Innovative tubular solutions for Innovating Nuclear technologies from your Nuclear Partner.

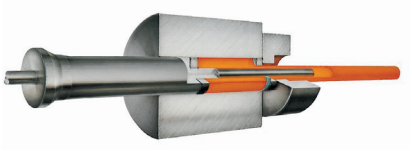
When supplying high specification seamless stainless & nickel alloy tubes and pipes to meet the needs of the global Nuclear power industry it's a 'given' that our experience and qualification demonstrates and gives our Customers complete assurance in our performance. But as today's Nuclear technologies evolve and we embrace the positive and sustainable place of Nuclear in our future energy mix it's essential that we also bring our Nuclear Customers and partners the innovation and flexibility they depend upon to meet tomorrow's standards.

By the Nuclear team, Mannesmann Stainless Tubes

Adapting manufacturing technologies to changing markets and Customer expectations is a key focus for the team at MST.

Fundamental to the innovation we bring to our Customers is the integration and control of the complete manufacturing process.

Hot Extrusion:



We utilize two extrusion presses within our facilities:

- Remscheid, Germany - from 44.5 to 122 mm Outside Diameter and
- Montbard, France – from 33.4 to 280 mm Outside Diameter

Hot Extrusion is a key determinate process in the structure, quality, mechanical properties and ultimately length of a seamless stainless steel or Nickel alloy tube or pipe.

Supporting the need for longer tube lengths, in both hot and cold finished products, the extrusion press located in Montbard, France has recently been upgraded. This press upgrade enabled an increase in ultimate extrusion force to 4300 tons but additionally to increase the maximum admissible billet diameter and length.

The production process by extrusion of heavy mechanical tubes and pipes has its challenges but the production of longer tubes and pipes creates different types of constraints and challenges. Due to the higher extrusion ratios, the glass powder lubrication system has been optimised to guarantee the soundness of the products. The increased billet length necessitates that the time needed for processing shall be controlled in order to obtain the metallurgical properties of the material, allowing optimized corrosion behavior with regard to the selected chemistry. The final properties and the dimensional characteristics such as straightness, roundness and eccentricity limits must be maintained along the complete length. All these facts need to be considered and consistently controlled.

From the important starting point of the hot extrusion we have a product that can either go through the finishing process as a hot finished product or be used as a mother tube or "hollow" – which forms the starting point for the cold manufacturing process.

Cold Production:

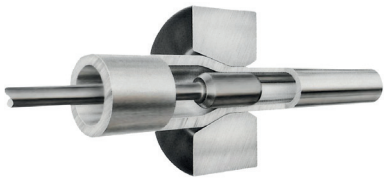
The two technologies we use are:

- Cold Pilgering: maximum 280 mm (11.024") Outside Diameter, at our Remscheid, Germany facility, for Nuclear applications typically associated with piping systems or mechanical tube (hollow bar) – bringing our Customers the benefit of the latest and one of the largest cold pilger mills in the world.
- Cold Pilgering, for applications typically up to 88.9 mm (3.5") Outside Diameter, from our

Costa Volpino, Italy facility for applications associated with Heat Exchanger, Instrumentation tubing and special profiles.

- Cold Pilgering is also used within our Houston, US facility from 6.35 mm (1/4”) to 101.6 mm (4”) Outside Diameter.

- Cold Drawing, from 1.6 mm (1/16”) Outside Diameter, from our Issoudun, France facility; with many In Core related applications.



Production of tubes at our Issoudun, France facility is focused on cold drawing technology which allows thin wall tolerance control down to +/-0.02 mm with tube diameters as small as 1.6 mm and lengths up to 43 m (141 ft) in straight length with serpentine coils being an alternative form of supply.

The cold drawing process utilizes hollows from the extrusion or cold pilgering process and reduces these to the required dimensional size in a number of draw passes. In the context of handling long tubes the manufacturing steps of drawing, degreasing, annealing, testing and final inspection all had processes specifically developed to take into consideration the length of the product.

Quality:

Nuclear standards: Nuclear pedigree. Our Quality system accreditations and extensive Customer references demonstrate our proven capabilities across the global Nuclear industry.

From the control of our raw materials to final inspection, certification and shipment we apply the highest standards of product integrity, process control combined with the Mannesmann reassurance of product originality:

- ASME III certified
- HAF 604- NNSA certified
- RCC-M compliant
- Label Fournisseur AREVA (Framatome)
- ISO 19443
- Extensive customer and design code accreditations

Our nuclear quality system approvals reflect our experience and commitment to global nuclear technologies.

Product Innovation:

From our historical development of PWR power generation for the French (RCC-M) and US (ASME III) programs our knowledge and skills have developed across the global technologies: CANDU, VVER Rosatom, China CPR’s and India PHWR’s.

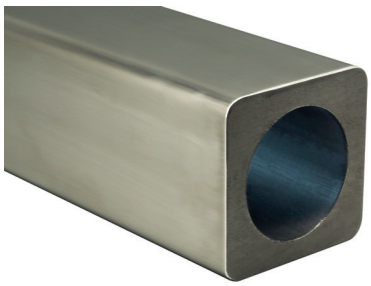
Applying our skills to the latest generation of EPR power plants whilst partnering with developing technologies and sciences such as CERN, ITER, Small Modular Reactors, and marine vessels.

With design engineers looking to optimise product performance in environments with temperatures simulating that of the sun or approaching zero kelvin whilst supporting the need for properties such as being superconductive or non-magnetic whilst retaining the essentials of mechanical and physical performance the need for a ‘partner’ from concept to delivery is essential.

Some of our recent major partnerships include:

- ITER:

35 nations collaborating to build the world’s largest tokamak, a magnetic fusion device designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy based on the same principle that powers our sun and stars.

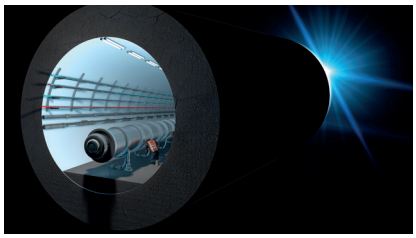


ITER is designed to produce a ten-fold return on energy (Q=10), or 500 MW of fusion power from 50 MW of input heating power.

We are proud to have developed a unique tube profile in modified 316L for the superconducting magnet system of Poloidal Field (PF) coils in addition to providing nuclear specification circular tubes on the Toroidal Field (TF) coils.

- CERN:

100 m below the earth’s surface of Geneva, a tunnel, 27 km long and more than nine times the weight of the Eiffel Tower, contains elementary particles, so called Hadrons, which are being accelerated to up to 99% of the speed of light – and subsequently destroyed.Its name: LHC – the Large Hadron Collider.



We are a part of it – and a very important one, providing unique specification tubes in DMV 316LN. These are the tubes where the actual collisions take place.

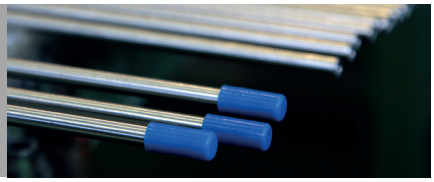
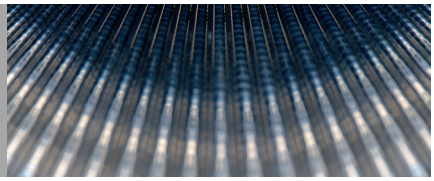
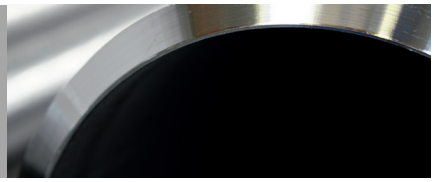
Our products couldn’t be any closer to the action.

Product Forms:

Our Product forms complement our round tube & pipes with profiles, serpentine coils, cutting and machining to form products to unique customer requirements.



Product & Applications:

Class 1, 2 & 3 Instrumentation tubes according to RCC-M, ASME III, CSA N285 and HAF 604 standards.	**Dimensions:** 6 mm (1/4") to 25 mm (1") outside diameter.	
In Core applications: RCCA, Guide Thimble tubes, Neutron flux distribution, thermocouples.	**Dimensions:** Outside diameter from 1.6 mm (1/16") in straight or coiled forms to 280 mm (11.02").	
Heat Exchanger tubes used for critical components within the Nuclear Island in the primary and secondary circuits (class 1 and class 2).	**Dimensions:** 12.7 mm (1/2") to 50.8 mm (2") outside diameter, straight lengths or U-tube form up to 43 m (141 ft) long.	
Nuclear pipes for Class 1,2 & 3 Piping for Nuclear steam supply systems and non-nuclear island applications such as Nuclear fuel reprocessing.	**Dimensions:** 6 mm (¼") to 280 mm (11.02") outside diameter.	

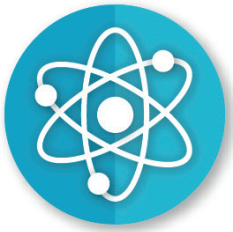
Global Manufacturing - Local Service:

Bringing together the skills and talents in our manufacturing facilities in France, USA, Germany and Italy to provide the optimum solution.

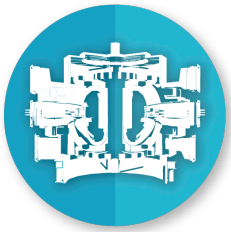
With over 50 years of history partnering with our global Nuclear Customers the 'next generation of Nuclear technologies brings with it both the opportunity but yet the expectation for innovation and adaptability in the Supply Chain – something the Nuclear team at MST is fully positioned to meet.

LWR/PHWR

SMR



FISSION



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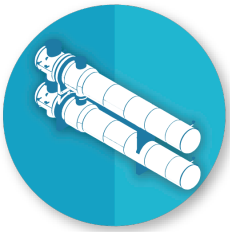
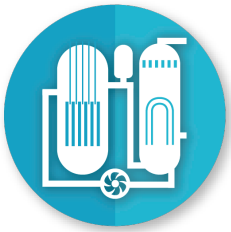
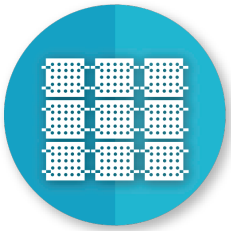


U TUBES

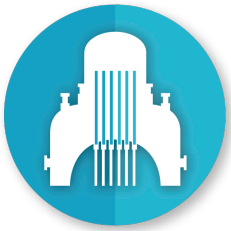


NUCLEAR STEAM
SUPPLY SYSTEM



FUEL REPROCESSING

U TUBES



INSTRUMENTATION
& CONTROL

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