

Accuracy of machine tools and methods of test —

Part 37: Specification for plano-milling machines, gantry type

Committees responsible for this British Standard

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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
- Ministry of Defence
- Society of British Aerospace Companies
- Coopted members

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Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
1 Scope and field of application	1
2 References	1
3 Preliminary observations	1
4 Definitions and description	1
5 Nomenclature and designation of axes	3
6 Acceptance conditions and permissible deviations	6
Annex Equivalent terms	31
Figure 1 — Gantry-type plano-milling machine with variable height cross-rail	3
Figure 2 — Type 1: Machine with one milling head on a movable cross-rail	4
Figure 3 — Type 2: Machine with one milling head on a movable cross-rail and an additional milling head swivelling on axes C and A	5
Figure 4 — Type 3: Machine with two milling heads on a movable cross-rail	5
Publications referred to	Inside back cover

National foreword

This Part of BS 4656 has been prepared under the direction of the Machine, Engineers and Hand Tools Standards Policy Committee and implements agreements of the International Organization for Standardization (ISO). It is identical with ISO 8636-2:1988 “*Acceptance conditions for plano-milling machines – Testing of the accuracy — Part 2: Gantry-type machines*”.

Inch dimensions. In accordance with the UK policy of metrication, inch dimensions given in this standard are not valid and are included for information purposes only.

Diagrams. For reasons of simplicity the diagrams in this standard illustrate only one type of machine.

Cross-references

International Standard	Corresponding British Standard
ISO 230-1:1986	BS 3800:1964 <i>Methods for testing the accuracy of machine tools</i> (Technically equivalent)
ISO 7572:1984	BS 4656 <i>Accuracy of machine tools and methods of test</i> Part 33:1985 <i>Specification for floor plates</i> (Identical)
ISO 8636-1:1987	BS 4656 <i>Accuracy of machine tools and methods of test</i> Part 36:1987 <i>Specification for plano-milling machines, portal type</i> (Identical)

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 32, 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 and field of application

This part of ISO 8636 specifies, with reference to ISO 230-1, the preliminary tests, geometrical tests and practical tests for gantry-type plano-milling machines, and the corresponding deviations which apply to general purpose, normal accuracy, machines, excluding machines for machining light alloy panels (for aircraft).

This part of ISO 8636 deals only with the verification of the machine accuracy. It does not apply to the testing of the running of the machine (vibration, abnormal noise, stick-slip motion of components, etc.) nor to the checking of machine characteristics (speeds, feeds, etc.) which should generally be checked before the accuracy is tested.

This part of ISO 8636 gives the nomenclature used for the principal parts of the machine and the designation of the axes.

NOTE In addition to terms used in the three official ISO languages (English, French and Russian), this part of ISO 8636 gives the equivalent terms in the German and Italian languages in an annex; these have been included at the request of Technical Committee ISO/TC 39 and are published under the responsibility of the member bodies for Germany, F.R. (DIN) and Italy (UNI). However, only terms given in the official languages can be considered as ISO terms.

2 References

ISO 230-1, *Acceptance code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or finishing conditions.*

ISO 7572, *Conditions of acceptance and installation for work-holding fixed tables of machine tools.*

ISO 8636-1, *Acceptance conditions for plano-milling machines — Testing of the accuracy — Part 1: Portal-type machines.*

3 Preliminary observations

3.1 In this part of ISO 8636, all dimensions and deviations are expressed in millimetres and inches.

3.2 To apply this part of ISO 8636, reference should be made to ISO 230-1, especially for the installation of the machine before testing, warming up of the spindle and other moving parts, description of measuring methods and recommended accuracy of test equipment.

3.3 The temperature conditions during the tests shall be specified by agreement between manufacturer and user.

3.4 The sequence in which geometrical tests are given is related to the sub-assemblies of the machine and in no way defines the practical order of testing. In particular, to make instrument mounting or gauging easier, tests may be applied in any order.

3.5 When inspecting a machine, it is not always necessary to carry out all the tests given in this part of ISO 8636. It is up to the user to choose, in agreement with the manufacturer, those tests relating to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.

3.6 Practical tests shall be carried out with finishing cuts and not with roughing cuts which are liable to generate appreciable cutting forces.

3.7 When establishing the tolerance for a measuring range different from that given in this part of ISO 8636 (see subclause **2.311** of ISO 230-1), it should be borne in mind that the minimum tolerance value is 0,005 mm (0.000 2 in).

3.8 For reasons of simplicity, the diagrams in this part of ISO 8636 are based on one single machine type.

4 Definitions and description

4.1 Definitions of the machining processes that can be carried out

4.1.1

milling operations

these are mainly end milling operations carried out using “face cutters” or “end mills”, and sometimes milling operations on two or three faces using end mills or side and face cutters. The tools are mounted either on the spindle taper or on the spindle front face

4.1.2

boring operations

boring consists of machining the diameters of cylindrical, conical, blind or through holes, to the required size

4.1.3

drilling and tapping operations

these operations consist of drilling and/or tapping blind or through holes

4.2 Definition of gantry-type plano-milling machines and main types

4.2.1 Definition

gantry-type plano-milling machines

machines with one fixed workpiece clamping table and two beds provided with slideways on either side of the table, which are independent or not of the table. The gantry, composed of a left-hand column and a right-hand column supported by respective column slides and made integral with a fixed top bridge, is moved along the bed slideways. The gantry supports a horizontal cross-rail, movable or fixed in the vertical plane, on which one or more milling heads are mounted with vertical or inclinable spindle axes

4.2.2

main types

in general these machines are classified into two types characterized by their particular configuration:

- gantry-type plano-milling machines with fixed cross-rail;
- gantry-type plano-milling machines with movable cross-rail.

4.3 Description

See the nomenclature given in 5.1 for an explanation of the numerals.

4.3.1

table and beds

the table (1) is a rigid fixed part placed between the beds (3) and (4). The beds are rigid parts, made integral with the table if required, which comprise horizontal slideways on which the movable gantry slides

NOTE The table may possibly be replaced by a floorplate.

4.3.2

columns, top bridge and cross-rail

the columns (9) and (10) are rigid parts with vertical greater axes and which either slide on the beds or are fixed rigidly to column slides (7) and (8) which slide horizontally on the beds

the top bridge (11) is a fixed part connecting the two columns near their upmost end

the cross-rail (14) is a part whose greater axis is parallel to the plane of the table. In the case of machines with fixed cross-rails, the cross-rail is made integral with the columns and may be used as a top bridge; in the case of machines with movable cross-rails, the cross-rail slides vertically on the slideways of the columns (12) and (13)

the cross-rail is provided with horizontal slideways on which one or more milling heads with vertical or inclinable spindle axes are mounted

4.3.3

milling heads

milling heads (16) are parts which move on the cross-rail slideways

the portion in direct contact with the cross-rail slideways is called the bottom slide (15). The milling head may be mounted so that it slides on the bottom slide in the direction of the spindle axis; it is then called a ram. The spindle may be mounted in a quill sliding in the milling head in the direction of the spindle axis. Some parts of the head may be inclinable

4.3.4 Cutting and feed movements

4.3.4.1

cutting motions

cutting movements are generated by the spindle motors and kinematic chain of the milling heads driving the milling spindles

4.3.4.2

feed motions

the following feed movements with continuous or discontinuous speed variation may exist on certain machines:

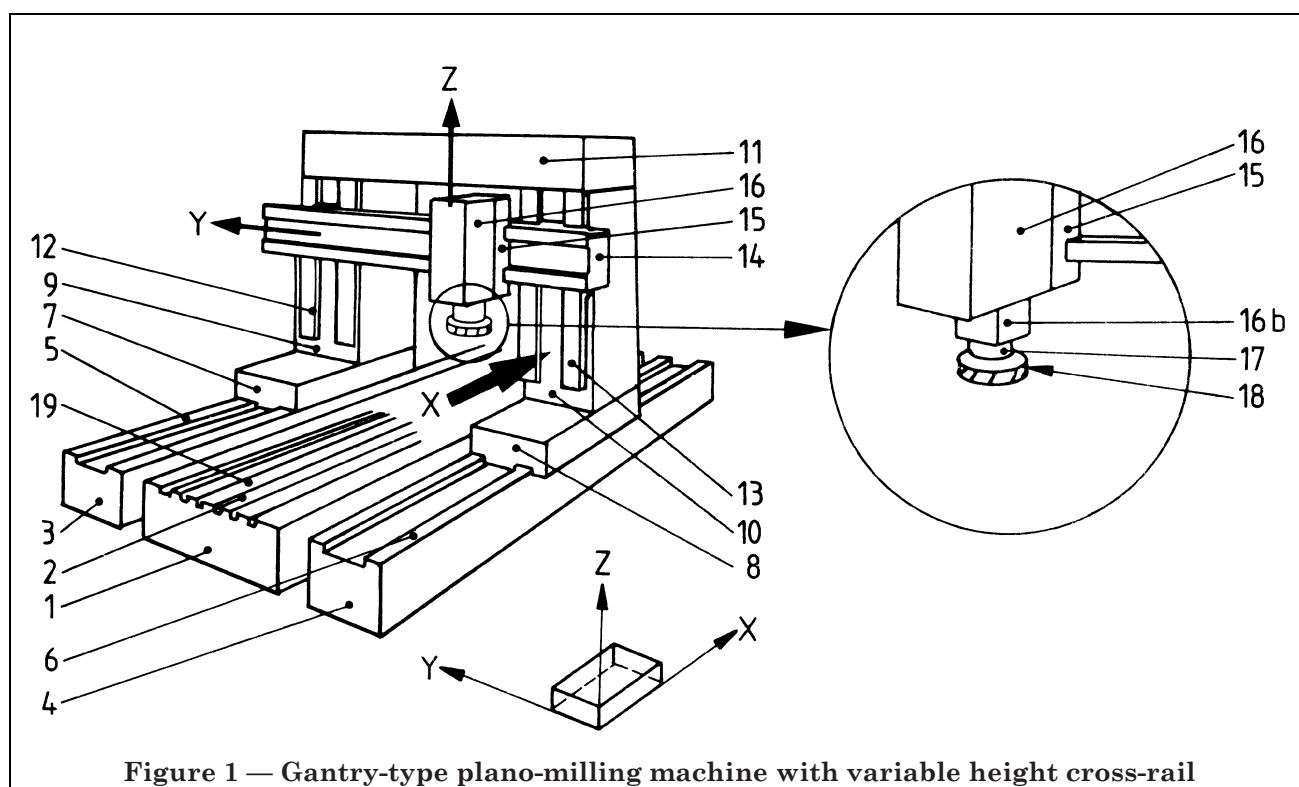
- horizontal movement of the movable gantry;
- vertical movement of the movable cross-rail;
- horizontal movements of the milling heads;
- vertical movements of rams, if any;
- vertical movements of quills, if any;
- rotational movements (tilt movements of milling heads), if any.

NOTE 1 In general rapid traverse is available in addition to feed movement of the driven parts.

NOTE 2 The vertical movement of the movable cross-rail may be either a feed movement (in which case the cross-rail is said to be movable when working) or a movement of displacement between two fixed working positions (the cross-rail is then said to be movable when being positioned).

5 Nomenclature and designation of axes

5.1 Nomenclature



Reference	Designation		
	English	French	Russian
1	Table (or floorplate)	Table (ou taque)	Стол (или плита основания)
2	Clamping surface	Surface de bridage	Рабочая поверхность
3	Left-hand bed	Banc gauche	Левая станина
4	Right-hand bed	Banc droit	Правая станина
5	Left-hand bed slideways	Glissières du banc gauche	Направляющие левой станины
6	Right-hand bed slideways	Glissières du banc droit	Направляющие правой станины
7	Left-hand column slide	Chariot porte-montant gauche	Каретка левой стойки
8	Right-hand column slide	Chariot porte-montant droit	Каретка правой стойки
9	Left-hand column	Montant gauche	Левая стойка
10	Right-hand column	Montant droit	Правая стойка
11	Top bridge	Entretoise	Поперечная балка
12	Left-hand slideways column	Glissières du montant gauche	Направляющие левой стойки
13	Right-hand slideways column	Glissières du montant droit	Направляющие правой стойки
14	Cross-rail (movable, fixed)	Traverse (mobile, fixe)	Траверса (подвижная, неподвижная)
15	Bottom slide	Cuirasse	Каретка суппорта
16	Vertical milling head	Tête de fraisage verticale	Головка вертикально- фрезерная
16b	Ram (quill)	Coulant (fourreau)	Ползун (втулка)
17	Milling spindle	Broche porte-fraise	Шпиндель фрезы
18	Tool (milling cutter)	Outil (fraise)	Инструмент (фреза)
19	Reference T-slot	Rainure de référence	Базовый паз

5.2 Designation of axes

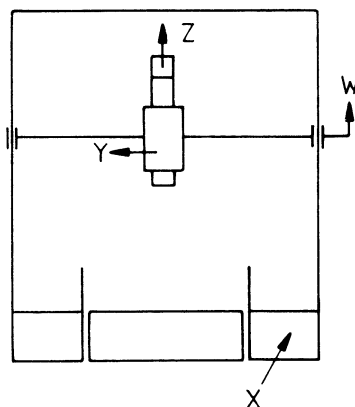


Figure 2 — Type 1: Machine with one milling head on a movable cross-rail

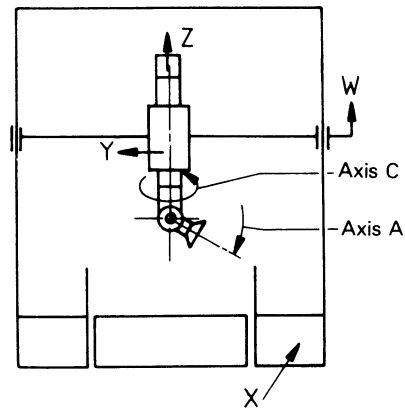


Figure 3 — Type 2: Machine with one milling head on a movable cross-rail and an additional milling head swivelling on axes C and A

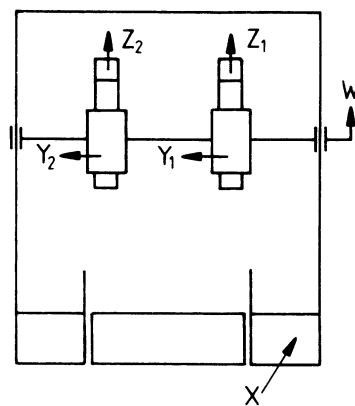
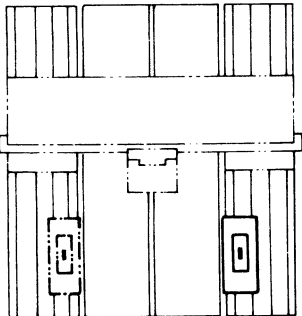
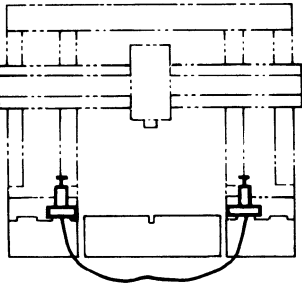
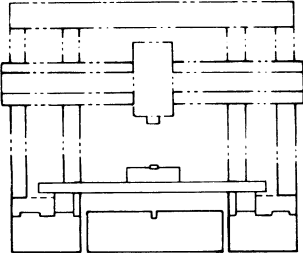


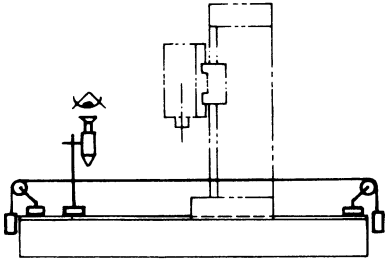
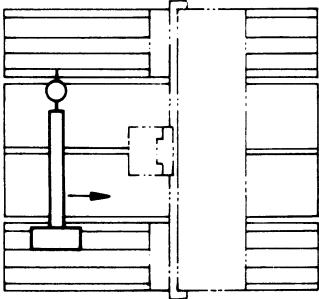
Figure 4 — Type 3: Machine with two milling heads on a movable cross-rail

6 Acceptance conditions and permissible deviations

6.1 Geometrical tests

No.	Diagram	Object
G01	a) 	A — Bed Checking of levelling of bed slideways^a: a) checking of slideway straightness in the vertical plane;
	b) 	b) checking of slideway parallelism in the vertical plane.
	Alternative 	

Permissible deviation		Measuring instruments	Observations and references to the ISO 230-1 acceptance code
mm	in		
a)		Precision level, straightedge or optical measurement instruments and water level micrometer	Gantry not in place. Subclauses 3.1 and 3.2 Place level in longitudinal direction on the slideways at various points equally spaced over the whole length. Subclause 5.412.7 Such checks are to be carried out when mounting the machine.
0,05 for $L^b \leq 15\,000$	0.002 for $L^b \leq 590$		
0,06 for $15\,000 < L \leq 25\,000$	0.002 4 for $590 < L \leq 984$		
0,08 for $25\,000 < L \leq 35\,000$	0.003 1 for $984 < L \leq 1\,378$		
0,1 for $L > 35\,000$	0.003 9 for $L > 1\,378$		
Local tolerance:			
0,02 over any measured length of 1 000	0.000 8 40		
b)			
0,02 over any measured length of 1 000	0.000 8 40		
Maximum permissible deviation:			
0,08 whatever the distance between slideways	0.003 1		
			^a The shape characteristics of the bed basic plane from which the permissible deviation is measured shall be supplied by the manufacturer as a drawing or a written description. ^b L is the length of the slideways.

No.	Diagram	Object
G02		a) Checking of straightness of reference slideway in the horizontal plane.
		b) Checking of parallelism of reference slideways in the horizontal plane (for machines having two reference slideways).