Programming Manual
CNC TURRET PUNCH PRESS
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Overview

Introduction

This program manual has been prepared to enable the users to get optimum performance from the CNC turret punch press. For best results it is essential that the information set forth in this manual on the fundamental method of creating ordinary machining programs be thoroughly read and understood before operating the machine.
Section 1  Programming

1-1. Programmer's Responsibility

The most important thing in the operation of the CNC turret punch press is the program created by the programmer.

Personnel who know how to read component drawings and have knowledge of the actual punching processes are most suitable for being programmers but there are factories where young persons, both male and female, are working as programmers since even complicated programs can be simplified by means of Wiedepoint, and Murata's proprietary software. The programmer must know items necessary in production, and whether the operation is repetitive or not. The programmer must be able to select the most economic method whether it be machining the part as one piece or as multiple pieces and then parting off later. Whether or not operation is efficiently performed depends largely on the program prepared by the programmer. Hence high responsibilities are taken by the programmer.

The programmer is required to prepare the program bearing the following points described below in mind.

Programmer responsibilities

1) Produce accurate programs.
2) Take production lots into consideration.
3) Designate turret layout.
4) Designate workholder locations.
5) Select an appropriate table speed (and ram speed for MOTORUM, VECTRUM series) that can stabilize machining.
6) Notify press operators of any special operations.
7) Understand tool usage.
8) Make product sheet layouts.

We hold the training course for those who have purchased any one of the CAMPATH series automatic programming systems.

1-2. Part Program

The part program will vary according to changes in the following items.

1) Type of NC (FANUC 16 or 00 or 0)
2) Press model
   a) Table
   b) Turret
   c) Station capacity, Index tool (I/T), presence or absence of the G H station
3) Option (loader etc.)
FDD (Floppy disc drive) facility is also available depending upon the machine type.
1-3-1. Preparation for Programming

(1) Tool Selection
   - Selection of tools as determined from part drawing.
   - Selection of appropriately sized tools when item cannot be punched with one punch.
   - Preparation of tools after they have been selected.

(2) Turret Layout
   - Arrangement of chosen tools on turret.
   - Notify press operators after they have been arranged.

(3) Sheet Layout
   - Decide whether parts are to be single or to be nested. (Multiple part punching)
   - This decision should be made after confirming part measurements, workholder safety zone, and whether or not workholders can clamp the worksheet.
   - Layout the sheet according to the needs of the production lot.

(4) Calculation of Work Sheet Measurements
   - Notify press personnel of work sheet measurements after sheet layout is finished.

(5) Designation of Workholder Location
   - Designate the location and the number of the workholders so that punching locations may not enter workholder safety zone and that machining can be stabilized. (Refer to page 1-08)
   - The operator should manually install the workholder according to the operation instructions.

(6) Selection of table speed and ram speed
   - Set up the table speed at which stripping failure or workpiece dislocation will not occur.
     25 ~ 100%
   - Select an appropriate ram speed (for the MOTORUM, VECTRUM series) considering tool life as well as stripping failure possibility.

1-3-2. Begin Programming
(Start preparing the program when preparations have been made.)

(1) Program staring from right edge.
   If table is moved by a large amount from the start of punching operation, it can result in such incidents as the work sheet edge being caught in the turrets. In that event, limiting the table travel range should be considered.
(2) Create a program where the Y axis does not move much. If the Y axis is moved largely, the workpiece may be dislodged, resulting in accidents.

(3) Tools should be used beginning with the smallest diameter towards the largest, and from round punches to square punches. Corner notching and special tools should be programmed last.

(4) Multiple hole punching
When punching a large number of holes in a small area, surplus area should be provided in the sheet layout and careful consideration given to the order of punching to prevent distortion of the work sheet.

(5) Effective use of OFS/ (Refer to Section 11. Local Coordinate Designation)
This is used to move program zero point to an advantageous point when using a left-over material, and avoid entry into the workholder safety zone.

(6) Tool-by-tool partial call by PAT**/ (Refer to Section 12. Macro Function)
PAT/**(macro function) command is used to store a pattern which is repeated by the same tool on the same work sheet.

(7) Multiple punching commands (Refer to Section 13. Macro Grid)
Machine the part as multiple pieces by PAT6 that is called by issuing the macrogrid MGR/ command.

(8) Selection of parting off method (Refer to Section 20. Micro-Joints)
A decision must be made on whether punching or shearing is to be the method used for cutting. If punching is decided upon, a punching program must be made. The next decision to be made is whether or not micro-jointing is to be done. If not, then the method of removal must be decided.
If punching the parting lines is decided upon, then precautions must be taken to ensure that the coordinate system used in punching and the one used in shearing must be coincided. Otherwise, work dimensions will become inaccurate.

(9) Maximum amount of REP/ (Refer to Section 14. Repositioning)
The REP/ command is used depending on work sheet length.
It is necessary to use the REP/ command to reposition the workholders when the size of the work sheet exceeds the effective stroke of X axis (Refer to 1-4-4. X Axis Travel).
Note that, depending on the work, there may be cases in which it is necessary to reposition the workholders even though the above values are not exceeded.
(10) Punching with forming tools
Punching with forming tools (louvers, burrings, lancing, etc.) or punching at corners should be done last since punching operation with forming tools might cause the tools to be caught in the turret, etc.

(11) Designation of unloading position (Refer to Section 1-5 page 1-14)
It is necessary to return the table to the position it was in at the beginning of the punching operation once the punching operation is completed. Generally, the unloading position is set same as the loading position by the following commands:

*  
<table>
<thead>
<tr>
<th>C-2000, M-2034</th>
<th>X1250Y1000M30</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-2044</td>
<td>X1250Y1250M30</td>
</tr>
<tr>
<td>C-2500</td>
<td>X1250Y1280M30</td>
</tr>
<tr>
<td>FL-1544</td>
<td>X1250Y1570M30</td>
</tr>
<tr>
<td>M-2048</td>
<td>X2500Y1525M30</td>
</tr>
<tr>
<td>C-3000, V-3000, V-3046α</td>
<td>X2000Y1525M30</td>
</tr>
<tr>
<td>C-3500, V-3056α</td>
<td>X2000Y1830M30</td>
</tr>
<tr>
<td>M-5000, V5 series</td>
<td>X1830Y1525M30</td>
</tr>
</tbody>
</table>

(12) Program Punch Out (NC data)
Once the program is completed, it is punched out as an NC tape or FD. There are following two NC data punch out methods.

1) Typewriter
The tape is punched out directly as the keys are pressed. It is necessary to conduct a tape check when finished.

2) Automatic programming
This method uses CAMPATH, an automatic programming system. This method allows a program to be checked by plotting the programmed path.

(13) Program Check
Once a program has been completed, it is necessary to check it to ensure that it operates as it was intended to. The following methods are available to the programmer.

1) Automatic
If CAMPATH, an automatic programming system is used, the program can be checked by plotting the programmed path, eliminating wasted of work sheets.

2) Center punch method
Set a center punch in the turret and index it to the punch center. After pushing the [TURRET OFF] button, start punching operation on the OFF state of the turret, and a measurement check is made of the markings made at the punching points.
3) Format check in the machine lock mode
   Set the machine lock mode. While the mechanical movements are not actually executed, the NC will operate as normal, enabling the detection of any formatting errors.

4) Punch off
   Push the [PUNCH OFF] button and lock the punching operation, then start operation. Although the table and turret will operate as programmed, no punching will occur. In program check, work holder safety zone, sheet getting struck in turrets etc. can be checked without actually punching.

(14) Confirmation of Operation Instructions

1) Turret layout
   Confirm that punches and dies are installed in their designated stations. Confirm that die clearance is as designated.

2) Work sheet dimensions

3) Workholder locations
   Be sure that the workholders are located in their designated locations.

4) Confirmation of table and motor speed (Refer to page 1-07)
   Table speed may have to be varied depending on the punching shapes, sheet thickness and special punching operations.

5) Confirmation of special operation instructions
   The programmer must instruct the press operators on operations that include stopping the press for slug removal, and changes in work sheet return location because of repositioning.

Although programming procedure is not limited only to the outlined in steps (1) through (14), it is recommended to observe these steps when programming.
Table Speed

Cars cannot run at full speed with full torque, and must save the power considering the road surface, load weight, and the car condition.

In the case of punch press machines, if the table speed is too fast, the following problems may arise. In such a case, slow down the speed by the buttons or M codes in the program.

- Punching cannot follow the table movement, resulting in stripping failure.
- Workpiece is dislodged from the workholder.
- Workpiece is dislocated by the table or the turret.
- Accuracy is poor.
- Micro joints are cut off.
- The workpiece bottom surface is damaged.

The reasons for slowing down the table speed are classified into two categories:

1) Restrictions from workpiece conditions
   a) Workpiece is heavy.
   b) Workpiece is large.
   c) Workpiece is narrow.
   d) Workpiece is thick.
   e) Workpiece is thin.
   f) Workpiece is distorted.
   g) Workpiece camber is great.
   h) Slag at the workpiece side (sheared surface) is great and is grasped by the fingers.
   i) Workpiece is too hard or sticky.
   j) Scratches on the workpiece bottom surface must be minimized.

2) Restrictions from machining-related reasons
   a) Gripping force of the workholder is weak.
   b) Gripping position of the workholder is not appropriate.
   c) Machining distortion occurs (punching metal, etc.).
   d) Joints are easily removed.
   e) Frame width for nesting is small.
   f) Forming (upward, downward) is to be executed.
   g) The tool (punch, die, stripper) is worn out.
1-4. Programming Precautions

1-4-1. Programming Coordinate System

Coordinate systems used in programming change depending on the position of the end locator. It is usually in the first quadrant, but may be located in the second quadrant, depending on the installation position of work loading equipment, (Loaders/Unloaders) if used. In such a case, X axis commands become negative values.

Programming does not vary, however, if the programming zero is off-set to a proper position using the OFS/ command, whether the quadrant is the first or the second.

For the details, refer to Section 19. Second Quadrant Programming.

First Quadrant
X1830Y1000M00
X100Y200T01
INC/R 50 5

Second Quadrant
X-1830Y1000M00
OFS/X-1000
X100Y200T01
INC/R 50 5

Enter offset amount equivalent to work sheet length.
1-4-2. Width of Clamp and Work Sheet

A Workholder safety zone is established around the area of the workholder. An attempt to punch within this zone generates an error. If this occurs, it requires the use of a work sheet with more width or change in programmed commands.

Take the safety zone into consideration while programming.

<table>
<thead>
<tr>
<th>Model</th>
<th>Station</th>
<th>X</th>
<th>A, B</th>
<th>C, D</th>
<th>E, F</th>
<th>G, H, J</th>
<th>K, L</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTORUM series</td>
<td>X1, Y1</td>
<td>70, 40</td>
<td>70, 40</td>
<td>84, 54</td>
<td>99, 69</td>
<td>117, 87</td>
<td></td>
</tr>
<tr>
<td>C-2000, C-2500</td>
<td>X2, Y2</td>
<td>80, 40</td>
<td>93, 55</td>
<td>108, 70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-3000, C-3500, V-3000</td>
<td>X3, Y3</td>
<td>70, 40</td>
<td>84, 54</td>
<td>99, 69</td>
<td>117, 87</td>
<td>127, 97</td>
<td></td>
</tr>
<tr>
<td>V3α series</td>
<td>X4, Y4</td>
<td>70, 40</td>
<td>84, 54</td>
<td>99, 69</td>
<td>117, 87</td>
<td>127, 97</td>
<td></td>
</tr>
<tr>
<td>M-5000, V5 series</td>
<td>X5, Y5</td>
<td>70, 40</td>
<td>84, 54</td>
<td>99, 69</td>
<td>117, 87</td>
<td>127, 97</td>
<td></td>
</tr>
<tr>
<td>FANUC 0PB</td>
<td>X6, Y6</td>
<td>99, 63</td>
<td>113, 78</td>
<td>137, 93</td>
<td>161, 110</td>
<td>189, 135</td>
<td></td>
</tr>
</tbody>
</table>

(Unit: mm)

The above table gives the safety zone area for standard workholders. For special workholders, refer to respective instruction manuals.
1-4-3. Press Tonnage

Punch tonnage changes with changes in the sheet thickness, type of work sheet material, and punch size.

Necessary tonnage can be calculated with the following formula.

\[
\frac{\text{Thickness (mm)} \times \text{Shearing resistivity (kg/mm}^2) \times \text{Punch outer circumference (mm)}}{1000}
\]

For calculation of tonnage, refer to 7-5 Graph of Tonnage Required for Punching in the "Tooling Manual".
1-4-4. X Axis Travel

Table travel range varies depending on machine models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Travel Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-2000, C-2500, M-2034, M-2044, FL-1544</td>
<td>-20 ~ 1270 mm</td>
</tr>
<tr>
<td>M-2048</td>
<td>-20 ~ 2520 mm</td>
</tr>
<tr>
<td>C-3000, C-3500, V-3000, V3α series</td>
<td>-25 ~ 2025 mm</td>
</tr>
<tr>
<td>M-5000, V5 series</td>
<td>-25 ~ 1855 mm</td>
</tr>
</tbody>
</table>

The values listed above indicate the table stroke in the X direction.

When punching the sheet, if the size is too great to match these strokes, use the sheet repositioner by issuing the REP command (see Section 14).

A sequence of operations performed by the sheet repositioner is given below.

```
Sheet repositioner pad down
         ▼
          ▼
Work holder open
          ▼
Axis movement
          ▼
Work holder close
         ▼
Sheet repositioner pad up
```

* After executing the REP/ command, return the table to its original position. The sheet can protrude from the origin, resulting in personal injury, if REP/ command is not cancelled before bringing the table back to the origin.
1-4-5. Square Punching

(1) The pitch of continuous overlapping punching must be at least $2/3$ that of tool size and not larger than the punch measurements. When the pitch is less than work sheet thickness add an edge and then punch. Without the edge, the sheet can be galled under lateral pressure applied by the die due to a too small punching area.

![Diagram of square punching with dimensions 3.2t and 2.0t, indicating an edge to be added.]

(2) Punch parallel to the longest side when using rectangular punch. Always punch within work sheet parallel to the longest side of the punch. Since punching parallel to the shortest side of the punch will result in side pressure being applied and the punch will be shifted to the shortest side direction, do not punch in such way.

(3) An round end punch may be used to avoid seaming caused by continuous overlapping punching.

(4) Corner notching
Always use punches that are larger than the notch when notching corners. If inaccurate work sheet is being punched, notching at corners with the tool of the same size as the notch, it will leave metal sliver as shown in the diagram.

![Diagram of corner notching with dimensions 30 and an indication of metal sliver.]

1-4-6. Slug Removal

It is difficult to continue with punching operations when slugs are left on the table after punching.
There are two methods of removing the slugs.

(1) Manual slug removal
Stop table movement with a command such as M00 and remove slugs by hand or with a magnet, etc.

(2) Drop all slugs in punching operation
Program punching path in such a way that no slug will be left.
The decision as whether to have the slugs punched or to manually remove them is based their size. The commands HOL/ and REC/ generate punching path along the required shape and, thus, slugs are inevitably left. Those commands OPN/ and OBL/ on the specified condition will automatically generate paths which do not leave slugs.

(3) Corner R slugs
When an R80 is to be made with a \( \phi 20 \) punch in the corner of the work sheet, slug will result as shown by the hatched lines of the diagram. It is necessary to punch and remove the slug prior to punching the R section.

(4) Corner notch slugs
When making a 90 mm notching in corners, and punching is done with a 50 mm square punch in the order of one through four, the section with hatched lines is left off as a slug. In this case, punch from the outside.
Punching in the order of 4 \( \rightarrow \) 1 \( \rightarrow \) 2 \( \rightarrow \) 3 or 4 \( \rightarrow \) 3 \( \rightarrow \) 2 \( \rightarrow \) 1 is efficient.
1-5. Programming Zero and Machine Zero

When programming, one point is chosen as the origin from which all other measurements are subsequently made.

(1) For the CNC turret punch press, the end locator is provided on the left-hand side of the table and the workholder on the lower side. The coordinate system is established taking the origin at the lower left-hand of the work sheet. This coordinate system is called the work coordinate system and the origin of its system is called the programming zero. The distance between the programming zero and the punch center varies depending on machine models.

![Diagram of End Locator, Sheet, Punch Center, and Workholder]

The position from the punch center by the above distance is called loading position. Therefore, the loading position and programming zero are set at the same point.

Punch center is called the machine zero (reference point).

(2) Origin stored in NC

While it is necessary to enter the distance between the programming zero and the machine zero into the NC memory, the control automatically establishes the work coordinate system after zero set (return to zero) making it unnecessary to enter the following command into the program at the beginning.

Initial program loading position setting:

The following data becomes not necessary:
FRM/ X1830 Y1525 (M-5000)
It is necessary to enter the unloading position at the end of the program.

Example; FRM / X  Y  M30

Refer to * on page 1-05.
1-6. Tape Code

1-6-1. Tape Code

A bit, the smallest unit of data, is expressed by the presence or absence of a hole on a tape. In the case of an NC tape, 8 bits make one character. Characters combine to make a word. A word contains an alphabet followed by one or more numbers.

A word can express dimensions like the X and Y commands, tool selection, or function that the NC is programmed for the press to do. A word is always preceded by a letter called an address code.

A block is composed of a number of words and indicates a particular type of operation. For example, one block could include the designations for the amount of X and Y axis movements, tool change and M code.

That is, one block is the minimum unit of commands and sent to the press via the NC. When the content of the punching is changed, it is necessary to program the commands in another block. Blocks are separated from each other by a CR (Carriage Return) code. This is expressed by a hole in the eighth channel which is exclusively used for this code (EIA).

The information contained by a word only has to be entered when it is necessary. If the word is not necessary or that block is to repeat the content designated by the previous block, then that word may be omitted.

A channel is the information contained in a row that runs parallel to the edges of the tape and is also called a track or level.

A character is a code read by the NC and includes the alphabet symbols, numbers, punctuation marks, plus, and minus signs and are expressed on one line in the tape by the presence and absence of holes.

The tape is available in 2 types: EIA code and ISO code. The NC automatically determines which code is used with reference to the first end of block code (EIA:CR, ISO:LF) (see page 1-16).
### Tape Code Chart

<table>
<thead>
<tr>
<th>ISO code</th>
<th>EIA code</th>
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<tbody>
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<td>0</td>
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</tr>
<tr>
<td>1</td>
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<tr>
<td>S</td>
<td>s</td>
</tr>
<tr>
<td>T</td>
<td>t</td>
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<tr>
<td>U</td>
<td>u</td>
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<tr>
<td>V</td>
<td>v</td>
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<tr>
<td>W</td>
<td>w</td>
</tr>
<tr>
<td>X</td>
<td>x</td>
</tr>
<tr>
<td>Y</td>
<td>y</td>
</tr>
<tr>
<td>Z</td>
<td>z</td>
</tr>
<tr>
<td>DEL</td>
<td>Del</td>
</tr>
<tr>
<td>NUL</td>
<td>Blank</td>
</tr>
<tr>
<td>BS</td>
<td>BS</td>
</tr>
<tr>
<td>HT</td>
<td>Tab</td>
</tr>
<tr>
<td>LF</td>
<td>CR or EOB</td>
</tr>
<tr>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>SP</td>
</tr>
<tr>
<td>%</td>
<td>ER</td>
</tr>
<tr>
<td>(</td>
<td>(2-4-5)</td>
</tr>
<tr>
<td>)</td>
<td>(2-4-7)</td>
</tr>
<tr>
<td>+</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td></td>
</tr>
<tr>
<td>/</td>
<td></td>
</tr>
<tr>
<td>*</td>
<td></td>
</tr>
<tr>
<td>$</td>
<td>&amp;</td>
</tr>
<tr>
<td>&amp;</td>
<td></td>
</tr>
</tbody>
</table>

*Note: The table represents binary codes for various ISO and EIA characters.*
NC tape address characters are predetermined and are shown in the tape code chart.

1) Program Number (O)
   Placed at the beginning of a program, the program number begins with the letter O followed by not more than four digits. This number is used to distinguish the program to be stored in the NC (memory) from other programs. Usually this must be specified.

   \[ O[ ][ ][ ][ ] \]

   Numbers ranging from 1 through 8999 can be used. However, it should be noted that some of them cannot be used.

   The program begins with the program number and ends with M30 or M99 (the end of the subprogram).

   \[ O1234 ..... M30 : O3456 ..... M99 \]
   Program of O1234 Program of O3456

2) Sequence number (N)
   Placed at beginning of a block the sequence number begins with the letter N followed by not more than four digits. It is used to indicate what number block it is in sequence from the beginning.

   \[ 4N[ ][ ][ ][ ] \] digits (1-9999)

3) Numerical words (X, Y, C)
   The numerical values entered after these letters designate a new location in either the X, Y, or C axis. (C is for automatic indexing and is optional.)

   Programmable range for X and Y axes is +999999.99mm (minimum value is 0.01 mm).

   The maximum value for C axis is ±359.99° (minimum value is +0.01°).

4) Tool change function (T)
   Used when a different punch is to be used, the two-digit number (or 4-digit numbers in case of varitool/varimark) following the letter T indicate the number of the turret station containing the next tool to be used. A single digit number station is preceded with a zero as in T01.

   The number of turret stations and the tool arrangement in each tooling range vary with the model. For command of Vari Tool/Vari Mark, refer to 7-2.

   And for selection of tools, refer to the "Tooling Manual"
5) M function
   The character M is followed by 00～9999 that designated the particular functions as explained below.

a) M00 - program stop
   This command stops both a punching operation after a designated position has been reached and the program. Next block is proceeded to after the [CYCLE START] button is pressed.
   [Example of slug removal]
   
   MOV/X800Y500
   HOL/400 20 3
   M00

b) M02 - program end
   ALMOST NO USE.
   This command stops both a punching operation after a designated position has been reached. Next block is proceeded to after the [CYCLE START] button is pressed. However, if M02 is read, the NC is cleared (reset) and the next block is ignored. (in TAPE mode.)
   Cancels BNX/ and BNY/.

c) M03 - no punching
   This command stops a punching operation after a designated position has been reached and program continues to the next block.
   [Example of sheet repositioning]
   
   X1000Y800M03 .... Positioning with the pad
   REP/DX600

   Used to provide movement for avoiding un-safe positions.
d) M06 - operator instruction
This command stops the press after carrying out punching at a designated position.
[Example of slug removal from work sheet]

: MOV/X500Y450T08
NBL/
RAD/O 300 20 93 354 3
X500Y760T04M06 .. Stops upon completion of machining


e) M12 - nibbling start
This command begins a nibbling operation. This command is used when consecutive
punching is to be done along irregular curves. Straight and circular continuous
overlapping punching use different commands. Nibbling operation will continue until
an M13 command is read.
An alarm will occur if either a T or M code is used in the block between M12 and M13.

f) M13 - nibbling cancel
This command stops the nibbling operation begun by M12.

g) M30 - tape (memory) rewind
This command stops punching operation after a designated position has been reached.
This command is used to automatically rewind the tape to the beginning after machine
operation has been completed and if rewind capability has been added.
When press operation is completed and if the executed program is stored in memory, the
cursor will automatically return to the beginning of the program. (reset rewind)
Therefore, it is recommended to program M30 instead of M02 for commanding the
unload position at the end of the program.
h) M41 - work sheet repositioning
   This command is used when shifting work holder positions.
   The following operations are executed when this command is used.

   Sheet repositioner pad down
   Workholders open

i) M42 - work sheet repositioning
   This command is used when shifting workholder positions.
   The following operations are executed when this command is used.

   Workholders close
   Sheet repositioner pad up

j) M50 - press motor speed high
   This command switches the press motor to high speed. (effective only for the M-5000)

k) M51 - press motor speed low
   This command switches the press motor to low speed. (effective only for the M-5000)
   Some presses may have other M commands in addition to those listed above if they have optional functions.

★ The M code cannot be provided in the same block with the pattern function command.
Be sure to provide it independently or together with the coordinates.
★ When two or more M codes are provided in one block, only the last M code is effective.
### M CODE CHART

<table>
<thead>
<tr>
<th>M Code</th>
<th>Function and Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>M00</td>
<td>Positioning, no-punch, stop</td>
</tr>
</tbody>
</table>
| M02    | Positioning, no-punch, stop, NC reset  
- BNX and BNY cancel |
| M03    | Positioning, no-punch, continue to next block  
- Sheet repositioner clamp down position designation |
| M05    | Unload command (Loader option) |
| M06    | Positioning, punch, stop  
- Slug and product removal |
| M08    | Forming mode start |
| M09    | Forming mode cancel |
| M12    | Nibbling mode start  
X, Y, and T axis commands can be made in blocks following M12, maximum positioning distance limits are ignored.  
Blocks following the first nibbling punch have limits on maximum positioning distance. |
| M13    | Nibbling mode cancel. |
| M30    | Positioning, no-punch, stop, NC reset  
Memory and tape rewind operation, (optional tape rewind device necessary for tape mode operation)  
- Unloading position designation |
| M40    | Take off (loader option) |
| M41    | Sheet repositioner clamp down  
Workholder open |
| M42    | Workholder close  
Sheet repositioner clamp up |
<p>| M50    | Press motor high speed |
| M51    | Press motor low speed |
| M55    | External deceleration mode start |
| M56    | External deceleration mode cancel (Work chute operation) |</p>
<table>
<thead>
<tr>
<th>M Code</th>
<th>Function and Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>M80</td>
<td>Table speed 100%</td>
</tr>
<tr>
<td>M81</td>
<td>Table speed 75%</td>
</tr>
<tr>
<td>M82</td>
<td>Table speed 50%</td>
</tr>
<tr>
<td>M83</td>
<td>Table speed 25%</td>
</tr>
<tr>
<td>M98</td>
<td>Call sub-program</td>
</tr>
<tr>
<td>M99</td>
<td>Sub-program end</td>
</tr>
</tbody>
</table>
1-7. Displays

1-7-1. Numeric Expression

Decimal point input

This is the most common input and is used for the input of distance, angle, and time. The smallest unit that can be used is 0.01. Units expressing decimal fractions greater than two places are ignored so that an input such as X0.123 would be output as 0.12.

1-7-2. Expression of Axis Movement

There are two methods of expressing axis movement, absolute and incremental.

1) Absolute

This method is used for measuring coordinates as distances from the point of origin.

N0001 X100 Y50
N0002 X300 .......... Y50 is omitted.
N0003 Y150 .......... X300 is omitted.

In N2, the value Y50, and in N3, the value X300, are omitted because they are the same as those programmed or active in the previous block.
2) Incremental

This method is used for measuring coordinates as distances from the last coordinate values given in the preceding block.

In Wiedepoint, D is used to designate X and Y Values as incremental, i.e., DX and DY; X and Y are absolute.

N0001 X100Y50
N0002 DX200
N0003 DY100
## Section 2  Types of Commands

### WIEDEPOINT COMMAND

<table>
<thead>
<tr>
<th>Command</th>
<th>Functions</th>
<th>Contents</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Address Program number registration</td>
<td>4 digits</td>
<td>Refer to Page 1-17</td>
</tr>
<tr>
<td>N</td>
<td>Address Sequence number registration</td>
<td>Less than 4 digits will do.</td>
<td>Refer to Page 1-17</td>
</tr>
<tr>
<td>X</td>
<td>Address X-axis coordinate value (absolute)</td>
<td>In mm (within ±0.01)</td>
<td>Refer to Page 1-23</td>
</tr>
<tr>
<td>Y</td>
<td>Address Y-axis coordinate value (absolute)</td>
<td>In mm (within ±0.01)</td>
<td>Refer to Page 1-23</td>
</tr>
<tr>
<td>DX</td>
<td>Address X-axis coordinate value (incremental)</td>
<td>In mm (within ±0.01)</td>
<td>Refer to Page 1-24</td>
</tr>
<tr>
<td>DY</td>
<td>Address Y-axis coordinate value (incremental)</td>
<td>Block-to-block designation allowed</td>
<td>Refer to Page 1-17</td>
</tr>
<tr>
<td>T</td>
<td>Address T function (tool function)</td>
<td>In increments of 0.01 deg</td>
<td>Refer to Page 1-17</td>
</tr>
<tr>
<td>C</td>
<td>Address C-axis (I/T) angular indexing</td>
<td>Use of the pattern function not allowed</td>
<td>Refer to Page 1-17</td>
</tr>
<tr>
<td>M</td>
<td>Address M function (miscellaneous functions)</td>
<td>Command not required due to loading position zero return</td>
<td>Refer to Page 1-14</td>
</tr>
<tr>
<td>FRM/</td>
<td>Coordinate system designation</td>
<td>OFS/Y0 Y0 canceling required</td>
<td>Refer to Page 11-01</td>
</tr>
<tr>
<td>OFS/</td>
<td>Local coordinate system designation</td>
<td></td>
<td>Refer to Page 10-01</td>
</tr>
<tr>
<td>MOV/</td>
<td>Reference point designation of center point and starting point for pattern function</td>
<td></td>
<td>Refer to Page 16-01</td>
</tr>
<tr>
<td>BNX/</td>
<td>X-axis bend compensation</td>
<td>#: outer dimensions +: inner dimensions</td>
<td>Refer to page 16-01</td>
</tr>
<tr>
<td>BNY/</td>
<td>Y-axis bend compensation</td>
<td></td>
<td>Refer to Page 14-01</td>
</tr>
<tr>
<td>REP/</td>
<td>Automatic repositioning</td>
<td>Workholder reclamping</td>
<td>Refer to Page 14-01</td>
</tr>
<tr>
<td>INC/</td>
<td>INCREMENTAL Linear pitch punching</td>
<td></td>
<td>Refer to Page 8-05</td>
</tr>
<tr>
<td>GRD/</td>
<td>GRID Grid pitch punching</td>
<td></td>
<td>Refer to Page 8-06</td>
</tr>
<tr>
<td>LAA/</td>
<td>LINE AT ANGLE Line-at-angle pitch punching</td>
<td></td>
<td>Refer to Page 8-07</td>
</tr>
<tr>
<td>ARC/</td>
<td>ARC Circular arc pitch punching</td>
<td></td>
<td>Refer to Page 8-08</td>
</tr>
<tr>
<td>BHC/</td>
<td>BOLT HOLE CIRCLE Bolt hole pitch punching</td>
<td></td>
<td>Refer to Page 8-09</td>
</tr>
<tr>
<td>RAD/</td>
<td>RADIUS Circular arc punching by NBL/</td>
<td></td>
<td>Refer to Page 8-11</td>
</tr>
<tr>
<td>HOL/</td>
<td>HOLE Open hole punching by NBL/</td>
<td></td>
<td>Refer to Page 8-12</td>
</tr>
<tr>
<td>OPN/</td>
<td>OPEN Open round hole punching by NBL/</td>
<td></td>
<td>Refer to Page 8-14</td>
</tr>
<tr>
<td>REC/</td>
<td>RECTANGULAR Punching of 1-axis and 2-axis designated rectangle</td>
<td></td>
<td>Refer to Page 8-15</td>
</tr>
<tr>
<td>OBL/</td>
<td>OBLONG Oblong shape punching</td>
<td></td>
<td>Refer to Page 8-18</td>
</tr>
<tr>
<td>RRC/</td>
<td>ROUNDABLE Punching of rectangle with round corner</td>
<td></td>
<td>Refer to Page 8-23</td>
</tr>
<tr>
<td>CAA/</td>
<td>CUT AT ANGLE Punching of line at angle by NBL/</td>
<td></td>
<td>Refer to Page 8-19</td>
</tr>
<tr>
<td>TGL/</td>
<td>CUT TRIANGLE 45°-inclined tool V-notch</td>
<td></td>
<td>Refer to Page 8-21</td>
</tr>
<tr>
<td>SAA/</td>
<td>SLOPE AT ANGLE Slope-at-angle punching for IT</td>
<td></td>
<td>Refer to Page 8-25</td>
</tr>
<tr>
<td>PTP/</td>
<td>POINT TO POINT Punching of point to point</td>
<td></td>
<td>Refer to Page 8-27</td>
</tr>
<tr>
<td>PPA/</td>
<td>POINT TO POINT ARC Punching of point to point arc</td>
<td></td>
<td>Refer to Page 8-29</td>
</tr>
<tr>
<td>NBL/</td>
<td>Nibbling : Continuous punching with round tools</td>
<td></td>
<td>Refer to Page 6-01</td>
</tr>
<tr>
<td>DWL/</td>
<td>Dwell : Non-operation period (sec)</td>
<td></td>
<td>Refer to Page 17-01</td>
</tr>
<tr>
<td>PAT**/</td>
<td>Macro function registration</td>
<td>Refer to Page 12-01</td>
<td></td>
</tr>
<tr>
<td>END**/</td>
<td>Macro function registration end</td>
<td></td>
<td>Refer to Page 12-02</td>
</tr>
<tr>
<td>PAT**/</td>
<td>**Calling of registered macro function</td>
<td></td>
<td>Refer to Page 12-03</td>
</tr>
<tr>
<td>MGR**/</td>
<td>Multiple work piece machining by PAT** call</td>
<td></td>
<td>Refer to Page 13-01</td>
</tr>
<tr>
<td>SYM/</td>
<td>Mirror image Symmetric machining about axis and point</td>
<td></td>
<td>Refer to Page 15-01</td>
</tr>
<tr>
<td>SYC/</td>
<td>Mirror image cancel</td>
<td></td>
<td>Refer to Page 15-01</td>
</tr>
<tr>
<td>MAT/</td>
<td>Work sheet data</td>
<td></td>
<td>Refer to Page 18-01</td>
</tr>
</tbody>
</table>
Section 3  Coordinate Input

Coordinates are input in mm (millimeter) units with up to a six-place integer and a two-place decimal fraction. Programmable range of X and Y words is from -999999.99 to 999999.99.

[Example]
X1830 (The programming zero moves to the point located at 1830 mm from punch center)
Y5.35 (The programming zero moves to the point located at 5.35 mm from punch center)
DX50 (moves 50 mm from the previous point)

[Example]
The same value can be written in the following ways.
+2, 2, +2.0, 2.0, +2.00, 2.00

Pattern function commands such as radius, pitch, tool length, and diameter and two-place decimal fractions are the same as coordinates. However, with the exception of pitch, negative commands cannot be given.

Pattern function angle commands of less than one degree can be expressed in a decimal fraction as small as two-places (0.01). Both positive and negative values can be expressed.

[Example]
RAD/O 50.5 20 7.35 -90 2.5
BHC/200.35 15 8

★ If switched from millimeters to inches, the input in inches can have decimal fractions as small as three-places (0.001).
Section 4  Coordinate Addition and Subtraction

4-1. Coordinate Addition and Subtraction Calculations

Values used in the following commands can be added and subtracted.

X-and Y-axis coordinate value
Radius, diameter, and angle commands in pattern function

[Example]

X1500-375 + 60
DY-230 + 0.5
BHC/100 90-65 12............... angle command
RAD/130 + 30 0 30 7............. radius command

Note that N (sequence number) T (turret number) M codes, and the number of holes to be punched in the pattern function must be entered in their designated places and that these items may not be added, subtracted, used with decimal points, or negative values.

4-2. Space Code

The space code can normally be used as desired by the programmer. For example, either of the following commands are valid:

X1830 Y1525 M00
X1830 Y1525 M00

While the space code may be freely used, note that block size is limited to 64 characters. It is possible that excessive use of the space code may result in this limit being exceeded and an error occurring.

The space code is always necessary in the pattern function where the space is used to separate variables from one another. This is shown in the following example:

BHC/100 90 4

Another limitation is in the pattern function.

The following usages are invalid.

1) Space entered between the slash and first variable.
   BHC/ 100 90 4
2) Space entered within variable.

BHC/10 0 90 4

(This is recognized by the NC as BHC/10 0 90 and corresponding machining is carried out.)

★ Do not use space code except for the case in which the address is ended or the parameter data is separated. If this code is used, memory capacity will be consumed.

### 4-3. Optional Block Skip

When a given block is to be skipped, enter a slash at the beginning of the program block. When the indicating lamp for the \([/\) block skip\] switch remains on in the tape memory mode, the block containing the slash code is ignored.

```plaintext
X200 Y150 T12
/X300 Y200
/INC/R 150 2  } With the optional block switch on, these two blocks are ignored.
MOV X500 Y630 T05
```

Note that the slash must be entered at the beginning of the block. The following use of the slash is invalid.

```plaintext
/X500 Y600
```

It must be used as in

```plaintext
/X500 Y600
```
Section 5  Coordinate Value Commands

5-1. Absolute/Incremental Commands

Absolute and incremental X and Y coordinates are differentiated by the use or non-use of D as in:

X, Y ................. absolute
DX, DY............... incremental

[Example]

X500Y340 (absolute)
:
DX-50DY200 (incremental)
:

Both the absolute and the incremental commands can be used within the same block.

[Example]

\[ \text{Incremental command} \]
\[ \text{Absolute command} \]

[Example]

1........... X100Y200T01
2........... DX100
3........... DX150
4........... DX100
5........... X50Y400T02
6........... DX100
7........... DY-100 (Y300)
8........... DX150DY100
9........... DX100
10........... DX150
Section 6  Nibbling (NBL/)

There are two types of punching operations. The first is one-punch operation in which the punch always stops at top dead center after one punch. In the second, the punching operation continues non-stopping and is referred to as nibbling.

NBL/ is given as in the following example.

```
MOV/X500Y400
NBL/
HOL/400 30 5
```

A nibbling command is valid for only the next block and is always followed by either of block containing pattern function, (1) HOL/, (2) OPN/, (3) RAD/ or (4) CAA/ Commands.

6-1. Nibbling

The following limits must be observed for nibbling operations.

1) Both the maximum and minimum feed pitch should be designated up to sheet thickness.

   (Unit: mm)

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum feed pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTORUM series</td>
<td>5</td>
</tr>
<tr>
<td>CENTRUM series</td>
<td></td>
</tr>
<tr>
<td>V3α series</td>
<td></td>
</tr>
<tr>
<td>M-5000</td>
<td>Motor-high speed</td>
</tr>
<tr>
<td></td>
<td>Motor-low speed</td>
</tr>
<tr>
<td>V3 series, V5 series</td>
<td></td>
</tr>
</tbody>
</table>

*: The model with laser cannot do nibbling operations at high speed.

If pitch command exceeds the maximum pitches listed above, alarm 147 will occur.

2) Nibbling may be conducted on sheets up to 3.2 mm (SPCC). For sheets exceeding this thickness conduct regular punching operations.

3) Metal stripper tool recommended

4) When performing nibbling operation, usually use a tool producing round cutting shape.
5) Determine the nibbling pitch referring to the tolerance table given below.

\[ P = 2 \sqrt{S (D - S)} \]

<table>
<thead>
<tr>
<th>Tolerance S</th>
<th>10φ</th>
<th>15φ</th>
<th>20φ</th>
<th>25φ</th>
<th>30φ</th>
<th>35φ</th>
<th>40φ</th>
<th>50φ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>5.2</td>
<td>6.5</td>
<td>7.6</td>
<td>8.5</td>
<td>9.4</td>
<td>10.1</td>
<td>10.9</td>
<td>12.2</td>
</tr>
<tr>
<td>0.5</td>
<td>4.4</td>
<td>5.4</td>
<td>6.3</td>
<td>7.0</td>
<td>7.7</td>
<td>8.3</td>
<td>8.9</td>
<td>10.0</td>
</tr>
<tr>
<td>0.2</td>
<td>2.8</td>
<td>3.4</td>
<td>4.0</td>
<td>4.5</td>
<td>4.9</td>
<td>5.3</td>
<td>5.6</td>
<td>6.3</td>
</tr>
<tr>
<td>0.1</td>
<td>2.0</td>
<td>2.4</td>
<td>2.8</td>
<td>3.2</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>0.05</td>
<td>1.1</td>
<td>1.3</td>
<td>1.6</td>
<td>1.7</td>
<td>1.9</td>
<td>2.1</td>
<td>2.2</td>
<td>2.5</td>
</tr>
</tbody>
</table>

☆ FL-1544

The "NBL/" command executes ordinary punching operation.
During "NBL/" motion, override is set to 100%. Therefore, there is no restriction on nibbling pitch.
6-2. Metal Stripper Tool

It is recommended to use a special metal stripper tool for nibbling work. The most commonly used sizes are φ10, φ20, and φ30. Designed for a work sheet thickness of 3.2 mm, this tool differs from other tolls with urethane strippers and should not be used with thickness greater than 3.2 mm.

In addition to NBL/, M code commands (M12 and M13) can be used for nibbling. Differing from NBL, these M codes are used for the work that requires the commands the pattern functions are not capable of, for example continuous overlapping punching on irregular curves.

![Diagram]

- T10.................nibbling tool designation
- M12.................nibbling start
- X50 Y120
- DX3DY2
- DX2DY3
- DX2DY3
- DX2DY4
- }
- M13 ...............nibbling end

If a T or M code is entered between M12 and M13, alarm 144 will occur. (Refer to "Operating Manual")

★ The machine may be brought to a temporary stop by pressing ON the [FEED HOLD] button on the control panel or raising the end locator.
   When the machine is re-started (by pressing ON the [CYCLE START] button) after temporary stop, it performs a single-punching operation instead of nibbling.
★ Even when the program contains the block in which a nibbling command is present, nibbling operation is not performed as long as the indicating lamp for the [SINGLE BLOCK] button remains on.
Section 7  I/T, V/T

7-1. Automatic Index Tool

7-1-1. C Axis Input

When the automatic index tool angle is to be indexed, designate the angle after the address C. Angle input is limited to the values 0° to ± 359.99° and the minimum unit of movement is 0.01°. In the keyboard input mode, the command is absolute regardless of the condition of ABS/INC.

Use the keystrokes in the keyboard input mode as follows:
Press the address key [4TH], numeric key [ANGULAR COMMAD], and [INPUT] in that order.

7-1-2. Programming

C-axis command can be used only on auto-index tool stations and the station numbers & locations differ from model to model.

<table>
<thead>
<tr>
<th>Model</th>
<th>Turret Station No.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTORUM series</td>
<td>30 stations</td>
<td>1, 11</td>
</tr>
<tr>
<td>C-2000, C-2500</td>
<td>18 stations</td>
<td>1, 10</td>
</tr>
<tr>
<td>C-3000, C-3500, V3 series</td>
<td>40 stations</td>
<td>1, 21</td>
</tr>
<tr>
<td></td>
<td>34 stations</td>
<td>1, 18</td>
</tr>
<tr>
<td></td>
<td>54 stations</td>
<td>1, 18</td>
</tr>
<tr>
<td>V3α series</td>
<td>54 stations</td>
<td>1, 16</td>
</tr>
<tr>
<td>M-5000, V5 series</td>
<td>54 stations</td>
<td>1, 18</td>
</tr>
<tr>
<td></td>
<td>57 stations</td>
<td>1</td>
</tr>
</tbody>
</table>

1) T01 C45

When the turret is not currently at station 01, this command orders the turret to rotate to station 01 and set the index tool to 45°.

When the turret is at station 01, the command orders the index tool to turn to 45°.
Punching is not conducted at this point.

2) C45

The tool is set to 45° but punching is not conducted at this point.
3) X100Y200C45
   Before punching, this command moves the table to the designated position in X and Y axes and turns the index tool to 45°.

4) MOV/X500Y100C45
   There is no positioning operations with the X, Y, and C axes.
   This command sets the location of the X, Y, and C axes prior to the first punch of the next pattern function.

5) INC/R 50 5 C45
   This command moves the table to the first pattern punching point, turns the index tool to 45°, and starts punching with the C axis placed at an angle of 45° until the pattern function is completed.
   The following commands have the same operation:
   LAA, GRD, and REC.

6) BHC/200 0 4 C90
   Patterns including a circle or an arc are specified using a format different from 5.
   This command moves the table to the first pattern punching point, turns the index tool to 90°, and allows punching. From the second punch onward, the tool is automatically offset at 90° intervals for punching.
   The following commands have the same operation:
   BHC/ of auto index tool/T01 command (tool 10×40)

   MOV/X500Y500T01
   BHC/200 0 4 C90

   ★ Never use the NBL/ command for the auto index tool. The tool may be adversely affected.
7-2. Vari Tool/Vari Mark

7-2-1. Tool Commands

Vari Tool/Vari Mark commands comprise of a T code followed by a 3- or 4-digit number. The first two digits represent the turret station number and the last two digits represent the Vari Tool/Vari Mark number.

\[ T \quad \text{OO} \quad \text{AA} \]
\[ \quad \rightarrow \text{Vari Tool tool number (2 digits)} \]
\[ \quad \rightarrow \text{Turret number (1 or 2 digits)} \]

★ T-1 or T-2 digits command executes an ordinary turret indexing.
★ Tool numbers for Vari Tool should be 01~12, and those for Vari Mark should be 51~90.
★ Vari Tool/Vari Mark numbers are determined by the turret station where they are mounted. The corresponding station and tool numbers are preset by NC parameters in the factory before despatch.
7-2-2. Program Example

The following is an example of program where tool No. 3 and 8 of Vari Tool mounted on the turret station T12 are indexed in order. On the right side of the program, indexing status of turret and Vari Tool for each block is indicated for easy understanding.

```
O2000;
N0001 X800Y800T11;  Turret number indexed
N0002 X700Y700T1203;  Vari Tool tool number indexed
N0003 X600Y600T1208;
N0004 X500Y500T32;
N0005 X1250Y1000M30;

In the same way as above, tool indexing of Vari Mark can be programmed. If the tool No. 03 and 08 of Vari Tool are changed to the required tool numbers of Vari Mark (51~90), the program will command respective Vari Mark. The Vari Mark and their respective numbers are listed on the next page.
```
## Section 8 Pattern Functions

The pattern function is a one block command containing location data which the punching follows forming a pattern. The following chart lists the pattern functions.

### Pattern Command

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
<th>Reference point</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC/</td>
<td>INCREMENTAL</td>
<td>★ 2</td>
<td>Refer to 8-05</td>
</tr>
<tr>
<td>GRD/</td>
<td>GRID</td>
<td>★ 4</td>
<td>Refer to 8-06</td>
</tr>
<tr>
<td>LAA/</td>
<td>LINE AT ANGLE</td>
<td>★ 2</td>
<td>Refer to 8-07</td>
</tr>
<tr>
<td>ARC/</td>
<td>ARC</td>
<td>○ 1</td>
<td>Refer to 8-08</td>
</tr>
<tr>
<td>BHC/</td>
<td>BOLT HOLE CIRCLE</td>
<td>○ 1</td>
<td>Refer to 8-09</td>
</tr>
<tr>
<td>RAD/</td>
<td>RADIUS</td>
<td>○ 1</td>
<td>Refer to 8-11</td>
</tr>
<tr>
<td>HOL/</td>
<td>HOLE</td>
<td>○ 1</td>
<td>Refer to 8-12</td>
</tr>
<tr>
<td>OPN/</td>
<td>OPEN</td>
<td>○ 1</td>
<td>Refer to 8-14</td>
</tr>
<tr>
<td>REC/</td>
<td>RECTANGULAR</td>
<td>★ 2, 4</td>
<td>Refer to 8-15</td>
</tr>
<tr>
<td>OBL/</td>
<td>OBLONG</td>
<td>★ 4</td>
<td>Refer to 8-18</td>
</tr>
<tr>
<td>CAA/</td>
<td>CUT AT ANGLE</td>
<td>★ 3</td>
<td>Refer to 8-19</td>
</tr>
<tr>
<td>TGL/</td>
<td>CUT TRIANGLE</td>
<td>○ 1</td>
<td>Refer to 8-21</td>
</tr>
<tr>
<td>RRC/</td>
<td>ROUNDBABLE RECTANGULAR</td>
<td>○ 1</td>
<td>Refer to 8-23</td>
</tr>
<tr>
<td>SAA/</td>
<td>SLOPE AT ANGLE</td>
<td>★ 2</td>
<td>Refer to 8-25</td>
</tr>
<tr>
<td>PTP/</td>
<td>POINT TO POINT</td>
<td>★ 2</td>
<td>Refer to 8-27</td>
</tr>
<tr>
<td>PPA/</td>
<td>POINT TO POINT ARC</td>
<td>★ 2</td>
<td>Refer to 8-30</td>
</tr>
</tbody>
</table>

Reference punching points (★ punching start point; ☆ start coordinate; ○ center coordinate) and number of settable patterns

* Refer to the List of One Wiedepoint Commands (see pages 8-02 and 8-03).
List of Wiedepoint Commands

X100Y100
1AC/R 50 5
Number of remaining holes
Pitch
60°
Machining direction

X250Y170
GRD/L 50 4 D 50 2
Number of remaining holes
Pitch
Machining direction

X150Y100
LAA/60 45 4
Number of remaining holes
Pitch
Machining angle

X150Y50
XBO/Y50
ABC/60 15 10 4
Radius
Pitch
Machining start angle

Note: Angular movement direction is denoted by (+) and (−).

XRV/X100Y250
BHC/150 0 4
Number of holes
Radius
Machining start angle

XRV/X100Y800
NRL/
RAD/O 100 90 90 3
Radius
Pitch
Machining start angle

Note: "O" indicates that the tool travels beyond the radius.
"F" indicates that the tool travels within the radius.

XRV/X500Y400
NRL/
OPH/400 0 0 0
Pitch
Tool diameter

Note: Tool diameter, up to 10 times larger than the original one.
The 13.2 not allowed for NRL.
These pattern functions repeat the following two operations during punching operations.

- Positioning of X and Y axes
- punching

Punching location can be any point except the pattern reference point. Consequently, it is always necessary that the pattern function reference point be set when giving a pattern command.

**Pattern function reference point designation (MOV/I)**

The pattern function reference point is the center coordinate of the functions ARC, BHC, RAD, HOL, OPN, RRC, and TG; and is the starting point coordinate of the functions INC, GRD, LAA, CAA, REC, and OBL. Usually, the punch location set in the block preceding the pattern function becomes the pattern reference point. When a different pattern reference point is to be set, the MOV/ command is used in the following way.

\[
\text{MOV/X a Y b}
\]

In this case, only the coordinates are indicated and neither positioning nor punching occurs. When the command MOV/DX a DY b is used, the point located at a distance a, b from present location becomes the pattern reference point. Note that the incremental command programmed immediately after the pattern function is referenced to the pattern end point. T code may be entered within a MOV/X a Y b command. When it is, the location of T axis is set.

\[
\text{MOV/X a Y b T05}
\]

Note that M codes may not be entered.

- When the reference point remains undesignated, the preceding point serves as the pattern reference point.
- Enter MOV/X a Y b absolute coordinate value as the pattern function reference point.
8-1. Incremental (Linear pitch punching)

*INC/a d n*

This function punches "n" times at pitch "d" mm, in a straight line in direction "a", parallel to either the X or Y axis incremental to either the present tool location or the reference point set by MOV/.

1) "a" designates the following directions.
   - R(right) : +X direction
   - L(left) : - X direction
   - U(up) : +Y direction
   - D(down) : - Y direction

2) "d"  
   "d" designates pitch. Pitch can be input as a decimal fraction of up to two places (0.01mm). This value must be a positive integer.

3) "n"  
   "n" designates the number of holes that remain to be punched. This value must be a positive integer.

[Example]

X100Y100  
INC/R 60 5

![Diagram of Incremental Linear Pitch Punching](image)
8-2. Grid (Grid pitch punching)

\[ GRD/\alpha \, dx \, nx \, \beta \, dy \, ny \]

This function punches "nx" times, at pitch "dx", in a direction of \( \alpha \) in the X axis, and "ny" times, at pitch "dy" a direction of \( \beta \) in the Y axis, parallel to the X and Y axis, beginning from either the present tool location or the reference point set by MOV/.

1) "\( \alpha \)" and "\( \beta \)" (Machining direction)

"\( \alpha \)" designates either of the following directions.
- R(right) :+X direction
- L(left) :- X direction

"\( \beta \)" designates either of the following directions.
- U(up) :+Y direction
- D(down) :- Y direction

2) "dx" and "dy"

"dx" and "dy" designate pitch. Pitch can be input as a decimal fraction of up to two places (0.01 mm). When negative, punching operation occurs in a direction 180° opposite that designated by "\( \alpha \)" and "\( \beta \)" (Reserved machining direction is designated.)

3) "nx" and "ny"

"nx" and "ny" designate the number of holes that remain to be punched. These values must be positive numbers.

**[Example]**

X250Y170  
GRD/L 50 4 D 50 2

![Diagram of punching pattern](image)

The following command changes the machining order while keeping the punching pattern unchanged.

X250Y170  
GRD/D 50 2 L 50 4
8-3. Line at Angle (Line-at-angle pitch punching)

$LAA/d \theta n$

This function punches "n" times at pitch "d", in a direction formed by the angle \( \theta \) measured to the X axis, in a straight line beginning from either the present tool location or the reference point set by MOV/.

1) "d"

"d" designates pitch. Pitch can be input as a decimal fraction of up to two places (0.01 mm). When negative, punching operation occurs in a direction 180° opposite that designated by angle \( \theta \). (Reversed machining direction is designated.)

2) "\( \theta \)"

This is the punching angle measured to the X axis. CCW direction is considered to be positive.

\[-360 < \theta < 360\]

CW: Clock wise
CCW: Counter Clock wise

3) "n"

"n" designates the number of holes that remain to be punched. This value must be a positive number.

[Example]

X150Y100
LAA/80 45 4

---

Diagram: Pattern (punch) end point, Punch starting point, Pattern reference point.
8-4. Arc (Circular arc pitch punching)

\[ ARC/r \theta_1 \theta_2 n \]

This function punches "n" times at pitch angle \( \theta_2 \) at a radius of "r" measured from the point of the present tool location or the reference point set by MOV, and beginning from the point set by the angle \( \theta_1 \) measured to the X axis.

1) "r"

"r" designates the radius. Radius can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

2) "\( \theta_1 \)"

"\( \theta_1 \)" designates the angle formed by the X axis and the punch starting point. CCW angles are considered to be positive. CW angles are indicated by negative numbers. Angles can be input as a decimal fraction of up to two places (0.01 mm).

3) "\( \theta_2 \)"

"\( \theta_2 \)" designates the pitch angle. CCW pitch angles are considered to be positive. CW pitch angles are indicated by negative numbers. Pitch angles can be input as a decimal fraction of up to two places (0.01 mm).

4) "n"

"n" designates the number of whole holes. This value must be a positive number.

[Example]

MOV/X80 Y50
ARC/360 15 10 5
8-5. Bolt Hole Circle (Bolt hole pitch punching)

\[ BHC/r \theta n \]

This function punches "n" times at equal pitch angle about a circle at a radius of "r" measured from the point of the present tool location or the reference point set by MOV/, and beginning from the point set by the angle \( \theta \) measured to the X axis.

1) "r"

"r" designates radius. Radius can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

2) "\( \theta \)"

"\( \theta \)" designates the angle formed by the X axis and the punch starting point. CCW angles are considered to be positive. CW angles are indicated by negative numbers. Angles that fall within the following range can be input.

\[-360 < \theta < 360\]

3) "n"

"n" designates the number of holes to be punched. CCW punching is indicated by positive numbers, CW punching is indicated by negative numbers.

[Example 1]

MOV/X300Y250
BHC/150 0 4
BHC/Command for Auto-Index Tool
T01 (Tool 10 x 40)

[Example 2]

MOV/X500 Y500 T01
BHC/200 0 4 C90

The MOV/command is used to set the reference point. Tool location is set at a point 200mm along a radius measured from the reference. The first punch occurs at the tool location at an angle of 90° to the X axis.
8-6. Radius (Circular arc punching by NBL/)

\[ \text{RAD}/\alpha r d \theta_1 \theta_2 p \]

This function punches an arc at the incremental pitch "p", the center of which is set by the MOV/ command. It begins at angle \( \theta_1 \) as measured from the X axis, ends at incremental angle \( \theta_2 \) as measured from angle \( \theta_1 \), and has the radius "r" measured from the center to either the inside of the tool or to the outside of the tool which has the diameter "d".

1) "\( \alpha \)"

"\( \alpha \)" designates whether the tool should be offset to the inside or outside of the radius.

\( I(\text{IN}) \): Tool is set to the Inside of the radius.
\( O(\text{OUT}) \): Tool is set to the Outside of the radius.

2) ""r"

"r" designates the radius. Radius can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

3) "d"

"d" designates the tool diameter.

4) "\( \theta_1 \)"

"\( \theta_1 \)" designates the angle of punching starting point as measured from the X axis. CCW angles are considered to be positive. CW angles are indicated by negative numbers.

"\( \theta_1 \)" can be input as a decimal fraction of up to two places (0.01).

5) "\( \theta_2 \)"

"\( \theta_2 \)" designates the incremental angle at which punching ends as measured from angle "\( \theta_1 \)".

6) "p"

"p" designates the feed pitch. "p" can be input as a decimal fraction of up to two places (0.01). No calculations are necessary as punching error is compensated for automatically.

[Example]

MOV/X100 Y800
NBL/
RAD/O 100 20 90 90 3
8-7. Hole (Open hole punching by NBL/)

HOL/r d p

This function punches a full circle at arc pitch "p", the center of which is set by the MOV/ command, has the diameter "r", and uses a tool with a diameter of "d".

1) "r"
   "r" designates the diameter. Diameter can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

2) "d"
   "d" designates the tool diameter.

3) "p"
   "p" designates the arc pitch. "p" can be input as a decimal fraction of up to two places (0.01). Inputs must be positive numbers. No calculations are necessary as punching error is compensated for automatically.

[Example]

MOV/X500 Y400
NBL/
HOL/400 30 5
When the HOL/ command is used and the diameter of the circle is large, a slug will remain in the center. It is necessary to program a command to remove this slug. This may be done in one of three ways.

1) When the slug disposal process precedes other processes:

   X353 Y253 T31 ........................................(1)
   GRD/ U 43 7 R 43 7 ....................................(2)
   MOV/X500 Y400 T08 ($30) .............................(3)
   NBL/ .....................................................(4)
   HOL/400 30 5 ..............................................(5)

(1) and (2) remove the slug by punching and (3), (4) and (5) punch the outer circumference.

2) Removal by stopping the table.

   MOV/X500 Y400 T08
   NBL/
   HOL/400 30 5
   M00
   M00 (program stop) stops the table movement and the slugs are removed by hand or magnets.

3) When the following OPEN/ command is used to make a hole:

   MOV/X500Y400T05($40)
   NBL/
   OPN/400 40 4

   Change the tool to be at least 1/10 of the tool diameter.
   Set the pitch to 4 mm to change the tolerance.

★ If the center round piece is to be used as a product, it is recommended to use RAD rather than HOL.

★ When the center slug is small, it is recommended to remove it by punching rather than by manual removal. Slugs that are small enough to fall from openings in the turret can cause the jamming of slugs, if left unpunched prior to HOL/ command.
8-8. Open (Open round hole punching by NBL/)

\[ \text{OPN/r d p} \]

This function punches a full circle at arc pitch "p", the center of which is set by the MOV/ command, has the diameter "r", and uses a tool with a diameter of "d". "r", "d", and "p" commands are exactly the same as those of the HOL/ function. Punching begins with one punch in the center and moves punch by punch to the outer circumference. When the diameter equals the last designated diameter, the punching operation continues at the pitch designated by "p". This command automatically punches the slug in the center prior to punching the circle. Note that the pitch used to punch the center slug is larger than that designated by "p". The insertion of an NBL/ command will result in the last punching operation to be carried out as a nibbling operation.

[Example]

MOV/X500Y500T05 (ϕ40)
NBL/
OPN/400 40 4

\[ \text{Pattern reference point and pattern end point} \]

\[ \star \text{The OPN/ function may be used to diameters up to ten times the diameter of the tool being used. If the diameter of the circle is larger, use the HOL/ function.} \]

\[ \star \text{The reference point of the OPN/ function must be designated by MOV/. X-and Y-axis commands must be made in absolute values.} \]
8-9. Rectangular
(Punching of 1-axis and 2-axis designated rectangle)

\[ REC/a \, Ix \, dx \, \alpha \, \beta \, Iy \, dy \, \alpha y \]

Or the following command changes the machining order while keeping the punching pattern unchanged.

\[ REC/\beta \, Iy \, dy \, \alpha y \, \alpha \, Ix \, dx \, \alpha x \]

This function punches a square at pitch "ax" in the X axis, at pitch "ay" in the Y axis, for a distance of "Ix" in the X axis and a distance of "Iy" in the Y axis with a tool of the width "dx" and length "dy", beginning at the reference point set by MOV/.

1) "\alpha" designates either of the following directions.
   R(ight) : +X direction
   L(left) : - X direction

2) "\beta" designates either of the following directions.
   U(up) : +Y direction
   D(down) : - Y direction

   Note: When machining thick workpiece or those of stainless steel, command "D" for the direction (from the top to the bottom).

3) "Ix" and "Iy"
   "Ix" and "Iy" designate length of punching. Designations can be input as a decimal fraction of up to two places (0.01 mm). These values must be positive numbers.

4) "dx" and "dy"
   "dx" and "dy" designate tool dimensions.
   \( dx \) : Tool dimension in the X-axis direction
   \( dy \) : Tool dimension in the Y-axis direction

5) "ax" and "ay"
   "ax" and "ay" designate feed pitch. Designations can be input as a decimal fraction of up to two places (0.01 mm). These values must be positive numbers and must not exceed tool dimensions.
8-9-1. One Axis Movement (in either the X or Y-axis)

1) REC/in the X-axis direction
   Either A or B can be chosen for the pattern reference point.
   
a) A is the pattern reference point.
      MOV/X60 Y80 T31 (□50)
      REC/R 250 50 45 50
   
b) B is the pattern reference point.
      MOV/X310 Y80 T31
      REC/L 250 50 45 50

   ![](diagram1)

2) REC/in the Y-axis direction
   Either C or D can be chosen for the pattern reference point.
   
a) C is the pattern reference point.
      MOV/X75 Y50 T09 (□30)
      REC/U 125 30 25 30
   
b) D is the pattern reference point (thick workpieces or those of stainless steel)
      MOV/X75 Y175 T09
      REC/D 125 30 25 30

   ![](diagram2)

Error will be automatically compensated for in all the four cases, as long as the feed pitch is less than the tool size and an appropriate value is chosen.
Either C or D can be chosen for the pattern reference point.

a) C is the pattern reference point.
   MOV/X400 Y280 T09 (□30)
   REC/L 300 30 25 D 200 30 25

b) D is the pattern reference point.
   MOV/X100 Y280 T09
   REC/D 200 30 25 R 300 30 25

In this example, since only the outer edges of the rectangle are punched, a large rectangular slug is left in the middle for which a removal command must be given separately.
8-10. Oblong (Oblong shape punching)

\[ OBL/α \, lx \, dx \, αx \, βy \, dy \, ay \]

Or the following command changes the machining order while keeping the punching pattern unchanged.

\[ OBL/β \, ly \, dy \, ay \, α \, lx \, dx \, αx \]

This function punches a square at pitch "ax" and "ay" in the X and Y axes respectively, for a distance of "lx" and "ly" in the X and Y axes respectively, with a tool of the width "dx" and length "dy", beginning at the reference point set by MOV/.

"α", "β", "lx", "ly", "dx", "dy", "ax", and "ay", commands are exactly the same as those of the REC/ function when used in the two-axis movement.

The punching begins with the shaded area in the center. Next, the 200 × 300 area is punched in the same manner as with the REC/ function. This command automatically punches the slug in the center prior to punching.

[Example]

MOV/X100 Y280 T31 (□50)

OBL/D 200 50 45 R 300 50 45

![Diagram showing punching pattern and tool paths]

* If a length of the punched line is less than two times the length of the tool, an alarm will occur.
8-11. Cut at Angle (Punching of line at angle by NBLJ)

$CAA/A \ L \ d \ \theta p$

This function punches at pitch "p" along a straight line at angle $\theta$ measured to the X axis for a distance of "L" beginning at the reference point set by MOV/.

1) "A"
   "A" designates the following tool offsets
   - R(right) : Offsets the tool to the right of the straight line L when looking in the direction in which the tool will move.
   - L(left) : Offsets the tool to the left of the straight line L when looking in the direction in which the tool will move.
   - Z(zero) : Sets the tool directly on the straight line L, i.e., no offset is made. (Coincidence of the pattern reference point with the tool center position)

2) "L"
   "L" designates the working length. Length can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

3) "d"
   "d" designates the tool diameter.

4) "$\theta$"
   "$\theta$" designates the angle of punching as measured from the X axis. CCW angles are considered to be positive. CW angles are indicated by negative numbers.

5) "p"
   "p" designates the feed pitch. "p" can be input as a decimal fraction of up to two places (0.01). Inputs must be positive numbers. Precise calculations are not necessary as any error is compensated for automatically.
Study the use of the pattern reference point and end point in the following diagram.

1) When point A is used as the reference point.  
   (punching direction →)  
   MOV/X0 Y700  
   NBL/  
   CAA/L 100 20 30 3  
   Point OB is the pattern end point.

2) When point B is used as the reference point.  
   (punching direction ←)  
   MOV/86.6 Y750  
   NBL/  
   CAA/R 100 20 210 3  
   Point ● A is the pattern end point.

3) When point C (punch center) is used as the reference point.  
   (punching direction →)  
   MOV/X-5 Y708.66  
   NBL/  
   CAA/Z 100 20 30 3  
   Point ⚫ D is the pattern end point.

* The value of feed pitch must be kept smaller than tool diameter. Otherwise an alarm will occur.  
* "L", "d", and "p" must be either zero or positive numbers, otherwise an alarm will occur.  
* The movement pitch of the final punch may vary with the designated punch in order to attain proper length.
8-12. Cut Triangle (45°-inclined tool V-notching)

\[ TGL/A \: L \: r \]

This function punches a notch for the distance of "L" in the designated direction "A" with right triangle punch with 45° beveled sides having the length "r".

1) "A"
   "A" designates the direction of notching in relation to the location it is at.
   - D (down) : Downward direction
   - U (up) : Upward direction
   - R (right) : Rightward direction
   - L( left) : Leftward direction

2) "L"
   "L" designates the depth of the notch. Depth can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

3) "r"
   "r" designates the tool dimensions. The tool must be a 45° beveled punch.
[Example]

MOV/X300 Y0 T09 (□20)
TGL/U 40 20

★ The machining travel pitch is not designated. It is calculated by the NC. The movement pitch is approximately 80% of the tool dimensions.
★ In TGL/ punching, only a and b protrude and are punched with the first and the last punch. Since the measurement of a is approximately 20% that of the tool dimensions and b can be as much as 80%, ensure that TGL/ punching is undertaken only at work sheet edges.
★ The shaded portion sometimes will remain as a slug. In such a case, a removal command must be given.
★ The pattern reference point is given with the MOV/ command in the TGL/ function. X and Y coordinates must be given in absolute values.
8-13. Roundable Rectangular (Punching of rectangle with round corner)

\[ RRC/L1 \ r1 \ P1 \ L2 \ r2 \ p2 \ R \]

This function punches a rectangle at a pitch of "p1" and "p2" in the X and Y axes respectively, for a length of "L1" and "L2" in the X and Y axes respectively with a tool of "r1" horizontally and "r2" vertically.

1) "L1" and "L2"
   "L1" and "L2" designate the length of the rectangle.
   \[ \text{L1: Length in the X-axis direction} \]
   \[ \text{L2: Length in the Y-axis direction} \]
   Length can be input as a decimal fraction of up to two places (0.01 mm). Inputs must be positive numbers.

2) "r1" and "r2"
   "r1" and "r2" designate the tool dimensions.
   \[ \text{r1: Dimension in the X-axis direction} \]
   \[ \text{r2: Dimension in the Y-axis direction} \]

3) "p1" and "p2"
   "p1" and "p2" designate the feed pitch. Both can be input as a decimal fraction of up to two places (0.01). Inputs must be positive numbers.

4) "R"
   "R" designates the corner R. "R" can be input as a decimal fraction of up to two places (0.01). Inputs must be positive numbers.
[Example]

MOV/X300 Y250
RRC/400 50 45 200 50 45 30

★ The pattern reference point is given with the MOV/ command as in the TGL/ function. X- and Y-coordinate must be given in absolute values.
★ Feed pitch calculations are not necessary as feed pitch error is compensated for, automatically.
★ As the shaded portion will remain as a slug, a removal command must be given.
★ Since the RRC/ function will not punch the corner sections R, these areas should be punched prior to this command.
8-14. Slope at Angle (Slope-at-angle punching for IT)

\( SAA/A \ell \theta p q j: \)

The index tool punches straight line at specified angle (\( \theta \)), at specified offset value to right or left (R or L), for a distance specified by punching length (\( \ell \)) with the rectangular tool.

Tool length along with the punching direction is to be specified by (p) and width is to be programmed by (q).

1) "A" Tool Offset Direction
   Looking at the punching direction, the tool is to be offset at 90 degree for tool width to right or left direction.
   - R (right) : Offset to right
   - L (left) : Offset to left

2) "\( \ell \)" Punching Length
   Value should be positive (plus) and the minimum value is 0.01 mm.

3) "\( \theta \)" Direction at angle
   - Plus (+) for CCW direction
   - Minus (-) for CW direction

4) "p" Tool Length
   Length along with the punching direction and the value should be plus.

5) "q" Tool Width
   The width for 90 degree against the tool length specified by "p".

6) "j" Width of micro-joint
   - \( j > 0 \) : The punching dimension extended by amount of 2XJ.
   - \( j < 0 \) : The punching dimension reduced by amount of 2XJ.
   - \( j = 0 \) or omitted : No compensation for micro-joint.
[Example]

MOV/X100Y100T01
SAA/L 200 75 30 10
SAA/L 150 15 30 10
SAA/L 100 -40 30 10
SAA/L 160 -100 30 10
SAA/L 250 180 30 10

The end point of the SAA/ pattern is used for datum point for the next SAA/ command.
The T command for turret index must be programmed in the MOV/block. The T command can not be programmed with the SAA/ command.

★ Devise the most ideal method of removing the product after machining the peripheral of the workpiece through continuous issuance of the SAA command as an automatic index dedicated command.
★ In case illegal character is programmed instead of R or L, or a minus value is designated for "ℓ", "p", "q", alarm 180 will be displayed on CRT.
★ In case the value for "ℓ" is smaller than 1.5 times of "p", alarm 154 will be displayed.
8-15. Point to Point (Punching of point to point)

PTP/αx2 y2 p q j:

With this command punching is done with a rectangular tool from a point arrived at by MOV/command of earlier block, up to a commanded point designated by the absolute coordinates (x2, y2) in a straight line, the tool is offset according to the (α) command to left, right or center of the line joining the start and end-points. The length and width of the tool are designated by (p) and (q) commands.

A micro-joint is automatically added at start and end points, if required by (J) command.

1) "α" can be designated by one of the following:
   R(right) : The tool is offset to the right side of the line joining the start and end points, looking in the direction of end point from start point.
   L(left) : The tool is offset to the left side of the line joining the start and end points, looking in the direction of end point from start point.
   Z(zero) : The tool is centered with-wise on the line joining the start and end points (zero offset).

2) "x2, y2" End point co-ordinates
   Only absolute value of co-ordinate must be commanded.

3) "p" Tool Length
   Length dimension of the tool in the direction of the line joining the start and end points.

4) "q" Tool Width
   Width dimension of the tool in the direction perpendicular to the length dimension "p".

5) "j" Width of micro-joint
   j>0 (+ve) : The punching dimension extended by amount of 2XJ.
   j<0 (-ve) : The punching dimension reduced by amount of 2XJ.
   j=0 or omitted : No compensation for micro-joint.
MOV/X0 Y300
PTP/L 400 500 50 20
8-16. Point to Point Arc (Punching of point to point arc)

PPA/α x2 y2 r d c p (1)

With this command punching is done with a round tool of diameter (d) from a point previously designated by MOV/ command, to the absolute co-ordinates (x2, y2) along an arc of radius r.

The tool is offset towards the arc center (in wards) or away from arc center (out wards) by (α) command. The punching pitch is commanded by (p).

1) "α" can be designated by one of the following:
   I(inside) : Inside the arc towards the arc center.
   O(outside) : Outside the arc away from the arc center.
   Z(zero) : Centered on the arc line with tool center.

2) "x2, y2": End point or arc designated by absolute co-ordinates only.

3) "r" Radius of the arc joining the start and end points.
   r>0 (+ve) : The arc of less than 180° included angle is selected.
   r<0 (-ve) : The arc of more than 180° included angle is selected.

4) "d" Tool diameter

5) "c" Direction of arc as seen from start point to end point.
   c=0 : Clockwise direction of arc.
   c=1 : Counter-clockwise direction of arc.

6) "p" Punching pitch

7) "(1)" Nibbling flag
   NBL flag = 1 : Punching is done in nibbling mode.
   NBL flag = 0, NBL flat omitted : Normal punching is done.
[Example]

MOV/X200 Y200
PPA/O 350 200 100 20 0 5

*Various patterns related to "r" and "c" values of command.
Section 9  Pattern Function Recall

INC, GRD, BHC, HOL and other pattern functions that are given a recall number and loaded into the memory can be recalled and used repeatedly within a part program if necessary.

1) Function recall numbering
A function is given recall capability by adding a number from one to ten between the three-letter code and the slash as shown in the following example.

MOV/X300Y400
BHC3/100 0 4

2) Pattern function recall example
MOV/X300Y400
BHC3/100 0 4
MOV/X800Y600
BHC3
MOV/X1400Y500
BHC3

3) Pattern function recall numbers
When patterns loaded into the memory vary yet have the same recall number, the contents of the first pattern in the memory is erased. Distinguish different pattern functions with different recall numbers.
Section 10  Pattern Function and the T and M Functions

Pattern functions and M codes cannot be used together within the same block.
Pattern functions and T codes can both be used within the same block if necessary.

1) Example of valid use
   MOV/X500 Y300
   BHC/200 0 8 T03
   ...
   MOV/X700 Y50 T18 .................. φ20
   NBL/
   RAD/O 50 20 -90 60 3
   NBL/
   CAA/R 250 30 60 5 T25 .............. φ30
   :

2) Example of invalid use

   ...
   ...
   MOV/X600 Y500
   NBL/
   HOL/300 20 3 M00
   :

Program the M code independently or with coordinate commands.
Section 11  Local Coordinate Designation (Offset)

OFS/X a Y b

This command enables origin points within a program to be freely changed to new locations. This command is effective until a new OFS/location is indicated.

[Example]
OFS/X500 Y300
X200 Y100

All commands that follow an OFS/ command within a program are measured from the new OFS/ designated origin point.
"a" and "b" may contain values up to ±999999.99 mm.
The OFS1 command is used to move the zero point to effectively use the material or to avoid the work holder safety zone, so that a program can be created effectively using the functions such as pattern function, coordinate parallel shift function, etc.

Notes:

1) It is possible to use incremental designations with the OFS/command as in OFS/DX100 DY200. In such a case, the new program origin points become those measured from the previously designated OFS/ command in the direction DX and DY.

OFS/X500 Y300 ..................(1)

......

OFS/DX100 DY200 ..........(2)

......

OFS/ command (2) is identical to the OFS/X600 Y500 commands.
2) Absolute and incremental may be used together as in the following example.

```
OFS/X600 DY200
```

3) Ensure that the local coordinate system ordered by the OFS/ command is canceled when no longer needed. The original origin points can be returned to by designating OFS/X0 Y0.

4) The OFS/ command sets only a coordinate system and does not carry out such operations as positioning.

5) T code cannot be used in the same block with an OFS/ command.

6) It is possible to designate only one a axis with the OFS/ command. In such a case, the local coordinate system of the remaining axis remains unchanged.
Section 12  Macro Function (PAT/ ~ END)

It is possible to load multiple blocks into the memory as one pattern set and then to recall it when needed. One group of multiple blocks is called a macro.

12-1. Macro Function Numbering

A macro is headed by the PATnn/ command, where nn is a numeric value between 1 and 99.

The end of the macro is designated by the ENDnn command, where nn is the same numeric value that the macro was headed with. The commands of all the blocks within these two commands become part of the macro.

[Example]

```
PAT5/
X100Y300T03
GRD/R 20 9 D30 5
MOV/X500Y500T27
BHC/200 30 6
END5
```

The standard capacity of PAT is 3000 characters. When this is exceeded and a new macro needs to be loaded into the memory, it is necessary to erase a macro that is no longer needed. This can be done by assigning a previously used macro number to the new macro, resulting in old macro being erased and the new one being loaded.

The macro function (PAT1/~PAT99/) is into three types and represented as such in the assignment of recall numbers.

1) Macro normal

```
PAT1/ ~PAT69/
PAT90/ ~PAT99/
```

[Designation]

```
PAT1/
:
:
:
END1
```

The designated portion is loaded into the memory and operation is conducted.
2) Macro definition
   PAT70/ ~ PAT79/
   [Designation]
   PAT70/
  ...
   END70
   ...

The designated portion is loaded into the memory but operation is not conducted.

3) Macro global
   PAT80/ ~ PAT89/
   [Designation]
   PAT80/
   PAT1/
   ...
   END1
   PAT7/
   ...
   END7
   PAT10/
   ...
   END10
   ...
   END80
   ...

The designated portion is loaded into the memory and operation is conducted. However, PAT80/ is reserved for only designating combination of other PAT macros.

The pattern can be called for as needed, provided each time the turret tooling is not changed.
Up to 15 macros may be designated within PAT80/ and END80.
12-2. Call

To call up a stored pattern, designate the previously stored number immediately following PAT.

[Example]

OFS/X300Y100
PAT5

To call up PAT5, use OFS/ or other commands so that it appears at the desired position.
The individual punch: PAT5 block designated in PAT80/ (see page 12-02, Macro Global) can be called up outside PAT80/.
Section 13 Macro Grid

The macro grid command, MGR/, is used to recall previously designated macros (PAT/ END) and to automatically calculate their offset values.

\[ \text{MGR(n1)/n2 D1 P1 N1 D2 P2 N2} \]

1) "n1"
   By entering a number between one and ten, the punching pattern is stored in the memory as number n1. This number is the same level as that of the recall number of the desired pattern function. Use of the same numeric value will erase the contents of the previous designated macro grid.

2) "n2"
   "n2" designates the number of the macro function that is to be recalled.

3) "D1" and "D2"
   "D1" and "D2" designate the direction of punching.
   - R(right) : Rightward direction
   - L(left) : Leftward direction
   - U(up) : Upward direction
   - D(down) : Downward direction

4) "P1" and "P2"
   "P1" and "P2" designate the amount of offset of the directions designated by "D1" and "D2". Offset can be input as a decimal fraction of up to two places (0.01 mm).

5) "N1" and "N2"
   "N1" and "N2" designate the number of offsets in the direction designated by "N1" and "N2".

\[ \text{\star In the case of macro-grid machining, it is recommended to machine from the top to the bottom for machining stability.} \]
(1) Multiple punching commands

OFS/X50Y350
PAT1/
MOV/X70Y125T06(ϕ5)
BHC/50 0 4
END1
MGR/1 R 300 2 D 250 1

PAT2/
MOV/X70Y125T05(ϕ30)
NBL/
OPN/90 30 5
END2
MGR/2 R 300 2 D 250 1

PAT3/
X175Y80T09(□30)
GRD/U 22.5 4 R 22.5 4
END3
MGR/3 R 300 2 D 250 1

OFS/X0Y0
X ___ Y ___ M30

Refer to * on page 1-05
The machining pattern R 300 2 D 250 1 in the program given on the previous page is the same as that indicated by the numbers (1), (2) and (3). Therefore, this pattern can be simplified, and stored as indicated below. (The numbers used to store the machining pattern ranges from 1 to 10. By way of example, number 5 is designated in the program mentioned below.)

The same machining operation is performed since the program which is shown on the previous page is written as follows.

```
OFS/X50Y350
PAT1/
MOV/X70Y125T06(Φ5)
BHC/50 0 4
END1
MGR5/1 R 300 2 D 250 1............................................. (1)'
PAT2/
MOV/X70Y125T05(Φ30)
NBL/
OPN/90 30 5
END2
MGR/5,2............................................................... (2)'
PAT3
X175Y80T09(□30)
GRD/U 22.5 4 R 22.5 4
END3
MGR5,3............................................................... (3)'
OFS/X0Y0
X  *  Y  *  M30
```

The following is an explanation of the designation in (1).

MGR5/1 R 300 2 D 250 1

Recalls PAT1

Loading of R 300 2 D 250 1

(2) and (3) recall MGR5 and PAT2 and 3 respectively and the punching patterns commanded by each are executed.
(2) Using the PAT80/Command

The same machining operation is programmed using the macro function, PAT80/, as follows:

OFS/X50Y350
PAT80/
PAT1
MOV/X70Y125T06(ψ5)
BHC/50 0 4
END1
PAT2/
MOV/X70Y125T05(ψ30)
NBL/
OPN/90 30 5
END2
PAT3/
X175Y80T09(□30)
GRD/U 225 4 R 225 4
END3
END80
MGR/80 R 300 2 D 250 1
OFS/X0Y0
X * Y * M30

This method allows the punching pattern to be checked since the designations of the first
PAT80 punches one workpiece.

The machining operation for the figure is usually performed by this program (PAT/80).
(3) When the REP/ command is used for large-size sheets:

[Example]

OFS/X30Y580
PAT80/
PAT1/
:
END1
END80
X1250-30M00.............. Return to the origin point, temporarily stop machining, remove the product, and make confirmation.

MGR1/80 R 300 2 D 330 1
OFS/X0Y0
X * Y * M03
REP/DX600 ............. The workpiece is reclamped since it goes beyond the table travel range.

OFS/X930Y580
PAT80
MGR1, 80
OFS/X0Y0
X * Y * M03
REP/DX-600
X * Y * M30

Refer to * on page 1-05.

* ....... Select a position where any pad does not get into a hole.
★ It is desirable that the 1-tool 1-pattern mode be employed for the program which is used to machine the part as multiple pieces.
★ When the multi-piece machining operation is to be performed based on the concept that each pattern corresponds to machining by each tool, programming error can be minimized by entering the data on size and other factors of the first product in pattern 80 and making first confirmation through use of the MGR command.
★ The blank should desirably travel downward. If machining is started on the front side, disconnection or deterioration in strength can result during micro joint.
★ If downward burring is to be executed, it may be desirable to machine in the "pull" direction from the turret (from the bottom to the top).
13-1. The Relationship between MGR/ and OFS/

ALL OFS/ commands may relate with the MGR/ command.

1) OFS/ commands outside of macros

```
OFS/X50Y100
PAT/1
X100Y200T08 ........................................ (1)
END1
MGR/1 R 200 2........................................ (2)
```

The actual punch point is (1) is at X150Y300 in relation to the original origin point. The actual punch point is (2) is at X350 and X550 (Y is unaffected). The OFS/ command is also valid for the program following MGR/1 R 200 2.

2) OFS/ commands within macros

```
PAT1/
OFS/DX50DY100
X100Y200T08 ........................................... (1)'
OFS/DX-50 DY-100
END1
MGR/1 R 200 2........................................ (2)'
```

The actual punch point in (1)' is at X150Y300. The actual punch point in (2)' is at X350 and X550 (Y is unaffected). When OFS/ is used within macros, only DX and DY values can be used, i.e., absolute values are invalid. Ensure that any OFS/ commands used within a macro are also canceled within the macro.
Section 14  Repositioning

When the size of a sheet metal exceeds the rated table stroke in X-axis direction for the machine being used, the sheet metal has to be repositioned in order to conduct punching process all over the sheet metal. Reposition command is used for this shift of working area.

REPD/ DX a

"a" This designates the distance of repositioning and is to be designated by incremental value with DX. In case of plus value, table moves in the plus direction (X+) and minus direction (X-) for minus value.

[Example]

......
X1000Y300M03 .............. (Positioning for repo-pad, on punch)
REPD/ DX500 ..................... (1)
X1000Y300M03 .............. (Positioning for repo-pad, on punch)
REPD/ DX-500 ................. (2)
......

The machine movement of first repositioning (1)
1) Table carriage moves 2 mm Y minus (-) direction, away from sheet metal.
2) X-axis moves plus (+) direction.
3) Table carriage returns 1 mm Y plus (+) direction, towards the sheet metal.

The movement of the second repositioning (2)

1) Table carriage moves 2 mm Y minus (-) direction, away from sheet metal.
2) X-axis moves minus (-) direction.
3) Table carriage returns 2 mm Y plus (+) direction, towards the sheet metal.

After first repositioning, the gap sheet metal and workholder will be kept 1 mm all the time and this is compensated at the end of the program. At the end of the program, table has to be returned to the home position by using absolute coordinate command for X-and Y-axis with the M-code M02, M03 and M40. An alarm will occur if it is not an absolute value.

If machine operation is interrupted during the automatic mode after repositioning, "ZERO SET" should done to cancel Y-axis shift value that is used for the repositioning.
Location of Reposition Pad

The position for repositioning is to be programmed as follows:

X1000Y800M03 ......................... Positioning for repo-pad, no punch
REP/DX500

Note that this position indicates not the pad position but the punch center.
The distance between the punch center and the pad center vary depending on machine models.
The pad is 40 mm in diameter.

Distance between the Punch Center and the Pad Center

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTORUM series, C-2000, C-2500</td>
<td>315</td>
<td>40</td>
</tr>
<tr>
<td>FL-1544</td>
<td>280</td>
<td>40</td>
</tr>
<tr>
<td>C-3000, C-3500, V-3000</td>
<td>310</td>
<td>90</td>
</tr>
<tr>
<td>V3α series</td>
<td>335</td>
<td>40</td>
</tr>
<tr>
<td>M-5000, V5 series</td>
<td>330</td>
<td>86</td>
</tr>
</tbody>
</table>

Repo-Safety Zero for Workholder

<table>
<thead>
<tr>
<th>Model</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTORUM series, FL-1544</td>
<td>-</td>
<td>72</td>
</tr>
<tr>
<td>C-2000, C-2500</td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td>C-3000, C-3500, V-3000, V-5058</td>
<td>-</td>
<td>120</td>
</tr>
<tr>
<td>V3α series</td>
<td>-</td>
<td>72</td>
</tr>
<tr>
<td>M-5000, V-5000</td>
<td>-</td>
<td>117</td>
</tr>
</tbody>
</table>

*70 mm is added to each value when the REP/ command is used for an in-track tool of a Double track models.

*For more information on special workholders, refer to the machine specifications.

When the sheet has a notched or irregular edge, use the M code (M41 or M42) to move it along the Y-axis.

⊙ M41 .......................... Pad DOWN, workholder open
⊙ DY5 .......................... Repo-Y relief
③ DX-400 .................. Repo-X travel
④ DY-5 .................. Repo-Y return
⑤ M42 .................... Workholder close, pad UP

* Pad Clamp Position and Reposition Amount
  The X-axis coordinate value must be larger than the reposition amount. In the following example, X-axis coordinate value should be larger than 500.

...  
...  
X400Y700M03  
REP/DX500  
...  
...

* How to return to homeposition without re-repositioning
  The following method is effective in order to reduce cycle time and in cases where sheet metal cannot be held by reposition pad.

...  
...  
X600Y700M03  
REP/DX500  
...  
...  
X1830+500Y700M03  
FRM/X1830 .................. Coordinate system designation  
X  *  Y  *  M30

But please be careful because the sheet will be projecting by the same amount of repositioning value beyond table on X-axis.

* Program zero point is not affected by repositioning
  Since the repositioning amount is automatically compensated by CNC, the programmer can reference to the original program zero point even after repositioning.
Program Examples (for the M-5000: 1830 table)

Three typical program examples which use the REP/ command are given below.

[Example 1]

---

X0Y200+35.4T13 .................................... (50° 45°)
X50-35.4Y250
X900+35.4Y250
X950Y200+35.4
X1450Y200+35.4
X1500-35.4Y250
MOV/X950Y225T32 .................................. (50°)
RECl/R 500 50 45 50 ............................... (1)
MOV/X950Y200
RECl

---

X1300Y200M03 ........................................ (2)
REP/DX600

X2350+35.4Y250T13
X2400Y200+35.4

---

X1300Y200M03 ........................................ (3)
REP/DX-600

X1830Y1525M30 ....................................... (4)

(1) ........... Machining on the edge to avoid burr
(2) ........... Repo-Pad down position

---

REP/DX600

\[ \text{Product length: } 2400 \quad \text{Machining range: } 1830 = 570 \]

(3) ........... Repo return
(4) ........... Unloading position
[Example 2]

Two times repositioning will be required in case of following example.

X1050Y800T04 ................................................... (ϕ10)
X100
MOV/X300Y100T13 ........................................... (□50)
REC1/R 1500 50 45 U 100 50 45
X-5 Y905
Y-5
X1800Y800M03
REP/DX1800
MOV/X2100Y100
REC1
X2000Y800T04 ................................................... (ϕ10)
X2950
X3000Y800M03
REP/DX400
X3900Y800
X4005Y905T13 ................................................... (□50)
Y-5
X1830+2200Y1525M03
FRM/X1830
X1830Y1525M30
[Example 3]

In the case of narrow sheet metal, use the REP/ command properly and avoid interference of workholder safety zone.

Workholder Position WH1:300 mm WH2: 1300 mm

X0Y-4T15.........................................................(□20, 45°)
X0Y254.14
X1600Y254.14
X1600Y-4.14
X200Y10T14...................................................(φ8)
GRD/R 200 6 U 230 l
X400Y200M03
REP/DX-100
X100Y10
GRD/R 200 6 U 230 l
X1830-100Y1525M03
FRM/X1830..................................................Coordinate system designation
X1830Y1525M30
Section 15  Mirror Images (Symmetry)

The SYM/ command will punch at a designated coordinate a pattern or macro function on a designated axis or a point symmetrical to the function.

\[ SYM/X \ a \ Y \ b \]

"a" and "b"
"a" and "b" designate the axes or the absolute coordinates of the mirror image. Values can be input as a decimal fraction of up to two places (0.01 mm).

SYC/

This cancels the coordinates or axes designated by SYM/Xa Yb.
When the SYM/ command is executed, the origin point is changed. Be sure to cancel the SYM/ command using the SYC/ command.

[Example]

: PAT1/
  : END1
  SYM/X a
  PAT1 .......................................................\( (1) \)
  SYC/
  SYM/Y b
  PAT1 .......................................................\( (2) \)
  SYC/
  SYM/X a Y b
  PAT1 .......................................................\( (3) \)
  SYC/

All coordinates given between SYM/ and SYC/ are read as being mirror image punching coordinates.
All designated coordinates, X and Y axes, and mirror image coordinates can be canceled by the last SYC/.
Relation between SYM/ and OFS/

\[
\begin{align*}
\text{OFS/X} & \text{ m Y n} \\
\text{SYM/X} & \text{ a Y b} \\
\text{SYC/} & 
\end{align*}
\]

"a" and "b" designated by SYM/ as X and Y coordinates, have the same level as the "m" and "n" designated by OFS/ as X and Y coordinates.

This prevents them from modifying each other. This means that the value of "a" and "b" of SYM has no relation to the value of the coordinate values of X and Y in OFS/, and usually program distance from the origin point.

* When a product is to be produced from one work sheet with SYM/, the mirror image products of SYM/X and SYM/Y, the punched burrs will extend from the opposite side.

* When a mirror image press operation using a program with an automatic indexing tool command is conducted, the commanded angle and mirror angle will become the same.

\[
\begin{align*}
\text{PAT1/} \\
\text{X200Y300T01C45} \\
\text{INC/R 50 2} \\
\text{END1} \\
\text{SYM/X350} \\
\text{PAT1} & \text{ .......................................................... Same as the C135 command} \\
\text{SYC/} & 
\end{align*}
\]

* The REP/ command will operate as normal when placed in blocks between SYM/ and SYC/ commands.

* Incremental values cannot be used, i.e., SYM/DX__DY__is an invalid command.
Section 16  Bend Compensation (BNX/ and BNY/)

X axis bend compensation command

    BNX/α X1 X2 X3 X4 X5

Y axis bend compensation command

    BNY/β Y1 Y2 Y3 Y4 Y5

The BNX/ and BNY/ commands execute punches that are compensated for location shifts caused by bends in the work sheets.

1) "α" and "β"
"α" and "β" designate bend coefficient. Values can be input as a decimal fraction of up to two places (0.01 mm). Outer measurements of the product are input as minus values. Inner measurements of the product are input as positive values.

2) "X1～X5" and "Y1～Y5"
"X1～X5" and "Y1～Y5" designate the amount of distance from the reference point in the X and Y axes respectively. Values must be measured from the reference point in the positive direction.

BNX/ may be used one time for up to four bends.

[Example]

    BNX/-1 200 450 1200 (or maximum value of X)
    X100Y500
    X325
    X700
    BNX/0

![Diagram of bend compensation]
The actual hole punching occurs as X100, 324, and 698. This is because the command values and pattern functions related to addresses X and Y in the blocks following the commands BNX/ and BNY/ are automatically compensated for, taking the number of bends into consideration.

Bend compensation commands remain in effect until canceled by either M02 or M30.

BNX/-1 200 450 1200
X100Y500
X325
X700
BNX/0 .................................................. BNX/ is canceled.
:
:

★ When bends are not uniform, use BNX/ and BNY/ commands for each bend separately.
★ This bend compensation is performed to compensate for the punch center, depending on the bend area this center lies in. The pitch changes when the start and end points reside in two or more areas.
Avoid using the program by which one pattern function (such as the REC command) is related to two or more areas.
★ Either BNX/0 or BNY/0 command can be used for canceling purposes.
Section 17  Dwell

$DWL/X \ t$

The DWL/Xt command controls the time interval between the execution of blocks with the variable "t".

1) "t"

"t" designates the length of time between block execution. Time is controlled in seconds from 0.01 to 999999.99 seconds.

This is used to set the timing between auxiliary equipment, optional, such as plasma and tapping equipment, and the press.

DO NOT use this command for slug removal as it can lead to operator injury.
Section 18  MAT/Command (Work Sheet Data)

On muratec machines such as MOTORUM series, VECTRUM series and HYBRID machines it is essential to use MAT/command at the beginning of the program after program number and before X, Y axis positioning.

This command is most important for optimum performance of the machine. This command is used to control hover height, calculation of required tonnage etc. for MOTORUM series, FL-1544, V3α series and V-5058 machine. This command is also used to set conditions for laser cutting.

\[ MAT/Ba Hb (Xc Yd) \quad (\quad ) \quad \ldots…\quad MOTORUM \text{ series, FL-1544, V3α series and V-5058 only} \]

1) "a" Material code (1~20)
2) "b" Material thickness (mm)
3) "c" Material dimension in X-direction (mm)
4) "d" Material dimension in Y-direction (mm)

Material code list

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPCC</td>
<td>Cold rolled mild steel plate</td>
</tr>
<tr>
<td>2</td>
<td>SPHC</td>
<td>Hot rolled steel plate</td>
</tr>
<tr>
<td>3</td>
<td>SS41</td>
<td>Rolled steel for general structure</td>
</tr>
<tr>
<td>4</td>
<td>SECC</td>
<td>Electrolytic zinc-coated steel</td>
</tr>
<tr>
<td>5</td>
<td>SK</td>
<td>Carbon tool steel</td>
</tr>
<tr>
<td>6</td>
<td>SUS30</td>
<td>Austenitic stainless steel</td>
</tr>
<tr>
<td>7</td>
<td>SUS43</td>
<td>Ferritic stainless steel</td>
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<td>8</td>
<td>A1000</td>
<td>Aluminium</td>
</tr>
<tr>
<td>9</td>
<td>A2000</td>
<td>Alloy steel (High strength)</td>
</tr>
<tr>
<td>10</td>
<td>A5000</td>
<td>Alloy steel (Medium strength)</td>
</tr>
<tr>
<td>11</td>
<td>C1000</td>
<td>Copper</td>
</tr>
<tr>
<td>12</td>
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<td>Brass</td>
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<td>13</td>
<td>TI</td>
<td>Titanium</td>
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<td>14</td>
<td>ACRYL</td>
<td>Acrylic</td>
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<td>15</td>
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<td>USER 2</td>
<td>Other 2</td>
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<td>Other 3</td>
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<td>USER 5</td>
<td>Other 5</td>
</tr>
<tr>
<td>20</td>
<td>USER 6</td>
<td>Other 6</td>
</tr>
</tbody>
</table>
[Example]

1) MAT/B2 H2.3 ;  • Material type : Hot rolled steel plate
   • Material thickness : 2.3 mm

2) MAT/B1 H3.2 X1250 Y1000 ;  • Material type : cold rolled mild steel plate
   • Material thickness : 3.2mm
   • Sheet size : 4' × 3'

☆ A program without MAT/command will be executed by considering following material conditions.
  • Material code : 1 (cold rolled mild steel plate)
  • Material thickness : Maximum material thickness according specification of the machine.
  • Sheet size : Maximum sheet size specification of the machine.

Thus optimum performance from machine is not achieved.

☆ In case of MOTORUM series, FL-1544, V3α series and V-5058 machine, if MAT/command is not used in the program, then after pressing of [CYCLE START] button in memory mode caution message, "NO MAT COMMAND" will be displayed on the screen. Cycle execution without MAT/command is possible by pressing [CYCLE START] button once again, but in this case optimum performance from machine is not expected.
Section 19  Second Quadrant Programming

If an optional automatic loading system is used, positioning might be carried out in the opposite direction depending on loading direction.

In this case (for the M-5000), the distance from the end locator to the punch center is the same (1830 mm) but programming is made in the second quadrant instead of the first quadrant.
Programming is made in reference to the programming zero.

The command for point A is X-800 Y500. As can be seen from this example, all X values become minus (Negative). When it is troublesome to use minus values, OFS/ can be used to shift the programming zero. In this case, the amount of OFS equal to the length of either the work sheet or the product is set.

Point A' command is X700 Y500, becoming the same as first quadrant programming. This is also true for programming for work sheets that exceed 1830 mm. However, REP/ operates opposite to that of the first quadrant.
The Program for Auto Loader/Unloader

<table>
<thead>
<tr>
<th>Model</th>
<th>1st</th>
<th>2nd</th>
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<td>M-5000/V5 series</td>
<td>X1830Y1500M05</td>
<td>X-1830Y1500M05</td>
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<td></td>
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<td>X-2000Y1500M05</td>
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<td>M-2034</td>
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</table>
Section 20  Micro-Joints

Micro-joints are small uncut portions left at the corners of small punched products to leave them connected to the stock after press operations. These micro-joints can then be broken by applying force with a plastic hammer etc. to them later, to separate the product from the stock.

20-1. Knock-out Method

The punching tool, usually a rectangle punch, has small work corner Rs on each of the four corners. The length is the same as that of the product.

20-2. Slit Method

Either the vertical or horizontal direction is cut with a rectangle punch and the other is sheared using a guide hole.
Punch the guide holes for shearing with special tools such as lances and center punches.
(1) Micro-joint Programming

[Example 1]

Tool: 10×40
Joint width: 0.6 mm

PAT/1
MOV/X30 Y100.3 T16
REC/U 199.4 40 35 10
END1
MGR/1 U 210 2 R 310 4
PAT2/
MOV/X40.3 Y90 T09
REC/R 299.4 40 35 10
END2
MGR/2 R 310 3 U 210 3
REFERENCE 2. MULTIPARTS PROGRAMMING

When you have to produce multiple pieces of the part illustrated below, optional parts layout should be found.

[Example 1] Simple layout

[Example 2] Layout using the mirror image function

Usually Example-2 is used for programming.
The program for Example-2

Sheet metal 400×360 mm
Multi Parts 8 parts
  OFS/X30Y100
  PAT80/
  PAT01/
  X25Y91.5T38..............................................(ϕ5)
  END01
  PAT02/
  MOV/X22.5Y56T03 .......................................(☐5)
  REC/U 35.5 5 4 5
  END02
  PAT03/
  X25Y25T04 ..............................................(ϕ20)
  MOV/X25Y25
  NBL/
  RAD/O 25 20 64.62 -309.24 3
  END03
  PAT04/
  MOV/X10Y50T05 .......................................(☐10)
  REC1/U 49.4 10 8 10
  MOV/X30Y50
  REC1
  X25Y105
  END04
  END80
  MGR/80 R 200 1 U 140 1
  SYM/X30+60 Y100+50....................................Points symmetry of third quadrant.
  PAT80
  MGR/80 L 200 1 D 140 1
  SYC/.....................................................Mirror image cancel
  OFS/X0Y0
  X *  Y * M30

Refer to * on page 1-05.
The MGR commands are effective only in the quadrant III, where machining directions are reversed. Therefore, the directions of MGR development are expressed by L (left) and D(down) instead of R (right) and U (up).
Section 21  Exercise (1)

Exercise 1

Make a program.

Exercise 2

Make a program.

\[ \phi_5 : T5 \]

\[ \Box 30 : T30 \]
Exercise 3

Make a program.

Exercise 4

Make a program.
Exercise 5

Make a program using an index tool.

Exercise 6

Make a program.
Exercise 7

Make a program.

Exercise 8

Make a program.
<table>
<thead>
<tr>
<th>Exercise 1</th>
<th>Answer</th>
<th>Exercise 5</th>
<th>Answer</th>
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<td>INC/R 30 4</td>
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<td>MOV/X100Y300</td>
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<td>GRD/L 150 1 D 150 1</td>
<td></td>
<td>ARC/400 -26 13 2</td>
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<td>X115Y115T30</td>
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<td>MOV/X100Y300</td>
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<td>GRD/R 17.5 4 U 17.5 4</td>
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<table>
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<td>X50Y60T10</td>
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<td>OFS/X100Y150</td>
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<td>X * Y * M30</td>
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<td></td>
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<td>Refer to * on page 1-05.</td>
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<table>
<thead>
<tr>
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<th>Answer</th>
<th>Exercise 8</th>
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<td>X50Y300T10</td>
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<td>OFS/X50Y100</td>
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<tr>
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<td>LAA/40 -30 6</td>
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<td>PAT80/</td>
</tr>
<tr>
<td>or</td>
<td>X50Y300T10</td>
<td></td>
<td>:</td>
</tr>
<tr>
<td></td>
<td>LAA/40 330 6</td>
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<td>END80</td>
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<td>MGR/80 R 350 3 U 410 1</td>
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## Section 22 Exercise (2)

### Exercise 1

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<tr>
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<td>MURATEC-0003</td>
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<table>
<thead>
<tr>
<th>Model</th>
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<td>50□</td>
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<td>T11()</td>
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<td>□40×10</td>
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<td></td>
<td>T21()</td>
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<td></td>
<td>T31()</td>
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<td>T41()</td>
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</tr>
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<td></td>
<td>T51()</td>
</tr>
</tbody>
</table>

---

### Diagram

The diagram appears to show a layout with various dimensions and symbols, but the specific details are not clearly visible from the image provided. The diagram likely corresponds to the part numbers or configurations mentioned in the table. The exact nature of the diagram and its relationship to the table would require closer inspection or additional context beyond what is visible in the image.
X908Y615T02
GRD/L 37 4 D 37 4
DX18.5D18.5
GRD/R 37 3 U 37 3
MOV/X590Y555
BHC/125 45 8
X390Y680
INC/L 120 2
MOV/X150Y590
ARC/90 135 45 2
INC/D 82.5 2
INC/R 120 2
MOV/X300Y515
ARC/90 45 45 2
INC/U 82.5 1
MOV/X150Y590T06
NBL/
RAD/I 75 15 90 90 2.50
MOV/X300Y515
NBL/
RAD/I 75 15 0 -90 2.50
PAT1/
MOV/X515Y200
NBL/
RAD/O 30 15 180 90 2.50
END1
SYM/X575
PAT1
SYM/Y235
PAT1
SYM/X575Y235
PAT1
SYC/
PAT2/
MOV/X760Y130
NBL/
CAA/Z 220 15 45 2.50
END2
MGR/U 80 2
MOV/X590Y555T18
NBL/
OPN/230 30 3.50
X515Y270
GRD/R 120 1 D 70 1
PAT3/
X215Y330T08
DY-25
DX-25
DX-25DY=25
INC/R 25 2
DY-25
INC/L 25 3
DX-25DY=25
INC/R 25 4
DY-25
INC/L 25 5
END3
SYM/X227.5
PAT3
SYM/Y192.5
PAT3
SYM/X227.5Y192.5
PAT3
SYC/
X540Y210T01
GRD/U 25 2 R 35 2
X525Y225
GRD/U 20 1 R 100 1
MOV/X75Y440T28
REC/U 150 40 35 10
MOV/X365Y515
REC/U 150 40 35 10
MOV/X75Y440T14
REC/R 225 40 35 10
MOV/X150Y655
REC/R 225 40 35 10
M00
X * Y * M30
Refer to * on page 1-05.
# Exercise 2

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<tr>
<td>T01(G)</td>
<td>T02(A)</td>
<td>T03()</td>
</tr>
<tr>
<td>50□</td>
<td>5φ</td>
<td></td>
</tr>
<tr>
<td>T11()</td>
<td>T12()</td>
<td>T13()</td>
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<tr>
<td>T21(B)</td>
<td>T22()</td>
<td>T23()</td>
</tr>
<tr>
<td>20□</td>
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<tr>
<td>T31()</td>
<td>T32()</td>
<td>T33()</td>
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<tr>
<td>T41()</td>
<td>T42()</td>
<td>T43()</td>
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<tr>
<td>T51()</td>
<td>T52()</td>
<td>T53()</td>
</tr>
</tbody>
</table>

Turret layout ( ) range

![Diagram](image-url)
X15Y225T02
INC/U 72.5 4
X155Y655
INC/R 130 2
X345Y495-7
GRD/L 40.2 D 96.1
MOV/X205Y275
ARC/65 90 45 5
INC/R 100 2
MOV/X405Y275
ARC/65 45 45 4
INC/L 100 1
X565Y225
GRD/U 145 2 R 360 1
DX-180
DY290
X635Y655
INC/R 130 2
X1035Y515
INC/D 72.5 4
PAT1/
MOV/X410Y50T21
NBL/
CAAR 39 20 66.80 3
END1
SYM/X525
PAT1
SYC/
PAT2/
MOV/X120Y550T18
NBL/
RAD/O 70 30 169.84 -69.68 3
END2
SYM/X525
PAT2
SYC/
PAT3/
MOV/X205Y275
NBL/
RAD/1 50 30 90 180 4
END3
SYM/X305
PAT3
SYC/
X220Y400
GRD/U 80 1 R 170 1
PAT4/
X635Y275
MOV/X635Y275
NBL/
RAD/1 35 30 -90 -90 3
END4
SYM/X765
PAT4
SYM/Y370
PAT4
SYM/X765Y370
PAT4
SYC/
PAT9/
X460Y150
MOV/X460Y150
NBL/
RAD/1 35 30 180 -90 3
END9
SYM/X525
PAT9
SYC/
PAT5/
X125Y90T08
GRD/R 22 11 U 22 3
END5
SYM/X525
PAT5
SYC/
X142.5Y402.5T07
GRD/U 18.75 4 R 315 1
X230Y395T05
GRD/U 90 1 R 150 1
PAT6/
X82.32Y-3.54T28
LAA/25 135 2
X377.68Y-3.54
LAA/25 45 2
END6
SYM/X525
PAT6
SYC/
X525Y607.63
X476.21Y620
LAA/23 -45 3
LAA/23 45 3
MOV/X205Y400T01
REC/R 200 50 45 U 80 50 30
X205Y275
DX200
MOV/X205Y225
REC/R 200.50 45 U 100 50 45
MOV/X455Y620
REC/R 140 50 45 U 80 50 45
X425Y0
DX200
MOV/X460Y135
REC/R 130 50 45 50
MOV/X425Y-10
OBL/U 160 50 45 R 200 50 45
PAT7/
X50Y0
MOV/X-20Y-10
REC/U 190 50 45 R 70 50 45
MOV/X-20Y550
REC/U 130 50 45 R 70 50 45
MOV/X120Y690
REC/L 130 50 45 D 70 50 45
END7
SYM/X525
PAT7
SYC/
MOV/X765Y370
RRC/330 50 45 260 50 45 35
M00
PAT6/
X-2.5Y117.5T25
DY375
X117.5Y672.5
END6
SYM/X525
PAT6
SYC/
X * Y * M30
Refer to * on page 1-05.
Specifications are subject to change without notice, due to design improvements.