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Dynaload — Design and construction — Use and maintenance

Dynaload — Conception et construction — Utilisation et maintenance

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 118 *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The measurement of physical parameters such as noise and vibration from hand-held tools has been the subject of investigation for many years. The means by which these parameters can be obtained have resulted in a number of devices to provide for a "working load" for the tool being investigated.

The resulting data can provide the customer with relevant information using a well-defined method that is both repeatable and reproducible. The last two issues, repeatability and reproducibility, are vital where the data obtained is required to demonstrate compliance with legislative requirements.

The equipment used to provide a "load" against which the hand-held power tool can "work" should be easily constructed from common materials and provide for ease of maintenance. This publication is intended to provide the specifications and guidance for such a loading device.

The information provided is primarily intended to instruct and supplement guidance given in standards for the measurement of noise, vibration of percussive hand-held power tools.

At the time of publication of this guidance document, dynamic loading devices, such as the ones described herein, had been used for many years in conjunction with the testing of percussive power tools. In particular, the vibration test code, ISO 28927-10, specified the use of such loading devices for testing a range of power tools, including chipping hammers, rock drills and concrete breakers. However, since the published standard not specified the design of the loading device in detail, there were inevitably many small differences between the loading devices which were manufactured. The question then arose as to whether these differences affected the measured results of the tests, for which the loading devices were used.

Dynaload — Design and construction — Use and maintenance

1 Scope

This document specifies the design, construction, guidance on use and maintenance of a dynamic loading device for the following categories of hand-held power tools:

— percussive;

— rotary-percussive.

The device can be used when measurements are being made for vibration and noise including when required for specification in test standards.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

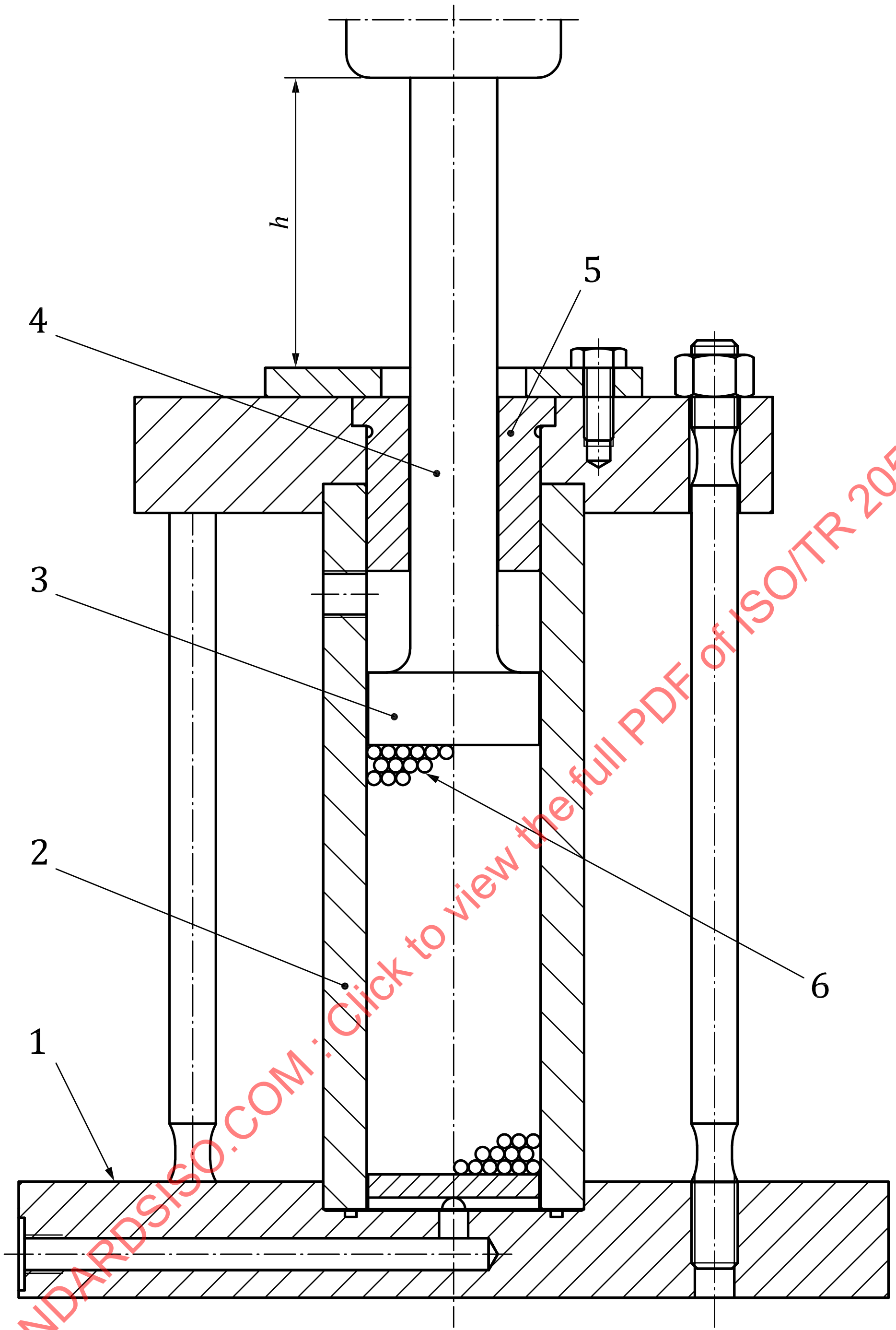
— IEC Electropedia: available at http://www.electropedia.org/

4 General

The dynamic loading device is given the common name of DYNALOAD. The device consists of a metallic cylinder filled with steel balls on which the hand-held power tool is brought to bear and which absorbs the energy transmitted by the tool. The device can either be fixed to a surface or buried below the working floor level.

Figure 1 identifies the essential items making up a Dynaload. The specification of each item is identified later in this publication.

The Dynaload device absorbs the blow energy from the power tool. Much of the shock wave is absorbed by the steel balls, however some 15 % to 20 % is reflected to the power tool, as would be the case in a normal working situation.

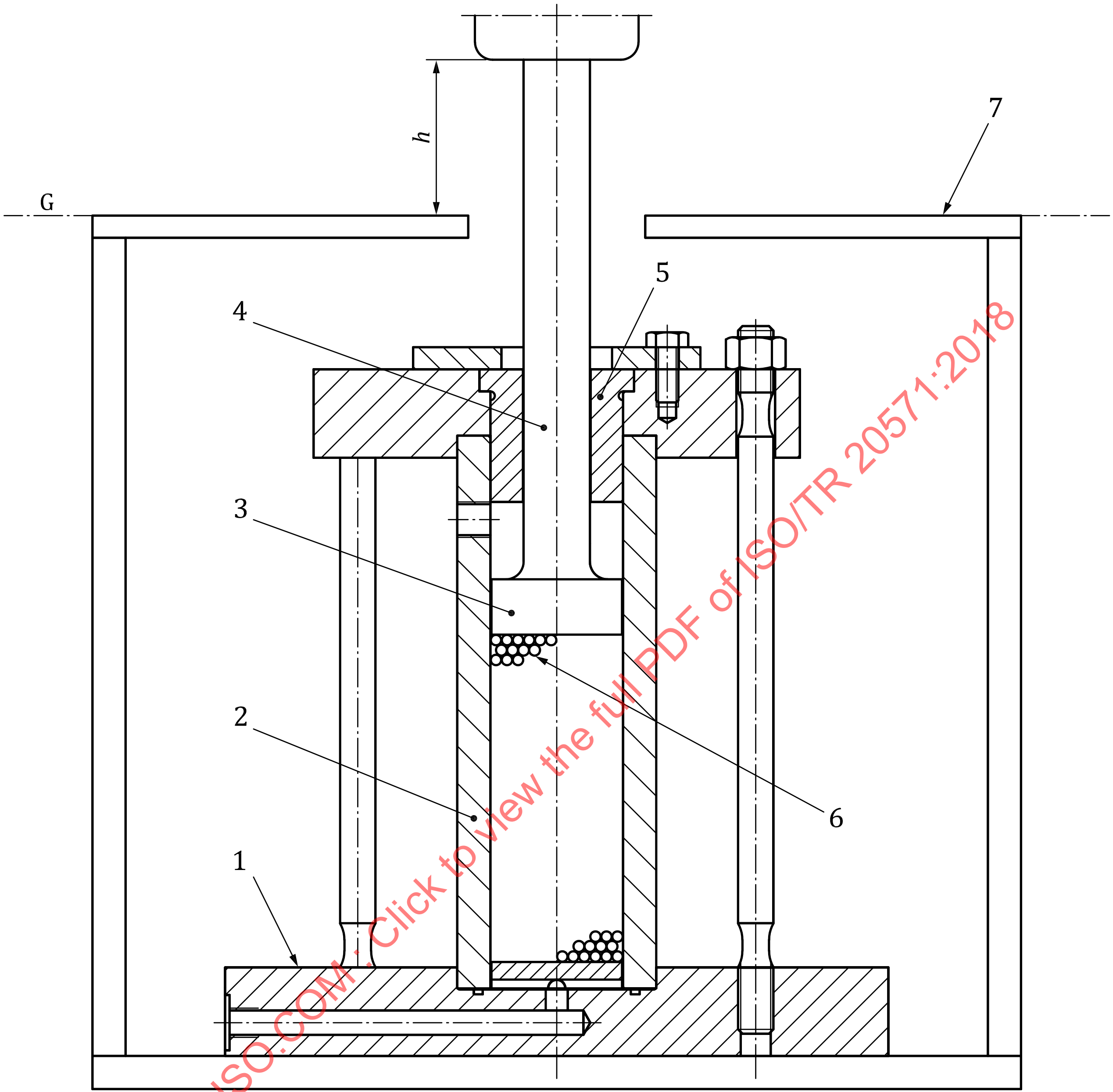


Key

1	steel plate
2	cylinder
3	tool foot
4	tool piece
5	guide bush
6	steel balls
h	free length

Figure 1 — Basic elements

Figure 2 shows a typical construction of an assembly, which holds a Dynaload below ground. This would be utilised with concrete breakers, as it would afford a convenient location for the operator during testing conditions.



Key

1 steel plate
2 cylinder
3 tool foot
4 tool piece
5 guide bush
6 steel balls
7 screening slab
h free length
G ground level

Figure 2 — Below ground mounting

5 Relationship with standards

This document only specifies the Dynaload device and it is the responsibility of experts on international and other standards committees and users of this specification to:

— select the appropriate size and type of Dynaload test rig for the particular tool being tested, such as noise, vibration or performance testing;

— specify any additional requirements needed for the purpose of the test, such as mounting blocks, screening slabs, etc.;

— specify the loading and operating conditions for the tool under test.

When selecting or referring to a particular type of Dynaload test rig, the following format should be used:

Size/Type, e.g. "60 mm/Type 1 Dynaload"

where "Size" refers to the internal diameter of the cylinder (see 6.1) and "Type" refers to the design of test tool (see 6.2).

6 Design

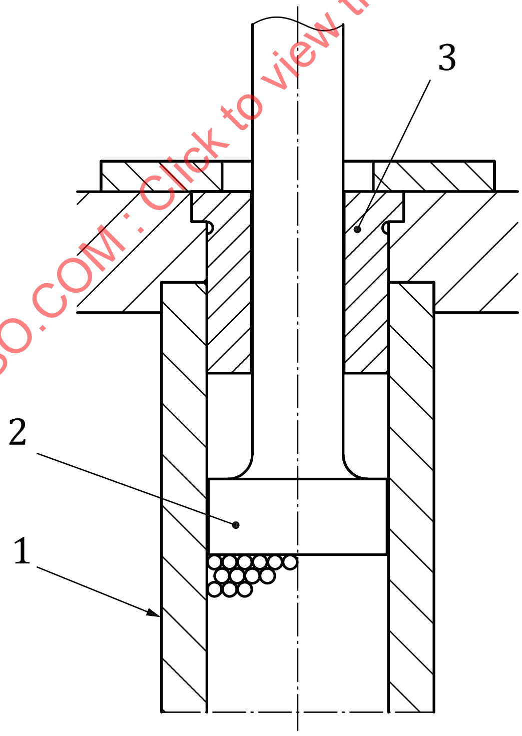
6.1 Preferred sizes

The Dynaload should be constructed to be of an appropriate size depending on the hand-held power tools to be tested. Two preferred sizes are in use, i.e. cylinder diameters of 40 mm and 60 mm, these sizes relate to the requirement for absorbed power capabilities.

6.2 Test tool

6.2.1 Type 1: 1 piece — Solid formed tool piece and tool foot

Figure 3 identifies the form of a one-part tool. A unitary construction reduces the possible sources of unwanted noise and non-smooth operation. See Annex A for a solid formed tool piece and tool foot.



Key

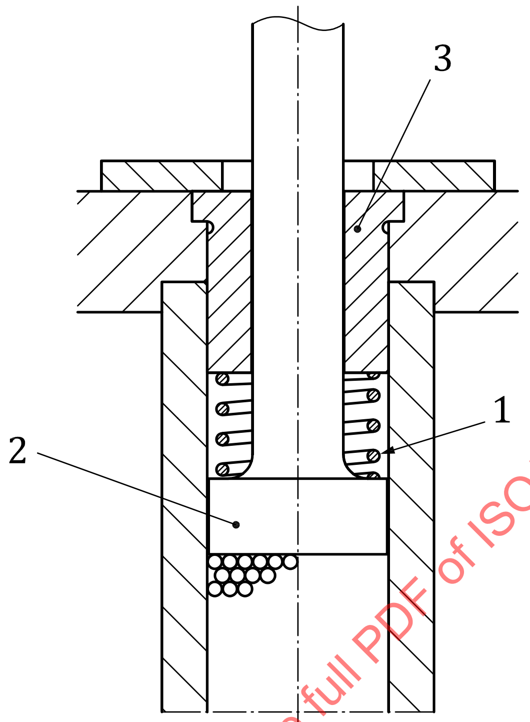
1 cylinder

2 tool and tool foot as unitary assembly

3 split guide bush

Figure 3 — One-part tool (without spring)

Figure 4 shows a spring, which is utilised when the effects of recoil from certain types of percussive power tool being tested may have an adverse effect on the Dynaload assembly and consequently any readings being taken. Without spring is an option, see Annex D.



Key

1 recoil spring

2 tool and tool foot as unitary assembly

3 split guide bush

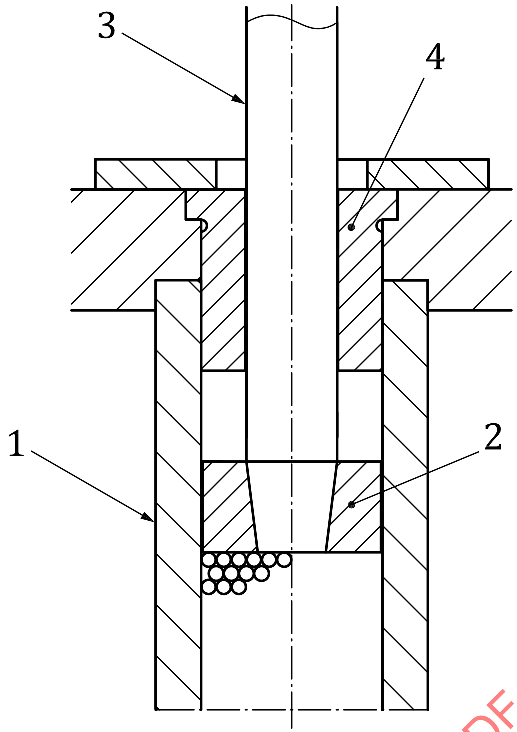
Figure 4 — One part tool (with recoil spring)

6.2.2 Type 2: Two pieces — Tapered end tool piece with a mating tool foot

The diagram in Figure 5 identifies an alternative approach to the construction of the tool piece and the tool foot. Although in separate parts in-use they act as a one-part tool.

This construction allows for a simple design for the guide bush as a one-part construction rather than that identified in Figures 3 and 4.

Standard tool steel can be modified to provide the necessary taper fit. Where the tool steel is used it should be of circular cross section and dimensioned to pass through the bush. See Annex B for tapered end tool piece with a mating tool foot.



Key

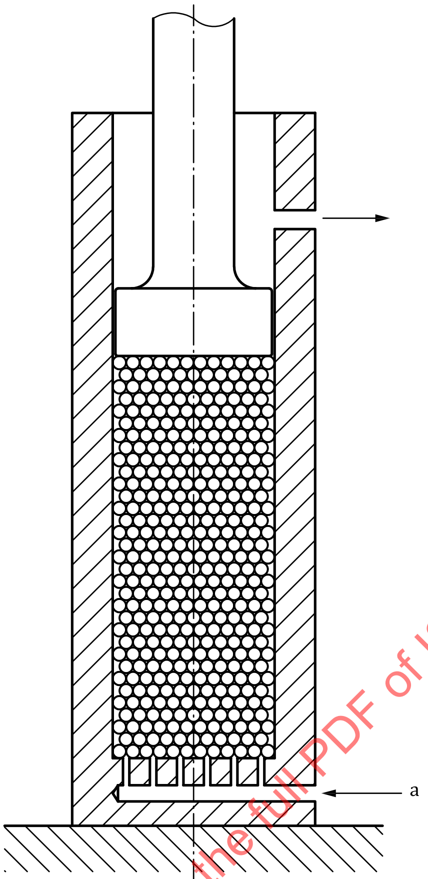
1 cylinder
2 tool foot with taper fit hole
3 tool piece with taper fit end
4 guide bush

Figure 5 — Taper fit tool piece

7 Cooling

7.1 Low pressure air cooling

Where the Dynaload is to be used for extended periods of time or repeated measurements then cooling is required, see Figure 6. This may be low pressure air blowing through the steel balls.



a Coolant inlet or outlet.

Figure 6 — Air cooling principle

7.2 Alternative cooling

It is also possible to arrange the cooling by sucking air downwardly.

NOTE If a powerful suction system is used, it can be possible to remove the spring and maybe also the bushing.

If there is a bigger play between the tool shaft and the bushing (>5 mm) or if the bushing is removed, the tool foot needs to be crowned towards the cylinder wall (R200).

Grease or oil is not allowed as coolant.

8 Operational features

Before operating the Dynaload device the Dynaload should be checked that all parts are within the dimensional specifications set out in this document.

If the condition of the steel balls has deteriorated then the entire charge should be replaced. The steel balls will during use be compressed and become fragmented, therefore the decision to replace the charge of steel balls will depend very much on experience. As a guide to the decision-making process when the surface layers have become fragmented then this can be taken as the time for the change. It is false economy to salvage balls from an exhausted batch since they are an unknown quantity and may lead to premature deterioration of steels balls in a new batch.

The Dynaload is specified in two sizes according to the power and size of the hand tool. The specified lengths of the tool piece should not be exceeded since this will lead to undue flexing of the tool piece and breakage, and may affect the noise and vibration readings.

Before any measurements are undertaken when a new charge of steel balls is introduced the equipment should be run for a period of 15 min to allow the column of steel balls to settle. In the new condition the point contact on each surface leads to a rapid deterioration of the surface of the balls that is quickly nullified by the running in procedure.

9 Maintenance

The Dynaload being of simple construction requires little maintenance. Since the device is constructed from steel the main problem will be rusting, especially where it is used with water as a coolant or air that has not been dried. Also, where the device is used outside and underground regular inspection of the steel balls and the main tube is essential.

When stored for long periods the steel balls should be removed and packed separately. The main construction should be stored in a dry area or be coated with a layer of grease or oil. The internal surface of the Dynaload should be inspected for wear. The Dynaload has been found to have a long service life with little deterioration of the main cylinder. However, it has been found that for approximately 40 mm from the top surface of the steel balls the cylinder wall becomes grooved. This is the area, which absorbs most of the blow energy.

10 Construction

All Dynaload types may have the items identified in Table 1. Their actual construction will depend on the type chosen for a particular application or preference on the part of the user. The construction of the Dynaload does not require any special engineering practices and can be successfully produced by any general engineering facility. See Annex C.

Table 1 — Identity of component parts as shown on diagrams in Annex A and B

See Figure A.1 and B.1 for key items: Ref. number	Quantity	Description	Note
1	1	Bottom plate	
2	1	Cylinder	
3	4	Stud	
4	1	Tool foot (for type 2 tool piece)	Identified in Figure B.1
5	1	Bush Clamp plate for item 7	
6	1	Flange	
7	1	Guide Bush	
8	1	Steel ball reaction plate	
9	1	O-ring	Cylinder seal[a]
10	4	Nut	For item 3 of size M16 to secure item 6
11	4	Screw	M10 bolt to secure item 5
12	As required	Steel balls	⌀4 mm/⌀5 mm
13 Type 1	1	Type 1 tool piece	Identified in Figure A.1
13 Type 2	1	Type 2 tool piece	Identified in Figure B.1

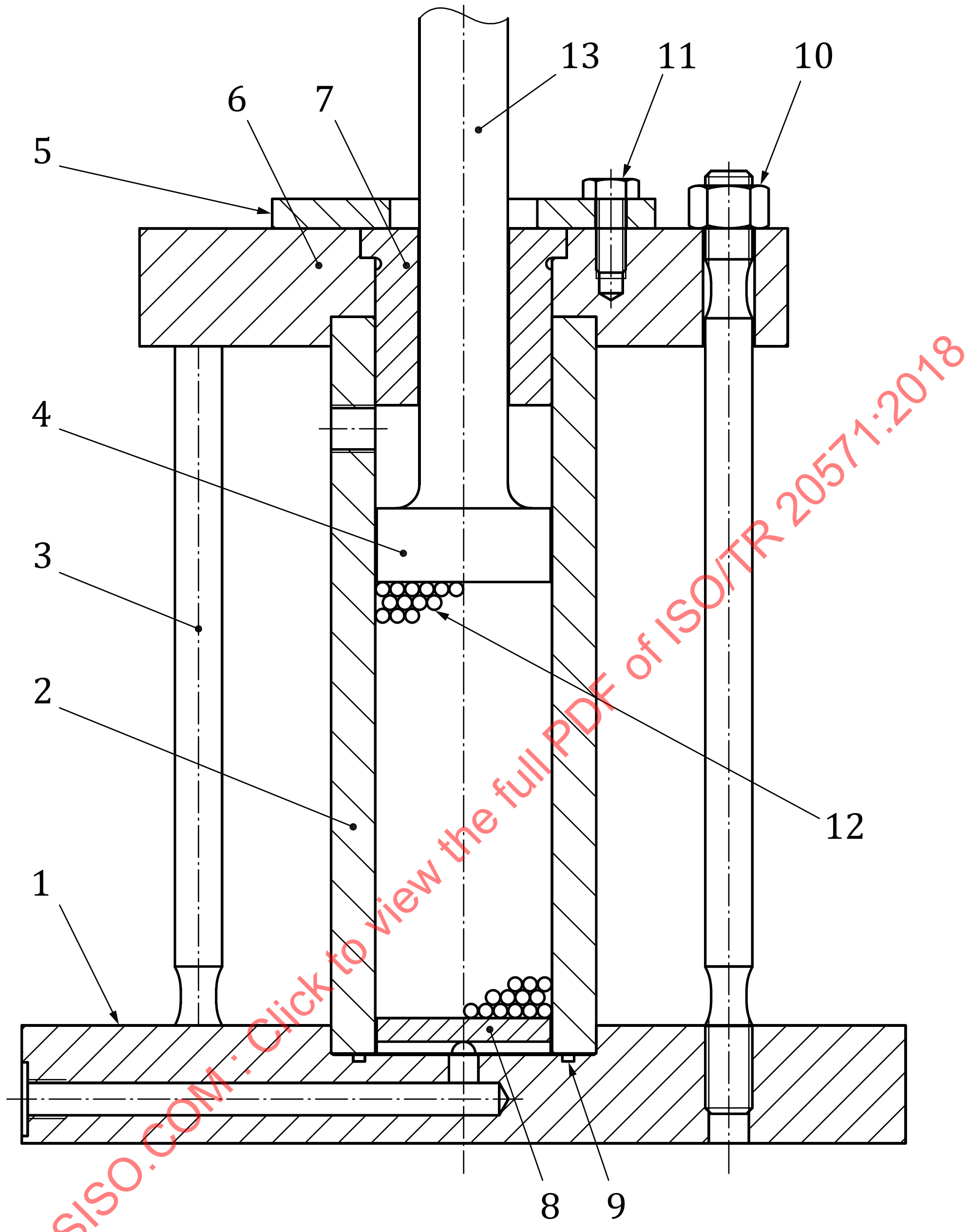
[a] This is optional and only required if a coolant is to be used during testing.

NOTE 1 **Tolerances:** Where no tolerance is shown but would be desirable then the method for allocating such a tolerance are done in accordance with ISO 2768-1.

NOTE 2 **Materials:** Material specifications given in this publication are those which have been successfully used, however they are not exclusive and alternatives can be used provided that the material is able to fulfil the functional requirements.

Annex A
(informative)

Type 1 Single piece square-end Dynaload



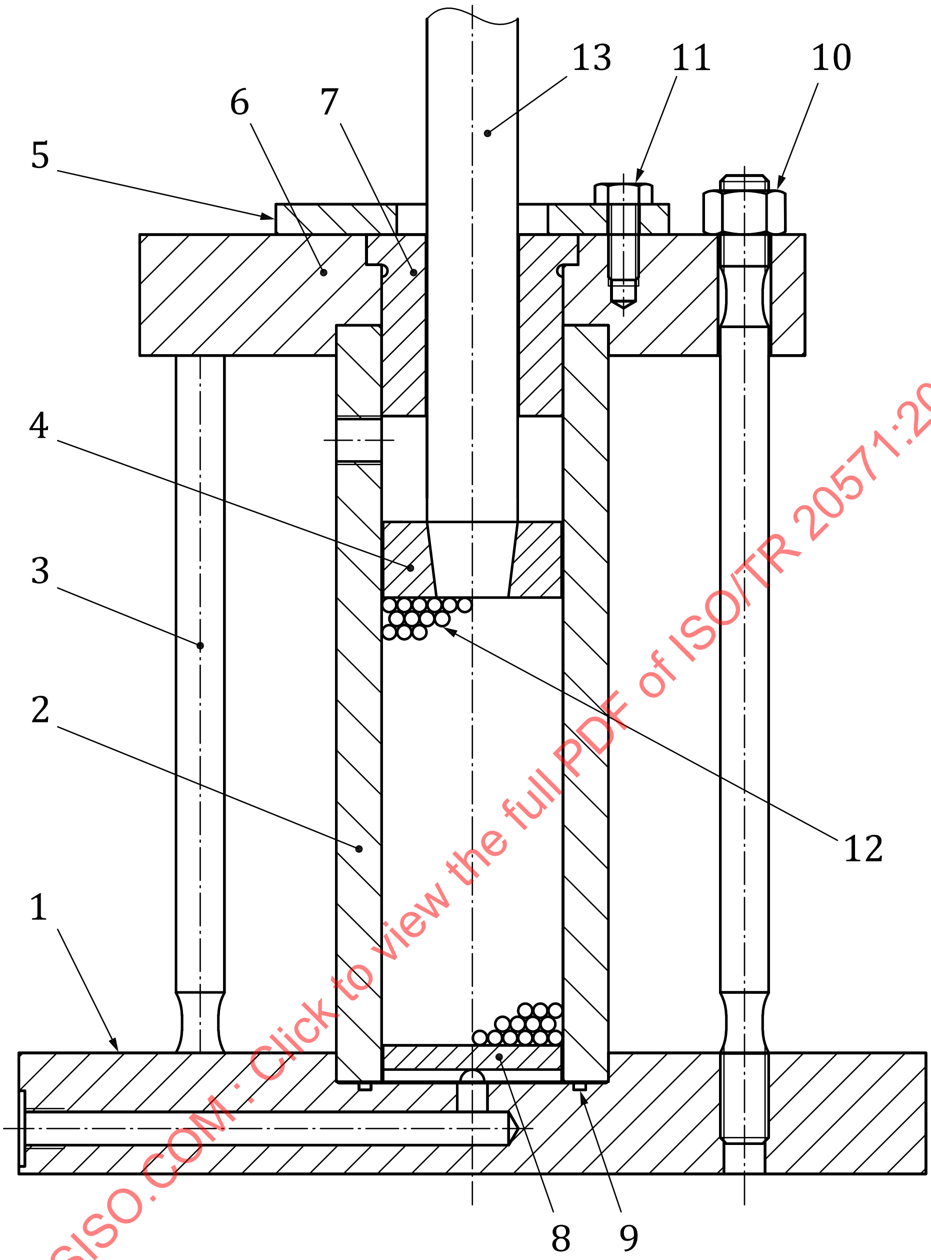
Key

1 bottom plate
2 cylinder
3 stud
4 tool foot
5 bush clamp plate
6 flange
7 guide bush
8 steel ball reaction plate
9 o-ring
10 nut
11 screw
12 steel ball
13 tool piece, type 1

Figure A.1 — One-part tool

Annex B
(informative)

Type 2 Single piece taper-fit Dynaload



Key

1	bottom plate
2	cylinder
3	stud
4	tool foot
5	bush clamp plate
6	flange
7	guide bush
8	steel ball reaction plate
9	o-ring
10	nut
11	screw
12	steel ball
13	tool piece, type 2

Figure B.1 — Taper fit tool piece — Design and Constructional Details

Annex C
(informative)

Design and constructional details

NOTE The item numbers in this annex follow the numbering system in Table 1 and Annexes A and B.

C.1 Bottom plate (1)

Dimensions in millimetres

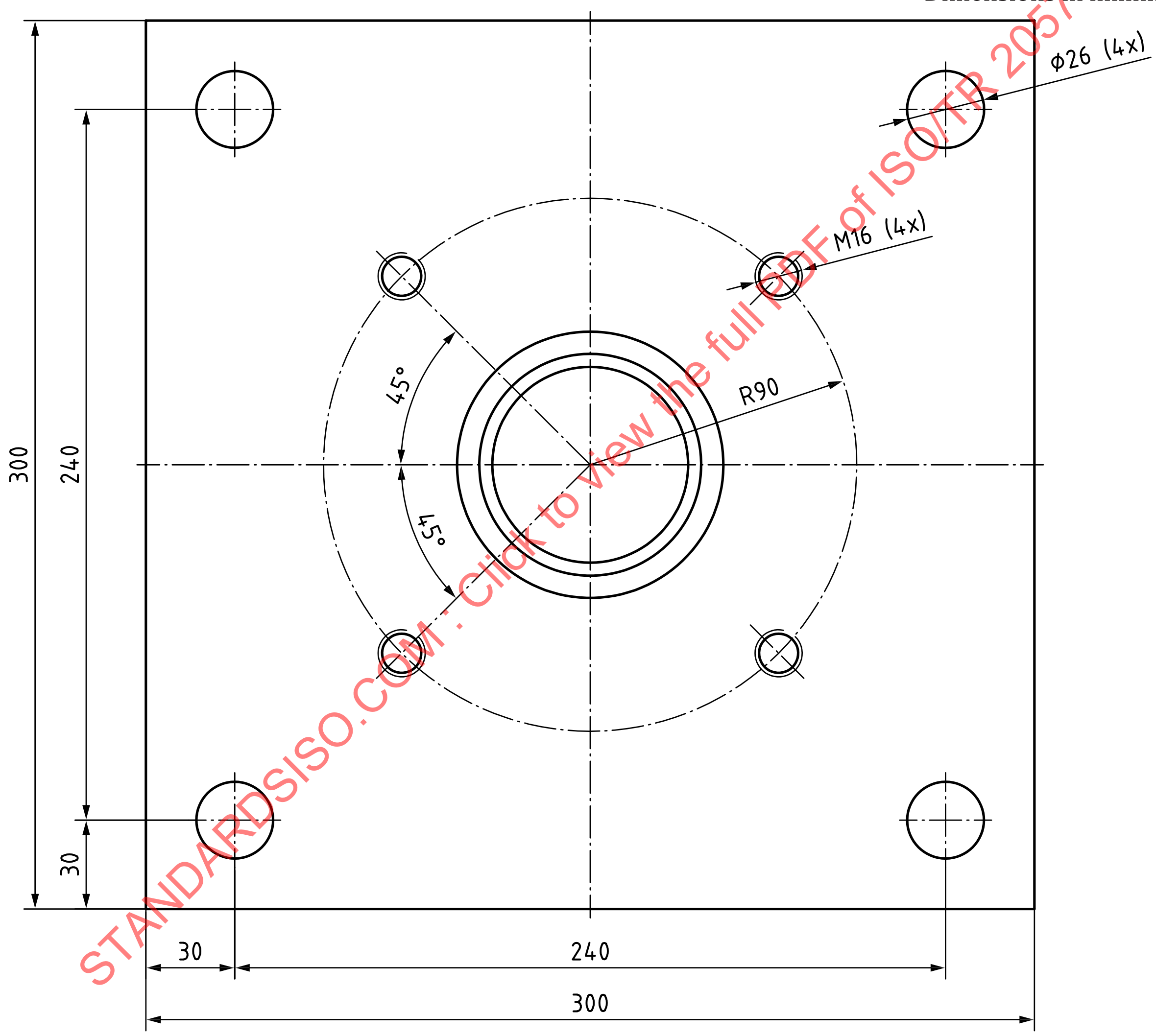


Figure C.1 — Bottom plate

C.2 Bottom plate regulated coolant supply (1)

Where a regulated coolant supply may be required then the following dimensional details are identified as a practical alternative to that shown for a plain connection at the bottom of this page.

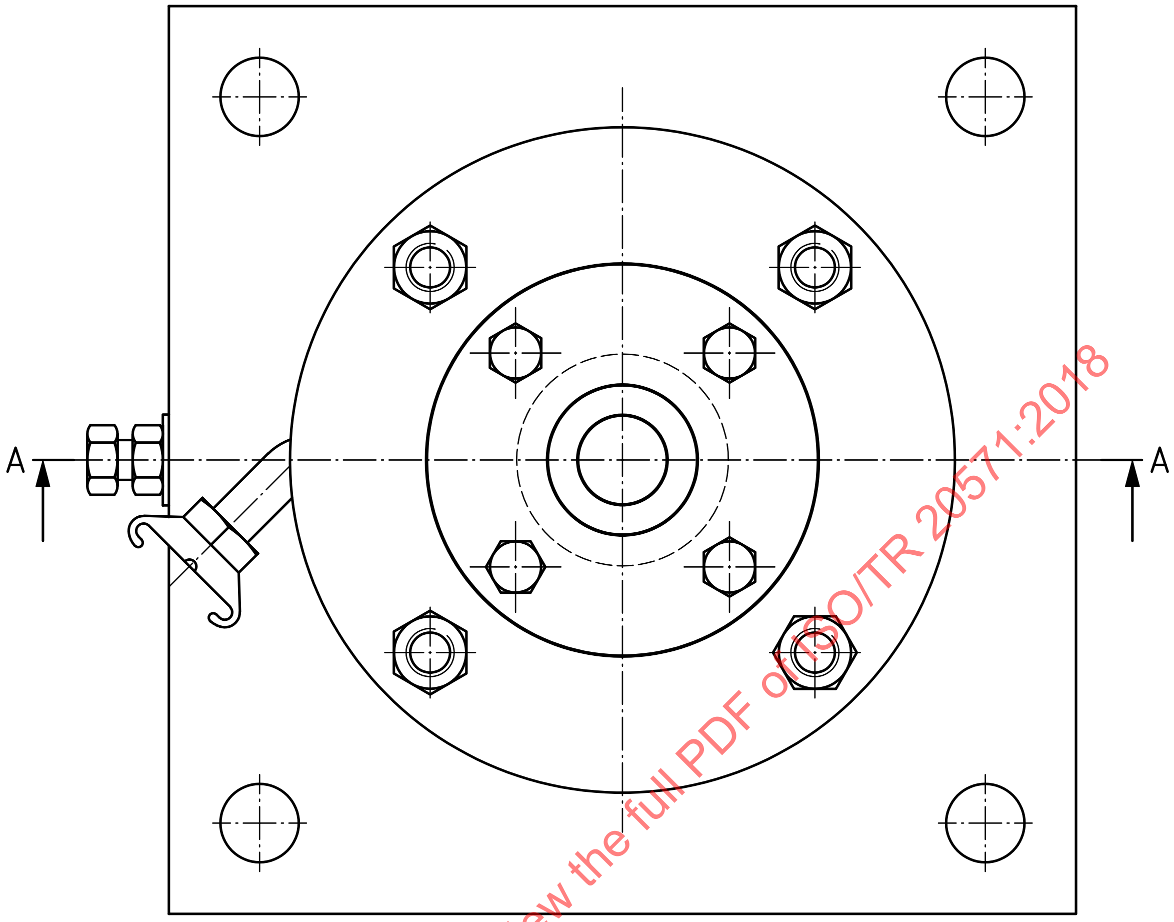
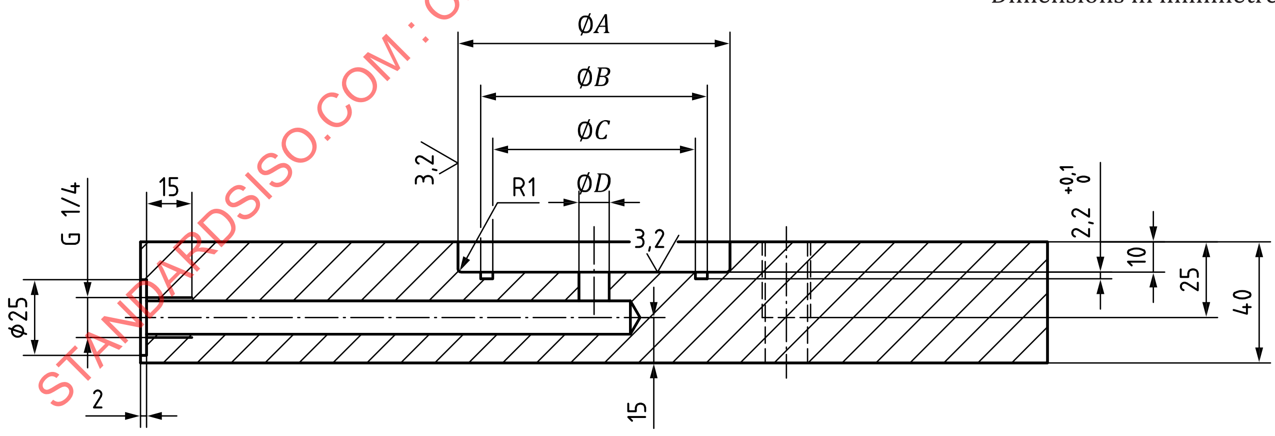


Figure C.2 — Dynaload with cooling connections

Dimensions in millimetres



Key

A cylinder diameter

B groove outer diameter

C groove inner diameter

D hole diameter

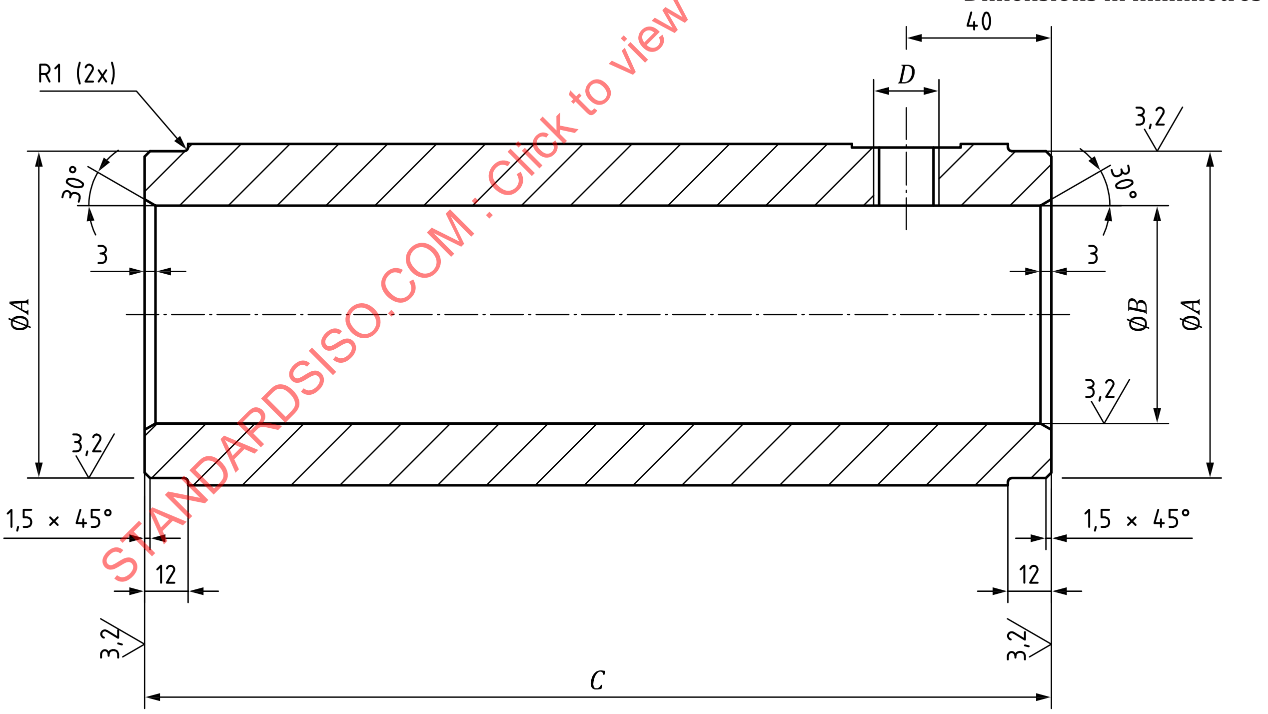
Figure C.3 — Dimension "A-A" — Dimension of cooling channels

Table C.1 — Bottom plate specifications

Dimension	Dynaload size	
	40	60
A	$70^{+0,046}_{\ \ 0}$	$90^{+0,054}_{\ \ 0}$
B	$55^{+0,190}_{\ \ 0}$	$75^{+0,190}_{\ \ 0}$
C	47	67
D	10	10
O-ring	Diagram ref. 9 fits in groove formed by dimensions '*B*' and '*C*'	
Material	Mild steel	
	AISI 1020[a]	
	EN 10025-2 – S235JR	
Hardening	Not required	
a Is one of the very commonly used plain carbon steels. It has a nominal carbon content of (SAE J1397) 0,20 % with approximately 0,50 % manganese. It is a good combination of strength and ductility and may be hardened or carburized. AISI – American Iron and Steel Institute; SAE – Society of Automobile Engineers (US).		

C.3 Cylinder (2)

Dimensions in millimetres



Key

A diameter
B inner diameter
C length
D thread dimension

Figure C.4 — Cylinder

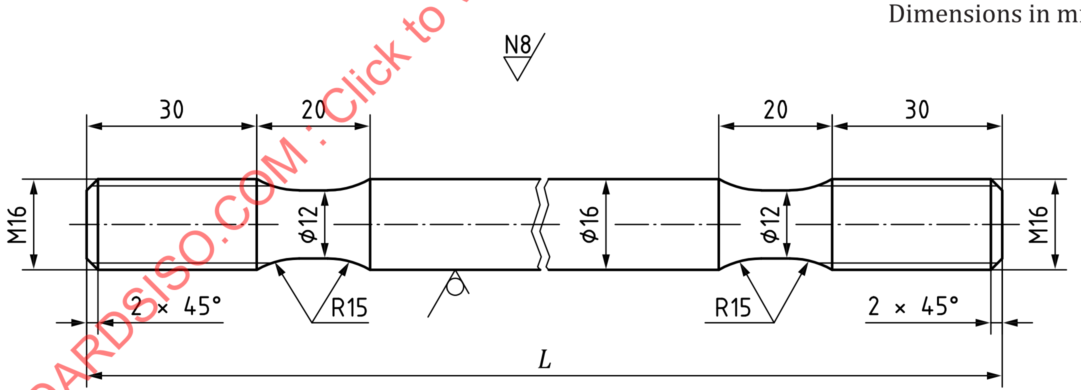
Table C.2 — Cylinder specifications

Dimension	Dynaload size		Notes
	40	60	
A	$70^{-0,060}_{-0,134}$	$90^{-0,060}_{-0,134}$	The dimension may be as shown on the diagram or it may represent the outside dimension of the whole table length. The only provision is that it should fit the allocation in the bottom plate and in the flange.
B	$40^{+0,62}_{0}$	$60^{+0,074}_{0}$	
C	200	250	
D	G½	G½ or G⅜	This dimension is given where a coolant outlet is to be provided. These port sizes are not critical any convenient fitting may be used.
Additional Specifications			
Material	AISI 8620[a] EN 10025-2 – S235JR EN 10277 – 20NiCrMo2-2		
Hardening depth	*DC* 1 ± 0,1		
Surface hardness	R_C 62 ± 2		Hardness relates to the finished part

a Is a hard enable chromium, molybdenum, nickel low alloy steel often used for carburizing to develop a casehardened part. This casehardening will result in good wear characteristics.

C.4 Stud (3)

Dimensions in millimetres



Key

L length

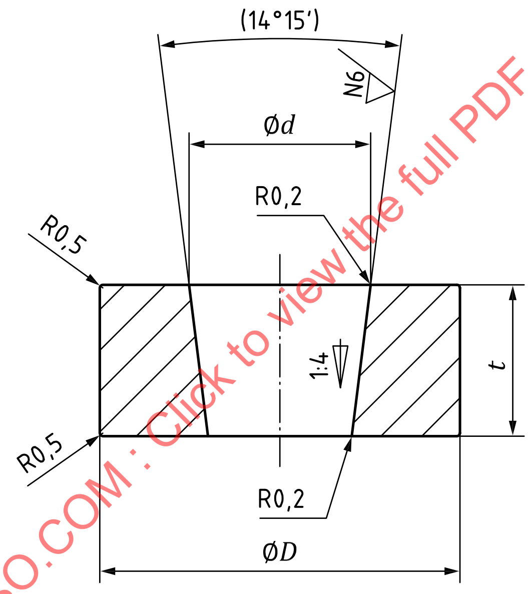
Figure C.5 — Stud

Table C.3 — Stud specifications

Dimension	Dynaload Size	
	40	**60**
L	270	320
Additional specification		
Material	AISI 4340a EN 10277 – 25CrMo4 EN 10277 – 34CrNiMo6	
Nut	Table 1, ref. no. 10	
a Is a heat treatable, low alloy steel containing nickel, chromium and molybdenum. It is known for its toughness and capability of developing high strength in the heat-treated condition while retaining good fatigue strength.		

C.5 Tool foot (4)

Dimensions in millimetres



Key

D diameter

t thickness

d tool diameter

Figure C.6 — Type 2 tool foot

Table C.4 — Tool foot specifications

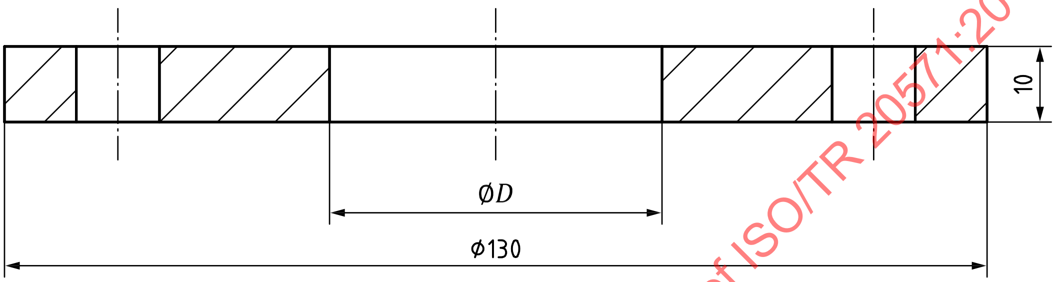
Dimensions	Dynaload Size	
	40	**60**
D	$39{,}5\,^{0}_{-0{,}3}$	$59{,}5\,^{0}_{-0{,}5}$
t	15	25
d	Same as "*d*" on toolpiece	

Table C.4 *(continued)*

Dimensions	Dynaload Size	
	40	**60**
Additional specifications		
Material	EN 10277 – 34CrNiMo6	
Surface hardness R_c	59 ± 1	

C.6 Bush clamp plate (5)

Dimensions in millimetres



Key

D hole diameter

Figure C.7 — Bush clamp plate — Cross section

Dimensions in millimetres

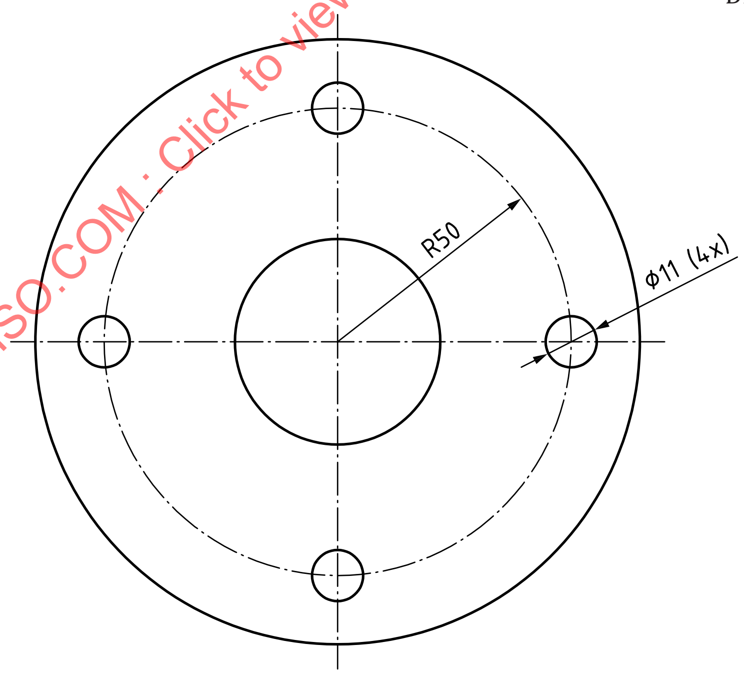


Figure C.8 — Bush clamp plate — Top view

Table C.5 — Bush clamp plate specifications

Dimension	Dynaload Size	
	40	**60**
D	30	50
Additional specifications		
Material	Mild steel AISI 1020 EN 10025-2 – S235JR	

C.7 Flange (6)

Dimensions in millimetres

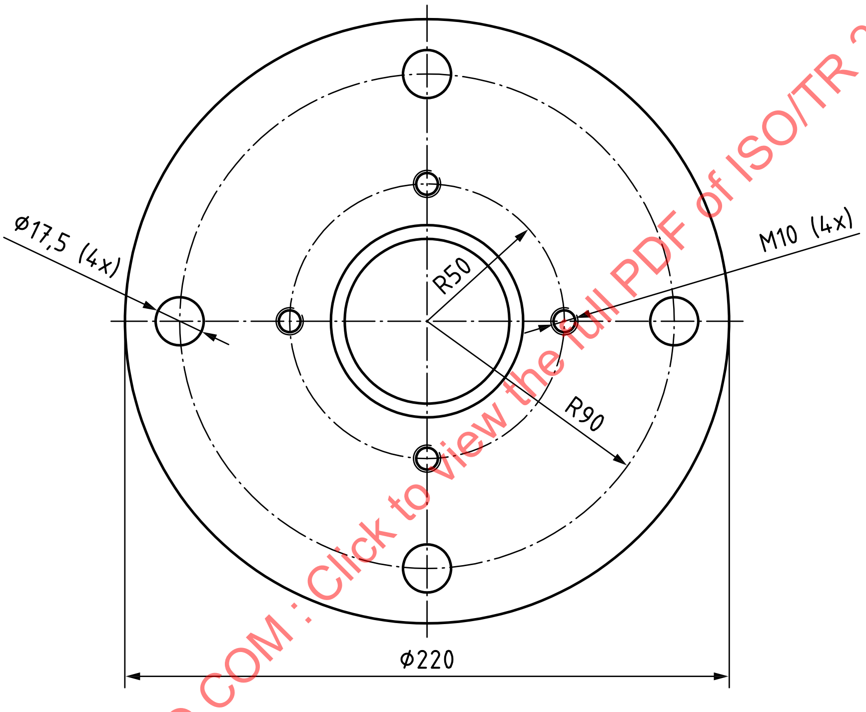
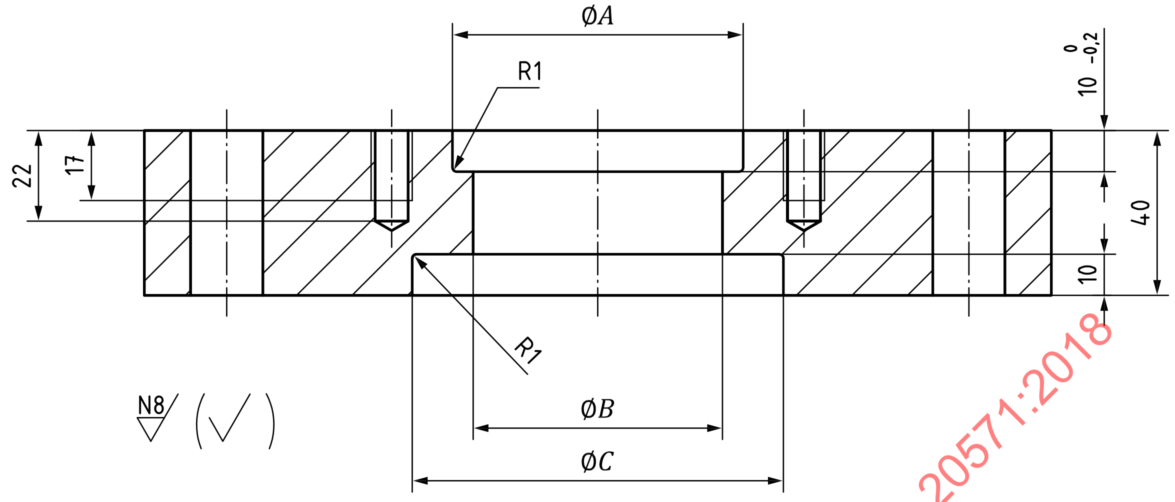


Figure C.9 — Flange — Top view

Dimensions in millimetres



Key

A diameter

B hole diameter

C cylinder diameter

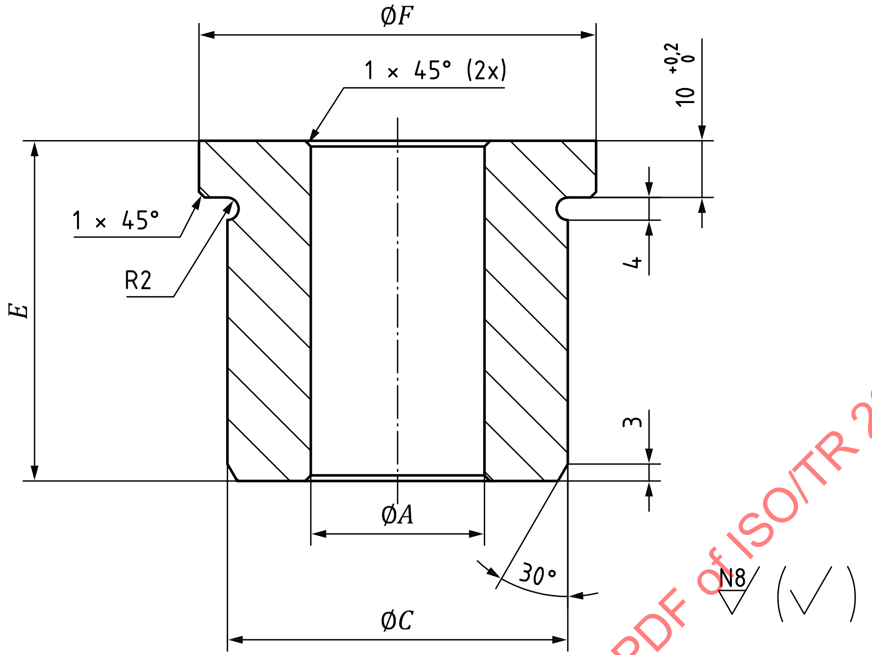
Figure C.10 — Flange — Cross section

Table C.6 — Flange specifications

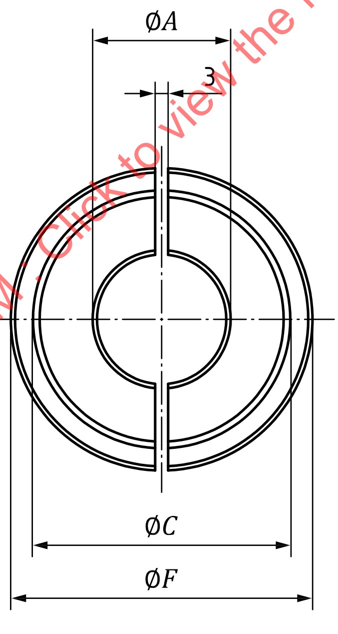
Dimensions	**Dynaload Size**	
	40	60
A	50,5	70,5
B	40,5	60,5
C	$70^{+0,074}_{0}$	$90^{+0,087}_{0}$
Additional Specifications		
Material	Mild steel	
	AISI 1020	

C.8 Guide bush (7)

Dimensions in millimetres



a) Cross section



b) Bottom view

Key

A diameter

C cylinder diameter

E length

F flange diameter

Figure C.11 — Cylinder bush

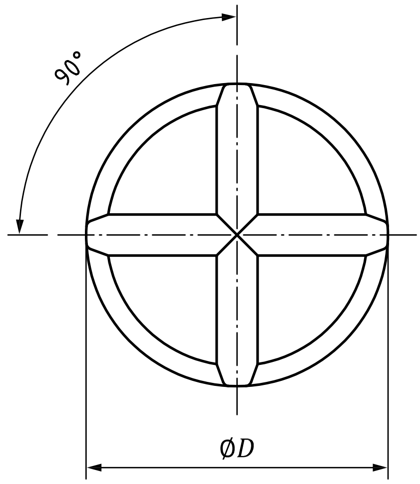
Table C.7 — Guide bush specifications

Dimensions	Dynaload size	
	40	**60**
A	$d^{+0,2}_{+0,1}$	$d^{+0,2}_{+0,1}$
C	$40^{-0,050}_{-0,089}$	$60^{-0,060}_{-0,106}$
E	60	60
F	50	70
Additional specifications		
Material type	Bronze: ASTM B139 Alloy 524000	
Clearance	A bigger clearance between the bush and the inserted tool piece is allowed for vibration measurements.	

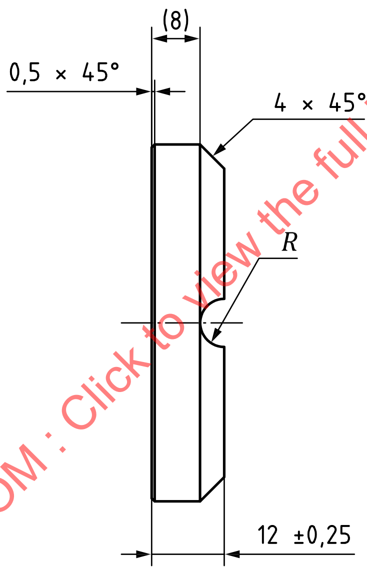
The diagram shows the dimensioning for the application of the bush as either in solid form or as a split bush. The splitting process is achieved by applying a cut of dimension as shown in the diagram on the right. The width of the cut applies to all sizes of dynaload.

C.9 Steel ball reaction plate (8)

Dimensions in millimetres



a) Bottom view



b) Side view

Key

D outer diameter

R groove radius

Figure C.12 — Steel ball reaction plate