A dark, atmospheric photograph of a ship's deck, likely a container ship, with shipping containers stacked high. The perspective is from the deck looking towards the superstructure. The lighting is low, creating a moody, industrial feel.

ENGINEERED PRODUCTS CATALOG

AUTOMATION iSHIP PENETRATION
SPECIALTY VALVES ACTUATION SOLUTIONS
PIPING SYSTEMS



CHOOSE W&O.

- We are there when you need us.
- North American footprint – 16 strategically located branches.
- 40 years as a reputable partner.
- Over \$45 Million in inventory.
- Automation experts with in-house design and fabrication.
- We represent top brands with the required certifications and registrations.
- Largest North American distributor of pipe, valves, fittings, and automation.
- Valve Services – ship checks and Engineered Solutions troubleshooting.
- Delivering new technologies and monitoring regulations to better serve our customers.
- Part of Pon, an \$8 Billion International Sales & Service Company.

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July 2015

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Application Chart

Product Brand	Profipress	Sanpress Inox	Seapress	Unipe	PureFlow Pex	iFit	Flex E & Grip E	Grip E-FP	PLAST/ COMBI
Application	Viela Profipress	Viela Sanpress Inox	Viela Seapress	Uponor	Viela	GF	Norma	Norma	Norma
Fuel Oil		X	X					X	
Lube Oil	X	X	X					X	
Sanitary Drains	X	X	X				X		X
Black Water		X	X				X		X
Grey Water	X	X		X	X	X	X		X
Potable Water	X	X		X	X	X	X		X
Bilge System			X				X		
Ballast System			X				X		
Compress Air	X	X		X		X	X		
Sprinkler			X						
Salt Water Cooling				X				X	
Fresh Water Cooling	X	X	X					X	
Exhaust Gas									
Hydraulic									
Heat Tracing									
Exterior Drains		X	X				X		
Tank Vent	X							X	
Sounding Tube			X					X	
Bunker Fuel									
Chemical Service		X							
Fire System			X					X	
Steam									
HVAC	X	X	X	X	X	X	X		
Engine Cooling									

Application Chart

Instaflex	GF	GF	PE-100	Seadrain	Rise Ultra	Rise NOFRINO	Slipsil	Amot	Amot	Actuated G valve	Quick Closing Valve	HS-ISO	HS-L 2383	HS IMO2	HS IMO2
X											X				
							X	X	X						
X				X											
X	X	X													
X	X						X								
X	X														
								X	X						
								X	X						
											X				
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												X			
													X		
													X		
														X	
															X

Introduction

W&O has been a leader in marine systems and solutions for nearly 30 years. Through our global presence, we are able to provide innovative, class-approved solutions focused on efficiency, safety and compliance to the world-wide shipbuilding and ship repair market.

W&O Engineered Products provide best in class technologies for many applications in the marine industry from yachts to offshore platforms to military vessels. W&O offers the technical expertise, service and training to ensure that our Engineered Products provide the best value for our customers. W&O Engineered Products focus on 3 areas:

- Marine Piping Systems: Increased efficiency and value in pipe material and mechanical joining methods.
- Penetration Systems: Safety and value in pipe and cable penetration sealing through bulkheads and decks.
- Specialty Valves: Specialized valve applications and solutions.

Marine valve automation and control requires specific products and knowledge to meet the rigorous conditions and safety considerations. W&O focuses on providing the specific products and innovative control systems designed to meet the most demanding applications. We provide a wide range of pneumatic, electric, and hydraulic actuation systems for all types of vessels and systems. From system design through assembly, commissioning and service we can meet virtually any marine valve automation need.

W&O now provides system based integrated solutions designed to meet emerging demands in the marine industry. From improved data management and vessel monitoring to regulatory compliance, W&O is developing systems to address the needs of the marine industry.

Shutdown System and Sensors

AMOT provides the marine, oil and gas, and many other markets with tailored design solutions for the control and monitoring engines, compressors and pumps.

AMOT has the technical capacity to advise what can and can't be used in your application, either providing you with the complete solution or working with your engineers to tailor your system.

Master Safety Shutdown systems are designed to shutdown an engine system quickly and safely, to minimize damage to the engine system and to prevent damage to surrounding equipment, personnel or structures/ facilities.

Shut off Valves

Diesel runaway is a potential problem that can cause damage to equipment. A diesel engine can runaway and self destruct on hydrocarbon vapors, even if the engine's primary source of fuel is taken away.

An air intake shutoff valve is recommended for diesel engines which have a possibility of encountering hydrocarbon vapors. The SpeedTrap™ 4261 Intake Air Shutoff Valves use the best available technology to shut down a runaway diesel by positively choking off engine intake air.

Overspeed Detection/Protection

Sensing engine speed and providing an electrical, hydraulic, or pneumatic signal and shutoff mechanism when the engine reaches a specific harmful set point.



Applications for Amot



Fuel/Lube Oil Shut-Off Valves 4164/1476 Fuel Shut-Off Valve

Operations of the Model 4164 is entirely mechanical, with lube-oil pressure used as the control medium. This feature eliminates the possibility of safety shutdown system failure due to vibration, corrosion or external (electrical) power failure.



2330 Temp. Valve

Protects engines, compressors, pumps, gear cases, and industrial machinery from over-temperature of: Lube Oil, Jacket Water Discharge Gases, Bearings or Packing

Fuel

Exhaust Gas

Lube Oil



Air Intake Shut-Off Valves 4261/4262 Air Intake Shut-Off Valve

The most compact design available that is easily installed and saves you money. It is available for manual, pneumatic, electric, or hydro mechanical actuation.

Applications:

- Oil field drilling rigs, mud trucks, wire line feeders, crude haulers, welders and other machinery

Fuel Oil
SteamLube Oil
Exhaust GasHeat Tracing
Fresh Water Cooling

Overspeed Detection 4110 Overspeed Sensing Valve

It uses a precision fly weight speed sensor to vent a pneumatic or hydraulic signal (via a built-in-two-way valve) at a preset RPM.



8210K Electronic Speed Sensing Switch

Dependable protection from overspeed conditions on engines and other rotating equipment in electric or electric/pneumatic systems.

Engine Cooling

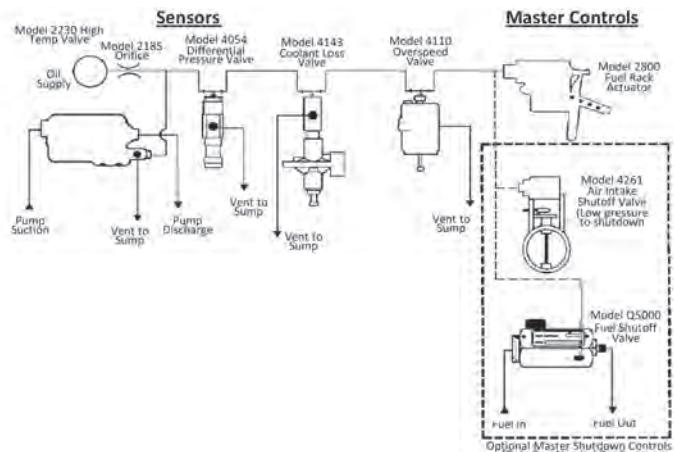
Shutdown System and Sensors

Features	Benefits	All Sensors & Controls	Overspeed Detection
Protection from Engine Overspeed	<ul style="list-style-type: none"> Prevents the degradation and failure of moving parts Prevents dangerous flash backs and explosions Senses a diesel engine which is being powered with combustible fumes from the air intake area and stops the engine from overheating 		✓ ✓ ✓
Wide Array of Mounting Options	<ul style="list-style-type: none"> Allows many parameters to be set in the field for customer flexibility Can be mounted in any position with field adjustable trip points Can be mounted in-line with existing tachometers on hydraulic or pneumatic systems 		✓ ✓ ✓
Lube Oil Operated	<ul style="list-style-type: none"> Fail-safe method of operation No electricity required Explosion-proof 		✓ ✓ ✓
Anodized Aluminum Finish (Gulfproofed)	<ul style="list-style-type: none"> Corrosion resistant Compatible with marine applications 	✓ ✓	✓ ✓
Heavy Duty Construction	<ul style="list-style-type: none"> Vibration resistant No wires to break or corrode No special enclosures or housings required Compact and rugged construction 	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Flexibility	<ul style="list-style-type: none"> End devices to monitor every condition Fuel, intake air, or injection pump shutoff Complete engine protection systems available from AMOT 	✓ ✓ ✓	✓ ✓ ✓
Easy Installation	<ul style="list-style-type: none"> Uses standard hose and fittings Quick and simple, no special tools required 	✓ ✓	✓ ✓

Benefit Focus

W&O and Amot can work together to supply you with the necessary system to keep your diesel engine protected.

Note: In a typical system, engine lubricating fluid is fed through an orifice to high jacket water temperature sensor 2230, then to water pump differential sensor 4143, then to overspeed sensor 4110. All sensors except the Master Shutdown Device vent oil back to the engine sump when they are tripped.



Type Approval by Agency



Shutdown System and Sensors

Amot Complete System

The system is fail-safe, because breakage of an oil pressure line, excessive oil leakage, or a plugged orifice will cause engine shutdown.

- Master shutdowns must be latched in run position to start engine.
- Engine oil pressure arms the master shutdown device.
- Sensors vent oil tripping the spring actuated master shutdown device.
- Loss of engine oil pressure causes shutdown.

System Components

4164/1476 Fuel/ Shutoff Valve  <ul style="list-style-type: none"> • Trips on low oil pressure • Simple tamperproof design • Easily installed 	4050/4054 Sensor Trip Indicator  <ul style="list-style-type: none"> • Pinpoint tripped sensor • Wide pressure range • Sensor or panel mounting • Oil or air actuated 	4064 Differential Pressure Sensing Valve  <ul style="list-style-type: none"> • Protect pump • Shutoff on low differential pressure between pump suction & discharge 	4261/4262 Air Intake Shutoff Valve  <ul style="list-style-type: none"> • Trips on low oil pressure • Quick positive shutoff • Light weight • Best method of shutdown for hazardous atmospheres
2800 Fuel Rack Actuator  <ul style="list-style-type: none"> • Trips on low oil pressure • Manual stop handle • Constructed for rugged use • Immediate shutdown of fuel at fuel rack (no fuel in fuel line) 	2230C/4155 Coolant Temperature Sensor  <ul style="list-style-type: none"> • Compact rugged design • Brass construction • Factory preset, field adjustable • Auto reset 	2330 Temperature Valve  <ul style="list-style-type: none"> • Lube oil or jacket water • Air temperature • Field adjustable 	4110 Overspeed Valve  <ul style="list-style-type: none"> • Manual or pneumatic reset • Rugged construction • Lifetime ball bearings

Mechanical Overspeed Valves

AMOT 4110 Overspeed Valve

- For dependable protection from overspeed for engines and rotating equipment
- Available settings from 800-4200 RPM
- Trip point is field adjustable
- Operates in hydraulic or pneumatic systems
- Can be mounted in any position and in-line with existing tachometer cable
- Has several mounting extensions and adapters including flexible shafts and 90° cable drives
- Body is constructed with anodized aluminum
- Internals are constructed with stainless
- Applications: Offshore, Oil & Gas, Marine, Oil Spill Recover, Gas Transmission

AMOT 8210K SpeedTrap™

- Is for dependable protection from overspeed conditions on engines and other rotating equipment in electric or electric/pneumatic systems
- Monitors RPM via AMOT magnetic pickup
- Can also monitor alternator pulse signal
- Trips when RPM exceeds set-point
- Adjustable using 67% speed test circuit
- 12 or 24 volts power source required
- Built in 5 amp relay
- Compact weatherproof design
- Installation kit available

Shut-off Valves

AMOT 4262 Air Intake Shut-off Valve



- Runaway/Overspeed shutdown of small diesel engines powering the following equipment
 - Oil well pump jacks, blowers, welders, hydrostatic power packs, marine engine.
- Installation
 - Turbo charged engines - Model 4262 is installed after the engine's intake air filter, on the inlet side of the turbo charger as close as possible to the turbo's inlet.
- Operation
 - It is manually cocked into the open position prior to starting the engine. To stop the engine in an emergency it can be actuated pneumatically, hydraulically, and electrically.

Shutdown System and Sensors

Choose Your System

Master Safety Control: (Only one required)

- 2800D002 - Fuel Rack Actuator Valve: Lube Oil Operated
 - Special setpoints other than 15 psi optional
- Q500 - Fuel Shutoff Valve: Lube oil operated.
Model No. Q5000 - inlet code - outlet code
 - Connections

Inlet (Female)	Inlet Code	Outlet (Male)	Outlet Code
12 x 1.5mm	A	12 x 1.5mm	A
14 x 2.0mm	B	14 x 2.0mm	B
1/4" NPT	C	1/4" NPT	C
14 x 1.5mm	E	14 x 1.5mm	E
10 x .99mm	F	10 x .99mm	F

- 4261 - Air Intake Shutoff Valve; Lube Oil Operated
Model No. 4261BO_A041
 - Size

Option (Size)	Code
2.8"	2
3.5"	3
5.5"	5
7.0"	7

Note: Model 4261 is used in hazardous areas where hydrocarbon vapors or combustible dusts are present. A diesel engine can runaway and selfdestruct on hydrocarbon vapors or combustible dust even if the engines primary fuel source is taken away: Model 4261 meets MMS CFR 250.80 and 250.100 required on offshore platforms.

Sensors: (As many as desired)

- 2230 - High Temperature Sensors.
Model No. 2330D120_N
 - Temperature ranges:
- Special extensions - other than 1-3/8" installed depth can be special ordered
- Special temperature - other than those listed under section (a) can be special ordered
- For a SS version of this valve, use model 4430 valve
- 4143 - Coolant Loss Valve
Model No. 4143A001
Setpoint must be specified
- 4110 - Overspeed Valve
Model No. 4110B2U20F
Comes with adjustable range from 1201-4200 rpm
- 4064 - Differential Pressure Sensing Valve
Model No. 4.4064B_2_

Pressure Ranges:

Increasing	Decreasing	Codes
5-35 psi	5-35 psi	1 A
25-125 psi	25-125 psi	2 A
90-285 psi	90-285 psi	3 A
20-215 psi	50-250 psi	4 B
50-580 psi	100-650 psi	5 B

*Viton seals can be special ordered.

Other Products By Amot

4075 & 4087 Exhaust Temperature Sensors

- Stainless steel thermo wells
- Automatic reset - 4075
- Manual or pneumatic reset
- 4087
- Viton seals



4143 & 4047 Differential Pressure Sensors

- Rugged anodized aluminum
- Construction
- Detects coolant loss or pump failure



4054 Sensor Trip Indicator

- Pinpoints tripped sensor
- Wide pressure range
- Sensor or panel mounting
- Oil actuated



4155 Temperature Sensing Valve

- Fast response
- Easy installation
- Adjustable 16°C - 120°C (61°F - 248°F)
- Virtually no maintenance



4021 Temp. Sensing and Low Temp. Alarm Valve

- Valve port overlap - efficient mixing
- Pressure can be applied to any port
- Long life
- Bubble tight seals - leak-free operation
- Easy installation and low maintenance



4102 Temperature Detectors for Moving Bearings

- Instant response, reliable protection
- Compact design, easy installation
- Long life



Note: These and other products are available upon request.

Actuation

W&O's Engineered Products – Automation Services (EP/A) Division provides specialized marine industry products such as valves, valve actuators, actuator controls, overrides, certified valve performance packages plus network interface devices and field service to the 18 W&O Branches and their customers.

EP/A has the unique ability to serve as a "single source" provider of automated valve solutions enabling the W&O to offer a complete package to the marine industry meeting all Society requirements.

Actuation provides operators the ability to control valve movement for many vessel processes. This control can be for both open and closed operation as well as modulating (throttling) operation for all types of valves. We offer many different actuators with performance parameters and designs to meet marine industry's service requirements and challenges.

In addition to automated packages W&O also offers design, assembly, testing, start up and repair as part of our value added services. From a single valve in a remote location to a complete cargo or ballast transfer system, W&O can fulfill all your actuation needs.

We are a stocking distributor for electric, pneumatic, hydraulic, and manual valve actuators. Our facilities in Houston, TX and San Diego, CA include a fully staffed automation shop and overhead crane capabilities. Our inventory size allows sales of all popular actuator types and sizes, as well as most optional accessories and control kits. We currently operate in 16 branches in North America. and 2 in Europe.

Master Control System



Local Control



Positioner and Controller



Actuator



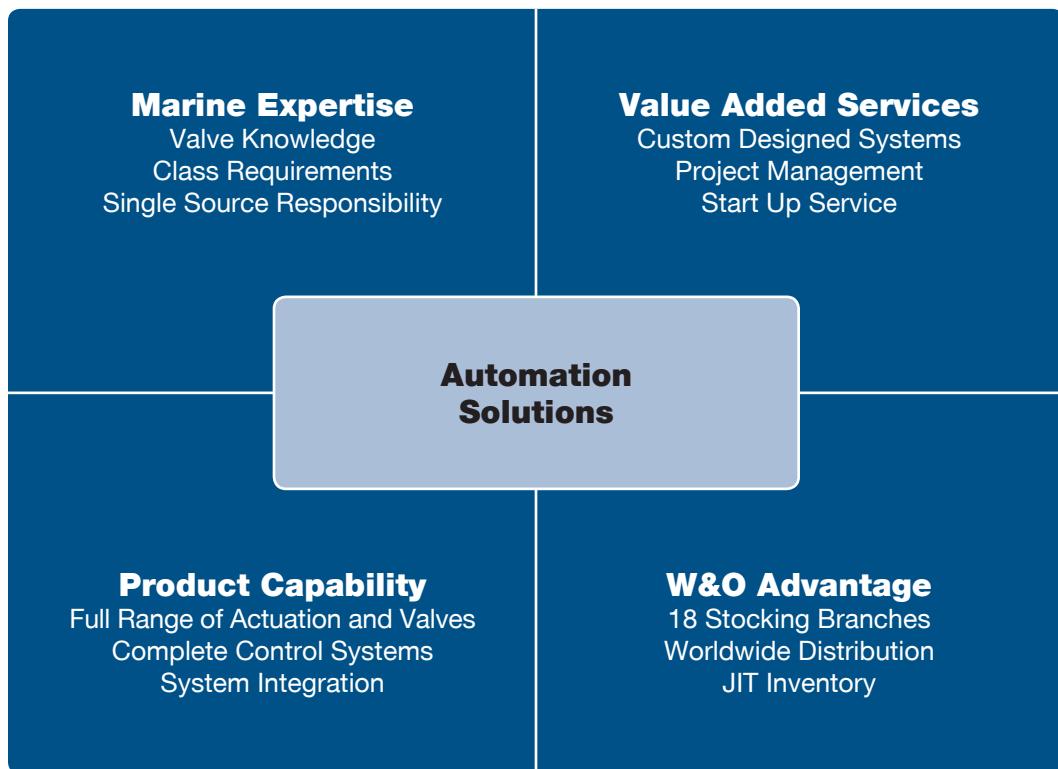
Valve

Actuation

Advantages of Popular Actuation Types

Actuation Type	Advantage
Double Acting Pneumatic	<ul style="list-style-type: none">Inexpensive application solution for a variety of quarter turn valves
Spring Return Pneumatic	<ul style="list-style-type: none">Provide failsafe operation in case of loss of air, power or both
Rotary Electric	<ul style="list-style-type: none">Advanced control capabilities and single power requirement
Linear (Hydraulic or Pneumatic)	<ul style="list-style-type: none">Economical actuation for rising stem valves
Self Contained Hydraulic	<ul style="list-style-type: none">Actuating high torque applications with no additional piping component

Benefit Focus: Why choose W&O for your automation needs?



W&O has the capability to design and provide custom solutions for our clients. We design solutions for virtually any automated valve assembly or application, and are capable of completing the conversion of manual valves into automated valve system per customer specifications.

We offer analog or digital two-wire controls that interface with most major SCADA or DCS systems. We are your most knowledgeable source for Mil Spec and DOD actuators. Our Automation division provides instrumentation products and control valves to meet your needs.

Type Approval by Agency



Note: Our custom actuation solution can be catered per your class society requirements.

Actuation

Technical Information

Electric Actuation Capabilities:

- Linear or Rotary Applications
- 110/220vAC-1Ph, 220/380/440/460/480vAC, 3-Ph, 50/60Hz, ±10%
- 24vDC, 24vAC
- 4-20mA, 0-10vDC, 1-5vDC, 0-135Ω Command Signal
- 4-20mA Position Feedback Transmitter
- Local Control Unit
 - Remote / Local Switch
 - Open / Stop / Close
- Weatherproof Enclosures & Explosionproof Enclosures
 - NEMA 4, 4X, 6, 7; IP 67, IP 68
- Fail in Place, Spring Return, & Battery Backup Units
- Network based automation solutions
 - AS-i
 - ModBus
 - DeviceNet
 - FieldBus



Pneumatic Actuation Capabilities:

- Linear or Rotary Applications
- Rack & Pinion, Scotch Yoke, & Piston Type
- Double acting & Spring return Units
- Accessories
 - Solenoid valves
 - Limit switches
 - Positioners
 - Declutchable gear override
- Network based automation solutions
 - AS-i
 - ModBus
 - DeviceNet
 - FieldBus



Hydraulic Actuation Capabilities:

- Linear or Rotary Applications
- Helical, Scotch Yoke, Rack & Pinion, & Piston Type
- Double acting & Spring return Units
- Direct / Indirect position indication
- Solenoid Cabinet, Hand Pump, Declutchable manual gear
- HPU - Hydraulic Power Unit



Actuation

Technical Information



Emergency Pneumatic Automated Valve Solution:

- Pneumatic Configurations
Incorporating the optimum in positive shutoff valves, low profile actuators, emergency position command override, manual override, and fail in place technology.
- Emergency Position Command
In an event of an emergency, a separate air supply overrides normal operation and automatically drives the valve to a user defined position (either open or closed)
- Fail in Place – Hold in Place
In the event of a loss of either normal or emergency command operating pressure the valve is locked in its last position eliminating potential sealing element movement.
- Local Manual Operation
Declutchable Manual Override
- Thermal Protection
Protection from fire utilizing either a fire blanket or a spray on insulating coating.



AS.iSmart 24: Emergency Electrical Automated Valve Solution:

- Emergency Position Command (EPC)
In an emergency valve is driven to a user defined position (either Open or Closed)
- Signal Sentinel
Continuously monitors the EPC system offering additional failsafe backup in the event of an unacceptable local event.
- Power, AS-i, & EPC Connectors
2 multi pin connectors serve as the power supply, EPC plus Signal Sentinel Connections



Actuation

Technical Information

Network Driven Solution:

W&O is able to design and implement different control systems on board vessels and platforms for the marine and oil & gas industry.

- Example: W&O can provide automated valves that transmit a position signal to a control device, which then relays the information to an HMI (Human Machine Interface) in the location on board previously specified. The control signal drives the operation.

We do everything from initial system design, to quotation, to installation, to commissioning, to servicing after install.

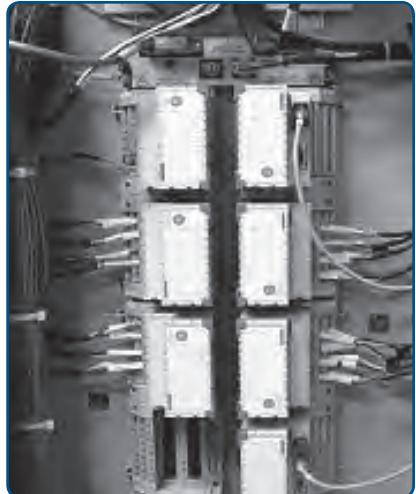
W&O Supply provides total integrated solutions.

W&O is project oriented and customer driven in Automation projects. This gives us the ability to provide the best service and price.

- Because of our extensive industry relations, we can provide the best service, at the lowest cost.
- W&O Supply has in house engineers which can handle projects as they come in on an ongoing basis.

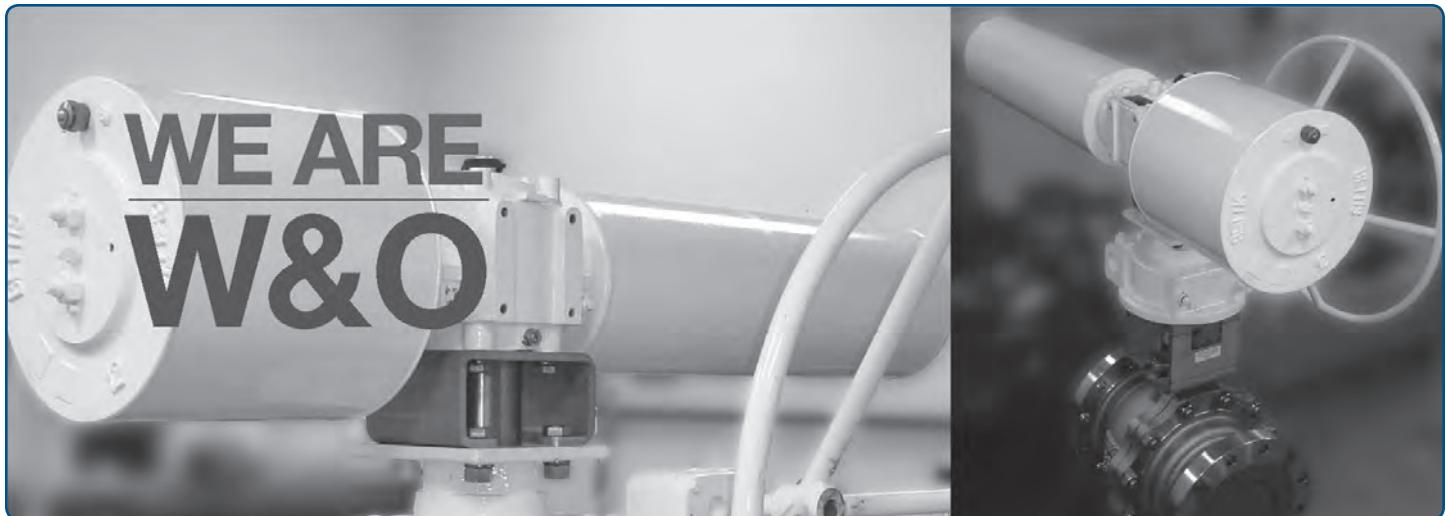
W&O is also capable of building custom cabinets and control boxes for PLC based applications with HMI controls.

- Easy termination inside box of all applicable equipment, and devices.
- Turnkey control boxes. Only requirement is power hookup.



Actuation

W&O Automation Solves Challenging Actuation Application



One of the nation's largest inland barge operators presented W&O with a stiff challenge recently: how to fit 3 new 220-foot state-of-the-art pressure barges with multiple automated valve packages that would withstand the harsh chemical butadiene—safely, effectively and economically to meet U.S. Coast Guard standards.

Known for its aggressive effects on fiberglass-reinforced Teflon® (RTFE), which is typically used as seat material on ball valves, butadiene posed unique challenges. The Engineered Products and Automation Services Division of W&O set to work, in close partnership with our customer.

After surveying the valve market, W&O engineers soon realized that a customized design was needed. So we partnered with a leading manufacturer to create an entirely new kind of ball valve.

Finding a suitable material to manufacture the valve seats was the first task. The solution was TFM™ 1600, a modified PTFE. While both seat materials are a Fluoropolymer, which has a high resistance to solvents, acids, and bases, TFM™ 1600 is a full melt material as compared to the RTFE process, which bonds particles and thus allows pores to form. The full melt eliminates any pores, making the seats impervious to butadiene penetration and preventing the tendency of typical RTFE to bubble or “popcorn,” which renders the valve inoperable.

It also became clear that conventional pneumatic automation for the valves would not be acceptable in this demanding application. Instead, W&O designed a hybrid spring-return, pneumatic actuator complete with a self-locking manual

override. This design incorporates a coil spring for failsafe operation. In the event that air pressure is lost during the critical loading or un-loading process, the stored energy of the spring closes the valve within 10 seconds, as required by the U.S. Coast Guard.

Yet the most difficult challenge lay ahead. W&O's customer required an uncomplicated means of adjusting and, when needed, replacing the valve's limited life stem packing while underway and without disassembling the automation package. For any industry, fugitive emissions are a large concern, as they may result in health hazards, potentially large fines and/or loss of operational income while equipment is taken out of service for repair. The barge industry is no different, requiring frequent inspection and adjustment of a valve's stem packing. Working with the customer, W&O developed a truly unique design that allows unencumbered access to the packing bolts and includes a removable lower section. Upon removal, the packing gland can be separated from the stem to allow the packing to be removed and replaced — all without any need to disconnect air lines, control lines, the actuator, or take the valve (and therefore the barge) out of service.

In the end, W&O did more than meet the original challenge. Working hand-in-hand with our customer, we were able to deliver a solution that was completely unique, low in maintenance, long lasting — and less expensive than any other alternative. We are proud to say that W&O is now the exclusive provider of automated valves to this customer.

Service Solutions

W&O is dedicated to providing complete solutions and service to our customers. We offer a wide range of high quality engineering, business and technical services. Our engineering team provides specification review, automation system design, estimating services and a digital library of products for marine designers. W&O provides valve and automation services including on-site commissioning, trouble shooting and repairs as well as in house repairs, maintenance and reconditioning. We also supply control system integration to provide a single-point solution for vessel instrumentation and valve control systems.

Valve Automation and Control Services

Our valve automation division is focused on providing our customers with the highest quality service from initial design and engineering through commissioning and in-field repairs. Our team provides the experience and knowledge to serve the industry in all types of valve actuation.

Pres-Vac

W&O is the only United States factory authorized service provider of Pres-Vac high velocity pressure/vacuum relief valves. We can provide fast turn-around, certified spare-parts and services for these critical items.

Business Solutions

Our commitment is to be the leader in providing integrated solutions to the marine industry. Along with being known for over 35 years for our quality products and services, W&O has teamed with leading technology partners to bring innovative new solutions in ship and fleet management. W&O's FuelProof™ and iShip systems represent a new era in ship systems and our Integrated Solutions engineering and integration teams can provide these systems as turn-key solutions for our customers.

Notes

Specialty Valves

Frequently, changing maritime industry regulations produced by organizations such as IMO, ABS, DNV, Llyod's Register and the USCG present unique valve problems to shipbuilders. The mission of these agencies and their regulations is to aid in protecting people, vessels, cargo and the environment by addressing issues such as safe cargo operations, fire safety, emissions and reliability.

W&O understands these various regulations and addresses these by providing 'Specialty Valves' that specifically meet these tough industry requirements. These include:

- Manual and automated fuel shutoff systems
- High velocity pressure/vacuum relief valves
- Automated and thermostatic temperature control valves

W&O can bring expertise to your vessel and will provide you the right product and specialty valve solution to address your specific problem.

AMOT provides the marine, oil and gas, and many other markets with tailored design solutions for the control and monitoring of engines, compressors and pumps.

AMOT is undoubtedly one of the most experienced manufacturers of control systems currently operating in the world market – and particularly in the field of temperature control valves and engine monitoring equipment.

AMOT has the technical capacity to advise what can and can't be used in your application, either providing you with the complete solution or working with your engineers to tailor your system.

Actuated Thermostatic Valves

AMOT valves are used for accurate temperature control of liquids in diverting or mixing service. The 3-Way Temperature Control Valves, which can be either electric or pneumatically actuated, are for extremely accurate temperature control, remote sensing, and low pressure drop.

W&O is the exclusive marine distributor of AMOT monitoring and control solutions in the United States and can provide the G-valve in electrically or pneumatically actuated configurations.

Thermostatic Valves

AMOT offers a wide range thermostatic control valve. These control valves can range in sizes from 1/2" up to 16" with a number of temperature settings and seals based upon the valve duty.

These thermostatic valves provide reliable, automatic control of fluid temperatures in turbines, compressors and engine jacket water and lubrication oil cooling systems or diverted depending on their temperatures.

Thermostatic: Model B

Self Actuated

- Maintenance is very simple animal
- Replace only 3 parts: Elements + O-ring + Gasket = "Good as New"
- 1/2 to 16 inches
- For long life, AMOT Model B valves should not be exposed to continuous temperatures exceeding 25°F above their nominal temperature setting
- Features: Tamper Proof, High Resistance to Shock, Manual Override

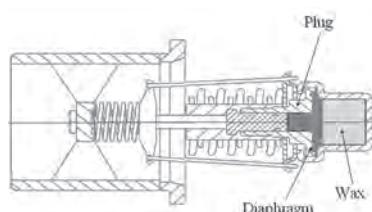
Fresh Water Cooling	Salt Water Cooling	HVAC
Lube Oil	Potable Water	



Temperature Control Valve



Thermostatic Valve



Temperature Control Element

Actuated G Valve

Electric and Electric-Pneumatic

- Rotary Valve
- Rotor moves 90° between 2 adjacent ports
- Mixing or Diverting
- For places requiring: High Vibration and Shock, Arduous Duty, High Duty Cycle Needs, Modulating Actuation Required, Accurate Positioning, Intelligent Communication

Fresh Water Cooling	Salt Water Cooling	HVAC
Lube Oil	Chemical	

Features	Benefits	Thermostatic B Valve	Actuated G Valve
High Degree of Engine Temperature Control	<ul style="list-style-type: none"> Quickly brings the engine to operating temperature at start Keeps engine within 1.5°F of optimal operating temp. Keeps engine within 10°F of optimal operating temp. Moving and rotating engine components last longer Provides best conditions for maximum fuel economy Optimal temperature means fewer harmful emissions 	✓	✓
Diverting of Mixing	<ul style="list-style-type: none"> Cooling systems can be arranged to best fit the customer's needs 	✓	✓
Long Service Life	<ul style="list-style-type: none"> 7-10 years of maintenance and cost free operation By replacing pills and springs, the valve can continue with maintenance and cost free operation for up to an additional 7-10 years 	✓	✓
Compact Size	<ul style="list-style-type: none"> Reduces design complexity and cost Reduces systems weight over competitors 	✓	✓
Low Pressure Drop	<ul style="list-style-type: none"> Minimizes size and power consumption of pump needed for the cooling system 	✓	
55 to 240°F Working Temp	<ul style="list-style-type: none"> Wide range of temperature meters and wax pill options to account for the needs of all marine industry engines 	✓	✓
10-16 Bar Working Pressure	<ul style="list-style-type: none"> Safety factor built in accounting for an over pressurized system 	✓	✓
Wide Array of Mounting Options	<ul style="list-style-type: none"> Allows many parameters to be set in the field for customer flexibility Can be mounted in any position with field adjustable trip points Can be mounted in-line with existing tachometers on hydraulic or pneumatic systems 		✓ ✓ ✓

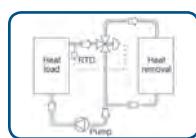
Benefit Focus: Temperature Control Benefits and Installation Options

Low Temperature

- Water combines with carbon to make sludge
- Sludge reduces power and efficiency
- Extra solids wears out moving parts



Diverting arrangement for Jacket and Seawater Cooling

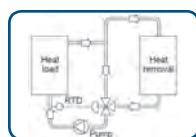


High Temperature

- Seals begin to melt and breakdown
- More polluting emissions from Nitrogen Oxides



Mixing arrangement for Lubricating Oil and Central Cooling



Right Temperature

- Water and Carbon stays in suspension
- Moving parts stay lubricated and last longer
- Seals are able to work at optimal temperature
- Maximized fuel efficiency
- Minimizes harmful Carbon and Nitrogen emissions



A typical thermostatic control valve will hold the oil temperature at a single set point regardless of load. This can cause oil to fall below normal operating temperatures, leading to sludge, deposits and excess emissions. With the AMOT externally actuated G-valve, a user can vary the oil temperature to stay constant at engine load. The engine will then provide cleaner operations because it will not develop low temperature deposits. The G valve with associated temperature probe and PID controller can provide precise temperature control to 0.5°F in mixing and diverting applications.

Type Approval by Agency



G Valve Benefits

AMOT G Valves are 3-way control valves consisting of a heavy duty rotary valve and either a quarter turn electric or pneumatic actuator. The valves provide a high degree of accuracy and repeatability for accurate temperature control. The valves are equally accurate in mixing or diverting service over a wide flow range. The heavy duty rotor design provides tight temperature control without high maintenance requirements. The system is available in 3 standard control configurations, offering flexibility for most requirements.

Key Benefits:

- Compact size – reduce system design cost
- Flexible design – ports can be configured to suit installation
- Low pressure drop – smaller valve size can be used compared to other designs

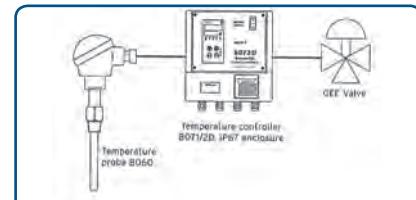


G Valve Specifications

Body Materials	Cast Iron	For fresh water, lubricating oils
	Bronze	For seawater, shock resistance, or magnetic permeability
	Steel	For high strength and high pressure rating
	Ductile Iron	High performance iron
	Stainless Steel	Corrosive and special applications
Maximum Internal Valve Pressure	Cast Iron, Ductile Iron, or Bronze	145 psi 10 bar
	Steel and Stainless Steel	232 psi 16 bar
Maximum Temperature of Fluid	212°F 100°C	Contact Amot for higher temperature requirements

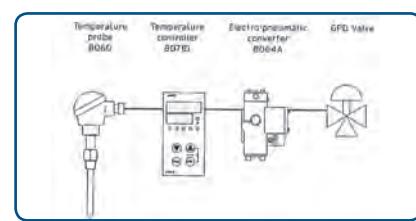
G Valve: Electric

- Temperature measurement and control
- Flexible powerful controller
- Interface with central computer
- Not fail-safe
- **Note:** electric actuators require regular maintenance



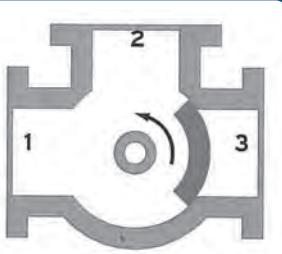
G Valve: Electric - Pneumatic

- Temperature measurement
- Flexible powerful controller
- Computer interface
- Fail-safe
- Combines better actuation of pneumatics with superior control characteristics of the electric system



G Valve Specifications: Modes of Operation

The unique construction of the AMOT G valve provides flexibility by allowing you to select the valve port positions most ideally suited to meet your application's requirements. There are two main types of mode of operation:



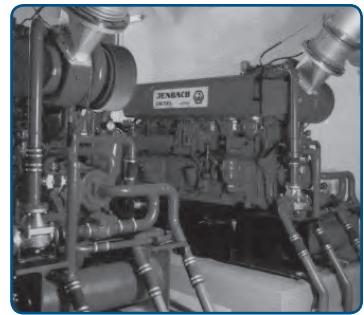
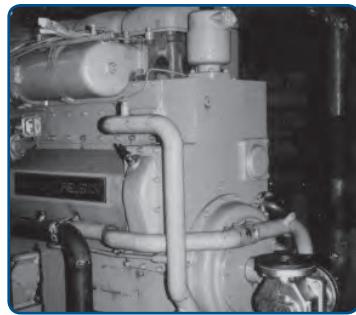
1.90 degree rotor that allows either ports 1 or 3 to be selected as the common port.

2.180 degree rotor that requires port 2 to be the common port
Arrows indicate valve movement with increasing temperature of mA.



Advantage of Thermostatic Valves

- Rapid rise to operating temperature
- Maintains operating temperature. As conditions change
 - operates in most efficient range
 - reduced fuel consumption
 - reduced formation of sludge
 - clearances are correct
 - reduced wear
- An engine operating at too low a temperature is as bad as an engine operating in a too high temperature.

**AMOT Thermostatic Valves**

B Valve Specifications (Most Common)		Available Thermostatic Valve Types
Connection	1-1/2" - 2" threaded, 1-1/2" - 8" flanged	Model A - Obsolete, Replaced by B
Flow Rate	68 - 1750 gpm	Model B - Large Flow Range
Body Material, Options	Aluminum Bronze Cast Iron Ductile Iron Steel Stainless Steel	Model C - Low Flow, Special CL Type Model D - High Flow Applications Model E - Size up from "CM" Model H - High Flow, Steel Model J - Low Flow, Valve Model R - Steel, Weldable Connections Filterstats: 3/4FJA, FED, FET, 1/2FMA 4500 Series Pressure/Temperature Valves
Minimum Operating Temp.	-10°C (14°F)	
Minimum Storage Temp.	-45°C (-49°F) if followed by slow rate	

Note: As an option, B valves can be fitted with a manual override, which allows the operator to drive the unit towards the maximum cooling position. Information on the other thermostatic valves is available upon request.

B Valve Layout Configurations

Cooling System without Temperature Control	Diverting	Mixing
<p>Temperature will fall out of range resulting in losses in efficiency</p>	<p>Used for applications such as Jacket Water Cooling and Sea Water Cooling</p>	<p>Used for applications such as Central Cooling and Lube Oil Temperature Control</p>

Note: The Model B valve is designed to provide fully automated, 3-way fluid temperature control for diverting or mixing applications.

Sample of Temperature Settings**Element Temperature Characteristics Chart for B Valves**

Nominal Temperature	Temp at Opening	Full Open Temperature	Max Allowable Temperature	Max Short Term Allowable Temp
90	81	95	110	140
150	145	161	180	203
180	175	191	220	250
225	216	236	244	257

Notes

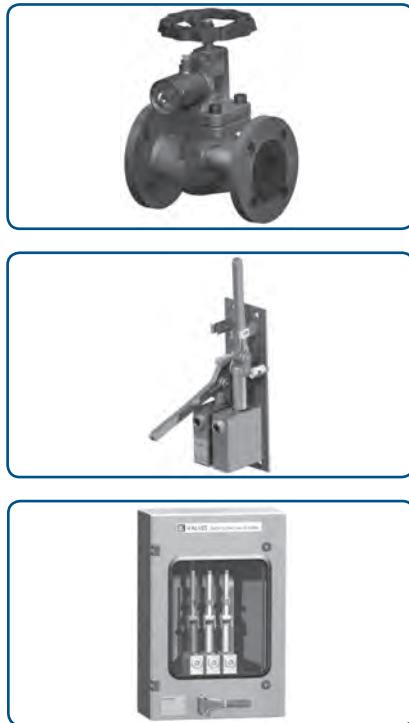


Emergency Fuel Shut Off System

LK Quick Closing Valves

W&O offers a complete emergency fuel shut off valve system, from LK Valve. Systems are Class Society Approved for emergency fuel shut off. The System consists of:

1. Flanged globe style, spring loaded fuel shut off valves made of ductile iron with stainless steel trim. ANSI, DIN, or JIS raised face flanged.
2. Hydraulic actuation cylinder with hand lever operator for remote actuation of valves. Each handle can actuate 4-6 valves depending on location of station and valves.
3. Totally enclosed system. No outside source of hydraulic fluid needed. Hydraulic fluid in the actuation handle reservoir holds all of the required fluid.
4. Stainless steel or steel cabinet with or without breakable glass to house hydraulic actuation cylinder in remote location typically up on deck outside the engine room.
5. Valves can be actuated manually by pull cable.
6. The systems are available with a complete pneumatic control station and air tank. These are sized depending on quantity of valves and piping runs.



Type approvals include: ABS, Lloyd's, DNV, BV and is in accordance to USCG and 46 CFR 56.50-60

- ABS Class Requirement 2008 Steel Vessel Rules, Part 4, Chapter 6, Section 4, Paragraph 13.5.3(a)

13.5.3 Valves on Fuel Oil Tanks

13.5.3(a) Required valves (2003). Every fuel oil pipe emanating from any fuel oil tank, which, if damaged, would allow fuel oil to escape from the tank, is to be provided with a positive closing valve directly on the tank. The valve is not to be of cast iron, although the use of nodular cast iron is permissible, see 4-6-2/3.1.4. The positive closing valve is to be provided with means of closure both locally and from a readily accessible and safe position outside of the space. In the event that the capacity of the tank is less than 500 liters (132 US gallons), this remote means of closure may be omitted.

LK offers an integrated automatic emergency fuel shut off system. A major benefit of this system is its low profile design.

- Fully enclosed system with hydraulic (W&O stock) or pneumatic (non-stock) control options.

Applications for LK

	LK Quick Closing Valve				
	Description <ul style="list-style-type: none">• Release by either hydraulic fluid, pneumatic signal or manually. Integrated fire release safety.				
	Application <ul style="list-style-type: none">• Quick closing application in accordance with type approvals.				
	Application <ul style="list-style-type: none">• Available flange standards: JIS 5K, JIS 10K, DIN 10/16, ANSI 150/300. Microswitch for remote position indication. Other materials available upon request.				
	<table><tr><td>Fuel Oil</td><td>Lube Oil</td></tr><tr><td>HVAC</td><td>Bunker Fuel</td></tr></table>	Fuel Oil	Lube Oil	HVAC	Bunker Fuel
Fuel Oil	Lube Oil				
HVAC	Bunker Fuel				



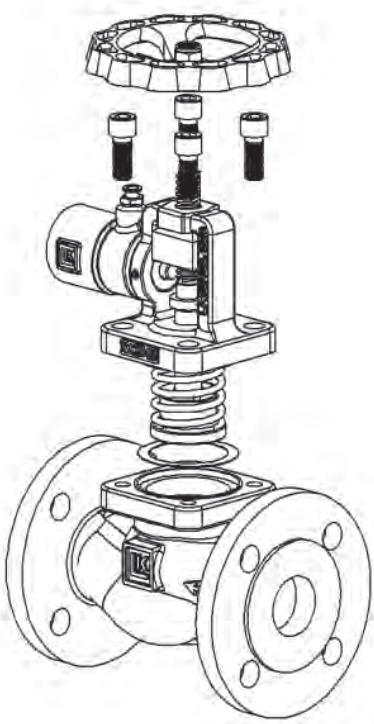
LK Valves

Emergency Fuel Shut Off System

LK Quick Closing Valves

Features	Benefits
Reverse Flow Through Globe Valve	<ul style="list-style-type: none">The reverse flow creates a positive seal upon closingThe weight from tank head pressure holds the seal tightly closed
5 Methods for Closing the Valves, Locally or Remotely	<ul style="list-style-type: none">Can be easily integrated into existing systems already in place on the shipComplies with all safety standards in any marine industryFlexible to the needs and space requirements of existing or new constructions
Steel Case Cabinets	<ul style="list-style-type: none">Keeps hydraulic cylinders organized and protectedGlass window and hammer allows viewing and access to shut off
One Quick Closing Cylinder	<ul style="list-style-type: none">A single LK cylinder can open any size globe valveThe cylinder can be activated in any of 4 ways, hydraulic, pneumatic, mechanical, or fire releaseThis minimizes the variety of spares parts, making repairs more simple
Full Systems are Available	<ul style="list-style-type: none">W&O can supply the entire package from valves to release valves and casesPiping and engineering are available from W&O as well

Benefit Focus: W&O offers the Complete System



W&O offers more than just the LK quick closing valves. We offer the complete package from necessary hardware for a hydraulic system to all of the pieces required for approvals. W&O Engineering Products and Services can help with engineering assistance in choosing the right size and number of products to fit your needs and your budget.

A great benefit of LK quick closing valves is how just about everything can be controlled from one location. The hydraulic release stations are available with a case holding up to 6 impulse transmitters. These self contained cases protect against accidental shutoff. Each cylinder then has the power and flexibility to close 1 to 6 valves, stopping the flow of 1 or up to 36 flammable fluid tanks upon one ship. When you come to us with your basic requirements, we can offer the complete LK quick closing package to get the job done for you and fulfill all the approval requirements.

Type Approval by Agency



Quick Closing Valve

05-LD120375-PDA

01592/G1 BV

P-13095

3263806 HH

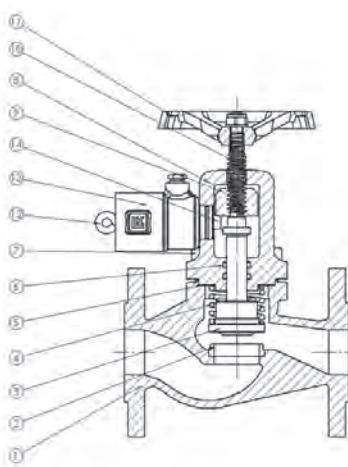
92/00135(E4)





Emergency Fuel Shut Off System

LK Quick Closing Valves



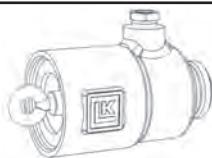
Position	Items	Material
1	Body	EN-GJS 400-15 EN 1563/Ductile
2	Seat	EN 10088-3 – 1.4301/Stainless Steel
3	Disc	EN 10088-3 – 1.4301/Stainless Steel
4	Spring	EN 10270-1:2001 SH/Steel
5	Gasket	Graphite
6	O-ring	FPM
7	Screw	ML65
8	Bonnet	EN-GJS 400-15 EN 1563/Ductile Iron
9	Setting Nut	Cu Zn 39 Pb 3 EN 12164/Brass
10	Stem	EN 10088-3 – 1.4301/Stainless Steel
11	Hand Wheel	EN GJL 250 SR EN 1561/Cast Iron
12	Eye Bolt	8.8 FZB/Galvanized Steel
13	Release Cylinder	Cu Zn 39 Pb 3 EN 12164/Brass
14	Piston Rod	EN 10088-3 – 1.4301/Stainless Steel

The valve is a stop valve with a remote quick closing function, but can also serve as a conventional stop valve by using the hand wheel (11).

- The quick closing action is instantly carried out by a spring (4), pre-compressed by turning the hand wheel.
- The stem (10) and attached disc (3) is hooked up by means of the setting nut (9).
- When the setting nut is released from loaded position - the valve will close.

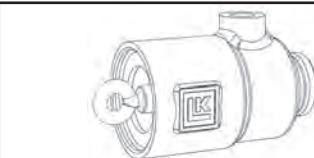
Release from loaded position is done by the release mechanism, see following description of release alternatives. Retracting the piston rod (14) extension in the release cylinder (13) by hand will also close the valve.

Release Cylinders Technical Data



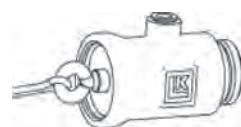
Technical data for the release cylinder (13), Hydraulic Execution

Stroke volume	3,8 cm ³
Recommended working pressure in pneumatic system	4,0 bar
Pressure class	PN30
Fire release temperature	178°C
Connecting thread	ISO G1/8"



Technical data for the release cylinder (13), Pneumatic Execution

Stroke volume	9,9 cm ³
Recommended working pressure in pneumatic system	7 bar
Pressure class	PN30
Fire release temperature	178°C
Connecting thread	ISO G1/4"



Technical data for the release cylinder (13), Mechanical Execution

Stroke volume	4,4 cm ³
Recommended working pressure in pneumatic system	8 bar
Max hydraulic static pressure	0,7 bar
Pressure class	PN30
Fire release temperature	178°C
Connecting thread	ISO G1/8"



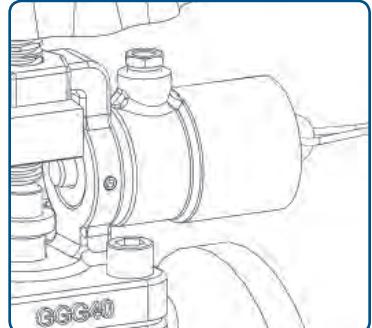
Emergency Fuel Shut Off System

LK Quick Closing Valves

Closing the Valves

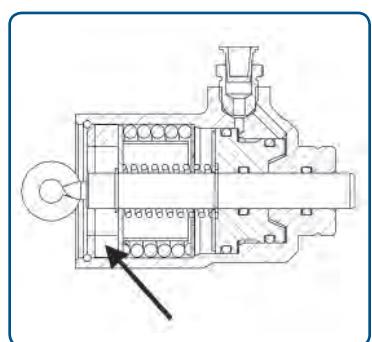
A. By Remote Quick Closing Function (hydraulic or pneumatic)

The valve is quick closed by a remote hydraulic or pneumatic signal or by pulling back the piston rod (14) of the universal release cylinder (13) by a wire arrangement. In all systems also the fire release arrangement is operating by the melting ring which in case of contact with fire will close the valve.



B. By Remote Quick Closing Mechanic System

The mechanical release system is arranged by connecting a wire to the eye bolt. By pulling the wire the position rod (14) is moved to release position and the valve will close.



C. By Manual Operation

The valve can be operated normally via the hand wheel.

D. By The Automatic Fire Release (happens in with any of the 3 options)

The release cylinder is internally equipped with a melting ring (see arrow) which will melt at the temperature 178°C. The strong spring will push the piston rod (14) into the release cylinder (13) allowing the valve to close by spring force.

Valve Flow Pressure Drops

Valve Size	Cv
1/2" (15mm)	4.9
3/4" (20mm)	8.6
1" (25mm)	14
1-1/4" (32mm)	22
1-1/2" (40mm)	36
2" (50mm)	54
2-1/2" (65mm)	89
3" (80mm)	139
4" (100mm)	218
5" (125mm)	334
6" (150mm)	475
8" (200mm)	841
10" (250mm)	1328

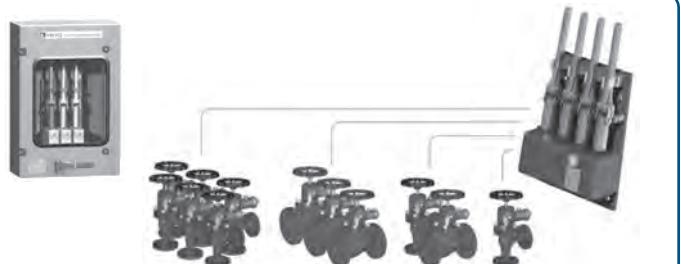
Cv = US Gallon Water Per Minute
At Pressure Drop 1 lb/square inch
Factors Listed Are Straight Globe Configuration



Hydraulic Impulse Lever

The new range of LK Quick Closing Valves are fully compatible with the existing and well proven range of LK hydraulic or pneumatic Release Station and Control Cabinets. As mentioned earlier there is a greater ease of installation with the Hydraulic system.

Note: 1 - 4 Impulse levers available.



Pres Vac Engineering

Valves and venting systems in marine vessels are critical safety equipment and must dependably operate fault-free at all times. They are required equipment on all cargo ships carrying any type of Volatile Organic Chemical (VOC) liquid. They serve to prevent the build-up of gas pressure in on-board tanks, which if not relieved, could result in a health and safety hazard for the crew, cargo contamination, cargo leakage, fire, or even an explosion. Mixtures of flammable cargo vapor and air are expelled during loading and unloading, and vent systems also prevent the hazard of flame entry into the cargo tank.

Pres-Vac Engineering offers a wide variety of valves for a multitude of applications, such as vessel cargo tanks, ballast tanks, fuel oil tanks, storage tanks, tank trucks, vapor recovery systems and for some ship-to-shore installations. They are also used for any type of VOC containers - e.g. river barge.

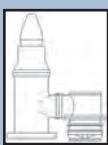
Various configurations of all valves are available for specialized applications such as long vent lines, FPSO's, high pressure gas tanks, ballast tanks, fuel oil tanks, storage tanks, high dispersion weight, low VOC/nitrogen loss, tank trucks and road tankers, pipelines, and vapor recovery systems, etc. Pres-Vac venting systems offer several alternatives for protection of storage and gas transfer systems.

HS-ISO

The development of the HS-ISO high velocity pressure/vacuum relief venting valve is the response to the first marine cargo tank venting equipment standard from the International Standard Organization. This valve is specifically designed with a focus to address in-service maintenance, allow inspection of all vital parts from the outside without use of tools, and allow wear parts to be replaced on site. Essential functions are reflected by indicators, which are clearly visible from the outside at all times. Thanks to the patented control system for opening and closing pressures, the valve conforms to requirements for non-hammering and non oscillation.



Applications for the Pres-Vac System



HS - ISO

Type HS-ISO high velocity pressure/vacuum relief vent is the response to the first marine cargo tank venting equipment standard from the International Standard Organization.

Tank Vent



HS-L 2383

Type HS-L is a cost effective alternative for a high yielding unit for VLCCs, storage vessels and other installations as well as for duplicate venting arrangements.

Tank Vent



HS IMO2

Type HSM-IMO2 provides protection from fire and explosion and automatically controls the tank pressure and vacuum during loading discharge, voyage and ballasting without manual operation and provides safe operation and provides safe operation regardless of flow volume.

Tank Vent

Pres Vac Engineering

Features	Benefits
Non Hammering Design	<ul style="list-style-type: none"> Minimizes the stresses on the pipes leading to the valve Pipes sizing can be reduced one nominal size as a consequence of the non pressure surge characteristics
Non-Oscillating Design (HS-ISO Only)	<ul style="list-style-type: none"> The valves can be set to more exact tolerances of tank presurization Eliminates fluttering, chattering, and hammering These valve have 15 times greater clearances than in valves that are only non-hammering
Reduces VOC Loss	<ul style="list-style-type: none"> More cargo in the tanks when reaching final destination for the benefit of the owner. Less pollution into the air for the benefit of all - especially when sailing close to populated areas
Self Draining to Tank	<ul style="list-style-type: none"> Vertical mounting ensures proper draining of VOCs back to the tank without sticky condensate No drain channels are necessary making installation even simpler
Few Moving Parts	<ul style="list-style-type: none"> Fewer chances for failure between cleaning and inspection, and less ware on the internal parts of the valve
Replicable Modules	<ul style="list-style-type: none"> Bolt on modules take only 1 to 2 minutes to remove and replace Most cleaning can be done in the desired area without complete disassembly Modules are the only parts which ever need to be replaced, and the heavy valve body never needs to leave the vent tower
Wide Range of Materials	<ul style="list-style-type: none"> Stainless Steel, Cast Iron, and Copper parts allow these valves to fit any system requirements and project budget
Large Clearances	<ul style="list-style-type: none"> Will continue to work despite a large amount of buildup within the valve

Benefit Focus: Lowest VOC Losses of Any Venting Valve Design (for HS-ISO)

Comparison of 5 Relief Valve Types

- Weight activated valves (A, B, C) will take longer to relieve pressure, and simmer near open and close settings increasing VOC loss
- Line D represents the highest valve performance resulting in the lowest VOC/IG release during venting
- A straighter line indicates constant, high velocity flow from the tank
- Constant pressure means no pressure surges
- High closing pressure (blow-down value)
- High net clearance through valve

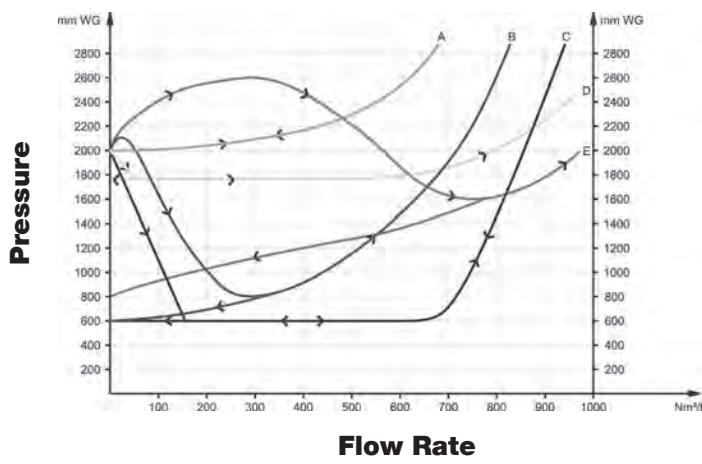
A: Conventional modulating type

B: Full-lifting type

C: Full-lifting non-hammering type

D: Non-oscillating type (HS-ISO)

E: Non-hammering type



Type Approval by Agency



HS ISO

02-LD311902/1-PDA

12321/BO BV

P-12479

4334102 HH

HSL

01-LD241576/1-PDA

1380099 HH

HS IMO2

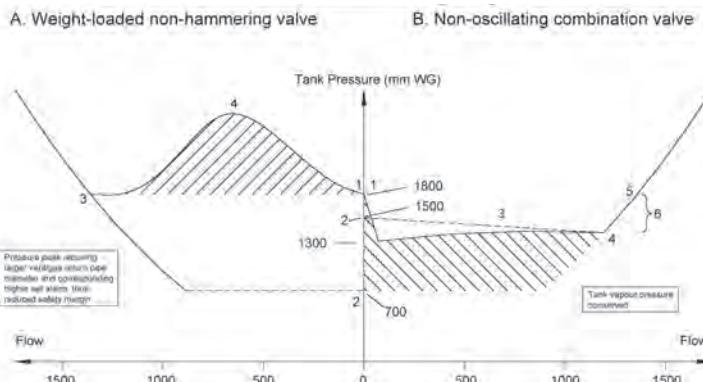
01-LD236261A/1-PDA

Pres Vac Engineering

Specification Chart for the Pres-Vac Valves

Type	HS-ISO	HS-L 2383	HS-IM02
Accuracy	$\pm 1\%$	$\pm 2\%$	$\pm 1\%$
Ice Layer	20 mm	5 mm	20 mm
Efflux Vel	Constant flow, above 30 m/sec.	Variable flow, min. 30 m.sec.	Constant flow, above 30 m/sec.
Check Lifts	Full stroke/self closing	Self-closing (full travel)	Self-closing (full travel)
Materials	Cast Iron, Ductile Cast Iron, Bronze, Stainless Grades	Cast Iron, Nodular Iron, Bronze, Stainless Steel	Cast Iron, Nodular Cast Iron, Bronze, Stainless Steel, SMOtrim
Function/Type	Controlled opening and closing pressure	Modulating valve	Delayed full-lift valve
Capacity	10,000 m ³ /hr.	Up to 13,000 Nm ³ /hr.	Up to 16,000 Nm ³ /hr.
Nom. Sizes	DN 50-400	DN 200-250	DN 50-400
Clearance	Pressure: Items are completely outside tank atmosphere Vacuum: 15 mm	—	10-25 mm
Additional Information	The disc position is indicated from outside	—	When modulation happens there is a pressure drop in excess of set-pressure

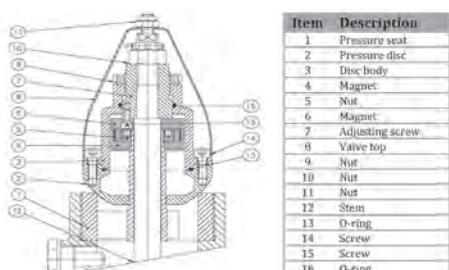
Reduces VOC loss (HS-ISO) VS. Weight Operated Non-Hammering Only Valves



- A. Non-Hammering
 - 1. Opening Setting
 - 2. Closing Pressure
 - 3. VCS Venting Rate
 - 4. SOLAS Venting Rate
- B. Non-Oscillating
 - 1. Opening Setting
 - 2. Closing Pressure
 - 3. VCS Venting Rate
 - 4. SOLAS Venting Rate
 - 5. Extra Capacity for High Density/Volatility Cargo
 - 6. Extra Pressure Span for Reduced Pipe Diameter

Note: The high closing pressures achieved by the use of combination of weight and magnet loads reduces VOC/IG loss. This minimizes loss of the Nitrogen or other Inert gasses protecting the tank.

Magnetic Advantages of the HS-ISO

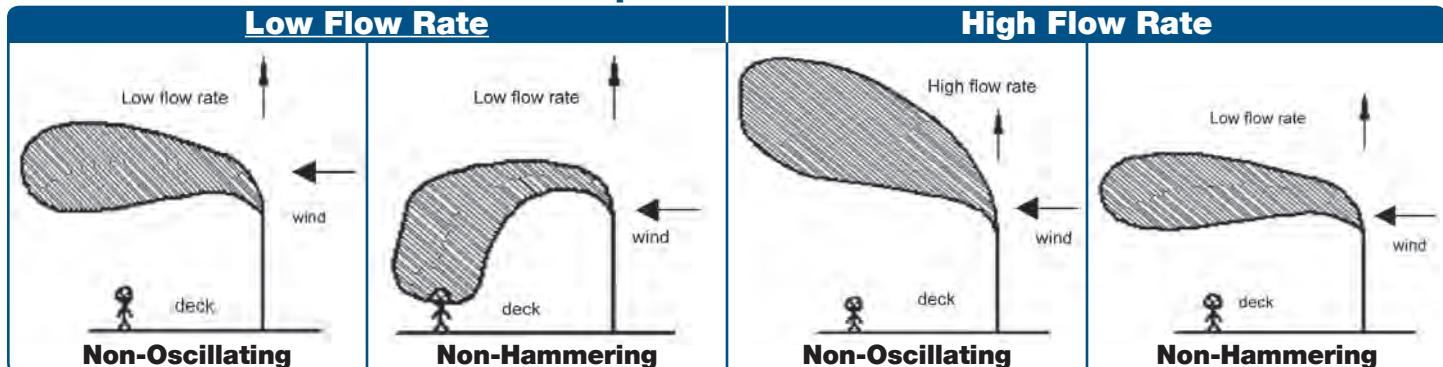


Item	Description
1	Pressure seat
2	Pressure disc
3	Disc body
4	Magnet
5	Nut
6	Magnet
7	Adjusting screw
8	Valve top
9	Nut
10	Nut
11	Nut
12	Stem
13	O-ring
14	Screw
15	Screw
16	O-ring

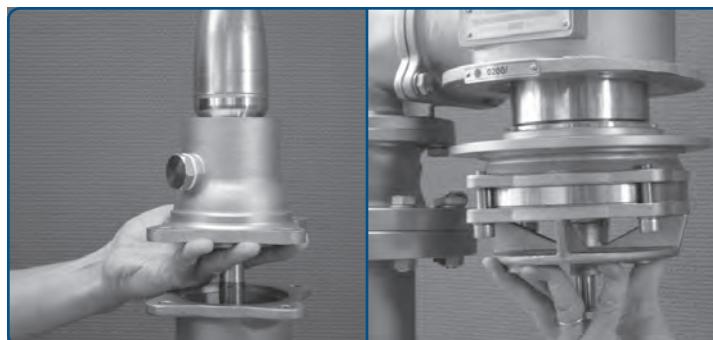
The magnetic closing mechanism ensures a full open or full closed vent opening, no simmering or hammering. This minimizes the loss of VOCs and inert gas, reducing the cost of regenerating the Nitrogen/inert gas blanket and reducing emissions into the atmosphere. Any emissions are also rejected high into the atmosphere far from crew members and equipment on the deck.

Pres Vac Engineering

Dispersion Patterns

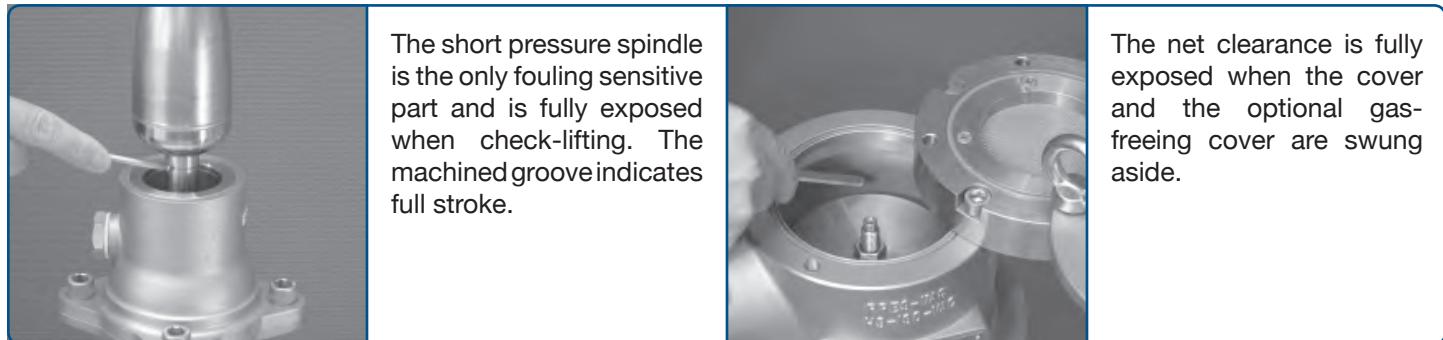


Repair and Replacement of Module System

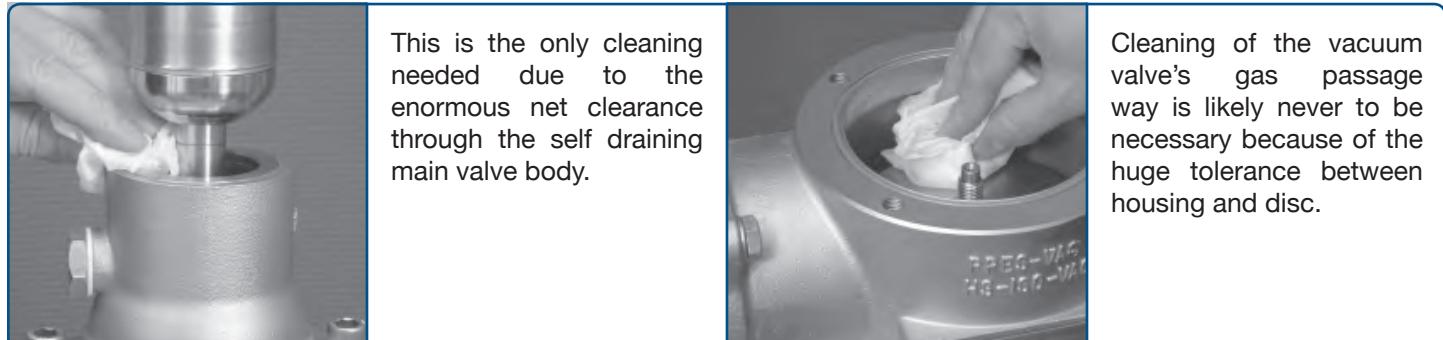


Note: Complete pressure unit and/or vacuum unit can be removed and replaced with new. Replaced units can be taken to workshop or sent to factory for repair.

Exterior Inspection of Fouling Sensitive Area



Exterior Cleaning of Fouling Sensitive Area



Piping and Cable Penetration Overview

In every business the threat of fire is present; perhaps even more so in the marine industry on board a vessel. For over 3 decades, Beele Engineering, the manufacturer of RISE and NoFirno, has specialized in passive fire safety in the form of systems which prevent the spread of fire, smoke, water and gases via cable and pipe penetrations. Now W&O has partnered with Beele to bring you the most innovative solutions for your fire prevention needs.

Through superior sealing technologies, Beele Engineering has become the undisputed leader in sealing systems for shipbuilding applications. Beele Engineering listens to the needs of the maritime industry and continues to develop new products through bold innovations.

Benefits of the RISE system

- Fewer parts than block systems
- Installs 7 times faster than comparable block systems
- RISE software maximizes the efficiency of RISE products by optimizing both material costs and space utilization
- Ease of maintenance

Penetration Solutions

The RISE multi-cable sealing system incorporates the latest in firestop technology, to seal all multi-cable penetrations. It is tested and class approved for A0 through H-120 single and multi-pipe transits. Approved by all major worldwide classification societies, RISE prevents the passage of fire, smoke, water and gases, up to the pressure of 4 bar. The system is easily re-enterable, maintaining the integrity of the penetration without the need to replace any blocks or compress the contents.

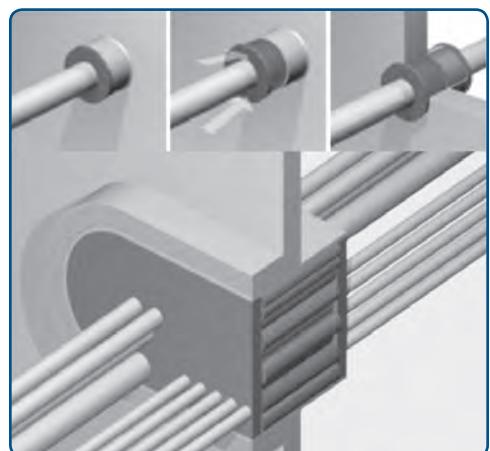
The RISE system offers the most cost-effective way of installation. The system is easy to handle on site and can be used both for vertical (deck) and horizontal (bulkhead) conduit openings.

The RISE metallic and plastic pipe sealing system is one of the most adaptive systems for sealing all pipe penetrations including eccentric and angled pipe penetrations. The few materials and components that are required for the RISE system make installation very quick and easy.

SLIPSIL, the new generation sealing plugs, are designed to provide fire safe and gas and watertight seals for transits carrying single or multiple plastic or metal pipes.

RISE/NOFIRNO is tested according to IMO Resolution A.754 (18) and approved water tight and gas tight.

The system is also approved for multi- mix pipe/cable penetrations.



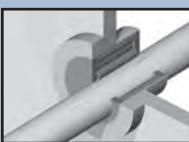
Penetration Solutions Applications



RISE Ultra

- Most simple and effective system for all plastic pipe penetration
- RISE/ULTRA C-fit crushers squeeze down and seal opening during fire
- Wraps are used for oversized conduit sleeves
- Approved for a multiple mixture of all kinds of plastic pipes
- NOFIRNO sealant adheres well to plastics: high degree of water tightness feasible
- Breakthrough - adhesion under fire load

Fire



RISE NOFIRNO

- Approved for harshest fire rating for pipe penetration (A, H and Jet Fire Class)
- Allows substantial movement of the ducted pipe within the conduit
- Prevents corrosion inside the penetration
- Longest service life and best Total Cost of Ownership in the market
- NOFIRNO rubber sleeves and sealant will remain stable and not be consumed by fire
- Breakthrough - Multi - Mix system approved for any combination of cable, metallic, GRP or plastic pipes

Fire



SLIPSIL

- For transits carrying single/multiple metal pipes with the same diameter (hydraulic and pneumatic lines)
- Fast Installation

DYNATITE

- For applications where a high degree of (instantaneous) tightness is required



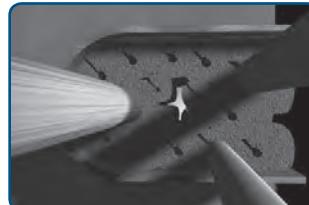
Note: "All trademarks are registered and are the property of Beele Engineering, BV, The Netherlands".



Penetration Solutions

Features	Benefits	RISE	SLIPSIL/ DYNATITE
New NOFIRNO Elastomer Compound	<ul style="list-style-type: none"> Fire, gas, and watertight seal No metal parts, therefore no corrosion of pipes or bulkhead No compression until heat activated, no deformation of pipe or wires Eliminates noise and vibration transfer from pipes to the wall Significant weight savings 	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Fewer Parts than Competing Systems	<ul style="list-style-type: none"> Substantially fewer parts than comparable block system Minimal inventory 	✓ ✓	✓
Saves Time and Space	<ul style="list-style-type: none"> Installs 7 times faster than comparable block system (independent shipyard testing) Holds more cable and pipe while maintaining 40% penetration fill limit Metal and plastic pipe and cables can be routed through the same collar Can be used with plastic and metal pipe 	✓ ✓ ✓ ✓	✓ ✓
Design Calculator Available	<ul style="list-style-type: none"> Maximizes the efficiency of RISE products by calculating both material costs and space utilization Create your own penetration collars specific to the needs of the project 	✓ ✓	
Ease of Maintenance	<ul style="list-style-type: none"> Lasts up to 50 years with no degradation in performance Refitting conduits or pipes takes just minutes and will not disturb any of the original pipes or cables The 2 halves can be removed and used again with no loss of effectiveness 	✓ ✓ ✓	✓ ✓
Wide Temperature Range	<ul style="list-style-type: none"> Works up to the activation temperature of the material of -57 to 357°F Works up to the activation temperature of the material of -40 to 450°F 	✓	✓

Benefit Focus: The Safest Fire Penetration Solutions in the Marine Industry



Beele Engineering, manufacturer of RISE, has remained at the forefront of innovation in penetration solutions for over 35 years in the marine industry. RISE/NOFIRNO sleeves fill in gaps and self correct when activated. In doing so, it has the ability to minimize human error. It can withstand up to 50 years of service life, which provides the ultimate long lasting fire protection.

Type Approval by Agency



RISE Ultra	09-LD398300A-PDA	MED-B-4906	SAS F060098
RISE NOFIRNO Cable	08-LD370677/1-PDA	09156/B2 EC	F-18482
RISE NOFIRNO Pipe	09-LD398300B-PDA	09156/B3 EC	MED-B-4908
SLIPSIL/DYNATITE	06-LD182012A-PDA	15823/A0 EC	F-17997

Note: Approvals are both water and fire rated.

Penetration Solutions

RISE Cable Sleeve – Sizing Chart

Sleeve Type	Cable Diameter	Cable Diameter MM	Fractions
12-6	.19 - .27	5-7	3/16 - 1/4
14/8	.27 - .35	7-9	1/4 - 11/32
16/10	.35 - .43	9-11	11/32 - 7/16
18/12	.43 - .51	11-13	7/16 - 1/2
20/14	.51 - .59	13-15	1/2 - 19/32
22/16	.59 - .67	15-17	19/32 - 11/16
27/19	.67 - .82	17-21	11/16 - 13/16
31/23	.82 - 1.00	21-25	13/16 - 1.0
35/27	1.00 - 1.14	25-29	1.0 - 1 1/16
39/31	1.14 - 1.30	29-33	1 1/16 - 1 5/16
46/36	1.30 - 1.53	33-39	1 5/16 - 1 1/2
52/42	1.53 - 1.77	39-45	1 1/2 - 1 3/4
58/48	1.77 - 2.00	45-51	1 3/4 - 2.0
64/54	2.00 - 2.25	51-57	2.0 - 2 1/4
70/60	2.25 - 2.50	57-63	2 1/4 - 2 1/2



Transit Calculator

Transit Specifications:		(All dimensions in inch)		
Width:		8.0000		
Height:		4.0000		
Corner Radius:		2.0000		
Depth:		8.000		
Filling Rate:		36.8%		
Class:		A-class		
RISE Materials Needed:				
Insert Sleeves		Amount	Length	
18/12		8	6.2992 inch	
31/23		9	6.2992 inch	
46/36		2	6.2992 inch	
Filler Sleeves		Amount	Length	
18/12		2	6.2992 inch	
27/19		6	6.2992 inch	
FIWA Sealant		646 ml (3 cartridges)		Total Amount of Cables: 19
Material Specifications:				
Type of Filler Sleeves:			Standard	
FIWA Sealant:			Cartridges 310 ml	
Cable Specifications:				
Cables (OD)			Amount	
0.5000			8	
0.8750			9	
1.5000			2	

Note: This calculator helps you design custom penetrations. It guarantees you will not exceed the 40% fill rate required by the IMO. RISE calculator uses benefit from a 40% increase in transit capacity vs. blocks.

NOFIRNO System Components



RISE Insert Sleeves



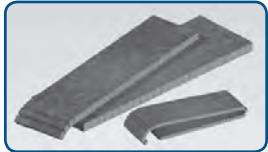
Crusher Sleeves



NOFIRNO Sealant



NOFIRNO Filler Sleeves



Actifoam Sheets

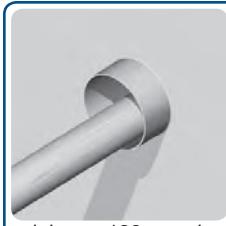
NOFIRNO Properties

- Shows minimum permanent deformation and optimizes mechanical stability on long term
- Can be exposed to high temperatures (up to 180° C), making the RISE/NOFIRNO sealing system suitable for steam lines
- The NOFIRNO sealant/rubber has improved fire stopping properties:
 - Creates immediate protective layer at the fire side
 - Will not be consumed under fire exposure
- Higher thermal insulation values under fire load with the RISE/NOFIRNO system
- Shorter conduit depths with the RISE/NOFIRNO system
- Approved for A-0 class without the use of any insulation



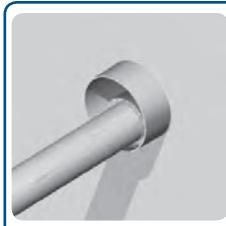
Penetration Solutions

NOFIRNO Installation Guide

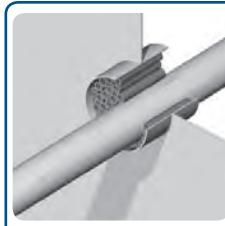


minimum 180 mm deep for A-60 class and 250 mm deep for A-0 class divisions.

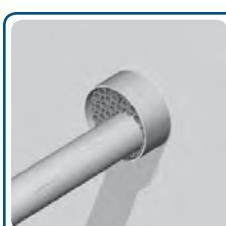
1. The metallic pipe can be passed through the conduit sleeve in any position, provided there is enough space between the sleeve and the ducted pipe (see 2). The conduit sleeve should be



2. Make sure that the minimum space between the pipe and the wall of the conduit sleeve is in accordance with the minimum allowed distance as certified.



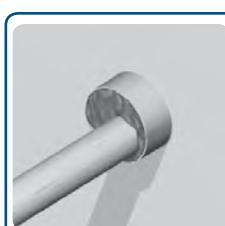
3. The free space in the conduit is filled with RISE/NOFIRNO filler sleeves type 27/19 and 18/12. For ease of filling the RISE/NOFIRNO filler sleeves are delivered non-split. The ratio of 27/19 to 18/12 should be about 2 to 1.



4. Push the filler sleeves into the conduit in such a way as to leave about 20 mm free space at the front. The whole set of filler sleeves should tightly fit into the conduit sleeve to offer sufficient mechanical stability.



5. A 20 mm thick layer of NOFIRNO® sealant is applied at each side of the conduit. Clean and dry the conduit opening and the pipe thoroughly and remove any dirt, rust or oil residues before applying the sealant.

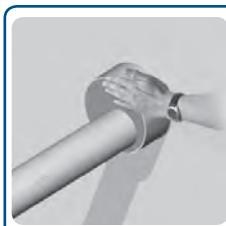


6. The conduit should be overfilled with NOFIRNO sealant, because some sealant will be pushed between and into the empty filler sleeves during further finishing. This will contribute to obtain higher tightness ratings.

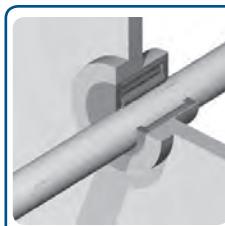


7. To smooth the surface of the NOFIRNO® sealant layer, a cloth is sprayed with water. This prevents the sealant from sticking to the cloth. Note: Do not use soap water!

The cloth is then used to press down the sealant layer. Please refer to the Safety Data Sheet for more info.



8. The surface can further be smoothed by hand. Just wet the hand thoroughly with soap and water. No dirty hands when working with NOFIRNO®. People with sensitive skin should use gloves when working with NOFIRNO®.



9. For A-class penetrations, the conduit sleeve/frame needs to be insulated only at the insulated side of the bulkhead or at the lower side of the deck. The ducted pipe has to be insulated according to the specifications on the certified drawings.



1. Sealant is removed.



2. Norfino sleeves are removed.



3. Cable is run, RISE sleeve is added.



4. NOFIRNO sealant is re-applied.

Note: Unlike other systems, NOFIRNO is easily re-installed and allows you to add other cables.

Actifoam Sheet Advantages



It is now possible to make fire stop penetrations for plastic pipes using a RISE/Ultra crusher sleeve around the plastic or insulated pipe, or cable bundle. The rubber first reacts by becoming adhesive and sticking to the pipe and walls surrounding the sleeve. Second, as the weaker material it is surrounding begins to burn away or collapse, the crusher sleeve has the ability to expand up to 10 times its original size, instantly sealing off any gaps which may form in the transit. This system can be used with both the RISE NOFIRNO system, and with the SLIPSIL fireproof barrier system.

Actifoam Sheet Advantages



Actifoam offers a cost effective replacement of NOFIRNO filler sleeves in large gaps. The bundles easily fill in square spaces, but come pre-slit to fill in rounded conduits very easily. The material really shines when filling in large gaps where there are no cable or pipe penetrations. When there are two conduit or pipe trays over top of one another, actifoam can create a cheaper fireproof seal in between the cable trays while still using a single transit. The sheets function properly even when installed next to NOFIRNO filler sleeves to get the best protection and cost benefit available.

Penetration Solutions

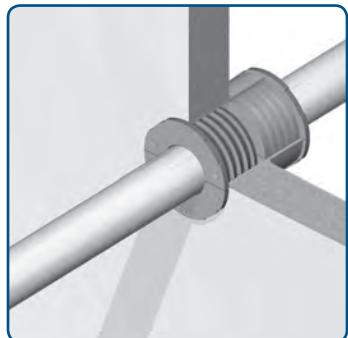
SLIPSIL Description

- SLIPSIL plugs are used for the gas, water tight and fire safe sealing of pipe and cable penetrations.
- The plugs can be used for steel, stainless steel, copper, GRP and plastic pipes and are approved for steel and aluminum partitions in marine and offshore applications.
- SLIPSIL sealing plugs are made of the advanced rubber grade NOFIRNO. This rubber is halogen free, does not harden during service life, has outstanding weathering properties, does not shrink during fire exposure, has an oxygen index of 55% (>30 is flame retardant) and a low smoke index.

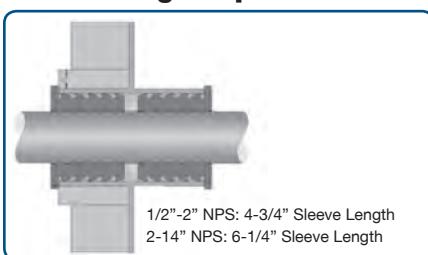


Selection of the SLIPSIL Plugs

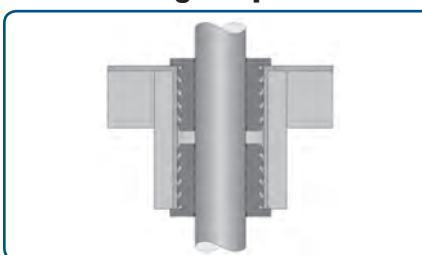
Nominal Pipe Size (Sleeve)	Plug Services for Use Inside Schedule 40 Sleeve	Plug Series for Use Inside Schedule 80 Sleeve
1 inch	25	N/A (Use NOFIRNO System)
1 - 1/4 inch	35	32
2 inch	53	50
3 inch	78	75
3 1/2 inch	90	N/A (Use RISE System)
4 inch	102	97
5 inch	128	122
6 inch	154	146
8 inch	203	N/A (Use RISE System)



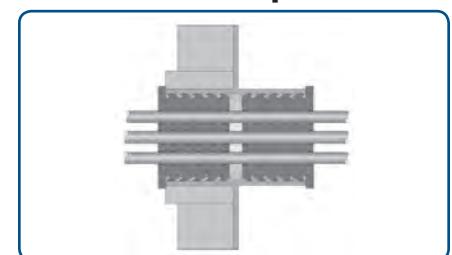
SLIPSIL Single Pipe - Horizontal



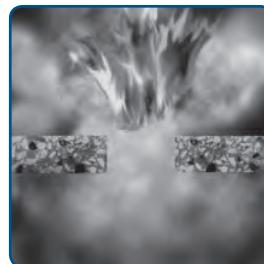
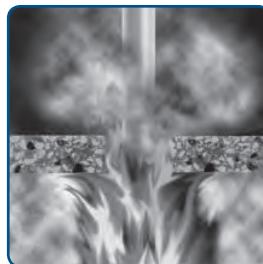
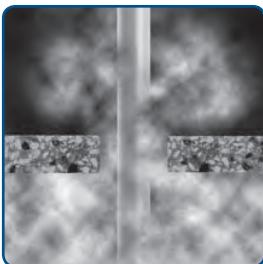
SLIPSIL Single Pipe - Vertical



Multi-Pipe



Crusher SLIPSIL Plug System for Plastic Pipe Transits



- Most plastics pipes start to soften at 75°C and can ignite at a temperature of 140°C
- RISE Slipsil Crusher is different in that as the plastic soften and the sleeve is exposed to these temperatures, it will expand to more than 10 times its original volume. This makes no opening left in the conduit for the passage of smoke and flames.

Penetration Solutions

SLIPSIL Installation Guide



1. Before starting the installation, remove any dirt, oil residues or welding spots from the conduit sleeve. For ease of installation, it is advisable to grind out the front side of the sleeve.



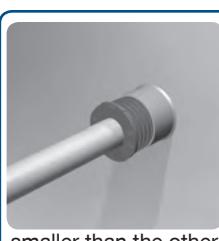
2. Then the side of the wall of the conduit sleeve is treated with CSD lubricant along a distance which approximately corresponds with the length of the sealing plug.



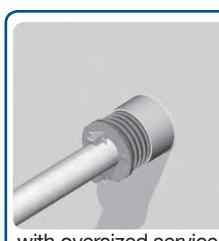
3. The inside surface of both segments of the SLIPSIL/DYNATITE sealing plug are then treated with CSD lubricant. For selecting the right sealing plug, look for the plug series and type on the basis of the ID of the sleeve and the OD of the pipe.



4. The segments of the SLIPSIL/DYNATITE sealing plug is also treated with the CSD lubricant on the outside. Note: Please refer to the Safety data sheet of the CSD lubricant for more information.



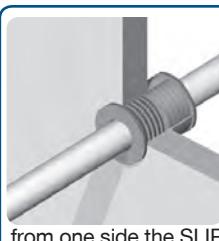
5. Both segments of the SLIPSIL/DYNATITE sealing plug are placed around the ducted pipe and then pushed into the conduit sleeve as far as the first serration. *The first serration is smaller than the other serration to make this procedure very easy.



6. Then both segments of the SLIPSIL/DYNATITE plug are pushed by hand evenly, serration by serration, further into the conduit sleeve. *Extremely thin plugs or plugs applied in undersized conduits with oversized service pipes can be tapped in using a hammer and a piece of wood.



7. The flanged edge of the sealing plug must be flush against the front side of the conduit sleeve. *Not only the right choice of the sealing plug, but also proper installation is a determining factor for the degree of tightness of the sealing plugs.



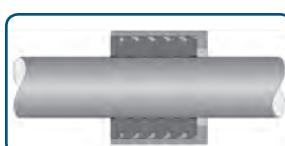
8. For fire rated penetrations SLIPSIL sealing plugs have to be inserted in both ends of the sleeve. This is also a must for watertight penetrations. To enable insertion of the sealing plugs from one side the SLIPSIL/DYNATITE combination can be used.

DYNATITE Description

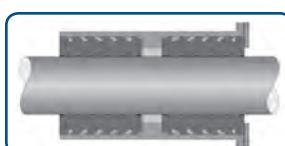
- Developed especially for those applications where a high degree of (instantaneous) tightness is required (or a sudden pressure exposure occurs) and, for all, to maintain this performance on long term.
- Specially developed for application in the columns of semi-submersible rigs, the system can be used in quite some other hazardous areas. To name some: partitions between hazardous and non-hazardous area, blast walls, explosion proof areas, tsunami areas and all those situations where a sudden pressure might arise.
- To be able to cope with the enormous loads at 15 bar, the DYNATITE multiple passage units are milled from solid stainless steel. Retainer rings are at the back side of each hole.



DYNATITE Installation Guide: When to use a single DYNATITE versus a double sided



When the side from which the pressure load will occur is known, a single sided DYNATITE conduit sleeve can be installed. The side of the conduit sleeve in which the DYNATITE plug will be inserted is the exposed face of the sleeve. The retainer ring is on the opposite side of the conduit sleeve.



It is also possible to install such a retainer flange at both sides when exposure is to be expected from both sides. This will ensure that the DYNATITE plug(s) will always be held inside the conduit. Retainer flanges can also be used for upgrading to DYNATITE.

Notes

Marine Piping Systems

Marine pipe work has traditionally been labor intensive with a large amount of in place hot work requiring specialized skills and low production rates. Currently the industry seeks ways to increase efficiency, improve productivity and decrease operating costs, and with W&O piping technologies those goals can be achieved. W&O's Marine Piping Systems Engineered Products include mechanical products designed to ensure that our customers remain competitive in the global market.

This section highlights some of the systems, applications, and benefits of our Marine Piping Systems:

- Minimized hot work
- Lowered installation labor
- Improved productivity
- Weight savings
- Reduced maintenance costs
- Improved life cycle costs and total cost of ownership benefits

Put down the torches and welding rods, pick-up your press tools, electro-fusion machines, and wrenches and step into the future of mechanical systems with W&O.

Multilayer Composite Piping

5-layer composite pipe has developed as an advanced product that unites the advantages of a metal and plastic pipe and eliminates the disadvantages of both materials at the same time. This offers product advantages that are second to none: the aluminum core is absolutely diffusion tight - it reliably prevents the ingress of oxygen. It compensates and reduces snap-back forces and heat expansion with changes of temperature.

The system is designed for easy, safe and fast pipe installation. The pipe is easy to bend and stays in position to meet the configurations required in tight shipboard applications. The ability to bend also minimizes the amount of fittings used, saving even more!

Multi-layer Composite Pipe (MLP) offers the ideal solution for your plumbing installation - both for accommodation repair and large projects. The comprehensive range of products enables complete installation with only one system.

Installation with MLP is extremely economical and easy; all components are designed to fit perfectly. The dimensional stability of the pipe and low heat expansion make only a few fixing points necessary - a practical advantage for fast installation. A range of pipe diameters are available from 1/2"(16mm) to 2" (63mm) and allow use for all supply, return, and fixture supply drops with one easy to use product.



Note: Courtesy of Uponor.



Note: Courtesy of Uponor.

Applications for the Multi-layer Composite Piping



**Unipe
Nickel Plated
Bronze**

The UNIPIPE multi-layer composite pipe is a pipe generation that unites the advantages of a plastic and metal pipe and therefore offers a high degree of flexibility and toughness, coupled with high pressure and temperature resistance.

Compressed Air	Grey Water	HVAC
Potable Water		



**PureFlow PEX
(Viega)
Bronze**

Viega - the first to introduce the PEX press technology to North America. Bronze PEX Press fittings make baseboard and plumbing connections fast and simple. Use these adapters to make a PEX press connection between ViegaPEX and FostaPex tubing and standards copper tubing.

Compressed Air	Grey Water	HVAC
Potable Water		



**iFIT (+GF+)
Brass/Plastic**

The iFIT is known for its capability of being used in multiple applications. In addition it's known for having a safe and solid connection that is also economical. It uses 50% less parts than other connectors for composite piping and it requires fewer steps for installation.

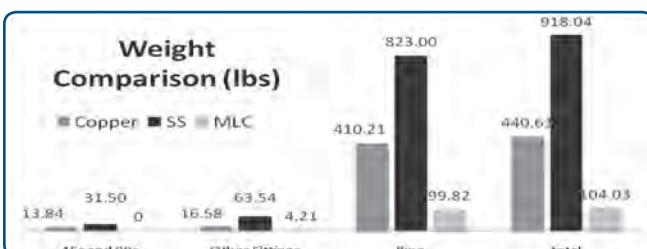
Compressed Air	Grey Water	HVAC
Potable Water		

Multilayer Composite Piping

Features	Benefits
Light Weight Composite	<ul style="list-style-type: none"> Increased fuel economy Ease of installation Aluminum and plastic construction is fully recyclable
Polyethylene Interior Lining	<ul style="list-style-type: none"> Corrosion reduction Extremely high chemical resistance leads to a long term service life
Copper/Nickel/SS Fittings	<ul style="list-style-type: none"> Choice of noncorrosive metal fittings leads to a long term service life
Flexible Pipe	<ul style="list-style-type: none"> Reduces number of fittings which, further reduces weight of piping systems Reduces labor time from reduction of fittings Reduces number of leak paths
Snap-On or Crimp-On Fittings	<ul style="list-style-type: none"> Flameless connections, eliminates hot work Reduces labor times and increases Ease of Installation
145 PSI Working Pressure	<ul style="list-style-type: none"> Available or use in general service shipboard applications
203°F Working Temp	<ul style="list-style-type: none"> Available for use in all potable water and some compressed air applications

Benefit Focus: Weight Comparison of a Lightweight Composite Piping System for a 9 bathrooms Crew Cabin

Pipes & Fittings	Copper		SS		MLC	
	Total	Weight (lbs)	Total (lbs)	Weight (lbs)	Total (lbs)	Weight (lbs)
1/2" 90s Elbow	72	0.04	2.95	0.16	11.52	0.00
1" 90s Elbow	18	0.18	3.19	0.40	7.20	0.00
1/2" 45s Elbow	54	0.04	2.05	0.09	4.86	0.00
1" 45s Elbow	36	0.16	5.65	0.22	7.92	0.00
1/2" Tee	54	0.06	3.24	0.35	18.90	0.02
1 x 1/2" Reducer	54	0.10	5.24	0.36	19.44	0.03
2 x 2 x 1 Tee	9	0.90	8.10	2.80	25.20	0.17
1/2" Pipe (ft)	366	0.34	126.01	0.85	311.36	0.08
1" Pipe (ft)	44	0.84	37.00	1.67	73.65	0.22
2" Pipe (ft)	120	2.06	247.20	3.65	438.00	0.50
Overall Total			440.63		918.04	
						104.03



Note: By using the MLC you will be using 76% less weight than Copper.

Note: For MLC's 45° and 90° bends and fittings are not necessary.

Type Approval by Agency



Unipipe	03-HG391167/2-PDA	K-3145	91 758 97 HH	96/20048(E2)
iFit (+GF+)	04-LD465502/4-PDA	K-3208		
PureFlow Pex (Viega)		K-2985	2611805 HH	96/20047(E3)

Multilayer Composite Piping

Sizes for the Multilayer Composite Pipe

Pipe Sizing Reference Chart

Outside Diameter (mm)	Wall Thickness (mm)	Inner Diameter (mm)	Dry Weight (g/m)	Volume (1/m)	Thermal Conductivity (W/m*K)
16	2	12	118	0.113	0.4
20	2.25	15.5	178	0.189	0.4
25	2.5	20	243	0.314	0.4
32	3	26	323	0.531	0.4
40	4	32	507	0.8	0.4
50	4.5	41	742	1.32	0.4
63	6	51	1223	20.4	0.4

Multilayer Composite Pipe Tooling

Tools fit Unipipe, Viega & +GF+



	REMS Mini-Press ACC	REMS Power-Press ACC	REMS Akku-Press ACC
Weight	2.5kg (with battery)	4.8kg	4.5kg (with battery)
Battery	12 V, 1.3Ah or 2.0 Ah	N/A	12 V, 2.0 Ah
Pipe pressing joints	Ø10 - 40 mm	Ø10 - 108 mm	Ø10 - 108 mm
Optimal Weight Distribution	Single Handed Operation	Single Handed Operation	Single Handed Operation
For operation with	REMS pressing jaws mini	REMS pressing jaws for these and other manufacturers	REMS pressing jaws for these and other manufacturers
Additional Information	Cordless radial press with automatic circuit control for producing pipe pressing joints for all common press fitting systems. For battery and corded operations.	Electro-hydraulic radial press with automatic retraction for producing pipe pressing joints for all common press fitting systems.	Cordless radial press with automatic circuit control for producing pipe pressing joints for all common press fitting systems. For battery or corded operation.



Note: Other tools for MLP installation are available.

Multilayer Composite Piping

Making a Multilayer Composite Pipe Connection +GF+ (iFIT)



1. Cutting the pipe.



2. Chamfering

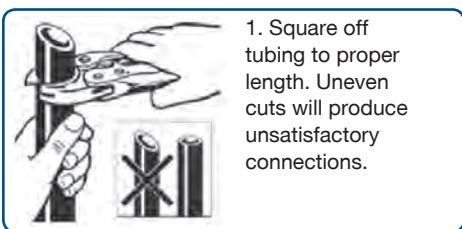


3. Attach the adapter on the pipe

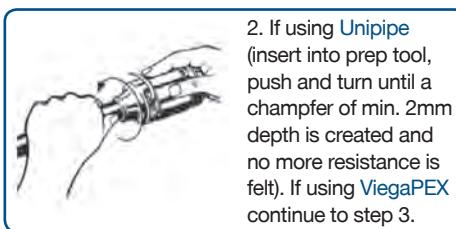


4. Snap the adapter on the module, hear the click

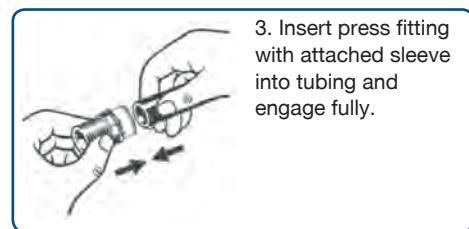
Viega (PureFlow Pex) & Unipipe



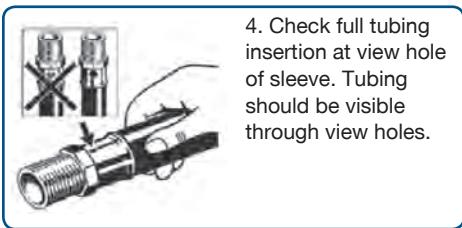
1. Square off tubing to proper length. Uneven cuts will produce unsatisfactory connections.



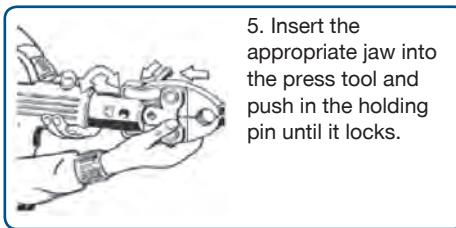
2. If using **Unipipe** (insert into prep tool, push and turn until a chamfer of min. 2mm depth is created and no more resistance is felt). If using **ViegaPEX** continue to step 3.



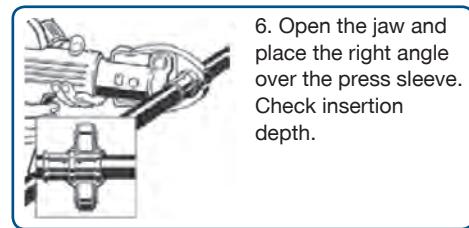
3. Insert press fitting with attached sleeve into tubing and engage fully.



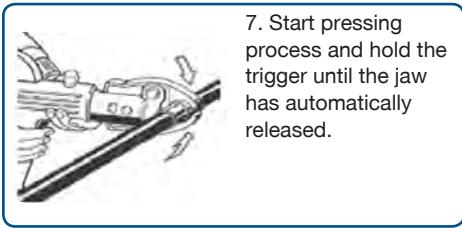
4. Check full tubing insertion at view hole of sleeve. Tubing should be visible through view holes.



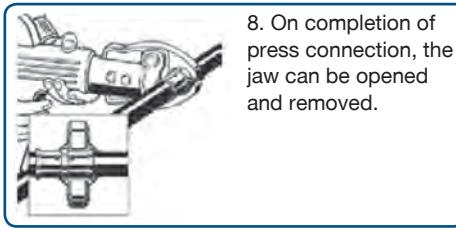
5. Insert the appropriate jaw into the press tool and push in the holding pin until it locks.



6. Open the jaw and place the right angle over the press sleeve. Check insertion depth.



7. Start pressing process and hold the trigger until the jaw has automatically released.

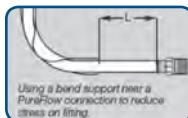


8. On completion of press connection, the jaw can be opened and removed.

Note: Some MLC's can be bent by hand however it is recommended that you use the tool to prevent damage and increase accuracy.

Note: For in depth information of Unipipe visit the W&O website.

Viega & Unipipe Guidelines for Pipe Bending



Viega & Unipipe: ViegaPex tubing can be free bent (unsupported bend) to a minimum radius of 8x the tubing O.D. and if you are using a **Viega** approved bend support or **Unipipe** the radius must be 5x the tubing O.D. For situations requiring tighter bonds, use elbow fittings. For **Viega**, if bending against a PEX coil bend direction, the bending radius is 24x the tubing O.D.

To reduce damaging stress on **Viega's** Pure Flow fittings, bend supports or tubing fasteners must be used to anchor all bends made close to fittings. Support must be provided for tubing bends located closer to fittings the distance "L" in the table below.



When using MLP's like **FostaPEX** (**Viega**) or **Unipipe** a tubing bender tool is available to assist with making accurate, tight bends in all sizes tubing.

Tubing Size	Distance from fitting to bend
3/8" PEX	L = 6 inches
1/2" PEX	L = 8 inches
3/4" PEX	L = 10 inches
1" PEX	L = 12 inches
1 1/4" PEX	L = 14 inches
1 1/2" PEX	L = 16 inches

The NORMACONNECT® pipe coupling is an economical alternative to conventional pipe joining techniques for nearly all kinds of pipe material. All plain-ended pipes can be joined easily by hand. The ready-to-fit coupling is pushed over the pipe ends, aligned and rotated to any radial fitting position. Tightening the 2 bolts alternately with a torque wrench is all it takes for a safe fitting.

Sealing reliability and integrity is insured even if there is slight axial misalignment, angular deflection and even with gaps between pipe ends from 3 mm up to 65 mm according to dimension.

Pressure surges, vibration and related noise are absorbed and minimized.

The NORMACONNECT pipe coupling is of light weight, compact material and can easily be fitted in a narrow space.



Applications for the Norma Applications: NORMACONNECT®



Flex E & Grip E
Flex / Flex E

Axial non-restraint coupling used to connect **metal and/or plastic pipe**. They are used for connecting non-restrained pipes.



Grip / Grip E

Axial restraint pipe coupling used to connect **metal pipes**. Due to its special design the coupling can withstand even high vibration loads.

Tank Vent	Exterior Drain	Sounding Tube
Potable Water	Grey Water	Compressed Air
Bilge System	Ballast Syste	Sanitary Drain
HVAC	Diesel Fuel	Black Water



Norma Grip E-FP

Axial restraint pipe coupling pipe coupling with integrated flame protection used to connect to **metal pipes**. Advantages include: flame resistance up to 1,561° F, crush resistance, 360° protection for even the lateral parts of the coupling's housing, retrofittable and chemical free. The flame protection mat is encases and protected against mechanical wear from the outside.



Norma PLAST / COMBI
PLAST GRIP / PLAST GRIP E

Axial restraint pipe coupling used to connect plastic pipes. It as an optional support sleeve used for **plastic pipes** made from PE and PP.



Norma PLAST / COMBI
PLAST GRIP / PLAST GRIP E

Axial restraint pipe coupling used to connect metal pipes with **plastic pipes**. Ther are different features used for a plastic pipe and a metal pipe.

Lube Oil	Salt Water C.	Fresh Water C.
Sprinkler	Fire	

Grey Water	Black Water	Potable Water
Sprinkler	Sanitary Drain	

Features

Low Profile Design

Benefits

- Saves space allowing closer parallel pipe runs
- **Large weight savings over flange connections**

Screw Tightening Seals

- Remarkable tolerance in pipe OD's and oval shape
- **Flameless connection, eliminates hot work**

- Reduces labor times by eliminating flange welding and precision
- Can be reused or reattached to new pipes
- Allow for greater angular deflection

Simple Installation

- Shipped fully assembled and ready to install
- All connections made with standard Allen wrenches
- No precise pipe gap and little to no end treatment required for connection

Full Stainless Steel Construction

- Resistant to most ship service applications
- Ozone, UV light, and fire resistant

Double-Lip Sealing System

- The inside lip presses onto the outside lip providing a reliable seal
- Provides extra seal pressure as the internal pressure increases

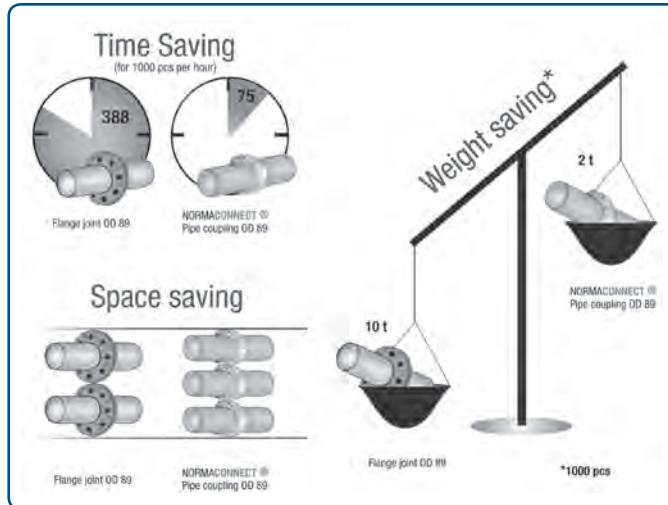
235 PSI Working Pressure

- For use in general service shipboard applications

Working Temperature

- For use in general service shipboard applications
- Can be used in -22°F (-30°C) to 257°F (125°C) temp range

Benefit Focus: Norma Coupling Time, Weight and Space Savings



Note: Norma gives you the best savings in weight, space. It also saves you in time which means that less labor is required – saving you money.

Type Approval by Agency



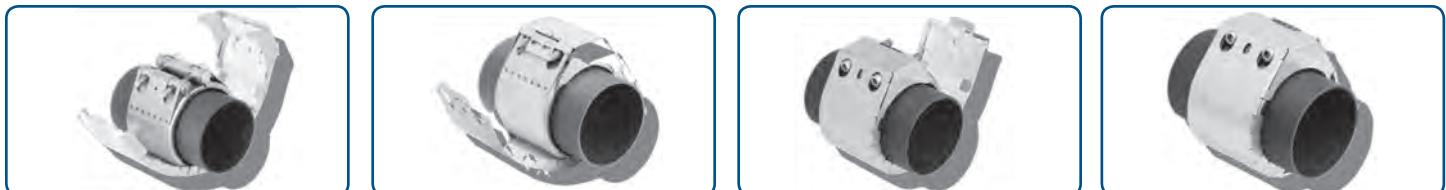
Flex E	03-HG407631/1-PDA	07346/C1 BV	P-12567	1101897 HH	97/20043(E7)
Grip E	03-HG407631/1-PDA	07345/C1 BV	P-12567	1101797 HH	97/20042(E6)
Grip E-FP	03-HG407631/1-PDA	07345/C1 BV	P-12565	1101797 HH	97/20042(E6)
PLAST / COMBI	03-HG403306/1-PDA	10351/B0 BV		2104804 HH	02/20017(E2)

Note: Please refer to the Norma Application document for more details on applications.

Coupling Types and Suitable Applications

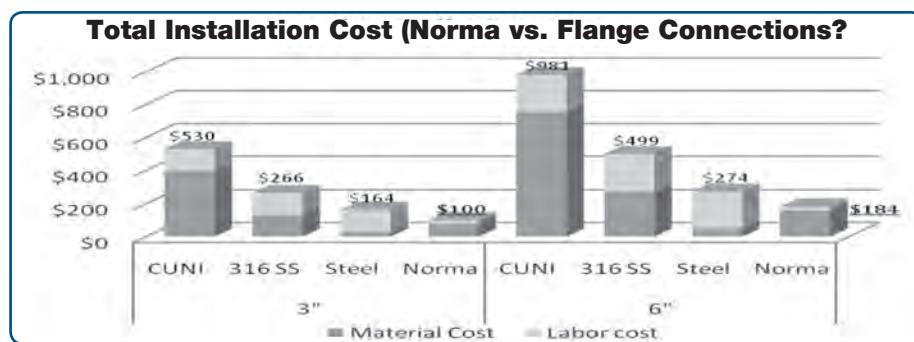
Pipes to be Connected	OD (mm)	ID (inches)	ID (mm)	Pressure (Bar/psi)	Installation Time (min)	Weight (kg)	Weight (lbs)
Flex/Flex E	26.9 to 170.0	0.5 to 6.0	15 to 150	16/232	2-7	0.4 to 2.8	0.9 to 6.2
	180.0 to 270.0	6.0 to 10.0	150 to 250	12/175	9-10	3.3 to 4.6	7.3 to 10.1
	270.0 to 360.0	10.0 to 14.0	250 to 350	~9/~130	10-12	4.1 to 5.8	9.0 to 12.8
	360.0 to 610.0	14.0 to 24.0	350 to 600	~5.5/~80	12	4.8 to 9.1	10.5 to 20.0
	610.0 up to 1220.0	24.0 to 48.0	600 to 1200	~3.5/~50	12	8.9 to 15.8	19.5 to 35.0
Rep/Rep E	34.5 to 170.0	1.0 to 6.0	25 to 150	16/232	2-7	0.5 to 3.7	1.1 to 8.1
	202.0 to 275.7	6.0 to 10.0	150 to 250	12/175	9-10	3.7 to 4.6	8.1 to 10.1
	301.0 to 410.5	10.0 to 16.0	250 to 400	9/102	10-12	4.8 to 5.9	10.6 to 13.0
	505.0 to 1224.0	16.0 to 48.0	400 to 1200	~3.5/~51	12	7.2 to 15.8	15.8 to 34.8
Grip/Grip E/ Grip FP/E-FP	26.9 to 170.0	0.5 to 6.0	15 to 150	16/232	2-7	0.4 to 6.1	0.9 to 13.4
	170.0 to 245.0	6.0 to 9.5	150 to 225	12/175	9-10	5.3 to 6.1	11.7 to 13.4
	250.0 to 360.0	10.0 to 14.0	250 to 350	~6/~90	10-12	6.1 to 7.4	13.4 to 16.3
	360.0 to 712.0	14.0 to 28.0	350 to 690	~2.5/	12	7.4 to 10.2	16.3 to 22.4
Plast Grip/E	38.0 to 204.0	1.0 to 7.0	25.0 to 177.8	16/232	2-9	0.6 to 6.6	1.3 to 14.5
	225.0 to 273.0	7.0 to 10.0	177.8 to 254.0	10/145	9-10	7.2 to 10.0	15.8 to 22.0
	355.0 to 406.4	14.0 to 16.0	355.6 to 406.4	6/90	10-12	10.8 to 11.8	23.8 to 26.0
Combi Grip/E	38.0 to 204.0	1.0 to 7.0	25.0 to 177.8	16/232	2-9	0.6 to 6.3	1.3 to 13.9
	225.0 to 273.0	7.0 to 10.0	177.8 to 254.0	10/145	9-10	6.8 to 8.5	15.0 to 17.0
	355.0 to 406.4	14.0 to 16.0	355.6 to 406.4	6/90	10-12	10.2 to 11.1	22.4 to 24.4

NORMACONNECT RFP Flame Protection: 1 flame protection for all couplings FLEX / FLEX E and GRIP / GRIP E



Characteristics

- Simple handling and assembly
- High flexibility for installers, shipyards and distributors
- Sizes ranging from 1.06 to 12.75 inches (26.9 to 323.9 mm)
- Temperature resistant up to 1,561°F (850°C)
- Meets the latest IACS requirements
- Retrofittable
- Low weight
- Flame protector made from stainless steel 1.4571 (316Ti) with attached silicate mineral fiber mat



Note: Norma offers the lowest overall installed cost.

Components and Materials in Accordance with DIN Standard

W4

No.	Component	Flex E		Grip E		COMBI GRIP E		PLAST GRIP E		REP E	
		DIN	AISI/AS								
1	Housing with Bridge	1.4301	304	1.4301	304	1.4301	304	1.4301	304	1.4301	304
2	Sealing Sleeve	EPDM/NBR									
3	Strip Insert	1.4571/PA-GF	316 Ti								
4A	Anchoring Ring for Metal Pipes	–		1.4310	301	1.4310	301	–		–	
4A	Anchoring Ring for Plastic Pipes	–		–		PA-GF-NS		PA-GF-NS		–	
4B	Protection Ring	1.4571	316 Ti	–		–		–		–	
5+ 6	Solid Lock Bars	1.4301	304	1.4301	304	1.4301	304	1.4301	304	1.4301	304
5+ 6	Hollow Lock Bars	1.4571	316 Ti								
7	Locking Bolts	1.4404	316 L								
8	Washer	1.4571	316 Ti								

Note: NORMACONNECT pipe couplings are available in the materials W2, W4 and W5 upon request.

Guideline on How to Order

Flex



Type

W4



Coupling Material

EPDM



Sealing Material

508



Note: When you want to order a NORMA coupling product, these are the 4 pieces of information that are required.

Sealing Sleeves: Areas of Application and Temperature Resistance

Material of Seal	EPDM	NBR
Temperature range	OD 26.9 up to 168.3 mm -22°F to +257°F -30°C up to +125°C OD > 180 mm -4°F to +176°F -20°C up to +80°C	-4°F to 176°F -20°C up to +80°C
Media	Drinking Water Alcohols Compressed Air Solids	Water Oils Gases (Combustible) Fuels Hydrocarbon Solutions

Shipbuilding

GF Piping Systems offers a complete range of fittings, valves and pipes made from thermoplastics that offer specialized benefits to the shipbuilding industry. Moreover, the scope of supply also includes basic planning and training programs for the engineers and fitters contracted to perform installation.

Ships are not only floating cities but are also essential for the world's economy. Preventing corrosion is more important here than anywhere else. With GF Piping Systems, corrosion is no longer an issue.

Marine installations are exposed to the forces of nature day and night. Wind, rain and saltwater can be very harsh on structures, housing and supply lines. The solutions from GF Piping Systems warrant the safe conveyance of drinking water and other process fluids – without altering their quality in the least.

Cost-effective and high-quality plastics are your right choice. GF will help you increase profits by reducing maintenance time and overall operational cost.

GF offers you pipes that weigh less than steel and can be repaired in a short period of time.

For drain systems, Georg Fischer has created specialized fittings which have a 1° increase in angle to help maximize flow in gravity system.



Applications for the GF Applications



Instaflex Polybutylene

This system offers perfect pre fabrication and dry fit, preassembly capabilities. Its temperature resistance is 95°C. Its high flexibility feature and its easy installation technology cuts time and costs to a minimum. For use in:

- Hot water applications
- Cold water applications

HVAC	Ballast System	Diesel Fuel
Black Water	Grey Water	Portable Water



PE-100 Polyethylene PE

This system has predominantly good resistance against acids and caustic substances. GF uses a polyethylene that is stabilized against the effects of ultraviolet radiation. For use in:

- Drinking water
- Cold ballast water

Chemical	Potable Water	Sanitary Drain
Ballast Water	Grey Water	



Seadrain Polypropylene

Seadrain is flame retardant system that yields a combination of high chemical resistance, toughness and high strength at elevated temperatures. It offers dry fit, pre assembly. For use in:

- black water drainage
- grey water drainage

Sanitary Drain	Exterior Drain	Black Water
Grey Water		

+GF+

Georg Fischer

Features

Advanced Plastic Material Choices

Benefits

- Extremely high chemical resistance
- Large weight savings over metal pipe and fittings**
- Flexible, to follow the curve of a hull or fit in tight spaces
- Long service life with minimal maintenance
- Reduces pipe noise and water hammer vibrations
- Can recycle plastic through reutilization or combustion**

Electro Fusion Welding

- Reduces welding times by up to 1/3

Flameless connection, eliminates hot work

- Joint is the strongest part of the pipe system after welding

Dry Fit Ability

- Joints are screwed or clamped tight before welding
- Pipe can be dry fitted in a large area before welding to eliminate errors
- Pipe runs can be prefabricated on shore and brought onboard to reduce dry dock labor time and coordination

Low Thermal Conductivity

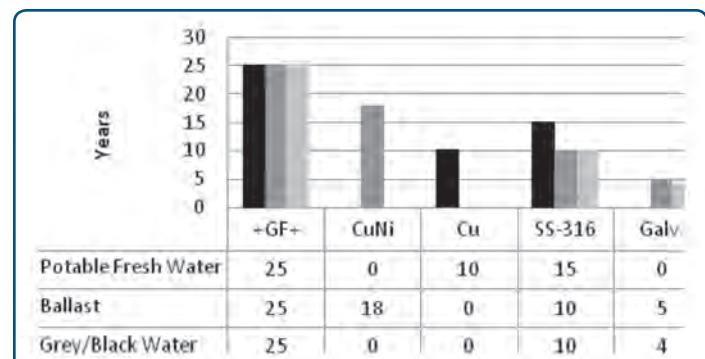
- Reduced need for insulation saving material and labor costs
- Increases available space in piping trunks

215 PSI/15 Bar Working Pressure

- For use in general service non-essential shipboard applications

Benefit Focus: GF Savings in Weight and Increase in Life Expectancy

Weight Savings				
Pipe Diameters (mm)	25	50	110	160
Plastic (kg/100 m)	16	53	248	550
Carbon Steel (kg/100 m)	—	310	927	1710
Stainless Steel (kg/100 m)	81	193	1041	1542
Copper (kg/100 m)	59	291	—	—
Savings (plastics to steel)	65	257	679	1160



Note: With GF you save in the initial cost, the weight and the labor. The pipes have an increased life expectancy.

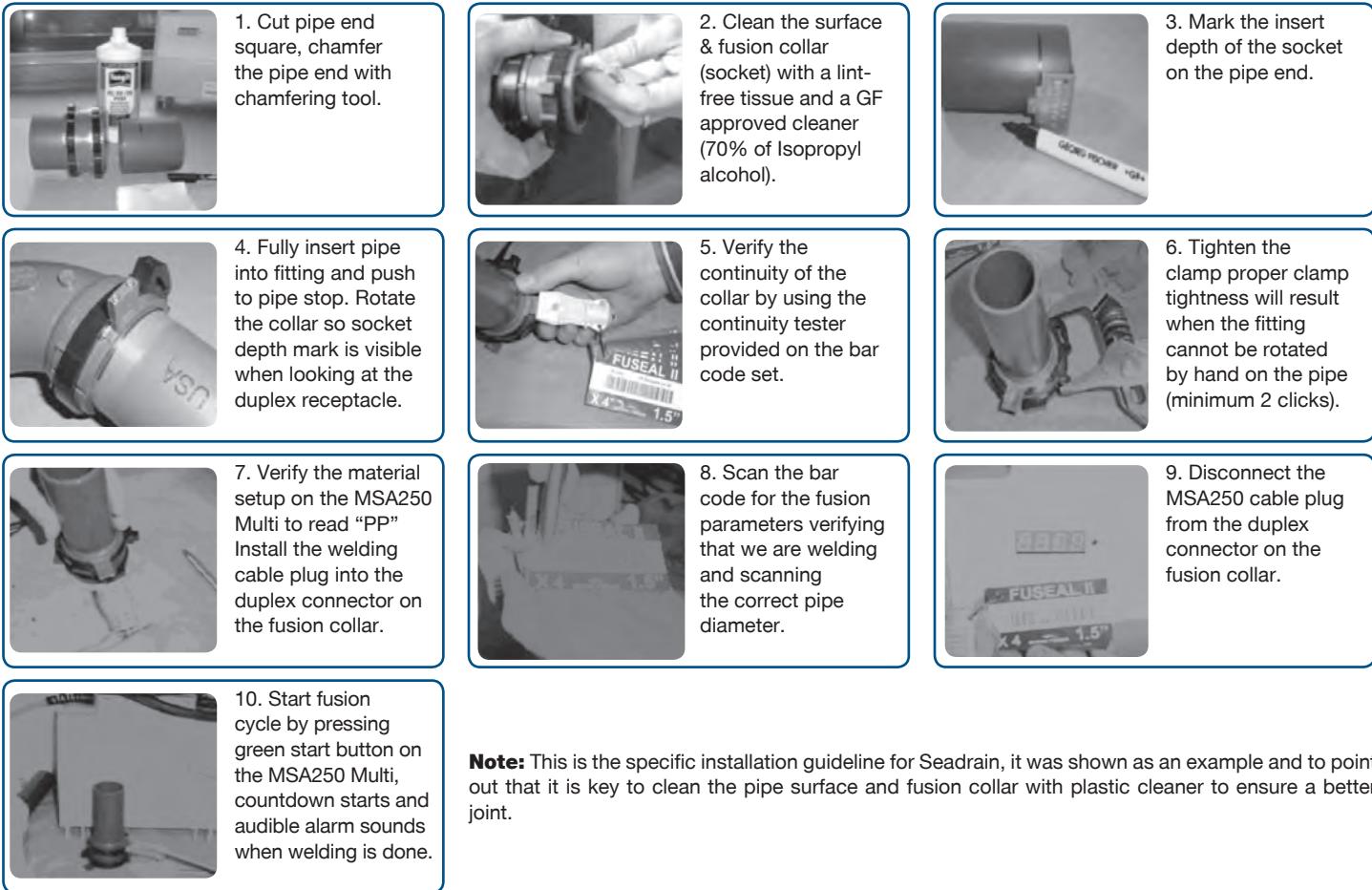
Note: Leave room for expansion and contraction when dealing with temperature extremes.

Type Approval by Agency



Instaflex	04-LD465505/5-PDA	12232/BO BV	K-2637	74 455 - 96 HH	02 / 20008 (E1)
PE - 100	05-LD502717-PDA	10132/BO BV	K-2629	13 655 - 98 HH	01 / 20029 (E2)
Seadrain	05-HS118095A-PDA	10132/BO BV	K-3205	2491005 HH	05 / 60003

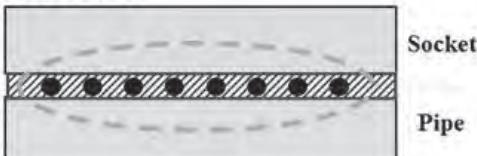
Installation Guide



Note: This is the specific installation guideline for Seadrain, it was shown as an example and to point out that it is key to clean the pipe surface and fusion collar with plastic cleaner to ensure a better joint.

Connection of Thermoplastics: Electro Fusion

Schematic



- The electro fusion process of joining a pipe to a socket uses wires to transfer the heat energy to the plastic material.

- The heat energy will be sufficient to melt the plastic surrounding the wires. This will generate a zone called the "melt" zone.

- The "melt" zone, by definition encapsulates the wires, which are at its origin along the center line.

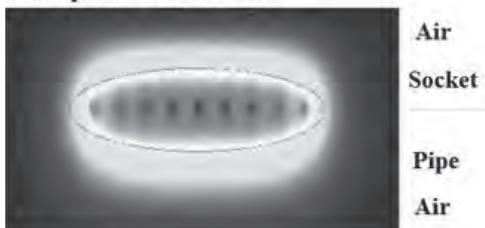
Advantages:

- Easy to use.
- No additional welding material necessary.
- Suitable for fusing all electro fusion joints from 16mm to 300mm.

Note: For a complete guide on how to use electro fusion to fuse joints go to the W&O website.

Note: Some electro fusion devices are available for rent upon request.

Computer Simulation



Material Specification

Characteristics	PE 100	PPFR	PB	Unit
Temperature Limits (25 years)	-40/ +60°C -40/ +140°F	0/ +80°C +32/ +176°F	0/ +90°C +32/ +194°F	°C °F
Weight/Meter Pipe (PN10, D63)	0.33	0.435	1.020	Kg/m
Density	0.95	0.91	0.94	g/cm ³
Flexural Modulus	23°C (73.4°F)	—	—	N/mm ²
Tensile Modulus	23°C (73.4°F)	900	1330	N/mm ²
Stiffness	2	3	1	
Toughness	23°C (73.4°F)	5	3	4
	0°C (32°F)	4	2	3
	-40°C (-40°F)	3	1	—
Charpy Notched Impact Strength	23°C (73.4°F)	83	~ 7	30
	0°C (32°F)	—	—	14
	-40°C (-40°F)	13	—	—
Taber Abrasion	60	150.....200	160	mm ³ /10 ³ cycles
Abrasion Resistance	5	4	4	
Coefficient of Thermal Expansion	Not Linear	0.15.....0.2	—	Mm/mK
Thermal Conductivity	23°C (73.4°F)	0.38	0.23	W/mK
Limiting Oxygen Index LOI	<19	—	<19	%
Burning Behavior (0 Burning/X Self-Extinguishing)	0	X	0	
Long-Term Strength MRS	10	—	31.5	
Pressure Resistance	2	1	5	

Penetration Seal for GF is Possible with Rise: The Rapid Sealing System

Pipe penetration solutions for GF Piping Systems are approved from:

- Beele Rise-System
- Beele CSD-Plugs

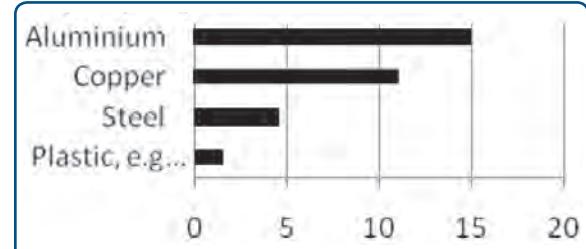
The RISE system offers the most cost-effective way of installation. The system is easy to handle on site and can be used both for vertical (deck) and horizontal (bulkhead) conduit openings. It is the system of choice for the fire safe and gas, smoke and watertight sealing of multi-cable and pipe penetrations.

The RISE system is a self-correcting sealing system that follows displacements of the pipe and deformation of the deck/bulkhead in case of a fire. The limited number of components make the system easy to handle on site.

With RISE no pre-engineering is needed, no special conduit frames have to be used, there are no restrictions on cable types and sizes, insulation in front of the penetration is not needed and the system can be used for the shortest possible conduit length.

- Plastic represents only 4% of the crude oil consumption in Europe.
- Manufacturing plastics requires less energy than producing metals.
- To manufacture 1 liter (dm³) of material, the amount of energy requires is shown in the following chart.

Plastic (PE/PP/PB) and the Environment



(Kilograms oil-equivalent/liter material)