

***NC TURRET PUNCH PRESS***

***ARIES 222, 224***

***PROGRAMMING MANUAL***

*PRO-01198908*

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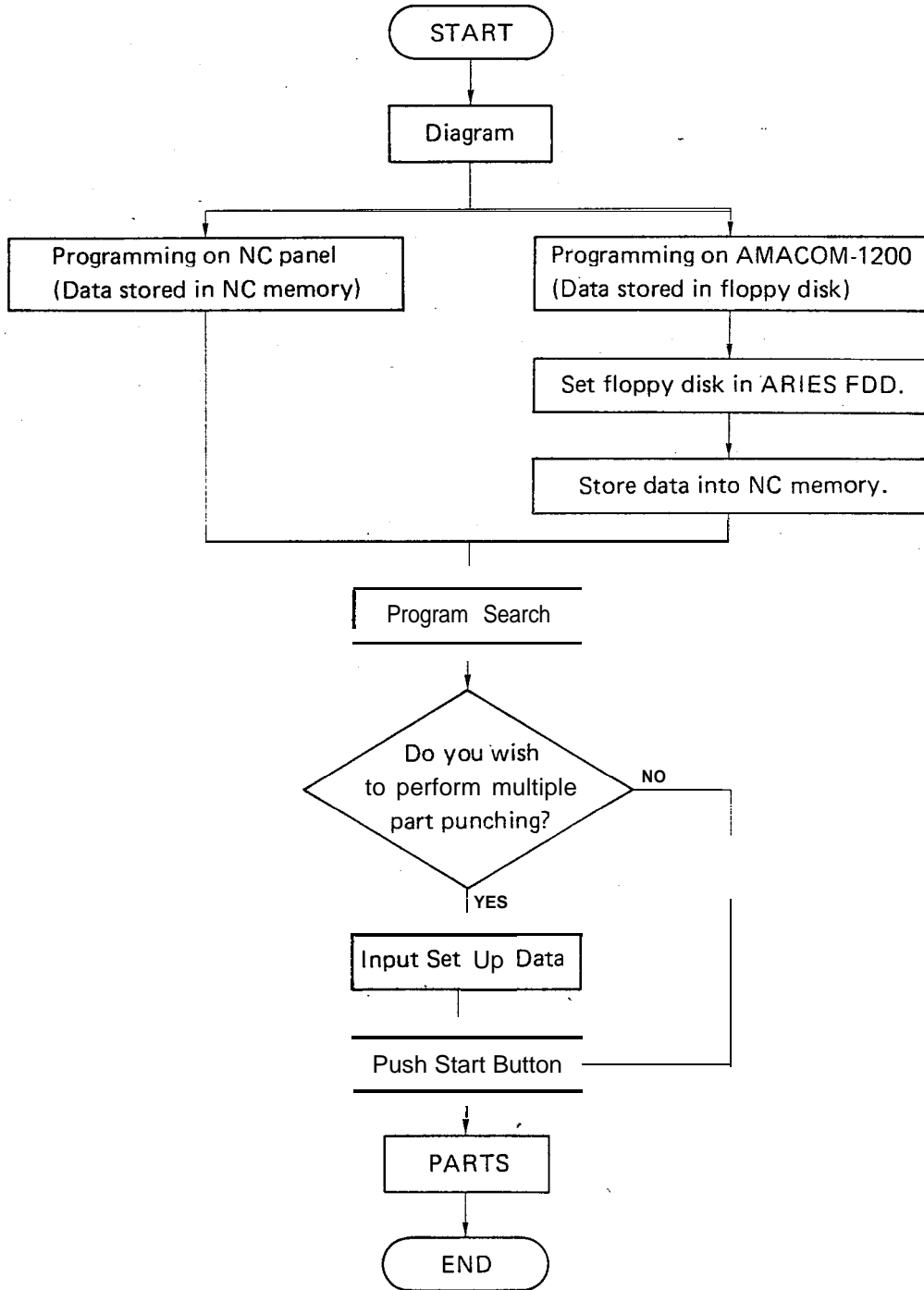
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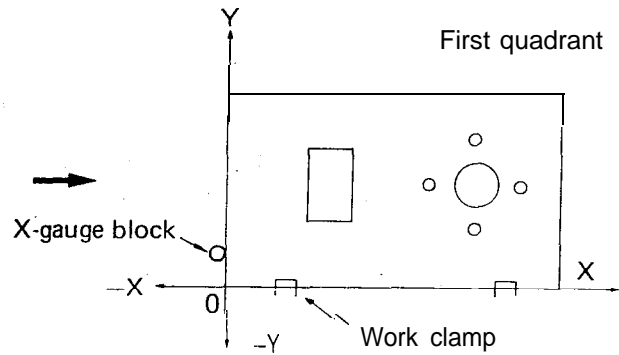
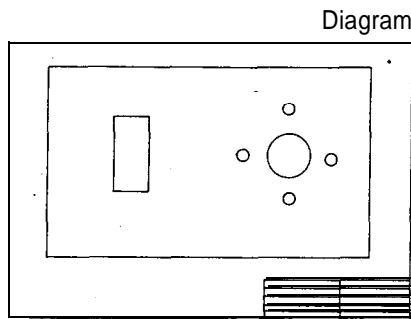
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# PROGRAMMING BASICS

## PROCESS FROM DIAGRAM TO PARTS



# PROGRAMMING



1. Diagram → First quadrant of X and Y coordinate system
2. Calculation of coordinates
3. X \_\_\_\_\_ Y \_\_\_\_\_ T \_\_\_\_\_

## UNIT OF MEASUREMENT FOR PROGRAMS

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

[millimeters]

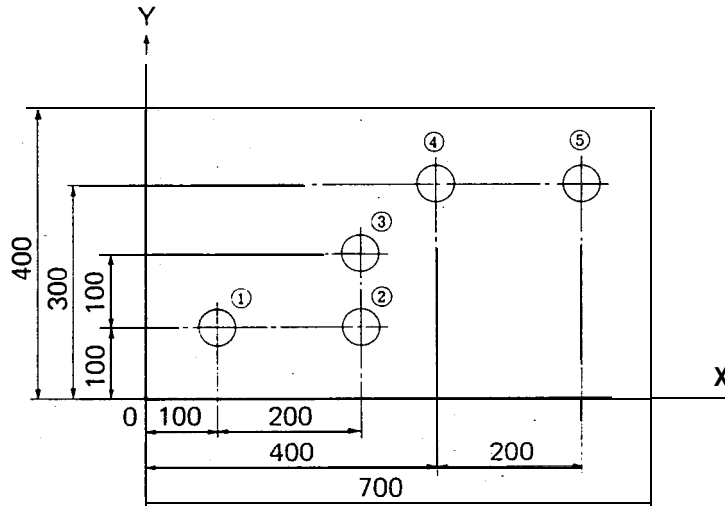
1 0 0	← 100 mm	→	100.00	→	100.	10000
35.5	← 35.5 mm	→	35.50	→	35.5	3550
0	← 0mm	→	0	→	0	0
↑				↑		↑
	NC SETUP DATA 8			NC SETUP DATA 8		
	DECIMAL POINT (INPUT): 0			DECIMAL POINT (INPUT): 0 or 1		: 1

[inches]

2 0	← 20"	→	2 0 . 0 0 0	→	.20.	20000
2.7	← 2.7"	→	2 . 7 0 0	→	2.7	2700
0	← 0	→	0	→	0	0
↑				↑		↑
	NC SETUP DATA 8			NC SETUP DATA 8		
	DECIMAL POINT (INPUT): 0			DECIMAL POINT (INPUT): 0 or 1		: 1

NOTE: Refer to the "NC setup" in the OPERATOR'S MANUAL.

## CALCULATION OF COORDINATES



**Absolute value** – Distance from origin

	<u>X coordinate value</u>	<u>Y coordinate value</u>
①	100.	100.
②	300.	100.
③	300.	200.
④	400.	300.
⑤	600.	300.

**Incremental value** – Distance from previous position

	<u>X coordinate value</u>	<u>Y coordinate value</u>	
①	100.	100.	(Absolute value)
②	200.	0	(Incremental value)
③	0	100.	(Incremental value)
④	100.	100.	(Incremental value)
⑤	200.	0	(Incremental value)

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

Problem: Calculate the absolute value of ⑤ and the incremental value of ④ thru ①.

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

**BASIC FUNCTION CODES**

- G00 "G" function (Preparatory function)
- M00 "M" function (Miscellaneous function)
- T00 "T" function (Tool function)
- N0000 Sequence number

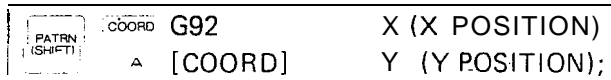
**FORMAT**

Arrange the function codes as follows:

N 0 0 0 0 G00 G00 X±000000 Y±000000 T 0 0 M 0 0

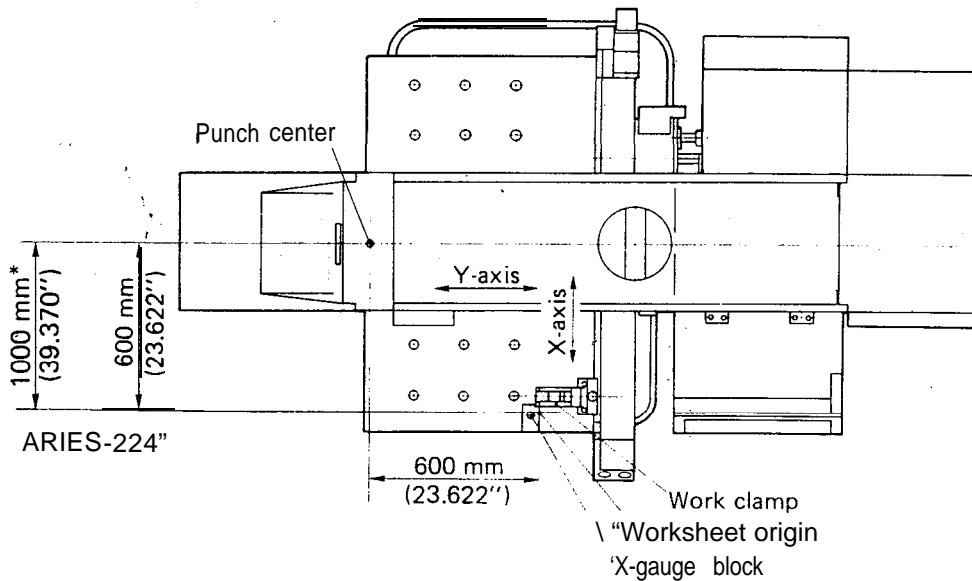
- NOTE: a) Unnecessary codes need not be entered.  
 b) Enter only necessary digits of X, Y and N.  
 c) The plus sign (+) of X and Y can be omitted.

**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.

	Metric-specification machine	Inch-specification machine
ARIES-222	G92 X600. Y600.	G92 X23.622 Y23.622
ARIES-224	G92 X1000. Y600.	G92 X39.370 Y23.622



## G90 – ABSOLUTE PROGRAMMING




		G90	X (X POSITION)
		[ABS]	Y (Y POSITION) T (TOOL NO.);

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. Y100. T2 (Absolute value)  
(2) x300. Y 100. (Absolute value)  
(3) x300. Y200. (Absolute value)  
(4) x400. Y300. (Absolute value)

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

## G91 – INCREMENTAL PROGRAMMING




		G91	X (X POSITION)
		[INC]	Y (Y POSITION) T (TOOL NO.);

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. Y100. T2 (Absolute value)  
(2) G91 X200. Y 0 (Incremental value)  
(3) x 0 Y100. (Incremental value)  
(4) x100. Y100. (Incremental value)

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

## G70 – PUNCH OFF

		G70	X (X POSITION)
		[PUNCH OFF]	Y (Y POSITION) T (TOOL NO.);

This code is used to move the worksheet without punching. Enter "G70" prior to entering 'X - Y - . . .'

- Ex.: G90 X100. Y100. T 2  
G70 X300. (The axes move at a position of "X300. Y 100." without punching.)

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

- Ex.: G90 X100. Y100. T2 (Punching)  
G91 G70 X200. (No punching)  
G90 Y300. (Punching)



## G27 – AUTO REPOSITIONING



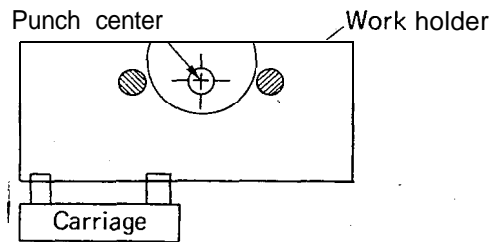
This code is used to extend the punching range in the X-axis direction. Enter "G27" and the X-axis value.

Ex.: G27 X500.

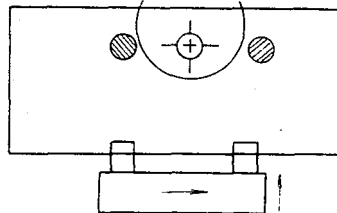
The X-axis value must be designated by an incremental value.

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

- (1) Work hold: The work holders hold the worksheet.
- (2) Unclamp: The clamps open.
- (3) G91 Y2.4: The table moves 2.4 mm in the positive direction from the current position.



- (4) X-500.: The carriage moves 500 mm in the negative direction from the current position,
- (5) Y-2.4: The table moves 2.4 mm in the negative direction.



- (6) Clamp: The clamps close.
- (7) Work release: The work holders release the worksheet,

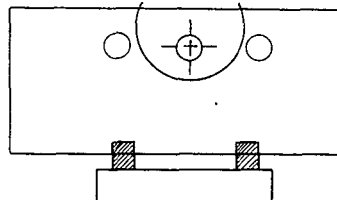
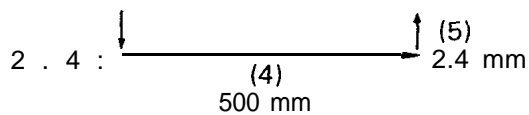


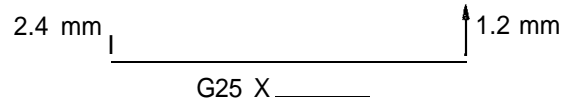
Table and Carriage movement



## G25 – AUTO REPOSITIONING



When the worksheet edge which is clamped has a bend, curves or 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 read, the same movement will be-obtained as in the following:

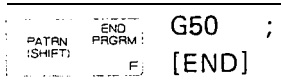


First the table moves 2.4 mm in the positive direction from the current position. Then the carriage moves X\_\_\_\_\_ from the current position and the table moves 1.2 mm in the negative direction. Next, the X and Y coordinate system is offset by Y1.2 to compensate for the difference between the table positions before and after the automatic repositioning.

After "G25" is read, the punching range along the Y-axis is moved 1.2 mm in the negative direction from the standard punching range.

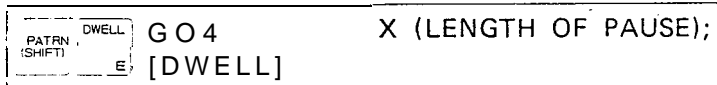
-11.4 to 609.0 mm (-0.448" to 23.976")

## G50 – HOME RETRACT



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

## G04 – DWELL



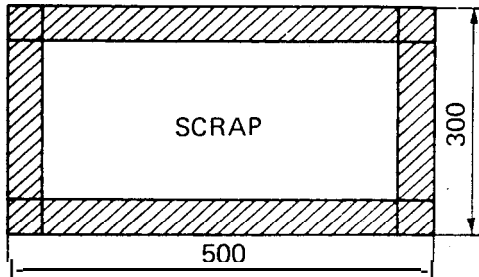
When "G04" is entered with "X" value, the punching operation stops during the time indicated by the value of "X." The minimum programmable increment of the value following "X" is 0.01 sec. The maximum value is 63.5 sec.

G04 X10. . . . . Operation stops during 10 sec. ✓

**MOO – PROGRAM STOP**

Enter "MOO" 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.



```
(ARIES-222)      [(ARIES-224) ]
G92 X600. Y600. [G92 X1000. Y600.]
.....
.....
.....
Y42.
Y42.
Y42.
MOO (Machine stops here)
.....
.....
```

When "MOO" is read, the machine stops. When the START button is pressed after the scrap has been removed, the machine will continue the punching operation. "MOO" 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 "MOO"; however, the machine will stop only when the OPTNAL STOP button is lighted. (Refer to the "NC CONTROL PANEL" in the OPERATOR'S MANUAL.) .

**M08 – PUNCH DELAY START**

**M09 – PUNCH DELAY CANCEL**

When "M08" is read, the hit rate is changed from standard to low until "M09" or "G50" is read. Use "M08" when the sum of worksheet thickness and the formed height is more than 3.2 mm (0.125"). "M08" and "M09" must be entered as a single block, respectively.

```
G92 X600. Y600. (ARIES-222) [G92 X1000. Y600.(ARIES-224)]
```

```
..... } Standard hit rate
..... }
```

```
M08
G90 X Y Z } Low hit rate
..... }
..... }
```

```
M09
..... } Standard hit rate
..... }
G50
```

## M12 – NIBBLING START

## M13 – NIBBLING CANCEL

When “M1 2” is read, nibbling is performed until “M1 3” is read. In nibbling, the press clutch is always engaged with the brake released. “M12” and “M13” must be entered as a single block, respectively. Pattern punching cannot be commanded between M12 and M13.

.....

M12

G90 X\_\_\_\_ Y\_\_\_\_

G91 X\_\_\_\_

G91 X\_\_\_\_

G91 X\_\_\_\_ .

} Nibbling [Hole intervals should be 6 mm (0.236”) or less.]

M13

.....

.....

## TOO – DESIGNATION OF TOOL NUMBER

This code is used. to designate the tool 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 X600. Y600. (ARIES-222) [G92 X1000. Y600.(ARIES-224)]

G90 X450. Y300. T2

G91 X50.00 (T2 not required)

x50.00 .(T2 not required)

G90 X500. Y450. T3

## 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.: G92 X600. Y600. (ARIES-222) [G92 X1000. Y600.(ARIES-224)]

N0001G90 X450. Y300. T2

N0002 G91 X50.

N0003 x50.

N0004 G90 X500. Y450. T3

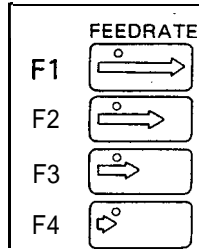
N9999 G50

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.

## FO – DESIGNATION OF AXIS FEED SPEED

The axis feed speed can be changed by this code. 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 buttons located on the NC control panel. When there is the difference between instructions by this code and the FEEDRATE buttons, the priority will be given to the slower axis feed speed. The instruction of the "F" code is held until a new "F" code is read or the RESET key is pressed.



## PROGRAM NAME

Enter the program name at the top of the program for the identification of individual ones. The name must be within 8 alphabets or numeral characters and only the alphabet letter can be used for the first character of the name.

Ex.: ARIES 1

G92 X600. Y600. (ARIES-2221 [G92 X1000. Y600.(ARIES-224)])

G50

This program name can also be input and changed from the NC control panel.

## **PROGRAMMING PROCEDURE**

### **1. Determining the processing method**

### **2. Determining the clamp position**

Position the clamps as far apart as possible and check the "dead zone" (see the DEAD ZONE DIAGRAMS).

### **3. Checking the tool and station number**

Ex.: (a) Check to ensure the proper tool is used for the cut-out required.

150 mm dia. round hole -nibbling with a 20 mm dia. punch

300 mm x 400 mm square opening → shear-proof punching with a 50 mm x

50 mm square punch

(b) Check to ensure desired tools can be loaded into the turret.

Problem: Is the combined use of the following tools for one program possible?

50 mm dia., 35 mm dia., 80 mm dia., 20 mm x 20 mm sq., and 30 mm dia.

(2" dia., 1.4" dia., 3" dia., 0.8" x 0.8" sq., and 1.25" dia.)

### **4. Determining the punching sequence**

This must be determined by taking into consideration both the 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 openings, and notching.

(c) The tools should not be selected more than twice.

(d) In multiple part punching, shearing of the worksheet should be done last.

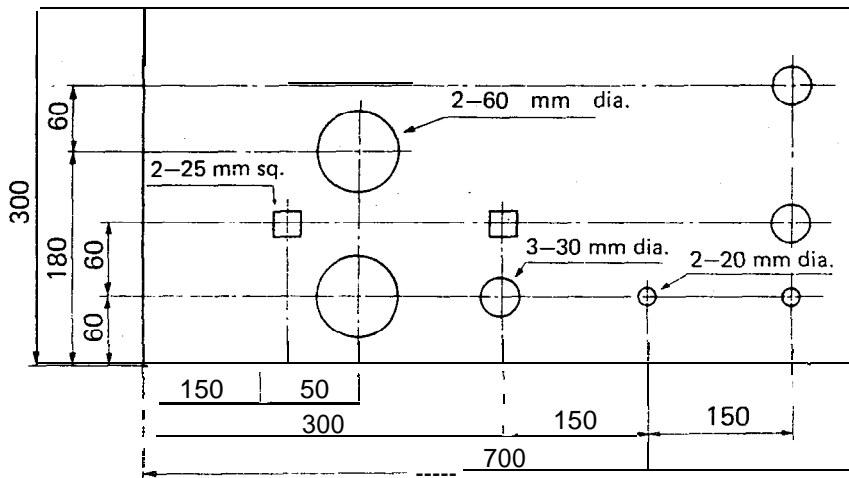
### **5. Calculating the coordinates**

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

### **6. Checking**

Check the clamp positions, punching sequence-and coordinate values.

Problem: Program the following diagram. (Enter the sequence No.)



60 mm dia. — T1

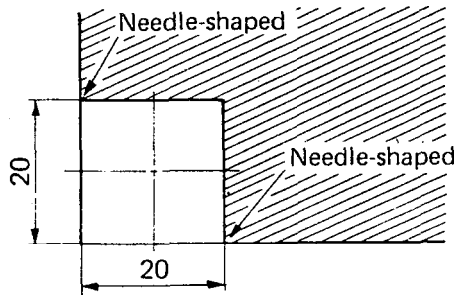
25 mm x 25 mm sq. — T6

30 mm dia. — T2

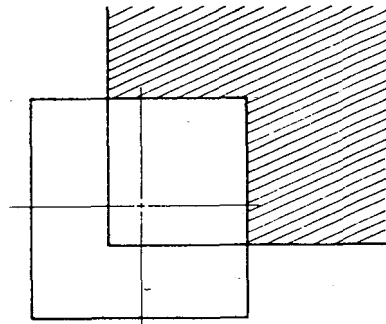
20 mm dia. — T4

## HINTS ON PROCESSING

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



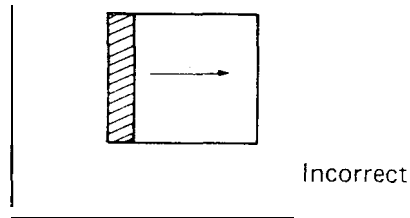
Incorrect  
(20 mm x 20 mm square punch is used.)



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

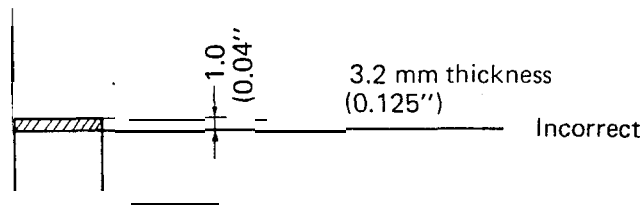
Problem: Prepare a program to punch out a 20 mm x 20 mm sq. notch with a 15 mm x 15 mm sq. punch.

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



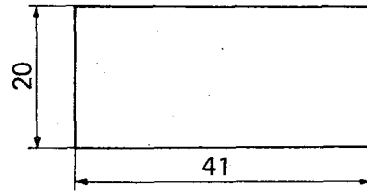
3. When shear-proof punching is performed, the feed pitch should be larger than 1/2 the punch width, but smaller than the entire punch width minus 0.5 mm (0.02").

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



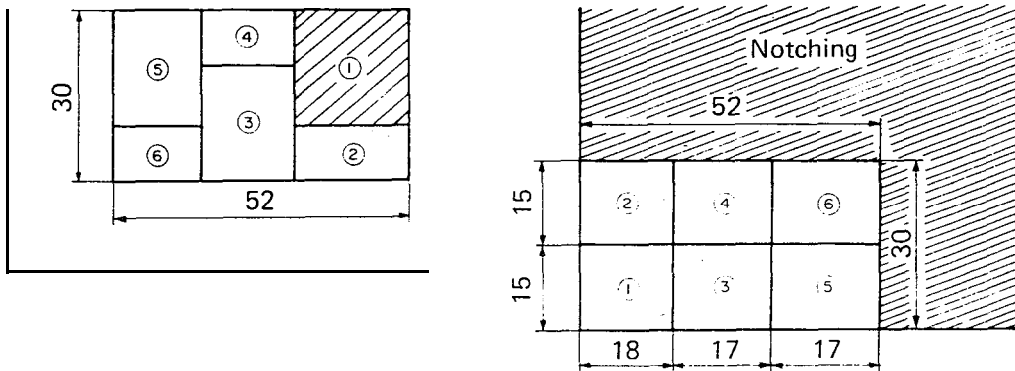


Problem: Determine the method for punching a 20 mm x 41 mm rectangular hole with a 20 mm x 20 mm sq. punch.



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

Ex.: Method for punching a 30 mm x 52 mm rect. hole with a 20 mm x 20 mm sq. punch.



6. The force required to punch the worksheet must not exceed the machine capacity. The required punching force is obtained by the following formula:

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

where, P: Force required

A: Length of cut edge

t: Thickness of worksheet

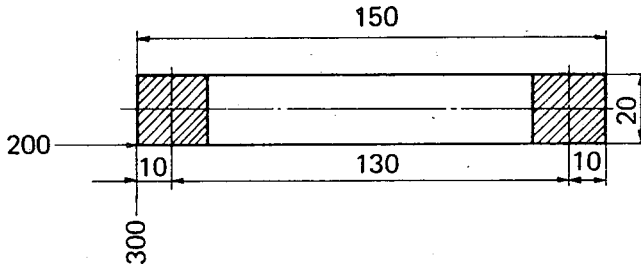
$\tau$ : Shearing strength of worksheet

Problem: Is it possible to punch holes with a diameter of 40 mm in a mild steel plate with a thickness of 4.5 mm and a shearing strength of 40 kg/mm<sup>2</sup>?

Problem: Is it possible to punch a 20 mm x 20 mm square hole in a stainless steel plate with a thickness of 3 mm and a shearing strength of 60 kg/mm<sup>2</sup>?

## CALCULATING LONG RECTANGULAR HOLE

Ex.: 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)



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

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

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

(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 - 7

When integral numbers are obtained

Ex.: 9 - 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.

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

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

$$(b) L = 150 - 20 = 130 \text{ mm}$$

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

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

Therefore the program is:

G90 X210. Y310. T3 (20 mm x 20 mm sq.)

G91 X 18.57

X 18.57

X 18.57

X 18.57

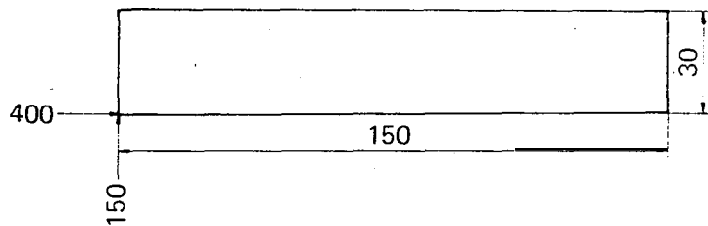
X 18.57

X 18.57

X 18.57

Problem: Punch a 30 mm x 150 mm rectangular hole with a 30 mm-x 30 mm sq. punch.

Problem: Punch a 30 mm x 150 mm rectangular hole with a 30 mm x 40 mm rect. punch.

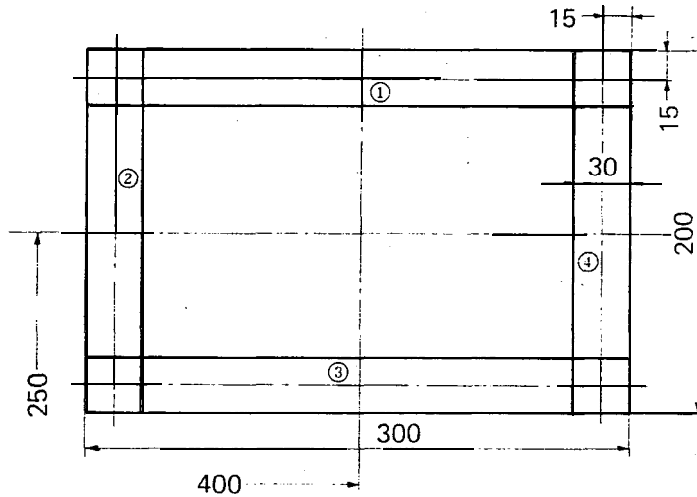


T1 30 mm x 30 mm sq.

T6 30 mm x 40 mm rect

## CALCULATING LARGE RECTANGULAR OPENING

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



T1 30 mm x 30 mm sq.

- Punching procedure  
Finish punching at the upper right corner in order to remove the scrap easily.
- First punch position " $X_0, Y_0$ " (Absolute value)  
 $X_0 = [X \text{ value at right end}] - 1/2 [\text{Punch length along X-axis}]$   
 $Y_0 = [Y \text{ value at upper end}] - 1/2 [\text{Punch length along Y-axis}]$
- Punching frequency and feed pitch of ①
- Punching frequency and feed pitch of ②
- Prepare the program in accordance with the punching sequence.  
NOTE: Do not punch the final punch position because the last punch fails- on the first punch position,
- Enter "MOO" 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. Y335. T1 (30 mm x 30 mm sq.)

G91 X-27. (10 times)

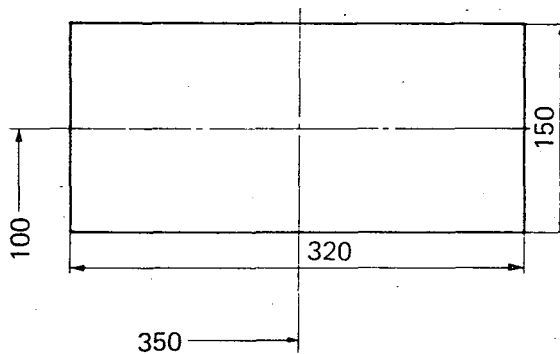
Y-28.33 (6 times)

X27. (10 times)

Y28.33 (5 times)

M00

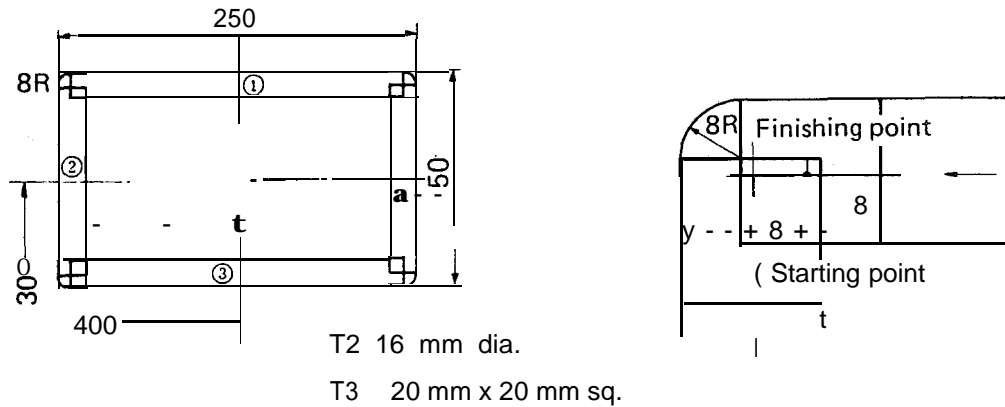
Problem: Punch a 150 mm x 320 mm rectangular opening with a 20 mm x 20 mm sq. punch.



T3 20 mm x 20 mm sq.

## CALCULATING RECTANGULAR OPENING WITH ROUNDED CORNERS

Ex.: 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 with 16 mm dia. round punch.  
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 (Opening length – 2 x R)
- (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 "MO1" in order to remove the scrap.

(a) 4 corners and then ① → ② → ③ → ④

(b) Absolute value (upper right corner)

$$X = [400 + 1/2 \times 250] - 8 = 517 \text{ mm}$$

$$Y = [300 + 1/2 \times 1501 - 8 = 367 \text{ mm}$$

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

$$X_0 = [400 + 1/2 \times 250 - 8] - [1/2 \times 20] = 507 \text{ mm}$$

$$Y_0 = [300 + 1/2 \times 1501 - 8] - [1/2 \times 20] = 365 \text{ mm}$$

(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 X517. Y367. T2 (16 mm dia.1

G91 X-234.

Y-I 34.

X234.

G90 X507. Y365. T3 (20 mm x 20 mm sq.)

G91 X-19.45. (11 times)

X-8. Y-8.

Y-I 9. (6 times)

X8. Y-8.

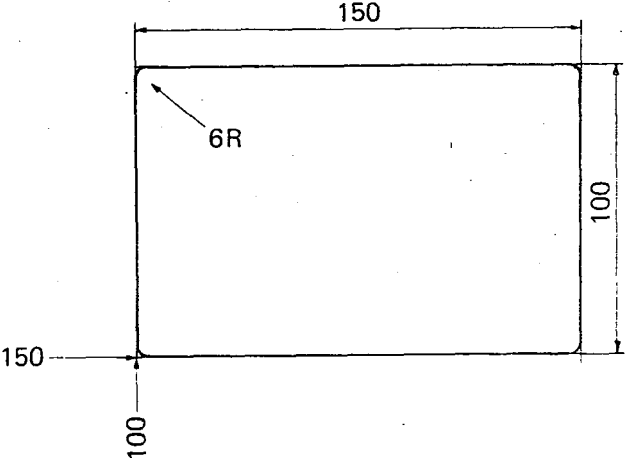
x19.45 (11 times)

X8. Y8.

Y19. (6 times)

MOO

Problem: Punch a 100 mm x 150 mm rectangular opening with rounded corners of 6R, using a 12 mm dia. round punch and a 20 mm x 20 mm square punch.



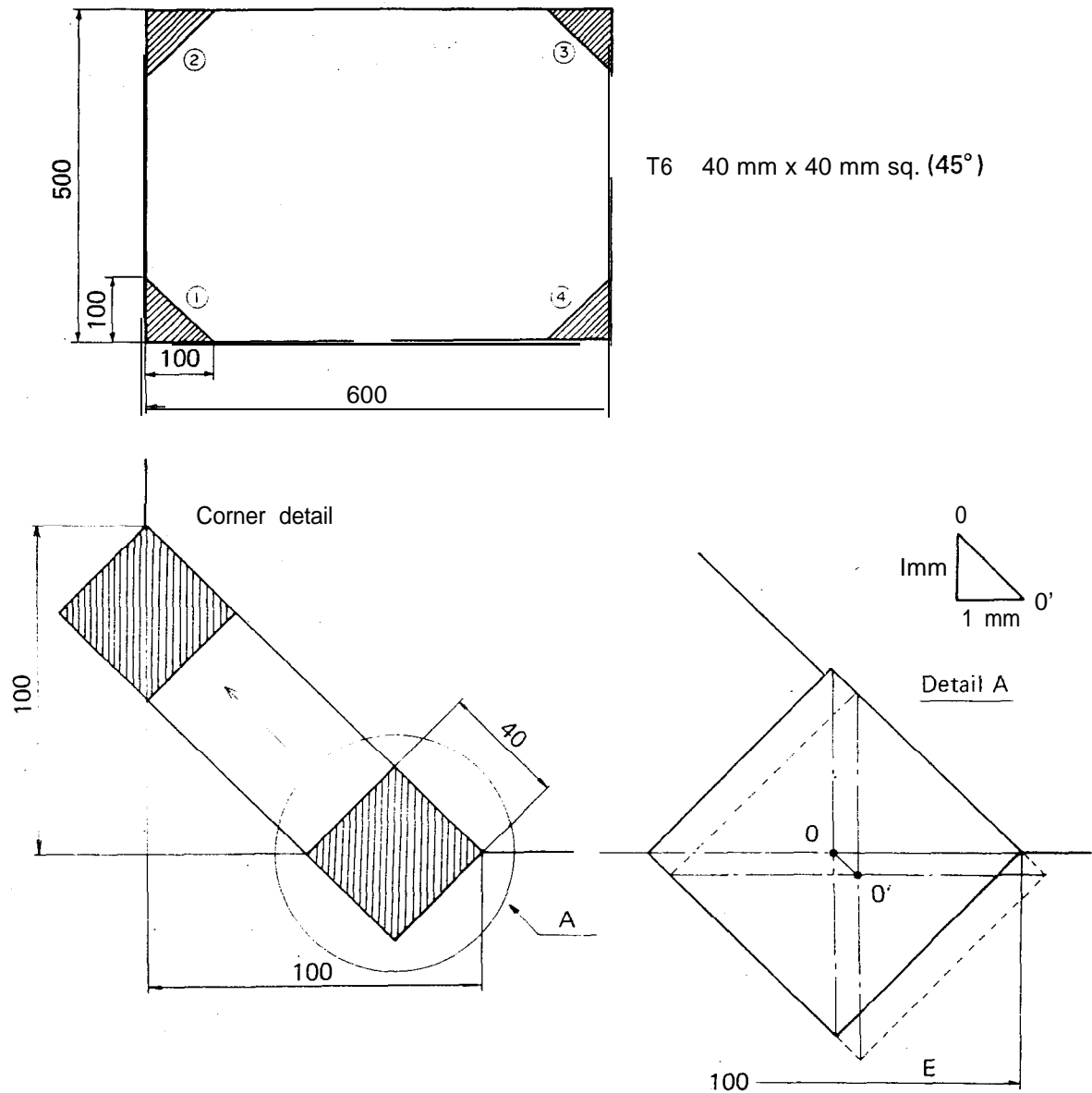
T2 12 mm dia.

T3 20 mm x 20 mm sq.

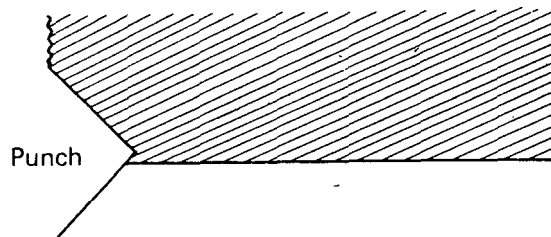


### CALCULATING 45° NOTCH

Ex.: When punching 45° notches in 4 corners of a 500 mm x 600 mm plate



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

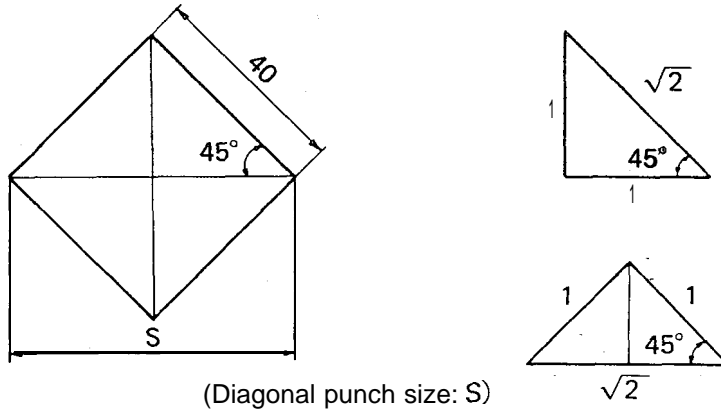


**Notching the lower left corner**

(a) Provisional starting point (0) "X<sub>1</sub>, Y<sub>1</sub>" (Absolute value)

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

$$Y_1 = 0$$



(Diagonal punch size: S)

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

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

(b) Starting point (0') "X<sub>0</sub>, Y<sub>0</sub>" (Absolute value)

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

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

$$Y_0 = Y_1 - 1 \text{ mm} \quad (\text{In case of the lower left corner } \textcircled{1})$$

(c) Punching frequency and feed pitch

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

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

When decimal numbers are obtained

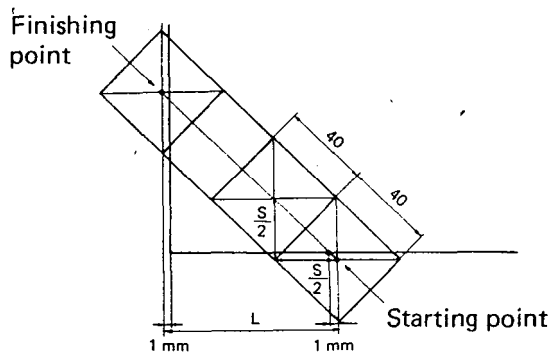
Ex.: 2.3 -> 3

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 S/4, but smaller than S/2 minus 0.5 mm (0.02").



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

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

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

Therefore the program is:

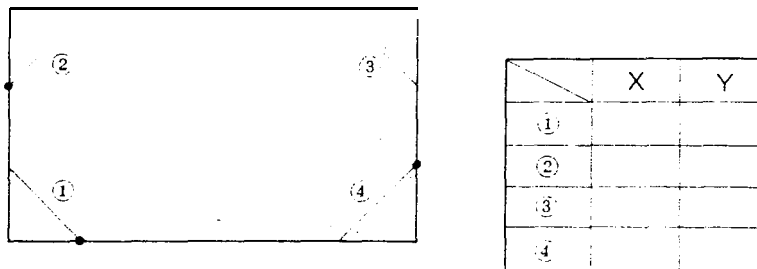
G90 X72.72 Y-1. T6 (40 mm x 40 mm sq. 45°)

G91 X-24.67 Y24.67 (3 times)

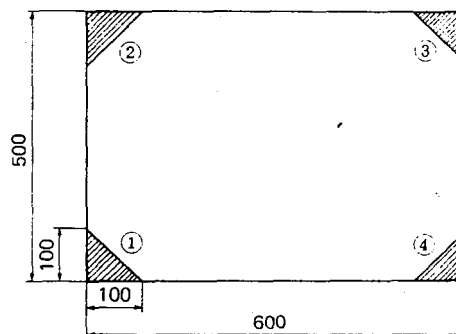
Problem: Calculate "S" of a 30 mm x 30 mm sq. 45° punch, and of a 50 mm x 50 mm sq. 45° punch.

Problem: What will the sign of 1 mm be when calculating the starting point (0') for each corner?

"•" mark means starting points.



Problem: Prepare the program for notching all corners (①, ②, ③ and ④) with a 35.4 mm x 35.4 mm sq. (45°) punch [T1].



## HINTS ON PROGRAMMING

### 1. PUNCHING RANGE

Punching range common to all stations

AR I ES-222

X-axis: -10.2 mm to 610.2 mm (metric), -0.401" to 24.023" (imperial)

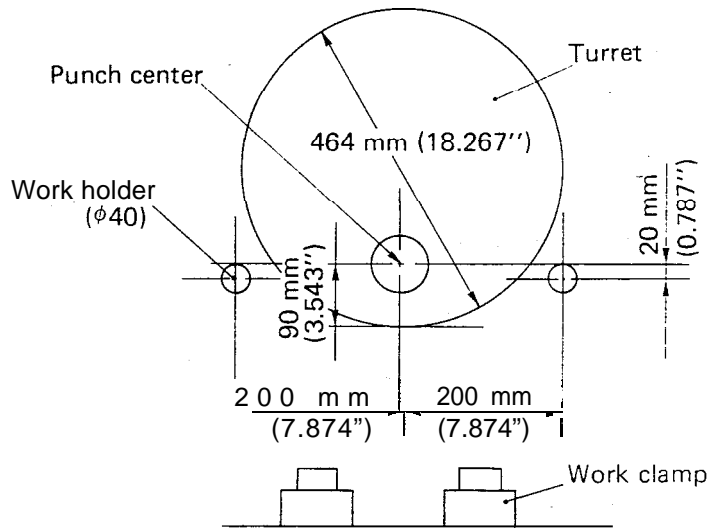
Y-axis: -10.2 mm to 610.2 mm (metric), -0.401" to 24.023" (imperial)

AR I ES-224

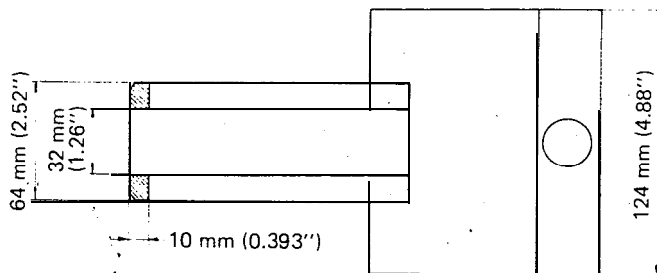
X-axis: -10.2 mm to 1010.2 mm (metric), -0.401" to 39.772" (imperial)

Y-axis: -10.2 mm to 610.2 mm (metric), -0.401" to 24.023" (imperial)

### 2. POSITION OF WORKHOLDERS



### 3. WORK CLAMP DIMENSIONS



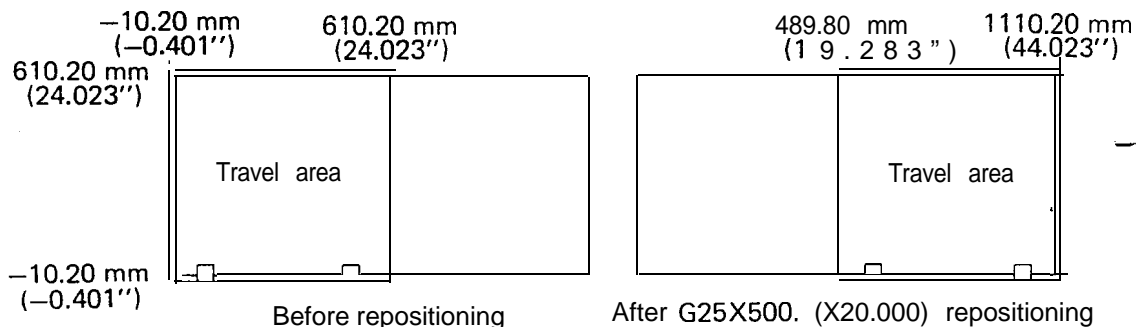
## HINTS ON AUTO REPOSITIONING .

1. Repositioning travel distance ---as small as possible  
 ARIES-222 [Maximum processing position (X value)] – 610 mm (24.015")  
 ARIES-224 [Maximum processing position (X value)] – 1010 mm (39.764")
2. Clamp position ---as far apart as possible  
 Consider the following:
  - Dead zone
  - Worksheet size
  - Notches
3. First processing area ----as large as possible
4. Reposition
  - (a) Ensure the worksheet is under the work holders.
  - (b) Ensure the clamps do not pass between the upper and lower turrets when the repositioning is done. Y100.00 mm (min.)
  - (c) Ensure the X-axis absolute value is greater than the repositioning travel distance. If it is not 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 auto repositioning (AR I ES-222)  
 $-10.2 \text{ mm } (-0.401") + \text{repositioning travel distance} \leq X \leq 610.2 \text{ mm } (24.023") + \text{repositioning travel distance}.$

Ex.: G27 X500. (X20.000)

Processing area after auto repositioning =  $489.8 \leq X \leq 1110.2 \text{ mm}$   
 $(19.283" \leq X \leq 44.023")$

NOTE: When the repositioning detector switch has been turned to ON, the repositioning light will be lighted and a pause is made for confirmation before auto repositioning provided the programmed Y-axis value is less than 95 mm (3.74"). In this case be "sure, to check to ensure that there is no interference between the work holders and work clamps before pressing start button.



# BASIC SOFTWARE

## G72 – DESIGNATION OF PATTERN ORIGIN

<small>PATRN (SHIFT)</small>	<small>PATRN ORG</small>	G72	X (X POSITION)
	<small>C</small>	[PATRN ORIGIN]	Y (Y POSITION);

G90 G72 X \_\_\_\_\_ Y \_\_\_\_\_

G91 G72 X \_\_\_\_\_ Y \_\_\_\_\_

This code is used to designate the pattern origin.

Ex.: G90 G72 X500. Y300.

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. Y200. T2

G91 G72 X150. Y250. MOO

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

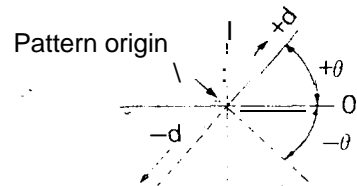
## G28 - LINE AT ANGLE

	G28	I (PITCH)	J (ANGLE)
	[LINE ANGLE1 K (NO. HOLE) T (TOOL NO.);		

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

I: Pitch " $\pm d$ " When "d" is negative, the punching is performed in the opposite direction from that of positive "d".

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



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

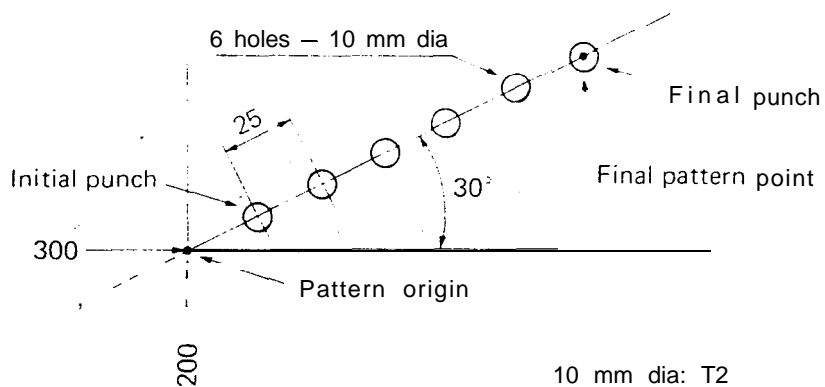
NOTE: "d" and "θ" are given as follows:

d 200 mm  $\longrightarrow$  200. (d5"  $\longrightarrow$  5.)

θ 45° 30'  $\longrightarrow$  45.5

θ 45"  $\longrightarrow$  45.

Example:



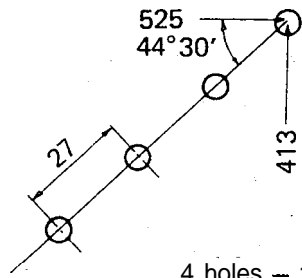
G90 G72 X300. Y200.

G28 125. J30. K6 T2

When punching the same hole at the pattern origin (X300., Y200.), omit "G72" and enter "T2" in the upper instruction block.

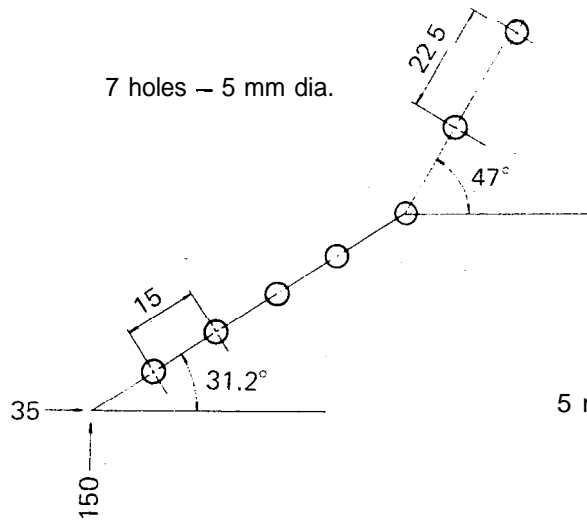
When "125." becomes "I-25.", punching is performed in the direction of 180° symmetry (210°).

Problem:



4 holes – 10 mm dia.      10 mm dia.: T2

Problem:





7 holes – 5 mm dia.

5 mm dia.: T8



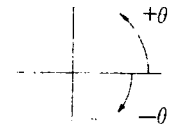
G29 — ARC

 	G29	I (RADIUS) J (START ANGLE)
	[ARC]	K (NO. HOLE) P (ANGLE INCR.)

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 increment of " $\Delta\theta$ " are punched, starting from a point at an angle of " $\theta$ " to the X-axis.

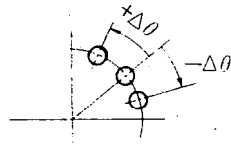
I: Radius "r" — positive

J: Start angle " $\pm 0$ "  
 Counterclockwise — positive  
 Clockwise — negative

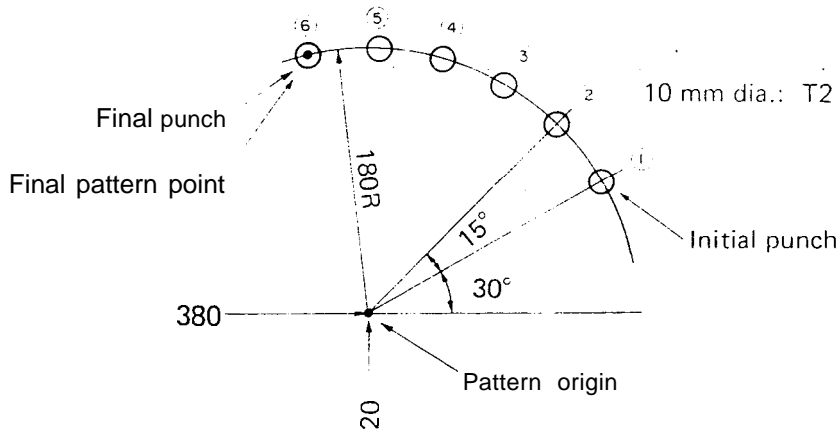


K: Number of holes "n"

P: Angle increment " $\pm \Delta\theta$ "  
 Counterclockwise — positive  
 Clockwise — negative



Example:

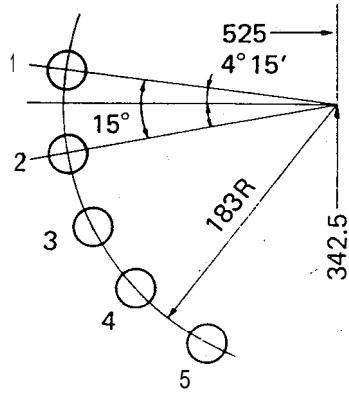


```
G90 G72 X380. Y120.
G29 1180. J30. K6 P15. T2
```

When punching the same hole at the pattern origin (X380.. Y120.), omit "G72" and enter "T2" in the upper instruction block.

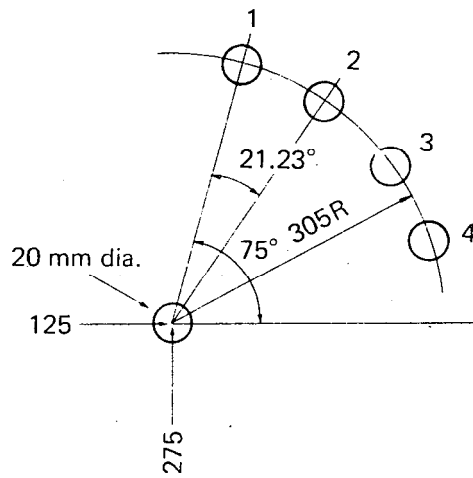
When "P15." becomes "P-I 5.", punching is performed in a clockwise direction beginning with the starting point.

Problem:



5 holes – 20 mm dia.  
20 mm dia.: T3

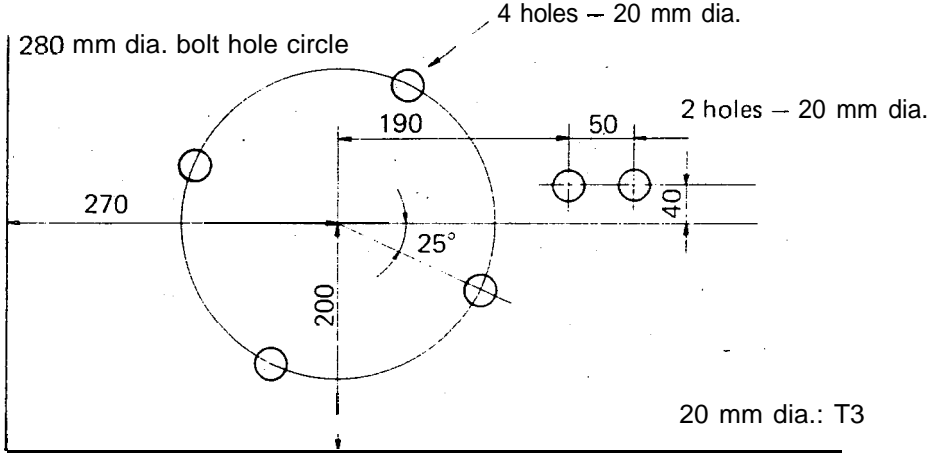
Problem:



5 holes – 20 mm dia.  
20 mm dia.: T3





Problem: Punch four 20 mm dia. holes using code G26, then punch two 20 mm dia. holes using an incremental instruction.



**G36 – GRID-X**

**G37 – G R I D - Y**

	<b>G36</b> [GRID-X]	I (PITCH X) P (#X SPACES) J (PITCH Y) K (#Y SPACES) T (TOOL NO.);
	<b>G37</b> [GRID-Y]	I (PITCH X) P (#X SPACES) J (PITCH Y) K (#Y SPACES) T (TOOL NO.);

Starting from either the current position or from a point designated by "G72", a grid pattern of "n<sub>1</sub>" spaces with a pitch of "d<sub>1</sub>" parallel to the X-axis and "n<sub>2</sub>" spaces with a pitch of "d<sub>2</sub>" parallel to the Y-axis is punched.

G36: Punching starts from the X-axis side.

G37: Punching starts from the Y-axis side.

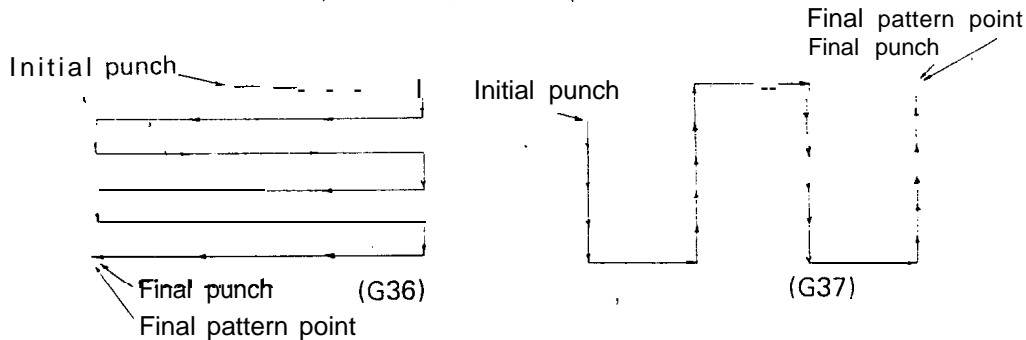
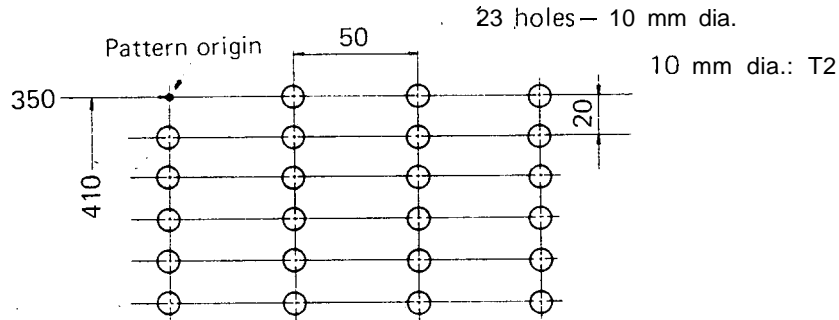
I: Pitch X "± d<sub>1</sub>" +X direction – positive  
-X direction – negative

P: #X spaces "n<sub>1</sub>"

J: Pitch Y "± d<sub>2</sub>" +Y direction – positive  
-Y direction – negative

K: #Y spaces "n<sub>2</sub>"

Example:

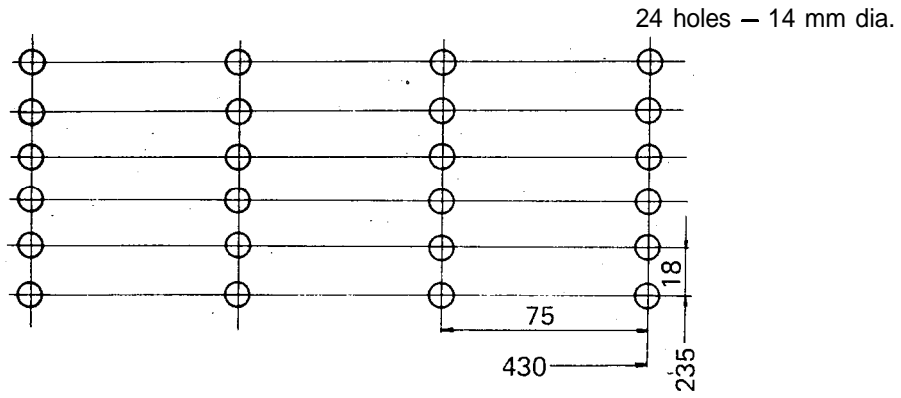


G90 G72 X350. Y410.  
G36 150. P3 J-20. K5 T2

G90 G72 X350. Y410.  
G37 150. P3 J-20. K5 T2

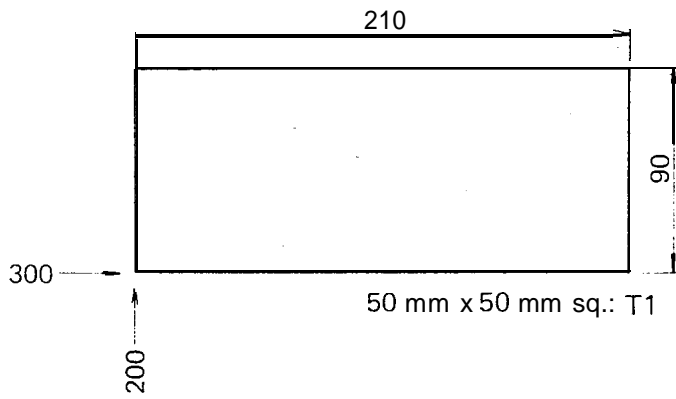
When punching the same hole at the pattern origin (X350., Y410.), omit "G72" and enter "T2" in the upper instruction block.

Problem: Program the following using codes G36 and G37. Indicate their respective final punches.



14 mm dia.: T3

Problem:





When "G72" is omitted and "T3" is entered in the upper instruction block, the pattern origin (X350., Y210.) is also punched.

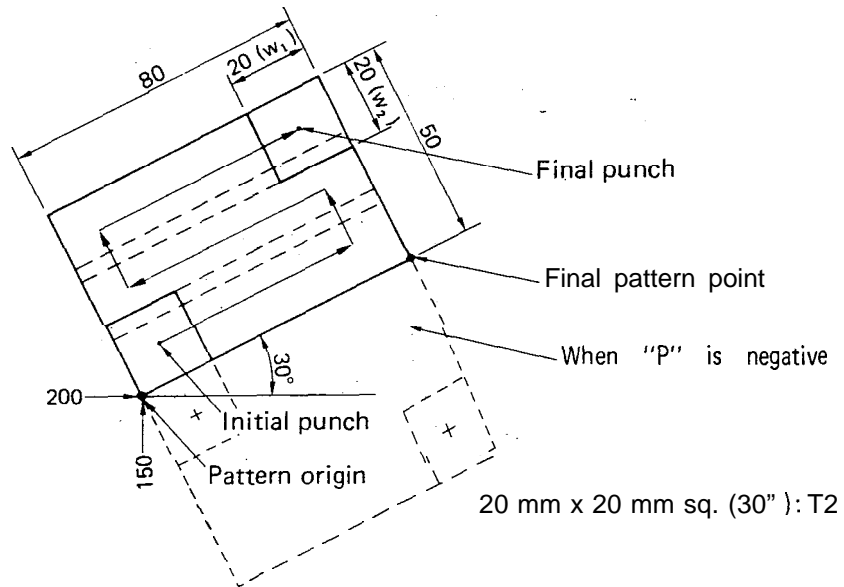
When "P20." becomes "P-20.", a shear proof is performed in the direction of the dotted line.

$l$  (length " $l_1$ ") must be at least 1.5 times as large as  $P$  (tool length " $\pm w_1$ ").

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

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

Example 2:



G90 G72 X200. Y150.

G66 180. J30. P20. K50. T2

When "G72" is omitted and "T2" is entered in the upper instruction block, the pattern origin (X200., Y150.) is also punched.

When "P20." becomes "P-20.", a shear proof is performed in the direction of the dotted line.

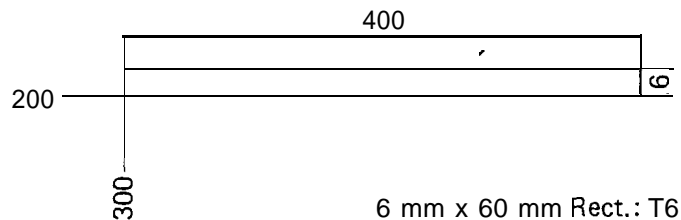
$l$  (length " $l_1$ ") must be at least 1.5 times as large as  $P$  (tool length " $l_w$ ").

$K$  (width " $l_2$ ") must be at least 1.5 times as large as  $P$  (tool length " $l_w$ ").

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

Square punch ( $w_1 = w_2$ ) must be used when  $K$  (width " $l_2$ ") is entered.

Problem:





## G67 — SQUARE

PATRN (SHIFT)	N	G67 [SQUARE]	I (LENGTH X) J (WIDTH Y) P (TOOL LTH. X) Q (TOOL WTH. Y), T (TOOL NO.); MOO (STOP);
------------------	---	-----------------	---

Starting from either the current position or from a point designated by "G72", a rectangular opening with a length of " $\ell_1$ " parallel to the X-axis and a length of " $\ell_2$ " parallel to the Y-axis is punched, using a square punch with a width of "w".

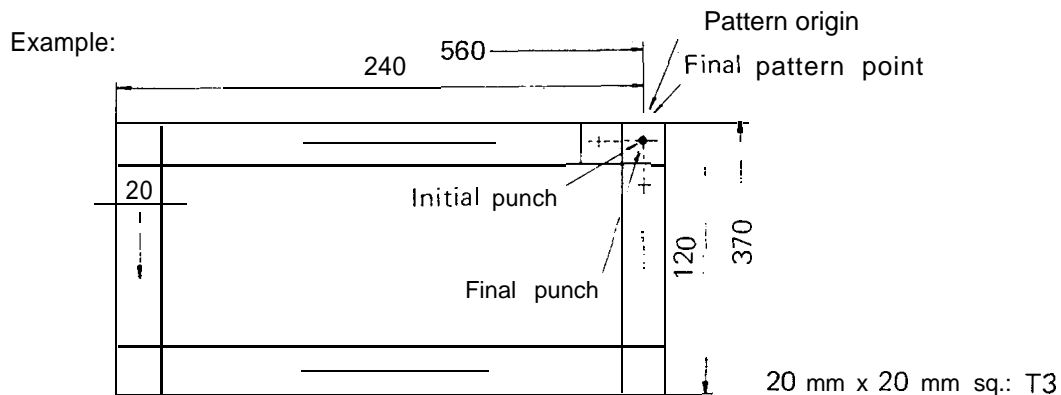
I: Opening length in the X-axis direction " $\pm \ell_1$ " +X direction — positive  
-Y direction — negative

J: Opening length in the Y-axis direction " $\pm \ell_2$ " +Y direction — positive.  
-Y direction — negative

P: Tool length in the X-axis direction "w" (positive value only)

Q: Tool width in the Y-axis direction "w" (positive value only)

NOTE: As a square punch is normally used on programming G67 function, "Q" is often omitted.

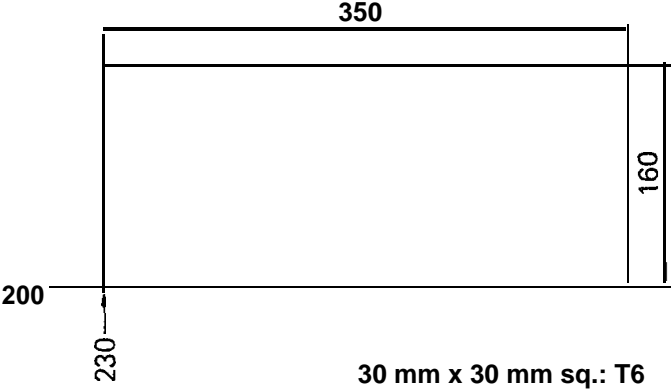


```
G90 G72 X560. Y370.
G67 I-240. J-120. P20. T3
MOO
```

When "G72" is omitted and "T3" is entered in the upper instruction block, the pattern origin (X560., Y370.) is also punched.

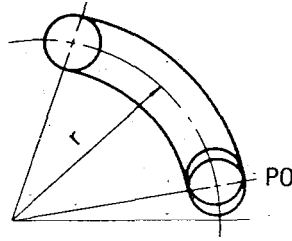
When "G67" is fused, "MOO" or "M01" should be entered in order to remove the scrap. Both I and J (length X " $\pm \ell_1$ " and Y " $\pm \ell_2$ ") must be at least three times as large as P (tool length "w").

Problem:



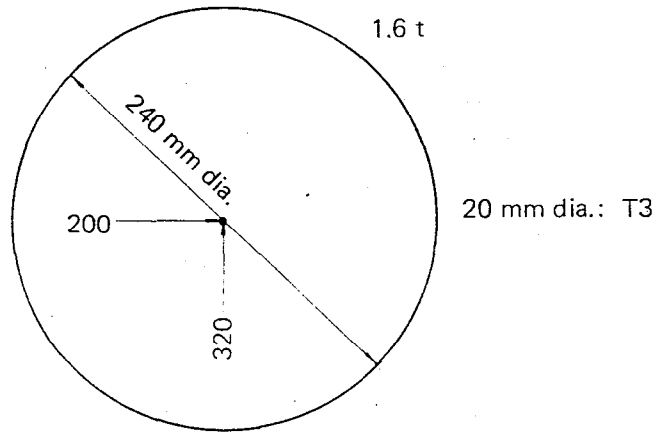


When the value of "P" is zero, nibbling is performed on the arc with the radius "r".  
 Example:

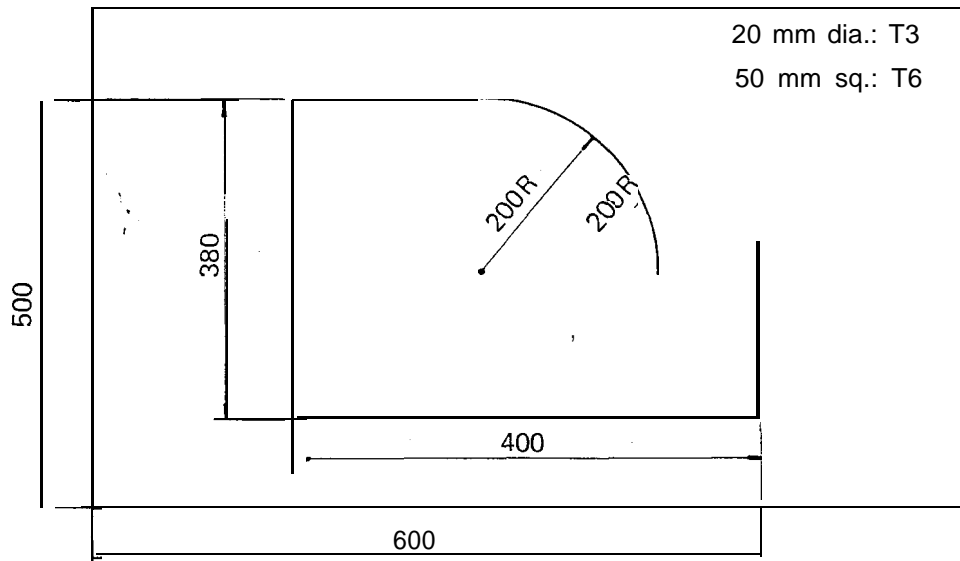


When nibbling a worksheet with a thickness of more than 3.2 mm (0.125"), use code G29 (ARC) or G78 (PUNCHING ARC).  
 When the scrap remains inside, make "J" (start angle " $\pm \theta_1$ ") 90" or 45" and enter "MOO" or "M01" in order to remove the scrap.

Problem:

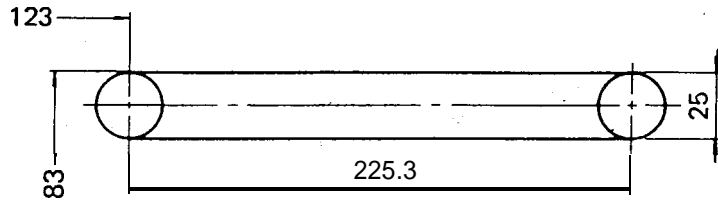


Problem: Program the following using NBL-A (G68) and SHP (G66).



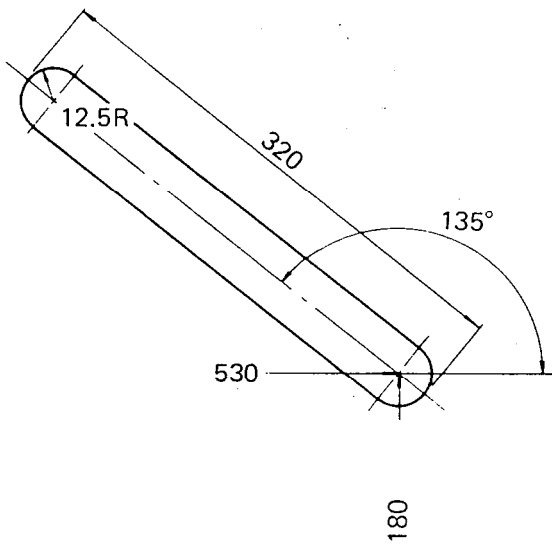


Problem:



25 mm dia.: T3  
Pitch: 4 mm

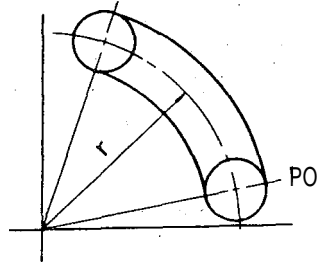
Problem:



25 mm dia.: T3  
Pitch: 5 mm



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



When the scrap remains inside, enter "MOO" or "M01" in order to remove the scrap.



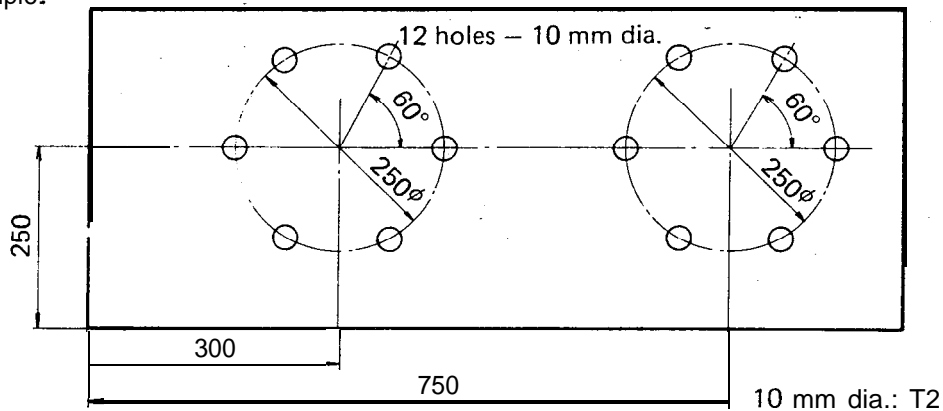


## PATTERN MEMORY AND PATTERN' RECALL

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

When a pattern instructed by the codes G26, G28, G29, G36, G37, G66, G67, G68, G69, G78 or G79 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".

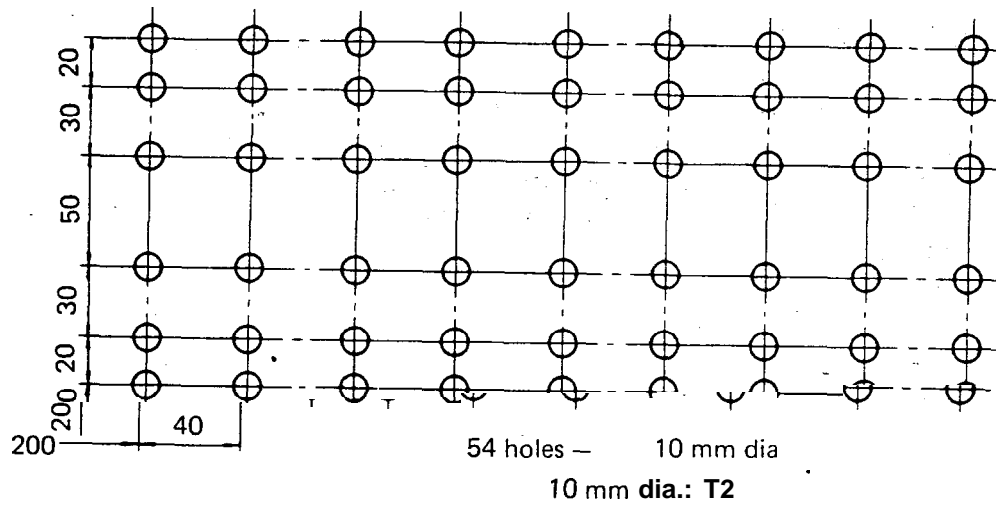
Example:



```
G90 G72 X300. Y250.
A1 G26 1125. J60. K6 T2 [Pattern memory]
G70 X400.
G25 X350.
G72 X750.
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.

Problem: Program the following with "AO", "BO" and "G28".



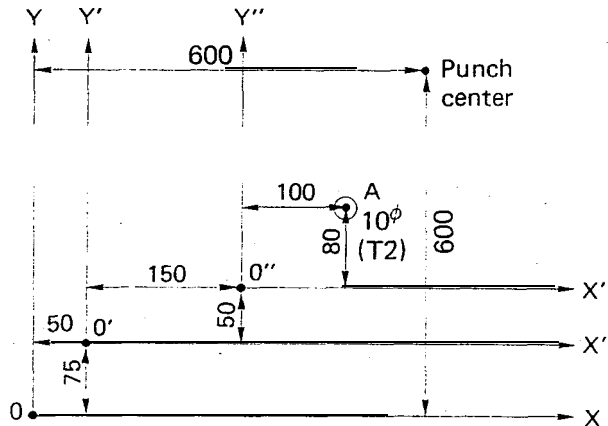
## G93 — OFFSET

PATRN (SHIFT)	OFFST	G93	X (OFFSET X)
		[OFFSET]	Y (OFFSET Y);

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. Y75.

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

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

Method of designating point A

(1) G90 X300. Y205. T2

(2) G90 G93 X50. Y75.

X250. Y130. T2

(3) G90 G93 X50. Y75.

G93 X200. Y125. (or G91 G93 X150. Y50.)

X100. Y80. T2

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. Y100. T2

\_\_\_\_\_ Program error

Basic format of a program using "G93"

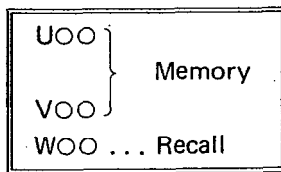
G92 X\_\_\_ Y\_\_\_

**G90** G93 X\_\_\_\_\_ Y\_\_\_\_\_

X\_\_\_\_\_ Y\_\_\_\_\_ T\_\_\_\_\_

G50

## 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

.....

.....

**U02**

**G90** X100. Y300. T8

**G72** X150. Y500.

**AI** G66 1100. JO P20.

**G72** X450. Y400.

**B1**

vo2

.....

.....

**U70**

**G90** X200. Y 100. T3

**G37** 18. P3 J10.K10

**G90** X550. Y250.

**G28** 125. J-90. K6

**V70**

.....

.....

wo2

.....

.....

**W70**

.....

.....

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

} These instructions are merely stored.

————— Recalling and processing of instructions stored between U02 and V02

————— 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.

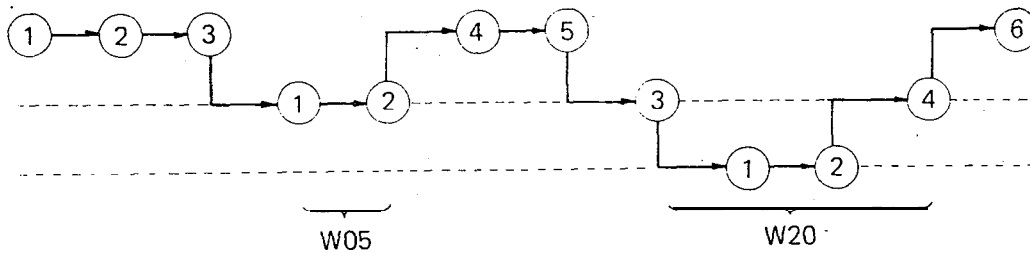
Example: U05

```

..... ①
..... ②
vo5
U20
..... ③
wo5
..... 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 (EOB, -, /, 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. Y200.----This block is not stored.  
uo2  
.....  
.....  
V02  
V90  
.....  
.....

$$W90 = \left\{ \begin{array}{l} W01 \\ W10 \\ W15 \\ W02 \end{array} \right.$$

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

## BLOCK DELETION

If a slash character is entered at the beginning of a block and if the LED of BLOCK SKIP button on the NC control panel is lighted, the block command following the slash character is disregarded. If the LED is not lighted, the command is not disregarded but is executed.

Example: G90 X320. Y210. T2  
G91 X50.  
/ X100. Y100. T3  
G90 X570. Y310. T4

Basic format of BLOCK DELETION

/ X \_\_\_\_\_ Y \_\_\_\_\_  
G90 X \_\_\_\_\_ Y \_\_\_\_\_ T \_\_\_\_\_

## INPUT OF DECIMAL POINT

Such data as the length, angle and time which are contained in the program can be input with the decimal point values as follows:

510 mm → x510. (= X51000)  
123.4 mm → X123.4 (= X12340)  
45.3" → J45.3 (= J4530)  
5 sec. → x5. (= X500)

The decimal point is available as an input for the addresses X, Y, C, I, J, K, P, Q and D.

# MULTIPLE PART PUNCHING

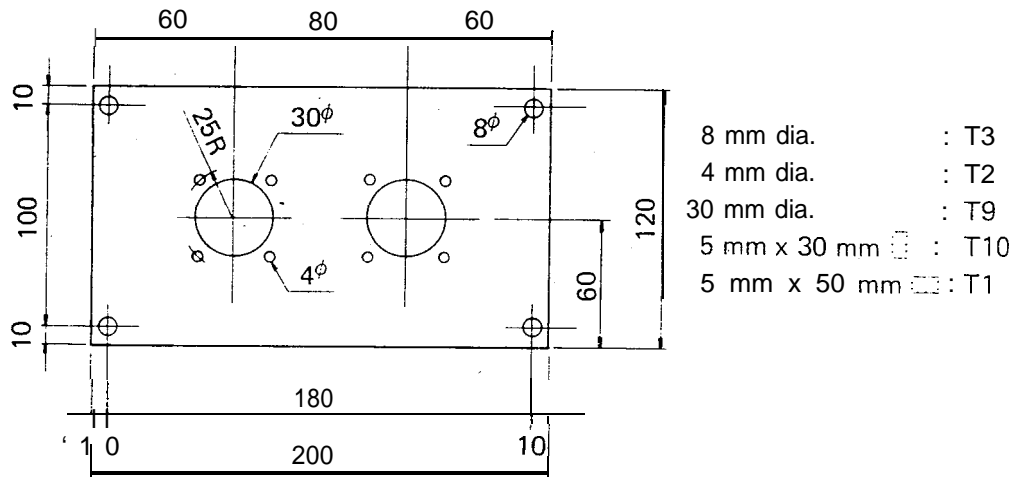
## GENERAL DESCRIPTION AND PROGRAMMING EXAMPLE

### 1. Multiple part punching function

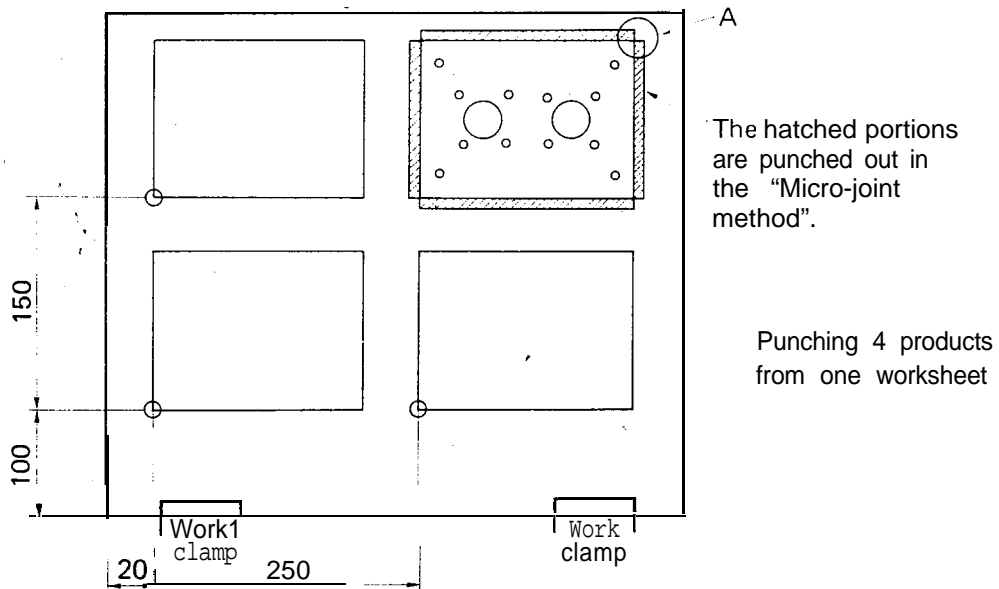
This function is used to punch multiple products which have the same punching pattern from one worksheet. Once the punching of only one product is programmed, the punching of multiple products with any desired layout on the worksheet can be performed by using simple commands.

### 2. Removal of each product after multiple part punching

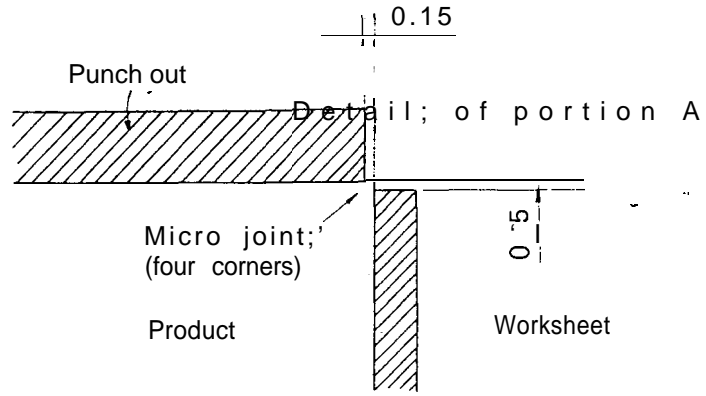
When punching four products from one worksheet, such as the one depicted in the figure below, the following two removal methods can be used:



#### a. Micro-joint method

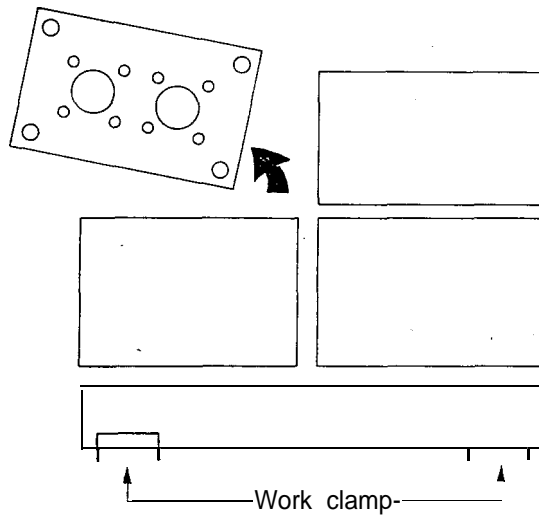


As shown in the figure, the hatched portions are punched out by rectangular punches in such a manner that the four corners of each product remain unpunched. The four corners are connected to the worksheet by means of an approx. 0.15 mm joint. After completing the entire punching process, the worksheet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



### 3. Program example using multiple part punching function

The program for punching the product depicted in the figure on Page 3-1 using the "micro-joint" method is as follows:

```

G92 X600. Y600. (ARIES-2221 [G92 X1000. Y600.(ARIES-224)]
G98 X20. Y100. I250. J150. P1K1

```

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

```

U1
G90 X190. Y110. T3 (8φ)
Y10.
X10.
Y110.
G72 X60. Y60.
AI G26 I25. J45. K4 T2 (4φ)
G72 X140. Y60.
B1
V1

```

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

```

u2
X140. Y60. T9 (30φ)
X60.
v2

```

```

u3
G72 x200. Y120.
G66 I120. J-90. P30. Q5. D-0.15 T10 (5 x 30 ▨)
G72 X0 Y0
G66 I120. J90. P30. Q5. D-0.15
v3

```

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

```

u4
G72 X0 Y120.
G66 I200. J0 P50. Q5. D-0.15 T1 (5 x 50 ▨)
G72 x200. Y0
G66 I200. J180. P50. Q5. D-0.15
v4

```

```



G76 W1Q4U1-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

```

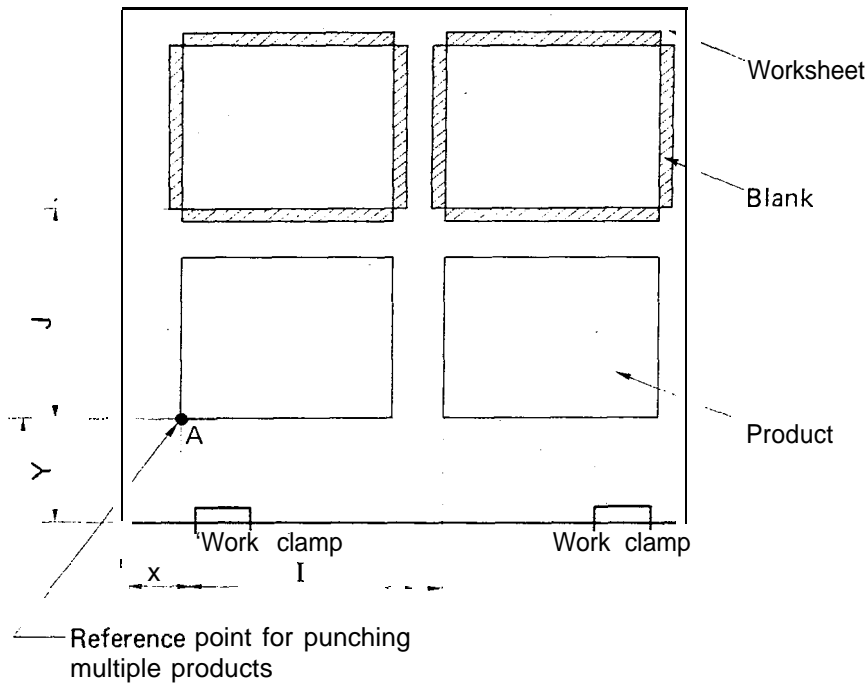
→ (4) Recalling and execution of each part program for the specified punching layout.

After preparing the above program, one product in the lower left, corner in the figure on Page 3-1 can be trial-punched by key operation on the NC control panel. 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 P A R T P U N C H I N G

		<b>G98</b>	X (OFFSET X) Y (OFFSET Y)
[MULTI PART]		I (PART LTH. X) J (PART.WTH. Y)	P (NO. PART-1X) K (NO. PART-1Y) D (SPACING) ;

- X . . . . Offset X (X-coordinate value of reference point)
- Y . . . . Offset Y (Y-coordinate value of reference point)
- I . . . . Part length X (Pitch along X-axis)
- J . . . . Part length Y (Pitch along Y-axis)
- P . . . . No. Part-I X (Number of products in X-axis direction, excluding product at reference point)
- K . . . . No. Part-I Y (Number of products in Y-axis direction, excluding product at reference point)
- D . . . . Spacing (Space between products when I and J are product dimensions)



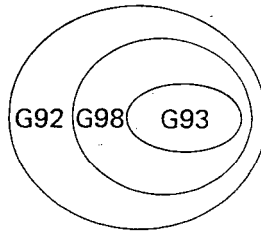
Ex.: If  $X = 30$  mm,  $Y = 80$  mm,  $I = 200$  mm and  $J = 150$  mm in the figure above, the program is:

G98 X30. Y80. I200. J150. P1 K1

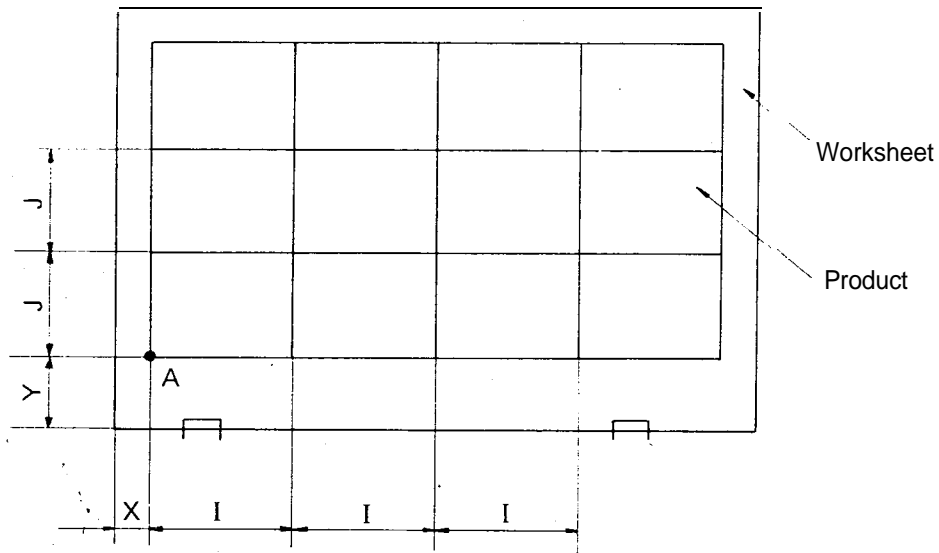
- NOTE:
- a) The reference point for punching multiple products must be located in the lower left corner of the product which is located at the lower left portion of the worksheet.
  - b) The values "I", "J", "P" and "K" specified by "G98" must be either zero or positive values.
  - c) The value "D"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

### 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 commands of "G98" or "G50".
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.

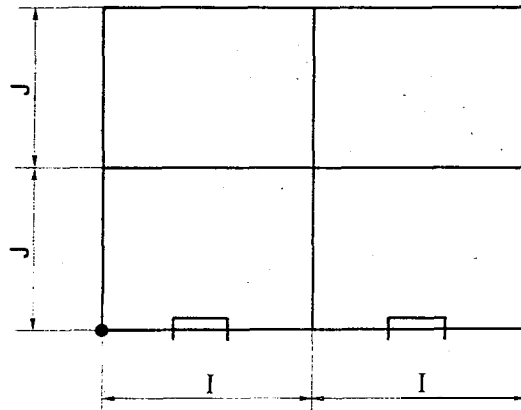


Example 1. When there is no cutting area between products and the outer edges of each product are cut either by shearing or other procedures after punching (Trimming will be necessary).



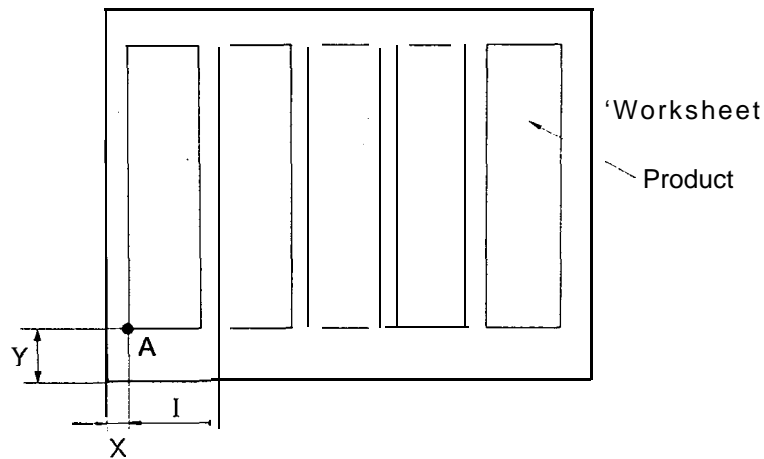
If  $X = 20$  mm,  $Y = 60$  mm,  $I = 100$  mm and  $J = 80$  mm in the above figure, the program is:  
**G98 X20. Y60. 1100. J80. P3 K2**

Example 2. 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  $X = 200$  mm and  $Y = 150$  mm, the program is:  
 G98 X0 YO 1200. J150. PI KI

Example 3. This depicts the punching of products only in the X-axis direction.

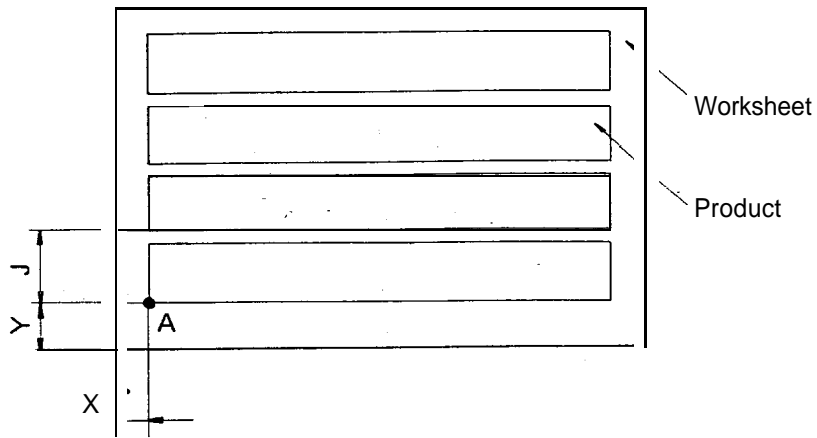


If  $X = 30$  mm,  $Y = 80$  mm and  $I = 1$  IO mm in the above figure, the program is:  
 G98 X30. Y80. I1 IO. JO P4 KO

As shown above,  $J = 0$  and  $K = 0$ .



Example 4. This shows the punching of products only in the Y-axis direction.



If  $X = 30 \text{ mm}$ ,  $Y = 80 \text{ mm}$  and  $J = 150 \text{ mm}$ , the program is:  
G98 X30. Y80. IO J150. PO K3

As'shown above,  $I = 0$  and  $P = 0$ .

## UOO TO VOO - STORING OF PART PROGRAM

```
uoo }  
..... }  
..... } Part program  
..... }  
Voo }
```

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 "UOO" and "VOO" 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  
 X190. Y110. T3 (8 $\phi$ )  
 Y10.  
 X10.  
 Y1 10.  
 V1  
 U2  
 G72 X60. Y60.  
 A1 G26 125. J45. K4 T2 (4 $\phi$ )  
 G72 X140. Y60.  
 81  
 v2  
 u3  
 X140. Y60. T9 (30 $\phi$ )  
 X60.  
 v3  
 u4  
 G72 X200. Y120.  
 G66 1120. J-90. P30.Q5. D-0.15 T10 (5 x 30  $\square$ )  
 G72 X0 Y0  
 G66 1120. J90.P30. Q5. D-0.15  
 v4  
 u5  
 G72 X0 Y120.  
 G66 1200. JO P50.Q5. D-0.15 T1(5 x 50  $\square$ )  
 G72 X200. Y0  
 G66 1200. J180.P50. Q5. D-0.15  
 v5

Program example (1)

In this example, the processing by one type of tool 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  
 X190. Y110. T3  
 Y10.  
 X10.  
 Y110.  
 G72 X60. Y60.  
 A1 G26 125. J45. K4 T2  
 G72 X140. Y60.  
 B1  
 X1 40. Y60. T9  
 X60.  
 G72 X200. Y120.  
 G66 1120. J-90. P30.Q5. D-0.15 T10  
 G72 X0 Y0  
 G66 1120. J90.P30. Q5. D-0.15  
 G72 X0 Y120.  
 G66 1200. JO P50.Q5. D-0.15 T1  
 G72 X200. Y0  
 G66 1200. J180.P50. Q5. 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 WOO QO – RECALLING AND EXECUTION OF PART PROGRAM**

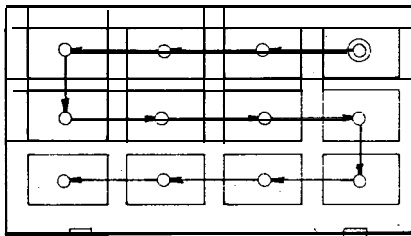
		<b>G75</b>	<b>W (MACRO NO.)</b>
		<b>[G98 RECALL X DIR.]</b>	<b>Q (QUADRANT);</b>
		<b>G76</b>	<b>W (MACRO NO.)</b>
		<b>[G98 RECALL Y DIR.]</b>	<b>Q (QUADRANT);</b>

The part program for punching one product entered between “UOO” and “VOO” is recalled by “WOO”, 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 “UOO” and “VOO” is executed -in the order shown in the figure below.

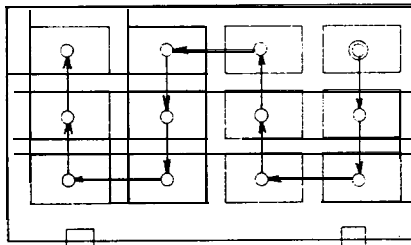
**G75 WOO Q4**



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

Execution is accomplished as shown in the figure below.

**G76 WOO Q4**





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 WOO 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 "UOO and VOO" by a single "UOO and VOO". 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)**

G92 X600. Y600. (ARIES-2221  
 [G92 X1000. Y600. (ARIES-22431

G 98 X 20. Y100. 1250. J150.P1.K2

U90

U1

X190. Y110. T 3

Y10.

x10.

Y110.

V1

u 2

G72 X60. Y60.

AI G26 125. J45. K4 T2

G72 X140. Y60.

B1

v 2

u 3

X140. Y60. T9

X60.

v 3

u 4

G72 x200. Y120.

G66 1120. J-90. P30.Q5. D-0.1 5 T10

G72 X0 Y0

G66 1120. J90.P30. Q5. D-0.15

v 4

u 5

G72 X0 Y120.

G66 1200. JO P50.Q5. D-0.15 T1

G72 x200. Y0

G66 1200. J180.P50. Q5. D-0.15

V5

V90

G75 W90 Q 4

G50

G92 X600. Y600. (ARIES-2221  
 [G92 X1000. Y600. (ARIES-224)]

G 98 X 20. Y100. 1250. J150.P1 K 2

U1

X190. Y110. T 3

Y10.

x10.

Y110.

V1

u 2

G72 X60. Y60.

AI G26 125. J45. K4 T2

G72 X140. Y60.

B1

v 2

u 3

X140. Y60. T9

X60.

v 3

u 4

G72 x200. Y 120.

G66 1120. J-90. P30.Q5. D-0.15 T10

G72 X0 Y0

G66 1120. J90.P30. Q5. D-0.15

v 4

U5

G72 X0 Y120.

G66 1200. JO P50.Q5. D-0.15 T1

G72 x200. Y0

G66 1200. J180.P50. Q5. D-0.15

v 5

G75 W1 Q4

G75 W2 Q4

G75 W 3 Q4

G75 W 4 Q4

G75 W5 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.

### **TRIAL PUNCHING, POST-TRIAL PUNCHING, AND FULL 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. "trial punching for one product", "multiple punching for remaining products after trial punching" and "full punching".

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

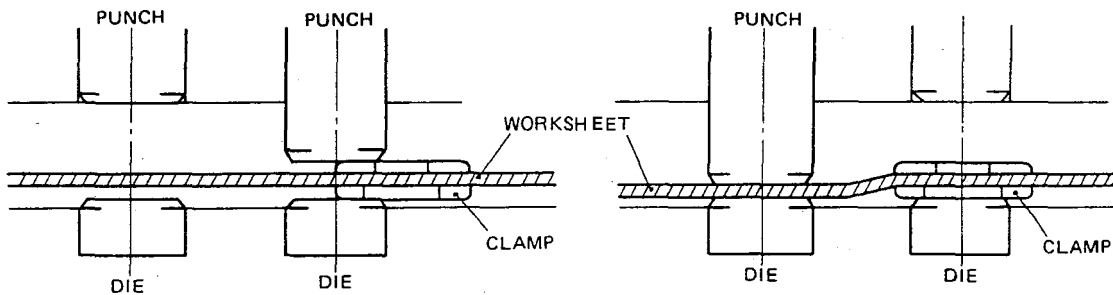


## CLAMP DEAD ZONE DIAGRAM

### CLAMP DEAD ZONE

A clamp dead zone is defined as any position in which the work clamp is so close to the punching point that the clamp itself is punched, or in which the clamp rests on top of adjacent dies or free-motion bearings, resulting in the worksheet being distorted if punching is performed.

When preparing the program, the position of the work clamps on the worksheet must be determined so that the clamps do not enter this dead zone during punching operation.

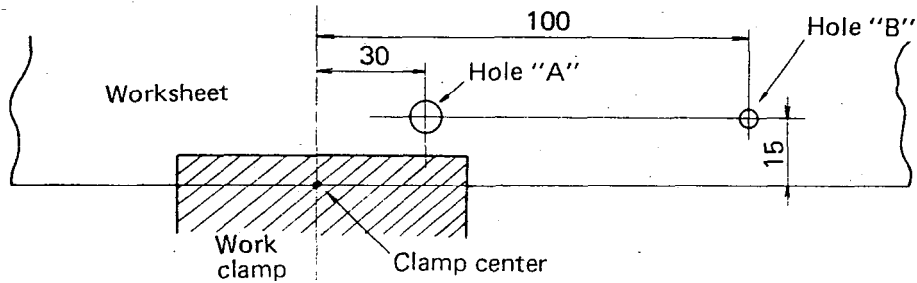


Clamp caught between punch and die.  
Clamp will be punched.

Clamp resting on top of adjacent die.  
Clamp will not be punched, but work-  
sheet will be distorted.

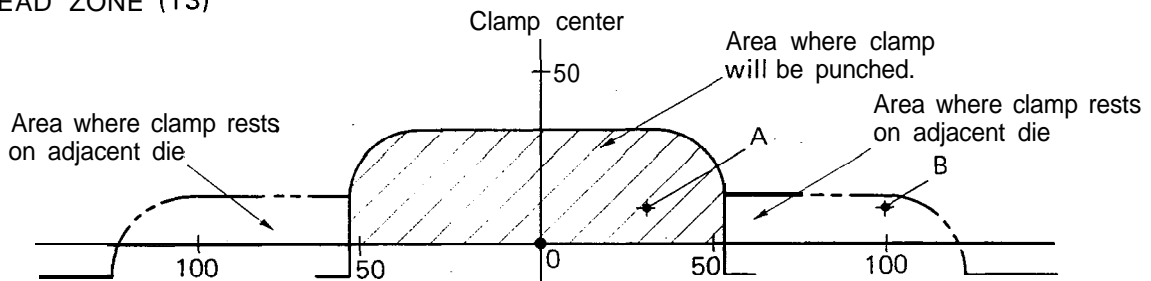
## HOW TO USE CLAMP DEAD ZONE DIAGRAMS

Example: When punching the following holes with tool station T3.



Measure the X and Y dimensions for holes A and B from the clamp center and, as shown in the following diagram, mark the positions for holes A and B in the clamp dead zone diagram.

### DEAD ZONE (T3)

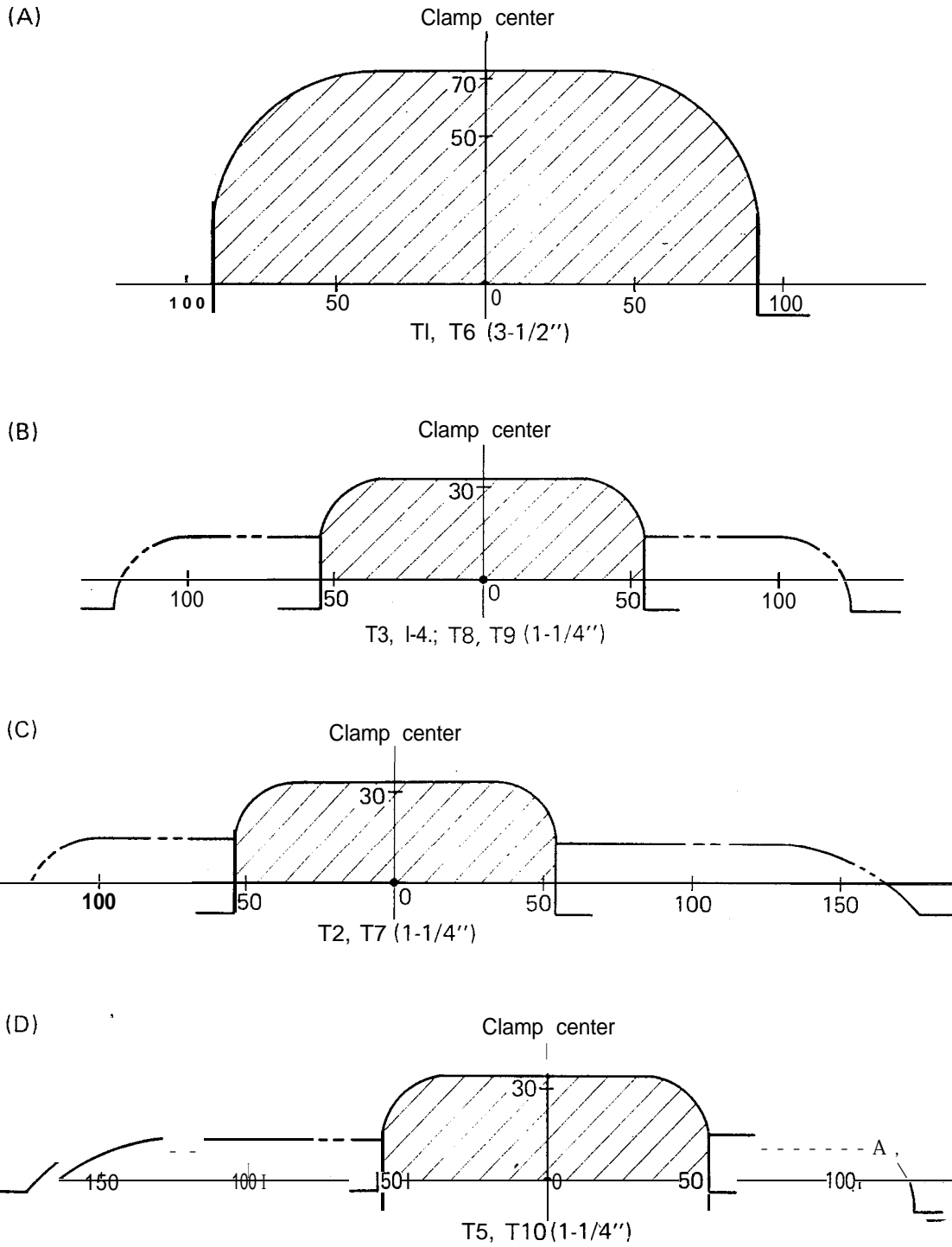


Hole A position is in the area where the clamp will be punched and hole B position is in the area where the clamp rests on adjacent dies. Consequently, in order to punch these holes, the following methods must be considered:

- Change the clamp position.
- Provide extra clamping area.
- Change the station to be used.
- Change the tool size to be used.
- Use the auto-repositioning function.

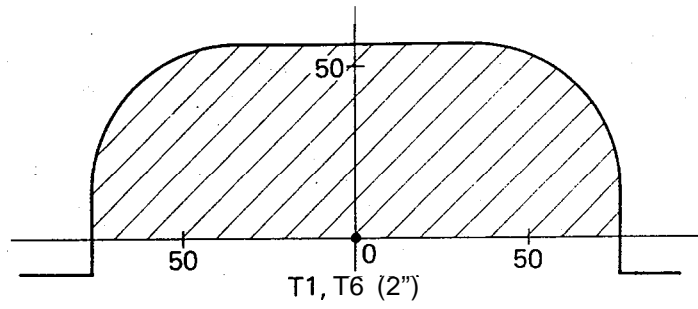
# DEAD ZONE DIAGRAMS

[IO-STATION TURRET]



(E)

Clamp center

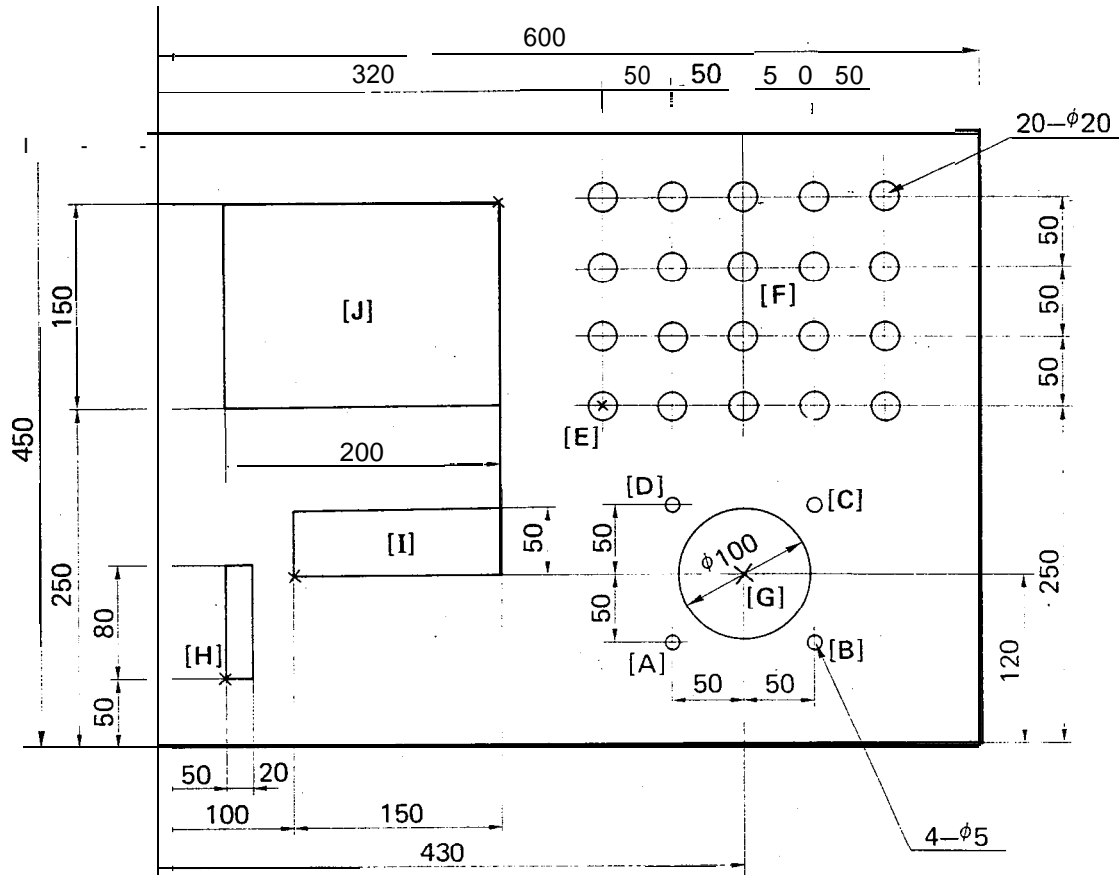


**[12-STATION TURRET]**

For 12-station turret, Fig. (B) is used.

# PROGRAMMING EXAMPLE

## EX. 1 GENERAL PUNCHING



T2: 5 mm dia.  
 T3: 20 mm dia.  
 T4: 20 mm x 20 mm

- NOTE: (a) The starting angle of nibbling arc "G" is 90 degrees to remove the scrap easily.  
 (b) The pattern origin of blanking "J" is on the right upper corner of the square and the opening lengths both "I" and "J" are negative value to remove the scrap easily.  
 (c) The blanking "I" is performed using "G66" function not to produce the scrap.  
 (d) Be careful of the "+" or "-" marks of tool length "P" and tool width "Q".

ACTUAL OPERATION

	<p>G90 X (X POSITION)          [ABS] Y (Y POSITION) T (TOOL NO.);          G90 X <input type="text" value="3"/> <input type="text" value="8"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="7"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> T <input type="text" value="2"/> <input type="text" value="INSRT"/></p>
	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="INPUT"/> Y <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="-"/> <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
	<p>G90 X (X POSITION)          [ABS] Y (Y POSITION) T (TOOL NO.);          G90 X <input type="text" value="3"/> <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="2"/> <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> T <input type="text" value="3"/> <input type="text" value="INSRT"/></p>
	<p>G36 I (PITCH X) P (#X SPACES)          [GRID-X] J (PITCH Y) K (#Y SPACES)          T (TOOL NO.);          G36 I <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> P <input type="text" value="4"/> <input type="text" value="INPUT"/> J <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/>          K <input type="text" value="3"/> <input type="text" value="INSRT"/></p>

[G]



G72 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 4 3 0 . INPUT Y 1 2 0 . INPUT



G68 I (RADIUS) J (START ANGLE)

[NIBBLE ARC] K (MOV. ANGLE). P (TOOL DIA.)

Q (NIB. PITCH) T (TOOL NO.); MOO (STOP);

G68 I 5 0 . INPUT J 9 0 . INPUT K 3 6 0 . INPUT

P - 2 0 . INPUT Q 3 . INPUT T INPUT ; MOO ; INPUT INPUT

[H]



G72 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 5 0 . INPUT Y 5 0 . INPUT



G66 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I 8 0 . INPUT J 9 0 . INPUT P - 2 0 . INPUT

Q INPUT K INPUT D INPUT T 4 INPUT

[I]



G72 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 1 0 0 . INPUT Y 1 2 0 . INSRT



G 6 6 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I 1 5 0 . INPUT J 0 INPUT P 2 0 . INPUT

Q 2 0 . INPUT K 5 0 . INSRT

[J]



G72 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 2 5 0 . INPUT Y 4 0 0 . INSRT



G67 I (LENGTH X) J (WIDTH Y)

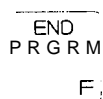
[SQUARE] P (TOOL LTH. X) Q (TOOL WTH. Y)

T (TOOL NO.); MOO (STOP);

G67 I - 2 0 0 . INPUT J - 1 5 0 . INPUT

P 2 0 . INPUT Q INPUT T INPUT ; MOO; INPUT INSRT

Program end



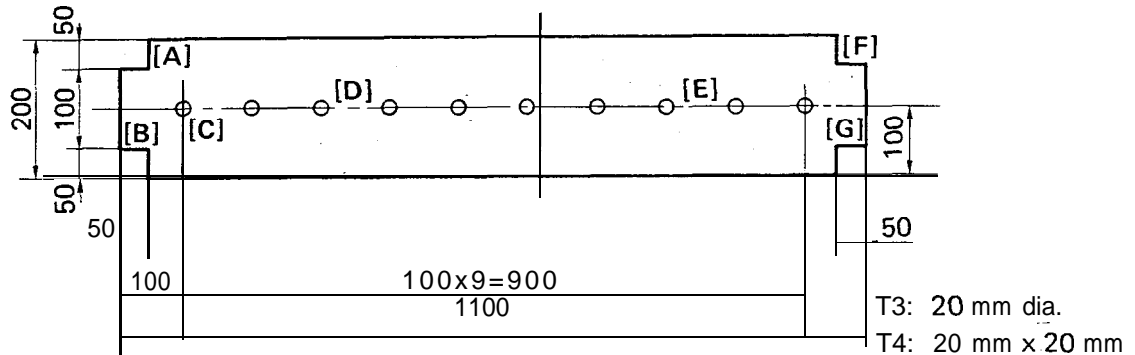
G50 ;

[ E N D ]

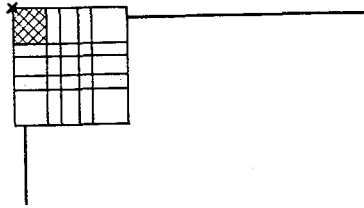
G50 ; INSRT



## EX. 2 PUNCHING WITH AUTO REPOSITIONING





NOTE: (a) Notching is performed from the outside of the worksheet and the order of punching must be taken care not to produce the scrap.



- (b) The edge of the punch must be out of the edge of the worksheet not to produce the needle-shaped scrap as the figure above.
- (c) The PUNCH-OFF function "G70" must be used to transfer the worksheet when the last punching position is in the following case on intending to perform the auto-repositioning.
- The X-axis absolute value is less than the repositioning travel distance.
  - The Y-axis absolute value is less than 50 mm (2").
  - Both two workholders do not hold the worksheet when they are down.
- (d) The tool width "Q" can be omitted when a square punch is used ("P" = "Q") on "G66" function.

ACTUAL OPERATION (ARIES-2221)


**[A]**

G72 X (X POSITION)  
 [PATTRN ORIGIN] Y (Y POSITION);

G72 X     Y




G66 I (LENGTH) J (ANGLE)  
 [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
 K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I     J   P

Q  K     D  T

---


**[B]**



G72 X (X POSITION)  
 [PATTRN ORIGIN] Y (Y POSITION);

G72 X     Y




G66 I (LENGTH) J (ANGLE)  
 [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
 K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I     J   P     Q

K

---

**[C]**



G90 X (X POSITION)  
 [ABS] Y (Y POSITION) T (TOOL NO.);

G90 X      Y

T

[D]



**G28** I (PITCH) J (ANGLE)

[LINE ANGLE1 K (NO. HOLE) T (TOOL NO.) ;

G28 I      J   K



**G25** X (DISTANCE) ;

[REPOSITION 2 WITH OFFSET]

G25 X

[E]



**G28** I (PITCH) J (ANGLE)

[LINE ANGLE1 K (NO. HOLE) T (TOOL NO.) ;

G28 I      J   K

[F]



**G72** X (X POSITION)

[PATTRN ORIGIN1 Y (Y POSITION) ;

G72 X       Y



**G66** I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.) ;

K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;

G66 I     J

P     Q  K     D

T

[G]



G72 X (X POSITION)

[PATTERN ORIGIN] Y (Y POSITION) ;

G72 X 1 1 0 1 . INPUT Y - 1 . INSRT



G66 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;

G66 I 5 1 . INPUT J 1 8 0 . INPUT ..

P - 2 0 . INPUT Q INPUT K 5 1 . INSRT

Program end










G50 ;

[END]

G50 ; INSRT

ACTUAL OPERATION (ARIES-2241)

<p>[C]</p>		<p>G90 X (X POSITION)                      [ABS] Y (Y POSITION) T (TOOL NO.) ;                      G90 X <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/>                      T <input type="text" value="3"/> <input type="text" value="INSRT"/></p>
<p>[D]</p>		<p>G28 I (PITCH) J (ANGLE)                      [LINE ANGLE] K (NO. HOLE) T (TOOL NO.) ;                      G28 I <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> J <input type="text" value="0"/> <input type="text" value="INPUT"/> K <input type="text" value="9"/> <input type="text" value="INSRT"/></p>
<p>[A]</p>		<p>G72 X (X POSITION)                      [PATTRN ORIGIN] Y (Y POSITION) ;                      G72 X <input type="text" value="-"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
		<p>G66 I (LENGTH) J (ANGLE)                      [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)                      K (WIDTH) D (MIC. JOINT) T (TOOL NO.);                      G66 I <input type="text" value="5"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/> J <input type="text" value="0"/> <input type="text" value="INPUT"/> P <input type="text" value="-"/> <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/>                      Q <input type="text" value="INPUT"/> K <input type="text" value="5"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/> D <input type="text" value="INPUT"/> T <input type="text" value="4"/> <input type="text" value="INSRT"/></p>
<p>[B]</p>		<p>G72 X (X POSITION)                      [PATTRN ORIGIN] Y (Y POSITION) ;                      G72 X <input type="text" value="-"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="-"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/></p>
		<p>G66 I (LENGTH) J (ANGLE)                      [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)                      K (WIDTH) D (MIC. JOINT) T (TOOL NO.);                      G66 I <input type="text" value="5"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INPUT"/> J <input type="text" value="0"/> <input type="text" value="INPUT"/> P <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Q <input type="text" value="INPUT"/>                      K <input type="text" value="5"/> <input type="text" value="1"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
		<p>G70 X (X POSITION)                      [PUNCH OFF] Y (Y POSITION) T (TOOL NO.) ;                      G70 X <input type="text" value="6"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="1"/> <input type="text" value="8"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/></p>



G25 X (DISTANCE) ;  
[REPOSITION 2 WITH OFFSET]

G25 X 1 0 0 .

[F]



G72 X (X POSITION)  
[PATTERN ORIGIN] Y (Y POSITION) ;

G72 X 1 1 0 1 .  Y 2 0 1 .



G66 I (LENGTH) J (ANGLE)  
[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.) ;  
K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;

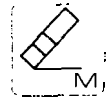
G66 I 5 1 .  J 1 8 0 .   
P 2 0 .  Q  K 5 1 .

[G]



G72 X (X POSITION)  
[PATTERN ORIGIN] Y (Y POSITION) ;

G72 X 1 1 0 1 .  Y - 1 .



G66 I (LENGTH) J (ANGLE)  
[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;

G66 I 5 1 .  J 1 8 0 .   
P - 2 0 .  Q  K 5 1 .

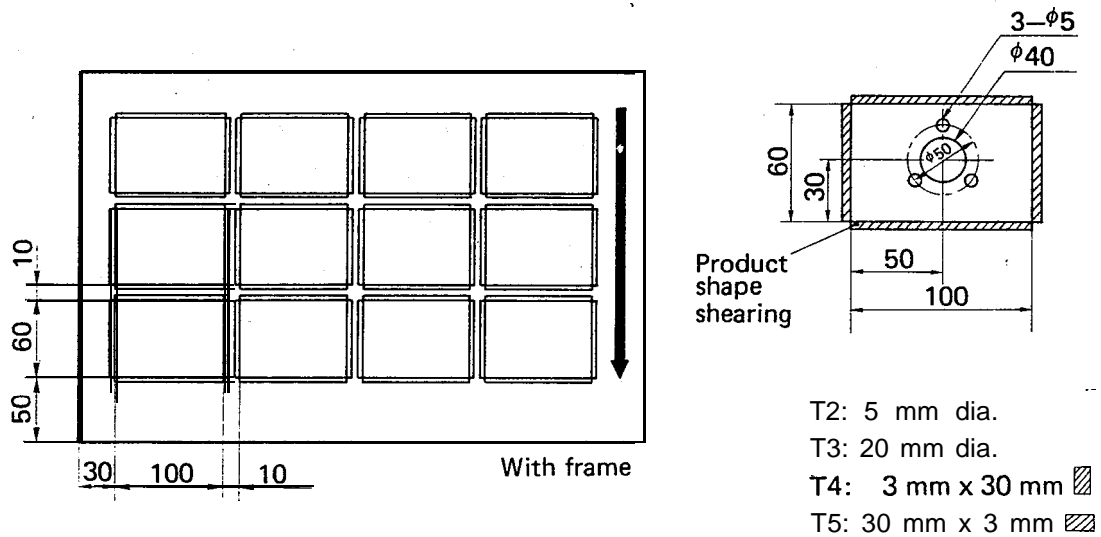
Program end



G50 ;  
[END]

G50 ;

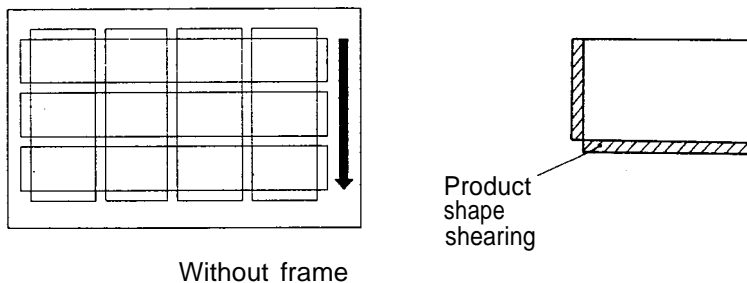
### EX. 3 MULTIPLE PART PUNCHING



NOTE: (a) There are two- method of the product shearing for multiple part punching, the way with frame or without frame.

For the way with frame, 2 vertical cuts and 2 horizontal cuts are required on each product.

For the way without frame, 1 vertical cut and 1 horizontal cut are required on each product. But, as each one row for the vertical cut and horizontal cut remains unpunched one number must be added to "P" of G98 for vertical cut and "K" of G98 for horizontal cut.





(b) The pattern origin position must be punched not to produce the scrap in the center of the circle when nibbling the circle more than 40 mm dia. using 20 mm , dia. punch.

(c) On the product shape shearing, make vertical cut first and then make horizontal cut from the top to the bottom as the arrow in the figure.



**ACTUAL OPERATION (THE WAY WITH FRAME)**



**Setting for multiple part punching**




**G98** X (OFFSET X) Y (OFFSET Y)  
 [MULTI PART] I (PART LTH.X) J (PART WTH. Y)  
 P (NO. PART-1X) K (NO. PART-1Y) D (SPACING) ;  
**G98** X     Y      
**I**      **J**     **P**    
**K**   **D**



---

**φ5 punching part program into memory**



**U**



**G72** X (X POSITION)  
 [PATRN ORIGIN1 Y (Y POSITION) ;  
**G72** X     Y


**G26** I (RADIUS) J (START ANGLE)  
 [BOLT HOLE1 K (NO. HOLE) T (TOOL NO.) ;  
**G26** **I**     **J**     **K**   **T**



**V**



**φ20 punching part program into memory**



U 2 (EOB) (INSRT)



G90 X (X POSITION)

[ABS] Y (Y POSITION) T (TOOL NO.);

G90 X 5 0 . (INPUT) Y 3 0 . (INPUT) T 3 (INSRT)



G68 I (RADIUS) J (START ANGLE)

[NIBBLE ARC] K (MOV. ANGLE) P (TOOL DIA.)

Q (NIB. PITCH) T (TOOL NO.1 ; MOO (STOP) ;

G68 I 2 0 . (INPUT) J 0 P - 2 0 .

K 3 6 0 . (INPUT) Q 3 . (INSRT)



V 2 (EOB) (INSRT)

**Vertical cut part program into memory**

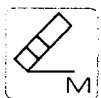
-REPOS - U 3 (EOB) (INSRT)  
I  
U



G 7 2 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION) ;

G72 X 0 (INPUT) Y 0 (INSRT)



G66 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;

G66 I 6 0 . (INPUT) J 9 0 . (INPUT) P 3 0 . (INPUT)

Q 3 . (INPUT) K (INPUT) D - 0 . 1 (INPUT) T 4 (INSRT)

**Vertical cut part program into memory (continued)**



G72 X (X POSITION)  
 [PATTERN ORIGIN] Y (Y POSITION) ;  
 G72 X 1 0 0 . INPUT Y 6 0 . INSRT



G66 I (LENGTH) J (ANGLE)  
 [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
 K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;  
 G66 I 6 0 . INPUT J - 9 0 . INPUT  
 P 3 0 . INPUT Q 3 . INPUT K INPUT  
 D - 0 . 1 INSRT



V 3 (EOB) INSRT

**Horizontal cut part program into memory**



U 4 (EOB) INSRT



G72 X (X POSITION)  
 [PATTERN ORIGIN] Y (Y POSITION) ;  
 G72 X 1 0 0 . INPUT Y 6 0 . INSRT



G66 I (LENGTH) J (ANGLE)  
 [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
 K (WIDTH) D (MIC. JOINT) T (TOOL NO.)  
 G66 I 1 0 0 . INPUT J 1 8 0 . INPUT  
 P 3 0 . INPUT Q 3 . INPUT K INPUT  
 D - 0 . 1 INPUT T 5 INSRT

Horizontal cut part program into memory (continued)



G72 X(X POSITION)  
[PATRN ORIGIN] Y(Y POSITION) ;

G72 X 0 INPUT Y 0 INSRT



G66 I (LENGTH) J (ANGLE)  
[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)  
K (WIDTH) D (MIC. JOINT) T (TOOL NO.)

G66 I 1 0 0 . INPUT J 0 INPUT  
P - 3 0 . INPUT Q - 3 . INPUT K 0 INPUT  
D - 0 . 1 INSRT



V. 4 (EOB) INSRT

φ5 punching part program into execution



G75 W (MACRO NO.)  
[G98 RECALL X DIR.1 Q (QUADRANT) ;

G75 W 1 INPUT Q 4 INSRT

φ20 punching part program in execution



G 7 5 W (MACRO NO.)  
[G98 RECALL X DIR.] Q (QUADRANT) ;

G75 W 2 INPUT Q 1 INSRT

Vertical cut part program in execution



G75 W (MACRO NO.)  
[G98 RECALL X DIR.] Q (QUADRANT) ;

G75 W 3 INPUT Q 4 INSRT

Horizontal cut part program in execution



G75 W (MACRO NO.)  
[G98 RECALL X DIR.1 Q (QUADRANT) ;

G75 W 4 INPUT Q 4 INSRT

Program end





G50 ;

[END]

G50 ; INSRT



**ACTUAL OPERATION (THE WAY WITHOUT FRAME)**



**Setting for multiple part punching**




**G98**                    **X (OFFSET X) Y (OFFSET Y)**  
**[MULTI PART] I (PART LTH. X) J (PART WTH. Y)**  
**P (NO. PART-1x) K (NO. PART-1Y) D (SPACING) ;**  
 G98 X     Y      
 I      J     P    
 K   D



---

**\$5 punching part program into memory**




**U**

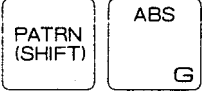


**G72**                    **X (X POSITION)**  
**[PATRN ORIGIN] Y (Y POSITION) ;**  
 G72 X     Y



**G26**                    **I (RADIUS) J (START ANGLE)**  
**[BOLT HOLE] K (NO. HOLE) T (TOOL NO.) ;**  
 G26 I     J     K    
 T

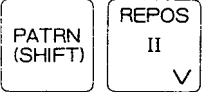


**V**

**φ20 punching part program into memory**




 U


 G90 X (X POSITION)  
 [ABS] Y (Y POSITION) ;  
 G90 X         Y        T



 G68 I (RADIUS) J (START ANGLE)  
 [NIBBLE ARC.] K (MOV. ANGLE) P (TOOL DIA.)  
 Q (NIB. PITCH) T (TOOL NO.) ; MOO (STOP) ;  
 G68 I         J       K                    P          Q


 V

**φ5 punching part program in execution**



 G75 W (MACRO NO.)  
 [G98 RECALL X DIR.1 Q (QUADRANT) ;  
 G75 W       Q

**φ20 punching part program in execution**


 G75 W (MACRO NO.)  
 [G98 RECALL X DIR.] Q (QUADRANT) ;  
 G75 W       Q

**Setting for multiple part vertical cut**



**G98 X (OFFSET X) Y (OFFSET Y)**  
 [MULTIPART] **I (PART LTH. X) J (PART WTH. Y)**  
**P (NO. PART-IX) K (NO. PART-1Y) D (SPACING) ;**

G98 X   .  Y   .   
 I    .  J   .  P    
 K   D  .

**Vertical cut part program into memory**



U



**G72 X (X POSITION)**  
 [PATRN ORIGIN] **Y (Y POSITION) ;**

G72 X   Y



**G66 I (LENGTH) J (ANGLE)**  
 [SHEAR PRF.] **P (TOOL LTH.) Q (TOOL WID.)**  
**K (WIDTH) D (MIC. JOINT) T (TOOL NO.) ;**

G66 I   .  J   .  P   .   
 Q  .  K  D   .   T



V

**Vertical cut part program in execution**



**G75 W (MACRO NO.)**  
 [G98 RECALL X DIR.] **Q (QUADRANT) ;**

G75 W   Q

### Setting for multiple part horizontal cut



**G98** X (OFFSET X) Y (OFFSET Y)  
 [MULTI PART] I (PART LTH. X) J -(PART WITH. Y)  
 P (NO. PART-IX) K (NO. PART-1Y) D (SPACING) ;

G98 X     Y      
 I      J     P    
 K   D

### Horizontal cut part program into memory



U

G72

X (X POSITION)

[PATRN ORIGIN]

Y (Y POSITION) ;

G72 X   Y



**G66** I (LENGTH) J (ANGLE)  
 [SHEAR PRF.] P (TOOL LTH.) Q (TOOL WID.)  
 K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I      J   P       
 Q     K  D      T



V

### Horizontal cut part program in execution



**G75** W (MACRO NO.)

[G98 RECALL X DIR.] Q (QUADRANT) ; )

G75 W   Q

### Program end

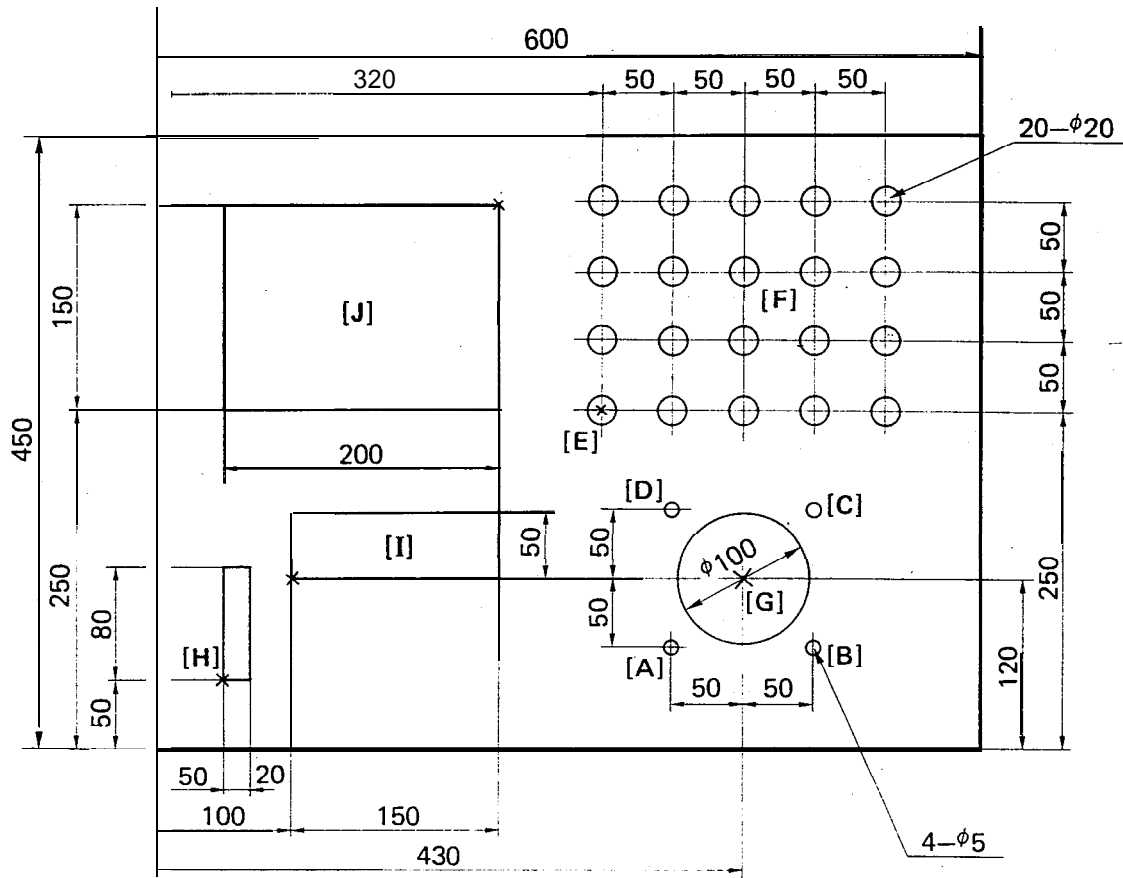


G50 ;

[END]

G50 ;

EX. 4 GENERAL PUNCHING (Example of plotting data entry)












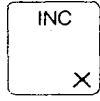
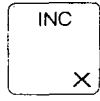
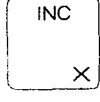
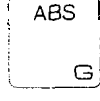
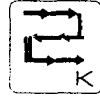
- T2: 5 mm dia.
- T3: 20 mm dia.
- T4: 20 mm x 20 mm
- WORK SIZE X600 Y450
- CLAMP POSITION A100 B400

NOTE: "Q (Tool size Y)" cannot be omitted in "02:SQ" when tool data are entered as plotting parameters, even though the tool size X "P" and tool size Y "Q" are the same (a square punch is used).



**ACTUAL OPERATION (Example of plotting data entry)**

		<input type="text" value="1"/>	<input type="text" value="INPUT"/>	<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>"01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP)</p> <p>[TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)</p> <p>J (ANGLE);</p> <p>*01 T <input type="text" value="2"/> <input type="text" value="INPUT"/> R <input type="text" value="1"/> <input type="text" value="INPUT"/> P <input type="text" value="5"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
		<input type="text" value="1"/>	<input type="text" value="INPUT"/>	<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>"01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 0: SP)</p> <p>[TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)</p> <p>J (ANGLE);</p> <p>*01 T <input type="text" value="3"/> <input type="text" value="INPUT"/> R <input type="text" value="1"/> <input type="text" value="INPUT"/> P <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
		<input type="text" value="1"/>	<input type="text" value="INPUT"/>	<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>"01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 0: SP)</p> <p>[TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)</p> <p>J (ANGLE);</p> <p>*01 T <input type="text" value="4"/> <input type="text" value="INPUT"/> R <input type="text" value="2"/> <input type="text" value="INPUT"/> P <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/></p> <p>Q <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> J <input type="text" value="0"/> <input type="text" value="INSRT"/></p>
		<input type="text" value="2"/>	<input type="text" value="INPUT"/>	<p>1 : TOOL -DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>"02: WORK X (WORK SIZE X) Y (WORK SIZE Y)</p> <p>[WORK SIZE1</p> <p>*02 X <input type="text" value="6"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="4"/> <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/></p>
		<input type="text" value="3"/>	<input type="text" value="INPUT"/>	<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>"03: CLAMP A (CLAMP POSITION A)</p> <p>B (CLAMP POSITION B)</p> <p>*03 A <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> B <input type="text" value="4"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>

<p>[A]</p> 	<p>G90 X (X POSITION)          [ABS] Y (Y POSITION) T (TOOL NO.);          G90 X <input type="text" value="3"/> <input type="text" value="8"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="7"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> T <input type="text" value="2"/> <input type="text" value="INSRT"/></p>
<p>[B]</p> 	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
<p>[C]</p> 	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="INPUT"/> Y <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
<p>[D]</p> 	<p>G91 X (X POSITION)          [INC] Y (Y POSITION) T (TOOL NO.);          G91 X <input type="text" value="-"/> <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INSRT"/></p>
<p>[E]</p> 	<p>G90 X (X POSITION)          [ABS] Y (Y POSITION) T (TOOL NO.);          G90 X <input type="text" value="3"/> <input type="text" value="2"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> Y <input type="text" value="2"/> <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> T <input type="text" value="3"/> <input type="text" value="INSRT"/></p>
<p>[F]</p> 	<p>G36 I (PITCH X) P (#X SPACES)  <b>[GRID-XI]</b> J (PITCH Y) K (#Y SPACES)          T (TOOL NO.);          G36 I <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/> P <input type="text" value="4"/> <input type="text" value="INPUT"/> J <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="."/> <input type="text" value="INPUT"/>          K <input type="text" value="3"/> <input type="text" value="INSRT"/></p>

[G]



G72 X (X POSITION).

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 4 3 0 . INPUT Y 1 2 0 . INSRT



G68 I (RADIUS) J (START ANGLE) .

[NIBBLE ARC] K (MOV. ANGLE) P (TOOL DIA.)

Q (NIB. PITCH) T (TOOL NO.); M00 (STOP);

G68 I 5 0 . INPUT J 9 0 . INPUT K 3 6 0 . INPUT  
P - 2 0 . INPUT Q 3 . INPUT T INPUT ; M00; INPUT INSRT

[H]



G72 X (X POSITION)

[PATTRN ORIGIN] Y (Y POSITION);

G72 X 5 0 . INPUT Y 5 0 . INSRT



G66 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I 8 0 . INPUT J 9 0 . INPUT P - 2 0 . INPUT  
Q INPUT K INPUT D INPUT T 4 INSRT

[I]

PATRN  
ORG

i - Q

G72' X (X POSITION)

[PATRN ORIGIN] Y (Y POSITION);

G72 X 1 0 0 . INPUT Y 1 2 0 . INSRT



G66 I (LENGTH) J (ANGLE)

[SHEAR PRF.] P (TOOL LTH.) Q (TOOL WTH.)

K (WIDTH) D (MIC. JOINT) T (TOOL NO.);

G66 I 1 5 0 . INPUT J 0 INPUT P 2 0 . INPUT

Q 2 0 . INPUT K 5 0 . INSRT

[J]



G72 X (X POSITION)

[PATRN ORIGIN] Y (Y POSITION);

G72 X 2 5 0 . INPUT Y 4 0 0 . INSRT



G67 I (LENGTH X) J (WIDTH Y)

[SQUARE] P (TOOL LTH. X) Q (TOOL WTH. Y)

T (TOOL NO.); M00 (STOP);

G67 I - 2 0 0 . INPUT J - 1 5 0 . INPUT

P 2 0 . INPUT Q INPUT T INPUT ; M00; INPUT INSRT

Program end






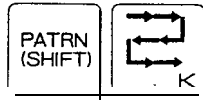
G50 ;

[END]

G50 ; INSRT

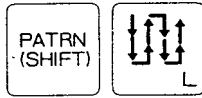
## DISPLAYED FORMAT ON CRT

PATRN (SHIFT)	COORD  A	<b>G92</b> [COORD]	X (X POSITION) Y (Y POSITION) ;
PATRN (SHIFT)	PUNCH OFF  B	G70 [PUNCH <b>OFF1</b>	X (X POSITION) Y (Y POSITION) T (TOOL NO.) ;
PATRN (SHIFT)	PATRN ORG  C	G72 [PATRN ORIGIN1	X (X POSITION) Y (Y POSITION) ;
PATRN (SHIFT)	OFFST  D	<b>G93</b> [OFFSET]	X (OFFSET X) Y (OFFSET Y) ;
PATRN (SHIFT)	DWELL  E	G04 [DWELL]	X (LENGTH OF PAUSE) ;
PATRN (SHIFT)	END PRGRM  F	G50 ; [END]	
PATRN (SHIFT)	ABS  G	<b>G90</b> [ABS]	X (X POSITION) Y (Y POSITION) T (TOOL NO.) ;
PATRN (SHIFT)	 H	G26 [BOLT HOLE]	I (RADIUS) J (START ANGLE) K (NO. HOLE) T (TOOL NO.) ;
PATRN (SHIFT)	 J	G28 [LINE ANGLE]	I (PITCH) J (ANGLE) K (NO. HOLE) T (TOOL NO.) ;
PATRN (SHIFT)	 J	G29 [ARC]	I (RADIUS) J (START ANGLE) K (NO. HOLE) P (ANGLE INCR.) T (TOOL NO.) ;



G36  
[GRID-X]

I (PITCH X) P (#X SPACES)  
J (PITCH Y) K (#Y SPACES)  
T (TOOL NO.) ;



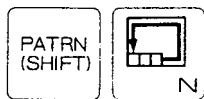
G37  
[GRID-Y]

I (PITCH X) P (#X SPACES)  
J (PITCH Y) K (#Y SPACES)  
T (TOOL NO.) ;



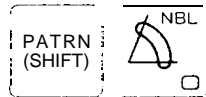
G66  
[SHEAR PRF.]  
K (WIDTH)

I (LENGTH) J (ANGLE)  
P (TOOL LTH.) Q (TOOL WTH.)  
D (MIC. JOINT) T (TOOL NO.) ;



G67  
[SQUARE]

I (LENGTH X) J (WIDTH Y)  
P (TOOL LTH. X) Q (TOOL WTH. Y)  
T (TOOL NO.) ; MOO (STOP) ;



G68  
[NIBBLE ARC]  
Q (NIB. PITCH)

I (RADIUS) J (START ANGLE)  
K (MOV. ANGLE) P (TOOL DIA.)  
T (TOOL NO.) ; MOO (STOP) ;



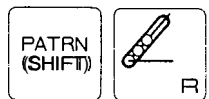
G69  
[NIBBLE LINE]

I (LENGTH) J (ANGLE)  
P (TOOL DIA.) Q (NIB. PITCH)  
T (TOOL NO.) ;



G78  
[PUNCH ARC]  
Q (NIB. PITCH)

I (RADIUS) J (START ANGLE)  
K (MOV. ANGLE) P (TOOL DIA.)  
D (THICKNESS) T (TOOL NO.) ;



G79  
[PUNCH LINE]

I (LENGTH) J (ANGLE)  
P (TOOL DIA.) Q (NIB. PITCH)  
D (THICKNESS) T (TOOL NO.) ;



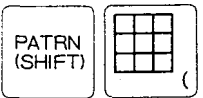
G27 X (DISTANCE) ;  
[REPOSITION 1]



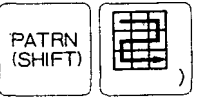
G25 X (DISTANCE) ;  
[REPOSITION 2 WITH OFFSET]



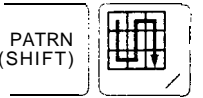
G91 X (X POSITION)  
[INC] Y (Y POSITION) T (TOOL NO.) ;



G98 X (OFFSET X) Y (OFFSET Y)  
[MULTI PART] I (PART LTH. X) J (PART WTH. Y)  
P (NO. PART-1X) K (NO. PART-1Y) D (SPACING) ;



G75 W (MACRO NO.)  
[G98 RECALL X DIR.] Q (QUADRANT) ;



G76 W (MACRO NO.)  
[G98 RECALL Y DIR.1] Q (QUADRANT) ;