

CNC TURRET PUNCH PRESS

VIPROS

PROGRAMMING MANUAL

AMADA

PROGRAMMING MANUAL:
VIPROS CNC TURRET PUNCH PRESS
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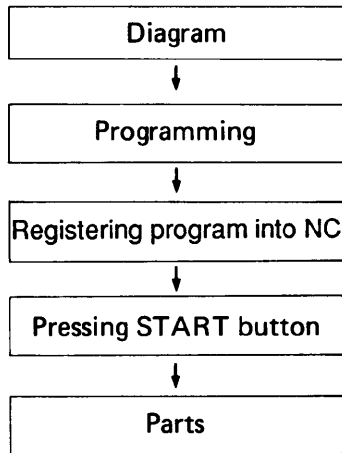
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PROGRAMMING BASICS

PROCESS FROM DIAGRAM TO PARTS



PROGRAMMING

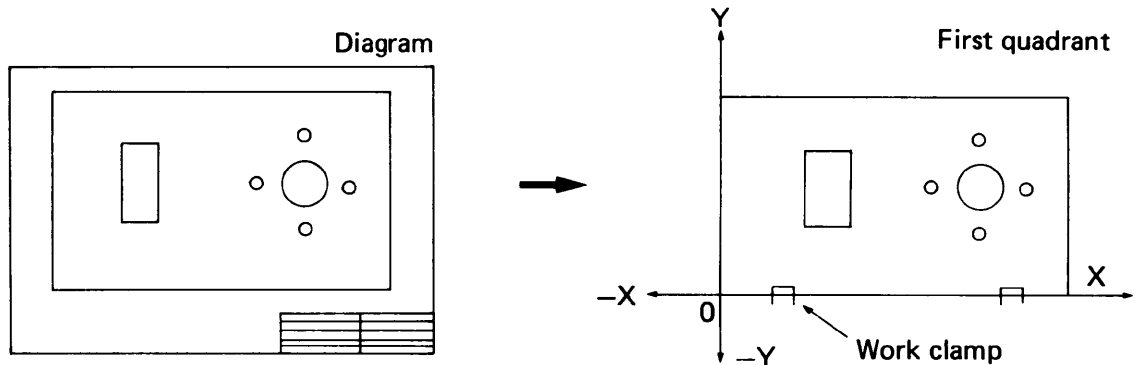


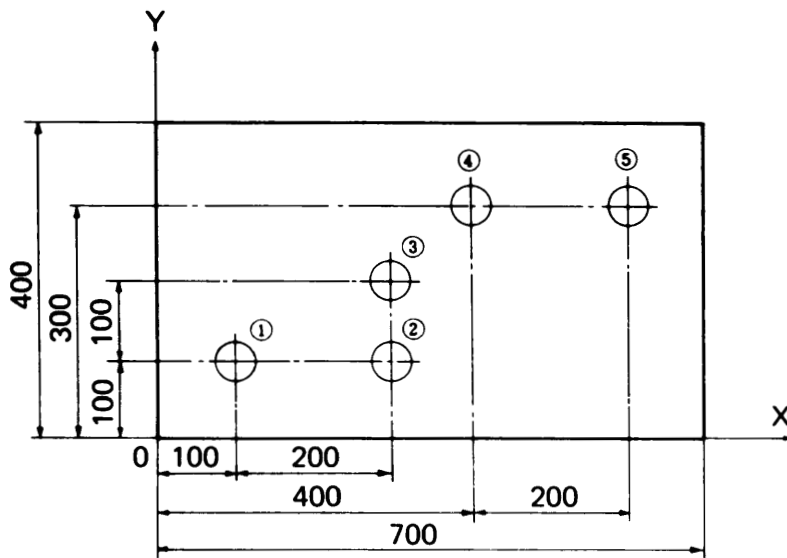
Diagram → First quadrant of X, Y coordinate system

UNIT OF MEASUREMENT FOR PROGRAMS

All dimensions for programs are based on units of 0.01 mm (millimeters) or 0.001" (inches).

	<u>Calculations</u>		<u>Program</u>		<u>Calculations</u>		<u>Program</u>
100 mm	→ 100.00	→	10000 (100.)		50"	→ 50.000	→ 50000 (50.)
35.5 mm	→ 35.50	→	3550 (35.5)		12.7"	→ 12.700	→ 12700 (12.7)
0 mm	→ 0	→	0		0"	→ 0	→ 0

CALCULATION OF COORDINATES



X and Y coordinates

	<u>X coordinate value</u>	<u>Y coordinate value</u>
①	100.00	100.00
②	300.00	100.00
③	300.00	200.00
④	400.00	300.00
⑤	600.00	300.00

Absolute value – Distance from origin

Incremental value – Distance from previous position

	<u>X coordinate value</u>	<u>Y coordinate value</u>	
①	100.00	100.00	(Absolute value)
②	200.00	0	(Incremental value)
③	0	100.00	(Incremental value)
④	100.00	100.00	(Incremental value)
⑤	200.00	0	(Incremental value)

(In the case of zero, no decimals are needed.)

PROGRAMMING PROCEDURE

1. Determining the processing method

2. Determining the clamp position

Position the workclamps as far apart as possible and check the "dead zone".

3. Checking the tool and station number

- Ex.: (a) 150 mm dia. round hole → nibbling with a 30 mm dia. punch
 (b) 500 mm x 600 mm square opening → shear-proof punching with a 50 mm x 50 mm square punch
 (c) Check to ensure all tools can be loaded on the turret.

4. Determining the punching sequence

This must be determined by taking into consideration both processing time and accuracy.

General precaution

- (a) Begin and finish with the upper right corner of the diagram.
 (b) Begin with small holes, then square holes, and notching; extrusion and counter-sinking come last.
 (c) The tools should not be selected more than twice except when the processing requires only a change of striker position.
 (d) In multiple part punching, shearing of the worksheet should be done last.

5. Calculating the coordinates

Calculate the coordinate values in units of 0.01 mm (millimeters) or 0.001" (inches).

6. Checking

Check the workclamp positions, punching sequence and coordinate values.

PUNCHING RANGE

The punching range of VIPROS varies with its model as listed below. When the X-coordinate value exceeds the punching range, automatic repositioning is performed.

Punching Range by Model

Unit: mm

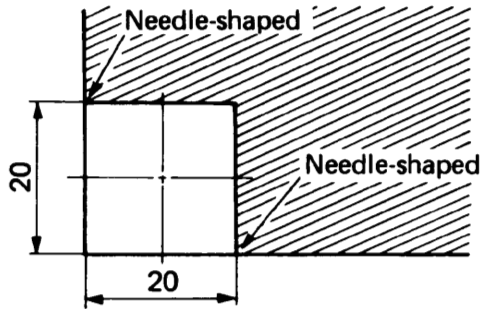
Model	Throat depth	Origin (X-axis distance)	Origin (Y-axis distance)	X-axis travel distance	Y-axis travel distance by track		
					100's (inner)	200's (center)	300's (outer)
VIPROS 345Q	1200	1270	1000	-10. to 1280.	30. to 1050.	-10. to 1010.	-50. to 970.
VIPROS 357Q	1325	1830	1270	-10. to 1840.	30. to 1310.	-10. to 1270.	-50. to 1230.
VIPROS 367Q	1570	1830	1525	-10. to 1840.	30. to 1615.	-10. to 1575.	-50. to 1535.
VIPROS 308080	2105	2000	2040	-10. to 2010.	30. to 2090.	-10. to 2050.	-50. to 2010.
VIPROS 358K(FS18PC) VIPROS 505080	1340	2000	1270	-10. to 2010.	30. to 1310.	-10. to 1270.	-50. to 1230.
VIPROS 368K(FS18PC) VIPROS 506080	1530	2000	1525	-10. to 2010.	30. to 1615.	-10. to 1575.	-50. to 1535.

Unit: mm

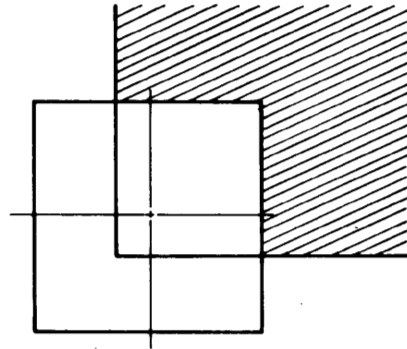
Model	Throat depth	Origin (X-axis distance)	Origin (Y-axis distance)	X-axis travel distance	Y-axis travel distance by track	
					200's (inner)	300's (outer)
VIPROS 255	1325	1210	1270	-10. to 1280.	-10. to 1300.	-50. to 1260.
VIPROS 258	1325	2000	1270	-10. to 2010.	-10. to 1300.	-50. to 1260.
VIPROS 2510K VIPROS 2510C	1325	2500	1270	-10. to 2510.	-10. to 1300.	-50. to 1260.

CAUTIONS ON PUNCHING

1. Notching should not be performed with a punch of the same size as the notch.

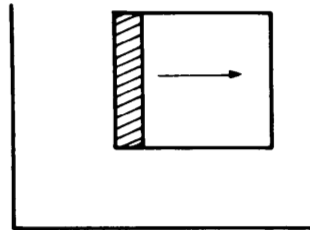


Incorrect
(20 mm x 20 mm square punch is used.)



Correct
(30 mm x 30 mm square punch is used.)

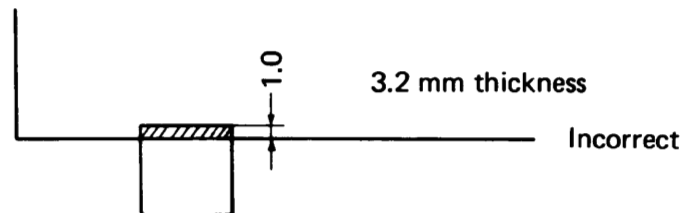
2. Do not punch along the shorter punch side when using a long rectangular punch.



Incorrect

3. When shear-proof punching is performed, the feed pitch should be larger than 1/2 the punch width, but smaller than the entire punch width minus 0.5 mm.

4. The depth of notching should not be less than the plate thickness.



5. Determine the punching method so that the stripper plate holds the worksheet as much as possible.

6. The force required to punch the worksheet must not exceed the machine capacity.

The required punching force is obtained by the following formula:

$$P \text{ (kN)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (MPa)}}{1000} \text{ or } P \text{ (metric ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

P: Force required

A: Length of cut edge

t: Thickness of worksheet

τ : Shearing strength of worksheet

7. Do not punch in the clamp dead zone. Punching in the clamp dead zone may punch the workclamp or distort the worksheet.

BASIC FUNCTION CODES

- G00 "G" function (Preparatory function)
- M00 "M" function (Miscellaneous function)
- T000 "T" function (Tool function)
- N0000 Sequence number
- O0000 Program number

TAPE FORMAT

Arrange the function codes as follows:

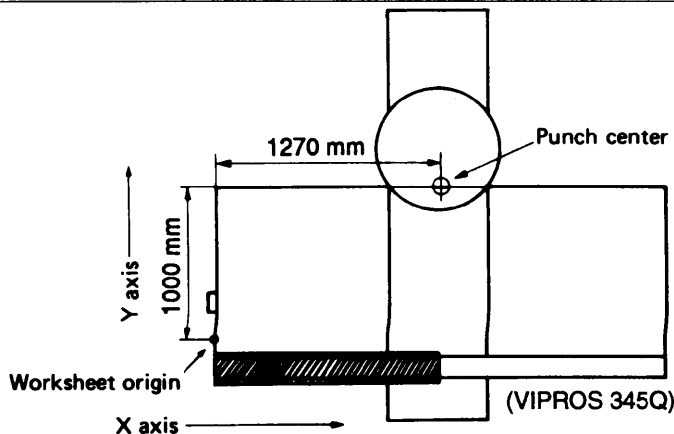
N0000 G00 G00 X±00000000 Y±00000000 T000 C±0000000 M00

- NOTE: a) Unnecessary codes need not be entered.
 b) Enter only necessary digits of X, Y, C and N.
 c) The plus sign (+) of X, Y and C can be omitted.

G92 – ESTABLISHING COORDINATE SYSTEM

This code is used to designate the distance from the worksheet origin to the punch center. Enter "G92" and the distances in the X- and Y-axis direction.

Model	Metric-specification machine	Inch-specification machine
VIPROS 308080	G92 X2000.00 Y2040.00	G92 X78.740 Y80.315
VIPROS 367Q	G92 X1830.00 Y1525.00	G92 X72.000 Y60.000
VIPROS 357Q	G92 X1830.00 Y1270.00	G92 X72.000 Y50.000
VIPROS 345Q	G92 X1270.00 Y1000.00	G92 X50.000 Y39.370
VIPROS 368K (FS18PC) VIPROS 506080	G92 X2000.00 Y1525.00	G92 X78.740 Y60.000
VIPROS 358K (FS18PC) VIPROS 505080	G92 X2000.00 Y1270.00	G92 X78.740 Y50.000
VIPROS 255	G92 X1210.00 Y1270.00	G92 X47.638 Y50.000
VIPROS 258	G92 X2000.00 Y1270.00	G92 X78.740 Y50.000
VIPROS 2510K VIPROS 2510C	G92 X2500.00 Y1270.00	G92 X98.425 Y50.000



G06 – DESIGNATION OF WORKSHEET THICKNESS AND MATERIAL

G06 A____B____

This code is used to designate the worksheet thickness and material.
Be sure to enter G06 at the beginning of the program.

A: Worksheet thickness 0.1 to 6.4 mm (0.002" to 0.253")
B: Worksheet material 0: Mild steel (SPC or CRS)
 1: Stainless steel (SUS)
 2: Aluminum (AL)

Example: OOOOO
 G06 A 1.0 B 0 (1-mm thick mild steel worksheet is designated.)
 G92 X____Y____
 .
 .
 .

When "G06" is omitted, the thickness is 6.4 mm and the material is mild steel.

The decimal point in the thickness data is handled as follows:

<u>Command data</u>		<u>Effective data</u>
1.6	—————>	1.6 mm
2.36	—————>	2.3 mm (Omit the figures below the second place of decimals.)
63	—————>	0.6 mm (Omit the figures below the second place of decimals.)

G90 – ABSOLUTE PROGRAMMING

When the absolute values are used for coordinate values, enter "G90" prior to the coordinate values. If the absolute values are used at the subsequent blocks of the program, it is not necessary to enter "G90" again until incremental values are used.

- Ex.: (1) G90 X100.00 Y100.00 (Absolute value)
(2) X300.00 Y100.00 (Absolute value)
(3) X300.00 Y200.00 (Absolute value)
(4) X400.00 Y300.00 (Absolute value)
(5) X600.00 Y300.00 (Absolute value)

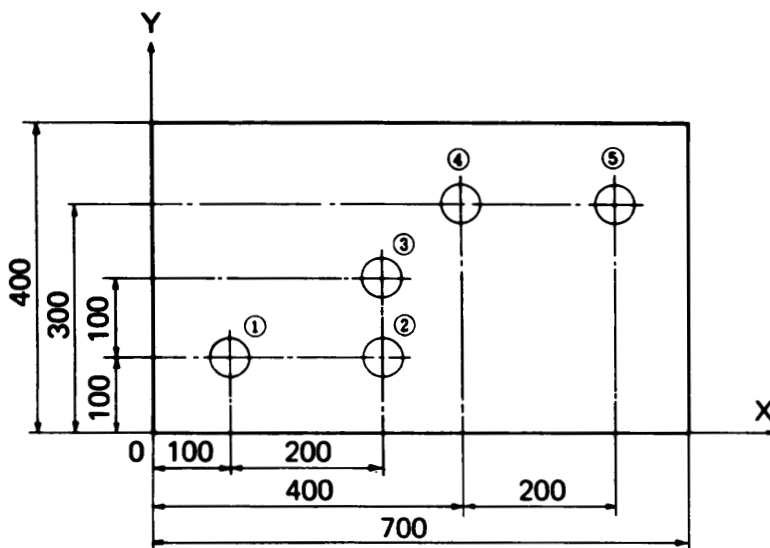
The value of the X- or Y-axis which does not move can be omitted.

G91 – INCREMENTAL PROGRAMMING

When the incremental values are used for coordinate values, enter "G91" prior to the coordinate values. If the incremental values are used at the subsequent blocks of the program, it is not necessary to enter "G91" again until absolute values are used.

- Ex.: (1) G90 X100.00 Y100.00 (Absolute value)
(2) G91 X200.00 Y 0 (Incremental value)
(3) X 0 Y100.00 (Incremental value)
(4) X100.00 Y100.00 (Incremental value)
(5) X200.00 Y 0 (Incremental value)

The value of the X- or Y-axis which does not move can be omitted.



G20/G21 – INCH/METRIC SELECT FUNCTION

The unit of the input program can be set either to the metric or inch system. When the inch unit is used, input "G20" directly before the worksheet thickness and material designation command G06 as a single block; when the metric unit is used, input "G21" as a single block.

Ex.: In the case of the VIPROS 305072 Metric-Specification machine:

<u>Metric</u>	<u>Inch</u>
G21	G20
G06 A ____ B ____	G06 A ____ B ____
G92 X1830.00 Y1270.00	G92 X72.047 Y50.000
:	:
(Program in metric unit dimensions)	(Program in inch unit dimensions)
:	:
G50	G50

- NOTE: a) The codes G20 and G21 should always be input as a single block.
 b) Do not input the "G20" or "G21" anywhere within the program.
 c) The origin setting values differ between the metric-specification and the inch-specification machines. Keep this fact in mind before using the inch-metric select function.

Model	Metric-specification machine	Inch-specification machine
VIPROS 308080	X2000.00 (78.740)* Y2040.00 (80.135)	X78.740 (2000.00)** Y80.315 (2040.00)
VIPROS 367Q	X1830.00 (72.047) Y1525.00 (60.039)	X72.000 (1828.80) Y60.000 (1524.00)
VIPROS 357Q	X1830.00 (72.047) Y1270.00 (50.000)	X72.000 (1828.80) Y50.000 (1270.00)
VIPROS 345Q	X1270.00 (50.000) Y1000.00 (39.370)	X50.000 (1270.00) Y39.370 (1000.00)
VIPROS 368K (FS18PC) VIPROS 506080	X2000.00 (78.740) Y1525.00 (60.039)	X78.740 (2000.00) Y60.000 (1524.00)
VIPROS 358K (FS18PC) VIPROS 505080	X2000.00 (78.740) Y1270.00 (50.000)	X78.740 (2000.00) Y50.000 (1270.00)
VIPROS 255	X1210.00 (47.638) Y1270.00 (50.000)	X47.638 (1210.00) Y50.000 (1270.00)
VIPROS 258	X2000.00 (78.740) Y1270.00 (50.000)	X78.740 (2000.00) Y50.000 (1270.00)
VIPROS 2510K VIPROS 2510C	X2500.00 (98.425) Y1270.00 (50.000)	X98.425 (2500.00) Y50.000 (1270.00)

* The numerals in parentheses indicate the origin setting value when the unit mode has been changed from metric to inch.

** The numerals in parentheses indicate the origin setting value when the unit mode has been changed from inch to metric.

- d) When the NC coordinate system is already set to the inch or the metric unit dimensions, the corresponding "G20" or "G21" need not be input.
- e) To confirm whether the NC coordinate system is set to the inch or metric unit dimensions, return the X- and Y-axes to their origins in the REF ZERO mode,* at this point, check the values displayed on the CRT screen of the NC unit and consult the values indicated in the table above for identification.

*RETRACT mode for Models 358K (FS18PC), 368K (FS18PC), 255, 258, 2510K and 2510C

T000 – DESIGNATION OF TOOL NUMBER

This code is used to designate the turret station number in order to select the tool to be used. If the same tool is to be used continuously, it is not necessary to enter this code again until a different tool is needed.

Ex.: G92 X1830.00 Y1270.00
 G90 X500.00 Y300.00 T102
 G91 X50.00 (T102 is omitted.)
 X50.00 (T102 is omitted.)
 G90 X700.00 Y450.00 T201

G50 – HOME RETRACT

When "G50" is entered, the carriage and table return to their origins, and the striker moves to the center position. No punching occurs during the retraction. The offset values designated by "G93," "G94" and "G98" are cancelled. "G50" must be entered as a single block at the end of the program; however, the sequence number can be entered along with it.

BLOCK DELETION

If a slash character is entered at the beginning of a block and if the BLOCK SKIP key on the main control panel is pressed and lighted, the block command following the slash character is disregarded. If the key is unlighted, the command is not disregarded but is executed.

Ex.: G90 X320.00 Y210.00 T203
 G91 X50.00
 / X100.00 Y100.00 T304
 G90 X570.00 Y310.00 T304

If the block following the block deletion command is entered in incremental values, the position where the BLOCK SKIP key is lighted is different from that where the BLOCK SKIP key is unlighted. If T304 is omitted for the reason that the same tooling is used, the block following the block deletion command is executed using T203 when the BLOCK SKIP key is lighted.

Basic format of BLOCK DELETION

/ X_____ Y_____
 G90 X_____ Y_____ T_____

O0000 – PROGRAM NUMBER

When some programs are to be stored in the NC memory, a maximum of 4-digit numeral (from 0 to 7999) is added directly after "O," at the beginning of the program for identification of individual programs. (Zeros which directly follow "O" may be omitted.)

Ex.: O0014
G06 A___ B___
G92 X1830.00 Y1270.00
.
.
G50

This program number can also be input from the main control panel keyboard when registering the programs into the memory.

N0000 – SEQUENCE NUMBER

Any numeral (from 1 to 9999), with four or less digits, beginning with "N" can be entered at the beginning of each block. This code is used for indexing each block.

Ex.: G06 A___ B___
G92 X1830.00 Y1270.00
N0001 G90 X500.00 Y300.00 T102
N0002 G91 X50.00
N0003 X50.00
N0004 G90 X650.00 Y450.00 T306
N9999 G50

The sequence number need not be entered if it is not necessary. Entry at key points instead of all blocks will be useful.

Zeros which directly follow "N" may be omitted.

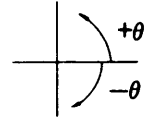
C±θ – TOOL ANGLE COMMAND

This code is used to control the angular orientation of punches and dies installed in the auto-index station.

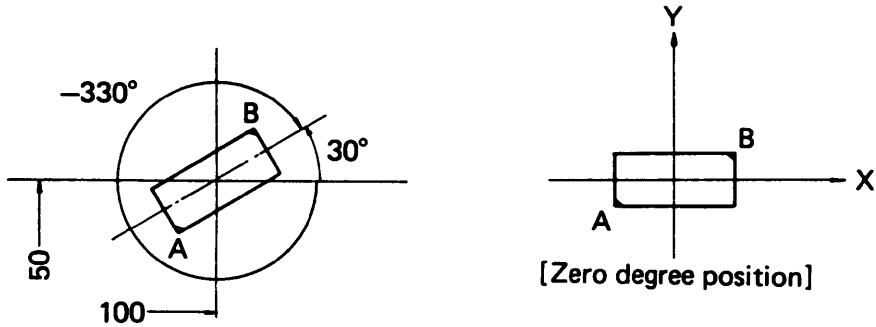
```
X_____Y_____T000 C±θ
```

Auto-Index punching is performed after the X, Y, T and C axes have been positioned. In the C-axis instruction, the value and sign of θ determine the angle of the punch and die with respect to the X axis.

- T: Auto-Index station number
- C: Tool angle “±θ” Counterclockwise – positive (+)
 Clockwise – negative (-)



Example:



```
G90 X100.00 Y50.00 T000 C30.00 (or C-330.00)
```

The punch and the die will be positioned 30 degrees (or -330°) with respect to the X axis.

- The angular input must be in the absolute angular value, referenced to the X axis. The minimum angular input is 0.01°.
- If both X and Y instructions are not entered, the index station and tool angle will be selected, but punching will not be performed.
- When the C-axis instructions are used within pattern instruction blocks G26, G29, G68, and G78, the Auto-Index tool angle will be automatically compensated in the tangential direction with the progress of hole punching.
- When the C-axis instructions are used within the following instructions, the C-axis instructions will be ignored and machine operation will continue.
G92, G93, G94, G72, G25, G27, G98, G75, G76, G04, U, V and W
- For stations other than Auto-Index stations, trying to use a C-axis instruction will cause a program error.

- When a program block with instructions to use a different station follows the Auto-Index punching instructions, the C axis will be returned to its zero degree position after the punching operation at the Auto-Index station is finished, then the next station will be selected.

G90 X500.00 Y600.00 T○○○ C45.00 Punching operation at Auto-Index station.

X350.00 Y200.00 T201 T201 is selected after C axis has returned to its zero degree position.

- When the same Auto-Index station is to be used two or more times in succession with the same tool angle, the T and C instructions may be omitted in the second and subsequent blocks.

G90 X500.00 Y600.00 T○○○ C45.00

X350.00 Y200.00 Punched with T○○○ and C45.00

FUNCTION CODES

G FUNCTION CODES

G70 – PUNCH OFF (NO PUNCHING)

This code is used to move the worksheet without punching so that the workclamp moves away from the die or the workholders can hold the worksheet when automatic repositioning is performed. Enter "G70" prior to entering X___Y___.

Ex.: G90 X100.00 Y100.00
G70 X300.00 (The axes move at a position of "X300.00 Y100.00" without punching.)

"G70" can be entered with "G90" or "G91."

Ex.: G90 X100.00 Y100.00 (Punching)
G70 G91 X200.00 (No punching)
G90 Y300.00 (Punching)

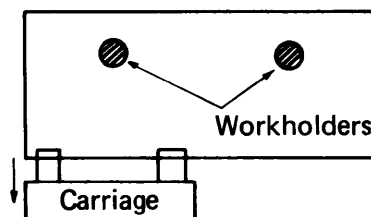
G27 – AUTO REPOSITIONING

This code is used to extend the punching range in the X-axis direction. Enter "G27" and the X-axis value.

Ex.: G27 X500.00
The X-axis value must be designated by an incremental value.

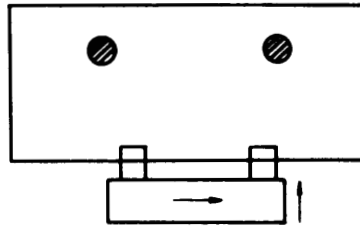
The following shows the repositioning cycle for a G27 X500.00 command.

- (1) Work hold: The workholders hold the worksheet.
- (2) Unclamp: The workclamps open.
- (3) G91 Y2.40: The Y axis moves 2.40 mm in the positive direction from the current position.



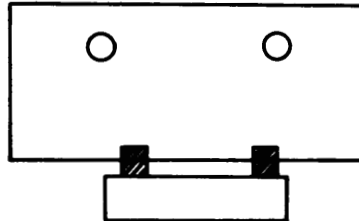
- (4) X-500.00: The X axis moves 500.00 mm in the negative direction from the current position.

(5) Y-2.40: The Y axis moves 2.40 mm in the negative direction.

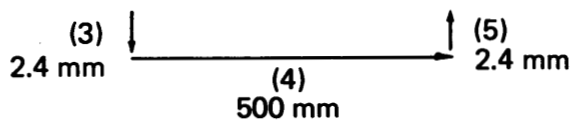


(6) Clamp: The workclamps close.

(7) Work release: The workholders release the worksheet.

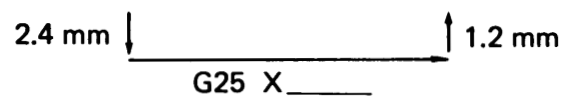


Y- and X-axis movement



G25 – AUTO REPOSITIONING

When the worksheet edge which is clamped has a bend or curves, and excessive burrs, enter "G25" instead of "G27" to ensure accurate repositioning. These factors can cause inaccurate worksheet positioning when automatic repositioning is performed, unless the G25 code is used. When "G25" is entered, the same movement will be obtained as in the following:



First the Y axis moves 2.40 mm in the positive direction from the current position. Then the X axis moves X____ from the current position and the Y axis moves 1.20 mm in the negative direction. Next, the X and Y coordinate system is offset by Y1.20 to compensate for the difference between the Y axis positions before and after the automatic repositioning.

After "G25" is entered, the punching range along the Y-axis is moved 1.20 mm in the negative direction from the standard punching range.

$-11.2 \leq Y \leq 1008.8$ (VIPROS 345Q, center track)

$-11.2 \leq Y \leq 1268.8$ (VIPROS 357Q/358K(FS18PC)/505080, center track)

$-11.2 \leq Y \leq 1573.8$ (VIPROS 367Q/368K(FS18PC)/506080, center track)

$-11.2 \leq Y \leq 2048.8$ (VIPROS 308080, center track)

$-11.2 \leq Y \leq 1298.8$ (VIPROS 255/258/2510K/2510C, inner track)

HINTS ON AUTO REPOSITIONING

1. Repositioning travel distance → as small as possible
[Maximum processing position (X value)] -1280 mm (VIPROS 345Q, 255)
[Maximum processing position (X value)] -1840 mm (VIPROS 357Q, 367Q)
[Maximum processing position (X value)] -2010 mm (VIPROS 358K(FS18PC), 368K(FS18PC), 308080, 505080, 506080, 258)
[Maximum processing position (X value)] -2510 mm (VIPROS 2510K, 2510C)
2. Workclamp positions → as far apart as possible
Consider the following:
 - Dead zone
 - Worksheet size
 - Notches
3. First processing area → as large as possible
4. Reposition
Ensure the worksheet is under the workholders.
Ensure the workclamps do not pass between the upper and lower turrets when the repositioning is done. Y200.00 (min.)
Ensure the X-axis absolute value is greater than the repositioning travel distance. (Over-travel will occur.)
5. Coordinate value after "G27" and "G25"
Use dimensions as per diagram. Mode of G90 and G91 does not change.
6. Avoid changing tools immediately after repositioning to save processing time.
7. Processing area after automatic repositioning
VIPROS 345Q, 255
 $-10 \text{ mm} + \text{repositioning travel distance} \leq X \leq 1280 \text{ mm} + \text{repositioning travel distance}$
VIPROS 357Q, 367Q
 $-10 \text{ mm} + \text{repositioning travel distance} \leq X \leq 1840 \text{ mm} + \text{repositioning travel distance}$
VIPROS 358K(FS18PC), 368K(FS18PC), 308080, 505080, 258
 $-10 \text{ mm} + \text{repositioning travel distance} \leq X \leq 2010 \text{ mm} + \text{repositioning travel distance}$
VIPROS 2510K, 2510C
 $-10 \text{ mm} + \text{repositioning travel distance} \leq X \leq 2510 \text{ mm} + \text{repositioning travel distance}$
Ex.: G27 X500.00
Processing area after automatic repositioning
 $490 \leq X \leq 1780$ (VIPROS 345Q, 255)
 $490 \leq X \leq 2340$ (VIPROS 357Q, 367Q)
 $490 \leq X \leq 2510$ (VIPROS 358K(FS18PC), 368K(FS18PC), 308080, 505080, 506080, 258)
 $490 \leq X \leq 3010$ (VIPROS 2510K, 2510C)

G04 – DWELL

When "G04" is entered with "X" value, the punching operation stops during the time indicated by the value of "X." The minimum programmable increment of the value following "X" is 0.01 sec.

G04 X10.00 Operation stops for 10 sec.

G72 – DESIGNATION OF PATTERN ORIGIN

G90 G72 X_____Y_____

G91 G72 X_____Y_____

This code is used to designate the pattern origin.

Ex.: G90 G72 X500.00 Y300.00

The pattern origin can be entered both as an absolute value and as an incremental value. "G72" merely selects a coordinate; neither positioning nor punching is performed.

Never enter the M or T code in a block with "G72."

For example, never enter:

G90 G72 X300.00 Y200.00 T201

G91 G72 X150.00 Y250.00 M00

If an incremental value of X and Y is given after a pattern command, the value must refer to the final pattern point.

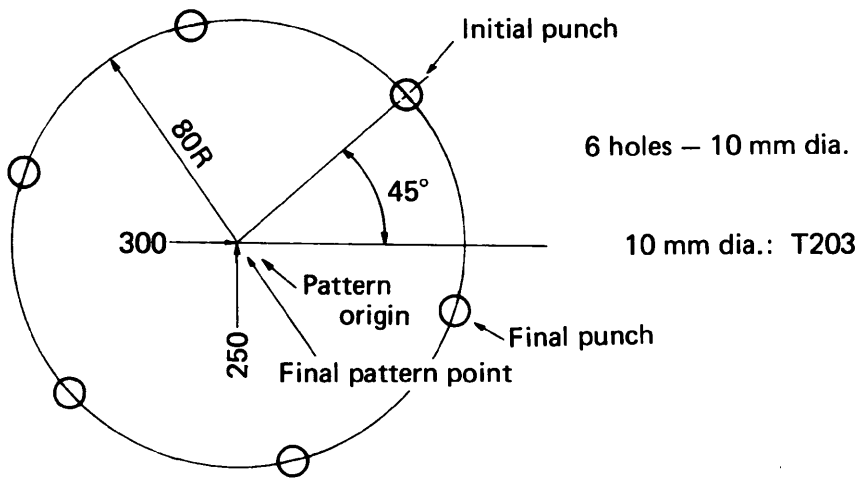
G26 – BOLT HOLE CIRCLE [BHC]

```
G26 Ir J±θ K±n T○○○
```

On the circumference of a circle having a radius "r" with either the current position or a point designated by "G72" as the center, "n" holes dividing the circumference into "n" equal parts are punched, beginning with a point at an angle of "θ" to the X axis.

- I: Radius of circle "r" – positive
- J: Starting angle "± θ" Counterclockwise – positive
 Clockwise – negative
- K: Number of holes "± n" Counterclockwise – positive
 Clockwise – negative

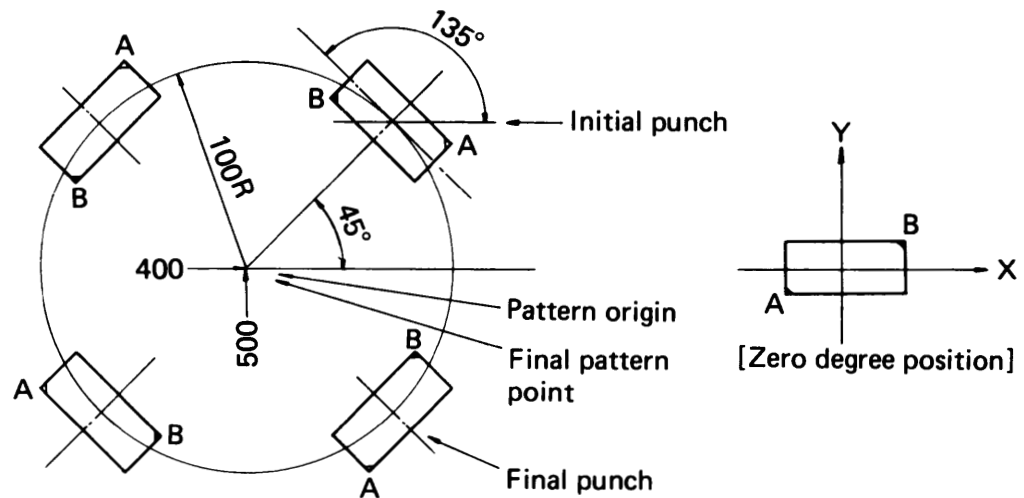
Example:



```
G72 G90 X300.00 Y250.00
G26 I80.00 J45.00 K6 T203
```

When punching the same hole at the pattern origin (X300.00, Y250.00), omit "G72" and enter "T203" in the upper instruction block.
The final pattern point coincides with the pattern origin.

PROGRAM EXAMPLE USING AUTO-INDEX STATION



```
G72 G90 X400.00 Y500.00
```

```
G26 I100.00 J45.00 K4 T○○○ C135.00 (or C-225.00)
```

The first punching will be performed with the tool angle positioned 135 degrees (-225°) with respect to the X axis and the second and subsequent punchings will be performed with the tool angle automatically compensated in the tangential direction.

- If the pattern origin (X400.00, Y500.00) is to be punched also, omit "G72" and enter "T○○○ C $\pm\theta$ " in the upper instruction block.

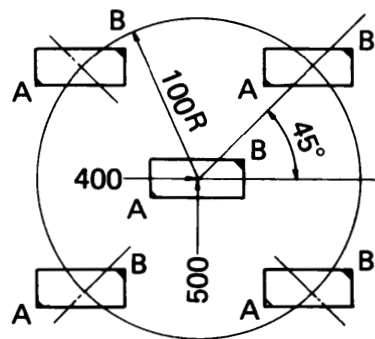
```
G90 X400.00 Y500.00 T○○○ C $\pm\theta$ 
```

```
G26 I100.00 J45.00 K4 C135.00
```

- If there is no C-axis instruction entered in the pattern instruction block, the pattern punching will be performed without compensation of the tool angle.

```
G90 X400.00 Y500.00 T○○○ C0
```

```
G26 I100.00 J45.00 K4
```



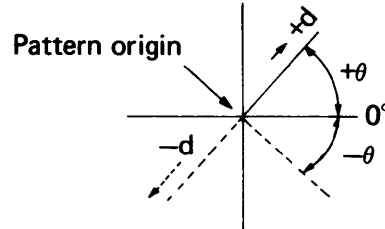
G28 – LINE AT ANGLE [LAA]

```
G28 I±d J±θ Kn T000
```

Starting from either the current position or from a point designated by "G72," "n" holes are punched with an interval of "d" at an angle of "θ" to the X axis.

I: Interval "± d" When "d" is negative, the punching is performed in the opposite direction from that of positive "d."

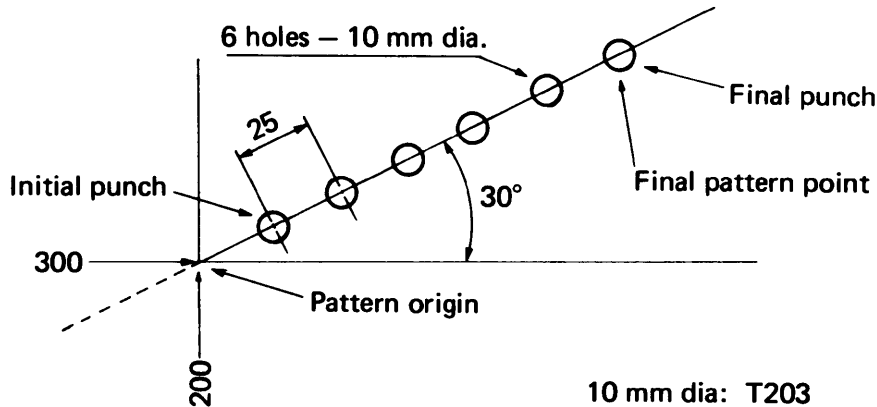
J: Angle "± θ" Counterclockwise – positive
Clockwise – negative



K: Number of holes "n" (excluding the point of the pattern origin)

NOTE: "d" and "θ" are given as follows:
 d 200 mm → 200.00 (d20" → 20.000)
 θ 45°30' → 45.50
 θ 45° → 45.00

Example:

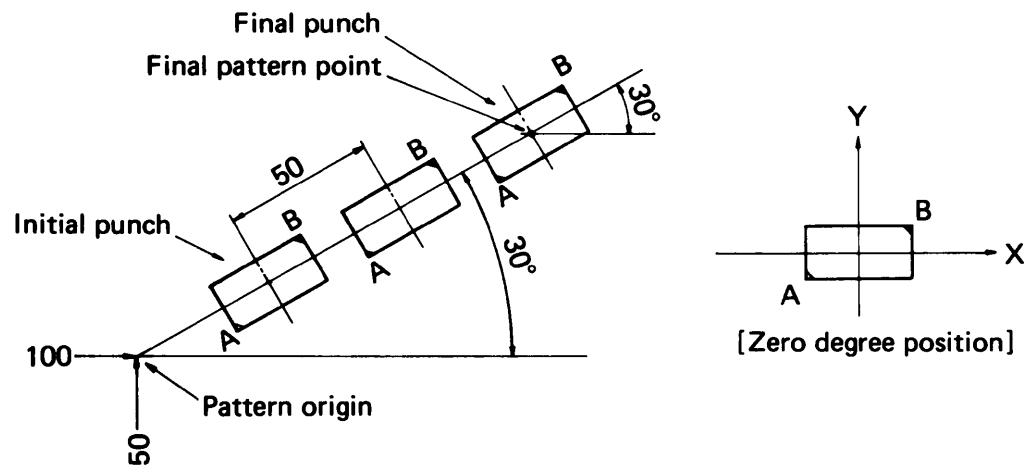


```
G72 G90 X300.00 Y200.00
G28 I25.00 J30.00 K6 T203
```

When punching the same hole at the pattern origin (X300.00, Y200.00), omit "G72" and enter "T203" in the upper instruction block.

When "I25.00" becomes "I-25.00," punching is performed in the direction of 180° symmetry (210°).

PROGRAM EXAMPLE USING AUTO-INDEX STATION



```
G72 G90 X100.00 Y50.00
      G28 I50.00 J30.00 K3 T000 C30.00 (or C-330.00)
```

The punch and the die will be positioned 30 degrees (-330°) with respect to the X axis and the Auto-Index punching will be performed according to the G28 pattern instruction.

- If the pattern origin (X100.00, Y50.00) is to be punched also, omit "G72" and move "T000 C30.00" to the end of the upper instruction block.

```
G90 X100.00 Y50.00 T000 C30.00
G28 I50.00 J30.00 K3
```

G29 – ARC [ARC]

G29 Ir J $\pm\theta$ P $\pm\Delta\theta$ Kn T○○○

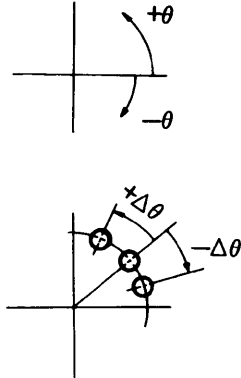
On the circumference of a circle having a radius “r” with either the current position or a point designated by “G72” as the center, “n” holes with an angle interval of “ $\Delta\theta$ ” are punched, starting from a point at an angle of “ θ ” to the X axis.

I: Radius “r” – positive

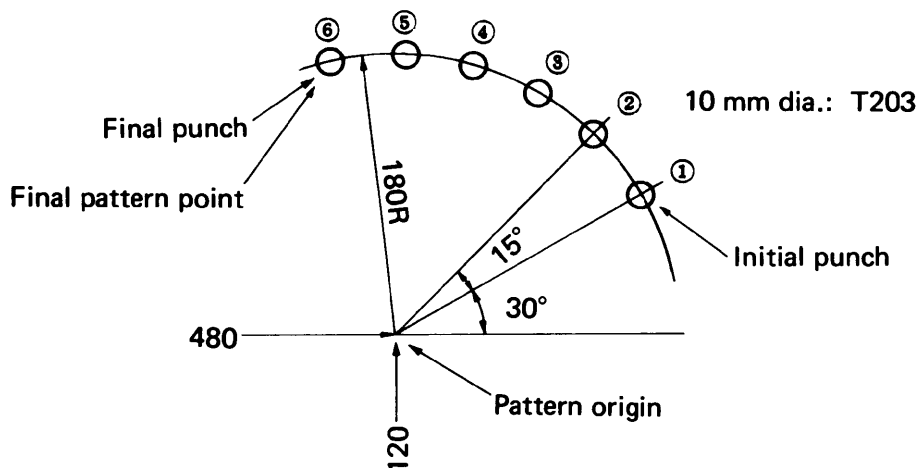
J: Starting angle “ $\pm\theta$ ” Counterclockwise – positive
Clockwise – negative

P: Angle interval “ $\pm\Delta\theta$ ” Counterclockwise – positive
Clockwise – negative

K: Number of holes “n”



Example:



G72 G90 X480.00 Y120.00
G29 I180.00 J30.00 P15.00 K6 T203

When punching the same hole at the pattern origin (X480.00, Y120.00), omit “G72” and enter “T203” in the upper instruction block.

When “P15.00” becomes “P–15.00,” punching is performed in a clockwise direction beginning with the starting point.

G36 – GRID-X [GRD-X]

G37 – GRID-Y [GRD-Y]

G36	$I \pm d_1$	Pn_1	$J \pm d_2$	Kn_2	T000
-----	-------------	--------	-------------	--------	------

G37	$I \pm d_1$	Pn_1	$J \pm d_2$	Kn_2	T000
-----	-------------	--------	-------------	--------	------

Starting from either the current position or from a point designated by "G72," a grid pattern of "n₁" holes with an interval of "d₁" parallel to the X axis and "n₂" holes with an interval of "d₂" parallel to the Y axis is punched.

G36: Punching starts from the X-axis side.

G37: Punching starts from the Y-axis side.

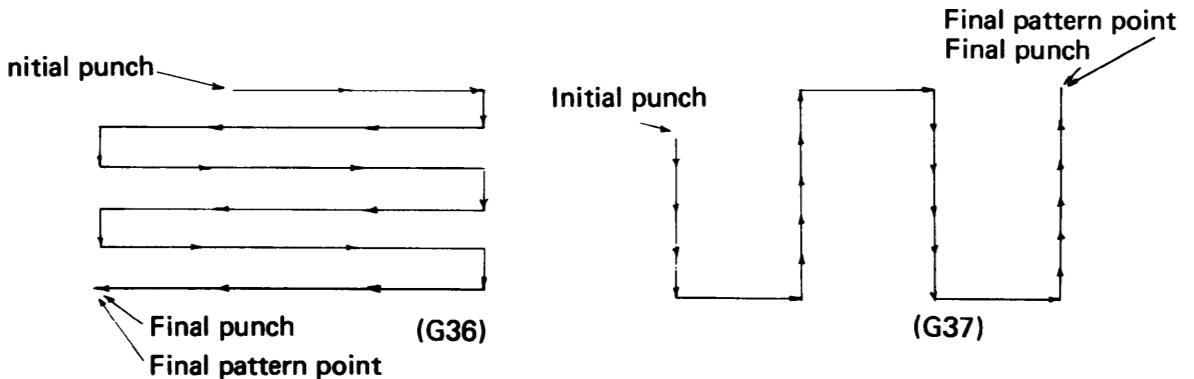
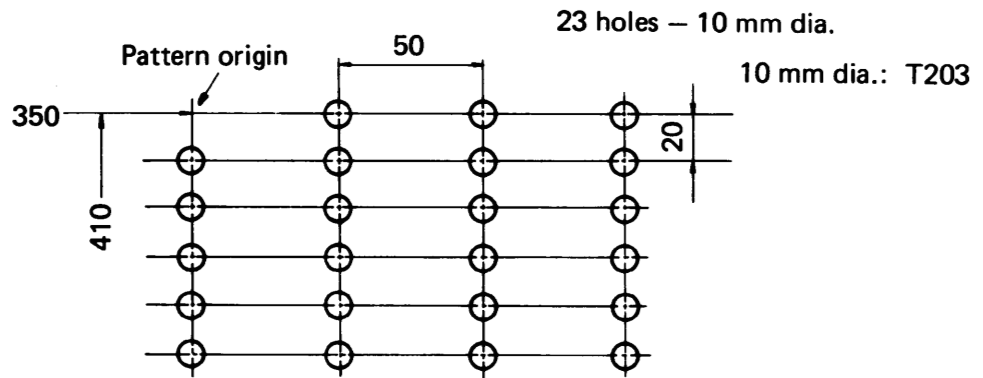
I: Interval " $\pm d_1$ " +X direction – positive
 -X direction – negative

P: Number of holes in the X-axis direction "n₁" (not including the pattern origin)

J: Interval " $\pm d_2$ " +Y direction – positive
 -Y direction – negative

K: Number of holes in the Y-axis direction "n₂" (not including the pattern origin)

Example:



G72 G90 X350.00 Y410.00
 G36 I50.00 P3 J-20.00 K5 T203

G72 G90 X350.00 Y410.00
 G37 I50.00 P3 J-20.00 K5 T203

When punching the same hole at the pattern origin (X350.00, Y410.00), omit "G72" and enter "T203" in the upper instruction block.

G66 – SHEAR PROOF [SHP]

G66 I ℓ J $\pm\theta$ P $\pm w_1$ Q $\pm w_2$ D $\pm d$ T $\circ\circ\circ$

Starting from either the current position or from a point designated by "G72," a shear proof with a length of " $\ell \pm 2d$ " and a punch width of " w_1 " x " w_2 " is performed at an angle of " θ " to the X axis.

I: Punching length " ℓ "

J: Angle " $\pm \theta$ " Counterclockwise – positive
Clockwise – negative

P: Punch width " $\pm w_1$ " (punch width in the "J" direction)

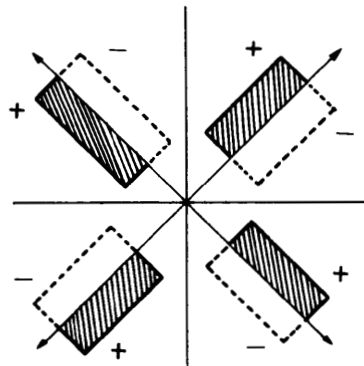
Q: Punch width " $\pm w_2$ " (punch width in the direction of 90° to "J")

D: Compensation value " $\pm d$ " (in relation to punching length I)
If $d = 0$, "D $\pm d$ " can be omitted.

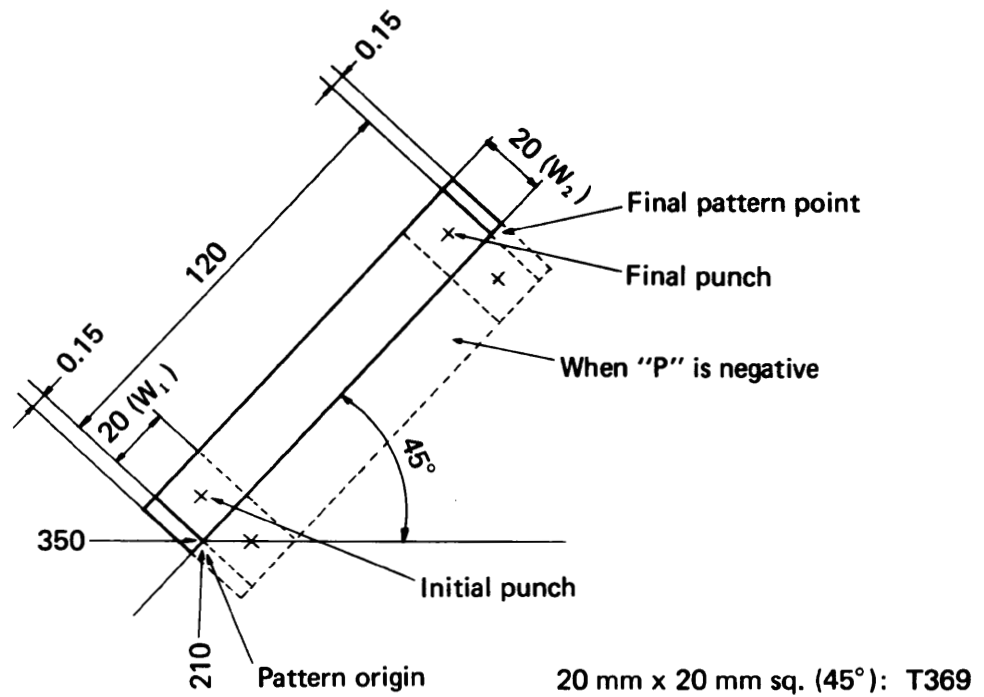
The values of " w_1 " and " w_2 " must have the same sign.

When a square punch is used ($w_1 = w_2$), "Q $\pm w_2$ " can be omitted.

The sign of " w_1 " and " w_2 "



Example:



```
G72 G90 X350.00 Y210.00
G66 I120.00 J45.00 P20.00 D0.15 T369
```

When "G72" is omitted and "T369" is entered in the upper instruction block, the pattern origin (X350.00, Y210.00) is also punched.

When "P20.00" becomes "P-20.00," a shear proof is performed in the direction of the dotted line.

I (punching length "ℓ") must be at least 1.5 times as large as P (punch width "± w₁").

The final pattern point does not coincide with the final punch center.

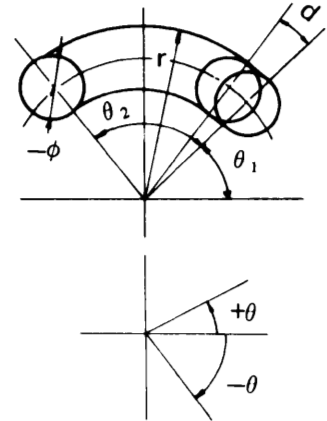
When "D0.15" becomes "D-0.15," the overall punching length "I" is 0.3 mm shorter as determined by $0.15 \times 2 = 0.3$.

G68 – NIBBLING ARC [NBL-A]

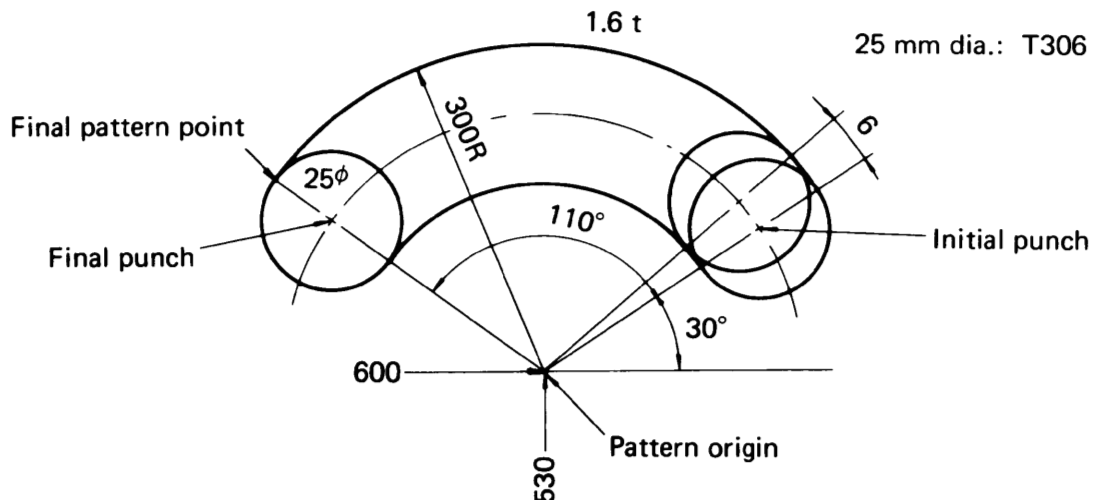
```
G68 I r J ± θ1 K ± θ2 P ± φ Q d T ○○○
```

On the circumference of a circle having a radius "r" with either the current position or a point designated by "G72" as the center, a nibbling with an interval of "d" is performed by using a punch with a diameter of "φ," starting from a point at an angle of "θ₁" to the X axis and moving up to an incremental angle of "θ₂."

- I: Radius "r" – positive value (I < 57000.00 mm)
 - J: Starting angle "± θ₁"
Counterclockwise – positive
Clockwise – negative
 - K: Angle in which nibbling occurs "± θ₂"
Counterclockwise – positive
Clockwise – negative
 - P: Punch diameter "± φ"
Enter the positive value when nibbling the outer side of the circle and the negative value when nibbling the inner side.
 - Q: Nibbling interval "d" – positive value only
Worksheet thickness < d ≤ 8 mm
- NOTE: Maximum worksheet thickness for nibbling: 3.2 mm



Example:

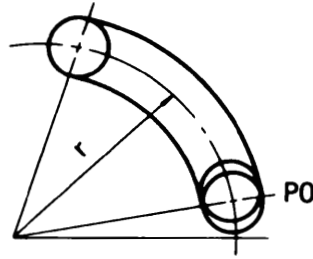


```
G72 G90 X600.00 Y530.00  
G68 I300.00 J30.00 K110.00 P-25.00 Q6.00 T306
```

When "G72" is omitted and "T306" is entered in the upper instruction block, the pattern origin (X600.00, Y530.00) is also punched.

When the value of "P" is zero, nibbling is performed on the arc with the radius "r."

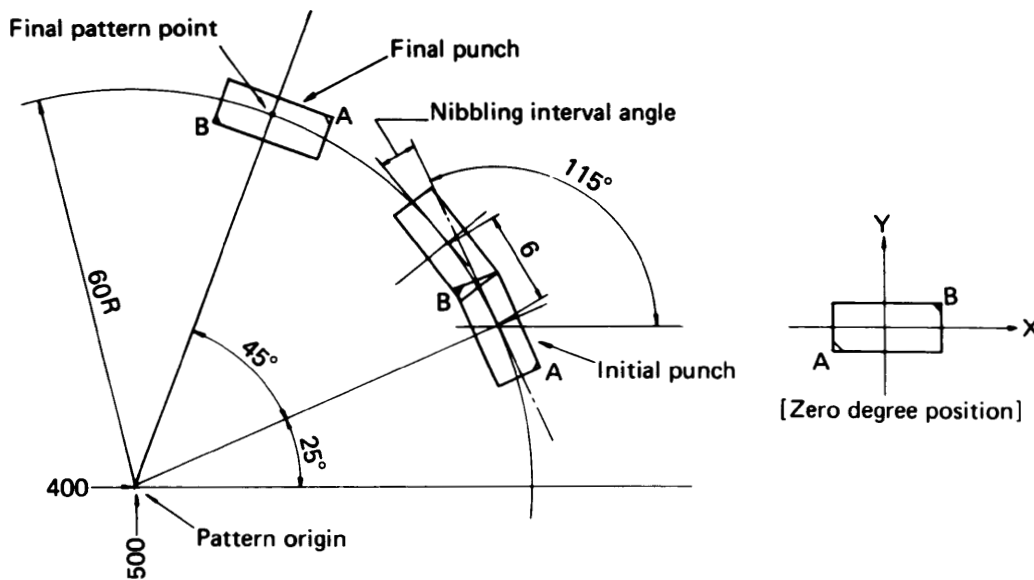
Example:



When nibbling a worksheet with a thickness of more than 3.2 mm, use code G29 (ARC) or G78 (PUNCHING ARC).

When the scrap remains inside, make "J" (starting angle " $\pm \theta_1$ ") 90° or 45° and enter "M00" or "M01" in order to remove the scrap.

PROGRAM EXAMPLE USING AUTO-INDEX STATION



G72 G90 X400.00 Y500.00

G68 I60.00 J25.00 K45.00 P0 Q6.00 T000 C115.00 (or C-245.00)

The tool angle is positioned 115 degrees (-245°) with respect to the X axis and it will be automatically compensated in the tangential direction with the progress of hole nibbling.

- If the pattern origin (X400.00, Y500.00) is to be punched also, omit "G72" and enter "T000 C $\pm\theta$ " in the upper instruction block.

G90 X400.00 Y500.00 T000 C $\pm\theta$

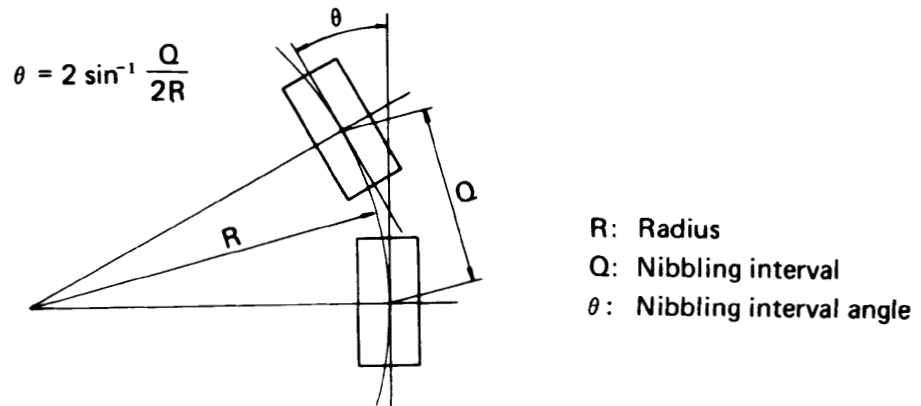
G68 I60.00 J25.00 K45.00 P0 Q6.00 C115.00

- If the nibbling interval or nibbling interval angle exceeds the following values, a program error will occur.

Maximum nibbling interval: 8 mm

Maximum nibbling interval angle: 8°

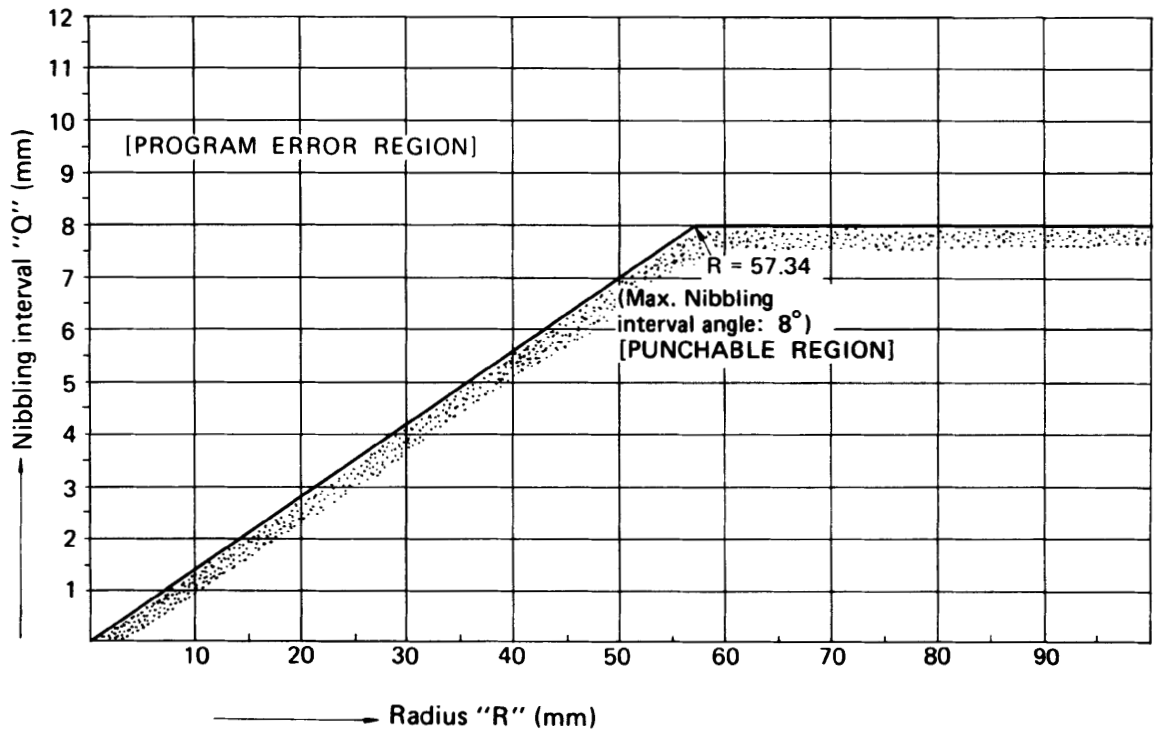
Relation between nibbling interval and nibbling interval angle



Even if the nibbling interval "Q" is within its limit, the calculated nibbling interval angle " θ " may exceed its limit when the radius "R" is small ($R < 57.34$).

Example: When the radius "R" is 25 mm and the nibbling interval "Q" is 6 mm

$$\begin{aligned} \theta &= 2 \sin^{-1} \frac{6}{50} \\ &= 2 \times 6.89^\circ \\ &= 13.78^\circ \dots \dots \text{Program error} \end{aligned}$$



Example: When the radius "R" is 50 mm, the largest nibbling interval "Q" is 6.97 mm.

G78 – PUNCHING ARC [PNC-A]

```
G78 Ir J±θ1 K±θ2 P±φ Qd Dt T○○○
```

On the circumference of a circle having a radius "r" with either the current position or a point designated by "G72" as the center, a punching operation which is the same as the NIBBLING ARC (G68) is performed at an interval of "d," using a punch with a diameter of "φ," starting from a point at an angle of "θ₁," to the X axis and moving up to an incremental angle of "θ₂."

I: Radius "r" – positive value

J: Starting angle "± θ₁" Counterclockwise – positive
Clockwise – negative

K: Angle in which punching occurs "± θ₂" Counterclockwise – positive
Clockwise – negative

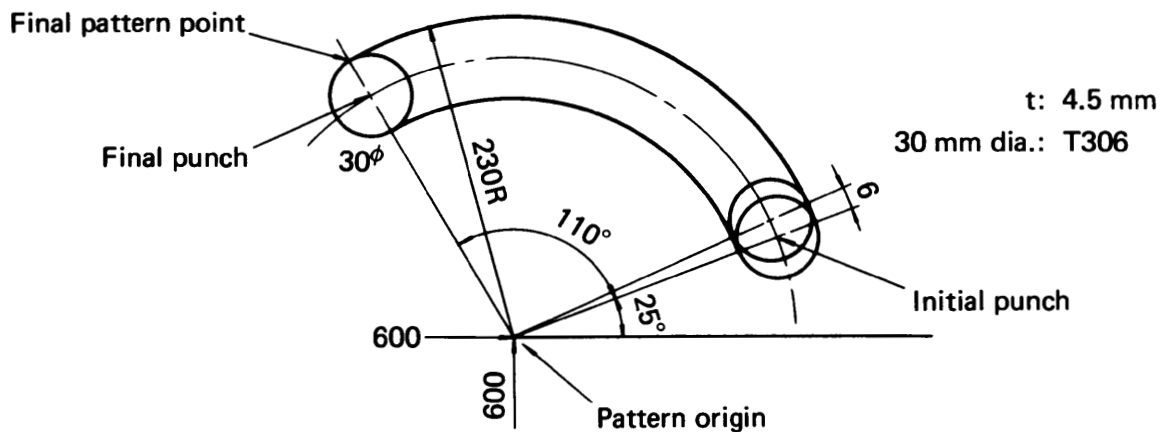
P: Punch diameter "± φ"
Enter the positive value when punching the outer side of the circle and the negative value when punching the inner side.

Q: Punching interval "d" – positive value only
Worksheet thickness < d

D: Worksheet thickness "t"

NOTE: When the value of "t" is larger than the value of "d" (t > d), it is regarded as a program error.

Example:



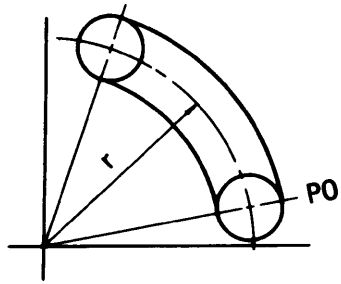
```
G72 G90 X600.00 Y600.00
```

```
G78 I230.00 J25.00 K110.00 P-30.00 Q6.00 D4.50 T306
```

When "G72" is omitted and "T306" is entered in the upper instruction block, the pattern origin (X600.00, Y600.00) is also punched.

When the value of "P" is zero, punching is performed on the arc with the radius "r."

Example:



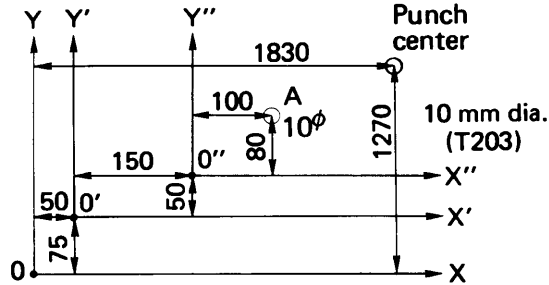
When the scrap remains inside, make "J" (starting angle " $\pm \theta_1$ ") 90° or 45° and enter "M00" or "M01" in order to remove the scrap.

G93 – OFFSET-1 [OFS-1]

```
G90 G93 X_____ Y_____
G91 G93 X_____ Y_____
```

This code designates the origin of the local coordinate system.

Example:



X and Y coordinate system: Basic coordinate system (Global coordinate system)

X' and Y' coordinate system: Local coordinate system

X'' and Y'' coordinate system: Local coordinate system

When designating the X' and Y' coordinate system

```
G90 G93 X50.00 Y75.00
```

When designating the X'' and Y'' coordinate system

```
G90 G93 X200.00 Y125.00 or, G91 G93 X150.00 Y50.00
```

Method of designating point A

```
(1) G90 X300.00 Y205.00 T203
```

```
(2) G90 G93 X50.00 Y75.00
      X250.00 Y130.00 T203
```

```
(3) G90 G93 X50.00 Y75.00
      G93 X200.00 Y125.00 (or G91 G93 X150.00 Y50.00)
      X100.00 Y80.00 T203
```

When changing from the local coordinate system to the global coordinate system

```
G90 G93 X0 Y0
```

The G93 code is merely for establishing a coordinate system; it is not to be used for positioning or punching. Do not enter "T" or "M" with "G93."

```
Example: G90 G93 X50.00 Y100.00 T201
```

Program error

Basic format of a program using "G93"

```
G06 A_____ B_____
G92 X1830.00 Y1270.00
G90 G93 X_____ Y_____
      X_____ Y_____ T_____
```

.
.

```
G50
```


G94 – OFFSET-2 [OFS-2]

G94	Xax	Yay	Pnx	Kny	Qt	D α
-----	-----	-----	-----	-----	----	------------

This code is used to designate the origin of the local coordinate system when taking "bending factor" into consideration.

X: Bending length in the X-axis direction "ax"

Y: Bending length in the Y-axis direction "ay"

P: Number of bends in the X-axis direction "nx"

Number of bends on the origin side should be entered by a positive number.

K: Number of bends in the Y-axis direction "ny"

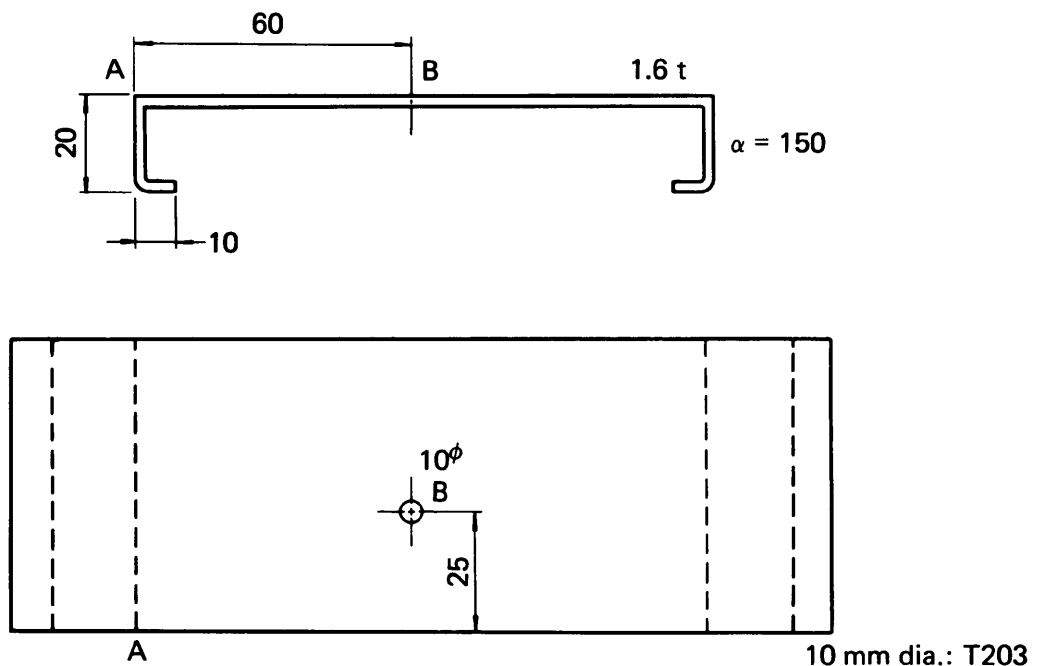
Number of bends on the origin side should be entered by a positive number.

Q: Worksheet thickness "t" – positive number

D: Bending coefficient " α " – positive and entered by a percentage

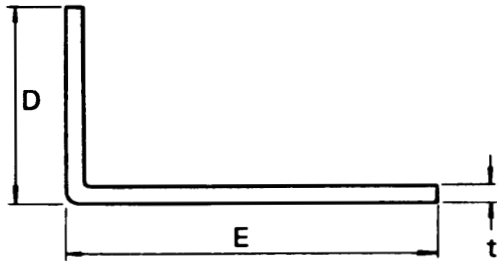
"D" can also be instructed by using the SETTING (SET DATA) display. For the method of inputting coefficient " α ," refer to the OPERATOR'S MANUAL.

Example:



G90 G94 X30.00 Y0 P2 K0 Q1.60 D150 (Setting "A" point as the origin)
X60.00 Y25.00 T203

Determining α



L: Developed length

$$L = (D + E) - \alpha t$$

$$\therefore \alpha = \frac{(D + E) - L}{t}$$

Ex.: When the worksheet thickness is 2.0 mm, the bending coefficient " α " is obtained using the following formula:

$$\alpha = \frac{(D + E) - L}{t} \times 100\% \quad \text{The developed length "L" is obtained by subtracting 3.6 mm from "D + E."}$$

$$= \frac{3.6}{2.0} \times 100\%$$

$$= 180 \longrightarrow \text{Therefore, } \alpha = 180$$

Method for returning to the global coordinate system is the same as that of "G93."

G90 G94 X0 Y0

Basic format of a program using "G94"

G06 A _____ B _____

G92 X1830.00 Y1270.00

G90 G94 X _____ Y _____ P _____ K _____ Q _____ D _____

X _____ Y _____ T _____

.

.

.

G50

G73 – SYMMETRY

G73	Xa	Yb	Qn	Ww
-----	----	----	----	----

When the patterns of holes to be punched are symmetrical, they can easily be programmed by using this instruction and the macro function (see page 54).

X: Distance from a specified pattern reference point "0" to the symmetrical pattern reference point along the "X" axis (dimension "a").

Y: Distance from the same specified pattern reference point "0" to the symmetrical pattern reference point along the "Y" axis (dimension "b").

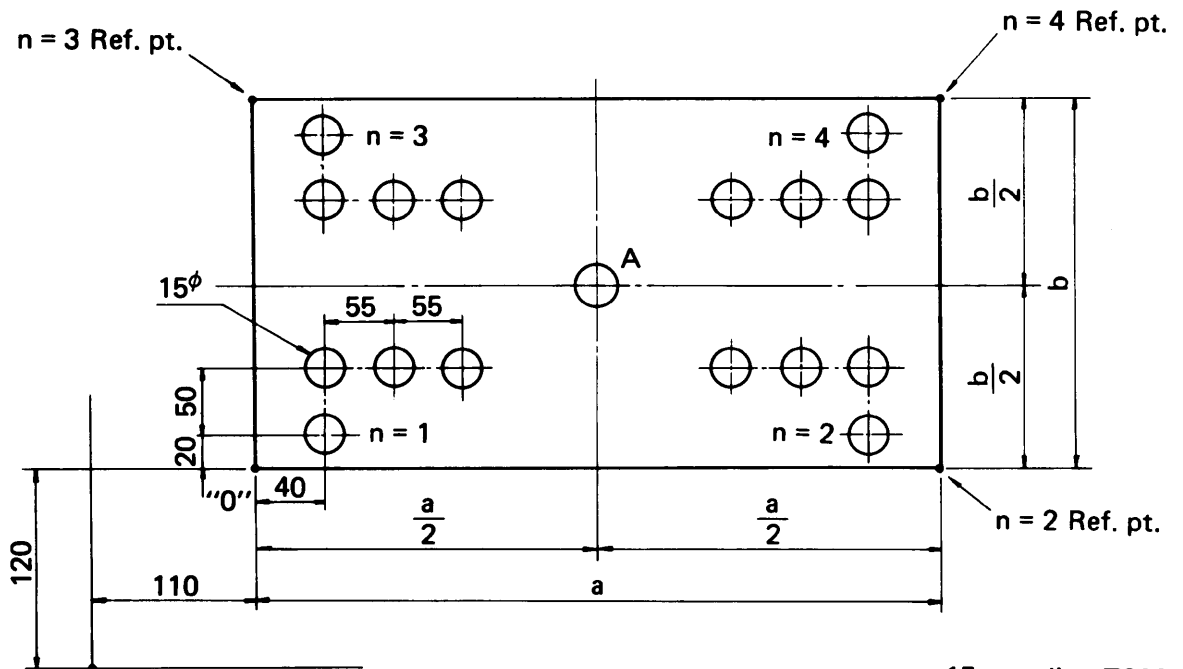
Q: n = 1: Specified pattern punching

n = 2: Symmetrical pattern punching along the "X" axis, centered on $a/2$.

n = 3: Symmetrical pattern punching along the "Y" axis, centered on $b/2$.

n = 4: Symmetrical pattern punching along both the "X" and "Y" axes, centered respectively on $a/2$ and $b/2$.

W: Macro number storing the specified hole pattern.



15 mm dia.: T303

Program example

When "a" is 600 mm and "b" is 400 mm in the diagram on the preceding page, the program is as follows:

```

G06 A____B____
G92 X____Y____
N001 G90 G93 X110.00 Y120.00 ← Specified pattern (n = 1) reference point
                                is defined.

    U1
N002 X40.00 Y20.00 T303 }
    Y70.00                } ← Specified pattern (n = 1) is punched and
    G28 I55.00 J0 K2      } this data is simultaneously stored.
    V1

N003 G73 X600.00 Y400.00 Q4 W1 ← Symmetrical pattern (n = 4) is punched.
N004 G73 Q3 W1                ← Symmetrical pattern (n = 3) is punched.
N005 G73 Q2 W1                ← Symmetrical pattern (n = 2) is punched.
N006 G91 X300.00 Y200.00      ← Hole "A" is punched.

    G50

```

- When the Xa and Yb dimensions of the G73 code have been entered in memory once, they may be omitted in the next G73 instruction if the symmetrical axes are the same (see blocks N004 and N005 in the above program).
- When the block following the G73 instruction is an incremental statement, the incremental dimensions start from the specified pattern reference point (see block N006 in the above program).
- G73 instructions can be used within the macro instructions of the multiple part punching.

```

Ex.: G98 X___ Y___ I___ J___ P___ K___
    Uxx
    _____
    _____
    _____
    Vxx
    U00
    G73 X___ Y___ Q___ Wxx
    G73 Q___ Wxx
    G73 Q___ Wxx
    G73 Q___ Wxx
    V00
    G75 W00 Q___
    .
    .
    .

```

xx: Macro number 60 to 89

00: Macro number 01 to 59

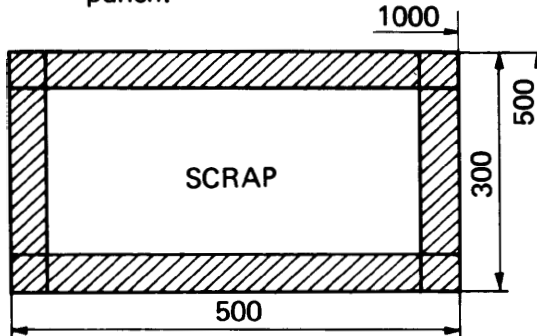
- M and T codes cannot be entered in G73 instruction blocks.

M FUNCTION CODES

M00 – PROGRAM STOP

Enter "M00" if a program stop is desired.

Ex.: Punching a 300 mm x 500 mm rectangular opening with a 50 mm x 50 mm square punch.



```
G72 G90 X1000.00 Y500.00
G67 I-500.00 J-300.00 P50.00 T219
M00 (Machine stops here)
```

When "M00" is read, the machine stops. When the START button is pressed after the scrap has been removed, the machine will continue the punching operation. "M00" must be entered as a single block; however, the sequence number can be entered with it.

M01 – OPTIONAL STOP

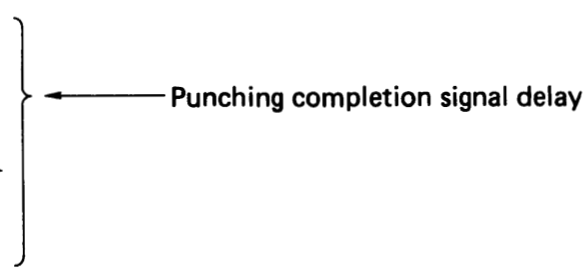
This code has the same function as "M00"; however, the machine will stop only when the OPT STOP key is pressed and lighted. (See the OPERATOR'S MANUAL.)

M08 – BEGINNING OF PUNCHING COMPLETION SIGNAL DELAY

M09 – END OF PUNCHING COMPLETION SIGNAL DELAY

These codes are used for forming, marking and knockout. They are also used for punching thick worksheets. The timing at which axis travel starts after punching is delayed between M08 and M09.

```
Ex.: G06 A___B___
      G92 X___Y___
      G90 X___Y___
      .
      .
      M510
      M08
      G90 X___Y___
      .
      .
      G28 I___J___K___
      .
      .
      M09
      M13
      .
      .
      G50
```



A diagram showing a vertical list of G-code commands. A large right-facing curly bracket spans from the line containing 'G90 X___Y___' to the line containing 'G28 I___J___K___'. An arrow points from the text 'Punching completion signal delay' to the middle of this bracket.

Do not place any nibbling command between M08 and M09.

M80 – WORK CHUTE OPEN (For machine equipped with work chute)

M81 – WORK CHUTE CLOSE (For machine equipped with work chute)

These codes are used to open and close the work chute.

```
Ex.: M692 ← Press raise command
      M80 ← Work chute open
      G04 X___
      M81 ← Work chute close
      M693 ← Press raise cancel command
```

When closing the work chute, enter the dwell command (G04 X___) and delay the work chute close timing.

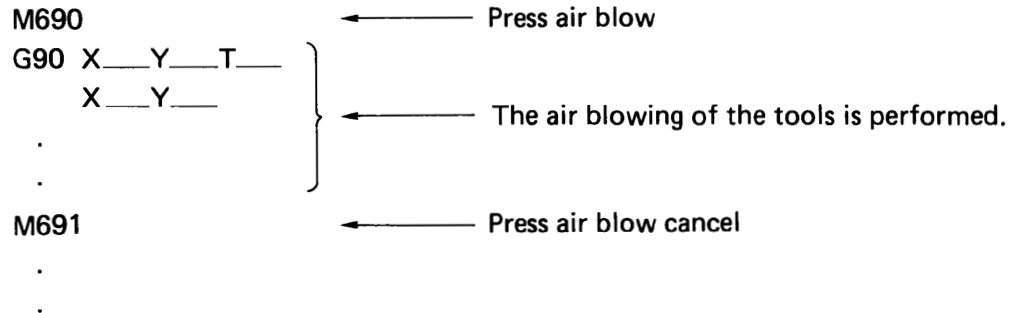
Enter the press raise command (M692) and raise the ram to the top dead center.

M690 – PRESS AIR BLOW

M691 – PRESS AIR BLOW CANCEL

“M690” or “M691” must be entered as a single block. When “M690” is entered, the air blowing of the tools is performed. When “M691” is entered, the air blowing of the tools is cancelled.

Ex.: .



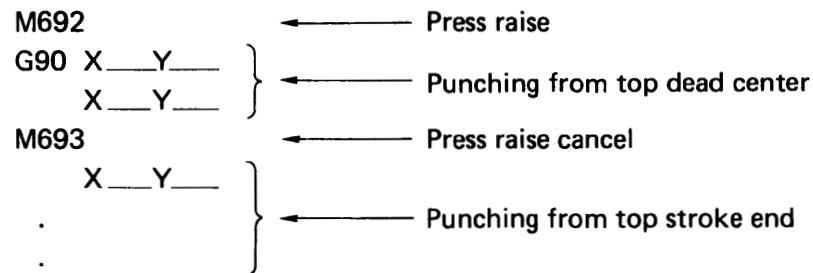
In the nibbling and slitting press modes, the air blowing of the tools is always performed, including the period of axis travel, between "M690" and "M691." When the RAM POSITION switch is turned to ON (top dead center) or when the press raise command (M692) is entered and the ram is punching from the top dead center, the air blowing of the tools is performed as long as the punching operation is performed. In a press mode other than nibbling and slitting, the air blowing of the tools is performed as long as the punching operation is performed.

M692 – PRESS RAISE

M693 – PRESS RAISE CANCEL

“M692” or “M693” must be entered as a single block. When “M692” is entered, the ram starts punching from the top dead center, while “M693” is entered, the press raise command is cancelled and the ram starts punching from the top stroke end.

Ex.: .



"M692" has the same function as when the RAM POSITION switch is turned to ON. (top dead center)

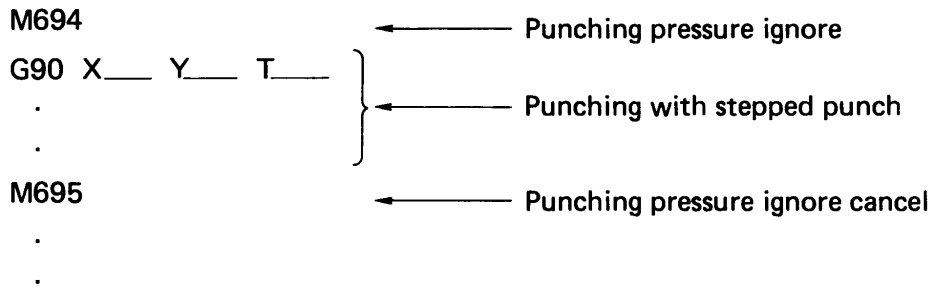
M694 – PUNCHING PRESSURE IGNORE

M695 – PUNCHING PRESSURE IGNORE CANCEL

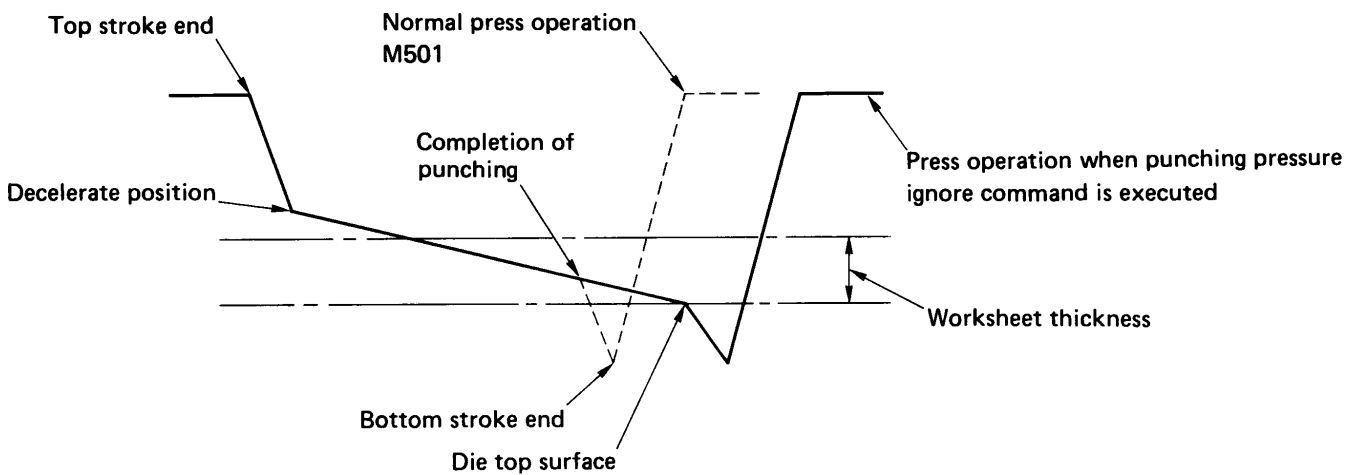
These codes are used to use stepped punches (cluster punches, etc.). "M694" or "M695" must be entered as a single block.

NOTE: Stepped punches are used in the punching mode (M501).

Ex.: .



These codes can be omitted for a turret station for which the "SHEAR ANGLE" of the TOOL INFO parameters is set as "SG" on the PHNC display.



In the punching mode (M501), the completion of worksheet punching is detected with a pressure sensor. When "M694" is entered, the completion of worksheet punching is not detected but the worksheet is punched at a decelerated speed until the end of the punch contacts the die top surface.

M680 – TAPE RESTART (except VIPROS 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C)

"M680" must be entered as a single block. When punching plural worksheets using one program in the TAPE mode, the second and subsequent worksheets can be punched at a speed regulated automatically according to the result of the first worksheet punching if a program tape with "M680" entered at the beginning of the program is used. When the "TAPE RESTART MODE" button is pressed and lighted on the PHNC panel, "M680" need not be entered in the program tape.

PRESS MODE RECALL AND CANCEL

M – PRESS MODE RECALL
M13 – PRESS MODE CANCEL

To recall a press mode registered in the PHNC, enter the M code for the press mode in question (refer to the following pages). The press mode recalled by the M code remains effective until "M13" is entered or another press mode is recalled. These M codes must be entered as a single block.

Basic Program

```
G06 A__B__
G92 X__Y__
G90 X__Y__
G36 I__P__J__K__
M○○○ ← Press mode recall
G72 X__Y__
G66 I__J__P__Q__T__
M13 ← Press mode cancel
G50
```

1. M500, M501 – PUNCHING

"M500" is entered for punching with a standard punch having a flat edge and "M501" is entered for punching with a punch having a shear angle.

```
Ex.: M500 ← For standard punch
      G90 X100. Y150. T342 (standard punch)
      G28 I20. J45. K5
      G90 X200. Y350. T255 (standard punch)
      G36 I50. P3 J75. K2
      M13 ← Mode cancel
      M501 ← For punch with shear angle
      G72 X120. Y100.
      G66 I200. J0 P110. Q10. T201 (punch with shear angle)
      M13 ← Mode cancel
```

"M500" and "M501" can be omitted in the program when the "SHEAR ANGLE" of the TOOL INFO parameters* is set for the turret station to be used on the PHNC display. If the parameter setting is different from the M-code command entered in the program, the ram performs the punching operation in the same way as when "M501" is instructed.

* "SHEAR TOOL" of TOOLING DATA parameters, for Models 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K and 2510C

2. M12 – NIBBLING

When "M12" is entered, the ram performs the punching operation without decelerating above the worksheet.

Ex.: M12 ← Nibbling mode
G90 X230. Y300. T303
G36 I150. P3 J40. K2
M13 ← Mode cancel

When the nibbling command "G68" or "G69" is entered in the block following "M12," the nibbling interval "Q" must not exceed the permissible pitch limit of 8 mm.

Ex.: When "G68" or "G69" command is entered
M12 ← Nibbling mode
G72 X300. Y400.
G69 I200. J45. P20. Q3. T306
M13 ← Mode cancel

3. M510 to M559 – FORMING

M800 to M999 – FORMING (only for VIPROS 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C)

When performing a forming operation, an M code that meets the content of the forming operation to be performed is entered. The press operation in the block following the M code is performed according to the data set for the parameters of the M code. For setting the parameters, refer to "PHNC parameters" in the OPERATOR'S MANUAL.

M510 ← Forming 1
(M08) ← Beginning of punching completion signal delay
G90 X500. Y300. T201 (Forming tool)
G28 I30. J0 K10
(M09) ← End of punching completion signal delay
M13 ← Mode cancel
M511 ← Forming 2
(M08) ← Beginning of punching completion signal delay
G90 X20. Y150. T333
G36 I800. P1 J400. K1
(M09) ← End of punching completion signal delay
M13 ← Mode cancel

"M08" and "M09" are entered as required.

4. M560 to M563 – MARKING

M564 to M569 – MARKING (only for VIPROS 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C)

When performing a marking operation, an M code that meets the content of the marking operation to be performed is entered. The press operation in the block following the M code is performed according to the data set for the parameters of the M code. For setting the parameters, refer to "PHNC parameters" in the OPERATOR'S MANUAL.

M560 ← Marking 1
(M08) ← Beginning of punching completion signal delay
G90 X130. Y280. T201 (Marking tool)
X350
(M09) ← End of punching completion signal delay
M13 ← Mode cancel

"M08" and "M09" are entered as required.

5. M502 to M505 – KNOCKOUT

M570 to M575 – KNOCKOUT (only for VIPROS 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C)

When performing a knockout operation, an M code that meets the content of the knockout operation to be performed is entered. The press operation in the block following the M code is performed according to the data set for the parameters of the M code. For setting the parameters, refer to "PHNC parameters" in the OPERATOR'S MANUAL.

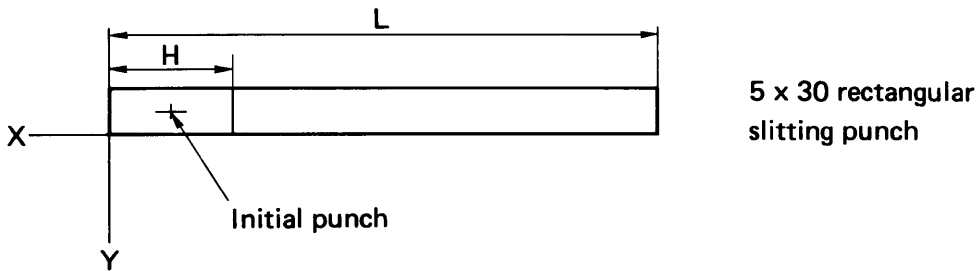
M502 ← Knockout 1
(M08) ← Beginning of punching completion signal delay
G90 X350. Y180. T246 (Knockout tool)
Y350
(M09) ← End of punching completion signal delay
M13 ← Mode cancel

"M08" and "M09" are entered as required.

6. M506 to M509 – SLITTING (except 50 series)

When performing a slitting operation, an M code that meets the content of the slitting operation to be performed is entered. The press operation in the block following the M code is performed according to the data set for the parameters of the M code. For setting the parameters, refer to "PHNC parameters" in the OPERATOR'S MANUAL.

(1) When the slitting feed direction is 0°, 90°, 180° or 270°:



M690	←	Press air blow
M506 (M507, M508, M509)	←	Slitting mode
G90 X <u>a</u> Y <u>b</u> T <u> </u> C <u> </u>		
G28 I <u>d₁</u> J <u>θ</u> K <u>n</u>		
M13	←	Mode cancel
G28 I <u>d₂</u> J <u>θ</u> K1	←	Final cutting punch
M691	←	Press air blow cancel

a: X-coordinate value of the initial punch center

b: Y-coordinate value of the initial punch center

θ: Angle corresponding to slitting feed direction (0°, 90°, 180°, 270°)

d₁: Feed pitch

The feed pitch is set according to the worksheet thickness and material and the punch to be used. (It is initially set at about 5 mm and is then adjusted as required according to the check results of the slitted product.)

n: Feed frequency

$[\text{Slitting length (L)} - \text{Wide-side length of punch (H)}] / \text{Feed pitch}$

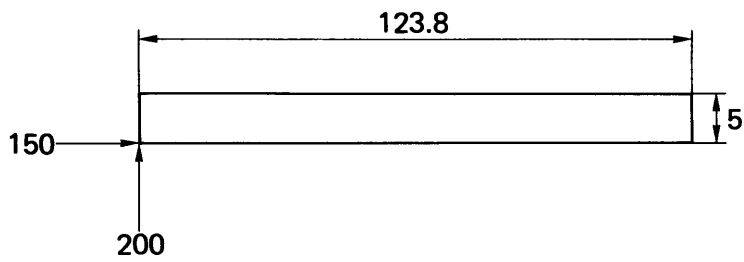
When the calculated value is a fraction, omit the figures below the first place of decimals.

d₂: Feed pitch

Value omitted at the feed frequency "n" x Feed pitch "d₁"

When the value calculated at the feed frequency "n" is an integer, "0" is entered.

Program Example: When the slitting feed direction is 0°



5 x 30 rectangular
slitting punch: T220

a: $150 + 30/2 = 165$

b: $200 + 5/2 = 202.5$

θ : 0

d_1 : 5

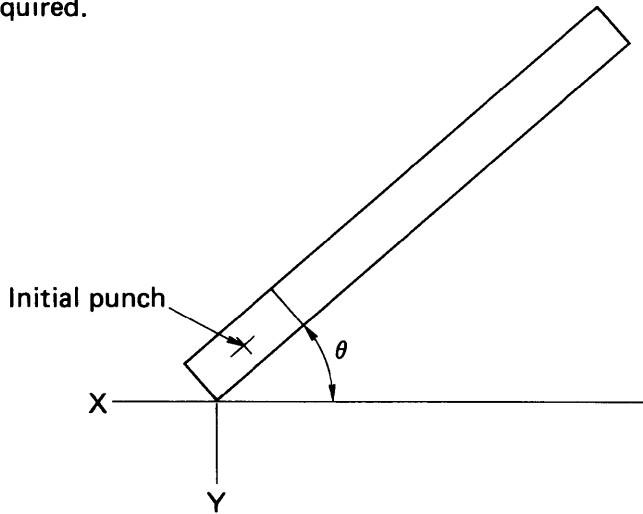
n: $(123.8 - 30)/5 = 18.76 \rightarrow 18$

d_2 : $0.76 \times 5 = 3.8$

M690	← Press air blow
M506 (M507, M508, M509)	← Slitting mode
G90 X165. Y202.5 T220 C0	
G28 I15. J0 K18	
M13	← Mode cancel
G28 I3.8 J0 K1	← Final cutting punch
M691	← Press air blow cancel

(2) When the slitting feed direction is an arbitrary angle:

Since a chip not separated from the worksheet occurs in the die, a linear interpolation is required.



M690	← Press air blow
M506 (M507, M508, M509)	← Slitting mode
G90 X _a Y _b T _c C _θ	
G01 F8000	← Linear interpolation positioning start
G28 I _{d₁} J _θ K _n	
M13	← Mode cancel
G28 I _{d₂} J _θ K1	← Final cutting punch
G00	← Normal positioning start
M691	← Press air blow cancel

a: X-coordinate value of the initial punch center

b: Y-coordinate value of the initial punch center

θ: Angle corresponding to slitting feed direction

d₁: Feed pitch

The feed pitch is set according to the worksheet thickness and material and the punch to be used. (It is initially set at about 5 mm and is then adjusted as required according to the check results of the slitted product.)

n: Feed frequency

(Slitting length – Wide-side length of punch)/Feed pitch

When the calculated value is a fraction, omit the figures below the first place of decimals.

d_2 : Feed pitch
 Value omitted at the feed frequency "n" x Feed pitch "d₁"
 When the value calculated at the feed frequency "n" is an integer, "0" is entered.

G01 F___: Positioning becomes linear interpolation (over the shortest distance).

G00: Positioning becomes normal positioning.

NOTES: (a) When "G01" has no F command, the program error occurs.
 (b) The F command is usually entered not to exceed "8000" (8 m/min). "8000" is normally entered.
 (c) When the T and C commands are placed between "G01" and "G00," the program error occurs.

(3) When single-stroke punching is performed with a slitting punch:

M690	←	Press air blow
M506 (M507, M508, M509)	←	Slitting mode
M13	←	Mode cancel
G90 X___Y___T___C___	←	Single-stroke punching
M691	←	Press air blow cancel

M681 to M685 – PUNCHING SPEED COMMAND

M686 – PUNCHING SPEED COMMAND CANCEL

"M681" to "M685" ("M683": 50 series) correspond to the F1 to F5 (F3: 50 series) positions of the RAM SPEED switch* on the PHNC panel. The punching speed can be designated only in the punching press mode. These M codes are effective only when the RAM SPEED switch is set at the AUTO position. The punching speed command M code remains effective until "M686" or another punching speed command is entered. These M codes must be entered as a single block.

* When the machine is Model 358K(FS18PC), 368K(FS18PC), 255, 258 or 2510K, 2510C, the RAM SPEED buttons (F1, F2, F3 and Auto) are installed on the main control panel, "M681" to "M683" correspond to the functions of the F1 to F3 buttons, and "M684" and "M685" are not available.

Example: (Punching speed selection by M code)

```

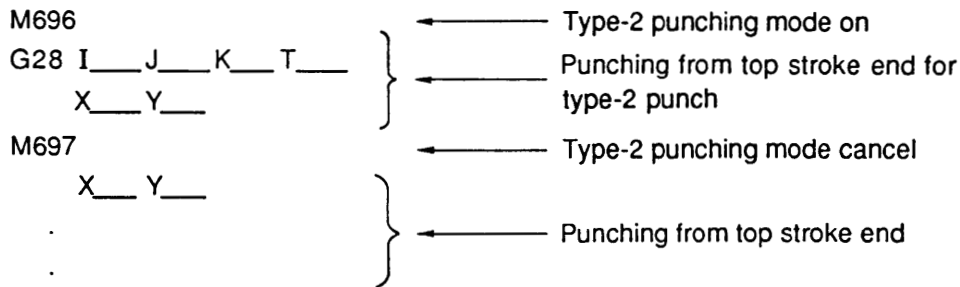
G06 A ___ B ___
G92 X ___ Y ___
G90 X200. Y100. T345
G28 I20. J0 K3
M683
G90 X500. Y500. T201 }
G36 I100. P2 J40. K3 } ← Punching at F3
G50
  
```

M696 – TYPE-2 PUNCHING MODE ON (only for VIPROS 358K(FS18PC), 368K (FS18PC), 255, 258, 2510K and 2510C)

M697 – TYPE-2 PUNCHING MODE CANCEL (only for VIPROS 358K(FS18PC), 368K (FS18PC), 255, 258, 2510K and 2510C)

These codes are used to use the type-2 tooling. "M696" or "M697" must be entered as a single block. When "M696" is entered and "T_" is entered in the lower instruction block, the ram starts punching from the top stroke end for the type-2 punch, which can be set on the PHNC. When "M697" is entered, the type-2 punching mode on command is cancelled and the ram starts punching from the top stroke end.

Example:



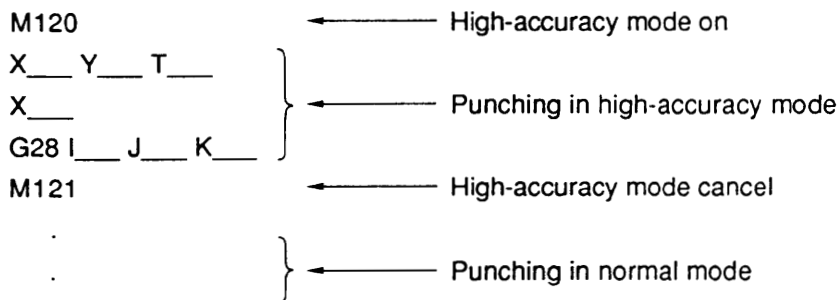
M120 – HIGH-ACCURACY MODE ON (only for VIPROS 358K(FS18PC), 368K (FS18PC), 255, 258, 2510K and 2510C)

M120 – HIGH-ACCURACY MODE CANCEL (only for VIPROS 358K(FS18PC), 368K (FS18PC), 255, 258, 2510K and 2510C)

These codes are used to change from the high-accuracy mode to the normal mode and vice versa. "M120" or "M121" must be entered as a single block.

NOTE: These M codes correspond to the ON and OFF functions of the FEEDRATE FA button on the main control panel, respectively.

Example:



M CODE LIST

<u>M code</u>	<u>Function</u>
M00	Program stop
M01	Optional stop
M02	Program end
M08	Beginning of punching completion signal delay
M09	End of punching completion signal delay
M10	Work hold and unclamp
M11	Work hold and release
M12	Nibbling
M13	Press mode cancel
M14	Tapping (C) preparation command*
M15	Tapping (A) preparation command*
M16	Tapping (B) preparation command*
M17	Tapping end command*
M18	Tapping (D) preparation command*
M30	End of tape
M31	Rear workholder and cassette cylinder lower*
M32	Side table bearings lower*
M33	Loading command*
M34	Unloading command*
M35	Job search end*
M36	Unloading preparation command*
M37	Penultimate worksheet signal*
M38	Job end signal*
M39	Total job end signal*
M80	Work chute open *****
M81	Work chute close *****
M82	Work selector left*
M83	Work selector right*
M86	Tapping preparation command (II)*
M87	Tapping completion command (II)*
M90	Workclamp 1 fix*
M91	Workclamp 2 fix*

*: Optional function

***** : For machine equipped with work shute

<u>M code</u>	<u>Function</u>
M92	Workclamp 1 start* (Fix cancel)
M93	Workclamp 2 start* (Fix cancel)
M94	Workclamp open*
M95	Workclamp close*
M96	Subprogram recall command
M97	Subprogram end command
M120	High-accuracy mode on**
M121	High-accuracy mode cancel**
M500	Punching 1 (punch without shear angle)
M501	Punching 2 (punch with shear angle)
M502 to M505	Knockout 1 to 4
M570 to M575	Knockout 5 to 10**
M506 to M509	Slitting 1 to 4*****
M510 to M559	Forming 1 to 50
M800 to M999	Forming 51 to 250**
M560 to M563	Marking 1 to 4
M564 to M569	Marking 5 to 10**
M680	Tape restart***
M681	Punching speed 1 (highest speed)
M682	Punching speed 2
M683	Punching speed 3
M684	Punching speed 4****
M685	Punching speed 5****
M686	Punching speed command cancel
M690	Press air blow
M691	Press air blow cancel
M692	Press raise
M693	Press raise cancel
M694	Punching pressure ignore
M695	Punching pressure ignore cancel
M696	Type-2 punching mode on**
M697	Type-2 punching mode cancel**

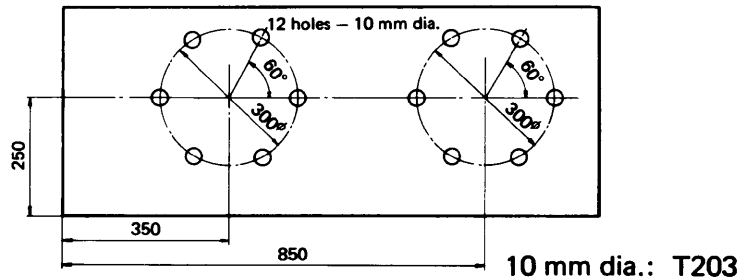
*:	Optional function
**:	Only for 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C
***:	Except 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C
****:	Except 358K(FS18PC), 368K(FS18PC), 255, 258, 2510K, 2510C, 505080, 506080
*****:	Except 505080, 506080

PATTERN MEMORY AND PATTERN RECALL

AO ... Pattern memory BO ... Pattern recall
--

When a pattern instructed by the codes G26 (BHC), G28 (LAA), G29 (ARC), G36 (GRD-X), G37 (GRD-Y), G66 (SHP), G67 (SQR), G68 (NBL-A), G69 (NBL-L), G78 (PNC-A) or G79 (PNC-L) is used repeatedly, the pattern can be memorized and recalled whenever required. To memorize a pattern, enter the address letter "A" along with a one-digit numeral (from 1 to 5). To recall the pattern, enter the address letter "B" and the same one-digit numeral as that was used by "A."

Example:



```

G72 G90 X350.00 Y250.00
A1  G26 I150.00 J0 K6 T203 ← Pattern memory
G72 X850.00
B1                                     ← Pattern recall
  
```

"AO" should always be entered at the front of the pattern command block; "BO" must be entered as a single block by itself. "AO" and "BO" are only used for the pattern memory and recall. Memorization and recalling of a coordinate value are impossible with these.

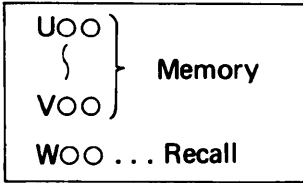
FO – DESIGNATION OF AXIS FEED SPEED

The axis feed speed can be changed by this code. "FO" must be entered as a single block. The axis feed speed is decreased as the value following "F" is changed from 1 to 4 (1 → 2 → 3 → 4). This code has the same function as the FEEDRATE key located on the main control panel of the NC unit. When there is a difference between the axis feed rate instructed by this code and that set by the FEEDRATE key, priority will be given to the slower axis feed speed. The instruction of the "F" code remains effective until a new "F" code is entered. If no "F" code is instructed, the axes move at the speed set by the FEEDRATE key.

```

G90 X__Y__T__
F3
  X__Y__ } ← Axis travel at F3
  X__Y__ }
F1
  X__Y__ } ← Axis travel at F1
  X__Y__ }
  
```

MACRO FUNCTION



1. Macro storing

Using the macro function, the contents of multiple blocks of data can be stored within the memory of NC as a single macro data; and this stored data can be recalled whenever required. To store multiple blocks of data, enter the address letter "U" along with a two-digit numeral from "01 to 99" as a single block, preceding the multiple blocks which you wish to memorize, and enter the address letter "V" using the same two-digit numeral as was used for the address letter "U" as a single block, after the multiple blocks which you wish to memorize.

The two-digit numeral following "U" or "V" is called the "macro number." This macro number comes in the following three types:

- 01 – 59: The blocks of data between "U" and "V" remain stored while they are simultaneously being executed.
- 60 – 89: The blocks of data between "U" and "V" are only stored into the memory.
- 90 – 99: Storing of multiple macros is accomplished.

2. Macro recalling

The multiple blocks of data which were stored by "U" and "V" can be recalled by the address letter "W" with the same two-digit numeral that was used at "U" and "V."

3. Example

G06 A ___ B ___

G92 X1830.00 Y1270.00 (VIPROS 357Q)

.....

.....

U02

G90 X100.00 Y500.00 T345

G72 X150.00 Y700.00

A1 G66 I100.00 J30.00 P20.00

N100 M00

G72 X450.00 Y600.00

B1

V02

.....

.....

} These instructions remain stored while they are simultaneously being executed.

U70

G90 X200.00 Y100.00 T304

G37 I8.00 P3 J10.00 K10

G90 X1000.00 Y800.00

G28 I25.00 J-90.00 K6

V70

.....

.....

} These instructions are merely stored.

W02

.....

.....

← Recalling and processing of instructions stored between U02 and V02

W70

.....

.....

← Recalling and processing of instructions stored between U70 and V70

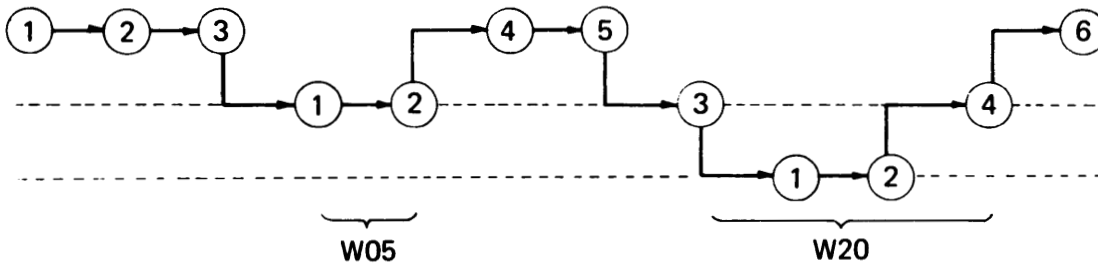
4. Multiple recalling of macro

The data which was stored as macro data can be recalled, and the recalled data can also be stored and then be recalled again.

Example: U05

- ①
- ②
- V05
- U20
- ③
- W05
- ④
- V20
- U70
- ⑤
- W20
- ⑥
- V70
- W70

In the above example, the execution is carried out in the following manner.



This multiple recalling is possible up to triple level.

5. Memory capacity for macro (Macro numbers 01 to 89)

The maximum memory capacity for macro is 3100 characters. One character equals:

- (1) One letter (G, X, Y, T, M, etc.)
- (2) One numeral (1, 2, 3,, 0)
- (3) One symbol (CR, LF, -, /, etc.)

The delete, space, and other codes which are ignored by the NC are not considered as characters.

6. Storing and recalling of multiple macros

Multiple macros can be stored and recalled by using the macro numbers 90 to 99. These macro numbers are only capable of defining a group of multiple macros as one macro, and they are unable to store execution instructions.

Example: U90

U01

....
....

V01

U10

....
....

V10

U15

....
....

V15

G90 X100.00 Y200.00 ← This block is not stored.

U02

....
....

V02

V90

....
....

W90 = { W01
W10
W15
W02

The maximum number of macros that can be stored by each of the macro numbers 90 to 99 is 15.

7. Macro memory setting

When the following occurs, all macro data stored in memory will be cancelled:

- (a) When the NC power is turned off
- (b) When the RESET key is pressed
- (c) When "G50," "M02" or "M30" command is executed

However, the macro data stored in memory can be retained under conditions (a) to (c) above by setting the NC through the main control panel. For this setting procedure, refer to the OPERATOR'S MANUAL.

MULTIPLE PART PUNCHING

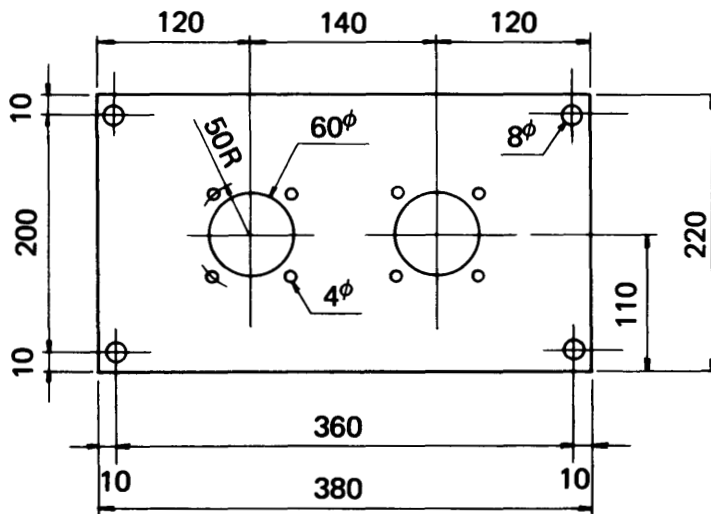
GENERAL DESCRIPTION AND PROGRAMMING EXAMPLE

1. Multiple part punching function

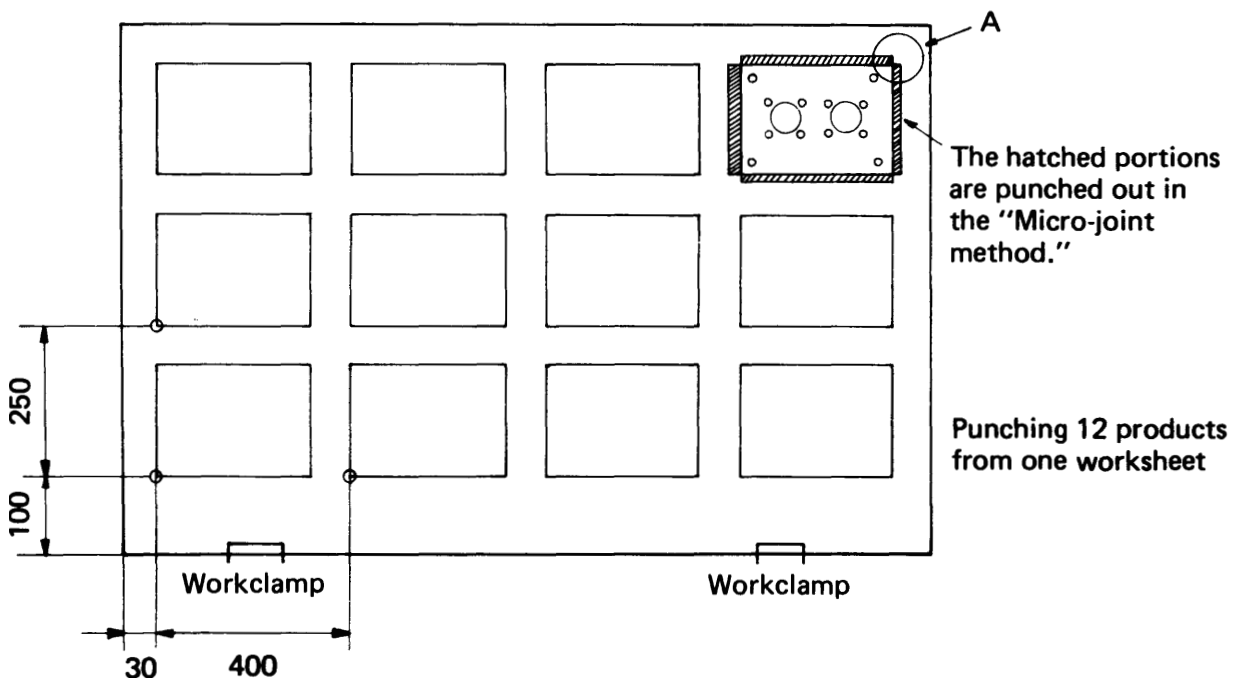
This function is used to punch multiple products which have the same punching pattern from one worksheet. Once the punching of only one product is programmed, the punching of multiple products with any desired layout on the worksheet can be performed by using simple commands.

2. Removal of each product after multiple part punching

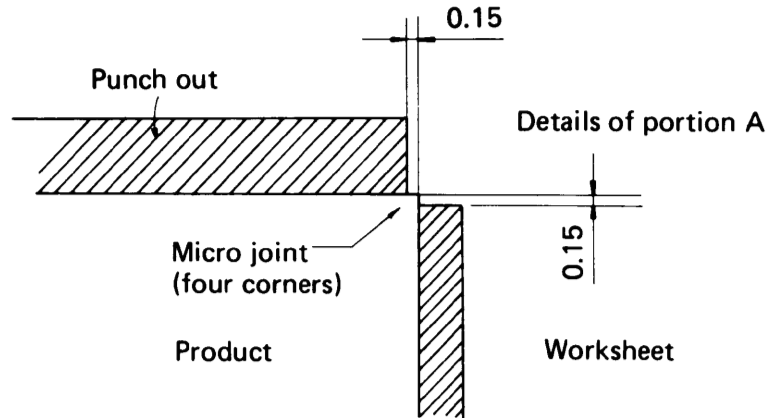
When punching twelve products from one worksheet, such as the one depicted in the figure below, the following three removal methods can be used:



a. Micro-joint method

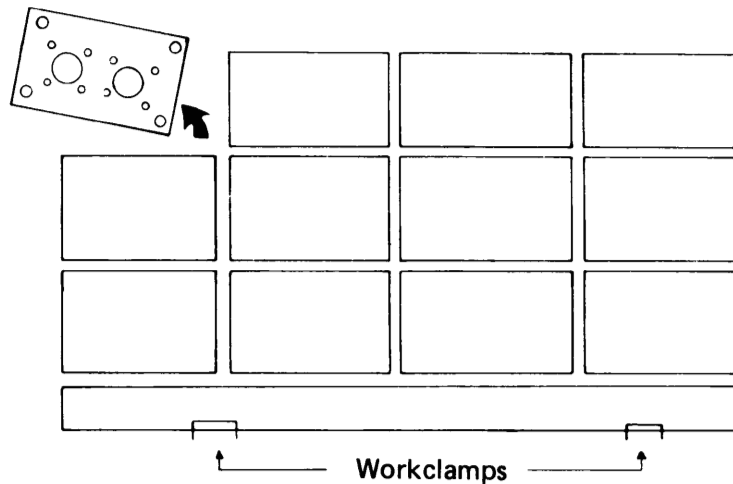


As shown in the figure, the hatched portions are punched out by rectangular punches in such a manner that the four corners of each product remain unpunched. The four corners are connected to the worksheet by means of an approx. 0.15 mm joint. After completing the entire punching process, the worksheet with punched products is removed from the machine, and each product is then separated from the worksheet.



b. Separation method

Each product is separated from the worksheet after punching. Each time one product is cut out, the operator stops the machine and removes the product using a magnet or by other means.



c. Work chute method

Each product which is separated from the worksheet automatically drops into the work chute. The work chute opening measures 200 × 200 mm and the product to be dropped must be thus smaller than this opening.

3. Program example using multiple part punching function

The program for punching the product depicted in the figure on Page 58 using the "micro-joint" method is as follows:

```

G06 A1.6 B0
G92 X1830.00 Y1270.00
G98 X30.00 Y100.00 I400.00 J250.00 P3 K2

```

→ (1) The reference point for multiple part punching is set.

```

U1
G90 X370.00 Y210.00 T304 (8φ)
Y10.00
X10.00
Y210.00
G72 X120.00 Y110.00
A1 G26 I50.00 J45.00 K4 T203 (4φ)
G72 X260.00
B1
V1

```

} → (2) Program (part program) for punching one product. This part program is stored.

```

U2
X260.00 Y110.00 T219 (60φ)
X120.00
V2

```

```

U3
G72 X380.00 Y220.00
G66 I220.00 J-90.00 P85.00 Q5.00 D-0.15 T255 (5 x 85 ▨ )
G72 X0 Y0
G66 I220.00 J90.00 P85.00 Q5.00 D-0.15
V3

```

} → (3) Program (part program) for punching the exterior shape of one product. This part program is stored.

```

U4
G72 X0 Y220.00
G66 I380.00 J0 P110.00 Q10.00 D-0.15 T201 (10 x 110 ▨▨▨ )
G72 X380.00 Y0
G66 I380.00 J180.00 P110.00 Q10.00 D-0.15
V4

```

```

G76 W1 Q4 . . . . U1-V1 execution instruction
G76 W2 Q3 . . . . U2-V2 execution instruction
G76 W3 Q2 . . . . U3-V3 execution instruction
G75 W4 Q3 . . . . U4-V4 execution instruction
G50

```

} → (4) Recalling and execution of each part program for the specified punching layout.

After preparing the above program, one product in the lower left corner in the figure on Page 58 can be first-punched by key operation on the control panel of NC unit. After checking the dimensions of the product, the punching of multiple products over the entire surface of the worksheet can then be performed.

G98 – SETTING OF REFERENCE POINT AND LAYOUT FOR MULTIPLE PART PUNCHING

G98 X x_A Y y_A I l_x J l_y P n_x K n_y

x_A ... X-coordinate value of reference point

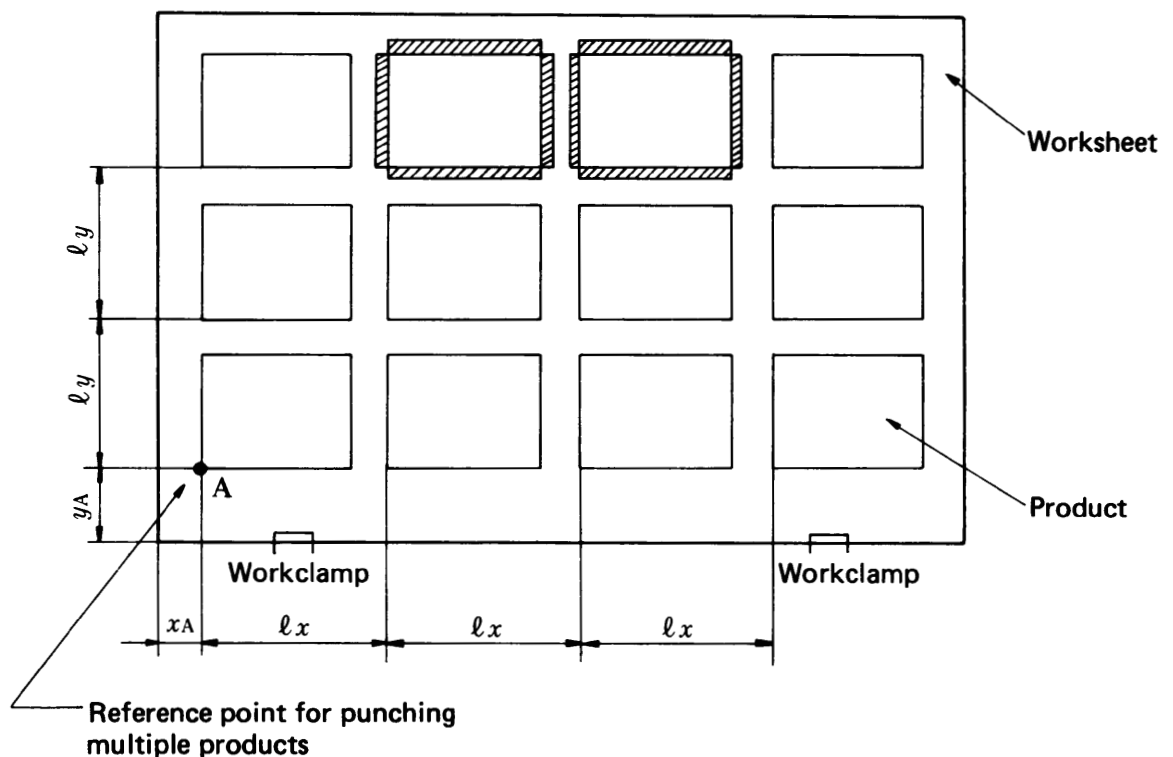
y_A ... Y-coordinate value of reference point

l_x ... Pitch along X-axis

l_y ... Pitch along Y-axis

n_x ... Number of products in X-axis direction, excluding product at reference point

n_y ... Number of products in Y-axis direction, excluding product at reference point

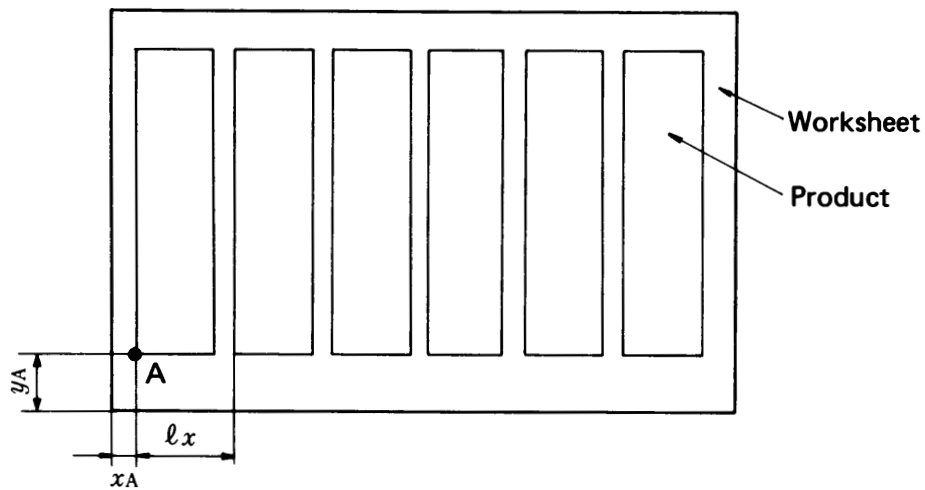


Ex.: If $x_A = 30$ mm, $y_A = 80$ mm, $l_x = 400$ mm and $l_y = 250$ mm in the figure above, the program is:

G98 X30.00 Y80.00 I400.00 J250.00 P3 K2

- NOTE: a) The reference point for punching multiple products must be located in the lower left corner of the product which is located at the lower left portion of the worksheet.
- b) The values " l_x ," " l_y ," " n_x " and " n_y " of I, J, P, K specified by "G98" must be either zero or positive values.

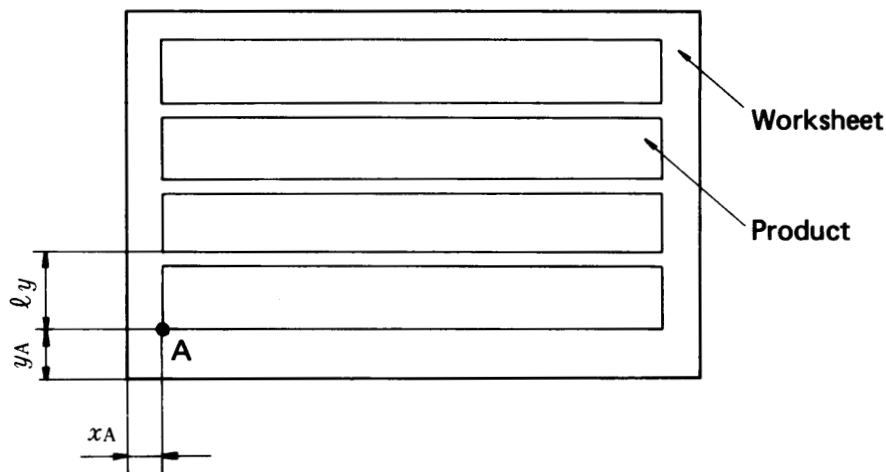
Example 1. This depicts the punching of products only in the X-axis direction.



If $x_A = 30$ mm, $y_A = 80$ mm and $l_x = 250$ mm in the above figure, the program is:
G98 X30.00 Y80.00 I250.00 J0 P5 K0

As shown above, $Jl_y = 0$ and $Kn_y = 0$.

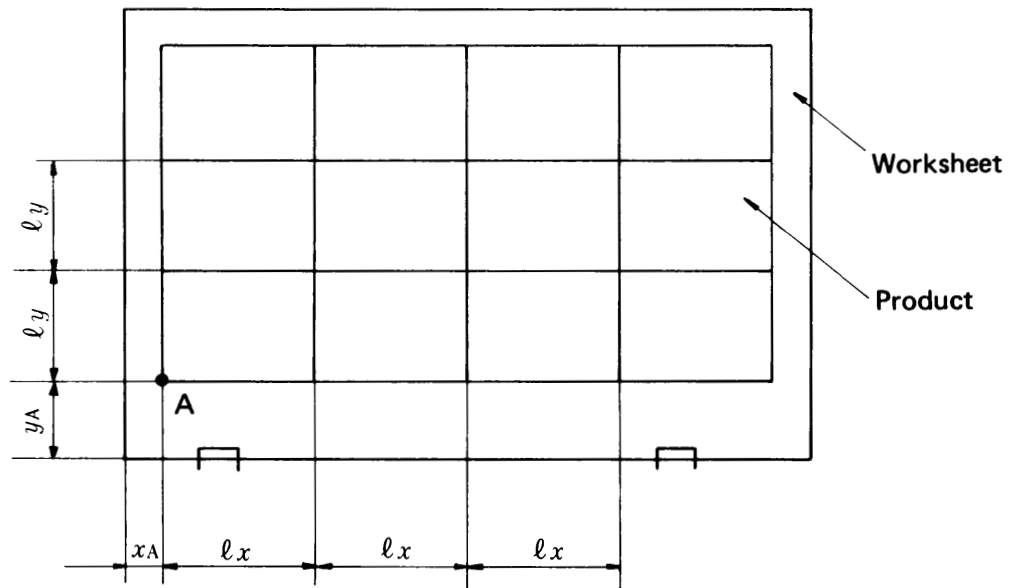
Example 2. This shows the punching of products only in the Y-axis direction.



If $x_A = 30$ mm, $y_A = 80$ mm and $l_y = 150$ mm, the program is:
G98 X30.00 Y80.00 I0 J150.00 P0 K3

As shown above, $I l_x = 0$ and $Pn_x = 0$.

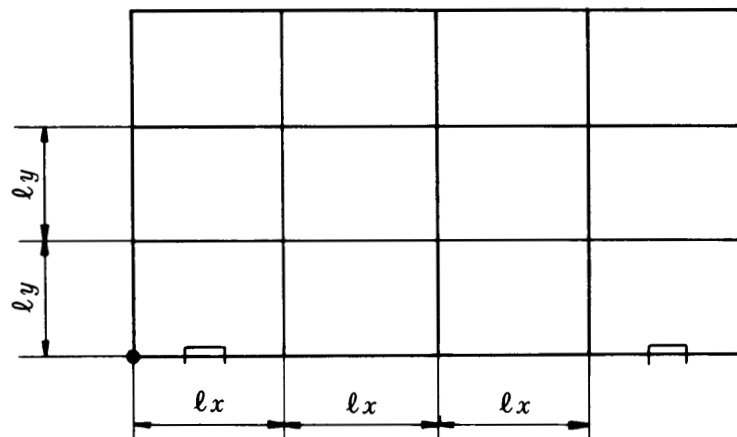
Example 3. When there is no cutting area between products and the outer edges of each product are cut either by shearing or other procedures after punching (Trimming will be necessary).



If $x_A = 20$ mm, $y_A = 100$ mm, $l_x = 450$ mm and $l_y = 260$ mm in the above figure, the program is:

G98 X20.00 Y100.00 I450.00 J260.00 P3 K2

Example 4. This is an example of a situation where there is neither a cutting area between products nor a clamping area and trimming is not performed.



If l_x (product length along X-axis) = 450 mm and l_y (product length along Y-axis) = 260 mm, the program is:

G98 X0 Y0 I450.00 J260.00 P3 K2

U00 TO V00 – STORING OF PART PROGRAM

U00
..... }
..... } Part program
..... }
V00

To store the part program for one product, "U" and a two-digit numeral (macro number) must be entered at the beginning of the part program to be stored, and "V" and the same two-digit numeral that was used by "U" must also be entered at the end of the part program. The part program thus positioned between "U00" and "V00" is stored in the memory.

- NOTE:
- a) The same macro numbers must be attached to "U" and "V" in order to store one part program.
 - b) Three types of macro numbers are available; one type ranges from 01 to 59, another type from 60 to 89 and the other type from 90 to 99.
 - c) The macro numbers 01 through 05 can be specified as one digit by omitting the zero.
 - d) On the macro numbers 01 through 89, the maximum limit of the part program allowed to be stored is 3100 characters on one processing tape.

U1
 X370.00 Y210.00 T304 (8 ϕ)
 Y10.00
 X10.00
 Y210.00
 G72 X120.00 Y110.00
 A1 G26 I50.00 J45.00 K4 T203 (4 ϕ)
 G72 X260.00
 B1
 V1
 U2
 X260.00 Y110.00 T219 (60 ϕ)
 X120.00
 V2
 U3
 G72 X380.00 Y220.00
 G66 I220.00 J-90.00 P85.00 Q5.00 D-0.15 T255 (5 x 85 \square)
 G72 X0 Y0
 G66 I220.00 J90.00 P85.00 Q5.00 D-0.15
 V3
 U4
 G72 X0 Y220.00
 G66 I380.00 J0 P110.00 Q10.00 D-0.15 T201 (10 x 110 \square)
 G72 X380.00 Y0
 G66 I380.00 J180.00 P110.00 Q10.00 D-0.15
 V4

Program example (1)

In this example, the processing by one type of tool (also including tools which are selected by simply moving the striker) is stored as a part program.

In this program, the processing by one type of tool is performed on the whole surface of the worksheet. Then, the next type of tool is selected and the processing by it also is made on the whole surface of the worksheet. The time required for selection of tool can thus be reduced.

U50
 X370.00 Y210.00 T304
 Y10.00
 X10.00
 Y210.00
 G72 X120.00 Y110.00
 A1 G26 I50.00 J45.00 K4 T203
 G72 X260.00
 B1
 X260.00 Y110.00 T219
 X120.00
 G72 X380.00 Y220.00
 G66 I220.00 J-90.00 P85.00 Q5.00 D-0.15 T255
 G72 X0 Y0
 G66 I220.00 J90.00 P85.00 Q5.00 D-0.15
 G72 X0 Y220.00
 G66 I380.00 J0 P110.00 Q10.00 D-0.15 T201
 G72 X380.00 Y0
 G66 I380.00 J180.00 P110.00 Q10.00 D-0.15
 V50

Program example (2)

In this example, the processing for one product by five types of tools is stored as a part program.

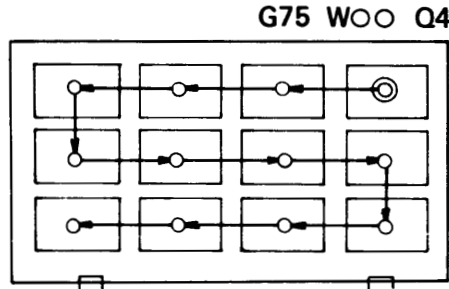
All processing of one product is performed by using five types of tools. Then, all processing of the next product is also performed by using the same five types of tools. The time for selection of tools increases. Although the program is simple, the processing time is greater than in example (1) above.

G75, G76 W00 Q0 – RECALLING AND EXECUTION OF PART PROGRAM

The part program for punching one product entered between "U00" and "V00" is recalled by "W00," and the program is executed to process all products according to the punching layout designated by "G98."

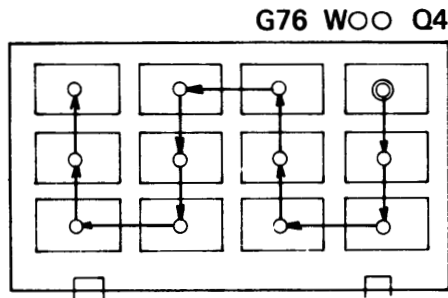
1. G75 . . . Execution of horizontal (X-axis direction) grid

The part program entered between "U00" and "V00" is executed in the order shown in the figure below.



2. G76 . . . Execution of vertical (Y-axis direction) grid

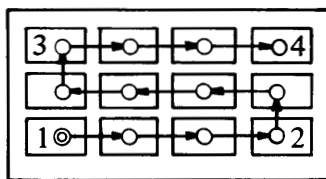
Execution is accomplished as shown in the figure below.



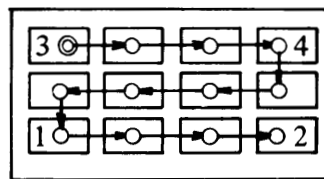
3. Q0 . . . Designation of starting point

This designates the corner of the punching layout from which the punching operation will begin by "G75" or "G76."

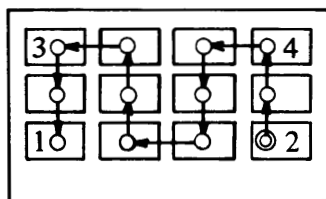
- Q1 . . . Lower left corner Q3 . . . Upper left corner
- Q2 . . . Lower right corner Q4 . . . Upper right corner



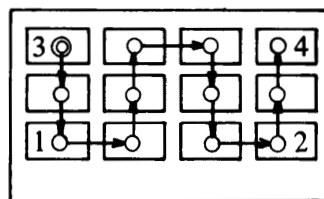
G75 W00 Q1



G75 W00 Q3



G76 W00 Q2

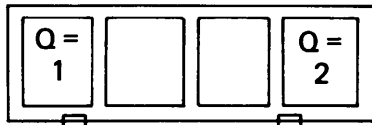


G76 W00 Q3

4. When punching multiple products in a single horizontal row:

G . . . Only "G75" can be used.

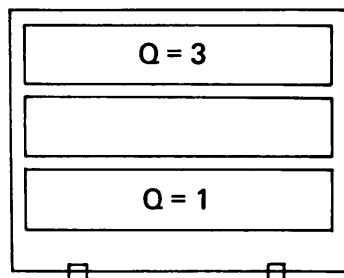
Q . . . Only 1 or 2 can be used.



5. When punching multiple products in a single vertical row:

G . . . Only "G76" can be used.

Q . . . Only 1 or 3 can be used.



6. Combination method of G75 and Q1 to Q4, or G76 and Q1 to Q4

(a) Either "G75" or "G76" must be selected so that the distance of movement can be minimized.

(b) If the processing of a part program starts from the upper right corner (Q4) and ends at the upper left corner (Q3), the processing of the next part program should start at the upper left corner (Q3) in order to guarantee efficient movement.

(c) When cutting the outside shape in the process of punching multiple products, it is desirable to start the punching at the upper portion of the worksheet and move lower in sequence. For such a procedure, enter the command of: G75 W00 Q4 or 3.

7. U90 to V90

If the starting point designated by "Q" is unchanged and either "G75" or "G76" is to be used alone, it is possible to represent multiple sets of "U00 and V00" by a single "U00 and V00." The macro number for this function is 90 to 99.

NOTE: In each of the macro numbers 90 to 99, it is possible to store a maximum of 15 types of part programs.

Application example of macro numbers in the nineties (90 to 99)

G06 A ___ B ___

G92 X1830.00 Y1270.00

G98 X30.00 Y100.00 I400.00 J250.00 P3 K2

U90

U1

X370.00 Y210.00 T304

Y10.00

X10.00

Y210.00

G72 X120.00 Y110.00

A1 G26 I50.00 J45.00 K4 T203

G72 X260.00

B1

V1

U2

X260.00 Y110.00 T219

X120.00

V2

U3

G72 X380.00 Y220.00

G66 I220.00 J-90.00 P85.00 Q5.00 D-0.15 T255

G72 X0 Y0

G66 I220.00 J90.00 P85.00 Q5.00 D-0.15

V3

U4

G72 X0 Y220.00

G66 I380.00 J0 P110.00 Q10.00 D-0.15 T201

G72 X380.00 Y0

G66 I380.00 J180.00 P110.00 Q10.00 D-0.15

V4

V90

G75 W90 Q4

G50

G06 A ___ B ___

G92 X1830.00 Y1270.00

G98 X30.00 Y100.00 I400.00 J250.00 P3 K2

U1

X370.00 Y210.00 T304

Y10.00

X10.00

Y210.00

G72 X120.00 Y110.00

A1 G26 I50.00 J45.00 K4 T203

G72 X260.00

B1

V1

U2

X260.00 Y110.00 T219

X120.00

V2

U3

G72 X380.00 Y220.00

G66 I220.00 J-90.00 P85.00 Q5.00 D-0.15 T255

G72 X0 Y0

G66 I220.00 J90.00 P85.00 Q5.00 D-0.15

V3

U4

G72 X0 Y220.00

G66 I380.00 J0 P110.00 Q10.00 D-0.15 T201

G72 X380.00 Y0

G66 I380.00 J180.00 P110.00 Q10.00 D-0.15

V4

G75 W1 Q4

G75 W2 Q4

G75 W3 Q4

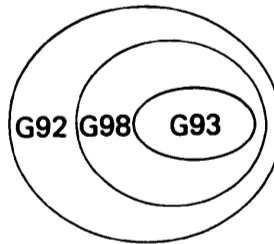
G75 W4 Q4

G50

The left side program is an example of the application of the macro numbers in the nineties. These two programs (left and right sides) are equivalent in movement of the machine.

INCLUSION AND PRIORITY RELATIONS BETWEEN G98 AND G93

1. The X- and Y-coordinates specified by "G98" are determined by the coordinate system which is set by "G92."
2. The coordinate system set by "G98," once specified, cannot be cancelled except by using the subsequent command "G98" or "G50," pressing the RESET key or turning off the power.
3. The X- and Y-coordinates specified by "G93" are determined by the coordinate system which is set by "G98."
4. "G93" which is specified prior to the setting of "G98" will remain effective even after "G98." The values obtained by adding the X and Y values of "G98" and the X and Y values of "G93," respectively, will determine the origin of this program.



FIRST PUNCHING, OTHERS PUNCHING, AND ALL PUNCHING

In the conventional method of multiple part punching, punching must be accomplished over the whole surface of the worksheet, and then dimensional and accuracy checks must be conducted. Should the program contain any error, substantial worksheet and time losses would result. However, in this multiple part punching function, selection between three types of processing is available by key operation on the control panel, i.e. "first punching for one product," "multiple punching for remaining products after first punching" and "all punching."

For details on this operation, refer to "Controls" in the OPERATOR'S MANUAL.

SUBPROGRAMS

When programs contain patterns which repeat frequently, these patterns can be stored in the memory in advance as subprograms to be recalled as required.

Subprogram format

00000 Subprogram number (0 to 7999)

```

)
)
) } Punching program
)
)
)

```

M97 Command for subprogram finish

Enter a subprogram number "00000" to the beginning of the punching program and enter "M97" to the end of the punching program.

Recalling format of subprogram

M96 P__ L__

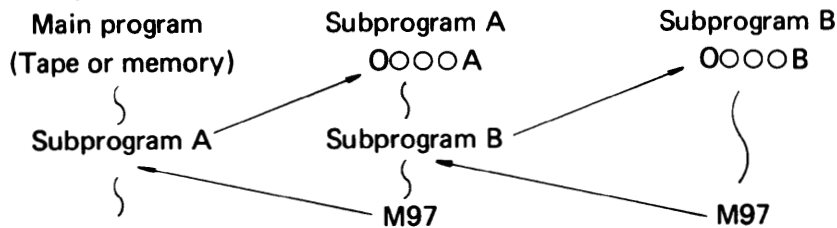
P: Program number to be recalled (0 to 7999)

L: No. of repetition times (up to a maximum of 9999)

The subprogram is recalled by programming "M96" followed by the program number designated by "P" and the number of repetition times designated by "L." When "L" is omitted, there will be only one recalling.

NOTE: "L" cannot be edited from the keyboard of the NC unit.

Multiple recalling of subprogram



A subprogram can recall another subprogram as shown above.

MDI operation

In the MDI operation, the subprogram cannot be recalled by entering "M96P0000." To recall the subprogram from the keyboard of the NC unit, input the following program in the memory by EDIT mode.

```

00000
M96 P0000
G50

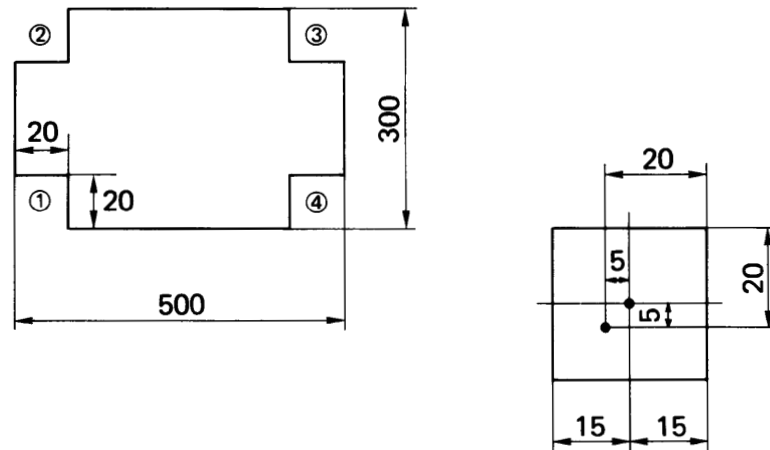
```

REFERENCES

HINTS ON PROGRAMMING BY SHAPE

1. CORNER NOTCHES

Example: When punching 20 mm x 20 mm notches in four corners of a 300 mm x 500 mm worksheet with a 30 mm x 30 mm sq. punch



When punching the corner notch ①, the center position of the punch is instructed in the program as follows:

$$X: 20 - \frac{30}{2} = 5 \text{ mm}$$

$$Y: 20 - \frac{30}{2} = 5 \text{ mm}$$

The center of the punch is thus located by:

G90 X5.00 Y5.00

When punching the corner notch ②, the center position of the punch is calculated as follows:

$$X: 5 \text{ mm as for ①}$$

$$Y: 300 - 20 + \frac{30}{2} = 295 \text{ mm}$$

When punching the corner notch ③, the center position of the punch is calculated as follows:

$$X: 500 - 20 + \frac{30}{2} = 495 \text{ mm}$$

Y: 295 mm as for ②

When punching the corner notch ④, the center position of the punch is calculated as follows:

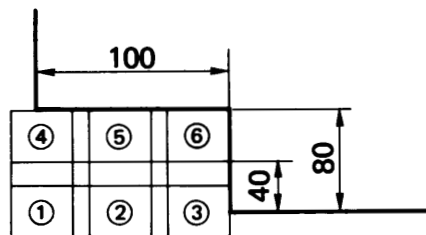
X: 495 mm as for ③

Y: 5 mm as for ①

The program for punching the four corner notches is thus prepared as follows:

- ① G90 X5.00 Y5.00 T___ (30 mm x 30 mm sq. punch)
- ② Y295.00
- ③ X495.00
- ④ Y5.00

Example: When punching a 80 mm x 100 mm notch with a 50 mm x 50 mm sq. punch



Program example

G90 G72 X-2.00 Y40.00

A1 G66 I102.00 J0 P-50.00 T___ (50 mm x 50 mm sq. punch)

G72 X-2.00 Y80.00

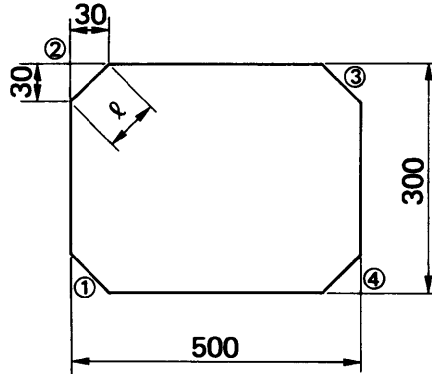
B1

2. 45° CORNER NOTCHES

Example: When a 45° notch can be punched in a single operation

(a) Determine the punch to be used.

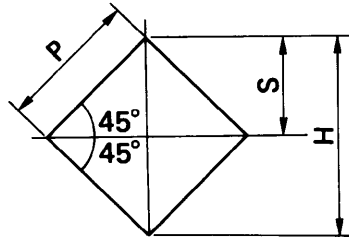
Since the length of the oblique side of the notch is $30 \times \sqrt{2} = 30 \times 1.414 = 42.42$ mm, the notch can be punched in a single operation with a 50 mm x 50 mm sq., 45° punch.



(b) Calculate the center position of the punch.

$$S = P \times \frac{\sqrt{2}}{2} (= P \times \sin 45^\circ)$$

$$H = 2 \times S = P \times \sqrt{2} (= 2 \times P \times \sin 45^\circ)$$



(c) Determine the coordinate values of the punch center.

- For the notch ①, position the center of the punch on the Y axis. The X-coordinate value of the punch center is 0.

- Calculate the length S.

$$S = \text{punch width} \times \frac{\sqrt{2}}{2}$$

Thus,

$$S = 50 \times \frac{\sqrt{2}}{2} = 35.35 \text{ mm}$$

- The Y-coordinate value of the punch center is

$$Y = 30 - S = 30 - 35.35 = -5.35$$

and the provisional punch center is

$$X0 \ Y-5.35$$

- Since a needlelike projection may occur on the edge of the worksheet in this condition, shift the punch by 1 mm each in the X-axis and Y-axis directions so that the edge of the punch does not coincide with the edge of the worksheet.

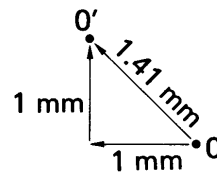
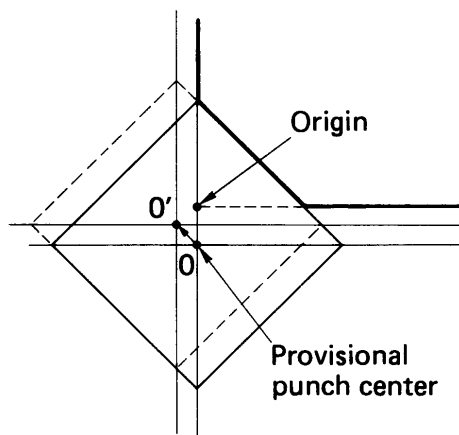
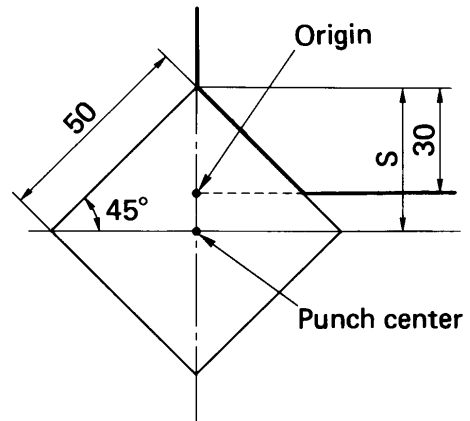
- Since the X-coordinate value is shifted by 1 mm in the negative direction and the Y-coordinate value is shifted by 1 mm in the positive direction, the center of the punch is

$$X: 0 - 1.00 = -1.00$$

$$Y: -5.35 + 1.00 = -4.35$$

and the program is

$$G90 \ X-1.00 \ Y-4.35 \ T___ (50 \text{ mm} \times 50 \text{ mm sq. punch})$$

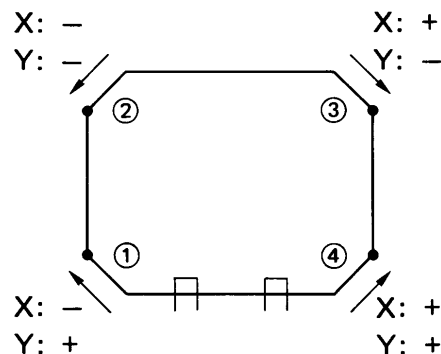


The notches ② to ④ are similarly programmed.

- ② X: $0 - 1.00 = -1.00$
Y: $300 - 30 + 35.35 - 1.00 = 304.35$
- ③ X: $500 - 30 + 35.35 + 1.00 = 505.35$
Y: $300 - 30 + 35.35 - 1.00 = 304.35$
- ④ X: $500 - 30 + 35.35 + 1.00 = 505.35$
Y: $30 - 35.35 + 1 = -4.35$

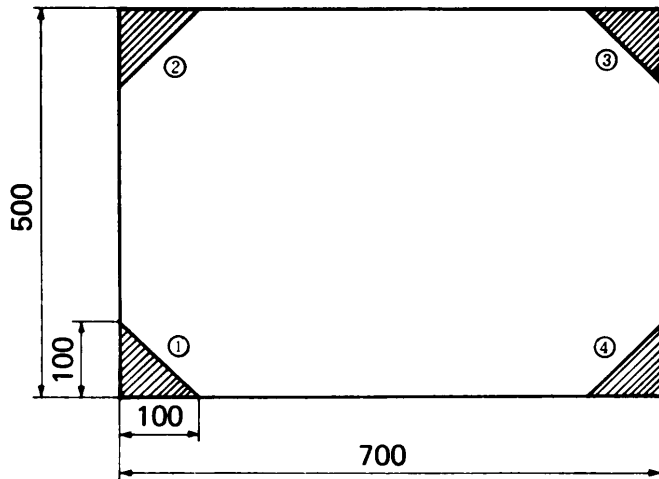
The program thus becomes as follows:

- ① G90 X-1.00 Y-4.35 T____ (50 mm x 50 mm sq.)
- ② Y304.35
- ③ X505.35
- ④ Y-4.35

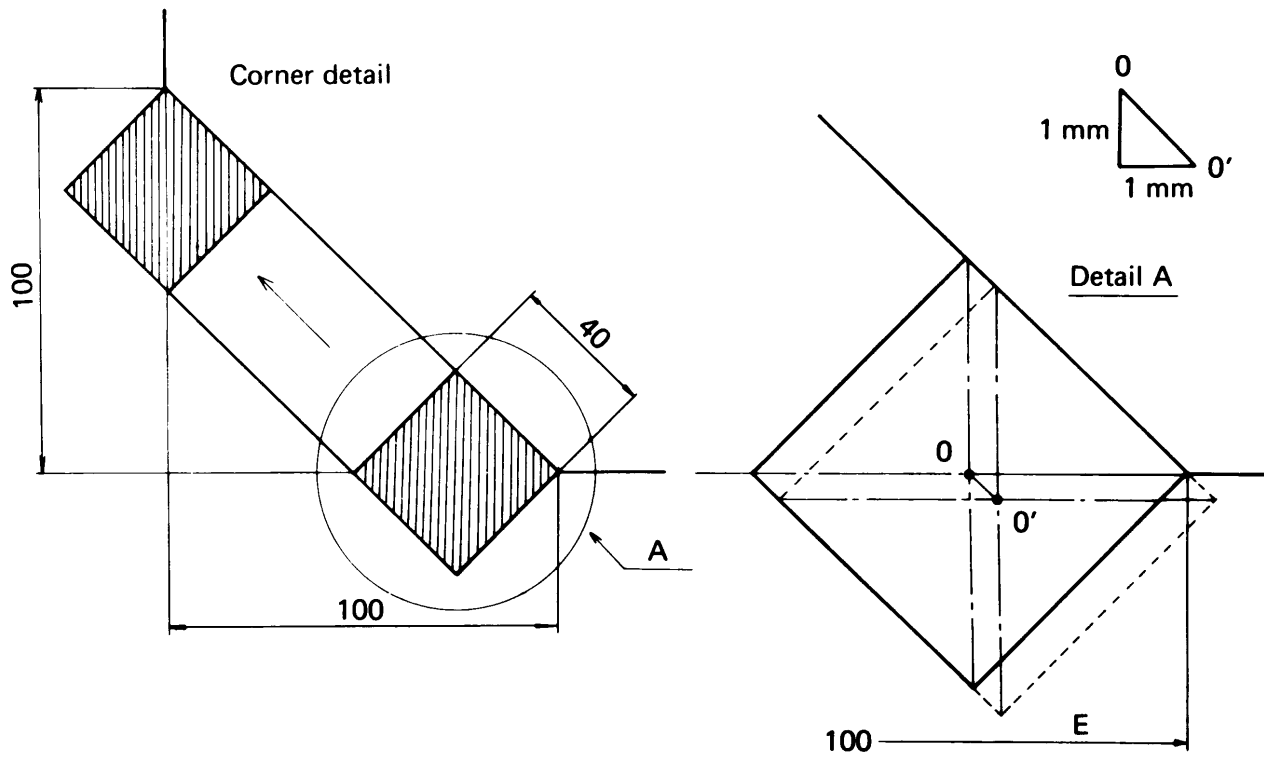


- Provisional coincidence point
- ← Shift direction

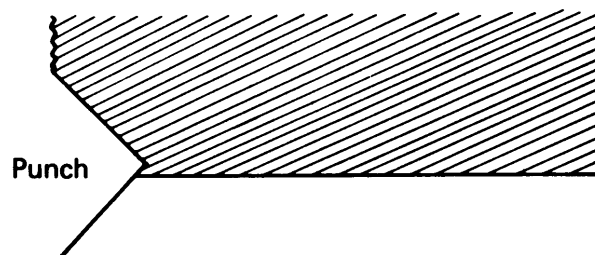
Example: When a 45° notch cannot be punched in a single operation



40 mm x 40 mm sq. (45°): T219



The starting and finishing points of notching should be shifted about 1 mm in order to ensure accurate notching.

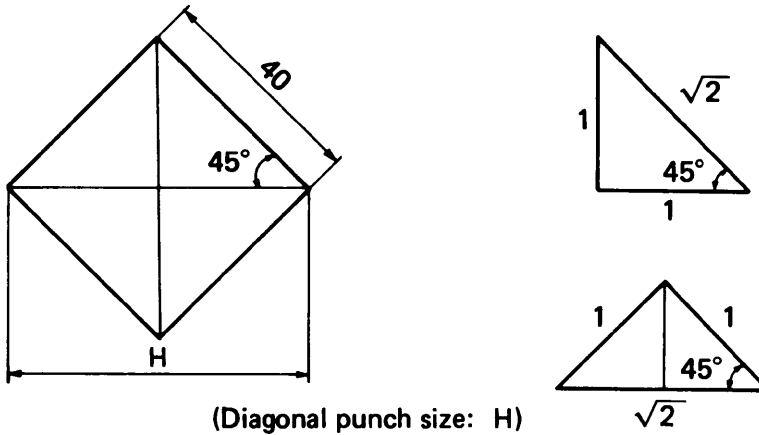


Notching the lower left corner

(a) Provisional starting point (0) "X₁, Y₁" (Absolute value)

$$X_1 = [\text{Notch size "E"}] - 1/2 [\text{Diagonal punch size "H"}]$$

$$Y_1 = 0$$



$$H = \sqrt{2} \times 40$$

$$= 1.414 \times 40 = 56.56 \text{ mm}$$

(b) Starting point (0') "X₀, Y₀" (Absolute value)

Shift both X and Y axes about 1 mm from (0).

$$X_0 = X_1 + 1 \text{ mm}$$

$$Y_0 = Y_1 - 1 \text{ mm}$$

(In case of the lower left corner ①)

(c) Punching frequency and feed pitch

$$\text{Travel distance } L = [\text{Notch size "E"}] - \frac{H}{2} + 2 \times 1 \text{ mm}$$

$$\text{Punching frequency } N = \frac{L}{H/2}$$

When decimal numbers are obtained

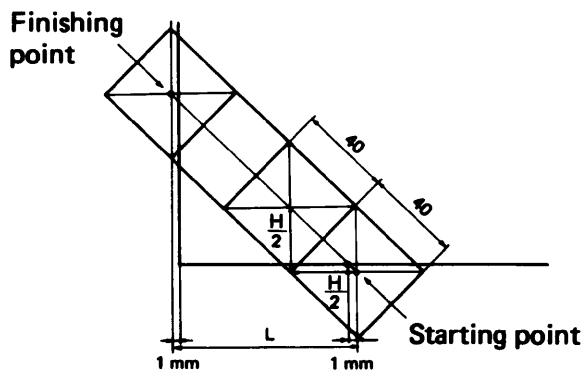
Ex.: 2.3 → 3

When integral numbers are obtained

Ex.: 3 → 4

$$\text{Feed pitch } P = \frac{L}{N}$$

NOTE: The feed pitches of the X- and Y-axes should be equal and should be larger than H/4, but smaller than H/2 minus 0.5 mm.



(a) $X_1 = 100 - 1/2 \times 56.56 = 71.72 \text{ mm}$
 $Y_1 = 0 \text{ mm}$

(b) $X_0 = 71.72 + 1 = 72.72 \text{ mm}$
 $Y_0 = 0 - 1 = -1.00 \text{ mm}$

(c) $L = 100 - 28.28 + 2 = 73.72$

$$N = \frac{74}{28.28} = 2.62 \rightarrow 3 \text{ times}$$

$$P = \frac{74}{3} = 24.67 \text{ mm}$$

Therefore the program is:

G90 X72.72 Y-1.00 T219 (40 mm x 40 mm sq. 45°)

G91 X-24.67 Y24.67 (3 times)

3. SMALL RECTANGULAR OPENING

"G36" or "G37" is used in place of "G67" for punching a small rectangular opening without any scrap.

Example: When punching a 300 mm x 100 mm rectangular opening with a 50 mm x 50 mm sq. punch

- (a) Determine the coordinate values of the initial punch center.

$$X: 200 + 25 = 225 \text{ (mm)}$$

$$Y: 300 + 25 = 325 \text{ (mm)}$$

- (b) Calculate the punching frequency "P" and feed pitch "I" in the X-axis direction.

$$P = \frac{\text{Travel distance} - \text{Punch width}}{\text{Punch width}}$$

$$= \frac{100 - 50}{50}$$

$$= 1.0 \rightarrow 2$$

$$I = \frac{\text{Travel distance} - \text{Punch width}}{\text{Punch frequency}}$$

$$= \frac{100 - 50}{2}$$

$$= 25 \text{ (mm)}$$

- (c) Calculate the punching frequency "K" and feed pitch "J" in the Y-axis direction.

$$K = \frac{300 - 50}{50}$$

$$= 5.0 \rightarrow 6$$

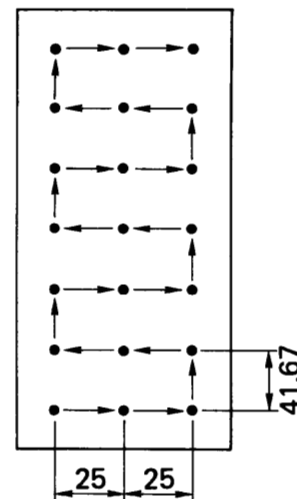
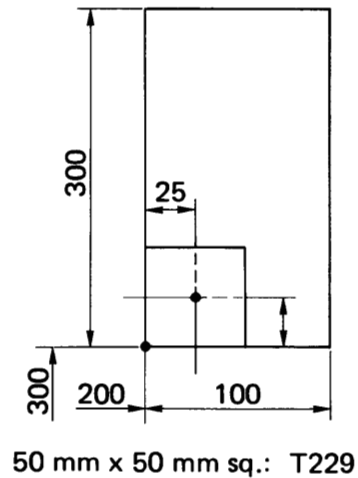
$$J = \frac{300 - 50}{6}$$

$$= 41.666 \rightarrow 41.67 \text{ mm}$$

- (d) The 100 x 300 mm rectangular opening can be punched on the grid shown at right and the program becomes as follows:

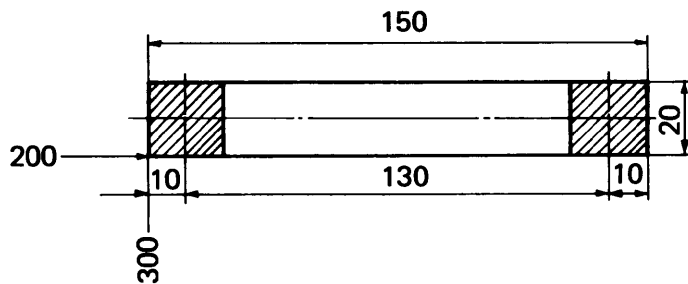
G90 X825.00 Y325.00 T219

G36 I25.00 P2 J41.67 K6



4. LONG RECTANGULAR HOLE

Example: When punching a 20 mm x 150 mm rectangular hole with a 20 mm x 20 mm sq. punch (Punching begins with the left side of the hole)



20 mm x 20 mm sq.: T306

(a) First punch position " X_0, Y_0 " (Absolute value)

$$X_0 = [\text{X value at left end}] + 1/2 [\text{Punch length along X-axis}]$$

$$Y_0 = [\text{Y value at lower end}] + 1/2 [\text{Punch length along Y-axis}]$$

(b) Travel distance " L "

$$L = [\text{Total length}] - [\text{Punch width}]$$

(c) Punching frequency " N "

$$N = \frac{[\text{Travel distance}]}{[\text{Punch width}]}$$

When decimal numbers are obtained

Ex.: 6.2 \rightarrow 7

When integral numbers are obtained

Ex.: 9 \rightarrow 10

(d) Feed pitch " P "

$$P = \frac{[\text{Travel distance}]}{[\text{Punching frequency}]}$$

NOTE: The value of " P " should be larger than 1/2 the punch width, but smaller than the entire punch width minus 0.5 mm.

(d') Feed pitch " P' "

$$P' = \frac{[\text{Travel distance}]}{[\text{Punching frequency}]}$$

Round decimal fractions of 0.005 thru 0.009 to 0.01.

(a) $X_0 = 200 + 1/2 \times 20 = 210$ mm

$Y_0 = 300 + 1/2 \times 20 = 310$ mm

(b) $L = 150 - 20 = 130$ mm

(c) $N = \frac{130}{20} = 6.5 \rightarrow 7$ times

(d) $P = \frac{130}{7} = 18.57$ mm

Therefore the program is:

```
G90 X210.00 Y310.00 T306 (20 mm x 20 mm sq.)
```

```
G91 X 18.57
```

```
X 18.57
```

```
X 18.57
```

```
X 18.57
```

```
X 18.57
```

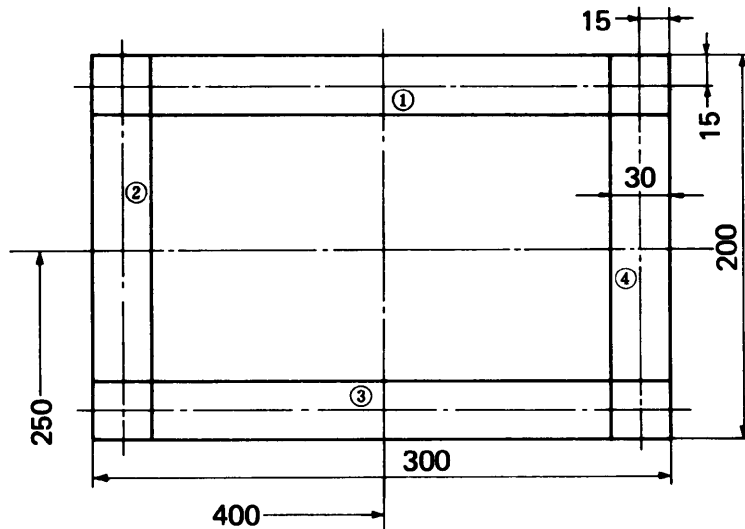
```
X 18.57
```

```
X 18.57
```

The G66 command can be used for this long rectangular hole punching (see page 24).

5. LARGE RECTANGULAR OPENING

Example: When punching a 200 mm x 300 mm rectangular opening with a 30 mm x 30 mm sq. punch



30 mm x 30 mm sq.: T210

(a) Punching procedure

Finish punching at the upper right corner in order to remove the scrap easily.

(b) First punch position "X₀, Y₀" (Absolute value)

$$X_0 = [X \text{ value at right end}] - 1/2 [\text{Punch length along X-axis}]$$

$$Y_0 = [Y \text{ value at upper end}] - 1/2 [\text{Punch length along Y-axis}]$$

(c) Punching frequency and feed pitch of ①

(d) Punching frequency and feed pitch of ②

(e) Prepare the program in accordance with the punching sequence.

NOTE: Do not punch the final punch position because the last punch falls on the first punch position.

(f) Enter "M00" or "M01" in order to remove the scrap.

(a) ① → ② → ③ → ④

(b) $X_0 = [400 + 1/2 \times 300] - [1/2 \times 30] = 535 \text{ mm}$

$Y_0 = [250 + 1/2 \times 200] - [1/2 \times 30] = 335 \text{ mm}$

(c) $L = 300 - 30 = 270 \text{ mm}$

$N = \frac{270}{30} = 9.0 \rightarrow 10 \text{ times}$

$P = \frac{270}{10} = 27 \text{ mm}$

(d) $L = 200 - 30 = 170 \text{ mm}$

$$N = \frac{170}{30} = 5.6 \rightarrow 6 \text{ times}$$

$$P = \frac{170}{6} = 28.33 \text{ mm}$$

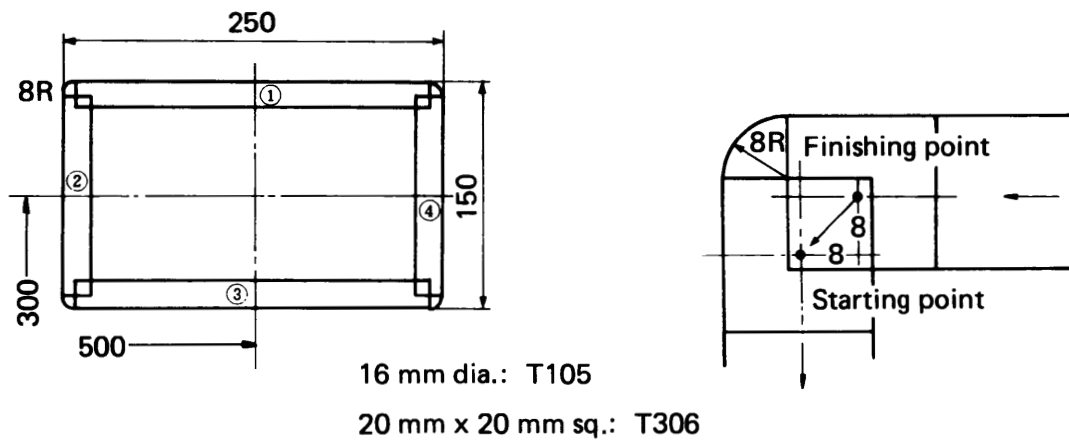
Therefore the program is:

```
G90 X535.00 Y335.00 T210 (30 mm x 30 mm sq.)
G91 X-27.00 (10 times)
      Y-28.33 (6 times)
      X27.00 (10 times)
      Y28.33 (5 times)
M00
```

The G67 command can be used for this large rectangular opening (see page 26).

6. RECTANGULAR OPENING WITH ROUNDED CORNERS

Example: When punching a 150 mm x 250 mm opening with rounded corners of 8R, using a 16 mm dia. round punch and a 20 mm x 20 mm square punch



- (a) Punching procedure
First, punch 4 corners of 8R.
Finish punching at the upper right corner.
- (b) Punching positions for 4 corners.
Punching position for one corner → Absolute value
Punching positions for other corners → Incremental value (Hole length - 2xR)
- (c) First punch position with a square punch (X_0, Y_0) → Absolute value
- (d) Punching frequency and feed pitch of ①
- (e) Punching frequency and feed pitch of ②
- (f) Travel distance from the finishing point on one side to the starting point on another side
→ Incremental value
X value: Radius
Y value: Radius
- (g) Prepare the program in accordance with punching procedures.
- (h) Enter "M00" or "M01" in order to remove the scrap.

(a) 4 corners and then ① → ② → ③ → ④

(b) Absolute value (upper right corner)

$$X = [500 + 1/2 \times 250] - 8 = 617 \text{ mm}$$

$$Y = [300 + 1/2 \times 150] - 8 = 367 \text{ mm}$$

Incremental value

$$X = 250 - [2 \times 8] = 234 \text{ mm}$$

$$Y = 150 - [2 \times 8] = 134 \text{ mm}$$

(c) Position of the first square punching

$$X_0 = [500 + 1/2 \times 250 - 8] - [1/2 \times 20] = 607 \text{ mm}$$

$$Y_0 = [300 + 1/2 \times 150] - [1/2 \times 20] = 365 \text{ mm}$$

(d) $L = [250 - 2 \times 8] - 20 = 214 \text{ mm}$

$$N = \frac{214}{20} = 10.7 \rightarrow 11 \text{ times}$$

$$P = \frac{214}{11} = 19.45 \text{ mm}$$

(e) $L = [150 - 2 \times 8] - 20 = 114 \text{ mm}$

$$N = \frac{114}{20} = 5.7 \rightarrow 6 \text{ times}$$

$$P = \frac{114}{6} = 19 \text{ mm}$$

(f) $X = 8 \text{ mm}$

$Y = 8 \text{ mm}$

Therefore the program is:

```
G90 X617.00 Y367.00 T105 (16 mm dia.)
G91 X-234.00
      Y-134.00
      X234.00
G90 X607.00 Y365.00 T306 (20 mm x 20 mm sq.)
G91 X-19.45
      X-8.00 Y-8.00
      Y-19.00 (6 times)
      X8.00 Y-8.00
      X19.45 (11 times)
      X8.00 Y8.00
      Y19.00 (6 times)
M00
```

REFERENCE DATA

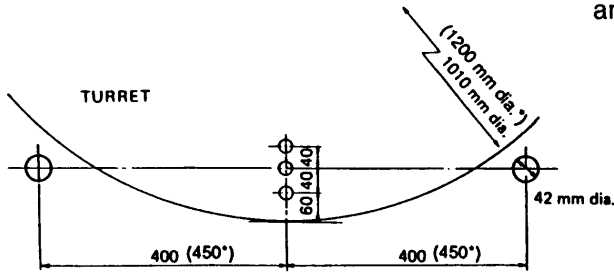
1. Punching range

VIPROS 308080	X	-10 mm to 2010 mm
	Y	-50 mm to 2010 mm (outer track) -10 mm to 2050 mm (center track) +30 mm to 2090 mm (inner track)
VIPROS 367Q	X	-10 mm to 1840 mm
	Y	-50 mm to 1535 mm (outer track) -10 mm to 1575 mm (center track) +30 mm to 1615 mm (inner track)
VIPROS 357Q	X	-10 mm to 1840 mm
	Y	-50 mm to 1230 mm (outer track) -10 mm to 1270 mm (center track) +30 mm to 1310 mm (inner track)
VIPROS 345Q	X	-10 mm to 1280 mm
	Y	-50 mm to 970 mm (outer track) -10 mm to 1010 mm (center track) +30 mm to 1050 mm (inner track)
VIPROS 368K(FS18PC)/506080		
	X	-10 mm to 2010 mm
	Y	-50 mm to 1535 mm (outer track) -10 mm to 1575 mm (center track) +30 mm to 1615 mm (inner track)
VIPROS 358K(FS18PC)/505080		
	X	-10 mm to 2010 mm
	Y	-50 mm to 1230 mm (outer track) -10 mm to 1270 mm (center track) +30 mm to 1310 mm (inner track)
VIPROS 255	X	-10 mm to 1280 mm
	Y	-10 mm to 1300 mm (inner track) -50 mm to 1260 mm (outer track)
VIPROS 258	X	-10 mm to 2010 mm
	Y	-10 mm to 1300 mm (inner track) -50 mm to 1260 mm (outer track)
VIPROS 2510K/ 2510C		
	X	-10 mm to 2510 mm
	Y	-10 mm to 1300 mm (inner track) -50 mm to 1260 mm (outer track)

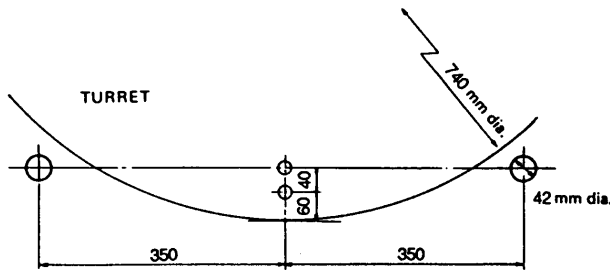
2. Position of workholder

Except VIPROS 255/258/2510K/2510C

*: 358K(FS18PC), 368K(FS18PC)
and 50 series



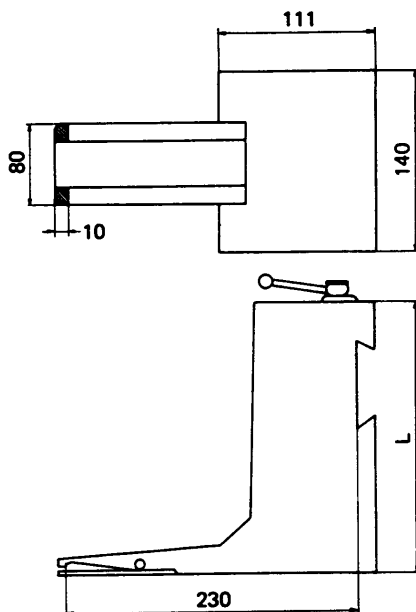
VIPROS 255/258/2510K/2510C



3. Outer diameter of die

- ½" (1.6 to 12.7 mm dia.) 25.40 mm dia.
- ¾" (12.8 to 31.7 mm dia.) 47.62 mm dia.
- 2" (31.8 to 50.8 mm dia.) 88.89 mm dia.
- 3½" (50.9 to 88.9 mm dia.) 125.43 mm dia.
- 4½" (89.0 to 114.3 mm dia.) 158.74 mm dia.

4. Workclamp dimensions



L: 165 mm (Pneumatic Clamp)
163 mm (Hydraulic Clamp)

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