DeltaValve
Retractable Center Feed Injection Device

Centralizes Flow Patterns to Minimize Drum Movement and Stresses
Retracts to Seal Against the Process
DeltaValve

The Value of a Trusted Partner

DeltaValve’s extensive experience in designing and building engineered severe service industrial valves and equipment for delayed cokers has made us a world recognized industry leader. In 2001, we designed, engineered, and installed the world’s first fully automated, fully enclosed coke drum unheading valve at the Chevron refinery in Salt Lake City, Utah. This valve revolutionized coke drum unheading by replacing traditionally unsafe and unreliable manual or semi-manual unheading equipment, with a fully automated system. The result has been a safer work environment, reduced downtime, and increased productivity.

Today we offer a full range of products for delayed coking including top and bottom coke drum unheading valves, isolation valves, hydraulic and electric actuators, controls and interlocks, auto-switch coke cutting tools and enclosures, and the retractable center-feed injection device. We listen to our customers and strive to provide innovative products that are designed and engineered to meet the critical service requirements of delayed coking.

DeltaValve is a trusted partner; delivering safe, reliable products while providing the best value for our customers. From the moment a customer contacts us, through delivery, installation, and beyond, we are there to provide unparalleled products, service, and support. We continually strive to make our products and services best in class.
DeltaValve

Retractable Center Feed Injection

The introduction of DeltaValve’s fully automated coke drum unheading valve in 2001 necessitated the development of side-feed entry into the coke drum. No longer was it possible to feed resid into the coke drum through the bottom flange as was standard with traditional manual or semi-automated unheading systems.

Over the years, various styles of side-feed entry technology emerged: single inlet, dual inlet, and others, some with straight feed-lines, or angled/curved feed-lines, each netting different resid flow pattern results. Questions began to arise in the industry about how new side-feed flow patterns compared to the traditional bottom center-feed flow patterns. Additional questions were raised regarding the impact on the coke drum wall opposite the side-feed inlet. Always the innovator, DeltaValve took a hard look at these questions and set out to develop a side-feed device which would provide traditional center-feed resid flow patterns.

Independent studies have shown that feeding resid into the drum directly up the center may contribute to a reduction in overall drum stresses, formation of local hot-spots, and top head blow-outs. These theories are based on center-feed analysis data which indicates that center feeding develops more centralized flow channels which improves quench water distribution. Improved flow channeling can produce shorter quench cycles while minimizing the thermal stresses experienced by the drum walls. In addition to the safety benefits, the retractable center-feed injection device is engineered to maximize coke drum life and minimize downtime and maintenance.

The device combined the necessity of side-feed entry with the desired results of traditional bottom center-feed systems. and since the first installation the results have been impressive. Feedback demonstrates a significant reduction in coke drum movement, and the elimination of top head blowouts and eruptions. The “calming effect” on the coke drum has exceeded our customers expectations.
Retractable Center Feed Injection Device

Key Features

- **Fully Retractable**: The center-feed nozzle assembly extends fully into the center of the coke drum and retracts completely out of the drum with an ultra-tight seal against the process.

- **Engineered Nozzles**: The nozzles are designed to direct flow upward into the center of the coke drum, reducing or eliminating hotspots, top head blowouts, drum distortion, and having an overall calming effect on the drum.

- **Space Saving Connection**: The retractable center-feed attaches to the side of the coke drum spool directly above the unheading valve with a standard bolted flanged connection.

- **Feed Line Versatility**: To conform to your refinery’s current standards, the feed line connection flange can be configured to accommodate any size feed line from 6 to 16 inches.

- **Easy Internal Inspection**: There are three clean-out ports on the center-feed; one opposing the feed inlet and two on either side of the device allowing for quick inspection of the internals.

- **Multiple Actuator Options**: Depending on your desired configuration, the center-feed can be supplied with either electric, electro-hydraulic or hydraulic actuation. These options allow full flexibility for your specific refinery standards.

- **Safety Features**: The center-feed is fully enclosed, inherently safe, and comes standard with a visual position indicator, positive lockout with sensors, and full safety interlocks.
Retractable Center Feed Injection Device
Engineering and Design

At the heart of the DeltaValve retractable center-feed (RCF) injection device design is the dual nozzle configuration through which feed enters the coke drum. Significant effort was required to engineer these nozzles to replicate or even improve flow patterns of a bottom-feed configuration. A test site was selected where the temperature, pressure, flow parameters, viscosity, specific gravity, and other physical properties of the feed stock were identified. This information was used to construct a kinetic model of the feed stock to determine its fluid properties (vapor phase) at the point of entry into the drum.

The calculated fluid properties were introduced as a boundary condition into a computational fluid dynamics model for the purpose of designing and analyzing various geometric configurations of the flow nozzles. The object of the analysis work was to arrive at a nozzle configuration which would deliver the flow of feed into the drum at its center line with a similar or improved flow stream distribution pattern as compared with traditional bottom feed entry.
Nozzle Design
A key RCF design feature is the nozzle configuration through which the feed exits the nozzles and enters the drum. The geometry of these nozzles has been highly engineered to efficiently direct flow upward into the center of the drum, and numerous computational fluid dynamic studies were performed to optimize this geometry. It has been noted that no change to flow direction is observed when experiencing varying fluid properties.

The inner diameter of the injection tube matches the inner diameter of the piping from the furnace to the drum, allowing for consistent flow through the RCF injection device. In the extended position, the nozzles are sealed by a spring loaded dynamic seat which uses the same sealing principals as DeltaValve’s unheading valves. This dynamic seat seals the bonnet from the feed, and eliminates the possibility of resid entering the nozzle housing, even in the event steam purge pressure is lost.

Clean-out and inspection port
Inlet feed line port connection
Housing and nozzle guide
Injection nozzles
Spool flange

United States Patents
8,282,074; 8,123,197
8,545,680; 6,964,727;
6,565,714; 6,843,889
7,033,460; 7,399,384;
6,660,131; 6,989,081
and other domestic and international patents pending
Retractable Center Feed Injection Device
Product Testing

When comparing pre-installation versus post-installation circumferential temperatures recorded at the elevation of the weld seam just above the lower skirt, the post-installation temperatures were within a close range. Data revealed significantly reduced temperature variance within coke drum skin temperatures from 825°F to less than 350°F, an overall reduction of approximately 500°F. As shown in the charts on the following page, the reduction in temperature can be attributed to the formation of an insulating layer of coke on the walls of the drum, this layer of coke also reduces the temperature of the drum skin when quench water is introduced. The most notable benefit of utilizing the RCF occurs during the quench cycle where it dramatically reduced stresses in the coke drum, reducing the potential of drum cracks and bulges and allowing for a significant increase in coke drum life.
Full DCU Cycle with Side-Feed

Coke insulation cools some of the cone early, but this breaks down and hot oil reheats the cone.

Large variance in temperature during filling of drum.

Full DCU Cycle with Retractable Center-Feed

Small variance in temperature during filling of drum.
# Retractable Center Feed Injection Device

## Specifications

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<td>Injection Nozzles</td>
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</tbody>
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## Construction
- Cast, fabricated

## Body Housing Material
- ASME SA217 WC6

## Nozzle
- ASME SA335 P11 and 182 F11

## Actuation
- Electric, electro-hydraulic, or hydraulic

## Interlocks/Controls
- Engineered to plant specifications

## Positive Lockout
- Removable lockout pin

## Purge Media
- Steam

## Maximum Design Pressure
- 154 PSIG (10.8 kgf/cm² @ 940°F (505°C))

## Inlet Feed Sizes
- 6” to 16” diameter

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![Diagram of Retractable Center Feed Injection Device](attachment:diagram.png)
Retractable Center Feed Injection Device

Actuator Options

The retractable center-feed (RCF) injection device is designed using a self contained electro-hydraulic system, though additional actuation options are available. Electro-hydraulic and hydraulic configurations utilize a standard double-rod hydraulic cylinder, where one rod is attached to the RCF nozzle, and the opposite rod is connected to a visual indicator on the lock-out shaft. The electro-hydraulic version uses a stainless steel box mounted directly on top of the hydraulic cylinder that contains the motor, hydraulic pump, reservoir, and controls. A full electric actuator, which significantly reduces maintenance when compared to hydraulics, is also available.
Transition Spool
The DeltaValve transition spool is designed to create a permanent connection between the bottom unheading valve and the coke-drum bottom flange. Single flanged weld-in transition spools incorporate a permanent side inlet feed connection where the retractable center-feed injection device can be attached.
DeltaValve

Additional DCU Equipment

**Bottom Unheading Valve**
The bottom unheading valve connects to the bottom flange of the coke drum or transition spool, creating a totally enclosed system from the coke drum to the accumulation pit. With the push of a single button from a remote location, safe and reliable unheading can be achieved. The DeltaValve bottom unheading valve is inherently safe, easy to operate, and designed to be maintenance-free from turnaround to turnaround.

**Top Unheading Valve**
The top unheading valve connects to the top flange of the coke drum. With this valve, top coke drum unheading can be safely accomplished with the push of a single button from a remote location, removing operators from the cutting deck and protecting them from potential coke drum blowouts or eruptions.

**Auto-Switch Coke Cutting Tool**
The innovative DeltaValve auto-switch coke cutting tool provides a high level of safety during de-coking operations by allowing the tool to remain in the drum during switching between cutting/boring modes. The auto-switch tool and enclosure, in combination with the DeltaValve top unheading valve, provides maximum coker safety on the top unheading deck by removing personnel from the area.

**Isolation Valves**
DeltaValve isolation valves are reliable, low-maintenance, tight shut-off valves, designed for extreme temperatures and harsh applications. These valves are designed for easy in-line removal of all internal components. Additionally, steam purge ports are capable of operating continuously in the partially open (throttling) position, while isolating body internals from the process. This product line is available with a complete suite of electric and hydraulic actuator options and complete PLC-based isolation valve control systems with safety interlocks and sequence controls.

**Safety Instrumented Systems**
Designed in compliance with IEC 61508 to provide an independent layer of protection to mitigate coker safety risk.

**Coker Automation**
DeltaValve's programmable logic controller (PLC) provides unparalleled safety, performance and reliability. The custom-built PLC can be manufactured with simplex or redundant processors and power supplies, configurable function blocks, internal sequence controls, interlocks, permissives, and more. The PLC logic manages the hydraulic power unit circuits to allow hydraulic pressure only to the appropriate unheading device when the process is safe.

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DeltaValve
Field Services

Our field service crews provide a superior level of service, including around-the-clock coverage to reduce downtime by responding to customers’ needs in a timely and efficient manner. Our team of technical experts has quick access to all equipment drawings, bills of material, and customer specifications. This information provides DeltaValve the unique capability to evaluate and troubleshoot issues and provide solutions quickly. Whether it’s routine maintenance, or a major equipment turnaround, DeltaValve is your trusted source for aftermarket and turnaround services.

DeltaValve field services:
• DeltaValve equipment installations
• Site acceptance tests
• Commissioning supervision
• Site audits
• Turnaround services
• Maintenance and repair
• Equipment rebuilds
• Storage
• Hydraulic flush services
• Electrical loop checks
• On-site training
• Bolt tensioning/torquing

In order to respond to our customers’ requirements, DeltaValve has sizeable service facilities staffed with our certified technicians in the United States, Canada, and Europe. We are also planning such facilities globally to meet the demands of our growing list of worldwide customers.

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