POLNACORP

ST-1V, ST-1F, SP-1 SERIES

DESUPERHEATERS

ST-1V SERIES DESUPERHEATERS

ST-1V series desuperheaters are used to reduce the steam temperature by directly water injection inside the superheated steam flow.
The above series includes ST-1V variable area and ST-1F fixed area models.
ST-1V variable area series, including ST-1V and ST-1VM models, allows solving the most common desuperheating problems without practical limitations in flow rate and operating conditions.
Fixed area ST-1F nozzles, on the contrary, are designed for limited power processes with limited load changes.

All the models are provided with the basic variable area spring-loaded ST-1V nozzle.

ST-1V - VARIABLE AREA NOZZLE

Description and operation

The ST-1V nozzle is the basic component of all ST-1V desuperheaters; it is threaded and locked by a special tab washer (5).
Main components of the nozzle are (see fig. 1):

- plug (1)
- nozzle body (2)
- spring (3)

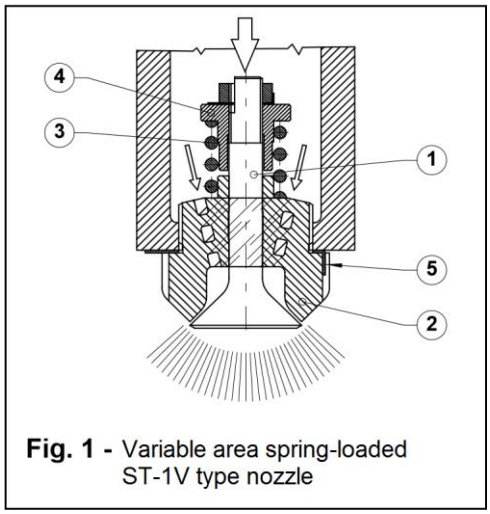


Fig. 1 - Variable area spring-loaded ST-1V type nozzle

The spring, compressed by the ring nut (4), keeps the plug pressed against the nozzle seat until the ∆p between water and steam exceeds its preload. When the plug opens the water circulates through nozzle openings, which, due to their multihelical design, make the flow to whirl before it gets in contact with the inside plug cone.
Due to such a special path, the water coming out of the 85° conical blade shaped nozzle is perfectly atomized.
While in a traditional type fixed area nozzle, decreasing the water flow rate the sprinkling velocity also decreases being the outlet section constant, with a ST-1V nozzle type the plug (1) sets automatically reducing the meatus with the nozzle body (2), reducing the differential pressure up to balancing the spring load (3). Thanks to spring preload, water velocity in the meatus is kept satisfactorily high also for low water flow rates.
Therefore, Parcol variable area spring-loaded ST-1V nozzles executions guarantee steady sprinkling efficiency independently of water flow rate.
Such a capability is correctly called *sprayability* (instead of the more known *rangeability*) to better identify the intrinsic atomization capability versus flow rate change taking into account also water ∆p changes across the nozzle.

Characteristic data

size:	Cv0,8; CV1,6; Cv2,3; Cv4,2; CV5,7
flow rates:	data of desuperheaters provided with ST-1V nozzles.
characteristic curve:	Cv/travel and travel/∆p characteristic curves are summarized in the diagram of Fig. 2, which plots Cv as a function of ∆p, for various values of set pressure.
settings:	standard setting = 3 bar
	Different settings (from 1 to 5 bar) may be used for special requirements. The 3 bar value is a compromise between the necessity to keep a certain back

pressure on the control valve and a minimum seating force on the plug and also to increase the control range of the desuperheater.

sprayability : $Cv_{max}/Cv_{min} \cdot \sqrt{\Delta p_{max} / \Delta p_{min}}$ where Δp_{min} is approximately 3 bar.

The ratio Cv_{max}/Cv_{min} can be determined accordingly to the minimum acceptable spray quality at minimum steam flow taking into account of nozzle size and superheated steam process conditions.

Cv_{min} and Δp_{min} values can be drawn out by the Fig. 2 as a function of setting pressure p_t.

Ex: nozzle Cv0,8, p_t = 3 bar, Δp_{max} = 30 bar, Δp_{min} = 3.5 bar, Cv_{max}/Cv_{min}= 11.4 (from figure 2).

$$Sy = 11.4 \cdot \sqrt{30 / 3.5} = 33.4$$

materials

: plug	:	1.4813
nozzle body	:	1.4913
spring	:	Nimonic 90
Nut	:	1.4006

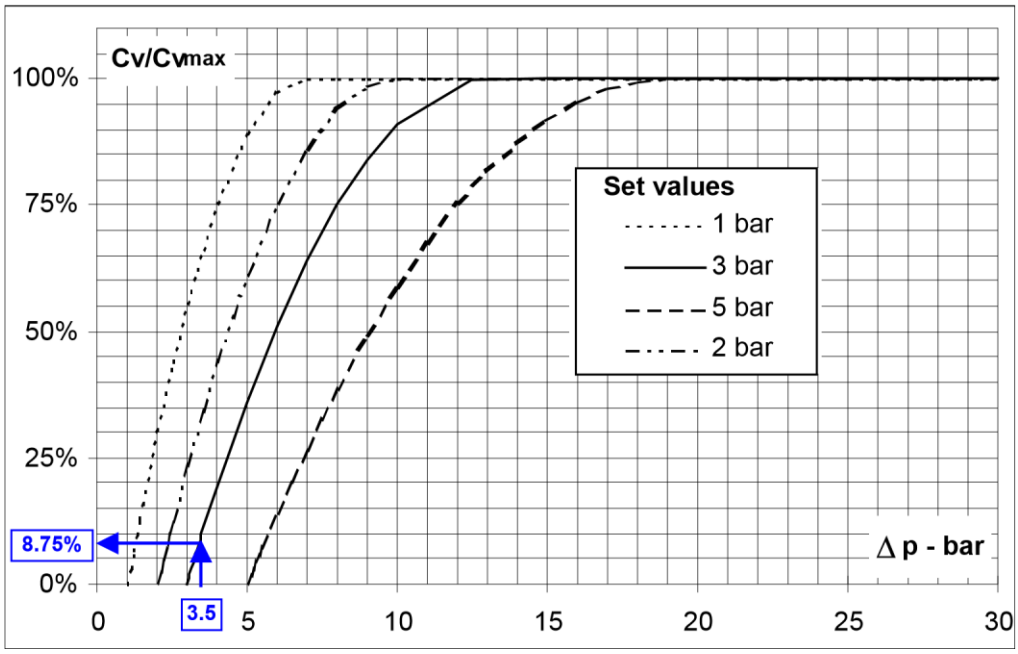


Fig.2
Cv versus Δp.
The maximum plug travel occurs with different Δp values depending on the value of nozzle set pressure.

ST-1V - PROBE TYPE DESUPERHEATER

It consists of a tubular flanged element where one or more downstream oriented ST-1V nozzles are mounted.
The desuperheater is fastened on a pipe nosepiece, the length of which is adjusted, according to the pipe diameter, to keep the center of the spraying area close to the pipe axis.
Two versions are available: injection chamber to be welded to the pipe (ST-1V with injection chamber), or flanged (ST-1V) for connection through a pipe nosepiece having the dimension listed apart.
The injection chamber of ST-1V model may be provided with inside protection liner, should it be required by the operating temperature. One ST-1V nozzle only is provided for in the standard design, two nozzles can be mounted on the same probe for special applications.
The nozzle orientation, with regard to flow direction, is granted by a gauge pin, whose seat must be drilled on site on the nosepiece flange, should the desuperheater be supplied disassembled (ST-1V).

ST-1V

Characteristic data

size : water side: from DN15 to DN50
steam side: from DN50 to DN150

connections : ANSI, UNI, DIN flanges

Injection chamber : BW connection according to pipe size

ratings : water side: ANSI 150 ÷ 1500 (PN 16÷250)
steam side: ANSI 150 ÷ 1500 (PN16÷ 250)
higher ratings on request

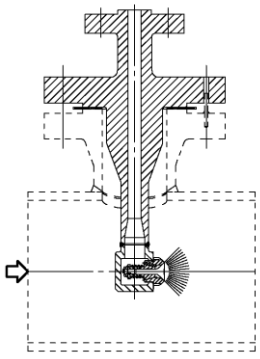
flow rates : may be calculated by common equations using the Cv's listed in the table.
The water mass flow rate can not exceed in any case 25%÷26% of the steam one

sprayability : for single nozzle desuperheaters see ST-1V nozzle basic values.
for multiple nozzles having different sizes and/or settings general turndown improvements are possible.

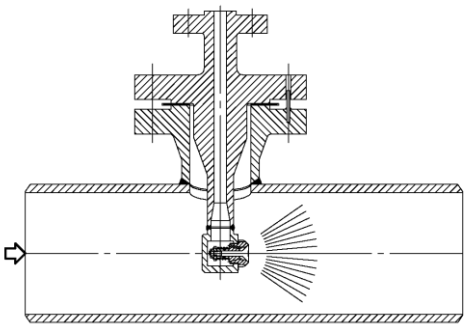
design :for water inlet perpendicular to the pipe (standard) : integral forged, suppliedwith welded nosepiece
for water inlet parallel to the pipe (on request) : forged or laminated parts welded together

materials : body : Carbon or Cr-Mo steels according to operating temperatures
injection chamber : same material as the pipe

ST-1V



ST-1V with injection chamber



Flow coefficients

maximum obtainable Cv (1)				Δp min bar	Δp max bar
nozzle number		1	2 (4)		
Nozzle type	1	0.8	1,5	(2)	30
	2	1,6	3		
	3	2,3	4,31		
	4	4,2	8		
	5	5,7	10,6		
Max injectable water % (3)		0,22	0,24		

(1) - Maximum reachable Cv values at maximum plug opening.
(2) - Value corresponding to spring setting (standard value is 3 bar).
(3) - % value referred to steam flow rate to be desuperheated.
(4) - ST-1VM model to be preferred for equipment provided with two nozzle chamber

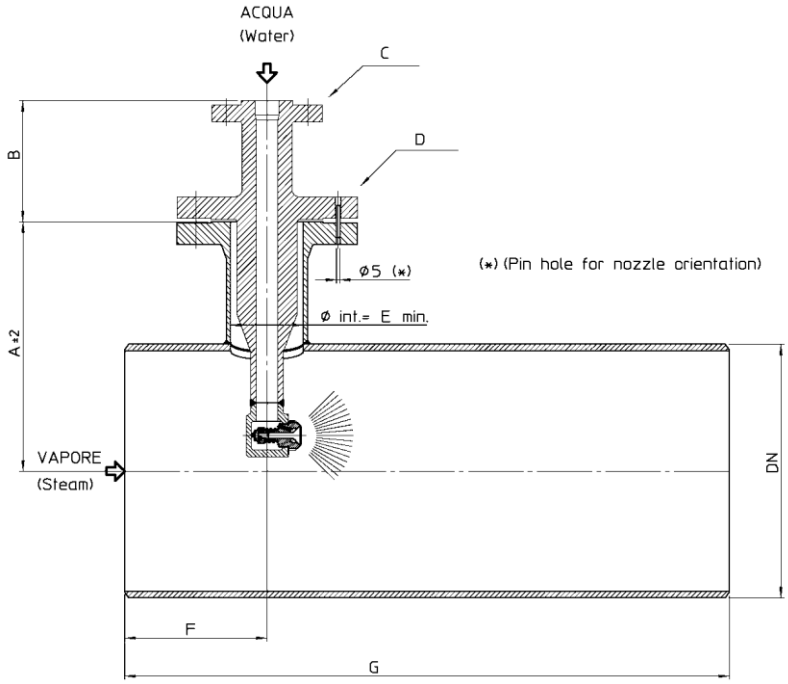
Nozzle size	1	2	3	4	5
steam side connection	**50**	**80**	**100**	**100**	**150**
minimum steam pipe DN (*)	**100**	**150**	**200**	**200**	**300**
w ater connection DN	**15**	**25**	**40**	**50**	**50**

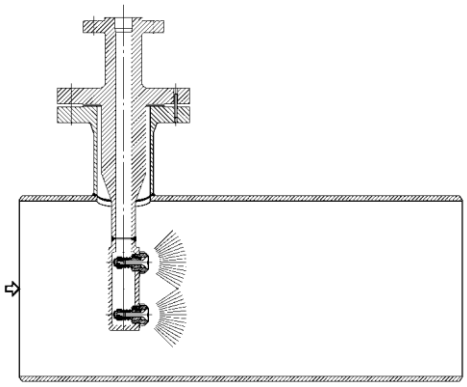
(*) Model w ithout pipe protecting liner

Overall dimensions
ST-1V models

Nozzle type	B	C	D	E
Cv 0,8	140	DN15	DN50	49
Cv 1,6	180	DN25	DN80	73,5
Cv 2,3	200	DN40	DN100	97
Cv 4,2	200	DN50	DN100	102
Cv 5,7	230	DN50	DN150	140

DN	A					F	G
	1	2	3	4	5		
DN100	250	300	350	350	450	150	1000
DN150						200	
DN200						200	
DN250						200	
DN300						200	
DN350	275					200	
DN400	300					200	
DN450	325	325				200	
DN500	350	350	375	375		250	
DN550	375	375	400	400		250	
DN600	400	400	425	425		250	
DN650	425	425	450	450	475	250	
DN700	450	450	475	475	500	250	





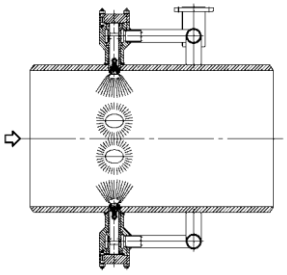
double ST-1V nozzle version

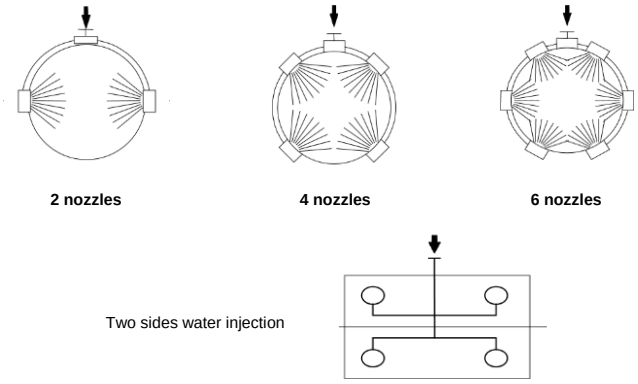
Above dimensions may change according to operating conditions and must be confirmed in the order

ST-1VM – EXTERNAL MOUNTED, MULTIPLE NOZZLES DESUPERHEATER

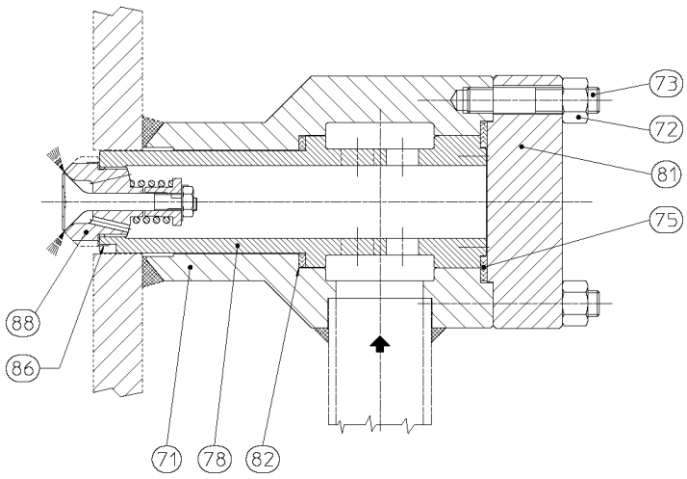
The ST-1VM model desuperheater is composed by more elements (or injectors) connected to one another and welded to an injection chamber that shall be installed on the piping by a BW welding. Each injector is composed by a ST-1V nozzle threaded inside a drilled cage inserted in a stub pipe welded on the injection chamber and closed by a flanged bottom.
The injectors are uniformly distributed on chamber and are oriented perpendicularly to the pipe axis. A piping leading to a single inlet makes up the connection among the various injectors.
Water distribution piping system is purposely designed to avoid dangerous stresses generated by different water and steam temperatures.
According to the operating conditions specified apart, the injection chamber may be provided with an inside protection liner (see Bulletin – Steam Conditioning Manual for further details).
The ST-1VM design may be provided with nozzles having different size and settings, for good performance at various regimes, and mainly to improve sprayability.

ST-1VM





ref.	Description
72	NUT
73	STUD
75	GASKET
78	NOZZLE HOLDER
81	COVER
82	GASKET
86	TAB WASHER
88	NOZZLE ASSEMBLY



Characteristic data

size : DN25 to DN100 for water connection; DN100 to DN1000 for the injection chamber

connection : ANSI, UNI, DIN flanges for water connection
BW for the injection chamber according to pipe size

rating : water side : ANSI 150÷1500 (PN16÷250)
steam side : ANSI 150÷1500 (PN16÷250)

flow rate : may be calculated by using the Cv listed apart as a function of nozzle number
the max water versus steam flow rate can not exceed the value shown in Cv table

sprayability : see values of basic ST-1V nozzle. Turndown improvement is possible through a combination of different nozzle sizes and settings

design : fabricated by welding together forged or laminated parts

material : desuperheaters: Carbon or Cr-Mo steels according to operating temperature
injection chamber: same material as the pipe
internal liner: Cr-Mo steel

ST-1VM desuperheater installed downstream a reducing valve

Flow coefficients

ST-1VM models

max obtainable Cv (1)				Δp min bar	Δp max bar
Number of nozzles		1	2		
Nozzle type	1	0,8	1,5	(2)	30
	2	1,6	3		
	3	2,3	4,31		
	4	4,2	8		
	5	5,7	10,6		

Maximum injectable water quantity

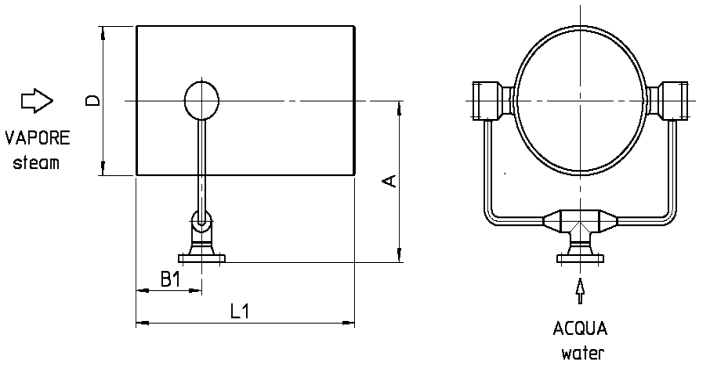
(% value referred to steam flow rate to be desuperheated)

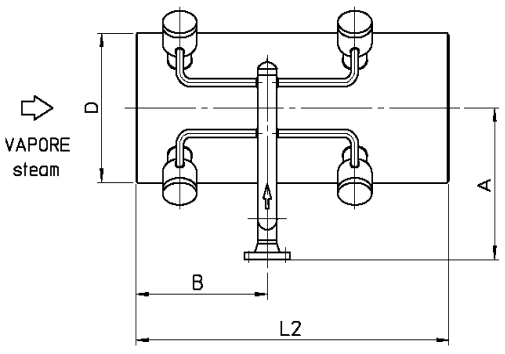
Number of nozzles	1	2
one section	20%	22%
two sections		

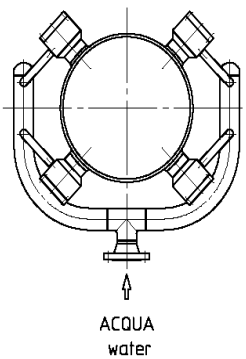
(1) - Maximum values reachable at maximum plug opening
(2) - Value corresponding to the spring setting (the standard value is 3 bar).

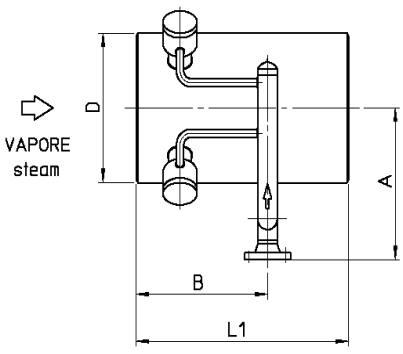
Overall dimensions

ST-1VM





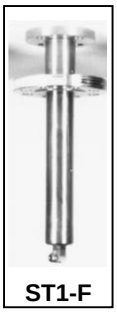




D		A	B	B1	L1	L2
inch	mm					
8"	200	350	350	150	550	800
10"	250	375	350	150	550	850
12"	300	450	400	150	600	900
14"	350	475	400	150	600	1000
16"	400	500	450	150	650	1100
18"	450	575	500	200	700	1200
20"	500	600	550	200	750	1300
22"	550	625	550	200	800	1400
24"	600	650	600	200	850	1500
26"	650	675	600	200	900	1600
28"	700	700	650	200	950	1700
32"	800	750	650	200	1000	1800
36"	900	850	700	200	1050	1900
40"	1000	900	700	200	1100	2000

Above dimension may change according to operation condition and must be confirmed in the order

ST-1F FIXED AREA TYPES


ST1-F

ST1-F type fixed atomizing nozzles are used in three models:

- LFP probe type to be mounted on flanged nosepiece
- LFC probe type provided with injection chamber
- LFW wafer type

ST-1F - FIXED AREA NOZZLES

LF nozzle is designed to perform a very fine atomization degree, similarly to that of injection engines (see fig. 3). The spraying area remains constant when the flow rate changes and consequently water velocity and jet turbulence are reduced. Nevertheless a whirl device (1) (called “turbulator”) mounted upstream the nozzle (2) can partially compensate for the above decrease of atomizing efficiency, thus keeping the turndown ratio acceptable for some applications.
The fixed area model, unlike variable area LV models, misses therefore the benefit of constant velocity; its rangeability and sprayability are the same and may be simply evaluated by the relationship:

$$R_y = S_y = \sqrt{\Delta p_{max} / \Delta p_{min}}$$

where Δp_{min} is the minimum differential pressure generating a satisfactory atomizing degree.
This type of nozzles shows an average value of $\Delta p_{min} \approx 1$ bar which corresponds to an apparent water velocity of 14 m/s (compared to ≈ 40 m/s of a plain not-assisted hole).
A max typical allowable $\Delta p_{max} = 25$ bar leads to a value of **R_y = 5:1.** For different Δp_{max} limits the R_y values have to be calculated accordingly.

LF desuperheaters are normally used where required water flow rates are lower than the minimum ones adjustable by ST-1V models (Cv lower than about 0.7).
Simple and inexpensive, ST-1F nozzles may be adopted instead of ST-1V nozzles of similar capacity, only if the magnitude of process load changes is compatible with the lower sprayability of these devices (about 5:1).

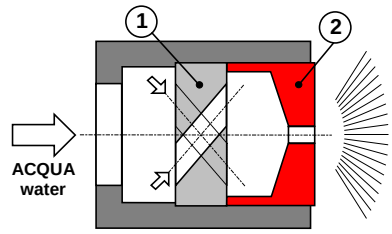


Fig. 3 - Fixed area ST-1F type nozzle

Characteristic data

size : ST-1F - water side: ½” to 1” DN15 - DN25
- steam side: 2” to 6” DN50 – DN150

ST-1F wafer - DN40 - DN100

connections : LFP and LFW: ANSI,UNI, DIN flanges (BW connection on request for LFP)
3-4512 type – BW connection according to pipe size.

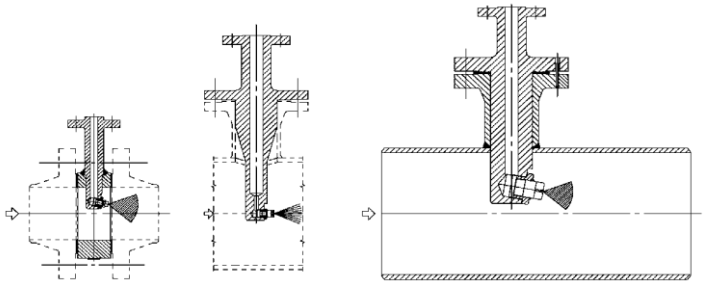
ratings : water side : ANSI 150 ÷ 1500 (PN 16÷250)
steam side : ANSI 150 ÷ 1500 (PN16÷ 250)
higher ratings on request.

flow rates : may be calculated by common equations (see bulletin1-I) using Cv listed in the table.
The maximum water mass flow rate can not in any case exceed 25% of the steam flow.

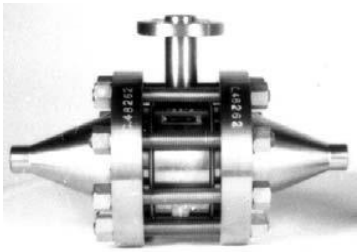
design : water inlet perpendicular to the pipe (standard): integral forged, supplied with threaded nozzle locked by tab washer.
water inlet parallel to the pipe (on request): welded construction between forged or laminated parts.

materials : body: Carbon steel or Cr-Mo steel according to operating temperature.
injection chamber: same material as the pipe.

ST1-F - options



ST1-F wafer



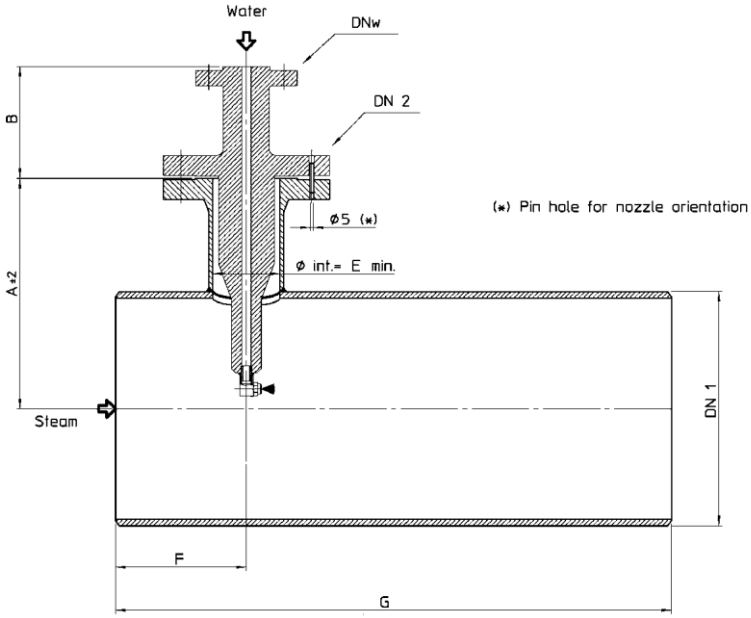
Flow coefficients

ST-1F models

DNw	DN15								DN20			DN25				
Cv - gpm	0.03	0.04	0.06	0.085	0.11	0.14	0.18	0.3	0.36	0.43	0.6	0.7	0.83	1.1	1.4	2.7

Overall dimensions

ST-1F models

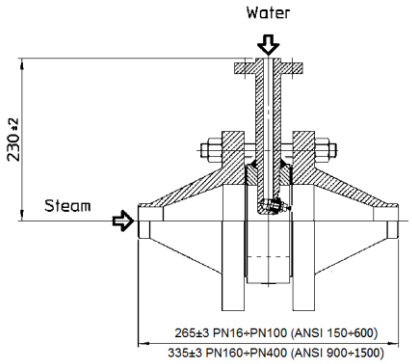


DN1	A			F	G
	DNw DN15	DNw DN20	DNw DN25		
DN80	250			150	500
DN100				150	550
DN150		300	300	200	650
DN200				200	700
DN250				200	750
DN300				200	800
DN350	275			200	850
DN400	300			200	900
DN450	325	325	325	200	950

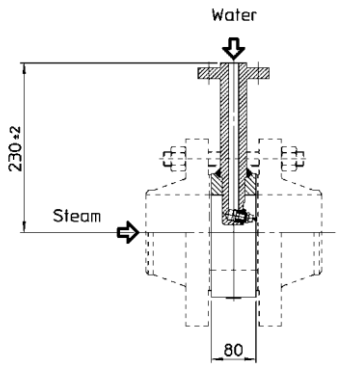
DNw	B	DN 2	E
DN15	140	DN50	49
DN20	180	DN80	73,5
DN25	180	DN80	73,5

SP-1 wafer models

DN40 - DN50 - DN65



DN80 - DN100



Above dimension may change according to operation condition and must be confirmed in the order

POLNACORP

POLNA corp. s.r.o.

Head office:

Oldřichovice 1044
739 61 Třinec
Czech Republic
tel.: +420 737 238 406
fax: +420 558 338 330
e-mail: info@polnacorp.ru
web: www.polnacorp.ru