

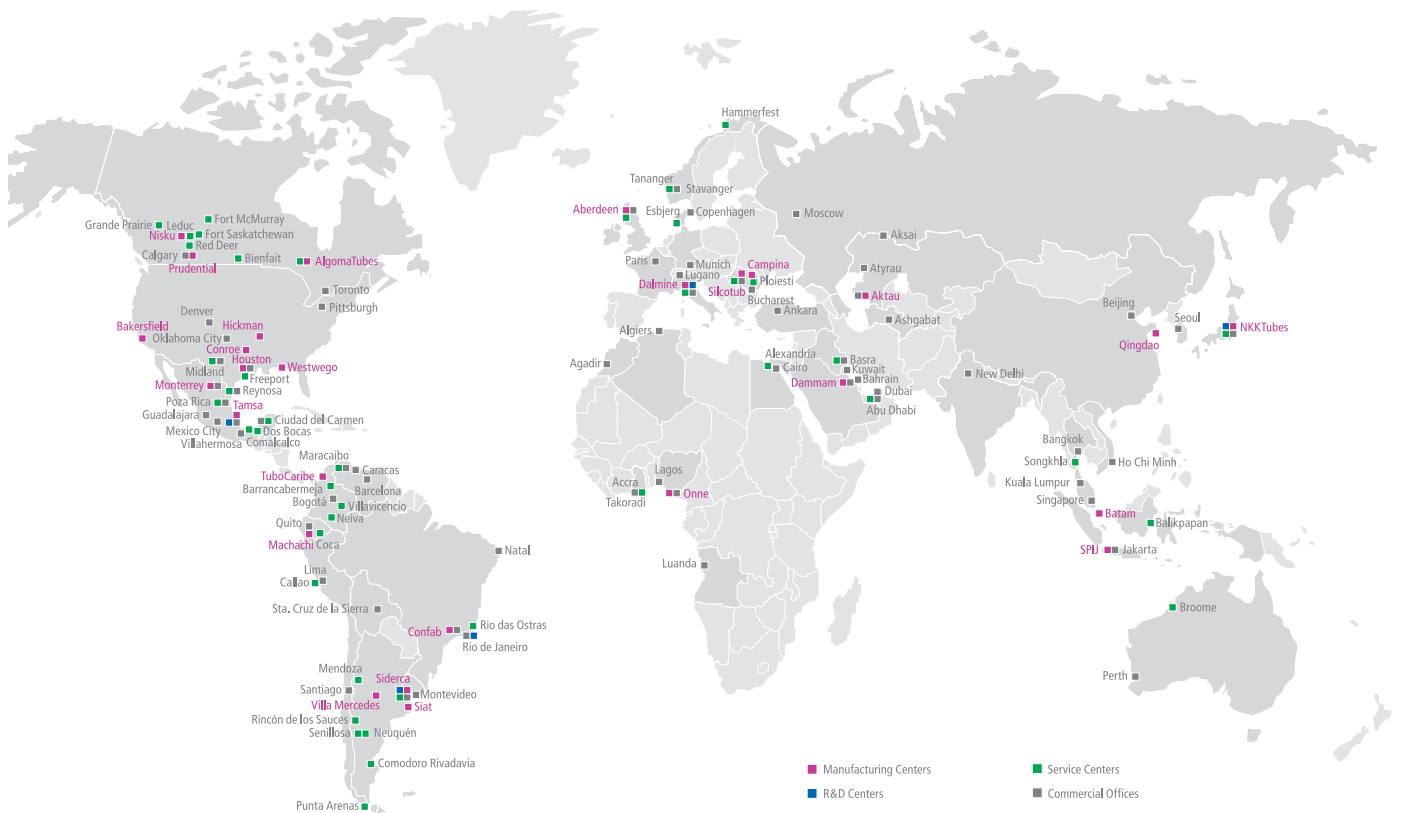
Offshore and Onshore Pipeline Coating Solutions



Tenaris

Tenaris is a leading supplier of tubes and related services for the world's energy industry and certain other industrial applications. Our mission is to deliver value to our customers through product development, manufacturing excellence, and supply chain management. We seek to minimize risk for our customers and help them reduce costs, increase flexibility and improve time-to-market. Tenaris employees around the world are committed to continuous improvement by sharing knowledge across a single global organization.

Tenaris aims to achieve the highest standards of Quality, Health, Safety and Environment, incorporating the principles of sustainable development throughout its operations. We are aligned with OHSAS 18001 and ISO 14001 standards as part of our commitment to developing a long-term sustainable business.



High performance coating solutions

Tenaris provides a complete package of coating solutions for pipes and customized tubular accessories such as bends, risers and buckle arrestors. Our coating plants work in compliance with the most rigorous international standards (ISO, ASTM, NACE, DIN, CAN) and following detailed project specifications.

Our external, internal, thermal and concrete coating systems are applied through methods such as extrusion, spray and painting, in various materials that include solids, liquids and powder.

Tenaris also offers TenCoat™, a proprietary pipe coating solution that includes internal and external coatings.

Tenaris supplies packages for onshore operations, shallow, deep and ultra-deep waters and other demanding applications. We design solutions that reduce costs for our customers and deliver them in exceptional lead times.

In addition to our own coating plants, we work in alliance with worldwide coating manufacturing companies. Tenaris manages and controls every step of the production process, from the manufacturing of steel products and accessories to the application of the coating.



Application of internal coating



Concrete weight coating



Infrared heating oven for thermal insulation



Thermal Insulation coating

External coatings

EXTERNAL BARRIERS FOR CORROSION PROTECTION

Tenaris's external coating systems are applied on the steel surface to prevent corrosion and improve mechanical resistance. The most widespread thermosetting and thermoplastic coatings for onshore or offshore pipes come in the form of Fusion Bonded Epoxy (FBE) and three-layer polyolefin coating systems. Tenaris also offers special coating solutions such as Neoprene, Liquid Epoxy Painting and TSA (Thermal Sprayed Aluminium).

FUSION BONDED EPOXY (FBE) COATING SYSTEM

The FBE coating system is a thermosetting resin, applied in the form of a dry powder at thicknesses of 400-600 microns onto the heated surface of the steel. Once applied and cured, the epoxy film exhibits an extremely hard surface with excellent adhesion to the steel surface.

The FBE protective surface is homogeneous and offers an excellent resistance to chemical reactions. It provides protection at moderate temperatures (-40°C/-104°F to 85°C/185°F) and comes with different options: Single and double layer FBE for pipelines and flowlines, and FBE Non-slip for pipelines that will subsequently be concrete coated.

POLYOLEFIN (POLYETHYLENE AND POLYPROPYLENE)

This three-layer anti-corrosion system consists of a layer of high-performance Fusion Bonded Epoxy onto which a co-polymer adhesive layer is applied, followed by a layer of extruded polyethylene or polypropylene until the desired thickness is obtained.

The three-layer polyethylene (3LPE) offers pipeline protection when temperatures are between -40°C/-104°F and 85°C/185°F, while the three-layer polypropylene (3LPP) is recommended for temperatures between -20°C/-68°F and 110°C / 230°F

Flame spray application of PE or PP (manual or semi-automatic) is used for bends and buckle arrestors.

In addition to the chemical and adhesive properties of the epoxy powder, the polyolefin coating system provides physical and mechanical advantages.

ELASTOMER (NEOPRENE)

Elastomer coating is the most effective anti-corrosion system for risers used in offshore operations, especially in the highly corrosive splash zone region.

Three-layer polypropylene and polyethylene



THERMAL INSULATION

Thermal coating solutions preserve the temperature and viscosity of the fluids transported, avoiding cooling down due to environmental and operating conditions and the consequent increase on the need for pump power.

Tenaris offers a wide range of thermal insulation solutions, that come with the thickness and configuration required to meet the specific performance and installation requirements of each operation.

Tenaris supplies the whole scope of solutions for onshore, shallow and deepwater applications.

We provide wet and pipe-in-pipe insulation. Our wet insulation solutions include:

- Polyurethane Systems: solid and syntactic for shallow and deepwaters. Foam (PUF) for applications involving very shallow waters, in temperatures ranging between -20°C / 68°F and 100°C / 212°F, to meet specific performance and subsea installation requirements.
- Polypropylene solid, foam and syntactic insulation: recommended for operating temperatures ranging from -20°C/-68°F to 155°C / 311°F and water depths of a maximum 4,000 m / 13,123.36 ft.
- Multi-layer polypropylene (5LPP) insulation: the multi-layer polypropylene is recommended for operating temperatures of up to 140°C / 284 °F and water depths greater than 3,000 m / 9,842.52 ft. Meanwhile, the multi-layer polypropylene foam works in operating temperatures ranging from -20°C / -68°F to 140°C / 284°F and water depths of up to 600 meters.

Tenaris's pipe-in-pipe (PiP) systems include an outer steel pipe able to withstand water pressure and prevent water penetration, and an inner steel pipe that conducts the production fluids. The thermal insulation material is placed between the production flowline and the carrier pipe.

CONCRETE WEIGHT COATING (CWC)

Tenaris provides heavy concrete coating solutions to ensure negative buoyancy in offshore pipelines and provide strong mechanical protection.

These systems are applied over an anticorrosion coating (FBE or 3LPO) or insulation coating with different densities and thicknesses, according to specifications.

Both the compression and impingement methods of application can be used to better fit the projects' specifications and cover a wide range of pipe ODs.

TenCoat™ Shield is an external coating that can be applied to pipes that include API or TenarisHydril premium connections.



— Thermal Insulation and concrete weight coating.



Internal coatings

Tenaris offers a variety of coating options that protect internal pipe surfaces from the effects of corrosion and erosion, and reduce friction and turbulence in order to increase flow efficiency. The coating also acts as a protection while in storage and during transport.

Tenaris supplies liquid epoxy, internal fusion bonded epoxy (FBE) and special anticorrosive painting for protection against corrosion. These options are:

- Suitable for fresh and salt water immersion
- Effective for speeding up production
- Suitable for corrosive environments
- Resistant to many solvents and chemicals
- Resistant to cathodic disbondment

TenCoat™, Tenaris's proprietary pipe coating solution, includes three options for internal coating: TenCoat™ 5000, TenCoat™ 7000 and TenCoat™ 8000. They are thermosetting coatings that come in the form of epoxy powder. They are recommended for production and injection tubing, flowlines, line pipe products and drill pipes.

Visual inspection of internal coating



A complete package of products and services

Tenaris accompanies its wide range of coated pipes with a service offer that covers every step of our customers' operations.

Our technical experts support oil and gas companies during string design and material selection to fulfill their needs in each particular operation. We also conduct qualification and testing requested by our customers, and offer a detailed and customized Pre-Qualification Trial (PQT).

Tenaris's quality assurance system is implemented during and after pipe coating procedures through visual inspections as well as destructive and non-destructive testing. This system is defined in a specific ITP (Inspection & Test Plan) shared and agreed with our customers, issued on the basis of international standards

Tenaris's offer also includes the application of coatings on Double Joint length pipes and customized coatings for tubular accessories, such as bends and buckle arrestors.

The close proximity of the coating facilities to Tenaris's manufacturing mills implies near-simultaneous pipe manufacturing and coating application with minimum overall material handling, which allows us to ensure excellent delivery times.

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Double joint coating solutions



Our coating facilities worldwide

Tenaris has a network of coating facilities that are strategically located close to our manufacturing mills, in major oil & gas markets. Each facility provides the following coatings:

BLYTHEVILLE, ARKANSAS, US

- Fusion Bonded Epoxy, coating range from 4” to 16” (101.6 mm to 406.4 mm).

HOUSTON, TEXAS, US

- Three layer polyethylene or polypropylene, coating range from 1” to 5.5” (25.4mm to 139.7 mm).
- Fusion Bonded Epoxy, coating range from 1” to 5.5” (25.4mm to 139.7 mm).

CARTAGENA, COLOMBIA

- Three layer polyethylene or polypropylene, coating range from 4” to 48” (101.6 mm to 1219.2 mm).
- Fusion Bonded Epoxy, coating range from 4” to 48” (101.6 mm to 1219.2 mm).

PIOMBINO, ITALY

- Three layer polyethylene or polypropylene, coating range from 1” to 10” (25.4mm to 254 mm).
- Fusion Bonded Epoxy, coating range from 1” to 10” (25.4mm to 254 mm).

ONNE, NIGERIA

- Three layer polyethylene or polypropylene, coating range from 4” to 48” (101.6 mm to 1219.2 mm).
- Fusion Bonded Epoxy, coating range from 4” to 48” (101.6 mm to 1219.2 mm).
- Thermal insulation by polypropylene solid, foam and syntactic, coating range from 4” to 24” (101.6 mm to 609.6 mm).
- Concrete for negative buoyancy – Compression, coating range from 4” to 36” (101.6 mm to 914.4 mm).
- Concrete for negative buoyancy – Impingement, coating range from 30” to 40” (762 mm to 1016 mm).

PINDAMONHANGABA, BRAZIL

- Three layer polyethylene or polypropylene, coating range from 4” to 48” (101.6 mm to 1219.2 mm).
- Fusion Bonded Epoxy, coating range from 4” to 48” (101.6 mm to 1219.2 mm).
- Thermal insulation by polypropylene solid, foam and syntactic – Compression, coating range from 4” to 24” (101.6 mm to 609.6 mm).
- Thermal insulation by polyurethane foam, coating range from 2” to 24” (50.8 mm to 609.6 mm).
- Concrete for negative buoyancy – Compression, coating range from 2” to 24” (50.8 mm to 609.6 mm).
- Concrete for negative buoyancy – Impingement, coating range from 12” to 48” (304.8 mm to 1219.2 mm).
- Liquid Paints (flow coat and anticorrosion, water pipeline, sewerage, etc), coating range from 16” to 48” (406.4 mm to 1219.2 mm).

VILLA CONSTITUCIÓN, ARGENTINA

- Three layer polyethylene or polypropylene, coating range from 1.5” to 10” (38.1mm to 254 mm).
- Fusion Bonded Epoxy, coating range from 1.5” to 10” (38.1mm to 254 mm).

Continuous improvements through R&D

Tenaris has a global network of Research and Development (R&D) centers that collaborate with top universities and research institutions worldwide. Our centers are located in Argentina, Brazil, Japan, Italy and Mexico. Tenaris leads its R&D activities on coating solutions from its Argentine center.

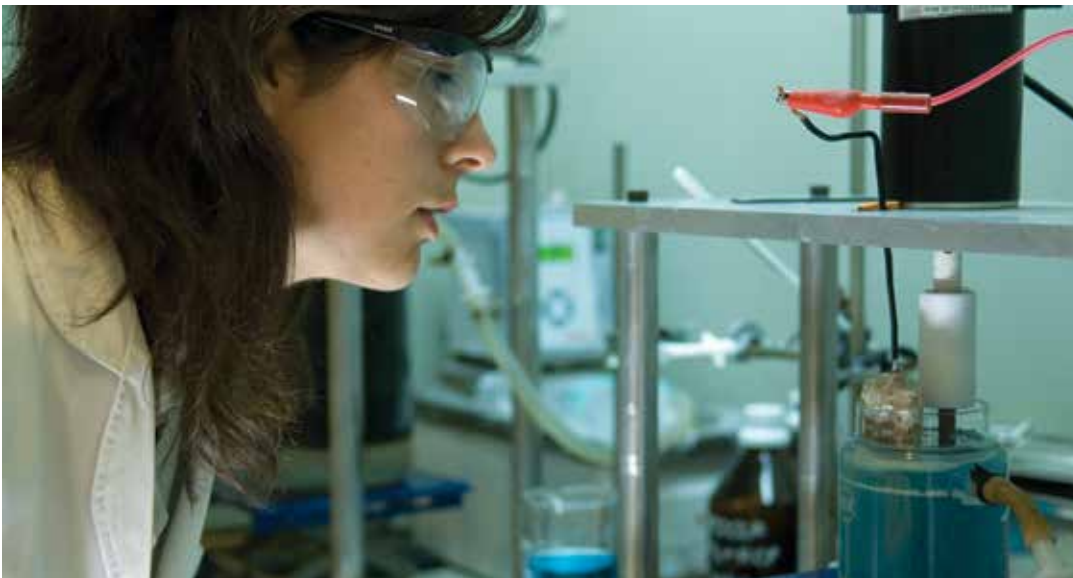
Our pilot plant for coating solutions applies internal and external coatings while Tenaris experts maintain a strict control of the process. Tenaris continuously gathers relevant information about coating processability, application techniques, curing mechanisms and best practices. We also conduct testing, evaluation and characterization of coating systems.

Tenaris's testing and analysis laboratory is committed to the full characterization of the coatings systems regarding chemical properties, chemical resistance and chemical degradation mechanisms; physical properties; mechanical properties and resistance; thermal properties, thermal resistance and thermal degradation; curing mechanisms and ageing processes.

Our state-of-the-art polymer characterization devices provide detailed information on the mechanical and thermal properties of the coatings. In addition, our samples conditioning and coating characterization equipment provide valuable information under simulated service conditions.

We contribute to the generation of knowledge through our R&D activities and our testing and analysis of coating solutions. Tenaris always incorporates the newest technologies and methods to its coating plants.

Our R&D centers offer technical support and testing services to answer any technical question. Tenaris's experts also qualify programs, conduct failure analysis and assist Tenaris coating plants with any requirement.



R&D laboratory in Campana, Argentina.

A history of success

TRACK RECORD MAIN PROJECTS				
PROJECT	END USER	COATING TYPE	COUNTRY	YEAR
ZOHR	IEOC	3LPE	EGYPT	2016
EGINA	TOTAL	FBE, 3LPP, 5LPP	NIGERIA	2014, 2015, 2016
NENE' MARINE	ENI	3LPP, CWC, NEOPRENE, INSULATION	CONGO	2016
SAKHALIN	EXXONMOBIL	3LPP	RUSSIAN FEDERATION	2016
KODIAK	DEEP GULF ENERGY	5LPP	UNITED STATES	2016
SCOLTY	ENQUEST	3LPP	UNITED KINGDOM	2016
WEST QURNA	EXXONMOBIL	3LPP	IRAQ	2016
CORDOBA ARGENTINA PIPELINE	ARGENTINA GOVERNMENT	3LPE	ARGENTINA	2017, 2016
GNEA	ENARSA	3LPE	ARGENTINA	2016, 2015
CLARA-BONACCIA	ENI	3LPP, CWC	ITALY	2015
CATCHER	PREMIER OIL	3LPP	UNITED KINGDOM	2015
SONAM	EXXONMOBIL	FBE, CWC, ANODE AND HOT INDUCTION BENDS COATING	NIGERIA	2015
WESTERN AREA EARLY DEVELOPMENT	KARACHAGANAK	PU	KAZAKHSTAN	2015, 2016
BLOCK 32 – KAOMBO	TOTAL	3LPP, 5LPP	ANGOLA	2015, 2016
GUNFLINT	NOBLE	3LPP, 5LPP, FBE	UNITED STATES	2014, 2015
GOR GAS BALANCING II	KARACHAGANAK	FBE, PU	KAZAKHSTAN	2014, 2015
MOHO NORD	TOTAL	3LPP, 3LPE, 5LPP, PU, CWC	CONGO	2014, 2015
TEN	TULLOW	3LPP	GHANA	2014, 2015
MAFUMEIRA	CHEVRON	3LPP, 3LPE, NEOPRENE	ANGOLA	2013, 2014
OSO-QIT	EXXONMOBIL	FBE, CWC, ANODE COATING	NIGERIA	2013, 2014
ERHA-NORTH PHASE II	EXXONMOBIL	3LPP, 5LPP	NIGERIA	2013, 2014
OFON II	TOTAL	3LPP, CWC, INTERNAL AND ANODE COATING	NIGERIA	2013, 2014
ALDER	CHEVRON	3LPP	UNITED KINGDOM	2014
LITCHENDJILI	ENI	3LPE, CWC, NEOPRENE, PU	CONGO	2014
LIANZI	CHEVRON	3LPE	CONGO	2013, 2014
WDDM PH 9A	BURULLUS	FBE	EGYPT	2013, 2014
BOURI	ENI	3LPP	LIBYA	2013
WHEATSTONE	CHEVRON	3LPE	AUSTRALIA	2013
ROTA 2 CABIUNAS	SAIPEM / PETROBRAS	CWC	BRAZIL	2013
SAS	ADNOC	3LPP, EPOXY, FBE	UNITED ARAB EMIRATES	2010, 2011, 2012
GUARA-LULA	PETROBRAS	5LPP	BRAZIL	2012
CASCADE & CHINOOK	PETROBRAS	FBE 3LPP	UNITED STATES	2008, 2009, 2012
WEST DELTA DEEP MARINE	BURULLUS	FBE	EGYPT	2010, 2011, 2012
GOLDEN EAGLE	NEXEN	3LPP	UNITED KINGDOM	2012
YOLOTEN	PETROFAC	3LPP	TURKMENISTAN	2012
SEALINE DP6-PP	ENI	CWC	CONGO	2012
JACK & ST MALO	CHEVRON	FBE, 3LPP, NEOPRENE	UNITED STATES	2011, 2012
LUCIUS	ANADARKO	FBE	UNITED STATES	2012
GORGON	CHEVRON	3LPP, SANDBLASTED, INCONEL 625	AUSTRALIA	2011

3LPP: Three-layer polypropylene, 3LPE: Three-layer polyethylene, 5LPP: Multi-layer polypropylene, FBE: Fusion Bonded Epoxy, CWC: Concrete Weight Coating, PU: Polyurethane



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