

NC Lathe

TC-100, TC-200, TC-350, TCC-1000

TCC-2000, TCN-2000, TCN-2500

TCN-3500, T-200, TT-200, TT-160

TT-350, TT-1600, TT-2000, TT-2100

TT-2500, T-2600, TT-2600

PROGRAMMING MANUAL

NC04050-103M

Please read each manual and
understand contents enough.
Then keep these manuals handy
for answers to any questions you
may have and to check.

MACHINE TOOLS
TAKISAWA

IMPORTANT NOTICE

- Be sure to read each instruction manual before operating the machine.

Be sure to observe the safety precautions in the instruction manuals and the contents of warning labels adhered to the machine. If ignored, an accident resulting in injury or death or machine malfunction may be caused.

There are many [DISABLE] or [MUST NOT DO] conditions.

Unless [ABLE] is written in the instruction manual, consider it [DISABLE].

- Some illustrations in the instruction manual are given without cover or door to illustrate the detailed parts. In actual operation, it is necessary to mount the cover or door.
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- When any instruction manual is required again, contact your agent with the number of the instruction manual (or model name, manual name).
- Japanese laws prohibit this machine from being used to develop or manufacture "weapons of mass destruction" or "conventional arms", as well as from being used to process parts for them.
Export of the product may require the permission of governmental authorities of the country from where the product is exported.
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- Observe the laws and regulations established by the national and local governments.
- Observe the laws and regulations established by the national and local government for disposal of machines and waste oil.

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- This instruction manual is prepared for native English-speakers. When the machine is operated by non-native English speakers, please provide safety instruction for the operators by customers. In addition, please provide warning labels in their native language.
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- The manual is written for people who have a basic knowledge of machine tools.
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If the specified parts are not used, not only the machine function is reduced but also safety is compromised, thus possibly causing an accident resulting in injury or death or machine malfunction.

- There are many kinds of coolants.

Since TAKISAWA does not specify the coolant, select your desired coolants by consulting with oil makers sufficiently.

In addition, TAKISAWA shall have no liability for trouble incurred by using coolants.

- Contact us for requesting an installation, modification, and specification change, and dismantlement of the machine. If the machine is installed, modified, or its specification is changed by customer, not only the performance of the machine may be lost but also the safety of the customer may not be secured.

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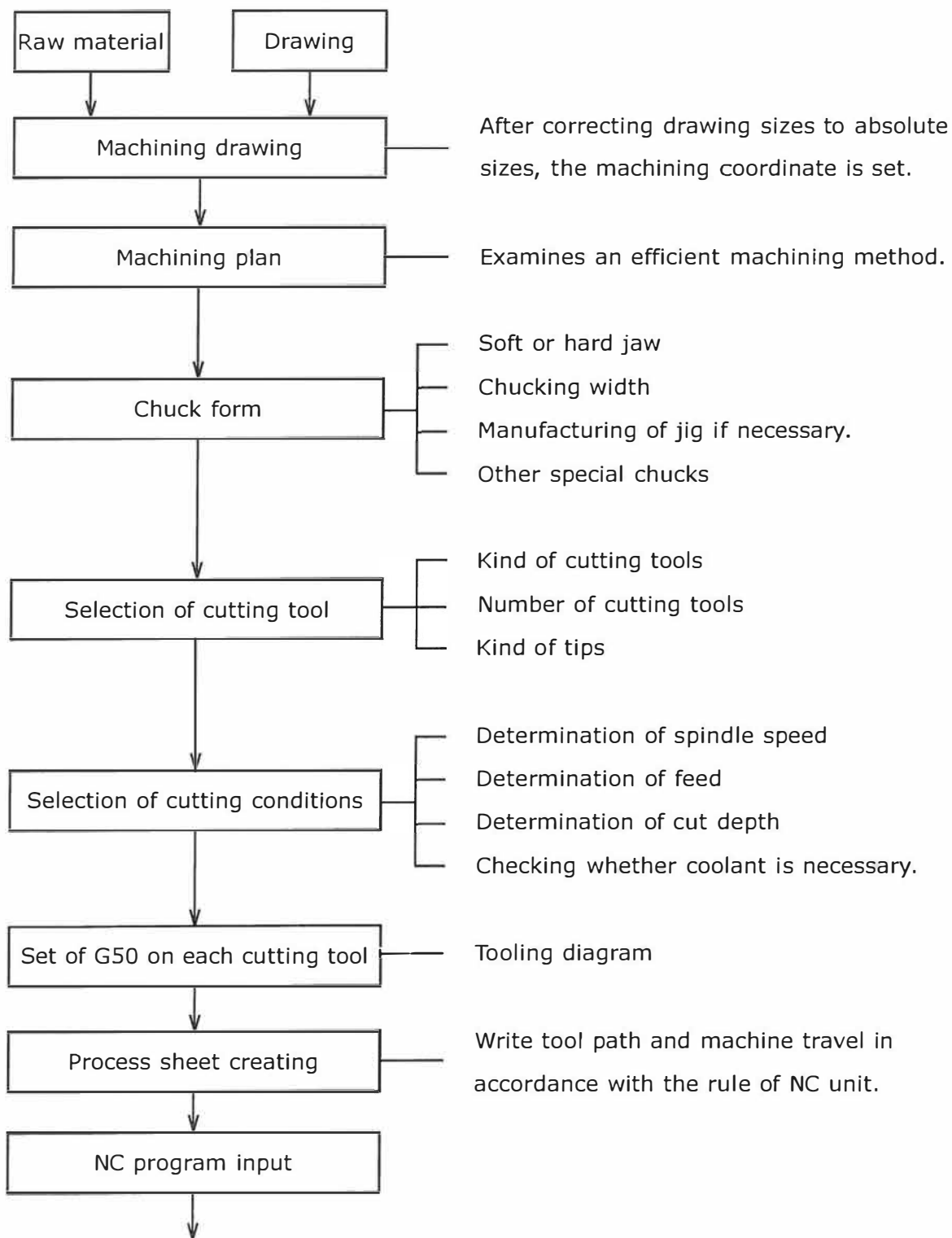
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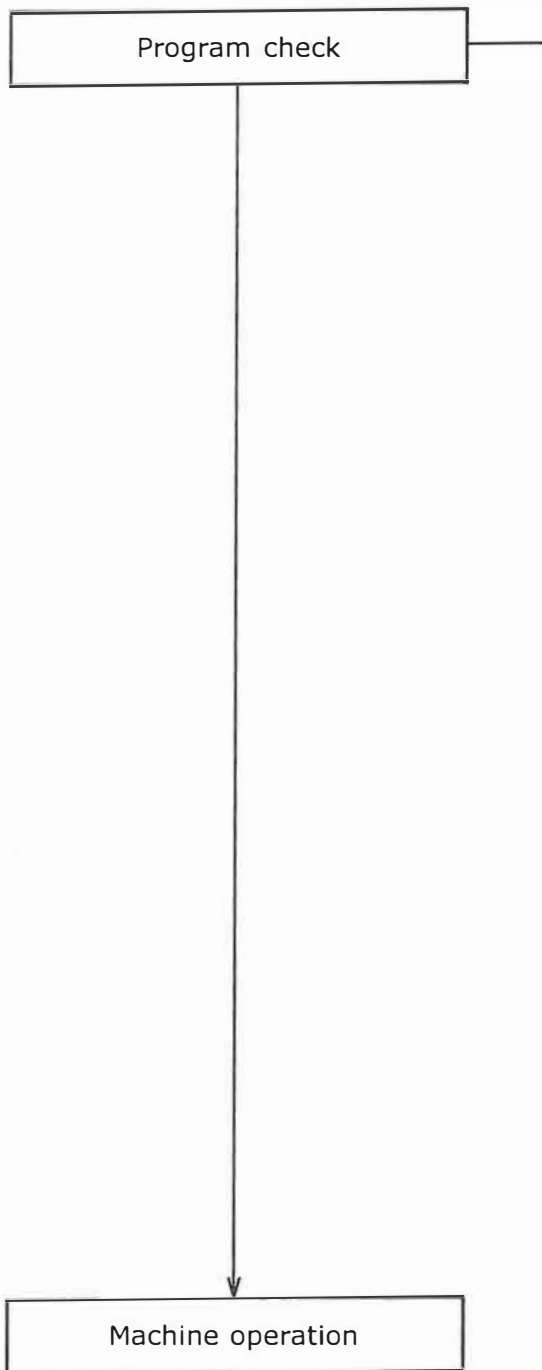
1 PREFACE

This manual deals with the basic program, which is essential for the NC lathe of use.

For details, refer to the instruction manual issued by NC unit manufacturer.

2 PROGRAM CREATION STEPS





Compare the indication of the current position and each operation (M. S. T. function) of the machine with the process sheet to check the program.

- (1) Temporarily cut before determining the offset (compensation amount) of each tool.
Reference : [4 COORDINATE SYSTEM AND TOOL NOSE SETTING]
- (2) Input the offset value corresponding to the offset No. of each tool with MDI.
- (3) Press [Program check switch].
- (4) The rapid traverse is mode to safety speed.
- (5) Travel starting points of both X and Z in the direction of plus (+) to start them from safety places.
- (6) Operate the system by the mode of single block.
- (7) Determine a start point, input the tool offset/compensation and run under no load in order to check interference.
(Specially, take care so that the tool is not interfered to the chuck, etc.)

Measure the workpiece and reinput the tool offset/compensation if required.

3 MAJOR FUNCTIONS AND SYMBOLS

3-1 X, Z, C, Y, U, W, H, V

The X, Z, C and Y are symbolic addresses used when the absolute command is input.

Thus, they are used for writing the X, Z, C and Y coordinate values on the coordinate system. (X-axis is a diameter value. C-axis and H-axis are spindle travel.)

U, W, H, V are symbolic addresses used when the incremental command is input.

U → X-axis (travel distance)

W → Z-axis (travel distance)

H → C-axis (rotary axis, angle)

V → Y-axis (travel distance)

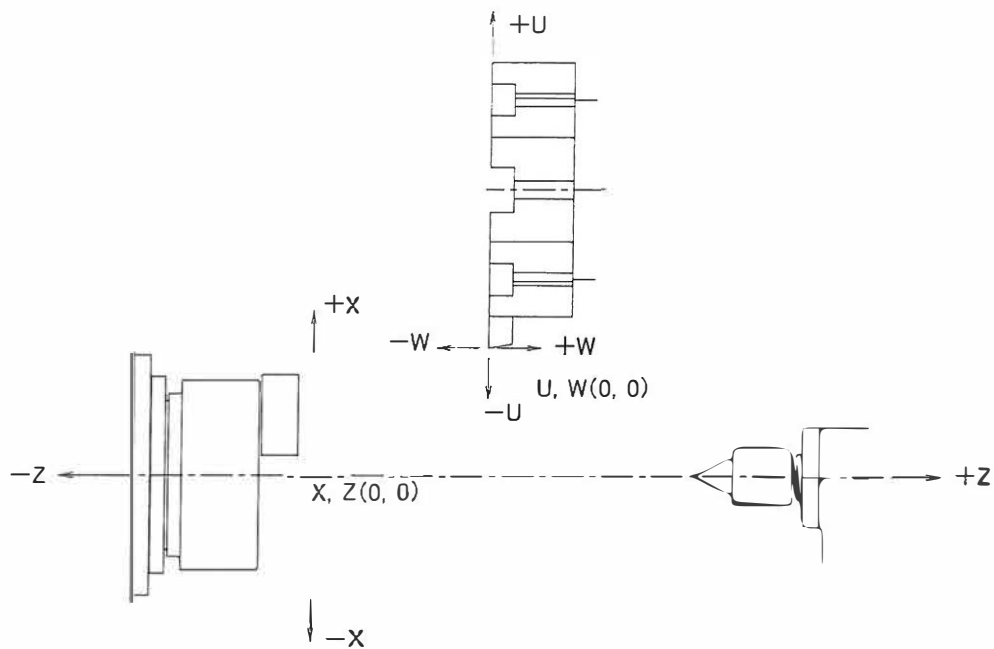


Fig. 3-1(a) Function and symbols (TC-series, TCC, TCN-series, Standard)

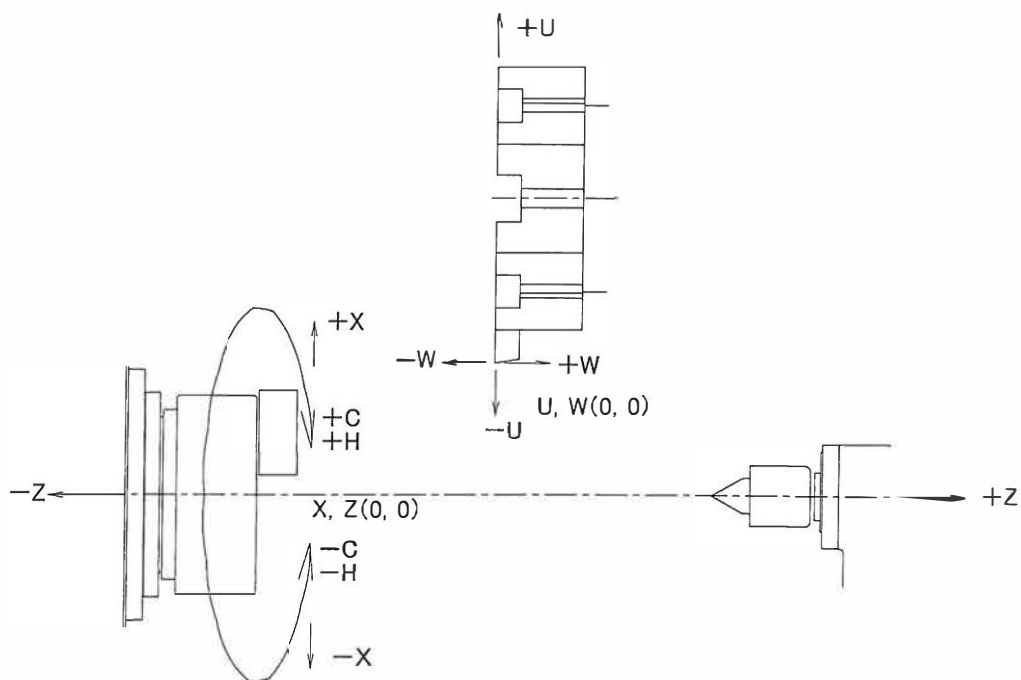


Fig. 3-1(b) Function and symbols (TC-series, TCN-series, C-axis/rotary tool)

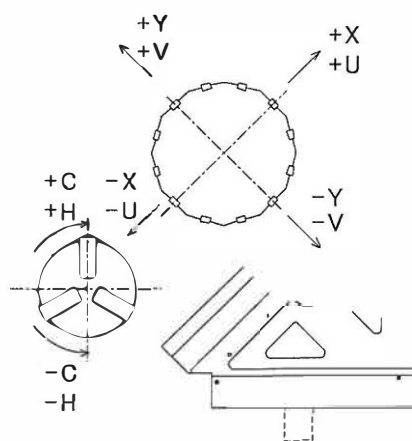
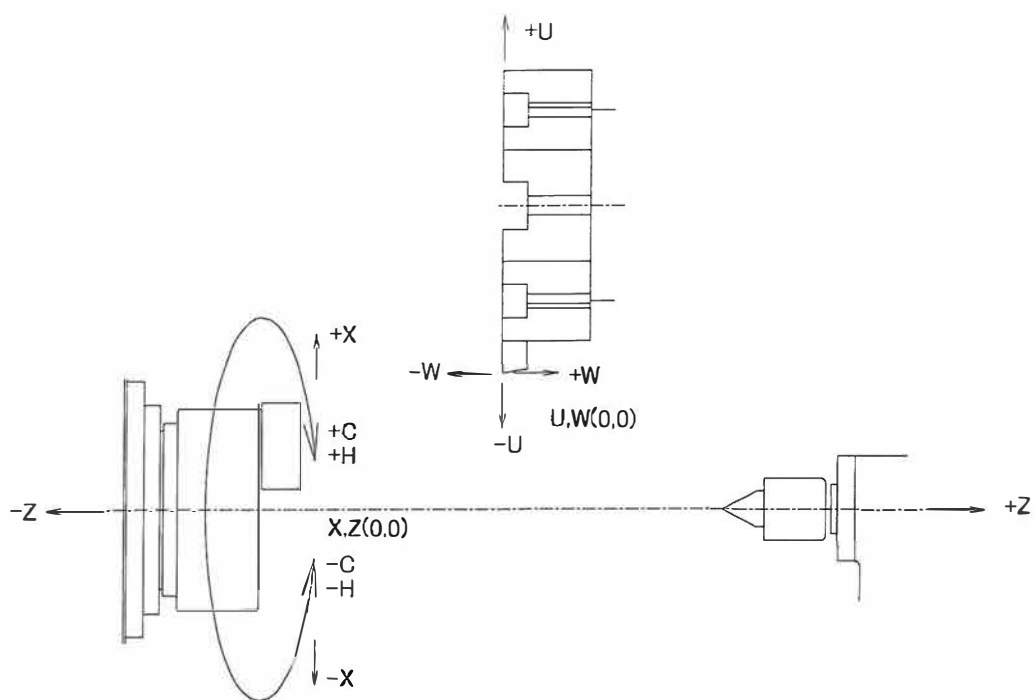
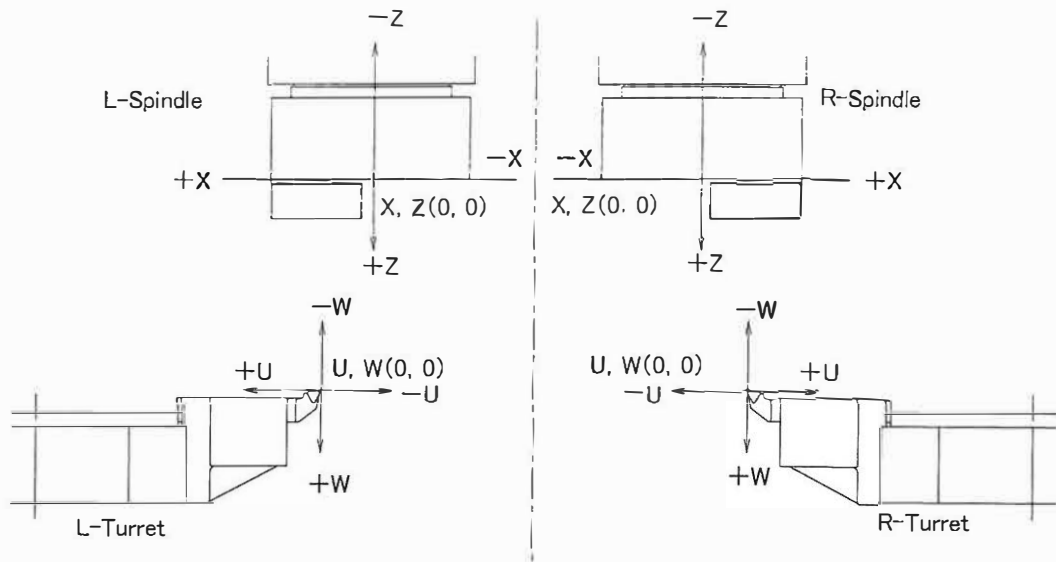
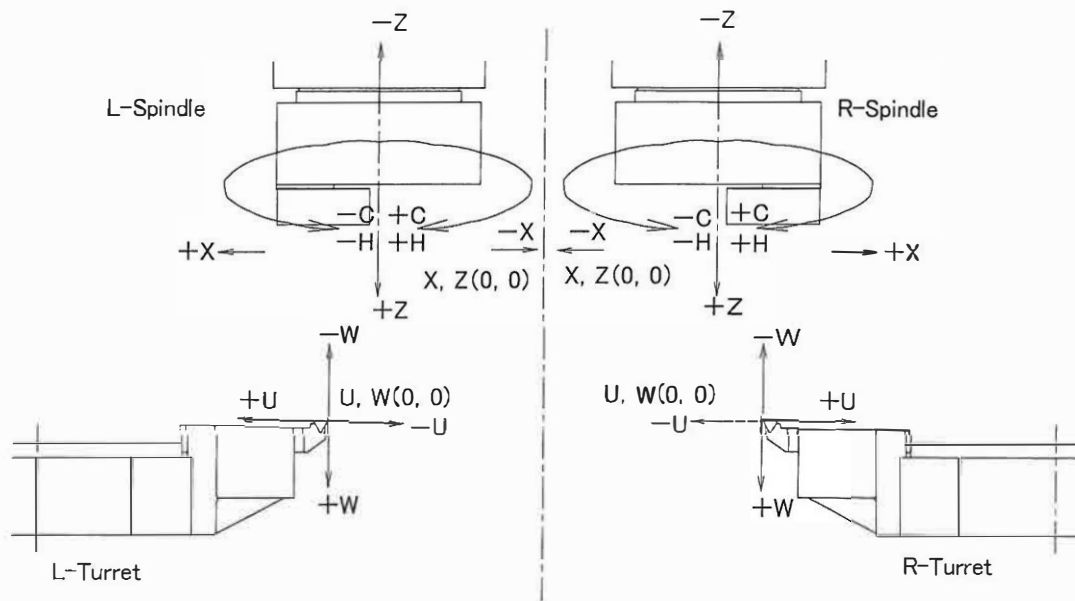


Fig. 3-1(c) Function and symbols (TCN-series, Y-axis)



* T-series is R-side only.

Fig. 3-1(d) Function and symbols (TT-series, Standard)



* T-series is R-side only.

Fig. 3-1(e) Function and symbols (TT-series, C-axis/rotary tool)

If the chuck jaw end face and spindle center are positioned as the work's zero point, (+), (-) symbol area of X, Z, C are as shown in the [Fig. 3-1(a)~(e)] figure.

However, in U, W direction, the (+) or (-) symbol is decided in accordance with the condition that the turret moves from the current position (0,0) to any direction.

Also, in H direction, the (+) or (-) symbol is decided in accordance with the condition that the spindle rotates from the current position (0) to any direction.

- * The X and U are commanded with diameter.
- * The absolute value can be used together with the incremental value.
- * Usually, a regular lathe used incremental system.

3-2 G-function used frequently

G00 To be used for positioning (Rapid traverse).

Also, it is used when operating the M, S and T functions.

Take care to avoid the interference of tailstock, workpiece, chuck and tool. (The route during shift is not always a straight line.)

G00 X_Z_

G00 U_W_

G00 M_

G01 The axis moves in the straight line with the velocity commanded on F.

G01 X_ F0.3

Feed per revolution : 0.3mm/rev

G01 X_Z_F_

When the X, Z or U, W exists in the same block, the tool movement is tapered. And there is a special specification to easily create the program which processes the chamfering or coner R.

If corner R (to be assigned with radius=R) :

G01 Z_R_ to X-direction from Z-direction

G01 X_R_ to Z-direction from X-direction

If chamfering (to be assigned with radius=C) :

G01 Z_C_

G01 X_C_

The value C is desided by the axis-direction of cutting.

For example, if the axis feeds to the Z-direction, the symbol of the R and C turns plus (+).

G02 Circular arc cutting CW (clockwise)

G02X(U)_Z(W)_R_F_
 or I_K_F_

G03 Circular arc cutting CCW (counterclockwise)

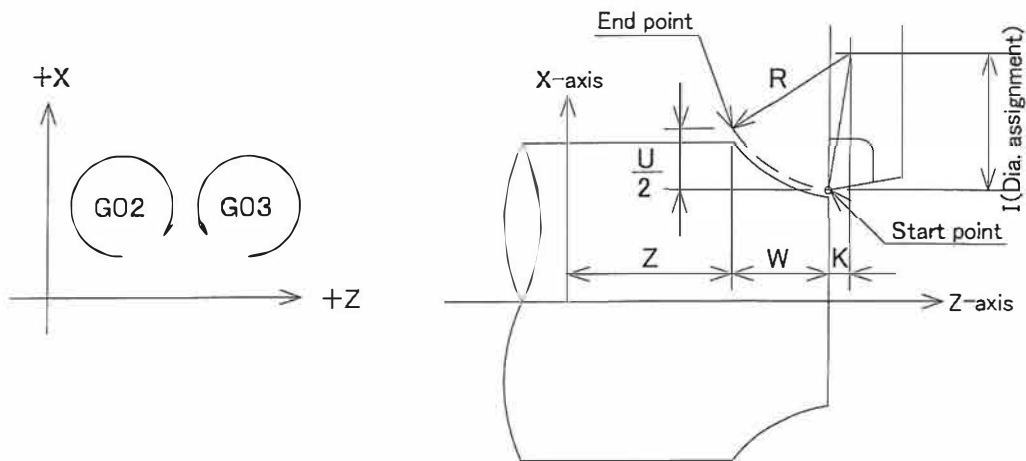
G03X(U)_Z(W)_R_F_
 or I_K_F_

X, Z : Position of circular arc end point

U, W : Distance from start point to end point

R : Circular arc radius

I, K : Distance from start point to center



G04 Dwell

G04 X(t)_

After executing the previous block, allow operation for (t) second before feeding to next block.

G32 Thread cutting

G32 X_Z_F_

F : Assigns the lead of thread directly.

G50 Input of coordinate system

G50 X_Z_

(1) This mode decides the coordinate system when moving the tool with the absolute command, thus, it is not an actual moving command.

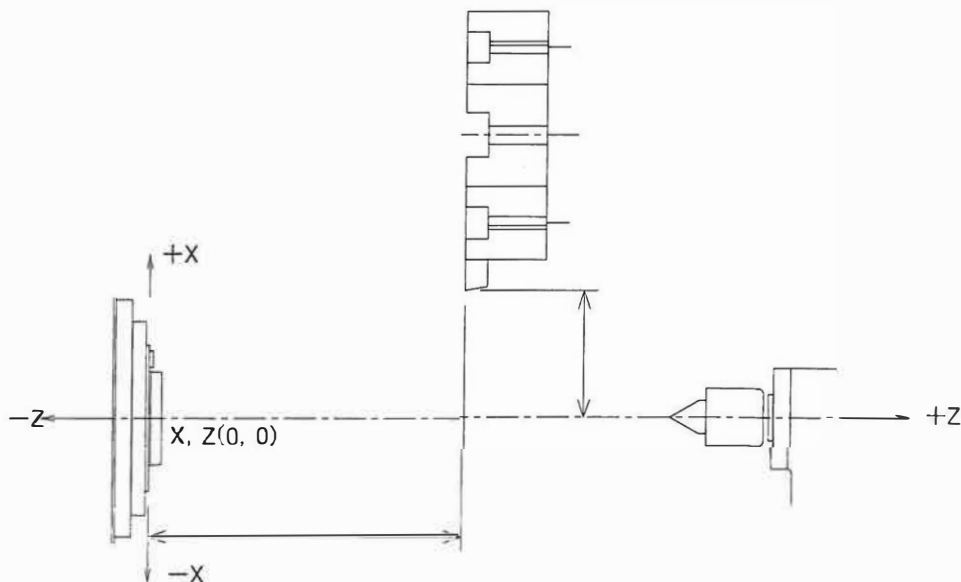
That is, if the nose is positioned as shown in the following figure, the system communicates the distance between the point $X=0, Z=0$ and the tool nose to the NC equipment.

(2) Input the dimensions of the nose start point and that from the coordinate $X=0, Z=0$.

(3) Search the start point X, Z of the G50 by hand before machining.
(Set the nose on the coordinate X, Z of the programmed G50.)

(4) Usually, the spindle center is $X=0$.

$Z=0$ is optional, but beside the chuck end face, material left end face and material right end face as $Z=0$.



G92 Threading cycle

G92 X_Z_R_F_

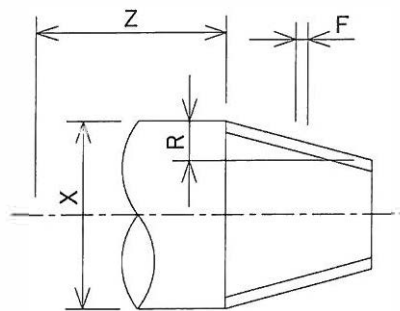
X : X coordinate of end point

Z : Z coordinate of end point

R : X-axis increase value

F : Thread lead

In case of the straight, no R required.



G96, G97

Constant surface speed control

If the spindle is driven by the DC motor or AC convertible motor, the mode G96 causes the constant surface speed to turn ON and the G97 to keep the revolutions constant.

G96 S200 Surface speed 200 m/min

G97 S200 Revolutions 200 min⁻¹

3-3 Constant surface speed control

The constant surface speed control mode controls the spindle rotation so that the tool will always feed at the assigned surface speed against the variable tool position by commanding the surface speed (relative speed of tool and workpiece) after commanding S.

The surface speed units are as follows.

Input unit	Surface speed unit
mm	m/min
inch	feet/min

Table 3-3(a) Surface speed unit

The constant surface speed control is performed by the following G-codes.

G-code	Meaning	Unit
G96	Operates constant surface speed control	m/min, feet/min
G97	Assigns spindle speed	min^{-1}

Table 3-3(b) G-code of constant surface speed control

To control the constant surface speed, set the workpiece coordinate system so that the rotary axis is Z-axis ($X=0$).

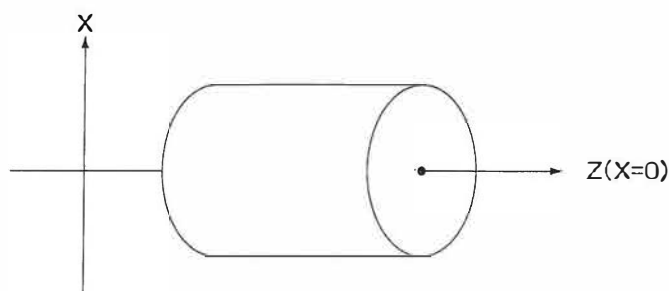


Fig. 3-3(a) Constant surface speed control

1. Keep of maximum spindle speed

This is the value continued to G50S and the maximum spindle speed of the constant surface speed control can be commanded at min^{-1} .

G50S_____;

When the machine is controlled at the constant surface speed and a spindle rotation speed is more than that assigned by the above program, constantly keep the spindle at a maximum spindle speed.

2. Rapid traverse (G00)

When executing the commanded rapid traverse block, the surface speed is calculated on the basis of the end point.

The rapid traverse mode dose not cut the workpiece.

Therefore, the surface speed corresponding to tool positions to change every second is not calculated.

Note : (1) With power on, the maximum spindle speed is not kept.

(2) The maximum spindle speed is keep only when G96 mode.

(3) G50S0* means that the speed is keep to 0 min^{-1} .

(4) S-value commanded during mode G96 is conserved even if changed to mode G97.

When returned to mode G96, S-value is recovered.

G96S50 ; (50 m/min or 50 feet/min)

G97S1000; (1000 min^{-1})

G96X1000; (50 m/min or 50 feet/min)

(5) The surface speed specified by constant surface speed control is for the program path.

It is not for the position of tool offset amounts.

(6) With the machine locked, the constant surface speed is calculated in accordance with the variation of X-coordinate value of program.

(7) The constant surface speed control is effective when threading.

Consequently, when threading the transverse thread and taper thread, it is desirable to cancel the constant surface speed control with the mode G97.

If do so, there is no problem for servo system for the spindle speed variation.

(8) When feed per minute (G98), the constant surface speed control mode (G96) is available.

(9) With the mode converted from G96 to G97, if S (min^{-1}) is not commanded in the mode of G97, the last speed of the mode G96 is used as S of the mode G97.

N111G97S800; 800 min^{-1}

*

*

*

N222G96S100; 100 m/min

*

*

*

N333G97; X min^{-1}

X-mode is X min^{-1} at the block before N333.

Thus, when converting the mode G96 to the mode G97, the spindle speed does not vary.

When G97 to G96, S-value of the mode G96 becomes effective.

If S is not assigned, it is S=0 m/min (feet/min).

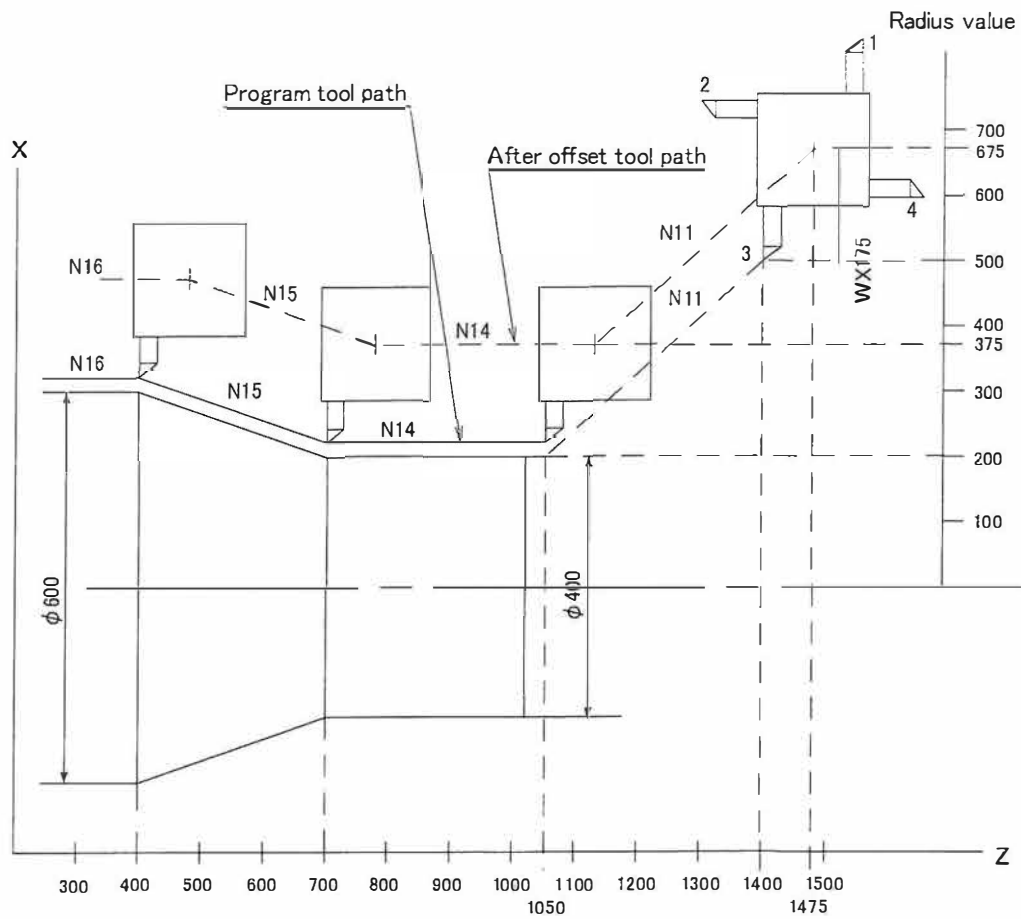


Fig. 3-3(b) Program example

(Diameter command)

```

N8 G00      X1000. Z1400.      ;
N9                                T0303;
N11      X400.      Z1050.      ;
N12 G50                                S3000; (Maximum spindle speed command)
N13 G96                                S200 ; (Surface speed 200 m/min)
N14 G01      Z700. F1000;
N15      X600.      Z400.      ;
N16                                Z...      ;

```

Since the NC calculates to be the assigned surface speed at the programmed X-coordinate, it does not calculate at X-value of passage after offset when offset is applied.

In the end point of N15 of the above example, the tool tip (dia. 600) is positioned at the radius of 200 m/min without positioning a turret center. If X-value is minus, it is calculated at the absolute value.

Note : When the system is equipped with the constant surface speed control, T-function is the command of 4-digit.

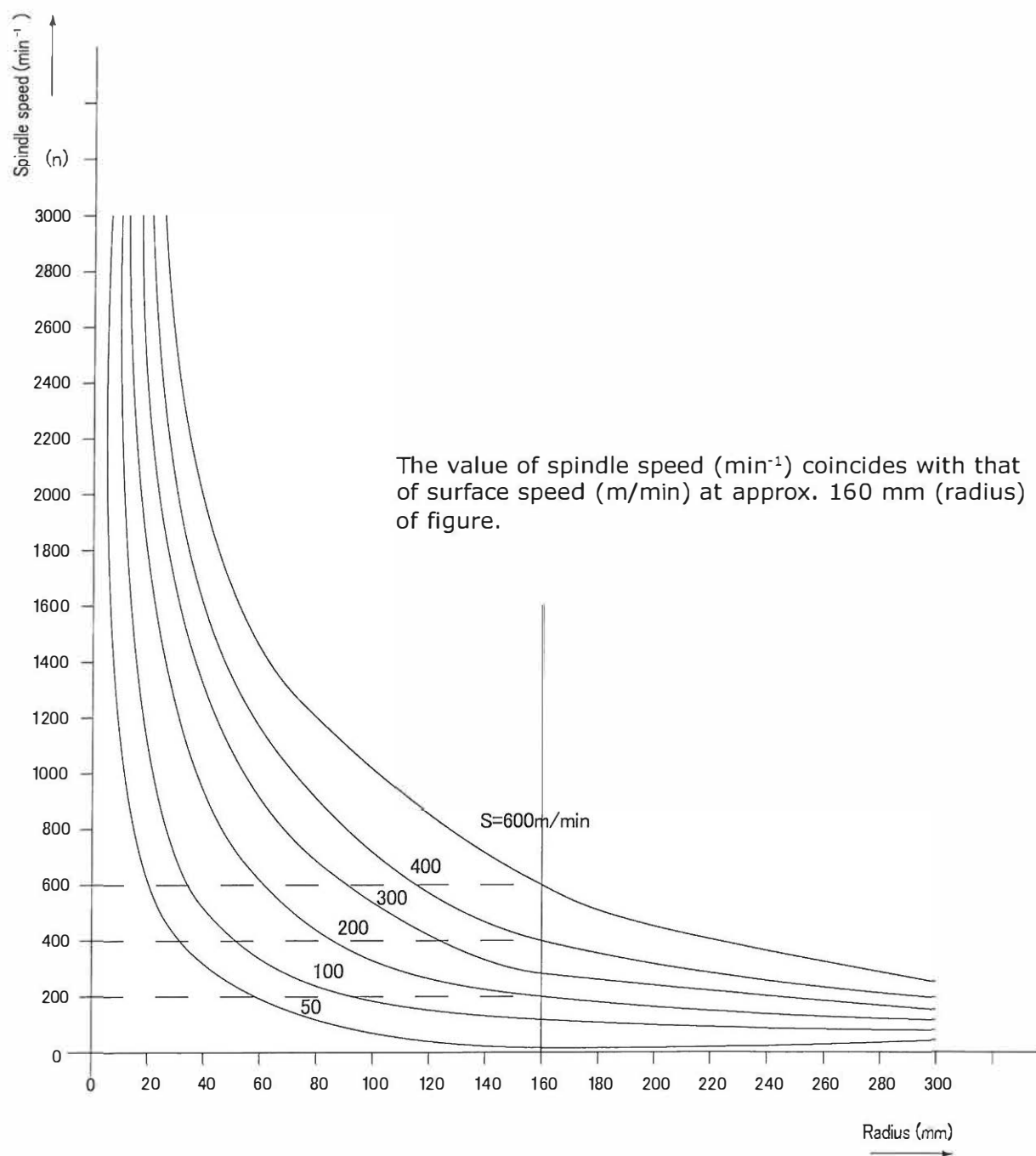


Fig. 3-3(c) Relationship between spindle speed and surface speed

3-4 G-code list

S : Standard O : Option

G-code	Group	Funciton	Partition
* G00	01	Positioning	S
G01		Linear interpolation	
G02		Circular interpolation (CW)	
G03		Circular interpolation (CCW)	
G04	00	Dwell	
G10		Offset amount input	
G20	06	Inch data input	
G21		Metric data input	
G27	00	Reference position return check	
G28		Reference position return	
G32	01	Thread cutting	
G50	00	Coordinate system setting	
G68	04	Mirror image for double turret ON	O
* G69		Mirror image for double turret OFF	S
G90	01	Cutting cycle A	
G92		Thead cutting cycle	
G94		Cutting cycle B	
G96	02	Constant surface speed control	O
* G97		Constant surface speed control CANCEL	
G98	05	Feed per minute	S
* G99		Feed per revolution	

Table 3-4 G-code list

Note : (1) G-code marked with * are set when the power supply is turned on.

(2) G-code in the group 00 are not modal.

They are effective only in the block in which they are specified.

(3) If the G-code which is not entered in the G-code list is commanded, alarm No.010 is displayed.

(4) G-code among different groups can be commanded in the same block.

If two G-codes or more among the same group are commanded in the same block, the last commanded G-code is effective.

(5) G-code from each group is displayed.

3-5 M-function

M-code	Name	Content and matters that require attention
M00	Program stop	The program stops at single block. Since coolant, air blow, spindle rotary commands are erased, program the coolant, air blow, spindle rotary commands again to the next block. * When programming to the same block as other M-code, alarm occurs.
M01	Optional stop	When the optional stop is effective with the operation switch, the program stops at the single block similarly with M00. Since coolant, air blow, spindle rotary commands are erased, program the coolant, air blow, spindle rotary commands again to the next block. * When programming to the same block as other M-code, alarm occurs.
M02	End of program	Though NC unit is reset, the program does not return to the first position. * When programming to the same block as other M-code, alarm occurs.
M03	Spindle forward	When programmed, the spindle rotates forward. When programming the spindle speed simultaneously with S*****, the spindle rotates at commanded speed. When S***** is not issued, the spindle rotates at the previously commanded speed. The spindle does not rotate during program check. Since the spindle rotation is cancelled at M00 (M01), program again if required. * If programmed to the same block as M04, M05, M19, alarm occurs.

M-code	Name	Content and matters that require attention
M04	Spindle reverse	When programmed, the spindle rotates reversely. The spindle speed command method is the same as M03. Since the spindle rotation is cancelled at M00 (M01), program again if required. * If programmed to the same block as M03, M05, M19, alarm occurs.
M05	Spindle stop	When programmed, the spindle stops. * If programmed to the same block as M03, M04, M19, alarm occurs.
M06	Chip flow ON (TT-350)	Though chip flow, it does not during dryrun. Since M06 is released at M00 (M01), program again if required. * If programmed to the same block as M09, alarm occurs.
M07	Second coolant ON	Though the second coolant or chip flow mode is applied, it is ineffective during dryrun. Since M07 is released at M00 (M01), program again if required. * If programmed to the same block as M09, alarm occurs.
M08	Coolant ON	Though coolant discharges, it dose not discharge during dryrun. Since M08 is released, at M00 (M01), program again if required. * If programmed to the same block as M09, alarm occurs.
M09	Coolant OFF	Coolant and second coolant stop. * If programmed to the same block as M06, M07, M08, alarm occurs.
M10	Tailstock spindle forward (Option)	The tailstock spindle travels forward. * If programmed to the same block as M11, alarm occurs.

M-code	Name	Content and matters that require attention
M11	Tailstock spindle reverse (Option)	The tailstock spindle travels reverse. * If programmed to the same block as M10, alarm occurs.
M12	Counter count (Option)	The completion lamp lights and the counter counts.
M13	Counter (RAKU-RAKU Monitor) (Option)	When RAKU RAKU monitor (option) is installed, the value of the free counter inside RAKU RAKU monitor (option) is added.
M14	Pressure select HIGH	The pressure of hydraulic pressure/air pressure is changed to two stages. With power ON, M14 is set. * If programmed to the same block as M15, alarm occurs.
M15	Pressure select LOW (Option)	The pressure of hydraulic pressure/air pressure is changed to two stages. * If programmed to the same block as M14, alarm occurs.
M16	Turret random select	The turret rotates at random. Program simultaneously with T-code. The turret can rotate at random if only T-code is programmed by the parameter setting. * If only M-code is programmed or the program is programmed to the same block as M17, M18, alarm occurs.
M17	Turret forward	The turret rotates at forward. Program simultaneously with T-code. The turret can rotate at forward if only T-code is programmed by the parameter setting. * If only M-code is programmed or the program is programmed to the same block as M16, M18, alarm occurs.

M-code	Name	Content and matters that require attention
M18	Turret reverse	The turret rotates at reverse. Program simultaneously with T-code. The turret can rotate at reverse if only T-code is programmed by the parameter setting. * If only M-code is programmed or the program is programmed to the same block as M16, M17, alarm occurs.
M19	Spindle orientation (Option)	The spindle stops at orientation. Usually, though the spindle is maintained at a stop torque during orientation stop, it can be forcibly maintained by option. When reset key or the spindle FORWARD/REVERSE switches of manual mode are pressed, holding force is released. * If programmed during orientation stop or the program is programmed to the same block as M03, M04, M05, alarm occurs.
M20	Robot (loader) call (Option)	The robot/loader, etc., are usable.
M22	Program start M code	When starting the program in the midst of program, the machine may collide with other components on the coordinate value relation. Program this M-code to the program top to prevent miss-operation by recognizing that the M-code is in the program top. The interlock can also be canceled by changing the setting value. * When programmed in the same block as other M-code, alarm occurs. * If there is no M-code to the program top, alarm occurs.

M-code	Name	Content and matters that require attention
M24	Front door open/ Shutter open (Option)	The front door or the shutter for loader opens. * If programmed during spindle rotation or the program is programmed to the same block as M25, alarm occurs.
M25	Front door close/ Shutter oclose (Option)	The front door or the shutter for loader closes. * If programmed during spindle rotation or the program is programmed to the same block as M24, alarm occurs.
M26	Air blow ON (Option)	Air blows on. The spindle can move at JOG feed and also, an air blow is possible simultaneously for time set to the timer by setting a parameter. Since M26 is released at M00 (M01), program again if required. * If programmed to the same block as M27, alarm occurs.
M27	Air blow OFF (Option)	The air blow on main side stops. * If programmed to the same block as M26, alarm occurs.
M28	Rigid tap rot. Change milling (Option)	The ruvolution of rigid tap is changed by the rotary tool. * Used only rotary tool for multiple spindle control.
M29	Rigid tap (Option)	The rigid tap is available by the spindle and rotary tool. * Since the G-code is also required when the rigid tap is used, refer to the instruction manual of FANUC.
M30	End of tape	The NC unit is reset and the program returns to the first position. * When programming to the same block as other M-code, alarm occurs.

M-code	Name	Content and matters that require attention
M31	Interlock bypass ON (Option)	The interlock of each motion is temporarily released, chuck and door are opened and closed during spindle rotation. * If programmed to the same block as M32, alarm occurs.
M32	Interlock bypass OFF (Option)	The temporarily released interlock mode is returned to the original mechanism. With power ON and reset, M32 is set. * If programmed to the same block as M31, alarm occurs.
M35	Second air blow ON (Option)	Second air blows on. The spindle can move at JOG feed and also, an air blow is possible simultaneously for time set to the timer by setting a parameter. Since M35 is released at M00 (M01), program again if required. * If programmed to the same block as M36, alarm occurs.
M36	Second air blow OFF (Option)	The second air blow is deactivated. * If programmed to the same block as M35, alarm occurs.
M40	Spindle steady CANCEL (TCN-3500)	The spindle coil fixed by M41 and M42 is canceled. When spindle speed exceeds 317min^{-1} , the wound coil of motor is automatically changed from low speed coil to high speed coil. When power is turned ON, M40 is set. * If programmed to the same block as M41, M42 alarm occurs.
M41	Spindle steady LOW (TCN-3500)	The wound coil of spindle motor is fixed to low speed. * If programmed to the same block as M40, M42 alarm occurs.
M42	Spindle steady HIGH (TCN-3500)	The wound coil of spindle motor is fixed to high speed. * If programmed to the same block as M40, M41 alarm occurs.

M-code	Name	Content and matters that require attention
M48	Override cancel OFF	The programmed spindle speed can be adjusted between 70%~120%. The programmed axis velocity (feed rate) can be adjusted between 0%~150%. For operation, refer to the [OPERATION MANUAL]. With power ON, M48 is set. * If programmed to the same block as M49, alarm occurs.
M49	Override cancel ON	The spindle speed and axis velocity can be fixed by the program, then the dial can not be adjusted. * If programmed to the same block as M48, alarm occurs.
M61	Bar feeder call 2 (Option)	Workpiece require signal out put to bar feeder. * Check the specifications of bar feeder.
M62	Bar feeder call 3 (Option)	Workpiece require signal out put to bar feeder. * Check the specifications of bar feeder.
M63	Prepative bar feed command	Workpiece require signal out put to bar feeder. * Check the specifications of bar feeder.
M66	Error detect ON	Error detect becomes effective. For detailed operation, refer to the Instruction Manual of FANUC. * If programmed to the same block as M67, alarm occurs.
M67	Error detect OFF	Error detect becomes ineffective. With power ON, M67 is set. * If programmed to the same block as M66, alarm occurs.
M68	Chuck tighten	In case of chuck with M-function, the chuck tighten. * If programmed to the same block as M69, alarm occurs.
M69	Chuck loosen	In case of chuck with M-function, the chuck loosen. * If programmed to the same block as M68, alarm occurs.

M-code	Name	Content and matters that require attention
M82	Parts catcher FORWARD (Option)	In case of parts catcher with the unloader of workpiece, the parts catcher travels forward to receive the workpiece. * If programmed to the same block as M83, alarm occurs.
M83	Parts catcher REVERSE (Option)	In case of parts catcher with the unloader of workpiece, the parts catcher receive the workpiece and unloads it. * If programmed to the same block as M82, alarm occurs.
M84	Bar feeder call (Option)	Workpiece require signal out put to bar feeder. * Check the specifications of bar feeder.
M86	Top cut command check (Option)	Confirm the top cut command signal from bar feeder. * Check the specifications of bar feeder.
M87	Top cut mode OFF (Option)	Confirm [OFF] signal of top cut command from bar feeder. * Check the specifications of bar feeder.
M88	Chuck close side	Chuck clamp the workpiece (outer dia.) with close side jaws. When performing the set up change, the program is made under MDI mode. Completion is performed with the reset key. (Refer to instruction manual for special operation.) * If programmed whit EDIT mode or to the same block as M89, alarm occurs.
M89	Chuck open side	Chuck clamp the workpiece (innner dia.) with open side jaws. When performing the set up change, the program is made under MDI mode. Completion is performed with the reset key. (Refer to the Instruction Manual for special operation.) * If programmed whit EDIT mode or to the same block as M88, alarm occurs.

M-code	Name	Content and matters that require attention
M90	Chamfering ON	Thread chamfering can be performed. With power ON, M90 is set. * If programmed to the same block as M91, alarm occurs.
M91	Chamfering OFF	Thread chamfering cannot be performed. * If programmed to the same block as M90, alarm occurs.
M92	Buffering OFF (Option)	This is M-code in which buffering becomes invalid.
M98	Call the sub program	The sub program is called from the main program and it is executed. * For detailed operation, refer to the Instruction Manual of FANUC.
M99	End of the program	The sub program stops and returns to the next block of the main program (M98). * For detailed operation, refer to the Instruction Manual of FANUC.

* Cs-axis control (option)

M-code	Name	Content and matters that require attention
M70	Rotary tool FORWARD	The rotary tool rotates in forward direction. When programming the spindle speed simultaneously with S*****, the spindle rotates at commanded speed. When S***** is not issued, the spindle rotates at the previously commanded speed. The spindle does not rotate during program check. Since the rotary tool is cancelled at M00 (M01), program again if required. * If programmed to the same block as M71, M72, M79 alarm occurs.
M71	Rotary tool REVERSE	The rotary tool rotates in reverse direction. The spindle speed command method is the same as M70. It does not rotate during program check. Since the rotary tool is cancelled at M00 (M01), program again if required. * If programmed to the same block as M70, M72, M79 alarm occurs.
M72	Rotary tool stop	The rotary tool stop. * If programmed to the same block as M70, M71, M79 alarm occurs.
M75	Turning mode	The system become a spindle turning mode. When programming M03, M04 under the spindle turning mode, the spindle can be rotated. * If programmed to the same block as M76, alarm occurs.
M76	C-axis mode	The system become a C-axis mode. The spindle can be rotated for C-axis under the C-axis mode. * If programmed to the same block as M75, alarm occurs.

M-code	Name	Content and matters that require attention
M77	C-axis brake ON	C-axis is clamped. * If programmed to the same block as M78, alarm occurs. * In the state in which the high pressure brake for the C-axis is specified, the machining in the polar coordinate interpolation mode (G12.1) and the cylindrical interpolation mode (G07.1) must not be performed. (A servo alarm is issued.)
M78	C-axis brake OFF	C-axis is unclamped. * If programmed to the same block as M77, alarm occurs.
M80	C-axis brake HIGH pressure (Option)	C-axis brake pressure is set high in the C-axis. * If programmed to the same block as M81, alarm occurs.
M81	C-axis brake LOW pressure (Option)	C-axis brake pressure is set low in the C-axis. * If programmed to the same block as M80, alarm occurs.

3-6 S-function

S4-digit command

G97 S1500;

Spindle speed is directly commanded at 4-digit value.

The above is 1500 min⁻¹.

(Without constant surface speed control)

G50 S1400;

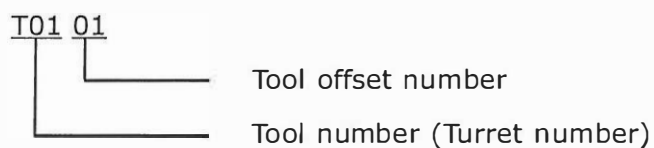
With constant surface speed control, maximum speed is
constant at 1400 min⁻¹.

G96 S120;

Constant surface speed of 120 m/min is controlled.

3-7 T-function

T4-digit command



Tool offset number

This function is used for compensation the slippage of cutting tools, tool wear, etc., and there are 16 offset numbers which can set the offset values (OFX and OFZ) corresponding to each tool offset number.

A maximum commanding value is +999.999 ~ -999.999.

Offset No.	OFX (X-axis offset value)	OFZ (Z-axis offset value)
1	0.010	0.020
2	0.000	0.000
3	3	3
16	0.100	1.340

Table 3-7 Tool offset number

T0000;

When the offset number is 00, the offset is canceled.

4 COORDINATE SYSTEM AND TOOL NOSE SETTING

4-1 Coordinate system setting

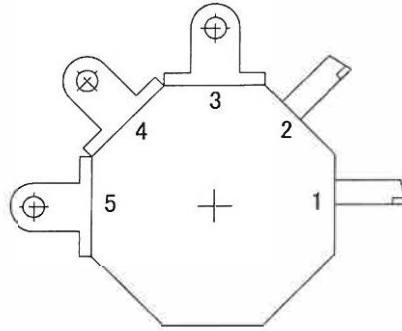


Fig. 4-1(a) Tool set

< Example > Tool set

No. 1 Outer diameter tool (standard tool)

No. 2 Outer diameter tool

No. 3 Inner diameter tool

No. 4 Inner diameter tool

No. 5 Drill

NOTE : All values of X-axis are diameter.

1. Automatic coordinate system setting

When manual or automatic reference position return is made by automatic coordinate system setting, the coordinate system setting can be made as shown in the following Fig. 4-1(b) Automatic coordinate system setting figure.

The setting value is different as machines model.

Refer to following [Table 4-1(a)~(c)].

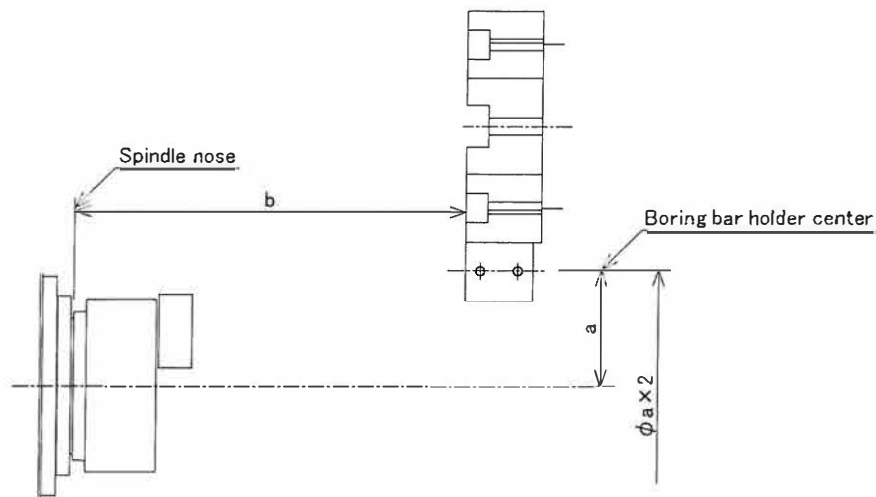


Fig. 4-1(b) Automatic coordinate system setting

NC parameter 1250 (X-axis) =c, 1250 (Z-axis) =d

After setting the above, and then returning to reference position, POS (position indication) is preset in the same condition with when G50 Xe Zf; are executed.

Machines Items		TC-100		TC-200 (L3)		TC-200 (L6)		
		T8	T12	T8	T12	T8	T12	T12CM
a	X-axis: Reference position	110	85	170	155	170	155	160
b	Z-axis: Reference position	280	280	450	450	750	750	750
c	X-axis: Setting value of automatic coordinate system	220000	170000	340000	310000	340000	310000	320000
d	Z-axis: Setting value of automatic coordinate system	280000	280000	450000	450000	750000	750000	750000
e	X-axis: Setting value	220.	170.	340.	310.	340.	310.	320.
f	Z-axis: Setting value	280.	280.	450.	450.	750.	750.	750.

Machines Items		TC-350 (L5)			TC-350 (L10)		
		T10	T12	T12CM	T10	T12	T12CM
a	X-axis: Reference position	215	230	220	215	230	220
b	Z-axis: Reference position	665	665	620	1165	1165	1120
c	X-axis: Setting value of automatic coordinate system	430000	460000	440000	430000	460000	440000
d	Z-axis: Setting value of automatic coordinate system	665000	665000	620000	1165000	1165000	1120000
e	X-axis: Setting value	430.	460.	440.	430.	460.	440.
f	Z-axis: Setting value	665.	665.	620.	1165.	1165.	1120.

Machines Items		TCC-2000 (L2)		TCC-2000 (L3)		TC-1000	
		T8	T12	T8	T12	T8	T12
a	X-axis: Reference position	175	160	175	160	110	85
b	Z-axis: Reference position	330	330	430	430	280	280
c	X-axis: Setting value of automatic coordinate system	350000	320000	350000	320000	220000	170000
d	Z-axis: Setting value of automatic coordinate system	330000	330000	430000	430000	280000	280000
e	X-axis: Setting value	350.	320.	350.	320.	220.	170.
f	Z-axis: Setting value	330.	330.	430.	430.	280.	280.

Table 4-1(a) Setting value of automatic coordinate system (TC-series, TCC-series)

Machines Items		TCN-2000 (L6)		TCN-2500 (L3)	TCN-2500 (L6)
		T8	T12CM	T8	T8
a	X-axis: Reference position	205	175	205	205
b	Z-axis: Reference position	750	685	410	710
c	X-axis: Setting value of automatic coordinate system	410000	350000	410000	410000
d	Z-axis: Setting value of automatic coordinate system	750000	685000	410000	710000
e	X-axis: Setting value	410.	350.	410.	410.
f	Z-axis: Setting value	750.	685.	410.	710.

Machines Items		TCN-3500(L5)			
		T8	T10	T12	T12CM
a	X-axis: Reference position	215	215	230	220
b	Z-axis: Reference position	665	665	665	620
c	X-axis: Setting value of automatic coordinate system	430000	430000	460000	440000
d	Z-axis: Setting value of automatic coordinate system	665000	665000	665000	620000
e	X-axis: Setting value	430.	430.	460.	440.
f	Z-axis: Setting value	665.	665.	665.	620.

Machines Items		TCN-3500(L10)			
		T8	T10	T12	T12CM
a	X-axis: Reference position	215	215	230	220
b	Z-axis: Reference position	1165	1165	1165	1120
c	X-axis: Setting value of automatic coordinate system	430000	430000	460000	440000
d	Z-axis: Setting value of automatic coordinate system	1165000	1165000	1165000	1120000
e	X-axis: Setting value	430.	430.	460.	440.
f	Z-axis: Setting value	1165.	1165.	1165.	1120.

Table 4-1(b) Setting value of automatic coordinate system (TCN-series)

Items \ Machines		TT-160	TT-200	T-200	TT-350			
					T8	T10	T12	T12CM
a	X-axis: Reference position	110	150	150	305	305	320	310
b	Z-axis: Reference position	265	310	310	505	505	505	460
c	X-axis: Setting value of automatic coordinate system	220000	300000	300000	610000	610000	640000	620000
d	Z-axis: Setting value of automatic coordinate system	265000	310000	310000	505000	505000	505000	460000
e	X-axis: Setting value	220.	300.	300.	610.	610.	640.	620.
f	Z-axis: Setting value	265.	310.	310.	505.	505.	505.	460.

Items \ Machines		TT-1600, TT-2000, TT-2100	TT-2500, T-2600, TT-2600
a	X-axis: Reference position	125	220
b	Z-axis: Reference position	275	395
c	X-axis: Setting value of automatic coordinate system	250000	440000
d	Z-axis: Setting value of automatic coordinate system	275000	395000
e	X-axis: Setting value	250.	440.
f	Z-axis: Setting value	275.	395.

Table 4-1(c) Setting value of automatic coordinate system (TT-series)

2. Workpiece coordinate system shift

In the coordinate system which indicates that the workpiece is clamped with the tool set, since it is necessary to shift the coordinate system on previous page, directly input the numerical data to the workpiece coordinate system shift.

After selecting the standard tool No. 1, cut the optional end face of workpiece and relieve the tool in the X-axis direction **without moving the tool in the Z-axis direction.**

Stop the spindle and measure the end face of workpiece.

< Example >

When Z-axis program datum of the workpiece is positioned 60 mm from the left end as follows and the currently cut end face is positioned 62 mm from the left end, the currently cut end face is Z2.0 on the program.

Calculation formula : When width to program datum is 60, end face is zero (0), when actually measured width is 62, it is 2 mm plus (+) and 59, 1 mm minus (-).

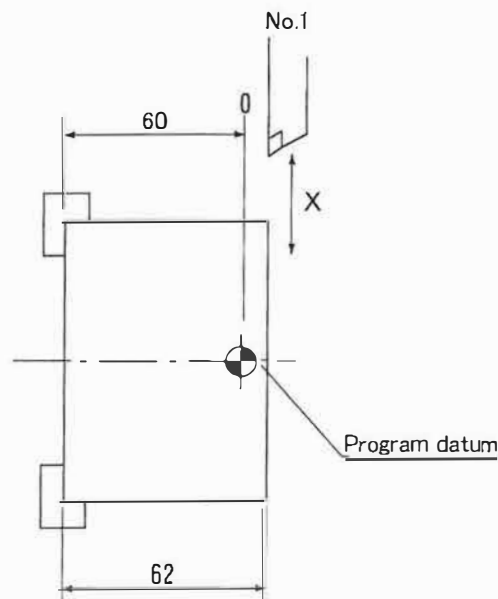


Fig. 4-1(c) Workpiece coordinate system shift

Operation steps are as follows.

- (1) Press the function key   several times to indicate the offset screen.
- (2) When pressing the chapter select key [WORK SHIFT], the work shift screen appears.

WORK SHIFT	
(SHIFT VALUE)	(MEASURING VALUE)
X 0	X
Z	Z
CURRENT POSITION (RELATIVE COORDINATE)	
U	W
[] [WORK SHIFT] [] [] [OPERATION]	



- (3) Set the cursor to a measuring value Z with the cursor traveling key and input the value of 2.0 with the ten-key before inputting [INPUT]. (When minus 1 mm, input the value of -1.0)

WORK SHIFT	
(SHIFT VALUE)	(MEASURING VALUE)
X 0	X
Z	Z
CURRENT POSITION (RELATIVE COORDINATE)	
U	W
[] [] [] [+ INPUT] [INPUT]	



Note : Check that a shift value X is 0.

If X and input the zero (0), set the cursor to the shift value X and input the zero (0) before pressing [INPUT].

After that, the shifted coordinate system is established after returning to reference position.

The SHIFT value can be directly inputted by pressing [INPUT] key after adjusting the cursor to shift value X or Z.

At this time, when pressing [+INPUT], the shift value is added to the previous shift value.

4-2 Tool nose setting

After selecting the standard tool No.1, cut the optional outer diameter of workpiece and relieve the tool in the Z-axis direction **without moving the tool in the X-axis direction.**

Stop the spindle and measure the outer diameter of workpiece.

< Example > When actually measured outer diameter is 50 mm.

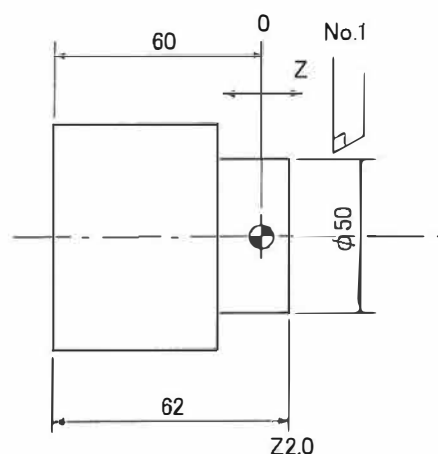
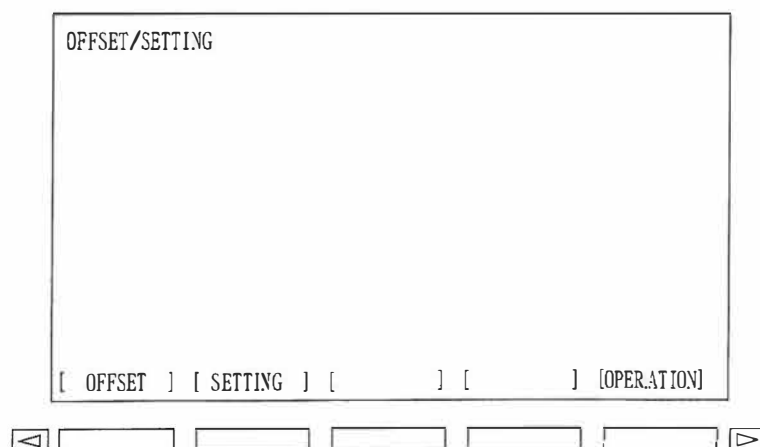


Fig. 4-2(a) Tool nose setting

Operation steps are as follows.

- (1) Press the function key   to indicate the offset screen.
- (2) Press [OFFSET].



(3) Press [FORM].

(4) Set the cursor traveling key to the offset number.

TOOL COMPENSATION/FORM

G01 _

G02

•

•

•

[WEAR] [FORM] [] [] [OPERATION]

◀ [] [] [] [] [] ▶

(5) Press [OPERATION].

TOOL COMPENSATION/FORM

G01 _

G02

•

•

•

[NO. SEARCH] [MEASUREMENT] [C INPUT] [+ INPUT] [INPUT]

◀ [] [] [] [] [] ▶

When inputting X50.0. and pressing [MEASUREMENT], the automatically calculated numerical value is entered to X of offset No.1.

Note : Z of offset No.1 is zero (0).

If it is not zero (0), set the cursor to Z and input zero (0) before pressing [INPUT].

1. Tool nose setting of outer diameter tool except standard tool

- (1) Touch the tool of No. 2 to the outer diameter face cut with the tool except the standard tool.

Do not move the X-axis.

Set the cursor to the offset number at the screen of operation sequence (5).

Input X50.0 with the ten-key and press the soft key [MEASUREMENT].

The slippage in X direction for the coordinate set with the automatic coordinate system is input and indicated as the compensation value.

- (2) Touch the tool of No. 2 to the end face cut with the workpiece coordinate system shift mode.

Do not move the Z-axis.

Set the cursor.

Input Z2.0 with the ten-key and press the soft key [MEASUREMENT].

The slippage in Z direction for standard tool No. 1 is input and indicated as the compensation value.

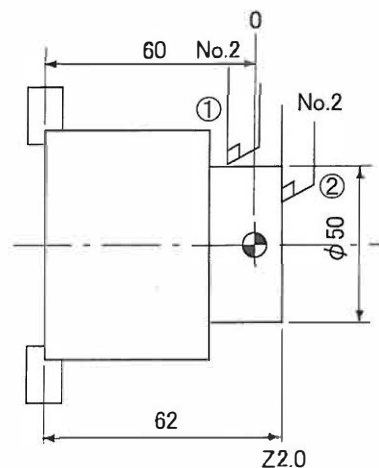


Fig. 4-2(b) Tool nose setting of inner diameter tool except standard tool

PROGRAMMING

3. Inner diameter tool B

- (1) Touch the tool of No. 4 to the inner diameter face cut with the inner diameter tool No. 3.

Do not move the X-axis.

Set the cursor to the offset number.

Input X30.0 with the ten-key and press the soft key [MEASUREMENT].

The slippage in X direction for the coordinate set with the automatic coordinate system is input and indicated as the compensation value.

- (2) Touch the tool of No. 4 to the end face cut with the workpiece coordinate system shift mode.

Do not move the Z-axis.

Set the cursor to the offset number.

Input Z2.0 with the ten-key and press the soft key [MEASUREMENT].

The slippage in Z direction for standard tool No. 1 is input and indicated as the compensation value.

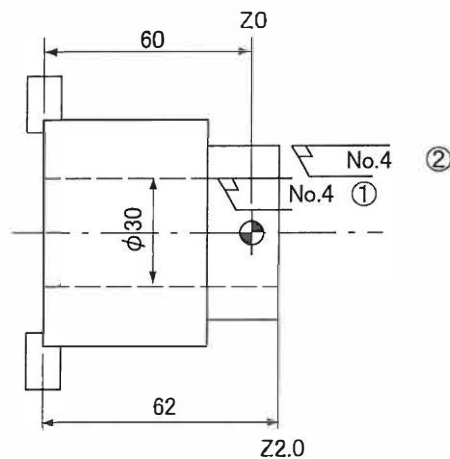


Fig 4-2(d) Inner diameter tool B

5 PROGRAM EXAMPLE

5-1 Example of turning

Material : S45C

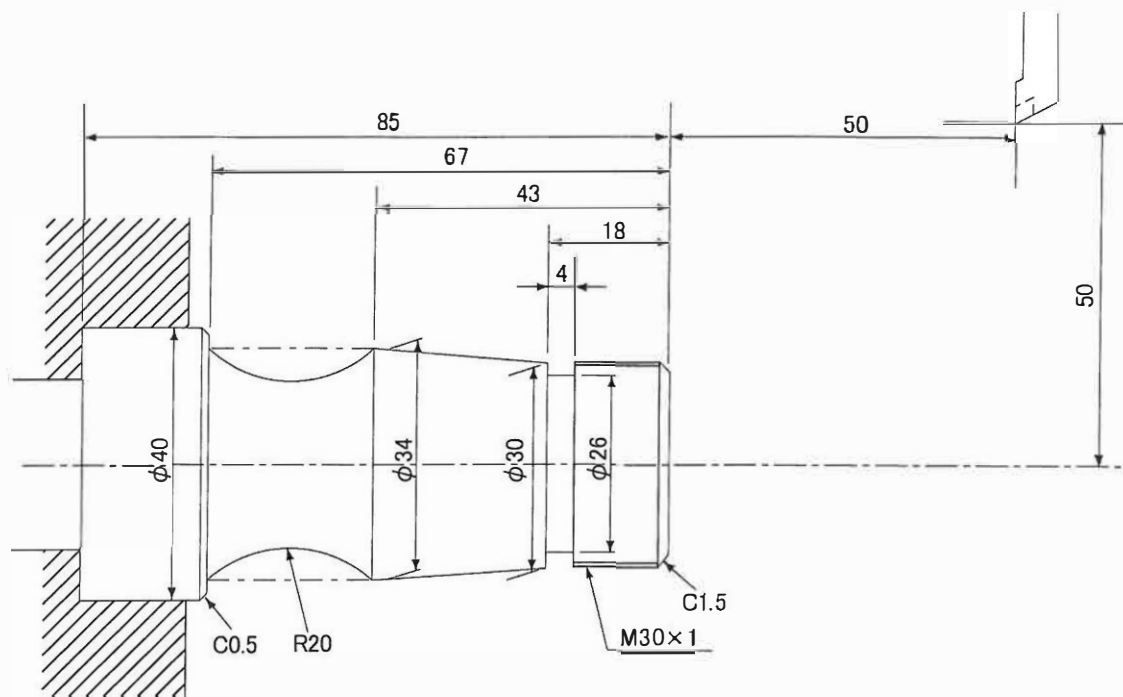


Fig. 5-1 Example of turning

NOTE : When using the G00 instead of G50, use "Automatic coordinate system setting" and "Workpiece shift".

Outer diameter rough cutting

```
G00 X100.0 Z50.0;
G96 S140 M03 T100 G99;
X35.0 Z2.0 T01 M08;
G01 Z-66.9 F0.4;
X44.0;
G00 Z2.0;
X23.5;
G01 X30.5 Z-1.5;
Z-18.0;
X34.5 Z-43.0;
G02 X33.851 Z-66.9 R20.0;
G01 X44.0;
G00 X100.0 Z50.0 T00;
M01;
```

Outer diameter finish cutting

```
G00 X100.0 Z50.0;
G96 S200 M03 T200;
X23.0 Z2.0 T02;
G01 X30.0 Z-1.5 F0.15;
Z-18.0;
X34.0 Z-43.0 F0.1;
G02 X34.0 Z-67.0 R20.0;
G01 X39.0;
X41.0 Z-68.0;
X44.0;
G00 X100.0 Z50.0 T00;
M01;
```

Outer diameter proving

```
G00 Z100.0 Z50.0;  
G96 S130 M03 T30;  
X34.0 Z-18.0 T03;  
G01 X26.0 F0.08;  
G04 U0.1;  
G01 X34.0 F0.5;  
G00 X100.0 Z50.0 T00;  
M01;
```

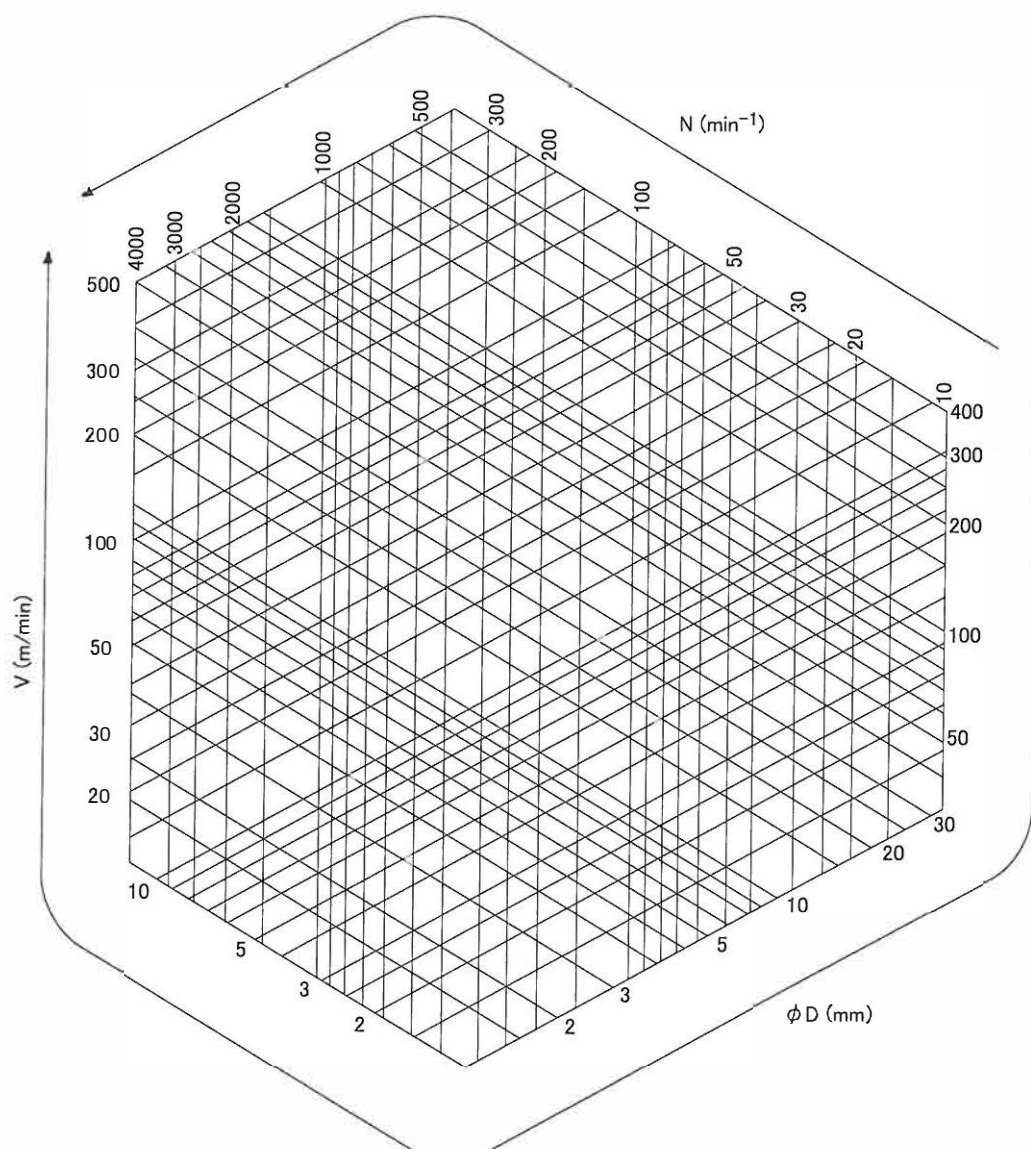
Outer diameter threading

```
G00 X100.0 Z50.0  
G97 S1300 M03 T400;  
X40.0 Z2.0 T04;  
G92 X29.4 Z-16.0 F-1.0;  
X29.0;  
X28.8;  
X28.7  
G00 X100.0 Z50.0 T00 M09;  
M05;  
M30;
```

5-2 Example of rotary tool turning

```
M76 G98;  
G28 H0.0;  
G0 X280.0 Z100.0;  
T600 M16;  
G97 S1500 M70;  
X50.0 Z2.0 C90.0 T06;  
G1 Z-3.0 F100;  
G0 Z2.0;  
C180.0;  
G1 Z-3.0;  
G0 Z2.0;  
X280.0 Z100.0 T00;  
M01;
```

6 CUTTING SPEED LIST



$$V = \frac{3.14 \times D \times N}{1000}$$

V= Cutting speed m/min

D= Workpiece diameter mm

N= Spindle speed min⁻¹

Fig. 6 Cutting speed list

7 CARBIDE TOOL CUTTING STANDARD CONDITION

Material name	Symbol	Feed 0.2~0.5 mm/rev		Feed 0.05~0.2 mm/rev	
		Cut. Speed V (m/min)	Tool	Cut. Speed V (m/min)	Tool
Carbon steel for machine structure	S20C~S30C	140~180	P20	150~230	P10
	S35C~S45C	100~140		120~190	
	S50C	70~100		80~140	
Finished steel bar	SGD20~SGD50	70~100		80~140	
Alloy steel	SNC236, SNC631, SNC836	70~100	P10	80~140	M10
Stainless steel	SUS430	60~100	M10	80~140	
	SUS304, SUS304L, SUS321, SUS316, SUS316L	40~70	M20	80~140	
Heat resisting steel	SUH1, SUH3, SUH4	40~70	P40	70~100	
Carbon steel forging	SF390A, SF490A	140~180	P20	150~230	P10
	SF540A, SF590A	100~140	P30	120~190	
Cast steel	SC410~SC480	100~120	P20	120~180	P10
Alloy cast steel	SCMn1, SCMn2, SCMnCr2~SCMnCr4	60~100		70~120	
	SCSiMn2	50~80		70~100	
Stainless cast iron	SCS1~SCS15	50~80	M20	70~140	M20
Heat resisting cast steel	SCH1~SCH2	60~90		70~120	
	SCH11~SCH13	50~80		60~100	

Material name	Symbol	Feed 0.2~0.5 mm/rev		Feed 0.05~0.2 mm/rev	
		Cut. Speed V (m/min)	Tool	Cut. Speed V (m/min)	Tool
Gray cast iron	FC200	70~110	K10	80~130	K10
	FC250~FC300	60~100		80~130	
Bronze casting	BC2~BC7	100~200		200~350	
Aluminum	AC3A-F	200~400		300~500	
Alloy casting	AC4A-F~AC7B-T4	800~900		800~1200	
Synthetic leather, wood		300~600	K10 K20	350~600	K10 K20

Table 7 Cutting standard condition

8 DRILL MACHINING CUTTING STANDARD CONDITION

8-1 Standard of drill cutting speed

Material		Cutting speed (m/min)	Material		Cutting speed (m/min)
Carbon steel	0.4C >	24~33	Aluminum/aluminum-alloy		60~90
	0.4C~0.7C	18~24	Bronze general high tensile strength	45~75	
	0.7C <	12~18		22.5~45	
Alloy steel	588 MPa	15~18	Magne, Magnetic alloy		60~120
	588~784 MPa	9~15	Monel metal		9~15
	784 MPa	5~9	Nickel		9~15
Stainless steel	Martensite	10~20	Zinc alloy		45~80
	Ferrite	15~18	Brass		45~90
	Austenite	5~15	Gun metal		60~75
Manganese steel	12~14%	3.5~4.5	Cutting steel		8~22
Plastic		30~90	Nimonic alloy		6~9

Table 8-1 Cutting speed

8-2 Standard of drill cutting feed

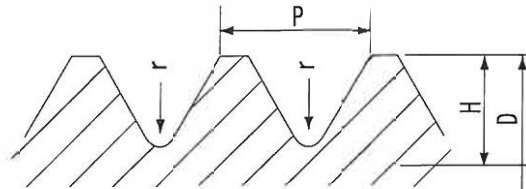
Drill dia. (mm)	Feed (mm/rev)	
	General steel	Stainless steel
1.6~3	0.05~0.06	0.05~0.08
3~4	0.05~0.01	0.06~0.15
4~5.5	0.08~0.15	0.1~0.23
5.5~8	0.1~0.2	0.13~0.3
8~11	0.15~0.25	0.19~0.35
11~14.5	0.2~0.3	0.25~0.45
14.5~17.5	0.23~0.33	0.28~0.6
17.5~20.5	0.25~0.36	0.31~0.53
20.5~24	0.28~0.38	0.34~0.56
24~28.5	0.3~0.4	0.38~0.6
28.5~38	0.35~0.45	0.44~0.68
38 <	0.4~0.5	0.5~0.7

Table 8-2 Cutting feed

9 APPENDIX

9-1 Thread cutting depth volume and times (Forreference)

Mail thread example



P : Pitch

D : Outer diameter

H : Height of thread

r : Round of thread bottom

Meter thread

(mm)

P (mm)		1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00
H (mm)		0.65	0.81	0.97	1.13	1.30	1.62	1.95	2.27	2.60
r (mm)		0.11	0.14	0.16	0.19	0.22	0.27	0.33	0.38	0.43
Cutting depth times and volume	1	0.30	0.30	0.35	0.40	0.40	0.40	0.40	0.40	0.40
	2	0.20	0.20	0.20	0.25	0.25	0.30	0.30	0.30	0.30
	3	0.10	0.20	0.20	0.25	0.25	0.25	0.25	0.25	0.30
	4	0.05	0.06	0.10	0.10	0.20	0.25	0.25	0.25	0.25
	5		0.05	0.07	0.08	0.10	0.15	0.25	0.25	0.25
	6			0.05	0.05	0.05	0.15	0.20	0.20	0.25
	7					0.05	0.07	0.10	0.20	0.25
	8						0.05	0.10	0.15	0.20
	9							0.05	0.15	0.20
	10							0.05	0.07	0.10
	11								0.05	0.05
	12									0.05

Table 9-1(a) Thread cutting depth volume (meter)

Whitworth screw thread

(mm)

Threads/inch		24	20	18	16	14	12	10	8	6
P (mm)		1.058	1.270	1.411	1.588	1.814	2.117	2.540	3.175	4.233
H (mm)		0.68	0.81	0.90	1.02	1.16	1.36	1.63	2.03	2.71
r (mm)		0.15	0.17	0.19	0.22	0.25	0.29	0.35	0.44	0.58
Cutting depth times and volume	1	0.30	0.30	0.35	0.35	0.40	0.40	0.40	0.40	0.40
	2	0.20	0.20	0.20	0.25	0.25	0.30	0.30	0.30	0.30
	3	0.10	0.20	0.20	0.20	0.25	0.25	0.25	0.25	0.30
	4	0.08	0.06	0.10	0.10	0.10	0.20	0.25	0.25	0.25
	5		0.05	0.05	0.07	0.10	0.15	0.15	0.25	0.25
	6				0.05	0.06	0.06	0.15	0.20	0.25
	7						0.05	0.08	0.15	0.25
	8							0.05	0.10	0.20
	9								0.08	0.20
	10								0.05	0.10
	11									0.10
	12									0.06
	13									0.05

Table 9-1(b) Thread cutting depth volume (whitworth)

9-2 Error by tool nose R (Circular cutting)

Because the tool is usually set for the tool nose R as shown in the right figure, the following error occurs as shown in the following figure when the circular cutting is performed.

To adjust the actual cutting circuit to drawing dimension, program as follows.

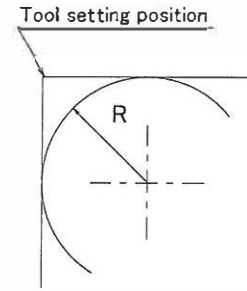


Fig. 9-2(a) Tool setting position

R : Nose R

r : Programmed circular radius

r' : Circular radius

(1) Cutting inside of circle

$$r + R = r'$$

$$r = r' - R$$

(2) Cutting outside of circle

$$r - R = r'$$

$$r = r' + R$$

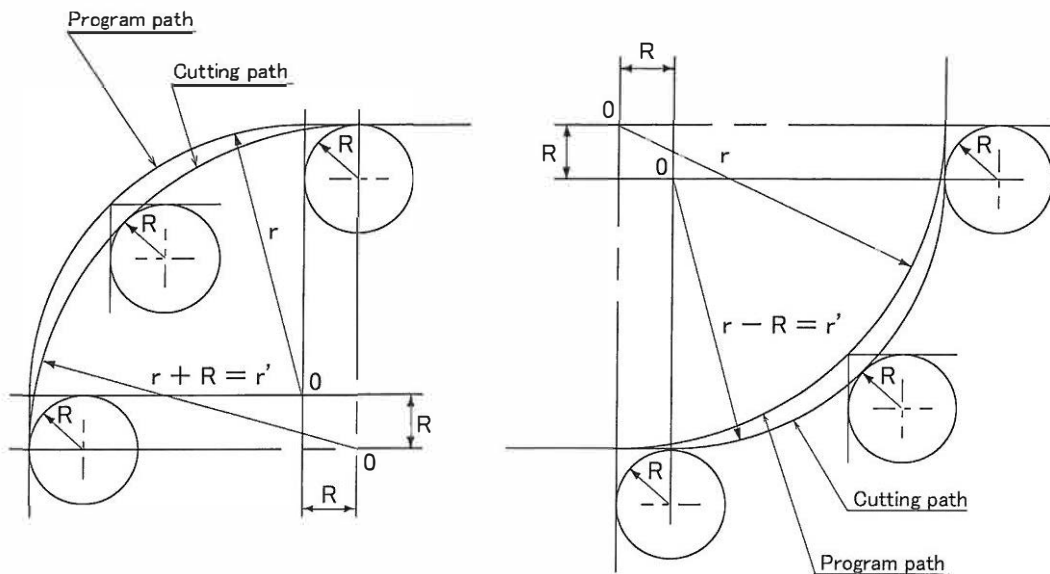


Fig. 9-2(b) Error by tool nose R

9-3 Tool nose R compensation list

Use corresponding to the minimum set unit of the machine.

(mm)

R Clearance angle (degree)		0.2	0.4	0.5	0.6	0.8	1.0	1.2
1	X	.0035	.0069	.0087	.0104	.0138	.0173	.0208
	Z	.1983	.3965	.4956	.5948	.7930	.9913	1.1895
1.5	X	.0052	.0103	.0129	.0155	.0207	.0258	.0310
	Z	.1974	.3948	.4935	.5921	.7895	.9869	1.1843
2	X	.0069	.0137	.0172	.0206	.0274	.0343	.0412
	Z	.1965	.3930	.4913	.5895	.7860	.9825	1.1791
2.5	X	.0085	.0171	.0214	.0256	.0342	.0427	.0512
	Z	.1956	.3913	.4891	.5869	.7825	.9782	1.1738
3	X	.0102	.0204	.0255	.0306	.0408	.0510	<u>.0612</u>
	Z	.1948	.3895	.4869	.5843	.7791	.9738	1.1686
3.5	X	.0119	.0237	.0296	.0356	.0474	.0593	.0712
	Z	.1939	.3878	.4847	.5817	.7756	.9694	1.1633
4	X	.0135	.0270	.0337	.0405	.0540	.0675	.0810
	Z	.1930	.3860	.4825	.5790	.7721	.9651	1.1581
4.5	X	.0151	.0302	.0378	.0454	.0605	.0756	.0907
	Z	.1921	.3843	.4804	.5764	.7686	.9607	1.1529
5	X	.0167	.0335	.0418	.0502	.0669	.0837	.1004
	Z	.1913	.3825	.4782	.5738	.7651	.9563	1.1476
5.5	X	.0183	.0367	.0458	.0550	.0733	.0917	.1100
	Z	.1904	.3808	.4760	.5712	.7616	.9520	1.1424
6	X	.0199	.0398	.0498	.0598	.0797	.0996	.1195
	Z	.1895	.3790	.4738	.5686	.7581	.9476	1.1371
6.5	X	.0215	.0430	.0537	.0645	.0860	.1075	.1290
	Z	.1886	.3773	.4716	.5659	.7546	.9432	1.1319

(mm)

R Clearance angle (degree)		0.2	0.4	0.5	0.6	0.8	1.0	1.2
7	X	.0231	.0461	.0576	.0692	.0922	.1153	.1383
	Z	.1878	.3755	.4694	.5633	.7511	.9388	1.1266
7.5	X	.0246	.0492	.0615	.0738	.0984	.1230	.1476
	Z	.1869	.3738	.4672	.5607	.7476	.9345	1.1213
8	X	.0261	.0523	.0654	.0784	.1046	.1307	.1569
	Z	.1860	.3720	.4650	.5580	.7441	.9301	1.1161
8.5	X	.0277	.0553	.0692	.0830	.1107	.1383	.1660
	Z	.1851	.3703	.4628	.5554	.7405	.9257	1.1108
9	X	.0292	.0584	.0730	.0876	.1167	.1459	.1751
	Z	.1843	.3685	.4606	.5528	.7370	.9213	1.1056
9.5	X	.0307	.0614	.0767	.0921	.1227	.1534	.1841
	Z	.1834	.3668	.4585	.5501	.7335	.9169	1.1003
10	X	.0322	.0644	.0805	.0965	.1287	.1609	.1931
	Z	.1825	.3650	.4563	.5475	.7300	.9125	1.0950
10.5	X	.0337	.0673	.0842	.1010	.1346	.1683	.2020
	Z	.1816	.3632	.4541	.5449	.7265	.9081	1.0897
11	X	.0351	.0703	.0878	.1054	.1405	.1757	.2108
	Z	.1807	.3615	.4519	.5422	.7230	.9037	1.0845
11.5	X	.0366	.0732	.0915	.1098	.1464	.1830	.2196
	Z	.1799	.3597	.4497	.5396	.7194	.8993	1.0792
12	X	.0380	.0761	.0951	.1141	.1522	.1902	.2283
	Z	.1790	.3580	.4474	.5369	.7159	.8949	1.0739
12.5	X	.0395	.0790	.0987	.1184	.1579	.1974	.2369
	Z	.1781	.3562	.4452	.5343	.7124	.8905	1.0686
13	X	.0409	.0818	.1023	.1227	.1637	.2046	.2455
	Z	.1772	.3544	.4430	.5316	.7089	.8861	1.0633
13.5	X	.0423	.0847	.1058	.1270	.1693	.2117	.2540
	Z	.1763	.3527	.4408	.5290	.7053	.8816	1.0580

(mm)

R Clearance angle (degree)		0.2	0.4	0.5	0.6	0.8	1.0	1.2
14	X	.0437	.0875	.1094	.1312	.1750	.2187	.2625
	Z	.1754	.3509	.4386	.5263	.7018	.8772	1.0527
14.5	X	.0451	.0903	.1129	.1354	.1806	.2257	.2709
	Z	.1746	.3491	.4364	.5237	.6982	.8728	1.0473
15	X	.0465	.0931	.1163	.1396	.1861	.2327	.2792
	Z	.1737	.3473	.4342	.5210	.6947	.8683	1.0420
15.5	X	.0479	.0958	.1198	.1437	.1917	.2396	.2875
	Z	.1728	.3456	.4320	.5183	.6911	.8639	1.0367
16	X	.0493	.0986	.1232	.1479	.1972	.2464	.2957
	Z	.1719	.3438	.4297	.5157	.6876	.8595	1.0314
16.5	X	.0507	.1013	.1266	.1520	.2026	.2533	.3039
	Z	.1710	.3420	.4275	.5130	.6840	.8550	1.0260
17	X	.0520	.1040	.1300	.1560	.2080	.2600	.3120
	Z	.1701	.3402	.4253	.5103	.6804	.8505	1.0207
17.5	X	.0534	.1067	.133 ⁴	.1601	.2134	.2668	.3201
	Z	.1692	.3384	.4230	.5077	.6769	.8461	1.0153
18	X	.0547	.1094	.1367	.1641	.2188	.2735	.3281
	Z	.1683	.3366	.4208	.5050	.6733	.8416	1.0099
18.5	X	.0560	.1120	.1401	.1681	.2241	.2801	.3361
	Z	.1674	.3349	.4186	.5023	.6697	.8371	1.0046
19	X	.0573	.1147	.1434	.1720	.2294	.2867	.3440
	Z	.1665	.3331	.4163	.4996	.6661	.8327	.9992
19.5	X	.0587	.1173	.1466	.1760	.2346	.2933	.3519
	Z	.1656	.3313	.4141	.4969	.6625	.8282	.9938
20	X	.0600	.1199	.1499	.1799	.2398	.2998	.3598
	Z	.1647	.3295	.4118	.4942	.6589	.8237	.9884
20.5	X	.0613	.1225	.1531	.1838	.2450	.3063	.3675
	Z	.1638	.3277	.4096	.4915	.6553	.8192	.9830

(mm)

R Clearance angle (degree)		0.2	0.4	0.5	0.6	0.8	1.0	1.2
21	X	.0625	.1251	.1564	.1876	.2502	.3127	.3753
	Z	.1629	.3259	.4073	.4888	.6517	.8147	.9776
21.5	X	.0638	.1276	.1596	.1915	.2553	.3191	.3829
	Z	.1620	.3241	.4051	.4861	.6481	.8101	.9722
22	X	.0651	.1302	.1627	.1953	.2604	.3255	.3906
	Z	.1611	.3222	.4028	.4834	.6445	.8056	.9667
22.5	X	.0664	.1327	.1659	.1991	.2655	.3318	.3982
	Z	.1602	.3204	.4005	.4807	.6409	.8011	.9613
23	X	.0676	.1352	.1691	.2029	.2705	.3381	.4057
	Z	.1593	.3186	.3983	.4779	.6372	.7965	.9559
23.5	X	.0689	.1377	.1722	.2066	.2755	.3444	.4132
	Z	.1584	.3168	.3960	.4752	.6336	.7920	.9504
24	X	.0701	.1402	.1753	.2104	.2805	.3506	.4207
	Z	.1575	.3150	.3937	.4725	.6300	.7874	.9449
24.5	X	.0714	.1427	.1784	.2141	.2854	.3568	.4281
	Z	.1566	.3132	.3914	.4697	.6263	.7829	.9395
25	X	.0726	.1452	.1815	.2178	.2903	.3629	.4355
	Z	.1557	.3113	.3892	.4670	.6226	.7783	.9340
25.5	X	.0738	.1476	.1845	.2214	.2952	.3690	.4429
	Z	.1547	.3095	.3869	.4642	.6190	.7737	.9285
26	X	.0750	.1501	.1876	.2251	.3001	.3751	.4502
	Z	.1538	.3077	.3846	.4615	.6153	.7691	.9230
26.5	X	.0762	.1525	.1906	.2287	.3049	.3812	.4574
	Z	.1529	.3058	.3823	.4587	.6116	.7645	.9174
27	X	.0774	.1549	.1936	.2323	.3098	.3872	.4646
	Z	.1520	.3040	.3800	.4560	.6079	.7599	.9119
27.5	X	.0786	.1573	.1966	.2359	.3145	.3932	.4718
	Z	.1511	.3021	.3777	.4532	.6042	.7553	.9064

(mm)

Clearance angle (degree) \ R		0.2	0.4	0.5	0.6	0.8	1.0	1.2
28	X	.0798	.1597	.1996	.2395	.3193	.3991	.4790
	Z	.1501	.3003	.3753	.4504	.6005	.7507	.9008
28.5	X	.0810	.1620	.2025	.2430	.3240	.4051	.4861
	Z	.1492	.2984	.3730	.4476	.5968	.7460	.8952
29	X	.0822	.1644	.2055	.2466	.3288	.4110	.4931
	Z	.1483	.2966	.3707	.4448	.5931	.7414	.8897
29.5	X	.0834	.1667	.2084	.2501	.3335	.4168	.5002
	Z	.1473	.2947	.3684	.4420	.5894	.7367	.8841
30	X	.0845	.1691	.2113	.2536	.3381	.4226	.5072
	Z	.1464	.2928	.3660	.4392	.5856	.7321	.8785
30.5	X	.0857	.1714	.2142	.2571	.3428	.4285	.5141
	Z	.1455	.2909	.3637	.4364	.5819	.7274	.8728
31	X	.0868	.1737	.2171	.2605	.3474	.4342	<u>.5211</u>
	Z	.1445	.2891	.3613	.4336	.5781	.7227	.8672
31.5	X	.0880	.1760	.2200	.2640	.3520	.4400	.5280
	Z	.1436	.2872	.3590	.4308	.5744	.7180	.8616
32	X	.0891	.1783	.2228	.2674	.3566	.4457	.5348
	Z	.1427	.2853	.3566	.4280	.5706	.7133	.8559
32.5	X	.0903	.1806	.2257	.2708	.3611	.4514	.5417
	Z	.1417	.2834	.3543	.4251	.5668	.7085	.8502
33	X	.0914	.1828	.2285	.2742	.3656	.4570	.5485
	Z	.1408	.2815	.3519	.4223	.5630	.7038	.8445
33.5	X	.0925	.1851	.2313	.2776	.3701	.4627	.5552
	Z	.1398	.2796	.3495	.4194	.5592	.6990	.8388
34	X	.0937	.1873	.2341	.2810	.3746	.4683	.5619
	Z	.1389	.2777	.3471	.4166	.5554	.6943	.8331
34.5	X	.0948	.1895	.2369	.2843	.3791	.4739	.5686
	Z	.1379	.2758	.3447	.4137	.5516	.6895	.8274

(mm)

R Clearance angle (degree)		0.2	0.4	0.5	0.6	0.8	1.0	1.2
35	X	.0959	.1918	.2397	.2877	.3835	.4797	.5753
	Z	.1369	.2739	.3424	.4108	.5478	.6847	.8216
35.5	X	.0970	.1940	.2425	.2910	.3880	.4850	.5820
	Z	.1360	.2720	.3399	.4079	.5439	.6799	.8159
36	X	.0981	.1962	.2452	.2943	.3924	.4905	.5886
	Z	.1350	.2700	.3375	.4050	.5401	.6751	.8101
36.5	X	.0992	.1984	.2480	.2976	.3968	.4960	.5952
	Z	.1340	.2681	.3351	.4021	.5362	.6702	.8043
37	X	.1003	.2006	.2507	.3009	.4011	.5014	.6017
	Z	.1331	.2662	.3327	.3992	.5323	.6654	.7985
37.5	X	.1014	.2027	.2534	.3041	.4055	.5069	.6082
	Z	.1321	.2642	.3303	.3963	.5284	.6605	.7927
38	X	.1025	.2049	.2561	.3074	.4098	.5123	.6147
	Z	.1311	.2623	.3278	.3934	.5245	.6557	.7868
38.5	X	.1035	.2071	.2588	.3106	.4141	.5177	.6212
	Z	.1302	.2603	.3254	.3905	.5206	.6508	.7809
39	X	.1046	.2092	.2615	.3138	.4184	.5230	.6276
	Z	.1292	.2584	.3229	.3875	.5167	.6459	.7751
39.5	X	.1057	.2113	.2642	.3170	.4227	.5284	.6340
	Z	.1282	.2564	.3205	.3846	.5128	.6410	.7692
40	X	.1067	.2135	.2668	.3202	.4270	.5337	.6404
	Z	.1272	.2544	.3180	.3816	.5088	.6360	.7632
40.5	X	.1078	.2156	.2695	.3234	.4312	.5390	.6468
	Z	.1262	.2524	.3155	.3786	.5049	.6311	.7573
41	X	.1089	.2177	.2721	.3266	.4354	.5443	.6531
	Z	.1252	.2504	.3131	.3757	.5009	.6261	.7513
41.5	X	.1099	.2198	.2748	.3297	.4396	.5495	.6594
	Z	.1242	.2485	.3106	.3727	.4969	.6211	.7454

(mm)

Clearance angle (degree) \ R		0.2	0.4	0.5	0.6	0.8	1.0	1.2
42	X	.1110	.2219	.2774	.3329	.4438	.5548	.6657
	Z	.1232	.2465	.3081	.3697	.4929	.6161	.7394
42.5	X	.1120	.2240	.2800	.3360	.4480	.5600	.6720
	Z	.1222	.2444	.3056	.3667	.4889	.6111	.7333
43	X	.1130	.2261	.2826	.3391	.4522	.5652	.6782
	Z	.1212	.2424	.3030	.3637	.4849	.6061	.7273
43.5	X	.1141	.2281	.2852	.3422	.4563	.5704	.6844
	Z	.1202	.2404	.3005	.3606	.4808	.6010	.7212
44	X	.1151	.2302	.2878	.3453	.4604	.5755	.6906
	Z	.1192	.2384	.2980	.3576	.4768	.5960	.7152
44.5	X	.1161	.2323	.2903	.3484	.4645	.5807	.6968
	Z	.1182	.2364	.2954	.3545	.4727	.5909	.7091
45	X	.1172	.2343	.2929	.3515	.4686	.5858	.7029
	Z	.1172	.2343	.2929	.3515	.4686	.5858	.7029

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NC Lathe

TT-2600

TOOLING MANUAL

XZ04060-101

Please read each manual and understand contents enough.

Then keep these manuals handy for answers to any questions you may have and to check.

MACHINE TOOLS

TAKISAWA

IMPORTANT NOTICE

- Be sure to read each instruction manual before operating the machine.

Be sure to observe the safety precautions in the instruction manuals and the contents of warning labels adhered to the machine. If ignored, an accident resulting in injury or death or machine malfunction may be caused.

There are many [DISABLE] or [MUST NOT DO] conditions.

Unless [ABLE] is written in the instruction manual, consider it [DISABLE].

- Some illustrations in the instruction manual are given without cover or door to illustrate the detailed parts. In actual operation, it is necessary to mount the cover or door.
- Keep instruction manuals handy for ready reference as it will help you operate the machine and equipment to their full advantage.
- When any instruction manual is required again, contact your agent with the number of the instruction manual (or model name, manual name).
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Export of the product may require the permission of governmental authorities of the country from where the product is exported.
Should you wish to resell, transfer or export the product, please notify Takisawa Machine Tool Co., Ltd. or our distributor in advance.
- Observe the laws and regulations established by the national and local governments.
- Observe the laws and regulations established by the national and local government for disposal of machines and waste oil.

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- Be sure to attach this instruction manual in case of reselling this machine.
- The manual is written for people who have a basic knowledge of machine tools.
TAKISAWA disclaims all responsibility for damage or accidents arising due to people with insufficient knowledge or training with machine tools, attempting to operate, maintain or program said tools.
- When replacing the parts, use the parts specified by company.
TAKISAWA disclaims all responsibility for damage or problems occurring due to using parts other than those specified.
If the specified parts are not used, not only the machine function is reduced but also safety is compromised, thus possibly causing an accident resulting in injury or death or machine malfunction.

- There are many kinds of coolants.

Though TAKISAWA does not specify the coolant, select the coolant by consulting with maker about the following items.

TAKISAWA disclaims all the responsibility for trouble incurred by the coolant.

- Contact us for requesting an installation, modification, and specification change, and dismantlement of the machine. If the machine is installed, modified, or its specification is changed by customer, not only the performance of the machine may be lost but also the safety of the customer may not be secured.

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1 OUT LINE

The turret of this machine is the total 10-station all holder type.

Also available is the 10-station rotary tool turret.

Since this turret has closest rotation, programming can be made without thinking of tool indexing time and cycle time can be reduced.

1. All holder type turret

- (1) Various holder (outer cutting tool holder, boring bar holder, facing holder and U-drill holder) can be mounted on the whole position of turret peripheral surface.
- (2) Each holder can be commonly used at right and left turrets.

2. Rotary tool type turret

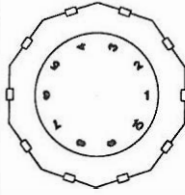
- (1) Designed for milling operations, this turret has 10-station all holder type turret.
- (2) Various holder (outer cutting tool holder, boring bar holder, facing holder and U-drill holder) can be mounted on the whole position of turret peripheral surface.
- (3) Each holder can be commonly used at right and left turrets.

2 TOOLING SYSTEM

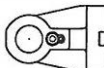
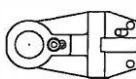
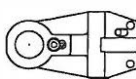
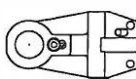
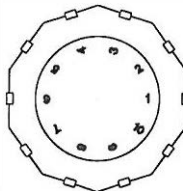
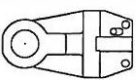
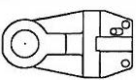
2-1 10-station turret

(mm)

Tool holder 	25×25 Turning holder NR22001-002			Tool holder clamp Bolt type or wedge type
	25×25 Facing holder NR22002-001B			
Boring bar 	Bushing 	φ 40	Boring bar holder NR22028-001A	
		φ 32 : NC30108-001A		
		φ 30 : NC30153-001A	Gauging NR22029-001A	
		φ 25 : NC30107-001A		
		φ 20 : NC30106-001A		
		φ 18 : NC30152-001A		
		φ 16 : NC30105-001A		
		φ 14 : NC30151-001A	Offset type Boring bar holder NR22030-001A	
		φ 12 : NC30104-001A		
		φ 10 : NC30103-001A		
		φ 8 : NC30102-001A		
		φ 6 : NC30101-001A	Gauging NR22031-001A	
Drill 	Socket 	MT.4 : NC00007-038		
		MT.3 : NC00007-037		
		MT.2 : NC00007-036		
		MT.1 : NC00007-035		
U drill 	Socket 	φ 40	U drill holder NR22024-001	
		φ 32 : NC32203-001A	Gauging NR22025-001	
		φ 25 : NC32202-001A		
		φ 20 : NC32201-001A		
			Offset type U drill holder NR22026-001	
			Gauging NR22027-001	

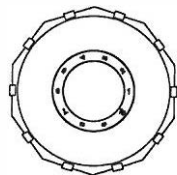

10-station
turret
XD21002-001

(inch)

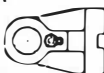
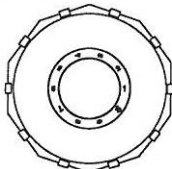
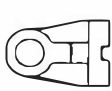
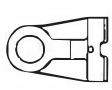
Tool holder 	1"×1" Turning holder NR22011-002			Tool holder clamp Bolt type or wedge type
	1"×1" Facing holder NR22012-001C			
Boring bar 	Bushing 	ϕ 1-1/2"	Boring bar holder NR22032-001A  Gauging NR22033-001A  Offset type Boring bar holder NR22034-001A  Gauging NR22035-001A 	 10-station turret XD21002-001
		ϕ 1-1/4" : NC31108-001		
		ϕ 1" : NC31107-001		
		ϕ 3/4" : NC31106-001		
		ϕ 5/8" : NC31105-001		
		ϕ 1/2" : NC31104-001		
		ϕ 3/8" : NC31103-001		
		ϕ 5/16" : NC31102-001		
		ϕ 1/4" : NC31101-001		
Drill 	Socket 	MT.3 : NC00007-242		
		MT.2 : NC00007-241		
		MT.1 : NC00007-240		
U drill 	Socket 	ϕ 40 mm	U drill holder NR22024-001  Gauging NR22025-001  Offset type U drill holder NR22026-001  Gauging NR22027-001	
		ϕ 32 mm : NC32203-001A		
		ϕ 25 mm : NC32202-001A		
		ϕ 20 mm : NC32201-001A		

2-2 Rotary tool type 10-station turret

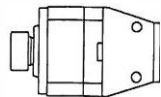
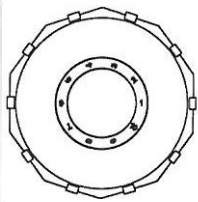
(mm)

Tool holder 	25×25 Turning holder NR22001-002			Tool holder clamp Bolt type or wedge type
	25×25 Facing holder NR22002-001B			
Boring bar 	Bushing 	φ 40	Boring bar holder NR22028-001A	
		φ 32 : NC30108-001A		
		φ 30 : NC30153-001A	Gauging NR22029-001A	
		φ 25 : NC30107-001A		
		φ 20 : NC30106-001A	Offset type Boring bar holder XD22005-001	
		φ 18 : NC30152-001A		
		φ 16 : NC30105-001A	Gauging XD22006-001	
		φ 14 : NC30151-001A		
		φ 12 : NC30104-001A		
		φ 10 : NC30103-001A		
		φ 8 : NC30102-001A		
		φ 6 : NC30101-001A		
Drill 	Socket 	MT.4 : NC00007-038		
		MT.3 : NC00007-037		
		MT.2 : NC00007-036		
		MT.1 : NC00007-035		
U drill 	Socket 	φ 40	U drill holder NR22024-001	
		φ 32 : NC32203-001A		
		φ 25 : NC32202-001A	Gauging NR22025-001	
		φ 20 : NC32201-001A		
			Offset type U drill holder XD22007-001	
			Gauging XD22008-001	

(inch)

Tool holder 	1"×1" Turning holder NR22011-002			Tool holder clamp Bolt type or wedge type
	1"×1" Facing holder NR22012-001C			
Boring bar 	Bushing 	φ 1-1/2"		Boring bar holder NR22032-001A Gauging NR22033-001A   10-station turret (Rotary tool type) XD21004-001
		φ 1-1/4" : NC31108-001		
		φ 1" : NC31107-001		
		φ 3/4" : NC31106-001		
		φ 5/8" : NC31105-001		
		φ 1/2" : NC31104-001		
		φ 3/8" : NC31103-001		
		φ 5/16" : NC31102-001		
		φ 1/4" : NC31101-001		
			Offset type Boring bar holder XD22009-001	
Drill 	Socket 	MT.3 : NC00007-242		Gauging XD22010-001 
		MT.2 : NC00007-241		
		MT.1 : NC00007-240		
U drill 	Socket 	φ 40 mm		U drill holder NR22024-001 Gauging NR22025-001  Offset type U drill holder XD22007-001 Gauging XD22008-001 
		φ 32 mm : NC32203-001A		
		φ 25 mm : NC32202-001A		
		φ 20 mm : NC32201-001A		

(mm)

Drill 	Collet 	φ 16 : GM70008-150	Rotary tool holder (X) GM81999-469 	Rotary tool holder (Z) GM81999-470 	 10-station turret (Rotary tool type) XD21004-001
		φ 15 : GM70008-149			
		φ 14 : GM70008-148			
		φ 13 : GM70008-147			
		φ 12 : GM70008-146			
		φ 11 : GM70008-145			
		φ 10 : GM70008-144			
		φ 9 : GM70008-143			
		φ 8 : GM70008-142			
		φ 7 : GM70008-141			
		φ 6 : GM70008-140			
		φ 5 : GM70008-139			
		φ 4 : GM70008-138			
		φ 3 : GM70008-137			
		φ 2 : GM70008-136			
		φ 1 : GM70008-192			
		Tap 			
M14 : GM70008-218					
M12 : GM70008-217					
M10 : GM70008-216					
M8 : GM70008-215					
M6 : GM70008-214					
M5 : GM70008-213					
M4 : GM70008-212					
Cover XD22001-002 	O-ring G-50 				

3 TURRET TRAVEL

3-1 8 inch type

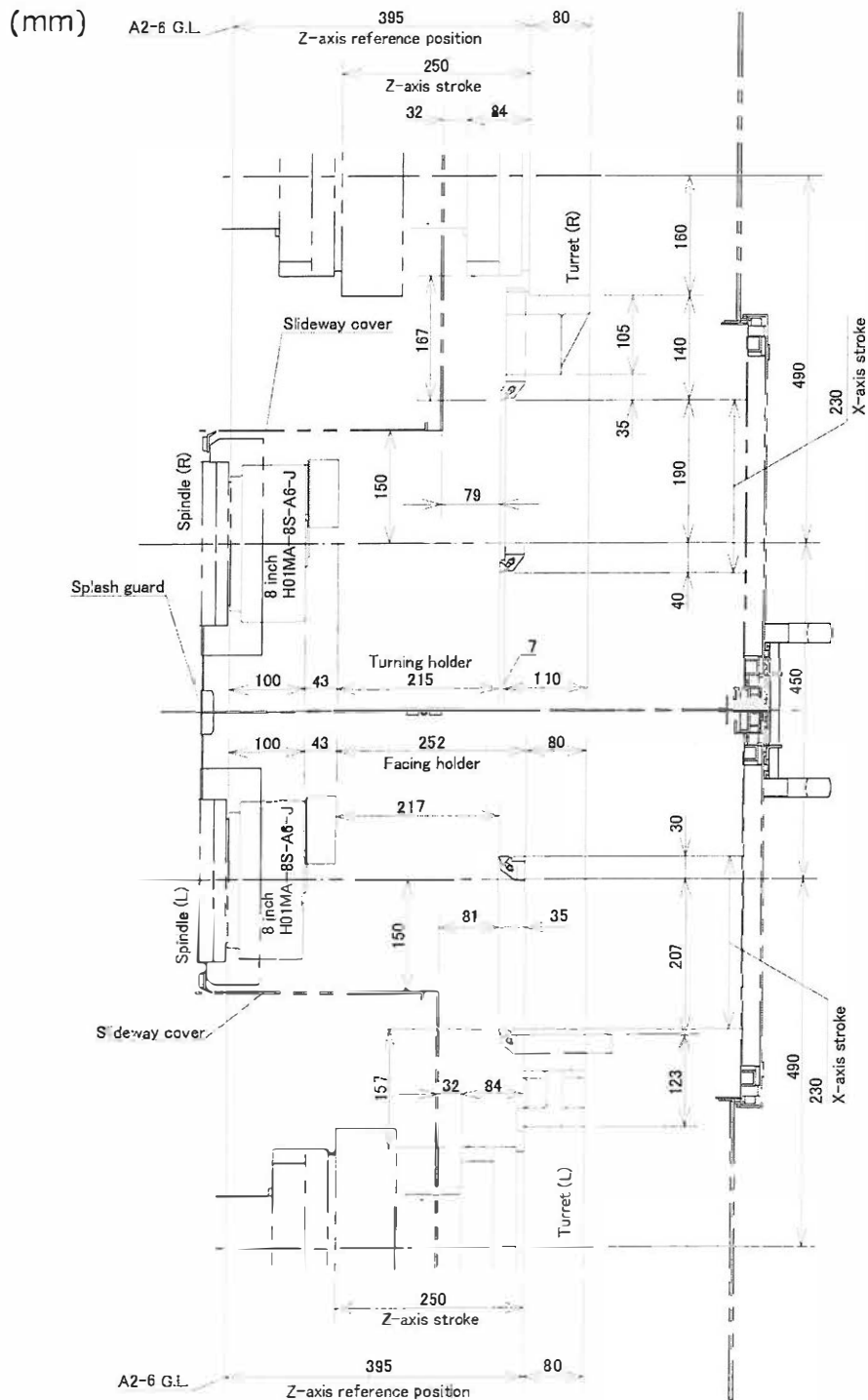


Fig. 3-1(a) Turret travel (turning holder)

(inch)

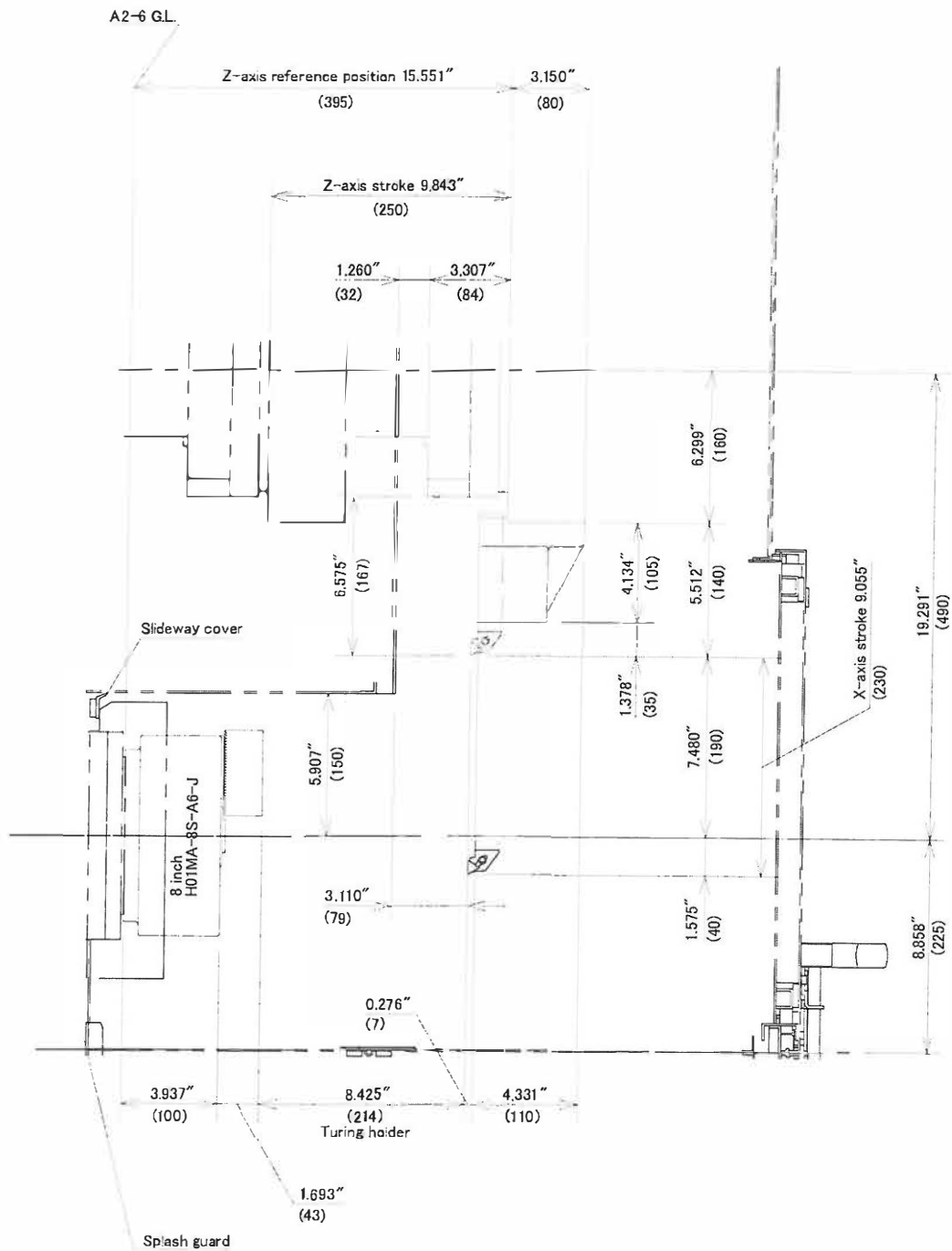


Fig. 3-1(b) Turret travel (Turning holder)

(inch)

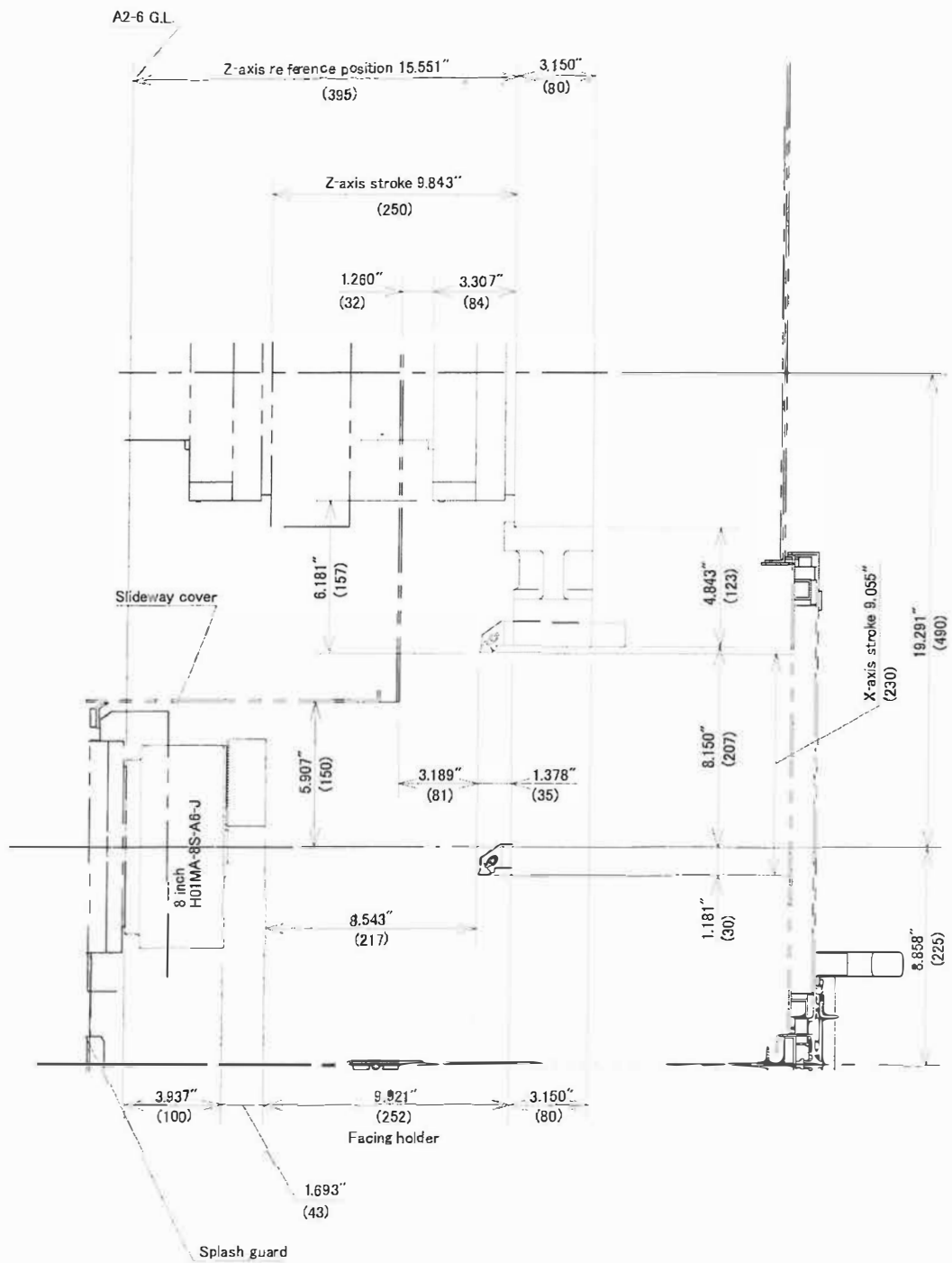


Fig. 3-1(c) Turret travel (Facing holder)

(mm)

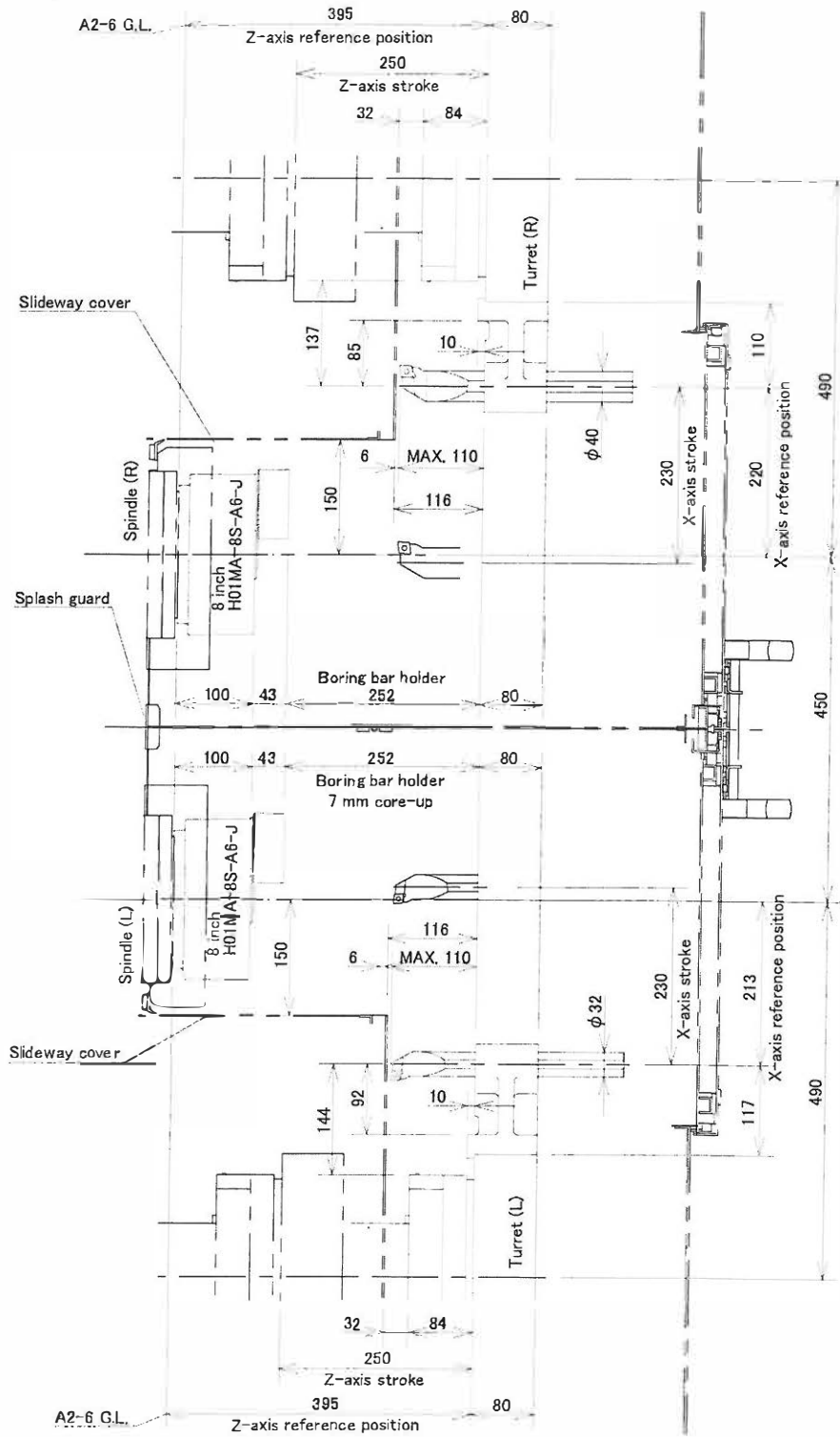


Fig. 3-1(d) Turret travel (Boring bar holder)

(inch)

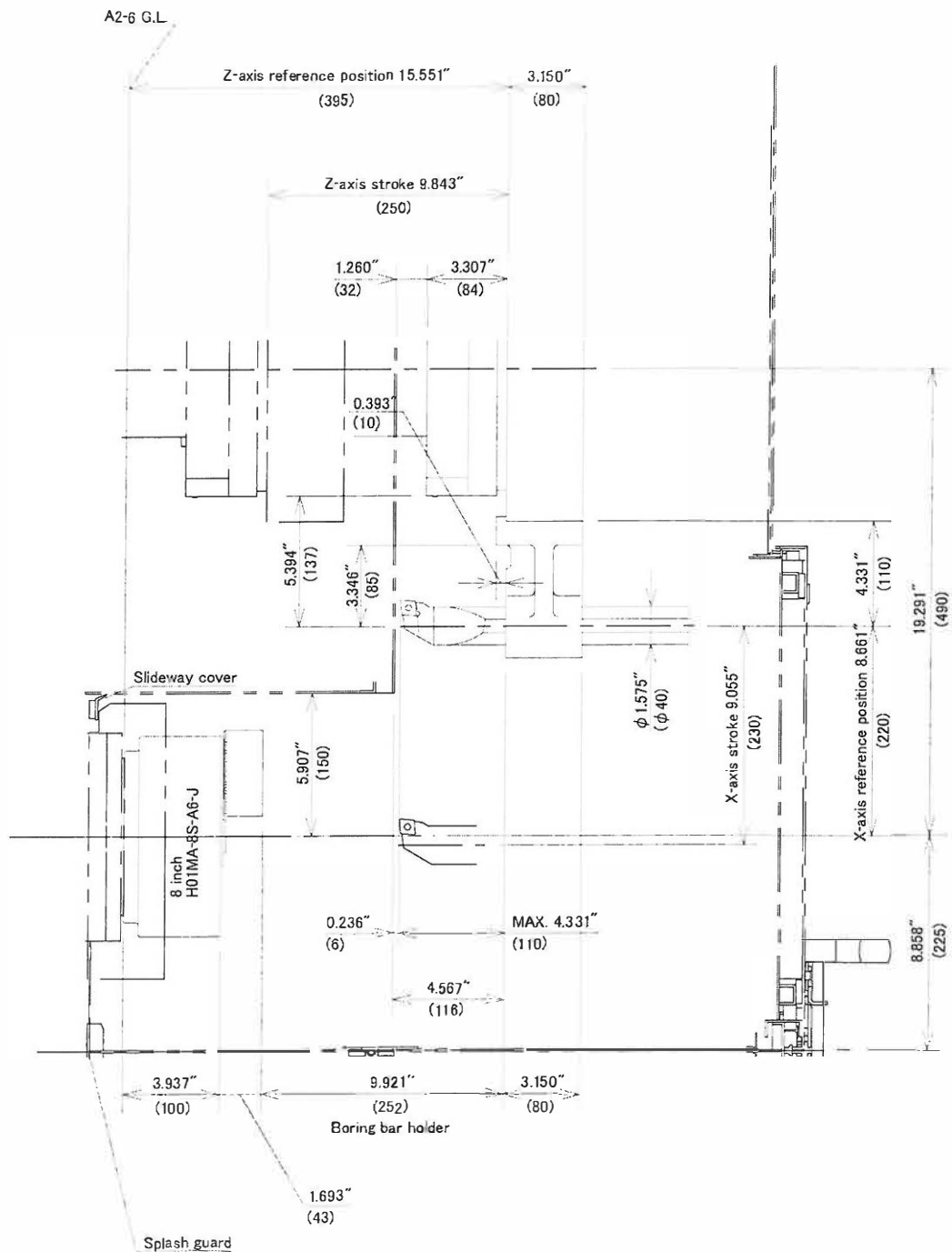


Fig. 3-1(e) Turret travel (Boring bar holder)

(inch)

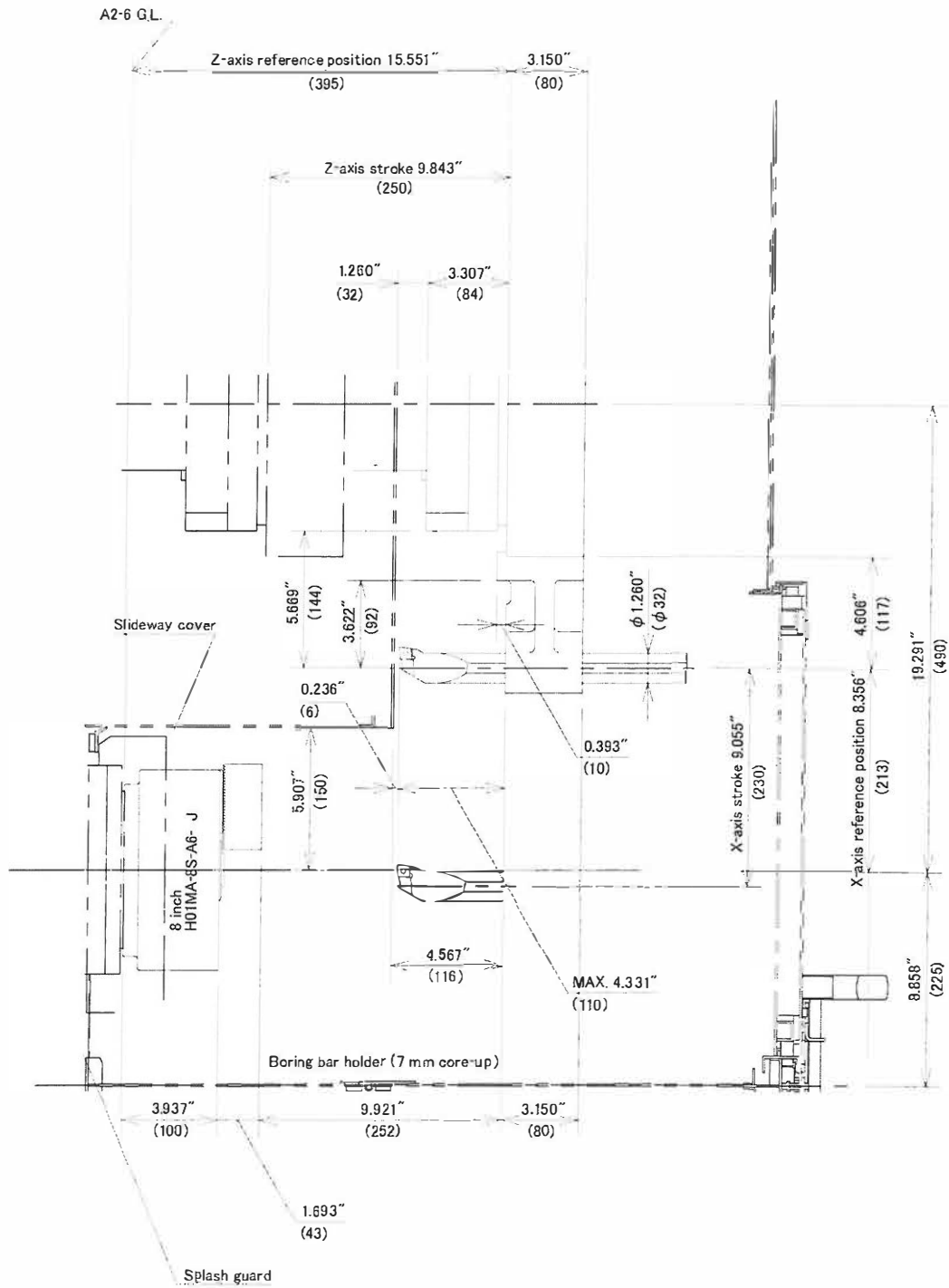


Fig. 3-1(f) Turret travel (Boring bar holder (7 mm core-up))

(mm)

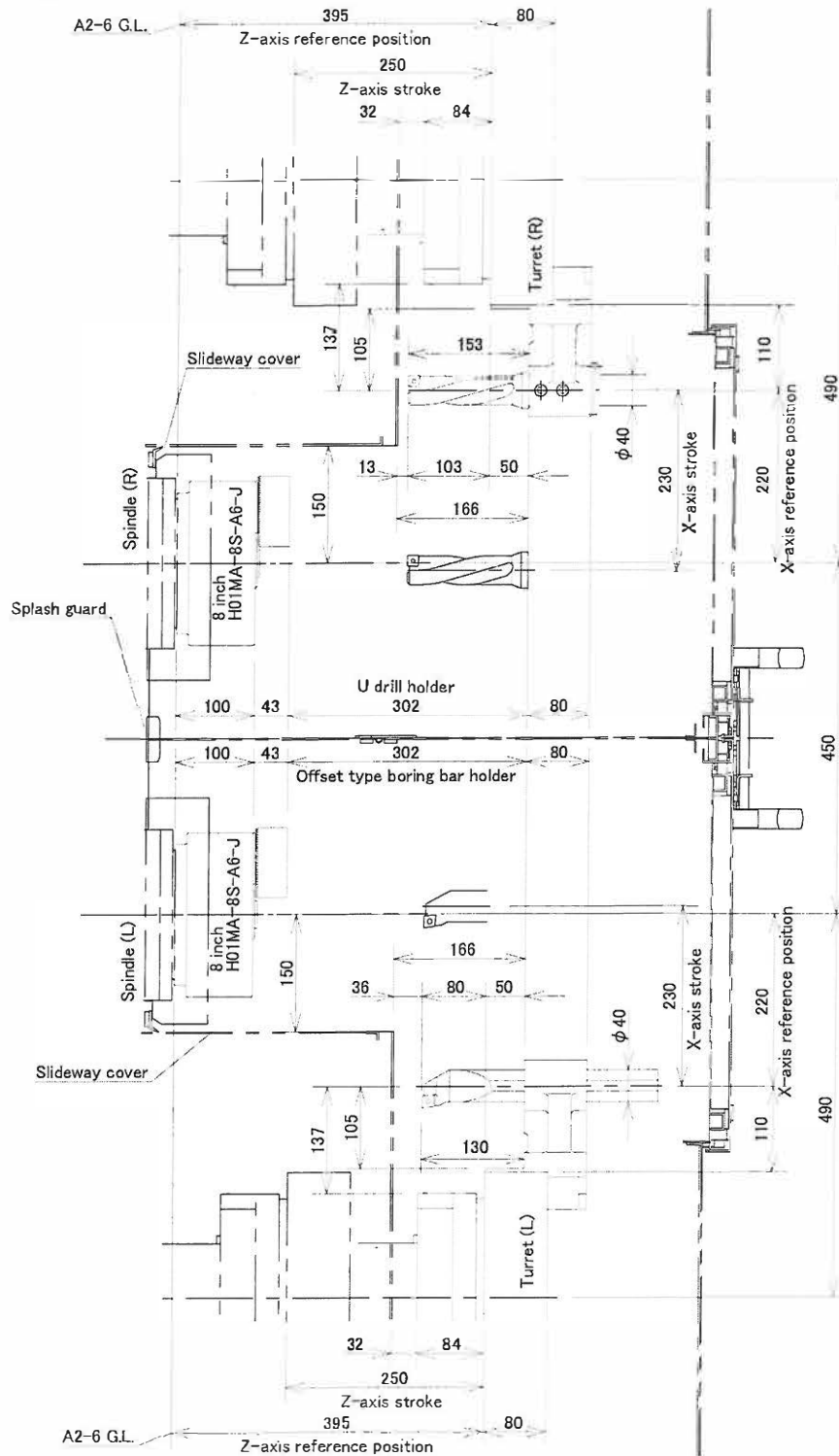


Fig. 3-1(g) Turret travel (U drill holder, Offset type boring bar holder)

(inch)

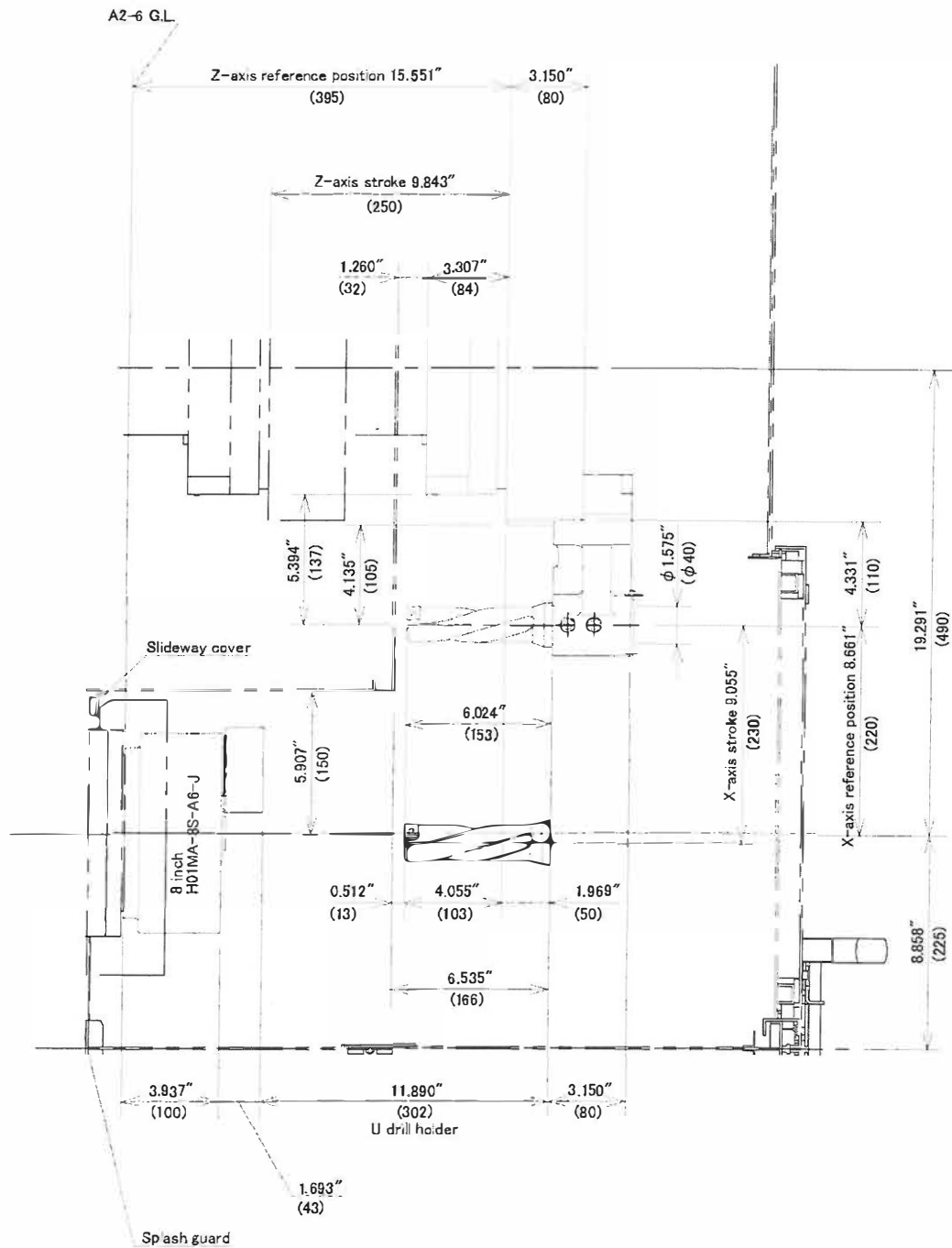


Fig. 3-1(h) Turret travel (U drill holder)

(inch)

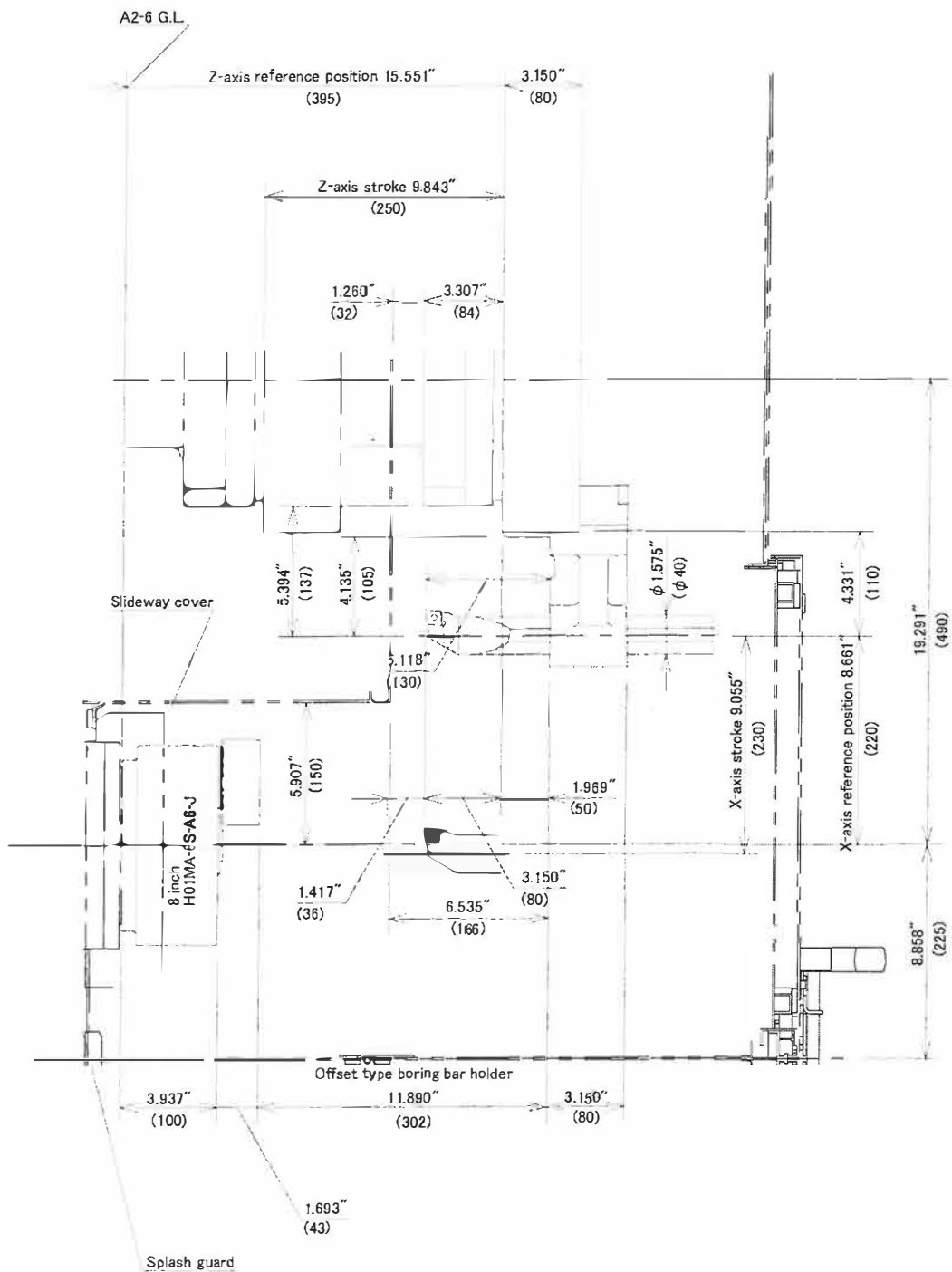


Fig. 3-1(i) Turret travel (Offset type boring bar holder)

(mm)

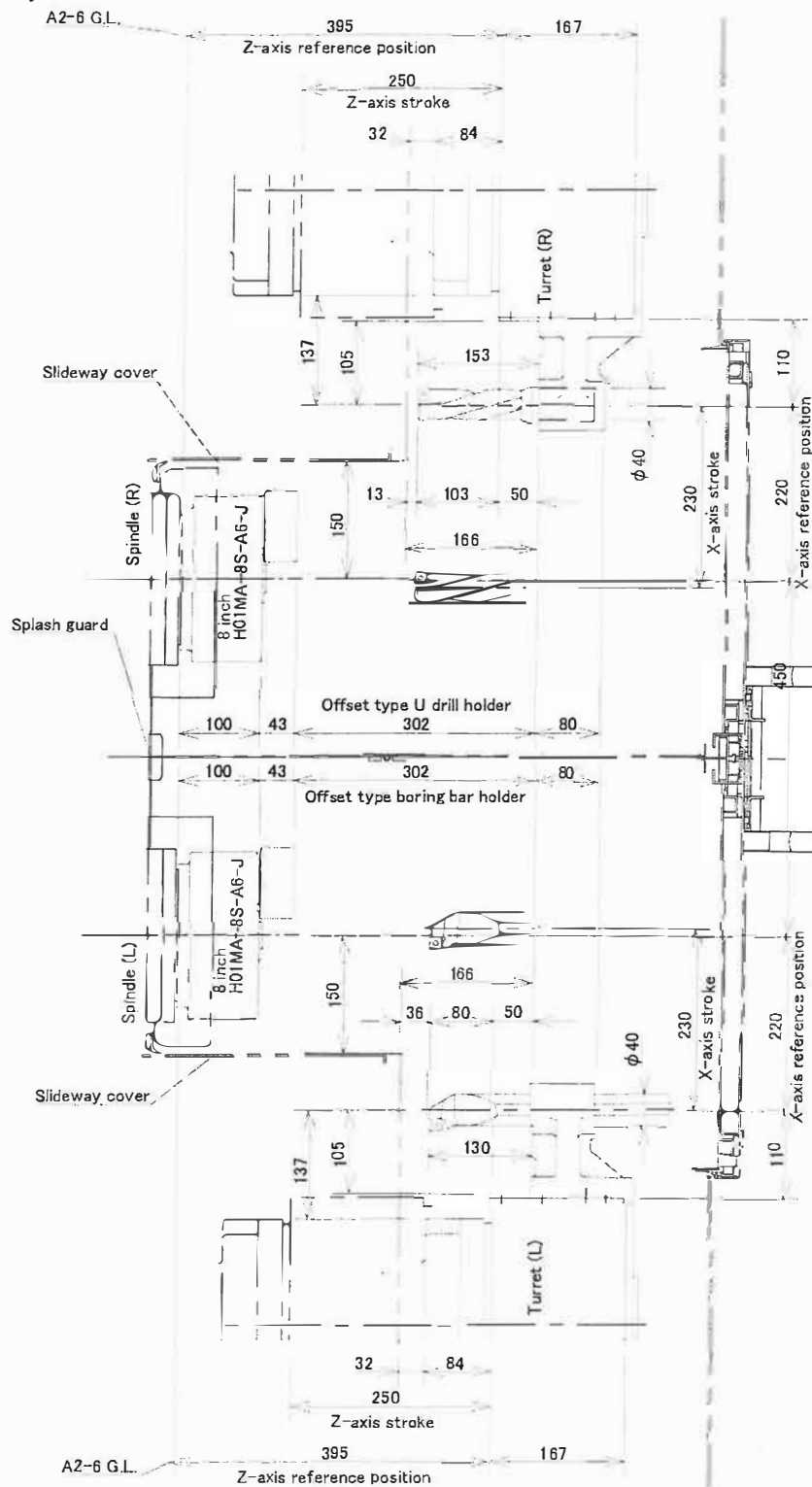


Fig. 3-1(j) Turret travel (Offset type U drill holder, Offset type boring bar holder)

(inch)

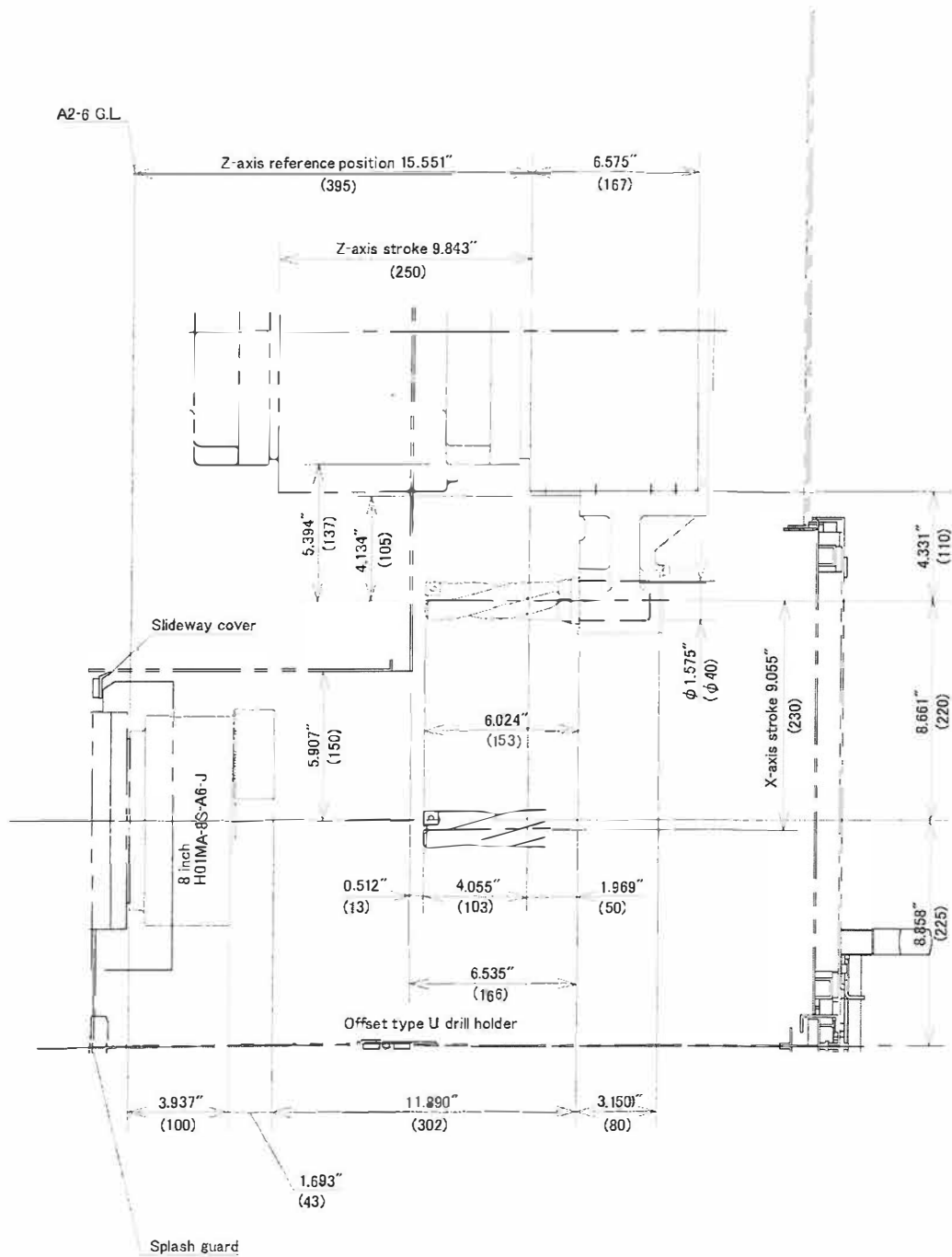


Fig. 3-1(k) Turret travel (Offset type U drill holder)

(inch)

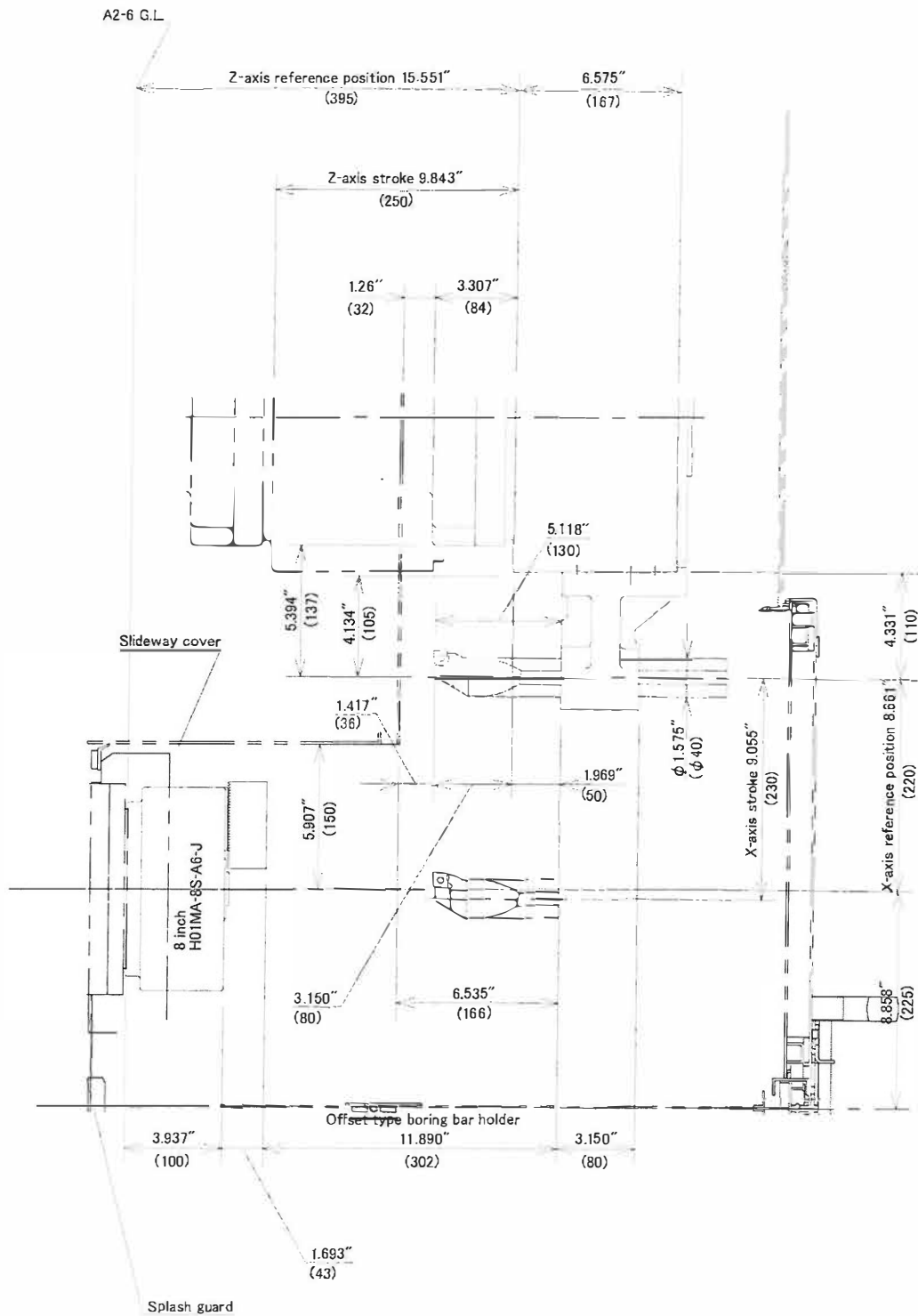


Fig. 3-1(I) Turret travel (Offset type boring bar holder)

(mm)

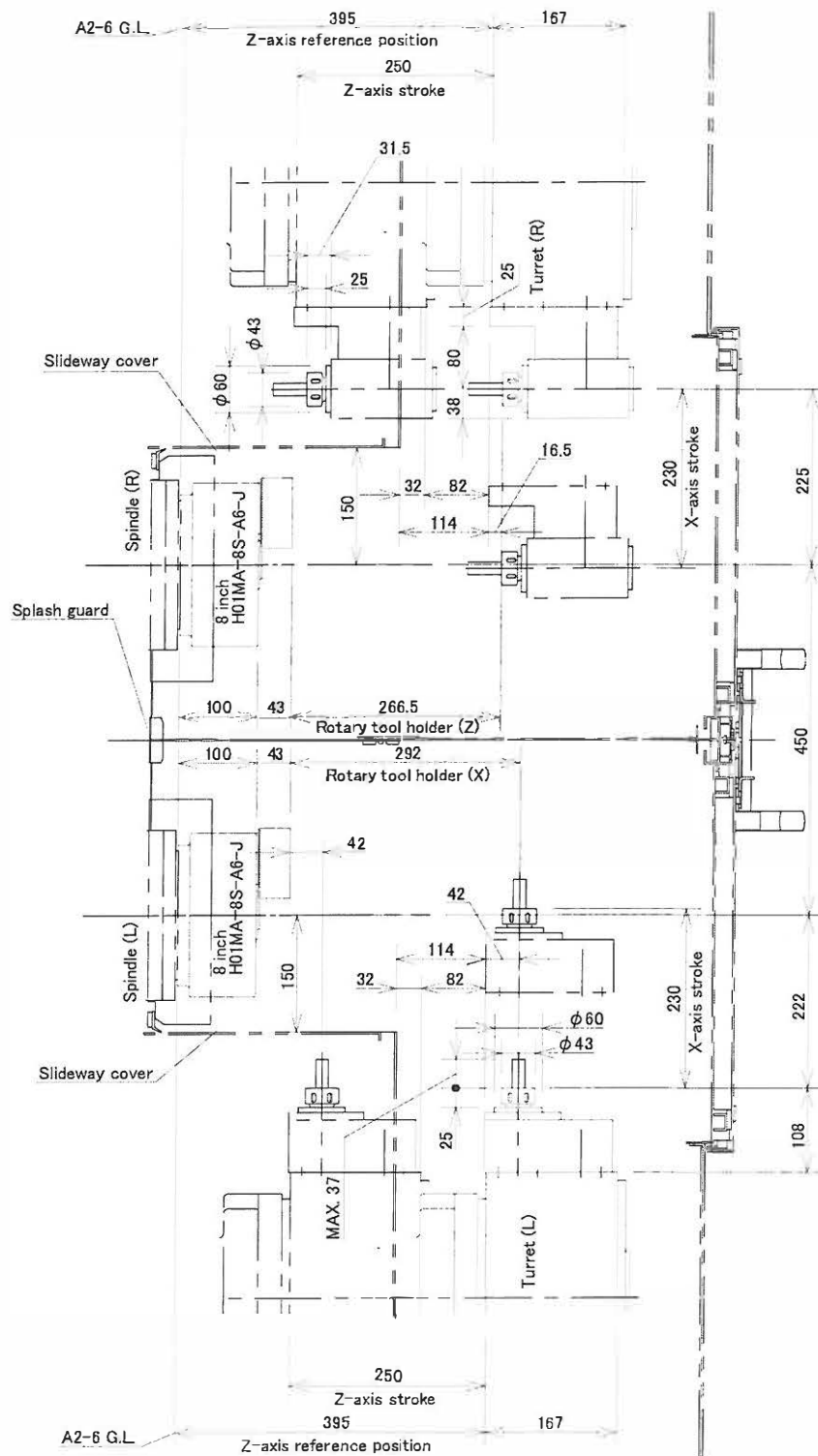


Fig. 3-1(m) Turret travel (Rotary tool holder)

(inch)

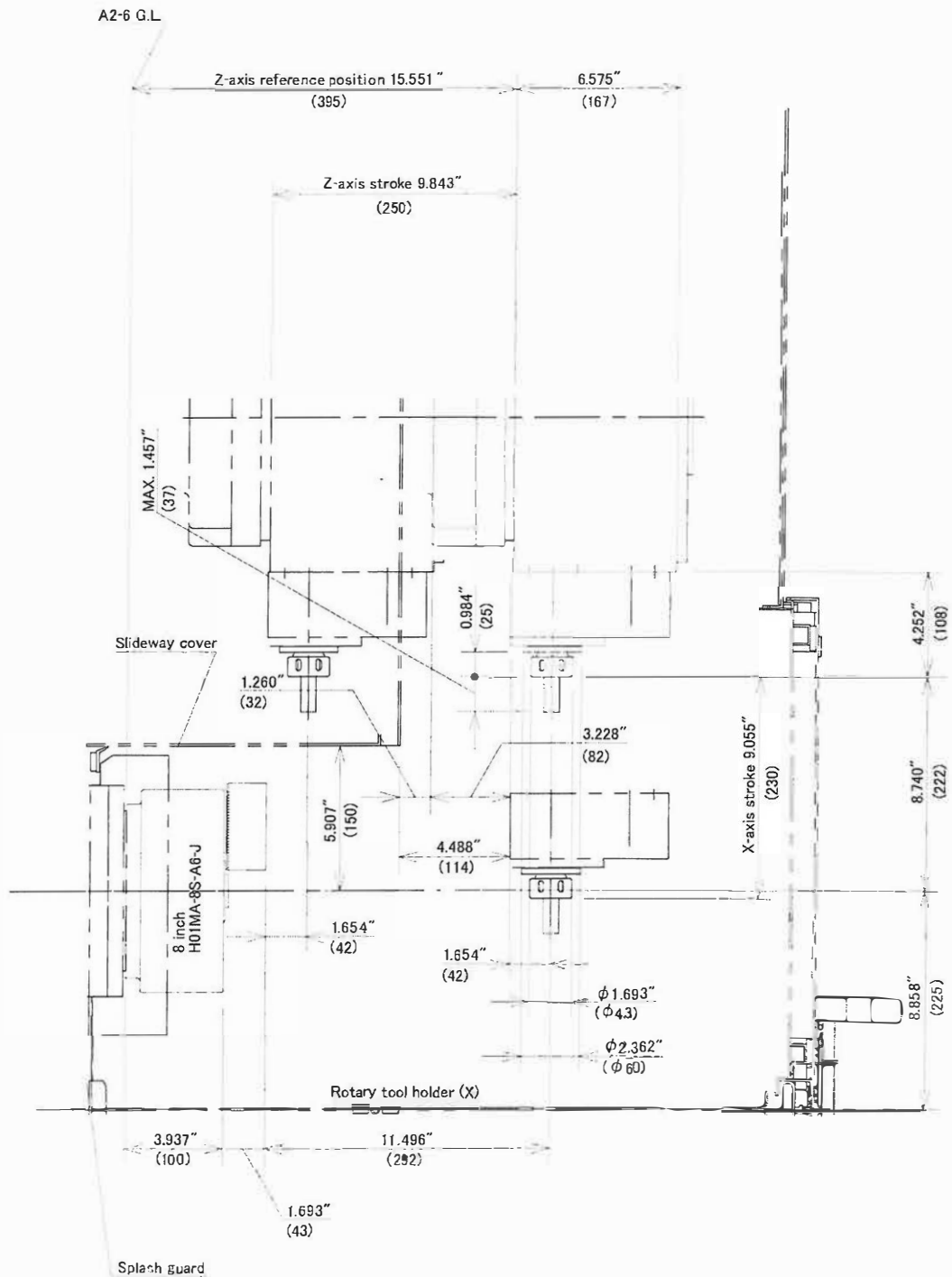


Fig. 3-1(n) Turret travel (Rotary tool holder (X))

(inch)

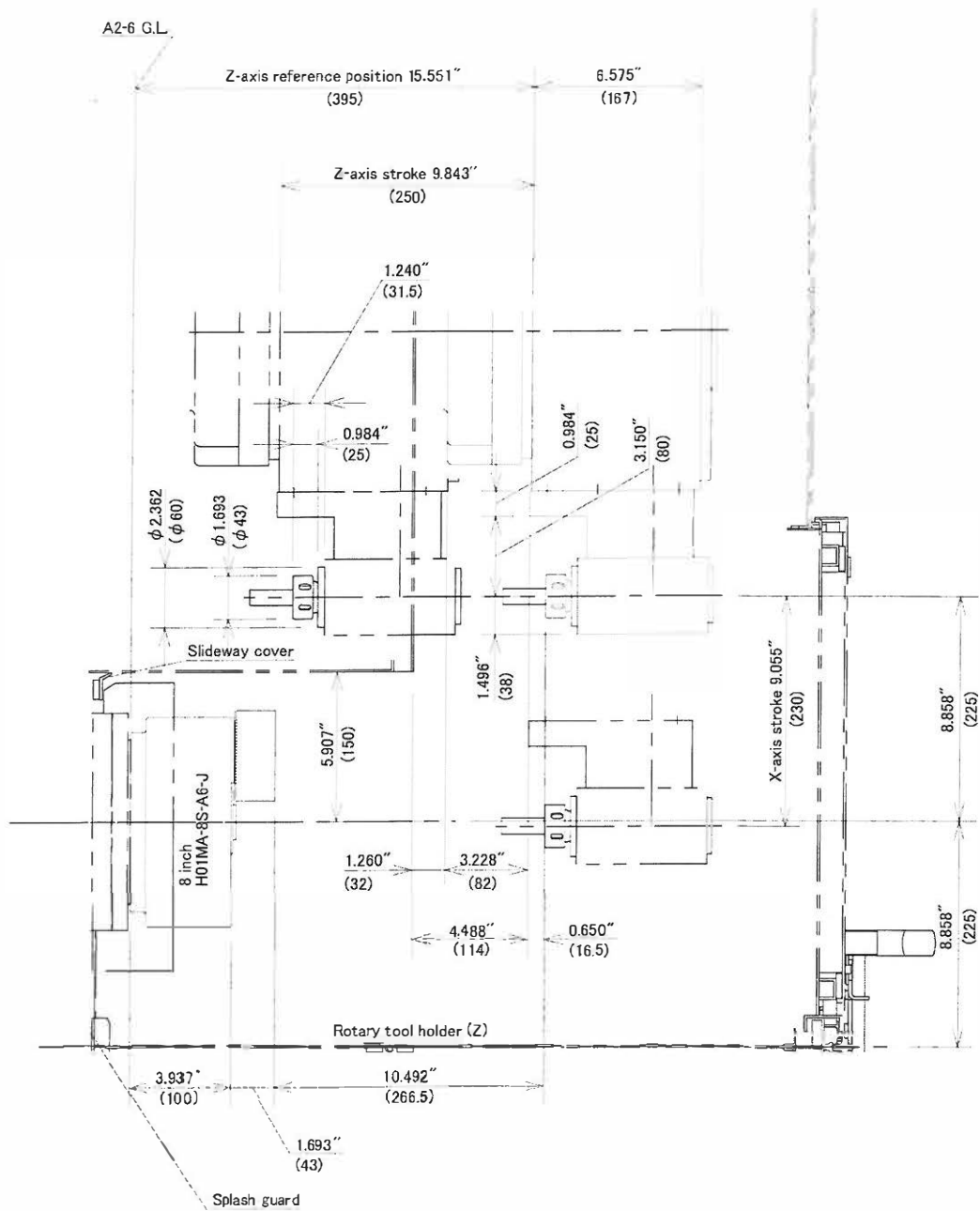


Fig. 3-1(o) Turret travel (Rotary tool holder (Z))