Refining Valve Application Guide

Engineered Solutions for the Refining Industry

MOGAS®
SEVERE SERVICE BALL VALVES

Valves for Refining

Located at the top of a major refinery, these MOGAS valves were chosen for their performance and low maintenance. Due to their location, reliability was a critical part of the installation decision.

Catalyst particulates and harsh solids are easily handled by MOGAS Valves. This valve was checked as part of a routine maintenance program and then was put back into service.

This large bore 24-inch metal seated ball valve was one of several chosen for a tar sands upgrade project. Ability to meet the stringent deadline was crucial to the success of the start-up.

Industry Codes & Standards

The following industry codes and standards are referenced in the manufacturing of MOGAS valves:
ASTM, CRN, DIN, ATEX, FCI, ISA, ISO, NBBI, PED, GOST-R, TUV, TA-Luft

ISO 9001 REGISTERED
Certificate No. 6593

ASME	Title
B16.5	Steel Pipe Flanges & Flanged Fittings
B16.10	Face to Face & End to End Dimensions of Valves
B16.11	Forged Fittings Socket Welding and Threaded
B16.25	Butt-welding Ends
B16.34	Valve – Flanged, Threaded & Welded End
FCI 70-2	Control Valve Seat Leakage

MSS	Title
SP-25	Standard Marking System for Valves, Flanges & Unions
SP-55	Quality Standard for Steel Castings for Valves, Flanges & Fittings
SP-61	Pressure Testing of Steel Valves

API	Title
598	Valve Inspection & Test
607 / 6A	Fire Test for Quarter Turn Valves

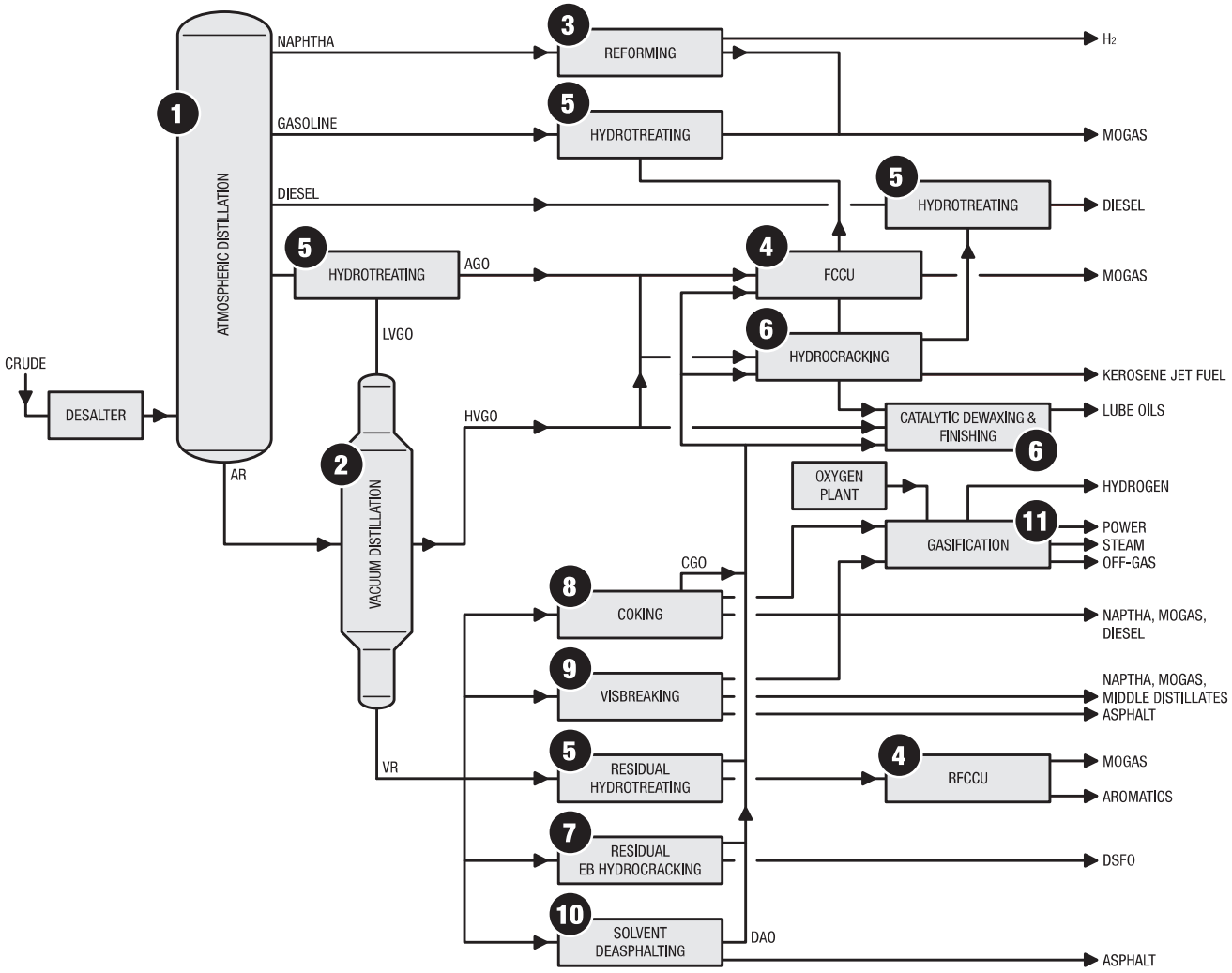
NACE	Title
MR-0103	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments

British Standard	Title
BS 6755	Testing of Valves Part 1 – Specification for Production Pressure Testing Requirements Part 2 – Specification for Fire Type Testing Requirements

MOGAS — Your Partner in the Process

Proven Reliability. Engineering Expertise. Dependable Service.

The refining industry has undergone many changes, from the methods of processing to the length of time that they operate their process units. These changes, along with the emergence of low sulfur fuel specifications, the requirement to process lower grade crude and the need to convert more bottom-of-the-barrel residuals, has put an extreme demand on isolation and control valves. Unreliable and unpredictable valves in emergency situations can cause enormous monetary losses and have devastating consequences for personnel. MOGAS has responded to these challenges by developing a combination of diverse trim configurations and high quality coatings for use in high temperature, high pressure, erosive, corrosive, viscous and coking / asphaltene applications.



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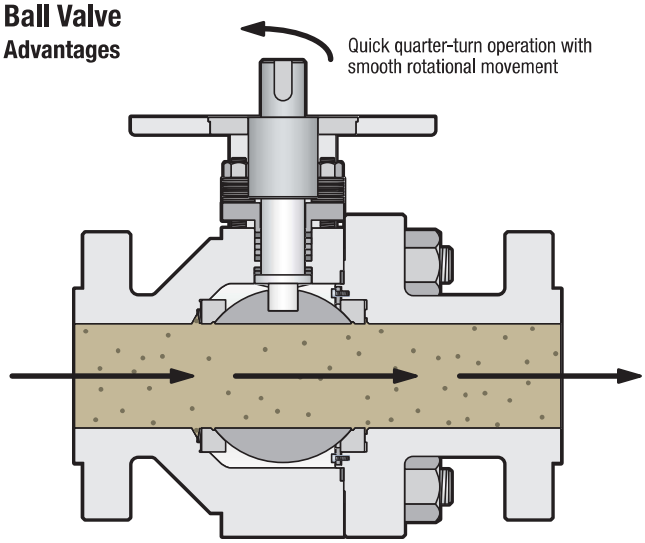
Ball Valve Advantages

Compared to Gate and Globe Valves

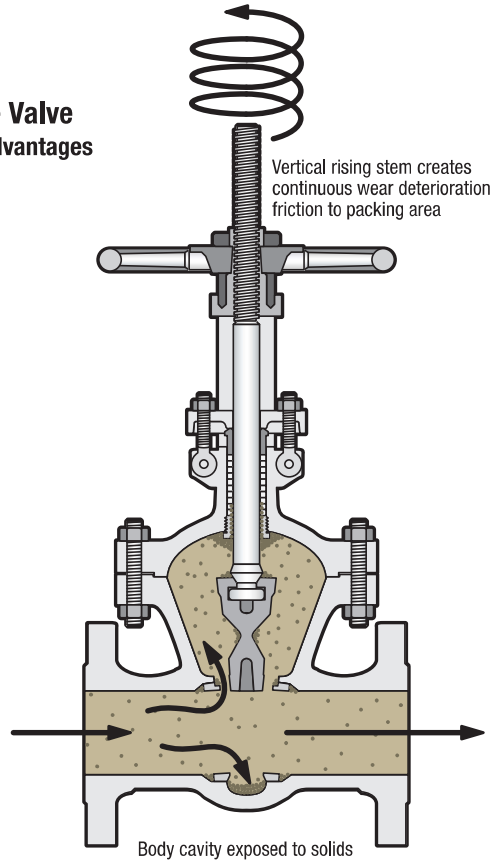
Ball Valve
Advantages



Straight-through bore path

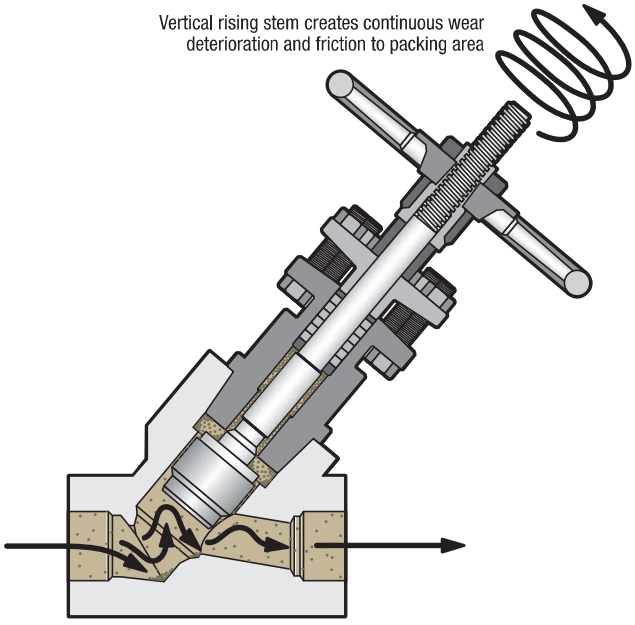
Ball Valve	Globe Valve	Gate Valve
Pressure assisted sealing	Relies on vertical thrust by the stem to drive the sealing plug into the seat	Torque seated to activate seal — thermal cycling relaxes stem
Recessed seats are protected from continual exposure to the process flow	Sealing components in the line of flow leading to erosion	Erosion of sealing surfaces due to exposure of the seats when the valve is open
Ball is wiped clean with each operation of the valve	Geometry of the exposed sealing surface wears and loses the ability to hold tight seal	Sealing trough / rib erodes over time and can capture flow particles
Rotates on own axis thus no volumetric displacement	When operated, flow path is interrupted causing volumetric displacement of the process fluid which must occur from behind the plug back into the flowstream	
Packing area is protected from potential particulate erosion	Multi-turn rising stems can pull destructive catalyst and pipe scale up through the interior diameter of packing area leading to possible hazardous atmospheric leaks	
Non-rising stem design meets EPA VOC packing leakage standards for greater number of cycles	A sliding stem valve will not provide the length of service life or number of cycles due to the stem moving through the packing box along with the process fluid	

Gate Valve
Disadvantages



Body cavity exposed to solids

Globe Valve
Disadvantages



Turbulent and interrupted flow path

MOGAS Valve Selection

Engineered Solutions for the Refining Industry

Quarter-Turn Isolation Technologies

These valves are for on / off isolation, drain or vent service involving high pressure and / or high temperature.

Model	End Size (Inches)	ASME Class	Sealing Capabilities
CA-1AS / 2AS	1 – 36	150 – 4500	Uni-directional and bi-directional with metal sealing surfaces
CA-HO1	1/2 – 3	2500	Uni-directional and bi-directional with metal sealing surfaces
CA-DRI	3 – 36	150 – 2500	Uni-directional with metal sealing surfaces
RSVP	1/2 – 2-1/2	600 – 4500	Uni-directional with metal sealing surfaces

Rotary Control Valve Technologies

A host valve body (normally floating ball or trunnion) is used to accommodate various internal control components.

Trim	End Size (Inches)	ASME Class	Description
RotaryTECH™	2 – 36	150 – 4500	Basic flow control for low ΔP applications Regulation of volumetric media Characterized flow options
FlexStream®	2 – 36	150 – 2500	Complex flow control for high ΔP applications Velocity control Mitigate cavitation Manage flashing Noise abatement Smaller dimensional envelope than standard gate or globe control valves

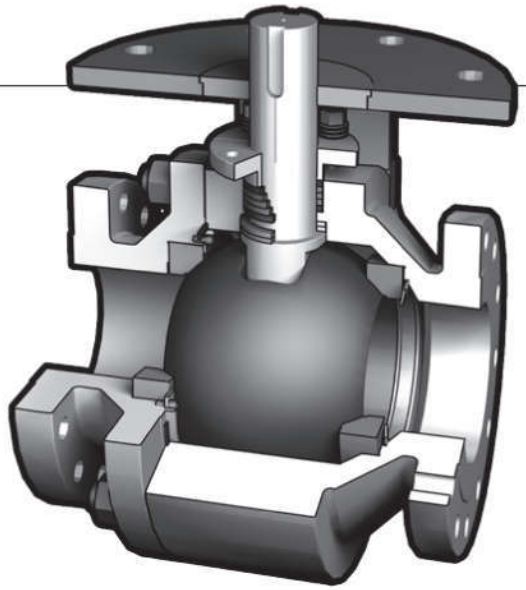
Body Materials: A105, WCC, F9, C12, F5, F316H, CF8M, 347H, 321H, 304H
Standard Trims: 410 HVOF CCC & 316 HVOF CCC / Spray & Fused
Special Trims: Inconel® 718 Spray & Fused, Incoloy® 800H Spray & Fused
End Connections Available: RFF, RTJ, Clamp, BW, SW or customer specification

MAX-Series for Customized Solutions

These valves are engineered for unique operational requirements and involve strong collaboration between engineering, operations, maintenance and manufacturing. All MAX-Series valves are in compliance with industry standards and codes.

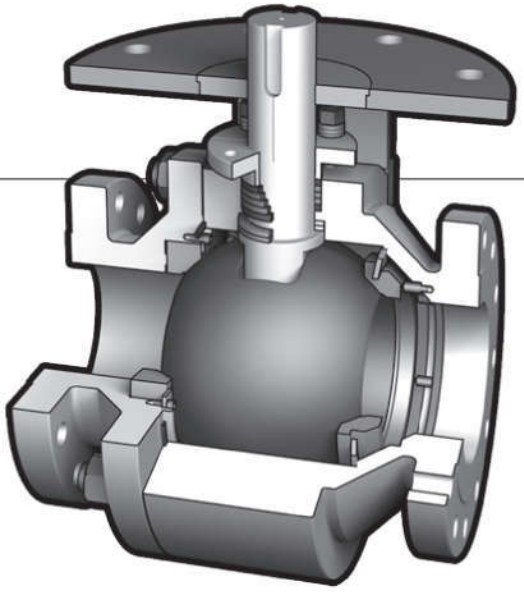
Examples	Description
Special Linkage (Dual valves, Quad Valves)	These valve configurations may involve multiple severe service valves that need to operate in a specific sequence or operate in such a manner that some are automatically closed when others are opened.
3, 4 or 5-Way Diverter Valves	When diverting the flowstream in different directions or to different locations, a dependable no leak through, absolute shutoff diverter valve is crucial. The ability to handle a rotary operated stream separation is critical to the reliability of the process as well as the safety of the plant. This often simplifies or eliminates the number of valves needed.
Special Automation	Often rapid operation, high cycling or even dimensional requirements will call for a unique automation package. MOGAS works closely with clients to ensure the demanding automation needs for their severe service valves are successfully achieved.
Unique Bore or Inlet / Outlet Sizing	Special piping or process requirements often create operational challenges for severe service valves. Dimensional sizing constraints often limit commodity valves. MOGAS has been able to offer uniquely fabricated and manufactured ball valves that meet operational specifications, maintain process integrity, fit mechanical dimensions and honor deadlines.
One-of-a-Kind	Custom requests are part of our legacy. MOGAS has been in the business for over 35 years engineering and fabricating that one exclusive valve that is a non-standard crucial component for your operating system. Unique bore sizes, different end connections and special trim materials are easily accomplished through our engineered products group.

Quarter-Turn Isolation Technologies



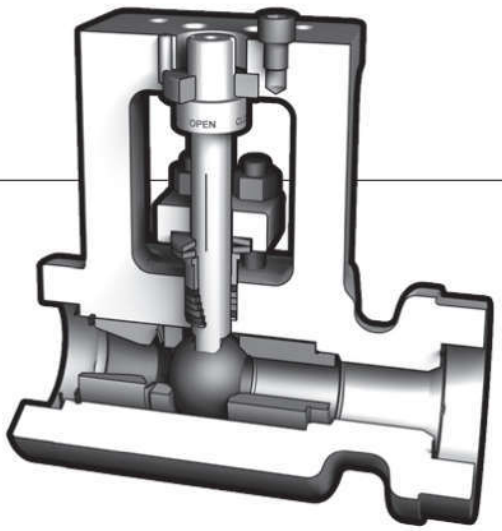
C-Series
Dependable Isolation

- Uni- or bi-directional sealing
- Blowout proof stem
- Two-piece forged body
- ASME 150 – 4500 Class
- Sizes: 1/2 – 36 inch
- Fire tested to API-607 rev. 4
- Floating ball design
- Coated metal sealing surfaces
- Seats protected in open position



CA-DRI
Reliable Service

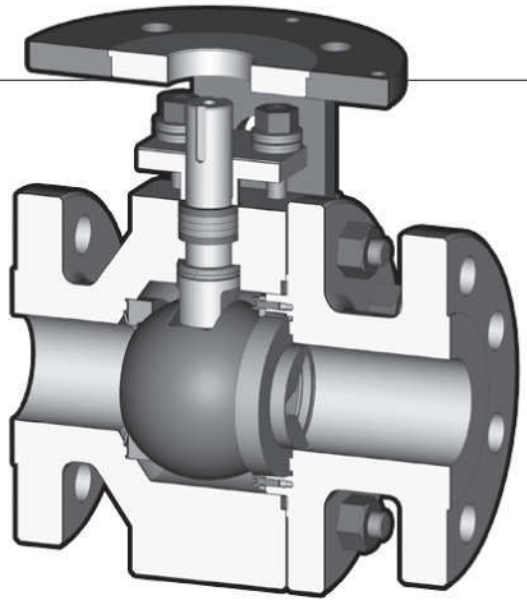
- Uni-directional sealing
- Upstream seat prevents build-up
- ASME 300 – 2500 Class
- Sizes: 2 – 36 inch
- Coated metal sealing surfaces
- Quarter-turn non-rising stem does not deteriorate packing
- Sealing surfaces not exposed to flow stream
- Recommended in heavy coking or solids handling media
- Reverse pressure seat stops



RSVP
Innovation by Design

- Mechanical precision stop
- Forged uni-body design
- ASME 600 – 4500 Limited Class
- Sizes: 3/4 – 2-1/2 inch
- Live loading of stem packing
- Seat spring, assisted by line pressure, provides constant mechanical force for sealing

Rotary Control Technologies

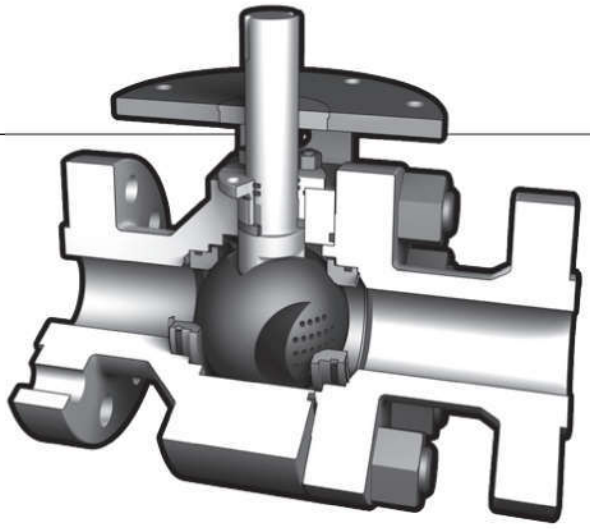


RotaryTECH™
Superior Solids Handling

- Controls flow of solids and slurries
- Low ΔP applications
- Regulation of volumetric media
- Characterized flow options

FlexStream®
Unprecedented Flexibility

- Controls pressure of gases, multi-phase fluids and liquids
- High ΔP applications
- Multi-stage letdown
- Limits velocity and vibration
- Eliminates cavitation
- Reduces noise
- Reduces flashing erosion
- Often smaller dimensional envelope than a traditional control valve
- Greater Cv per inch compared to competition



FlexStream VC

The Velocity Control (VC) technology utilizes a torturous path design which provides up to 36 stages of pressure letdown and 35 dBA of noise reduction, while being able to deliver a far greater rate of Cv than a linear valve of the same size.

FlexStream DS

The Diffusion Seat (DS) consists of a number of drilled holes that are engineered within the seats. When added to a valve assembly, the DS technology provides an excellent quarter-turn throttling trim for the C-Series and RSVP lines.

Features and Benefits

of MOGAS Valves for Refining

1 Matched ball and seat sets

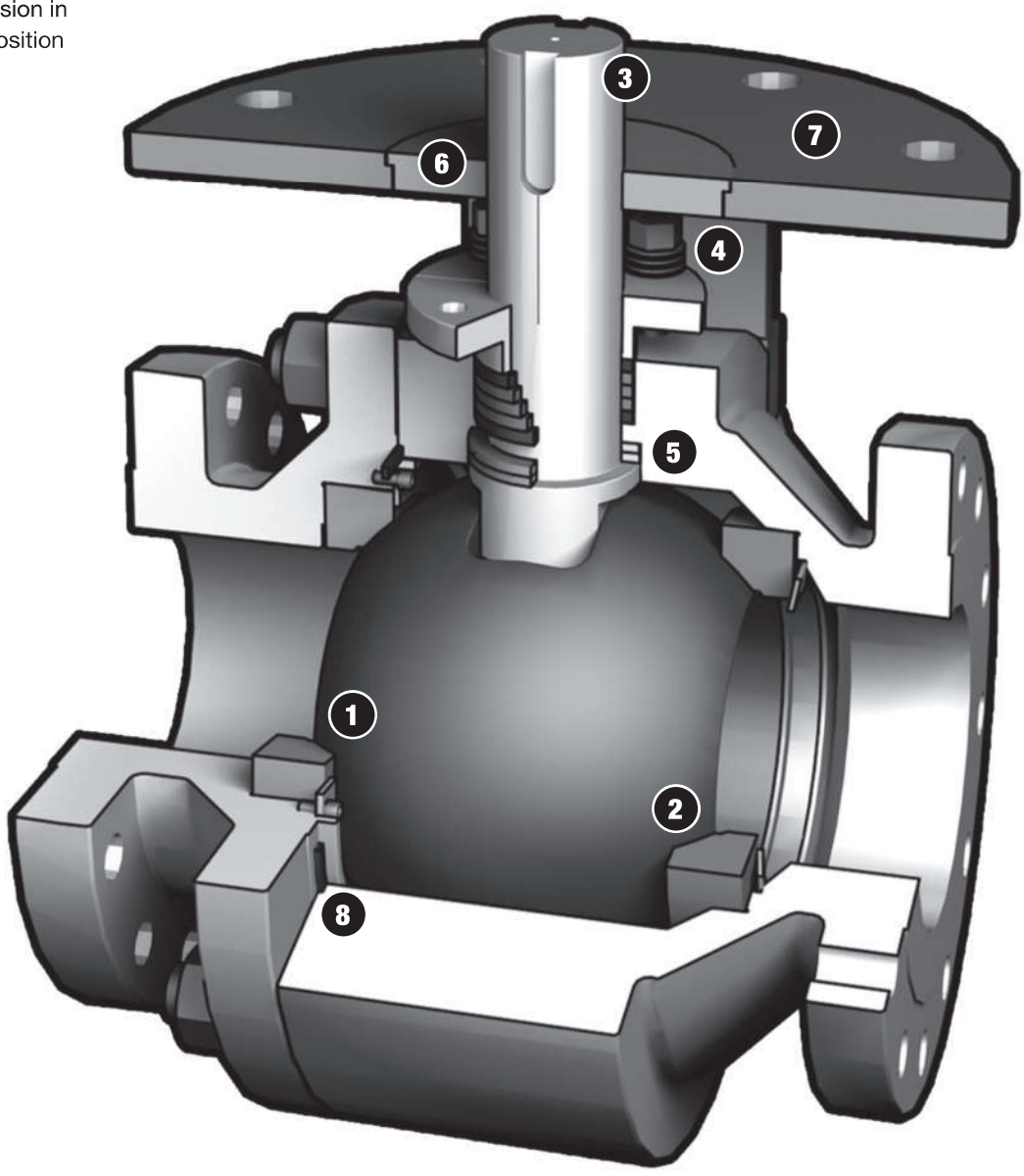
- Two-sided seat lapping delivers outstanding seal performance
- Each ball and seat set are "blued" to verify continual contact is achieved across entire seat face
- Oversized spheres allow slight over travel, which reduces wear and can accommodate misaligned actuator stops
- Seating surfaces are protected from erosion in the fully-opened position

2 Crucial metal seats

- Sharp leading edge design of seat ring "wipes" sealing surface each time valve is operated
- Proprietary MOGAS reverse seat geometry minimizes the effect of solid build-up on the sealing surface

3 Oversized stems

- MOGAS provides oversized stems to accommodate torque increases that can happen over time. Economical, under-designed stems can cause significant operational problems with frequent use and catalyst build-up.



4 Standard live-loaded packing

- Live loads of stem packing gland ensures constant packing energization, even after several thermal cycles
- Packing design meets EPA VOC emissions standards

5 Pressure-energized inner stem seal

- Two hard coated and lapped metal thrust bearings serve as both a pressure-energized inner stem seal and stem guide
- Bearings prevent migration of media into the packing box
- Lapped surfaces provide tight seal in combination with line pressure exerting additional vertical force
- Dual coated inner stem seals prevent galling between body, stem and the inner stem seals

6 Stem support bushing

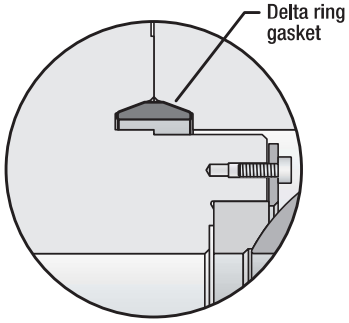
- Secondary stem bearing guide eliminates movement and packing deformation caused by side-loading of stem by the actuator
- The stem support bushing, in combination with the double inner stem seals, provides a dual guiding system which prevents lateral movement of the valve stem

7 Sturdy mounting bracket

- To properly support actuator weight, MOGAS heavy duty mounting brackets are first welded or bolted into place then machined for precise alignment
- Alignment surface is both square with and centered over the stem, promoting proper stem and stem bushing alignment

8 Body gaskets

- ASME 150 – 1500 class valves use an Inconel spiral-wound gasket with impregnated Grafoil®
- ASME 2500 class valves and above use a pressure energized Inconel metal gold-plated delta ring gasket (see drawing)



Features Not Shown

Reliable coating

- Use of identical base materials ensures thermal growth properties are consistent for the ball and seat
- Coatings on ball and seats have compatible thermal growth rates to prevent bond failure
- Rounded ball bore edges eliminate risk of coating spalling
- Two types of coatings — spray and fused, which is metallurgically-bonded, and HVOF, which is mechanically-bonded

Rugged application-specific materials

- Heavy coking streams where EOR torque increases significantly over SOR torque require the selection of higher strength materials to prevent stem slot deformities

Withstands thermal shock

- Sufficient clearance is designed between seat back and seat pocket to ensure that valves remain fully operable (will not bind or seize), even when subjected to sudden swings in temperatures

Repairability

- Two easy to replace seats minimize the repair cost (welding, remachining, recoating) compared to the refurbishment of a complete integral seat end connection

Distillation

Atmospheric Distillation

In atmospheric distillation, the pipe still process takes the raw desalted crude and heats it up in the crude furnace until it is partially vaporized. This allows for the separation process to begin in the crude tower where several side streams are taken off at different boiling points.

A refinery fire is always a dangerous event, but a fire that reaches the large amounts of crude contained in the main tower and related side strippers can quickly go from dangerous to catastrophic.

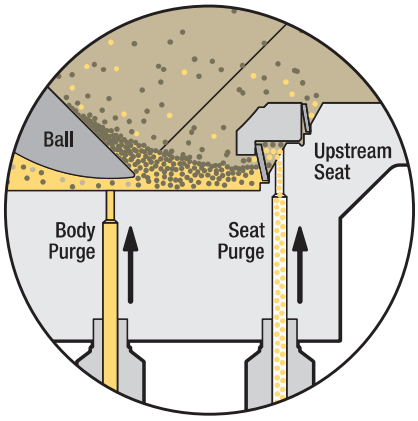
As a leading provider of critical service valves, MOGAS has worked with several oil companies to create a reliable emergency bottoms isolation system. In a fire-related emergency, this system isolates the tower and strippers—and the highly flammable product they contain—from the source of the fire.

One harmful characteristic of this process is heavy media build-up. MOGAS has developed optional purge ports to assist with clearing excessive coke (see detail).

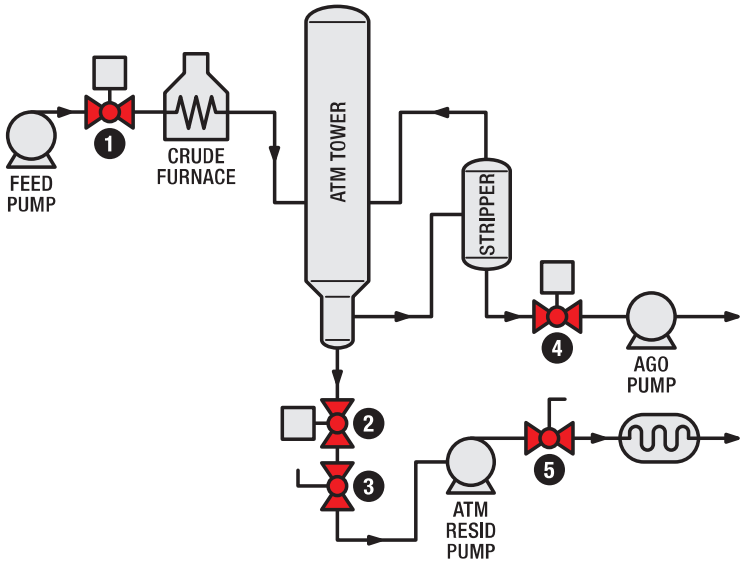
The MOGAS solution has worked so reliably that some companies have incorporated it into their best practices design manual.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Coking service
- Temperature cycling
- Erosive conditions



Optional body and seat purge ports can be added to assist with removing coke.



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Feed Isolation	400 – 600	205 – 315	100 – 200	5 – 15	6 – 10	150 – 250	●	—	—	—	—
2	Atmospheric Bottoms EBV	600 – 800	315 – 430	20	1	4 – 8	100 – 200	●	●	—	—	—
3	Atmospheric Bottoms Pump Isolation	600 – 800	315 – 430	20	1	8 – 14	200 – 350	●	●	—	—	—
4	Atmospheric Gas Oil Stripper EBV	600 – 800	315 – 430	20	1	6 – 10	150 – 250	●	●	—	—	—
5	Atmospheric Bottoms Exchanger Isolation	600 – 800	315 – 430	150	10	6 – 10	150 – 250	●	●	—	—	—

Vacuum Distillation

The vacuum flasher provides a separation of atmospheric crude tower residue to produce heavy, medium and light vacuum gas oil and non-distillable products such as vacuum residue.

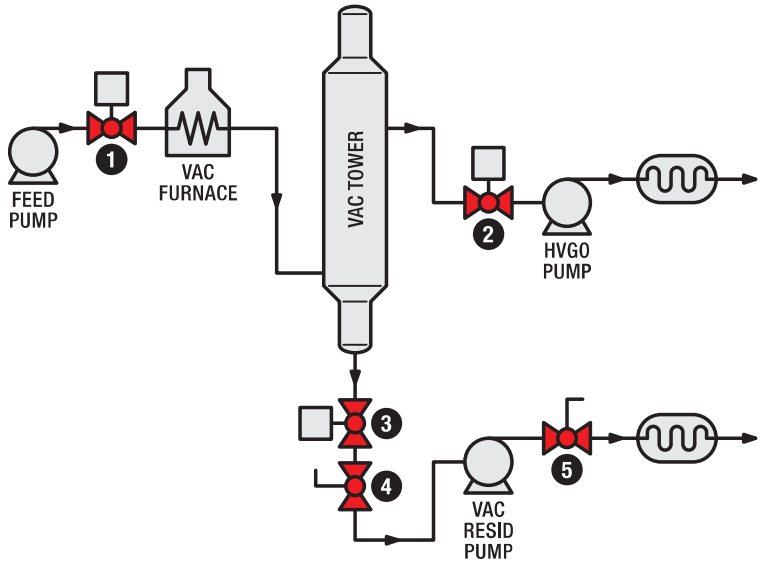
A refinery fire is always a dangerous event, but a fire that reaches the large amounts of crude contained in the main tower and related side strippers can quickly go from dangerous to catastrophic.

As a leading provider of critical service valves, MOGAS has worked with several oil companies to create a reliable emergency bottoms isolation system. In a fire-related emergency, this system isolates the tower and strippers—and the highly flammable product they contain—from the rest of the refinery.

The MOGAS solution has become so reliable that some companies have incorporated it into their best practices design manual.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Coking and heavy asphaltene service
- Temperature cycling
- Erosive conditions



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Feed Isolation	400 – 800	205 – 430	100 – 200	5 – 15	6 – 10	150 – 250	●	—	—	—	—
2	Heavy Vacuum Gas Oil Pump EBV	400 – 800	205 – 430	0 – 20	0 – 1	4 – 8	100 – 200	●	●	—	—	—
3	Vacuum Tower Bottoms EBV	700 – 900	370 – 480	0 – 20	0 – 1	8 – 14	200 – 350	●	●	—	—	—
4	Vacuum Bottoms Pump Isolation	700 – 900	370 – 480	0 – 20	0 – 1	6 – 10	150 – 250	●	●	—	—	—
5	Vacuum Bottoms Exchanger Isolation	700 – 900	370 – 480	150	10	6 – 10	150 – 250	●	●	—	—	—

Reforming

Continuous Catalytic Reforming (CCR)

Installed between the lockhopper and lift engager at a major southwest refinery, these 3-inch ASME 300 class metal seated isolation valves cycle at least three times an hour. These valves replaced another manufacturer's design that lasted only two months. The MOGAS valves have been operating for over eight months.

The CCR process is primarily used in the refinery to improve the research octane number (RON) of the motor gasoline pool. It can also be configured for the production of aromatics for a petrochemical complex. A catalytic dehydrogenation reaction converts paraffins into iso-paraffins and naphthenes into aromatics. Hydrogen is a byproduct produced within this process and is utilized in other parts of the refinery.

The leading licensor of this process has over 600 units installed globally. This licensor has specified MOGAS isolation valves in its Schedule A specification package. This process package has evolved from a semi-regenerative to a continuous process, thus increasing the performance demands placed on the catalyst movement valves.

MOGAS has developed spray coatings that can cycle up to 50,000 times with no degradation in shutoff performance, which led to MOGAS being the preferred choice of the leading licensor of this process.

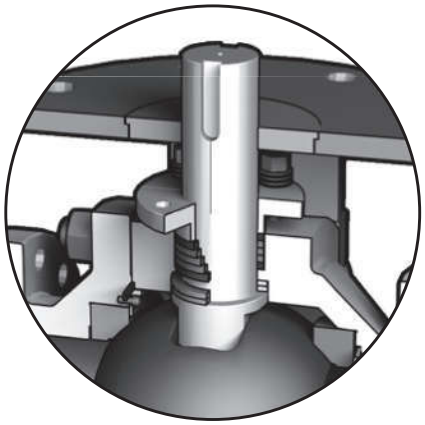
MOGAS has also developed a spring-loaded packing design to eliminate potential problem fires caused by hydrogen leakage within the process operating unit.

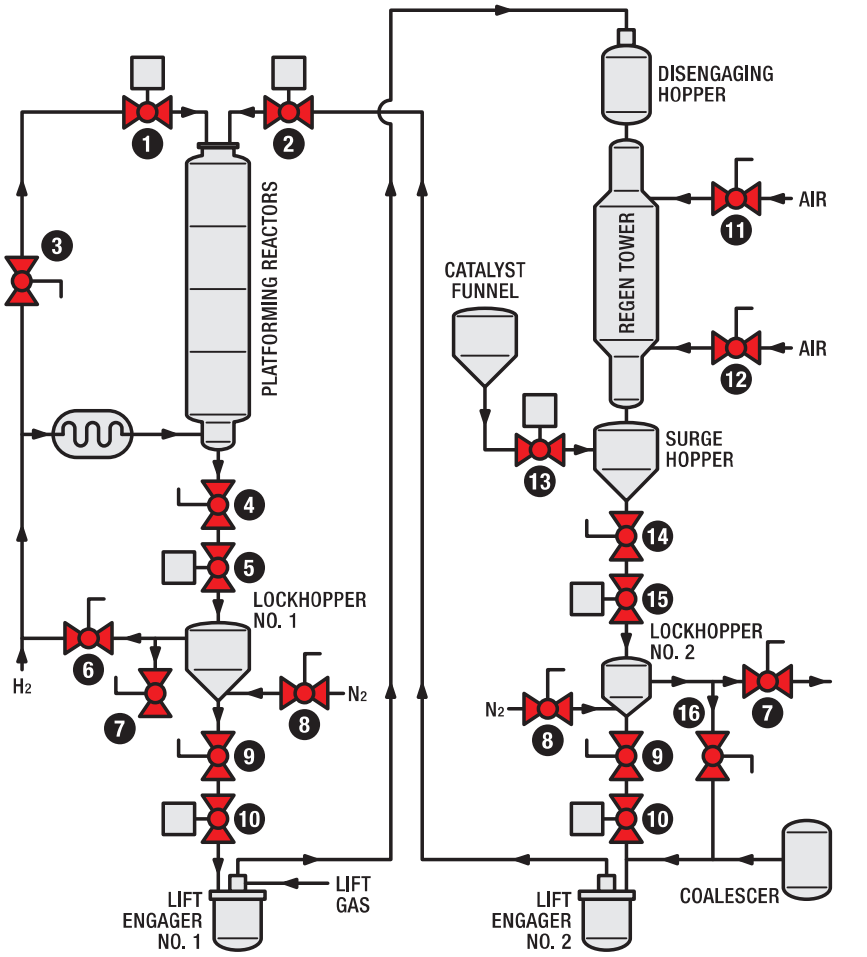
Typical operating conditions are:

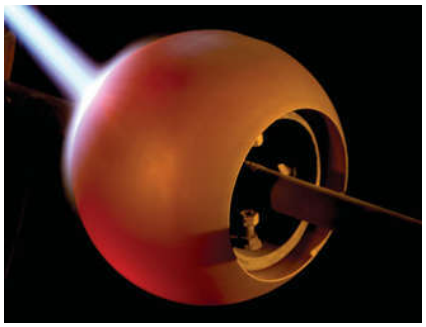
- High temperature
  (300 – 600° F / 149 – 320° C)
- High cycle
- High pressure / temperature hydrogen
- Bi-directional shutoff in the presence of H_2
- High pressure / temperature catalyst handling

Designed for Dependable Stem Performance

- All CCR application stems are made of A638 Gr. 660 and work in unison with the inner bearing
- Rigid mounting bracket and stem bushing designed to handle high cycling
- Stem and bushing support eliminates radial stem movement and packing deformation caused by side loading of the stem by an actuator
- Two piece inner stem seals function as a pressure energized seal and bearing preventing catalyst from entering the packing box
- Stem alignment protects packing box, keeping solids out — extending cycle life of the valve
- All stem packing gland followers are live-loaded to ensure packing is constantly energized after both thermal and mechanical cycling







F.W. Gartner Thermal Spraying, Ltd.

Thermal spray and fuse coatings bond metallurgically to the surface of the ball, resulting in high bond strengths which gives high cycle life to the valve design

Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Automated Reactor Overhead Purge	400 – 1000	205 – 540	300 – 800	20 – 55	1 – 8	25 – 200	●	—	—	—	—
2	Automated Reactor Overhead Regeneration	400 – 1000	205 – 540	300 – 800	20 – 55	1 – 8	25 – 200	●	—	—	—	—
3	Manual Standby Reduction Zone Purge	400 – 1000	205 – 540	300 – 800	20 – 55	1 – 8	25 – 200	●	—	—	—	—
4	Manual Reactor Bottoms Unloading Valve	400 – 1000	205 – 540	300 – 800	20 – 55	1 – 8	25 – 200	●	—	—	—	—
5	Automated Reactor Bottoms Unloading Valve (qty. 2)	400 – 1000	205 – 540	300 – 800	20 – 55	1 – 8	25 – 200	●	—	—	—	—
6	Manual Hydrogen Loading to Lockhopper 1	400 – 700	205 – 370	300 – 700	20 – 50	1 – 8	25 – 200	●	—	—	—	—
7	Manual Hydrogen Vent for Lockhopper 1 & 2	400 – 700	205 – 370	300 – 700	20 – 50	1 – 8	25 – 200	●	—	—	—	—
8	Manual Nitrogen Purge for Lockhopper 1 & 2	400 – 700	205 – 370	300 – 700	20 – 50	1 – 8	25 – 200	●	—	—	—	—
9	Manual Catalyst to Lift Engager 1 & 2	400 – 700	205 – 370	300 – 700	20 – 50	1 – 8	25 – 200	●	—	—	—	—
10	Automated Catalyst to Lift Engager 1 & 2 (qty. 2 each)	400 – 700	205 – 370	300 – 700	20 – 50	1 – 8	25 – 200	●	—	—	—	—
11	Manual Air Valve to Regeneration Cooler	400 – 700	205 – 370	300 – 700	20 – 50	6	150	●	—	—	—	—
12	Manual Air Valve to Surge Hopper	400 – 700	205 – 370	300 – 700	20 – 50	6	150	●	—	—	—	—
13	Automated Fresh Catalyst Addition	200 – 300	95 – 150	300 – 500	20 – 35	2 – 8	50 – 200	●	—	—	—	—
14	Manual Regen Catalyst Unloading from Surge Hopper	400 – 700	205 – 370	300 – 700	20 – 50	6	150	●	—	—	—	—
15	Automated Regen Catalyst Unloading from Surge Hopper (qty. 2)	400 – 700	205 – 370	300 – 700	20 – 50	6	150	●	—	—	—	—
16	Manual Pressure Balancing for Lockhopper / Lift Engager 2	400 – 700	205 – 370	300 – 700	20 – 50	6	150	●	—	—	—	—

Fluidized Catalytic Cracking

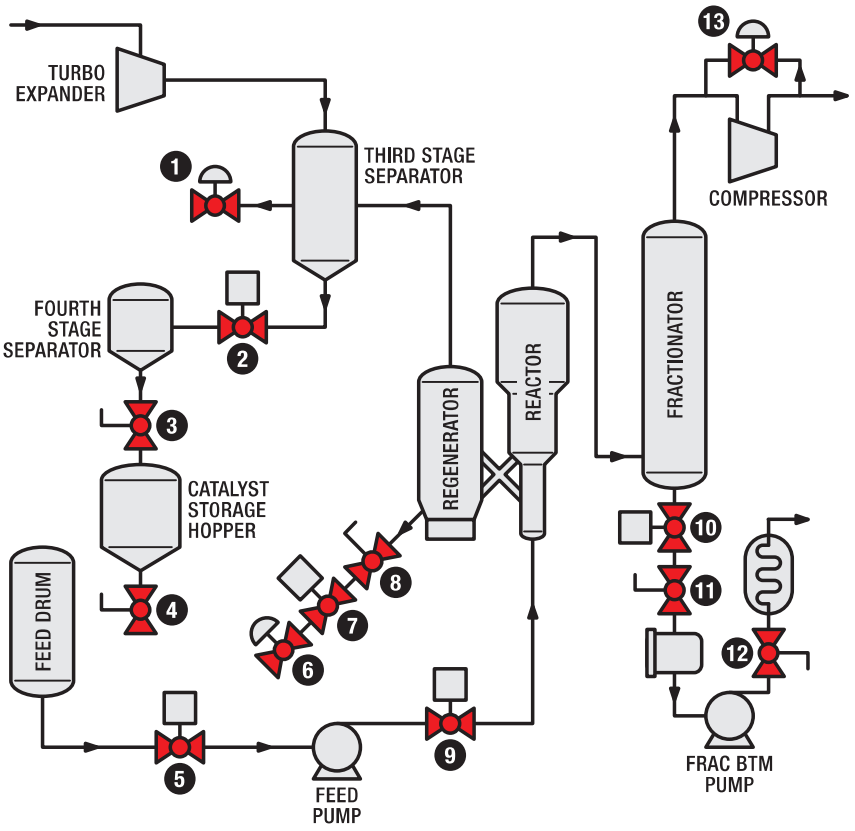
The Fluidized Catalytic Cracking (FCC) process is used for converting higher molecular weight hydrocarbons into value-added products. The conversion occurs in the presence of a catalyst that converts hydrotreated gas oils and fractionator bottoms into gasoline, C3 / C4 olefins and light cycle oils.

MOGAS has developed valve designs to handle the powdery ultra high temperature catalyst fines present during the removal process from the regenerator. In some cases the catalyst is carried over into the fractionator and is very erosive to gates and globe style valves. MOGAS' full-ported ball valves with special coatings have outperformed these designs lasting throughout the entire four- to five-year run times.

In applications where heavy coking occurs, MOGAS offers an intermittent / continuous purge system to remove the coke build-up from the seats and body cavities.

Typical operating conditions are:

- Ultra high temperature (800 – 1500° F / 420 – 820° C)
- Coking service
- Fine powdery catalyst handling
- Polythionic acid corrosion
- Erosive conditions



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Flue Gas Control	800 – 1425	420 – 770	30	2	1 – 4	25 – 100	—	—	—	●	—
2	Third Stage Separator Isolation	800 – 1425	420 – 770	30	2	4 – 10	100 – 250	●	●	—	—	—
3	Fourth Stage Separator Isolation	500 – 1000	260 – 540	30	2	6 – 12	150 – 300	—	●	—	—	—
4	Spent Catalyst Storage Hopper Isolation	200 – 500	100 – 260	ATM	ATM	4 – 10	100 – 250	—	●	—	—	—
5	Feed Drum EBV	200 – 300	100 – 150	50	5	6 – 12	150 – 300	●	—	—	—	—
6	Throttling Spent Catalyst Withdrawal Valve	800 – 1425	420 – 770	30	2	2 – 6	50 – 150	—	—	—	●	—
7	Spent Catalyst Withdrawal EBV	800 – 1425	420 – 770	30	2	2 – 8	50 – 200	●	●	—	—	—
8	Spent Catalyst Withdrawal Root Isolation	800 – 1425	420 – 770	30	2	2 – 8	50 – 200	●	●	—	—	—
9	Slurry Feed Isolation	200 – 300	100 – 150	100	5	6 – 10	150 – 250	●	—	—	—	—
10	Frac Bottoms EBV	500 – 850	260 – 450	50	5	8 – 20	200 – 500	—	●	—	—	—
11	Frac Tower Bottoms Filter Isolation	500 – 850	260 – 450	150	10	6 – 12	150 – 300	●	●	—	—	—
12	Frac Bottoms Exchanger Isolation	500 – 850	260 – 450	150	10	4 – 10	100 – 250	●	●	—	—	—
13	Wet Gas Compressor Surge Control Valves	100 – 200	40 – 100	30 – 200	2 – 15	10 – 20	250 – 500	—	—	—	—	●

This CA-DRI 2-inch ASME 300 class isolation valve handles the withdrawal of hot spent catalyst from the regenerator.

This CA-DRI 8-inch ASME 300 class valve has been handling catalyst at 1425° F / 774° C for numerous years. It is the major isolation valve between the third stage and fourth stage cyclone separator.

Catalyst Handling Valves

Effectively Managing Catalyst

The FCC unit regenerator / reactor circulates catalyst and regenerates for reuse in the reactor. This cycle continues until the catalyst is spent. Once the catalyst is spent, it must be removed from the process, so that fresh catalyst can be introduced to the unit. Isolation valves in the spent catalyst line allow for removal of this catalyst.

These valves must perform two critical functions during the operation of the unit: leak-free isolation of the spent catalyst line and control of the spent catalyst removal rate, along with temperature control of downstream piping and equipment. Leaking isolation valves can cause waste of unspent catalyst affecting the performance of the unit and overheat the downstream piping and equipment resulting in failure of the piping system. Inoperable valves cause spent catalyst levels to build in the regenerator, resulting in entrained catalyst in the flue gas system. This can cause the FCC unit to exceed mandatory EPA particulate emissions, resulting in enormous monetary fines to the refinery.

This CA-1AS 6-inch ASME 300 class feed isolation valve is a critical part of the emergency shutdown system.

Frac Bottoms Isolation Valves

Equipment Repairability and Emergency Shutdown

Run time is absolutely critical to these high-profit units. To avoid shutdown during the cleaning and repair of equipment, due to severe coke build-up, operators must be able to perform this function while the unit is online. The equipment used to control the fractionation tower performance has been engineered with redundancy specifically in the bottoms circuit of the tower where pumps, strainers and heat exchangers require frequent maintenance.

The automated isolation valves between the tower and this redundant equipment must perform two critical functions. The isolation valve must perform tight shutoff during the repair or cleaning of this redundant equipment. Secondly, during a fire situation the valve must close quickly and isolate to prevent the inventory from becoming a fire source. If this inventory is not contained a volatile situation can turn into a catastrophe quickly causing millions of dollars worth of damage to the operating unit.

Hydroprocessing

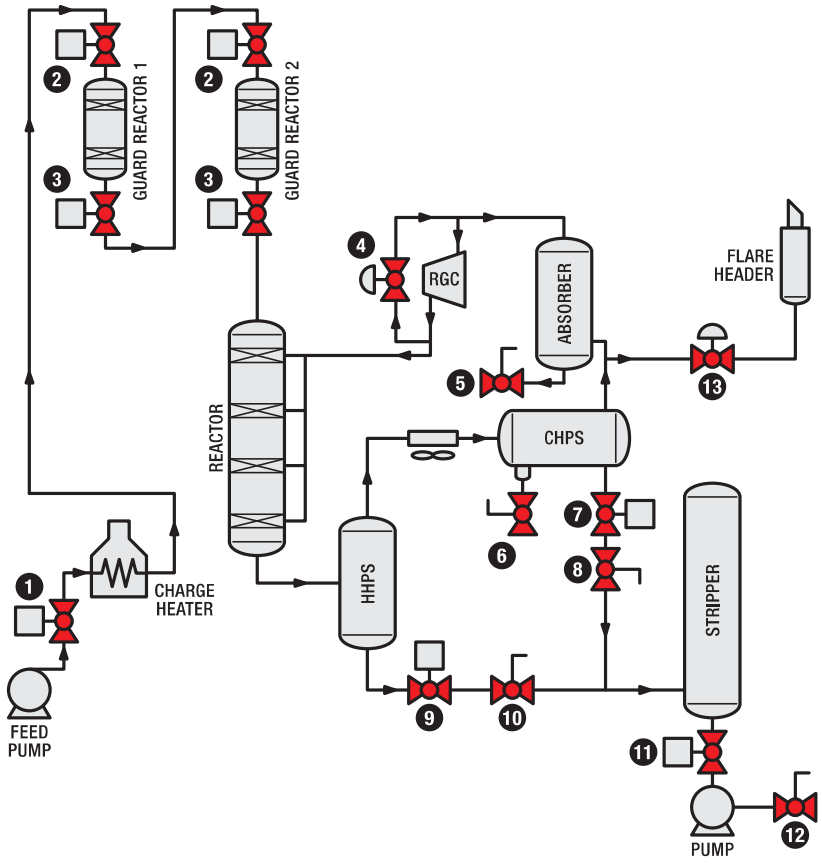
Fixed Bed Hydrotreating

High pressures and temperatures are required to break the sulfur and nitrogen molecular bonds which occur in residual, gas oil and diesel streams. In heavy metal crude processing refineries, a guard reactor system is typically put in place to prevent poisoning of the hydrotreating catalyst. The catalyst in the guard reactor has to frequently be removed due to collection of heavy metals on the catalyst.

Two licensors of fixed-bed hydrotreating process have developed unique methods of loading the guard reactors with fresh catalyst without taking the unit off-line. These guard reactor systems require catalyst withdraw and addition valves which MOGAS can provide.

Typical operating conditions are:

- High temperature (300 – 1000° F / 150 – 540° C)
- High pressure (1000 – 3500 psig / 65 – 240 bar g)
- High pressure / temperature hydrogen
- Coking service
- Asphaltene formation
- Ammonium bisulfide corrosion
- Viscous sludge
- Hydrogen sulfide corrosion
- High pressure / temperature catalyst handling
- Polythionic acid corrosion



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Chopper Valve	400 – 600	200 – 320	3200	220	8 – 12	200 – 300	●	—	—	—	—
2	Guard Reactor Isolation / Catalyst Addition	800 – 1000	420 – 540	3200	220	4 – 12	100 – 300	●	—	—	—	—
3	Guard Reactor Isolation / Catalyst Withdrawal	800 – 1000	420 – 540	3200	220	4 – 12	100 – 300	●	—	—	—	—
4	Recycle Gas Compressor Surge	150 – 200	60 – 100	2000 – 3000	135 – 205	4 – 8	100 – 200	—	—	—	—	●
5	Rich Amine Isolation	200	100	2000 – 3000	135 – 205	4 – 10	100 – 250	●	—	—	—	—
6	Sour Water Isolation	200	100	3200	220	2 – 6	50 – 150	●	—	—	—	—
7	Cold High Pressure Separator Automated LCV Isolation	200	100	2200	150	6 – 10	150 – 250	●	—	—	—	—
8	Cold High Pressure Separator Manual LCV Isolation	200	100	2200	150	6 – 10	150 – 250	●	—	—	—	—
9	Hot High Pressure Separator Automated LCV Isolation	800 – 900	420 – 480	2600	180	8 – 12	200 – 300	●	●	—	—	—
10	Hot High Pressure Separator Manual LCV Isolation	800 – 900	420 – 480	2600	180	8 – 12	200 – 300	●	●	—	—	—
11	Stripper Bottoms EBV	500 – 850	260 – 460	50	5	8 – 12	200 – 300	●	●	—	—	—
12	Stripper Bottoms Pump Isolation	500 – 850	260 – 460	150	10	6 – 10	150 – 250	●	●	—	—	—
13	Unit Depressurization	200	100	2200	150	6 – 10	150 – 250	—	—	—	—	●

Fixed Bed Hydrocracking

Hydrocracking is one of the leading processes for upgrading the bottom of the barrel residuals. This process charges the feedstock to high pressure and temperature, and the stream is then hydrogenated before cracking in the reactor.

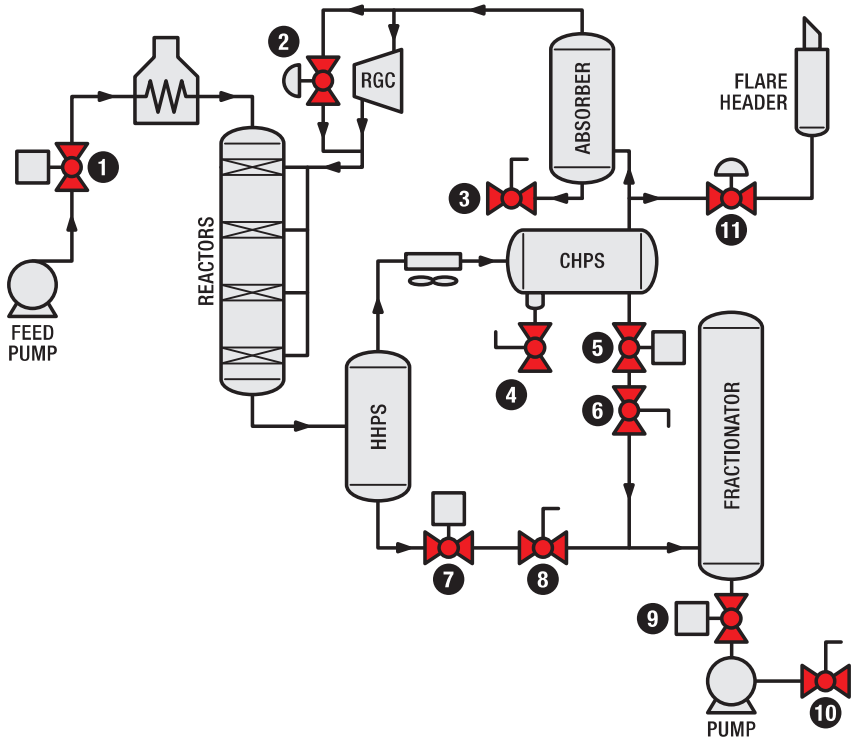
There are two distinct methods of hydrocracking processes — fixed and ebullated bed. MOGAS has engineered valves for the most severe isolation services in the hydrocracking process. Special trim and purging configurations for high pressure and temperature coking services along with the state-of-the-art coatings are applied to make the MOGAS design the most reliable isolating design available.

Typical operating conditions are:

- *High temperature (300 – 1000° F / 150 – 540° C)*
- *High pressure (1000 – 3500 psig / 65 – 240 bar g)*
- *High pressure / temperature hydrogen*
- *Coking service*
- *Asphaltene formation*
- *Ammonium bisulfide corrosion*
- *Viscous sludge*
- *Hydrogen sulfide corrosion*

The fixed bed hydrocracking process has the largest installed base of the two reactor types. The reactor will typically have multiple beds of catalyst. This catalyst cannot be removed as it is in the ebullated-bed process. Therefore the run times are limited to approximately two years before catalyst performance is affected by coke build-up.

MOGAS has worked with several licensors of fixed-bed hydrocracking process technology to improve the performance of isolation applications in an attempt to make the overall process unit more reliable and safer to operate for the 600 to 700 operating process units throughout the world.



Valve Specification

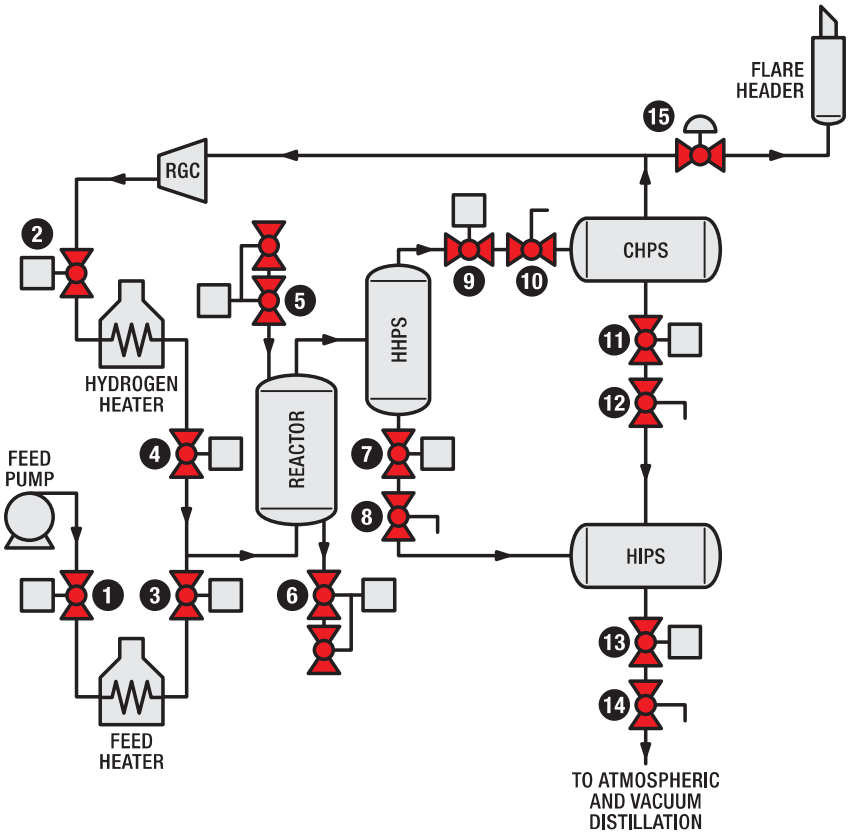
Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Chopper Valve	200 – 500	90 – 260	3200	220	8 – 12	200 – 300	●	—	—	—	—
2	Recycle Gas Compressor Surge	150 – 200	60 – 100	2000 – 3000	135 – 205	4 – 8	100 – 200	—	—	—	—	●
3	Rich Amine Isolation	200	100	2000 – 3000	135 – 205	4 – 10	100 – 250	●	—	—	—	—
4	Sour Water Isolation	200	100	2200	150	2 – 6	50 – 150	●	—	—	—	—
5	Cold High Pressure Separator Automated LCV Isolation	200	100	2200	150	6 – 10	150 – 250	●	—	—	—	—
6	Cold High Pressure Separator Manual LCV Separation	200	100	2200	150	6 – 10	150 – 250	●	—	—	—	—
7	Hot High Pressure Separator Automated LCV Isolation	800 – 900	430 – 480	2600	180	8 – 12	200 – 300	●	●	—	—	—
8	Hot High Pressure Separator Manual LCV Separation	800 – 900	430 – 480	2600	180	8 – 12	200 – 300	●	●	—	—	—
9	Frac Bottoms EBV	500 – 850	260 – 450	50	5	8 – 16	200 – 400	●	●	—	—	—
10	Frac Bottoms Pump Isolation	500 – 850	260 – 450	150	10	6 – 10	150 – 250	●	●	—	—	—
11	Unit Depressurization	200	100	2200	150	6 – 10	150 – 250	—	—	—	—	●

Ebullated Bed Hydrocracking

Currently in 100 percent of the ebullated bed hydrocracking units throughout the world, MOGAS has been working with the two ebullated bed hydrocracking technology licensors for over 20 years. MOGAS has been involved in the development of coatings and valve designs that can operate in arduous duty service conditions with 100 percent reliability for the entire projected four to five year run time.

In applications where heavy coke build-up occurs, MOGAS offers an intermittent / continuous purge system to remove excessive coke from the seats and body cavities.

This experience, performance record and continuous improvement has made MOGAS the preferred valve vendor for this process technology.

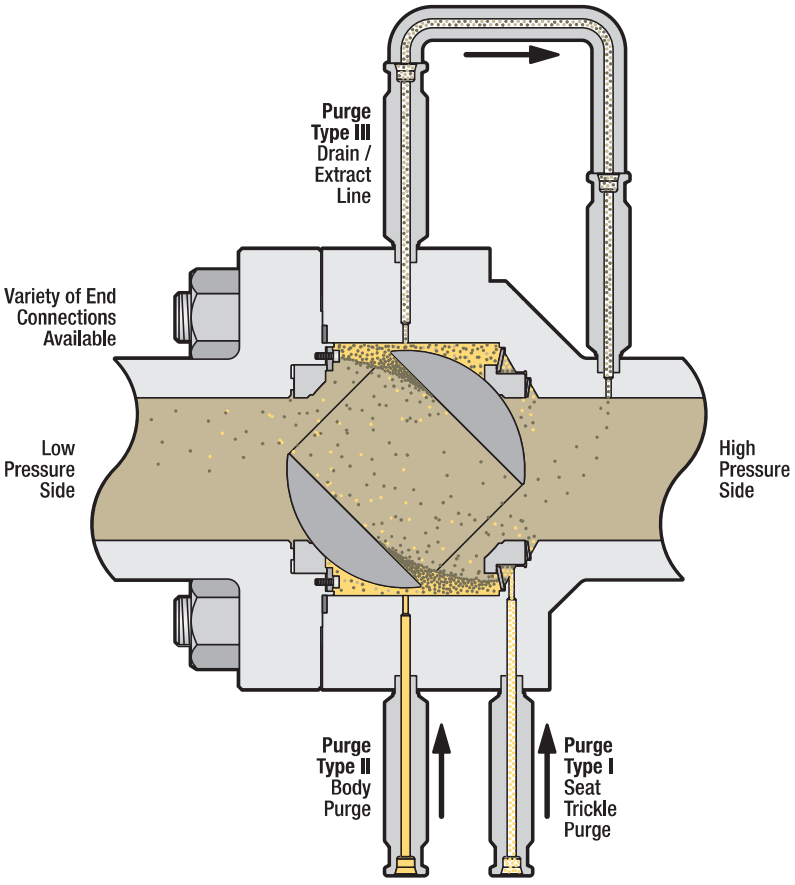


Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Chopper Valve	200 – 500	90 – 260	3200	220	8 – 12	200 – 300	●	—	—	—	—
2	Hydrogen Heater Inlet EBV	200 – 500	90 – 260	3200	220	8 – 12	100 – 300	●	—	—	—	—
3	Feed Heater Outlet EBV	500 – 800	260 – 430	3200	220	10 – 16	250 – 400	●	●	—	—	—
4	Hydrogen Heater Outlet EBV	500 – 800	260 – 430	3200	220	10 – 16	250 – 400	●	—	—	—	—
5	Reactor Catalyst Addition	800 – 1000	420 – 540	3200	220	2 – 4	50 – 100	●	—	—	—	—
6	Reactor Catalyst Withdrawal	800 – 1000	420 – 540	3200	220	2 – 4	50 – 100	●	—	—	—	—
7	Hot High Pressure Separator Automated LCV Isolation	800 – 900	420 – 480	3700	260	8 – 12	200 – 300	●	●	—	—	—
8	Hot High Pressure Separator Manual LCV Isolation	800 – 900	420 – 480	3700	260	8 – 12	200 – 300	●	●	—	—	—
9	Hot High Pressure Automated Overhead Vapor Isolation	800 – 900	420 – 480	3700	260	8 – 12	200 – 300	●	●	—	—	—
10	Hot High Pressure Manual Overhead Vapor Isolation	800 – 900	420 – 480	3700	260	8 – 12	200 – 300	●	●	—	—	—
11	Cold High Pressure Separator Automated LCV Isolation	200	100	1000 – 2600	70 – 180	3 – 10	80 – 250	●	—	—	—	—
12	Cold High Pressure Separator Manual LCV Isolation	200	100	1000 – 2600	70 – 180	3 – 10	80 – 250	●	—	—	—	—
13	Hot Intermediate Pressure Separator Automated LCV Isolation	800 – 900	420 – 480	600	40	12 – 16	300 – 400	●	●	—	—	—
14	Hot Intermediate Pressure Separator Manual LCV Isolation	800 – 900	420 – 480	600	40	12 – 16	300 – 400	●	●	—	—	—
15	Unit Depressurization	200	100	1000 – 2600	70 – 180	8 – 16	200 – 400	—	—	—	—	●

Optional Purging System Can Help Alleviate Coking Build-up

- Reduces operating torques from SOR to EOR in critical isolation valves
- Provides lubrication preventing excessive frictional forces on coating surface of ball and seats resulting in reduced repair costs
- Keeps coke build-up on ball in a soft condition allowing for optimal cleaning by scraper seats
- Proper sequencing allows for warm up avoiding temperature shock to control valves
- Allows isolation of redundant line for safe repair of instruments and control valves
- Eliminates coking in control valve station allowing for safe venting and draining of high pressure reactor effluent liquid and vapor



Located in a frigid Scandinavian environment, this large bore ASME 4500 class metal seated ball valve is installed on the outlets of the hydrogen heater.

These 12-inch and 16-inch ASME 2500 class floating ball valves are installed at the letdown station of a European refinery responsible for producing 115,000 bpd.

This clamped end CA-HO1 10-inch ASME 2500 class catalyst valve installed in 1995 is still in service at a major Italian refinery.

Thermal Cracking

Delayed Coking

Coking is a batch process that requires frequent operation of the isolation valve system during the coke drum switching operation.

MOGAS' simple floating ball design provides trouble-free operation in this heavy coking application, unlike complicated trunnion designs that provide several high tolerance areas for coke to build-up and cause torque to increase significantly from SOR to EOR of the unit.

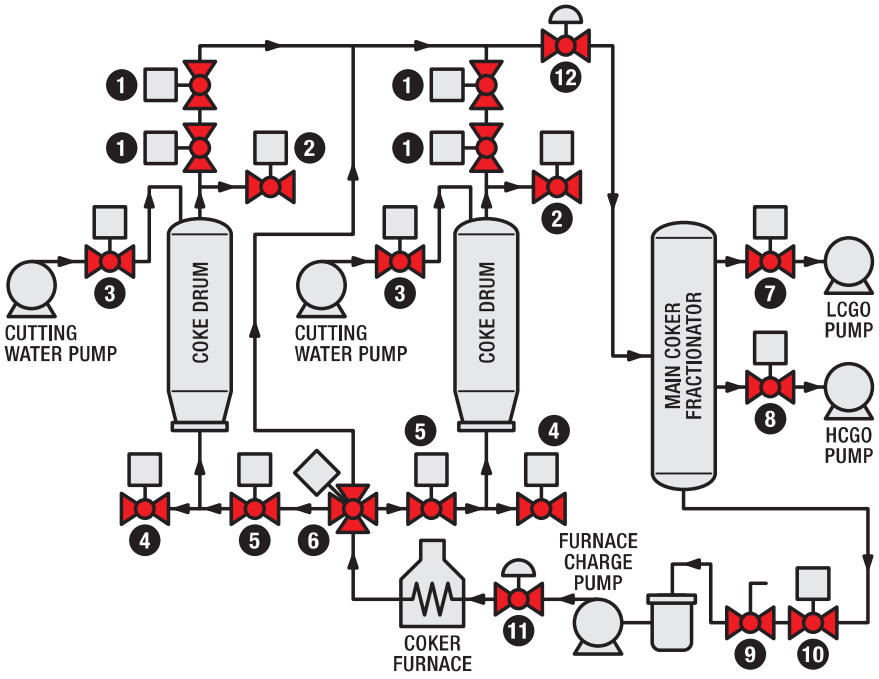
Our floating ball design requires much less steam during purging operations than the typical trunnion designs, saving thousands of dollars annually in energy costs.

This midwestern refinery has four 20-inch ASME 300 class MOGAS ball valves in overhead vapor service. Several are beginning their second decade of service.

As a continuous improvement to the company's design, MOGAS has taken data from the field to determine the exact amount of service duty that should be applied to actuator and valve stem sizing. This helps avoid valve and actuator failure from increased torque due to coke build-up.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Coking service
- High cycle
- Erosive conditions
- Temperature cycling
- High pressure water service
- HP steam blowdown



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Overhead Vapor	800 – 900	420 – 480	50	5	16 – 42	400 – 1050	●	—	—	—	—
2	Steam Blowdown Control	800 – 900	420 – 480	80	5	6 – 12	150 – 300	—	●	—	—	●
3	Cutting Water Pump Isolation	100 – 200	40 – 100	2000 – 3000	135 – 205	3 – 6	80 – 150	●	—	—	—	—
4	Quench Extraction	800 – 900	420 – 480	200	15	8 – 14	200 – 350	●	●			
5	Coke Drum Feed Isolation	800 – 900	420 – 480	200	15	8 – 14	200 – 350	●	●	—	—	—
6	Coke Drum Switching Valve[1]	800 – 900	420 – 480	200	15	8 – 14	200 – 350	—	—	—	—	—
7	Light Coker Gas Oil Pump EBV	300 – 600	150 – 320	50	5	4 – 10	100 – 250	●	—	—	—	—
8	Heavy Coker Gas Oil Pump EBV	300 – 600	150 – 320	50	5	4 – 10	100 – 250	●	—	—	—	—
9	Coke Filter Isolation	500 – 850	260 – 450	50	5	4 – 10	100 – 250	●	●	—	—	—
10	Frac Bottoms EBV	500 – 850	260 – 450	50	5	8 – 16	200 – 400	●	●	—	—	—
11	Furnace Feed	100 – 300	150 – 320	80	5	4 – 10	100 – 250	—	—	—	—	●
12	Ring Valve	800 – 900	420 – 480	50	5	16 – 42	400 –1500	—	—	—	—	—

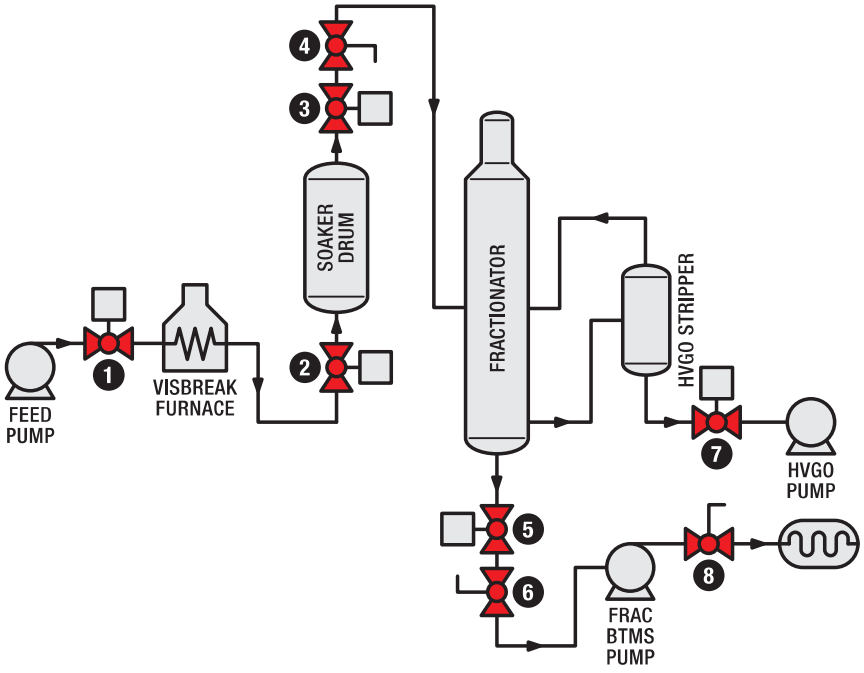
[1] MAX-Series valve line — Page 5

Visbreaking

The MOGAS C-Series valve, with its engineered trim configuration, gives 100 percent reliability during the visbreaking process which reduces downtime significantly over gate designs. In applications where heavy coking occurs, MOGAS offers an intermittent / continuous purge system to remove the coke build-up.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Coking service
- High cycle
- Erosive conditions
- Temperature cycling
- High pressure water service
- HP steam blowdown



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Feed Isolation	300 – 600	150 – 315	100 – 250	5 – 20	4 – 12	100 – 300	—	●	—	—	—
2	Visbreaker Furnace Isolation	600 – 800	315 – 430	100 – 250	5 – 20	4 – 12	100 – 300	—	●	—	—	—
3	Automated Soaker Drum Isolation	600 – 800	315 – 430	100 – 250	5 – 20	4 – 12	100 – 300	—	●	—	—	—
4	Manual Soaker Drum Isolation	600 – 800	315 – 430	100 – 250	5 – 20	4 – 12	100 – 300	—	●	—	—	—
5	Frac Tower Bottoms EBV	600 – 800	315 – 430	30 – 75	2 – 5	4 – 12	100 – 300	—	●	—	—	—
6	Frac Bottoms Pump Isolation	600 – 800	315 – 430	30 – 75	2 – 5	4 – 12	100 – 300	—	●	—	—	—
7	Heavy Vacuum Gas Oil Stripper EBV	600 – 800	315 – 430	30 – 75	2 – 5	4 – 12	100 – 300	●	—	—	—	—
8	Frac Tower Bottom Heat Exchanger Isolation	600 – 800	315 – 430	30 – 75	2 – 5	4 – 12	100 – 300	—	●	—	—	—

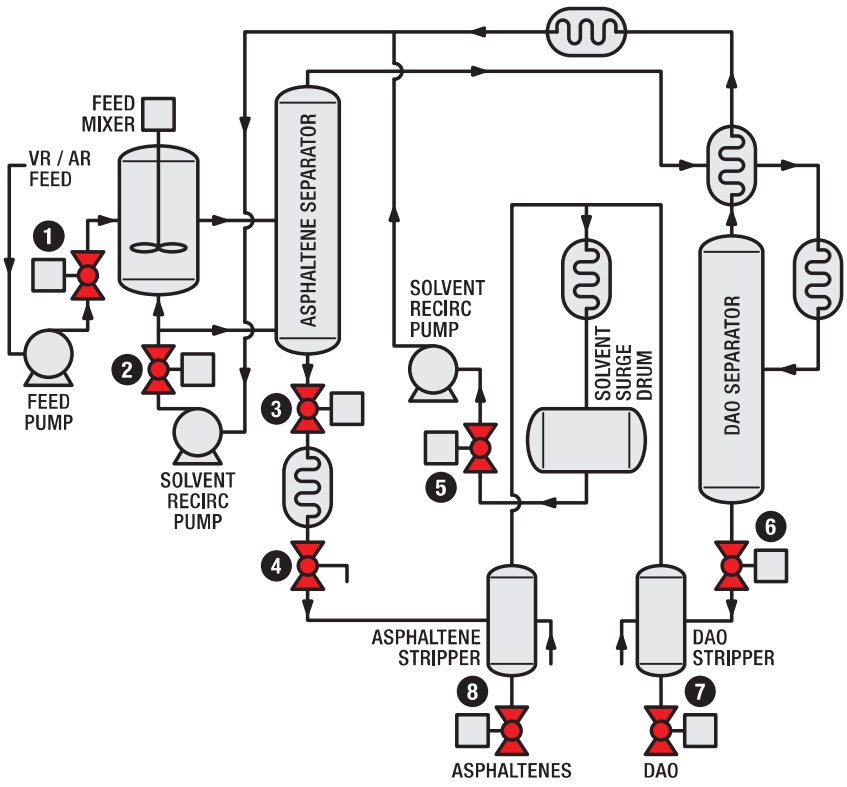
Deasphalting

Deasphalting is the process of removing asphalt, metals and sulphur from petroleum fractions. Removing asphaltenes prevents coke build-up on catalyst in downstream unit processing. It produces asphalt (asphaltenes, hard and soft resins) and deasphalted oil (DAO) as final products. This refining process can be considered a carbon rejection process, since asphaltenes that are removed have relatively low hydrogen-to-carbon (H:C) ratios. Since asphaltene yields increase as operating temperatures increase, deasphalting is a severe service that requires rugged valve designs and engineered coatings.

The MOGAS C-Series full-ported valve design can be used in all asphaltene and deasphalted oil services with 100 percent reliability. In applications where heavy asphaltene build-up occurs, MOGAS offers an intermittent / continuous purge system to remove the asphaltene.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Coking service
- Temperature cycling
- Erosive conditions



Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Feed Isolation	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	●	—	—	—	—
2	Solvent Circulating Pump Isolation	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	●	—	—	—	—
3	EBV for Asphaltene Separator	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	—	●	—	—	—
4	Asphaltine Exchanger Isolation	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	—	●	—	—	—
5	EBV for Solvent Surge Drum	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	●	—	—	—	—
6	EBV for Deasphalted Oil Separator	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	●	—	—	—	—
7	Asphaltine Stripper Isolation	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	●	—	—	—	—
8	Deasphalted Oil Stripper Isolation	500 – 900	260 – 480	400 – 900	25 – 60	4 – 16	100 – 400	—	●	—	—	—

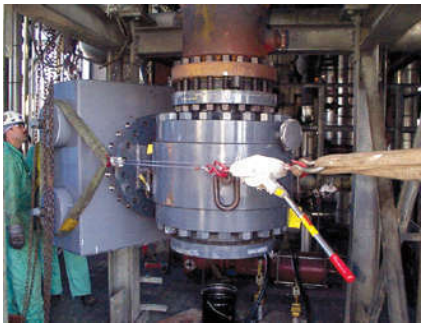
Gasification

MOGAS has worked with the leading licensor of the gasification process globally to develop trim and coating technology to increase the operational reliability of critical isolation valves.

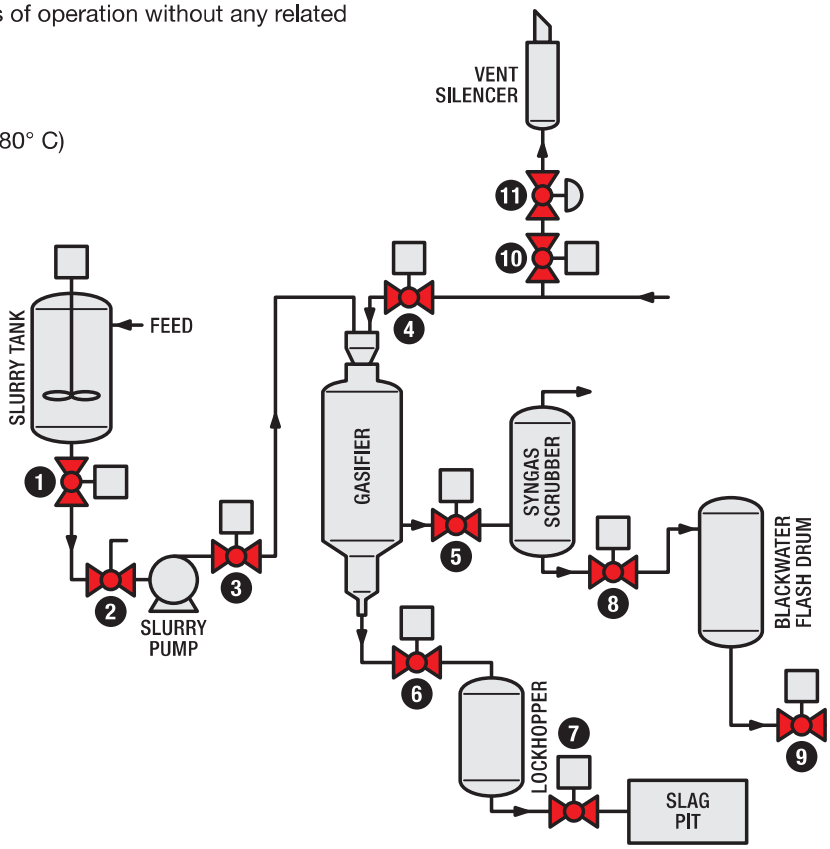
MOGAS' most recent achievement was to extend the lockhopper valve system for de-slagging operations. This achievement improved performance from six months to five years with over 50,000 cycles of operation without any related valve or actuator failures.

Typical operating conditions are:

- High temperature (500 – 900° F / 260 – 480° C)
- Fine & coarse slag service
- High cycle
- Erosive conditions
- Temperature cycling
- Flashing water service
- Chloride corrosion
- High pressure oxygen service



This 16-inch 600 ASME class valve was installed for 550° F at 1095 psig (290° C at 75 bar g) lockhopper isolation service. Several of these valves withstood over 50,000 cycles.

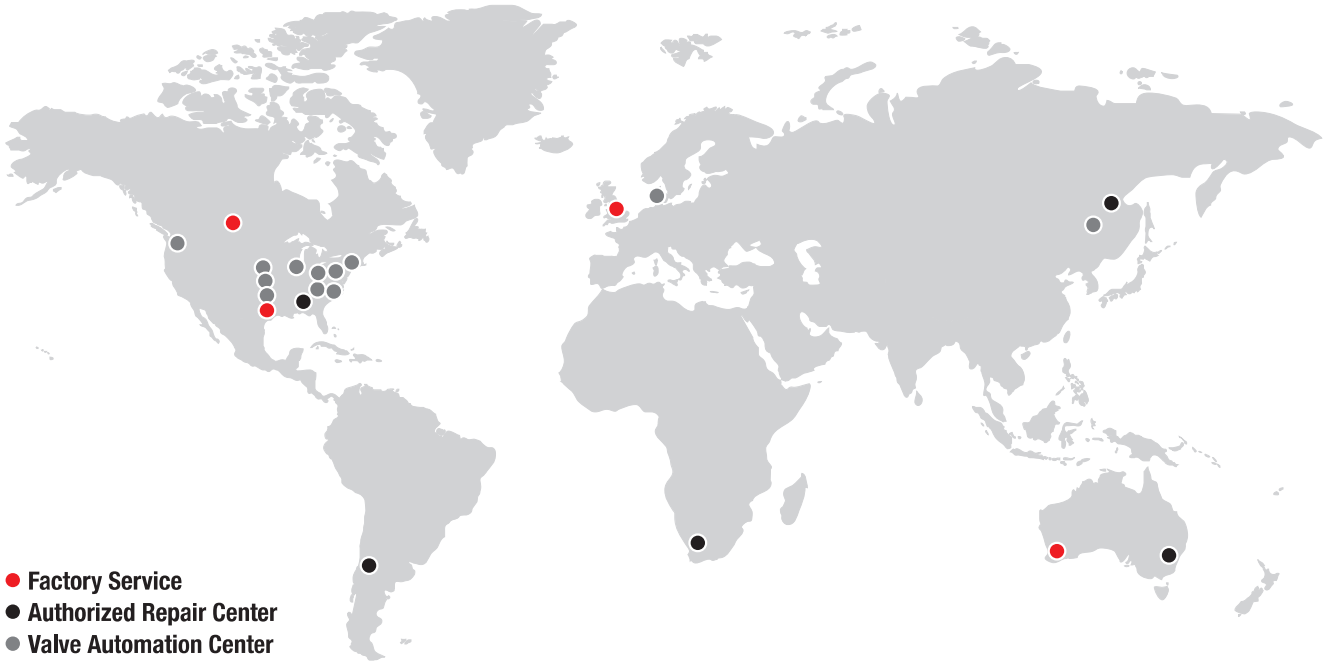


Valve Specification

Valve Number	Valve Description	Temperature Range		Pressure Range		Pipe Size		Recommended Model				
		deg F	deg C	psig	bar g	inches	dn	CA-1AS	CA-DRI	RSVP	RotaryTech	FlexStream
1	Slurry Tank EBU	500 – 900	260 – 480	100 – 200	5 – 15	6 – 10	150 – 250	—	●	—	—	—
2	Feed Slurry Pump Isolation	100 – 300	40 – 150	100 – 200	5 – 15	6 – 10	150 – 250	—	●	—	—	—
3	Gasifier Isolation	100 – 300	40 – 150	900 – 1200	60 – 85	6 – 10	150 – 250	—	●	—	—	—
4	Oxygen Feed Isolation	100 – 200	40 – 100	900 – 1200	60 – 85	4 – 8	100 – 200	●	—	—	—	—
5	Course Slag Lockhopper Isolation	150 – 650	60 – 350	900 – 1200	60 – 85	6 – 12	150 – 300	●	—	—	—	—
6	Lockhopper Drum Inlet	400 – 600	200 – 320	900 – 1200	60 – 85	12 – 24	300 – 600	●	—	—	—	—
7	Lockhopper Drum Outlet	400 – 600	200 – 320	900 – 1200	60 – 85	12 – 24	300 – 600	●	—	—	—	—
8	LCV Letdown Isolation	100 – 300	40 – 150	100 – 200	5 – 15	4 – 10	100 – 250	●	—	—	—	—
9	Blackwater Flash Drum Isolation	150 – 650	60 – 350	900 – 1200	60 – 85	4 – 10	100 – 250	●	—	—	—	—
10	Oxygen Depressurizing Valve	100 – 200	40 – 100	900 – 1200	60 – 85	4 – 8	100 – 200	●	—	—	—	—
11	Oxygen Depressurizing Isolation	100 – 200	40 – 100	900 – 1200	60 – 85	4 – 8	100 – 200	—	—	—	—	●

Service

Global Capabilities



As part of a repair, the MOGAS service technician checks the depth of the seat pocket to certify original design specifications are accurate.

Service Excellence in Action

When you select MOGAS products, service is a big part of what comes with them. The MOGAS commitment to service means more than basic repairs. It also means timely access to our knowledgeable and experienced team of experts—anytime, anywhere in the world. And when our team becomes part of your team, you can trust that we will do everything we can to come through for you.

When you have a problem, our technical advisors get to the root of it. They will look at your entire application to accurately identify and solve the issue. Using a comprehensive approach helps you improve equipment reliability and operational efficiency, as well as reduce costs. Our core services include:

Project Support

- Installation, startup and commissioning
- Shutdown planning and implementation
- Procurement and contract management

Preventive Maintenance

- Complete system inspection
- Routine maintenance, valve repacking
- Valve asset management

Repair, Refurbish & Customization

- 24-hour emergency response
- Troubleshooting
- Valve performance analysis
- 3D finite analysis
- High pressure testing
- Online repair documentation

Asset Management Plan

Optimize Your Investment

Getting more **value** for every dollar is now more important than ever. To help **minimize your total cost of ownership** while truly benefiting from predictive maintenance, MOGAS offers the **MORE™ Asset Management Plan**—a totally customizable valve purchase and service plan. Whether you buy a few valves or several hundred valves, you can choose from a variety of options to help optimize your investment.

On-site Services
- Start-up and commissioning assistance
- Field support and troubleshooting
- Quarterly walkdowns
- Major shutdown planning

Managed Inventories
- Revolving consignment inventory (located and managed at MOGAS facility)
- On-site inventory (for emergency use)

Walkdown Evaluations
- On-site inspection of installed valves
- Customized reports

Valve Management Program (Online)
- Initial setup, input, links to P&ID and maintenance reports
- Repair history
- Performance analysis reports
- Incident reports
- Valve repair cost
- Valve torques
- Revised bills of material
- Revised drawings
- Predictive / preventive maintenance recommendations

Certified Training
- Lunch-n-learns
- Valve installation & operation (hands-on)
- Maintenance & troubleshooting

Get **MORE**™...with **MOGAS**®

MANAGING OPERATION & REPAIR EXPENSES

- *Improved Safety*
- *Enhanced Reliability*
- *Predictive Maintenance*
- *Anticipated Budget*
- *Less Downtime*
- *Value Pricing*

Major Customers

Partial Listing

End Users

Atofina
BP
ExxonMobil
Caltex
Chevron
Citgo
ConocoPhillips
ENI
CPC
Flint Hills
Frontier Refining
Gazprom
Giant
Husky
KNPC
Lion Oil
Lukoil
Lyondell – Citgo
Marathon
MOL
Motiva
Mozyr
Murphy Oil
Navajo Refining
Neste Oil
OMV
Opti Canada
Pasadena Refining
PDVSA
Pemex
Petro-Canada
Petrobras
Premcor
PRSI
Repsol YPF
Sasol
Shell
Shenhua
Sinopec
Suncor
Sunoco
Syncrude
TOTAL
TNK – BP
Valero
Western Refining

Licensors

Axens
CBI Lummus
Chevron
Chevron Lummus Global
ConocoPhillips
EMRE
Foster Wheeler
GE
Haldor Topsoe
Headwaters
KBC Advanced Technologies
KBR
Lurgi
Rentech
Shell
Siemens
Sinopec Engineering Inc.
UOP

Engineering & Consulting Firms

ABB
Aker Kvaerner
Bechtel
CBI Lummus
Fluor
Foster Wheeler
Jacobs
JGC
KBR
LG Engineering
Lurgi
Mitsubishi
Mustang
SEI
Shaw
Snamprogetti
SNC Lavalin
Technip
Toyo
Wood Group

Abbreviations & Acronyms

Refining Industry

AC	Absorbent chamber
AGO	Atmospheric gas oil
API	American Petroleum Institute
AR	Atmospheric residue
ARU	Amine recovery unit
ASME	American Society of Mechanical Engineers
ASO	Acid soluble oils
ASTM	American Society for Testing and Materials
BOC	Black oil conversion
BPD	Barrels per day
BPSD	Barrels per stream day
BTMS	Bottoms
BTX	Benzene, toluene, xylene
BV	Block valve
B/D	Barrels per day
B/SD	Barrels per stream day
CCR	Conradson carbon residue
CCR	Continuous catalyst regeneration
CFD	Cold flash drum
CGO	Coker gas oil
CHPS	Cold-high-pressure separator
CO	Carbon monoxide
COD	Chemical oxygen demand
CS	Carbon steel
CV	Control valve
CW	Cooling water
DAO	Deasphalted oil
DCC	Deep catalytic cracking
DEA	Diethanol amine
DMB	Dimethylbutane
DMO	Demetallized oil
EBV	Emergency block valve
EC	Extraction column
EIV	Emergency isolation valve
EPA	(U.S.) Environmental Protection Agency
EOR	End of run
ESD	Emergency shutdown
FC	Fail closed on air failure
FCC	Fluidized catalytic cracking
FCV	Cv for flow control loop
FO	Fail open on air failure
GO	Gas oil
H_2S	Hydrogen sulfide
H_2SO_4	Sulfuric acid
HC	Hand controlled
HCGO	Heavy coker gas oil
HCO	Heavy cycle oil
HCU	Hydrocracking unit
HDM	Hydrodemetallization
HDS	Hydrodesulfurization
HF	Hydrofluoric acid
HFD	Hot flash drum
HHPS	Hot-high-pressure separator
HIPS	Hot-intermediate-pressure separator
HIPPS	High integrity pressure protection system
HSFO	Heavy sulfur fuel oil
HSRN	Heavy straight run naphtha
HVGO	Heavy vacuum gas oil
LAB	Linear alkylbenzene
LCO	Light cycle oil
LCGO	Light coker gas oil
LCV	Cv for level control loop
LPG	Liquid petroleum gas
LSFO	Low sulfur fuel oil
LSRN	Light straight run naphtha
LVGO	Light vacuum gas oil
MCP	Methylcyclopentane
MDEA	Methyl diethanol amine
MEA	Diethanol amine
MOGAS	Motor gasoline
MON	Motor octane number
MOV	Motor operated valve
MP	Methylpentane
MSS	Manufacturers Standardization Society
MTBE	Methyl tertiary butyl ether
NH_3	Ammonia
NPSH	Net positive suction head
PCV	Cv for pressure control loop
RC	Raffinate column
RCD	Reduced crude desulfurization
RCR	Ramsbottom carbon residue
RFCC	Residual fluidized catalytic cracking
RFG	Reformulated gasoline
RGC	Recycled gas compressor
RON	Research octane number
RVP	Reid vapor pressure (gas)
SDA	Solvent deasphalting
SOR	Start of run
SP	Specialty item
SRU	Sulfur recovery unit
SWS	Sour water stripping
TAA	Tertiary amyl alcohol
TAEE	Tertiary amyl ethyl ether
TBA	Tertiary butyl alcohol
TCV	Cv for temperature control loop
VGO	Vacuum gas oil
VOC	Volatile organic compounds
VR	Vacuum residue

Severe Service

The MOGAS Definition

- Extreme temperatures
- High pressures
- Abrasive particulates
- Acidic products
- Heavy solids build-up
- Critical plant safety
- Large pressure differentials
- Velocity control
- Noise control

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SEVERE SERVICE BALL VALVES