CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER

Rev.	Date	Purpose of Issue	Prepared	Checked	Approved	AC Code
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

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1.	X	X	X		
2.	X	X	X		
3.	X	X	X		
4.	X	X	X		
5.	X	X	X		
6.	X	X	X		
7.	X	X	X		
8.			X		
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10.			X		
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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 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.	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	55 °C
	15	Flow			707 Kg/hr / 565 Nm3/hr	
BASIS AND SELECTION	16	Set Pressure			18 bar(g)	
	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					

NOTES :

				INSTRUMENT AND VALVE DATASHEET
				Pressure Safety Valve
02	TT	09/05/2022	Approve for construction	Airpack Netherlands
01	TT	27/10/2021	Approve for construction	
00	TT	20/09/2021	For Approval	
Rev	By	Date	Description	

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	55 °C	
	15	Flow			707 Kg/hr / 565 Nm3/hr		
BASIS AND SELECTION	16	Set Pressure			26 bar(g)		
	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 :

				INSTRUMENT AND VALVE DATASHEET	
				Pressure Safety Valve	
02	TT	09/05/2022	Approve for construction	Airpack Netherlands	
01	TT	27/10/2021	Approve for construction		
00	TT	20/09/2021	For Approval		Sheet 5 of 15
Rev	By	Date	Description		Based on P&ID Rev.03

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	State		Water	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					

NOTES :

				INSTRUMENT AND VALVE DATASHEET
				Pressure Safety Valve
02	TT	09/05/2022	Approve for construction	Airpack Netherlands
01	TT	27/10/2021	Approve for construction	
00	TT	20/09/2021	For Approval	Sheet 6 of 15
Rev	By	Date	Description	Based on P&ID Rev.03

W I _Ki The-Safety-Valve com	Sizing acc. to API 5 2 0 for Gas VALVESTAR ® - v.7.3.1.6 0 92 0	Pane:	lof6
		Date:	2022-04-22 09:21:51
		Project:	New project
		Tag No:	PSV-10151
		LESER Job NQ	

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-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	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	44.699	m^3/h
1110	Volume flow to be discharged (std condition) [T=60 °F P=14.7 psi]	qvn,ab	598.007	m^3/h
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
1 1 54	Selected orifice	D

Sizing - Calculation				
1200	Certified massflow	qm,zu	991.671	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	62.697	m^3/h
1203	Certified volumeflow (standard condition)	qvn,zu	838.792	m^3/h
1204	Maximum mass flow	qnn,max	1,101.857	kg/h
1205	Maximum volume flow (working condition)	qvb,max	69.663	m^3/h
1206	Maximum volume flow (standard condition)	qvn,max	931.991	m^3/h
1207	Capacity exceed		40.26	%

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

Valve - General			
1500	Article number		
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	Order code		

Inlet connection		
1303	Connection standard	acc. to ASME B16.5
1304	DN / NPS	1"
1305	PN / PR	#300
1 306	Flange facing	RF

Outlet connection		
1353	Connection standard	acc. to ASME B16.5
1354	DN / NPS	2"
1355	PN / PR	#150
1 356	Flange facing	RF

Valve - Dimensions				
1400	Discharge area	Ao	153.938	m m^2
1401	Discharge diameter	do	14	mm
1402	Centre to Face dimensions	a	105	mm
1 403	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	991.671	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	62.697	m^3/h
1203	Certified volumeflow (standard condition)	qvn,zu	838.792	m^3/h
1204	Maximum mass flow	qnn,max	1,101.857	kg/h
1205	Maximum volume flow (working condition)	qvb,max	69.663	m^3/h
1206	Maximum volume flow (standard condition)	qvn,max	931.991	m^3/h
1207	Capacity exceed		40.26	%
1 600	Required actual discharge area	Ao, req	1 09.74 8	mm^2
1 601	Required discharge diameter	do,req	11.821	mm
1 61 7	Back pressure correction factor	Kb	1.0 00	
1 61 8	Cold differential test pressure	CDTP	1 8.1 74	bar-g
1 62 0	Cold differential test pressure, manually	CDTP		

Valve - Accessories	
J69	Lifting device H4: Test Gag

W I _Ki The-Safety-Valve com	Sizing acc. to API 5 2 0 for Gas VALVESTAR ® - v.7.3.1.6 0 92 0	Pane:	lof6
		Date:	2022-04-22 10:14:34
		Project:	New project
		Tag No:	PSV-10152
		LESER Job N9	

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-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	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	28.309	m^3/h
1110	Volume flow to be discharged (std condition) [T=60 °F P=14.7 psi]	qvn,ab	577.984	m^3/h
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
1 1 54	Selected orifice	D

Sizing - Calculation				
1200	Certified massflow	qm,zu	1,486.382	kg /h
1201	Certified volumeflow (operating condition)	qvb,zu	59.515	m^3/h
1203	Certified volumeflow (standard condition)	qvn,zu	1,215.141	m^3/h
1204	Maximum mass flow	qnn,max	1,651.536	kg/h
1205	Maximum volume flow (working condition)	qvb,max	66.128	m^3/h
1206	Maximum volume flow (standard condition)	qvn,max	1,350.156	m^3/h
1207	Capacity exceed		110.24	%

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

Valve - General			
1500	Article number		
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	Order code		

Inlet connection		
1303	Connection standard	acc. to ASME B16.5
1304	DN / NPS	1"
1305	PN / PR	#300
1 306	Flange facing	RF

Outlet connection		
1353	Connection standard	acc. to ASME B16.5
1354	DN / NPS	2"
1355	PN / PR	#150
1 356	Flange facing	RF

Valve - Dimensions				
1400	Discharge area	Ao	153.938	m m^2
1401	Discharge diameter	do	14	mm
1402	Centre to Face dimensions	a	105	mm
1 403	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

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

Valve - Calculation				
1200	Certified massflow	qm,zu	1,486.382	kg /h
1201	Certified volumeflow (operating condition)	qvb,zu	59.515	m^3/h
1203	Certified volumeflow (standard condition)	qvn,zu	1,215.141	m^3/h
1204	Maximum mass flow	qnn,max	1,651.536	kg/h
1205	Maximum volume flow (working condition)	qvb,max	66.128	m^3/h
1206	Maximum volume flow (standard condition)	qvn,max	1,350.156	m^3/h
1207	Capacity exceed		110.24	%
1 600	Required actual discharge area	Ao, req	73.221	mm^2
1 601	Required discharge diameter	do,req	9.6 5 5	mm
1 61 7	Back pressure correction factor	Kb	1 .000	
1 61 8	Cold differential test pressure	CDTP	26.1 53	bar-g
1 62 0	Cold differential test pressure, manually	CDTP		

Valve - Accessories	
J69	Lifting device H4: Test Gag

WI The-Safety-Valve com	**Sizing acc. to API 520 for Liquid VALVESTAR® - v.7.3.1.60920**	Page:	1of6
		Date:	2022-04-22 10:27:07
		Project:	New project
		Tag No:	PSV - 10153
		LESER Job Ng	

Sizing - Medium				
1000	Designation	Water		
1004	Formula	H2O		
1005	Density	p	998	kg/m³
1006	Viscosity	p or el		

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	Wo
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	

Initial Sizing according to API 520 for conventional safety valve		
1150	NPS inlet Orifice NPS outlet	1 1/2G3
1151	PR inlet x PR oultet	#150 x #150
1152	Material	WCB
1153	Required orifice	G
1154	Selected orifice	G

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	Wo

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

Valve - General			
1500	Article number		
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	Order code		

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	mm^2
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	m^3/h
1203	Certified volumeflow (standard condition)	qvn,zu		
1204	Maximum mass flow	qnn,max	16,332.51	kg/h
1205	Maximum volume flow (working condition)	qvb,max	16.365	m^3/h
1206	Maximum volume flow (standard condition)	qvn,max		
1207	Capacity exceed		1.58	%
1600	Required actual discharge area	Ao, req	250.517	mm^2
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