



DEW® RC+T

Rapid Cooling + Tempering

DEW® RC+T

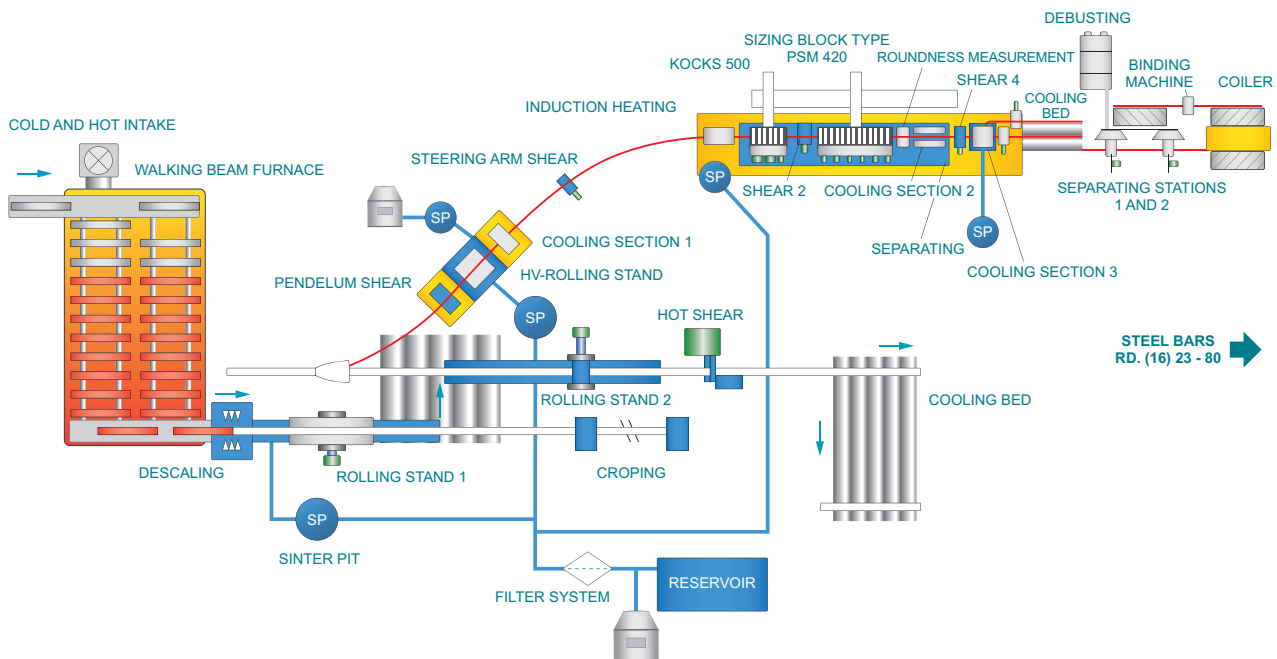
The requirements on steel bars for the production of components in cold forming are manifold.

In addition to chemical composition, hardenability, austenitic grain size and microstructure, mechanical and technological properties such as hardness and surface quality are of particular importance for consistent product properties and efficient production processes.

To meet the increasing requirements, Deutsche Edelstahlwerke developed an alternative to classic heat treatment with a significant added value along the entire process chain.

By integrating heat treatment into the rolling process, Deutsche Edelstahlwerke create material properties that are not achieved by the classic annealing processes isothermally (FP) and spheroidizing annealing (GKZ) alone. Temperature control over the entire rolling strand, from the rolling start temperature to the cooling bed temperature, is the key of DEW® RC+T.

The parameters can be varied to suit the specific material, allowing the corresponding microstructure, including all mechanical and technological properties, to fulfill customer requirements.



For this purpose, cooling via the available cooling sections can be added after each rolling stand according to the planned temperature control.

Due to the temperature control, by means of cooling sections and inductive heating, uniform properties and a homogeneous hardness profile over the entire cross-section can be achieved.

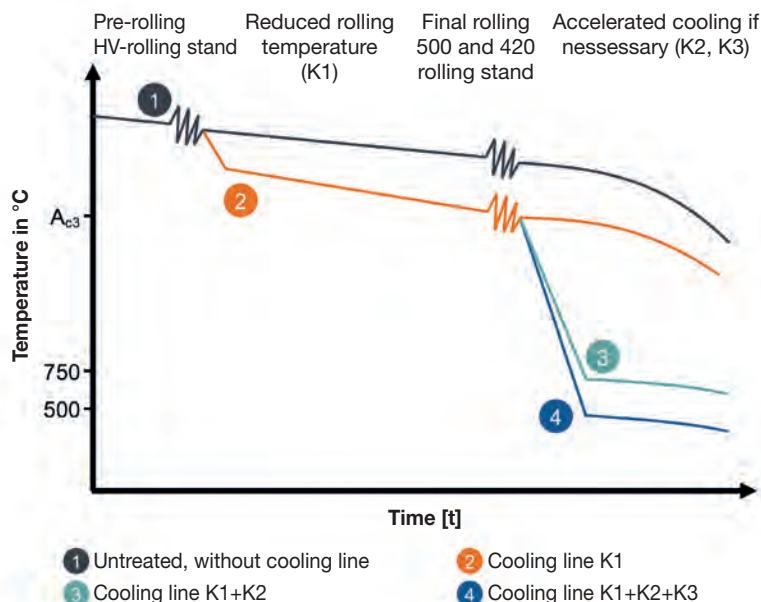
According to the existing cooling sections in the rolling mill, the temperature control is divided into three areas.

Similar to thermomechanical rolling, but at temperatures above A_{c3} , cooling section 1 (see figure K1) promotes precipitation formation. As a result a finer microstructure is achieved and consequently the final strength is adjusted.

Furthermore, the cooling leads to delayed dynamic recrystallization during the rolling process. The treatment via K1 can increase the potential ferrite content of case-hardening steels and thus reduce their strength.

Cooling down to temperatures close to A_{c3} further promotes this process. Together with the grain refinement and the germination condition during the forming process, the transformation into a ferrite-pearlite microstructure can be accelerated and completed on the downstream cooling bed. With regard to hardenability, the chemical composition plays a particular role.

The final quenching by means of cooling section 3 (see Figure K3) leads to a tendency finer grain size in the surface area of the DEW® RC+T material compared to the FP or GKZ annealed condition.

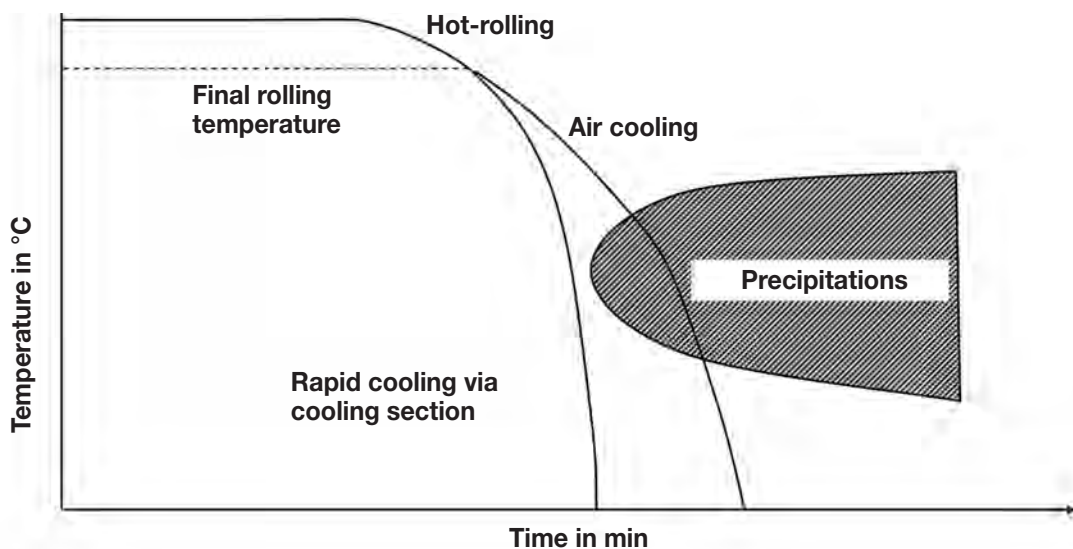


The rolling vein is cooled in such a way that the surface area is transformed bainitically or martensitically. In addition to limited diffusion, also grain growth is inhibited. Temperatures can fall below 550°C, which inhibits further transformation.

The temperature control with the material feed ends onto the cooling bed. This process step enables a uniform and controlled cooling of each individual bar over the entire width - the bars lie next to each other on a rake bed at a defined distance and are rotated during cooling. A consistently good reproducibility and a higher quality surface are the result. By saving the classical heat treatment, these parameters are retained throughout the entire process route for the production of case-hardened components.

Advantages of DEW® RC+T at a glance

- Microstructure is fine-grained and resembles a spheroidizing annealed structure
- Homogeneous hardness profile over the entire cross-section
- Higher formability
- Smooth and score-free surface in rolled condition
- Lower decarburization tendency compared to isothermal annealed material
- Increased output due to reduced scale formation
- Better microstructure structure for further surface treatments



Case-hardening steels

In order to ensure good formability during cold forging, case-hardening steels are isothermally annealed (FP) or spheroidizing annealed (GKZ).

However, this type of heat treatment is very energy- and time-consuming. In addition,

complex downstream processes for good straightness and surface quality are necessary.

With DEW® RC+T treated case-hardening steels these energy- and time-consuming process steps can be saved as well as time-consuming downstream processes.

Brand	Material number	Designation
Carbodur 2722	1.2722	18CrNi8
Carbodur 3523	1.3523	19MnCr5
Carbodur 3567	1.3567	20CrMo4
Carbodur 5918	1.5918	17CrNi6-6
Carbodur 5919	1.5919	15CrNi6
Carbodur 5920	1.5920	18CrNi8
Carbodur 6571	1.6571	20NiCrMo6-5
Carbodur 6587	1.6587	18CrNiMo7-6
Carbodur 6587	1.6587	17CrNiMo7-6
Carbodur 6757	1.6757	20NiMoCr6-5
Carbodur 7131	1.7131	16MnCr5
Carbodur 7139	1.7139	16MnCrS5
Carbodur 7147	1.7147	20MnCr5
Carbodur 7149	1.7149	20MnCrS5
Carbodur 7160	1.7160	16MnCrB5
Carbodur 7168	1.7168	18MnCrB5
Firmodur 7193	1.7193	27MnCr5
Carbodur 7218	1.7218	25CrMo4
Carbodur 7321	1.7321	20MoCr4
Carbodur 7325	1.7325	25MoCr4

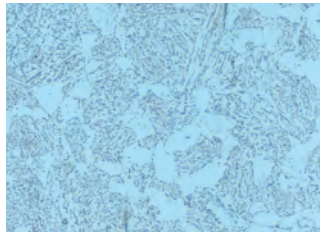
The microstructure produced by DEW® RC+T is much finer compared to steel which has been soft annealed to spheroidized cementite or to ferrite-pearlite microstructure. The surface quality of the case-hardening steel compared to steel rod is good. This means the material can be directly processed by cold forgers after temperature-controlled rolling, tempering and straightening without peeling the surface.

Thanks to the homogenous microstructure, the case-hardening steel is more uniform and easier to form.

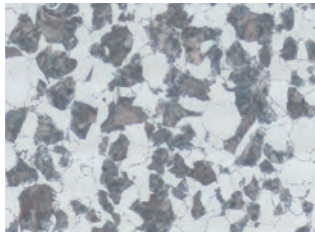
Moreover, the microstructure is more homogenous and thus less prone to distortion. The fine-grained microstructure is durable and thus offers optimum conditions for case hardening.

As a result, users have more freedom of actions in the precise adjustment of the hardening depth and a homogeneous distribution of the steel properties down to its core.

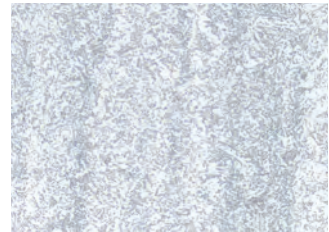
In addition, customers profit from significant savings in energy and CO₂ emissions.



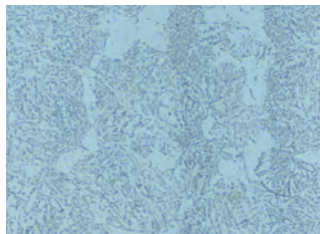
Surface in spheroidizing annealed condition
(magnification 500:1)



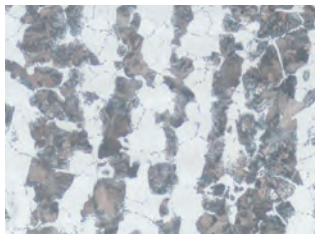
Surface in isothermal annealed condition
(magnification 500:1)



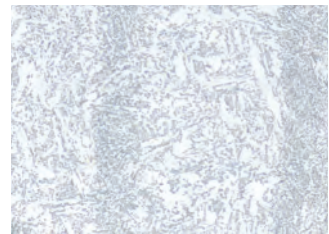
Surface in DEW® RC+T condition
(magnification 500:1)



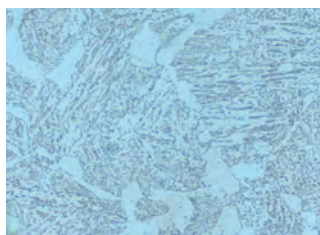
Transition in spheroidizing annealed condition
(magnification 500:1)



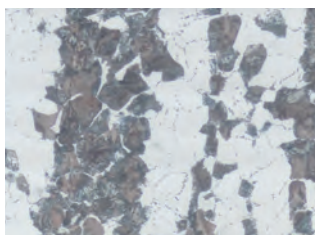
Transition in isothermal annealed condition
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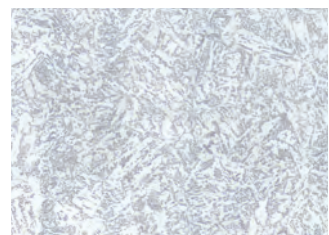
Transition in DEW® RC+T condition
(magnification 500:1)



Core in spheroidizing annealed condition
(magnification 500:1)



Core in isothermal annealed condition
(magnification 500:1)



Core in DEW® RC+T condition
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Quenched and tempered steels and nitriding steels

The fine structure of quenched and tempered steels, proceeded via DEW® RC+T, leads to faster austenitization and thus to a more homogeneous hardening microstructure, which saves time and temperature. This advantage is particularly shown in induction hardening.

In case of nitriding steels, the more homogeneous structure leads to better nitriding be-


havior in addition. The nitride forming elements are homogeneously distributed due to the temperature-controlled rolling via DEW® RC+T and are not stably fixed.

Furthermore, the nitriding process can be optimized with regard to process time and the nitriding hardness, which can be controlled uniformly by grain refinement

Brand	Material number	Designation
Quenched and tempered steels		
Duodur 0503	1.0503	C45
Duodur 0540	1.0540	C50
Duodur 0601	1.0601	C60
Firmodur 1213	1.1213	Cf53
Durapur 1219	1.1219	C56E2
Firmodur 1181	1.1181	C35E
Durapur 3505	1.3505	100Cr6
Firmodur 7003	1.7003	38Cr2
Firmodur 7076	1.7076	32CrB4
Carbodur 7177	1.7177	60Cr3
Firmodur 7225	1.7225	42CrMo4
Formadur 7227	1.7227	42CrMoS4
Firmodur 7701	1.7701	51CrMoV4
Firmodur 7707	1.7707	30CrMoV9
Nitrodur 8519	1.8519	31CrMoV9
Nitriding steels		
Nitrodur 6580	1.6580	30CrNiMo8
Nitrodur 8519	1.8519	31CrMoV9
Nitrodur 8524	1.8524	8CrMo16
Nitrodur 8550	1.8550	34CrAlNi 7-10

General note (liability)

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2019-005

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