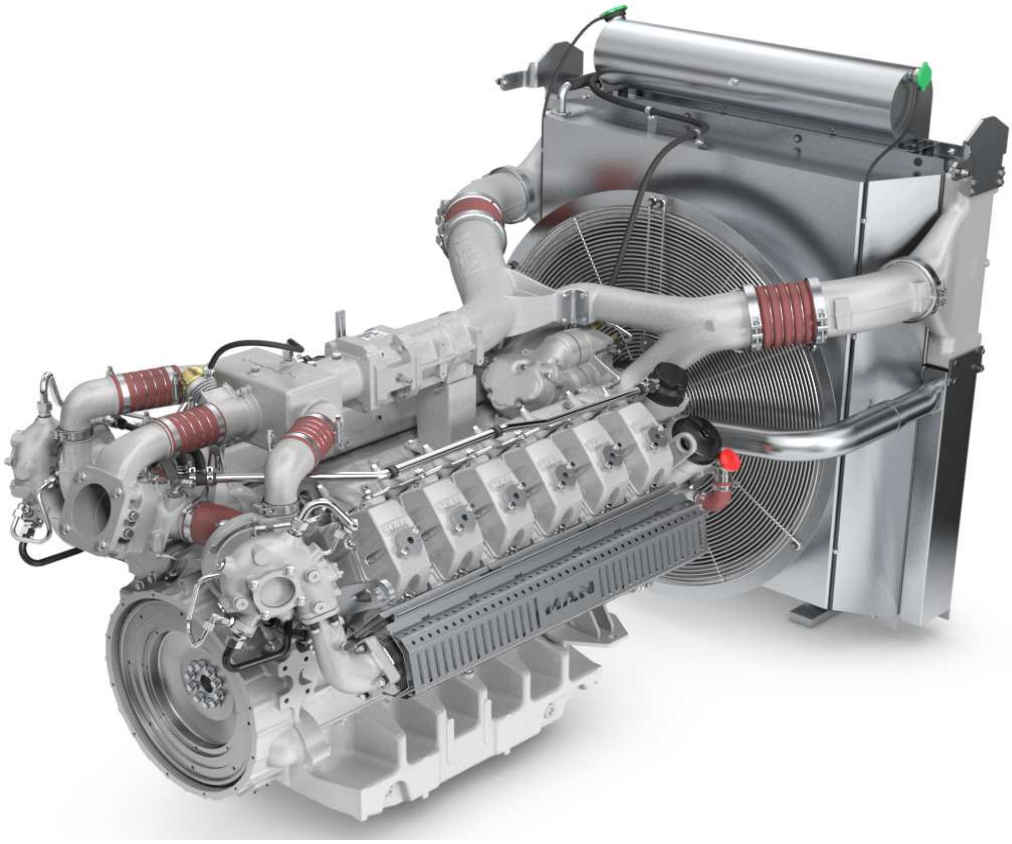
Technical Datasheet

E3262 LE252

(Use of the cooling module 51.06100-7042 up to 35 °C air temperature in front of cooler)



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

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Released	17.03.2022	KG/PW		

Content

Technical Data - Variants of Operation Mode

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:	Water cooled exhaust pipes
Turbocharging:	Pressure oil lubricated turbocharger with water cooled bearing block and water cooled turbine housing
Mixture cooling / engine cooling:	Cooling module with integrated air-intercooler and air-cooled water cooler (51.06100-7042). Air fan (51.06601-0304) driven by engine
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 (J-Gap) 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 mixed gas temperature Intake mixed gas pressure Cooling water temperature Oiltemperature Oilpressure Exhaust temperature
	or optional: Dataloggerbox with CAN - Interface J1939
Documentation:	Installation instructions 51.99496-8324 Repair Manual 51.99598-8506 Operating instructions 51.99587-8047 Maintenance instructions 51.99597-8099 Assembly drawing 51.00512-7177

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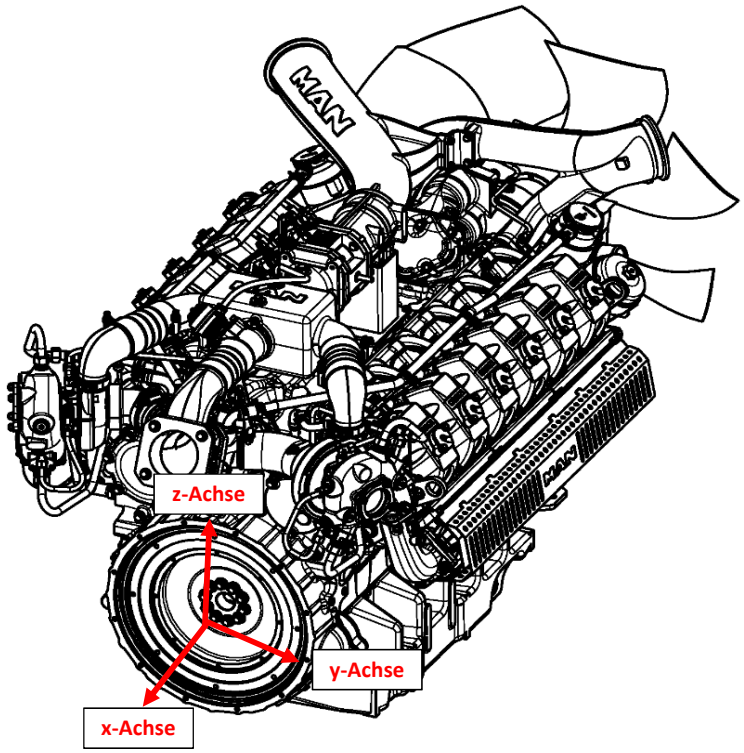
Geometric Data

		metric		standard
Dimensions (with cooling module)				
Engine width	mm	1601	in	63,0
Engine length	mm	2559	in	100,7
Engine height	mm	1787	in	70,4
Weight (with cooling module)				
Engine weight, dry	kg	2014	lb	4440
Gravity data (without cooling module)				
Center of gravity, longitudinal axis Reference: Flywheel housing, rear edge	mm	-699	in	-27,5
Center of gravity, transversal axis Reference: Crankshaft axis in direction of flywheel housing	mm	-14	in	-0,55
Center of gravity, vertical axis Reference: Crankshaft axis in direction of flywheel housing	mm	207	in	8,1
Mass moments of inertia				
Mass moment of inertia, longitudinal axis	kgm²	131	lbin²	447649
Mass moment of inertia, transversal axis	kgm²	347	lbin²	1185757
Mass moment of inertia, vertical axis	kgm²	287	lbin²	980727

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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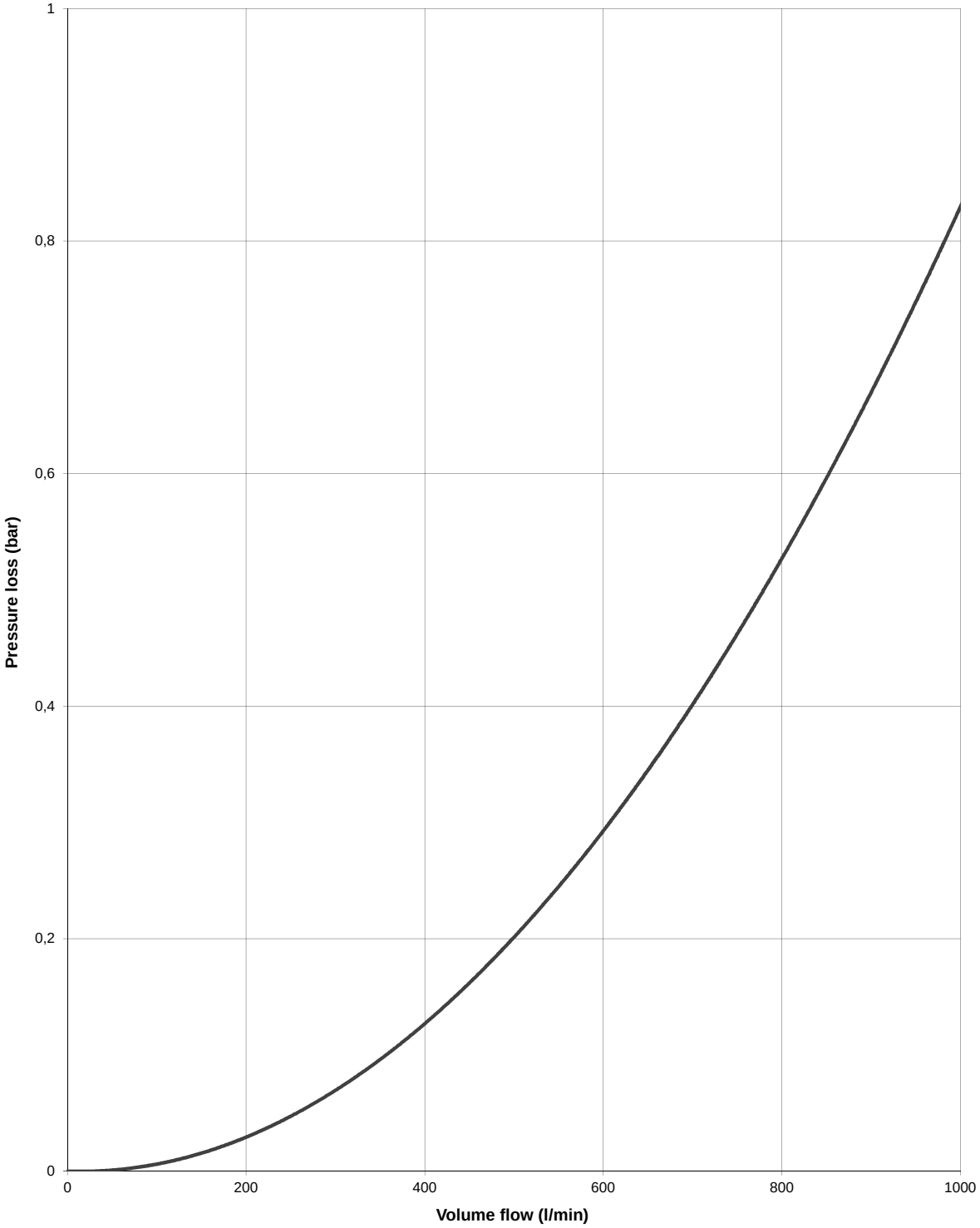
Resistance Level Engine Coolant Circuit (with cooling pump)

metric



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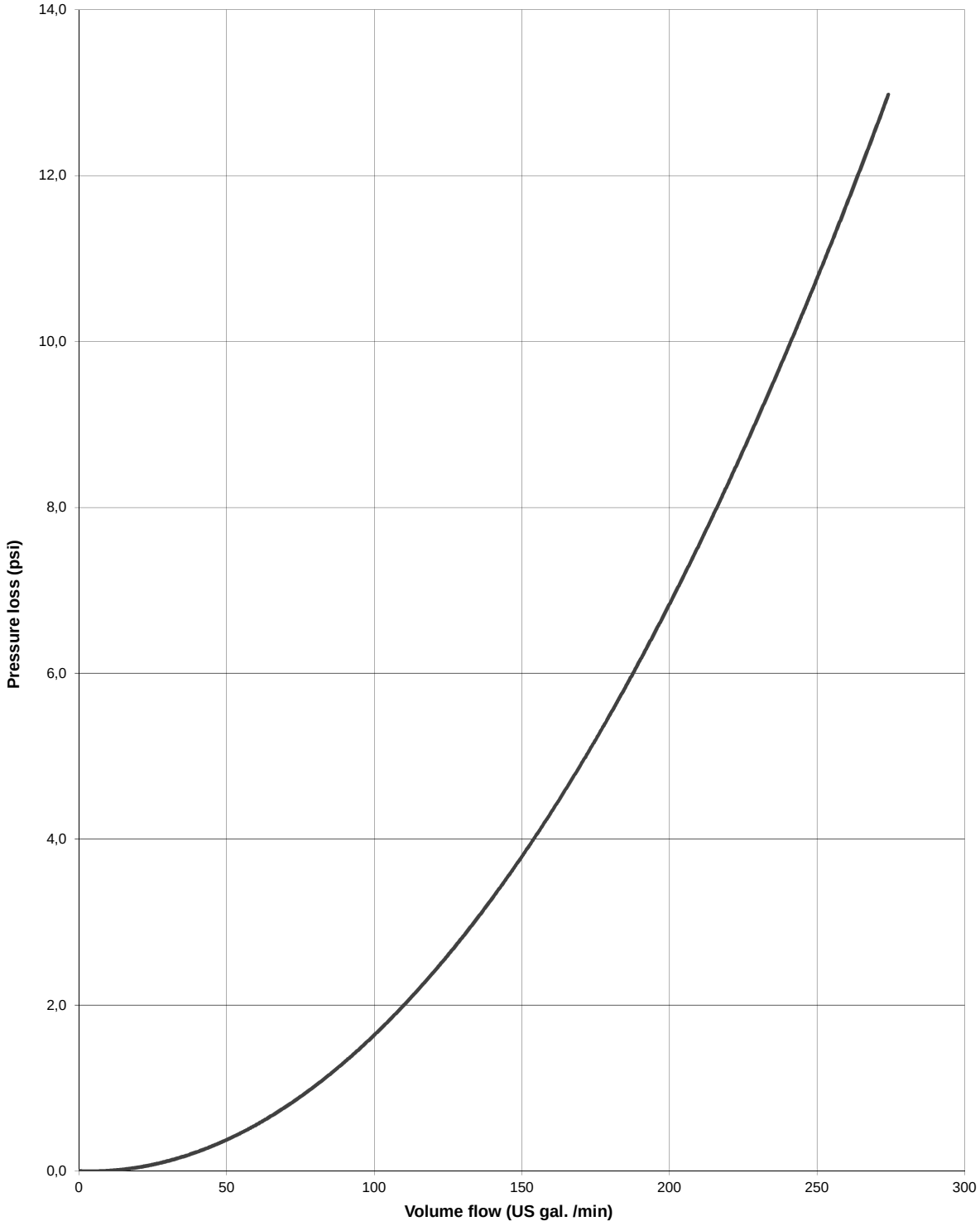
Resistance Level Engine Coolant Circuit (with cooling pump)

standard



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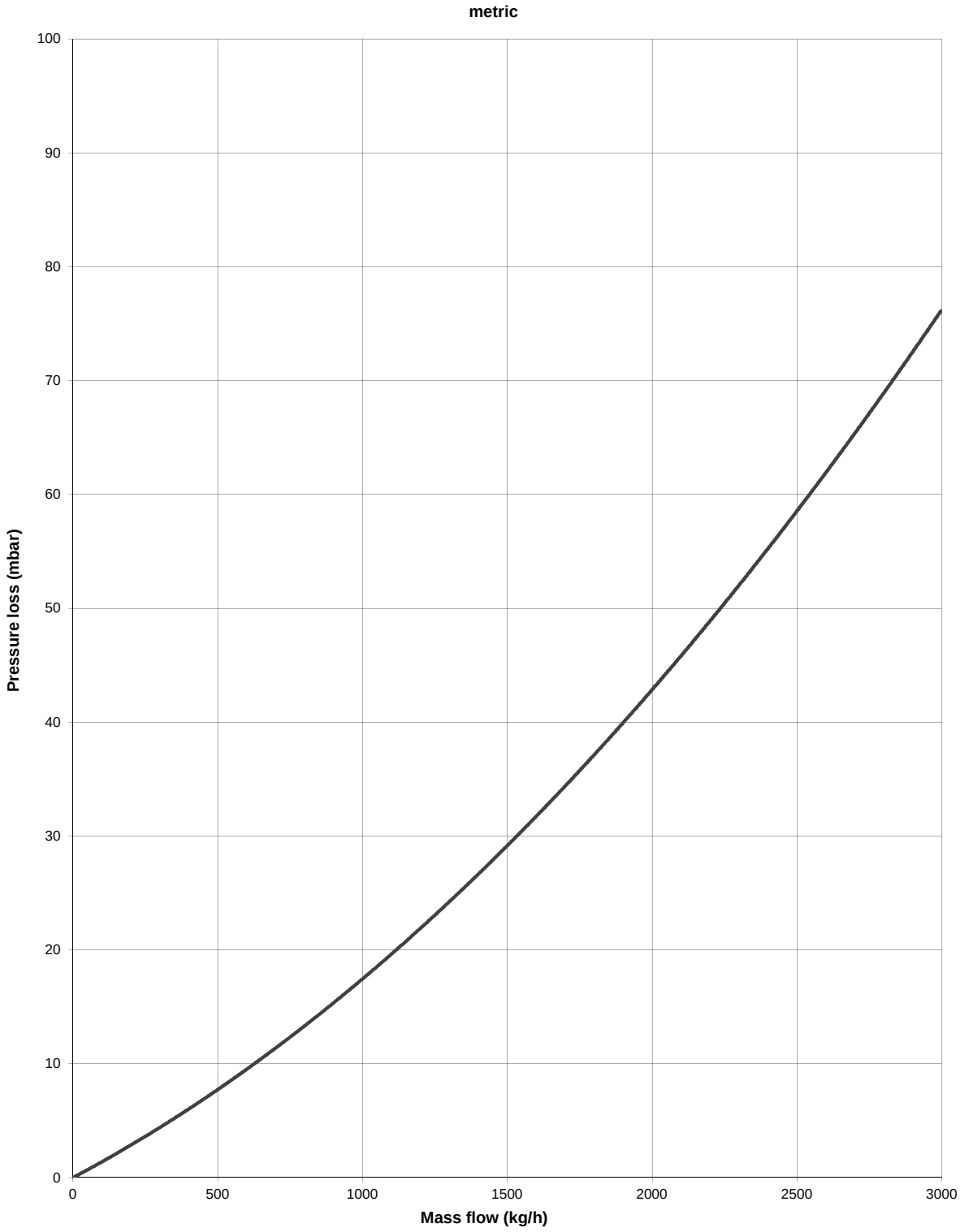
Resistance Level of Mixture Cooler



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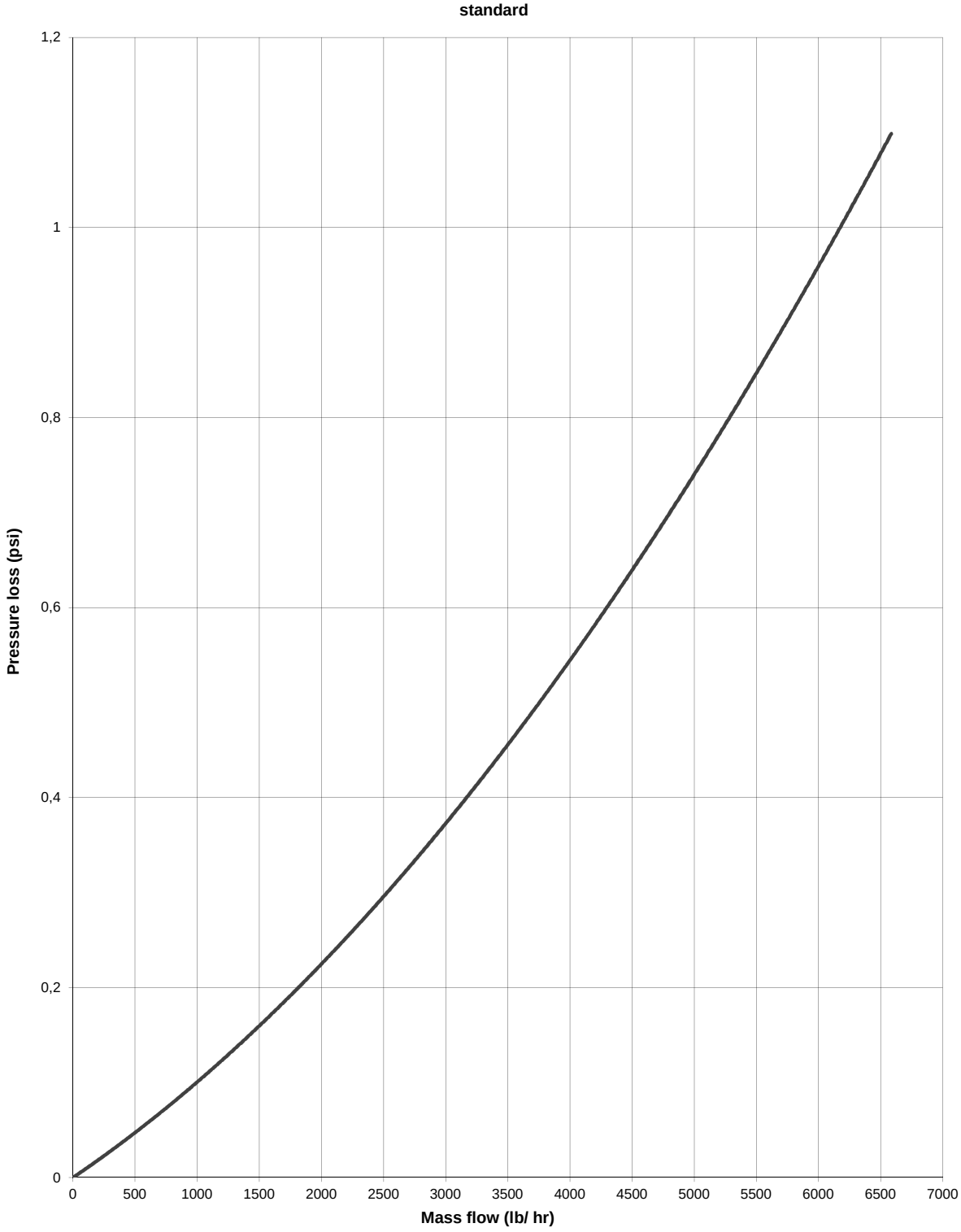
Resistance Level of Mixture Cooler



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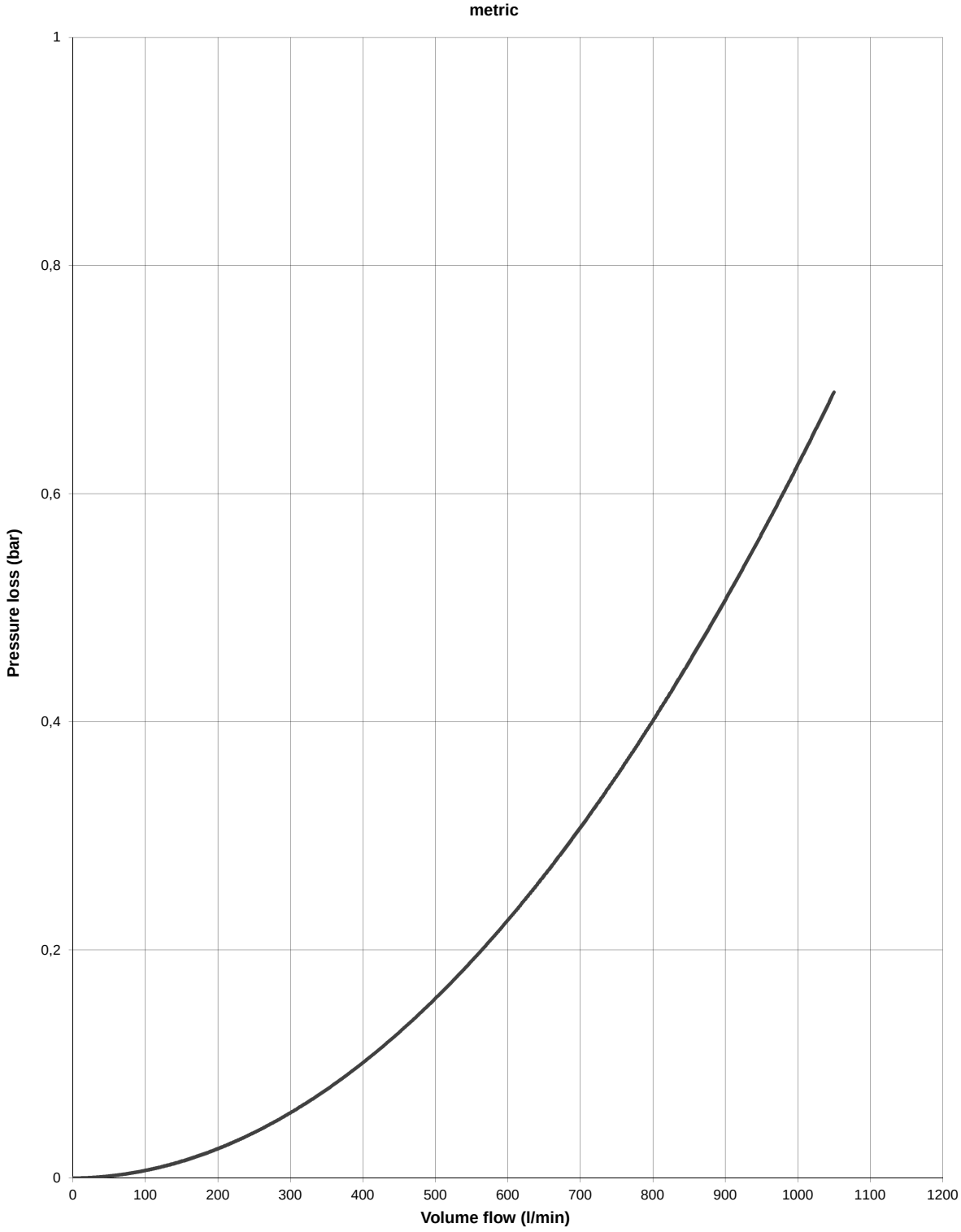
Resistance Level of Water Cooler



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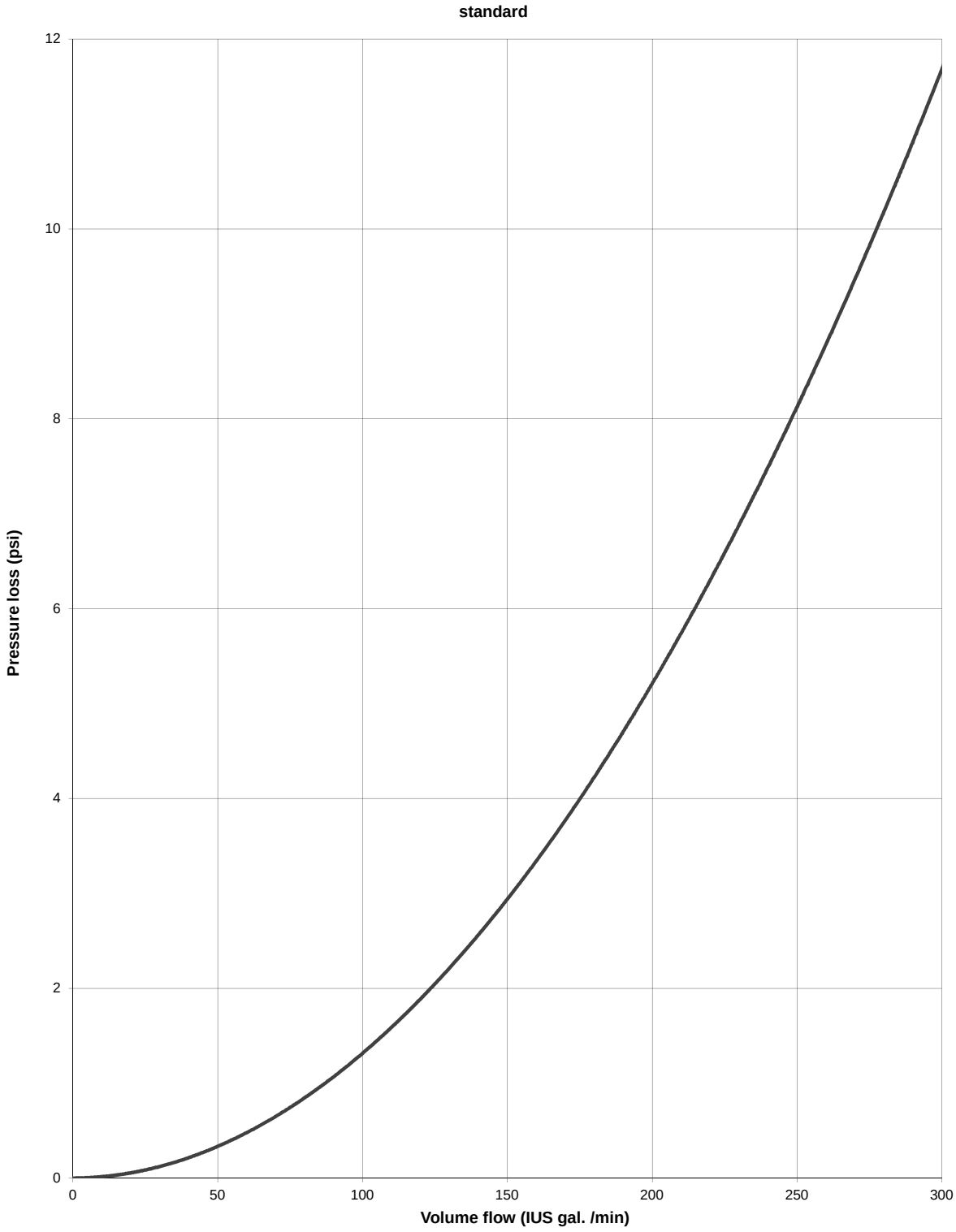
Resistance Level of Water Cooler



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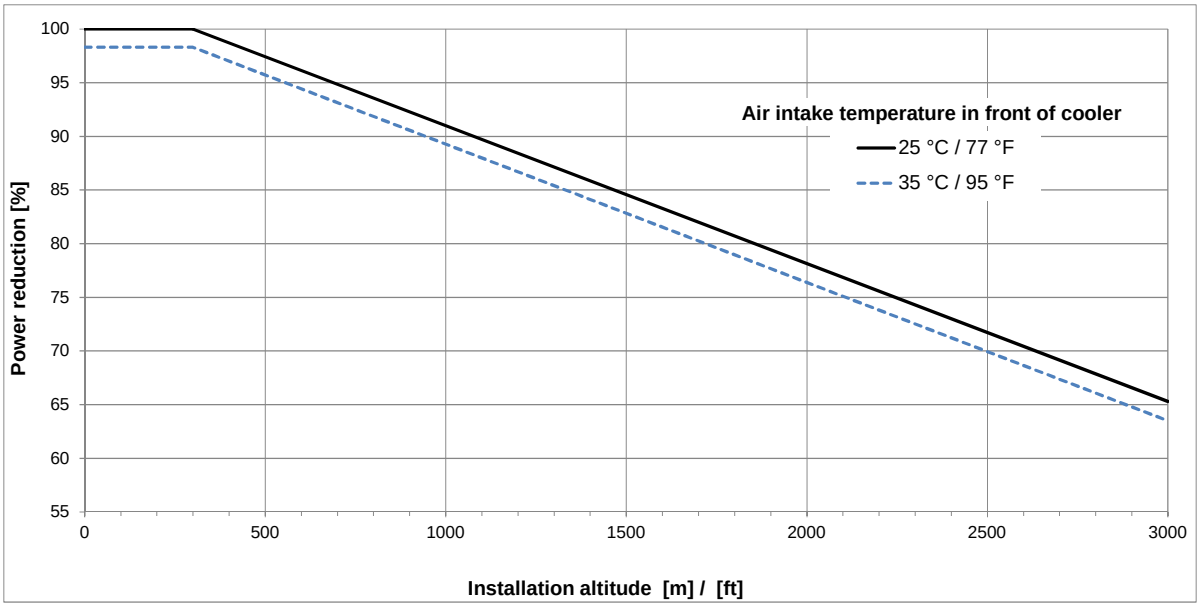
Power Reduction

Power reduction acc. to ISO 3046-1 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 temp. after mixture cooler °C	°F	Power reduction %
≥ 55	131	2
≥ 60	140	6
≥ 65	149	Operation not permitted / Engine stop

Power reduction depending on exhaust gas temperature

Exhaust gas temp. before turbocharger °C	°F	Power reduction %
≥ 690	1274	6
≥ 700	1292	Operation not permitted / Engine stop

Operation with methane numbers < 80 or H_2 - content > 2 Vol-%

Operation with natural gas with methane numbers < 80 or H_2 content > 2 Vol-% requires mandatorily the use of one of the following knock control systems:

- AKS 100, Firma HügliTech
- ARIADNE KC 01, Firma Heinzmann
- DET-16-MAN, Firma Hatraco

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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Acoustic Data (reference E3262LE202)

Intake noise according to DIN 45635 - 11 - KL2

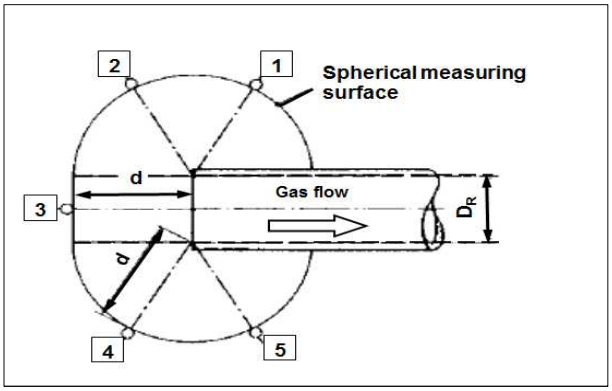
Natural Gas - 1500 rpm (50 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	L_{pA} (re 20 µPa)	dB(A)	98,3
A - weighted sound power level	L_{WA} (re 1 pW)	dB(A)	109,8
Surface dimension	L_S	dB	11,5

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]
25	18,3	18,0	18,2	18,3	18,4
31,5	22,2	22,4	22,1	22,2	22,4
40	24,6	26,1	29,4	28,4	26,9
50	30,0	28,3	33,2	31,7	30,1
63	47,7	46,2	46,8	42,5	45,6
80	62,2	60,0	58,8	56,5	61,9
100	57,6	53,4	48,3	53,8	55,9
125	57,7	57,2	57,4	60,2	60,5
160	66,7	67,4	64,9	66,1	66,1
200	69,6	67,8	66,4	68,9	70,8
250	70,0	66,0	63,9	65,6	72,1
315	72,4	65,3	70,7	66,7	72,5
400	78,8	69,9	78,9	70,0	79,8
500	77,4	73,2	77,2	72,1	77,0
630	81,0	77,5	76,7	78,7	79,7
800	78,7	76,6	78,9	77,7	77,1
1000	77,9	75,6	78,6	75,5	75,3
1250	69,4	69,1	73,7	70,7	69,5
1600	72,5	73,8	82,3	75,9	73,7
2000	73,3	74,0	81,2	75,4	72,8
2500	74,0	75,7	86,7	77,2	72,5
3150	70,8	76,9	86,5	80,6	70,7
4000	71,5	78,2	87,7	82,3	72,9
5000	75,2	79,9	87,2	83,3	77,2
6300	74,2	77,4	85,1	83,3	76,1
8000	72,9	79,1	87,5	83,9	75,8
10000	82,5	91,2	99,0	96,2	85,5
12500	83,9	93,3	98,1	95,9	86,5
16000	63,6	70,6	79,3	73,9	66,7
20000	60,8	66,3	78,5	73,1	64,1
Sum	**90,2**	**96,1**	**102,6**	**99,7**	**91,5**

Placement of measuring points of intake noise



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Acoustic Data (reference E3262LE202)

Engine surface noise according to DIN 45635 - 11 - KL2

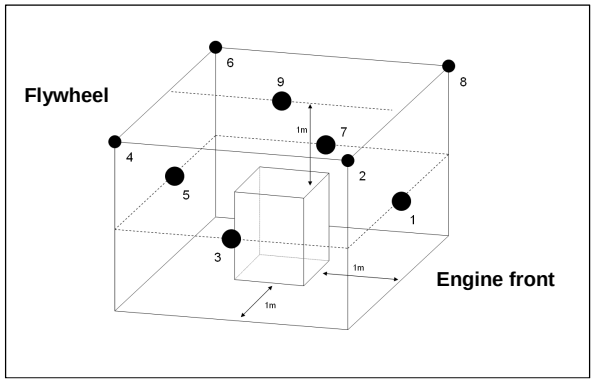
Natural Gas - 1500 rpm (50 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	LpA (re 20 µPa)	dB(A)	92,9
A - weighted sound power level	LWA (re 1 pW)	dB(A)	110,0
Surface dimension	LS	dB	16,8

Frequency [Hz]	MP 1	MP 2	MP 3	MP 4	MP 5	MP 6	MP 7	MP 8	MP 9
	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
25	10,9	6,6	16,5	21,1	23,6	17,2	9,5	13,3	12,7
31,5	8,7	9,9	13,9	16,8	19,9	13,5	11,8	13,3	8,2
40	19,3	21,0	20,0	26,7	30,3	16,1	25,5	23,8	20,6
50	32,8	28,9	37,0	29,6	52,0	39,8	42,1	25,0	38,1
63	41,9	34,4	42,8	35,4	41,8	38,5	47,6	38,5	41,6
80	58,5	52,6	58,2	52,6	53,6	56,7	66,3	57,0	61,8
100	54,0	51,8	55,8	49,4	58,1	46,6	59,0	45,2	58,7
125	54,3	52,4	56,8	50,9	58,6	47,5	54,7	47,9	63,1
160	63,2	55,7	61,9	58,2	67,4	56,7	61,4	57,6	61,2
200	60,1	59,4	60,7	61,2	67,1	59,2	61,8	56,2	64,8
250	62,1	62,9	65,5	64,5	68,2	61,0	65,8	59,8	68,4
315	66,5	64,5	71,9	64,4	71,9	64,3	71,3	66,1	71,1
400	70,6	76,1	76,7	71,5	81,9	69,2	77,6	74,2	73,0
500	74,3	71,6	76,6	73,4	74,5	69,6	76,8	69,6	78,6
630	79,2	72,8	75,7	71,0	73,8	70,8	74,6	72,5	79,1
800	87,3	76,9	78,0	72,2	74,7	73,5	80,5	74,5	82,9
1000	88,4	84,3	79,6	77,7	78,9	75,6	85,9	77,3	80,5
1250	83,3	77,3	82,0	75,4	80,2	75,9	83,5	77,3	79,4
1600	84,3	79,0	85,1	77,3	81,5	77,8	83,1	77,6	81,7
2000	86,3	80,4	84,8	79,9	81,2	80,7	85,4	80,2	86,6
2500	85,0	80,4	86,2	81,2	82,0	81,4	88,1	80,9	89,0
3150	82,7	78,4	83,0	79,6	79,6	79,9	82,5	77,8	85,0
4000	82,3	77,9	83,8	78,3	79,7	78,5	83,3	77,3	84,0
5000	80,4	74,1	79,8	75,5	77,2	74,8	80,0	73,0	82,3
6300	76,4	71,8	78,1	74,0	75,8	73,2	78,9	71,7	80,8
8000	72,7	71,1	77,6	73,2	78,8	72,3	76,9	70,7	79,6
10000	70,2	69,2	75,6	71,8	76,2	70,4	76,2	69,0	80,0
12500	72,4	75,4	80,4	78,5	78,9	75,8	79,9	73,5	89,4
16000	64,3	65,9	72,1	69,3	77,6	69,2	72,0	64,9	71,7
20000	68,6	72,6	77,2	75,3	83,9	75,3	76,7	70,2	74,1
Sum	**95,0**	**90,0**	**93,8**	**89,1**	**92,2**	**88,9**	**94,6**	**88,4**	**96,0**

Placement of measuring points of engine noise surface



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Acoustic Data (reference E3262LE202)

Exhaust outlet noise according to DIN 45635 - 11 - KL2

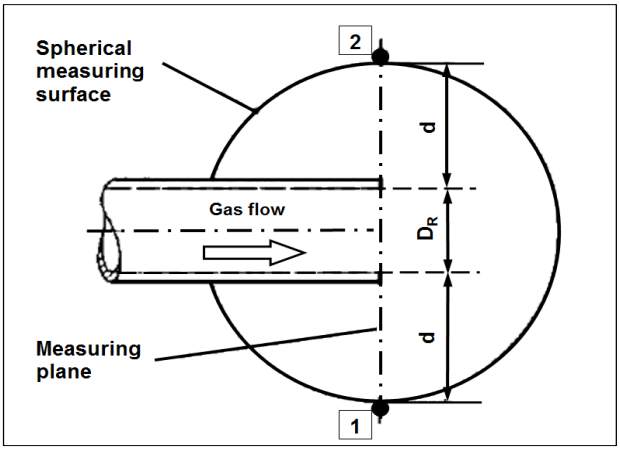
Natural Gas - 1500 rpm (50 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	L_{pA} (re 20 µPa)	dB(A)	109,3
A - weighted sound power level	L_{WA} (re 1 pW)	dB(A)	121,0
Surface dimension	L_S	dB	12,1

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]
25	40,1	39,9
31,5	39,0	41,1
40	49,6	52,1
50	63,9	66,6
63	67,3	70,7
80	87,9	88,1
100	79,7	74,7
125	91,3	88,7
160	100,1	103,4
200	93,0	88,5
250	98,1	96,5
315	100,3	105,4
400	100,4	102,2
500	94,9	95,6
630	91,8	98,2
800	96,0	96,4
1000	97,2	98,6
1250	95,2	93,0
1600	89,7	92,7
2000	87,1	90,8
2500	86,6	87,2
3150	81,7	85,2
4000	78,5	80,0
5000	70,6	73,5
6300	59,8	62,2
8000	47,2	50,9
10000	37,6	42,2
12500	33,4	40,2
16000	30,3	39,0
20000	25,1	33,7
Sum	**107,9**	**110,3**

Placement of measuring points of exhaust outlet noise



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Acoustic Data (reference E3262LE202)

Intake noise according to DIN 45635 - 11 - KL2

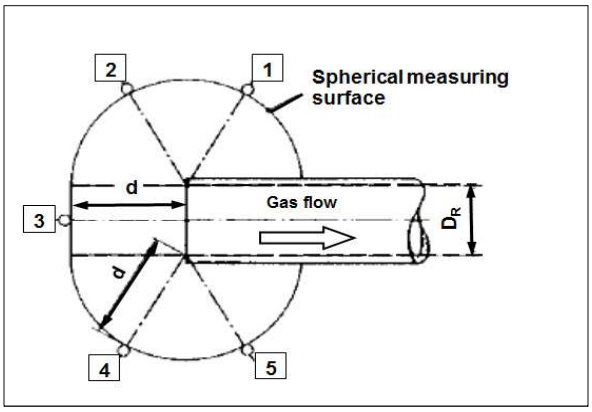
Natural Gas - 1800 rpm (60 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	L_{pA} (re 20 µPa)	dB(A)	96,0
A - weighted sound power level	L_{WA} (re 1 pW)	dB(A)	107,5
Surface dimension	L_S	dB	11,5

Frequency [Hz]	MP 1 [dB(A)]	MP 2 [dB(A)]	MP 3 [dB(A)]	MP 4 [dB(A)]	MP 5 [dB(A)]
25	16,1	16,7	16,8	15,5	15,0
31,5	22,0	23,7	24,7	25,0	25,4
40	22,4	22,7	23,9	23,5	23,6
50	29,1	27,9	29,6	26,8	26,9
63	39,3	36,6	37,7	32,9	35,9
80	52,7	48,5	46,0	46,1	51,1
100	61,4	57,1	50,4	53,4	57,3
125	56,3	54,9	56,7	59,3	59,5
160	66,2	67,0	65,2	66,0	65,8
200	70,4	68,7	67,7	69,4	71,5
250	69,5	65,4	64,7	64,9	71,0
315	71,3	63,5	69,5	65,7	71,5
400	78,5	71,2	78,2	70,9	81,2
500	75,7	72,3	75,2	71,0	75,1
630	80,2	77,2	75,7	78,2	78,6
800	78,6	76,3	78,5	78,8	78,6
1000	78,0	76,0	78,8	75,9	75,8
1250	71,4	70,8	75,4	71,8	71,6
1600	73,0	74,3	81,7	76,1	74,1
2000	75,5	75,7	81,0	76,1	74,8
2500	74,4	77,4	87,3	79,8	73,9
3150	73,9	80,3	88,7	83,6	73,8
4000	73,5	80,2	89,2	83,4	73,7
5000	74,5	79,6	86,0	82,5	75,9
6300	73,7	77,3	83,7	82,2	75,4
8000	72,9	79,2	87,5	83,7	75,4
10000	75,2	84,5	92,1	89,5	78,2
12500	82,4	91,5	96,9	93,8	86,2
16000	67,8	75,0	82,6	78,1	70,7
20000	58,9	65,0	74,4	70,2	62,0
Sum	**89,1**	**94,0**	**100,3**	**96,8**	**90,6**

Placement of measuring points of intake noise



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Acoustic Data (reference E3262LE202)

Engine surface noise according to DIN 45635 - 11 - KL2

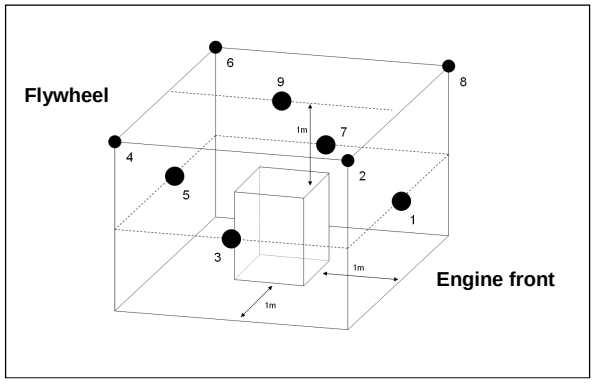
Natural Gas - 1800 rpm (60 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	LpA (re 20 µPa)	dB(A)	93,7
A - weighted sound power level	LWA (re 1 pW)	dB(A)	110,5
Surface dimension	LS	dB	16,8

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

Placement of measuring points of engine noise surface



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Acoustic Data (reference E3262LE202)

Exhaust outlet noise according to DIN 45635 - 11 - KL2

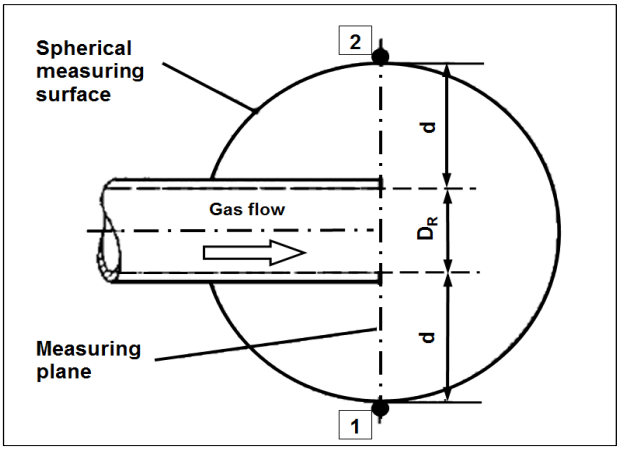
Natural Gas - 1800 rpm (60 Hz) - eff. Power 530 kW - NO_x 0.5 g/Nm³ (5 % O_2)

Sound pressure level of single measuring points ($^1/_3$ Octaves)

A - weighted measuring surface - sound pressure level	L_{pA} (re 20 µPa)	dB(A)	104,2
A - weighted sound power level	L_{WA} (re 1 pW)	dB(A)	116,0
Surface dimension	L_S	dB	11,8

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

Placement of measuring points of exhaust outlet noise



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Information for the radiator (cooling module) and fan

Radiator and fan (back pressure 2 mbar)

Speed	[min^{-1}]	1500	1800
Power	[kW]	530	530
Air consumption	[m^3/h]	39000	49000
Power input for fan	[kW]	21	35
Radiator designed up to (Air temperature at radiator inlet)	[°C]	35	35

Mode of Operation

Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2) - J-Gap Spark Plug

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Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2) - J-Gap Spark Plug

Basic Data

		metric			standard	
Engine Data						
Rated speed	min^{-1}	1500		rpm	1500	
Effective rated power	kW	530		bhp	711	
Max. engine torque at rated speed	Nm	3374		Nm	3374	
Mean effective pressure	bar	16,5		psi	239,1	
Mean piston speed	m/s	7,85		m/s	7,85	
Oil circuit						
Mean oil consumption	g/h	80		lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
Cooling circuit						
Engine cooling water filling quantity	l	85		Imp.gal.	22,5	
- therefrom cooler	l	35		Imp.gal.	9,2	
Engine cooling water operating pressure	bar	1,4		psi	20	
Engine cooling water volume flow rate	l/min	705		ft^3/min	24,9	
Engine cooling water temperature min.	°C	80		°F	176	
Engine cooling water temperature max.	°C	92		°F	198	
Difference inlet - outlet max.	K	7		K	7	
Mixture temperature after throttle valve max.	°C	190		°F	374	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Coolant concentration min. / max.	%	40	50	%	40	50
						44
Pressure conditions						
Intake depression after air filter max. (measured in 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 gas mixer max.		35		psi	0,51	
Pressure loss gas mixture intercooler max.	mbar	65		psi	0,94	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58

Emissions* metric (with 5 % O_2 correction, dry)

Load	%	100	75	50
NO_X	g/Nm^3	0,50	0,50	0,50
CO	g/Nm^3	0,63	0,64	0,64
THC	g/Nm^3	0,50	0,58	0,68
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,32	0,38	0,47
HCHO	mg/Nm^3	52	54	61

Emissions* standard (with 15 % O_2 correction, dry)

Load	%	100	75	50
NO_X	ppmvd	83	81	78
CO	ppmvd	189	190	192
THC	ppmvd	294	343	407
HCHO	ppmvd	14	15	17
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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	07.03.2022	FM	51.99494-7089	B
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Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2) - J-Gap Spark Plug

Flow and Heat Balance

IT 16 °CA / 530 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	16	16	16
Effective rated power[1]	kW	532	397	267
Engine cooling water heat output[2]	kW	291	260	220
Mixture cooling heat	kW	96,3	57,0	27,6
Charge cooler 2 heat output LT	kW	0,0	0,0	0,0
Exhaust heat output (cooled down to 120 °C)	kW	304,4	245,3	185,3
Residual heat output max. incl. radiation heat	kW	50,9	34,3	28,3
Rated thermal input	kW	1362	1060	775
Specific fuel consumption	MJ/kWh	9,23	9,62	13,08
Air-fuel ratio	-	1,61	1,56	1,53
Efficiency Data				
Effective mechanical[1]	%	39,0	37,4	34,5
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(41,4)	(39,7)	(36,5)
Thermal[5]	%	22,4	23,1	23,9
Total	%	61,4	60,5	58,4
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2713	2056	1463
Fuel mass flow rate	kg/h	105,3	82,0	75,0
Exhaust gas mass flow rate, wet	kg/h	2818	2138	1538
Exhaust gas volume flow rate, dry[6]	Nm³/h	1919	1450	1028
Engine cooling water mass flow rate	kg/h	43555	43625	43655
Charge cooler 2 water mass flow rate HT	kg/h	0	0	0
Charge cooling water mass flow rate LT	kg/h	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°C	630	618	602
Measured temperature outlet turbine (averaged)	°C	452	470	488

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45	
	Spec. effective heat capacity c_p	kJ/kg K	3,67	
	Difference (inlet - outlet max.)	K	6	
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"			

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	98,1	98,2	98,3
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	23,4	24,8	25,0
Natural gas conditions	Calorific value	MJ/kg	46,6	46,6	46,6
	Methane number		83,2	83,2	83,2
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100
Provided permissible tolerances acc. to ISO 3046-1:			
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) - NO_x Level 0,50 g/Nm^3 (5 % O_2) - J-Gap Spark Plug

Flow and Heat Balance

IT 16 °CA / 530 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	16	16	16
Effective rated power[1]	bhp	713	532	358
Engine cooling water heat output[2]	bhp	390	348	295
Mixture cooling heat	bhp	129,1	76,4	37,0
Charge cooling water heat output LT	bhp	0,0	0,0	0,0
Exhaust heat output (cooled down to 120 °C)	bhp	408	329	248
Residual heat output max. incl. radiation heat	bhp	68,3	46,0	38,0
Rated thermal input	bhp	1826	1422	1039
Specific fuel consumption	BTU/ bhp-hr	6521	6799	9248
Air-fuel ratio	-	1,61	1,56	1,53
Efficiency Data				
Effective mechanical[1]	%	39,0	37,4	34,5
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(41,4)	(39,7)	(36,5)
Thermal[5]	%	22,4	23,1	23,9
Total	%	61,4	60,5	58,4
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	5981	4533	3225
Fuel mass flow rate	lb/hr	232	181	165
Exhaust gas mass flow rate, wet	lb/hr	6213	4714	3391
Exhaust gas volume flow rate, dry[5]	Nm³/h	1919	1450	1028
Engine cooling water mass flow rate	lb/hr	96022	96177	96244
Charge cooling water mass flow rate HT	lb/hr	0	0	0
Mixture cooling water mass flow rate LT	lb/hr	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1166	1144	1116
Measured temperature outlet turbine (averaged)	°F	846	878	910

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	14,2	14,2	14,3
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	23,4	24,8	25,0
Natural gas conditions	Calorific value	MJ/kg	46,6	46,6	46,6
	Methane number		83,2	83,2	83,2
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Provided permissible tolerances acc. to ISO 3046-1:					
Tolerance for usable heat at rated output		%	±7		
Tolerance for specific fuel consumption at rated output		%	+5		

	Date	Signature	No. of data sheet	Index
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Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2) - J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data		Hz	50		Hz	50	
Ignition timing (±2 °CA)		°CA	16		°CA	16	
Effective rated power		kW	532		bhp	713	
Operating parameters							
Cooling water operating pressure		bar	1,4		psi	20	
Intake depression after air filter max. (measured in 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	
Pressure loss gas mixture intercooler 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	
Standard conditions:	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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Mode of Operation

Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

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Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Basic Data

		metric		standard	
Engine Data					
Rated speed	min^{-1}	1800	rpm	1800	
Effective rated power	kW	530	bhp	711	
Max. engine torque at rated speed	Nm	2812	Nm	2812	
Mean effective pressure	bar	13,7	psi	198,7	
Mean piston speed	m/s	9,42	m/s	9,42	
Oil circuit					
Mean oil consumption	g/h	80	lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180	lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42 90	Imp.gal.	11	24
Cooling circuit					
Engine cooling water filling quantity	l	85	Imp.gal.	22,5	
- therefrom cooler	l	35	Imp.gal.	9,2	
Engine cooling water operating pressure	bar	1,5	psi	22	
Engine cooling water volume flow rate	l/min	841	ft^3/min	29,7	
Engine cooling water temperature min.	°C	80	°F	176	
Engine cooling water temperature max.	°C	92	°F	198	
Difference inlet - outlet max.	K	7	K	7	
Mixture temperature after throttle valve max.	°C	200	°F	392	
Mixture temperature after mixture cooler max.	°C	50	°F	122	
Coolant concentration min. / max.	%	40 50	%	40	50
Pressure conditions					
Intake depression after air filter max. (measured in 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 gas mixer max.		45	psi	0,65	
Pressure loss gas mixture intercooler max.	mbar	80	psi	1,16	
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07	0,58

Emissions* metric (with 5 % O_2 correction, dry)

Load	**%**	100	75	50
NO_X	g/Nm^3	0,50	0,50	0,50
CO	g/Nm^3	0,72	0,71	0,68
THC	g/Nm^3	0,64	0,73	0,83
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,40	0,47	0,55
HCHO	mg/Nm^3	64	67	73

Emissions* standard (with 15 % O_2 correction, dry)

Load	**%**	100	75	50
NO_X	ppmvd	82	79	81
CO	ppmvd	215	211	203
THC	ppmvd	378	433	494
HCHO	ppmvd	18	19	20
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 22 °CA / 530 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	22	22	22
Effective rated power[1]	kW	531	400	267
Engine cooling water heat output[2]	kW	331	294	238
Mixture cooling heat	kW	111,6	70,0	35,7
Exhaust heat output (cooled down to 120 °C)	kW	323,0	259,0	200,4
Residual heat output max. incl. radiation heat	kW	67,0	63,6	61,0
Rated thermal input	kW	1459	1160	855
Specific fuel consumption	MJ/kWh	9,96	10,48	11,56
Air-fuel ratio[3]	-	1,63	1,58	1,54
Efficiency Data				
Effective mechanical[1]	%	36,4	34,5	31,2
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(38,6)	(36,6)	(33,1)
Thermal[5]	%	22,1	22,3	23,4
Total	%	58,5	56,8	54,7
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2809	2278	1407
Fuel mass flow rate	kg/h	113,7	90,3	66,4
Exhaust gas mass flow rate, wet	kg/h	2923	2368	1474
Exhaust gas volume flow rate, dry[6]	Nm³/h	1992	1615	987
Engine cooling water mass flow rate	kg/h	51965	52060	52093
Temperatures				
Measured temperature inlet turbine (averaged)	°C	627	616	599
Measured temperature outlet turbine (averaged)	°C	441	457	475

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	95,6	95,7	95,8
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	28,0	29,7	27,0
Natural gas conditions	Calorific value	MJ/kg	46,5	46,5	46,5
	Methane number		83,5	83,5	83,5
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100
Provided permissible tolerances acc. to ISO 3046-1:			
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) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 22 °CA / 530 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	22	22	22
Effective rated power[1]	bhp	712	536	358
Engine cooling water heat output[2]	bhp	444	395	319
Mixture cooling heat	bhp	149,7	93,9	47,9
Exhaust heat output (cooled down to 120 °C)	bhp	433	347	269
Residual heat output max. incl. radiation heat	bhp	89,9	85,3	81,8
Rated thermal input	bhp	1957	1556	1147
Specific fuel consumption	BTU/ bhp-hr	7039	7405	8174
Air-fuel ratio[3]	-	1,63	1,58	1,54
Efficiency Data				
Effective mechanical[1]	%	36,4	34,5	31,2
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(38,6)	(36,6)	(33,1)
Thermal[5]	%	22,1	22,3	23,4
Total	%	58,5	56,8	54,7
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	6193	5022	3102
Fuel mass flow rate	lb/hr	251	199	146
Exhaust gas mass flow rate, wet	lb/hr	6443	5221	3249
Exhaust gas volume flow rate, dry[5]	Nm³/h	1992	1615	987
Engine cooling water mass flow rate	lb/hr	114564	114774	114846
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1161	1141	1110
Measured temperature outlet turbine (averaged)	°F	826	855	887

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45
	Spec. effective heat capacity c_p	kJ/kg K	3,67
	Difference (inlet - outlet max.)	K	6

[3] Air-fuel ratio Measured with ETAS LA 4_E. Please see chapter "Values / limits"

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	13,9	13,9	13,9
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	28,0	29,7	27,0
Natural gas conditions	Calorific value	MJ/kg	46,5	46,5	46,5
	Methane number		83,5	83,5	83,5
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32
	Atmospheric pressure abs.	psi	14,5
Provided permissible tolerances acc. to ISO 3046-1:			
Tolerance for usable heat at rated output		%	±7
Tolerance for specific fuel consumption at rated output		%	+5

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Released	17.03.2022	KG/PW		

Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data		Hz	60		Hz	60	
Ignition timing (±2 °CA)		°CA	22		°CA	22	
Effective rated power		kW	531		bhp	712	
Operating parameters							
Cooling water operating pressure		bar	1,5		psi	22	
Intake depression after air filter max. (measured in 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	45		psi	0,65	
Pressure loss gas mixture intercooler max.		mbar	80		psi	1,16	
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	
Standard conditions:	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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Released	17.03.2022	KG/PW		

Mode of Operation

Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

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Released	17.03.2022	KG/PW		

Natural Gas
1500 rpm (50 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Basic Data

		metric		standard	
Engine Data					
Rated speed	min^{-1}	1500	rpm	1500	
Effective rated power	kW	480	bhp	644	
Max. engine torque at rated speed	Nm	3056	Nm	3056	
Mean effective pressure	bar	14,7	psi	213,2	
Mean piston speed	m/s	7,85	m/s	7,85	
Oil circuit					
Mean oil consumption	g/h	80	lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180	lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42 90	Imp.gal.	11	24
Cooling circuit					
Engine cooling water filling quantity	l	85	Imp.gal.	22,5	
- therefrom cooler	l	35	Imp.gal.	9,2	
Mixture cooling water filling quantity LT	l	15	Imp.gal.	0,4	
Engine cooling water operating pressure	bar	1,5	psi	22	
Engine cooling water volume flow rate	l/min	703	ft^3/min	24,8	
Engine cooling water temperature min.	°C	80	°F	176	
Engine cooling water temperature max.	°C	92	°F	198	
Difference inlet - outlet max.	K	7	K	7	
Mixture temperature after throttle valve max.	°C	190	°F	374	
Mixture temperature after mixture cooler max.	°C	50	°F	122	
Coolant concentration min. / max.	%	40 50	%	40	50 44
Pressure conditions					
Intake depression after air filter max. (measured in 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 gas mixer max.		35	psi	0,51	
Pressure loss gas mixture intercooler max.	mbar	65	psi	0,94	
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07	0,58

Emissions* metric (with 5 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	g/Nm^3	0,25	0,25	0,25
CO	g/Nm^3	0,67	0,66	0,63
THC	g/Nm^3	0,61	0,68	0,67
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,40	0,46	0,46
HCHO	mg/Nm^3	56	57	64

Emissions* standard (with 15 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	ppmvd	46	46	48
CO	ppmvd	200	197	187
THC	ppmvd	364	404	397
HCHO	ppmvd	16	16	18
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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 rpm (50 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 14 °CA / 480 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	14	14	14
Effective rated power[1]	kW	476	360	241
Engine cooling water heat output[2]	kW	287	254	210
Mixture cooling heat	kW	89,0	54,2	24,8
Exhaust heat output (cooled down to 120 °C)	kW	306,2	248,9	184,4
Residual heat output max. incl. radiation heat	kW	89,0	72,6	63,2
Rated thermal input	kW	1331	1055	770
Specific fuel consumption	MJ/kWh	10,06	10,54	11,50
Air-fuel ratio	-	1,58	1,54	1,49
Efficiency Data				
Effective mechanical[1]	%	35,8	34,2	31,3
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(37,9)	(36,2)	(33,2)
Thermal[5]	%	23,0	23,6	24,0
Total	%	58,8	57,7	55,3
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2572	1992	1406
Fuel mass flow rate	kg/h	101,9	80,8	58,9
Exhaust gas mass flow rate, wet	kg/h	2674	2073	1465
Exhaust gas volume flow rate, dry[6]	Nm³/h	1778	1443	938
Engine cooling water mass flow rate	kg/h	43373	43474	43559
Mixture cooling water mass flow rate HT	kg/h	0	0	0
Mixture cooling water mass flow rate LT	kg/h	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°C	644	631	612
Measured temperature outlet turbine (averaged)	°C	471	485	501

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	97,9	97,9	98,0
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	46,6	45,0	44,0
Natural gas conditions	Calorific value	MJ/kg	47,0	47,0	47,0
	Methane number		85,4	85,4	85,4
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0	
	Atmospheric pressure abs.	kPa	100	
Provided permissible tolerances acc. to ISO 3046-1:				
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) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 14 °CA / 480 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	14	14	14
Effective rated power[1]	bhp	639	483	323
Engine cooling water heat output[2]	bhp	385	341	282
Mixture cooling heat	bhp	119,4	72,7	33,3
Mixture cooling water heat output LT[2]	bhp	0,0	0,0	0,0
Exhaust heat output (cooled down to 120 °C)	bhp	411	334	247
Residual heat output max. incl. radiation heat	bhp	119,3	97,4	84,7
Rated thermal input	bhp	1785	1415	1033
Specific fuel consumption	BTU/ bhp-hr	7111	7450	8125
Air-fuel ratio	-	1,58	1,54	1,49
Efficiency Data				
Effective mechanical[1]	%	35,8	34,2	31,3
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(37,9)	(36,2)	(33,2)
Thermal[5]	%	23,0	23,6	24,0
Total	%	58,8	57,7	55,3
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	5670	4392	3101
Fuel mass flow rate	lb/hr	225	178	130
Exhaust gas mass flow rate, wet	lb/hr	5895	4570	3231
Exhaust gas volume flow rate, dry[5]	Nm³/h	1778	1443	938
Engine cooling water mass flow rate	lb/hr	95622	95844	96031
Mixture cooling water mass flow rate HT	lb/hr	0	0	0
Mixture cooling water mass flow rate LT	lb/hr	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1191	1167	1134
Measured temperature outlet turbine (averaged)	°F	879	906	934

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	14,2	14,2	14,2
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	46,6	45,0	44,0
Natural gas conditions	Calorific value	MJ/kg	47,0	47,0	47,0
	Methane number		85,4	85,4	85,4
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32	
	Atmospheric pressure abs.	psi	14,5	
Provided permissible tolerances acc. to ISO 3046-1:				
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) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data	Hz	50			Hz	50	
Ignition timing (±2 °CA)	°CA	14			°CA	14	
Effective rated power	kW	476			bhp	639	
Operating parameters							
Cooling water operating pressure	bar	1,5			psi	22	
Intake depression after air filter max. (measured in 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	
Pressure loss gas mixture intercooler 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
Standard conditions:	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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Mode of Operation

Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

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Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Basic Data

		metric			standard	
Engine Data						
Rated speed	min^{-1}	1800		rpm	1800	
Effective rated power	kW	480		bhp	644	
Max. engine torque at rated speed	Nm	2547		Nm	2547	
Mean effective pressure	bar	12,4		psi	179,8	
Mean piston speed	m/s	9,42		m/s	9,42	
Oil circuit						
Mean oil consumption	g/h	80		lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180		lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42	90	Imp.gal.	11	24
Cooling circuit						
Engine cooling water filling quantity	l	85		Imp.gal.	22,5	
- therefrom cooler	l	35		Imp.gal.	9,2	
Mixture cooling water filling quantity LT	l	3		Imp.gal.	0,8	
Engine cooling water operating pressure	bar	1,5		psi	22	
Engine cooling water volume flow rate min.	l/min	841		ft^3/min	29,7	
Engine cooling water temperature min.	°C	80		°F	176	
Engine cooling water temperature max.	°C	92		°F	198	
Difference inlet - outlet max.	K	7		K	7	
Mixture temperature after throttle valve max.	°C	200		°F	392	
Mixture temperature after mixture cooler max.	°C	50		°F	122	
Mixture cooling water inlet temperature HT	°C	83		°F	181,4	
Mixture cooling water volume flow rate HT	l/min	0		ft^3/min	0,0	
Difference inlet - outlet max. HT max.	K	5		K	5	
Mixture cooling water inlet temperature LT	°C	44		°F	111,2	
Mixture cooling water volume flow rate LT	l/min	0		ft^3/min	0,0	
Difference inlet - outlet LT max.	K	5		K	5	
Coolant concentration min. / max.	%	40	50	%	40	50
						44
Pressure conditions						
Intake depression after air filter max. (measured in 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 gas mixer max.		45		psi	0,65	
Pressure loss gas mixture intercooler max.	mbar	75		psi	1,09	
Exhaust back pressure min. / max.	mbar	5	40	psi	0,07	0,58

Emissions* metric (with 5 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	g/Nm^3	0,25	0,25	0,25
CO	g/Nm^3	0,75	0,70	0,65
THC	g/Nm^3	0,63	0,70	0,71
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,41	0,47	0,49
HCHO	mg/Nm^3	68	67	65

Emissions* standard (with 15 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	ppmvd	48	46	48
CO	ppmvd	223	208	194
THC	ppmvd	376	414	423
HCHO	ppmvd	19	19	18
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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 rpm (60 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 16 °CA / 480 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	16	16	16
Effective rated power[1]	kW	481	361	241
Engine cooling water heat output[2]	kW	321	295	245
Mixture cooling heat	kW	105,6	66,7	33,1
Mixture cooling water heat output LT[5]	kW	0,0	0,0	0,0
Exhaust heat output (cooled down to 120 °C)	kW	335,9	277,7	212,3
Residual heat output max. incl. radiation heat	kW	104,7	82,9	75,1
Rated thermal input	kW	1439	1155	858
Specific fuel consumption	MJ/kWh	10,78	11,51	12,83
Air-fuel ratio[3]	-	1,60	1,55	1,51
Efficiency Data				
Effective mechanical[1]	%	33,4	31,3	28,1
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(35,4)	(33,2)	(29,8)
Thermal[5]	%	23,3	24,0	24,7
Total	%	56,7	55,3	52,8
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2804	2194	1588
Fuel mass flow rate	kg/h	111,8	89,7	66,7
Exhaust gas mass flow rate, wet	kg/h	2916	2284	1655
Exhaust gas volume flow rate, dry[6]	Nm³/h	1984	1548	1117
Engine cooling water mass flow rate	kg/h	51991	52101	52123
Mixture cooling water mass flow rate HT	kg/h	0	0	0
Mixture cooling water mass flow rate LT	kg/h	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°C	661	648	572
Measured temperature outlet turbine (averaged)	°C	472	491	509

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	97,8	97,9	98,0
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	37,0	37,0	37,0
Natural gas conditions	Calorific value	MJ/kg	46,3	46,3	46,3
	Methane number		84,8	84,8	84,8
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0	
	Atmospheric pressure abs.	kPa	100	
Provided permissible tolerances acc. to ISO 3046-1:				
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) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 16 °CA / 480 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	16	16	16
Effective rated power[1]	bhp	645	485	323
Engine cooling water heat output[2]	bhp	430	395	329
Mixture cooling heat	bhp	141,6	89,4	44,4
Mixture cooling water heat output LT[2]	bhp	0,0	0,0	0,0
Exhaust heat output (cooled down to 120 °C)	bhp	450	372	285
Residual heat output max. incl. radiation heat	bhp	140,4	111,2	100,6
Rated thermal input	bhp	1930	1549	1151
Specific fuel consumption	BTU/ bhp-hr	7617	8132	9067
Air-fuel ratio[3]	-	1,60	1,55	1,51
Efficiency Data				
Effective mechanical[1]	%	33,4	31,3	28,1
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(35,4)	(33,2)	(29,8)
Thermal[5]	%	23,3	24,0	24,7
Total	%	56,7	55,3	52,8
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	6183	4837	3501
Fuel mass flow rate	lb/hr	247	198	147
Exhaust gas mass flow rate, wet	lb/hr	6429	5035	3648
Exhaust gas volume flow rate, dry[5]	Nm³/h	1984	1548	1117
Engine cooling water mass flow rate	lb/hr	114621	114864	114911
Mixture cooling water mass flow rate HT	lb/hr	0	0	0
Mixture cooling water mass flow rate LT	lb/hr	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1221	1199	1062
Measured temperature outlet turbine (averaged)	°F	882	916	948

Reference setting: Gasmixer Heinzmann VE 1251-12x9,0/12x12,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	14,2	14,2	14,2
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	37,0	37,0	37,0
Natural gas conditions	Calorific value	MJ/kg	46,3	46,3	46,3
	Methane number		84,8	84,8	84,8
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32		
	Atmospheric pressure abs.	psi	14,5		
Provided permissible tolerances acc. to ISO 3046-1:					
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	07.03.2022	FM	51.99494-7089	B
Released	17.03.2022	KG/PW		

Natural Gas
1800 rpm (60 Hz) - NO_x Level 0,25 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data	Hz	60			Hz	60	
Ignition timing (±2 °CA)	°CA	16			°CA	16	
Effective rated power	kW	481			bhp	645	
Operating parameters							
Cooling water operating pressure	bar	1,5			psi	22	
Intake depression after air filter max. (measured in 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	45			psi	0,65	
Pressure loss gas mixture intercooler max.	mbar	75			psi	1,09	
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	
Standard conditions:	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	07.03.2022	FM	51.99494-7089	B
Released	17.03.2022	KG/PW		

Mode of Operation

Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

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Created	07.03.2022	FM	51.99494-7089	B
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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Basic Data

		metric		standard	
Engine Data					
Rated speed	min^{-1}	1500	rpm	1500	
Effective rated power	kW	530	bhp	711	
Max. engine torque at rated speed	Nm	3374	Nm	3374	
Mean effective pressure	bar	16,3	psi	236,4	
Mean piston speed	m/s	7,85	m/s	7,85	
Oil circuit					
Mean oil consumption	g/h	80	lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180	lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42 90	Imp.gal.	11 24	
Cooling circuit					
Engine cooling water filling quantity	l	85	Imp.gal.	22,5	
- therefrom cooler	l	35	Imp.gal.	9,2	
Engine cooling water operating pressure	bar	1,4	psi	20	
Engine cooling water volume flow rate	l/min	704	ft^3/min	24,9	
Engine cooling water temperature min.	°C	80	°F	176	
Engine cooling water temperature max.	°C	92	°F	198	
Difference inlet - outlet max.	K	7	K	7	
Mixture temperature after throttle valve max.	°C	190	°F	374	
Mixture temperature after mixture cooler max.	°C	50	°F	122	
Coolant concentration min. / max.	%	40 50	%	40 50 44	
Pressure conditions					
Intake depression after air filter max. (measured in 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 gas mixer max.		60	psi	0,87	
Pressure loss gas mixture intercooler max.	mbar	55	psi	0,80	
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07 0,58	

Emissions* metric (with 5 % O_2 correction, dry)

Load	%	100	75	50
NO_X	g/Nm^3	0,50	0,50	0,50
CO	g/Nm^3	0,59	0,60	0,60
THC	g/Nm^3	0,44	0,55	0,65
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,32	0,41	0,50
HCHO	mg/Nm^3	47	52	57

Emissions* standard (with 15 % O_2 correction, dry)

Load	%	100	75	50
NO_X	ppmvd	82	74	75
CO	ppmvd	175	179	179
THC	ppmvd	258	325	385
HCHO	ppmvd	13	15	16
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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	07.03.2022	FM	51.99494-7089	B
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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 20 °CA / 530 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	20	20	20
Effective rated power[1]	kW	529	402	266
Engine cooling water heat output[2]	kW	296	261	213
Mixture cooling heat	kW	91,5	56,8	26,2
Exhaust heat output (cooled down to 120 °C)	kW	312,1	257,0	191,4
Residual heat output max. incl. radiation heat	kW	58,1	39,0	25,6
Rated thermal input	kW	1373	1084	770
Specific fuel consumption	MJ/kWh	9,46	9,82	10,55
Air-fuel ratio	-	1,45	1,42	1,37
Efficiency Data				
Effective mechanical[1]	%	38,5	37,1	34,5
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(40,9)	(39,3)	(36,6)
Thermal[5]	%	22,7	23,7	24,9
Total	%	61,2	60,8	59,4
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2473	1933	1357
Fuel mass flow rate	kg/h	288,0	227,5	162,2
Exhaust gas mass flow rate, wet	kg/h	2761	2161	1516
Exhaust gas volume flow rate, dry[6]	Nm³/h	1858	1446	1410
Engine cooling water mass flow rate	kg/h	43536	43653	43687
Mixture cooling water mass flow rate HT	kg/h	0	0	0
Mixture cooling water mass flow rate LT	kg/h	0	0	0
Temperatures				
Measured temperature inlet turbine (averaged)	°C	640	627	611
Measured temperature outlet turbine (averaged)	°C	465	480	499

Reference setting: Gasmixer Heinzmann VE-1001-24-S22-12x9,8/12x11,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	97,6	97,6	97,7
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	22,0	20,6	18,6
Natural gas conditions	Calorific value	MJ/kg	17,2	17,2	17,1
	Methane number		143,0	143,0	143,0
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100
Provided permissible tolerances acc. to ISO 3046-1:			
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	07.03.2022	FM	51.99494-7089	B
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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 20 °CA / 530 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	20	20	20
Effective rated power[1]	bhp	709	539	357
Engine cooling water heat output[2]	bhp	397	350	285
Mixture cooling heat	bhp	122,7	76,2	35,1
Exhaust heat output (cooled down to 120 °C)	bhp	419	345	257
Residual heat output max. incl. radiation heat	bhp	77,9	52,3	34,4
Rated thermal input	bhp	1842	1454	1033
Specific fuel consumption	BTU/ bhp-hr	6686	6944	7456
Air-fuel ratio	-	1,45	1,42	1,37
Efficiency Data				
Effective mechanical[1]	%	38,5	37,1	34,5
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(40,9)	(39,3)	(36,6)
Thermal[5]	%	22,7	23,7	24,9
Total	%	61,2	60,8	59,4
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	5451	4262	2991
Fuel mass flow rate	lb/hr	635	502	358
Exhaust gas mass flow rate, wet	lb/hr	6086	4763	3342
Exhaust gas volume flow rate, dry[5]	Nm³/h	1858	1446	1410
Engine cooling water mass flow rate	lb/hr	95982	96239	96314
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1183	1161	1132
Measured temperature outlet turbine (averaged)	°F	869	896	930

Reference setting: Gasmixer Heinzmann VE-1001-24-S22-12x9,8/12x11,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	14,2	14,2	14,2
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	22,0	20,6	18,6
Natural gas conditions	Calorific value	MJ/kg	17,2	17,2	17,1
	Methane number		143,0	143,0	143,0
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32
	Atmospheric pressure abs.	psi	14,5
Provided permissible tolerances acc. to ISO 3046-1:			
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	07.03.2022	FM	51.99494-7089	B
Released	17.03.2022	KG/PW		

Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1500 rpm (50 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data		Hz	50		Hz	50	
Ignition timing (±2 °CA)		°CA	20		°CA	20	
Effective rated power		kW	529		bhp	709	
Operating parameters							
Cooling water operating pressure		bar	1,4		psi	20	
Intake depression after air filter max. (measured in 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	60		psi	0,87	
Pressure loss gas mixture intercooler max.		mbar	55		psi	0,80	
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	
Standard conditions:	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	07.03.2022	FM	51.99494-7089	B
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Mode of Operation

Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

	Date	Signature	No. of data sheet	Index
Created	07.03.2022	FM	51.99494-7089	B
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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Basic Data

		metric		standard	
Engine Data					
Rated speed	min^{-1}	1800	rpm	1800	
Effective rated power	kW	530	bhp	711	
Max. engine torque at rated speed	Nm	2812	Nm	2812	
Mean effective pressure	bar	13,4	psi	194,3	
Mean piston speed	m/s	9,42	m/s	9,42	
Oil circuit					
Mean oil consumption	g/h	80	lb/hr	0,176	
Max. permissible lubricating oil consumption	g/h	180	lb/hr	0,397	
Lubricating oil filling quantity min. / max.	l	42 90	Imp.gal.	11 24	
Cooling circuit					
Engine cooling water filling quantity	l	85	Imp.gal.	22,5	
- therefrom cooler	l	35	Imp.gal.	9,2	
Engine cooling water operating pressure	bar	1,5	psi	22	
Engine cooling water volume flow rate	l/min	844	ft^3/min	29,8	
Engine cooling water temperature min.	°C	80	°F	176	
Engine cooling water temperature max.	°C	92	°F	198	
Difference inlet - outlet max.	K	7	K	7	
Mixture temperature after throttle valve max.	°C	200	°F	392	
Mixture temperature after mixture cooler max.	°C	50	°F	122	
Mixture cooling water inlet temperature HT	°C	83	°F	181,4	
Coolant concentration min. / max.	%	40 50	%	40 50 44	
Pressure conditions					
Intake depression after air filter max. (measured in 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 gas mixer max.		70	psi	1,02	
Pressure loss gas mixture intercooler max.	mbar	65	psi	0,94	
Exhaust back pressure min. / max.	mbar	5 40	psi	0,07 0,58	

Emissions* metric (with 5 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	g/Nm^3	0,50	0,50	0,50
CO	g/Nm^3	0,66	0,63	0,62
THC	g/Nm^3	0,66	0,62	0,49
TOC (emission without O_2 correction acc. to VDI 3481-4)	g/Nm^3	0,48	0,46	0,38
HCHO	mg/Nm^3	53	56	62

Emissions* standard (with 15 % O_2 correction, dry)				
Load	**%**	100	75	50
NO_X	ppmvd	72	82	78
CO	ppmvd	195	188	185
THC	ppmvd	395	366	288
HCHO	ppmvd	15	16	17
NMHC	ppmvd	-	-	-
NMNEHC	ppmvd	-	-	-

* For dimensioning of exhaust after treatment systems tolerances and aging effects must be inlcuded in calculations.

Lube oil to MAN works standard M 3271-5 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	07.03.2022	FM	51.99494-7089	B
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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 22 °CA / 530 kW
metric

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	22	22	22
Effective rated power[1]	kW	524	399	266
Engine cooling water heat output[2]	kW	345	299	248
Mixture cooling heat	kW	108,0	69,2	34,9
Exhaust heat output (cooled down to 120 °C)	kW	346,8	285,5	218,3
Residual heat output max. incl. radiation heat	kW	66,8	49,4	39,4
Rated thermal input	kW	1484	1176	860
Specific fuel consumption	MJ/kWh	10,33	10,75	11,80
Air-fuel ratio[3]	-	1,44	1,39	1,35
Efficiency Data				
Effective mechanical[1]	%	35,3	33,9	30,9
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(37,5)	(36,0)	(32,8)
Thermal[5]	%	23,4	24,3	25,4
Total	%	58,7	58,2	56,3
Mass and Volume Flow Rates				
Combustion air mass flow rate	kg/h	2667	2076	1497
Fuel mass flow rate	kg/h	312,5	247,2	180,3
Exhaust gas mass flow rate, wet	kg/h	2979	2323	1610
Exhaust gas volume flow rate, dry[6]	Nm³/h	1994	1527	1119
Engine cooling water mass flow rate	kg/h	52015	52148	52202
Temperatures				
Measured temperature inlet turbine (averaged)	°C	664	652	636
Measured temperature outlet turbine (averaged)	°C	475	491	510

Reference setting: Gasmixer Heinzmann VE-1001-24-S22-12x9,8/12x11,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	kPa	100		
	Air temperature	°C	25		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	m	310		
	Atmospheric pressure abs.	kPa	96,2	95,9	96,0
	Inlet air temperature	°C	25,0	25,0	25,0
	Relative air humidity	%	33,4	31,4	30,0
Natural gas conditions	Calorific value	MJ/kg	17,1	17,1	17,2
	Methane number		144,0	144,0	144,0
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°C	0
	Atmospheric pressure abs.	kPa	100
Provided permissible tolerances acc. to ISO 3046-1:			
Tolerance for usable heat at rated output		%	±7
Tolerance for specific fuel consumption at rated output		%	+5

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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Flow and Heat Balance

IT 22 °CA / 530 kW
standard

Performance Data				
Load	%	100	75	50
Ignition timing before TDC	°CA	22	22	22
Effective rated power[1]	bhp	703	535	357
Engine cooling water heat output[2]	bhp	463	401	332
Mixture cooling heat	bhp	144,8	92,7	46,7
Exhaust heat output (cooled down to 120 °C)	bhp	465	383	293
Residual heat output max. incl. radiation heat	bhp	89,5	66,3	52,8
Rated thermal input	bhp	1990	1577	1154
Specific fuel consumption	BTU/ bhp-hr	7301	7598	8337
Air-fuel ratio[3]	-	1,44	1,39	1,35
Efficiency Data				
Effective mechanical[1]	%	35,3	33,9	30,9
Corrected (ISO 3046-1 incl. 5 % fuel tolerance) mechanical[4]	%	(37,5)	(36,0)	(32,8)
Thermal[5]	%	23,4	24,3	25,4
Total	%	58,7	58,2	56,3
Mass and Volume Flow Rates				
Combustion air mass flow rate	lb/hr	5879	4577	3301
Fuel mass flow rate	lb/hr	689	545	397
Exhaust gas mass flow rate, wet	lb/hr	6568	5122	3550
Exhaust gas volume flow rate, dry[5]	Nm³/h	1994	1527	1119
Engine cooling water mass flow rate	lb/hr	114675	114967	115087
Temperatures				
Measured temperature inlet turbine (averaged)	°F	1227	1205	1177
Measured temperature outlet turbine (averaged)	°F	887	916	950

Reference setting: Gasmixer Heinzmann VE-1001-24-S22-12x9,8/12x11,0
Ignition System Motortech MIC 4

[1] For profitability analysis it is recommended to use the effective values. Conditions during the measurement see below.

[2] Cooling water data based on	Antifreeze proportion	%	45		
	Spec. effective heat capacity c_p	kJ/kg K	3,67		
	Difference (inlet - outlet max.)	K	6		
[3] Air-fuel ratio	Measured with ETAS LA 4_E. Please see chapter "Values / limits"				

[4] The corrected mechanical efficiency (ISO 3046-1, Section 13) refers to the below-mentioned values, whereby the permissible tolerance for fuel consumption by 5 % is taken into account.

Standard conditions	Atmospheric pressure abs.	psi	14,5		
	Air temperature	°F	77		
	Relative air humidity	%	30		
Conditions during the measurement	Installation altitude	ft	1017		
	Atmospheric pressure abs.	psi	14,0	13,9	13,9
	Inlet air temperature	°F	77,0	77,0	77,0
	Relative air humidity	%	33,4	31,4	30,0
Natural gas conditions	Calorific value	MJ/kg	17,1	17,1	17,2
	Methane number		144,0	144,0	144,0
	Hydrogen content fuel gas	Vol.-%	0,0	0,0	0,0

[5] Permissible tolerance for usable thermal output is not taken into account

[6] Standard conditions acc. to TA-Luft	Air temperature	°F	32
	Atmospheric pressure abs.	psi	14,5
Provided permissible tolerances acc. to ISO 3046-1:			
Tolerance for usable heat at rated output		%	±7
Tolerance for specific fuel consumption at rated output		%	+5

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Special Gas (60 Vol.-% Natural Gas + 40 Vol.-% CO_2)
1800 rpm (60 Hz) - NO_x Level 0,50 g/Nm^3 (5 % O_2)- J-Gap Spark Plug

Values / limits for 100 % load*

Performance Data	Hz	60			Hz	60	
Ignition timing (±2 °CA)	°CA	22			°CA	22	
Effective rated power	kW	524			bhp	703	
Operating parameters							
Cooling water operating pressure	bar	1,5			psi	22	
Intake depression after air filter max. (measured in 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	70			psi	1,02	
Pressure loss gas mixture intercooler 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
Standard conditions:	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
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