INTERNATIONAL STANDARD 1057

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Numerical control of machines — Interchangeable punched tape variable block format for positioning and straight-cut machining

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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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, International Standard ISO 1057 replaces ISO Recommendation R 1057-1969, drawn up by Technical Committee ISO/TC 97, *Computers and information processing*.

The Member Bodies of the following countries approved the Recommendation :

Australia	Iran	Spain
Belgium	Israel	Sweden
Czechoslovakia	Japan	Switzerland
Denmark	Netherlands	Turkey
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Poland	U.S.A.
Germany	Portugal	

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

Italy

Printed in Switzerland

Numerical control of machines — Interchangeable punched tape variable block format for positioning and straight-cut machining

0 INTRODUCTION

The preparation of this International Standard has revealed the availability of a wide range of formats. Providing full interchangeability would lead, in many instances, to unwarranted and expensive equipment.

Accordingly, it was found better to draft two International Standards, namely :

— this International Standard, providing for interchangeability of input media for machines with compatible characteristics;

NOTE — The degree of interchangeability will depend upon the conformity of machines with respect to function, capacity, range, horsepower, geometric relationship of the axes and preparatory, miscellaneous and tooling functions.

— ISO 1058, which is consistent with this International Standard and which specifies the rules providing a minimum of uniformity in the manufacture of input media.

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard applies to variable block format punched tapes, with tabulation and addresses, for positioning and straight-cut machining; it is intended to

a) recommend application of the rules providing interchangeability of input media between machines of compatible characteristics;

b) inform users of numerically controlled machines on the potentialities of control systems.

1.2 This International Standard is consistent with ISO 1058.

1.3 The format characteristics are specified in clause 4 and in annexes C and D.

1.4 The technical tems used in this International Standard are based on the ISO data processing vocabulary[1].

1.5 Tape dimensions, character codes and nomenclature of axes conform respectively to ISO 1154 and ISO 1729, ISO 840 and ISO 1113, and ISO 841.

2 REFERENCES

ISO 840, *Numerical control of machines — 7-bit coded character set.*

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.*[2]

ISO 1058, *Numerical control of machines — Punched tape variable block format for positioning and straight-cut machining.*

ISO 1113, *Information processing — Representation of 6- and 7-bit coded character sets on punched tape.*

ISO 1154, *Information processing — Punched paper tape — Dimensions and location of feed holes and code holes.*

ISO 1729, *Information processing — Unpunched paper tape — Specification.*

3 FORMAT MAKE-UP

3.1 Addresses

The address consists of a character which shall be in accordance with annex B.

3.2 Blocks

3.2.1 A block consists of the following :

1) In preparation.

2) At present at the stage of draft. (Revision of ISO/R 1056.)

3.2.1.1 The "sequence number" word.

3.2.1.2 The data words.

3.2.1.3 The "end of block" character, showing the end of each block, and which must, in addition, precede the first block of the program.

3.2.2 The data words are presented in the following sequence, and shall not be repeated within a block :

3.2.2.1 The "preparatory function" word.[1)]

3.2.2.2 The "dimension" words.

These words shall be arranged in the following sequence :

X, Y, Z, U, V, W, P, Q, R, A, B, C, D, E.

3.2.2.3 The "feed function" word or words.

The "feed function" word applying only to a specific axis shall immediately follow the "dimension" word for that axis.

The "feed function" word applying to one or more of several axes shall follow the last "dimension" word to which it may apply.

3.2.2.4 The "spindle speed function" word.

3.2.2.5 The "tool function" word.

3.2.2.6 The "miscellaneous function" word.[1)]

3.2.3 The words, the "tab" character excepted, may be omitted when not indispensable in a specific block of data. This should be understood as meaning that there is no change in the condition of the machine with respect to the function corresponding to the omitted word.

Instructions which are inherently executed in a single block must be repeated whenever necessary, for example a tool change.

3.2.4 The words appearing after the last one having an actual use within a block may be omitted, including the "tab" character, i.e. the "end of block" character may be used after any complete word.

3.3 Words

3.3.1 The length of each specific word and the position of the implicit decimal sign, as defined in the format specification, shall remain constant. Hence, to keep up the aforementioned length, the relevant number of zeros must be included.

3.3.2 The "tab" character is the first character in each word (except that the "sequence number" word has no "tab" character); the address character ("sequence number" excepted) is the second character and is followed by digital data.

3.3.3 The "dimension" words shall be either co-ordinate dimension words (absolute dimension) or incremental dimension words (relative dimension) according to format specification, and shall contain digital data as follows :

3.3.3.1 The most significant digit of the "dimension" word shall be first.

3.3.3.2 *Units*

3.3.3.2.1 All linear dimensions shall be expressed in millimetres or inches and decimal fractions thereof.

3.3.3.2.2 All angular dimensions shall be expressed in decimal parts of a revolution or in degrees and decimal parts of a degree; decimal parts of a revolution is recommended practice.

3.3.3.3 *Decimal sign*

Decimal sign shall not be used, its implicit position being defined by the format specification.

3.3.3.4 *Sign of linear and angular dimensions*

3.3.3.4.1 When the control system allows using absolute dimensions either positive or negative with respect to the origin of the co-ordinate system, the algebraic sign (+ or −) is part of the "dimension" word and shall precede the first digit.

3.3.3.4.2 When the control system only permits use of positive dimensions, the algebraic sign shall be omitted from the "dimension" words.

3.3.3.4.3 When the control system uses incremental dimensions, the albebraic sign (+ or −) is compulsory and shall precede the first digit of each dimension in order to show the direction of motion.

3.3.4 Non-dimension words shall contain digital data as follows :

3.3.4.1 The "sequence number" shall consist of three (3) digits.

3.3.4.2 The "preparatory function" shall be expressed by a two (2)-digit coded number. For designation, see the footnote on page 2.

1) For coding of preparatory and miscellaneous functions, see ISO 1056.

3.3.4.3 The "feed function or functions" shall be expressed by a coded number, the composition of which is described in annex A.

3.3.4.4 The "spindle speed function" shall be expressed by a coded number, the composition of which is described in annex A.

3.3.4.5 The "tool function" shall be expressed by a coded number, the number of digits being specified in the format specification.

3.3.4.6 The "miscellaneous function" shall be expressed by a two (2)-digit coded number. For designation, see the footnote on page 2.

4 FORMAT SPECIFICATION

This consists of three sections, as follows :

– format classification shorthand, in accordance with annex C;

– format classification detailed shorthand, in accordance with annex D;

– itemized data of the format contents, which are not subject to standardization. An explanatory note is attached for guidance of users (annex F).

NOTE – Annex E shows an example of tab and address variable block format.

ANNEX A

FEED AND SPINDLE SPEED CODE

Feed and spindle speed functions shall be expressed by a coded number. The codes used and the units which are employed are specified in the format specification.

A.1 NUMBER

The number is composed of three, four or five digits, the significance of which is as follows :

– the first digit is a decimal multiplier, and has a value three (3) greater than the number of digits to the left of the decimal sign of the feed or speed value;

– the subsequent digits are the feed or spindle speed rounded to two- three- or four-digit accuracy.

When there are no digits to the left of the decimal sign, then the number of zeros immediately to the right of the decimal sign is subtracted from three (3) to provide the value of the first digit.

Example

Feed or spindle speed	Coding
1728	717
150,3	615
15,25	515
7,826	478
0,1537	315
0,01268	213
0,008759	188
0,0004624	046

NOTE – The second digit can never be zero unless all digits are zero.

If the three-digit coded number does not satisfy the degree of control necessary for the process, this number may be expanded to a four (4)- or five (5)-digit number, as necessary, to meet the requirement. This coded number for the "feed function" or the "spindle speed function" is rounded to three (3)-digit accuracy for a four (4)-digit code and rounded to four (4)-digit accuracy for a five (5)-digit code. This must be defined in accordance with format classification detailed shorthand. (See annex D.)

Example

Feed or spindle speed	4-digit coding	5-digit coding
1728	7173	71728
150,3	6150	61503
15,25	5153	51525
7,826	4783	47826
0,1537	3154	31537
0,01268	2127	21268
0,008759	1876	18759
0,0004624	0462	04624

NOTE – The second digit can never be zero unless all digits are zero.

A.2 UNITS

Units employed are as follows :

A.2.1 Feeds

For linear motions independent of spindle speed :

inch/min or mm/min.

For linear motions dependent on spindle speed :

inch/rev or mm/rev.

For threading, tapping or chasing, in the "inch" system :

rev/inch.

For threading, tapping or chasing, in the metric system :

mm/rev.

A.2.2 Speeds

For rotary table motion and spindle speed :

rev/min.

ANNEX B

CHARACTERS

B.1 ADDRESS CHARACTERS

Character	Meaning
A	Angular dimension about X axis
B	Angular dimension about Y axis
C	Angular dimension about Z axis
D	Angular dimension about special axis or : third feed function[1]
E	Angular dimension about special axis or : second feed function[1]
F	Feed function
G	Preparatory function
H	Permanently unassigned
I	Unassigned } Not to be used in positioning and straight-cut systems
J	Unassigned
K	Unassigned
L	Permanently unassigned
M	Miscellaneous function
N	Sequence number
O	Do not use
P	Tertiary motion dimension parallel to X[1]
Q	Tertiary motion dimension parallel to Y[1]
R	Rapid traverse dimension in the Z axis or : tertiary motion dimension parallel to Z[1]
S	Spindle speed function
T	Tool function
U	Secondary motion dimension parallel to X[1]
V	Secondary motion dimension parallel to Y[1]
W	Secondary motion dimension parallel to Z[1]
X	Primary X motion dimension
Y	Primary Y motion dimension
Z	Primary Z motion dimension
:	Alignment function[2]

B.2 MISCELLANEOUS CHARACTERS

Character	Meaning
+	Plus
–	Minus
[tab][3]	Tabulation
/	Optional block skip[4]
%	Program start[5]
[LF][3]	End of block
(	Control Out[6]
)	Control In[6]

1) When D, E, P, Q, R, U, V and W are not used as indicated above, they become unassigned, and may be used as necessary for special application.

2) After an "alignment function" word, all information necessary to commence or recommence machining must be encoded. The "alignment function" character shall be used instead of N as the address character for the "sequence number" word. The "alignment function" character may be used as a "reference rewind stop".

3) Square brackets indicate non-printing characters.

4) The "/" (slash) character shall be used to provide an "optional block skip" function validated at the option of the operator. When used, this character shall immediately precede the "sequence number" word.

5) The "program start" character shall precede the first "end of block" character in the program. It may be used as an "absolute rewind" stop.

6) Any statement appearing between "left parenthesis" character and "right parenthesis" character shall be ignored by the control system. If such a statement appears within a control program, it shall contain neither ":" not "%" characters.

ANNEX C

FORMAT SPECIFICATION

Format classification shorthand

The format classification shorthand shall consist of groups of characters defined as follows :

C.1 The first group of characters shall contain the letter I (meaning "Interchangeable") followed by others selected as follows :

C.1.1 P for the variable block format applied to positioning systems

or

L for the variable block format applied to positioning and straight-cut systems.[1)]

C.1.2 M for linear dimensions expressed in millimetres and decimal fractions thereof

or

I for linear dimensions expressed in inches and decimal fractions thereof.

C.1.3 If need be :

R for angular dimensions expressed in decimal fractions of a revolution

or

D for angular dimensions expressed in degrees and decimal fractions thereof.

C.2 The next group, comprising three digits, denotes the geometrical characteristics of both machine and control system, as follows :

C.2.1 The first digit shows the number of motions either digitally or symbolically (i.e. stop-dogs) controlled.

C.2.2 The second digit shows the number of motions controlled by the "dimension" words (and not by marks denoting a stop-dog, an indexed setting, etc.).

C.2.3 The third digit shows the number of simultaneously controlled motions.

TYPICAL EXAMPLE

The format of a control system for a machine featuring

- a vertical-spindle head moving on vertical slideways,
- a moving quill in the aforementioned head,
- a cross-slide table,

will be written thus : IPM321.

This denotes interchangeable (I) variable block format positioning (P) control system, the linear motions of which are expressed in millimetres (M), there being no angular motion.

This machine has three (3) motions controlled by the numerical control system (cross-slide, work-table, quill); a table position is digitally defined while the quill's is secured by selecting a preset stop-dog; both (2) table motions are provided by "dimension" words, the system controlling but a single (1) motion at a time.

1) This possibility is pointed out among the itemized characteristics of the format (see annex F).

ANNEX D

FORMAT SPECIFICATION

Format classification detailed shorthand

The classification detailed shorthand must specify the words and length thereof that are required by the system, as follows :

D.1 Every "tab" character shall be symbolized by a full stop (.).

D.2 The "end of block" character shall be symbolized by by an asterisk (*).

D.3 Any letter acting as address for a word shall be recorded in the proper sequence.

D.3.1 The address of every "dimension" word is followed by two (2) digits, the first showing the number of digits ahead of the implicit decimal sign, the other those following the said sign. If the absolute dimensions are always positive, no sign separates the address letter from the next number, whereas, if they are either positive or negative, the plus (+) sign is inserted between the address and the next number; if incremental dimensions are involved, the letter D is written between the address and the next number.

D.3.2 The address of a non-dimension word is followed by a single digit showing the number of digits in the word.

TYPICAL EXAMPLE

For a boring machine with a cross-slide, work-table and rotary table, a horizontal spindle head sliding vertically on upright slideways and a manually positioned quill, the classification shorthand being ILMD442, the classification detailed shorthand is

N3.G2.X+42.Y+32.Z31.B33.F3.S3.T2.M2*

the meaning being as follows :

N3	–	Three-digit sequence number;
G2	–	Two-digit preparatory function;
X + 42	–	Dimension X, with either + or − sign, four digits to the left of the implicit decimal sign, two to the right;
Y + 32	–	Dimension Y, with either + or − sign, three digits to the left of the decimal sign, two to the right;
Z31	–	Dimension Z, positive, three digits to the left of the decimal sign, one to the right;
B33	–	Dimension B, three digits to the left of the decimal sign, three to the right;
F3	–	Three-digit feed function code;
S3	–	Three-digit spindle speed function code;
T2	–	Two-digit tool function;
M2	–	Two-digit miscellaneous function;
*	–	End of block symbol;
.	–	Shows a tabulation and should appear before every word.