NITRONIC® 30 STAINLESS STEEL offers significantly higher strength than Type 304 and potential for applications requiring resistance to aqueous and atmospheric corrosion combined with good toughness and economy. The nickel content is among the lowest of all commercially available austenitic steels.

Applications include automotive hose clamps, safety belt anchors, truck and bus frames, water supply and control structures, sewage treatment plant structures, bulk solids handling equipment, magnetic ore separator screens, coal buckets, and hopper cars.
NITRONIC® 30 STAINLESS STEELS

Product Description

Stainless steels have served successfully in many structural components in the transportation industry. Bus space frames and bumpers take advantage of the excellent fabricability and high strength and toughness of stainless steel. Tensilized NITRONIC 30 Stainless Steel has been used in rapid transit structurals where the strength-to-weight ratio of up to three times that of carbon steel has improved operating efficiency. Rear frames of refrigerated trucks are easily welded and formed from NITRONIC 30 Stainless Steel, resulting in protective units that can withstand impact blows without cracking. Shipboard container structurals use stainless steel successfully where carbon steel becomes scuffed and rusts wherever the paint is damaged.

NITRONIC 30 Stainless Steel is a nitrogen-strengthened austenitic stainless steel developed for applications requiring a good level of aqueous corrosion resistance combined with toughness and economy. NITRONIC 30 Stainless Steel provides approximately 50% higher yield strength than Type 304L and may allow lighter gauges to further reduce costs. NITRONIC 30 Stainless Steel work hardens rapidly while retaining ductility. Unlike some other nitrogen-strengthened stainless steels, NITRONIC 30 Stainless Steel is subject to magnetic transformation and Transformation Induced Plasticity (TRIP) behavior when cold worked.

### AVAILABLE FORMS

NITRONIC 30 Stainless Steel is available in sheet, strip, and plate in thicknesses from 0.020 – 0.250 in. (0.5 – 6.4 mm) and up to and including 48 in. (1219 mm) wide.

### METRIC PRACTICE

The values shown in this bulletin were established in U.S. customary units. The metric equivalents of U.S. customary units shown may be approximate.

### SPECIFICATIONS

NITRONIC 30 Stainless Steel is listed as Grade UNS S20400 in:

**ASTM A240** – Plate, Sheet and Strip for Pressure Vessels.

**ASTM A666** – Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

#### Composition

<table>
<thead>
<tr>
<th>Element</th>
<th>(wt %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.03 max.</td>
</tr>
<tr>
<td>Manganese</td>
<td>7.0 – 9.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.040 max.</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.030 max.</td>
</tr>
<tr>
<td>Silicon</td>
<td>1.00 max.</td>
</tr>
<tr>
<td>Chromium</td>
<td>15.0 – 17.0</td>
</tr>
<tr>
<td>Nickel</td>
<td>1.5 – 0.30</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.15 – 0.30</td>
</tr>
<tr>
<td>Copper</td>
<td>1.00 max.</td>
</tr>
</tbody>
</table>
Mechanical Properties

As noted in Table 1, NITRONIC 30 Stainless Steel has annealed tensile properties which are well above those of typical austenitic alloys such as Type 304L. Excellent elongation is also maintained. This higher strength affords the opportunity to reduce gauge at equivalent engineering loads.

The high work-hardening rate or TRIP behavior of NITRONIC 30 Stainless Steel results in a high-strength material with elongation equal or superior to Type 304L with the same cold reduction. Comparative properties are shown in Table 4 and provided graphically in Figure 1. Table 5 presents additional data on the effect of cold reduction at heavy gauge. Such cold reductions would produce a smoother surface and reduce the coefficient of friction for sliding applications such as coal chutes.

### TABLE 1 – TYPICAL ANNEALED ROOM-TEMPERATURE MECHANICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTS, ksi (MPa)</td>
<td>110 (758)</td>
</tr>
<tr>
<td>0.2% YS, ksi (MPa)</td>
<td>55 (379)</td>
</tr>
<tr>
<td>Elongation % in 2&quot; (50.8 mm)</td>
<td>50</td>
</tr>
<tr>
<td>Rockwell Hardness, B</td>
<td>95</td>
</tr>
</tbody>
</table>

### TABLE 2 – PROPERTIES ACCEPTABLE FOR MATERIAL SPECIFICATION

<table>
<thead>
<tr>
<th>Condition</th>
<th>ASTM Spec.</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, B</th>
<th>Free Bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annealed</td>
<td>A240</td>
<td>95 min. (655)</td>
<td>48 min. (331)</td>
<td>35 min.</td>
<td>100 max.</td>
<td>180°-1T</td>
</tr>
<tr>
<td>1/4 Hard</td>
<td>A666</td>
<td>140 min. (965)</td>
<td>100 min. (689)</td>
<td>20 min.</td>
<td>–</td>
<td>≤ 0.050 in., 180°-1T &gt; 0.050 in. – ≤ 0.1874 in., 90°-2T</td>
</tr>
</tbody>
</table>

### TABLE 3 – TYPICAL ANNEALED PLATE PROPERTIES

<table>
<thead>
<tr>
<th>Thickness, in. (mm)</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, B</th>
<th>CVN, ft-lbs. (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.375 (10)</td>
<td>114 (786)</td>
<td>57 (393)</td>
<td>56</td>
<td>94</td>
<td>–</td>
</tr>
<tr>
<td>0.875 (22)</td>
<td>124 (855)</td>
<td>50 (345)</td>
<td>50</td>
<td>92</td>
<td>217 (244)</td>
</tr>
<tr>
<td>2.0 (50.8)</td>
<td>120 (827)</td>
<td>52 (358)</td>
<td>54</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
Mechanical Properties

**FIGURE 1 – EFFECT OF COLD REDUCTION ON TENSILE PROPERTIES OF NITRONIC 30 STAINLESS STEEL**

![Graph showing the effect of cold reduction on tensile properties of NITRONIC 30 stainless steel.](image)

**TABLE 4 – EFFECT OF COLD WORK ON TENSILE PROPERTIES**

<table>
<thead>
<tr>
<th>% Cold Work</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>125 (862)</td>
<td>57 (393)</td>
<td>49</td>
<td>B95</td>
</tr>
<tr>
<td>10</td>
<td>150 (1034)</td>
<td>86 (593)</td>
<td>35</td>
<td>C31</td>
</tr>
<tr>
<td>20</td>
<td>173 (1193)</td>
<td>113 (779)</td>
<td>25</td>
<td>C37</td>
</tr>
<tr>
<td>30</td>
<td>194 (1338)</td>
<td>142 (979)</td>
<td>18</td>
<td>C43</td>
</tr>
<tr>
<td>40</td>
<td>207 (1467)</td>
<td>172 (1186)</td>
<td>15</td>
<td>C45</td>
</tr>
<tr>
<td>Type 304</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>89 (614)</td>
<td>35 (241)</td>
<td>61</td>
<td>B74</td>
</tr>
<tr>
<td>10</td>
<td>110 (758)</td>
<td>70 (483)</td>
<td>40</td>
<td>C21</td>
</tr>
<tr>
<td>20</td>
<td>130 (896)</td>
<td>100 (689)</td>
<td>27</td>
<td>C30</td>
</tr>
<tr>
<td>30</td>
<td>148 (1020)</td>
<td>125 (862)</td>
<td>20</td>
<td>C36</td>
</tr>
<tr>
<td>40</td>
<td>167 (1151)</td>
<td>150 (1034)</td>
<td>13</td>
<td>C39</td>
</tr>
</tbody>
</table>

*Average of five thickness ranges – 0.0215 – 0.026 in. (5.5 – 0.7 mm).*
Mechanical Properties

EFFECT OF COLD WORK ON MARTENSITE FORMATION

NITRONIC® 30 Stainless Steel will undergo magnetic transformation due to cold reduction. This magnetism is the result of forming deformation martensite with cold work. This martensite increases the strength, work-hardening rate and abrasion resistance of the alloy.

<table>
<thead>
<tr>
<th>Thickness, in. (mm)</th>
<th>Direction</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, C</th>
<th>Bend 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1875&quot; (4.8)</td>
<td>Longitudinal</td>
<td>148.0 (1020)</td>
<td>104.0 (717)</td>
<td>35.5</td>
<td>34</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Transverse</td>
<td>148.6 (1025)</td>
<td>111.4 (768)</td>
<td>31.5</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>0.25&quot; (6.4)</td>
<td>Longitudinal</td>
<td>144.7 (998)</td>
<td>101.8 (702)</td>
<td>35.5</td>
<td>34</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Transverse</td>
<td>146.6 (1011)</td>
<td>110.1 (759)</td>
<td>29.6</td>
<td>34</td>
<td>11</td>
</tr>
</tbody>
</table>

*Duplicates – 1 heat.  
**5 Tests – 2 heats.

Table 5 – Typical Tensile Properties 1/4-Hard Nitronic 30 Plate

<table>
<thead>
<tr>
<th>Test Temperature, °F (°C)</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, B</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 (24)</td>
<td>122.5 (844)</td>
<td>63.1 (437)</td>
<td>46.8</td>
<td>97</td>
</tr>
<tr>
<td>200 (93)</td>
<td>100.3 (691)</td>
<td>47.3 (326)</td>
<td>63.3</td>
<td>–</td>
</tr>
<tr>
<td>300 (149)</td>
<td>86.8 (599)</td>
<td>41.1 (284)</td>
<td>53.7</td>
<td>–</td>
</tr>
<tr>
<td>400 (204)</td>
<td>81.4 (561)</td>
<td>37.6 (259)</td>
<td>44.8</td>
<td>–</td>
</tr>
<tr>
<td>500 (260)</td>
<td>79.3 (547)</td>
<td>34.9 (240)</td>
<td>41.3</td>
<td>–</td>
</tr>
<tr>
<td>600 (316)</td>
<td>79.3 (547)</td>
<td>33.8 (234)</td>
<td>41.3</td>
<td>–</td>
</tr>
<tr>
<td>700 (371)</td>
<td>76.7 (529)</td>
<td>31.4 (217)</td>
<td>44.3</td>
<td>–</td>
</tr>
<tr>
<td>800 (427)</td>
<td>73.4 (506)</td>
<td>30.0 (207)</td>
<td>43.7</td>
<td>–</td>
</tr>
<tr>
<td>900 (482)</td>
<td>70.3 (485)</td>
<td>28.6 (197)</td>
<td>40.7</td>
<td>–</td>
</tr>
<tr>
<td>1000 (538)</td>
<td>66.5 (458)</td>
<td>27.1 (187)</td>
<td>34.1</td>
<td>–</td>
</tr>
</tbody>
</table>

*0.088 in. (2.2 mm) and 0.074 in. (1.9 mm) thicknesses, average of 6 tests from 2 heats.

Table 6 – Elevated Temperature Tensile Properties of Nitronic 30 Stainless Steel Sheet*

<table>
<thead>
<tr>
<th>Test Temperature, °F (°C)</th>
<th>UTS, ksi (MPa)</th>
<th>0.2% YS, ksi (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, B</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 (24)</td>
<td>123.3 (850)</td>
<td>52.4 (362)</td>
<td>50.0</td>
<td>93</td>
</tr>
<tr>
<td>200 (93)</td>
<td>91.4 (630)</td>
<td>38.6 (266)</td>
<td>77.8</td>
<td>–</td>
</tr>
<tr>
<td>300 (149)</td>
<td>78.2 (539)</td>
<td>32.1 (222)</td>
<td>65.5</td>
<td>–</td>
</tr>
<tr>
<td>400 (204)</td>
<td>71.8 (496)</td>
<td>27.6 (190)</td>
<td>48.0</td>
<td>–</td>
</tr>
<tr>
<td>500 (260)</td>
<td>70.6 (487)</td>
<td>26.4 (182)</td>
<td>48.6</td>
<td>–</td>
</tr>
<tr>
<td>600 (316)</td>
<td>70.7 (488)</td>
<td>25.3 (174)</td>
<td>46.4</td>
<td>–</td>
</tr>
<tr>
<td>700 (371)</td>
<td>69.5 (480)</td>
<td>24.4 (168)</td>
<td>49.0</td>
<td>–</td>
</tr>
<tr>
<td>800 (427)</td>
<td>66.7 (460)</td>
<td>22.7 (157)</td>
<td>48.3</td>
<td>–</td>
</tr>
<tr>
<td>900 (482)</td>
<td>63.7 (439)</td>
<td>22.4 (155)</td>
<td>47.7</td>
<td>–</td>
</tr>
<tr>
<td>1000 (538)</td>
<td>60.4 (417)</td>
<td>20.4 (131)</td>
<td>42.9</td>
<td>–</td>
</tr>
</tbody>
</table>

*0.0875 in. (2.2 mm) and 0.1875 in. (4.8 mm) thicknesses, average of 4 tests from 2 heats.
Mechanical Properties

**FIGURE 2 – TYPICAL ENGINEERING STRESS-STRAIN CURVE**

Typical engineering stress-strain curves for NITRONIC 30 Stainless Steel and Type 304 (tested in tension in the longitudinal direction) are shown in Figure 2.

**FIGURE 3 – NITRONIC 30 STAINLESS STEEL STRESS RUPTURE AT 1200 °F (648 °C)**

Time to Failure, hrs. vs. Stress, ksi. (MPa) comparison between Type 304 and NITRONIC® 30 SS.
Mechanical Properties

NITRONIC 30 Stainless Steel offers superior fatigue resistance due to its higher strength relative to other austenitic stainless steels like Type 304. Figures 4 through 7 show the excellent fatigue resistance of NITRONIC 30 Stainless Steel that may benefit users in the transport and vibratory equipment industries.

**FIGURE 4 – NITRONIC 30 STAINLESS STEEL UNIAXIAL FATIGUE 0.072 in. SHEET COLD ROLLED + ANNEALED R = 0.5 TRANSVERSE DIRECTION**

![Uniaxial Fatigue graph](image1)

**FIGURE 5 – NITRONIC 30 STAINLESS STEEL REVERSE BEND FATIGUE 0.072 in. SHEET COLD ROLLED + ANNEALED R = -1 TRANSVERSE DIRECTION**

![Reverse Bend Fatigue graph](image2)
**Mechanical Properties**

**Figure 6** – NITRONIC 30 STAINLESS STEEL UNIAXIAL FATIGUE 0.1875 in. PLATE HOT ROLLED + ANNEALED R = 0.1, 16 TO 20 Hz, TRANSVERSE DIRECTION

- **UTS**: 119 ksi
- **YS**: 59.3 ksi
- **%EL**: 53.1%
- **HRB**: 95

Endurance Limit = 60 ksi.

**Figure 7** – NITRONIC 30 STAINLESS STEEL NOTCHED UNIAXIAL FATIGUE 0.1875 in. PLATE HOT ROLLED + ANNEALED R = 0.1, 16 Hz, KT = 3, TRANSVERSE DIRECTION

- **UTS**: 119 ksi
- **YS**: 59.3 ksi
- **%EL**: 53.1%
- **HRB**: 95

Endurance Limit = 34 ksi.
Wear Resistance

The following tables and figures demonstrate the outstanding corrosive wear resistance of NITRONIC 30 Stainless Steel under many different sliding conditions. The stainless steels as a class are much more abrasion resistant than abrasion resistant (AR) steels under even mildly corrosive conditions. NITRONIC 30 Stainless Steel is more cost effective than AK Steel 409 Ni and Type 304 which are sometimes used in wet abrasive applications.

### TABLE 8 – METAL-TO-METAL WEAR*

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Wear, mg/1000 cycles**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25 RPM</td>
</tr>
<tr>
<td>Type 4340</td>
<td>C52</td>
<td>0.8</td>
</tr>
<tr>
<td>Stellite 6</td>
<td>C48</td>
<td>1.1</td>
</tr>
<tr>
<td>Hadfield Mn</td>
<td>B95</td>
<td>1.7</td>
</tr>
<tr>
<td>NITRONIC 30 SS</td>
<td>B93</td>
<td>1.9</td>
</tr>
<tr>
<td>NITRONIC 32 SS</td>
<td>B95</td>
<td>2.4</td>
</tr>
<tr>
<td>4130 (H+400 °F S.R.)</td>
<td>C47</td>
<td>3.8</td>
</tr>
<tr>
<td>Type 304</td>
<td>B85</td>
<td>13.9</td>
</tr>
<tr>
<td>AK Steel 17-4 PH® SS</td>
<td>C43</td>
<td>45.3</td>
</tr>
<tr>
<td>(H900)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 410 (H+600 °F S.R.)†</td>
<td>C40</td>
<td>–</td>
</tr>
<tr>
<td>4130 (H+1000 °F S.R.)</td>
<td>C32</td>
<td>66.0</td>
</tr>
<tr>
<td>Type 410 (Annealed)</td>
<td>B95</td>
<td>–</td>
</tr>
</tbody>
</table>

*Self-mated crossed cylinders, 16 lbs. (71 N), 10,000 or 40,000 cycles, unlubricated, in air, room temperature, corrected for density differences.
**Relative wear rate for comparison of alloys and not for design purposes.
†H-hardened S.R: stress relieved

### TABLE 9 – METAL-TO-METAL WELD WEAR*

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness, C</th>
<th>Total Wear, (mated to 17-4 PH, Condition H900), 105 RPM mg/100 cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>NITRONIC 30 SS Weld**</td>
<td>24</td>
<td>27.58</td>
</tr>
<tr>
<td>Type 420 Weld 1150 °F</td>
<td>34</td>
<td>68.32</td>
</tr>
</tbody>
</table>

*Self-mated crossed cylinders, 16 lbs. (71 N), 10,000 or 40,000 cycles, unlubricated, in air, room temperature, corrected for density differences.
**Weldment in stationary position.
Wear Resistance

### TABLE 10 – DRY ABRASIVE WEAR

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Volume of Metal Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Alloy Wear-Mated to WC, mm³/10,000 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>105 RPM</td>
</tr>
<tr>
<td>Type 4340</td>
<td>C52</td>
<td>0.1</td>
</tr>
<tr>
<td>Colmonoy 6</td>
<td>C56</td>
<td>0.1</td>
</tr>
<tr>
<td>NITRONIC 30 SS</td>
<td>B93</td>
<td>1.9</td>
</tr>
<tr>
<td>NITRONIC 32 SS</td>
<td>B96</td>
<td>2.8</td>
</tr>
<tr>
<td>Type 304</td>
<td>B85</td>
<td>4.2</td>
</tr>
<tr>
<td>Type 431</td>
<td>C42</td>
<td>6.2</td>
</tr>
<tr>
<td>AK Steel 17-4 PH SS</td>
<td>C42</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.9</td>
</tr>
</tbody>
</table>

*Crossed cylinders, 16 lbs. (71 N), 10,000 or 40,000 cycles, unlubricated, in air, room temperature, corrected for density differences.

### TABLE 11 – CORROSIVE WEAR HUB TEST*

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Wear, mm³</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5% NaCl + 0.5% Acetic Acid</td>
<td></td>
</tr>
<tr>
<td>NITRONIC 30 SS</td>
<td>B91</td>
<td>8.15</td>
<td>2.79</td>
</tr>
<tr>
<td>AK Steel 17-4 PH SS</td>
<td>C46</td>
<td>11.95</td>
<td>3.32</td>
</tr>
<tr>
<td>NITRONIC 33 SS</td>
<td>B94</td>
<td>13.74</td>
<td>3.40</td>
</tr>
<tr>
<td>Type 409</td>
<td>B85</td>
<td>28.50</td>
<td>10.56</td>
</tr>
<tr>
<td>Hadfield Mn</td>
<td>B93</td>
<td>39.20</td>
<td>2.28</td>
</tr>
<tr>
<td>4340</td>
<td>C49</td>
<td>45.47</td>
<td>2.27</td>
</tr>
</tbody>
</table>

*Abrasives: 2.5 liters pea sized gravel plus slag, 1 liter angular quartz, 400 hrs., 1000 in./min. tip speed, 0.095 in. (2.4 mm) sheet thickness, triplicate tests, sheet specimens mounted on hub rotating in and out of slurry.*
Wear Resistance

**FIGURE 8 – CORROSIVE WEAR OF ALLOY AND STAINLESS STEELS**

Hub Machine, tip speed – 83 ft./min., 200 hours, R.T. 1500 ml AFS 50/70 sand, 1500 ml slag, 1500 ml pea size gravel, pH 8.8 – 9.2, duplicates, specimens immersed 2.25 in. in slurry.

Distilled water – 1500 ml
### Wear Resistance

#### TABLE 12 – BALL MILL TEST

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Wear, mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>NITRONIC 30 SS</td>
<td>B91</td>
<td>4.89</td>
</tr>
<tr>
<td>NITRONIC 33 SS</td>
<td>B94</td>
<td>6.46</td>
</tr>
<tr>
<td>AK Steel 17-4 PH SS</td>
<td>C46</td>
<td>7.00</td>
</tr>
<tr>
<td>Type 304</td>
<td>B75</td>
<td>7.76</td>
</tr>
<tr>
<td>Type 409</td>
<td>B85</td>
<td>10.15</td>
</tr>
<tr>
<td>Astralloy V</td>
<td>C45</td>
<td>32.14</td>
</tr>
<tr>
<td>Type 434</td>
<td>C49</td>
<td>36.54</td>
</tr>
</tbody>
</table>

#### TABLE 13 – CORROSIVE WEAR OF ALLOY AND STAINLESS STEELS IN A COAL MINE EFFLUENT*

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Cumulative Volume Loss, mm³</th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astralloy V</td>
<td>C45</td>
<td></td>
<td>3.50</td>
<td>11.45</td>
<td>20.17</td>
</tr>
<tr>
<td>ANSI 4340</td>
<td>C48</td>
<td></td>
<td>4.25</td>
<td>12.76</td>
<td>21.75</td>
</tr>
<tr>
<td>Type 409</td>
<td>B85</td>
<td></td>
<td>3.80</td>
<td>5.46</td>
<td>8.99</td>
</tr>
<tr>
<td>AK Steel 17-4 PH SS</td>
<td>C44</td>
<td></td>
<td>1.51</td>
<td>4.55</td>
<td>7.39</td>
</tr>
<tr>
<td>NITRONIC 30 SS</td>
<td>B90</td>
<td></td>
<td>1.31</td>
<td>4.27</td>
<td>7.13</td>
</tr>
<tr>
<td>Type 304</td>
<td>B75</td>
<td></td>
<td>1.58</td>
<td>4.98</td>
<td>8.30</td>
</tr>
<tr>
<td>Type 316</td>
<td>B73</td>
<td></td>
<td>2.08</td>
<td>7.39</td>
<td>12.56</td>
</tr>
</tbody>
</table>

*Test Conditions: Laboratory ball mill, 0.64 m/s, room temperature. Five 16-hr. periods, pH 6.7, 2 liters of coal mine effluent, 0.2 liters pea size gravel – 6.4 mm + 3.2 mm, duplicate sheet specimens.

#### FIGURE 9 – CORROSIVE WEAR OF ALLOY AND STAINLESS STEELS

Ball Mill – Synthetic Nickel Mine Water

Speed – 126 ft./min., R.T., pH 9.1 – 9.6 2000 ml of 2 g/l sulfate + 0.2 g/l chloride ion 100 ml – 1/4 in. + 1/8 in. and 100 ml – 3/8 in. + 1/4 in. pea sized gravel.
**Wear Resistance**

**TABLE 14 – CORROSIVE WEAR OF STEEL, STAINLESS STEELS AND CAST IRONS IN A COAL PREPARATION PLANT**

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Rockwell Hardness</th>
<th>Metal Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mils/year</td>
</tr>
<tr>
<td>NITRONIC 30 SS (Annealed)</td>
<td>B94</td>
<td>0.3</td>
</tr>
<tr>
<td>NITRONIC 30 SS (Tensilized)</td>
<td>C33</td>
<td>0.3</td>
</tr>
<tr>
<td>Type 304</td>
<td>B90</td>
<td>0.4</td>
</tr>
<tr>
<td>Type 316</td>
<td>B85</td>
<td>0.4</td>
</tr>
<tr>
<td>Type 410 (Annealed)</td>
<td>B81</td>
<td>0.5</td>
</tr>
<tr>
<td>Type 301</td>
<td>C36</td>
<td>0.6</td>
</tr>
<tr>
<td>F45009 (Ni Hard* #1)</td>
<td>C55</td>
<td>1.6</td>
</tr>
<tr>
<td>F45003 (Ni Hard* #4)</td>
<td>C42</td>
<td>13.1</td>
</tr>
<tr>
<td>F45001 (White Cast)</td>
<td>C58</td>
<td>51.5</td>
</tr>
<tr>
<td>AISI 1044</td>
<td>B84</td>
<td>68.4</td>
</tr>
</tbody>
</table>

*Trademark of The International Nickel Co.*

**TABLE 15 – NITRONIC 30 STAINLESS STEEL THE RUST RESISTANT STEEL**

<table>
<thead>
<tr>
<th>Category</th>
<th>AR500</th>
<th>AK Steel 409 Ni</th>
<th>Type 304</th>
<th>AK Steel NITRONIC 30 SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formability</td>
<td>Very Poor</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Weldability</td>
<td>Very Poor</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>Poor</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Corrosive Wear (CW)</td>
<td>4.50</td>
<td>3.10</td>
<td>1.60</td>
<td>1.00</td>
</tr>
<tr>
<td>Alloy Cost Factor (ACF)</td>
<td>1.00</td>
<td>1.16</td>
<td>1.49</td>
<td>1.42</td>
</tr>
<tr>
<td>Life Cycle Cost Factor (CW x ACF)</td>
<td>4.50</td>
<td>3.60</td>
<td>2.40</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Typical Applications: buckets, ore separator screens, hopper cars, chutes, distributors.
Corrosion Resistance

NITRONIC 30 Stainless Steel exhibits good corrosion resistance to a variety of media. Pitting resistance, as measured by tests in 10% FeCl₃ solution, is better than Type 304. In sulfuric acid and hydrochloric acid, NITRONIC 30 Stainless Steel is much better than Types 409 and 410, and approaches Type 304 in more dilute solutions. However, caution should be used with reducing acids. Activated NITRONIC 30 Stainless Steel may not repassivate when exposed to HCl or H₂SO₄ and significant corrosion may occur. Typical laboratory test data obtained on these alloys are shown in Table 16.

**TABLE 16 – IMMERSION TESTS IN VARIOUS MEDIA**

<table>
<thead>
<tr>
<th>Test Medium</th>
<th>Corrosion Rates in IPY (unless otherwise indicated)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NITRONIC 30 SS</td>
</tr>
<tr>
<td>65% HNO₃ @ Boiling</td>
<td>0.043</td>
</tr>
<tr>
<td>50% H₃PO₄ @ Boiling</td>
<td>0.008</td>
</tr>
<tr>
<td>5% Formic @ 80 °C</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1% H₂SO₄ @ 80 °C</td>
<td>&lt; 0.001 – 0.360</td>
</tr>
<tr>
<td>1% HCl @ 35 °C</td>
<td>&lt; 0.001 – 0.012</td>
</tr>
<tr>
<td>2% HCl @ 35 °C</td>
<td>0.100</td>
</tr>
<tr>
<td>33% Acetic @ Boiling</td>
<td>Nil</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Immersion tests of 1 x 2 in. sheet coupons in lab-annealed (1950 °F – 5 min. – AC) condition for NITRONIC 30 Stainless Steel, and mill-annealed for the other alloys. Results are the average of duplicate specimens exposed for five 48-hour periods. Those specimens tested at 35 °C and at 80° C were intentionally activated for the third, fourth and fifth periods. Where both active and passive conditions occurred, the averages of both are shown.

<sup>(2)</sup> Average of three 48-hour periods, not activated.

INTERGRANULAR ATTACK

Intergranular attack tests were performed following the procedures of ASTM A262 on duplicate annealed sheet specimens of NITRONIC 30 Stainless Steel and Type 304. Before testing, some of these specimens were heat treated at 1250 °F (675 °C) for one hour and air cooled to exaggerate the conditions that might be found in the heat-affected zones of heavy weldments. Results are shown in Table 17.

**TABLE 17 – INTERGRANULAR CORROSION RESISTANCE OF NITRONIC 30 STAINLESS STEEL**

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Practice C Treatment</th>
<th>Practice E Boiling 65% HNO₃ (Huey Test)</th>
<th>Copper – Accelerated Copper Sulfate</th>
</tr>
</thead>
<tbody>
<tr>
<td>NITRONIC 30 SS</td>
<td>Annealed 1250 °F (675 °C) 1 hr.</td>
<td>0.0034 IPM 0.0052 IPM</td>
<td>Passed Passed</td>
</tr>
<tr>
<td>Type 304</td>
<td>Annealed 1250 °F (675 °C) 1 hr.</td>
<td>0.0010 IPM 0.0620 IPM</td>
<td>Passed Failed Badly</td>
</tr>
</tbody>
</table>

Note that although the nitric acid attack rate for NITRONIC 30 Stainless Steel in the annealed condition is higher than that for Type 304, it did not increase greatly with the 1250 °F (675 °C) heat treatment. This indicates that there would be little tendency for preferential attack of weldments in service. NITRONIC 30 Stainless Steel is currently limited to a maximum 0.03% carbon content.
Oxidation Resistance

**FIGURE 10 – CYCLIC OXIDATION AT 1000 °F (538 °C)**

![Graph showing oxidation resistance at 1000 °F.](image)

**FIGURE 11 – CYCLIC OXIDATION AT 1250 °F (677 °C) 1000 CYCLES OF 15 MIN. HEATING + 5 MIN. COOLING**

![Bar chart comparing weight gain for different stainless steels.](image)
Weldability

The austenitic class of stainless steels is generally considered to be weldable by the common fusion and resistance techniques including high frequency tube and pipe welding. Special consideration is required to avoid weld "hot cracking" by assuring formation of ferrite in the weld deposit. This particular alloy is generally considered to have similar weldability to the most common alloy of this stainless class, Type 304L. A major difference is that the alloy requires slower arc welding speed to obtain penetration. When a weld filler is needed, AWS E/ER 308L, 309L and 209 are most often specified. Additional information concerning the welding of austenitic stainless steels can be obtained in the following references:

1. ANSI/AWS A5.9, A5.22, and A5.4 (stainless welding electrode specifications).
3. ANSI/AWS B2.1.009:2002 (GTAW 300’s @ 0.50 – 0.14 in.).
4. ANSI/AWS B2.1-8-024:2001 (GTAW 300’s @ 0.125 – 1.5 in.).
5. ANSI/AWS B2.1.013:1997 (SMAW 300’s @ 0.050 – 0.14 in.).
6. ANSI/AWS B2.1-8-023-94 (SMAW 300’s @ 0.125 – 1.5 in.).
7. ANSI/AWS B2.1.005:2002 (GMAW 300’s @ 0.050 – 0.14 in.).
Weldability

STRESS-CORROSION CRACKING
As shown by Table 18, the threshold stress for cracking of NITRONIC 30 Stainless Steel in boiling 42% MgCl₂ solution is about 25 ksi (172 MPa), compared with about 10 ksi (69 MPa) for Types 304 and 304L. This suggests that NITRONIC 30 Stainless Steel is more resistant than these alloys to cracking in hot MgCl₂ solutions at lower stress levels. At higher stress levels about 25 ksi (172 MPa) and above the MgCl₂ stress corrosion cracking resistance of NITRONIC 30 Stainless Steel appears similar to Types 304 and 304L.

### TABLE 18 – TYPICAL MECHANICAL PROPERTIES OF NITRONIC 30 IN AUTOGENOUS TUNGSTEN ARC WELDING*

<table>
<thead>
<tr>
<th>Area Tested</th>
<th>Thickness, in. (mm)</th>
<th>UTS, ksi. (MPa)</th>
<th>0.2% YS, ksi. (MPa)</th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, B</th>
</tr>
</thead>
<tbody>
<tr>
<td>As-Welded (Stressed Transverse to Weld Direction)</td>
<td>0.060 (1.52)</td>
<td>119.1 (821)</td>
<td>57.6 (397)</td>
<td>50.7</td>
<td>87</td>
</tr>
<tr>
<td>Unwelded (Annealed)</td>
<td>0.060 (1.52)</td>
<td>113.0 (779)</td>
<td>46.1 (318)</td>
<td>55.7</td>
<td>87</td>
</tr>
<tr>
<td>Unwelded (As Hot Rolled)</td>
<td>0.112 (2.8)</td>
<td>120.4 (829)</td>
<td>48.9 (337)</td>
<td>60.0</td>
<td>90</td>
</tr>
</tbody>
</table>

*GTA Welded vs. Unwelded; 40.1122050 °F (1121 °C)
Mechanical properties from duplicate tests.

### TABLE 19 – WELD BEND TEST RESULTS*

<table>
<thead>
<tr>
<th>Bend Direction</th>
<th>Bend Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Face</td>
<td>OT</td>
</tr>
<tr>
<td>Weld Root</td>
<td>OT</td>
</tr>
</tbody>
</table>

*NITRONIC 30 hot-rolled and pickled sheet 0.112 in. (2.8 mm) has been autogenous gas tungsten arc welded to make bend tests.
Bend tests on this material (HR Condition) were successfully flattened (0 bend diameter) when either the weld face or weld root was in tension, illustrating the excellent formability of as-welded NITRONIC 30 Stainless Steel.

### TABLE 20 – TENSILE PROPERTIES OF NITRONIC 30 GTAW WELDED PIPE (1.25 in. (31.8 mm) OD, 0.135 in. (3.4 mm) WALL THICKNESS)

<table>
<thead>
<tr>
<th></th>
<th>Elongation % in 2&quot; (50.8 mm)</th>
<th>Rockwell Hardness, C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Metal*</td>
<td>40.1</td>
<td>34</td>
</tr>
<tr>
<td>As-Welded**</td>
<td>37.8</td>
<td>–</td>
</tr>
</tbody>
</table>

*Taken from pipe side wall away from weld.
**Weld parallel to specimen length; cut from pipe side wall. 1 heat – duplicate tests.
Cryogenic Impact Properties

**FIGURE 12 – IMPACT TOUGHNESS EFFECT OF TEMPERATURE ON THE IMPACT TOUGHNESS OF NITRONIC 30 STAINLESS STEEL, TYPE 304 AND TYPE 409**

**TABLE 21 – CRYOGENIC IMPACT STRENGTH OF ANNEALED SHEET AND PLATE**

<table>
<thead>
<tr>
<th>Thickness, in. (mm)</th>
<th>Direction</th>
<th>Number of Tests</th>
<th>Test Temperature, °F (°C)</th>
<th>Impact Energy, W/A in.-lbs./in² (mm•N/mm²)</th>
<th>Lateral Expansion, mils (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.130 (3)</td>
<td>Longitudinal</td>
<td>2</td>
<td>-100 (-73)</td>
<td>9340 (1633)</td>
<td>18.5 (0.73)</td>
</tr>
<tr>
<td>0.130 (3)</td>
<td>Transverse</td>
<td>2</td>
<td>-100 (-73)</td>
<td>7257 (1269)</td>
<td>15.2 (0.60)</td>
</tr>
<tr>
<td>0.130 (3)</td>
<td>Longitudinal</td>
<td>2</td>
<td>-320 (-196)</td>
<td>5557 (972)</td>
<td>9.6 (0.38)</td>
</tr>
<tr>
<td>0.130 (3)</td>
<td>Transverse</td>
<td>2</td>
<td>-320 (-196)</td>
<td>3606 (631)</td>
<td>7.5 (0.29)</td>
</tr>
<tr>
<td>0.1875 (5)</td>
<td>Transverse</td>
<td>3</td>
<td>-320 (-196)</td>
<td>4626 (809)</td>
<td>21.7 (0.86)</td>
</tr>
<tr>
<td>0.50 (13)</td>
<td>Transverse</td>
<td>5</td>
<td>-320 (-196)</td>
<td>5597 (979)</td>
<td>27.8 (1.10)</td>
</tr>
</tbody>
</table>

Weld Metal w/notch in HAZ**

<table>
<thead>
<tr>
<th>Thickness, in. (mm)</th>
<th>Direction</th>
<th>Number of Tests</th>
<th>Test Temperature, °F (°C)</th>
<th>Impact Energy, W/A in.-lbs./in² (mm•N/mm²)</th>
<th>Lateral Expansion, mils (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 (13)</td>
<td>Transverse</td>
<td>5</td>
<td>-320 (-196)</td>
<td>4068 (711)</td>
<td>18.5 (0.73)</td>
</tr>
</tbody>
</table>

*ASTM A353 and A20
**With 308L Filler Metal
Cryogenic Impact Properties

TABLE 22 – CRYOGENIC IMPACT STRENGTH OF ANNEALED NITRONIC 30 STAINLESS STEEL PLATE

<table>
<thead>
<tr>
<th>Thickness, in. (mm)</th>
<th>Test Temperature, °F (°C)</th>
<th>Direction</th>
<th>Impact Strength Charpy V-Notch, ft.-lbs. (J)</th>
<th>Lateral Expansion, mils (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.875 (22)</td>
<td>-100 (-73)</td>
<td>Lateral</td>
<td>125 (167)</td>
<td>69 (1.8)</td>
</tr>
<tr>
<td></td>
<td>-150 (-101)</td>
<td>Lateral</td>
<td>77 (103)</td>
<td>47 (1.2)</td>
</tr>
<tr>
<td></td>
<td>-320 (-195)</td>
<td>Transverse</td>
<td>25 (33)</td>
<td>14 (0.4)</td>
</tr>
</tbody>
</table>

*Average of 4 tests.
Formability

**TABLE 23 – FORMABILITY**

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Olsen Cup Height, in. (mm)</th>
<th>3 in. Stretch Cup</th>
<th>LDR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NITRONIC 30 SS Base Metal</td>
<td>0.480 (12.2)</td>
<td>1.40</td>
<td>2.04</td>
</tr>
<tr>
<td>NITRONIC 30 SS Weld Face in Tension</td>
<td>0.483 (12.3)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>NITRONIC 30 SS Weld Root in Tension</td>
<td>0.498 (12.6)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Type 301 Base Metal</td>
<td>0.480 (12.2)</td>
<td>–</td>
<td>2.06</td>
</tr>
<tr>
<td>Type 304L Base Metal</td>
<td>–</td>
<td>1.14</td>
<td>2.04</td>
</tr>
</tbody>
</table>

*Limiting Draw Ratio

**TABLE 24 – EFFECT OF STRENGTH LEVEL ON FORMABILITY ASTM E643 BIAXIAL STRETCH (Cup Height)**

<table>
<thead>
<tr>
<th>0.2% YS, ksi. (MPa)</th>
<th>Type 304L, in. (mm)</th>
<th>NITRONIC 30 SS, in. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 (276)</td>
<td>0.43 (11)</td>
<td>–</td>
</tr>
<tr>
<td>50 (345)</td>
<td>0.39 (10)</td>
<td>0.52 (13)</td>
</tr>
<tr>
<td>60 (414)</td>
<td>0.36 (9)</td>
<td>0.46 (12)</td>
</tr>
<tr>
<td>60 (483)</td>
<td>0.34 (9)</td>
<td>0.40 (10)</td>
</tr>
<tr>
<td>80 (552)</td>
<td>0.32 (8)</td>
<td>0.37 (9)</td>
</tr>
<tr>
<td>90 (621)</td>
<td>0.31 (8)</td>
<td>0.34 (9)</td>
</tr>
<tr>
<td>100 (689)</td>
<td>0.30 (8)</td>
<td>0.33 (8)</td>
</tr>
</tbody>
</table>
### Physical Properties

**TABLE 25 – PHYSICAL PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, lbs./in.³ (g/cm³)</td>
<td>@70 °F (21 °C) 0.284 (7.862)</td>
</tr>
<tr>
<td>Modulus of Elasticity, ksi. (MPa)</td>
<td>@ 70 °F (21 °C) 28.0 x 10⁶ (0.193 x 10⁹)</td>
</tr>
</tbody>
</table>

**TABLE 26 – MAGNETIC PERMEABILITY (ANNEALED)**

<table>
<thead>
<tr>
<th>Field Strength Oersteds</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.011</td>
</tr>
<tr>
<td>200</td>
<td>1.011</td>
</tr>
<tr>
<td>500</td>
<td>1.014</td>
</tr>
<tr>
<td>1000</td>
<td>1.015</td>
</tr>
</tbody>
</table>

**TABLE 27 – THERMAL EXPANSION**

<table>
<thead>
<tr>
<th>Temperature, °F</th>
<th>Relative Expansion %</th>
<th>Coefficient of Expansion, ΔL/L/°F x 10⁻⁶</th>
<th>Temperature, °C</th>
<th>Relative Expansion %</th>
<th>Coefficient of Expansion, ΔL/L/°C x 10⁻⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>79 – 200</td>
<td>0.123</td>
<td>9.35</td>
<td>26 – 50</td>
<td>0.048</td>
<td>16.13</td>
</tr>
<tr>
<td>79 – 300</td>
<td>0.223</td>
<td>9.60</td>
<td>26 – 100</td>
<td>0.135</td>
<td>16.90</td>
</tr>
<tr>
<td>79 – 400</td>
<td>0.326</td>
<td>9.81</td>
<td>26 – 150</td>
<td>0.225</td>
<td>17.29</td>
</tr>
<tr>
<td>79 – 500</td>
<td>0.432</td>
<td>10.01</td>
<td>26 – 200</td>
<td>0.317</td>
<td>17.64</td>
</tr>
<tr>
<td>79 – 600</td>
<td>0.541</td>
<td>10.18</td>
<td>26 – 250</td>
<td>0.413</td>
<td>17.95</td>
</tr>
<tr>
<td>79 – 700</td>
<td>0.654</td>
<td>10.35</td>
<td>26 – 300</td>
<td>0.511</td>
<td>18.24</td>
</tr>
<tr>
<td>79 – 800</td>
<td>0.766</td>
<td>10.50</td>
<td>26 – 350</td>
<td>0.611</td>
<td>18.51</td>
</tr>
<tr>
<td>79 – 900</td>
<td>0.884</td>
<td>10.63</td>
<td>26 – 400</td>
<td>0.713</td>
<td>18.77</td>
</tr>
<tr>
<td>79 – 1000</td>
<td>1.002</td>
<td>10.75</td>
<td>26 – 450</td>
<td>0.817</td>
<td>19.00</td>
</tr>
<tr>
<td>79 – 1100</td>
<td>1.123</td>
<td>10.88</td>
<td>26 – 500</td>
<td>0.922</td>
<td>19.20</td>
</tr>
<tr>
<td>79 – 1200</td>
<td>1.245</td>
<td>11.00</td>
<td>26 – 550</td>
<td>1.029</td>
<td>19.41</td>
</tr>
<tr>
<td>79 – 1300</td>
<td>1.368</td>
<td>11.11</td>
<td>26 – 600</td>
<td>1.137</td>
<td>19.61</td>
</tr>
<tr>
<td>79 – 1400</td>
<td>1.492</td>
<td>11.21</td>
<td>26 – 650</td>
<td>1.248</td>
<td>19.80</td>
</tr>
<tr>
<td>79 – 1500</td>
<td>1.619</td>
<td>11.31</td>
<td>26 – 700</td>
<td>1.358</td>
<td>19.98</td>
</tr>
<tr>
<td>79 – 1600</td>
<td>1.749</td>
<td>11.42</td>
<td>26 – 750</td>
<td>1.470</td>
<td>20.14</td>
</tr>
</tbody>
</table>

*Average of duplicate tests. Full heating curves available upon request.
AK Steel Corporation
9227 Centre Pointe Drive
West Chester, OH 45069
844.STEEL99 | 844.783.3599
www.aksteel.com
sales@aksteel.com

AK Steel is a leading producer of flat-rolled carbon, stainless and electrical steel products, primarily for the automotive, infrastructure and manufacturing, electrical power generation and distribution markets. Through its subsidiaries, the company also provides customer solutions through carbon and stainless steel tubing products, die design and tooling, and hot and cold stamping. Headquartered in West Chester, Ohio (Greater Cincinnati), the company employs approximately 9,200 men and women at manufacturing operations across seven states (Alabama, Indiana, Kentucky, Michigan, Ohio, Pennsylvania and West Virginia), as well as Canada and Mexico. Additional information about AK Steel is available at www.aksteel.com.

The information and data in this document are accurate to the best of our knowledge and belief, but are intended for general information only. Applications suggested for the materials are described only to help readers make their own evaluations and decisions, and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications.

Data referring to material properties are the result of tests performed on specimens obtained from specific locations of the products in accordance with prescribed sampling procedures; any warranty thereof is limited to the values obtained at such locations and by such procedures. There is no warranty with respect to values of the materials at other locations.

SAFETY | QUALITY | PRODUCTIVITY | INNOVATION

MAKING INNOVATION HAPPEN

AK and the AK Steel logo are registered trademarks of the AK Steel Corporation. ©2018 AK Steel. All Rights Reserved.