

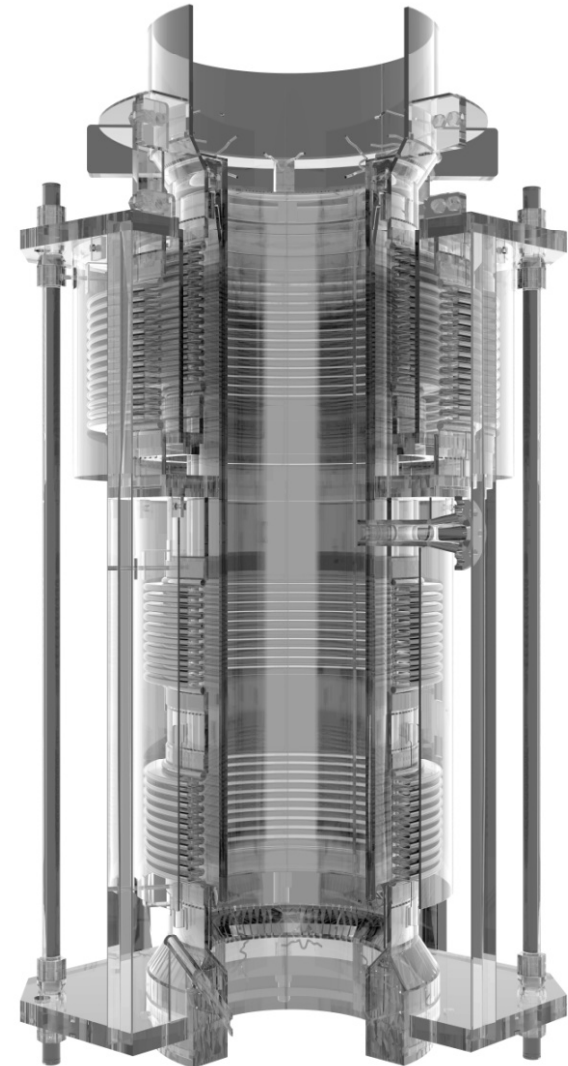
# Expansion Joints for Fluid Catalytic Cracking (FCCU)



# Expansion Joints for FCCU

## Intro

- Highly engineered units
- Most critical and complex types of expansion joints
- Exposed to high temperatures, high pressures, large movement conditions, and very aggressive media





## Expansion Joints for FCCU

### Intro

MACOGA designs and manufacture FCCU Expansion Joints according to:

UOP  
ExxonMobil  
KBR  
Lummus  
etc.



# Expansion Joints for FCCU

## 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 are categorized in three major groups:

- Hot Wall
- Cold Wall
- Unlined



## Expansion Joints for FCCU

### Types of FCCU Expansion Joints

#### Hot Wall

The Hot Wall units incorporate 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). The lining is not intended to be used as a thermal barrier and requires a specific and controlled drying.





## Expansion Joints for FCCU

### Types of FCCU Expansion Joints

#### Cold Wall

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. 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.

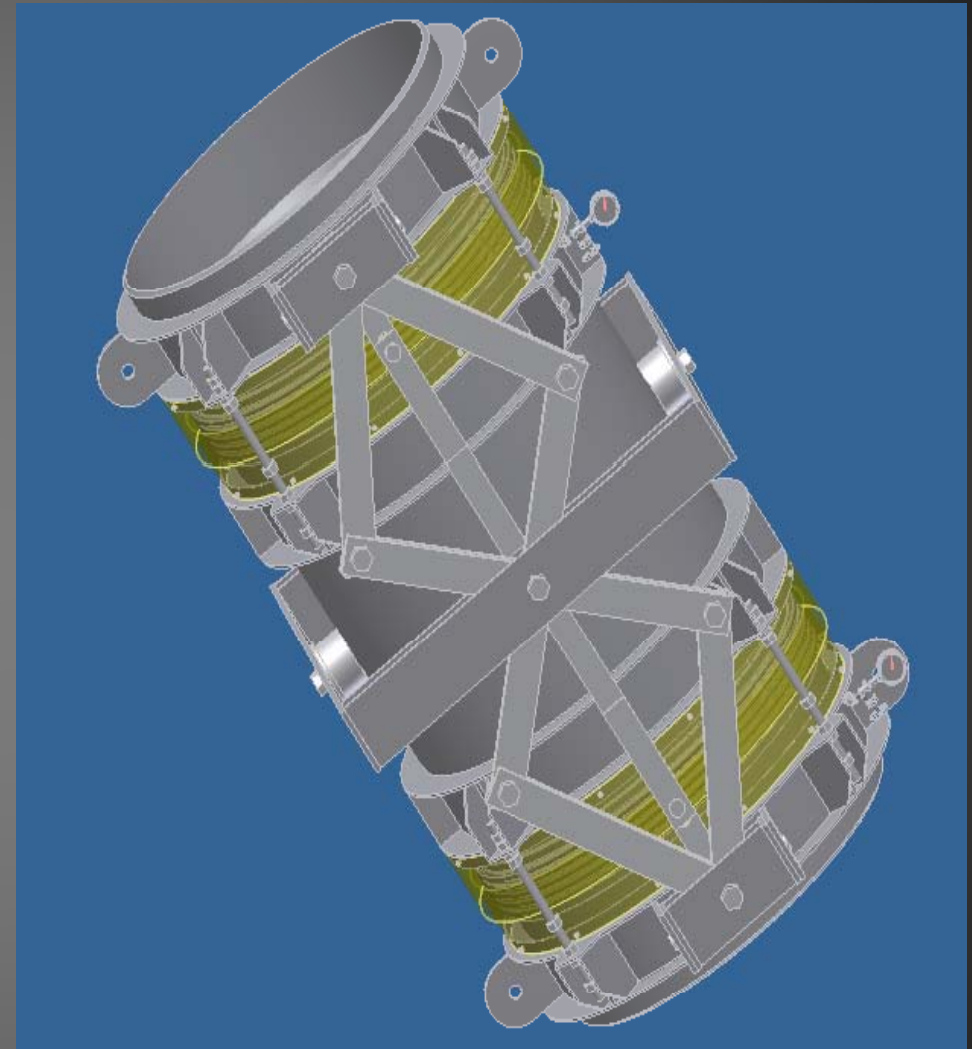


## Expansion Joints for FCCU

### Types of FCCU Expansion Joints

#### Unlined

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.



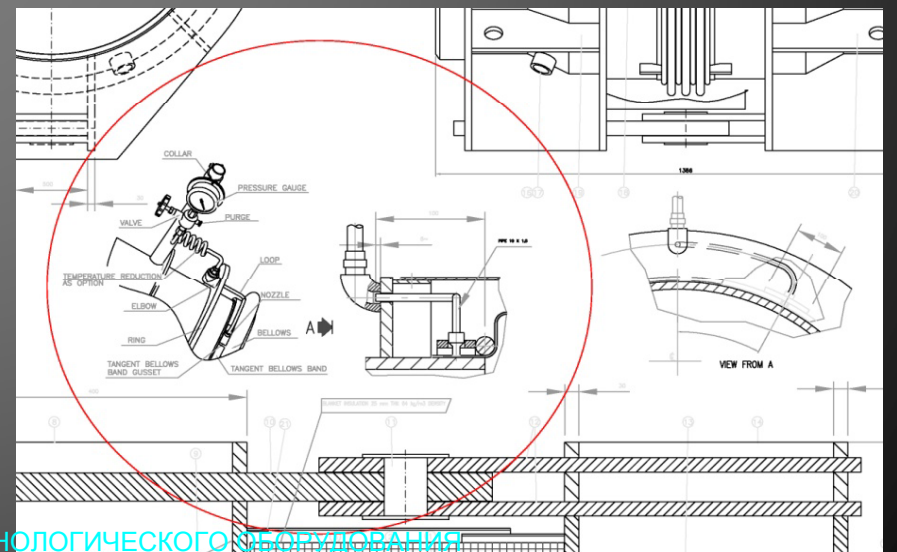
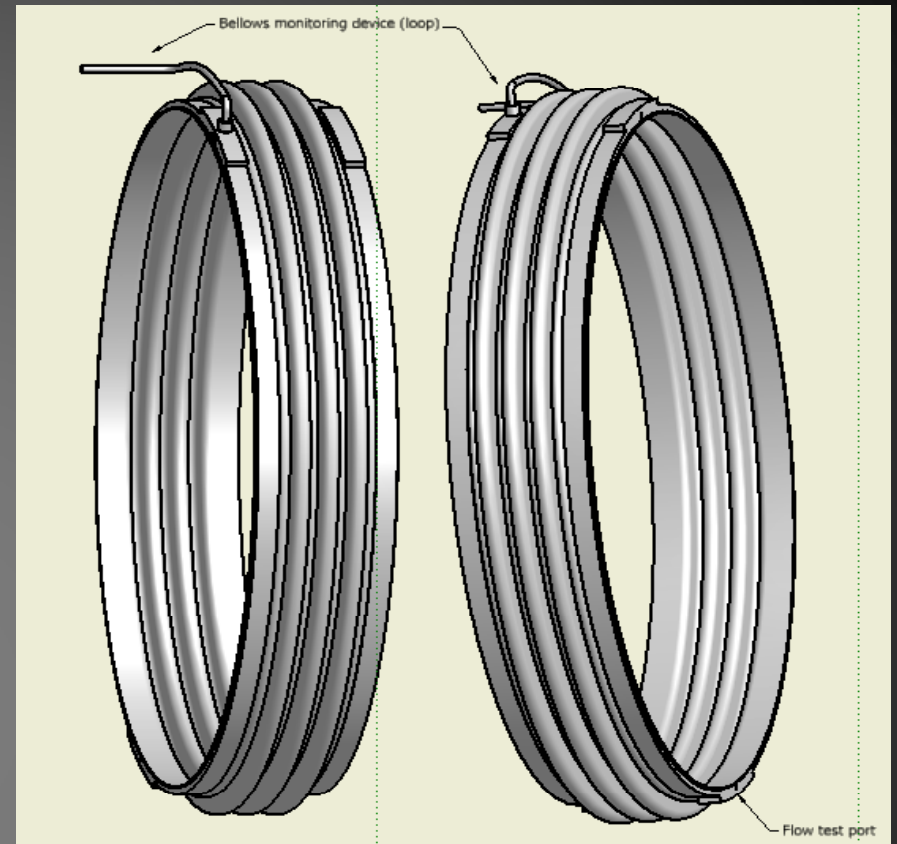
# Expansion Joints for FCCU

## FCCU Bellows

- Single ply
- Multiply
- Redundant ply – 2 ply testable
- Reinforced

Generally incorporate an early warning system (active or passive monitoring)

The material for bellows for most FCCU applications is Inconel 625LCF. INCONEL® alloy 625LCF (UNS N06626 / W. Nr. 2.4856)



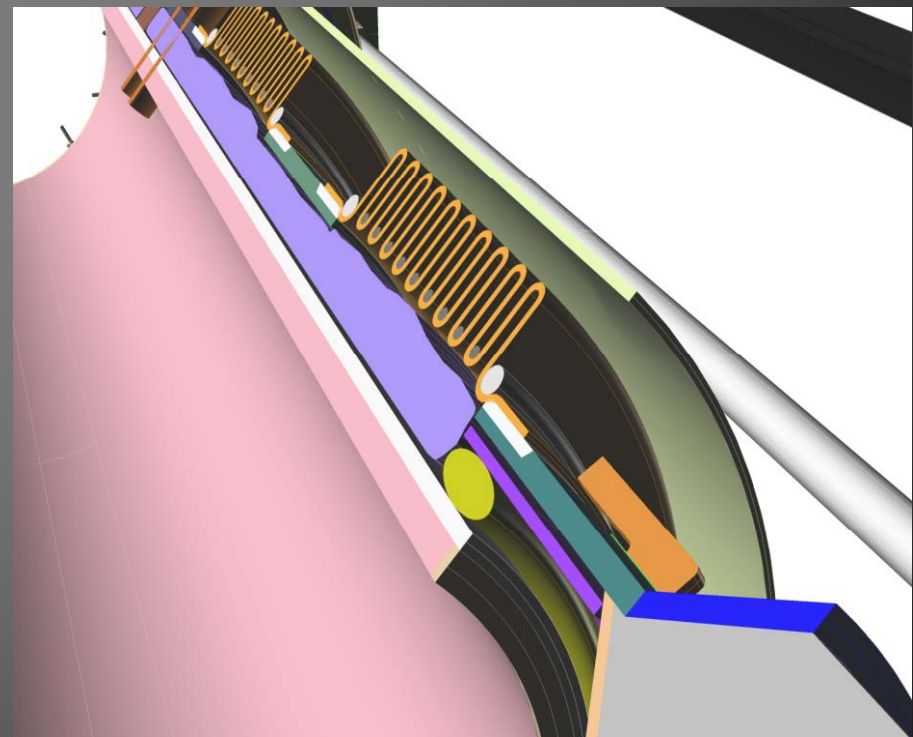
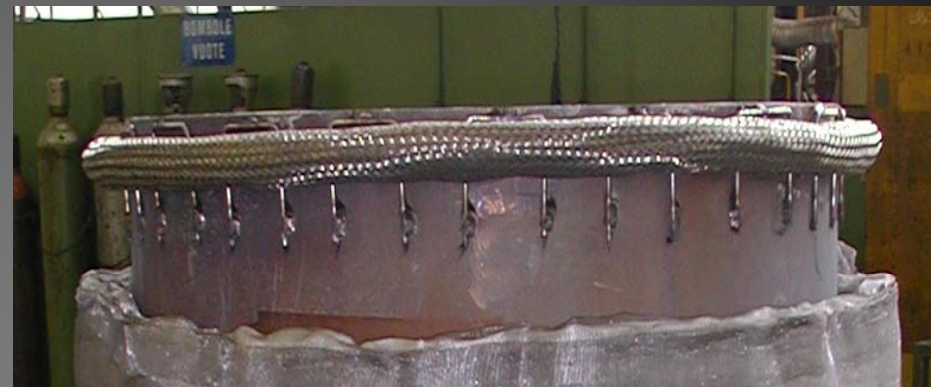


## Expansion Joints for FCCU

### FCCU Bellows

**Packed Bellows:** avoid the dust entering into the bellows cavity as the catalyst can solidify and damage the bellows or restrain the movement. Purged bellows are not as commonly used today.

**Self-equalizing rings:** are commonly used on FCCU Expansion Joints to prevent the convolutions from contacting each other ensuring a uniform compression distribution over the convolutions.



## Expansion Joints for FCCU

### External Hardware

FCCU joints usually fit in different types of external hardware. The most widely used are:

Control Rods

Pantographic linkages

Slotted Hinges,

Gimbal Pantographs

Pressure retaining covers

Aeration pipes

Etc .



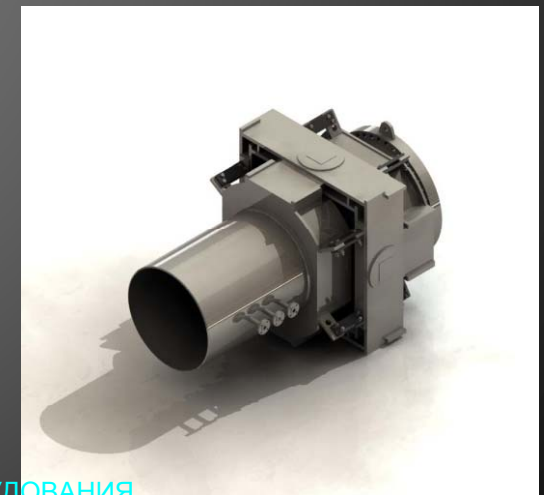
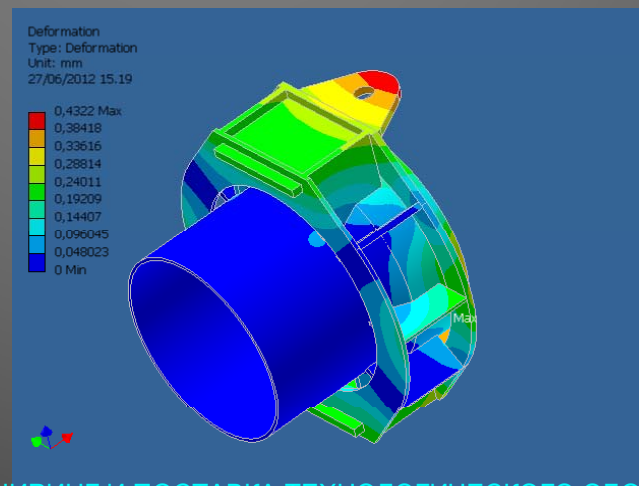
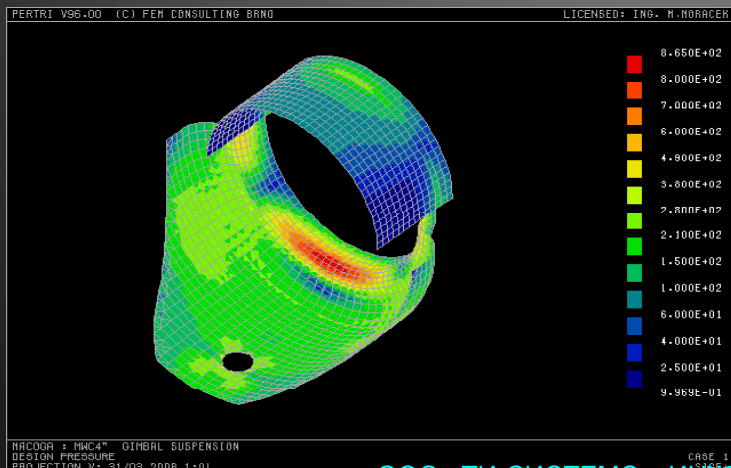
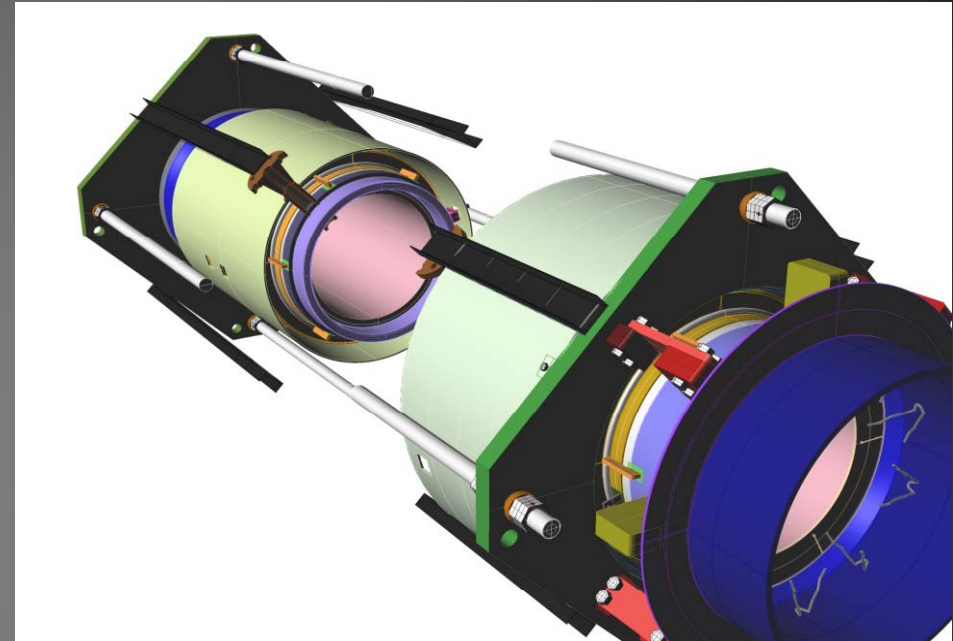


# Expansion Joints for FCCU

## Design & Calculation

As per UOP, ExxonMobil, KBR  
Lummus, etc. specifications

- EN, EJMA, ASME
- Finite Element Analysis (FEA)
- Pipe Stress Analysis
- CAD
- 3-D Modelling



## Expansion Joints for FCCU

### Quality Assurance & Testing

Comprehensive quality control and testing program including:

- Review Drawings
- Review Calculations
- Check Material Certificates
- Review WPS, PQR and WQR
- Review NDE Procedures
- Operator Qualification
- RT - Radiographic Examination
- PT - Liquid Penetrant Examination
- MT - Magnetic Particle Examination
- Hardness Testing of Welds
- Pressure & Leak Detection Test
- PMI Positive Material Identification
- Inspection of Refractory Lining
- Surface Prep. & Paint System
- Check Packing & Marking





## Expansion Joints for FCCU

### FCCU On-Site Service

Your next FCCU turnaround or plant outage can benefit from the revealing information that MACOGA On-Site staff can provide.

MACOGA offers a unique means to evaluate your FCCU Expansion Joints condition and equipment reliability.

Our technicians are experienced, knowledgeable engineers who have worked throughout the world in innumerable refineries.



# Expansion Joints for FCCU

## FCCU On-Site Service

MACOGA on-site staff can provide you:

- Installation guidance for new FCCU
- Inspection in cold conditions
- Inspection in hot conditions
- Periodical Inspections
- Maintenance and refurbishment
- Problem resolution
- Immediate response to site needs
- Quick-turn expansion joint replacement during shutdowns and turnarounds

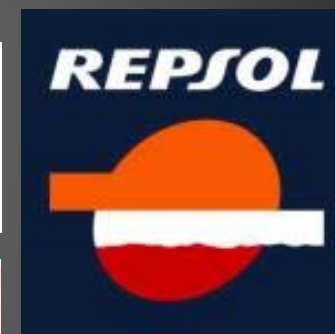
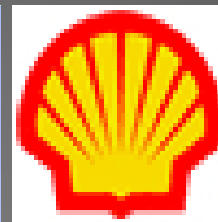




## Expansion Joints for FCCU

### Some of our customers

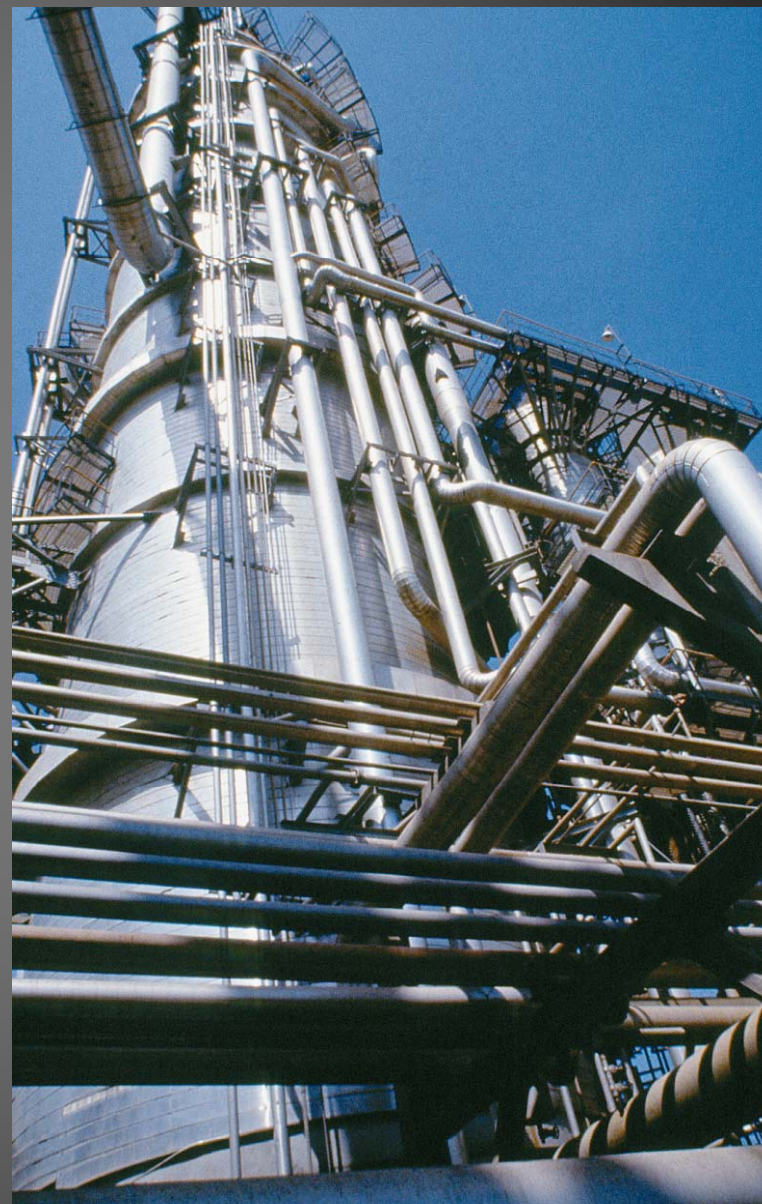
BPOil	Spain
UOP LLC	USA
ExxonMobil	USA
Technip	Italy
KBR	USA
Repsol	Spain
Cepsa	Spain
Ceska Rafinerska	Czech Republic
ÖMV	Austria
Shell Oil Products	USA
ConocoPhillips	USA
PDVSA	Venezuela
Sonatrach	Algeria
KNPC	Kuwait
Chemopetrol	Czech Republic
GALP	Portugal
Takreer	Abu Dhabi
Petronor	Spain
Petrobras	Brazil
Petroperu	Peru
ADNOC	Abu Dhabi
Qatar Petroleum	Qatar
MOL	Hungary



# Expansion Joints for FCCU

## Some of our customers in Oil & Gas

PLUSPETROL ENERGY S.A.	B. Aires	Argentina
ÖMV RAFFINERIE SCHWECHAT	Schwechat	Austria
ÖSTERREICHISCHE BUNDESBAHNEN	Knittelfeld	Austria
BRITISH PETROLEUM CHEMICALS	Antwerp	Belgium
TOTAL REFINERY	Antwerp	Belgium
CESKA RAFINERSKA, A.S.	Litvinov	Czech Republic
CHEMOPETROL, A.S.	Litvinov	Czech Republic
ESMERALDAS REFINERY	Esmeraldas	Ecuador
PETROINDUSTRIAL	Esmeraldas	Ecuador
ALEXANDRIA PETROLEUM CO.	Alexandria	Egypt
FORTUM OIL OY	Porvoo	Finland
NESTE OIL OY - Hydrocracking Unit	Kulloo	Finland
TOTAL	Donges	France
NORDDEUTSCHE AFFINERIE AG	Hamburg	Germany
HELLENIC ASPROPYRGOS REFINERY	Athens	Greece
HELLENIC PETROLEUM S.A.		Greece
KALA NAFT COMPANY	Tehran	Iran
NATIONAL IRANIAN OIL CO.	Tehran	Iran
ESSO ITALIANA srl	Augusta	Italy
A/S NORSE SHELL	Oslo	Norway
ESSO SLAGEN 2000 REFINERY	Slagen	Norway
PETROPERU	Lima	Peru
CEPSA	Lisboa	Portugal
ANGARSK PETROCHEMICAL CO.	Angarsk	Russia
SLOVNAFT	Bratislava	Slovakia
BP OIL ESPAÑA	Castellón	Spain





## Expansion Joints for FCCU

### Some of our customers in Oil & Gas

ELF ATOCHEM ESPAÑA S.A.	Miranda	Spain
CEPSA	Madrid	Spain
PETROMED	Madrid	Spain
REPSOL PETROLEO S.A.	Madrid	Spain
AMOCO NETHERLANDS BV	Ljmuiden	Holland
SHELL NETHERLAND RAFFINADERIJ	Rotterdam	Holland
TEXACO PERNIS REFINERY	Rotterdam	Holland
ESSO PRETROLEUM COMPANY LTD.	Fawley	UK
EXXONMOBIL	Surrey	UK
TEXACO NORTH SEA	Aberdeen	UK
ANCAP	Montevideo	Uruguay
CONOCOPHILLIPS CO.	Wilmington	USA
SHELL PUGET SOUND REFINERY	Anacortes	USA
SHELL OIL PRODUCTS US	Houston	USA
TESORO CO.	Anacortes,	USA
PDVSA	Caracas	Venezuela
UOP LLC	Des Moines	USA

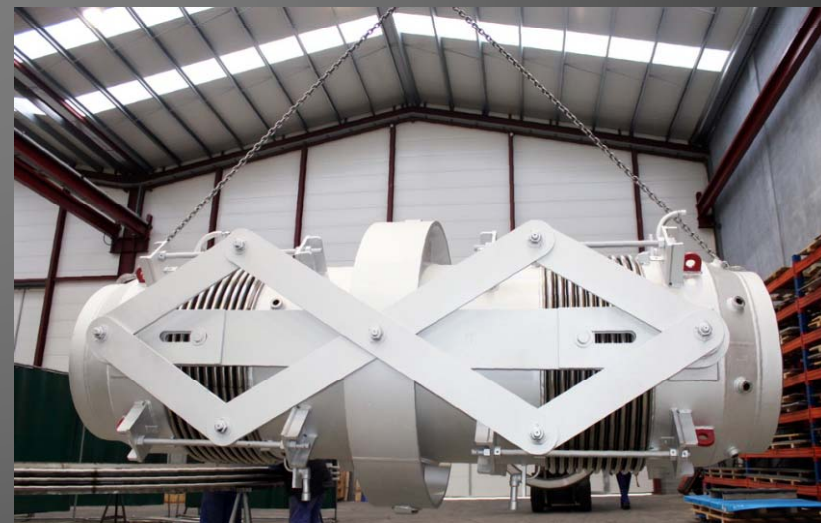


# Expansion Joints for FCCU

## Some of our FCCU Projects

MOL Refinery Százhalombatta, Hungary  
FCCU Expansion Joints  
Expansion Joint for FCCU Type MWCD Double Gimbal  
Packed Type DN 900  
Expansion Joint for FCCU Type MWP Hinged Packed  
Type DN 900  
Design Temperature: 760 °C  
Design Pressure: 2.76 kg/cm<sup>2</sup>g  
Year: 2012

BP Oil, Castellón Refinery, Spain  
FLEXICRACKING UNIT REACTOR, R-2201 Replacement  
SPENT CATALYST EXPANSION JOINTS designed per  
ExxonMobil practices  
FCCU MPB-I In-Line Universal, Pressure Balanced  
2-ply testable bellows  
Design Temperature: 566°C  
Design Pressure: 7.33 kg/cm<sup>2</sup>g  
Expansion Joint ID: 457 mm (ID of refractory lining)  
Total Length: 2250 mm (erection length with cold pull)  
Year: 2011





# Expansion Joints for FCCU

## Some of our FCCU Projects

Ceska Rafinerska a.s. Litvinov, Czech Republic  
FLEXICRACKING REACTOR Revamping  
SPENT CATALYST EXPANSION JOINT  
Universal Pantographic with 2-ply testable bellows  
Inconel 625 LCF  
As per UOP Specs.  
Design Temp.: 552°C / Design Pressure: 6.02 kg/cm<sup>2</sup>g  
Expansion Joint ID: 850 mm  
Total Length: 3400 mm  
Year: 2011

UOP LLC, Illinois - USA for PETROBRAS  
REPLAN CGR, PAULINA REFINERY, SAO PAULO BRASIL  
Expansion Joints Alloy 800, 316H and 304H Pipes  
MEP Dual Axial In-line Externally Pressurised  
MWY Type Double Lateral Hinged  
Regeneration Heater Piping Section  
Year: 2009

IAG, FCC Reactor Internals replacement Project  
UOP Fluid Catalytic Cracking Process Unit  
Mažeikiai Refinery  
Reactor Regenerator Section  
Project Specification 61941-805  
MWD Type MACOGA Expansion Joints  
Universal Expansion Joints DN 1900



# Expansion Joints for FCCU

## Some of our FCCU Projects

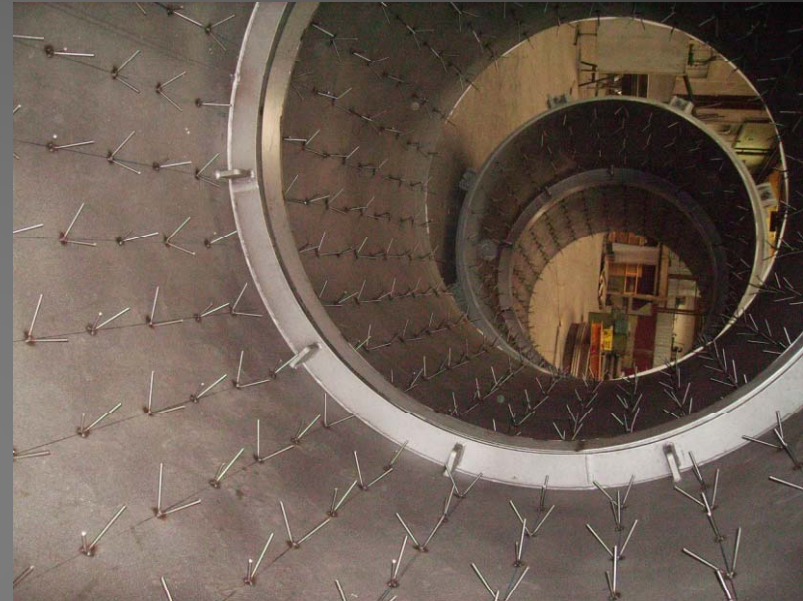
UOP LLC, Illinois - USA for PETROBRAS  
RPBC Refinery Pres. BERNARDES-CUBATO  
Project no. 946314 - U13 CATALITIC Reactor BRASIL  
Bellows Alloy 800, 316H and 304H Pipes and  
accessories

MEP Dual Axial In-line Externally Pressurised  
MWY Type Double Lateral Hinged  
Regeneration Heater Piping Section

Technip / ExxonMobil  
ExxonMobil

RFCC Joliet, Illinois - USA  
FCC Gas Scrubber  
4 units MFD Type 96"

CONOCOPHILLIPS Company  
Jacobs Engineering, Cypress, CA  
Wilmington Refinery, California – USA  
C1180-022/RFCC Project  
FCC Particulate Project  
MFD Type 96"





# Expansion Joints for FCCU

## Some of our FCCU Projects

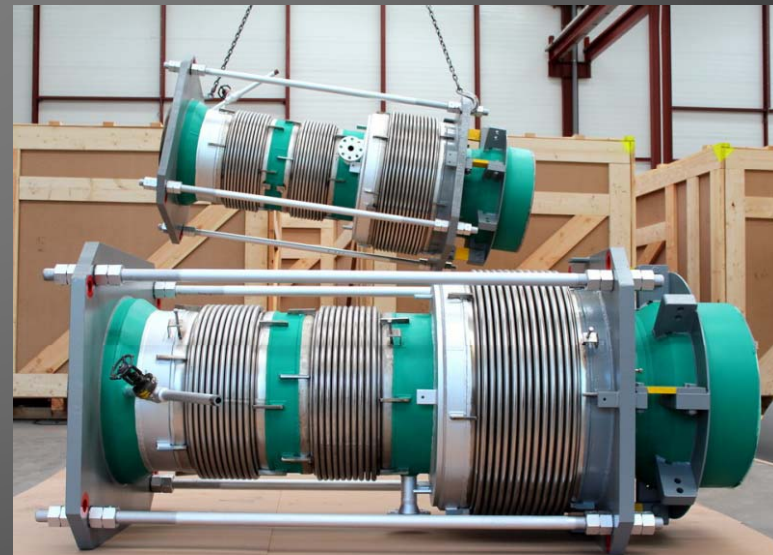
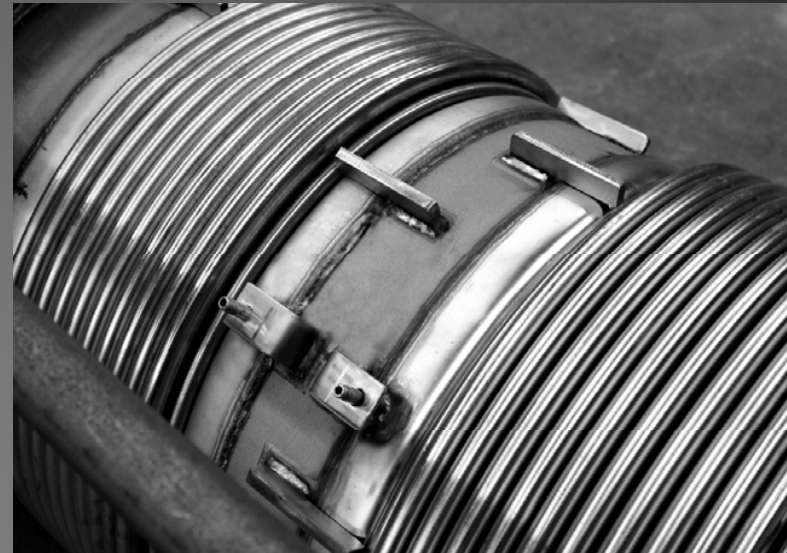
Geska Rafinereska Czech Republic  
FCC Reactor Rising Kralupy Refinery  
FCC Reactor Rising Termination Expansion Joints  
MWD Type 1492 - Temp. 538 deg C.  
As per UOP Fluid Catalytic Cracking Process  
Reactor Regenerator Sector

Neste Oil Porvoo Refinery Fortum Oil Oy Finland  
Porvoo Project Diesel Residue Hydrocracking Unit  
Several Expansion Joints for Hydrocracking application

SHELL Oil Products US  
JACOBS Engineering Houston, TX  
FCC Project # PUGET Sound Refinery Anacortes, WA  
156" Expansion Joints + 4 x Axial 84"

SHELL Oil Products US Tesoro Northwest Company  
FFC Unit Revamp Project  
Anacortes, WA - USA Expansion Joints for FFC  
4 Axial 84" + 2 Universal 84"

Tecnicas Reunidas / UOP / BIG WEST Oil  
North Slat Lake City, Utah - USA  
Expansion Joints for UOP FCCU  
FCC Reactor Internal Expansion Joint 1000 °F  
1 x Universal 54"



# Quality Approvals & Certifications

- ISO 9001:2008
- ISO 14001:2004
- ISO 3834
- PED 97/23/CE, Module H
- TÜV / AD 2000-Merkblatt HP0 EN 729-2
- U-Stamp ASME
- Certificate of Authorization “NB”
- BV Type Approval Certificate
- Lloyd’s Register Type Approval
- Det Norske Veritas Type Approval
- Spanish Ministry Defence & NATO

