CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER

	BUSHEHR PETROCHEMICAL COMPANY MEG PLANT

Document Review

Issue Purpose:	AFC
Result Code: AP,AN,CM,RE,NC	AN
Next Status : IFC,IFA,IFI,AFC,AB	AFC
Responsible Department	MECHANICAL
Commented Date	7/5/2022

Rev.	Date	Purpose of Issue	Prepared	Checked	Approved	AC Code
03	22/06/2022	Approved for Construction	TvT	KP	JR	
02	09/05/2022	Approved for Construction	TvT	KP	LdM	
01	27/10/2021	Approved for Construction	TvT	KP	LdM	
00	20/09/2021	For approval	TvT	KP	LdM	

Class: 1 | Phase: P

TABULATION OF REVISED PAGES

Page	D00	D01	D02	D03	D04
1.	X	X	X	X	
2.	X	X	X	X	
3.	X	X	X	X	
4.	X	X	X	X	
5.	X	X	X	X	
6.	X	X	X	X	
7.	X	X	X	X	
8.			X	X	
9.			X	X	
10.			X	X	
11.			X	X	
12.			X	X	
13.			X	X	
14.			X	X	
15.			X	X	

Page	D00	D01	D02	D03	D04

INDEX

Notes:

GENERAL	1	Tag Number			PSV-10151	
	2	Service			Pressure Safety Valve	
	3	P&ID No.			BU-20-VD-303-PR-WG-0013	
	4	Location			Compressor upstream After-cooler	
	5	Line/equip. No.			2"-NL-1002-539D(N)	
	6	Design / nozzle typ			Safety / Full	
	7	Conv., Bellows, Pilot op.			Conventional type	
	8	Bonnet Type /connection			Closed / bolted	
	9	Spring Cap /connection			Closed/ threaded	
PROCESS CONDITIONS	10	Fluid	State		Nitrogen	Dry Gas
	11	Pressure	Norm.	Max.	15,5 Bar(a)	18 Bar(a)
	12	Temperature	Norm.	Max.	160°C	170°C
	13	Design	Press.	Temp.	26 Bar(a)	200°C
	14	Ambient Temp.	Min.	Max.	5 °C	52 °C
	15	Flow			707 Kg/hr / 565 Nm3/hr	
BASIS AND SELECTION	16	Set Pressure			18 bar(a)	
	17	Molecular Weight	Oper. Sp. Gr.		28,97 kg/mol	1
	18	Back Pres. (bar(g))			0 bar(g)	
	19	Allowable Overpressure (%)			10 %	
	20	Compressibility Factor (Z)			1	
	21	Ratio of Specific Heat (Cp/Cv)			1.4	
	22	Operating Viscosity (cP)			-	
	23	Barometric Pressure			1,013	
	24	Max. Allowable Relief Pressure			20,813	
	25	Design Code			API 520, API 521, API 526	
	26	Size Basis			Blocked discharge	
	27	Calculated Area (sq.mm)			109	
	28	Selected Area (sq.mm)			153	
	29	Orifice Designation			D	
	30					
CONNECTIONS	31	Inlet Size	Outlet Size		1"	2"
	32	Inlet Connection	Outlet Conn.		RF	RF
	33	Inlet Rating	Outlet Rating		300#	150#
	34					
	35					
MATERIAL	36	Body and Bonnet			Carbon steel (SA-216 Gr. WCB)	
	37	Seat and Disc			SS 316	
	38	Guide and Rings			SS 316	
	39	Spring			Chrome Alloy	
	40	Nozzle			SS 316	
	41	Bonnet Bolt/nut			A193 B7 / A194 grade 2H	
	42					
OPTIONS	43	Lever: Plain or Packed			Plain	
	44	Test Gag			Yes	
	45					
	46					
	47					
CERTIFICATES	48	3.1 Material certificate			Yes	
	49	Calibration certificate			Yes	
	50	Leakage test acc to API STD 527			Yes	
	51	Functional test			Yes	
CALCULATIONS	52	Sizing calculation			Yes	
	53					
	54					
PURCHASE	55	Manufacturer			Leser	
	56	Model			5262	
	57					

1. All Documents must be consistent withe each other. in data sheet. In data sheet 14.5 bara.

NOTES :

Rev	By	Date	Description
03	TT	22-62022	Approve for construction
02	TT	09/05/2022	Approve for construction
01	TT	27/10/2021	Approve for construction
00	TT	20/09/2021	For Approval

INSTRUMENT AND VALVE DATASHEET

Pressure Safety Valve

Airpack Netherlands

GENERAL	1	Tag Number			PSV-10152	
	2	Service			Pressure Safety Valve	
	3	P&ID No.			BU-20-VD-303-PR-WG-0013	
	4	Location			Compressor upstream After-cooler	
	5	Line/equip. No.			2"-NL-1003-539D(N)	
	6	Design / nozzle type			Safety / Full	
	7	Conv., Bellows, Pilot op.			Conventional type	
	8	Bonnet Type /connection			Closed / bolted	
	9	Spring Cap /connection			Closed/ threaded	
PROCESS CONDITIONS	10	Fluid	State		Nitrogen	Dry Gas
	11	Pressure	Norm.	Max.	23,5 Bar(a)	26 Bar(a)
	12	Temperature	Norm.	Max.	135°C	140°C
	13	Design	Press.	Temp.	26 Bar(a)	170°C
	14	Ambient Temp.	Min.	Max.	5 °C	52 °C
	15	Flow			707 Kg/hr / 565 Nm3/hr	
BASIS AND SELECTION	16	Set Pressure			26 bar(a)	
	17	Molecular Weight	Oper. Sp. Gr.		28,97 kg/mol	1
	18	Back Pres. (bar(g))			0 bar(g)	
	19	Allowable Overpressure (%)			10 %	
	20	Compressibility Factor (Z)			1	
	21	Ratio of Specific Heat (Cp/Cv)			1.4	
	22	Operating Viscosity (cP)			-	
	23	Barometric Pressure			1,013	
	24	Max. Allowable Relief Pressure			29,613	
	25	Design Code			API 520, API 521, API 526	
	26	Size Basis			Blocked discharge	
	27	Calculated Area (sq.mm)			73	
	28	Selected Area (sq.mm)			153	
	29	Orifice Designation			D	
	30					
CONNECTIONS	31	Inlet Size	Outlet Size		1"	2"
	32	Inlet Connection	Outlet Conn.		RF	RF
	33	Inlet Rating	Outlet Rating		300#	150#
	34					
	35					
MATERIAL	36	Body and Bonnet			Carbon steel (SA-216 Gr. WCB)	
	37	Seat and Disc			SS 316	
	38	Guide and Rings			SS 316	
	39	Spring			Chrome Alloy	
	40	Nozzle			SS 316	
	41	Bonnet Bolt/nut			A193 B7 / A194 grade 2H	
	42					
OPTIONS	43	Lever: Plain or Packed			Plain	
	44	Test Gag			Yes	
	45					
	46					
	47					
CERTIFICATES	48	3.1 Material certificate			Yes	
	49	Calibration certificate			Yes	
	50	Leakage test acc to API STD 527			Yes	
	51	Functional test			Yes	
CALCULATIONS	52	Sizing calculation			Yes	
	53					
	54					
PURCHASE	55	Manufacturer			Leser	
	56	Model			5262	
	57					

NOTES :

Rev	By	Date	Description
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INSTRUMENT AND VALVE DATASHEET

Pressure Safety Valve

Airpack Netherlands

GENERAL	1	Tag Number			PSV-10153		
	2	Service			Pressure Safety Valve		
	3	P&ID No.			BU-20-VD-303-PR-WG-0013		
	4	Location			Compressor Cooling water outlet		
	5	Line/equip. No.			2"-CWR-1011-501C(N)		
	6	Design / nozzle type			Safety / Full		
	7	Conv., Bellows, Pilot op.			Conventional type		
	8	Bonnet Type /connection			Closed / bolted		
	9	Spring Cap /connection			Closed/ threaded		
PROCESS CONDITIONS	10	Fluid	Stat		er		Liquid
	11	Pressure	Norm.	Max.	2,5 Bar(g)		3 Bar(g)
	12	Temperature	Norm.	Max.	45°C		55°C
	13	Design	Press.	Temp.	7 Bar(g)		100°C
	14	Ambient Temp.	Min.	Max.	5 °C		52 °C
	15	Flow			14,5 m3/hr		
BASIS AND SELECTION	16	Set Pressure			3,5 bar(g)		
	17	Molecular Weight	Oper. Sp. Gr.		18,015 g/mol		1
	18	Back Pres. (bar(g))			0 bar(g)		
	19	Allowable Overpressure (%)			10 %		
	20	Compressibility Factor (Z)			1		
	21	Ratio of Specific Heat (Cp/Cv)			1.4		
	22	Operating Viscosity (cP)			-		
	23	Barometric Pressure			1,013		
	24	Max. Allowable Relief Pressure			4,863		
	25	Design Code			API 520, API 521, API 526		
	26	Size Basis			Blocked discharge		
	27	Calculated Area (sq.mm)			250		
	28	Selected Area (sq.mm)			254		
	29	Orifice Designation			F		
	30						
CONNECTIONS	31	Inlet Size	Outlet Size		1 1/2"		2"
	32	Inlet Connection	Outlet Conn.		RF		RF
	33	Inlet Rating	Outlet Rating		150#		150#
	34						
	35						
MATERIAL	36	Body and Bonnet			Carbon steel (SA-216 Gr. WCB)		
	37	Seat and Disc			SS 316		
	38	Guide and Rings			SS 316		
	39	Spring			Chrome Alloy		
	40	Nozzle			SS 316		
	41	Bonnet Bolt/nut			A193 B7 / A194 grade 2H		
	42						
OPTIONS	43	Lever: Plain or Packed			N/A		
	44	Test Gag			Yes		
	45						
	46						
	47						
CERTIFICATES	48	3.1 Material certificate			Yes		
	49	Calibration certificate			Yes		
	50	Leakage test acc to API STD 527			Yes		
	51	Functional test			Yes		
CALCULATIONS	52	Sizing calculation			Yes		
	53						
	54						
PURCHASE	55	Manufacturer			Leser		
	56	Model			5262		
	57						

2. The set pressure of PSV is 7 barg

NOTES :

Rev	By	Date	Description
03	TT	22-62022	Approve for construction
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00	TT	20/09/2021	For Approval

INSTRUMENT AND VALVE DATASHEET

Pressure Safety Valve

Airpack Netherlands

Sizing - Medium				
1000	Designation	Nitrogen		
1004	Formula	N2		
1001	Molar mass	M	28	kg/kmol
1002	Ratio of specific heats	k	1.400	
1003	Compressibility factor	Z	1.000	

Sizing - Service condition				
1100	Maximum allowable working pressure			
1101	Set pressure	p	18	bar-a
1102	Constant superimposed back pressure	paf		
2102	Variable superimposed back pressure			
1103	Built up back pressure	pae		
1104	Backpressure			
1105	Overpressure	dp	10.00	%
1106	Environmental pressure	pu	1.013	bar
1107	Relieving Temperature	T	170	°C
1111	Operating Temperature		170	°C
1108	Required massflow	qm,ab	707	kg/h
1109	Volume flow to be discharged (working condition)	qvb,ab	47.228	m³/h
1110	Volume flow to be discharged (std condition) [T=60 °F P=14.7 psi]	qvn,ab	351.927	SCFM
1120	Rupture disc correction factor	Kc	1.000	

Initial Sizing according to API 520 for conventional safety valve		
1150	NPS inlet Orifice NPS outlet	1D2
1151	PR inlet x PR oultet	#300 x #150
1152	Material	WCB
1153	Required orifice	D
1154	Selected orifice	D

Sizing - Calculation				
1200	Certified massflow	qm,zu	938.566	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	62.697	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu	793.873	m³/h
1204	Maximum mass flow	qm,max	1,042.851	kg/h
1205	Maximum volume flow (working condition)	qvb,max	69.663	m³/h
1206	Maximum volume flow (standard condition)	qvn,max	882.082	m³/h
1207	Capacity exceed		32.75	%

Name	AD 2000-Merkblatt A2				
Date	2022-04-22 09:21:51				
Rev.No	1				

Valve - General			
1500			
1512	Reseller article number		
1513	Quantity of safety valve		1
1501	Certified coefficient of discharge for steam and gases	K,DG	0.455
1502	Certified coefficient of discharge for liquid	K,F	0.343
1453	Orifice		D
1505	Bonnet / Lifting device		Lifting device H4 (gastight)
1506	Body-/ Inlet base material		1.0619 / SA 216 WCB
1511	Bonnet		Closed Bonnet
1514			

Inlet connection		
1303	Connection standard	acc. to ASME B16.5
1304	DN / NPS	1"
1305	PN / PR	#300
1306	Flange facing	RF

Outlet connection		
1353	Connection standard	acc. to ASME B16.5
1354	DN / NPS	2"
1355	PN / PR	#150
1356	Flange facing	RF

Valve - Dimensions				
1400	Discharge area	Ao	153.938	mm^2
1401	Discharge diameter	do	14	mm
1402	Centre to Face dimensions	a	105	mm
1403	Centre to Face dimensions	b	114	mm
1405	Height	H	440	mm
1406	Weight	M	17.3	kg
1411	Inlet flange thickness incl. raised face	S1	30	mm

Lift				
1507	Standard		1.5	mm

Valve - Calculation				
1200	Certified massflow	qm,zu	938.566	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	62.697	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu	793.873	m³/h
1204	Maximum mass flow	qm,max	1,042.851	kg/h
1205	Maximum volume flow (working condition)	qvb,max	69.663	m³/h
1206	Maximum volume flow (standard condition)	qvn,max	882.082	m³/h
1207	Capacity exceed		32.75	%
1600	Required actual discharge area	Ao, req	115.958	mm²
1601	Required discharge diameter	do,req	12.151	mm
1617	Back pressure correction factor	Kb	1.000	
1618	Cold differential test pressure	CDTP	17.151	bar-g
1620	Cold differential test pressure, manually	CDTP		

Valve - Accessories	
J69	Lifting device H4: Test Gag

Sizing - Medium				
1000	Designation	Nitrogen		
1004	Formula	N2		
1001	Molar mass	M	28.97	kg/kmol
1002	Ratio of specific heats	k	1.400	
1003	Compressibility factor	Z	1.000	

Sizing - Service condition				
1100	Maximum allowable working pressure			
1101	Set pressure	p	26	bar-a
1102	Constant superimposed back pressure	paf		
2102	Variable superimposed back pressure			
1103	Built up back pressure	pae		
1104	Backpressure			
1105	Overpressure	dp	10.00	%
1106	Environmental pressure	pu	1.013	bar
1107	Relieving Temperature	T	140	°C
1111	Operating Temperature		140	°C
1108	Required massflow	qm,ab	707	kg/h
1109	Volume flow to be discharged (working condition)	qvb,ab	29.416	m³/h
1110	Volume flow to be discharged (std condition) [T=60 °F P=14.7 psi]	qvn,ab	340.143	SCFM
1120	Rupture disc correction factor	Kc	1.000	

Initial Sizing according to API 520 for conventional safety valve		
1150	NPS inlet Orifice NPS outlet	1D2
1151	PR inlet x PR oultet	#300 x #150
1152	Material	WCB
1153	Required orifice	D
1154	Selected orifice	D

Sizing - Calculation				
1200	Certified massflow	qm,zu	1,430.438	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	59.515	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu	1,169.406	m³/h
1204	Maximum mass flow	qm,max	1,589.376	kg/h
1205	Maximum volume flow (working condition)	qvb,max	66.128	m³/h
1206	Maximum volume flow (standard condition)	qvn,max	1,299.34	m³/h
1207	Capacity exceed		102.33	%

Name	AD 2000-Merkblatt A2				
Date	2022-04-22 10:14:34				
Rev.No	1				

Valve - General			
1500			
1512	Reseller article number		
1513	Quantity of safety valve		1
1501	Certified coefficient of discharge for steam and gases	K,DG	0.455
1502	Certified coefficient of discharge for liquid	K,F	0.343
1453	Orifice		D
1505	Bonnet / Lifting device		Lifting device H4 (gastight)
1506	Body-/ Inlet base material		1.0619 / SA 216 WCB
1511	Bonnet		Closed Bonnet
1514		_	

Inlet connection		
1303	Connection standard	acc. to ASME B16.5
1304	DN / NPS	1"
1305	PN / PR	#300
1306	Flange facing	RF

Outlet connection		
1353	Connection standard	acc. to ASME B16.5
1354	DN / NPS	2"
1355	PN / PR	#150
1356	Flange facing	RF

Valve - Dimensions				
1400	Discharge area	Ao	153.938	mm^2
1401	Discharge diameter	do	14	mm
1402	Centre to Face dimensions	a	105	mm
1403	Centre to Face dimensions	b	114	mm
1405	Height	H	440	mm
1406	Weight	M	17.3	kg
1411	Inlet flange thickness incl. raised face	S1	30	mm

Lift				
1507	Standard		1.5	mm

Valve - Calculation				
1200	Certified massflow	qm,zu	1,430.438	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	59.515	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu	1,169.406	m³/h
1204	Maximum mass flow	qm,max	1,589.376	kg/h
1205	Maximum volume flow (working condition)	qvb,max	66.128	m³/h
1206	Maximum volume flow (standard condition)	qvn,max	1,299.34	m³/h
1207	Capacity exceed		102.33	%
1600	Required actual discharge area	Ao, req	76.085	mm²
1601	Required discharge diameter	do,req	9.842	mm
1617	Back pressure correction factor	Kb	1.000	
1618	Cold differential test pressure	CDTP	25.134	bar-g
1620	Cold differential test pressure, manually	CDTP		

Valve - Accessories	
J69	Lifting device H4: Test Gag

Sizing - Medium				
1000	Designation	Water		
1004	Formula	H2O		
1005	Density	ρ	998	kg/m³
1006	Viscosity	μ or ṅ		

Sizing - Service condition				
1100	Maximum allowable working pressure			
1101	Set pressure	p	3.5	bar-g
1102	Constant superimposed back pressure	paf		
2102	Variable superimposed back pressure			
1103	Built up back pressure	pae		
1104	Backpressure			
1105	Overpressure	dp	10.00	%
1106	Environmental pressure	pu	1.013	bar
1107	Relieving Temperature	T	60	°C
1111	Operating Temperature		60	°C
1108	Required massflow	qm,ab	14,471	kg/h
1109	Volume flow to be discharged (working condition)	qvb,ab	14.5	m³/h
1120	Rupture disc correction factor	Kc	1.000	

Sizing - Calculation				
1200	Certified massflow	qm,zu	14,699.259	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	14.729	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu		
1204	Maximum mass flow	qm,max	16,332.51	kg/h
1205	Maximum volume flow (working condition)	qvb,max	16.365	m³/h
1206	Maximum volume flow (standard condition)	qvn,max		
1207	Capacity exceed		1.58	%

Valve - General			
1500			.
1512	Reseller article number		
1513	Quantity of safety valve		1
1501	Certified coefficient of discharge for steam and gases	K,DG	0.801
1502	Certified coefficient of discharge for liquid	K,F	0.579
1453	Orifice		F
1505	Bonnet / Lifting device		Cap H2
1506	Body-/ Inlet base material		1.0619 / SA 216 WCB
1511	Bonnet		Closed Bonnet
1514			

Name	AD 2000-Merkblatt A2				
Date	2022-04-22 10:27:07				
Rev.No	1				

Inlet connection		
1303	Connection standard	acc. to ASME B16.5
1304	DN / NPS	1 1/2"
1305	PN / PR	#150
1306	Flange facing	RF

Outlet connection		
1353	Connection standard	acc. to ASME B16.5
1354	DN / NPS	2"
1355	PN / PR	#150
1356	Flange facing	RF

Valve - Dimensions				
1400	Discharge area	Ao	254.469	mm²
1401	Discharge diameter	do	18	mm
1402	Centre to Face dimensions	a	124	mm
1403	Centre to Face dimensions	b	121	mm
1405	Height	H	536	mm
1406	Weight	M	30.6	kg
1411	Inlet flange thickness incl. raised face	S1	32	mm

Lift				
1507	Standard		5	mm

Valve - Calculation				
1200	Certified massflow	qm,zu	14,699.259	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	14.729	m³/h
1203	Certified volumeflow (standard condition)	qvn,zu		
1204	Maximum mass flow	qm,max	16,332.51	kg/h
1205	Maximum volume flow (working condition)	qvb,max	16.365	m³/h
1206	Maximum volume flow (standard condition)	qvn,max		
1207	Capacity exceed		1.58	%
1600	Required actual discharge area	Ao, req	250.517	mm²
1601	Required discharge diameter	do,req	17.86	mm
1618	Cold differential test pressure	CDTP	3.5	bar-g
1620	Cold differential test pressure, manually	CDTP		

Valve - Accessories	
J70	Lifting cap H2: Test Gag

Name	AD 2000-Merkblatt A2				
Date	2022-04-22 10:27:07				
Rev.No	1				

Valve - Part list

	PosNo	Denomination	Q	Material ASME	Material DIN
12010	1	Body	1	SA 216 WCB	1.0619
12050	5	Full nozzle	1	CF8M or 316L	1.4408 or 1.4404
12060	6	Adjusting ring	1	CF8M	1.4408
12070	7	Disc	1	Hardened Stainless steel	1.4122
12080	8	Guide	1	Carbon steel/chrome st. Tenifer	1.0501/ 1.4104 tenifer
12090	9	Bonnet	1	SA 216 WCB	1.0619
12120	12	Spindle	1	420	1.4021
12140	14	Split ring	2	Chrome steel	1.4104
12160	16	Spring plate	1	Steel	1.0718
12170	17	Spring plate	1	Steel	1.0718
12180	18	Adjusting screw	1	Chrome steel	1.4104
12190	19	Lock nut	1	Steel	1.0718
12220	22	Lift stopper	1	316L	1.4404
12400	40	Cap H2	1	SA 105	1.0460
12540	54	Spring	1	High temperature alloy steel	1.8159
12550	55	Bolt	4	B8M	1.4401
12560	56	Nut	4	8M	1.4401
12570	57	Ball	15	316	1.4401
12600	60	Gasket	1	Graphite / 316	Graphit / 1.4401
12610	61	Ball washer	1	Hardened stainless steel	1.3541
12660	66	Hex. nut	1	B8M	1.4401
12690	69	Thrust needle bearing	1	316L	1.4404
12730	73	Locking screw	1	8M	1.4404
12870	87	Plug	1	B8M	1.4401