Tubular construction solutions for structural applications

Tenaris

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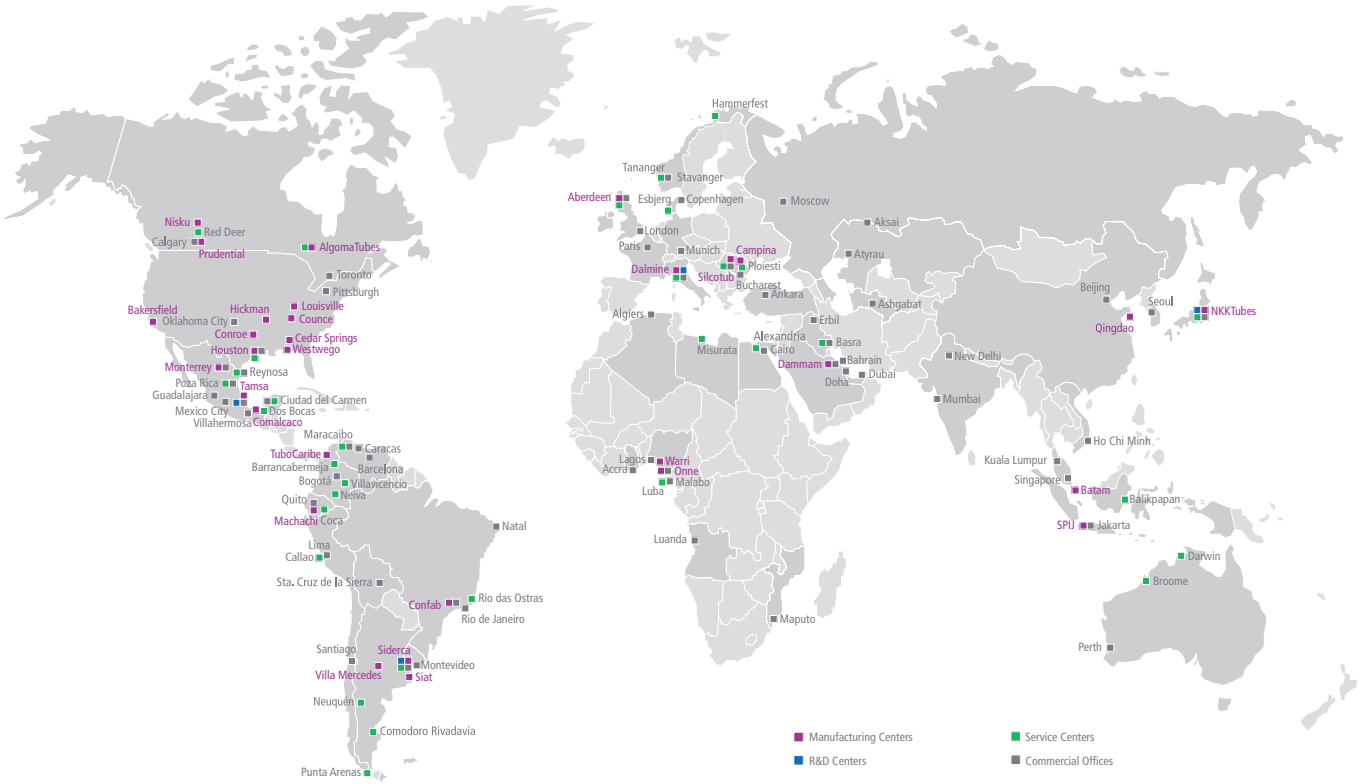
Tenaris is the leading global manufacturer and supplier of tubular products and services used in the drilling, completion and production of oil and gas and a leading supplier of tubular products and services used in process and power plants and in specialized industrial and automotive applications.

Through our integrated global network of manufacturing, R&D and service facilities, we are working with our customers to meet their needs for the timely supply of high performance products in increasingly complex operating environments. Tenaris has annual revenues of US$10.8 billion and 26,500 employees worldwide.



Tenaris tubular construction solutions

Tenaris produces a large range of dimensions in tubular structural hollow sections, in different steel grades, for use in construction.
Tenaris structural tubes have applications in civil structures including stadiums, bridges, airports and industrial structures such as hangars, commercial buildings, industrial units.

Due to excellent mechanical characteristics, very good weldability and geometric tolerances, steel tube for engineering applications are ideal for those types of constructions where light weight, high load-bearing structures with a contained overall weight are required.

Steel in construction

Aesthetic Value & Experimentation

Modern architecture around the world is full of examples showing how steel has been used to realize architectural projects that give pleasing aesthetic results, where the impression of “lightness”, typical of steel structures, is fundamental.
The resistance properties, compression, traction and buckling capacity of steel, combined with the use of various materials, allow for almost limitless forms, colours, uses and sizes, making the grandest design ideas possible. Celebrated international architects like Norman Foster, Massimiliano Fuksas and Santiago Calatrava make use of steel to produce structures with great architectural impact.

Eco-sustainable design

Every year around the world 435 million tons of steel is globally recycled, representing about half of the total steel used.
Steel can be reused many times without losing its properties, thereby avoiding the dumping of scrap in the environment.
The use of steel, along with glass, favours natural lighting and heating, helping to keep down energy costs.

Synergy with other materials

Steel can be used alongside a wide selection of materials, such as glass, wood, aluminium and concrete. Thanks to these mixed structures the various features of these materials can be exploited, producing a wide variety of architecture.

Building lightness

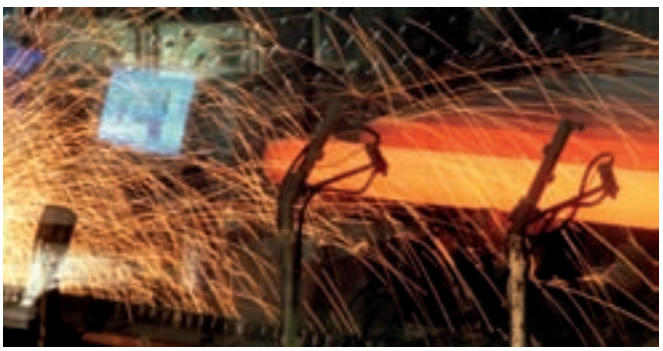
Using high strength steel in construction permits an elevated load capacity and height, producing outstanding light structures.

Fast planning and assembly

Thanks to the use of innovative design technology, like CAD/CAM, structures can be designed with extreme accuracy and relative speed, improving the time taken to execute a project. Industrial prefabrication makes for easy, quick assembly on the building site.

Greater seismic resistance

Steel frames possess greater ductility and can bear severe deformation without compromising the integrity of the structure.
Many examples in the past have demonstrated how superior a steel frame is with respect to one of reinforced concrete, due to the capacity of steel to absorb and discharge seismic waves.



Research activities

Tenaris is responsible for developing and testing the tubular materials used in many of the world's most advanced oil and gas exploration, production and processing activities and in specialized mechanical applications. In our research, we explore the boundaries of material science and mechanical design to develop products to help our customers meet their needs.
Tenaris conducts ongoing research in the following areas:

- Advanced metallurgy
- Advanced computer modelling of processes and products
- Fracture mechanics and structural integrity
- Full-scale testing of tubular products and premium connections
- Advanced corrosion testing
- Nanotechnology
- Advanced non-destructive testing techniques and optical measurement devices
- Welding metallurgy and technology

Tenaris has a worldwide research and development network that employees around 200 scientists and engineers, more than half of whom have a master or doctorate degree.

Worldwide Centers for Product Research and Development

Tenaris Research and Development center, Veracruz, Mexico
Research work is centered on the advancement of innovative welding technology and the qualification of premium connections, as well as improving metallurgy and materials, process development, and fracture mechanics studies.

Tenaris Research and Development center, Kawasaki, Japan
The Kawasaki center specializes in high-chromium steel tubular products (i.e., Cr13 steel grade) for thermal applications.

Tenaris Research and Development center, Campana, Argentina
Research at the Argentina center covers both products and processes. In terms of processes, researchers focus on steel making innovations, rolling, heat treatment, non-destructive testing and the tracking of tubular products.

Tenaris Research and Development center, Dalmine, Italy
Research at this facility mainly focuses on two areas: hot rolling processes and product development for mechanical, structural and thermal applications.

The center conducts its own independent research and also collaborates with external research institutes on either extensive basic or highly specialized areas of research.

Collaboration with external institutes

Tenaris actively works with recognized Italian research institutes and academic bodies, including Politecnico of Milan, University of Trento and the "Centro Sviluppo Materiali (CSM)" in Rome, on research projects related to weldability and fatigue characterization.

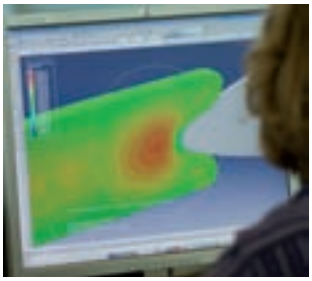
One of the most recent projects Tenaris has been participating in providing high strength steel TS 690 (on a proprietary specification) material for testings is the ATTEL project in collaboration with the University of Trento. It is a EU funded research, aimed to explore the use of high strength steel (HSS) circular hollow sections in buildings subject to earthquakes and fires, in order to understand the actual behaviour of HSS materials and to show the possible benefits with respect to mild steel.

Advanced research on fire resistant steel

As use of steel becomes critical when used in territories subject to earthquake and fire, Tenaris has been setting up an extensive research program to set up a steel grade with enhanced fire-resistance properties. Leveraging on the experience gained in the oil&gas and power generation sectors where products are able to withstand high pressures and temperatures, Tenaris carried out steel chemical characterization of its material.

Weldability

In our R&D centers in Argentina, Mexico and Italy and in collaboration with the IIS (Italian Welding Institute), we are carrying out a joint program for the qualification of welding procedures for high strength structural steels and investigation on the effect of the welding parameters on the characteristics of the heat affected zone.
As a result, Tenaris has developed special steels and manufacturing process for each grade and tube dimension range, avoiding increasing cost in alloying elements that can have also a negative effect in weldability, due to an increase in carbon equivalent.



Design support

Tenaris supply not just high quality tubes but also specialized consulting services, both in the design stage and in project development.
Our collaboration with well-known planning firms provides invaluable advice concerning in particular assembly, connections and cost optimization.

An elliptical profile

For the realization of the grand "sail" steel and glass façade of the New Hospital in Mestre, an Italian innovative healthcare structure, designed by Alberto Altieri and Emilio Ambasz, Tenaris transformed its circular sections into elliptical ones to obtain inclined columns. Tenaris tubes showed excellent reliability to cold deformation as well as high impact strength and homogeneous mechanical characteristics - thanks to heat treatment - which allowed for a smooth welding and no particular deformation of the profile.Tenaris also designed optimal lengths, testing the entire consignment and was an active interface for all the most critical aspects of assemblage. Furthermore, it recommended the optimum use for the test and final materials.

A special threaded joint for canopy roof

At its mill in Japan, NKKTubes, Tenaris developed a special threaded joint that was used to connect the tubular elements of the canopy roof of a sporting center, the Kumagaya Dome, in the Saitama prefecture.

Lombardy Region: collaborating since an early stage

For the realization of the spatial gridded roof, an impressive structure at 30 meters high, over the square of the new 190.000 sqm headquarters of the Lombardy Regional Council, better known as Palazzo Lombardia, designed by the New York studio Pei Cobb Freed & Partners, in cooperation with Caputo Partnership and Sistema Duemila, Tenaris cooperated in all the project phases, providing seamless pipes in S355J2H steel, which complies to the EN 10210 European standard for tubular construction elements.

Recycling steel and engineering consultancy the bridge on the Po river

Besides supplying the steel tubular sections for the reconstruction of the spatial metal girder of the of 1.1 km long and 9.5 meters wide bridge (a very advanced structure with respect to even the most modern anti-seism criteria and safety requirements in the case of spate), Tenaris also supplied additional services, such as galvanising – to prevent corrosion – and machining the ends of

the pipes delivering to the site ready for installation.
It was also an innovative project for its environmental aspects, because it was one of the first constructions to calculate the CO_2 emissions. Tenaris worked directly to recover and reuse the previous steel girders, melting the steel in its steel shop in Italy.

Certified Quality and Sustainability

Profiles are produced in an extensive dimensional range and various steel grades according to EN/ASTM/CSA/JIS and other international standards.
Tenaris, in its European plants is able to apply the CE mark to the documentation accompanying its tubular products destined for structural applications.
The CE mark, a guarantee of quality and reliability, attests the conformity of product, including the metallurgical characteristics and production processes, described in the European harmonized norms UNI EN 10210-1 or UNI EN 10219-1.

Tenaris's production site and its power plant in Italy hold the UNI CEI EN 16001:2009 certification from Lloyd's Register Quality Assurance, this certificate is a very innovative standard applied to medium and large companies recording significant energy consumption levels. It confirms that certified companies have a management system designed to safeguard energy, reduce consumption, and thus, minimize environmental impact.
This plant is the world's first tube manufacturer to obtain this certification and the fourth company in Italy.

In addition, Tenaris's steel sites use mostly scrap as raw material. More than 80% of Tenaris total metallic charge is recycled, helping in the LEED design requirements. Steel used in a building can therefore be recovered, melt and re-used as scrap for a new production cycle.
Tenaris commitment to ISO 14020 and 14040 environmental management series standards is witnessed by the continuous effort to work in compliace with EPD (Environmental Product Declaration) and LCA (Life Cycle Assessment).

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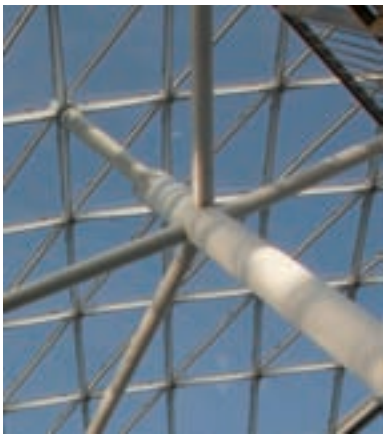
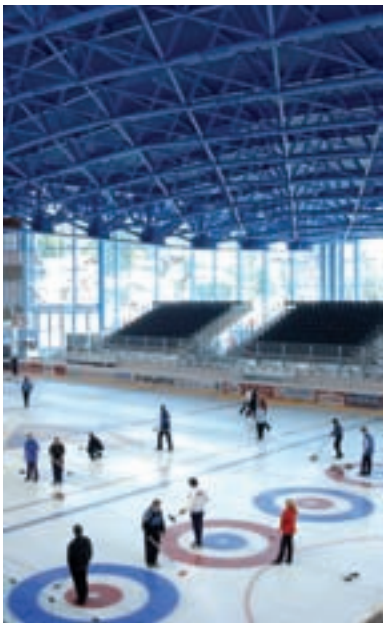
Exhibition center Milan Rho, Italy
Structural hollow section to support the "Vela"



Ponte S. Michele all'Adige, Trento, Italy
Tubular arch structure support

Volos Stadium, Athene, Greece / Canopy roof



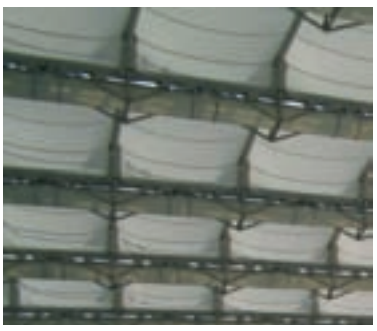
Olympic Stadium Cortina D'Ampezzo, Italy / Canopy roof

International airport Pistarini, Terminal A , Buenos Aires, Argentina / Canopy roof

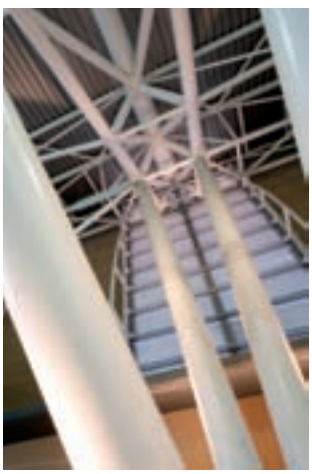
Olympic Stadium Spyros Louis, Athene, Greece / Canopy roof

Carrasco International Airport, Montevideo, Uruguay / Supporting structure
for roof and glass façade

Oval Indoor Stadium, Turin, Italy
Bow string truss and supporting structure

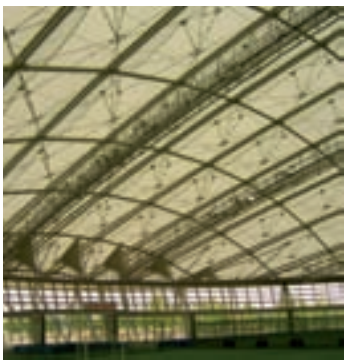


Olympic stadium, Rome, Italy / Canopy roof



Fiumicino airport, railway terminal, Rome, Italy
Circular hollow sections to support the railway

Palazzo Lombardia, Milan, Italy / Canopy roof



Kumagaya Dome, Saitama, Japan / Roofing structure

Bridge on the Po river, Piacenza, Italy / Tubular steel supporting the bridge

Hospital in Mestre, Venice, Italy / Tubular structure for the "Sail"

Museum of Modern and Contemporary Art of Trento and Rovereto, Italy / Structure to support the roof

Bocconi University, Milan, Italy / Steel structure to support the roof

PROJECTS REFERENCE LIST

	Application	Standard	Grade	Principal Sizes	Quantity	Steel Constructor	Architectural Design	Structural Design	Project Organizer	Project Closure
Museum of Modern and Contemporary Art of Trento and Rovereto – Rovereto, Italy	Structure to support the roof	UNI 7806/7807	Fe 510	168x10,12 219x16		BIT S.p.A.	Mario Botta and Giulio Andreolli	Contec Ingegneria	Provincia Autonoma di Trento	2002
Kumagaya Dome – Saitama, Japan	Roofing Structure	Japanese Standards Association	JIS-STKN490B JIS-STK490-FR	350x35, 350x30, 350x25	1100 tons			JV Special Construction Work	Prefecture of Saitama	2003
Terminal "A" Pistarini International Airport – Buenos Aires, Argentina	Canopy roof	ASTM	A618 Grade Ia	152.4x4.5, 273x12.7, 101.6x4	400 tons	DIN S.A. (Estructuras Metalicas DIN)	Manteola, Sanchez Gomez, Santos, Solsona, Sallaberry y asociados		City of Buenos Aires	2003
Panthessaliko Stadium – Volos, Greece	Canopy roof	DIN 17124 D86 EN 10210	HSS TN690	457x20, 267x25, 219x36, 177.8x8, 168.3x20	700 tons	Intramet	Hasapis Sargentis associates		Olimpic Real Estate S.A.	2004
Spyros Louis Olympic Stadium – Athens, Greece	Canopy roof	EN 10210	S 355 J2H	273x12.5, 273x16, 273x20, 298x16, 406x10, 406x12.5, 406x20, 406x25, 406x30, 457x12.5, 457x20, 457x30, 558x10, 558x20 RHS 180x180x12.5	1500 tons	Costruzioni Cimolai Armando S.p.A.	Studio Zoppini Associati and HOK Sport	Santiago Calatrava	General Secretariat of Sports (GSS)	2004
New Exhibition Center – Milan, Italyt	Structure to support the "vela"	UNI 7806	Fe 510 D	508x20, 508x25, 273x20	1.000 tons	Mero Italiana S.p.A.	Massimiliano Fuksas	Marzullo srl	Fondazione Fiera Milano	2005
Oval indoor Stadium – Turin, Italy	Bow-string truss and supporting structure	EN 10210, UNI7807	S 355 J2H Fe 510 D	168x18, 244.5x16, 273x12, 406x18, 508x20, 508x30, 609x25	900 tons	Costruzioni Cimolai Armando S.p.A.	Santiago Calatrava	Buro Happold ltd	Agenzia Torino 2006	2006
Sport City Tower – Doha, Qatar	Petal shape metallic structure					Costruzioni Cimolai Armando S.p.A.	Hadi Simaan - AREP	Ove ARUP	Doha City - Asian Olympic games 2006	2006
Hospital in Mestre – Venice, Italy	Tubular structure for the "sail" façade in steel and glass	EN 10210	S355 J2H	406.4x10, 12.5, 16, 20, 25		OCAM	Emilio Ambasz	Studio Altieri	ASL 12	2007
Commercial University Luigi Bocconi – Milano, Italy	Structure with steel post tensioned elements		S355 J2H	127x30, 90x21, 168x30	350 tons		Grafton Architects	Procom		2008
Carrasco International Airport - Montevideo, Uruguay	Supporting structure for roof and glass facade	API	X-42, X-60		700 tons	Cinter	Rafael Viñoly	Thornton & Tomasetti	Municipality of Montevideo	2009
Ponte ciclopedonale S.Michele all'Adige Trento, Italy	Tubolar arch structure support	--	S460 NH	711x22	100 tons	CMM F.lli Rizzi	Ing. Alfonso Dalla Torre	Ing. Alfonso Dalla Torre	Provincia Autonoma di Trento - Comune San Michele all'Adige	2009
Palazzo Lombardia, Piazza delle Città Lombarde – Milan, Italy	Spatial gridded roof over the square	EN 10210	S355 J2H	355.6x12.5, 16, 20	380 tons	Vega Engineering - OCML	Pei Cobb Freed & Partners, Studio Caputo, Sistema Duemila	F. Mola – Politecnico of Milan	Infrastrutture Lombarde	2010
Bridge on the Po river – Piacenza, Italy	Tubular steel structure supporting the bridge	EN 10210	S355 J2H	323x22, 28	1200 tons	S.C.L. Costruzioni e Montaggi	MCA Engineering	MCA Engineering	ANAS	2010
King Fahad National Library – Riyadh, Saudi Arabia	Tubular steel supporting structure	EN 10210	S355 J2H	559x40, 508x30, 406x40, 178x36	800 tons	Tamimi Group	Gerber Architekten	B+G Ingenieure Bollinger und Grohmann	Riyadh Development Authority	2010
La Canopèe, Paris, France	Roofing tubolar structure	--	S460 NH	508x12,5 - 14,2x15 711x15 - 22	420 tons	Viry - FAYAT Group	Patrick Berger & Jacques Anziutti Architects	Patrick Berger & Jacques Anziutti Architects	Municipality of Paris - Les Halles	Work in progress

Photo Credits

"Olympic Stadium Cortina" courtesy of Municipality

"Panthessaliko Stadium" courtesy of Gaumy - Magnum Photos

"Hospital in Mestre" courtesy of Ocam srl, Studio Altieri, Davide Dolcini

"Oval Indoor Stadium" courtesy of Claudio Agnese, Daniele Badolato - Ageniza Turin 2006

"Spyros Louis Olympic Stadium" courtesy od Cimolai

"Fiumicino Airport" courtesy of ADR Architetti

"Modern and Contemporary Art of Trento and Rovereto" courtesy of MART

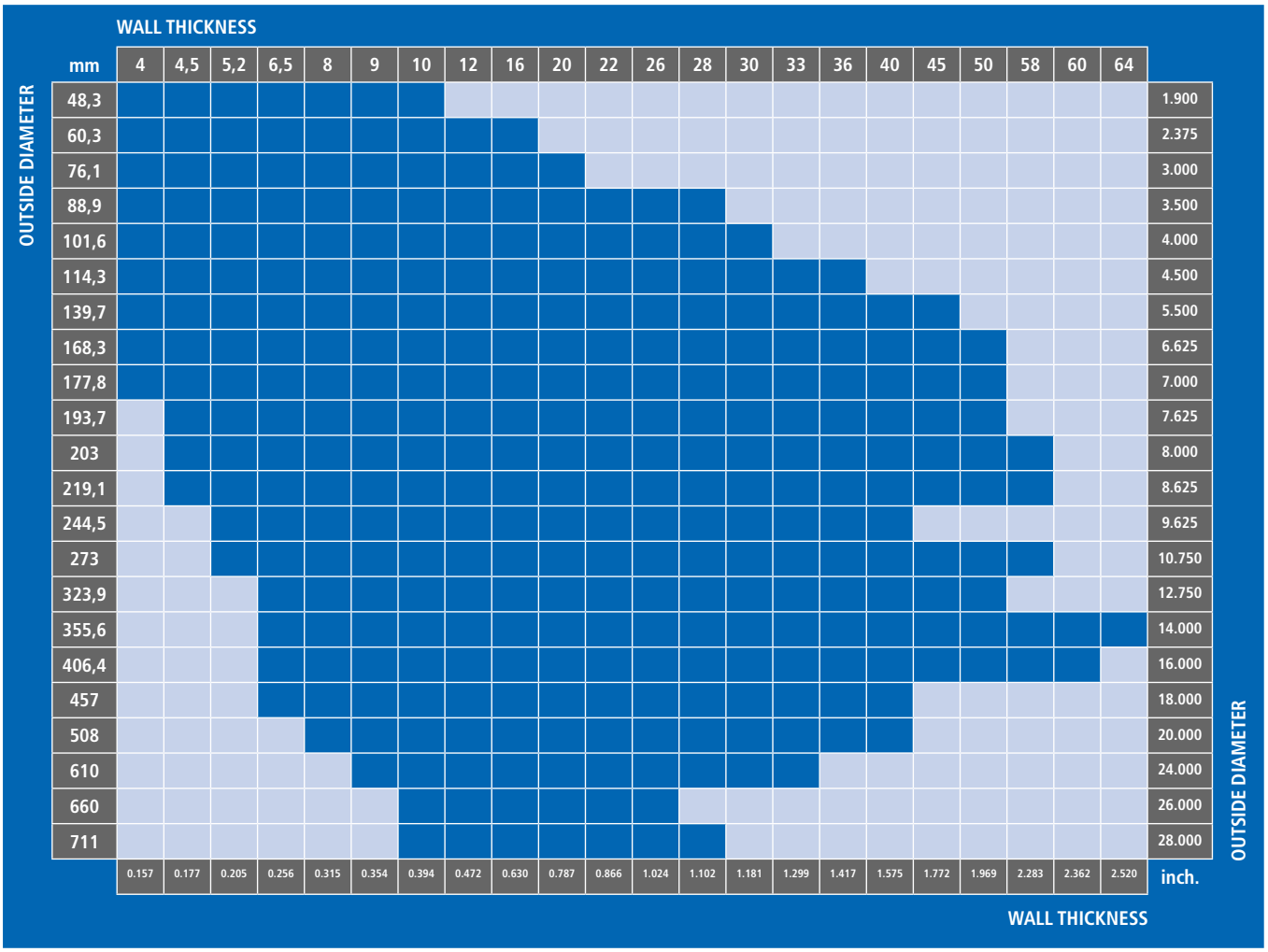
COMPARISON OF EN 10210 (EU) VS. ASTM A500 , A618/A 618M (USA) & CSA G40.21 (CANADA)

STANDARD	EN 10210	ASTM A500	ASTM A618/A 618M	CSA G40.21
Grade	S355J0H/J2H/K2H	C	II	50W
Analysis % (max)	C 0,22	C 0,23	C 0,22	C 0,23
	Mn 1,60	Mn 1,35	Mn 0,85 -1,35	Mn 1,35
Yeld Strength Min (MPA)	355	317	345	345
Tensile Strength Min (MPA)	510	427	485	450
Elongation Min % in 2"	22	21	22	22
Impact test Min	J0H at 0°C = 27J	N.A	N.A	N.A
	J2H at -20°C = 27J	N.A	N.A	N.A
	K2H at -20°C = 40J	N.A	N.A	N.A

EN 10210 – (Europe)	Hot finished structural hollow sections of non -alloy and fine grain steels
ASTM A500 – (USA)	Cold -Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A618/A618 M – (USA)	Hot -Formed Welded and Seamless High-Strength Low -Alloy Structural Tubing
CSA G40.21 – (CANADA)	Rolled or Welded Structural Quality Steel

Dimensions

DIMENSIONS



Other dimension not shown can be produced on request. According to EN 10210-2

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For additional information, please visit
www.tenaris.com

For technical assistance, please contact
civilconstruction@tenaris.com

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