Material data sheet
# Steel grade

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OVAKO

# 32CrMoV12-10* All

### General Information

Ovako 398Q is an ingot cast high tensile quench and tempering steel with high hardenability. The grade has high strength and toughness. The strong carbide and nitride formers makes it very well suited for nitriding. The grade is produced with the quality class IQ (isotropic quality). This ensures a very low number of elongated sulphide inclusions which will give more isotropic properties.

** Designation followed by "*" is not an official EN standard grade but named according to the rules in EN 10027.*

### IQ-Steel®

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

### Similar designations

AMS 6481, 1.7765

### Chemical composition

| Variant | Cast | Weldability | | C% | Si% | Mn% | P% | S% | Cr% | Ni% | Mo% | V% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 398Q | IC | CEV $1.48_{max}$ | Min | 0.30 | 0.20 | 0.40 | - | - | 2.80 | - | 0.80 | 0.250 |
| | | Pcm $0.71_{max}$ | Max | 0.35 | 0.35 | 0.60 | 0.015 | 0.001 | 3.30 | 0.30 | 1.20 | 0.350 |

## Mechanical Properties

| Variant | Condition | Format | Dimension [mm] | Yield strength min [MPa] | Tensile strength [MPa] | Elongation $A_5$ [%] | Reduction of area $Z_{min}$ [%] | Hardness | Impact (ISO-V) $strength_{min}$ |
|---|---|---|---|---|---|---|---|---|---|
| 398Q | +QT | Tube,wall | 0 typical | 800* | 940 typical | 19 | 70 | 300 HB typical | 20 °C 200 J (long) 20 °C 130 J (transv) |

$Rp_{0.2}$ * $R_{eh}$, ** $R_{el}$

## Transformation temperatures

| | Temperature °C |
|---|---|
| MS | 357 |
| AC1 | 773 |
| AC3 | 884 |

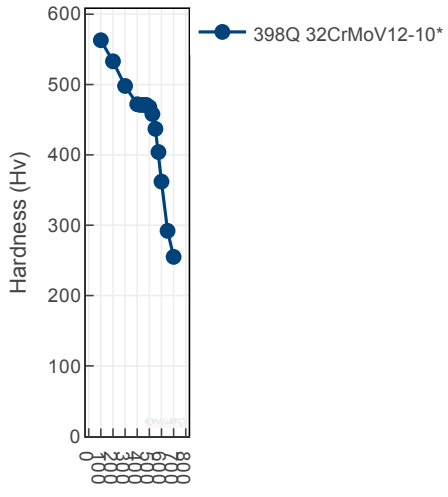
## Heat treatment recommendations

| Treatment | Condition | Temperature cycle | Cooling/quenching |
|---|---|---|---|
| Hot forging | +AR | 850-1150°C | In air |
| Normalizing | +N | 900-980°C | In air |
| Annealing | +A | 650-730°C | In air |
| Hardening | +QT | 900-940°C | In oil |
| Tempering | +QT | 570-700°C See tempering response diagram | In air |

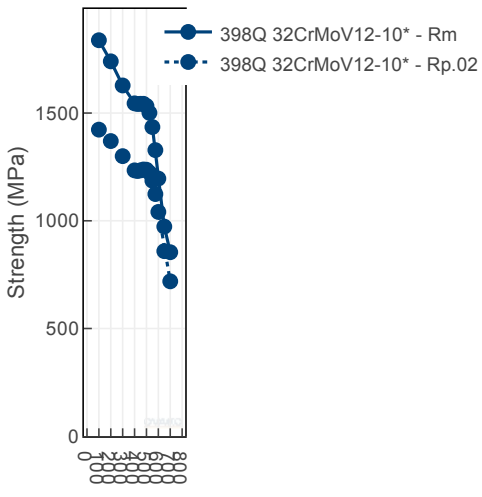
## Heat Treatment Guide generated Graphs

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.

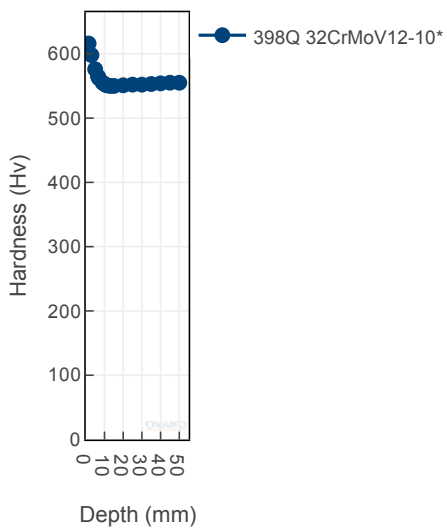
Tempering Diagram (hardness)




Tempering Diagram (strength)



Jominy

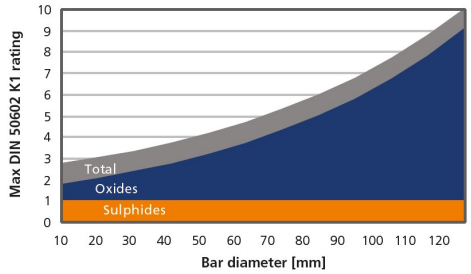

398Q 32CrMoV12-10*
600
500
400
300
200
100
0
Hardness (Hv)
0
10
20
30
40
50
Depth (mm)

### Steel cleanliness

| Micro inclusions - IQ | | | Macro inclusions - IQ | |
|---|---|---|---|---|
| Applied standard | DIN 50602 K1 | | Applied standard | 10 M Hz UST<br>(Ovako internal standard) |
| 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 limits given in the graph | | Limits | < 10 defects/dm3<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) |
|---|---|---|---|---|
| 398Q | Round bar | +AR | 690 | 297 |
| 398Q | Round bar | +QT | 696 | 298 |

As of 1 January 2022 we use carbon offset for all our scope 1- 2 emissions, so in practice the climate compensated data is the same as the full Scope 3 level.
All above data are to be seen as typical values for the specified format and condition. Detailed information about your specific product please contact your sales contact.

## 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:

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Via telephone: +46 8 622 1300

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

## Disclaimer