

NC TURRET PUNCH PRESS

ARIES 245

PROGRAMMING MANUAL

JUNE 1988

Copyright © 1998 by Amada Engineering & Service Co., Inc.
14921 East Northam Street, La Mirada, CA 90638

All rights reserved. No part of this book shall be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher. No patent liability is assumed with respect to the use of the information contained herein. While every precaution has been taken in the preparation of this book, the publisher assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein.

CONTENTS

PROGRAMMING BASICS

PROCESS FOR THE PRODUCTS	1-1
PROGRAMMING	1-2
CALCULATION OF COORDINATES	1-3
BASIC FUNCTION CODES	1-4
TAPE FORMAT	1-4
G92 - ESTABLISHING COORDINATE SYSTEM	1-4
G90 - ABSOLUTE PROGRAMMING	1-5
G91 - INCREMENTAL PROGRAMMING	1-5
G70 - PUNCH OFF (NO PUNCHING)	1-5
G27 - AUTO REPOSITIONING	1-6
G25 - AUTO REPOSITIONING	1-7
G50 - HOME RETRACT	1-7
MOO - PROGRAM STOP	1-8
M01 - OPTIONAL STOP	1-8
MO8 - PUNCH DELAY START, MO9 - PUNCH DELAY CANCEL	1-8
MI2 - NIBBLING START, MI3 - NIBBLING CANCEL	1-9
TOO - DESIGNATION OF TOOL NUMBER	1-9
NO000 - SEQUENCE NUMBER	1-9
FO - DESIGNATION OF AXIS FEED SPEED	1-10
PROGRAM NAME	1-10
PROGRAMMING PROCEDURE	1-11
HINTS ON PROCESSING	1-13
CALCULATING LONG RECTANGULAR HOLE	1-15
CALCULATING LARGE RECTANGULAR OPENING	1-17
CALCULATING RECTANGULAR OPENING WITH ROUNDED CORNERS	1-19
CALCULATING 45° NOTCH	1-22
HINTS ON PROGRAMMING	1-25
HINTS ON AUTO REPOSITIONING	1-26

BASIC SOFTWARE

G72 - DESIGNATION OF PATTERN ORIGIN	2-1
G22 - LINE AT DISTANCE	2-2
G28 - LINE AT ANGLE	2-3
G29 - ARC	2-5
G26 - BOLT HOLE CIRCLE	2-7
G36 - GRID-X, G37 - GRID-Y	2-9
G66 - SHEAR PROOF	2-11
G67 - SQUARE	2-13
G68 - NIBBLING ARC	2-15
G69 - NIBBLING LINE	2-17
G78 - PUNCHING ARC	2-19
G79 - PUNCHING LINE	2-21
PATTERN MEMORY AND PATTERN RECALL	2-22
G93 - OFFSET	2-24
MACRO FUNCTION	2-26
G73 - SYMMETRY	2-30
G77 - ROTATION	2-31
BLOCK DELETION	2-32
INPUT OF DECIMAL POINT	2-32

MULTIPLE PART PUNCHING

GENERAL DESCRIPTION AND PROGRAMMING EXAMPLE	3-1
G98 - SETTING OF REFERENCE POINT AND LAYOUT FOR MULTIPLE PART PUNCHING	3-4
U00 TO V00 - STORING OF PART PROGRAM	3-8
G75, G76 W00 Q0 - RECALLING AND EXECUTION OF PART PROGRAM	3-10
TRIAL PUNCHING, POST-TRIAL PUNCHING, AND FULL PUNCHING	3-14

CLAMP DEAD ZONE DIAGRAM

CLAMP DEAD ZONE	4-1
HOW TO USE DEAD ZONE DIAGRAMS	4-2
DEAD ZONE DIAGRAMS	4-3

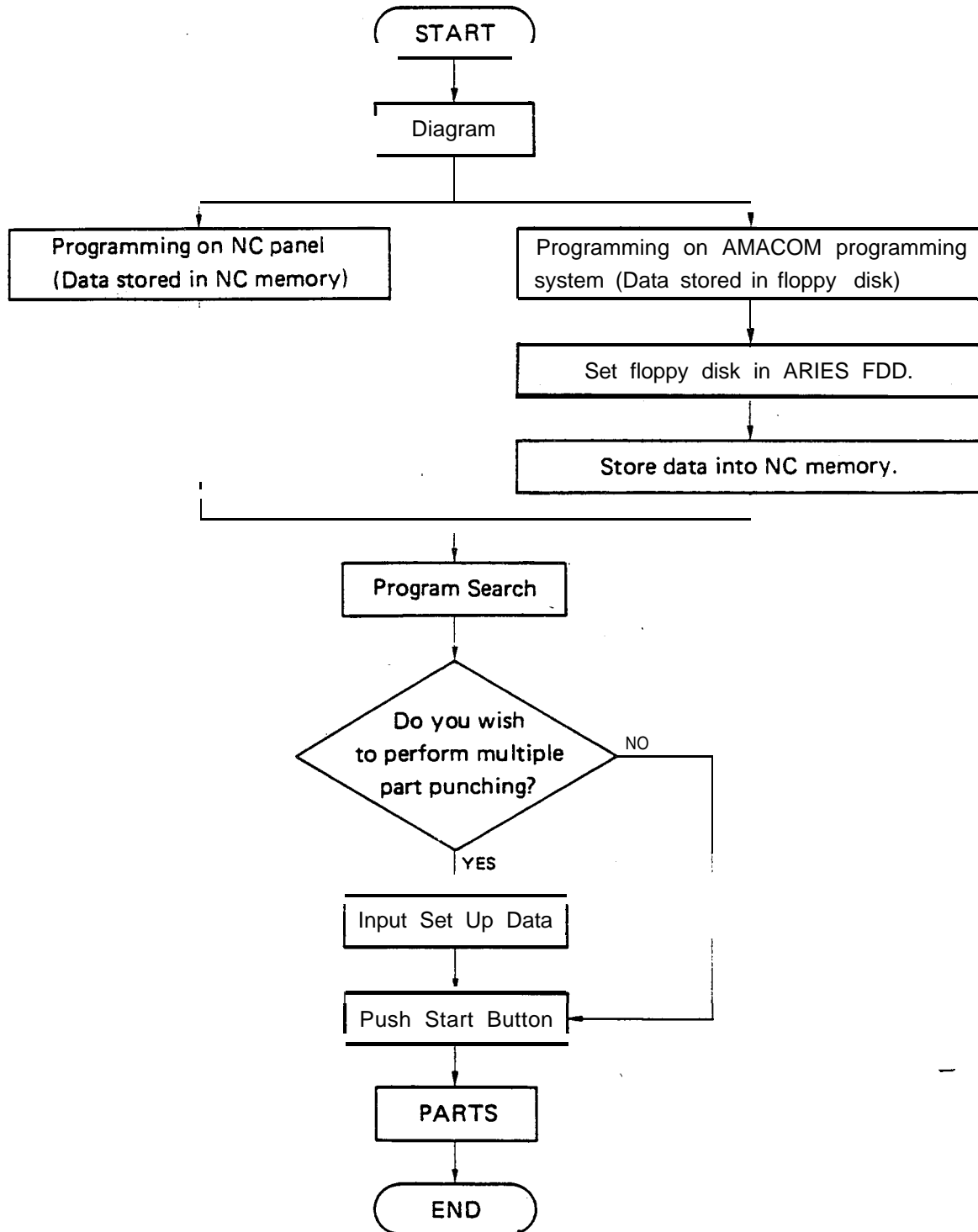
(APPENDIX) PROGRAMMING EXAMPLE

EX. 1 GENERAL PUNCHING	5-1
EX. 2 PUNCHING WITH AUTO REPOSITIONING	5-6
EX. 3 MULTIPLE PART PUNCHING	5-11

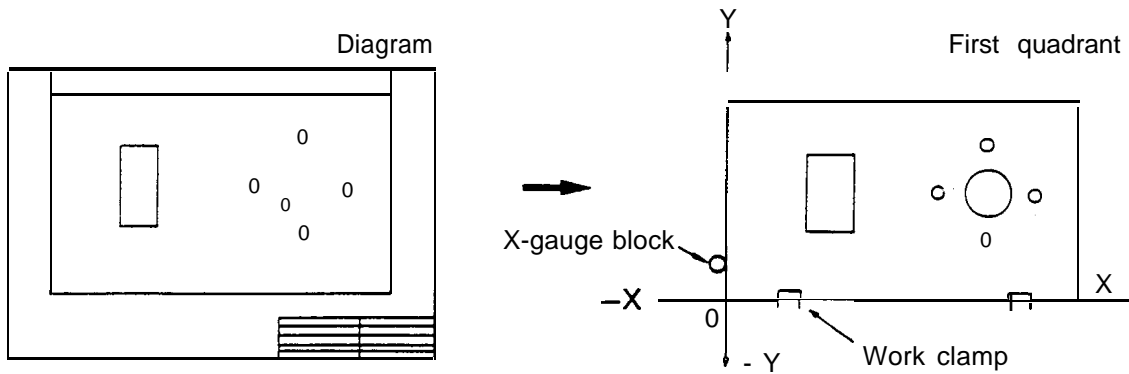
(APPENDIX) DISPLAYED FORMAT ON CRT	6-1
--	-----

PROGRAMMING BASICS

PROCESS FROM DIAGRAM TO PARTS



PROGRAMMING



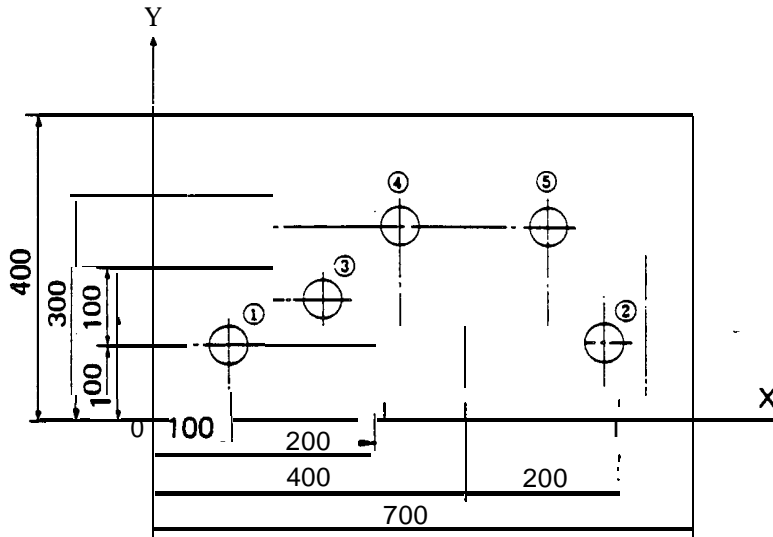
1. Diagram → First quadrant of X and Y coordinate system
2. Calculation of coordinates
3. x _____ Y _____ T _____

UNIT OF MEASUREMENT FOR PROGRAMS

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

	Calculations	Program		Calculations	Program
100 mm	→ 100.00	- 1 0 0 .	20"	→ 20.000~	→ 20.
35.5 mm	→ 35.50	→ 35.5	2.7"	→ 2.700	→ 2.7
0mm	- 0	→ 0	0"	- 0	- 0

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

- GOO "G" function (Preparatory function)
- MOO "M" function (Miscellaneous function)
- TOO "T" function (Tool function)
- NO000 Sequence number

FORMAT

Arrange the function codes as follows:

N O 0 0 0 G O O G O O X ± 0 0 0 0 0 Y ± 0 0 0 0 0 T O O M O O

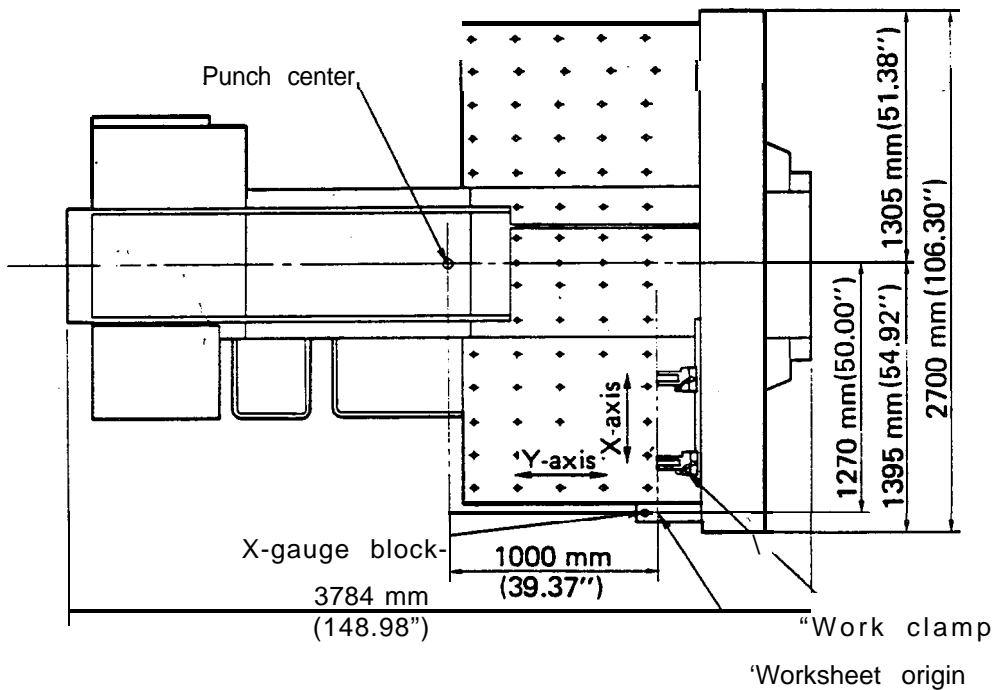
- NOTE: a) Unnecessary codes need not be entered.
 b) Enter only necessary digits of X, Y and N.
 c) The plus sign (+) of X and Y can be omitted.

G92 – ESTABLISHING COORDINATE SYSTEM

COORD
 PATRN (SHIFT)
 92-A

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
 G92 X1270. Y1000. G92 X50. Y39.37



G90 – ABSOLUTE PROGRAMMING

 ABS
PATRN
(SHIFT) 90 G

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. Y1 00. T2 (Absolute value)
(2) x300. Y1 00. (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

 INC
PATRN
(SHIFT) 91 X

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 X1 00. Y1 00. T2 (Absolute value)
(2) G91 X2 00. 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

 PUNCH
 OFF
PATRN
(SHIFT) 70 B

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

- Ex.: G90 X100. Y100. T2
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

PATRN (SHIFT)	REPOS	INPUT
27	U.	

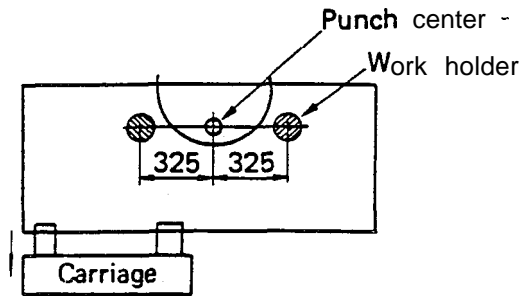
This code is used to extend the punching range in the X-axis direction. Enter "G27" and the X-axis value.

Ex.: **G27 X500.**

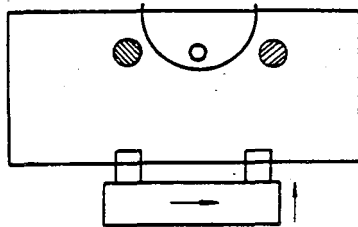
The X-axis value must be designated by an incremental value.

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.

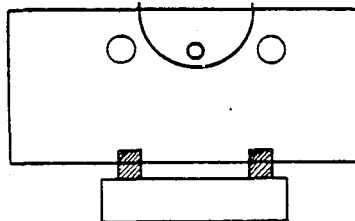
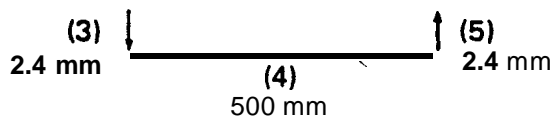
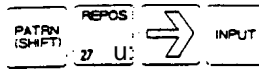


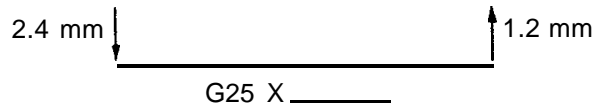
Table and Carriage movement



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:

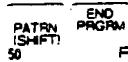


First the table moves 2.4 mm in the positive direction from the current position. Then the carriage moves X_____ from the current position and the table moves 1.2 mm in the negative direction. Next, the X and Y coordinate system is offset by Y1.2 to compensate for the difference between the table positions 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 1009.0 mm (-0.448" to 39.724")

G50 – HOME RETRACT

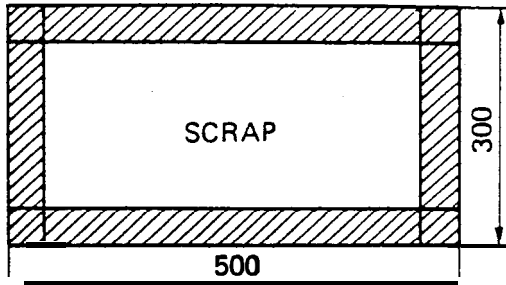


When "G50" is read, the carriage and table return to their origins. No punching occurs during the retraction. The offset values designated by "G93" and "G98" are cancelled. "G50" must be entered as a single block; however, the sequence number can be entered along with it.

MOO — PROGRAM STOP

Enter "MOO" if a program stop is desired.

- E x . Punching a 300 mm x 500 mm rectangular opening with a 50 mm x 50 mm square punch.



G92 X1270. Y1000.

.....

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 OPTIONAL STOP key is lighted. (See Page 13 of 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 4.5 mm (0.18"). "M08" and "M09" must be entered as a single block, respectively.

G92 X1270. Y1000.

..... } Standard hit rate

M08

G90 X____Y____; } Low hit rate

M09

..... } Standard hit rate

G50

M12 — NIBBLING START

M13 — NIBBLING CANCEL

When "M12" is read, nibbling is performed until "M13" 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 _____

M13

.....

.....

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

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 X1270. Y1000.
G90 X450. Y300. T2
G91 X50.00 (T2 not required)
x50.00 (T2 not required)
G90 X500. Y450. T3

NO000 — 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.

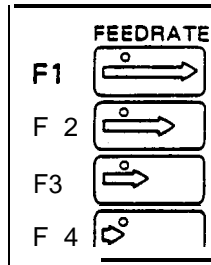
Ex.: G92 X1270. Y1000.
NO001 G90 X450. Y300. T2
NO002 G91 X50.
NO003 x50.
NO004 G90 X500. Y450. T3
N9999 G50

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 button is pressed. When "G50" is read, when the EMERGENCY STOP button is pressed, or when the power source is turned off, the instruction value of the "F" code automatically becomes "4";



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 XI 270. Y1000.

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.

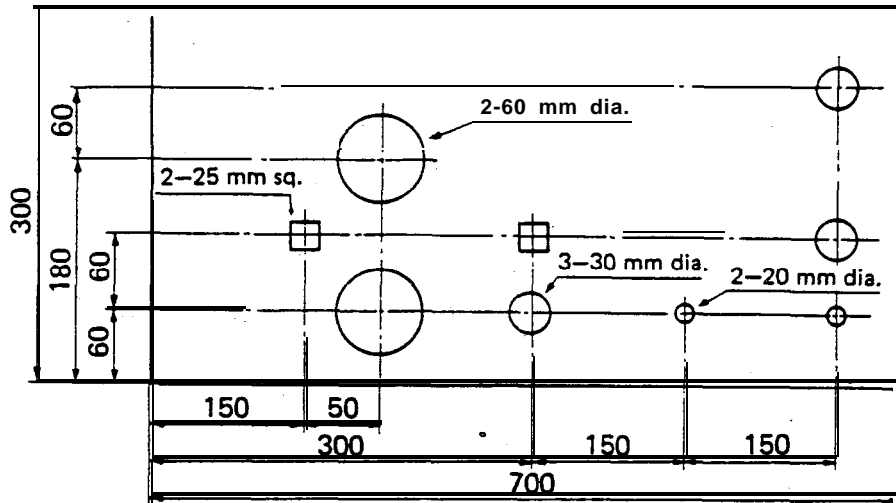
5. Calculating the coordinates

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. - T12

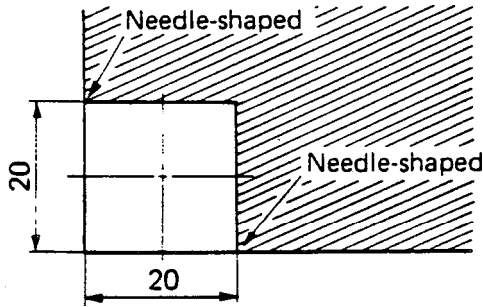
30 mm dia. - T10

20 mm dia. - T11

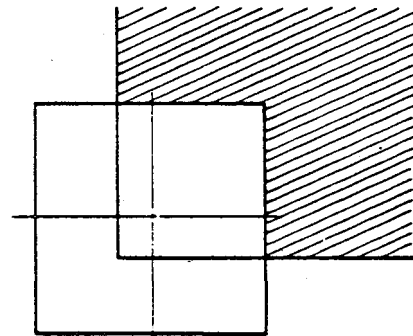
(Thick turret with Auto-Index)

HINTS ON PROCESSING

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



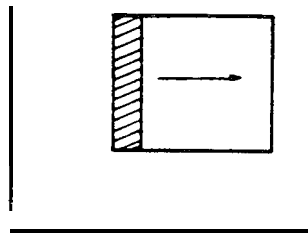
Incorrect
(20 mm x 20 mm square punch is used.)



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.

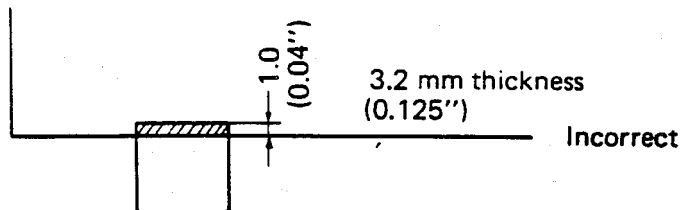
2. Do not punch along the shorter punch side when using a long rectangular punch.



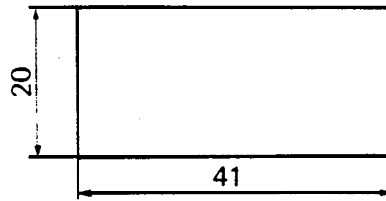
Incorrect

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

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

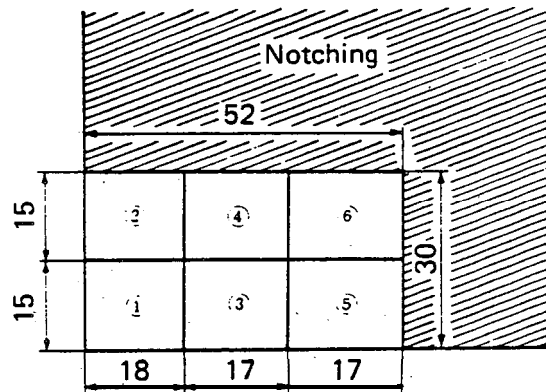
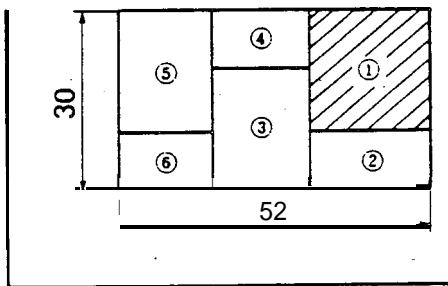


Problem: Determine the method for punching a 20 mm x 41 mm rectangular hole with a 20 mm x 20 mm sq. punch.



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

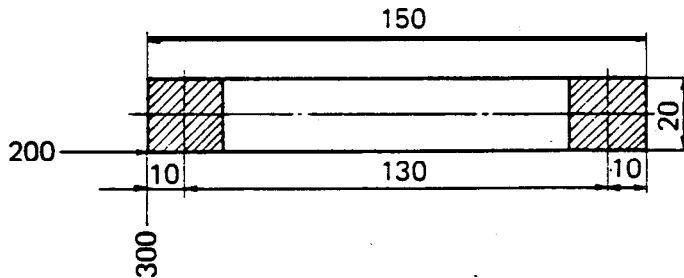
τ : Shearing strength of worksheet

Problem: Is it possible to punch holes with a diameter of 40 mm in a mild steel plate with a thickness of 3.2 mm and a shearing strength of 40 kg/mm' ?

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/mm² ?

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) $X_0 = 100 + 1/2 \times 20 = 110 \text{ mm}$

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

(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 X 210. Y310. T9 (20 mm x 20 mm sq.)

G91 X 18.57

X 18.57

X 18.57

X 18.57

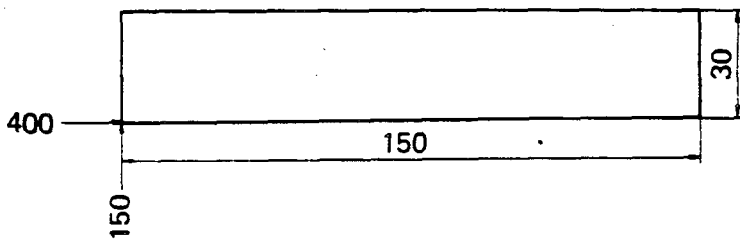
X 18.57

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.



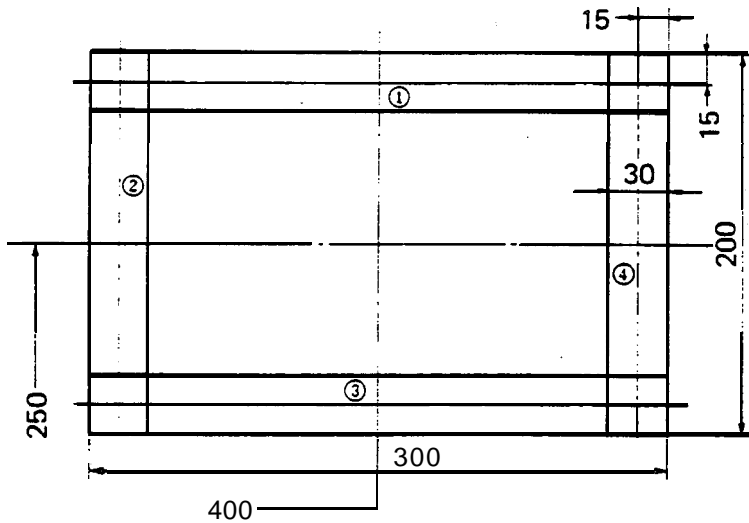
T1 30 mm x 30 mm sq.

T12 30 mm x 40 mm rect.

(Thick turret with Auto-Index)

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.

(a) Punching procedure

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

(b) First punch position " X_o, Y_o " (Absolute value)

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

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

(c) Punching frequency and feed pitch of ①

(d) Punching frequency and feed pitch of ②

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

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

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

(a) ① → ② → ③ → ④

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

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

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

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

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

(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)

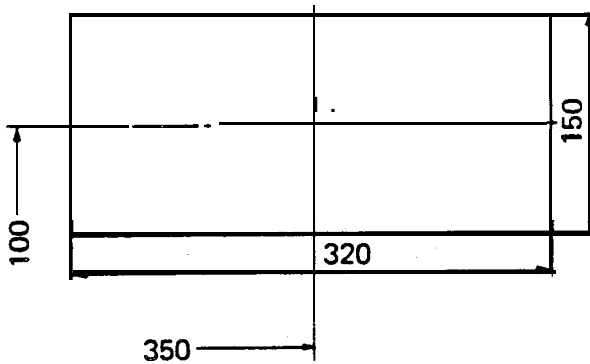
Y-28.33 (6 times)

X27. (10 times)

Y28.33 (**5** times)

MOO

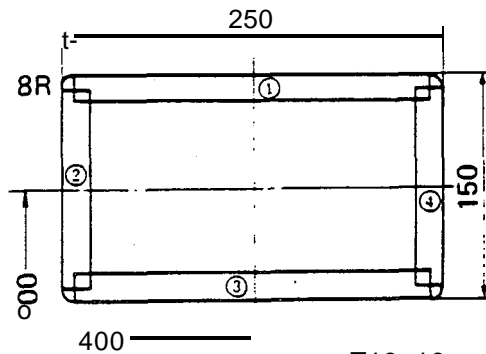
Problem: Punch a 150 mm x 320 mm rectangular opening with a 20 mm x 20 mm sq. punch.



T18 20 mm x 20 mm sq.
(Thick turret with Auto-Index)

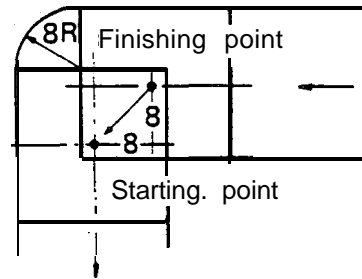
CALCULATING RECTANGULAR OPENING WITH ROUNDED CORNERS

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



T16 16 mm dia.
T18 20 mm x 20 mm sq.

(Thick turret with Auto-Index)



- Punching procedure
First, punch 4 corners of $8R$ with 16 mm dia. round punch.
Finish punching at the upper right corner.
- Punching positions for 4 corners.
Punching position for one corner -Absolute value
Punching positions for other corners -Incremental value (Opening length $- 2 \times R$)
- First punch position with a square punch (X_0, Y_0)-Absolute value
- Punching frequency and feed pitch of ①
- Punching frequency and feed pitch of ②
- Travel distance from the finishing point on one side to the starting point on another side
-Incremental value
X value: Radius
Y value: Radius
- Prepare the program in accordance with punching procedures.
- Enter "MOO" or "M01" in order to remove the scrap.

(a) 4 corners and then ① → ② → ③ → ④

(b) Absolute value (upper right corner)

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

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

Incremental value

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

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

(c) Position of the first square punching

$$X_0 = [400 + 1/2 \times 250 - 81 - [1/2 \times 201 = 507 \text{ mm}]$$

$$Y_0 = [300 + 1/2 \times 150] - [1/2 \times 201 = 365 \text{ mm}]$$

(d) $L = [250 - 2 \times 81 - 20 = 214 \text{ mm}]$

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

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

(e) $L = [150 - 2 \times 81 - 20 = 114 \text{ mm}]$

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

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

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

$$Y = 8 \text{ mm}$$

Therefore the program is:

G90 X517. Y367. T16 (16 mm dia.)

G91 X-234.

Y-134.

X234: ,

G90 X507. Y365. T18 (20 mm x 20 mm sq.)

G91 X-19.45 (11 times)

X-8. Y-8.

Y-19. (6 times)

X8. Y-8.

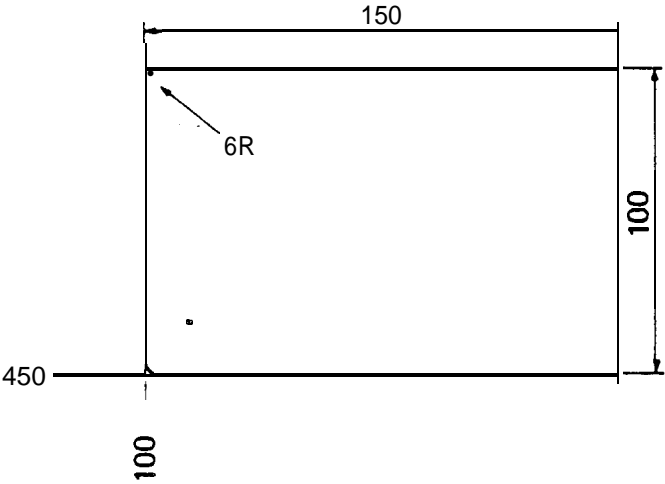
x19.45 (11 times)

X8. Y8.

Y19. (6 times)

M00

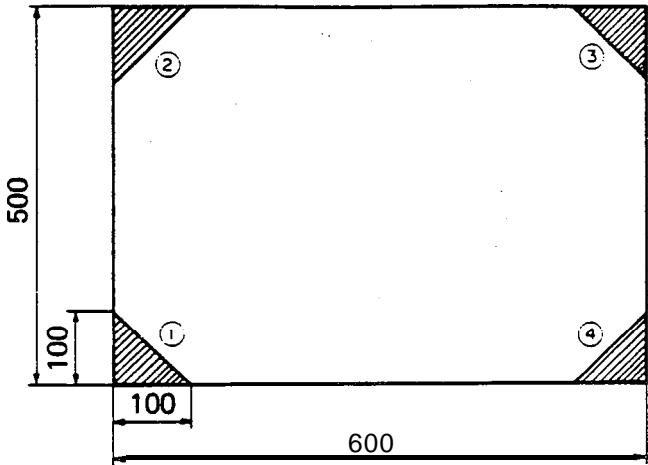
Problem: Punch a 100 mm x 150 mm rectangular opening with rounded corners of **6R**, using a 12 mm dia. round punch and a 20 mm x 20 mm square punch.



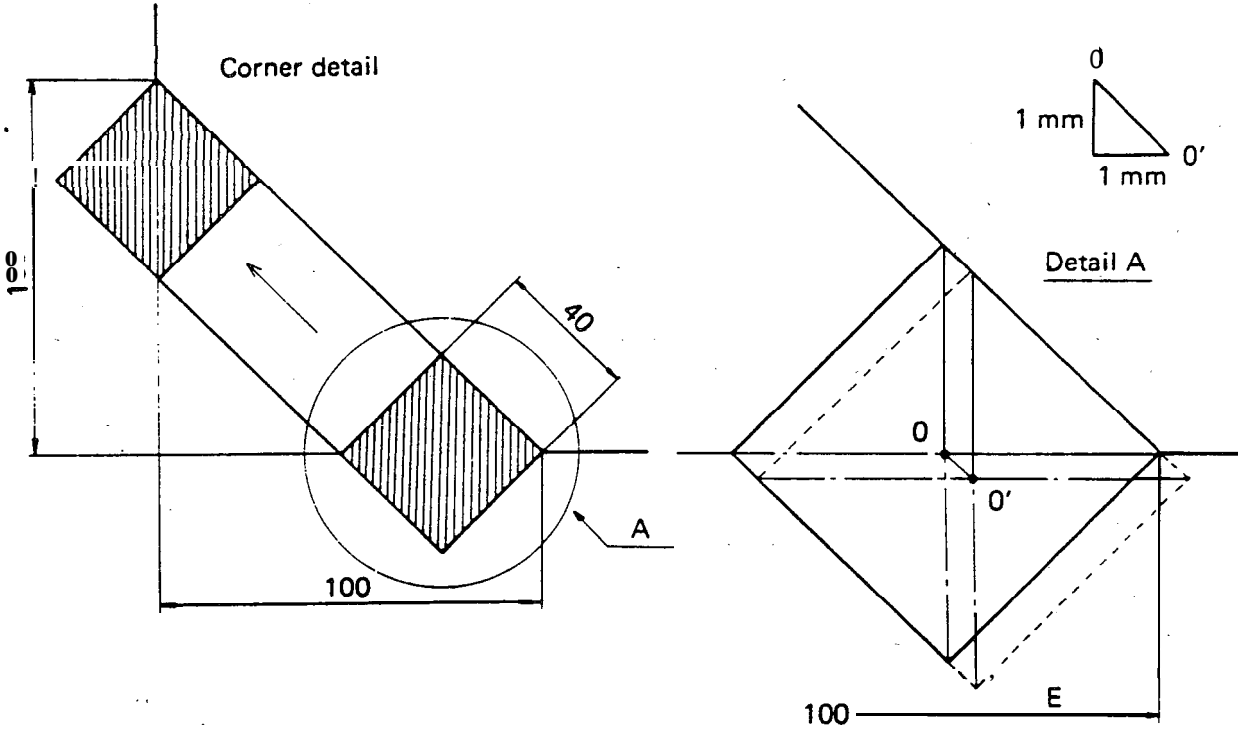
T2 12 mm dia.
T 1 8 20 mm x 20 mm sq.
(Thick turret with Auto-Index)

CALCULATING 45° NOTCH

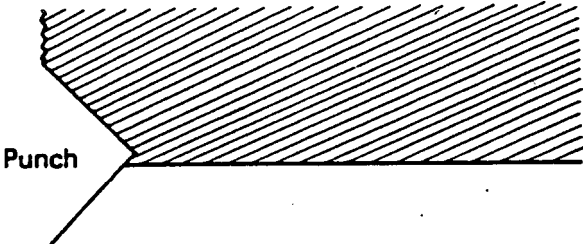
Ex.: When punching 45° notches in 4 corners of a 500 mm x 600 mm plate



T1 40 mm x 40 mm sq. (45°)



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

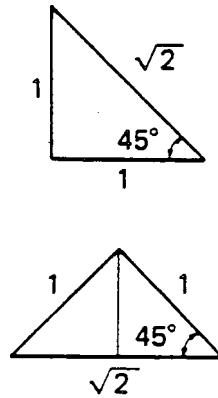
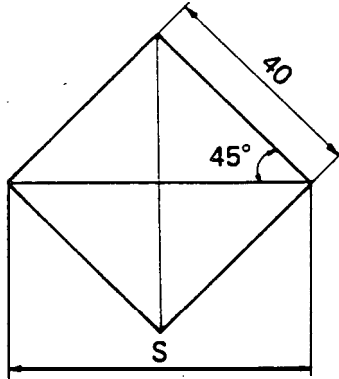


Notching the lower left corner

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

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

$$Y_1 = 0$$



(Diagonal punch size: S)

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

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

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

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

$$X_0 = X_1 + 1 \text{ mm} \quad (\text{In case of the lower left corner } \textcircled{1})$$

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

(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

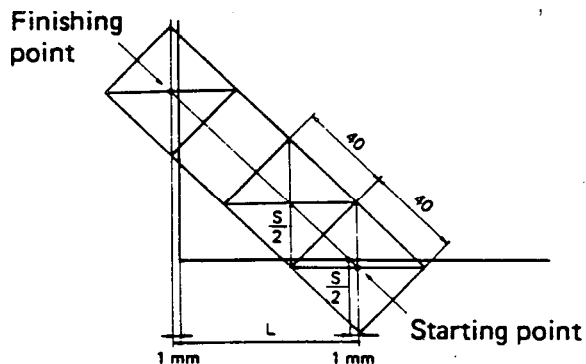
Ex.: 2.3 - 3

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:

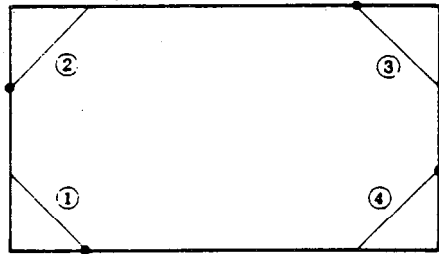
G90 X72.72 Y-1. T1 (40 mm x 40 mm sq. 45")

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.

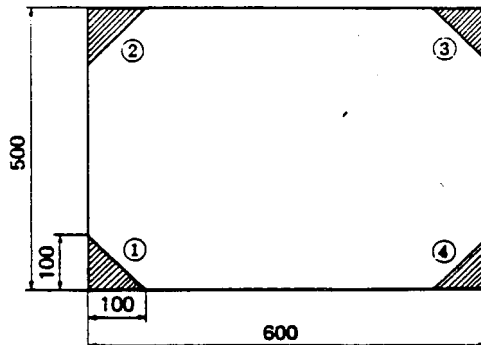
Problem: What will the sign of 1 mm be when calculating the starting point (0') for each corner?

"•" mark means starting points.



	X	Y
①		
②		
③		
④		

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

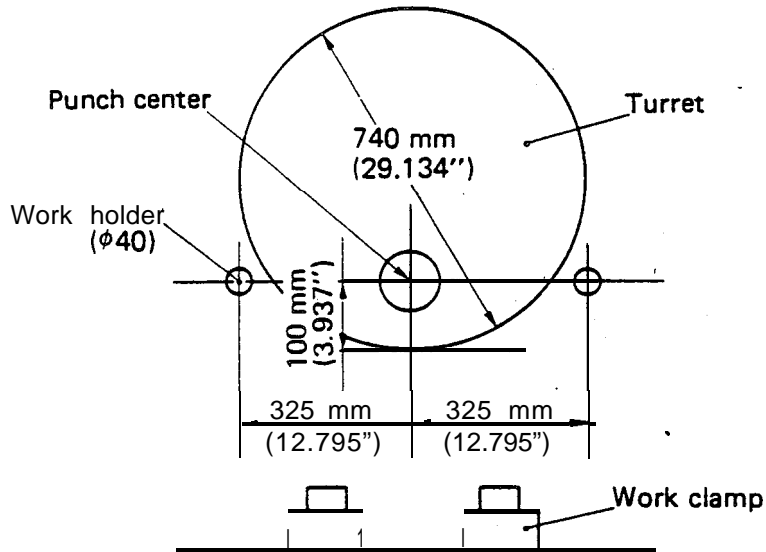
1. PUNCHING RANGE

Punching range common to all stations

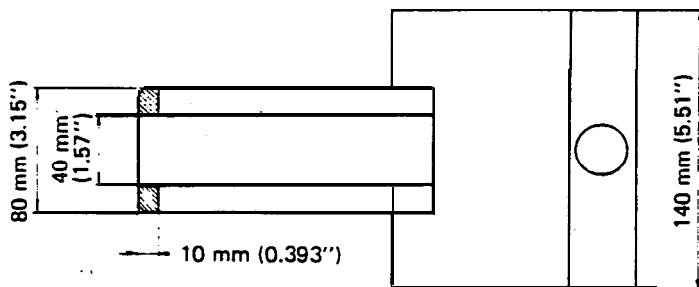
X-axis: -10.2 mm to 1280.2 mm (metric), -0.401" to 50.401" (imperial)

Y-axis: -10.2 mm to 1010.2 mm (metric), -0.401" to 39.771" (imperial)

2. POSITION OF WORKHOLDERS



3. WORK CLAMP DIMENSIONS

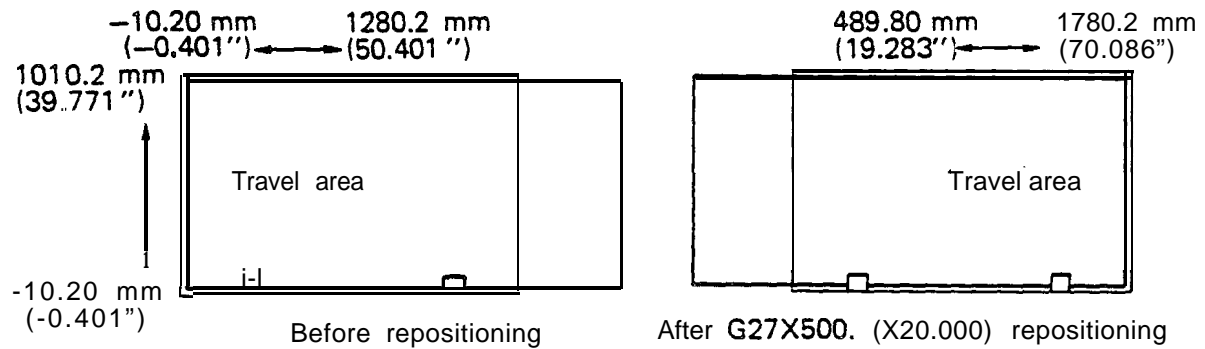


HINTS ON AUTO REPOSITIONING

1. Repositioning travel distance -as small as possible
[Maximum processing position (X value)] -1280 mm (50.393")
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. Y 100.00 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, **overtravel** 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
-10.2 mm (-0.401") + repositioning travel distance $\leq X \leq$ 1280.2 mm (50.401") + repositioning travel distance.
Ex.: G27 X500. (X20.000)
Processing area after auto repositioning = 489.8 $\leq X \leq$ 1780.2 mm
(19.283" $\leq X \leq$ 70.086")

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 the specified value*. 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.

* Specified value	Tool type
40 mm (1.57")	1/2"
60 mm (2.36")	1-1/4"
60 mm (2.36")	2"
110 mm (4.33")	3-1/2"



BASIC SOFTWARE

G72 — DESIGNATION OF PATTERN ORIGIN

PATRN :SHIFT:	PATRN ORG
	72 C

G90 G72 X_____Y_____

G91 G 7 2_____XY_____

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”.

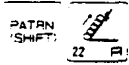
For example, never enter:

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.

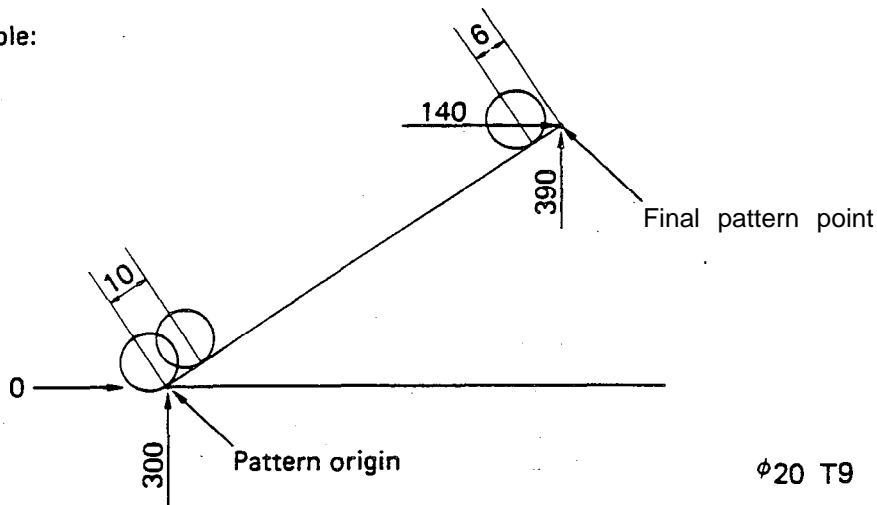
G22 - LINE AT DISTANCE



Starting from either the current position or from a point designated by "G72", the holes are punched with a punch of diameter " ϕ " at a pitch of "d" -to the final position (x, y).

- x:** X-coordinate of the final pattern point, "x"
- Y:** Y-coordinate of the final pattern point, "y"
- J:** Compensation for punching length at the final pattern point, " $\pm d\ell$ "
 - Final pattern point - " $d\ell$ " when " $d\ell$ " > 0
 - Final pattern point + " $d\ell$ " when " $d\ell$ " < 0
- P:** Punch diameter, " $\pm\phi$ "
 - The hole is punched at the left of the line of travel when " ϕ " > 0
 - The hole is punched on the line of travel when " ϕ " = 0
 - The hole is punched at the right of the line of travel when " ϕ " < 0
- Q:** Feed pitch, "d"

Example:



G 7 2 X0 Y300.00

G22 X140.00 Y390.00 J6.00 P20.00 Q10.00 T9

When G91 (Incremental) is placed before G22, the final pattern point (x, y) can be specified in incremental values referenced to the pattern origin.

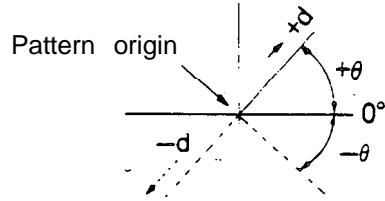
G 7 2 X0 Y300.00

G91 G22 X140.00 Y90.00 J6.00 P20.00 Q10.00 T9

G28 - LINE AT ANGLE

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.

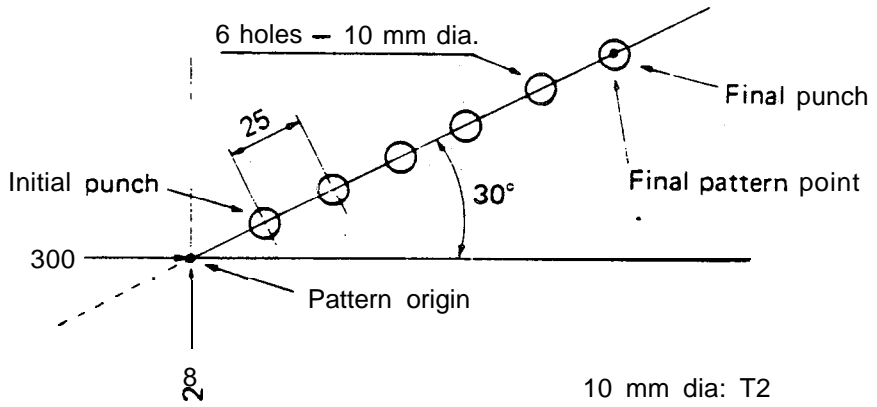
- I: Pitch "t d" When "d" is negative, the punching is performed in the opposite direction from that of positive "d".
- J: Angle "± θ" Counterclockwise - positive
Clockwise - negative



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

NOTE: "d" and "θ" are given as follows:
 d 200 mm → 200. (d5" → 5.)
 θ 45° 30' → 45.5
 θ 45" → 45.

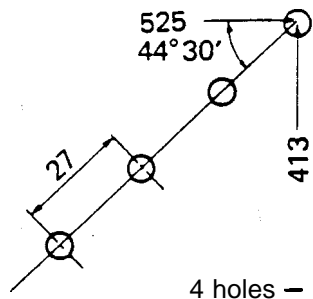
Example:



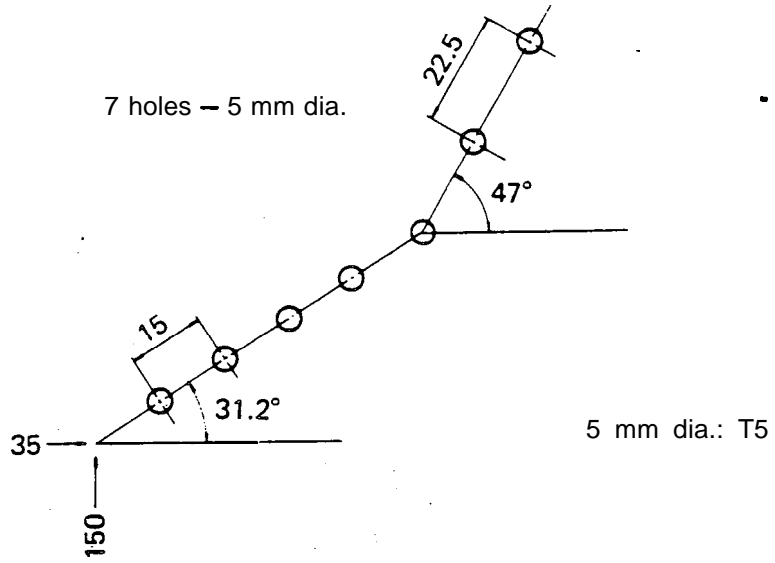
**G90 G72 X300. Y200.
G28 I25. J30. K6 T2**

When punching the same hole at the pattern origin (X300., Y200.), omit "G72" and enter "T2" in the upper instruction block.
 When "I25." becomes "I-25.", punching is performed in the direction of 180° symmetry (210°).

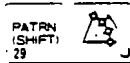
Problem:



Problem:



G29 - ARC



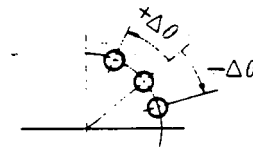
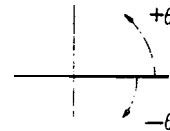
On the circumference of a circle having a radius "r" with either the current position or a point designated by "G72" as the center, "n" holes with an angle increment of " $\Delta\theta$ " are punched, starting from a point at an angle of " θ " to the X-axis.

I: Radius "r" - positive

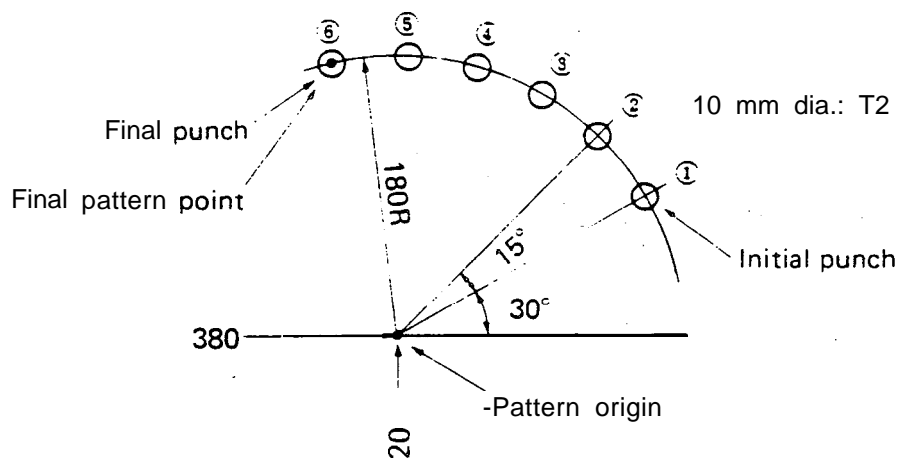
J: Start angle " $\pm\theta$ "
Counterclockwise - positive
Clockwise - negative

K: Number of holes "n"

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



Example:



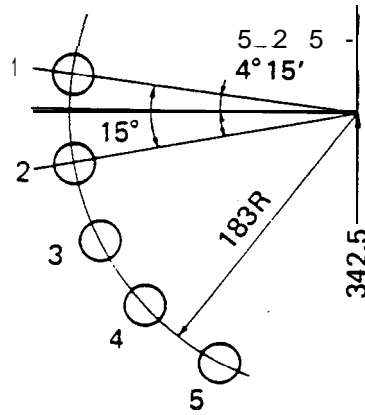
G90 G72 X380. Y120.

G29 I1 80. 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:

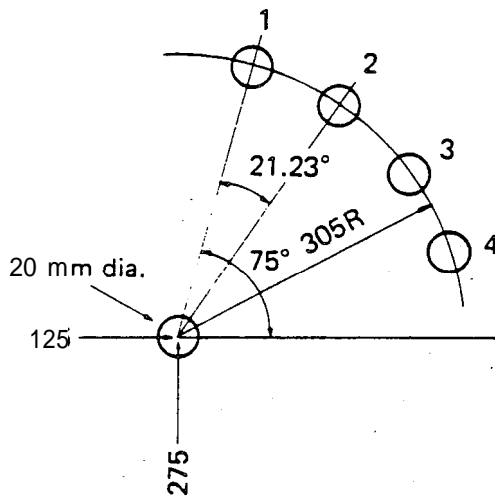


5 holes — 20 mm dia.

20 mm dia.: T11

(Thick turret with Auto-Index)

Problem:

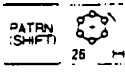


5 holes — 20 mm dia.

20 mm dia.: T11

(Thick turret with Auto-Index)

G26 — BOLT HOLE CIRCLE



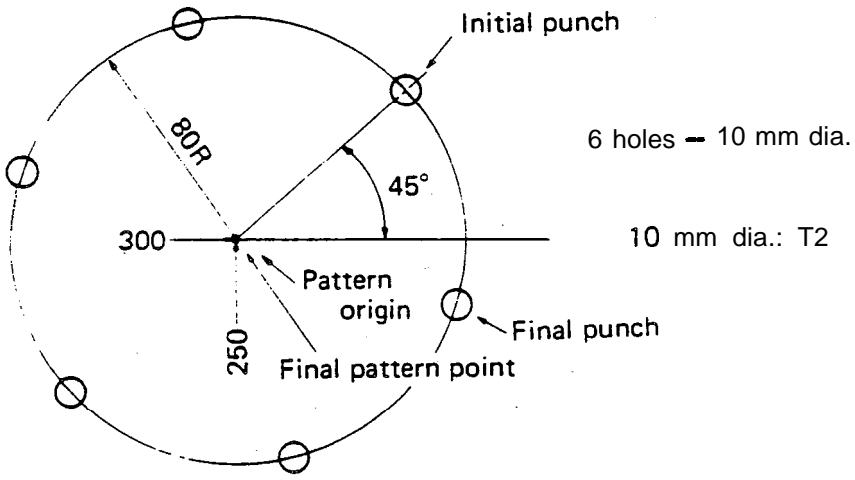
On the circumference of a circle having a radius “r” with either the current position or a point designated by “G72” as the center, “n” holes dividing the circumference into “n” equal parts are punched, beginning with a point at an angle of “θ” to the X-axis.

I: Radius “r” — positive

J: Start angle “±θ” Counterclockwise — positive
 Clockwise — negative

K: Number of holes “±n” Counterclockwise — positive
 Clockwise — negative

Example:

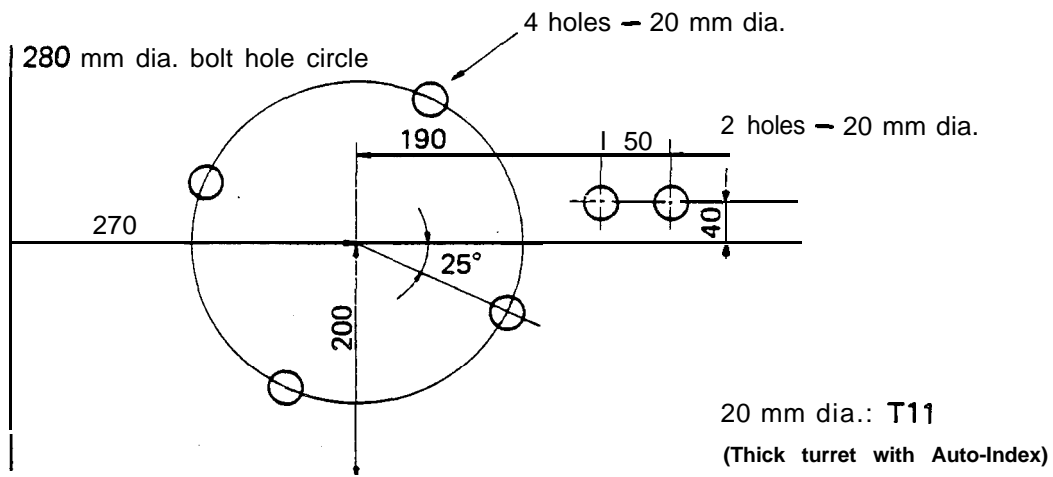


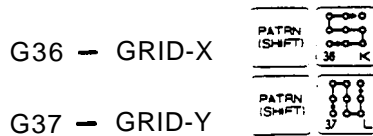
```
G90 G72 X300. Y250.
G26 180. J45. K6 T2
```

When punching the same hole at the pattern origin (X300.,Y250.), omit “G72” and enter “T2” in the upper instruction block.

The final pattern point coincides with the pattern origin.

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





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

G36: Punching starts from the X-axis side.

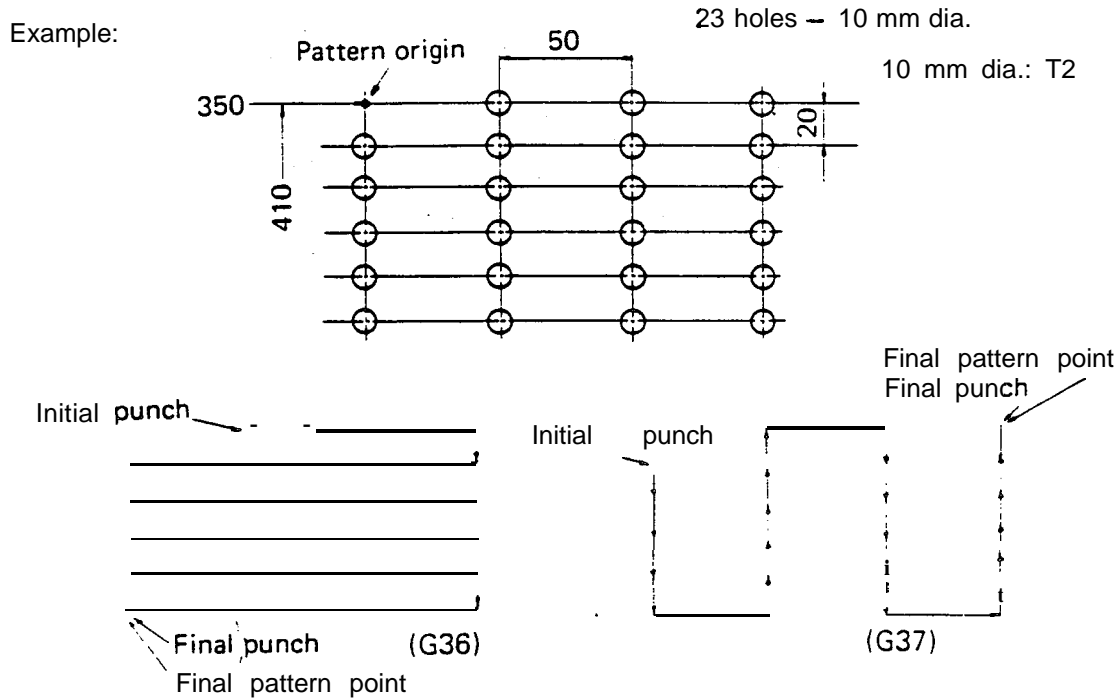
G37: Punching **starts** from the Y-axis side.

I: Pitch X " $\pm d_1$ " +X direction — positive
 -X direction — negative

P: #X spaces "n₁"

J: Pitch Y " $\pm d_2$ " +Y direction — positive
 -Y direction — negative

K: #Y spaces "n₂"



G90 G72 X350. Y410.

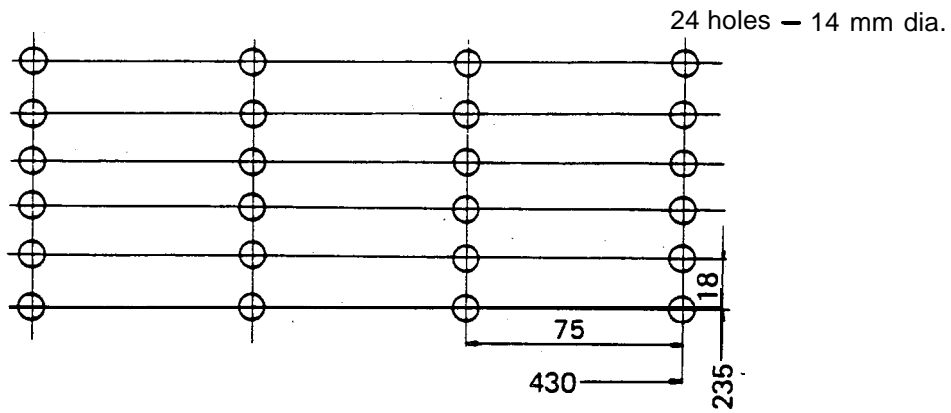
G36 150. P3 J-20. K5 T2

G90 G72 X350. Y410.

G37 150. P3 J-20. K5 T2

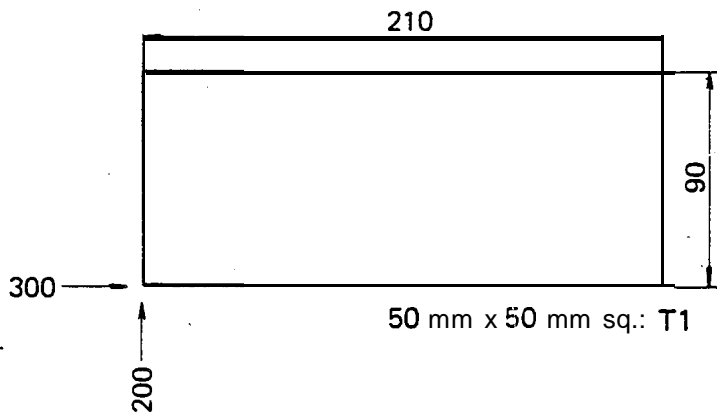
When punching the same hole at the pattern origin (X350., Y410.), omit "G72" and enter "T2" in the upper instruction block.

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

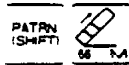


14 mm dia.: T16
(Thick turret with Auto-Index)

Problem:



G66 - SHEAR PROOF



Starting from either the current position or from a point designated by "G72", a shear proof with a length of " $l_1 \pm 2d$ " and a punch width of " w_1 " x " w_2 " is performed at an angle of " θ " to the X-axis.

I: Length " l_1 "

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

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

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

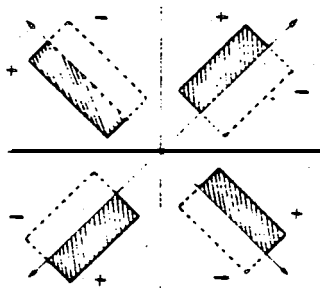
K: Width " l_2 " (Punching length in the direction of 90° to "J")
If $K = Q$, " $K l_2$ " can be omitted.

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

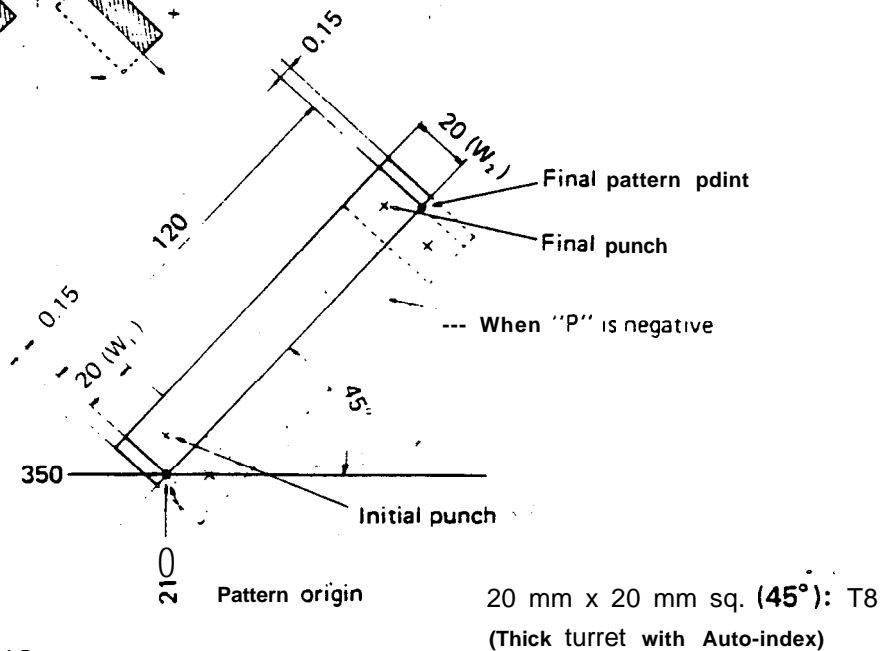
The values of " w_1 " and " w_2 " must have the same sign.

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

The sign of "w, " and " w_2 "



Example 1:



G90 G72 X350. Y210.

G66 1120. J45. P20. DO.1 5 T8

20 mm x 20 mm sq. (45°): T8
(Thick turret with Auto-index)

When "G72" is omitted and "T8" is entered in the upper instruction block, the pattern origin (X350., Y210.) is also punched.

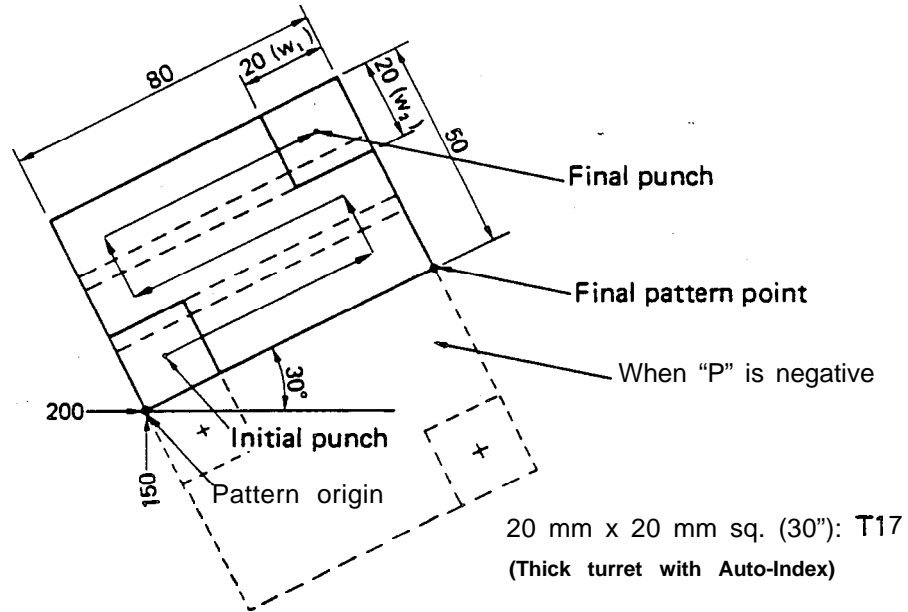
When "P20." becomes "P-20.", a shear proof is performed in the direction of the dotted line.

I (length "l₁") must be at least 1.5 times as large as P (tool length "±w₁").

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

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

Example 2:



G90 G72 X200. Y150.

G66 180. J30.P20. K50. T17

When "G72" is omitted and "T17" 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.

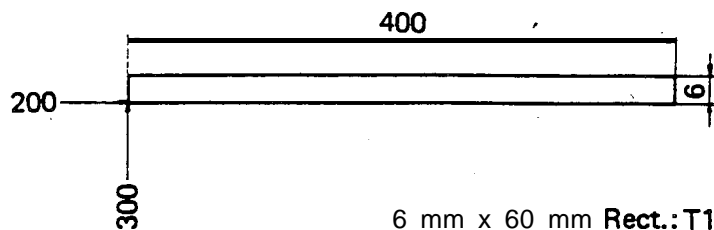
I (length "l₁") must be at least 1.5 times as large as P (tool length "Iw₁").

K (width "P,") must be at least 1.5 times as large as P (tool length "Iw₁").

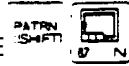
The final pattern point does not coincide with the final punch center.

Square punch (w, = w₂) must be used when K (width "l₂") is entered.

Problem:



G67 - SQUARE



Starting from either the current position or from a point designated by "G72", a rectangular opening with a length of " l_1 " parallel to the X-axis and a length of "P," parallel to the Y-axis is punched, using a square punch with a width of "w".

I: Opening length in the X-axis direction " $\pm l_1$ " +X direction - positive
 -Y direction - negative

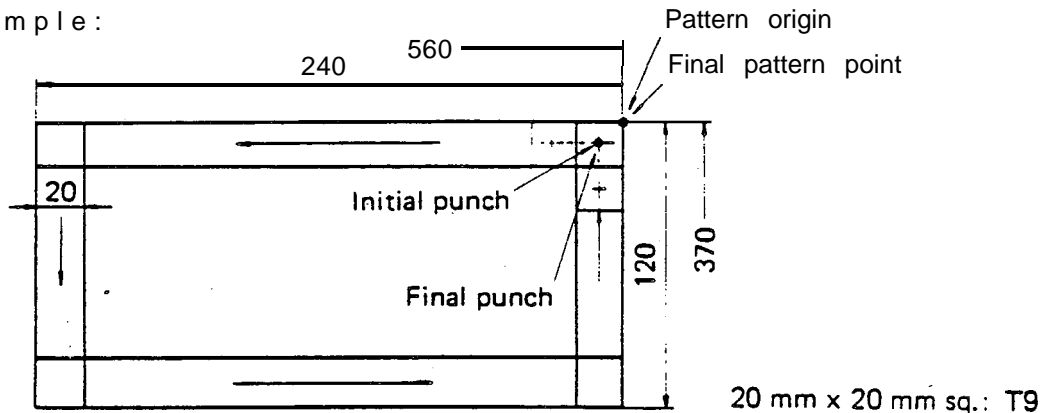
J: Opening length in the Y-axis direction " $\pm l_2$ " +Y direction - positive
 -Y direction - negative

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.

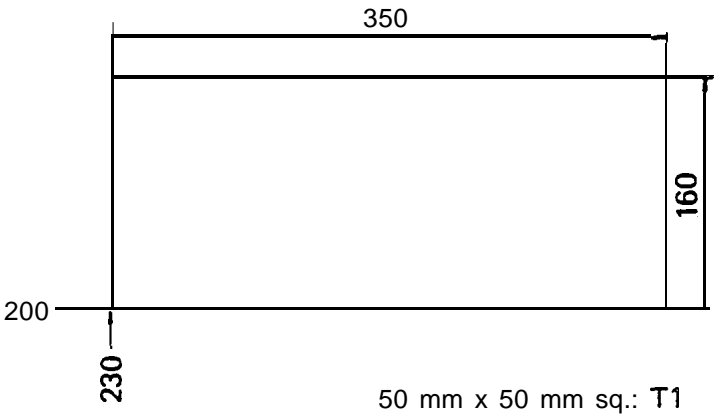
Example:



```
G90 G72 X560. Y370.
G67 I-240. J-120. P20. T9
MOO
```

When "G72" is omitted and "T9" is entered in the upper instruction block, the pattern origin (X560., Y370.) is also punched.
 When "G67" is used, "MOO" or "M01" should be entered in order to remove the scrap.
 Both I and J (length X " $\pm l_1$ " and Y " $\pm l_2$ ") must be at least three times as large as P (tool length "w").

Problem:



G68 — NIBBLING ARC

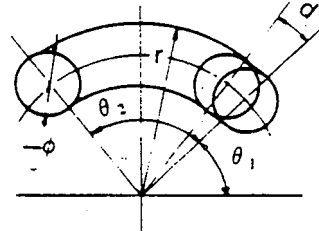


On the circumference of a circle having a radius “r” with either the current position or a point designated by “G72” as the center, a nibbling with a pitch of “d” is performed by using a punch with a diameter of “ ϕ ,” starting from a point at an angle of “ θ_1 ” to the X-axis and moving up to an incremental angle of “ θ_2 ”.

I: Radius “r” — positive value

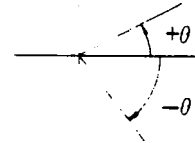
J: Start angle “ $\pm\theta_1$ ” Counterclockwise — positive
 Clockwise — negative

K: Moving angle in which nibbling occurs “ $\pm\theta_2$ ”
 Counterclockwise — positive
 Clockwise — negative



P: Tool diameter “ $\pm\phi$ ”

Enter the positive value when nibbling the outer side of the circle and the negative value when nibbling the inner side.

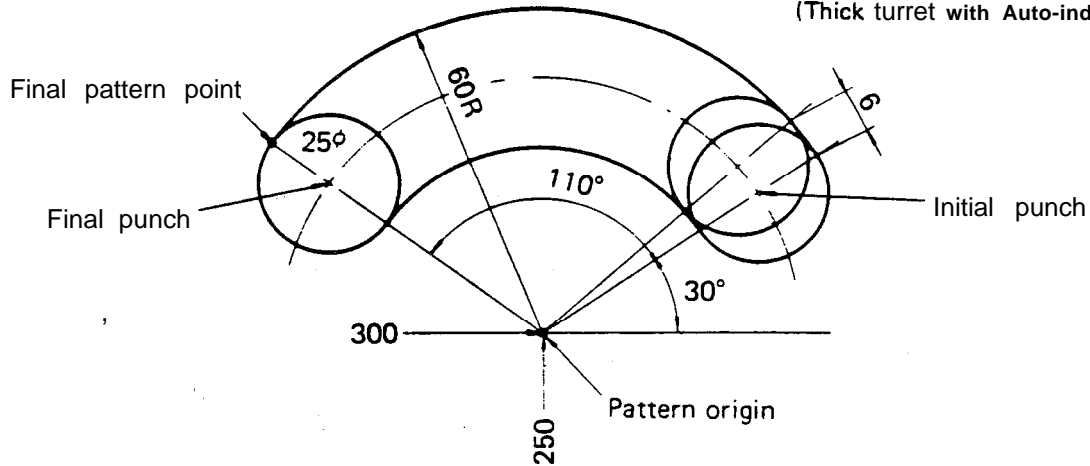


Q: Nibbling pitch “d” — positive value only
 Worksheet thickness < $d \leq 6$ mm (0.236”)

NOTE: Maximum worksheet thickness for nibbling: 3.2 mm (0.125”)

Example:

25 mm dia.: T10
 (Thick turret with Auto-index)



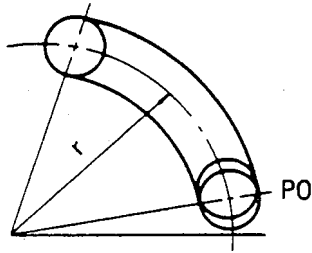
G90 G72 X300. Y250.

G68 160. 530. K1 10. P-25. Q6. T10

When “G72” is omitted and “T10” is entered in the upper instruction block, the pattern origin (X300., Y250.) is also punched.

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

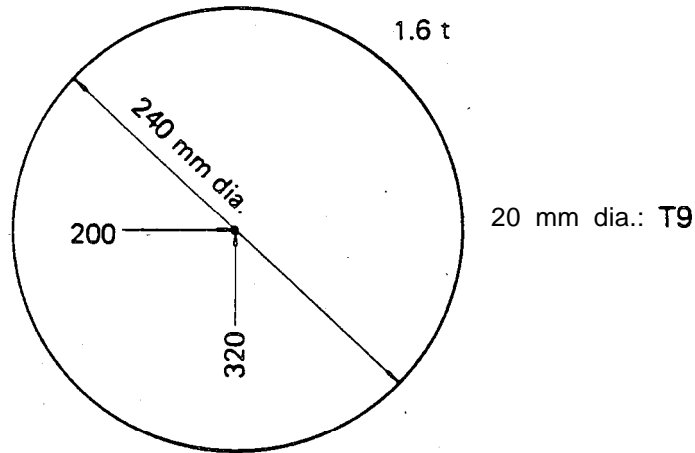
Example:



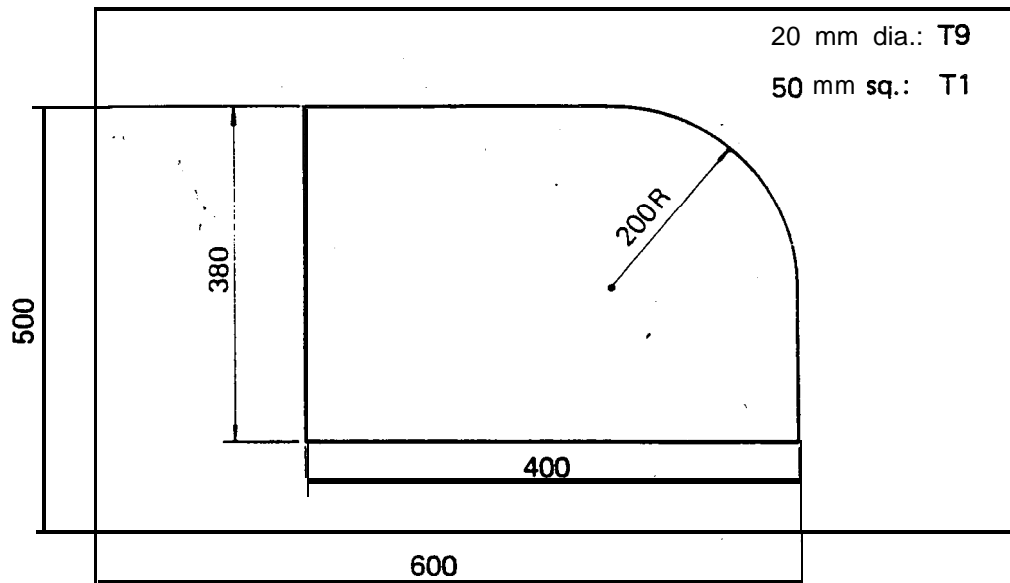
When nibbling a workpiece with a thickness of more than 3.2 mm (0.125"), use code G29 (ARC) or G78 (PUNCHING ARC).

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.

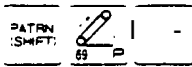
Problem:



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



G69 -- NIBBLING LINE



Starting from either the current position or from a point designated by "G72", a nibbling with a pitch of "d" and a length of "l" at an angle of "θ" to the X-axis is performed using a punch with a diameter of "φ".

I: Length "P" (from the initial punch center to the final punch center)

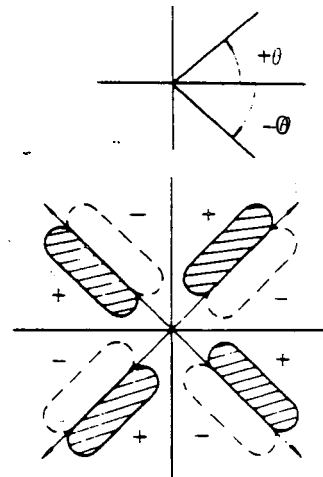
J: Angle "±θ" Counterclockwise -- positive
 Clockwise -- negative

P: Tool diameter "±φ"

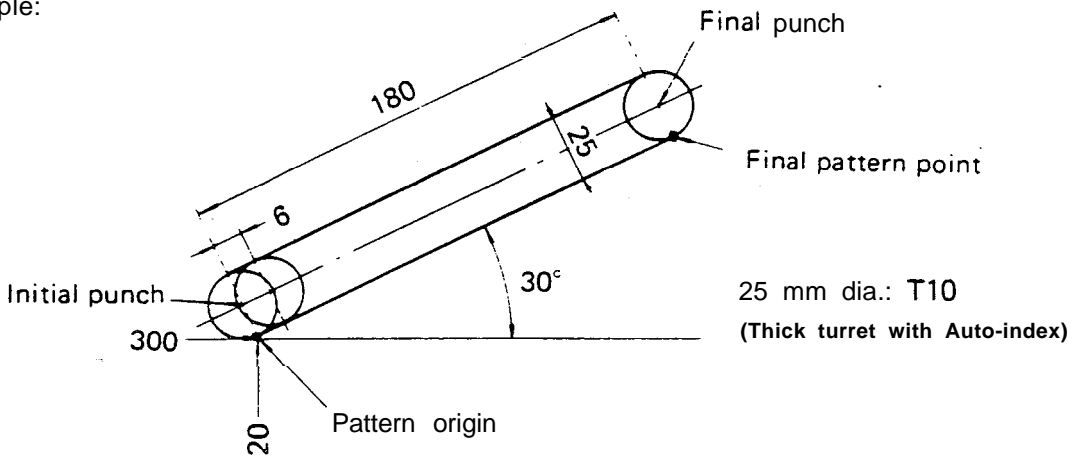
When the value is positive, nibbling is performed on the left side of the straight line (on the hatched side in the figure); when it is negative, nibbling is performed on the right side of the straight line.

Q: Nibbling pitch "d" -- positive value only
 Worksheet thickness < d ≤ 6 mm (0.236").

NOTE: Maximum worksheet thickness for nibbling: 3.2 mm (0.125")



Example:



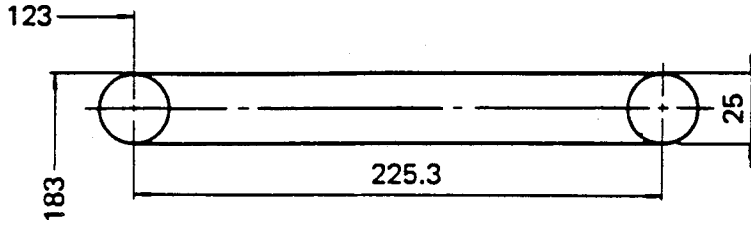
```
G90 G72 X300. Y 120.
G69 1180. J30. P25. Q6. T10
```

If "G72" is omitted and "T10" is entered in the upper instruction block, the pattern origin (X300., Y 120.) is also punched.

If P = 0, the initial punch center coincides with the pattern origin.

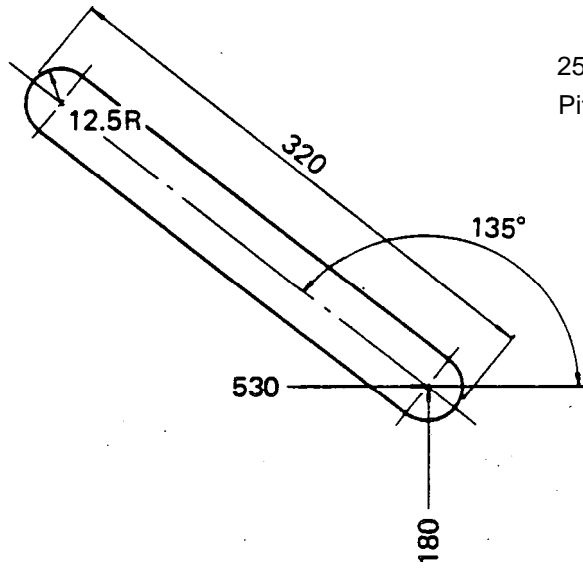
When nibbling a worksheet with a thickness of more than 3.2 mm (0.125"), use code G28 (LINE AT ANGLE) or G79 (PUNCHING LINE).

Problem:



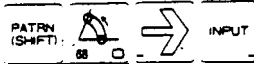
25 mm dia.: **T10** (Thick turret with
Pitch: 4 mm Auto-Index)

Problem :



25 mm dia.: **T10** (Thick turret with
Pitch: 5 mm Auto-Index)

G78 - PUNCHING ARC



On the circumference of a circle having a radius "r" with either the current position or a point designated by "G72" as the center, a punching which is the same as the NIBBLING ARC (G68) is performed by turning the clutch on and off at a pitch of "d", using a tool with a diameter of " ϕ ", starting from a point at an angle of " θ_1 " to the X-axis and moving up to an incremental angle of " θ_2 ".

I: Radius "r" - positive value

J: Start angle " $\pm\theta_1$ " Counterclockwise - positive
Clockwise - negative

K: Angle in which punching occurs " $\pm\theta_2$ " Counterclockwise - positive
Clockwise - negative

P: Tool diameter " $\pm\phi$ "

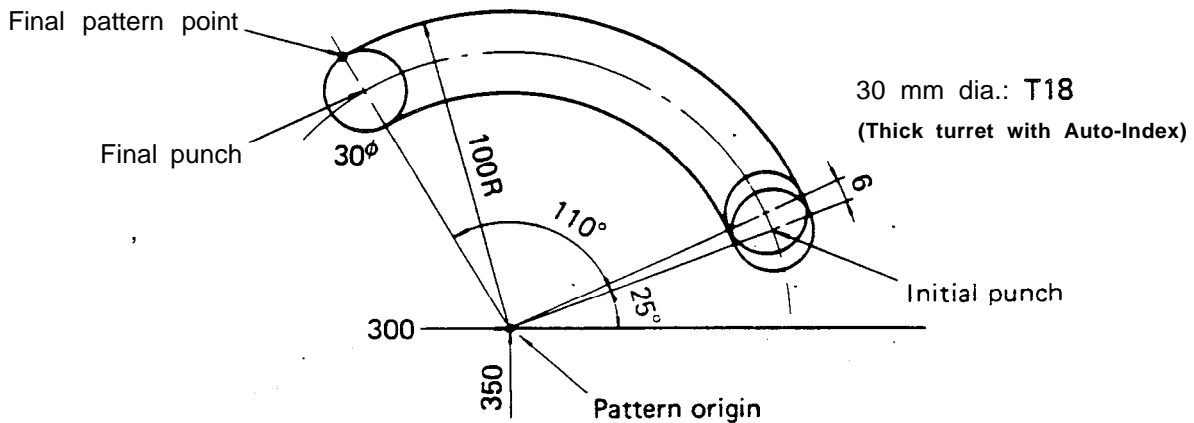
Enter the positive value when punching the outer side of the circle and the negative value when punching the inner side.

Q: Nibbling pitch "d" - positive value only
Worksheet thickness < d

D: Worksheet thickness "t"

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

Example:

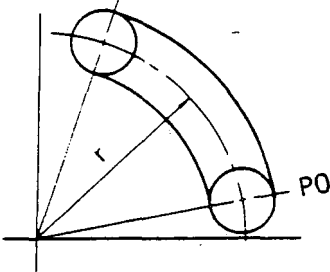


G90 G72 X300. Y350.

G78 1100. J25.K1 10. P-30. Q6. D4.5 T18

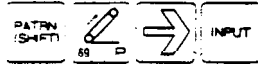
When "G72" is omitted and "T18" is entered in the upper instruction block, the **pattern origin (X300., Y350.)** is also punched.

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



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

G79 – PUNCHING LINE



Starting from either the current position or from a point designated by "G72", a punching which is the same as the NIBBLING LINE (G69) is performed by turning the clutch on and off at a pitch of "d", using a punch with a diameter of " ϕ ", in the length of "P" at an angle of "O" to the X-axis.

I: Length "P" (from the initial punch center to the final punch center)

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

P: Tool diameter " $\pm\phi$ "

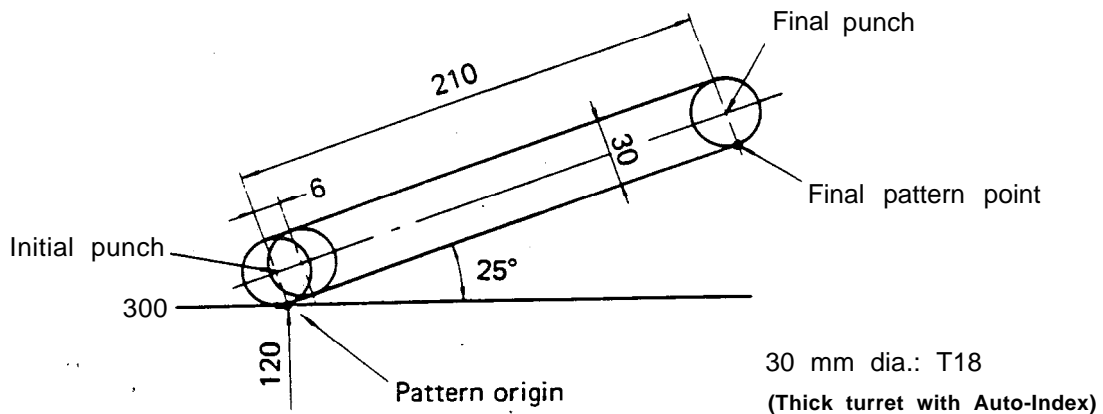
When the value is positive, punching is performed on the left side of the straight line (on the hatched side in the figure); when it is negative, punching is performed on the right side of the straight line. Refer to the NIBBLING LINE (G69) on page 2-17.

Q: Nibbling pitch "d" – positive value only
Worksheet thickness < d

D: Worksheet thickness "t"

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

Example:



G90 G72 X3001 Y120.

G79 1210. J25. P40. Q6. D4.5 T18

If "G72" is omitted and "T18" is entered in the upper instruction block, the pattern origin (X300.. Y120.) is also punched.

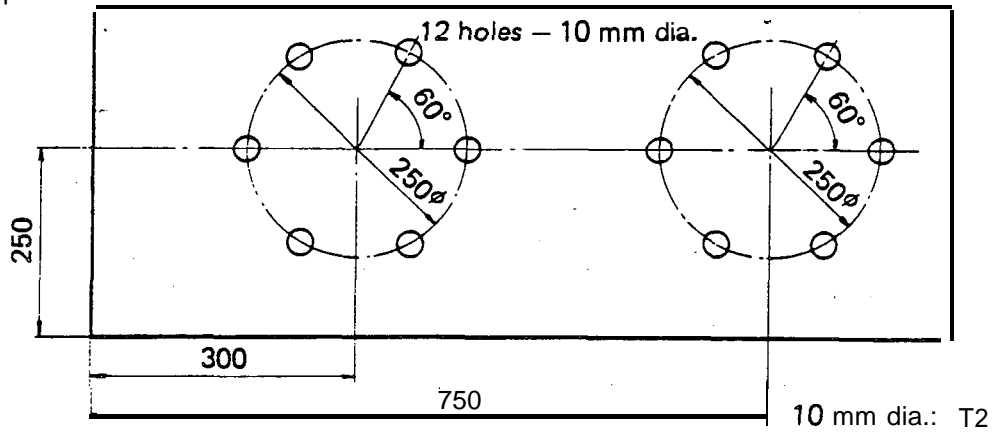
If P = 0, the initial punch center coincides with the pattern origin.

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.

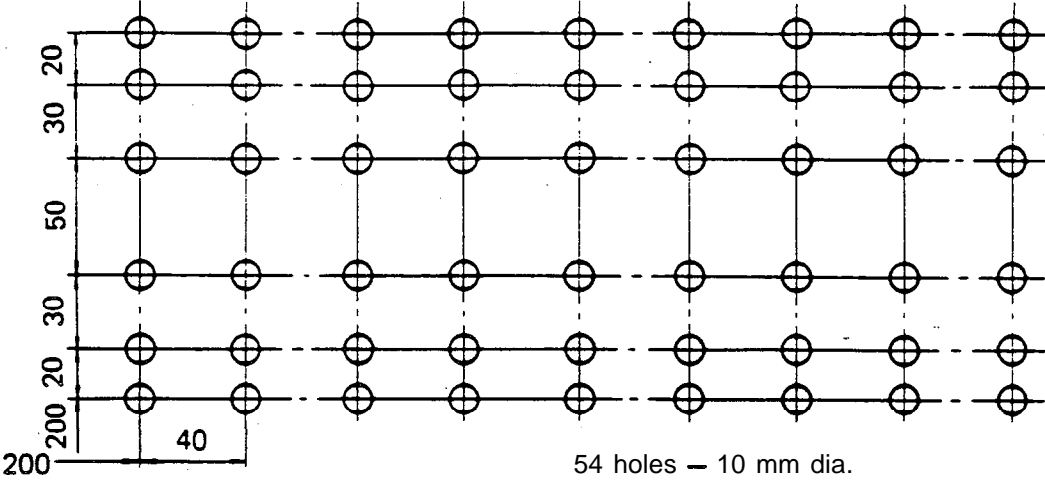
G25 X350.

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".

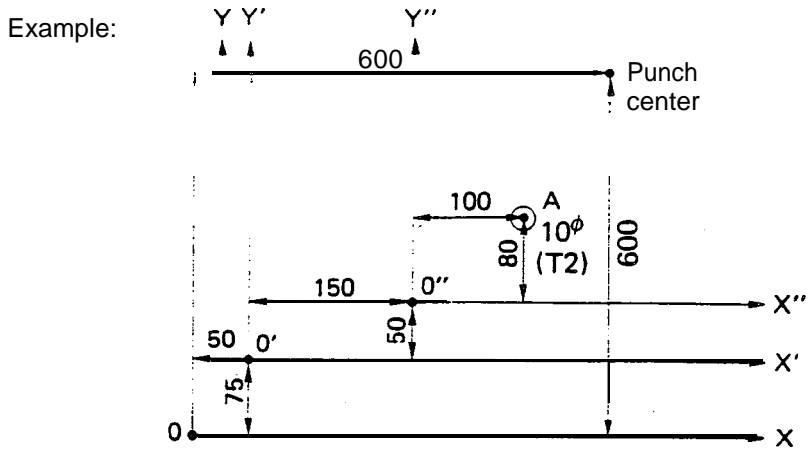


G93 — OFFSET

PATRN	OFFSET
SHIFT	33 □

```
G90 G93 X - Y -
G91 G93 X ____ Y ____
```

This code designates the origin of the local coordinate system.



- 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. T 2

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

```
G90 G93 X0 YO'
```

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. Y 100. T2
_____ Program error

Basic format of a program using "**G93**"

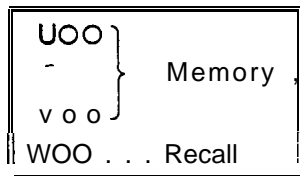
G92 X1270. Y1000.

G90 G93 X _____ Y _____
X _____ Y _____ T _____

G50

MACRO FUNCTION

PATRN SHIFT	MACRO	PATRN SHIFT	#
	V		W



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

G92 X1270. Y1000.

.....

.....

u02

G90 X100. Y300. T8

G72 X150. Y500.

AI G66 1100. JO P20.

G72 X450. Y400.

B1

v02

.....

.....

U70

G90 X200. Y100. T3

G37 18. P3 J10.K10

G90 X550. Y250.

G28 125. J-90. K6

V70

.....

.....

w02

.....

.....

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
. . . . .a... ②

vo5
U20
..... ③

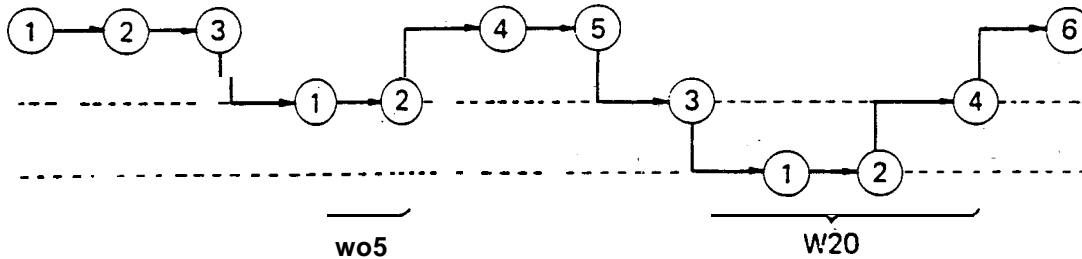
wo5
..... ④

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 8000 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

....

....

vo2

V90

....

....

$$W90 = \left\{ \begin{array}{l} W01 \\ W10 \\ w15 \\ wo2 \end{array} \right.$$

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

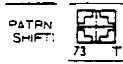
7. Macro memory setting

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

- (a) When the NC power is turned off
- (b) When the RESET button is pressed
- (c) When "G50" command is executed

However, the macro **data stored in memory can be retained** under conditions (a) to (c) above by setting the NC through the control panel. For this setting procedure, refer to instructions under the "NC setup data" on Page 22 of the OPERATOR'S MANUAL.

G73 — SYMMETRY



The specified pattern stored by the macro number "m" is symmetrically mapped with a median line of length "a" or "b" from the reference point in the X-axis or Y-axis direction as the axis of symmetry designated by "n" and is punched in the symmetrical position.

X: Distance from the reference point of the specified pattern to the reference point of the symmetrical pattern in the X-axis direction, "a"

Y: Distance from the reference point of the specified pattern to the reference point of the symmetrical pattern in the Y-axis direction, "b"

Q: Numbers for the axis of symmetry, "n"

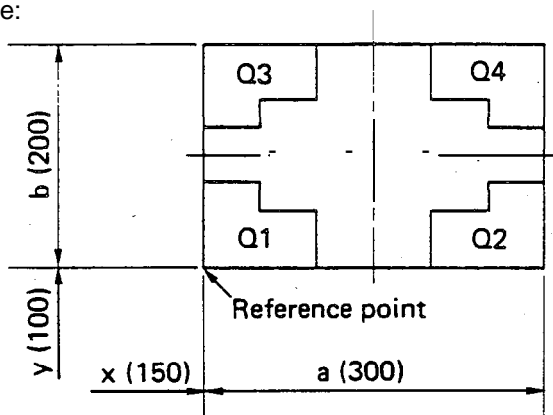
n = 1: Position of the specified pattern

n = 2: Position of the symmetrical pattern with the axis of symmetry parallel to the Y-axis and centered on $X = a/2$

n = 3: Position of the symmetrical pattern with the axis of symmetry parallel to the X-axis and centered on $Y = b/2$

n = 4: Position of the symmetrical pattern with the axis of symmetry centered on $X = a/2$ and $Y = b/2$

Example:

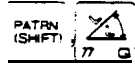


```

U60
?
V60
G93 X150. Y100.
G73 X300. Y200. Q1W60
G73 X300. Y200. Q3 W60
G73 X300. Y200. Q4 W60
G73 X300. Y200. Q2 W60
    
```

- When the offset command (**G93** or **G98**) is used, the origin of the local coordinate system becomes the reference point.
- When the values of X and Y can be omitted if they are the same as those for the preceding block.
- The values of X and Y in "Q1," the value of Y in "Q2" and the value of X in "Q3" are ignored.
- Multiple recalling cannot be done on the code G73.

G77 — ROTATION



The specified pattern stored by the macro number "m" is rotated through an angle of " θ " with the point (x,y) as the reference point and is punched in the new position.

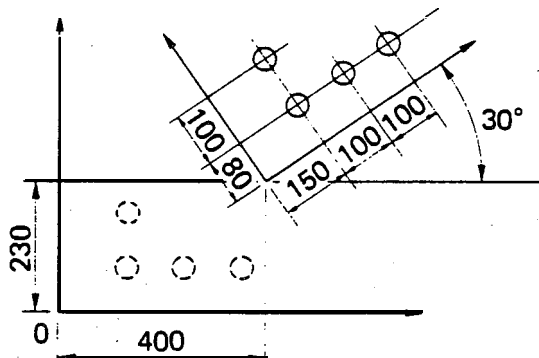
X: X-coordinate of the center of rotation, "x"

Y: Y-coordinate of the center of rotation, "y"

W: Macro number, "m"

J: Angle of rotation of the coordinate system, " $\pm\theta$ "

Example:



```
U60 -  
G90 X350. Y80. T9  
X250:  
x150.  
Y180  
V60  
G77 X400. Y230. W60 J30.
```

- When the macro number is set at between 1 and 59, the holes indicated by the broken lines can be punched as well.
- When the values of X and Y are omitted, the origin of the coordinate system or the offset origin (**G93**, **G98**, or **G77**) is taken as the center of rotation.
- When the coordinates are designated by incremental values, they are referenced to the values of X and Y specified by the preceding G77 command.
- Specify the starting part of the macro instruction by an absolute value.
- The auto-index (**C-axis**) cannot rotate unless the macro instruction contains a command for the auto-index to rotate.
- The following codes cannot be specified in the macro instruction for rotation:
M02, **G25**, **G27**, G50, G73, G75, G76, G77, G92, G98
- Multiple recalling cannot be done on the code G77.

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. Y**100**. T3
 G90 X570. Y**310**. T4

Basic format of BLOCK DELETION

I 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.
123.4 mm → XI 23.4
45.3" → J45.3
5 sec. → x5.

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

MULTIPLE PART PUNCHING

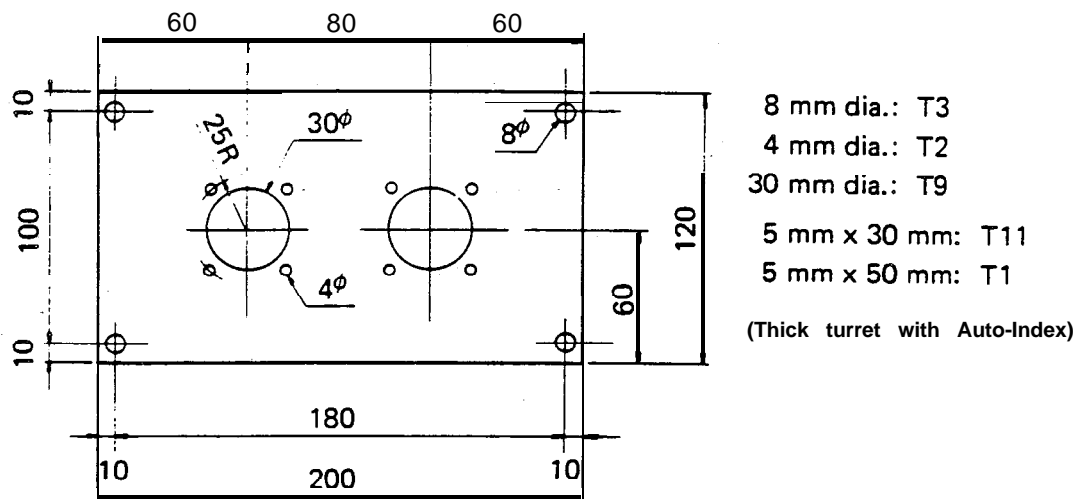
GENERAL DESCRIPTION AND PROGRAMMING EXAMPLE

1. Multiple part punching function

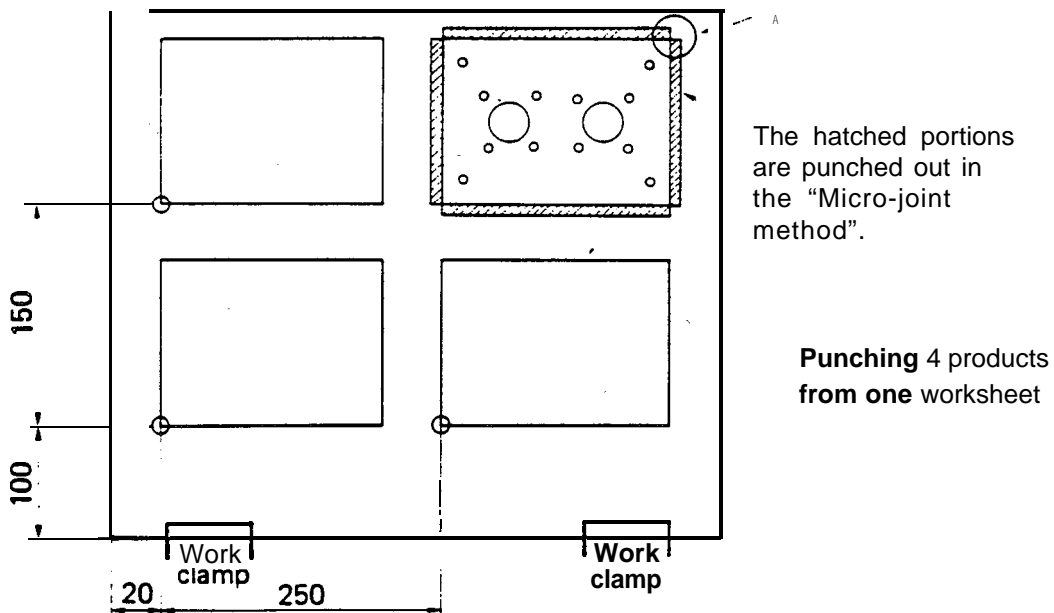
This function is used to punch multiple products which have the same punching pattern from one worksheet. Once the punching of only one product is programmed, the punching of multiple products with any desired layout on the worksheet can be performed by using simple commands.

2. Removal of each product after multiple part punching

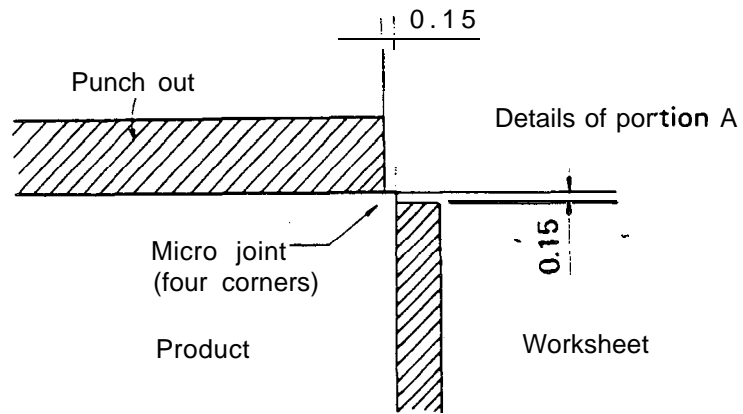
When punching four products from one worksheet, such as the one depicted in the figure below, the following two removal methods can be used:



a. Micro-joint method

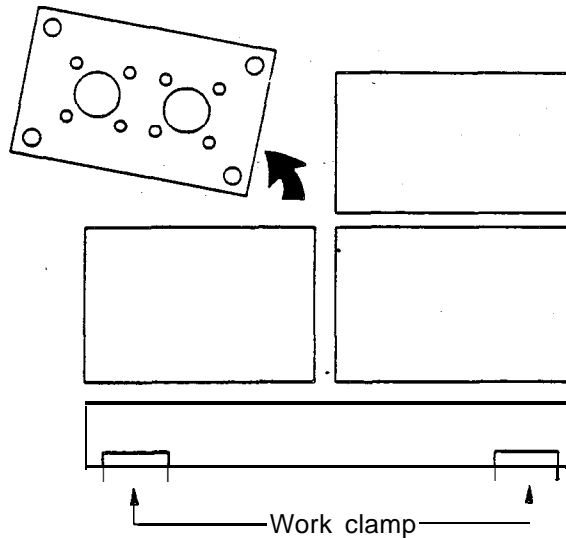


As shown in the figure, the hatched portions are punched out by rectangular punches in such a manner that the four corners of each product remain unpunched. The four corners are connected to the worksheet by means of an approx. 0.15 mm joint. After **completing** the entire punching process, the worksheet 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-I using the "micro-joint" method is as follows:

```

G92 X1270. Y1000.
G98 X20. Y100. I250. J150. P1 K1

```

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

```

U1
G90 X190. Y110. T3 (8φ)
Y10.
X10.
Y110.
G72 X60. Y60.
A1 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 T11 (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 W1 Q4 . . . . . U1-V1 execution instruction
G76 W2 Q3 . . . . . U2-V2 execution instruction
G76 W3 Q2 . . . . . U3-V3 execution instruction
G75 W4 Q3 . . . . . U4-V4 execution instruction
G50

```

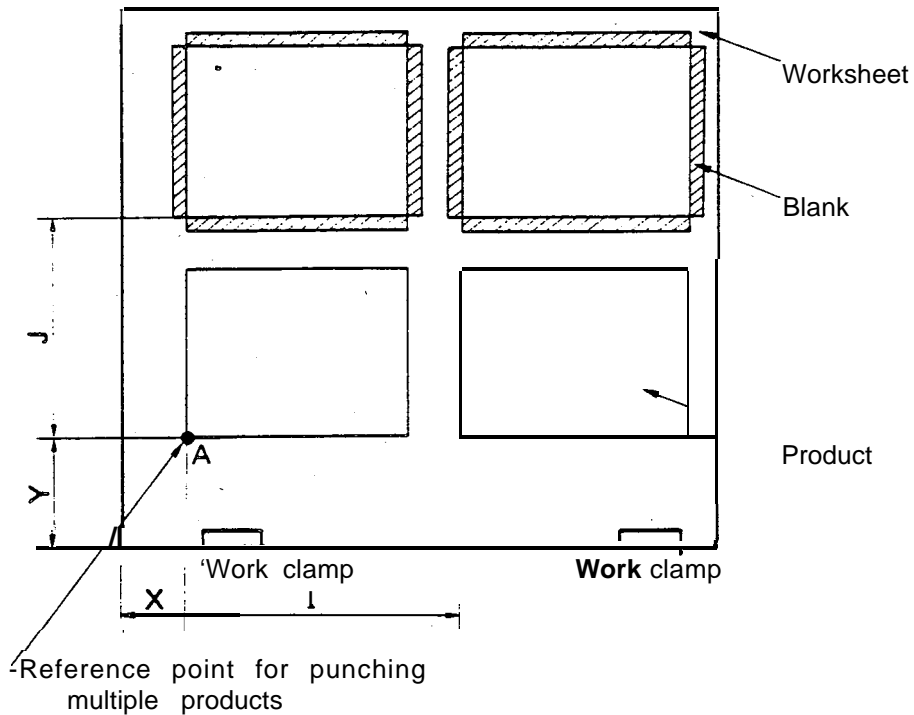
→ (4) Recalling and execution of each part program for the specified punching layout.

After preparing the above **program**, one product in the lower left corner in the figure on Page 3-I 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 PART PUNCHING**



- 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** M. Joint (Compensation value for micro joint)



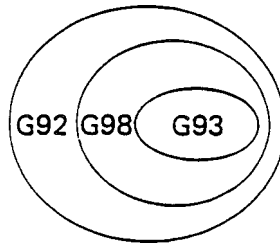
Ex.: If $X = 30$ mm, $Y = 80$ mm, $I = 200$ mm and $J = 150$ mm in the figure above, the program is:

G98 X 30 . Y80. 1 2 0 0 . J150. P1K1

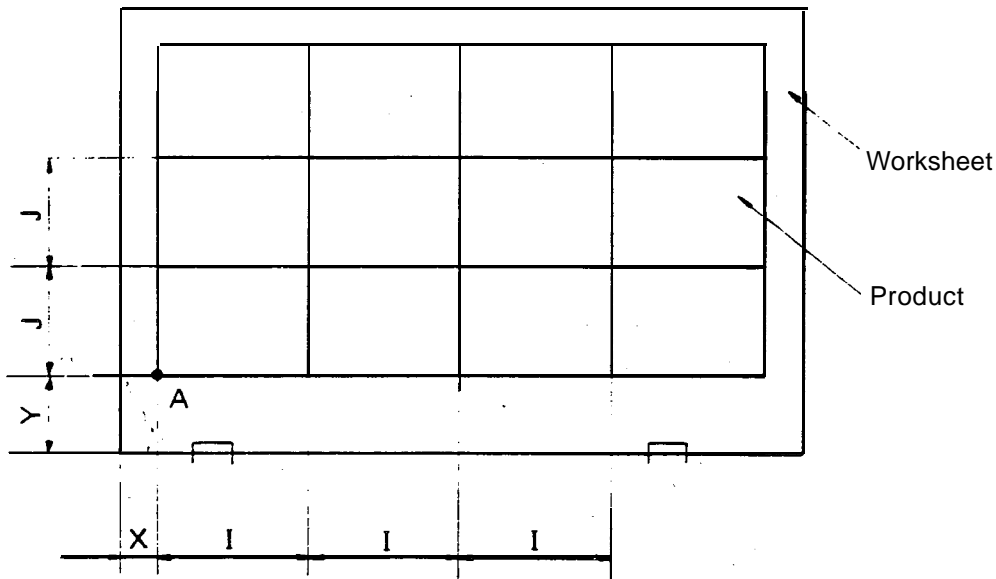
- NOTE:**
- a) The reference point for punching multiple products must be located in the lower left corner of the product which is located at the lower left portion of the worksheet.
 - b) The values "I", "J", "P" and "K" specified by "G98" must be either zero or positive values.
 - c) The value "D"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

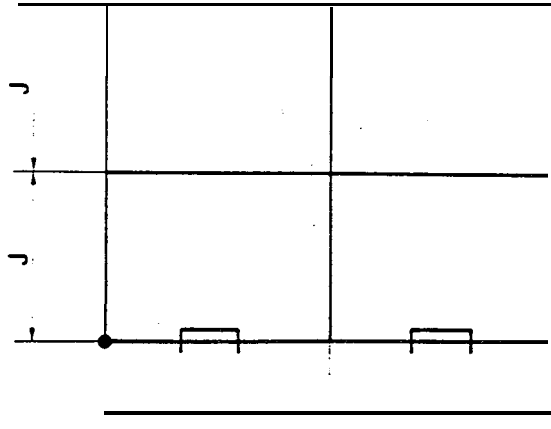


Example 1. When there is no cutting area between products and the outer edges of each product, cut either by shearing or other procedures after punching (Trimming will be necessary).



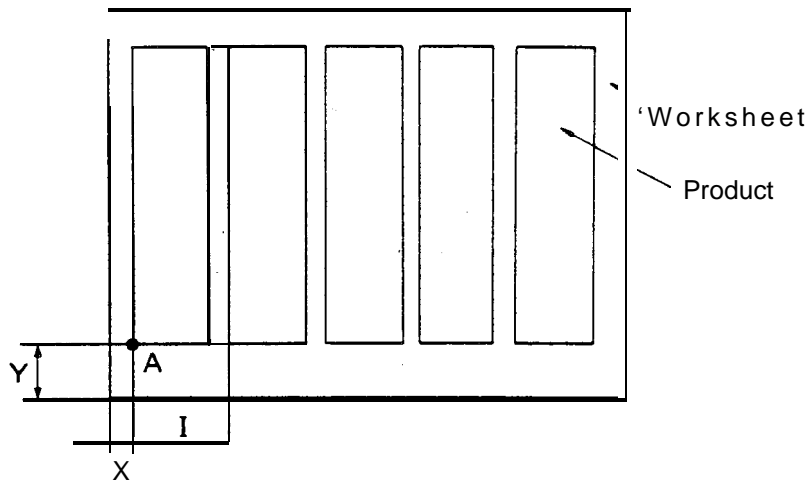
If $X = 20$ mm, $Y = 60$ mm, $I = 100$ mm and $J = 80$ mm in the above figure, the program is:
G98 X20. Y60. 1100. 580. P3 K2

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.P1K1

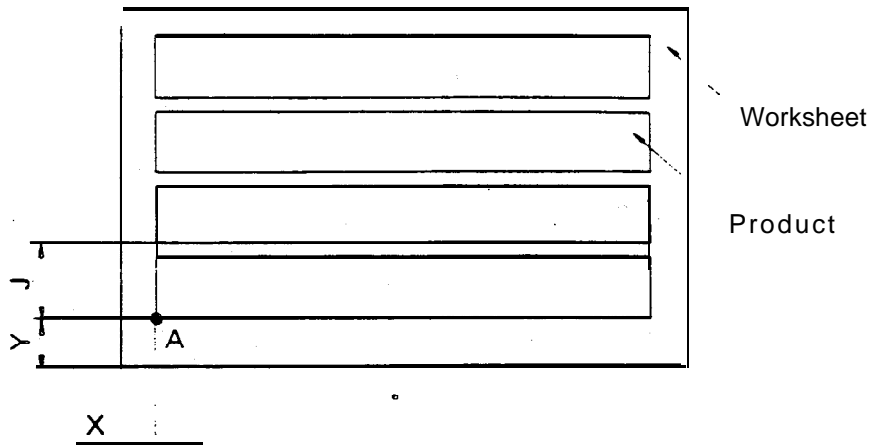
Example 3. This depicts the punching of products only in the X-axis direction.



If $X = 30$ mm, $Y = 80$ mm and $I = 110$ mm in the above figure, the program is:
 G98 X30. Y80. 1110. 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 $X = 30$ mm, $Y = 80$ mm and $J = 150$ 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

```
u o o  
.....*  
..... Part program  
.....  
v o o |
```

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 8000 characters on one processing tape.

U1

X190. Y110. T3 (8 ϕ)

Y10.

x10.

Y110.

V1

u2

G72 X60. Y60.

AI G26 125. J45. K4 T2 (4 ϕ)

G72 X140. Y60.

B1

v2

u3


X140. Y60. T9 (30 ϕ)

X60.

v3

u4

G72 X200. Y120.

G66 I120. J-90. P30. Q5. D-0.15 T1 1 (5 x 30 )


G72 X0 Y0

G66 1920. J90. P30. Q5. D-O.1 5

v4

u5

G72 X0 Y120.

G66 1200. JO P50. Q5. D-O. 15 T1(5 x 50 )

G72 X200. Y0

G66 1200. 5180. 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.

AI G26 125. J45. K4 T2

G72 X140. Y60.

B1

X140. Y60. T9

X60.

G72 x200. Y 120.

G66 1120. J-90. P30. Q5. D-O. 15 T1 1

G72 X0 Y0

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

G72 X0 Y120.

G66 1200. JO P50. Q5. D-0.1 5 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

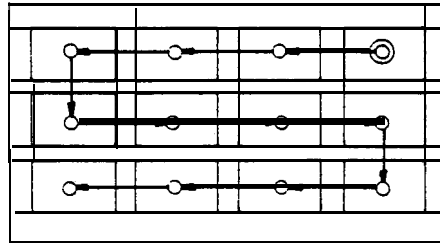


The part program for punching one product entered between “UOO” and “VOO” is recalled by “WOO”, and the program is executed to process all products according to the punching layout designated by “G98”.

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.

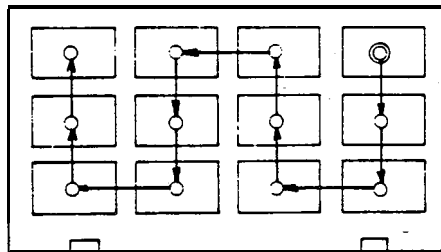
G75 WOO Q4



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

Execution is accomplished as shown in the figure below.

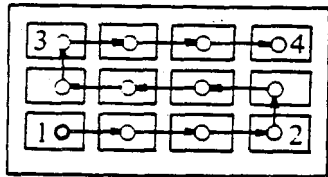
G76 WOO Q4



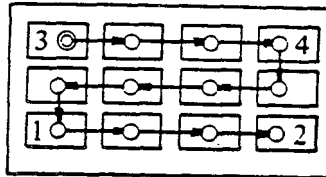
3. **QO** ... Designation of starting point

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

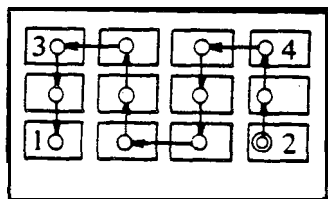
- Q1 ... Lower left corner Q3 ... Upper left corner
 Q2 ... Lower right corner Q4 ... Upper right corner



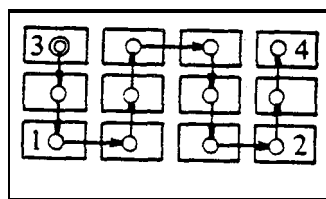
G75 WOO Q1



G75 WOO- Q3



G76 W o o Q2

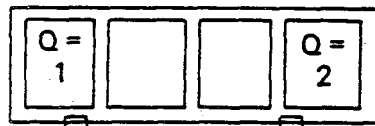


G76 W o o Q3

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

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

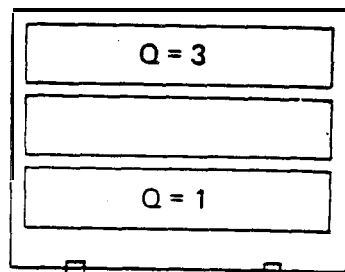
Q ... Only 1 or 2 can be used.



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

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

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



6. Combination method of G75 and Q1 to Q4, or G76 and Q1 to Q4
 - (a) Either **"G75"** or "G76" must be selected so that the distance of movement can be minimized.
 - (b) If the processing of a part program starts from the upper right corner (Q4) and ends at the upper left corner (Q3), the processing of the next part program should start at the upper left corner (Q3) in order to guarantee efficient movement.
 - (c) When cutting the outside shape in the process of punching multiple products, it is desirable to start the punching at the upper portion of the worksheet and move lower in sequence. For such a procedure, enter the command of: G75 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 X1270. Y1000.

G98 X20. Y100. I250. J150. P1 K2

U90

U1

X190. Y110. T3

Y10.

X10.

Y110.

V1

U2

G72 X60. Y60.

A1 G26 I25. J45. K4 T2

G72 X140. Y60.

B1

V2

U3

X140. Y60. T9

X60.

V3

U4

G72 X200. Y120.

G66 I120. J-90. P30. Q5. D-0.15 T11

G72 X0 Y0

G66 I120. J90. P30. Q5. D-0.15

V4

U5

G72 X0 Y120.

G66 I200. J0 P50. Q5. D-0.15 T1

G72 X200. Y0

G66 I200. J180. P50. Q5. D-0.15

V5

V90

G75 W90 Q4

G50

G92 X1270. Y1000.

G98 X20. Y100. I250. J150. P1 K2

U1

X190. Y110. T3

Y10.

X10.

Y110.

V1

U2

G72 X60. Y60.

A1 G26 I25. J45. K4 T2

G72 X140. Y60.

B1

V2

U3

X140. Y60. T9

X60.

V3

U4

G72 X200. Y 120.

G66 I120. J-90. P30. Q5. D-0.15 T11

G72 X0 Y0

G66 I120. J90. P30. Q5. D-0.15

V4

U5

G72 X0 Y120.

G66 I200. J0 P50. Q5. D-0.15 T1

G72 X200. Y0

G66 I200. J180. P50. Q5. D-0.15

V5

G75 W1 Q4

G75 W2 Q4

G75 W3 Q4

G75 W4 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".

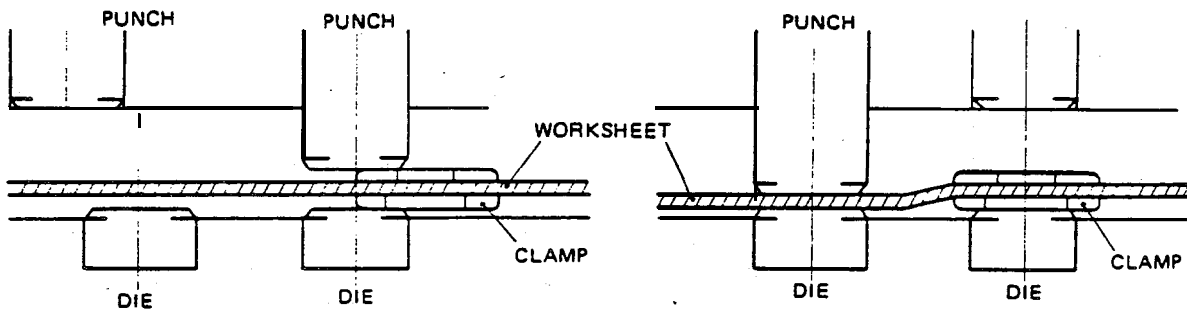
Refer to Page 13 of the OPERATOR'S MANUAL.

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.

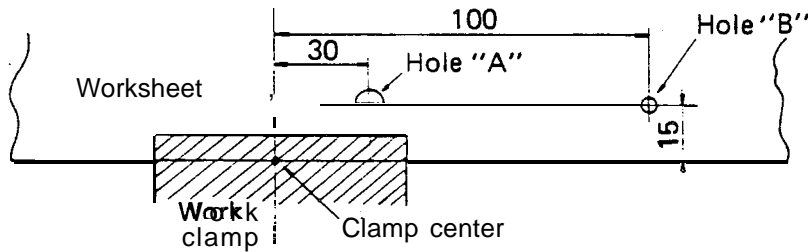


Clamp caught between punch and die.
Clamp will be punched.

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

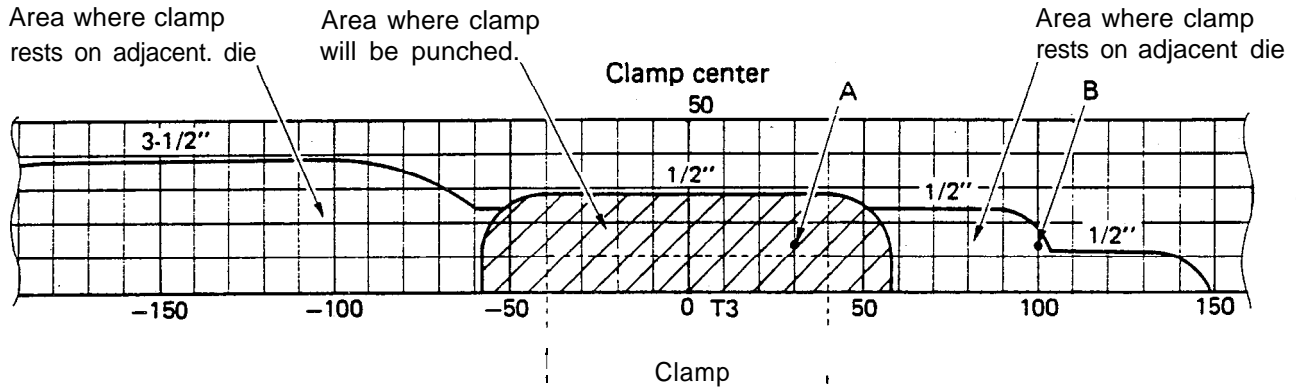
Example: When punching the following holes with tool station T3 on the thick turret with the Auto-Index.



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"

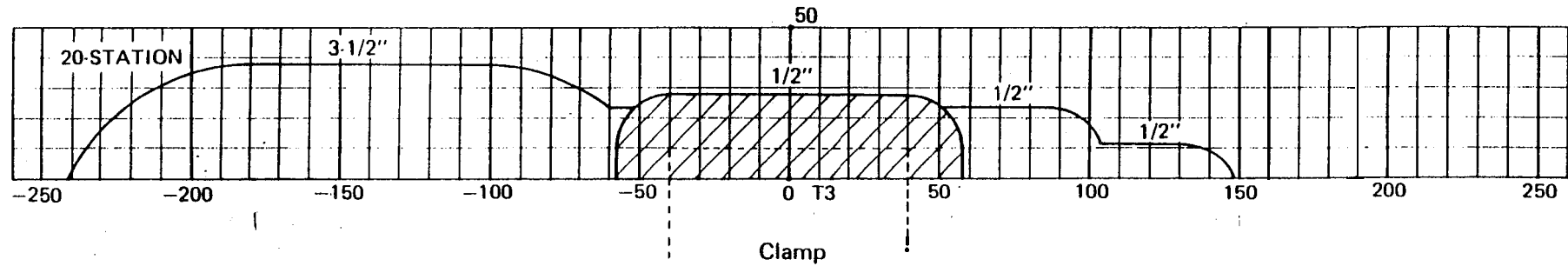
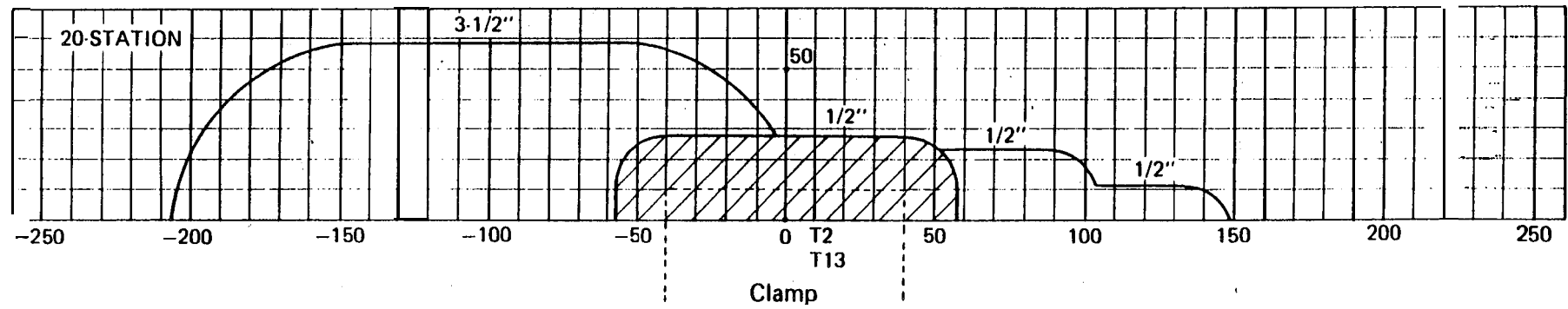
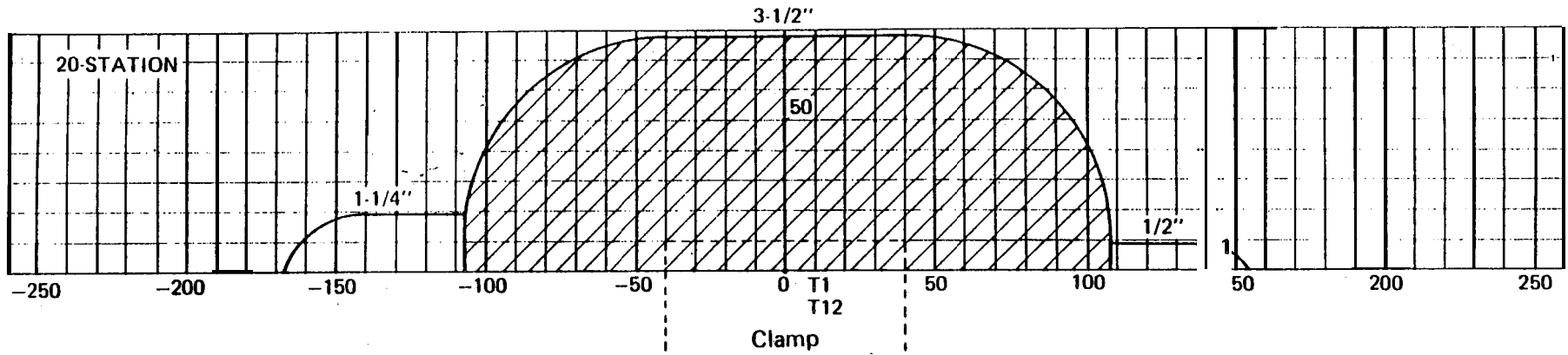
(Thick turret with Auto-Index)



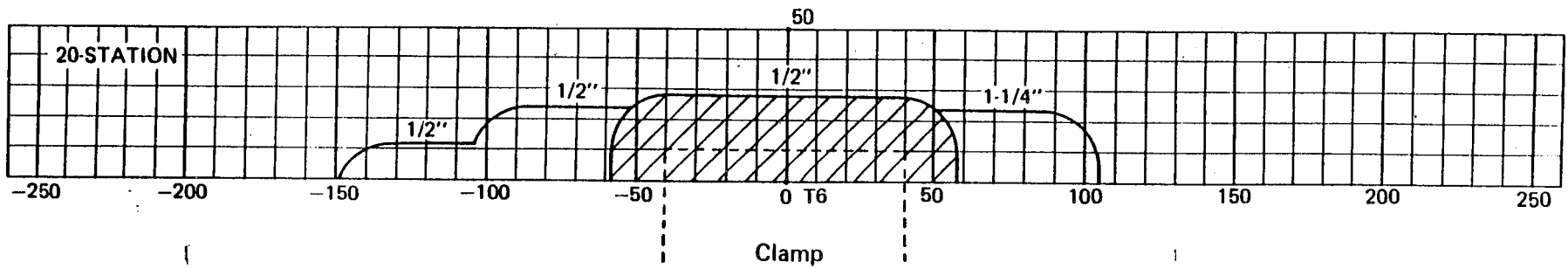
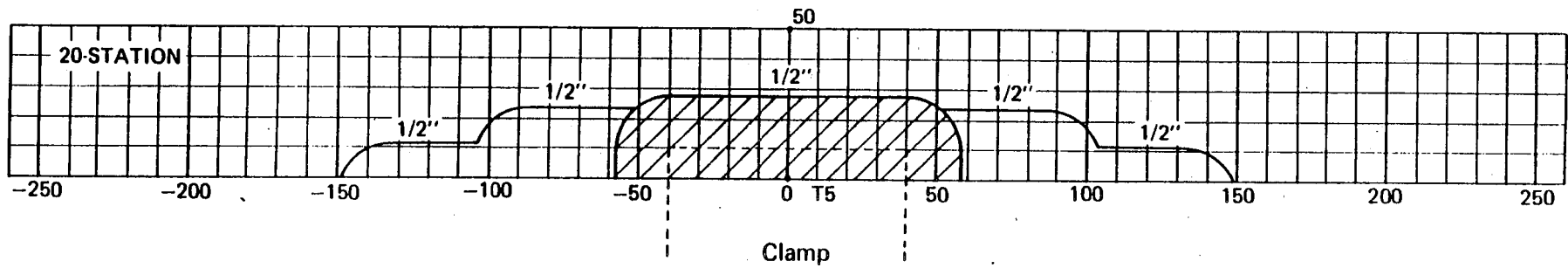
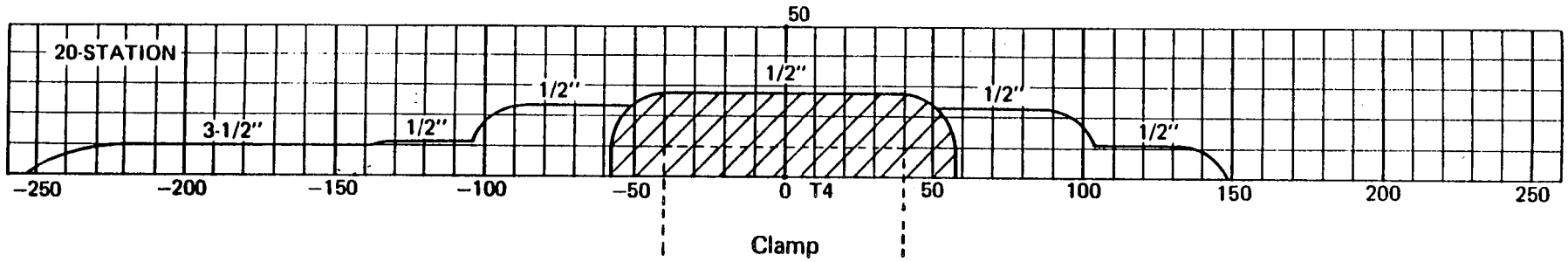
Hole A position is in the area where the clamp will be punched and hole B position is in the area where the clamp rests on adjacent dies. Consequently, in order to punch these holes, the following methods must be considered:

- 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
[THICK TURRET WITH AUTO-INDEX]

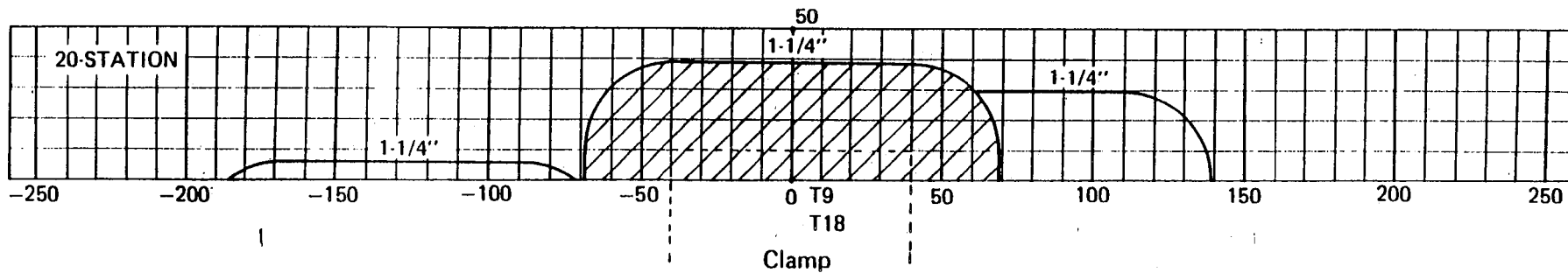
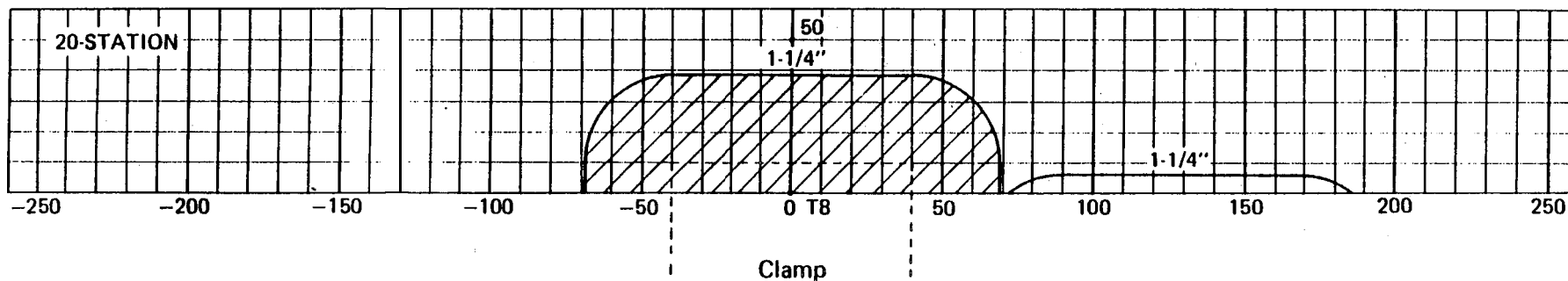
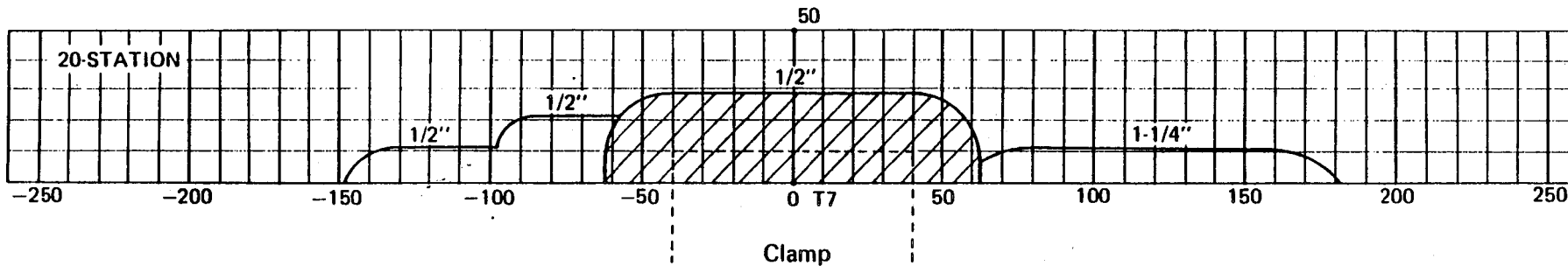


DEAD ZONE DIAGRAMS
[THICK TURRET WITH AUTO-INDEX]

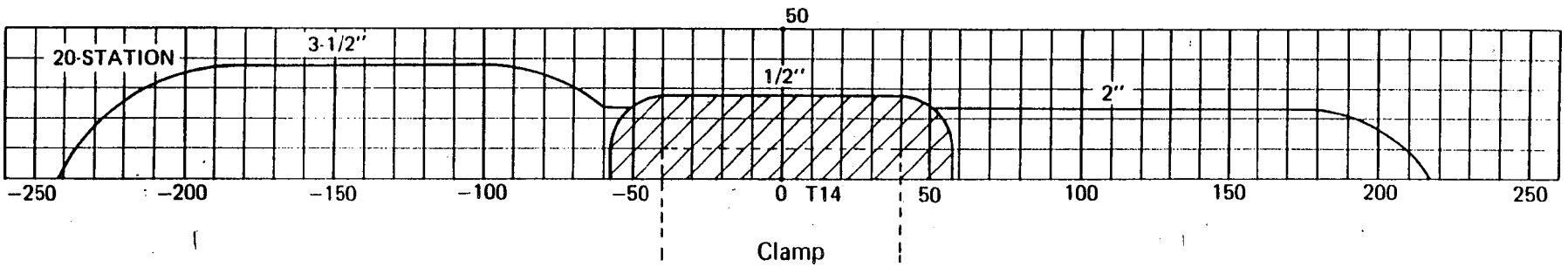
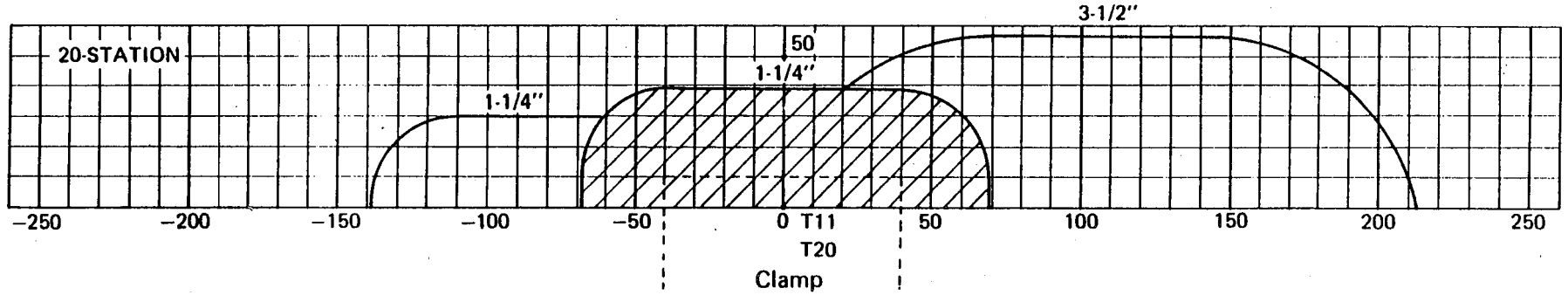
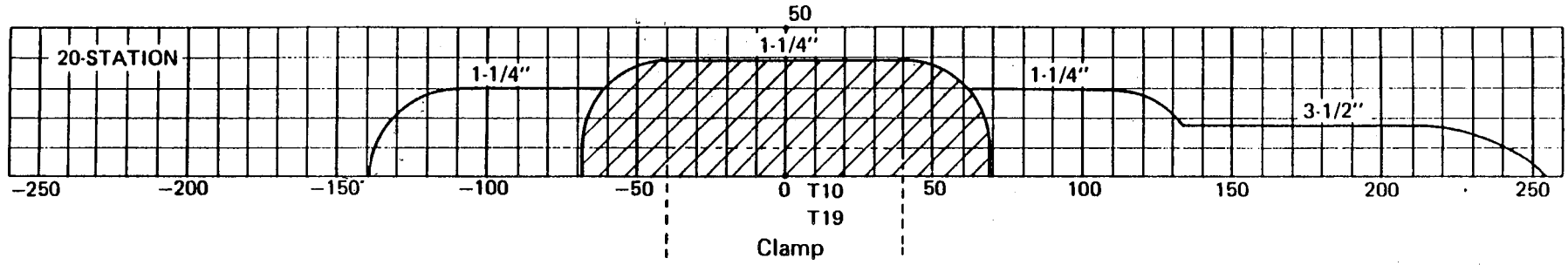


4-4

DEAD ZONE DIAGRAMS
 [THICK TURRET WITH AUTO-INDEX]

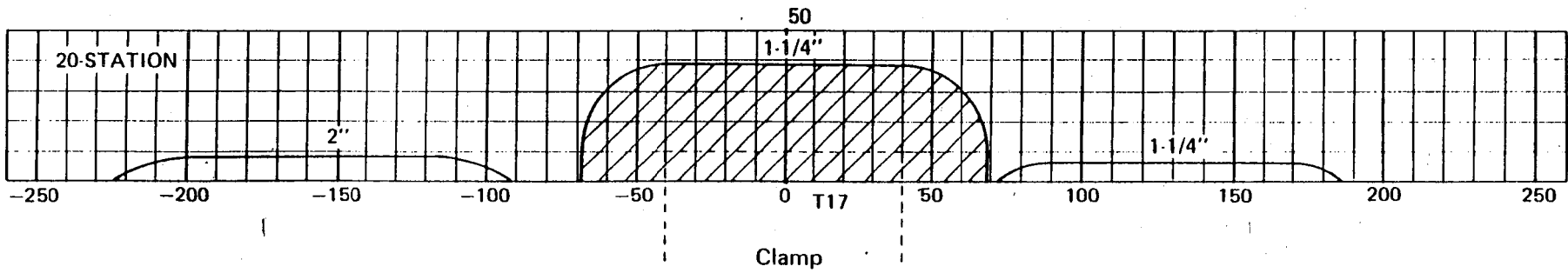
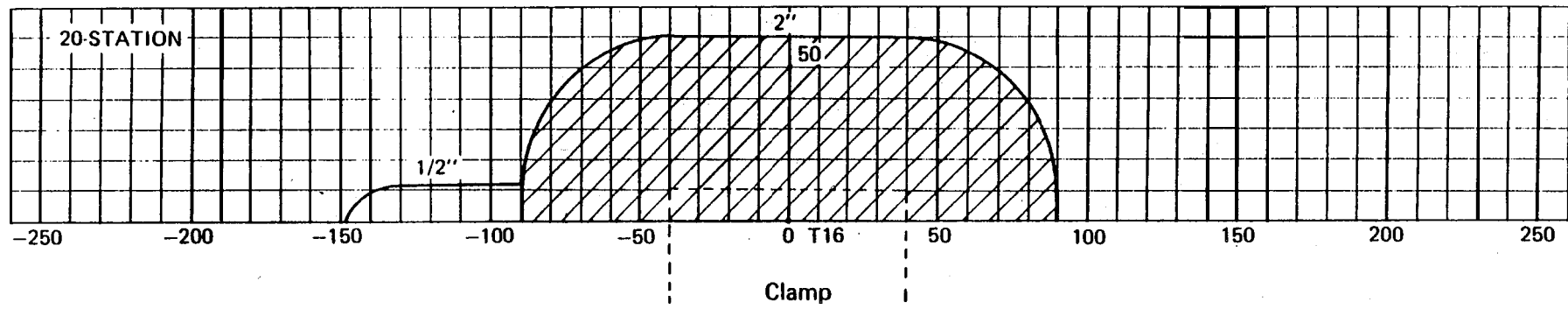
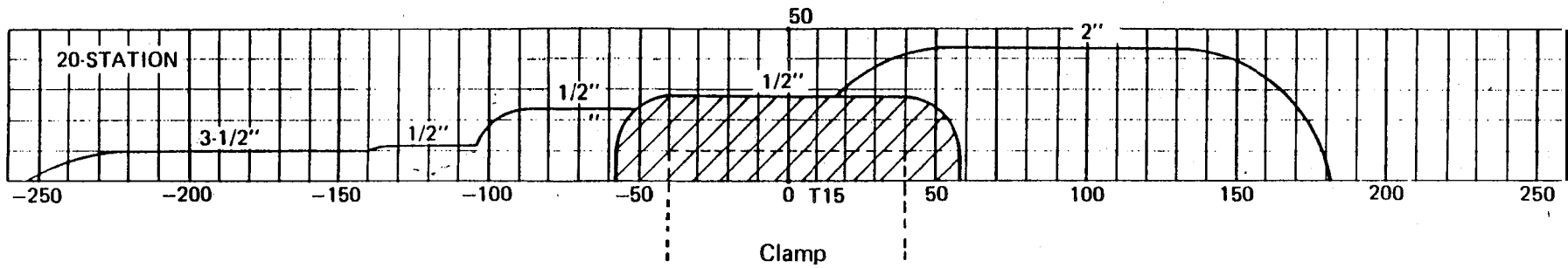


DEAD ZONE DIAGRAMS
[THICK TURRET WITH AUTO-INDEX]

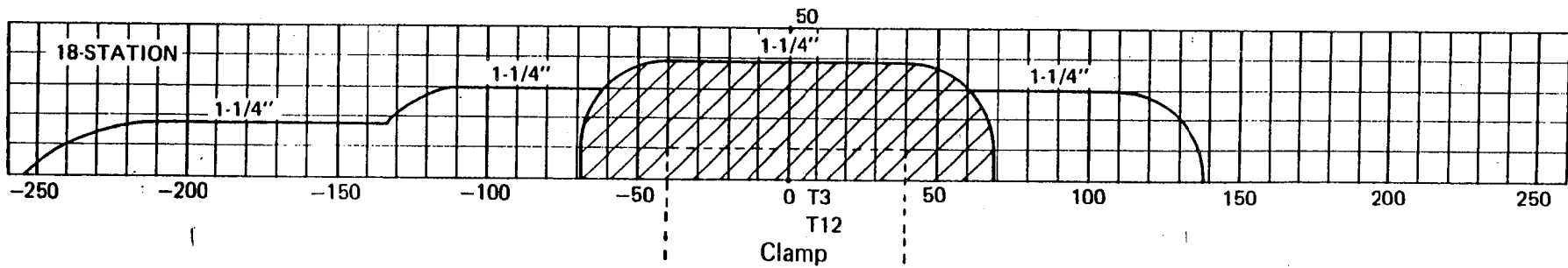
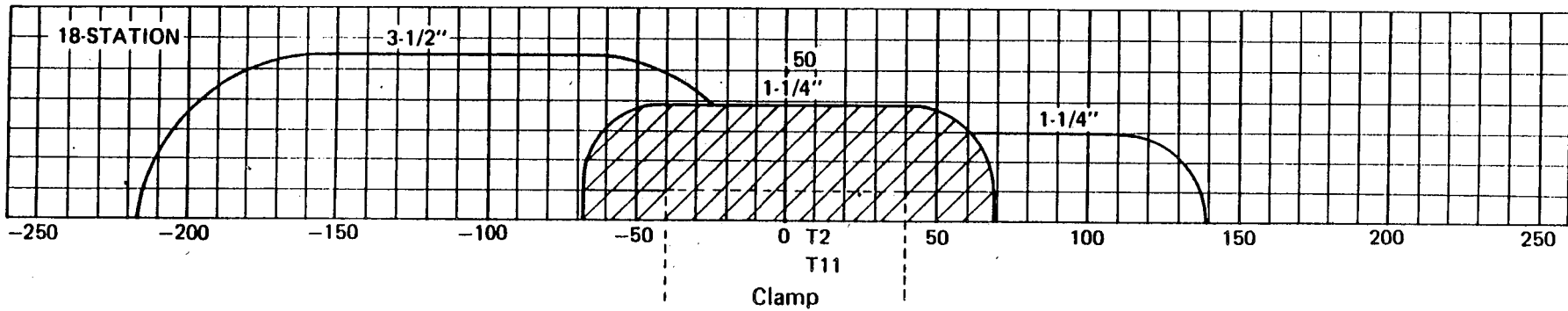
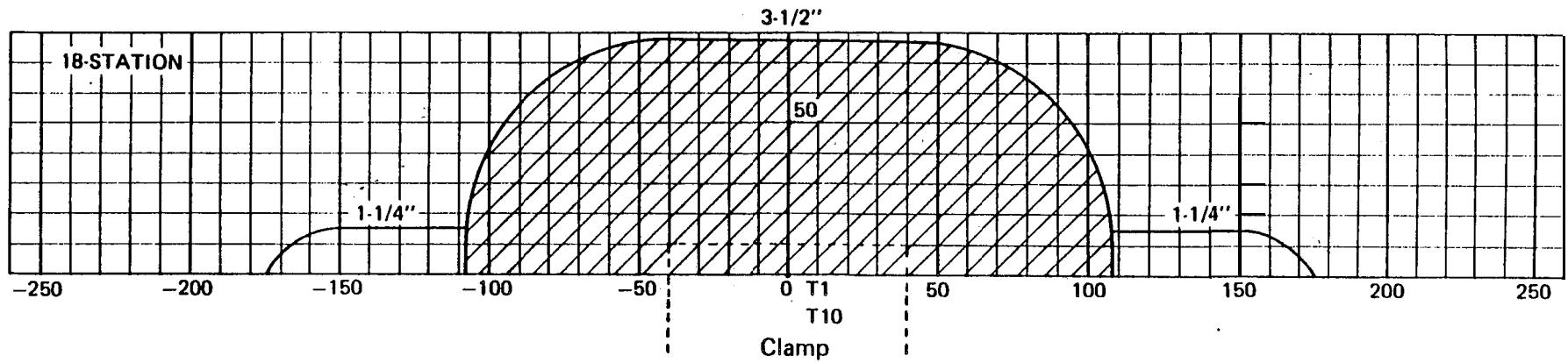


4-6

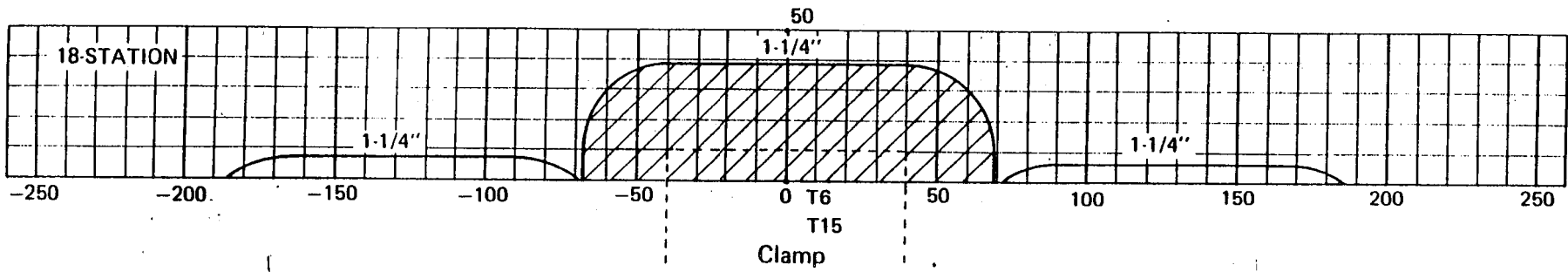
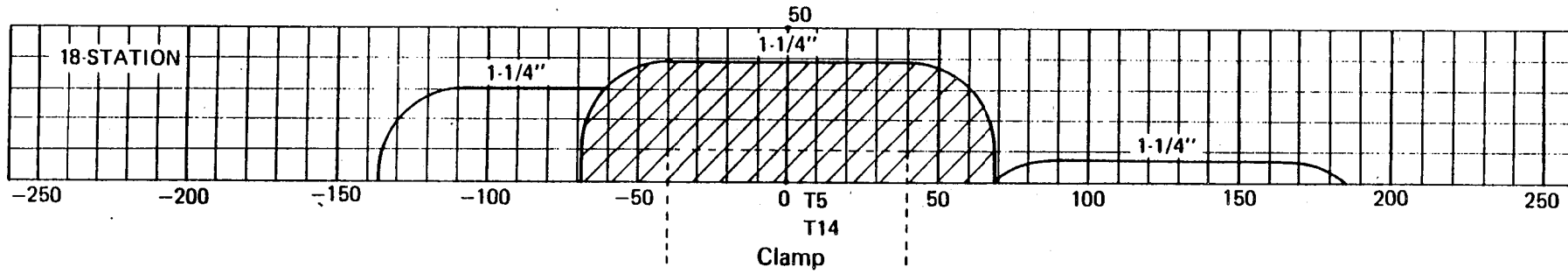
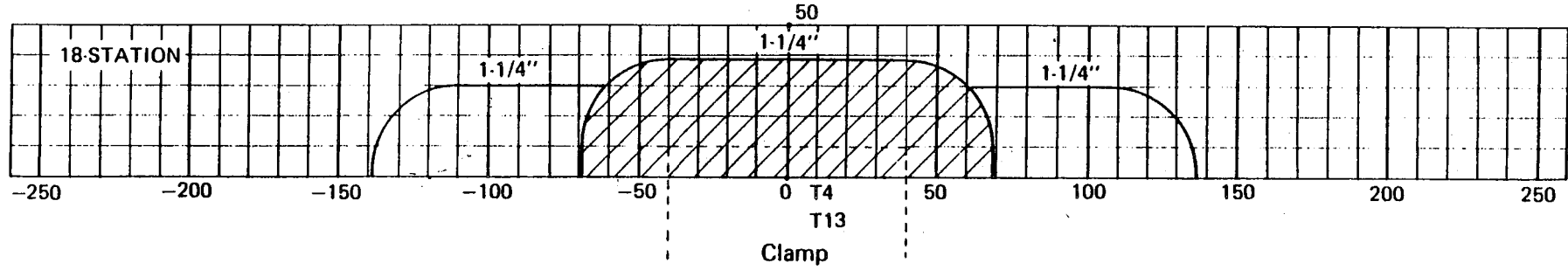
DEAD ZONE DIAGRAMS
[THICK TURRET WITH AUTO-INDEX]



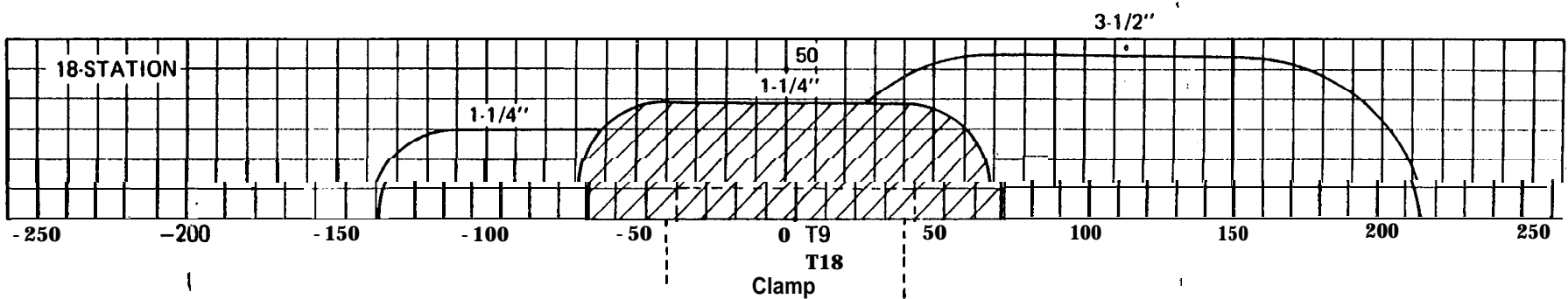
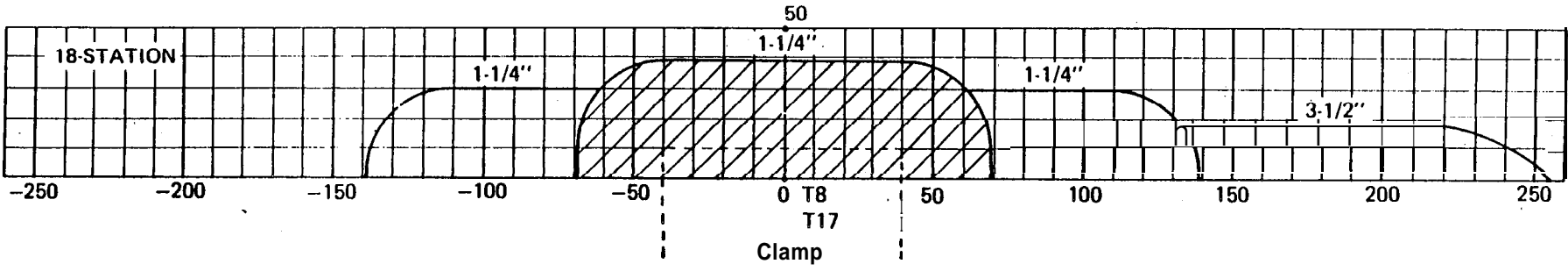
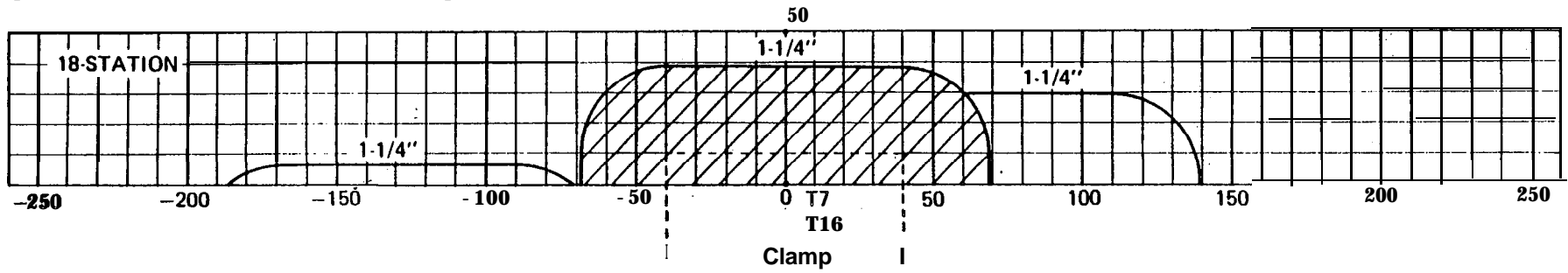
DEAD ZONE DIAGRAMS
[THIN TURRET WITH AUTO-INDEX]



DEAD ZONE DIAGRAMS
[THIN TURRET WITH AUTO-INDEX]

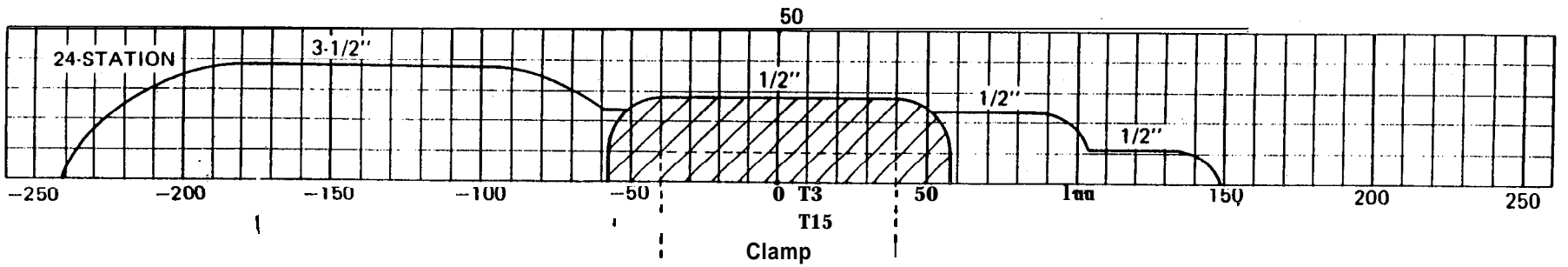
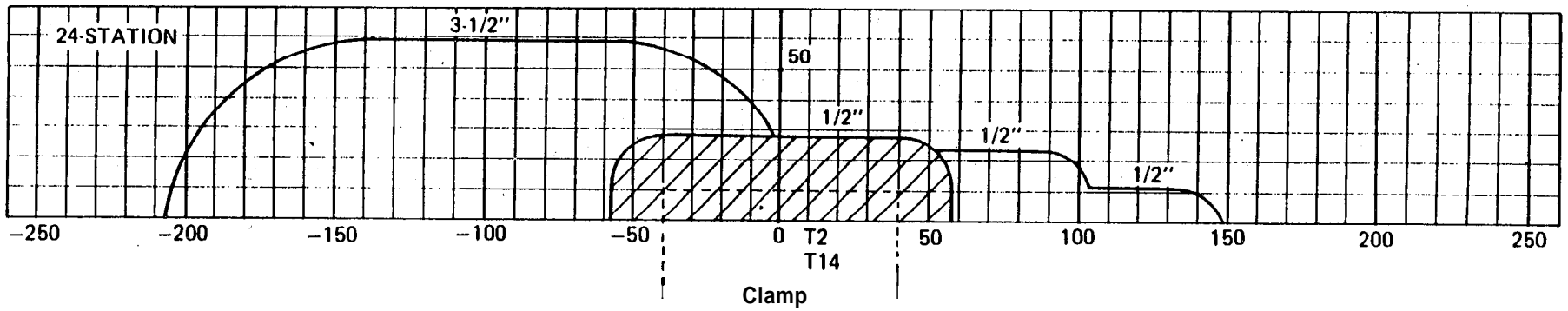
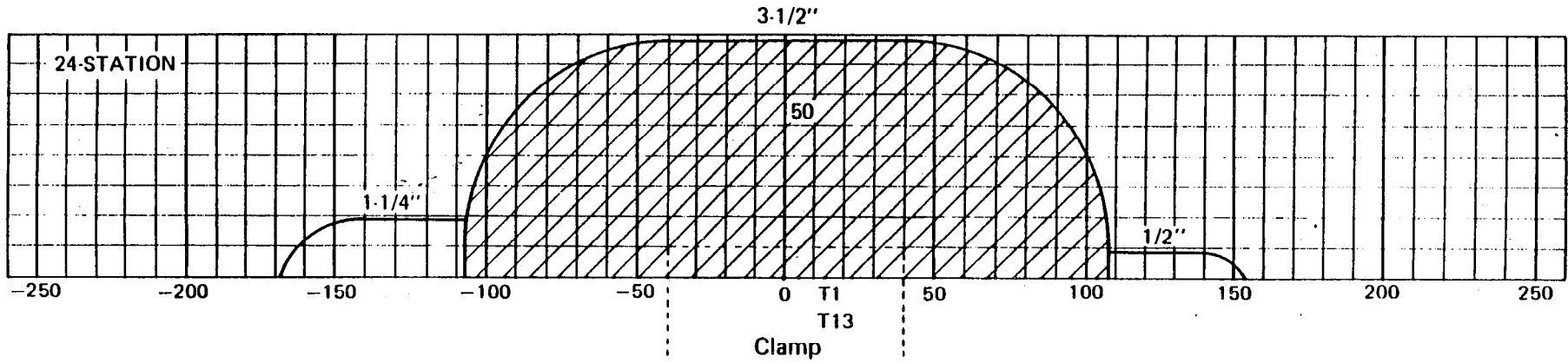


DEAD ZONE DIAGRAMS
[THIN TURRET WITH AUTO-INDEX]

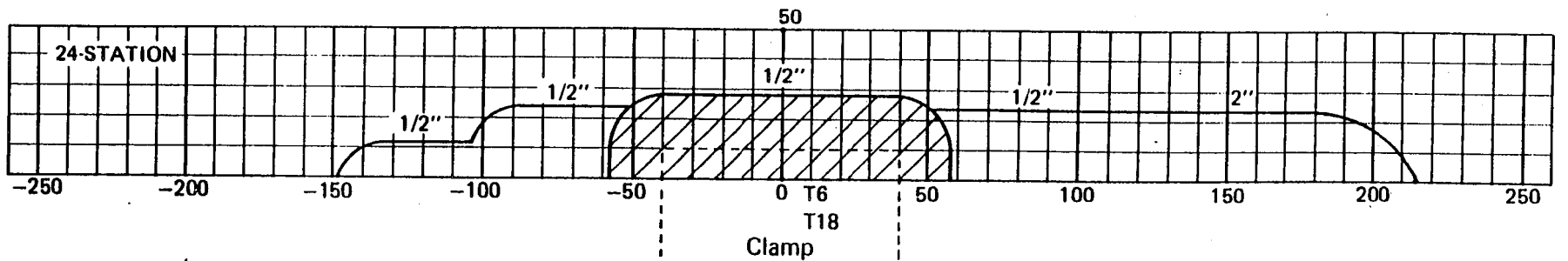
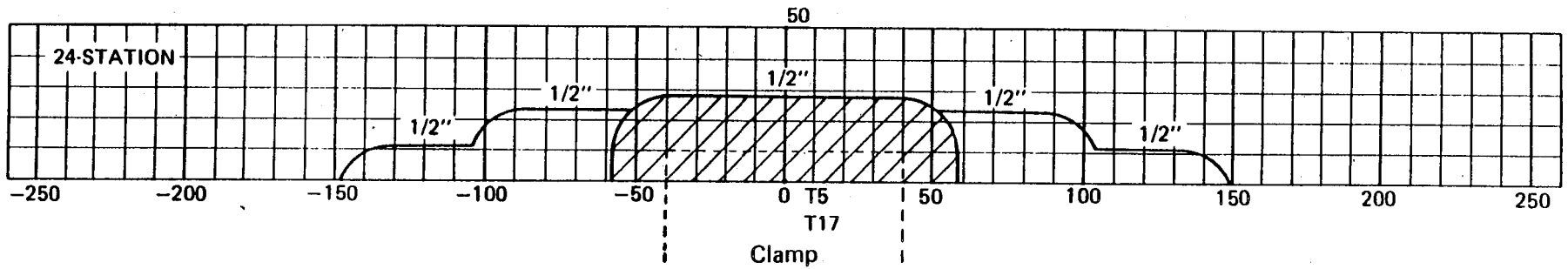
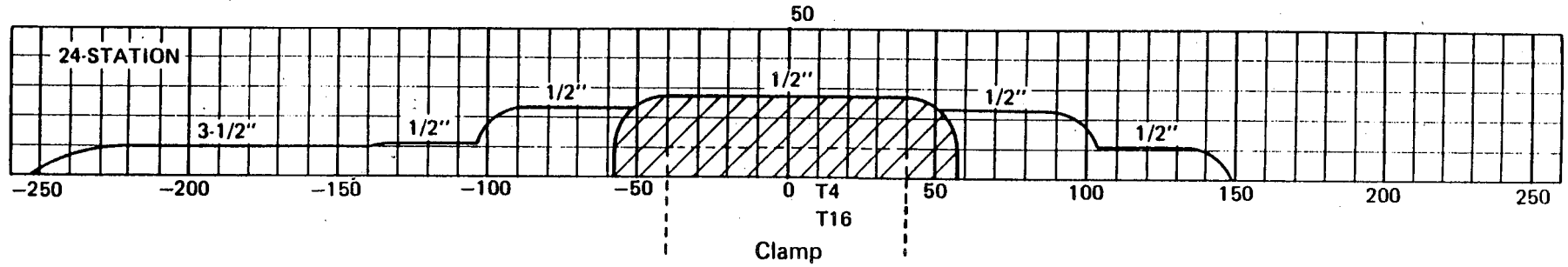


4-10

DEAD ZONE DIAGRAMS
[THICK TURRET WITHOUT AUTO-INDEX]

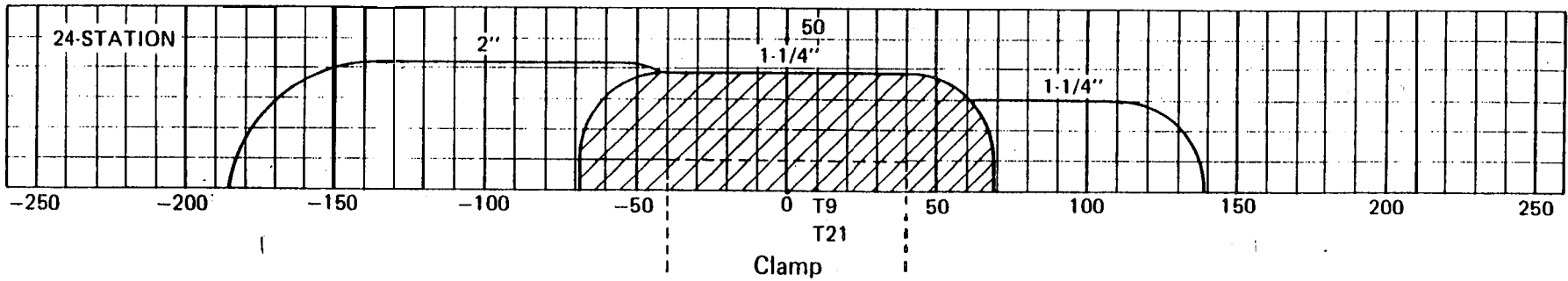
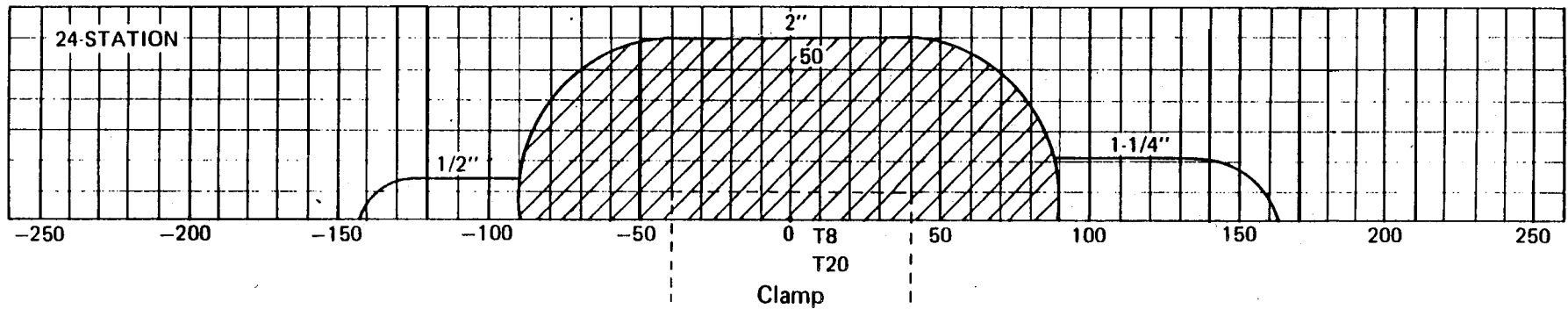
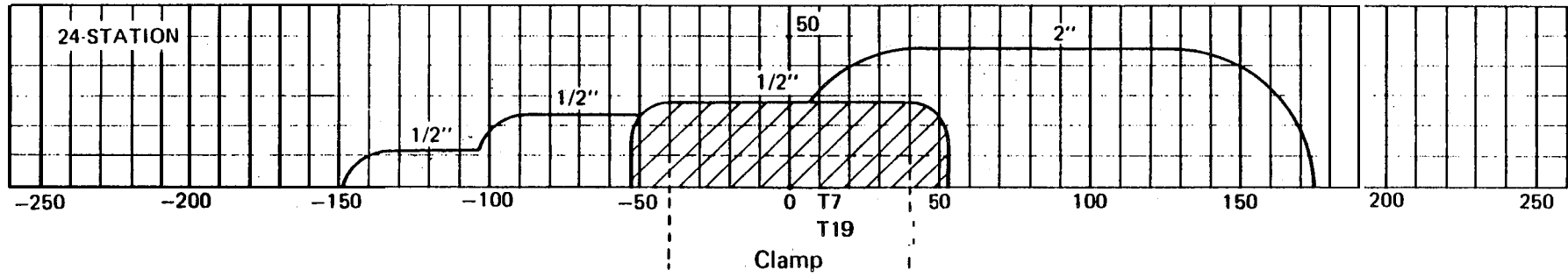


DEAD ZONE DIAGRAMS
[THICK TURRET WITHOUT AUTO-INDEX]

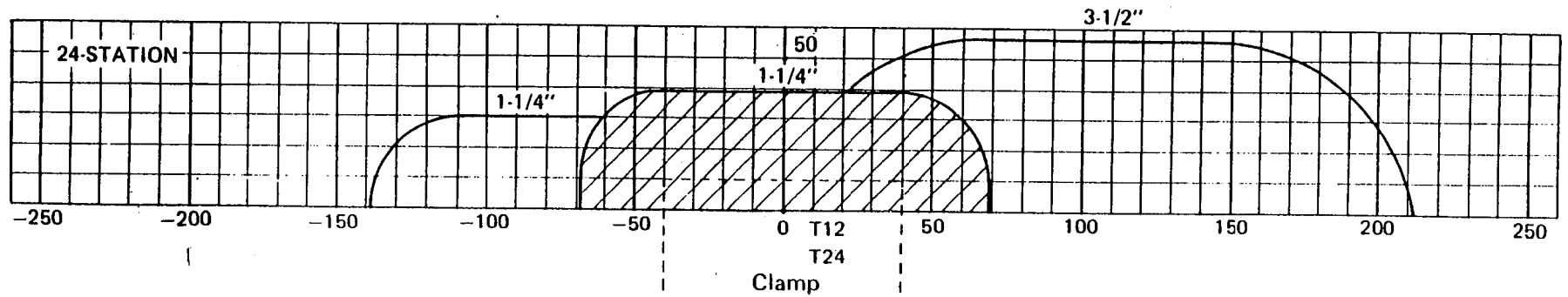
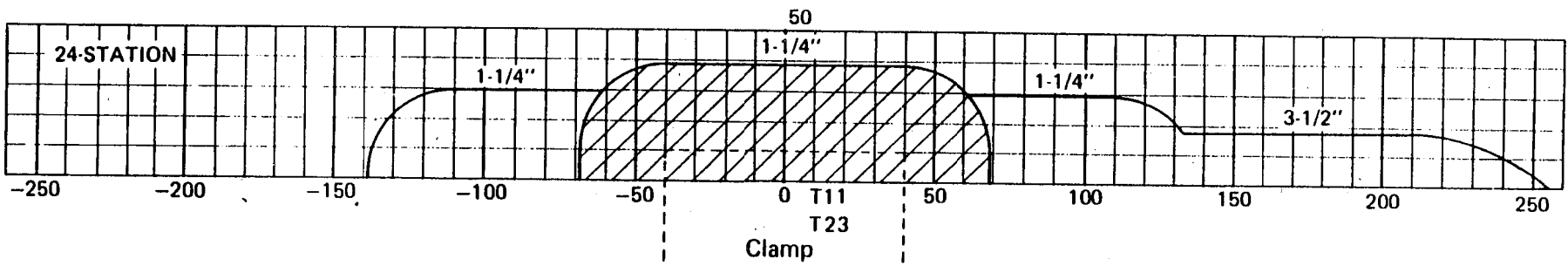
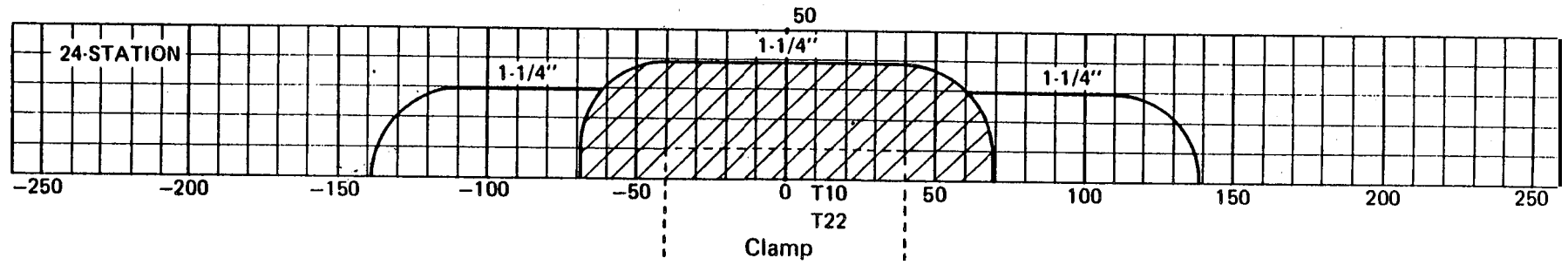


4-12

DEAD ZONE DIAGRAMS
[THICK TURRET WITHOUT AUTO-INDEX]

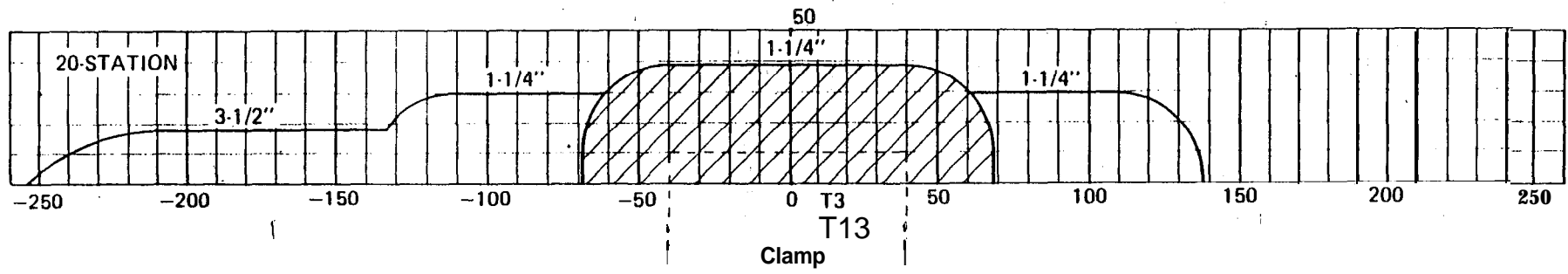
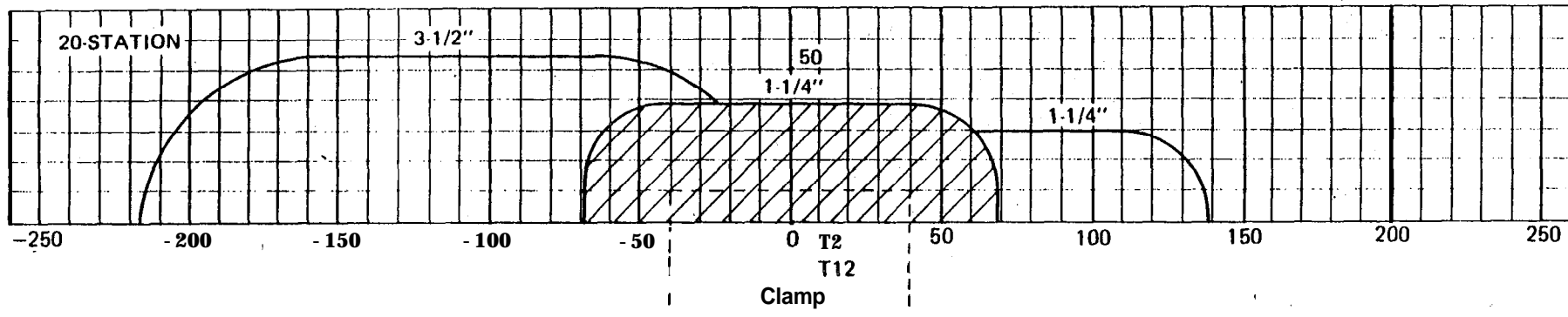
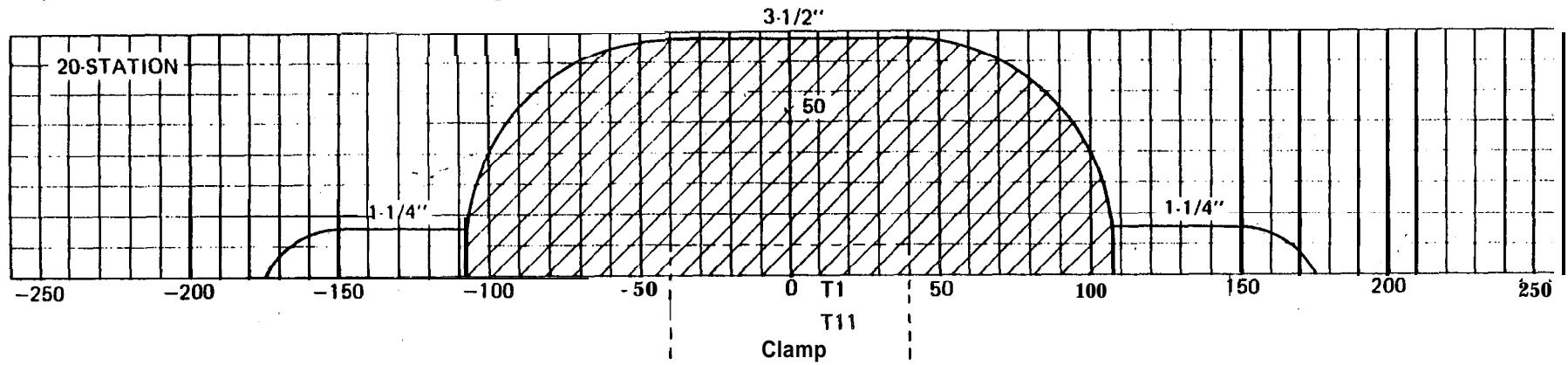


DEAD ZONE DIAGRAMS
[THICK TURRET WITHOUT AUTO-INDEX]

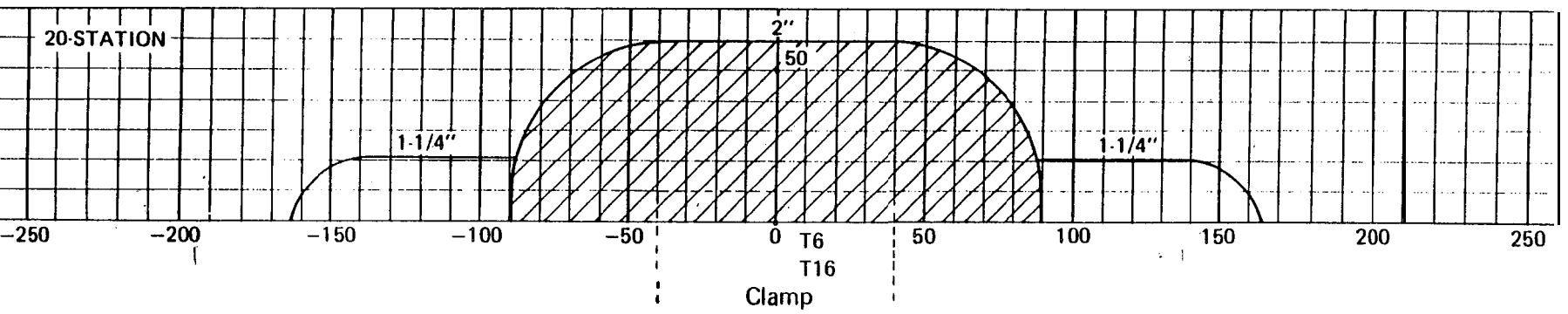
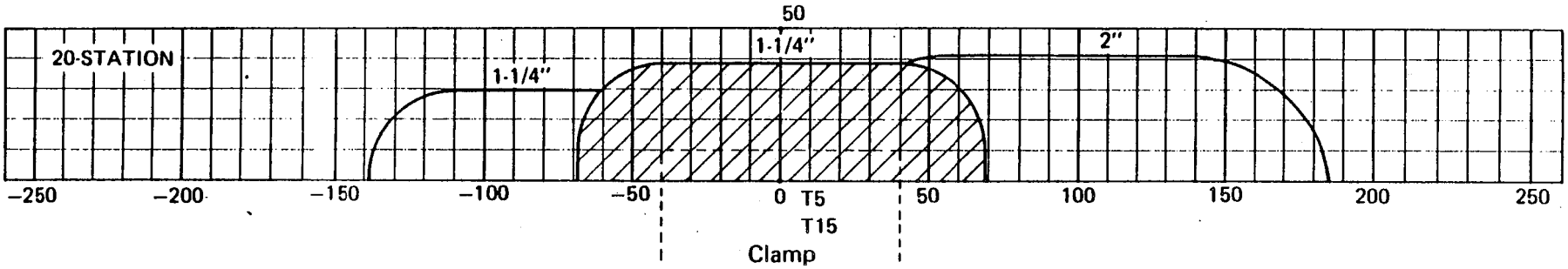
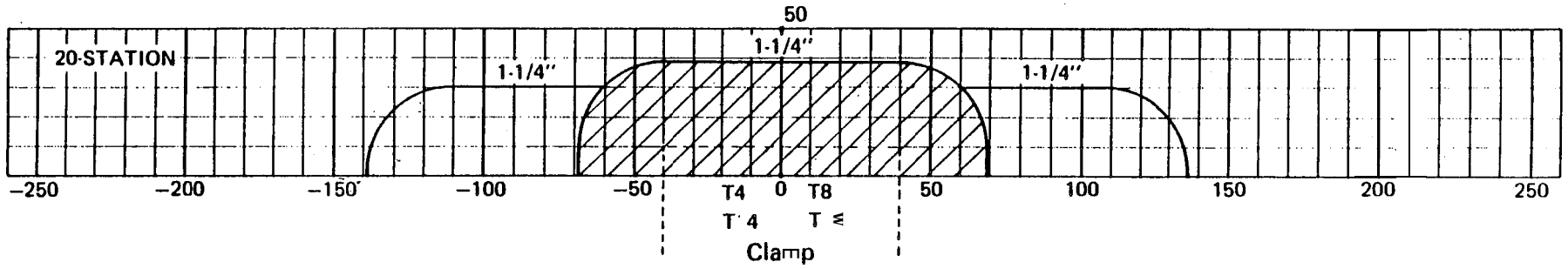


4-14

DEAD ZONE DIAGRAMS
[THIN TURRET WITHOUT AUTO-INDEX]

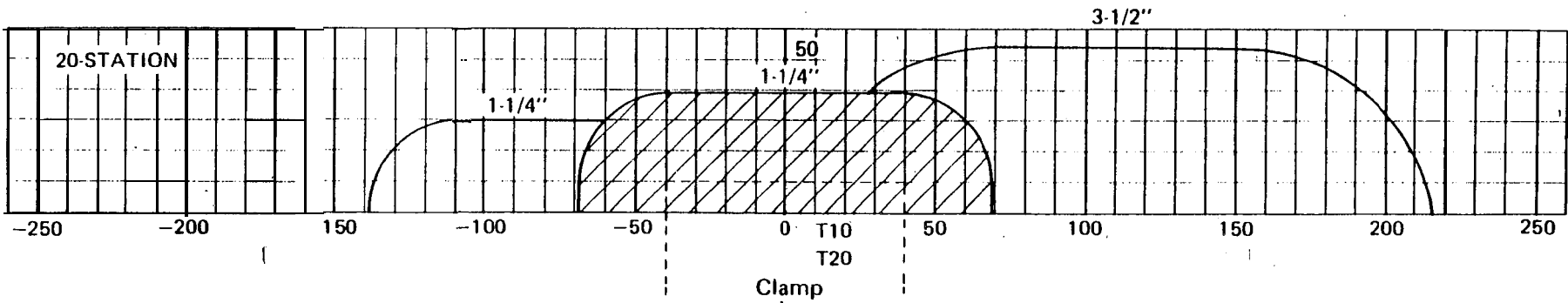
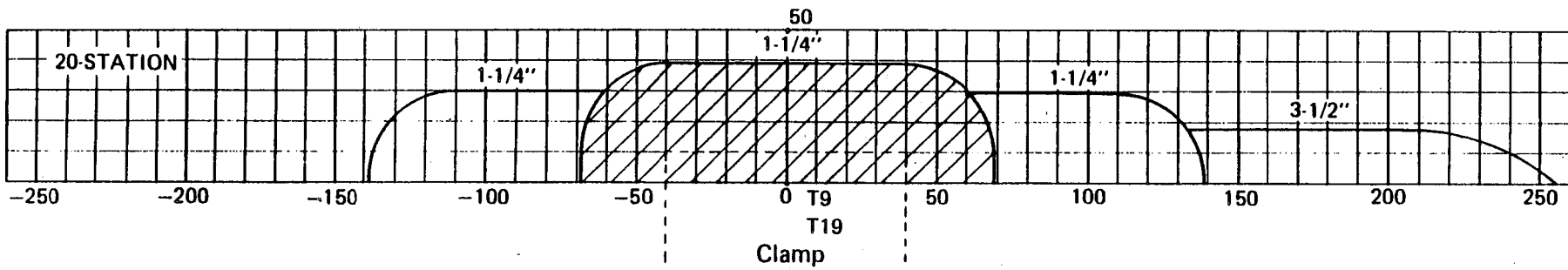
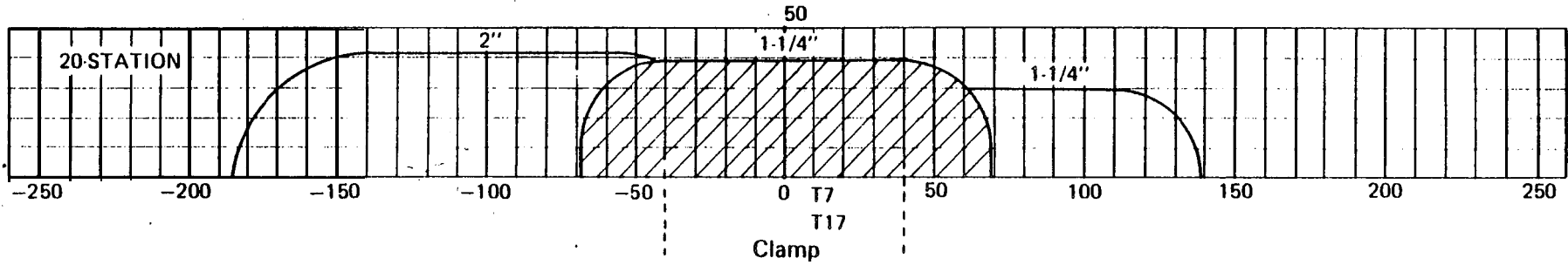


DEAD ZONE DIAGRAMS
[THIN TURRET WITHOUT AUTO-INDEX]



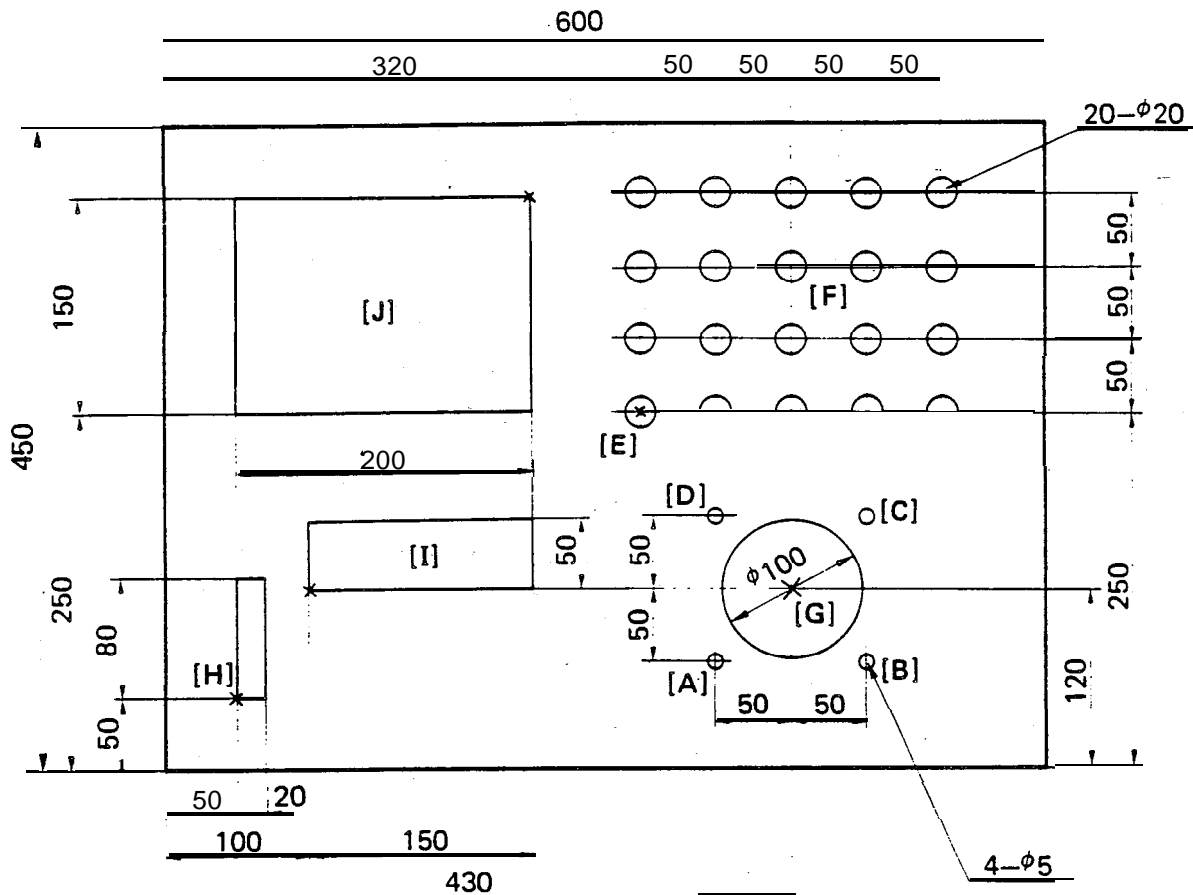
4-116

DEAD ZONE DIAGRAMS
[THIN TURRET WITHOUT AUTO-INDEX]



PROGRAMMING EXAMPLE

EX.. 1 GENERAL PUNCHING



5 mm dia.: T2
 20 mm dia.: T9
 20 mm x 20 mm: T10

(Thick turret with Auto-Index)

- NOTE: (a) The starting angle of hole "G" is 90 degrees to remove the scrap easily.
 (b) The pattern origin of hole "J" is on the right upper corner of the square and the lengths "I" and "J" are negative value, to remove the scrap easily.
 (c) Hole "I" is punched 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

PATRN (SHIFT)	* S	1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		INPUT 0
		● 01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X)Q (TOOL SIZE Y) J (ANGLE);
		*01 T 2 INPUT R 1 INPUT P 5 . INSRT
<hr/>		
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		INPUT
		● 01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X)Q (TOOL SIZE Y) J (ANGLE);
		*01 T 9 INPUT R 1 INPUT P 2 0 . INSRT
<hr/>		
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		INPUT
		● 01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X)Q (TOOL SIZE Y) J (ANGLE);
		*01 T 1 0 INPUT R 2 INPUT P 2 0 . INPUT Q 2 0 . INPUT J 0 INSRT
<hr/>		
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		↻
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		INPUT
		● 02: WORK X (WORK SIZE X) Y (WORK SIZE Y) [WORK SIZE]
		*02 X 6 0 0 . INPUT Y 4 5 0 . INSRT
<hr/>		
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		↻ ↻
		1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION
		INPUT
		● 03: CLAMP A (CLAMP POSITION A) [CLAMP POSITION1 B (CLAMP POSITION B)
		*03 A 1 0 0 . INPUT B 5 0 0 . INSRT

[A]

ABS G90: X (X POSITION) Y (Y POSITION)
 [ABSOLUTE] T (TOOL NO.) C (INDEX ANGLE);
 90 G - G90 X Y T

[B]

INC G91: X (X POSITION) Y (Y POSITION)
 [INCREMENTAL] T (TOOL NO.) C (INDEX ANGLE);
 91 X - - - G91 X

[C]

INC G91: X (X POSITION) Y (Y POSITION)
 [INCREMENTAL] T (TOOL NO.) C (INDEX ANGLE);
 91 X G91 X Y

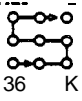
[D]

INC G91: X (X POSITION) Y (Y POSITION)
 [INCREMENTAL] T (TOOL NO.) C (INDEX ANGLE);
 91 X G91 X

[E]

ABS G90: X (X POSITION) Y (Y POSITION)
 [ABSOLUTE] T (TOOL NO.) C (INDEX ANGLE);
 90 G G90 X

[F]

 G36: [INPUT POSITION]
 [GRID-X] X (POSITION X) Y (POSITION Y)
 T (TOOL NO.) C (INDEX ANGLE);
 X Y T
 C ;

G36: I (PITCH X) P (#X SPACES)
 [GRID-X] J (PITCH Y) K (#Y SPACES)
 T (TOOL NO.) C (INDEX ANGLE);
 G36 I P J
 K

[G]



68 0

1- INPUT: G68 [NIBBLE ARC] 2 : G78 [PUNCH ARC1

0

G68: [INPUT POSITION1

[NIBBLE ARC] X (POSITION X) Y (POSITION Y);

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 (NBL. PITCH) T (TOOL NO.)

C (INDEX ANGLE); 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 C INPUT
MOO INPUT INSERT

[H]



66 M'

666: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

G72 X 5 0 . INPUT Y 5 0 . INPUT

G66: SHP I (LENGTH) J (ANGLE) P (TOOL LTH.)

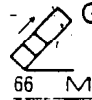
[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TCOL NO.)

C (INDEX ANGLE);

G66 I 8 0 . INPUT J 9 0 . INPUT P - 2 0 . INPUT
Q - 2 0 . INPUT K INPUT D INPUT T 1 0 INSERT

[I]



66 M

G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

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

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

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

[J]



G67: [INPUT POSITION]

[SQUARE] X (POSITION X) Y (POSITION Y);

G72 X Y

G67: I (LENGTH X) J (WIDTH Y) P (TOOL LTH. X)

[SQUARE] Q (TOOL WTH. Y) T (TOOL NO.)

C (INDEX ANGLE); MOO (STOP);

G67 I J
P Q T C
; MOO

END
PRGRM

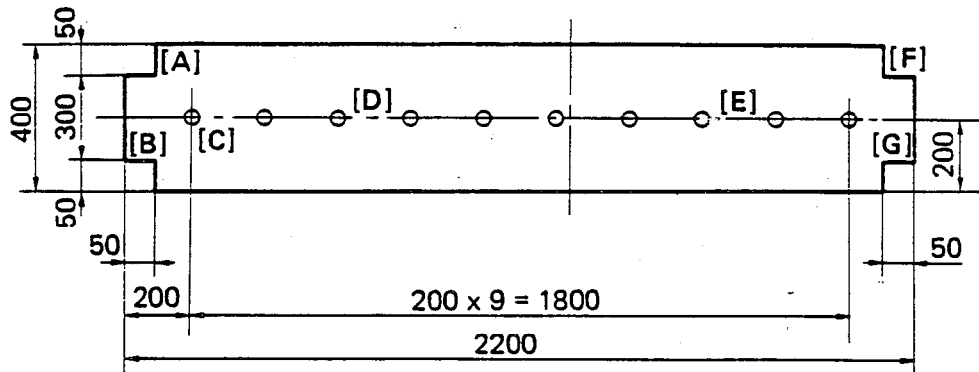
G50: ;

50. F

[E N D]

G50;

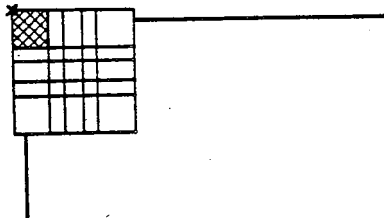
EX. 2 PUNCHING WITH AUTO REPOSITIONING



20 mm dia.: T9
20 mm x 20 mm: T10

(Thick turret with Auto-index)

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.

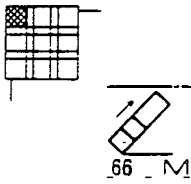


- (b) The edge of the punch must be out of the edge of the worksheet not to produce the needle-shaped scrap as the figure above.
- (c) The PUNCH-OFF function "G70" must be used to transfer the worksheet when the last punching position is in the following case on intending to perform the auto-repositioning. .
- 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

<div style="border: 1px solid black; padding: 2px; width: 50px; margin: 0 auto;">PATRN (SHIFT)</div>	<div style="border: 1px solid black; padding: 2px; width: 50px; margin: 0 auto;">* S</div>	<div style="border: 1px solid black; padding: 2px; width: 30px; margin: 0 auto;">INPUT</div>	<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>● O: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y) J (ANGLE);</p> <p>*01 T 9 INPUT R 1 INPUT P 2 0 . INSRT</p>
			<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>● O: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: OB 4: SP) [TOOL DATA1 P (TOOL SIZE X) Q (TOOL SIZE Y) J (ANGLE);</p> <p>*01 T 1 0 INPUT R 2 INPUT P 2 0 . INPUT Q 2 0 . INPUT J 0 INSRT</p>
			<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>● O: WORK X (WORK SIZE X) Y (WORK SIZE Y) [WORK SIZE1</p> <p>*02 X 2 2 0 0 . INPUT Y 4 0 0 . INSRT</p>
			<p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION</p> <p>● O: CLAMP A (CLAMP POSITION A) [CLAMP POSITION1 B (CLAMP POSITION B)</p> <p>*03A [0 0 . INPUT B 8 0 0 . INSRT</p>

[A]



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

G72 X Y

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

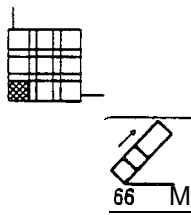
[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I J P
Q K D T

[B]



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

G72 X Y

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

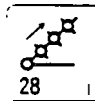
[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH).

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I J P
Q K D

[C]



G28: [INPUT POSITION]

[LINE ANGLE] x (POSITION X) Y (POSITION Y)

T (TOOL NO.) C (INDEX ANGLE);

X Y T
C

G28: I (PITCH) ,J (ANGLE) K (NO. HOLE)

[LINE ANGLE] T (TOOL NO.) C (INDEX ANGLE);

G28 I J K

[D]

REPOS 1 : G27 [REPOSITION 1] 2 : G25 [REPOSITION 2]

27 u



1 : G27 [REPOSITION 1] 2 : G25 [REPOSITION 2]



G25: [PUNCH OFF]

[REPOSITION 2 X (POSITION X) Y (POSITION Y); WITH OFFSET1

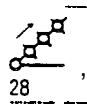
G70 X 1 2 0 0 . INPUT Y 3 0 0 . INPUT

G25: [PUNCH OFF1 X (DISTANCE);

[REPOSITION 2 WITH OFFSET]

G25 X 9 3 0 . INSRT

[E]



G28: [INPUT POSITION]

[LINE ANGLE] X (POSITION X) Y (POSITION Y)

T (TOOL NO.) C (INDEX ANGLE);

X 1 4 0 0 . INPUT Y 2 0 0 . INPUT T INPUT

C INPUT

G28: I (PITCH) J (ANGLE) K (NO. HOLE)

[LINE ANGLE] T (TOOL NO.) C (INDEX ANGLE);

G28 I 2 0 0 . INPUT J 0 INPUT K 3 INSRT

[F]



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

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

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

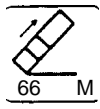
D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I 5 1 . INPUT J 1 8 0 . INPUT P 2 0 .

INPUT Q INPUT K 5 1 . INPUT D INPUT T 1 0 INSRT

[G]



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y);

G72 X Y

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH). K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I J

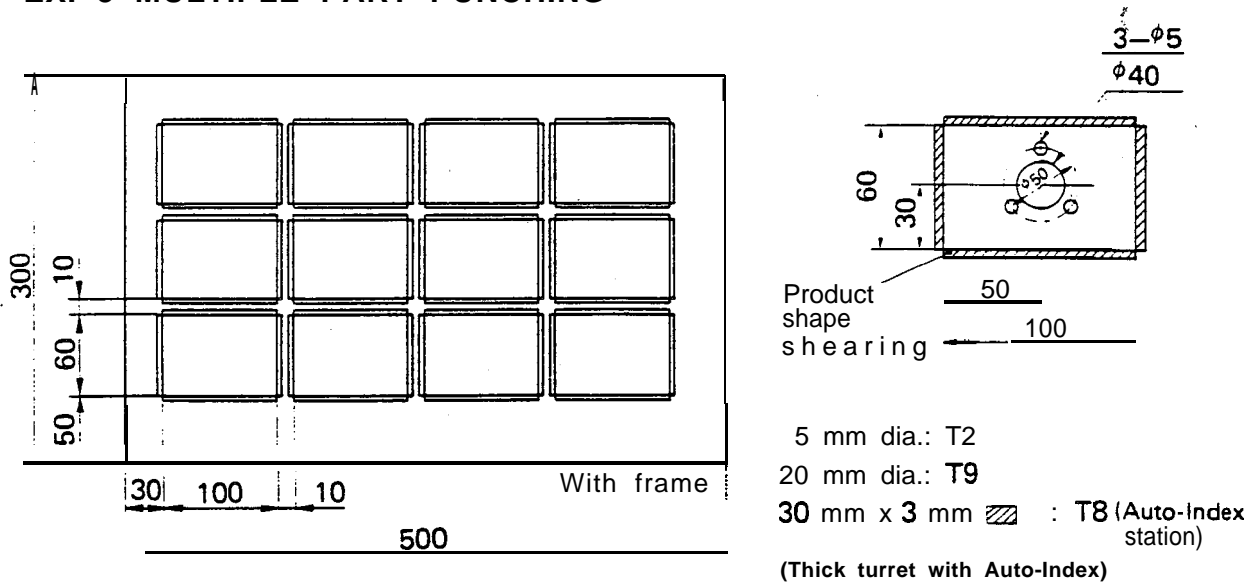
P Q K

END PRGRM I G50:;

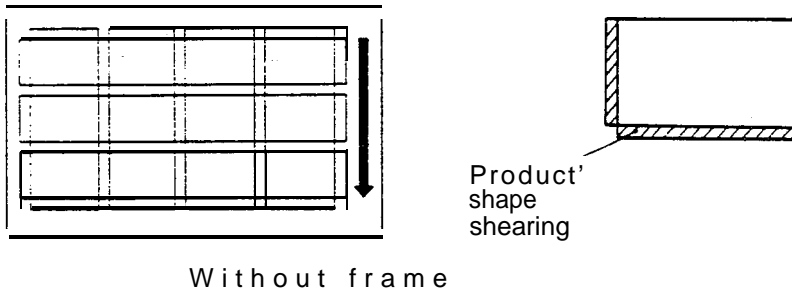
50 F [END]

G50;

EX. 3 MULTIPLE PART PUNCHING



NOTE: (a) There are **two** methods 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 20mm 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)

PATRN
(SHIFT)

*

S

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

INPUT

*01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: 08 4: SP)
 [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)
 J (ANGLE);

*01 T 2 INPUT R 1 INPUT P 5 . INSRT

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

INPUT

*01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: 08 4: SP)
 [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)
 J (A N G L E) ;

*01 T 8 INPUT R 2 INPUT P 3 0 . INPUT Q 3 . INPUT
 J 0 INSRT

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

INPUT

*01: TOOL T (TOOL NO.) R (1: RO 2: SQ 3: 08 4: SP)
 [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y)
 J (ANGLE);

*01 T 9 INPUT R 1 INPUT P 2 0 . INSRT

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

↻ INPUT

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

INPUT

*02: WORK X (WORK SIZE X) Y (WORK SIZE Y)
 [WORK SIZE1

*02 X 5 0 0 . INPUT Y 3 0 0 . INSRT

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

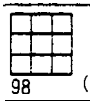
↻ ↻

1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION

INPUT

*03: CLAMP A (CLAMP POSITION A)
 [CLAMP POSITION] B (CLAMP POSITION B)

*03 A 1 0 0 . INPUT B 4 0 0 . INSRT



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

G98 X Y I
 J P K

MACRO 1 : U [MACRO START NO.1] 2 : V -[MACRO END NO.]

V



[MACRO START NO.]:U (MACRO NO.);

U



G26: [INPUT POSITION]
 [BOLT HOLE] X (POSITION X) Y (POSITION Y);

G72 X Y

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

C (INDEX ANGLE);

G26 I J K
 T

MACRO 1 : U [MACRO START NO.] 2 : V [MACRO END NO.1]

V



1 : U [MACRO START NO.1] 2 : [MACRO END NO.1]



[MACRO END NO.1 V (MACRO NO.);

V

MACRO 1 : U [MACRO START NO.1] 2 : V [MACRO END NO.]

V



-- [MACRO START NO.1 U (MACRO NO.);

U



1 : G68 [NIBBLE ARC] 2 : G78 [PUNCH ARC]

G68: [INPUT POSITION]

[NIBBLE ARC] X (POSITION X) Y (POSITION Y)

G72 X Y

G68 I (RADIUS) J (START ANGLE)

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

Q (NBL. PITCH) T (TOOL NO.)

C (INDEX ANGLE); MOO (STOP);

G68 I J K
P Q T

MACRO

V

1 : U [MACRO START NO.1] 2 : V [MACRO END NO.1]

1 : U [MACRO START NO.1] 2 : V [MACRO END NO.1]

[MACRO END NO.] V (MACRO NO.);

V

MACRO

V

1 : U [MACRO START NO.] 2 : V [MACRO END NO.1]

[MACRO START NO.1 U (MACRO NO.);

U



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)

G72 X Y

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I J
P Q K
D T



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)

G72 X Y



G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE)

G66 I 60. J-90. P-3
0. Q-3. K D-0.
1 T C-90. INSRT



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)

G72 X Y



G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I 100. J0 P-30. INSRT
Q-3. K D-0. 1 INSRT
T C0 INSRT



G66: SHP [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)

G72 X Y



G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

c (INDEX ANGLE);

G66 I 60. J90. P-30
. Q-3. K D-0. 1
 T C90. INSRT

MACRO : 1 : U [MACRO START NO.1 2 : v [MACRO END N O.]

V ↗₀

1 : U [MACRO START NO.1 2 : V [MACRO END NO.1

INPUT

[MACRO END NO.] V (MACRO NO.);

V 3

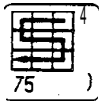


G75: W (MACRO NO.) Q (QUADRANT);

[G98 RECALL X DIR.]

G75 W 1 Q 4

5 mm dia. hole part
program is executed.



G75: W (MACRO NO.) Q (QUADRANT);

[G98 RECALL X DIR.]

G75 W 2 Q 1

40 mm dia. hole part
program is executed.



G75: W (MACRO NO.) Q (QUADRANT);

[G98 RECALL X DIR.]

G75 W 3 Q 4

Product shape part
program is executed.

END
PRGRM

G50;;

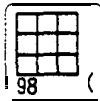
[END]

50 F

G50;

ACTUAL OPERATION (THE WAY WITHOUT FRAME)

P ATRN (SHIFT)	*	S	1	: TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION									
													INPUT
01: TOOL T (TOOL NO.) R(1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y) J (ANGLE);													
*01 T 2 INPUT R 1 INPUT P 5 . INSRT													
<hr/> 1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
● 01: TOOL T (TOOL NO.) R(1: RO 2: SQ 3: OB 4: SP) [TOOL DATA1 P (TOOL SIZE X) Q (TOOL SIZE Y) J (ANGLE);													
*01 T 8 INPUT R 2 INPUT P 3 0 . INPUT Q 3 . INPUT J 0 INSRT													
<hr/> 1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
● 01: TOOL T (TOOL NO.) R(1: RO 2: SQ 3: OB 4: SP) [TOOL DATA] P (TOOL SIZE X) Q (TOOL SIZE Y) J (ANGLE);													
*01 T 9 INPUT R 1 INPUT P 2 0 . INSRT													
<hr/> 1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
● 02: WORK X (WORK SIZE X) Y (WORK SIZE Y) [WORK SIZE1													
*02 X 5 0 0 . INPUT Y 3 0 0 . INSRT													
<hr/> 1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
1 : TOOL DATA 2 : WORK SIZE 3 : CLAMP POSITION INPUT													
● 03: CLAMP A (CLAMP POSITION A) [CLAMP POSITION1 B (CLAMP POSITION B)													
*03 A 1 0 0 . INPUT B 4 0 0 . INSRT													



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

G98 X Y I
 J P K

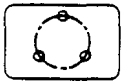


: U [MACRO START NO.] 2 : V [MACRO END NO.1]



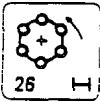
[MACRO START NO.1 U (MACRO NO.);

U



G26: [INPUT POSITION]

[BOLT HOLE1 X (POSITION X) Y (POSITION Y)



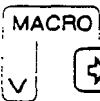
G72 X Y

G26: I (RADIUS) J (START ANGLE)

[BOLT HOLE1 K (NO. HOLE) T (TOOL NO.)

C (INDEX ANGLE);

G26 I J K
 T



: U [MACRO START NO.1 2 : V [MACRO END NO.1]

: U [MACRO START NO.1 : V [MACRO END NO.1]



[MACRO END NO.1 V (MACRO NO.);

V



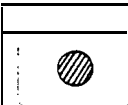
: U [MACRO START NO.] 2 : V [MACRO END NO.]




[MACRO START NO.1 U (MACRO NO.);

U





1 : G68 [NIBBLE ARC] 2 : G78 [PUNCH ARC]




G68: [INPUT POSITION]
 [NIBBLE ARC] X (POSITION X) Y (POSITION Y)

G72 X Y


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

G68 I J K
 P Q T

MACRO O 1 : U [MACRO START NO.] 2 : V [MACRO END NO.1]




1 : U [MACRO START NO.1] 2 : V [MACRO END NO.1]



[MACRO END NO.1 V (MACRO NO.);

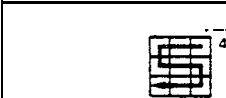
V



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

G75 W Q

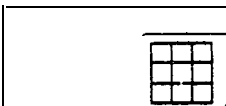
5 mm dia. hole part program is executed.



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

G75 W Q

40 mm dia. hole part program is executed.



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

G98 X Y
 I J P
 K

MACRO: 1 : U [MACRO START NO.] 2 : V [MACRO END NO.]

V INPUT

[MACRO START NO.1 U (MACRO NO.);

U 3 INSRT



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)

G72 X 0 INPUT Y 0 INPUT

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

c (INDEX ANGLE);

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

Q 3 . INPUT K INPUT D - 0 . 1 INPUT

T 8 INPUT C 9 0 . INSRT

MACRO: 1 : U [MACRO START NO.1 2 : V [MACRO END NO.1

V INPUT

1 : U [MACRO START NO.1 2 : V [MACRO END NO.]

INPUT

[MACRO END NO.1 V (MACRO NO.);

V 3 INSRT

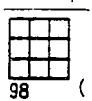


Vertical cut part program is executed.

G75: W (MACRO NO.); Q (QUADRANT);

[G98 RECALL X DIR.1

G75 W 3 INPUT Q 4 INSRT



G98: X (OFFSET X) Y (OFFSET Y)

[MULTI PART] I (PART LTH. X) J (PART WTH. Y)

P (NO. PART-1X) K (NO. PART-I Y)

D (SPACING);

G98 X 3 0 . INPUT Y 5 0 . INPUT

I 1 0 3 . INPUT J 6 3 . INPUT P 3 INPUT

K 3 INSRT

MACRO 1 : U [MACRO START NO.1 2 : V [MACRO END NO.]

V



[MACRO START NO.1 U (MACRO NO.);

U



G66: [INPUT POSITION]

[SHEAR PRF] X (POSITION X) Y (POSITION Y)



G72 X Y

G66: I (LENGTH) J (ANGLE) P (TOOL LTH.)

[SHEAR PRF] Q (TOOL WIDTH) K (WIDTH)

D (MIC. JOINT) T (TOOL NO.)

C (INDEX ANGLE);

G66 I J P
Q K D
T C

MACRO 1 : U [MACRO START NO.1 2 : V [MACRO END NO.1

V



1 : U [MACRO START NO.] 2: V [MACRO END NO.]



[MACRO END NO.] V (MACRO NO.);

V



Horizontal cut part program is **executed**.

G75: W (MACRO NO.) Q (QUADRANT);

[G98 RECALL X DIR.1

G75 W Q

END PRGRM

G50:;

50 F

[END]

G50;

DISPLAYED FORMAT ON CRT

PATRN (SHIFT)	COORD 92 A	G92 [COORD]	X (X POSITION) Y (Y POSITION) ;
------------------	---------------	----------------	---------------------------------


PATRN (SHIFT)	PUNCH OFF 70 B	G70 [PUNCH OFF]	X (X POSITION) Y (Y POSITION) T (TOOL NO.);
------------------	----------------------	--------------------	--


PATRN (SHIFT)	PATRN ORG 72 C	G72 [PATRN OR IGIN]	X (X POSITION) Y (Y POSITION) ;
------------------	----------------------	------------------------	---------------------------------

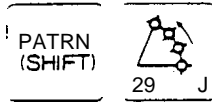
PATRN (SHIFT)	OFFST 93 D	G93 [OFFSET]	X (OFFSET X) Y (OFFSET Y) ;
------------------	---------------	-----------------	-----------------------------

PATRN (SHIFT)	END PRGRM 50 F	G50 ; [END]	
------------------	----------------------	----------------	--

PATRN (SHIFT)	ABS 90 G	G90 [ABS]	X (X POSITION) Y (Y POSITION) T (TOOL NO.) C (INDEX ANGLE) ;
------------------	-------------	--------------	---

PATRN (SHIFT)	 26 H	G26: [INPUT POSITION] [BOLT HOLE]	X (POSITION X) Y (POSITION Y) ; G26: [BOLT HOLE] I (RADIUS) J (START ANGLE) K (NO. HOLE) T (TOOL NO.) C (INDEX ANGLE);
------------------	---	--------------------------------------	--

PATRN (SHIFT)	 28 L	G28: [INPUT POSITION] [LINE ANGLE]	X (POSITION X) Y (POSITION Y) T (TOOL NO.) C (INDEX ANGLE) ;
		G28 [LINE ANGLE1]	I (PITCH) J (ANGLE) K (NO. HOLE) T (TOOL NO.) C (INDEX ANGLE);



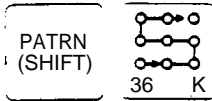
G29: [INPUT POSITION]

[ARC] X (POSITION X) Y (POSITION Y) ;

G29 I (RADIUS) J (START ANGLE)

[ARC] K (NO. HOLE) P (ANGLE INCR.)

T (TOOL NO.) C (INDEX ANGLE) ;



G36: [INPUT POSITION]

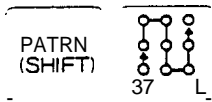
[GRID-XI] X (POSITION X) Y (POSITION Y)

T (TOOL NO.) C (INDEX ANGLE) ;

G36: I (PITCH X) P (#X SPACES)

[GRID-X] J (PITCH Y) K (#Y SPACES)

T (TOOL NO.) C (INDEX ANGLE) ;



G37: [INPUT POSITION]

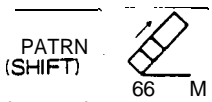
[GRID-Y] X (POSITION X) Y (POSITION Y)

T (TOOL NO.) C (INDEX ANGLE) ;

G37 I (PITCH X) P (#X SPACES)

[GRID-Y] J (PITCH Y) K (#Y SPACES)

T (TOOL NO.) C (INDEX ANGLE) ;



G66: [INPUT POSITION]

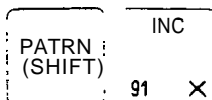
[SHEAR PRF] X (POSITION X) Y (POSITION Y) ;

G66 I (LENGTH) J (ANGLE)

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

K (WIDTH) D (MIC. JOINT)

T (TOOL NO.) C (INDEX ANGLE) ;

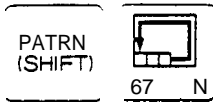


G91

[INCREMENTAL]

X (X POSITION) Y (Y POSITION)

T (TOOL NO.) C (INDEX ANGLE) ;



G67: [INPUT POSITION]

X (POSITION X) Y (POSITION Y) ;

G67

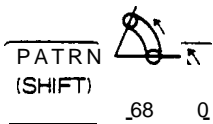
I (LENGTH X) J (WIDTH Y)

[SQUARE]

P (TOOL LTH. X) Q (TOOL WTH. Y)

T (TOOL NO.) C (INDEX ANGLE) ;

MOO (STOP) ;



1: G68 [NIBBLE ARC]

2: G78 [PUNCH ARC]

G68: [INPUT POSITION]

[NIBBLE ARC]

X (POSITION X) Y (POSITION Y) ;

G68

I (RADIUS) J (START ANGLE)

[NIBBLE ARC]

K (MOV. ANGLE) P (TOOL DIA.)

Q (NBL. PITCH) T (TOOL NO.)

C (INDEX ANGLE) ;

G78: [INPUT POSITION]

[NIBBLE ARC]

X (POSITION X) Y (POSITION Y) ;

G78

I (RADIUS) J (START ANGLE)

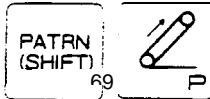
[NIBBLE ARC]

K (MOV. ANGLE) P (TOOL DIA.)

Q (NBL. PITCH) D (THICKNESS)

T (TOOL NO.) C (INDEX ANGLE) ;

MOO (STOP) ;



1: G69 [NIBBLE LINE] 2: G79 [PUNCH LINE]

G69: [INPUT POSITION]

[NIBBLE LINE] X (POSITION X) Y (POSITION Y);

G69 I (LENGTH) J (ANGLE)

[NIBBLE LINE] P (TOOL DIA.) Q (NBL. PITCH)

T (TOOL NO.) C (INDEX ANGLE);

G79: [INPUT POSITION]

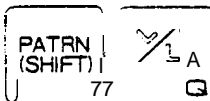
[PUNCH LINE] X (POSITION X) Y (POSITION Y);

G79 I (LENGTH) J (ANGLE)

[PUNCH LINE] P (TOOL DIA.) Q (NBL. PITCH)

D (THICKNESS) T (TOOL NO.)

C (INDEX ANGLE);



G77 X (X POSITION) Y (Y POSITION)

[ROTATION] W (MACRO NO.) J (ANGLE);



G22: [INPUT POSITION]

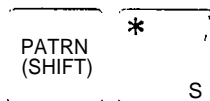
[LAD] X (POSITION X) Y (POSITION Y);

G22 X (END POINT X) Y (END POINT Y)

[LAD] J (CORRECTION) P (TOOL DIA.)

Q (NBL. PITCH) T (TOOL NO.)

C (INDEX ANGLE);



1: TOOL DATA 2: WORK SIZE 3: CLAMP POSITION

"01: TOOL T (TOOL NO.) R(1: RO, 2: SQ, 3: OB, 4: SP)

[TOOL DATA1] P (TOOL SIZE XI Q (TOOL SIZE Y)

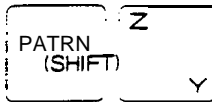
J (ANGLE);

● 02: WORK X (WORK SIZE X) Y (WORK SIZE. Y);

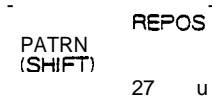
[WORK SIZE1

"03: CLAMP A (CLAMP POSITION A)

[CLAMP POSITION] B (CLAMP POSITION B);



Z



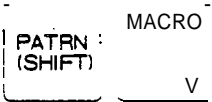
1: G27 [REPOSITION 1] 2: G25 [REPOSITION 21]

G27: [PUNCH OFF1
[REPOSITION 1] X (POSITION X) Y (POSITION Y);

G27 X (DISTANCE) ;
[REPOSITION 1]

G25: [PUNCH OFF]
[REPOSITION 2 WITH OFFSET]
 X (POSITION X) Y (POSITION Y);

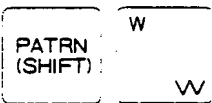
G25 X (DISTANCE) ;
[REPOSITION 2 WITH OFFSET]



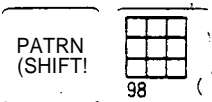
1: U [MACRO START NO.] 2: V [MACRO END NO.1]

[MACRO START NO.1 U (MACRO NO.) ;

[MACRO END NO.1 V (MACRO NO.) ;



[MACRO CALL1 W (MACRO NO.) ;



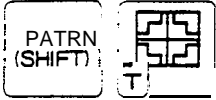
G98 X (OFFSET X) Y (OFFSET Y)
[MULTI PART] I (PART LTH. X) J (PART WTH. Y)
 P (NO. PART-1X) K (NO. PART-1Y)
 D (SPACING)



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



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



G73 X (SYMMETRY X) Y (SYMMETRY Y)
[SYMMETRY] Q (SYM. POS.) W (MACRO NO.) ;