UDC 669.1 : 001.4

March 1991

Definition and classification of pig iron

English version of DIN EN 10 001

DIN EN 10001

Begriffsbestimmung und Einteilung von Roheisen

European Standard EN 10 001 : 1990 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ECISS/TC 5.

The responsible German body involved in the preparation of this standard was the *Normenausschuß Eisen und Stahl* (Steel and Iron Standards Committee).

The standard conforms to EURONORM 1, 1981 edition (which was hitherto used in Germany), and the related International Standard ISO 9147, except that

a) in table 2, the permissible total carbon content is now specified as 3,0 to 4,5 % (instead of 3,0 to 4,0 %);

b) footnote 4 to table 2 was brought into line with the relevant text in ISO 9147;

c) the second paragraph of clause A.4.2 has been added.

Standards referred to

ISO 9147 : 1987 Pig-irons; definition and classification

EURONORM 1-81 Definition and classification of pig-irons

International Patent Classification

C 21 C 1/00

Editor's note

This standard reproduces the official text of the English version of EN 10 001 as issued by CEN. In its preparation for publication as DIN EN 10 001 (English version), certain points have been noted which we consider to be in need of correction. These have been marked +). The suggested amendments are given below and will be forwarded to the responsible CEN Secretariat for its consideration.

In presentation, orthography, punctuation and hyphenation, the aim has been to implement the PNE Rules consistently. Obvious errors (e.g. redundancies and omissions) have been rectified without further reference.

Suggested amendments

1 *'pig-irons' should preferably read 'pig iron'.*

2 *In clause 2, 'granules' should preferably be substituted for 'granulates'.*

EN comprises 6 pages.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 10 001

July 1990

UDC 669.1 : 001.4

Descriptors: Iron and steel products, pig castings, designation, classification, chemical composition, sampling.

English version

Definition and classification of pig-irons+)

Définition et classification des fontes brutes

Begriffsbestimmung und Einteilung von Roheisen

This European Standard was approved by CEN on 1989-07-28. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 10 001 : 1990 E

Brief history

This European Standard was prepared by the Technical Committee ECISS/TC 5 'Definition, classification and conventional designation of pig iron and ferroalloys'. The Secretariat is held by DIN.

This European Standard replaces EURONORM EU 1-81 Definition and classification of pig-irons.

This European Standard was adopted by CEN on 1990-07-28.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Contents

1 Purpose

The purpose of this European Standard is to standardize the definition of pig-irons+) and to standardize the subdivision of pig-irons+) into different classes.

2 Definition

A pig-iron is an iron-carbon alloy with more than 2 % C and with contents of other elements equal to or less than the limit values given for them in table 1. It is intended for further processing in the molten condition into steel or cast iron. Pig-iron is delivered either, in the molten state or in the solid state, in primary forms such as pigs or similar solid pieces, and granulates+).

3 Subdivision of pig-irons +)

3.1 Pig-iron is subdivided into the classes indicated in table 2 on the basis of its chemical composition.

3.2 In cases of doubt, the correct classification of the pig-iron into one of the classes indicated in table 2 is to be determined by check analysis. The conditions for sampling including the conditions for the number of the tests shall correspond to the conditions usually applied in cases of dispute for deliveries of disputed chemical composition (see annex A).

3.3 The designations used in the different languages for the various classes of pig-iron are given in table 3.

Table 1. **Limits of the alloy contents for pig-iron**

Element	Limit[1])
Manganese	≤30,0 %
Silicon	≤8,0 %
Phosphorus	≤3,0 %
Chromium	≤10,0 %
Other alloying elements in total [2])	≤10,0 %

[1]) Materials with higher contents are ferroalloys.

[2]) In cases of doubt, all elements for which a minimum content is specified or whose content exceeds the lower limit given in table 2, footnote 8, paragraph (d), are, in accordance with table 2, footnote 8, paragraph (c) and (d), regarded as 'Other alloying elements' with the exception of carbon, silicon, manganese, phosphorus and chromium.

Table 2. Classification and designation of pig-irons according to its chemical composition[1)]

1	2			3	4	5	6	7	8	9
No.	Pig-iron class Designation			Abbreviation	% C total	% Si	% Mn	% P	% S max.	Other
1.1	Unalloyed	Steel-making pig-iron	Low phosphorus	Pig-P2	(3,3 to 4,8)	≤1,0 [2)]	0,4 to 6,0 (0,5 to 1,5)	≤0,25	0,06	
1.2			High phosphorus	Pig-P20	(3,0 to 4,5)		≤1,5	1,5 to 2,5	0,08	
2.1		Foundry pig-iron	[4)]	Pig-P1 Si	(3,3 to 4,5)	1,0 to 4,0 [2)] (1,5 to 3,5)	0,4 to 1,5 [2)]	≤0,12	0,06	[3)]
2.2				Pig-P3 Si				>0,12 to 0,5		
2.3				Pig-P6 Si				>0,5 to 1,0 (>0,5 to 0,7)		
2.4				Pig-P12 Si				>1,0 to 1,4		
2.5				Pig-P17 Si				>1,4 to 2,0		
3.1			Nodular (SG) base	Pig-Nod	(3,5 to 4,6)	≤3,0 [2)]	≤0,1	≤0,08	0,03	[3)], [6)]
3.2			Nodular (SG) base higher manganese [5)]	Pig-Nod Mn		≤4,0 [2)]	>0,1 to 0,4 [2)]			
3.3			Low carbon	Pig-LC	>2,0 to 3,5	≤3,0 [2)]	>0,4 to 1,5	≤0,30	0,06	[3)]
4.0			Other unalloyed pig-iron	Pig-SPU	[7)]					
5.1	Alloyed		Spiegel iron	Pig-Mn	(4,0 to 6,5)	max. 1,5	>6,0 to 30,0 [2)]	≤0,30) (≤0,20)	0,05	[3)]
5.2			Other alloyed pig-iron	Pig-SPA	[8)]					

[1)] The unbracketed values are those which determine the classification of pig-iron. Values given in brackets indicate, for information only, the ranges in which actual contents of the elements concerned normally lie.

[2)] By subdividing this range into various sub-ranges, the class of pig-irons[7)] concerned is normally further subdivided into different grades.

[3)] No minimum values are specified for other elements. Depending, for example, on the raw materials used, the pig-iron may unintentionally contain elements other than those indicated in columns 4 to 8 and, in percentages, for some elements, may reach a value of about 0,5 %. The contents of these indicated elements should not be used in the classification of pig-iron.

[4)] For these classes of foundry pig-iron, different terms such as low, medium, intermediate and high phosphorus, normal haematite and semi-haematite, Cleveland, etc. are used in the various parts of the world and this partly in a different sense. Consequently, it is recommended to renounce on the international level on such terms and to apply as designations in these cases only the abbreviations given in column 3.

[5)] Normally used for either pearlitic nodular cast iron or for malleable cast iron.

[6)] A further characteristic of these pig-iron grades is that the contents of elements prejudicing the formation of nodular graphite and promoting the formation of carbide are low according to the intended use of the grade concerned.

[7)] This class includes pig-iron that cannot be classified either in classes 1.1 to 3.3 or in classes 5.1 and 5.2.

[8)] Other alloyed pig-iron includes:

a) pig-iron with a silicon content between >4,0 and 8,0 %;

b) pig-iron with a manganese content between >6,0 and 30,0 %, provided that it cannot be classified as Spiegel iron (see class 5.1);

c) pig-iron for which a minimum content is specified for at least one of the elements not specified in columns 4 to 8;

d) pig-iron whose content of at least one of the following elements is within the limits indicated below:

Cr >0,3 to 10,0 %

Mo >0,1
Ni >0,3
Ti >0,2
V >0,1
W >0,1

} up to the total content of 10,0 % of 'other' elements resulting from table 1.

Table 3. **Designations of various pig-irons[+]) classes**

No. [1])	Pig-iron class Abbreviation[1])	English			German			French					
1.1	Pig-P2		Steel-making pig iron	Low phosphorus		Stahl-roheisen	Phosphorarm		Fonte d'affinage	pauvre en phosphore			
1.2	Pig-P20			High phosphorus			Phosphorreich			riche en phosphore			
2.1	Pig-P1 Si	Unalloyed	Foundry pig iron	[2])	Unlegiert	Gießereiroheisen	[2])	Non alliées	Fonte de moulage	[2])			[2])
2.2	Pig-P3 Si												
2.3	Pig-P6 Si												
2.4	Pig-P12 Si												
2.5	Pig-P17 Si												
3.1	Pig-Nod			Nodular (SG) base			Sphaero			à graphite sphéroïdal			
3.2	Pig-Nod Mn			Nodular (SG) base higher manganese			Sphaero-Mn			à graphite sphéroïdal Mn			
3.3	Pig-LC			Low carbon			Kohlenstoffarm			pauvre en carbone			
4.0	Pig-SPU			Other unalloyed pig iron			Sonstiges unlegiertes Roheisen			autres fontes non alliées			
5.1	Pig-Mn	Alloyed		Spiegel iron	Legiert		Spiegeleisen	Alliées		fonte Spiegel			
5.2	Pig-SPA			Other alloyed pig iron			Sonstiges legiertes Roheisen			autres fontes alliées			

[1]) See table 2.
[2]) See footnote 4 in table 2.

Annex A

Sampling and preparation of samples intended for the determination of the chemical composition of pig-irons+)

A.1 Field of application

This annex is applicable to pig-iron in the solid state, unless otherwise agreed at the time of ordering.

NOTE: In the case of pig-iron in the liquid state, special regulations are to be agreed between the producer and the purchaser.

A.2 Number of pigs to be taken

The number of pigs to be taken shall be representative of the batch. In cases of dispute, and if there has been no other agreement between the parties, the minimum number of pigs to be taken from each batch is given in the table below.

Mass of the batch, in t	Minimum number of pigs to be taken
≤ 10	9
> 10 ≤ 20	11
> 20 ≤ 40	12
> 40 ≤ 80	14
> 80 ≤160	16
>160 ≤300	18
>300 ≤600	21
>600	24

A.3 Selection of samples

A.3.1 The samples are to be taken at random, preferably in accordance with one of the procedures described below.

A.3.1.1 Case of pigs arranged in piles

Throw a rope having a certain number of knots onto the pile. Take as samples the pigs touched by these knots. Repeat the operation until a sufficient number of pigs are obtained.

A.3.1.2 Case of pigs being loaded or unloaded

Throughout the loading or unloading operations, take pigs as samples so that the time intervals between pigs are approximately equal.

A.4 Preparation of the sample for analysis

A.4.1 Chemical analysis

A.4.1.1 Machineable pig-iron

A.4.1.1.1 Determination of elements other than carbon

In the centre of each pig taken from the batch, drill a hole 12 mm to 14 mm in diameter. Remove the first chips which may contain surface scale and other impurities. For the same reason, cease drilling approximately 2 mm from the opposite face of the pig (see figure 1, item 1). Then treat the chips in accordance with A.4.1.3.

A.4.1.1.2 Determination of carbon

Apply one of the two procedures A or B below. In cases of dispute, apply procedure A.

Procedure A

In the centre of each pig taken from the batch and on each side, drill a hole 12 mm to 14 mm in diameter (where appropriate, use the hole drilled in accordance with A.4.1.1). Remove the scale and other impurities about the holes on both sides of the pigs. Then drill another hole coaxial with the first hole, 20 to 24 mm in diameter in such a way that large chips are obtained and collected in a suitable container (see figure 1, item 2a).

Then treat these chips in accordance with A.4.1.3.

Procedure B

Using a gouge or a chisel, remove from the pigs small chips of suitable size (A.4.1.3) from the lower bulging face in the skin zone which solidifies rapidly, and is in practice free from segregation to a thickness of 5 mm (see figure 1, item 2b). It should be checked that the chips are taken from a fractured surface or, if the pigs have not been broken, that the surface impurities have been previously removed, e.g. by grinding.

Then treat these chips in accordance with A.4.1.3.

A.4.1.2 Non-machinable pig-iron

Break up each pig taken from the batch, for example with a pneumatic hammer, then reduce further until pieces of a suitable size for further reduction to A.4.1.3 are obtained.

A.4.1.3 Sample for analysis for the determination of the average composition

The chips or fragments taken according to A.4.1.1 and A.4.1.2 are reduced using appropriate equipment, that means wear-resistant and, if necessary, dust-tight, to a size appropriate for chemical analysis.

That is:

— in the case of carbon, about 1 to 2 mm,

— in the case of other elements, < 0,20 mm.

Mix equal quantities of the material originating from each of the pigs taken. From this mixture it is possible to obtain a sample for analysis by the usual quartering method.

A.4.2 Spectrometric analysis

If use of spectrometric methods of analysis is provided for, the preparation of samples shall be carried out in accordance with methods giving identical results to those used for the chemical analysis.

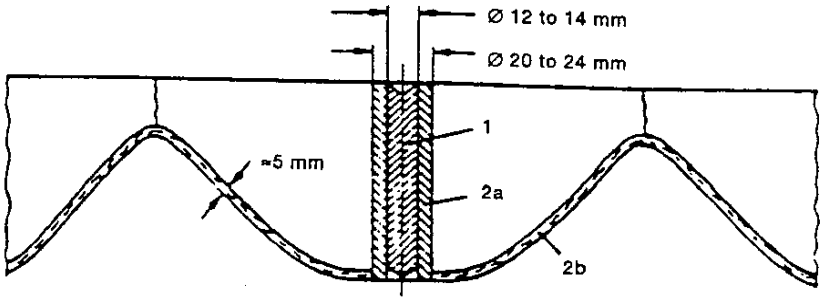
Rapidly cooled (with solidified) analysis samples taken in the liquid condition shall be preferred in order to avoid segregation.

A.5 Methods of analysis

A.5.1 Use either chemical or spectrometric methods of analysis.

A.5.2 For the chemical analysis, apply the corresponding European Standards as far as possible.

Dimensions in millimetres



1 First hole for taking chips for the determination of elements other than carbon (see A.4.1.1.1).

2a Second hole for taking chips for the determination of the carbon content when using procedure A (see A.4.1.1.2).

2b Rapid solidification zone from which fragments are to be taken for the determination of the carbon content when using procedure B in accordance with A.4.1.1.2.

Figure 1. Selection of samples from machineable pig-iron