BS EN 14700:2014

BSI Standards Publication

Welding consumables — Welding consumables for hard-facing

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National foreword

This British Standard is the UK implementation of EN 14700:2014. It supersedes BS EN 14700:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/39, Welding consumables.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

Welding consumables - Welding consumables for hard-facing

Produits consommables de soudage - Produits consommables pour le rechargement dur

Schweißzusätze - Schweißzusätze zum Hartauftragen

This European Standard was approved by CEN on 8 February 2014.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 14700:2014) has been prepared by Technical Committee CEN/TC 121 “Welding and allied processes”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2014 and conflicting national standards shall be withdrawn at the latest by October 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14700:2005.

The main following changes have been made:

a) the classification is now divided in two compulsory parts and 3 optional parts;

b) 4.3 “Designation of the typical composition” added;

c) 4.4 “Symbol for the range of hardness” added;

d) 4.5 “Symbol for the auxiliary material” added;

e) new alloys added;

f) in Table A.3 “Form of supply of consumables and applicable processes for hard-facing” the welding processes are updated according to EN ISO 4063:2010;

g) in Table A.4 “Examples of application”;

h) normative references updated.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard applies to welding consumables for hardfacing. The range of application includes surfaces of new structural components, semi-finished products as well as repair of surfaces of structural components which have to resist to mechanical, chemical, thermal or combined stress.

This European Standard specifies requirements for classification of the consumables based on their chemical composition of the all weld metal of covered electrodes, cored wires, cored rods, cored strips, sintered strips, sintered rods and metal powders and on the chemical composition of solid wires, solid rods, solid strips and cast rods.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 544, *Welding consumables - Technical delivery conditions for filler materials and fluxes - Type of product, dimensions, tolerances and markings (ISO 544:2011)*

EN ISO 6847, *Welding consumables - Deposition of a weld metal pad for chemical analysis (ISO 6847:2013)*

EN ISO 14174:2012, *Welding consumables - Fluxes for submerged arc welding and electroslag welding - Classification (ISO 14174:2012)*

EN ISO 14175:2008, *Welding consumables - Gases and gas mixtures for fusion welding and allied processes (ISO 14175:2008)*

EN ISO 14344, *Welding consumables - Procurement of filler materials and fluxes (ISO 14344:2010)*

EN ISO 80000-1:2013, *Quantities and units - Part 1: General (ISO 80000-1:2009 + Cor 1:2011)*

3 Classification

The classification is divided in two compulsory parts and 3 optional parts:

Compulsory part:

a) the first part gives a symbol indicating the product form, see 4.1;

b) the second part gives an alloy symbol indicating the range of composition and the suitability, see Table 2.

Optional part:

c) the third part indicates the typical composition, see 4.3;

d) the fourth part indicates the range of hardness of the all weld metal, see 4.4;

e) the fifth part indicates the welding auxiliary material (shielding gas and fluxes), see 4.5.

The parts c), d) and e) will be hyphenated from the compulsory part.

4 Symbols and requirements

4.1 Symbol for the product form

The following symbols for the product forms shall be used (see Table 1).

Table 1 — Symbols for the product form

Symbol	Product form (consumable)
E	covered electrode
S	solid wire and solid rod
T	cored wire and cored rod
R	cast rod
B	solid strip
C	sintered rod, cored strip and sintered strip
P	metal powder

NOTE See also Table A.3.

4.2 Symbol for the chemical composition

The alloy symbols in Table 2 indicate the chemical composition of the all weld metal of covered electrodes, cored wires, cored strips, sintered strips, sintered rods and metal powder or the chemical composition of solid wires, solid rods, solid wires and cast rods.

4.3 Designation of the typical composition

Additional to the alloy symbols in Table 2 the typical chemical composition of the all weld metal of covered electrodes, cored wires, cored strips, sintered strips, sintered rods and metal powder or the chemical composition of solid wires, solid rods, solid wires and cast rods will be indicated. The designation of the typical composition will be indicated by the chemical symbol of the most important alloying elements, except the base, followed by their percentage.

Table 2 — Alloy symbols and chemical composition

Alloy symbol	Suitability	Chemical composition in % (by mass)[c]												
		C	Cr	Ni	Mn	Mo	W	V	Nb	Fe	Co	Cu	Al	Other
Fe1	p	≤ 0,4	≤ 3,5	≤ 3	≤ 4,5	≤ 1	≤ 1	≤ 1	–	Balance	–	–	–	Si, Ti
Fe2	p (g) (s)	0,4 to 1,5	≤ 7	≤ 1	≤ 3	≤ 4	≤ 1	≤ 1	–	Balance	≤ 1	≤ 1	–	Si, Ti
Fe3	s t	0,1 to 0,5	1 to 15	≤ 5	≤ 3	≤ 5	≤ 10	≤ 1,5	≤ 3	Balance	≤ 13	–	–	Si, Ti
Fe4	s t (p)	0,2 to 1,5	2 to 10	≤ 4	≤ 3	≤ 10	≤ 20	≤ 4	–	Balance	≤ 5	–	–	Si, Ti
Fe5	c p s t w	≤ 0,5	≤ 0,1	17 to 22	≤ 1	3 to 5	–	–	–	Balance	10 to 15	–	≤ 1	Si, Ti
Fe6	g p s	≤ 2,5	≤ 10	–	≤ 3	≤ 3	–	–	≤ 10	Balance	–	–	–	Si, Ti
Fe7	c p t	≤ 0,2	11 to 30	≤ 6	≤ 3	≤ 2	–	≤ 1	≤ 1	Balance	–	–	–	Si, N
Fe8	g p t	0,2 to 2	5 to 20	–	≤ 3	≤ 5	≤ 2	≤ 2	≤ 10	Balance	–	–	–	Si, Ti
Fe9	k p (n)	≤ 1,2	≤ 20	≤ 5	9 to 20	≤ 2	–	≤ 1	–	Balance	–	–	–	Si, Ti
Fe10	c k p z (n)	≤ 0,25	17 to 22	7 to 11	3 to 8	≤ 1,5	–	–	≤ 1,5	Balance	–	–	–	Si
Fe11	c n z	≤ 0,3	17 to 32	8 to 20	≤ 3	≤ 4	–	–	≤ 1,5	Balance	–	–	–	Si, Cu
Fe12	c n (z)	≤ 0,12	17 to 27	9 to 26	≤ 3	≤ 4	–	–	≤ 1,5	Balance	–	–	–	Si
Fe13	g	≤ 1,5	≤ 7	≤ 4	≤ 3	≤ 4	–	–	–	Balance	–	–	–	Si, B, Ti
Fe14	g (c)	1,5 to 4,5	25 to 40	≤ 4	≤ 3	≤ 4	–	–	–	Balance	–	–	–	Si
Fe15	g	3 to 7	20 to 40	≤ 4	≤ 3	≤ 2	–	–	≤ 10	Balance	–	–	–	Si, B
Fe16	g z	4 to 8	10 to 40	–	≤ 3	≤ 10	≤ 10	≤ 10	≤ 10	Balance	–	–	–	Si, B
Fe17	c k p v	≤ 0,3	≤ 20	≤ 5	8 to 20	≤ 2	≤ 0,3	–	–	Balance	10 to 15	–	–	Si
Fe20	c g t z	–	–	–	–	–	–	–	–	Balance	–	–	–	hard material[b]
Ni1	c p t	≤ 1	15 to 30	Balance	≤ 1	≤ 6	≤ 2	≤ 1	–	≤ 5	–	–	–	Si, B
Ni2	c k p t z	≤ 0,1	14 to 30	Balance	≤ 1,5	10 to 30	≤ 8	≤ 1	≤ 5	≤ 10	≤ 5	–		Si, Ti
Ni3	c p t	≤ 1	≤ 15	Balance	≤ 1	≤ 6	≤ 2	≤ 1	–	≤ 5	–	–	–	Si, B
Ni4	c k p t z	≤ 0,1	1 to 20	Balance	≤ 1,5	≤ 30	≤ 8	≤ 1	≤ 5	≤ 3	≤ 15	–	≤ 3	Si, Ti
Ni20	c g t z	–	–	Balance	–	–	–	–	–	–	–	–	–	hard material[b]
Co1	c k t z	≤ 0,6	20 to 35	≤ 10	0,1 to 2	≤ 10	≤ 15	–	≤ 1	≤ 5	–	–	–	Si
Co2	t z (c) (s)	0,6 to 3	20 to 35	≤ 4	0,1 to 2	–	4 to 10	–	–	≤ 5	–	–	–	Si
Co3	t z (c) (s)	1 to 3	20 to 35	≤ 4	≤ 2	≤ 1	6 to 15	–	–	≤ 5	–	–	–	Si
Cr1	g n	1 to 5	Balance	–	≤ 1	–	–	15 to 30	–	≤ 5	–	–	–	Si, B, Zr
Cu1	c (n)	–	–	≤ 6	≤ 2	–	–	–	–	≤ 5	–	Balance	7 to 15	Sn
Cu2	c (n)	–	–	≤ 6	≤ 15	–	–	–	–	≤ 5	–	Balance	≤ 9	Sn
Al1	c n	–	–	10 to 35	≤ 0,5	–	–	–	–	–	–	≤ 6	Balance	Si
Z	–	Any other agreed composition[a]												

Suitability:
- c: resistance to rusting
- g: resistance to abrasion
- k: work hardenable
- (): limited suitability or may not apply to all alloys of this type
- n: cannot be magnetised
- p: impact resistance
- s: edge retention
- v: cavitation resistance
- t: heat resistance
- z: scaling resistance
- w: precipitation hardened

[a] Consumables for which the chemical composition is not listed in the table shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified and therefore it is possible that two products with the same Z classification are not interchangeable.

[b] Tungsten fused carbide or tungsten carbide broken or spherical.

[c] Single values shown in the table are maximum values.

4.4 Symbol for the range of hardness

The symbol (see Table 3) indicates the range of hardness of the all weld metal without post-treatment. The following symbol for the maximal range of hardness after post weld heat treatment or cold work hardening can be indicated in brackets.

Table 3 — Symbol for the range of hardness

Symbol	Range of hardness
150	125 HB and ≤ 175 HB
200	> 175 HB and ≤ 225 HB
250	> 225 HB and ≤ 275 HB
300	> 275 HB and ≤ 325 HB
350	> 325 HB and ≤ 375 HB
400	> 375 HB and ≤ 450 HB
40	37 HRC and ≤ 42 HRC
45	> 42 HRC and ≤ 47 HRC
50	> 47 HRC and ≤ 52 HRC
55	> 52 HRC and ≤ 57 HRC
60	> 57 HRC and ≤ 62 HRC
65	> 62 HRC and ≤ 67 HRC
70	> 67 HRC

4.5 Symbol for the auxiliary material

The designation of the symbol for the auxiliary material shall follow the EN ISO 14175:2008, Table 2, for shielding gases and the EN ISO 14174:2012, Table 1, for fluxes. If metal or flux cored wires will be used without gas protection, the symbol “NO” is applicable.

5 Alloy types, form of supply, requirements and applications

The most usual alloy types are listed in Table 2. Typical application is given in Table A.1. The forms of supply listed in Tables A.2 and A.3 may support the decision making as regards applicable welding processes.

The applications shown in Table A.4 give reference to the suitability of individual alloy types for different kind of requirements and system structures. It may be concluded that other alloy types may also be considered with regard to complex kind of requirements.

6 Chemical composition

The chemical analysis shall be performed on specimens of solid wires, solid rods and solid strips according to EN ISO 6847 respectively or on any suitable all-weld metal specimen and cast rods (covered electrodes, cored wires, cored strips, sintered rods, sintered strips and metal powder). Any analytical technique can be used, but in case of dispute reference shall be made to established published methods.

NOTE See Bibliography.

7 Rounding off procedure

For purposes of determining compliance with the requirements of this European Standard, the actual test values obtained shall be subjected to the rounding-off rules of EN ISO 80000-1:2013, Annex B, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this standard, the

measured values shall be converted to the units of this standard before rounding off. If an average value is to be compared to the requirements of this document, rounding off shall be done only after calculating the average. In the case where the testing document cited in the normative references of this European Standard contains instructions for rounding off that conflict with the instructions of this standard, the rounding off requirements of the testing document shall apply. The rounded-off results shall fulfil the requirements of the appropriate table for the classification under test.

8 Retest

If any test fails to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for the retest may be taken from the original test sample or from a new test sample. For chemical analysis, retest need be only for those specific elements that failed to meet their test requirement. If the results of one ore both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the sample or test specimen(s), or in conducting the tests, the test shall be considered invalid, without regard to whether the test was actually completed, or whether the test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

9 Technical delivery conditions

The technical delivery conditions shall meet the requirements in EN ISO 544 and EN ISO 14344. The requirements for cored strips, sintered rods and sintered strips as well as for cast rods and metal powders shall be defined separately.

10 Designation

The designation of the consumables shall follow the principle given in the examples below:

EXAMPLE 1 A solid wire (S) for gas shielded metal arc welding with a chemical composition within the limits for the alloy symbol Fe7 of Table 2 is designated:

Solid wire EN 14700 S Fe7

where

EN 14700	is the standard number;
S	is the product form (see Table 1);
Fe7	is the alloy symbol (see Table 2).

EXAMPLE 2 A cored wire (T) for gas shielded metal arc welding with a chemical composition within the limits for the alloy symbol Fe9 of Table 2, a typical composition of the all weld metal of 0,4 % C, 16,0 % Mn, and 14,0 % Cr, a hardness of the all weld metal without post weld treatment of 240HB, a hardness after cold work hardening of 48HRC and welded with a shielding gas according to EN ISO 14175:2008, M21 is designated:

Cored wire EN 14700 T Fe9 – C0,4Mn16Cr14 – 250(50) – M21

where:

EN 14700	is the standard number;
T	is the product form (see Table 1);
Fe9	is the alloy symbol (see Table 2);
C0,4Mn16Cr14	is the designation of the typical composition;
250(50)	is the symbol for the range of hardness (see Table 3);
M21	is the symbol for the shielding gas according to EN ISO 14175:2008.

Annex A
(informative)

Application and supply forms

Table A.1 — Suitability of alloy types for different kind of requirements (1 of 2)

Alloy symbol	Requirement							Alloy / microstructure	Hardness range	
	mechanical		thermal		corrosive	crack resistance	machining		[HB]	[HRC]
	friction	impact	high temp.	thermo shock						
Fe1	3 and 4	2 and 3	4	4	4	1	1	ferritic / martenstic	150 to 450	–
Fe2	3 and 4	2	4	4	4	2	3	martensitic	–	30 to 58
Fe3	3	2	2	2	3	2	2	martenstic (carbides)	–	40 to 55
Fe4	2	2 and 3	1 and 2	1 and 2	3	2 and 3	3 and 4	martenstic + carbides	–	55 to 65
Fe5	2	1	1	1	2	1	1	martensitic	–	30 to 40
Fe6	1	1	2 and 3	2 and 3	4	2 and 3	3 and 4	martenstic + carbides	–	48 to 55[a]
Fe7	2	2	1 and 2	1 and 2	1 and 2	1	1 and 2	ferritic / martenstic	250 to 450	–
Fe8	1 and 2	1 and 2	4	4	3	2 and 3	3 and 4	martenstic + carbides	–	50 to 65
Fe9	4	1	4	4	2 and 3	1 and 2	3	austenitic	200 to 250	40 to 50[b]
Fe10	4	1	1 and 2	1	2	1	2	austenitic	180 to 200	38 to 42[b]
Fe11	4	3	1	4	1	1	1	austenitic	–	–
Fe12	4	3	1	4	1	1	1	austenitic	150 to 250	–
Fe13	1	4	2	4	4	4	4	martenstic / austenitic + FeB	–	55 to 65
Fe14	1	3 and 4	3	4	2	4	4	martenstic / austenitic + carbides	–	40 to 60
Fe15	1	4	2	4	3	4	4	martenstic / austenitic + carbides	–	55 to 65
Fe16	1	4	1	4	3	4	4	martenstic / austenitic + carbides	–	60 to 70
Fe17	2 and 3	1	2	2	1	1	1	austenitic	150 to 350	40 to 55[b]
Fe20	1	3	3	4	3	4	4	hard material in a Fe-matrix	1500 to 2800 HV (hard material)	50 to 60 (matrix)

Table A.1 (2 of 2)

Alloy symbol	Requirement							Alloy / microstructure	Hardness range	
	mechanical		thermal		corrosive	crack resistance	machining		[HB]	[HRC]
	friction	impact	high temp.	thermo shock						
Ni1	1 and 2	2 and 3	2	3	2	3	3	Ni-alloy	–	45 to 60
Ni2	2 and 3	2	1	1	2	1	2	Ni-alloy	200 to 400	–
Ni3	2	2 and 3	2	3	2	2	2	Ni-alloy	–	45 to 60
Ni4	2 and 3	2	2	1	2	1	2	Ni-alloy	200 to 400	–
Ni20	1	2	2	3	2	1 and 2	4	hard material in a Ni-matrix	1500 to 2800 HV (hard material)	40 to 55 (matrix)
Co1	2 and 3	1	1	1 and 2	1	1	1	Co-alloy	250 to 350	40 to 45[b]
Co2	1 and 2	2 and 3	1	1 and 2	2	2 and 3	3 and 4	Co-alloy	–	35 to 50
Co3	1 and 2	2 and 3	1	1 and 2	2	2 and 3	3 and 4	Co-alloy	–	45 to 60
Cu1	3 and 4	2 and 3	4	3	1	2 and 3	2	CuAl-alloy	200 to 450	–
Cu2	3 and 4	2	4	3	1	3	2	CuAlMn-alloy	200 to 300	–
Al1	1	3	4	4	2	2 and 3	3	alpha solid solution + intermetallic phase	150 to 300 HV	–
Cr1	1	3	3	3	1	2 and 3	3 and 4	austenitic + precipitate	600 to 700 HV	–

Suitability criteria:

1 excellent

2 good

3 acceptable

4 not acceptable

a artificial ageing 3 h to 4 h at 480 °C

b work hardened

Table A.2 — Forms of supply

Alloy symbol	Forms of supply							
	cored wire and cored rod	cored strip	solid strip and sintered strip	solid wire and solid rod	sintered rod	covered electrode	cast rod	metal powder
Fe1	●	●	●	●	–	●	–	–
Fe2	●	●	●	●	–	●	–	–
Fe3	●	●	●	●	–	●	–	–
Fe4	●	○	○	●	–	●	–	–
Fe5	●	○	○	●	–	●	–	○
Fe6	●	●	–	–	–	○	–	–
Fe7	●	●	●	●	–	●	–	●
Fe8	●	●	●	●	–	●	–	–
Fe9	●	●	●	–	–	●	–	–
Fe10	●	●	●	●	–	●	–	–
Fe11	●	●	●	●	–	●	–	–
Fe12	●	●	●	●	–	●	–	–
Fe13	●	–	–	–	–	○	–	–
Fe14	●	○	●	–	–	●	–	–
Fe15	●	–	–	–	–	●	–	–
Fe16	●	–	–	–	–	●	–	–
Fe17	●	○	○	●	–	●	–	●
Fe20	●	–	–	–	●	●	●	–
Ni1	●	–	–	●	–	●	–	●
Ni2	●	–	–	●	–	●	–	●
Ni3	●	–	–	●	–	●	–	●
Ni4	●	–	–	●	–	●	–	●
Ni20	●	–	–	–	●	●	●	●
Co1	●	–	○	●	–	●	●	●
Co2	●	–	○	●	–	●	●	●
Co3	●	–	○	●	–	●	●	●
Cu1	●	–	–	●	–	●	–	●
Cu2	●	–	–	●	–	●	–	●
Al1	●	○	–	–	–	–	–	●
Cr1	–	–	–	–	○	–	–	●

● = in use ○ = manufacture possible – = not in use

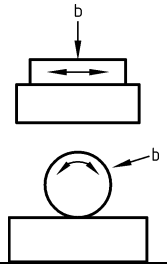
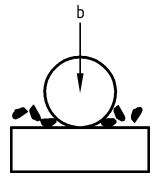
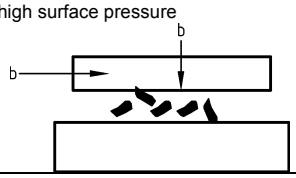
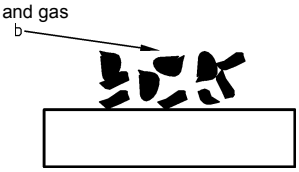
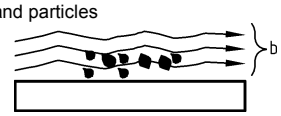
Table A.3 — Form of supply of consumables and applicable processes for hard-facing

Consumable	Welding processes – Designation according to EN ISO 4063									
	111	131/135	132, 133, 136, 138	114	141, 143	121/122	72	15	52	311
Covered electrode	●	–	–	–	–	–	–	–	–	–
Cast rod	–	–	–	–	●	–	–	○	–	●
Solid wire	–	●	–	–	●	●	–	●	●	●
Solid rod	–	–	–	–	●	–	–	–	●	●
Solid strip	–	○	–	–	●	●	●	●	○	–
Cored wires	–	–	●	●	●	●	○	●	●	–
Cored strip	–	–	○	–	○	●	○	○	–	–
Cored rod	–	–	–	–	●	–	–	–	–	●
Sintered strip	–	○	–	–	●	●	●	●	○	–
Sintered rod	–	–	–	–	●	–	–	–	–	●
Metal powder	–	–	–	–	–	–	–	●	●	●

15: Plasma arc welding
52: Laser welding
72: Electroslag welding
111: Manual metal arc welding (metal arc welding with covered electrode)
114: Self-shielded tubular-cored arc welding
121: Submerged arc welding
122: Submerged arc welding with strip electrode
131: MIG welding with solid wire electrode
132: MIG welding with flux cored electrode
133: MIG welding with metal cored electrode
135: MAG welding with solid wire electrode
136: MAG welding with flux cored electrode
138: MAG welding with metal cored electrode
141: TIG welding with solid filler material (wire/rod)
143: TIG welding with tubular cored filler material (wire/rod)
311: Oxyacetylene welding

● = in use ○ = manufacture possible – = not in use

Table A.4 — Examples of applications

System structure	Type of wear	Examples of components	Alloy symbol[a]
Solid-body – solid-body Solid – body friction Boundary friction Mixed friction 	Frictional wear	Guiding way, sliding rail	Fe1, Fe2, Fe3, Cu1, Cu2
	Rebound wear Impact wear	Forging hammer	Fe9, Fe10, Al1, Ni2, Ni4
		Valve rocker, cam	Fe1, Fe2, Fe3
	Rolling wear Friction wear	Tram rail, switch	Fe9, Fe10
		Bogie wheel	Fe1, Fe2, Fe3, Fe9
		Track rails	Fe1, Fe9, Fe10
	Rolling-impact wear Thermal shock	Casting guide roll	Fe7
		Roller table roll	Fe3, Fe6, Fe7, Fe8
		Driving roller, coiler	Fe3
		Forging die	Fe3, Fe4, Fe6, Fe8, Co1, Co2, Co3, Ni2, Ni4
	Impact-sliding wear cold	Shear blade, cutting edge	Fe4, Fe5, Fe8, Co1, Co2, Co3
	Impact-sliding wear hot	Hot shear blade	Fe4, Fe3, Co2, Ni2, Ni4
		Punch	Fe4, Fe3, Co2, Ni2, Ni4
Solid-body – solid-body and particles 	Impact-sliding wear	Jaw crusher, breaker hammer	Fe6, Fe8, Fe9, Fe14
		Beating arm	Fe6, Fe8, Fe9
		Clod crusher	Fe6, Fe8, Fe9, Fe13, Fe14, Fe15
		Bandage for cement roll crusher	Fe6, Fe8
		Coal-, ore mill ring	Fe6, Fe8, Fe13, Fe14, Fe15, Fe16
		Fire bar, grating bar	Fe13, Fe14, Fe15
		Coal mill hammer	Fe8, Fe13, Fe14, Fe15
		Wear plate	Fe13, Fe14, Fe15
Solid-body - particles high surface pressing and impact	Impact-sliding wear	Plough-share, bucket blade	Fe15, Fe20, Ni20
		Run-off table, chute	Fe14, Fe15, Fe20, Ni20
		Wear plate	Fe14, Fe15, Ni1, Ni2, Ni3, Ni4, Ni20
Solid-body – solid-body and particles, high surface pressure 	Grooving wear	Extruder	Fe14, Fe15, Fe20, Ni1, Ni3, Ni20, Co2, Co3, Cr1
		Screw conveyor	Fe14, Fe15, Fe20, Ni1, Ni3, Ni20, Co2, Cr1
		Bucket blade	Fe15, Fe20, Ni20
		Ripper tooth, scarifies	Fe6, Fe2, Fe8
		Plough-share	Fe2, Fe6, Fe8, Fe20, Ni20
		Mixer part, mixer bottom	Fe6, Fe8, Fe14, Fe20, Ni1, Ni3, Ni20
		Brick pressing die	Fe6, Fe8, Fe14, Ni1, Ni3
		Mill segment, mill ring	Fe14
Solid-body – particles and gas 	Grain-sliding wear, T ≥ 500°C	Blast furnace valve, top gas valve	Fe6, Fe7, Fe8
		Furnace-top bell, seat area	Fe6, Fe3, Fe8 (Fe16)
		Blast furnace hopper	Fe15, Fe16
		Furnace fittings, furnace gate	Fe7, Co1, Co2
		Fan, rotor wheel blade, reinforced edge	Fe10, Fe15, Fe16, Fe20, Ni1, Ni2, Ni3, Ni4, Ni20
		Clod crusher, grating bar	Fe15, Fe16
		Impellor, wear plate	Fe14, Fe15, Fe20, Ni1, Ni3, Ni20
Solid-body – liquid and particles 	Washing wear, Fluid film erosion	Nozzle pipe feeder, wear plate	Fe14, Fe15
		Sea dredger slide guide, shackle	Fe6, Fe8
		Fluid pump	Fe6, Fe7, Fe8, Ni1, Ni3
		Mixer parts	Fe6, Fe7, Fe8
	Corrosion caused by erosion	Ship's screw	Cu1, Cu2
		Water turbine	Fe7, Fe17, Cu1
Solid-body – liquid	Corrosion	Chemical equipment	Fe7, Fe11, Fe12
		Sealing surface of fittings	Fe7, Fe17, Co1, Co2, Co3
	Cavitation	Water turbine	Fe17, Fe7, Co1, Co2, Co3, Fe11, Fe12

[a] according to Table 2

[b] wear direction

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