Designation: D6672 – 08

Standard Practice for Formatting Cutting Data to Drive Numerically Controlled Fabric Cutting Machines[1]

This standard is issued under the fixed designation D6672; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice specifies a data format for numerically-controlled cutting machines for fabric.

1.2 This standard uses a subset of the defined instruction set defined in ANSI/EIA-274-D in addition to the codes defined by this practice.

1.3 This practice does not support curve interpolation or definitions. All curves are represented by discrete vectors (stroked) and are dependent on the resolution of the CAD software.

1.4 This practice requires that all coordinates are absolute, not relative.

1.5 This practice only supports positive coordinates that are measured from a single X-Y origin point with coordinates (0,0). The origin point is specified as the lower left corner of the cut file.

1.6 This practice intends to transfer a static image with no provision for editing.

1.7 This practice imposes no limits on the width or length of the cut data. Physical limitations imposed by the hardware and their effects on the output are the responsibility of the hardware manufacturer.

1.8 This practice does not support bite commands or any methods that insert multiple origin points or floating coordinate systems.

1.9 This practice does not support notch tools.

1.10 This practice does not support pattern matching.

1.11 This practice limits the cut file to contain a single block of data demarked by a compatible header and terminator. Multiple blocks of data in a single file are not allowed.

1.12 Any commands found in the cut file that are not defined by this standard shall be ignored.

1.13 The intended application of this practice is limited to the class of output devices found in the sewn product industries that produce apparel, textiles, upholstery, and others that use soft or semi-rigid materials.

1.14 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D6963 Terminology Relating to Sewn Products Automation

2.2 *ANSI/EIA Standard:*

ANSI/EIA-274-D Interchangeable Variable Block Data Format For Positioning, Contouring, and Contouring/ Positioning Numerically Controlled Machines[3]

3. Terminology

3.1 For all terminology related to Sewn Products Automation, see Terminology D6963.

3.2 For all other terms related to textiles see Terminology D123.

4. Summary of Practice

4.1 Cut data are organized to allow a parsing algorithm to recognize adherence to the ASTM format and are written as a data block into a computer file.

4.1.1 A specific group of commands are required at the beginning of the data block, called a header.

4.2 Cut data follow a subset of the ANSI/EIA-274-D codes.

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.66 on Sewn Product Automation.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Electronic Industries Association, Standards and Technology Department, Electronic Components Association, 2500 Wilson Blvd., Suite 310, Arlington, VA 22201-3834.

Available from Engineering Department, 2001 Eye Street N.W., Washington, DC 20008.

4.2.1 The practice specifies syntactical and parametric constraints to limit ambiguity.

4.2.2 The practice defines functions which are necessary to the task of cutting fabric in addition to the ANSI/EIA-274-D functions. These functions are assigned commands from the collection of "permanently unassigned" codes in ANSI/EIA-274-D and from other codes which that standard allows to be redefined.

5. Significance and Use

5.1 This practice provides a common format that allows a computer design system to generate data that an output device can accurately reproduce independent of the hardware manufacturer.

6. Cut File

6.1 Cut data are written in data blocks of ASCII characters, one data block per computer file.

6.2 Data blocks are made up of commands.

6.2.1 Each command is a 1 to 3 character alphanumeric string written in CAPITAL letters.

6.2.2 An instruction and its associated parameters (if required) are terminated by the asterisk (*) terminator.

6.3 Some commands are followed by parameters.

6.3.1 Parameters immediately follow the command with no separating space and come before the command terminator.

6.3.2 X and Y motion dimension commands must exist in pairs (for example, X123Y123*). Strings of coordinates are not permitted (for example, X123Y123X456Y456*).

6.4 Blocks of data that adhere to this practice begin and end in a specific way.

6.4.1 Blocks begin with specific commands in a defined order, commonly called a header, as follows (information in brackets, [ ], are variable):

> %/ASTMD6672-XX. Author: [Author Name]. Creation Date: [DD-MM-YYYY]. Creation Time: [HH-MM on a 24 hour time scale]. Drill Sizes(T41-T49): [T41 drill size, T42 drill size, T43 drill size, T44 drill size, T45 drill size, T46 drill size, T47 drill size, T48 drill size, T49 drill size]./G00*G01*G90*G70[or G71]*U[# decimal points in coordinate data]*[All subsequent plot file data follow this header]…

6.4.2 Blocks are terminated with the M00 command.

7. Syntax

7.1 Syntax commands are used to govern interpretation of formatted data. The following is a list of the supported syntax and a description of the command.

7.1.1 *Preparatory Function Codes:*

7.1.1.1 *G00*—Point to point positioning (required in header). Defines that coordinate values in the cut file are absolute coordinate values referenced to (0,0), not movements relative to the current position. This practice requires a single G00 command in the header. No other instances of G00 are allowed.

7.1.1.2 *G01*—Linear interpolation (required in header). Movement between two coordinate points is to be performed in a straight line connecting those points. This practice requires a single G01 command in the header. No other instances of G01 are allowed.

7.1.1.3 *G08*—Resume Normal Speed. A controlled speed increase to the cutter's programmed rate starting immediately. This command effects a linear speed increase on all tools.

7.1.1.4 *G09*—Slow Down. A controlled speed decrease to a fixed percent of the programmed rate (as defined by the cutter) starting immediately. This command effects a linear speed decrease on all tools and remains in effect until a G08 command is received or the end of the piece is encountered.

7.1.1.5 *G25*—Inhibit next overcut. An overcut is defined as the cutting blade moving an extra predefined cut distance in the current direction of motion. Overcuts are normally applied by the cutter on the last tool down move prior to a tool up move. This command instructs the cutter not to overcut at the next place where it would normally do so. Subsequent overcuts will be applied as normal.

7.1.1.6 *G26*—Inhibit next overcut and next advance. In addition to inhibiting the next overcut, the next advance before plunge is also inhibited. Subsequent overcuts and advance before plunge values will be applied as normal. An advance before plunge is normally applied by the cutter before the first tool down move following a tool up move.

7.1.1.7 *G70*—Imperial coordinates (required in header—or G71). Causes all subsequent X,Y parameters to be interpreted in units of inches. The decimal point is interpreted according to the U command. This practice requires a single G70 (or G71) command in the header. No other instances of G70 are allowed.

7.1.1.8 *G71*—Metric coordinates (required in header—or G70). Causes all subsequent X,Y parameters to be interpreted in units of millimeters. The decimal point is interpreted according to the U command. This practice requires a single G71 (or G70) command in the header. No other instances of G71 are allowed.

7.1.1.9 *G90*—Absolute dimension input (required in header). This practice requires a single G90 command in the header. No other instances of G90 are allowed.

7.1.2 *Miscellaneous Function Codes:*

7.1.2.1 *M00*—Program stop (required at the end of the block). This command signifies the end of the block of data. Subsequent data in the file is ignored.

7.1.2.2 *M01*—Optional stop. Similar to M00, except the cutter pauses when encountering the M01 and waits for operator input on whether to stop or continue.

7.1.2.3 *M20*—Message stop. The parameter is a string of up to 30 characters long that represents a message to be displayed on the operator console of the cutter. The cutter stops while the message is displayed. Operation is resumed when the operator manually restarts the cutter. The M20 command is followed by the message string enclosed by the same start and end delimiters as used for a label string. Example:

> …*M20'THIS IS AN M20 MESSAGE STRING'*

7.1.2.4 *M21*—Lift and plunge corner. This command causes the knife blade to lift, rotate into alignment with the next data segment and plunge into the material again. This command is often used to cut precise corners.

7.1.2.5 *M31*—Label Data. The parameter is a string of characters to be printed on a label. The string of characters to be printed on the label is enclosed by the open quote symbol, `, (ASCII character decimal 96) on the leading side and the

apostrophe symbol, ', ASCII character decimal 39 on the trailing side. The open quote and apostrophe may be printed by preceding each occurrence with the escape character (ASCII character decimal 9). A label is applied using the *momentary activation of tool* command, D3. Example:

...*M31'THIS IS A LABEL STRING'*

7.1.3 *Other Function Codes:*

7.1.3.1 *Select Tool Commands*—Tool commands define which tool is used for all subsequent commands. A tool remains selected until a different tool is selected or the end of the piece is encountered. There are 5 categories of tools: Knife, Light, Marker, Labeler, and Drill. The first tool within each category defines the default tool for that category. Different tools are supported within each category of tools. If a specified tool is not supported by the output device, the default tool within that tool's category is used. A *Select Tool Command* is required in each piece before the first *Activate Tool (D) Command* is encountered in the piece. If a *Select Tool Command* is not present before the first *Activate Tool (D) Command* is encountered in the piece, the Default tool will be used.

T01—Select Knife tool (Default tool) (Default knife tool)
T11—Select Light Tool (Default light tool)
T21—Select Marker Tool (pen) (Default marker tool)
T31—Select Labeler Tool (Default label tool)
T41—Select Drill Tool (Default drill tool)

7.1.3.2 *Activate Tool Commands*—Activate tool commands are used to activate or otherwise change the state (up/down) of the active tool, where the active tool is defined by one of the *Select Tool Commands*. The tool is activated at the last specified XY coordinate location as defined by the X and Y commands. The D3 command has an optional C parameter. The C coordinate value specifies an angle in degrees based on a Cartesian coordinate system where 0 degrees corresponds to an angle along the +X axis direction, 90 degrees corresponds to an angle along the +Y axis, etc. Valid C coordinate values are 0-359 degrees. If the C parameter is not present, a C angle of 0 degrees is assumed.

D1—Tool down. Puts the active tool in the down position at the current (X,Y) coordinate location. The active tool remains down until a *Tool up Command* is received, a new tool is selected via a *Select Tool Command*, a new piece is encountered as designated by the *Piece Number Command* or the *Program Stop Command* is encountered.

D2—Tool up. Puts the active tool in the up position at the current (X,Y) coordinate location.

D3—Momentary activation of tool (drill, label, etc.). This command activates the currently selected tool. The primary purpose of this command is to activate drill and label tools although it may also be used to effect a momentary plunge of the knife (slit notch). There is an optional parameter (C) which specifies the angular position at which the tool is activated. There are only 2 valid forms of this command:

D3*—Momentarily activate tool at the current (X,Y) coordinate location. C angle of 0 degrees is assumed.

D3C[c-coordinate]*— Rotate tool to angular position C and then activate the tool.

7.1.3.3 *F*—Set cutter arm feedrate. F is followed by a feedrate value corresponding to the units as specified by the G70 or G71 command. If Metric programming is selected via the G70 command, the F code units are millimeters per minute. If Imperial programming is selected, the F code units are inches per minute. The command sets the linear speed of all tools and will remain in effect until another F command is received.

7.1.3.4 *R*—Piece number. This command marks the beginning of a piece (a collection of commands). Each piece should have a unique number. Piece numbers in a cut file typically begin with number 1.

7.1.3.5 *U*—Decimal format (required in header). The U code is used to change interpretation of the decimal point format of all motion coordinate values. This practice requires a single U command in the header. No other instances of U are allowed. Only the parameters listed below are accepted:

U1—One decimal place. Only permitted in Metric programming mode (G71).

U2—Two decimal places. Only permitted in Imperial programming mode (G70).

U3—Three decimal places. Only permitted in Imperial programming mode (G70).

7.1.3.6 *X*—X motion dimension. Used to move the cutter arm in two dimensional space above the cutting table. Always followed by a Y motion dimension.

7.1.3.7 *Y*—Y motion dimension. Used to move the cutter arm in two dimensional space above the cutting table. Always preceded by an X motion dimension.

7.1.3.8 */*—Comment character. This command is used as a comment character. All characters between successive comment characters are ignored.

8. Keywords

8.1 apparel; cut file; cutter; marker; sewn goods; sewn product; upholstery; vector data

APPENDIX

(Nonmandatory Information)

X1. SAMPLE CUT FILE COMPLIANT WITH PRACTICE D6672

X1.1 The following example is a cut file in compliance with Practice D6672. It will render a 250 by 250 mm box with an origin at (0,0), containing a drill hole made by drill #1 at location (125,125) mm, a drill hole made by drill #2 at location (150,150) mm and a label with text "ASTM" placed at location (150,100) mm.

X1.1.1 *Example:*

```
%/ASTMD6672-08. Author: John Doe. Creation Date: 01-01-2008.
Creation Time: 17-49. Drill Sizes(T41-T49): 10mm, 15mm, 0, 0, 0,
0, 0, 0, 0./ G00*G01*G90*G71*U1*M20'Square.astm'*R1*T01*D2*
X0Y0*D1*X2500Y0*X2500Y2500*X0Y2500*X0Y0*D2*T41*
X1250Y1250*D3*T42*X1500Y1500*D3*T31*M31'ASTM'*
X1500Y1000*D3C270*M00*
```