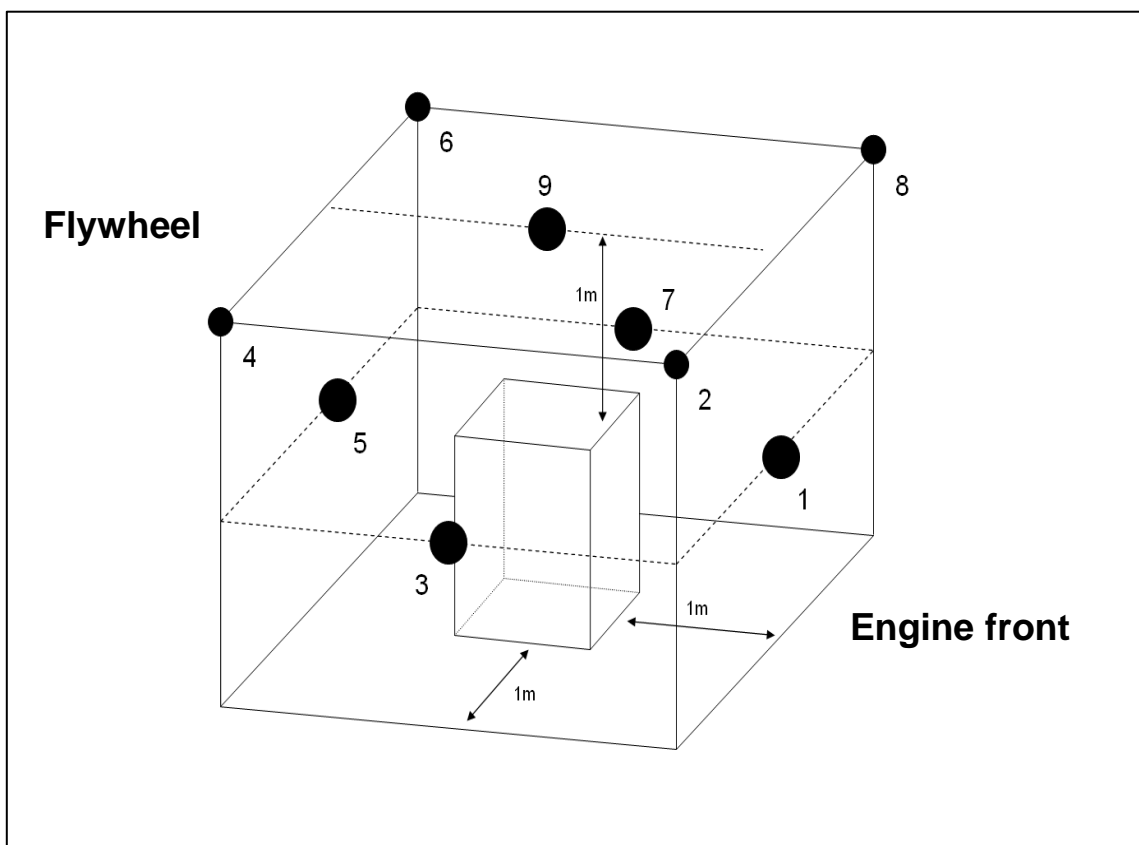
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	93,7
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	110,5
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	8,1	9,8	14,8	17,6	14,9	9,3	11,6	11,6	6,7	12,9
31,5	26,9	26,7	21,6	21,1	28,1	23,7	23,0	23,0	17,6	24,6
40	17,3	15,2	22,5	21,8	23,7	16,8	16,7	16,3	14,3	19,6
50	27,0	25,1	30,1	28,5	33,3	26,9	27,1	21,7	25,1	28,4
63	37,6	29,4	38,6	42,2	49,0	36,8	42,9	31,6	37,8	42,0
80	42,6	39,1	53,1	53,2	54,4	52,7	58,0	40,8	51,7	52,7
100	50,4	42,8	58,2	44,5	58,8	42,4	62,9	48,3	56,5	56,5
125	53,4	45,8	49,6	46,1	62,5	45,8	50,3	46,9	51,9	54,5
160	57,6	54,2	60,0	56,6	62,5	54,3	56,5	53,1	63,9	59,2
200	63,6	61,7	64,0	65,1	66,6	64,3	65,9	56,9	72,4	66,3
250	69,5	71,1	71,8	69,7	81,3	68,9	74,0	71,5	76,4	74,8
315	72,8	67,5	72,3	68,5	78,9	67,1	73,3	69,4	73,6	73,1
400	81,8	75,6	81,3	75,7	86,2	74,7	77,1	78,4	79,7	80,5
500	82,2	75,4	80,6	75,1	84,1	76,5	79,3	74,5	77,9	79,6
630	84,5	77,1	79,9	75,5	79,4	77,1	79,5	78,1	85,4	80,9
800	83,3	78,0	81,1	74,7	76,3	75,8	81,6	78,8	86,4	81,1
1000	85,2	81,1	82,6	80,6	79,0	80,6	82,3	80,7	83,3	82,1
1250	85,1	79,2	82,0	77,5	78,5	79,1	82,2	79,3	78,1	80,8
1600	87,8	80,9	84,3	78,8	81,4	81,1	85,7	81,3	83,5	83,6
2000	89,0	82,7	85,4	80,8	80,3	82,2	86,6	83,4	84,7	84,8
2500	87,0	80,0	84,3	78,6	76,5	78,4	83,6	79,2	83,7	82,5
3150	83,8	78,5	82,1	78,0	74,2	77,3	83,7	78,5	83,3	81,0
4000	83,2	78,5	83,3	77,4	75,3	76,6	84,3	77,7	82,6	81,0
5000	80,0	75,6	80,8	74,5	75,1	75,3	84,9	75,5	81,9	79,8
6300	76,4	73,5	81,4	73,3	74,9	73,6	84,7	74,7	79,7	78,9
8000	74,6	73,1	80,3	73,3	77,1	71,9	81,6	71,8	77,2	77,1
10000	72,5	73,4	79,3	73,7	78,7	73,2	80,6	72,0	79,1	77,0
12500	73,9	80,4	84,0	82,4	87,2	82,4	83,4	80,6	87,3	83,7
16000	68,4	69,7	78,6	70,2	77,0	70,3	82,1	68,7	75,6	76,1
20000	67,1	69,9	78,1	73,1	82,5	72,4	78,3	68,0	72,6	76,3
<b>Sum</b>	96,1	<b>90,8</b>	<b>94,7</b>	<b>90,1</b>	<b>93,9</b>	<b>90,6</b>	<b>95,6</b>	<b>91,0</b>	<b>95,4</b>	

Placement of measuring points of engine noise surface



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/m<sup>3</sup> / 0,5 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

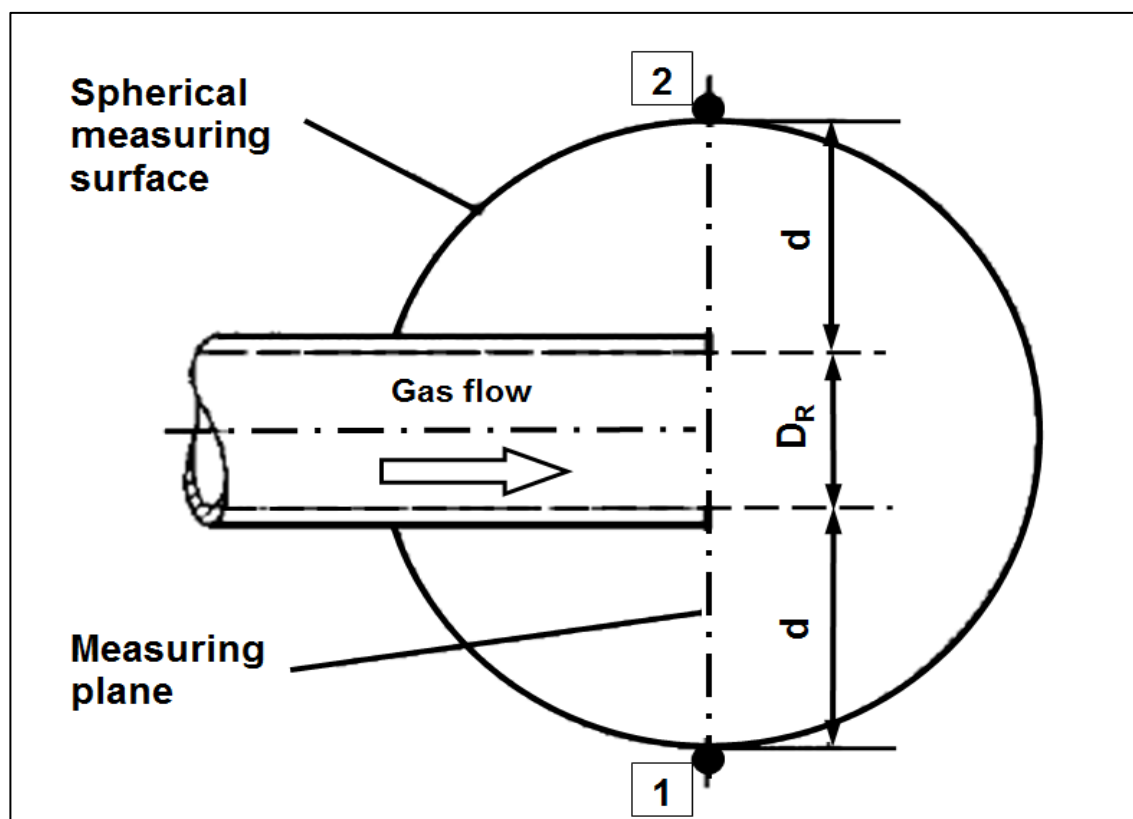
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      104,2  
 L<sub>WA</sub> (re 1 pW)      dB(A)      116,0  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	46,4	45,9	<b>46,2</b>
31,5	42,3	39,8	<b>41,2</b>
40	50,4	48,4	<b>49,5</b>
50	60,6	58,4	<b>59,6</b>
63	66,8	60,9	<b>64,8</b>
80	84,7	76,3	<b>82,3</b>
100	91,7	84,6	<b>89,5</b>
125	82,2	83,4	<b>82,8</b>
160	85,5	92,0	<b>89,9</b>
200	91,2	95,2	<b>93,6</b>
250	94,7	94,7	<b>94,7</b>
315	98,0	98,4	<b>98,2</b>
400	97,0	92,5	<b>95,3</b>
500	97,2	96,6	<b>96,9</b>
630	91,6	89,4	<b>90,6</b>
800	92,4	87,2	<b>90,5</b>
1000	86,1	82,2	<b>84,6</b>
1250	82,6	80,0	<b>81,5</b>
1600	85,4	82,8	<b>84,3</b>
2000	84,9	83,7	<b>84,3</b>
2500	85,8	82,4	<b>84,4</b>
3150	83,6	80,6	<b>82,4</b>
4000	81,7	79,5	<b>80,7</b>
5000	81,3	77,9	<b>79,9</b>
6300	79,0	77,0	<b>78,1</b>
8000	77,0	73,9	<b>75,7</b>
10000	70,4	67,2	<b>69,1</b>
12500	64,7	61,8	<b>63,5</b>
16000	55,1	54,7	<b>54,9</b>
20000	50,6	51,2	<b>50,9</b>
<b>Sum</b>	<b>104,6</b>	<b>103,8</b>	

Placement of measuring points of exhaust outlet noise



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



### Mode of Operation

**Natural Gas - 1500 min-1 (50 Hz) - NOx < 250 mg/mN<sup>3</sup> - 50 °C**

**Natural Gas - 1500 rpm (50 Hz) - NOx < 0,3 g/bhp - 122 °F**

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



**Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 250 mg/m<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F**

**Basic Data**

		metric			standard	
<b>Engine Data</b>						
Rated speed	min <sup>-1</sup>	1500		rpm	1500	
ISO standard power (COP)	kW	550		bhp	738	
Engine Torque max. (ISO 1585) at rated speed	Nm	3501,666667		Nm	3502	
Mean effective pressure	bar	17,1		psi	248,0	
Mean piston speed	m/s	7,85		m/s	7,9	
<b>Oil circuit</b>						
Mean oil consumption	g/h	80		lb/hr	0,176	
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lube oil filling quantity min. / max.	l	42 90		Imp.gal.	11 24	
<b>Cooling circuit</b>						
Coolant filling quantity	l	55		Imp.gal.	14,5	
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3	
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8	
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5	
Engine cooling water circulation quantity min.	l/min	747		ft <sup>3</sup> /min	26,4	
Coolant temperature min.	°C	80		°F	176	
Coolant temperature max.	°C	88		°F	190	
Difference inlet - outlet max.	K	6		K	6	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature LT	°C	42		°F	108	
Mixture cooling water circulation quantity LT	l/min	130		ft <sup>3</sup> /min	4,6	
Difference inlet - outlet max. LT max.	K	5		K	5	
Mixture cooling water inlet temperature HT	°C	82		°F	180	
Mixture cooling water circulation quantity HT	l/min	264		ft <sup>3</sup> /min	9,3	
Difference inlet - outlet HT max.	K	5		K	5	
Coolant concentration min . / max.	%	40 50		%	40 50	
<b>Pressure conditions</b>						
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22	
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100		psi	0,44 1,45	
Pressure loss over gas mixer max.	mbar	19		psi	0,28	
Boost pressure before mixture cooler max.	bar	1,9		psi	27,12	
Pressure loss over mixture cooler	mbar	25			0,36	
Exhaust back pressure min. / max.	mbar	5 40		psi	0,07 0,58	
<b>Emissions</b>						
NO <sub>x</sub>	mg/m <sub>N</sub> <sup>3</sup>	< 250 (5 % O <sub>2</sub> )		g/bhp	< 0,3 (15 % O <sub>2</sub> )	
CO	mg/m <sub>N</sub> <sup>3</sup>	< 750 (5 % O <sub>2</sub> )		g/bhp	< 0,8 (15 % O <sub>2</sub> )	
HCHO (measured by FTIR)	mg/m <sub>N</sub> <sup>3</sup>	< 60 (5 % O <sub>2</sub> )		g/bhp	< 0,1 (15 % O <sub>2</sub> )	
HC	mg/m <sub>N</sub> <sup>3</sup>	< 700 (5 % O <sub>2</sub> )		g/bhp	< 0,8 (15 % O <sub>2</sub> )	
NMHC	ppm	< 60		ppm	< 60	
NMNEHC (VOC)	ppm	< 10		ppm	< 10	
TOC (without Methan)	mg/m <sub>N</sub> <sup>3</sup>	< 100 (5 % O <sub>2</sub> )		g/bhp	< 0,1 (15 % O <sub>2</sub> )	

Lube oil to MAN works standard M 3271-2 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1500 min<sup>-1</sup> (50 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> - 50 °C

Flow and Heat Balance

MZ > 80 / IT 16 °CA / 550 kW  
metric

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	16	16	16
ISO standard power <sup>1</sup>	kW	550	412	275
Coolant heat <sup>2</sup>	kW	281,56	237,94	188,83
Mixture heat HT <sup>2</sup>	kW	83	39	9
Mixture heat LT <sup>2</sup>	kW	45	32	20
Exhaust heat up to 120 °C	kW	265	211	156
Radiation heat max.	kW	37	30	27
Energy input	kW	1348	1027	722
Specific fuel consumption	MJ/kWh	8,8	9,0	9,4
Air ratio <sup>3</sup>		1,66	1,63	1,59

**Efficiency Data**

mechanical <sup>1</sup>	%	40,8	40,1	38,1
thermal	%	46,7	47,4	49,0
total	%	87,5	87,5	87,1

**Mass flows**

Combustion air	kg/h	2743	2053	1407
Fuel	kg/h	105	80	56
Exhaust gas mass flow rate, wet	kg/h	2848	2133	1463
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2277	1706	1171
Engine coolant mass flow rate	kg/h	46033		
Mixture cooling water mass flow rate LT	kg/h	7735		
Mixture cooling water mass flow rate HT	kg/h	16279		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	589
Measured exhaust gas temperature after turbocharger (average)	°C	407

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 23 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	39,2	38,6	36,7
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	96,1		
	Inlet air temperature	°C	27		
	Relative air humidity	%	23		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°C	0		
	Atmospheric pressure abs.	kPa	100		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		





Natural Gas - 1500 rpm (50 Hz) - NOx < 0,3 g/bhp - 122 °F

Flow and Heat Balance

MZ > 80 / IT 16 °CA / 738 bhp standard

Performance Data

Load	%	100	75	50
Ignition timing	°CA	16	16	16
ISO standard power <sup>1</sup>	bhp	738	553	369
Coolant heat <sup>2</sup>	bhp	378	319	253
Mixture heat HT <sup>2</sup>	bhp	111	52	12
Mixture heat LT <sup>2</sup>	bhp	60	43	27
Exhaust heat up to 248 °F	bhp	355	283	210
Radiation heat max.	bhp	49	41	36
Energy input	bhp	1808	1378	968
Specific fuel consumption	BTU/bhp-hr	6236	6345	6678
Air ratio <sup>3</sup>		1,66	1,63	1,59

Efficiency Data

mechanical <sup>1</sup>	%	40,8	40,1	38,1
thermal	%	46,7	47,4	49,0
total	%	87,5	87,5	87,1

Mass flows

Combustion air	lb/hr	6047	4525	3101
Fuel	lb/hr	232	177	124
Exhaust gas mass flow rate, wet	lb/hr	6279	4702	3225
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2277	1706	1171
Engine coolant mass flow rate	lb/hr	101487		
Mixture cooling water mass flow rate LT	lb/hr	17054		
Mixture cooling water mass flow rate HT	lb/hr	35889		

Temperatures

Measured exhaust gas temperature before turbocharger (average)	°F	1092
Measured exhaust gas temperature after turbocharger (average)	°F	765

Reference setting: Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 0,9 in Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1. The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	39,2	38,6	36,7
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	13,9		
	Inlet air temperature	°F	81		
	Relative air humidity	%	23		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



Natural Gas - 1500 min-1 / 1500 rpm (50 Hz) - NOx < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Values / limits for 100 % load\*

		metric		standard
<b>Methane number</b>		> 80		> 80
<b>Performance Data</b>				
Ignition timing (±2 °CA)	Hz	50	Hz	50
ISO standard power	°CA	16	°CA	16
O <sub>2</sub> - proportion in the exhaust gas min.	kW	550	bhp	738
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	8,6	Vol-%	8,6
	mg/Nm <sup>3</sup>	250	g/bhp	0,3
<b>Operating parameters</b>				
Coolant operating pressure max. (pump in pressure operation)	bar	3,0	psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15	psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100	psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	19	psi	0,28
Boost pressure before mixture cooler max.	bar	1,87	psi	27
Pressure loss over mixture cooler max.	mbar	25	psi	0,36
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

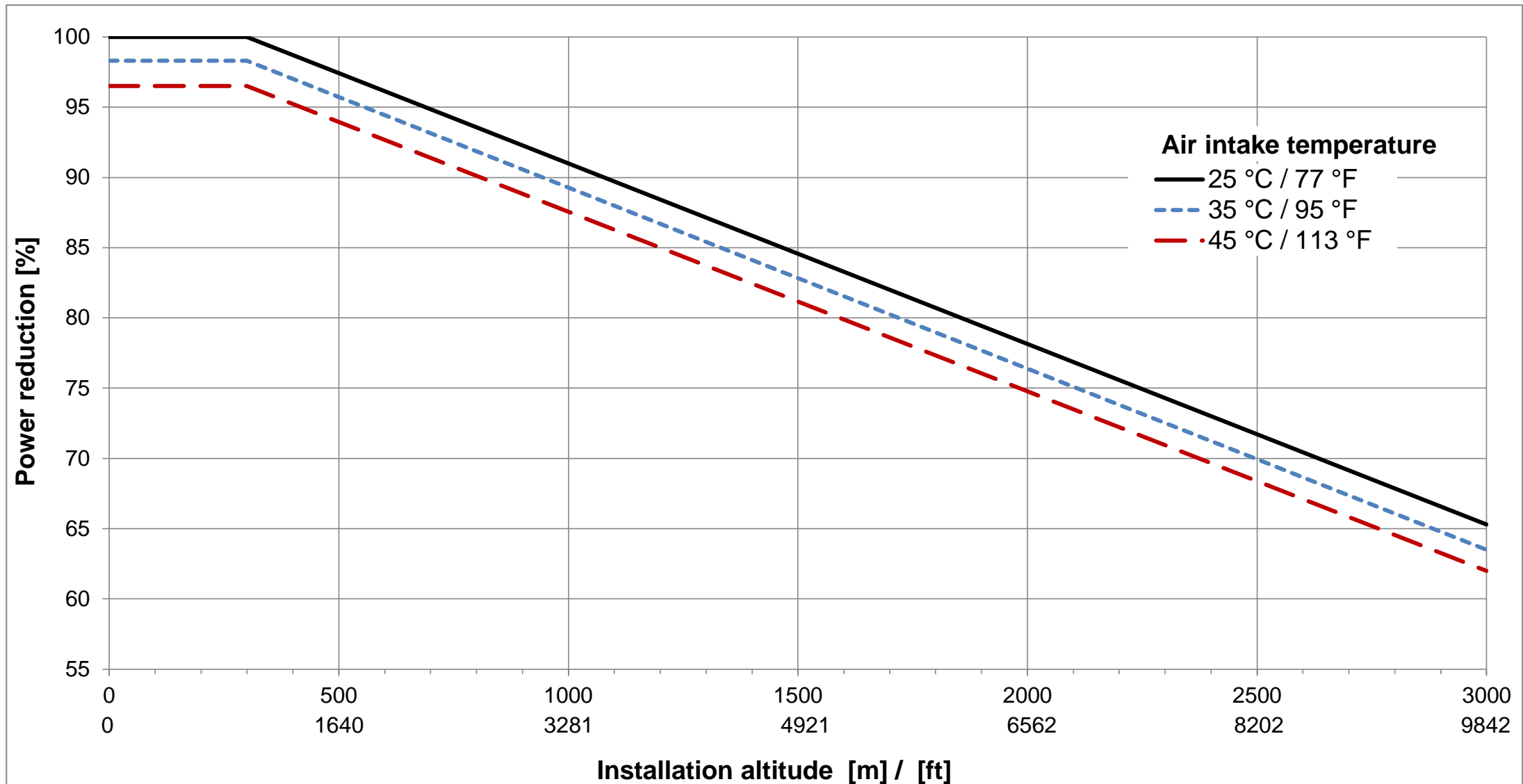
For alternative operating parameters please see chapter "Power reduction".

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 640	≥ 1184	2
≥ 650	≥ 1202	6
≥ 660	≥ 1220	Operation not permitted / Engine stop

Operation with methane numbers < 80

Operation with methane numbers < 80 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Acoustic Data

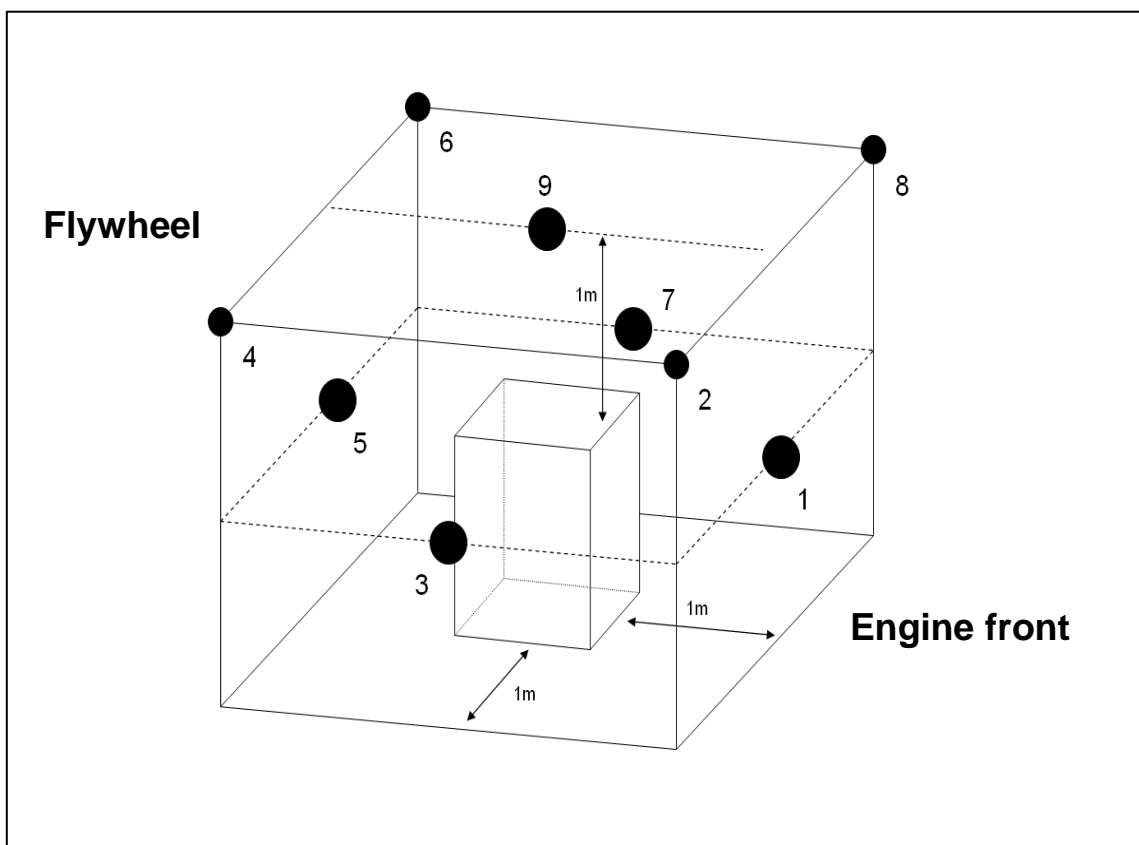
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	91,4
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	108,2
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	19,1	18,7	17,2	24,4	17,0	17,3	17,0	16,5	11,2	18,9
31,5	15,5	13,9	18,3	19,6	18,3	13,7	13,0	14,7	12,0	16,2
40	19,9	16,1	22,6	22,7	22,8	18,0	18,9	15,0	15,7	20,0
50	28,3	27,5	31,9	33,4	42,0	34,3	37,3	22,3	28,0	35,2
63	32,9	37,0	45,4	38,8	41,0	36,5	37,4	28,0	38,9	39,5
80	49,0	45,6	55,5	41,1	48,7	52,0	52,9	43,8	56,7	51,9
100	42,2	42,9	47,9	40,4	50,8	41,2	47,7	43,6	51,3	47,1
125	50,2	50,5	51,1	47,6	60,1	48,6	54,3	49,8	54,2	53,7
160	57,2	49,7	57,3	52,9	63,2	58,9	58,8	52,4	63,7	59,2
200	59,5	59,1	60,6	62,9	66,3	62,3	63,1	57,8	67,6	63,3
250	64,0	63,5	67,6	66,7	73,6	63,3	67,0	63,9	71,7	68,4
315	69,2	64,0	68,8	62,5	77,1	61,0	70,4	64,6	72,5	70,6
400	75,9	72,2	77,0	72,0	85,2	68,8	78,5	75,4	74,5	78,2
500	78,0	70,2	77,8	70,1	85,9	76,2	77,5	71,7	76,5	78,8
630	81,7	75,7	76,3	75,1	76,6	75,1	76,5	76,1	81,1	77,9
800	81,4	75,3	78,7	72,6	75,1	73,2	80,2	78,6	83,8	79,1
1000	78,3	75,9	79,2	75,1	74,9	74,9	79,9	76,0	79,7	77,6
1250	82,8	76,4	81,0	77,6	76,9	76,1	80,2	76,9	77,0	79,0
1600	88,0	78,9	81,8	78,1	81,1	77,8	81,3	77,6	82,5	82,2
2000	85,3	79,1	82,4	78,1	77,0	78,6	83,9	80,1	81,6	81,5
2500	83,6	77,5	81,3	76,0	74,8	76,5	81,3	76,9	81,5	79,8
3150	79,2	74,5	79,2	73,8	71,0	73,5	80,8	75,0	80,0	77,5
4000	79,3	75,4	80,8	74,2	73,0	73,9	81,1	74,6	79,9	78,0
5000	76,6	73,9	80,2	72,7	74,0	74,1	83,9	73,9	80,5	78,4
6300	74,0	73,6	81,7	73,1	74,8	72,7	84,1	73,5	78,5	78,3
8000	71,0	72,1	80,1	72,6	76,7	70,5	80,5	70,5	76,0	76,1
10000	71,6	77,0	80,7	77,3	84,0	76,6	81,0	73,3	82,0	79,7
12500	69,3	74,1	79,7	75,3	82,8	74,3	82,3	71,6	79,6	78,6
16000	68,9	71,4	80,3	74,2	81,7	73,0	81,6	69,8	74,1	77,5
20000	64,7	68,2	76,8	71,3	78,3	68,9	77,4	65,0	69,7	73,8
<b>Sum</b>	<b>93,3</b>	<b>88,0</b>	<b>92,6</b>	<b>87,6</b>	<b>92,9</b>	<b>87,5</b>	<b>93,8</b>	<b>88,0</b>	<b>92,5</b>	

Placement of measuring points of engine noise surface



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Natural Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

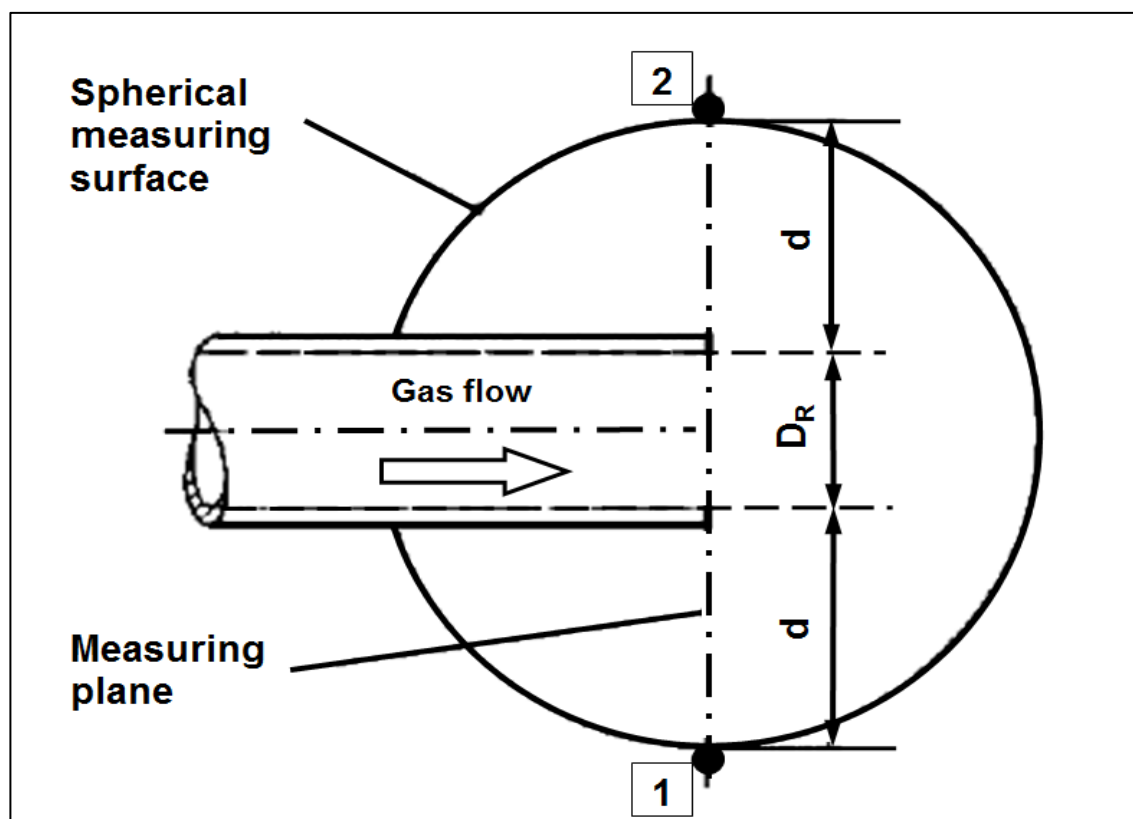
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      106,3  
 L<sub>WA</sub> (re 1 pW)      dB(A)      118,1  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	53,9	52,7	<b>53,3</b>
31,5	42,3	40,9	<b>41,7</b>
40	52,1	48,2	<b>50,6</b>
50	68,3	66,2	<b>67,4</b>
63	74,0	65,7	<b>71,6</b>
80	92,3	82,8	<b>89,8</b>
100	79,9	79,4	<b>79,7</b>
125	86,8	84,9	<b>86,0</b>
160	88,4	95,2	<b>93,0</b>
200	84,3	87,6	<b>86,3</b>
250	96,7	96,5	<b>96,6</b>
315	100,1	102,5	<b>101,5</b>
400	101,4	96,6	<b>99,6</b>
500	95,2	95,1	<b>95,2</b>
630	92,9	89,8	<b>91,6</b>
800	94,7	88,6	<b>92,6</b>
1000	87,3	83,8	<b>85,9</b>
1250	83,9	81,9	<b>83,0</b>
1600	88,2	86,1	<b>87,3</b>
2000	89,2	87,5	<b>88,4</b>
2500	91,8	86,6	<b>89,9</b>
3150	88,9	85,3	<b>87,5</b>
4000	88,0	85,4	<b>86,9</b>
5000	88,1	85,0	<b>86,8</b>
6300	86,6	83,4	<b>85,3</b>
8000	83,6	80,9	<b>82,5</b>
10000	77,5	73,8	<b>76,0</b>
12500	72,0	68,6	<b>70,6</b>
16000	61,4	59,1	<b>60,4</b>
20000	54,0	52,4	<b>53,3</b>
<b>Sum</b>	<b>106,7</b>	<b>106,0</b>	

Placement of measuring points of exhaust outlet noise



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



### Mode of Operation

**Natural Gas - 1800 min<sup>-1</sup> (60 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> - 50 °C**

**Natural Gas - 1800 rpm (60 Hz) - NO<sub>x</sub> < 0,3 g/bhp - 122 °F**

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 250 mg/m<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Basic Data

		metric			standard	
<b>Engine Data</b>						
Rated speed	min <sup>-1</sup>	1800		rpm	1800	
ISO standard power (COP)	kW	580		bhp	778	
Engine Torque max. (ISO 1585) at rated speed	Nm	3077		Nm	3077	
Mean effective pressure	bar	15		psi	217,5	
Mean piston speed	m/s	9,42		m/s	9,4	
<b>Oil circuit</b>						
Mean oil consumption	g/h	90		lb/hr	0,198	
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lube oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
<b>Cooling circuit</b>						
Coolant filling quantity	l	55		Imp.gal.	14,5	
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3	
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8	
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5	
Engine cooling water circulation quantity min.	l/min	823		ft <sup>3</sup> /min	29,1	
Coolant temperature min.	°C	80		°F	176	
Coolant temperature max.	°C	88		°F	190	
Difference inlet - outlet max.	K	6		K	6	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature LT	°C	42		°F	108	
Mixture cooling water circulation quantity LT	l/min	155		ft <sup>3</sup> /min	5,5	
Difference inlet - outlet max. LT max.	K	5		K	5	
Mixture cooling water inlet temperature HT	°C	82		°F	180	
Mixture cooling water circulation quantity HT	l/min	347		ft <sup>3</sup> /min	12,3	
Difference inlet - outlet HT max.	K	5		K	5	
Coolant concentration min . / max.	%	40	50	%	40	50
<b>Pressure conditions</b>						
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22	
Gas flow pressure before zero pressure regulator min. / max.	mbar	30	100	psi	0,44	1,45
Pressure loss over gas mixer max.	mbar	24		psi	0,35	
Boost pressure before mixture cooler	bar	2,01		psi	29,15	
Pressure loss over mixture cooler	mbar	45			0,65	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58
<b>Emissions</b>						
NO <sub>x</sub>	mg/m <sub>N</sub> <sup>3</sup>	< 250	(5 % O <sub>2</sub> )	g/bhp	< 0,3	(15 % O <sub>2</sub> )
CO	mg/m <sub>N</sub> <sup>3</sup>	< 750	(5 % O <sub>2</sub> )	g/bhp	< 0,8	(15 % O <sub>2</sub> )
HCHO (measured by FTIR)	mg/m <sub>N</sub> <sup>3</sup>	< 60	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )
HC	mg/m <sub>N</sub> <sup>3</sup>	< 600	(5 % O <sub>2</sub> )	g/bhp	< 0,7	(15 % O <sub>2</sub> )
NMHC	ppm	< 60		ppm	< 60	
NMNEHC (VOC)	ppm	< 10		ppm	< 10	
TOC (without Methan)	mg/m <sub>N</sub> <sup>3</sup>	< 100	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )

Lube oil to MAN works standard M 3271-2 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

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Natural Gas - 1800 min<sup>-1</sup> (60 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> - 50 °C

Flow and Heat Balance

MZ > 80 / IT 16 °CA / 580 kW  
metric

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	16	16	16
ISO standard power <sup>1</sup>	kW	580	435	290
Coolant heat <sup>2</sup>	kW	310	275	228
Mixture heat HT <sup>2</sup>	kW	109	56	14
Mixture heat LT <sup>2</sup>	kW	53	38	25
Exhaust heat up to 120 °C	kW	306	245	181
Radiation heat max.	kW	40	32	25
Energy input	kW	1495	1154	812
Specific fuel consumption	MJ/kWh	9,3	9,5	10,1
Air ratio <sup>3</sup>		1,64	1,60	1,56

**Efficiency Data**

mechanical <sup>1</sup>	%	38,8	37,7	35,7
thermal	%	48,5	49,9	52,0
total	%	87,3	87,6	87,7

**Mass flows**

Combustion air	kg/h	3005	2263	1553
Fuel	kg/h	117	90	63
Exhaust gas mass flow rate, wet	kg/h	3121	2353	1617
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2497	1883	1295
Engine coolant mass flow rate	kg/h	50683		
Mixture cooling water mass flow rate LT	kg/h	9238		
Mixture cooling water mass flow rate HT	kg/h	21390		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	620
Measured exhaust gas temperature after turbocharger (average)	°C	421

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 23 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	37,1	36,1	34,2
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	96		
	Inlet air temperature	°C	29		
	Relative air humidity	%	19		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°C	0		
	Atmospheric pressure abs.	kPa	100		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Natural Gas - 1800 rpm (60 Hz) - NOx < 0,3 g/bhp - 122 °F

Flow and Heat Balance

MZ > 80 / IT 16 °CA / 778 bhp standard

Performance Data

Load	%	100	75	50
Ignition timing	°CA	16	16	16
ISO standard power <sup>1</sup>	bhp	778	583	389
Coolant heat <sup>2</sup>	bhp	416	369	305
Mixture heat HT <sup>2</sup>	bhp	146	75	18
Mixture heat LT <sup>2</sup>	bhp	72	51	34
Exhaust heat up to 248 °F	bhp	410	328	242
Radiation heat max.	bhp	54	43	33
Energy input	bhp	2005	1547	1089
Specific fuel consumption	BTU/bhp-hr	6558	6749	7127
Air ratio <sup>3</sup>		1,64	1,60	1,56

Efficiency Data

mechanical <sup>1</sup>	%	38,8	37,7	35,7
thermal	%	48,5	49,9	52,0
total	%	87,3	87,6	87,7

Mass flows

Combustion air	lb/hr	6624	4989	3424
Fuel	lb/hr	257	198	140
Exhaust gas mass flow rate, wet	lb/hr	6882	5187	3564
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2497	1883	1295
Engine coolant mass flow rate	lb/hr	111738		
Mixture cooling water mass flow rate LT	lb/hr	20366		
Mixture cooling water mass flow rate HT	lb/hr	47157		

Temperatures

Measured exhaust gas temperature before turbocharger (average)	°F	1148
Measured exhaust gas temperature after turbocharger (average)	°F	790

Reference setting: Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 0,9 in Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1. The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	37,1	36,1	34,2
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	13,9		
	Inlet air temperature	°F	84		
	Relative air humidity	%	19		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	46,20		
	Methane number		85		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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Released	04.12.2017	Kn		



Natural Gas - 1800 min-1 / 1800 rpm (60 Hz) - NOx < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Values / limits for 100 % load\*

		metric		standard
<b>Methane number</b>		> 80		> 80
<b>Performance Data</b>				
Ignition timing (±2 °CA)	Hz	60	Hz	60
ISO standard power	°CA	16	°CA	16
O <sub>2</sub> - proportion in the exhaust gas min.	kW	580	bhp	778
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	8,3	Vol-%	8,3
	mg/Nm <sup>3</sup>	250	g/bhp	0,3
<b>Operating parameters</b>				
Coolant operating pressure max. (pump in pressure operation)	bar	3,0	psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15	psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100	psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	24	psi	0,35
Boost pressure before mixture cooler max.	bar	2,01	psi	29
Pressure loss over mixture cooler max.	mbar	45	psi	0,65
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

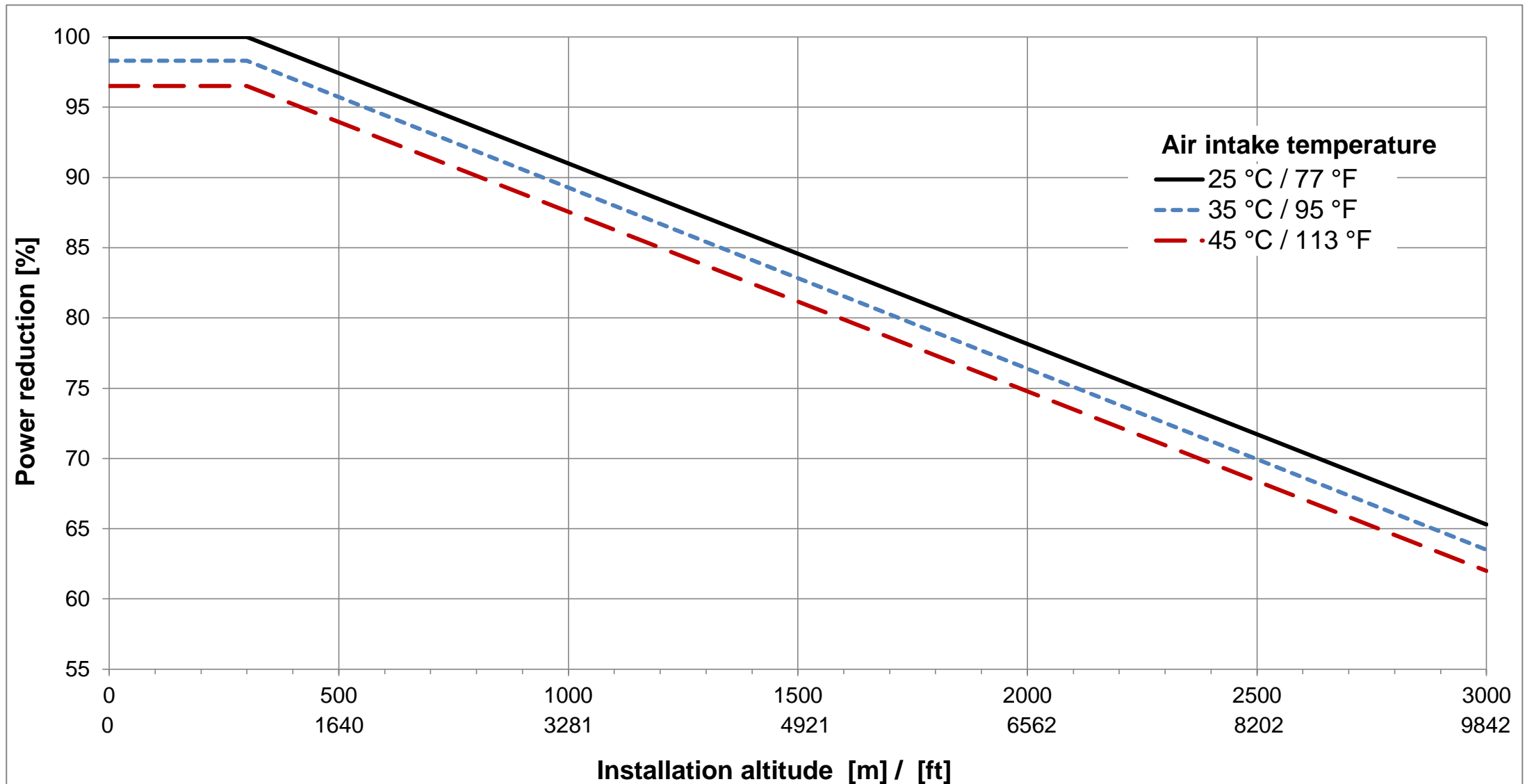
For alternative operating parameters please see chapter "Power reduction".

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
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Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 670	≥ 1238	2
≥ 680	≥ 1256	6
≥ 690	≥ 1274	Operation not permitted / Engine stop

Operation with methane numbers < 80

Operation with methane numbers < 80 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

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Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Acoustic Data

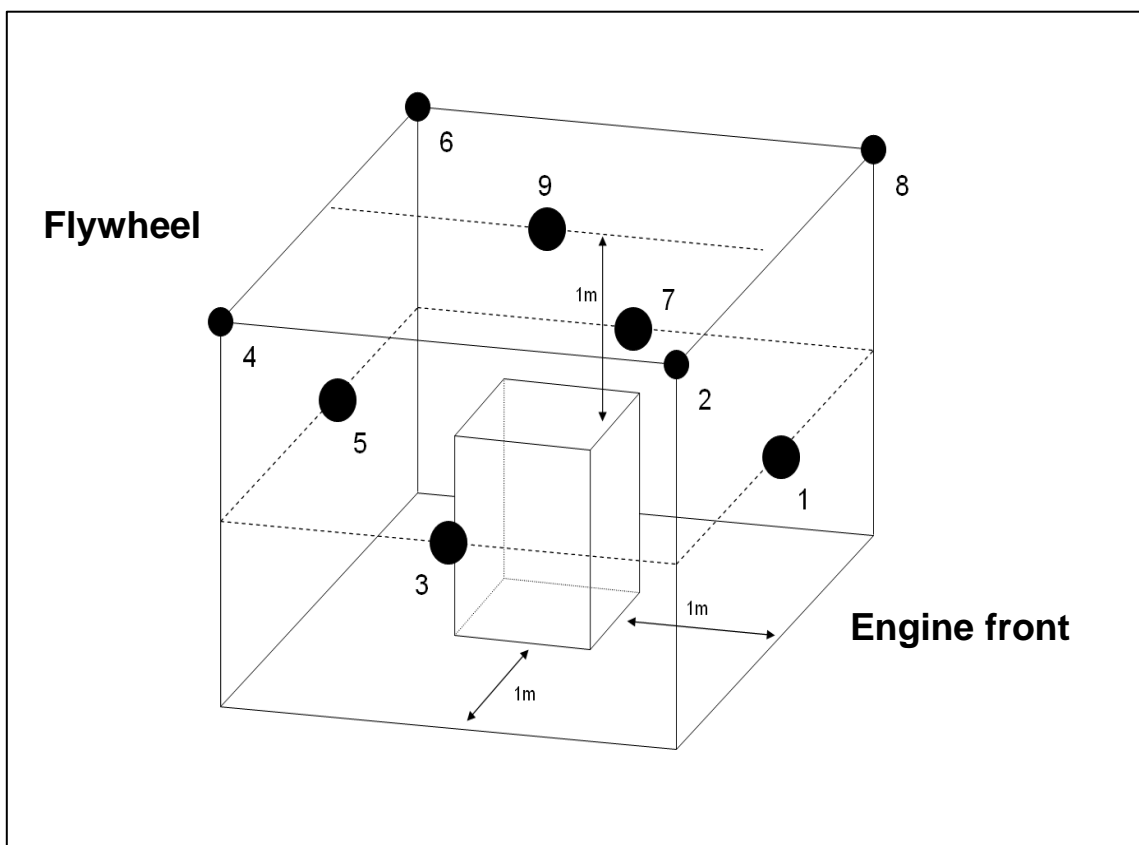
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	93,7
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	110,5
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	8,1	9,8	14,8	17,6	14,9	9,3	11,6	11,6	6,7	12,9
31,5	26,9	26,7	21,6	21,1	28,1	23,7	23,0	23,0	17,6	24,6
40	17,3	15,2	22,5	21,8	23,7	16,8	16,7	16,3	14,3	19,6
50	27,0	25,1	30,1	28,5	33,3	26,9	27,1	21,7	25,1	28,4
63	37,6	29,4	38,6	42,2	49,0	36,8	42,9	31,6	37,8	42,0
80	42,6	39,1	53,1	53,2	54,4	52,7	58,0	40,8	51,7	52,7
100	50,4	42,8	58,2	44,5	58,8	42,4	62,9	48,3	56,5	56,5
125	53,4	45,8	49,6	46,1	62,5	45,8	50,3	46,9	51,9	54,5
160	57,6	54,2	60,0	56,6	62,5	54,3	56,5	53,1	63,9	59,2
200	63,6	61,7	64,0	65,1	66,6	64,3	65,9	56,9	72,4	66,3
250	69,5	71,1	71,8	69,7	81,3	68,9	74,0	71,5	76,4	74,8
315	72,8	67,5	72,3	68,5	78,9	67,1	73,3	69,4	73,6	73,1
400	81,8	75,6	81,3	75,7	86,2	74,7	77,1	78,4	79,7	80,5
500	82,2	75,4	80,6	75,1	84,1	76,5	79,3	74,5	77,9	79,6
630	84,5	77,1	79,9	75,5	79,4	77,1	79,5	78,1	85,4	80,9
800	83,3	78,0	81,1	74,7	76,3	75,8	81,6	78,8	86,4	81,1
1000	85,2	81,1	82,6	80,6	79,0	80,6	82,3	80,7	83,3	82,1
1250	85,1	79,2	82,0	77,5	78,5	79,1	82,2	79,3	78,1	80,8
1600	87,8	80,9	84,3	78,8	81,4	81,1	85,7	81,3	83,5	83,6
2000	89,0	82,7	85,4	80,8	80,3	82,2	86,6	83,4	84,7	84,8
2500	87,0	80,0	84,3	78,6	76,5	78,4	83,6	79,2	83,7	82,5
3150	83,8	78,5	82,1	78,0	74,2	77,3	83,7	78,5	83,3	81,0
4000	83,2	78,5	83,3	77,4	75,3	76,6	84,3	77,7	82,6	81,0
5000	80,0	75,6	80,8	74,5	75,1	75,3	84,9	75,5	81,9	79,8
6300	76,4	73,5	81,4	73,3	74,9	73,6	84,7	74,7	79,7	78,9
8000	74,6	73,1	80,3	73,3	77,1	71,9	81,6	71,8	77,2	77,1
10000	72,5	73,4	79,3	73,7	78,7	73,2	80,6	72,0	79,1	77,0
12500	73,9	80,4	84,0	82,4	87,2	82,4	83,4	80,6	87,3	83,7
16000	68,4	69,7	78,6	70,2	77,0	70,3	82,1	68,7	75,6	76,1
20000	67,1	69,9	78,1	73,1	82,5	72,4	78,3	68,0	72,6	76,3
<b>Sum</b>	96,1	<b>90,8</b>	<b>94,7</b>	<b>90,1</b>	<b>93,9</b>	<b>90,6</b>	<b>95,6</b>	<b>91,0</b>	<b>95,4</b>	

Placement of measuring points of engine noise surface



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Released	04.12.2017	Kn		

Natural Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 250 mg/mN<sup>3</sup> / 0,3 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

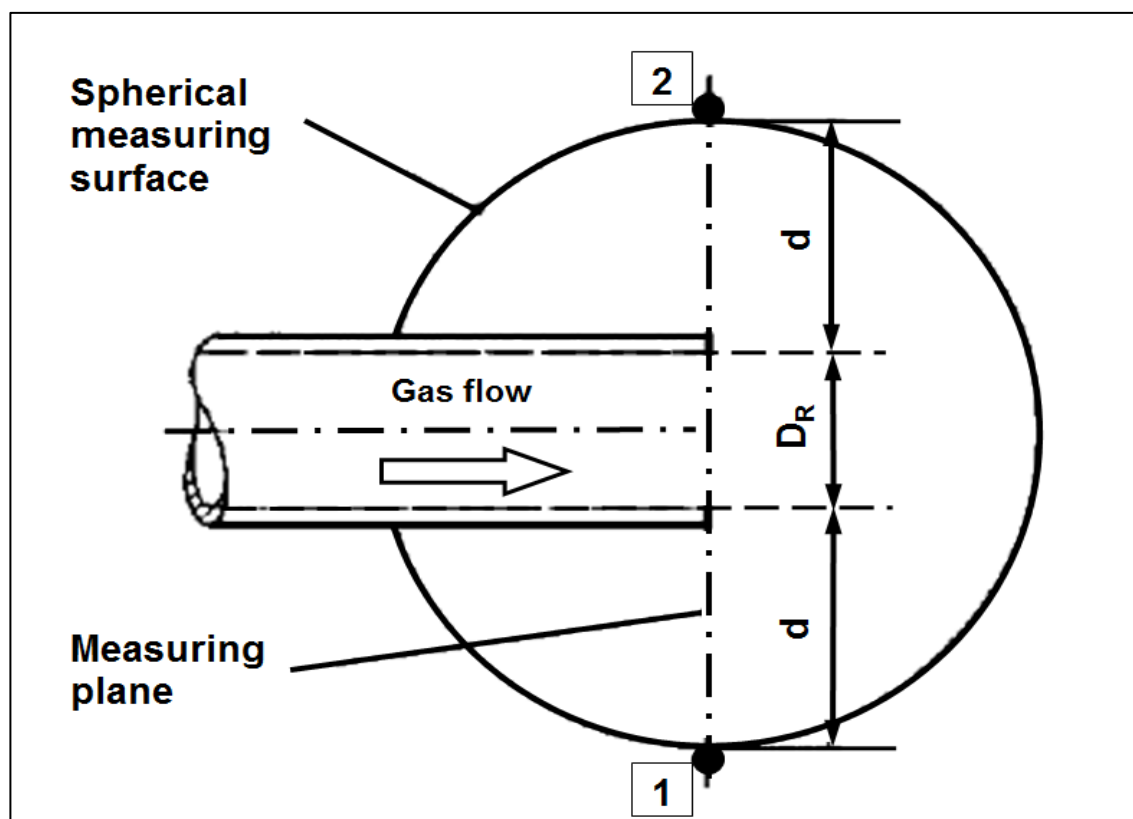
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      104,2  
 L<sub>WA</sub> (re 1 pW)      dB(A)      116  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	46,4	45,9	<b>46,2</b>
31,5	42,3	39,8	<b>41,2</b>
40	50,4	48,4	<b>49,5</b>
50	60,6	58,4	<b>59,6</b>
63	66,8	60,9	<b>64,8</b>
80	84,7	76,3	<b>82,3</b>
100	91,7	84,6	<b>89,5</b>
125	82,2	83,4	<b>82,8</b>
160	85,5	92,0	<b>89,9</b>
200	91,2	95,2	<b>93,6</b>
250	94,7	94,7	<b>94,7</b>
315	98,0	98,4	<b>98,2</b>
400	97,0	92,5	<b>95,3</b>
500	97,2	96,6	<b>96,9</b>
630	91,6	89,4	<b>90,6</b>
800	92,4	87,2	<b>90,5</b>
1000	86,1	82,2	<b>84,6</b>
1250	82,6	80,0	<b>81,5</b>
1600	85,4	82,8	<b>84,3</b>
2000	84,9	83,7	<b>84,3</b>
2500	85,8	82,4	<b>84,4</b>
3150	83,6	80,6	<b>82,4</b>
4000	81,7	79,5	<b>80,7</b>
5000	81,3	77,9	<b>79,9</b>
6300	79,0	77,0	<b>78,1</b>
8000	77,0	73,9	<b>75,7</b>
10000	70,4	67,2	<b>69,1</b>
12500	64,7	61,8	<b>63,5</b>
16000	55,1	54,7	<b>54,9</b>
20000	50,6	51,2	<b>50,9</b>
<b>Sum</b>	<b>104,6</b>	<b>103,8</b>	

Placement of measuring points of exhaust outlet noise



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### Mode of Operation

**Special Gas - 1500 min-1 (50 Hz) - NOx < 500 mg/mN<sup>3</sup> - 50 °C**

**Special Gas - 1500 rpm (50 Hz) - NOx < 0,4 g/bhp - 122 °F**

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



**Special Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F**

**Basic Data**

		metric			standard	
<b>Engine Data</b>						
Rated speed	min <sup>-1</sup>	1500		rpm	1500	
ISO standard power (COP)	kW	550		bhp	738	
Engine Torque max. (ISO 1585) at rated speed	Nm	3502		Nm	3502	
Mean effective pressure	bar	17,1		psi	248,0	
Mean piston speed	m/s	7,85		m/s	7,9	
<b>Oil circuit</b>						
Mean oil consumption	g/h	80		lb/hr	0,176	
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lube oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
<b>Cooling circuit</b>						
Coolant filling quantity	l	55		Imp.gal.	14,5	
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3	
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8	
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5	
Engine cooling water circulation quantity min.	l/min	751		ft <sup>3</sup> /min	26,5	
Coolant temperature min.	°C	80		°F	176	
Coolant temperature max.	°C	88		°F	190	
Difference inlet - outlet max.	K	6		K	6	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature LT	°C	42		°F	108	
Mixture cooling water circulation quantity LT	l/min	56		ft <sup>3</sup> /min	2,0	
Difference inlet - outlet max. LT max.	K	5		K	5	
Mixture cooling water inlet temperature HT	°C	82		°F	180	
Mixture cooling water circulation quantity HT	l/min	220		ft <sup>3</sup> /min	7,8	
Difference inlet - outlet HT max.	K	5		K	5	
Coolant concentration min . / max.	%	40	50	%	40	50
<b>Pressure conditions</b>						
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22	
Gas flow pressure before zero pressure regulator min. / max.	mbar	30	100	psi	0,44	1,45
Pressure loss over gas mixer max.	mbar	30		psi	0,44	
Boost pressure before mixture cooler max.	bar	2		psi	27,70	
over mixture cooler max.	mbar	50			0,73	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58
<b>Emissions</b>						
NO <sub>x</sub>	mg/mN <sup>3</sup>	< 500	(5 % O <sub>2</sub> )	g/bhp	< 0,4	(15 % O <sub>2</sub> )
CO	mg/mN <sup>3</sup>	< 700	(5 % O <sub>2</sub> )	g/bhp	< 0,5	(15 % O <sub>2</sub> )
HCHO (measured by FTIR)	mg/mN <sup>3</sup>	< 60	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )
HC	mg/mN <sup>3</sup>	< 400	(5 % O <sub>2</sub> )	g/bhp	< 0,5	(15 % O <sub>2</sub> )
NMHC	ppm	< 50		ppm	< 50	
NMNEHC (VOC)	ppm	< 10		ppm	< 10	
TOC (without Methan)	mg/mN <sup>3</sup>	< 100	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )

Lube oil to MAN works standard M 3271-4 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



**Special Gas - 1500 min<sup>-1</sup> (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> - 50 °C**

**Flow and Heat Balance**

**MZ > 80 / IT 20 °CA / 550 kW  
metric**

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	20	20	20
ISO standard power <sup>1</sup>	kW	550	412	275
Coolant heat <sup>2</sup>	kW	283	238	192
Mixture heat HT <sup>2</sup>	kW	69	31	6
Mixture heat LT <sup>2</sup>	kW	19	16	14
Exhaust heat up to 120 °C	kW	312	247	176
Radiation heat max.	kW	36	27	18
Energy input	kW	1355	1035	726
Specific fuel consumption	MJ/kWh	8,9	9,0	9,5
Air ratio <sup>3</sup>		1,45	1,42	1,40

**Efficiency Data**

mechanical <sup>1</sup>	%	40,6	39,9	37,9
thermal	%	49,0	49,8	51,6
total	%	89,6	89,7	89,5

**Mass flows**

Combustion air	kg/h	2424	1814	1254
Fuel	kg/h	276	211	148
Exhaust gas mass flow rate, wet	kg/h	2700	2025	1402
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2110	1583	1096
Engine coolant mass flow rate	kg/h	46268		
Mixture cooling water mass flow rate LT	kg/h	3309		
Mixture cooling water mass flow rate HT	kg/h	13578		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	641
Measured exhaust gas temperature after turbocharger (average)	°C	469

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 60 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	39,8	39,1	37,1
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	96,5		
	Inlet air temperature	°C	24		
	Relative air humidity	%	47		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	17,65		
	Methane number		140		
	Ratio CH <sub>4</sub> / CO <sub>2</sub>		60 / 40		

<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67
	Difference (inlet - outlet max.)	K	6

<sup>3</sup> Air ratio Measured with ETAS LA 4\_E. Please see chapter "Values / limits"

<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100

Tolerance for usable heat at rated output	%	±7
Tolerance for specific fuel consumption at rated output	%	+5

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**Special Gas - 1500 rpm (50 Hz) - NOx < 0,4 g/bhp - 122 °F**

**Flow and Heat Balance**

**MZ > 100 / IT 20 °CA / 738 bhp  
standard**

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	20	20	20
ISO standard power <sup>1</sup>	bhp	738	553	369
Coolant heat <sup>2</sup>	bhp	380	319	257
Mixture heat HT <sup>2</sup>	bhp	93	42	8
Mixture heat LT <sup>2</sup>	bhp	25	21	19
Exhaust heat up to 248 °F	bhp	418	331	236
Radiation heat max.	bhp	48	36	24
Energy input	bhp	1817	1388	974
Specific fuel consumption	BTU/bhp-hr	6290	6361	6714
Air ratio <sup>3</sup>		1,45	1,42	1,40

**Efficiency Data**

mechanical <sup>1</sup>	%	40,6	39,9	37,9
thermal	%	49,0	49,8	51,6
total	%	89,6	89,7	89,5

**Mass flows**

Combustion air	lb/hr	5344	3999	2765
Fuel	lb/hr	608	465	326
Exhaust gas mass flow rate, wet	lb/hr	5953	4464	3091
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2110	1583	1096
Engine coolant mass flow rate	lb/hr	102004		
Mixture cooling water mass flow rate LT	lb/hr	7295		
Mixture cooling water mass flow rate HT	lb/hr	29935		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°F	1186
Measured exhaust gas temperature after turbocharger (average)	°F	876

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 2,4 in  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	39,8	39,1	37,1
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	14,0		
	Inlet air temperature	°F	75		
	Relative air humidity	%	47		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	17,65		
	Methane number		140		
	Ratio CH4 / CO2		60 / 40		

<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67
	Difference (inlet - outlet max.)	K	6

<sup>3</sup> Air ratio Measured with ETAS LA 4\_E. Please see chapter "Values / limits"

<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32
	Atmospheric pressure abs.	psi	14,5

Tolerance for usable heat at rated output	%	±7
Tolerance for specific fuel consumption at rated output	%	+5

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		



**Special Gas - 1500 min-1 / 1500 rpm (50 Hz) - NOx < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F**

**Values / limits for 100 % load\***

		metric		standard	
<b>Methane number</b>		> 100		> 100	
<b>Performance Data</b>					
Ignition timing (±2 °CA)	Hz	50		Hz	50
ISO standard power	°CA	20		°CA	20
O <sub>2</sub> - proportion in the exhaust gas min.	kW	550		bhp	738
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	6,7		Vol-%	6,7
	mg/Nm <sup>3</sup>	500		g/bhp	0,4
<b>Operating parameters</b>					
Coolant operating pressure max. (pump in pressure operation)	bar	3,0		psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100		psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	30		psi	0,44
Boost pressure before mixture cooler max.	bar	1,91		psi	28
Pressure loss over mixture cooler max.	mbar	50		psi	0,73
Exhaust back pressure min. / max.	mbar	5 40		psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

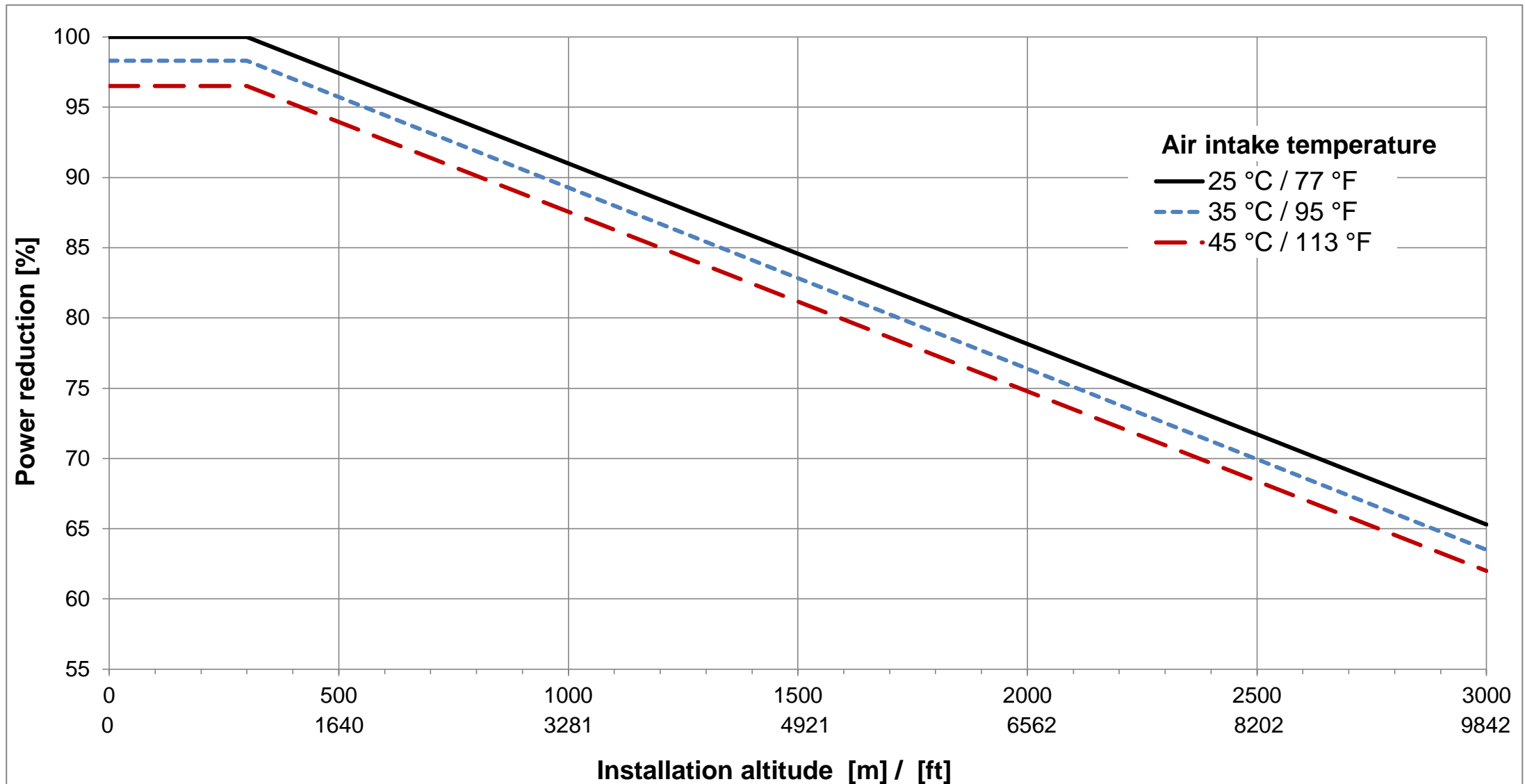
For alternative operating parameters please see chapter "Power reduction".

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Special Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 670	≥ 1238	2
≥ 680	≥ 1256	6
≥ 690	≥ 1274	Operation not permitted / Engine stop

Operation with methane numbers < 100

Special gas operation with methane numbers < 100 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Special Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Acoustic Data

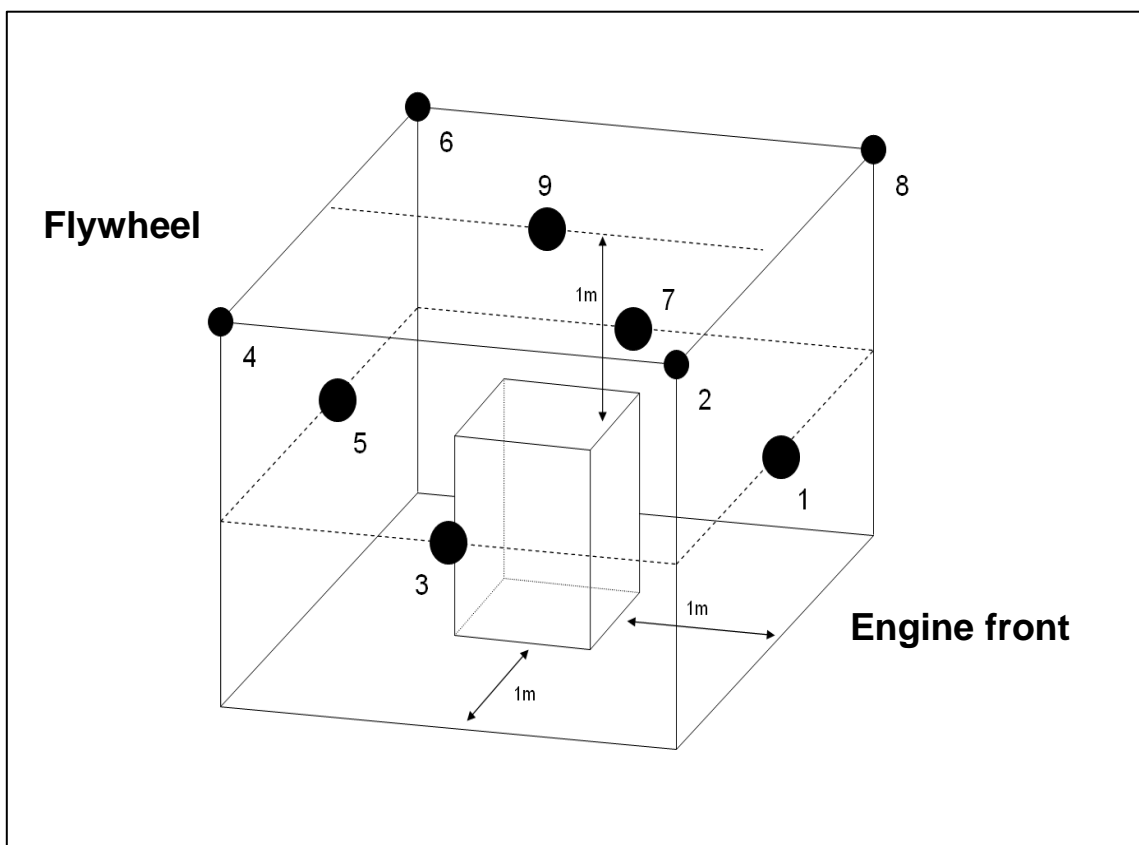
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	91,4
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	108,2
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	19,1	18,7	17,2	24,4	17,0	17,3	17,0	16,5	11,2	18,9
31,5	15,5	13,9	18,3	19,6	18,3	13,7	13,0	14,7	12,0	16,2
40	19,9	16,1	22,6	22,7	22,8	18,0	18,9	15,0	15,7	20,0
50	28,3	27,5	31,9	33,4	42,0	34,3	37,3	22,3	28,0	35,2
63	32,9	37,0	45,4	38,8	41,0	36,5	37,4	28,0	38,9	39,5
80	49,0	45,6	55,5	41,1	48,7	52,0	52,9	43,8	56,7	51,9
100	42,2	42,9	47,9	40,4	50,8	41,2	47,7	43,6	51,3	47,1
125	50,2	50,5	51,1	47,6	60,1	48,6	54,3	49,8	54,2	53,7
160	57,2	49,7	57,3	52,9	63,2	58,9	58,8	52,4	63,7	59,2
200	59,5	59,1	60,6	62,9	66,3	62,3	63,1	57,8	67,6	63,3
250	64,0	63,5	67,6	66,7	73,6	63,3	67,0	63,9	71,7	68,4
315	69,2	64,0	68,8	62,5	77,1	61,0	70,4	64,6	72,5	70,6
400	75,9	72,2	77,0	72,0	85,2	68,8	78,5	75,4	74,5	78,2
500	78,0	70,2	77,8	70,1	85,9	76,2	77,5	71,7	76,5	78,8
630	81,7	75,7	76,3	75,1	76,6	75,1	76,5	76,1	81,1	77,9
800	81,4	75,3	78,7	72,6	75,1	73,2	80,2	78,6	83,8	79,1
1000	78,3	75,9	79,2	75,1	74,9	74,9	79,9	76,0	79,7	77,6
1250	82,8	76,4	81,0	77,6	76,9	76,1	80,2	76,9	77,0	79,0
1600	88,0	78,9	81,8	78,1	81,1	77,8	81,3	77,6	82,5	82,2
2000	85,3	79,1	82,4	78,1	77,0	78,6	83,9	80,1	81,6	81,5
2500	83,6	77,5	81,3	76,0	74,8	76,5	81,3	76,9	81,5	79,8
3150	79,2	74,5	79,2	73,8	71,0	73,5	80,8	75,0	80,0	77,5
4000	79,3	75,4	80,8	74,2	73,0	73,9	81,1	74,6	79,9	78,0
5000	76,6	73,9	80,2	72,7	74,0	74,1	83,9	73,9	80,5	78,4
6300	74,0	73,6	81,7	73,1	74,8	72,7	84,1	73,5	78,5	78,3
8000	71,0	72,1	80,1	72,6	76,7	70,5	80,5	70,5	76,0	76,1
10000	71,6	77,0	80,7	77,3	84,0	76,6	81,0	73,3	82,0	79,7
12500	69,3	74,1	79,7	75,3	82,8	74,3	82,3	71,6	79,6	78,6
16000	68,9	71,4	80,3	74,2	81,7	73,0	81,6	69,8	74,1	77,5
20000	64,7	68,2	76,8	71,3	78,3	68,9	77,4	65,0	69,7	73,8
<b>Sum</b>	<b>93,3</b>	<b>88,0</b>	<b>92,6</b>	<b>87,6</b>	<b>92,9</b>	<b>87,5</b>	<b>93,8</b>	<b>88,0</b>	<b>92,5</b>	

Placement of measuring points of engine noise surface



	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

Special Gas - 1500 min<sup>-1</sup> / 1500 rpm (50 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

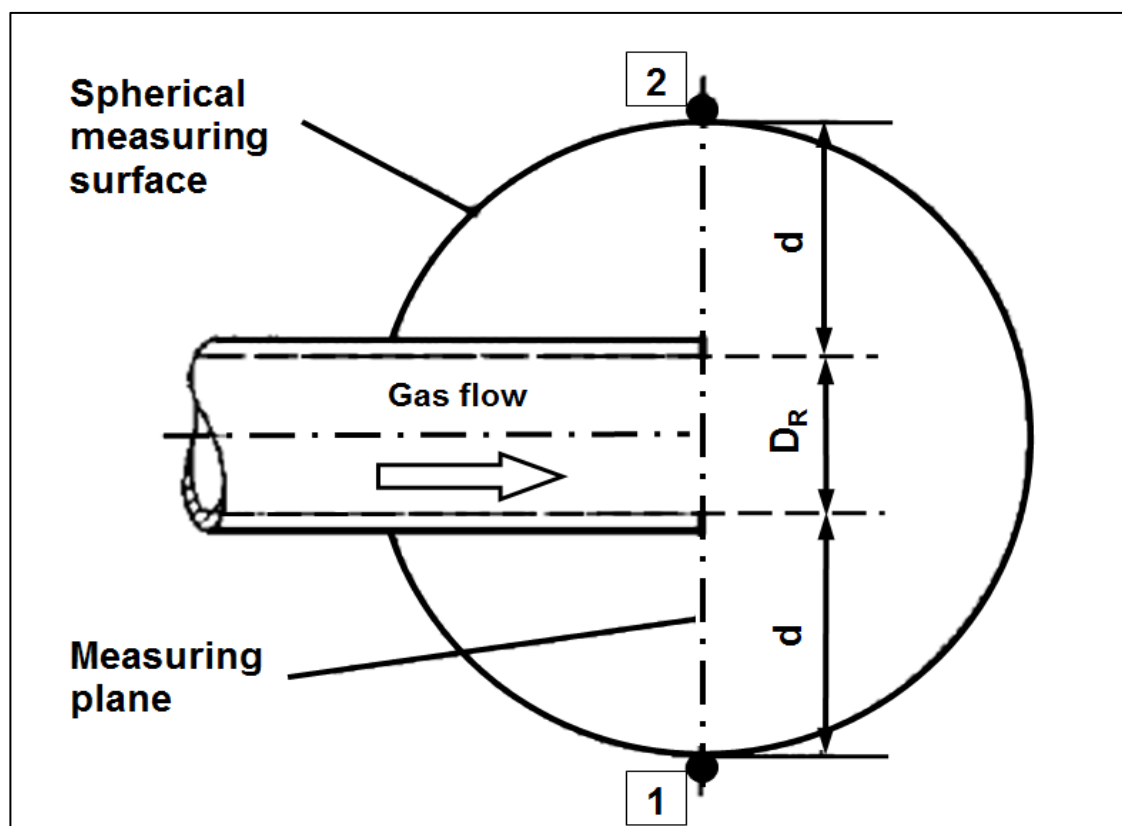
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      106,3  
 L<sub>WA</sub> (re 1 pW)      dB(A)      118,1  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	53,9	52,7	53,3
31,5	42,3	40,9	41,7
40	52,1	48,2	50,6
50	68,3	66,2	67,4
63	74,0	65,7	71,6
80	92,3	82,8	89,8
100	79,9	79,4	79,7
125	86,8	84,9	86,0
160	88,4	95,2	93,0
200	84,3	87,6	86,3
250	96,7	96,5	96,6
315	100,1	102,5	101,5
400	101,4	96,6	99,6
500	95,2	95,1	95,2
630	92,9	89,8	91,6
800	94,7	88,6	92,6
1000	87,3	83,8	85,9
1250	83,9	81,9	83,0
1600	88,2	86,1	87,3
2000	89,2	87,5	88,4
2500	91,8	86,6	89,9
3150	88,9	85,3	87,5
4000	88,0	85,4	86,9
5000	88,1	85,0	86,8
6300	86,6	83,4	85,3
8000	83,6	80,9	82,5
10000	77,5	73,8	76,0
12500	72,0	68,6	70,6
16000	61,4	59,1	60,4
20000	54,0	52,4	53,3
<b>Sum</b>	<b>106,7</b>	<b>106,0</b>	

Placement of measuring points of exhaust outlet noise



	Date	Signature	No. of data sheet	Index
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### Mode of Operation

**Special Gas - 1800 min<sup>-1</sup> (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> - 50 °C**

**Special Gas - 1800 rpm (60 Hz) - NO<sub>x</sub> < 0,5 g/bhp - 122 °F**

	Date	Signature	No. of data sheet	Index
Created	04.12.2017	FM	51.99494-7059	a
Released	04.12.2017	Kn		

**Special Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F**

**Basic Data**

		metric			standard	
<b>Engine Data</b>						
Rated speed	min <sup>-1</sup>	1800		rpm	1800	
ISO standard power (COP)	kW	580		bhp	778	
Engine Torque max. (ISO 1585) at rated speed	Nm	3077		Nm	3077	
Mean effective pressure	bar	15		psi	217,5	
Mean piston speed	m/s	9,42		m/s	9,4	
<b>Oil circuit</b>						
Mean oil consumption	g/h	90		lb/hr	0,198	
Max . Permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lube oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
<b>Cooling circuit</b>						
Coolant filling quantity	l	55		Imp.gal.	14,5	
- therefrom mixture cooler HT	l	5		Imp.gal.	1,3	
Coolant filling quantity mixture cooler LT	l	3		Imp.gal.	0,8	
Coolant operating pressure max. (coolant pump on engine inlet side)	bar	3		psi	43,5	
Engine cooling water circulation quantity min.	l/min	867		ft <sup>3</sup> /min	30,6	
Coolant temperature min.	°C	80		°F	176	
Coolant temperature max.	°C	88		°F	190	
Difference inlet - outlet max.	K	6		K	6	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature LT	°C	42		°F	108	
Mixture cooling water circulation quantity LT	l/min	61		ft <sup>3</sup> /min	2,2	
Difference inlet - outlet max. LT max.	K	5		K	5	
Mixture cooling water inlet temperature HT	°C	82		°F	180	
Mixture cooling water circulation quantity HT	l/min	280		ft <sup>3</sup> /min	9,9	
Difference inlet - outlet HT max.	K	5		K	5	
Coolant concentration min . / max.	%	40	50	%	40	50
<b>Pressure conditions</b>						
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22	
Gas flow pressure before zero pressure regulator min. / max.	mbar	30	100	psi	0,44	1,45
Pressure loss over gas mixer max.	mbar	35		psi	0,51	
Boost pressure before mixture cooler	bar	2,2		psi	31,90	
Pressure loss over mixture cooler	mbar	65			0,94	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58
<b>Emissions</b>						
NO <sub>x</sub>	mg/mN <sup>3</sup>	< 500	(5 % O <sub>2</sub> )	g/bhp	< 0,4	(15 % O <sub>2</sub> )
CO	mg/mN <sup>3</sup>	< 750	(5 % O <sub>2</sub> )	g/bhp	< 0,6	(15 % O <sub>2</sub> )
HCHO (measured by FTIR)	mg/mN <sup>3</sup>	< 60	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )
HC	mg/mN <sup>3</sup>	< 400	(5 % O <sub>2</sub> )	g/bhp	< 0,5	(15 % O <sub>2</sub> )
NMHC	ppm	< 50		ppm	< 50	
NMNEHC (VOC)	ppm	< 10		ppm	< 10	
TOC (without Methan)	mg/mN <sup>3</sup>	< 100	(5 % O <sub>2</sub> )	g/bhp	< 0,1	(15 % O <sub>2</sub> )

Lube oil to MAN works standard M 3271-4 and coolant to MAN works standard MAN 324 NF  
 Gas quality to MAN data sheet - minimum requirement for the gas quality for MAN gas engines

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**Special Gas - 1800 min<sup>-1</sup> (60 Hz) - NOx < 500 mg/mN<sup>3</sup> - 50 °C**

**Flow and Heat Balance**

**MZ > 100 / IT 22 °CA / 580 kW  
metric**

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	22	22	22
ISO standard power <sup>1</sup>	kW	580	435	290
Coolant heat <sup>2</sup>	kW	327	274	226
Mixture heat HT <sup>2</sup>	kW	88	47	23
Mixture heat LT <sup>2</sup>	kW	21	17	15
Exhaust heat up to 120 °C	kW	352	278	196
Radiation heat max.	kW	20	12	11
Energy input	kW	1480	1133	810
Specific fuel consumption	MJ/kWh	9,2	9,4	10,1
Air ratio <sup>3</sup>		1,42	1,41	1,39

**Efficiency Data**

mechanical <sup>1</sup>	%	39,2	38,4	35,8
thermal	%	51,8	52,9	55,0
total	%	91,0	91,3	90,8

**Mass flows**

Combustion air	kg/h	2593	1971	1389
Fuel	kg/h	302	231	165
Exhaust gas mass flow rate, wet	kg/h	2894	2202	1555
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2262	1721	1215
Engine coolant mass flow rate	kg/h	53394		
Mixture cooling water mass flow rate LT	kg/h	3614		
Mixture cooling water mass flow rate HT	kg/h	17277		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°C	672
Measured exhaust gas temperature after turbocharger (average)	°C	486

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 60 mm  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	38,4	37,6	35,0
<b>Conditions at measurement</b>	Installation location	m	310		
	Atmospheric pressure abs.	kPa	97		
	Inlet air temperature	°C	23		
	Relative air humidity	%	44		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	17,65		
	Methane number		140		
	Ratio CH <sub>4</sub> / CO <sub>2</sub>		60 / 40		

<sup>2</sup> Cooling water data based on	Antifreeze proportion	%	45
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67
	Difference (inlet - outlet max.)	K	6

<sup>3</sup> Air ratio Measured with ETAS LA 4\_E. Please see chapter "Values / limits"

<sup>4</sup> Standard conditions acc. to TA-Luft	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100

Tolerance for usable heat at rated output	%	±7
Tolerance for specific fuel consumption at rated output	%	+5

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**Special Gas - 1800 rpm (60 Hz) - NOx < 0,4 g/bhp - 122 °F**

**Flow and Heat Balance**

**MZ > 100 / IT 22 °CA / 778 bhp  
standard**

**Performance Data**

Load	%	100	75	50
Ignition timing	°CA	22	22	22
ISO standard power <sup>1</sup>	bhp	778	583	389
Coolant heat <sup>2</sup>	bhp	439	367	303
Mixture heat HT <sup>2</sup>	bhp	118	63	31
Mixture heat LT <sup>2</sup>	bhp	28	23	20
Exhaust heat up to 248 °F	bhp	472	373	263
Radiation heat max.	bhp	27	16	15
Energy input	bhp	1985	1519	1086
Specific fuel consumption	BTU/bhp-hr	6502	6644	7139
Air ratio <sup>3</sup>		1,42	1,41	1,39

**Efficiency Data**

mechanical <sup>1</sup>	%	39,2	38,4	35,8
thermal	%	51,8	52,9	55,0
total	%	91,0	91,3	90,8

**Mass flows**

Combustion air	lb/hr	5717	4345	3062
Fuel	lb/hr	666	509	364
Exhaust gas mass flow rate, wet	lb/hr	6380	4855	3428
Exhaust gas volume flow rate, dry <sup>4</sup>	Nm <sup>3</sup> /h	2262	1721	1215
Engine coolant mass flow rate	lb/hr	117714		
Mixture cooling water mass flow rate LT	lb/hr	7968		
Mixture cooling water mass flow rate HT	lb/hr	38089		

**Temperatures**

Measured exhaust gas temperature before turbocharger (average)	°F	1242
Measured exhaust gas temperature after turbocharger (average)	°F	907

**Reference setting:** Gasmixer Motortech Varifuel 2 / 200 - 120 with flow body Ø 2,4 in  
Ignition System Motortech MIC 4

<sup>1</sup> The stated power data refers to the below-mentioned values acc to ISO 3046-1.  
The stated mechanical efficiency data is related to the ISO standard power.

<b>Standard conditions</b>	Atmospheric pressure abs.	psi	14,50		
	Air temperature	°F	77		
	Relative air humidity	%	30		
<b>Measured efficiency data</b>	Load	%	100	75	50
	Efficiency mech.	%	38,4	37,6	35,0
<b>Conditions at measurement</b>	Installation location	ft	1017		
	Atmospheric pressure abs.	psi	14,0		
	Inlet air temperature	°F	73		
	Relative air humidity	%	44		
<b>Gas conditions at measurement</b>	Calorific value	MJ/kg	17,65		
	Methane number		140		
	Ratio CH4 / CO2		60 / 40		
<b><sup>2</sup> Cooling water data based on</b>	Antifreeze proportion	%	45		
	Spec. effective heat capacity c <sub>p</sub>	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
<b><sup>3</sup> Air ratio</b>	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				
<b><sup>4</sup> Standard conditions acc. to TA-Luft</b>	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

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**Special Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F**

**Values / limits for 100 % load\***

		metric		standard	
<b>Methane number</b>		> 100		> 100	
<b>Performance Data</b>					
Ignition timing (±2 °CA)	Hz	60		Hz	60
ISO standard power	°CA	22		°CA	22
O <sub>2</sub> - proportion in the exhaust gas min.	kW	580		bhp	778
NO <sub>x</sub> - proportion in the exhaust gas	Vol-%	6,4		Vol-%	6,4
	mg/Nm <sup>3</sup>	500		g/bhp	0,4
<b>Operating parameters</b>					
Coolant operating pressure max. (pump in pressure operation)	bar	3,0		psi	44
Intake air pressure after air filter max. (measured at new condition)	mbar	15		psi	0,22
Gas flow pressure before zero pressure regulator min. / max.	mbar	30 100		psi	0,44 1,45
Pressure loss over gas mixer max.	mbar	35		psi	0,51
Boost pressure before mixture cooler max.	bar	2,2		psi	32
Pressure loss over mixture cooler max.	mbar	65		psi	0,94
Exhaust back pressure min. / max.	mbar	5 40		psi	0,07 0,58

\* The values and limits are valid with standard conditions acc. to ISO 3046-1 at 100 m / 328 ft above sea level

			metric		standard
<b>Standard conditions:</b>	Atmospheric pressure abs.	kPa	100	psi	14,5
	Air temperature	°C	25	°F	77
	Relative air humidity	%	30	%	30

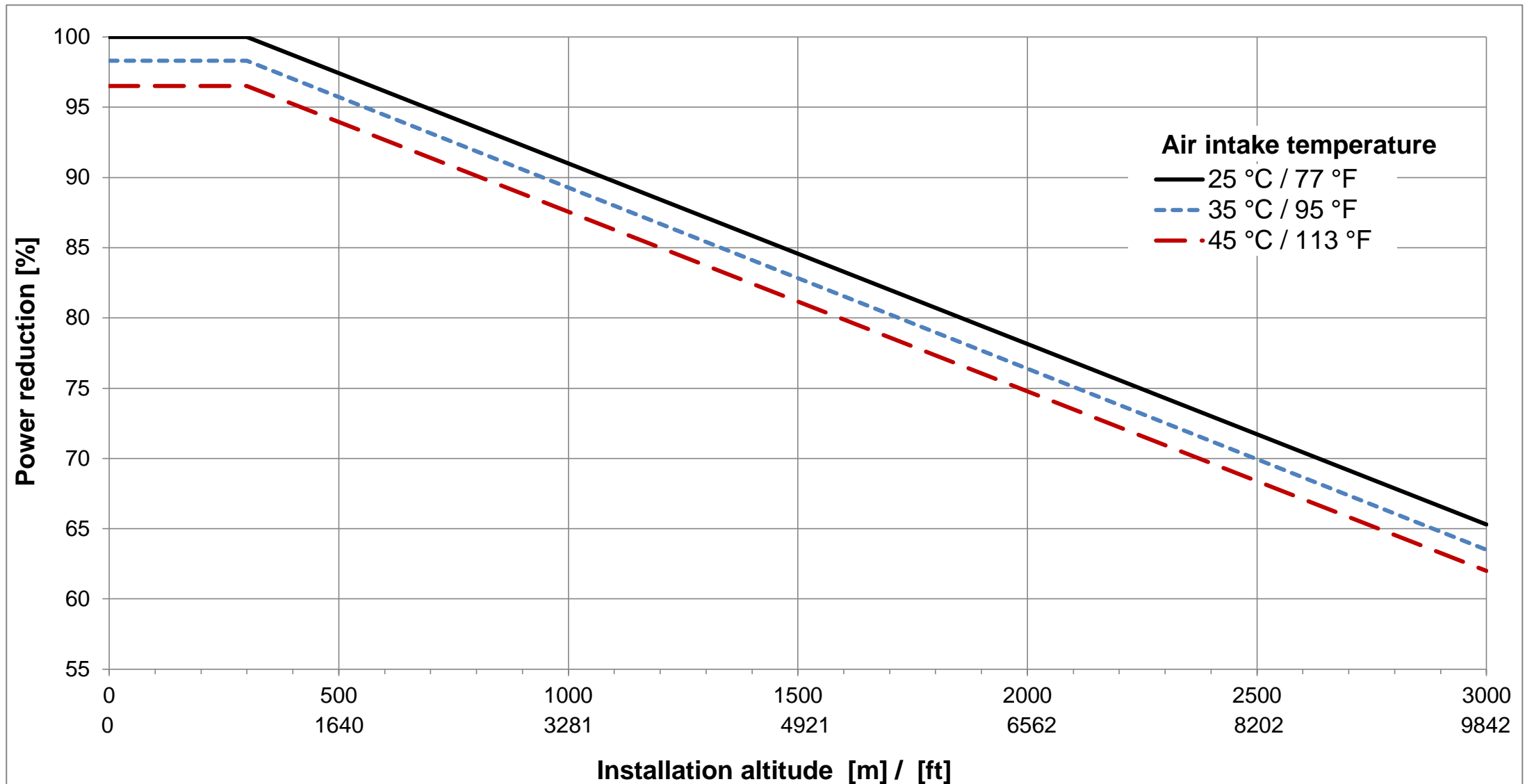
For alternative operating parameters please see chapter "Power reduction".

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Special Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Power Reduction

Power reduction depending on installation altitude



Power reduction depending on installation altitude has to be implemented permanently in the system control.

Power reduction depending on mixture temperature

Mixture temperature after mixture cooler		Power reduction
°C	°F	%
≥ 55	≥ 131	2
≥ 60	≥ 140	6
≥ 65	≥ 149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temperature before turbocharger		Power reduction
°C	°F	%
≥ 690	≥ 1274	2
≥ 700	≥ 1292	6
≥ 710	≥ 1310	Operation not permitted / Engine stop

Operation with methane numbers < 100

Special gas operation with methane numbers < 100 is only allowed after consultation with MAN and requires mandatorily the use of one of the following knock control systems:

- AKS 100, Fa. HügliTech
- KC-01 ARIADNE, Fa. Heinzmann

The power reduction depending on mixture- and exhaust gas temperature has to be implemented in addition to the power reduction depending on installation altitude.

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Special Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Acoustic Data

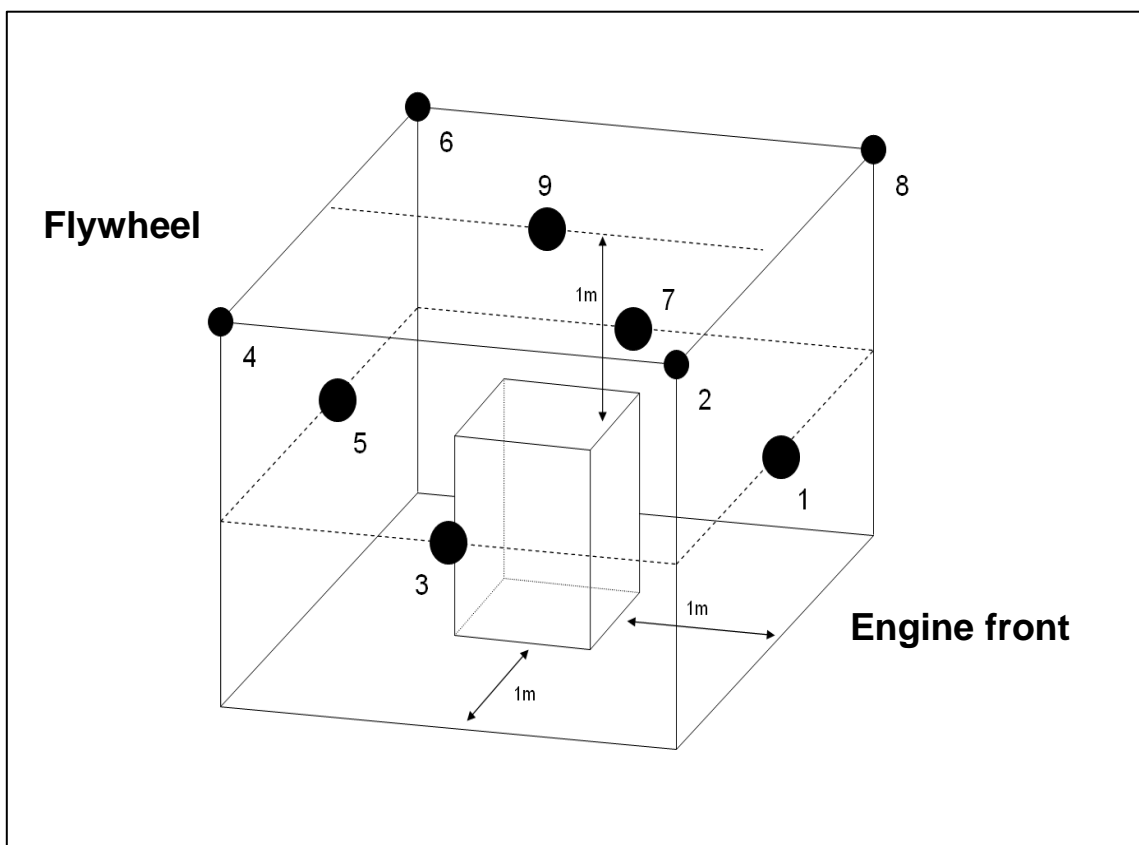
Engine surface noise according to DIN 45635 - 11 - KL2

Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level	L <sub>pA</sub> (re 20 µPa)	dB(A)	93,7
A - weighted sound power level	L <sub>WA</sub> (re 1 pW)	dB(A)	110,5
Surface dimension	L <sub>S</sub>	dB	16,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]	MP 6 [dB(A)]	MP 7 [dB(A)]	MP 8 [dB(A)]	MP 9 [dB(A)]	1-9 av. [dB(A)]
25	8,1	9,8	14,8	17,6	14,9	9,3	11,6	11,6	6,7	12,9
31,5	26,9	26,7	21,6	21,1	28,1	23,7	23,0	23,0	17,6	24,6
40	17,3	15,2	22,5	21,8	23,7	16,8	16,7	16,3	14,3	19,6
50	27,0	25,1	30,1	28,5	33,3	26,9	27,1	21,7	25,1	28,4
63	37,6	29,4	38,6	42,2	49,0	36,8	42,9	31,6	37,8	42,0
80	42,6	39,1	53,1	53,2	54,4	52,7	58,0	40,8	51,7	52,7
100	50,4	42,8	58,2	44,5	58,8	42,4	62,9	48,3	56,5	56,5
125	53,4	45,8	49,6	46,1	62,5	45,8	50,3	46,9	51,9	54,5
160	57,6	54,2	60,0	56,6	62,5	54,3	56,5	53,1	63,9	59,2
200	63,6	61,7	64,0	65,1	66,6	64,3	65,9	56,9	72,4	66,3
250	69,5	71,1	71,8	69,7	81,3	68,9	74,0	71,5	76,4	74,8
315	72,8	67,5	72,3	68,5	78,9	67,1	73,3	69,4	73,6	73,1
400	81,8	75,6	81,3	75,7	86,2	74,7	77,1	78,4	79,7	80,5
500	82,2	75,4	80,6	75,1	84,1	76,5	79,3	74,5	77,9	79,6
630	84,5	77,1	79,9	75,5	79,4	77,1	79,5	78,1	85,4	80,9
800	83,3	78,0	81,1	74,7	76,3	75,8	81,6	78,8	86,4	81,1
1000	85,2	81,1	82,6	80,6	79,0	80,6	82,3	80,7	83,3	82,1
1250	85,1	79,2	82,0	77,5	78,5	79,1	82,2	79,3	78,1	80,8
1600	87,8	80,9	84,3	78,8	81,4	81,1	85,7	81,3	83,5	83,6
2000	89,0	82,7	85,4	80,8	80,3	82,2	86,6	83,4	84,7	84,8
2500	87,0	80,0	84,3	78,6	76,5	78,4	83,6	79,2	83,7	82,5
3150	83,8	78,5	82,1	78,0	74,2	77,3	83,7	78,5	83,3	81,0
4000	83,2	78,5	83,3	77,4	75,3	76,6	84,3	77,7	82,6	81,0
5000	80,0	75,6	80,8	74,5	75,1	75,3	84,9	75,5	81,9	79,8
6300	76,4	73,5	81,4	73,3	74,9	73,6	84,7	74,7	79,7	78,9
8000	74,6	73,1	80,3	73,3	77,1	71,9	81,6	71,8	77,2	77,1
10000	72,5	73,4	79,3	73,7	78,7	73,2	80,6	72,0	79,1	77,0
12500	73,9	80,4	84,0	82,4	87,2	82,4	83,4	80,6	87,3	83,7
16000	68,4	69,7	78,6	70,2	77,0	70,3	82,1	68,7	75,6	76,1
20000	67,1	69,9	78,1	73,1	82,5	72,4	78,3	68,0	72,6	76,3
<b>Sum</b>	96,1	<b>90,8</b>	<b>94,7</b>	<b>90,1</b>	<b>93,9</b>	<b>90,6</b>	<b>95,6</b>	<b>91,0</b>	<b>95,4</b>	

Placement of measuring points of engine noise surface



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Special Gas - 1800 min<sup>-1</sup> / 1800 rpm (60 Hz) - NO<sub>x</sub> < 500 mg/mN<sup>3</sup> / 0,4 g/bhp - 50 °C / 122 °F

Acoustic Data

Exhaust outlet noise according to DIN 45635 - 11 - KL2

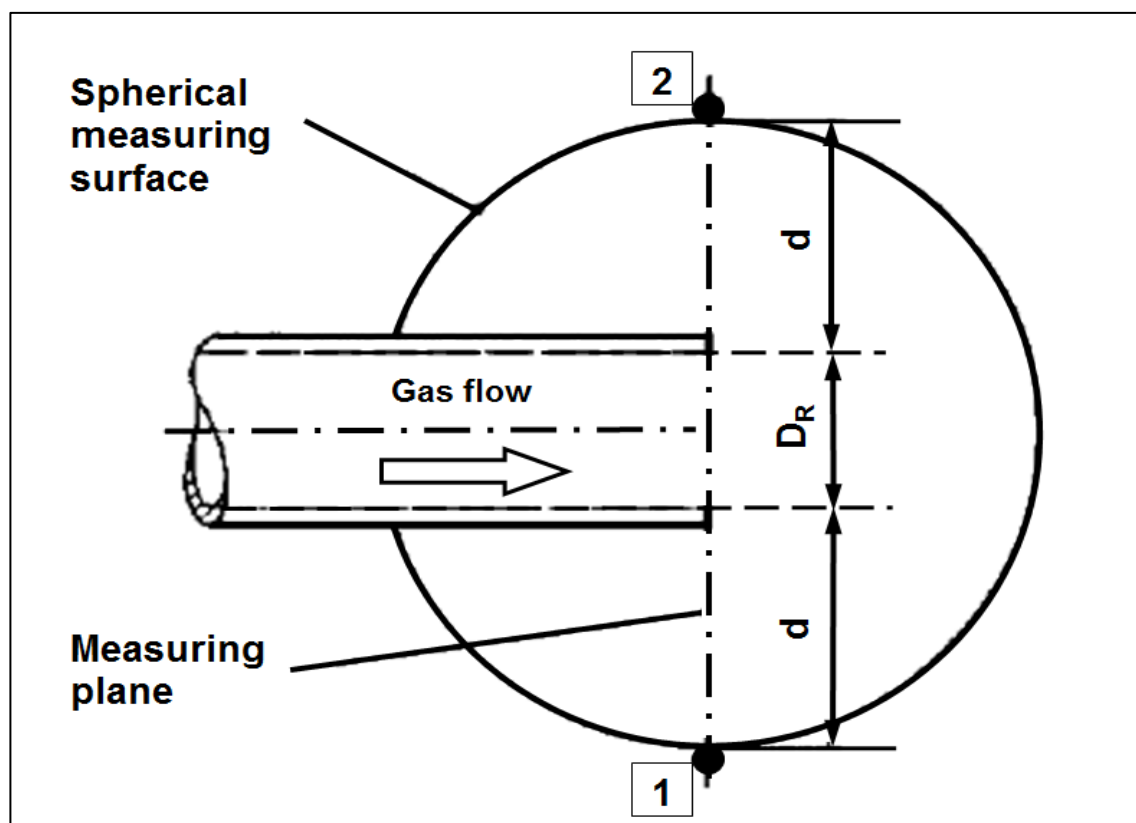
Sound pressure level of single measuring points (Octaves)

A - weighted measuring surface - sound pressure level  
 A - weighted sound power level  
 Surface dimension

L<sub>pA</sub> (re 20 µPa)      dB(A)      104,2  
 L<sub>WA</sub> (re 1 pW)      dB(A)      116,0  
 L<sub>S</sub>                      dB            11,8

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	1-2 av. [dB(A)]
25	46,4	45,9	<b>46,2</b>
31,5	42,3	39,8	<b>41,2</b>
40	50,4	48,4	<b>49,5</b>
50	60,6	58,4	<b>59,6</b>
63	66,8	60,9	<b>64,8</b>
80	84,7	76,3	<b>82,3</b>
100	91,7	84,6	<b>89,5</b>
125	82,2	83,4	<b>82,8</b>
160	85,5	92,0	<b>89,9</b>
200	91,2	95,2	<b>93,6</b>
250	94,7	94,7	<b>94,7</b>
315	98,0	98,4	<b>98,2</b>
400	97,0	92,5	<b>95,3</b>
500	97,2	96,6	<b>96,9</b>
630	91,6	89,4	<b>90,6</b>
800	92,4	87,2	<b>90,5</b>
1000	86,1	82,2	<b>84,6</b>
1250	82,6	80,0	<b>81,5</b>
1600	85,4	82,8	<b>84,3</b>
2000	84,9	83,7	<b>84,3</b>
2500	85,8	82,4	<b>84,4</b>
3150	83,6	80,6	<b>82,4</b>
4000	81,7	79,5	<b>80,7</b>
5000	81,3	77,9	<b>79,9</b>
6300	79,0	77,0	<b>78,1</b>
8000	77,0	73,9	<b>75,7</b>
10000	70,4	67,2	<b>69,1</b>
12500	64,7	61,8	<b>63,5</b>
16000	55,1	54,7	<b>54,9</b>
20000	50,6	51,2	<b>50,9</b>
<b>Sum</b>	<b>104,6</b>	<b>103,8</b>	

Placement of measuring points of exhaust outlet noise



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