

INSTITUTION OF MECHANICAL ENGINEERS HONG KONG BRANCH  
EVENING LECTURE “ON-STREAM MAINTENANCE & REPAIR – CARRYING OUT  
PLANT MODIFICATIONS, MAINTENANCE AND REPAIR WITHOUT PROCESS  
INTERRUPTION” ON 9/11/2017



*Mr. Adam Thistlethwaite, Global Service Line Director of On-Stream Repair delivered the evening lecture in The Hong Kong Polytechnic University on 9/11/2017*

On-stream maintenance and repair can apply to valves, process lines and structures, pipelines and safety valves. It maximises plant up-time and hence efficiency, improves safety through arresting dangerous releases, improves environmental performances and serves the compliance with regulations in terms of safety and environment.

## **Mechanical Leak Sealing for Flanges and Valves**

Bolted joint leak, or leakage at flanges, is caused by the corrosion of gasket sandwiched between the flange surfaces. The solution of controlling the flange leakage is the injection of sealant, which arrests the leak at source and maintains the original pressure area and bolt loads. It is effective for pressure up to 200 bars, temperature ranges from -196 °C to 1,000 °C, full range of process chemical and all flange face types (i.e. flat face, raised face, ring-type joint and o-ring joint).

Valve leak often occurs at the spindle. Should this be occurring, the packing chamber is broken-through by small diameter drill using a sealed drilling device to let sealant be injected into the packing chamber without the release of the process content. The sealant serves as the original packing material and fill the packing chamber again. After the reparation, the valve returns to its original function and becomes operable again. Same as the reparation of bolted joint leakage, this valve packing reparation is effective for pressure up to 200 bars, temperature ranges from -196 °C to 1,000 °C, full range of process chemicals, all valve thickness and both manual and actuated valves.

If a valve passes, it is likely that the seal is damaged. Injecting the sealant to the seal can provide either permanent or temporary isolation. If a valve fails to open, the gate wedge may have been seized. Using hot tap and push-rod can un-seize the wedge and re-operate the valve.

## **Piping and Vessels Repair by Engineered Enclosure**

Engineered enclosure is an effective method of on-stream reparation of piping and valves, creating a new pressure boundary around the damaged component. The method is effective for pressure up to 780 bars, temperature ranges from -196 °C to 1,000 °C, full range of process chemicals and all sizes. In case a section of piping cracks and leaks due to stress-induced corrosion, a suitable mechanical restraint clamp can be applied to maintain the containment of the internal pressure and the structural integrity of the damaged equipment. The clamp is of complex design to accommodate thermal displacements. Designed to contain pressures, the clamp can satisfy the requirements stipulated in ASME Boiler and Pressure Vessel Code Section VIII Division 2.

## **Composite Repair**

The high performances of composite materials, typically carbon fibre or glass fibre with epoxy or polyurethane resins, are ideal for the restoration of the integrity of the degraded components, such as pipelines, tanks and vessels and structural components. The method is effective for pressure up to 345 bars, temperature ranges from -180 °C to 260 °C, diameter and length up to 18 m and 150 m respectively, and processes of hydrocarbons, water and other chemicals. It is particularly useful to redress external corrosion under insulation and labels on stainless steel lines, as well as at the transition zones, such as from air to soil for tank walls, and damages at pipe supports. The method is engineered in compliance with ISO 24817 “Petroleum, petrochemical and natural gas industries – Composite repairs for pipework – Qualification and design, installation, testing and inspection” and ASME PCC-2 Article 4.1 “Repair of Pressure Equipment and Piping – non-metallic composite repair systems: high risk applications”. Composite repair can be applied on-stream and without hot work. It applications of repairing the facilities in the oil and gas production platforms in

North Sea have been accepted by classification societies such as Lloyd's Register and DNV and are under scrutiny by Health and Safety Executive of the U.K. government.

The method comprises of applying several layers of composite material. After the defect is filled by filler and the surface in vicinity is grit-blasted to Swedish Standard SA 2.5, the first glass fibre layer is bonded to the surface by epoxy, providing leak sealing, resistance to chemicals and the environment and electrical isolation. The subsequent carbon fibre-made layers are applied on the first layer for providing structural strength. The number of carbon fibre layers is subject to the application. If the subject of reparation is pipeline, the second layer fibre is bi-directional. If, however, the subject of reparation is process piping, quadric-directional fibre is used.

Composite repair is subject to limitations. Firstly, it is suitable for processes below 260 °C and can only be installed at under 100 °C. The ambient pH value should be between 3.5 and 11, and the solvents used should not exceed concentration of 25 % should the composite is to be wetted. Moreover, the pressure containment capability after reparation is subject to the size of the defect in the following order:-

Defect Size	Permissible Pressure Containment after reparation
below 20 mm in diameter	below 40 bars
below 6" / 150 mm on pipe	below 20 bars
below 16" / 400 mm on pipe	below 10 bars
over 16" / 400 mm on pipe	below 5 bars

### **Hot Tapping and Line Stop**

Hot tapping permits new connections to the existing process lines and vessels when the unit remains in operation, providing additional branches for supply to and from other areas of the plant, monitoring points for flow condition probing and entry points for line isolation. Not only can it be performed on-stream, it can be carried out without disruption to the existing flow, pressure and temperature. In addition, it provides access to the defect for the injection of the sealant in the aforesaid mechanical leak sealing method. The method can be applied to the pipelines and process lines of transferring hydrocarbons, gases, steam and water.

After a line in operation is hot-tapped, line stop can be applied to temporarily isolate the main line for repair, modification and maintenance after a temporary by-pass, which connects upstream and downstream of the line stop locations, is installed also with the hot-tapping method. Line stop, in the form of either pivoting/folding head or inflatable bag, is suitable to line sizes from 3" / DN80 to 36" / DN900.

### **Pipe Freezing**

Should the isolation of only a section of a process line be desired, pipe freezing can help to freezing the content of the line to become a solid plug at both upstream and downstream of the section of isolation. It is attained by jacketing the locations where plugging is required and lowering the temperature of the locations with a stream of liquid nitrogen.

The resulted solid plug, in two (2) to three (3) times of the line diameter, is able to withstand substantial differential pressures, whereby ice and crude oil plugs are tested to 480 bars and 103 bars respectively. The formation of the solid plugs does not apply additional internal

pressure to the pipe thickness, because the strength comes from the molecular bonds between the plug and the pipe inner wall. However, since this method is temperature-sensitive, heat flux sensors are to be attached to the pipe surface and within the freezing jacket, as well as immersed in the liquid nitrogen. Although a freezing time-pipe size chart for the plug formation is available, a minimum 50 % margin for planning purpose is suggested.

Where maintenance and reparation of process facilities of fluids and gases is essential and unavoidable for the productivity, safety and reliability of plants, the shut-down of the system is not necessary prerequisite. Various developed and matured methods are in place to permit maintenance and reparation to be carried out when the system remains in operation. For plant planners and maintenance personnel it is definitely good news to gain both production and maintenance and repair, which are contradictory in nature, in a single hand.

Institution of Mechanical Engineers (IMechE) Hong Kong Branch thanks Mr. Adam Thistlethwaite and IMechE Pressure Systems Group for the inspiring knowledge sharing.

\*\*\* END \*\*\*

Encl.  
WHT



# **TEAM**<sup>®</sup> Industrial Services

On-Stream Maintenance & Repair

Carrying out plant modifications, maintenance and repair  
without process interruption

# PPE – Focus on Hard Hats

We are all programmed to wear hard hats where overhead hazards may exist but do we take them for granted?

- Use a chinstrap when working above floor level
- Only use approved stickers, never paint!
- Observe manufacturers service life.



- + This is the time from first use not the time since the date stamp
  - + Identify the start of service by writing on the sticker (usually) provided with the helmet.
  - + TEAM currently supply MSA V-Guard 500 hats with a storage life of 3 years and service life of a further 5 years.
  - + Wearing a hard hat with a “HK Electric outage 1993” will not win you friends!
- Don't store in direct sunlight, particularly in van window
  - Only clean with mild soap and warm water
  - Always change your hat after a significant impact or drop
  - Inspect your hard hat prior to each use looking for deep scratches, cracks, discolouration or a chalky appearance. Also inspect internal harness.





# Agenda

- I. Introduction
- II. On-Stream Leak Sealing
- III. Composite Repair
- IV. Hot Tapping
- V. On-Stream Isolation
- VI. Pipe Freezing
- VII. On-Stream Safety Valve Calibration



# Industrial Services



Complete  
maintenance and  
repair solutions for  
specialized industrial  
service needs across  
the globe.

Comprehensive  
inspection and heat  
treating solutions for  
your specialized  
industrial service  
needs.

Advanced integrity  
and reliability  
management  
solutions for your  
assets.



# On-Stream Maintenance & Repair - Value Proposition

2

SAFETY



1

EFFICIENCY

1

Improves efficiency through minimizing plant downtime & energy costs

2

Improves safety through arresting dangerous releases

3

Improves environmental performance

4

Demonstrates compliance to regulators

3



ENVIRONMENT



COMPLIANCE

4

# **TEAM**® Industrial Services

## **MECHANICAL LEAK SEALING**

# Bolted joint Leak Repair



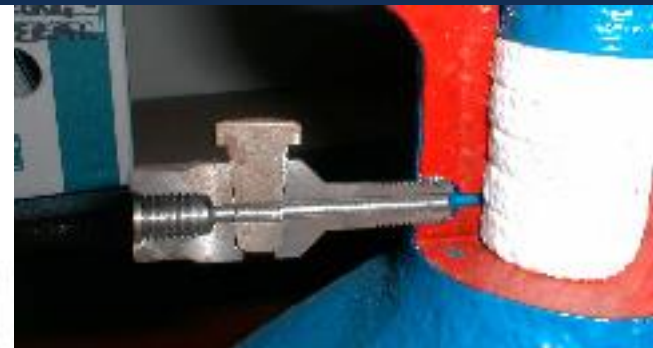
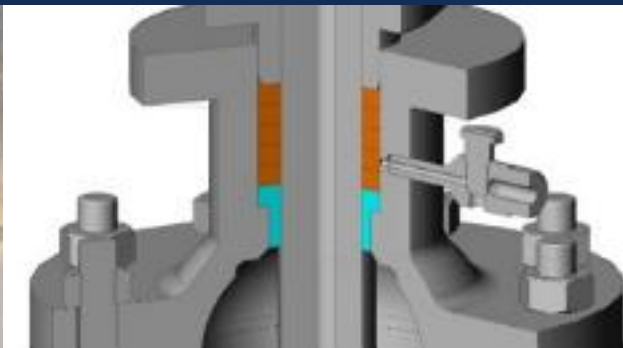
- On-stream repair of any bolted joint type
- Basic process
  - Vent gap
  - Close gap
  - Inject sealant
- Injection of sealant arrest leak at source maintaining original pressure area and bolt load
- Instant repairs possible through stock hardware & craft repair techniques

## Capabilities

- Pressure up to 3,000psi (200bar)
- Temperature -320 to + 1,800°F (-196 to +1,000°C)
- Miniature flanges to large vessel joints
- Full range of process chemicals
- Flat face, raised face, RTJ & o-ring joints



# Valve Packing Leak Repair



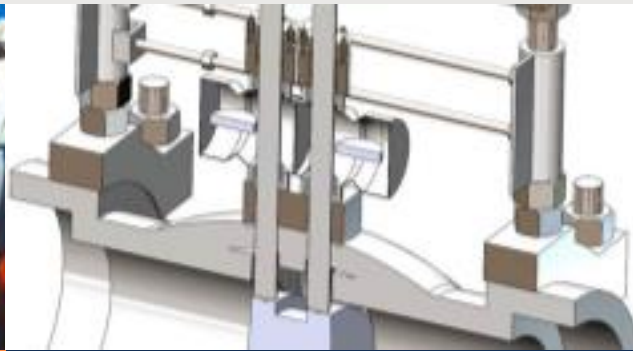
- On-stream repacking of valve stem seals
- Basic process
  - Blind-drill and tap valve body
  - Install injection valve
  - Break-through into packing chamber with small diameter drill
  - Inject sealant whilst backing off follower fasteners
  - Tighten follower to create and maintain seal
- Valve remains operable following the repair
- Sealant equivalent to original packing material
- Break-through achieved using sealed drilling device ensuring no release of product

## Capabilities

- Pressure up to 3,000psi (200bar)
- Temperature -320 to +1,800°F (-196 to +1,000°C)
- Thin and thick wall valves
- Full range of process chemicals
- Manual and actuated valves



# On-Stream Valve Repair



## Failure to Isolate

- Injection of sealant to create isolation on passing valves
- Sealant can provide temporary or permanent isolation
- Flushing and greasing ball valve seats

## Failure to open

- Seized wedge gate valves successfully driven open using hot tap and push-rod (even with spindle separation)



## Body Leaks

- Enclosure solutions providing pressure containment
- Spindles can be extended through enclosure to allow valve to remain operational





# Piping and Vessels Repairs using Engineered Enclosures

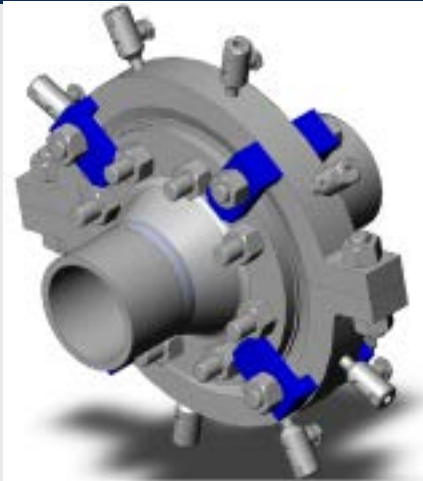


- On-stream repair of any piping or vessel component
- Creates a new pressure boundary around the damaged component
- Suitable for leaking and non-leaking defects
- Instant repairs possible through stock hardware

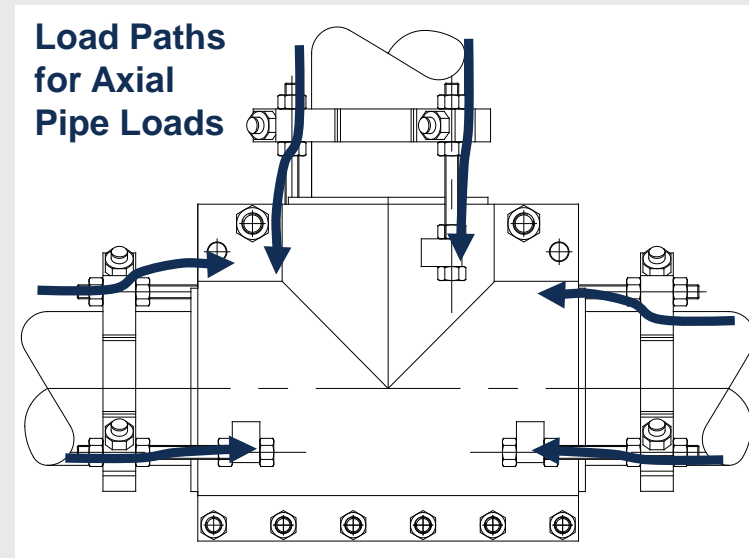
## Capabilities

- Pressure up to 11,300psi (780bar)
- Temperature -320 to + 1,800°F (-196 to +1,000°C)
- Not limited by size (60in+)
- Full range of process chemicals

# Restraint of failed components



- Maintaining Structural Integrity of the degraded component is a key consideration
- Team's in-depth defect analysis and failure risk assessment defines the requirement to restrain or "strongback" piping
- Safe, compliant repairs every time





# Structural Restraint for Cracked Steam Line

## *Outline of Problem:*

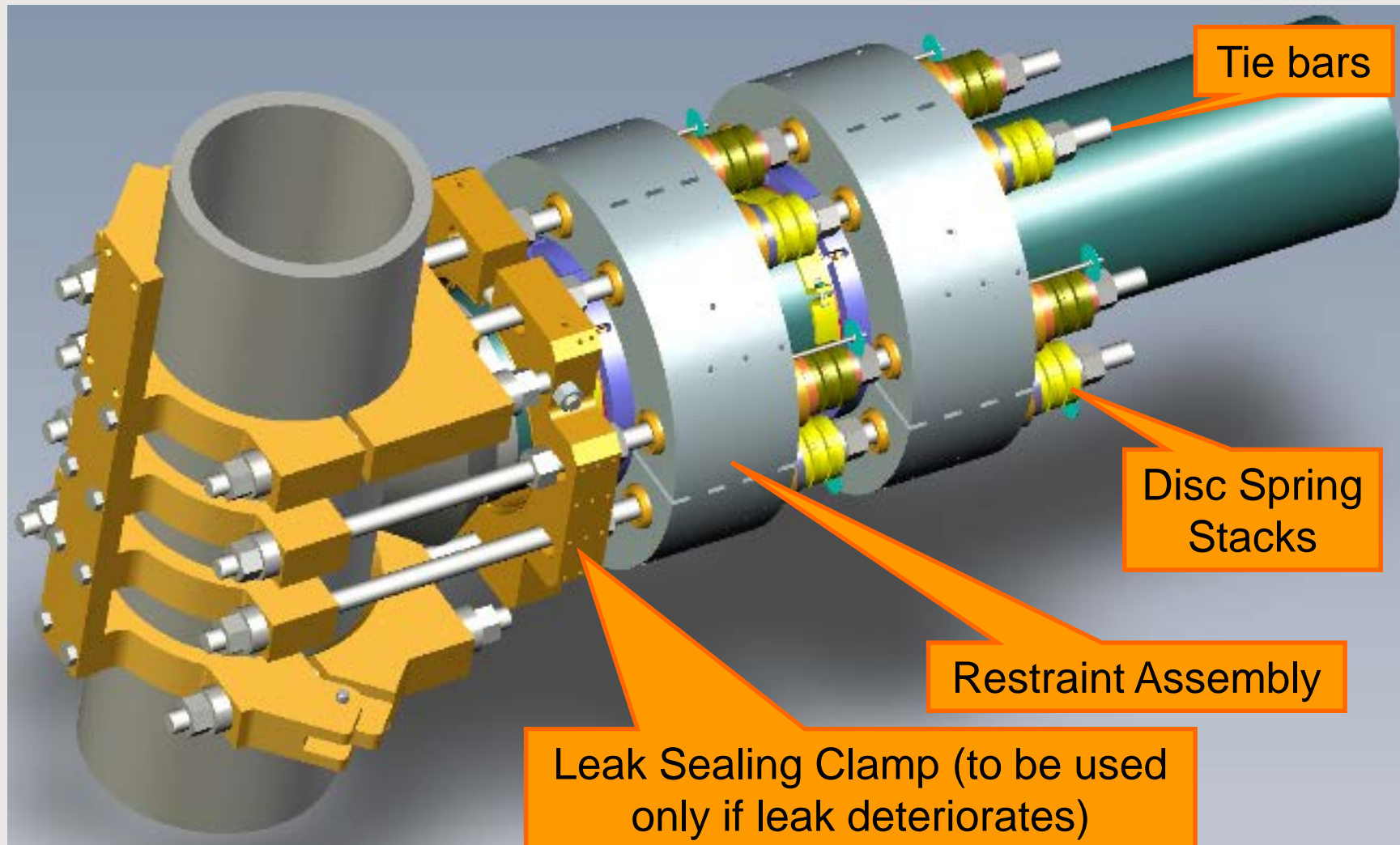
- A client discovered a significant sized crack in the weld between a 20” header and a 16” branch
- The operating conditions were 100 bar (1450 psi) and 490°C (914°F)
- Using fracture mechanics the customer determined that the pipe would not fail before the crack had grown to an observable extent
- TeamFurmanite were requested to design a restraint clamp for the 16” branch – while the customer monitored the crack size

# Structural Restraint for Cracked Steam Line

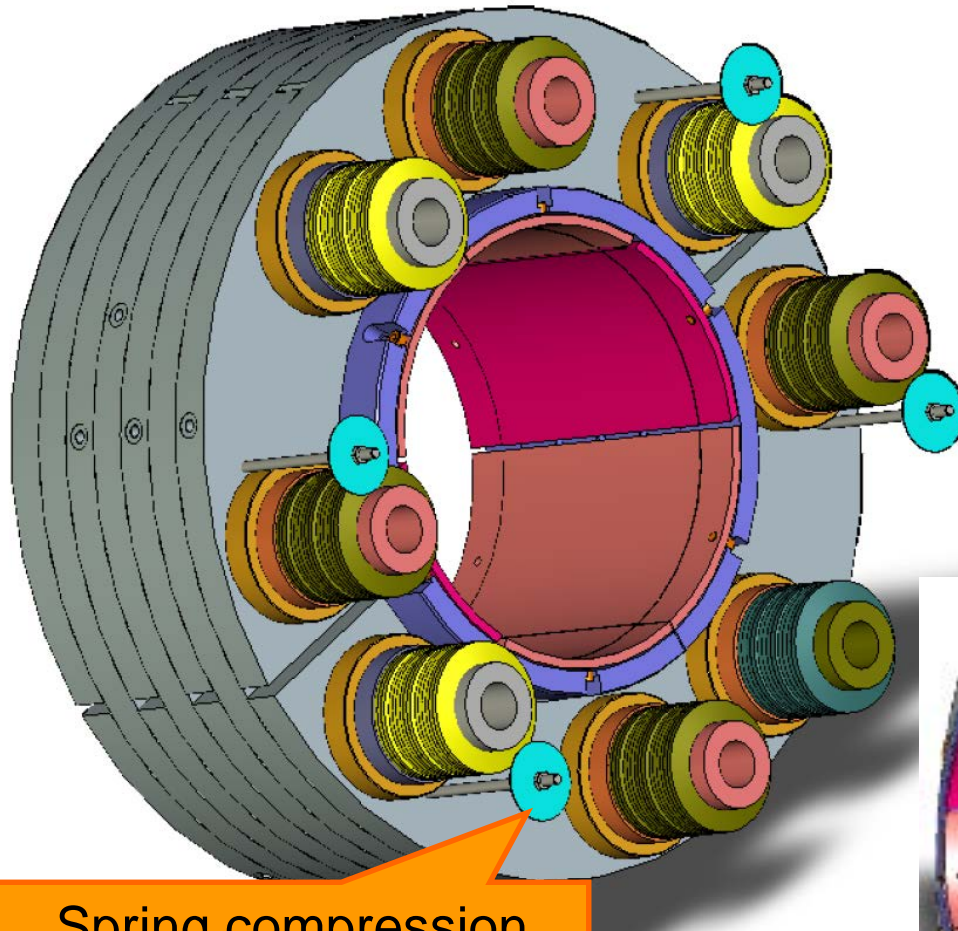
- The clamp was required to restrain the full axial pressure load (about 100 tonnesf)
- It had to be pre-tensioned so as to remove the axial stress from the pipe
  - + This should stop the crack propagating
- The clamp was to be installed with the pipe depressurised
  - + The pipe could be depressurised for only a short period of time and would still be very hot – speed was of the essence
- The clamp needed to maintain the pretension with allowance for differential thermal expansion



# Structural Restraint for Cracked Steam Line



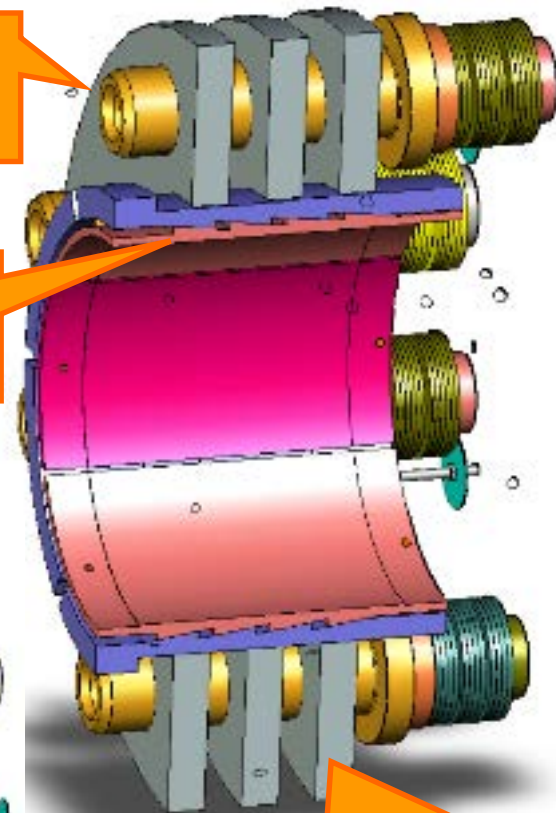
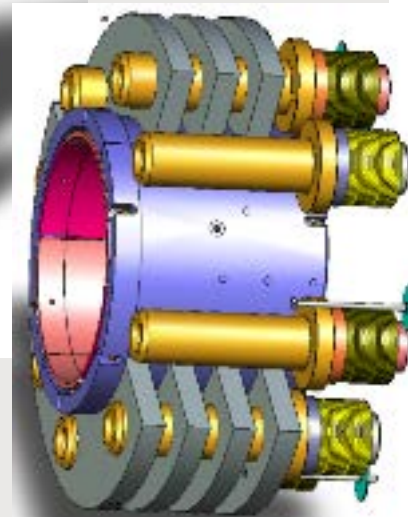
# Structural Restraint for Cracked Steam Line



Spring compression markers – visually indicates spring load

Bushes link half rings

Self-lock Grip System

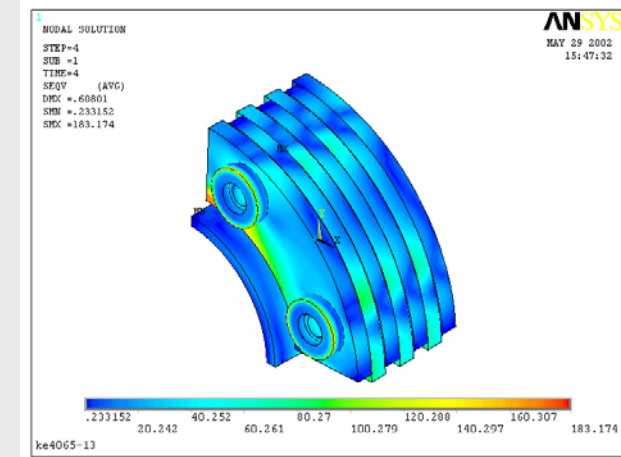
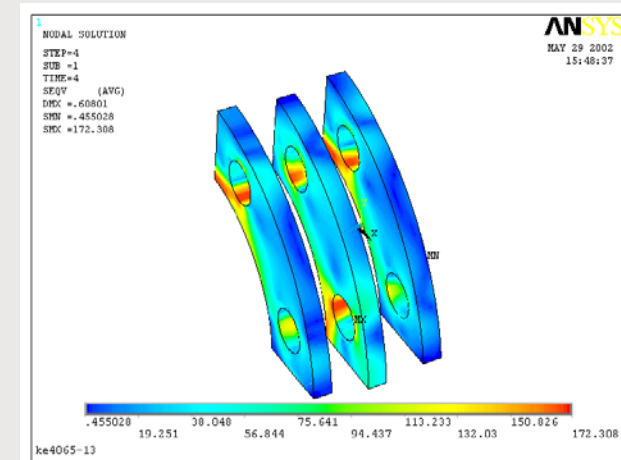


Restraint structure formed from 14 half-rings (3 shown here)



# Structural Restraint for Cracked Steam Line

- Project completed in 32 days (initial site visit to installation)
- 600 man hours expended on design and engineering
- Innovative design validated using finite element analysis
- Full workshop test completed prior to installation
- Assembly on-site took just 8 hours (with the pipe still hot)



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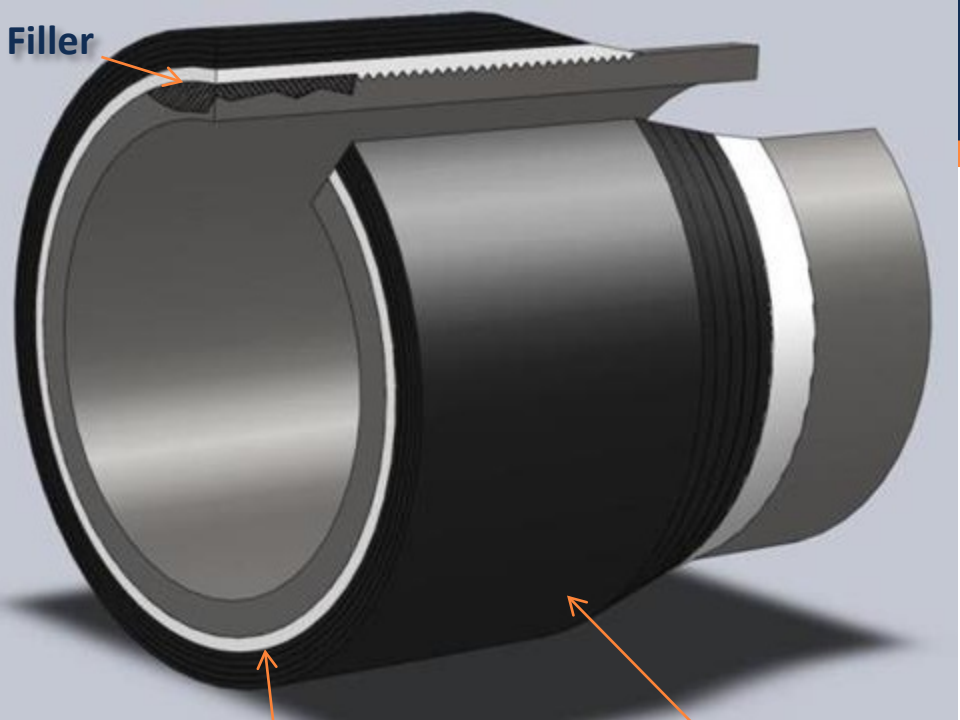
**COMPOSITE REPAIR**

# What is a composite?



- Composites are used in many familiar applications
- Typically use carbon or glass fibres with epoxy or polyurethane resins
- Thorough testing in other industries has proven the durability of composites in demanding applications
- Their high performance makes them ideal for repair applications in our industry





Epoxy bond to pipe  
provides leak sealing and  
chemical and  
environmental resistance

Structural repair provided  
by fiber reinforcement

## What is a composite repair?

- A composite repair uses advanced composite technology to restore the integrity of degraded components
- Engineered in compliance with ISO 24817 or ASME PCC-2 Article 4.1 for life of up to 20 years
- Materials conform to the shape of the original component and require no pre-fabrication
- Simple and fast to apply; do not add significant mass to the component
- Can be applied without hot work and without interrupting operation of the plant
- Technology has been in use and continues to be developed since 1990's



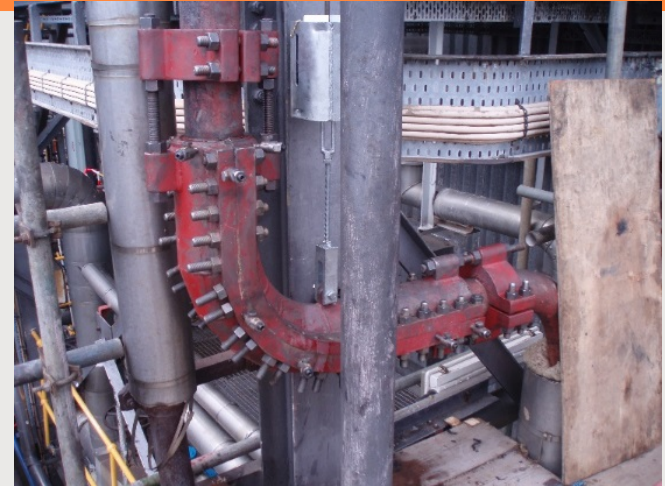
## Engineered repairs – typical applications

- Pressures up to 345bar (5000psi)
- Temperatures from -180°C to 260°C (-292°F to 500°F)
- 18m (60') diameter, 150m (500') lengths, wide range of geometries and defects
- Pipes, tanks, vessels, decks and other components
- Transmission pipelines suffering corrosion, dents and cracks
- Hydrocarbons, water and chemicals
- Intended repair lifetimes from weeks to 50 years

# Limitations of Composite Repairs



- ✓ Design temperature <260°C
- ✓ Installation temperature <100°C
- ✓ Required surface preparation is possible & safe
- ✓ Dry surfaces
- ✓ Structural reinforcement only or,
- ✓ Limited potential for perforation\*
  - ✓ <20mm dia defects @ <40bar
  - ✓ Gross damage to pipes <6in @<20bar
  - ✓ Gross damage to pipes <16in @<10bar
  - ✓ Gross damage to pipes >16in @<5bar
- ✓ pH between 3.5 and 11, solvents <25% concentration if composite is to be wetted



\*Capability varies by repair system, quoted values are for illustration



# Typical repairs – external corrosion



- External corrosion is a relatively common problem
- Composite repairs provide strengthening and increase protection to prevent further degradation
- Corrosion under insulation (CUI)
- Corrosion at transition zones (e.g. air to soil)
- Damage at pipe supports
- Corrosion under labels on stainless steel lines

# Pipeline Repairs



- Applications on transmission and midstream pipelines now standard
- Proven through extensive test programmes
- Simple, reliable and cost-effective
- Experience with repair of external corrosion, dents and cracking in welds
- FEA can be used to analyse dents/buckles and determine contribution of composite

# Tanks and vessels



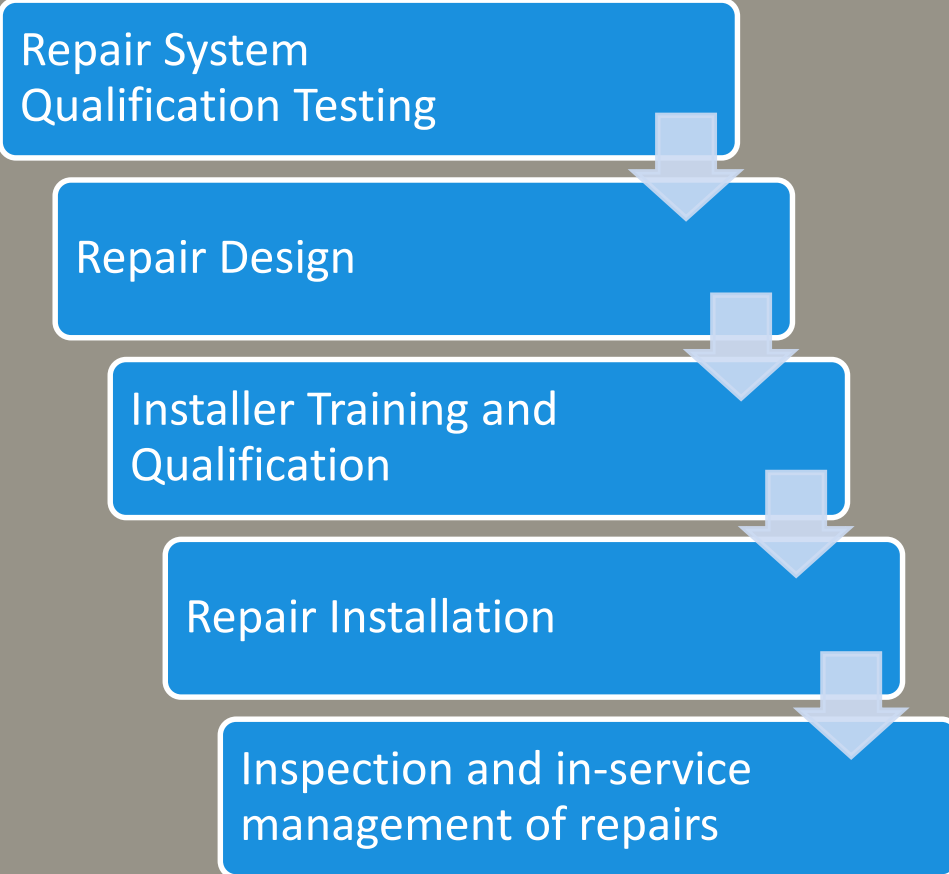
- Applications include roof repairs, nozzle repairs and general corrosion
- Composites are a good solution for corrosion under insulation
- Patches can be applied to treat local damage
- Experience includes wide range of tanks/fluids

# Structural repairs



- TeamFurmanite technology was the first to be used to repair structural defects offshore
- Decks suffering severe external corrosion were reinforced using composite materials
- Repairs avoid hot work and accommodate the original surface topography
- Repairs include top layer that is resistant to container movement/impact damage





## Assurance of Repair Performance

ASME PCC-2 Article 4.1 and ISO 24817

- **Compliance with standards ensures repairs will perform as intended**
- **All elements within the standard are important, from qualification through to installation**
- **Team take responsibility for and control the entire process in-house**
- **We will recommend the right repair option for each application**

# Control of installation



- The best materials with an accurate design will only perform as well as they are installed
- Contractor should have an in-house competence scheme to track skills of technicians beyond initial training
- Key hold points during installation are measured and recorded, including
  - Surface cleanliness and roughness
  - Temperature, humidity and dew point
  - Material batch numbers

# In-service management of repairs



- Installation records are retained, identified by a unique reference number
- Full traceability on materials used for the repairs from batch numbers
- Radiography, eddy current and ultrasonic methods provide information on the pipe and repair
- Recording an initial 'fingerprint' will help identify future changes

# Case Study – Unique Flare Line Repair



- Our wider expertise enables development of novel solutions, e.g. fitting a new flange to a flare line without hot work
- Clamp technology is used to align the flange
- Composite technology provides the pressure-tight connection (in compliance with requirements in ASME PCC-2 Article 4.1)
- Designed for 3.5bar and 200°C (50psi and 392°F)



# Case Study - High Pressure Hydrocarbon Lines

- Examples include long term repair on a high pressure export line
- Repairs have been verified by Lloyd's and DNV offshore in Europe
- Designs for service at up to 167bar and over 133°C
- These high-performing repairs have been enabled by tight control of the repair process
- Repairs have also been applied to natural gas and oil transmission pipelines in Europe



# Case Study – Hong Kong Terminal Repair



- Fuel terminal Jetty supplying Hong Kong Airport
- 20" Pipeline suffering severe external corrosion at the air/water interface region, 66% wall loss in places
- Cofferdam constructed to allow repair to be carried out to correct quality
- Full rehabilitation with 20 year design life
- Repair installed in three days with no loss of service

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**HOT TAPPING**





# What is a Hot Tap

## ➤ What is a Hot Tap?

- Hot tapping pressurize systems has been at the disposal of the engineer for well over 90 years and is utilized for new connections to existing pipes, or vessels, while the unit remains operational.

## ➤ What is it used for?

- Installation of additional branches allowing supply to and from other areas of the plant
- Provides monitoring points for temperature probes, etc.
- Entry points for line stops

## ➤ What advantages are there?

- Can be performed without the need to shut down.
- No need for loss of production or supply to other areas
- No disruption to either flow, pressure or temperature.

# Where can hot tapping activities be utilized?

## ➤ Petrochemical Industry

- Hydrocarbons such as Crude & Heavy Oils
- Light Oils, Diesel, Kerosene, Petroleum, etc.
- Various Chemicals and Gases

## ➤ Power Generation Industry

- Steam & Water

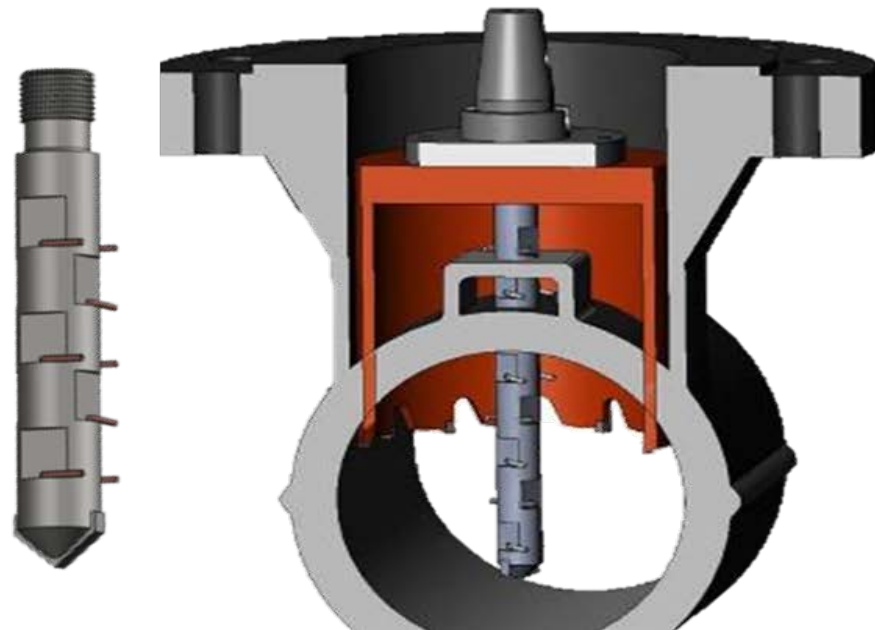
## ➤ Utilities - Pipeline

- Gas
- Potable Water
- Sewage



# TEAM's High Flow Pipeline Pilot Drill

- The pilot serves 3 purposes during a hot tap
- Stabilize the cutter during the hot tap
- Penetrates the pipe allowing the product to push air from the tapping adapter
- Capture the coupon using u-wires
- Team's Labatt Bridge is used in high flow conditions to help ensure retaining the coupon



# **TEAM**® Industrial Services

## **ON-STREAM ISOLATION**

# What is a Line Stop

## ➤ What is a Line Stop?

- A line stop operation is an extension of the hot tapping principal, it is a collective term used for the temporary isolation of live lines.

## ➤ What is it used for?

- By utilizing line stops with temporary bypasses, (that have been previously commissioned by hot tapping) the repair, modification, maintenance or diversion of live lines may be carried out without disruption to service.

## ➤ What advantages are there?

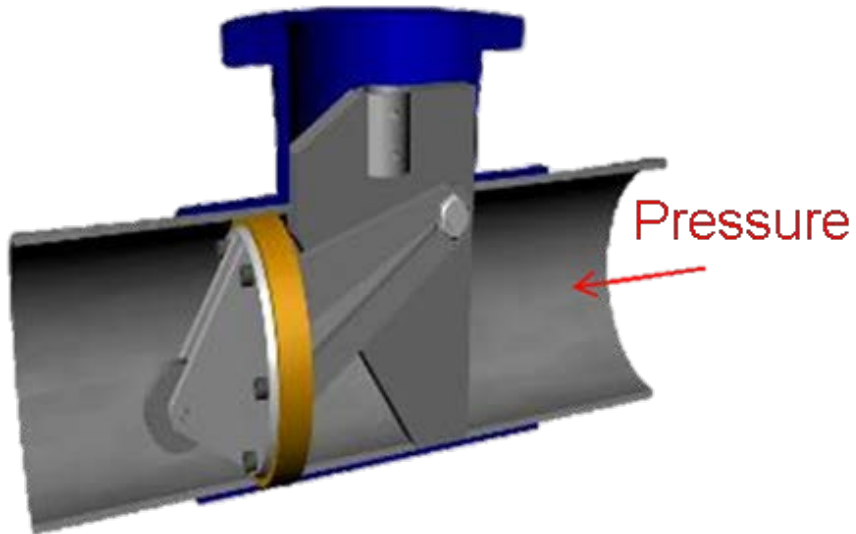
- Can be performed without the need to shut down.
- No need for loss of production or supply to other areas
- No disruption to either flow, pressure or temperature.



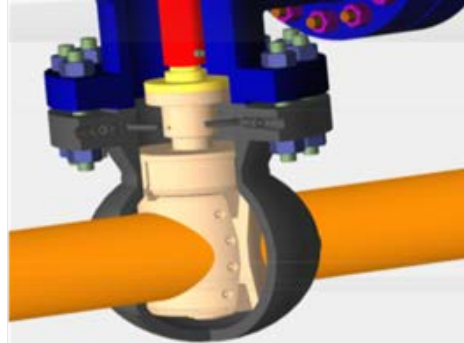
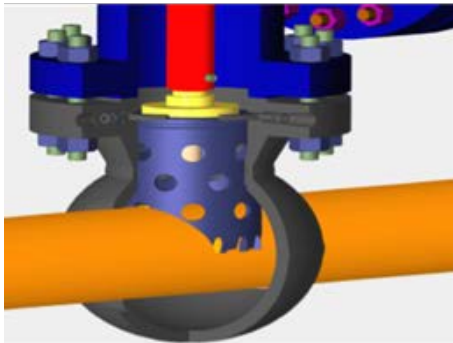
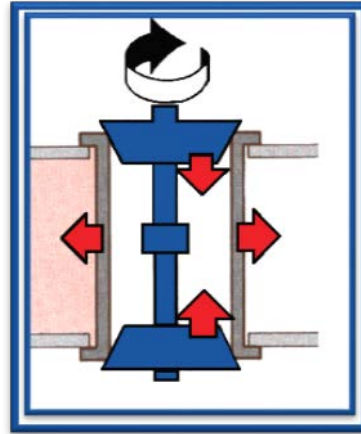
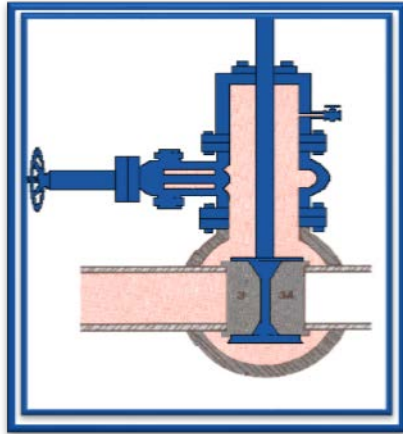


# Pivoting Head Line Stop

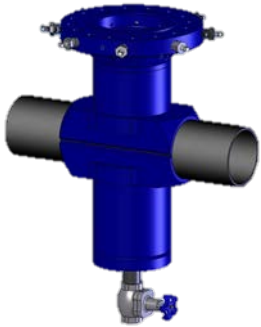
- For lines 3" to 36" diameter
- Medium range temperature and maximum pressures up to 1480 psi, depending on the size, temperature and service



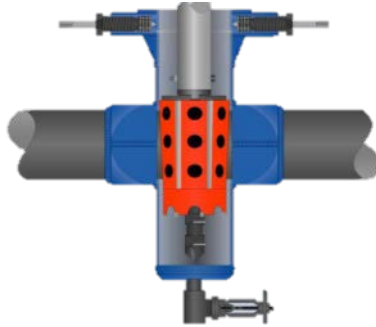
# High Temperature Pressure (HTP) Line Stop



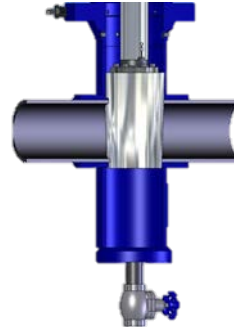
# Hi Stop



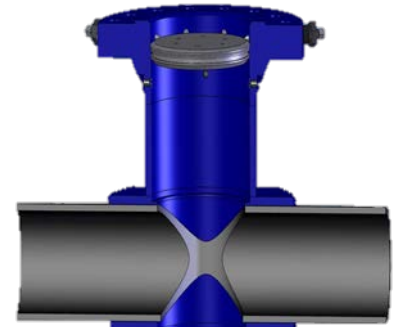
Install Fitting



Tap & Ream Pipe



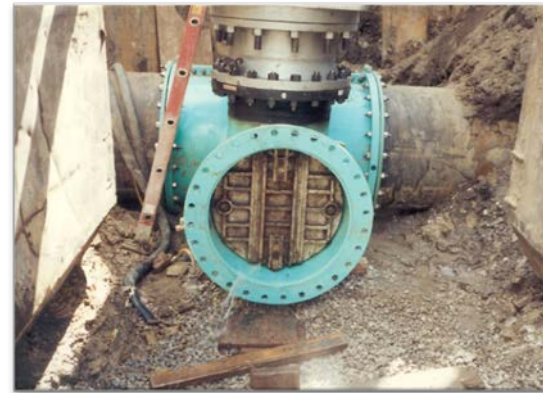
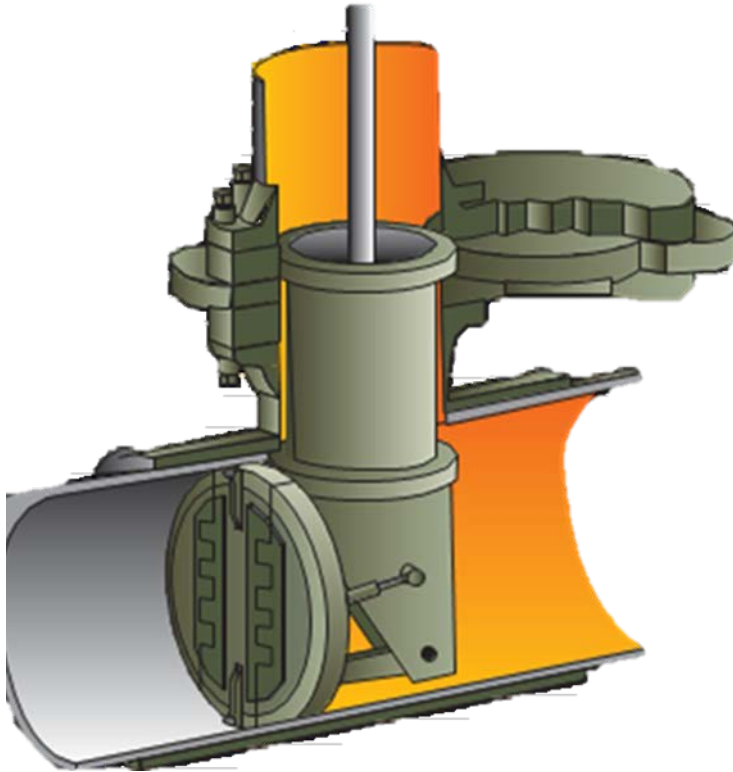
Set Hi Stop Plug



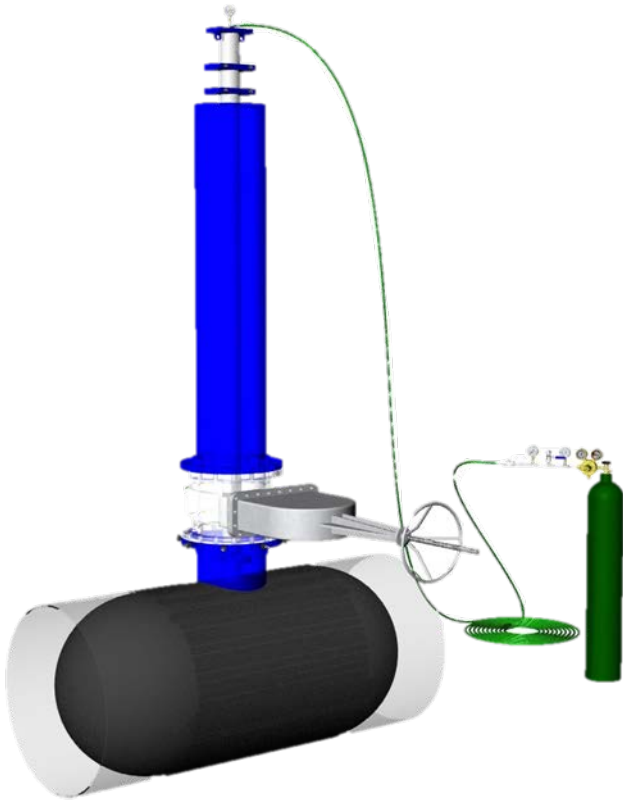
Set Completion Plug



# Folding Head Line Stop

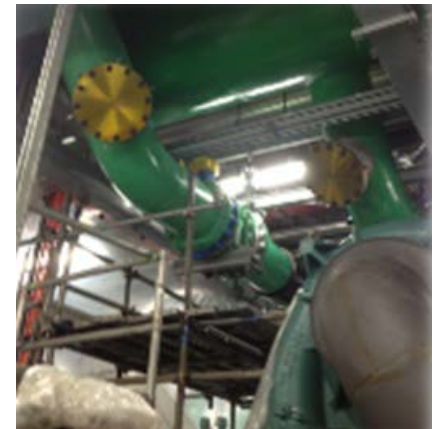
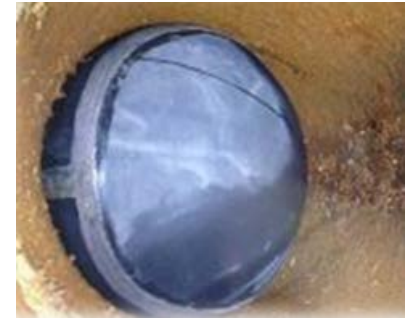
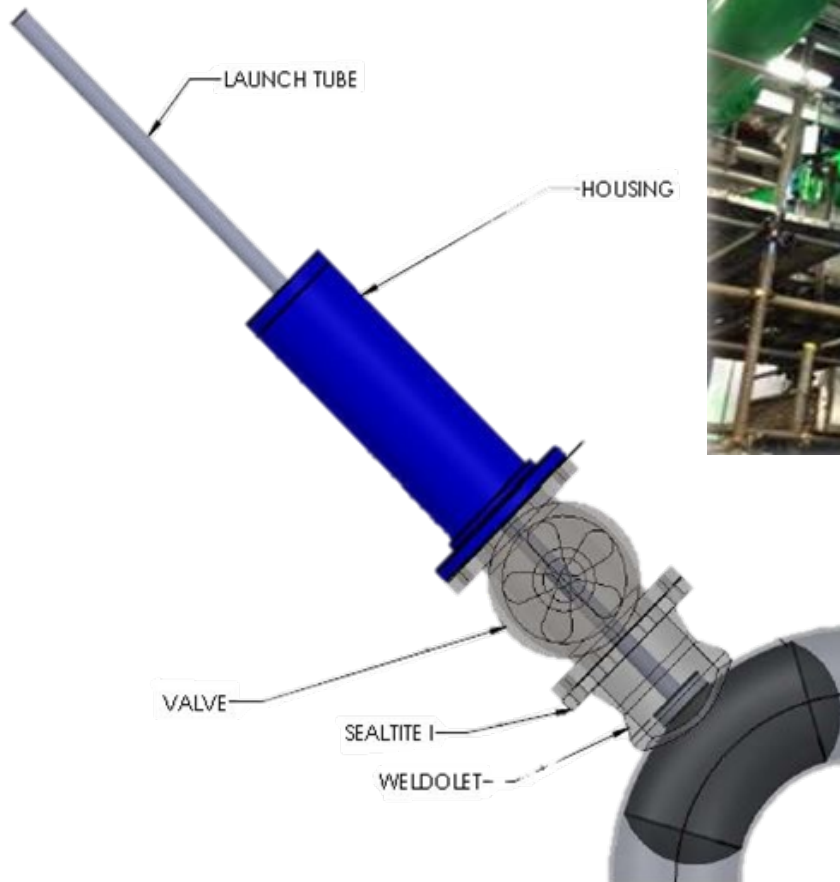


# Inflatable Bag Stop

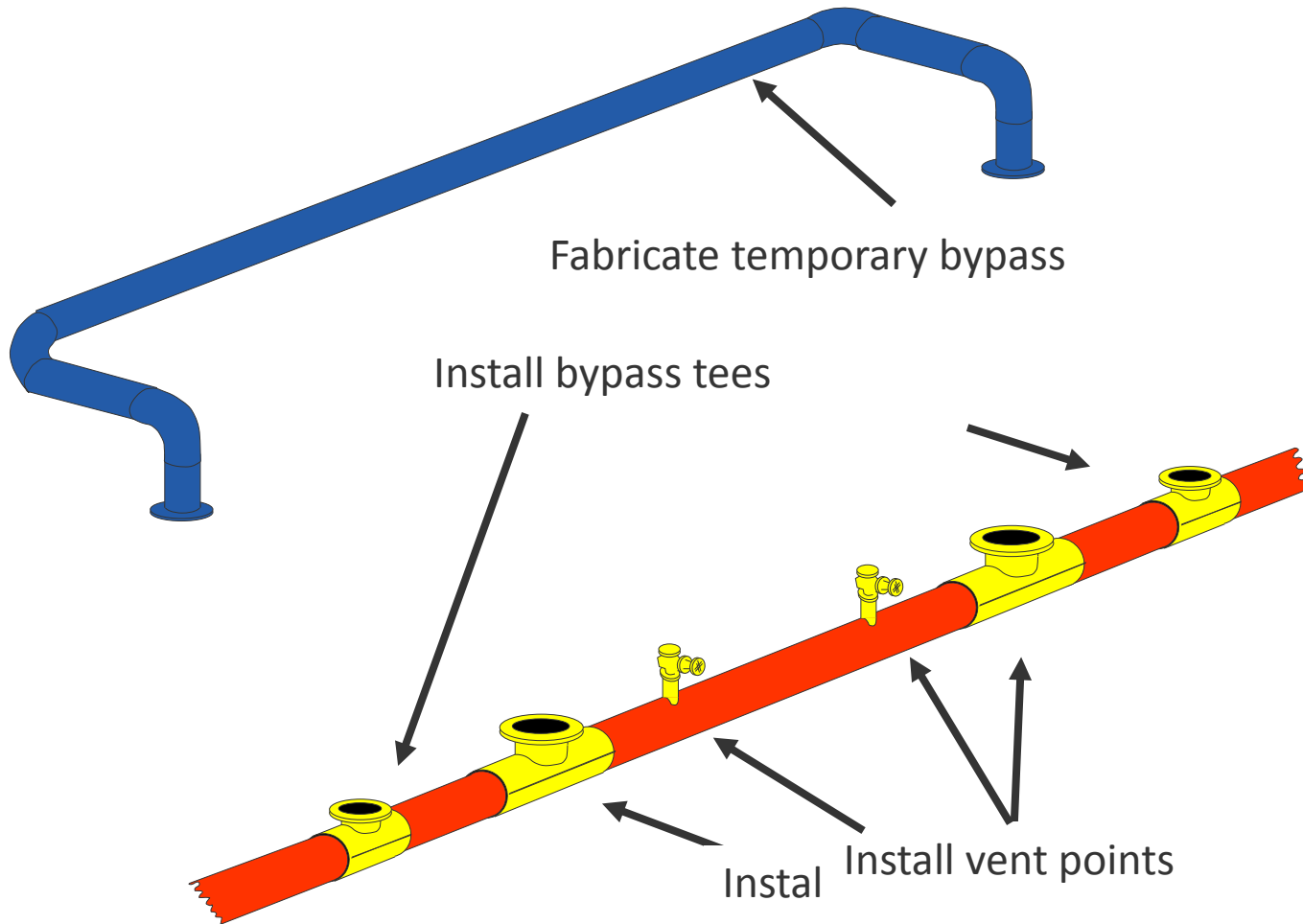




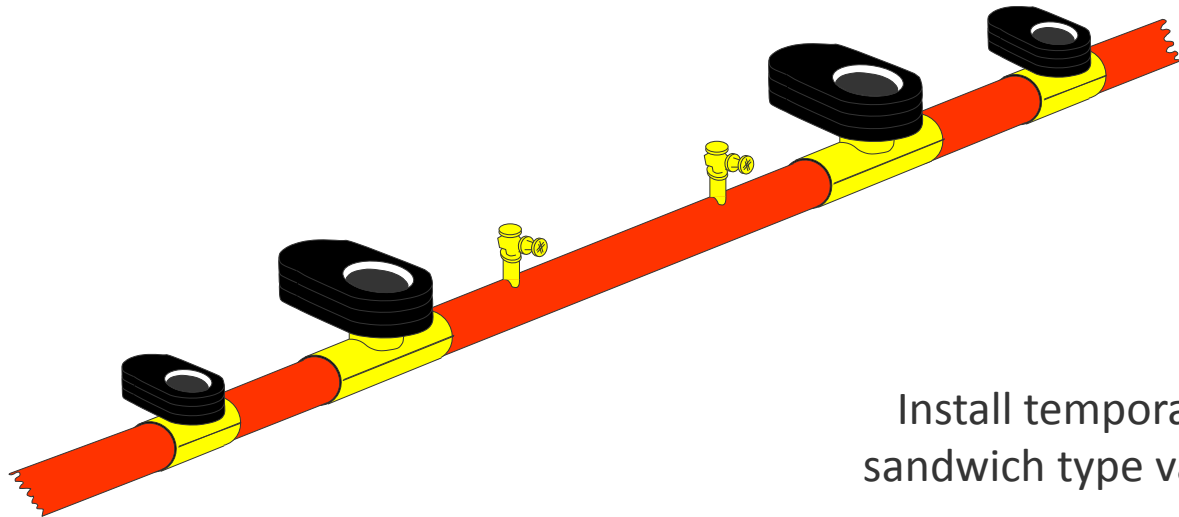
# Inflatable Bag Stop



## Two position linestop with bypass

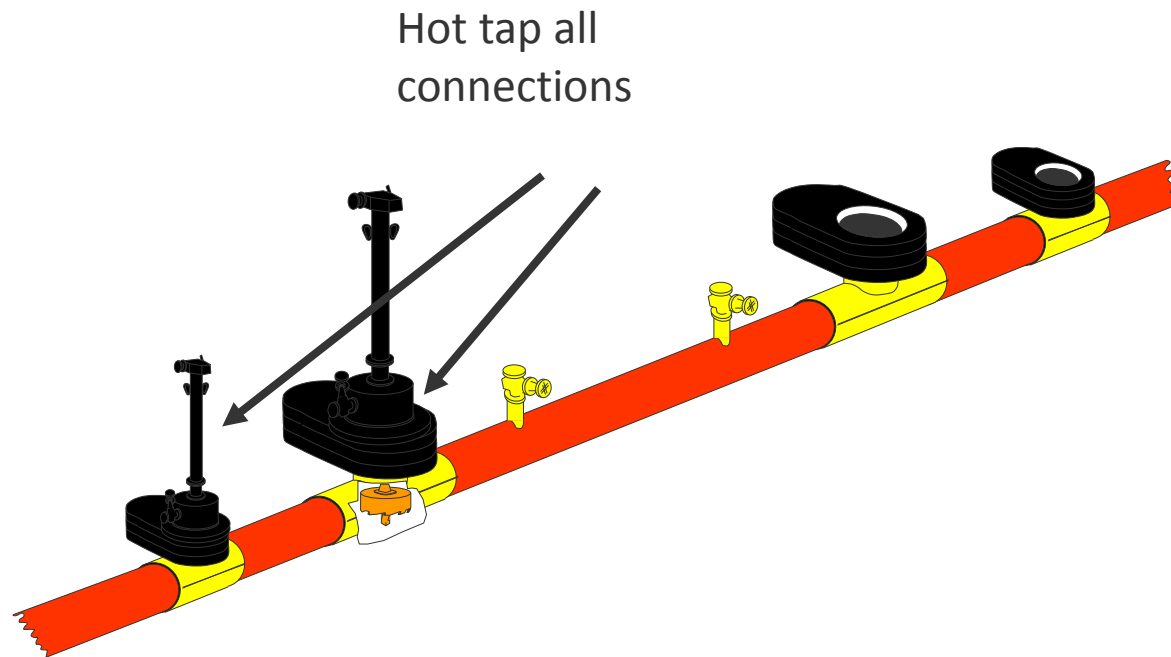


## Two position linestop with bypass

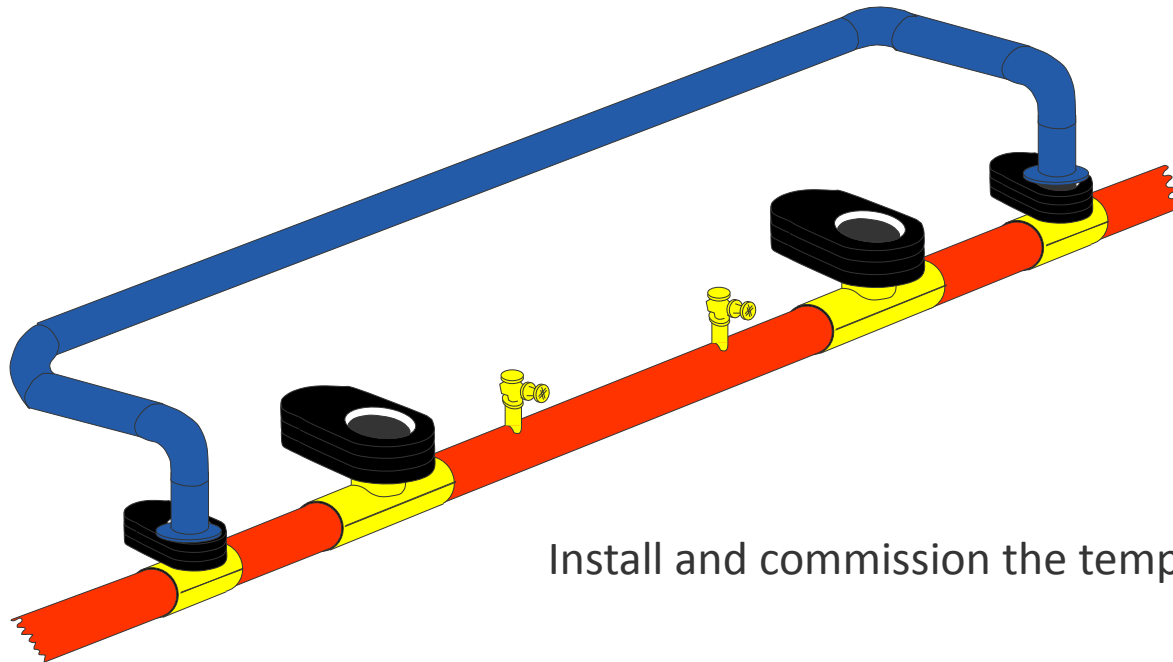


Install temporary  
sandwich type valves

## Two position linestop with bypass



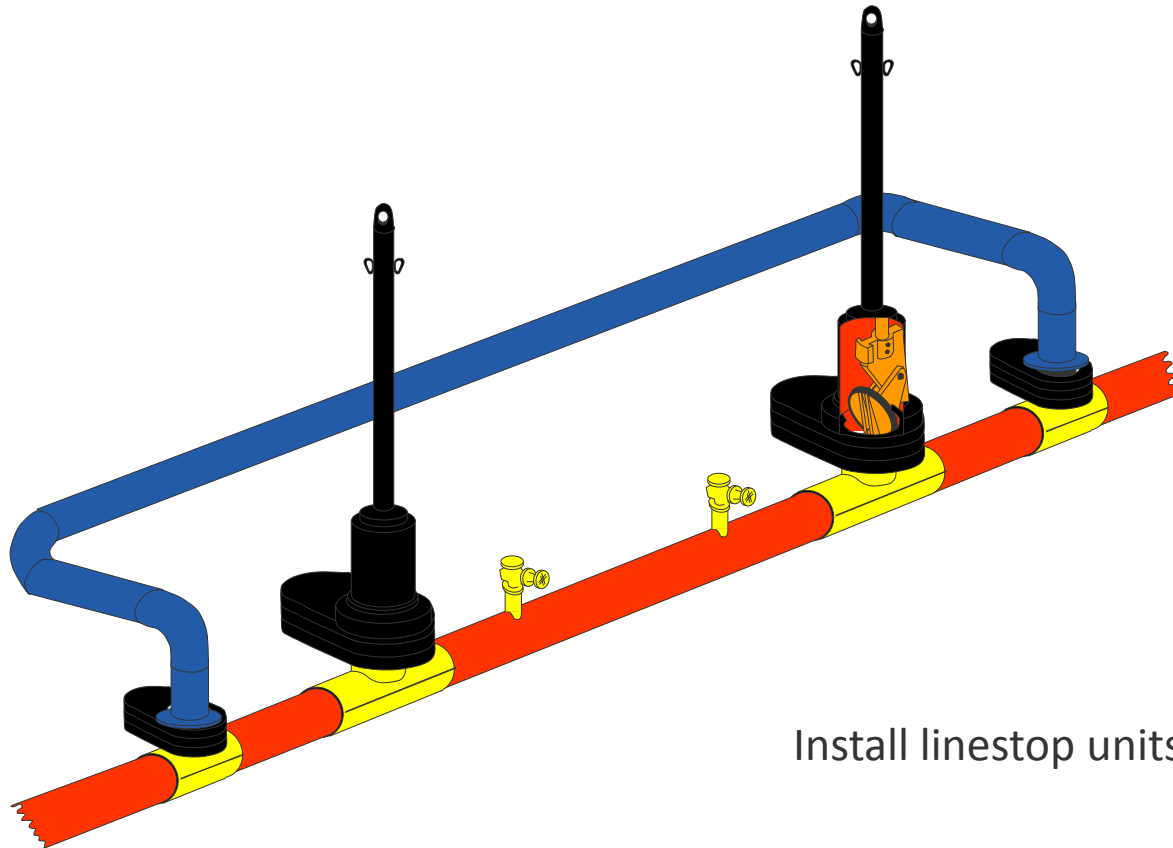
## Two position linestop with bypass



Install and commission the temporary bypass

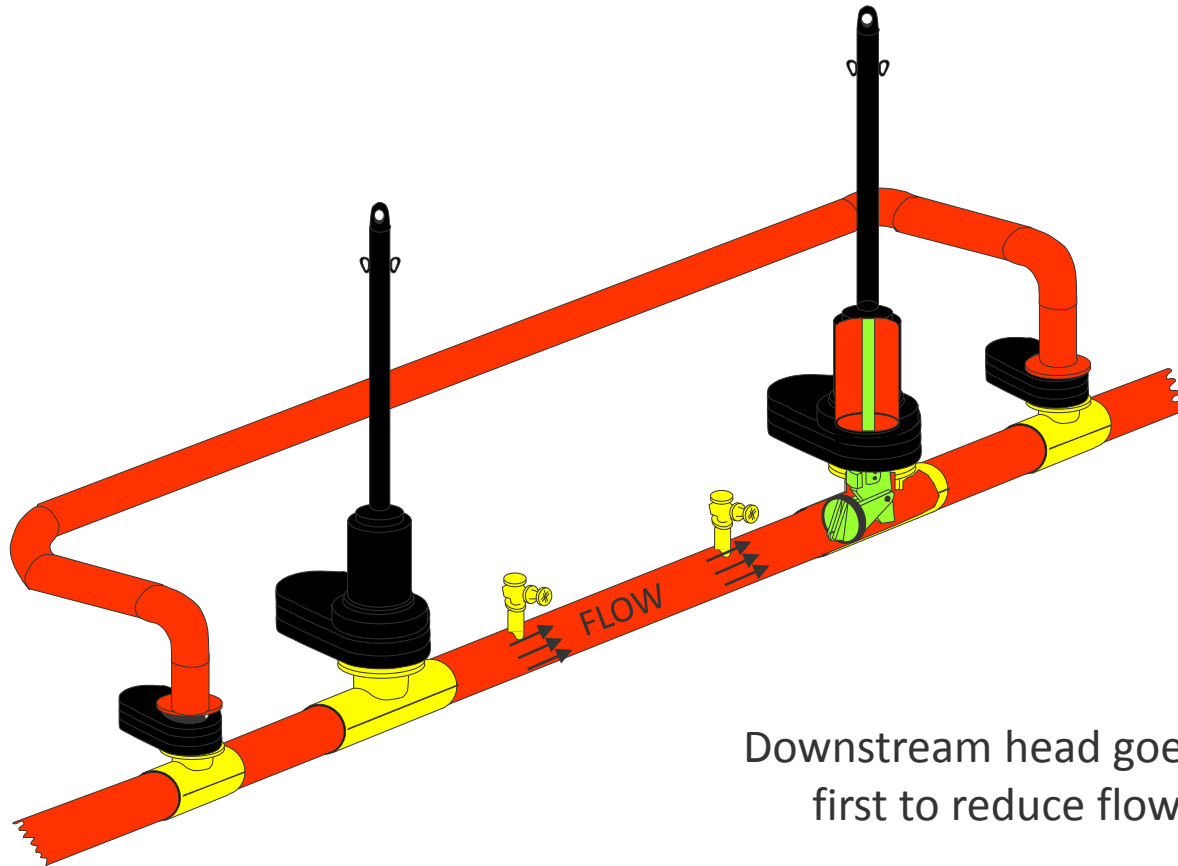


## Two position linestop with bypass



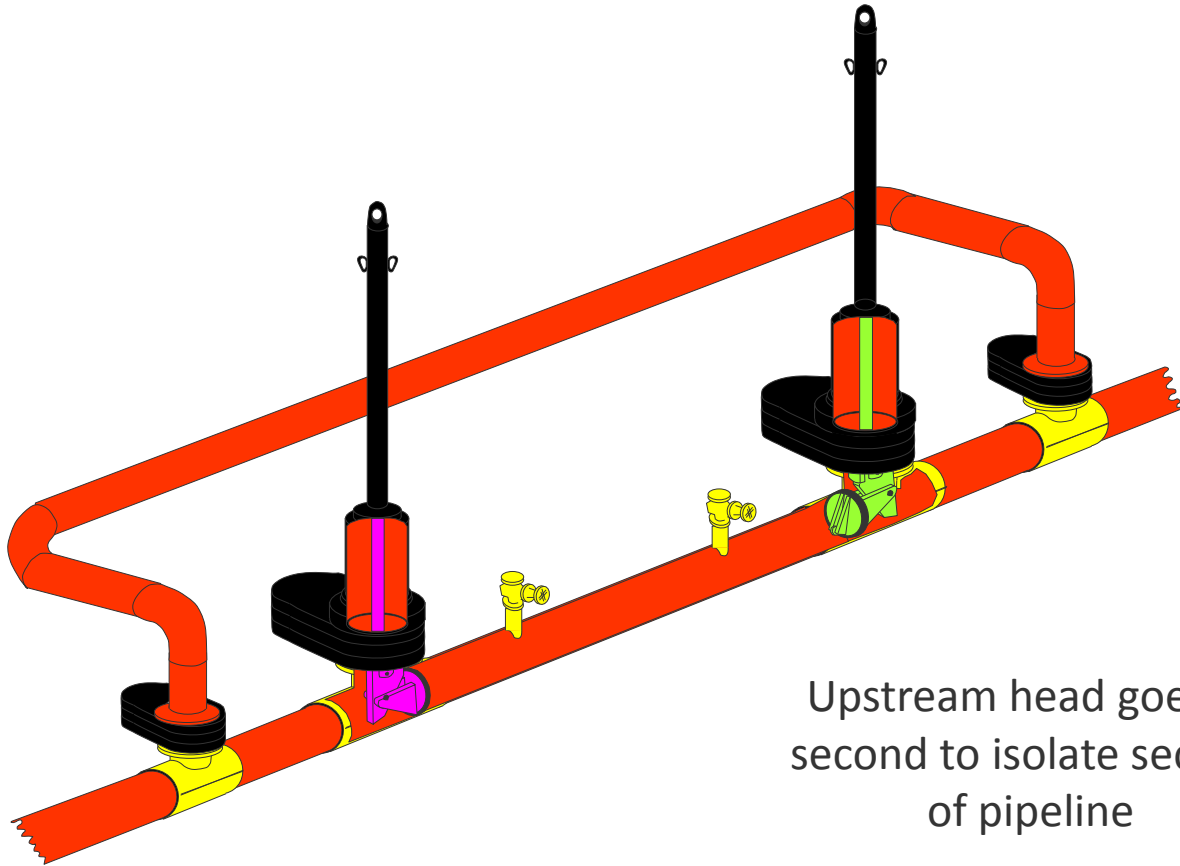
Install linestop units

## Two position linestop with bypass



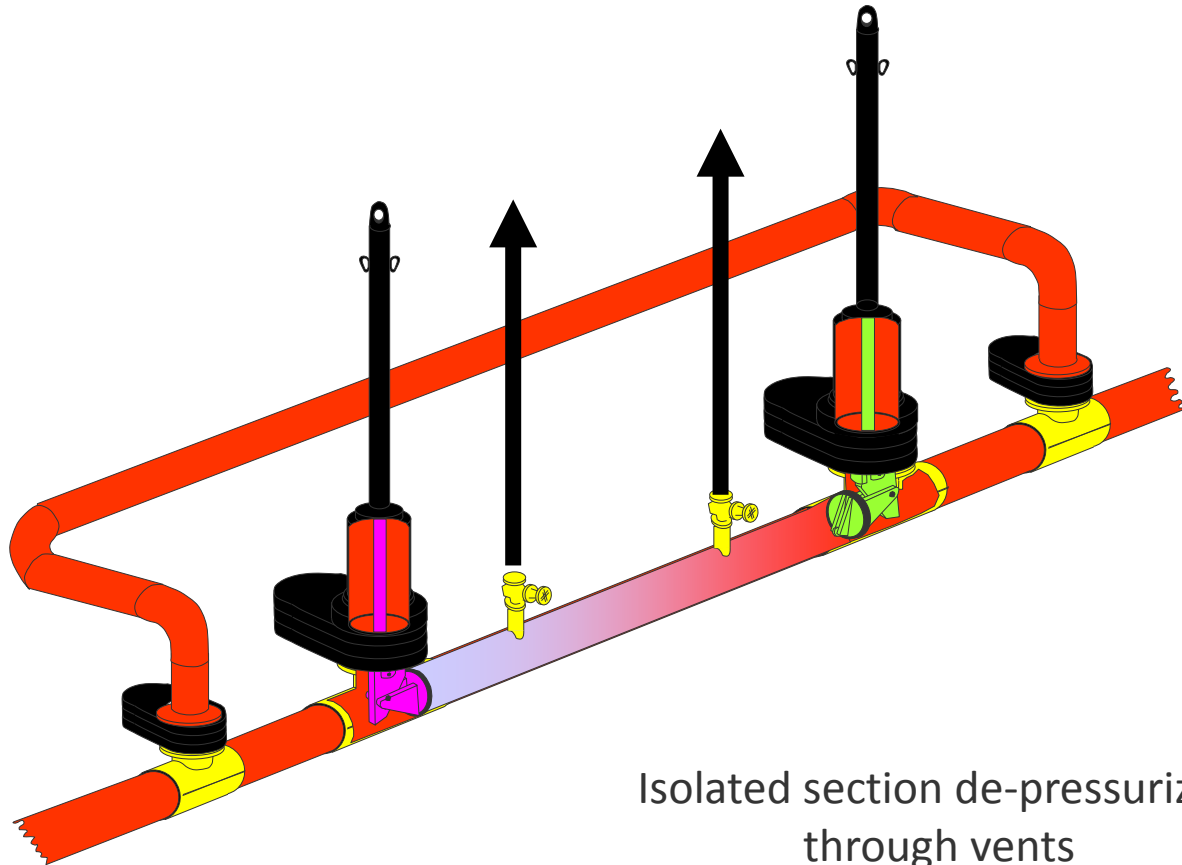
Downstream head goes in  
first to reduce flow

## Two position linestop with bypass



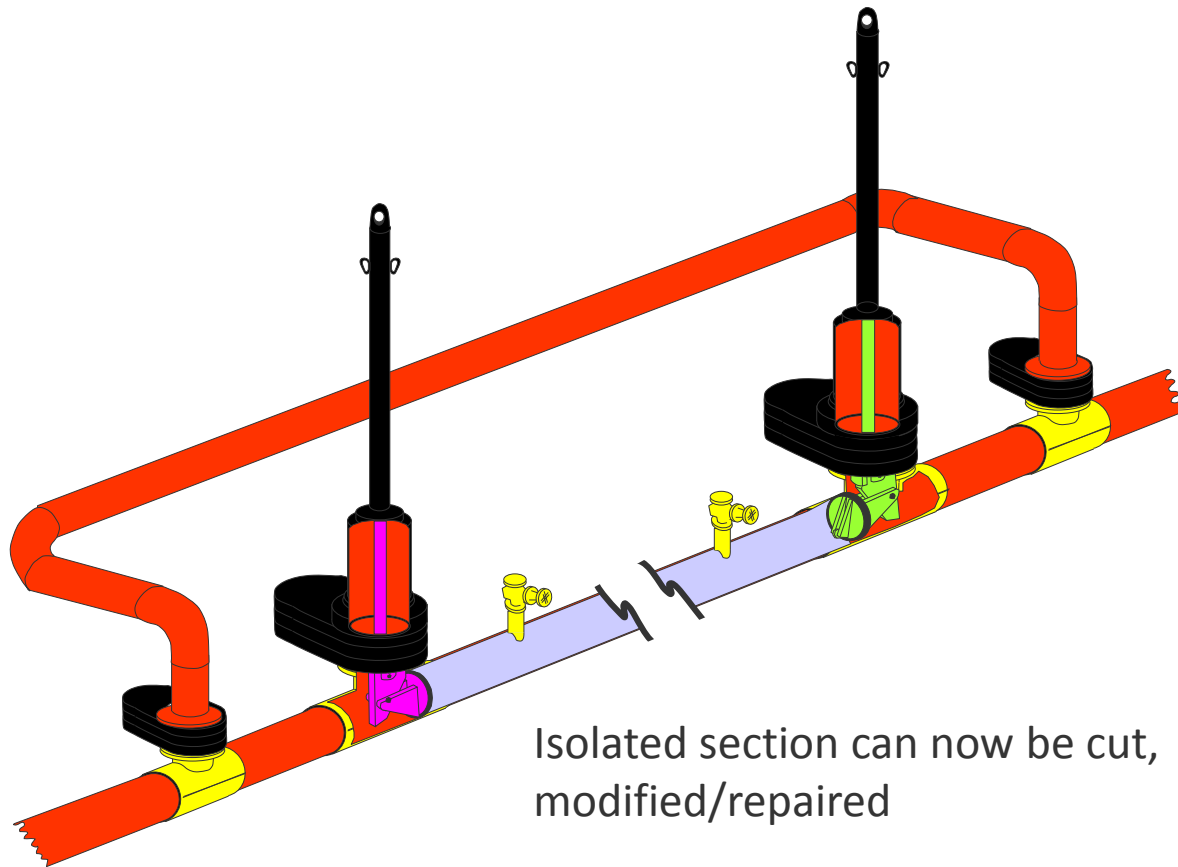
Upstream head goes in  
second to isolate section  
of pipeline

## Two position linestop with bypass



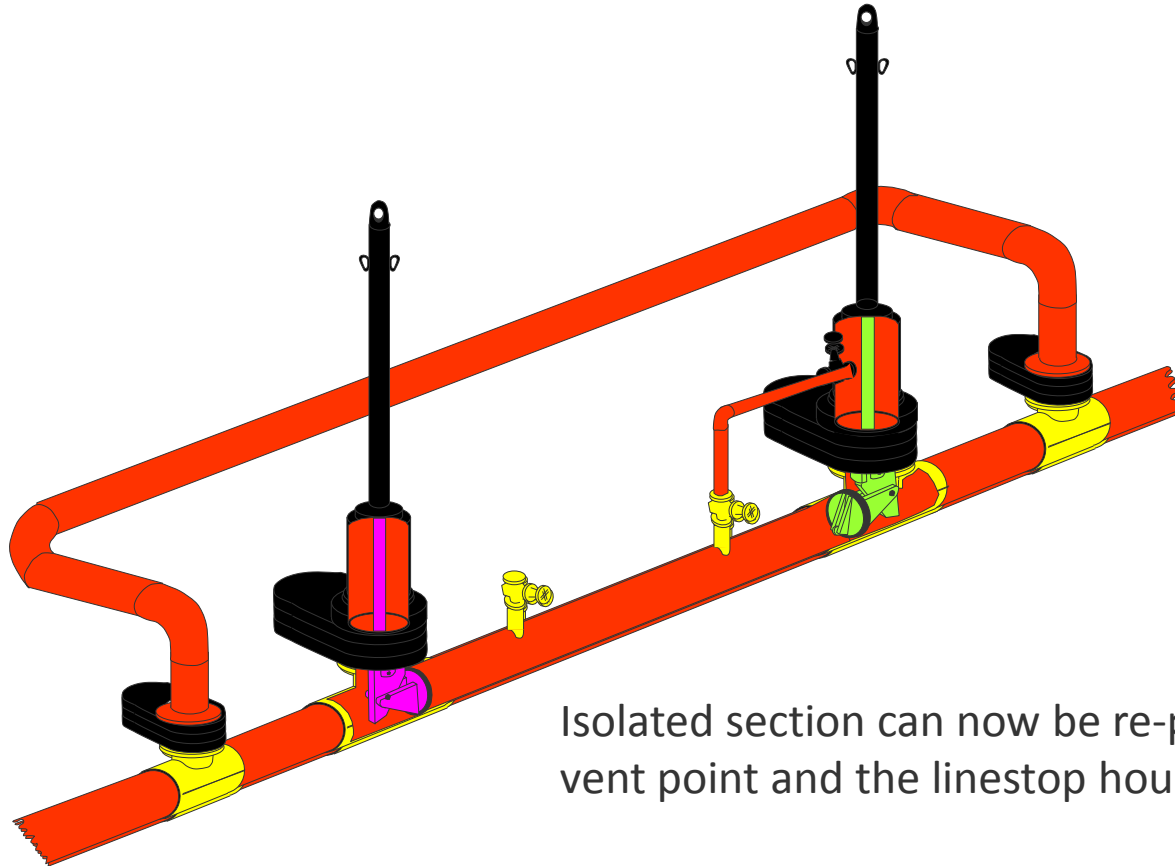
Isolated section de-pressurized  
through vents

## Two position linestop with bypass



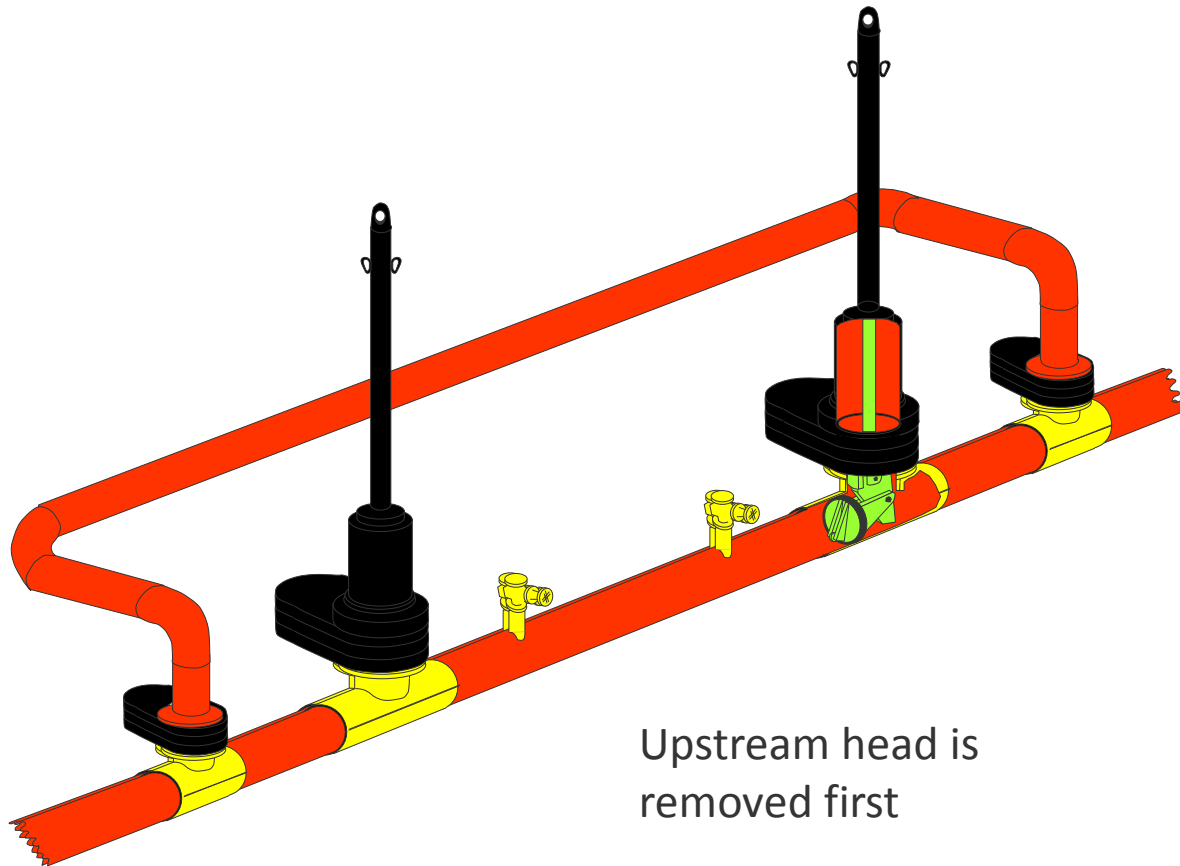


## Two position linestop with bypass

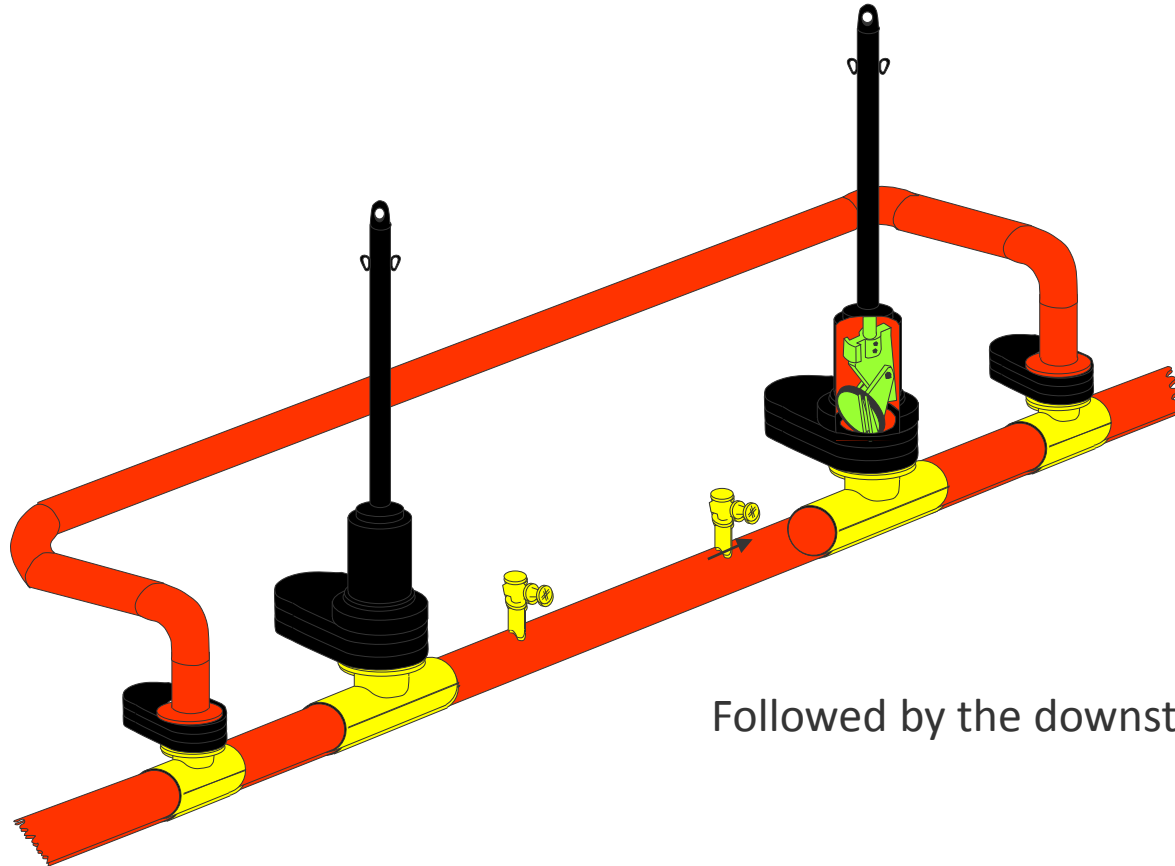


Isolated section can now be re-pressurized via the vent point and the linestop housing

## Two position linestop with bypass

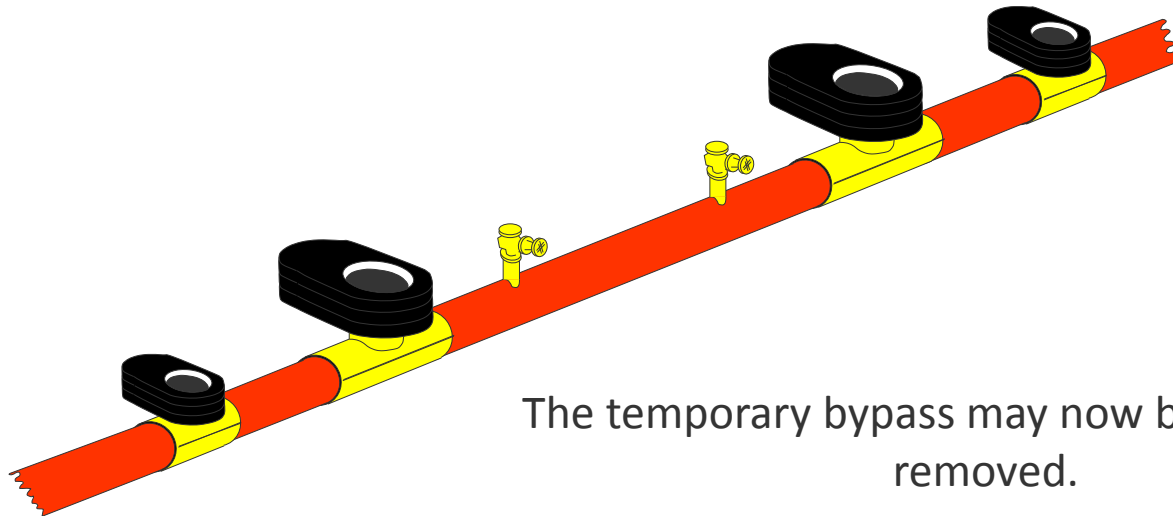


## Two position linestop with bypass



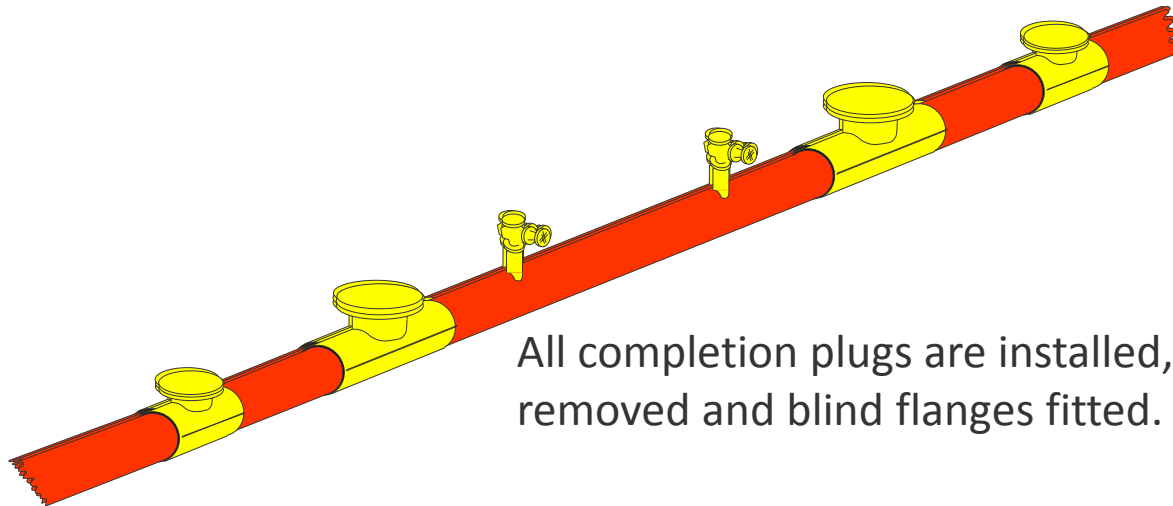
Followed by the downstream head

## Two position linestop with bypass



The temporary bypass may now be drained and removed.

## Two position linestop with bypass



All completion plugs are installed, temporary valves removed and blind flanges fitted.



# InsertValve™

## ➤ Applications

- Cooling water, chilled water, fire water, waste water, potable water, HVAC supply and return
- Including; Military bases, Hospitals, Airports, Municipalities, Universities, Power plants, Ski Resorts, Disney World

## ➤ Capabilities

- 4 to 12" up to 17bar (DI, CI, PVC, Steel)
- EPDM elastomers 140 degrees celsius.
- Nitrile elastomers are custom

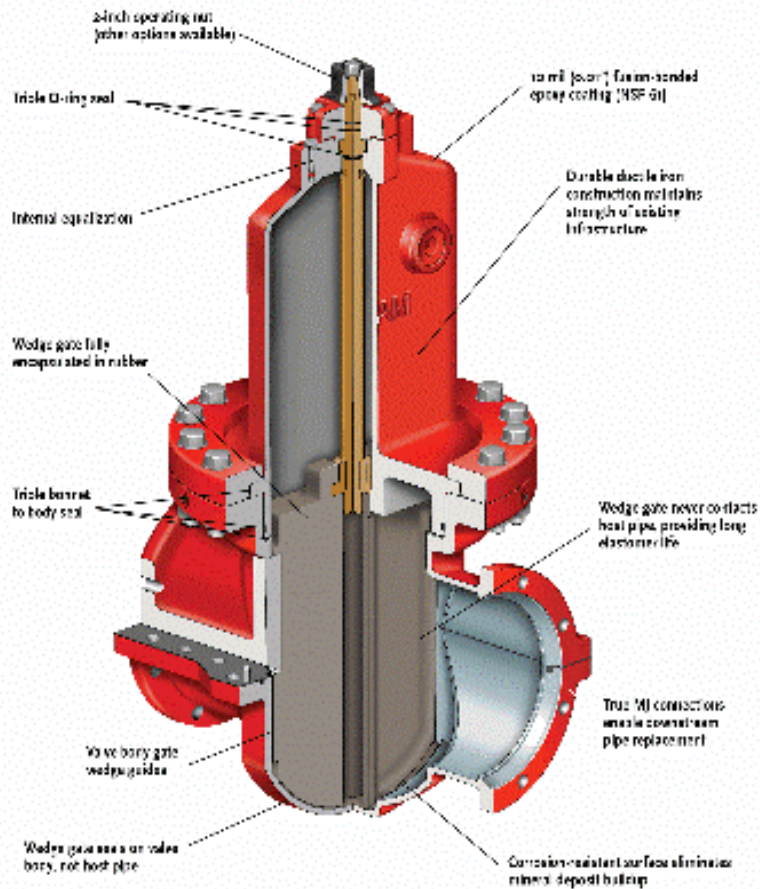
## ➤ Features

- Full functioning valve
- Valve gate seats on the valve body not the pipe
- Multiple functions once installed



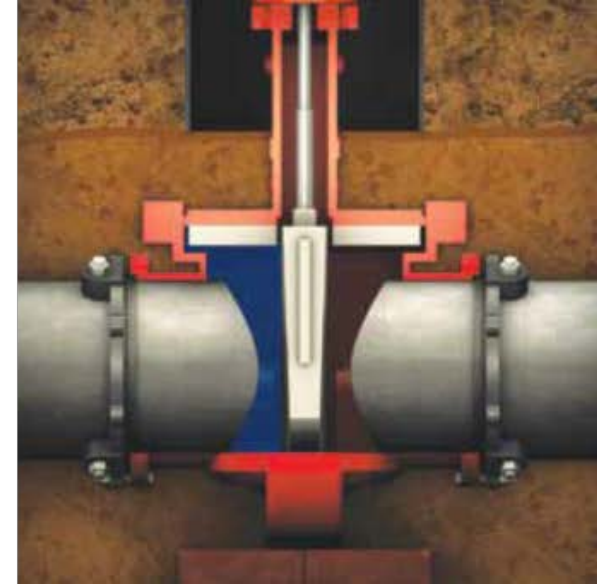
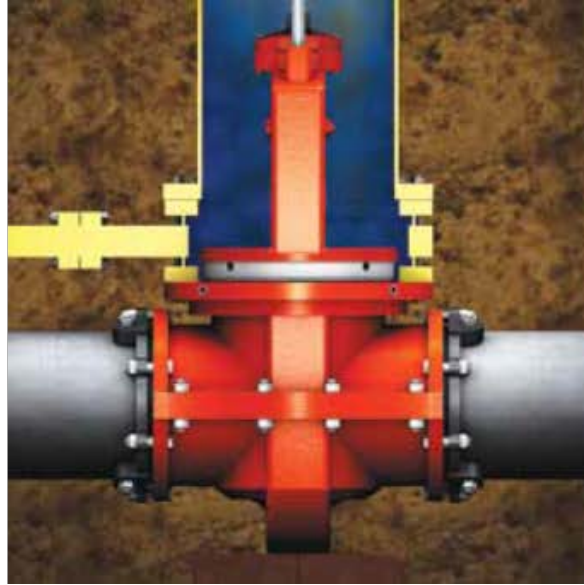
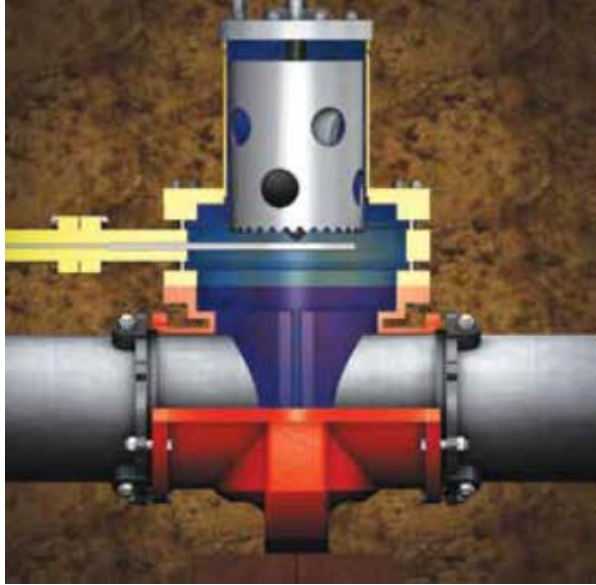
# InsertValve™

## TEAM® Industrial Services InsertValve®





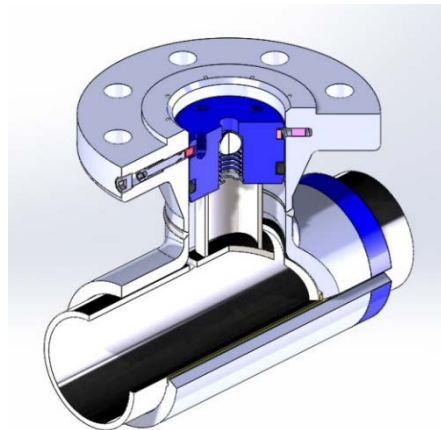
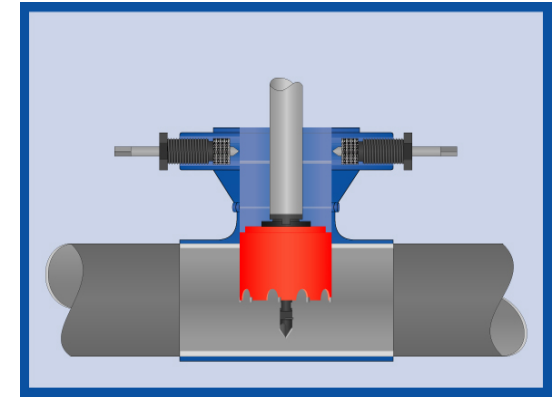
# InsertValve™



- The ductile iron body, bonnet and wedge provide strength and a pressure rating that meets or exceeds the requirements of AWWA C515.
- Insert Valve shall be ductile iron construction meeting ASTM A536 Grade 65-45-12. Heavy-duty ductile iron construction for maximum toughness and strength.

# Hot Tapping Services

- Hot Tap - ½" thru 48" up to 1350°F & 4,300 psi
- Line Stop - ½" thru 36" up to 1480 psi (Pivoting Head)
  - Folding Head 16" thru 84", up to 150 psi
- Hot Stop® - specialty elastomer to 700°F & 700 psi
- Hi-Stop® - applications up to 1,200°F & 2,600 psi
- Hot Tap and Line Stop Fittings
- Valve Insertions
- Line Freeze
- Bag Stops



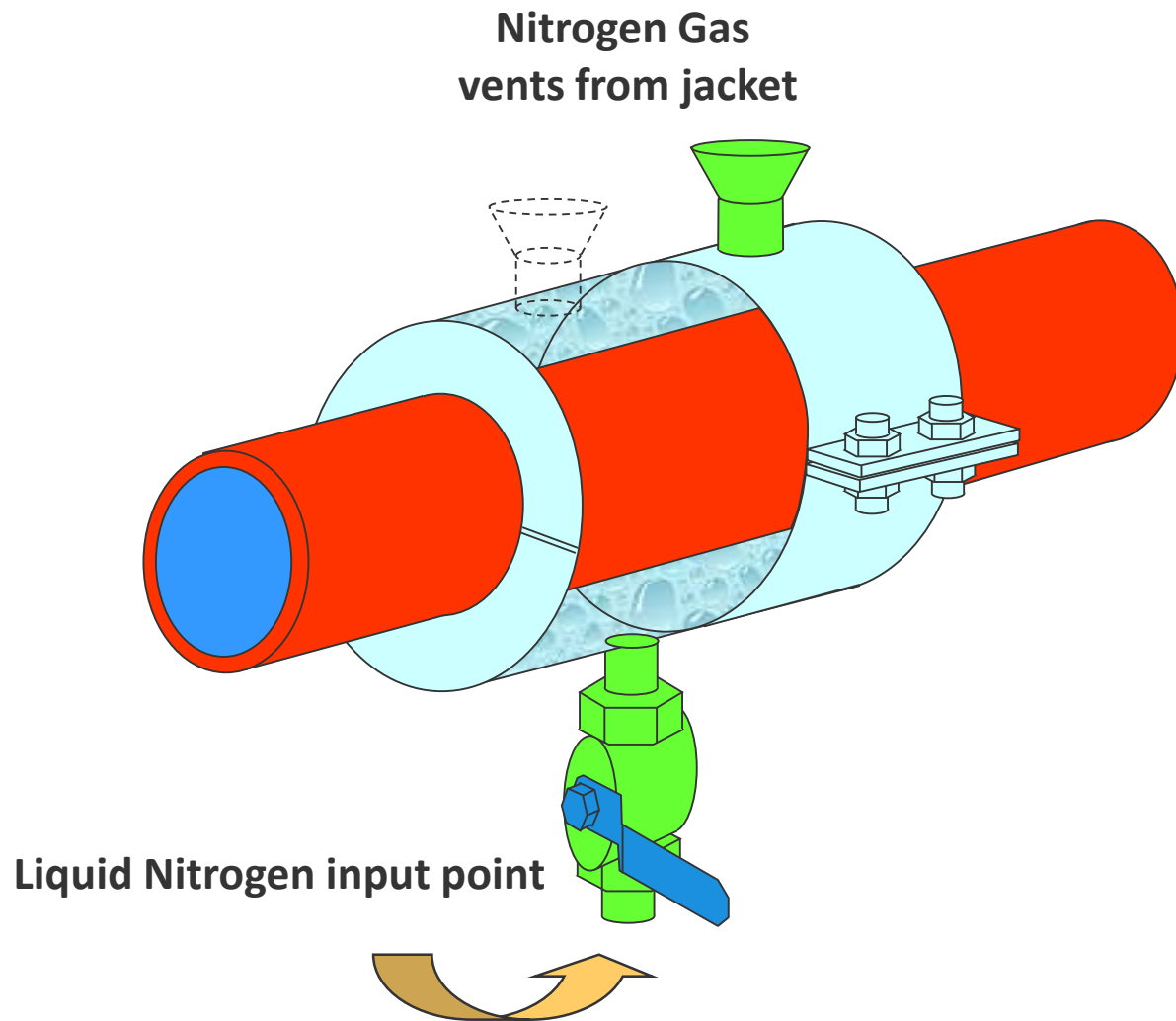
# **TEAM**® Industrial Services

## **PIPE FREEZING**

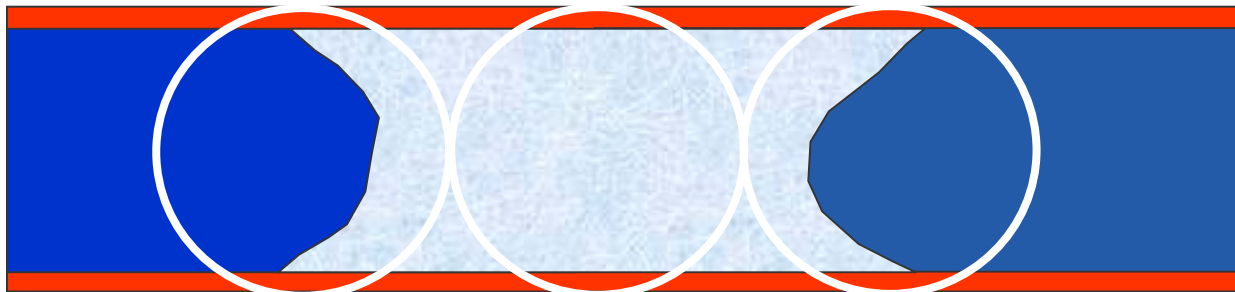


A method used for the temporary isolation of a line where the contents of the pipe are frozen to form a solid plug.





The resultant ice plug is made up of 2 to 3 pipe diameters.

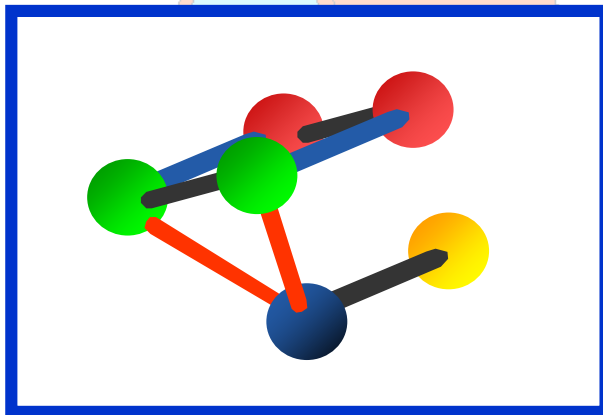
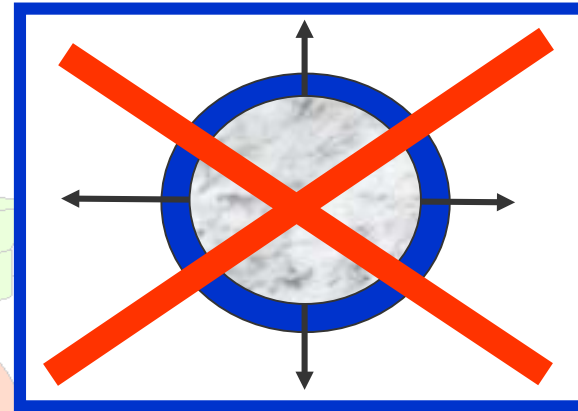


**The ice plug can withstand substantial differential pressures.**

**Ice plugs tested to 480 bar (7000 psi)  
Crude oil plugs tested to 103 bar (1500 psi)**



The strength of the ice plug is not gained from the ice pushing outwards against the pipe wall.....

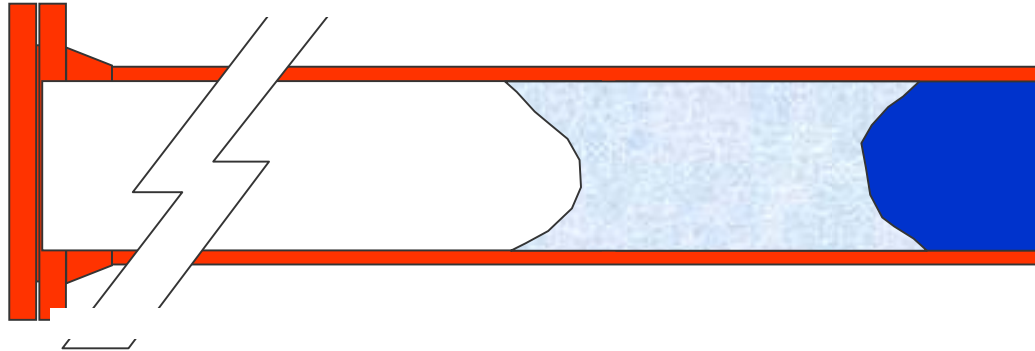


.....but from the molecular bond that occurs between the ice and the internal wall of the pipe.

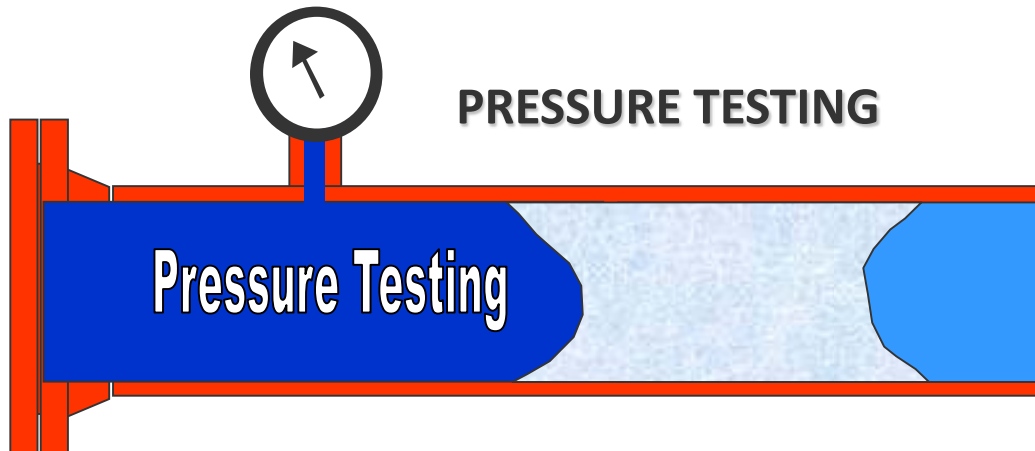


What can it be used for?

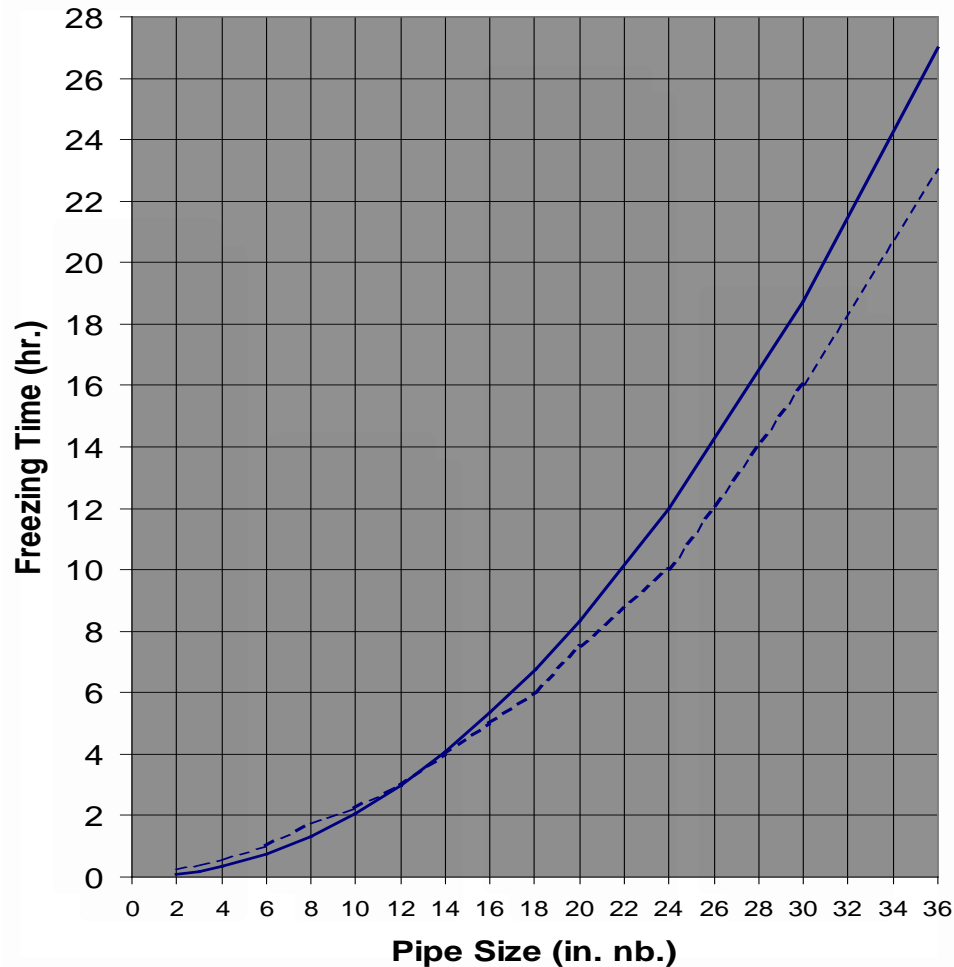
## MODIFICATIONS TO PLANT



## PRESSURE TESTING



### Plug formation.



- Reasonable estimation under normal circumstances.
- Will not apply at elevated temperatures close to maximum.
- Allow a 50% minimum margin for planning purposes.

## Heat Flux Instrumentation

- Heat flux sensor attached to the pipe surface, within the freeze jacket and immersed in liquid nitrogen

- A voltage reading data logger



# **TEAM**® Industrial Services

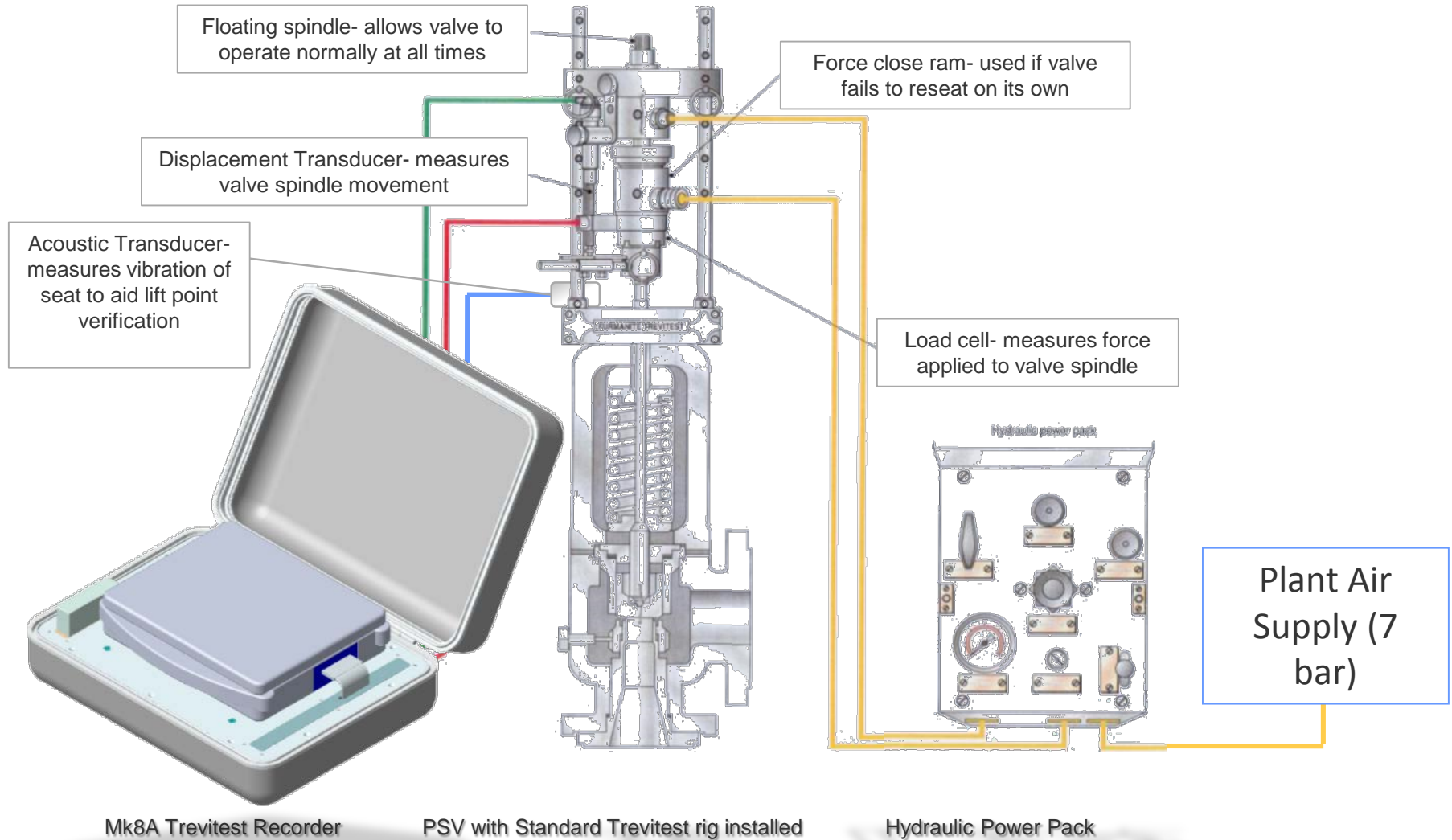
## **ON-STREAM RELIEF VALVE CALIBRATION**

# Tradition vs. Trevitest

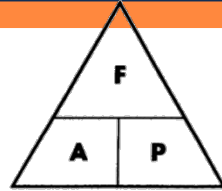
Method	System/Boiler Floating	Valve Removal and Service	Trevitest (on line)
<b>What happens?</b>	The system, boiler, tank or line is deliberately over-pressurised so that the valves are forced into a lift. Valves are selectively gagged	The system is isolated (or more commonly, shutdown). Valves are removed, sent for a full service and bench test before being re-instated.	The system continues to operate under normal load. Trevitest assist-lifts the valve and records the resultant set pressure.
<b>Advantages</b>	An accepted, historical method in many countries that encounters little resistance from clients and insurers	Bubble/ leak test possible	Plant operation is never disrupted.
		Internal valve inspection/ check possible	Can be used as a pre-outage test to minimise valve overhaul
	The best way of indicating blow down settings	Can clean valve internals	Does not gag or effect valve operation
			Allows testing of vent pipe-work
<b>Disadvantages</b>	can cause serious damage, shorten system life and cause safety risks due to overpressure	Down time will lose the client money	No internal visuals of valve components
	Gagging valves can cause serious safety risks	Full valve service is not always required	No accurate leak test (however acoustics do indicate this)
	Loss of line medium (cost and environmental risks)	Thermal cycling of plant.	
		Full flow, temperature or operating conditions are not emulated	



# The Equipment- Overview (Hydraulic Powerpack)



# Calculations



## TO DETERMINE SET PRESSURE

Set pressure = (force / MSA ) + line pressure

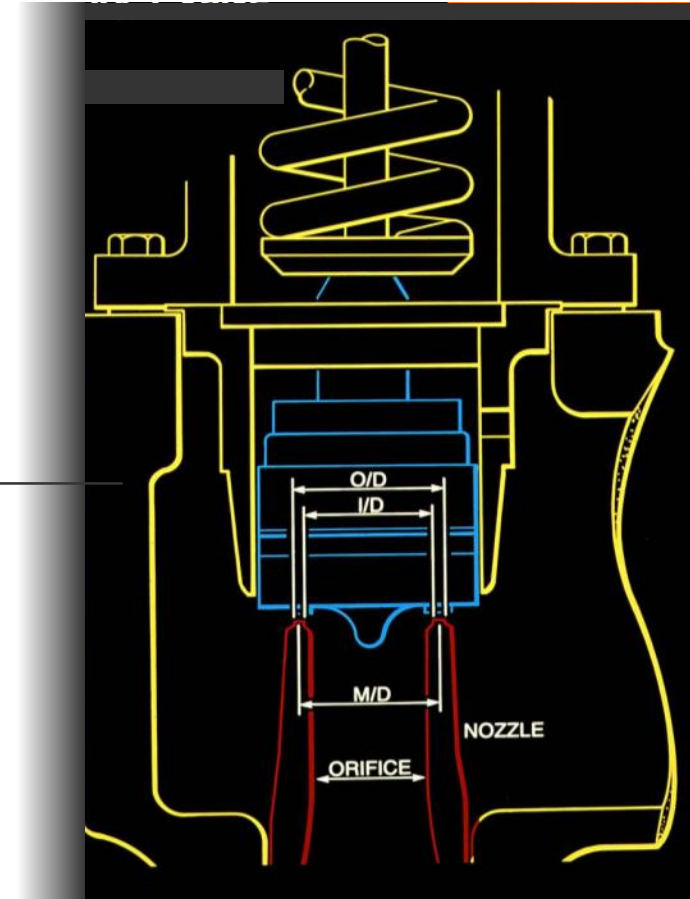
ie: 635.30 psi = (432.92lb/f / 2.330"² ) + 449.5 psi

- It is essential to us an accurate line pressure reading (calibrated)
- Any error in this value is accentuated by Trevitest
- It is advised that line pressure be 80% to 90% of set pressure at time of test

## TO DETERMINE THE MSA (Mean Seat Area)

$$MSA = \left( \left( \frac{ID + OD}{2} \right)^2 \pi \right) \div 4$$

- The Mean Diameter (MD) requires both the ID and OD
- The MSA is an essential value for Trevitest
- TEAM has a large catalogue of these values
- It must not be confused with 'orifice' or other values
- Different valve types can sometimes vary the equation used



# Summary

- On-stream maintenance & repair offer plant operators many advantages
  - + Cost Effective
    - Maximizing plant efficiency
    - Minimizes energy costs
  - + Safety First Quality Always
    - Offline maintenance can introduce hazards

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IMechE Hong Kong Branch  
Activity Sub-Committee  
Education and Training Group

## TECHNICAL SEMINAR

### On-Stream Maintenance & Repair – carrying out plant modifications, maintenance and repair without process interruption

**Hong Kong Branch**

Institution of  
**MECHANICAL  
ENGINEERS**



**Date:** 9 November 2017  
**Time:** 19:00 to 20:30  
**Venue:** N001, PolyU

With plant operators facing continual pressure to maintain the availability of assets, on-stream maintenance is more important than ever before. This presentation will educate the audience in technologies that can allow the operator to avoid unplanned or unwanted plant shut-downs.

#### About the Speaker:

Mr. Adam Thistlethwaite, Global Service Line Director of TeamFurmanite's On-Stream Repair Group, is a Member of the IMechE Pressure Systems Group board. A Chartered Engineer and Fellow of the IMechE, Adam also sits on the ASME PCC-2 Sub-Committee on Mechanical Repair. Prior to his current role he was Pressure Systems Technical Authority and Asset Integrity Manager (Surface Equipment) for Centrica Exploration and Production.

#### Free admission

For detail, please visit IMechE webpage or scan the adjacent QR code:

<http://nearyou.imeche.org/nearyou/north-east-asia/hong-kong/events>