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**Steel intended to be used in the moulding part of die for
plastics and its heat treatment - Technical conditions**

塑料模具成型部分用钢及其热处理

技术条件

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Table of Contents

1 Subject content and scope.....	3
2 Normative references.....	3
3 Technical requirements for steel intended to be used in the moulding of die for plastics.....	4
4 Acceptance methods and inspection rules	8
5 Packaging, marking and quality certificate	9
Appendix A.....	10
Appendix B	15
Additional Information:	16

Steel intended to be used in the moulding part of die for plastics and its heat treatment - Technical conditions

1 Subject content and scope

This Standard specifies the technical requirements and technical conditions of heat treatment of steel intended to be used in the moulding part of die for plastics.

This Standard applies to the mould cavity part of injection mould, compression mould and pressure injection mould for plastic products.

2 Normative references

GB 222 Method of sampling steel for determination of chemical composition and permissible variations for product analysis

GB 223 Methods of chemical analysis of iron, steel and alloy

GB 224 Determination of depth of decarburization of steels

GB 226 Etch test for macrostructure and defect of steels

GB 230 Metallic materials - Rockwell hardness test

GB 231 Metallic materials - Brinell hardness test

GB 702 Hot-rolled round and square steel bars - Dimension, shape, weight and tolerance

GB 1220 Stainless steel bars

GB 1814 Inspection method for steel work fractures

GB 1979 Standard diagrams for macrostructure and defect of structural steels

GB 2101 General requirement of acceptance packaging marking and certification for section steel

GB 9452 Testing method for working zone of heat treatment furnace

GB 10561 Steel - Determination of content of non-metallic inclusion - Micrographic method using standard diagrams

GB 11880 Specification of large die-blocks used for die-forging hammer and mechanical forging press

JB 3814 Normalizing steel processing and containment of fire

JB 3877 Quenched and tempered steel processing

3 Technical requirements for steel intended to be used in the moulding of die for plastics

3.1 Classification of steels

The using properties of steel intended to be used in the mould cavity part of die for plastics can be divided into carburizing, hardening, pre-hardening, and corrosion-resistant type; see Table 1.

3.2 Chemical compositions and smelting methods

3.2.1 Steels can be produced by adopting smelting methods such as: open-hearth furnace, electric furnace, converter, electroslag remelting, and secondary refining; the purchaser may select the steel designation and smelting method according to the mould's performances and requirements.

3.2.2 Supplier shall analyse the chemical compositions of every smelting furnace No.; its results shall comply with Table 1. Chemical compositions of other steels shall be decided by both supplier and purchaser, and accepted according to relevant standards.

3.7.6 All the heat treatment equipment and quenching medium shall be tested and analysed regularly to guarantee the accuracy and performance of equipment and to save the relevant records.

3.7.7 Technical staffs shall determine the specific heat treatment technique; it may refer to Appendix A (supplement) and the standards related to steels. Normalizing and annealing of steel shall comply with JB 3814. Quenching and tempering of steel shall comply with JB 3877.

3.7.8 The heating speed of mould shall be controlled during the heating process; Heating of large complex moulds shall comply with 7.4.2 in JB 3877. When adopting the heat treatment of salt bath, the mould preheating shall comply with Table 5.

Table 5

°C

Quenching temperature	First preheating	Second preheating
<1000	500~550	-
≥1000	500~600	840~860

3.7.9 Quality of moulds after heat treatment shall be inspected according to Chapter 8 of JB 3877.

3.8 Selection of plastic mould steel

3.8.1 Select and use the plastic mould steel according to the principle: "meet using requirements - exploit material's potential - economically and rationally use steels".

3.8.2 Use and processing performance of common plastic mould steel is shown Appendix B (reference).

4 Acceptance methods and inspection rules

4.1 Inspection and acceptance of steels and moulds shall be responsible by supplier.

4.2 Inspection items and sample quantity of steels shall be carried out according to Table 6.

Table 6

No.	Inspection items	Test methods	Sampling requirements and positions	Sample quantity /piece
1	Chemical compositions and deviations	GB 233 GB 11880	GB 11880 GB 222	2

Appendix A

Basic data of pre-hardening steel

(Supplement)

A1 Steel designation 3Cr2NiMnMo

A1.1 Performance of steels

Steels have high toughness, fine processing performance and polished performance (It can be polished to $R_r 0.020\mu\text{m}$); it can be processed at the pre-hardened state (30~36HRC).

A1.2 Chemical compositions (sample analysis)

Table A1

%

C	Mn	Cr	Mo	Ni	S	P	Si	Cu
0.38	0.98	1.90	0.34	1.03	0.002	0.015	0.40	0.05

A1.3 Critical point

Table A2

Critical point	A_{C1}	A_{C3}	Ms
Temperature °C	725	810	285

A1.4 Application Scope

It applies to large plastic moulds or moulds of which the cavity is complex and mirror needs to be polished.

A1.5 Forging process

Table A3

°C

Heating temperature	Initial forging temperature	Final forging temperature	Cooling
1180~1250	1180	>850	Cooling with furnace or slow cooling

A1.6 Heat treatment process

A1.6.1 Annealing

A3.4 Application scope: compression mould and injection mould.

A3.5 Forging process

Table A15

°C

Heating temperature	Initial forging temperature	Final forging temperature	Cooling
1100~1150	1050	850	Cooling with furnace or slow cooling

A3.6 Heat treatment process

A3.6.1 Annealing

Table A16

Annealing temperature °C	Cooling	Hardness HB
710~740	Furnace cooling	≤235

A3.6.2 Quenching

Table A17

Temperature °C	Cooling medium	Hardness HRC	σ_b MPa
840~870	Oil or 180 °C~220 °C of salt bath	51	1780

A3.6.3 Tempering

Table A18

Temperature °C	100	200	300	400	500	600	700
Hardness HRC	51	50	48	46	42	36	28
σ_b MPa	1730	1670	1570	1480	1330	1140	920

A4 Steel designation 8Cr2MnWMoVS (8Cr2S)

A4.1 Characteristics of steels

It is easy to be cut; cutting performance of quenching and tempering conditions (40~42 HRC) is equivalent to the T10A processing performance of annealing state (200HB); it has good comprehensive mechanical properties, wear resistance, mirror polishing performance, lithography erosion performance; The polishing can reach to $R_{\pi}0.025\mu\text{m}$.

A4.2 Chemical compositions (sampling analysis)

Appendix B

**Table for use and processing performance of common plastic mould steel
(Reference)**

Table B1

Steel designation		Working hardness HRC	Wear resistance	Polishing performance	No quenching deformation	Hardening depth	Process-ability	Decarbonisation sensitivity	Corrosion resistance
Category	Designation								
Carburizing type	20	30~45	Bad	Better	Moderate	Shallow	Moderate	Larger	Bad
	20Cr	30~45	Bad	Better	Larger	Shallow	Moderate	Larger	Worse
Hardening type	45	30~50	Bad	Bad	Smaller	Shallow	Good	Smaller	Bad
	40Cr	30~50	Bad	Bad	Moderate	Shallow	Better	Small	Worse
	T10(A)	40~62	Moderate	Good	Small	Shallow	Good	Moderate	Worse
	CrWMn	58~62	Moderate	Bad	Moderate	Shallow	Moderate	Larger	Worse
	9SiCr	58~62	Moderate	Bad	Moderate	Moderate	Moderate	Larger	Worse
	9Mn2V	58~62	Moderate	Bad	Large	Shallow	Better	Larger	Fair
Pre-hardening type	5CrNiMnMoVSCa	40~45	Moderate	Good	Large	Deep	Good	Smaller	Moderate
	3Cr2NiMnMo	32~40	Moderate	Good	Large	Deep	Good	Moderate	Moderate
	3Cr2Mo	40~58	Moderate	Good	Larger	Deeper	Good	Smaller	Better
	8Cr2MnWMoVS	40~42	Better	Good	Large	Deep	Good	Smaller	Moderate
Corrosion resistant type	2Cr13	30~40	Better	Better	Large	Deep	Moderate	Small	Good
	1Cr18Ni9	-	Better	Better	Large	Deep	Moderate	Small	Good
	4Cr13	30~40	Better	Better	Large	Deep	Moderate	Small	Good
	3Cr17Mo	30~40	Better	Better	Large	Deep	Moderate	Small	Good

Additional Information:

This Standard was proposed by and shall be under the jurisdiction of National Technical Committee on Die and Mould of Standardization Administration of China.

Drafting organizations of this Standard: Ministry of Machinery and Electronics Industry - Beijing Research Institute of Mechanical and Electrical Technology, General Plant of Inner Mongolia Second Machinery Manufacture, Huazhong University of Science and Technology, and Beijing Mould Factory.

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