

FED. SUPPLY CLASS

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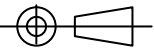
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THIRD ANGLE PROJECTION		CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 4
PROCUREMENT SPECIFICATION NONE		TITLE INTERCHANGEABLE PERFORATED TAPE STANDARDS VARIABLE BLOCK FORMAT, FOR NUMERICALLY CONTROLLED EQUIPMENT	CLASSIFICATION SPECIFICATION DAS955 SHEET 1 OF 24



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FOREWORD

The information and comments contained in this foreword should not be considered part of the standard. They have been included for clarification and guidance.

With the advent of numerical control and the continually increasing use of numerically controlled machine tools, many people, including control systems builders, machine tool builders and users, have realized the importance of a standardized input medium. This is particularly true for the large majority of numerically controlled machines using perforated tape input.

Based on this need, the Aerospace Industries Association/Manufacturing Committee has had liaison with the Electronic Industries Association committee TR-27 and subsequently TR-31, Numerical Control Systems and Equipment, to obtain unanimity of thinking. This committee is made up of representatives of control systems builders, machine tool builders and users.

A word address tape format is described in these standards and does not include tab characters. If a columnized listing is desired, tab characters may be included between words but will be ignored by the control system.

These revised standards replace NAS943 and NAS955 (Interchangeable Perforated Tape Standard Variable Block Format for Positioning and Straight Cut Numerically Controlled Equipment and Interchangeable Perforated Tape Standards Variable Block Format, Contouring and Contouring/Positioning Numerically Controlled Equipment) by combining methods, character and code assignments into a single format standard for numerically controlled equipment.

These standards cover perforated tape variable block format only and are not intended to specify machine design. If tape interchangeability is desired, certain provisions must be included by the control system builder and machine builder. Some of the provisions are:

- A. Feed & Speed: When the part programmer calls for feeds or speeds as outlined in Paragraphs 3.2.4.3 and 3.2.4.5, all such coded feeds and speeds within the range from at least 10% below the available minimum to at least 10% above the available maximum shall produce the most appropriate feeds and speeds available. Feed or speed codes outside the acceptable range shall stop operation.
- B. Tape Interchangeability at the Machine: Users desiring tape interchangeability between machines must make sure that these machines use tape with the same Format Classification (see Appendix A). In addition, the user must make sure that the machines have the same capability.
- C. Non-programmed Functions: Certain functions are normally controlled by the operator. These include mirror image, axis interchange, amount of cutter compensation, floating zero or zero offset and similar functions.
- D. Leading and Trailing zeros must be included in all words.
- E. Machine axis dynamics, such as maximum step velocity capability and cornering capability.
- F. Auxiliary code sequencing required by the machine, such as in tool change, pallet shuttles and spindles.

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1. SCOPE

1.1 Purpose

This specification is intended to serve as a guide in the coordination of system design to minimize the variety of program manuscripts required, to promote uniformity of programming techniques, and to foster interchangeability of input tapes between numerically controlled machines of the same classification by type, process function, size, and accuracy. It is intended that simple numerically controlled machines be programmed using a simple format which is systematically extensible for more complex machines.

1.2 Classification

This standard applies wherever variable block format is used on perforated tape to control numerically controlled machines. (Note: This format will usually be used with tape read row-by-row.)

1.2.1 Class III

Positioning and straight cut numerically controlled machine/controller.

1.2.2 Class IV

Continuous path or contouring/positioning numerically controlled machine/controller.

1.3 Intended Uses

Perforated tape with variable block format as described in the following sections shall be usable, interchangeably, among numerically controlled machines which conform to the same format classification as shown in Appendix A. (Note: The degree of interchangeability will depend upon the conformity of the machines with respect to function, capacity, range, horsepower, geometric relationship of axes, preparatory, miscellaneous and tooling functions and use of absolute or incremental dimensions.)

1.4 Revisions and Amendments

Revisions to these standards will be proposed as technical progress warrants, or as future standards are adopted which conflict with these standards.

2. APPLICABLE DOCUMENTS

The latest revisions of the following standards are included as a portion of this specification. Detail requirements listed in this specification shall override any contradictory portions of the following standards.

Aerospace Industries Association

All NAS900 series machine specifications adaptable to numerical control and using perforated tape as the input control, or any other machine not now covered by NAS which utilizes perforated tape.

NAS938 Machine Axis and Motion Nomenclature
NAS972 Glossary of Manufacturing Equipment Terms

Copies can be obtained from AIA, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209. www.aia-aerospace.org

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TechAmerica

- EIA-227-A One-Inch Perforated Tape
EIA-RS-244-B Character Code for Numerical Machine Control Perforated Tape
EIA-358-C American National Standard Code for Information Interchange for Numerical Machine Control

Copies can be obtained from TechAmerica, 601 Pennsylvania Avenue NW, North Building, Suite 600, Washington DC, 20004. www.techamerica.org

3. REQUIREMENTS

3.1 Tape Characteristics

- 3.1.1 Physical Characteristics per EIA-227-A.
3.1.2 Character Code per EIA-RS-244-B.
3.1.3 Customer Option: Character Code per EIA-358-C.

3.2 Words

- 3.2.1 The length of each word, as assigned by the Format Detail, shall remain constant (Appendix A).
3.2.1.1 Customer Option: Positive signs and either leading or trailing zeros shall be omitted.
3.2.2 Address characters shall be the first character of the word (Table I).
3.2.2.1 Customer Option: "Tab" characters shall be used and they shall precede the address character.
3.2.2.1.1 The "tab" character shall be omitted from the Sequence Number word (See Paragraph 3.5.2.1).
3.2.3 Dimension words shall be either coordinate (absolute dimension) or incremental (as specified by Format Classification) and shall contain digital data as follows:
3.2.3.1 The most significant digit of the dimension word shall be read first.
3.2.3.2 Decimal points shall not be used. The implicit position shall be defined by the Format Detail (Appendix A).
3.2.3.3 Coordinate Dimension Words
3.2.3.3.1 All linear coordinates shall be absolute and expressed in decimal inches (millimeters).
3.2.3.3.2 All angular coordinates shall be absolute and expressed in decimal degrees.
3.2.3.3.2.1 Customer Option: Angular coordinates shall be absolute and expressed in decimal parts of a revolution.
3.2.3.3.3 Where positive and negative coordinates are used, the + or – character is considered part of the coordinate and shall immediately precede the first digit of the corresponding coordinate.
3.2.3.3.3.1 Customer Option: The + sign shall be omitted and plus shall be assumed.
3.2.3.4 Incremental Dimension Words
3.2.3.4.1 All linear increments shall be expressed in decimal inches (millimeters) preceded by an algebraic sign to indicate direction.

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- 3.2.3.4.2 All angular increments shall be expressed in decimal degrees preceded by an algebraic sign to indicate direction.
- 3.2.3.4.2.1 Customer Option: Angular increments shall be expressed in decimal parts of a revolution.
- 3.2.3.4.3 The + and – character is considered part of the coordinate and shall immediately precede the first digit of the corresponding coordinate.
- 3.2.3.4.3.1 Customer Option: The + sign shall be omitted and plus shall be assumed.
- 3.2.4 Non-dimension words shall contain digital data as follows:
- 3.2.4.1 The "Sequence Number" (n) shall be designated by the Format Detail (Appendix A).
- 3.2.4.2 The "Preparatory Function" (g) shall consist of two (2) digits. For designations, see Appendix B.
- 3.2.4.3 The "Feed Function" (f) for linear, and for customer options circular (3.6.1) and parabolic (3.6.2), motions whose rate is independent of spindle speed shall be programmed in vectorial inches (millimeters) per minute. The length and range shall be designated by the Format Detail and Classification Sheet (Appendix A).
- 3.2.4.3.1 Customer Option: The "Feed Function" (f) for rates of vectorial motion (linear and/or rotary) independent of spindle speed and which are programmed in linear interpolation may be expressed by a "Feed Command". This "Feed Command" is the reciprocal of time in minutes to execute the block and is equivalent to the vector velocity (expressed in inches/millimeters per minute or degrees per minute) divided by the corresponding programmed vector distance (expressed in inches, millimeters, or degrees). The length and range of the "Feed Command" shall be designated by the Format Detail (Appendix A).
- 3.2.4.4 The "Feed Function" for rates of vectorial linear motion dependent upon spindle speed shall be programmed directly in inches (millimeters) per revolution. The length and range shall be designated by the Format Detail (Appendix A).
- 3.2.4.5 The "Spindle Speed Function(s)" shall be programmed directly in revolutions per minute. The length and range shall be designated by the Format Detail (Appendix A).
- 3.2.4.5.1 Customer Option: The "Spindle Speed Function" shall be programmed directly in surface feet (meters) per minute through the g96 Preparatory Function. The length and range shall be designated by the Format Detail (Appendix A).
- 3.2.4.6 Customer Option: "Feed and Speed Function" may be expressed in three (3) or more digit coded numbers. The second and third digits of this coded number are the feed or speed rounded to two digit accuracy. This coded number may be expanded to four (4) or five (5) digits. The coded number for feed or speed 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.
- 3.2.4.6.1 The first digit of the coded number 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. If there are no digits of the feed or speed 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. This must be defined in accordance with Format Detail (Appendix A).

Feed or Speed	3 Digit Coding	4 Digit Coding	5 Digit Coding
1728	717	7173	71728
150	615	6150	61500
15.2	515	5152	51520
7.82	478	4782	47820
.153	315	3153	31530
.0126	213	2126	21260
.00875	188	1875	18750
.0004624	046	0462	04624

(a) The second digit can never be zero unless all digits are zero.

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- 3.2.4.7 Start, stop and direction signals of feed and speed where required shall be "Miscellaneous Functions" or part of "Preparatory Functions", such as "Fixed Cycles" (Appendix B).
- 3.2.4.8 The "Tool Function" (t) shall consist of a number of digits defined by the Format Detail (Appendix A). When the tool identification and tool compensation are separately designated in the "t" word, then the tool compensation digits shall follow the associated tool identification digits.
- 3.2.4.8.1 Customer Option: Tool compensation shall be selected by a word with "d" address. The "d" word should immediately follow the "t" word within a block.
- 3.2.4.9 The "Miscellaneous Function" (m) shall consist of two (2) digits (Appendix B).
- 3.3 Blocks
- 3.3.1 The maximum number of characters per block for any particular case shall be derived from the Format Detail (Appendix A).
- 3.3.2 The "End of Block" character shall be used to indicate the end of each block. In addition, the first block of information shall be preceded by this character.
- 3.3.3 The "Sequence Number" word shall be first in the block.
- 3.3.4 The "Preparatory Function" word shall immediately follow the "Sequence Number" word.
- 3.3.5 "Dimension" words shall follow the "Preparatory Function" word. In systems containing multiple axes, dimensions in each block shall be in the order x, y, z, u, v, w, p, q, r, a, b, c, d, e (Sections 3.2 and 3.4).
- 3.3.6 The "Interpolation Parameter" words (i, j, & k) shall follow immediately in respective order the group of dimension words to which they apply.
- 3.3.7 The "Feed Function" word applying only to a specific axis shall immediately follow the "Dimension" word for that axis (Section 3.4.1.3).
- 3.3.8 The "Feed Function" word applying to one or more of several axis shall follow the last "Dimension" word to which it applies (Section 3.4.1.3).
- 3.3.9 The "Spindle Speed Function" word shall immediately follow the "Feed Function" or "Dimension" word.
- 3.3.10 The "Tool Function" word shall immediately follow the "Spindle Speed Function" word.
- 3.3.10.1 Customer Option: If "d" word was specified (Section 3.2.4.8.1) then it shall follow the "t" word in the block.
- 3.3.11 The "Miscellaneous Function" word shall immediately follow the "Tool Function" word and immediately precede the "end of block" character.
- 3.3.12 The above words shall appear only in the order specified and shall not be repeated within any one block.
- 3.4 Addresses
- 3.4.1 In the variable block word address format, the address consists of a letter and these letter characters shall be in accordance with Table I.
- 3.4.1.1 Customer Option: Character coding per EIA-358-C may be specified. Reference character coding per EIA-358-C appears in Appendix C.

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- 3.4.1.2 Customer Option: If "tab" character is specified (Section 3.2.2.1), then the "address" shall be preceded by a "tab" character. The "tab" character shall be omitted from the "Sequence Number" word.
- 3.4.1.3 Where one "Feed Function" word is used, the address shall be "f". Where additional "Feed Function" words are used, their addresses shall be in accordance with Table I.
- 3.4.1.4 Where one "Rapid Traverse Dimension" word is used, the address shall be "r". Where additional "Rapid Traverse Dimension" words are used, their addresses shall be in accordance with Table I.

TABLE I – ADDRESSES

CHARACTER	DESCRIPTION OR ADDRESS FOR	REF. EIA-RS-244-B TRACK NUMBERS /d/							
		1	2	3	4	5	6	7	8
1	Digit 1	1	.						
2	Digit 2		2	.					
3	Digit 3	1	2	.		5			
4	Digit 4			3	.				
5	Digit 5	1	3	.		5			
6	Digit 6		2	3	.		5		
7	Digit 7	1	2	3	.				
8	Digit 8				.	4			
9	Digit 9	1			.	4	5		
0	Digit 0						6		
a	Angular dimension around x axis	1	.			6	7		
b	Angular dimension around y axis		2	.		6	7		
c	Angular dimension around z axis	1	2	.		5	6	7	
d /c/	Angular dimension around special axis or third feed function, or tool function for selection of tool compensation /b/		3	.		6	7		
e	Angular dimension around special axis or second feed function /b/	1	3	.		5	6	7	
f	Feed Function		2	3	.		5	6	7
g	Preparatory Function	1	2	3	.		6	7	
h	Unassigned				.	4	6	7	
i	Interpolation parameter or thread lead parallel to x	1		.	4	5	6	7	
j	Interpolation parameter or thread lead parallel to y	1	.			5	7		
k	Interpolation parameter or thread lead parallel to z		2	.		5	7		
l	Unassigned	1	2	.			7		
m	Miscellaneous Function		3	.		5	7		
n	Sequence Number	1	3	.			7		
o	Reference Rewind Stop		2	3	.		7		
P	Third rapid traverse dimension or tertiary motion dimension parallel to x /b/	1	2	3	.		5	7	
q	Second rapid traverse dimension or tertiary motion dimension parallel to y /b/			.	4	5	7		
r	First rapid traverse dimension or tertiary motion dimension parallel to z /b/	1		.	4		7		
s	Spindle Speed Function		2	.		5	6		
t	Tool Function	1	2	.			6		
u	Secondary motion dimension parallel to x /b/		3	.		5	6		
v	Secondary motion dimension parallel to y /b/	1	3	.		6			
w	Secondary motion dimension parallel to z /b/		2	3	.		6		
x	Primary x motion dimension	1	2	3	.		5	6	
y	Primary y motion dimension		.	4	5	6			
z	Primary z motion dimension	1	.	4		6			
End of Record	Rewind Stop	1	2	.	4				
Carriage Return	End of Block		.						8

TABLE I – ADDRESSES (CONT)

CHARACTER	DESCRIPTION OR ADDRESS FOR	REF. EIA-RS-244-B TRACK NUMBERS /d/ 1 2 3 . 4 5 6 7 8							
		1	2	3	.	4	5	6	7 8
Tab	Tab	2	3	.	4	5	6		
+	Plus			.		5	6	7	
–	Minus			.				7	
Period	Block Delete (slash)	1		.		5	6		
Comma	Decimal Point	1	2	.	4	6	7		
&	Unassigned Addresses (Character)	1	2	.	4	5	6		
%		2	3	.	4				
Delete		1	2	.	4	5		7	
Space		1	2	3	.	4	5	6	7
Back Space				.		5			
Upper Case		2	.	4		6			
Lower Case			3	.	4	5	6	7	
Tape Feed		2	.	4	5	6	7		
Hole				.					
No Feed				.					
Hole	Virgin Tape			.					

Notes:

/b/ Where d, e, p, q, r, u, v and w are not used as indicated, they may be used elsewhere.

/c/ On drafting machines, the character "d" may be used as a secondary miscellaneous function word with the following assignments:

- d-1 Stylus Down
- d-2 Stylus Up
- d-3 Index Turret
- d-4 Dash Line Generator On
- d-5 Dash Line Generator Off
- d-6 thru d-8 Unassigned
- d-9 Transfer Hold

/d/ Numbers indicate a punch in that particular track.

3.5 Format

3.5.1 Formats must conform in at least the following areas to be considered in the same classification.

3.5.1.1 Number of axes and their nomenclature.

3.5.1.2 Number of words in the format block.

3.5.1.3 Number of digits in each word.

3.5.1.4 Position of understood decimal point.

3.5.1.5 Presence or absence of algebraic signs.

3.5.1.6 Meaning of each character and word.

3.5.1.7 Use of coordinate or incremental dimension words.

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