International Standard 6524

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Plain bearings — Methods of dimensional control — Peripheral length checking of thin-walled half bearings

Paliers lisses — Méthodes de contrôle dimensionnel — Contrôle de la longueur développée des demi-coussinets minces

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Foreword

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Plain bearings — Methods of dimensional control — Peripheral length checking of thin-walled half bearings

1 Scope and field of application

This International Standard specifies the methods of checking the measuring equipment and gauging tools which are necessary for the measurement of the peripheral length (or nip) 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.

In addition, measuring equipment different from that illustrated in this International Standard can be used, providing the measuring values determined with this equipment are within the tolerances of repeatability, reproducibility and comparability given in clause 17. [1)]

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

This International Standard applies to thin-walled half bearings the specifications of which are given in ISO 3548 and ISO 6864.

2 References

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

ISO 5725, *Precision of test methods — Determination of repeatability and reproducibility by inter-laboratory tests.*

ISO 6864, *Plain bearings — Thin-walled flanged half bearings — Dimensions, tolerances and checking methods.* [2)]

3 Definitions

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

3.2 nip (crush): Size S_N 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 — In practice, the datum serves as a basis for measuring S_N (see figure 2).

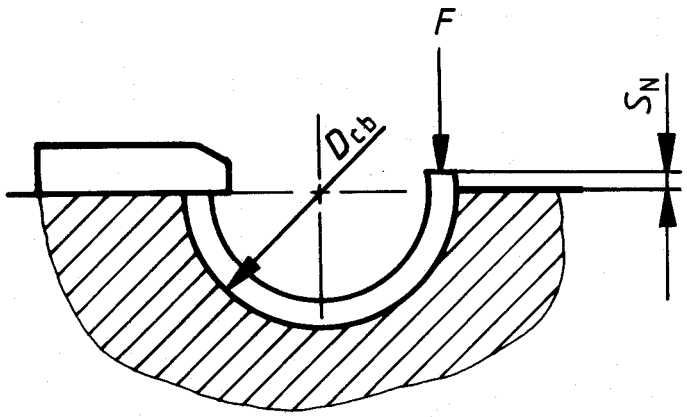

Figure 1 — Nip

1) These three concepts and their definitions conform to ISO 5725, but the mathematical formulae used for the calculation in this International Standard (see annex E) have been simplified.

2) At present at the stage of draft.

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4 Purpose of checking

It is necessary to keep to 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.

5 Symbols

NOTE — The characteristic subscripts are the following:

bs: bearing to be checked
cb: checking block
cbs: series checking block
cs: master shell

S_N or $S_{N1} + S_{N2}$ = nip, in millimetres

$F = F_1 = F_2$ = checking load, in newtons

CF = correction factor, in millimetres [1)]

PL = peripheral length, in millimetres [1)]

D_{cb} = diameter of the checking block bore, in millimetres [1)]

H_{cb} = distance from the bottom of the checking block bore to the datum plane, in millimetres [1)]

B_1 = checking block width (construction for flanged half bearings), in millimetres

B_3 = checking block width (construction for half bearings without flange), in millimetres

B_2 = checking block width, 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

D_{bs} = outside diameter of the half bearing to be checked, in millimetres

e_T = total wall thickness of the half bearing, in millimetres

L = width of the half bearing without flange, in millimetres

Z = distance between flanges of the flanged half bearing, in millimetres

h = fillet radius between back and flange on flanged half bearing, in millimetres

d_{cs} = outside diameter of the master shell, in millimetres [1)]

L_{cs} = master shell width, in millimetres

s_{cs} = wall thickness of the master shell, in millimetres

δ = correction to compensate the difference of elastic deflections under load between method A and method B, in millimetres

f = coefficient in calculation of deflection under load, in millimetres/newton

Δ = deviation of the actual peripheral length of the checking block, in millimetres

ΔH_{cb} = elastic deformation of the height of the checking block under load, in millimetres

E_e = elastic depression of the toe piece, in millimetres

6 Methods of checking

6.1 Checking 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 whereas the other joint face is in contact with a fixed stop (see figure 2).

6.2 Checking method B

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

7 Selection and designation of the checking method

7.1 Selection of the checking method

Recommendations for the selection of method A or B are given in table 1 based upon the dimensions of the half bearings to be checked.

However, any size of bearing may be tested by either method by agreement between 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 such that:

$$S_N = S_{N1} + S_{N2} + \delta$$

(See also 16.5 and clause E.3 in annex E.)

Table 1

D_{bs} mm		Recommended method of checking
above	up to and including	
—	160	A
160	340	A or B
340	500	B

1) The symbol may be followed by a subscript that defines the gauging tool to which the symbol is applied and/or by the subscript "M" or "th" indicating an effective measured value or a theoretical value respectively.

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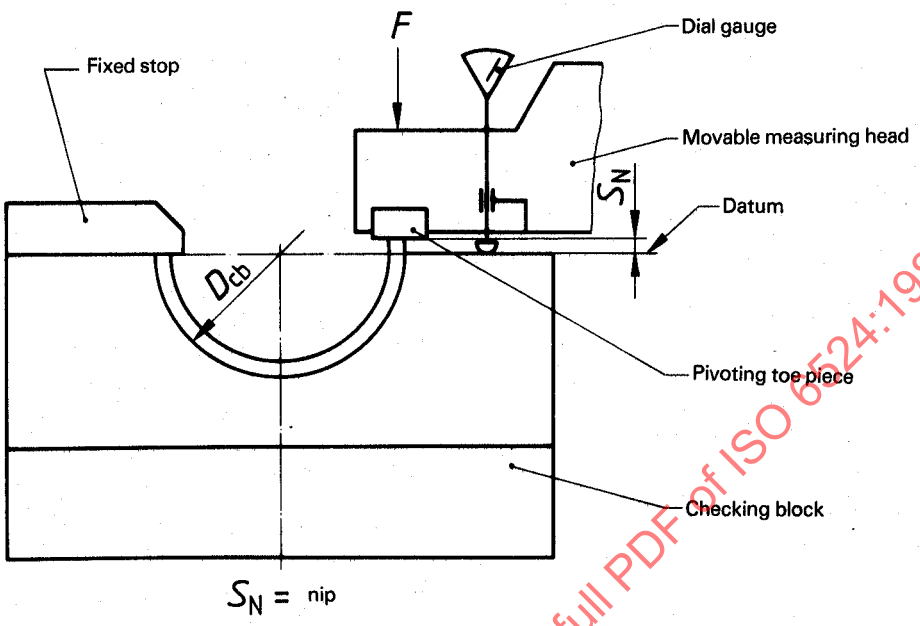

Figure 2 — Principle of checking method A

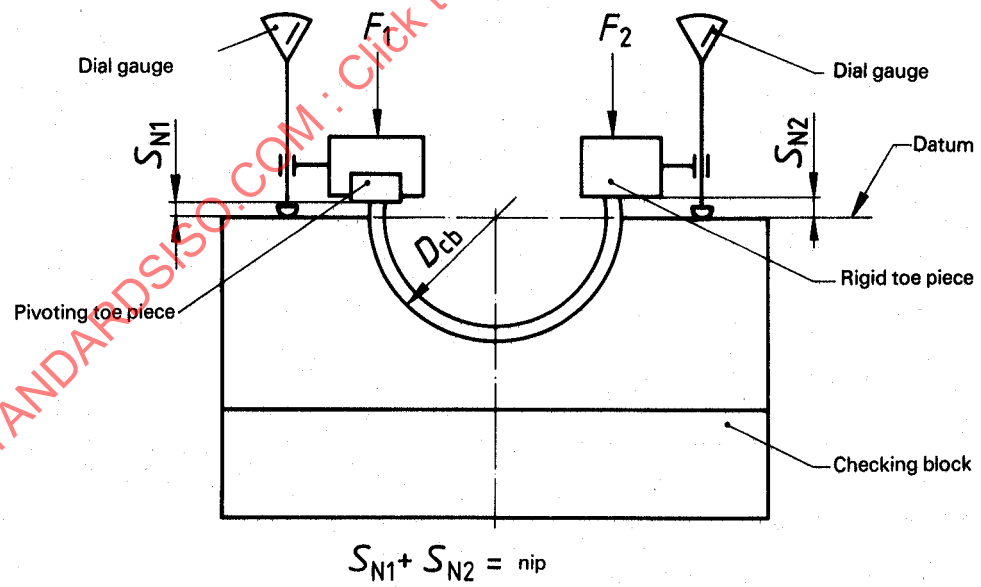

Figure 3 — Principle of checking method B

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

Example : Method A $F = 6\,000$ N

Method B $F_1 = 6\,000$ N, $F_2 = 6\,000$ N

7.2 Designation of the checking method

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

Method ISO 6524 — A — 340

8 Measuring equipment

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

8.1 Measuring equipment for method A

See figure 4.

8.2 Measuring equipment for method B

See figure 5.

9 Measuring equipment requirements

In the following the most important points, that have a substantial effect on the accuracy of measuring equipment and consequently on the measured nip values, are specified.

9.1 Tolerance of checking load setting

The permissible tolerances are given in table 2.

Table 2

F N above	F N up to and including	Tolerance for F ± %
—	2 000	1,25
2 000	5 000	1,0
5 000	10 000	0,75
10 000	50 000	0,5
50 000	—	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. Maximum speed of approach : 10 mm/s.

9.3 Construction of measuring head

The measuring head must 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 for the accuracy of the measuring plane of the toe pieces are given in table 3.

Table 3

D_{bs} mm above	D_{bs} mm up to and including	Surface roughness R_a µm	Tolerance of flatness mm
—	160	0,2	0,001 5
160	340	0,4	0,003
340	500		0,004

9.5 Accuracy of the dial gauge

Total deviation : ± 0,6 µm

Scale graduation value : 1 µm

10 Gauging tools for establishing the datum

The following equipment is available as the case may be, to carry out measurements :

— a master checking block (for reference measurements), see clause 11;

— a series checking block (for series control), see clause 11;

— a master shell (for series control), see clause 12.

They can be used in three possible ways (see 10.1, 10.2 and 10.3) in order to establish the datum against which dial gauges are set for checking.

10.1 Master checking block (alone)

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

10.2 Series checking block 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.

10.3 Series checking block with master shell

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

This combination of gauging tools is applied in series control.

NOTE — 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.

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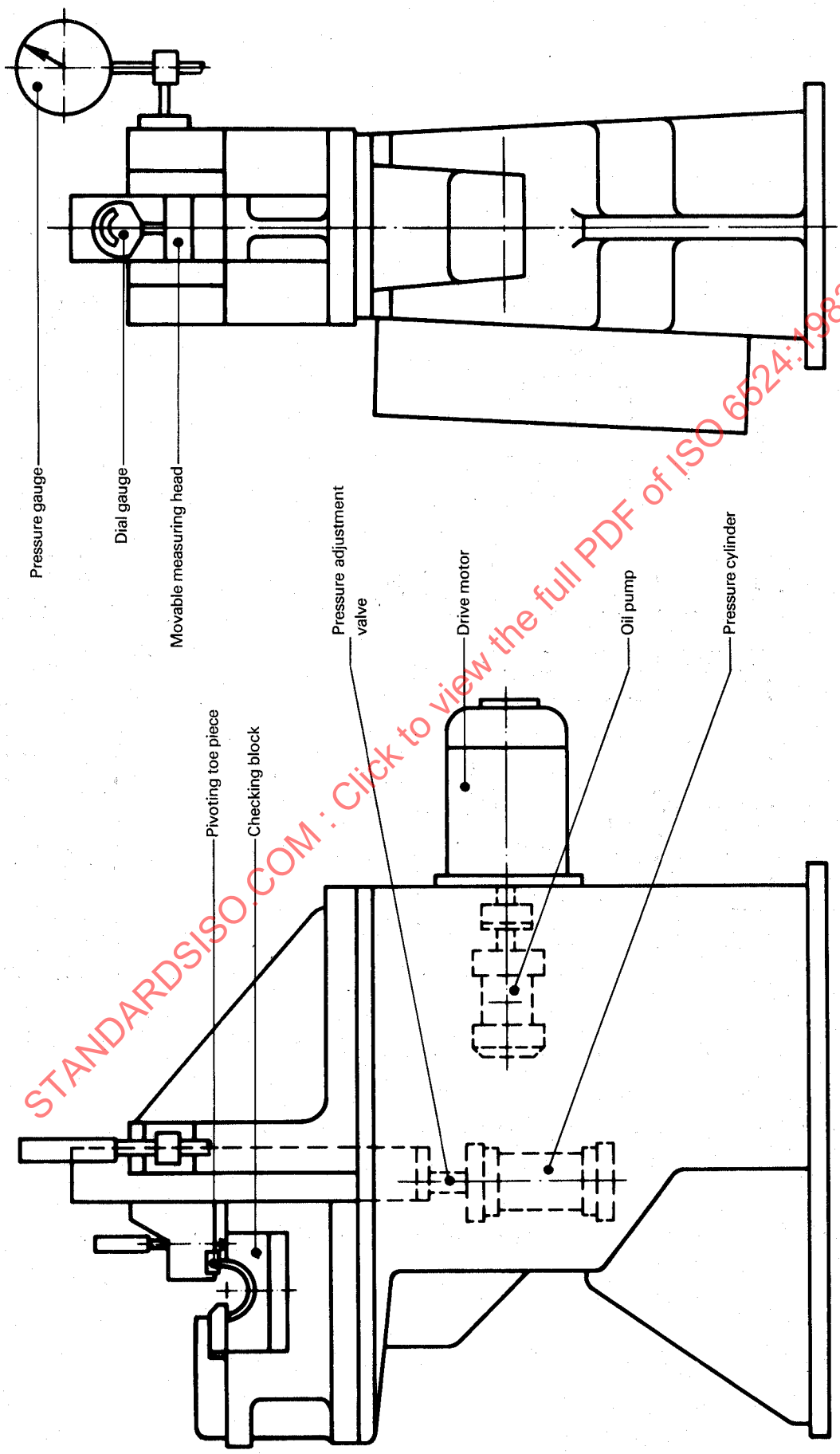

Figure 4 — Typical measuring equipment with one column for checking method A

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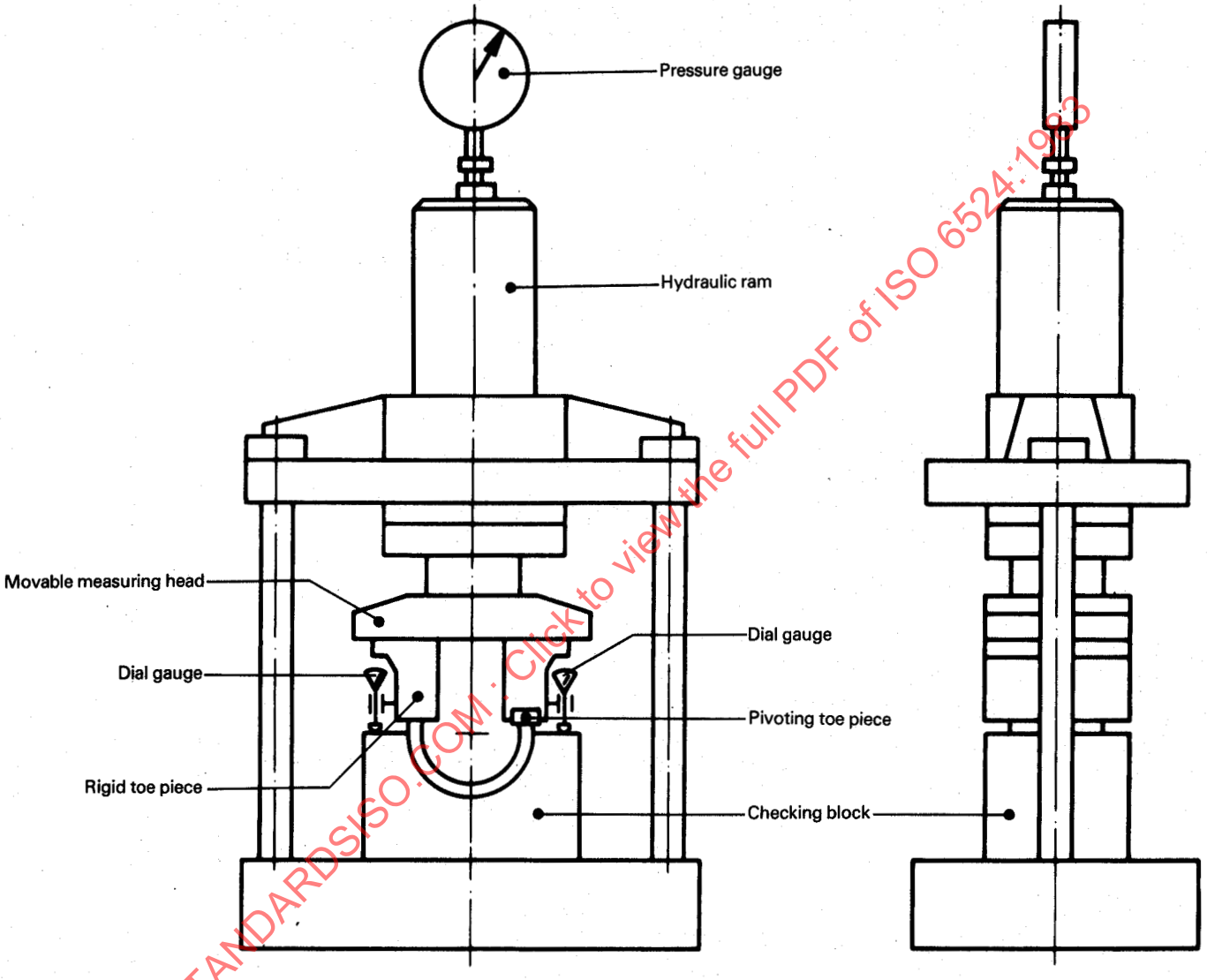

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Figure 5 — Typical measuring equipment with two columns for checking method B

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

11 Checking block requirements

The checking block is a typical block as shown in figure 6, the gauging part of which has a bore diameter D_{cb} and height H_{cb} and is intended to admit the half bearings to be checked.

The checking block should preferably be of hardened steel and of rigid construction so that requirements in 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 (see 16.2).

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.

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 for t_1 to t_7 are 50 % of those shown in tables 6 and 7.

11.1.1.2 Values for surface roughness a_1 and a_2 : see tables 6 and 7.

11.1.1.3 Specifications for B_1, B_2 and B_3 : see tables 6 and 7.

11.1.2 Measuring accuracy of equipment used for establishing D_{cbM} and H_{cbM}

Determination of D_{cbM} and H_{cbM} must be carried out by measuring equipment within a tolerance of :

$\pm$ 0,000 5 mm for $D_{cb} \leqslant 160$ mm
$\pm$ 0,001 0 mm for $D_{cb} > 160$ mm

These values are necessary for calculating the correction factor CF_{cb} (see 13.1) via the peripheral length, which is calculated from the formula:

$$PL_M = D_{cbM} \times \frac{\pi}{2} + 2\left(H_{cbM} - \frac{D_{cbM}}{2}\right)$$

11.1.3 Permissible wearing limit

No wear is permitted for the master checking block.

11.2 Series gauging tools

11.2.1 Series checking block 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_{cb} and H_{cb} are accepted.

11.2.1.1 Manufacturing limits

Manufacturing limits and specifications for the series checking block are given in tables 5 to 7.

11.2.1.2 Correction factor, CF_{cbs}

For calculation of CF_{cbs}, see 13.2.1.

Table 4

D_{bs} mm above	D_{bs} mm up to and including	Tolerance for D_{cb} mm	Surface roughness of checking block bore, R_a µm	Tolerance for H_{cb} mm	Surface roughness of the datum, R_a µm
–	75	+ 0,003 0	0,2	+ 0,003 0 0	0,3
75	110	+ 0,004 0		+ 0,003 5 0	
110	160	+ 0,005 0		+ 0,004 0 0	
160	250	+ 0,006 0	0,4	+ 0,004 5 0	0,6
250	340	+ 0,007 5 0	0,6	+ 0,005 0 0	1,0
340	500	+ 0,01 0		+ 0,006 0 0	

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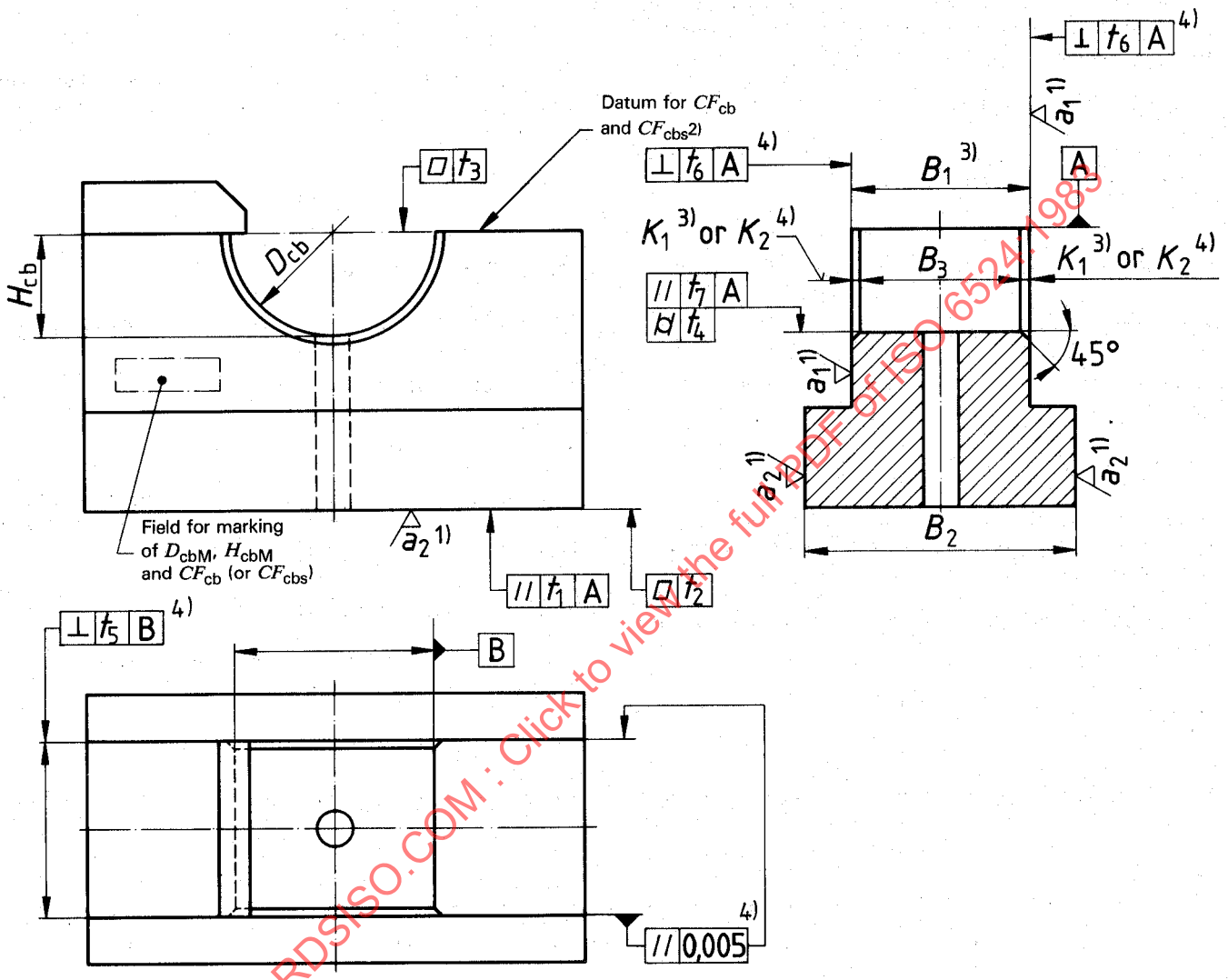

Figure 6 — Checking block

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1) It is recommended that the values given in tables 6 and 7 are 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 equal to $L_{max} + 3K_{1max}$

with $K_{1max} = 0{,}4$ mm

4) Construction for flanged half bearing :

B_1, see table 6

$K_2 = h_{max} + 0{,}5$ mm

Table 5

D_{bs} mm above	D_{bs} mm up to and including	Tolerance for D_{cb} mm	Surface roughness of checking block bore, R_a µm	Tolerance for H_{cb} mm	Surface roughness of the datum, R_a µm
—	75	$+\ 0{,}008\ 0$	0,2	$+\ 0{,}008\ 0$	0,3
75	110	$+\ 0{,}010\ 0$		$+\ 0{,}009\ 0$	
110	160	$+\ 0{,}012\ 0$		$+\ 0{,}010\ 0$	
160	250	$+\ 0{,}014\ 0$	0,4	$+\ 0{,}010\ 0$	0,6
250	340	$+\ 0{,}017\ 0$	0,6	$+\ 0{,}011\ 0$	1,0
340	500	$+\ 0{,}022\ 0$		$+\ 0{,}012\ 0$	

Table 6

D_{bs} mm above	D_{bs} mm up to and including	Bearing without flange $B_{3\,min}$ mm	Flanged bearing mm $B_{1\,min}$	Flanged bearing mm $B_{1\,max}$	Surface roughness, R_a $\frac{a_1}{\nabla}$ µm	Tolerances of form and orientation mm t_1	t_2	t_3	t_4	t_5	t_6
—	75	$L_{max} + 0{,}4$	$Z_{min} - 0{,}05$	$Z_{min} - 0{,}02$	1,2	0,003	0,002	0,002	0,002	0,002	0,002
75	110							0,003			
110	160							0,004			
160	250					0,005	0,005	0,005	0,004	0,003	0,003
250	340		$Z_{min} - 0{,}15$	$Z_{min} - 0{,}1$	1,6						
340	500		$Z_{min} - 0{,}2$	$Z_{min} - 0{,}15$		0,007		0,007			

Table 7

L mm above	L mm up to and including	B_2 $+\ 2\ 0$ mm	Surface roughness, R_a $\frac{a_2}{\nabla}$ µm	Tolerance of parallelism t_7 mm
—	55	60	1,2	0,002
55	80	85		0,003
80	—	$L + 5$		0,004

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11.2.1.3 Permissible wearing limit

The limit of permissible wear of the series checking block is reached when the difference between the correction factor in original and worn conditions is equal to the values stated in table 8.

Table 8

D_{cb} mm above	D_{cb} mm up to and including	$\lvert CF_{cbs\ new} - CF_{cbs\ worn} \rvert$ mm
–	75	0,012
75	110	0,016
110	160	0,020
160	250	0,024
250	340	0,030
340	500	0,040

11.2.2 Series checking block with master shell

11.2.2.1 Manufacturing limits

Manufacturing limits and specifications for the checking block are the same as in previous cases (see 11.2.1) : see tables 5 to 7.

11.2.2.2 Correction factor

For calculation, see 13.2.2.

11.2.2.3 Permissible wearing limit

The limit of permissible wear of the checking block is the same as in previous cases : see table 8.

12 Master shell requirements

The master shell is a typical piece as shown in figure 7 the basic dimensions of which must correspond to those of the half bearings to be checked, and which has a similar behaviour to the half bearing when it is fitted into the checking block.

NOTE — This cylindrical master shell is also used for checking flanged half bearings.

Master shells with an outside diameter up to 160 mm shall be made from hardened steel (a minimum of HRC 55).

In order that a single master shell may be used for a group of parts down to 1,5 mm undersize, s_{cs} is the total wall thickness e_T of the half bearing to be checked plus 0,125 mm.

12.1 Manufacturing limits

Manufacturing limits and specifications for the master shell are given in tables 9 and 10.

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Table 9

d_{cs} mm above	d_{cs} mm up to and including	Tolerance for L_{cs} mm	Tolerance for s_{cs} mm	Surface roughness, R_a µm a_3	Surface roughness, R_a µm a_5
–	160	± 0,1	± 0,015	0,2	2
160	340	± 0,15	± 0,020	0,6	
340	500	± 0,20	± 0,025	0,6	

Table 10

d_{cs} mm above	d_{cs} mm up to and including	Surface roughness, R_a a_4 µm	Tolerance of parallelism t_8 mm	Spread	Tolerance of flatness t_9 mm
–	160	0,3	0,004	Within the limits of the half bearing to be checked	0,002
160	340	0,6	0,006		
340	500	1	0,008		0,003

12.2 Correction factor, CF_{cs}

For calculation of CF_{cs}, see 13.2.3.

12.3 Permissible wearing limit

The limit of the permissible wear of the master shell is reached when the difference between the correction factor (13.2.3) in original and worn conditions is equal to the values stated in table 11.

Table 11

d_{cs} mm		$\lvert CF_{cs\ new} - CF_{cs\ worn} \rvert$ mm
above	up to and including	
–	160	0,010
160	340	0,015
340	500	0,025

13 Correction factors

13.1 Reference tooling: master checking block correction factor, CF_{cb}

The measured peripheral length of the master checking block bore is determined as follows :

$$PL_M = D_{cbM} \times \frac{\pi}{2} + 2\left(H_{cbM} - \frac{D_{cbM}}{2}\right)$$

The theoretical peripheral length of the master checking block bore is calculated by

$$PL_{th} = D_{cbth} \times \frac{\pi}{2}$$

The correction factor of the master checking block is therefore

$$CF_{cb} = PL_M - PL_{th}$$

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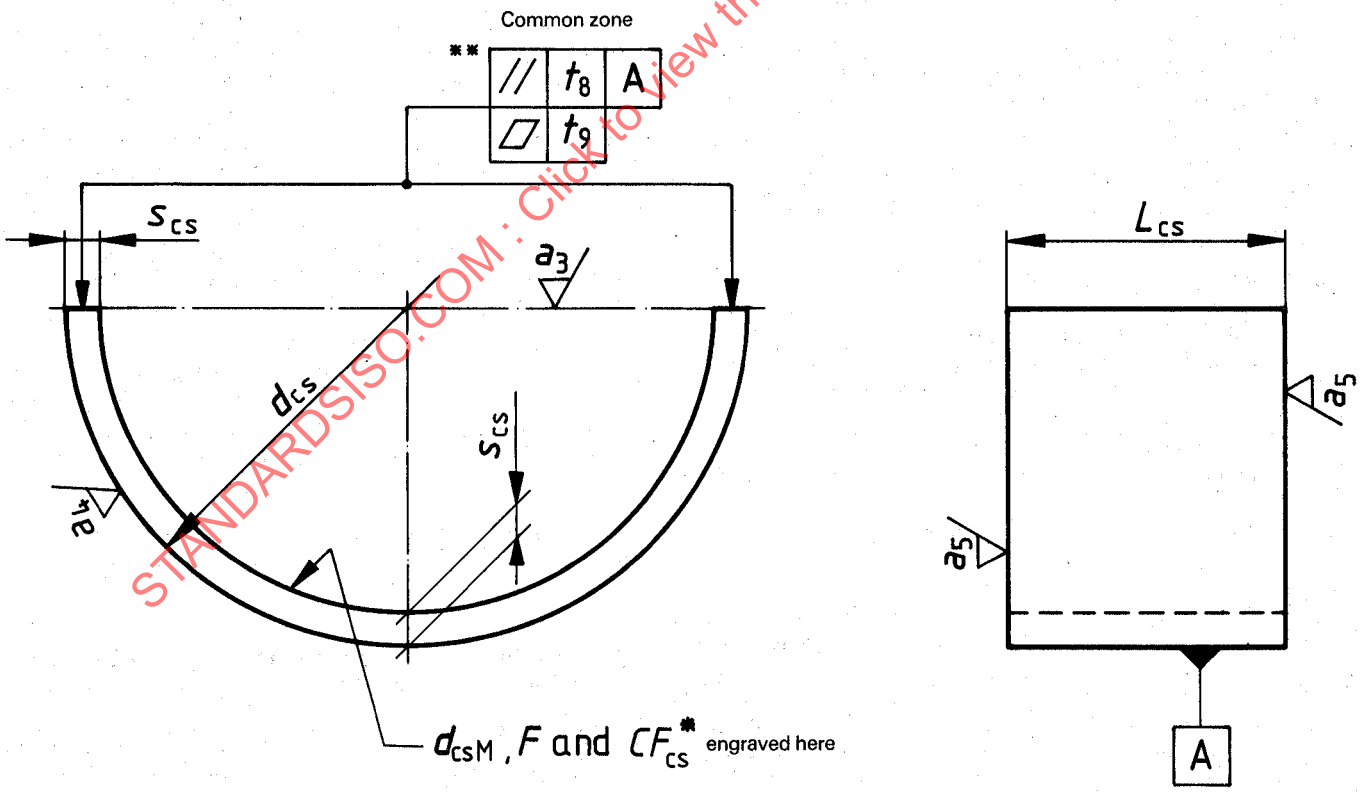

* See 13.2.3

** Tolerances of parallelism t_8 and flatness t_9 apply when the master shell is fitted in the checking block (zero free spread) under the checking load.

Figure 7 — Master shell

The other factors to be taken into consideration, their determination and calculation, are given in annex A (checking method A) and annex B (checking method B).

The basis for the correction factor CF_{cb} is the datum of the master checking block.

13.2 Series control tooling

13.2.1 Series checking block alone correction factor, CF_{cbs}

The correction factor CF_{cbs} is determined by the difference between the nip value of a half bearing measured in a master checking block (S_{NM}) and in a series checking block (S_{Ns}) under equal checking conditions (see annex C).

$$CF_{cbs} = S_{NM} - S_{Ns}$$

When setting the dial gauge, the correction factor CF_{cbs} of the series checking block only shall be taken into consideration.

The basis for the correction factor CF_{cbs} is the datum of the series checking block.

13.2.2 Correction factor for series checking block with master shell

The correction factor CF_{cbs} of the series checking block should not be taken into consideration when carrying out measurements; it is only to check the wearing limit of the series checking block.

When setting the dial gauge, the correction factor CF_{cs} of the master shell only (see 13.2.3) shall be taken into consideration.

13.2.3 Master shell correction factor, CF_{cs}

The correction factor CF_{cs} is the size by which a master shell fitted in a master checking block bore, under a predetermined checking load, deviates from the theoretical peripheral length of the master checking block bore.

For determination of the correction factor CF_{cs}, see annex D.

When setting the dial gauge, the correction factor of the master shell CF_{cs} shall be taken into consideration.

The basis for the correction factor CF_{cs} is the joint face of the master shell the peripheral length of which is to be measured in a master checking block, according to 13.1.

NOTE — The correction factor CF_{cs} is ZERO when the master shell is exactly adjusted to the peripheral length of the master checking block bore the bore diameter D_{cb} of which corresponds to the outside diameter D_{bs} of the half bearing to be checked.

13.3 Marking

The determined correction factors shall be engraved on each of the gauging tools.

13.4 Reference setting

In cases of dispute, the setting shall be made according to the determined correction factor in a master checking block (see 13.1) and the method agreed between manufacturer and customer.

14 Typical procedure for checking [1)]

14.1 Place the checking block in the measuring equipment, line it up and secure it against lateral movement.

14.2 Set the checking load according to the drawing.

14.3 Under the specified checking load, lower the pivoting toe piece (method A) or the toe pieces (method B) vertically onto the datum of the checking block or onto the joint face of the master shell.

In the case of checking method A, the dial gauge has to be adjusted by the full value of the correction factor engraved on the checking block (CF_{cb} or CF_{cbs}) or on the master shell (CF_{cs}).

In the case of checking method B, both dial gauges should be adjusted by one half of the correction factor.

14.4 Place the half bearing to be checked (see also clause 15) in the checking block and apply the checking load via the measuring head.

14.5 Determine the nip variation of the half bearing, in the case of checking method A, by reading off the dial gauge direct or, in the case of checking method B, by adding the partial nip variations recorded on the two dial gauges.

14.6 The measuring temperature should be between 20 and 25 °C.

15 Condition of the half bearings to be checked

The joint and back faces of the half bearing shall be free of foreign matter, of grease, free of any damage, and at the same temperature as the checking block being used.

1) When carrying out reference measurements, the value of the nip is always the average of three measurements (at a temperature of 20 °C).

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16 Measuring errors

16.1 Errors due to the measuring equipment

These errors are due to :

— incorrect position of the checking block (longitudinal and/or transverse direction);

— the checking block is not correctly fixed in the measuring equipment;

— incorrect setting of the checking load;

— excessive speed of approach of load;

— the pivoting toe piece is too tight or has too much clearance;

— damage or wear of the toe piece or toe pieces.

16.2 Errors due to the checking block

These errors are due to :

— difference of temperature between the half bearing and checking block;

— damage or wear of the checking block;

— recess for locating nicks too large;

— the locating nick fouling the notch in the checking block (the recess for the locating nick of the bearing in the checking block must be 1 mm greater in width and depth and 1,5 mm greater in length than the corresponding dimension of the locating nicks in the half bearing);

— the bore of the checking block has been chromium plated;

— the fixed stop (checking method A) does not cover the total joint face of the half bearing;

— the fixed stop (checking method A) deflects too much and/or is poorly attached;

— damage or wear of the fixed stop;

— checking block width B_3 is smaller than the bearing width in the case of bearings without flange;

— checking block width B_1 or B_3 for flanged bearings is too large, so that bearings are in contact with the checking block at the fillet radius between back and flange.

16.3 Errors due to the correction factor

These errors are due to :

— incorrect reading off at measurement of D_{cbM} and H_{cbM};

— wrong calculation of the correction factor.

16.4 Errors due to the half bearing

These errors are due to :

— grease, dirt or damage on the outside diameter or joint face;

— joint face taper is excessive.

16.5 Error due to the selection of the checking method

An error may arise if the correction δ is not considered, when the half bearing is tested by a method other than the method specified on the bearing drawing (see 7.1 and clause E.3 in annex E).

17 Repeatability, reproducibility and comparability of the methods used

This clause is intended to give a statistical approach in order to evaluate the repeatability, reproducibility and comparability of the methods used from test results.

17.1 Definitions and checking conditions

17.1.1 Definitions

17.1.1.1 repeatability of the method used: The precision of the method in the case of a single operator working in a given checking place and achieving successive results using the same measuring equipment and the same method for checking the same half bearing.

NOTE — Repeatability is assessed from the standard deviation of repeatability s_R.

17.1.1.2 reproducibility of the method used: The precision of the method in the case of operators working in different checking places, or in the same place but at different periods, and each of them achieving individual results using the same methods and the same checking block for checking the same half bearing.

NOTE — Reproducibility is assessed from the difference between the two averages obtained from two sets of measuring equipment.

17.1.1.3 comparability of the methods used: The precision in the case of operators working at different periods and each of them achieving individual results, one of them using the method A and the other the method B, for checking the same half bearing in the same checking block.

NOTE — Comparability is assessed from the difference between the two averages obtained from the two methods.

17.1.2 Checking conditions

See table 12.

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17.2 Limits

The values of repeatability, reproducibility and comparability given in table 13 are a basis for interpreting the test results.

17.3 Calculation

Indications on the test procedure of repeatability, reproducibility and comparability, the statement of calculation and their interpretation are given in annex E.

18 Specifications on bearing drawings

The following should be specified in the drawing, represented graphically or otherwise for the measurement of the nip :

a) checking method A or B specified (see clause 7);

b) checking load;

c) nip (crush);

d) diameter D_{cbth} and distance from the bottom of the checking block to the datum plane H_{cbth}.

19 Specifications for the control of the checking means

19.1 The gauging tools shall be checked regularly, significant damage made good and any dimensional changes to the gauging tools engraved on them.

19.2 The measuring equipment shall be checked as to its accuracy, at time intervals which can be specified (in accordance with statistical methods).

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Table 12

Datum	Repeatability within checking method A or B	Reproducibility within checking method A or B	Comparability between checking method A and B
Half bearings	Identical	Identical	Identical
Measuring equipment	Identical	Identical or different construction	Different
Checking block	Identical	Identical	Identical
Checking person	Identical	Different	Different
Checking place	Identical	Different	Different
Checking time	Identical	Different	Different

Table 13

D_{bs} mm above	D_{bs} mm up to and including	Repeatability $4\,s_R$ max. µm	Reproducibility $\lvert\bar{x}_1 - \bar{x}_2\rvert$ max. µm	Comparability [1] $\lvert\bar{x}_A - \bar{x}_B\rvert$ max. µm
–	75	3	4,5	6
75	160	4	6	8
160	340	6	9	12
340	500	8	12	16

1) A good quality contact between toe pieces (fixed stop) and the bearing joint faces is of prime importance to achieve these values especially for bigger bearings.

Annex A

Determination of the correction factor of the master checking block — Method A

A.1 Calculation form

Firm	Number of drawing	Type of bearing

D_{cbth} = ☐☐☐☐☐☐ mm e_T = ☐☐☐☐☐ mm L_{max} = ☐☐☐☐☐ mm

F = ☐☐☐☐☐☐ N B_1 or $B_{3\ min}$ = ☐☐☐☐☐ mm

1 Actual peripheral length before correction (see figure 8)

$D_{cbM} \times \frac{\pi}{2}$ = ☐☐☐☐☐☐ × 1,570 8 = ⟶ ☐☐☐☐☐☐☐ mm

2 Deviations Δ_1 and Δ_2 (Take signs into account, see note under figure 8)

Δ_1 = ☐☐☐☐ mm

Δ_2 = + ☐☐☐☐ mm

$\Sigma\Delta$ = ☐☐☐☐ mm ⟶ ☐ ☐☐☐☐ mm

3 Elastic variation of H_{cbth} (see figure 10)

$$\Delta H_{cb} = \frac{H_{cbth} \times F}{5 \times 10^6 \times B_1} = \frac{☐☐☐☐☐☐ \times ☐☐☐☐☐☐}{5\,000\,000 \times ☐☐☐☐☐} =$$ − ☐☐☐☐☐☐☐ mm

4 Elastic depressions at the fixed stop and toe piece (see figure 11)

$$E_{e1} + E_{e2} = \frac{0{,}000\ 03 \times F}{e_T \times L} = \frac{0{,}000\ 03 \times ☐☐☐☐☐☐}{☐☐☐☐☐ \times ☐☐☐☐☐}$$ = + ☐☐☐☐☐☐☐ mm

5 Flexibility of the fixed stop under checking load (see figure 9)

+ ☐☐☐☐ mm

6 Measured peripheral length (after correction)

$PL_M = \Sigma$ (1 to 5) = + ☐☐☐☐☐☐☐ mm

7 Theoretical peripheral length

$PL_{th} = D_{cbth} \times \frac{\pi}{2}$ = ☐☐☐☐☐☐ × 1,570 8 = ⟶ − ☐☐☐☐☐☐☐ mm

8 Correction factor for master checking block

CF_{cb} = ☐ ☐☐☐☐ mm ⟵ ☐ ☐☐☐☐ mm

Determine steps 1, 2 and 5 by measurement

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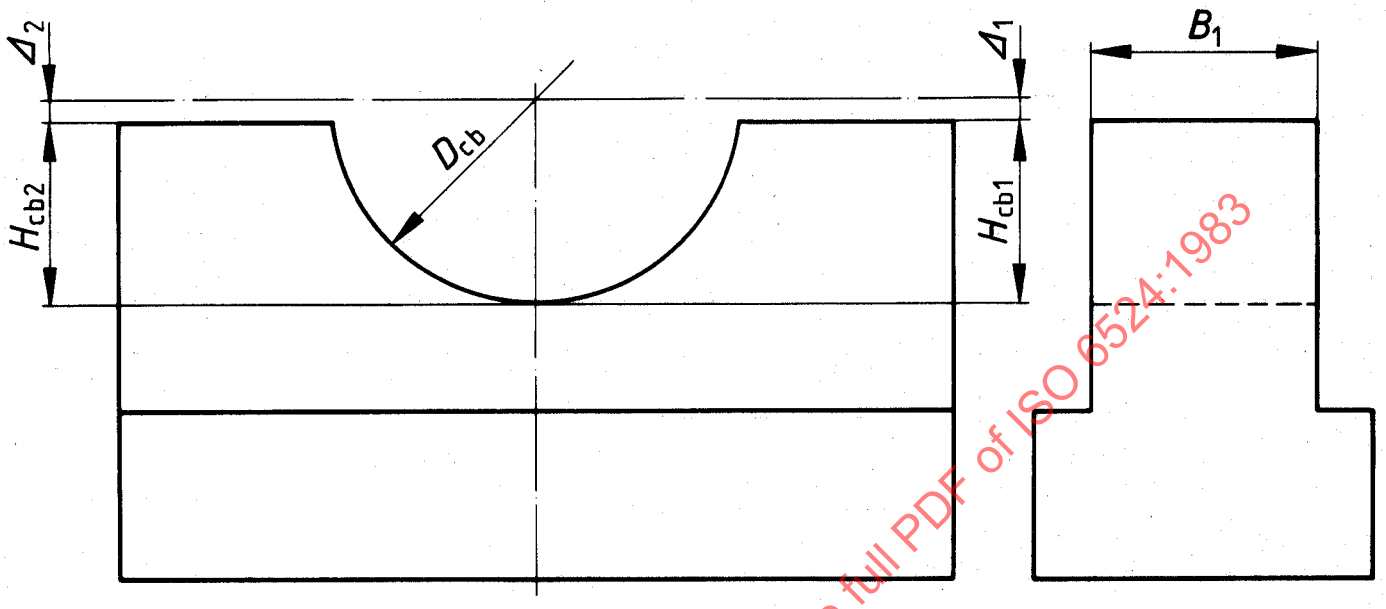
A.2 Explanatory figures



NOTE — $\Delta_1 = H_{cb1M} - \frac{D_{cbM}}{2}$ and $\Delta_2 = H_{cb2M} - \frac{D_{cbM}}{2}$

Figure 8

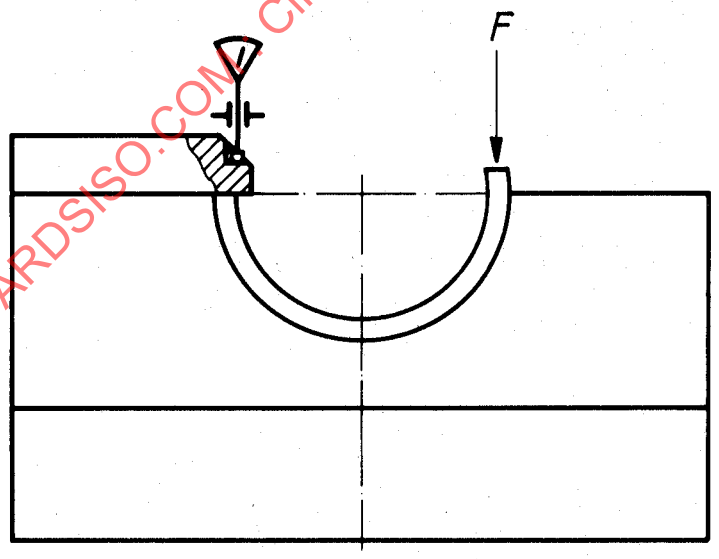


Figure 9

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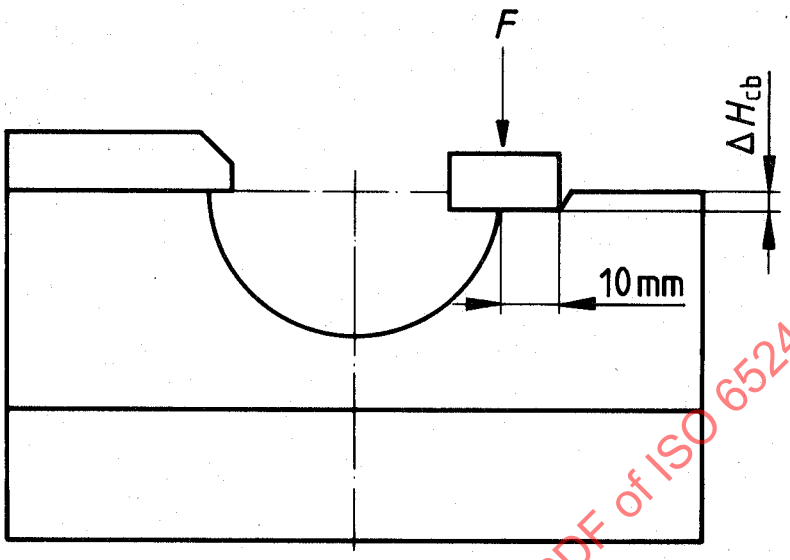
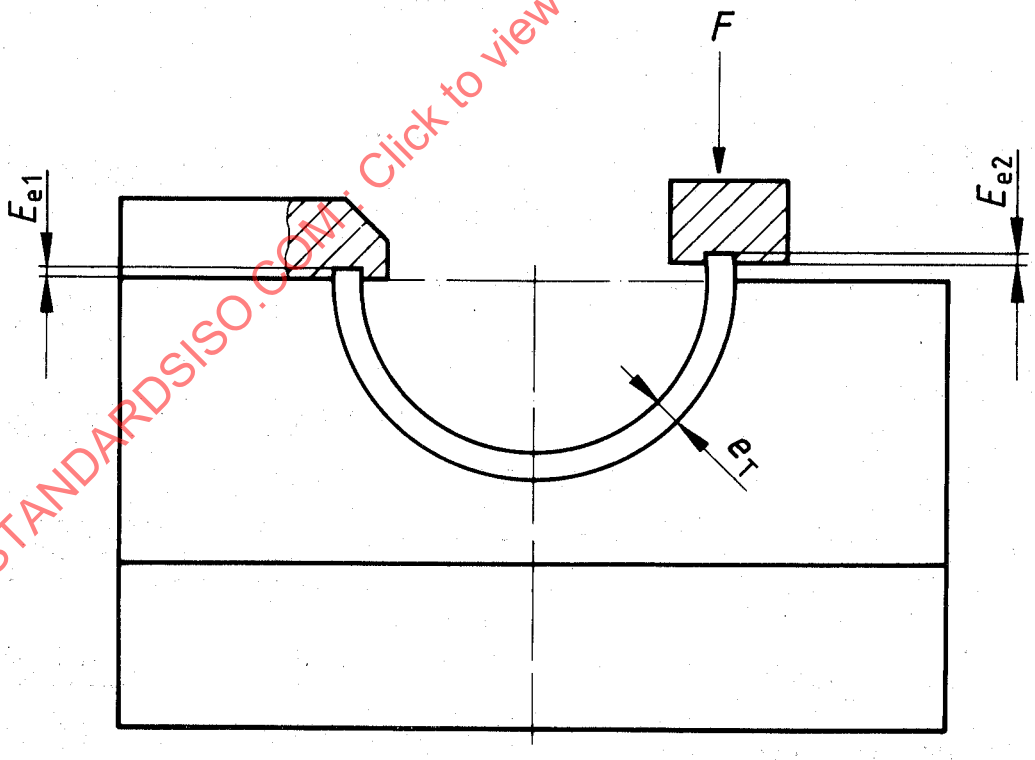


Figure 10



NOTE — E_{e1} and E_{e2} can be ignored if the measuring planes of the toe piece and the fixed stop are coated with hard carbide.

Figure 11

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A.3 Numerical example

Firm	Number of drawing	Type of bearing

D_{cbth} = 54521 mm e_T = 1950 mm L_{max} = 3500 mm

F = 5800 N B_1 or $B_{3\,min}$ = 3500 mm

1 Actual peripheral length before correction (see figure 8)

$D_{cbM} \times \frac{\pi}{2}$ = 54522 × 1,570 8 = → 85642966 mm

2 Deviations Δ_1 and Δ_2 (Take signs into account, see note under figure 8)

Δ_1 = − 0001 mm

Δ_2 = + 0000 mm

$\Sigma\Delta$ = − 0001 mm → − 0001 mm

3 Elastic variation of H_{cbth} (see figure 10)

$$\Delta H_{cb} = \frac{H_{cbth} \times F}{5 \times 10^6 \times B_1} = \frac{27260 \times 5800}{5\,000\,000 \times 3500} = -\,000090 \text{ mm}$$

4 Elastic depressions at the fixed stop and toe piece (see figure 11)

$$E_{e1} + E_{e2} = \frac{0{,}000\,03 \times F}{e_T \times L} = \frac{0{,}000\,03 \times 5800}{1950 \times 3500} = +\,000255 \text{ mm}$$

5 Flexibility of the fixed stop under checking load (see figure 9)

+ 0002 mm

6 Measured peripheral length (after correction)

$PL_M = \Sigma$ (1 to 5) = + 85645561 mm

7 Theoretical peripheral length

$PL_{th} = D_{cbth} \times \frac{\pi}{2}$ = 54521 × 1,570 8 = → − 85641393 mm

8 Correction factor for master checking block

CF_{cb} = + 0004 mm ← + 000422 mm

Determine steps 1, 2, and 5 by measurement

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Annex B

Determination of the correction factor of the master checking block — Method B

B.1 Calculation form

Firm	Number of drawing	Type of bearing

D_{cbth} = ☐☐☐☐☐☐ mm e_T = ☐☐☐☐☐☐ mm L_{max} = ☐☐☐☐☐☐ mm

F = ☐☐☐☐☐☐ N B_1 or $B_{3\ min}$ = ☐☐☐☐☐☐ mm

1 Actual peripheral length before corrections (see figure 12)

$D_{cbM} \times \frac{\pi}{2}$ = ☐☐☐☐☐☐ × 1,570 8 = ⟶ ☐☐☐☐☐☐☐☐ mm

2 Deviations Δ_1 and Δ_2 (Take signs into account, see note under figure 12)

Δ_1 = ☐☐☐☐☐ mm

Δ_2 = + ☐☐☐☐☐ mm

$\Sigma\Delta$ = ☐☐☐☐☐ mm ⟶ ☐ ☐☐☐☐☐☐☐ mm

3 Elastic variation : $\Delta H_{cb} = \Delta H_{cb1} + \Delta H_{cb2}$ (see figure 13)

$$\Delta H_{cb} = \frac{H_{cbth} \times F}{2{,}5 \times 10^6 \times B_1} = \frac{☐☐☐☐☐☐ \times ☐☐☐☐☐☐}{2\,500\,000 \times ☐☐☐☐} = - ☐☐☐☐☐☐☐☐ \text{ mm}$$

4 Elastic depressions at both toe pieces (see figure 14)

$$E_{e1} + E_{e2} = \frac{0{,}000\,03 \times F}{e_T \times L} = \frac{0{,}000\,03 \times ☐☐☐☐☐☐}{☐☐☐☐☐ \times ☐☐☐☐☐} = + ☐☐☐☐☐☐☐☐ \text{ mm}$$

5 Measured peripheral length (after correction)

$PL_M = \Sigma$ (1 to 4) = + ☐☐☐☐☐☐☐☐ mm

6 Theoretical peripheral length

$PL_{th} = D_{cbth} \times \frac{\pi}{2}$ = ☐☐☐☐☐☐ × 1,570 8 = ⟶ − ☐☐☐☐☐☐☐☐ mm

7 Correction factor for master checking block

CF_{cb} = ☐ ☐☐☐☐ mm ⟵ ☐ ☐☐☐☐☐☐☐ mm

Determine steps 1 and 2 by measurement

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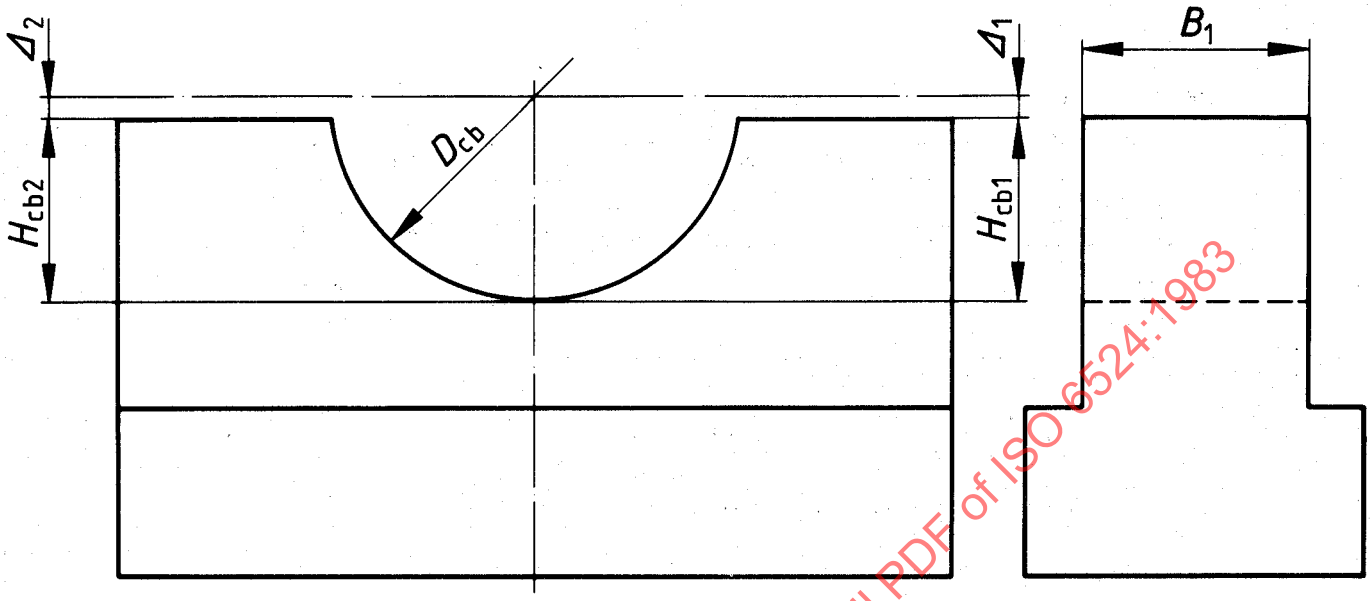
B.2 Explanatory figures



NOTE — $\Delta_1 = H_{cb1M} - \frac{D_{cbM}}{2}$ and $\Delta_2 = H_{cb2M} - \frac{D_{cbM}}{2}$

Figure 12

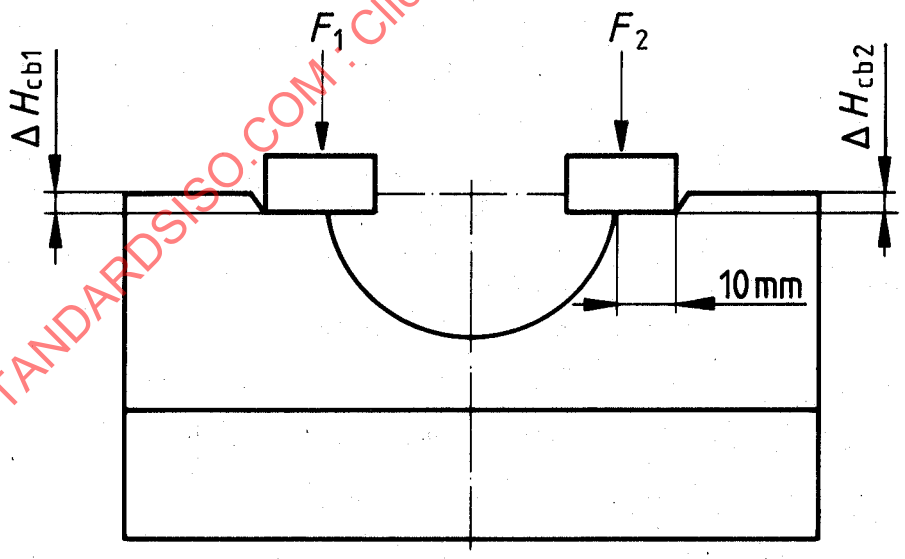


Figure 13

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