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Numerical control of machines — NC processor output — Logical structure (and major words)

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FOREWORD

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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 3592 was developed by Technical Committee ISO/TC 97, *Computers and information processing*, and was circulated to the member bodies in October 1977.

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

Belgium	Japan	Sweden
Czechoslovakia	Mexico	Switzerland
Egypt, Arab Rep. of	Netherlands	United Kingdom
France	Poland	U.S.A.
Germany F.R	Romania	U.S.S.R.
Hungary	South Africa, Rep. of	Yugoslavia
Italy	Spain	

No member body expressed disapproval of the document.

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Numerical control of machines – NC processor output – Logical structure (and major words)

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 "cutter location data".

0.2 CLDATA consists of logical records in blocks on physical media. The logical records of CLDATA are independent of computer implementation and are defined in this International Standard. The physical blocks are dependent on the computer implementation and are not defined here.

0.3 This CLDATA specification is based on APT[1] 3 working practice, and consideration is given to technological extensions. These extensions have been made in such a manner that there should be little interference with existing post-processors.

0.4 The choice of major words (annex A)[2], and the semantics (explanation) given for each, represents the result of 5 years' thorough study of the relevant sources by the ISO working groups.

1 SCOPE

This International Standard specifies the logical records of CLDATA for use with numerical control programming languages.

2 FIELD OF APPLICATION

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

2.2 Each post-processor shall be capable of using the CLDATA defined in this International Standard as its input.

3 GENERAL STRUCTURE OF CLDATA

3.1 CLDATA consists of a sequence of logical records.

3.2 Each logical record consists of a sequence of logical words, up to a maximum of 245.

3.3 A logical word is capable of representing

a) an integer number,

b) a real number,

c) six characters.

3.4 The first three logical words of a record have the same physical size and are always integers.

3.5 The logical words 4 to 245 have the same physical size (but not necessarily the same as the first three words).

3.6 If the logical word represents a character item, the six left-most positions of the physical representation are used. Any remaining positions are filled with blanks.

If character data in the equivalent input part-program statement consist of less than six characters, on NC processor output the data will be right-justified with leading blanks to make up the necessary six characters.

3.7 The first word of each logical record contains a sequence number, commencing with 1, and incremented by 1.

The second word contains a record type code.

1) APT : Commonly used abbreviation for "automatically programmed tools".

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

3.8 The physical representation of a logical word is computer dependent.

3.9 The general format of each record is as follows :

W1 = record sequence number (integer);

W2 = record type (integer);

W3 . . . W*n* = data dependent on W2 and consisting of some or all of integer numbers, real numbers and character strings.

3.10 Where no character information exists, a data item will be "blank". Where no integer exists, the integer number 0 (zero) will be used.

3.11 The record types (W2) are coded by numbers as detailed below.

Record type	Name	Explanation
1 000	Input sequence	This record carries the sequence and identification of the statements of the original part program.
2 000**	Post-processor instructions	This record carries specific instructions to the post-processor.
3 000	Surface data	This record carries the canonical form of input geometry.
4 000*	Relative tool position	This record carries the relative tool position with respect to the drive and part surfaces.
5 000	Tool position	This record carries tool position and motion vector information relating to the tool.
6 000	Tolerance or cutter information	This record carries one type of information of tolerance, cutter or CUT-DNTCUT information.
7 000*	Starting information	This record carries the tool position with respect to the start-up surface
8 000*	Motion information	This record carries information indicating tool direction with respect to the last move.
9 000	Axis mode; units	This record carries multi-axis or units information
12 000*	Special program parameter	This record carries information or data for invocation of a special program to be called with an argument string.
14 000	Fini record	This record carries the termination record.
15 000	Unsegmented tool path	This record carried unsegmented information concerning non-linear tool paths.
16 000	Workpiece contour description	This record carries the workpiece contour description.
17 000	Tool description	
18 000	Material description	These records are under consideration for tool, material and machine descriptions respectively. The numbers are reserved for this purpose.
19 000	Machine description	
20 000**	Literal type post-processor command	This record carries specific literal instructions to the post-processor
28 000 to 32 000	Proprietary records	Numbers reserved for private use. These records will not be standardized.

* The 4 000, 7 000, 8 000 and 12 000 type records **are included "for information only"**.

These records do not normally form part of CLDATA files input to post-processors **but are here included for information.**

** Vocabulary words used in a part program may be represented in the output data in either of two ways. In the first method, each word is represented by an integer code, and the records are of type 2 000. Output data using this form consist of intermixed strings of integer and real numbers. (The distinction between integers and real numbers is computer dependent.) In the second method, each word appears as a literal string of characters and the records are of type 20 000. Output using this form consists of strings of couplets. The first member of each couplet identifies the nature of the second member. If the first member is the integer zero, then the second member is a real member. If the number in the first member is an integer, *n*, greater than zero, then the second member is a literal string of length *n*. The record type 20 000 is a non-preferred alternative to the 2 000 type. At the present time most existing systems use the 2 000 type.

4 LOGICAL STRUCTURE AND CONTENTS OF EACH RECORD TYPE

4.1 1 000 type record

This record carries the sequence and identification of the statements of the original part program.

W1 (integer) = record sequence number.

W2 (integer) = 1000.

W3 (integer) = part program statement number.

W4 (character string) = identification of original source statement.

W5 (character string) = identification or original source statement.

4.2 2 000 type record

This record carries specific instructions to the post-processor.

W1 (integer) = record sequence number.

W2 (integer) = 2000.

W3 (integer) = *n* (code representing the major word as detailed in annex A).

W4 onwards may contain a minor element list.[1] [2]

1) The following example is used to indicate the major and minor portions of an input statement : 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.

W1 (integer) = *n* (sequence number)
W2 (integer) = 2000
W3 (integer) = 1031 (code for SPINDL)
W4 (integer) = 78 (code for RPM)
W5 (real) = 5000.0
W6 (integer) = 145 (code for RANGE)
W7 (real) = 2.0

2) See ISO 4343, *Numerical control of machines — NC processor output — Minor elements of 2000 type records.*

3) See 4.17 for alternative method of carrying post-processor instructions.

4.3 3 000 type record

This record carries the canonical form of input geometry. Currently only circular drive surface information[1] is on this record.

W1 (integer) = record sequence number.

W2 (integer) = 3000.

W3 (integer) = surface use indicator. Not defined for post-processor use.

W4 (integer) = surface condition indicator (TO, ON, PAST, TANTO, PSTAN). Not defined for post-processor use.

W5 (integer) = surface type indicator (4 for CIRCLE).

W6 (integer) = number of words of surface data (name, subscript and canonical form) (9 for CIRCLE).

W7 (character string) = symbolic name of drive surface.

W8 (integer) = subscript.

W9 (real) = X coordinate of centre of circle.

W10 (real) = Y coordinate of centre of circle.

W11 (real) = Z coordinate of centre of circle.

W12 (real) = I component of axis unit vector.

W13 (real) = J component of axis unit vector.

W14 (real) = K component of axis unit vector.

W15 (real) = value of circle radius.

1) Generally used by post-processors but W5 is used for other surface type information with a corresponding change to W6 through W245 as required.

4.4 4 000 type record

This record carries the tool position with respect to the drive and part surfaces. This record is used by some NC processors as intermediate file data. It is not normally part of the CLDATA file written by the processor for input to a post-processor but is included here for information only.

W1 (integer) = record sequence number.

W2 (integer) = 4000.

W3 (integer) = tool position indicator

= 1 for TLLFT

= 2 for TLRGT

= 3 for TLON

= 5 for TLONPS

= 6 for TLOFPS

4.5 5 000 type record

This record carries tool position and motion vector information relating to the tool (for example centre of end of a cylindrical milling cutter). The information can represent the co-ordinates of a single point, a succession of points, or the co-ordinates and associated tool axis vectors.

W1 (integer) = record sequence number.

W2 (integer) = 5000.

W3 (integer) = 3 for FROM, 4 for GODLTA, 5 for all other motion types, for example GOTO and 6 for a continuation of a type 5 (i.e. where there are more points generated than can be carried in one logical record).

W4 (character string) = first geometric symbol of the minor part of the part-program instruction.

W5 (integer) = subscript or point index.

Basic three-axis co-ordinate information[1]

W6 (real)	= *X* co-ordinate of first point	
W7 (real)	= *Y* co-ordinate of first point	triplet
W8 (real)	= *Z* co-ordinate of first point	
W9 (real)	= *X* co-ordinate of second point	
W10 (real)	= *Y* co-ordinate of second point	triplet
W11 (real)	= *Z* co-ordinate of second point	

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W245

or multi-axis information sets[2]

W6 (real	= *X* co-ordinate of first point	
W7 (real)	= *Y* co-ordinate of first point	
W8 (real)	= *Z* co-ordinate of first point	
W9 (real)	= *I* component of first tool axis vector	sextet
W10 (real)	= *J* component of first tool axis vector	
W11 (real)	= *K* component of first tool axis vector	

1) See 4.12, figure 2, for an example of the use of 5 000 type records.

2) Indicated by a previous MULTAX record (9 000 type record) (see 4.9).

W12 (real)	= *X* co-ordinate of second point	sextet
W13 (real)	= *Y* co-ordinate of second point	
W14 (real)	= *Z* co-ordinate of second point	
W15 (real)	= *I* component of second tool axis vector	
W16 (real)	= *J* component of second tool axis vector	
W17 (real)	= *K* component of second tool axis vector	

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W245

NOTES

1 As the maximum size of a record is 245 words, one record can contain a maximum of 80 sets of three axis data or 40 sets of multi-axis data.

2 In multi-axis information sets, tool axis vectors point from tool tip to tool holder.

4.6 6 000 type record

This record carries one type of information of tolerance, cutter or CUT-DNTCUT cut information.

CUT-DNTCUT cut information :

W1 (integer) = record sequence number.

W2 (integer) = 6000.

W3 (integer) = record subtype (1 for CUT-DNTCUT).

W4 (integer) = 1 for DNTCUT.

= 0 for CUT.

Tolerance information :

W1 (integer) = record sequence number.

W2 (integer) = 6000.

W3 (integer) = record subtype (4 for INTOL, 5 for OUTTOL).

W4 (real) = tolerance for part surface.

W5 (real) = tolerance for drive surface.

W6 (real) = tolerance for check surface.

Cutter information (see figure 1 for generalized cutter) :

W1 (integer) = record sequence number.

W2 (integer) = 6000.

W3 (integer) = record subtype (6 for CUTTER).

W4 (real) = cutter diameter, *d*.

W5 (real) = corner radius, *r*.

W6 (real) = horizontal distance, *e*.

W7 (real) = vertical distance, *f*.

W8 (real) = angle, α, between horizontal and bottom line, AB.

W9 (real) = angle, β, between vertical and side line, BC.

W10 (real) = cutter height, *h*.