

Hot rolled Steel Plates, Sheets and Coils

Structural steels

Weather-resistant, ultra high-strength structural steel Optim 960 QCW

Ruukki's weather-resistant, ultra high-strength structural steel is based on our customer-oriented product development. This steel grade opens up new possibilities for designers to create lighter steel structures. Thanks to the good atmospheric corrosion resistance, additional coatings of the steel structures can be omitted, which brings a significant cost advantage in applications, where the objective is a dark brown patina on the steel surface.

Applications

- Electric power line pylons
- Steel structures for railways, roads, ski slopes, industrial facilities and similar out-door objects
- Chassis and bodywork of commercial vehicles

Ruukki is a metal expert you can rely on all the way, whenever you need metal based materials, components, systems or total solutions. We constantly develop our product range and operating models to match your needs.

Using the weather-resistant, ultra high-strength Optim structural steel will bring clear performance benefits in steel structures, vehicles and lifting equipment. Lighter steel structures, higher payloads for machinery and equipment and a lower energy consumption can be achieved. The manufacturing of steel products will become more efficient thanks to good weldability and flangeability and lower unit weight. The Optim steel is developed to promote environmentally sound construction and sustainable development.

- **Description of the steel grade**

Optim 960 QCW is a structural steel that has very high strength, good weather resistance and reasonable wear resistance. The surface quality, the accuracy of dimensions and consistency of properties are among the best in the market. The residual stress relief carried out by the “Dead Flat” process ensures good flatness and high usability of cut lengths.

- **Designation**

The figure in the designation for the weather-resistant, ultra high-strength structural steel, Optim 960 QCW, refers to the minimum yield strength in MPa. The letter “Q” stands for quenching, which is the manufacturing process and delivery condition for this grade. The letter “C” stands for cold formability. The letter “W” refers to weather-resistant steel.

- **Weather resistance and its applications**

The steel combines good atmospheric corrosion resistance with the high strength and hardness. Good atmospheric corrosion resistance means atmospheric corrosion properties at least equal to or better than with the COR-TEN® B steel grade. More information on weather resistance and its applications in steel structures can be found in the “Weather resistant structural steels” data sheet.

- **Delivery condition**

Quenched cut lengths.

- **Compliance with standards**

The steels are not compliant to any standards of structural or other steels.

- **Forms of delivery and dimensions**

The steel is delivered in cut lengths, the maximum width per thickness and the length range of which are shown in Table 1.

- **Tolerances on dimension and shape**

Thickness, width and length of cut lengths: tolerances as per EN 10051.

Flatness of cut lengths: tolerances as per EN 10029, class N, steel type H.

- **Dead Flat process (straightening rolling) of cut lengths**

Cut lengths delivered from the steel mill undergo the Dead Flat (DF) process, that is very powerful cold levelling. In this process, cut lengths are cold formed throughout their thickness, resulting in a plastic, i.e. permanent deformation. Any residual stresses are relieved and the cut length receives excellent flatness. Thanks to this, controlling welding distortions during workshop processes becomes easier and repeatability in flanging is improved. When being cut, DF products will maintain their flatness and no further straightening is required before the subsequent process stages. The DF process will be noted in the inspection document.

- **Chemical composition**

The chemical composition is shown in Table 2.

- **Carbon equivalent value (CEV)**

The typical carbon equivalent value (CEV) is 0.51.

$$CEV = C + Mn / 6 + (Cr + Mo + V) / 5 + (Cu + Ni) / 15$$

- **Mechanical properties**

The mechanical properties are shown in Table 3.

- **Wear resistance and hardness**

The mean hardness of the quenched Optim 960 QCW steel is slightly above 300 HBW, in other words twice the hardness of S355 structural steels. The high hardness and tensile strength indicate good wear resistance.

- **Materials testing**

The steel is tested according to the EN 10149-1:1995 standard (Hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions). The tensile test and impact tests are performed with test pieces longitudinal to the rolling direction. The flanging test is performed with transverse test pieces.

- **Inspection documents**

Inspection certificate EN 10204-3.1.

- **Forming**

The cold formability (i.e. at +20°C) of weather-resistant, ultra high-strength structural steel is good, considering strength level. This steel can be formed in any direction and the bend line can be placed independently of the rolling direction. The smallest tool's bending radius per thickness is shown in Table 4. Due to the higher

strength, the bending force, springback effect and the bending radius are greater than those for the S355 structural steel, for example.

To obtain full advantage of the formability, good engineering workshop techniques and careful design are essential. Worn tools, poor lubrication, surface defects and burrs on cut edges may all impair forming quality. Plates taken from a cold storage must be allowed to warm up to room temperature (+20°C) before forming. More information on forming can be obtained from the “Flanging and forming” data sheet.

● **Welding and other engineering workshop processes**

In welding and other engineering workshop processes, the properties of this steel grade are similar to the ultra high-strength Optim 960 QC structural steel. More information on welding and other workshop processes on ultra high-strength structural steels can be obtained from the “Optim QC” data sheet.

● **Work safety**

Workshop processing of hardened steel, such as bending, flanging or cutting, requires special care. The instructions issued by the steel supplier and high-quality workshop practices are essential aspects of safety.

● **Further information**

The following data sheets are related to the selection and use of the weather-resistant, ultra high-strength Optim 960 QCW structural steel: Weather resistant structural steels (COR-TEN®), Ultra high-strength Optim QC structural steels, Coil products production programme, Dimensional and shape tolerances, Welding, Thermal cutting and flame straightening, Flanging and forming, Mechanical cutting.

● **Maximum width per thickness and length range of cut lengths**

Table 1

	Thickness of cut lengths mm	Max width of cut lengths ¹⁾ mm
Optim 960 QCW	2.50 – 2.99	1300
Optim 960 QCW	3.00 – 3.99	1530
Optim 960 QCW	4.00 – 6.20	1560
Optim 960 QCW	6.21 – 6.40	1530

¹⁾ Max width of cut lengths, with mill edges.

Length range of cut lengths: 2,000 – 12,000 mm.

● **Chemical composition**

Table 2

	Maximum content % (ladle analysis)									
	C	Si	Mn	Cu ¹⁾	Cr ²⁾	Ni	P	S	P + S	Ti
Optim 960 QCW	0.12	0.25	1.20	0.70	1.50	0.50	0.020	0.010	0.030	0.07

¹⁾ Copper content no less than 0.25% Cu.

²⁾ Chromium content no less than 0.50% Cr.

In addition, aluminium (Al), niobium (Nb), vanadium (V), molybdenum (Mo) or boron (B) may be used either singly or in combination.

• **Mechanical properties**

Table 3

Steel grade	Thickness range mm	Yield strength R _{p0.2} MPa Minimum	Tensile strength R _m MPa Minimum	Elongation A ₅ % Minimum	Impact strength longitudinally ²⁾ t °C Charpy V J/cm ² Minimum
Optim 960 QCW ¹⁾	2.5 – 6.4	960	1000	7	-40 34 ²⁾

¹⁾ The yield and tensile strength are tested longitudinal to the rolling direction, but guaranteed both in the longitudinal and transverse direction. The elongation is tested longitudinal to the rolling direction.

²⁾ Impact strength is tested as Charpy V notch test in accordance with EN 10045-1. The impact strength value 34 J/cm² corresponds to the value 27 J for a full size 10 x 10 mm standard test pieces. No impact tests are carried out for thicknesses less than 6 mm.

• **Minimum bending radii for cut lengths of various thicknesses, bending angle 90°**

Table 4

	Thickness mm 3	(3) – 4	(4) – 5	(5) – 6	(6) – 6.4
	Minimum internal bending radius mm				
Optim 960 QCW	10.5	14.0	17.5	22.0	28.0

There are no restrictions for the location of the bend line. The formability of ultra high-strength steels is tested with the flanging test.

• **Our Customer Service is happy to give you further information**

Sales, Technical Customer Support

info.metals@ruukki.com

Rautaruukki Corporation, P.O. Box 138, FI-00811 Helsinki, Finland. tel. +358 20 5911

www.ruukki.com

This data sheet is accurate to the best of our knowledge and understanding. Although every effort has been made to ensure accuracy, The company cannot accept responsibility for any loss, damage or other consequence resulting from the use of this publication. We reserve the right to make changes.

Copyright © 2009 Rautaruukki Corporation. All rights reserved. Ruukki, Rautaruukki, More With Metals and Ruukki's product names are trademarks or registered trademarks of Rautaruukki Corporation. COR-TEN® is the registered trademark of United States Steel Corporation.