AISI 1020 Low Carbon/Low Tensile Steel

Introduction

AISI 1020 is a low hardenability and low tensile carbon steel with Brinell hardness of 119 – 235 and tensile strength of 410-790 MPa. It has high machinability, high strength, high ductility and good weldability. It is normally used in turned and polished or cold drawn condition. Due to its low carbon content, it is resistant to induction hardening or flame hardening. Due to lack of alloying elements, it will not respond to nitriding. However, carburization is possible in order to obtain case hardness more than Rc65 for smaller sections that reduces with an increase in section size. Core strength will remain as it has been supplied for all the sections. Alternatively, carbon nitriding can be performed, offering certain benefits over standard carburizing.

AISI 1020 steel can be largely utilized in all industrial sectors in order to enhance weldability or machinability properties. It is used in a variety of applications due to its cold drawn or turned and polished finish property.

Chemical Composition

The chemical composition of AISI 1020 steel is:

<table>
<thead>
<tr>
<th>Element</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon, C</td>
<td>0.17 - 0.230 %</td>
</tr>
<tr>
<td>Iron, Fe</td>
<td>99.08 - 99.53 %</td>
</tr>
<tr>
<td>Manganese, Mn</td>
<td>0.30 - 0.60 %</td>
</tr>
</tbody>
</table>
Physical Properties

The physical properties of AISI 1020 steel are:

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Metric</th>
<th>Imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>7.87 g/cc</td>
<td>0.284 lb/in³</td>
</tr>
</tbody>
</table>

Mechanical Properties

The mechanical properties of AISI 1020 steel are:

<table>
<thead>
<tr>
<th>Mechanical Properties</th>
<th>Metric</th>
<th>Imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness, Brinell</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td>Hardness, Knoop (Converted from Brinell hardness)</td>
<td>129</td>
<td>129</td>
</tr>
<tr>
<td>Hardness, Rockwell B(Converted from Brinell hardness)</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Hardness, Vickers (Converted from Brinell hardness)</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Tensile Strength, Ultimate</td>
<td>394.72 MPa</td>
<td>57249 psi</td>
</tr>
<tr>
<td>Tensile Strength, Yield</td>
<td>294.74 MPa</td>
<td>42748 psi</td>
</tr>
<tr>
<td>Elongation at Break (in 50 mm)</td>
<td>36.5 %</td>
<td>36.5 %</td>
</tr>
<tr>
<td>Reduction of Area</td>
<td>66.0 %</td>
<td>66.0 %</td>
</tr>
<tr>
<td>Modulus of Elasticity (Typical for steel)</td>
<td>200 GPa</td>
<td>29000 ksi</td>
</tr>
<tr>
<td>Bulk Modulus (Typical for steel)</td>
<td>140 GPa</td>
<td>20300 ksi</td>
</tr>
<tr>
<td>Poissons Ratio</td>
<td>0.290</td>
<td>0.290</td>
</tr>
<tr>
<td>Charpy Impact</td>
<td>16.9 J</td>
<td>12.5 ft-lb</td>
</tr>
<tr>
<td>@Temperature -30.0 °C/-22.0 °F</td>
<td>18.0 J</td>
<td>13.3 ft-lb</td>
</tr>
<tr>
<td>@Temperature -18.0 °C/-0.400 °F</td>
<td>20.0 J</td>
<td>14.8 ft-lb</td>
</tr>
<tr>
<td>@Temperature -3.00 °C/26.6 °F</td>
<td>24.0 J</td>
<td>17.7 ft-lb</td>
</tr>
<tr>
<td>@Temperature 10.0 °C/50.0 °F</td>
<td>41.0 J</td>
<td>30.2 ft-lb</td>
</tr>
<tr>
<td>@Temperature 38.0 °C/100 °F</td>
<td>54.0 J</td>
<td>39.8 ft-lb</td>
</tr>
<tr>
<td>@Temperature 65.0 °C/149 °F</td>
<td>61.0 J</td>
<td>45.0 ft-lb</td>
</tr>
<tr>
<td>@Temperature 95.0 °C/203 °F</td>
<td>68.0 J</td>
<td>50.2 ft-lb</td>
</tr>
<tr>
<td>@Temperature 150 °C/302 °F</td>
<td>125 J</td>
<td>92.2 ft-lb</td>
</tr>
<tr>
<td>Shear Modulus (Typical for steel)</td>
<td>80.0 GPa</td>
<td>11600 ksi</td>
</tr>
</tbody>
</table>

Machining

In the cold drawn or turned and polished condition, AISI 1020 steel has high machinability. As per recommendations of machine manufacturers, AISI 1020 steel can be used for drilling, turning, milling and tapping operations using suitable feeds, tool type and speeds.

Weldability

AISI 1020 can be welded by performing the most common welding processes. In the cold drawn or turned and polished condition, it has better weldability. It has been suggested that the welding process should not be performed in heat treated or carburized condition.

Heat Treatment

Annealing

Related Stories

- New Generation Mini Laser Bars produce Exceptional Brilliance from 910 to 1020 nm (/news.aspx?newsID=17597)
- AISI 1020 Carbon Steel (UNS G10200) (/article.aspx?ArticleID=9145)

Related ANSI Standards

- ASTM E110-14: Standard Test Method for Rockwell and Brinell Hardness of Metallic Materials by Portable Hardness Testers
AISI 1020 steel is heated at 870°C - 910°C followed by holding for certain time until the temperature remains constant all over the section. It is then cooled in a furnace.

**Carburizing**

AISI 1020 is heated to between 880°C - 920°C in a suitable carburizing atmosphere followed by holding for sufficient amount of time to produce the needed carbon content and case depth. After this, refining/hardening and tempering processes are carried out to optimize the core and case properties.

**Core Refining**

AISI 1020 steel is slowly cooled and re-heated at 870°C - 900°C followed by holding until the temperature remains constant all over the section and quenching in water, oil or brine.

**Case Hardening**

After performing the core refining process, it is re-heated to 760°C - 780°C followed by holding until the temperature is consistent all over the section. It is then quenched in water.

**Tempering**

AISI 1020 steel is re-heated at 150°C - 200°C followed by holding for certain time until the temperature remains constant throughout the section. It is soaked for 1 hour per 25 mm of section and then cooled under normal atmosphere. By performing the tempering process, the toughness of the case will be improved and grinding cracks will be reduced.

**Normalizing**

AISI 1020 steel is heated at 890°C - 940°C followed by holding until the temperature remains constant throughout the section. It is soaked for 10 - 15 minutes and then cooled in still air.

**Stress Relieving**

AISI 1020 steel is heated to 650°C - 700°C followed by holding until the temperature remains constant all over the section and soaking for 1 hour per 25 mm of section. It is then cooled in still air.

**Applications**

AISI 1020 steel is used in case hardened condition. The applications of AISI 1020 steel are:

- It is used for simple structural application such as cold headed bolts.
- AISI 1020 steel also finds use in the following components:
  - axles
  - general engineering parts and components
  - machinery parts
  - shafts
  - camshafts
  - gudgon pins
  - ratchets
  - light duty gears
  - worm gears and
  - spindles
Comments

Yousif Drizzy says:
March 24, 2014 at 2:47 PM
My question is, is it easier or more difficult to form martensite in a 1020 steel than in a eutectoid steel?

Reply 0 0

Andy Saputra says:
September 17, 2016 at 11:54 PM
u need to analyze both of the isothermal diagram of the eutectoid steel to this one.

Reply 0 0

Pintu Chaurasiya says:
April 20, 2015 at 4:57 PM
my question is which one is best for gears of baja car either 1020 or en 353 ?

Reply 0 0

Heubach Mahendra says:
April 18, 2016 at 9:34 AM
AISI 1017
AISI 1018
AISI 4130

Reply 0 0

Saima Muneer says:
February 24, 2017 at 11:27 PM
what is the austenitizing temperature of 1020 steel and what type of micro structural changes take place during heat treatment and austenitization.

Reply 1 0

Saima Muneer says:
February 24, 2017 at 11:29 PM
thank you

Reply 0 0

vinay kumar says:
March 21, 2017 at 2:16 AM
I Would like to make a Go Kart .which is the best material in high strength in mediam costand light in weight

Reply 0 0

NASHORNS PCCOER says:
April 26, 2017 at 2:41 PM
BEST SUITABLE MATERIAL FOR BAJA CHASSIS MANUFACTURING. MAIN FOCUS ON COST, WEIGHT, STRENGTH
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