

- **Flexible Elastomeric Foams (FEF) and Polyethylen Foams (PEF): Solutions in the Building Industry**
- *Georgios Eleftheriadis, Manager Technical Market Development, Armacell
, Chairman CEFEP (FEF / PEF interest group)*

➤ **CEFEP**

➤ **FEF/PEF product knowledge**

➤ **FEF/PEF basic „requirements“**

➤ **Applications and Solutions**

➤ **Project pictures/case studies**

CONTENTS

- **CEFEF (European FEF and PEF Interest Group) is the European group of technical insulation manufacturers. The group intends to communicate the benefits of its products to the European market. Its expertise is characterised by the long-term market knowledge of its members.**
- **CEFEF was founded under the umbrella of Güteschutzgemeinschaft Hartschaum e.V. (Celle) in 2012.**



CEFEF members





- **FEFs/PEFs Material Knowledge**



Types of Insulation Materials

	Insulation Material	Advantages	Disadvantages	
Inorganic	Mineral Wool	High temperature range, non-combustible	Open cell – absorbs moisture, dusty – loose fibres in the atmosphere	
	Calcium Silicate	High temperature range, non-combustible, high compressive strength	Open cell – absorbs moisture, difficult to fully seal	
	Cellular Glass	Closed cell, high and low temperature range, lightweight, non-combustible	Difficult to work with, sulphur smell when cut, extremely fragile, can be abrasive to pipes or substrate	
Duroplasts	Phenolic Foam	Low thermal conductivity, good fire performance	Absorbs moisture – reliant on thin foil barrier, difficult to get a 100% vapour seal	
	PUR/PIR	Low thermal conductivity, good load bearing capacity	Absorbs moisture – reliant on thin foil barrier, difficult to get 100% vapour seal, fire performance not as good as other insulation materials	
Thermoplastics	Elastomers	Elastomeric Foam	Low thermal conductivity, flexible and easy to install, closed cell – high resistance to moisture, retains its long term performance, can be used at low temperatures, good fire performance	Mechanical protection may be required in areas of heavy traffic
		Polyethylene Foam	Inexpensive, low thermal conductivity, fairly flexible	Difficult to seal at the joints, low fire performance, limited temperature range

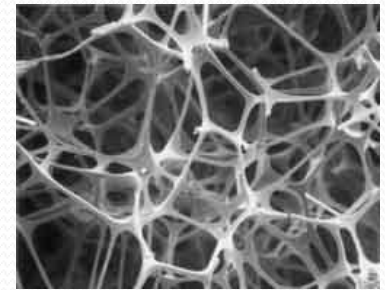
Open and Closed Cell Materials

- Open Cell Materials

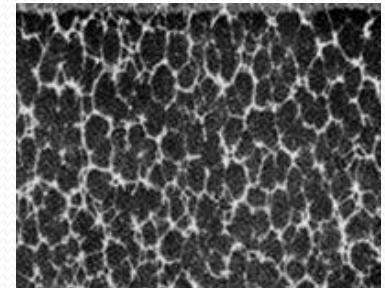
- ❖ In the case of open-cell foams the cells are aligned one below the other and, if there is no outer membrane, they are in contact with the surrounding air. Open-cell foams offer little resistance to the passage of liquids and gases through them.
- ❖ The cell structure has sound-absorbing properties and, when flexible, cushioning characteristics. This makes these foams suitable for use as sound-absorbing materials and in cushioning applications.

Closed Cell Materials (FEFs/PEFs)

- ❖ **Closed-cell foams consist of tiny cavities which are totally surrounded by their walls and, therefore, are not in gas exchange with other cells.**
- ❖ **Closed-cell foams, therefore, have:**
 - ❖ **lower water absorption and**
 - ❖ **lower water vapor permeability than open-cell foams.**



Open cell



Closed cell

Material Structure

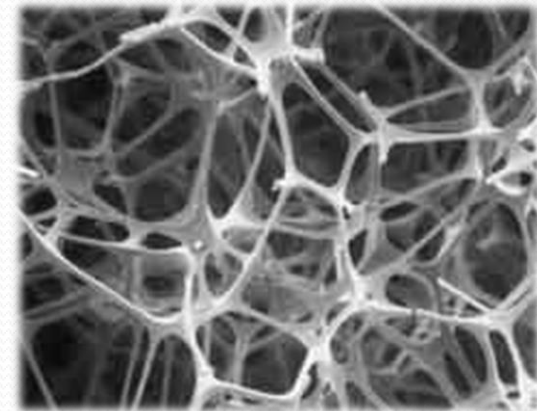
Flexible Elastomeric Foam

- ❖ Dust and fibre free, flexible insulation product with closed cell structure provides a total system solution and multiple benefits..



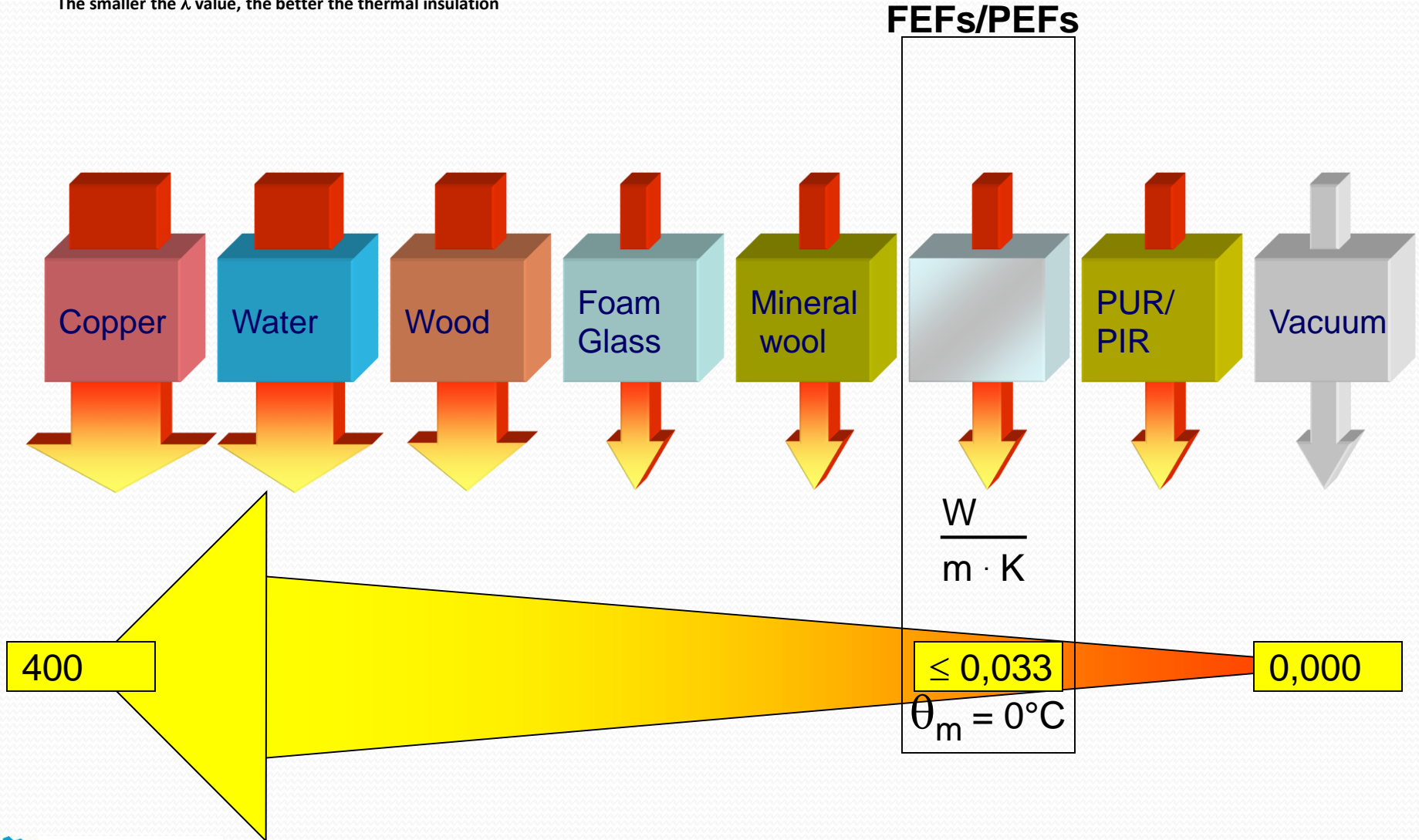
Mineral Fibre Insulation Products

- ❖ Consists of loosely joined fiber strands with an open cell structure and high surface porosity resulting in negligible vapour diffusion resistance and high water absorption rates.






Some examples of thermal conductivity values

The smaller the λ value, the better the thermal insulation



Key Drivers

EL Foams and PE Foams are superior products vs. other insulation materials

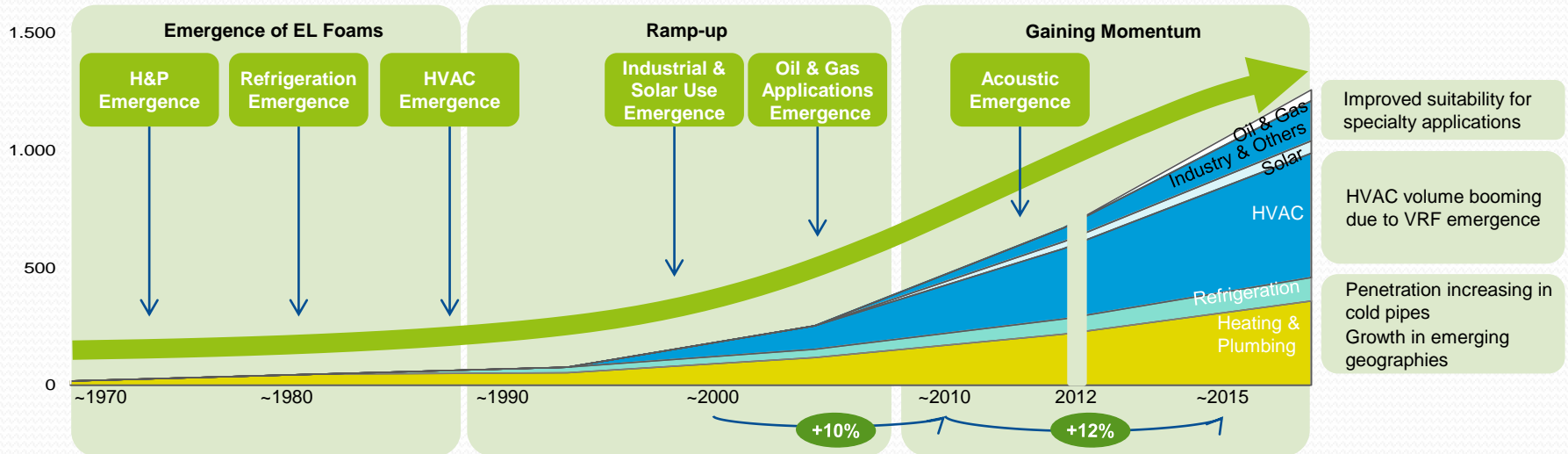
Key End-Markets			
	Illustration	Description of Insulation Needs	FEF Key Benefits vs. Other Materials
Heating & Plumbing		<ul style="list-style-type: none"> Water pipes in contact with ambient air to prevent heat loss, condensation and sometimes noise 	<ul style="list-style-type: none"> ✓ Ease of installation ✓ Condensation control for cold pipes ✓ Low cost for small pipes
Refrigeration		<ul style="list-style-type: none"> Pipes carrying refrigerant to prevent energy loss, condensation and protect pipes 	<ul style="list-style-type: none"> ✓ Unique condensation resistance ✓ Low total system cost ✓ Vibration protection
HVAC Heating Ventilation Air Conditioning		<ul style="list-style-type: none"> Chilled water pipes (cooling function) and to prevent condensation and sometimes also on ducting to prevent noise 	<ul style="list-style-type: none"> ✓ Condensation control ✓ Low total system cost
Solar		<ul style="list-style-type: none"> Solar pipes carrying hot water to prevent heat loss and protect against UV radiations 	<ul style="list-style-type: none"> ✓ High flexibility ✓ Ease of installation
Industry		<ul style="list-style-type: none"> Sanitise pipes in food processing and pharmaceutical industries 	<ul style="list-style-type: none"> ✓ Mechanical resistance ✓ Condensation control for cold pipes
Oil & Gas		<ul style="list-style-type: none"> Pipelines, machinery, tanks and equipment for Oil & Gas and petrochemical industries 	<ul style="list-style-type: none"> ✓ Low total system cost ✓ Suitable for cryogenic applications (pipes with -200°C liquefied gas) ✓ Mechanical resistance

EL Foams – Evolution

EL Foams have grown rapidly and expanded into several new end-markets, since their inception in the 1970's

Evolution of FEFs

Global, EUR in million



Key Benefits of FEFs

Key benefit #1 ✓
Condensation resistance

The ability of EL Foams to prevent condensation easily without supplementary layering (Condensation resistance = water vapour diffusion resistance)

Key benefit #2 ✓
Mechanical resistance

EL Foams have better resistance to surface deterioration, shocks and vibrations due to its flexible structure

Key benefit #3 ✓
Ease of installation

EL Foams can be installed quickly and effectively
EL Foams are easier to use (ability to cut to the right shape without dust)

Key benefit #4 ✓
Low total system cost

EL Foams are cost effective on a total system basis including materials and installation labour



- **FEFs/PEFs Basic Requirements**



Product Overview – FEFs

Product Description

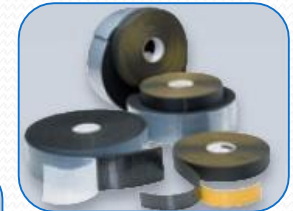
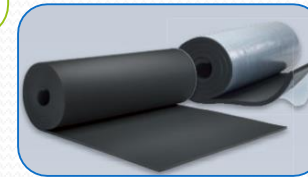
- FEFs have an effective in-built water vapour barrier and closed-cell structure that reduces the risk of corrosion under insulation (CUI)
- Low thermal conductivity for long term efficiency
- Ideal for condensation control on chilled and refrigeration pipework
- Application areas include: healthcare facilities like hospitals, education facilities like schools offices and other commercial buildings, as well as process industry like milk plants

Product Examples



FEF Tubes

FEF Sheets



FEF Tapes / pipe hanger / adhesives/ cleaners etc.

Key Characteristics

Temperature Range	(50)°C to +110°C
Thermal Conductivity (λ)	$\lambda \leq 0.033 \text{ W/m}\cdot\text{K} - 0.038 \text{ W/m}\cdot\text{K}$ at 0°C
Water Vapour Resistance	$\mu \geq 3,000 - 10,000$
Reduction of Structure-borne Sound Transmission	$\leq 28 \text{ dB(A)}$

Application Examples



Refrigeration Facility



Milk Processor

- FEF Pipe Insulation is used to delay heat gain and control condensation drip from chilled water and refrigeration systems
- It also efficiently reduces heat flow for hot-water plumbing and liquid-heating and dual temperature piping

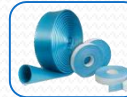
Product Overview – PEFs

PEFs – The Energysaver

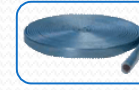
Product Description

- PEFs are complete insulation packages for effective energy conservation and mechanical protection along with acoustic insulation
- PEFs provide a complete range of insulation products for a broad range of applications
 - Heating, domestic hot and cold water and sewage pipes in both residential and commercial buildings
- Conforms to Energy Saving regulations
- Promotes energy savings of up to 80%
- Matching range available for a wide range of plastic pipe sizes

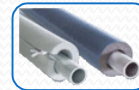
Product Examples and Range (tubes/sheets)



e.g. Sewage pipe tube insulation.
(sound reduction on plastic pipes)



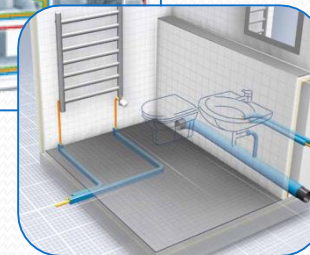
Covered tubes



tubes covering Energy Saving law requirements

Product	Type of Installation				Additional Benefit/Requirement			
	Heating	Domestic Hot Water	Cold Water Pipes	Waste Water	Extra Protection	50% Faster Reduction	Noise Reduction	Under Plaster
Diverse products	***	***	**					
Diverse products	***	***	**			✓		
Diverse products			***		✓		✓	✓
Diverse products				***	✓		✓	
				***	✓		✓	

Application Examples



- PEFs are easy to sleeve over new pipework or cut longitudinally to snap over existing pipework to provide thermal insulation

- Cold water pipes
- Domestic hot water pipes
- Heating system pipes
- Waste water pipes

Key Characteristics

Temperature Range	Up to 102 °C (85°C for tapes)
Thermal Conductivity (λ)	$\lambda \leq 0.038 \text{ W/m}\cdot\text{K at } 10^\circ\text{C}$ $\lambda \leq 0.040 \text{ W/m}\cdot\text{K at } 40^\circ\text{C}$
Fire Performance	Euroclass :B - E
Acoustic Performance	Reduction of 11 ~ 30 dB(A)

Why Insulate Technical Equipment?

- ❖ Inadequate insulation is a leading cause of energy waste. Insulation saves money and energy resources.
- ❖ Insulation also protects pipework and systems, increasing its lifespan.
- ❖ Insulating mechanical equipment is important for a number of reasons, such as:

- **Energy & cost saving**
- **Condensation control**
- **Fire protection**
- **Frost protection**
- **Personnel protection**
- **Noise reduction**



Condensation Control

- ❖ CONDENSATION occurs when water vapour present in the air is released in the form of droplets on suitably cold (dew point temperature) surfaces. Condensation results in:
Reduction in the thermal insulation capability e.g. of an open cell material (increasing thermal conductivity)
- *corrosion under insulation on the pipes.*

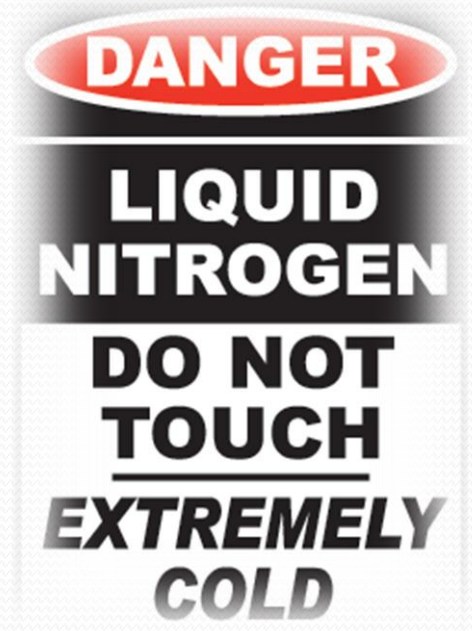


Fire Protection

- ❖ Used in combination with other materials, insulation helps provide fire protection. For example piping and ventilation systems, electric cables, etc
- ❖ By choosing the insulation material with high reaction to fire class we can delay or eliminate the flashover.

Personnel Protection

- ❖ Thermal insulation is one of the most effective means of personal protection from second and third degree burns.
- ❖ Such burns occur when skin comes into contact with surfaces of hot piping and equipment operating at temperatures above approx. 60°C.
- ❖ Insulation reduces the surface temperature of piping or equipment to a safer level. In the same way, insulation provides protection against freezer burn from extremely cold temperature pipes below -10°C.



Noise Reduction



❖ Air-borne sound and Structure-borne sound.

❖ In the case of pipes, the following noises must be prevented:

- Noises caused by the flow of water through the pipes.
- Noises that are caused by expansion due to a change in temperature.

❖ In the case of ducts, the following noises must be prevented:

- Noises caused by the flow of air through the ducts.
- Noises caused by the vibration of the ventilation mechanism

hEN Harmonized Product Standards for Insulation materials



- FEF and PEF products are „harmonised“, i.e. CE-mark is necessary to sell them in Europe
 - **EN 14304: 2009+A1:2013** Thermal insulation products for building equipment and industrial installation Factory made flexible elastomeric foam (**FEF**)
 - **EN 14313+A1** Thermal insulation products for building equipment and industrial installation Factory made polyethylene foam (**PEF**)



- How are the products used and applied



Solving the Problems with FEF Insulation

- ❖ The **highly flexible foam** fits around even the most complicated of application areas, and can be bonded over the entire insulation thickness at critical points (e.g. penetrations, junctions...).
- ❖ The air flow (**breathing**) is prevented, because a flexible FEF material reacts to changes in pressure by changing its volume.
- ❖ FEF insulation can be installed **without any gaps** thanks to **cold welded** connections.



Tight Joints

- ❖ The integrity of the system (tight joints) is only ensured by correct installation procedures and the use of correct adhesive.
- ❖ The contact System Armaflex Adhesive binds the Armaflex insulation surfaces by **chemical reactions** providing a “cold welded” joint.

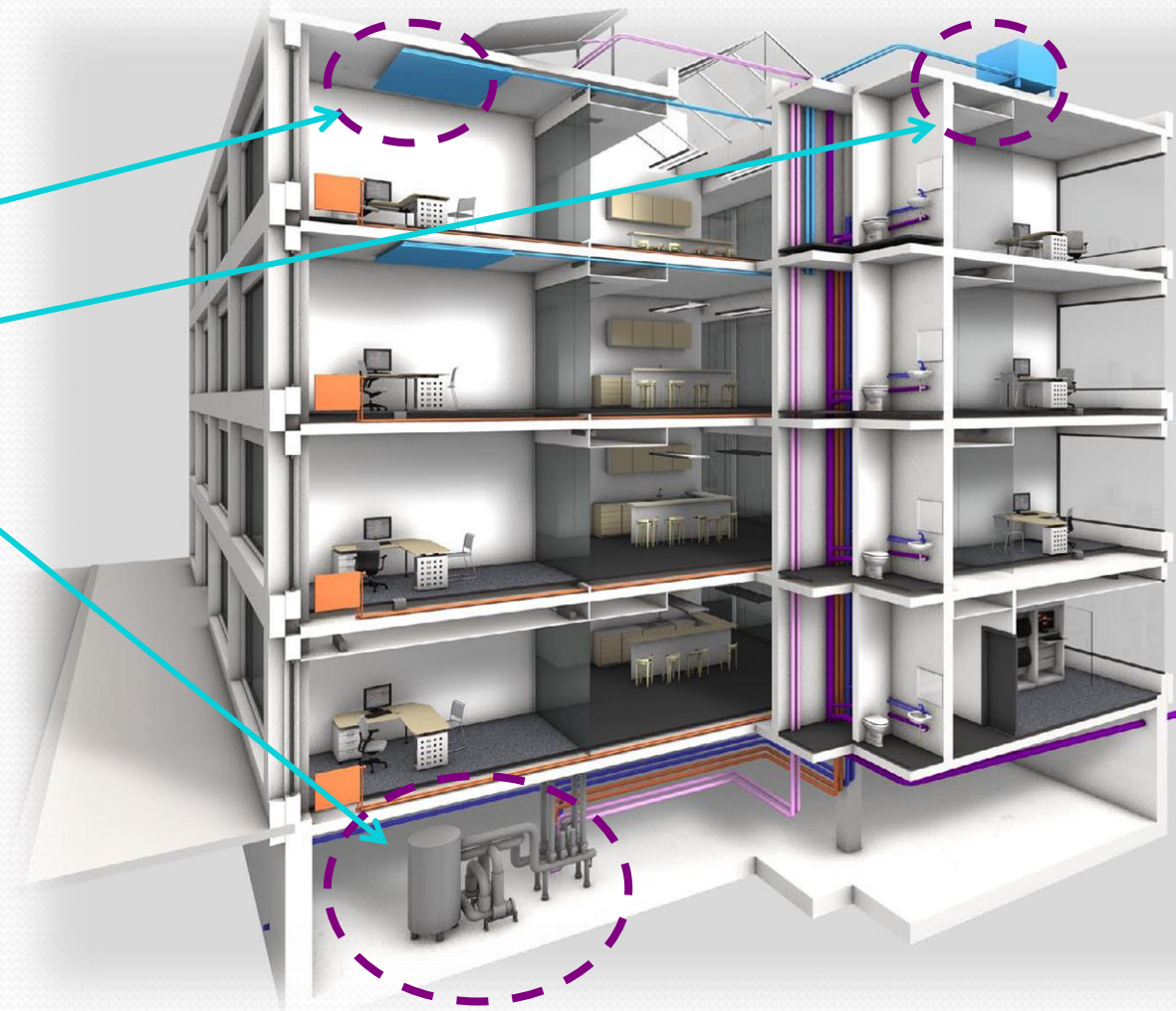
“cold welded”
joint guarantees
required
tightness



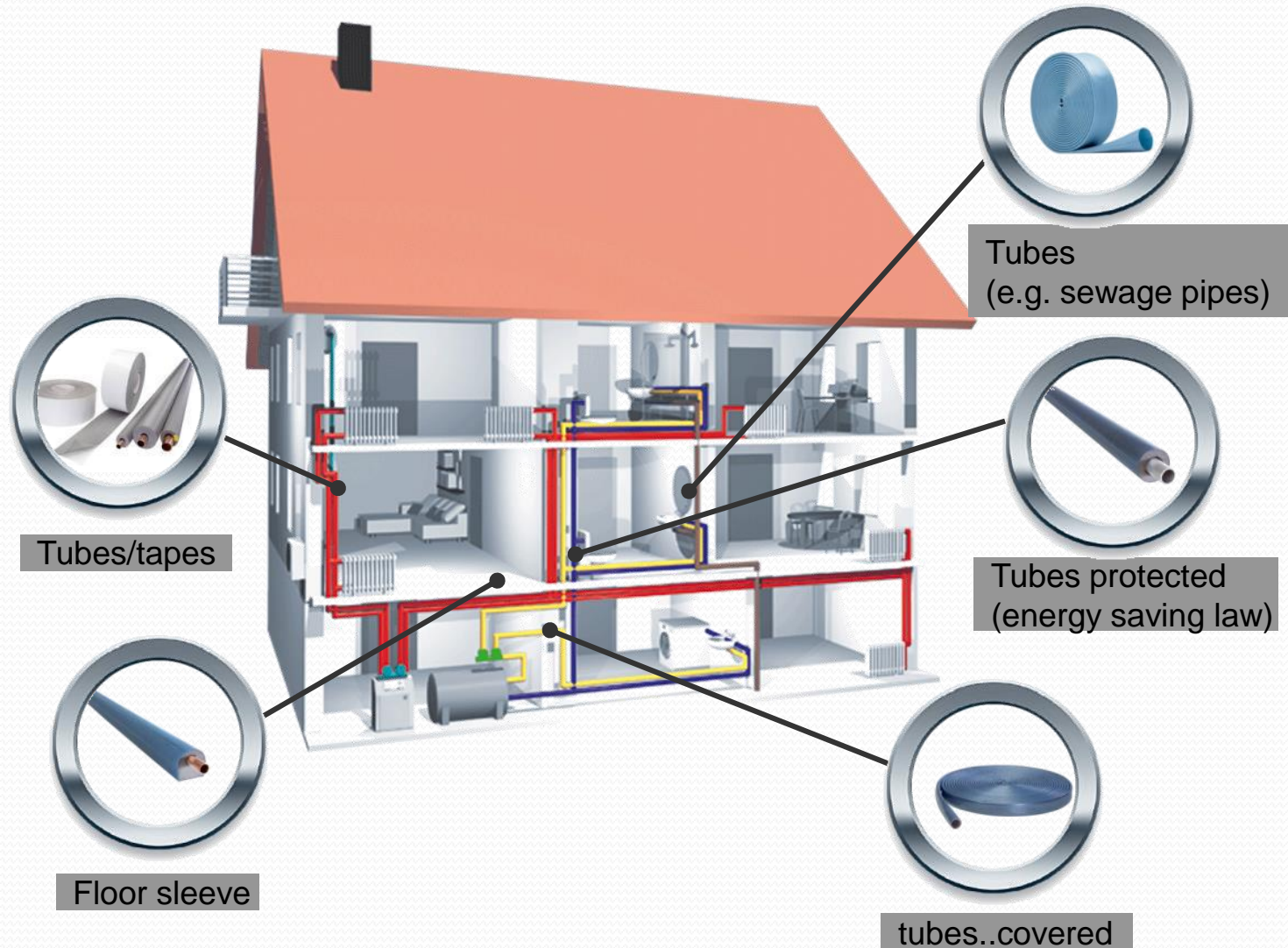
Systems & Solutions FEFs

- ❖ Pipes,
- ❖ Air ducts,
- ❖ Vessels of air conditioning
- ❖ Refrigeration and process equipment

- *Preventing condensation,*
- *Saving energy,*
- *With structure-borne noise reduction*



Systems & Solutions PEFs



Lost Track?





- **Project pictures**

FEF insulation - Refrigeration



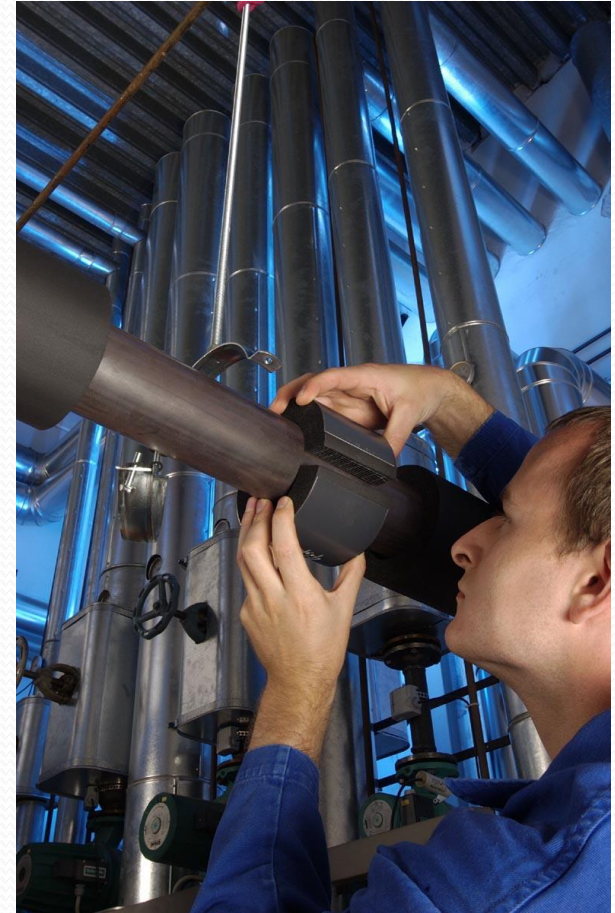
FEF insulation - Refrigeration



FEF insulation – technical room



PEF insulation and pipe hanger





- **Case Studies**

EMPIRE STATE BUILDING NEW YORK CITY, NY (USA)

When the Empire State Building underwent an extensive LEED Gold® certification in 2011, the building was carefully scrutinized to identify energy-saving potential in all areas. The AP Armaflex Duct Liner installed on the air ducts many years ago was then and is now the best choice and did not have to be substituted. The fibre-free insulation will continue to provide high energy efficiency, indoor air quality (IAQ) protection and noise attenuation.

BUILDING: NON-RESIDENTAL





BUILDING: NON-RESIDENTIAL



OLYMPIC STADIUM
"BIRD'S NEST"
BEIJING (CHINA)

Armacell won the contract to provide the insulation for the air-conditioning system. The elastomeric insulation material Armaflex achieved by far highest score for its technical properties.



**AIDA
MEYER WERFT, PAPANBURG
(GERMANY)**

Over the years, the Meyer Werft has built 37 luxury liners for discerning customers from all over the world. When it comes to the insulation of chilled water and refrigeration pipes, the shipyard only trusts in products from Armacell: AF/Armaflex and Armafix AF pipe hangers reliability prevent condensation and energy loss.



DEUTSCHE WELLE TV STUDIO BONN (GERMANY)

Ventilation ducts supply the TV studio with fresh air. However, they can also carry unwanted noise with the building. Compared to traditional products, ArmaSound RD achieves the desired sound absorption with lower insulation thicknesses. In addition, the acoustic foam has good sound barrier properties and also reduces the transmission of structure-borne noise.

INDUSTRIAL: MEDIA





• **THANK YOU!**