SLOVENSKI STANDARD
SIST EN 1371-1:1998

01-avgust-1998

Livarstvo - Preiskava s penetrirno tekočino - 1. del: Ulitki v pesek, težnostno kokilno uliti in nizkotlačno uliti ulitki

Founding - Liquid penetrant inspection - Part 1: Sand, gravity die and low pressure die castings

Gießereiwesen - Eindringprüfung - Teil 1: Sand-, Schwerkraftkokillen- und Niederdruckkokillengußstücke

Fonderie - Contrôle par ressuage - Partie 1: Pieces moulées au sable, en coquille, par gravité et basse pression

Ta slovenski standard je istoveten z: **EN 1371-1:1997**

ICS:

77.140.80	Železni in jekleni ulitki	Iron and steel castings

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English version

Founding – Liquid penetrant inspection
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This European Standard was approved by CEN on 1997-06-02.

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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.

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CEN

European Committee for Standardization
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Europäisches Komitee für Normung

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Contents

Foreword

This European Standard 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of an identical text or by endorsement, at the latest by December 1997, and conflicting national standards shall be withdrawn at the latest by December 1997.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 4.20 "Surface inspection" to prepare the following standard:

EN 1371-1
Founding – Liquid penetrant inspection – Part 1: Sand, gravity die and low pressure die castings

This is one of two European Standards for liquid penetrant inspection. The other standard is:

prEN 1371-2
Founding – Liquid penetrant inspection – Part 2: Investment castings

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard complements the general principles of liquid penetrant inspection given in EN 571 for the additional requirements of the foundry industry.

Liquid penetrant inspection as well as any other non destructive examination method is part of a general or specific assessment of the quality of a casting to be agreed between the manufacturer and the purchaser at the time of acceptance of the order.

Penetrant testing examination of castings is standardized in two parts:

- EN 1371-1: Sand, gravity die and low pressure die castings
- prEN 1371-2: Investment castings

1 Scope

This European Standard applies to the liquid penetrant testing of all castings (except copper-tin and/or copper-tin-lead alloy castings, where copper is the major constituent) produced in conventional sand moulds, by gravity and low-pressure die casting whatever their grade and the casting procedure used to produce them.

This standard does not apply to investment and pressure die castings.

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 473
Qualification and certification of NDT personnel – General principles

EN 571-1
Non-destructive testing – Penetrant testing – Part 1: General principles

EN 1370
Founding – Surface roughness inspection by visualtactile comparators

prEN 1371-2
Founding – Liquid penetrant inspection – Part 2: Investment castings

prEN 1956
Non-destructive testing – Penetrant testing and magnetic particle testing – Viewing conditions

NOTE: Informative reference to documents used in the preparation of this standard, and cited at the appropriate places in the text, are listed in a bibliography, see annex A.

3 Conditions for liquid penetrant inspection

The manufacturing stage(s) when liquid penetrant inspection is to be performed shall be clearly defined by agreement between the manufacturer and the purchaser.

Inspection shall be carried out only on those areas of the castings and on the percentage of castings agreed. Inspection requirements shall be clearly stated in the call for tender, in the request for prices and, more particularly, in the order sent to the manufacturer and accepted by him, so that the manufacturer can assess the costs of manfacturing to satisfy the required severity level and the costs of additional inspections and operations, and the manufacturing risks involved.

For each agreed area of the casting to be inspected, the following shall be indicated:

- type of discontinuity;
- severity level.

Sensitivity can differ depending on the method of liquid penetrant inspection selected. Therefore the severity levels required shall be selected as a function of the liquid penetrants used and the method agreed between the manufacturer and the purchaser.

The type of discontinuity and the severity level can vary depending on the area of the casting inspected (see tables 1 to 3).

4 Method of inspection

4.1 Operating mode

Inspection shall be carried out as described in EN 571-1. The characteristics of the penetrant materials shall be checked in accordance with specifications to be agreed between the manufacturer and the purchaser.

4.2 Qualification of the operators

Inspection shall be performed by personnel, qualified in accordance with EN 473 or by a certification scheme which is considered to be equivalent. The qualification level of the personnel shall be agreed between the manufacturer and the purchaser at the time of acceptance of the order.

4.3 Surface preparation

The surface to be inspected shall be clean and free from oil, grease, moulding and coating residues or any other contaminant which could interfere with the correct implementation and interpretation of the penetrant inspection test results.

The surface finish of the casting in the area to be tested shall have sufficient brightness and contrast of colour and adequate shape to determine the required severity level. Unless otherwise specified at the time of ordering, the surface finish shall be selected from table 4.

NOTE: It is recommended that the assessment of surface finish is carried out using a visual cast-surface roughness comparator.

Liquid penetrant inspection shall be performed on castings in the as-delivered conditon. If sand blasting or shot blasting[1]) is required, it shall be as light as possible, in order to avoid sealing or closing up possible discontinuities. If the risk of sealing or closing up possible discontinuities is unacceptable then blasting shall be followed by chemical etching in order to enable detection of discontinuities. The chemical composition of the etching bath and other parameters such as concentration, temperature, immersion time neutralizing and rinsing, if applicable, shall be recorded.

4.4 Conditions of inspection

The inspection shall be carried out with the naked eye or at a maximum magnification of 3 and viewing conditions in conformity with prEN 1956.

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[1]) Shot blasting is not recommended prior to liquid penetrant testing.

5 Acceptance criteria

5.1 Indications of discontinuities

5.1.1 General

The indication of discontinuities can be non-linear (isolated or clustered), aligned or linear. Although liquid penetrant inspection cannot generally be used to determine the size of detected discontinuities, it allows discontinuities to be assessed by measurement of the length L of the indication. In the following clauses

- L indicates length;
- W indicates width;
- t indicates section thickness;
- P indicates liquid penetrant;
- SP indicates non-linear isolated indication;
- CP indicates non-linear clustered indication;
- AP indicates aligned indication;
- LP indicates linear indication.

5.1.2 Criteria

The various types of penetrant indication can correspond to the discontinuities (A, B, C, etc.) shown in table 1.

The physical discontinuities detailed in table 1 shall give either a non-linear, linear or aligned liquid penetrant inspection indication.

5.2 Definition of liquid penetrant inspection indications

a) linear indication (LP). An indication with a largest dimension three or more times its smallest dimension (i.e. $L \geq 3\ W$);

b) non-linear indication. An indication with a largest dimension less than three times its smallest dimension (i.e. $L < 3\ W$):

- isolated (SP);
- clustered (CP): area of multiple indications, the distance between the indications cannot be measured (they seem to form only one indication);

c) aligned indication (AP). Indications that are either

- linear: the distance between two indications is smaller than the length of the longest discontinuity in the alignment;

or

- non-linear: the distance between two indications is less than 2 mm and at least three indications are noted.

5.3 Severity levels

5.3.1 General

Several severity levels are recognized in accordance with tables 2 and 3. It is necessary to carry out the test on a surface corresponding to a given degree of finish (see table 4) depending on the severity level desired.

The liquid penetrant inspection for each type of indication and its severity levels shall be specified at the time of ordering, by the purchaser, depending on the use of the castings. The manufacturer shall give his agreement.

The penetrant indications to be taken into account shall have dimensions in accordance with the severity level.

The required severity level shall be selected accordingly and specified in the order by agreement between the manufacturer and the purchaser.

5.3.2 Criteria

The maximum permissible length for linear or aligned indications varies with the section thickness t. Three section thickness types are specified (see table 3):

- type a: $t \leq 16$ mm;
- type b: 16 mm $< t \leq 50$ mm;
- type c: $t > 50$ mm.

Tables 2 and 3 show the largest dimensions of the smallest indications to be considered in the severity level concerned.

5.3.3 Tables

Table 2 corresponds to non-linear isolated or non-linear clustered indications.

Examples of non-linear indications are shown in annexes B and C. These have been established in accordance with table 2; the reference figures are given to and shall be interpreted against a scale of 1:1.

Table 3 corresponds to linear or aligned indications.

Tables 2 and 3 are independent (differing severity levels may be selected from these tables).

6 Classification of the indications and interpretation of results

In order to classify an indication of discontinuity, a frame measuring 105 mm × 148 mm [2]) should be placed in the most unfavourable location. The observed indications shall be in relation to the reference severity levels as described in this standard and compared to the equivalent or immediately better severity level.

Indications shall be considered to be equivalent when the same number of non-linear spots and/or the same length of linear indications of similar appearance are detected. Maximum permissible discontinuities may appear simultaneously on the area of 105 mm × 148 mm [2]).

If, for any indication type, the observed severity level is worse than that specified in the order, the casting shall be considered to be in non-conformance with this standard. It shall be considered as conforming with this standard when the observed severity level is equal to or better than that specified in the order.

For severity levels 1, 2, 3, 4 and 5, classification shall be made by comparison with reference figures. For severity levels 001, 01, 02 and 03, and in the event of dispute in the interpretation of severity levels 1, 2, 3, 4 and 5, reference shall be made to the values in tables 2 and 3.

NOTE 1: Reference figures corresponding to non-linear, aligned and clustered indications in accordance with tables 2 and 3 are represented in annexes B, C and D for guidance only, drawn to a scale of 1 : 1.

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[2]) ISO format A6. If the casting dimensions in total are smaller than 105 mm × 148 mm, then the indicating criteria should be in proportion to the surface area and agreed between the manufacturer and the purchaser.

The requirements detailed in the order or in the specifications shall be written in conformance to the terminology used in this standard.

Examples of how the requirements shall be specified are as follows:

- non-linear indications level 2 (abbreviated as SP 2);
- linear and aligned indications level 5 (abbreviated as LP 5c and AP 5c).

NOTE 2: "c" in LP 5c means: The section thickness type *t* is greater than 50 mm.

NOTE 3: Severity level references are arbitrary. They cannot be considered in the same progression from one table to the other nor from one kind of indication to another.

NOTE 4: Provided that on the casting surface no tested area contains discontinuities which exceed the agreed severity level, there is no limit to the acceptability of discontinuities.

7 Ordering

The enquiry and/or order shall specify the following points:

b) the manufacturing stage or stages when the inspection is to be carried out, as agreed between the parties (see clause 3);

c) the type of discontinuity indications and the severity level for each area of the casting(s) to be inspected (see clause 3 and 5.2).

8 Retesting

Retesting shall be in accordance with EN 571-1.

9 Post-examination cleaning procedures

Post-examination cleaning procedures shall be in accordance with EN 571-1.

10 Inspection documentation

Inspection documentation shall be in accordance with EN 571-1. A model of a trilingual inspection document is shown in annex E.

Table 1: Nature of discontinuities and types of corresponding liquid penetrant inspection indications

Nature of discontinuities	Symbol	Types of liquid penetrant inspection indications			
		non-linear		linear	aligned
		isolated SP	clustered CP	LP	AP
Gas porosity	A	X	X	–	X
Sand and/or slag inclusions (other than alumina)	B	X	X	–	X
Shrinkage defects due to nitrogen[1])	C	X	X	X	X
Cracks	D	–	–	X	X
Hot tears	E	–	–	X	X
Inserts	F	X	–	X	X
Laps and cold shuts	H	–	–	X	X
Presence of alumina[2])	J	–	–	X	X
Graphite flotation[1])	K	No image, but "background" indications			

[1]) For cast iron only

[2]) For non-ferrous alloys only

Table 2: Severity levels for liquid penetrant inspection – Non-linear indications[1] isolated (SP) or clustered (CP)

Characteristic	Severity levels							
	SP 01[2] CP 01[2]	SP 02 CP 02	SP 03 CP 03	SP 1 CP 1	SP 2 CP 2	SP 3 CP 3	SP 4	SP 5
Inspection means	magnifying glass or eye	eye						
Magnification for observation of penetrant indication	≤ 3	1						
Diameter of smallest indication to be considered in mm	0,3	0,5	1	1,5	2	3	5	5
Maximum number of non-linear indications allowed	5	6	7	8	8	12	20	32
Maximum size of discontinuity indication A, B, C and F allowed in mm								
– isolated indications SP	1	1	1,5	3	6	9	14	21
– clustered indications CP (for aluminium alloys only, with a maximum of 2 per area)	3	4	6	10	16	25	–	–

[1]) Such that $L \leq 3\ W$ where L is the length and W is the width of the indication.

[2]) Severity level to be reserved for particular uses.

NOTE 1: Only values expressed in this table are valid. Reference figures are for information only (see annexes B and C).

NOTE 2: The sensitivity can differ, depending on the method of penetrant inspection selected.

NOTE 3: The penetrant indications may grow over a period of time and this should be taken into account.