

SchuF  **FETTEROLF**

The SchuF Valve Range for Delayed Coker Systems



SchuF is a highly specialised group of companies, whose expertise is the design and manufacture of process control valves for critical service applications.

Patented Innovation

SchuF is the inventor of the Lift Plug Valve. The patent dates back to 1914. Since its invention SchuF has continued to develop the valve, with many innovations. These include the addition of electric, hydraulic and pneumatic operators, and new applications such as switching and dumping variants. It also pioneered the inverted plug design, which can be serviced in line; designed flushing systems; and several high pressure and high vacuum versions. SchuF's special high temperature valve range can be used in operating conditions to 1000° C.

Feature Rich

SchuF valves offer unique flexibility:

- the valve can be automatically actuated either using a SchuF **Lift-Turn-(re)Seat (LTS)** operator or using two separate actuators for maximum reliability on larger sizes
- the plugs can be straightway or inverted for better flushing or ease of maintenance
- the plug can be solid or lightweight
- full or reduced bore, pig-able round or space saving oval
- the valves can be supplied with standard or oversized flushing connections
- the body of the switching valve can have its three outlets at 120° to each other or be in a T configuration
- the Automated Control Panel can automate the process system including the switching valve and all the on/off isolation valves associated with a two or three drum delayed coking installation
- trunnion spindle guiding can be used for high pressure applications or to prevent vibration damage

Rugged Simplicity

The valve essentially consists of only two parts, the body and the plug. There are no sealing rings, bellows or gaskets. There is little to break, fail, or clog.

Material Choice

SchuF's strengths include flexibility of design and construction. We have produced Lift Plug valves in all stainless steels, high Nickel alloys, Titanium and Zirconium, with many different coatings including full stellite and gold plating. SchuF uses special surface coatings and trunnion spindle guiding to improve resistance against vibration and erosion. SchuF also offers solid Tungsten Carbide and ceramic trims. For Coking Services the valve plug is usually in A217 C12, and the body can be in A217 WC6 or C12. Other materials are available on request.



Reliable Operation

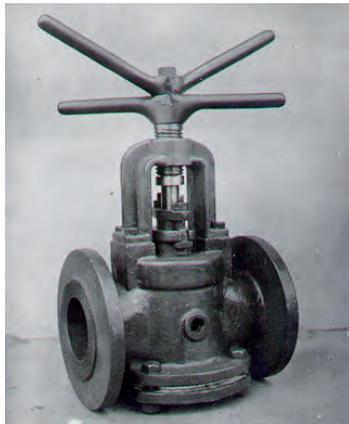
Most lift plug valves come equipped with manual or electric actuators. SchuF can also fit the valves with pneumatic or hydraulic systems. The SchuF lift-turn-(re)seat (**LTS**) operator converts simple rotation to lift, turn and reseat the plug.

Industry Experience

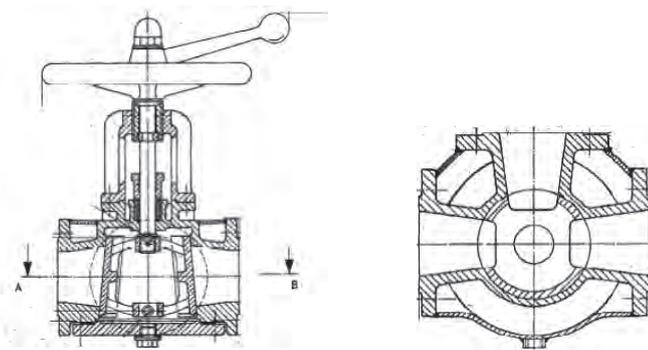
SchuF valves can be found in a wide cross section of industry and process applications. The ability of our engineers to adapt the SchuF valve to almost any critical or severe condition is well established in the Hydrocarbon, Cement, Alumina, Power and Chemical Industries.

The Original Lift Plug Valve

The original invention features an upside down plug with a removable lid at the bottom. The inverted plug consists of curved plates cast as a single plug and connections to allow cleaning and declogging of the spaces in, above and below the plug whilst the valve is in service. This first valve already satisfied all requirements for an effective double block & bleed.



The "original" Lift Plug Valve – 14NR



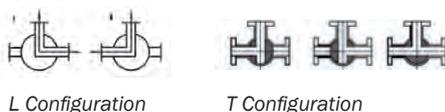
The 2 Way Type 12NR

This two way valve features standard lengths to API and DIN. The bore section is oval, but the cross-sectional area matches that of a full bore.

The plug can be cast or solid with machined purge lines, allowing top to bottom purging.

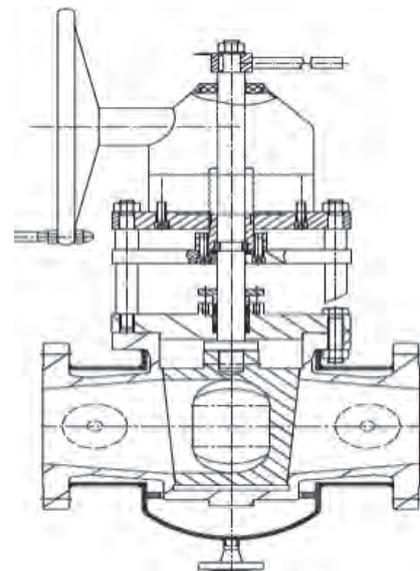
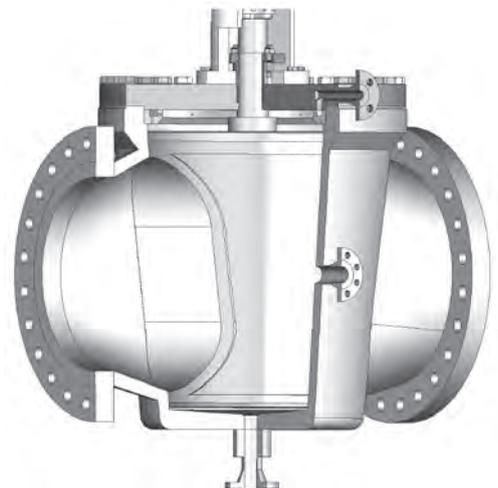
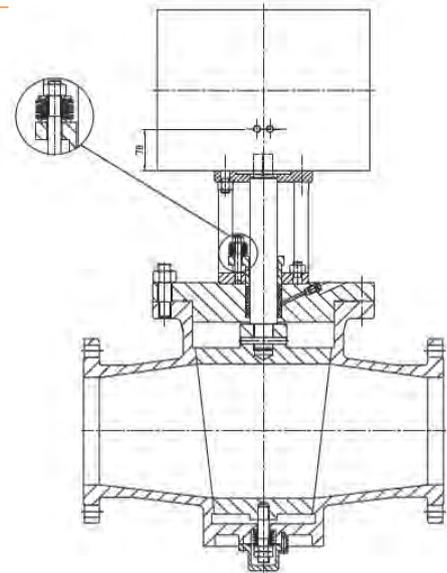
The 3 Way Type 12DR

The 12DR valve is a three way valve with a straight way plug and can be designed in either a T or an L configuration. It is shown opposite with an optional heating jacket.



L Configuration

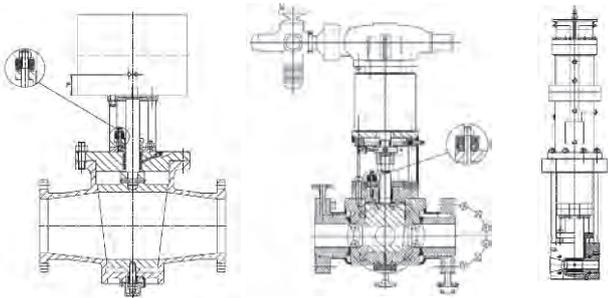
T Configuration



Actuation Procedure

SchuF Valves can be actuated electrically, pneumatically or hydraulically. The SchuF LTS lift/turn/ (re)seat operation allows a single rotational actuator to lift, turn and reseat the plug. Two actuators can also be used; one to lift and lower, and one to turn.

Special plug plating or the use of dissimilar metals can be applied to allow turning of the plug without lifting or reseating it.



Pneumatic Actuator,
Special Plate (no lift)

Electric
Motor LTS

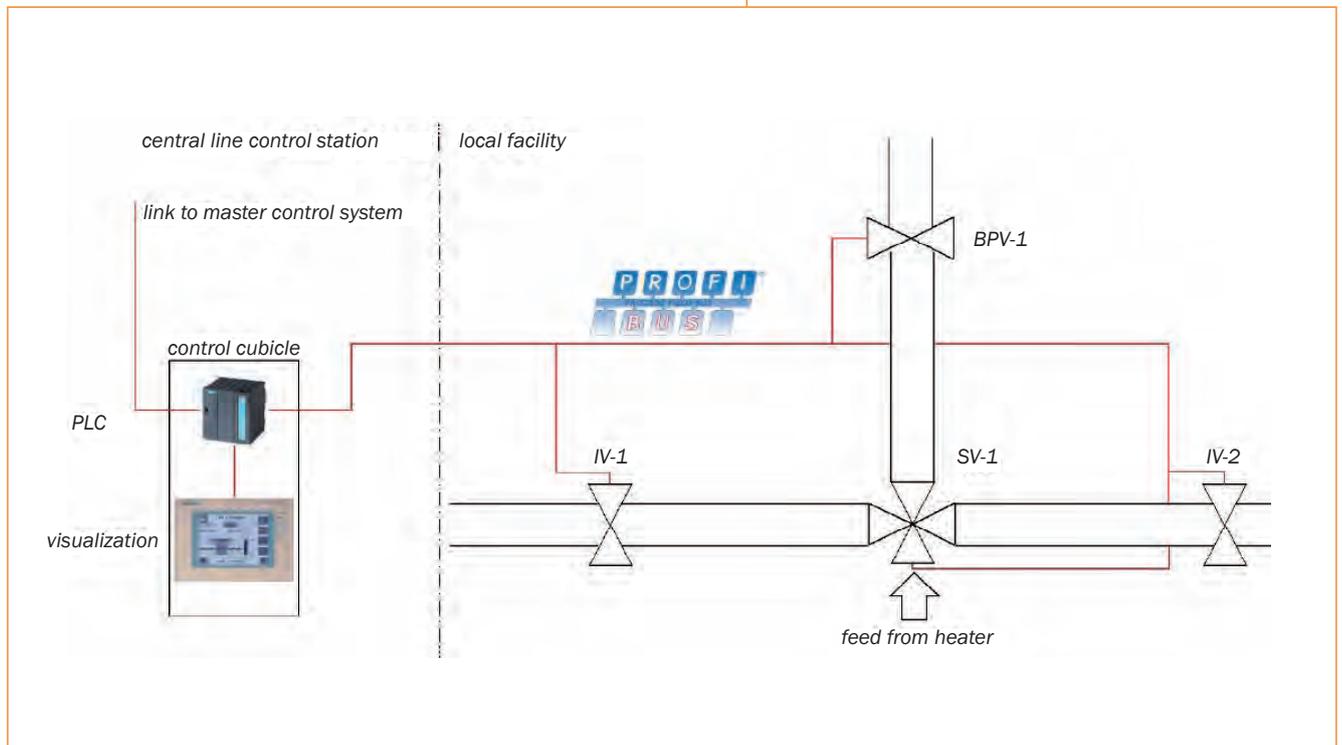
Hydraulic lift,
Hydraulic turn

Automated Control Panel

SchuF delivers an Automated Control Panel (ACP) consisting of programmable logic controllers and peripheral instrumentation. The control panel actuates the valves, whether they have one or two motors, and ensures the proper sequencing, for example, that the correct inlet isolation valve is opened before operating the switching valve. If required the control panel can be designed to control the total process including for example steam sensors (to ensure that equipment does not coke up if there is insufficient steam).

It can be placed in the field (explosion proof, weather proof) or in the control room. Suitable position indicators can be fitted to the valves to allow the panel to feedback all valve positions to the control room.

The automated control panel can also be integrated with your own or any commercially available DCS software.



Delayed Coking Systems Overview

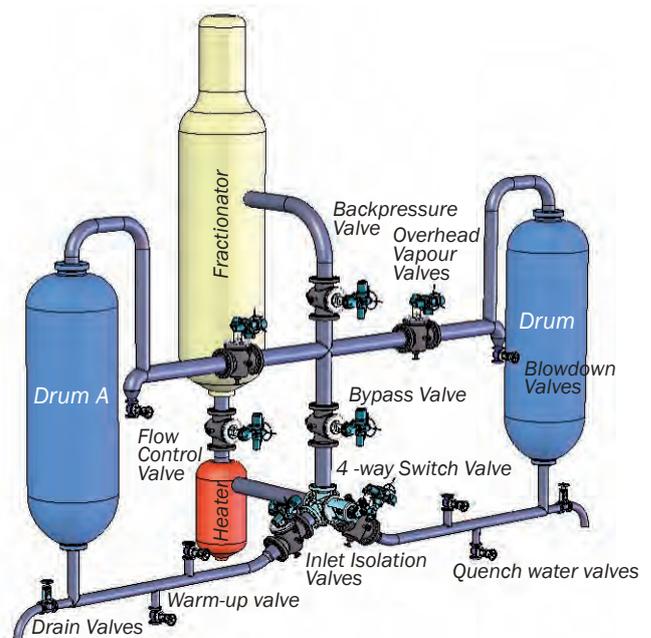
Delayed Coking is one of the most hostile environments in the refinery with process temperatures of 1000° F and which outputs a very abrasive and erosive coke by-product. As a result valves are cycled more frequently than in other parts of the refinery and failure can lead to complete shut down of a unit. This can lead to large process and financial cost.

Delayed coking is a semi-continuous thermal cracking process. After being heated in a coke furnace the coke feed (a liquid-vapour combination) is fed into and separated in a coke drum. Delayed cokers are designed as pairs (or three) of drums so that one drum can be cleaned while the other remains in operation. General process steps are outlined below:



Delayed Coking Process Steps

- heat residue to about 930° F in coker furnace
- transfer the hot residue to coke drum before it has formed coke
- fill the drum and allow the tars to coke
- switch the drums on timed cycle (12 to 24 hours)
- decoke the full drum hydraulically
- recover the cut, crush and prepare for shipment
- recycle water to eliminate waste
- fractionate cracked products into gas, coker naphtha, light coker gasoil and heavy coker gasoil
- further process fractionated products in downstream units



*Pump and pump isolation valve are not shown

SchuF supplies a four or a five way switch valve as well as isolation, overhead and blow down valves as lift-plugs. Drain, warm up and quench water valves can be supplied as lift plugs or as piston valves with integrated T-pieces where desired.

SchuF Valve Portfolio for Delayed Coking

SchuF SwitchPlug Valves

The Switching Valve is the heart of the delayed coker process. The SchuF **SwitchPlug** Valves illustrated on this page are ideally suited as switching valves in delayed coker systems.

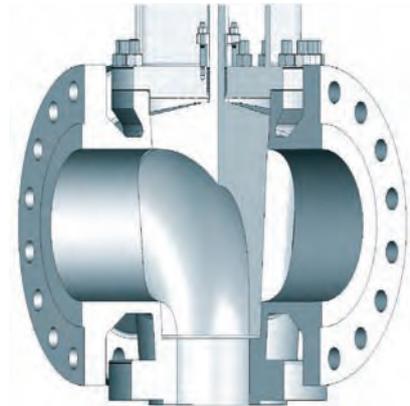
A four way switching valve is typically required to allow coke feed into whichever coke drum is active. During start up, shut down or an emergency the valve can also bypass both drums. If three drums are used, SchuF can supply a single valve with four outlets.

SchuF switching valves offer great flexibility:

- the plug can be straight up or inverted
- the actuation can be electric with two motors or with one motor and the SchuF LTS operator
- the flush and purge connections can be oversized.

The normal body configuration is 3 outlets at 120°, though a T configuration with two 90° and one 180° angle is available. When four outlets are required they are all at 90° to each other.

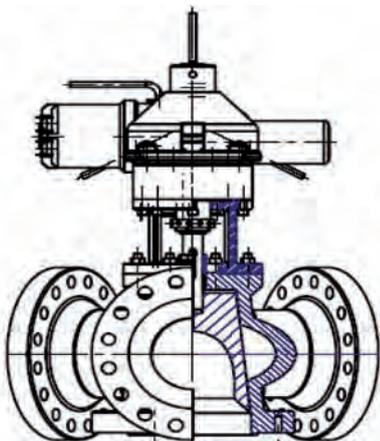
The valves come in sizes that range from 10" to 24" ANSI 600#, with the plug in WCB carbon steel or A217 C12, and the body in WCB carbon steel or A217 WC6, WC12 or C12A.



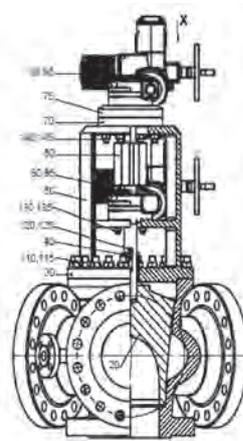
Valve Type 14S*



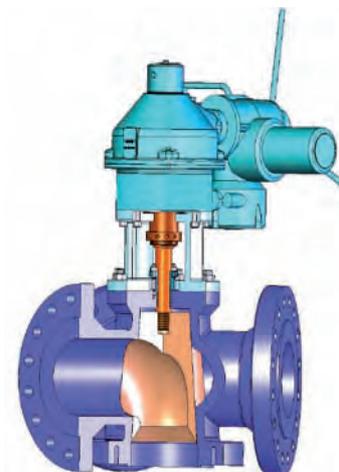
Valve Type 12SD



Valve Type 14SD



Valve Type 12S*



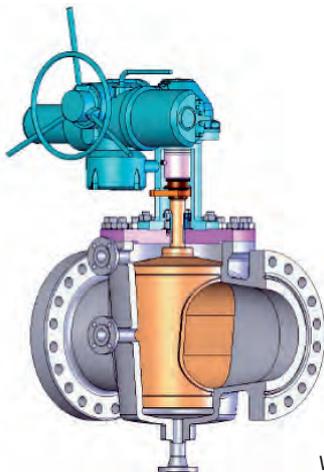
Valve Type 14SD

IsoPlug Valve for Isolation and Bypass

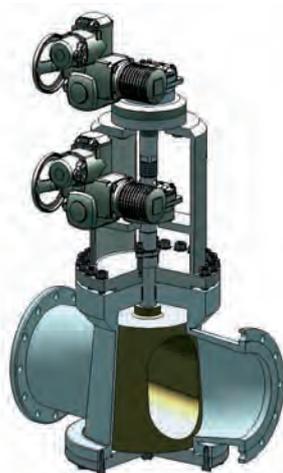
The **IsoPlug** valve can be supplied in sizes up to 36". Smaller sizes up to 16" are usually actuated electrically with the SchuF LTS operator. Valve sizes over 24" are usually fitted with two actuators, controlled by a PLC housed in the control panel supplied with the system

Flushing and purging connections are also supplied; two flush connections at the top, one at the bottom and two purge connections at the side. If there are leaks as a result of sealing surface damage, the purge prevents accumulation of coke between the plug and the body.

The valve can be supplied with an inverted plug as Type 14, where ease of maintenance is of primary concern. For large sizes the lighter plug consists of curved plates cast as a single unit. This allows in-service declogging.



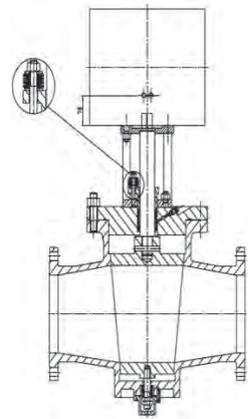
Valve Type 12ND



Valve Type 14ND

ControlPlug for Backpressure Control – Type 12NO

The **ControlPlug for Backpressure** is specially gold plated or manufactured in dissimilar metals so it does not need to be lifted before turning. It is never fully closed so the associated drop in sealing level to class III is not significant. The trunion mount ensures maximum valve life.



Valve Type 12NO



Delayed Coking Plant

QuenchPlug Valve for Injection, Warming and Draining

The **QuenchPlug** Valve (Type 30) is a dead space free valve to allow injecting or draining from a side line into the main line. It is easy to automate and when closed, leaves no space which can clog between the branch line and the main line. It is available for main lines up to 36" and up to 12" for branch lines.



Advantages of the Lift Plug Valve for Delayed Coking

The key advantages of a lift plug valve for coking systems are their simplicity and crevice free design. In any position, be it open, or in a particular switching position, the plug and the body form a smooth continuous contour, without gaps or crevices. This eliminates the need for flushing during routine operation.

To operate the lift plug valve, the plug is raised slightly from the body. It can then be turned easily, without the type of torque associated with a ball valve. Once the plug has been turned to its required position, the plug is lowered again.

During operation the valve is flushed with steam to prevent solid entrapment between the plug and body. However once the plug is seated, flushing stops automatically.



The SchuF 3 line **Coking Defense System (CDS)** is unique. After discussion with the Coking industry SchuF has designed a valve that offers 3 lines of defense against coke build up in and around the valve:

1. Steam flushing during plug lifting or turning
2. Integration of a flush drain/dump valve at the maintenance of the valve. Once the drain valve is opened a steam purge is activated that clears any coke debris above or below the plug and deposits it to a dump point
3. The IsoPlug is designed with a detachable bottom lid in order to allow hydro-blasting of any remaining lodged coke or debris

All three elements of the Coking Defense system can be achieved without taking the plug out of the valve, or the valve out of the line. This significantly reduces maintenance and down time.



Cost of Ownership

The cost of ownership of valves in a delayed coker operation comprises of a number of key elements including initial purchase cost, flushing costs and repair. We can assume that the lift plug valve has a slightly higher initial acquisition cost than that of the ball valve. However, the costs of flushing, maintenance and repairs are significantly higher for ball valves.

Assuming a 24" valve cycling four times a day – the **ball valve** would use approximately 5lbs of steam/minute through each of 3 purges i.e. about 8 million lbs of steam per valve per year for flushing. In addition, we would expect to have to repair the ball valve on average every two years.

The **lift plug** valve in comparison uses only 3 x 5lbs/minute for the 2 minutes that it is being operated four times a day i.e. 15x2x4x360 or 65,000lbs of steam per year.

On the above basis the difference in cost of ownership of a ball valve could amount to twice that of a lift plug valve. This excludes the additional cost for downtime.

Lift Plug and Ball Valve Comparison Table

Lift Plug Valve	Ball Valve
<i>Simple rugged design, only two main parts</i>	<i>Complex design, many major parts</i>
<i>Plug seizing is not possible</i>	<i>Can get stuck</i>
<i>Seals do not wear during operation</i>	<i>Seal wear with every operation</i>
<i>Seat seals are load free during rotation, but thrust loaded by lowering the plug after the rotation, ensuring a perfect seal</i>	<i>Seals are exposed to the process while loaded, sealing cannot be improved by the actuator</i>
<i>Flushing only required during valve operation</i>	<i>High flushing requirements, leads to high cost of ownership</i>
<i>If flushing fails while valve is in service the valve suffers no ill effects</i>	<i>If flushing fails, expensive maintenance with expensive spare parts</i>
<i>Uses two actuators for the most rugged design at larger sizes</i>	<i>Single much bigger actuator</i>
<i>Automation can be more complex</i>	<i>Less complex to automate</i>
<i>Low torque required to turn the valve</i>	<i>High torque, large motors</i>
<i>Electric, hydraulic or pneumatic actuation</i>	<i>Electric and pneumatic options</i>
<i>Switching valves available with inlet from below and either 3 or 4 outlets</i>	<i>Switching valves available with inlet from below and 3 outlets.</i>
<i>Plug can be trunnion guided top and bottom / important for non horizontal installation</i>	<i>Trunnion guided ball valves available, but then sealing becomes an issue</i>
<i>Double block and bleed when in bypass position</i>	<i>Similar</i>
<i>Top or bottom entry design permits inspection and easy maintenance without removal from the line</i>	<i>Not always possible with a ball valve and therefore difficult to maintain</i>
<i>Maintenance rarely required, no parts required</i>	<i>Expensive spare parts and repairs are required</i>

Coal Liquefaction Case Study

A major Chinese coal company established a Direct Coal Liquefaction Plant in Inner Mongolia.

Direct Coal Liquefaction presents a number of challenges for valve systems:

- The 3 phase media is very erosive and prone to severe flashing. The life expectancy of the valve is therefore short.
- The high solid content means that any increase in the cross sectional area or dead spaces is likely to lead to plugging
- The high pressure environment 200bar and temperatures of 500° C and it's implications for the materials used in the valves



The customer required valves to: **1)** control flow from the pumps to the heaters, **2)** recycle flow around the feed pumps in start-up situations, **3)** prevent build up of solids in the reactor, **4)** maintain levels in the separators and atmospheric vacuum distillation units, and **5)** let down pressure successively from 200bar to vacuum.



SchuF assembled an experienced team consisting of it's own design and engineering staff and experts from a previous Coal Liquefaction plant "Kohleölanlage Bottrop" to which SchuF had already delivered numerous valves.

The result was an expert group that proposed a revised process schematic as well as a package

of valves for control and the associated replacement of the valves in line. It also included double bleed and block systems.

The valves included a number of special attributes such as the SchuF proprietary impulse control system, optimised flow characteristics, solid Tungsten Carbide trim and body sleeve, removable critical parts in-situ, SchuF cross sectional acceleration design, proprietary packing protection and an integral quenching system.

These critical valves were delivered on time to perform in one of the most severe operating environments in the Oil, Gas and Refining industry.

Catofin Dehydrogenation Case Study

A leading provider of plastics runs an Air Products Catofin Dehydrogenation plant.

- A de-oiler stripper takes C4+ heavies from C3 gas (propane); the bottom stream heavies are sent to 2 re-boilers to further remove C3

- Initially our client equipped the lines to and from the stripper with double block and bleed gate valves and spectacle plates.



- However the gate valve could not provide sufficient tightness and leakage followed. The leakage was so severe that the bleed could not relieve the pressure. Coke lumps also formed in the lines from the stripping column
- The customer then considered using a knife gate valve (due to cost), but finally decided to use a SchuF Lift Plug Valve as a double block and bleed
- The Lift Plug stopped the leakage and proved to work well in dirty service as it allowed the seat to be cleaned by grinding during closure
- After two years of successful operation, an additional Lift Plug valve was bought from SchuF for the 2nd re-boiler

General Specifications

Coker Valve Portfolio:

- SwitchPlug
- IsoPlug
- ControlPlug
- QuenchPlug

Valve sizes:

- **SwitchPlug** – Typical sizes range from 8" to 24".
- **IsoPlug** – Typical sizes range from 8" to 36".

Materials and Options:

- **Body**
WCB, WC6, WC12, WC12A
- **Bore**
Full bore, oval or round
- **Trim**
Chrome and Ceramics
- **Lining / Sleeves**
Gold, Titanium, and other materials on request
- **Sealing**
Standard metal to metal; wide sealing lip
- **Flanges**
Fully flanged RF and RTJ, DIN and ANSI
Through bolt holes
- **Jacketing**
Full or partial jacketing available.
- **Purge and Flushing connections**
Five connections as standard: more on request
Port size – 1 to 2 inch

Rating:

Class 150 to 900 ASME, DIN or JIS.

Flow Direction:

Bi-directional; flow to open or close

Coking Defense System:

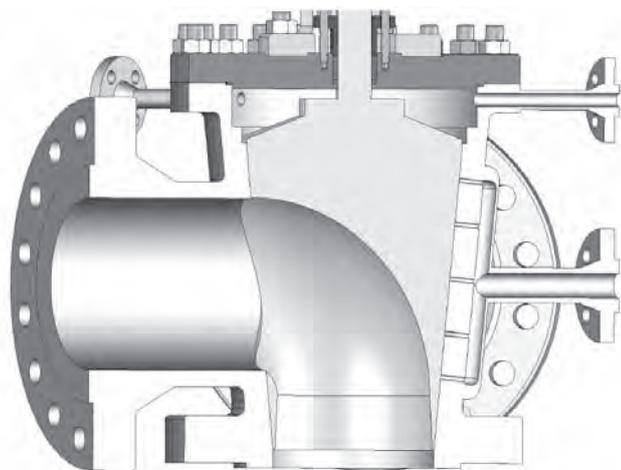
- 1. Steam flushing during plug operation
- 2. Integral flush drain/dump valve enabling steam purging above or below the plug
- 3. IsoPlug valves with detachable bottom lids to allow hydro blasting of any lodged coke or debris.

Actuation:

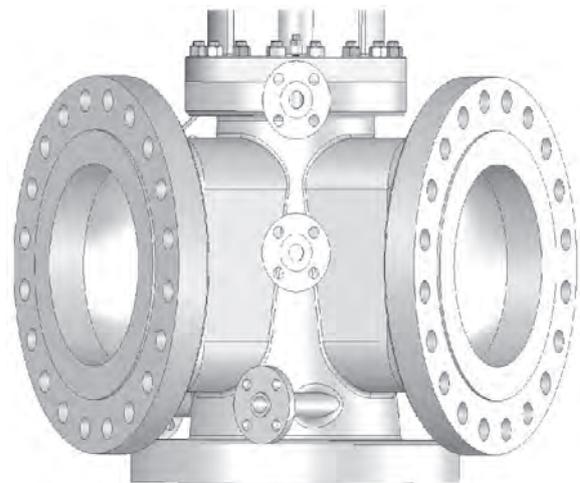
Electric, pneumatic or hydraulic are available

Cv & Steam Values for Full Port Valves

Port	Valve Size	Cv	Steam (lbs p.h.)
1"	12 inch	22.000	5
	14 inch	31.000	5
	16 inch	42.000	5
1.5"	18 inch	57.000	10
	20 inch	71.000	10
	24 inch	101.000	10
2"	30 inch	170.000	20
	36 inch	260.000	20

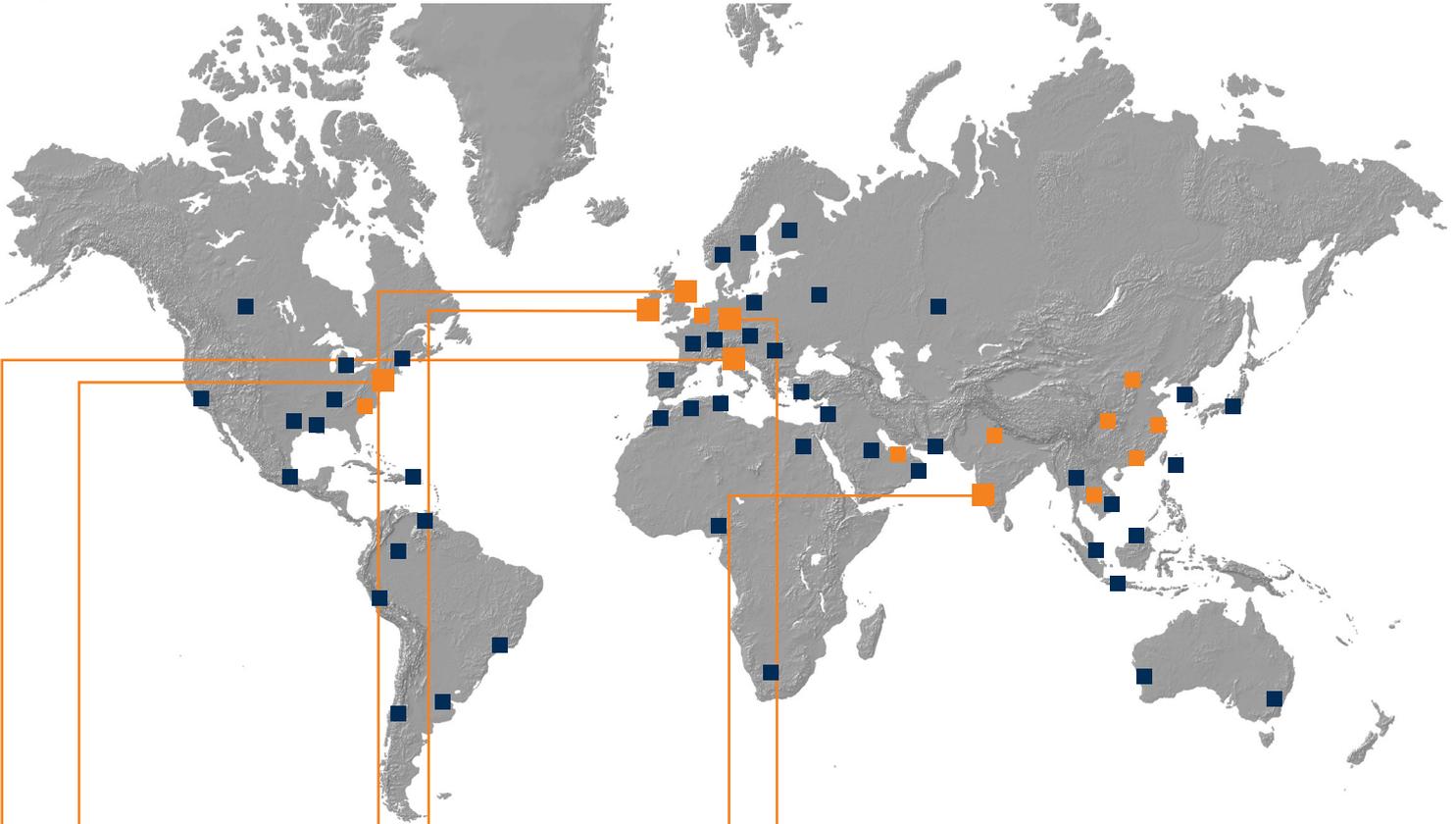


Type 12S* round bore



Type 14 with tangential flushing

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