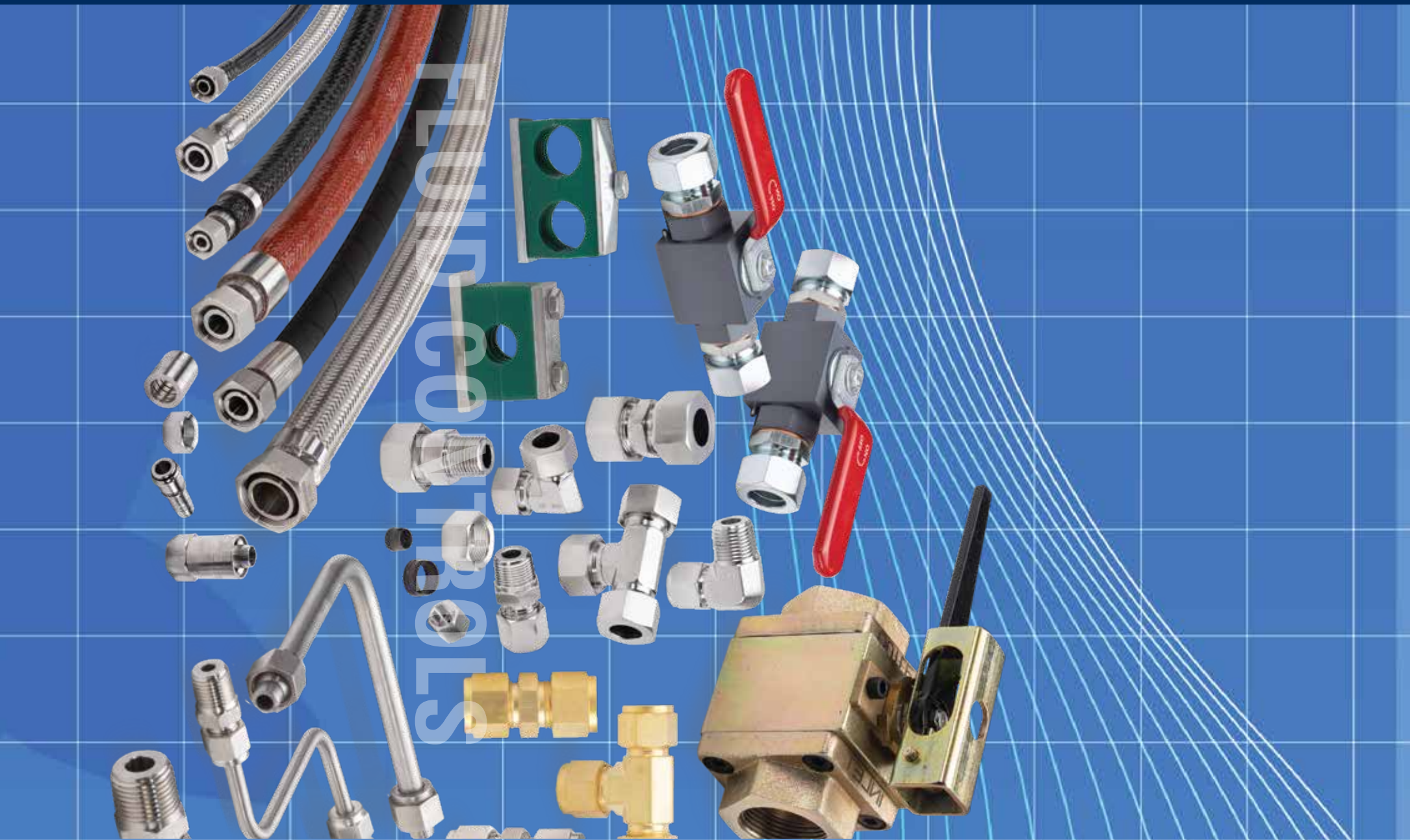
FLUID CONTROLS®
ENGINEERING CONNECTIONS EVERYDAY

PERFORMANCE ENGINEERING FOR RAIL & METRO BRAKE PIPING APPLICATIONS

WE ENGINEER



CONTENTS

WE HAVE HERITAGE

OUR COMPANY

Fluid Controls Private Limited was established in 1974 by Dr. Y.E. Moochhala, a Ph.D. from Northwestern University, with a vision to deliver high quality, high-performance products which delight customers. Headquartered in Mumbai with a manufacturing facility at Pune, Fluid Controls® has a state-of-the-art R&D centre, which offers clients customized solutions based on analytical formulations, 3D Modelling and FEA.

OUR FOCUS

With 50 years of experience, Fluid Controls® engineers connectors, isolating cocks and hose and tube assemblies for Rail & Metro brake piping applications. Certified for the **International Railway Industry Standard (IRIS)** for Rail Application (ISO/TS 22163:2017), we offer customers comprehensive "Make in India" solutions for locomotive and coach brake piping arrangements – from design & engineering services to supply of high performance connectors, tube and hose assemblies and installation services.

50 YEARS OF FOCUS ON DESIGN FOR CUSTOMER NEEDS AND PRODUCT PERFORMANCE

50 YEARS

OUR QUALITY ETHOS

CUSTOMER DELIGHT

RIGOROUS TESTING
& CERTIFICATION
PROGRAM

NO COMPROMISES

IRIS & NABL (ISO/IEC) CERTIFIED

The Fluid Controls Rail & Metro business is Certified for **International Railway Industry Standard (IRIS)** for Rail Application (ISO/TS 22163:2017). The in-house Fluid Controls Testing Laboratory is accredited to ISO/IEC 17025:2017 / National Accreditation Board for Testing and Calibration Laboratories for a range of pressure, vibration, reliability and metrology tests. Fluid Controls® also has the latest system and performance certifications including ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, PED, ASTM F1387-99 (2012), ISO 19879, NGV, ISO 15500, ECER 110, PDA for DIN Connectors, ABS PDA for Fittings, MSS-SP-99, API 607 and Fugitive Emission for Valves and Manifolds.

IRIS CERTIFIED

AS 9100

CERTIFIED ISO/IEC 17025:2017 COMPANY

NABL

WE HAVE COMMITMENT

FACILITY

MANUFACTURING FACILITY LOCATED AT CHAKAN, PUNE

SPREAD OVER 120,000 SQUARE FEET

EQUIPPED TO HANDLE THE MOVEMENT OF MILLIONS OF PRODUCTS MONTHLY

CORPORATE OFFICE BASED AT MUMBAI

The Fluid Controls manufacturing facility is located at Chakan, an industrial hub outside the city of Pune in Western India. Spread over 120,000 square feet, the facility has a covered area of 60,000 square feet. We manufacture precision parts on automated equipment and multi-spindle CNCs, and our production and assembly is 24x7. The facility houses special equipment for tube assemblies and hose assemblies.

The Fluid Controls facility has 10,500 square feet dedicated to a Research & Development Centre which is accredited by the Department of Scientific & Industrial Research (Government of India) as an "In-House R&D Center". The Center also houses performance and metrology laboratories that are certified to NABL (ISO/IEC 17025:2017).

RAIL & METRO CUSTOMERS

With 50 years of experience, Fluid Controls® offers customers comprehensive "Make in India" solutions for locomotive, passenger coach and metro brake piping arrangements. Our products include a range of double ferrule connectors, DIN connectors, adaptors, hose connectors, valves, DIN clamps, cleats and tube and hose assemblies for rolling stock brake piping systems. We also offer design and engineering services, site installation services, and testing services

Fluid Controls® is approved by all Indian Government Locomotive and Coach production units, Bombardier Transportation, Alstom Transport (Metro & E-Loco), WABTEC and over 60 Rail & Metro system integrators such as Knorr-Bremse, Escorts, Medha and Titagarh Wagons.

Millions of Fluid Controls® products have been successfully installed and have performed on:

- HIGH-SPEED ELECTRIC LOCOMOTIVES
- DIESEL LOCOMOTIVES
- PASSENGER COACHES
- METRO CARS

ELECTRIC LOCOMOTIVES **EMU COACHES**
DIESEL LOCOMOTIVES
CHITTARANJAN LOCOMOTIVE WORKS
EQUIPMENT INTEGRATORS
DIESEL MODERNISATION WORKS
ALSTOM TRANSPORT
WABTEC-FAIVELEY **LHB COACHES**
KNORR BREMSE INDIA
RAIL COACH FACTORY
METRO RAIL COACHES
GE TRANSPORT **BHEL-JHANSI**
BHARAT EARTH MOVERS **ESCORTS**
INTEGRAL COACH FACTORY
TITAGARH WAGONS MODERN COACH FACTORY

WE HAVE INNOVATION

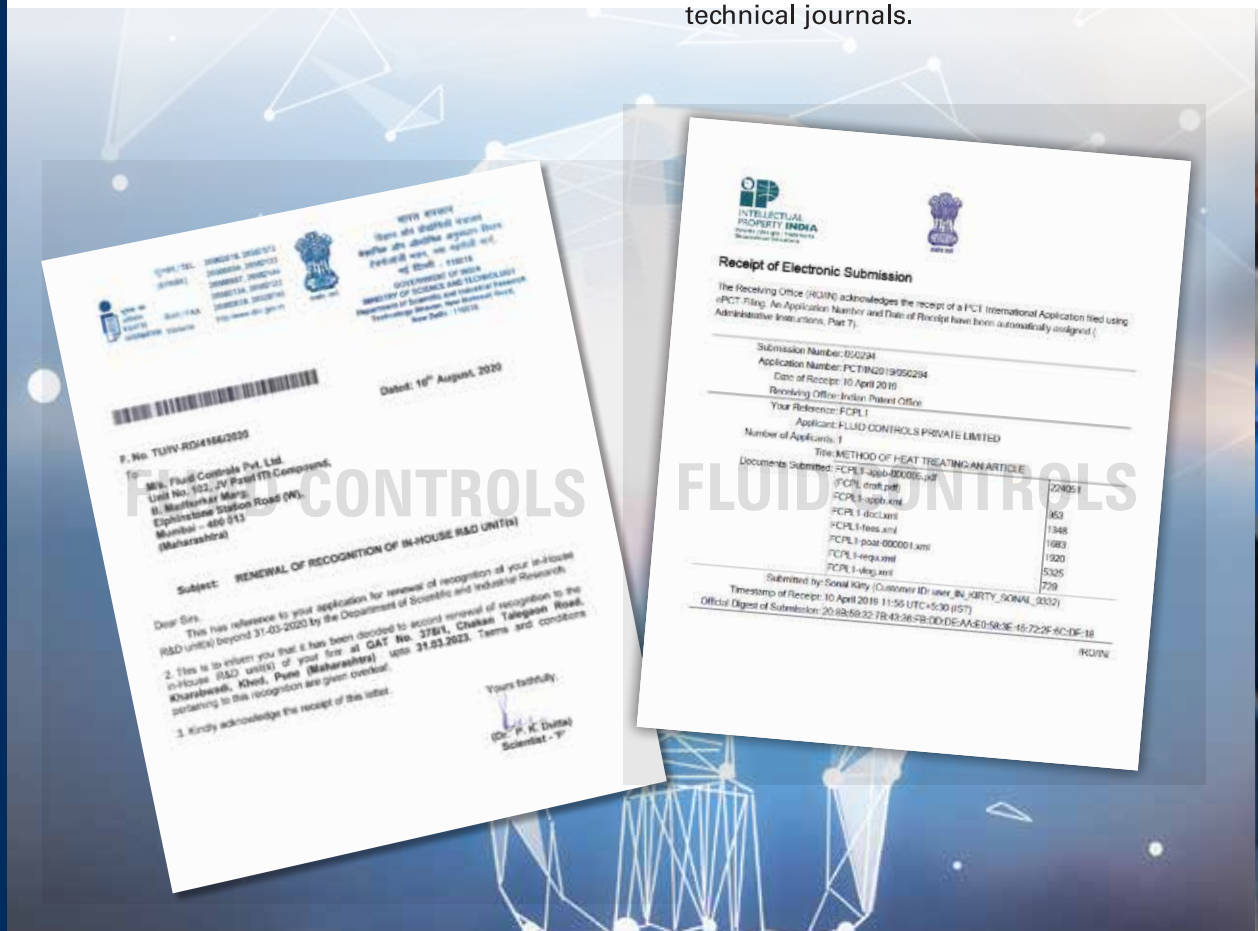
RESEARCH & DEVELOPMENT

AN ETHOS OF R&D

Since its inception in 1974, Fluid Controls® has engaged in original R&D and has an ethos of developing products which are indigenous replacements of imported products. Today, Fluid Controls® is approved as an "In- House R&D Center" by Department of Scientific & Industrial Research (DSIR), Government of India. Our state-of-the-art R&D center is located at Chakan, Pune. We offer design services and conversion engineering, including 3D modelling, FEA and prototyping via SolidWORKS and ANSYS.

PATENTS & PUBLICATIONS

Fluid Controls® has been granted one patent and has filed several more disclosures. We have developed over 25 new products in recent years and our original research has been published in national and international technical journals.



TESTING CAPABILITIES

The Fluid Controls® Performance Testing and Metrology Laboratories are certified for NABL-ISO/IEC 17025:2017. Our facility is equipped for all pressure, vibration and reliability tests from routine pressure and vibration testing to pressure and burst tests for the military for HARD Bomb Shells. We also conduct in-house Spectro, PMI and UT testing.

- Hydrostatic pressure up to 58,000psi. Pneumatic testing up to 20,000psi
- In-house Spectro Testing and Oxy-Cleaning Facility
- SCADA Multi Test Bench
- Hydraulic Impulse and Vibration Test
- Temperature Cycling
- Corrosion Resistance of plating as per ASTM B840: 2002 by Salt Spray Method ASTM B117
- Stress Corrosion Test as per ASTM F1387
- Flexure Fatigue, Rotary Flexure and Tensile Pull Test
- Vacuum Test - up to 750mbar
- NRV's - Cracking Pressure to 0.5kg
- Cryogenic Test Setup for Temperatures to -196°C
- Valve Reliability Test Bench – for Cycle Testing
- In-house UTS, PMI and Rockwell & Vickers Hardness Testing

WE CREATE

RAIL & METRO PRODUCTS & SERVICES

TWIN FERRULE CONNECTORS

DIN CONNECTORS

ISOLATING COCKS

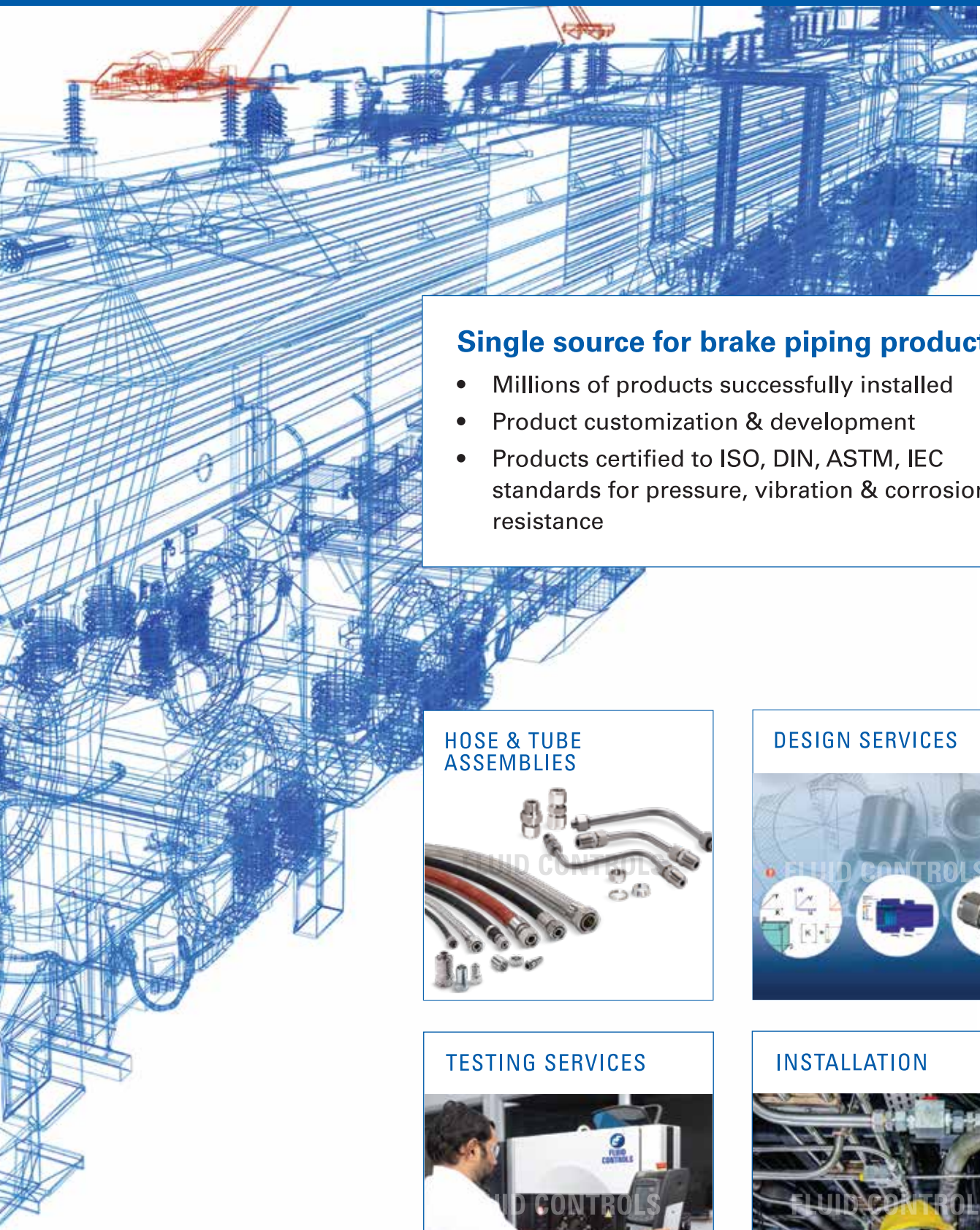
FLEXIGRIP™ CONNECTORS

THREADED ADAPTERS

ACROSS FRAME CONNECTORS

QUICK RELEASE CONNECTORS

CLAMPS & CLEATS



Single source for brake piping products

- Millions of products successfully installed
- Product customization & development
- Products certified to ISO, DIN, ASTM, IEC standards for pressure, vibration & corrosion resistance

HOSE & TUBE ASSEMBLIES

DESIGN SERVICES

TESTING SERVICES

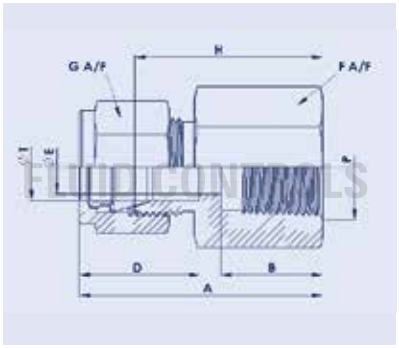
INSTALLATION

WE CONNECT

PRODUCTS

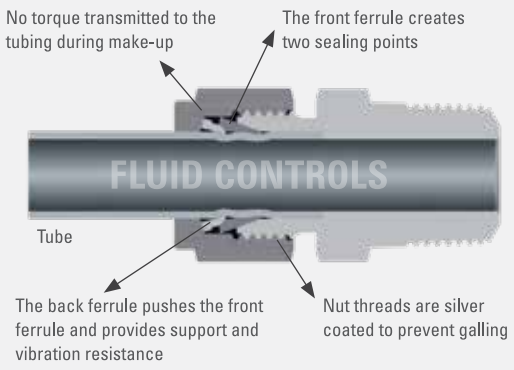
DOUBLE FERRULE CONNECTORS

Fluid Controls Double Ferrule Connectors provide leak-proof, torque-free seals for brake piping connections. The twin ferrule action provides multiple sealing points in the joint which effectively eliminate hazardous leaks and ensure high vibration resistance and temperature cycling.



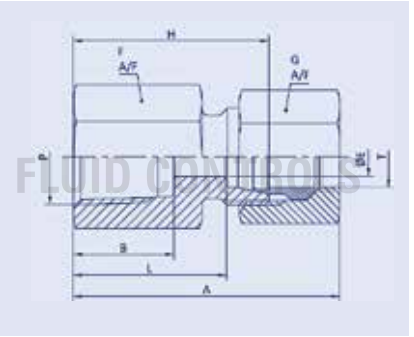
- Over 45 years of "fit and forget" performance on rolling stock piping
- Design approved by the American Bureau of Shipping
- The case-hardened edge of the rear ferrule provides a leak-proof joint
- Performance certified to ASTM F1387 (2012), AS9100 aerospace standards and CNG standards
- Comply with BS EN 61373 shock & vibration norm
- Corrosion resistance to IEC 60068
- Sizes up to 2" / 42mm
- Working pressures as per ASME B31.3
- Metric, NPT, BSPP, BSPT threads

- Two ferrules grasp the tube tightly. There is no damage to the tube wall as all the action in the connector is by an axial movement along the tube instead of a rotary motion to create a joint. As no torque is transmitted from the connector to the tubing, there is no initial strain which might weaken the tubing
- The Fluid Controls double ferrule system provides a sequential action which overcomes variations in the wall thickness and provides a leak-free joint which can withstand heavy impulse and vibration in pressure systems



DIN CONNECTORS

Fluid Controls DIN Connectors form leak-free, corrosion and vibration resistant connections and are designed to DIN & ISO standards and performance validated to ISO 19879 & ISO 8434-5.

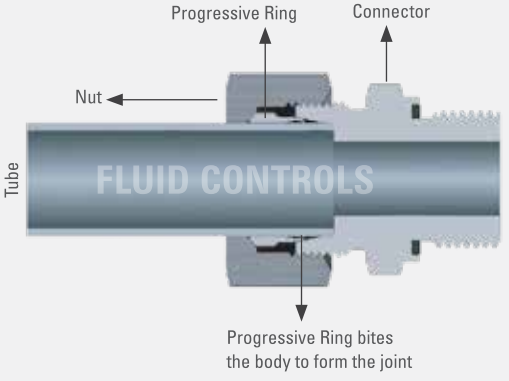


- The edge of the progressive ring is hardened by a proprietary patented process to form a leak-free connection with tubing
- Performance validated to ISO 19879
- Validated for Salt Mist Performance to ISO 9227
- Comply with Vibration norms of IEC 61373
- Cyclic Endurance, Fire Endurance, Pull Out Tested to IACS P211:2011
- Available in a series of designs for pressure ratings (LL, L, and S)
- Sizes from 4 to 42 mm
- Nominal Pressure rating to 800 bar
- Connection points include progressive rings, elastomer sealing or tube flaring connections

A single ferrule bites into the tube to create a joint ("bite type fittings"). The cutting edge of the progressive ring is case hardened by a proprietary patented process and the edge bites into the tube during installation. This "biting" or "crimping" action is the heart of the connector and is a combination of geometry and metallurgy.

Fluid Controls® DIN Progressive Rings are available in two options:

- **Single Bite (SB)** progressive rings for use across applications
- **Double Bite (DB)** progressive rings can be used for higher pressures and high vibration environments



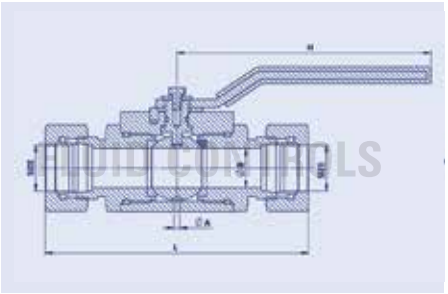
WE CONNECT

PRODUCTS

Fluid Controls® offers a range of isolating cocks designed for vacuum applications and railway pneumatic brake circuits. Standard isolating cocks are available with vented and non-vented options and a special series offers forged bodies in carbon steel and brass forged bodies. For underframe locomotive applications, Fluid Controls® offers an isolating cock with a latched handle safety feature.

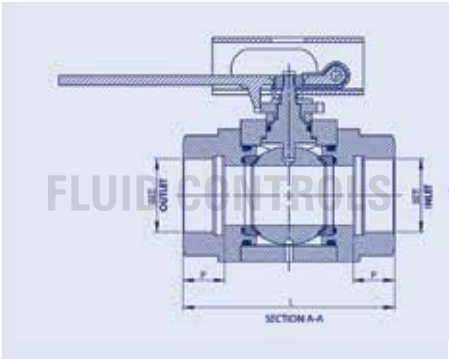
RAILWAY ISOLATING COCKS

- High-performance Isolating Cocks designed for vacuum applications and railway pneumatic brake circuits
- Threaded, single ferrule, twin ferrule, and weld nipple end connections
- Available with a vented option at the outlet end
- Pressure performance up to 400kg/cm^2
- Available in sizes 6mm to 42 mm and ¼" to 1"
- RPTFE or Delrin Seat with a soft handle operation



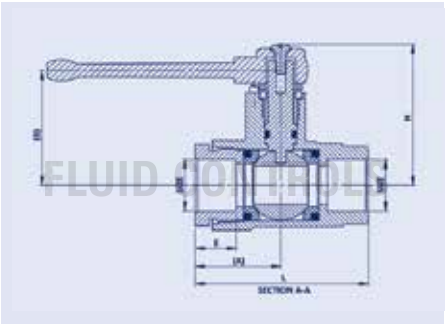
LATCHED ISOLATING COCKS

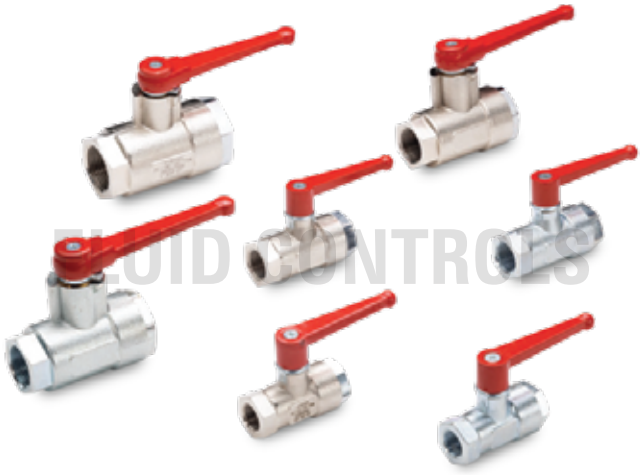
- Specially designed Latched Isolating Cock (ball valve) with an added safety feature for use in locomotive underframe brake piping
- The handle has a locking (latching) arrangement to secure it in position and to prevent the valve from being inadvertently opened
- Constructed from steel and zinc coated for corrosion resistance
- Pressure performance range from 10 kg/cm^2 to 120 kg/cm^2



SPECIAL SERIES FORGED ISOLATING COCKS

- Forged body in brass or steel for high durability
- Designed for vacuum applications and railway pneumatic brake circuits
- Coated for corrosion resistance
- Pressure performance to 120 kg/cm^2
- Available in sizes 6mm to 42mm and ¼" to 1½"
- Replaceable handles in different colours to differentiate in-line applications



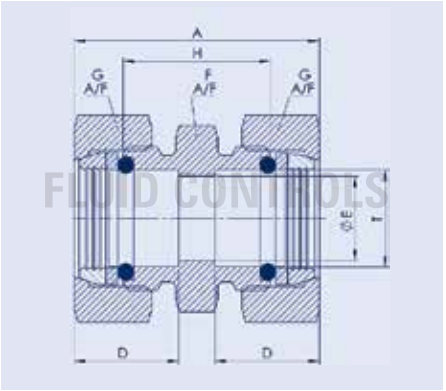


WE CONNECT

PRODUCTS

FLEXIGRIP™ CONNECTORS

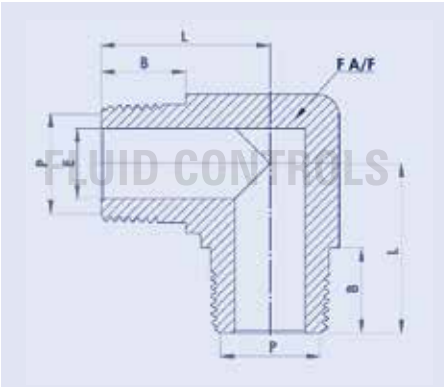
Fluid Controls FlexiGrip™ Connectors offer zero leakage and vibration resistant connections on mis-aligned pipes or pipes of different materials.



- Offers connections on mis-aligned piping up to 3”
- Can be used to connect several pipes / tubes of different materials
- Triple sealing action provided by a split ring, a washer and an O-ring
- The split ring provides superior vibration resistance
- Easy to assemble and offers “Make & Break” re-usability

THREADED ADAPTORS

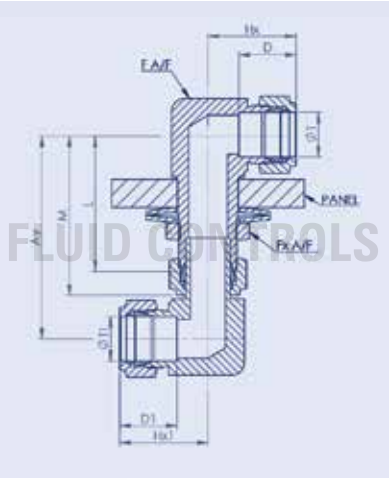
Fluid Controls Threaded Adaptors provide reliable sealing with NPT, ISO/BSP and SAE thread connections.



- Sealing for tubing and piping installations
- High-quality finish, capped protection threads
- NPT, ISO/BSP and SAE thread connections
- Available in stainless steel and carbon steel

ACROSS FRAME CONNECTORS

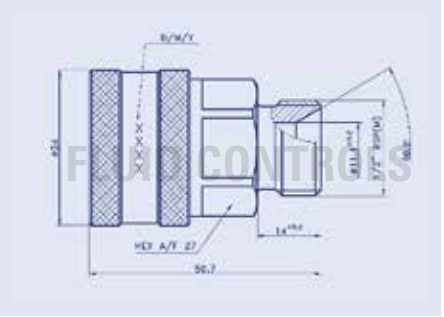
Fluid Controls Across Frame Connectors are custom- designed swiveling adaptors to connect brake system pipelines separated by a panel. These connectors are used in piping connections between the bogie and the shell in rolling stock.



- Bulkhead application at one end and a swiveling action at the other end for orientation and height adjustment
- Can be used to join pipelines of different material
- Easy to install and eliminate welding processes
- End connections are tested and validated to ASTM, DIN or ISO standards

QUICK RELEASE CONNECTORS

Fluid Controls Quick Release Connectors offer easy connection and disconnection by hand with zero leakage and no spillage at high working pressures.



- Designed to ISO and DIN standards
- High reliability for repetitive operations, quick change operations and for in-line operations
- Easy connection and disconnection by hand
- A wide range of end connections

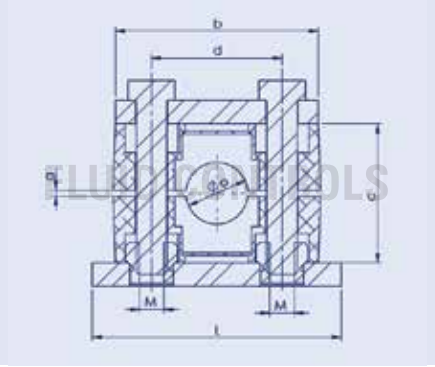
WE CONNECT

PRODUCTS

CUSTOMIZED CLEATS

Fluid Controls Cleats provide compact vibration resistance for systems with multiple parallel pipelines and offer a cost-effective alternative to using rail mounted clamps.

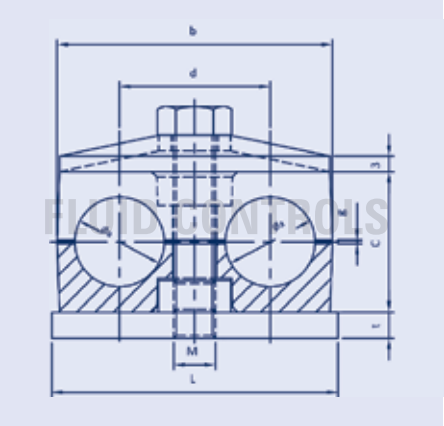
- Customised to client requirements
- Designed to provide support for multiple pipelines in high vibration environments
- Offered in polyamide and polypropylene
- Available for fractional and metric pipes

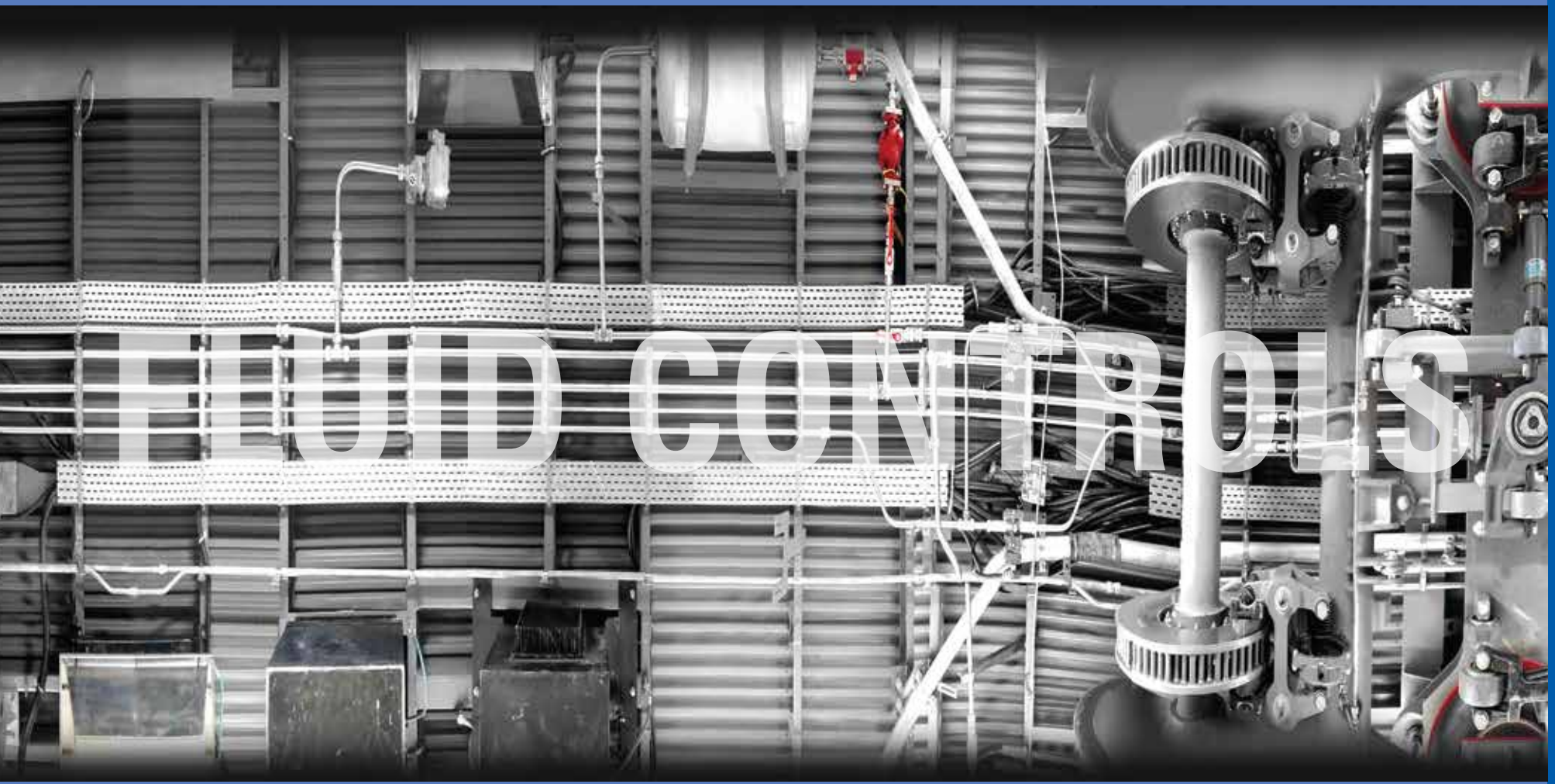


DIN CLAMPS

Fluid Controls DIN Pipe & Tube Clamps are easy to install, provide shock absorption and vibration dampening and provide a high impact resistance. They provide reliable sealing for tubing and piping installations.

- 4-rib construction design to prevent the transmission of vibration and to provide rigid support laterally & longitudinally
- Designed and design validated to DIN standards
- Design series are Standard Duty, Heavy Duty and Twin as per DIN 3015 specifications
- Stackable and mountable for clamping on multiple pipelines
- Available for fractional and metric pipes and in polyamide, polypropylene and aluminium




FLUID CONTROLS

WE ASSEMBLE

HOSE & TUBE ASSEMBLIES

INTEGRATED HOSE ASSEMBLIES

Fluid Controls® offers designed and integrated hose assemblies, which consist of a specific length of hose with a properly chosen connector attached on each end. Based on in-house design parameters, sourced hoses and connectors manufactured in-house are crimped, assembled and tested at our facility. These assemblies facilitate customer inventory management and ensure faster turnarounds.

- In-house equipment for hose cutting, crimping, skiving and nut crimping
- Hose procurement from customer approved vendors
- In-house manufacture of hose connectors
- In-house crimping and assembly by our resident team
- Each assembly is tested before despatch
- Transport-worthy packaging for domestic or overseas shipping

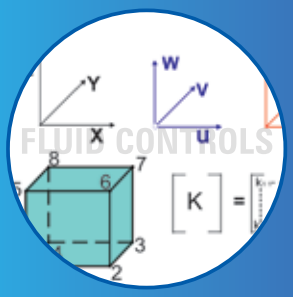
ENGINEERED TUBE ASSEMBLIES

Based on brake piping layouts provided by customers, Fluid Controls® offers engineered tube assemblies. These assemblies consist of bent or cut-length tubes with connectors assembled onto each end. The assemblies are designed and validated in-house and the assemblies are manufactured, assembled and tested at our facility. These assemblies facilitate customer inventory management and ensure faster turnarounds.

- Engineering and design at our facility with 3D modeling and layouts to customer requirements
- Tube bending on a 5 Axis CNC tube bending machine. All bends are checked with a CMM measurement machine
- End connector swaging by our in-house team of experts
- Sample pressure hydrostatic and pneumatic testing of assemblies
- Transport-worthy packaging for domestic or overseas shipping
- On-site fitment of sub-assemblies or site supervision if required

WE DESIGN

DESIGN & ENGINEERING SERVICES



ANALYTICAL FORMULATIONS / FIRST PRINCIPLES

IN-HOUSE 2D & 3D MODELING

FINITE ELEMENT MODELING & ANALYSIS

MANUFACTURING & TESTING AT OUR FACILITIES

Fluid Controls® offers design services for brake piping arrangements and conversion engineering, including 3D modelling, FEA and prototyping. All engineering and design is at in-house at the Fluid Controls® R&D Center.

PRODUCT DEVELOPMENT

- Development of new products for customers
- The product development cycle includes design, FEA, prototyping, and testing. In-house or third-party certification is provided on request.

3D MODELING AND ANSYS ANALYSIS

- Studies and analysis for in-place systems or for comparing systems based on customer briefs
- In-depth FEA studies covering vibration impact, reliability, life estimation and energy absorption of connectors

PRODUCT CUSTOMIZATION

- Customized solutions when installing standard products is challenging. For example, Across Frame Connectors™ were designed by Fluid Controls® for electric locomotives to reduce welding operations, thus saving time and cost.

CONVERSION ENGINEERING

- Design and engineering support if brake piping systems are being converted from one connector system to another
- The Fluid Controls® service includes on-site visits, design conversion of standard connectors, estimation of piping lengths and requirements, and designing of special connectors and prototyping

Fluid Controls® uses “Design for Six Sigma” as a platform for Product Development: tools include Solid-WORKS, Ansys, AutoCad, HyperMesh, PDMS software.


DEFINE
MEASURE
ANALYSE
IMPROVE
CONTROL
FLUIDCONTROLS

WE CERTIFY & INSTALL

TESTING SERVICES

Fluid Controls® offers standard and customized testing based on customer and/or project requirements and specifications at our NABL (ISO/IEC 17025:2017) accredited laboratory. Our testing laboratory is equipped to conduct all pressure, vibration and reliability tests as well as in-house Spectro, PMI and UT testing.

PRODUCT PERFORMANCE VALIDATION TESTING

Testing on prototype or sample type-testing. These tests simulate actual environmental conditions or are designed to test extreme operating conditions (for example burst tests, cyclic endurance tests, vibration endurance tests).

METALLURGICAL TESTING

Chemical testing of metals via Spectro, Hardness testing, Viscosity testing.

NON-DESTRUCTIVE TESTING (NDT)

Positive Material Identification (PMI) and Ultrasonic Testing (UT) performed in-house by certified technicians and engineers.

CUSTOMIZED TESTING

Customized testing based on customer and/or project requirements and specifications.

APPLICATION SERVICES

SITE INSTALLATION SERVICES

As an extension of our design and supply services, Fluid Controls® offers clients on-site brake piping installation services. Fluid Controls® has completed the successful installation of brake piping on over 1500 passenger coaches to date.

Services include:

- Material handling and inventory management at site
- Tube formation, connector fitment
- Coordination with the customer for mounting of ancillary equipment
- Mounting of piping on the underframe
- Leak testing of piping

WE PERFORM

CERTIFICATIONS & AWARDS

SYSTEM CERTIFICATIONS

- Integrated Management System: ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 for Connectors, Valves and Manifolds
- Quality Management: ISO 9001:2015 for Pipe Clamps, Flanges and Hydraulic Connectors
- European Pressure Equipment (PED) Directive for Connectors, Valves & Manifolds
- European Pressure Equipment (PED) Module H for Valves and Manifolds
- International Railway Industry Standard (IRIS) ISO/TS 22163:2017
- Quality Management: AS9100:2016

PERFORMANCE CERTIFICATIONS: CONNECTORS

- American Bureau of Shipping Certificate of Design Assessment for Double Ferrule Connectors
- Design Assessment (DRIV) as per ISO 8434-1 & DIN2353 for DIN Single Ferrule Connectors
- ASTM F1387-99 (2012) Certification for Double Ferrule Connectors
- ISO 19879/BS EN 61373/IEC 60068 / IACS P2.2-12 Certification for DIN Single Ferrule Connectors
- Vibration Test as per EN 61373 and ISO 19879
- Cyclic Endurance (Impulse) Test With Vibration as per ISO 19879
- Salt Mist Test as per IEC 60068-2-52
- Oxy-Clean Certification for Double Ferrule Connectors as per ASTM G93, G131, G127

PERFORMANCE CERTIFICATIONS: VALVES

- American Bureau of Shipping Certificate of Design Assessment for Valves & Manifolds
- Design Verification for Needle & Ball Valves – ASME 816.34, MSS SP 99 MSS SP 99 (2001)
- Fugitive Emission Testing ISO 15848-1
- Fire Safe Test API 607:2010 / ISO 10497:2010
- Cryogenic Test Validation for Needle Valves
- Check Valve CV Test with Air & Water – ANSI/ISA-S75.02-1996
- Seismic Vibration Test Reports and Non-Seismic Vibration Testing to Nuclear Standards

OUR AWARDS

- "Performance Excellence Award for Product Development & Innovation" 2022 by the Indian Institute of Industrial Engineering (IIIE)
- "Innovation in Underframe Components & Engineering" at the Rail & Metro Awards 2022
- "Most Innovative Product by Emerging Enterprises" at the BW Emerging Businesses Awards 2021
- "National Winner for Quality Innovation Award 2021" by Indian Society of Quality
- Recognized as "Top 25 Innovative Companies of the Year for 2021" by the Confederation of Indian Industry (CII)
- "Best Industry Partner Award 2021" by VIIT Pune
- "Innovative Industries Award 2021" by the Institution of Engineers
- "Rail Solution Provider of the Year 2020" at Rail Infra Mobility Digital Awards
- "Urban Infra Solution Provider of the Year 2019" by Urban Transport News
- "Recognition in Excellence in Technical Innovation 2020" by ISA Maharashtra Section
- "India's 5000 Best MSME Award for Quality Excellence 2020" by India 5000 MSME
- "CII Industrial Innovation Award - Medium Scale Manufacturing Organization 2019" by Confederation of Indian Industry (CII)
- Recognized as "Top 25 Innovative Companies of the Year for 2019" by the Confederation of Indian Industry (CII)

FLUID CONTROLS Channel Partner

LMG GROUP
— ENGINEERING GROWTH —
LMG HYDRO PNEUMATICS

LMG HYDRO PNEUMATICS

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