SNIJSTAAL

# ACCESSORIES

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## HARDENING
## ANNEALING
## CARBURISING
## NITRIDING
## BLACKING

# 2 INTRODUCTION

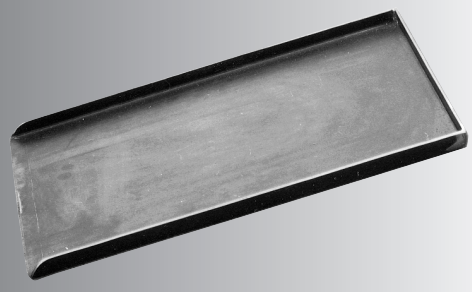
The production of tools, dies and other machine parts, needs a very accurate control during the fabrication. One of the most important works is the heat-treatment afterwards, which give the last “pep” to the parts.
We offer you the right furnace and accessories so you can do your hardening job from the beginning to the end without any problems. We don’t like to suggest that self hardening is a complicate job. The MHS1 hardening-system in brochure H5 for example is the ideal and low-cost solution for the heat-treatment of smaller parts.

We can supply you with “ready for use” systems as well as individual solutions, adjusted to your needs and what do you think of our hardening guide in advance, full with practical tips (see page 13).

Finally, we hope you have a lot of pleasure by doing your self-hardening job.

In our Heat Treatment Centre we can execute heat treatments for you. We also offer the opportunity to take a base course in 'Hardening and other Heat Treatments', enabling you to do the hardening job yourself and other possible heat treatments in daily practice.

## CHARGING PLATES up to 1100 °C



**Specialized in High Temperature Resistant accessories for heat treatment, we can supply:**

- **Hardening pots**
- **Heat resisting baskets**
- **Large hardening boxes**
- **Retorts, containers, etc.**

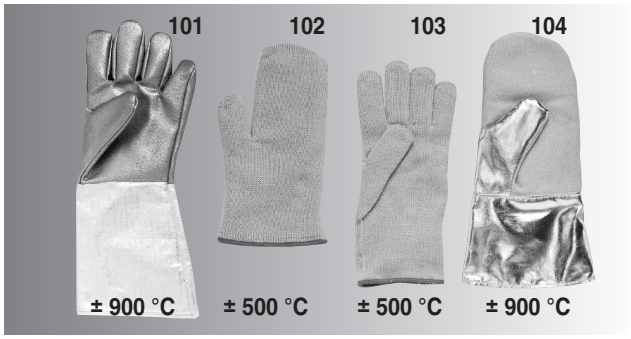
- Heat resistant steel
- 3 sides up
- Protection furnace bottom
- Special dimensions upon request

| article no. | sizes |
|---|---|
| **02020** | 150 x 150 x 3 mm |
| **02030** | 190 x 180 x 3 mm |
| **02040** | 220 x 250 x 4 mm |
| **02050** | 215 x 290 x 4 mm |
| **02100** | 240 x 290 x 4 mm |
| **02150** | 215 x 390 x 4 mm |
| **02200** | 240 x 390 x 4 mm |
| **02220** | 215 x 540 x 4 mm |
| **02230** | 240 x 540 x 4 mm |
| **02250** | 340 x 540 x 4 mm |
| **02350** | 340 x 790 x 4 mm |
| **02400** | 480 x 790 x 4 mm |
| **02450** | 530 x 790 x 4 mm |
| **02500** | 720 x 1140 x 5 mm |
| **02550** | 950 x 1330 x 6 mm |

## BLACKING

| consumables for blacking | article no. | description | |
|---|---|---|---|
| ● Detergent for hot rinsing bath | **00300** | - G 22 | - 25 kg |
| ● Blacking salt for blacking bath | **80150** | - Ferroblack MH | - 50 kg |
| ● Water displacing oil (Kaltöl) for a deep black lustre and oxidation protection | **05250** | - Kaltöl | - 45 kg |
| ● A combination for cold degreasing and pickling slightly rusted parts | **00100** | - Pickling agent | - 30 kg |
| ● Medium for cold blacking. Only to be used for smaller single parts for which no bath is needed | **80400** | - Cold blacking medium | - 1 kg |

## HEAT RESISTING GLOVES




- Specially selected for use with furnaces
- The work pieces can be held for a short time at the temperatures mentioned

| article no. | description |
|---|---|
| **41101** | – Glass fibre gloves, lenght 400 mm |
| **41102** | – Kevlar mittens, lenght 300 mm |
| **41103** | – Kevlar gloves, lenght 300 mm |
| **41104** | – Kevlar mittens, aluminized, lenght 300 mm |

## FACE SHIELD

- Heat resistant
- Lightweight
- Wide visor
- Folding visor

| article no. | description |
|---|---|
| **37105** | – Face shield |

## UNIVERSAL HARDENING OIL


- Suitable for most types of tool steel
- Evaporation proof and thermochemically stable
- Unlimited lifetime when used properly
- Flash point 228 °C - Bath temperature ranging from 50 - 150 °C
- Mild cooling action in the critical martensite range

| article no. | description |
|---|---|
| **00140** | – high performance quenching oil W25 - 50 litre drum |
| **00160** | – high performance quenching oil W25 - 200 litre drum |
| **00240** | – high performance quenching oil W25w - 50 litre drum (water washable) |

## ADDITIVE FOR COOLING WATER


- Intended for quick and uniform hardening
- A water temperature up to 70 °C is permitted, which greatly reduces risks of cracks and deformation

| article no. | description |
|---|---|
| **50200** | – Hydrodur GF - 50 kg sack |

## CLEANING AND DEGREASING MEDIUM

- Add ca. 4 kg to 100 l water
- At a temperature of ca. 70 °C this solution degreases and cleans work pieces
- At the same time a rust preventing film is formed

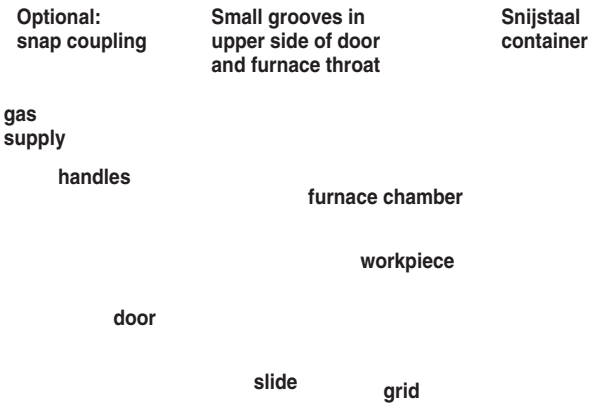
| article no. | description |
|---|---|
| **00300** | - Cleaning and degreasing medium G22 - 25 kg sack |

# 4 THE SNIJSTAAL GAS GRID SYSTEM

## A NEW HARDENING SYSTEM

- By using an ultra thin **SNIJSTAAL container** in combination with the special gas grid, semi-vacuum heating followed by gas quenching has become very simple
- Work is put on the grid and a container pushed over it against the conical plug, a small amount of protective gas is fed in thus providing a controlled atmosphere furnace facility in the smaller workshop or laboratory

- Bright hardening
- Bright annealing of precious metals
- Bright annealing of steel
- Bright soldering/brazing
- Bright research and laboratory work
- **Up to 1200 °C**
- Delivery includes 3 containers




- As the thin container is quickly at temperature, work can also be done quickly.
- As the work pieces are surrounded by protective gas, a larger container can be used in which more work pieces can be treated at the same time, if desired
- Larger work pieces which cannot reach top-hardness by air-cooling because of their size or alloy, can be hardened in the container by accelerated "gas quenching"
- By placing the gas grid over a fan, the cooling on the outside can be even faster
- As a protective gas, nitrogen or protective gas (95/5) is used. Non-combustible and non-hazardous
- As the consumption of gas is low because of the small container volume, very pure nitrogen (less than 10 ppm residual oxygen) or high-grade inert gases like argon and helium may also be considered
- **Option:** thermo-couple in container for recording of temperature

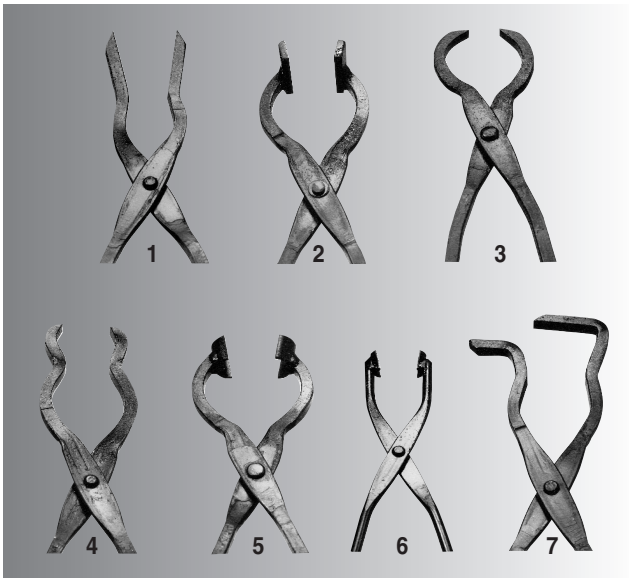
| art. no. | type of gas grid | containersizes in mm wide | high | long | max. length of work piece 'fitting in' |
|---|---|---|---|---|---|
| **47110** | A 80/ 40 | 80 | 40 | 250 | 180 mm |
| **47130** | A 120/ 60 | 120 | 60 | 250 | 180 mm |
| **47140** | B 120/ 60 | 120 | 60 | 350 | 280 mm |
| **47150** | B 160/ 80 | 160 | 80 | 350 | 280 mm |
| **47155** | C 160/ 80 | 160 | 80 | 420 | 350 mm |
| **47160** | C 200/100 | 200 | 100 | 420 | 350 mm |

| article no. | description |
|---|---|
| **01997** - | snap coupling |
| **73000** - | flow meter for protective gas 95/5 |
| **73505** - | gas tubing per metre |
| **73520** - | thermo-couple NiCr-Ni (type K) for gas-grid |
| **73525** - | compensation cable for thermo-couple (K) per metre |
| **47165** - | digital temperature indicator GTH1100 (Type K) |

The foil container size is given for each gas grid. As the container is to be pushed over the tapered plug, the maximum lenght of workpiece is also given. Other sizes of grid and container can be supplied to suit customers' requirements.

**PLEASE ASK FOR OUR DETAILED DOCUMENTATION**

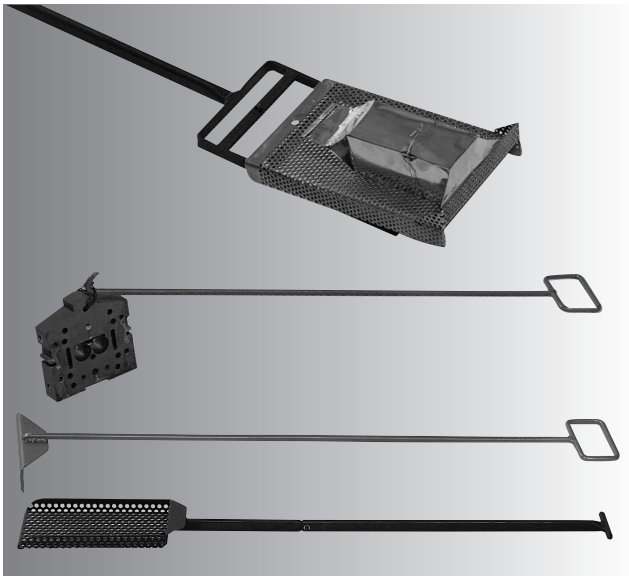
## HARDENING TONGS




- Firm-grip tongs in many shapes and sizes
- In particular extra long handles (600 mm) which makes it easier to pick up the steel from the furnace and immerse it sufficiently deep into the quenching medium

| article no. | description |
|---|---|
| 03001 | **1.** Flat nosed pliers which can be shaped and adjusted |
| 03002 | **2.** Tongs with square reversed nose to pick up pieces easily from the bottom |
| 03003 | **3.** Bent tongs for universal use |
| 03004 | **4.** Double bent tongs for universal use |
| 03005 | **5.** Tongs with half-round noses for round bars |
| 03008 | **6.** Handy tongs for small work (grips 500 mm) |
| 03006 | **7.** Tongs to grasp thickwalled larger rings easily and firmly (pincers) |

## CHARGING ACCESSORIES



- Two-piece safety hardening shovel with heat resistant platform, which stays in the furnace together with the workpiece. The charging fork serves for taking the platform out of the furnace, and further for plunging the workpiece (with platform) into the quenching tank. The piece can be fixed to the platform with binding wire.

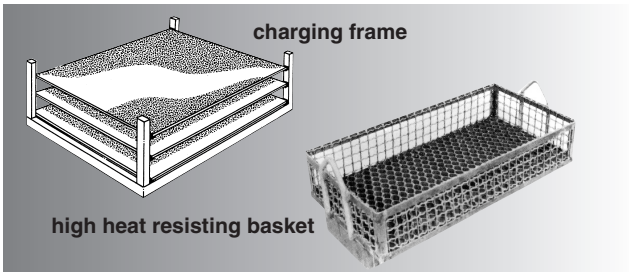
| article no. | description |
|---|---|
| 03030 | – Two-piece safety hardening shovel, width 190 mm, lenght 350 mm |
| 03012 | – Firm draw hook, lenght 800 mm |
| 03014 | – Firm draw hook, lenght 1200 mm |
| 03016 | – Rake for withdrawing flat cutting plates vertically |
| 03018 | – Hardening shovel for easy-charging into the furnace, blade width 190 mm and length 330 mm |

## BINDING WIRE

- Specially soft double-annealed
- May be fastened easily onto work pieces
- Suitable to bind on foil-wrapped pieces
- Does not break during charging

| article no. | | description |
|---|---|---|
| 36090 | – 1 | mm in coils of 25 kg |
| 36125 | – 1,2 | mm in coils of 25 kg |
| 36150 | – 1,5 | mm in coils of 50 kg |
| 36200 | – 2 | mm in coils of 50 kg |
| 36300 | – 3 | mm in coils of 50 kg |

## BASKETS AND FURNACE FRAMES




- Examples of a heat resisting frame with charging plates for economic furnace use
- Heat resisting baskets
- Usually the user has individual needs, we have not given standard sizes
- Made to measure

# PROTECTIVE MEDIA AGAINST OXIDATION AND DECARBURISATION

## INTRODUCTION

### OXIDATION

Air contains ca. 78% of nitrogen and 20% of oxygen. An important property of oxygen is to react readily with other elements in the formation of OXIDES, for example steel corrosion. At high temperature these reactions arise much faster and give symptoms of combustion. Steel will blister (hammer scales) which gives loss of material.

### DECARBURISATION

At the same time oxygen reacts at a high temperature with the carbon present in the steel, giving DECARBURISATION. This means that after hardening the optimum hardness cannot be achieved at the surface.
Below are some protective methods against oxidation and decarburisation which can easily be applied in every hardening shop using a simple chamber furnace.

## PROTECTIVE PASTE up to 850°C and 1100°C


Die protected with protective paste

Flange protected with protective paste

- Prevents oxidation and decarburisation
- Suitable for low and non-alloyed types of steel which have to be annealed or hardened at temperatures up to 850 °C (Z0095) resp. 1100 °C (Z1100)
- It is easy to use (like paint)
- Easily removed with hot water
- Environmentally friendly
- Ideal for annealing free from oxidation stop-planes of flanges etc. and other annealing work

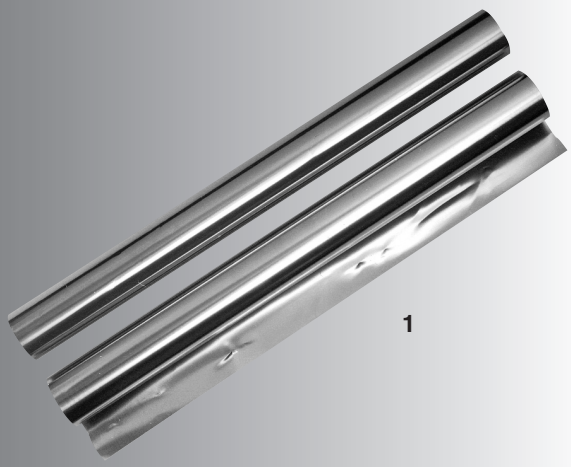
| article no. | description |
|---|---|
| **04500** | – Protective paste up to 850 °C, Z 0095, 1 kg |
| **05000** | – Protective paint up to 1100 °C, Z 1100, 1 kg |
| **05750** | – special thinner, 2,5 litre |

## NEUTRAL ANNEALING COMPOUND up to 1000°C


- For the protection of tool steel
- This specially pure extra fine annealing compound reduced at a very high temperature, can be used many times. It gives a neutral protection, both at low and high temperatures when packed into a heat-resisting box together with the work piece
- For heat resisting boxes, see page 10
- Multiple usable

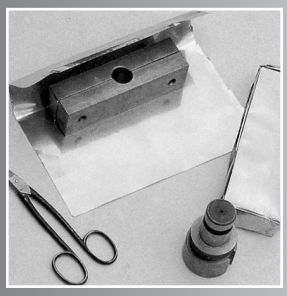
| article no. | description |
|---|---|
| **75110** | – annealing compound K, 10 kg bucket |
| **75125** | – annealing compound K, 25 kg sack |

## WRAPPING FOIL up to 1200°C

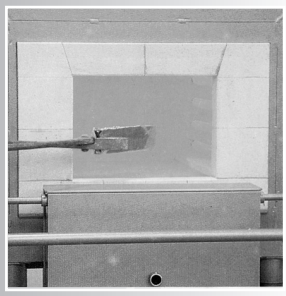


1

2



3



4

1. Ultra thin foil, only 0.05 mm thick
2. The foil is cut to size from the roll and folded entirely around the work piece
3. The packed work piece is brought to temperature in the furnace
4. Afterwards the work piece with the foil is quenched into oil, air or water

- The foil is suitable for wrapping all kinds and sizes of work
- A surface free from decarburisation will be achieved
- This method is relatively cheap
- For an airtight sealing of work pieces to give the so-called "vacuum-effect" see following pages
- After hardening, a small insignificant discoloration may arise
- Also during tempering, the piece may remain wrapped in foil
- Also during transfer to the quenching tank the work is protected by the foil
- The foil reacts with the remaining oxygen in the packing, because it becomes red hot within minutes while the work piece inside, still remains cool (also see page 8)
- Also deliverable in other shapes, like envelopes and containers (see the next pages)

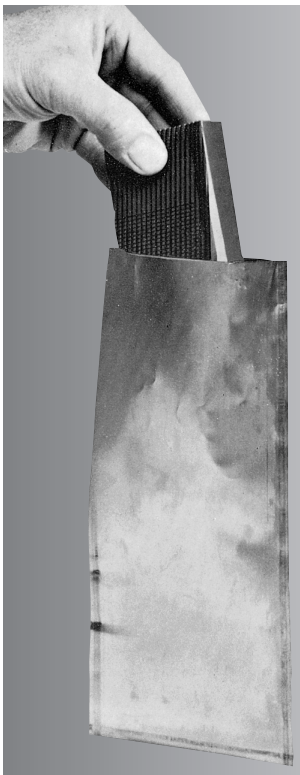
| article no. | sizes |
|---|---|
| **20310** | – 1 roll of wrapping foil, 310 mm wide - 30 m long |
| **20610** | – 1 roll of wrapping foil, 610 mm wide - 15 m long |
| **20615** | – 1 roll of wrapping foil, 610 mm wide - 7,5 m long (once usable) |

## PROTECTIVE GLOVES when using WRAPPING FOIL

- To avoid injury during cutting and folding the foil
- Ultra thin, so finger-sensitive
- Correct shape
- Very strong and protecting against cutting

| article no. | description |
|---|---|
| **41106** | – gloves Hynit L (pair) |

## SNIJSTAAL ENVELOPES up to 1200°C



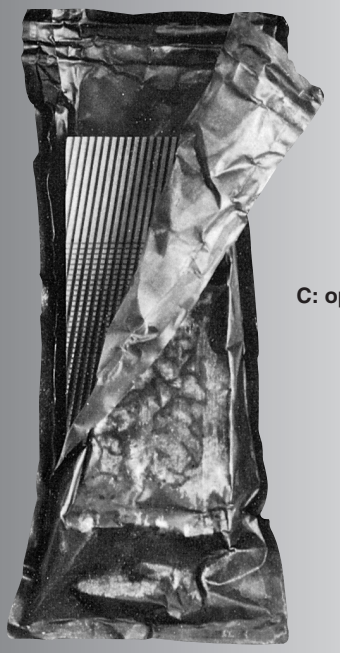
A: insert and seal

- Ultra thin foil, only 0.05 mm thick
- Packing is done quickly
- Only one end of the envelope has to be closed
- By this hermetic sealing, it is impossible for oxygen to enter
- During heating a VACUUM-ATMOSPHERE arises in the envelope, giving as a result a bright work piece, entirely free from decarburisation and super hard
- An extra advantage is that heating and quenching are slightly delayed by the envelope, which will influence the stability of size for the better
- Also during transfer to the quenching tank the work is protected by the envelope
- A wide range of applications, ranging from 400 °C to 1200 °C

B: heat up to hardening temperature

**Explanation of the advantages:**

After having been placed into the furnace the ultra-thin envelope becomes red hot within minutes while the work piece inside, still remains cool. At this point the oxygen remaining in the envelope reacts with the inside of the hot envelope and so disappears.
Also in case of a long soak in the furnace neither decarburisation nor any other form of reaction with the work piece will occur.

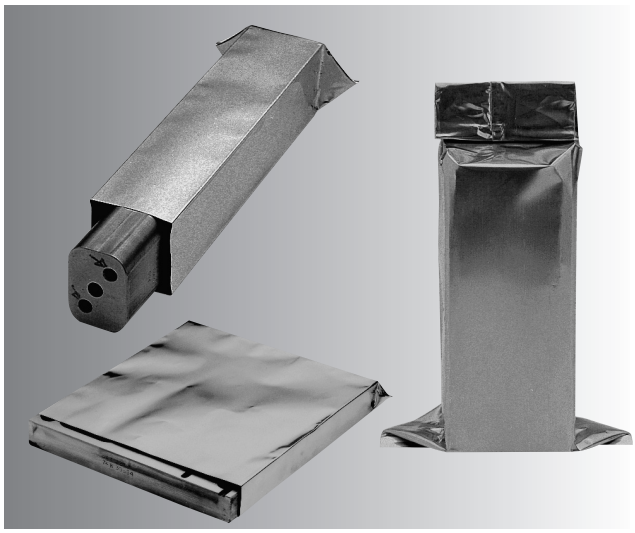


C: open

| article no. | sizes* |
|---|---|
| **01000** | – 63 x 127 mm long |
| **01500** | – 63 x 203 mm long |
| **02000** | – 101 x 152 mm long |
| **02500** | – 101 x 228 mm long |
| **03000** | – 152 x 203 mm long |
| **03500** | – 152 x 304 mm long |
| **04000** | – 203 x 254 mm long |
| **04500** | – 203 x 355 mm long |
| **05000** | – 254 x 304 mm long |
| **05500** | – 254 x 406 mm long |
| **06000** | – 304 x 355 mm long |
| **06500** | – 304 x 457 mm long |

* other sizes can be supplied

## SNIJSTAAL CONTAINERS up to 1200°C



- For longer and/or rectangular work
- Closed hermetically at the end
- The work piece is pushed easily into the container (without too much free space)
- The open end can easily be folded up by hand or with the aid of tools mentioned below
- A "VACUUM-MUFFLE" for hardening high and medium alloyed steel can quickly and easily be made
- The containers are also suitable for:
  - hardening of high speed steel at 1050 °C - 1150 °C (for cold work)
  - powder nitriding and boriding
- Other sizes can also be supplied

### SQUARE (sizes in mm)

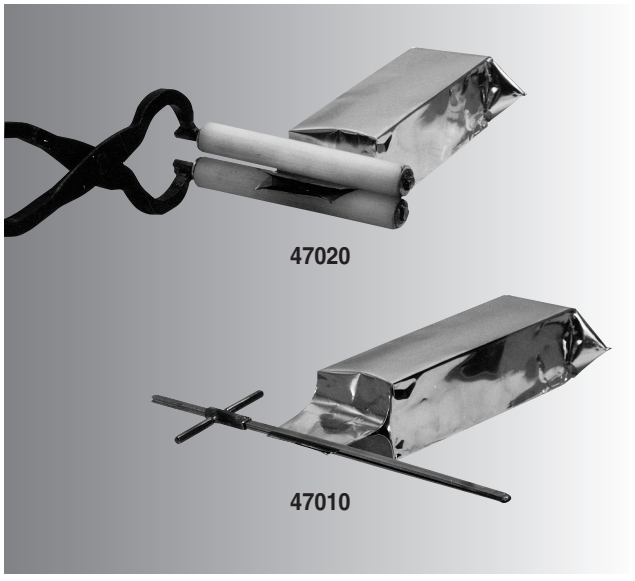
| article no. | wide | high | long | article no. | wide | high | long |
|---|---|---|---|---|---|---|---|
| **63015** | 30 | 30 | 150 | **64535** | 60 | 60 | 350 |
| **63020** | 30 | 30 | 200 | **65020** | 70 | 70 | 200 |
| **63025** | 30 | 30 | 250 | **65025** | 70 | 70 | 250 |
| **63030** | 30 | 30 | 300 | **65520** | 80 | 80 | 200 |
| **63040** | 30 | 30 | 400 | **65525** | 80 | 80 | 250 |
| **63515** | 40 | 40 | 150 | **65530** | 80 | 80 | 300 |
| **63520** | 40 | 40 | 200 | **66015** | 90 | 90 | 150 |
| **63525** | 40 | 40 | 250 | **66020** | 90 | 90 | 200 |
| **63530** | 40 | 40 | 300 | **66025** | 90 | 90 | 250 |
| **64015** | 50 | 50 | 150 | **66515** | 100 | 100 | 150 |
| **64020** | 50 | 50 | 200 | **66520** | 100 | 100 | 200 |
| **64025** | 50 | 50 | 250 | **66525** | 100 | 100 | 250 |
| **64040** | 50 | 50 | 400 | **66530** | 100 | 100 | 300 |
| **64045** | 50 | 50 | 450 | **66545** | 100 | 100 | 450 |
| **64515** | 60 | 60 | 150 | **67020** | 120 | 120 | 200 |
| **64520** | 60 | 60 | 200 | **67025** | 120 | 120 | 250 |
| **64525** | 60 | 60 | 250 | **67030** | 120 | 120 | 300 |
| **64530** | 60 | 60 | 300 | **67035** | 120 | 120 | 350 |

* The sizes printed in bold type are intended for the gas-grid system

### RECTANGULAR

| article no. | wide | high | long | article no. | wide | high | long |
|---|---|---|---|---|---|---|---|
| **40825** | **80** | **40** | **250** * | **43515** | 150 | 40 | 150 |
| **41015** | 100 | 15 | 150 | **43520** | 150 | 40 | 200 |
| **41020** | 100 | 15 | 200 | **43525** | 150 | 40 | 250 |
| **41030** | 100 | 15 | 300 | **43550** | 150 | 40 | 500 |
| **41515** | 100 | 25 | 150 | **43635** | **160** | **80** | **350*** |
| **41520** | 100 | 25 | 200 | **43640** | **160** | **80** | **420*** |
| **41525** | 100 | 25 | 250 | **44520** | 200 | 30 | 200 |
| **41530** | 100 | 25 | 300 | **44530** | 200 | 30 | 300 |
| **42015** | 100 | 40 | 150 | **45025** | 200 | 40 | 250 |
| **42020** | 100 | 40 | 200 | **45030** | 200 | 40 | 300 |
| **42025** | 100 | 40 | 250 | **45242** | **200** | **100** | **420*** |
| **42030** | 100 | 40 | 300 | **45530** | 250 | 20 | 300 |
| **42225** | **120** | **60** | **250*** | **46025** | 250 | 30 | 250 |
| **42235** | **120** | **60** | **350*** | **46535** | 250 | 40 | 350 |
| **42530** | 150 | 15 | 300 | **47020** | 300 | 20 | 200 |
| **43015** | 150 | 25 | 150 | **48020** | 300 | 40 | 200 |
| **43020** | 150 | 25 | 200 | **48040** | 300 | 40 | 400 |
| **43030** | 150 | 25 | 300 | **48045** | 300 | 40 | 450 |
| | | | | **48050** | 300 | 40 | 500 |

## TOOLS for QUICK CLOSING




- After the work piece has been pushed into the container, the open size is closed with 'roller-tongs'

| article no. | description |
|---|---|
| **47020** | – 1 roller tongs with nylon rolls |

- The part closed by rolling is folded 3 to 4 times with the folder

| article no. | description |
|---|---|
| **47010** | – folder incl. grip |

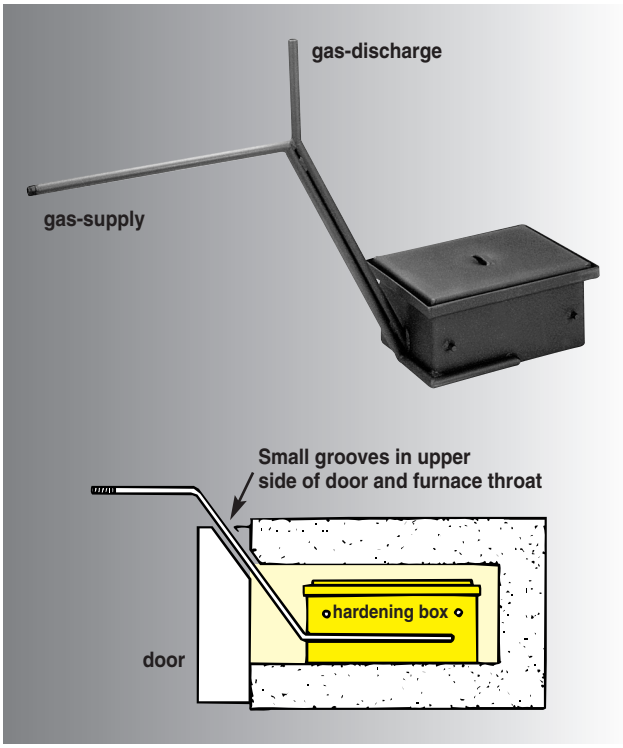
## HEAT RESISTING BOXES with SAND SEAL and FORK up to 1100 °C

**Note:** These sizes are without sand seal.
For each side 15 mm and for the lid 20 mm are to be added.
Other box sizes upon request.

- The work pieces are packed together with neutral annealing compound K (page 6) to create a protective atmosphere. The seal is filled with sand or an insulating medium (page 12) to make the box gas tight
- When the box is at temperature it is taken from the furnace with the manipulating fork, the work pieces removed and cooled
- The manipulating fork is also used to remove the lid and emptying the box
- The boxes are also intended for **carburising**, **nitriding** and **boriding**

| article no. | lenght | width | height | thickness | |
|---|---|---|---|---|---|
| **01050** | 120 | 90 | 60 | 3 mm | |
| **01055** | 105 | 105 | 80 | 3 | |
| **01060** | 135 | 150 | 110 | 3 | |
| **01070** | 205 | 180 | 150 | 3 | |
| **01100** | 170 | 120 | 80 | 4 | |
| **01150** | 200 | 180 | 100 | 4 | |
| **01200** | 250 | 180 | 110 | 4 | |
| **01250** | 300 | 200 | 110 | 4 | |
| **01260** | 400 | 180 | 110 | 4 | |
| **01275** | 450 | 200 | 110 | 4 | |
| **01300** | 300 | 200 | 150 | 4 | |
| **01350** | 350 | 250 | 180 | 4 | |
| **01400** | 400 | 300 | 200 | 4 | |
| **01425** | 500 | 280 | 200 | 4 | (without fork) |
| **01450** | 500 | 400 | 200 | 4 | (without fork) |
| **01500** | 550 | 450 | 250 | 4 | (without fork) |

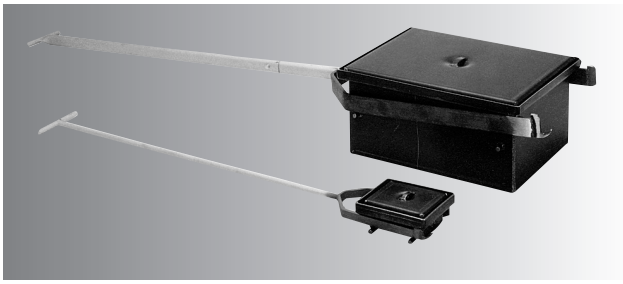
## GAS CONNECTION METHOD 1

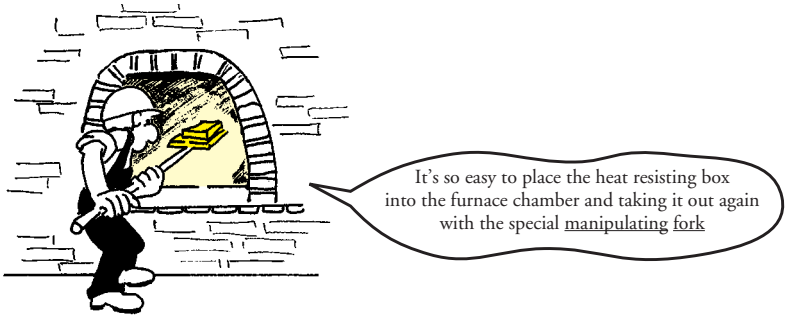



- For oxidation free annealing up to 900 °C the above boxes can be provi - ded with a protective gas connection according to method 1 with gas supply and discharge
- The box with work piece is placed into the heated furnace with the mani - pulating fork, after which pre-purging is done abt. 5 x the box volume, followed by lower gas flow. Gas types to be used are for example nitrogen or forming gas (95/5)
- By making grooves in the door and furnace throat, it easily ca be suited to the box
- Standard connection: 1/4" or 3/8" depending boxsize

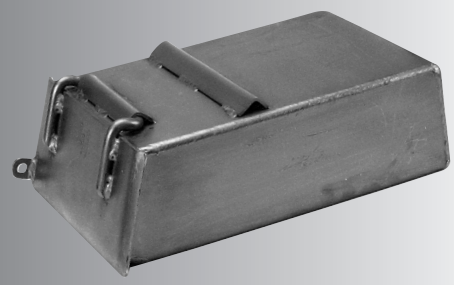
In case of furnaces where the door opens upwards (N81 and larger), the gas tubes are placed in horizontal position. Gas connections for other boxes upon request.

| please state when ordening: | | |
|---|---|---|
| **01991** | - | method 1 for articlenr. 01050 - 01425 |
| **01999** | - | method 1 for articlenr. 01450 - 01500 |
| **01997** | - | snap coupling instead of standard coupling |
| **73000** | - | flowmeter for protective gas 95/5 |
| **73001** | - | flowmeter for nitrogen/argon |
| **73505** | - | gas tubing per metre |





## ATMOSPHERE BOXES with HINGED LID up to 1100 °C



**Note:** The box dimensions given are excl. of the hinge, for which 20 mm is to be added to the height

- These heat resisting steel boxes can stay permantly in the furnace
- On the bottom of the box near the lid, charcoal or carburising granules are thrown. The heat causes a reaction with the air present, producing a protective gas which prevents decarburisation and oxidation
- The lid is opened with a hook (3012 or 3014 on page 5), the work pieces removed with a tong and quenched

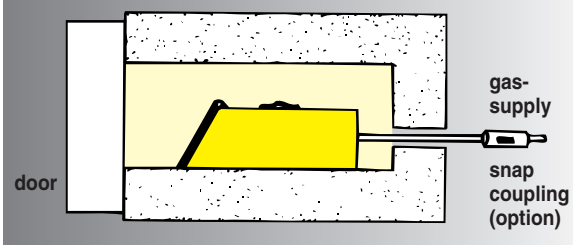
| article no. | lenght | width | height |
|---|---|---|---|
| **00050** | 120 | 120 | 60 |
| **00060** | 160 | 160 | 90 |
| **00070** | 220 | 200 | 120 |
| **00100** | 230 | 200 | 80 |
| **00150** | 230 | 220 | 80 |
| **00250** | 320 | 200 | 100 |
| **00300** | 320 | 220 | 100 |
| **00310** | 450 | 200 | 100 |
| **00325** | 450 | 220 | 100 |
| **00200** | 300 | 160 | 120 |
| **00350** | 320 | 220 | 150 |
| **00400** | 320 | 220 | 200 |
| **00450** | 450 | 300 | 200 |
| **00475** | 700 | 300 | 200 |
| **00500** | 700 | 400 | 200 |
| **00550** | 700 | 450 | 320 |

## GAS CONNECTION METHOD 2

- The boxes with hinged lid can also be supplied with a protective gas connection
- However, the application is limited to a max. temperature of approx. 1100 °C when gas is used
- The gas is supplied to the box from the rear and escapes around the lid
- With the aid of the fork the whole unit is easily charged into the furnace
- Standard with gasthread

| please state when ordening: | |
|---|---|
| **00995** | - method 2 for articlenr. 00050 - 00475 |
| **00999** | - method 2 for articlenr. 00500 - 00550 |
| **01997** | - snap coupling instead of standard connection |
| **73000** | - flow meter for protective gas 95/5 |
| **73001** | - flow meter for nitrogen/argon |
| **73505** | - gas tubing per metre |

## GAS CONNECTION METHOD 3




- In this case the box with hinged lid remains in the furnace
- By opening the lid with a hook, the work piece can be removed
- A hole is made in the back wall of the furnace for the gas supply
- Standard with gasthread

| article no. | description |
|---|---|
| **00994** | - method 3 |
| **01997** | - snap coupling instead of standard connection |
| **73000** | - flow meter for protective gas 95/5 |
| **73001** | - flow meter for nitrogen/argon |
| **73505** | - gas tubing per metre |

## CARBURISING (CARBON DIFFUSION)

- Carbon is added to the surface of soft steel up to a depth of ca. 0,2 - 2 mm at a temperature of approx. **900 °C**
- The work pieces are packed together with granules into a heat-resisting steel box (page 10) and the sand seal is closed gas tight with sealing medium (see below)
- The thickness of the carburised layer depends on the time at 900 °C. Rule of thumb is ca. 0,1 mm per hour carburising time. Usually about 6-10 hrs for good average results
- Can be applied in any furnace
- Carburising powder generally is used only once:
  - KRATOS U for non-alloyed steel
  - KRATOS L for alloyed steel
- Carburising granules that can be re-used:
  KG 30 for non-alloyed steel
  KG 6 for alloyed steell

| article no. | description | |
|---|---|---|
| **70250** | **-** carburising granules KG 6 | 25 kg |
| **70275** | **-** carburising granules KG 30 | 25 kg |
| **70300** | **-** carburising powder KRATOS-L (2 - 4) | 25 kg |
| **70430** | **-** carburising powder KRATOS-U (2 - 4) | 25 kg |

## POWDER NITRIDING (NITROGEN DIFFUSION)


- At about **550 °C** nitrogen is diffused to produce a thin and extremely hard layer (up to 1000 HV) over a hardened zone 0.2 - 0.4 mm deep
- Packed work pieces are surrounded by nitriding powder and activator in a heat-resisting box (page 10) while sealing the sand tray with a sealing material (see below)
- Time of process approx. 10 hrs. (or more) at ca. 550 °C
- Can be applied in any furnace
- The thin upper layer gives a high resistance against "scuffing" and abrasive wear and the fatigue strength is greatly increased
- May be used on all types of steel (cast iron also), for example:
  - hot work and die-casting moulds
  - wearing parts and machine components

| article no. | description | |
|---|---|---|
| **10250** | **-** nitriding powder | 100 kg |
| **10100** | **-** activator | 5 kg |
| **10150** | **-** activator | 25 kg |
| **03500** | **-** anti-nitriding paste | 1 kg |

## INSULATING MEDIUM

- A ceramic mouldable material for sealing boxes air tight
- Also for covering parts of work pieces which are to remain soft after carburising
- Can also be used for areas of tools which after treating must be partly hardened only
- Insulating exactly to the mm.

| article no. | description |
|---|---|
| **00120** | **-** Insulating paste - 19 kg |
| **00136** | **-** Insulating paste - 37 kg |

For detailed documentation about carburising and nitriding please consult our **Hardening Guide**.

## SELF HARDENING AND ANNEALING, EASIER THAN YOU THINK!

**The investment in a hardening system already repays itself in a very short time.**

- ❑ **The latest development of easy hardenable species of steel enables you to harden safely and without difficulties**
- ❑ **For tools, dies, forms etc. one often uses only a limited number of steel qualities with which you will become familiar with quit easily**
- ❑ **Self hardening stimulates the interest of the tool makers and adds new variety to his jobs. All gathered experience will only benefit your own company**
- ❑ **Waiting times and paying invoices of the commercial hardening shop is prevented. Because immediate hardening can take place, the next working can follow only a few hours later. The production cycle can be calculated better this way and flexibility and economics improve**
- ❑ **Operating a modern, electrical furnace is almost only a matter of loading and emptying the chamber. Further advantages are short heating up times enabling you to deal with rush orders and low energy consumption**
- ❑ **The hardening curves of various species of steel are programmable individualy into the regulators memory. A pre-timer enables you to set a pre-destined starting time. Programmed in the afternoon and automatically started during the night offers you a furnace with workpiece already heated through at the moment you start your working day**

The alongside hardening and annealing furnace on a table with quenching tank is often sufficient for smaller hardening jobs. At the bottom shelf and in front of the table some accessories for easy charging are shown. With the foil articles (rolls, envelopes or containers) the workpiece is protected in a simple way - enabling you to execute a semi-vacuum hardening job against little costs. Additional products are heat resistant boxes with charging fork for carburising, nitriding, annealing without oxidation etc.

We will support you by means of professional information and practical tips. What do you think of our Hardening Guide in advance?

**You already harden?** Perhaps we can support you, often against low costs, but speldid results.

Complete 'ready for use' systems can be supplied by us as individual solution, adjusted to your needs.

**Our delivery program:**

- complete hardening systems, accessories, hardness testers and consumables
- air circulation furnaces from 50-850 °C, chamber furnaces from 3 litres, bogie furnaces up to 15 $m^3$
- protection gas furnaces, salt baths, melting furnaces, laboratory furnaces up to 3000 °C
- environmentally friendly blacking installations

### HARDENING GUIDE

**Many pages... full with knowledge, practice tips and tricks about steel choice and shaping for the hardening of steel. You will experience the things worth knowing and the back-ground information of many heat treatments like e.g. carburising, nitriding, nitro-carburising etc. These subjects are completed with many drawings and sketches, working sheets and tables for the right steel choice**

SNIJSTAAL

# HARDENING GUIDE

- STEEL CHOICE
- FURNACES and SYSTEMS
- ACCESSORIES
- CAST and NON-FERROUS MATERIALS

A book for daily practice for people in toolshop and office. ca. 180 pages.

## COUPON

I order _____ copies.

(Price each € 28,–, excl. VAT and postal costs)

Name _____

Address _____

Place _____

Date _____

Signature _____

| German steel no. | B.S. | SAE/ AISI | ANALYSIS IN % C | Si | Mn | Cr | Mo | Ni | V | W | others | Soft annealing temp. °C | hardn. HB | Hardening °C core | outside layer | Quenching in | Tempering °C | Tensile strenght N/mm² |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Carburising steels** | | | | | | | | | | | | | | | | | | |
| **1.1141** | 080 M 15 | 1015 | 0,15 | 0,25 | 0,45 | | | | | | | 650-700 | 131 | 900 | 790 | W/WB/oil **6)** | 150-180 | 590 - 780 **1)** |
| **1.5752** | 655 M 13 | 3310 | 0,14 | 0,30 | 0,55 | 0,75 | | 3,50 | | | | 610-650 | 230 | 850 | 790 | WB/oil | 170-200 | 930-1230 " |
| **1.5919** | | 3215 | 0,15 | 0,30 | 0,50 | 1,55 | | 1,55 | | | | 650-700 | 217 | 860 | 810 | WB/oil | 170-210 | 880-1180 " |
| **1.6587** | 820 A 16 | | 0,17 | 0,30 | 0,50 | 1,65 | 0,30 | 1,55 | | | | 650-700 | 229 | 860 | 810 | WB/oil | 170-210 | 1080-1320 " |
| **1.7131** | 527 M 17 | 5115 | 0,16 | 0,30 | 1,15 | 0,95 | | | | | | 650-700 | 207 | 870 | 820 | WB/oil | 170-210 | 780-1080 " |
| **1.7147** | | 5120 | 0,20 | 0,30 | 1,25 | 1,15 | | | | | | 650-700 | 217 | 870 | 820 | WB/oil | 170-210 | 980-1270 " |
| **Tough hardened steels** | | | | | | | | | | | | | | hardening temp.°C | | | | |
| **1.1191** | 080 M 46 | 1045 | 0,45 | 0,40 | 0,65 | | | | | | | 650-700 | 207 | 830 -860 | | W/oil | 550-650 | 730-660 |
| **1.6580** | 823 M 30 | | 0,30 | 0,40 | 0,45 | 2,00 | 0,40 | | | | | 650-700 | 248 | 830 -860 | | oil | 550-650 | 1280-920 |
| **1.6582** | 817 M 40 | 4340 | 0,34 | 0,40 | 0,55 | 1,55 | 0,25 | 1,55 | | | | 650-700 | 235 | 830 -860 | | oil | 550-650 | 1170-900 |
| **1.7033** | 530 A 32 | 5132 | 0,34 | 0,40 | 0,75 | 1,05 | | | | | | 680-720 | 217 | 840 -870 | | W/oil | 550-650 | 930-800 |
| **1.7218** | 1717 CDS 110 | 4130 | 0,25 | 0,40 | 0,75 | 1,05 | 0,25 | | | | | 680-720 | 212 | 850 -880 | | W/oil | 550-650 | 900-700 |
| **1.7220** | 708 A 37 | 4137 | 0,34 | 0,40 | 0,75 | 1,05 | 0,25 | | | | | 680-720 | 217 | 840 -870 | | W/oil | 550-650 | 990-800 |
| **1.7225** | 708 M 40 | 4140 | 0,42 | 0,40 | 0,65 | 1,05 | 0,25 | | | | | 680-720 | 217 | 830 -860 | | W/oil | 550-650 | 1090-840 |
| **1.7228** | 708 A 47 | 4150 | 0,50 | 0,40 | 0,65 | 1,05 | 0,25 | | | | | 680-720 | 235 | 830 -860 | | W/oil | 550-650 | 1180-920 |
| **1.8159** | 735 A 50 | 6150 | 0,50 | 0,40 | 0,90 | 1,05 | | | 0,15 | | | 680-720 | 235 | 830 -860 | | W/oil | 550-650 | 1260-980 |
| **Nitriding steels** | | | | | | | | | | | | | | | | | | hardness |
| **1.8507** | 905 M 31 | | 0,34 | 0,40 | 0,65 | 1,15 | 0,20 | | | 1,0 A | 1,0 Al | 650-700 | 248 | 910 -940 | | W/oil | 570-650 | ca 950 HV **3)** |
| **1.8519** | | | 0,31 | 0,40 | 0,55 | 2,50 | 0,20 | | 0,15 | | | 650-700 | 248 | 850 -870 | | W/oil | 580-630 | ca 750 HV " |
| **1.8550** | | | 0,34 | 0,40 | 0,55 | 1,65 | 0,20 | 1,00 | | 1,0 A | 1,0 Al | 650-700 | 245 | 850 -900 | | oil | 580-660 | ca 950 HV " |
| **Cold work steels** | | | | | | | | | | | | | | | | | | |
| **1.1545** | | W1 | 1,05 | 0,20 | 0,20 | | | | | | | 680-710 | 190 | 770 -800 | | W | 180-300 | 64-56 HRC **2)** |
| **1.1730** | | | 0,45 | 0,30 | 0,70 | | | | | | | 680-710 | 190 | 800 -830 | | W | 180-300 | 56-49 HRC " |
| **1.2080** | BD 3 | D3 | 2,10 | 0,25 | 0,30 | 11,50 | | | | | | 800-830 | 230 | 930 -980 | | oil/WB/A | 180-300 | 63-60 HRC " |
| **1.2162** | | 5120 | 0,21 | 0,25 | 1,25 | 1,15 | | | | | | 680-710 | 217 | 810 -830 | | oil/WB | 150-180 | 60 HRC **4)** |
| **1.2210** | | L2 | 1,15 | 0,25 | 0,30 | 0,65 | | | 0,10 | | | 710-740 | 211 | 810 -830 | | W/oil | 180-250 | 62-60 HRC " |
| **1.2312** | | | 0,40 | 0,40 | 1,50 | 1,90 | 0,20 | | | | | 740-760 | 230 | 830 -870 | | oil/WB/A | 180-400 | 53-48 HRC " |
| **1.2316** | | | 0,40 | 1,00 | 1,00 | 16,00 | 1,20 | 1,00 | | | | 780-820 | 240 | 1000-1030 | | oil/WB | 180-300 | 48-42 HRC " |
| **1.2363** | BA 2 | A2 | 1,00 | 0,20 | 0,60 | 5,30 | 1,10 | | 0,20 | | | 850 | 210 | 930- 970 | | oil/WB | 180-400 | 62-57 HRC " |
| **1.2379** | BD 2 | D2 | 1,55 | 0,25 | 0,30 | 12,00 | 0,70 | | 1,00 | | | 840-860 | 240 | 1000-1030 | | oil/WB/A | 180-250 | 62-60 HRC " |
| **1.2436** | | D6 | 2,10 | 0,25 | 0,30 | 11,50 | | | | 0,70 | | 800-830 | 240 | 930- 980 | | oil/WB/A | 180-250 | 63-60 HRC " |
| **1.2510** | BO 1 | 01 | 0,90 | 0,30 | 1,20 | 0,50 | | | 0,10 | 0,50 | | 780 | 190 | 780- 820 | | oil/WB | 180-250 | 62-58 HRC " |
| **1.2542** | BS 1 | | 0,45 | 0,95 | 0,30 | 1,05 | | | 0,15 | 2,00 | | 720-750 | 225 | 890- 920 | | oil | 180-300 | 56-54 HRC " |
| **1.2550** | | S1 | 0,65 | 0,60 | 0,30 | 1,10 | | | 0,20 | 2,00 | | 720-750 | 230 | 860- 900 | | oil | 180-300 | 59-56 HRC " |
| **1.2601** | | D2 | 1,65 | 0,30 | 0,30 | 11,50 | 0,60 | | 0,30 | | | 800-830 | 240 | 980-1020 | | oil/WB/A | 180-250 | 61-59 HRC " |
| **1.2721** | | | 0,55 | 0,30 | 0,50 | 1,00 | 0,30 | 3,00 | | | | 760 | 230 | 840- 870 | | oil/A | 160-300 | 57-52 HRC " |
| **1.2767** | | | 0,45 | 0,25 | 0,30 | 1,35 | | 4,00 | | | | 610-640 | 250 | 840- 870 | | oil/A | 160-250 | 55-53 HRC " |
| **1.2842** | BO 2 | 02 | 0,90 | 0,25 | 2,00 | 0,35 | | | 0,10 | | | 690-720 | 210 | 760- 820 | | oil/WB | 150-250 | 63-59 HRC " |
| **Hot work steels** | | | | | | | | | | | | | | | | | | |
| **1.2343** | BH 11 | H11 | 0,38 | 1,00 | 0,40 | 5,30 | 1,10 | | 0,40 | | | 750-780 | 235 | 1020-1050 | | oil/WB/A | 550-650 | 52-37 HRC " |
| **1.2344** | BH 13 | H13 | 0,40 | 1,00 | 0,40 | 5,30 | 1,40 | | 1,00 | | | 750-800 | 240 | 1020-1050 | | oil/WB/A | 550-650 | 55-40 HRC " |
| **1.2365** | | H10 | 0,32 | 0,25 | 0,30 | 3,00 | 2,80 | | 0,50 | | | 750-800 | 235 | 1020-1050 | | oil/WB/A | 500-650 | 51-41 HRC " |
| **1.2567** | | | 0,32 | 0,20 | 0,30 | 2,40 | | | 0,60 | 4,30 | | 760-800 | 240 | 1050-1100 | | oil/WB | 600-700 | 50-36 HRC " |
| **1.2581** | BH 21 | H21 | 0,30 | 0,25 | 0,30 | 2,60 | | | 0,40 | 8,50 | | 740-780 | 250 | 1100-1150 | | oil/WB/A | 550-700 | 52-38 HRC " |
| **1.2714** | | L6 | 0,55 | 0,25 | 0,80 | 1,10 | 0,50 | 1,70 | 0,10 | | | 650-700 | 250 | 840-870 | | oil | 400-650 | 50-36 HRC " |
| **High-speed steels** | | | | | | | | | | | | | | | | | | |
| **1.3207** | BT 42 | C1 | 1,23 | 0,25 | 0,30 | 4,00 | 3,80 | | 3,30 | 9,30 | 10,5 Co | 770-840 | 300 | 1210-1240 **5)** | | oil/WB/A | 550-570 | 65-67 HRC " |
| **1.3243** | | M41 | 0,92 | 0,40 | 0,30 | 4,00 | 5,00 | | 1,90 | 6,40 | 4,8 Co | 770-840 | 280 | 1210-1250 " | | oil/WB/A | 550-570 | 64-66 HRC " |
| **1.3247** | BM 42 | M42 | 1,10 | 0,25 | 0,25 | 4,00 | 9,20 | | 1,20 | 1,40 | 8,0 Co | 770-840 | 280 | 1170-1210 " | | oil/WB/A | 530-560 | 67-69 HRC " |
| **1.3265** | BT 5 | T5 | 0,76 | 0,25 | 0,30 | 4,20 | 0,65 | | 1,55 | 18,0 | 9,5 Co | 820-850 | 300 | 1260-1300 " | | oil/WB/A | 560-580 | 64-66 HRC " |
| **1.3343** | BM 2 | M2 | 0,90 | 0,25 | 0,30 | 4,10 | 5,00 | | 1,90 | 6,40 | | 770-840 | 280 | 1200-1240 " | | oil/WB/A | 540-560 | 64-66 HRC " |
| **1.3344** | | M3 | 1,22 | 0,25 | 0,30 | 4,00 | 5,00 | | 2,90 | 6,40 | | 770-840 | 280 | 1200-1240 " | | oill/WB/A | 550-570 | 64-66 HRC " |
| **1.3346** | BM 1 | M1 | 0,80 | 0,40 | 0,30 | 4,00 | 8,60 | | 1,15 | 1,75 | | 790-820 | 280 | 1180-1220 " | | oil/WB/A | 530-550 | 64-66 HRC " |
| **1.3355** | BT 1 | T1 | 0,75 | 0,20 | 0,30 | 4,20 | | | 1,10 | 18,0 | | 770-840 | 280 | 1250-1290 " | | oil/WB/A | 550-570 | 64-66 HRC " |

**1**) Tensile strenght after case hardening in the core in N/mm² at ø 30 mm
**2**) Hardness values after tempering on lowest and highest temperature
**3)** Ca. surface hardness after nitriding in HV
**4)** After case hardening
**5)** For cold work, low hardening temperatures are usual
**6)** W = water / WB = warmbath / A = air

**THE INFORMATION ABOVE CONTAINS SUMMARIZED DATA OF SOME PAGES FROM OUR HARDENING GUIDE WITH CA. 180 PAGES, OF WHICH YOU'LL FIND MORE INFO AT PAGE 13**

| german steel no. | applications |
|---|---|
| **1.1141** | non-alloyed steel for small dimensions |
| **1.5752** | Ni/Cr-alloyed for heavy loads |
| **1.5919** | ca. like the above quality |
| **1.6587** | Cr/Ni/Mo-alloyed for larger dimensions |
| **1.7131** | Mn/Cr-alloyed for normal and higer loads |
| **1.7147** | and average sections |
| **1.1191** | For smaller sections and loads |
| **1.6580** | Cr/Ni/Mo-steels for heavy demands, like |
| **1.6582** | gear components and mech. engineering |
| **1.7033** | Axles, axle arms, control components etc. |
| **1.7218** | Cr/Mo-steels for higher toughness and |
| **1.7220** | strength demands for average and larger |
| **1.7225** | sections, e.g. axle arbors, cog wheels |
| **1.7228** | and crankshafts |
| **1.8159** | Springs etc. with higher toughness and elasticity |
| **1.8507** | Are being delivered in a tough-hardened |
| **1.8519** | (ca. 100 N/mm$^2$ tensile strength) condition |
| **1.8550** | and are often nitrided |
| **1.1545** | Cutting and punching tools |
| **1.1730** | Hand tools, guiding plates etc. |
| **1.2080** | Heavy duty steel, very resistant to wear |
| **1.2162** | Plastic moulding dies |
| **1.2210** | Drills and taps, engravings in silver steel |
| **1.2312** | Tough cold shear blades etc. |
| **1.2316** | Dies for pressing chemically agressive compounds |
| **1.2363** | Universal steel with good toughness |
| **1.2379** | Tough heavy duty steel, good cutting lifetime |
| **1.2436** | Heavy duty steel, high cutting lifetime |
| **1.2510** | Drills and taps, engravings in silver steel |
| **1.2542** | Pneumatic tools, a special cold work steel |
| **1.2550** | Dto., a little harder |
| **1.2601** | Tough heavy duty steel, good cutting lifetime |
| **1.2721** | Tough-hard, hobbing dies, plastic moulding dies |
| **1.2767** | Dies for cutlery and plastic moulding, shear blades |
| **1.2842** | Universal tool steel |
| **1.2343** | Tough, hot work Cr-alloyed qualities for pressure |
| **1.2344** | casting moulds for light metal, hot shears etc. |
| **1.2365** | Pressure casting moulds for heavy metal alloys |
| **1.2567** | W-alloyed for heavy duty tools, cores etc. |
| **1.2581** | Dto., extra red-hardness by higher W-content |
| **1.2714** | Forge drop hammers dies for deep engravings |
| **1.3207** | Finishing & roughing tools, wood working tools, cold work tools |
| **1.3243** | Lathe & planing tools, wood working tools, milling cutters |
| **1.3247** | Milling cutters, drills, broaches, cold work tools |
| **1.3265** | Heavy duty lathe and planing tools for **roughing** |
| **1.3343** | Drills, saws etc. **cold work steels** |
| **1.3344** | dto., and segments for circular saws |
| **1.3346** | Broaches, screw cutting tools and reamers |
| **1.3355** | Milling cutters, drills and file cutter's chisels |

All mentioned values and species of steel mentioned on these two sides are to be seen as general information, because the heat treatment of steels can be complex with many angles of incidence, many sizes and shapes and many different demands and applications. All advises are without any responsibility!

## CHOOSE THE RIGHT HARDNESS

| | hardness HRC | german steel no. 1) |
|---|---|---|
| **Tools from high-speed steel:** | | |
| * for cutting jobs with turning chisels, milling cutters etc. | 65 | 1.3343 |
| * for cold seperating jobs like cutting dies and punches etc. | 62 | 1.3343 or PM qualities |
| **Species of steel for seperating tools:** | | |
| * for thinner sheeting | 62 | 1.2510-1.2080 |
| * for thicker sheeting | 57 | 1.2363-1.2379 |
| **Species of steel for cold forming tools:** during which the thickness of the piece changes, e.g. embossing medals etc. Also bending tools and folding tools | | |
| * for thinner sheeting | 60 | 1.2510-1.2363 |
| * for thicker sheeting | 56 | 1.2721 |
| **Species of steel for hot working tools:** like forging, pressing and extruding tools and pressure casting moulds etc. | | |
| * for small deformations | 50 | 1.2344 |
| * for larger deformations | 44 | 1.2344 |
| **Drilling and thread-cutting tools:** | | |
| * as a mechanical tool | 64 | 1.3343 |
| * as a hand tool | 62 | 1.2510-1.2363 |
| **Thread rolling dies:** | | |
| * high hardness, wear resistant and sufficiently tough | 60 | 12379-1.3343 |
| **Milling cutters:** | | |
| * for metal machining | 62 | 1.3343 |
| * for wood machining | 64 | 1.2379-1.3343 |
| **Hamers:** | | |
| * only the stroking surface is hardened | 56 | 1.1730-(1.1545) 1.2542 |
| **Edging tools and similars:** | | |
| * short shears | 54 | 1.2510-1.2721 |
| * long shears | | often flame hardened; non- or alloyed tough-hardened steel |
| **Rolling deformation:** | | |
| * Flattening, border and straight knurling rolls | 60 | 1.3343-1.2379 |
| * Knurling rolls (sometimes nitrided | 60 | 1.2510-1.2363 |
| **Cold rolls and rolling dies:** | | |
| * Short rolls and profiling rolls | 60 | 1.2379-1.2363 |
| * Long rolls (must resist bending stresses) | | lower alloyed steel |
| **Hand and agricultural tools:** | | |
| * tough and wear resistant | 58 | 1.1730 |
| * with high strength | 42 | 1.2103 - 1.2542 |
| **Species of steel as supporting parts:** | | |
| * e.g. punch holders, top and bottom plates, structural parts for composite tools, frame and backing plates | 40 | 1.1730 - 1.2710 1.2721 |
| **Parts for machines:** | | |
| * for heavy duty; tough hardened alloyed steel | 35 | It is difficult to give more info because of the numerous alloys |
| * for low demands; tough hardened non-alloyed steel | 25 | |
| **Toothed wheels and similar parts:** | | |
| * for low demands; non-alloyed case-hardening or non-alloyed tough hardened steel | | |
| * for higher demands; alloyed case-hardening or alloyed tough hardened steel | | |

**1) for alternative qualities, please contact your steel supplier**

**See catalogue H5 for our comprehensive delivery program of systems**