

	A	B	C	D	E	F	G	H	I	J	K	L
1	On site at -Pipeline Station, Espana			Date						29.02.12	29.02.12	29.02.12
2	Company: MAN Diesel & Turbo SE, Testing Dept.			Time						16:42	18:25	19:55
3	Name: A. Kohlberger, U. Feldhoff			MP-No.				Punta A		MP01	MP02	MP03
4										transport	transport	transport
5	<b>NOTATION</b>	<b>TAG-NO.</b>	<b>SYMBOL</b>	<b>UNIT</b>	<b>INSTRUM.</b>	<b>LOCAT.</b>				GasAna: 05.03.12-12:31		
6	<b>1.) Measured Values</b>											
7	Barometric Pressure	add	p_0	bar	barom.	add.		1,0000		0,986	0,986	0,986
8												
9	<b>1.1) PV024/24 Pipeline Compressor</b>											
10	Gas inlet pressure	PI-	p_C1	[bar_g]	PT	DCS		44,4000		44,06	44,4	44,1
11	Gas inlet pressure, corr	PI-	p_C1cor	[bar_g]				44,40		44,01	44,30	44,00
12	Gas inlet temperature	TI-	T_C1	[°C]	TC	DCS		21,00		21,65	23,3	18,5
13	Gas discharge pressure	PI-	p_C2	[bar_g]	PT	DCS		72,40		72,10	70,30	73,80
14	Gas discharge pressure, corr	PI-	p_C2cor	[bar_g]				72,40		72,15	70,35	73,85
15	Gas discharge temperature	TI-	T_C2	[°C]	TC	DCS		61,84		64,50	63,30	63,00
16												
17	Diff. press.	FE-	dp_C,suc	[mbar-d]	PT	DCS				1050,0	1205,0	1009,0
18	Compressor suction flow	FI-	V_P_1	[m3/h]	FC	DCS		5376				
19	Compressor isentr. head		Y_s	[kJ/kg]		DCS				61,6	57,35	63,77
20	Compressor Safty Line	XI-	x_d	[%]		DCS				-15	-20	-13
21	Compressor speed	SI-	N_C	rpm	SI			7541		7540	7542	7540
22	Position station recycle valve	ZI-	Z_StRV	[%-open]	ZI	DCS				0	0	0
23												
24	<b>1.2) Flow meter unit</b>											
25	Pressure	PI-	p_C,FM	[bar_g]	PT	DCS						
26	Pressure		p_C,FM	[bar_a]								
27	Diff. press.	PDI-	dp_C,FM	[mbar-d]	PT	DCS						
28	Diff. press.		dp_C,FM	[bar-d]								
29	Temp.	TI-	T_C,FM	[°C]								
30	Gas Volume Flow	FI-	V_P_St	[Nm3/h]	FC	DCS		251127		229925	248745	224181
31												
32												
33	<b>2.) Evaluation</b>											
34	<b>2.1) Pipeline Compressor</b>											
35	<b>2.1.1) Mass Flow unit</b>											
36	Molecular weight		M_g	kg/kmol				18,1713		17,5014	17,5014	17,5014
37	Real gas constant		R_g	J/kg/K				457,56		475,08	475,08	475,08
38	normal density		rho_N					0,8107		0,7808	0,7808	0,7808
39	Mass flow		m_P_C	[kg/h]				203584		179531	194226	175046
40	Mass flow		m_P_C	[kg/s]				56,551		49,870	53,952	48,624
41												
42	<b>2.1.2) Volume Flow Compressor Suction</b>											
43	Suction Density		rho_1	[kg/m3]		BWRS				35,69	35,67	36,24
44	SQRT(dp_suc/rho_1)					calc				5,424	5,813	5,277
45	Suction Volume flow		V_P_1	[m3/h]		calc						
46	Volume flow (recalc)		V_P_C,suc	[m3/h]		calc				5010	5451	4846
47	Suction Mass Flow (recalc)		m_P	[kg/s]		calc				49,670	54,003	48,775
48												
49	<b>2.1.3) Evaluation</b> rad: b: 41.LA: Sehne: 63mm; Durchmesser LA:631,26mm											
50	Suction Pressure		p_1	[bar_g]		calc		44,396		44,010	44,300	44,000
51	Total Suction Pressure		p_1t	[bar_a]	650	calc		<b>45,400</b>		<b>44,999</b>	<b>45,290</b>	<b>44,989</b>
52	Suction Temperature		T_1	[°C]		calc		<b>21,000</b>		<b>21,650</b>	<b>23,300</b>	<b>18,500</b>
53	Real Gas Constant		R*Z1	[J/kgK]		BWRS		407,55		427,66	428,36	425,71
54	Suction Density		rho_1	[kg/m3]		BWRS		37,87		35,69	35,67	36,24
55	Polytropic Exponent inlet		n_1	[-]		BWRS		1,4576		1,4256	1,4229	1,4244
56	Isentropic Exponent inlet		kap_1	[-]		BWRS		1,3035		1,3120	1,3132	1,3132
57	Dyn. Viscosity		eta_1	[Pa*s]		BWRS		1,30E-5		1,20E-5	1,20E-5	1,20E-5
58	Suction Volume flow		V_P_1	[m3/h]		calc		5376		5030	5446	4831
59	Velocity (inlet)		v_1	[m/s]		calc		4,500		4,211	4,559	4,044
60	Reynolds No. (inlet)		Re_d,1	[-]		calc		8,5E+6		8,1E+6	8,8E+6	7,9E+6
61	Tip Speed (1st Blade)		u_1	[m/s]		VDI 2045		187,6		187,5	187,6	187,5
62												
63	Discharge Pressure		p_2	[bar_g]		calc		72,397		72,150	70,350	73,850
64	Total Discharge Pressure		p_2t	[bar_a]	650	calc		<b>73,400</b>		<b>73,138</b>	<b>71,339</b>	<b>74,838</b>
65	Discharge Temperature		T_2	[°C]		calc		<b>61,840</b>		<b>64,500</b>	<b>63,300</b>	<b>63,000</b>
66	Real Gas Constant		R*Z1	[J/kgK]		BWRS		411,81		432,83	433,00	431,25
67	Density Outlet		rho_2	[kg/m3]		BWRS		53,21		50,05	48,97	51,63
68	Polytropic Exponent inlet		n_2	[-]		BWRS		1,4499		1,4531	1,4476	1,4561
69	Isentropic Exponent inlet		kap_2	[-]		BWRS		1,3339		1,3399	1,3370	1,3450
70	Dyn. Viscosity		eta_2	[Pa*s]		BWRS		1,70E-5		1,40E-5	1,40E-5	1,40E-5
71	Discharge Volume flow		V_P_2	[m3/h]		calc		3826		3587	3966	3391
72	Velocity (disch.)		v_2	[m/s]		calc		3,203		3,003	3,320	2,838
73												
74	Suction Volume flow		V_P_1	[m3/h]		calc		5376		5030	5446	4831
75	Suction volume flow (stand.)		V_P_1,N	[Nm3/h]		calc		251118		229925	248745	224181

	A	B	C	D	E	F	G	H	I	J	K	L
76	Pressure Ratio		pi	[-]		calc		1,617		1,625	1,575	1,663
77	Temp. difference		dT	[K]		calc		40,84		42,85	40,00	44,50
78	Enthalpy Difference		dh_i	[kJ/kg]		BWRS		75,436		82,461	77,017	84,931
79	polytropic efficiency		eta_p	[-]		BWRS		0,8191		0,7997	0,8025	0,8040
80	polytropic head		y_p	[kJ/kg]		calc		61,790		65,941	61,808	68,285
81	Tip Reynolds No. (1st Blade)		Re_u,1	[-]		VDI 2045		8,8E+6		9,0E+6	9,0E+6	9,2E+6
82	Tip Mach No. (1st Blade)		Ma_u,1	[-]		VDI 2045		0,4745		0,4611	0,4593	0,4644
83	Volumetric Flow Coefficient		phi_u,1	[-]		VDI 2045		0,0240		0,0225	0,0243	0,0216
84	Ref. Process Work Coefficient		psi_u,1	[-]		VDI 2045		3,5132		3,7502	3,5133	3,8836
85	Suction Mass Flow		m_P	[kg/s]		calc		56,551		49,870	53,952	48,624
86	Suction Mass Flow		m_P	[kg/h]		calc		203584		179531	194226	175046
87	Internal Gaspower		P_i	[kW]		calc		4266		4112	4155	4130
88	Mechanical Loss		P_m,e	[kW]		design		110		110	110	110
89	Power at Coupling		P_Co,C	[kW]		calc		4376		4222	4265	4240
91	<b>2.5) Performance Checks</b>											
92	kap_m=SQRT(kap_1*kap_2)			[-]				1,3186		1,3259	1,3250	1,3290
93	kap_m/(kap_m-1)			[-]				4,1386		4,0687	4,0765	4,0395
94	((kap_m/(kap_m-1))_v-(...)_g/(...)_g			[%]						-1,6882	-1,5012	-2,3955
95												
96	n_m=SQRT(n_1*n_2)			[-]				1,4537		1,4393	1,4352	1,4402
97	n_m/(n_m-1)			[-]				3,2039		3,2764	3,2978	3,2719
98	((n_m/(n_m-1))_v-(...)_g/(...)_g			[%]						2,264	2,932	2,123
99												
100	Re_u,1,v/Re_u,1,g			[-]						1,0209	1,0204	1,0364
101	Ma_u,1,v/Ma_u,1,g			[-]						0,9718	0,9681	0,9789
102	PHI=(V_P_1/V_P_2)_v/(V_P_1/V_P_2)_g			[-]						0,9980	0,9773	1,0141
103	X=(N/SQRT(RZ_1*T_1))_v/(...)_g			[-]						0,9750	0,9717	0,9825
104												
105	<b>2.5) Correction/Conversion</b> (according VDI 2045, Part 1, Fig. 7, Page 51)											
106	n_v/(n_v-1)		über kappa, eta	[-]				3,3899		3,2536	3,2715	3,2478
107	n_v/(n_v-1) (con)			[-]				3,2039		3,2764	3,2978	3,2719
108	polytropic head (con)		y_p,con	[kJ/kg]				61,79		<b>65,96</b>	<b>61,79</b>	<b>68,30</b>
109	Enthalpy Difference (con)		dh_i	[kJ/kg]				75,44		82,48	77,00	84,95
110												
111	Pressure Ratio (con)		pi_con	[-]				1,613		1,663	1,614	1,691
112	Discharge Pressure (con)		p_2,con	[bar-a]				73,22		75,50	73,29	76,77
113												
114	Temperature Difference (con)		dT_con	[K]				43,8		45,8	42,5	47,7
115	Suction Volume flow (con)		V_P_1,con	[m3/h]				5376		<b>5031</b>	<b>5445</b>	<b>4832</b>
116	Suction Mass Flow (con)		m_P,con	[kg/h]				203584		190511	206212	182973
117	Suction volume flow (normal) (con)		V_P_1,N,con	[Nm3/h]				251118		234993	254360	225695
118												
119	Internal Gaspower (con)		P_i,con	[kW]				4266			4410	
120	Coupl. Power Compr. (con)		P_C_Co,con	[kW]				4376			4520	
121	Coupling Power Difference		dP_C_Co,cd	[kW]				0			144	
122	Coupling Power Difference		dP_C_Co,cd	[%]				0,00			3,30	
123												
124	Coupl. Power Compr. (con,corr)		P_C_Co,corr	[kW]				<b>4376</b>			<b>4464</b>	
125	Coupling Power Difference		dP_C_Co,Gl	[kW]				0			<b>88</b>	
126	Coupling Power Difference		dP_C_Co,Gl	[%]				0,00			<b>2,01</b>	

	A	B	C	D	E	F	G	H	I	J	K	L
1	On site at -Pipeline Station, Espana			Date						05.03.12	05.03.12	05.03.12
2	Company: MAN Diesel & Turbo SE, Testing Dept			Time						12:00	13:10	14:45
3	Name: A. Kohlberger, U. Feldhoff			MP-No.				Punta A		MP01	MP02	MP03
4										transport	transport	transport
5	<b>NOTATION</b>	<b>TAG-NO.</b>	<b>SYMBOL</b>	<b>UNIT</b>	<b>INSTRUM</b>	<b>LOCAT.</b>				GasAna: 05.03.12-12:31		
6	<b>1.) Measured Values</b>											
7	Barometric Pressure	add	p_0	bar	barom.	add.		1,0000		0,994	0,994	0,993
8												
9	<b>1.1) PV024/24 Pipeline Compressor</b>											
10	Gas inlet pressure	PI-	p_C1	[bar_g]	PT	DCS		44,4000		44,37	44,17	44,24
11	Gas inlet pressure, corr	PI-	p_C1cor	[bar_g]				44,40		44,32	44,07	44,14
12	Gas inlet temperature	TI-	T_C1	[°C]	TC	DCS		21,00		23,22	20,96	18,47
13	Gas discharge pressure	PI-	p_C2	[bar_g]	PT	DCS		72,40		72,36	70,23	74,42
14	Gas discharge pressure, corr	PI-	p_C2cor	[bar_g]				72,40		72,41	70,28	74,47
15	Gas discharge temperature	TI-	T_C2	[°C]	TC	DCS		61,84		66,09	61,58	63,72
16												
17	Diff. press.	FE-	dp_C,suc	[mbar-d]	PT	DCS				1093,0	1256,0	1000,0
18	Compressor suction flow	FI-	V_P_1	[m3/h]	FC	DCS		5376				
19	Compressor isentr. head		Y_s	[kJ/kg]		DCS				61,35	57,5	64,4
20	Compressor Safty Line	XI-	x_d	[%]		DCS				-15,8	-21	-13
21	Compressor speed	SI-	N_C	rpm	SI			7541		7540	7541	7540
22	Position station recycle valve	ZI-	Z_StRV	[%-open]	ZI	DCS				0	0	0
23												
24	<b>1.2) Flow meter unit</b>											
25	Pressure	PI-	p_C,FM	[bar_g]	PT	DCS						
26	Pressure		p_C,FM	[bar_a]								
27	Diff. press.	PDI-	dp_C,FM	[mbar-d]	PT	DCS						
28	Diff. press.		dp_C,FM	[bar-d]								
29	Temp.	TI-	T_C,FM	[°C]								
30	Gas Volume Flow	FI-	V_P_St	[Nm3/h]	FC	DCS		251127		225787	243811	216845
31										206000	221000	201000
32										1,10	1,10	1,08
33	<b>2.) Evaluation</b>											
34	<b>2.1) Pipeline Compressor</b>											
35	<b>2.1.1) Mass Flow unit</b>											
36	Molecular weight		M_g	kg/kmol				18,1713		17,5014	17,5014	17,5014
37	Real gas constant		R_g	J/kg/K				457,56		475,08	475,08	475,08
38	normal density		rho_N					0,8107		0,7808	0,7808	0,7808
39	Mass flow		m_P_C	[kg/h]				203584		176300	190374	169318
40	Mass flow		m_P_C	[kg/s]				56,551		48,972	52,882	47,033
41												
42	<b>2.1.2) Volume Flow Compressor Suction</b>											
43	Suction Density		rho_1	[kg/m3]		BWRS				35,70	35,88	36,37
44	SQRT(dp_suc/rho_1)					calc				5,533	5,917	5,244
45	Suction Volume flow		V_P_1	[m3/h]		calc						
46	Volume flow (recalc)		V_P_C,suc	[m3/h]		calc				4935	5307	4657
47	Suction Mass Flow (recalc)		m_P	[kg/s]		calc				48,944	52,893	47,050
48												
49	<b>2.1.3) Evaluation</b>	rad: b: 4	1.LA: Sehne: 63mm; Durchmesser LA:631,26mm									
50	Suction Pressure		p_1	[bar_g]		calc		44,396		44,322	44,074	44,136
51	Total Suction Pressure		p_1t	[bar_a]	650	calc		<b>45,400</b>		<b>45,319</b>	<b>45,072</b>	<b>45,132</b>
52	Suction Temperature		T_1	[°C]		calc		<b>21,000</b>		<b>23,223</b>	<b>20,957</b>	<b>18,466</b>
53	Real Gas Constant		R*Z1	[J/kgK]		BWRS		407,55		428,29	427,16	425,54
54	Suction Density		rho_1	[kg/m3]		BWRS		37,87		35,70	35,88	36,37
55	Polytropic Exponent inlet		n_1	[-]		BWRS		1,4576		1,4283	1,4333	1,4297
56	Isentropic Exponent inlet		kap_1	[-]		BWRS		1,3035		1,3118	1,3124	1,3135
57	Dyn. Viscosity		eta_1	[Pa*s]		BWRS		1,30E-5		1,20E-5	1,20E-5	1,20E-5
58	Suction Volume flow		V_P_1	[m3/h]		calc		5376		4938	5306	4656
59	Velocity (inlet)		v_1	[m/s]		calc		4,500		4,134	4,442	3,897
60	Reynolds No. (inlet)		Re_d,1	[-]		calc		8,5E+6		8,0E+6	8,6E+6	7,7E+6
61	Tip Speed (1st Blade)		u_1	[m/s]		VDI 2045		187,6		187,5	187,6	187,5
62												
63	Discharge Pressure		p_2	[bar_g]		calc		72,397		72,415	70,281	74,471
64	Total Discharge Pressure		p_2t	[bar_a]	650	calc		<b>73,400</b>		<b>73,411</b>	<b>71,277</b>	<b>75,466</b>
65	Discharge Temperature		T_2	[°C]		calc		<b>61,840</b>		<b>66,092</b>	<b>61,584</b>	<b>63,720</b>
66	Real Gas Constant		R*Z1	[J/kgK]		BWRS		411,81		433,55	432,11	431,37
67	Density Outlet		rho_2	[kg/m3]		BWRS		53,21		49,91	49,28	51,93
68	Polytropic Exponent inlet		n_2	[-]		BWRS		1,4499		1,4551	1,4585	1,4619
69	Isentropic Exponent inlet		kap_2	[-]		BWRS		1,3339		1,3392	1,3382	1,3458
70	Dyn. Viscosity		eta_2	[Pa*s]		BWRS		1,70E-5		1,40E-5	1,40E-5	1,40E-5
71	Discharge Volume flow		V_P_2	[m3/h]		calc		3826		3532	3863	3260
72	Velocity (disch.)		v_2	[m/s]		calc		3,203		2,957	3,234	2,729
73												
74	Suction Volume flow		V_P_1	[m3/h]		calc		5376		4938	5306	4656
75	Suction volume flow (stand.)		V_P_1,N	[Nm3/h]		calc		251118		225787	243811	216845

	A	B	C	D	E	F	G	H	I	J	K	L
76	Pressure Ratio		pi	[-]		calc		1,617		1,620	1,581	1,672
77	Temp. difference		dT	[K]		calc		40,84		42,87	40,63	45,25
78	Enthalpy Difference		dh_i	[kJ/kg]		BWRS		75,436		82,861	78,150	86,576
79	polytropic efficiency		eta_p	[-]		BWRS		0,8191		0,7956	0,7907	0,7976
80	polytropic head		y_p	[kJ/kg]		calc		61,790		65,920	61,792	69,048
81	Tip Reynolds No. (1st Blade)		Re_u,1	[-]		VDI 2045		8,8E+6		9,0E+6	9,1E+6	9,2E+6
82	Tip Mach No. (1st Blade)		Ma_u,1	[-]		VDI 2045		0,4745		0,4596	0,4619	0,4645
83	Volumetric Flow Coefficient		phi_u,1	[-]		VDI 2045		0,0240		0,0220	0,0237	0,0208
84	Ref. Process Work Coefficient		psi_u,1	[-]		VDI 2045		3,5132		3,7490	3,5133	3,9270
85	Suction Mass Flow		m_P	[kg/s]		calc		56,551		48,972	52,882	47,033
86	Suction Mass Flow		m_P	[kg/h]		calc		203584		176300	190374	169318
87	Internal Gaspower		P_i	[kW]		calc		4266		4058	4133	4072
88	Mechanical Loss		P_m,e	[kW]		design		110		110	110	110
89	Power at Coupling		P_Co,C	[kW]		calc		4376		4168	4243	4182
91	<b>2.5) Performance Checks</b>											
92	kap_m=SQRT(kap_1*kap_2)			[-]				1,3186		1,3255	1,3252	1,3295
93	kap_m/(kap_m-1)			[-]				4,1386		4,0726	4,0748	4,0346
94	((kap_m/(kap_m-1))_v-(...)_g/(...)_g			[%]						-1,5954	-1,5424	-2,5130
95												
96	n_m=SQRT(n_1*n_2)			[-]				1,4537		1,4417	1,4458	1,4457
97	n_m/(n_m-1)			[-]				3,2039		3,2642	3,2431	3,2435
98	((n_m/(n_m-1))_v-(...)_g/(...)_g			[%]						1,883	1,224	1,238
99												
100	Re_u,1,v/Re_u,1,g			[-]						1,0211	1,0263	1,0402
101	Ma_u,1,v/Ma_u,1,g			[-]						0,9686	0,9735	0,9790
102	PHI=(V_P_1/V_P_2)_v/(V_P_1/V_P_2)_g			[-]						0,9951	0,9777	1,0164
103	X=(N/SQRT(RZ_1*T_1))_v/(...)_g			[-]						0,9717	0,9768	0,9827
104												
105	<b>2.5) Correction/Conversion (according VDI 2045, Part 1, Fig. 7, Page 51)</b>											
106	n_v/(n_v-1)		über kappa, eta	[-]				3,3899		3,2399	3,2219	3,2178
107	n_v/(n_v-1) (con)			[-]				3,2039		3,2642	3,2431	3,2435
108	polytropic head (con)		y_p,con	[kJ/kg]				61,79		<b>65,94</b>	<b>61,79</b>	<b>69,07</b>
109	Enthalpy Difference (con)		dh_i	[kJ/kg]				75,44		82,88	78,15	86,60
110												
111	Pressure Ratio (con)		pi_con	[-]				1,613		1,662	1,613	1,699
112	Discharge Pressure (con)		p_2,con	[bar-a]				73,22		75,48	73,25	77,16
113												
114	Temperature Difference (con)		dT_con	[K]				43,8		46,0	43,2	48,7
115	Suction Volume flow (con)		V_P_1,con	[m3/h]				5376		<b>4939</b>	<b>5306</b>	<b>4656</b>
116	Suction Mass Flow (con)		m_P,con	[kg/h]				203584		187036	200957	176333
117	Suction volume flow (normal) (con)		V_P_1,N,cc	[Nm3/h]				251118		230707	247877	217505
118												
119	Internal Gaspower (con)		P_i,con	[kW]				4266				4242
120	Coupl. Power Compr. (con)		P_C_Co,co	[kW]				4376				4352
121	Coupling Power Difference		dP_C_Co,c	[kW]				0				-24
122	Coupling Power Difference		dP_C_Co,c	[%]				0,00				-0,56
123												
124	Coupl. Power Compr. (con,corr)		P_C_Co,co	[kW]				<b>4376</b>				<b>4491</b>
125	Coupling Power Difference		dP_C_Co,G	[kW]				0				<b>115</b>
126	Coupling Power Difference		dP_C_Co,G	[%]				0,00				<b>2,63</b>

	A	B	C	D	E	F	G	H	I	J	K	L
1	On site at -Pipeline Station, Espana			Date						07.03.12	07.03.12	07.03.12
2	Company: MAN Diesel & Turbo SE, Testing Dept.			Time						12:25	14:00	15:45
3	Name: A. Kohlberger, U. Feldhoff			MP-No.				Punta A		MP01	MP02	MP03
4										transport	transport	transport
5	<b>NOTATION</b>	<b>TAG-NO.</b>	<b>SYMBOL</b>	<b>UNIT</b>	<b>NSTRUM</b>	<b>LOCAT.</b>				GasAna: 07.03.12-12:31		
6	<b>1.) Measured Values</b>											
7	Barometric Pressure	add	p_0	bar	barom.	add.		1,0000		0,992	0,991	0,991
8												
9	<b>1.1) PV024/24 Pipeline Compressor</b>											
10	Gas inlet pressure	PI-	p_C1	[bar_g]	PT	DCS		44,4000		44,3	44,5	44,3
11	Gas inlet pressure, corr	PI-	p_C1cor	[bar_g]				44,40		44,25	44,40	44,20
12	Gas inlet temperature	TI-	T_C1	[°C]	TC	DCS		21,00		19,6	22,6	21,6
13	Gas discharge pressure	PI-	p_C2	[bar_g]	PT	DCS		72,40		72,50	70,40	74,20
14	Gas discharge pressure, corr	PI-	p_C2cor	[bar_g]				72,40		72,55	70,45	74,25
15	Gas discharge temperature	TI-	T_C2	[°C]	TC	DCS		61,84		62,20	62,70	66,50
16												
17	Diff. press.	FE-	dp_C,suc	[mbar-d]	PT	DCS				960,0	1090,0	815,0
18	Compressor suction flow	FI-	V_P_1	[m3/h]	FC	DCS		5376				
19	Compressor isentr. head		Y_s	[kJ/kg]		DCS				60,94	57,2	64,55
20	Compressor Safty Line	XI-	x_d	[%]		DCS				-13	-17	-8
21	Compressor speed	SI-	N_C	rpm	SI			7541		7540	7539	7540
22	Position station recycle valve	ZI-	Z_StRV	[%-open]	ZI	DCS				0	0	0
23												
24	<b>1.2) Flow meter unit</b>											
25	Pressure	PI-	p_C,FM	[bar_g]	PT	DCS						
26	Pressure		p_C,FM	[bar_a]								
27	Diff. press.	PDI-	dp_C,FM	[mbar-d]	PT	DCS						
28	Diff. press.		dp_C,FM	[bar-d]								
29	Temp.	TI-	T_C,FM	[°C]								
30	Gas Volume Flow	FI-	V_P_St	[Nm3/h]	FC	DCS		251127		226000	243811	202000
31												
32												
33	<b>2.) Evaluation</b>											
34	<b>2.1) Pipeline Compressor</b>											
35	<b>2.1.1) Mass Flow unit</b>											
36	Molecular weight		M_g	kg/kmol				18,1713		17,5261	17,5261	17,5261
37	Real gas constant		R_g	J/kg/K				457,56		474,41	474,41	474,41
38	normal density		rho_N					0,8107		0,7819	0,7819	0,7819
39	Mass flow		m_P_C	[kg/h]				203584		176715	190642	157949
40	Mass flow		m_P_C	[kg/s]				56,551		49,088	52,956	43,875
41												
42	<b>2.1.2) Volume Flow Compressor Suction</b>											
43	Suction Density		rho_1	[kg/m3]		BWRS				36,33	35,93	35,93
44	SQRT(dp_suc/rho_1)					calc				5,141	5,508	4,763
45	Suction Volume flow		V_P_1	[m3/h]		calc						
46	Volume flow (recalc)		V_P_C,suc	[m3/h]		calc				4855	5310	4401
47	Suction Mass Flow (recalc)		m_P	[kg/s]		calc				48,990	53,002	43,926
48												
49	<b>2.1.3) Evaluation</b> rad: b: 41 1.LA: Sehne: 63mm; Durchmesser LA:631,26mm											
50	Suction Pressure		p_1	[bar_g]		calc		44,396		44,250	44,400	44,200
51	Total Suction Pressure		p_1t	[bar_a]	650	calc		<b>45,400</b>		<b>45,245</b>	<b>45,395</b>	<b>45,193</b>
52	Suction Temperature		T_1	[°C]		calc		<b>21,000</b>		<b>19,600</b>	<b>22,600</b>	<b>21,600</b>
53	Real Gas Constant		R*Z1	[J/kgK]		BWRS		407,55		425,46	427,15	426,75
54	Suction Density		rho_1	[kg/m3]		BWRS		37,87		36,33	35,93	35,93
55	Polytropic Exponent inlet		n_1	[-]		BWRS		1,4576		1,4263	1,4283	1,4231
56	Isentropic Exponent inlet		kap_1	[-]		BWRS		1,3035		1,3130	1,3120	1,3121
57	Dyn. Viscosity		eta_1	[Pa*s]		BWRS		1,30E-5		1,20E-5	1,20E-5	1,20E-5
58	Suction Volume flow		V_P_1	[m3/h]		calc		5376		4865	5305	4396
59	Velocity (inlet)		v_1	[m/s]		calc		4,500		4,072	4,441	3,680
60	Reynolds No. (inlet)		Re_d,1	[-]		calc		8,5E+6		8,0E+6	8,6E+6	7,2E+6
61	Tip Speed (1st Blade)		u_1	[m/s]		VDI 2045		187,6		187,5	187,5	187,5
62												
63	Discharge Pressure		p_2	[bar_g]		calc		72,397		72,550	70,450	74,250
64	Total Discharge Pressure		p_2t	[bar_a]	650	calc		<b>73,400</b>		<b>73,544</b>	<b>71,444</b>	<b>75,243</b>
65	Discharge Temperature		T_2	[°C]		calc		<b>61,840</b>		<b>62,200</b>	<b>62,700</b>	<b>66,500</b>
66	Real Gas Constant		R*Z1	[J/kgK]		BWRS		411,81		430,71	431,95	432,30
67	Density Outlet		rho_2	[kg/m3]		BWRS		53,21		50,92	49,25	51,24
68	Polytropic Exponent inlet		n_2	[-]		BWRS		1,4499		1,4556	1,4532	1,4535
69	Isentropic Exponent inlet		kap_2	[-]		BWRS		1,3339		1,3425	1,3375	1,3427
70	Dyn. Viscosity		eta_2	[Pa*s]		BWRS		1,70E-5		1,40E-5	1,40E-5	1,40E-5
71	Discharge Volume flow		V_P_2	[m3/h]		calc		3826		3471	3871	3082
72	Velocity (disch.)		v_2	[m/s]		calc		3,203		2,905	3,240	2,580
73												
74	Suction Volume flow		V_P_1	[m3/h]		calc		5376		4865	5305	4396
75	Suction volume flow (stand.)		V_P_1,N	[Nm3/h]		calc		251118		226000	243811	202000

	A	B	C	D	E	F	G	H	I	J	K	L
76	Pressure Ratio		pi	[-]		calc		1,617		1,625	1,574	1,665
77	Temp. difference		dT	[K]		calc		40,84		42,60	40,10	44,90
78	Enthalpy Difference		dh_i	[kJ/kg]		BWRS		75,436		81,373	77,145	86,290
79	polytropic efficiency		eta_p	[-]		BWRS		0,8191		0,8001	0,7960	0,8030
80	polytropic head		y_p	[kJ/kg]		calc		61,790		65,106	61,405	69,292
81	Tip Reynolds No. (1st Blade)		Re_u,1	[-]		VDI 2045		8,8E+6		9,2E+6	9,1E+6	9,1E+6
82	Tip Mach No. (1st Blade)		Ma_u,1	[-]		VDI 2045		0,4745		0,4637	0,4606	0,4616
83	Volumetric Flow Coefficient		phi_u,1	[-]		VDI 2045		0,0240		0,0217	0,0237	0,0196
84	Ref. Process Work Coefficient		psi_u,1	[-]		VDI 2045		3,5132		3,7027	3,4932	3,9408
85	Suction Mass Flow		m_P	[kg/s]		calc		56,551		49,088	52,956	43,875
86	Suction Mass Flow		m_P	[kg/h]		calc		203584		176715	190642	157949
87	Internal Gaspower		P_i	[kW]		calc		4266		3994	4085	3786
88	Mechanical Loss		P_m,e	[kW]		design		110		110	110	110
89	Power at Coupling		P_Co,C	[kW]		calc		4376		4104	4195	3896
91	<b>2.5) Performance Checks</b>											
92	kap_m=SQRT(kap_1*kap_2)			[-]				1,3186		1,3276	1,3247	1,3273
93	kap_m/(kap_m-1)			[-]				4,1386		4,0521	4,0802	4,0553
94	((kap_m/(kap_m-1))_v-(...)_g/(...)_g			[%]						-2,0914	-1,4123	-2,0133
95												
96	n_m=SQRT(n_1*n_2)			[-]				1,4537		1,4409	1,4407	1,4382
97	n_m/(n_m-1)			[-]				3,2039		3,2682	3,2692	3,2820
98	((n_m/(n_m-1))_v-(...)_g/(...)_g			[%]						2,009	2,038	2,437
99												
100	Re_u,1,v/Re_u,1,g			[-]						1,0390	1,0276	1,0276
101	Ma_u,1,v/Ma_u,1,g			[-]						0,9774	0,9707	0,9729
102	PHI=(V_P_1/V_P_2)_v/(V_P_1/V_P_2)_g			[-]						0,9977	0,9755	1,0152
103	X=(N/SQRT(RZ_1*T_1))_v/(...)_g			[-]						0,9809	0,9739	0,9761
104												
105	<b>2.5) Correction/Conversion</b> (according VDI 2045, Part 1, Fig. 7, Page 51)											
106	n_v/(n_v-1)	über kappa, eta		[-]				3,3899		3,2420	3,2477	3,2565
107	n_v/(n_v-1) (con)			[-]				3,2039		3,2682	3,2692	3,2820
108	polytropic head (con)		y_p,con	[kJ/kg]				61,79		<b>65,12</b>	<b>61,44</b>	<b>69,31</b>
109	Enthalpy Difference (con)		dh_i	[kJ/kg]				75,44		81,39	77,19	86,31
110												
111	Pressure Ratio (con)		pi_con	[-]				1,613		1,653	1,610	1,703
112	Discharge Pressure (con)		p_2,con	[bar-a]				73,22		75,04	73,08	77,33
113												
114	Temperature Difference (con)		dT_con	[K]				43,8		45,3	42,6	48,2
115	Suction Volume flow (con)		V_P_1,con	[m3/h]				5376		<b>4865</b>	<b>5307</b>	<b>4397</b>
116	Suction Mass Flow (con)		m_P,con	[kg/h]				203584		184256	200974	166508
117	Suction volume flow (normal) (con)		V_P_1,N,con	[Nm3/h]				251118		227277	247899	205386
118												
119	Internal Gaspower (con)		P_i,con	[kW]				4266				3992
120	Coupl. Power Compr. (con)		P_C_Co,con	[kW]				4376				4102
121	Coupling Power Difference		dP_C_Co,cor	[kW]				0				-274
122	Coupling Power Difference		dP_C_Co,cor	[%]				0,00				-6,26
123												
124	Coupl. Power Compr. (con,corr)		P_C_Co,corr	[kW]				<b>4376</b>				<b>4461</b>
125	Coupling Power Difference		dP_C_Co,GE	[kW]				0				<b>85</b>
126	Coupling Power Difference		dP_C_Co,GE	[%]				0,00				<b>1,95</b>