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REPORT

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**Welding — Guidelines for a metallic
materials grouping system**

焊接-金属材料分类指南

*Soudage — Lignes directrices pour un système de groupement des
matériaux métalliques*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

This fourth edition cancels and replaces the third edition (ISO/TR 15608:2013), which has been revised and contains the following changes:

- a) the grouping system for steels has been revised ([Clause 2](#));
- b) the Bibliography has been updated and the document editorially revised.

Requests for official interpretations of any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Welding — Guidelines for a metallic materials grouping system

焊接-金属材料分类指南

1 Scope

This document provides guidelines for a uniform system for grouping materials for welding purposes. It can also be applied for other purposes, such as heat treatment, forming and non-destructive testing.

从焊接的角度出发，本技术报告提出了材料的分类体系。本报告也可用于其它方面，如热处理、成型加工、无损检测。

It covers grouping systems for the following standardized materials:

本技术报告包括下列标准材料的分类

- Steels (钢);
- Aluminium and its alloys (铝及铝合金);
- Copper and its alloys (铜及铜合金);
- Nickel and its alloys (镍及镍合金);
- Titanium and its alloys (钛及钛合金);
- Zirconium and its alloys (锆及锆合金);
- Cast irons (铸铁).

2 Normative references

引用标准

There are no normative references in this document.

本文件中没有引用规范

3 Terms and definitions

术语及定义

No terms and definitions are listed in this document.

本文档中没有列出术语和定义

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

ISO和IEC维护术语数据库，用于标准化，其地址如下：

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Grouping system for steels

钢的分类体系

Steels are grouped as shown in [Table 1](#). Only those elements that are specified in material standards or specifications should be considered. Ladle (or heat) analyses should be used in preference of product analysis when both are specified. The figures given in groups:

钢按表1所示进行分组。只考虑材料标准或规范中规定的那些要素。两者都指定时，钢包(或热)分析应优先于产品分析使用。分组给出的数字：

- 1, 2, 3 and 11 refer to the chemical composition specified in the material standard (specified values);
1、2、3、11为材料标准规定的化学成分(规定值);
- 4 to 10 are based on the elemental content used in the designation of the alloys.
4到10是根据合金名称中使用的元素含量

Materials assigned to a group in ISO/TR 20172, ISO/TR 20173 and ISO/TR 20174 should be considered assigned to those groups by this document. For materials that are not assigned to a group, the criteria of this document apply.

本文件应考虑将ISO/TR 20172、ISO/TR 20173和ISO/TR 20174中指定给某个组的材料分配给这些组。对于不属于一个组的材料，适用本文件的标准。

Table 1 — Grouping system for steels
钢的分类体系

Group	Subgroup	Type of steel
1		Steels with a specified minimum yield strength $ReH \leq 460 \text{ N/mm}^2$ ^a and with analysis in per cent (%): 规范中屈服极限 $ReH \leq 460 \text{ N/mm}^2$,且成分为 (%)
		$C \leq 0,25$
		$Si \leq 0,60$
		$Mn \leq 1,8$
		$Mo \leq 0,70b$
		$S \leq 0,045$
		$P \leq 0,045$
		$Cu \leq 0,40b$
		$Ni \leq 0,5b$
		$Cr \leq 0,3$ (0,4 for castings) ^b
		$Nb \leq 0,06$
		$V \leq 0,1b$
		$Ti \leq 0,05$
	1.1	Steels with a specified minimum yield strength $ReH \leq 275 \text{ N/mm}^2$ 规范中最小屈服极限 $ReH \leq 275 \text{ N/mm}^2$ 的钢
	1.2	Steels with a specified minimum yield strength $275 \text{ N/mm}^2 < ReH \leq 360 \text{ N/mm}^2$ 规范中最小屈服极限 $275 \text{ N/mm}^2 \leq ReH \leq 360 \text{ N/mm}^2$ 的钢
1.3	Normalized fine-grain steels with a specified minimum yield strength $ReH > 360 \text{ N/mm}^2$ 规范中最小屈服极限 $ReH > 360 \text{ N/mm}^2$	
1.4	Steels with improved atmospheric corrosion resistance whose analysis may exceed the requirements for the single elements as indicated in group 1 分析结果可能超过第一组中某单一元素的要求而提高耐大气腐蚀性能的钢,	
2		Thermomechanically treated fine-grain steels and cast steels with a specified minimum yield strength $ReH > 360 \text{ N/mm}^2$ 热控轧处理细晶粒钢和铸钢, 规范的最低屈服强度 $ReH > 360 \text{ N/mm}^2$
	2.1	Thermomechanically treated fine-grain steels and cast steels with a specified minimum yield strength $360 \text{ N/mm}^2 < ReH \leq 460 \text{ N/mm}^2$ 规范中的最低屈服强度 $360 \text{ N/mm}^2 < ReH \leq 460 \text{ N/mm}^2$ 的热控轧处理细晶粒钢和铸钢
	2.2	Thermomechanically treated fine-grain steels and cast steels with a specified minimum yield strength $ReH > 460 \text{ N/mm}^2$ 规范中的最低屈服强度 $ReH > 460 \text{ N/mm}^2$ 的热控轧处理细晶粒钢和铸钢
3		Quenched and tempered and precipitation hardened fine-grain steels except stainless steels with a specified minimum yield strength $ReH > 360 \text{ N/mm}^2$ 调质钢(淬火、回火)和沉淀硬化细晶粒钢, 除不锈钢外, 规范中的最低屈服强度 $ReH > 360 \text{ N/mm}^2$ 的钢
	3.1	Quenched and tempered fine-grain steels with a specified minimum yield strength $360 \text{ N/mm}^2 < ReH \leq 690 \text{ N/mm}^2$ 规范中的最低屈服强度 $360 \text{ N/mm}^2 < ReH \leq 690 \text{ N/mm}^2$ 的调质钢(淬火、回火)和沉淀硬化细晶粒钢
	3.2	Quenched and tempered fine-grain steels with a specified minimum yield strength $ReH > 690 \text{ N/mm}^2$ 规范中的最低屈服强度 $ReH > 690 \text{ N/mm}^2$ 的调质钢(淬火、回火)和沉淀硬化细晶粒钢
	3.3	Precipitation-hardened fine-grain steels except stainless steels 沉淀硬化细晶粒钢, 不锈钢除外

4		Low vanadium alloyed Cr-Mo-(Ni) steels with Mo \leq 0,7 % and V \leq 0,1 % Mo \leq 0.7%,V \leq 0.1%的低钒合金Cr-Mo—(Ni)钢
	4.1	Steels with Cr \leq 0,3 % and Ni \leq 0,7 % Cr \leq 0.3% & Ni \leq 0.7%的钢
	4.2	Steels with Cr \leq 0,7 % and Ni \leq 1,5 % Cr \leq 0.7% & Ni \leq 1.5%的钢
5		Cr-Mo steels free of vanadium with C \leq 0,35 % C \leq 0,35 %的Cr-Mo合金无钒钢
	5.1	Steels with 0,75 % \leq Cr \leq 1,5 % and Mo \leq 0,7 % 0,75 % \leq Cr \leq 1,5 % & Mo \leq 0,7 %的钢
	5.2	Steels with 1,5 % < Cr \leq 3,5 % and 0,7 % < Mo \leq 1,2 % 1,5 % < Cr \leq 3,5 % & 0,7 % < Mo \leq 1,2 %的钢
	5.3	Steels with 3,5 % < Cr \leq 7,0 % and 0,4 % < Mo \leq 0,7 % 3,5 % < Cr \leq 7,0 % & 0,4 % < Mo \leq 0,7 %的钢
	5.4	Steels with 7,0 % < Cr \leq 10,0 % and 0,7 % < Mo \leq 1,2 % 7,0 % < Cr \leq 10,0 % & 0,7 % < Mo \leq 1,2 %的钢
6		High vanadium alloyed Cr-Mo-(Ni) steels 高钒Cr-Mo-(Ni)钢
	6.1	Steels with 0,3 % \leq Cr \leq 0,75 %, Mo \leq 0,7 % and V \leq 0,35 % 0,3 % \leq Cr \leq 0,75%, Mo \leq 0,7% & V \leq 0,35 %的钢
	6.2	Steels with 0,75 % < Cr \leq 3,5 %, 0,7 % < Mo \leq 1,2 % and V \leq 0,35 % 0,75 %<Cr \leq 3,5 %, 0,7%<Mo \leq 1,2 % & V \leq 0,35 %的钢
	6.3	Steels with 3,5 % < Cr \leq 7,0 %, Mo \leq 0,7 % and 0,45 % \leq V \leq 0,55 % 3,5%<Cr \leq 7,0 %, Mo \leq 0,7% & 0,45 % \leq V \leq 0,55 %的钢
	6.4	Steels with 7,0 % < Cr \leq 12,5 %, 0,7 % < Mo \leq 1,2 % and V \leq 0,35 % 7,0 %<Cr \leq 12,5%, 0,7%<Mo \leq 1,2% & V \leq 0,35 %的钢
7		Ferritic, martensitic or precipitation-hardened stainless steels with C \leq 0,35 % and 10,5 % \leq Cr \leq 30 % C \leq 0,35 % and 10,5 % \leq Cr \leq 30 %的铁素体, 马氏体或沉淀硬化不锈钢
	7.1	Ferritic stainless steels 铁素体不锈钢
	7.2	Martensitic stainless steels 马氏体不锈钢
	7.3	Precipitation-hardened stainless steels 沉淀硬化不锈钢
8		Austenitic stainless steels, Ni \leq 35 % Ni \leq 35 %的奥氏体不锈钢
	8.1	Austenitic stainless steels with Cr \leq 19 % Cr \leq 19%的奥氏体不锈钢
	8.2	Austenitic stainless steels with Cr > 19 % Cr>19%的奥氏体不锈钢
	8.3	Manganese austenitic stainless steels with 4 % < Mn \leq 12 % 4%<Mn \leq 12%的含锰奥氏体不锈钢

a In accordance with the specification of the steel product standards, ReH may be replaced by Rp0,2 or Rt0,5.

依照钢产品标准的规范, ReH可能被Rp0,2或Rt0,5代替.

b A higher value is accepted, provided Cr + Mo + Ni + Cu + V \leq 0,75 %
可接受更高的值, Cr + Mo + Ni + Cu + V \leq 0,75 %

c A higher value is accepted, provided Cr + Mo + Ni + Cu + V \leq 1 %.
可接受更高的值, Cr + Mo + Ni + Cu + V \leq 1 %

9		Nickel alloy steels with Ni ≤ 10,0 % Ni≤10%的镍合金钢
	9.1	Nickel alloy steels with Ni ≤ 3,0 % Ni ≤ 3,0 %的镍合金钢
	9.2	Nickel alloy steels with 3,0 % < Ni ≤ 8,0 % 3,0 % < Ni ≤ 8,0 %的镍合金钢
	9.3	Nickel alloy steels with 8,0 % < Ni ≤ 10,0 % 8,0 % < Ni ≤ 10,0 %的镍合金钢
10		Austenitic ferritic stainless steels (duplex) 奥氏体铁素体双相不锈钢
	10.1	Austenitic ferritic stainless steels with Cr ≤ 24 % and Ni > 4 % Cr≤24% & Ni> 4%的奥氏体-铁素体不锈钢
	10.2	Austenitic ferritic stainless steels with Cr > 24 % and Ni > 4 % Cr>24% & Ni> 4%的奥氏体-铁素体不锈钢
	10.3	Austenitic ferritic stainless steels with Ni ≤ 4 % Ni< 4%的奥氏体-铁素体不锈钢
11		Steels covered by group 1 ^c except 0,30 % < C ≤ 0,85 % 0.30%<C≤0.85%其余成分与1类钢相同的钢
	11.1	Steels as indicated under 11 with 0,30 % < C ≤ 0,35 % 0,30 %<C≤0,35 % 11组的钢
	11.2	Steels as indicated under 11 with 0,35 % < C ≤ 0,5 % 0,35 % < C ≤ 0,5 % 11组的钢
	11.3	Steels as indicated under 11 with 0,5 % < C ≤ 0,85 % 0,5 % < C ≤ 0,85 % 11组的钢
<p>Based on the actual product analysis, group 2 steels may be considered group 1 steels. 根据实际产品分析, 可将第2组钢视为第1组钢</p> <p>If a material has different minimum specified yield strengths depending on the thickness, the highest yield strength shall be used for the determination of the subgroup. 如果一种材料根据厚度, 最高屈服强度不同, 而有不同的最小规定屈服强度应使用确定的次级分组。</p> <p>a In accordance with the specification of the steel product standards, R_{eH} may be replaced by $R_{p0,2}$ or $R_{t0,5}$. 依照钢产品标准的规范, R_{eH}可能被$R_{p0,2}$或$R_{t0,5}$代替。</p> <p>b A higher value is accepted, provided $Cr + Mo + Ni + Cu + V \leq 0,75$ 可接受更高的值, $Cr + Mo + Ni + Cu + V \leq 0,75$ %</p> <p>c A higher value is accepted, provided $Cr + Mo + Ni + Cu + V \leq 1$ %. 可接受更高的值, $Cr + Mo + Ni + Cu + V \leq 1$ %</p>		

5 Grouping system for aluminium and aluminium alloys

铝和铝合金分组

Aluminium and aluminium alloys are grouped as shown in [Table 2](#). The figures given are based on the element content used in the designation of the alloys.

表2中显示的是铝和铝合金的分组。这些数值以合金规范中使用的元素含量为准

Table 2 — Grouping system for aluminium and aluminium alloys

铝和铝合金分组体系

Group	Subgroup	Type of aluminium and aluminium alloy
21		Pure aluminium ≤ 1 % impurities or alloy content 纯铝杂质或合金含量≤1%
22		Non heat treatable alloys 不可热处理合金
	22.1	Aluminium-manganese alloys Al-Mn合金

	22.2	Aluminium-magnesium alloys with Mg ≤ 1,5 % Mg≤1,5 %的Al-Mg合金
	22.3	Aluminium-magnesium alloys with 1,5 % < Mg ≤ 3,5 % 1,5 % < Mg ≤ 3,5 %的Al-Mg合金
	22.4	Aluminium-magnesium alloys with Mg > 3,5 % Mg > 3,5 %的Al-Mg合金
23		Heat treatable alloys 可热处理合金
	23.1	Aluminium-magnesium-silicon alloys Al-Mn-Si合金
	23.2	Aluminium-zinc-magnesium alloys Al-Zn-Mg合金
24		Aluminium-silicon alloys with Cu ≤ 1 % Cu≤1%的Al-Si合金
	24.1	Aluminium-silicon alloys with Cu ≤ 1 % and 5 % < Si ≤ 15 % Cu≤1%&Si≤15%的Al-Si合金
	24.2	Aluminium-silicon-magnesium alloys with Cu ≤ 1 %; 5 % < Si ≤ 15 % and 0,1 % < Mg ≤ 0,80 % Cu≤1%; 5%<Si≤15% & 0,1%<Mg≤0,80 %的Al-Si-Mg合金
25		Aluminium-silicon-copper alloys with 5 % < Si ≤ 14 % ; 1 % < Cu ≤ 5 % and Mg ≤ 0,8 % 5%<Si≤14% ; 1%<Cu≤5% & Mg≤0,8%的Al-Si-Cu合金
26		Aluminium-copper alloys with 2 % < Cu ≤ 6 % 2 % < Cu ≤ 6 %的铝-铜合金
NOTE Groups 21 to 23 are generally for wrought materials and groups 24 to 26 are generally for cast materials. 第21至23组一般用于锻造材料，第24至26组一般用于铸造材料。		

6 Grouping system for copper and copper alloys

铜及铜合金分组体系

Copper and copper alloys are grouped as indicated in [Table 3](#).

表3为的铜及铜合金分组

Table 3 — Grouping system for copper and copper alloys

铜及铜合金分组

Group	Subgroup	Type of copper and copper alloy
31		Copper with up to 6 % Ag and 3 % Fe 银含量达6%，铁含量达3%的铜
32		Copper-zinc alloys Cu-Zn合金
	32.1	Copper-zinc alloys, binary 二元Cu-Zn合金
	32.2	Copper-zinc alloys, complex 多元Cu-Zn合金
33		Copper-tin alloys Cu-Sn合金
34		Copper-nickel alloys Cu-Ni合金
35		Copper-aluminium alloys Cu-Al合金
36		Copper-nickel-zinc alloys Cu-Ni-Zn合金
37		Copper alloys, low alloyed (less than 5 % other elements) not covered by groups 31 to 36 31-36 类组以外的，低合金含量（其他元素含量低于5%）的铜合金

38	Other copper alloys (5 % or more other elements) not covered by groups 31 to 36 31-36 类组以外的其他铜合金 (其他元素含量等于或高于5%)
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7 Grouping system for nickel and nickel alloys

镍和镍合金分组

Nickel and nickel alloys are grouped as indicated in [Table 4](#). The figures given are based on the element content used in the designation of the alloys.

表4为镍和镍合金分组。这些数值以合金规范中使用的元素含量为准

Table 4 — Grouping system for nickel and nickel alloys

镍和镍合金分组

Group	Type of nickel and nickel alloy
41	Pure nickel 纯镍
42	Nickel-copper alloys (Ni-Cu) Ni ≥ 45 %, Cu ≥ 10 % Ni ≥ 45 %, Cu ≥ 10 % 的Ni-Cu合金
43	Nickel-chromium alloys (Ni-Cr-Fe-Mo) Ni ≥ 40 % Ni ≥ 40 % 的Ni-Cr合金(Ni-Cr-Fe-Mo)
44	Nickel-molybdenum alloys (Ni-Mo) Ni ≥ 45 %, Mo ≤ 32 % Ni ≥ 45 %, Mo ≤ 32 % 的Ni-Mo合金
45	Nickel-iron-chromium alloys (Ni-Fe-Cr) Ni ≥ 31 % Ni ≥ 31 % 的Ni-Fe-Cr合金
46	Nickel-chromium-cobalt alloys (Ni-Cr-Co) Ni ≥ 45 %, Co ≥ 10 % Ni ≥ 45 %, Co ≥ 10 % 的Ni-Cr-Co合金
47	Nickel-iron-chromium-copper alloys (Ni-Fe-Cr-Cu) Ni ≥ 45 % Ni ≥ 45 % 的Ni-Fe-Cr-Cu合金
48	Nickel-iron-cobalt alloys (Ni-Fe-Co-Cr-Mo-Cu) 31 % ≤ Ni ≤ 45 % and Fe ≥ 20 % 31 % ≤ Ni ≤ 45 % & Fe ≥ 20 % 的Ni-Fe-Co合金(Ni-Fe-Co-Cr-Mo-Cu)

8 Grouping system for titanium and titanium alloys

钛及钛合金分组

Titanium and titanium alloys are grouped as indicated in [Table 5](#).

表5为钛及钛合金分组

Table 5 — Grouping system for titanium and titanium alloys

钛及钛合金分组

Group	Subgroup	Type of titanium and titanium alloy
51		Pure titanium 纯钛
	51.1	Titanium with O ₂ ≤ 0,20 % O ₂ < 0.2% 的钛
	51.2	Titanium with 0,20 % < O ₂ ≤ 0,25 % 0.2% < O ₂ ≤ 0.25% 的钛
	51.3	Titanium with 0,25 % < O ₂ ≤ 0,35 % 0.25% < O ₂ ≤ 0.35% 的钛
	51.4	Titanium with 0,35 % < O ₂ ≤ 0,40 % 0.25% < O ₂ ≤ 0.35% 的钛
52		Alpha alloys ^a α合金
53		Alpha-beta alloys ^b α-β合金

54	Near-beta and beta alloys ^c B及近似β合金
a	Alloys covered by group 52 are: Ti-0,2Pd; Ti-2,5Cu; Ti-5Al-2,5Sn; Ti-8Al-1Mo-1V; Ti-6Al-2Sn-4Zr-2Mo; Ti-6Al-2Nb-1Ta-0,8Mo. 52组合金包括:
b	Alloys covered by group 53 are: Ti-3Al-2,5V; Ti-6Al-4V; Ti-6Al-6V-2Sn; Ti-7Al-4Mo. 53组合金包括:
c	Alloys covered by group 54 are: Ti-10V-2Fe-3Al; Ti-13V-11Cr-3Al; Ti-11,5Mo-6Zr-4,5Sn; Ti-3Al-8V-6Cr-4Zr-4Mo. 54组合金包括:

9 Grouping system for zirconium and zirconium alloys

锆及锆合金分组体系

Zirconium and zirconium alloys are grouped as indicated in [Table 6](#).

锆及锆合金的分组见表6

Table 6 — Grouping system for zirconium and zirconium alloys

锆及锆合金的分组

Group	Type of zirconium and zirconium alloy
61	Pure zirconium 纯锆
62	Zirconium with 2,5 % Nb 2.5%Nb的锆

10 Grouping system for cast irons

铸铁分组体系

Cast irons are grouped as indicated in [Table 7](#).

表7为铸铁分组

Table 7 — Grouping system for cast irons

铸铁分组体系

Group	Subgroup	Type of cast iron
71		Grey cast irons with specified tensile strength or Brinell hardness 规定了抗拉强度或布氏硬度的灰口铸铁
72		Spheroidal graphite cast irons with specified mechanical properties 规定了力学性能的球墨铸铁
	72.1	Spheroidal graphite cast irons, ferrite type, with specified tensile strength, 0,2 % proof stress, elongation and specified impact resistance values 铁素体球墨铸铁, 规定了抗拉强度、0.2%屈服强度、延伸率和冲击值
	72.2	Spheroidal graphite cast irons, ferrite type, with specified tensile strength, 0,2 % proof stress and elongation or specified Brinell hardness 铁素体球墨铸铁, 规定了抗拉强度、0.2%屈服强度、延伸率或布氏硬度
	72.3	Spheroidal graphite cast irons EN-GJS-500-7 and EN-GJS-450-10 (if > 20 % perlite) or specified Brinell hardness EN-GJS-500-7和EN-GJS-450-10型(含珠光体量20%以上或规定了硬度)的球墨铸铁
	72.4	Spheroidal graphite cast irons, perlite type, with specified tensile strength, 0,2 % proof stress and elongation or specified Brinell hardness 珠光体球墨铸铁, 规定了抗拉强度、屈服强度、延伸率或规定布氏硬度
73		Malleable cast irons 可锻铸铁
74		Austempered ductile cast irons 奥氏体回火的可锻铸铁
75		Austenitic cast irons 奥氏体铸铁
76		Cast irons excepting 71 to 75 71-75以外的其它铸铁

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