The German national technical approval for use of stainless steels in structural applications

Fourth International Structural Stainless Steel Experts Seminar
London 6 and 7 December 2012

Dipl. Ing. Detlef Ulbrich (EWE)
Zulassungsbescheid

Zulassungsgegenstand: Nichtrostender Stahl
Antragsteller: Informationsstelle Edelstahl Rostfrei
Technisches Büro Bauwesen 4 Düsseldorf 11, Postfach 266
Geltungsbereich: Nordrhein-Westfalen
Geltungsdauer: bis 31. Januar 1977


Der Zulassungsbescheid umfasst 18 Seiten und alle Anlagen 6 Tafeln. Die Anlage ist Bestandteil des Zulassungsbescheides.


Allgemeine baufällig zugelassenen Zulassung

Zulassungsnummer: Z-30.3-6
Geltungsdauer bis: 30. April 2014

Antragsteller: Informationsstelle Edelstahl Rostfrei
Sohnstraße 65, 40237 Düsseldorf

Erzeugnisse, Verbindungsmittel und Bauteile aus nichtrostenden Stählen

## Contents

- **1** Subject of approval and field of application
  - **1.1** Subject of approval
  - **1.2** Field of application
- **2** Characteristics of the construction product
  - **2.1** Production, properties and composition of products and fasteners
    - **2.1.1** Steel grades, product forms, strength classes
    - **2.1.2** Technical delivery conditions for products according to Table 1 of Annex 1
    - **2.1.3** Technical delivery conditions for fasteners according to Table 2 of Annex 2
    - **2.1.4** Suitability for welding; filler metals
    - **2.1.5** Limit dimensions of the products and fasteners
    - **2.1.6** Corrosion protection of the construction products
  - **2.2** Package, transport, storage and marking of the products and the fastening elements
    - **2.2.1** Package, transport, storage
    - **2.2.2** Marking
  - **2.3** Verification of conformity
    - **2.3.1** General
    - **2.3.2** Factory production control
    - **2.3.3** Surveillance
- **3** Provisions for the design and calculation of structural parts and joints
  - **3.1** General
  - **3.1.1** Technical rules to be applied
  - **3.1.2** Different steel grades in a supporting structure
  - **3.2** Design
    - **3.2.1** Bolted connections
    - **3.2.2** Welded joints
  - **3.3** Structural design
    - **3.3.1** Characteristic values of mechanical properties for proofs of structural safety and serviceability
    - **3.3.2** Stress strain relations
    - **3.3.3** Delimitation criteria
    - **3.3.4** Service strength
    - **3.3.5** Proofs according to DIN 18800-1:2008-11
    - **3.3.6** Proofs according to DIN 18800-2, -3 and -4:2008-11
    - **3.3.7** Proofs according to DIN 18800-2:2008-11
    - **3.3.8** Proofs according to DIN 18800-3:2008-11
    - **3.3.9** Proofs according to DIN 18800-4:2008-11
    - **3.3.10** Proofs according to DIN 18808:1984-10 (structures made of hollow sections)
    - **3.3.11** Proof of the fatigue strength of façade elements
    - **3.3.12** Fire protection
4 Provisions for execution of the structural parts
  4.1 General
  4.2 Suitability for cutting
  4.3 Thermal treatment
  4.4 Cold forming
  4.5 Hot forming
  4.6 Performance of welding work
    4.6.1 General
    4.6.2 Arc welding (111, 121, 131, 135, 136, 141)
    4.6.3 Resistance spot welding (21)
    4.6.4 Flash welding (24) and upset welding (25)
    4.6.5 Stud welding (78)
    4.6.6 Friction welding (42)
    4.6.7 Laser beam welding (52)
    4.6.8 Electron beam welding (51)
    4.6.9 Flame-straightening
  4.7 Requirements on the welding manufacturers
    4.7.1 Constructor´s qualification for welding manufacturers
    4.7.2 Manufacturer´s qualification for firms producing welded joints
         between stainless steels and reinforcing steels
    4.7.3 Prerequisite for welding stainless steels
  4.8 Verification of compliance and marking of the components
  5 Provisions for acceptance, service and maintenance
    5.1 Acceptance
    5.2 Service and maintenance
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Number</th>
<th>Micro-structure</th>
<th>S 235</th>
<th>S 275</th>
<th>S 355</th>
<th>S 460</th>
<th>S 690</th>
<th>Corrosion Resistance Class</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X2CrNi12</td>
<td>1.4003</td>
<td>F</td>
<td>B, Ba, H, P</td>
<td>D, H, S, W</td>
<td>D, S</td>
<td>D, S</td>
<td>—</td>
<td>I / low</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X8Cr17</td>
<td>1.4016</td>
<td>F</td>
<td>D, S, W</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>X2CrNi18-9</td>
<td>1.4307</td>
<td>A</td>
<td>B, Ba, D, H, P, S, W</td>
<td>B, Ba, D, H, P, S</td>
<td>B, Ba, D, H, S</td>
<td>Ba, D, S</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>X3CrNiCu18-9-4</td>
<td>1.4557</td>
<td>A</td>
<td>D, S, W</td>
<td>D, S</td>
<td>D, S</td>
<td>—</td>
<td>—</td>
<td>II / moderate</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>X8CrNiTi18-10</td>
<td>1.4541</td>
<td>A</td>
<td>B, Ba, D, H, P, S, W</td>
<td>B, Ba, D, H, P, S</td>
<td>B, Ba, D, H, S</td>
<td>Ba, D, S</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>X2CrNi38</td>
<td>1.4318</td>
<td>A</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>B, Ba, D, H, P, S</td>
<td>B, Ba, H</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>X5CrNiMo17-12-2</td>
<td>1.4401</td>
<td>A</td>
<td>B, Ba, D, H, P, S, W</td>
<td>B, Ba, D, H, P, S</td>
<td>Ba, D, H, S</td>
<td>Ba, D, S</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>X2CrNiMo17-12-2</td>
<td>1.4404</td>
<td>A</td>
<td>B, Ba, D, H, P, S, W</td>
<td>B, Ba, D, H, P, S</td>
<td>Ba, D, H, S</td>
<td>Ba, D, S</td>
<td>D, S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>X3CrNiCuMo17-11-3-2</td>
<td>1.4578</td>
<td>A</td>
<td>D, S, W</td>
<td>D, S</td>
<td>D, S</td>
<td>—</td>
<td>—</td>
<td>III / medium</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>X5CrNiMoTi17-12-2</td>
<td>1.4571</td>
<td>A</td>
<td>B, Ba, D, H, P, S, W</td>
<td>B, Ba, D, H, P, S</td>
<td>Ba, D, H, S</td>
<td>Ba, D, S</td>
<td>D, S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>X2CrNiMo17-13-5</td>
<td>1.4439</td>
<td>A</td>
<td>—</td>
<td>—</td>
<td>B, Ba, D, H, S</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>X2CrNi23-4</td>
<td>1.4562</td>
<td>FA</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>B, Ba, D, S, W</td>
<td>D, S</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>X2CrNiMo22-5-3</td>
<td>1.4402</td>
<td>FA</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>B, Ba, D, P, S, W</td>
<td>D, S</td>
<td>IV / high</td>
</tr>
<tr>
<td>16</td>
<td>X2CrNiMoN28-18-5-4</td>
<td>1.4525</td>
<td>A</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>B, Ba, D, S</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>X1NiCrMoCu20-18-7</td>
<td>1.4547</td>
<td>A</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>B, Ba</td>
<td>—</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) according to DIN EN 10088-1:2005-09
2) A = Austenite, F = Ferrite, FA = Ferrite – Austenite (Duplex)
3) The strength classes higher than the lowest are achieved by cold-working.
4) B = Plate; Ba = Strip and plates made of strips; D = Wire, drawn; H = Hollow sections; P = Sections; S = Rods; W = Wire, rolled
5) Applies to metallic bright surfaces only. When bimetallic corrosion is possible the less noble metal may be jeopardised.
6) Required corrosion resistance class see Annex 1.1, Table 1a
<table>
<thead>
<tr>
<th>Exposure</th>
<th>Exposure class</th>
<th>Criteria and Examples</th>
<th>Corrosion Resistance Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>humidity, yearly average value U of humidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF0</td>
<td>dry</td>
<td>U &lt; 60 %</td>
<td>X</td>
</tr>
<tr>
<td>SF1</td>
<td>seldom moist</td>
<td>60 % ≤ U &lt; 80 %</td>
<td>X</td>
</tr>
<tr>
<td>SF2</td>
<td>often moist</td>
<td>80 % ≤ U &lt; 95 %</td>
<td>X</td>
</tr>
<tr>
<td>SF3</td>
<td>permanent moist</td>
<td>95 % &lt; U</td>
<td>X</td>
</tr>
<tr>
<td>chloride content of surrounding area, distance M from the sea, distance S from busy roads with road salt application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC0</td>
<td>low</td>
<td>rural, urban, M &gt; 10 km, S &gt; 0.1 km</td>
<td>X</td>
</tr>
<tr>
<td>SC1</td>
<td>medium</td>
<td>industrial area, 10 km ≤ M ≤ 1 km, 0.1 km ≤ S ≤ 0.01 km</td>
<td>X</td>
</tr>
<tr>
<td>SC2</td>
<td>high</td>
<td>M ≤ 1 km, S ≤ 0.01 km</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>SC3</td>
<td>very high</td>
<td>indoor swimming pool, road tunnel</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>exposure to redox affecting chemicals (e.g. SO₂, HClO, Cl₂, H₂O₂)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR0</td>
<td>low</td>
<td>rural, urban</td>
<td>X</td>
</tr>
<tr>
<td>SR1</td>
<td>medium</td>
<td>industrial area</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>SR2</td>
<td>high</td>
<td>indoor swimming pool, road tunnel</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>pH-value on the surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SH0</td>
<td>alkaline (e.g. with contact to concrete)</td>
<td>9 &lt; pH</td>
<td>X</td>
</tr>
<tr>
<td>SH1</td>
<td>neutral</td>
<td>5 &lt; pH ≤ 9</td>
<td>X</td>
</tr>
<tr>
<td>SH2</td>
<td>low acidic (e.g. with contact to wood)</td>
<td>3 &lt; pH ≤ 5</td>
<td>X</td>
</tr>
<tr>
<td>SH3</td>
<td>acidic (exposure to acids)</td>
<td>pH ≤ 3</td>
<td>X</td>
</tr>
<tr>
<td>location of structural parts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SL0</td>
<td>indoors</td>
<td>heated, not heated</td>
<td>X</td>
</tr>
<tr>
<td>SL1</td>
<td>outdoors, exposed to rain</td>
<td>exposed structures</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>SL2</td>
<td>outdoors, accessible but protected from weather</td>
<td>roofed structures</td>
<td>X^{(3)}</td>
</tr>
<tr>
<td>SL3</td>
<td>outdoors, non-accessible² with ambient air has access</td>
<td>accumulation of pollutants on surface by air pollution, cleaning not possible</td>
<td>X</td>
</tr>
</tbody>
</table>

---

Only the exposure leading to the highest Corrosion Resistance Class (CRC) has to be taken into account. No higher requirements result from the coincidence of exposure conditions.

---

² If **accessible** structures are cleaned regularly or exposed to rain corrosion will be much lower and the CRC may be reduced by one class. Otherwise the CRC has to be increased by one class if corrosion relevant substances can deposit and remain on the surfaces of structural parts.

³ If **accessible** structures are cleaned regularly corrosion will be much lower and the CRC may be reduced by one class.

⁴ If the life cycle is limited to 20 years and pitting corrosion up to 100 μm is tolerated CRC 1 may be chosen (no visual demands).

⁵ Structures are classified as non-accessible² if an inspection of their condition is extremely difficult and a necessary rehabilitation is very expensive.

---

Informationsstelle
Edelstahl Rostfrei
Sohnstr. 65
40237 Düsseldorf
Germany

Table 1a:
Choice of steel grade under atmospheric exposure

Annex 1.1a
to allgemeinen bauaufsichtlichen Zulassung Z-30.3-6 of 2 May 2011
3.3.7.10.5 Effective width for the procedure elastic-elastic

Corresponding to the conditions of the elements 711 to 713, the effective width \(b'\) is to be determined with the changes mentioned below.

The limit case \(\sigma = f_{y,d}\) mentioned in note 2 regarding element 712 is to be assumed.

Consequently, \(\bar{\lambda}_p\) is written instead of \(\bar{\lambda}_{p,\sigma}\).

\[
b' = 0.74 \cdot \left( \frac{1}{\bar{\lambda}_p^2} - \frac{0.22}{\bar{\lambda}_p^2} \right) \cdot b \\
\text{for } \bar{\lambda}_p > 0.673 \cdot \sqrt[4]{\frac{E_{sek,y}}{E}}
\]

Effective width with bearing on one side:

\[
b' = b \\
\text{for } \bar{\lambda}_p \leq 0.7 \cdot \sqrt[4]{\frac{E_{sek,y}}{E}}
\]

\[
b' = \left( \frac{0.68}{\bar{\lambda}_p^2} - \frac{0.11}{\bar{\lambda}_p^2} \right) \cdot b \\
\text{for } 0.7 \cdot \sqrt[4]{\frac{E_{sek,y}}{E}} < \bar{\lambda}_p < 0.6875
\]

\[
b' = \frac{0.52}{\bar{\lambda}_p} \cdot b \\
\text{for } \bar{\lambda}_p \geq 0.6875
\]

with \(E_{sek,y}\) = secant modulus according to 3.3.2.3.2(1),

\(E\) = modulus of elasticity according to Annex 8.1 and 8.2, Table 11, column 6.

Deviating from the factors defined in DIN 18800-2:2008-11, element 712, these are:

\[
\bar{\lambda}_p = \sqrt{\frac{f_{y,K}}{k \cdot \sigma_e}}
\]

\[
\sigma_e = 153 \, 600 \cdot \left( \frac{t}{b} \right)^2 \text{N/mm}^2
\]

In Table 27, line 1, the effective widths are to be determined as follows:
Thank you for your Attention