

ENERGY

High Precision Tubing Solutions
for Demanding Power Applications

NUCLEAR • CONVENTIONAL • SOLAR

HIGH PRECISION TUBES FOR DEMANDING ENVIRONMENTS

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TUBING EXCELLENCE

With over 70 years of engineering expertise in supplying high precision tubes, Superior Tube and Fine Tubes work closely with customers worldwide, developing high-specification tubing solutions to help them solve their technical challenges. We manufacture high-performance tubes in an ever-expanding range of stainless steel, nickel, titanium and zirconium alloys for supercritical and ultra-supercritical nuclear, thermal and solar power applications.

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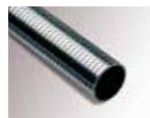
TUBING INNOVATIONS

Fine Tubes and Superior Tube benefit from a world-class reputation for innovative and high-quality tubing solutions geared towards the power industry. Here are a few examples:



1940

Superior Tube supplies tubing for the Manhattan Project, where mankind first learned to control the energy of the atom.



1970

Fine Tubes develops 20-25Nb nuclear fuel cladding and supplies for the UK's first generation of Advanced Gas Reactors.



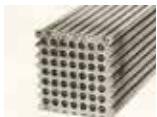
1954

Superior Tube manufactures zirconium reactor tubes for the first nuclear-powered submarine, the USS Nautilus.



2000

The Tennessee Valley Authority's Watts Bar nuclear reactor facility uses Zirconium Zr4 tubing from Superior Tube.



1957

Superior Tube supplies cladding to Shippingport Atomic Power Station, the first plant to produce electricity for a civilian population.



2008

Fine Tubes supplies CERN with cooling tubes for the Large Hadron Collider experiment.



1960

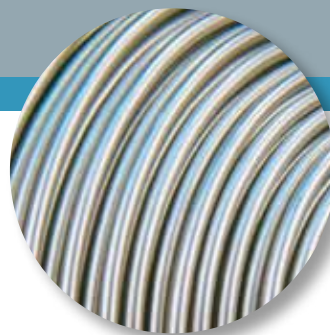
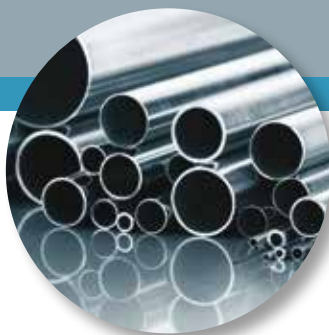
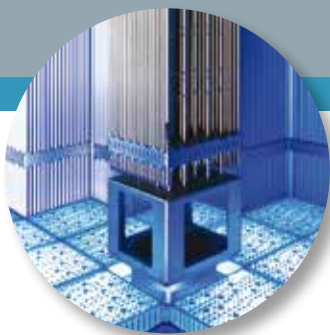
Superior Tube produces fuel cladding for Argonne National Laboratory's Experimental Breeder Reactor-II.



2012

Fine Tubes manufactures high-performance tubing for the Gemasolar thermosolar plant in Spain.

TUBING INNOVATIONS



TUBING SOLUTIONS

NUCLEAR POWER

Our involvement with the nuclear industry goes back as far as the 1930s. Since then, Superior Tube and Fine Tubes have been developing and supplying high-quality tubing solutions for in-core reactor components, where tubing is critical to the safe operation of nuclear reactors that have to withstand extreme temperatures, pressures and radiation.

From developing tubing solutions to be used as fuel cans for the U.K's AGR program, we have continued to evolve our product range in support of PWR, PHWR, LWR, BWR and FBR reactor technologies.

Fine Tubes and Superior Tube have worked closely with the world's prominent nuclear reactor suppliers to develop tubular solutions for both new builds and maintenance projects globally, including the United Kingdom, United States, Canada, France, India and China.

NUCLEAR APPLICATIONS:

- Control and Instrumentation
- Control Rod Drive Mechanism
- Fuel Rods or Cladding Tubes
- Flux Thimble Guide Tubes
- Heat Exchangers
- Steam Generators
- Turbine Island Condensers

THERMAL POWER

Superior Tube and Fine Tubes supply hollow conductors or cooling tubes for water-cooled or helium/hydrogen-cooled turbine generators used in 660 MW or above supercritical thermal power plants, as well as 1000 MW or above ultra-supercritical coal-fired power plants.

As leading tube manufacturers, we also have the capability to supply welded or welded & redrawn tubes for low-pressure and high-pressure heaters manufactured in our fully automated multi mill.

THERMAL APPLICATIONS:

- Control and Instrumentation
- Steam Turbine Generators
- Super Heaters
- Condensers

SOLAR POWER

Fine Tubes and Superior Tube manufacture tubing solutions for use in CSP (Concentrated Solar Power) technology in solar tower or solar thermal power plants.

Our expertise in processing exotic alloys for high-performance tubing satisfied the need of mission-critical heat exchangers at the heart of the solar process of Gemasolar, the award-winning commercial solar power plant near Seville in Spain. In collaboration with SENER, we have developed and produced the corrosion-resistant heating exchanger tubes for the steam generators as well as the high-performance tubing that make up the receiver of the Gemasolar central tower containing molten salt.

SOLAR APPLICATIONS:

- Control and Instrumentation
- Heat Collectors
- Heat Exchangers
- Super Heaters
- Condensers

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MANUFACTURING CAPABILITIES

ALLOYS

Fine Tubes and Superior Tube produce a wide range of custom-sized tubing in an ever expanding range of alloys – available in three different forms, i.e. seamless, welded or welded & redrawn (Weldrawn®) finish.

SEAMLESS, WELDED, WELDED & REDRAWN

Stainless Steel 303Se, 304, 304L, 316, 316L, Vacuum Melted 316L, 321 and 347
Duplex S31803, Super Duplex S32750 and S32760

Nickel 200, 201, 211, 230, Monel 400, 600, 625, 690, 718, 750, 800, 825

SEAMLESS ONLY

Titanium Ti CP (Grade2)

Zirconium Zircaloy2, Zircaloy4

We also manufacture tubing in many other grades. Please contact us for more details.

SUPPLIED FORMS

Straight lengths: Maximum 65 ft (20 m)

Coils: Up to 200 lb (100 kg) or up to 32,808 ft (10,000 m) length with orbital joints

Forms: Straight or 'U' bent

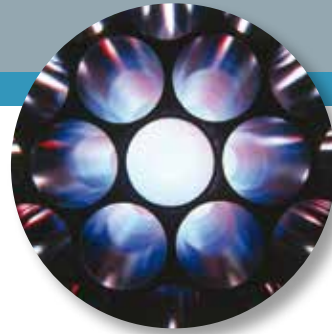
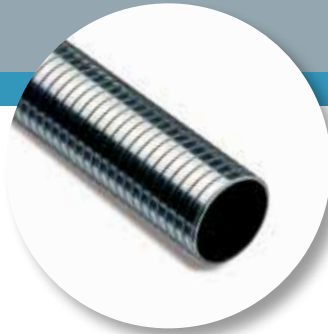
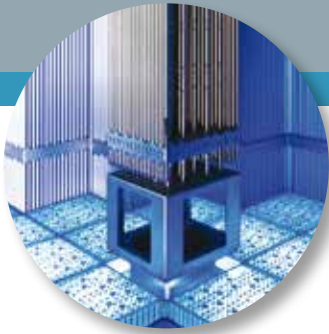
Surface Finish: 16 micro inch Ra (ID 0.4 micron Ra) (as drawn)
4 micro inch Ra (ID 0.1 micron Ra) (electropolished)

The exceptional performance of our high-performance tubing is a reflection of our years of experience with specialty alloys and our state-of-the-art manufacturing processes. Each manufacturing run is custom designed, precision fabricated and finished to exacting specifications.

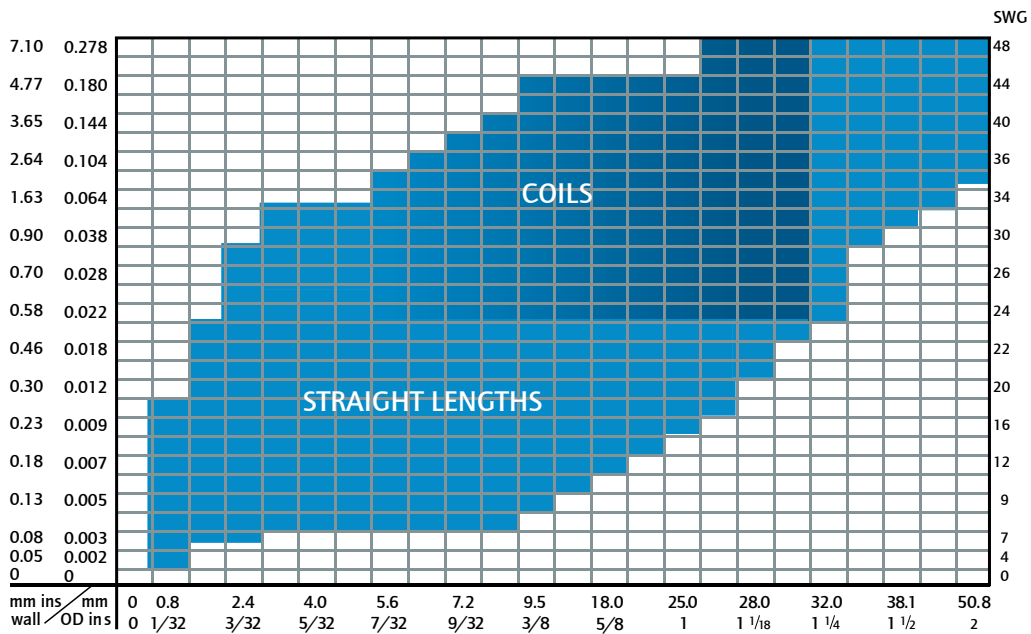
PRODUCTION FACILITIES

- Pilger mills
- Multi-roll rolling mills
- Draw benches
- Tube welding mills - In-line weld mills
- Controlled atmosphere heat treatment
- Bright annealing/hydrogen furnace
- Vacuum annealing
- Pickling & passivation plant
- NDT ultrasonic & eddy current testing
- Hydrostatic testing
- Radiographic examination
- Electropolishing capabilities
- Full chemical and physical laboratory analysis

MANUFACTURING CAPABILITIES



SIZE RANGE



Tubing sizes typical for power applications range from 0.1181 in (3 mm) to 2 in (50.8 mm) OD in seamless, welded, welded & redrawn. Other sizes are available on request, starting from 0.0098 in (0.25 mm) OD.

TUBING QUALITY

TUBING QUALITY

- RCC-M
- Nadcap (Heat Treatment)
- Nadcap (NDT)
- Nadcap (Welding)
- TUV AD-2000 info sheet W0/TRD 100
- 97/23/EC (PED) - TÜV
- ISO 9001 / AS EN 9100
- 10CFR50 Appendix B
- ASME NQA1
- ANSI/NCSL-Z-540
- ISO 10012
- ISO 14001

Tubing supply is based on the technical requirements of ASME III.

SUPERCritical TUBING • GRADE CHARTS

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ALLOY GROUP	ALLOY UNS No.	WNR	Chemical Analysis %											Density		Temper		Tensile Rm (min)		Yield Rp 0.2% (min)		Elong. % min	Hardness HV	Properties
			C	Mn	Ni	Cr	Fe	Mo	Ti	Nb	N	Other	g/cm ³	lb/in ³	ksi	MPa	ksi	MPa	ksi	MPa				
NUCLEAR	303 Se S30323	1.4305	.15 max	2.0 max	8.0-11.0	17.0-19.0	1 max							Se 0.15-0.40 Si1 max	7.93	0.286	ANN	100	670	30-207	670	45	255	Non-magnetic austenitic stainless steel. Not hardenable by heat treatment. Free-machining characteristics with good mechanical and corrosion-resistant properties.
	304L S30403	1.4306	0.035 max	2.0 max	8.0-11.0	18.0-20.0	bal							7.93	0.286	ANN	70	485	25	170	35	200 max	Lower carbon of 304 with good weldability.	
	316L S31603	1.4404 1.4435	0.035 max	2.0 max	10.0-13.0	16.0-18.0	2.0-2.5 2.5-3							7.93	0.286	ANN	70	485	25	170	35	200 max	Standard AOD melt austenitic stainless steel grade. 316L with minimum molybdenum content of 2.5%.	
	316LN S31653	1.4429	0.030 max	2.0 max	10.0-14.0	16.0-18.0	2.0-3.0		0.10-0.16	Si 0.75 max	7.93	0.286	ANN	75	515	30	205	30	205	40	200 max	Because of its low magnetic permeability, 316LN has been used in concrete rebar applications in close proximity to sensitive electronic devices.		
STAINLESS STEEL	321 S32100	1.4541	0.080 max	2.0 max	9.0-12.0	17.0-19.0	bal						10XC -1000	Ti 5XC -0.600	7.93	0.286	ANN	75	515	30	205	35	200 max	Titanium stabilized grade with good weldability, improved resistance to weld decay attack & better mechanical properties at elevated temperatures.
	347 S34700	1.4546	0.080 max	2.0 max	9.0-12.0	17.0-19.0	bal						10XC -1000		7.93	0.286	ANN	75	515	30	205	35	200 max	As for 321 but uses niobium as stabilizing element.
	904L N08904	1.4539	0.020 max	2.0 max	23.0-28.0	19.0-23.0	bal							Cu 1.0-2.0	8	0.289	ANN	70	485	40	275	35	200 max	Stainless steel with higher resistance to general, pitting & crevice corrosion than 316L.
	6Mo S31254	1.4547	0.020 max	1.0 max	17.5-18.5	19.5-20.5	bal							Cu 0.5-1.0	8	0.289	ANN	98	675	45	310	35	230 max	Superaustenitic stainless steel with good resistance to pitting & crevice corrosion.
Ti	Duplex S31803	1.4462	0.030 max	2.0 max	4.5-6.5	21.0-23.0	bal							0.08-0.20	7.8	0.281	ANN	90	620	65	450	25	290 max	High mechanical strength & good resistance to localized cracking & chloride stress corrosion.
	Super Duplex S32750	1.441	0.030 max	1.2 max	6.0-8.0	24.0-26.0	bal							0.24-0.32	7.79	0.28	ANN	116	800	80	550	15	310 max	Superduplex alloy combining excellent strength with good corrosion resistance in high-chloride and seawater environments.
	Super Duplex S32760	1.4501	0.020 max	1.0 max	6.0-8.0	24-26	bal							24-32 Cu 0.50 W 0.50	7.70	0.278	ANN	109	750	73.5	507	35	310 max	Very high strength-to-weight ratio combined with excellent seawater corrosion resistance.
	CP Grade 2 R50400	3.7035	0.08 max			0.30 max								0.03 max	4.51	0.163	ANN	50	345	40-65	275-450	20		
ZIRCONIUM	Zircaloy 2 R60802		0.005 max		0.1 max									Zr+Hf 99.2	6.50		ANN	55	379	30	207	16	150	Zirconium nuclear grade alloy (weight %) 1.2-1.7 Sn, 0.07-0.2 Fe, 0.05-0.15 Cr, 0.03-0.08 Ni. Low absorption of thermal neutrons. Main use is for cladding of fuel rods in nuclear reactors. Zr2 = BWR, CANDU.
	Zircaloy 4 R60804		0.05 Max											Zr+Hf 97.5 Hf 4.5	6.56		ANN	60	415	35	240	14	150	Zirconium nuclear grade alloy (weight %) 1.2-1.7 Sn, 0.18-0.24 Fe, 0.07-0.13 Cr. Low absorption of thermal neutrons. Main use is for cladding of fuel rods in nuclear reactors. Zr4 = BWR, PWR, CANDU.

ALLOY GROUP	ALLOY UNS No.	WNR	Chemical Analysis %											Density		Temper	Tensile Rm (min)		Yield Rp 0.2% (min)		Elong. % min	Hardness HV	Properties	
			C	Mn	Ni	Cr	Fe	Mo	Ti	Nb	Al	Other	g/cm ³	lb/in ³	ksi		MPa	ksi	MPa					
																				Co 0.3 max				Cu 0.5 max
NICKEL ALLOYS	Alloy 59 N06059	2.4605	0.010 max	0.5 max	bal	22.0-24.0	1.5 max	15.0-16.5					0.10-0.40	Co 0.3 max	8.60	0.311	ANN	100	690	45	310	45	270 max	Excellent in sour service environments. Highly resistant to chloride, sea waters and acids.
	Alloy 75 N06075	2.4951	0.08-0.15 max	1.0 max	bal	18.0-21.0	5.0 max		0.20-0.60					Cu 0.5 max	8.37	0.303	ANN	100-120	690-830	46	300	30	230 max	High temperature oxidation resistance.
	Alloy 200 N02200	2.4065	0.15 max	0.4 max	99.0 min	0.4 max								Cu 0.25 max	8.9	0.321	ANN	75	515	15	105	33	150 max	Commercially pure nickel. Good corrosion resistance.
	Alloy 263 N07263		0.04-0.08 max	0.6 max	bal	19.0-21.0	0.7 max	5.6-6.1	1.9-2.4					Co 19.0-21.0 N 0.30-0.6	8.36	0.302	HT	140	970	90	620	39	250 min	High creep strength with good weldability.
	Alloy 276 N10276	2.4819	0.02 max	1.0 max	bal	14.5-16.5	4.0-7.0	15.0-17.0						W 3.0-4.5	8.9	0.321	ANN	100	690	41	283	40	210 max	Excellent sour service corrosion resistance.
	Alloy 400 N04400	2.4360	0.30 max	2.0 max	63.0-70.0	2.5 max								Cu bal	8.83	0.319	ANN	70	480	28	195	35	180 max	General purpose Ni alloy with a good combination of strength, ductility & corrosion resistance.
	Alloy 600 N06600	2.4816	0.15 max	1.0 max	72.0 min	6.0-10.0								Cu 0.50 max	8.42	0.304	ANN	80	550	35	240	30	200 max	Very good combination of strength & oxidation resistance.
	Alloy 625 N06625	2.4856	0.10 max	0.5 max	bal	20.0-23.0	5.0 max	8.0-10.0	0.40 max	3.15-4.15				0.40 max	8.44	0.305	ANN	120	827	60	414	30	260 max	Nickel alloy with high strength, excellent fabricability. Superior resistance to corrosive environments of unusual severity as well as to high-temperature effects such as oxidation & carburization.
	Alloy 690 N06690	2.4642	0.05 max	0.05 max	58 min	7.0-11.0								Cu 0.50 Si 0.50	8.19	0.296	ANN	84	586	34	240	30	200 max	Excellent resistance to many corrosive aqueous media & high-temperature atmospheres.
	Alloy 718 N07718	2.4668	0.08 max	0.4 max	50.0-55.0	17.0-21.0	bal	2.80-3.30	0.65-1.15	4.75-5.50				0.20-0.80	8.19	0.296	HT	185	1275	150	1034	12	331 min	Age hardenable, high-strength nickel alloy with excellent corrosion resistance and formability. Used at temperatures up to 700°C.
	Alloy X750 N07750	2.4669	0.08 max	1.0 max	70.0 min	14.0-17.0	5.0-9.0		2.25-2.75	0.70-1.20				0.40-1.00	8.25	0.298	HT	160	1103	100	689	20	260-360	High-temperature strength performance.
	Alloy 800 N08800	1.4876	0.15 max	1.5 max	30.0-35.0	19.0-23.0	39.5 min		0.15-0.60					0.15-0.60	8	0.289	ANN	75	517	30	207	30	200 max	Resistant to stress corrosion & good in aqueous media.
Alloy 800H N08810	1.4876	0.05-0.10 max	1.5 max	30.0-35.0	19.0-23.0	39.5 min		0.15-0.60					0.15-0.60	8.08	0.292	ANN	75	517	30	207	30	200 max	Excellent high-temperature creep resistance, combined with oxidation and carburization resistance.	
Alloy 800HT N08811		0.06-0.10 max	1.5 max	30.0-35.0	19.0-23.0	39.5 min		0.15-0.60					Al + Ti 0.85-1.20	7.94	0.287	ANN	75	517	30	207	30	200 max	Similar corrosion properties to A800 & 800H with significantly high creep-rupture strength.	
Alloy 825 N08825	2.4858	0.05 max	1.0 max	38.0-46.0	19.5-23.5	bal	2.5-3.5	0.6-1.20					0.20 max	8.1	0.292	ANN	85	586	35	241	30	209 max	Excellent corrosion resistance in both oxidizing and reducing environments. Good resistance to chloride stress-corrosion cracking and pitting.	

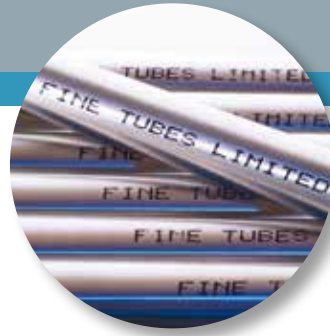
For further details on our grades visit:

www.superiortube.com/products/our-grades

www.finetubes.co.uk/products/tube-grades

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GLOBAL PRESENCE

Through the partnership between U.S.-based Superior Tube and U.K.-based Fine Tubes, both companies can offer increased capabilities, leading to significantly reduced lead times, an extended product portfolio, increased global reach and outstanding customer service.

Our tubing experts deliver high-precision tubing to customers in over 35 countries worldwide.

In addition to tube mills in the United Kingdom and the United States, we have sales offices in Germany, France, India and the United States, as well as an extensive network of partners in Asia, Europe and the Middle East.

Fine Tubes and Superior Tube are collectively a unit of AMETEK, Inc., a leading global manufacturer of electronic instruments and electromechanical devices.



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