BRITISH STANDARD

BS 6808-1: 1987

Coordinate measuring machines —

Part 1: Glossary of terms

Committees responsible for this British Standard

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Contents

Foreword

This Part of BS 6808 has been prepared under the direction of the General Mechanical Engineering Standards Committee at the request of manufacturers and users of coordinate measuring machines (CMMs).

This Part of BS 6808 defines the terms used in Part 2[1)], whilst Part 3[1)] is a code of practice and gives guidance on the implementation of Part 2.

The terms which are defined relate to CMMs themselves, but further terms are to be added which will cover the associated computer software.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, 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)] In preparation.

This Part of BS 6808 defines terms relating to coordinate measuring machines.

NOTE The titles of the publications referred to in this Part of BS 6808 are listed on the inside back cover.

1 General

No.	Term	Definition
101	**coordinate measuring machine (CMM)**	A machine having a series of movable members, a sensing probe and a workpiece support member, which can be operated in such a way that the probe can be brought into a fixed and known relationship with points on the workpiece surface, and the coordinates of these points can be displayed or otherwise determined with respect to the origin of the coordinate system. NOTE In most cases the coordinate system is a rectangular or Cartesian one, but a polar or cylindrical system may be used.
102	**computer controlled coordinate measuring machine**	A *coordinate measuring machine* that has the capability of performing a pre-programmed measurement sequence automatically under the control of a computer.
103	**manually operated coordinate measuring machine**	A *coordinate measuring machine* where the measurement procedures are under direct human control and where operations are performed by hand.

2 Types of coordinate measuring machine

NOTE There are a very large number of possible machine configurations and those types listed in 2.01 to 2.08 are by no means exhaustive. However, the configurations described are a sample of those in common usage.

No.	Term	Definition
201	**cantilever coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on, and moves vertically relative to, the second; the combined assembly of the first and second components moves horizontally relative to the third; the third component is supported at one end only, cantilever fashion, and moves horizontally relative to the machine base, and the workpiece is supported on the base. NOTE See Figure 1.

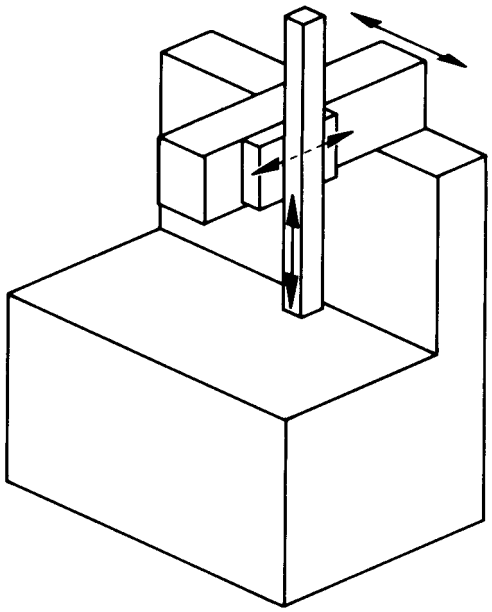

Figure 1 — Cantilever coordinate measuring machine

No.	Term	Definition
202	**column coordinate measuring machine**	A *coordinate measuring machine* employing two movable components in which the probe is attached to the first component which moves vertically relative to the machine base; the second component is mounted on, and moves in a horizontal plane relative to, the machine base, and the workpiece is mounted on the second component. NOTE See Figure 2.

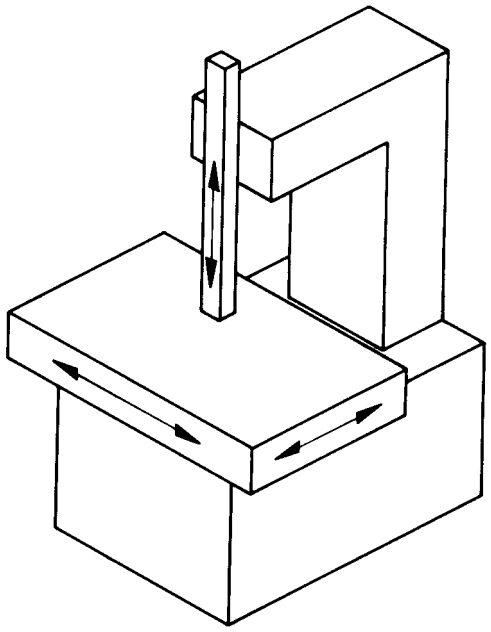

Figure 2 — Column coordinate measuring machine

No.	Term	Definition
203	**moving horizontal arm coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on, and moves horizontally relative to, the second component; the combined assembly of the first and second components moves vertically relative to the third component; the third component moves horizontally relative to the machine base, and the workpiece is mounted on the machine base. NOTE See Figure 3.

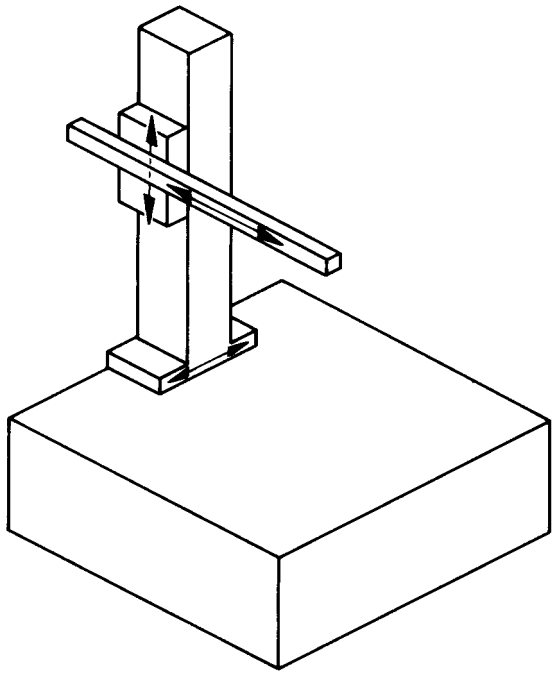

Figure 3 — Moving horizontal arm coordinate measuring machine

No.	Term	Definition
204	**fixed horizontal arm coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is supported horizontally at one end only, cantilever fashion, and is carried on, and moves vertically relative to, the second; the combined assembly of the first and second components and the third component move horizontally relative to the machine base, and the workpiece is mounted on the third component. NOTE See Figure 4.

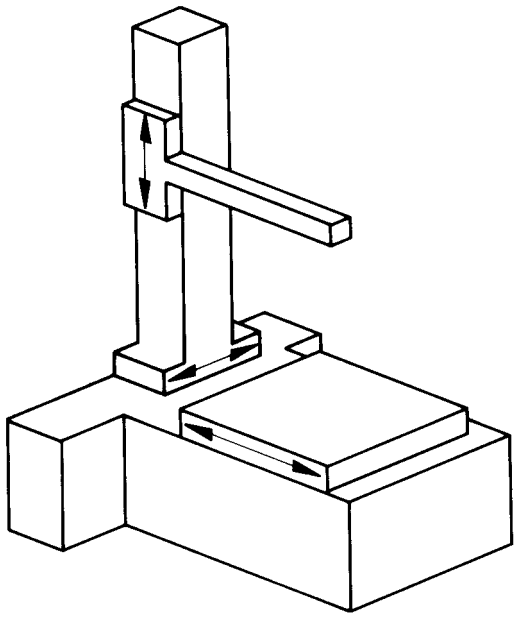

Figure 4 — Fixed horizontal arm coordinate measuring machine

No.	Term	Definition
205	**gantry coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on, and moves vertically relative to, the second; the combined assembly of the first and second components moves horizontally relative to the third; the third component moves horizontally on two guide rails raised above the machine base on either side and the workpiece is supported on the base. NOTE See Figure 5.

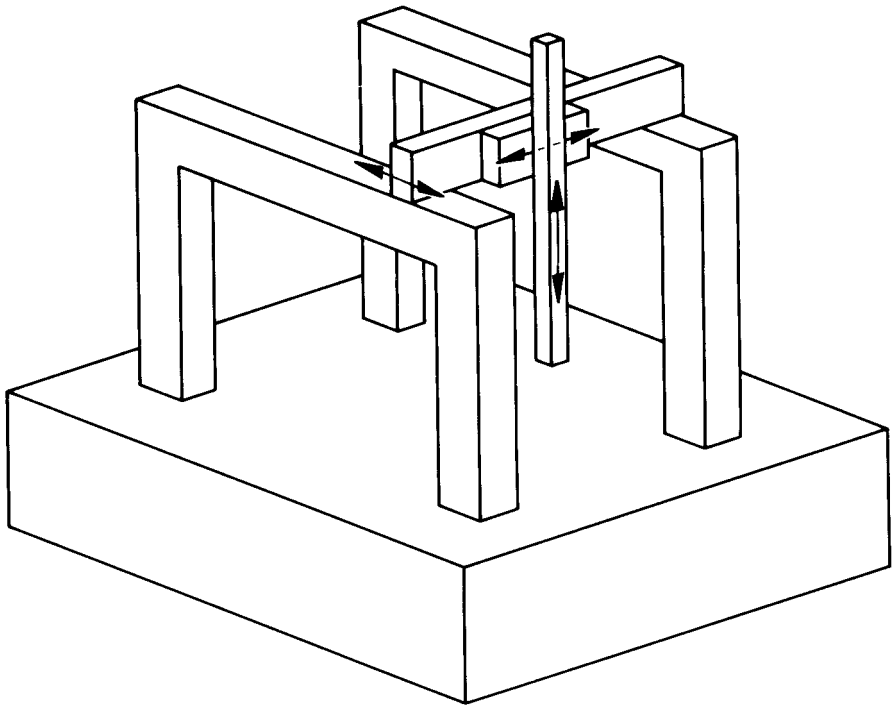

Figure 5 — Gantry coordinate measuring machine

No.	Term	Definition
206	**L-shaped bridge coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on and moves vertically relative to the second; the combined assembly of the first and second components moves horizontally relative to the third; the third component moves horizontally on two guide ways, one at the base level or below, the other raised above the base, and the workpiece is supported on the base. NOTE See Figure 6.

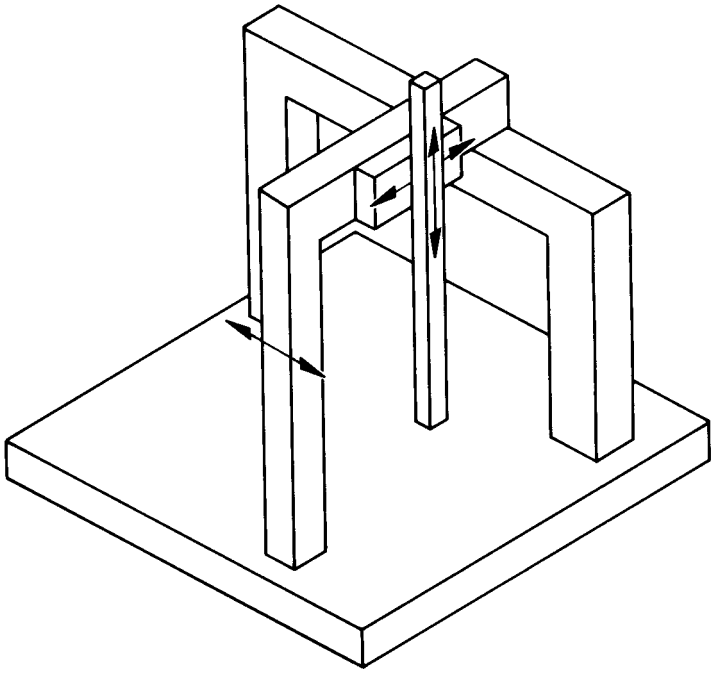

Figure 6 — L-shaped bridge coordinate measuring machine

No.	Term	Definition
207	**fixed bridge coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on, and moves vertically relative to, the second; the combined assembly of the first and second components moves horizontally along a bridge structure above, and rigidly attached at each end to, the machine base, and the workpiece is mounted on the third component. NOTE See Figure 7.

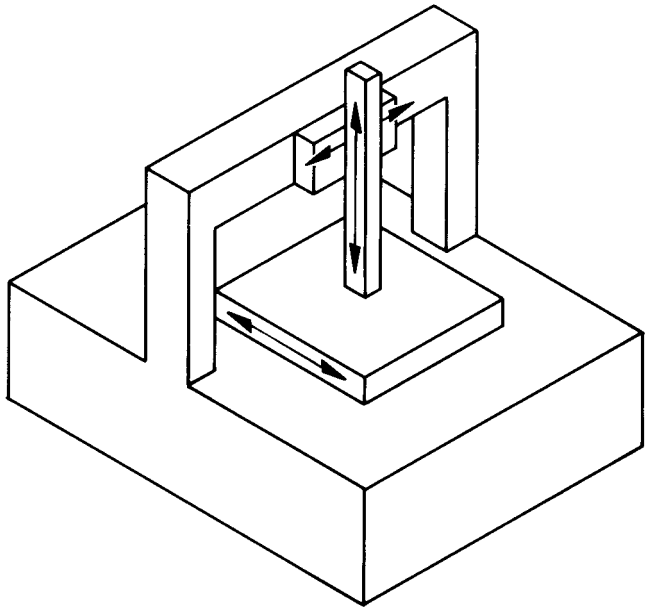

Figure 7 — Fixed bridge coordinate measuring machine

No.	Term	Definition
208	**moving bridge (portal) coordinate measuring machine**	A *coordinate measuring machine* employing three movable components moving along mutually perpendicular guideways in which the probe is attached to the first component which is carried on, and moves vertically relative to, the second; the combined assembly of the first and second components moves horizontally relative to the third; the third component is supported on two legs, which reach down to opposite sides of the machine base, and moves horizontally relative to the base, and the workpiece is supported on the base. NOTE See Figure 8.

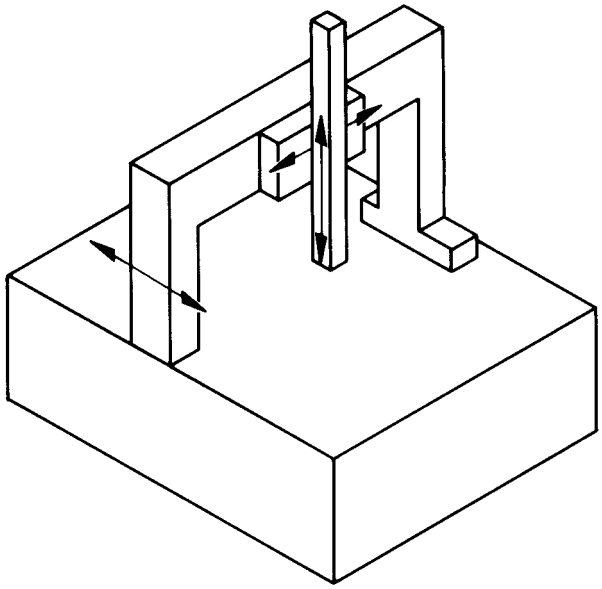

Figure 8 — Moving bridge (portal) coordinate measuring machine

3 Mechanical artefacts for calibration

No.	Term	Definition
301	**ball-ended bar**	A gauge consisting of two spheres of the same nominal diameter mounted at the ends of a connecting rigid bar.
302	**ball-plate**	A mechanical artefact comprising a number of spheres mounted in fixed positions on the plate, usually in a single plane.
303	**gauge block**	A mechanical artefact with an accurately known length between its two flat and parallel end faces. NOTE The blocks are often rectangular in cross section and less than 100 mm in length (see BS 888 or BS 4311-1 for a more detailed description).
304	**hole-plate**	A mechanical artefact that comprises a flat plate pierced with holes whose axes are normal to one of the surfaces.
305	**length bar**	A mechanical artefact with an accurately known length between its two flat and parallel end faces. NOTE Length bars are often circular in cross section and greater than 100 mm in length (see BS 1790 and BS 5317 for a more detailed description).
306	**material measure**	A measuring instrument reproducing in a permanent fashion during its use one or more known values of a given quantity for example, a *gauge block* for length.
307	**space frame**	A mechanical artefact in which the coordinates of a number of points in three-dimensional space within the *work zone* of a *coordinate measuring machine* are established by reference to points on the space frame.
308	**square**	A mechanical artefact with accurately known squareness. NOTE See BS 939 for a more detailed description.
309	**step gauge (uni- and bi-directional)**	A gauge comprising a rigid bar with calibrated features used for determining the accuracy of distance measurements in the direction of linear motion. NOTE Some gauges can only be probed from one direction, others are constructed such that probing can be performed from both directions.
310	**straightedge**	A mechanical artefact with accurately known straightness along one or more of its edges. NOTE See BS 5204 for a more detailed description.
311	**transfer standard**	A one-, two- or three-dimensional artefact used as an intermediary to compare measurement standards, material measures or measuring instruments.

4 Calibration procedures

401 reversal

A measurement procedure in which the test surface is measured by operating the probe in one direction and then rotating the component through 180° and measuring the same test surface by operating the same probe in the opposite direction.

NOTE If, for example, the straightness of a component is to be measured, the test surface is first measured in the line of the axis under consideration. The component is then rotated through 180° along the measurement axis and the same test surface measured with the same probe, operating in the opposite direction. By combining the two sets of results obtained by summation and subtraction the straightness of the component and of the *coordinate measuring machine* can be separately determined. By extending the technique to two axes, squareness may also be measured.

402 staging

The moving of a gauge from a first position to a second position such that a series of measurements started in the first position may be continued in the second position with the results related to the first.

5 Measurement

501 Abbe error

An *error* in a measuring slide system, resulting from an angular *error* of movement of the slide, that causes a relative displacement between the slide measuring scale and the probe operating on the measuring line and that is proportional to the *Abbe offset* and the angular *error* of the slide.

502 Abbe offset

The value of the perpendicular distance between the measurement system of a *coordinate measuring machine,* and that point on the line of measurement where the workpiece measurement takes place.

503 cosine error

The measurement *error* in the motion direction caused by angular misalignment between a linear displacement measuring system and the gauge being measured.

504 discrimination

The quantity that characterizes the ability of a measuring instrument to react to small changes of the quantity being measured.

505 error

The algebraic difference between the result of a measurement of a dimension minus the (conventional) true value of the dimension measured.

506 hysteresis

The difference between the indications of a measuring instrument when the same value of the quantity measured is reached by increasing or decreasing that quantity.

507 measuring line

A line in the *work zone* of a *coordinate measuring machine* along which measurements are made.

508 measuring point

A point on the surface of the workpiece at which the coordinates of the *coordinate measuring machine* are recorded as part of the measurement.

509 random uncertainty

An *error* that varies in an unpredictable manner in absolute value and in sign when a large number of measurements of the same value of a quantity are made under effectively identical conditions.

No.	Term	Definition
510	**repeatability**	The closeness of the agreement between the results of successive measurements of the same measurand carried out subject to all of the following conditions: the same method of measurement; the same observer; the same measuring instrument; the same location; the same conditions of use; repetition over a short period of time.
511	**systematic error**	An *error* which, in the course of a number of measurements of the same quantity made under the same conditions, either remains constant in absolute value and sign or varies according to a definite law when conditions change.
512	**uncertainty**	The characteristic of the dispersion of the results of measurement defined by the limits of *error*.
513	**uncertainty of length measurement**	The *uncertainty* with which a *coordinate measuring machine* determines the separation of two opposite points on parallel surfaces of a reference measurement standard.
514	**volumetric accuracy**	The *uncertainty* resulting from the combination of systematic and random uncertainties in the complete measuring system used in the execution of a compound movement of the *coordinate measuring machine*.

6 Geometry

601	**orthogonality**	The property of being at right angles.
602	**pitch**	The angular motion of a carriage, designed for linear motion, about an axis perpendicular to the motion direction and the plane swept out by a line on the carriage surface when the carriage moves over its working length.
603	**roll**	The angular motion of a carriage, designed for linear motion, about the linear motion axis.
604	**yaw**	The angular motion of a carriage, designed for linear motion, about an axis perpendicular to the plane swept out by a line on the carriage when the carriage moves over its working length.

7 Components

701	**analogue contacting probe**	A probe that gives a signal, or signals, proportional to the displacement of the probe from its free position.
702	**non-contacting probe**	A probe which has no material contact with the surface being measured.
703	**nulling contacting probe**	A probe that, when referenced to a workpiece, gives a signal which causes the *coordinate measuring machine* to be driven to a position giving a constant probe reading, usually (but not necessarily), zero or near zero output.
704	**passive (solid) probe**	A probe that mechanically locates the moveable components of the *coordinate measuring machine* relative to the workpiece.
705	**touch-trigger probe**	A probe that gives a binary signal as a result of contact with a workpiece.
706	**probe holder**	The mechanical arrangement for locating and fixing the probe to the *coordinate measuring machine*.
707	**reference cube**	A high precision cube placed at a convenient position within the *work zone* of the *coordinate measuring machine* to establish: a) a fiducial point for the machine; and b) a means of re-qualifying the probe.
708	**reference sphere**	A high-precision sphere placed at a convenient position within the *work zone* of the *coordinate measuring machine* to establish: a) a fiducial point for the machine; and b) a means of re-qualifying the probe.
709	**vector drive**	The means by which a *coordinate measuring machine* may be driven precisely along a predetermined vector within the *work zone* of the machine, by using simultaneous control of the motion of all three axes.
710	**work zone**	The measurement volume of the *coordinate measuring machine* as specified by the supplier.
711	**work table**	The part of the *coordinate measuring machine* upon which the workpiece is normally mounted.

Index

Publications referred to

BS 888, *Slip (or block) gauges and their accessories.*
BS 939, *Specification for engineers' squares (including cylindrical and block squares).*
BS 1790, *Length bars and their accessories.*
BS 4311, *Specification for metric gauge blocks.*
BS 4311-1, *Gauge blocks.*
BS 5204, *Straightedges.*
BS 5317, *Metric length bars and their accessories.*
BS 6808, *Coordinate measuring machines.*
BS 6808-2, *Method of verifying performance*[2)].
BS 6808-3, *Code of practice for implementing performance verification procedure*[2)].

[2)] In preparation and referred to in the foreword only.

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