

BS EN 1370:2011



BSI Standards Publication

## Founding — Examination of surface condition

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**National foreword**

This British Standard is the UK implementation of EN 1370:2011. It supersedes [BS EN 12454:1998](#) and [BS EN 1370:1997](#), which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/111, Steel Castings and Forgings.

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

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**Founding - Examination of surface condition**

Fonderie - Contrôle de l'état de surface

Gießereiwesen - Bewertung des Oberflächenzustandes

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## Foreword

This document (EN 1370:2011) has been prepared by Technical Committee CEN/TC 190 "Foundry technology", 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of an identical text or by endorsement, at the latest by June 2012, and conflicting national standards shall be withdrawn at the latest by June 2012.

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 will supersede [EN 1370:1996](#) and [EN 12454:1998](#).

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 11 "Surface inspection" to revise the following standards:

— [EN 1370:1996](#), *Founding — Surface roughness inspection by visual tactile comparators*

and

— [EN 12454:1998](#), *Founding — Visual examination of surface discontinuities — Steel sand castings.*

Annex A provides details of significant technical changes between this European Standard and the previous edition.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## Introduction

The surface roughness of a casting is influenced by the manufacturing process (moulding, grinding, finishing, etc.), the moulding materials used (sand, coating, etc.), the production equipment available and the alloy cast.

Depending on the applications of the casting, the surface requirements are related to mechanical loadings, appearance, surface treatment, etc.

Since cast surfaces do not exhibit the same cyclic character as machined surfaces it is difficult to evaluate their roughness using conventional mechanical, optical, or pneumatic devices. Other optical/electronic means are now available for measuring surface roughness of cast surfaces. For the ease of use, visual tactile comparators are preferred.

Moreover, in order to take into account the irregularities on as-cast surfaces, ground surfaces or other means of finishing of castings, comparators should have relatively large dimensions<sup>1)</sup> in order to make them more reliable and their results repeatable and consistent.

Two sets of comparators are in widespread use:

- "BNIF 359 Recommandation technique du Bureau de Normalisation des Industries de la Fonderie. Caractérisation d'états de surface des pièces moulées - Utilisation des échantillons types de 110 × 160 mm", available from Editions Techniques des Industries de la Fonderie, 44 avenue de la Division Leclerc, 92310 Sèvres, France [1];
- "SCRATA comparators for the definition of surface quality of steel and iron castings", ASTM A 802 Shorter Set, available from Castings Technology International, Advanced Manufacturing Park, Brunel Way, Rotherham, S60 5WG, South Yorkshire, United Kingdom [2].

A third set of comparators, for precision steel castings, is also available:

- "SCRATA surface comparators for the definition of surface texture of precision steel castings", precision set, available from Castings Technology International, Advanced Manufacturing Park, Brunel Way, Rotherham, S60 5WG, South Yorkshire, United Kingdom [3].

This European Standard also specifies 8 levels of surface imperfections based on maximum dimensions to be detected by visual examination.

The SCRATA comparators shorter set [2], can also be used for the classification of surface discontinuities on steel and iron castings.

BNIF N°359 comparators can be used for all cast metals.

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1) 100 mm × 150 mm for SCRATA comparators;  
110 mm × 160 mm for BNIF comparators.

## 1 Scope

This European Standard specifies methods for the examination of surface condition (roughness and surface discontinuities) of castings.

This European Standard is applicable to all cast metals and all casting processes except die casting.

## 2 Comparators

The comparators are essentially positive replicas of actual casting surfaces: as-cast or after further fettling treatment such as shot blasted or ground.

Full size photographs of the comparators can be used to assist in making a rapid evaluation of the overall roughness of the comparators. These can give preliminary information for the appropriate selection of a moulding or finishing process.

It is emphasized however that the comparators, and not the photographs, shall be used to form the basis of an agreement between the manufacturer and the purchaser.

An overview and a comparison of the different categories and levels of the three sets of comparators are given in Tables 1, 2 and 4.

## 3 Requirements

### 3.1 General

When examination of surface conditions is required, the following shall be agreed by the time of ordering:

- the category and severity level required. More than one severity level can be specified for different surfaces of the same casting. This shall be clearly indicated on the drawing;
- any types of discontinuities which are unacceptable;
- the areas of the castings which are to be examined; these shall be clearly indicated on the drawing;
- number of castings to be examined;
- the manufacturing stage at which surfaces are to be examined.

**NOTE 1** Guidelines for the specification of acceptance criteria for surface condition of iron castings are given in [EN 1559-3](#) [4].

**NOTE 2** General principles for visual examination are described in [EN 13018](#) [5].

The examination shall be performed by trained personnel with satisfactory visual acuity.



### 3.2 Surface roughness examination

#### 3.2.1 General

The methods detailed in this European Standard shall only apply to the surfaces of castings and the percentage or number of castings to be checked.

These conditions shall be subject of an agreement between the manufacturer and the purchaser by the time of ordering.

This information enables the manufacturer to assess the additional inspections and operations involved.

**Table 1 — BNIF and SCRATA surface roughness and dressing comparators [1] [2]**

Roughness	Ra (µm) For guidance only	Moulding			Mechanical dressing			Thermal dressing								
		BNIF [1]	SCRATA [2]	Corresponding process	BNIF [1]	SCRATA [2]	Corresponding process	BNIF [1]	SCRATA [2]	Corresponding process						
Smoothest	0,8				2/0S2		Very fine grinding									
	1,6	3/0S1	—	Investment	1/0S2		Fine grinding									
	3,2	2/0S1	—		1S2		Medium grinding									
	6,3	1/0S1	—	Shell resins	2S2		Medium-coarse grinding									
											1S1	A1	3S2			
	12,5	2S1	A2	Green sand and cold setting small-medium castings	4S2		Coarse grinding									
											3S1	A3	5S2	H1	G1	
	25	5S1	—	Green sand and cold setting medium-large castings	4S1	—	H3	Very coarse grinding	1S3	G2	Fine thermal cutting					
												6S1	A4	H5	2S3	G3
												7S1	—		3S3	
Roughest	50	8S1	A5	Moulding for large castings				4S3	G5	Coarse thermal cutting						



**Table 2 — SCRATA surface comparators for the definition of surface texture of precision steel castings [3] [6]**

Moulding process	Roughness
	Smoothest ← → Roughest
Resin shell process	V1, V2, V3
Lost polystyrene process	W1, W2, W3
Shaw process	X1, X2, X3
Lost-wax process	Y1, Y2
Fettled/grinded surfaces	Z1, Z2, Z3

### 3.2.2 Surface roughness examination by visual tactile comparators

To evaluate casting roughness, the areas indicated on the drawing shall be compared without optical aids, but with the appropriate visual tactile comparators of the category and level involved.

Comparison between the appropriate comparator and the casting surface shall be made with the comparators held next to the casting under sufficient conditions of lighting.

NOTE When the surface to be checked is significantly smaller than the surface of a comparator, an agreement on the method to be used should be made between the manufacturer and the purchaser.

The outcome of the comparison is satisfactory if, in the area under consideration, the roughness corresponds to that of the comparator or, if it is generally smoother.

### 3.2.3 Surface roughness examination by contact (stylus) instruments or non contact (optical) instruments

If one of these methods is to be used, it shall be subject of an agreement between the manufacturer and the purchaser by the time of ordering.

The following shall be agreed:

- method to be used;
- area(s) to be examined;
- scanning dimensions;
- surface profile parameters to be measured;
- required values (minimum, maximum) for these parameters.

### 3.3 Visual examination of surface discontinuities

#### 3.3.1 General

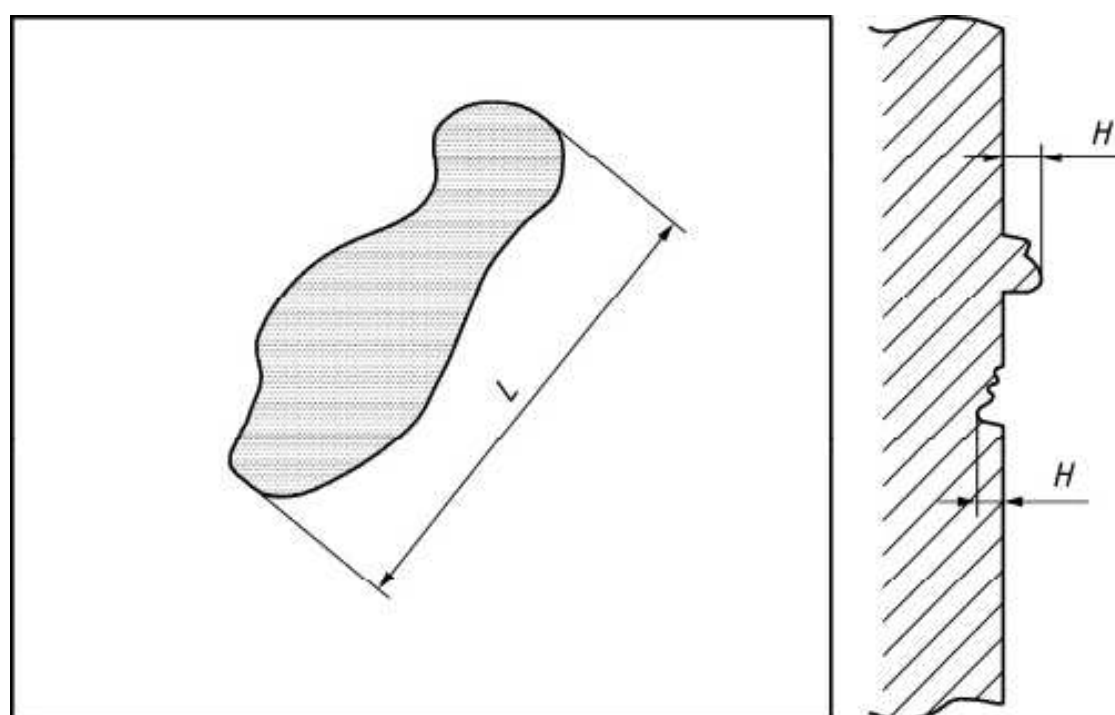
The area to be considered shall be examined without optical aids and it is essential to use sufficient lighting. Surface discontinuities can be facing outwards or inwards. Discontinuities can be eliminated either by grinding down to minimum wall thickness as stated in the drawing, or, after approval by the customer, by finishing welding.

The surface to be inspected shall be clean, free from rust, sand, scale, moulding and mould coating residues, oil, grease or any other contaminant, which can interfere with a correct examination.

#### 3.3.2 Classification of surface discontinuities by dimensions

In Table 3 severity levels for surface discontinuities by dimensions are specified. It can be used for as-cast, shot blasted, grinded or machined surfaces.

The size of the discontinuities is characterized by the dimensions  $H$  and  $L$  (see Figure 1):



#### Key

$L$  largest length;

$H$  largest depth or height perpendicular to the surface.

Figure 1 — Size of discontinuities  $L$  and  $H$

Borders and edges, not resulting from parting lines, having the shape of “steps” in cast surfaces should be considered as discontinuities, see Figure 2.

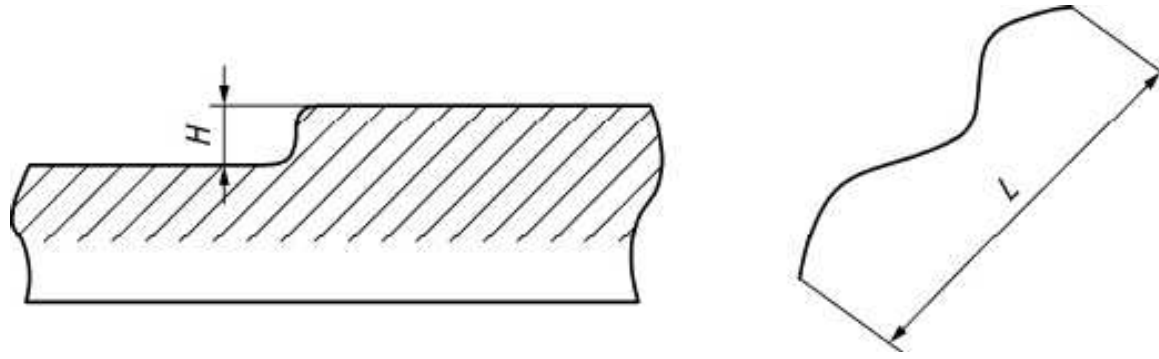



Figure 2 — Step irregularities

Table 3 — Severity levels for surface discontinuities (dimensions)

Severity Level	Size of discontinuities		Weight and/or thickness of casting
	Range of height or depth $H$ (mm)	Largest length $L$ (mm) within the $H$ range	
VD1	< 0,5	0,5	Small castings  Large castings
VD2	0,5 to 1,0	1,0	
VD3	1,0 to 1,5	1,5	
VD4	1,0 to 1,5	2,5	
VD5	1,0 to 2,0	5,0	
VD6	1,5 to 3,0	10	
VD7	1,5 to 3,0	15	
VD8	2,0 to 4,0	20	
NOTE <b>VD</b> stands for <b>V</b> isual examination of discontinuities <b>D</b> imensions.			

When the height or depth of discontinuities is less than the lower limit of the  $H$  range, the discontinuities shall not be taken into account. A maximum number of discontinuities may be agreed between the purchaser and the manufacturer.

### 3.3.3 Classification of surface discontinuities for steel and iron castings by visual tactile comparators

For evaluating casting surfaces, the areas to be assessed shall be visually compared, without optical aids, with the appropriate comparators on the basis of the category and severity level.

Comparison of the comparators with the casting surface shall be made with the comparators held next to the casting under sufficient lighting conditions.

When two or more discontinuity categories are present in any area to be assessed, each shall be assessed according to its specified severity level.

The outcome of the assessment is satisfactory if, in the required area, it is equal to or better than the stated reference comparators.

Surface discontinuities not covered by these comparators shall be a matter of agreement between the purchaser and manufacturer.

In Table 4 most common categories of discontinuities and severity levels within each of the categories are defined.

**Table 4 — Severity levels for surface discontinuities for steel and iron castings (Scrata visual comparators)**

Discontinuities	Severity Level VC			
	VC1	VC2	VC3	VC4
	Surface comparator			
Inclusions	B1	B2	B4	B5
Gas porosities	C2	C1	C3	C4
Laps and cold shuts	D1	D2	D5	—
Scabs	—	—	E3	E5
Inserts	F1	—	F3	—
Welds	J1	J2	J3	J5

NOTE VC stands for Visual examination of discontinuities by Comparators.

The severity level of discontinuities that are to be detected depends on the roughness of the surface on which they appear.

Table 5 gives the comparator level that can normally be detected according to the surface roughness as defined in 3.2.2.

**Table 5 — Relationship between surface roughness and detectable surface discontinuities for steel and iron castings**

Comparator	Minimum surface roughness <sup>a</sup>		
BNIF	2S1	3S1	6S1
SCRATA	A2	A3	A4
Category	Comparator		
Surface inclusions	B1 to B5	B5	B5
Gas porosities	C1 to C4	C3 to C4	C4
Fusion discontinuities	D1 to D5	D2 to D5	D2 to D5
Expansion discontinuities	E3 to E5	E3 to E5	E3 to E5
Inserts	F1 to F3	F1 to F3	F1 to F3
Welds	J1 to J5	J2 to J5	J2 to J5
<sup>a</sup> The surface roughness influences the minimum discontinuity severity level which can be examined. For example, it is unlikely that severity level 1 surface inclusions can be detected on an A3 surface condition.			

#### 4 Documentation

The manufacturer shall, if requested by the purchaser at the time of ordering, keep a record of the examination and provide a report.

The records of the manufacturer shall contain the following:

- the identification of the casting;
- the name and qualification of the person undertaking the examination;
- the reference of the comparator or instrument used;
- the designated category and specified level for each area examined;
- the results of the examination.

## Annex A (informative)

### Significant technical changes between this European Standard and the previous edition

**Table A.1 — Significant technical changes between this European Standard and the previous edition**

Clause/Paragraph/Table/Figure	Change
General	This standard supersedes <a href="#">EN 1370:1996</a> and <a href="#">EN 12454:1998</a>
1	Revised standard also describes a method for the evaluation of surface discontinuities.
3.2.1, Table 1	Table 1 replaces Figures 1, 2 and 3 of <a href="#">EN 1370:1996</a>
3.2.3	Surface roughness examination by contact (stylus) instruments or non contact (optical) instruments added.
3.3	Examination of surface discontinuities added.
3.3.2	Classification of surface discontinuities by dimensions added.
3.3.3	Classification of surface discontinuities for steel and iron castings by visual tactile comparators added.
<p>NOTE The technical changes referred include the significant technical changes from the EN revised but is not an exhaustive list of all modifications from the previous version.</p>	

## Bibliography

- [1] "BNIF 359 - Recommandation technique du Bureau de Normalisation des Industries de la Fonderie. Caractérisation d'états de surface des pièces moulées - Utilisation des échantillons types de  $110 \times 160 \text{ mm}^{(2)}$ ", available from Editions Techniques des Industries de la Fonderie, 44 avenue de la Division Leclerc, 92310 Sèvres, France
- [2] "SCRATA surface comparators for the definition of surface quality of steel and iron castings", ASTM A 802 shorter set, available from Castings Technology International, Advanced Manufacturing Park, Brunel Way, Rotherham, S60 5WG, South Yorkshire, United Kingdom
- [3] "SCRATA surface comparators for the definition of surface texture of precision steel castings", precision set, available from Castings Technology International, Advanced Manufacturing Park, Brunel Way, Rotherham, S60 5WG, South Yorkshire, United Kingdom
- [4] [EN 1559-3](#), *Founding — Technical conditions of delivery — Part 3: Additional requirements for iron castings*
- [5] [EN 13018](#), *Non-destructive testing — Visual testing — General principles*
- [6] [BS 7900:1998](#), *Specification for examination of the surface texture of precision steel castings*

2) "BNIF 359 Technical Recommendation issued by Bureau de Normalisation des Industries de la Fonderie - Characterization of surface condition of castings - Use of 110 x 160 mm standard specimens"







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