MASCOT

STEAM DESUPERHEATING

Reliability • High End Technology • Simplicity

MASCOT provides world class Process Valve solutions, specialising in the design and manufacture of Heavy Duty Industrial Control Valves, Choke Valves, Steam Desuperheaters, Actuated Valves and Manual Valves from its headquarters in Campbellfield, Australia.

MASCOT Valves are ideally suited and widely used throughout the Oil and Gas, Gas Transmission, LNG Processing and Regasification, Power Generation, Petrochemical and Mining Industries for both General Service and Severe Service applications.

Extensive execution and project management capabilities ensure orders are executed on-time and to customer specifications, whether it be for smaller quantity orders, short lead times or complex projects.

The Australian facility utilises vendor partnerships to complete the manufacture of castings and machining of Valve components. Our workflow methodologies provide flexibility of machine shop loadings and substantial reduction in manufacturing lead times. MASCOT's well established partnerships have a 20-year proven track record of high quality and on-time performance.

A robust Management and Quality Assurance approach ensures exacting technical requirements are guaranteed from initial application engineering and process data analysis through to technical design, assembly and testing covered by stringent industry standards.

MASCOT provides functional and technical assistance during installation and commissioning, and promptly responds to all customer enquiries and issues.

Overview

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A plant generates steam for heating purposes, electricity generation or for both.

Saturated steam occurs at temperatures and pressures where steam (gas) and water (liquid) coexists. In other words, when the rate of water vaporization is equal to the rate of condensation. Saturated steam spreads evenly over heating surfaces due to its moisture content and therefore has excellent heat transfer properties. Hence saturated steam is commonly used in heating applications around industrial plants.

Superheated steam is another term used to describe steam and represents steam at a higher temperature than saturated steam. Having a higher temperature, superheated steam has a lack of moisture, behaves more like a gas and has a higher kinetic energy value. In the Power Generation Industry, superheated steam is commonly used for the operation of turbine blades.

Superheated steam is devoid of moisture. Moisture is undesirable within the operation of moving and rotating parts such as those found within steam turbine blades. Superheated steam is therefore a more suitable medium for the operation of steam turbines and electricity generating plants.

Saturated Steam Characteristics

- Improved heat transfer due to moisture content
- Constant heat transfer co-efficient
- Prevents equipment from high temperature damage

Superheated Steam Characteristics

- More kinetic energy compared to saturated steam
- Less friction and reduced erosion due to no water content
- Higher pipeline velocities (up to 100 m/s) and smaller distribution pipelines
- No condensation in the pipelines for continuously running plants

Why we use Desuperheaters?

An example of a Desuperheater application includes superheated steam, initially utilised for power generation whereby it is captured in a steam recovery system for further use within the same plant's heating applications.

In this case, the best way of altering the steam characteristics from high temperature and high kinetic energy value is to reduce the steam temperature to its saturated state suitable for heating purposes.

The process of desuperheating involves injecting water into the steam path in a controlled and calculated manner allowing for the steam and water to efficiently atomise and mix, thus cooling the steam at controlled rate suitable for heating processes.

Desuperheater Advantages

Superheated steam behaves like gas, leaving hot and cold patches over a heating surface. This results in poor heat transfer and wastes valuable steam. A Desuperheater provides the following advantageous solutions;

- Generates equal amount of steam, as injected water is ideally converted into steam
- Plant efficency is enhanced as the heating process becomes faster

Product Offering

- MSD Mechanical Spray Desuperheater
- VSD Variable Spray Desuperheater
- CSCV Combined Steam Conditioning Valve
- PRDS Pressure Reducing and Desuperheating Stations

Technical Sizing Information

Important factors in a Desuperheater design:

Differential pressure between water & steam (superior pressure)

Higher differential pressure will result in better atomizing and smaller water particle size. The smaller the water particles are, the faster the desuperheating process.

Velocity differential between water & steam

Higher velocity difference helps water molecules to tear apart, resulting in better atomization.

Temperature differential between water & steam

This should be as low as possible. Water at near saturation temperature evaporates faster because it doesn't require much heat to be converted into steam. Although this requires a higher amount of water, it will produce more steam and is significant to the efficency of Desuperheaters.

Turbulence

Water exiting the nozzle is sprayed in a swirling motion ensuring the steam and spraywater is mixed effectively. The more turbulent the water particles are as they are injected into the steam path, the better the mixing process.

Required Sizing Parameters

To design the most efficient Desuperheater, the following parameters are needed:

- ✓ Operating pressure of steam
- ✓ Maximum inlet temperature of steam
- ✓ Required outlet temperature of steam
- ✓ Steam flow rate
- ✓ Available cooling water pressure
- ✓ Available cooling water temperature

MSD Mechanical Spray Desuperheater

Mechanical Spray Desuperheaters (MSD) utilise an elementary Desuperheater design.

As their name suggests, MASCOT manufactures MSD's with a fixed nozzle area.

Features

- Configuration: Fixed Spray Nozzle
- Spray method: Multiple jets throughout the periphery of the MSD body ensure a large surface area is available for heat transfer
- A stainless sleeve acts as thermal liner and takes account of the thermal stresses
- Turndown ratio up to 4:1
- Relying on the pressure differential available across the nozzle to achieve rapid absorption of the water into the steam
- Sizes available:
  - Steam side flange: In accordance with steam pipe sizes
  - Water side flange: In accordance with spray water pipe requirements
- Available pressure rating: 150# to 4500#
- No moving parts
- Custom made for any size

Fig. 1 MSD Mechanical Spray Desuperheater

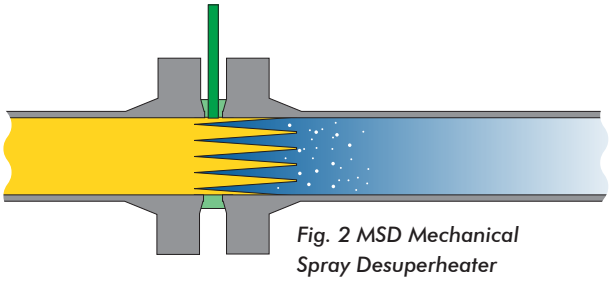

Fig. 2 MSD Mechanical Spray Desuperheater Standard Installation

VSD Variable Spray Desuperheater

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The Variable Spray Desuperheater (VSD) represents a major advancement in the design of Desuperheaters. In order to recover loss of performance in a MSD under low load conditions, VSD's are recommended as their design allows for the spray nozzle area to be reduced.

VSD's provide a more economical control of steam temperature through an advanced nozzle design and by introducing cooling water into the steam flow. In this design, water pressure above steam pressure is used to produce a thin film of conical sprayed water which evaporates as soon as it is injected into the steam flow, thereby increasing turn-down ratio.

Features

- Configuration: Variable Spray Desuperheater
- Efficient up to turndown ratio of 100:1
- Spray method: Swirling hollow cone spray pattern of injected water directly in to steam line
- Varying opening area allowing for the spraying of required water into the stream line
- No need to separate flow Control Valve to regulate water quantity
- Sizes available:
  - Steam side flange: In accordance with steam pipe sizes
  - Water side flange: In accordance with spray water pipe requirements
- Available pressure rating: 150# to 4500#
- Precise control capability
- Equal percentage characteristic plug
- Sprayed water evaporates quickly and eliminates impingement on the piping walls
- Easy to install and low maintenance
- Small enough to mount through a DN 100 flange in the steam line
- Can be mounted on any existing pipe line or on long radius bands

Design Overview

Water at a pressure of 4 to 5 bar above superheated steam enters the Desuperheater and flows down the angle style body to the nozzle area.

The equal percentage characterised plug controls the amount of atomised water being injected into the steam flow. A control signal is received from the temperature controller and varies the position of the control element (plug) within the VSD. Changing the amount of cooling water flow going through the inlet orifices is achieved by altering the opening of the plug to either increase or decrease the cooling water flow.

The contoured equal percentage plug design creates a variable area around the nozzle which provides excellent control of injected water into the steam flow. This allows for accurate temperature control.

MASCOT's nozzle design allows the water jet to disperse into fine particles and distributes them evenly across the flow path of steam. Due to the mounting arrangement, steam velocity aids the creation and dispersion of fine water particles. As a result, spray water quickly evapraotes and eliminates the possibility of impingement on the piping wall and generates uniform desuperheated steam.

The actuator moves the Desuperheater control plug, which regulates the quantity of water not the pressure injected into the steam.

Fig. 3 VSD Variable Spray Desuperheater

VSD Standard Construction

The Variable Spray Desuperheater (VSD) consists of a nozzle tube, nozzle head, seat ring, and plug. The nozzle tube assembly fits into the bore of the mounting flange and is locked in place by a retaining ring. In doing so, the coolant inlet connection can be located in any direction in relation to the nozzle spray discharge.

The cooling water from the water pipe enters the area between the front of the inlet pipe and the injection nozzle.

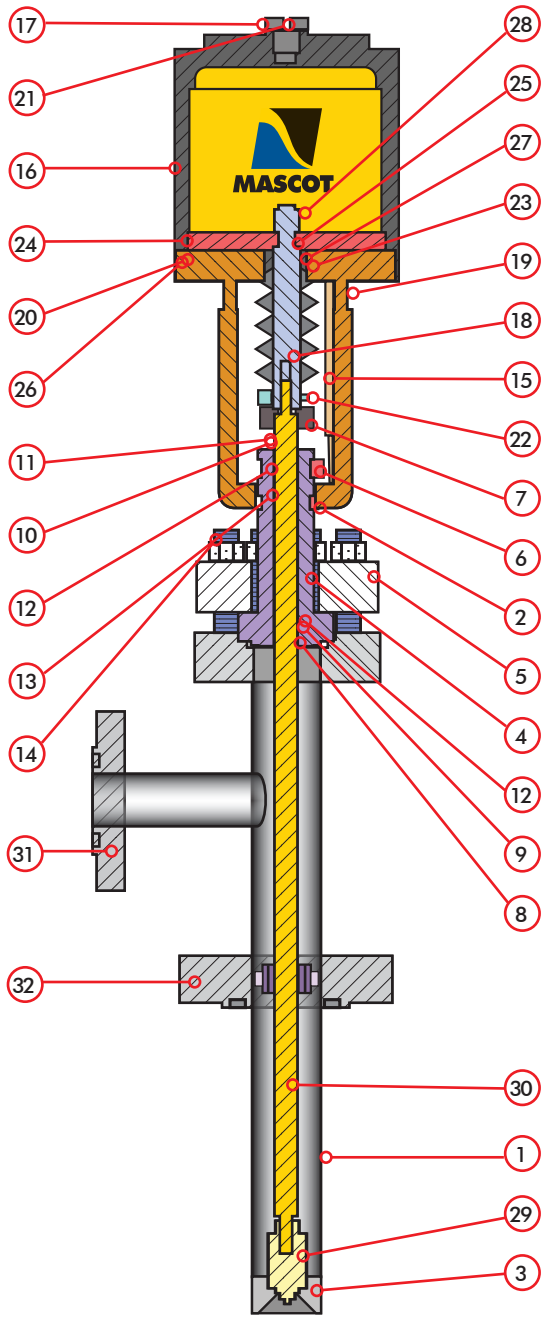

Fig. 4 VSD Variable Spray Desuperheater Cross Sectional View

Item	Name
1	Desuperheater Body
2	Yoke Half Ring
3	Seat & Nozzle
4	Bonnet
5	Bonnet Flange
6	Yoke Clamp
7	Gland Flange
8	Guide Liner Lower
9	Guide Retainer Lower
10	Guide Liner Upper
11	Guide Retainer Upper
12	Packing
13	Packing Spacer
14	Studs & Nuts
15	Yoke
16	Cylinder
17	Adjusting Screw
18	Actuator
19	Stroke Plate
20	Piston
21	Adjusting Screw Gasket
22	Steam Clamp
23	Yoke Bush
24	Piston O-Ring
25	Piston O-Ring
26	Yoke O-Ring
27	Actuator O-Ring
28	Actuator Lock Nut
29	Plug Head
30	Plug
31	Cooling Water Flange
32	Steam Flange

VSD Standard Installation

There are a number of important considerations to take into account when installing a Desuperheater, namely:

- The properties of the cooling water
- The installation of the Desuperheater itself
- The ancillary components required
- The Control Valves used on the cooling waterline and the superheated steam line

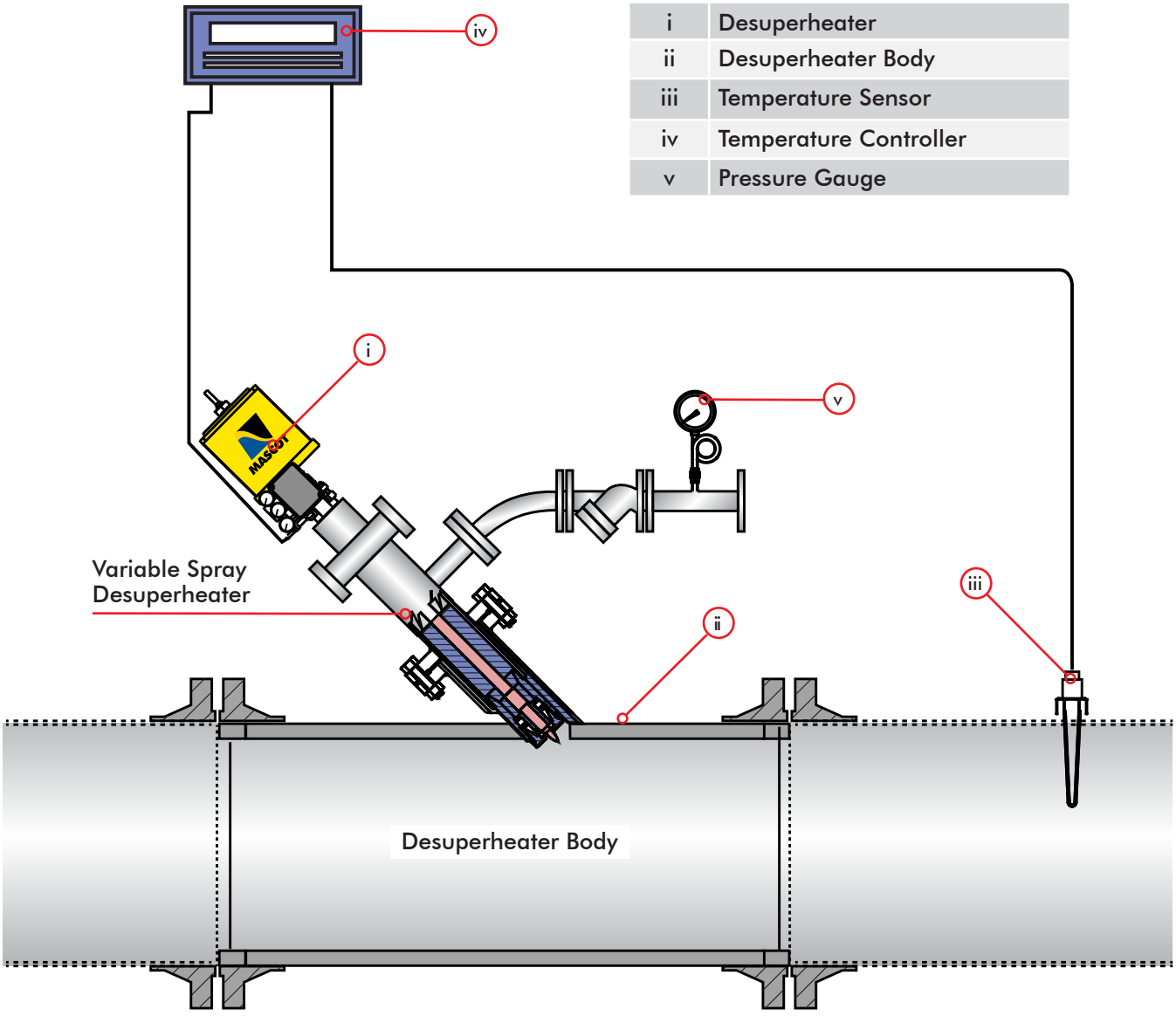

Fig. 5 VSD Variable Spray Desuperheater Standard Installation

CSCV Combined Steam Conditioning Valve

Combined Steam Conditioning Valves (CSCV) offer both pressure reduction and the desuperheating process in a single unit. This application involves injection of cooling water into a highly turbulent zone soon after pressure reduction, resulting in thorough mixing of cooling water with superheated steam. Injected water breaks into infinitely small particles both with the help of pressure and velocity differentials between steam and water. This results in a quick evaporation of injected water.

CSCV's are particularly popular as they do not have a traditional bypass arrangement and are a compact device in which pressure reduction and desuperheating can take place simultaneously.

Features

- Configuration: Globe inline or angle with expanded outlet where required
- Spray method: Small jets of spray through stainless sleeve at the outlet flange
- Very effective, space and cost saving compared to the conventional Pressure Reducing Desuperheating station (PRDS)
- Sizes available:
  - Steam side flange: In accordance with steam pipe sizes
  - Water side flange: In accordance with spray water pipe requirements
- Available pressure rating: 150# to 4500#
- Using two CSCV's, one in operation and one as a standby, can offer uninterrupted automatic operation which is economical and requires less space
- No special trim is needed by using standard Control Valve spares
- Water is sprayed in a way that the CSCV is well protected against pitting and thermal stress / shocks. This is an advantage over other conditioning Valves whereby water is sprayed into a belly of a Valve body
- Efficient up to turndown ratio of 100:1
- Variable orifice nozzle is specially designed to avoid flashing inside the nozzle
- Advanced seat design for tight shut off
- All internal parts of the Valve can be removed without the Valve having to be dismantled from the pipe

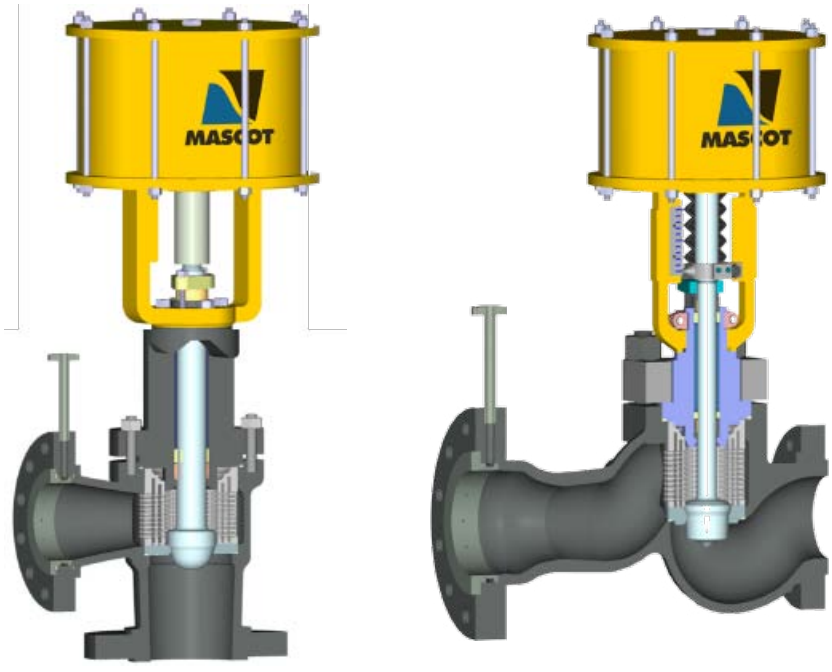

Fig. 6 CSCV Combined Steam Conditioning Valve

PRDS Pressure Reducing & Desuperheating Stations

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MASCOT Pressure Reducing & Desuperheating Stations (PRDS) are pre-fabricated ready to install for steam system management.

The pre-assembled Steam Pressure Reducing Stations are individually sized to meet specific customer needs. Inlet and outlet piping and Valves are sized as per best engineering practices. Each unit is custom engineered and designed to meet specific system requirements.

Features

- Minimum sizes available: 0.5" to higher size as per design requirement
- Available pressure rating:
  - Class 150-600 (normally flanged ends)
  - Class 900-2500 (normally BW ends)
- All stations are engineered and factory assembled
- Stations are mostly supplied with 'Combined PRDS' Valves which provide the advantage of pressure reduction and temperature control in a single unit
- The water flow Control Valve and waterline are offered with the steam line, which ensures correct design and matching of pressure and temperature control stations
- The entire assembly is hydro tested
- Stations are available in various sizes from 25mm up to 1500mm or larger
- Pipe materials:
  - A106 Gr.B with flanges A105/A515 for temp. Up to 427°C
  - A335 P11 with flanges A182 F11 for temp. above 427°C and below 493°C
  - A335 P22 with flanges A182 F22 for temp. above 493°C

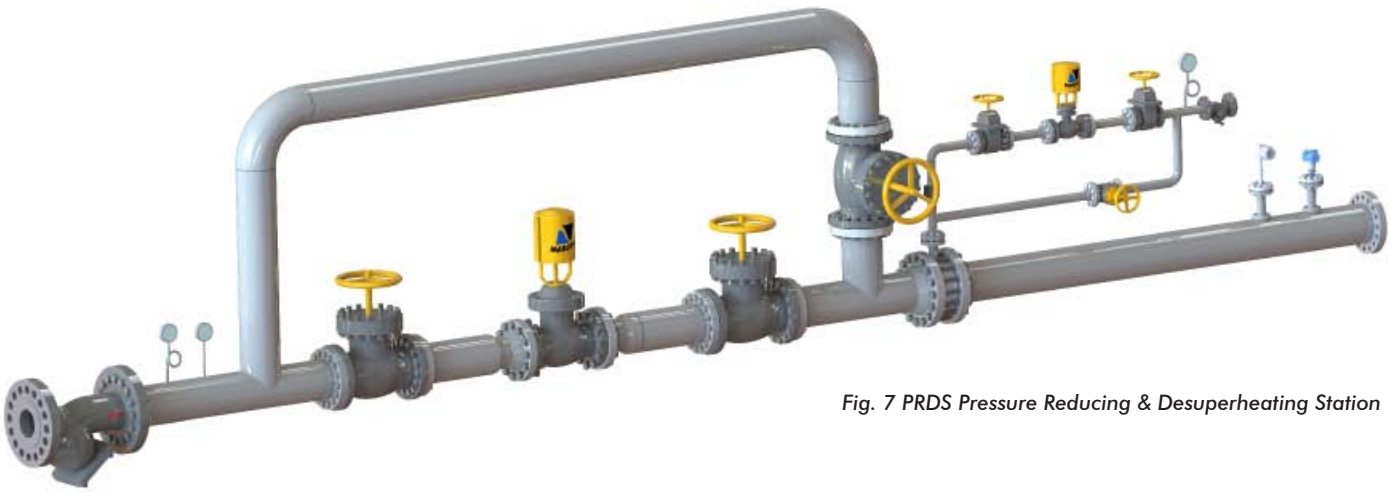

Fig. 7 PRDS Pressure Reducing & Desuperheating Station

PDRS Standard Construction

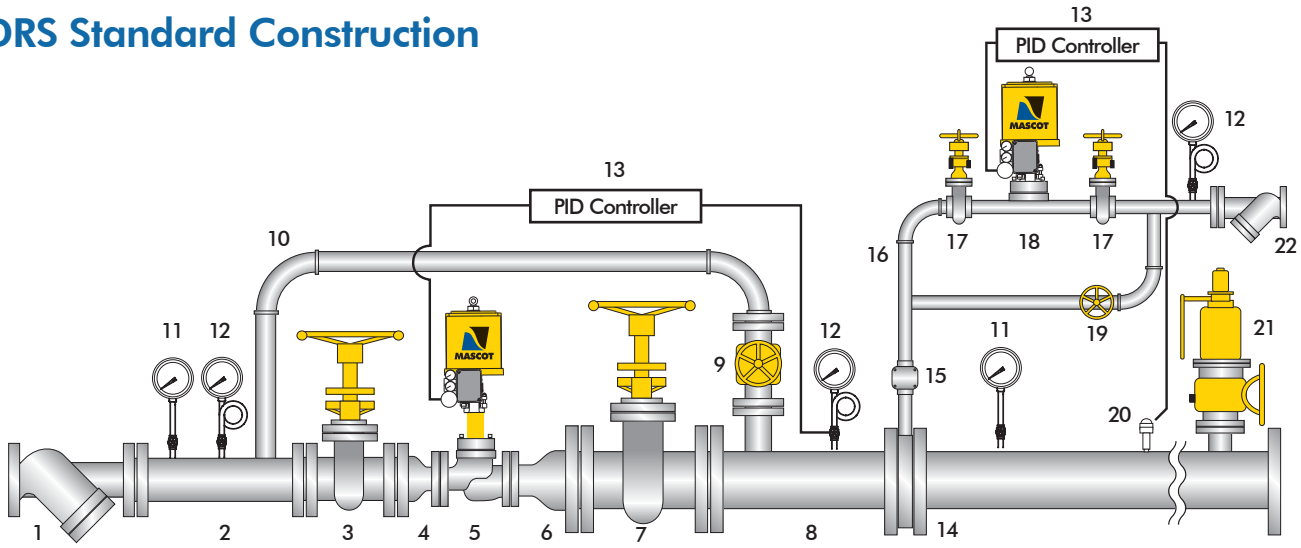

Fig. 8 PRDS Pressure Reducing & Desuperheating Station Standard Construction

No.	Item	Qty.
1	Strainer	1
2	Inlet Pipe	1
3	Inlet Stop Valve	1
4	Pipe Reducer	1
5	Pressure Control Valve	1
6	Pipe Expander	1
7	Outlet Stop Valve	1
8	Outlet Pipe	1
9	Bypass Stop Valve	1
10	Bypass Line	1
11	Temperature Gauge	1
12	Pressure Gauge	1
13	P+I+D Controller	2
14	Desuperheater	1
15	Non-Return Valve	1
16	Cooling water line	1
17	Isolation Valves	2
18	Flow Control Valve	1
19	Bypass Valve	1
20	Temperature sensing element	1
21	Safety Valve	1
22	Strainer	1

Note: We recommend a minimum of a 6 meter distance between the Temperature Gauge and the point of water injection.

Pressure Control Valve: Pressure Control Valve is designed, engineered and manufactured by MASCOT.

Strainer: This ensures clean steam goes into station and prevents foreign particles from entering the main Valve.

Isolation Valves: Zero leakage Gate Valves prevent inline leakage and help to isolate the main pressure Control Valve in the event of maintenance activities.

Bypass Valve: This is a Globe type Valve which ensures reduced steam pressure and an uninterrupted supply if the main pressure Control Valve is under maintenance.

Desuperheater: Fixed or Variable Nozzle Desuperheaters are provided for accurate temperature control. These are designed, engineered and manufactured in house which ensures high quality.

Safety Valve: A good quality Safety Valve is essential in the event of a sudden steam pressure increase.

Pressure & Temperature Gauges: Good quality Pressure and Temperature Gauges are essential at the inlet and outlet of the station. These ensure correct parameters and measurement at the inlet and outlet of the Pressure Reducing and Desuperheating Station.

Instrumentation: High accuracy instrumentation for pressure and temperature controls, such as transmitters, controllers and the DCS system, are offered as per customer requirements with options for various makes and models.

Desuperheater	MSD	VSD	CSCV	PRDS
Turndown Ratio	4:1	100:1	100:1	50:1
Type of Atomizing	Mechanical	Velocity	Velocity	Velocity
ANSI Pressure Class	150 - 4500	150 - 4500	150 - 4500	150 - 2500
Pressure Drop	Negligible	Per Application	Per Application	Per Application

Fig. 9 MSD Mechanical Spray Desuperheater

Fig. 10 VSD Variable Spray Desuperheater

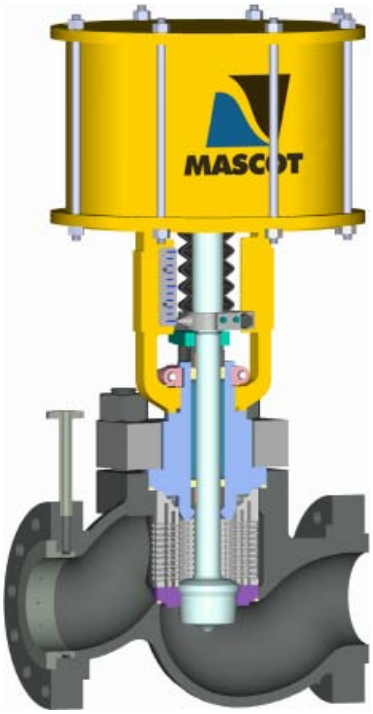

Fig. 11 CSCV Combined Steam Conditioning Valve

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Control Valves

High Performance Control Valves utilising Heavy Duty design suitable for Industrial applications. MASCOT manufactures General and Severe Service Control Valves, Cryogenic Globe and Butterfly Control Valves, Rotary Style Valves, High Pressure Butterfly Valves, Eccentric Plug Style Valves, and Characterised Ball Valves.

Choke Valves

Choke Valves API 6A and ASME Heavy Duty design suitable for Oil and Gas. We manufacture Positive Choke Valves with Nonadjustable Trim, Needle, and Seat Trim and Standard Service Cage and Plug. Severe and Erosive Service Choke Valves include cavitation minimisation, noise attenuation and vibration reduction.

Steam Desuperheating

Steam Desuperheating for continuous steam Processing and Power Generation. These include Mechanical Spray Desuperheaters, Variable Spray Desuperheaters , Steam Conditioning Valves either Globe, Inline or Angle Style and combined Pressure Reducing and Desuperheating Stations.

Actuated Valves

MASCOT manufactures and supplies a range of Actuated Valves including Ball, Butterfly, Globe and Gate Valves. Actuation and accessories are either supplied using MASCOT's own manufactured product, or third party actuators and accessories specific to customer needs and requirements.

Manual Valves

MASCOT manufactures and supplies a range of Manual Valves including Ball, Butterfly, Globe, Gate and many more. We supply these in a range of materials and pressure classes.

After Sales Services & Support

MASCOT has a strong after sales service and support network and is fully committed to support MASCOT products wherever they are installed. Support is available in the form of engineering, technical, installation and ongoing operational support. Capabilities include providing manpower to cover site shutdowns and service requirements.

MASCOT

91 Metrolink Circuit Campbellfield VIC 3061 Australia

Tel: +61 3 9308 6400 | Fax: +61 3 9308 7055

Email: sales@mascot-global.com | Web: www.mascot-global.com