

CONFIRMED
DECEMBER 2007

Machine tool components —

Part 14: Method for determination of the pilot diameter of 60° centre holes

UDC 621.9 [621.957.2 + 620.178.151.4]:003.62:(083.4)

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- Advanced Manufacturing Technology Research Institute
- Cranfield Institute of Technology
- Department of Trade and Industry, Mechanical Engineering and Manufacturing Technology Division (Mmt)
- Health and Safety Executive
- Institution of Production Engineers
- Ministry of Defence
- University of Aston in Birmingham

This British Standard, having been prepared under the direction of the Machine, Engineers and Hand Tools Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 December 1987

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The following BSI references relate to the work on this standard:
Committee reference MTE/1
Draft for comment 84/71289 DC

ISBN 0 580 16281 8

Amendments issued since publication

Amd. No.	Date of issue	Comments

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Foreword

This Part of BS 4185 has been prepared under the direction of the Machine, Engineers and Hand Tools Standards Committee and is based on a draft submitted by the Advanced Manufacturing Technology Research Institute (AMTRI) formerly the Machine Tool Industry Research Association (MTIRA).

The theoretical basis of the calculation is explained in Appendix A and the purpose of the standard is to assist in determining the correct size of centre hole to be drilled into workpieces.

The full equations given in Appendix A can be used to obtain more accurate results. However, it should be clearly understood that if d , D , D_w and F_t are all independent variables then the choice of values of d and D becomes a task needing a computer.

The standard considers only the stress in the workpiece. The assumptions can, it is agreed, lead to a larger size than is strictly necessary being selected or could, in extreme cases, indicate no acceptable choice being possible. The recourse then, as indicated above, is to use the full equations.

It should be noted that nowhere is the shear stress in the supporting centre featured in the calculations.

The range of sizes of centre hole covered in this standard is from $d = 0.5$ mm to $d = 10$ mm as in BS 328-2 but the range has also been extended by including part of the preferred series from $d = 12.5$ mm to $d = 50$ mm which takes account of DIN 333 and DIN 332-7 published by the Deutsches Institut für Normung (DIN).

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 4185 describes a method for the determination of the pilot diameter, d , of a 60° centre hole, type A, B or R as illustrated in Appendices A to C of BS 328-2:1972, covering the range $0.5 \text{ mm} \leq d \leq 50 \text{ mm}$.

This method applies only to workpieces satisfying the following conditions:

- force acting at the centre hole, F_G , $\leq 180\,000 \text{ N}$;
- cutting force, F_s , $\leq 110\,000 \text{ N}$;
- where $\frac{D_w}{D} \geq 3$ or $\frac{D_w}{D} \geq 6.3$ (see BS 328-1 for D in relation to d) (see also clause 2).

NOTE 1 The theoretical concept is explained in Appendix A and additional considerations are given in Appendix B.

NOTE 2 A typical centre hole is illustrated in Figure 1.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Symbols

For the purposes of this Part of BS 4185, the following symbols apply.

Symbol	Term	Units
A_e^a	Projected area	mm^2
C_1, C_2	Fixed centres (see Figure 2)	—
D	Diameter of large end of the 60° taper (see Figure 1)	mm
D_e^a	External diameter of thick-walled pipe	mm
D_i^a	Internal diameter of thick-walled pipe	mm
D_w	Diameter of workpiece when cutting operations are completed (see Figure 1)	mm
d	Nominal diameter of the cylindrical pilot bore of the centre hole (see Figure 1)	mm
F_1, F_2	The force acting at the centre holes due to mass of workpiece for asymmetrical workpieces (see 4.2.2 and Figure 2)	N
F_G	Force acting at the centre hole due to mass of workpiece	N
F_s	Cutting force	N
F_t	Total force	N
NOTE $F_t = F_G + F_s$ [see equation (2)]		
k_s	Specific cutting force	N/mm^2
l_1, l_2, l_3, l_4	Lengths (see 4.2.2 and Figure 2)	mm

M_1, M_2, M_3	Gravitational forces due to masses (see 4.2.2 and Figure 2)	N
P^a	Internal pressure	N/mm^2
q	Cross-sectional area of chip	mm^2
s	Safety factor	—
$\sigma_{\max}^a$	Maximum shear stress	N/mm^2
σ_u	Tensile strength of machined material	N/mm^2
$\sigma_{0.2}$	0.2 % proof stress of the machined material	N/mm^2

^a Referred to in Appendix A only.

3 Definitive equation

The diameter d (in mm) of the pilot bore of the centre hole is given by the equation:

$$d = 1.15 \sqrt{\frac{F_t s}{\sigma_{0.2}}} \quad (1)$$

where

$$F_t = F_G + F_s \quad (2)$$

NOTE For symmetrical workpieces, F_G is the force in N equivalent to half the workpiece mass (in kg). For asymmetrical workpieces see 4.2.2.

The cutting force F_s (in N) is given by:

$$F_s = k_s q \quad (3)$$

The cross-sectional area of chip q (in mm^2) is given by:

$$q = \text{feed per revolution} \times \text{depth of cut} \quad (4)$$

where

feed per revolution and depth of cut are measured in mm.

The safety factor s is given by:

$$s = 1.75$$

The relationship between the tensile strength of the material, σ_u , and the 0.2 % proof stress of the material, $\sigma_{0.2}$, is approximated by:

$$\sigma_{0.2} = 0.6 \sigma_u \quad (5)$$

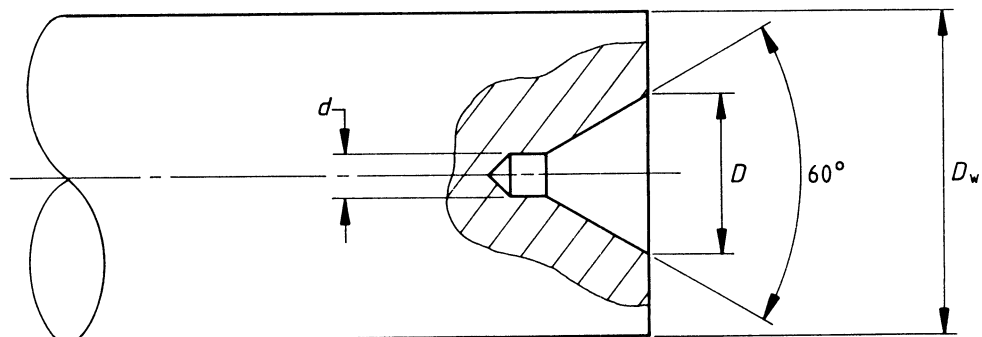


Figure 1 — Typical centre hole

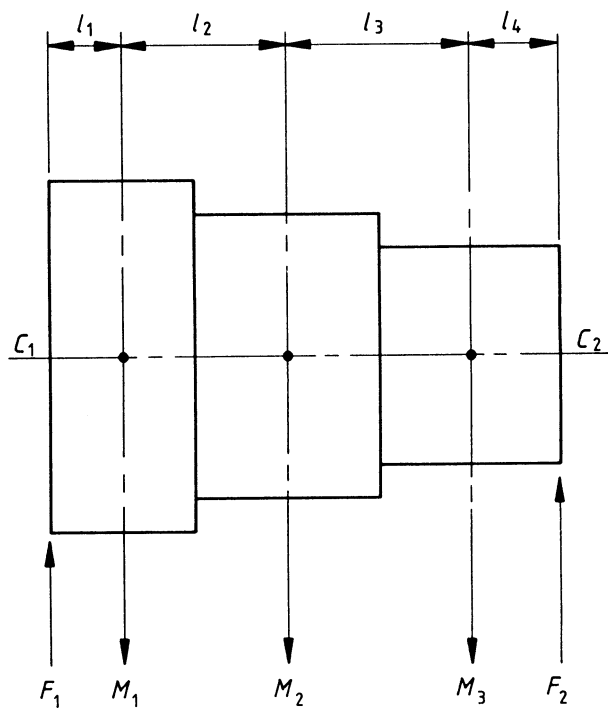


Figure 2 — Forces due to gravity for an asymmetrical workpiece