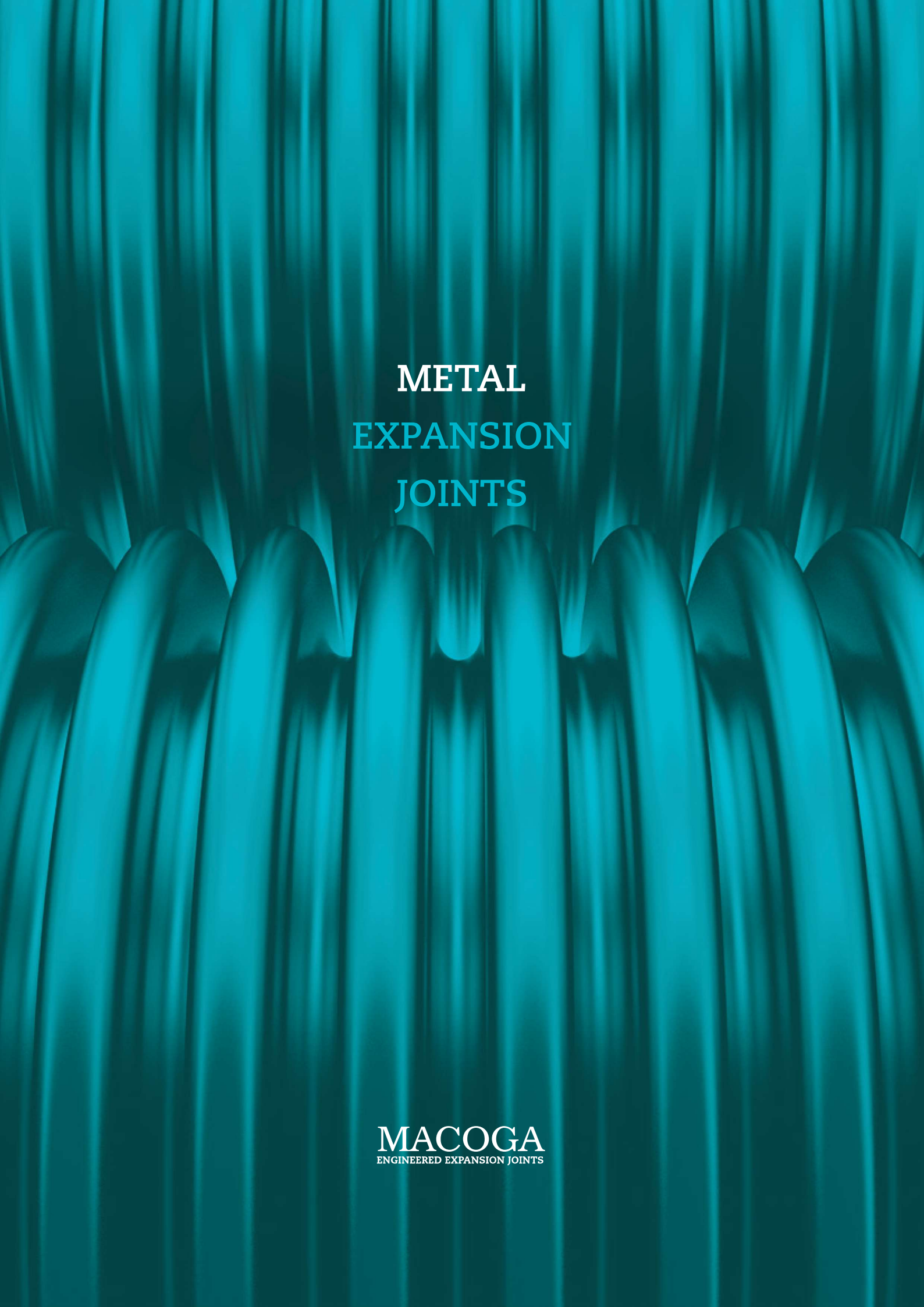




METAL EXPANSION JOINTS

MACOGA
ENGINEERED EXPANSION JOINTS

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MACOGA IS A WORLDWIDE LEADING MANUFACTURER OF EXPANSION JOINTS AS WELL AS COMPREHENSIVE SPECIFIC SOLUTIONS



In 1960 Manuel Concheiro and his sons Mario and Carlos founded a small company dealing with technical products for serving the Spanish industry. This space housed some of the company's first breakthrough expertise and big ideas that would

later come into the present production of Expansion Joints.

Early in the 70's the first Expansion Joints were designed, manufactured and shipped from MACOGA.

Throughout its more than 40-year history, MACOGA has been a leader in developing technologies and in converting those technologies for use in commercial markets. From its early days as an industrial distributor MACOGA has successfully built upon its pioneering tradition to become a global leader.

During our history, we have developed many innovative technologies and design and manufacturing of Expansion Joints became our area of expertise.

Today MACOGA is a worldwide leading manufacturer of Expansion Joints.

GLOBAL PRESENCE

MACOGA is bringing solutions to our customers in more than 80 countries throughout the world and has been synonymous with international focus and worldwide presence for many years.

Today, MACOGA has businesses and customers in nearly every corner of the globe. Day in and day out, members of our team interact with people from an extremely diverse range of backgrounds and countries.



**GLOBAL
PRESENCE
80+
COUNTRIES**



FACILITIES

MACOGA headquarters and manufacturing operation is in Ordes, La Coruña, Spain.

MACOGA operates the most advanced production facilities and equipment specifically designed for manufacturing Expansion Joints, which guarantee production efficiency and flexibility.

From raw material to final product in our factory. Our 100% internal production retains absolute control over the fabrication of your Expansion Joints.

We have excellent in-house facilities and machinery which empower our team to deliver high quality Expansion Joints. These include:

1500 m² (16,145 sq. feet) headquarters building of offices. 18000 m² (193,000 sq. feet) of Production Plant including:

- Plasma & Oxygen cutting
- Bending, rollers, presses, forming machines
- Machining equipment, CNC lathes, etc.
- Hydraulic and mechanical forming
- Shot blasting and painting cabins
- Testing benches & testing equipment including X-ray bunker

Bellows forming machinery:

- Hydraulic/Elastomeric forming
- Punching/Expander forming
- Rolling

Welding equipment:

- Automatic Submerged Arc Welding
- TIG Welding Machines
- MIG Automatic & Semiautomatic

Other facilities & equipment:

- Hydraulic Presses from 2,5 to 600 Tons
- Drilling machines
- Milling/plate grinding machines up to 8 meters
- CNC Lathes
- Forklifts
- Cranes (24 cranes from 2,5 to 20 Tons)
- Own packing fabrication area and equipment

We consistently invest in the latest technology and equipment to assure the capabilities needed to meet the demands of the industry.





M-Lens Expansion Joints
DN5900 for a cement plant.

Tied Universal FCCU Expansion
Joint for one of the largest
crude oil processing refinery in
the north of Europe.



Sumerged Arc Welding

Lateral Tied Expansion Joints
DN3300 for a Power Plant.

HEALTH AND SAFETY AT WORK

Ensuring the health, safety and security of our employees and visitors are fundamental priorities for MACOGA.

We uphold these values in the same way that we ensure the quality of our work: by implementing rigorous controls through every phase of our production processes.

Our people receive training on how to perform their jobs safely, properly and in compliance with regulations.

Safety is the responsibility of every employee at MACOGA, and “zero incidents” is our foremost goal.

If you are visiting us, please note that there are specific regulations relating to visitors who may enter the workplace. We would ask that you take a few moments to familiarize yourself with the health and safety information for visitors available on our web site. The well-being and safety of our many customers and visitors is our highest priority.



ENVIRONMENTAL PROTECTION

Environmental protection is part of our corporate citizenship.

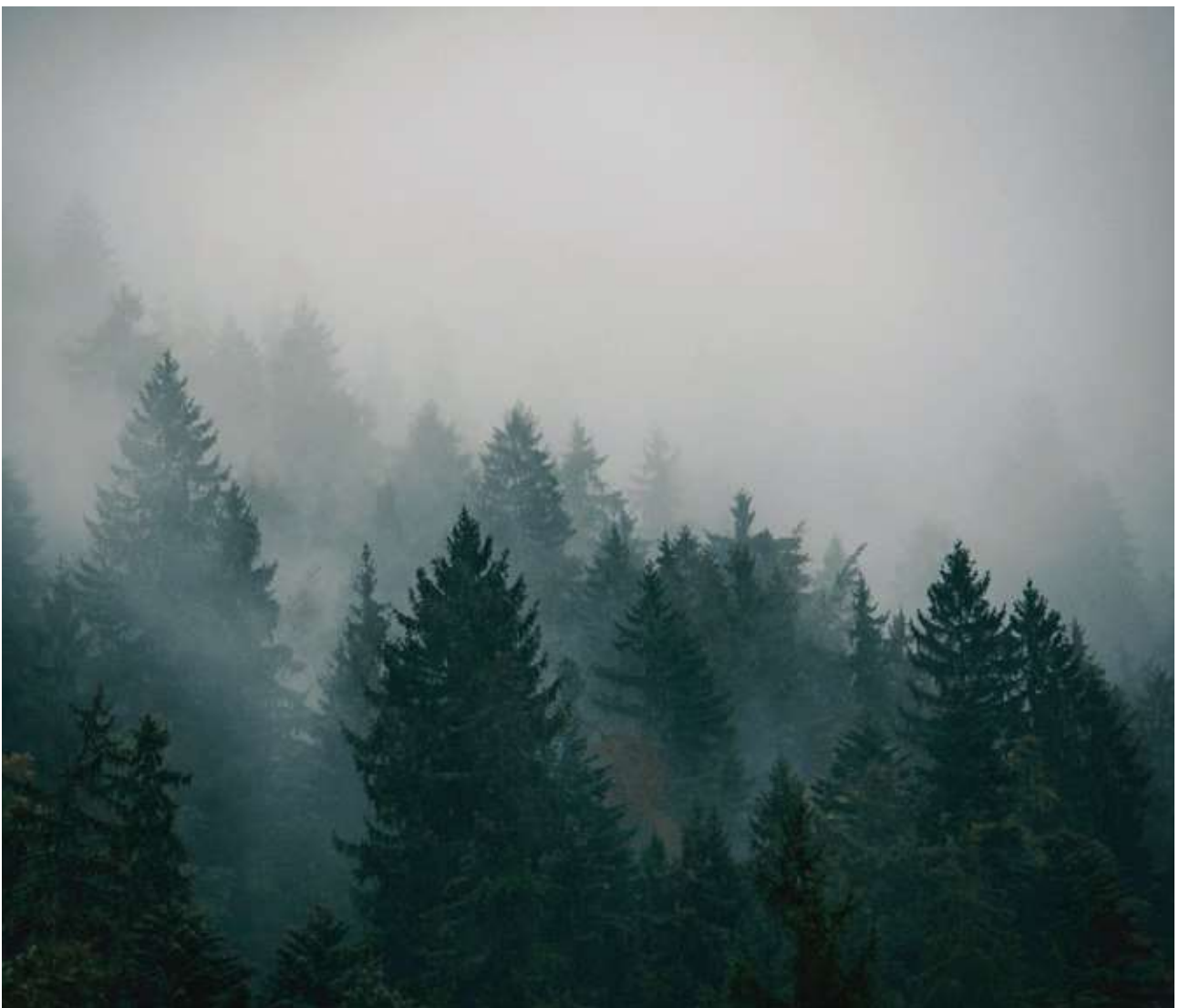
Protecting the environment is one of MACOGA's fundamental priorities.

We believe environmental responsibility goes beyond regulatory compliance. We continually strive to meet and where practicable exceed strict safety, health and environmental performance targets and we are committed to continuous improvement in all aspects of our operations.

We are committed to ensuring that our facilities have as low an impact as possible on local people and the environment.

We recycle paper, plastic, packaging, batteries, etc. in our offices and all the waste generated during the production process receives its corresponding legally mandatory collection and recycling.

The dangerous toxic waste generated (oil, picklers, paint strippers, etc.) is treated in strict accordance with the Environmental Directives, 100% of our steel waste is recycled and reused in other areas of the industry, we have special zones designed to prevent certain production processes from emitting harmful and pollutant elements into the atmosphere (paint cabin and plasma cutting machinery with highly efficient purifying filters, X Ray bunker, etc.) and we have emergency plans for critical situation that imply possible environmental impact.



QUALITY

MACOGA is fully committed to a quality management process with quality as a foundational business principle. The core of the process is achieving customer satisfaction by meeting our internal and customer requirements on time. Employee participation in a continuous improvement effort develops reviews and implements the quality assurance system, procedures, and practices needed to meet the highest standards. The end goal is to continue meeting world-class standards for the mutual benefit of our customers and employees.

Quality is the engine for improvement in our Company. It is the combination of actions that increase efficiency and output in activities and processes to provide added advantages to both the company and customers.

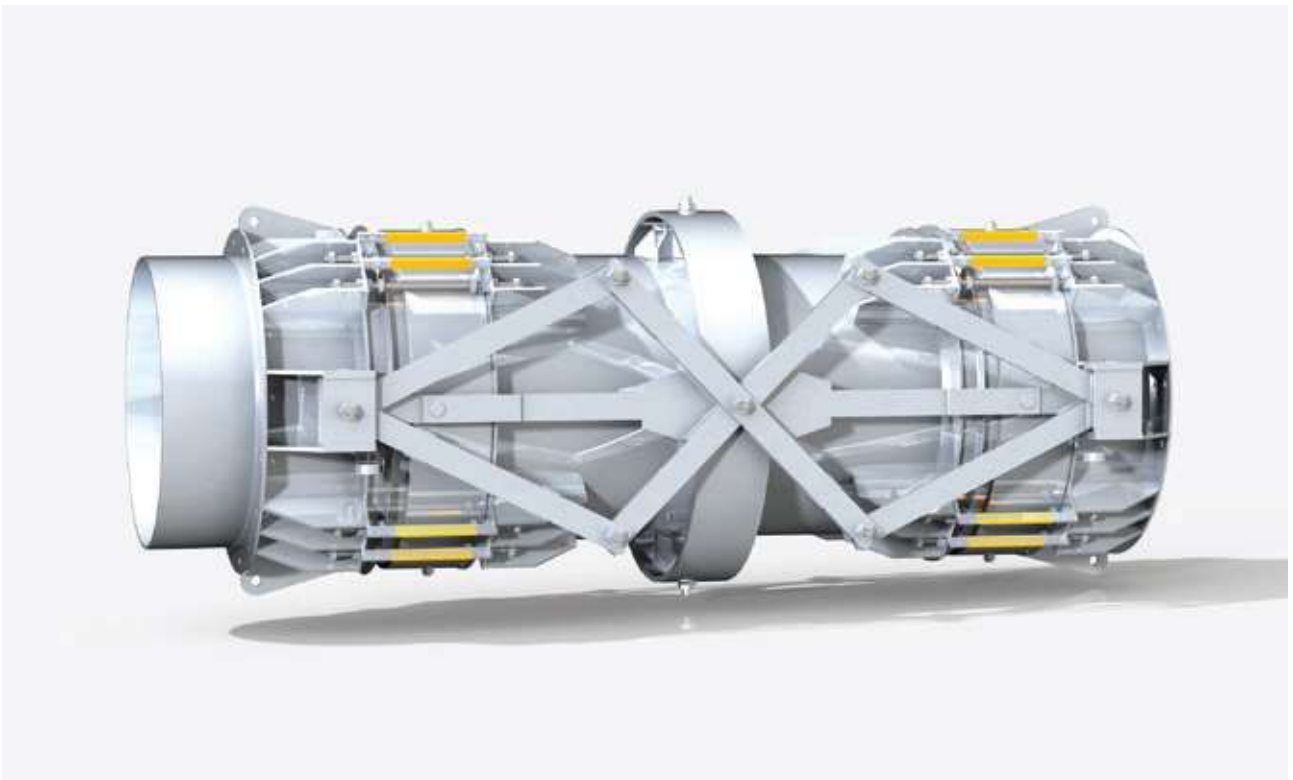
Our vision is to create value through innovation and continual improvement. And we apply it to all areas in our company, from the purchasing of raw materials to the final tests and controls carried out on each Expansion Joint, from design control and verification to the perfect efficiency of all departments.

MACOGA management fully supports and provides the necessary resources for continual implementation of the quality assurance system. All management levels participate in quality assurance activities incorporated into daily functional requirements. No product is shipped to the customer until its quality and conformance to customer specifications is assured. Management assesses the effectiveness of the quality system on a regular basis and directs internal efforts towards continual improvement.

Quality Approvals

- ISO 9001:2008
- PED 97/23/CE. Module H
- TÜV AD 2000-Merkblatt HPO & DIN ISO 3834-2
- ASME "U" Stamp
- "NB" Certificate of Authorization
- Bureau Veritas Type Approval
- Lloyd's Register Type Approval
- Ministry of Defense and NATO Member Countries
- GOST





FCCU Regenerator Stand Pipe Expansion Joint – Cold wall design
Universal with Pantographs. Two ply monitored Inconel 625 LCF
bellows. Design temperature: 760 °C (medium) 538 °C (bellows)

METAL EXPANSION JOINTS

Thermal growth, equipment movement, vibration or pressure pulsation may generate movement in a piping system. When this movement is not absorbed by the piping system itself, an expansion joint is the perfect solution.

An expansion joint is a device primarily formed by flexible bellows used to absorb movements in a piping system while containing pressure and a medium running through it.

ADVANTAGES

The basic advantages to be gained from using Expansion Joints are:

- Little space required for installation
- Absorption of movements in multiple directions due to their inherent flexibility
- They require no maintenance
- They reduce load and temperature loss to a minimum

There are three basic movements that can be absorbed by an Expansion Joint:

Axial Movement

Axial movement is the change in dimensional length of the bellows from its free length in a direction parallel to its longitudinal axis.

Angular Movement

Angular movement is the rotational displacement of the longitudinal axis of the bellows toward a point of rotation.

Lateral movement

Lateral movement is the relative displacement of one end of the bellows to the other end in a direction perpendicular to its longitudinal axis.

MACOGA Expansion Joints are designed, manufactured and tested in accordance with:

- E.J.M.A. (Expansion Joint Manufacturers Association, Inc.)
- ASME VIII, Div. I, App. 26
- EN 14917, European Standard for Metal Expansion Joints.





QUALITY CONTROL AND TESTING

Expansion Joints are thought of as high engineering products to which end our Quality Control Department carefully monitors each of the different steps involved in the production process itself, right from the moment the raw materials are purchased up to the final controls and tests carried out on each Expansion Joint which come off our production line.

All the quality controls and tests we carry out are based on our Quality Control Manual, approved under ISO 9001, as well as our Quality Procedures.

All our Expansion Joints undergo a series of controls and tests at each of the different steps in the manufacturing process and before they leave the factory. Every Expansion Joint is submitted to a final Dimensional Check and a Leak Detection Test.

The following tests can also be carried out if requested and/or if stipulated in the terms of a contract:

Non-Destructive

- Radiographic Examination
- Liquid Penetrant Examination
- Ultrasonic Examination
- Magnetic Particle Examination
- Pneumatic Pressure Test & Leak Detection Test
- Hydraulic Pressure Test
- PMI (Positive Material Identification)
- Chemical and Mechanical Analysis of materials used
- Spring Rate Test
- Helium Leak Detection Test

Destructive

- Fatigue Life Testing
- Squirm Testing
- Meridional Yield Rupture Testing
- Burst Test

These controls and tests are carried out in line with the procedures and guidelines approved by the Quality Control Department which certifies such tests. These tests can be carried out, monitored and/or certified by independent companies or classification societies such as the following: TÜV, Lloyd's Register of Shipping, Bureau Veritas, Det Norske Veritas, ABS Industrial Verification, etc.

MANUFACTURING

MACOGA uses different methods for producing metal bellows depending upon a range of different contributing factors (e.g. diameters, the number of sheets used, the materials used, etc.), although in all cases the bellows are manufactured using seamless tubes or metal cylinders welded along their length. The methods used are as follows: Expanding, Elastomeric, Hydraulic and Roll forming.

Circular Expansion Joints are manufactured with single or multiple ply with a diameter ranging from 15 to 8000 mm.

Our manufacturing range includes Circular Expansion Joints of the following types:

Basic Types

- Single Unrestrained
- Single Tied
- Hinged
- Universal Unrestrained
- Universal Tied
- Gimbal
- Double Hinged
- Double Gimbal
- Double Articulated
- Rectangular

Specific Purposes

- Pressure Balanced
- FCCU Expansion Joints
- Thick Wall
- Flanged & Flued
- Reinforced bellows (high pressure)
- Externally Pressurized
- Jacketed
- Clamshell

As well as **Rectangular Expansion Joints**, which, with limitless dimensions, can be supplied with different convolution and corner types:

- W-shaped, Camera Corner
- V-shaped, Miter Corner (single or double)
- U-shaped, Rounded Corner

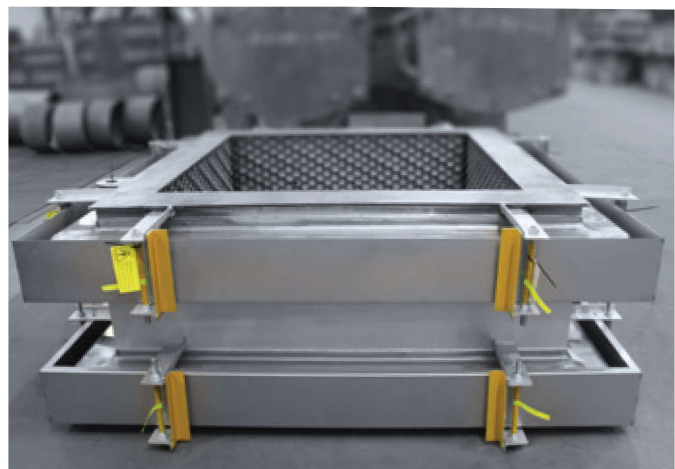
The use of circular **multiply bellows** are the ideal solution for Expansion Joints which are exposed to high pressures. This system involves constructing a bellows using several thin sheets instead of one single thick ply. This technique considerably improves the flexibility of the bellows, its most important characteristic.

There are five main advantages to be gained from using multiply metal bellows:

- They are highly resistant to high pressures.
- They maintain a high degree of flexibility even when working under high pressures.
- They have lower spring rates than the single thick sheet bellows.
- They have a high absorption rate for movements across short lengths thus ensuring a longer working life.

They guarantee important savings:

- Few units are required within any given system owing to their greater capacity to absorb movements.
- The low spring rates reduce the costs incurred by anchorage and supporting structures.
- To avoid corrosion, special materials (eg. Inconel, Incoloy, etc.) can be applied to the inner layer to protect against temperature and corrosion and austenitic steel can be used to cover the remaining layers to withstand high pressures.



Rectangular Expansion Joint
for a Refinery in Europe



High Pressure Universal Untied Reinforced Expansion Joints for a water transfer pipeline in North Africa

Hinged Expansion Joints for a Combined Cycle Power Plant in the USA





In-Line Pressure Balanced MPB-I DN 4000 for a Power Plant in Europe

MATERIALS

The essential component of an Expansion Joint resides in the degree flexibility of its bellows and this depends upon the design of its convolution and the materials used during the production process.

The choice of metals to be used in manufacturing the bellows, being the basic component of the Expansion Joint, is made taking the following criteria into account:

- Temperature resistance.
- Resistance to corrosion.
- Forming capacity.
- Mechanical characteristics.
- Resistance to fatigue.
- Flexibility when in use.

Materials used in manufacturing are basically Austenitic Steels as **AISI 321, 304, 316, 316L, 316Ti, 309, 253 Ma, 254 SMO, etc.** and Nickel Alloys such as **Monel 400, Inconel 600, 625, Incoloy 800 H, Hastelloy, etc.**





Elbow Pressure Balanced Expansion Joint for a Waste to Energy facility in the UK

SERVICES

DESIGN AND CALCULATION

Analysis and Design Practices

Our analysis and design practices include:

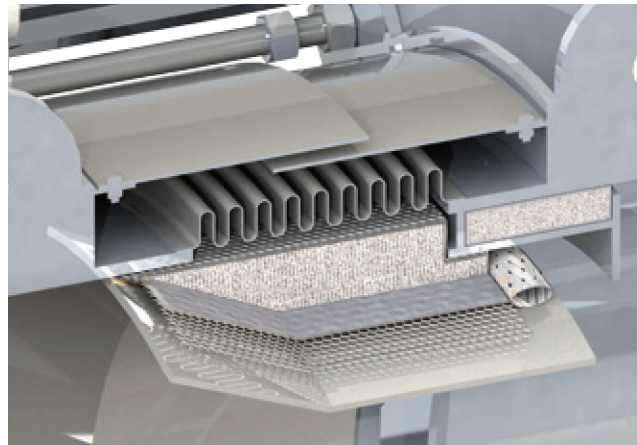
- Design calculations (EJMA, ASME, AD-Merkblatter)
- Finite Element Analysis (FEA)
- Pipe Stress Analysis
- CAD
- 3-D Modelling

Computer Aided Design

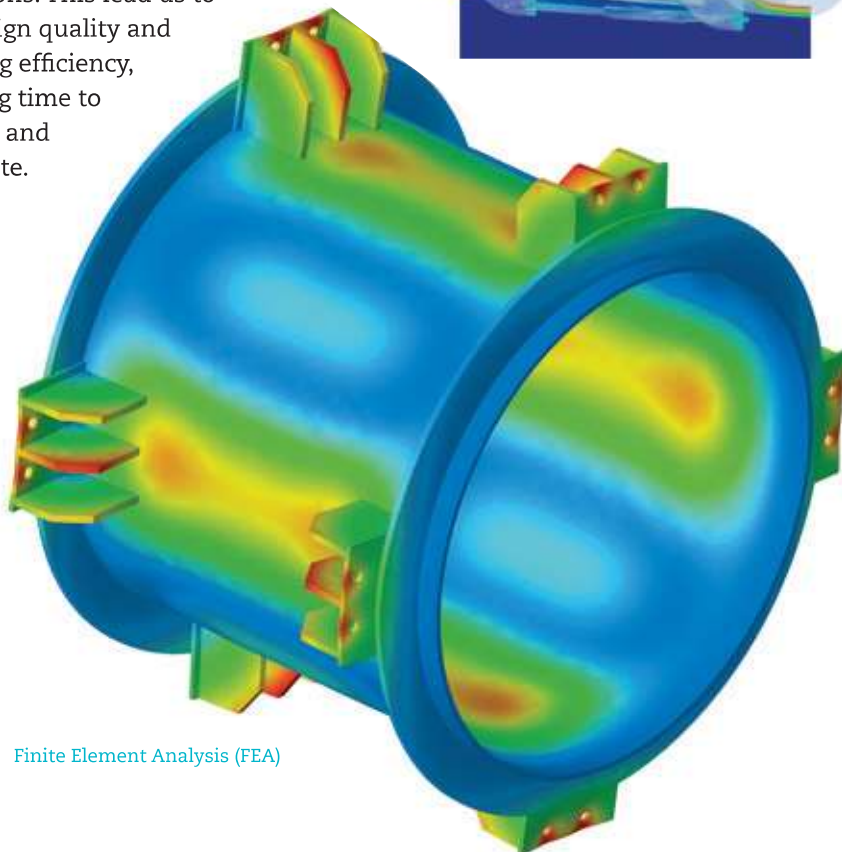
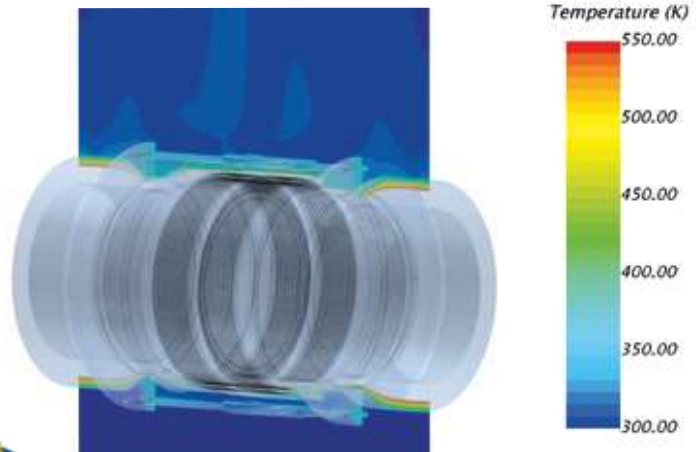
When it comes to Expansion Joints we offer overall solutions to meet your needs.

We use the most sophisticated analysis and calculation software to design your pipe systems and select the most appropriate Expansion Joints providing you a complete pipe stress analysis when required.

With our 3D mechanical CAD software our engineers design Expansion Joints to the same conditions that they'll experience in the real world before they have been built. This is a design validation tool that helps our engineers to test the designs earlier in the design cycle and against real-world conditions. This lead us to improved design quality and manufacturing efficiency, while reducing time to market, costs, and materials waste.



3D modeling



Finite Element Analysis (FEA)

PACKING & PROTECTION

Our Expansion Joints are available to the customer securely packed as per the type of transport selected or contract requirements and they are always properly protected to prevent physical damage and corrosion during transit, handling and storage.

MACOGA, is authorized to apply ISPM15 mark as a manufacturer of wood packaging.

All the wood used in our packing is Heat Treated until its core reaches 56 °C for at least 30 minutes to meet the International Standards for Phytosanitary Measures 15 (ISPM15).



SHIPPING

We provide our customers complete solutions and help them to organize transport.

We can easily arrange transport of your Expansion Joints to job site or customers' warehouses anywhere in the world.

With deliveries to over 80 different countries every year we can offer our customers cost-effective freight logistics solutions.

Our Shipping Department is well experienced arranging oversize cargoes, sea freights, air freight or road cargoes.

Due to the enormous volume of material shipped from our factory we can certainly provide you a cost-effective freight for your Expansion Joints.



We can organize for you:

- Air freight
- Sea freight
- Oversize cargoes
- Express deliveries
- Road transportation



ON-SITE SERVICES

MACOGA provides its customers a complete field service package. We help you get the Expansion Joints properly installed.

We provide a professional variety of site services including assembly, supervision of installation and inspection that minimize risks of unplanned shutdowns and help to avoid failures and breakdowns.

Our service group consists of highly-qualified technicians and engineers specialized in expansion joints. Our staff is well trained about health and safety issues. Compliance with international, local, customer and company regulations is mandatory, and is assessed on a regular basis.

Supervising Package

Qualified and trained Engineers are available for guidance and instruction during assembly and/or erection process (by others) of our Expansion Joints. We offer pre-instruction and guidance for starting assembly and periodical inspections that guarantee

the correct procedures are being carried out and unquestionably a Final Inspection after completion the assembly and/or erection works.

Assembly Package

For those Expansion Joints that due to its size are not transportable in one piece, we offer our customers the Assembly Package. This package includes the Supervising Package (as above) plus a team of Qualified (ASME, EN) and trained welders that carry out the works to weld and assemble all the individual parts and accessories of the Expansion Joints into one complete unit ready to be welded to the site ducts or equipment.

Installation Package

MACOGA site staff is always ready for installing the Expansion Joint into our customers' site ducts or equipment. If required, a site-specific erection plan is developed during one or more pre-construction conferences and site inspections involving the customer, the contractor, and others such as the project engineer and the manufacturer.



Supervising installation of FCCU Expansion Joints in a refinery in Spain



Assembly of a 7200 mm diameter MUX Expansion Joints in a Power Plant in Turkey



Assembly of a 7300 mm diameter Hinged Expansion Joints in a Power Plant in Virginia, USA





PREMIUM SERVICE

During an emergency (plant shut-down, parts failure, etc.) you can't afford to wait in line for a standard delivery to get your Expansion Joints.

This Premium tool is the most reliable and efficient solution for those customers who require Expansion Joints in a record time.

Features & Benefits

— Immediate reply to your inquiry

Our Sales Department will provide you a detailed quotation in a record time, including price, standard delivery time and the optional cost for the Premium Service.

— Drawings

After placing the order you will receive a detailed drawing for your review and approval within a few hours.

— High Priority Production

Once the drawing is approved and released for manufacturing, your order will receive a "high priority level" at our factory. This implies it will go directly to every production step avoiding any queuing.

— Guaranteed Delivery

Delivery is 100% guaranteed anywhere in the world in a record time.

— Express Delivery

Our Logistic Department will assist you to find the most suitable transport for your Expansion Joints considering the shortest transit time, competitive costs, etc.

— Tracking of your shipment

If we organize your Premium order shipment, we will track and give you updated information on your shipment and you will receive a delivery confirmation once the Expansion Joint arrived to your shop or to the site.

INDUSTRIES

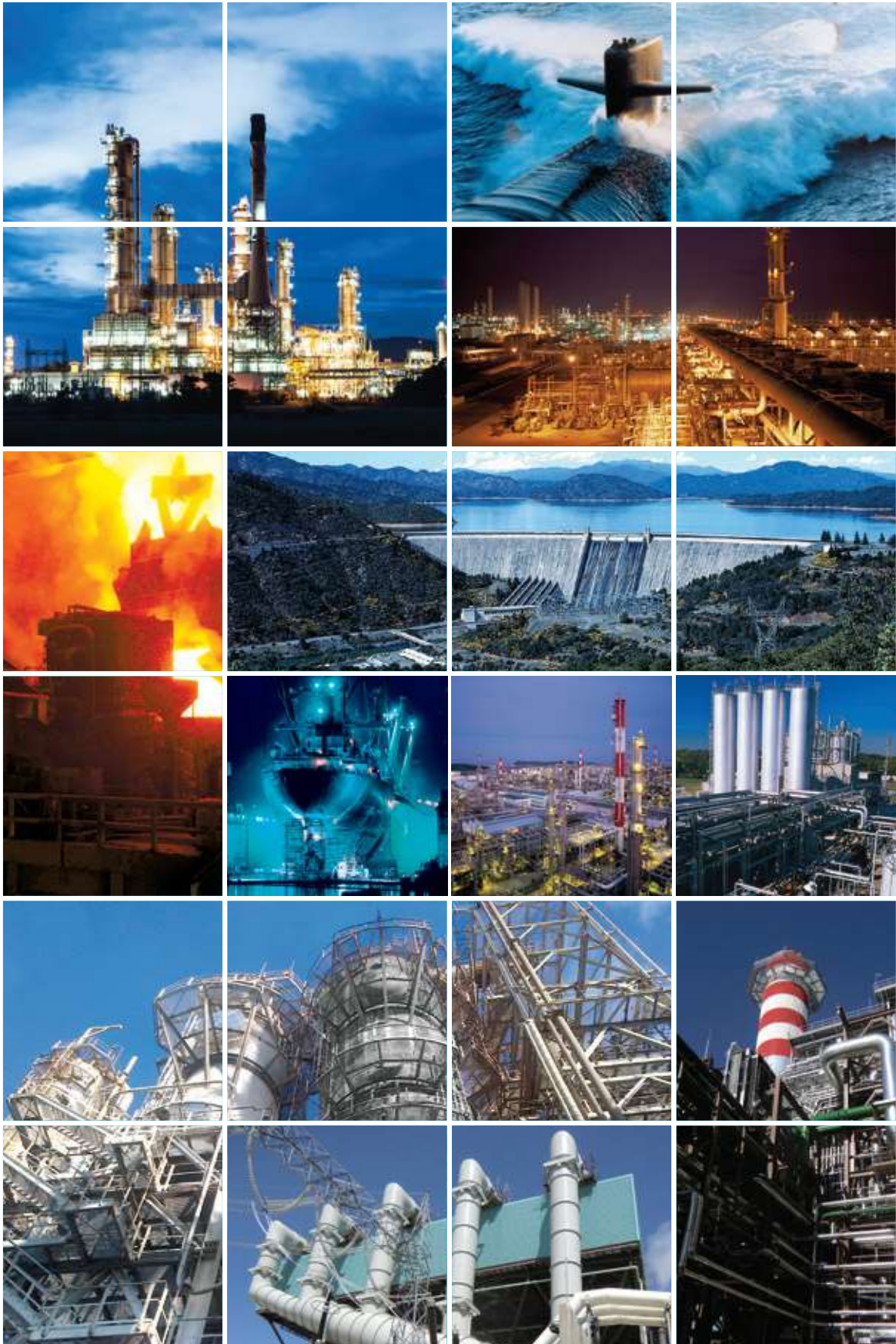
Our expansion joints are present in more than 80 countries across all continents performing demanding tasks and we build this global experience into every expansion joint and support service that bears our name. We listen and learn about the challenges our customers face, and strive to help meet them.

We offer a complete package of integrated engineering, design, fabrication and delivery of Expansion Joints to selected industries so we can provide our customers with in-depth knowledge and expertise. We've developed tools, methodologies and best-practices based on years of experience with companies in key industries. That's why more than three-quarters of our business comes from repeat customers.

Each industry has its own unique requirements and challenges and we are aware that different industries have different requests and needs.

Some of the industries that we provide Expansion Joints to are:

- Energy
- Engineering Companies
- Petroleum Refining, FCC
- Petrochemical
- Aerospace
- Government/ Military
- Cryogenic
- Engines & Turbines
- Air-Conditioning & Air Heating
- Aircraft Engines & Engine Parts
- Cement Plants
- Co-generation
- Electrical Industrial Apparatus
- Energy/Public Utilities
- Food Industry
- Gas Compression Equipment
- General Bldg Contractors
- Heavy Construction
- Hydraulic plants
- Industrial Process Furnaces & Ovens
- Iron & Steel Foundries
- Mining
- Natural Gas Transmission
- Nuclear
- OEMs
- Offshore
- Paper Mills
- Pharmaceutical
- Railroad Equipment
- Ship Building & Repairing
- Steel Mills
- Steel Works, Blast Furnaces
- Water Transportation



MACOGA provides the most comprehensive range of Expansion Joints and services for a large variety of applications. Based on our long experience, understanding of industry needs, strong technical competencies and continuous innovation, we can provide our customers outstanding reliability and performance.



