



MACOGA

ENGINEERED EXPANSION JOINTS

MACOGA is a global leader in the design, manufacture and delivery of metal and rubber expansion joints on a global scale. The company prides itself on its innovation and unrivalled customer service.

MACOGA has advanced capabilities to design and analyse FCCU Expansion Joints and all its components and accessories operating at high temperatures. Their analysis tools, e.g. non-linear finite element stress and heat transfer analysis (FEA) enable analysis of complex components.

Types of FCCU Expansion Joints

Typical types of expansion joints used in FCCU applications are: Restrained Universal, Gimbal, Hinged and Pressure Balanced (in-line and elbow type) and can be categorized in three major groups:

- ◆ Cold Wall
- ◆ Hot Wall
- ◆ Unlined

Cold Wall

Cold Wall units are refractory lined to ensure the shell wall temperature does not exceed the allowed parameters. The lining consists of stainless steel anchors and a high-density vibrocast/self-levelled refractory material. They incorporate internal insulation/ packing made of bio-soluble ceramic fibre or silica blankets, a liner seal that keeps in place the internal insulation blankets while keeping fluid particles out of the bellows/liner cavity.

Expansion Joints

An important advantage of cold wall design is that the pipe is insulated so it operates below the media temperature reducing the pipe growth and consequently the expansion joint movement.



Universal - Cold wall design

Two ply testable Inconel 625 LCF bellows.
Design temperature: 768 °C (flue gas) 538 °C (bellows)

An insulation pillow is included to reduce the temperature. An external insulation is incorporated to prevent the bellows element from dropping below the acid dew point, the main reason of premature bellows failure.

The Hot Wall units incorporate an abrasion resistant lining, including hex-mesh and castable material or refractory (a multi-purpose abrasion resistant castable which can be hand-packed, vibration cast and gunned) such as RESCO AA-22. The lining is not intended to be used as a thermal fence and requires a specific and controlled drying.

MACOGA



Double Gimbal - Hot Design - Floating Ring. Two ply monitored Inconel 625 LCF bellows.
Design temperature: 760°C (flue gas) 538°C (bellows)

The Unlined FCCU Expansion Joints can be exposed to very high temperatures but usually do not convey catalyst so they do not require abrasion resistant lining. This type is generally used for inlet and outlet air and transferring gases from the reactor.

The Bellows

The bellows, as the most critical part of the Expansion Joint, can be single ply, multiply, redundant ply or reinforced and generally incorporate an early warning system (active or passive monitoring).

FCCU expansion joints commonly incorporate 2-ply testable bellows where each ply is designed for the full operating conditions. If a hole or stress crack develops in the inner ply during service, the outer ply takes over without exposing operators to increased risk or creating the need for an unscheduled shutdown.

A 2 ply testable bellows system improves reliability and makes the expansion joint more maintenance friendly.

Monitored Bellows

The annular space between plies can be monitored for leakage to detect a ply failure and warn of an imminent problem. A pressure device in the outer ply alerts the inner ply failure. The 2-ply testable bellows also allows inspectors to pressure test the inner and outer ply during shutdowns.

There are several types of devices used for monitoring the 2 ply testable bellows from simple pressure gauges to electronic devices and can be categorized as Active and Passive Monitors.

Passive monitor: when the inner ply fails the monitor is activated by the pressure between the plies.

Active monitor: the active monitor can detect inner and outer ply failures. A vacuum is created between the inner and outer ply before installing the monitoring device. If the inner ply fails, the pressure between the plies will activate the monitoring device and if the outer ply fails the vacuum will be lost and the monitoring device will be activated.

Packed Bellows

FCCU bellows are generally internally and externally packed with ceramic blankets and the gap between the sleeve and body is filled with a metal braided hose connected to the sleeve by pins. The thickness of the blankets is determined following heat transfer calculations to assure bellows temperature $200 < T < 500^{\circ}\text{C}$. The reason to specify the temperature of the bellows at a temperature higher than 200°C , is to prevent dew point corrosion.

The upper limit of 500°C is to prevent high temperature embrittlement of Inconel 625. To avoid the dust entering into the bellows cavity (as the catalyst can solidify and damage the bellows or restrain the movement capability) packed or purged bellows are used. The most frequent is the packed bellows. Purged bellows are not as commonly used today.

Self-equalizing Rings

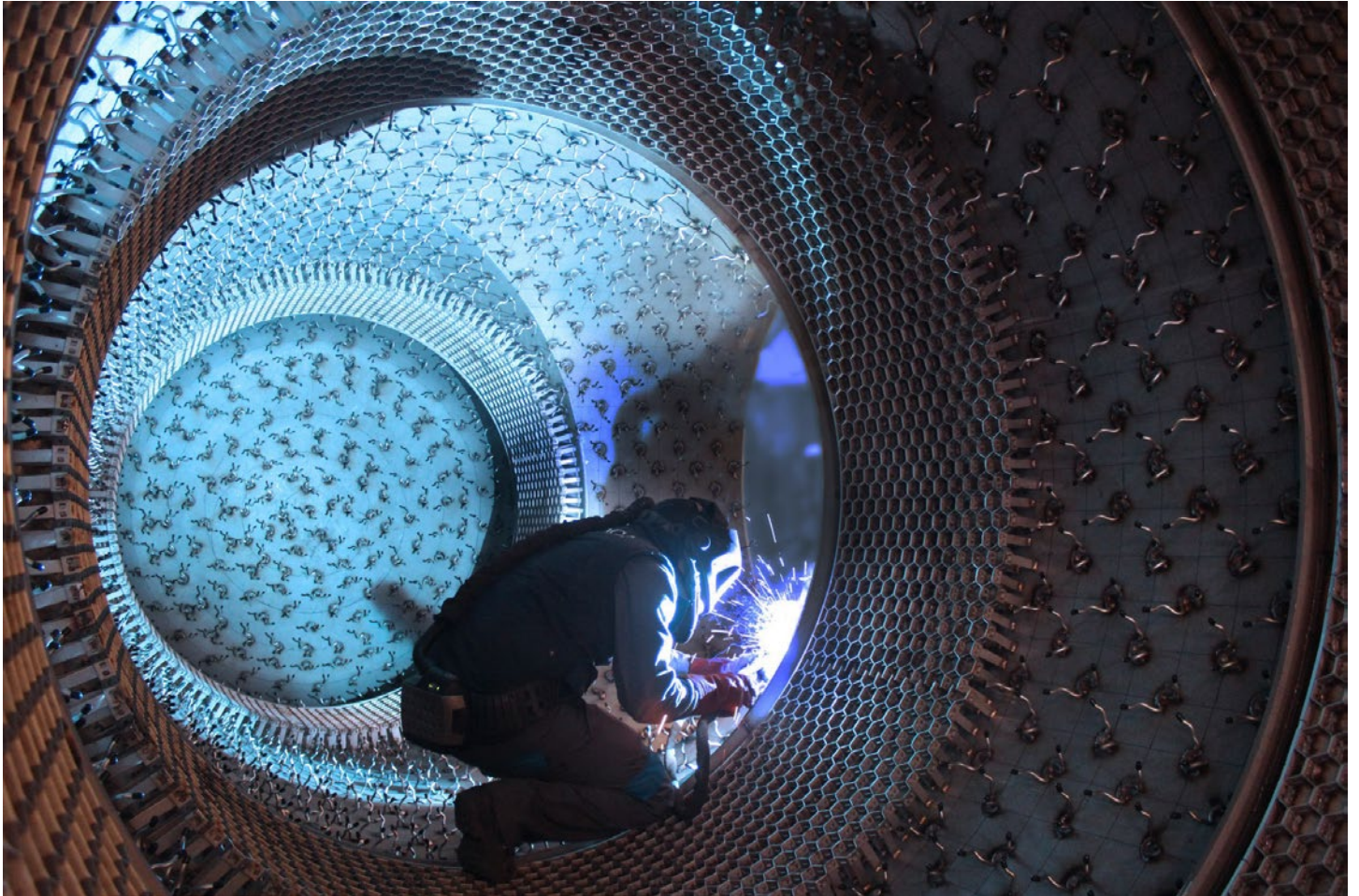
FCCU Expansion Joints are equipped with self-equalizing rings to prevent the convolutions from contacting each other ensuring a uniform compression distribution over the convolutions. Equalizing rings prevent bellows from an excessive deflection or stress concentration in one or a few convolutions by spreading the movements over all the corrugations. They also provide a pressure reinforcement capacity when necessary.

Refractory Materials and Installation

Refractory is a major element of all FCC components. Without proper refractory installation the process unit is risking a costly unscheduled unit shutdown. FCC Expansion Joints are designed with a hot wall (external insulation) or cold wall (internal insulating refractory). The internals that are exposed to catalyst erosion are protected with abrasion resistant refractory even in hot wall designs.

Generally, all these critical linings are designed and installed according to the most up-to-date and demanding refractory licensors specifications as UOP 3-series, ExxonMobil Research and Engineering EMRE Gp, KBR and API 936 or proprietary own specifications.

The insulating or abrasion resistant refractory linings can be installed by casting, gunning (pneumatic application), hand-placing or pneumatic ramming. The abrasion resistant refractory installation involves several critical activities like anchor system (hexmesh or equivalent), quality control (QC) of materials, prequalification, application and heat dry outs. It is very important that all refractory installation activities are, during the whole of the process, carefully controlled to ensure good QC through a good method statement with drawings, materials selection, testing frequency, installation systems and dry out curve.



MACOGA closely cooperates world leader refractory consultants and engineers, who provide specialized refractory inspection and supervision services.

FCCU Expansion Joint On-Site Services

In any refining facility the FCCU Expansion Joints are critical units that require a high level of expertise during installation and maintenance to ensure that the refining process is not disrupted and optimal production can be achieved.

MACOGA offers its customers in the oil and gas, refinery and petrochemical industries a complete field service package. It provides 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.

Assembly of the Expansion Joints

MACOGA's on-site team consists of qualified welders, technicians and engineers who work in plants and refineries worldwide. They have many years of experience

in manufacturing and installing FCCU Expansion Joints.

A site-specific erection plan is developed during one or more pre-construction conferences and site inspections involving the customer, the contractor, and other key people such as the project engineer.

MACOGA manages all aspects of site work for the Expansion Joints supplied. From initial delivery of the equipment to site, installation to agreed standards, and final commissioning, MACOGA will manage the project.

Assembly Supervision

Qualified and trained engineers are available for guidance and instruction during assembly and/or erection process (by others) of MACOGA Expansion Joints. Pre-instruction and guidance for assembly is available along with periodical inspections that guarantee the correct procedures are being carried out plus a Final Inspection after completion of the assembly and/ or erection works.

Additional services available include Nondestructive Examination.

MACOGA

FCCU Expansion Joints On-Site Inspection Service

Whether your operations follow predictive maintenance or corrective maintenance procedures, detecting early signs of Expansion Joint fatigue or failure can save you on costly repairs and extend your asset lifecycle for optimal refining operations.

Why FCCU Expansion Joints On-Site Inspection?

The life of the expansion joints varies with the design, storage conditions, installation practices, application, and service.

Appropriately timed inspections, repairs, and/or replacement of critical joints will ensure the reliable operation of the associated equipment and of the whole refinery.

Pre-mature or unexpected failure of the expansion joints and emergencies can be avoided carrying onsite scheduled inspections. On-site Inspections will provide valuable information about the conditions of the Expansion Joints and will allow the refinery to take appropriate actions in due time.

What are the key benefits?

MACOGA offers on-site inspection of FCC Expansion Joints well in advance of your next planned outage, during the beginning stages of a turnaround to aid in planning and expediting the turnaround, during installation of new Expansion Joints, during start-up and subsequent periodical inspections.

MACOGA on-site staff can provide:

- ◆ Installation guidance for new FCCU Expansion Joints
- ◆ Inspection in cold conditions (plant shutdown)
- ◆ Inspection in hot conditions (plant in operation)
- ◆ Periodical Inspections
- ◆ Maintenance and refurbishment
- ◆ Problem resolution
- ◆ Immediate response to site inspections needs
- ◆ Quick-turn expansion joint replacement during shutdowns and turnaround.



Dawcul is a Trusted Distributor for MACOGA products.

For expert advice on procurement, logistics and installation talk to one of our local experts.



Your partner in energy since 1977