Valves for Refining Applications

Engineered Solutions for the Refining Industry

MOGAS®

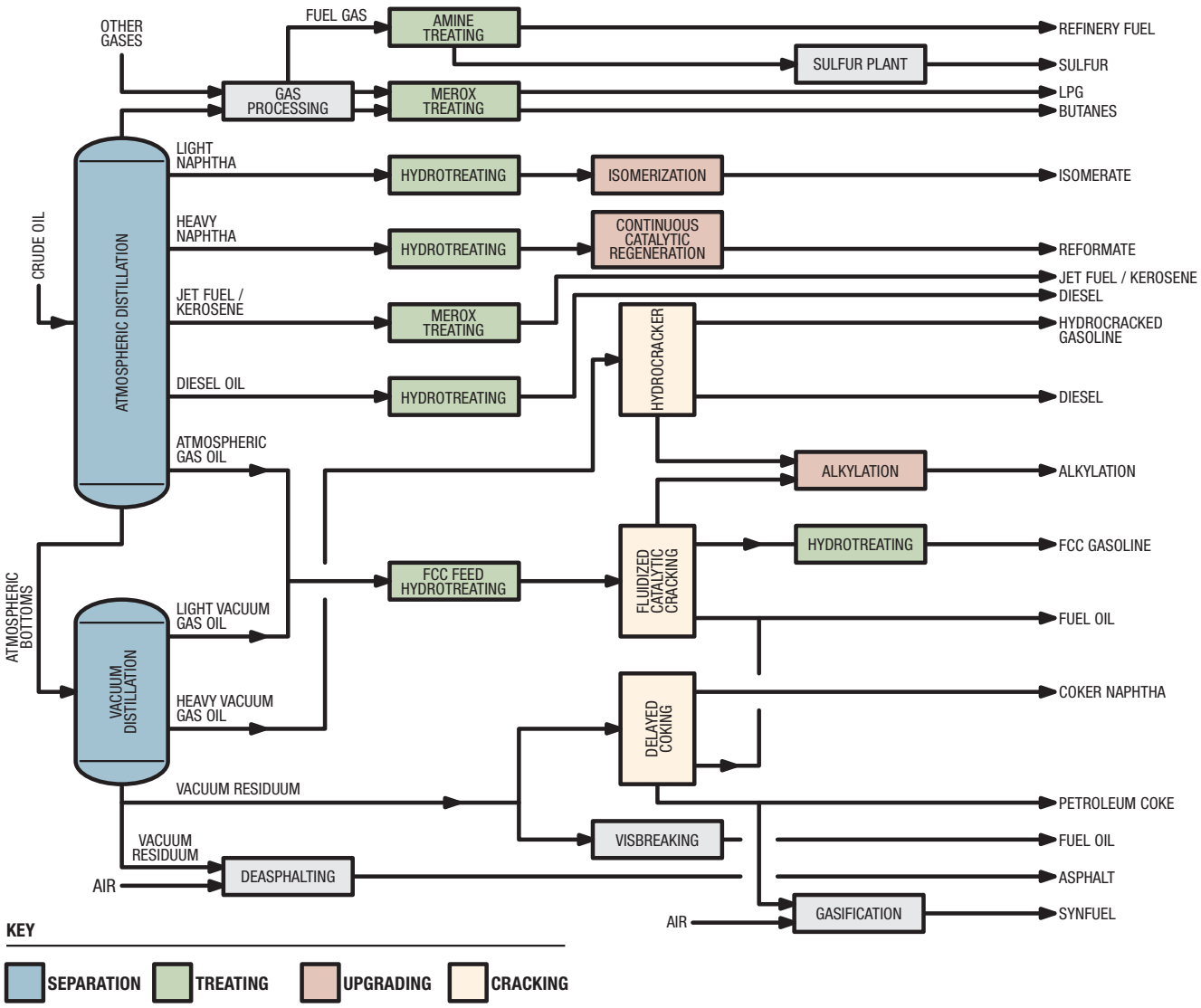
MOGAS severe service ball valves have proven successful in these processes and more:

- *Atmospheric Distillation*
- *Vacuum Distillation*
- *Continuous Catalytic Reforming (CCR)*
- *Visbreaking*
- *Fluidized Catalytic Cracking (FCC)*
- *Fixed Bed Hydrotreating*
- *Fixed Bed Hydrocracking*
- *Ebullated Bed Hydrocracking*
- *Delayed Coking*
- *Gasification*
- *Deasphalting*

MOGAS — Your Partner in the Process

Proven Reliability. Engineering Expertise. Dependable Service.

The refining industry has undergone many changes, from processing methods to the duration they operate. 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, have put an extreme demand on isolation and control valves. 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.



Valves for Refining Applications

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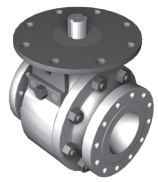
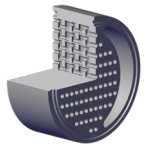
	Key Features	Size (in)	Pressure	Body Materials	Max Temp.
	**C-Series** Customizable Isolation Valves • engineered specifically for customer application • cast or forged; 2- or 3-piece designs • blowout-proof stem	1/2 to 42 (13 to 1066 dn)	150 to 4500	Application specific	1652° F (900° C)
	**CA-HO1** Heavy Oil Valves • engineered specifically for heavy oil applications • 2-piece forged body • blowout-proof stem	1 to 3 (25 to 75 dn)	900 to 4500	300 Series, Carbon Steel, Chrome Molybdenum	1100° F (593° C)
	**T-Series** Trunnion Valves • Reduced torque; smaller actuator • bi-directional sealing • metal- or soft-seated • 2- or 3-piece forged body, or cast body • API 6D or ASME B16.34	3 to 60 (75 to 1500 dn)	150 to 2500	A105 A182-F316 A182-F51 B564 Gr N06600	400° F (204° C)
	**ISOLATOR 2.0™** Low Pressure Isolation Valves • full bore • 2-piece forged body • metal-seated • bi-directional • blowout-proof stem	1 to 12 (25 to 305 dn)	150 to 600	F9 F53 A105 17-4 Ti Gr 12	850° F (454° C)
				F316	1000° F (537° C)
	**RSVP / iRSVP** Vent and Drain Valves • uni-directional sealing • forged uni-body; integrated vented body • mechanical precision stop • rigid mounting bracket	1/2 to 4 (13 to 100 dn)	150 to 4500	A105 F22 F91 F92	1100° F (593° C)
	**G-Series** Drain and Vent Valves • in-line repairable • uni-directional • metal/graphite laminated seats • 3-piece forged body	1 to 3 (25 to 75 dn)	150 to 600	A105	800° F (426° C)
				316SS F22	900° F (482° C)
	**DV-4** Coker Switching Valve • patented bonnet reduces coke build up • oversized outlet • purge and drain flush • reliable seat springs	6 to 16 (150 to 400)	600 to 900	A217-C12 A217-C12A A351-CF8M A182-F9 A182-F91 A182-F316	1000° F (538° C)
	**FlexStream™** Control Technology • velocity control • variable characterization • high rangeability • precision modulation	1 to 42 (25 to 1066 dn)	300 to 4500	300 Series, Carbon Steel, Chrome Molybdenum	1100° F (593° C)

Design Flexibility

C-Series Valve Adapts to Applications

Common Features for the MOGAS C-Series Valve Line

1 Floating ball design
- Rotating ball does not displace volume or solids
- Straight-through bore path protects sealing surfaces

2 Pressure-energized sealing
- Seat springs maintain constant sealing contact between ball and seats
- Allows for thermal expansion of trim
- Metal seats wipe sealing surface of ball clean during operation

3 Wide seat sealing surface
- SphereSeal℠ lapping process on ball and seat set provides 100% sealing contact through the full transition between the open and closed position
- Greater sealing contact area withstands minor scratches or abrasions

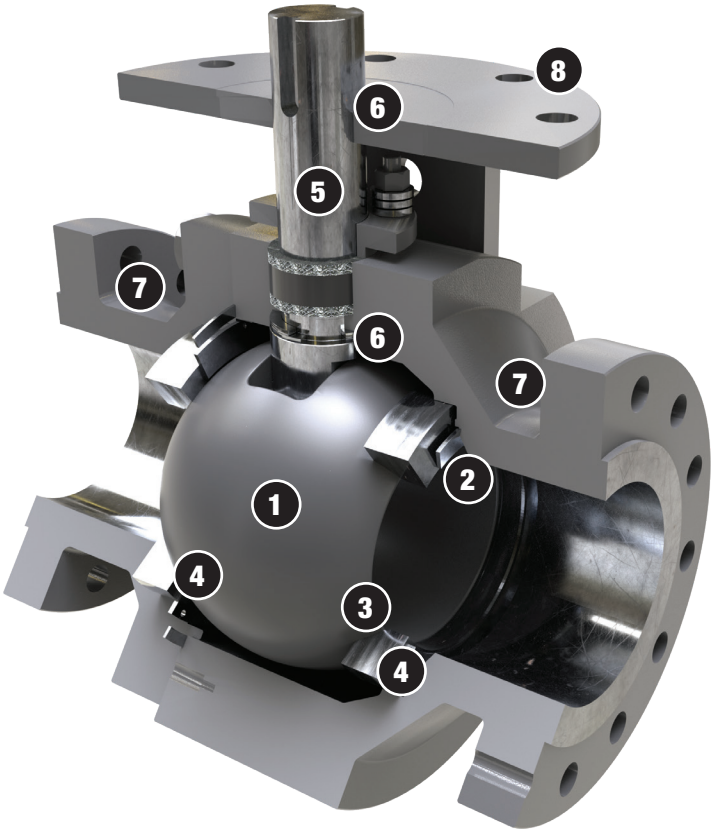
4 Independent replaceable seats
- Minimizes maintenance and repair costs

5 Blowout-proof stem design
- One piece design meets industry safety standards
- Withstands severe service torques and maximum working pressures

6 Dual-guided stem design
- Pressure-energized inner stem seals serve as thrust bearing and lower stem guide
- Valve stem bushing serves as upper stem guide
- Eliminates lateral movement of valve stem
- Prevents media migration
- Prevents stem packing leaks and risk of fugitive emissions

7 Body & end connections
- Greater wall thickness in critical areas provides longer valve life
- Cast or forged; 2- or 3-piece designs

8 Heavy-duty mounting flange
- Machined after attaching to ensure precise stem alignment
- Provides structural support for operator mounting
- Provides visual inspection for confirmation of ball position



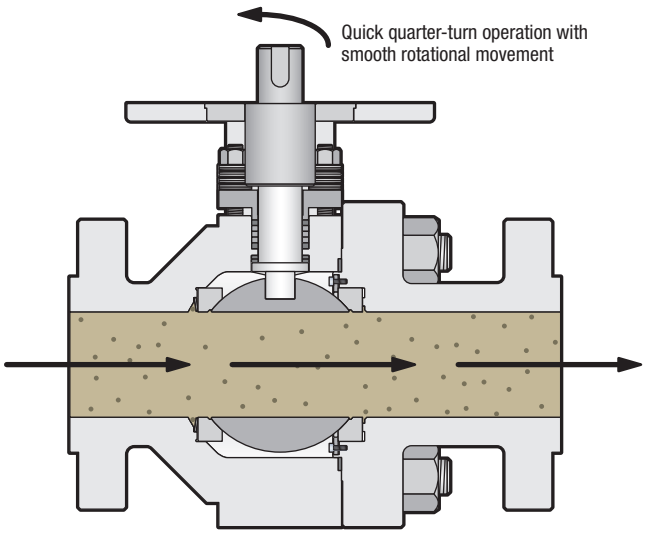
Application Specific Options

Seat designs	Engineered for maximum performance in application-specific conditions
Live-loaded packing	Ensures constant packing energization
	Prevents stem packing leaks and risk of fugitive emissions
Body Gaskets	Pressure energized body gasket available to meet industry codes
Materials	Application-specific materials available, including exotics
	Extends valve life
Coatings	Application-specific coatings provide enhanced erosion and corrosion resistance
Liners and inlays	Liners and inlays can be applied to the through-bore or wetted surfaces
Purge ports	Purge ports are available
End connections	Available end connections include flanged, welded, hub/clamp or RTJ

Ball Valve Advantages

Compared to Gate and Globe Valves

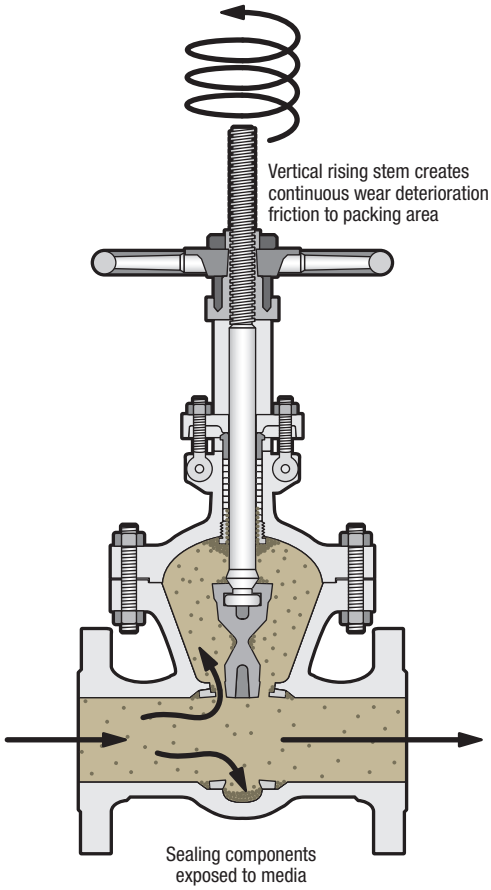
When it comes to valve types, there are distinctive differences in design, intent and purpose. Whether a valve has rotary operation or linear action is a critical part of the **longevity** and **performance** of the valve in severe services. Exposed sealing mechanisms versus protected sealing surfaces can make a big difference. Commodity valves manufactured for clean environments at ambient or low temperatures are simply not engineered to withstand the strenuous demands of extreme operating conditions.

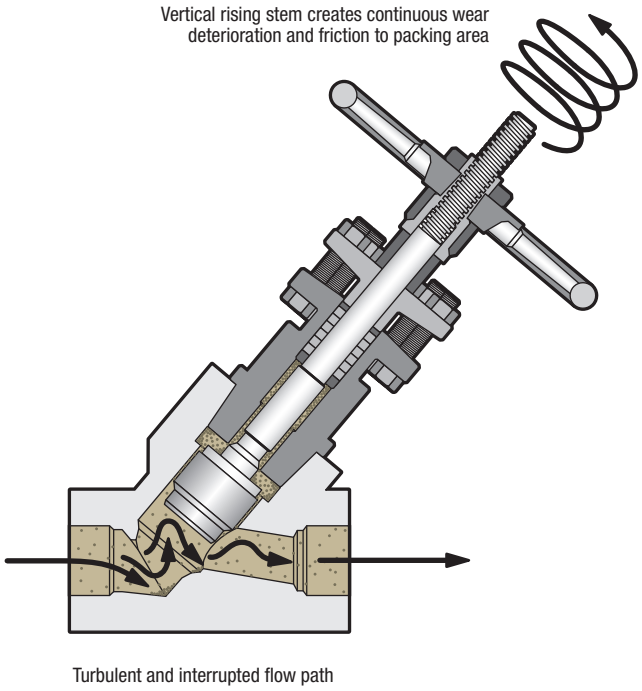


Straight-through bore path

Serious industrial processes require serious valve choices. Understanding the fundamental differences in valve types can assist with those important decisions.

Ball Valve Advantages
Recessed seats are protected from continual exposure to the process flow
Ball is wiped clean with each operation of the valve
Rotates on own axis, thus no volumetric displacement
Packing area is protected from potential media erosion, maintaining integrity of stem seal area while reducing risk of fugitive emissions
Non-rising stem design meets EPA VOC packing leakage standards for greater number of cycles
Pressure-assisted sealing





Gate Valve Disadvantages

Sealing components in the line of flow lead to potential wear and corrosion attack
Geometry of the exposed sealing surface wears and loses the ability to hold tight seal
When operated, flow path is interrupted causing volumetric displacement of the process fluid which must occur from behind the plug back into the flowstream
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
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
Relies on vertical thrust by the stem to drive the sealing plug into the seat

Globe Valve Disadvantages

Damage to sealing surfaces due to exposure of the seats when the valve is open
Sealing trough / rib erodes over time and can capture flow particles
When operated, flow path is interrupted causing volumetric displacement of the process fluid which must occur from behind the plug back into the flowstream
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
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
Torque seated to activate seal — thermal cycling relaxes stem

Application Guide

Industry Expertise

Distillation — Atmospheric and Vacuum

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.

In 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 source of the fire.

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.

Continuous Catalytic Reforming (CCR)

The CCR process is primarily used in the refinery to improve the research octane number 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 used in other parts of the refinery.

The leading licensor of this process has over 600 units installed globally, and has specified MOGAS isolation valves in its Schedule A specifications. 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 fires caused by hydrogen leakage within the process operating unit.

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.

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 and continuous purge system to remove the coke build-up.

Application Guide

Industry Expertise

Fluidized Catalytic Cracking (FCC)

The 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.

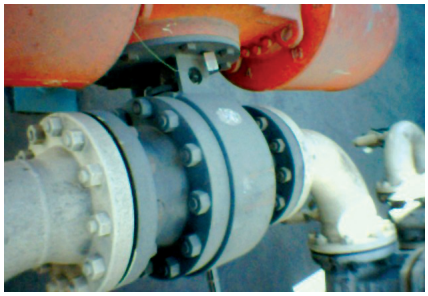
MOGAS has developed valve designs to handle the powdery ultra high temperature catalyst fines present during the removal process from the regenerator. In some cases the catalyst is carried over into the fractionator and is very erosive to gates and globe style valves. MOGAS' full-ported ball valves with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

This CA-DRI 8-inch ASME 300 class valve handles catalyst at 1425° F (774° C). It is the major isolation valve between the third stage and fourth stage cyclone separator.

Fixed Bed Hydrotreating

High pressures and temperatures are required to break the sulfur and nitrogen molecular bonds that 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.



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

Fixed Bed Hydrocracking

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.

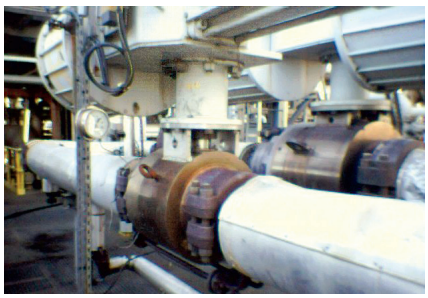
MOGAS has worked with several licensors of fixed-bed hydrocracking process technology to improve the performance of isolation applications in an attempt to make the overall process unit more reliable and safer to operate for the 600 to 700 operating process units throughout the world.

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

Ebullated Bed Hydrocracking

MOGAS valves operate in 100 percent of the ebullated bed hydrocracking units throughout the world, and 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.

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



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

Delayed Coking

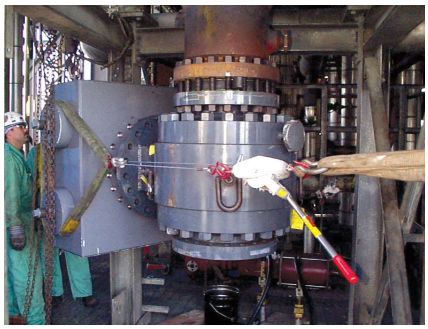
The coking batch process requires frequent use of isolation valves during the coke drum switching operation. It is very important for the isolation of the coke drum to be stripped, cooled and decoked. These valves are the safety isolation devices that allow personnel to safely unhead a cooled drum while another drum is 'live'. If the valves do not positively isolate the coker drum, product could leak into an off-line drum causing a safety hazard to the personnel.

The valves isolating the feed heaters are also critical to operation when it becomes necessary to de-coke a heater. If the valves do not isolate, the unit will be shutdown.

MOGAS ball valve designs provide trouble-free operation in this heavy coking application. Over the decades of working in partnership with end users, technology licensors and EPCs, MOGAS has become a solutions provider, not just a valve manufacturer. Many of our design advancements are the direct result of creating and customizing a solution that specifically addresses customer's unique process or problem. For example, MOGAS valves with purge require much less steam than competitive designs, saving thousands of dollars annually in energy costs.

Also, MOGAS engineers work directly with the Service department to do failure analysis, so they can continuously improve their valves to perform in even more harsh environments.

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



This 16-inch ASME Class 600 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.

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.

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.

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.

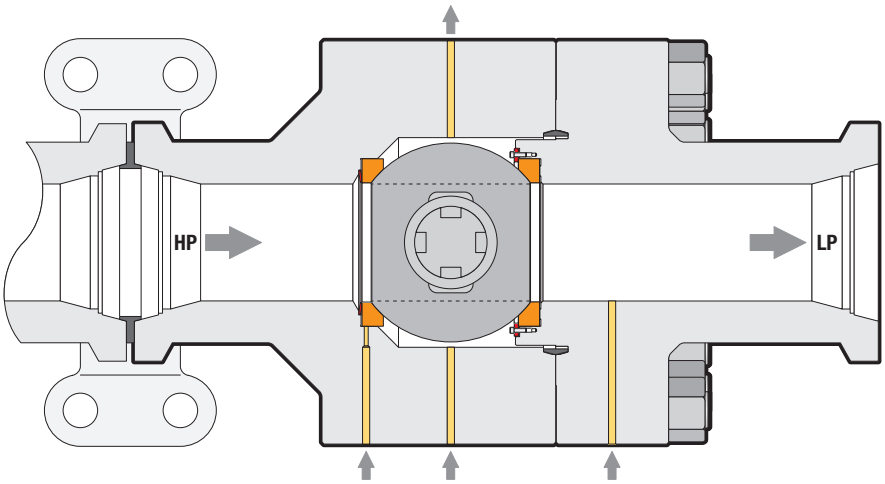
The MOGAS C-Series full-ported valve design can be used in all asphaltene and deasphalted oil services with 100 percent reliability. In applications where heavy asphaltene build-up occurs, MOGAS offers an intermittent and continuous purge system to remove the asphaltene.

Purge System

Alleviates Coke Build-up

Purging has been demonstrated to be effective in numerous field applications at minimizing the ill effects of coke formation. MOGAS highly recommends and offers purge systems designed specifically for valves in high-fouling applications to maximize the valve's operating service life.

MOGAS purge solutions have worked so reliably that some companies have incorporated it into their best practices design manual.



Purge locations shown are for illustration purposes only; actual purge locations will be determined based on application-specific data.

Purge Benefits

- Reduces operating torques from start of run to end of run 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

Industry Codes & Standards

The following partial list of industry codes and standards are referenced in the manufacturing of MOGAS valves: API, ASTM, ATEX, CRN, DIN, FCI, GOST-R, ISA, ISO, NACE, NBBI, PED, SIL, TUV.

For a complete list, download our Design Conformance Standards from our Media Centre at www.mogas.com

ISO 9001 REGISTERED
UKAS MANAGEMENT SYSTEMS 0060
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
B31.3	Chemical Plant and Petroleum Refining Piping
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
6D	Specification for Pipeline Valves
641	Type Testing of Quarter-turn Valves for Fugitive Emissions

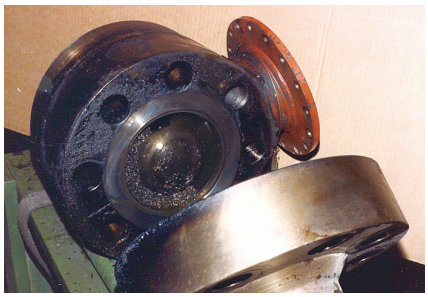
NACE	Title
MR-0103	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments

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

Service

Global Capabilities

We provide exceptional service for unique locations—everyday, everywhere.



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.

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 dedicated 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

- *Technical Assistance*
- *Dependable Operation*
- *Preventive Maintenance*
- *Data Collection*
- *Proactive Communications*
- *Value Pricing*

Confidence for Tomorrow

A Warranty is Not a Performance Guarantee

CONFIDENCE

PREDICTABILITY

RISK FREE DECISIONS

IMPROVED SAFETY

ENHANCED RELIABILITY

LESS DOWNTIME

ANTICIPATED BUDGETS

Only from MOGAS

Continuous years of research and development, design innovation, advanced manufacturing techniques and field experience allow us to offer an application-specific PERFORMANCE GUARANTEE on our isolation and control valves…plus a lifetime warranty on materials and workmanship.

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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For other MOGAS locations or a distributor in your area, visit us online at www.mogas.com