







OWNER:  شرکت سست و سویی آبرسان (سهایی نخس)	BUSHEHR PETROCHEMICAL COMPANY MEG PLANT						EPC CONTRACTOR:  Chagalesh-Enerchimi-Steam Joint Venture BUPC-MEG PLANT PROJECT		
MC :  شرکت سست و سویی آبرسان تهران	CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER						 Netherlands		
Owner Document Number: 17811-52A							Project	Area	Phase
	BU	20	VD	303	IN	DSH	0015	Rev.: 04	Page 1 of 15



CALCULATION & DATA SHEET OF SAFETY VALVE FOR NITROGEN GAS BOOSTER

 شرکت سست و سویی آبرسان تهران	 Chagalesh-Enerchimi-Steam Joint Venture BUPC-MEG PLANT PROJECT	BUSHEHR PETROCHEMICAL COMPANY MEG PLANT
Document Review		
Issue Purpose:	AFC	
Result Code: AP,AN,CM,RE,NC	AP	
Next Status : IFC,IFA,IFI,AFC,AB	-	
Responsible Department	MECHANICAL	
Commented Date	7/25/2022	
Approval or review hereunder shall not be construed to relieve Vendor / Subcontractor of his responsibilities and liability under the contract.		

Rev.	Date	Purpose of Issue	Prepared	Checked	Approved	AC Code
04	07/07/2022	Approved for Construction	TvT	KP	JR	
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					

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Notes:

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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		
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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.	14,5 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	
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			
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03	TT	22-6/2022	Approve for construction				
02	TT	09/05/2022	Approve for construction				
01	TT	27/10/2021	Approve for construction				
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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	
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	
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				


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01	TT	27/10/2021	Approve for construction						
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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
	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	
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	
OPTIONS	42				
	43	Lever: Plain or Packed		N/A	
	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				
	54				
PURCHASE	55	Manufacturer		Leser	
	56	Model		5262	
	57				

NOTES :

				INSTRUMENT AND VALVE DATASHEET		
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		Project:	New project
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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 %

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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


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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

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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	%

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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


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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			
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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			
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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

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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

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