



Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 1 of 41

Acceptance Test Procedure and Report for the THM Gas Turbine

Appendix RVT Results of Thermodynamic and Mechanical Verification Test

Contract Engine	Gas Turbine Type: THM 1304 – 12 DLN Serial No. GG: 2155 / PT: 2155
Location of Test	MAN Turbo AG, Oberhausen, Germany
Date of Test	25.11.09
Test Engineer	B.Zimprich, M.Nern
Customer's Representatives	Mr. Eduardo Garcia Ramirez (SGS) Mr. Cabezas (Enagas)

Contents

- 1 General**
- 2 Comments on the Verification Test**
- 3 Results**
- 4 Graphical Analysis**
- 5 Test Run Log Sheets**
- 6 Measurement Readings**
- 7 Fuel Gas Analysis**
- 8 Vibration Report SMB 1773**

REVIEWED ONLY
 Date: 30/12/2010
 Signed: *[Signature]*

The Revision was marked with <1>.

Date:	<i>19.01.10</i>	prepared by:	Zimprich / PP53 <i>Zimprich</i>
Date:	<i>22.01.10</i>	checked by:	Krüger / PG 1 <i>Krüger</i>
Date:	<i>27/01/2010</i>	released by:	Thomas / PP53 <i>Thomas</i>

MAN TURBO AG



Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 2 of 41

1 General

This document is an Appendix to the document "Acceptance Test Procedure an Report for the THM Gas Turbine, Cover Sheet ", No. 100005 64540.

The verification test was performed on 25.11.09 as described in Appendix DVT.

2 Comments on the Verification Test

The handwritten log sheets of the test and the signed printouts of the measured data were given to the customer's representative at the end of the test run.

3 Results

The thermodynamic performance test and the mechanical running test were conducted on the test stand of MAN Turbo AG, to furnish proof of compliance with designed data of the gas turbine.

Guarantee values

The expected shaft power output of 12.25 MW according to Document 100001 65361 (Annex LGD) was reached at a measured PT inlet temperature T4 of 789 °C. This temperature is below the max. allowable temperature of 811 °C .

The emission measurement values related to 15 % O2 are below the guarantee values NOx (50 mg/m³_n) and CO (30 mg/m³_n) according ATP Appendix LGD.

<1>

Operating Point A

Measured Values	MP. 40
Ambient pressure [kPa]	100.05
Ambient temperature [°C]	12.8
Inlet pressure loss [kPa]	2.73
Outlet pressure loss [kPa]	0
Power turbine speed [rpm]	7323
Torque [Nm]	5565
Fuel gas volume flow [m ³ _n/h]	2341
Calorific value [MJ/m ³ _n]*	32.516
Correction factor of inlet loss	
ε ₁ Power	0.9466
ε ₁ Heat rate	0.9746
Calculated Values (real)	
Power [kW]	4268

* Calorific value according the taken gas sample

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Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
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	MP.40	Operating point A (ISO Cond.)
Calculated Values (ISO Cond.)		
Power turbine speed [rpm]	7351	7354
Power [kW]	4583	4577
Heat Rate [kJ/kWh]	17382	17690

The heat rate guarantee for operating point A has been met.

Therefore all guarantees have been met.

The vibratory condition of the gas turbine "VILLARPIPE 2" is good and according to the above mentioned specifications.

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Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
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4 Graphical Analysis

Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

Order: VILLARPIPE 2
 Order No.: H.0200017
 Mach-No.: 2155

Date of Test: 25.11.2009
 Prepared: Zimprich
 Checked: D.Kruger

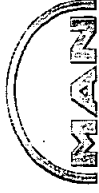
Date: 01.12.2009
 Date: 03.12.2009



Measured Data during Acceptance Test Fuel Lower Heating Value : 32,5160 MJ/m³

Measuring Point	Time	GG Speed rpm	PT Speed rpm	TORQUE Nm	Fuel Volume Flow m ³ /h	Ambient Pressure kPa	Inlet Press. Loss kPa	Average Inlet Temperature °C	Average PT Inlet Temperature °C	Exh. Press. Loss kPa	Degradation Factor	
												1
GG Speed 1												
1	41	10759	6187	7521	2406	100,05	2,795	12,9	594,9	0,000	1,000	
2	42	10760	6977	6749	2421	100,05	2,775	12,8	599,3	0,000	1,000	
3	43	10760	7774	5991	2432	100,05	2,760	12,8	601,9	0,000	1,000	
4							0,000					
5							0,000					
6							0,000					
GG Speed 2												
1	44	11153	6876	9137	2946	100,02	3,455	12,6	654,3	0,000	1,000	
2	45	11154	7780	8303	2955	100,01	3,430	12,6	656,8	0,000	1,000	
3	46	11154	8571	7426	2973	100,00	3,455	12,6	659,8	0,000	1,000	
4							0,000					
5							0,000					
6							0,000					
GG Speed 3												
1	47	11351	7374	10129	3271	99,99	3,870	12,5	695,7	0,000	1,000	
2	48	11358	7772	9739	3284	99,99	3,875	12,6	697,1	0,000	1,000	
3	49	11358	8171	9303	3291	99,99	3,870	12,5	698,3	0,000	1,000	
4	50	11358	8570	8832	3302	99,99	3,870	12,6	699,7	0,000	1,000	
5	51	11358	9003	8328	3306	99,99	3,830	12,9	700,5	0,000	1,000	
6							0,000					
GG Speed 4												
1	52	11563	7383	11899	3683	99,95	4,335	12,8	738,5	0,000	1,000	
2	53	11563	7776	11266	3689	99,95	4,330	12,8	739,6	0,000	1,000	
3	54	11549	8170	10790	3680	99,93	4,340	12,9	739,8	0,000	1,000	
4	55	11562	8568	10377	3689	99,94	4,305	12,9	741,3	0,000	1,000	
5	56	11561	9015	9856	3704	99,94	4,360	12,7	742,3	0,000	1,000	
6							0,000					
GG Speed 5												
1	57	11757	7378	13318	4116	99,95	4,815	12,4	781,6	0,000	1,000	
2	58	11754	7780	12869	4115	99,95	4,800	12,4	781,8	0,000	1,000	
3	59	11756	8169	12414	4122	99,95	4,855	12,5	782,9	0,000	1,000	
4	60	11753	8568	11970	4131	99,94	4,870	12,5	783,6	0,000	1,000	
5	61	11754	8997	11486	4133	99,92	4,875	12,4	784,8	0,000	1,000	
6							0,000					
GG Speed 6												
1	62	11800	7768	13229	4236	99,91	4,950	12,2	792,6	0,000	1,000	
2	63	11804	8168	12806	4236	99,90	4,945	12,0	793,8	0,000	1,000	
3	64	11802	8565	12350	4247	99,89	4,955	12,0	794,7	0,000	1,000	
4	65	11803	8998	11824	4243	99,90	5,035	12,0	795,7	0,000	1,000	
5												
6												

Degradation Factors acc. to Document 10000010153



Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

Order: VLLARPIPE 2
 Order No.: H.0200017
 Mach No.: 2155

Date of Test: 25.11.2009
 Prepared: Zimpon
 Checked: D.Krieger

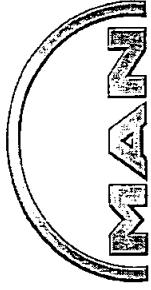
Date: 01.12.2009
 Date: 03.12.2009

Date corrected to :
 Sea Level, No Losses, 12.5°C Inlet Temperature

Measuring Point	Time	Measured Shaft Power kW	Power			Efficiency			Corr. Factor			PT Speed rpm	GG Speed rpm	Shaft Power Output kW	Efficiency (%)	PT Inlet Temperature °C	Average Inlet Temp. °C	Average GG Speed rpm
			Corr. Factor	Exh. Press.	Loss $\eta_{p,m}$	Corr. Factor	Exh. Press.	Loss $\eta_{p,cor}$	Corr. Factor	Ambient Press. δ	Average Inlet Temp. θ							
GG Speed 1																		
1	41	10:50:13	0.8453	1.0000	0.9740	1.0000	0.9874	1.0012	0.9874	1.0012	6183	10753	5217	23.02	584	12.8	10753	
2	42	10:53:48	0.8457	1.0000	0.9742	1.0000	0.9874	1.0012	0.9874	1.0012	6973	10754	5277	23.15	587			
3	43	10:56:43	0.8460	1.0000	0.9743	1.0000	0.9874	1.0012	0.9874	1.0012	7769	10754	5218	22.79	601			
4																		
5																		
GG Speed 2																		
1	44	11:15:58	0.9324	1.0000	0.9679	1.0000	0.9871	1.0003	0.9871	1.0003	6975	11151	7251	26.82	654			
2	45	11:19:36	0.9328	1.0000	0.9681	1.0000	0.9870	1.0004	0.9870	1.0004	7779	11152	7345	26.18	656			
3	46	11:23:08	0.9324	1.0000	0.9679	1.0000	0.9869	1.0005	0.9869	1.0005	8569	11151	7242	25.65	659			
4																		
5																		
6																		
GG Speed 3																		
1	47	11:40:37	0.9242	1.0000	0.9640	1.0000	0.9868	1.0001	0.9868	1.0001	7374	11350	8575	27.46	696			
2	48	11:43:50	0.9241	1.0000	0.9640	1.0000	0.9868	1.0002	0.9868	1.0002	7771	11357	8690	27.72	697			
3	49	11:46:04	0.9242	1.0000	0.9640	1.0000	0.9868	1.0001	0.9868	1.0001	8171	11357	8727	27.78	698			
4	50	11:46:36	0.9242	1.0000	0.9640	1.0000	0.9868	1.0002	0.9868	1.0002	8569	11357	8889	27.57	698			
5	51	11:52:21	0.9250	1.0000	0.9644	1.0000	0.9866	1.0002	0.9866	1.0002	9002	11357	8600	27.28	700			
6																		
GG Speed 4																		
1	52	12:12:10	0.9151	1.0000	0.9597	1.0000	0.9854	1.0009	0.9854	1.0009	7389	11558	10016	28.33	738			
2	53	12:14:45	0.9152	1.0000	0.9597	1.0000	0.9854	1.0009	0.9854	1.0009	7772	11558	10157	28.69	739			
3	54	12:17:45	0.9150	1.0000	0.9596	1.0000	0.9852	1.0012	0.9852	1.0012	8165	11542	10223	28.94	739			
4	55	12:19:35	0.9157	1.0000	0.9600	1.0000	0.9853	1.0013	0.9853	1.0013	8562	11554	10301	29.11	740			
5	56	12:21:39	0.9147	1.0000	0.9595	1.0000	0.9853	1.0008	0.9853	1.0008	9011	11556	10308	28.99	741			
6																		
GG Speed 5																		
1	57	12:35:35	0.9057	1.0000	0.9552	1.0000	0.9854	0.9996	0.9854	0.9996	7379	11758	11519	28.98	782			
2	58	12:38:34	0.9060	1.0000	0.9554	1.0000	0.9854	0.9995	0.9854	0.9995	7781	11758	11733	29.52	782			
3	59	12:40:39	0.9050	1.0000	0.9548	1.0000	0.9854	0.9989	0.9854	0.9989	8169	11756	11887	29.88	783			
4	60	12:43:17	0.9047	1.0000	0.9547	1.0000	0.9853	0.9989	0.9853	0.9989	8566	11754	12034	30.14	784			
5	61	12:46:11	0.9048	1.0000	0.9547	1.0000	0.9851	0.9988	0.9851	0.9988	8959	11756	12112	30.31	785			
6																		
GG Speed 6																		
1	62	13:00:58	0.9031	1.0000	0.9540	1.0000	0.9850	0.9988	0.9850	0.9988	7773	11807	12092	28.49	784			
2	63	13:04:35	0.9032	1.0000	0.9540	1.0000	0.9850	0.9984	0.9850	0.9984	8175	11814	12311	30.01	786			
3	64	13:06:55	0.9030	1.0000	0.9539	1.0000	0.9850	0.9983	0.9850	0.9983	8572	11812	12454	30.27	786			
4	65	13:09:05	0.9014	1.0000	0.9532	1.0000	0.9850	0.9982	0.9850	0.9982	9006	11813	12547	30.50	786			
5																		
6																		

Correction Factors for Pressure Losses acc. to Document 1000008928

Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

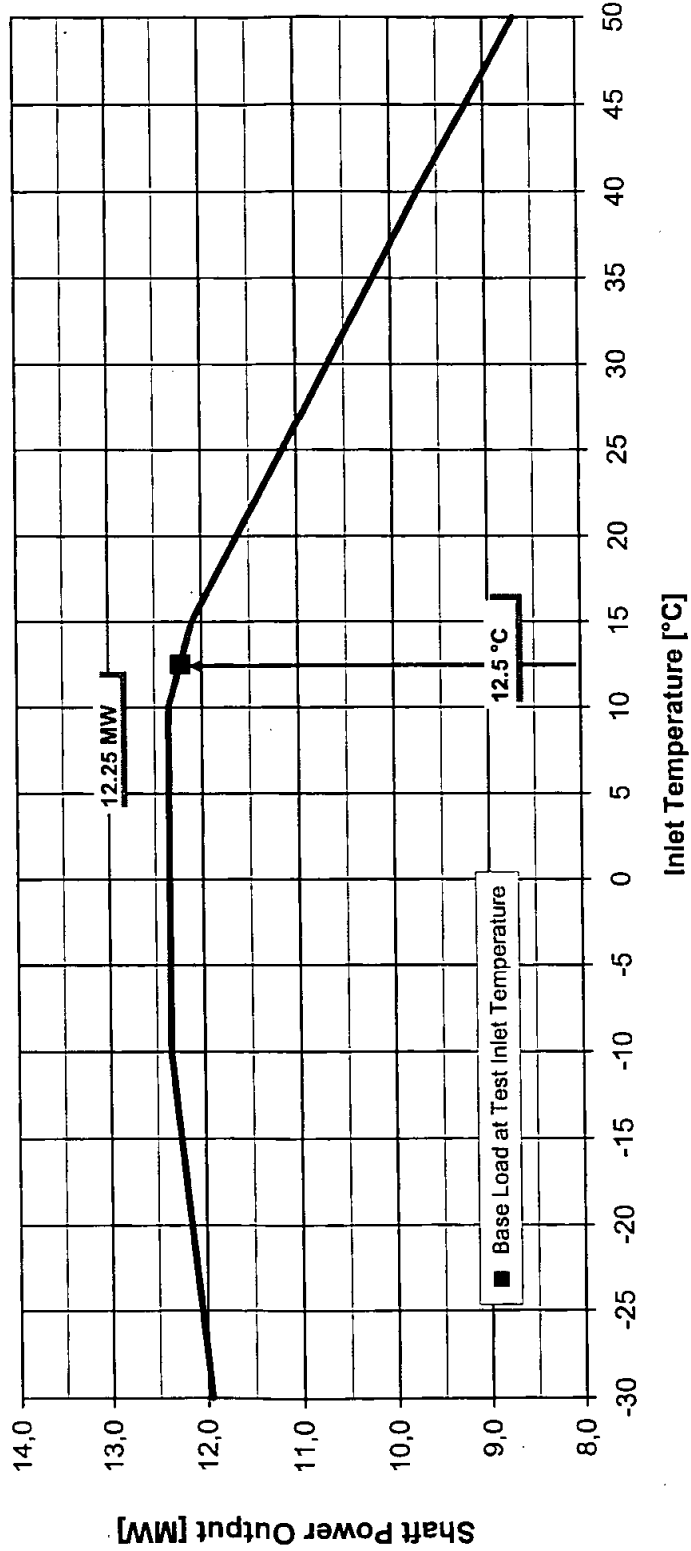


Order: VILLARPIPE 2 Date of Test: 25.11.2009 Date: 01.12.2009
 Order No.: H.0200017 Prepared: Zimprich Date: 03.12.2009
 Mach No.: 2155 Checked: D.Krüger

Sea Level, No Losses

Shaft Power Output vs. Inlet Temperature

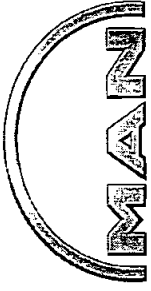
Power Turbine Speed 8600 rpm
 No Water Injection



Refer to Document 10000165361

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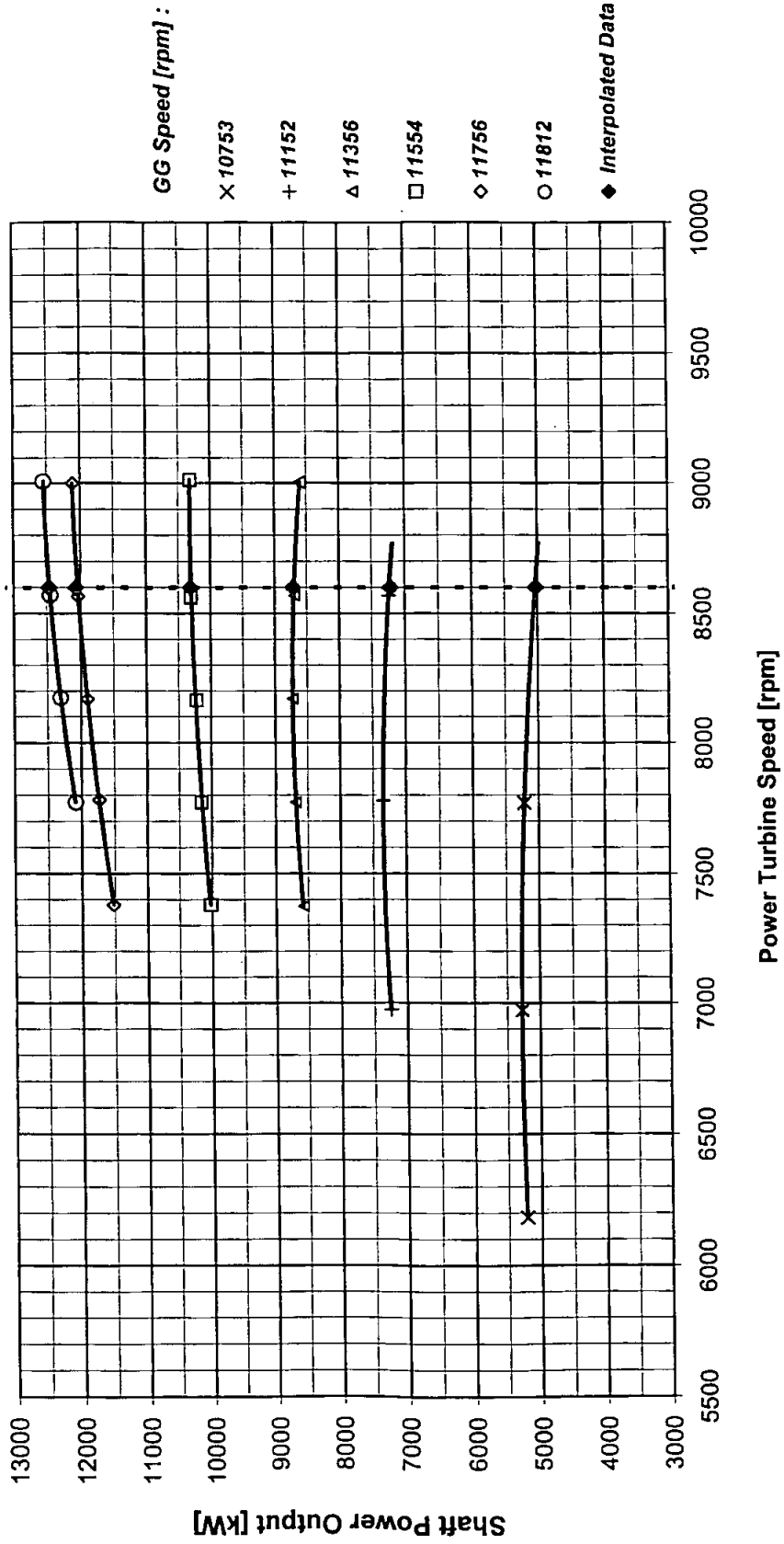
Conversion of Measured Data to Guarantee Conditions CMG Rev. 2



Order: VILLARPIPE 2 Date of Test: 25.11.2009
 Order No.: H.0200017 Prepared: Zimprich Date: 01.12.2009
 Mach No.: 2155 Checked: D.Krüger Date: 03.12.2009

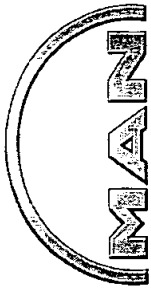
Sea Level, No Losses, 12,5°C Inlet Temperature

Shaft Power Output vs. Power Turbine Speed



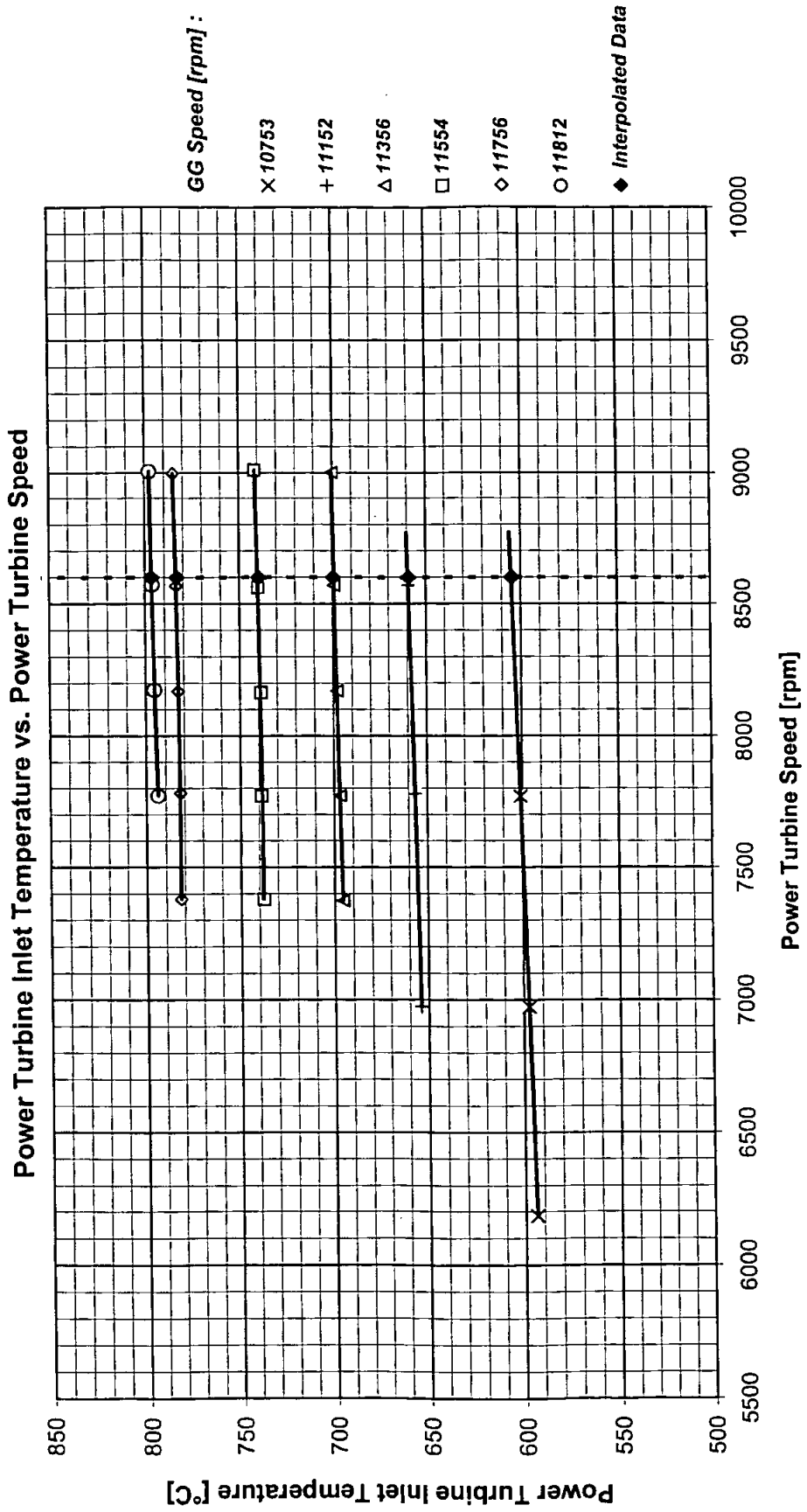
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Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

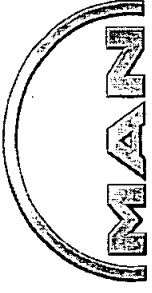


Order: VILLARPIPE 2 **Date of Test:** 25.11.2009
Order No.: H.0200017 **Prepared:** Zimprich **Date:** 01.12.2009
Mach No.: 2155 **Checked:** D.Krüger **Date:** 03.12.2009

Sea Level, No Losses, 12,5°C Inlet Temperature



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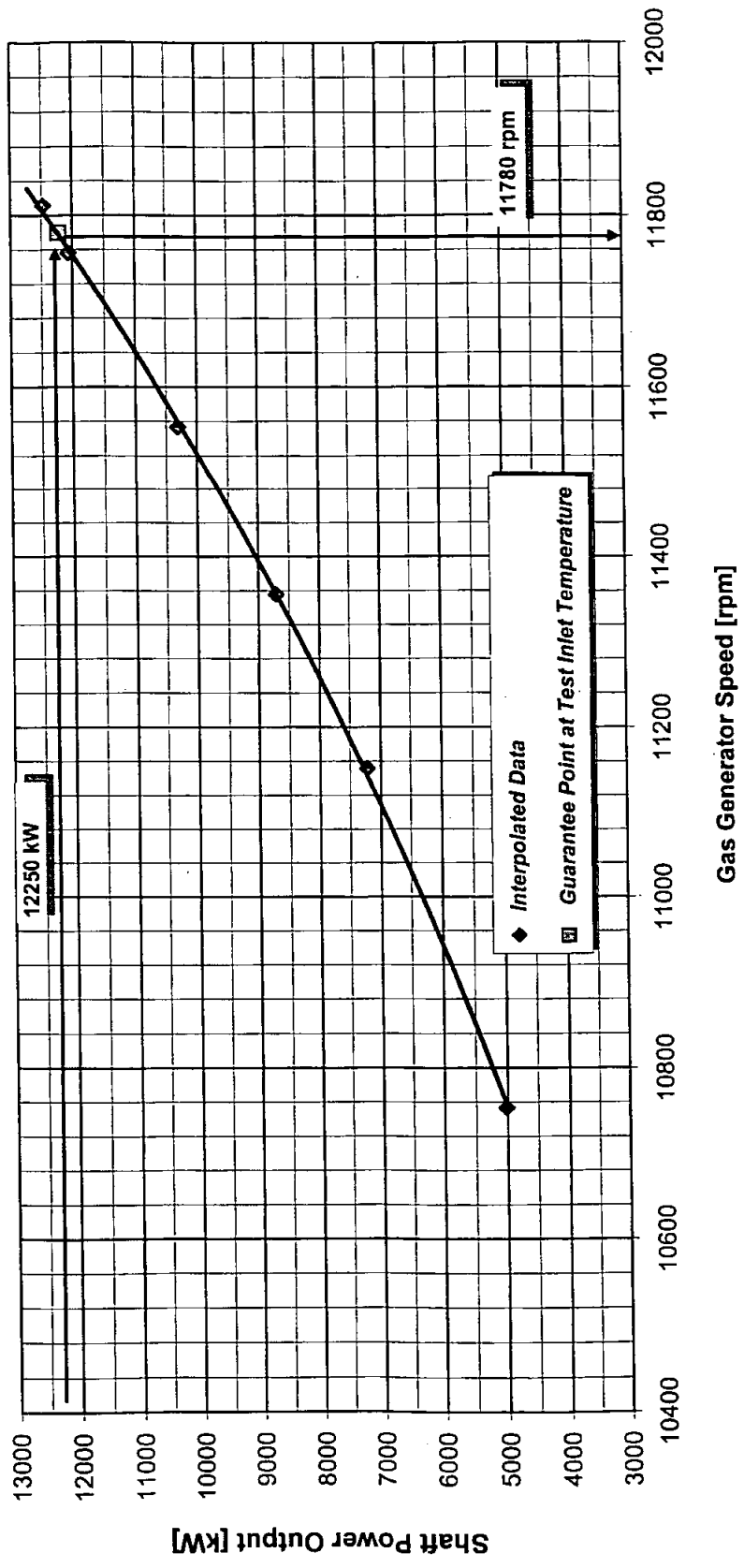


Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

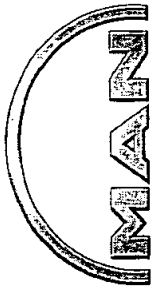
Order: VILLARPIPE 2 Date of Test: 25.11.2009
 Order No.: H.0200017 Prepared: Zimprich Date: 01.12.2009
 Mach No.: 2155 Checked: D.Krüger Date: 03.12.2009

Sea Level, No Losses, 12,5°C Inlet Temperature, 8600 rpm Power Turbine Speed

Shaft Power Output vs. Gas Generator Speed



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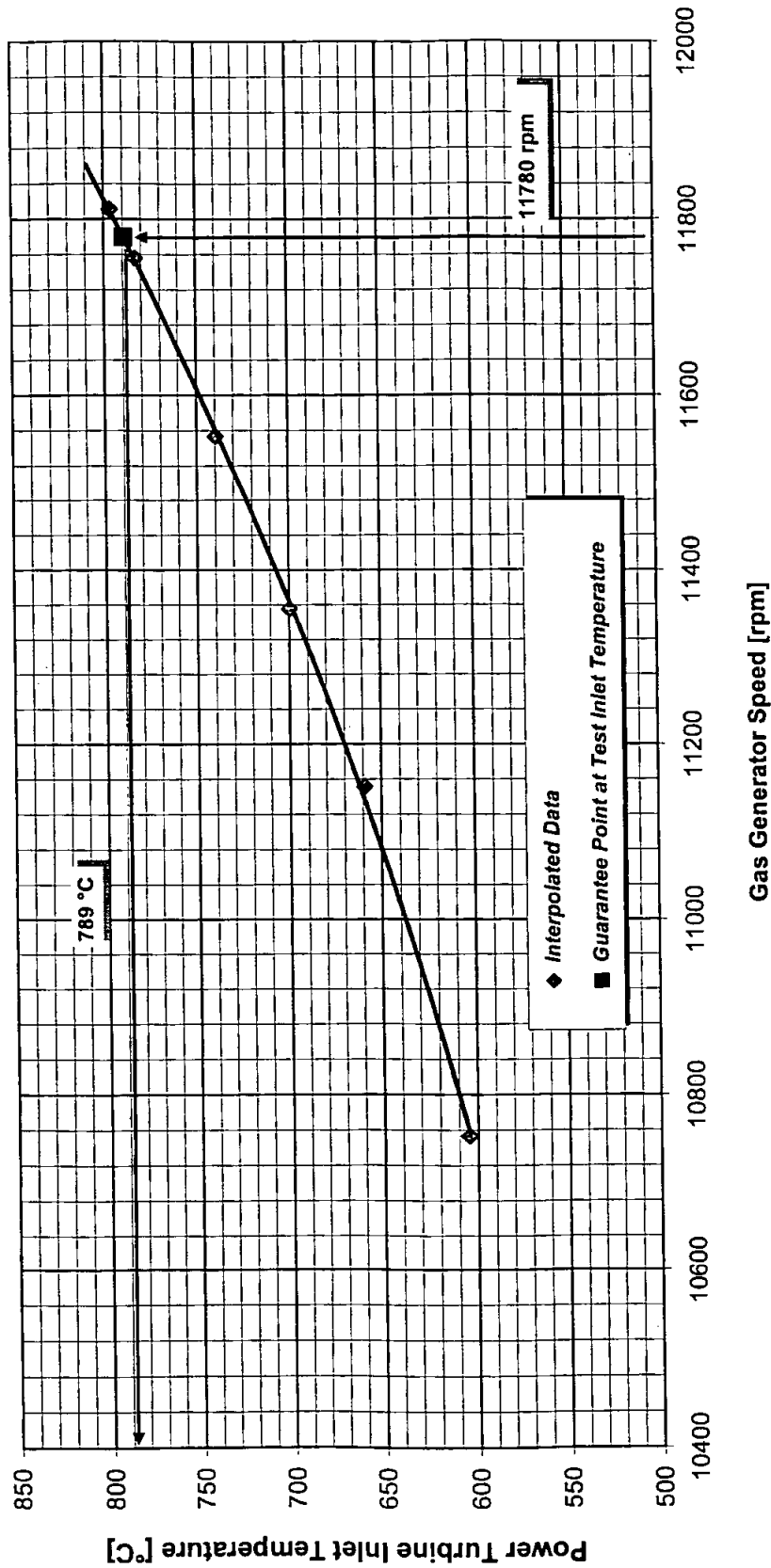


Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

Order: VILLARPIPE 2 Date of Test: 25.11.2009
Order No.: H.0200017 Prepared: Zimprich Date: 01.12.2009
Mach No.: 2155 Checked: D.Krüger Date: 03.12.2009

Sea Level, No Losses, 12,5°C Inlet Temperature, 8600 rpm Power Turbine Speed

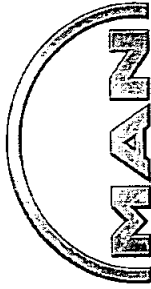
Power Turbine Inlet Temperature vs. Gas Generator Speed



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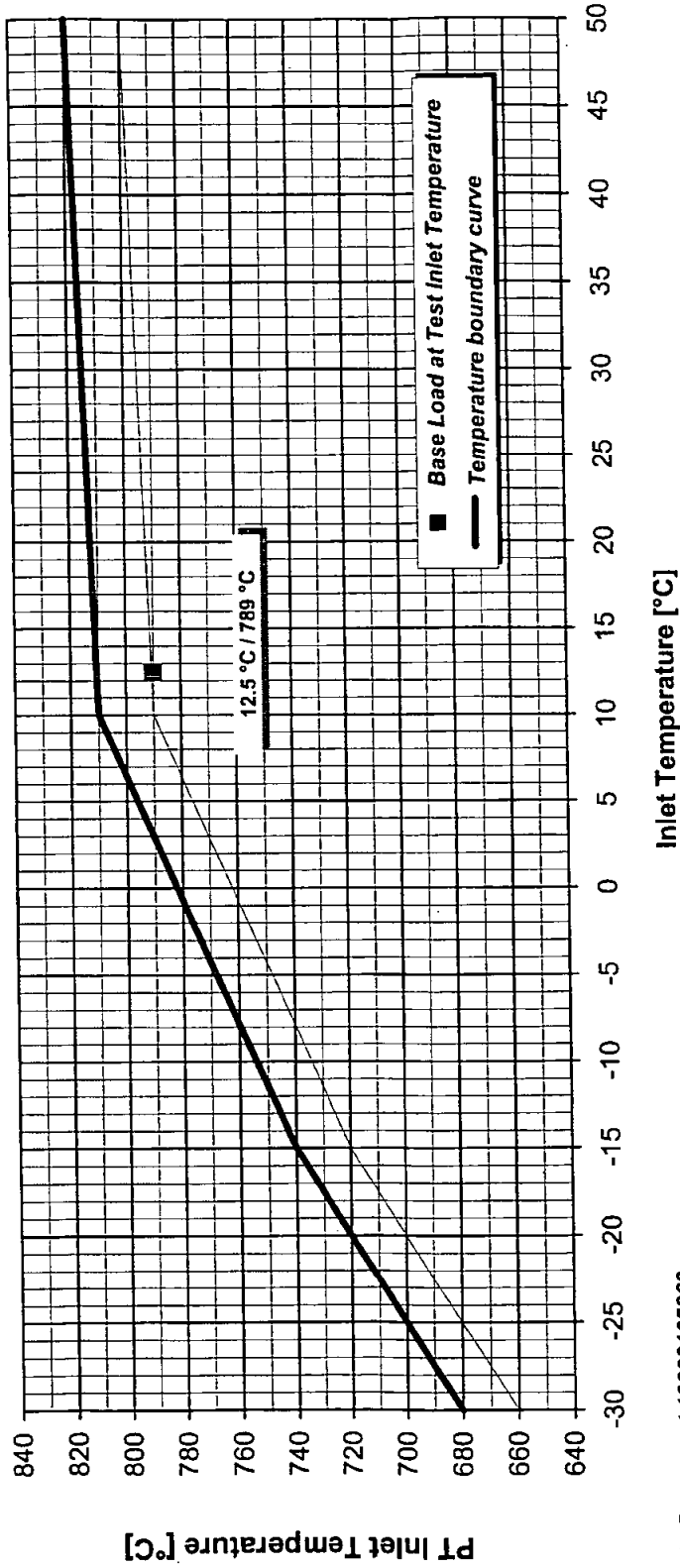
Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

Order: VILLARPIPE 2 Date of Test: 25.11.2009
 Order No.: H.0200017 Prepared: Zimprich Date: 01.12.2009
 Mach No.: 2155 Checked: D.Krüger Date: 03.12.2009



Sea Level, No Losses

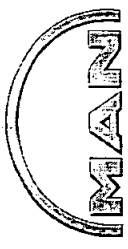
Power Turbine (PT) Inlet Temperature vs. Inlet Temperature
Power Turbine Speed 8600 rpm
Standard Combustion System, No Water Injection



Refer to Document 10000165362

Temperature curve points			
Inlet Temperature [°C]	50	10	-30
PT Inlet Temperature [°C]	800	790	660

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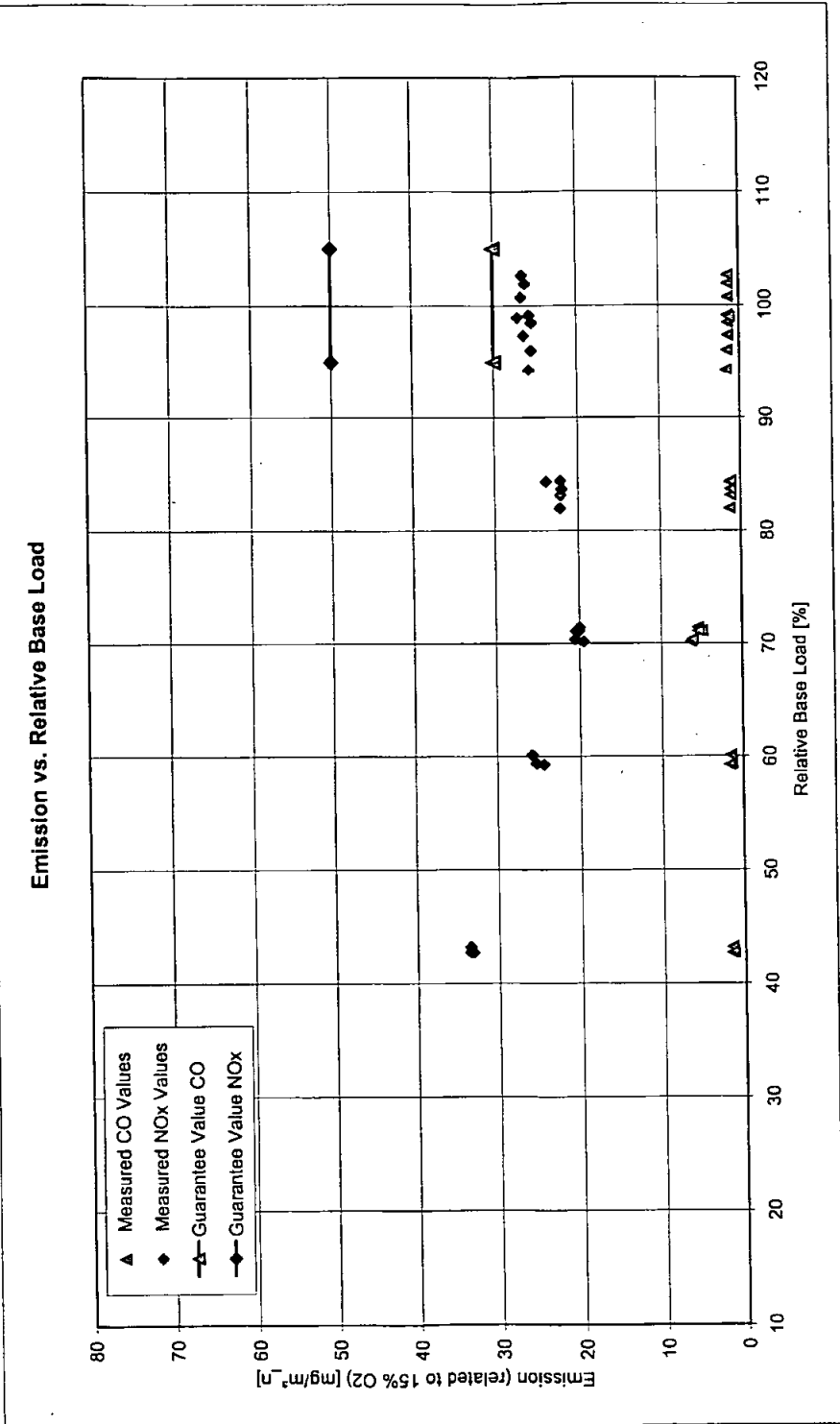
Conversion of Measured Data to Guarantee Conditions CMG Rev. 2

Order: VILLARPIPE 2
 Order No.: H.0200017
 Mach No.: 2155

Date of Test: 25.11.2009
 Prepared: M.Nem
 Checked: D.Kröger

Date: 09.03.09
 Date: 11.03.09

Measuring Point	GG Speed 1					GG Speed 2					GG Speed 3					GG Speed 4					GG Speed 5					GG Speed 6									
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
O2 measured	16,9	16,8	16,8	16,4	16,3	16,3	16,1	16,0	16,0	16,0	16,0	15,6	15,7	15,6	15,6	15,6	15,2	15,2	15,2	15,2	15,2	15,1	15,1	15,1	15,0	15,0	14,8	14,8	14,8	14,8	14,8	14,7	14,7	14,7	14,7
CO Measured	1,1	1,1	1,0	1,1	1,2	1,3	5,2	4,1	4,5	4,5	5,1	1,2	1,1	1,1	1,2	1,1	1,5	1,4	1,4	1,4	1,4	1,2	1,2	1,2	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
NO measured	11,1	11,2	11,3	8,5	8,8	8,2	6,3	6,9	6,7	6,6	6,9	8,4	8,4	8,4	9,4	8,5	11,2	11,1	11,1	11,1	11,2	12,1	12,1	12,1	11,8	11,8	11,8	11,8	11,8	11,8	11,8	11,8	11,8	11,8	11,8
NO2 measured	5,7	6,0	5,9	6,5	6,6	6,4	6,4	6,3	6,3	6,5	6,4	6,9	6,8	6,7	6,9	6,9	7,7	7,7	7,7	7,7	7,7	8,2	8,2	8,2	8,3	8,3	8,3	8,3	8,3	8,3	8,3	8,3	8,3	8,3	8,3
NOx measured	22,7	23,2	23,2	19,5	20,1	19,0	16,1	16,9	16,6	16,6	17,0	19,8	19,7	19,6	21,3	19,9	24,9	24,7	25,6	24,7	25,1	26,8	26,4	25,9	26,4	26,4	26,4	26,4	26,4	26,4	26,4	26,4	26,4	26,4	26,4
CO (related to 15% O2)	1,6	1,6	1,4	1,4	1,5	1,7	6,3	5,0	5,4	5,4	6,2	1,2	1,2	1,2	1,3	1,2	1,7	1,5	1,4	1,4	1,4	1,2	1,2	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
NOx (related to 15% O2)	33,1	33,5	33,5	25,3	25,8	24,4	19,5	20,4	20,0	20,5	20,5	22,2	22,1	21,9	23,8	22,1	25,8	25,5	26,4	25,4	25,7	27,1	26,7	26,1	26,6	26,6	26,6	26,6	26,6	26,6	26,6	26,6	26,6	26,6	26,6
CO (related to 15% O2) ppm	1,3	1,3	1,2	1,1	1,2	1,3	5,1	4,0	4,3	4,3	4,9	1,1	1,0	1,0	1,1	1,0	1,3	1,2	1,2	1,2	1,2	1,0	1,0	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
NOx (related to 15% O2) ppm	16,1	16,3	16,3	12,3	12,6	11,9	9,5	9,9	9,7	9,8	10,0	10,8	10,8	10,7	11,6	10,8	12,6	12,4	12,9	12,4	12,5	13,2	13,0	12,7	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9	12,9



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Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 14 of 41

5 Test Run Log Sheets

TEST READINGS

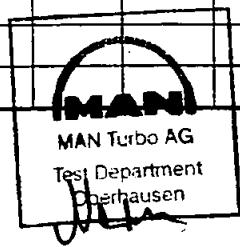
Official Mechanical Running and Shop Performance Test



-15-

Dept.		Code Word		Job No.		Machine No.					
PP53		VILLARPIPE 2		H.0200017		GG 2155 / PT 2155					
Name				Date		Sheet					
Nern				25.11.09		1 / 2					
MP-No.	Time	Speed GG actual	Speed PT actual								
/	hh:mm	rpm	rpm								
				Gas Turbine							
				Type: PHM 1304-12							
				Machine No.: 2155							
	9:47			Start of the gas turbine							
	9:52			Warming up speed reached							
40	10:38	10617	7323	Measurement for Operating point A							
41	10:50	10753	6187	Measurement } for $n_{GG,iso} = 10800$ rpm							
42	10:53	10760	6977					"			
43	10:56	10760	7774					"			
44	11:15	11553	6976	Measurement } for $n_{GG,iso} = 11200$ rpm							
45	11:19	11554	7380					"			
46	11:23	11554	8571					"			
47	11:40	11351	7374	Measurement } for $n_{GG,iso} = 11400$ rpm							
48	11:43	11358	7772					"			
49	11:46	11358	8171					"			
50	11:48	11358	8570					"			
51	11:52	11358	9003					"			
52	12:12	11563	7387	Measurement } for $n_{GG,iso} = 11600$ rpm							
53	12:14	11567	7776					"			
54	12:17	11549	8170					"			
55	12:19	11562	8568					"			
56	12:21	11561	9015					"			

SGS Tecnos, S.A.
Fdo: *[Signature]*



TEST READINGS

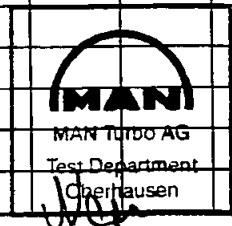
Official Mechanical Running and Shop Performance Test



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Dept. PP53		Code Word VILLARPIPE 2		Job No. H.0200017		Machine No. GG 2155 / PT 2155									
Name Nern				Date 25.11.09		Sheet 2 / 2									
MP-No.	Time	Speed GG actual	Speed PT actual												
/	hh:mm	rpm	rpm												
57	12:35	11757	7378	Measurement } for $n_{GG} = 11800 \text{ rpm}$											
58	12:38	11754	7780							"					
59	12:40	11756	8169							"					
60	12:43	11753	8566							"					
61	12:46	11754	8997							"					
62	13:00	11800	7768	Measurement } for $n_{GG} \text{ test max}$											
63	13:04	11804	8168							"					
64	13:06	11802	8565							"					
65	13:09	11803	8998							"					
66	13:10	11789	8995	Measurement } mechanical test run											
67	13:25	11788	8998							"					
68	13:40	11791	8997							"					
	13:42	11784	9309	Trip speed of powerturbine reached											
69	13:47	11784	9309	Measurement											
	13:48			Speed decreased											
	13:50			Normal Stop											
				End of test run											

SGS Tecno S.A.
Edo. *[Signature]*



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Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 17 of 41

6 Measurement Readings

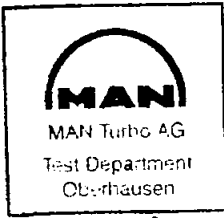


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	040	041	042	043
SAMPLETIME	10:38	10:50	10:53	10:56
Gas Generator (GG) speed	1/min 10617	10759	10760	10760
Power turbine (PT) speed	1/min 7323	6187	6977	7774
Torque at PT	Nm 5565.5	7520.8	6748.5	5991.0
Guide vane position	GRAD -19.4	-18.4	-18.4	-18.4
Ambient pressure	bar 1.0005	1.0005	1.0005	1.0005
Relative humidity	% 57.7	56.7	56.3	56.8
Reference temperature	GrdC 13.3	13.5	13.5	13.5
Pressure loss filter	bar -0.0018	-0.0018	-0.0017	-0.0017
Pressure loss venturi A	bar 0.1041	0.1060	0.1059	0.1056
Pressure loss venturi B	bar 0.1039	0.1058	0.1056	0.1053
Pressure loss venturi C	bar 0.1065	0.1084	0.1082	0.1079
Inlet press. compressor A	bar_g -0.0278	-0.0284	-0.0282	-0.0279
Inlet press. compressor B	bar_g -0.0268	-0.0275	-0.0273	-0.0273
Inlet temp. compr. Tt_11	GrdC 12.7	12.8	12.8	12.8
Inlet temp. compr. Tt_12	GrdC 12.8	12.9	12.8	12.9
Inlet temp. compr. Tt_13	GrdC 12.7	12.7	12.7	12.7
Inlet temp. compr. Tt_14	GrdC 12.8	12.9	12.9	12.9
Inlet temp. compr. Tt_15	GrdC 13.0	13.0	13.1	13.0
Inlet temp. compr. Tt_16	GrdC 12.6	12.7	12.7	12.7
Outlet press.compressor A	bar_g 5.8014	6.2258	6.2318	6.2384
Outlet press.compressor B	bar_g 5.8021	6.2279	6.2339	6.2402
Outlet temp. compr. Tt_21	GrdC 270.0	283.1	283.3	283.5
Outlet temp. compr. Tt_22	GrdC 269.8	283.0	283.3	283.6
Inlet press. PT	bar_g 1.0266	1.1262	1.1336	1.1413
Inlet temp. PT Tt_41	GrdC 706.2	674.7	683.0	692.3
Inlet temp. PT Tt_42	GrdC 608.2	597.1	599.4	604.2
Inlet temp. PT Tt_43	GrdC 528.4	535.9	536.3	535.1
Inlet temp. PT Tt_44	GrdC 555.1	543.7	547.6	551.6
Inlet temp. PT Tt_45	GrdC 562.7	569.7	572.7	573.8
Inlet temp. PT Tt_46	GrdC 685.6	678.4	681.0	683.7
Inlet temp. PT Tt_47	GrdC 624.5	599.0	602.2	607.7
Inlet temp. PT Tt_48	GrdC 570.6	560.9	564.0	567.0
Outlet press. PT A	bar_g -0.0026	-0.0017	-0.0004	-0.0011
Outlet press. PT B	bar_g -0.0045	-0.0029	-0.0034	-0.0038
Outlet temp. PT Tt_51	GrdC 455.9	427.0	437.8	443.7
Outlet temp. PT Tt_52	GrdC 468.5	443.7	448.2	456.0
Outlet temp. PT Tt_53	GrdC 467.9	446.9	442.3	456.3
Outlet temp. PT Tt_54	GrdC 453.9	432.4	441.4	443.1
Fuel gas temp.	GrdC 17.6	21.3	22.4	23.3
Fuel gas pressure	bar 10.0823	9.9085	10.0159	10.2354
Fuel gas volume flow	m3n/h 2341.6	2406.3	2421.0	2431.9
Oil press.GG f. bearing	bar_g 2.4	2.4	2.4	2.4

SGS Technos, S.A.
 Fdo.: *[Signature]*



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MACHINE NO. : 2155
ORDER-NO. : H.0200017
CODEWORD : VILLARPIPE 2
TYPE : THM 1304-12
DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	040	041	042	043	
SAMPLETIME	10:38	10:50	10:53	10:56	
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.1	2.2	2.2	2.2
Oil inlet temp.	GrdC	46.0	44.6	44.6	44.6
Oil vol.flow GG f.bearing	l/min	133.0	132.0	131.9	131.9
Oil vol.flow GG r.bearing	l/min	53.8	53.7	53.8	53.8
Oil vol.flow PT	l/min	125.4	122.7	123.0	123.2
Oil outl.temp.GG f.bear.	GrdC	51.9	50.8	50.7	50.7
Oil outl.temp.GG r.bear.	GrdC	66.0	66.1	66.2	66.2
Oil outl.temp.PT	GrdC	62.9	59.3	60.8	63.1
Shaft vib. GG f.1 unfilt.	my_pp	13	14	13	14
Shaft vib. GG f.2 unfilt.	my_pp	37	37	39	37
Shaft vib. PT r.1 unfilt.	my_pp	23	20	16	25
Shaft vib. PT r.2 unfilt.	my_pp	21	23	19	27
Shaft position GG axial	mm	0.14	0.13	0.13	0.13
Shaft position PT axial	mm	0.11	0.10	0.10	0.10
Temp.journal bear. GG f.1	GrdC	72.1	72.0	71.9	72.0
Temp.journal bear. GG f.2	GrdC	57.8	56.9	56.8	56.8
Temp.thrust bear.GG act.1	GrdC	56.6	55.9	55.7	55.7
Temp.thrust bear.GG act.2	GrdC	55.3	54.5	54.4	54.4
Temp.journal bear. GG r.1	GrdC	77.7	79.0	79.0	79.1
Temp.journal bear. GG r.2	GrdC	59.2	57.9	57.9	58.0
Temp.journal bear. PT f.1	GrdC	63.2	59.0	60.6	63.3
Temp.journal bear. PT f.2	GrdC	83.8	79.8	82.9	85.4
Temp.journal bear. PT r.1	GrdC	55.8	54.2	54.7	55.5
Temp.journal bear. PT r.2	GrdC	57.3	55.6	56.3	57.1
Temp.thrust bear.PT act.1	GrdC	62.4	61.1	62.3	63.2
Temp.thrust bear.PT act.2	GrdC	61.5	58.7	60.3	63.1
Measured O2	%	16.97	16.87	16.83	16.82
Measured CO	mg/m3	1.1	1.1	1.1	1.0
Measured NO	mg/m3	10.5	11.1	11.2	11.3
Measured NO2	mg/m3	5.3	5.7	6.0	5.9

SGS Tecnos, S.A.
Fdo.: *[Signature]*



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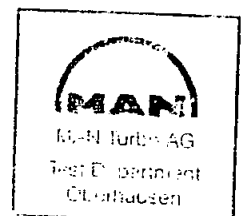
-20-

MACHINE NO. : 2155
ORDER-NO. : H.0200017
CODEWORD : VILLARPIPE 2
TYPE : THM 1304-12
DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT		044	045	046
SAMPLETIME		11:15	11:19	11:23
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.1	45.1	45.2
Oil vol.flow GG f.bearing	l/min	133.1	133.1	133.1
Oil vol.flow GG r.bearing	l/min	54.4	54.4	54.4
Oil vol.flow PT	l/min	125.0	125.5	125.6
Oil outl.temp.GG f.bear.	GrdC	51.4	51.5	51.6
Oil outl.temp.GG r.bear.	GrdC	69.1	69.1	69.3
Oil outl.temp.PT	GrdC	62.5	64.9	67.4
Shaft vib. GG f.1 unfilt.	my_pp	15	15	14
Shaft vib. GG f.2 unfilt.	my_pp	36	36	34
Shaft vib. PT r.1 unfilt.	my_pp	17	22	23
Shaft vib. PT r.2 unfilt.	my_pp	19	25	22
Shaft position GG axial	mm	0.12	0.12	0.12
Shaft position PT axial	mm	0.09	0.10	0.10
Temp.journal bear. GG f.1	GrdC	73.4	73.4	73.4
Temp.journal bear. GG f.2	GrdC	57.3	57.1	57.2
Temp.thrust bear.GG act.1	GrdC	57.2	57.0	56.9
Temp.thrust bear.GG act.2	GrdC	55.7	55.7	55.7
Temp.journal bear. GG r.1	GrdC	79.3	79.2	79.2
Temp.journal bear. GG r.2	GrdC	59.6	59.7	59.7
Temp.journal bear. PT f.1	GrdC	65.0	67.2	69.2
Temp.journal bear. PT f.2	GrdC	81.2	83.4	85.7
Temp.journal bear. PT r.1	GrdC	54.8	55.7	56.4
Temp.journal bear. PT r.2	GrdC	57.1	58.2	59.6
Temp.thrust bear.PT act.1	GrdC	65.7	67.5	68.5
Temp.thrust bear.PT act.2	GrdC	63.4	64.8	70.1
Measured O2	%	16.36	16.32	16.33
Measured CO	mg/m3	1.1	1.2	1.3
Measured NO	mg/m3	8.5	8.8	8.2
Measured NO2	mg/m3	6.5	6.6	6.4

SGS TecnoS, S.A.
Fdo.: *[Signature]*



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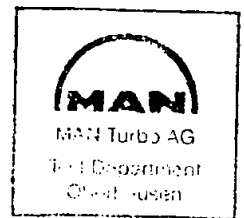


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT		044	045	046
SAMPLETIME		11:15	11:19	11:23
Gas Generator (GG) speed	1/min	11153	11154	11154
Power turbine (PT) speed	1/min	6976	7780	8571
Torque at PT	Nm	9137.0	8302.8	7426.1
Guide vane position	GRAD	-11.8	-11.8	-11.8
Ambient pressure	bar	1.0002	1.0001	1.0000
Relative humidity	%	55.8	55.3	55.4
Reference temperature	GrdC	13.7	13.9	13.8
Pressure loss filter	bar	-0.0021	-0.0021	-0.0021
Pressure loss venturi A	bar	0.1334	0.1330	0.1330
Pressure loss venturi B	bar	0.1328	0.1326	0.1325
Pressure loss venturi C	bar	0.1361	0.1360	0.1358
Inlet press. compressor A	bar_g	-0.0349	-0.0348	-0.0349
Inlet press. compressor B	bar_g	-0.0342	-0.0338	-0.0342
Inlet temp. compr. Tt_11	GrdC	12.6	12.7	12.7
Inlet temp. compr. Tt_12	GrdC	12.6	12.6	12.6
Inlet temp. compr. Tt_13	GrdC	12.4	12.5	12.5
Inlet temp. compr. Tt_14	GrdC	12.6	12.6	12.7
Inlet temp. compr. Tt_15	GrdC	12.8	12.8	12.8
Inlet temp. compr. Tt_16	GrdC	12.5	12.4	12.5
Outlet press.compressor A	bar_g	7.2781	7.2857	7.2949
Outlet press.compressor B	bar_g	7.2767	7.2834	7.2924
Outlet temp. compr. Tt_21	GrdC	303.2	303.5	303.6
Outlet temp. compr. Tt_22	GrdC	303.3	303.5	303.8
Inlet press. PT	bar_g	1.3812	1.3891	1.3980
Inlet temp. PT Tt_41	GrdC	690.3	689.5	680.4
Inlet temp. PT Tt_42	GrdC	662.9	668.3	681.5
Inlet temp. PT Tt_43	GrdC	592.0	595.2	604.4
Inlet temp. PT Tt_44	GrdC	629.4	631.4	632.3
Inlet temp. PT Tt_45	GrdC	577.4	581.0	592.5
Inlet temp. PT Tt_46	GrdC	698.4	697.6	696.9
Inlet temp. PT Tt_47	GrdC	713.8	717.0	716.2
Inlet temp. PT Tt_48	GrdC	670.0	674.0	674.3
Outlet press. PT A	bar_g	-0.0012	0.0000	-0.0010
Outlet press. PT B	bar_g	-0.0023	-0.0043	-0.0044
Outlet temp. PT Tt_51	GrdC	460.7	477.4	473.8
Outlet temp. PT Tt_52	GrdC	491.4	481.8	468.9
Outlet temp. PT Tt_53	GrdC	469.5	454.7	473.3
Outlet temp. PT Tt_54	GrdC	460.0	473.7	479.2
Fuel gas temp.	GrdC	27.2	27.4	27.6
Fuel gas pressure	bar	10.4534	10.3298	10.2504
Fuel gas volume flow	m3n/h	2945.7	2955.4	2972.7
Oil press.GG f. bearing	bar_g	2.5	2.5	2.5

SGS Tecnos, S.A.
 Fdo.: *[Signature]*



Zürich

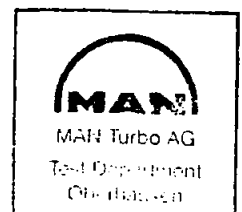


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	047	048	049	050	051
SAMPLETIME	11:40	11:43	11:46	11:48	11:52
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.6	45.6	45.6	45.6
Oil vol.flow GG f.bearing	l/min	134.0	134.0	133.9	133.9
Oil vol.flow GG r.bearing	l/min	54.8	54.8	54.8	54.8
Oil vol.flow PT	l/min	126.7	127.0	127.2	127.0
Oil outl.temp.GG f.bear.	GrdC	52.1	52.0	52.1	52.1
Oil outl.temp.GG r.bear.	GrdC	71.1	71.1	71.1	71.2
Oil outl.temp.PT	GrdC	65.2	66.4	67.4	68.9
Shaft vib. GG f.1 unfilt.	my_pp	15	15	14	14
Shaft vib. GG f.2 unfilt.	my_pp	32	32	31	31
Shaft vib. PT r.1 unfilt.	my_pp	18	20	19	21
Shaft vib. PT r.2 unfilt.	my_pp	14	21	16	17
Shaft position GG axial	mm	0.12	0.12	0.12	0.12
Shaft position PT axial	mm	0.08	0.09	0.09	0.09
Temp.journal bear. GG f.1	GrdC	74.0	73.9	73.8	74.2
Temp.journal bear. GG f.2	GrdC	58.0	58.0	57.8	58.0
Temp.thrust bear.GG act.1	GrdC	57.6	57.4	57.3	57.5
Temp.thrust bear.GG act.2	GrdC	56.3	56.4	56.3	56.4
Temp.journal bear. GG r.1	GrdC	79.8	79.8	79.7	79.8
Temp.journal bear. GG r.2	GrdC	59.8	60.0	59.8	60.0
Temp.journal bear. PT f.1	GrdC	64.8	65.6	66.2	67.5
Temp.journal bear. PT f.2	GrdC	81.9	83.0	84.3	85.7
Temp.journal bear. PT r.1	GrdC	56.0	56.5	56.7	57.2
Temp.journal bear. PT r.2	GrdC	59.0	59.7	59.8	60.5
Temp.thrust bear.PT act.1	GrdC	68.2	69.2	70.1	70.5
Temp.thrust bear.PT act.2	GrdC	66.1	66.9	67.5	70.1
Measured O2	%	16.05	16.03	16.02	16.01
Measured CO	mg/m3	5.2	4.1	4.5	4.5
Measured NO	mg/m3	6.3	6.9	6.7	6.6
Measured NO2	mg/m3	6.4	6.3	6.3	6.5

SGS Tecnos, S.A.
 Fdo.: *[Signature]*



[Signature]

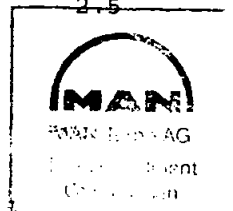


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	047	048	049	050	051	
SAMPLETIME	11:40	11:43	11:46	11:48	11:52	
Gas Generator (GG) speed	1/min	11351	11358	11358	11358	11358
Power turbine (PT) speed	1/min	7374	7772	8171	8570	9003
Torque at PT	Nm	10128.8	9738.5	9302.8	8831.6	8327.8
Guide vane position	GRAD	-7.5	-7.5	-7.5	-7.5	-7.5
Ambient pressure	bar	0.9999	0.9999	0.9999	0.9999	0.9999
Relative humidity	%	55.9	56.0	55.7	55.6	55.4
Reference temperature	GrdC	13.8	13.8	13.9	13.9	13.9
Pressure loss filter	bar	-0.0023	-0.0023	-0.0023	-0.0023	-0.0023
Pressure loss venturi A	bar	0.1493	0.1496	0.1493	0.1494	0.1493
Pressure loss venturi B	bar	0.1487	0.1489	0.1489	0.1490	0.1488
Pressure loss venturi C	bar	0.1523	0.1526	0.1528	0.1526	0.1527
Inlet press. compressor A	bar_g	-0.0392	-0.0391	-0.0392	-0.0391	-0.0386
Inlet press. compressor B	bar_g	-0.0382	-0.0384	-0.0382	-0.0383	-0.0380
Inlet temp. compr. Tt_11	GrdC	12.7	12.7	12.7	12.7	12.8
Inlet temp. compr. Tt_12	GrdC	12.4	12.5	12.5	12.5	12.5
Inlet temp. compr. Tt_13	GrdC	12.4	12.4	12.4	12.5	12.4
Inlet temp. compr. Tt_14	GrdC	12.6	12.6	12.6	12.6	12.6
Inlet temp. compr. Tt_15	GrdC	12.7	12.7	12.6	12.7	12.7
Inlet temp. compr. Tt_16	GrdC	12.4	12.4	12.4	12.4	12.4
Outlet press.compressor A	bar_g	7.8992	7.9112	7.9169	7.9263	7.9324
Outlet press.compressor B	bar_g	7.8968	7.9101	7.9163	7.9241	7.9306
Outlet temp. compr. Tt_21	GrdC	316.4	316.5	316.6	316.8	316.9
Outlet temp. compr. Tt_22	GrdC	316.4	316.6	316.8	316.9	317.0
Inlet press. PT	bar_g	1.5335	1.5390	1.5424	1.5477	1.5518
Inlet temp. PT Tt_41	GrdC	707.0	708.6	709.2	710.3	710.3
Inlet temp. PT Tt_42	GrdC	723.3	724.6	725.5	726.6	727.0
Inlet temp. PT Tt_43	GrdC	692.8	693.7	695.2	696.6	697.1
Inlet temp. PT Tt_44	GrdC	641.2	642.8	644.4	646.5	647.7
Inlet temp. PT Tt_45	GrdC	683.6	685.6	689.0	692.0	695.4
Inlet temp. PT Tt_46	GrdC	724.8	725.4	725.9	726.3	726.3
Inlet temp. PT Tt_47	GrdC	710.8	711.9	712.4	713.0	713.3
Inlet temp. PT Tt_48	GrdC	681.7	683.9	684.6	686.0	686.8
Outlet press. PT A	bar_g	-0.0008	-0.0006	0.0008	0.0002	-0.0005
Outlet press. PT B	bar_g	-0.0019	-0.0015	-0.0024	-0.0036	-0.0038
Outlet temp. PT Tt_51	GrdC	489.6	486.4	485.6	488.3	490.7
Outlet temp. PT Tt_52	GrdC	487.1	488.4	486.2	486.2	486.3
Outlet temp. PT Tt_53	GrdC	493.8	487.2	478.8	478.4	488.8
Outlet temp. PT Tt_54	GrdC	487.6	479.9	484.0	492.3	493.0
Fuel gas temp.	GrdC	27.7	27.7	27.7	27.7	27.7
Fuel gas pressure	bar	9.8884	9.8419	9.8813	9.8986	10.1277
Fuel gas volume flow	m3n/h	3271.4	3283.8	3291.2	3302.1	3306.4
Oil press.GG f. bearing	bar_g	2.5	2.5	2.5	2.5	2.5

SGS Tecnos, S.A.
 Fdo.: *[Signature]*





MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	052	053	054	055	056	
SAMPLETIME	12:12	12:14	12:17	12:19	12:21	
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.6	45.5	45.4	45.4	45.4
Oil vol.flow GG f.bearing	l/min	134.4	134.3	134.2	134.2	134.3
Oil vol.flow GG r.bearing	l/min	55.1	55.1	55.1	55.1	55.1
Oil vol.flow PT	l/min	127.5	127.6	127.5	127.8	127.5
Oil outl.temp.GG f.bear.	GrdC	52.4	52.3	52.2	52.2	52.2
Oil outl.temp.GG r.bear.	GrdC	72.3	72.3	72.3	72.3	72.4
Oil outl.temp.PT	GrdC	66.1	67.0	68.2	69.5	71.1
Shaft vib. GG f.1 unfilt.	my_pp	16	16	15	15	15
Shaft vib. GG f.2 unfilt.	my_pp	28	28	27	27	28
Shaft vib. PT r.1 unfilt.	my_pp	18	20	19	20	22
Shaft vib. PT r.2 unfilt.	my_pp	16	22	14	18	22
Shaft position GG axial	mm	0.12	0.12	0.12	0.12	0.12
Shaft position PT axial	mm	0.07	0.08	0.08	0.08	0.09
Temp.journal bear. GG f.1	GrdC	74.9	74.7	74.8	74.7	74.8
Temp.journal bear. GG f.2	GrdC	58.4	58.1	58.3	58.0	58.2
Temp.thrust bear.GG act.1	GrdC	57.9	57.7	57.6	57.6	57.5
Temp.thrust bear.GG act.2	GrdC	56.9	56.7	56.7	56.6	56.5
Temp.journal bear. GG r.1	GrdC	81.3	81.1	81.3	81.2	81.1
Temp.journal bear. GG r.2	GrdC	60.2	60.1	60.1	60.1	60.0
Temp.journal bear. PT f.1	GrdC	65.4	65.9	66.6	67.5	69.2
Temp.journal bear. PT f.2	GrdC	81.8	82.8	84.2	85.4	86.5
Temp.journal bear. PT r.1	GrdC	55.8	56.2	56.8	57.4	57.4
Temp.journal bear. PT r.2	GrdC	59.1	59.5	60.1	60.3	60.6
Temp.thrust bear.PT act.1	GrdC	69.8	70.6	71.7	72.6	72.8
Temp.thrust bear.PT act.2	GrdC	68.1	68.5	69.1	70.1	74.7
Measured O2	%	15.64	15.65	15.64	15.63	15.58
Measured CO	mg/m3	1.2	1.1	1.1	1.2	1.1
Measured NO	mg/m3	8.4	8.4	8.4	9.4	8.5
Measured NO2	mg/m3	6.9	6.8	6.7	6.9	6.9

SGS TecnoS, S.A.
 Fdo.: *[Signature]*





MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT		052	053	054	055	056
SAMPLETIME		12:12	12:14	12:17	12:19	12:21
Gas Generator (GG) speed	1/min	11563	11563	11549	11562	11561
Power turbine (PT) speed	1/min	7383	7776	8170	8568	9015
Torque at PT	Nm	11699.4	11266.1	10789.5	10376.6	9855.7
Guide vane position	GRAD	-2.5	-2.5	-2.5	-2.5	-2.5
Ambient pressure	bar	0.9995	0.9995	0.9993	0.9994	0.9994
Relative humidity	%	54.2	54.3	53.8	53.6	54.7
Reference temperature	GrdC	14.2	14.2	14.2	14.2	14.3
Pressure loss filter	bar	-0.0025	-0.0024	-0.0024	-0.0024	-0.0024
Pressure loss venturi A	bar	0.1684	0.1680	0.1676	0.1676	0.1679
Pressure loss venturi B	bar	0.1676	0.1675	0.1670	0.1671	0.1673
Pressure loss venturi C	bar	0.1719	0.1717	0.1711	0.1713	0.1713
Inlet press. compressor A	bar_g	-0.0438	-0.0437	-0.0437	-0.0434	-0.0439
Inlet press. compressor B	bar_g	-0.0429	-0.0429	-0.0431	-0.0427	-0.0433
Inlet temp. compr. Tt_11	GrdC	13.0	13.0	13.1	13.1	12.9
Inlet temp. compr. Tt_12	GrdC	12.6	12.7	12.7	12.8	12.6
Inlet temp. compr. Tt_13	GrdC	12.6	12.6	12.7	12.8	12.6
Inlet temp. compr. Tt_14	GrdC	12.8	12.8	12.9	12.9	12.8
Inlet temp. compr. Tt_15	GrdC	12.9	12.9	13.0	13.0	12.9
Inlet temp. compr. Tt_16	GrdC	12.6	12.6	12.7	12.7	12.6
Outlet press.compressor A	bar_g	8.5404	8.5416	8.5253	8.5390	8.5437
Outlet press.compressor B	bar_g	8.5398	8.5404	8.5242	8.5380	8.5426
Outlet temp. compr. Tt_21	GrdC	330.4	330.6	330.3	330.7	330.5
Outlet temp. compr. Tt_22	GrdC	330.6	330.7	330.7	330.8	330.8
Inlet press. PT	bar_g	1.7062	1.7084	1.7066	1.7124	1.7167
Inlet temp. PT Tt_41	GrdC	746.0	747.1	747.3	748.6	749.9
Inlet temp. PT Tt_42	GrdC	765.2	766.2	766.2	767.6	768.8
Inlet temp. PT Tt_43	GrdC	735.9	736.8	736.5	738.7	739.1
Inlet temp. PT Tt_44	GrdC	682.4	684.0	683.9	685.3	686.2
Inlet temp. PT Tt_45	GrdC	732.1	732.3	733.1	734.7	735.5
Inlet temp. PT Tt_46	GrdC	767.1	767.3	767.6	769.6	769.9
Inlet temp. PT Tt_47	GrdC	752.3	754.2	754.2	755.3	756.9
Inlet temp. PT Tt_48	GrdC	727.2	729.2	729.3	730.6	732.1
Outlet press. PT A	bar_g	-0.0020	-0.0011	-0.0010	0.0001	0.0017
Outlet press. PT B	bar_g	-0.0010	-0.0001	-0.0010	-0.0023	-0.0028
Outlet temp. PT Tt_51	GrdC	512.3	513.8	512.0	510.2	509.7
Outlet temp. PT Tt_52	GrdC	509.7	509.7	511.1	513.2	511.2
Outlet temp. PT Tt_53	GrdC	519.9	519.2	515.8	508.8	500.0
Outlet temp. PT Tt_54	GrdC	518.0	516.6	510.7	505.7	509.6
Fuel gas temp.	GrdC	27.4	27.3	27.3	27.2	27.2
Fuel gas pressure	bar	10.3322	10.2187	10.1643	10.1002	10.1209
Fuel gas volume flow	m3n/h	3683.2	3689.0	3680.3	3688.6	3703.6
Oil press.GG f. bearing	bar_g	2.5	2.5	2.5	2.5	2.5

SGS Tecnos, S.A.
 Fdo.: *SGR*



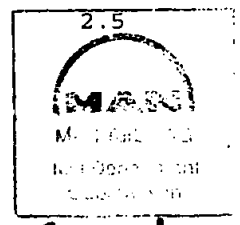


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	057	058	059	060	061	
SAMPLETIME	12:35	12:38	12:40	12:43	12:46	
Gas Generator (GG) speed	1/min	11757	11754	11756	11753	11754
Power turbine (PT) speed	1/min	7378	7780	8169	8566	8997
Torque at PT	Nm	13318.1	12868.6	12413.9	11970.1	11465.9
Guide vane position	GRAD	2.4	2.6	2.6	2.6	2.6
Ambient pressure	bar	0.9995	0.9995	0.9995	0.9994	0.9992
Relative humidity	%	56.6	56.8	56.7	56.9	56.4
Reference temperature	GrdC	14.2	14.1	14.1	14.1	14.2
Pressure loss filter	bar	-0.0026	-0.0025	-0.0026	-0.0027	-0.0026
Pressure loss venturi A	bar	0.1873	0.1874	0.1873	0.1875	0.1873
Pressure loss venturi B	bar	0.1867	0.1868	0.1867	0.1868	0.1867
Pressure loss venturi C	bar	0.1912	0.1913	0.1908	0.1909	0.1909
Inlet press. compressor A	bar_g	-0.0487	-0.0484	-0.0491	-0.0492	-0.0493
Inlet press. compressor B	bar_g	-0.0476	-0.0476	-0.0480	-0.0482	-0.0482
Inlet temp. compr. Tt_11	GrdC	12.8	12.7	12.7	12.7	12.7
Inlet temp. compr. Tt_12	GrdC	12.3	12.3	12.3	12.3	12.2
Inlet temp. compr. Tt_13	GrdC	12.2	12.2	12.3	12.3	12.2
Inlet temp. compr. Tt_14	GrdC	12.4	12.5	12.6	12.5	12.5
Inlet temp. compr. Tt_15	GrdC	12.5	12.5	12.7	12.7	12.6
Inlet temp. compr. Tt_16	GrdC	12.2	12.2	12.3	12.3	12.2
Outlet press.compressor A	bar_g	9.1610	9.1622	9.1595	9.1663	9.1698
Outlet press.compressor B	bar_g	9.1615	9.1624	9.1601	9.1672	9.1697
Outlet temp. compr. Tt_21	GrdC	344.3	344.3	344.3	344.4	344.6
Outlet temp. compr. Tt_22	GrdC	344.5	344.5	344.7	344.8	345.0
Inlet press. PT	bar_g	1.8814	1.8861	1.8885	1.8922	1.8953
Inlet temp. PT Tt_41	GrdC	793.2	793.0	794.4	795.4	796.9
Inlet temp. PT Tt_42	GrdC	816.2	816.8	818.2	819.3	820.4
Inlet temp. PT Tt_43	GrdC	783.9	783.8	785.8	786.0	786.3
Inlet temp. PT Tt_44	GrdC	730.0	730.5	731.9	732.7	733.4
Inlet temp. PT Tt_45	GrdC	777.7	779.2	779.9	781.0	782.2
Inlet temp. PT Tt_46	GrdC	816.5	816.7	818.1	819.1	820.7
Inlet temp. PT Tt_47	GrdC	785.2	784.6	784.7	785.1	787.1
Inlet temp. PT Tt_48	GrdC	750.1	749.9	750.2	750.4	751.7
Outlet press. PT A	bar_g	-0.0006	-0.0017	-0.0018	-0.0019	-0.0007
Outlet press. PT B	bar_g	0.0016	0.0001	-0.0003	-0.0004	-0.0014
Outlet temp. PT Tt_51	GrdC	544.5	540.2	539.8	539.4	537.5
Outlet temp. PT Tt_52	GrdC	535.3	532.4	531.7	531.5	534.7
Outlet temp. PT Tt_53	GrdC	542.3	543.7	545.6	545.4	543.5
Outlet temp. PT Tt_54	GrdC	549.9	546.1	545.0	540.5	536.3
Fuel gas temp.	GrdC	26.8	26.8	26.7	26.7	26.6
Fuel gas pressure	bar	9.7934	9.7101	9.7043	9.7339	9.9522
Fuel gas volume flow	m3n/h	4116.1	4115.2	4121.6	4131.0	4132.7
Oil press.GG f. bearing	bar_g	2.5	2.5	2.5	2.5	2.5

SGS Tecnos, S.A.
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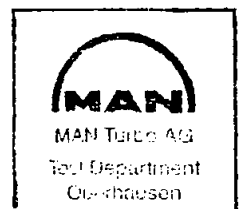


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	057	058	059	060	061	
SAMPLETIME	12:35	12:38	12:40	12:43	12:46	
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.4	45.4	45.4	45.5	45.6
Oil vol.flow GG f.bearing	l/min	134.6	134.6	134.5	134.6	134.7
Oil vol.flow GG r.bearing	l/min	55.4	55.5	55.5	55.5	55.5
Oil vol.flow PT	l/min	128.0	128.0	128.1	128.2	128.2
Oil outl.temp.GG f.bear.	GrdC	52.5	52.5	52.5	52.5	52.7
Oil outl.temp.GG r.bear.	GrdC	73.4	73.4	73.5	73.5	73.7
Oil outl.temp.PT	GrdC	66.5	67.7	68.9	70.4	72.4
Shaft vib. GG f.1 unfilt.	my_pp	16	16	16	15	15
Shaft vib. GG f.2 unfilt.	my_pp	29	29	28	28	29
Shaft vib. PT r.1 unfilt.	my_pp	19	21	20	21	22
Shaft vib. PT r.2 unfilt.	my_pp	18	21	14	18	22
Shaft position GG axial	mm	0.11	0.11	0.11	0.12	0.12
Shaft position PT axial	mm	0.06	0.06	0.07	0.07	0.08
Temp.journal bear. GG f.1	GrdC	75.4	75.5	75.5	75.4	75.6
Temp.journal bear. GG f.2	GrdC	58.5	58.5	58.6	58.5	58.7
Temp.thrust bear.GG act.1	GrdC	58.0	57.9	57.8	57.6	57.7
Temp.thrust bear.GG act.2	GrdC	56.9	56.8	56.9	56.8	56.9
Temp.journal bear. GG r.1	GrdC	82.9	82.9	82.9	82.9	82.9
Temp.journal bear. GG r.2	GrdC	60.0	59.9	60.1	60.0	60.1
Temp.journal bear. PT f.1	GrdC	64.5	64.8	65.2	65.8	67.2
Temp.journal bear. PT f.2	GrdC	81.9	83.0	84.3	85.7	86.9
Temp.journal bear. PT r.1	GrdC	55.9	56.9	57.8	59.0	59.7
Temp.journal bear. PT r.2	GrdC	58.3	59.0	59.5	60.1	60.9
Temp.thrust bear.PT act.1	GrdC	71.2	72.0	73.2	74.1	74.3
Temp.thrust bear.PT act.2	GrdC	69.5	70.2	70.8	71.6	75.4
Measured O2	%	15.21	15.18	15.17	15.18	15.15
Measured CO	mg/m3	1.6	1.5	1.4	1.4	1.4
Measured NO	mg/m3	11.2	11.1	11.7	11.0	11.2
Measured NO2	mg/m3	7.7	7.7	7.7	7.8	7.9

SGS Tecnos, S.A.
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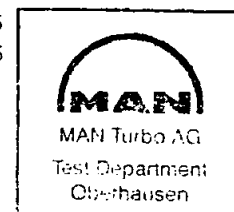


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	062	063	064	065	
SAMPLETIME	13:00	13:04	13:06	13:09	
Gas Generator (GG) speed	1/min	11800	11804	11802	11803
Power turbine (PT) speed	1/min	7768	8168	8565	8998
Torque at PT	Nm	13228.8	12806.1	12350.0	11824.4
Guide vane position	GRAD	3.9	3.9	3.9	3.9
Ambient pressure	bar	0.9991	0.9990	0.9989	0.9990
Relative humidity	%	60.1	61.0	61.8	61.5
Reference temperature	GrdC	13.9	13.9	13.8	13.7
Pressure loss filter	bar	-0.0027	-0.0027	-0.0026	-0.0026
Pressure loss venturi A	bar	0.1920	0.1919	0.1915	0.1916
Pressure loss venturi B	bar	0.1912	0.1913	0.1909	0.1909
Pressure loss venturi C	bar	0.1953	0.1958	0.1954	0.1957
Inlet press. compressor A	bar_g	-0.0500	-0.0498	-0.0500	-0.0507
Inlet press. compressor B	bar_g	-0.0490	-0.0491	-0.0491	-0.0500
Inlet temp. compr. Tt_11	GrdC	12.4	12.4	12.4	12.3
Inlet temp. compr. Tt_12	GrdC	12.0	11.9	11.9	11.8
Inlet temp. compr. Tt_13	GrdC	12.0	11.8	11.8	11.8
Inlet temp. compr. Tt_14	GrdC	12.3	12.1	12.1	12.1
Inlet temp. compr. Tt_15	GrdC	12.3	12.2	12.1	12.2
Inlet temp. compr. Tt_16	GrdC	11.9	11.8	11.8	11.8
Outlet press.compressor A	bar_g	9.3023	9.3124	9.3138	9.3108
Outlet press.compressor B	bar_g	9.3034	9.3139	9.3150	9.3121
Outlet temp. compr. Tt_21	GrdC	347.6	347.6	347.7	347.5
Outlet temp. compr. Tt_22	GrdC	347.9	347.9	347.9	348.1
Inlet press. PT	bar_g	1.9274	1.9360	1.9343	1.9386
Inlet temp. PT Tt_41	GrdC	805.9	810.5	806.2	810.7
Inlet temp. PT Tt_42	GrdC	829.7	830.6	831.8	832.4
Inlet temp. PT Tt_43	GrdC	792.0	789.4	794.8	792.5
Inlet temp. PT Tt_44	GrdC	739.0	738.5	742.2	741.0
Inlet temp. PT Tt_45	GrdC	790.1	791.7	791.6	793.8
Inlet temp. PT Tt_46	GrdC	829.5	831.0	831.7	833.2
Inlet temp. PT Tt_47	GrdC	795.5	797.7	797.3	799.6
Inlet temp. PT Tt_48	GrdC	759.4	760.9	761.7	762.7
Outlet press. PT A	bar_g	0.0006	-0.0018	-0.0020	-0.0011
Outlet press. PT B	bar_g	0.0030	0.0010	-0.0014	-0.0016
Outlet temp. PT Tt_51	GrdC	548.5	546.5	544.9	543.5
Outlet temp. PT Tt_52	GrdC	539.4	536.5	538.3	539.4
Outlet temp. PT Tt_53	GrdC	548.3	551.5	552.3	552.0
Outlet temp. PT Tt_54	GrdC	554.6	551.1	548.8	543.8
Fuel gas temp.	GrdC	26.1	25.9	25.8	25.7
Fuel gas pressure	bar	10.3336	10.2323	10.1767	10.1125
Fuel gas volume flow	m3n/h	4235.7	4236.0	4247.3	4242.5
Oil press.GG f. bearing	bar_g	2.5	2.5	2.5	2.5

SGS Techos, S.A.
 Fdo. *[Signature]*



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MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	062	063	064	065	
SAMPLETIME	13:00	13:04	13:06	13:09	
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.8	45.8	45.7	45.7
Oil vol.flow GG f.bearing	l/min	135.1	135.0	134.9	134.9
Oil vol.flow GG r.bearing	l/min	55.6	55.6	55.6	55.6
Oil vol.flow PT	l/min	128.8	128.9	128.9	128.7
Oil outl.temp.GG f.bear.	GrdC	52.9	52.9	52.8	52.7
Oil outl.temp.GG r.bear.	GrdC	74.1	74.1	74.1	74.1
Oil outl.temp.PT	GrdC	68.4	69.7	70.9	72.6
Shaft vib. GG f.1 unfilt.	my_pp	18	16	16	17
Shaft vib. GG f.2 unfilt.	my_pp	30	29	28	31
Shaft vib. PT r.1 unfilt.	my_pp	22	20	22	23
Shaft vib. PT r.2 unfilt.	my_pp	22	15	18	23
Shaft position GG axial	mm	0.11	0.11	0.11	0.11
Shaft position PT axial	mm	0.06	0.06	0.07	0.07
Temp.journal bear. GG f.1	GrdC	75.7	75.7	75.8	75.8
Temp.journal bear. GG f.2	GrdC	58.7	58.7	58.7	59.0
Temp.thrust bear.GG act.1	GrdC	58.0	58.0	57.9	57.9
Temp.thrust bear.GG act.2	GrdC	57.1	57.1	57.2	57.0
Temp.journal bear. GG r.1	GrdC	83.4	83.5	83.5	83.6
Temp.journal bear. GG r.2	GrdC	60.2	60.3	60.4	60.3
Temp.journal bear. PT f.1	GrdC	64.4	65.1	66.1	67.3
Temp.journal bear. PT f.2	GrdC	83.3	84.5	85.9	87.0
Temp.journal bear. PT r.1	GrdC	57.3	58.1	59.1	59.8
Temp.journal bear. PT r.2	GrdC	59.1	59.7	60.4	60.7
Temp.thrust bear.PT act.1	GrdC	72.5	73.6	74.6	74.9
Temp.thrust bear.PT act.2	GrdC	70.6	71.5	72.2	74.6
Measured O2	%	15.08	15.06	15.06	15.04
Measured CO	mg/m3	1.2	1.4	1.4	1.4
Measured NO	mg/m3	12.1	12.0	11.6	11.8
Measured NO2	mg/m3	8.2	8.0	8.1	8.3

SGS Tecnos, S.A.
 Fdo.: *[Signature]*



[Signature]

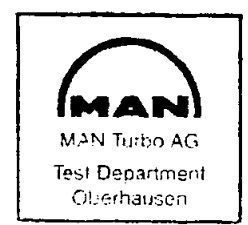


MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	066	067	068	069
SAMPLETIME	13:10	13:25	13:40	13:47
Gas Generator (GG) speed	1/min 11789	1/min 11788	1/min 11791	1/min 11784
Power turbine (PT) speed	1/min 8995	1/min 8998	1/min 8997	1/min 9309
Torque at PT	Nm 11740.5	Nm 11720.3	Nm 11740.5	Nm 11284.8
Guide vane position	GRAD 3.9	GRAD 3.9	GRAD 3.9	GRAD 3.9
Ambient pressure	bar 0.9990	bar 0.9990	bar 0.9987	bar 0.9987
Relative humidity	% 61.9	% 62.5	% 62.8	% 62.4
Reference temperature	GrdC 13.7	GrdC 13.8	GrdC 13.9	GrdC 13.9
Pressure loss filter	bar -0.0027	bar -0.0027	bar -0.0027	bar -0.0027
Pressure loss venturi A	bar 0.1906	bar 0.1906	bar 0.1907	bar 0.1896
Pressure loss venturi B	bar 0.1899	bar 0.1900	bar 0.1899	bar 0.1890
Pressure loss venturi C	bar 0.1946	bar 0.1943	bar 0.1945	bar 0.1937
Inlet press. compressor A	bar_g -0.0499	bar_g -0.0497	bar_g -0.0490	bar_g -0.0490
Inlet press. compressor B	bar_g -0.0490	bar_g -0.0489	bar_g -0.0484	bar_g -0.0485
Inlet temp. compr. Tt_11	GrdC 12.4	GrdC 12.3	GrdC 12.4	GrdC 12.5
Inlet temp. compr. Tt_12	GrdC 11.9	GrdC 11.9	GrdC 11.9	GrdC 12.1
Inlet temp. compr. Tt_13	GrdC 11.8	GrdC 11.8	GrdC 11.9	GrdC 12.0
Inlet temp. compr. Tt_14	GrdC 12.1	GrdC 12.1	GrdC 12.1	GrdC 12.2
Inlet temp. compr. Tt_15	GrdC 12.1	GrdC 12.1	GrdC 12.2	GrdC 12.3
Inlet temp. compr. Tt_16	GrdC 11.8	GrdC 11.8	GrdC 11.8	GrdC 12.0
Outlet press.compressor A	bar_g 9.2834	bar_g 9.2770	bar_g 9.2804	bar_g 9.2475
Outlet press.compressor B	bar_g 9.2839	bar_g 9.2781	bar_g 9.2813	bar_g 9.2487
Outlet temp. compr. Tt_21	GrdC 346.9	GrdC 346.7	GrdC 346.7	GrdC 346.3
Outlet temp. compr. Tt_22	GrdC 347.3	GrdC 346.9	GrdC 346.9	GrdC 346.5
Inlet press. PT	bar_g 1.9283	bar_g 1.9253	bar_g 1.9252	bar_g 1.9178
Inlet temp. PT Tt_41	GrdC 808.9	GrdC 805.3	GrdC 804.8	GrdC 803.4
Inlet temp. PT Tt_42	GrdC 829.5	GrdC 829.4	GrdC 830.1	GrdC 828.0
Inlet temp. PT Tt_43	GrdC 790.3	GrdC 792.9	GrdC 795.0	GrdC 793.0
Inlet temp. PT Tt_44	GrdC 739.0	GrdC 739.9	GrdC 741.6	GrdC 740.2
Inlet temp. PT Tt_45	GrdC 790.5	GrdC 788.8	GrdC 789.5	GrdC 788.1
Inlet temp. PT Tt_46	GrdC 829.6	GrdC 829.6	GrdC 830.5	GrdC 828.7
Inlet temp. PT Tt_47	GrdC 795.4	GrdC 796.4	GrdC 796.4	GrdC 795.6
Inlet temp. PT Tt_48	GrdC 759.1	GrdC 760.5	GrdC 760.8	GrdC 760.0
Outlet press. PT A	bar_g -0.0017	bar_g -0.0013	bar_g -0.0010	bar_g 0.0004
Outlet press. PT B	bar_g -0.0019	bar_g -0.0016	bar_g -0.0012	bar_g -0.0018
Outlet temp. PT Tt_51	GrdC 542.4	GrdC 541.9	GrdC 542.7	GrdC 539.8
Outlet temp. PT Tt_52	GrdC 538.2	GrdC 538.5	GrdC 539.4	GrdC 541.8
Outlet temp. PT Tt_53	GrdC 550.3	GrdC 549.1	GrdC 549.9	GrdC 544.7
Outlet temp. PT Tt_54	GrdC 542.2	GrdC 541.5	GrdC 542.4	GrdC 538.9
Fuel gas temp.	GrdC 25.7	GrdC 25.3	GrdC 25.2	GrdC 25.2
Fuel gas pressure	bar 10.1177	bar 9.8340	bar 9.9514	bar 10.5512
Fuel gas volume flow	m3n/h 4215.5	m3n/h 4468.4	m3n/h 4381.0	m3n/h 4351.2
Oil press.GG f. bearing	bar_g 2.5	bar_g 2.5	bar_g 2.5	bar_g 2.5

SGS Techos, S.A.
 Fda.: *[Signature]*



[Handwritten signature]



MACHINE NO. : 2155
 ORDER-NO. : H.0200017
 CODEWORD : VILLARPIPE 2
 TYPE : THM 1304-12
 DATE OF TEST: 25.11.2009

Shop Performance Test

MEASURINGPOINT	066	067	068	069	
SAMPLETIME	13:10	13:25	13:40	13:47	
Oil press.GG r. bearing	bar_g	1.9	1.9	1.9	1.9
Oil press.PT	bar_g	2.2	2.2	2.2	2.2
Oil inlet temp.	GrdC	45.8	46.4	46.5	46.5
Oil vol.flow GG f.bearing	l/min	134.9	135.4	135.6	135.6
Oil vol.flow GG r.bearing	l/min	55.6	55.7	55.7	55.7
Oil vol.flow PT	l/min	128.6	129.4	129.6	129.9
Oil outl.temp.GG f.bear.	GrdC	52.8	53.4	53.4	53.5
Oil outl.temp.GG r.bear.	GrdC	74.2	74.6	74.6	74.7
Oil outl.temp.PT	GrdC	72.9	74.2	74.4	75.7
Shaft vib. GG f.1 unfilt.	my_pp	16	17	17	17
Shaft vib. GG f.2 unfilt.	my_pp	31	29	30	28
Shaft vib. PT r.1 unfilt.	my_pp	23	24	24	25
Shaft vib. PT r.2 unfilt.	my_pp	22	23	23	26
Shaft position GG axial	mm	0.11	0.11	0.11	0.11
Shaft position PT axial	mm	0.08	0.08	0.08	0.08
Temp.journal bear. GG f.1	GrdC	75.7	75.8	76.1	76.2
Temp.journal bear. GG f.2	GrdC	59.0	59.1	59.3	59.5
Temp.thrust bear.GG act.1	GrdC	58.0	58.3	58.6	58.7
Temp.thrust bear.GG act.2	GrdC	57.3	57.5	57.8	58.0
Temp.journal bear. GG r.1	GrdC	83.6	83.2	83.4	83.5
Temp.journal bear. GG r.2	GrdC	60.6	60.9	61.1	61.3
Temp.journal bear. PT f.1	GrdC	67.4	66.9	67.2	68.2
Temp.journal bear. PT f.2	GrdC	87.1	86.7	86.8	88.4
Temp.journal bear. PT r.1	GrdC	60.1	62.1	62.0	62.1
Temp.journal bear. PT r.2	GrdC	61.3	62.3	62.5	62.2
Temp.thrust bear.PT act.1	GrdC	74.9	75.1	75.4	76.6
Temp.thrust bear.PT act.2	GrdC	75.8	75.4	75.6	79.2
Measured O2	%	15.07	15.06	15.06	15.07
Measured CO	mg/m3	1.4	1.4	1.5	1.6
Measured NO	mg/m3	11.9	11.9	12.9	13.1
Measured NO2	mg/m3	8.0	8.2	8.5	8.5

SGS Tecnos, S.A.
 Fdo.: *[Signature]*



Zimpriol

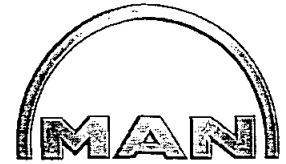
MAN TURBO AG



Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 32 of 41

7 Fuel Gas Analysis

DEPARTMENT : PP53
VILLARPIPE 2



- 33 -

Fuel Gas Data Analysis

Instrument : Gaschromatograph Foxboro Typ 931C-1C1A1B3
Ser.No. 94F21196-01-701

Sampling time : 25.11.2009 13:00:00 hours

Readings :

Components	Equation	Vol.-%
Helium	He	0,058
Nitrogen	N2	11,946
Methane	CH4	82,668
Carbon Dioxide	CO2	1,414
Ethane	C2H6	3,142
Propane	C3H8	0,488
i-Butane	i-C4H10	0,078
Butane	n-C4H10	0,089
i-Pentane	i-C5H12	0,024
Pentane	n-C5H12	0,024
Summary C6+	C6+	0,069
Summary		100,000

Determination of Fuel Gas Data according to DIN 51857 :

Calorific Value (MJ/m³-n) 32,5160
Specific Density Ratio (-) 0,6429

Date

25.11.09

Signature

Opal

MAN TURBO AG



Doc. No.:	100005 64543	Rev. 1	ATP&R-THM
Code Word:	VILLARPIPE 2		Appendix RVT
Order No.:	H.0200017		Page 34 of 41

8 Vibration Report SMB 1773



Abt./Dept. PP53	MAN Turbo Kennwort/Code Word : MAN Turbo Auftrag-Nr./Job No.:	VILLARPIPE 2 H.0200017	Seite/Page 1/5 SMB 1773
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Date: 30.11.09

SMB 1773

Vibration Measurements during the Mechanical Shop Running Test

Code Word	"VILLARPIPE 2"
Job Number	H.0200017
Date of Test	25.NOV.2009

1. Machines, Serial Numbers, Manufactures, ...	
Air Multi-shaft Compressor	----
Air Axial Compressor	----
Screw Compressor	----
Expander	----
Steam Turbine	----
Gas Turbine	THM 1304 – 12 / No. 2155 / 2155 / MAN Turbo AG
Gear	----
Electric Motor	----
Generator	----

2. Operation Speeds [rpm].					
Machine		N _{min}	N _{norm}	N _{max}	N _{trip}
1	Gas Generator (GG)	9400	11900	12100	12200
2	Power Turbine (PT)	3870	8600	9030	9480
3	----	--	--	--	--
4	----	--	--	--	--
5	----	--	--	--	--
6	----	--	--	--	--



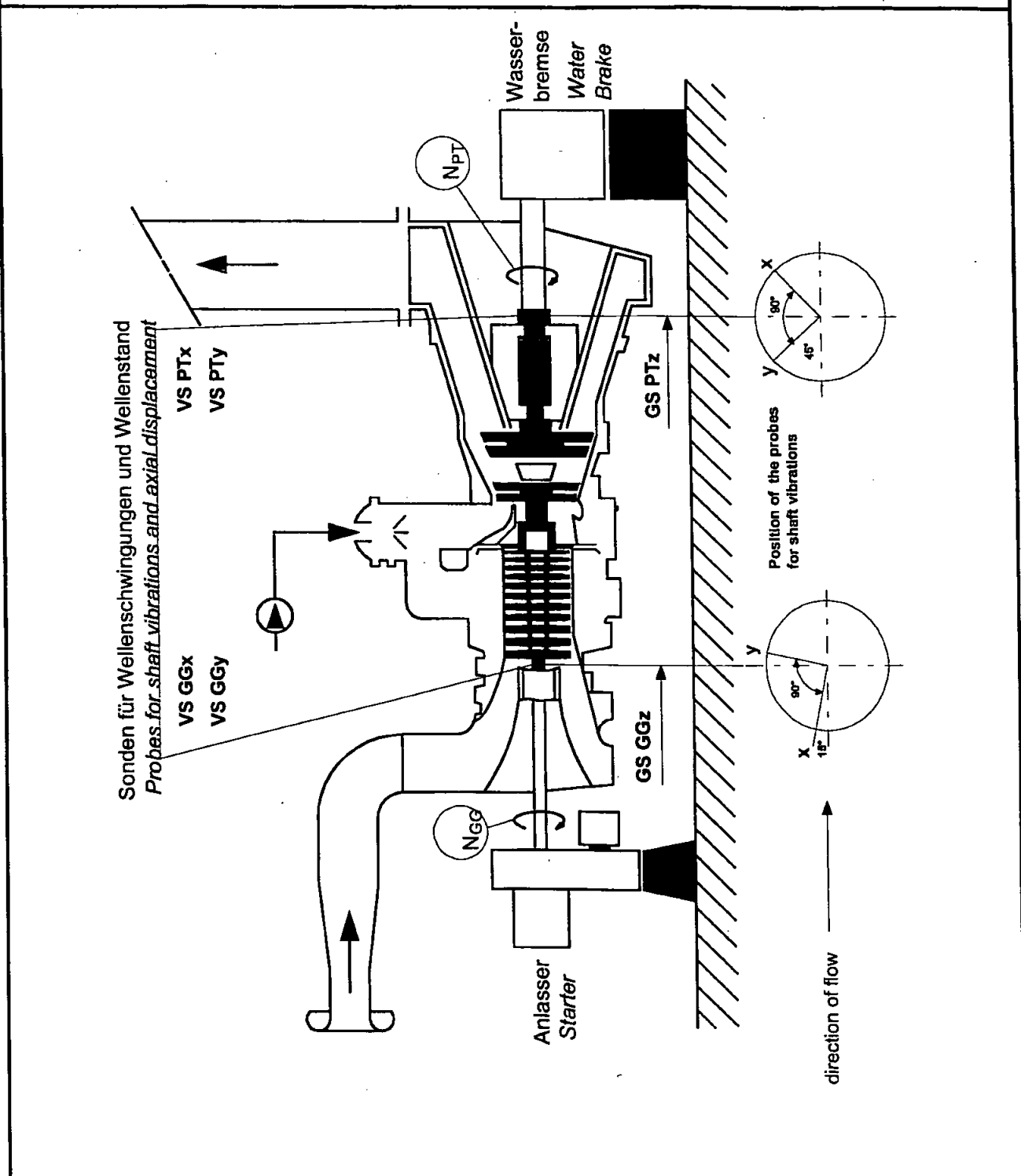
Abt./Dept. PP53	MAN Turbo Kennwort/Code Word : MAN Turbo Auftrag-Nr./Job No.:	VILLARPIPE 2 H.0200017	Seite/Page 2/5 SMB 1773
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3. Lateral Critical Speeds [rpm].		Calculated		
Machine		N _{c1}	N _{c2}	N _{c3}
1	Gas Generator (GG)	~20000	--	--
2	Power Turbine (PT)	~21000	--	--
3	---	--	--	--
4	---	--	--	--
5	---	--	--	--
		Measured		
Machine		N _{c1}	N _{c2}	N _{c3}
1	Gas Generator (GG)	--	--	--
2	Power Turbine (PT)	--	--	--
3	---	--	--	--
4	---	--	--	--
5	---	--	--	--

4. Applicable Specifications.							
4.1. Vibrations measured on the shafts.**)							
Specification:	Limits [µm]	GG	60*		PT	60*	
ATP & R -THM Rev.1	Speeds [rpm]	GG	11900		PT	8600	
Measurement Quantity: *) Peak to Peak Value S _{p-p}							
4.2. Vibrations measured on the Bearing Housings.							
Specification: ISO 10816-4 not applicable.	Limits [mm/s]	GG	4.5*		PT	4.5*	
Measurement Quantity: *) RMS Value							
Remarks: **) Filtered values (rotational frequency, only).							

Abt./Dept. PP53	MAN Turbo Kennwort/Code Word : MAN Turbo Auftrag-Nr./Job No.:	VILLARPIPE 2 H.0200017	Seite/Page 3/5 SMB 1773
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5. Schematic Test Arrangement with Measurement Points.





Abt./Dept. PP53	MAN Turbo Kennwort/Code Word : MAN Turbo Auftrag-Nr./Job No.:	VILLARPIPE 2 H.0200017	Seite/Page 4/5 SMB 1773
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6. Instrumentation.
6.1 Vibration Measurements on the Shafts.
<p>Transducers, Proximitors S 3300 (Bently Nevada), Monitors S 3500 (Bently Nevada), Data Acquisition Interface Unit 208 DAIU (Bently Nevada), ADRE for Windows Version 5.1 (Bently Nevada).</p>
6.2 Vibration Measurements on the Bearing Housings.
<p>Not applicable.</p>
7. Other.
<p>See appendix to this report on plot 1 - 2.</p>
8. Commentary of Results.
<p>The vibratory conditions of the Gas Turbine set „VILLARPIPE 2“ are good and according to the specifications.</p> <p>The survey of the vibration spectrum during the mechanical shop running test gave no indication of a vibration problem.</p>



Abt./Dept. PP53	MAN Turbo Kennwort/Code Word : MAN Turbo Auftrag-Nr./Job No.:	VILLARPIPE 2 H.0200017	Seite/Page 5/5 SMB 1773
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9. Enclosures: Plots 1 – 2.	
Plot	Commentary
1	Spectra at high speed (GG and PT),
2	Bode diagrams of shutdown (GG and PT).
-	---
-	---
-	---

10. Tester: Friedhoff / PP53	Checked: Nem / PP53
30.11.2009 <u>R. Friedhoff</u>	30.11.2009 <u>M. Nem</u>

MAN Turbo AG

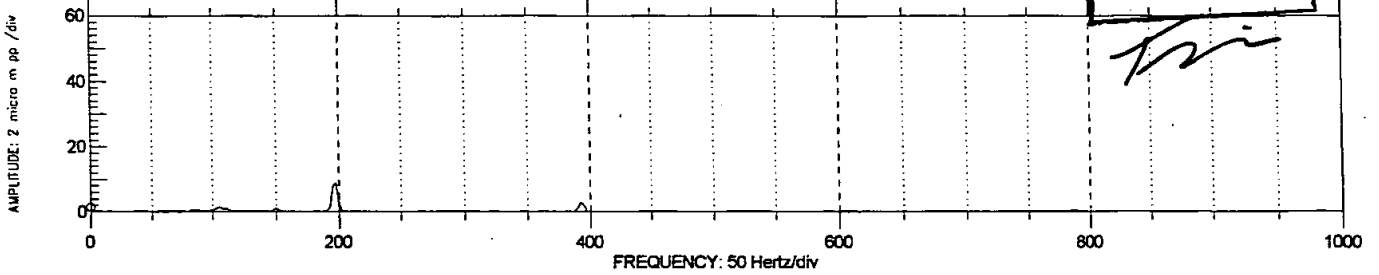
HALF SPECTRUM PLOT
COMPANY: MAN Turbo AG
MACHINE TRAIN: VILLARPIPE 2

PLOT NO. 1
PLANT: Test Stand
JOB REFERENCE: H.02000172155

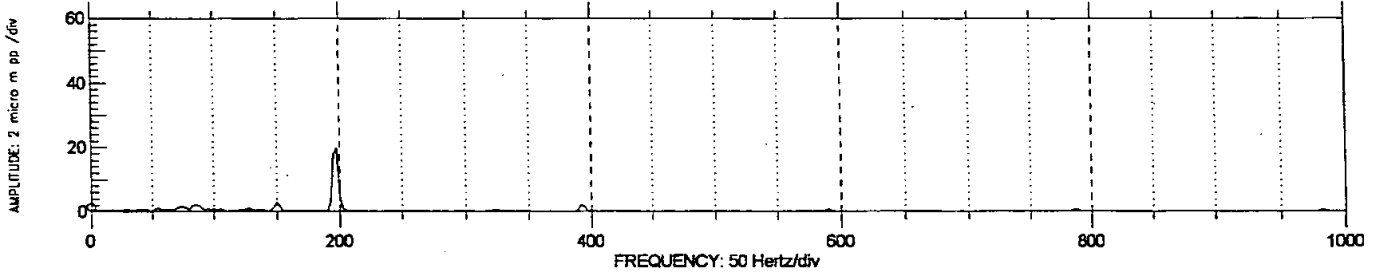
SGS Tecros, S.A.
Fdo.: *[Signature]*



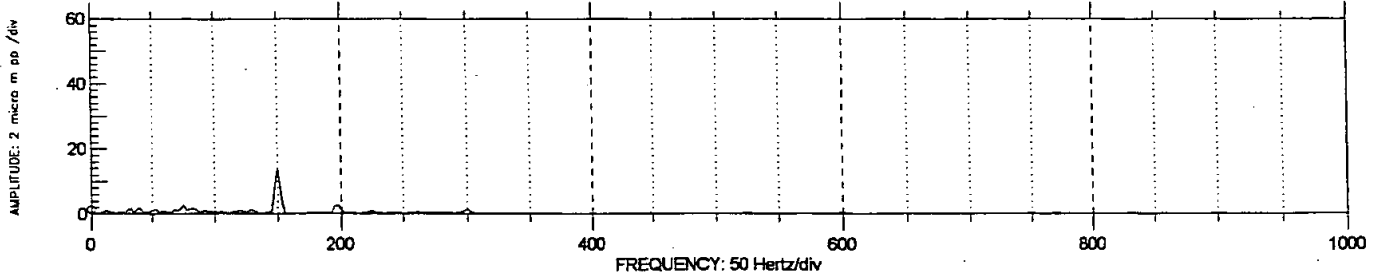
POINT: VS GG X /75° Left DIR AMPL: 15.0 micro m pp
MACHINE: THM 1304-12 MACHINE SPEED: 11.8 krpm
25 NOV 2009 13:22:48.1 Steady State
WINDOW: Hanning SPECTRAL LINES: 400 RESOLUTION: 2.5 Hertz



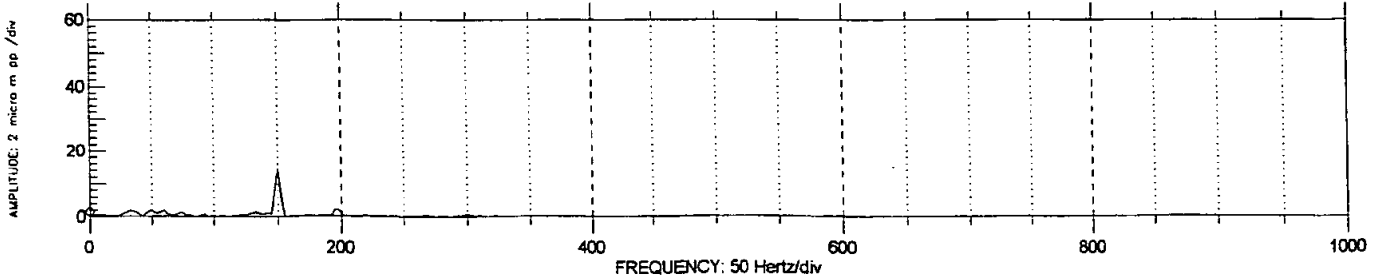
POINT: VS GG Y /15° Right DIR AMPL: 28.6 micro m pp
MACHINE: THM 1304-12 MACHINE SPEED: 11.8 krpm
25 NOV 2009 13:22:48.1 Steady State
WINDOW: Hanning SPECTRAL LINES: 400 RESOLUTION: 2.5 Hertz



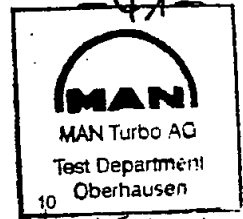
POINT: VS PT X /45° Left DIR AMPL: 20.5 micro m pp
MACHINE: THM 1304-12 MACHINE SPEED: 8992 rpm
25 NOV 2009 13:22:41.9 Steady State
WINDOW: Hanning SPECTRAL LINES: 400 RESOLUTION: 2.5 Hertz



POINT: VS PT Y /45° Right DIR AMPL: 19.4 micro m pp
MACHINE: THM 1304-12 MACHINE SPEED: 8992 rpm
25 NOV 2009 13:22:41.9 Steady State
WINDOW: Hanning SPECTRAL LINES: 400 RESOLUTION: 2.5 Hertz



MAN Turbo AG

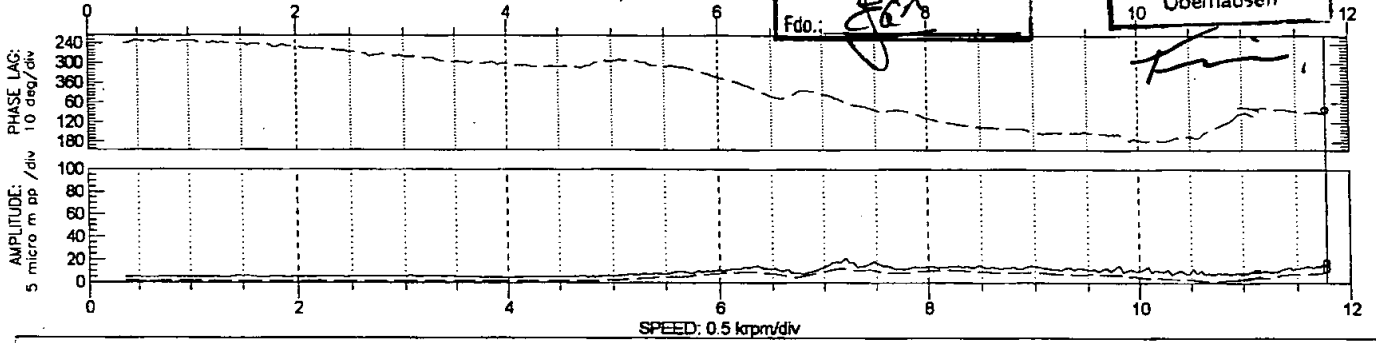


BODE PLOT
 COMPANY: MAN Turbo AG
 MACHINE TRAIN: VILLARPIPE 2

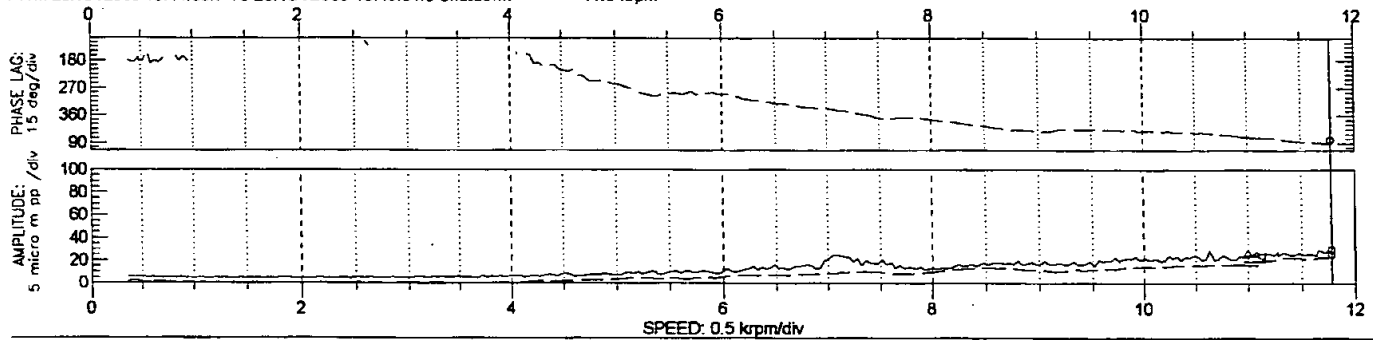
PLOT NO. 2
 PLANT: Test Stand
 JOB REFERENCE: H.0200017/2155

POINT: VS GG X /75° Left — DIRECT 14.7
 POINT: VS GG X /75° Left - - 1X UNCOMP 9.27/91°
 MACHINE: THM 1304-12
 From 25NOV2009 13:44:33.7 To 25NOV2009 13:49:51.5 Shutdown 11.8 krpm

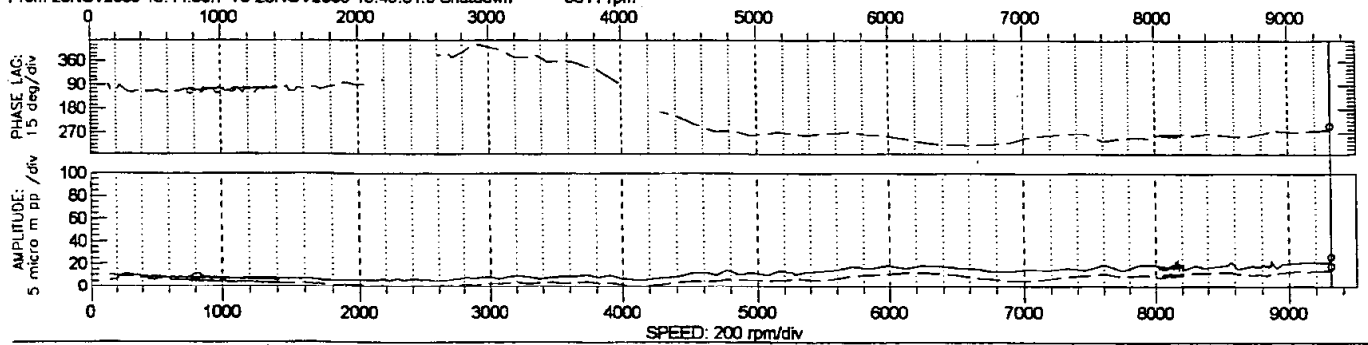
SGS Tecnos, S.A.
 Fdo.: *[Signature]*



POINT: VS GG Y /15° Right — DIRECT 26.5
 POINT: VS GG Y /15° Right - - 1X UNCOMP 22.2/91°
 MACHINE: THM 1304-12
 From 25NOV2009 13:44:33.7 To 25NOV2009 13:49:51.5 Shutdown 11.8 krpm



POINT: VS PT X /45° Left — DIRECT 23.5
 POINT: VS PT X /45° Left - - 1X UNCOMP 14.8/258°
 MACHINE: THM 1304-12
 From 25NOV2009 13:44:33.7 To 25NOV2009 13:49:51.5 Shutdown 9311 rpm



POINT: VS PT Y /45° Right — DIRECT 26.3
 POINT: VS PT Y /45° Right - - 1X UNCOMP 17.5/168°
 MACHINE: THM 1304-12
 From 25NOV2009 13:44:33.7 To 25NOV2009 13:49:51.5 Shutdown 9311 rpm

