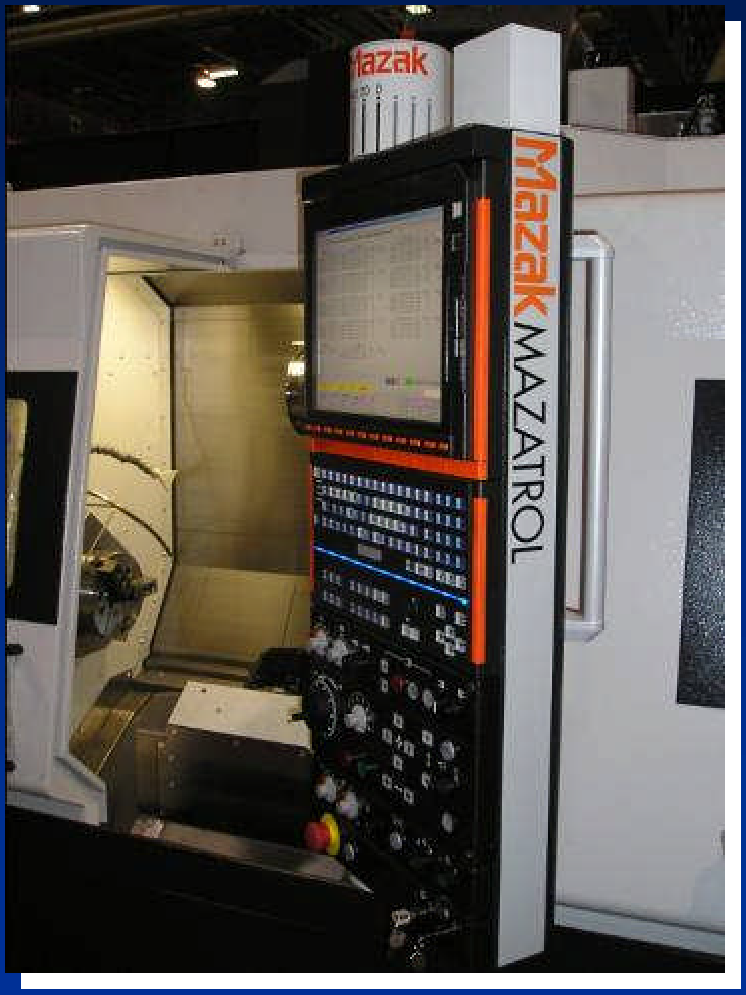
INTEGREX-IV



Compensation Parameters Added for Mark IV

- Upper Turret: B-axis Rotational Center Compensation (BA61 & BA62)

  Displacement of B-axis rotational center on upper turret

- W-axis Center Height Compensation

  RS11 (Amount of runout of X-axis)
  RS12 (Amount of runout of Yt-axis)
  RS13 (Amount of runout of X2-axis)

- Automatic Tool Setting Value Calculation Compensation (BA109)

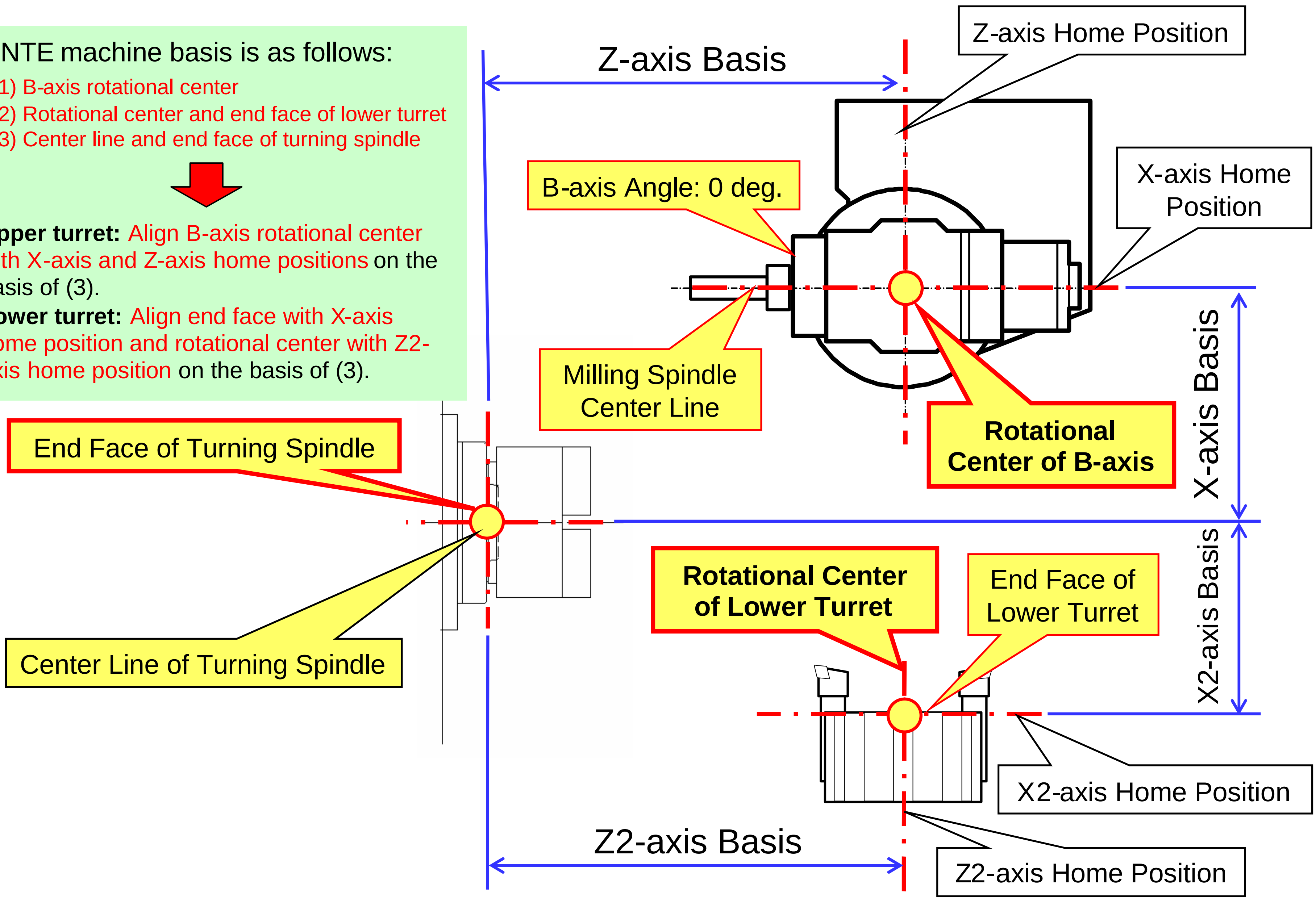
  Inclination of lower turret rotation

Machine Basis

INTE machine basis is as follows:

(1) B-axis rotational center
(2) Rotational center and end face of lower turret
(3) Center line and end face of turning spindle

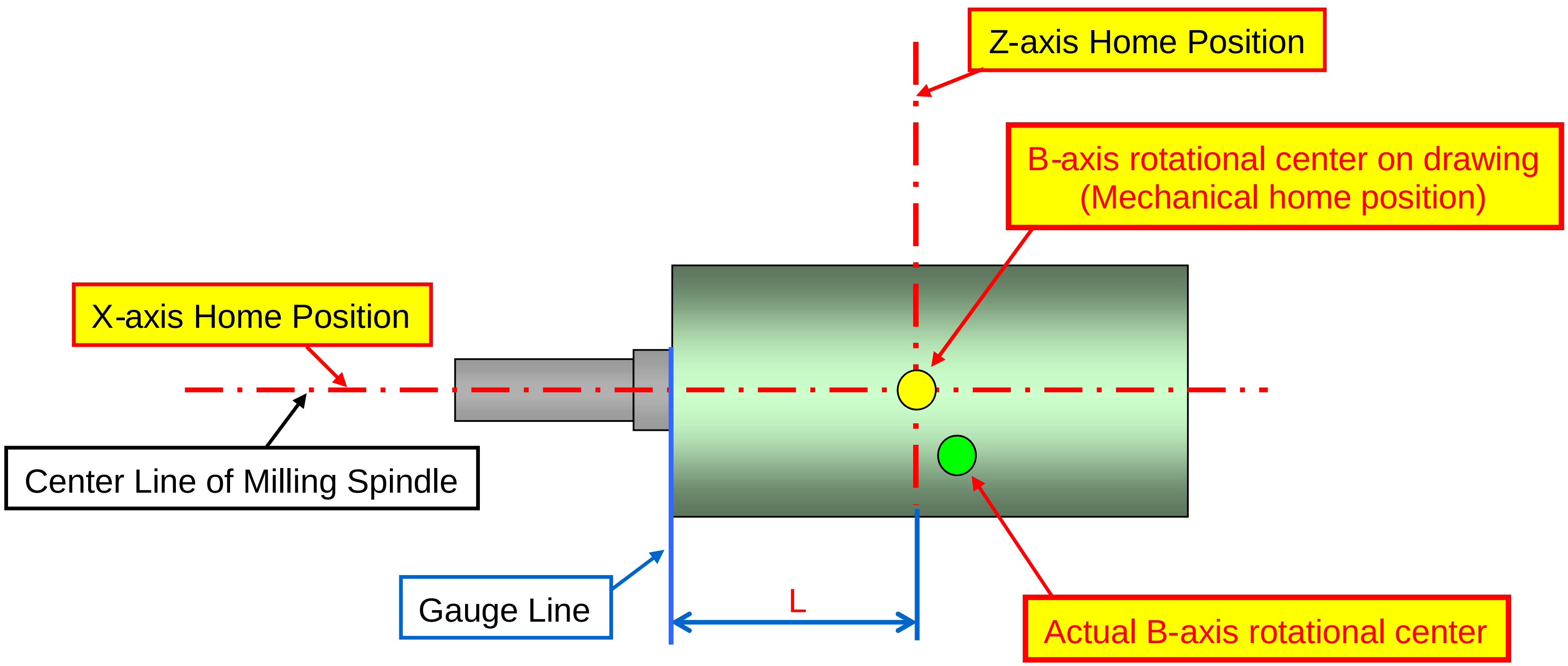
Upper turret: Align B-axis rotational center with X-axis and Z-axis home positions on the basis of (3).
Lower turret: Align end face with X-axis home position and rotational center with Z2-axis home position on the basis of (3).



Upper Turret: B-axis Rotational Center

- The B-axis rotational center is designed to be L (149mm [5.8661in] for 372 and 240mm [9.4488in] for 373 & 374) from the gauge line on the mill spindle center line.

The displacement of the actual B-axis rotational center necessarily occurs due to the accuracy of assembly and production.



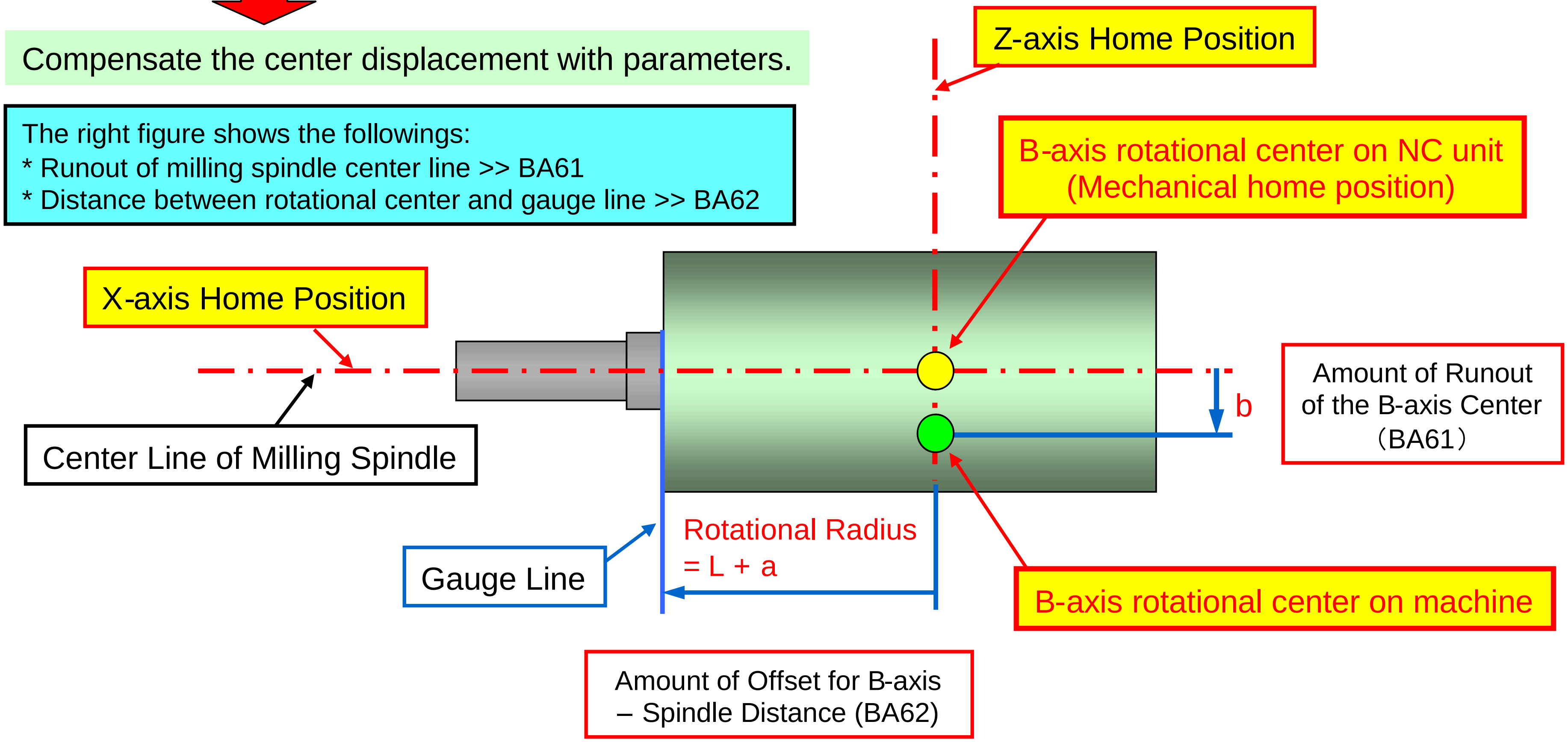
INTEGREX Upper Turret: B-axis Rotational Center

■ The B-axis rotational center is designed to be L (149mm [5.8661in] for 372 and 240mm [9.4488in] for 373 & 374) from the gauge line on the mill spindle center line.

The displacement of the actual B-axis rotational center necessarily occurs due to the accuracy of assembly and production.

Compensate the center displacement with parameters.

The right figure shows the followings:
* Runout of milling spindle center line >> BA61
* Distance between rotational center and gauge line >> BA62

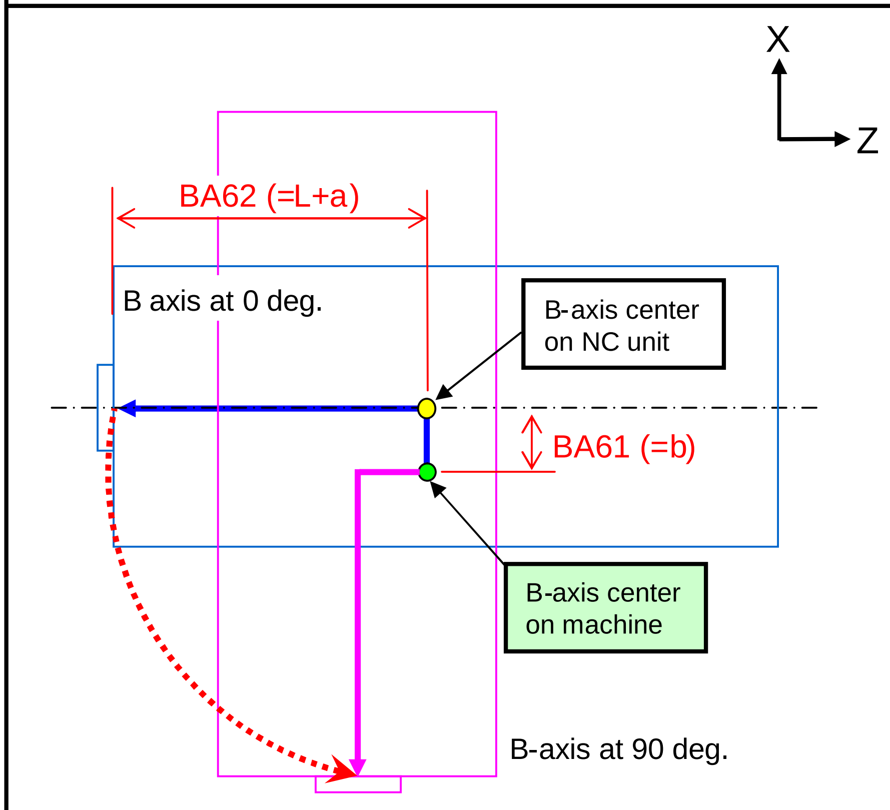
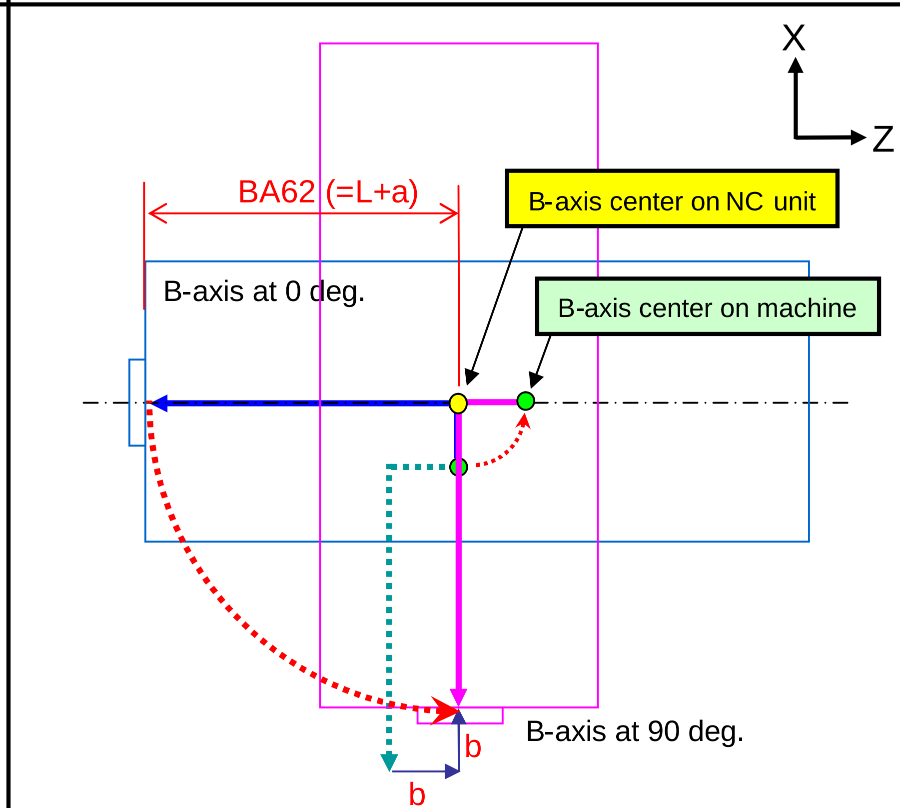


INTEGREX

Upper Turret: B-axis Rotational Center Compensation

B61 [Amount of runout of the B-axis center]

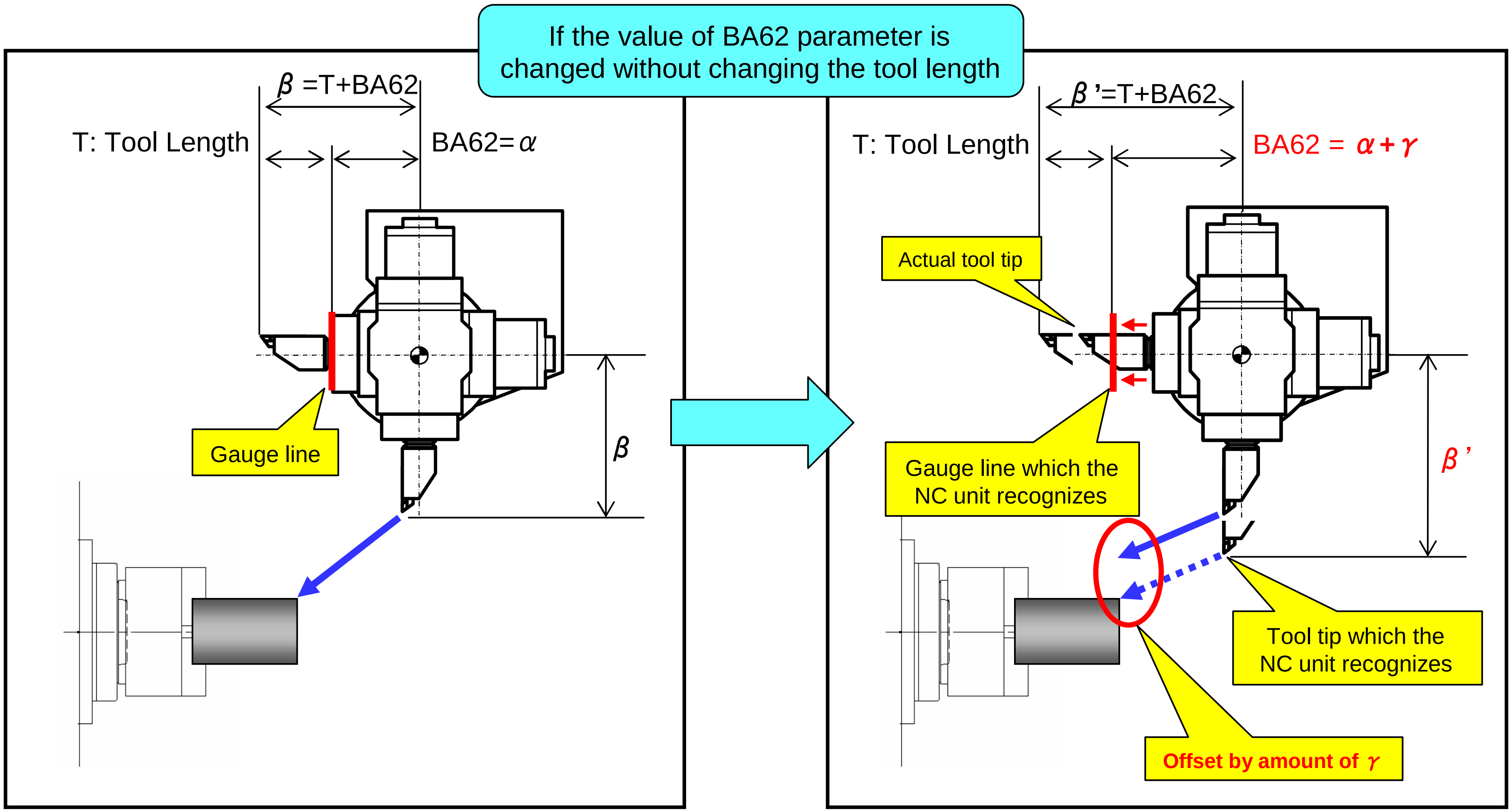
- When the compensation is not applied, the relation between the B-axis center on the NC unit and the gauge line will vary depending on the B-axis angle because the machine rotates on the basis of the actual B-axis center.
- When the compensation is applied, the machine will rotate on the basis of the B-axis center on the NC unit; and the actual B-axis center on the machine will be moved depending on the B-axis angle. If the position of the actual B-axis center is off by the amount of b [BA61] when B-axis is set at 0 deg., it will be compensated by the amount of b in the X and Z directions when B-axis is set at 90 deg.

When B-axis rotation center runout is not compensated:	When B-axis rotation center runont is compensated:
	

Upper Turret: B-axis Rotational Center Compensation

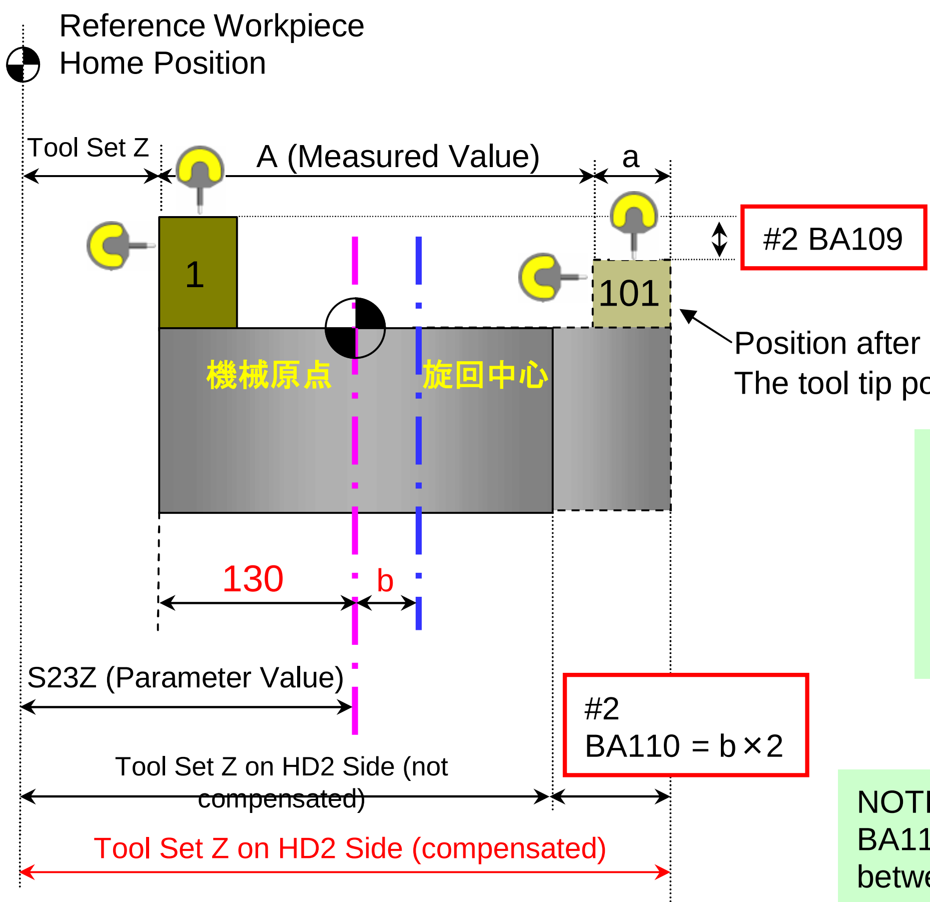
B62 [Amount of offset for the B-axis – spindle distance (from rotational center to gauge line)]

- Even when the value of the BA62 parameter is changed, the X-axis and Y-axis will not be moved depending on the B-axis rotational angle as done for BA61.
- When the value of the BA62 parameter is changed, the position of the gauge line which the NC unit recognizes will vary. >> When the tool length is measured again, the measurement result will reflect the variation.



Lower Turret: Automatic Tool Setting Value Calculation Compensation

- Unlike in the case of the upper turret, the machine position will not be compensated.
- When the automatic calculation function is used, the tool setting value will reflect the result.



Position after rotation.
The tool tip position is automatically calculated.

BA109 = (Measured value)
--- Convert to 0.1 μm
BA110 = -(2x<u>S23Z</u>-2x(<u>Tool Set Z</u>)+A+a)
Convert to 0.1 μm
Negative value

- ✧ If the position of Tool No. 101 is lower than that of Tool No.1, enter the radius value with minus sign (-) for BA109.
- ✧ If the rotational center is closer to the +Z direction than the machine home position, the BA110 value will be negative.

NOTE:
BA110: Parameter used to compensate the distance between the machine home position and the rotational center
To align the machine home position with the rotational center, make sure to enter "0" for BA110.

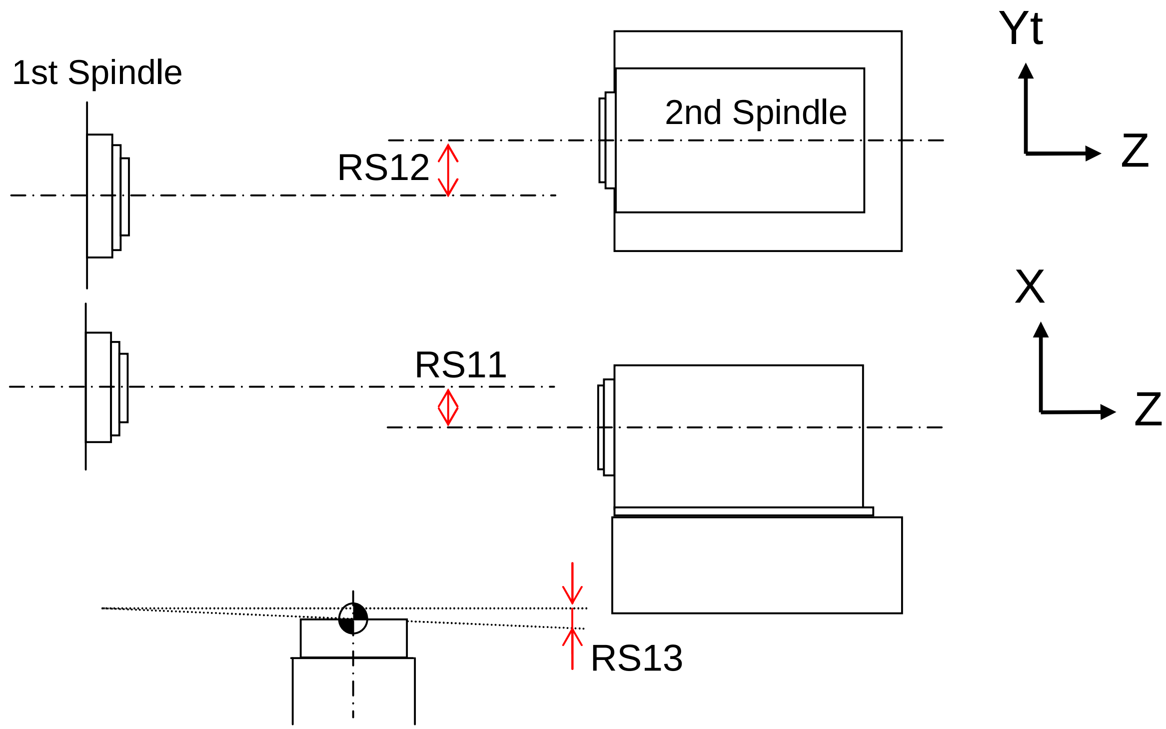
INTEGREX

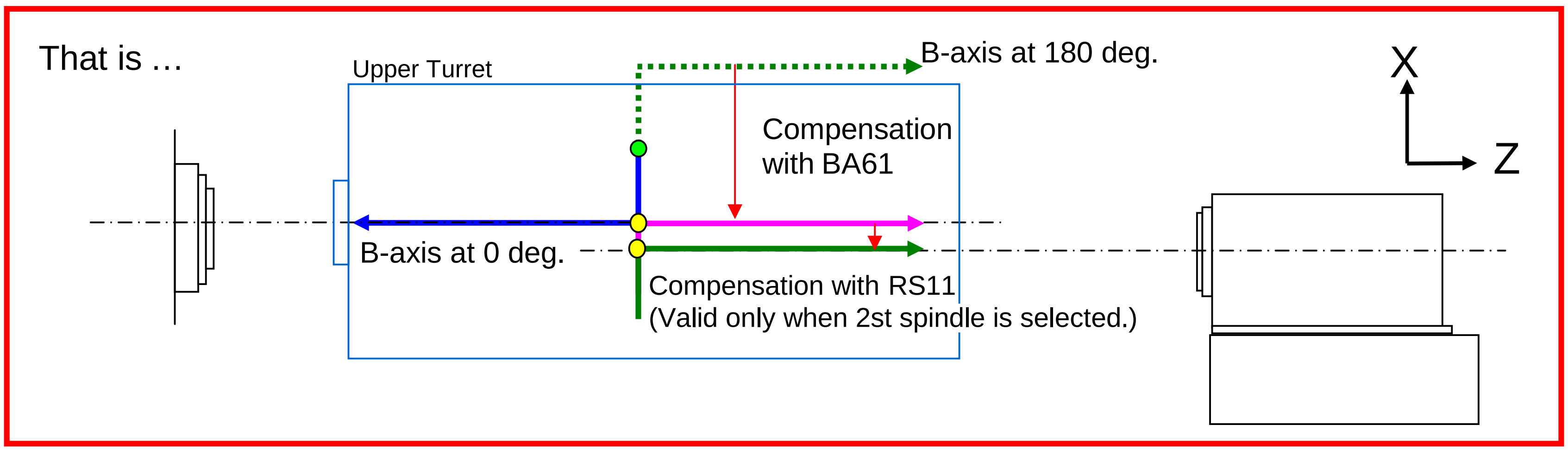
W-axis Center Height Compensation

RS11 (Amount of runout of X-axis)
RS12 (Amount of runout of Yt-axis)
RS13 (Amount of runout of X2-axis)

Valid when 2nd spindle is selected
The machine positions are compensated as in the case of BA61

* All the values are entered with the plus (+) sign in the right figure.





Machine Adjustment

(1) Perform the home positioning of X-axis (X2-axis).

✧ NOTE

* Perform the home positioning of the milling coupling under an unclamped condition.

(2) Perform the home positioning of Z-axis (Z2-axis).

✧ NOTE

* Perform the home positioning of the milling coupling under a unclamped condition.

(3) Upper Turret: Seek for the values of the parameters for the B-axis rotational center compensation (BA61 & BA62).

✧ NOTE

* Perform the home positioning of the milling coupling under an unclamped condition.

(4) Lower Turret: Seek for the value of the parameter for the automatic tool setting value compensation (BA109).

(5) Seek for the values of the parameters for the W-axis center height compensation (RS11, RS12 and RS13).

(6) Seek for the values of the parameters for the tool eye positioning (BA95 to BA99).

✧ NOTE

* As for BA95 and BA96, read the width with the milling coupling clamped.
(Make sure to fix the indexing angle at 0 deg.)

* When seeking for the values of BA97 and BA99, perform the home positioning of the milling coupling under a unclamped condition and read the middle value of the runout of the test bar.

INTEGREX

Machine Adjustment (3): B-axis Rotational Radius Measurement Method

1-1

Mount a test bar on the upper turret and fix the millimess on an appropriate position. Then move the upper turret to the machine position where the millimess indicates zero (0) with the B-axis set at 0 deg.

1-2

Read the X-coordinate of the machine position and add the diameter value of the test bar to the absolute value of the coordinate. (= $2x_1$)

2-1

Replace the test bar with a jig. Rotate the B-axis by 90 deg. and move it to the position where the millimess indicates zero (0) with the millimess and the Y-axis fixed.

2-2

Read the X-coordinate of the machine position and add twice the value of the jig thickness to the absolute value of the coordinate. (= $2x_2$)

3-1

As for the Z-axis, perform the same things done in step **1-1** with the B-axis set at 90 deg.

3-2

Read the Z-coordinate of the machine position and add the radius value of the test bar to the absolute value of the coordinate. (= Z_1)

4-1

perform the same things done in step **2-1** with the B-axis set at 0 deg.

4-2

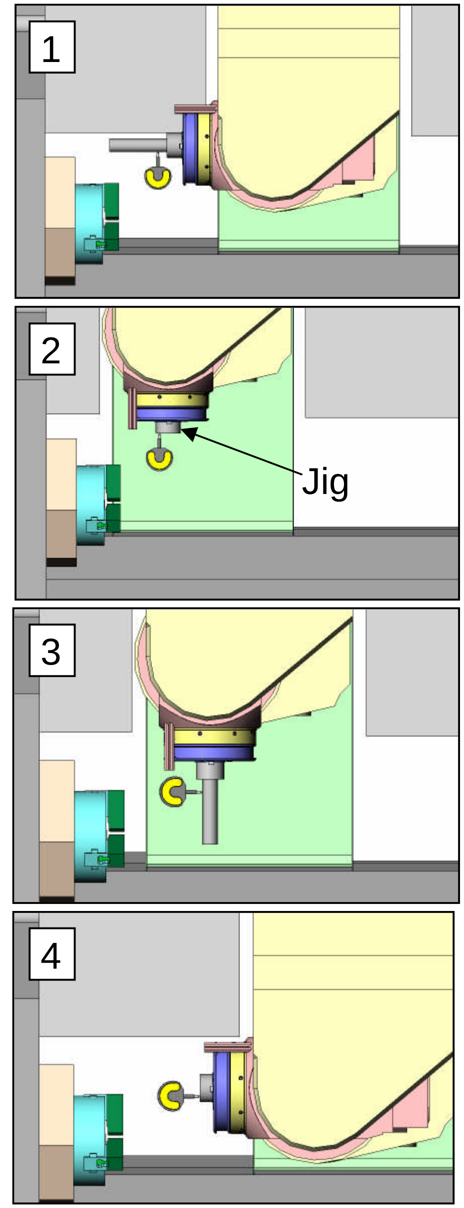
Read the Z-coordinate of the machine position and add the value of the jig thickness to the absolute value of the coordinate. (= Z_2)

✧ Perform the home positioning of all milling couplings under an unclamped condition. When adjusting the millimess so that it indicates zero (0) with the test bar, make sure that the test bar indicates the middle value of the runout .

$X = X_1 - X_2$: Rotational radius in the X direction
$Z = Z_1 - Z_2$: Rotational radius in the Z direction

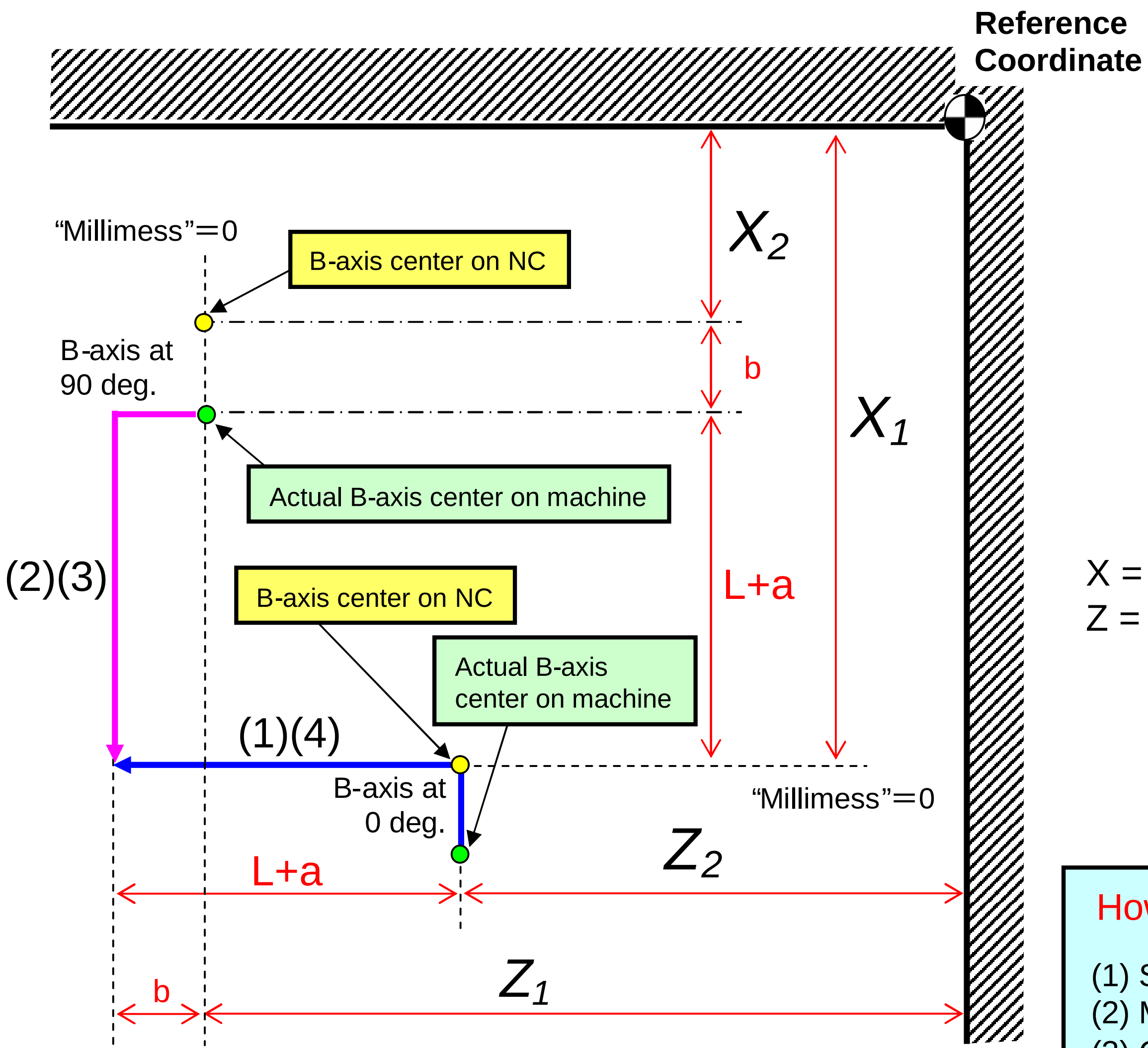
BA61=(X-Z)/2X1000
BA62=(X+Z)/2X10000

NOTE) If the value of BA61 becomes positive (+), that means that the position of the actual B-axis center is lower than that on the NC unit.



INTEGREX

Machine Adjustment (3): B-axis Rotational Radius Measurement Method



$$\begin{cases} X_1 = X_2 + L + a + b \\ Z_1 = Z_2 + L + a - b \end{cases}$$

$$\begin{cases} b = \dfrac{(X_1 - X_2) - (Z_1 - Z_2)}{2} \\ L + a = \dfrac{(X_1 - X_2) + (Z_1 - Z_2)}{2} \end{cases}$$

$X = X_1 - X_2$: Rotational radius in the X direction
$Z = Z_1 - Z_2$: Rotational radius in the Z direction

BA61=(X-Z)/2X1000
BA62=(X+Z)/2X10000

How to check

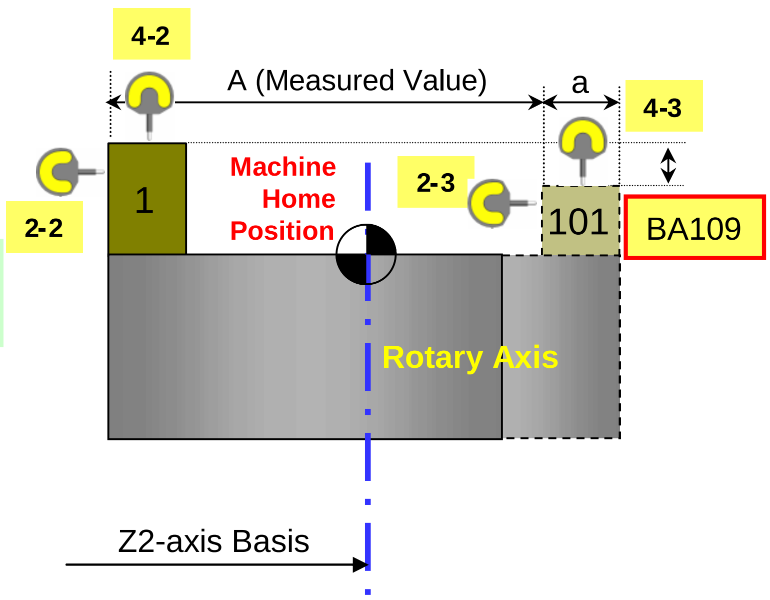
(1) Set BA61 and BA 62 after zero return.
(2) Measure the values and calculate X and Z again.
(3) Check whether the values of both X and Z are same as that of BA62.

INTEGREX

Machine Adjustment (2)(4): Lower Turret Measurement Method

(2) How to measure the rotational radius ← Required for Z2-axis home positioning

2-1. Mount a jig with the thickness of “a” on the lower turret.
2-2. Select Tool No. 1 and apply the millimess mounted on the upper turret to the left side surface of the jig. Then read the Z-coordinate of the upper turret at the position where the millimess indicates zero (0).
2-3. Select Tool No. 101 and read the Z-coordinate as done in step 2-2. (Make sure that the Y-axis is fixed.)
2-4. The sum of the value “a” and the difference A between two coordinates read in the above steps is the rotational diameter. Therefore, calculate the rotational radius from the value.



(4) How to measure the offset amount of the automatic tool setting value calculation (BA109)

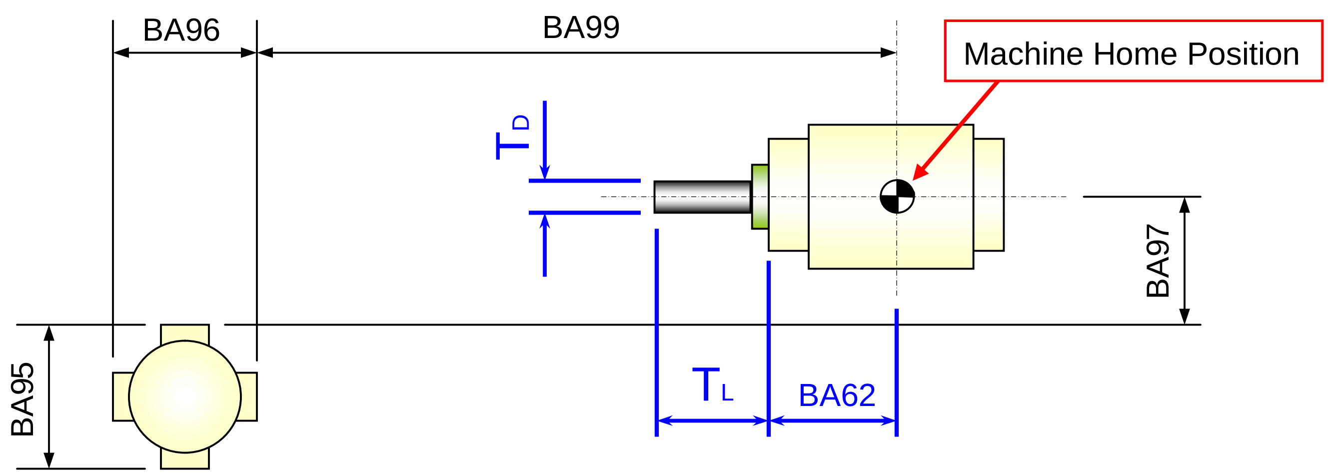
4-1. Mount a jig on the lower turret.
4-2. Select Tool No. 1 and apply the millimess mounted on the upper turret to the upper surface of the jig. Then read the X-coordinate of the upper turret at the position where the millimess indicates zero (0).
4-3. Select Tool No. 101 and read the X-coordinate as done in step 4-2. (Make sure that the Y-axis is fixed.)
4-4. Divide the difference between the two values read in the above steps by 2 (to seek for the radius value).
4-5. If the position of Tool No.101 is lower, convert the value to 0.1 μ m with the minus sign (-).

NOTE) BA110: Parameter to compensate the misalignment between the machine home position and the rotational center.
To align the machine home position with the rotational center, make sure to enter “0” for BA110.

INTEGREX

Machine (6): Tool Eye Positioning

- Perform the tool eye positioning after completing to set the values of the parameters for the B-axis rotational center (BA61 & BA62) and perform the X-axis & Z-axis home positioning.
- As for BA95 and BA96, read the width with the milling coupling clamped. (Make sure to fix the indexing angle at 0 deg.)
- When seeking for the values of BA97 and BA99, perform the home positioning of the milling coupling under a unclamped condition and read the middle value of the runout of the test bar.



INTEGREX

Machine (6): Tool Eye Positioning

■ How to measure the values of BA95 and BA96 (#1)

(1) Enter zero (0) for BA95, BA96, BA97 and BA99.

(2) Mount a test bar with the width of T_n. (Make sure that the milling coupling is clamped and the the orientation is fixed at 0 deg.)

(3) Set the B-axis to 0 deg. and measure the tool length B[*1] from the upper side of the tool eye at an optional Z-coordinate. (=T_{D1})

(4) Measure the tool length B[*1] from the lower side of the tool eye at the same Z-coordinate. (=T_{D2})

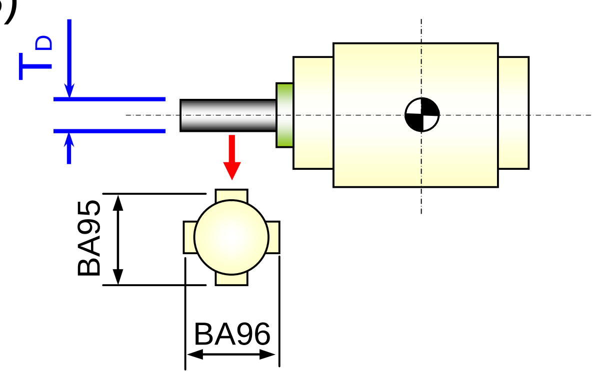
(5) Subtract T_D from the difference between T_{D1} and T_{D2} (absolute value). (=BA95[*2])

(6) Measure the tool length from the both sides of the tool eye with the B-axis at 90 deg. as done in steps (3) and (4). (Adjust the X-coordinate.)

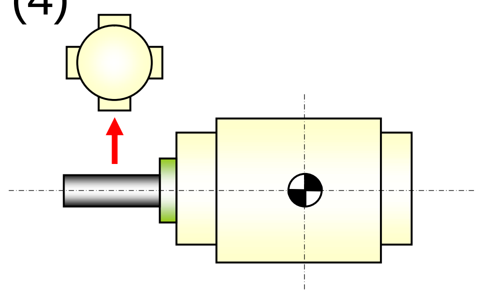
(7) Perform the calculation as done in step (5). (=BA96[*2])

*1 --- Register the tool data with R = 0 for the tool tip.
*2 --- Convert to 0.1 μm.

(3)



(4)



EX)	T_D=34.96
(3)	T_{D1}=378.5863
(4)	T_{D2}=447.4895
(5)	(447.4895-378.5863)-34.96=33.9432
	>> BA95=**339432**
(6)	T_{D1}=-479.7816
	T_{D2}=-548.6806
(7)	(548.6806-479.7816)-34.96=33.939
	⇒BA96=**339390**

NOTE) Do not perform operations such as “to move the jig mounted on the turret in the cutting feed mode to apply it to the sensor and read the coordinates when the machine stops due to an alarm.”
Otherwise, the accurate measurements cannot be obtained due to the 椿走 of the turret.

Machine (6): Tool Eye Positioning

■ How to measure the values of BA97 and BA99 (#1)

(1) Enter the values for BA95 and BA96.

(2) Mount a test bar with the width of T_D. (Make sure that the milling coupling is clamped.)

(3) Set the B-axis and the indexing angle to 0 deg. and then measure the tool length B*1 from the upper side of the tool eye at an optional Z-coordinate. (=T_{D1})

(4) Set the indexing angle to 180 deg. and then measure the tool length B*1 from the lower side of the tool eye at the same Z-coordinate. (=T_{D2})

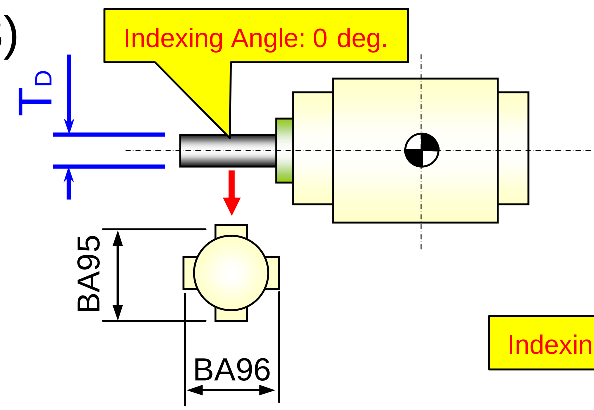
(5) Add T_{D1} and T_{D2} and then divide it by 2. (=BA97*2)

(6) Measure the tool length from the both sides of the tool eye with the B-axis at 90 deg. as done in steps (3) and (4). (Pay attention to the indexing angle.)

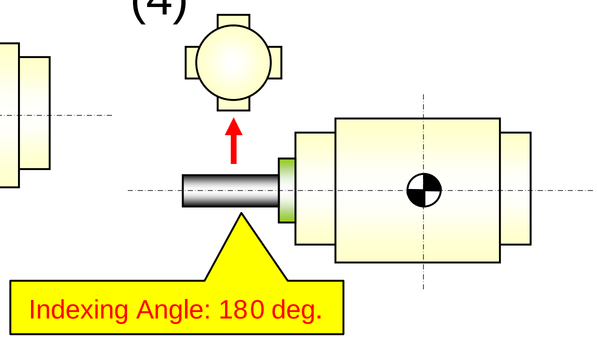
(7) Perform the calculation as done in step (5) and assign the minus sign (-) to the value. (=BA99*2)

*1 --- Register the tool data with R = 0 for the tool tip.
*2 --- Convert to 0.1 μ m.

(3)



(4)



EX)
(3) T_{D1}=-479.9562
(4) T_{D2}=-514.7079
(5) (-479.9562-514.7079)/2=-497.23205
⇒BA97=**-4972321**

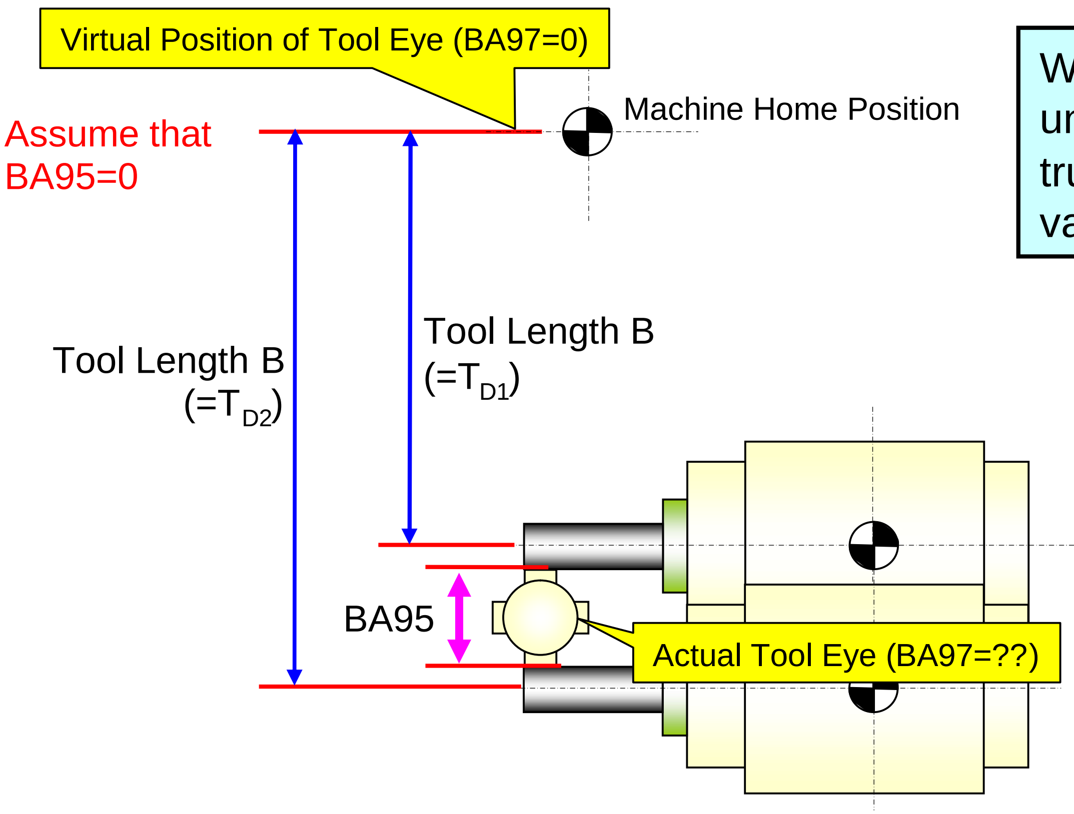
(6) T_{D1}=378.6094
T_{D2}=413.5769
(7) (378.6094+413.5769)/2=396.0931
⇒BA99=**-3960931**

NOTE) Do not perform operations such as “to move the jig mounted on the turret in the cutting feed mode to apply it to the sensor and read the coordinates when the machine stops due to an alarm.”
Otherwise, the accurate measurements cannot be obtained due to the 惰走 of the turret.

INTEGREX

Machine (6): Tool Eye Positioning

■ Principle of BA95 and BA96 Measurement (#1)

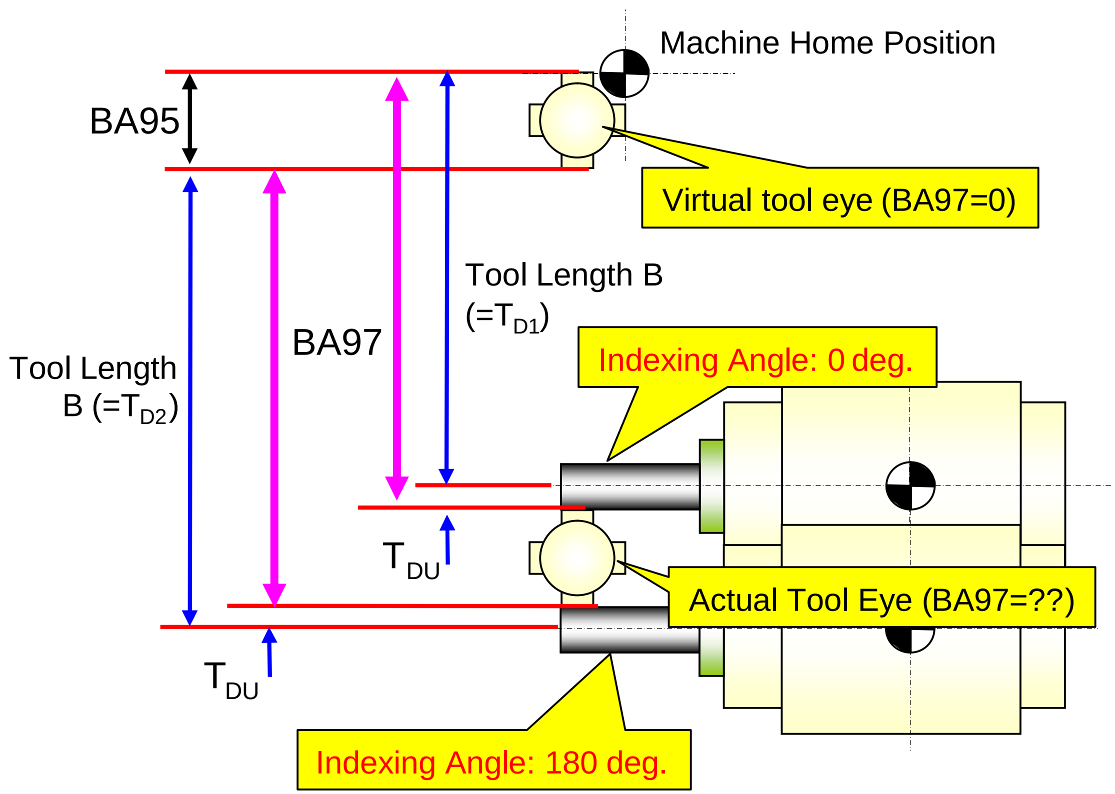


When the tool length B is measured under the condition that BA95 = 0, the true value of BA95 is included in T_{D2} value.

$$BA95=(T_{D2}-T_{D1}-T_{D})\times 10000$$

Machine (6): Tool Eye Positioning

■ Principle of BA97 and BA99 Measurement (#1)

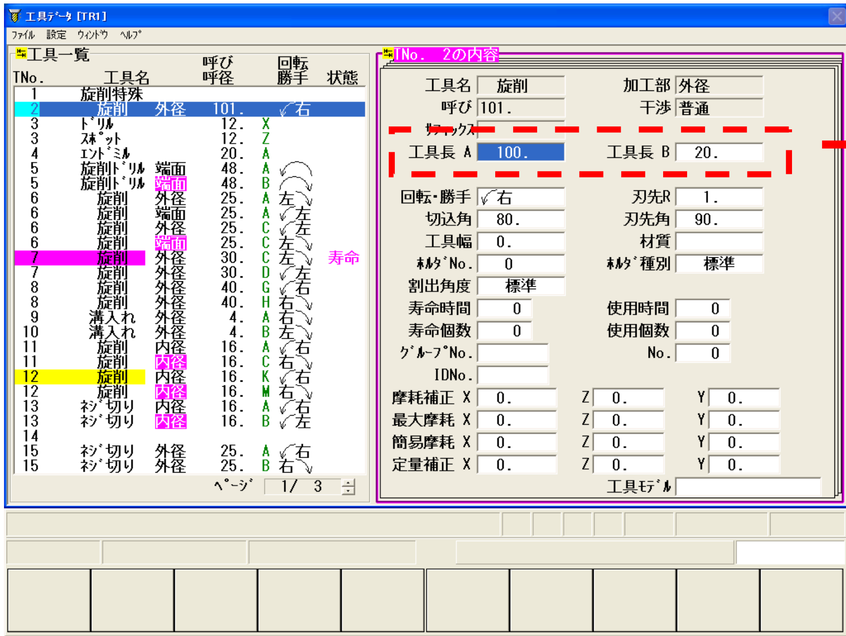


When the tool length B is measured under the condition that BA95 = 0, the true value of BA97 is included in T_{D1} and T_{D2} values.

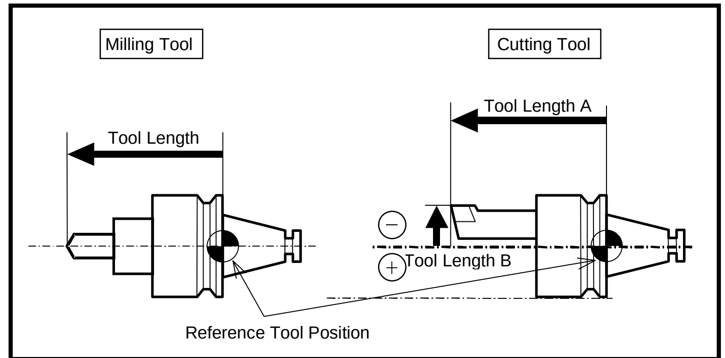
$$T_{D1}+T_{D2}=BA97-T_{DU}+BA97+T_{DU}$$

$$BA97=(T_{D1}+T_{D2})/2 \times 10000$$

Tool Data

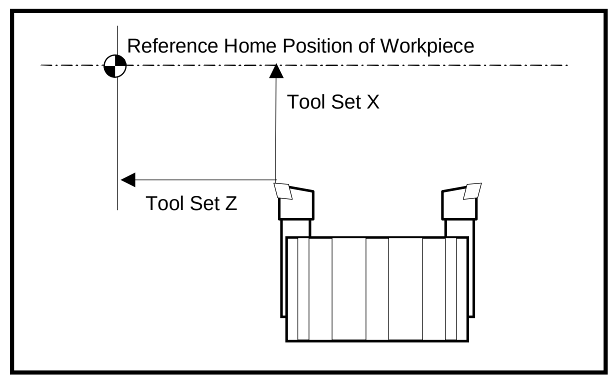


Upper Turret : Tool Length A and B



- Distance from the reference tool position to the tool tip
- The distances to the tool tip in the X and Z directions are automatically calculated from **the tool set measurement value** (allowed display in 1131mode) **and the B-axis angle** under the condition that the tool is set at 0 deg. (It is required to set the tool depending on the used B-axis angle.)

Lower Turret : Tool Set X and Z



- Distance from the reference home position of the workpiece to the tool tip

■ Upper Turret >> **Tool Length Measurement**
Unlike in the case of Mark III, the data on “the direction of the tool (H or V direction)” is not included in the tool data. Also, there are no parameters for “Tool Set X and Z.” Therefore, set the values for “Tool Length A and B.”

■ Lower Turret >> **Tool Set Measurement**
As for the tools of the lower turret, set the values for “Tool Set X and Z” as before. 。

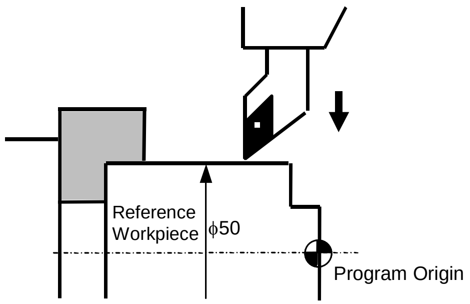
INTEGREX

Tool Registration: Difference between III and IV (Upper Turret)

When utilizing the [TEACH] function (to memorize the tool tip position) for cutting tools:

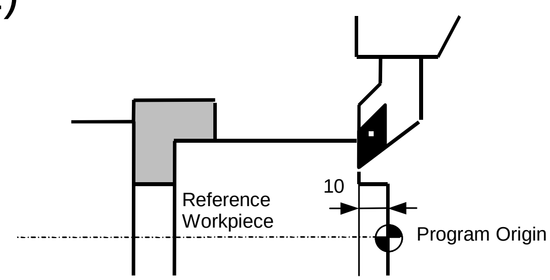
Mark III (Tool Set Measurement)

(1)



Set the X-coordinate value of the tool tip position to the program origin, which is **a diameter value**. >> In case of the above figure, set “50.”

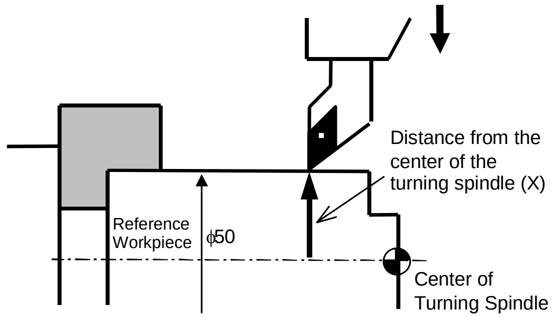
(2)



Set **the Z-coordinate value of the tool tip position to the program origin**. >> In case of the above figure, set “-10.”

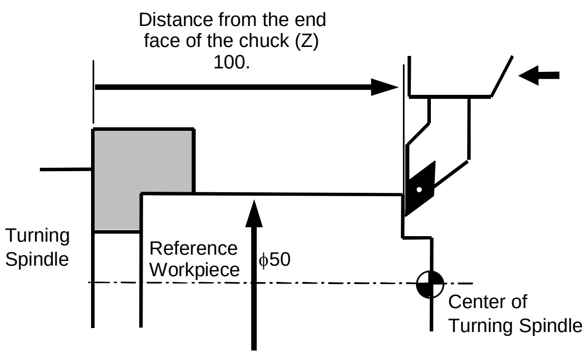
Mark IV (Tool Length Measurement)

(1)



Enter the distance from the rotational center of the turning spindle (X), which is **a radius value**, by using numeric keys. >> In case of the above figure, enter “25.”

(2)



Enter **the distance from the end face of the chuck (Z)** by using numeric keys. >> In case of the above figure, enter “100.”

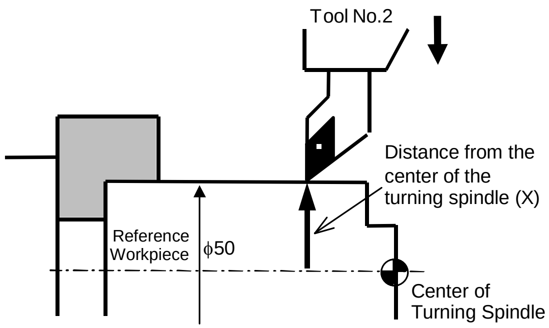
INTEGREX

Tool Registration: Difference between Upper and Lower Turrets (IV)

When utilizing the [TEACH] function (to memorize the tool tip position) for cutting tools:

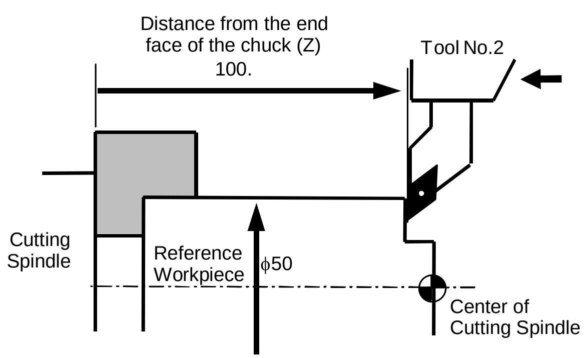
Upper Turret (Tool Length Measurement)

(1)



Enter the distance from the rotational center of the turning spindle (X), which is **a radius value**, by using numeric keys. >> In case of the above figure, enter "25."

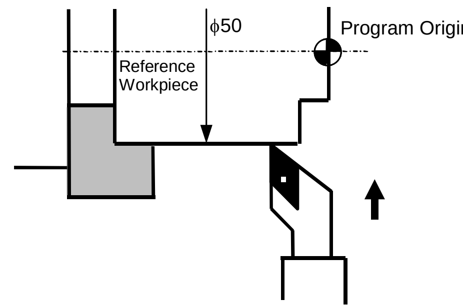
(2)



Enter **the distance from the end face of the chuck (Z)** by using numeric keys. >> In case of the above figure, enter "100."

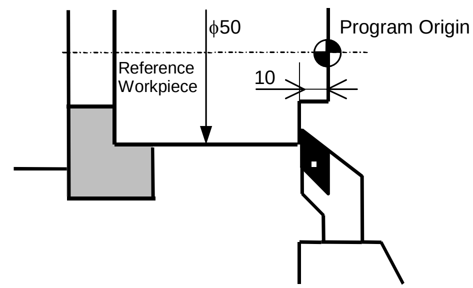
Lower Turret (Tool Set Measurement)

(1)



Enter the distance from the rotational center of the turning spindle (X), which is **a diameter value**, by using numeric keys. >> In case of the above figure, enter "50."

(2)



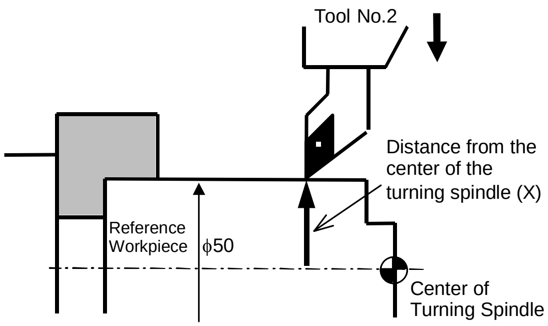
Set **the Z-coordinate value of the tool tip position to the program origin**. >> In case of the above figure, set "-10."

Tool Registration: Tool Offset Amount Setting (IV)

When utilizing the [TEACH] function (to memorize the tool tip position) for cutting tools:

Method Common for Upper and Lower Turret

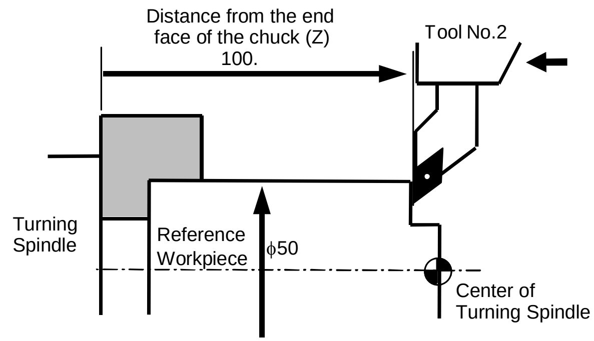
(1)



Enter the distance from the rotational center of the turning spindle (X), which is **a radius value**, by using numeric keys. >> In case of the above figure, enter "25."

>> The NC unit calculates the tool length mounted on the spindle and automatically sets the calculated value for "Shape Compensation X."

(2)



Enter **the distance from the end face of the chuck (Z)** by using numeric keys. >> In case of the above figure, enter "100."

>> The NC unit calculates the tool length mounted on the spindle and automatically sets the calculated value for "Shape Compensation Z."