The Aluminum Company of America has pioneered aluminum research for over 100 years. Alcoa was the first company to research aluminum behavior at extremely low temperatures, demonstrating that certain alloys have the characteristics needed to withstand severe cryogenic environments. Alcoa’s advancements in welding technology further improved fabrication of processing and marine equipment. Welded properties were improved by developing alloys containing magnesium for strength, ductility, and toughness. Alcoa’s improvements in welding processes have reduced welding time by 50 - 80%.

Alcoa’s current focus is on developing new alloys and tempers, new fabrication techniques, and better finishing and joining methods. Committed to continuous improvement and product development, Alcoa remains a worldwide industry leader.

**ALUMINUM CAN SAVE YOU MONEY**

**High resistance to corrosion**
Using aluminum in process and marine operations provides significant savings through longer equipment life, less maintenance and reduced downtime.

**Light weight**
Aluminum’s light weight lowers costs of erection or construction and reduces handling and transportation expenses. Operating costs, fuel consumption and horsepower also can be lowered as a result of aluminum’s light weight.

**High strength-to-weight ratio**
Many of the alloys used in processing and marine equipment have strengths comparable to the most commonly used mild steels at one third the weight.

**Ease of fabrication and joining**

**ALUMINUM SHEET AND PLATE FOR CRYOGENICS, SHIPYARD AND TREAD**

**A WORLDWIDE ALUMINUM INDUSTRY LEADER**

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Superior performance in supercold environments makes Alcoa aluminum an ideal material for handling fluids such as liquified natural gas (LNG) efficiently, safely and economically. Its excellent mechanical properties at cryogenic and ambient temperatures, combined with superior corrosion resistance, make it attractive for applications such as LNG tankers or storage tanks.

Wider Alcoa aluminum requires fewer plates for welded structures, reducing the number of welded joints and lowering fabrication costs. For example, LNG tank domes can be spun formed from one Alcoa plate circle up to 197 in. (5.00m) in diameter.

Alcoa aluminum is used in a variety of petroleum and process industry applications including:

- Oil and gas field machinery and equipment
- Cryogenic process and gas manufacturing and storage equipment
- Equipment for nuclear, fuel, coal gasification, ocean thermal fusion and geothermal requirements
- Petroleum refinery machinery and equipment
- Chemical industry (including plastics) machinery and equipment
- Food, dairy products and beverage industry machinery and equipment
- Water treatment, including desalting and sewage treatment machinery and equipment
- Pulp and paper industry machinery and equipment

Examples of aluminum structures include:

- Silos
- Storage tanks
- Blenders or mixers
- Scrubber towers
- Heat exchangers
- Dryers
- Cooling towers

**ADVANTAGES OF ALUMINUM**

**Protection from discoloration and chemical reaction**

Aluminum salts are white or colorless so products are not stained or discolored in aluminum equipment. Aluminum is also noncatalytic, minimizing oxidation, polymerization or decomposition reactions.

**High reflectance**

Because it reflects light and heat, aluminum can be an excellent thermal insulator. Reflective aluminum surfaces can also reduce evaporation losses of volatile liquids from storage tanks.

**Excellent low-temperature properties**

Unlike some structural metals, many aluminum alloys maintain or increase their ductility and toughness at extremely low temperatures.

**High thermal conductivity**

**Non-toxic**

**Non-magnetic**

**Does not blister, absorb water or burn**

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Alcoa aluminum’s light weight and superior corrosion resistance make it a star performer in the marine industry. When designed into ocean-going yacht and ship structures, aluminum is one of the most cost effective materials available. Its lighter weight improves weight distribution, expands equipment capacity, increases payload, improves stability, decreases displacement and facilitates ship design and operation. Size for size, ocean-going aluminum yachts are stronger, faster, and more fuel efficient because of aluminum’s high strength-to-weight ratio. Lightweight aluminum materials are essential to naval combatant ships because of the expanded use of on board electronics hardware and damage control equipment. Aluminum also increases speed and improves maneuverability. For LNG ship construction, aluminum has the additional advantage of higher strength and ductility at cryogenic temperatures.

Alcoa aluminum is used for a variety of marine applications:

- Naval and coast guard ship and boat construction and repair
- Commercial LNG ship construction, equipment and repairs
- Hydrofoil vessels
- Other non-recreational water transportation equipment
- Super structures and hulls on cruise ships and ferry boats
- Hulls for ocean-going yachts and fishing or work boats, especially for drilling and operating offshore oil and gas wells

Pegasus, built by Broward Marine, is a 72-foot aluminum motor yacht.

U.S.S. Yorktown CG 48, built by Ingalls Shipbuilding Division of Litton Industries.
Determined to provide customers with the highest quality products, Alcoa Davenport Works is constantly improving the processes of making aluminum. One tool Alcoa uses in its quality improvement processes is Statistical Process Control (SPC). Through SPC, a team of metallurgical, production, maintenance, engineering and marketing employees measure manufacturing parameters to reduce process variations and prevent defects. They analyze data to solve critical quality issues, resulting in consistent products for you.

Computer Integrated Manufacturing Systems (CIMS) technology tracks more than 8,000 product specifications, and 138 production centers. Almost 3,000 employees use hundreds of computers in their manufacturing processes to reduce flow time by up to 30%, allowing Alcoa to deliver your metal more quickly.

Alcoa’s commitment to customer satisfaction doesn’t end with providing quality products on time. They will also work with you in the design and use of aluminum. From the preparation of specifications to welding and fabricating procedures, the Alcoa team of metallurgical, field, and sales engineers can provide assistance. Help is available to all fabricators, engineers, owners and regulatory bodies using Alcoa sheet and plate products in the process and marine industries.

**ALCOA ALUMINUM LOWERS FABRICATION COSTS**

Alcoa’s wider plates require fewer welds, reducing welding, x-ray and inspection time. Also, the Alcoa high deposition welding processes can further reduce welding time up to 80% on a given joint (depending on plate thickness). In combination, the wider plates and special welding processes can significantly reduce your total fabrication costs.

**CALL FOR MORE INFORMATION**

With over a century of experience in the aluminum industry, the Aluminum Company of America has the technical resources and expertise you need. For more information about the benefits of using Alcoa sheet and plate products, contact your Alcoa sales representative or agent.
<table>
<thead>
<tr>
<th>ALLOY</th>
<th>CHARACTERISTICS</th>
<th>TYPICAL USES</th>
<th>TEMPER</th>
<th>TYPICAL TENSILE STRENGTH ksi (MPa)</th>
<th>TYPICAL YIELD ksi (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>Excellent forming qualities resistance to corrosion, weldability, electrical conductivity.</td>
<td>Chemical equipment, heat exchanger fins, sheet metal work.</td>
<td>H14</td>
<td>13 (90) 18 (124)</td>
<td>5 (35) 17 (117)</td>
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<td>H18</td>
<td>24 (166)</td>
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<td>3003</td>
<td>Similar characteristics to 1100 but with slightly higher strength, good workability, low earing when deep drawn, weldability, resistance to corrosion. Low cost. ASME Unfired Pressure Vessel Code approved.</td>
<td>Fan blades, pressure vessels, chemical equipment.</td>
<td>H14</td>
<td>16 (110) 22 (152)</td>
<td>6 (41) 21 (145)</td>
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<td></td>
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<td></td>
<td>H112</td>
<td>17 (117)</td>
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<tr>
<td>5052</td>
<td>Excellent resistance to corrosion, especially marine environment; good workability, higher strength than 1100 or 3003. Good finishing characteristics. 5052-H112 plate is ASME Unfired Pressure Vessel Code approved.</td>
<td>Small boats, fan blades, sheet metal parts, tank cars, storage tanks, shipping drums.</td>
<td>H14</td>
<td>28 (193) 33 (228)</td>
<td>13 (90) 28 (193)</td>
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<td>H32</td>
<td>38 (262)</td>
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<td>H34</td>
<td>38 (262)</td>
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<td></td>
<td>H112</td>
<td>30 (207)</td>
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<tr>
<td>5083</td>
<td>High strength, high resistance to corrosion, highly suitable for welding.</td>
<td>Chemical equipment, welded structures (high strength), pressure vessels, storage tanks, truck, marine and cryogenic applications.</td>
<td>H11</td>
<td>42 (290)</td>
<td>21 (145)</td>
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<td>H111</td>
<td>45 (311)</td>
<td>31 (211)</td>
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<td>H112</td>
<td>43 (297)</td>
<td>23 (159)</td>
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<td>H116</td>
<td>46 (317)</td>
<td>33 (228)</td>
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<td>H321</td>
<td>46 (317)</td>
<td>33 (228)</td>
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<tr>
<td>5086</td>
<td>Higher strength than 5052 with similar characteristics, excellent resistance to corrosion in marine environment. Good workability, weldability.</td>
<td>Shipyard sheet and plate, tank can, shipping drums, support structures, welded structures, bulkheads and superstructures, patrol and work boat hulls.</td>
<td>H14</td>
<td>38 (262)</td>
<td>17 (117)</td>
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<td>H32</td>
<td>44 (304)</td>
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<td>H34</td>
<td>47 (324)</td>
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<td>H111</td>
<td>40 (276)</td>
<td>26 (179)</td>
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<td>H112</td>
<td>39 (269)</td>
<td>19 (131)</td>
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<td>H116</td>
<td>45 (311)</td>
<td>36 (248)</td>
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<tr>
<td>5454</td>
<td>Superior corrosion resistance at elevated temperatures, high strength, good workability, weldability.</td>
<td>Stack enclosures or other applications with prolonged temperatures higher than 65.6°C (150°F).</td>
<td>H11</td>
<td>36 (248)</td>
<td>17 (117)</td>
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<td>H34</td>
<td>44 (304)</td>
<td>35 (242)</td>
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<tr>
<td>5456</td>
<td>Higher strength than 5086 and 5083 with similar characteristics, good workability, weldability.</td>
<td>Bulkheads and superstructures, patrol boat and work boat hulls. Shipyard sheet &amp; plate.</td>
<td>H14</td>
<td>45 (311)</td>
<td>23 (159)</td>
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<td>H116</td>
<td>50 (345)</td>
<td>40 (276)</td>
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<td>H321</td>
<td>51 (352)</td>
<td>37 (255)</td>
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<tr>
<td>6061</td>
<td>Combines relatively high strength, good workability and high resistance to corrosion. ASME Unfired Pressure Vessel Code approved.</td>
<td>Chemical equipment, marine equipment, tankage, general structural applications, paper and textile rods, heat exchangers, fan blades, pressure vessels.</td>
<td>H11</td>
<td>18 (124)</td>
<td>8 (55)</td>
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<td>T4</td>
<td>35 (242)</td>
<td>21 (145)</td>
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<td>T6</td>
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<td>T651</td>
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