Nitrogen-containing Martensitic Stainless Steel

控氮马氏体不锈钢
控氮马氏体不锈钢暂行供货技术条件
Nitrogen-containing martensitic stainless steel temporary supply conditions

控氮马氏体不锈钢
以传统马氏体不锈钢为基础，降低钢中的碳含量，增加一定的氮，并调整锰、钒、铬等合金元素的含量，开发了新型控氮型马氏体不锈钢，显著提升了刀具用钢的性能。

Nitrogen-containing martensitic stainless steel
The new series of nitrogen–containing martensitic stainless steels are developed on the basis of traditional grades by reducing carbon content, adding nitrogen and adjusting manganese, vanadium, chromium contents, improve the properties of knife tool steel.

交付状态 Delivery status
以热轧退火状态或NO.1状态交货。
Be supplied in coils either not annealed or annealed–and–pickled.

牌号和化学成分 Grade and chemical composition

<table>
<thead>
<tr>
<th>钢号 Grade</th>
<th>C</th>
<th>Si</th>
<th>P</th>
<th>S</th>
<th>Mn</th>
<th>Cr</th>
<th>Mo</th>
<th>V</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>20C13N</td>
<td>0.12~0.16</td>
<td>≤0.10</td>
<td>≤0.10</td>
<td>≤0.005</td>
<td>≤0.010</td>
<td>13.50~14.50</td>
<td>-</td>
<td>-</td>
<td>≤0.12</td>
</tr>
<tr>
<td>20C13NH</td>
<td>0.16~0.20</td>
<td>≤0.10</td>
<td>≤0.10</td>
<td>≤0.005</td>
<td>≤0.010</td>
<td>13.50~14.50</td>
<td>-</td>
<td>-</td>
<td>≤0.12</td>
</tr>
<tr>
<td>3C14N</td>
<td>0.21~0.27</td>
<td>≤0.10</td>
<td>≤0.15</td>
<td>≤0.005</td>
<td>≤0.010</td>
<td>13.50~14.50</td>
<td>-</td>
<td>0.15</td>
<td>≤0.12</td>
</tr>
<tr>
<td>4C14N</td>
<td>0.28~0.34</td>
<td>≤0.10</td>
<td>≤0.15</td>
<td>≤0.005</td>
<td>≤0.010</td>
<td>13.50~14.50</td>
<td>-</td>
<td>-</td>
<td>≤0.12</td>
</tr>
<tr>
<td>4Cr15MoVN</td>
<td>0.30~0.35</td>
<td>≤0.10</td>
<td>≤0.15</td>
<td>≤0.005</td>
<td>≤0.010</td>
<td>14.50~15.50</td>
<td>0.50~1.00</td>
<td>0.15</td>
<td>≤0.15</td>
</tr>
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</table>

力学性能 Mechanical properties

<table>
<thead>
<tr>
<th>钢号 Grade</th>
<th>抗拉强度(MPa)</th>
<th>屈服强度(MPa)</th>
<th>伸长率(%)</th>
<th>硬度Hv</th>
<th>备注 Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>20C13N</td>
<td>≥520</td>
<td>≥225</td>
<td>≥18</td>
<td>≤234</td>
<td>热处理状态 Heat treatment</td>
</tr>
<tr>
<td>20C13NH</td>
<td>≥520</td>
<td>≥225</td>
<td>≥18</td>
<td>≤234</td>
<td>热处理状态 Heat treatment</td>
</tr>
<tr>
<td>3C14N</td>
<td>≥550</td>
<td>≥225</td>
<td>≥18</td>
<td>≤250</td>
<td>热处理状态 Heat treatment</td>
</tr>
<tr>
<td>4C14N</td>
<td>≥550</td>
<td>≥225</td>
<td>≥18</td>
<td>≤250</td>
<td>热处理状态 Heat treatment</td>
</tr>
<tr>
<td>4Cr15MoVN</td>
<td>≥550</td>
<td>≥225</td>
<td>≥15</td>
<td>≤250</td>
<td>热处理状态 Heat treatment</td>
</tr>
</tbody>
</table>

供货规格 Specification available

<table>
<thead>
<tr>
<th>钢号 Grade</th>
<th>宽度(mm) Width</th>
<th>厚度(mm) Thickness</th>
<th>交货状态 Delivery status</th>
<th>边部 Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>20C13N</td>
<td>1000~1250</td>
<td>3<del>10 3</del>7</td>
<td>酸洗黑皮 Annealed</td>
<td>机边 Mill edge</td>
</tr>
<tr>
<td>20C13NH</td>
<td>1000~1250</td>
<td>3<del>10 3</del>5</td>
<td>酸洗黑皮 Annealed</td>
<td>机边 Mill edge</td>
</tr>
<tr>
<td>3C14N</td>
<td>1000~1250</td>
<td>3<del>10 3</del>4</td>
<td>酸洗黑皮 Annealed</td>
<td>机边 Mill edge</td>
</tr>
<tr>
<td>4C14N</td>
<td>1000~1250</td>
<td>3~10</td>
<td>酸洗黑皮 Annealed</td>
<td>机边 Mill edge</td>
</tr>
<tr>
<td>4Cr15MoVN</td>
<td>1000~1250</td>
<td>3~10</td>
<td>酸洗黑皮 Annealed</td>
<td>机边 Mill edge</td>
</tr>
</tbody>
</table>

注: 其他规格及未尽事宜可由双方协议确定。
Else specification can be determined by agreement.
宝钢不锈钢事业部控氮型马氏体不锈钢产品

有害物质和重金属含量说明

宝钢生产的控氮型马氏体不锈钢产品主要用于餐具、刀具和其他与人体接触的制品。为保证人体安全性，宝钢采取了严格措施控制钢中有害物质和重金属的含量，每年在SGS检测机构按RoHS和LFGB等国际标准对产品进行检测。

在SGS的历次检测中，产品的有害物质和重金属离子析出水平全部达到了标准要求。由此可以认为，宝钢控氮型马氏体不锈钢产品严格控制了有害物质的含量，能够通过RoHS标准中有关有害金属元素残留量的检测；经过适当热处理后，重金属析出量较少，能够通过德国《食品与日用品法》（LFGB）第三十和三十一条中有关重金属离子析出限量的检测。

质量负责人签名

宝钢不锈钢事业部

2010年9月
宝山钢铁股份有限公司
http://www.baosteel.com

不锈钢事业部（本部）

地址：上海市浦东新区580号
邮编：200431
电话：021-26034567
传真：021-26034993

宁波宝新不锈钢有限公司

地址：宁波市经济技术开发区（北仑港区）
邮编：315807
电话：0574-86718888
传真：0574-86907128

技术服务中心

电话：021-26034993

国内贸易公司

上海宝钢不锈钢贸易有限公司
电话：021-66933311
传真：021-66932873

佛山宝钢不锈钢加工配送有限公司
电话：0757-26602888
传真：0757-26602303

西宁宝钢不锈钢贸易有限公司
电话：0931-8766050
传真：0931-8766090

成都宝钢西部贸易有限公司
电话：028-85335888
传真：028-85335680

天津宝钢北方贸易有限公司
电话：022-84405680
传真：022-84405856

沈阳宝钢钢材配送有限公司
电话：024-82205899
传真：024-82210186

青岛宝钢钢材配送有限公司
电话：0532-86792822
传真：0532-86798880

济南宝钢钢材配送有限公司
电话：0531-61324015
传真：0531-61324018

亚洲地区 Asia and Australia

宝和通商株式会社
HOWA TRADING CO., LTD.
TEL 0081-3-3237-9121
FAX 0081-3-3237-9123

宝和通商首尔事务所
HOWA TRADING CO., LTD., SEOUL OFFICE
TEL 0082-2-5050893
FAX 0082-2-5050891

宝钢新加坡贸易有限公司
BAOSTEEL SINGAPORE PTE LTD.
TEL 0065-63336818
FAX 0065-63330819

宝钢澳大利亚贸易有限公司
BAO AUSTRALIA Pty Ltd.
TEL 0061-8-94810535
FAX 0061-8-94810536

欧非地区 Europe and Africa

宝钢欧洲有限公司
BAOSTEEL EUROPE GmbH
TEL 0049-40-41949101
FAX 0049-40-41949120

宝钢西班牙有限公司
BAOSTEEL ESPAÑA, S.L.
TEL 0034-93-4119325
FAX 0034-93-4119330

宝钢中东公司
BAOSTEEL MIDDLE EAST FZE
TEL 00971-4-4810789
FAX 00971-4-8810789

美洲地区 America

宝钢美洲贸易有限公司
BAOSTEEL AMERICA INC.
TEL 001-201-3073355
FAX 001-201-3073358

洛杉矶代表处
LOS ANGELES REPRESENTATIVE OFFICE
TEL 001-949-7526789
FAX 001-949-7821234

迈特律代表处
DETROIT REPRESENTATIVE OFFICE
TEL 001-248-2069916
FAX 001-248-2060999

休斯顿代表处
HOUSTON REPRESENTATIVE OFFICE
TEL 001-281-4647333
FAX 001-281-4848695
4Cr15MoVN

4Cr15MoVN is a medium-chromium nitrogen-containing martensitic grade, featuring the existence of molybdenum and vanadium, as well as the following:

- Delivery as-annealed (or softened), good workability.
- After heat treatment the grade is characterised by high hardness and toughness, as well as good corrosion resistance and wear resistance.

### Chemical composition

<table>
<thead>
<tr>
<th></th>
<th>Typical value, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.32</td>
</tr>
<tr>
<td>Si</td>
<td>0.36</td>
</tr>
<tr>
<td>Mn</td>
<td>0.80</td>
</tr>
<tr>
<td>Cr</td>
<td>14.70</td>
</tr>
<tr>
<td>Mo</td>
<td>0.60</td>
</tr>
<tr>
<td>V</td>
<td>0.10</td>
</tr>
<tr>
<td>N</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Product condition

Be only supplied in coils hot annealed, 1250mm (nominal) in width, 3.0-9.5mm in thickness, and coil weight 22 tons in maximum. Tolerance tables are referred to Baosteel’s standard Q/BQB4301-2009.

### Typical microstructure

1. 退火组织
   - 经过退火后的组织为铁素体基体+颗粒状的碳化物，其中碳化物均匀分布在基体中。这种组织使材料具有较低的硬度和较高的延伸率，使材料易于加工。
   - 1. as-annealed microstructure
      - A matrix of ferrite and uniformly dispersed granular carbides, making the steel grades very soft and easy to be further worked.

2. 正火组织
   - 马氏体+细颗粒碳化物+少量的残余奥氏体，这种组织使材料具有高硬度、良好的耐蚀性，还具有一定的韧性。经过深冷处理后可以消除残余奥氏体组织。
   - 2. as-hardened microstructure
      - A structure of martensite, granular carbides and small amount of retained austenite, exhibiting high hardness, good corrosion resistance, and toughness suitable for the application. The retained austenite can be eliminated by deep freezing treatment.

### Hardened hardness

<table>
<thead>
<tr>
<th></th>
<th>Hardness</th>
<th>Temperature</th>
<th>Cooling type</th>
</tr>
</thead>
<tbody>
<tr>
<td>57HRC</td>
<td>1050℃</td>
<td>Air cooling</td>
<td></td>
</tr>
<tr>
<td>58HRC</td>
<td>1075℃</td>
<td>Air cooling</td>
<td></td>
</tr>
<tr>
<td>57HRC</td>
<td>1100℃</td>
<td>Air cooling</td>
<td></td>
</tr>
<tr>
<td>58HRC</td>
<td>1100℃</td>
<td>Air cooling</td>
<td></td>
</tr>
<tr>
<td>60HRC</td>
<td>1100℃</td>
<td>Deep-freezing (~70℃)</td>
<td></td>
</tr>
</tbody>
</table>

### Tempering hardness

Heat treatment principals:

- Hardening temperature no higher than 1100℃ is recommended in order not to avoid the loss of hardness and corrosion resistance. But hardening below 1050℃ may result in low hardness.
- Long soaking time in quenching should be avoided as not to lose hardness.
- Above 350℃, rapid cooling is preferable: below 350℃, air or oil cooling is recommended.
- Deep freezing increases the hardness with about 2 HRC.
- Corrosion resistance deteriorates above 500℃ in tempering.
- Re-quenching treatment is not recommended.

### Disclaimer

4Cr15MoVN is a proprietary alloy of Baosteel. Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions.
3Cr14N/4Cr14N

3Cr14N and 4Cr14N are nitrogen-containing martensitic grades, featuring as follows:

- Delivery as-annealed (or softened), good workability.
- After heat treatment, the two grades are characterised by high hardness and toughness, as well as good corrosion resistance.

### Chemical composition

<table>
<thead>
<tr>
<th>Grade</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>N</th>
<th>Typical value, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Cr14N</td>
<td>0.25</td>
<td>0.30</td>
<td>1.00</td>
<td>14.25</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>4Cr14N</td>
<td>0.30</td>
<td>0.30</td>
<td>0.70</td>
<td>13.75</td>
<td>-</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Mechanical properties

<table>
<thead>
<tr>
<th>Grade</th>
<th>Delivery status</th>
<th>Yield strength (MPa)</th>
<th>Tensile strength (MPa)</th>
<th>Elongation</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Cr14N</td>
<td>Annealed</td>
<td>315</td>
<td>630</td>
<td>28</td>
<td>180</td>
</tr>
<tr>
<td>4Cr14N</td>
<td>Annealed</td>
<td>310</td>
<td>635</td>
<td>27</td>
<td>190</td>
</tr>
</tbody>
</table>

### Product condition

3Cr14N and 4Cr14N are hot-rolled or annealed or annealed and pickled. 3Cr14N can be supplied in coils, whereas 4Cr14N can only be supplied in hot-rolled coils.

### Typical microstructure

1. *Annealed microstructure:
   - A matrix of ferrite and uniformly dispersed granular carbides, making the steel grades very soft and easy to be further worked.

2. *As-hardened microstructure:
   - A structure of martensite, exhibiting high hardness, good corrosion resistance, and toughness suitable for the application.

### Hardened hardness

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>3Cr14N</th>
<th>4Cr14N</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>56</td>
<td>57</td>
</tr>
<tr>
<td>200</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>250</td>
<td>53</td>
<td>54</td>
</tr>
<tr>
<td>300</td>
<td>52</td>
<td>53</td>
</tr>
</tbody>
</table>

### Tempering hardness

Above 350°C, brittleness of the grades occurs and corrosion resistance decreases.

### Heat treatment guidelines

- Hardening temperature range: 1050–1100°C. Air cooling (or normalizing) is good enough.
- Deep-freezing is not effective in increasing hardness.
- Brittness occurs with tempering above 350°C and corrosion resistance deteriorates.
- Re-quenching treatment is not recommended.

### Disclaimer

Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions.
2Cr13N and 2Cr13NH are new kinds of martensitic stainless steel by reducing carbon and adding nitrogen on the basis of typical 2Cr13. The two grades have high hardness, as well as corrosion resistance.

### Chemical composition

<table>
<thead>
<tr>
<th>Grade</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Cr13N</td>
<td>0.14</td>
<td>0.50</td>
<td>0.50</td>
<td>13.70</td>
<td>0.08</td>
</tr>
<tr>
<td>2Cr13NH</td>
<td>0.17</td>
<td>0.45</td>
<td>0.60</td>
<td>14.25</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Product condition

Currently, 2Cr13N and 2Cr13NH can be supplied in coils either hot annealed or annealed-and-pickled. The coils of the two grades can be 1000mm or 1250mm (nominal) in width, 3.0-10.0mm thick in hot annealed condition and 3.0-7.0mm in pickled condition, and coil weight 22 tons in maximum. Tolerance tables are referred to Baosteel's standard Q/BQB4301-2009.

### Mechanical properties

<table>
<thead>
<tr>
<th>Grade</th>
<th>Delivery status</th>
<th>Yield strength MPa</th>
<th>Tensile strength MPa</th>
<th>Elongation %</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Cr13N</td>
<td>Annealed</td>
<td>310</td>
<td>565</td>
<td>32</td>
<td>170</td>
</tr>
<tr>
<td>2Cr13NH</td>
<td>Annealed</td>
<td>320</td>
<td>570</td>
<td>31</td>
<td>172</td>
</tr>
</tbody>
</table>

### Hardened hardness

<table>
<thead>
<tr>
<th>Grade</th>
<th>Heat treatment</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Cr13N</td>
<td>1000-1150℃ Air cooling</td>
<td>≥48</td>
</tr>
<tr>
<td>2Cr13NH</td>
<td>1000-1150℃ Air cooling</td>
<td>≥52</td>
</tr>
<tr>
<td>2Cr13</td>
<td>1000-1150℃ Air cooling</td>
<td>≥48</td>
</tr>
</tbody>
</table>
2Cr13N/2Cr13NH

2Cr13N exhibits much better corrosion resistance than 2Cr13, as shown in the salt spray test.

Typical microstructure

1. as-annealed microstructure
   A matrix of ferrite and uniformly dispersed carbides.

2. as-hardened microstructure
   A matrix of martensitic, showing appropriate hardness, good corrosion resistance. Since the lower carbon content, it also has relatively good toughness.

Heat treatment principals

- Hardening temperature range: 1000~1150°C
- Air cooling (or normalizing) is good enough
- Oil quenching provides better microstructure and performance
- Deep-freezing is not effective in increasing hardness

Disclaimer

This document is intended as general guidance, and specific information or guidance for specific applications can only be confirmed after a detailed review of specific conditions.

High pitting potential corresponds to high corrosion resistance. As shown in the electrochemical test in 26°C, 3.5% NaCl solution, 2Cr13N exhibits much better pitting resistance than 2Cr13.