# INTERNATIONAL STANDARD ISO 4343

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

# Numerical control of machines — NC processor output — Minor elements of 2000-type records (post-processor commands)

*Commande numérique des machines — Informations de sortie des processeurs CN — Éléments mineurs des enregistrements de type 2000 (instruction post-processeur)*

First edition — 1978-04-01



UDC 681.3 : 621.9-52

Ref. No. ISO 4343-1978 (E)

**Descriptors** : data processing, numerical control, language processors, vocabulary.

Price based on 92 pages

## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4343 was developed by Technical Committee ISO/TC 97, *Computers and information processing*, and was circulated to the member bodies in April 1976.

It has been approved by the member bodies of the following countries :

| | | |
|---|---|---|
| Australia | Japan | South Africa, Rep. of |
| Belgium | Korea, Rep. of | Turkey |
| Brazil | Mexico | United Kingdom |
| Czechoslovakia | Netherlands | U.S.A. |
| France | New Zealand | U.S.S.R. |
| Germany | Poland | |
| Hungary | Romania | |

No member body expressed disapproval of the document.





Printed in Switzerland

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## 0 INTRODUCTION

**0.1** The output of a general purpose numerical control processor is information used as input to a post-processor. This information is called CLDATA, which is derived from the term "centre line data".

**0.2** The logical structure of CLDATA records and the listing and definition of major words are given in ISO 3592.

**0.3** This International Standard defines, in the context of major word, the minor elements that can be associated in a post-processor statement with each of these major words (for an example of major and minor portions of a processor input statement, see the footnote to clause 1).

**0.4** Although this International Standard defines the CLDATA processor output of post-processor statements, there is usually a one-to-one correspondence between the minor elements of a post-processor statement in the input language and the words of the corresponding 2000-type record in CLDATA. In consequence, the symbolic input language has been chosen to describe the representation of the CLDATA records in this International Standard.

**0.5** Therefore, unless otherwise stated, the syntax and semantic definitions contained in this International Standard apply to both the input language statements and the corresponding CLDATA output.

**0.6** This International Standard is intended to define, in general terms, the elements of the set of post-processor statements that are commonly used. The writer of a post-processor is expected to use this International Standard for the selection of post-processor statements. The user of the input language (i.e. the part programmer) is expected to use the documentation of the appropriate post-processor that he intends to execute.

**0.7** The existing numerical control processors allow minor elements of post-processor statements in any order without restriction. Post-processors usually check the validity of particular element strings. The syntax definitions given in this International Standard are examples of common usage.

**0.8** The syntax, semantics and minor elements given under the heading of each major word are the result of several years' study of documents representing existing practice.

**0.9** The integer code numbers (IC)[1] given in this International Standard are the code numbers that are used to represent the input language vocabulary key words in CLDATA.

## 1 SCOPE

**1.1** This International Standard defines the elements of a set of post-processor statements that are commonly used in numerical control software.

It utilizes

a) the syntax and semantics of the major and minor elements[2] of the input language of this set,

and specifies

b) the syntax and semantics of the corresponding CLDATA processor output of type 2000, W4 to W245,

c) the rules governing the interpretation of the syntax of CLDATA.

**1.2** This International Standard does not prescribe

a) the mechanism by which the statements are processed and the CLDATA developed;

b) the medium on which the input language statements or the CLDATA are recorded;

c) the order of statements within a part program.

**1.3** The rules used for the syntax definitions are shown in annex A.

1) A register of keywords and their associated integer codes is maintained by the Secretariat of TC 97/SC 9 (as at June 1977, AFNOR, Paris). The TC 97/SC 9 Secretariat should be consulted for the possible assignment of codes for vocabulary not included in this International Standard.

2) The following example indicates the major and minor portions of a processor input statement and of the corresponding CLDATA record :

SPINDL/RPM, 5000, RANGE, 2

The major word is SPINDL
The minor element list is "RPM, 5000, RANGE, 2"
The minor elements are "RPM, 5000" and "RANGE, 2"

## 2 FIELD OF APPLICATION

**2.1** Each processor using one of the ISO numerical control programming languages shall be capable of producing CLDATA minor elements as defined in this International Standard, possibly by means of some interface routine.

**2.2** Each post-processor shall be capable of using as its input at least a sub-set of the minor elements specified in this International Standard.

## 3 REFERENCES

ISO 841, *Numerical control of machines — Axis and motion nomenclature.*

ISO 1056, *Numerical control of machines — Punched tape block formats — Coding of preparatory functions G and miscellaneous functions M.*

ISO 3592, *Numerical control processor output — Logical structure.*

## 4 LOGICAL STRUCTURE OF 2000-TYPE RECORDS

**4.1** 2000-type records carry post-processor instructions and are formed of words as follows :

Word W1 (integer) = record sequence number

Word W2 (integer) = 2000

Word W3 (integer) = *n* (integer code number representing major word)

Words W4 onwards may contain a minor element list as defined in clause 5 of this International Standard.

**4.2** A minor element can consist of one or more items.

**4.3** Each item is contained in one logical word and can be one of the following :

a) an integer representing a key vocabulary minor word;

b) a real number;

c) a character item.

**4.4** If the logical word represents a character item, the six left-hand positions of the physical representations shall be used, any remaining positions being filled with the space character.

If character data in the equivalent input part program statement consist of less than six characters, on numerical control processor output the data shall be right-justified within the first six characters, with leading space characters inserted as necessary.

## 5 MINOR ELEMENT LISTS

**5.1** In this International Standard, a separate logical page is used for each major word.

**5.2** On each of the following logical pages, major words and key vocabulary minor words are shown in capital letters. Its integer code number is shown alongside each word.

**5.3** Scalar values, represented by real numbers in the logical words of CLDATA, are shown by the symbols *a, b, c, d,* etc.

**5.4** Character items are represented by "character item" (see 4.4).

**5.5** Where an alternative, but non-standard, order of the items within a minor element is known to be frequently used, the non-standard order is shown in parentheses in the minor element definitions. These orders of the items shall be understood to be non-preferred.

**5.6** The key vocabulary minor words, their integer code numbers and brief definitions are listed in alphabetical order and in numerical order in annex B.

**5.7** Cross-references between the minor words and the major words that use them are given in annex C.

**5.8** The major words utilized in this International Standard are listed in annex D for reference purposes. The standard definition of major words is embodied in ISO 3592.

## A I R

[Integer code $n = 1011$]

Air. Controls the supply of air.

**Syntax**

$$\text{AIR} / \begin{matrix}\text{ON}\\\text{OFF}\end{matrix} [, a]$$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Specifies air is on. |
| OFF | IC = 72 | Specifies air is off. |
| *a* | | Specifies the time in seconds during which air is on. |

A U X F U N [Integer code $n = 1022$]

Auxiliary function. Provides facilities to insert miscellaneous function (M) code numbers on control tape.

**Syntax**

AUXFUN / $a\,{}^{n}_{0}\,[, a]$

**Minor element definitions**

| | |
|---|---|
| *a* | Specifies miscellaneous function (M) code number to be output in a single block. |

## C H U C K

[Integer code $n = 1073$]

Chuck. Specifies the chuck to be used.

**Syntax**

CHUCK/*a*, *b*, *c*, *d* [, *e*, *f*]

CHUCK/*a*, *g*

**Minor element definitions** (see figures 1 and 2)

| | |
|---|---|
| *a* | Specifies the identity number of the chuck. |
| *b* | Specifies the position of the clamping plane of the chuck in terms of the machine-tool co-ordinate system. |
| *c* | Specifies the maximum outer diameter of the chuck. |
| *d* | Specifies the position of the outer plane surface of the chuck in terms of the chuck co-ordinate system. |
| *e* | Specifies either the diameter of the hole of an external clamping chuck (if *f* has a negative value) or the diameter of a mounting arbor (if *f* has a positive value). |
| *f* | Specifies either the depth of the hole of an external clamping chuck (if negative), or the length of a mounting arbor (if positive), in terms of the chuck co-ordinate system. |
| *g* | Specifies the position on the *x*-axis of the part co-ordinate origin in terms of the machine-tool co-ordinate system. |

C L A M P

[Integer code $n = 1074$]

Clamp. Controls a holding operation.

**Syntax**

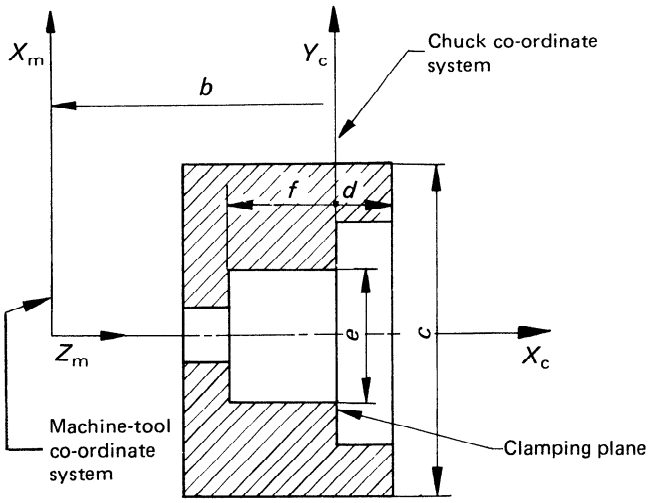
CLAMP/*a* [, INVERS]

CLAMP/ 1 [ ALL, COLLET, PALLET, RAIL, SADDLE, TABLE, ] [ ON, OFF ]

0 [ *b*, ]

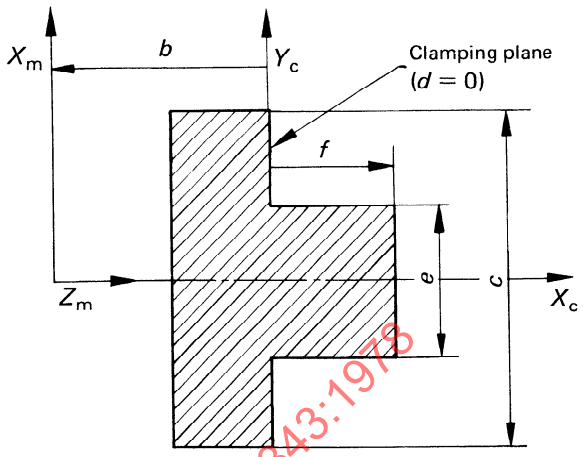
**Minor element definitions and integer code numbers** (See figures 3 and 4)

| | | |
|---|---|---|
| *a* | | Specifies the position of the clamping plane in terms of the part co-ordinate system. |
| INVERS | IC = 6 | Specifies rotation of the part by 180° in the *XY* plane before clamping. |
| ALL | IC = 51 | Specifies all holding devices. |
| COLLET | IC = 139 | Specifies a collet device. |
| PALLET | IC = 239 | Specifies a pallet device. |
| RAIL | IC = 93 | Specifies a rail device. |
| SADDLE | IC = 150 | Specifies a saddle device. |
| TABLE | IC = 177 | Specifies a table device. |
| *b* | | Specifies a device by number. |
| ON | IC = 71 | Initiates the operation. |
| OFF | IC = 72 | Terminates the operation. |



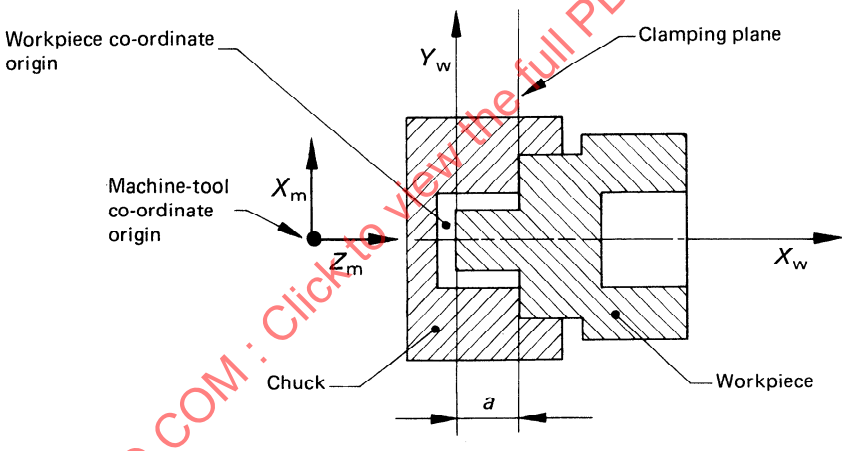

CHUCK/*a, b, c, d, e, f*
for example : CHUCK/11, 240, 300, 60, 120, – 100

FIGURE 1 – **Description of an external clamping chuck**



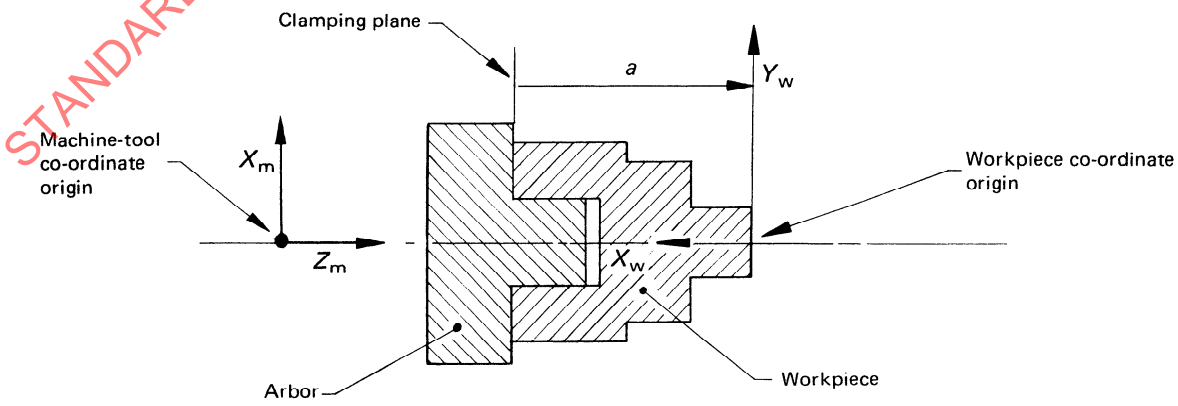

CHUCK/*a, b, c, d, e, f*
for example : CHUCK/12, 240, 300, 0, 120, 100

FIGURE 2 – **Description of a mounting arbor**




CLAMP/*a*
for example : CLAMP/80

FIGURE 3 – **Clamping with an external clamping chuck**




CLAMP/*a*, INVERS
for example : CLAMP/300, INVERS

FIGURE 4 – **Clamping at a mounting arbor in a position turned through 180°**

C L D I S T [Integer code $n = 1071$]

Clearance distance. Indicates a clearance envelope for collision avoidance at the given distance from the surface.

**Syntax**

CLDIST/*a*

**Minor element definitions**

*a* Specifies thickness of the clearance envelope.

**C L E A R P** [Integer code $n = 1004$]

Clearance plane. Specifies a clearance plane to which the tool tip will be moved when RETRCT (7) is encountered.



**Syntax**

CLEARP/[symbol, *a*,] *b*, *c*, *d*, *e*

[XYPLAN,]*e*
CLEARP/ YZPLAN, *e*
ZXPLAN, *e*

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| symbol, *a* | | Optionally inserted by the processor where the symbolic plane is previously defined.<br><br>*a* is either a subscript, if any, or zero. |
| *b*, *c*, *d* | | Specify the *X*, *Y*, *Z* components of the plane normal unit vector. |
| *e* | | Specifies the distance of the plane from the part co-ordinate origin in the direction of the plane normal unit vector. |
| XYPLAN, *e* | IC = 33 | Defines the position of a plane normal to the *Z*-axis in the part co-ordinate system. |
| YZPLAN, *e* | IC = 37 | Defines the position of a plane normal to the *X*-axis in the part co-ordinate system. |
| ZXPLAN, *e* | IC = 41 | Defines the position of a plane normal to the *Y*-axis in the part co-ordinate system. |

C L R S R F

[Integer code $n = 1057$]

Clearance surface. Specifies a clearance surface to which the tool tip will be moved when RETRCT (7) is encountered*.

**Syntax**

CLRSRF/[ [PLANE,] symbol, $a$,] $b$, $c$, $d$, $e$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| PLANE, symbol, $a$ | IC = 3003 | Inserted by the processor when the symbolic plane is previously defined.<br><br>$a$ is either a subscript, if any, or zero. |
| $b$, $c$, $d$ | | Specify the $X$, $Y$, $Z$ components of the plane normal unit vector. |
| $e$ | | Specifies the distance of the plane from the part co-ordinate origin in the direction of the plane normal unit vector. |



* Currently, only planes are defined as clearance surfaces.

## C O O L N T

[Integer code $n$ = 1030]

Coolant. Specifies coolant flow, or type, or both.

### Syntax

$$\text{COOLNT/}\begin{matrix}\text{ON}\\\text{OFF}\\\text{FLOOD}\\\text{MIST}\\\text{TAPKUL}\end{matrix}\overset{n}{\underset{0}{}}[,a]$$

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| ON | IC = 71 | Initiates coolant. |
| OFF | IC = 72 | Terminates coolant. |
| FLOOD | IC = 89 | Initiates flood coolant. |
| MIST | IC = 90 | Initiates mist coolant. |
| TAPKUL | IC = 91 | Initiates tapping coolant. |
| *a* | | Specifies the required delivery pipe. |

C O U P L E

[Integer code $n = 1049$]

Couple. Commands the synchronization of feedrate and spindle speed for threading operations.

**Syntax**

COUPLE / $\begin{matrix}\text{ON}\\\text{OFF}\end{matrix}$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Initiates the synchronization of feedrate and spindle speed. |
| OFF | IC = 72 | Cancels the synchronization of feedrate and spindle speed. |

## C U T C O M

[Integer code $n$ = 1007]

Cutter compensation. Commands the inclusion of cutter compensation information on the control tape and optionally specifies the relationship of workpiece to cutter, the plane of compensation and the cutter compensation register to be used.

**Syntax**

CUTCOM / { ON / OFF / RIGHT / LEFT } [, LENGTH [, *a*] ]

CUTCOM / { ON / OFF / RIGHT / LEFT } [, XCOORD, *b*] [, YCOORD, *c*] [, ZCOORD, *d*]

CUTCOM / { ON / OFF / RIGHT / LEFT / *e* } [ , XYPLAN / , YZPLAN / , ZXPLAN ] [, OSETNO, *e*]

CUTCOM / { ON / OFF / RIGHT / LEFT } [, RADIUS, *f*]

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Causes cutter compensation information to be output. |
| OFF | IC = 72 | Causes cancellation of the last CUTCOM command. |
| RIGHT | IC = 24 | Specifies position of the cutter in relation to the workpiece in accordance with ISO 1056. |
| LEFT | IC = 8 | |
| LENGTH | IC = 9 | Specifies tool length compensation. |
| LENGTH, *a* | IC = 9 | Specifies a cutter compensation register to be used with length compensation. |
| XCOORD, *b* | IC = 116 | Specifies a cutter compensation register to be associated with the *X*-axis. |
| YCOORD, *c* | IC = 117 | Specifies a cutter compensation register to be associated with the *Y*-axis. |
| ZCOORD, *d* | IC = 118 | Specifies a cutter compensation register to be associated with the *Z*-axis. |
| XYPLAN | IC = 33 | Specifies the plane of compensation. |
| YZPLAN | IC = 37 | |
| ZXPLAN | IC = 41 | |

| | | |
|---|---|---|
| *e*<br>OSETNO, *e* | IC = 508 | Specifies the cutter compensation register to be used. |
| RADIUS, *f* | IC = 23 | Specifies a cutter compensation register to be associated with the radius. |

## C Y C L E

[Integer code $n = 1054$]

Cycle. Specifies or identifies operations to be carried out at each point of a 5000-type motion record.



**General syntax**

The syntax is of the following general form.

CYCLE/operation depth feedrate clearance modifier

where

operation defines the type of machining cycle, for example

DRILL, TAP, etc.

depth defines the distance(s) from the point* along the spindle axis over which the machining operation will be performed,

feedrate defines the feedrate to be used in the cycle,

clearance defines a distance above the point(s)* to which the tool will first be positioned at rapid,

and modifier allows the modification of the basic machining cycle.

* Each point of the 5000-type motion record at which the cycle is to be performed.

Syntax

CYCLE/ DRILL / FACE / TAP / BORE / REAM , *a*, IPM, *b* / IPR, *c* / MMPM, *d* / MMPR, *e* [, *f*] [, RAPTO, *g*] [, DWELL [, *h*] ] [, ORIENT [, *o*] ]

CYCLE/ DEEP / BRKCHP , *n* [, 1 [*a*,] ] IPM, *b* / IPR, *c* / MMPM, *d* / MMPR, *e* [, *f*] [, *n*] [, RAPTO, *g*] [, DWELL [, *h*] ]

[, TIMES, *p*]

CYCLE/ DEEP / BRKCHP , *a*, INCR *n* [, 1 [, *q*], ] IPM, *b* / IPR, *c* / MMPM, *d* / MMPR, *e* [, *f*] [, *r*] [, RAPTO, *g*]

[, DWELL [, *h*] ] [, TIMES, *p*]

CYCLE/THRU, *n* [, 1 [, *a*], ] IPM, *b* / IPR, *c* / MMPM, *d* / MMPR, *e* [, *f*] [, DWELL [, *h*] ]

CYCLE/CSINK, *k*, *l* [, *m*], IPM, *b* / IPR, *c* / MMPM, *d* / MMPR, *e* [, *f*] [, *n*] [, RAPTO, *g*] [, DWELL [, *h*] ]

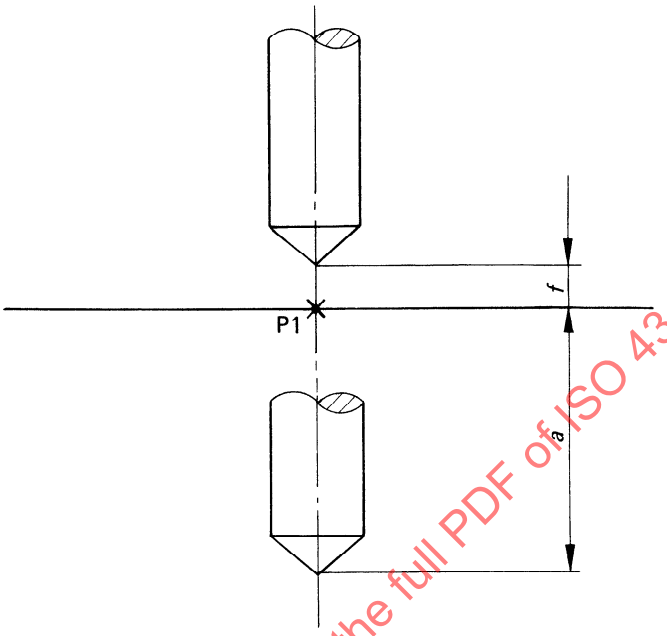
CYCLE/ ON / OFF / MANUAL

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Re-establishes the sequence of operations carried out at each point that was suppressed by an OFF (72) command. |
| OFF<br>(NOMORE) | IC = 72<br>IC = 53 | Suppresses the sequence of operations in the manner of the G80 in ISO 1056. |
| MANUAL | IC = 158 | Specifies that the tool is to stop at each point to allow the operator to perform a non-tape operation. |
| DRILL | IC = 163 | Specifies a sequence of operations equivalent to the G81 fixed cycle in ISO 1056 (see figure 5 for example). |
| FACE | IC = 81 | Specifies a sequence of operations equivalent to the G82 fixed cycle in ISO 1056 (see figure 6 for example). |
| TAP | IC = 168 | Specifies a sequence of operations equivalent to the G84 fixed cycle in ISO 1056 (see figure 7 for example). |
| BORE | IC = 82 | Specifies a sequence of operations equivalent to the G86 fixed cycle in ISO 1056. |
| REAM | IC = 262 | Specifies a sequence of operations equivalent to the G85 fixed cycle in ISO 1056 (see figure 8 for example). |
| DEEP | IC = 153 | Specifies a sequence of operations equivalent to the G83 fixed cycle in ISO 1056 (see figures 9 to 12 for examples). The sequence includes retraction at rapid to the clearance *f* after each peck. |
| BRKCHP<br>(STEP) | IC = 288<br>IC = 92 | Specifies a sequence of operations equivalent to the G83 fixed cycle in ISO 1056 (see figure 13 for example). The sequence includes a dwell or a small retraction between each peck of the operation. |
| THRU | IC = 152 | Specifies a feed-in, rapid-in, feed-in, rapid-in operation with a final rapid-out, used for drilling multiple walls separated by air spaces (see figure 14 for example). |
| CSINK | IC = 256 | Specifies a sequence of operations equivalent to the G82 fixed cycle in ISO 1056 (see figures 15 and 16 for example). |

| | | |
|---|---|---|
| *a* | | Specifies the distance from the point along the spindle axis over which the machining operation will be performed. |
| IPM, *b*<br>(*b*, IPM) | IC = 73 | Specifies magnitude of velocity of feed movement to be used during cycle, in inches per minute. |
| IPR, *c*<br>(*c*, IPR) | IC = 74 | Specifies magnitude of velocity of feed movement to be used during cycle, in inches per revolution. |
| MMPM, *d*<br>(*d*, MMPM) | IC = 315 | Specifies magnitude of velocity of feed movement to be used during cycle, in millimetres per minute. |
| MMPR, *e*<br>(*e*, MMPR) | IC = 316 | Specifies magnitude of velocity of feed movement to be used during cycle, in millimetres per revolution. |
| *f* | | Specifies a distance above the point to which the tool will first be positioned at rapid. |
| RAPTO, *g* | IC = 280 | Specifies a rapid movement which modifies the basic cycle (see the examples in figures 17 to 19). |
| DWELL, *h* | IC = 279 | Specifies in seconds a period of no tool motion. |
| *k* | | Specifies the diameter of countersink. |
| *l* | | Specifies the included angle of the countersink. |
| *m* | | Specifies the diameter of the pilot hole. Used to calculate the secondary rapid distance from the point (see figure 16 for example). |
| *r* | | Specifies the clearance distance above the last established. |
| ORIENT [, *o*] | IC = 246 | Specifies an index position at which the spindle may be stopped in boring cycles. |
| TIME, *p* | IC = 28 | Specifies a rapid retraction to *f* above the point every *p* pecks. |
| INCR, *q* | IC = 66 | Specifies that the values of *q* are successive incremental distances rather than absolute from the point. |

CYCLE/DRILL, *a*, IPM, *b*, *f*



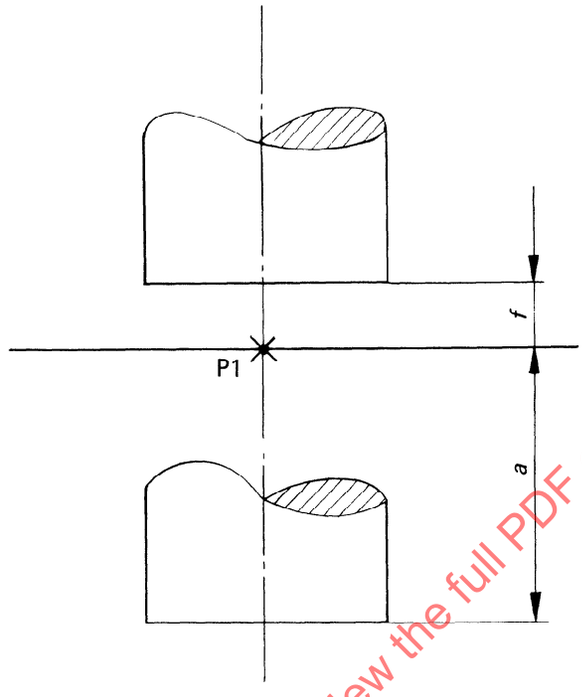

1 Position at rapid to *f* above the point P1

2 Feed a distance $f + a$

3 Rapid retract to a position *f* above P1

FIGURE 5

CYCLE/FACE, *a*, IPM, *b*, *f*




1 Position at rapid to *f* above the point P1

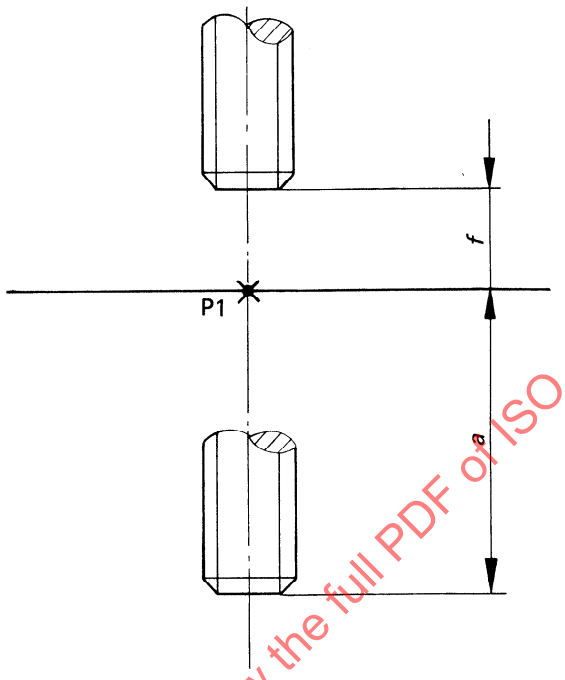
2 Feed a distance $f + a$

3 Dwell

4 Rapid retract to a position *f* above P1

FIGURE 6

CYCLE/TAP, *a*, IPM, *b*, *f*




1 Position at rapid to *f* above the point P1

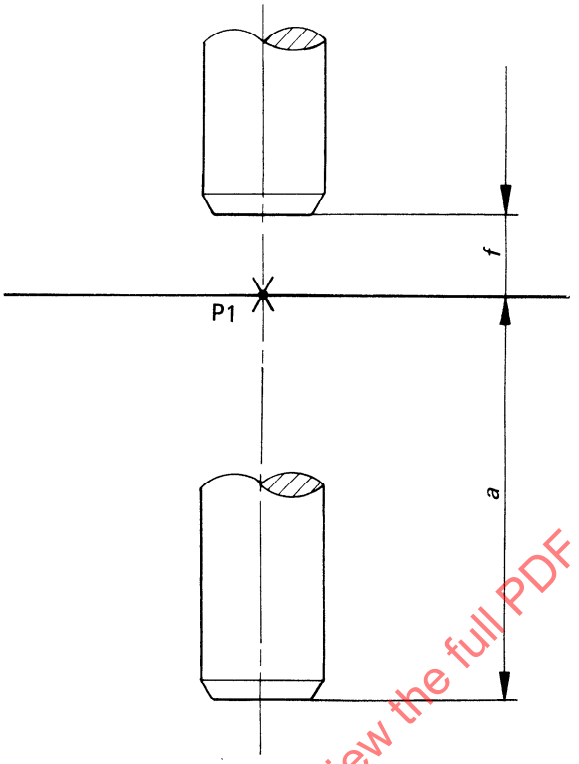
2 Feed a distance $f + a$

3 Spindle reverse and retract at feed to a position *f* above P1

4 Reinstate the initial spindle condition.

FIGURE 7

CYCLE/BORE, *a*, IPM, *b*, *f*



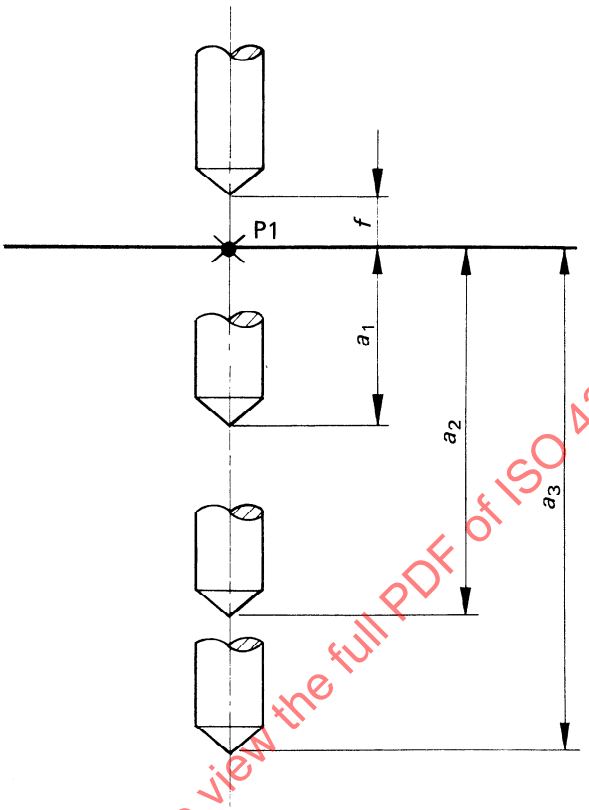

1 Position at rapid to *f* above the point P1

2 Feed a distance $f + a$

3 Retract at feedrate to a position *f* above P1

FIGURE 8

CYCLE/DEEP, $a_1, a_2, a_3, \ldots, a_z$, IPM, $b, f, n$




When subscript $Z$ equals 3, the following sequence is generated :

1 Position at rapid to $f$ above the point P1

2 Feed a distance $f + a_1$

3 Retract at rapid to a position $f$ above P1

4 Rapid a distance $f + a_1$ less specified ($n$) clearance

5 Feed to a position $a_2$ below P1

6 Retract at rapid to a position $f$ above P1

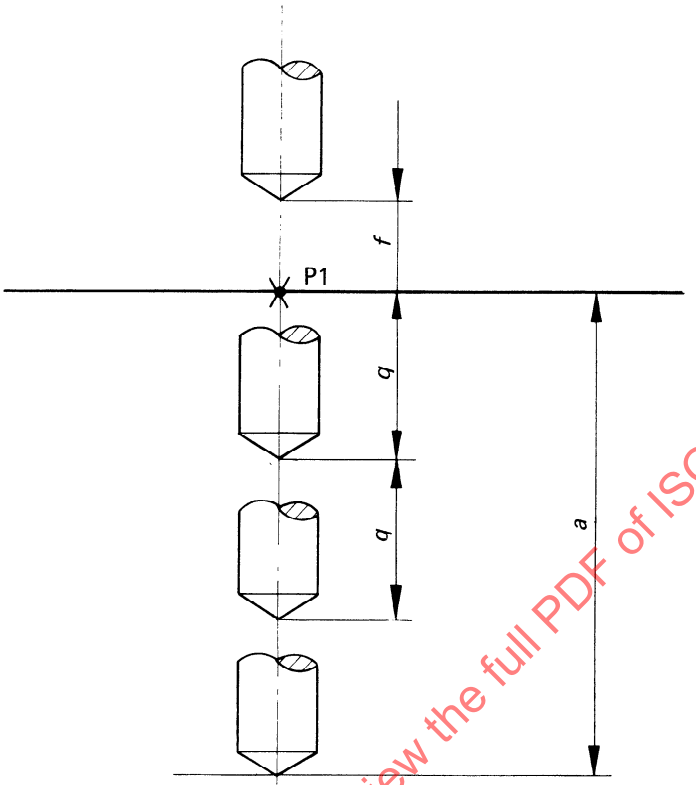
7 Rapid a distance $f + a_2$ less specified ($n$) clearance

8 Feed to a position $a_3$ below P1

9 Retract at rapid to a position $f$ above P1

FIGURE 9

CYCLE/DEEP, *a*, INCR, *q*, IPM, *b*, *f*
where *a* is less than 3 *q*




1 Position at rapid to *f* above the point P1

2 Feed a distance $f + q$

3 Retract at rapid to *a* position *f* above P1

4 Rapid a distance $f + q$ less some fixed clearance

5 Feed to a position 2 *q* below P1

6 Retract at rapid to a position *f* above P1

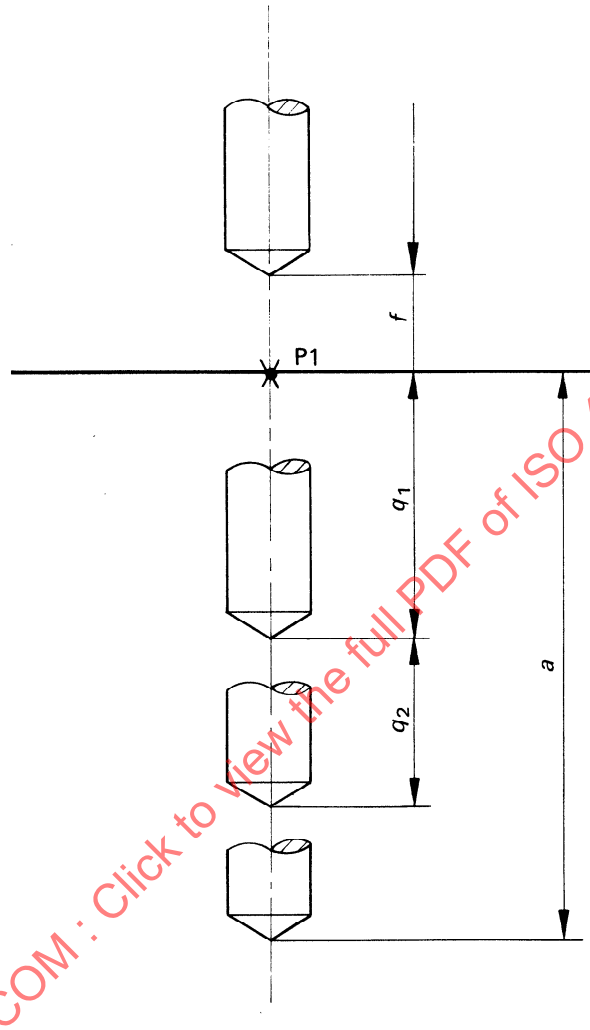
7 Rapid a distance $f + 2q$ less some fixed clearance

8 Feed to a position *a* below P1

9 Retract at rapid to a position *f* above P1

FIGURE 10

CYCLE/DEEP, $a$, INCR, $q_1$, $q_2$, MMPR, $b$, $f$
where $a$ is less than $q_1 + 2\,q_2$




1 Position at rapid to $f$ above the point P1

2 Feed a distance $f + q_1$

3 Retract at rapid to a position $f$ above P1

4 Rapid a distance $f + q_1$ less some fixed clearance

5 Feed to a position $q_1 + q_2$ below P1

6 Retract at rapid to a position $f$ above P1

7 Rapid a distance $f + q_1 + q_2$ less some fixed clearance

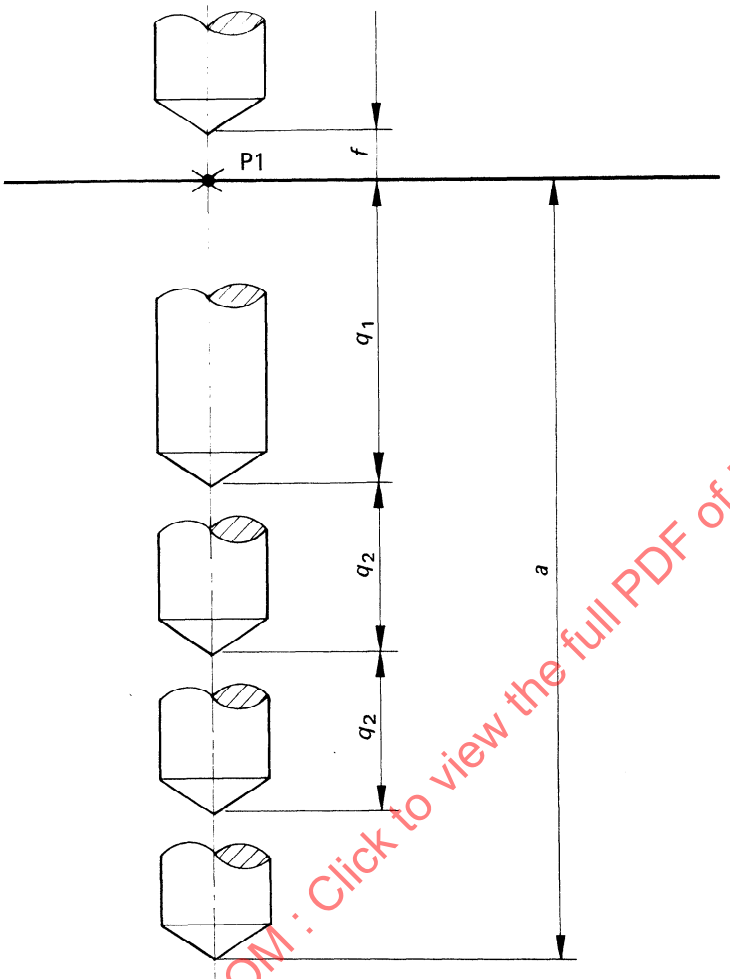
8 Feed to a position $a$ below P1

9 Retract at rapid to a position $f$ above P1

FIGURE 11

CYCLE/DEEP, $a$, INCR, $q_1$, $q_2$, MMPR, $b$, $f$

NOTE — This is the same statement as figure 11. This time, however, it is assumed that $q_1 + 2\,q_2 < a < q_1 + 3\,q_2$.




1 Position at rapid to $f$ above the point P1

2 Feed a distance $f + q_1$

3 Retract at rapid to a position $f$ above P1

4 Rapid a distance $f + q_1$ less some fixed clearance

5 Feed to a position $q_1 + q_2$ below P1

6 Retract at rapid to a position $f$ above P1

7 Rapid a distance $f + q_1 + q_2$ less some fixed clearance

8 Feed to a position $f + q_1 + q_2 + q_2$ below P1

9 Retract at rapid to a position $f$ above P1

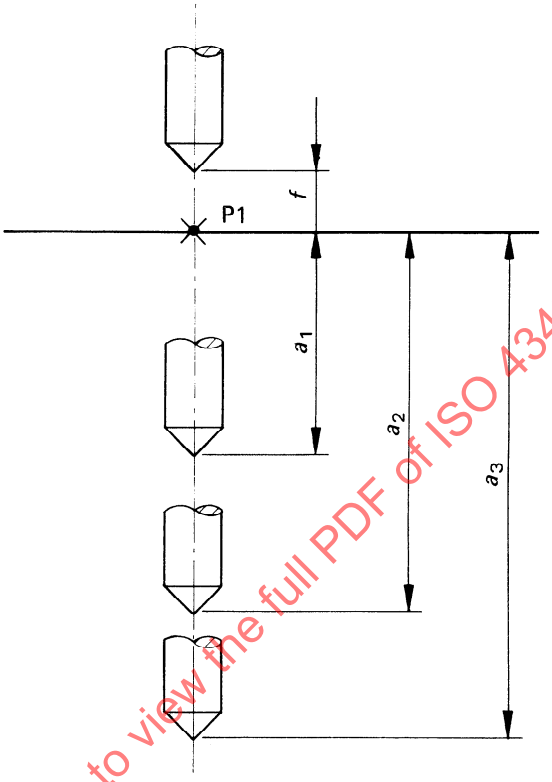
10 Rapid a distance $f + q_1 + q_2 + q_2$ less some fixed clearance

11 Feed to a position $a$ below P1

12 Retract at rapid to a position $f$ above P1

FIGURE 12

CYCLE/BRKCHP, $a_1$, $a_2$, $a_3$, . . ., $a_z$, IPM, $b$, $f$




1 Position at rapid to $f$ above the point P1

2 Feed a distance $f + a_1$

3 Dwell or small retraction

4 Feed to a point at a distance $a_2$ below P1

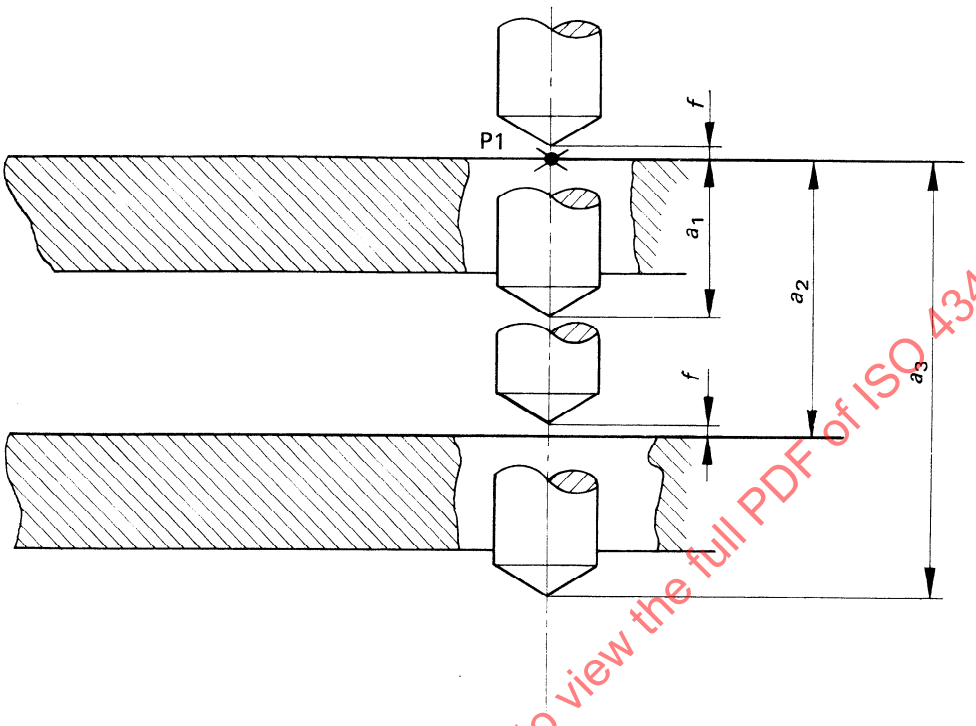
5 Dwell or small retraction

6 Feed to a point at a distance $a_3$ below P1

7 Retract at rapid to a position $f$ above P1

FIGURE 13

CYCLE/THRU, $a_1$, $a_2$, $a_3$, . . ., $a_z$, IPM, $b$, $f$




1 Position at rapid to $f$ above the point P1

2 Feed a distance $f + a_1$

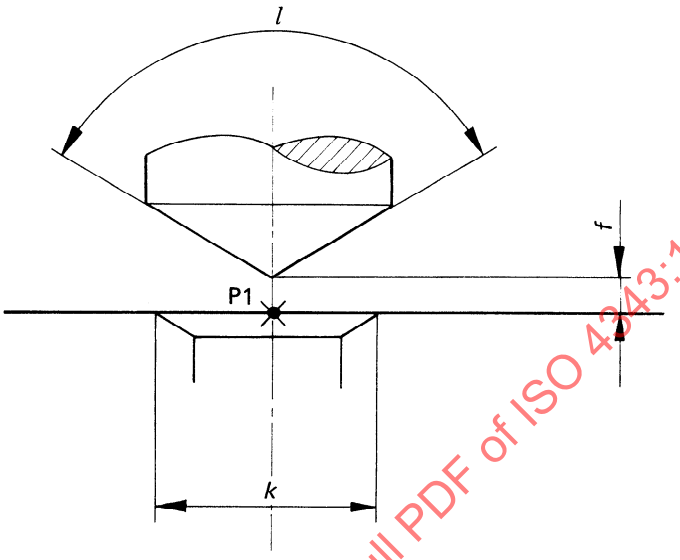
3 Rapid to a position $a_2 - f$ below P1

4 Feed to a position $a_3$ below P1

5 Retract at rapid to a position $f$ above P1

FIGURE 14

CYCLE/CSINK, *k*, *l*, IPM, *b*, *f*




1 Position at rapid to *f* above point P1

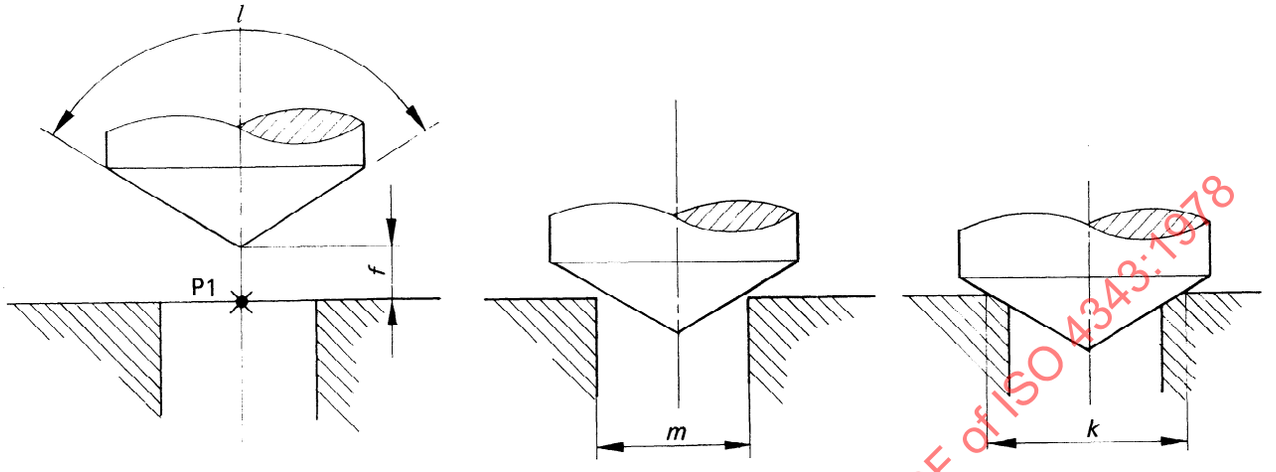
2 Feed to depth, cutting diameter *k* (i.e. a distance $f + [k/(2 \tan 1/2)]$

3 Dwell

4 Retract at rapid to a position *f* above P1

FIGURE 15

CYCLE/CSINK, *k*, *l*, *m*, IPM, *b*, *f*




(1) (2) (3)

1 Rapid to *f* above P1

2 Rapid to a position, cutting a diameter *m*, less some clearance

3 Feed to a position, cutting diameter *k*

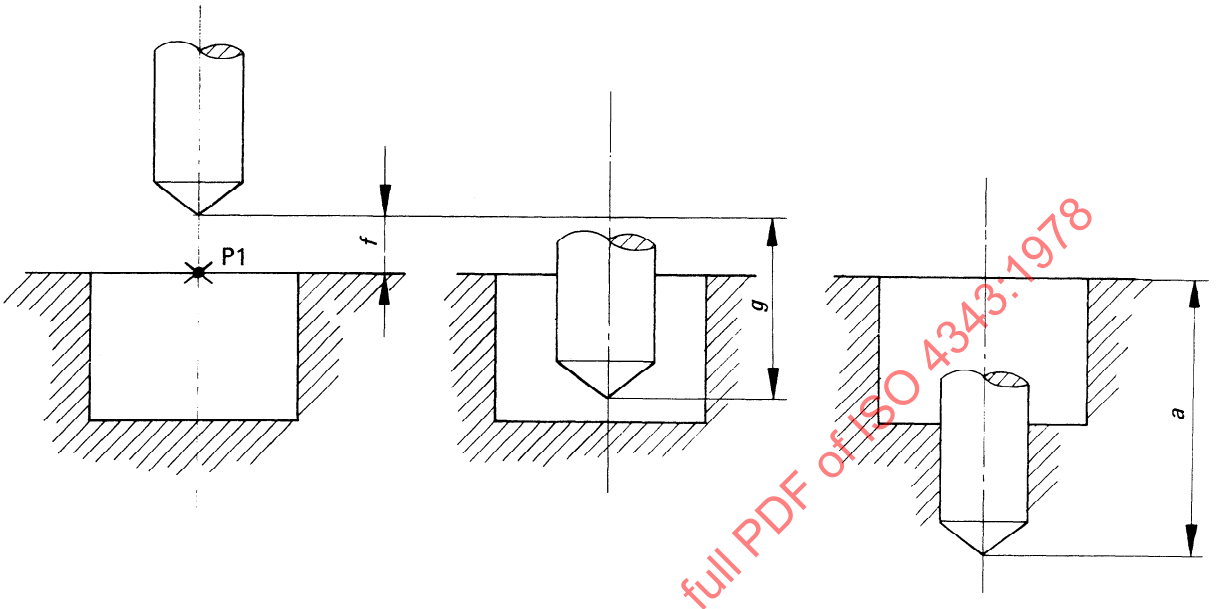
4 Dwell

5 Retract at rapid to a position *f* above P1

NOTE – 1 and 2 would usually be combined for the tool-axis motions.

FIGURE 16

CYCLE/DRILL, *a*, IPM, *b*, *f*, RAPTO, *g*




1 Rapid to *f* above P1

2 Rapid further distance *g*

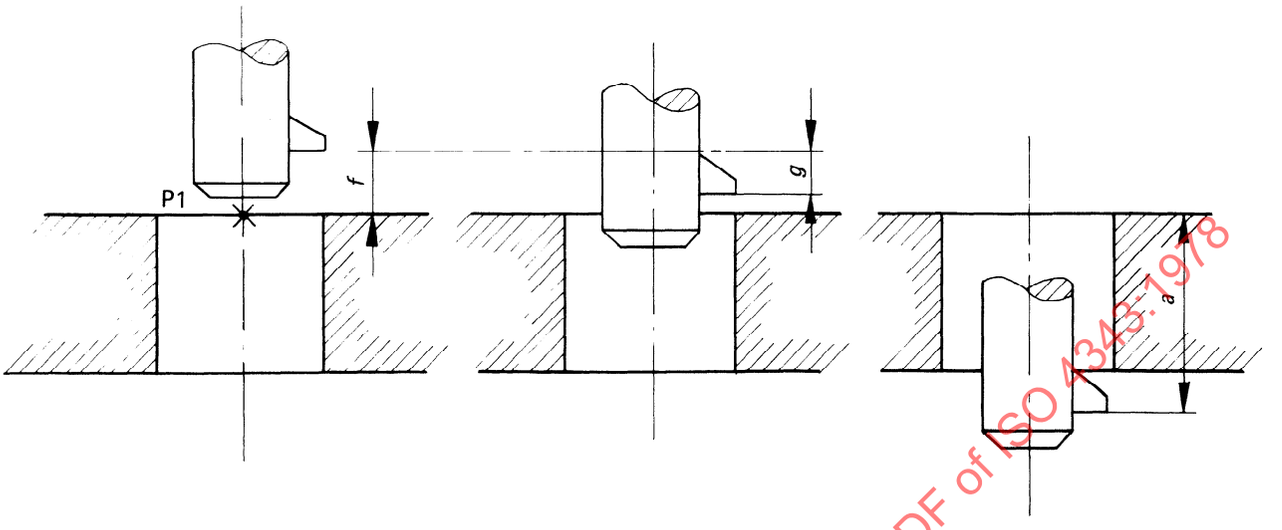
3 Feed to a position *a* below P1

4 Retract at rapid to a position *f* above P1

NOTE – 1 and 2 would usually be combined for the tool-axis motions.

FIGURE 17

CYCLE/BORE, *a*, IPM, *b*, *f*, RAPTO, *g*




(1) (2) (3)

1 Rapid to *f* above point P1

2 Rapid further distance *g*

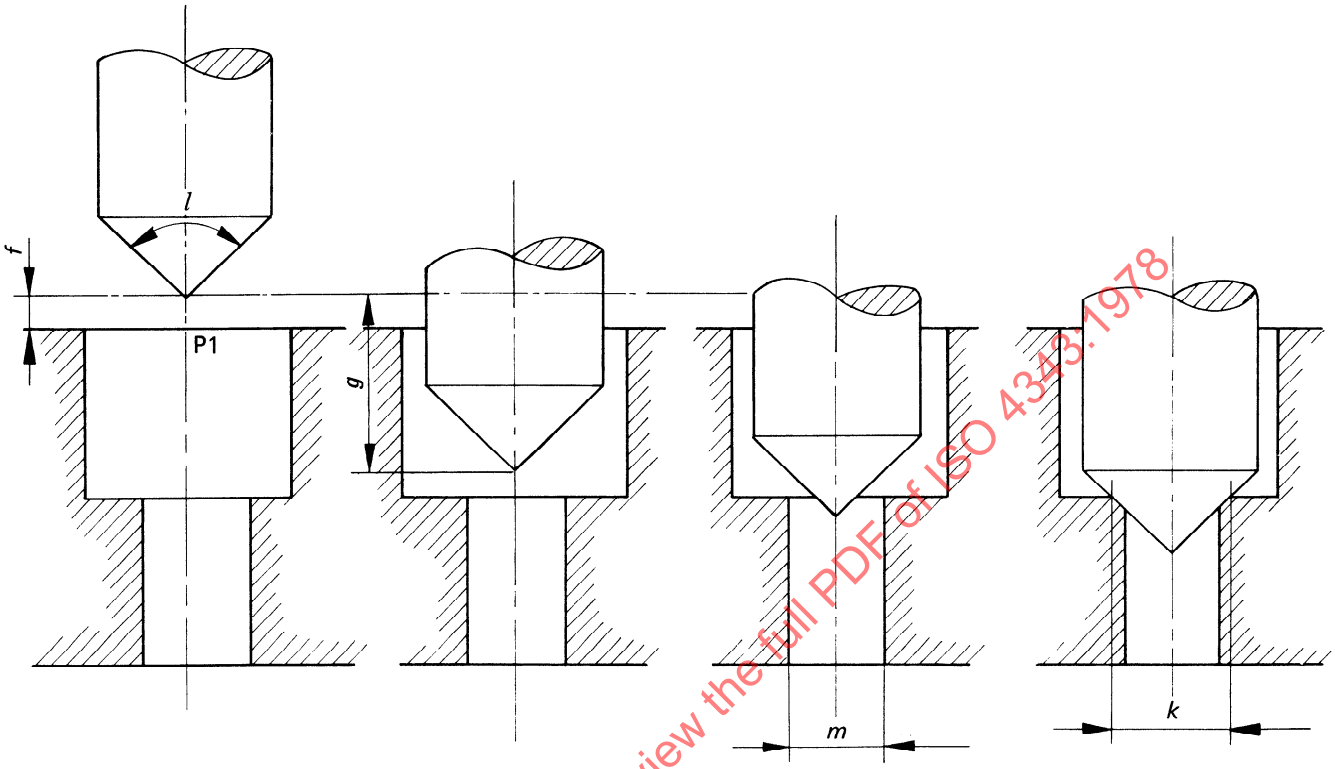
3 Feed to a position *a* below P1

4 Retract at feedrate to a position *f* above P1

NOTE – 1 and 2 would usually be combined for the tool-axis motions.

FIGURE 18

CYCLE/CSINK, *k*, *l*, *m*, IPM, *b*, *f*, RAPTO, *g*




1 Rapid to *f* above P1

2 Rapid further distance *g*

3 Rapid further to a position, cutting a diameter *m*, less some clearance

4 Feed to a position, cutting diameter *k*

5 Dwell

6 Retract at rapid to a position *f* above P1

NOTE — 1, 2 and 3 would usually be combined for the tool-axis motions.

FIGURE 19

D E L A Y

[Integer code $n = 1010$]

Delay. Specifies time, or number of revolutions, of no motion.

**Syntax**

DELAY / $\overset{a}{\text{REV}, b}$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a* | | Specifies duration of the dwell in seconds. |
| REV, *b*<br>(*b*, REV) | IC = 97 | Specifies duration of the dwell in terms of *b* revolutions of the spindle. |

## D I S P L Y

[Integer code $n = 1021$]

Display. Used to control console lights or to control the presentation of display words for the machine-tool operator.



### Syntax

DISPLY / $\begin{matrix} a \\ \text{ON} \\ \text{OFF} \end{matrix}$

DISPLY / $\begin{matrix} n \\ 1 \end{matrix}$ [character string]

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| *a* | | Specifies a console light or display pattern. |
| ON | IC = 71 | Commands the display action. |
| OFF | IC = 72 | Inhibits the display action. |

D R A F T

[Integer code $n = 1059$]

Draft. Specifies information pertaining to a drafting machine.

**Syntax**

DRAFT / ON | OFF | SOLID | DASH | DOTTED | CTRLIN | DITTO [, PEN, BLACK | , PEN, RED | , PEN, GREEN | , PEN, BLUE | , PEN, SCRIBE | , PEN, *a*] [, INTENS, LIGHT | , INTENS, MEDIUM | , INTENS, DARK] [, MEDIUM, *b*, *c*, *d*]

DRAFT / *e* INTENS, *f*

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Specifies drafting action. |
| OFF | IC = 72 | Specifies no drafting action. |
| SOLID | IC = 123 | Specifies continuous line ———————— |
| DASH | IC = 124 | Specifies dashed line – – – – – – – – – – – – – – – – – – – – – – |
| DOTTED | IC = 125 | Specifies dotted line . . . . . |
| CTRLIN | IC = 126 | Specifies dash-dotted line —.—.—.—.—.—.—.—.—.—.—.—.— |
| DITTO | IC = 127 | Specifies double-dotted line . . . . . |
| PEN, BLACK | IC = 128, 130 | Specifies black line. |
| PEN, RED | IC = 128, 131 | Specifies red line. |
| PEN, GREEN | IC = 128, 132 | Specifies green line. |
| PEN, BLUE | IC = 128, 133 | Specifies blue line. |
| PEN, SCRIBE | IC = 128, 129 | Specifies scribed line. |
| PEN, *a* | IC = 128 | Specifies pen by number. |
| INTENS, LIGHT | IC = 134, 100 | Specifies light intensity of line. |
| INTENS, MEDIUM | IC = 134, 61 | Specifies medium intensity of line. |
| INTENS, DARK | IC = 134, 137 | Specifies dark intensity of line. |
| MEDIUM, *b*, *c*, *d* | IC = 61 | Specifies code numbers which indicate the paper type, size and orientation respectively. |
| *e* | | Specifies line type by number. |
| INTENS, *f* | IC = 134 | Specifies intensity of line by number. |

## F E D R A T

[Integer code $n = 1009$]

Feedrate. Specifies magnitude of feed movement velocity.

### Syntax

FEDRAT/a[, AUTO / , STEP]

FEDRAT / IPM, *b* / MMPM, *c* / PERMIN, *d* / IPR, *e* / MMPR, *f* / PERREV, *g* { [, MAXIPM, *h* / , MXMMPM, *i* / , MXPERM, *j*] [, RANGE, *k* / , [RANGE] LOW / MEDIUM / HIGH] }

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| *a* | | Specifies the velocity. |
| AUTO | IC = 88 | Specifies that the acceleration/deceleration function be used. |
| STEP | IC = 92 | Specifies that acceleration/deceleration be achieved with a stepping function. |
| IPM, *b*<br>(*b*, IPM) | IC = 73 | Specifies velocity in inches per minute. |
| MMPM, *c* | IC = 315 | Specifies velocity in millimetres per minute. |
| PERMIN, *d*<br>(*d*, PERMIN) | IC = 501 | Specifies velocity per minute in units of the part program. |
| IPR, *e*<br>(*e*, IPR) | IC = 74 | Specifies velocity in inches per revolution of the spindle. |
| MMPR, *f* | IC = 316 | Specifies velocity in millimetres per revolution of the spindle. |
| PERREV, *g* | IC = 504 | Specifies velocity per revolution of the spindle in the units of the part program. |
| MAXIPM, *h* | IC = 96 | Specifies maximum permitted velocity in inches per minute. |

| | | |
|---|---|---|
| MXMMPM, *i* | IC = 506 | Specifies maximum permitted velocity in millimetres per minute. |
| MXPERM, *j* | IC = 507 | Specifies maximum permitted velocity in the units of the part program. |
| RANGE, *k* | IC = 145 | Specifies range by number. |
| RANGE, LOW | IC = 145, 63 | Specifies a low, medium or high range. |
| RANGE, MEDIUM | IC = 145, 61 | |
| RANGE, HIGH | IC = 145, 62 | |
| LOW | IC = 63 | |
| MEDIUM | IC = 61 | |
| HIGH | IC = 62 | |

## H E A D

[Integer code $n$ = 1002]

Head. Specifies a particular machine headstock when a choice of more than one is available.

**Syntax**

HEAD / BOTH | HIGH | LOW | LEFT | MAIN | QUILL | RAM | RIGHT | SADDLE | *a*

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| BOTH | IC = 83 | Specifies both headstocks. |
| HIGH | IC = 62 | Specifies the higher headstock. |
| LOW | IC = 63 | Specifies the lower headstock. |
| LEFT | IC = 8 | Specifies the left-hand headstock. |
| MAIN | IC = 93 | Specifies the main headstock. |
| QUILL | IC = 287 | Specifies the quill headstock. |
| RAM | IC = 500 | Specifies the ram headstock. |
| RIGHT | IC = 24 | Specifies the right-hand headstock. |
| SADDLE | IC = 150 | Specifies the saddle headstock. |
| *a* | | Scalar specifies the desired headstock by number. |

I N S E R T [Integer code $n = 1046$]

Insert. Specifies that the following characters shall be inserted directly as control system commands.

**Syntax**

INSERT/ $\overset{n}{1}$ [character item]

---

As the maximum size of a CLDATA record is 245 words, the maximum size of $n$ in current implementations is 80.

## L E A D E R

[Integer code $n = 1013$]

Leader. Specifies the length of leader punched in a code, parity, and unit given by the post-processor.



**Syntax**

LEADER/*a*

**Minor element definitions**

| | |
|---|---|
| *a* | Specifies the length of leader to be punched. |

## L E T T E R

[Integer code $n = 1043$]

Letter. Specifies the position on the plot of the characters given in an immediately following PPRINT (1044) statement.

### Syntax

LETTER/*a*, *b*, *c* [, *d*]

LETTER/{*a*, *b* / NOW'} {XAXIS / YAXIS / ATANGL, *e*} ' LENGTH, *f*, AT, *g* [, CONST, *h*, *i*] [, XYPLAN] [, YZPLAN] [, ZXPLAN]

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| *a*, *b* | | Specifies the position on the plot for the first character of the PPRINT statement. |
| *c* | | Specifies the scaling factor. |
| *d* | | Specifies the number of letters. |
| NOW | IC = 161 | Specifies that the script be placed at the current position. |
| XAXIS<br>YAXIS | IC = 84<br>IC = 85 | Specifies that the script be placed along the relevant axis. |
| ATANGL, *e* | IC = 1 | Specifies the angle in degrees to the *X*-axis at which the script is to be plotted. |
| LENGTH, *f*, AT, *g* | IC = 9, 189 | Specifies the number of characters, *f*, to be taken from the PPRINT statement and, *g*, the height of the script. |
| ALL | IC = 51 | Specifies that all the characters in the PPRINT statement be used. |

| | | |
|---|---|---|
| CONST, *h*, *i* | IC = 64 | Specifies that a numeric value or a special character be plotted. A following PPRINT record is unnecessary in such a case.<br><br>If $h < -1$, a symbol is to be plotted, where *i* is a numeric code for the symbol required.<br><br>If $h \geqslant -1$, a numeric value is to be plotted, this value being given by *i*.<br><br>If $h = -1$, no decimal places or decimal point are given, for example $i = 99$.<br><br>If $h = 0$, no decimal places with a decimal point are given, for example $i = 99.$<br><br>If $h > 0$, *i* decimal places with a decimal point are given, for example $i = 99.000$. |
| XYPLAN<br>YZPLAN<br>ZXPLAN | IC = 33<br>IC = 37<br>IC = 41 | Specify the projection plane or planes to which the LETTER command applies. |

## L I N T O L

[Integer code $n = 1067$]

Linearization tolerance. Specifies an acceptable deviation from the straight line motion of the tool tip.

**Syntax**

LINTOL / $\begin{matrix} a \\ \text{ON} \\ \text{OFF} \end{matrix}$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a* | | Specifies the magnitude of the allowable deviation. |
| ON | IC = 71 | Initiates the linearization algorithm. |
| OFF | IC = 72 | Cancels the linearization algorithm. |

## L O A D T L

[Integer code $n = 1055$]

Load tool. Commands the loading of the tool.

### Syntax

LOADTL/ [TOOL, Symbol, $a$,] $b$ [, LENGTH, $c$]

{ [, SETOOL, $d$, $e$, $f$] [, SETANG, $g$]

[, ATANGL, $h$] [, HOLDER, $i$ / , [HOLDER,] LARGE / SMALL] [, MANUAL] [CLW / CCLW]

[, ADJUST [, NOW / , NEXT]] [, DIAMET, $j$] } [, OSETNO, $k$ [, $l$]]

LOADTL/$m$ [, $n$]

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| TOOL, Symbol, $a$ | IC = 3017 | Inserted by the processor when the symbolic tool is previously defined.<br><br>$a$ is either a subscript, if any, or zero. |
| $b$ | | Specifies identification number or magazine position of the tool. |
| LENGTH, $c$ | IC = 9 | Specifies the length of the tool. |
| SETOOL, $d$, $e$, $f$ | IC = 155 | Specifies the $X$, $Y$, $Z$ distances from the reference point on the tool to the control point on the tool holder with the setting angle applied. |
| SETANG, $g$ | IC = 156 | Specifies setting angle of tool. $g$ corresponds to angle between machine axis and tool axis in degrees. |
| ATANGL, $h$ | IC = 1 | Specifies angle of tool axis to holder axis in degrees. |
| HOLDER, $i$ | IC = 157 | Specifies the holding device used to grip the tool. |
| [HOLDER,] LARGE | IC = 157,7 | Specifies the larger holding device. |
| [HOLDER,] SMALL | IC = 157,26 | Specifies the smaller holding device. |
| MANUAL | IC = 158 | Specifies that the tool is to be loaded manually by the operator. |

| | | |
|---|---|---|
| DIAMET, *j* | IC = 509 | Specifies the tool diameter. |
| ADJUST | IC = 159 | Specifies that tool compensations be applied. |
| ADJUST, NOW<br>ADJUST, NEXT | IC = 159, 161<br>IC = 159, 162 | Specifies that compensation be applied in the current or next block respectively. |
| OSETNO, *k* | IC = 508 | Specifies the correction dial number. |
| OSETNO, *k*, *l* | IC = 508 | Specifies the two axis correction dial numbers. |
| *m*, *n* | | Specifies the identity number of the tool and magazine position. |
| CLW<br>CCLW | IC = 60<br>IC = 59 | Specifies direction of rotation of a turret mechanism. |

## M A C H I N

[Integer code $n = 1015$]

Machine. Identifies the post-processor for a particular machine/control system and provides parameters to initialize it.

### Syntax

MACHIN/name [, *a*] $\overset{n}{\underset{0}{\left[\begin{matrix}\text{symbol}\\ \text{, WORD}\\ b\end{matrix}\right]}}$

### Minor element definitions

| | |
|---|---|
| name | The specification in character data of the required post-processor to be linked to the processor. |
| *a* | Identification number of the post-processor. |
| $\overset{n}{\underset{1}{\left[\begin{matrix}\text{symbol}\\ \text{, WORD}\\ b\end{matrix}\right]}}$ | These elements provide for the initialization and alteration of specific internal post-processor parameters. The identification, definition and usage of each parameter will be documented for each post-processor by the post-processor writer. |

**M C H T O L** [Integer code $n = 1016$]

Machining tolerance. Specifies the maximum allowable error due to machine slide dynamics at discontinuities.

**Syntax**

MCHTOL / $\begin{matrix} a \\ b, c \end{matrix}$

**Minor element definitions**

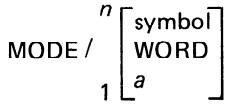
| | |
|---|---|
| *a* | Specifies the magnitude of the allowable error. |
| *b, c* | Specifies the magnitude of the allowable overshoot and undershoot error. |

## M O D E

[Integer code $n = 1003$]

Mode. Specifies the working mode.

### Syntax




### Minor element definitions

[symbol / WORD / *a*]

These elements specify the working mode. The identification of each is specific to each post-processor.

O F S T N O

[Integer code $n = 1083$]

Offset switch number. Specifies association of the tool with a particular compensation switch at the machine.

**Syntax**

OFSTNO / $\begin{matrix} a\,[,b] \\ \text{NOMORE}\,[,c] \end{matrix}$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a* | | Specifies the first correction dial number to be associated with the tool currently in action. |
| *b* | | Specifies the second correction dial number to be associated with the tool currently in action. |
| NOMORE | IC = 53 | Specifies that the compensation switch number(s) in the last mentioned OFSTNO statement is(are) no longer associated with the tool currently in action. |
| NOMORE, *c* | IC = 53 | Specifies that the compensation switch number *c* is no longer associated with the tool currently in action. |

**O P S K I P** [Integer code $n = 1012$]

Optional skip. Provides the facility for the operator to optionally skip control blocks.

**Syntax**

OPSKIP / ON / OFF

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| ON | IC = 71 | Indicates the beginning of the information to be optionally skipped. |
| OFF | IC = 72 | Indicates the end of the information to be optionally skipped. |

## ORIGIN

[Integer code $n = 1027$]

Origin. Specifies the machine-tool co-ordinate system origin in terms of the part reference system.

### Syntax

ORIGIN/$a, b \begin{matrix} n \\ 0 \end{matrix} [, c]$

### Minor element definitions

| | |
|---|---|
| $a, b$ | Specifies $X$ and $Y$ co-ordinates |
| $c$ | A first $c$ specifies the $Z$ co-ordinate. Any other $c$ specifies other machine axis parameters. |

## O V P L O T

[Integer code $n = 1042$]

Over plot. Specifies a contour to be superimposed on a previous plot.



### Syntax

OVPLOT / ON / OFF [, XYPLAN] [, YZPLAN] [, ZXPLAN] [, *a, b, d, e* / , *a, b, c, d, e, f*] [, SCALE, *g*]

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| ON<br>(START) | IC = 71<br>IC = 57 | Specifies plot of all cutter co-ordinates until OFF encountered. |
| OFF<br>(NOMORE) | IC = 72<br>IC = 53 | Specifies end of plot. |
| XYPLAN<br>YZPLAN<br>ZXPLAN | IC = 33<br>IC = 37<br>IC = 41 | Specifies projection plane(s). |
| *a, b, d, e*<br>*a, b, c, d, e, f* | | Specifies the rectangular CLDATA co-ordinates corresponding to the opposite corners of the range of CLDATA to be plotted. |
| SCALE, *g* | IC = 25 | Specifies a scaling factor. |

## P A R T N O

[Integer code $n = 1045$]

Part number. Provides the part-program identification.

**Syntax**

PARTNO/ $\overset{n}{1}$[character item]

---

As the maximum size of a CLDATA record is 245 words, the maximum size of $n$ in current implementations is 80.

## P I E R C E

[Integer code $n = 1090$]

Pierce. Specifies the condition of the gas mixture for a torch in order to pierce the plate and sustain the cutting action (used on flame cutters).

**Syntax**

PIERCE / OFF / ON [, *a*, *b*, *c*, *d*]

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| OFF | IC = 72 | Specifies the off condition of the torch. |
| ON | IC = 71 | Specifies the on condition of the torch. |
| *a* | | Specifies the heating period in seconds. |
| *b* | | Specifies the setting for fuel gas valve. |
| *c* | | Specifies the setting for heating oxygen valve. |
| *d* | | Specifies the setting for cutting oxygen valve. |

## P I T C H

[Integer code $n = 1050$]

Pitch. Specifies thread pitch.

### Syntax

PITCH/$a$ [, INCR, $b$ / , DECR, $c$] [, MULTRD, $d$]

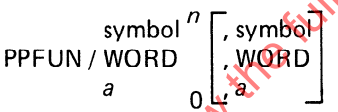
### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| $a$ | | Specifies the thread pitch. |
| INCR, $b$ | IC = 66 | Specifies the rate of increase or decrease in the pitch. |
| DECR, $c$ | IC = 65 | |
| MULTRD, $d$ | IC = 119 | Specifies the number of starts in a multiple thread. |

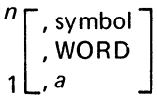
**P P F U N** [Integer code $n = 1079$]

Post-processor function. Specifies special commands or instructions given by the part-programmer for the use of the post-processor.

**Syntax**




**Minor element definitions**




These elements provide for the initialization and alteration of specific internal post-processor parameters. The identification, definition and use of each parameter will be documented for each post-processor by the post-processor writer.

**P P L O T** [Integer code $n = 1014$]

Post-processor plot. Generates a plot of CLDATA co-ordinates.

**Syntax**

PPLOT/ ON / OFF [, XYPLAN] [, YZPLAN] [, ZXPLAN] [, *a, b, d, e* / , *a, b, c, d, e, f*] [, SCALE, *g*]

PPLOT/MEDIUM, *h, i, j*

PPLOT/PEN, BLACK / RED / GREEN / BLUE / SCRIBE / *k* / *k, l, m*

PPLOT/DOTTED, SOLID / DASH / CTRLIN / SYMBOL, *n* [XYPLAN / , YZPLAN / ZXPLAN]

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| OFF<br>(NOMORE) | IC = 72<br>IC = 53 | Stops plotting of CLDATA co-ordinates. |
| ON<br>(START) | IC = 71<br>IC = 57 | Starts plotting of CLDATA co-ordinates. |
| XYPLAN<br>YZPLAN<br>ZXPLAN | IC = 33<br>IC = 37<br>IC = 41 | Specifies projection plane(s). |

| | | |
|---|---|---|
| *a, b, d, e*<br>*a, b, c, d, e, f* | | Specifies the rectangular CLDATA co-ordinates corresponding to the opposite corners of the range of CLDATA to be plotted. |
| SCALE, *g* | IC = 25 | Specifies a scaling factor. |
| MEDIUM, *h, i, j* | IC = 61 | Specifies code numbers which indicate paper type, size and orientation respectively. |
| PEN, BLACK | IC = 128, 130 | Specifies pen by colour or type. |
| PEN, RED | IC = 128, 131 | |
| PEN, GREEN | IC = 128, 132 | |
| PEN, BLUE | IC = 128, 133 | |
| PEN, SCRIBE | IC = 128, 129 | |
| PEN, *k* | IC = 128 | |
| PEN, *k, l, m* | IC = 128 | Specifies pen type, size and colour respectively. |
| SOLID | IC = 123 | Specifies continuous line ———————— |
| DASH | IC = 124 | Specifies dashed line — — — — — — — — — — — — — — — — — — — — — — |
| DOTTED | IC = 125 | Specifies dotted line . . . . . |
| CTRLIN | IC = 126 | Specifies dash-dotted line —.—.—.—.—.—.—.—.—.—.—.—.—.—.— |
| SYMBOL, *n* | IC = 235 | Specifies the symbol by code number which will be plotted at each of the co-ordinates given. |
| XYPLAN | IC = 33 | Specifies the view to which the line or symbol specification applies. |
| YZPLAN | IC = 37 | |
| ZXPLAN | IC = 41 | |

## P P R I N T

[Integer code $n = 1044$]

Post-processor print. Indicates that the characters which follow the printed on the post-processor output listing or plotted as specified by a previous LETTER (1043) command.

**Syntax**

PPRINT / $\overset{n}{1}$[character item]

---

As the maximum size of a CLDATA record is 245 words, the maximum size of $n$ in current implementations is 80.

**P R E F U N** [Integer code $n = 1048$]

Preparatory function. Provides facility to insert preparatory function (G) code numbers on control tape.

**Syntax**

PREFUN/$a\,{}^{n}_{0}[, a]$

**Minor element definitions**

| | |
|---|---|
| *a* | Specifies the preparatory function (G) code number or numbers to be output in a single block. |

## REWIND

[Integer code $n = 1006$]

Rewind. Commands the rewinding of the control tape back to some TMARK (1005) or start of program position.

**Syntax**

REWIND/[*a*]

**Minor element definitions**

*a* Specifies a tape mark identification.

NOTE – Most control systems only rewind to the start of program position. Rewind to a TMARK is normally manually initiated.

**R O T A B L** [Integer code $n = 1026$]

Rotate table. Commands rotation of the table to the specified position or through the given angle.

**Syntax**

$$\text{ROTABL} / \begin{matrix} a \\ \text{INCR}, b \\ \text{ATANGL}, a \end{matrix} \left[ \begin{matrix} , \text{CLW} \\ , \text{CCLW} \end{matrix} \right] [, \text{ROTREF}] \left[ \begin{matrix} , \text{NOW} \\ , \text{NEXT} \end{matrix} \right]$$

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a*<br>ATANGL, *a*<br>(*a*, ATANGL) | IC = 1<br>IC = 1 | Specifies positioning to an angle *a* in degrees where the direction of rotation and the absolute zero position are as defined in ISO 841. |
| INCR, *b*<br>(*b*, INCR) | IC = 66<br>IC = 66 | Specifies rotation by an angle *b* in degrees where the direction of rotation is as specified in ISO 841. |
| CLW<br>CCLW | IC = 60<br>IC = 59 | Specifies that the direction of rotation is negative or positive respectively. |
| ROTREF | IC = 68 | Specifies a rotation of the part programmer's reference system. |
| NOW | IC = 161 | Specifies that the rotation command be output immediately. |
| NEXT | IC = 162 | Specifies that the rotation command be output with the next motion command. |

## R O T H E D

[Integer code $n$ = 1035]

Rotate head. Commands rotation of the machine-tool head to the specified position or through the given angle.

### Syntax

$$\text{ROTHED} \;/\; \begin{matrix} a \\ \text{INCR}, b \\ \text{ATANGL}, a \end{matrix} \left[ \begin{matrix} \text{, CLW} \\ \text{, CCLW} \end{matrix} \right] [\text{, ROTREF}] \left[ \begin{matrix} \text{NOW} \\ \text{, NEXT} \end{matrix} \right]$$

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| *a*<br>ATANGL, *a*<br>(*a*, ATANGL) | IC = 1<br>IC = 1 | Specifies positioning to an angle *a* in degrees where the direction of rotation and the absolute zero position are as specified in ISO 841. |
| INCR, *b*<br>(*b*, INCR) | IC = 66 | Specifies rotation by an angle *b* in degrees where the direction of rotation is as specified in ISO 841. |
| CLW<br>CCLW | IC = 60<br>IC = 59 | Specifies that the direction of rotation is negative or positive respectively. |
| ROTREF | IC = 68 | Specifies a rotation of the part programmer's reference system. |
| NOW | IC = 161 | Specifies that the rotation command be output immediately. |
| NEXT | IC = 162 | Specifies that the rotation command be output with the next motion command. |

## S A F P O S

[Integer code $n = 1094$]

Safe position. Indicates a position for tool changing.

**Syntax**

SAFPOS/*a*

SAFPOS/*b*, *c* [, *a*]

SAFPOS/NOMORE

**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a* | | Specifies the *Z* height to which the tool reference point has to be retracted for tool changing (given in terms of workpiece co-ordinate system). |
| *b*, *c* | | Specify the *X* and *Y* co-ordinates to which the tool reference point has to be moved for tool changing. |
| NOMORE | IC = 53 | Specifies that an earlier stated safe position (SAFPOS statement) is no longer valid. |

## S E L C T L

[Integer code $n = 1056$]

Select tool. Commands tool selection for subsequent loading.

### Syntax

SELCTL/ [TOOL, Symbol, *a*,] *b* [, LENGTH, *c*]

{ [, SETOOL, *d*, *e*, *f*] [, SETANG, *g*] [, ATANGL, *h*]

[, HOLDER, *i*] / [, [HOLDER,] LARGE / SMALL] [, MANUAL] [, DIAMET, *j*] [, CLW / , CCLW]

[, ADJUST [, NOW / , NEXT]] [, OSETNO, *k* [, *l*]] }

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| TOOL, Symbol, *a* | IC = 3017 | Inserted by the processor when the symbolic tool is previously defined. |
| *b* | | Specifies identification number or magazine position of the tool. |
| LENGTH, *c* | IC = 9 | Specifies the length of the tool. |
| SETOOL, *d*, *e*, *f* | IC = 155 | Specifies the *X*, *Y*, *Z* distances from the reference point on the tool to the control point on the tool holder with the setting angle applied. |
| SETANG, *g* | IC = 156 | Specifies setting angle of tool. *g* corresponds to angle between machine axis and tool axis in degrees. |

| | | |
|---|---|---|
| ATANGL, *h* | IC = 1 | Specifies angle of tool axis to holder axis in degrees. |
| HOLDER, *i* | IC = 157 | Specifies the holding device used to grip the tool. |
| [HOLDER,] LARGE | IC = 157,7 | Specifies the larger holding device. |
| [HOLDER,] SMALL | IC = 157,26 | Specifies the smaller holding device. |
| MANUAL | IC = 158 | Specifies that the tool is to be loaded manually by the operator. |
| DIAMET, *j* | IC = 509 | Specifies the tool diameter. |
| CLW | IC = 60 | Specifies direction of rotation of a selection mechanism. |
| CCLW | IC = 59 | |
| ADJUST | IC = 159 | Specifies that tool compensations be applied. |
| ADJUST, NOW | IC = 159, 161 | Specifies that compensation be applied in the current or next block respectively. |
| ADJUST, NEXT | IC = 159, 162 | |
| OSETNO, *k* | IC = 508 | Specifies the correction dial number. |
| OSETNO, *k*, *l* | IC = 508 | Specifies the two axis correction dial numbers. |

S E Q N O

[Integer code $n = 1019$]

Sequence number. Permits modification of the sequence numbering of control blocks.

**Syntax**

SEQNO / OFF
ON
AUTO
*a* [, INCR, *b*]
[*a*,] INCR, *c* [, *d*]
CONST, *e*

**Minor element definitions and integer code numbers**

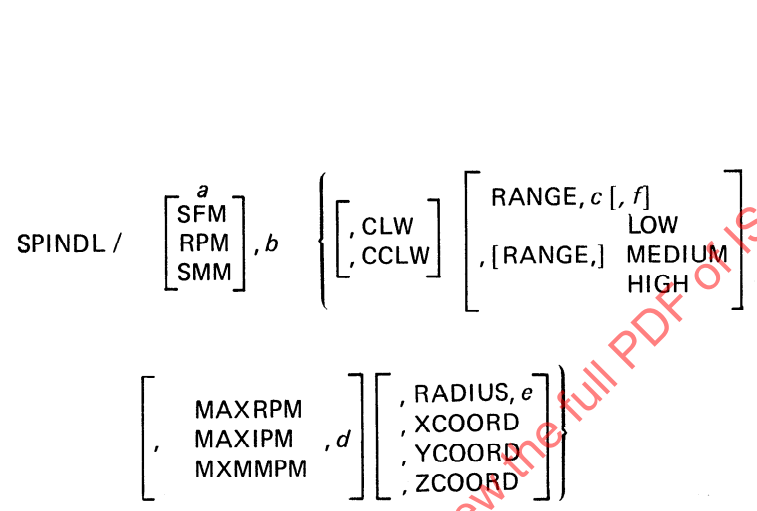
| | | |
|---|---|---|
| OFF | IC = 72 | Specifies interruption of numbering of blocks. |
| ON | IC = 71 | Reactivates the last method of sequence numbering. |
| AUTO | IC = 88 | Specifies that the sequence number is to correspond to the CLDATA sequence number. |
| *a* | | Specifies that the next block is to numbered *a*. Unless further instructed, numbering will then revert back to previous system. |
| INCR, *b* | IC = 66 | Specifies that the sequence number for each *b*th block will be incremented by 1. |
| INCR, *c*, *d* | IC = 66 | Specifies that the sequence number for each *d*th block is to be incremented by *c*. |
| CONST, *e* | IC = 64 | Specifies that subsequent blocks are to be numbered *e*. |

## S P I N D L

[Integer code $n = 1031$]

Spindle. Specifies spindle functions.

**Syntax**




**Minor element definitions and integer code numbers**

| | | |
|---|---|---|
| *a* | | Specifies speed in revolutions per minute. |
| SFM, *b* | IC = 115 | Specifies peripheral cutting speed in feet per minute. |
| RPM, *b* | IC = 78 | Specifies speed in revolutions per minute. |
| SMM, *b* | IC = 505 | Specifies peripheral cutting speed in metres per minute. |
| CLW | IC = 60 | Specifies clockwise and anticlockwise spindle rotation as defined in ISO 1056. |
| CCLW | IC = 59 | |
| RANGE, *c*, *f* | IC = 145 | Specifies outer and inner ranges. |

| | | |
|---|---|---|
| RANGE, *c*<br>LOW<br>RANGE, LOW<br>MEDIUM<br>RANGE, MEDIUM<br>HIGH<br>RANGE, HIGH | IC = 145<br>IC = 63<br>IC = 63<br>IC = 61<br>IC = 61<br>IC = 62<br>IC = 62 | Specifies a given range. |
| MAXRPM, *d* | IC = 79 | Specifies maximum permitted revolutions per minute. |
| MAXIPM, *d* | IC = 96 | Specifies maximum permitted feedrate in inches per minute. |
| MXMMPM, *d* | IC = 506 | Specifies maximum permitted feedrate in millimetres per minute. |
| RADIUS, *e* | IC = 23 | Specifies the value of the radius to be used in calculation of cutting speed. |
| XCOORD<br>YCOORD<br>ZCOORD | IC = 116<br>IC = 117<br>IC = 118 | Specifies that the current value of the given co-ordinate will be used in calculation of cutting speed. |
| ON | IC = 71 | Establishes or re-establishes spindle speed. |
| OFF | IC = 72 | Stops spindle. |
| LOCK | IC = 114 | Specifies locking of the spindle. |
| NEUTRL | IC = 166 | Specifies disengagement of the spindle drive. |
| ORIENT | IC = 246 | Specifies indexing of the spindle to a fixed position, then locking. |

## S T A N

[Integer code $n = 1080$]

Setting angle. Specifies the angle at which the tool is to be set.

### Syntax

STAN/*a*

### Minor element definitions

| | |
|---|---|
| *a* | Specifies angle between machine axis and tool axis in degrees. |

## THREAD

[Integer code $n = 1036$]

Thread. Activates the threading mode for the next move only.

### Syntax

$$\text{THREAD } / \left\{ \begin{matrix} \text{FACE,} \\ \text{TURN,} \\ \text{TAPER,} \end{matrix} \right. \left[ \begin{matrix} \text{INCR,}\ a, \\ \text{DECR,}\ b, \end{matrix} \right] \left[ \begin{matrix} \text{TPI,}\ c, \\ \text{MMPR,}\ d, \end{matrix} \right] [\text{MULTRD,}\ e,]$$

$$[\text{DEPTH,}\ f,] \left[ \begin{matrix} \text{CUTS,}\ g \\ \text{CUTS,}\ h,\ i, \end{matrix} \right] [\text{FINCUT,}\ j,] [\text{CUTANG,}\ k,]$$

$$\left. [\text{OSETNO,}\ l,\ m,] \right\}$$

**Syntax note** – All of the above elements are shown as optional and are enclosed in braces, i.e { } showing that they can appear in any order. It is necessary, however, for at least one of the elements to appear in the statement.

The final comma of the last element appearing in the statement should not be used (see example given in figure 20).

### Minor element definitions and integer code numbers

| | | |
|---|---|---|
| FACE | IC = 81 | Specifies a thread normal to the axis of rotation. |
| TURN | IC = 80 | Specifies a thread parallel to the axis of rotation. |
| TAPER | IC = 540 | Specifies a thread at an angle to the principal axes of machine. |
| INCR, *a*<br>DECR, *b* | IC = 66<br>IC = 65 | Specifies the rate of increase or decrease in the lead of the thread. |

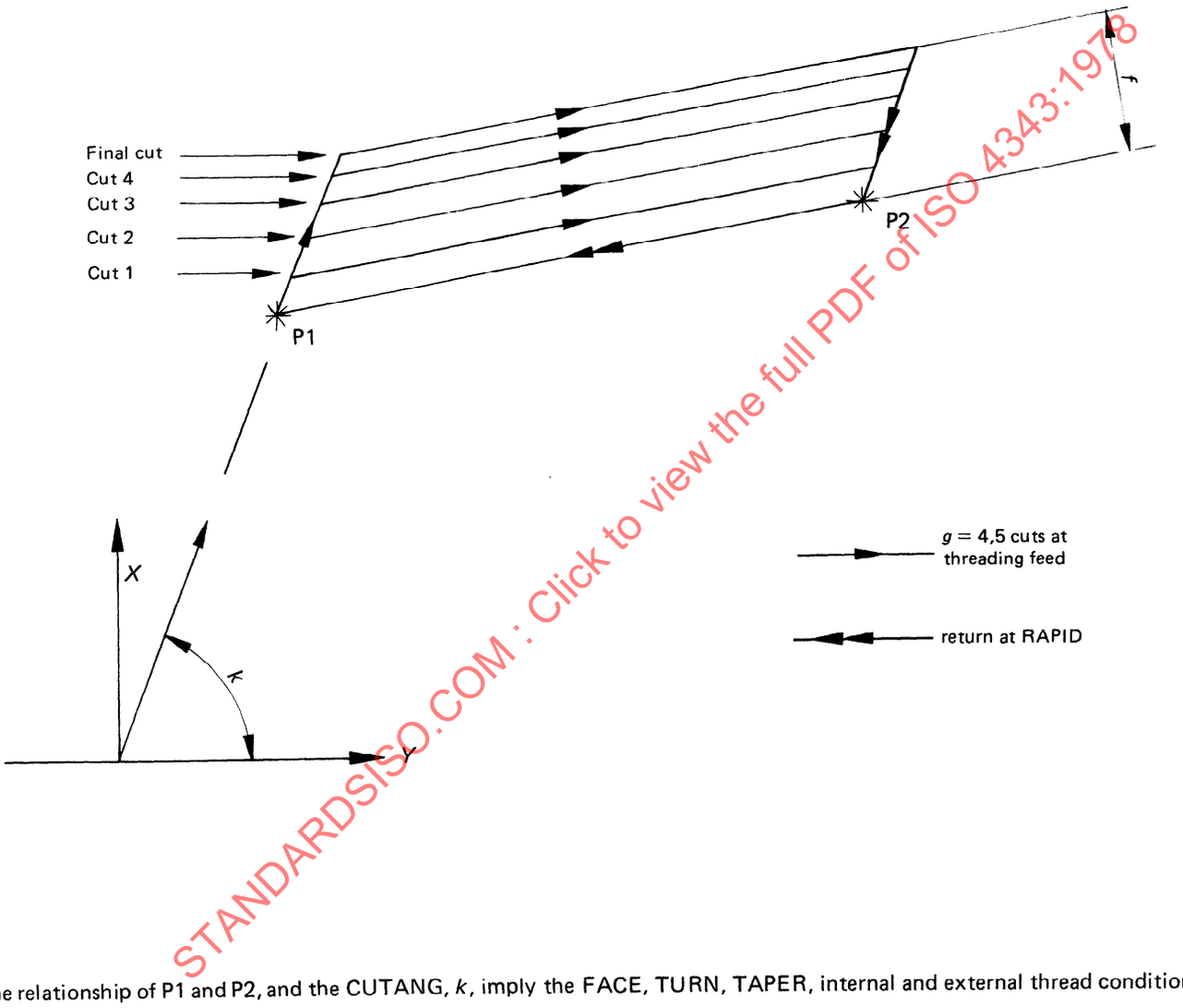
| | | |
|---|---|---|
| TPI, *c* | IC = 143 | Specifies the number of threads per inch. |
| MMPR, *d* | IC = 316 | Specifies the lead of the thread in millimetres per revolution. |
| MULTRD, *e* | IC = 119 | Specifies the number of starts in a multiple thread. |
| DEPTH, *f* | IC = 510 | Specifies the total depth of the threading operation. |
| CUTS, *g* | IC = 511 | Specifies the number of cuts over the total depth. |
| CUTS, *h*, *i* | IC = 511 | Specifies the number of cuts *h*, of depth *i*. |
| FINCUT, *j* | IC = 512 | Specifies the number of finishing cuts at final depth. |
| CUTANG, *k* | IC = 160 | Specifies the angle of the plunge direction. |
| OSETNO, *l*, *m* | IC = 508 | Specifies two correction switch dials activated alternately for each threading cut. |

Figure 20 shows an example of the use of some of the above elements.

GO TO/P1

THREAD/TPI, *c*, DEPTH, *f*, CUTS, *g*, CUTANG, *k*

GO TO/P2




The relationship of P1 and P2, and the CUTANG, *k*, imply the FACE, TURN, TAPER, internal and external thread conditions.

FIGURE 20