







OWNER:  شرکت سست و موبلی آوند ایرانیان (سهایی نطیر)	BUSHEHR PETROCHEMICAL COMPANY MEG PLANT						EPC CONTRACTOR:  Chagalesh-Enerchimi-Steam Joint Venture BUPC-MEG PLANT PROJECT		
	CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER						 Netherlands		
MC :  شرکت سست و موبلی آوند ایرانیان موبلی نطیر	Project	Area	Phase	Unit	Dis.	Doc.	Seq.	Contract No : 52-98/445	
Owner Document Number: 17811-52A	BU	20	VD	303	IN	DSH	0015	Rev.:	Page
								03	1 of 15

CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER

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		
Rev.	Date	Purpose of Issue	Prepared	Checked	Approved	AC Code	
						Class: 1	Phase: P

INDEX			
No.	Device	Tag Number	Page
1	Pressure Safety Valve	PSV-10151	4
2	Pressure Safety Valve	PSV-10152	5
3	Pressure Safety Valve	PSV-10153	6
4	Pressure safety valves calculations	PSV-10151	7/8/9
5	Pressure safety valves calculations	PSV-10152	10/11/12
6	Pressure safety valves calculations	PSV-10153	13/14/15
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
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45			
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47			
48			
49			
50			
51			
52			
53			
54			
55			

Notes:

				INSTRUMENT AND VALVE DATASHEET Index 	
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		
Rev	By	Date	Description	Sheet	3 of 15
				Based on P&ID	Rev.03

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	52 °C
BASIS AND SELECTION	15	Flow		707 Kg/hr / 565 Nm3/hr	
	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	
	CONNECTIONS	27	Calculated Area (sq.mm)		109
28		Selected Area (sq.mm)		153	
29		Orifice Designation		D	
30					
31		Inlet Size	Outlet Size	1"	2"
MATERIAL	32	Inlet Connection	Outlet Conn.	RF	RF
	33	Inlet Rating	Outlet Rating	300#	150#
	34				
	35				
	36	Body and Bonnet		Carbon steel (SA-216 Gr. WCB)	
OPTIONS	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	
CERTIFICATES	42				
	43	Lever: Plain or Packed		Plain	
	44	Test Gag		Yes	
	45				
	46				
CALCULATIONS	47				
	48	3.1 Material certificate		Yes	
	49	Calibration certificate		Yes	
	50	Leakage test acc to API STD 527		Yes	
PURCHASE	51	Functional test		Yes	
	52	Sizing calculation		Yes	
	53				
NOTES :	54				
	55	Manufacturer		Leser	
	56	Model		5262	
57					

NOTES :

				INSTRUMENT AND VALVE DATASHEET			
				Pressure Safety Valve			
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				
Rev	By	Date	Description			Sheet	4 of 15
						Based on P&ID Rev.03	

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
BASIS AND SELECTION	15	Flow		707 Kg/hr / 565 Nm3/hr	
	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		
CONNECTIONS	30				
	31	Inlet Size	Outlet Size	1"	2"
	32	Inlet Connection	Outlet Conn.	RF	RF
	33	Inlet Rating	Outlet Rating	300#	150#
	34				
MATERIAL	35				
	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	
OPTIONS	42				
	43	Lever: Plain or Packed		Plain	
	44	Test Gag		Yes	
	45				
	46				
CERTIFICATES	47				
	48	3.1 Material certificate		Yes	
	49	Calibration certificate		Yes	
	50	Leakage test acc to API STD 527		Yes	
CALCULATIONS	51	Functional test		Yes	
	52	Sizing calculation		Yes	
	53				
PURCHASE	54				
	55	Manufacturer		Leser	
	56	Model		5262	
57					


NOTES :

				INSTRUMENT AND VALVE DATASHEET			
03	TT	22-62022	Approve for construction			Sheet 5 of 15 Based on P&ID Rev.03	
02	TT	09/05/2022	Approve for construction				
01	TT	27/10/2021	Approve for construction				
00	TT	20/09/2021	For Approval				
Rev	By	Date	Description				

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
BASIS AND SELECTION	15	Flow		14,5 m3/hr	
	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	
	CONNECTIONS	27	Calculated Area (sq.mm)		250
28		Selected Area (sq.mm)		254	
29		Orifice Designation		F	
30					
31		Inlet Size	Outlet Size	1 1/2"	2"
32		Inlet Connection	Outlet Conn.	RF	RF
33		Inlet Rating	Outlet Rating	150#	150#
MATERIAL	34				
	35				
	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	
OPTIONS	40	Nozzle		SS 316	
	41	Bonnet Bolt/nut		A193 B7 / A194 grade 2H	
	42				
	43	Lever: Plain or Packed		N/A	
	44	Test Gag		Yes	
CERTIFICATES	45				
	46				
	47				
	48	3.1 Material certificate		Yes	
CALCULATIONS	49	Calibration certificate		Yes	
	50	Leakage test acc to API STD 527		Yes	
	51	Functional test		Yes	
PURCHASE	52	Sizing calculation		Yes	
	53				
54					
55	Manufacturer		Leser		
56	Model		5262		
57					

NOTES :

				INSTRUMENT AND VALVE DATASHEET			
				Pressure Safety Valve			
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				
Rev	By	Date	Description			Sheet	6 of 15
						Based on P&ID Rev.03	

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® - v.7.3.1.60920	Page:	1 of 6
		Date:	2022-04-22 09:21:51
		Project:	New project
		Tag No:	PSV-10151
		LESER Job N°	


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 outlet	#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 volume flow (operating condition)	qvb,zu	62.697 m³/h
1203	Certified volume flow (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			

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® - v.7.3.1.60920	Page:	2 of 6
		Date:	2022-04-22 09:21:51
		Project:	New project
		Tag No:	PSV-10151
		LESER Job N°	

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


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

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® – v.7.3.1.60920	Page:	3 of 6
		Date:	2022-04-22 09:21:51
		Project:	New project
		Tag No:	PSV-10151
		LESER Job №	

Valve - Calculation				
1200	Certified massflow	qm,zu	938.566	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	62.697	m ³ /h
1203	Certified volumeflow (standard condition)	qvn,zu	793.873	m ³ /h
1204	Maximum mass flow	qm,max	1,042.851	kg/h
1205	Maximum volume flow (working condition)	qvb,max	69.663	m ³ /h
1206	Maximum volume flow (standard condition)	qvn,max	882.082	m ³ /h
1207	Capacity exceed		32.75	%
1600	Required actual discharge area	Ao, req	115.958	mm ²
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

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

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® - v.7.3.1.60920	Page:	1 of 6
		Date:	2022-04-22 10:14:34
		Project:	New project
		Tag No:	PSV-10152
		LESER Job N°	


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 outlet	#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 volume flow (operating condition)	qvb,zu	59.515	m³/h
1203	Certified volume flow (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			

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® - v.7.3.1.60920	Page:	2 of 6
		Date:	2022-04-22 10:14:34
		Project:	New project
		Tag No:	PSV-10152
		LESER Job N°	

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


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

 The-Safety-Valve.com	Sizing acc. to API 520 for Gas VALVESTAR® – v.7.3.1.60920	Page:	3 of 6
		Date:	2022-04-22 10:14:34
		Project:	New project
		Tag No:	PSV-10152
		LESER Job №	

Valve - Calculation				
1200	Certified massflow	qm,zu	1,430.438	kg/h
1201	Certified volumeflow (operating condition)	qvb,zu	59.515	m ³ /h
1203	Certified volumeflow (standard condition)	qvn,zu	1,169.406	m ³ /h
1204	Maximum mass flow	qm,max	1,589.376	kg/h
1205	Maximum volume flow (working condition)	qvb,max	66.128	m ³ /h
1206	Maximum volume flow (standard condition)	qvn,max	1,299.34	m ³ /h
1207	Capacity exceed		102.33	%
1600	Required actual discharge area	Ao, req	76.085	mm ²
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

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

 The-Safety-Valve.com	Sizing acc. to API 520 for Liquid VALVESTAR® - v.7.3.1.60920	Page:	1 of 5
		Date:	2022-04-22 10:27:07
		Project:	New project
		Tag No:	PSV - 10153
		LESER Job N°	


Sizing - Medium			
1000	Designation	Water	
1004	Formula	H2O	
1005	Density	ρ	998 kg/m ³
1006	Viscosity	μ or $\dot{\eta}$	

Sizing - Service condition			
1100	Maximum allowable working pressure		
1101	Set pressure	p	3.5 bar-g
1102	Constant superimposed back pressure	p_{af}	
2102	Variable superimposed back pressure		
1103	Built up back pressure	p_{ae}	
1104	Backpressure		
1105	Overpressure	dp	10.00 %
1106	Environmental pressure	p_u	1.013 bar
1107	Relieving Temperature	T	60 °C
1111	Operating Temperature		60 °C
1108	Required massflow	$q_{m,ab}$	14,471 kg/h
1109	Volume flow to be discharged (working condition)	$q_{vb,ab}$	14.5 m ³ /h
1120	Rupture disc correction factor	K_c	1.000

Sizing - Calculation			
1200	Certified massflow	$q_{m,zu}$	14,699.259 kg/h
1201	Certified volume flow (operating condition)	$q_{vb,zu}$	14.729 m ³ /h
1203	Certified volume flow (standard condition)	$q_{vn,zu}$	
1204	Maximum mass flow	$q_{m,max}$	16,332.51 kg/h
1205	Maximum volume flow (working condition)	$q_{vb,max}$	16.365 m ³ /h
1206	Maximum volume flow (standard condition)	$q_{vn,max}$	
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			

 The-Safety-Valve.com	Sizing acc. to API 520 for Liquid VALVESTAR® - v.7.3.1.60920	Page:	2 of 5
		Date:	2022-04-22 10:27:07
		Project:	New project
		Tag No:	PSV - 10153
		LESER Job No	

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 volume flow (operating condition)	qvb,zu	14.729	m ³ /h
1203	Certified volume flow (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	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

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

 The-Safety-Valve.com	Sizing acc. to API 520 for Liquid VALVESTAR® - v.7.3.1.60920	Page:	3 of 5
		Date:	2022-04-22 10:27:07
		Project:	New project
		Tag No:	PSV - 10153
		LESER Job No	

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

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