Easson

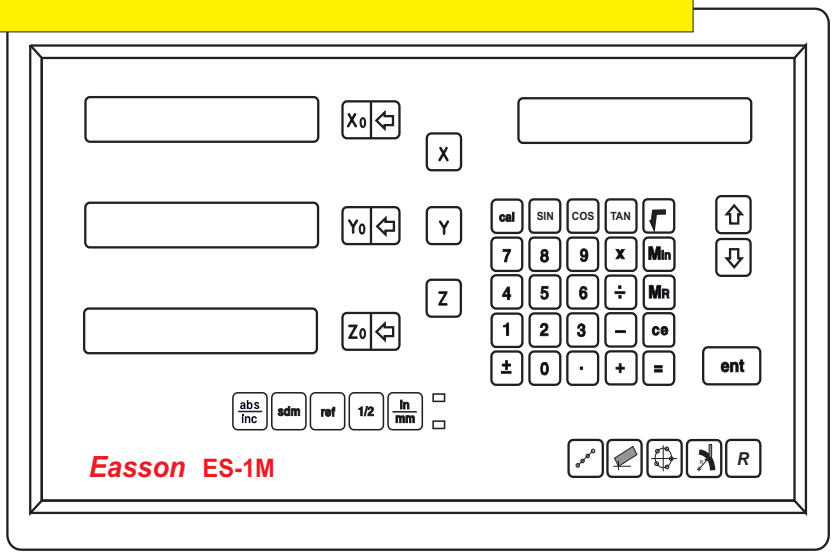
Always Committed to Quality Technology & Innovation

ES-1M DRO Counter

Operation Manual

Easson Technologies Co., Ltd.

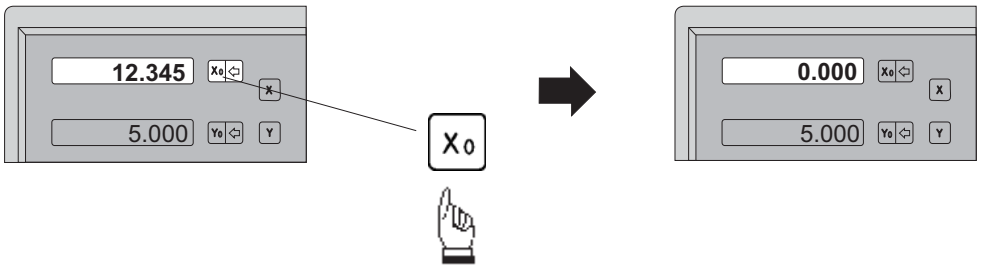
Basic Functions



Set Display to Zero

Purpose : Set the current position for that axis to zero

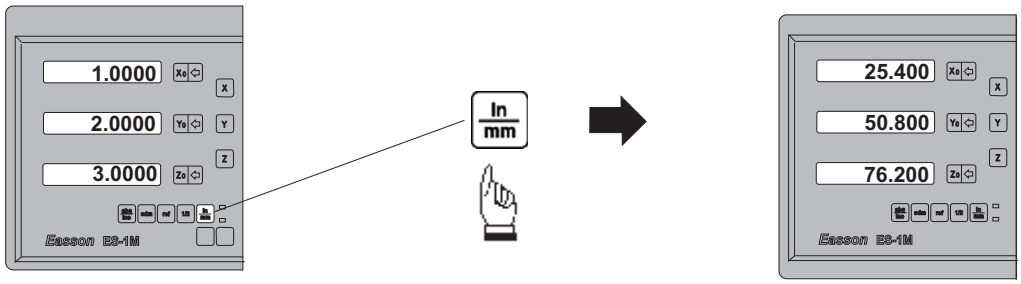
Example : To set the current **X Axis** position to **zero**



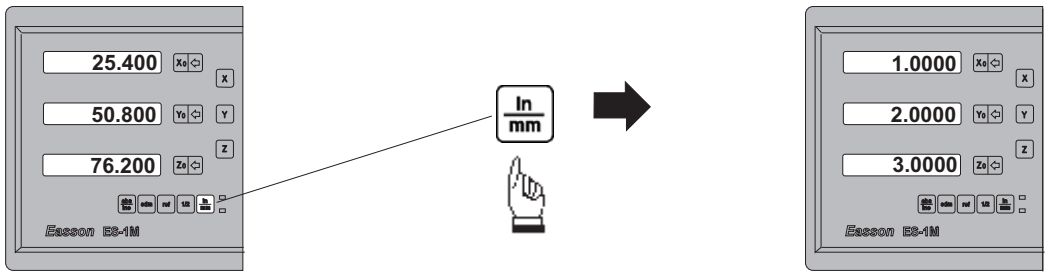
Inch / Metric Display Conversion

Purpose : Switches between inch and metric display

Example 1 : Currently in **inch** display, to switch to **metric** display



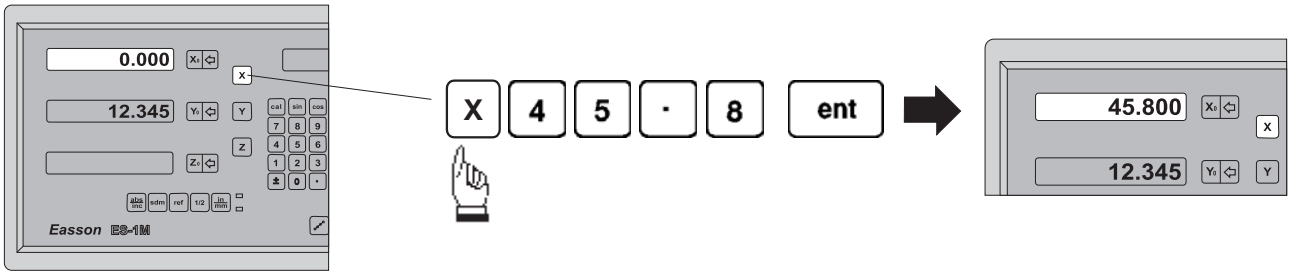
Example 2 : Currently in **metric** display, to switch to **inch** display



Enter Dimensions

Purpose : Set the current position for that axis to an entered Dimension

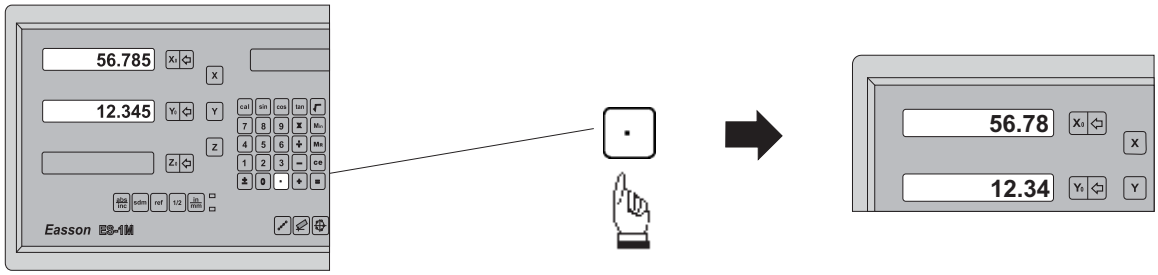
Example : To set the current **X Axis** position to **45.800 mm**



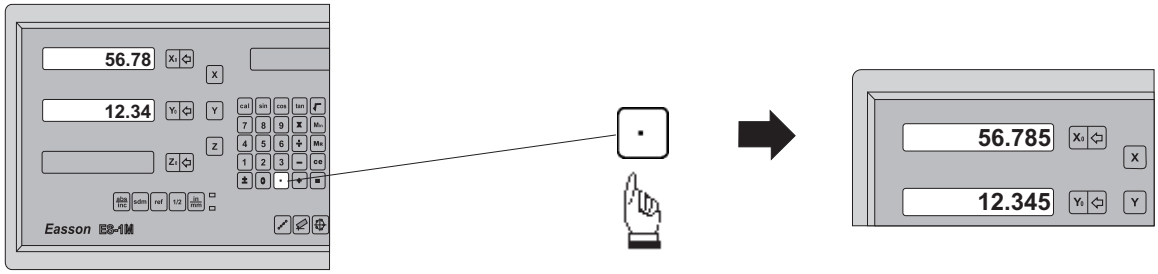
0.005 / 0.01 resolution display switches

Purpose : Switches between 0.005mm/(0.0002") and **0.01mm(0.0005") resolution display**

Example 1 : Currently in **0.005mm** display resolution, to switch to **0.01mm** display resolution



Example 2 : Currently in **0.01mm** display resolution, to switch to **0.005mm** display resolution



ABS / INC Coordinates display switches

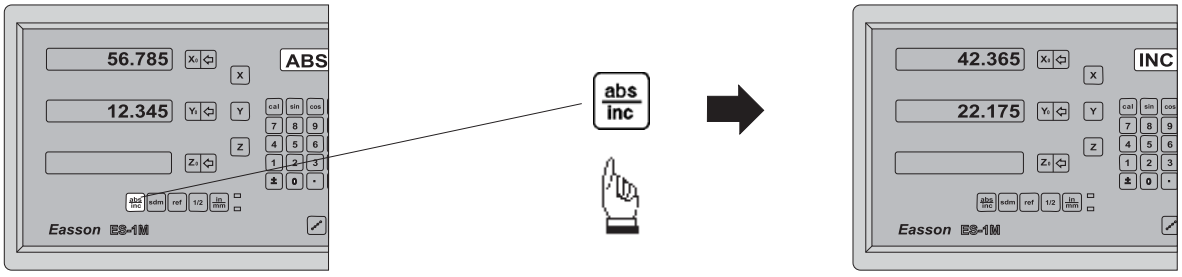
Purpose : **ES-1** provides two sets of basic coordinate display, they are **ABS** (absolute) and **INC** (incremental) displays.

During machining operations, the operator can *store the work piece datum (zero position) in ABS coordinate, then switch to INC coordinate to continue machining operations.*

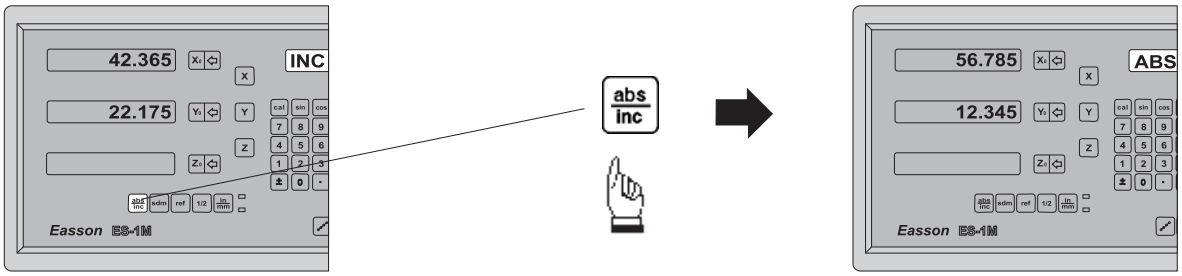
The operator is then free to zero the axes or preset any dimensions into any axis in INC coordinate for relative position machining. The work piece datum (work piece zero position) is still retained in ABS coordinate by the ES-1.

Operator can then toggle between ABS (absolute) and INC (incremental) coordinates without losing the work piece datum (work piece zero position).

Example 1 : Currently in **ABS** display coordinate, to switch to **INC** display coordinate



Example 2 : Currently in **INC** display coordinate, to switch to **ABS** display coordinate

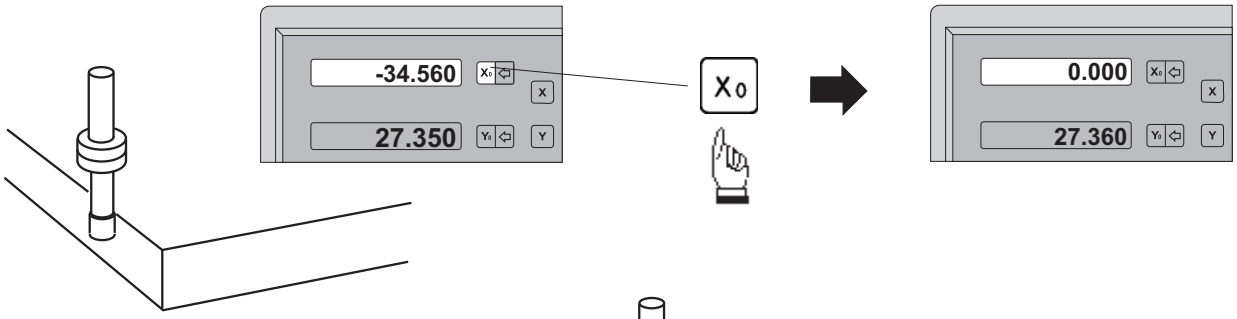


Centre-find

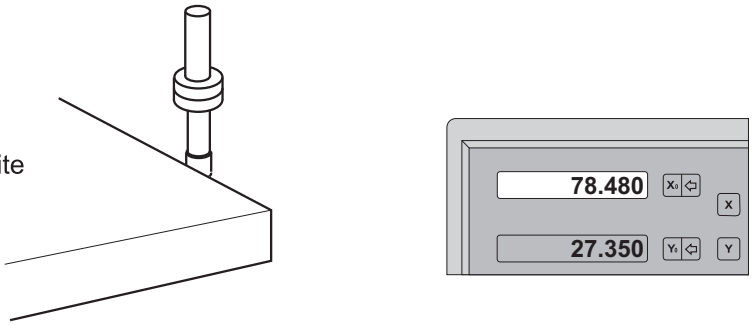
Purpose : ES-1 provides the centre-find function by halving the current display coordinate, so that the zero point of the work piece is located at the centre of the work piece.

Example : To set the X Axis zero point at the centre of the work piece.

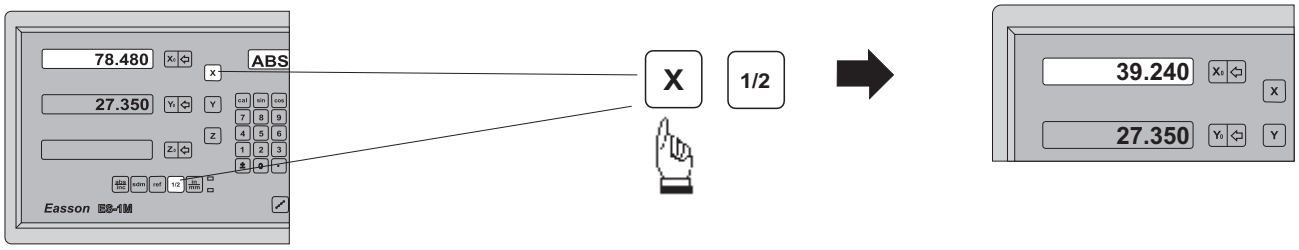
Step 1 : Locate the edge finder at one end of the work piece, then zero the X Axis.



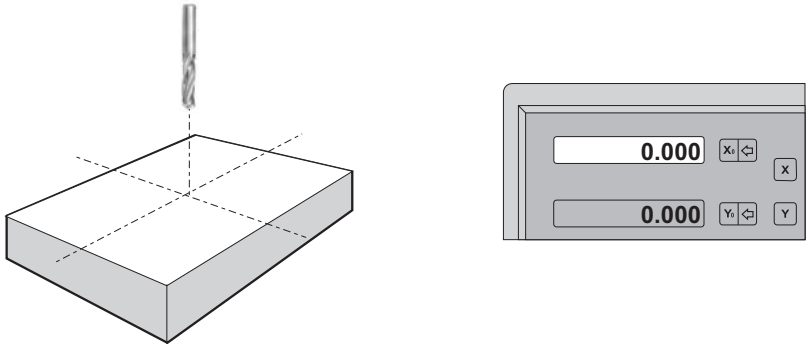
Step 2 : Locate the edge finder at the opposite end of the work piece.



Step 3 : Then half the display coordinate using centre-find function as per follows:



Now the X Axis zero point (0.000) is located at the X centre of the work piece.



SLEEP FUNCTION

Purpose : Although the power consumption of ES-1 is very low, for the purpose of environmental protection (power saving) and to prolong its service life , the ES-1 provides sleep function which permits the operator to put the ES-1 into sleep mode (power saving mode) when they have to leave the machine for a short period of time such as lunch time, receiving a TEL call or etc.

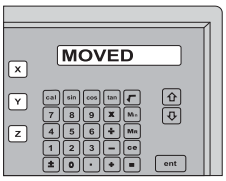
When ES-1 is in sleep mode, it will switch off all LED display (which consumes the most power) but still keep the transducer operational, therefore, the operator will not lose the work datum even if the machine has been moved whilst the ES-1 was in sleep mode.
The Sleep function is offering the following advantages :

- Saves unnecessary power usage, heat generation and prolongs the ES-1 service life.

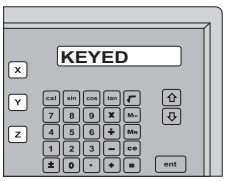
- When ES-1 is in sleep mode, it seems that the ES-1 has been switched off, therefore, it is less attractive for other people to tamper with in the absence of the operator from the machine

Example : To put the ES-1 in sleep mode

In case the machine has been moved whilst the ES-1 was in sleep mode, the message display will show the error message"MOVED" as a warning signal.

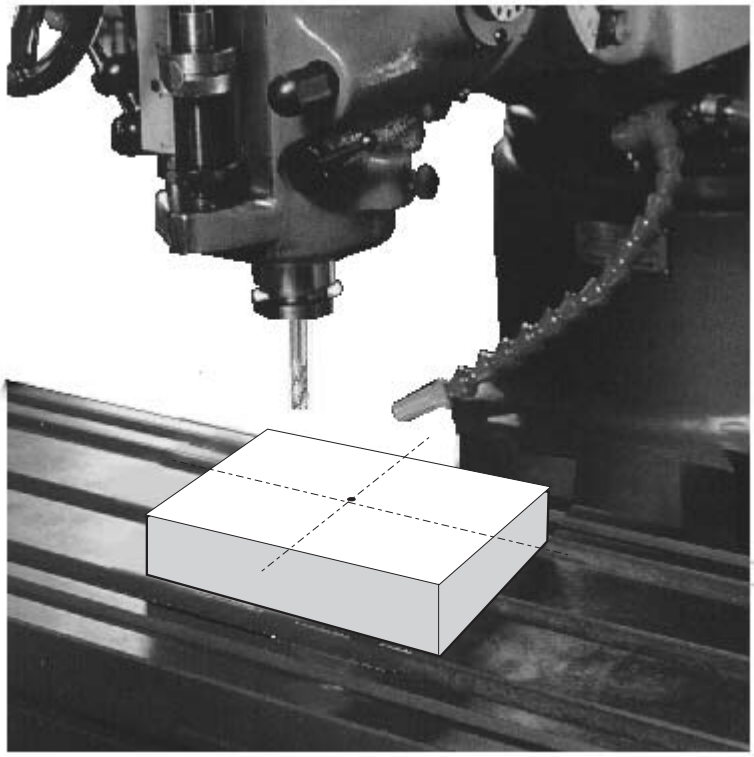


In case the machine has been used with the keyboard whlist the ES-1 was in sleep mode, the message display will show the error message "KEYED" as a warning signal.



To resume the ES-1 from sleep mode.

ref datum memory



ref datum memory function

function : During the daily machining process, it is very common that the machining cannot be completed within one working shift, and hence the DRO has to be switched off, or less commonly, a power failure occurs whilst machining which leads to loss of the work piece datum (work piece zero position). The re-establishment of work piece datum using edge finder or other method inevitably introduces machining inaccuracies, because it is not possible to re-establish the work piece datum exactly at the previous position.

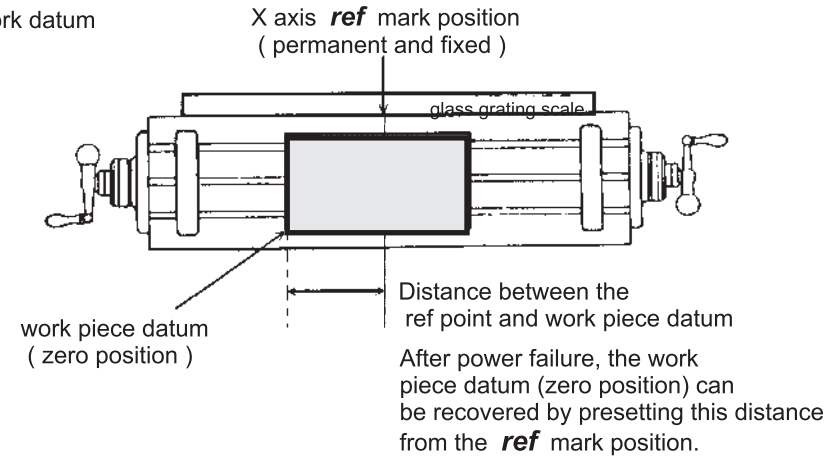
To allow the recovery of work piece datum very accurately, with no need to re-establish the work piece datum using an edge finder or other methods, every transducer has a reference point location to provide a datum point memory function.

The working principal of the ref datum memory function is as follows.

- **There are a permanent and fixed mark (position) on the transducer, normally called *ref* mark or *ref* point..**

  Since this *ref* point position is permanent and fixed, it will never change or disappear when the DRO system is switched off. Therefore, we simply need to store the distance between the *ref* point and the work piece datum (zero position) in DRO's memory. Then, in case of the power failure or the ES-1 being switched off, we can recover the work piece datum (zero position) by presetting the display zero position as the stored distance from the *ref* point.

Example : to store the X axis work datum



Operation : **ES-1** provides one of the most easy-to-use ***ref*** datum memory function.

There is no need to store the relative distance between the ***ref*** mark and your work datum zero into the **ES-1**, *whenever you alter the zero position of **ABS** coordinate, such as by zeroing, centre find, coordinate preset or etc.., **ES-1** will automatically store the relative distance between **ABS** zero and the **ref** mark location into **ES-1**'s memory.*

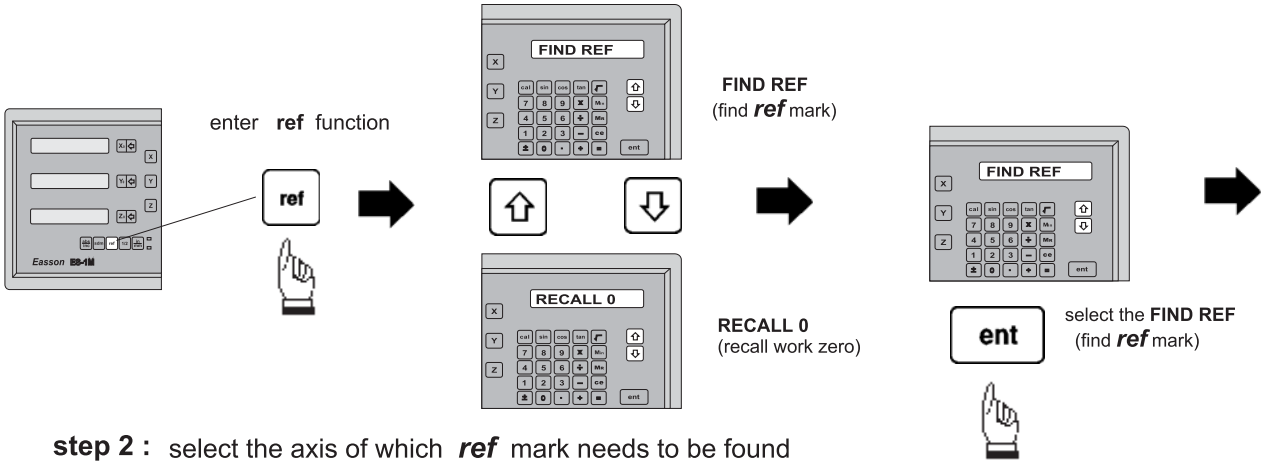
In daily operation, operator simply needs to locate the ***ref*** mark position whenever they switch on the **ES-1** to let it know where the ***ref*** mark position is, then **ES-1** will automatically do the work datum storage on its' own . In the case of a power failure or the **ES-1** being switched off, the operator can recover the work piece datum easily by using the **RECALL 0** procedure.

Find the scale's *ref* mark position (**FIND REF**)

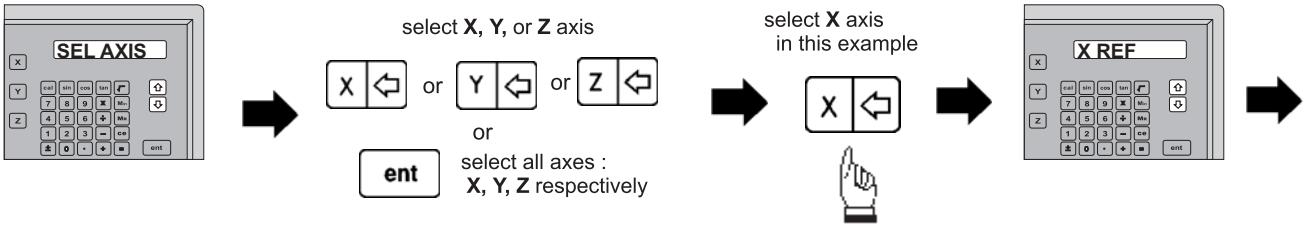
function : In ref datum memory function, the **ES-1** will automatically store the relative distance between the ***ref*** mark position and the work piece datum (zero position) whenever the operator alter the **ABS** zero position, such as zeroing, centre find, co-ordinate preset or etc...

Therefore, the **ES-1** needs to store the ***ref*** mark position prior to any machining operation. So that the loss of the work piece datum (zero position) is avoided during any accidential or unexpected events, such as power failure or etc.. it is recommend that the operator finds the ref mark position using the (**FIND REF**) function whenever he switches on the **ES-1**.

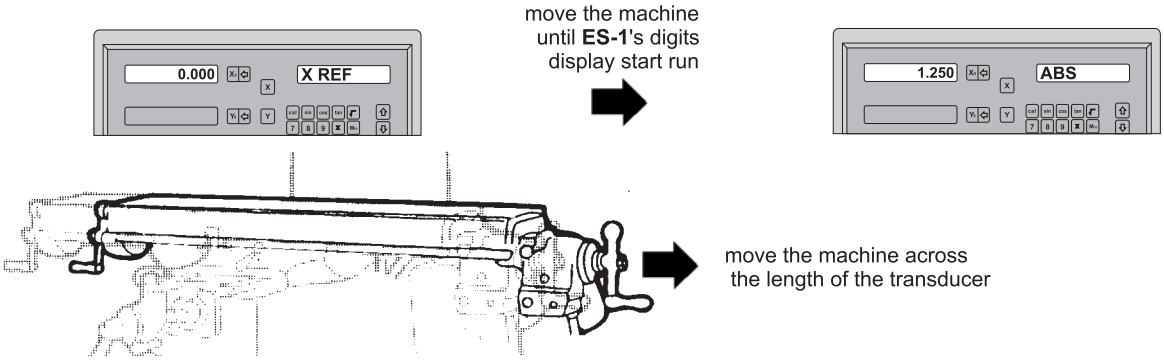
step 1 : To enter the ref function, select the **FIND REF** (find ***ref*** mark)



step 2 : select the axis of which ***ref*** mark needs to be found



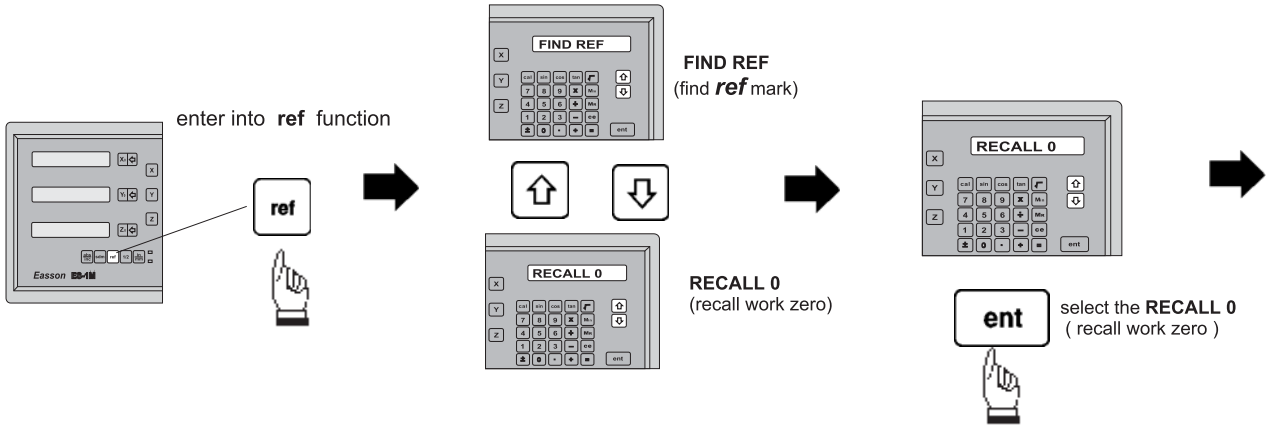
step 3 : move the machine reader head across the length of the transducer until digits display in ES-1 start to count.



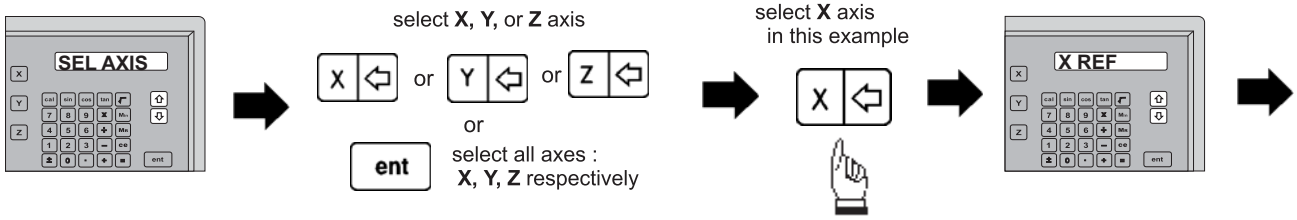
Recall the work datum zero (**RECALL 0**)

function : If the ref point is lost for any reason, the work piece datum can be recovered by **RECALL 0** function as follows:.

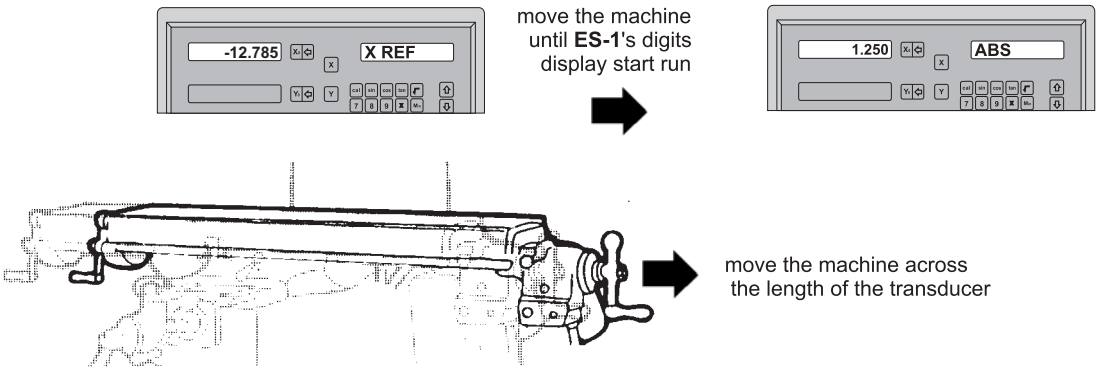
step 1 : enter into the **ref** function, select the **RECALL 0** (recall work piece zero)



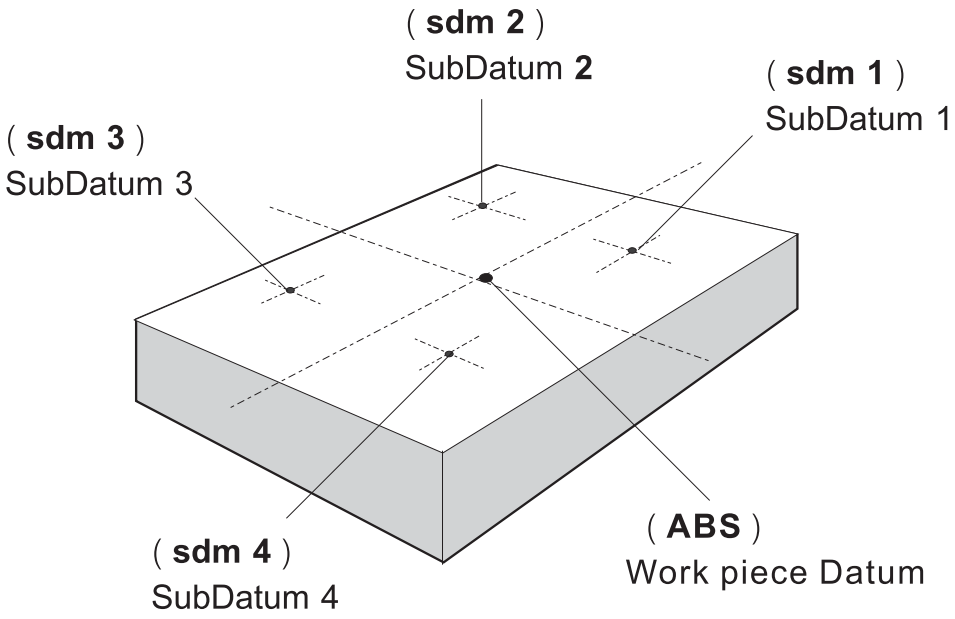
step 2 : select the axis of which work datum (zero position) needed to be recovered



step 3 : move the machine across the length of the transducer until the **ES-1** display starts to count, then the work piece datum is recovered



199 SubDatum Function



199 SubDatum function

Purpose : Most DRO cabinet on the market provide just two set of work co-ordinates - ABS/INC. It was found that ABS/INC was inadequate and inconvenient to use, and, particularly in the case of complex machining or repetitive work, which needed more than just two sets of working co-ordinates.

ABS / INC operation has the following shortfalls :

- In much machining work, the work-piece machining dimensions are derived from more than two datums, therefore, the operator has to switch between ABS and INC to set up the machining datums time after time. This process is very time consuming and prone to error.

- In the case of batch machining of repetitive work, the operator has to set up and calculate all the machining positions time after time.

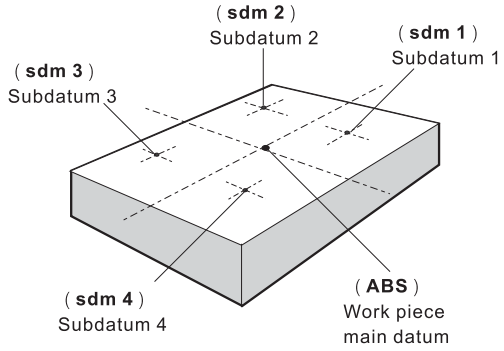
ES-1 provides a 199 subdatum (sdm) memory to cope with the shortfalls of ABS/INC. SdM function does not just simply provide 199 sets of INC co-ordinates, it is specially designed to provide much more convenient features for the operator to cope with repetitive work.
The difference between INC and SdM is as follows:.

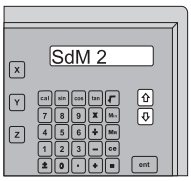
1. INC is independent of ABS and will not follow any change in ABS zero point. All sdm co-ordinates are relative to the ABS coordinates, so, all SdM positions will move together when the ABS zero position changes.

2. All SdM relative distance data to ABS can be entered directly into ES-1 memory using the keypad. No need for any additional calculations.

SdM application in a work piece that has more that one datum.

Operator can store all the work subdatums in ES-1's memory as per follows.





Operator then can switch between the subdatums directly by pressing key

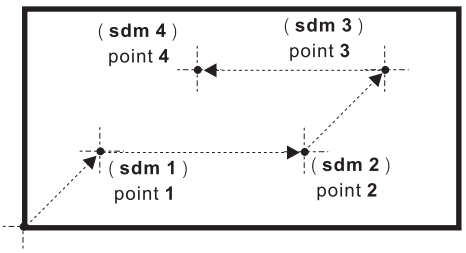
or

No need to refer back to ABS coordinate and set up the subdatums from their relative distance from ABS point

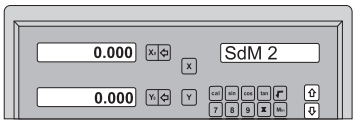
SdM application on the repetitive batch machining of parts

Because all sdm subdatums (0.000) are relative to ABS zero, so, for any repeative work, the operator just needs to set up the first work piece zero at ABS and store the machining position in subdatum zero.

For anymore repeative parts, just set up the 2nd, 3rd.. work piece zero at ABS, then all the machining positions will reappear



(ABS)
Work Piece Datum (0.000)



Press Up/Down key to go to machining points

or

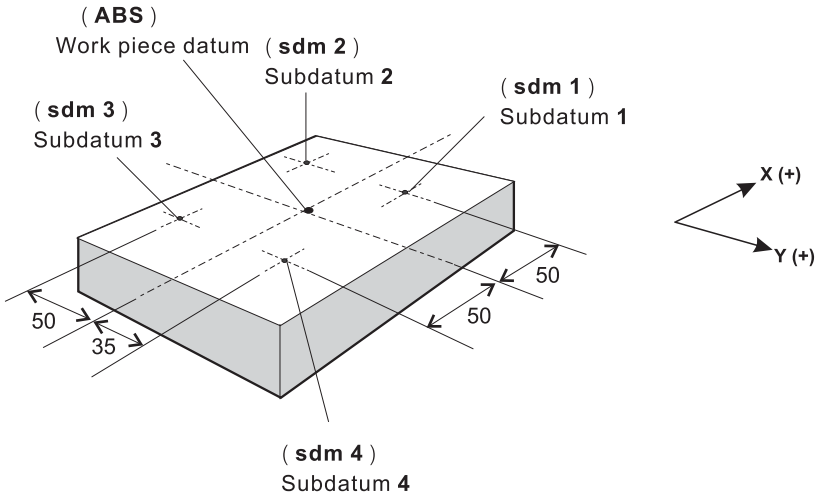
move the machine to display = 0.000, then machining location reached

199 SubDatum function

Application example:

To set up four subdatum zero (SdM 1 to SdM 4) the following two methods can be used

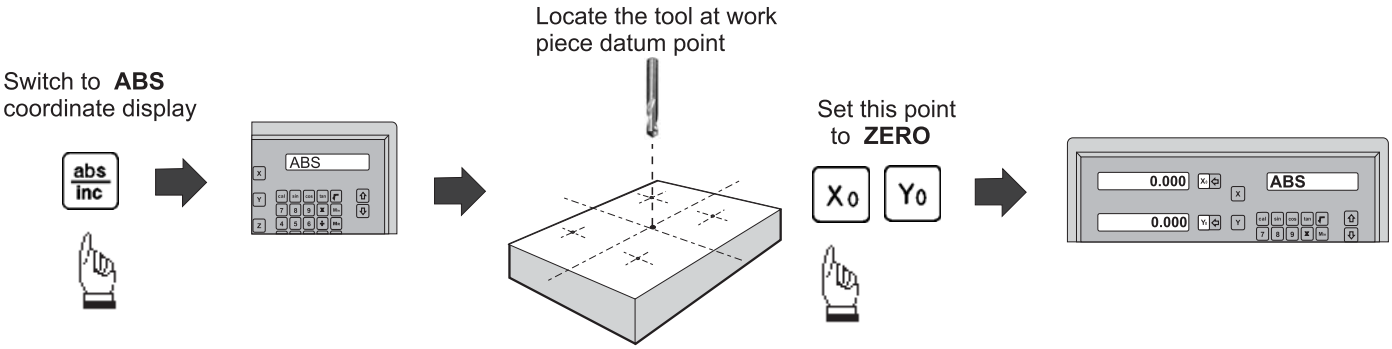
Either 1. Move machine to required subdatum position, then zero SdM display coordinates
Or 2. Directly key in the sdm zero position co-ordinates (co-ordinate relative to ABS zero)



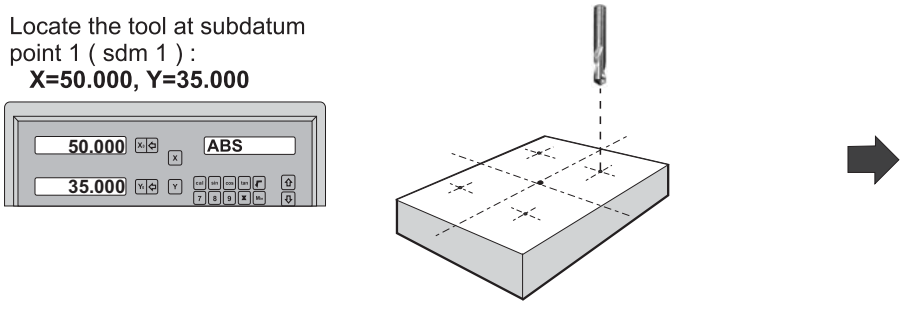
Method 1 : Move machine to required subdatum position, then zero SdM display coordinate

Set up the work piece datum in ABS co-ordinate, move the machine to the required subdatum position, then zero SdM display co-ordinate.

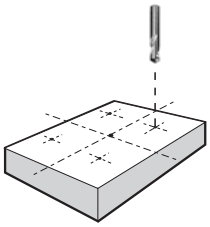
Step 1 : Set up the work piece datum in ABS co-ordinate



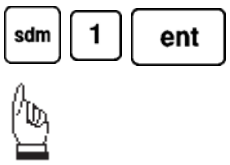
Step 2 : Set up the subdatum point 1 (sdm1)

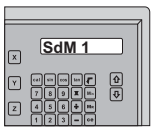


199 SubDatum function

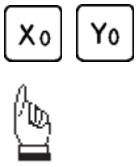


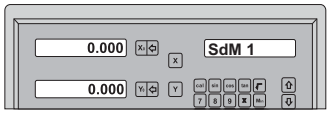
switch to **sdm 1**
coordinate display





Set this point
to **ZERO**

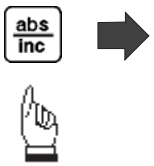


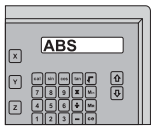


sdm 1 set up already

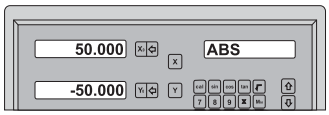
Step 3 : Set up the subdatum point 2 (sdm 2)

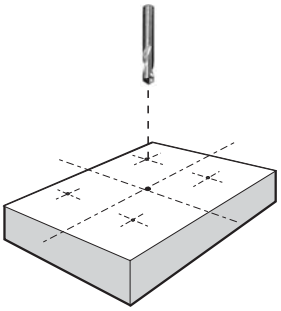
switch back to
ABS coordinate
display

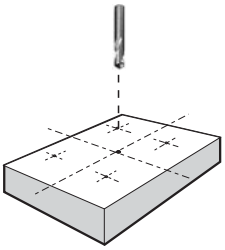




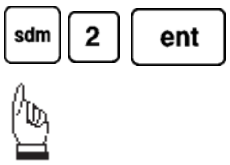
Locate the tool at subdatum
point 2 (sdm 2) :
X=50.000, Y=-50.000

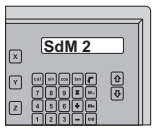




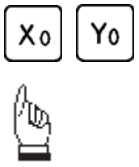


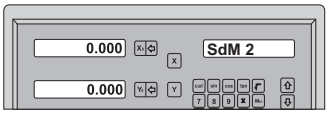
switch to **sdm 2**
coordinate display





Set this point
to **ZERO**

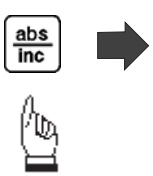


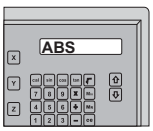


sdm 2 set up already

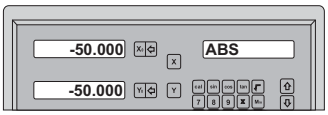
Step 4 : Set up the subdatum point 3 (sdm 3)

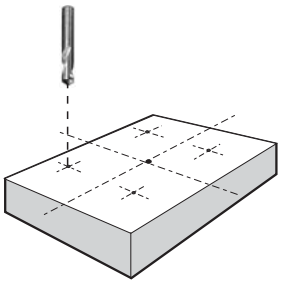
switch back to
ABS coordinate
display



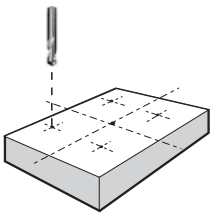


Locate the tool at subdatum
point 3 (sdm 3) :
X=-50.000, Y=-50.000

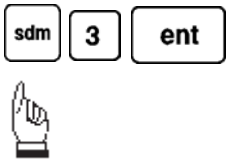


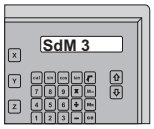


199 SubDatum function

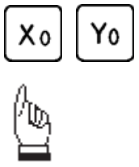


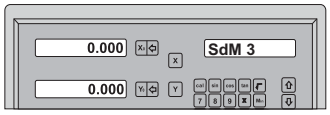
switch to **sdm 3** coordinate display





Set this point to **ZERO**

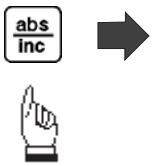


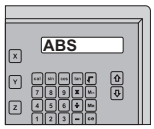


sdm 3 set up already

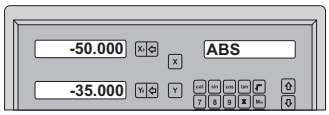
Step 5 : Set up the subdatum point 4 (sdm 4)

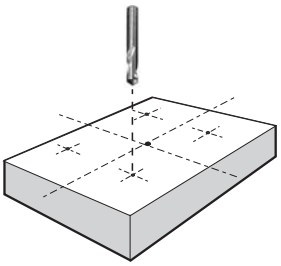
switch back to **ABS** coordinate display

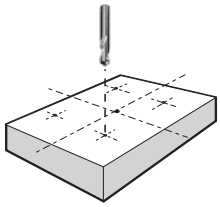




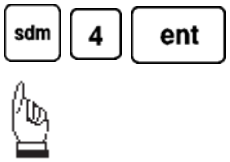
Locate the tool at subdatum point 4 (sdm 4) :
X=-50.000, Y=-35.000

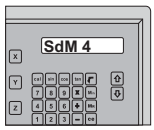




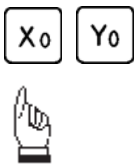


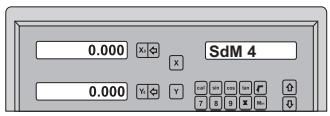
switch to **sdm 4** coordinate display





Set this point to **ZERO**





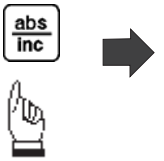
sdm 4 set up already

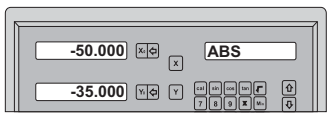
All the four subdatum points have already been set up

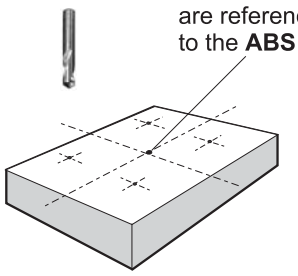
Operator can ⇧ or ⇩ to directly switch to the required subdatum (**sdm**) coordinate

Example :

switch to **ABS** coordinate display

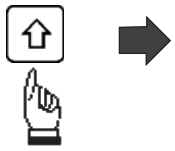


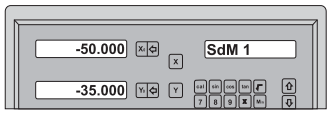




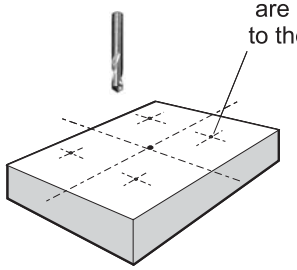
199 SubDatum function

switch to next (**up**)
sdm coordinate display

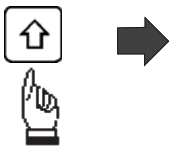


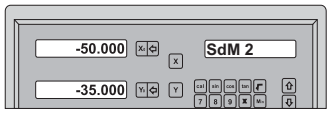


ES-1's XY displays
are referenced
to the **sdm 1** zero

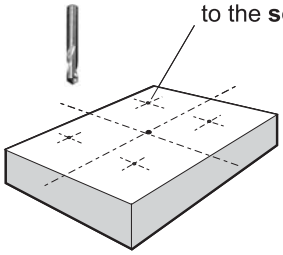


switch to next (**up**)
sdm coordinate display

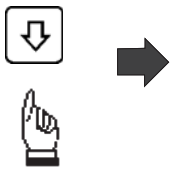


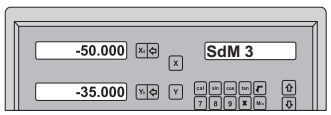


ES-1's XY displays
are referenced
to the **sdm 2** zero

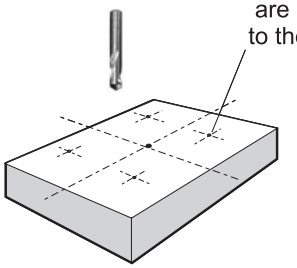


switch to previous (**down**)
sdm coordinate display





ES-1's XY displays
are referenced
to the **sdm 1** zero



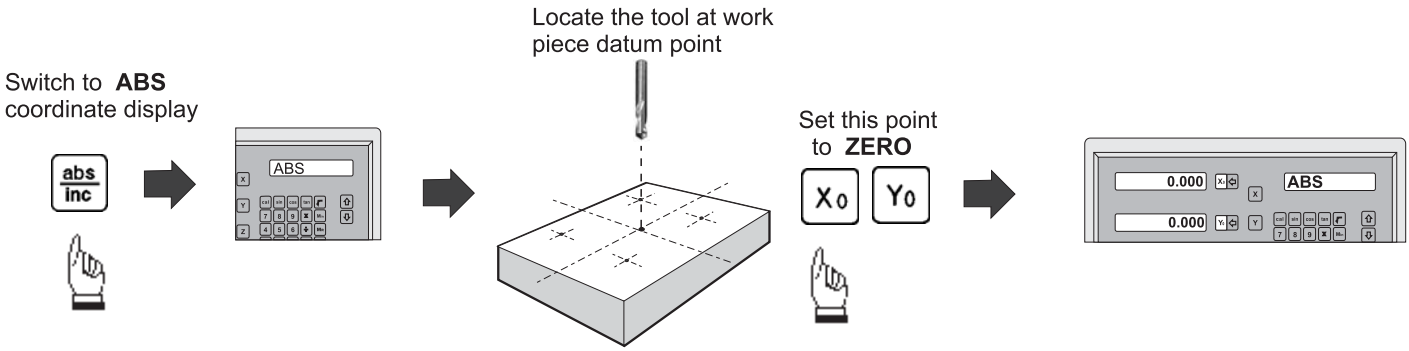
199 SubDatum function

In a case where many subdatum (sdm) points need to be set up,the operator will find that the method of **direct keying in the of SdM zero position co-ordinates (co-ordinate relative to ABS zero)** is much quicker and less prone to error.

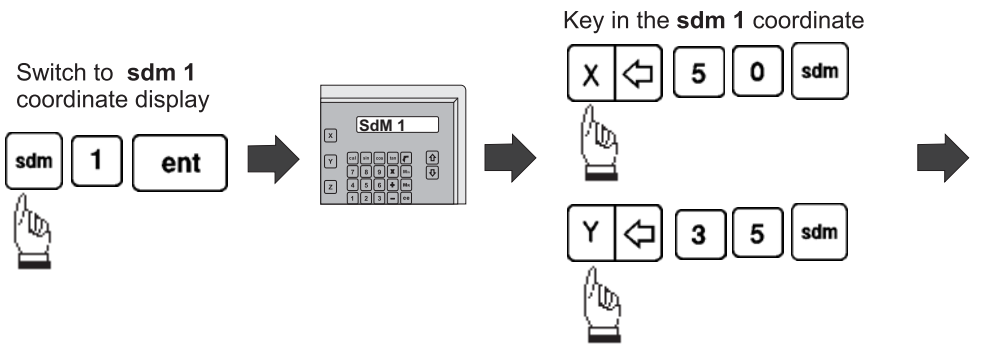
Mtheod 2 : Direct keying in the of SdM zero position co-ordinate (co-ordinate relative to ABS zero)

Set up the work piece datum (ZERO) at ABS co-ordinate, then move the tool located at the work piece datum (ABS zero point)and directly key in all subdatum point co-ordinates (the relative position to ABS zero) using the keypad.

Step 1 : Set up the work piece datum in ABS coordinate



Step 2 : Set up the subdatum point 1 (sdm 1)

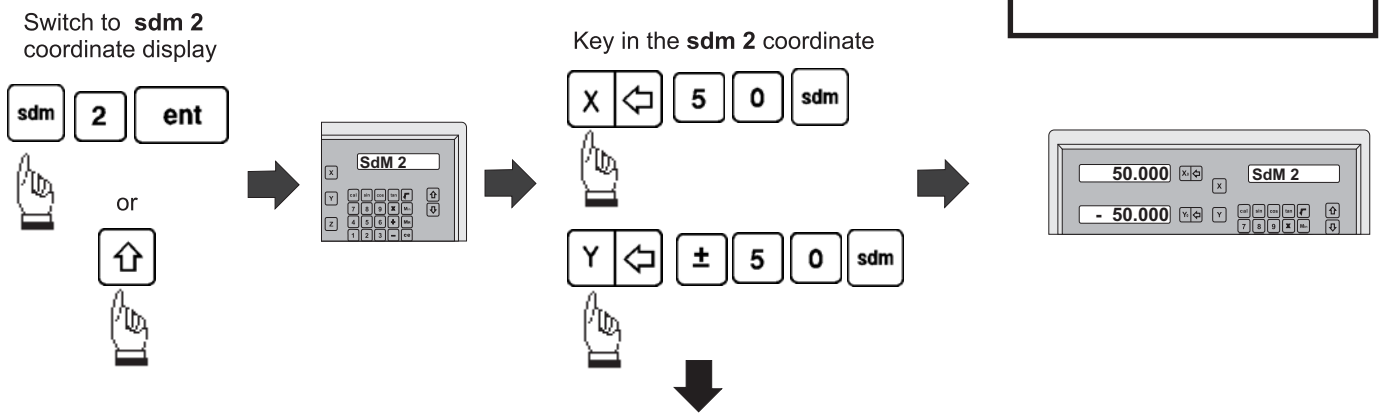


NOTICE :

When you enter the sdm co-ordinate into the ES-1, the co-ordinates displayed will indicate a **negative sign.**

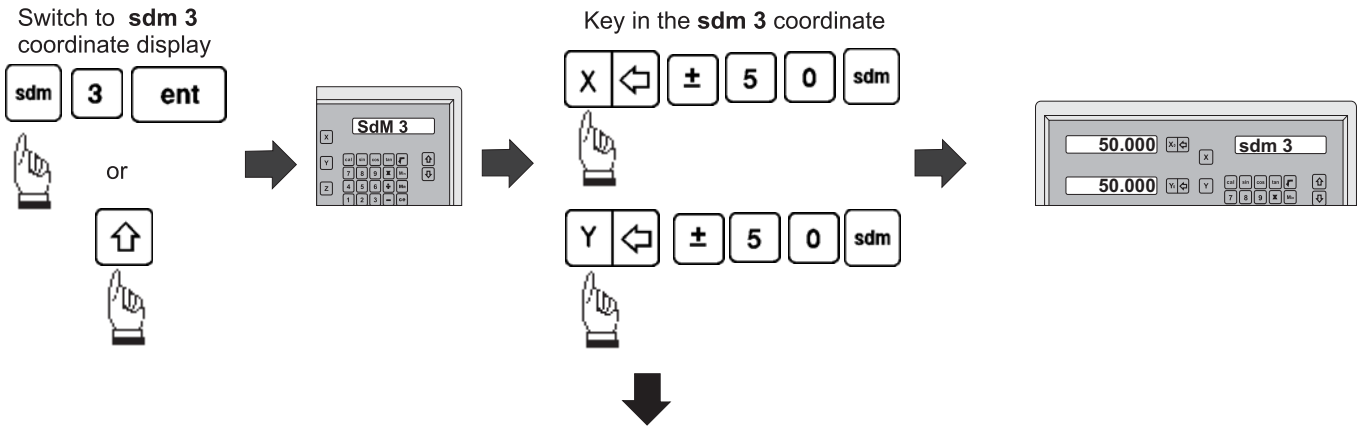
This is correct because your tool is now located at zero position at ABS coordinate. If you calculate from the sdm co-ordinates, the tool is at a negative value.

Step 3 : Set up the subdatum point 2 (sdm 2)

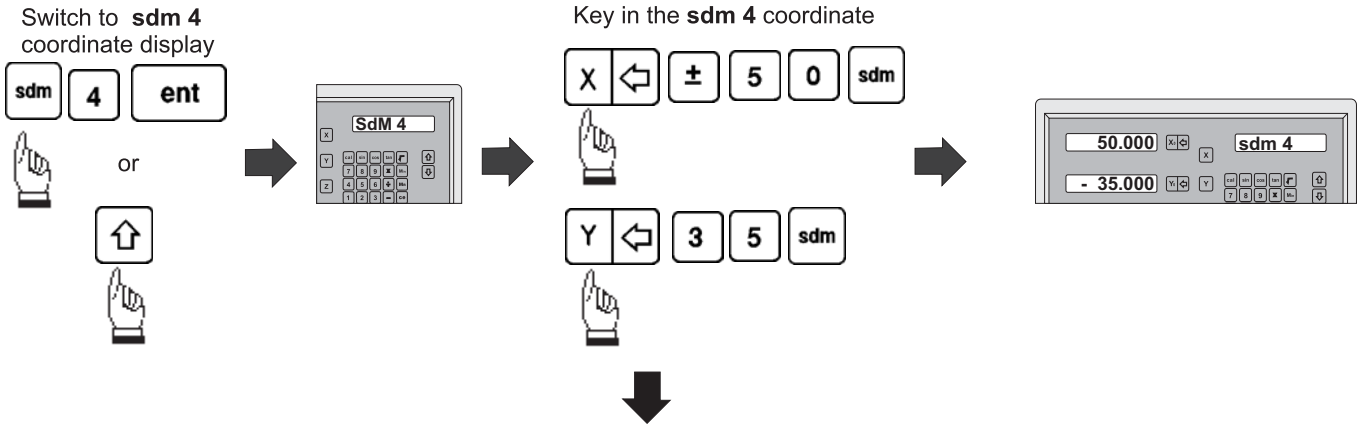


199 SubDatum function

Step 4 : Set up the subdatum point 3 (sdm 3)



Step 5 : Set up the subdatum point 4 (sdm 4)

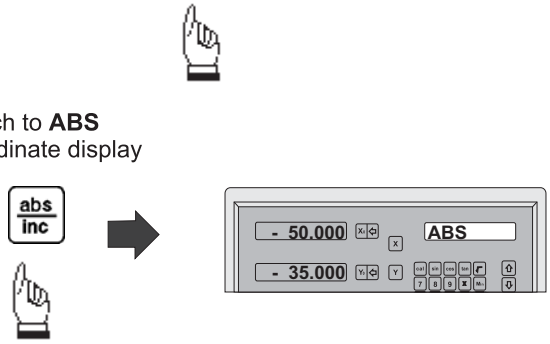


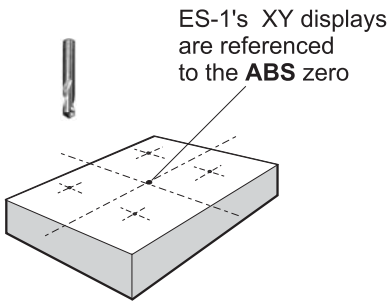
All the four subdatum points have already been set up

Operator can ⇧ or ⇩ to directly switch to the required subdatum (**sdm**) coordinate

Example :

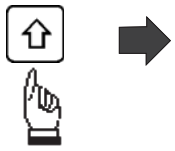
switch to **ABS** coordinate display

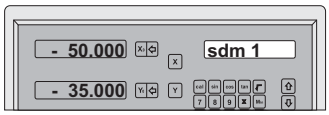




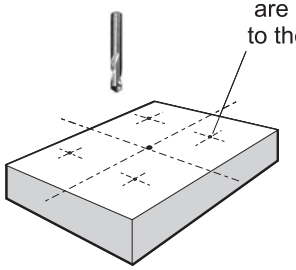
199 SubDatum function

switch to next (**up**)
sdm coordinate display

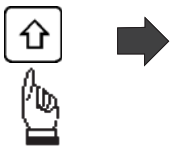


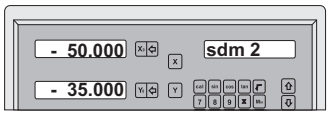


ES-1's XY displays
are referenced
to the **sdm 1** zero

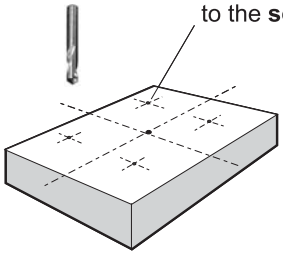


switch to next (**up**)
sdm coordinate display

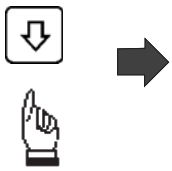


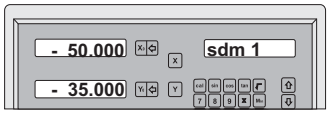


ES-1's XY displays
are referenced
to the **sdm 2** zero

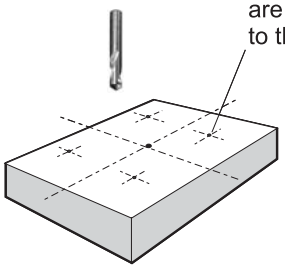


switch to previous (**down**)
sdm coordinate display

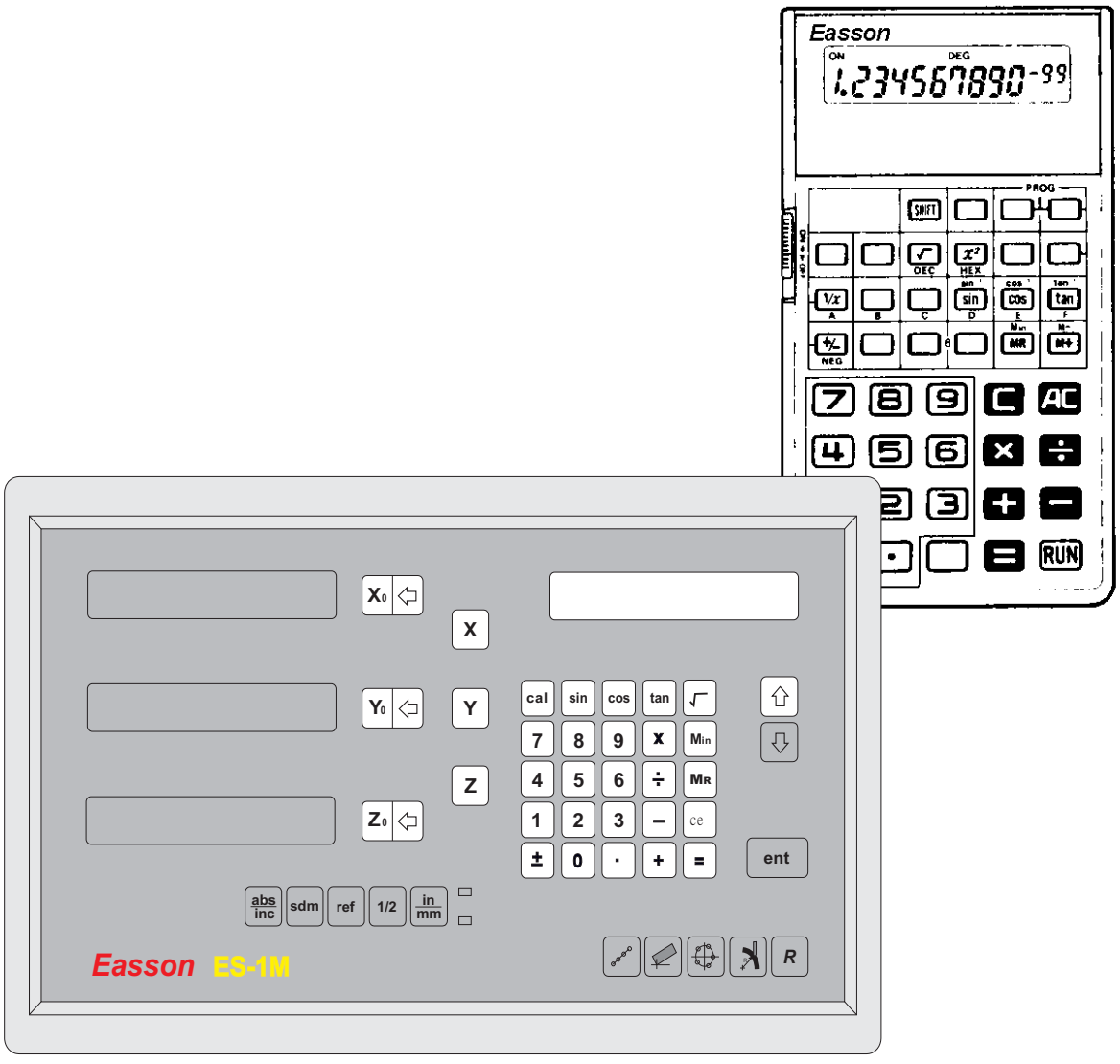




ES-1's XY displays
are referenced
to the **sdm 1** zero



Built- in Calculator



Built in Calculator

Function : A calculator is used frequently during a manual machining process..

ES-1 is the first DRO that has a built-in calculator

The built-in calculator of the ES-1 not only provides normal mathematical calculations such as add, substract, multiply & divide, it also provides useful trigonometric calculations that are frequently required during a machining process such as **SIN, COS, TAN, SQRT** and also ***inv* SIN, *inv* COS, *inv* TAN, SQUARE...**

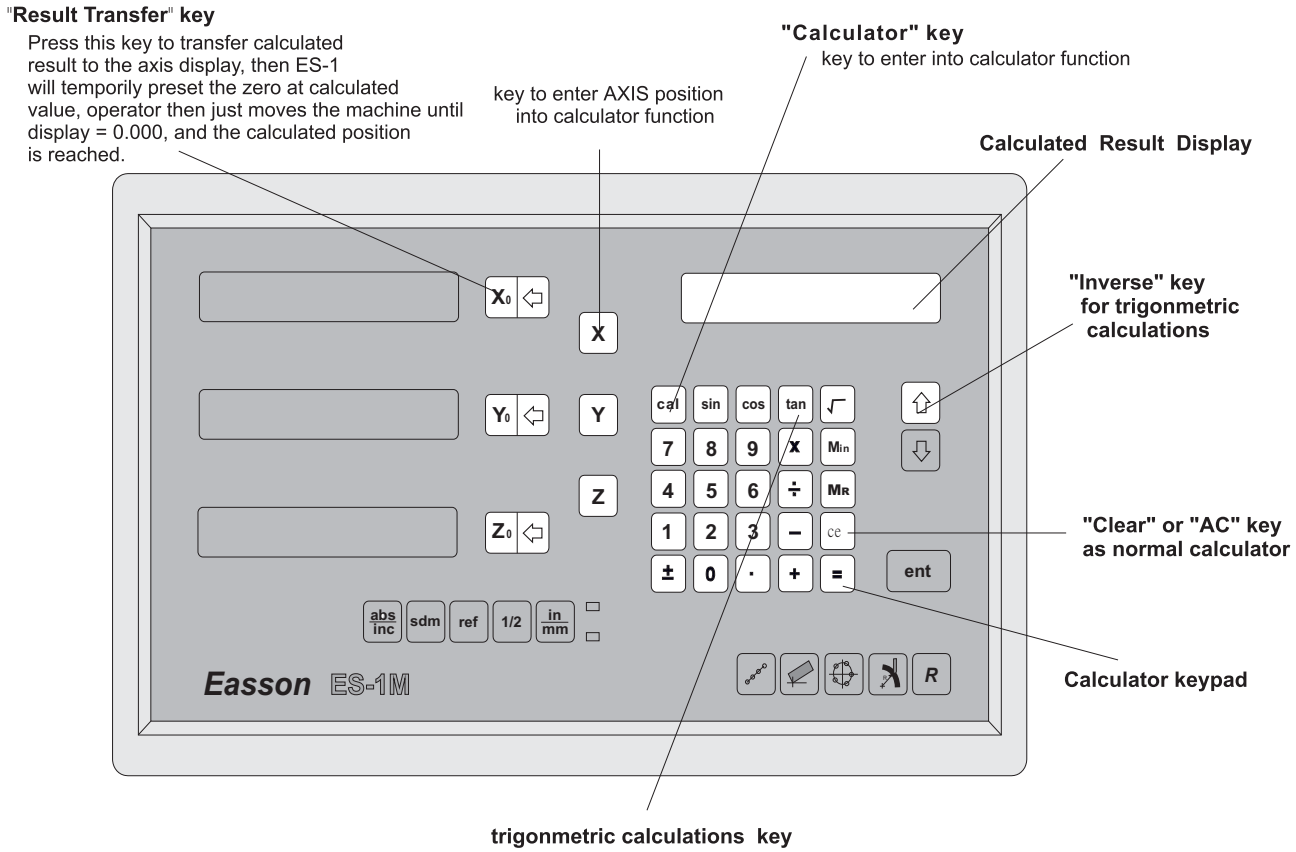
In addition a major feature of the calculator of the ES-1 is "***Result Transfer***", in that all calculated results from the calculator of ES-1 can be "transferred" to any axis to enable you to position the tool. After the result has been transferred to an axis, the ES-1 will ***temporarily*** preset the zero position at the calculated value, enabling the operator to simply move the machine back to axis display = 0.000, leaving the tool positioned at the calculated coordinate .

The built-in calculator offers the following advantages :

1. Operations are the same as commerically availiable calculators and it is easy to use ;

2. The calculated result can be directly transfered to any axis, eliminating the need to make notes of a calculation on paper, thus saving time and avoiding errors;

3. No unnecessary down-time in finding or sharing calculators whenever you need one to make calculations.



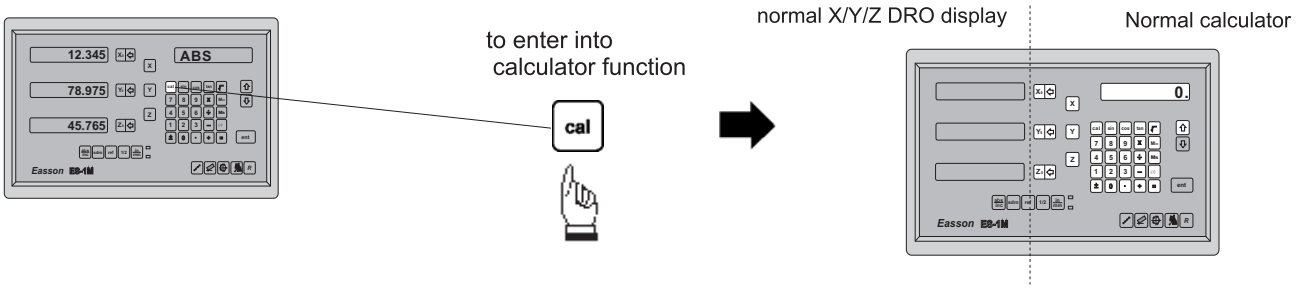
Key layout of the built-in calculator

Built in Calculator

Example :

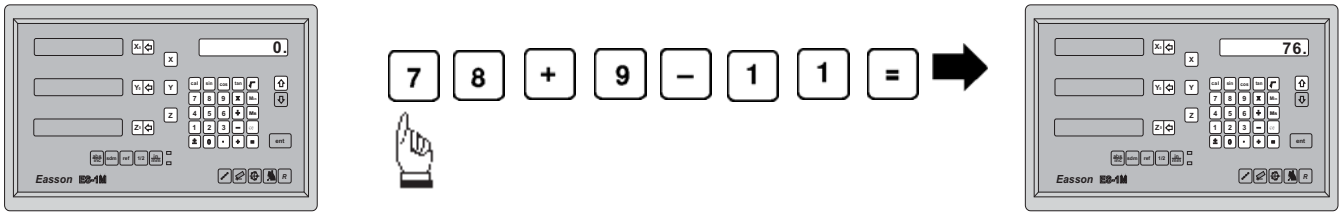
Working principle of ES-1's calculator function

when the ES-1 is put in calculator mode, the operation of ES-1 actually divided into two parts as follows



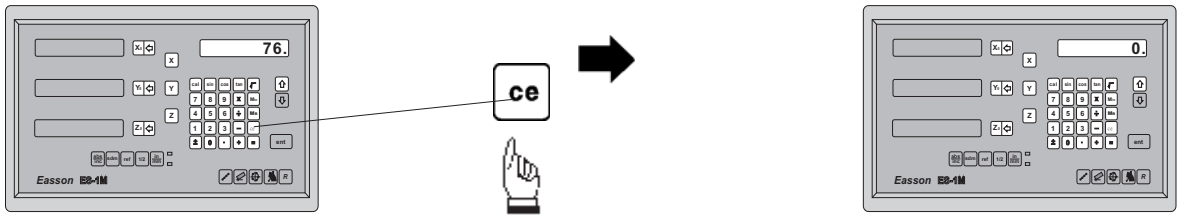
The operations of ES-1's built-in calculator is the same as other ordinary calculators

i.e. Basic mathematics **- add ; substract :** 78 + 9 - 11 = 76

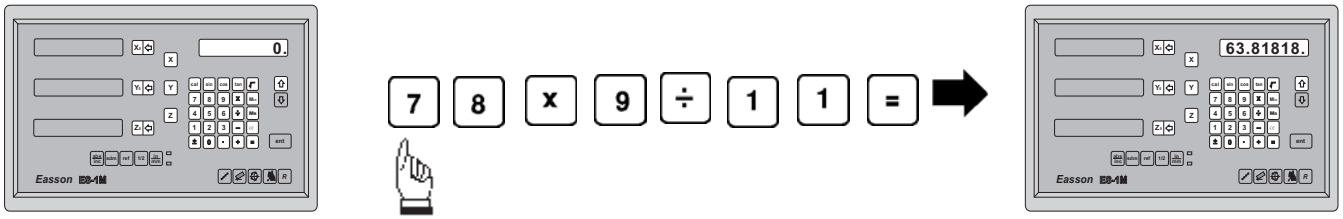


Clear - Restart the calculation

The ES-1 uses the **CE** key instead of the **AC** key (per normal calculator)

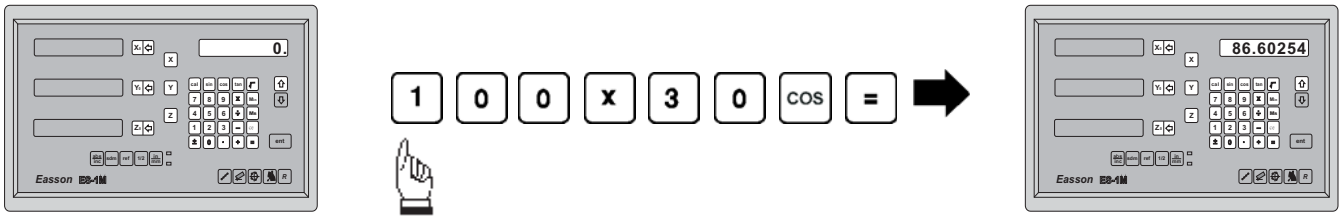


i.e. Basic mathematics **- multiply, division :** 78 X 9 / 11 = 63.81818

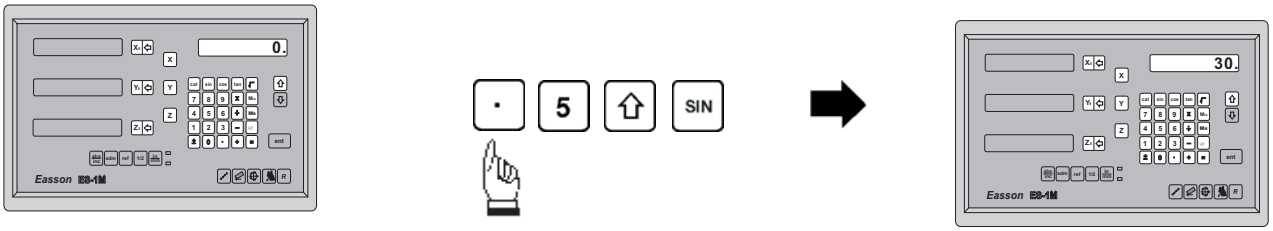


Built-in Calculator

i.e. Trigonometric calculation **- COS :** 100 X COS 30° = 86.602540

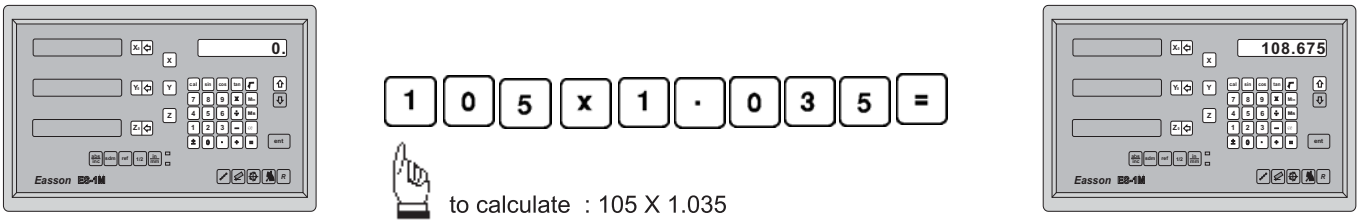


i.e. Trigonometric calculation **- inverse SIN :** $SIN^{-1} 0.5 = 30^{\circ}$

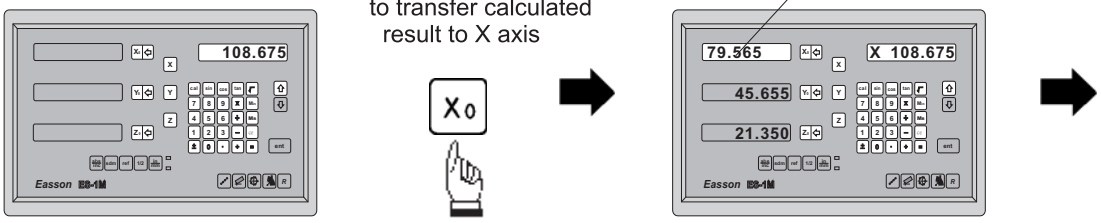


Result Transfer

i.e. : **To move the tool at the position of X axis coordinate :** 105 X 1.035 = 108.675

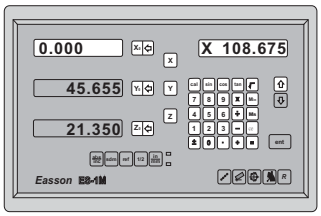


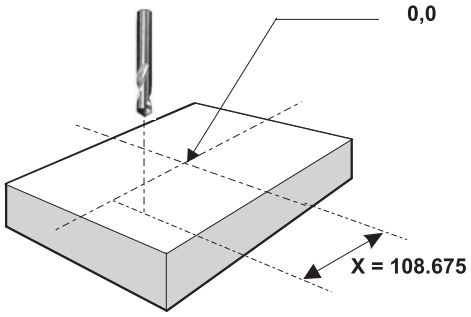
transfer the calculated result : 108.675
onto the X axis for tool positioning



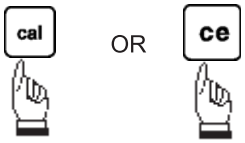
Built-in Calculator

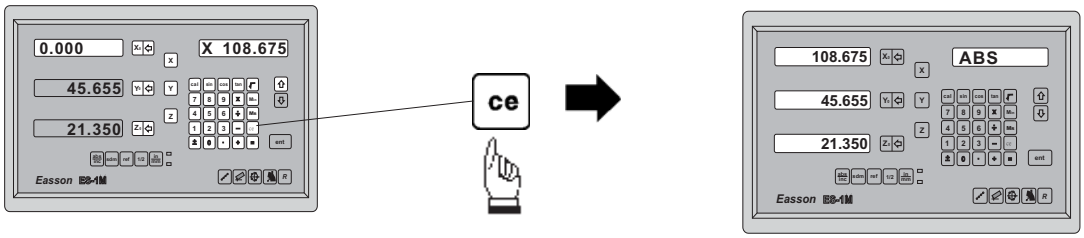
Move the machine to X display = 0.000
then it is at the position of X = 108.675





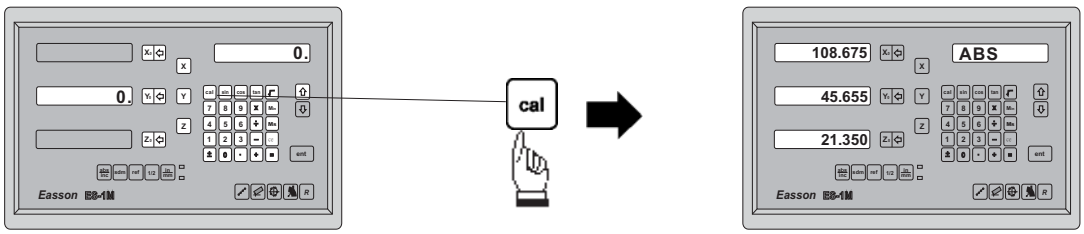
The tool is now at the position of the calculated result
(X = 108.675 in the above example)
To get back to normal coordinate display to continue the machining



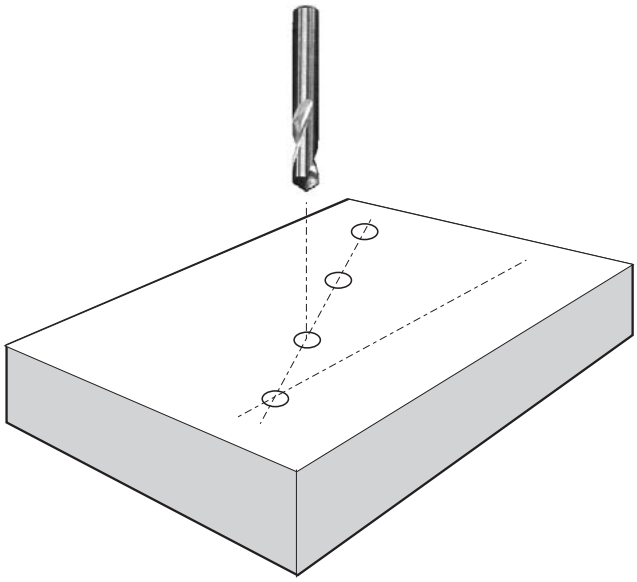


When you are in calculator mode, you can 

to exit the calculator mode, to return to normal coordinate display to continue the machining.

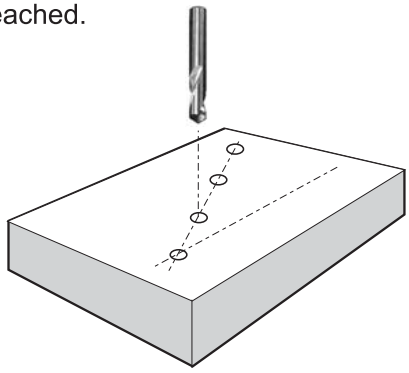


LHOLE - Tool positioning for a Line of Holes



LHOLE - Tool positioning for a Line of Holes

Function : ES-1 provides LHOLE function for drilling a line of holes.
Simply enter the machining parameters below (following the step by step guides that are displayed on the ES-1's message screens), and the ES-1 will calculate all the hole position co-ordinates and temporarily preset the hole position coordinates to zero (0.000). The operator then moves the machine until the display axes = 0.000, then the Line of Holes start-position is reached.

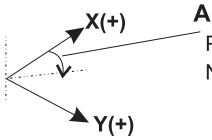


- Line Angle **(LIN ANG)**
- Line Distance **(LIN DIST)**
- No.of Holes **(NO. HOLE)**

After the above machining parameters are entered into ES-1, it presets all the Line Hole positions to 0.000

Operator can press ⇧ or ⇩ to select

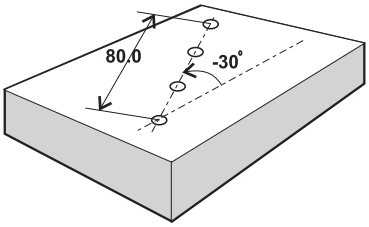
the Line Hole, and then move the machine to display = 0.000, then the Line Hole position is reached



Angular direction :
Positive (+) - *Clockwise*
Negative (-) - *Anti Clockwise*

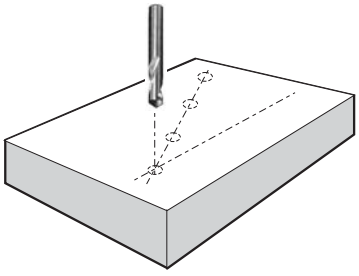
Example

Line Angle **(LIN ANG)..... - 30** degree (Anti-clockwise)
Line Distance **(LIN DIST)..... 80.00 mm**
No. of Holes **(NO. HOLE)..... 4**

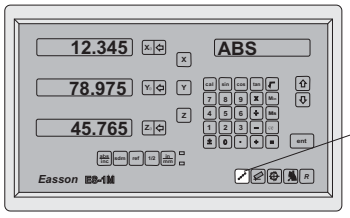


step 1 : The LHOLE function starts by using the current tool position as the starting point, therefore, locate the tool at the ***first*** LINE HOLE position

to enter the **LHOLE** function

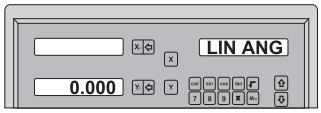


locate the tool at the ***first*** Line Hole position

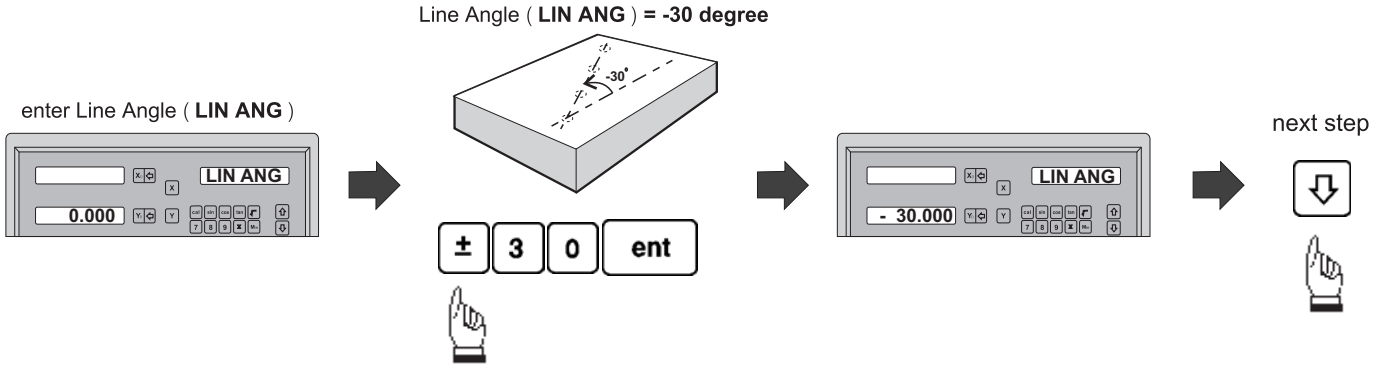


to enter the **LHOLE** function

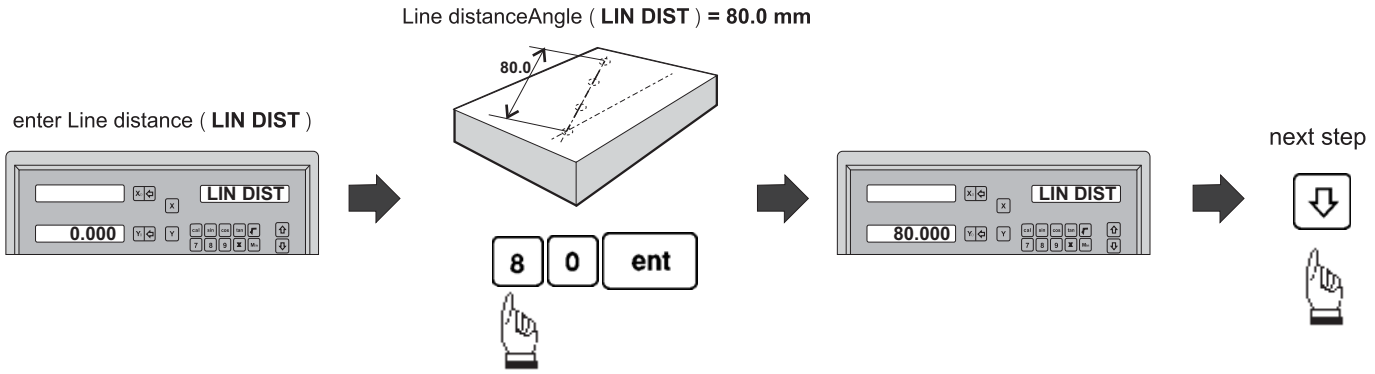
enter the Line Angle (**LIN ANG**)



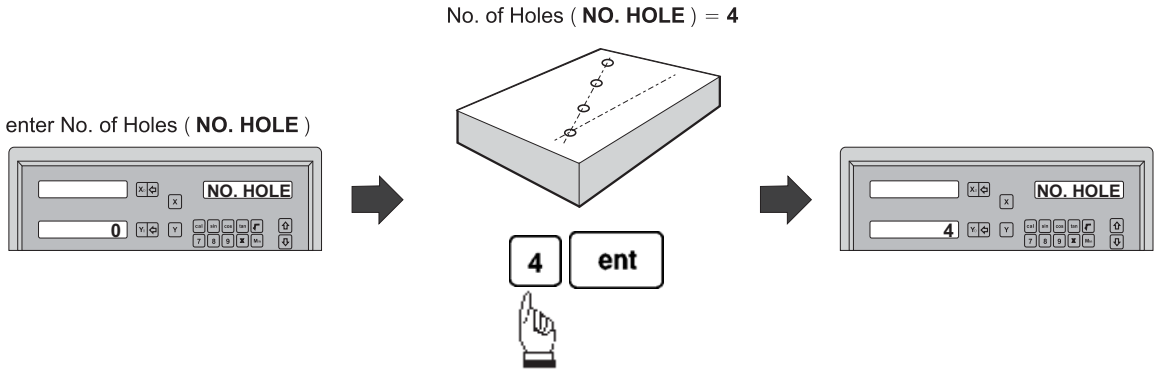
step 2 : Enter Line Angle (**LIN ANG**)



step 3 : Enter Line distance (**LIN DIST**)



step 4 : Enter No. of Holes (**NO. HOLE**)



LHOLE - Tool positioning for a Line of Holes

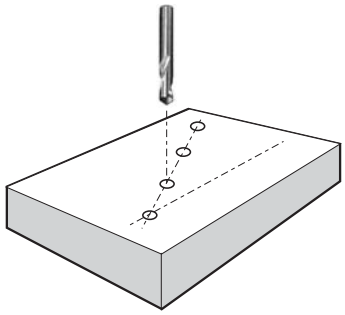
All LHOLE machining parameters are already entered into ES-1 ⇩ **to enter into LHOLE drilling mode**

Operator can ⇧ or ⇩ to select the Line Hole, then move the machine to display = 0.000, then the Line Hole position is reached.

Next Line Hole ⇩

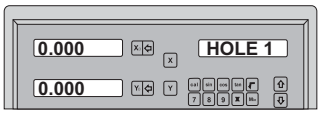
move the machine to display = **0.000**

HOLE 2 = Line Hole no. 2

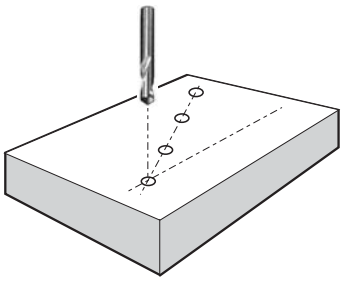


Last Line Hole ⇧

move the machine to display = **0.000**

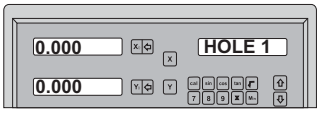


HOLE 1 = Line Hole no. 1



If the operator wants to check or verify that the ES-1's LHOLE calculation is correct, or wants to temporarily exit the LHOLE function cycle (ie swap to normal XYZ display). The operation is as follows :.

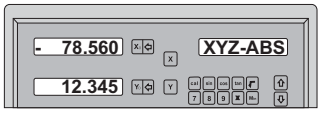
presently in **LHOLE** cycle



temporarily ***swap*** to normal XYZ coordinate display

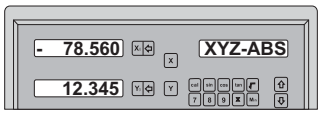
0

temporarily return to XYZ coordinate display

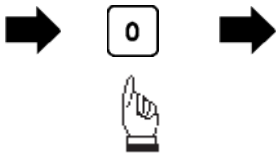


swap back to LHOLE cycle to continue the Line Holes drilling operation

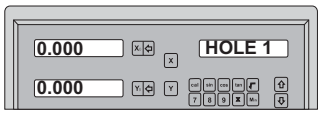
presently in the temporarily XYZ coordinate display



swap back to **LHOLE** function cycle

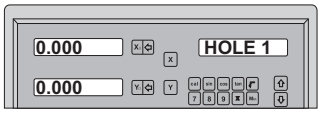


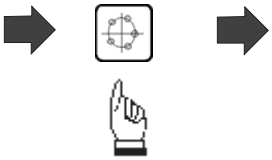
return to **LHOLE** function cycle



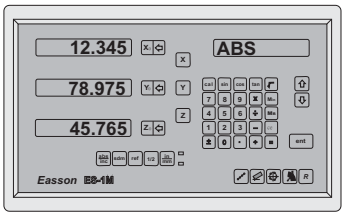
After the Line Holes drilling operation is completed, and to leave the LHOLE function cycle, follow the procedure below

presently in **LHOLE** function cycle

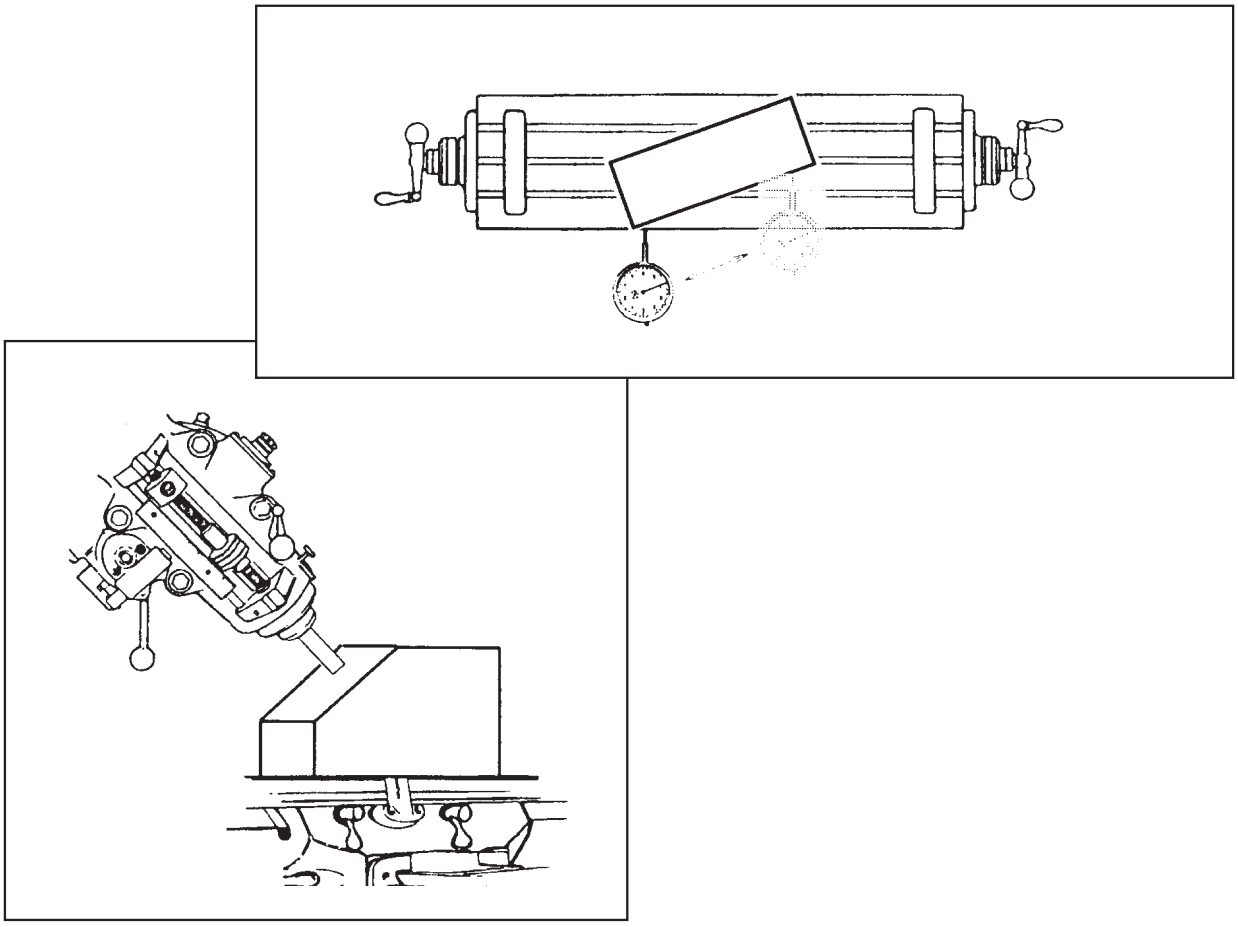




return back to normal XYZ coordinate display

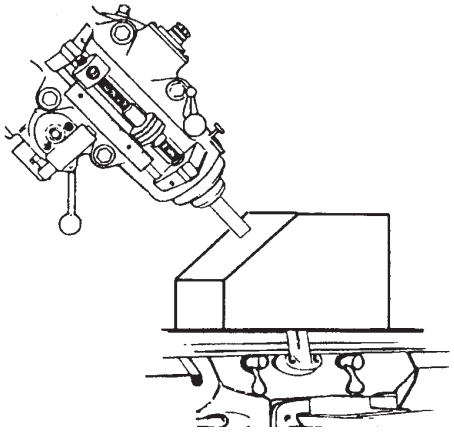


INCL - Inclined surface datum tool positioning



INCL - Inclined surface datum tool positioning

Function : During a machining process, it is quite common to machine an inclined surface.



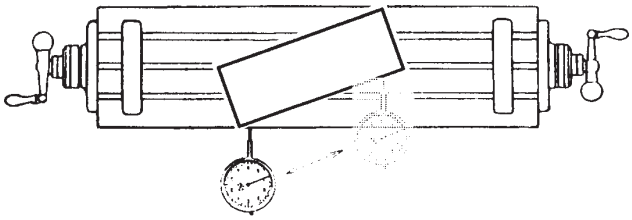
If the work piece is small or the accuracy requirement is quite low, the operator can simply work on an incline or rotary table to machine the inclined working surface easily.

However, when the **work piece is too big** to be installed onto the incline table, or the **accuracy requirement is high,** the only solution is to calculate the machining points or datuming points using the mathematical method. This is generally very time consuming.

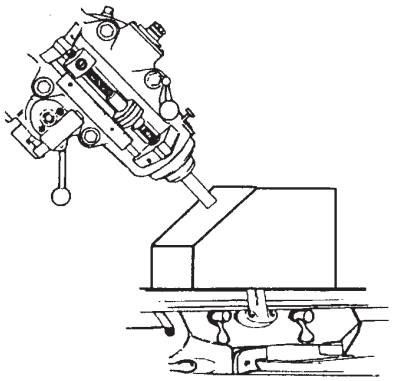
The ES-1 provides easy-to-use **INCL** function to help the operator for precision inclined surface datuming and machining.

Application of the INCL function are as follows :

A) **XY** plane - to accurately datum the work piece at an inclined angle



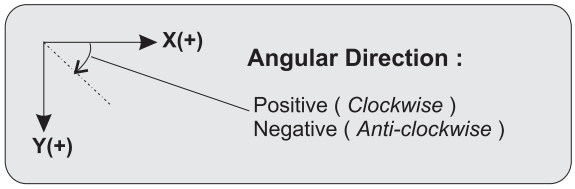
B) **XZ/YZ** plane - Machine an inclined surface

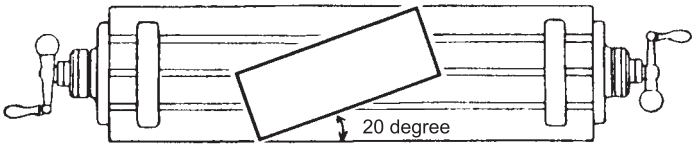


INCL - Inclined surface datum tool positioning

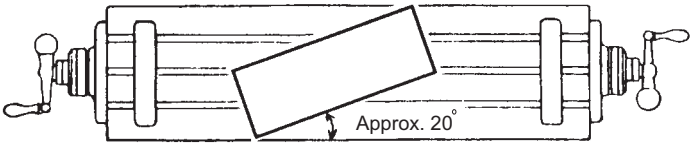
Example :

To accurately datum the
work piece at a 20 degree angle
on the XY plane



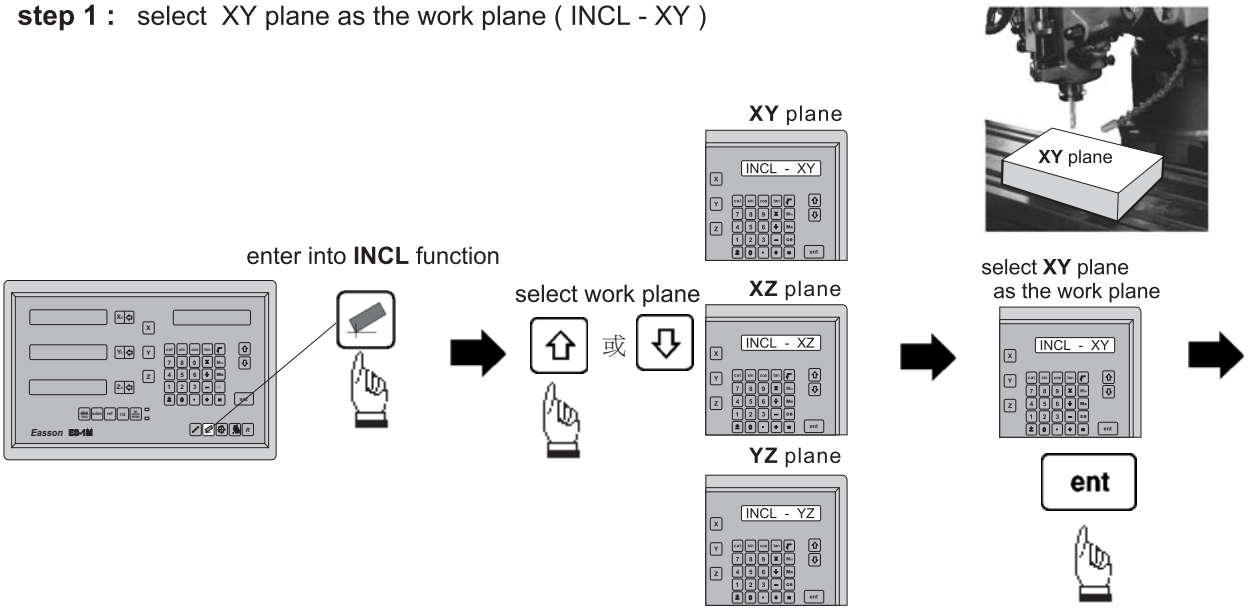


Operational procedure



Install the work piece onto an rotary table at approxiately 20 degree.

step 1 : select XY plane as the work plane (INCL - XY)

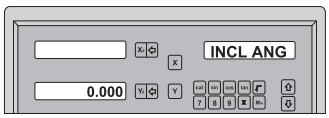


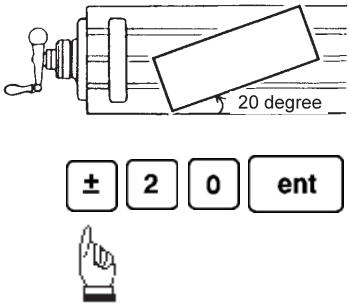
INCL - Inclined surface datum tool positioning

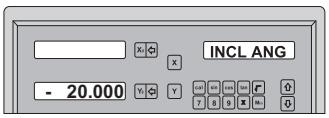
step 2 : enter incline angle (**INCL ANG**)

incline angle (**INCL ANG**) = -**20** degree

enter incline angle (**INCL ANG**)



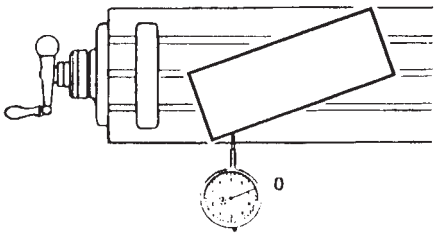




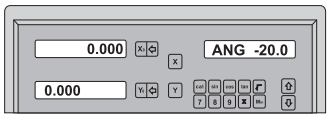
All INCL machining parameters already entered into ES-1

to enter into INCL datuming mode

A) zero the dial indicator on one end of the work piece

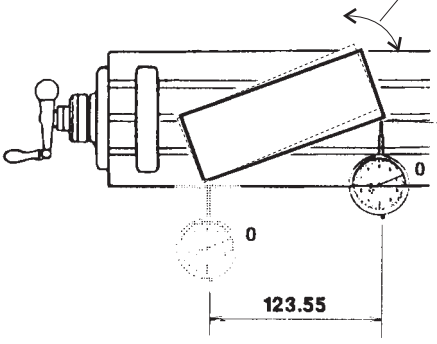


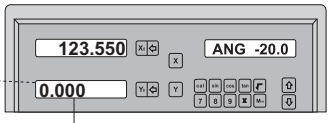
zero the ES-1



since in INCL mode, the Y display is set according to X * tan (ANG), therefore, zeroing the X axis also clear the Y axis.

B) After move the machine to Y axis display = 0.000, then the Y axis position is accurately posited at 20 degree. operator can fine tune the work piece incline angle until the dial indicator at zero.



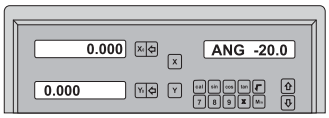


Y axis zero position will follow the X axis position at the angle of ANG (-20 degree in this example) operator just move the Y axis to display = 0.000 - it is then at an accurate 20 degree position

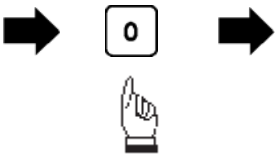
During the incline angle alignment, angular adjustment of any one end of the work piece will affect the the position on the other end, the above angular alignment procedure A) & B) has to be carried out iteratively until operator is satisfied with the angular alignment achieved.

If the operator wants to check or verify if ES-1's INCL calculation is correct, or wants to temporarily exit the INCL function cycle (swap to normal XYZ display). The operation are as follows :.

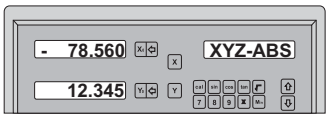
presently in **INCL** cycle



temporarily ***swap*** to normal XYZ coordinate display

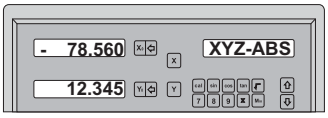


temporarily return to XYZ coordinate display

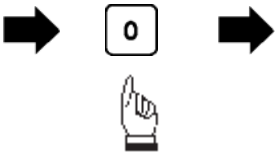


swap back to INCL cycle to continue the **INCL** incline angle alignment

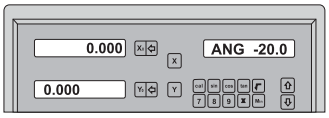
presently in the temporarily XYZ coordinate display



swap back to **INCL** function cycle



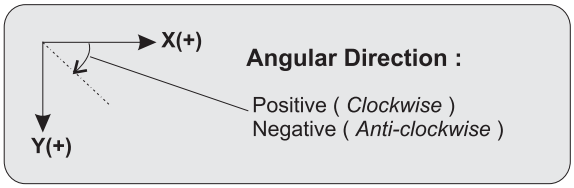
presently in **INCL** cycle

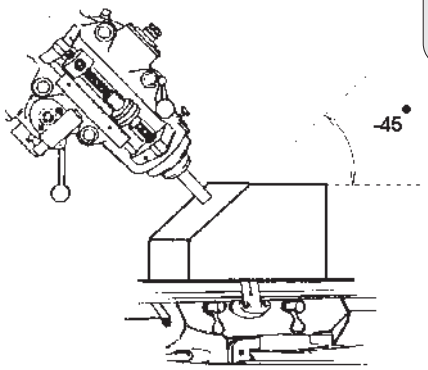


INCL - tool positioning for inclined machining

Example :

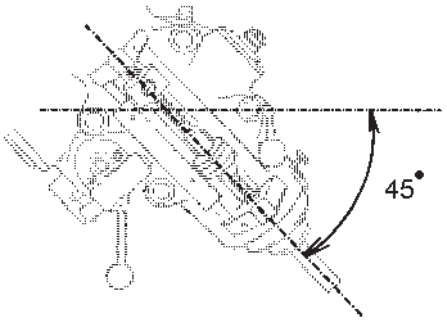
To machine a 45 degree inclined surface
on XZ plane using a two axis ES-1



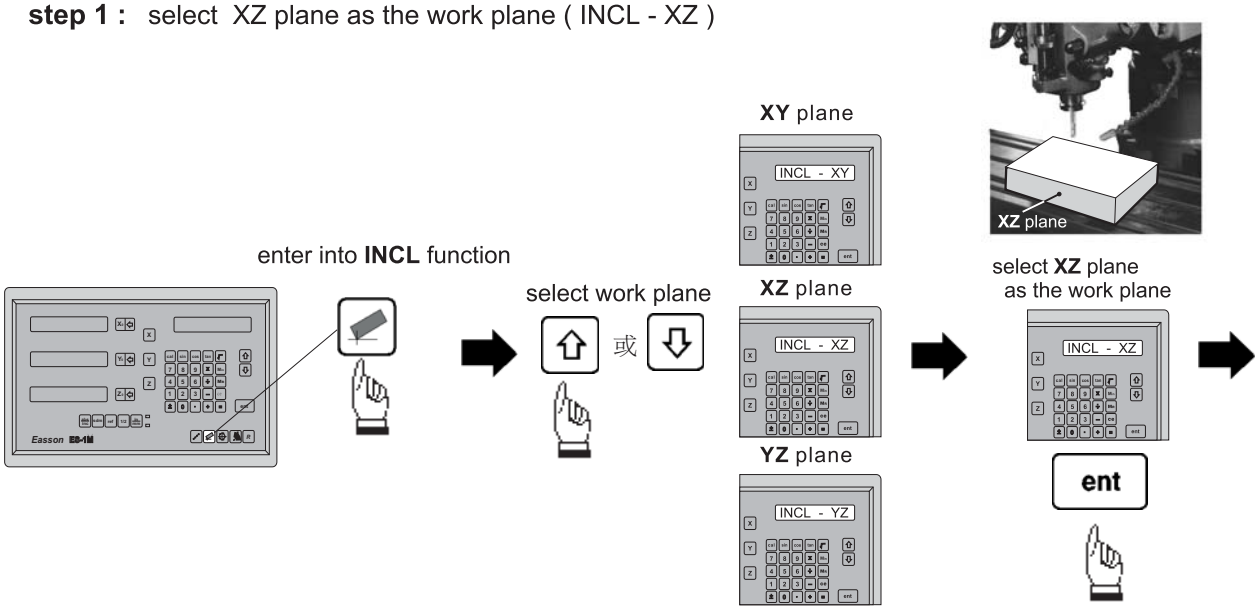


Operation procedure

Inclines the mill head by 45 degree

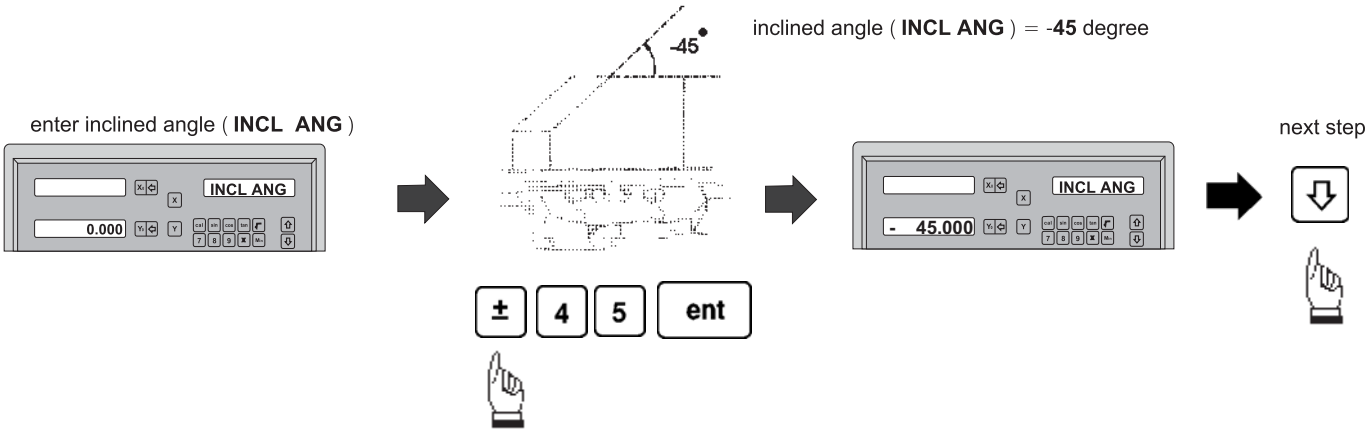


step 1 : select XZ plane as the work plane (INCL - XZ)

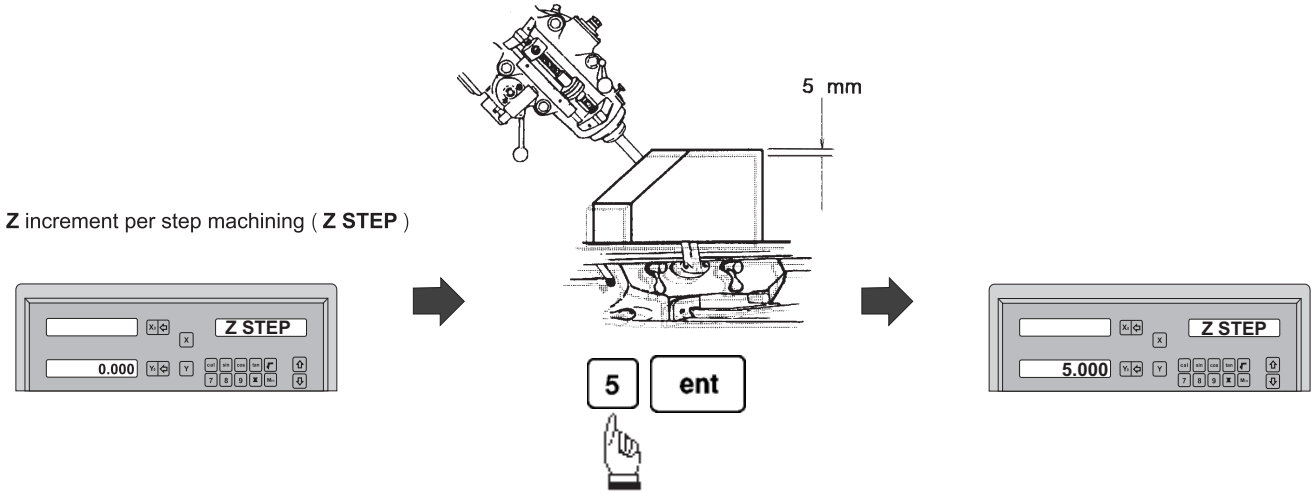


INCL - tool positioning for inclined machining

step 2 : enter inclined angle (**INCL ANG**)



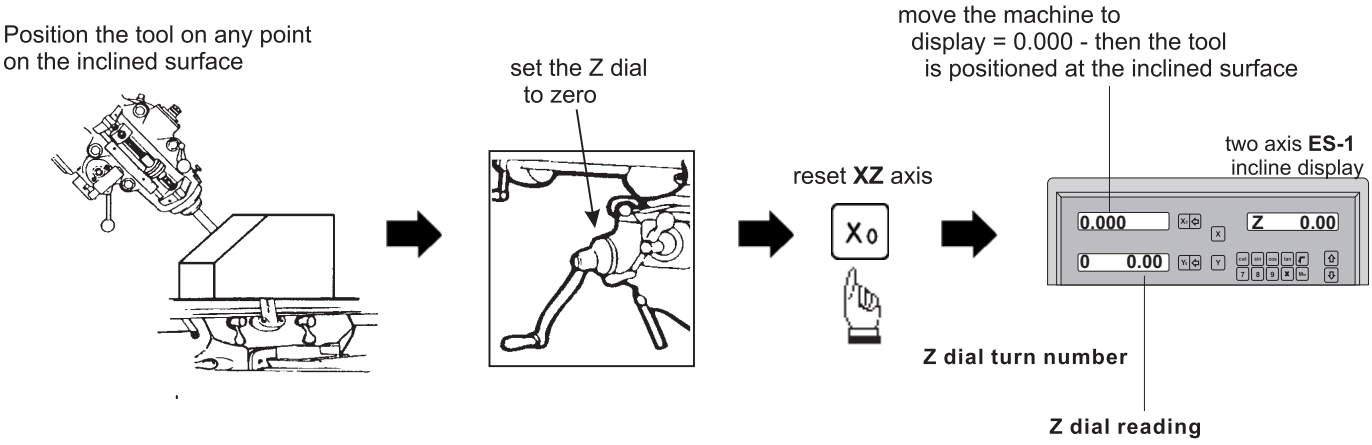
step 3 : Z increment per step machining (**Z STEP**)



All INCL machining parameters already entered into ES-1

to enter into INCL datuming mode

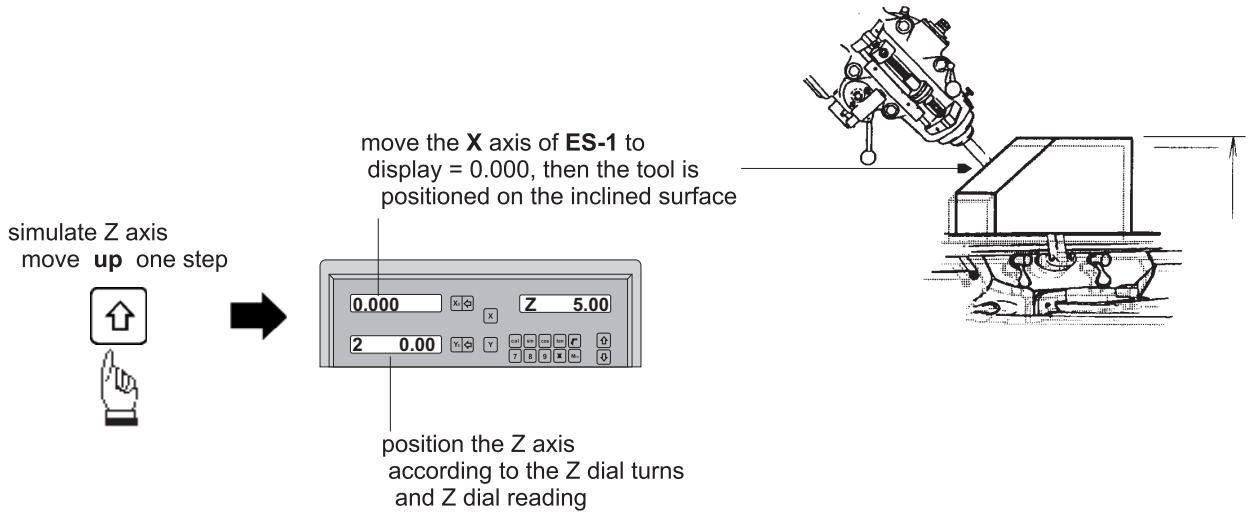
INCL - tool positioning for Inclined machining

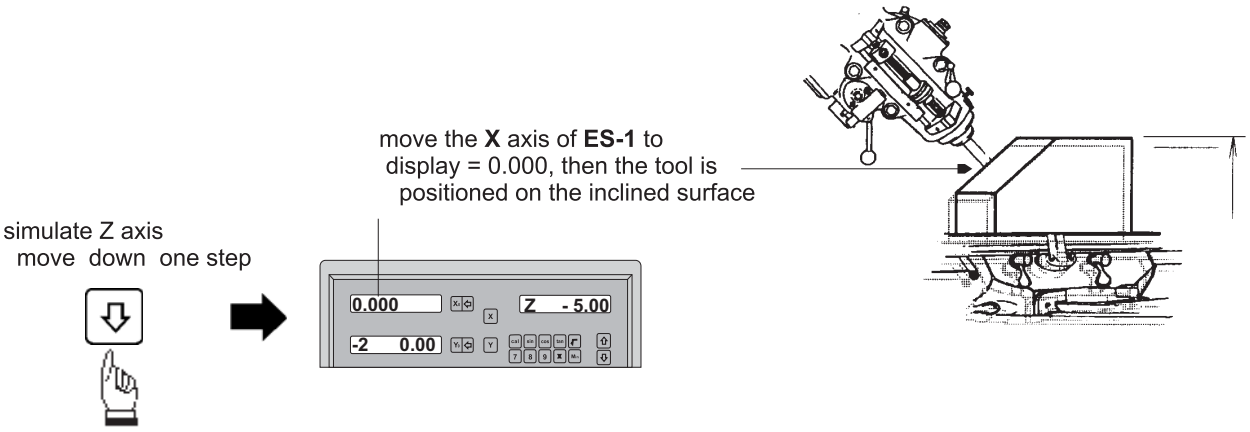


As a 2- Axis **ES-1** does not have Z Axis, the **ES-1** uses the ⇧ and ⇩ to simiulate the Z axis movement

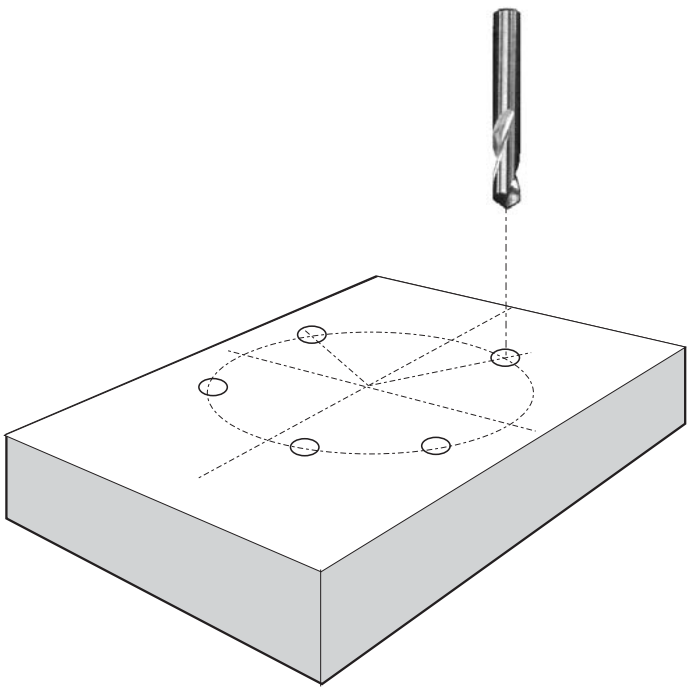
⇧ — simulate Z axis move **up** one step

⇩ — simulate Z axis move **down** one step



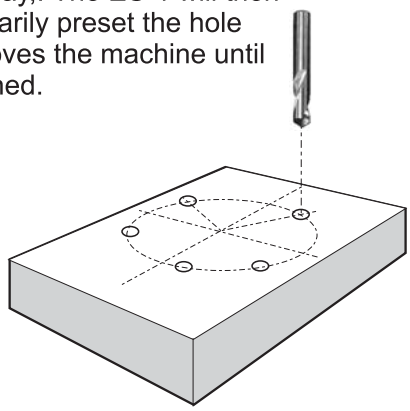


PCD - Tool positioning for Pitch Circle Diameter



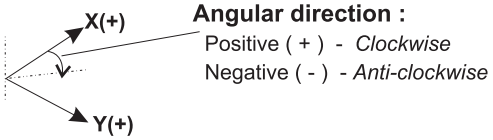
PCD - Tool positioning for Pitch Circle Diameter

Function : ES-1 provides a PCD function to for drilling holes around a Pitch Circle Diameter. The operator simply enters the following machining parameters in accordance with the step by step guides shown on the ES-1's message display,. The ES-1 will then calculate all the pitch hole position coordinates and temporarily preset the hole position coordinates to zero (0.000). The operator then moves the machine until the display axes = 0.000 and the pitch hole position is reached.



- Centre (**CENTRE**)
- Diameter (**DIA**)
- No. of Holes (**NO. HOLE**)
- Start Angle (**ST. ANG**)
- End Angle (**ENd. ANG**)

After the above machining parameters are entered into ES-1, it presets all the pitch hole positions to 0.000

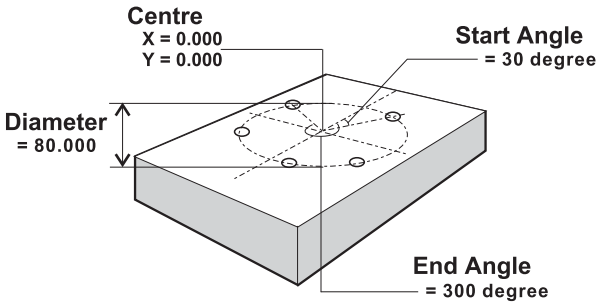


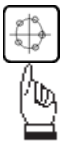
Operator can press ⇧ or ⇩ to select

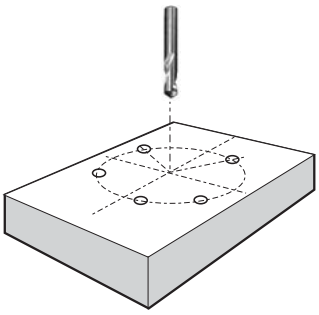
the pitch hole, and then move the machine to display = 0.000 - the pitch hole position is then reached

Example

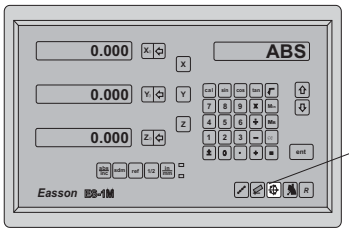
Centre Coordinate **(CENTRE) ..... X= 0.000, Y=0.000**
Diameter **(DIA) 80.000mm**
No. of Holes **(NO. HOLE) ..... 5 holes**
Start Angle **(ST. ANG) ..... 30 degree** (clockwise)
End Angle **(ENd. ANG).....300 degree** (clockwise)



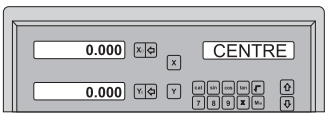
step 1 : Set up the work piece datum (work piece zero)  to enter the **PCD** function



set up work piece datum

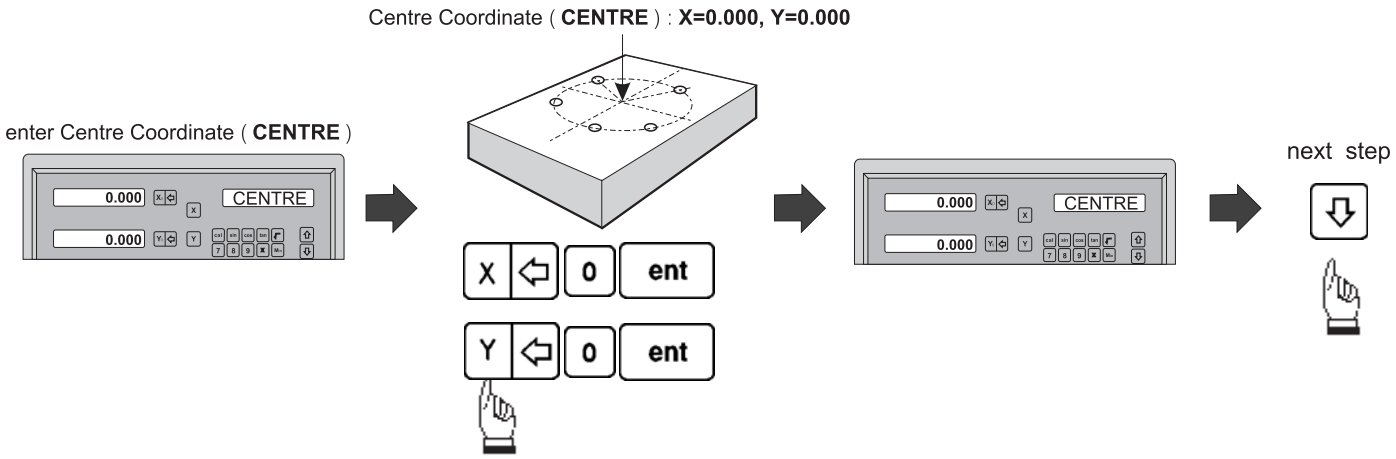


to enter the **PCD** function

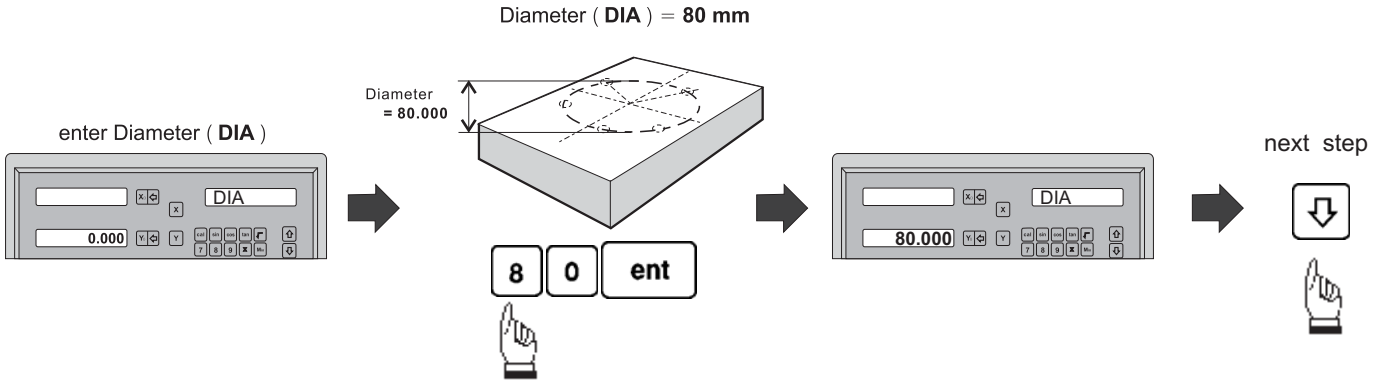


enter the **CENTRE** coordinate

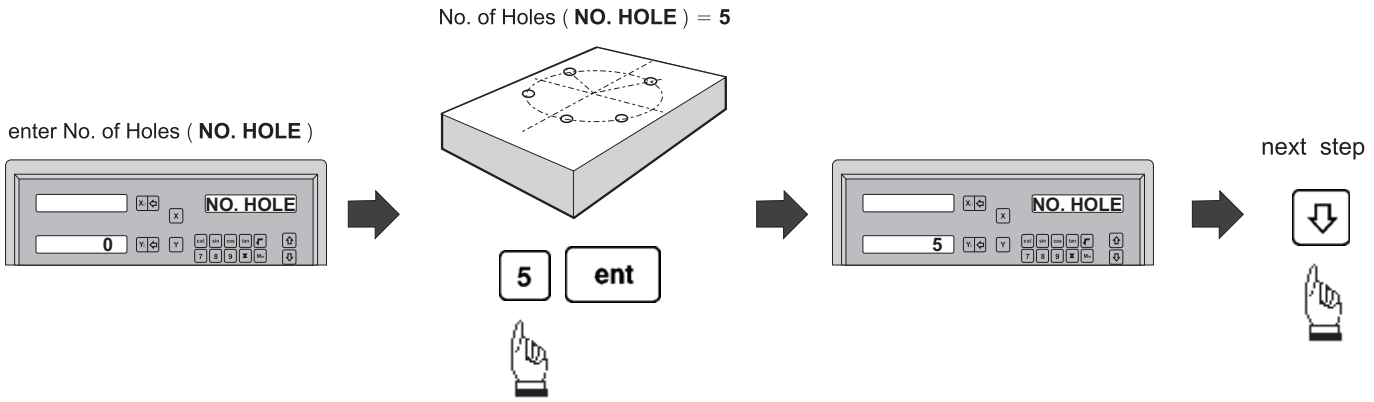
step 2 : Enter Centre Coordinate (CENTRE)



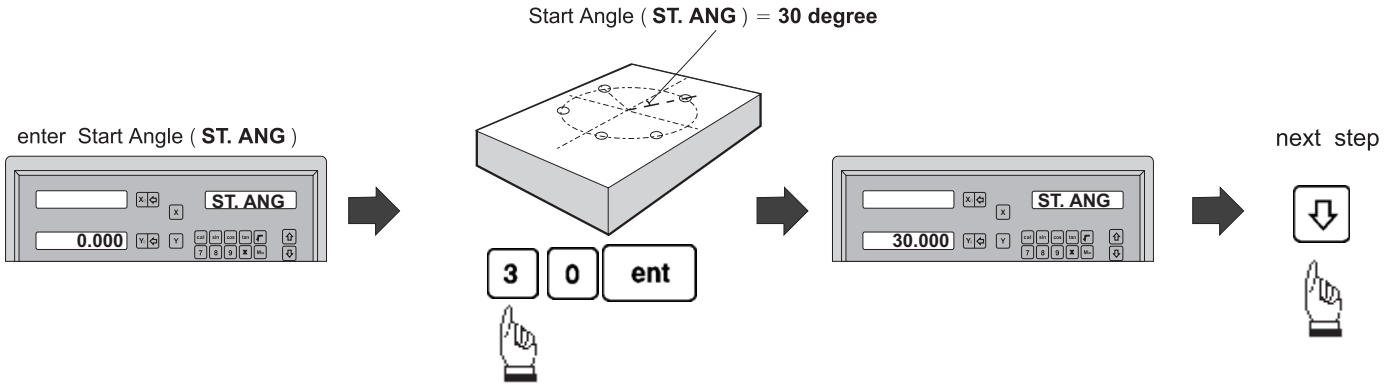
step 3 : Enter Diameter (DIA)



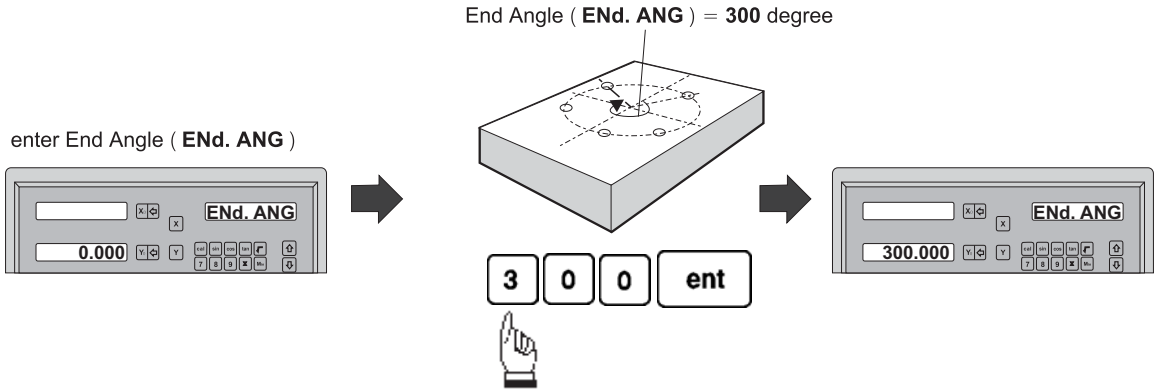
step 4 : Enter No. of Holes (NO. HOLE)



step 5 : Enter the Start Angle (**ST. ANG**)



step 6 : Enter the End Angle (**ENd. ANG**)

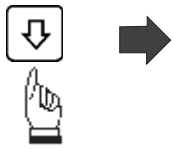


All PCD machining parameters are already entered into ES-1 ⇩ **to enter into PCD drilling mode**

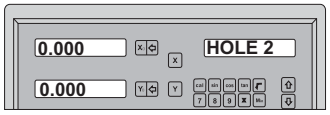
Operator can ⇧ or ⇩ to select the pitch hole, then move the machine to display = 0.000, to reach the pitch hole position

PCD - Tool positioning for Pitch Circle Diameter

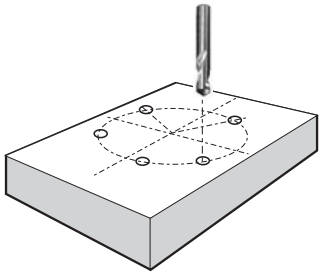
Next Pitch hole



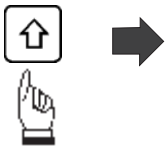
move the machine to display = **0.000**



HOLE 2 = picth hole no. 2

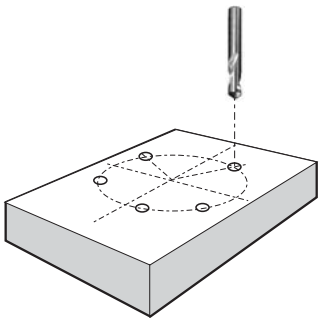


Last Pitch hole



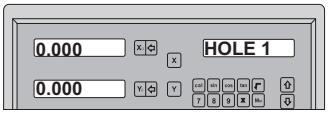
move the machine to display = **0.000**

HOLE 1 = picth hole no. 1

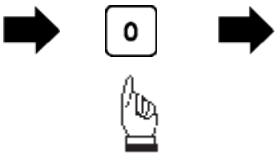


Anytime the operator wants to check or verify that the **PCD** calculation is correct, or wants to temporarily exit the **PCD** function cycle (swap to normal XYZ display).
The operations are as follows :.

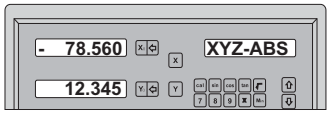
presently in **PCD** cycle



temporarily ***swap*** to normal XYZ coordinate display

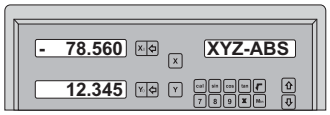


temporarily return to XYZ coordinate display

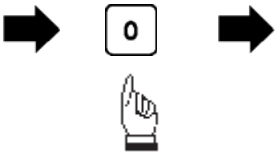


swap back to PCD cycle to continue the **PCD** hole drilling

presently in the temporarily XYZ coordinate display



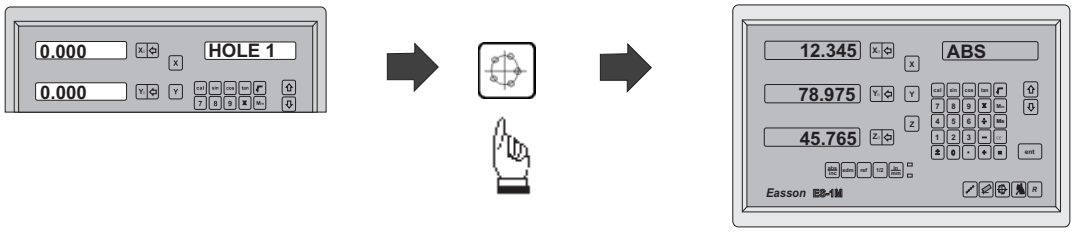
swap back to **PCD** function cycle



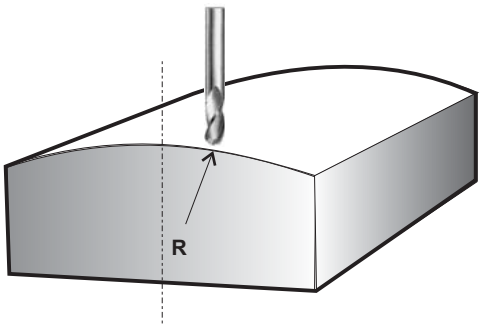
return to **PCD** function cycle

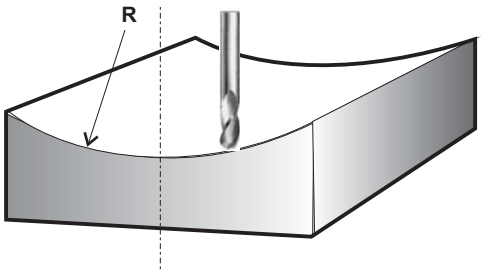
To leavet the PCD function, after the PCD hole drilling operation is completed follow the under-mentioned procedure:

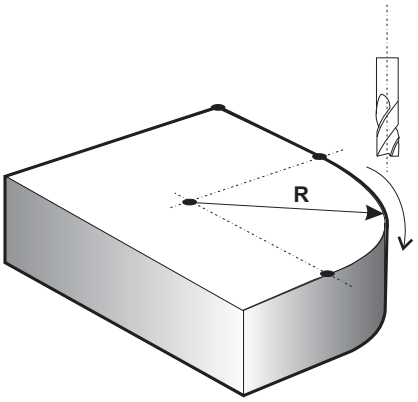
presently in **PCD** function cycle



Tool positioning for ARC machining







Tool positioning for ARC machining

function : It is quite common to need to machine round a corner or an arc surface in the course of a day's work, especially in mould making.

If the arc surfaces are complicated or a number of round corners have to be precisely machined, or arc or round corners are to be machined, then CNC milling machine should be used.

There are still a lot of the cases, however, that only a simple arc surface or one or two round corners need to be machined and the precision of those arc or round corners machining are not demanding (especially in mould making). If we do not have a CNC machine in house, it is then more cost effective and time saving to carry out simple arc or round corners machining on your manual milling machine in-house rather than sub-contract it as CNC machining externally.

In the past, many mould makers made their tool positioning calculations for ARC machining with a scientific calculator. But the process is time consuming and easily prone to mistakes.

ES-1 features has a very easy-to-use tool positioning function for ARC machining which enables mould makers to machine simple ARC in the shortest possible time. But before you make your decision to use the ARC function or to have your work piece to be machined in a CNC machine, please bear in mind that ARC function is only cost effective and time saving under following conditions

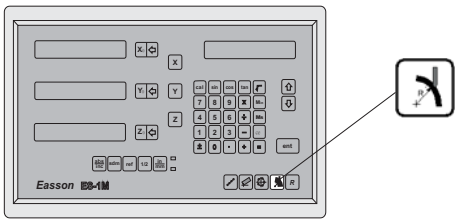
1) **One off job**
2) **Only simple ARC surface or round corners to be machined.**

.

ARC functions groups

In ES-1, the ARC function group consists of two functions as follows

R function



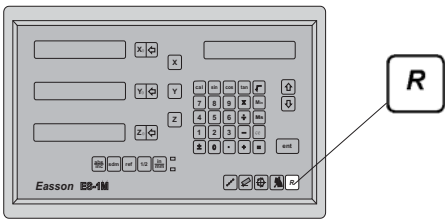
R function provides maximum flexibility in ARC machining, the ARC sector to be machined is defined by the co-ordinates of :

1) ARC centre ; 2) ARC Radius ; 3) ARC start point
4) ARC end point

Advantage :
- Very flexible, R function can machine virtually all kinds of ARC, even the intersected ARCs.

Limitation :
- Relatively complicated to operate, operator needs to calculate and enter the co-ordinates of ARC centre, start point and end point into ES-1.

Simplified R function



The ES-1's ARC function is aimed at machining only simple ARC or round corners, and to make the operation really very easy for the operator, the ES-1 presets the eight type of most frequently-used ARC machining processes.

Advantage :
- Very easy to use, operator doesn't need to calculate the ARC parameters, just position the tool at the start point, and then he can start the ARC machining immediately.

Limitation :
- Restricted to eight type of preset ARC only, cannot machine more complicated ARC such as intersected ARCs.

Understanding the Co-ordinate System :

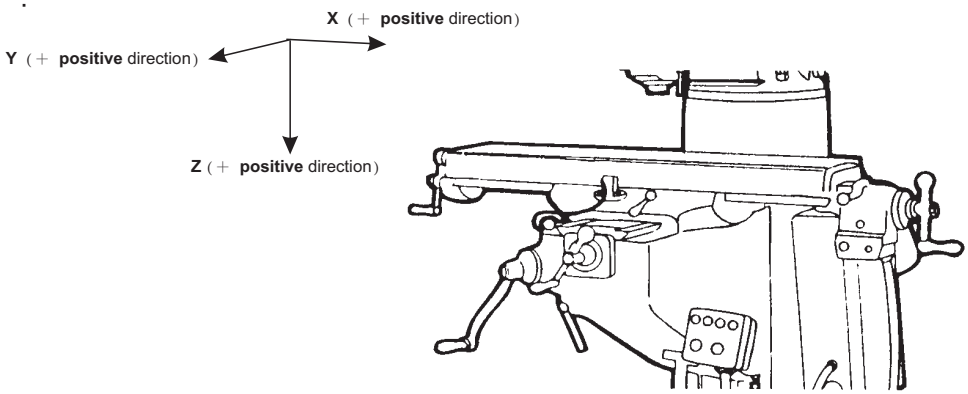
For those operator who do not have experience in CNC programming, or the first time user of ES-1's R functions, they may find that it is difficult to understand what is meant by "co-ordinate".

The co-ordinate is a pair of numbers which specify a position on a surface.

When using ES-1's R function, it is necessary to enter the co-ordinates of ARC center, start point, end point and etc. to let ES-1 know the geometry of the ARC to be machined.

During installation, the engineer will set the display direction same the the dial of the machine. For a Taiwanese made knee-type machine, because of the lead screw dial direction, the ES-1display directions are also be normally set as follows

.

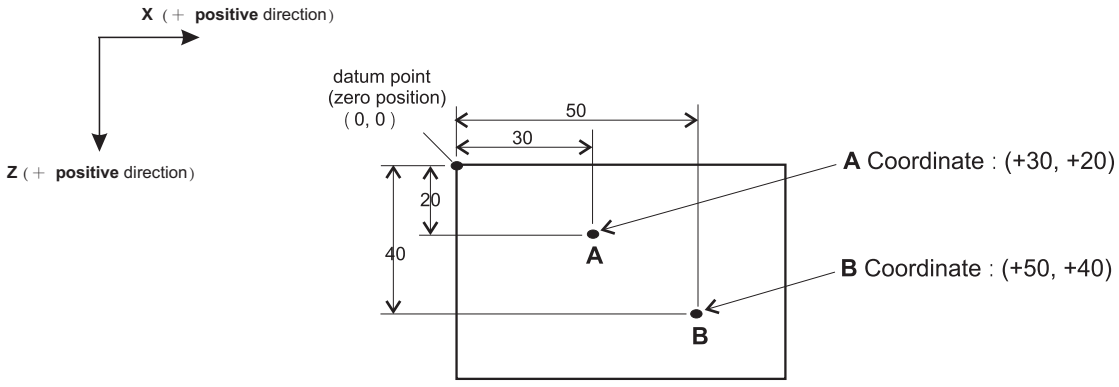


-- NOTICE --

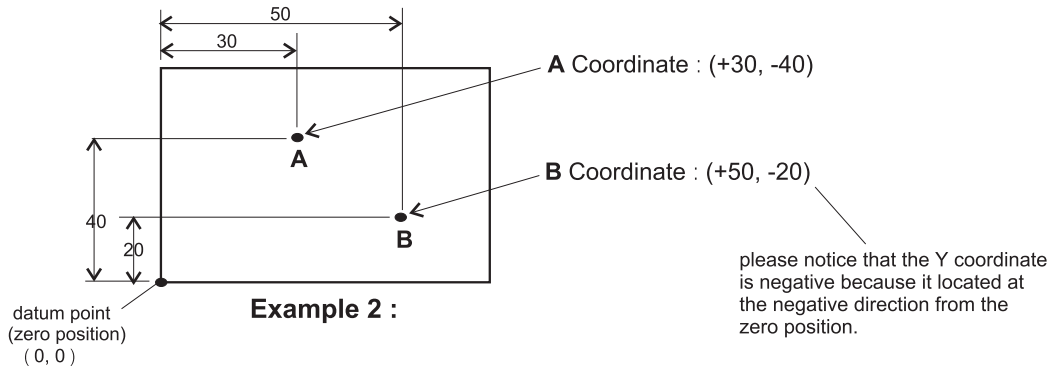
Co-ordinate have signs to specify its' relative location from zero.

Co-ordinate Example

Co-ordinate is a pair of number which specify the distance from the datum point (zero position), the number can be either be positive or negative and depends on the direction relative to the zero position

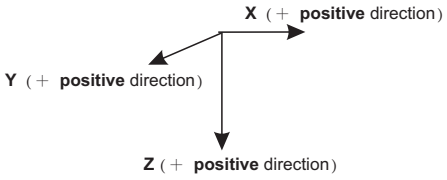


Example 1 :

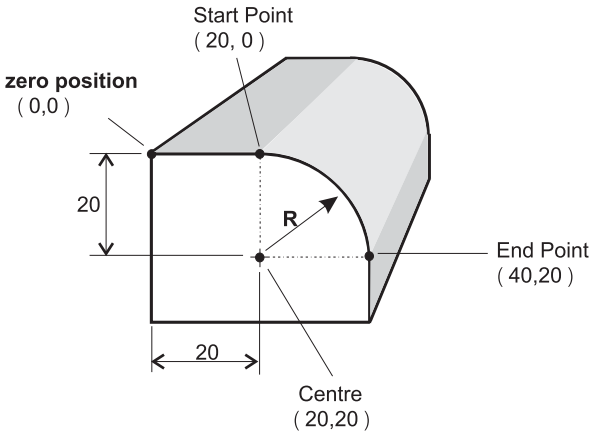


Example 2 :

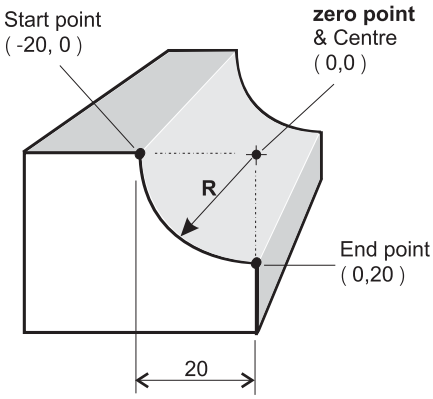
R function



Example 3 :

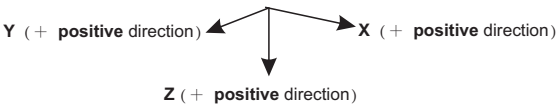


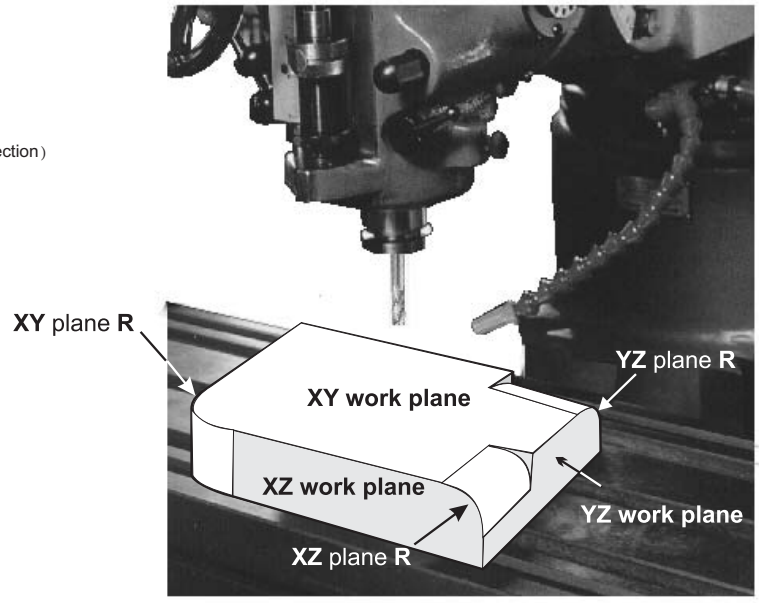
Example 4 :



Work plane :

The R function of ES-1 allows the operator to machine R in XY, XZ & YZ plane as the illustration shows. Even for 2 axis DRO, ES-1 can calculate all the ARC machining positions on XZ & YZ work-planes. It is necessary, therefore, to select the work-plane required as one of the machining parameters entered into the ES-1 during in R function data entry.

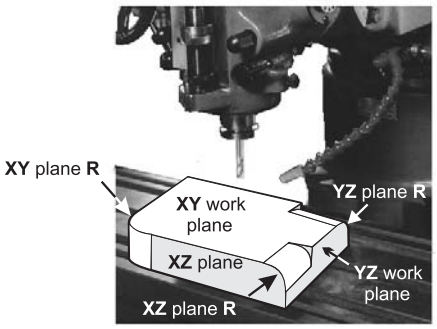




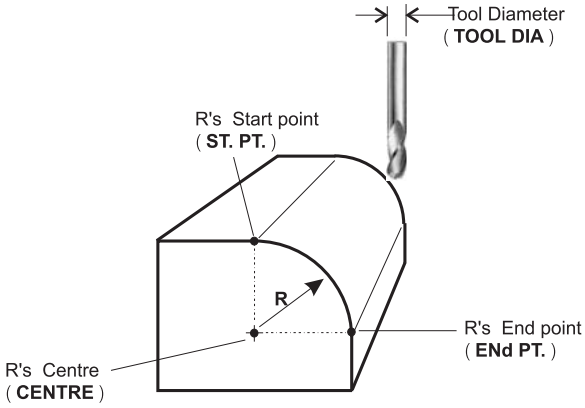
R function

Following parameters need to be entered into ES-1 for ARC machining :

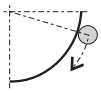
1. Select work plane - **XY, XZ** or **YZ** plane **R**



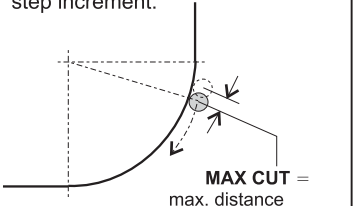
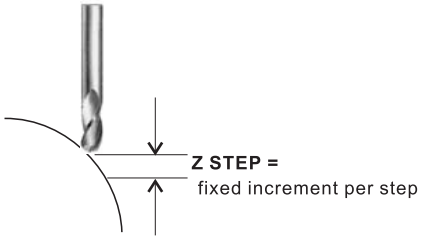
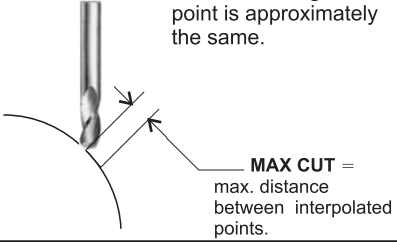
2. R's Centre (**CENTRE**)
3. R's Radius (**R**)
4. R's start point (**ST. PT.**)
5. R's end point (**ENd PT.**)
6. Tool Diameter (**TOOL DIA**)



7. Select Tool radius compensation (**R+TOOL**) or (**R-TOOL**)

	(R+TOOL)	(R-TOOL)
XZ / YZ plane **R**		
XY plane **R**		

8. machining step Increment

XY plane **R**	**XZ / YZ** plane **R**	
For XY plane R, Max. distance between interploated points is to be specified as the machining step increment.  **MAX CUT** = max. distance between interpolated points.	For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.  **Z STEP =** fixed increment per step	For XZ/YZ plane R, under smooth R option selected. ES-1 will calculate the Z step increment so that the Max. distance between each machining point is approximately the same.  **MAX CUT** = max. distance between interpolated points.

R function

Example :

To machine an **XZ** plane **R** using a 2 Axis **ES-1**

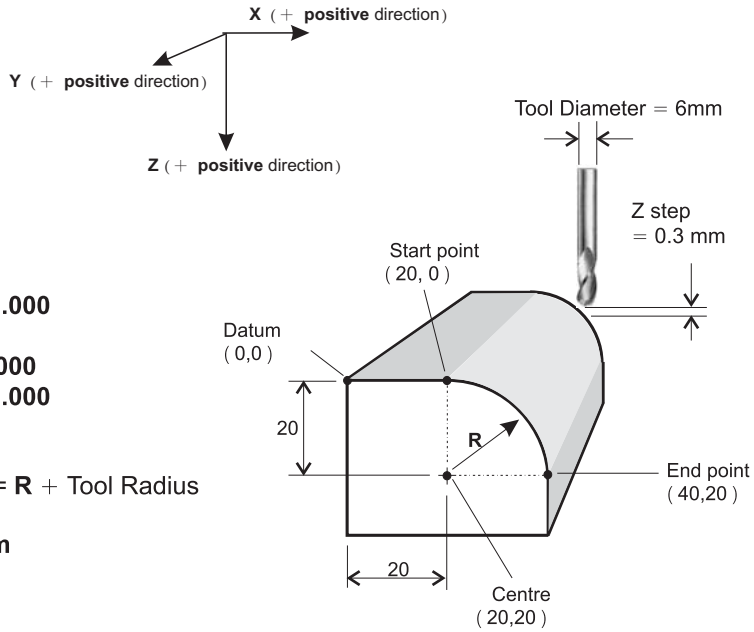
The following machining parameters have to be entered into the **ES-1** :

1. select **XZ** plane **R** **(S.R - XZ)**

2. Centre **(XZ CENTR) ..... X = 20.000, Z = 20.000**
3. Radius **(R) 20.000**
4. Start point **(XZ ST. PT) ..... X = 20.000, Z = 0.000**
5. End Point **(XZ ENd P) ..... X = 40.000, Z = 20.000**
6. Tool diameter **(TOOL DIA) ..... 6.000 mm**

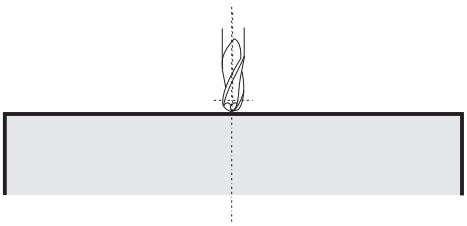
7. Tool Compensation-**(R+TOOL)**, Actual ARC Radius = **R** + Tool Radius

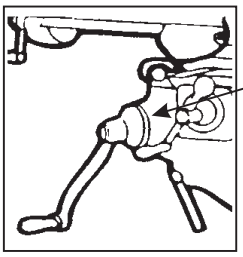
8. **Z** incremental step machining **(Z STEP) ..... 0.3 mm**



Operation Example

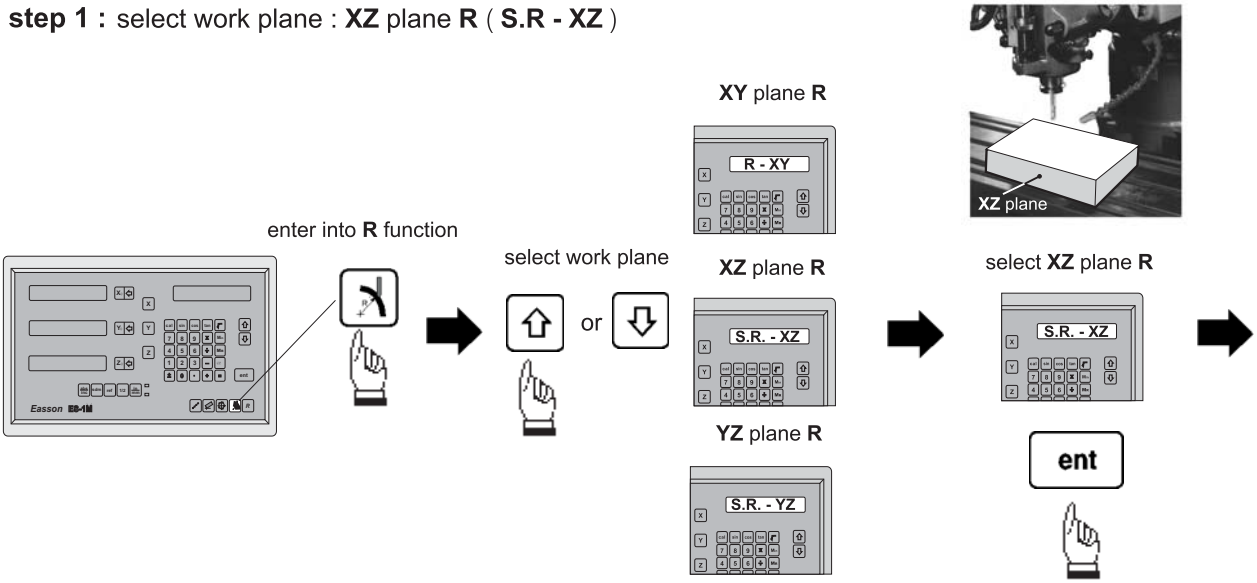
Position the tool at the start point of the ARC



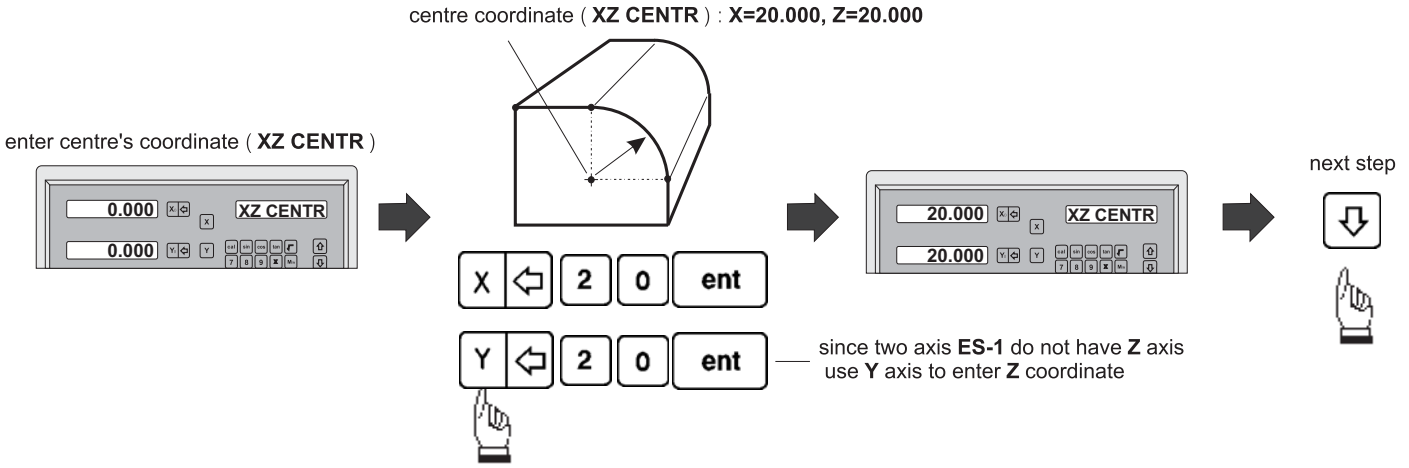


Set the Z axis dial to Zero (0.000)

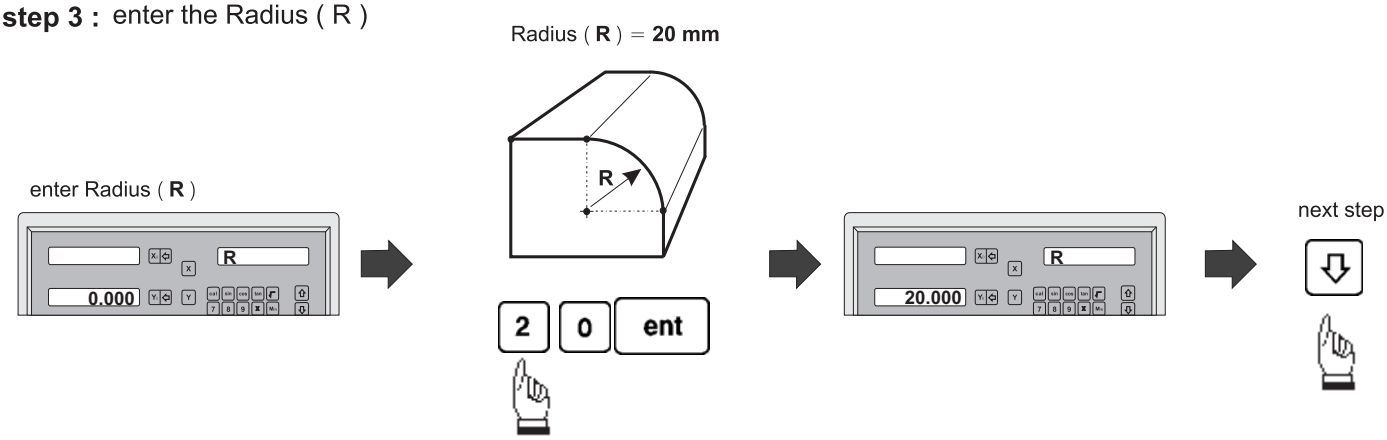
step 1 : select work plane : **XZ** plane **R** (**S.R - XZ**)



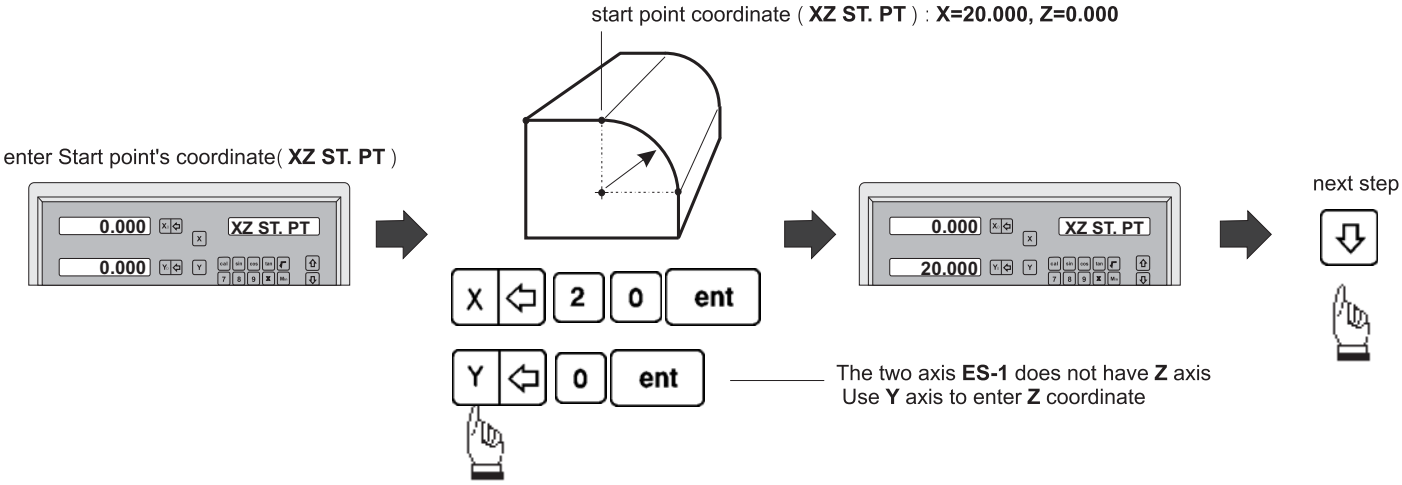
step 2 : enter the Centre's co-ordinate (**XZ CENTR**)



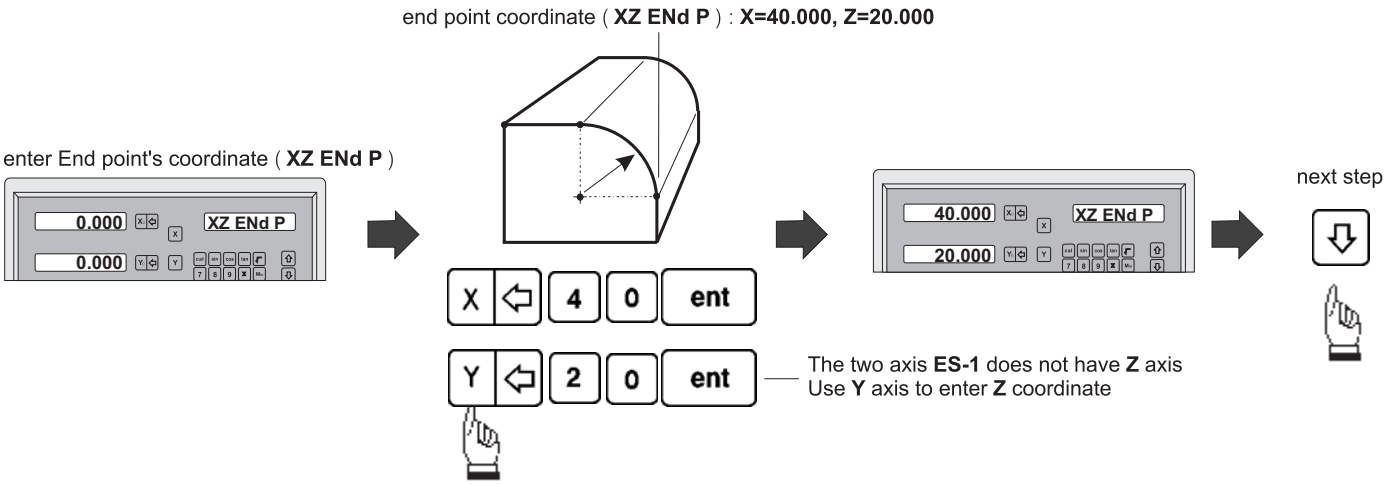
step 3 : enter the Radius (R)



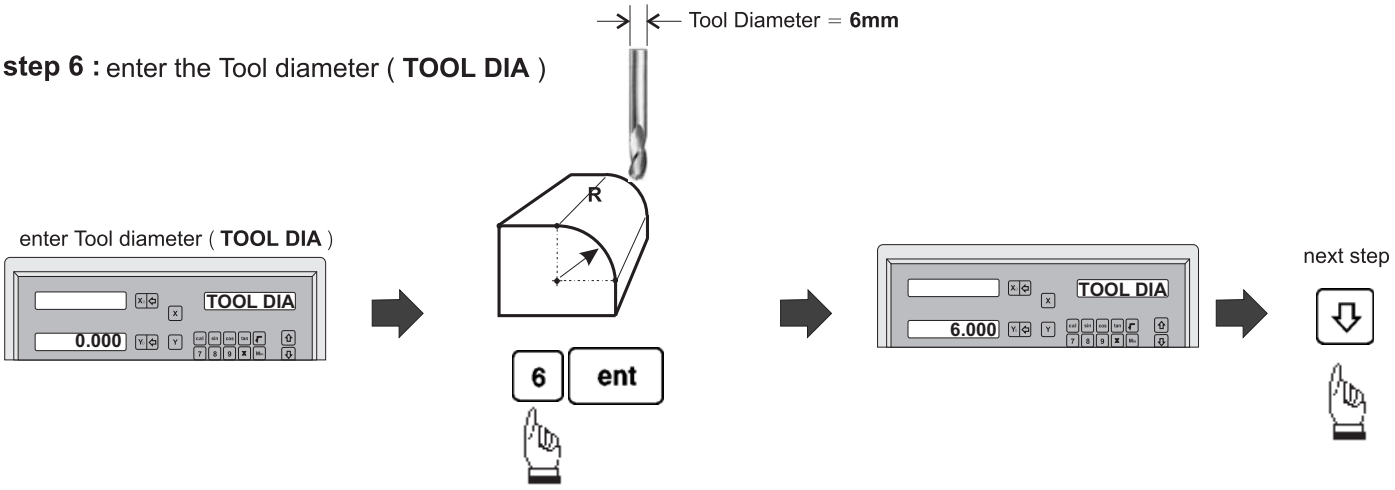
step 4 : enter the Start point co-ordinate (**XZ ST.PT**)



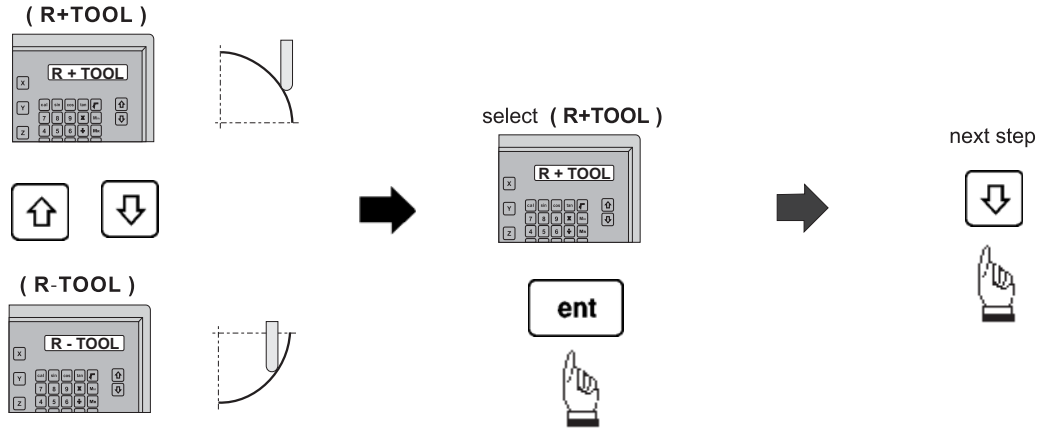
step 5 : enter the End point's coordinate (**XZ End P**)



step 6 : enter the Tool diameter (**TOOL DIA**)



step 7 : select tool compensation direction

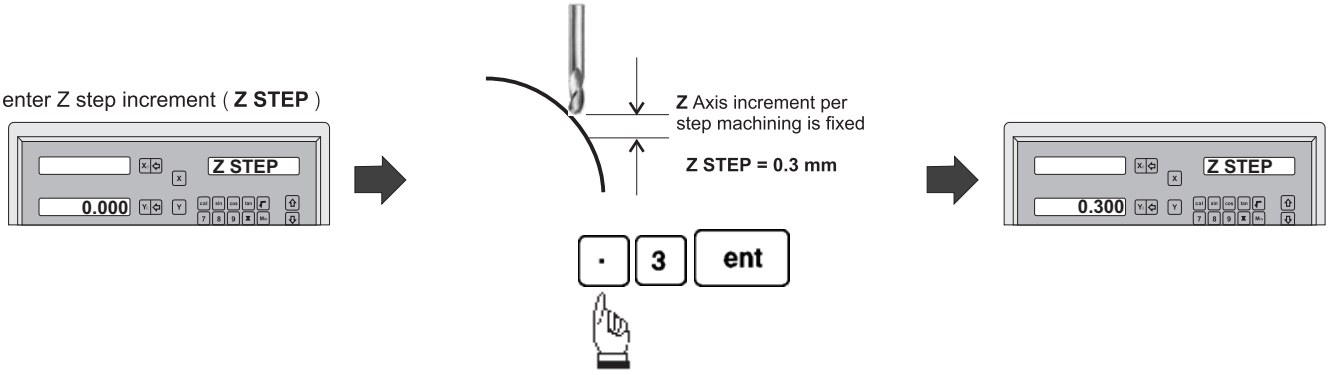


step 8 : enter Z incremental step machining

ES-1 provides two options on the Z incremental step machining. The Operator can enter select the smooth R function which best suits the job.

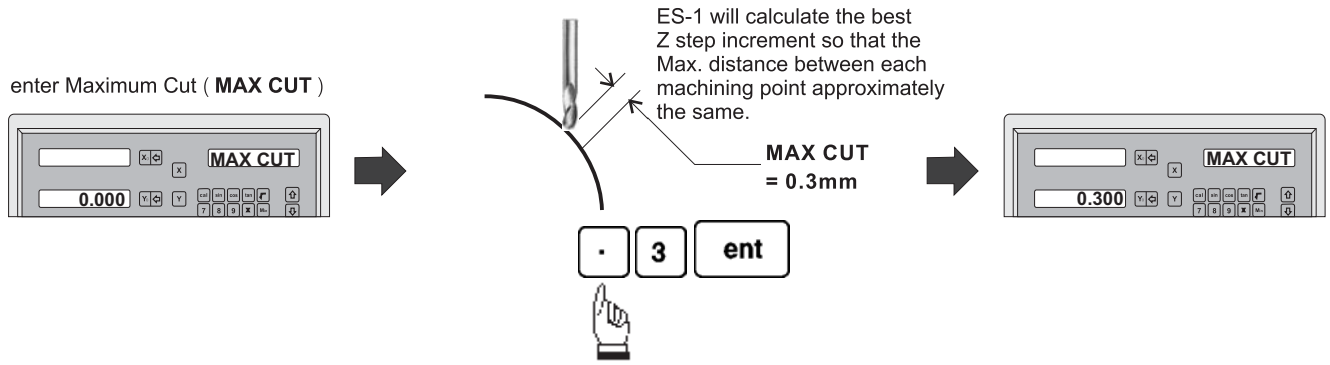
Option 1 : Fixed Z step (**Z STEP**)

The Z increment per step machining is fixed, and as the ARc's curvature varies with their Z position, the operator has to use their experience to select different Z STEP increments during the ARC machining to get the optimal, fast machining



Option 2 : Maximum Cut (**MAX CUT**)

Under this option, ES-1 will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.



All R funtion machining parameters have already entered into ES-1

to enter into ARC machining mode

The two Axis **ES-1** does not have a Z Axis, therefore, **ES-1** uses the  and  to simulate the Z axis movement

 — simulate Z axis move **up** one step

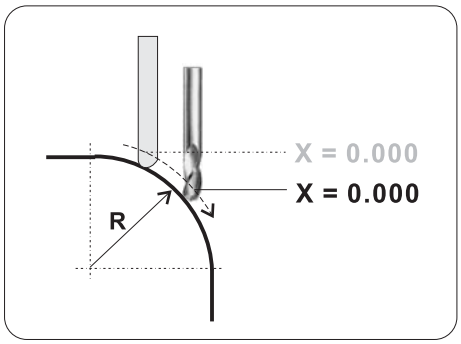
 — simulate Z axis move **down** one step

before the start of ARC machining, please ensure the tool is positioned at the ARC starting point and Z axis dial is set to zero (0.000)

two axis **ES-1 - ARC** machining mode

During the XZ or YZ plane R machining, it is necessary to accurately position the Z axis. However, as there is no Z axis in a two axis ES-1, and guide the operator easily to position the Z axis during the ARC machining, ES-1 uses the unused axis display to show the **Z dial turn number** and **Z dial reading.**.

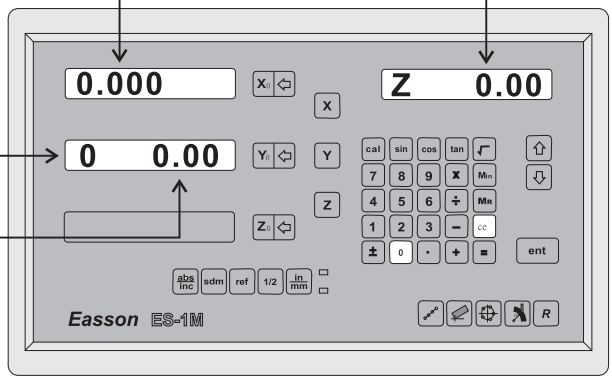
At the begining of the ARC machining, the ES-1 will assume the Z axis dial is at zero position with the tool positioned at the starting point of the ARC. then press the ⇧ and ⇩ once to simulate Z axis move up or down one step, the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator then moves the Z axis according the dial reading displayed on this axis, until the correct Z axis height is reached..



Move the X axis until display = 0.000, then the tool is positioned on the ARC curve

The display will **shift left** to signify it is not normal coordinate display.

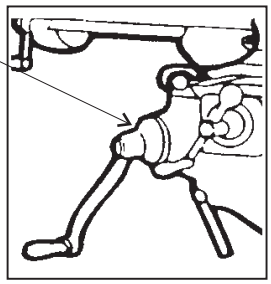
Z axis simulated height



Z dial turn number

Z dial reading

move the Z axis according to the dial settings displayed on Y axis



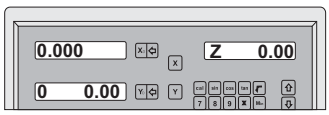
Display data in **XZ** plane **R** machining mode

If the **Z** axis is positioned outside the **R** curvature, the **ES-1** will display "**Z OU LI**" (**Z OUT LIMIT**)

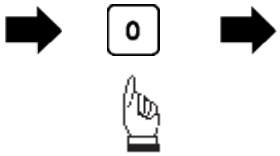
R function

If the operator wants to verify if the ES-1's **R** calculation is correct , or wants to temporarily exit the **R** function cycle (swap to normal XYZ display). The procedure is as follows :.

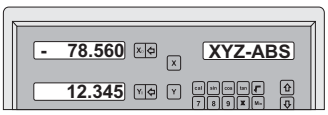
presently in **R** cycle



temporarily ***swap*** to normal XYZ coordinate display

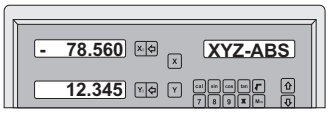


temporarily return to XYZ coordinate display

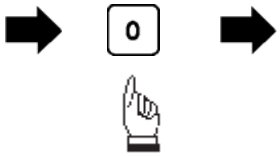


swap back to R cycle to continue the **R** machining mode

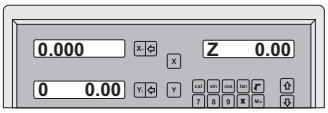
presently in the temporarily XYZ coordinate display



swap back to **R** function cycle



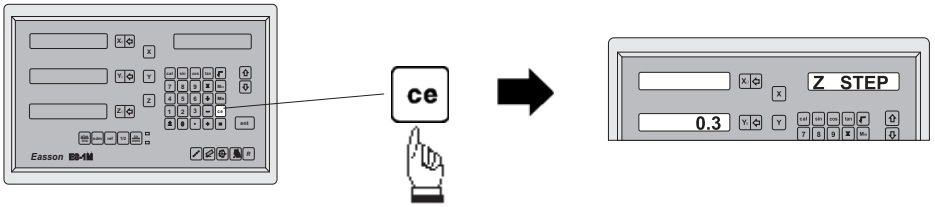
return to **R** function cycle

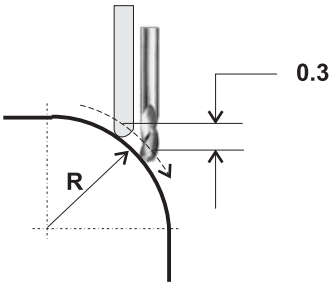


If fixed **Z STEP** option choosed, the **Z STEP** increment can be change anytime during the ARC machining

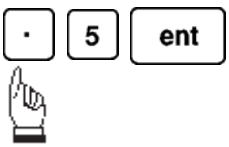
change the **Z STEP**

currently **Z STEP** increment = **0.3 mm**

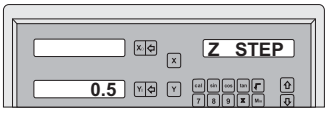


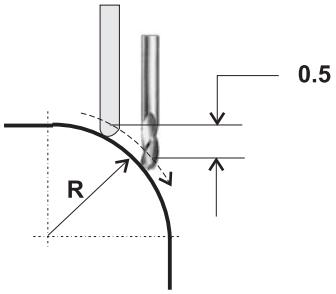


Change **Z STEP** increment to = **0.5 mm**



now the **Z STEP** increment = **0.5 mm**





R function

Example :

To machine an **XY** plane **R** using a 2 Axis **ES-1**

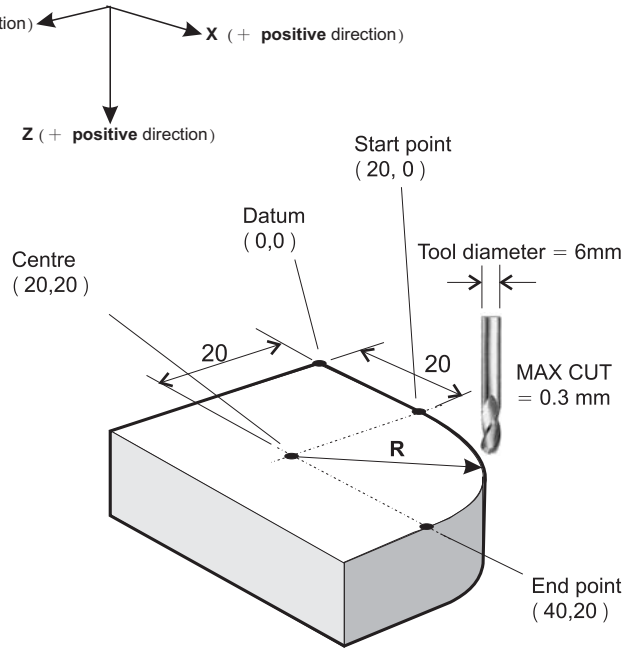
Following machining parameters have to be entered into the **ES-1** :

1. select **XY** plane **R** **(R. - XY)**

2. Centre **(CENTER) ..... X = 20.000, Y = 20.000**
3. Radius **(R) 20.000**
4. Start point **(ST. PT) ..... X = 20.000, Y = 0.000**
5. End point **(ENd PT) ..... X = 40.000, Y = 20.000**
6. Tool diameter **(TOOL DIA) ..... 6.000 mm**

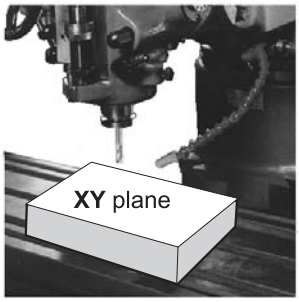
7. Tool Compensation - **(R+TOOL) :**
   Actual ARC Radius = **R** + Tool Radius

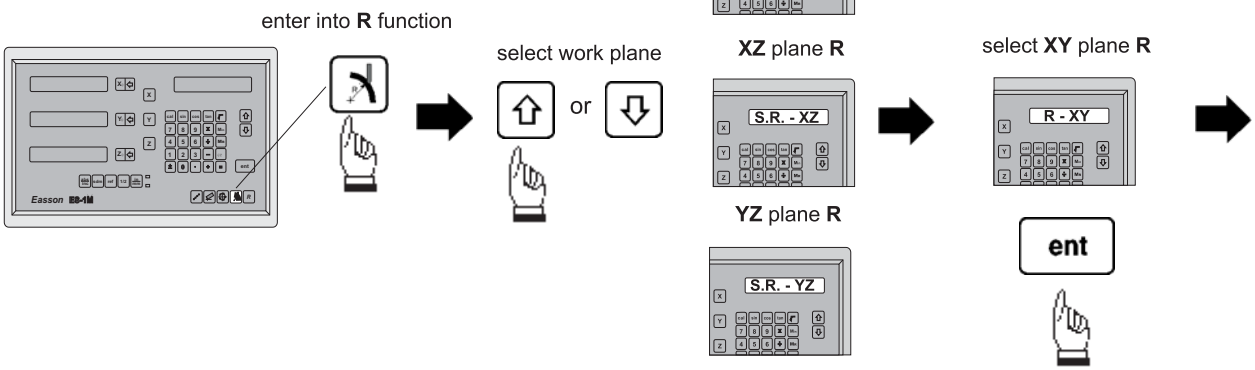
8. Max. Cut between Interpolated points **(MAX CUT) .... 0.3 mm**



Operation Example

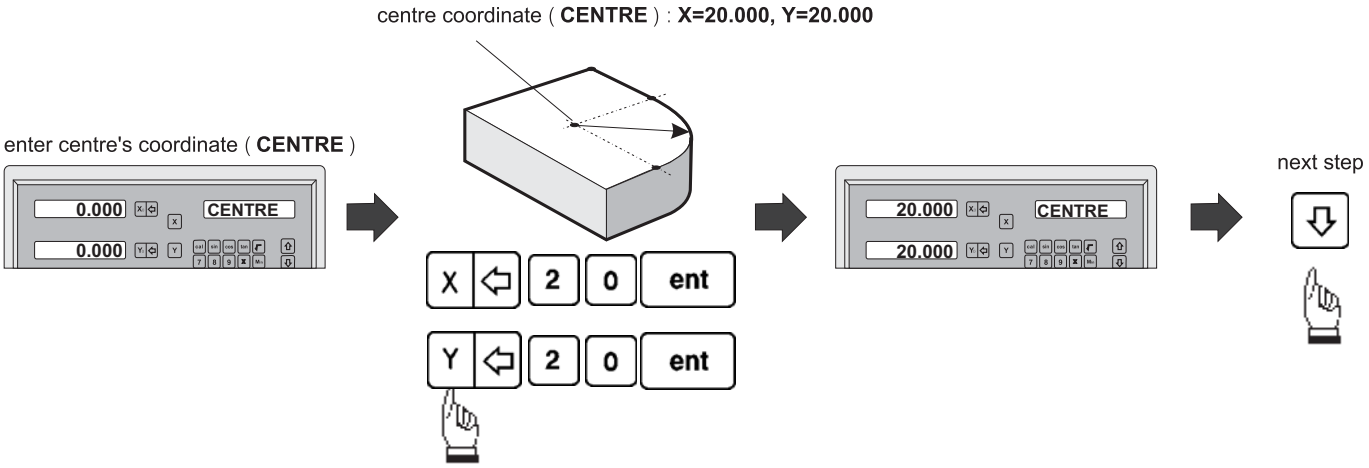
step 1 : select **XY** plane **R** (**R. - XY**)



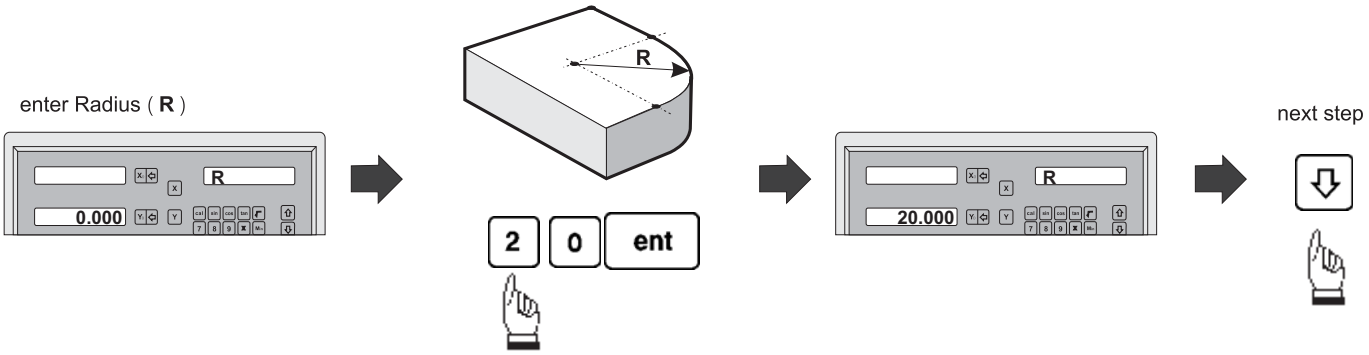


R function

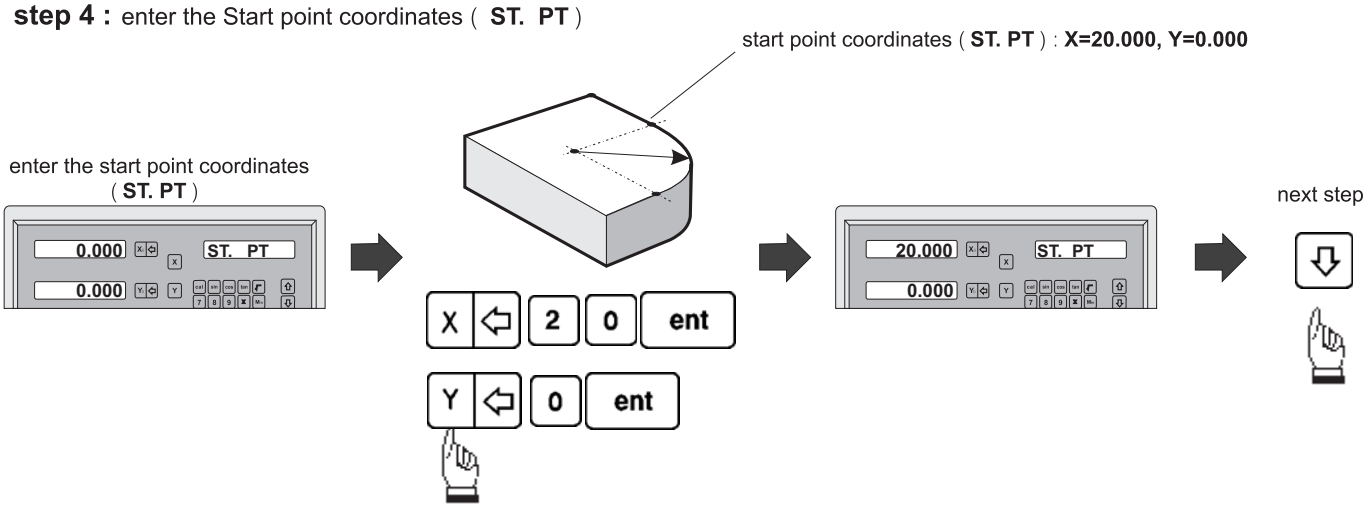
step 2 : enter the centre coordinates (**CENTRE**)



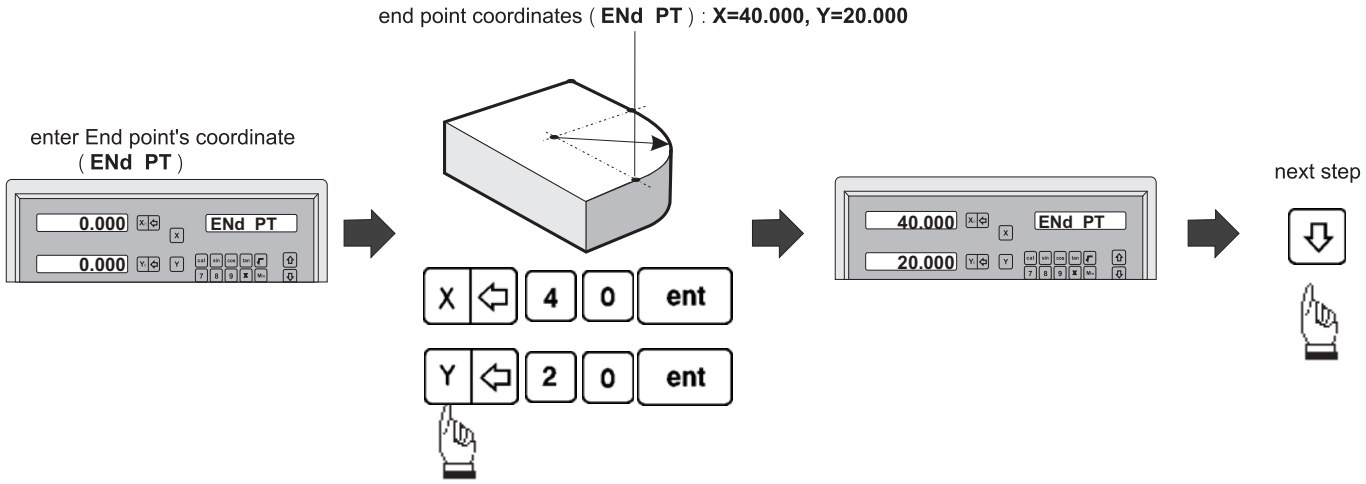
step 3 : enter the Radius (**R**)



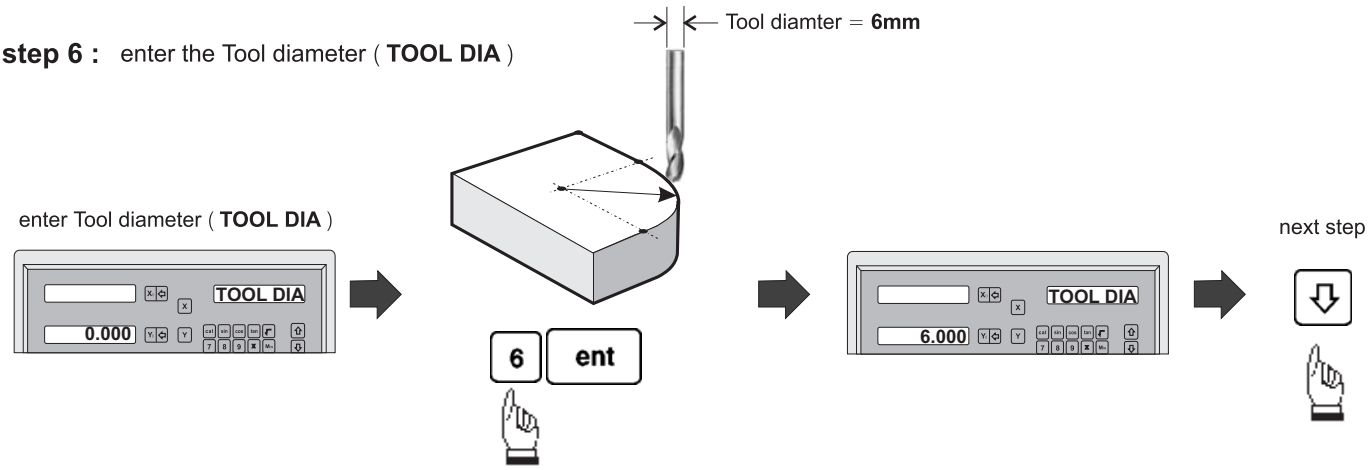
step 4 : enter the Start point coordinates (**ST. PT**)



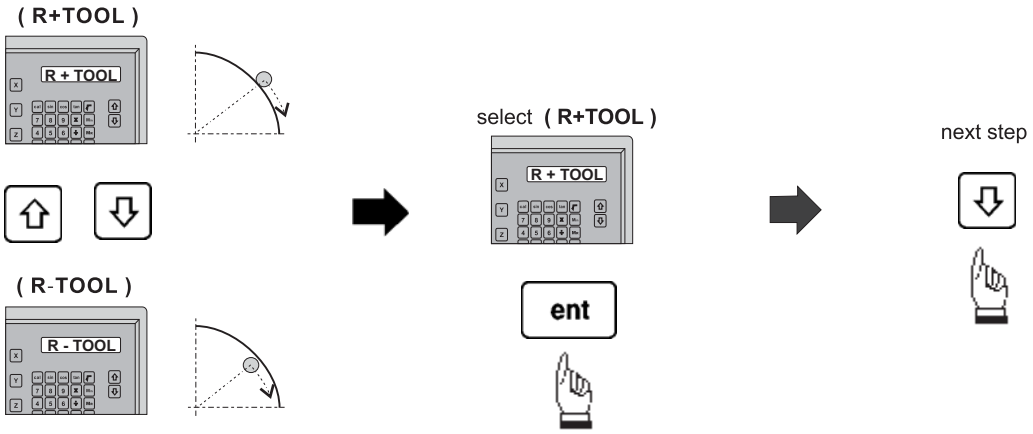
step 5 : enter the End point coordinates (**ENd PT**)



step 6 : enter the Tool diameter (**TOOL DIA**)

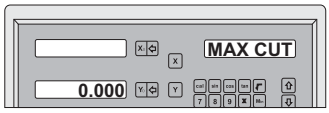


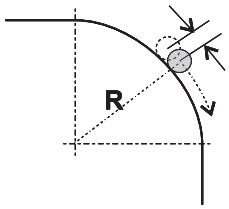
step 7 : select tool compensation direction



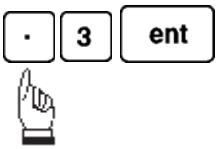
step 8 : enter Max. Cut between interpolated points (**MAX CUT**)

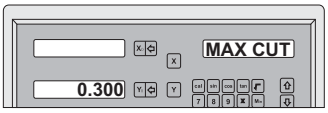
enter Max. Cut (**MAX CUT**)





MAX CUT = 0.3 mm





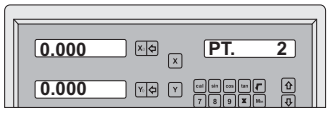
All R funtion machining parameters have already been entered into the ES-1

to enter into ARC machining mode

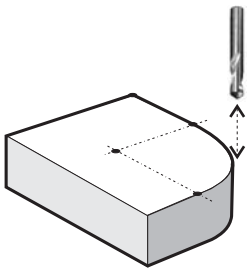
Operator can  or  to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, to arrive at the ARC curvature position.

next **R** point

move the machine to display = **0.000**

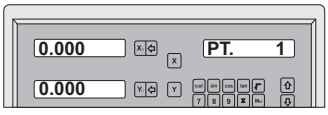


PT. 2 = interploated point No.2

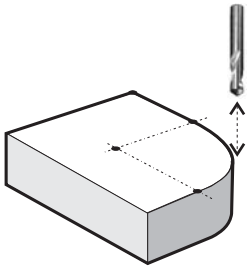


last **R** point

move the machine to display = **0.000**



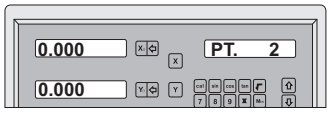
PT. 1 = interploated point No.1



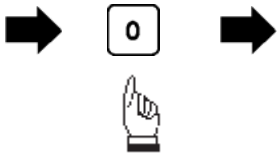
R function

If the operator want to verify if the ES-1's **R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XYZ display). The procedure is as follows :.

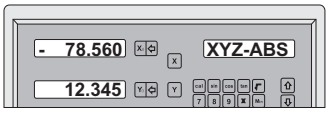
presently in **R** cycle



temporarily ***swap*** to normal XYZ coordinate display

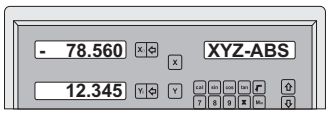


temporarily return to XYZ coordinate display

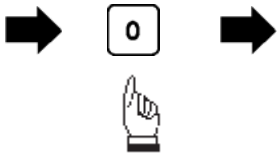


swap back to R cycle to continue the **R** machining mode

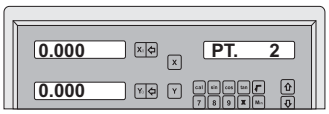
presently in the temporarily XYZ coordinate display



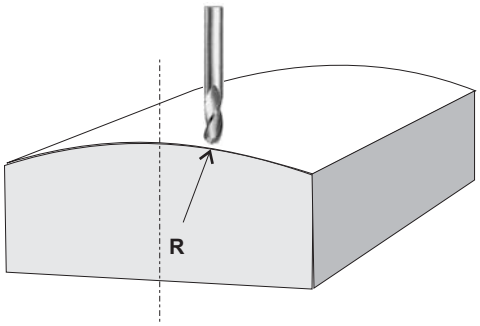
swap back to **R** function cycle

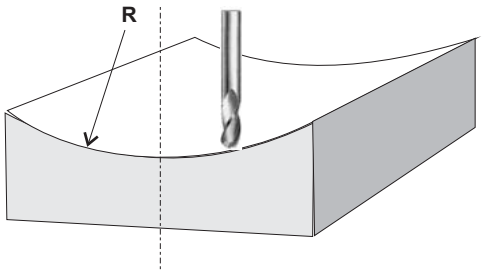


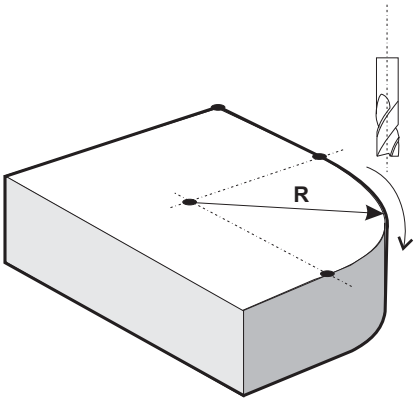
return to **R** function cycle



Simplifiied R function





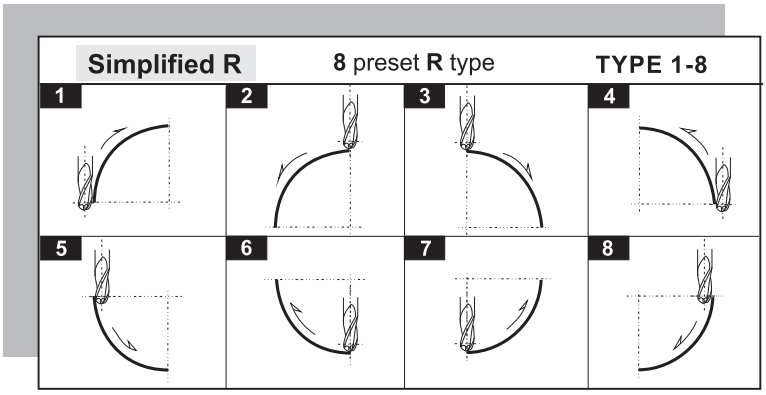


Simplified R function

function : The R function of ES-1 has been designed to machine simple ARC, We have discovered and concluded from our years of experience in DRO, that in over 95% of cases, our customer only use the ES-1 to machine extremely simple ARC. This is because they found that the parameters entry of an R function was too complicated for them.

The new-design ES-1 provides a very easy-to-use R function to enable the operator to machine simple R in a very short time.

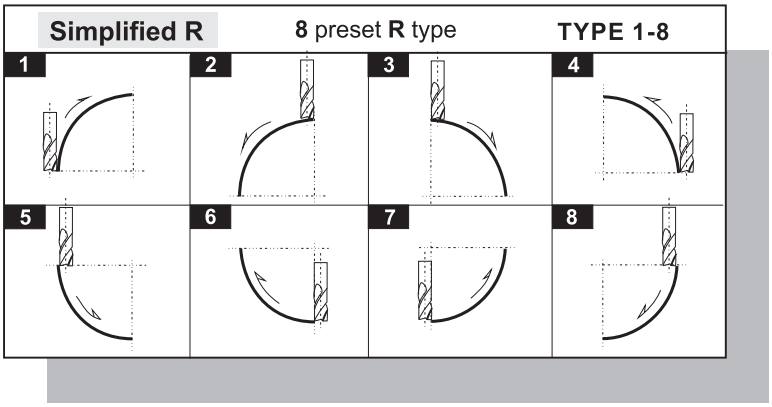
In majority of cases, only eight types of ARC are used for machining. The ES-1 has therefore incorporated those 8 type of R, and the operator must just select the type of R they need to machine their part, and input the Radius, tool compensation and increment per machining step. Then they can immediately begin ARC machining.

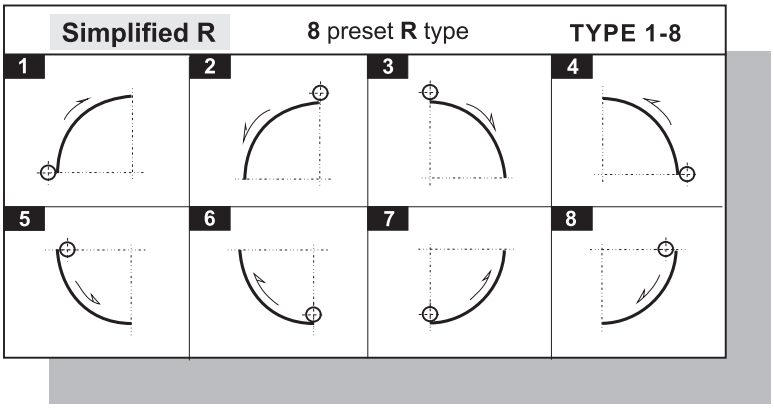


Using Ball Nose slot drill
to machine **XZ/YZ** plane **R**

Using 4 Flute End Mill
to machine **XZ/YZ** plane **R**

please notice that when using flat end end mill to machine R, as we are actually using the sharp corner for cutting, therefore the TOOL DIA must be set to 0.000



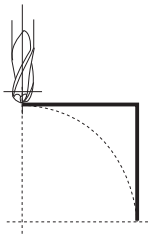


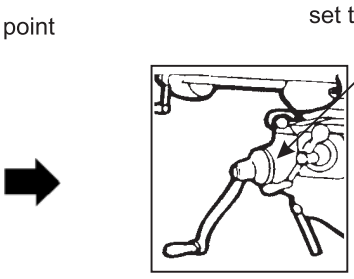
Using two Flute(**SLOT DRILL**)
for **XY** plane **R**

Simplified R function

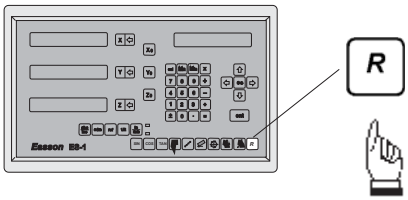
The operation procedures of Simplified R are as follows

positions the tool at the ARC starting point



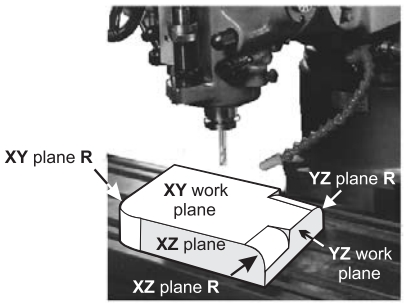


enter into Simplified R function

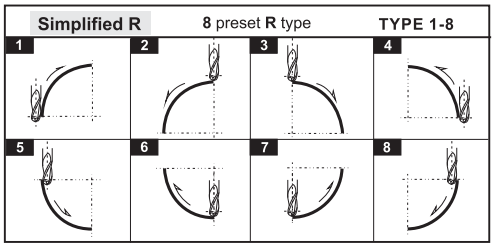


Following parameters needed to enter into ES-1 for ARC machining :

1. Select work plane - **XY, XZ** or **YZ** plane **R**

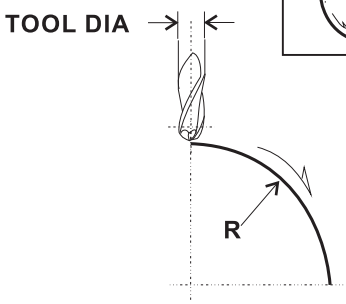


2. Select the R type (**R TYPE**) - Type 1 to 8

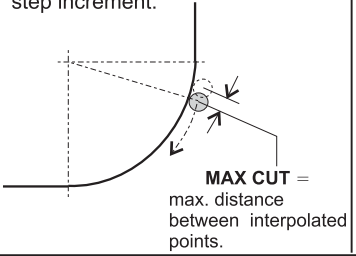
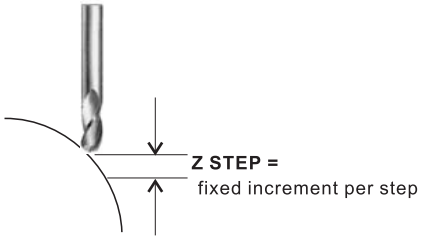
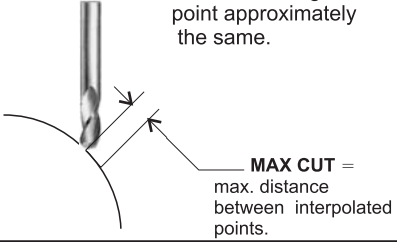


3. Radius (**R**)

4. Tool diameter (**TOOL DIA**)



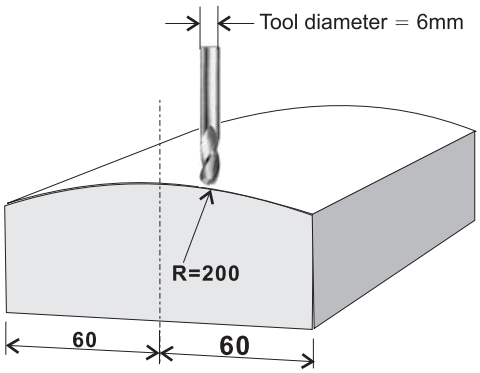
5. Machining step Increment

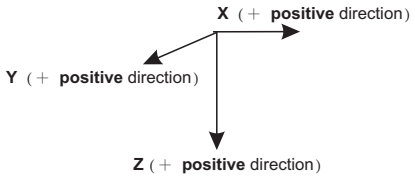
XY plane **R**	**XZ / YZ** plane **R**	
For XY plane R, Max. distance between interpolated points is to be specified as the machining step increment.  **MAX CUT** = max. distance between interpolated points.	For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.  **Z STEP =** fixed increment per step	For XZ/YZ plane R, under smooth R option selected. ES-1 will calculate the Z step increment so that the Max. distance between each machining point approximately the same.  **MAX CUT** = max. distance between interpolated points.

Simplified R function

Example :

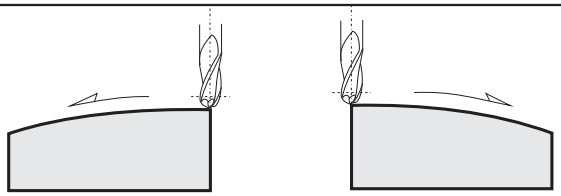
To machine the copper electrode as shown which has an ARCof **R = 200 mm** using a Two Axis **ES-1**





Operation procedures

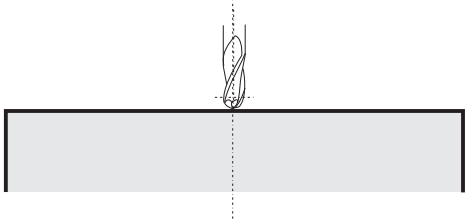
Because ES-1's XZ/YZ can only machine an arc which is less than 90 degrees, it is necessary to divide this arc machining into two parts.

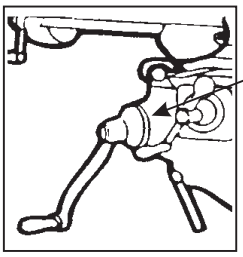


First Part
Use preset **R** type **2**

Second Part
Use preset **R** type **3**

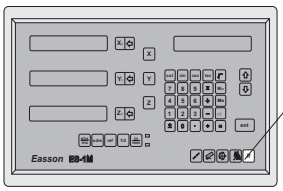
position the tool at the ARC starting point
(surface of the work piece centre in this case)



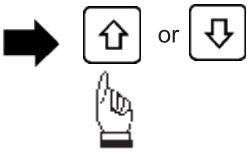


set the Z dial to zero

step 1 : select work plane : **XZ** plane **R** (**S.R - XZ**)

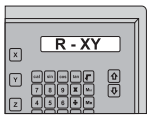


enter into **Simpflified R** function

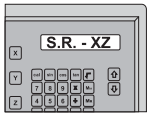


select work plane

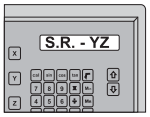
XY plane **R**

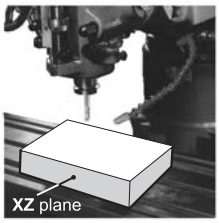


XZ plane **R**

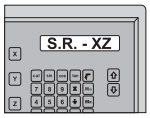


YZ plane **R**



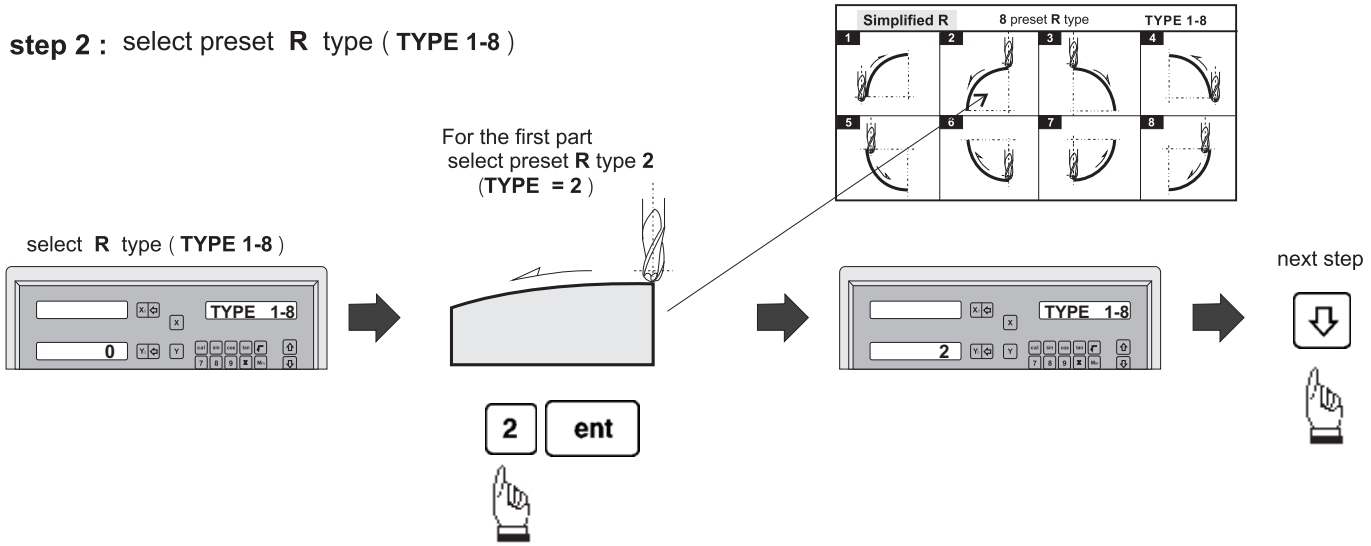


select **XZ** plane **R**

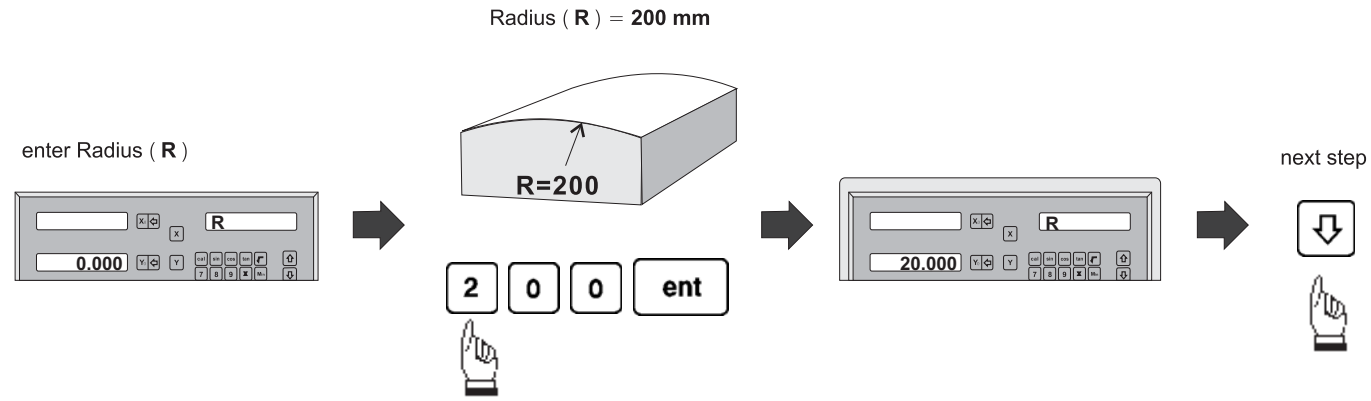


Simplified R function

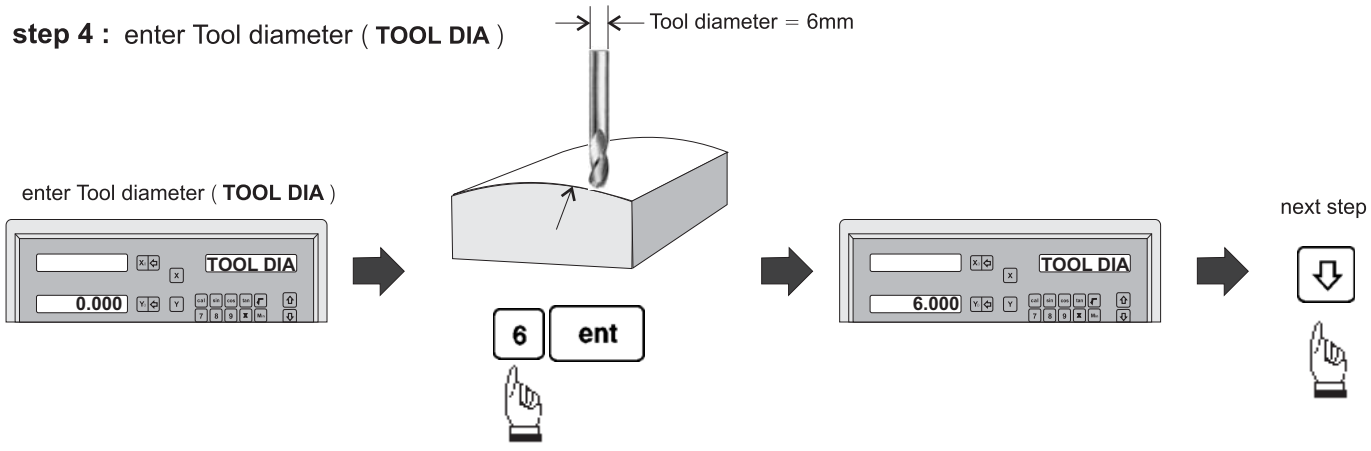
step 2 : select preset **R** type (**TYPE 1-8**)



step 3 : enter Radius (**R**)



step 4 : enter Tool diameter (**TOOL DIA**)



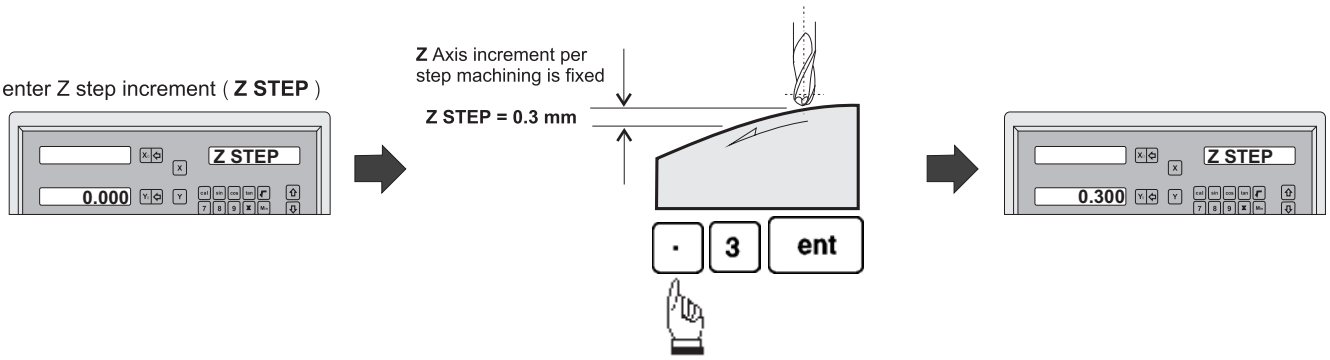
Simplified R function

step 5 : enter Z increment per step machining

ES-1 provides two options on the Z increment per step machining. The operator can enter their selection on the smooth R function.

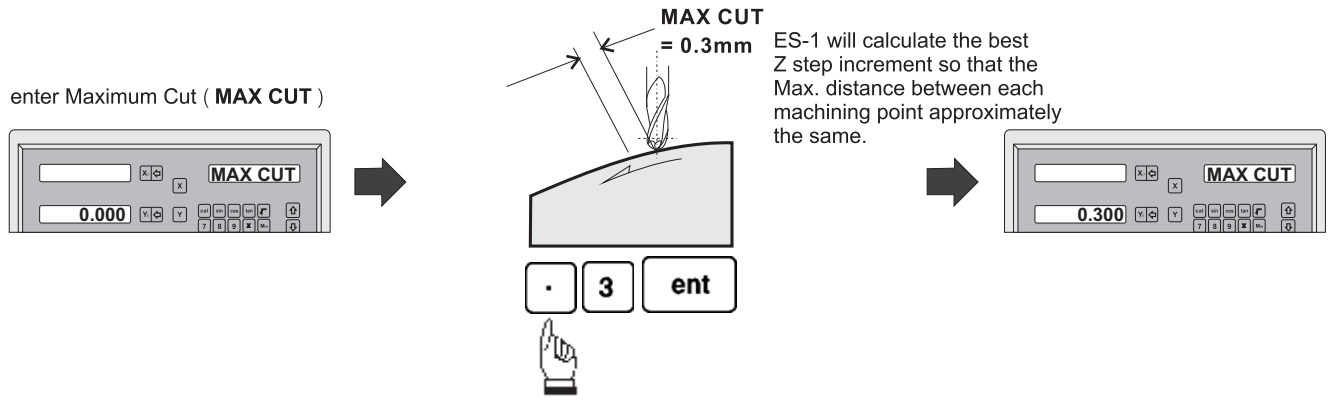
Option 1 : Fixed Z step (**Z STEP**)

Under this option, the Z increment per step machining is fixed, since the ARc's curvature varies with their Z position, the operator has to use their experience to select different Z STEP increment during the ARC machining to get the optimal, fastest machining



Option 2 : Maximum Cut (**MAX CUT**)

Under this option, ES-1 will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.



All simplified R funtion machining parameters have already entered into ES-1

⇩ **to enter into ARC machining mode**

The two Axis **ES-1** does not have a Z Axis, so the **ES-1** uses the ⇧ and ⇩ to simulate the Z axis movement

⇧ — simulate Z axis move **up** one step

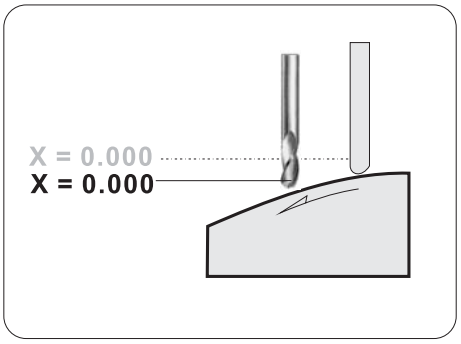
⇩ — simulate Z axis move **down** one step

before the start of ARC machining, please ensure that the tool is positioned at the ARC starting point and Z axis dial is set to zero (0.000)

Two axis **ES-1 - ARC** machining mode

During the XZ or YZ plane R machining, it is necessary to carefully position the Z axis to obtain a precise Z position. As, there is no Z axis in the two axis ES-1, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the ES-1 uses the unused axis display to display the **Z dial turn number** and **Z dial reading.**

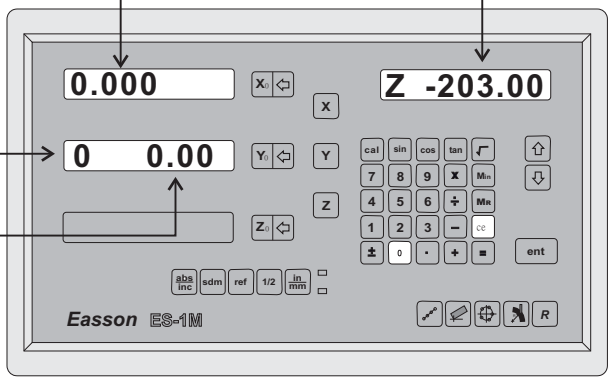
At the beginning of the ARC machining, the ES-1 will assume the Z axis dial at zero position with the tool positioned at the starting point of the ARC. Press the ⇧ and ⇩ once to simulate Z axis move up or down for one step - the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator must move the Z axis according the dial reading display on this axis, then the correct Z axis height is reached..



Move the X axis until display = 0.000, then the tool is positioned on the ARC curve

The display will **shift left** to signify it is not normal co-ordinate display.

Z axis simulated height

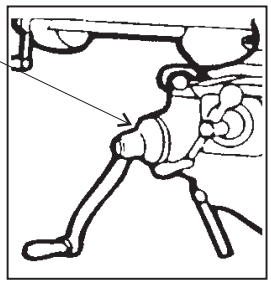


Display data in **XZ** plane **R** machining mode

Z dial turn number

Z dial reading

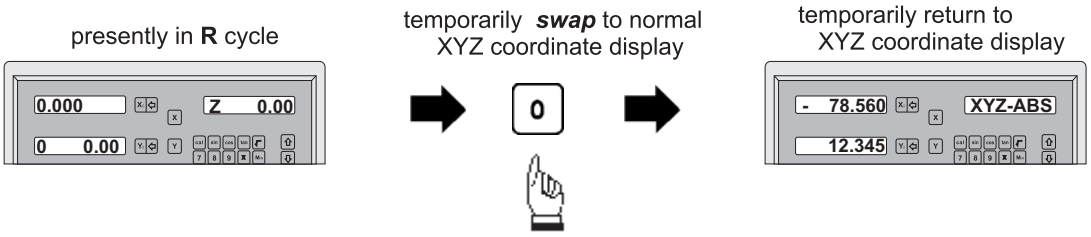
move the Z axis according to the dial settings displayed on Y axis



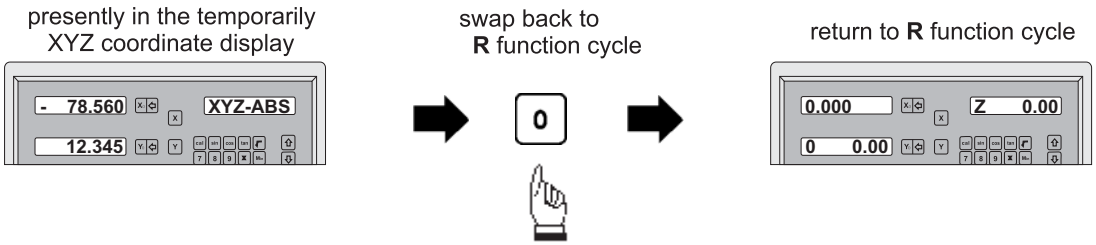
If the **Z** axis is positioned outside the **R** curvature, **ES-1** will display "**Z OU LI**" (**Z OUT LIMIT**)

two axis **ES-1 - ARC** machining mode

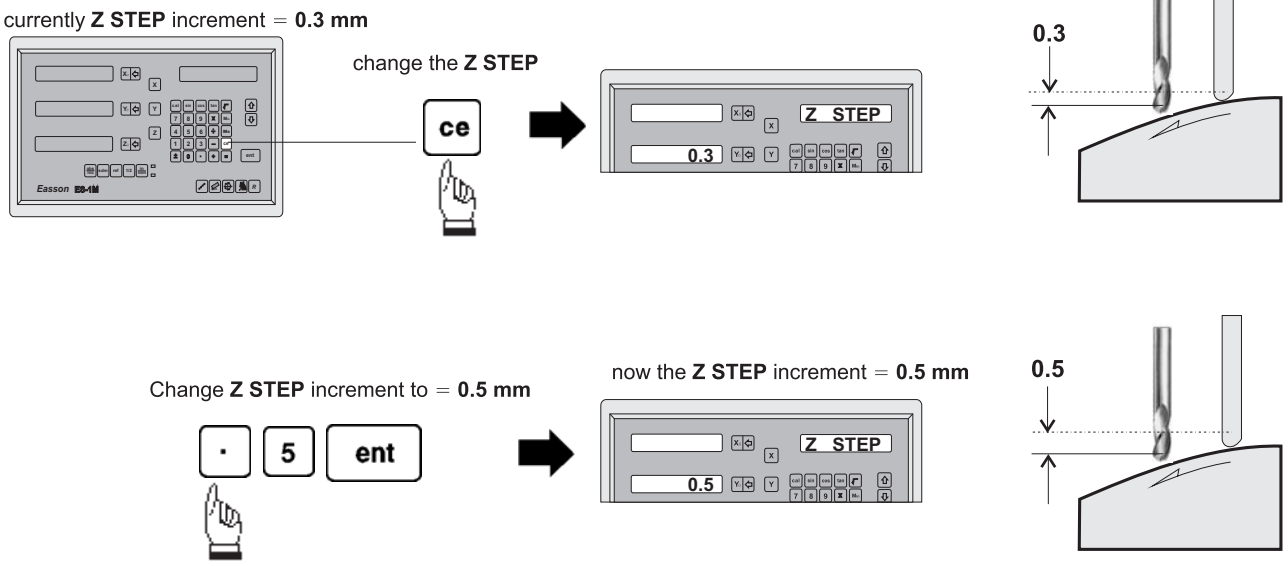
If the operator wants to verify if ES-1's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XYZ display), The procedure is as follows :



swap back to R cycle to continue the **R** machining mode



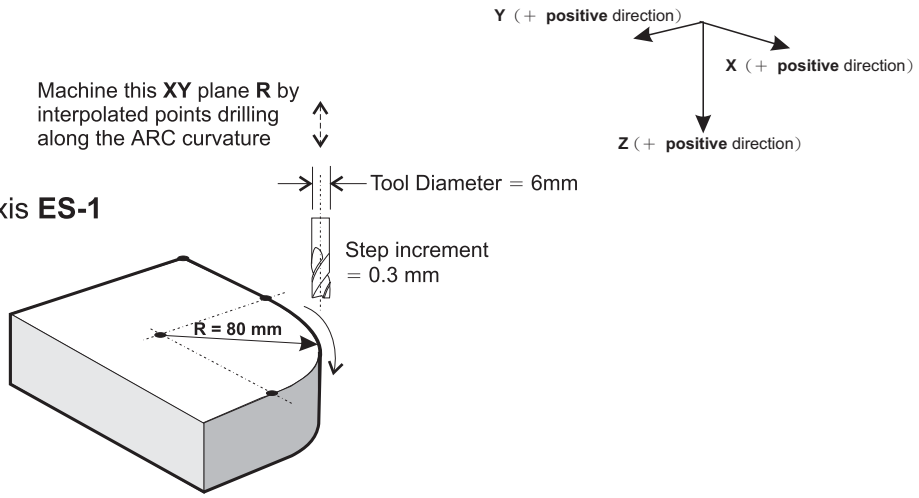
If fixed **Z STEP** option choosed, the **Z STEP** increment can be changed at any time during the ARC machining



Simplified R function

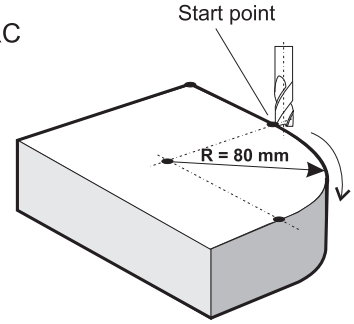
Example :

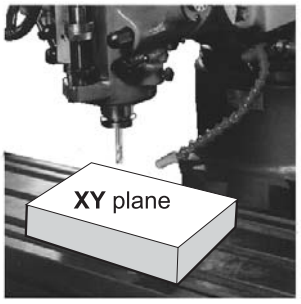
To machine an **XY** plane **R** using 2 Axis **ES-1**



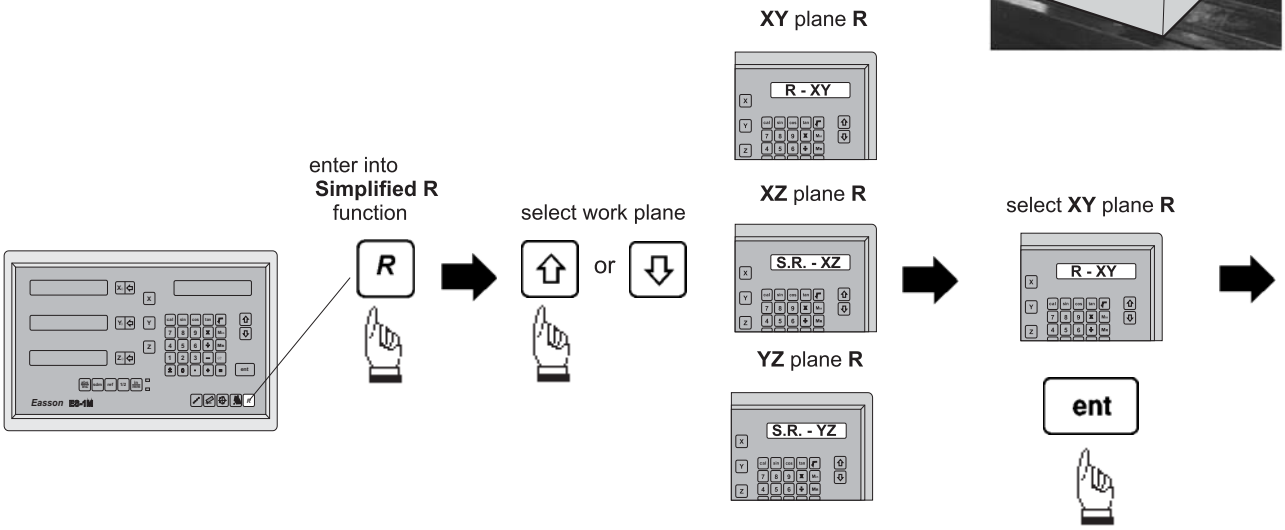
Operation procedures

position the tool at the start point of the ARC



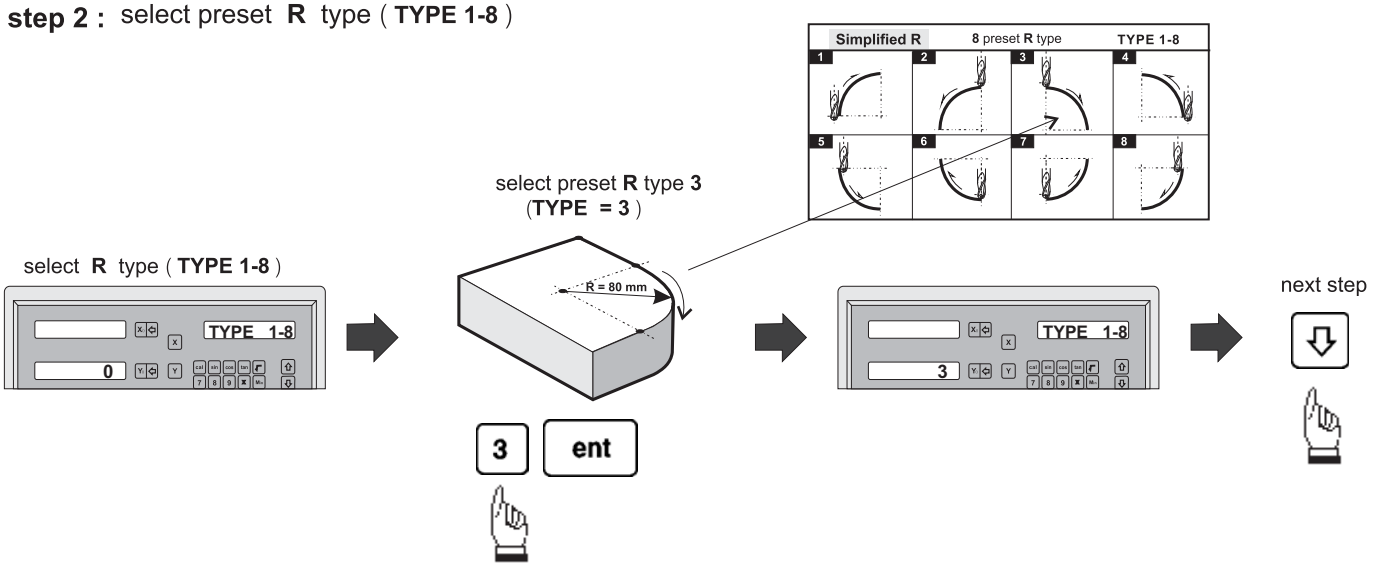


step 1 : select **XY** plane **R** (**R. - XY**)

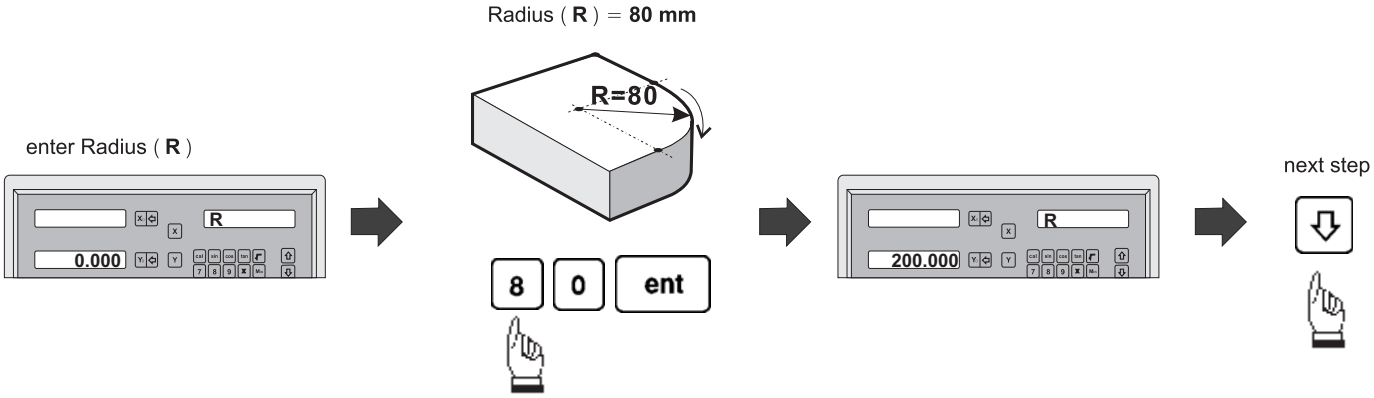


Simplified R function

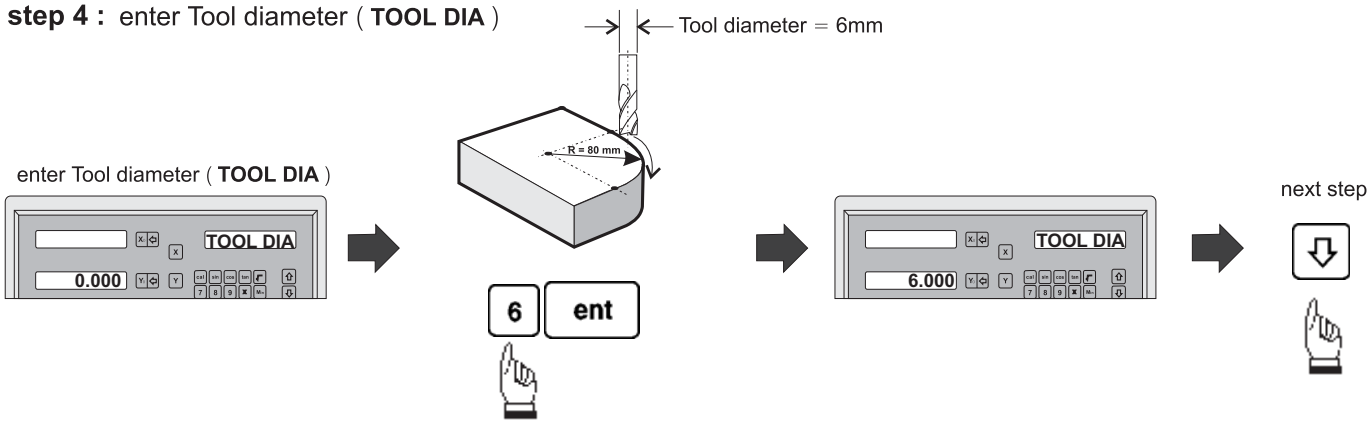
step 2 : select preset **R** type (**TYPE 1-8**)



step 3 : enter Radius (**R**)

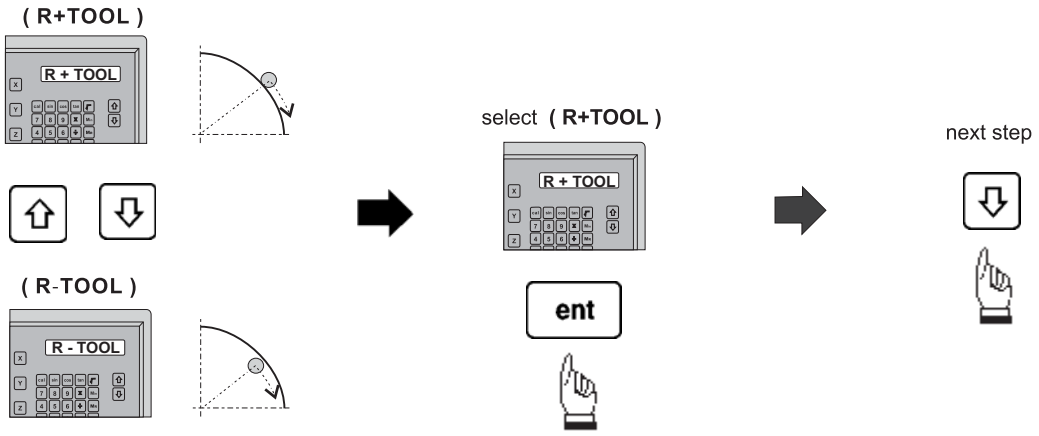


step 4 : enter Tool diameter (**TOOL DIA**)

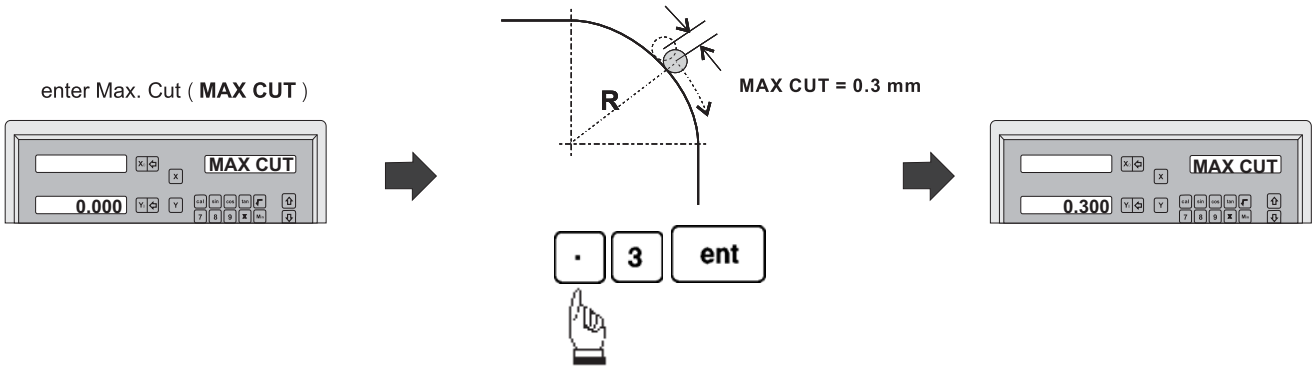


Simplified R function

step 5 : select tool compensation direction



step 6 : enter Max. Cut between interpolated points (**MAX CUT**)

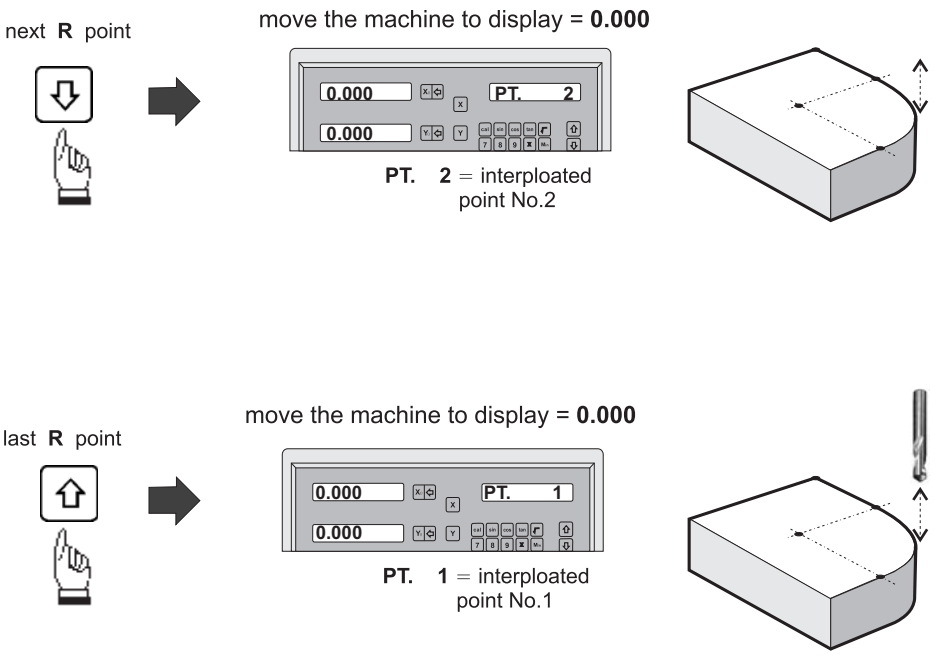


All simplified R funtion machining parameters have already entered into ES-1

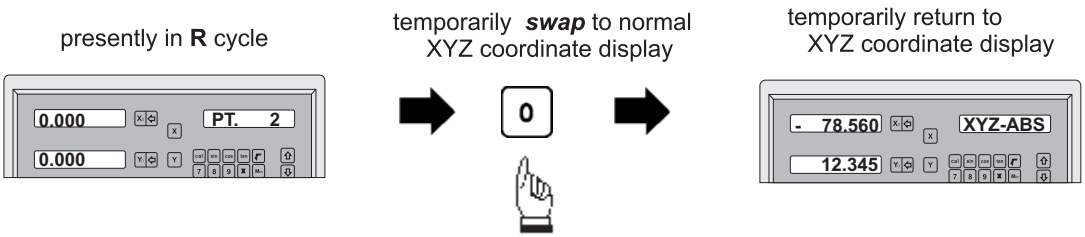
to enter into ARC machining mode

Operator can ⇧ or ⇩ to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, then the ARC curvature position is reached.

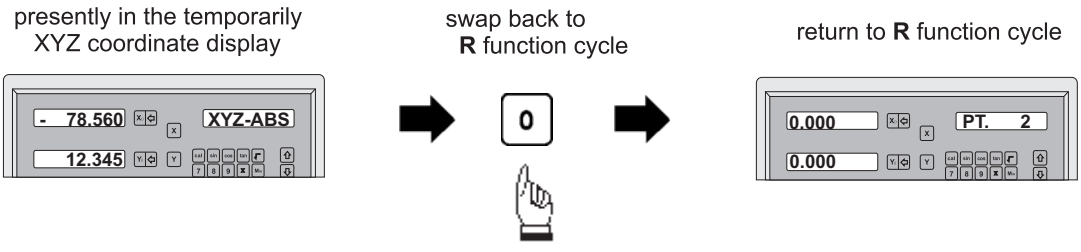
Simplified R function



If the operator wants to verify if ES-1's **R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XYZ display). The procedure is as follows :



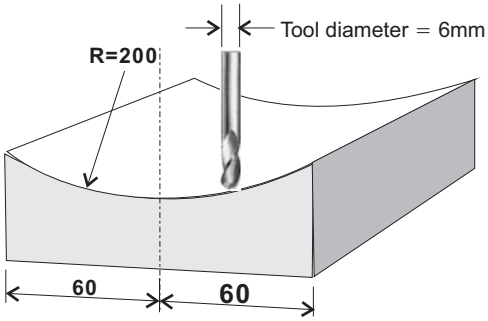
swap back to R cycle to continue the **R** machining mode

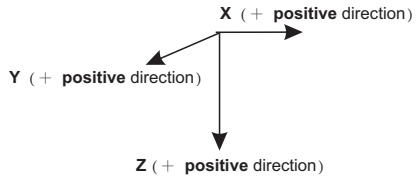


Simplified R function

Example :

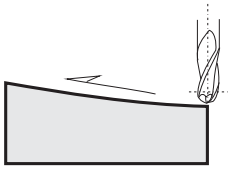
To machine the copper electrode as shown which has an ARCof **R = 200 mm** using a Two Axis **ES-1**



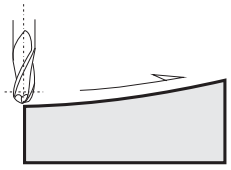


Operation procedures

Because ES-1's XZ/YZ can only machine an arc which is less than 90 degrees, it is necessary to divide this arc machining into two parts.

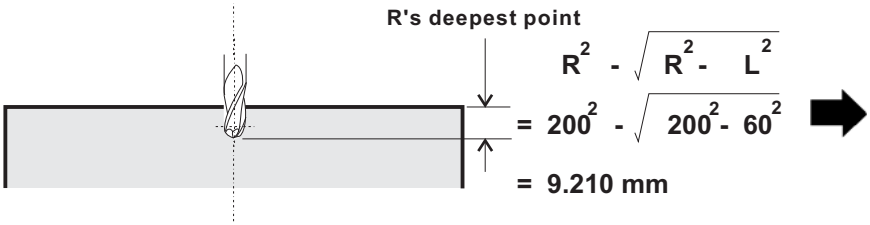


First Part
Use preset **R** type **6**

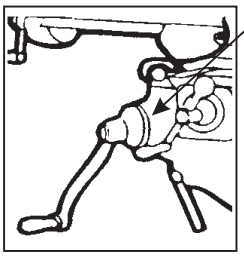


Second Part
Use preset **R** type **7**

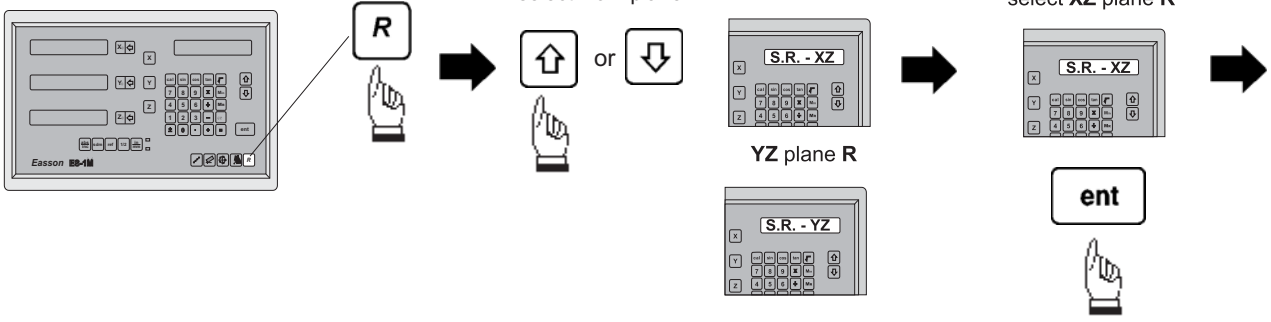
posit the tool at the ARC starting point



set the Z dial to zero

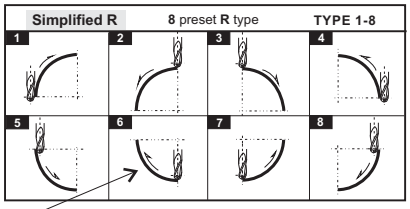


step 1 : select work plane : **XZ** plane **R** (**S.R - XZ**)



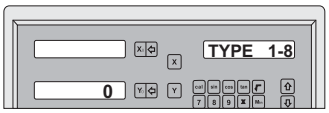
Simplified R function

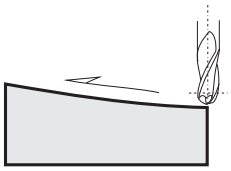
step 2 : select preset **R** type (**TYPE 1-8**)

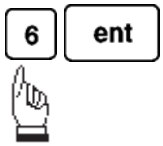


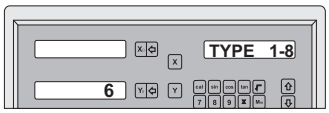
For the first part
select preset **R** type **6**
(**TYPE = 6**)

select **R** type (**TYPE 1-8**)







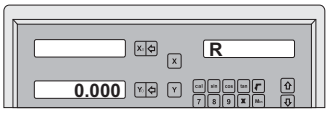


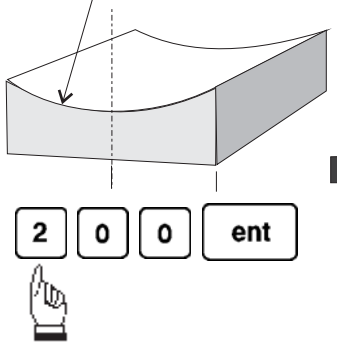
next step

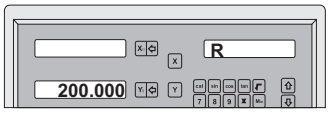
step 3 : enter Radius (**R**)

Radius (**R**) = **200 mm**

enter Radius (**R**)





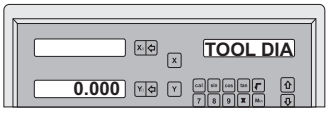


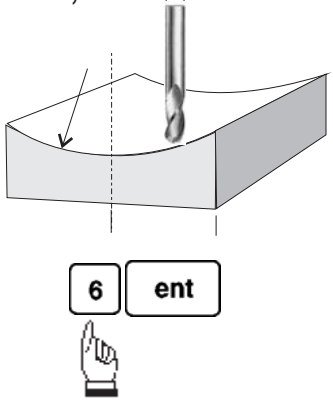
next step

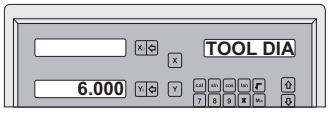
step 4 : enter Tool diameter (**TOOL DIA**)

Tool diameter = 6mm

enter Tool diameter (**TOOL DIA**)







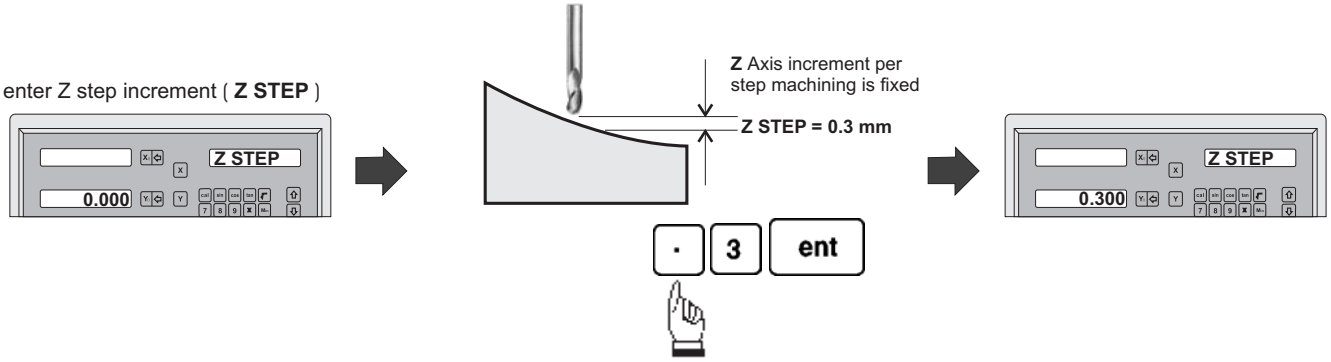
next step

step 5 : enter Z increment per step machining

ES-1 provides two options on the Z increment per step machining. Operator can make their selection on the smooth R function.

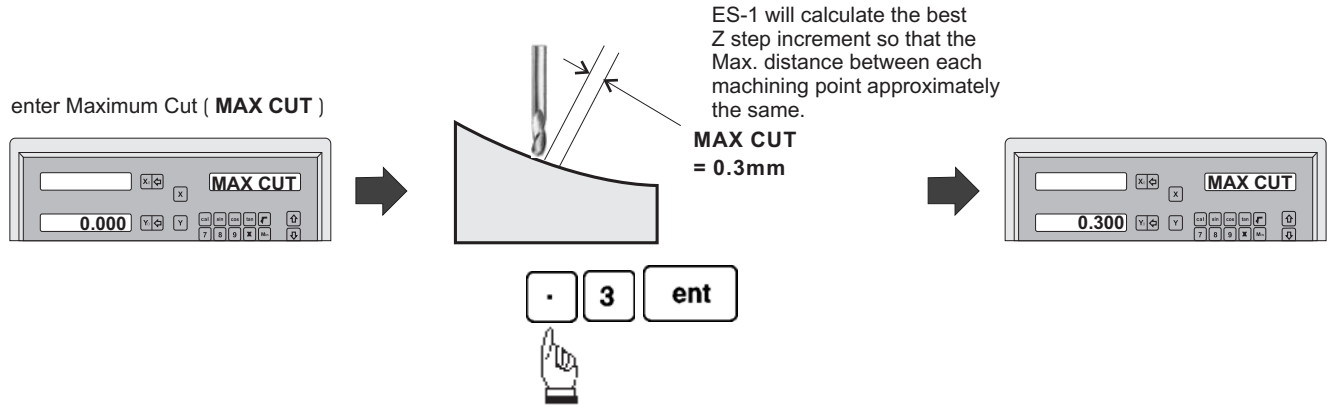
Option 1 : Fixed Z step (**Z STEP**)

Under this option, the Z increment per step machining is fixed, since the ARc's curvature varies with the Z position, the operator has to use their experience to select different Z STEP increment during the ARC machining to get the optimal, fast machining



Option 2 : Maximum Cut (**MAX CUT**)

Under this option, ES-1 will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.



All simplified R funtion machining parameters have already entered into ES-1

⇩ **to enter into ARC machining mode**

|The two Axis **ES-1** does not have a Z Axis, so the **ES-1** uses the ⇧ and ⇩ to simulate the Z axis movement

⇧ — simulate Z axis move **up** one step

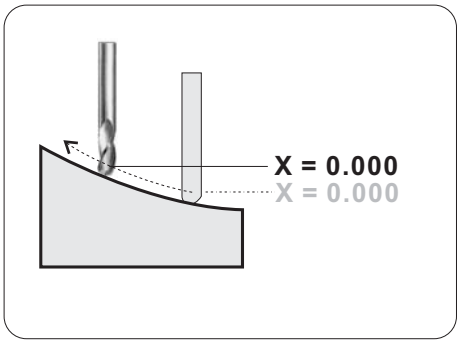
⇩ — simulate Z axis move **down** one step

before the start of ARC machining, please make sure the tool is posited at the ARC starting point and Z axis dial is set to zero (0.000)

Two axis ES-1 - ARC machining mode

During the XZ or YZ plane R machining, it is necessary to carefully position the Z axis to obtain a precise Z position. As, there is no Z axis in the two axis ES-1, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the ES-1 uses the unused axis display to display the **Z dial turn number** and **Z dial reading.**

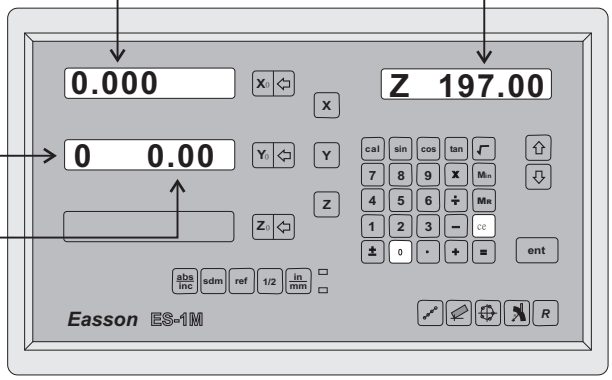
At the beginning of the ARC machining, the ES-1 will assume the Z axis dial at zero position with the tool positioned at the starting point of the ARC. Press the ⇧ and ⇩ once to simulate Z axis move up or down for one step - the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator must move the Z axis according the dial reading display on this axis, then the correct Z axis height is reached..



Move the X axis until display = 0.000, then the tool is positioned on the ARC curve

The display will **shift left** to signify it is not normal co-ordinate display.

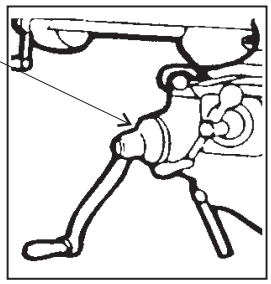
Z axis simulated height



Z dial turn number

Z dial reading

move the Z axis according to the dial settings displayed on Y axis

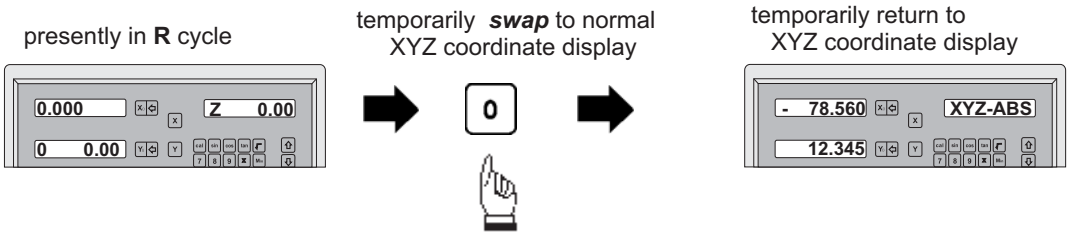


Display data in **XZ** plane **R** machining mode

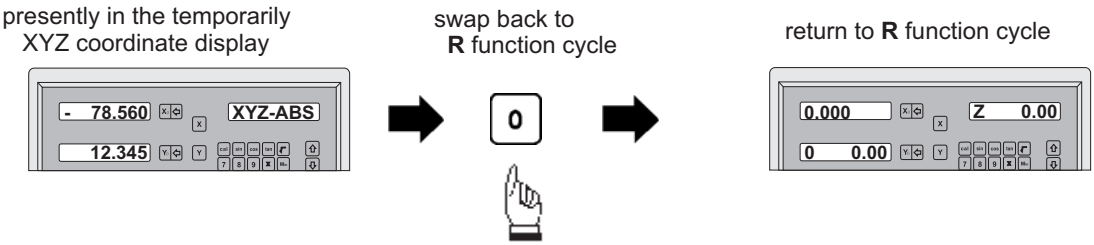
If the **Z** axis is positioned outside the **R** curvature, **ES-1** will display "**Z OU LI**" (**Z OUT LIMIT**)

Two axis ES-1 - ARC machining mode

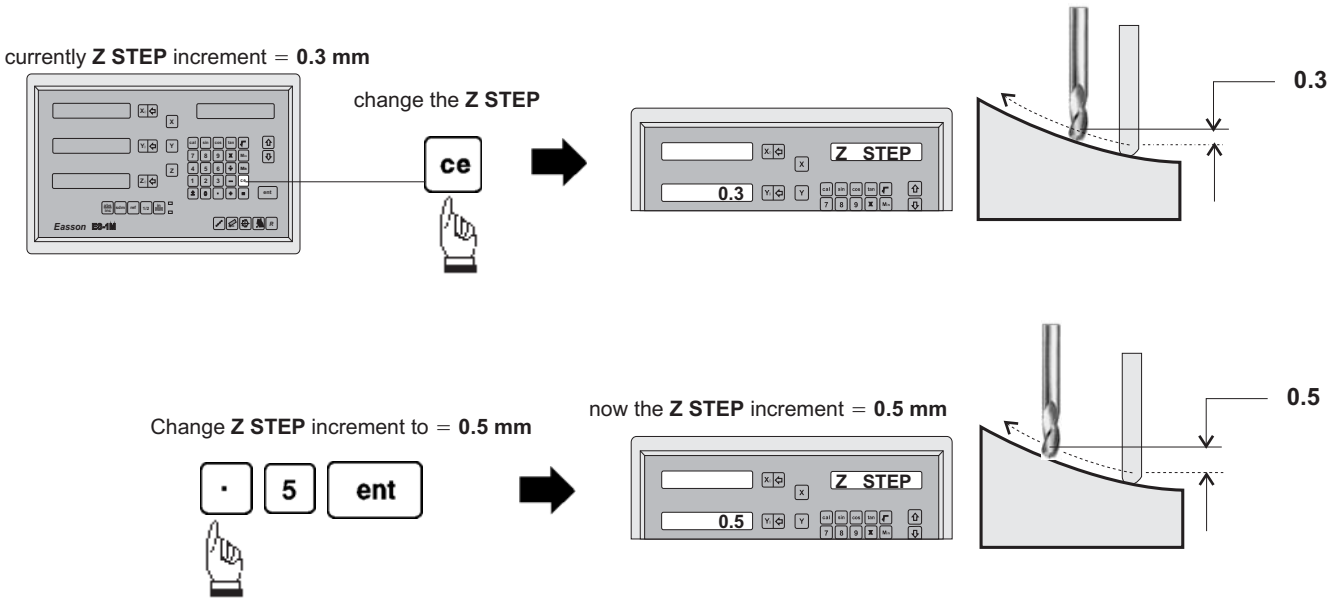
If the operator wants to verify if the ES-1's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XYZ display). The procedure is as follows :



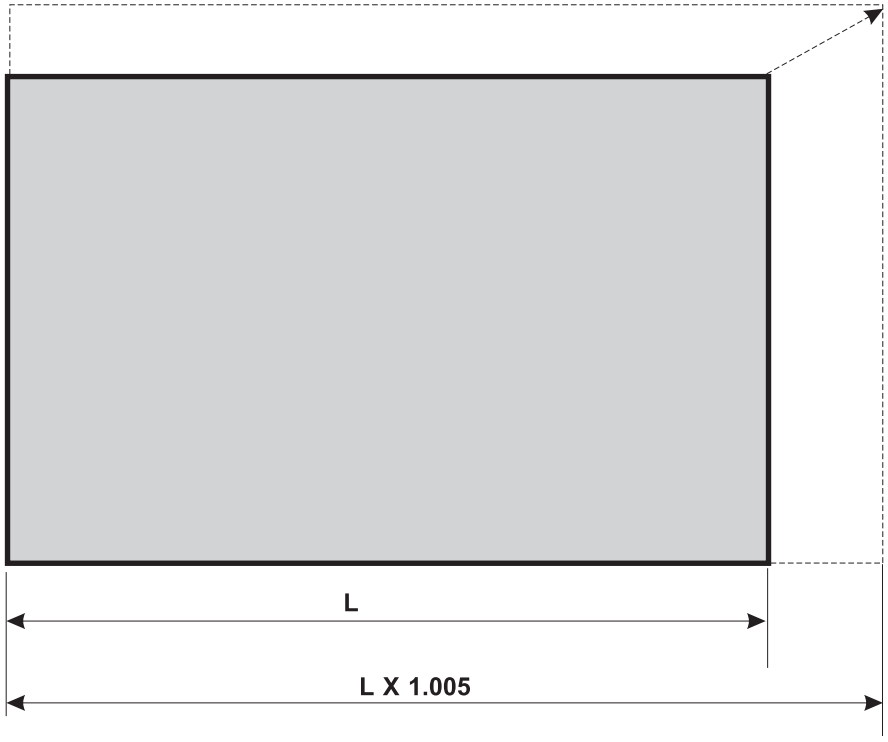
swap back to R cycle to continue the **R** machining mode



If fixed **Z STEP** option is chosen, the **Z STEP** increment can be change anytime during the ARC machining

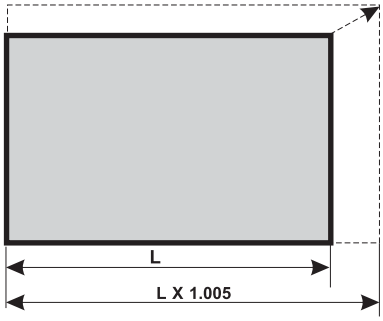


Shrinkage Calculation



Shrinkage calculation

function : Because plastic material shrinks during cooling after the the plastic injection process, therefore, when making a mould for plastic injection, the dimensions of the mould cavity have to be expanded or reduced according to a "shrink factor", ie for normal ABS material, the "shrink factor" is 1.005.



Normally, the mould maker has to calculate all the reduced or expanded dimensions prior to the actual machining, marking down the dimensions on the drawing. The pitfalls of this method areas follows:

1) It is a very time consuming process
2) Because there are a lot of calculations, it is inevitable that some calculation mistakes, or incomplete calculation (some calculations are omitted by mistake) occurs. There is also no easy method of verifying the calculated dimensions and it is too easy to make mistakes, subjecting the operator to heavy psychological pressure.
3) Mould work has to be correct first time, bearing in mind the cost of the product.

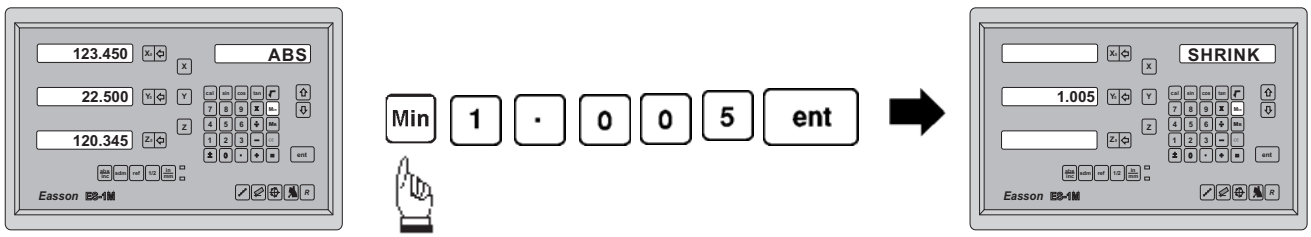
ES-1 provides the world's first practical "SHRINKAGE CALCULATION" function to help the mould maker calculate the shrinkage and verify the calculated expanded/ reduced dimension.

Operation procedure

1. Entering the "SHRINK FACTOR"

All the shrinkage dimensions are actually the multiples or divisions of a shrinkage factor, the shrinkage factors change for different plastic material.Before machining the operator must enter the shrink factor into the **ES-1.**

Example : For material (ABS plastic), the shrink factor is 1.005.



2. Shrinkage Calculations

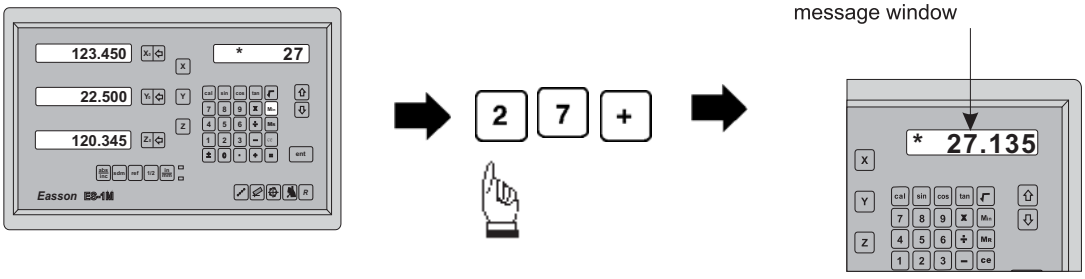
ES-1 provides a very easy-to-use shrinkage function, and allows the operator to easily calculate the expanded or reduced dimensions.

It is normally used in a case where incomplete shrinkage calculation have been made, ie some dimensions have been forgotten to be marked onto the drawing. Using the ES-1 during the machining process, the operator can calculate the shrinkage dimensions directly with the readout. ES-1 also provides an easy method of verifying the calculated dimension marked on the drawings.

ES-1 uses [+] for expand calculation [−] for shrink calculation

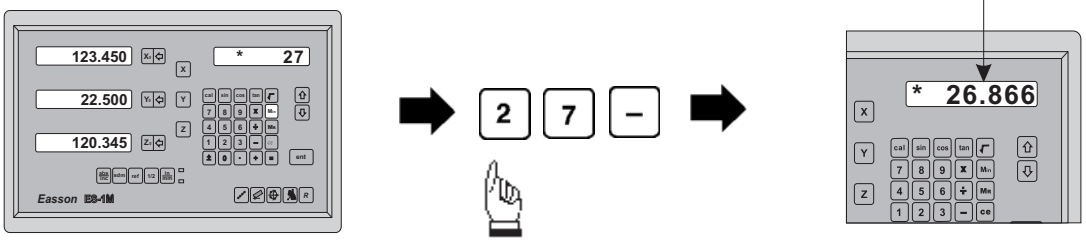
Example : To calculate the expanded dimension of 27mm

27mm expand = 27 x 1.005 = 27.135
Calculation result will display in the message window



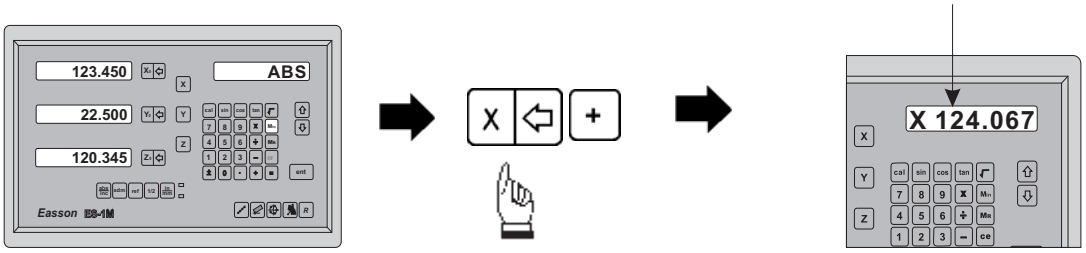
Example : To calculate the shrinked dimension of 27mm

27mm shrink = 27 / 1.005 = 26.866
Calculation result will display in the message window



Example : To calculate the expanded dimension of current X axis dimension

The current position of X axis is 123.45, therefore, 123.45 mm expands = 123.45 x 1.005 = 124.067
Calculation result will display in the message window



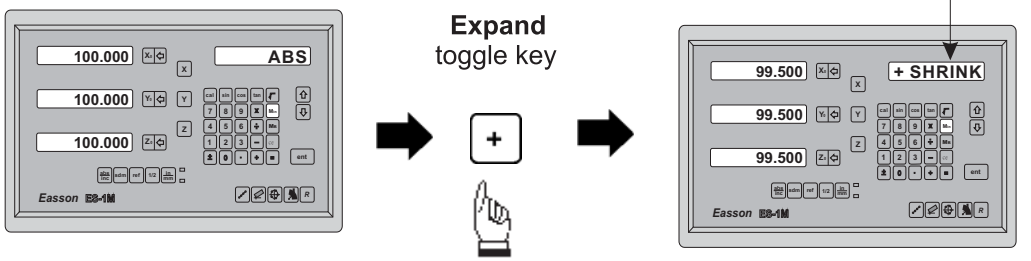
3. Shrinkage Compensation

When the operator is familiar with the shrinkage function of ES-1, instead of calculating all the shrink dimensions and marking them onto the drawing, the operator can use the shrinkage compensation features of the ES-1 which actually expand or reduce all display dimension acccording to the multiples of the shrink factor, thereby, the need to calculate all the working dimensions one by one.

If the operator still insists that they have more confidence by calculating all shrink dimensions prior to the actual machining process and marking them on the drawing, the ES-1 shrinkage compensation function can still be used to provide a very efficient way of verifying the operator's calculated dimensions, marked on the drawing by using the "Expand" and "Shrink" toggle-function to switch between real-dimension display and shrinkage-compensated-dimension display.

ES-1 uses [+] for expand calculation [−] for shrink calculation

Example : To compensate by "Expand", so that the actual dimensions are the expanded dimension of the ES-1's display dimensions.



Real Dimension

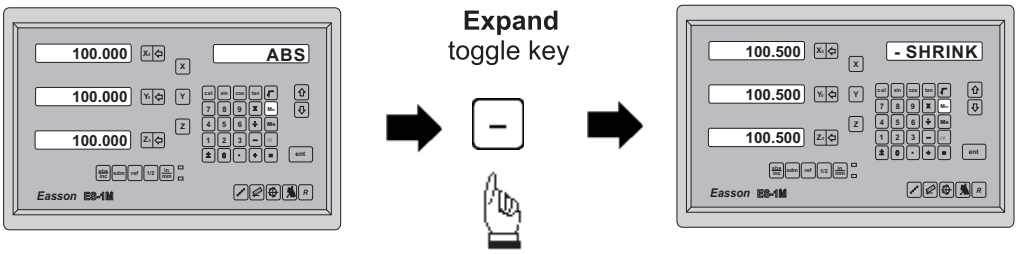
Because the display dimension has compensated by the shrink factor, in order to remind operator that ES-1 is currently in shrink compensation mode to avoid operation mistake, ES-1 will display

1. flashing display of "+ SHRINK"
2. get a beep sound for every 10 SEC.
3. disable all functions and function keys

Compensated dimensions :

The actual dimension are now X 1.005 of the displayed dimensions

Example : To compensate by "Shrink", so that the actual dimensions are the shrinked dimension of the ES-1's display dimensions.



Real Dimension

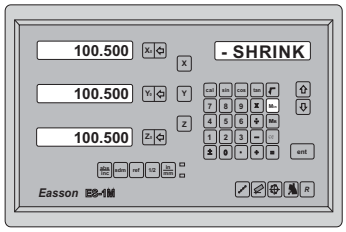
Compensated dimensions :

The actual dimension are now / 1.005 of the displayed dimensions

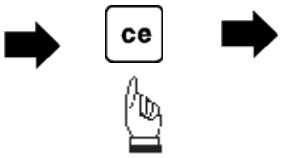
Shrinkage calculation

When the ES-1 is in shrink compensation mode, if the operator wants to return to normal real dimension display. press ce or ent

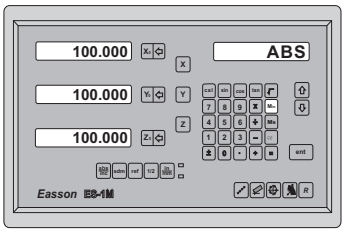
Currently in "shrink" compensation mode



return to normal display

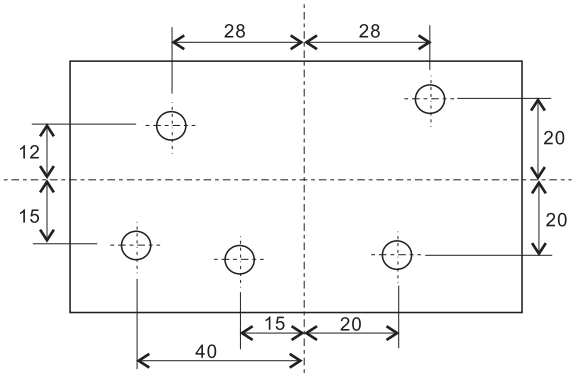


normal real dimension display



Shrinkage calculation

Example : To drill the following holes in the plastic injection mould



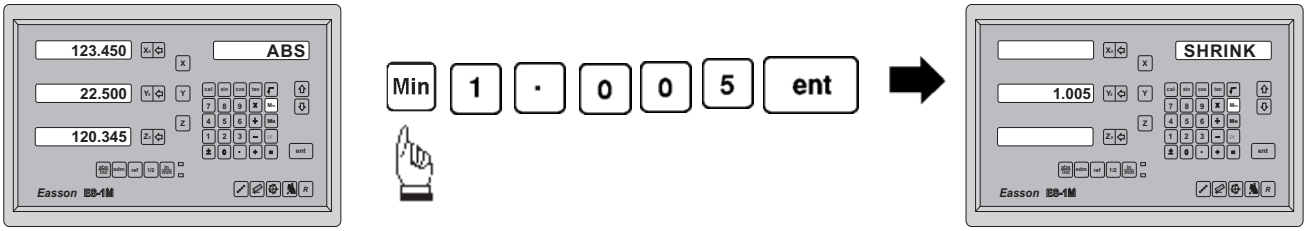
Because the plastic material shrinks when it cools down after the plastic injection process, the dimensions of the holes in the mould have to be expanded according to the shrink factor.

Normally, the operator has to calculate all the expanded dimensions prior to the machining, but with ES-1, the operator can use ES-1's "shrink compensation" function which actually expands the display dimension by the shrink factor, enabling , the operator to drill directly according to the dimensions specified in tjhe drawing, obviating the need to calculate the reduced dimensions one by one.

Operation procedure

1. Entering the "SHRINK FACTOR"

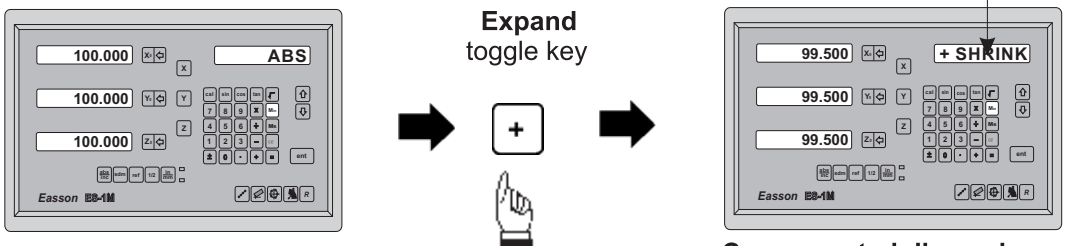
i.e : For plastic material (ABS), it's shrink factor is 1.005.



2. Set the ES-1 to "Expand Compensation"

Because the display dimension has compensated by the shrink factor, in order to remind operator that ES-1 is currently in shrink compensation mode to avoid operation mistake, ES-1 will display

1. flashing display of "+ SHRINK"
2. get a beep sound for every 10 SEC.
3. disable all functions and function keys



Real Dimension

Compensated dimensions :

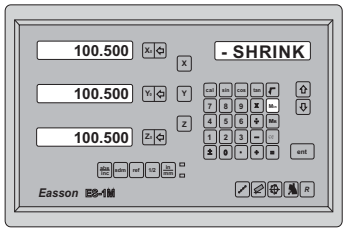
The actual dimension are now X 1.005 of the displayed dimensions

Operator can drill the holes as above in this mode without the need of calculation

Shrinkage calculation

When the ES-1 is in shrink compensation mode, if the operator wants to return to normal real dimension display. press ce or ent

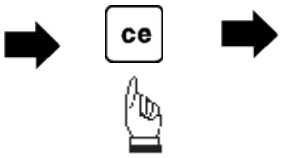
Currently in "shrink" compensation mode



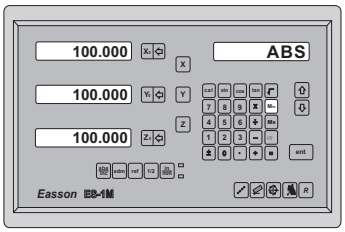
Compensated dimensions :

The actual dimension are now X 1.005 of the displayed dimensions

return to normal display

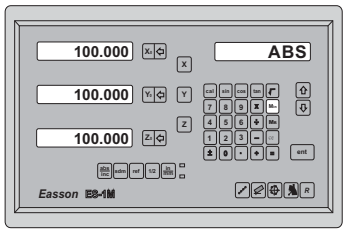


normal real dimension display



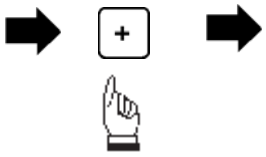
Real Dimension

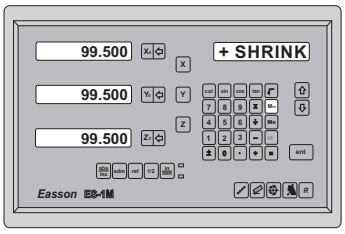
After verifying and need further machining in shrink compensated mode



Real Dimension

Expand toggle key





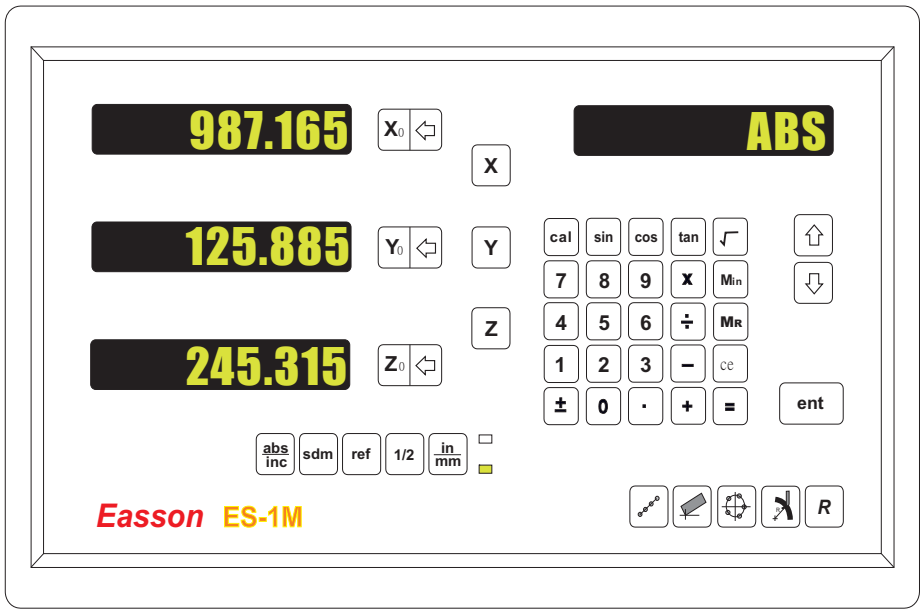
Compensated dimensions :

The actual dimension are now X 1.005 of the displayed dimensions

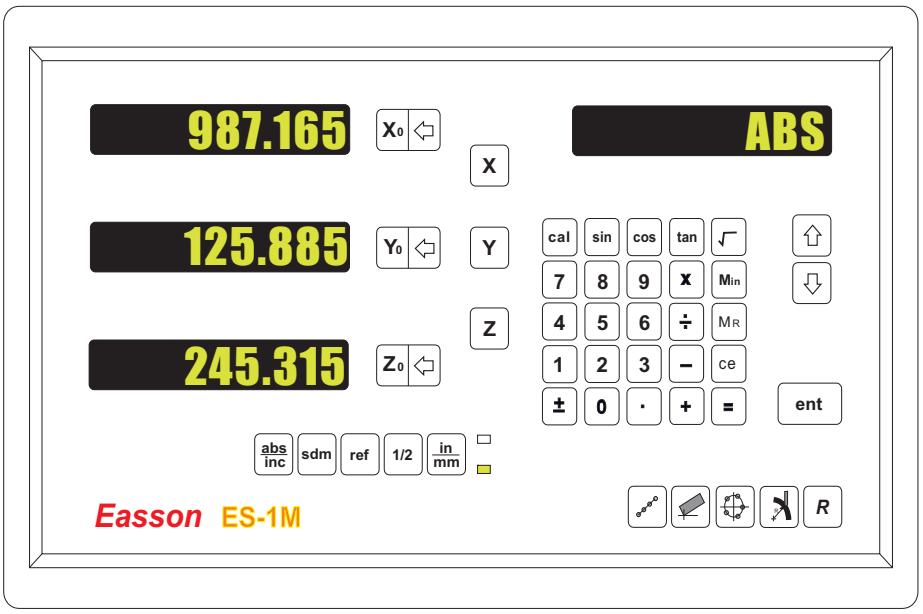
Operator can drill the holes as above in this mode without the need of calculation

ES-1/1M

Digital Readout Setup Function



ES-1/1M ORIGINAL PARAMETER RESET FUNCTION



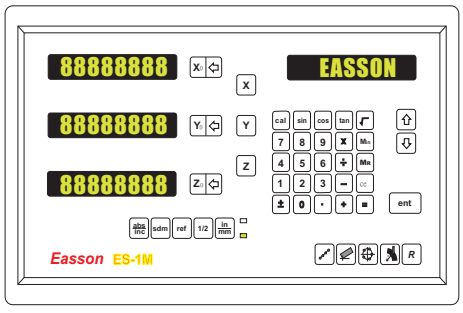
Some inscrutable cases or improper operations cause the chaos of parameter, then you need to initialize the parameter to reset the system.

Operational procedure：

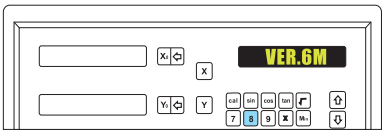
(1) Turn off the ES-1/1M.

(2) Power on ES-1/1M once again, when "ES-1" or "ES-6" moving in display window, please press "8" key then ES-1/1M enters into the RESET function.

power on the DRO, then DRO starts the self-test function



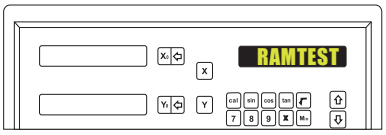
when "VER.6" appears in display window, please press " 8 " key.



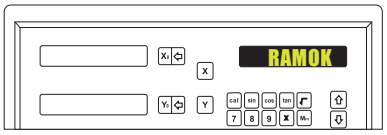
8

when some messages are displayed over, the DRO enters into the RESET function.

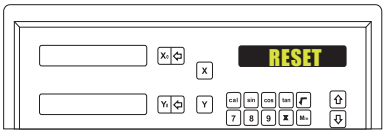
(3) When enter into the RESET function, ES-1/1M will display：



display "RAM TEST" that means the RAM is testing

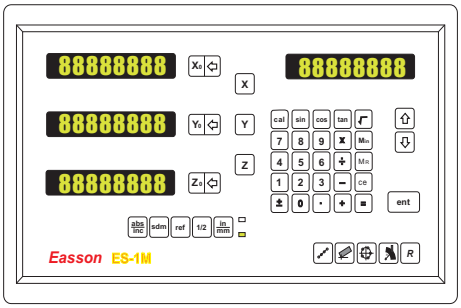


if the RAM function is normal，ES-1/1M can display "RAM OK"



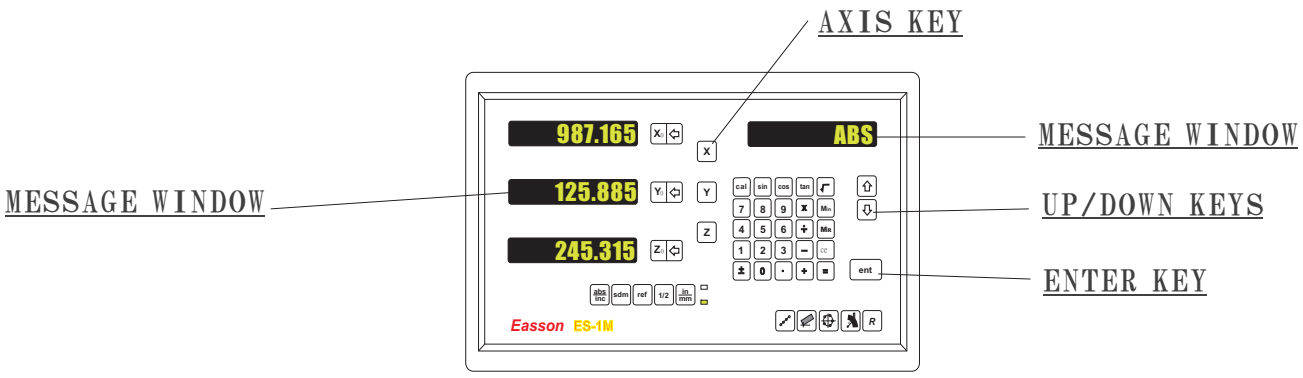
display "RESET" that means the parameter has reset

(4) The reset of parameter has completed then start to enter into the test procedure of display light.



(5) Turn off the DRO after complete the reset, then power on the DRO once again.

ES-1/1M SETUP FUNCTION



During changing the different program version IC or some abnormal voltages and operations, you need to SETUP the DRO.

Procedure :

1). Turn off the ES-1 or ES-1M.
2). Power on the ES-1 or ES-1M once again, when the message "ES-1" or "ES-6" showing in the MESSAGE WINDOW, please press the letter E of the Easson logo in the left bottom of the key panel immediately, then into the SETUP function.

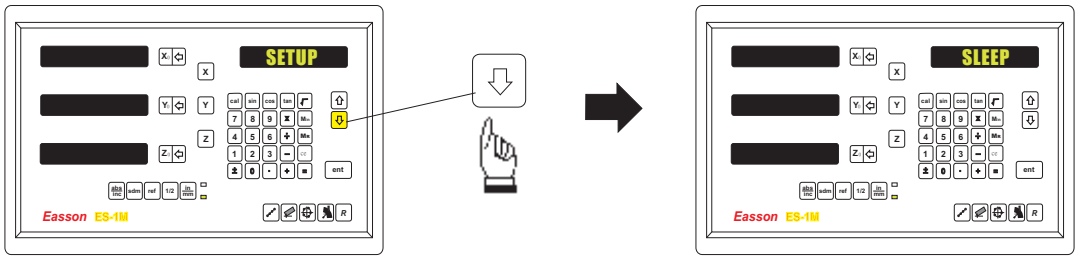
When the DRO displays some messages over, it will into the "SETUP" function.

The SETUP procedure is written in a menu mode which enables you to scroll through the top level options and enter, configure and exit the sub-functions as they arise.

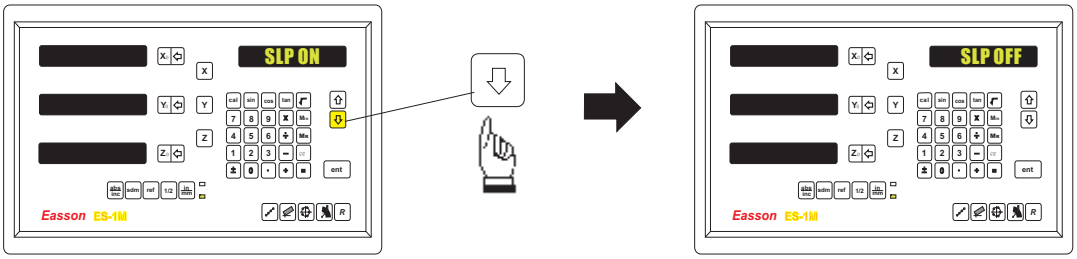
The top level menu headers in order are as follows :

		ES-1	ES-1M
SLEEP	activates the sleep mode function	●	
DIRECTIN	specifies the direction of count for each axis	●	●
LIN COMP	permits linear error compensation to be input	●	●
REF SIGN	specifies the signal of the reference point for each axis	●	●
Z DIAL	forms part of the dial parameters for a milling machine, and specifies one turn of Z dial travel.	●	●
DIAL INC	enters the Z increment for ARC machining	●	●
Z MOVE	forms second part of the dial parameters for milling machine, specifying the direction of the Z axis positioning.	●	●
AXIS NO	configures the DRO axis number	●	●
R MODE	set up "Z STEP" or "MAX CUT" for Radius (R)		●
DRO TYPE	permits toggling between software packages ie MOULD & MILL	●	
NORMAL	returns the DRO settings to the factory preset values	●	●
QUIT	exits the SETUP function to proceed to normal working	●	●

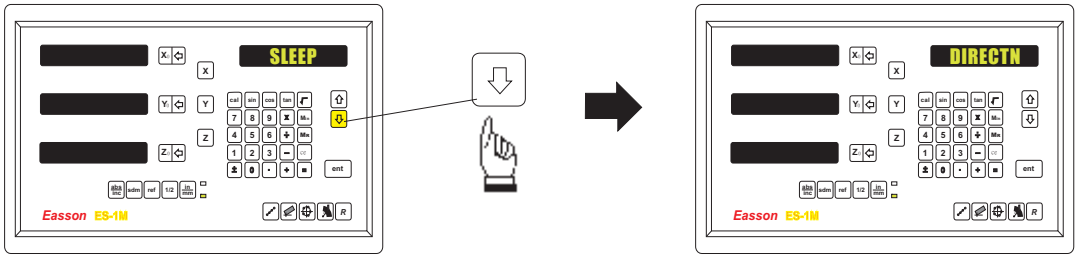
3.) Press ⇩ key to selsct the "SLEEP" function. Press ⇧ key to return to the last function.



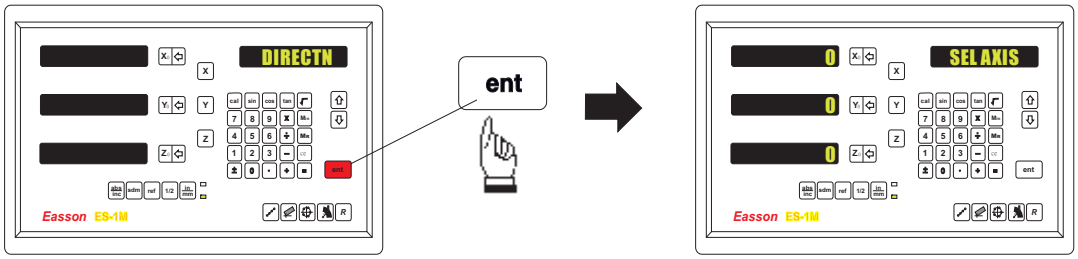
Press **ent** key into the sleep mode function. Press the DOWN key once and the message "SLP ON" appears in the MESSAGE WINDOW. Press the DOWN key again, the words "SLP OFF" appear in the MESSAGE WINDOW then press the ENTER key to make you selecting whether you want sleep mode activated or not.



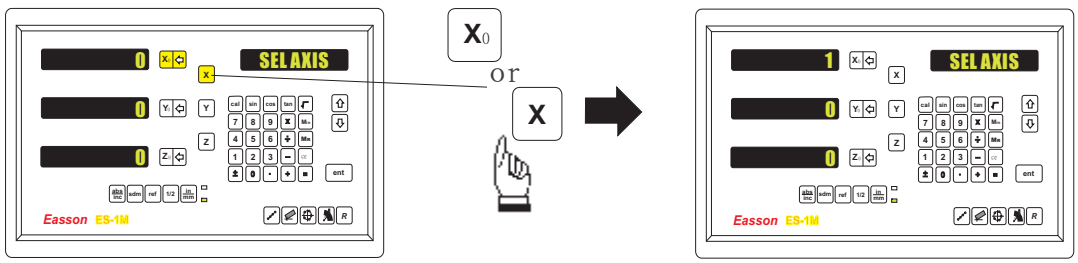
4.) Press ⇩ key to select the "DIRECTN" (counting direction) function. Press ⇧ key to return to the last function.



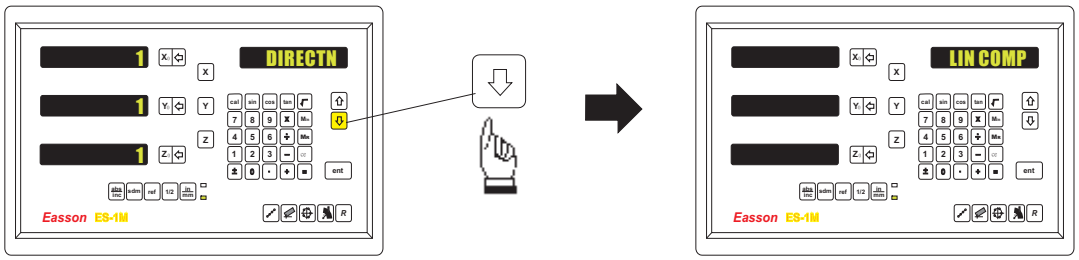
Press **ent** key into the direction setting function, the 0 represents a positive, 1 represents a negative.



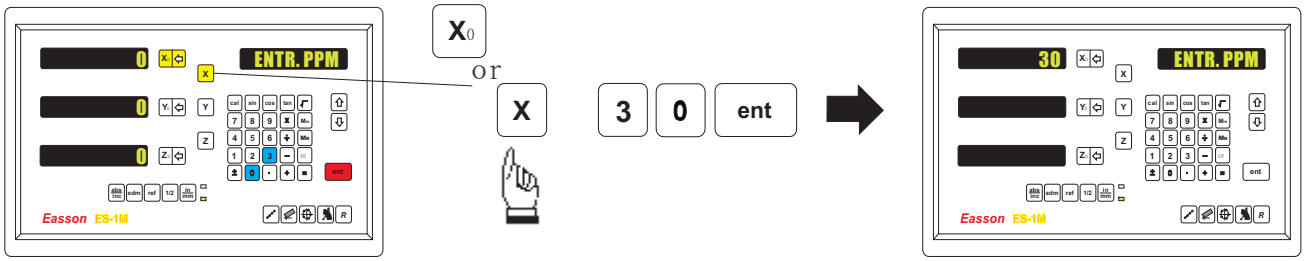
Press **X0** or **X** key to set up a negative direction "1" for X Axis, make a same procedure for Y Axis.



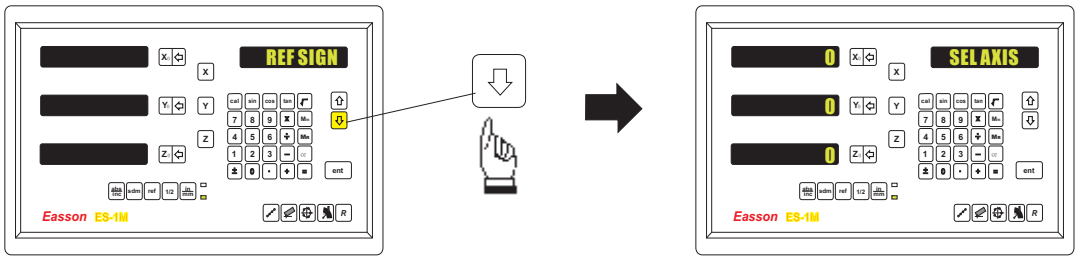
5.) Press ent key to make your setting, then press ⇩ key to select the "LIN COMP" (linear compensation) function.



Press ent key into the linear error compensation function, the formula as below:
error value X -(1000/measuring length) = compensation value
(ML) measuring length unit = mm, error unit = μm
Example:
ML=500mm Error = -15μm
-15μ X -(1000/500) = 30μm
the compensation value is 30μm
If set up the linear compensation value of X Axis = 30, through the AXIS key make a same procedure for Y Axis.

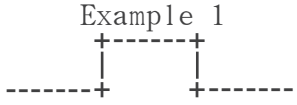


6.) Press ent key to make youn setting, then press ⇩ key to select the "REF SIGN" function.



Press the UP/DOWN keys until the word "REF SIGH" is shown in the MEASSAGE WINDOW, Press the ENTER key to access the next menu level. Press the DOWN key once and the message "SEL AXIS" appears in the MESSAGE WINDOW. Press the individual axis key and enter a 0 or 1 in accordance with the instructions below. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item.
In the market there are many gratings using a 20μm pitch. There are two types of electronic signal which generate the reference point. The first associates the signal with a rise in voltage, the second with a drop.

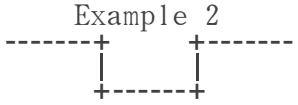
Example 1



REF SIGN = 0
Normal Voltage = 0V
At ref point = 5V

Suppliers-Easson, Mitutoyo, Futaba

Example 2

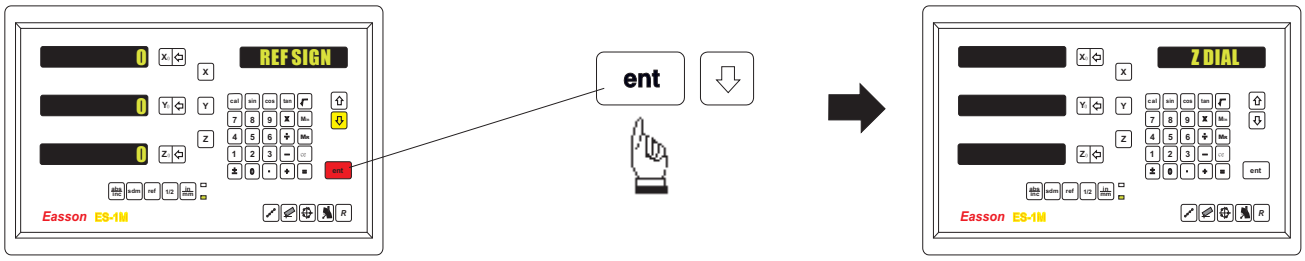


REF SIGN = 1
Normal Voltage = 5V
At ref point = 0V

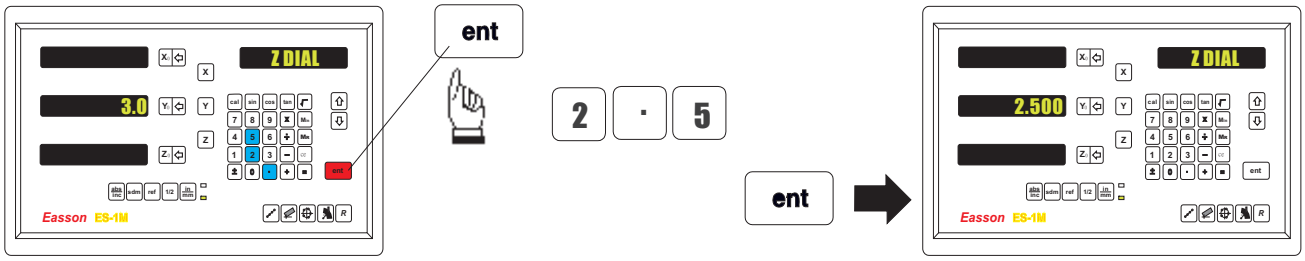
Suppliers-Fagor

When fitting an EASSON scale always set to 0

7.) Press ent key to make you setting, then press ⇩ key to select the "Z DIAL" function.



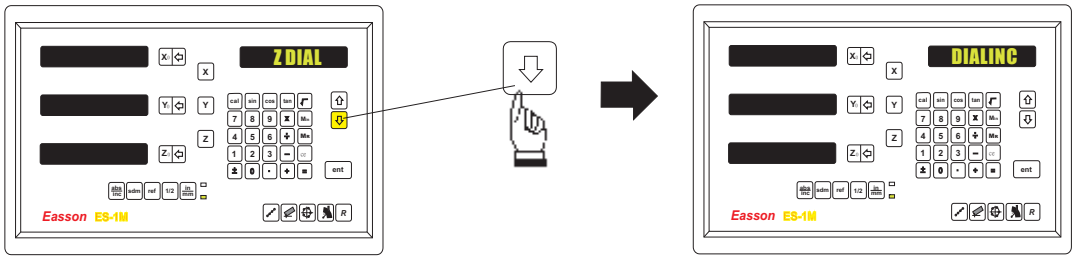
Press ent key into the setting function, i.e. your setting value is "2.500mm".



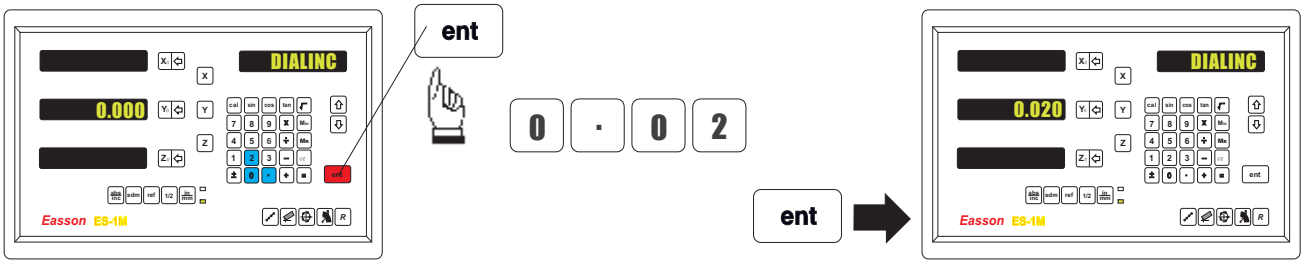
Z DIAL INSTRUCTIONS :
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "Z DIAL" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level, Press the DOWN key once and the message "0.00" appears in the Y AXIS WINDOW. Press the individual axis key and enter a number to specify one turn of the Z DIAL. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item.

For a Taiwanese type milling machine the travel is 2.5mm usually.

8.) Press ⇩ key to selsct the "DIAL INC" (dial increment) function.



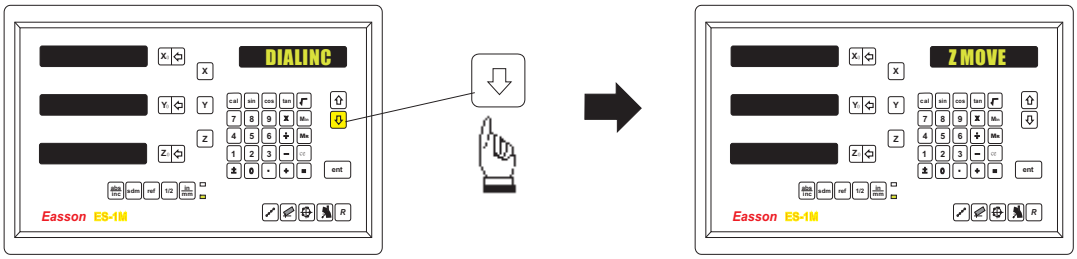
Press ent key into the setting function, i.e. your setting value is "0.020mm".



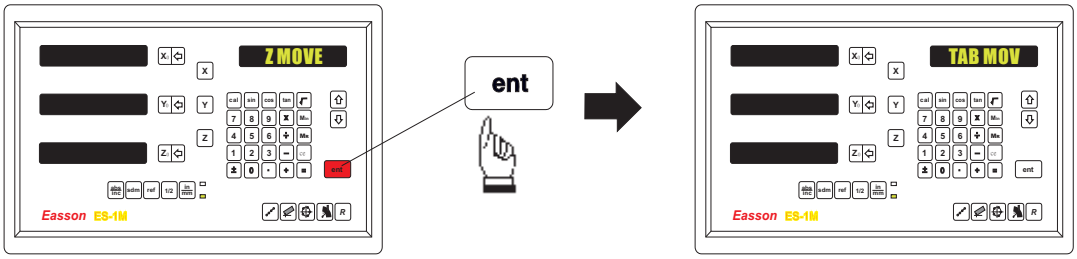
DIAL INC INSTRUCTIONS :
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "DIAL INC" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "0.000" appears in the Y AXIS WINDOW. Press the individual Y axis key and enter a value for the minimum increment for positioning a Z axis. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item.

For a Taiwanese knee-type milling machine the minimum increment is 0.02mm.

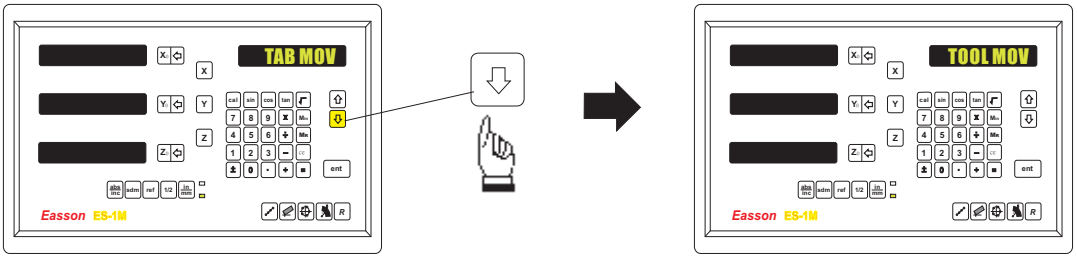
9.) Press ⇩ key to select the "Z MOVE" function.



Press ent key into the setting function, the message "TAB MOV" is shown in the MESSAGE WINDOW.

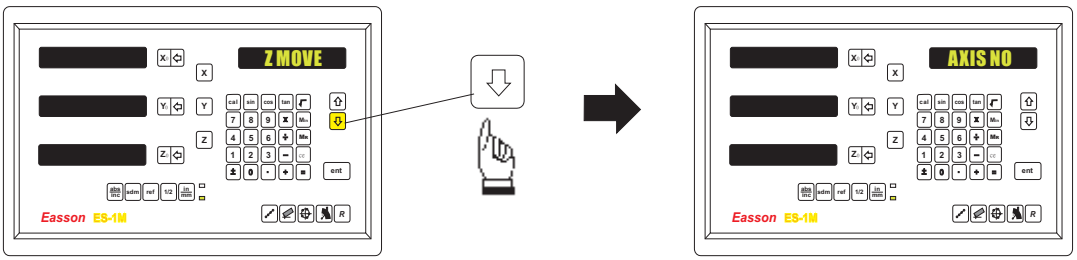


Press ⇩ key to select the "TOOL MOV" function, then press the ENTER key to make your selection.

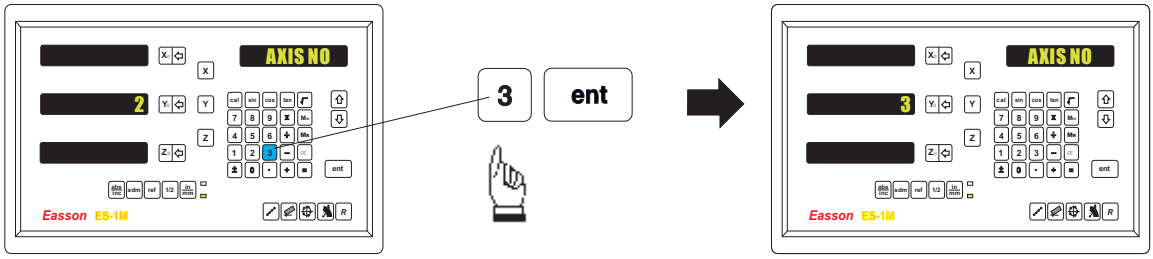


Z MOVE INSTRUCTIONS：
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "Z MOVE" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "TAB MOV" appears in the MESSAGE WINDOW. Press the DOWN key again and the message "TOOL MOV" appears. You can toggle between these options until making your choice. Press the ENTER key to accept the displayed type of your choice. Press the UP/DOWN keys to move to the next menu item.
The NORMAL setting for the machine is the TAB MOV, indicating that the table moves during the machining process. Some machines need to have the opposite directional setting facilitated by the TOOl MOV setting. It facilitates the direction of the increment in a similar manner to the DIRECTIN command setting described earlier. As already described the DEFAULT for the Z DIAL, DIAL INC and Z MOV is a normal Taiwanese kenn-type milling machine. Only in the case of the DRO system being installed on another different style machine do these parameters need changing.

10.) Press ⇩ key to selsct the "AXIS NO" function.

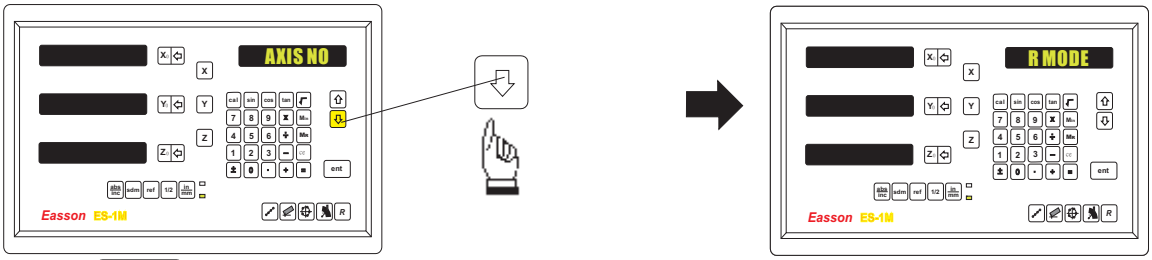


Press ent key into the setting function, i.e. your setting axis number is "3".

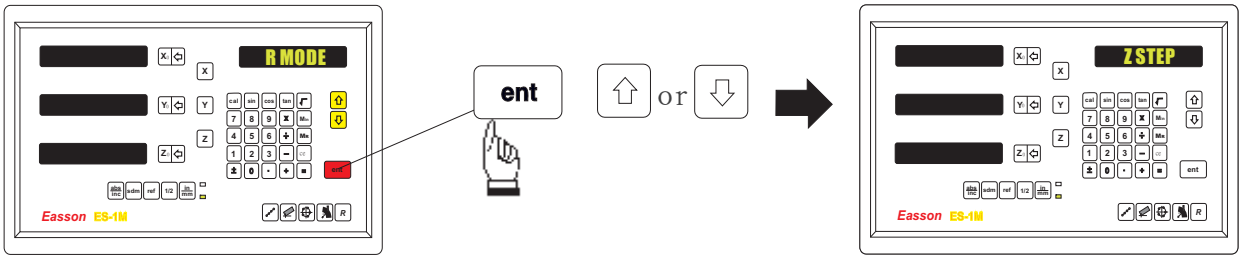


After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "AXIS NO" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "2" (for a 2 axis etc) appears in the Y AXIS WINDOW. Press the individual axis key and enter a number to specify the axis number. Press the ENTER key to store the information. Press the UP/DOWN keys to move to the next menu item.

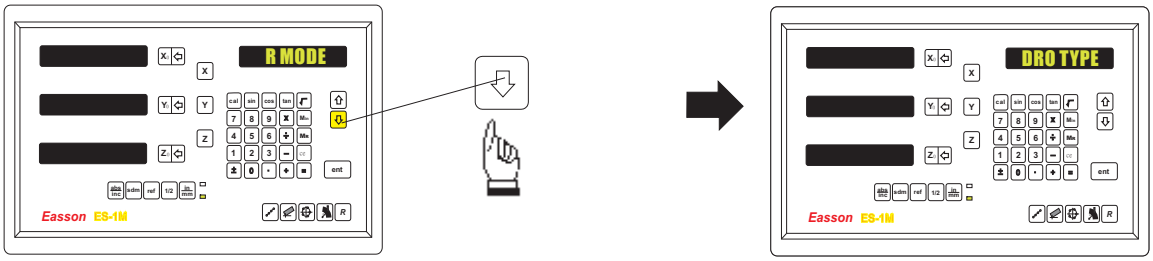
11.) Press ⇩ key to select the "R MODE" function.



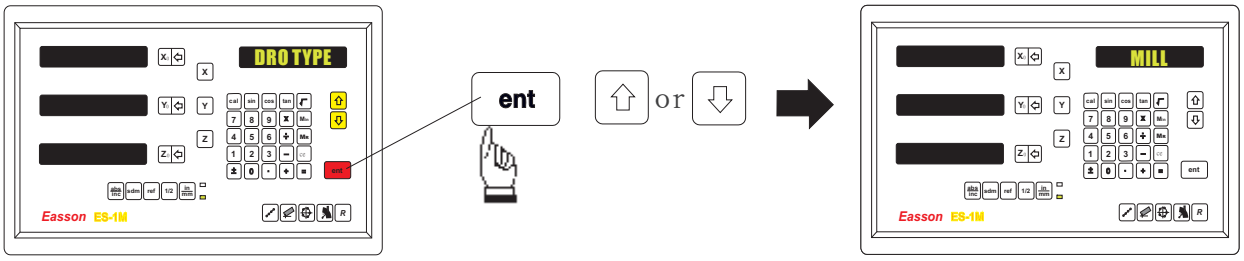
Press ent key to make your setting, then press ⇧ key or ⇩ key to select the "Z STEP" or "MAX CUT" function.



12.) Press ent key to make your setting, then press ⇩ key to select the "DRO TYPE" function.

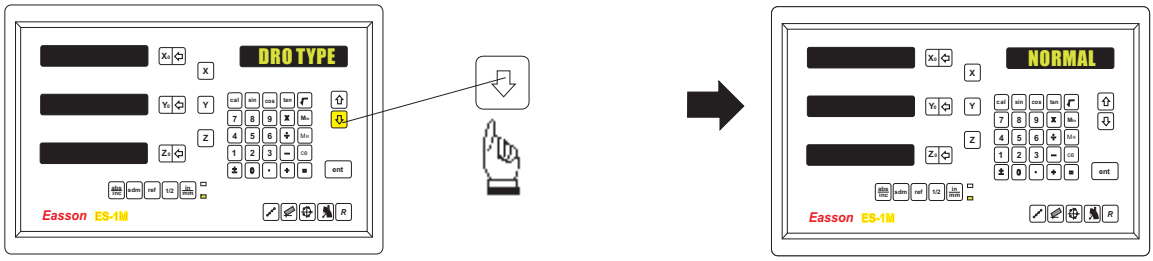


Press ent key to make your setting, then press ⇧ key or ⇩ key to select the "MOULD"、"MILL" or "BASIC" function.

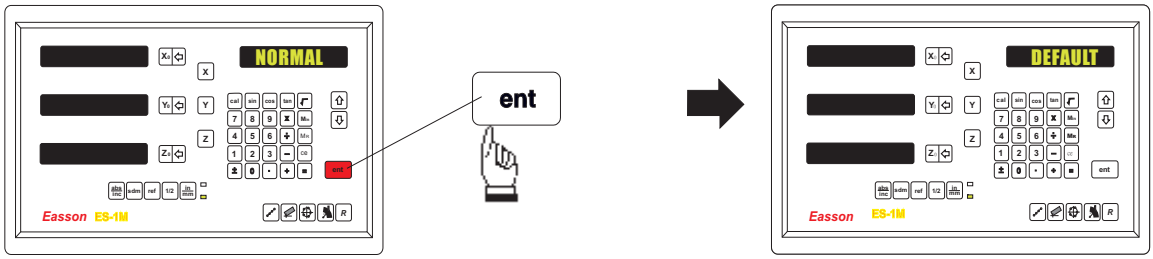


The MOULD software package is fully functional according to the OPERATOR'S MANUAL, including the SHRINKAGE calculation, which compensate for shrinkage during machining.
The MILL software is fully functional but excludes the SHRINKAGE option.
BASIC option removes all the more complex functions and returns the DRO to a basic plus the CALCULATOR functions.

13.) Press ent key to make your setting, then press ⇩ key to select the "NORMAL" function.

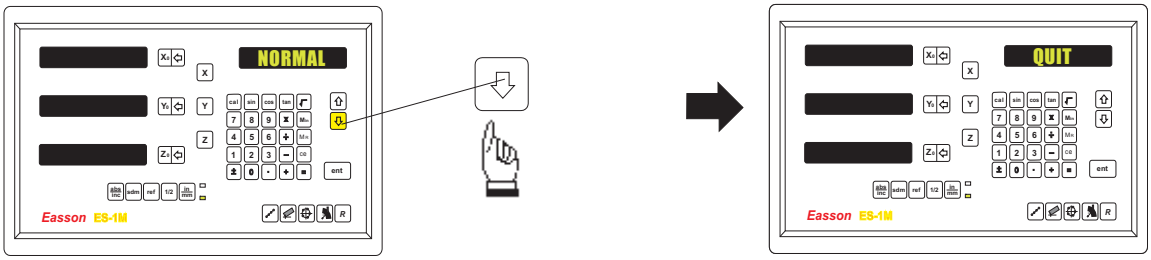


Press ent key into the setting function, the meassage "DEFAULT" is shown in the MESSAGE WINDOW.

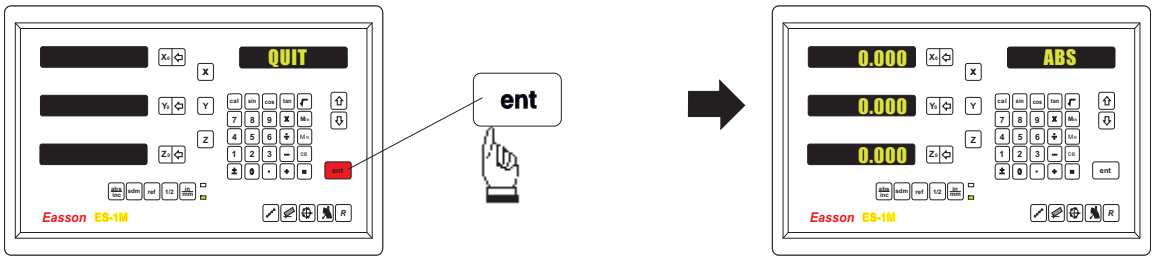


After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "NORMAL" is shown in the MEASSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "DEFAULT" appears in the MEASSAGE WINDOW. By pressing the ENTER key the software is restored to default level. Press the UP/DOWN keys to move to the next menu item.

14.) Press ent key to make your setting, then press ⇩ key to select the "QUIT" function.



Press ent key to make your selection, then the DRO will exit the SETUP function and return to the "ABS" state.



By pressing the ENTER key the DRO exits the SETUP program and is ready for machining operations. If use the error compensation function, you must turn off the DRO then power on the DRO again, otherwise your compensated value will invalid.