INTERNATIONAL STANDARD

ISO 6524

Second edition
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Plain bearings — Thin-walled half-bearings — Checking of peripheral length

Paliers lisses — Demi-coussinets minces — Contrôle de la longueur développée

INTERNATIONAL ISO

Reference number
ISO 6524:1992(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6524 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Sub-Committee SC 3, *Dimensions, tolerances and construction details*.

This second edition cancels and replaces the first edition (ISO 6524:1983), of which it constitutes a technical revision.

Annexes A, B, C, D and E form an integral part of this International Standard.

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Plain bearings — Thin-walled half-bearings — Checking of peripheral length

1 Scope

This International Standard specifies methods of checking the measuring equipment and gauging tools necessary for measuring the peripheral length (or nip or crush) of thin-walled half-bearings.

Thin-walled half-bearings are flexible and, in the free condition, do not conform to a cylindrical profile. This is one reason why the peripheral length of the half-bearings can only be measured under a constraining load by use of specialized measuring equipment.

Measuring equipment different from that illustrated in this International Standard can be used, providing the measuring accuracy of the equipment is consistent with the specifications given in clause 17.

This International Standard does not include measurement of the joint face taper.

It applies to thin-walled half-bearings, the specifications of which are given in ISO 3548 and ISO 6864.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3548:1978, *Plain bearings — Thin-walled half bearings — Dimensions, tolerances and methods of checking.*

ISO 6864:1984, *Plain bearings — Thin-walled flanged half bearings — Dimensions, tolerances and methods of checking.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 peripheral length: The circumferential length which runs from one joint face to the other.

3.2 nip; crush: The value, a, by which a half-bearing fitted in a checking block of bore diameter d_{cb} under a predetermined checking load F exceeds the defined peripheral length of the checking block bore (see figure 1).

NOTE 1 In practice, the datum serves as a basis for measuring a (see figure 2).

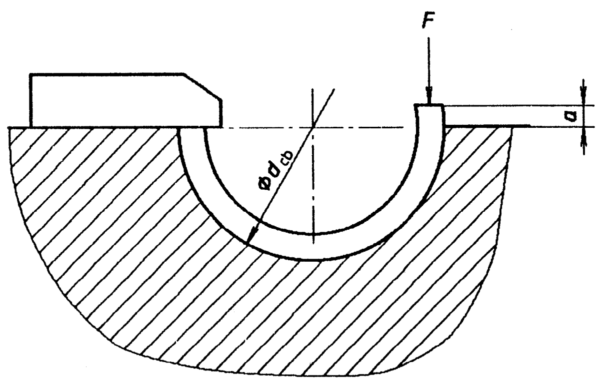


Figure 1 — Nip, a

3.3 repeatability: The closeness of agreement between successive results obtained with the same method on the same test piece, under the same conditions (same operator, same measuring equipment, same checking place and time intervals).

NOTE 2 Repeatability is assessed from the standard deviation of repeatability σ_{Δ}. See annex E.

3.4 reproducibility: The closeness of agreement between individual results obtained with the same method on the same test piece but under different conditions (identical or different operator, measuring equipment, checking place and times).

NOTE 3 For the purposes of this International Standard, reproducibility is the difference between the two averages obtained from two sets of measuring equipment. See annex E.

3.5 comparability: The accuracy in the case of operators working in different checking places at different periods and each of them achieving individual results, one using method A and the other method B, on the same half-bearing in different checking blocks.

NOTE 4 Comparability is assessed from the difference between the two averages obtained from the two methods. See annex E.

4 Symbols

NOTE 5 The characteristic subscripts are as follows:

- bs: bearing to be checked
- cb: checking block
- cbm: master checking block
- cbs: series checking block
- cs: comparison shell
- M: measured
- ms: master shell
- th: theoretical

a or $a_1 + a_2$	nip, in millimetres
B	width of the half-bearing without flange, in millimetres
B_1	checking block width (construction for flanged half-bearings), in millimetres
B_2	checking block width, in millimetres
B_3	checking block width (construction for half-bearings without flange), in millimetres
B_{ms}	master shell width, in millimetres
d_{cb}	diameter of the checking block bore, in millimetres[1]
D_{bs}	outside diameter of the half-bearing to be checked, in millimetres
D_{ms}	outside diameter of the master shell, in millimetres[1]
E	Young's modulus, in newtons per square metre
f	coefficient of friction in calculation of deflection under load
$F = F_1 = F_2$	checking load, in newtons
F_{cor}	correction factor, in millimetres[1]
h	fillet radius between back and flange on flanged half-bearing, in millimetres
H_{cb}	distance from the bottom of the checking block bore to the datum plane, in millimetres[1]
ΔH_{cb}	elastic deformation of the height of the checking block under load, in millimetres
K_1	checking block chamfer (construction for half-bearings without flange), in millimetres
K_2	checking block chamfer (construction for flanged half-bearings), in millimetres
l	peripheral length, in millimetres[1]
Δl	deviation of the actual peripheral length of the checking block, in millimetres
p_E	elastic depression of the toe piece, in millimetres
R_a	surface roughness, in microns
s_{cs}	wall thickness of the comparison shell, in millimetres
s_{ms}	wall thickness of the master shell, in millimetres
s_{tot}	total wall thickness of the half-bearing, in millimetres
u	uncertainty of measurement
w	width of the toe piece contact area, in millimetres
z	distance between flanges of the flanged half-bearing, in millimetres

1) The symbol may be followed by a subscript defining the gauging tool to which the symbol is applied and/or by a subscript indicating an effective measured value or a theoretical value.

δ	empirical correction to compensate for the difference in elastic deflections under load between method A and method B, in millimetres
$\tilde{\delta}$	correction estimated by calculation
σ	standard deviation

5 Purpose of checking

It is necessary to keep to within the nip tolerances of ISO 3548 and ISO 6864 in order to guarantee the designated mounting compression (interference fit) for the half-bearings in the housing bore.

6 Checking methods

6.1 Method A

The checking load, F, is directly applied via the measuring head with a pivoting toe piece to one joint face of the half-bearing whilst the other joint face is in contact with a fixed stop (see figure 2).

6.2 Method B

The checking loads F_1 and F_2 are applied via the measuring head and two toe pieces to both joint faces of the half-bearing (see figure 3).

NOTE 6 In the case of method A, the fixed stop exerts the required counter-force which, in the case of method B, is applied directly by the measuring equipment via two toe pieces.

EXAMPLE

Method A $F = 6\ 000$ N

Method B $\begin{cases} F_1 = 6\ 000 \text{ N} \\ F_2 = 6\ 000 \text{ N} \end{cases}$

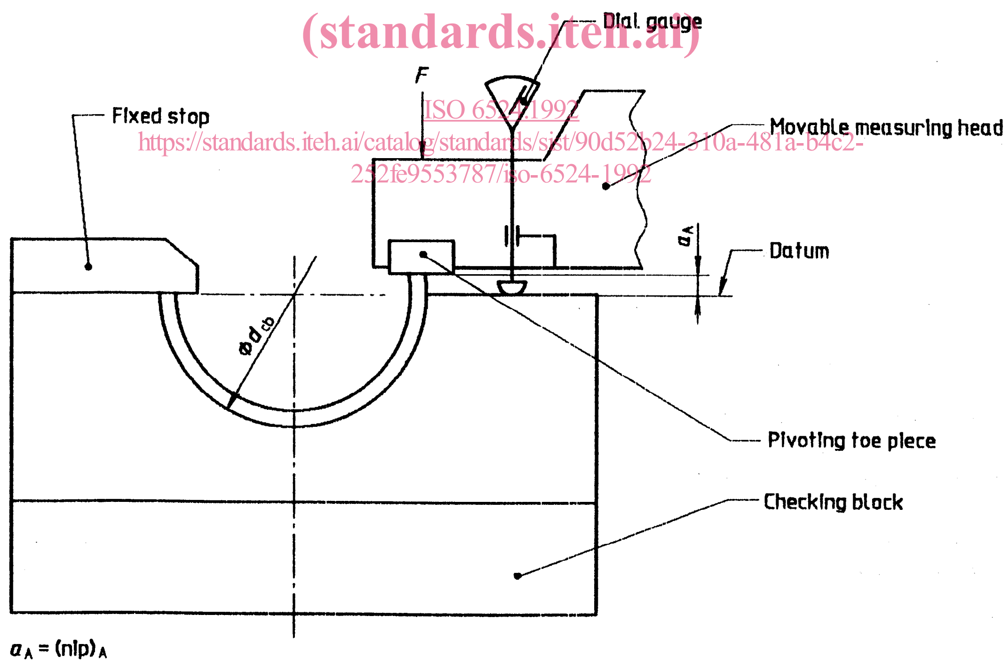
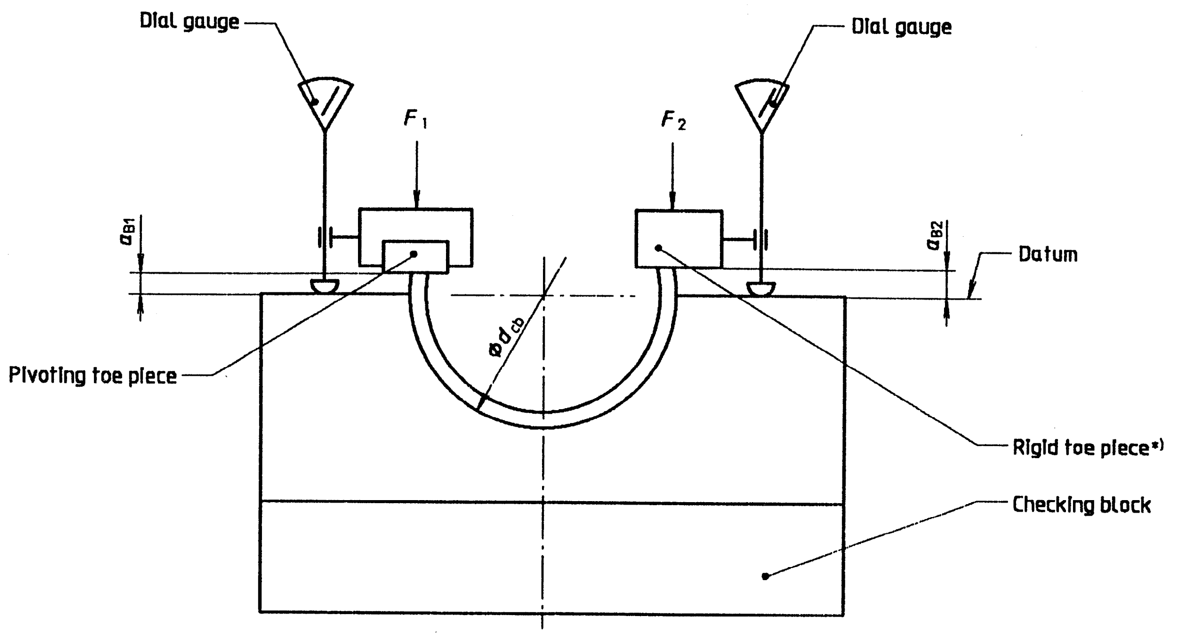


Figure 2 — Principle of method A



$a_B = a_{B1} + a_{B2} = (nip)_B$

*) Bearings may also be checked using two pivoting toe pieces.

Figure 3 — Principle of method B

7 Choice and designation of checking method

7.1 Choice of checking method

Recommendations for choosing either method A or method B, based on the dimensions of the half-bearings to be checked, are given in table 1.

However, any size of bearing may be tested by either method by agreement between the manufacturer and user. In that case, a correction δ should be applied to compensate for the difference in deflections at joint face(s) under load between method A and method B, and be such that

$$a_A = a_{B1} + a_{B2} + \delta$$

The value of δ shall be determined empirically by actual measurements obtained on the two different types of equipment used. Since the detailed design of the checking feature will vary between different manufacturers, the value of δ established by one manufacturer cannot be transferred to another, who shall determine it separately. See example in annex E.

For general guidance, the value of δ may be derived from the formula used in the mathematical analysis of belt friction, which gives

$$\delta = \frac{d_{cb,M}F}{s_{ms}B_{ms}} \times \frac{4}{2Ef}\left(1 + e^{-f\pi} - 2e^{-f\pi/2}\right)$$

With a value of the friction coefficient $f = 0{,}15$, the formula becomes

$$\tilde{\delta} = 7 \times 10^{-7} \times \frac{d_{cb,M}F}{s_{ms}B_{ms}}$$

(See also 16.5.)

Table 1

D_{bs} mm	Recommended checking method
$D_{bs} \leqslant 200$	A, B
$200 < D_{bs} \leqslant 500$	B

7.2 Designation of checking method

Example of the designation of method B for checking thin-walled half-bearings with an outside diameter, D_{bs}, of 340 mm:

Method ISO 6524-B-340

8 Measuring equipment

Figures 4 and 5 show typical measuring equipment for measuring the nip (crush) by method A and by method B, respectively.

NOTE 7 Figures 4 and 5 show hydraulically operated equipment. Pneumatically or mechanically operated equipment may also be used.

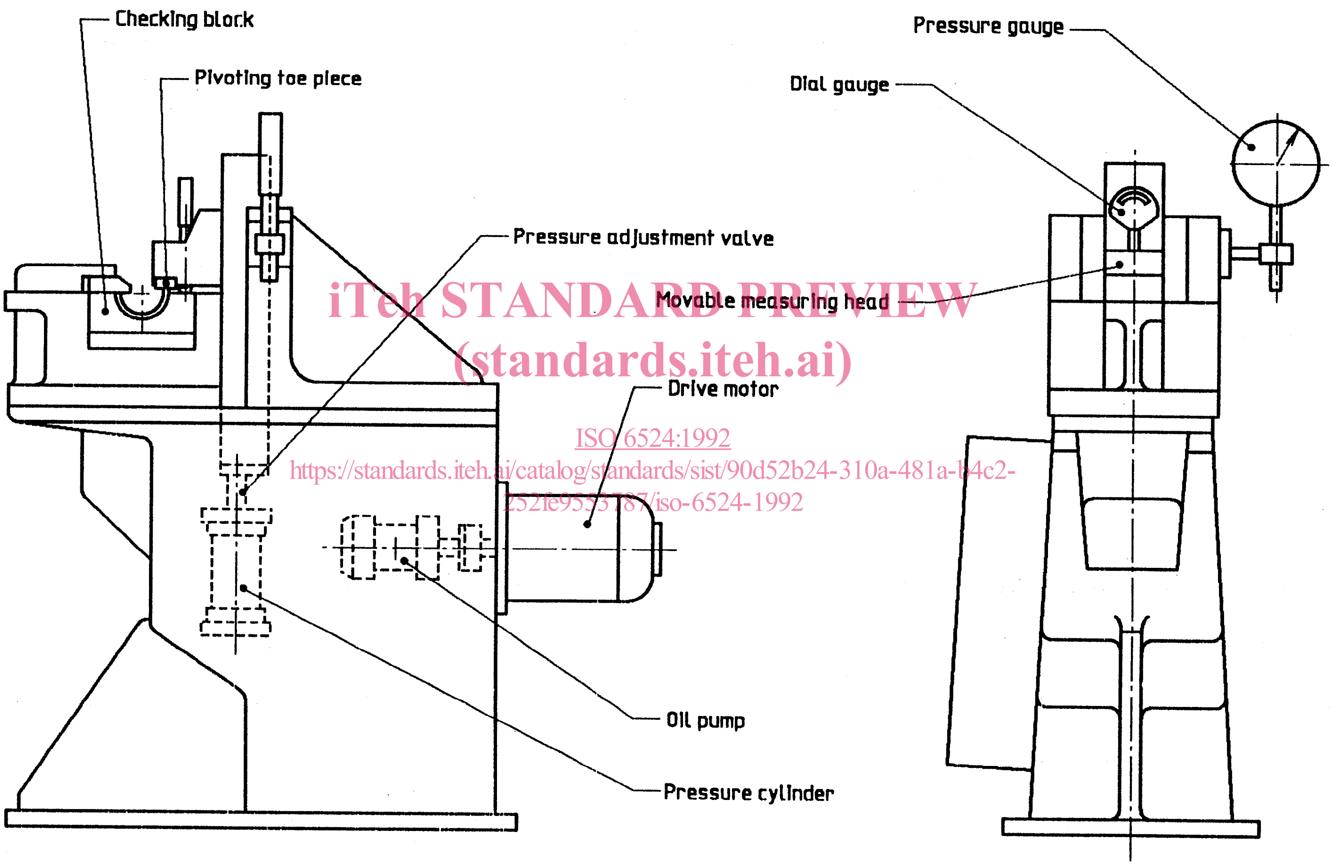
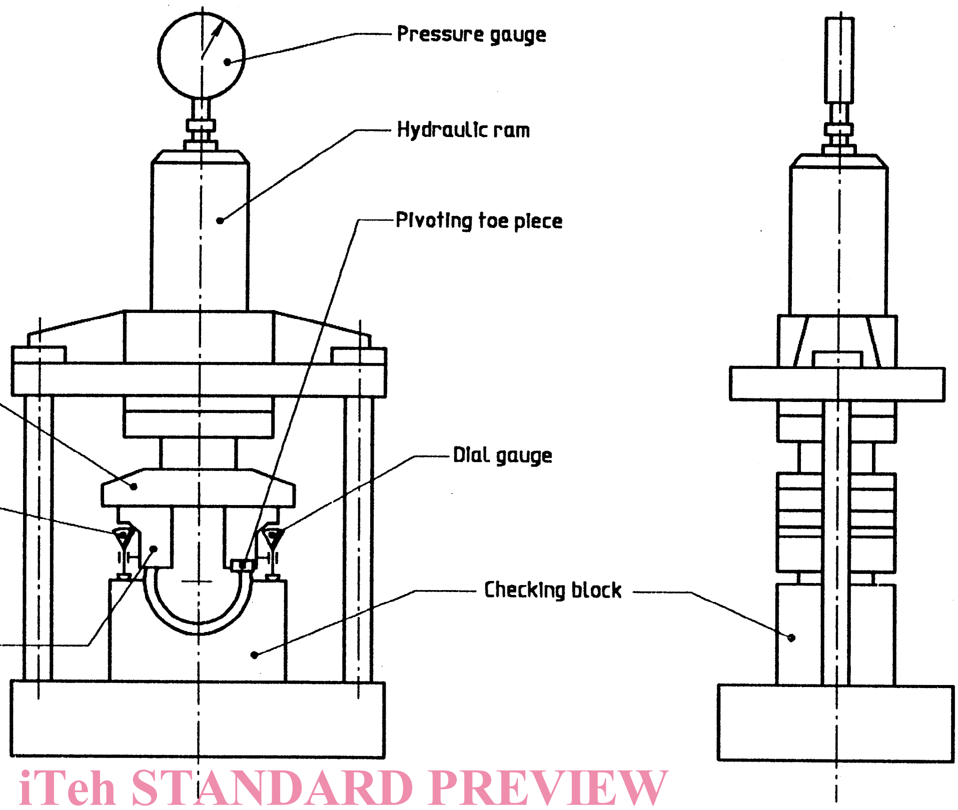


Figure 4 — Typical measuring equipment with one column, for method A



*) Bearings may also be checked using two pivoting toe pieces.

Figure 5 — Typical measuring equipment with two columns, for method B

9 Measuring equipment requirements

The most important factors affecting the accuracy of the measuring equipment (and hence the measured nip value) are given below.

9.1 Tolerance on checking load setting

The permissible tolerances are given in table 2.

Table 2

F N	Tolerance on F %
$F \leqslant 2\ 000$	± 1,25
$2\ 000 < F \leqslant 5\ 000$	± 1
$5\ 000 < F \leqslant 10\ 000$	± 0,75
$10\ 000 < F \leqslant 50\ 000$	± 0,5
$50\ 000 < F$	± 0,25

9.2 Speed of approach of measuring head

The checking load, F, shall be applied to the joint face(s) of the half-bearing so that shock load will not occur. The speed of approach shall be 10 mm/s ± 2 mm/s.

For devices in which the speed of approach cannot be altered, the load shall be applied, released and applied a second time before the measurement is made.

9.3 Construction of measuring head

The measuring head shall be so constructed that it is accurately guided and moves normal to the datum of the checking block. The deviation from parallelism between the toe piece(s) in the measuring head and the supporting plane of the checking block shall not exceed 0,04 mm per 100 mm in a radial direction.

9.4 Accuracy of the measuring plane of the toe pieces

Specifications on the accuracy of the measuring plane of the toe pieces are given in table 3.

Table 3

Dimensions and tolerances in millimetres
Surface roughness in microns

D_{bs}	Surface roughness R_a	Tolerance on flatness
$D_{bs} \leqslant 160$	0,2	0,001 5
$160 < D_{bs} \leqslant 340$	0,4	0,003
$340 < D_{bs} \leqslant 500$		0,004

9.5 Accuracy of the dial gauge

Uncertainty of measurement $u \leqslant 1{,}2$ µm ($\pm 2\sigma$) with $\sigma = 0{,}3$ µm

10 Gauging tools for establishing the datum

The following equipment can be used for carrying out measurements:

- a master checking block (for reference measurements) (see clause 11),
- a series checking block (for series control in production) (see clause 11), or
- a master shell or comparison shell (for series control in production) (see clause 12).

It can be used in three ways (as indicated in 10.1, 10.2 and 10.3) to establish the appropriate datum for setting the dial gauge.

10.1 Master checking block (used alone)

The master checking block is the comparison basis for the other checking blocks used for series control.

10.2 Series checking block used alone

The peripheral length of the bore of this type of checking block is determined by comparison with the master checking block.

It is applied in series control without using a master shell or a comparison shell.

10.3 Series checking block with master shell

The peripheral length of the checking block bore is determined by the master shell or comparison shell, the peripheral length of which was determined in the master checking block.

This combination of gauging tools is applied in series control.

NOTE 8 For series control, a checking block may also be used with a checking master, but this combination of gauging tools is not within the scope of this International Standard.

11 Checking block requirements

A typical checking block is shown in figure 6. The gauging part has a bore diameter d_{cb} and height H_{cb} and holds the half-bearings to be checked.

The checking block should preferably be of hardened steel and of rigid construction so that the requirements of clause 16 are met when the half-bearing is tested under load.

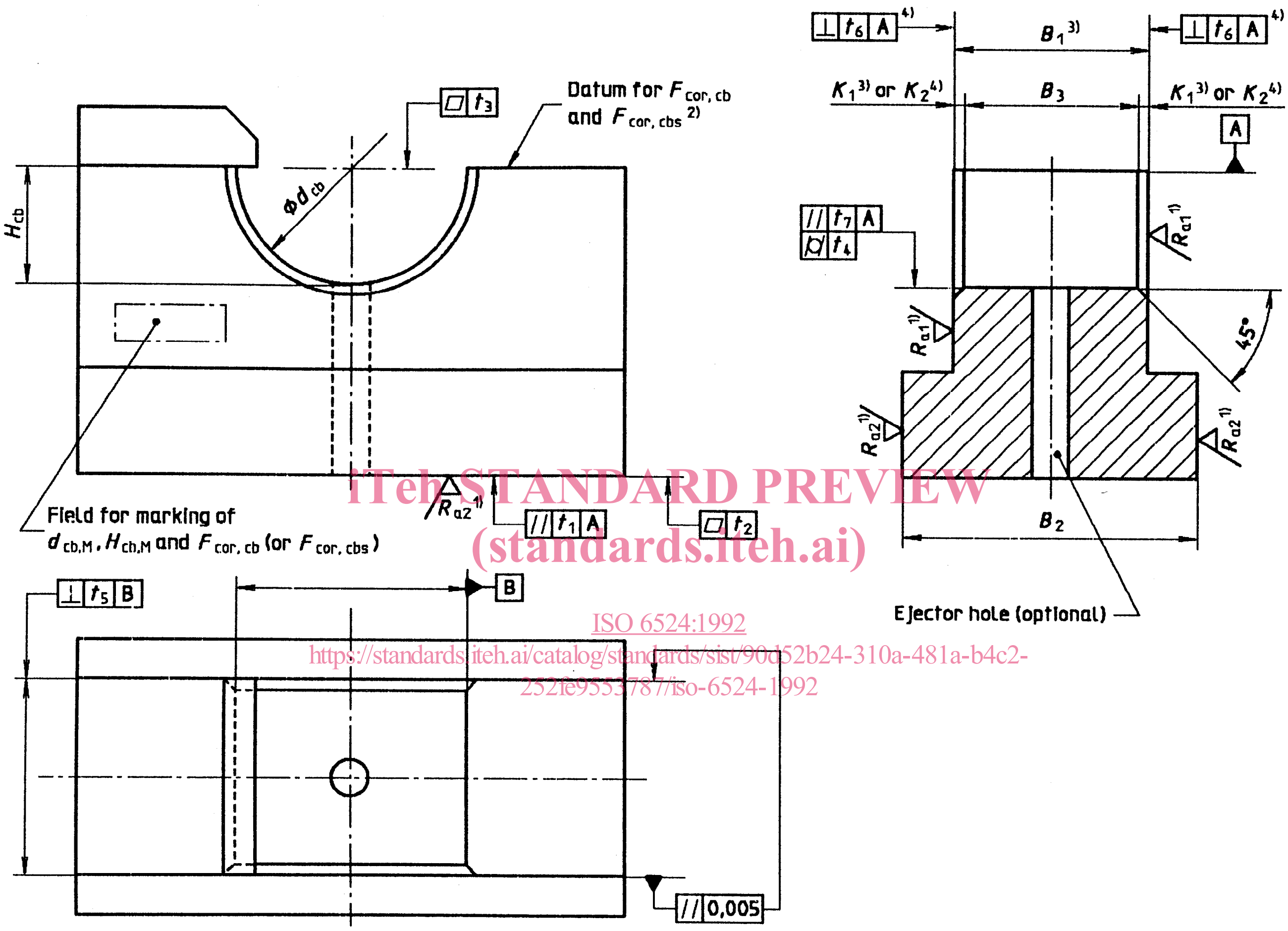
The bore of the checking block shall not be chromium plated.

Recesses shall be cut into the checking block to accommodate the nick in the half-bearings. They shall be 1 mm wider and deeper and 1,5 mm longer than the locating nicks in the half-bearings.

11.1 Reference tooling: Master checking block

11.1.1 Manufacturing limits

Manufacturing limits and specifications for the master checking block are given in table 4.



1) It is recommended that the values given in tables 5 and 6 be observed.
2) See 13.1 and 13.2.1.
3) Construction for half-bearing without flange:
B_1 may correspond to B_2 or it may be adjusted to the width of the half-bearing, i.e. to B_{max} + 1,2 mm with $K_{1\,max}$ = 0,4 mm
4) Construction for flanged half-bearing:
B_1: see table 5
$K_2 = h_{max}$ + 0,5 mm

Figure 6 — Checking block

Table 4

Dimensions and tolerances in millimetres
Surface roughness in microns

Outside diameter D_{bs}	Tolerance on d_{cbm}	Surface roughness of checking block bore R_a	Tolerance on H_{cbm}	Surface roughness of the datum R_a
$D_{bs} \leqslant 75$	$^{+0,003}_{0}$		$^{+0,003}_{0}$	
$75 < D_{bs} \leqslant 110$	$^{+0,004}_{0}$	0,2	$^{+0,003\,5}_{0}$	0,3
$110 < D_{bs} \leqslant 160$	$^{+0,005}_{0}$		$^{+0,004}_{0}$	
$160 < D_{bs} \leqslant 250$	$^{+0,006}_{0}$	0,4	$^{+0,004\,5}_{0}$	0,6
$250 < D_{bs} \leqslant 340$	$^{+0,007\,5}_{0}$	0,6	$^{+0,005}_{0}$	1
$340 < D_{bs} \leqslant 500$	$^{+0,01}_{0}$		$^{+0,006}_{0}$	

11.1.1.1 Tolerances of form and orientation

It is the responsibility of the manufacturer of the master checking block to achieve high quality regarding tolerances of form and orientation, the values of which are given in tables 5 and 6.

11.1.1.2 Surface roughnesses R_{a1} and R_{a2}

See tables 5 and 6.

11.1.1.3 Specifications for B_1, B_2 and B_3

See tables 5 and 6.

11.1.2 Measuring accuracy of equipment used for establishing $d_{cbm,M}$ and $H_{cbm,M}$

Determination of $d_{cbm,M}$ and $H_{cbm,M}$ shall be carried out using measuring equipment with a tolerance of

$\pm$ 0,001 mm, for $d_{cbm} \leqslant 160$ mm

$\pm$ 0,002 mm, for $d_{cbm} > 160$ mm

These values are necessary for calculating the correction factor $F_{cor,cbm}$ (see 13.1), which is based on the peripheral length, determined from the formula:

$$l_{cbm,M} = d_{cbm,M} \times \frac{\pi}{2} + 2\left(H_{cbm,M} - \frac{d_{cbm,M}}{2}\right)$$

11.1.3 Permissible wearing limit

The tolerance specified in 11.1.1 for the master checking block shall not be exceeded through wear. If wear occurs within the specified tolerance range, then it will be necessary to change the correction factor.

11.2 Series gauging tools

11.2.1 Series checking block used alone

Since the peripheral length of this checking block bore is determined by comparison with the master checking block (11.1), larger tolerances for d_{cbs} and H_{cbs} are acceptable.

11.2.1.1 Manufacturing limits

Manufacturing limits and specifications for the series checking block are given in tables 7 to 9.

11.2.1.2 Correction factor, $F_{cor,cbs}$

See 13.2.1.

Table 5

Dimensions and tolerances in millimetres
Surface roughness in microns

<table>
<tr><th rowspan="2">D_{bs}</th><th>Bearing without flange</th><th colspan="2">Flanged bearing</th><th>Surface roughness</th><th colspan="6">Tolerances of form and orientation</th></tr>
<tr><th>$B_{3\ min}$</th><th>$B_{1\ min}$</th><th>$B_{1\ max}$</th><th>R_{a1}</th><th>t_1</th><th>t_2</th><th>t_3</th><th>t_4</th><th>t_5</th><th>t_6</th></tr>
<tr><td>$D_{bs} \leqslant 75$</td><td rowspan="6">$B_{max} + 0,4$</td><td rowspan="6">$z_{min} - 0,1$</td><td rowspan="6">$z_{min} - 0,05$</td><td rowspan="4">1,2</td><td rowspan="3">0,002</td><td rowspan="3">0,002</td><td rowspan="3">0,002</td><td rowspan="3">0,002</td><td rowspan="3">0,002</td><td rowspan="3">0,005</td></tr>
<tr><td>$75 < D_{bs} \leqslant 110$</td></tr>
<tr><td>$110 < D_{bs} \leqslant 160$</td></tr>
<tr><td>$160 < D_{bs} \leqslant 250$</td><td rowspan="2">0,005</td><td rowspan="3">0,005</td><td rowspan="2">0,005</td><td rowspan="3">0,004</td><td rowspan="3">0,003</td><td rowspan="3">0,006</td></tr>
<tr><td>$250 < D_{bs} \leqslant 340$</td><td rowspan="2">1,6</td></tr>
<tr><td>$340 < D_{bs} \leqslant 500$</td><td>0,007</td><td>0,007</td></tr>
</table>

Table 6

Dimensions and tolerances in millimetres
Surface roughness in microns

<table>
<tr><th>B</th><th>$B_2\ {}^{+2}_{\ 0}$</th><th>Surface roughness
R_{a2}</th><th>Tolerance on parallelism
t_7</th></tr>
<tr><td>$B \leqslant 55$</td><td>60</td><td rowspan="3">1,2</td><td>0,002</td></tr>
<tr><td>$55 < B \leqslant 80$</td><td>85</td><td>0,003</td></tr>
<tr><td>$80 < B$</td><td>$B + 5$</td><td>0,004</td></tr>
</table>

Table 7

Dimensions and tolerances in millimetres
Surface roughness in microns

<table>
<tr><th>D_{bs}</th><th>Tolerance on d_{cbs}</th><th>Surface roughness of checking block bore
R_a</th><th>Tolerance on H_{cbs}</th><th>Surface roughness of the datum
R_a</th></tr>
<tr><td>$D_{bs} \leqslant 75$</td><td>${}^{+0,008}_{\ 0}$</td><td rowspan="3">0,2</td><td>${}^{+0,008}_{\ 0}$</td><td rowspan="3">0,3</td></tr>
<tr><td>$75 < D_{bs} \leqslant 110$</td><td>${}^{+0,01}_{\ 0}$</td><td>${}^{+0,009}_{\ 0}$</td></tr>
<tr><td>$110 < D_{bs} \leqslant 160$</td><td>${}^{+0,012}_{\ 0}$</td><td>${}^{+0,01}_{\ 0}$</td></tr>
<tr><td>$160 < D_{bs} \leqslant 250$</td><td>${}^{+0,014}_{\ 0}$</td><td>0,4</td><td>${}^{+0,01}_{\ 0}$</td><td>0,6</td></tr>
<tr><td>$250 < D_{bs} \leqslant 340$</td><td>${}^{+0,017}_{\ 0}$</td><td rowspan="2">0,6</td><td>${}^{+0,011}_{\ 0}$</td><td rowspan="2">1</td></tr>
<tr><td>$340 < D_{bs} \leqslant 500$</td><td>${}^{+0,022}_{\ 0}$</td><td>${}^{+0,012}_{\ 0}$</td></tr>
</table>