AEROSPACE

High Strength Tubing Solutions for Critical Aerospace Applications
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 and titanium alloys for supercritical aerospace applications.

TUBING INNOVATIONS

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

- **1950**
  North American X-15 rocket-powered aircraft uses Superior Tube’s products in its ballistic control system.

- **1957**
  Fine Tubes starts to supply stainless steel tubing to Vickers Viscount Aircraft.

- **1965**
  Fine Tubes and Superior Tube collaborate to supply AM350 tubes for the Concorde programme.

- **1970**
  Superior Tube supplies the Ti 3Al-2.5V hydraulic line tubing used in the F-15 Eagle fighter.

- **1980**
  NASA Space Shuttle life support system relies on high-pressure stainless steel tubing made by Superior Tube.

- **1999**
  Eurofighter uses Fine Tube’s titanium tubing for hydraulic systems & EJ200 engine.

- **2006**
  Fine Tubes supplies Airbus A380 with Ti 3Al-2.5V tubing for 5,000 psi hydraulic systems.

- **2014**
  Fine Tubes supplies specialized tubing for the Solar Orbiter satellite to investigate the sun.
TUBING SOLUTIONS

AEROSPACE
Superior Tube and Fine Tubes have been supplying high-quality tubular products to the civil aerospace, defense and space industries since inception. Our position in the aerospace industry has been achieved through the culmination of our long-term commitment to development and innovation.

With an international reputation for manufacturing high-specification tubing in a wide range of advanced metals and lightweight alloys, we supply tubing for critical airframe and aircraft engine applications.

Starting with stainless steels, we have continually expanded our process capability and have developed a unique expertise in processing nickel alloys for high-temperature/high-strength applications and titanium alloys where a high strength-to-weight ratio is required.

Fine Tubes and Superior Tube continue to lead in meeting the exacting quality demands of the aerospace industry, ensuring that new design concepts today become the industry standards of tomorrow.

CIVIL
Our high-strength tubing has been deployed in engines and airframes of major commercial aircraft programs including Airbus and Boeing.

Critical to the safe operation of the aircraft, our lightweight hydraulic tubes are used to actuate flight control surfaces and are crucial components in landing gear and brake systems.

We also supply heat-resistant tubing for various systems within commercial aero engines, including fuel delivery, fire suppression, drain lines and bleed air systems.

DEFENSE
Fine Tubes and Superior Tube primarily supply hydraulic and aero engine tubing deployed in the engines and airframes of military aircraft. From developing the lightweight titanium tubing for the hydraulic systems of the Eurofighter to manufacturing high-performance Waspaloy™ tubing for the afterburners of the F-15/F-16, we work closely with major defense aviation manufacturers globally.

SPACE
Our involvement in the space industry goes back to the 1960s, where we contributed to Telstar 1, the world’s first communications satellite. Since then, Fine Tubes and Superior Tube have been developing and supplying high-quality tubing solutions for various space exploration programs, including NASA’s Space Shuttle and Mars Exploration projects.

Our expertise in manufacturing high-precision seamless tubing also fulfills the exacting requirements in terms of high quality and cleanliness levels needed for the critical Chemical Propulsion System of the highly anticipated Solar Orbiter satellite project.

AEROSPACE APPLICATIONS:
- Aero engine tubes
- Convoluting tube-seals
- Ducting systems
- Hydraulic and pneumatic control systems
- Instrumentation
- Landing gear
- Pitot tubes
- Torque control rods
- Transmission tubes
- Waveguides
HIGH PRECISION TUBES FOR DEMANDING ENVIRONMENTS
AEROSPACE

MANUFACTURING CAPABILITIES

ALLOYS
Superior Tube and Fine Tubes 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
- 304, 316, 321, 347, 15-5PH, 17-4PH, 21-6-9, FV607

Nickel
- Waspaloy™, X-750, 75, 263, 600, 625, 718

SEAMLESS ONLY
Titanium
- Ti 3Al-2.5V (Grade 9), Ti 6Al-4V (Grade 5), Ti CP (Grade 1 and 2), Ti 4Al-2.5V

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

SIZE RANGE

Our tubing sizes typical for aerospace applications range from 0.010 in (0.25 mm) to 1.5 in (38.10 mm) OD in seamless, welded and welded & redrawn.
### Supercritical Tubing • Grade Chart

#### Aerospace

<table>
<thead>
<tr>
<th>ALLOY GROUP</th>
<th>ALLOY UNS No.</th>
<th>WNR</th>
<th>Chemical Analysis %</th>
<th>Density</th>
<th>Tensile Rm (min)</th>
<th>Yield Rp 0.2% (min)</th>
<th>Elong. % min</th>
<th>Hardness HV</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALLOY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower carbon of 304 with good weldability.</td>
</tr>
<tr>
<td><strong>304L</strong></td>
<td>S30403</td>
<td>1.4306</td>
<td>0.035 max</td>
<td>2.0 max</td>
<td>8.0-11.0</td>
<td>18.0-20.0</td>
<td>bal</td>
<td>7.93 0.286</td>
<td>ANN</td>
</tr>
<tr>
<td><strong>316L</strong></td>
<td>S31603</td>
<td>1.4404</td>
<td>0.035 max</td>
<td>2.0 max</td>
<td>10.0-13.0</td>
<td>16.0-18.0</td>
<td>bal</td>
<td>2.0-2.5</td>
<td>2.5-3</td>
</tr>
<tr>
<td><strong>321</strong></td>
<td>S32100</td>
<td>1.4541</td>
<td>0.080 max</td>
<td>2.0 max</td>
<td>9.0-12.0</td>
<td>17.0-19.0</td>
<td>bal</td>
<td>SX:0.600</td>
<td>7.93 0.286</td>
</tr>
<tr>
<td><strong>316</strong></td>
<td>S31600</td>
<td>1.4445</td>
<td>0.080 max</td>
<td>2.0 max</td>
<td>9.0-12.0</td>
<td>17.0-19.0</td>
<td>bal</td>
<td>SX:1.00</td>
<td>7.93 0.286</td>
</tr>
<tr>
<td><strong>21-6-9</strong></td>
<td>S21910</td>
<td>1.4546</td>
<td>0.080 max</td>
<td>80-10.0</td>
<td>5.575</td>
<td>19.0-21.5</td>
<td>bal</td>
<td>0.15-0.40</td>
<td>8</td>
</tr>
<tr>
<td><strong>FV607</strong></td>
<td>S64607</td>
<td>0.12-0.16</td>
<td>0.5-1.2</td>
<td>0.4-0.9</td>
<td>10.0-11.7</td>
<td>bal</td>
<td>0.7-1.2</td>
<td>0.35</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>17-4 PH</strong></td>
<td>S17400</td>
<td>1.4542</td>
<td>0.070 max</td>
<td>2.0 max</td>
<td>3.0-5.0</td>
<td>15.0-17.5</td>
<td>bal</td>
<td>0.15-0.45</td>
<td>Cu:3.0</td>
</tr>
<tr>
<td><strong>15-5 PH</strong></td>
<td>S15500</td>
<td>0.070 max</td>
<td>1.0 max</td>
<td>3.50-5.5</td>
<td>14.5-15.5</td>
<td>bal</td>
<td>0.15-0.45</td>
<td>Cu:2.5</td>
<td>7.8</td>
</tr>
<tr>
<td><strong>Alloy 75</strong></td>
<td>N06607</td>
<td>2.4951</td>
<td>0.06-0.15</td>
<td>1.0 max</td>
<td>bal</td>
<td>18.0-21.0</td>
<td>5.0</td>
<td>bal</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Alloy 263</strong></td>
<td>N07263</td>
<td>0.04-0.08</td>
<td>0.6 max</td>
<td>bal</td>
<td>19.0-21.0</td>
<td>0.7 max</td>
<td>5.6-6.1</td>
<td>19.2-24.0</td>
<td>0.3-0.6</td>
</tr>
<tr>
<td><strong>Alloy 600</strong></td>
<td>N06600</td>
<td>2.4816</td>
<td>0.15 max</td>
<td>1.0 max</td>
<td>bal</td>
<td>12.0-19.0</td>
<td>6.0-10.0</td>
<td>bal</td>
<td>Co:0.5 max</td>
</tr>
<tr>
<td><strong>Alloy 625</strong></td>
<td>N06625</td>
<td>2.4856</td>
<td>0.10 max</td>
<td>0.5 max</td>
<td>bal</td>
<td>20.0-23.0</td>
<td>5.0 max</td>
<td>8.0-10.0</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Alloy 718</strong></td>
<td>N07718</td>
<td>2.4668</td>
<td>0.08 max</td>
<td>0.4 max</td>
<td>5.0-55.0</td>
<td>17.0-21.0</td>
<td>bal</td>
<td>2.80</td>
<td>3.30</td>
</tr>
<tr>
<td><strong>Alloy X750</strong></td>
<td>N07750</td>
<td>2.4669</td>
<td>0.08 max</td>
<td>1.0 max</td>
<td>bal</td>
<td>70.0 min</td>
<td>14.0-17.0</td>
<td>5.0</td>
<td>2.25</td>
</tr>
<tr>
<td><strong>CP Grade 1</strong></td>
<td>R05250</td>
<td>3.7025</td>
<td>0.08 max</td>
<td>0.20 max</td>
<td>bal</td>
<td>0.03 max</td>
<td>bal</td>
<td>4.48</td>
<td>0.162</td>
</tr>
<tr>
<td><strong>CP Grade 2</strong></td>
<td>R05400</td>
<td>3.7035</td>
<td>0.08 max</td>
<td>0.2 max</td>
<td>bal</td>
<td>0.03 max</td>
<td>bal</td>
<td>4.51</td>
<td>0.163</td>
</tr>
<tr>
<td><strong>Ti 3Al-2.5V</strong></td>
<td>Grade 9</td>
<td>R5632</td>
<td>3.7194</td>
<td>0.08 max</td>
<td>0.25 max</td>
<td>bal</td>
<td>0.03 max</td>
<td>2.5-3.50</td>
<td>2.0-2.5</td>
</tr>
<tr>
<td><strong>Ti 6Al-4V</strong></td>
<td>Grade 5 ELI</td>
<td>R5640</td>
<td>3.7165</td>
<td>bal</td>
<td>bal</td>
<td>60</td>
<td>V:4.0</td>
<td>4.33</td>
<td>0.156</td>
</tr>
<tr>
<td><strong>Ti 4Al-2.5V</strong></td>
<td>Grade 5</td>
<td>R5425</td>
<td>1.5 max</td>
<td>bal</td>
<td>bal</td>
<td>4.0</td>
<td>V:2.5</td>
<td>4.25</td>
<td>0.156</td>
</tr>
</tbody>
</table>

For further details on our grades visit: www.superiortube.com/products/our-grades www.finetubes.co.uk/products/tube-grades
HIGH PRECISION TUBES FOR DEMANDING ENVIRONMENTS
AEROSPACE

TUBING QUALITY

TUBING QUALITY CERTIFICATIONS
• ISO 9001
• AS EN 9100
• Nadcap (Heat Treatment)
• Nadcap (NDT)
• Nadcap (Welding)
• TUV AD-2000 Merkblatt WO-TRD 100
• 97-23-EC (PED) - TüV
• ISO 10012
• ISO 14001
• RCC-M

CUSTOMER APPROVALS
• Airbus
• BAE Systems
• Boeing (commercial and military)
• Bombardier
• Embraer
• GE Aviation
• Gulfstream
• Hawker Beechcraft
• Liebherr
• Lockheed Martin
• Messier-Dowty
• Raytheon
• Rolls-Royce
• SNECMA-SAIFAN
• UTC
• Westland

MANUFACTURING STANDARDS

TITANIUM 3AI-2.5V
ABS 5004
ABS 5141
ABS 5918
AMS 4943
AMS 4944
AMS 4945
AMS 4946
M8BN 6001-4
MSRR 8673

TITANIUM 6AI-4V
FT2312 SEAMLESS

TITANIUM C.P.
AMS 4942
BAEM 4044
MSRR 8609

STAINLESS STEEL 21-6-9
ABM 7-3058
AMS 5561
ASN-A3288-NSA384510
BACM 157
BMS7-185
DAN 41
SO7-2210

OTHER STAINLESS STEELS
AMS-5566 Alloys 304
AMS-5643 Alloys 17-4PH
AMS-5659 Alloys 15-5PH
AMS-T-6845 Alloys 304
BS2T66 Alloys 347
BST68 Alloys 347
BST72 Alloys 347
LN 9398 Alloys 304-321-347
MIL-T-8808 Alloys 321-347
MSRR 6524 Alloys 347

NICKEL ALLOYS/NIMONICS
AMS 5580 Alloys 600
AMS 5581 Alloys 625
AMS 5582 Alloys X750
AMS 5589 Alloys 718
BSHR 403 HTA75 (Alloy 75)
BSHR 404 Alloys 263
MSRR 6513 FV607
MSRR 7006 Alloys 75
MSRR7037 Alloys C263
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.

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

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.

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

GLOBAL SALES OFFICES AND AGENTS NETWORK
HIGH PRECISION TUBES FOR DEMANDING ENVIRONMENTS

AEROSPACE

SUPERIOR TUBE
3900 Germantown Pike
Collegeville, PA 19426-3112
UNITED STATES

E: aerospace.supertiube@ametek.com
T: +1 610.489.5200
F: +1 610.489.5252

www.supertiube.com

SALES OFFICES
Sales Office U.S. West
11631 NE 3rd Street
Kirkland, WA 98033-8107
UNITED STATES

E: dirk.fanning@ametek.com
T: +1 425.985.1398

Sales Office U.S. East
3900 Germantown Pike
Collegeville, PA 19426-3112
UNITED STATES

E: donna.l.brown@ametek.com
T: +1 610.489.5260

Sales Office Europe West
23, Rue Antigna
F-45000 Orléans
FRANCE

E: sales.fr.finetubes@ametek.com
T: +33 (0) 238775-702
F: +33 (0) 238812-407

Sales Office Europe Central
AMETEK GmbH
Rudolf-Diesel-Strasse 16
D-40670 Meerbusch
GERMANY

E: sales.de.finetubes@ametek.com
T: +49 7345 235 9505
C: +49 173 3661337

Sales Office India
AMETEK Instruments India Pvt Ltd
601, Raaj Chambers
Old Nagardas Road
Andheri (East)
Mumbai - 400 069
INDIA

E: sales.in.finetubes@ametek.com
T: +91 (0) 22 6196 8200
F: +91 (0) 22 2836 3613

Disclaimer: The information contained within this brochure is for guidance only and is not intended for warranty of individual application - express or implied.