Material data sheet
Steel grade

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# 20MnCr5 All

## General Information

20MnCr5 is a case-hardening steel with low carbon content but good hardenability reaching good wear resistance due to high surface hardness after hardening. The small grain size benefits in good ductility and fatigue strength. Suitable for gearboxes and axle gears.

Ovako 236F is a standard variant with controlled sulphur content for consistent machining properties.

Ovako 236Q is an IQ (isotropic quality) variant.

### IQ-Steel®

IQ-Steel® is an isotropic quality ultra clean steel optimized for high fatigue strength under multi axial loading.

## Similar designations

20MnCrS5, 1.7147, 20MnCr4, 1.7149

## Chemical composition

| Variant | Cast | Di | Weldability | | C % | Si % | Mn % | P % | S % | Cr % | Ni % | Mo % | Cu % | Al % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 236Q | IC | | CEV $0.73_{max}$ | Min | 0.17 | 0.10 | 1.10 | - | - | 1.00 | 0.10 | - | - | 0.050 |
| | | | Pcm $0.38_{max}$ | Max | 0.22 | 0.25 | 1.30 | 0.025 | 0.002 | 1.20 | 0.25 | 0.08 | 0.25 | 0.200 |
| 236F | IC | | CEV $0.79_{max}$ | Min | 0.17 | 0.20 | 1.10 | - | 0.015 | 1.10 | - | - | - | 0.020 |
| | | | Pcm $0.4_{max}$ | Max | 0.22 | 0.35 | 1.40 | 0.025 | 0.025 | 1.30 | 0.25 | 0.08 | 0.30 | 0.040 |
| MC212 | CC | 3.11 | CEV $_{max}$ | Min | 0.17 | 0.15 | 1.10 | - | - | 1.00 | - | - | - | 0.020 |
| | | | Pcm $_{max}$ | Max | 0.22 | 0.40 | 1.40 | 0.025 | 0.035 | 1.30 | - | - | 0.30 | 0.040 |
| 20MnCr5 +H EN ISO 683-3 | Std | | CEV $_{max}$ | Min | 0.17 | 0.15 | 1.10 | - | - | 1.00 | - | - | - | - |
| | | | Pcm $_{max}$ | Max | 0.22 | 0.40 | 1.40 | 0.025 | 0.035 | 1.30 | - | - | 0.40 | - |

## Transformation temperatures

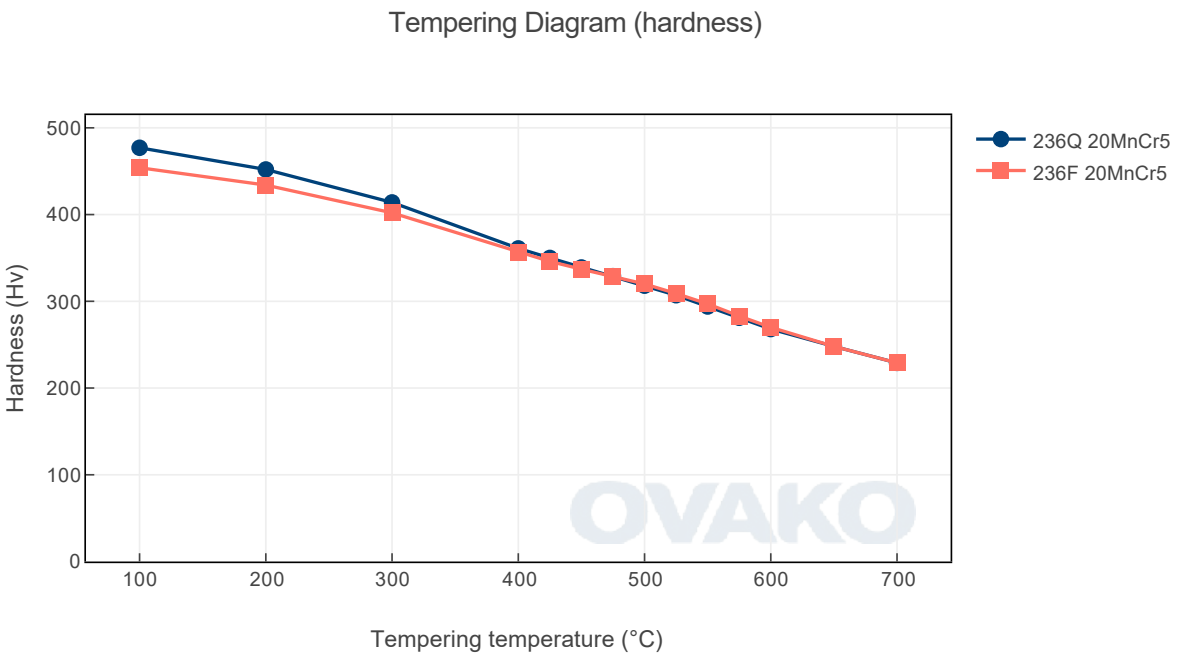
| | Temperature °C |
|---|---|
| MS | 385 |
| AC1 | 731 |
| AC3 | 831 |

## Heat treatment recommendations

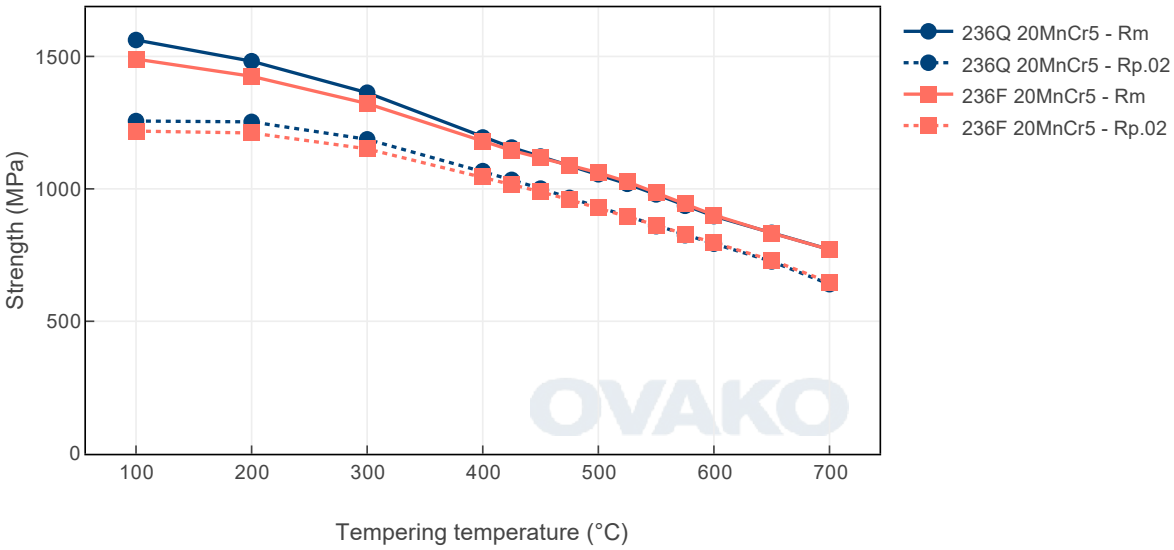
| Treatment | Condition | Temperature cycle | Cooling/quenching |
|---|---|---|---|
| Hot forging | | 850 - 1 200 | Slowly or in air |
| Annealing | +A | 670 - 710 | Slowly (15°C/h) until 600°C |
| | +FP | 950 - 1 000 | Quickly to following stage |
| | +FP | 630 - 650 | Keeping about 3 hours, after that: in air |
| Normalizing | | 860 - 890 | In air |
| Stress relieve annealing | | 650 - 680 | In air |
| Carburizing | | 860 - 900 | In air |
| Hardening | | 830 - 870 | Quenching in oil or water |
| Tempering | | 150 - 200 | In air |

## Heat Treatment Guide generated Graphs

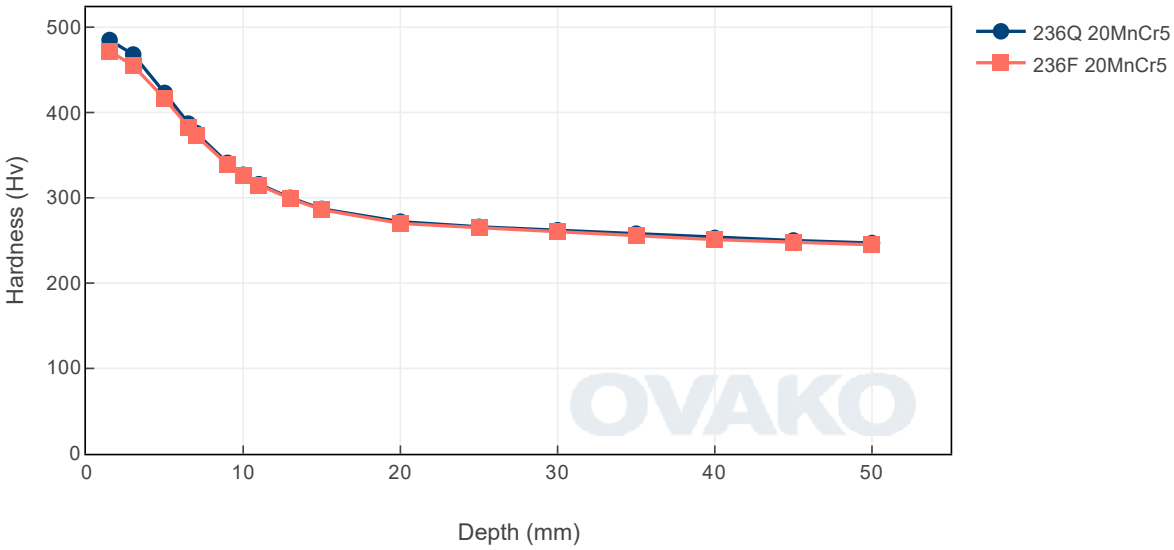
The following graphs are generated from a theoretical model. For further info see the Heat treatment guide module. Select a specific grade version for individual display.



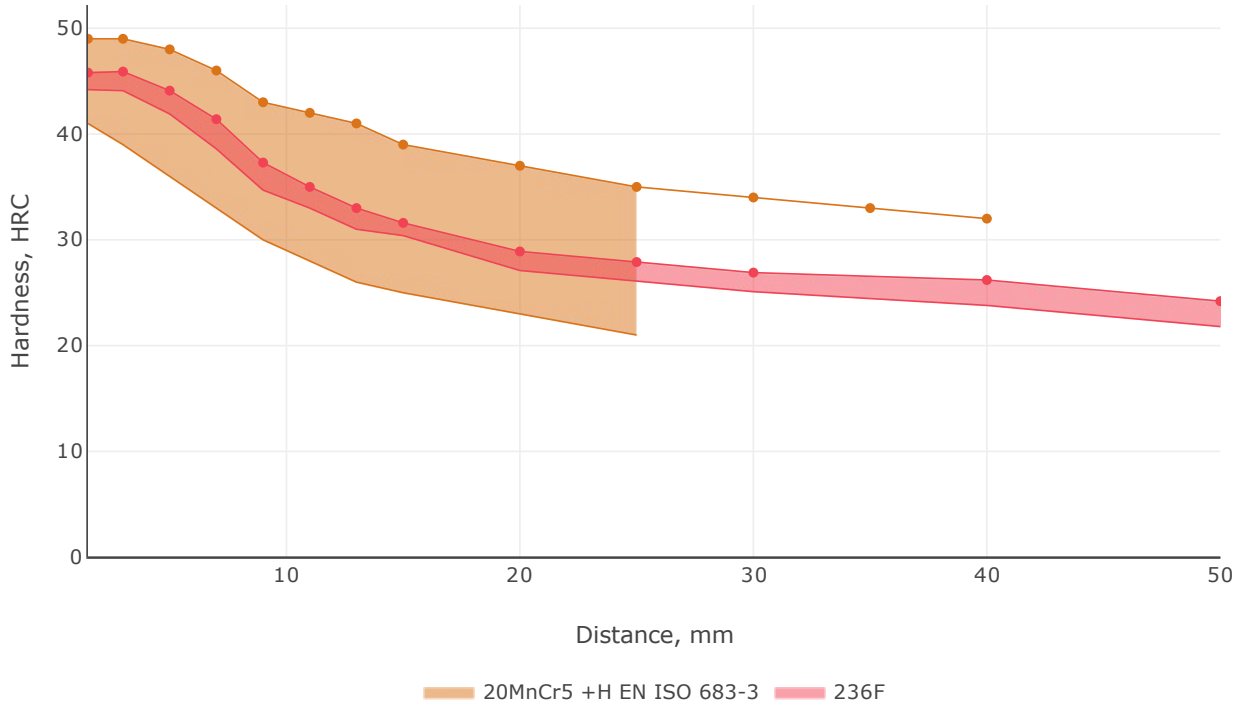
Tempering Diagram (strength)



# Jominy

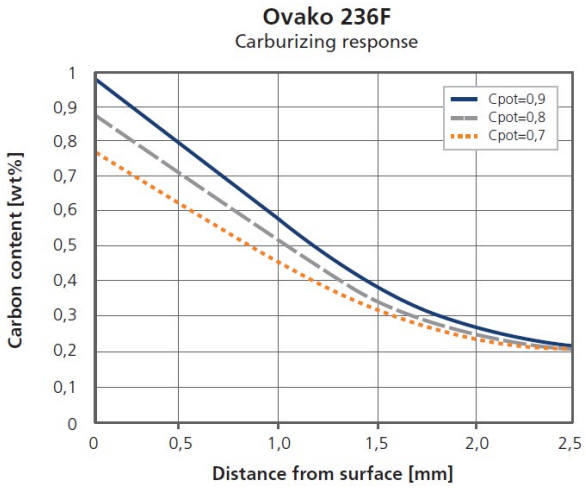

Hardness (Hv)
500
400
300
200
100
0
0
10
20
30
40
50
Depth (mm)
236Q 20MnCr5
236F 20MnCr5
OVAKO

## Hardenability

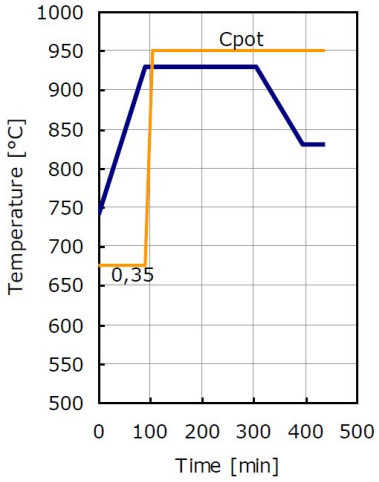



The hardenability is estimated from cast analysis. The hardenability can be verified with the end quench test if agreed on enquire and order.Jominy hardenability of Ovako 236F:  Measured average value with +/-standard deviation.

## Carburizing response




## Heat treatment



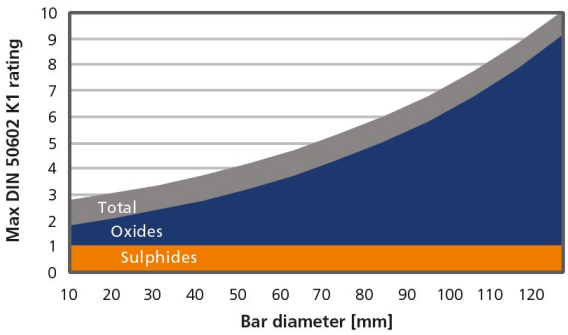
## Steel cleanliness

| Micro inclusions - steel grade 236F | | | | | | | | | Macro inclusions - 236F | |
|---|---|---|---|---|---|---|---|---|---|---|
| Applied standard | ASTM E45 | | | | | | | | Applied standard | ISO 3763<br>(Blue fracture) |
| Sampling | ASTM A295 | | | | | | | | Sampling | Statistical testing on billets. |
| Maximum average limits | A | | B | | C | | D | | Limits | < 2,5 mm/dm$^2$ |
| | Th | He | Th | He | Th | He | Th | He | | |
| | 2.5 | 1.5 | 1.5 | 0.5 | 0 | 0 | 0.5 | 0.5 | | |

| Micro inclusions - steel grade 236Q | | Macro inclusions - 236Q | | |
|---|---|---|---|---|
| Applied standard | DIN 50602 K1 | Applied standard | ISO 3763<br>(Blue fracture) | 10 M Hz UST<br>(Ovako internal procedure) |
| Sampling | Six random samples from final product dimension | Sampling | Statistical testing on billets | |
| Limits | The limit is dimension dependent. The average rating of six samples should not exceed the<br>limits given in the graph. | Limits | < 1 mm/dm$^2$ | < 10 defects/dm$^3$<br>> 0,2 mm FBH |

## IQ

**Inclusion limits IQ-processed steel**




## SUSTAINABILITY-ENVIRONMENTAL IMPACT DATA

At Ovako sustainability and reduction of our environmental impact is a major focus in everything we do.
Further information is found here.

In many international comparisons the crude steel Scope 1-2 emission is a key parameter, ie. the $CO_2$ emission from the steel works itself.
As of 1 January 2022 we carbon offset all our scope 1 and 2 volume shown below.

| Steel works | Hofors | Smedjebacken | Imatra |
|---|---|---|---|
| CO2e/kg | 120 | 62 | 76 |

To get the full picture of our products environmental impact we have to look at all of our $CO_2$ emission

sources.
Not only the steel work Scope 1-2 itself, but all operations downstream in our production, heating and heat treatment furnaces etc (full scope 1-2) as well as all the emission from input material, eg. alloys, scope 3.

| Steel Grade | Format | Condition | Scope 1-3 (CO2e kg /1000 kg steel) | Climate compensated Net emission = Scope 3 (CO2e kg /1000 kg steel) Scope 1 - 2 = 0 (compensated) |
|---|---|---|---|---|
| 236 | Round bar | +AR | 612 | 216 |
| 236 | Round bar | +SA | 618 | 217 |
| 236 | Tube,wall | +AR | 629 | 226 |
| 236 | Tube,wall | +SA | 631 | 226 |

To get the full picture of our products environmental impact we have to look at all of our $CO_2$ emission sources.
Not only the steel work Scope 1-2 itself, but all operations downstream in our production, heating and heat treatment furnaces etc (full scope 1-2) as well as all the emission from input material, eg. alloys, scope 3.

## Other properties (typical values)

| Youngs module (GPa) | Poisson´s ratio (-) | Shear module (GPa) | Density (kg/m3) |
|---|---|---|---|
| 210 | 0.3 | 80 | 7800 |
| **Average CTE 20-300°C (µm/m°K)** | **Specific heat capacity 50/100°C (J/kg °K)** | **Thermal conductivity Ambient temperature (W/m°K)** | **Electrical resistivityAmbient temperature (µΩm)** |
| 12 | 460 - 480 | 40 - 45 | 0.20 - 0.25 |

### Contact us

Would you like to know more about our offers? Don´t hesitate to contact us:

Via e-mail: info@ovako.com

Via telephone: +46 8 622 1300

For more detailed information please visit http://www.ovako.com/en/Contact-Ovako/