



Precision Engineering for the Process Industries

Established in New York in 1917, Croll-Reynolds is the world's leading source for innovative, high-performance Vacuum and Air Pollution Control systems for all segments of the Process Industries. State-of-the-art design, production and test facilities strategically located throughout the world create an ideal environment for the development of custom solutions for complex applications.

CROLL REYNOLDS DESIGNS VACUUM SYSTEMS INCLUDING:

- Multi-Stage Steam Jet Ejectors
- Combination Liquid Ring/Ejector Systems
- Thermocompressors
- Vacuum Chillers

CROLL REYNOLDS' PRIMARY MARKET IS THE CHEMICAL PROCESS INDUSTRY HOWEVER IT HAS EXTENSIVE EXPERIENCE IN:

- the Petrochemical Industry
- the Pulp and Paper Industry
- the Pharmaceutical Industry
- the Power Industry
- the Aerospace Industry
- the Steel Industry
- the Food Processing Industry

in such diverse applications as:

- Evaporative Cooling
- Desalination
- Atmosphere Simulation
- Degassing

THE CLEAN AIR GROUP, AN AFFILIATE OF CROLL REYNOLDS, DESIGNS:

- Jet Venturi Scrubbers
- High Energy Venturi Scrubbers
- NOX Scrubbers
- Packed Towers

CROLL-REYNOLDS

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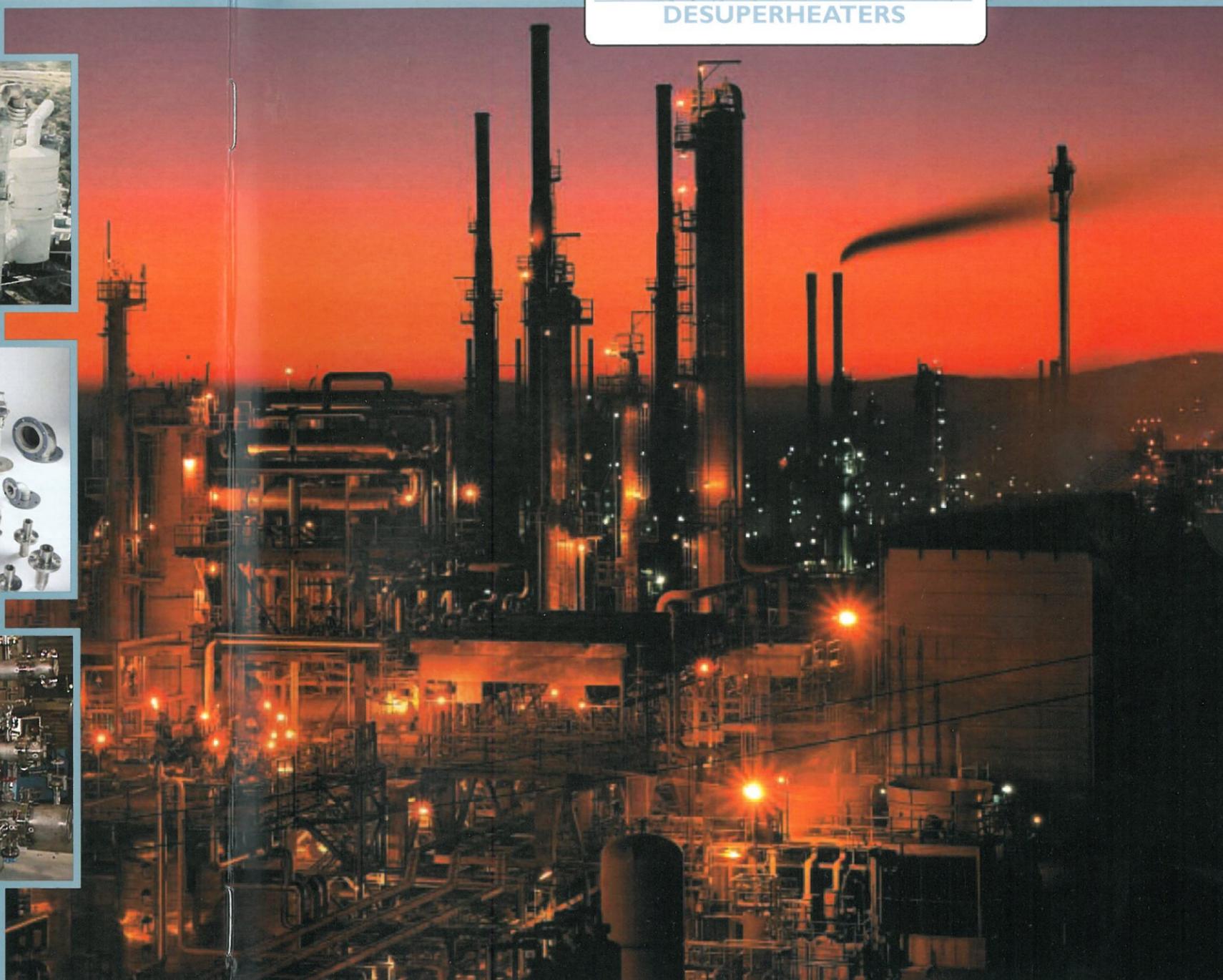
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CROLL-REYNOLDS
DESUPERHEATERS



Precision Engineering for the Process Industries

DESUPERHEATERS

Superheated steam is pressurized water vapor that is at a temperature higher than the saturation temperature of the steam pressure. Although process steam is typically throttled and superheated for efficient distribution, it must be cooled before it is condensed and therefore it is less efficient than saturated steam for a majority of heat transfer applications. The most efficient way to reduce the superheat value of steam is by "desuperheating" it. This involves the direct introduction of water to the steam.

Superheated steam:

- *Increases cycle time for heat transfer*
- *Yields lower rates for heat transfer*
- *Creates temperature gradients over heat transfer surfaces, and thereby affects product quality*
- *Requires larger heat transfer area and thereby increases design and installation costs*

Desuperheaters are utilized in the power industry for boiler heat recovery systems, in the pulp and paper industry for the control of dryer drum temperature, for optimal heat transfer in surface condensers, and for a myriad of other process and refinery applications where make-up steam is required or where process conditions require the control of excess temperature.



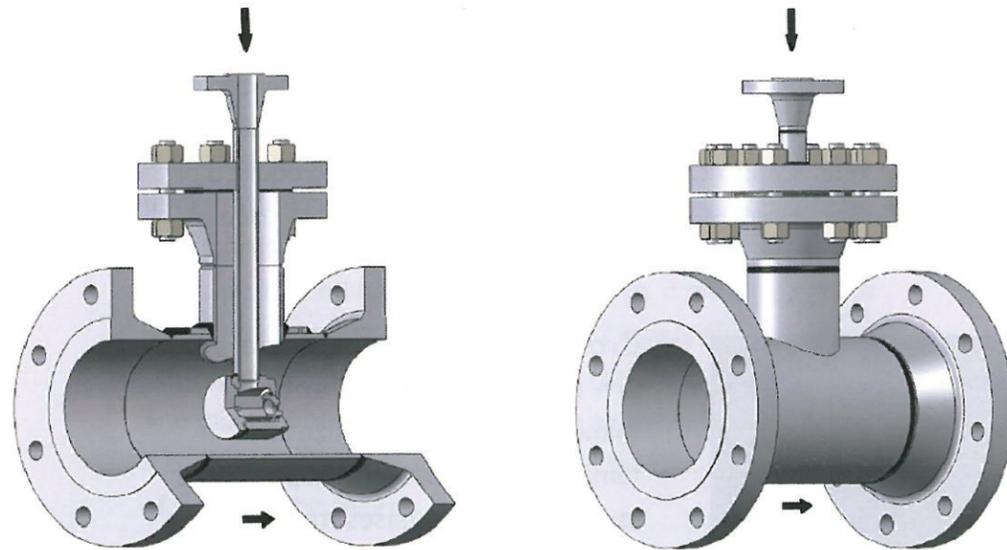
Croll Reynolds' Desuperheaters are custom designed and manufactured to optimize the temperature reduction of superheated steam which increases its energy exchange capacity and results in ideal heat transfer efficiency.

Desuperheaters are usually supplied with pressure and temperature controllers, actuators, steam pressure reducing valves and water control valves as part of an engineered system. With nearly 100 years of experience in the design and manufacture of steam systems, Croll Reynolds' Desuperheaters offer proven efficiency and guaranteed process performance.

Croll Reynolds offers a full line of desuperheater configurations and specializes in the custom design of engineered systems. The following is a general overview of our desuperheater designs.

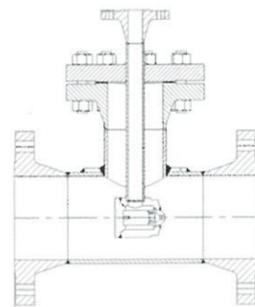
Please contact Croll Reynolds with your specific requirements

FIXED NOZZLE DESUPERHEATER (HOLLOW CONE)



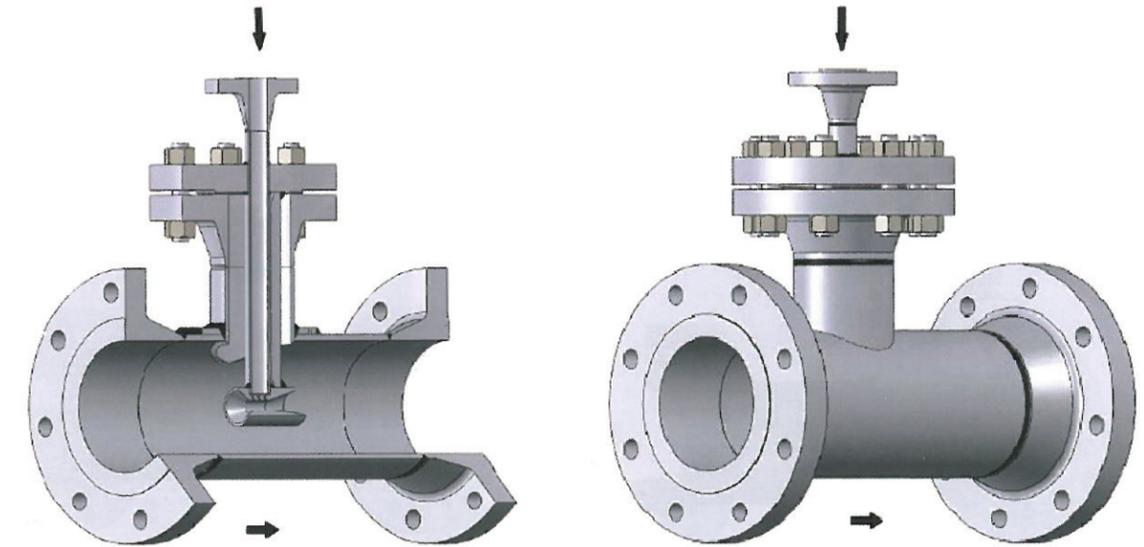
The Fixed Nozzle Desuperheater, also known as a mechanical desuperheater, is our most simple design. Water is introduced by way of a spray nozzle which creates a fine mist, thus cooling the superheated steam through the process of evaporation. The Fixed Nozzle design requires water pressure in excess of 5 bar (g) of the steam operating pressure.

The design of the spray nozzle is critical to the performance of the Fixed Nozzle design. Croll Reynolds' Fixed Nozzle Desuperheater offers negligible pressure drop across the system and is designed to handle low turndown requirements (up to 3:1). This design is appropriate for relatively steady load conditions.



- **Materials of construction:**
 - ♦ Fabricated carbon steel with stainless steel internals
 - ♦ Alternative materials are available
- **Dimensions are typically engineered to fit existing piping/flange requirements**

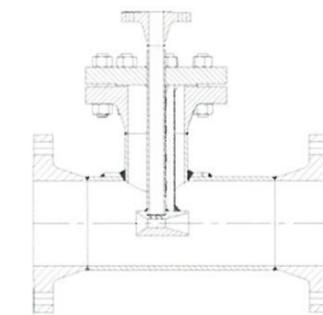
VENTURI DESUPERHEATER (ATTEMPERATOR)



The venturi design, also known as an Attemperator, features a converging, stabilizing and diverging nozzle which promotes the turbulent mixing of atomized water and steam thus maximizing efficiency in a wide range of process conditions including steady and variable flows.

Croll Reynolds' Venturi Desuperheater features negligible pressure drop and is recommended when high pressure water and/or atomized steam is unavailable. This design will operate efficiently at low steam velocity and under conditions where the differential of water over steam pressure is 2 bar (g).

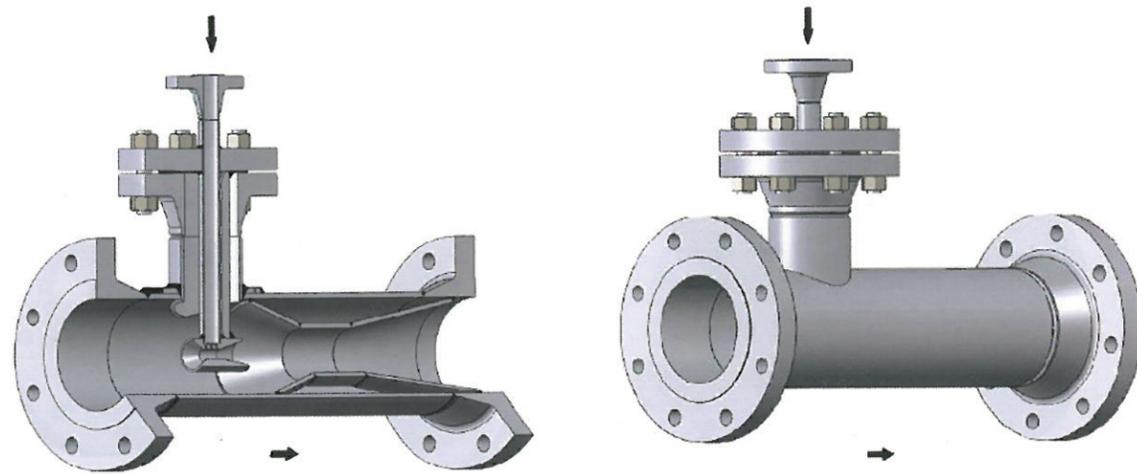
Nozzle design is critical to the performance of a venturi desuperheater. Atomized water must be instantaneously evaporated for the efficient cooling of superheated process steam. Croll Reynolds has nearly 100 years of experience in the design of nozzles for its line of steam jet ejectors. This expertise assures



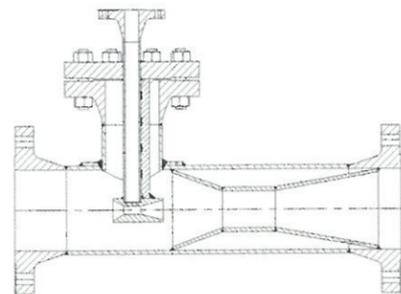
the highest efficiency in Croll Reynolds' Venturi Desuperheaters. Croll Reynolds Venturi Desuperheaters offer a turndown ratio of 6:1.

- **Materials of construction:**
 - ♦ Fabricated carbon steel with stainless steel internals
 - ♦ Alternative materials are available
- **Dimensions are typically engineered to fit existing piping/flange requirements**

DOUBLE VENTURI DESUPERHEATER MODEL NO: DVD



Similar to the Venturi Desuperheater, Croll Reynolds' Double Venturi Desuperheater features negligible pressure drop and is recommended when high pressure water and/or atomized steam is unavailable. This design will operate efficiently at low steam velocity and under conditions where the differential of water over steam pressure is 2 bar (g). The converging, stabilizing and diverging nozzle promotes the turbulent mixing of atomized water and steam thus maximizing efficiency in a wide range of process conditions including steady and variable flows.

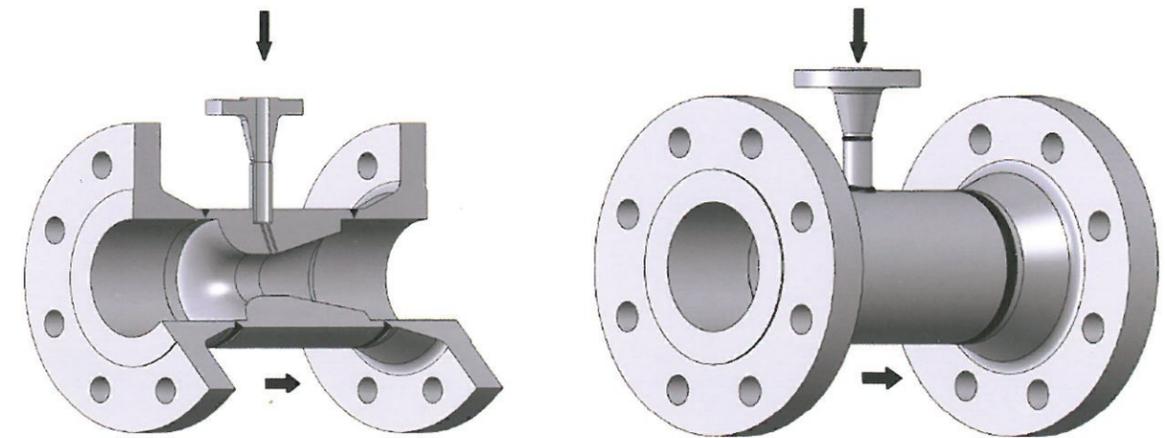


Croll Reynolds' Double Venturi Desuperheater offers the following advantages over its Single Venturi counterpart:

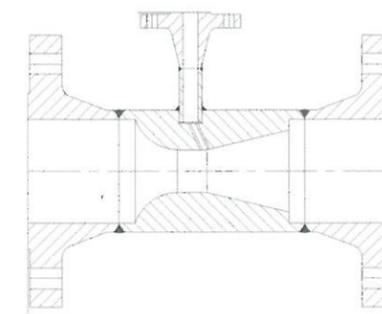
- A high turndown ratio of 12:1
- A thermal sleeve/liner design which:
 - Prevents impingement of the main pipe walls
 - Reduces thermal stress and shock
 - Promotes rapid evaporation of water droplets
 - Facilitates turbulence thus enhancing the mixture of steam & water
- **Materials of construction:**
 - ◆ Fabricated carbon steel with stainless steel internals
 - ◆ Alternative materials are available
- Dimensions are typically engineered to fit existing piping/flange requirements

For further information, visit www.croll.com

FULL VENTURI DESUPERHEATER MODEL NO: FVD



To complete its line of Venturi Desuperheaters, Croll Reynolds' Full Venturi Desuperheater features negligible pressure drop, offers a turndown ratio of 6:1 and is recommended when high pressure water and/or atomized steam is unavailable. This design will operate efficiently at low steam velocity and under conditions where the differential of water over steam pressure is 2 bar (g). The



converging, stabilizing and diverging nozzle promotes the turbulent mixing of atomized water and steam thus maximizing efficiency in a wide range of process conditions including steady and variable flows.

The Full Venturi design is typically manufactured from forged steel. Available in sizes up to 4."

- **Materials of construction:**
 - ◆ Fabricated carbon steel with stainless steel internals
 - ◆ Alternative materials are available
- Dimensions are typically engineered to fit existing piping/flange requirements

For further information, visit www.croll.com