TECHNICAL REPORT

ISO/TR 16806

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Pneumatic fluid power — Cylinders — Load capacity of pneumatic slides and their presentation method

Transmissions pneumatiques — Vérins — Capacité de charge des unités de guidage pneumatique et leur méthode de présentation

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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The main task of technical committees is to prepare International Standards. 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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 16806 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 3, *Cylinders*.

Introduction

In pneumatic fluid power systems, power is transmitted and controlled through a gas under pressure within a circuit. A pneumatic slide consists of a mounting surface for attaching a load, which is moved by an air cylinder and guided by stiff shafts to maintain alignment. There are limits to the amount of load that can be attached to a pneumatic slide, and these limits should be described as shown in this Technical Report.

Pneumatic fluid power — Cylinders — Load capacity of pneumatic slides and their presentation method

1 Scope

1.1 This Technical Report describes how to calculate the loading limits for a pneumatic slide based upon:

— external forces applied in the three principle planes of a tool plate, and applied at any point;

— external torque applied in the three principle planes of a tool plate;

— bearing limits determined by the slide manufacturer in conjunction with the bearing supplier.

1.2 This Technical Report also describes how to calculate tool plate deflections due to the loads.

1.3 This Technical Report describes how to present the rating information in technical documentation for application by a user.

1.4 This Technical Report assumes that all of the applied loads and torque will be absorbed by the guide rods and not by the piston rod. Only the axial thrust load (but not the resulting moments) will be absorbed by the piston rod.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5598:1985, *Fluid power systems and components — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

3.1
pneumatic slide
slide
mechanism containing a movable loading plate with guide rods, operated by an air cylinder

3.2
guide rod
shaft, passing through a set of bearings, which controls the deflection and twist of the loading plate

3.3
loading plate
plate onto which is placed a load to be moved

3.4
tool plate
loading plate attached at the end of the piston rod and guide rods

3.5
carriage plate
loading plate attached in the middle of the slide, containing the guide rod bearings

NOTE In this design, mounting plates are attached at both ends of the guide rods for mounting the slide, allowing the carriage to move.

3.6
housing
portion of the slide containing the bearings, when there is no carriage plate, and used for mounting the slide

4 Rating factors

4.1 Pressure containing capability

The manufacturer shall determine the maximum pressure that the pressure containing envelope is capable of sustaining if there is no load attached.

4.2 Maximum axial load

The manufacturer shall determine the maximum load for both push and pull directions, when the load reactions pass through the centre of the piston rod. Describe the limitations for any column buckling.

4.3 Maximum combined loading for a tool plate, and its deflections

The manufacturer shall determine the following coefficients:

$$A = 2l_1 / f$$

$$B = 2l_1 / f \, (l_1 + l_2)$$

$$C = l_2 \, (l_1 + l_2) \; / \; (2l_1 + 3l_2)$$

$$D = (3l_2^2 + l_1 l_2 - l_1^2) \, / \, (2l_1 + 3l_2)$$

$$H = 12EI \, / \, l_2 \, (2l_1 + 3l_2)$$

$$W = w \, (l_1 + l_2)$$

where

l_1 is the distance between the two bearing centrelines on one guide rod (this may vary with stroke); if there is only one bearing on a guide rod, then l_1 is the length of the bearing;

l_2 is the distance from the outer edge of the tool plate to the centreline of the closest bearing (this may vary with stroke);

f is the scaling factor chosen by the manufacturer to bring calculated numbers into convenient size for tabulation;

E is the modulus of elasticity for the guide rods;

I is the plane moment of inertia for two guide rods;

$I = \pi\ (d_G^4) / 32$

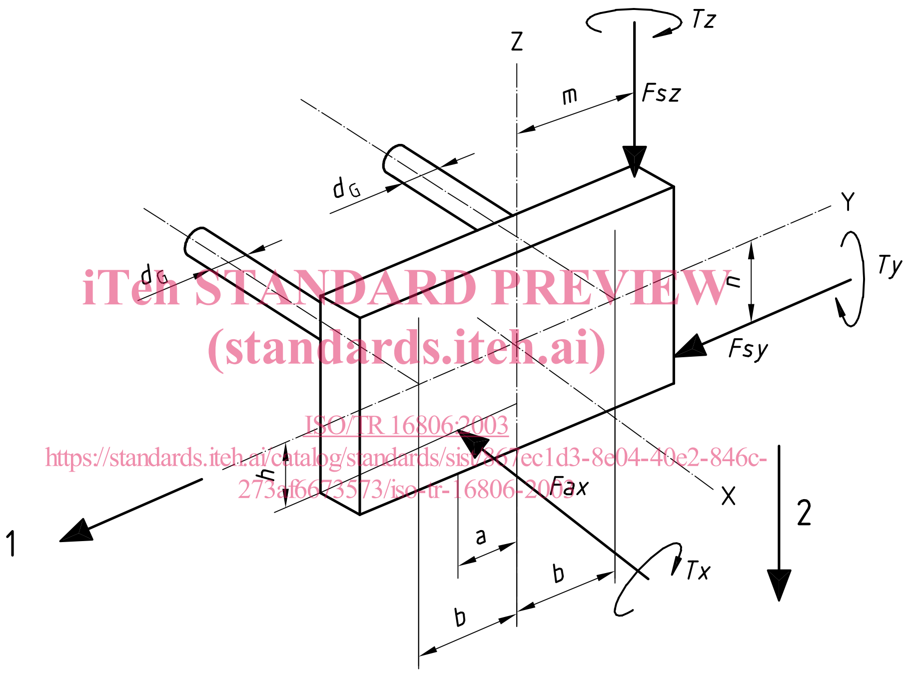
d_G is the diameter of guide rod;

w is the weight of guide rod per unit of length.

5 Presentation of ratings

5.1 Sketch of loading on tool plate

See Figure 1.



Key

1 inline deflections

2 parallel deflections

Figure 1 — Tool plate identifications

5.2 Tabulations

Coefficient *A*

STROKE	BORE SIZE			

Coefficient *B*

STROKE	BORE SIZE			

Coefficient *C*

STROKE	BORE SIZE			

Coefficient *D*

STROKE	BORE SIZE			

Coefficient *W*

STROKE	BORE SIZE		

Coefficient *H*

STROKE	BORE SIZE					

5.3 Graph

See Figure 2.

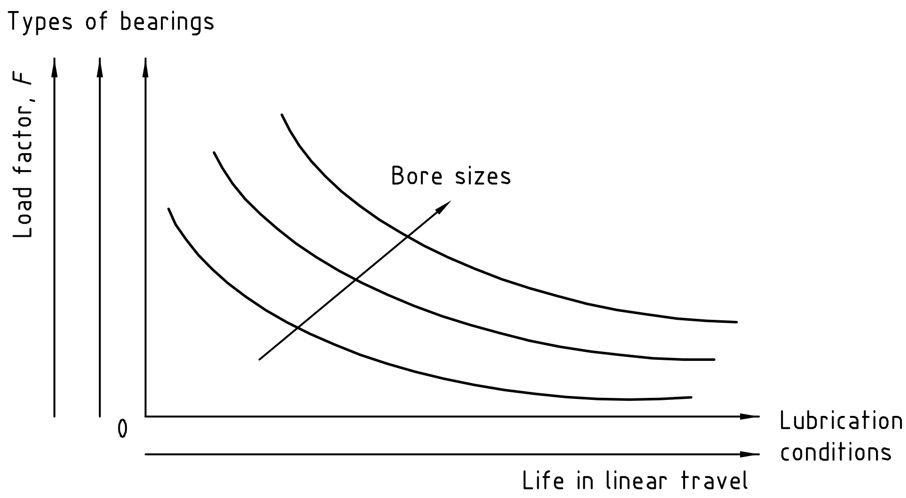


Figure 2 — Graph

5.4 Calculation formulas

5.4.1 Maximum tool plate load capacity

$$F^2 = \{(Fsy + W)/B + [(a)Fax + Tz]/A\}^2 + \{[Fsz\ (1 + m/b) + W]/B + [(h)Fax + Ty]/A + [Tx + (n)Fsy]/bB\}^2$$

where

A, B, W are coefficients determined in 4.3 and tabulated in 5.2;

a, b, h, m, n are dimensions on the tool plate as shown in Figure 1;

Fax, Fsy, Fsz, Tx, Ty, Tz are the applied forces and moments as shown in Figure 1.

The above formula describes the maximum combined loads that can be carried by the tool plate. If some of the loads do not exist in an application then it is possible to increase the other loads.

$F = fR_A$, the load factor presented in Figure 2

where

f is the arbitrary scaling factor described in 4.3;

R_A is the bearing capacity which the slide manufacturer establishes, in conjunction with a bearing supplier, taking into account the bearing design, materials, its life rating, and lubrication conditions. These are then reflected in Figure 2.

5.4.2 Linear deflections of the tool plate

— For inline deflections:

$$\delta = [4(C)Fsy + 2(a)Fax + 2Tz + W(D)]/H$$