

Bulletin for Yarway™ AT-18/28 Heavy Duty A.T.-Temp Desuperheater

This bulletin was prepared by Emerson.

Do not install, operate or maintain this product without being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance.

To avoid personal injury or property damage it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings.

If you have any questions about these instructions, contact your [Emerson sales office](#) before proceeding.

Installation

⚠ WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations. Check with your process or safety engineer for any other hazards that may be present from exposure to process media.

Personal injury or equipment damage caused by sudden release of pressure may result if the desuperheater is installed where service conditions could exceed the limits given on the product nameplate. To avoid such injury or damage, provide a relief valve for over-pressure protection as required by government or accepted industry codes and good engineering practices.

CAUTION

When ordered, the desuperheater configuration and construction materials were specified to meet particular pressure, temperature, pressure drop, and fluid conditions. Do not apply any other conditions to the desuperheater without first contacting your local Emerson sales office .

Maintenance

⚠ WARNING

Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:

- **Do not remove the actuator from the valve while the valve is still pressurized.**
- **Always wear protective gloves, clothing, and eyewear when performing any maintenance operations.**
- **Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.**
- **Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.**
- **Safely vent the power actuator loading pressure.**
- **Use lock-out procedures to be sure the above measures stay in effect with you work on the equipment.**
- **The valve packing box may contain process fluids that are pressurized, even with the valve has been removed from the pipeline. Process fluids may spray out under pressure when removing the packing hardware or packing rings.**
- **Check with your process or safety engineer for any other hazards that may be present from exposure to process media.**

CAUTION

When adjusting the travel stop for the closed position of the valve ball or disk, refer to the appropriate valve instruction manual for detailed procedures. Undertravel or overtravel at the closed position may result in poor valve performance and/or damage to the equipment .

Neither Emerson, Emerson Automation Solutions, nor any of their affiliated entities assumes responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use, and maintenance of any product remains solely with the purchaser and end user.

Yarway is a mark owned by one of the companies in the Emerson Automation Solutions business unit of Emerson Electric Co. Emerson Automation Solutions, Emerson, and the Emerson logo are trademarks and service marks of Emerson Electric Co. All other marks are the property of their respective owners.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available upon request. We reserve the right to modify or improve the designs or specifications of such products at any time without notice.

Emerson Automation Solutions
Marshalltown, Iowa 50158 USA
Sorocaba, 18087 Brazil
Cernay, 68700 France
Dubai, United Arab Emirates
Singapore 128461 Singapore

www.Fisher.com

© 2019 Fisher Controls International LLC. All rights reserved.



YARWAY MODEL 18 AND 28
HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER



FEATURES

- Forged construction
- High quality stuffing box
- Variable nozzle type
- Wide range of C_V (K_V) capacities available
- Special nozzle combinations available
- Semi balanced internals for economic actuator selection
- Pressure ratings
 - ASME B16.34 class 900 to 2500
 - EN 1092 PN 160 to 400
- Materials
 - ASTM SA 182 F22 or 1.7383
 - ASTM SA 182 F347H or 1.4550
 - ASTM SA 182 F91 or 1.4903
 - Other materials upon request

GENERAL APPLICATION

Desuperheaters are used for temperature control of:

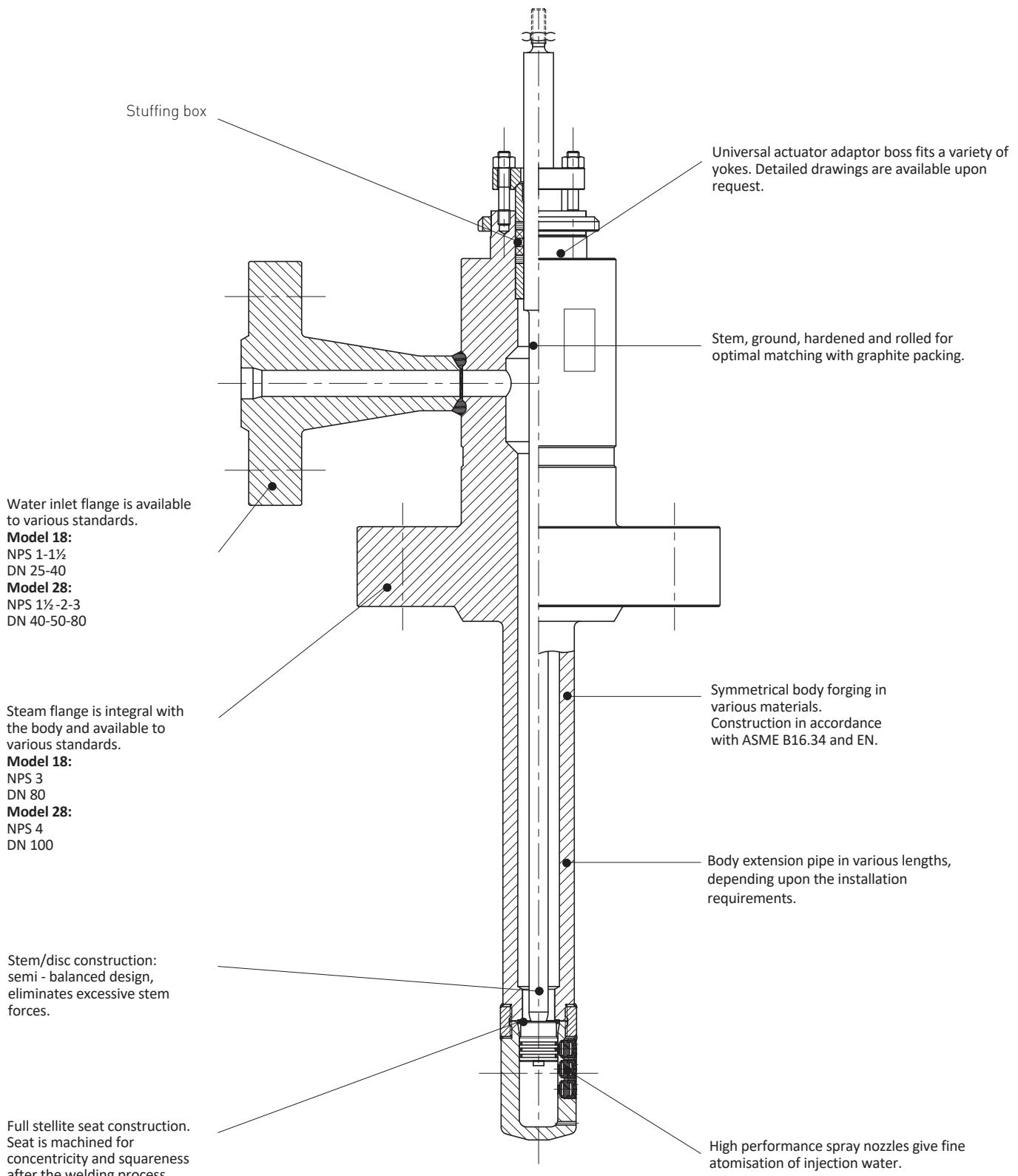
- Cooling of process steam or gas
- Boiler superheater
- Boiler reheater
- Turbine bleed steam
- Pressure reducing valve

TECHNICAL DATA

AT18	Steam NPS 3 / DN 80 Water NPS 1-1/2 - 2 / DN 25-40-50
AT28	Steam NPS 4 / DN 100 Water NPS 1½-2-3 / DN 40-50-80

YARWAY MODEL 18 AND 28
HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

FIGURE 1



YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

The Yarway Heavy Duty A.T.-Temp Desuperheater is specifically developed for use on medium/high pressure steam applications. The fabricated construction makes it easy adaptable to meet various boiler codes and material specifications. The unit can also be used as a liquid into gas injector for which high grade alloy such as stainless steel is often used. The vital trim components are identical to those used in Yarway Standard Duty A.T.-Temp Desuperheater.

More than 3800 units of both Heavy - and Standard Duty A.T.-Temp Desuperheaters are in service today. The valve stem is rolled to obtain a smooth finish. This highly finished surface is then nitrided to give a hardness of > 1000 Vickers. The combination of these processes improves sealing tightness, whilst reducing packing friction. Piston rings are specially hardened and subsequently nitrided and are provided with a special gas tight slot. These rings offer excellent running properties and enable controllable C_v (K_v) values as low as 0.005 (0.0043).

SYSTEM COMPARISON

Conventional

Conventional injection water systems consist of:

- Fixed size spray nozzle
- Control valve
- Steam pipe section

The water injection quantity is regulated by the control valve. As a consequence of this flow regulation the downstream water pressure P_2 , varies as a function of the valve plug position. At reduced capacity the control valve starts to throttle, reducing P_2 and hence the available water to steam ' Δp ', resulting in larger droplet size and poor atomization.

The water evaporation rate slows down and temperature control becomes troublesome. This typical system problem becomes compounded as nozzles and valves are usually sized for the design capacity but normally operate significantly below these design conditions. This oversizing results in a partially open control valve, even at normal operating conditions. With reducing load, downstream water pressure P_2 decays rapidly resulting in larger droplet size. Conventional systems therefore will work satisfactorily only at relatively steady load conditions. Improvement of their performance is realized by applying Venturi type pipeline sections.

A.T.-Temp Desuperheater

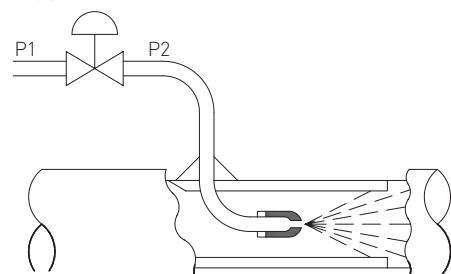
The A.T.-Temp Desuperheater valve regulates the amount of injection water by varying the number of injection nozzles. This enables the water pressure to remain constant, independently of the number of injection nozzles in operation. This results in an excellent and near uniform spray quality over the entire operating range. Control of nozzle opening is achieved by the positioning of a piston which is operated directly by an actuator mounted onto the valve. Through this simple design, there is no separate water control valve necessary.

APPLICATIONS

Yarway A.T.-Temp Desuperheaters are used for temperature control of:

- Boiler superheaters
- Boiler reheaters
- Turbine bleed steam
- Pressure reducing valve outlet steam
- Process steam
- Process gases

FIGURE 2



YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

SUPERIOR SPRAY NOZZLE

Yarway has incorporated the latest technology in the spray nozzle design.

The high quality surface finish minimizes frictional losses, thereby ensuring that the total water to steam Δp is available for atomization of the water (see Figure 4).

The nozzle consists of two components A) the orifices and B) the nozzle body. Each nozzle is served by individual feed holes in the cylinder wall. Water enters the chamber behind the orifice plate through these openings.

The relatively large volume of this chamber ensures that water is proportioned evenly through each orifice.

The Δp across this orifice plate results in an increase in the fluid velocity. The water is subsequently rotated in the nozzle chamber before being emitted through the central hole. The combination of splitting the feed flow, increasing velocity and rotating effect, ensures that the water is injected into the system in a fine symmetrical hollow cone spray.

The nozzles are assembled with the spray cylinder and sealed by a vacuum brazing process. This maintains the integrity of these components even under the most extreme conditions.

Material compatibility of spray cylinder, piston and piston rings is well proven in hot/cold service conditions, as typically found in steam attemperators. This enables reliable operation over an extended period.

Surfaces are finely machined to reduce frictional losses and internal contours are so designed as to optimize water swirl action, ensuring uniform and consistent droplet size.

Minimum Δp available from the A.T.-Temp Desuperheater inlet flange to steam pressure must be:

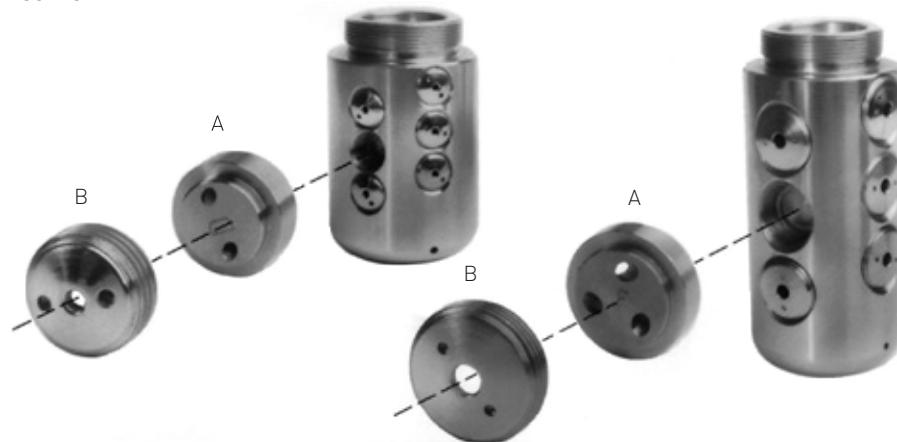
Nozzles A through Dx: 1 bar

Nozzles E through K: 2 bar

CODES AND STANDARDS

The A.T.-Temp Desuperheater is designed and manufactured to meet a wide variety of international codes and standards. Certified acceptance documents are available upon request. If special codes or standards are required by your local authority, then we would be pleased to discuss them.

FIGURE 3



MULTIPLE NOZZLE HEADS

The A.T.-Temp Desuperheater may be equipped with a variety of spray heads.

The uniform body threading accepts spray cylinder heads with a wide range of C_v (K_v) values.

Standard configurations are with either 6 or 9 equally sized spray nozzles but combinations are available.

This feature enables the A.T.-Temp Desuperheater to be customized to specific system requirements. Consult your local representative for details at www.emerson.com.

YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

A.T.-Temp standard capacity range

Type Number	Nozzle Configuration	Max Kv	Max Cv
1	6A	0,0648	0,0749
2	4A-2B	0,0888	0,1027
3	2A-3B-1C	0,1338	0,1547
4	1A-2B-3C	0,1878	0,2171
5	1A-2B-1C-2D	0,2686	0,3105
6	1A-1B-2C-1D-1Dx	0,3721	0,4302
7	1A-2B-3C-1D-1Dx-1D	0,5229	0,6045
8	3B-2C-1D-3Dx	0,7403	0,8558
9	1C-2D-1Dx-2D-3Dx	1,0474	1,2109
10	9Dx	1,5003	1,7345
11	1B-1C-1D-1Dx-1E-1F	0,9988	1,1547
12	1C-1D-1Dx-1E-2F	1,3840	1,6000
13	1C-1D-1Dx-1E-2G	2,3014	2,6606
14	1C-1D-1E-1F-1G-1H	3,0260	3,4983
15	1D-1Dx-2F-1H-1K	4,3549	5,0346
16	2D-1E-1G-1E-1F-1K-1H-1G	6,1444	7,1034
17	1E-2Dx-1H-2F-3K	8,5867	9,9268
18	1G-1F-1G-1K-2H-3K	12,5934	14,5588
19	9K	17,4420	20,1642

Definition

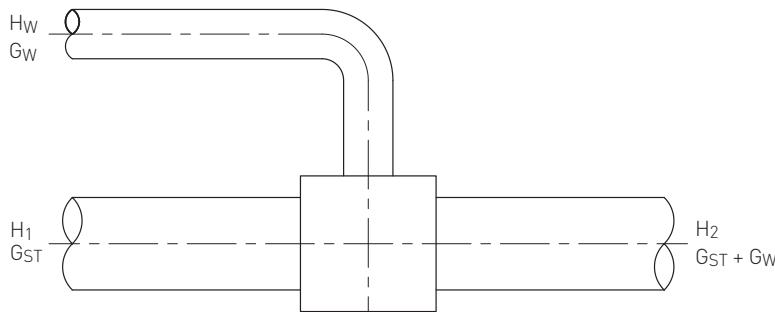
$$K_V = Q \sqrt{\frac{S.G}{\Delta p}}$$

Q = m³/hr
S.G. = kg/dm³
ΔP = bar

Flow capacity limitations are:

- Model 18 with a maximum water flow capacity of 25 m³/hr. in continuous service.
- Model 28 with a maximum water flow capacity of 50 m³/hr. in continuous service.

FIGURE 4



SIZING FORMULA

Every desuperheating station is a mixing point where there is a heat and mass balance.

The universal formula is:

$$G_W = G_{ST} (H_1 - H_2) : (H_2 - H_W)$$

In which:

G_W = Injection water mass

G_{ST} = Inlet steam mass

H₁ = Enthalpy of the inlet steam

H₂ = Enthalpy of the outlet steam

H_W = Enthalpy of the injection water

This formula enables calculation of the quantity of water required to lower the inlet steam temperature to the set - point temperature of the outlet steam.

YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

IMPORTANT SYSTEM PARAMETERS

Apart from the spray quality of the atomizer (primary atomization) there are other system parameters which influence the Desuperheater stations performance. These are:

Inlet steam velocity

At high steam velocities, water droplets are easily disintegrated. This factor contributes to the overall atomization quality (secondary atomization). The minimum acceptable steam velocity varies as a function of the nozzle size and pipe diameter. In case of doubt, consult Yarway.

Water to steam ratio

This ratio is determined by dividing G_w by G_{st} . For system steam pressures below 15 bar, this ratio should not exceed 10% for the normal operating conditions. Systems operating between 15 and 25 bar can have a ratio of up to 15%. For higher pressure duties, consult Yarway.

Required straight pipe run

The distance from injection point to the first pipe bend is also a function of steam pressure, temperature and nozzle size. Experience has shown that in systems up to 25 bar, 4 to 6 meters, is an acceptable distance.

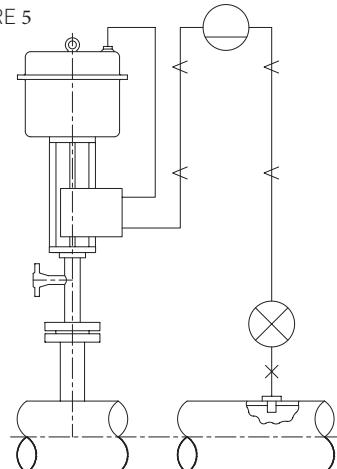
Distance to sensor

The distance from the injection point to the temperature sensor should be 12 to 15 meters. Systems operating at pressures above 25 bar can have significantly less run to the sensor, consult Yarway.

CONTROL SYSTEMS

The injection water quantity is controlled as a function of the outlet steam temperature. The A.T.-Temp Desuperheater actuation is compatible with conventional control systems operated from temperature transmitters, temperature indicating controllers and positioners. Fully pneumatic or fully electric systems are compatible and also combinations of the two. Exact requirements should be specified in the ordering / sizing data paragraph of this brochure.

FIGURE 5



YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

ACTUATOR STEM FORCES

The stem forces for the Heavy Duty A.T.-Temp Desuperheater are determined by the following formula:

Model 18: $P_{\text{water}} \times 36 + 1000 = \text{Newton}$ (P_{water} in bar)

The maximum stem force must be limited to 15 kN.

Model 28: $P_{\text{water}} \times 68 + 1250 = \text{Newton}$ (P_{water} in bar)

The maximum stem force must be limited to 50 kN.

Special care should be taken when electric actuators are used. By their momenta of inertia these actuators can generate stem forces exceeding the specified nominal stem force during short intervals.

Yarway supplies special spring loaded couplings for such applications.

Actuator sizing formula

Units:

D seat in cm

d stem in cm

D bal in cm

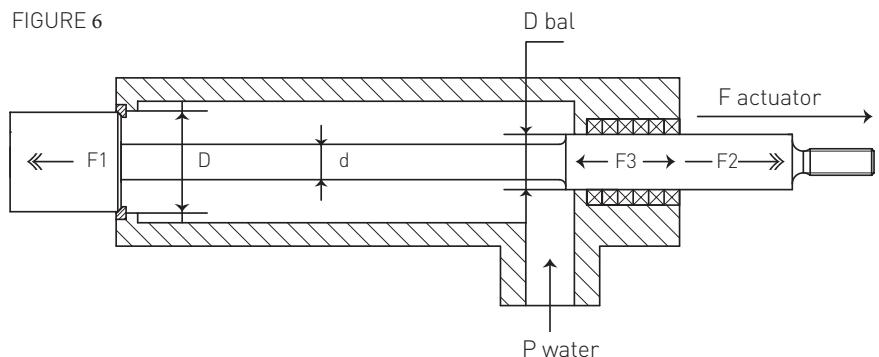
P water in bar

$$F1 = \pi / 4 (D_{\text{seat}}^2 - d_{\text{stem}}^2) \times P_{\text{water}}$$

$$F2 = \pi / 4 (D_{\text{bal}}^2 - d_{\text{stem}}^2) \times P_{\text{water}}$$

F3 = **F** friction (+ or -).

FIGURE 6



ORDERING / SIZING DATA

Steam desuperheaters are selected specifically against application data. For optimal sizing, the following comprehensive data should always be supplied.

Steam data

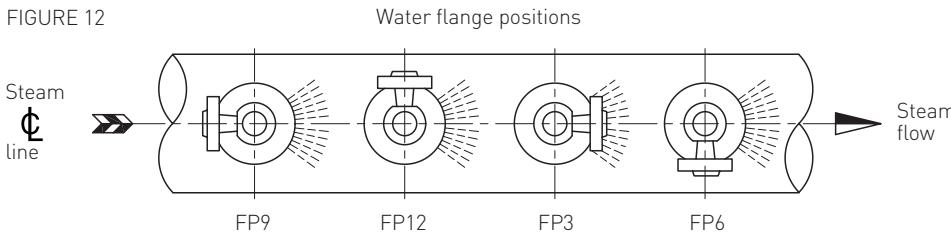
Inlet pressure bar
Inlet temperature °C
Outlet temperature °C setpoint
Steam flow max. t / hr
Steam flow normal t / hr
Steam flow min. t / hr

Water data Water pressure bar
Water temperature °C

General
Pipe size mm
Pipe schedule Required
waterflange position (9) (12) (3) (6)
It is essential not to over specify the required
turndown ratio i.e.: $\frac{\text{steam flow max.}}{\text{steam flow min.}}$

Otherwise this will necessitate selection of special nozzle heads which are non-stock items. Standard stock consists of nozzles with 6 or 9 equally sized atomizers giving turndown ratios of 18:1 and 27:1 respectively, on the water flow control. Experience shows that the majority of applications fall within this range.

FIGURE 12



Spray water must be injected in the direction of the steam flow. To facilitate installation of the water supply line, 4 different spray head positions are available in relation to the water connecting flange. Specification of this spray head orientation is required with the ordering data.

Yarway always recommends a strainer with a mesh size of approx. 100 µ (400 µ upon request) in the water supply line to protect the A.T.-Temp Desuperheater from clogging.

YARWAY MODEL 18 AND 28
HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

TABLE 1 - STANDARD MATERIALS

Item	Name	ASME material	EN material
1 + 2	Spray Cylinder/Nozzle	S41000/S41000	1.4006/1.4006
		S41000/Alloy 6	1.4006/Alloy 6
		N07718/N07718	N07718/N07718
3	Piston Ring	S43100 (1)	1.4057 (1)
4	Piston	S43100 (1)	1.4057 (1)
5	Fastener Ring	SA182 F11 Class 2	1.7335
		ALLOY 800H (1)	ALLOY 800H (1)
7	Stem	S43100 (1)	1.4057 (1)
9	Body/Seat	SA 182 F22/Alloy 6 or 17% Cr	1.7383/Alloy 6 or 17% Cr
		SA 182 F347H/Alloy 6 or 17% Cr	1.4550/Alloy 6 or 17% Cr
		SA 182 F91/Alloy 6 or 17% Cr	1.4903/Alloy 6 or 17% Cr
10	Water Flange	SA 182 F22	1.7383
		SA 182 F347H	1.4550
		SA 182 F91	1.4903
12	Packing Box Ring	S43100 (1)	1.4057 (1)
14	Nut,Hex	SA194 GR7 (4)	SA194 GR7 (4)
15	Packing Set	GRAPHITE K80/K80S	GRAPHITE K80/K80S
16	Stud Bolt	SA193 GR B16 (4)	SA193 GR B16 (4)
17	Packing Follower	S43100 (1)	1.4057 (1)
18	Flange, Packing	S30400	1.4301
19	Nameplate	SST	SST
20	Yoke Locknut	SA105 (3)	SA105 (3)
23	Securing Washer	CARBON STEEL (2)	CARBON STEEL (2)

NOTE

- (1) Nitrided
- (2) Zinc plated
- (3) NCF
- (4) ENC

Certification

A.T.-Temp Desuperheaters comply with the requirements of ASME B16.34 and EN 12516.

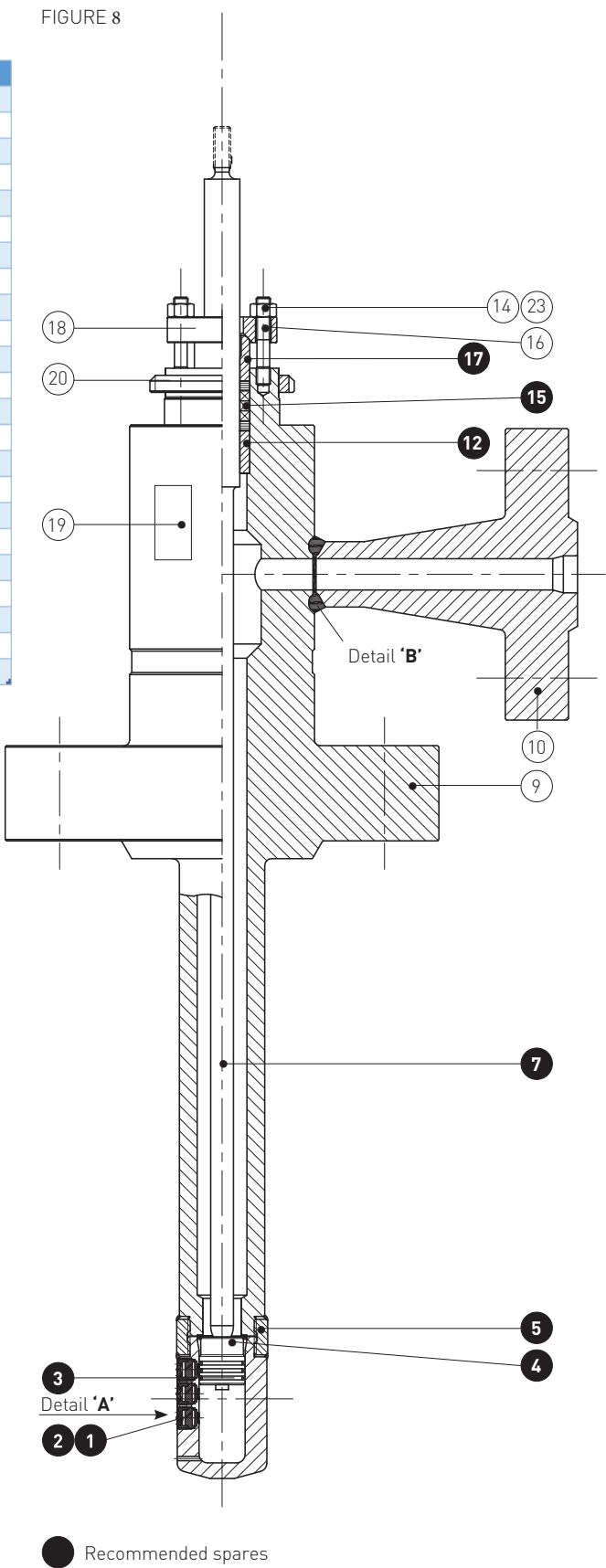
All data subject to changes.

Other materials are available upon request.

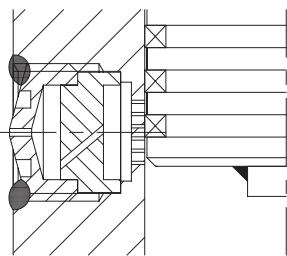
Materials and data of units supplied, may deviate from this brochure.

Please consult order documents in case of doubt.

FIGURE 8



Detail 'A'



● Recommended spares

YARWAY MODEL 18 AND 28

HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

TABLE 2 - DIMENSIONS (mm)

	Model 38	Model 48
	Qmax = 25 m ³ / hr.	Qmax = 50 m ³ / hr.
Standard length for steam line sizes up to 12" (DN 300)		
A	55 mm travel	380
	90 mm travel	399
B	55 mm travel	436
	90 mm travel	476

Option: standard length for steam line sizes 14" (DN 350) and higher		
A	55 mm travel	580
	90 mm travel	599
B	55 mm travel	636
	90 mm travel	676
C		200
D		290
E		300
F		108
G		M16 x 2.00
K		3 9/16" Yoke Boss
L		See table 2-1
M		min. 68.0
N		60.3 x 12.6
P		64.0
STROKE		
	55 mm travel - Minimum pipeline diameter 6"	
	90 mm travel - Minimum pipeline diameter 8"	

TABLE 2-1 DIMENSIONS (mm)

	PN100	PN160	PN250	PN320	PN400
DN 25	150	150	150	150	200
DN 40	150	150	150	200	250
DN 50	150	150	200	250	250
L (mm) AT18	CL600	CL900	CL1500	CL2500	
NPS 1	150	150	150	200	
NPS 1-1/2	150	200	200	250	
NPS 2	150	250	250	250	

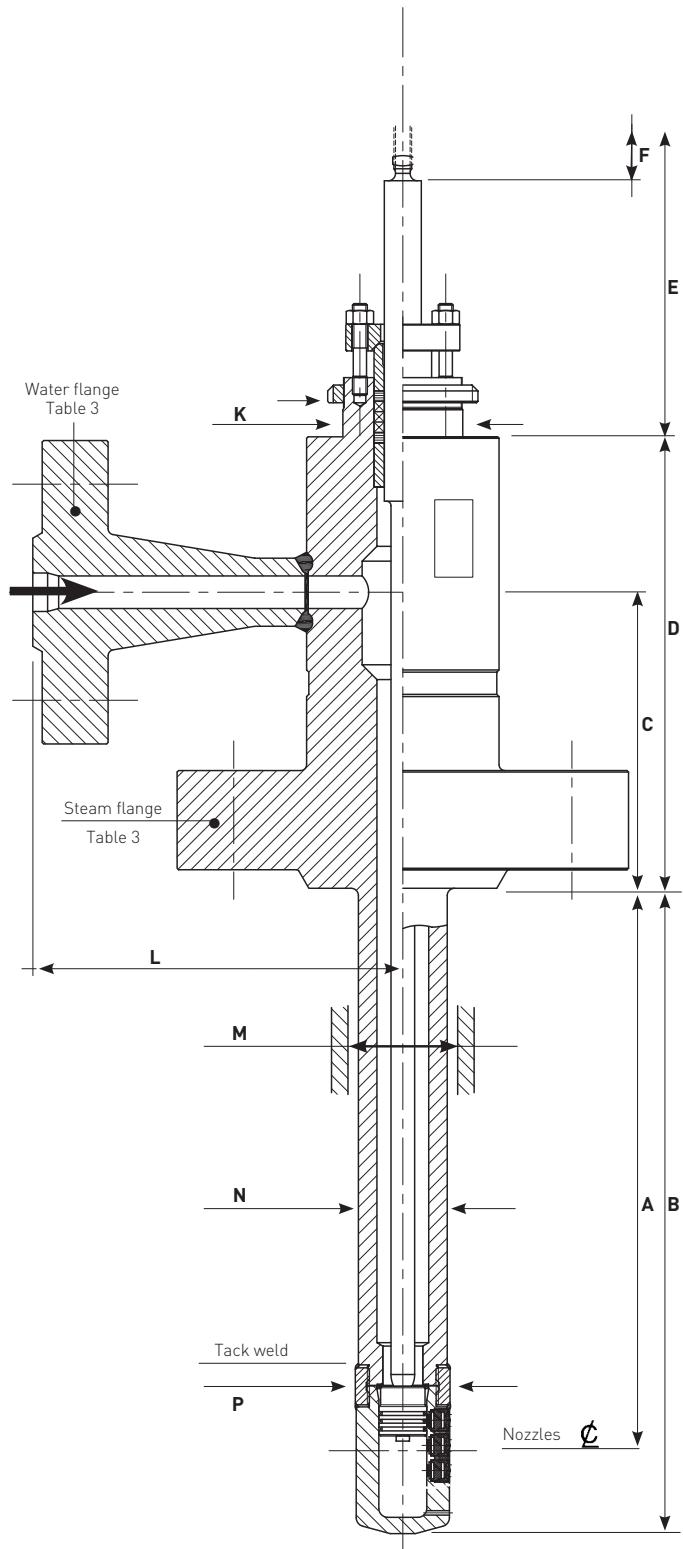
TABLE 2-2 DIMENSIONS (mm)

	PN100	PN160	PN250	PN320	PN400
DN 40	150	150	150	200	200
DN 50	150	150	200	200	200
DN 80	150	150	200	300	300
L (mm) AT28	CL600	CL900	CL1500	CL2500	
NPS 1-1/2	150	200	200	200	
NPS 2	150	200	200	250	
NPS 3	200	200	300	300	

TABLE 3 - FLANGE CONNECTIONS

	Model 18	Model 28
Steam flange	Qmax = 25 m ³ / hr.	Qmax = 50 m ³ / hr.
Steam flange	NPS 3	NPS 4
	Class 600 through 2500	Class 600 through 2500
	DN 80	DN 100
	PN 100 through 400	PN 100 through 400
Water flange	NPS 1 - 1½ - 2	NPS 1½ - 2 - 3
	Class 600 through 2500	Class 600 through 2500
	DN 25- 40 - 50	DN 40 - 50 - 80
	PN 100 through 400	PN 100 through 400

FIGURE 9



YARWAY MODEL 18 AND 28
HEAVY DUTY HEAVY DUTY A.T.-TEMP DESUPERHEATER

Neither Emerson, Emerson Automation Solutions, nor any of their affiliated entities assumes responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use, and maintenance of any product remains solely with the purchaser and end user.

Yarway is a mark owned by one of the companies in the Emerson Automation Solutions business unit of Emerson Electric Co. Emerson Automation Solutions, Emerson and the Emerson logo are trademarks and service marks of Emerson Electric Co. All other marks are the property of their respective owners.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available upon request. We reserve the right to modify or improve the designs or specifications of such products at any time without notice.

www.Emerson.com
