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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1058

PUNCHED TAPE VARIABLE BLOCK FORMAT
FOR POSITIONING AND STRAIGHT-CUT
NUMERICALLY CONTROLLED MACHINES

1st EDITION
April 1969

BRIEF HISTORY

The ISO Recommendation R 1058, *Punched tape variable block format for positioning and straight-cut numerically controlled machines*, was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, the Secretariat of which is held by the American National Standards Institute (ANSI).

Work on this question led to the adoption of a Draft ISO Recommendation.

In August 1967, this Draft ISO Recommendation (No. 1318) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

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

One Member Body opposed the approval of the Draft :

Italy

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in April 1969, to accept it as an ISO RECOMMENDATION.

ISO Recommendation	R 1058	April 1969

PUNCHED TAPE VARIABLE BLOCK FORMAT

FOR POSITIONING AND STRAIGHT-CUT

NUMERICALLY CONTROLLED MACHINES

INTRODUCTION

The preparation of this ISO Recommendation 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 ISO Recommendations, namely :

— this ISO Recommendation, specifying the rules providing a minimum of uniformity in the manufacture of input media;

— ISO Recommendation R 1057, *Interchangeable punched tape variable block format for positioning and straight-cut numerically controlled machines*, which is consistent with this ISO Recommendation, 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 ISO Recommendation are asked to follow it as much as possible.

1. SCOPE

1.1 This ISO Recommendation 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 ISO Recommendation does not guarantee interchangeability of tapes between machines of compatible features. To provide for interchangeability, tapes must conform to ISO Recommendation R 1057, *Interchangeable punched tape variable block format for positioning and straight-cut numerically controlled machines.*

1.3 The format characteristics are specified in section 3 and in Annexes C and D.

1.4   The technical terms used in this ISO Recommendation are based on the data processing vocubulary of ISO Recommendation R . . . [1].

1.5   Tape dimensions, character codes and nomenclature of axes conform respectively to the following ISO Recommendations :

R . . . [2],   *Dimensions for punched paper tape for data interchange*;

R 840,   *Code for numerical control of machines (compatible with the ISO 7-bit character set)*;

R . . . [3],   *Representation of six and seven bit coded character sets on punched tape*;

R 841,   *Axis and motion nomenclature for numerically controlled machines.*

2. FORMAT MAKE-UP

2.1   Addresses

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

2.2   Blocks

2.2.1   A block consists of the following :

2.2.1.1   The "sequence number" word (optional).

2.2.1.2   The data words.

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

2.2.2   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 :

2.2.2.1   The "preparatory function" word. [4]

2.2.2.2   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.

2.2.2.3   The "feed function" word or words.

2.2.2.4   The "spindle speed function" word.

2.2.2.5   The "tool function" word.

2.2.2.6   The "miscellaneous function" word.

2.2.3   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, e.g. a tool change.

2.2.4   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.

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[1] Now being drafted within Sub-Committee ISO/TC 97/SC 1, *Vocabulary.*

[2] At present, Draft ISO Recommendation No. 1671.

[3] At present, Draft ISO Recommendation No. 1418.

[4] For coding of preparatory and miscellaneous functions, see ISO Recommendation R 1056, *Punched tape block formats for the numerical control of machines – Coding of preparatory functions G and miscellaneous functions M.*

2.3 Words

2.3.1 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 point 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.

2.3.2 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.

2.3.3 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 :

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

2.3.3.2 *Units*

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

2.3.3.2.2 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.

2.3.3.3 *Decimal point*

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

2.3.3.4 *Sign of linear and angular dimensions*

2.3.3.4.1 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.

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

2.3.3.4.3 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.

2.3.4 Non-dimension words, when employed, shall contain digital data as follows :

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

2.3.4.2 The "preparatory function" shall be expressed by a two (2) digit coded number. For designation, see footnote [4] on page 4.

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

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

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

2.3.4.6 The "miscellaneous function" shall be expressed by a two (2) digit coded number. For designation, see footnote [4] on page 4.

3. 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 (Appendix Z).

NOTE. – Appendix Y 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 point 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 point, then the number of zeros immediately to the right of the decimal point 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	Code	Feed or spindle speed	Code	Feed or spindle speed
00	0 Stop	20	10.0	40	100	60	1000	80	10000
01	1.12	21	11.2	41	112	61	1120	81	11200
02	1.25	22	12.5	42	125	62	1250	82	12500
03	1.40	23	14.0	43	140	63	1400	83	14000
04	1.60	24	16.0	44	160	64	1600	84	16000
05	1.80	25	18.0	45	180	65	1800	85	18000
06	2.00	26	20.0	46	200	66	2000	86	20000
07	2.24	27	22.4	47	224	67	2240	87	22400
08	2.50	28	25.0	48	250	68	2500	88	25000
09	2.80	29	28.0	49	280	69	2800	89	28000
10	3.15	30	31.5	50	315	70	3150	90	31500
11	3.55	31	35.5	51	355	71	3550	91	35500
12	4.00	32	40.0	52	400	72	4000	92	40000
13	4.50	33	45.0	53	450	73	4500	93	45000
14	5.00	34	50.0	54	500	74	5000	94	50000
15	5.60	35	56.0	55	560	75	5600	95	56000
16	6.30	36	63.0	56	630	76	6300	96	63000
17	7.10	37	71.0	57	710	77	7100	97	71000
18	8.00	38	80.0	58	800	78	8000	98	80000
19	9.00	39	90.0	59	900	79	9000	99	Rapid

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 point

The decimal point 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
J	Unassigned ⎬ straight-cut systems
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]

[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".

B.2 MISCELLANEOUS CHARACTERS

Character	Meaning
+	Plus
–	Minus
[tab] [4]	Tabulation
/	Optional block skip [1]
%	Programme start [2]
[LF] [4]	End of block
(	Control Out [3]
)	Control In [3]

[1] 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.

[2] The "programme start" character shall precede the first "end of block" character in the programme. It may be used as an "absolute rewind stop".

[3] 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 programme, it shall contain neither ":" nor "%" characters.

[4] Square brackets indicate non-printing 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 afore-mentioned 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.

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[1] This possibility is pointed out among the itemized characteristics of the format (see Appendix Z).

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, if any, shall be symbolized by a full stop (.).

D.2   The "end of block" character shall be symbolized 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 point, the other those following the said point. If leading or trailing zeros may be omitted, the two digit designation should be changed to a three digit designation. If leading zeros may be omitted, the first digit shall be zero (0). If trailing zeros may be omitted, the last digit shall be zero (0). 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 LSMD442, the classification detailed shorthand is

N3.G2.X+42.Y+32.Z31.B33.F2.S2.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 point, two to the right;
Y + 32	–	Dimension Y, with either + or – sign, three digits to the left of the decimal point, two to the right;
Z31	–	Dimension Z, positive, three digits to the left of the decimal point, one to the right;
B33	–	Dimension B, three digits to the left of the decimal point, three to the right;
F2	–	Two-digit (geometric progression) feed function code;
S2	–	Two-digit (geometric progression) spindle speed function code;
T2	–	Two-digit tool function;
M2	–	Two-digit miscellaneous function;
*	–	End of block symbol;
.	–	Shows a tabulation and should appear, where employed, before every word.