INTERNATIONAL STANDARD 1058

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Numerical control of machines — 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, Technical Committee ISO/TC 97, *Computers and information processing,* has received ISO Recommendation R 1058-1969 and found it technically suitable for transformation. International Standard ISO 1058 therefore replaces ISO Recommendation R 1058-1969, which was approved by the Member Bodies of the following countries :

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 – 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 may instances, to unwarranted and expensive equipment.

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

– this International Standard, specifying the rules providing a minimum of uniformity in the manufacture of input media;

– ISO 1057, which is consistent with this International Standard and which provides for interchangeability of input media for machines with compatible characteristics.

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

Machine builders who do not wish to comply fully with this International Standard are asked to follow it as much as possible.

1 SCOPE AND FIELD OF APPLICATION

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

a) recommend application of the rules providing a minimum of uniformity in the manufacture of input media;

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

1.2 Compliance with the conditions expressed in this International Standard does not guarantee interchangeability of tapes between machines of compatible features. To provide for interchangeability, tapes must conform to ISO 1057.

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

1.4 The technical terms 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 1057, *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.*

1) In preparation.

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

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 :

3.2.1.1 The "sequence number" word (optional).

3.2.1.2 The data words.

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

3.2.2 The data words are shown below. Their use depends on the function provided by the machine. "Dimension" words shall not be repeated in the same block.

It is recommended that the order be the following one :

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.

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 denoting 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 In order to reduce tape length, either leading or trailing zeros may be omitted from the "dimension" words where consistent with the control system, the location of the implicit decimal sign as defined in the format specification remaining constant. When a system with "tab" and without address is used, a number containing only zeros must be expressed by at least one zero.

3.3.2 The "tab" and/or address characters are the first of the word; the address character follows the "tab", if any, and is followed by digital data.

The "tab" character shall be omitted in the "sequence number" word.

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 in 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 absolute dimensions, the algebraic sign shall be omitted from the "dimension" words.

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

3.3.3.4.3 When the control system uses incremental dimensions, the algebraic 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, when employed, 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.

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 ARITHMETIC PROGRESSION

(Three- (four- or five-) digit code)

A.1.1 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.1.2 Units

Units employed are as follows :

A.1.2.1 *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.1.2.2 *Spindle speeds*

For rotary table motion and spindle speed :

rev/min.

A.2 GEOMETRIC PROGRESSION

(Two-digit code)

A.2.1 Number

Feed and spindle speed shall be given by a two (2)-digit code with increasing values of feed and spindle speed represented by increasing code numbers. In general, the ratio of any two feeds or spindle speeds in the table represented by two successive code numbers is constant. It is recommended that the coding shown as follows be used.

Code	Feed or spindle speed	Code	Feed or spindle speed	Code	Feed or spindle speed
00	0 Stop	34	50,0	68	2 500
01	1,12	35	56,0	69	2 800
02	1,25	36	63,0	70	3 150
03	1,40	37	71,0	71	3 550
04	1,60	38	80,0	72	4 000
05	1,80	39	90,0	73	4 500
06	2,00	40	100	74	5 000
07	2,24	41	112	75	5 600
08	2,50	42	125	76	6 300
09	2,80	43	140	77	7 100
10	3,15	44	160	78	8 000
11	3,55	45	180	79	9 000
12	4,00	46	200	80	10 000
13	4,50	47	224	81	11 200
14	5,00	48	250	82	12 500
15	5,60	49	280	83	14 000
16	6,30	50	315	84	16 000
17	7,10	51	355	85	18 000
18	8,00	52	400	86	20 000
19	9,00	53	450	87	22 400
20	10,0	54	500	88	25 000
21	11,2	55	560	89	28 000
22	12,5	56	630	90	31 500
23	14,0	57	710	91	35 500
24	16,0	58	800	92	40 000
25	18,0	59	900	93	45 000
26	20,0	60	1 000	94	50 000
27	22,4	61	1 120	95	56 000
28	25,0	62	1 250	96	63 000
29	28,0	63	1 400	97	71 000
30	31,5	64	1 600	98	80 000
31	35,5	65	1 800	99	Rapid
32	40,0	66	2 000		
33	45,0	67	2 240		

A.2.2 Units

Units employed are as follows :

A.2.2.1 *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.2.2.2 *Spindle speeds*

For rotary table motion and spindle speed :

rev/min.

A.2.3 Decimal sign

The decimal sign may be shifted to the left, its position being indicated by the format specification.

A.3 SYMBOLIC

(one-digit code)

Feed and spindle speed shall each be given by a one (1)-digit code. This code selects a spindle speed or feed from those available on the machine. The value of the spindle speed or feed appropriate to each code shall be detailed in the itemized data.

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 ":" nor "%" 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 letters 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 A for systems with addresses and without "tab".

T for systems with "tab" and without addresses.

S for systems with "tab" and addresses.

C.1.3 M for linear dimensions expressed in millimetres and decimal fractions thereof

or

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

C.1.4 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 : LAM321.

This denotes variable block format straight-cut and positioning (L) control system, without "tab" and with address (A), 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).