BRITISH STANDARD

BS EN
12890:2000

Founding — Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores

The European Standard EN 12890:2000 has the status of a British Standard

ICS 77.020

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ISE/NFE/9, Foundry technology, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Summary of pages

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Founding - Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores

Fonderie - Modèles, outillages et boîtes à noyaux pour la production des moules et noyaux au sable

Gießereiwesen - Modelle, Modelleinrichtungen und Kernkästen zur Herstellung von Sandformen und Sandkernen

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Contents

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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of an identical text or by endorsement, at the latest by August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.

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.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 1.30 “Production equipment, tools, foundry auxiliaries (e.g. patterns, permanent moulds, moulding materials)” to prepare the following standard:

EN 12890
Founding – Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores

This is one of three of European Standards for foundry patterns and tools. The other standards are:

prEN 12883
Founding – Equipment for the production of lost patterns for the lost wax casting process

EN 12892
Founding – Equipment for the production of lost patterns for the lost foam casting process

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Introduction

This standard is intended for purchasers, manufacturers (patternmakers) and founders. It is also intended to ensure the correct interpretation of casting and tooling drawings/numerical data and to ensure that pattern equipment will produce sand moulds and/or sand cores, suitable for use, and to assist in determining the usually undefined limits of good workmanship. This standard stresses the need for consultation between the purchaser, manufacturer (patternmaker) and founder before work commences.

The manufacture of a casting by a sand mould and/or a sand core manufacturing process requires the construction of pattern equipment.

The CEN members had a variety of national standards and specifications relating to pattern equipment. This standard brings together all the important features of these former documents.

This standard enables the parties concerned to deal more easily with the complex problems associated with the design and manufacture of pattern equipment.

This standard not only specifies the usual features of design, construction, materials, tolerances, contractions and required machining allowances but also specifies other features such as usage, classification, quality control, marking, packaging and storage.

1 Scope

This standard specifies the requirements for patterns, pattern equipment and coreboxes for the production of sand moulds and/or sand cores.

This standard does not specify equipment for the production of lost patterns, permanent moulds and die casting dies.

This standard does not specify the requirements for ancillary items used in the manufacture of pattern equipment (such as screws, dowels, etc.).

2 Normative references

This European 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 European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1559-1
Founding – Technical conditions of delivery – Part 1: General

EN 20286-1
ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits (ISO 286-1:1988)

ISO 1302
Technical drawings – Method of indicating surface texture

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

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply:

3.1 purchaser

Person or body responsible for the ordering of the patterns, pattern equipment and coreboxes.

3.2 manufacturer (patternmaker)

Person or body responsible for the production of the patterns, pattern equipment and coreboxes.

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3.3 founder

Person or body responsible for the manufacture of castings from the moulds made from patterns, pattern equipment and coreboxes supplied to it by the manufacturer (patternmaker) or the purchaser.

3.4 sand mould

Part or assembly of parts, made of heat resistant sand (such as silica sand, zircon sand, etc.), which usually forms the external surfaces of a casting and is not re-usable after pouring.

3.5 sand core

Part or assembly of parts, made of heat resistant sand (such as silica sand, zircon sand, etc.), which usually forms the inner surfaces of a casting and is not re-usable after pouring.

3.6 pattern

Model which forms part or all of a subsequent mould or core assembly.

3.7 corebox

Model which forms all of a core or part or all of a subsequent core assembly.

3.8 pattern equipment

All the components which make up all the necessary pieces to ensure the correct manufacture of a mould.

3.9 quality class

Classification system which enables the parties concerned with the manufacture and use of patterns, pattern equipment and coreboxes to be aware of their properties (such as fitness for purpose, quality and life time).

3.10 contract review

Analysis and/or check of the order details carried out by the parties concerned, both before and during the processing of the order.

3.11 core print

Projection either attached to a pattern to form recesses in the mould or attached to a core at points where cores are to be supported.

3.12 required machining allowance (RMA)

Additional material deliberately added to certain surfaces of patterns, pattern equipment and coreboxes which is removed, partially or wholly, from the casting during subsequent machining.

3.13 contraction

Dimensional factor deliberately built into patterns, pattern equipment and coreboxes during manufacture to take account of the change(s) in dimension(s) that may take place when the casting is made.

3.14 taper

Slope or angle deliberately given to certain pattern or corebox surfaces to aid the stripping of the pattern from the mould or the core from the corebox.

NOTE: Taper is sometimes referred to as draft or draft angle.

3.15 clearance

Space deliberately built into certain pattern or corebox surfaces to aid the assembly of the mould and/or core.

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4 Order information and delivery conditions

4.1 General

This clause details the technical order information and delivery condition requirements to be agreed between the purchaser and the manufacturer (patternmaker).

The patterns, pattern equipment and coreboxes can be ordered either by the purchaser or by the founder. If the purchaser is not the founder, it shall be a requirement that there is consultation between the purchaser and the founder.

As applicable, there shall have been an agreement made and an exchange of information carried out between the purchaser, the manufacturer (patternmaker) and the founder by the time of the acceptance of the order, to ensure a full understanding of the respective requirements of the parties concerned.

NOTE: The production of castings requires the use of patterns and/or coreboxes. The starting point in their manufacture is the drawing/numerical data of the as-cast casting and/or the machined part as agreed with the purchaser who can:

– either order the castings and pattern equipment together from the founder who can sub-contract the pattern equipment manufacture to a patternmaker;

– or order the castings from the founder and the patterns, pattern equipment and coreboxes from the manufacturer (patternmaker) separately.

4.2 Points to be agreed

The following points, as applicable, shall have been agreed by the time of the acceptance of the order:

– cast material(s) and its (their) identification;

– moulding and/or coremaking techniques;

– dimensional tolerances;

– mould and core joint lines;

– pattern equipment identification;

– pattern surface coating;

– contractions;

– clearances;

– tapers;

– required machining allowances;

– pattern material(s);

– pattern material quality class(es);

– extent and type of quality inspection;

– protection and packaging for transportation and storage.

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4.3 Mandatory information

The enquiry and order shall include information on:

a) designation of material to be cast (symbol and/or number);

b) number of castings to be produced;

c) number of sets of pattern equipment to be supplied;

d) delivery time;

e) relevant drawing(s) or numerical data;

f) quality class(es) required;

g) inspection(s) and documentation required;

and, as applicable:

h) specification of the pattern and/or corebox materials to be used;

i) moulding joint(s);

j) sizes and positions of gates and risers required;

k) contractions to be used;

l) type of protection and packaging;

NOTE: Transport arrangements can be included.

m) repair and refurbishment;

n) storage arrangement;

o) approval procedure;

p) any other requirements.

5 Classification

Patterns, pattern equipment and coreboxes shall be classified in accordance with the quality classes given in Table 1.

NOTE: In Table 1, reference is made to Tables 2 to 6 in which the applicability of the material is specified (see also annex A).

6 Specifications

6.1 General

Drawings/numerical data, design and specifications shall be in accordance with the requirements of EN 1559-1, as applicable.

The quality class of patterns, pattern equipment and coreboxes shall be stated on the order (see Tables 2 to 6).

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6.2 Designation

The designation of the quality class on the drawings and other relevant documents shall contain the following:

– the number of this European Standard (EN 12890);

– the quality class.

EXAMPLE:
EN 12890 – H3

7 Manufacturing requirements

7.1 Materials

Unless otherwise agreed, patterns, pattern equipment and coreboxes shall be made of one or more of the material types shown in Table 1.

7.2 Manufacture

Unless otherwise agreed, patterns, pattern equipment and coreboxes shall be manufactured in accordance with the requirements detailed in Tables 2 to 6, as applicable. By agreement between the parties concerned, parts of the patterns, pattern equipment and coreboxes can be manufactured of other materials and to other quality classes than those specified in Table 1.

7.3 Contractions

Unless otherwise specified, the reference values for linear casting contractions given in annex B shall apply.

NOTE 1: The contractions and contraction ranges in certain castings can differ from the values given in annex B and can vary across the three axes of the casting. Therefore it is recommended that there is consultation between the manufacturer (patternmaker) and the founder.

NOTE 2: The casting design can often lead to distortion or initiate defects on solidification. Therefore it is recommended that there is consultation between the parties concerned to make provision for these possibilities before deciding upon the construction and shape of the patterns, pattern equipment and coreboxes.

7.4 Tapers

Unless otherwise specified, the tapers given in Table 7 shall be used.

NOTE: Reference can also be made to ISO 8062:1994.

7.5 Clearances

Closing, covering and mould assembly clearances shall be agreed between the manufacturer (patternmaker) and the founder.

NOTE: Further information on clearances is given in Figures 1 to 3.

7.6 Required machining allowances (RMA)

Any required machining allowance (RMA) to be added to the patterns, pattern equipment and coreboxes shall be agreed between the parties concerned (see clause 4).

NOTE: Guidance on the choice of required machining allowances (RMA) is given in ISO 8062:1994.

7.7 Dimensional tolerances

Dimensional tolerances shall be in accordance with the values given in Tables 2 to 4 for each quality class of pattern material, unless otherwise agreed by the time of acceptance of the order.

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7.8 Surface coating

As applicable, the surfaces of patterns, pattern equipment and coreboxes shall be coated to provide for their protection and/or identification in accordance with the agreement made between the parties concerned (see clause 4).

When a surface coating is specified, the materials used in the moulding/coremaking process and the surface coating shall be compatible.

Unless otherwise agreed, the requirements detailed in Table 8 shall apply.

NOTE: It is normal practice for the manufacturer (patternmaker) to protect the surfaces of the patterns, pattern equipment and coreboxes and at the same time identify the various functional surfaces with a colour coding arrangement.

8 Quality control

As applicable, the manufacturer (patternmaker) shall maintain written evidence that he has carried out the following quality control procedures before, during and after the manufacture of the equipment:

a) pre-production planning;

b) contract review;

c) dimensional inspection and completion of dimension sheets;

d) identification;

e) jig/fixture inspection;

f) jig location point inspection.

NOTE: It is recommended that the manufacturer (patternmaker) operates a third party quality assurance system such as that specified in either EN ISO 9001, EN ISO 9002 or EN ISO 9003 or any other system.

9 Usage

9.1 General

The materials used and the processing and handling employed in the manufacture and use of patterns, pattern equipment and coreboxes shall meet the appropriate environmental and safety requirements.

NOTE: The lifetime of patterns, pattern equipment and coreboxes depends upon the quality class and the conditions of use and of storage.

9.2 Identification

9.2.1 Identification of the patterns, pattern equipment and coreboxes

All parts of the patterns, pattern equipment and coreboxes shall be durably and legibly marked and identified in accordance with either the drawing(s) or the agreement made between the parties concerned (see clause 4).

NOTE 1: The following list of possible identifying details is given for information only:

- drawing number;
- part number;
- purchaser identity;
- date or date code;
- pattern and corebox identity;
- material specifications;
- other references.

NOTE 2: It is recommended that the parts of the patterns, pattern equipment and coreboxes are individually

- identified to show a sequence, for example:
  - different identities of similar patterns on one pattern plate or of similar cores in one corebox;
  - mould assembly sequence;
  - core assembly sequence.

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9.2.2 Identification of the casting

The location of the agreed identification shall be such that any subsequent operation does not remove the casting identity details, unless an agreement to the contrary has been made between the parties concerned (see clause 4).

9.3 Modifications

Modifications to patterns, pattern equipment and coreboxes during or after their manufacture shall be carried out only after an agreement has been made between the parties concerned. Such agreements shall be included in the documentation concerned with the contract review (see clause 8).

9.4 Repair and refurbishment

The responsibility for the repair and/or refurbishment of the equipment shall be agreed between the parties concerned (see clause 4).

NOTE 1: The need for repair and/or refurbishment can arise normally through the production process and repetitive use of the equipment or through damage in handling and transportation.

The requirement to re-approve the equipment after repair and/or refurbishment shall be agreed between the parties concerned (see clause 4).

NOTE 2: The requirement to re-approve the equipment after repair and/or refurbishment depends upon the degree and nature of that repair and/or refurbishment.

9.5 Protection and packaging for transportation and storage

Protection and packaging for transportation and storage shall be agreed between the parties concerned (see clause 4).

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Table 1 – Quality classes for patterns, pattern equipment and coreboxes

Material type	Quality classes	Further details see table
Wood	H1, H2, H3	2, 5 and 6
Metal	M1, M2	3, 5 and 6
Plastics	K1, K2	4, 5 and 6

Table 2 – Quality classes – patterns, pattern equipment and coreboxes made of wood

Features	Quality class		
	H1	H2	H3
Use	For large quantities in hand and machine moulding shops when very high standards are required.	For small quantities and recurring single castings in hand and machine moulding shops.	For single castings in hand moulding shops.
Number of moulds[1]:			
– large pattern sizes[2]	up to 200	5 up to 20	up to 10
– intermediate pattern sizes[2]	200 up to 5 000	20 up to 100	10 up to 20
– small pattern sizes[2]	1 000 up to 10 000	100 up to 200	20 up to 50
Material type[3]	Plywood panels, composite boards, hardwood or softwood may be used (see also wearing edges)	Veneered panels or soft sawn timber.	Soft sawn timber or particleboards.
Joints	Framing should be box-jointed, connections, e.g. segments, should be glued and additionally bolted or screwed according to stress conditions.	Framing should be box-jointed, 1/2 or 2/3 rebate-jointed as required. Bolting and/or screwed and/or nailing should be used.	Framing should be rebate-jointed. Bolting and/or screwed or otherwise nailing should be used.
Pattern, pattern equipment and corebox distortion	Shall not distort either during compaction or stripping.	As for H1.	As for H1. NOTE: Additional strengthening can be necessary to prevent distortion when laminated or particleboard is used in its construction.
Wood grain direction	Preferably in the lifting direction; where possible, there shall be no change in long timber and grain wood at sides.	Preferably in the lifting direction but can be crosswise when sides are steeply sloping; change between long timber and end-grain wood should be avoided.	No special instructions.

(continued)

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Table 2 (continued)

Features	Quality class		
	H1	H2	H3
Guides	Interchangeable metal dowels should be used for machine moulding patterns and pattern equipment; dowels of sufficient size should be used.	Dowels that can be driven in should be used.	As for H2.
Fillets	Compression strength and abrasion resistance of fillets shall correspond to that of the pattern material.	As for H1.	No special instruction.
Loose pieces	No loose pieces should be used with machine moulding; dovetailed guides should be used for hand moulding patterns. Material: light metal, synthetic resin, hard wood or hard wood veneered panels with veneer thicknesses < 1 mm.	No loose pieces should be used with machine moulding; dovetailed guides should be used for hand moulding patterns. Material: as for H1, but no light metal.	Wooden dovetailed guides with fixing pins or screws should be used.
Wearing edges	Plywood panels, composite boards and softwood should be hardwood-edged.	Templates, if used, should be faced with sheet metal.	As for H2.
Lifting arrangements	Small to intermediate sized patterns, pattern equipment and coreboxes and loose pieces used for hand moulding should be let-in and bolted with lifting plates or insert nuts at the bottom side (rear side). Intermediate and large sized patterns should be equipped with lifting straps for transport and removal from the mould; drawing plates on the pattern body should be inserted or rigidly bolted on the frame. Core prints directly connected with the pattern body should be mounted on the outside and bolted.	As for H1.	Small sized patterns, pattern equipment and coreboxes without drawing device should be provided with pilot-drilled holes, about 5 mm diameter, to fasten the pattern screws. For intermediate and large sized patterns, see H1.

(continued)

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Table 2 (continued)

Features	Quality class		
	H1	H2	H3
Core print design	Guides and supports should be of adequate size; protection should be provided against distortion, shifting and mispositioning.	As for H1.	As for H1.
Corebox design	Dump coreboxes should be framed with metal closures. Wooden injection coreboxes should be protected against injection pressure. Provision should be made for core print tapers. Wedge fastenings should be made of steel; threaded rods should be provided with wing nuts; stripping edges should be made of metal, wearing points should be made of metal or plastics.	Coreboxes should be dowelled or bolted.	As for H2.

(continued)

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Table 2 (concluded)

Features		Quality class		
		H1	H2	H3
Tolerances on dimensions[4] measured at (20 ± 5) °C, in millimetres Range of dimension (basic size, see EN 20286-1)[5] mm				
over	up to and including			
	30	± 0,2	± 0,2	± 0,4
30	50	± 0,3	± 0,3	± 0,5
50	80	± 0,3	± 0,3	± 0,6
80	120	± 0,4	± 0,4	± 0,7
120	180	± 0,5	± 0,5	± 0,8
180	250	± 0,6	± 0,6	± 0,9
250	315	± 0,6	± 0,6	± 1,0
315	400	± 0,7	± 0,7	± 1,1
400	500	± 0,8	± 0,8	± 1,2
500	630	± 0,9	± 0,9	± 1,4
630	800	± 1,0	± 1,0	± 1,6
800	1 000	± 1,1	± 1,1	± 1,8
1 000	1 250	± 1,3	± 1,3	± 2,1
1 250	1 600	± 1,5	± 1,5	± 2,5
1 600	2 000	± 1,8	± 1,8	± 3,0
2 000	2 500	± 2,2	± 2,2	± 3,5
2 500	3 150	± 2,7	± 2,7	± 4,3
3 150	4 000	± 3,2	± 3,2	± 5,0

[1] Reference value for number of moulds dependent upon batch size, serviceable life and moulding process, with appropriate maintenance (for guidance only).

[2] Pattern sizes can be considered to be:

a) large, with a volume over 30 dm^3;
b) intermediate, with a volume more than 10 dm^3 and up to 30 dm^3;
c) small, with a volume up to 10 dm^3.

[3] Wood should be dry having a moisture content of between 8 % and 12 % (mass fraction).

[4] When specifying the tolerances, the parties concerned should verify whether the required casting dimension tolerances can be achieved with these figures.

[5] Tolerances on dimensions (basic sizes) over 4 000 mm shall be agreed between the parties concerned.

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Table 3 – Quality classes – patterns, pattern equipment and coreboxes made of metal

Features		Quality class	
		M1	M2
Use		Long run production when very high standards are required.	Long run production.
Material type		Copper-tin-zinc alloys, copper-zinc alloys, aluminium alloys, cast iron or steel.	As for M1, but also hard lead and pattern metal (83 % Sn, 17 % Sb).
Surface finish		Should be machined all over and ground, roughness depth R_a = 1,6 μm; average peak-to-valley height, according to ISO 1302.	Only parting and guiding surfaces should be machined; pattern surfaces should be smoothed and ground by hand, roughness depth R_a = 12,5 μm, average peak-to-valley height, according to ISO 1302.
Fillets		Should be integral with the equipment.	As for M1.
Loose pieces		Should only be used with coreboxes.	As for M1.
Wearing areas		Replaceable inserts should be made of abrasion-resistant material.	As for M1.
Core print design		With sand traps (see Figure 1)	As for M1.
Tolerances on dimensions[1] measured at (20 ± 5) °C, in millimetres Range of dimension (basic size, see EN 20286-1)[2] mm			
over	up to and including		
	30	± 0,10	± 0,15
30	50	± 0,15	± 0,20
50	80	± 0,15	± 0,25
80	120	± 0,20	± 0,30
120	180	± 0,20	± 0,30
180	250	± 0,25	± 0,35
250	315	± 0,25	± 0,40
315	400	± 0,30	± 0,45
400	500	± 0,30	± 0,50
500	630	± 0,4	± 0,6
630	800	± 0,4	± 0,6
800	1 000	± 0,5	± 0,7
1 000	1 250	± 0,5	± 0,8
1 250	1 600	± 0,6	± 1,0
1 600	2 000	± 0,7	± 1,1
2 000	2 500	± 0,8	± 1,4
2 500	3 150	± 1,0	± 1,6
3 150	4 000	± 1,3	± 2,0

[1] When specifying the tolerances, the parties concerned should verify whether the required casting dimension tolerances can be achieved with these figures.

[2] Tolerances on dimensions (basic sizes) over 4 000 mm shall be agreed between the parties concerned.

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Table 4 – Quality classes – patterns, pattern equipment and coreboxes made of plastics

Features	Quality class	
	K1	K2
Use	When very high standards are required. Appropriate resistance to pressure shall be ensured for high-pressure moulding machines.	Large sized patterns and coreboxes for hand moulding as well as small to medium series production.
Material type	Plastics with high dimensional stability and resistance to abrasion should be used, e.g. epoxy resins or polyurethanes with metallic or inert fillers taking into account the process temperature. The plastics shall be compatible with the materials that are to be processed (binders, stripping agents etc.).	As for K1.
Manufacture		
– plastic shell process (surface casting process)	The plastic coating shall be cast onto a metallic base element; the coating thickness shall be at least 5 mm.	The plastic coating shall be cast onto an element strengthened with ribbing of veneered or sandwich panels; the coating can be cast resins with fillers or fast cycling cast resins.
– laminating process	Successive layering should be carried out with epoxy resins and glass fibres; depending upon the equipment size and moulding process, shells should be backed with metallic or inert fillers.	As for K1.
– solid material	The equipment should be machined from solid material, e.g. polypropylene milled or copy milled.	As for K1.
Parting surface finish	Parting surfaces should be machined or smooth surfaced as a result of the casting process.	As for K1.
Loose pieces	Metal guides should be located on both sides; the metal guides shall be permanently linked with the plastic material, e.g. dovetailed guides.	No special instructions.
Core print design	With sand traps; guides and supports should be of adequate size; protection should be provided against distortion and mispositioning.	Without sand traps; guides, supports and protection as for K1.
Corebox design	In general, see manufacture; if coreboxes require ejector pins, then metal bushes shall be fixed into the plastic material.	No special instructions.
Colouration	In general no specification; light colours are preferred for better detection of adhering moulding sand.	As for K1.

(continued)

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Table 4 (concluded)

Features		Quality class	
		K1	K2
Tolerances on dimensions[1] measured at (20 ± 5) °C, in millimetres Range of dimension (basic size, see EN 20286-1)[2] mm			
over	up to and including		
	30	± 0,15	± 0,25
30	50	± 0,20	± 0,30
50	80	± 0,25	± 0,35
80	120	± 0,30	± 0,45
120	180	± 0,30	± 0,50
180	250	± 0,35	± 0,60
250	315	± 0,40	± 0,65
315	400	± 0,45	± 0,70
400	500	± 0,50	± 0,80
500	630	± 0,6	± 0,9
630	800	± 0,6	± 1,0
800	1 000	± 0,7	± 1,1
1 000	1 250	± 0,8	± 1,3
1 250	1 600	± 1,0	± 1,5
1 600	2 000	± 1,1	± 1,8
2 000	2 500	± 1,4	± 2,2
2 500	3 150	± 1,6	± 2,7
3 150	4 000	± 2,0	± 3,2

[1] When specifying the tolerances, the parties concerned should verify whether the required casting dimension tolerances can be achieved with these figures.

[2] Tolerances on dimensions (basic sizes) over 4 000 mm shall be agreed between the parties concerned.

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Table 5 – Characteristics of patterns and pattern equipment

Feature	Main use						
	Hand moulding – repetitive single castings	Hand moulding – short repetitive production runs Machine moulding – average production runs	Hand moulding – short repetitive production runs Machine moulding – average repetitive production runs	Hand or machine moulding – small patterns difficult to strip Machine moulding – average production runs	Hand or machine moulding – large sized parts, suitable shapes, small dimensions, average production runs	Machine moulding – average production runs	Machine moulding – very long production runs
Quality class	H2 H3	H1 H2	H1 K2	K2	K1	M2	M1
Maximum good number of parts which can be produced[1)]	20	300	750	3 000	10 000[2)]	10 000	150 000
	10	150	300	1 000	3 000	3 000	–
Material	soft wood and ordinary plywood	medium-hard wood, plywood and veneered wood	plywood, improved wood and laminated resin[3)]	resin[3) 4)], reinforced laminated resin and improved wood[5)]	cast resin or metallic reinforced laminated resin[3) 4)]	machined or dressed and hand-finished light metal and resin, if applicable	machined low alloy steels
Maximum shelf life time[6)]	1 year	2 years	4 years	5 years	6 years	10 years	10 years
Means of assembling of pattern parts	wooden dowels	steel dowels (dowels with sleeve for demountable parts)	metal dowels with sleeve	dowels with inserted metal sleeve	dowels with inserted metal sleeve	high strength steel dowels	high strength steel dowels
Fillets	leather or resin[3)]	hand shaped or resin[3)]	hand shaped or resin[3)]	machined	machined	machined	machined
Demountable parts	wood or resin[3)]	wood or resin[3)]	light metal, resin with metal guide, if applicable, or PVC	resin[3)], with metal guide, if applicable	not applicable	not applicable	not applicable
Locking of demountable parts	screws	dovetails and/or pins	dovetails and/or pins	dovetails and/or pins	not applicable	not applicable	not applicable
Demountable components from upper part	screws	wing screws	quick-release nut locking	quick-release nut locking	not applicable	not applicable	not applicable

(continued)

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Table 5 (concluded)

Feature	Main use						
	Hand moulding – repetitive single castings	Hand moulding – short repetitive production runs Machine moulding – average production runs	Hand moulding – short repetitive production runs Machine moulding – average repetitive production runs	Hand or machine moulding – small patterns difficult to strip Machine moulding – average production runs	Hand or machine moulding – large sized parts, suitable shapes, small dimensions, average production runs	Machine moulding – average production runs	Machine moulding – very long production runs
Quality class	H2 H3	H1 H2	H1 K2	K2	K1	M2	M1
Provision for core prints	no requirement	sand trap or fillet at bottom	sand trap or fillet at bottom	sand trap or fillet at bottom	sand trap or fillet at bottom	sand trap or fillet at bottom	sand trap or fillet at bottom
Surface finish	sand paper, grain size 60	sand paper, grain size 80	sand paper, grain size 100	if applicable, sand blasting, R_a = 12,5 μm	if applicable, sand blasting, R_a = 12,5 μm	as-spark eroded or NC machining or polishing, R_a = 6,3 μm	as-spark eroded or NC machining or polishing, R_a = 3,2 μm
Surface coating	paint, varnish or similar coating	resin, paint or varnish	paint, varnish or similar coating on top of base coating	no requirement	no requirement	no requirement	no requirement
Pattern plate material	plywood	improved plywood with hard-wood frame, if applicable	improved plywood with hard-wood frame, if applicable	improved plywood or plywood and metal	metal or one-piece resin on metal plate	metal or one-piece resin on metal plate	metal
Wearing plate material	no requirement	metal	metal	no requirement	no requirement	no requirement	no requirement

[1)] The numbers of castings which can be produced are indicated for information only and are maximum values: the lower number corresponds to shapes that are difficult to mould or strip; the higher number corresponds to favourable conditions where shapes are easy to mould or strip.

[2)] For simple-shaped parts and using a suitable resin, the number of castings produced may be significantly higher (100 000 or more).

[3)] Compatible with moulding process.

[4)] Machining of resin blocks or moulded resins makes it possible to obtain similar characteristics, but gives better dimensional accuracy.

[5)] Use of a metal base instead of a wooden base increases the life time of this quality class and makes it more suitable for machine use. The maximum number of castings which can be produced can be increased to 5 000.

[6)] Without a significant overhaul. The shelf life is linked to shapes, dimensions, humidity and temperatures and should be the subject of a prior agreement.

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Table 6 – Characteristics of coreboxes

Features	Quality class								
	B	D1	D2	E1	E2	F1	F2	G	H
Corresponding pattern quality class	H1 and H2	H1 and H2		H1 and K2		K2		K1 and M2	M1
Maximum number of cores[1)]									
– easy to make	20	300		750		3 000		10 000	30 000
– difficult to make	10	150		300		1 000		2 000	30 000
Main material	soft wood and plywood	hard wood		improved wood and/or resin		resin and/or light metal		metal	steel and/or spheroidal graphite cast iron
Other materials	no requirement	resin[2)]		resin[2)]		wooden or metal frame		no requirement	no requirement
Type of corebox	no requirement	no requirement		in two parts with machined impression		in two parts with machined impression		manually operated or mechanized metal corebox	mechanized metal corebox
Type of core production	manual	manual	core shooter	manual	core shooter	manual	core shooter	core shooter	multiple coreboxes and transfer machines
Core locking	screws and bolts	threaded rods	keys and pins	keys and pins	keys, pins and bushes	keys and pins	pins and bushes	manual by cam or mechanized	mechanized
Wearing guide material	wood	metal	metal	metal	metal	metal	metal	metal	metal

(continued)

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Table 6 (concluded)

Features	Quality class								
	B	D1	D2	E1	E2	F1	F2	G	H
Accessories[3)]	no requirement	demountable parts and brittle metal parts[2])	demountable parts and brittle metal parts[2)]	wear reinforcing pieces	filters, wear reinforcing pieces, metallization of joint face	no requirement	filters, demountable parts or metal wear reinforcing pieces, metallization of joint face	interchangeability of wearing parts (plus heat treatment), venting wires, ejectors etc., filters	interchangeability of wearing parts (plus heat treatment), venting wires, ejectors etc., filters and mould lifting cylinders
Other accessories (for reference only)	no requirement	no requirement	no requirement	no requirement	core shooting plates and degassing plates	no requirement	core shooting plates and degassing plates	stripping plates, mould lifting cylinders and jigs	stripping plates and jigs
Protection of brittle areas	no requirement	no requirement	metal	reinforced resin or metal		reinforced resin or metal		no requirement	no requirement

[1)] The numbers of cores which can be produced are stated for information only and are maximum values; the lower number corresponds to a core which is difficult to make; the higher number corresponds to a core which is easy to make.

[2)] The joint faces may be metal faced.

[3)] For certain coremaking processes, systems for the removal of gases should be provided.

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Table 7 – Tapers
Dimensions in millimetres

Height *H*	Taper *T*					
	shallow surfaces ($H/W \leq 1$)			deep surfaces ($H/W > 1$)		
	handmoulding		machine moulding	handmoulding		machine moulding
	claybonded sand	chemically bonded sand		claybonded sand	chemically bonded sand	
up to and including 30	1,0	1,0	1,0	1,5	1,0	1,0
over 30 up to and including 80	2,0	2,0	2,0	2,5	2,0	2,0
over 80 up to and including 180	3,0	2,5	2,5	3,0	3,0	3,0
over 180 up to and including 250	3,5	3,0	3,0	4,0	4,0	4,0
over 250 up to and including 1 000	+ 1,0 per 250-mm step	+ 1,0 per 250-mm step	+ 1,0 per 250-mm step	+ 1,0 per 250-mm step	+ 1,0 per 250-mm step	+ 1,0 per 250-mm step
over 1 000 up to and including 4 000	+ 2,0 per 1 000-mm step	+ 2,0 per 1 000-mm step	+ 2,0 per 1 000-mm step	+ 2,0 per 1 000-mm step	+ 2,0 per 1 000-mm step	+ 2,0 per 1 000-mm step
W = internal width						

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Table 8 – Surface coatings (painting and colour-coding) of patterns, pattern equipment and coreboxes

Feature	Material to be cast					
	Cast steel	Spheroidal graphite cast iron	Grey cast iron	Malleable cast iron	Heavy metal[1)]	Light metal[2)]
Colour for surfaces to be left unmachined on the casting	blue	violet	red	grey	yellow	green
Colour for surfaces to be machined on the casting	yellow stripes[3)]	yellow stripes[3)]	yellow stripes[3)]	yellow stripes[3)]	red stripes[3)]	yellow stripes[3)]
Seatings for loose pieces and their fixing	outlined in black					
Locations for chill plates	red	red	blue	red	blue	blue
Core prints and/or core position	black					
Fillets	If fillets are not incorporated in the equipment, but are required on the casting, they shall be indicated by a black dashed line with the values of their radii.					
Risers	yellow stripes					
Threaded lifting arrangement[4)]	indication of thread size on pattern area					
Strickle boards	clear varnish					

[1)] Copper, nickel, lead and zinc and their alloys

[2)] Aluminium, magnesium and titanium and their alloys

[3)] Small and intermediate sized areas should be painted all over.

[4)] M18 should be avoided.

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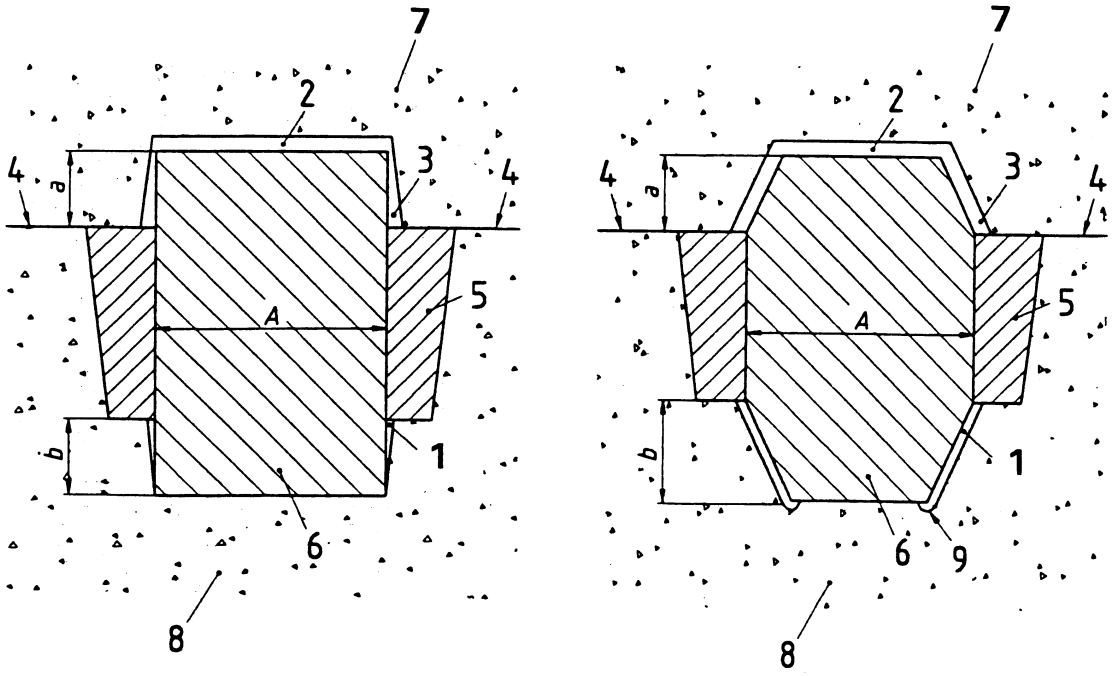

Legend:

1 mould assembly clearance
2 closing clearance
3 covering clearance
4 joint line
5 casting
6 core
7 cope
8 drag
9 sand trap

a 10 mm to 15 mm
b 15 mm to 30 mm

Figure 1 – Examples of clearances of core prints (vertical core)

values for A see Figure 3

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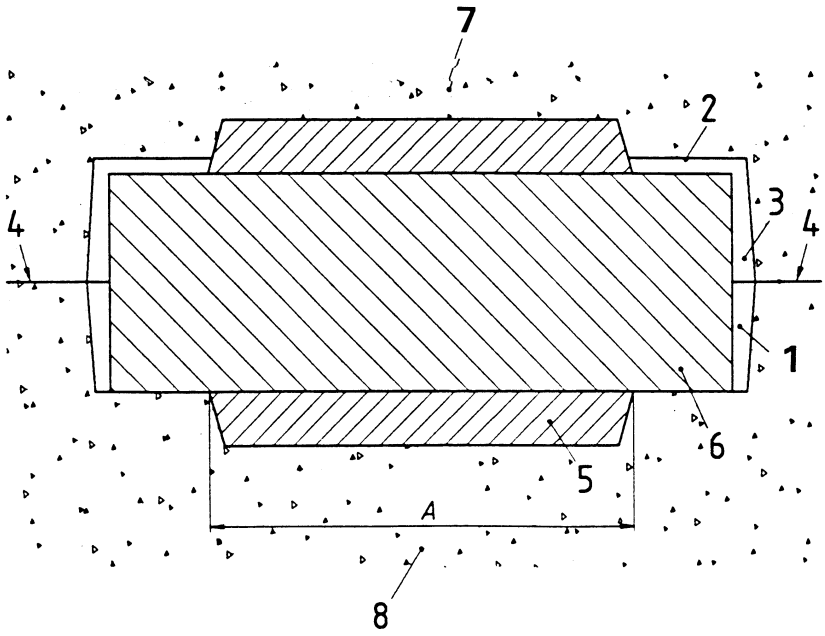

Legend:

1 mould assembly clearance
2 closing clearance
3 covering clearance
4 joint line
5 casting
6 core
7 cope
8 drag

Figure 2 – Example of clearances of core prints (horizontal core); values for *A* see Figure 3

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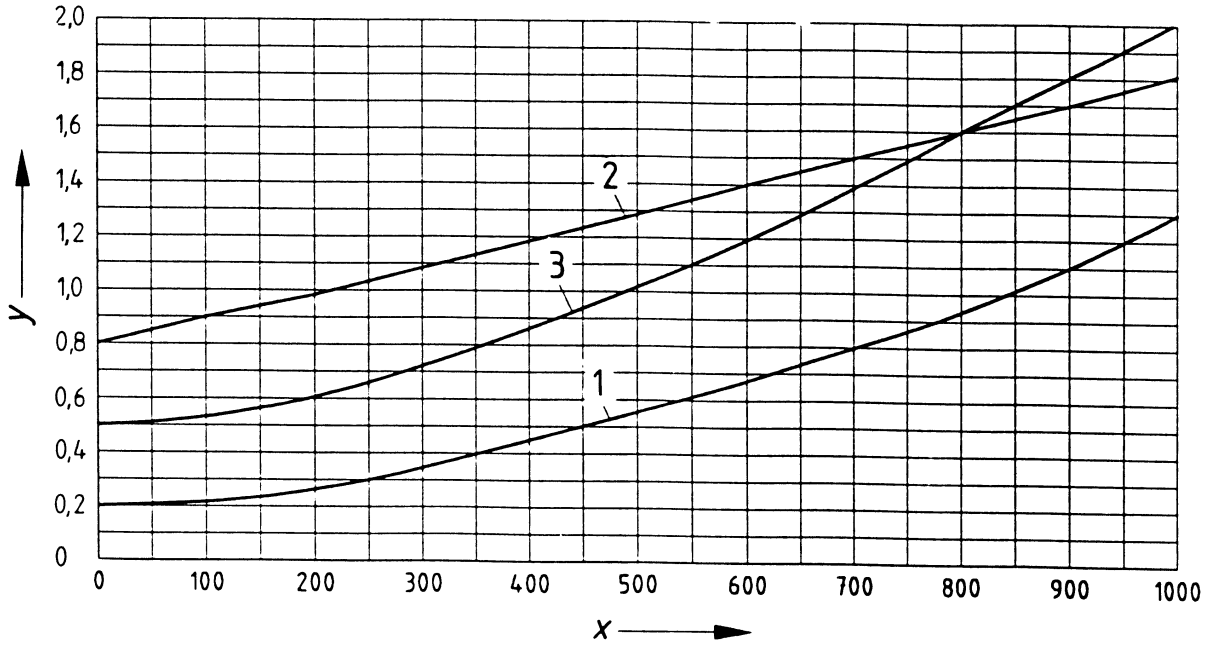

Legend:

x Dimension *A* in millimetres
y Clearance in millimetres

1 Closing clearance
2 Covering clearance
3 Mould-assembly clearance

Figure 3 – Values for clearances of core prints (for moulding with horizontal joint surface)

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Annex A (informative)

Guidelines on the use of the tables in this standard

A.1 Patterns, pattern equipment and coreboxes can be produced in a variety of materials. For efficient usage it can be helpful for the purchaser to be aware of the characteristics of the range of materials available.

A.2 The purchaser can thus be in a better position to assess the possibility of proposals made to him by the founder and/or manufacturer (patternmaker).

A.3 For this purpose Tables 2 to 8 have been prepared. They give guidance on the characteristics of patterns, pattern equipment and coreboxes and should be read in conjunction with the main text and annex B of this standard.

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Annex B (informative)

Reference values for linear casting contractions

Reference values for linear casting contractions are given in Table B.1.

Table B.1

Material	Contraction %
Grey cast irons	1,0
Spheroidal graphite cast irons, unannealed	1,2
Spheroidal graphite cast irons, annealed	0,5
Austenitic cast irons (wear resistant cast irons)	2,5
Cast steels	2,0
Cast austenitic manganese steels	2,3
Whiteheart malleable cast irons	1,6
Blackheart malleable cast irons	0,5
Cast aluminium alloys	1,0 changed by Mr. Schnurrbusch
Cast magnesium alloys	1,2
Cast copper	1,9
Cast copper-tin alloys (cast bronzes)	1,5
Cast copper-tin-zinc alloys (gunmetals)	1,3
Cast copper-zinc alloys (cast brasses)	1,2
Cast copper-zinc-(Mn, Fe, Al) alloys (cast special brasses)	2,0
Cast copper-aluminium-(Ni, Fe, Mn) alloys (cast aluminium-bronzes)	1,9
Cast zinc alloys	1,3
Cast bearing metal alloys (white metals)	0,5
Cast nickel alloys	2,1

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Bibliography

In the preparation of this European Standard, use was made of a number of documents for reference purposes. These informative references are cited at the appropriate places in the text and the publications are listed hereafter.

EN ISO 9001
Quality systems – Model for quality assurance in design/development, production, installation and servicing (ISO 9001:1994)

EN ISO 9002
Quality systems – Model for quality assurance in production, installation and servicing (ISO 9002:1994)

EN ISO 9003
Quality systems – Model for quality assurance in final inspection and test (ISO 9003:1994)

ISO 8062:1994
Castings – System of dimensional tolerances and machining allowances

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