



PLANT STANDARD

HEEP-HARDWAR

0912.002

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② BASED ON
MUN 054.3/1,
TEXT BOOK &
OWN EXPERIENCE

TECHNOLOGICAL INSTRUCTIONS FOR SURFACE HARDENING

1.0 SCOPE : These technological instructions cover the requirements of surface hardening such as Gas Nitriding, Bath Nitriding, Flame Hardening, Induction Hardening, Gas Carburising & Boronising.

2.0 APPLICATIONS: These instructions for surface hardening are applicable for components of thermal sets, hydro sets, and electrical machines as well as dies and toolings.

3.0 PREPARATION OF COMPONENTS:

3.1 Prior to surface hardening the components and test samples shall be heat treated to desired properties as per the drawing requirements.

3.2 The components requiring nitriding shall be stress relieved at 30 to 50°C below the last tempering temperature, before nitriding.

3.3 Prior to the surface hardening operation all the component surfaces shall be ensured free from rust.

3.4 Surface protection: Surfaces where, gas nitriding/boronising/ carburising is not required, shall be preserved as per specification HW 0980804. IN CASE OF BATH NITRIDING PROTECTION OF SURFACE, THREADS ARE NOT REQUIRED. ①

3.5 Test Samples: The test samples must be made of same steel grade and must be subjected to similar heat treatment as the component. If more than one steel grade has been charged, one test piece for each grade shall be charged. The dimensions of the test piece shall be as following:

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① - Test sample: Approx. OD X ID X H = 30X8X25 ~~25X10X25~~ mm Surface finish 6.3 μ
- The test sample shall be stamped on flat surface with material specification/grade.

4.0 NITRIDING PROCESS :

4.1 Gas Nitriding :

The job alongwith test sample shall be placed inside the nitriding furnace (electrically heated) in such a way that all the surfaces requiring nitriding treatment come into contact with the ammonia gas. After loading and sealing the furnace at the start of the nitriding cycle, the air inside the furnace shall be purged out by ammonia gas at 150°C max. for 8-10 minutes. After purging flow rate of ammonia gas shall be maintained at 4 to 6 liters/minute. Then the furnace temperature shall be increased to 570 ± 10 °C @ 120°C/hour max. The job shall be soaked at this temperature for ~~* 66 ± 6~~ hours. After completion of the soaking period, the job shall be allowed to cool inside the furnace. During cooling, flow of ammonia shall be continued upto 200 °C @ 1-2 liter/minute after which the gas flow shall be cut off and furnace shall be opened to take out the jobs. The case depth & hardness on the test sample/job shall be as per table-1.

② - * 80 ± 5

4.2 Bath Nitriding:

Bath nitriding shall be performed in bath nitriding furnace (electrically heated) at 570 ± 10 °C. The soaking time shall be ~~3 ± 0.5 hours. 2.5 to 4.5 HOURS.~~ ②
The job requiring bath nitriding shall be preheated at 350-400°C in preheating furnace (soaking time minimum 1 hr. per 25mm). After pre-heating, the job & test sample shall be transferred to tuffride salt bath (TF 1). The bath shall be kept at temperature 570 ± 10 °C. The soaking time shall be ~~* 3 ± 0.5~~ hours. After soaking, the job shall be quenched in a neutralising salt bath (AB 1) for 1/2 to 1 hour. Then the bath nitrided job shall be thoroughly rinsed in the water bath for minimum 5 minutes.

③ - 3.0 to 6.0
④ - * 25 to 45

Bath control:
⑤ - TF1 salt bath shall be replenished by REG-1 & TF1 salts if %CNO in bath

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is less than 38% ^②

TF1, AB1 & REG-1 are proprietary salt of M/s DEGUSSA, Germany. The minimum case depth and hardness shall be as per table-1.

5.0 FLAME HARDENING PROCESS:

The job shall be mounted on a suitable fixture and the surface marked for hardening as per drawing shall be heated with the help of neutral Oxy-acetylene flame to the temperature 50°C above the normalising/hardening temperature (refer HW 0640599). However for grade T118Cr45 & C40 the flame hardening temperature shall be 850-900 °C & 880-930 °C respectively. After heating, the job shall be quenched in water/oil/air. For thin components, to avoid through hardening, the job (except the surface requiring hardening) shall be kept under water while heating. The flame hardened job shall be tempered at 150-250 °C for 1/2 to 1 hour.

The hardness shall be as per table-1. Case depth is given for reference only.

6.0 INDUCTION HARDENING PROCESS:

The job shall be mounted on a suitable induction coil and heated to the temperature 50°C above normalising/hardening temperature (refer HW 0640599). However for grade T118Cr45 & C40 the induction hardening temperature shall be 850-900 °C & 880-930 °C respectively. After heating, the job shall be quenched in water/oil/air. The induction hardened job shall be tempered at 150-250 °C for 1/2 to 1 hour.

The hardness shall be as per table-1. Case depth is given for reference only.

7.0 GAS CARBURISING PROCESS:

The job along with the test sample shall be placed in the basket/fixture and kept inside the gas carburising furnace. There should be clearance between components for free circulation of carburising gas. The furnace temperature is raised to carburising temperature of 910±10 °C. Then the supply of kerosene shall be started and exhaust gases are ignited near the exhaust pipe (so called test candle). If the tip of flame is yellow red colour without any soot, the process is considered to be normal and if there is any soot on the tip of the flame, it indicates the incomplete atomisation of kerosene which can be corrected by reducing

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ing the flow of kerosine. Incase there is flickering of flame it indicates insufficient kerosine supply. The supply of kerosine shall be regulated. The time for holding (soaking) at carburising temperature is dependant on case depth requirement which is as following:

| <u>Depth of carburis-</u> <u>ed layer in mm.(min.)</u> | <u>Holding time in</u> <u>hours.(min.)</u> |
|---|---|
| 0.8 mm | 5 hrs |
| * 1.0 mm | 8 hrs |
| * 1.5 mm | 14 hrs |

* If specified on drawing.

After soaking, the job shall be cooled in the furnace up to 700°C and below 700°C it is allowed to cool in the open air. Again the items shall be austenised at 820 ± 10°C for 30-45 minutes and quenched in water followed by tempering at 160 - 190°C for 1/2 to 1 hour.

The minimum hardness & case depth shall be as per table-1.

8.0 BORONISING PROCESS :

The jobs requiring boronising shall be finish machined and the surfaces shall be free from dust, grease. Surfaces where no boronising is required shall be preserved. The jobs to be boronised and the boriding powder are to be kept into a box. The bottom of the box shall be covered with a layer of boriding powder, at least 10mm thick. The components are put on the top of the boriding powder layer and pressed down lightly. The components are to be covered with a approximately 10mm thick layer of fresh boriding powder. If several components are to be treated, these are kept side by side or in a layers but covered by a layer of fresh boriding powder of appx 10mm thickness. The of the box is to be filled up to the top with boriding powder (fresh or used) and sealed with a lid. The box is put into the chamber furnace and heated to 900 ± 20 °c. The soaking time is 5-6 hrs. At the end of soaking time the box is removed from the furnace and allowed to cool in air & the component is removed from the box. The powders which get sintered can be reused in part. For

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each fresh boronising process the 10mm layer must be of fresh boriding powder. Sintered boriding powder can be used for topping up the boxes. Boronised components shall be washed and dried. The case depth & hardness shall be as per the table:1.

9.0 RECORDING & DOCUMENTATION :

9.1

The following informations shall be recorded in a heat treatment chart or register by the furnace operator and countersigned by section supervisor :

- 9.1.1 Drawing nos. of jobs to be heat treated in the heat load.
- 9.1.2 Steel grade, quantity
- 9.1.3 Heat treatment batch no.
- 9.1.4 The actual heat-treatment regime (soaking time, temperature)

9.2 Identification of samples shall be done by shop QC & the record of hardness and case depth shall be maintained as *designed in drawings.*

10.0 SAFETY PRECAUTIONS:

All safety precautions as per the instructions of safety department are to be observed during the above processes.

11.0 REWORK:

In case properties as required are not achieved, Metallurgy engineering shall be consulted regarding repetition of the process cycle.

12.0 SALT SPECIFICATION FOR BATH NITRIDING & BORONISING :

Following are the plant purchase specification no. for salts used in bath nitriding and boronising:

| Salt | Specification No. |
|----------------------|-------------------|
| (For bath nitriding) | |
| TF1 | HW 55180 |
| REG1 | HW 55181 |

DURBORID-1 (For boronising) HW 55172

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TABLE 1

CASE DEPTH AND HARDNESS VALUES TO BE ACHIEVED DURING SURFACE HARDENING PROCESS

| TYPE OF SURFACE TREATMENT | MATERIAL GRADE | EQV. SPECIFICATION | LOAD INC REAMENT HV(MIN) | CASE DEPTH (MIN) MM |
|---------------------------|---------------------------|-------------------------|--------------------------|---------------------|
| GAS NITRIDING | 15X1M1Φ | 0500.701 | HV30 | 900 |
| | 21CrMoNiV47 | HW19386/HW10673 | HV30 | 550 |
| | 30CrMoV9 | HW10582 | HV30 | 900 |
| | 42Cr4Mo2 | HW10573 } AA 10504 } | HV30 | 900 |
| | 40Cr7Al10Mo2 | AA10502 | HV30 | 550 |
| | 38XM10A | AA19353 | HV30 | 550 |
| | 40CrMoV47 | HW10672 | HV30 | 550 |
| | X20Cr13 | AA10721/ | HV5 | 550 |
| | 30CrMoV9 | AA19321 | HV5 | 550 |
| | 16MnCr5 | HW19482 | | |
| | X22CrMoV12 1 (15X11MΦ) | HW19390/ | HV5 | 550 |
| | | HW10683/ | | |
| | | HW10687 | | |
| | 25Cr1Mo1V1/4 (25X1 MΦ) | HW10681/ | HV30 | 550 |
| | | 0500.213 | | |
| 20X1M1ΦTP | AA10622 | HV30 | 550 | |
| BATH NITRIDING | C 40 | AA10208/ | Hv5 HV1 | 450 |
| | | AA10219/ | | |
| | | AA10218 | | |
| | 21CrMoNiV47 | HW19386/ | Hv5 HV1 | 500 |
| | | HW10673 | | |
| | 24CrMo5 | HW19388/ | Hv5 HV1 | 500 |
| | | HW10674/ | | |
| | | HW19388 | | |
| | X20Cr13 (2X13) | AA10721/ | Hv5 HV1 | 500 |
| | | AA19321/ | | |
| | | HW10765 | | |
| | X30Cr13(3X13) | AA10722 | HV5 HV1 | 500 |
| X22CrMoV12 1 (15X11MΦ) | HW10683/ | Hv5 HV1 | 500 | |
| | HW19390/ | | | |
| | HW10687 | | | |
| 40Cr4 | 0500.052/ | HV5 HV1 | 450 | |
| | AA19351/ | | | |
| | HW10571/ | | | |
| | AA10504 | | | |
| 10CrMo910 | HW10685 | HV5 HV1 | 500 | |
| 40Cr1Mo28 | HW10573 | HV5 HV1 | 450 | |
| 20X1M1ΦTP | AA10622 | Hv5 HV1 | 550 | |

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| TYPE OF SURFACE TREATMENT | MATERIAL GRADE | EQV. SPECIFICATION | LOAD INC REAMENT | HARDNESS HV (MIN) | CASE DEPTH (MIN) MM | |
|---|--|------------------------|------------------|-------------------|---------------------|-----|
| (f) — 40Cr7Al10Mo234CrAlMo7 40Ni2Cr1Mo18 | 16MnCr5 C 20 | AA10502 | Hv5 HV1 | 450 | 0.1 | |
| | | AA10501/ | Hv5 HV1 | 450 | 0.1 | |
| | | AA19358/ | | | | |
| | | HW19376 | | | | |
| | | HW10584 | Hv5 HV1 | 450 | 0.1 | |
| | | HW10191/ | Hv5 HV1 | 450 | 0.1 | |
| | | AA10108/ | | | | |
| | | AA10119 | | | | |
| | | (d) — x8CrNiNb1613 | HW10782 | Hv5 HV1 | 450 | 0.1 |
| | | 25Cr1Mo1V1/4 25X1Mφ | HW10681 | Hv5 HV1 | 500 | 0.1 |
| | 0500.213 | Hv5 HV1 | 500 | 0.1 | | |
| (d) — 21CrMoV57 15Mo3 | HW10673 | Hv5 HV1 | 450 | 0.1 | | |
| | HW10567 | Hv5 HV1 | 450 | 0.1 | | |
| FLAME HARDENING AND INDUCTION HARDENING | X20Cr13 (2X13) X30Cr13 (3X13) X22CrMoV12 1 40Cr4 (40X) C 40 T118Cr45 40Ni6Cr4Mo3 | AA10721/ | Hv30 | 500 | 0.6 | |
| | | AA19321 | | | | |
| | | AA10722 | HV30 | 500 | 0.6 | |
| | | HW10683/ | Hv30 | 500 | 0.6 | |
| | | HW19390/ | | | | |
| | | HW10687 | | | | |
| | | AA19351/ | Hv30 | 500 | 0.6 | |
| | | 0500.052/ | | | | |
| | | HW10571/ | | | | |
| | | AA10504 | | | | |
| AA10208/ | Hv30 | 400 | 0.6 | | | |
| AA10209/ | | | | | | |
| AA10218 | | | | | | |
| IS 3741 | Hv30 | 500 | 0.6 | | | |
| AA10506/ | HV30 | 500 | 0.6 | | | |
| AA19358 | | | | | | |
| CARBURIZING | 16MnCr5 C 20 | HW10583/ | Hv30 | 700 | 0.8 | |
| | | HW10584 | | | | |
| | | HW10191/ | Hv30 | 600 | 0.8 | |
| | | HW19381/ | | | | |
| | | AA10108/ | | | | |
| (f) — x 832M13 (En36c) - AA10503 | AA10109/ | Hv30 | 600 | 0.8 | | |
| | HW19331 | Hv30 | | | | |
| BORONISING | 15Mo3 21CrMoV57 | HW10568 | Hv5 HV1 | 500 | 0.02 | |
| | | HW10673 | Hv5 HV1 | 500 | 0.02 | |

NOTE: 1. For steel grades not covered in table, the hardness & depth shall be achieved as specified on the drg. or to be obtained from respective design deptt.
2. If case depth & hardness as desired other than table 1, the same shall be specified on the drawing by respective design department.

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