This booklet was written for operators of CINCINNATI® VERCI-POWER® Milling Machines.

At the time of writing, the booklet was completely up to date. However, due to continual improvements in design, it is possible that descriptions contained herein may vary slightly from the machine delivered to you. This merely implies that the machine has been improved to better fulfill your requirements.

Publication No. M-2571-1

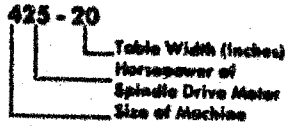
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO 45209

ILLUSTRATION REFERENCE NUMBERS

For your convenience in quickly finding illustrations referred to in the text, we have given all illustrations the same number as the page on which they appear. For example, Figs. 11A and 11B, are both on page 11.

SERIAL NUMBER

The serial number of the machine is stamped on the face of the carrier and also on the right-hand end of the table.



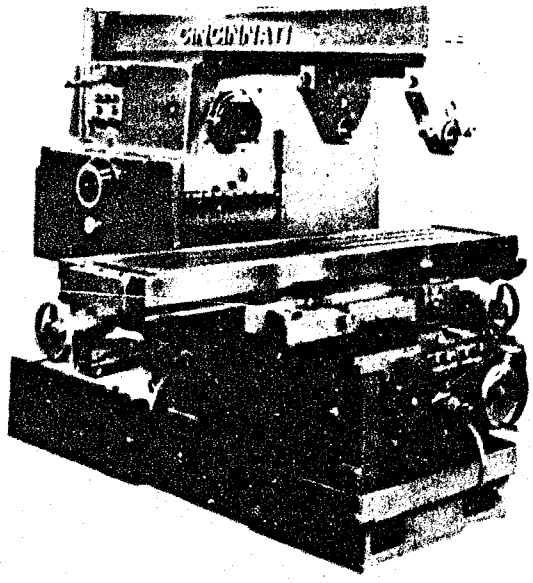


Figure 3A
CINCINNATI Horizontal VERCIPOWER
Milling Machine

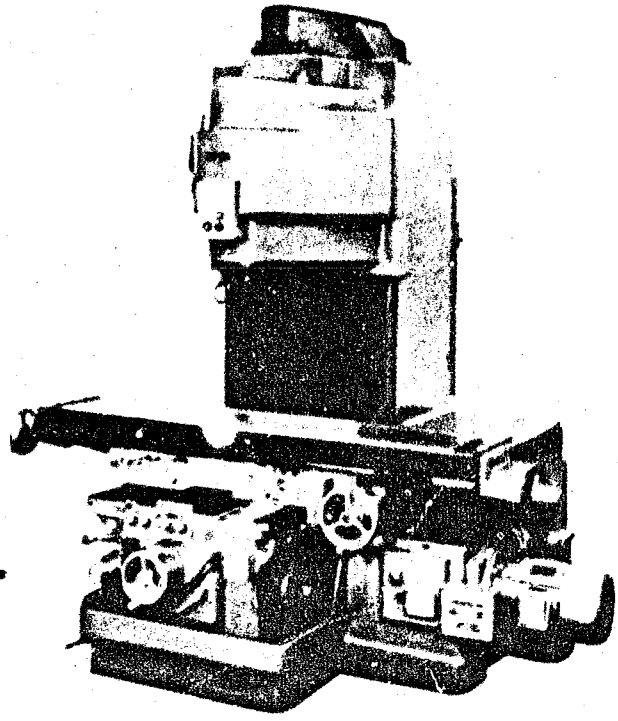
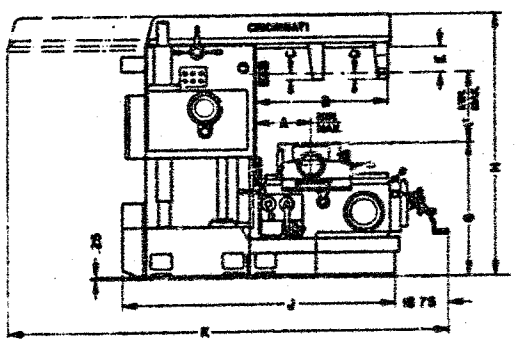
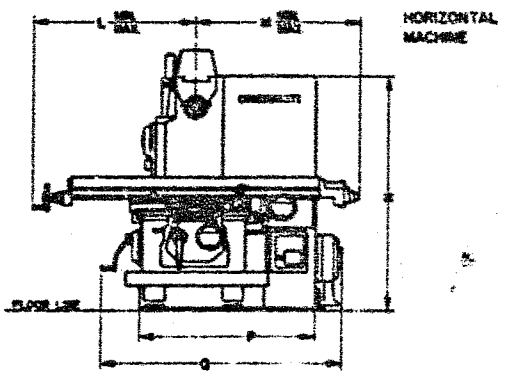


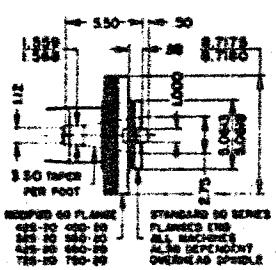
Figure 3B
CINCINNATI Vertical
VERCIPOWER Milling Machine

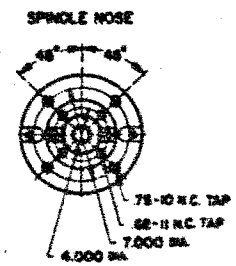
CONTENTS

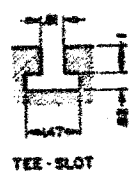
MACHINE SPECIFICATIONS

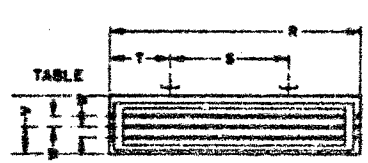










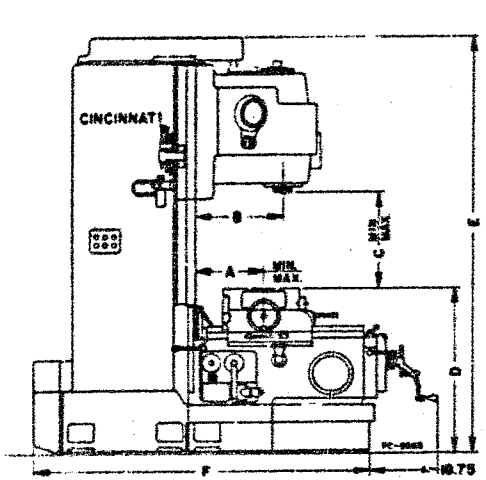


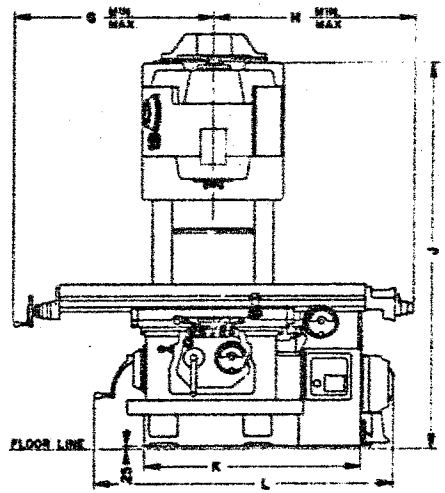
Machine Size		A		B	C	D		E	F		G	H	J	K	L		M		N	P	Q	R	S	T	U	V	W
		Min.	Max.			W/O Lugs	With Lugs		Min.	Max.					Min.	Max.	Min.	Max.									
320-16	330-16	12.63"	24.63"	40.25"	1.81"	1.81"	1.81"	7.38"	2"	24"	39"	80"	79.13"	139.75"	28"	42"	32.50"	68.50"	71.88"	49.25"	76.25"	72"	34"	16.75"	18"	8.50"	3.25"
420-16	430-16	12.63"	26.63"	40.25"	1.81"	1.81"	1.81"	7.38"	2"	24"	39"	80"	79.13"	139.75"	28"	70"	32.50"	74.50"	71.88"	49.25"	76.25"	80"	42"	16.75"	18"	8.50"	3.25"
425-20	450-20	13.75"	28.75"	44.25"	2.25"	2.25"	2.56"	8.13"	3"	27"	39.50"	85.50"	87.63"	148.38"	30"	72"	36.50"	78.50"	76.38"	56.44"	83.88"	86.50"	42"	19.25"	20"	9.50"	4.25"
525-20	550-20	13.75"	28.75"	44.25"	2.25"	2.25"	2.56"	8.13"	3"	27"	39.50"	85.50"	87.63"	148.38"	30"	80"	36.50"	86.50"	76.38"	56.44"	83.88"	94.50"	50"	19.25"	20"	9.50"	4.25"
625-20	650-20	13.75"	31.75"	44.25"	2.25"	2.25"	2.56"	8.13"	3"	27"	39.50"	85.50"	87.63"	148.38"	30"	90"	36.50"	96.50"	76.38"	56.44"	83.88"	104.50"	60"	19.25"	20"	9.50"	4.25"
725-20	750-20	13.75"	31.75"	44.25"	2.25"	2.25"	2.56"	8.13"	3"	27"	39.50"	85.50"	87.63"	148.38"	30"	102"	36.50"	108.50"	76.38"	56.44"	83.88"	116.50"	72"	19.25"	20"	9.50"	4.25"

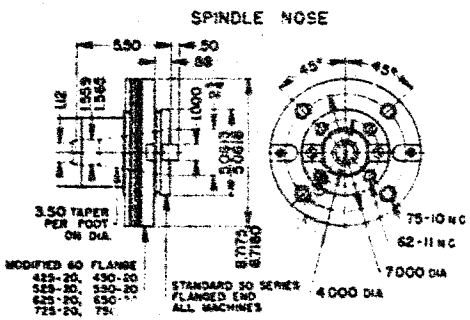
MACHINE SPECIFICATIONS (Horizontal Machines)

SIZE	320-18	330-18	420-18	430-18	425-30	450-20	525-20	550-20	625-20	650-20	725-20	750-20
TABLE												
Working surface	72" x 18"		80" x 18"		86½" x 20"		94½" x 20"		104½" x 20"		116½" x 20"	
Size overall	72" x 18"		80" x 18"		86½" x 20"		94½" x 20"		104½" x 20"		116½" x 20"	
T-Slots, number and size	Three—$^{13}/_{16}$"		Three—$^{13}/_{16}$"		Three—$^{13}/_{16}$"		Three—$^{13}/_{16}$"		Three—$^{13}/_{16}$"		Three—$^{13}/_{16}$"	
RANGE												
Longitudinal	34"		42"		42"		50"		60"		72"	
Cross (without brace)	12"		14"		16"		16"		18"		18"	
Vertical	22"		22"		24"		24"		24"		24"	
SPINDLE												
Standard milling machine spindle nose	No. 50		No. 50		(No. 60 Flange) No. 50		(No. 60 Flange) No. 50		(No. 60 Flange) No. 50		(No. 60 Flange) No. 50	
Diameter of nose	5$^{1}/_{16}$"		5$^{1}/_{16}$"		5$^{1}/_{16}$" & 8$^{23}/_{32}$"		5$^{1}/_{16}$" & 8$^{23}/_{32}$"		5$^{1}/_{16}$" & 8$^{23}/_{32}$"		5$^{1}/_{16}$" & 8$^{23}/_{32}$"	
Diameter of hole in draw-in bolt	1$^{1}/_{8}$"		1$^{1}/_{8}$"		1$^{1}/_{8}$"		1$^{1}/_{8}$"		1$^{1}/_{8}$"		1$^{1}/_{8}$"	
Speeds Number	24		24		24		24		24		24	
Speeds Range	16-1600		16-1600		14-1400		14-1400		14-1400		14-1400	
	16, 19, 24, 29, 35, 42, 52, 62, 78, 93, 114, 136, 188, 221, 280, 334, 410, 489, 605, 720, 906, 1080, 1325, 1600 rpm.				14, 17, 21, 26, 31, 37, 46, 55, 69, 82, 101, 120, 168, 200, 252, 300, 388, 440, 542, 645, 815, 970, 1190, 1400 rpm.							
Reverse	Included		Included		Included		Included		Included		Included	
FEEDS												
Number	32		32		32		32		32		32	
Range Longitudinal and cross per min.	⅛"-90"		⅛"-90"		⅛"-90"		⅛"-90"		⅛"-90"		⅛"-90"	
Range Vertical per min.	¼"-45"		¼"-45"		¼"-45"		¼"-45"		¼"-45"		¼"-45"	
Longitudinal and cross feeds per min.	⅛", $^{7}/_{16}$", $^{9}/_{16}$", $^{11}/_{16}$", $^{13}/_{16}$", $^{15}/_{16}$", 1⅛", 1$^{3}/_{16}$", 1⅜", 1⅝", 2¼", 2$^{5}/_{16}$", 3¼", 3$^{5}/_{16}$", 4½", 5¼", 6½", 7½", 9", 11", 13", 15¼", 19", 22", 27", 31", 39", 45", 54", 63", 79", 90"											
	Vertical feeds are ½ longitudinal rates											
POWER RAPID TRAVERSE (spindle stopped or running)												
Longitudinal and cross per min.	150"		150"		150"		150"		150"		150"	
Vertical per min.	75"		75"		75"		75"		75"		75"	
SPINDLE DRIVE												
Motor rating AC	20 hp	30 hp	20 hp	30 hp	25 hp	50 hp	25 hp	50 hp	25 hp	50 hp	25 hp	50 hp
FEED DRIVE												
Motor rating AC	7.5 hp		7.5 hp		7.5 hp		7.5 hp		7.5 hp		7.5 hp	
CUTTING FLUID PUMP (included)												
Motor driven—gals. per min.	5		5		5		5		5		5	
FLOOR SPACE	135¼" x 128⅛"—121 sq. ft.		135¼" x 144⅛"—136 sq. ft.		146⅛" x 151"—153 sq. ft.		146⅛" x 167"—170 sq. ft.		146⅛" x 187"—190 sq. ft.		146⅛" x 211"—214 sq. ft.	
SHIPPING DATA												
Net weight, lbs. (approx.)	15680	16180	16350	16850	18700	19000	19400	19700	20100	20400	20800	21100
Size of case	112" x 84" x 94"		120" x 84" x 94"		127" x 92" x 99"		135" x 92" x 99"		145" x 92" x 99"		157" x 92" x 99"	
Volume of case	511 cu. ft.		560 cu. ft.		669 cu. ft.		711 cu. ft.		794 cu. ft.		827 cu. ft.	

MACHINE SPECIFICATIONS







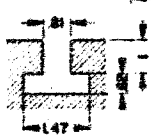
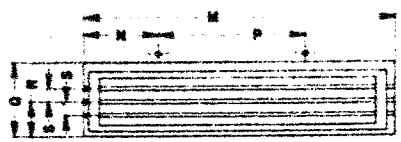


TABLE & TEE SLOT



Machine Size		A		B	C		D	E	F	G		H		J	K	L	M	N	P	Q	R	S
		Min.	Max.		Min.	Max.				Min.	Max.	Min.	Max.									
320-18	330-18	12.50"	28.50"	20.50"	2"	26"	39"	107.25"	83.13"	28"	62"	32.50"	66.50"	99.75"	50.50"	76.25"	72"	16.75"	34"	18"	8.50"	3.25"
420-18	430-18	12.50"	28.50"	20.50"	2"	26"	39"	107.25"	83.13"	28"	70"	32.50"	74.50"	99.75"	50.50"	76.25"	80"	16.75"	42"	18"	8.50"	3.25"
425-20	450-20	13.13"	31.13"	22.13"	2"	26"	39.50"	112.25"	88.63"	30"	72"	36.50"	78.50"	104.75"	57.69"	83.88"	86.50"	19.25"	42"	20"	9.50"	4.25"
525-20	550-20	13.13"	31.13"	22.13"	2"	26"	39.50"	112.25"	88.63"	30"	80"	36.50"	86.50"	104.75"	57.69"	83.88"	94.50"	19.25"	50"	20"	9.50"	4.25"
625-20	650-20	13.13"	31.13"	22.13"	2"	26"	39.50"	112.25"	88.63"	30"	90"	36.50"	96.50"	104.75"	57.69"	83.88"	104.50"	19.25"	60"	20"	9.50"	4.25"
725-20	750-20	13.13"	31.13"	22.13"	2"	26"	39.50"	112.25"	88.63"	30"	102"	36.50"	108.50"	104.75"	57.69"	83.88"	116.50"	19.25"	72"	20"	9.50"	4.25"

CINCINNATI VERTICIPOWER MILLING MACHINES

MACHINE SPECIFICATIONS (Vertical Machines)

SIZE	320-18 | 330-18	420-18 | 430-18	425-20 | 450-20	525-20 | 550-20	625-20 | 650-20	725-20 | 750-20
TABLE						
Working surface	72" x 18"	80" x 18"	86½" x 20"	94½" x 20"	104½" x 20"	116½" x 20"
Size overall	72" x 18"	80" x 18"	86½" x 20"	94½" x 20"	104½" x 20"	116½" x 20"
T-Slots, number and size	Three—$^{13}/_{16}$"	Three—$^{13}/_{16}$"	Three—$^{13}/_{16}$"	Three—$^{13}/_{16}$"	Three—$^{13}/_{16}$"	Three—$^{13}/_{16}$"
RANGE						
Longitudinal	34"	42"	42"	50"	60"	72"
Cross	16"	16"	18"	18"	18"	18"
Vertical	24"	24"	24"	24"	24"	24"
SPINDLE						
Standard milling machine spindle nose	No. 50	No. 50	(No. 60 Flange) No. 50	(No. 60 Flange) No. 50	(No. 60 Flange) No. 50	(No. 60 Flange) No. 50
Diameter of nose	$5^{1}/_{16}$"	$5^{1}/_{16}$"	$5^{1}/_{16}$" & $8^{23}/_{32}$"	$5^{1}/_{16}$" & $8^{23}/_{32}$"	$5^{1}/_{16}$" & $8^{23}/_{32}$"	$5^{1}/_{16}$" & $8^{23}/_{32}$"
Diameter of hole for draw-in bolt	1⅛"	1⅛"	1⅛"	1⅛"	1⅛"	1⅛"
Speeds Number	24	24	24	24	24	24
Speeds Range	16-1600	16-1600	14-1400	14-1400	14-1400	14-1400
	16, 19, 24, 29, 35, 42, 52, 62, 78, 93, 114, 136, 188, 221, 280, 334, 410, 489, 605, 720, 906, 1080, 1325, 1600 rpm.		14, 17, 21, 26, 31, 37, 46, 55, 69, 82, 101, 120, 168, 200, 252, 300, 308, 440, 542, 645, 815, 970, 1190, 1400 rpm.			
Reverse	Included	Included	Included	Included	Included	Included
FEEDS						
Number	32	32	32	32	32	32
Range Longitudinal and cross per min	⅛"-90"	⅛"-90"	⅛"-90"	⅛"-90"	⅛"-90"	⅛"-90"
Range Vertical per min	$^{1}/_{16}$"-45"	$^{1}/_{16}$"-45"	$^{1}/_{16}$"-45"	$^{1}/_{16}$"-45"	$^{1}/_{16}$"-45"	$^{1}/_{16}$"-45"
Longitudinal and cross feeds per min	⅛", $^{7}/_{16}$", $^{9}/_{16}$", $^{11}/_{16}$", $^{13}/_{16}$", $^{15}/_{16}$", 1⅛", $1^{3}/_{16}$", 1⅜", 1⅝", 2⅛", $2^{3}/_{16}$", 3¼", $3^{3}/_{16}$", 4½", 5¼", 6½", 7½", 9", 11", 13", $15^{1}/_{4}$", 19", 22", 27", 31", 39", 45", 54", 63", 79", 90"					
	Vertical feeds are ½ longitudinal rates					
POWER RAPID TRAVERSE (spindle stopped or running)						
Longitudinal and cross per min	150"	150"	150"	150"	150"	150"
Vertical per min	75"	75"	75"	75"	75"	75"
SPINDLE DRIVE						
Motor rating AC	20 hp | 30 hp	20 hp | 30 hp	25 hp | 50 hp	25 hp | 50 hp	25 hp | 50 hp	25 hp | 50 hp
FEED DRIVE						
Motor rating AC	7.5 hp	7.5 hp	7.5 hp	7.5 hp	7.5 hp	7.5 hp
CUTTING FLUID PUMP (Included)						
Motor driven—gals. per min	5	5	5	5	5	5
FLOOR SPACE	135¾" x 128¾"= 121 sq. ft.	135¾" x 144¾"= 136 sq. ft.	146⅛" x 151"= 153 sq. ft.	146⅛" x 167" = 170 sq. ft.	146⅛" x 187"= 190 sq. ft.	146⅛" x 211"= 214 sq. ft.
SHIPPING DATA						
Net weight, lbs. (approx.)	21180 | 21380	21550 | 21650	23300 | 24200	24600 | 24900	25300 | 25600	26000 | 26300
Size of case	90" x 122" x 94"	98" x 122" x 94"	105" x 122" x 99"	113" x 122" x 99"	123" x 122" x 99"	135" x 122" x 99"
Volume of case	596 cu. ft.	649 cu. ft.	733 cu. ft.	778 cu. ft.	859 cu. ft.	922 cu. ft.
CODE NAME	YUXWA | YUXWB	YUXWC | YUXWD	YUXWE | YUXWF	YUXWG | YUXWH	YUXWI | YUXWJ	YUXWK | YUXWL

INSTALLATION INSTRUCTIONS

To obtain accurate results from a milling machine over a long period of time, three requirements must be met. First, the foundation upon which the machine rests must be heavy enough to maintain stability and flatness under the weight of the machine. Second, the machine must be firmly anchored to the foundation; and third, the machine must be carefully leveled and then checked occasionally to be sure that level is maintained.

Foundation. Special foundations for CINCINNATI® VERCIPOWER Milling Machines are not required. Any substantial floor, wood or concrete, fairly flat, and sufficiently heavy to withstand the weight of the machine, will be satisfactory. For weights and dimensions see pages 7 and 9.

Lifting the Machine. The machine may be lifted with a crane using a three point suspension where cable ends are attached to lifting hooks. (See Figures 10A and 10B). The hooks are fastened to lifting clamps, one located at the front right-side of the base, another located at the bottom left-rear and a third located at the rear of the headstock. The lifting clamps are located as shown in Figures 10B. The lifting hooks and clamps, supplied with the machine, should be returned to The Cincinnati Milling Machine Company after the machine has been installed. If you expect to move the machine, at some time in the future, it would be well to make similar set of hooks or to purchase them from The Cincinnati Milling Machine Co.

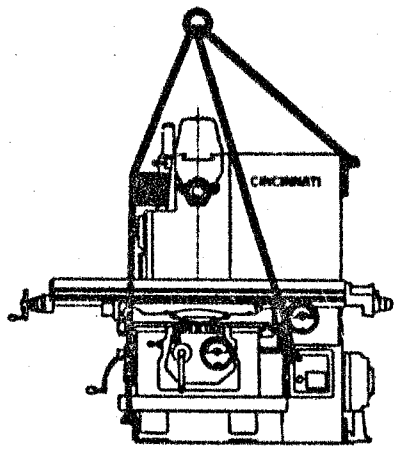


Figure 10A
Lifting the Horizontal Machine

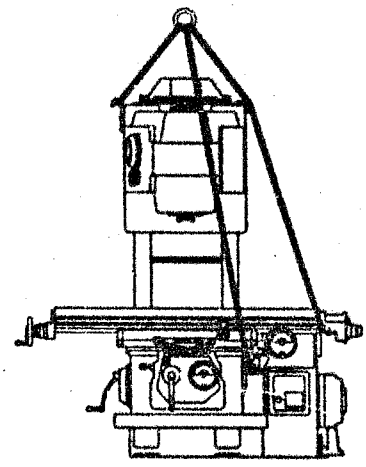


Figure 10B
Lifting the Vertical Machine

Assembling Table to Machine. If the machine table and leadscrew have been removed for convenience in shipping, the following instructions must be adhered to when re-assembling machine table and leadscrew.

Important. Never remove the backlash eliminator housing and do not disturb the relationship between the two steel adjusting nuts and the bronze leadscrew nuts. Backlash eliminator disengaging knob should be in disengaged position (see page 30) before assembling table to machine.

1. Remove wire which holds two backlash eliminator nuts in housing. Remove one bronze leadscrew nut at a time, clean and replace.
2. Push in right-hand nut (as viewed from front of machine) and align scribed line on nut with line on housing by turning nut against spring tension. Insert leadscrew from right-hand end of machine. Make sure nut is held tight against housing and also that scribed lines are kept aligned while inserting leadscrew. Turn leadscrew until its end is just through right-hand nut.
3. Push in left-hand nut and align scribed line on nut with line on housing. Turn leadscrew into left-hand nut. *Make sure that both nuts are held tight against housing and also that scribed lines on both nuts are kept aligned with lines on housing.* Turn leadscrew in far enough so that it passes completely through left-hand nut.
4. Wash bearing surfaces on the saddle and table perfectly clean. Apply a liberal coat of machine oil to saddle bearings.
5. Place table control lever in its neutral or middle position.
6. Insert two table locking shoes in holes in front of saddle and follow up with table clamping screws.
7. Insert table from the left-hand side of machine.
8. Insert table gib between saddle and table and adjust gib (see page 38).
9. Turn leadscrew in until apron on right-hand end of leadscrew is tight against right-hand end of table. Be sure dowel pins in apron match with pin holes in end of table. Insert and tighten apron screws.
10. Attach left-hand apron to left-hand end of table. Adjust the adjusting nut on right-hand end of leadscrew to take up end play in leadscrew. There should not be more than .005" backlash in leadscrew dial. Tighten lock screw in adjusting nut.
11. Place clutch, dial, spring, handwheel, etc. on left-hand end of leadscrew. Check table movement by turning hand crank. If too tight or too loose, re-adjust gib.

Assembling Counterweight to Spindle Carrier

In some cases the counterweight has been removed from the Vertci-Power milling machines for safe shipment. In addition, wood blocks are placed under the spindle carrier to support it during shipment.

To assemble the counterweight and remove the wood blocks proceed as follows:

1. From the top of the headstock, by crane, lower counterweight into machine until the hole through the weight lines up with the holes on either side of the headstock.

2. Insert bar (supplied with machine) through headstock and weight, remove crane hook from weight.

3. Locate "bonnet" on top of headstock and fasten securely in place.

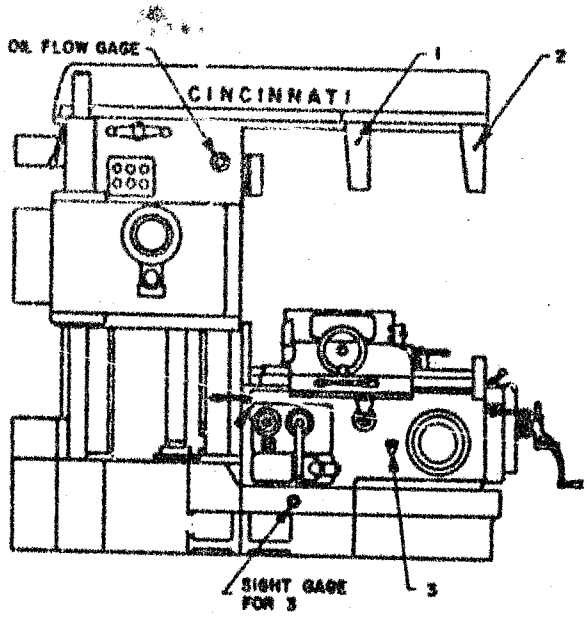
4. Raise spindle carrier by hand and remove wood blocks.

5. Assemble sprocket chain to spindle carrier through "bonnet" on sprocket and fasten to counterweight.

6. Fasten lubrication lines, coolant hose and electrical conduit to headstock and carrier. Holes are stamped on both units or identification when assembling these hoses.

7. Lower spindle carrier by hand until tension is removed between counterweight and supporting bar (step No. 2).

8. Remove bar and place cover over the holes. Note: Make sure lubricating lines are properly assembled before starting machine.



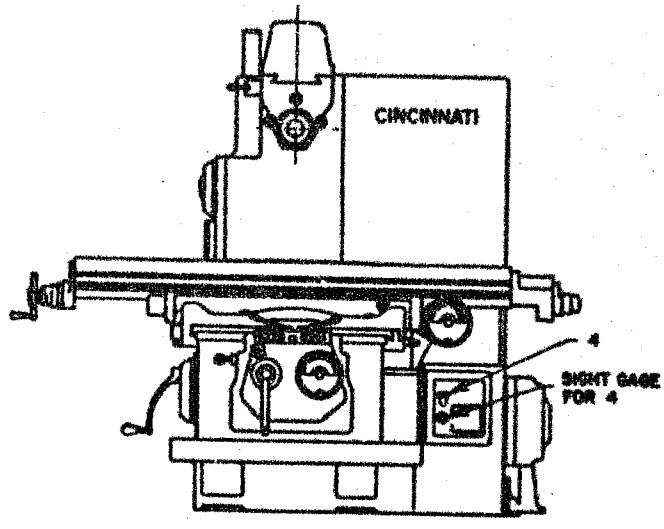


Figure 16
Lubrication Diagram

LUBRICATING INSTRUCTIONS AND SPECIFICATIONS

See Lubrication Diagram, Page 16

Thoroughly oil all moving parts as they are installed. Then, lubricate all principal points as listed below before starting machine. Periodic and thorough lubrication with correct lubricant, as specified, will help maintain the long life and accuracy built into machine. The intervals listed are based on a normal eight-hour day.

PURCHASE LUBRICANTS FROM RELIABLE DEALERS

When to Oil	Number	Instructions	Parts Lubricated	Specifications
Daily	1 and 2	*Remove cap, keep filled to high limit. Use oil pot to fill. (Check daily).	Arbor support bearings.	P-55 Good quality paraffin base rust and oxidation inhibited oil. Viscosity range 300-330 S.U.S. at 110°F.
Weekly	3	*Keep filled above low limit on gage. Use oil pot to fill (check weekly).	Gears and bearings in base and spindle carrier.	
	4	*Keep filled above low limit on gage. Use oil pot to fill (check weekly).	Saddle and spindle carrier bearing ways.	P-47 A non-corrosive, medium-heavy bodied oil possessing antistick slip characteristics. Viscosity range 300 - 350 S.U.S. at 100°F.

*Quantity required stations No. 1 or No. 2 approx. 1 qt., Station No. 3 approx. 10 pts., station No. 4 approx. 1½ qts.

Note—Lubricate motor according to motor manufacturer's specifications.

P-47, P-55 are The Cincinnati Milling Machine Co. Specifications Numbers.

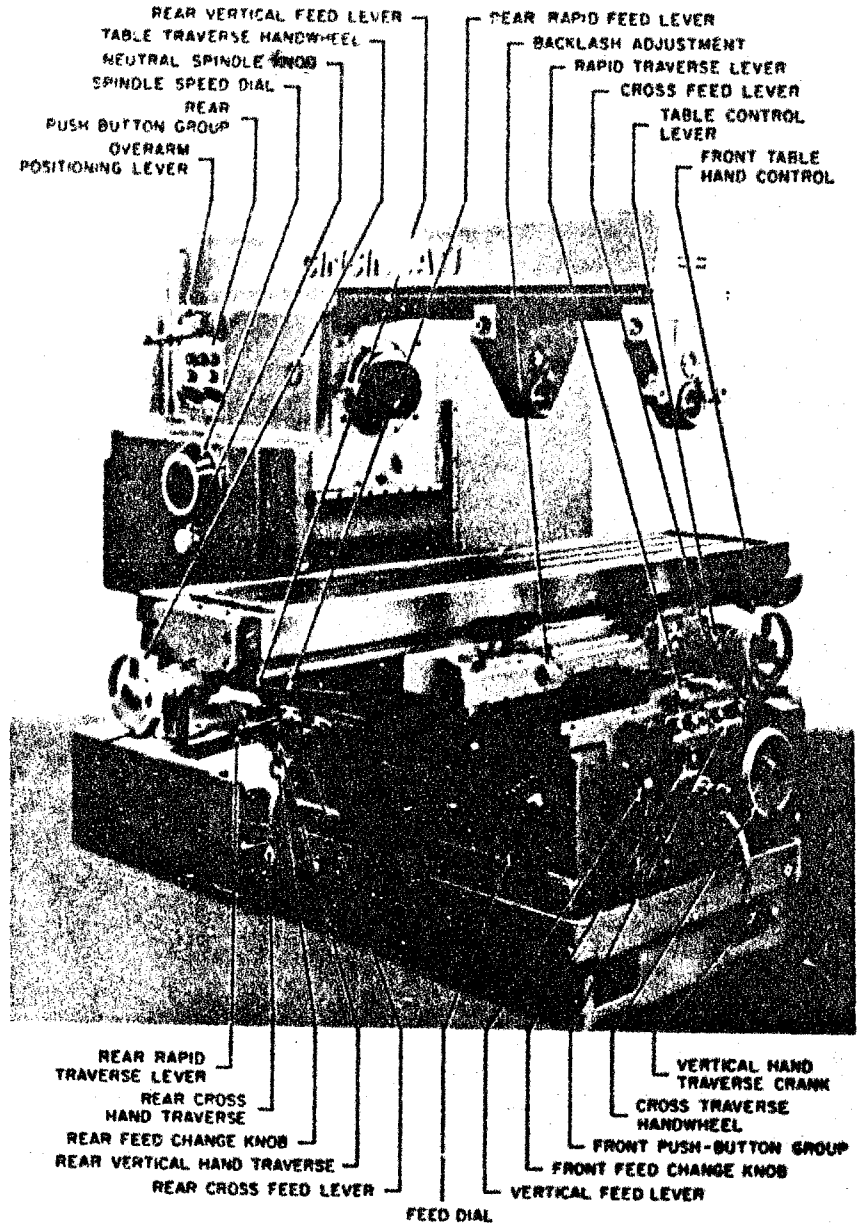


Figure 18
Functional Diagram

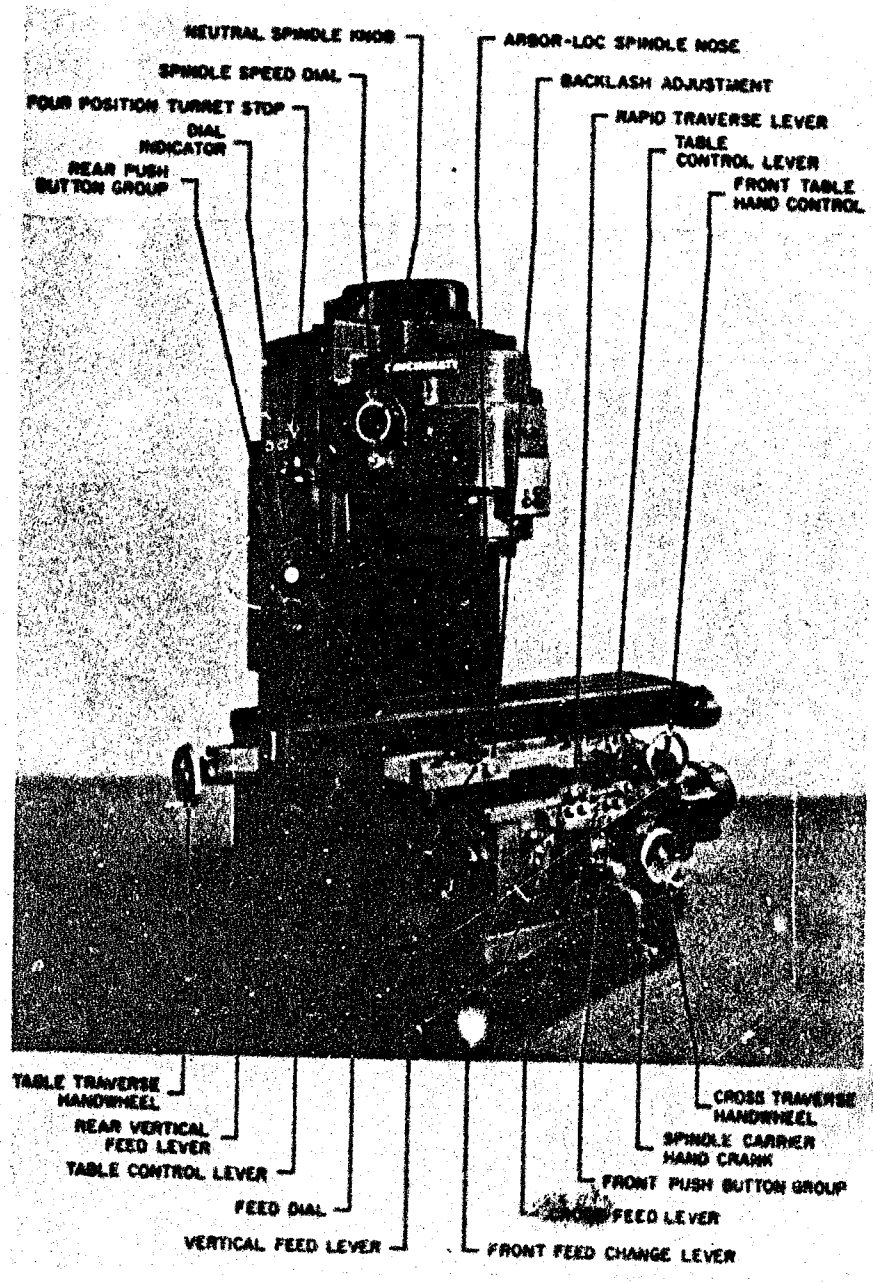


Figure 19
Functional Diagram
(rear controls available at extra cost)

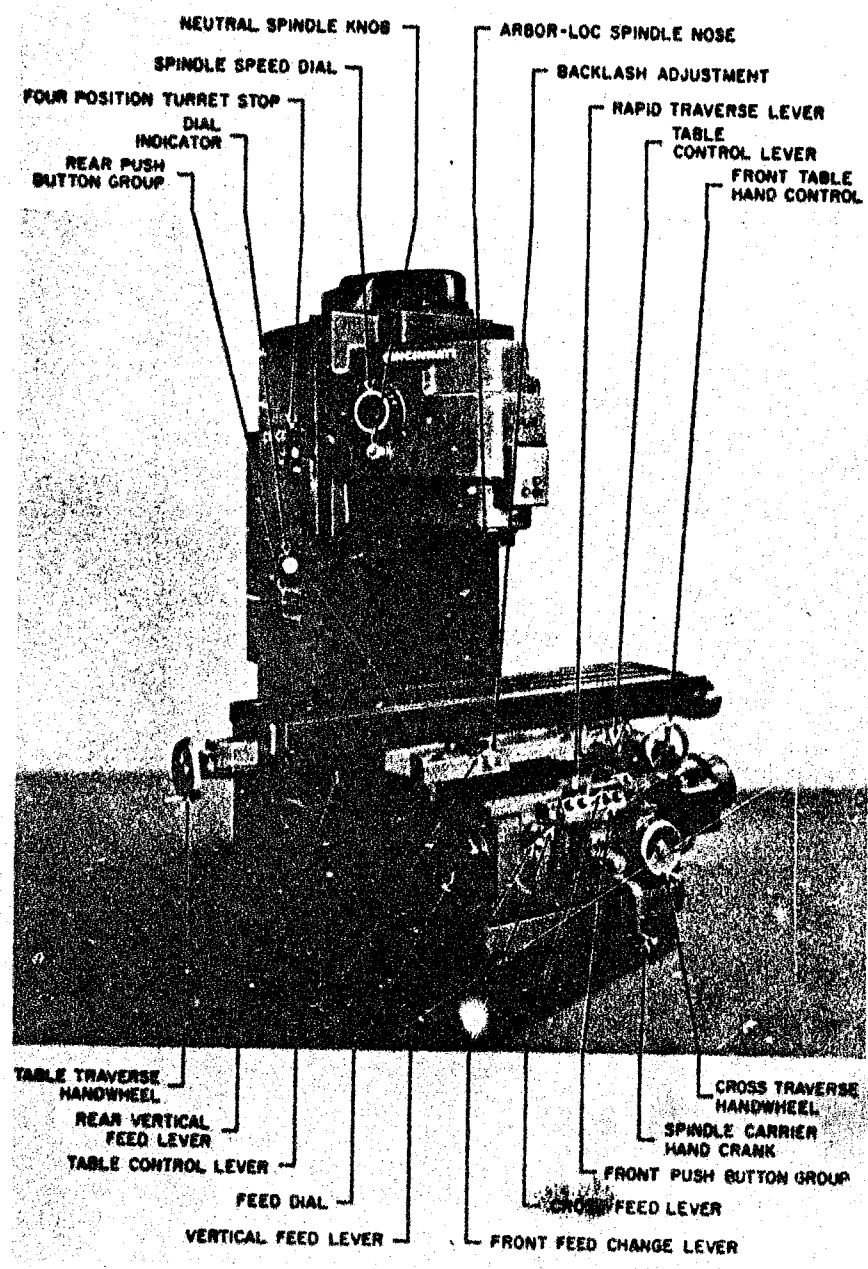


Figure 19
Functional Diagram
(rear controls available at extra cost)

MACHINE CONTROLS AND OPERATING INSTRUCTIONS

In general, these instructions apply to horizontal and vertical machines. See pages 25 and 26 for instructions which apply to vertical machines only.

Before Starting a New Machine:

1. Comply with the "Installation Instructions", page 10.
2. Wash off the slushing oil and any dirt with naphtha or a similar grease solvent; never use caustic cleaning compounds.
3. Comply with the "Machine Lubrication Instructions", page 17.

WARNING: Never attempt to start the machine or move the machine slides until all points have been properly lubricated.

4. Fill the cutting fluid reservoir. (See page 44.)
5. Following the directions of "Starting the Machine," page 21, immediately check the direction of the spindle and feed drive motors.

   Check the spindle motor direction by observing the direction of the pulleys and belt. Check the feed motor by looking in the end of the motor. Both motors should turn clockwise. (See Figure 20.) If either motor rotates in the wrong direction have the electrician check for crossed leads. Also, if the feed motor is running backwards there will be no hydraulic pressure to power the table and saddle.

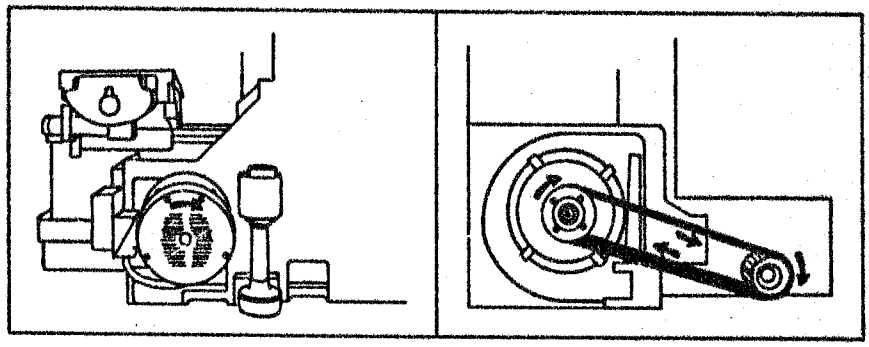


Figure 20
Motor Directions

6. Allow the machine to run for at least a half hour to insure adequate lubrication to all bearings. Do not add oil to the reservoir with the machine running.
7. Thoroughly study the "Functional Diagrams" (Figures 18 and 19) and the "Operating Instructions," page 18.

Starting the Machine. Place all feed levers in their neutral or stop positions (Figure 22). Start the motor. **Note**—The hinged belt guard cover at the rear of the machine must be closed and latched before the push button will start the motor. Depress the "Spindle Start" button to start the rotation of the spindle. An automatic spindle brake is engaged when the "Spindle Stop" button is depressed, stopping the rotation of the spindle.

Changing Spindle Speeds. Start the motor. With the spindle stationary, and clear of the work, depress and hold the "Speed Increase" or "Speed Decrease" push button (Figure 22). When the spindle speed dial (Figure 18) rotates to the speed desired, lining up with the index mark, release the push button. Now, pause a second or two and then depress the "Spindle Start" button. The spindle will rotate at the speed indicated by the dial and index mark. The short pause mentioned, gives the gears time to fully engage, and thereby prevents clashing of the teeth.

When working from the rear of the machine, the speed dial and spindle start-stop is controlled by the group of push buttons located on the spindle carrier.

Note: *On long run jobs, change speeds one full rotation of dial each day.*

Nos. 3 & 4	16, 19, 24, 29, 35, 42, 52, 62, 78, 93, 114, 136, 188, 221, 280, 334, 410, 489, 605, 720, 906, 1080, 1325, 1600 rpm.
Nos. 4, 5, 6, & 7	14, 17, 21, 26, 31, 37, 46, 55, 69, 82, 101, 120, 168, 200, 252, 300, 368, 440, 542, 645, 906, 1080, 1325, 1600 rpm.

Figure 21—Standard Spindle Speeds

Micrometer Dials. All of the hand controls, longitudinal, cross, and vertical, are provided with adjustable micrometer dials. To reset, or "zero", one of these dials, pull it outward against light spring pressure, rotate to the desired position and release.

Hand Table Feed. The table traverse handwheels (Figure 18), located at the front and left end of the table, control the movement of the table when the power feed is disengaged. When the handwheel is rotated one turn in a clockwise direction, the table moves away from the operator ¼ inch. The dial is graduated into 250 equal spaces, which is equivalent to .001" movement of the table for each space.

Hand Cross Feed. The cross traverse handwheel (Figure 20), enables the saddle to be moved by hand when working from the front of the machine. One clockwise turn of the handwheel moves the saddle ¼ inch toward the carrier. The dial is graduated into 250 spaces, which is equivalent to .001" movement of the saddle for each space.

Hand Vertical Feed. The vertical hand traverse crank (Figure 18), enables the spindle carrier to be moved up or down when working from the front of the machine. One clockwise turn moves the carrier up 1/20 inch. The dial is graduated into 100 equal spaces, which is equivalent to .0005" movement of the carrier for each space.

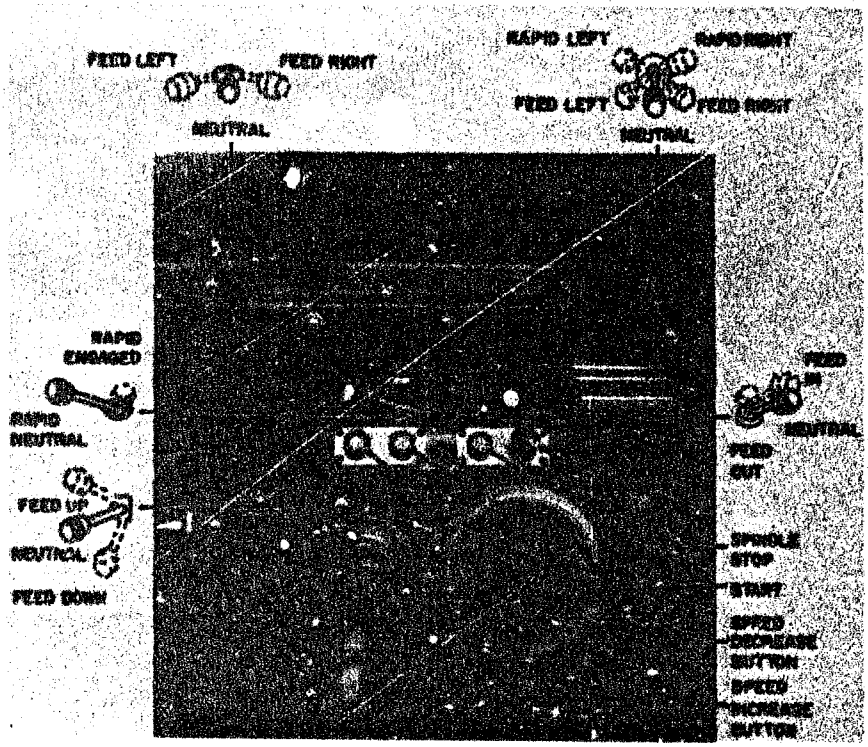


Figure 22
Push Button Group and Positions of Front Control Power Feed Levers

Power Feed Controls. All power feed control levers—longitudinal, cross, and vertical—are of the directional control type, i.e., the sliding unit moves in the direction in which the lever is moved. For instance, if the table power feed lever is moved to the left, the table moves to the left; if the lever is moved to the right, the table moves to the right.

Power Feed Table. Longitudinal power movements of the table are engaged from the front of the machine by means of the table control lever (Figure 18). To feed the table left, move the lever to the left; to feed the table right, move the lever to the right. Power rapid

traverse is obtained by first engaging the power table feed and then engaging the rapid traverse lever (Figure 18). Loosen the table clamping screws before engaging the table feed or rapid traverse. It is also advisable to tighten the saddle and carrier clamps when using the table feed alone. See "Clamping Devices for Sliding Units", pages 29 and 30.

Power Cross Feed. Traverse power feed movements of the saddle are engaged by means of the cross feed control lever (Figure 18). To feed to the rear, shift lever to the rear, to feed to the front, shift lever to front. Before engaging the cross feed, loosen the saddle clamp. It is also advisable to tighten the table clamping screws when using the cross feed. See "Clamping Devices for Sliding Units", pages 29 and 30.

Power Vertical Feed. Vertical power feed movements of the carrier are engaged by means of the vertical feed control lever (Figure 18). Shift the lever upward to raise the carrier, downward to lower the carrier. Before engaging the vertical feed, loosen the carrier clamp. It is also advisable to tighten the table clamping screws and saddle clamp when using the vertical feed alone. See "Clamping Devices for Sliding Units", pages 29 and 30. Power vertical feed rates are ½ the rates shown on the feed dial.

Feeds. The method of changing the feed rates, described below, is similar to the method of changing spindle speeds. If desired, any combination of feed motions, such as cross and table, may be engaged at the same time. The spindle must be running to obtain a feed movement except when in neutral position for tramming. Reversing the direction of rotation of the spindle (explained on page 27) does not affect the direction of the feeds.

Changing Feeds. Start the motor. The spindle should be stopped and all front and rear feed engaging levers should be in their neutral or stop positions. Rotate the feed change knob (Figure 18) clockwise or counter-clockwise and hold until the desired feed shown on the feed dial (Figure 18) is registered with the index mark. Release the feed change knob. The proper feed gears are now in mesh to move the table at the feed rate indicated by the dial and index mark.

Table and Cross Feeds	3/8, 7/16, 1/2, 11/16, 13/16, 15/16, 1 1/16, 1 1/8, 1 3/16, 1 1/4, 2 1/16, 2 3/16, 3 1/4, 3 3/4, 4 1/2, 5 1/4, 6 1/2, 7 1/2, 9, 11, 13, 15 1/4, 19, 22, 27, 31, 39, 45, 54, 63, 79, 90 in./min.

Figure 23
Standard Feed Rates

Power Rapid Traverse. The power rapid traverse, controlled from the front of the machine by the rapid traverse lever (Figure 18), may be engaged at any time and for any direction of travel with the spindle either running or stationary. (Of course, the motor must be running.) The feed lever, which will give the direction of travel desired, must be engaged at the time the rapid traverse lever is engaged.—*Always engage the feed lever first, especially when using the vertical rapid traverse.* The rapid traverse rate for the longitudinal and cross movements is 150 inches a minute, while the vertical rate is 75 inches a minute.

Rear Hand Controls. Standard equipment includes rear hand adjustments for the cross and vertical movements, in addition to the table traverse handwheel which also can be operated from the rear. These controls, adjusted by means of a hand crank, easily moved from one shaft to the other, are shown in Figure 24. The cross traverse dial is graduated into 250 equal spaces each of which is equal to .001" movement, while the vertical traverse dial is graduated into 100 spaces with each space being equal to .0005" movement.

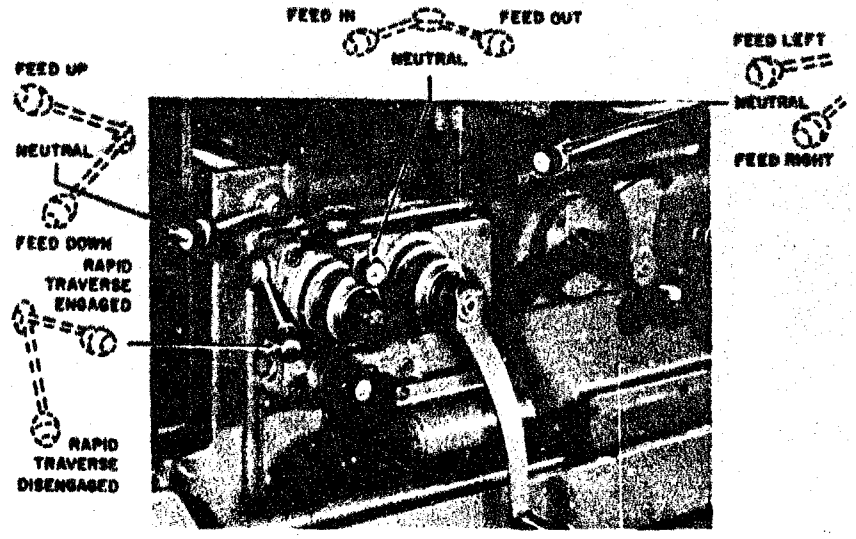


Figure 24
Rear Hand and Power Feed Controls on Plain Machines

Rear Power Feed Controls. Standard equipment includes rear power feed controls for cross, longitudinal, and vertical movements (Figure 24). Unlike the front table control lever, the rear table control lever has only two operating positions—feed left or feed right. Table rapid traverse is obtained by moving the table feed lever the direction of travel desired, right or left, and then engaging the rapid traverse lever. Cross and vertical rapid traverse can be obtained by moving the feed lever to a feed position and then engaging the rear rapid traverse lever.

(Vertical Machines only)

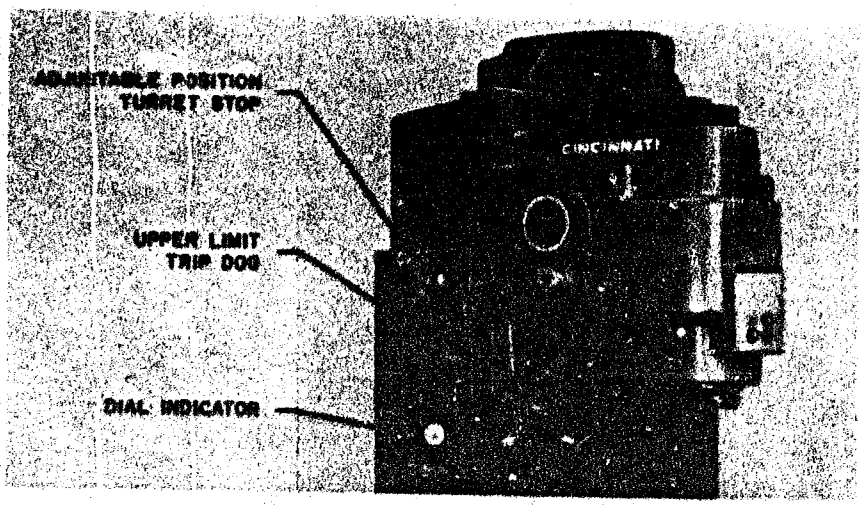


Figure 25
Vertical Spindle Carrier

Hand Feed to Vertical Spindle Carrier. The spindle carrier can be moved by hand, when power feed is disengaged, by rotating the vertical feed hand crank (Figure 19). One clockwise turn of the hand crank moves the carrier up .050". The micrometer dial is graduated into 50 spaces, which is equivalent to .001" movement for each space. To reset the micrometer dial, merely pull out against a light spring tension, rotate the dial to the desired setting and then release.

Power Feed to Vertical Spindle Carrier. Vertical power feed movements of the carrier are engaged by means of the vertical power feed lever (Figure 19). When the lever is moved up, the carrier moves up; when the lever is moved down, the carrier moves down. The power feed rates to the spindle carrier are ½ the feed rates shown on the feed dial.

Power Rapid Traverse to Vertical Spindle Carrier. The power rapid traverse to spindle carrier is controlled by the vertical power feed lever in conjunction with the power rapid traverse lever (Figure 19). First move the feed lever in the direction you want the carrier to move and then pull the rapid traverse lever upward. Rapid traverse rate to the spindle carrier is 75 inches per minute.

Four-Position Turret Stop and Dial Indicator. The turret stop and dial indicator, shown in Figure 25, are standard equipment supplied with all Vertical VERCIPOWER Machines. The turret stop should be used as a *feed* trip only, downward power rapid traverse movement should always be disengaged before the turret stop screw contacts the plunger at the top of the indicator bracket. Failure to do so may result in serious damage to the machine, if the spindle carrier should "coast" after tripping the plunger. After tripping out of feed down, the spindle carrier should be lowered, by means of the vertical feed handcrank; movements of the spindle carrier can be disengaged by the upper limit trip dog (Figure 25).

Rear Controls. Rear controls for hand adjustment and power feed for cross and vertical movements can be supplied at extra cost on the vertical machines. Operating instructions for these controls are the same as for the horizontal machines. A rear table feed control lever is supplied as standard equipment. With this lever the table feed can be operated from the rear working position. Rapid traverse is obtained by first engaging the feed lever and then the rapid traverse lever.

SETTING UP THE MACHINE

Overarm and Arbor Supports. The overarm may be positioned by first loosening the clamping lever located on the rear of the spindle carrier and then turning the overarm adjusting crank (Figure 27A). Turning the crank clockwise moves the overarm toward the front of the machine, while turning it counter-clockwise moves the overarm toward the rear. After the overarm is positioned, tighten the hand clamp. All machines are equipped with a Dynapoise unit which damps self-excited chatter.

Figure 27A
Overarm and Arbor Support Clamps

The arbor supports may be positioned at any desired place on the overarm and clamped in position by tightening the clamping nuts (Figure 27A).

Reversing the Direction of Rotation of the Spindle. Spindle rotation must be the same as the "hand" of the cutter; that is, the rotation must be clockwise for a "right-hand" cutter and counter-clockwise for a "left-hand" cutter. The direction of rotation is controlled by a reversing switch on electrical panel shown in Figure 27B. Note that RIGHT and LEFT on the spindle reverse plate indicate the direction of rotation of the spindle when viewed from the rear end of the spindle.

Figure 27B
Spindle Reverse Switch

Feed Trip Dogs. Trip dogs are provided for automatically stopping the power table, cross, or vertical feeds at the end of the cut or at any desired point in the travel of the unit. (See pages 32-35 for automatic table cycles).

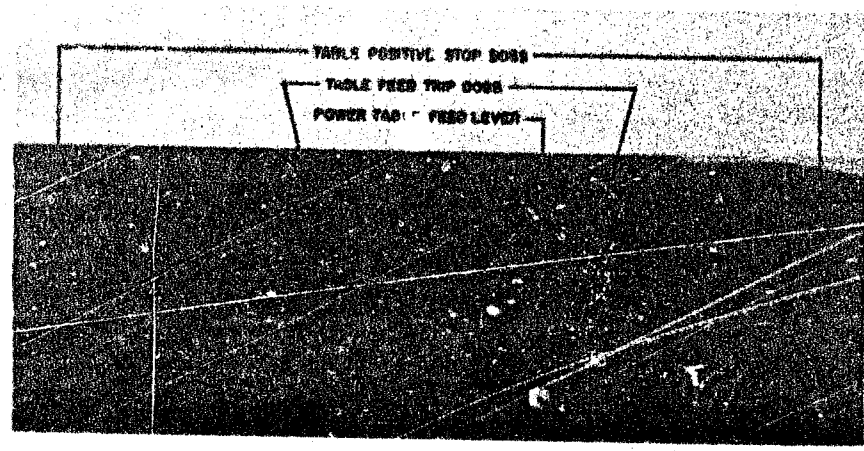


Figure 28
Table Trip Dogs

Table Trip Dogs. Thirteen table trip dogs are supplied with VERCIPOWER Milling Machines. These act to trip the table out of feed to stop, reverse direction, or shift from rapid traverse to feed or vice versa. (See pages 32-35 for automatic table cycles). A pair of positive stop dogs are fastened to the front of the table to prevent moving the table beyond its actual operating range.

Caution: Do not remove these fixed stop dogs in an effort to obtain greater travel or you may seriously damage the machine. If the job requires a greater travel than the machine allows, it must be milled on a larger machine with greater range.

Spindle Carrier Trip Dogs. The power vertical movements of the carrier can be stopped automatically at any desired point in its travel in either direction by means of trip dogs, adjustably mounted in a tee-slot at the rear of the carrier. Two dogs are supplied, one for each direction of travel. Fixed stop pins, located in the dog rail, prevent setting the upper and lower trip dogs beyond the operating range of the machine.

Caution: Do not attempt to remove the fixed stop pins in an effort to obtain increased vertical movement or you may seriously damage the machine.

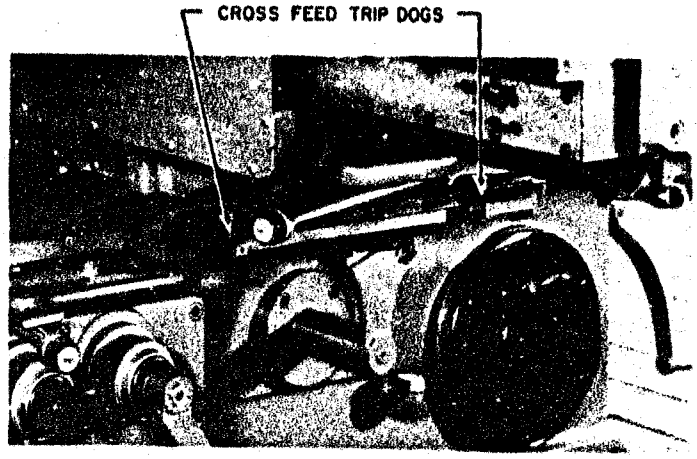


Figure 29
Saddle Trip Dogs

Saddle Trip Dogs. The power cross feed movement of the saddle can be stopped automatically at any desired point in its travel in either direction by means of trip dogs, adjustably mounted in a tee-slot beneath the left-hand side of the saddle (Figure 29).

In addition to the trip dogs, a separate pair of positive stop dogs are located under the dog rail. These positive stop dogs act as a safety device to prevent moving the saddle beyond its actual operating range.

Caution: Do not attempt to remove these positive stops in an effort to obtain greater cross travel or you ma seriously damage the machine.

Clamping Devices for Sliding Units. The table, saddle and housing may be clamped in position by tightening the screws and levers shown in Figures 29 and 30. Two screws are provided for clamping the table to the saddle, one lever for clamping the saddle to the base. The sole purpose of these screws and lever is to firmly tighten the unit which is not in motion during the machining operation. For example if you are using the table feed alone, tighten the saddle clamping device. The rigidity of the machine as a whole will thereby be increased.

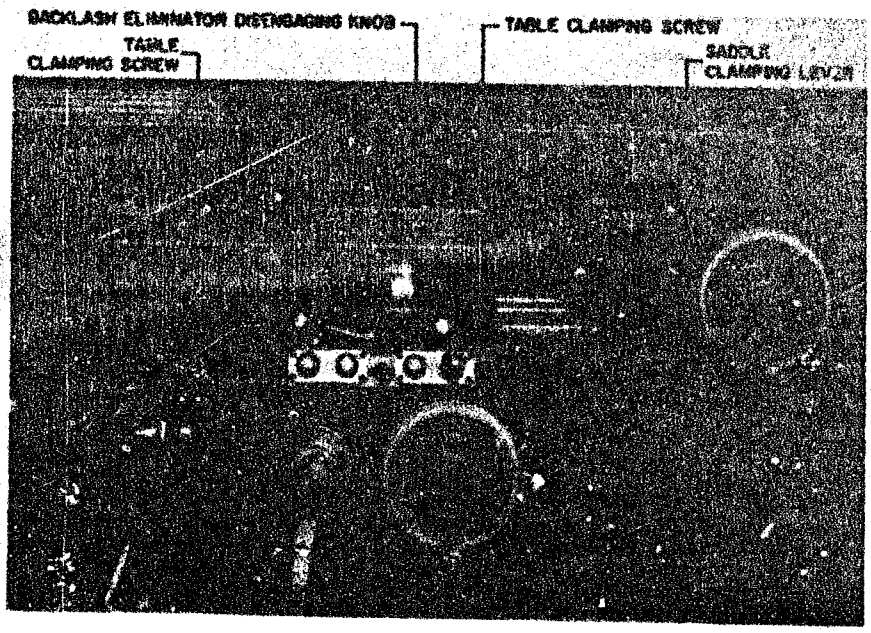


Figure 30
Saddle and Table Clamping Devices

These clamping devices should never be used as a method of adjustment for wear. Obviously, such a practice would result in rapid wear in the spots at which the pressure from the clamps is applied, and there is also a greater possibility of the bearings scoring, because of the concentrated pressures. Tapered gibs are provided for adjustment to compensate for wear (see "Adjusting the Gibs", page 36).

Automatic Backlash Eliminator. An integral part of the table drive mechanism is a device which *automatically* eliminates the backlash between the leadscrew and the nuts *during down-milling cuts.* The mechanism is activated by forces set up when the cutter contacts the workpiece in a down milling cut; it does not function during conventional up-milling cuts, or during rapid traverse movements of the table.

AUTOMATIC TABLE CYCLES

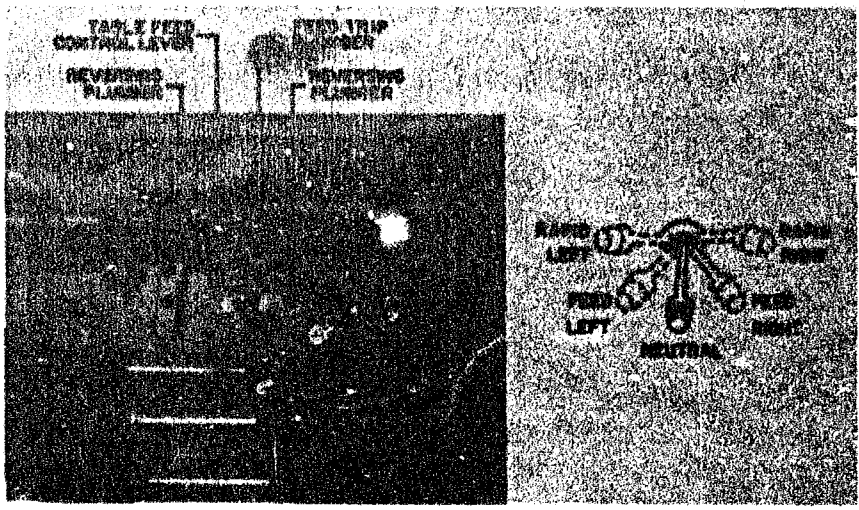


Figure 32
Automatic Table Cycle Controls and Lever Positions

Table Control Lever. The position of the automatic table cycle control lever (Figure 32) determines the longitudinal direction of table movement at the feed rate or in rapid traverse. The control lever is designed to cause table movement *in the same direction that it is shifted from the center, or stop position.* Table movement at the *feed rates* is engaged when the lever is shifted to the lower right or lower left positions. *Rapid traverse* is engaged when the lever is shifted to the upper right or upper left positions.

Rapid traverse can be engaged from either of the feed positions by causing the control lever to move directly up to the rapid traverse position. Conversely, rapid traverse can be changed to the feed rate by causing the control lever to move directly down to the feed position.

Note: The rapid traverse lever on the left front of the base (Figure 18) will cause the table to move at the rapid traverse rate if engaged while the table control lever is in either of the "feed" positions.

The control lever can be shifted to all of the operating positions by hand, or by placing the necessary feed trip dogs at the desired points in an automatic table cycle.

Feed Trip Dogs. The feed trip dogs are designed to deflect the feed trip plunger (Figure 32), resulting in a change in the operating position of the table control lever. The following standard dogs are supplied with plain machines equipped with automatic table cycle control: Four rate change dogs—two for each direction of table travel; two reverse rate dogs—one for each direction of the table reversal; two stop dogs—one for each direction of table reversal; two reversing plunger trip dogs—one for each direction of table reversal; one intermediate stop dog; two positive stop dogs—one for each direction of table travel. Before attempting to set up an automatic table cycle, the operator should become thoroughly familiar with the function of each dog, as outlined below.

Rate Change Dog. The rate change dog will raise or lower the feed trip plunger, shifting the control lever vertically from feed to rapid traverse or from rapid traverse to feed.

Reverse Rate Dog and Reversing Plunger Trip Dog. These two dogs are used together where table reversal is required in the cycle. The reverse rate dog shifts the control lever out of feed to rapid traverse position. The reversing plunger is then depressed by the reversing plunger trip dog, shifting the control lever to *rapid traverse* in the opposite direction.

Stop Dog and Reversing Plunger Trip Dog. These two dogs are used together where table reversal is required in the cycle. The stop dog shifts the control lever out of feed or rapid traverse to the stop position. The reversing plunger is then depressed by the reversing plunger trip dog, shifting the control lever to cause table movement *at the same rate* in the opposite direction. The stop dog may be used by itself as a stop in the rate dog, wherever manual reverse is desired.

Intermediate Stop Dog. The intermediate stop dog shifts the control lever from feed or rapid traverse position to the stop position. Design of this dog permits feed or rapid traverse to be resumed in either direction.

Positive Stop Dog. Positive stop dogs are screwed in position to prevent movement of the table beyond the actual operating range. The stop dogs should never be removed to obtain greater range of table travel. One positive stop dog is provided for each direction of table movement.

The table feed trip dogs can be arranged in many different ways for a wide variety of automatic table cycles. The cycle drawings on page 34 illustrate a few typical setups which can be made with the standard table dogs. In reading the drawings, notice that the cycle progresses in a direction opposite to the actual movement of the table.

This illustrates the relative movement between the table feed trip dogs and the feed trip plunger. The numbers at each function of the cycle correspond to the numbers designated to the table dogs in Figure 35.

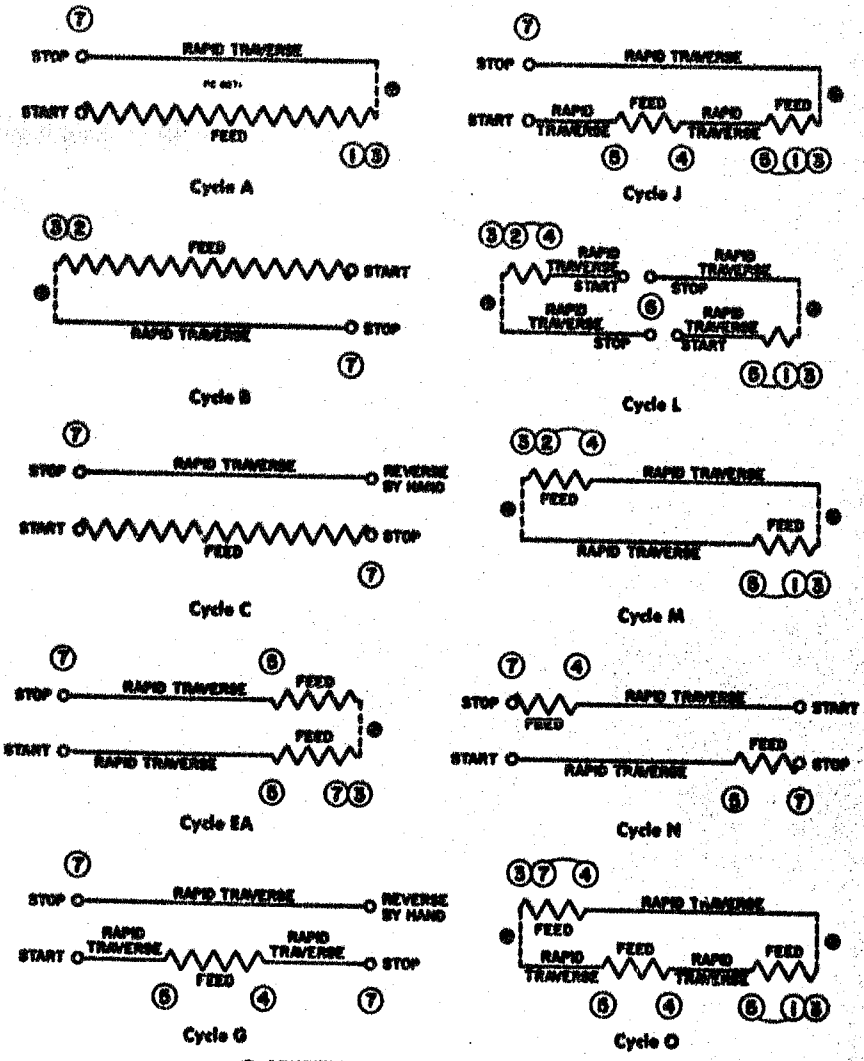
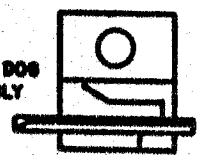


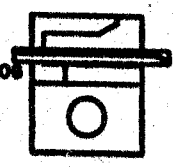
Figure 34
Typical Cycles of the 46 Obtainable

AUTOMATIC TABLE CYCLES

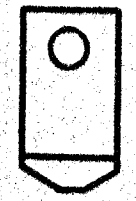
① REVERSE RATE DOG
RIGHT HAND ONLY



② REVERSE RATE DOG
LEFT HAND ONLY



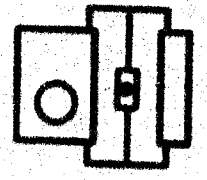
③ REVERSING PLUNGER
TRIP DOG
PC-6875



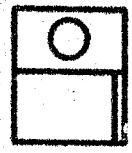
④ RATE CHANGE DOG
AS SHOWN
WILL TRIP TABLE
FROM FEED
TO RAPID TRAVERSE,
TABLE MOVING
RIGHT TO LEFT.
INVERT DOG
TO TRIP TABLE
FROM RAPID TRAVERSE
TO FEED,
TABLE MOVING
LEFT TO RIGHT

⑤ RATE CHANGE DOG
AS SHOWN
WILL TRIP TABLE
FROM RAPID TRAVERSE
TO FEED,
TABLE MOVING
RIGHT TO LEFT,
INVERT DOG
TO TRIP TABLE
FROM FEED
TO RAPID TRAVERSE
TABLE MOVING
LEFT TO RIGHT

⑥ INTERMEDIATE
STOP DOG



⑦ STOP DOG



POSITIVE STOP
DOG

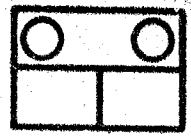


Figure 35
Standard Table Feed Trip Dogs

ADJUSTMENTS

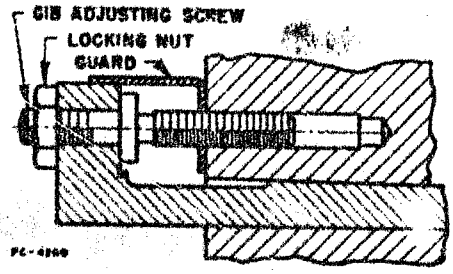


Figure 36A
Section Through Head Type Gib with Guard

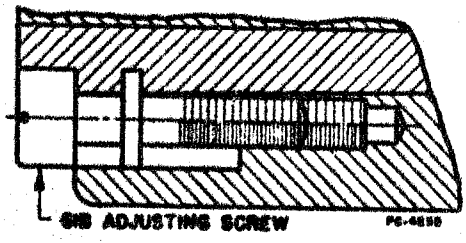


Figure 36B
Section Through Headless Type Gib

Adjusting the Drive Belt Tension. If the drive belt begins to whip due to stretch or wear, it can be tightened in the following manner:

1. Open the motor compartment door.
2. Loosen the .62" screw in the slotted clamp (Figure 36C) allowing only the motor's weight to tighten the belt.
3. Retighten .62" screw and close compartment door.

Adjusting the Gibs. Two types of gibs, shown in Figures 36A and 36B, are used to take up the wear between the sliding units. The amount and method of adjustment, however, are about the same for each type. Adjust the gib inward (the screws have right hand threads) and try the movement of the unit with the hand crank.

When adjustment of the gibs is necessary, they should never be drawn up so tightly as to prohibit free movement of the particular unit by means of the hand crank. Tight adjustment squeezes out the oil film and causes scoring and untimely wear. Clean the bearings of the sliding units occasionally to avoid undue wear on the ends of the gibs.

Be sure to tighten lock nut when adjusting head type gibs.

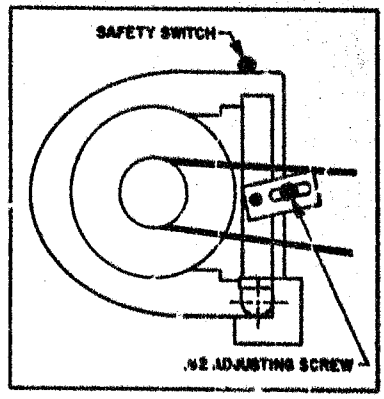


Figure 36C
Belt Tension Adjustment

Adjusting the Table Feed Screw Bearings. The table feed screw of these machines is provided with two sets of adjustable tapered roller bearings. When adjustment is necessary, adjust right hand bearing only.

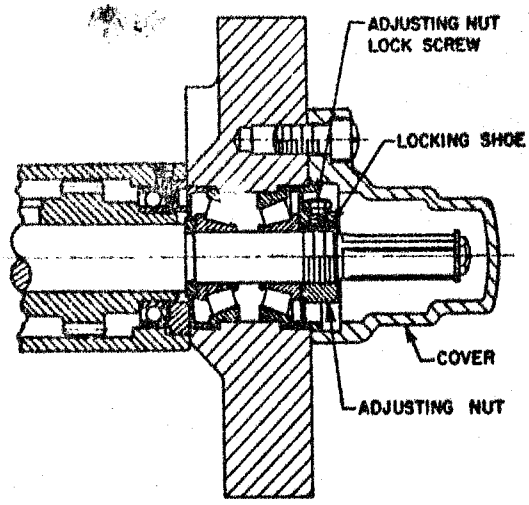


Figure 38
Section Through Right Hand End of Table Feed Screw Mounting

1. Remove the cone shaped cover over the end of the table feed screw at the right hand end of the table.
2. Loosen the hex head screw through the adjusting nut, and tap the screw and nut to loosen the lock shoe.
3. Tighten the adjusting nut with a face spanner wrench, and then back away about $\frac{1}{16}$ turn or less.
4. Re-tighten the hex head screw and replace the cover.

Turn the table traverse handwheel with the power feed disengaged and try to determine by the "feel" whether the bearings have been adjusted correctly. They should not be adjusted so tightly as to make it difficult to move the table, but on the other hand, there should not be a noticeable amount of "play" in the bearings. It is important, of course, to see that the table gib is loose enough so that the table can be easily moved in order to differentiate between a tight lead screw bearing and a tight gib bearing.

When the "play" is caused by a worn lead screw and nut, it is necessary to replace these parts in order to obtain accurate work.

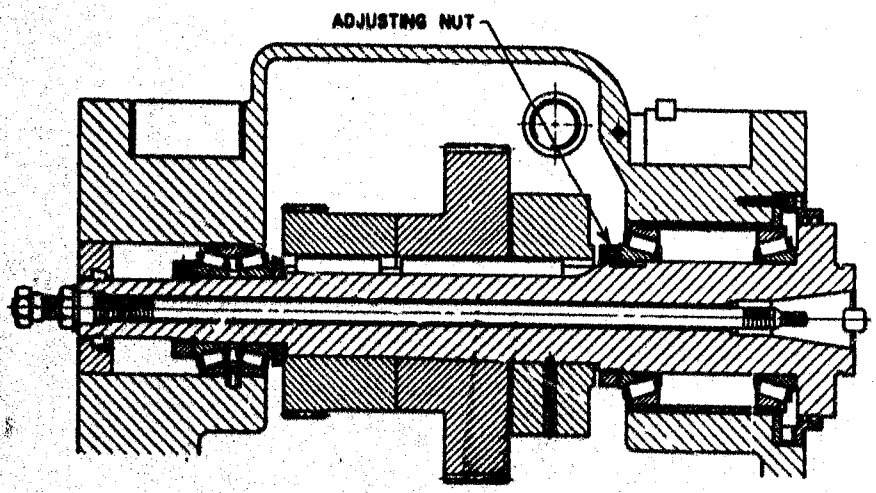


Figure 39
Section Through Spindle of Machine

Adjusting the Spindle Bearings.

1. Start the machine and run the spindle at a speed in the high range (above 500 rpm). Stop the spindle and set the spindle selector knob in the neutral position.

2. Remove the two driving keys from the spindle nose. Clamp a rectangular rod (1" square) and about 12" long in the key slots.

3. On horizontal machines, slide overarm forward until cover plate near the front of the overarm guide ways on the carrier is exposed. Remove cover.

WARNING: Be sure to support the extended front end of the overarm as it is moved forward with a device capable of supporting a minimum of 2000 lb., or remove the overarm as outlined in the service manual.

4. Loosen the adjusting nut locking screw and tap the wrench to loosen the locking shoe beneath the screw.

5. Insert a steel bar into one of the radially drilled holes in the adjusting nut. Rotate the spindle counterclockwise about one revolution and then clockwise until the bearings are drawn up snug.

6. Remove the bar from the adjusting nut and rotate the spindle to be sure the bearings are properly seated.

7. Tighten the adjusting nut locking screw and replace the driving keys in the spindle nose.

8. Replace the cover and slide overarm back in position.

Machines which are used for general purpose work should have about .001" end play in the spindle bearings. Machines for high speed work exclusively, such as those for high speed carbide milling, should have about .002" end play in the spindle bearings. The readings are taken with the bearings cold.

This "end play" can be measured by indicating the end of the spindle nose with a 1/10,000 indicator and lightly tapping the spindle from the front to the rear and reading the indicator dial. The temperature of the spindle when run continuously at its highest speed for four hours, should not exceed 145°F. when properly adjusted. Test the temperature with a thermometer inserted into one of the screw holes in the spindle cap.

Automatic Backlash Eliminator Adjustment. The backlash eliminator (Figure 40) consists essentially of two nuts "A" and "B" freely mounted on the table lead screw. The crown teeth on gear "D" mesh with the gear teeth on nuts "A" and "B". Therefore, when one nut rotates, the other nut will rotate in the opposite direction. The spur teeth on gear "D" mesh with rack "C" which rotates the crown gear "D" and nuts "A" and "B" a sufficient amount to eliminate the backlash. Normally, this unit is self compensating for wear and should

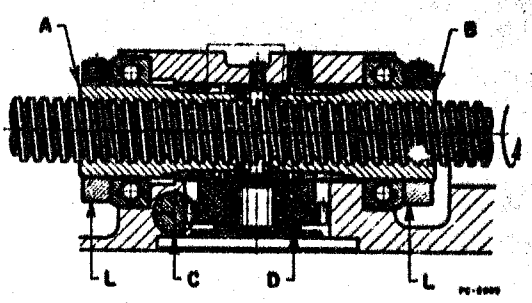


Figure 40
Section Through Backlash Eliminator

Spindle Carrier Oil Pressure. The relief valve in the lubricating system is set for the correct pressure at the factory and should not require resetting during the life of the machine. However, adjustment is provided should it become necessary. Test the pressure before making the following adjustments:

Figure 42A
Adjusting Spindle Carrier Oil Pressure

1. Start machine and run until oil is warm, then stop machine.
2. Remove the ⅛" pipe plug from the front side of the pump, nearest the filter, (Figure 42A) and insert a pressure gage.

Figure 42B
Adjusting Base Oil Pressure

3. Start the machine and check the pressure. If it is higher or lower than 300 psi proceed to adjust.
4. Loosen the lock screw and adjust screw "A" until the pressure registers 300 psi, then tighten the lock screw.
5. Stop the machine, remove the gage and replace the pipe plug.

To adjust the Base Oil Pressure:

1. Remove the ⅛" pipe plug in the top of the hose block, at the right of the table feed lever. Screw a pressure gage in its place (Figure 42B).

2. Start the machine and check the pressure. If it is higher or lower than 225 psi proceed to adjust.

3. Remove the cover and cap screw shown in Figure 42A. Remove the locking screw under the cap screw and rotate the adjusting screw until the pressure registers 225 psi.

4. Replace the locking screw, cap screw and cover.

5. Stop the machine, remove the gage and replace the pipe plug.

SAFETY PRECAUTIONS

The table, cross and vertical traverse dog slots are provided with stop dogs and screws, which limit the position for setting the trip dogs. Do not remove these stops or the trip dogs in effort to obtain more travel, as serious damage to the machine may result. If the job requires a greater range than the safety stops and dogs allow, it must be milled on a machine with greater table travel.

If the spindle speed decreases when the table starts to feed the work into the cutter, the motor is probably at fault. Have the motor inspected and repaired, if necessary, by a competent repairman. To avoid possible damage to the clutch or motor, make these corrections as soon as you notice the spindle speed decreasing under load.

The clutches on all hand cranks are provided with releasing devices to keep them out of engagement while they are not in use. Do not remove the devices for the sake of keeping the crank in engagement, as it may result in serious injury to yourself or some other operator.

If you should decide to inspect the drive belt or the motor, and forget to shut off the electric current at the push-button station, the motor will stop as soon as the hinged cover at the rear of the machine is opened. The contact switch above the latch bracket (Figure 36C) compensates for such an oversight by automatically breaking the circuit. When again starting the machine, it will be necessary, of course, to latch the cover and push the starting button.

CUTTING FLUIDS AND SYSTEM

Recommended Cutting Fluid. CIMCOOL® cutting fluids, made by the Products Division of The Cincinnati Milling Machine Co., reduce as well as remove heat created during machining. At the same time Cimcool provides rust and rancidity control, clean parts cool to the touch, plus freedom from smoke and slippery film.

The table below suggests starting concentrate-to-water mix ratios:

RECOMMENDED CIMCOOL MIXES

Material	Average Milling Cutters	Form and Low Clearance Cutters
Mild Steel Malleable Iron Wrought Iron Bronze	FIVE-STAR CIMCOOL 1:40	FIVE-STAR CIMCOOL 1:25
Cast Iron	FIVE-STAR CIMCOOL 1:40	FIVE-STAR CIMCOOL 1:40
Brass Soft Bronze	CIMCOOL S-2 1:40	CIMCOOL S-2 1:25
Aluminum	CIMCOOL S-2 or AL 1:40	CIMCOOL S-2 or AL 1:25
Cast Steel Tool Steel and other high tensile strength steels	FIVE-STAR CIMCOOL 1:25	FIVE-STAR CIMCOOL 1:20

Ordinarily cast iron, brass, soft bronze and aluminum are machined without a cutting fluid, or an air blast. However, a cutting fluid is recommended for milling these materials (1) when there is danger of part deformation due to the heat of machining; (2) when the parts are too hot to handle; or (3) when chips clog in slots. Also, when milling cast iron, a cutting fluid helps when greater cleanliness and dust control are needed.

Your Cimcool representative will be glad to help you choose from the Cimcool array of products one that meets your exact requirements.

Operation. The key to efficient cutting fluid operation is to get as much cutting fluid as possible in the cutter-work contact area. To prolong cutting fluid life and reduce reservoir draining and cleaning: (1) When stock removal is heavy, remove chip accumulations from the cutting tank daily; (2) If the machine is shut down for longer than a weekend, aerate the cutting fluid by starting the machine and circulating the cutting fluid for half an hour.

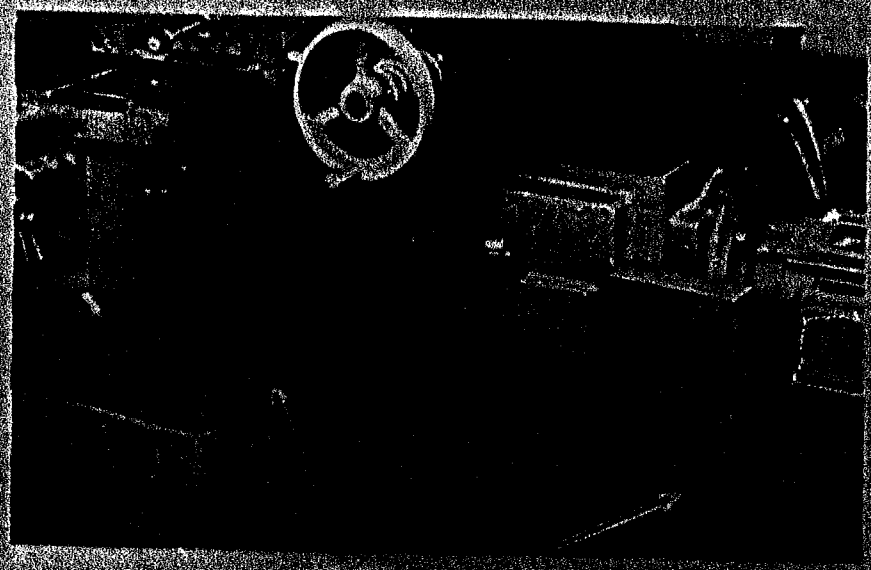


Figure 45
Cutting Fluid Reservoir, Pump and Strainer

Cleaning the Cutting Fluid System. The cutting fluid reservoir, located in the base of the machine, should be cleaned out occasionally to maintain full capacity for the cutting fluid. After pumping out the cutting fluid, remove the cleanout cover (Figure 45) on the base and scrape out the sludge.

To remove grit, dirt and cut slime or oil clinging to the walls of the reservoir or inside the coolant lines, use one of the GEMCO machine cleaners. Cleaning can be done (1) by removing the used fluid before adding Cimclean, (2) by adding the cleaner to the used fluid in the machine during a shut-down period or (3) by adding Cimclean to the used cutting fluid while the machine is in operation.

Before refilling the reservoir, clean the cutting fluid strainers in the front base (Figure 45). Lift out the strainer and clean by washing off the Cimclean mixture and then blowing it off with an air hose. Replace the strainer.

After the system has been cleaned, recharge with a fresh cutting fluid mix. Approximate reservoir capacities: 20 gallons for the 320-18 thru 430-18 machines—25 gallons for the 425-20 thru 750-20 machines.

ACCESSORIES AND ATTACHMENTS

SNAP-SET. The SNAP-SET™ units are position readout arrangements, which can be seen in Figure 47, for the longitudinal, cross and vertical slides. They present a positive illuminated numeral, to the nearest 0.001" which indicates the slide position from a reference point, or zero setting. From the established reference point, blue print dimensions can be read directly on SNAP-SET to either side of zero. The slide position is always read on the clear dial, not the one showing the red flag.

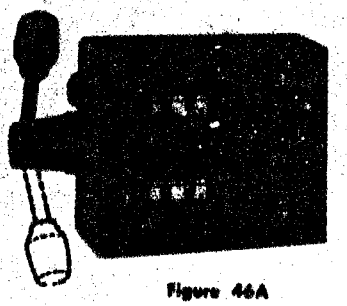


Figure 46A
SNAP-SET Arrangement

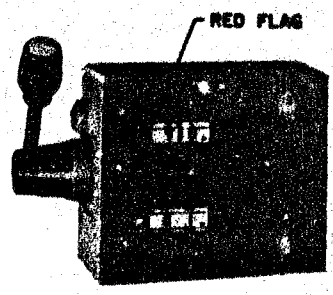


Figure 46B
SNAP-SET Arrangement

SNAP-SET is set to zero by pulling the reset lever *all* the way *down*, as indicated by the dotted line in Figure 46A, then back up to normal position. The reset lever must be in the normal "up" position for the unit to register, as shown in Figure 46B.

CAUTION: When cleaning dials and setting to zero, the reset lever must be moved *all* the way *down* to prevent possible damage to SNAP-SET unit. Then be sure to return the lever completely to the "up" position.

After resetting SNAP-SET to zero, and then moving a slide, one dial will show an ascending count from zero (See Figure 46B) while the other dial will show a descending count from 100. Both dials should total 100 at all times. Both dials indicate the slide position, to one side or the other at a zero position, but not necessarily the direction of slide movement.

In using SNAP-SET, bring the machine slide into position with spindle centerline at the starting point and set the unit to zero. Now move the slide, by power or hand, until the SNAP-SET dial shows the desired reading. Operator can position for multiple cuts either by reference to a single starting zero point or by resetting the unit to zero as he goes from one cut to the other.

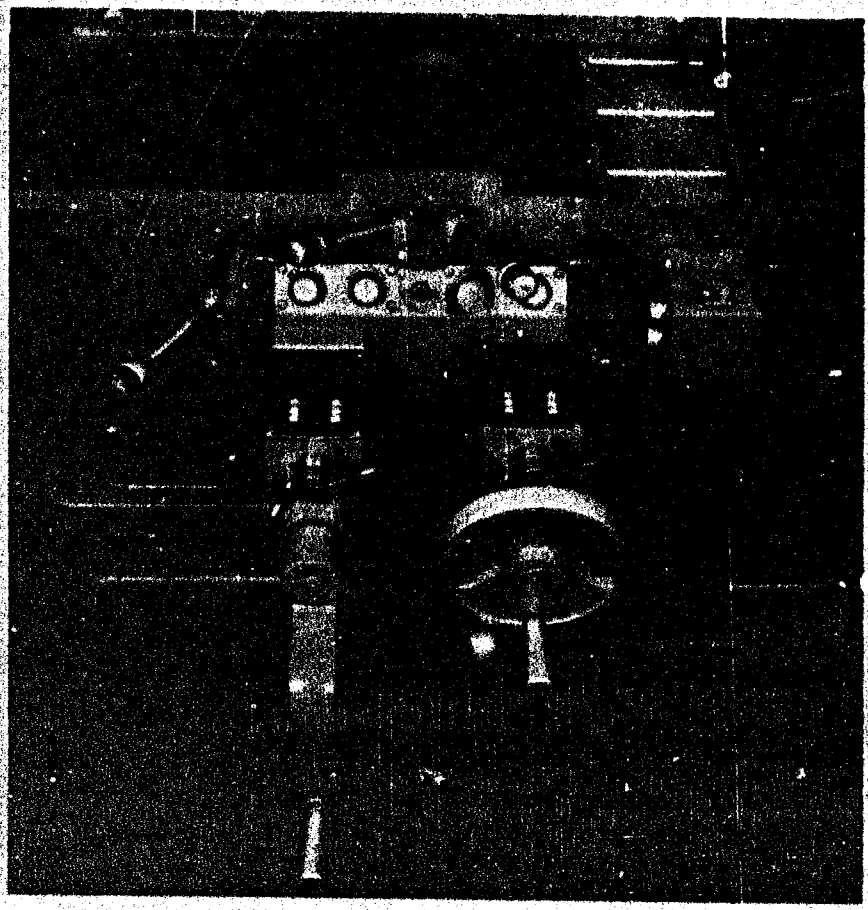
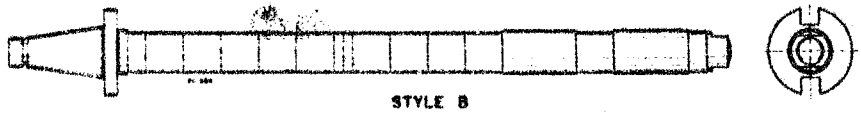


Figure 47
SNAP-SET Readouts

ARBORS — "50" Spindle Series



STYLE B

STYLE A

Figure 48
Conventional Milling Machine Arbors

Catalog Number	Diameter	Style	Usable Length of Cutter Space	Diameter of Bearing Collar	Keyway	
					Width	Depth
50- ⅛A10	.88"	A	10"	None	.....	.....
50-1 A12	1.00"	A	12"	None	.25"	.16"
50-1 A15	1.00"	A	15"	None	.25"	.16"
50-1 A18-4	1.00"	A	18"	2.13"	.25"	.16"
50-1 B18-4	1.00"	B	18"	2.13"	.25"	.16"
50-1 B24-4	1.00"	B	24"	2.13"	.25"	.16"
50-1¼A12	1.25"	A	12"	None	.31"	.19"
50-1¼A15	1.25"	A	15"	None	.31"	.19"
50-1¼A18-4	1.25"	A	18"	2.13"	.31"	.19"
50-1¼B18-4	1.25"	B	18"	2.13"	.31"	.17"
50-1¼B24-4	1.25"	B	24"	2.13"	.31"	.19"
50-1½B18-4	1.50"	B	18"	2.13"	.38"	.20"
50-1½B24-4	1.50"	B	24"	2.13"	.38"	.22"
50-1½B30-4	1.50"	B	30"	2.13"	.38"	.22"
50-1½B36-4	1.50"	B	36"	2.13"	.38"	.22"

ARBOR-LOC SHELL END MILL ARBORS

Catalog No.	Diameter Range of End Mills	Stud Diam.
50- ½FCFS	1.25"–1.50"	.50"
50- ¾FCFS	1.75"–2.00"	.75"
50-1 FCFS	2.25"–2.50"–2.75"	1.00"
50-1¼FCFS	3.00"–3.50"	1.25"
50-1½FCFS	4.00"–4.50"–5.00"	1.50"
50-2 FCFS	5.50"–6.00"	2.00"

ARBOR-LOC COLLETS

(Include Draw-in Bolt)

Catalog No.	Inside Taper
50NS—FEB 7FS	No. 7 B. & S.
50NS—FEB 9FS	No. 9 B. & S.
50NS—FEB 10FS	No. 10 B. & S.
50NS—FEB 11FS	No. 11 B. & S.
50NS—FEM 2FS	No. 2 Morse
50NS—FEM 3FS	No. 3 Morse
50NS—FEM 4FS	No. 4 Morse

Always Order Arbors by the Catalog Number

ARBOR-LOC SPINDLE ADAPTER

Reducing No. 50 to No. 40 Spindle Series

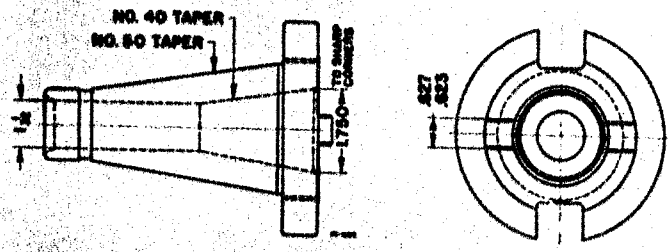


Figure 49A

Arbors and cutters having No. 40 series standard taper shanks may be used on VersaPowers with the above adapter.

Outside Taper.....No. 50 Milling Machine Standard
Inside Taper.....No. 40 Milling Machine Standard

VISES

Milling machine vises are shown in Figure 49B below. The Toolmakers Universal Vise is shown at the top, at the lower left is the Swivel Vise, which is also available as a Plain Vise, without the swivel plate. The All Steel Vise, at the lower right, is used for holding workpieces with irregular surfaces, such as castings and forgings.

Figure 49B
Milling Machine Vises

CIRCULAR MILLING TABLES

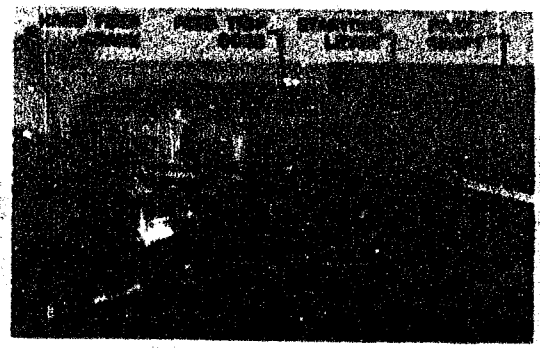


Figure 50
20" Circular Milling Table Arranged for Power Feed

Circular Milling Tables are built in three sizes, 16", 20", and 24" diameter tables. The table shown in the illustration, Figure 50, is a 20" size, equipped with power feed. Hand feed tables are essentially the same except that the driving bracket at the right-hand end of the milling machine table is not supplied.

Note: When using the drive mechanism for circular milling tables, reverse dog must be placed to left of arrow on table.

To set up the Circular Milling Tables with power feed mechanism, proceed in the following manner:

1. Clean the milling machine table and the bottom of the circular milling table.
2. Mount the table in the center slot about midway between the ends.
3. Remove the bell-shaped cover at the right-hand end of the table.
4. Remove the hexagon head screw from the end of the spline shaft bearing in the power driving bracket. (Also remove the spline shaft if it has been left in the driving bracket from previous use.)
5. Assemble the driving bracket to the right-hand end of the table with the screws provided, and at the same time slip the driving sleeve from the bracket over the fork shaft from the table (or vice-versa if the shaft and sleeve are reversed).
6. Insert the splined shaft in its bearing and push it through until the shoulder rests against the end of the bearing. The other end of the shaft is then engaged in the driving gear. Try by hand to see that it turns without binding.
7. Replace the hexagon head screw in the end of the spline shaft bearing to keep the spline shaft in position.
8. The table is now ready for use, either with hand feed or power feed rotary motion. For conventional circular milling, the machine feed

levers must be in neutral position and the machine table should be locked in position with the table clamping screws provided for this purpose. For milling scrolls or cams, disregard these two requirements.

Starting and stopping the circular table should always be performed by means of the lever at the rear of the table housing. This is labeled "Starting Lever" (see Figure 50).

To obtain *power rapid traverse* to the circular table, engage the conventional machine rapid traverse lever and then engage the table starting lever.

The actual feed rate obtained with the circular milling table depends upon two factors; (1) diameter of work; (2) table feed setting. For example, if the machine feed dial indicates 3½" per minute, you probably will not be obtaining this feed rate on the work unless the diameter happens to be exactly right.

The tables on pages 54 to 57 list the actual feeds obtained, corresponding to the indicated feed and the diameter of the work to be milled. The tables should be used in this manner—Suppose you have a 20" table on the machine with an 8" diameter work piece, and you desire to use a feed of about 4½" per minute. Under 8" diameter follow down the 20" column until you come to 4.40 and then follow to the left where you will see that you should set the table feed for 3¼" per minute.

Adjustments for 16" Table. To adjust for wear between the worm and wormwheel of the 16" table proceed as follows:

1. Loosen screw "B" (Figure 51).
2. Move lever "A" to the left beyond the upper pin hole, fully engaging the worm with the wormwheel.
3. Tighten screw "B".
4. Loosen screw "C" and turn lever "A" to the right until the pin falls into the upper hole.
5. Retighten screw "C". Do not make the adjustment so tight as to prohibit free movement of the circular table by means of the handwheel.

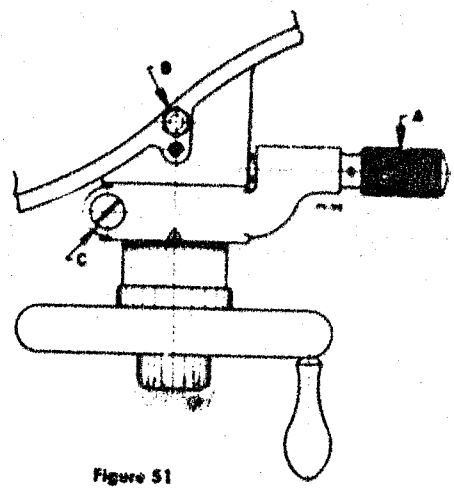


Figure 51
Worm Adjustment for 16" Table

Circular gibs are provided to take up the wear between the circular table and housing. To make this adjustment proceed as follows:

1. Remove the four set screws "A" from the bottom of the housing. (Figure 52A)
2. Tighten each gib adjusting screw "B" the same amount until there is no play in the table. Try table rotation by hand after each screw adjustment.
3. Replace set screws "A". Try table rotation by hand. It must rotate smoothly.

The two ½" hexagon nuts located between the four set screws are for clamping the table in position.

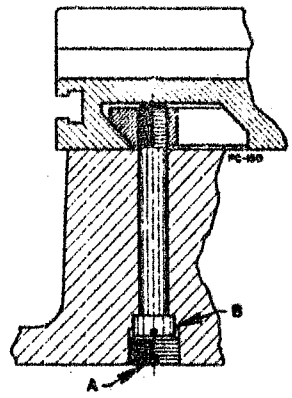


Figure 52A
Gib Adjustment for 16" Table

The driving worm of the 16" table may be entirely disengaged from the wormwheel by moving lever "A" (Figure 52A) to the right until the pin falls into the lower pin hole. The table is then free to revolve independently of the worm.

Adjustment for the 20" and 24" Table. Cincinnati Circular Milling Tables are provided with means of adjustment for wear between the worm and wormwheel.

If this adjustment is necessary on the 20" and 24" sizes, proceed as follows:

1. Remove the hand crank and micrometer dial.
2. Take up the end play of the worm by tightening the adjusting nut. (The worm of the 20" and 24" tables is provided with ball thrust bearings for absorbing the end thrust when making heavy cuts with power feed.)

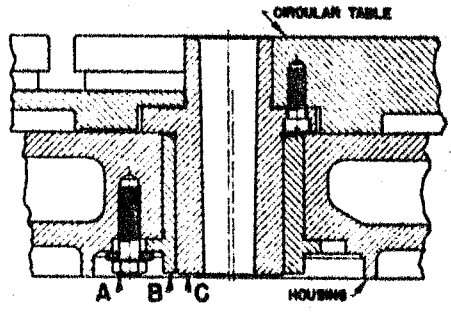


Figure 52B
Section Through Eccentric Adjusting Bushing

3. Replace the micrometer dial and hand crank.

4. Loosen the two hex head screws "A" from the bottom of the housing. (Figure 52B)

5. Turn the eccentric bushing "B" until there is no play between the worm and wormwheel. (The sleeve "C" and the wormwheel are bolted to the circular table and move as a unit in a straight line when the eccentric bushing "B" is turned.)

6. Retighten screws "A".

Do not make the adjustment so tight as to prohibit free movement of the circular table with the hand crank.

FEEDS OBTAINED ON CIRCULAR MILLING TABLES CORRESPONDING TO DIAMETER OF WORK AND INDICATED FEED — FOR ¼"-60" PER MIN. FEED RANGE

Dia. Work→		1"		2"		3"		4"		5"		6"		7"		8"		9"	
Size Table↔		16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"
INDICATED MACHINE FEED RATE	¼	.028	.042	.057	.084	.078	.126	.113	.168	.142	.210	.170	.253	.199	.295	.227	.337	.255	.379
	⅜	.035	.053	.071	.106	.106	.158	.142	.221	.177	.263	.213	.316	.248	.368	.284	.422	.319	.474
	½	.043	.063	.085	.127	.128	.190	.170	.253	.212	.316	.256	.379	.298	.442	.341	.506	.383	.568
	⅝	.050	.074	.099	.148	.149	.221	.198	.295	.248	.369	.298	.443	.348	.516	.398	.590	.447	.665
	¾	.057	.084	.114	.169	.170	.253	.227	.337	.284	.421	.340	.506	.397	.590	.454	.675	.510	.758
	⅞	.071	.105	.142	.211	.213	.316	.284	.421	.354	.526	.426	.633	.497	.737	.568	.843	.639	.948
	1	.085	.126	.170	.253	.256	.379	.340	.505	.425	.632	.511	.759	.596	.884	.682	1.02	.766	1.14
	1⅛	.099	.148	.199	.296	.298	.442	.397	.590	.496	.737	.596	.885	.695	1.03	.795	1.18	.894	1.33
	1¼	.122	.179	.242	.358	.362	.537	.482	.716	.603	.895	.725	1.07	.845	1.25	.967	1.43	1.08	1.61
	1⅜	.142	.211	.284	.422	.426	.633	.568	.843	.709	1.05	.852	1.26	.993	1.47	1.14	1.69	1.27	1.90
	1½	.170	.253	.340	.506	.511	.759	.681	1.01	.851	1.26	1.02	1.52	1.19	1.77	1.36	2.02	1.53	2.28
	1⅝	.199	.295	.397	.590	.596	.885	.795	1.18	.993	1.48	1.19	1.77	1.39	2.06	1.59	2.36	1.79	2.68
	2½	.241	.358	.482	.717	.724	1.07	.965	1.43	1.21	1.79	1.45	2.15	1.69	2.51	1.93	2.87	2.17	3.22
	2½	.284	.421	.568	.843	.852	1.27	1.13	1.69	1.42	2.11	1.70	2.53	1.99	2.95	2.27	3.37	2.55	3.79
	3	.340	.505	.380	1.01	1.02	1.52	1.36	2.02	1.70	2.53	2.04	3.03	2.38	3.54	2.73	4.04	3.06	4.55
	3½	.397	.590	.795	1.18	1.19	1.77	1.59	2.36	1.98	2.94	2.38	3.54	2.78	4.13	3.18	4.72	3.58	5.31
	4¼	.482	.716	.965	1.43	1.45	2.15	2.04	2.86	2.41	3.58	2.90	4.30	3.38	5.01	3.86	5.73	4.33	6.45
	5	.567	.843	1.14	1.69	1.70	2.53	2.27	3.37	2.84	4.21	3.40	5.06	3.97	5.90	4.54	6.74	5.10	7.58
	6¼	.709	1.05	1.42	2.11	2.13	3.16	2.84	4.21	3.54	5.26	4.26	6.32	4.97	7.37	5.68	8.43	6.38	9.48
	7½	.851	1.26	1.70	2.53	2.56	3.79	3.40	5.05	4.25	6.31	5.11	7.59	5.96	8.85	6.81	10.2	7.66	11.4
	8¾	.993	1.48	1.99	2.96	2.98	4.42	3.97	5.90	4.96	7.36	5.96	8.85	6.95	10.6	7.95	11.8	8.94	13.3
	10	1.13	1.68	2.26	3.36	3.40	5.06	4.54	6.74	5.67	8.43	6.81	10.1	7.94	11.8	9.09	13.5	10.2	15.2
	12	1.36	2.02	2.73	4.04	4.08	6.07	5.45	8.09	6.81	10.1	8.18	12.1	9.54	14.2	10.9	16.2	12.3	18.2
	14½	1.65	2.44	3.29	4.89	4.94	7.33	6.58	9.78	8.23	12.2	9.88	14.7	11.5	17.1	13.2	19.6	14.8	22.0
	18	2.04	3.03	4.08	6.07	6.13	9.10	8.17	12.1	10.2	15.2	12.3	18.2	14.3	21.2	16.4	24.3	18.4	27.3
	21½	2.44	3.62	4.88	7.25	7.33	10.9	9.76	14.5	12.2	18.1	14.6	21.8	17.1	25.4	19.6	29.0	21.9	32.6
	26	2.95	4.38	5.90	8.77	8.85	13.2	11.8	17.5	14.7	21.9	17.7	26.3	20.6	30.6	23.6	35.1	26.6	39.4
	31	3.52	5.22	7.04	10.4	10.6	15.7	14.1	20.9	17.6	26.1	21.1	31.4	24.6	36.6	28.2	41.8	31.6	47.0
	36	4.08	6.07	8.17	12.1	12.3	18.2	16.3	24.2	20.4	30.3	24.5	36.4	28.6	42.4	32.7	48.5	36.8	54.6
	42	4.77	7.07	9.53	14.2	14.3	21.2	19.1	28.3	23.8	35.4	28.6	42.5	33.4	49.5	38.2	56.6	42.8	63.7
	50	5.67	8.43	11.4	16.9	17.0	25.3	22.7	33.7	28.3	42.1	34.0	50.6	39.7	59.0	45.4	67.5	51.1	75.8
	60	6.81	10.1	13.6	20.2	20.4	30.3	27.2	40.4	34.0	50.5	40.8	60.7	47.7	70.7	54.5	90.9	61.2	91.0

FEEDS OBTAINED ON CIRCULAR MILLING TABLES CORRESPONDING TO DIAMETER OF WORK AND INDICATED FEED — FOR ¼"-60" PER MIN. FEED RANGE

Dia. Work→		10"		11"		12"		13"		14"		15"		16"		17"	18"	19"	20"
Size Table*→		16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	20" and 24"	20" and 24"	20" and 24"	20" and 24"
INDICATED FEED	¼	.284	.421	.312	.463	.341	.506	.369	.548	.397	.590	.426	.632	.454	.674	.716	.758	.800	.842
	⅜	.355	.527	.391	.580	.426	.632	.461	.685	.497	.737	.533	.791	.567	.843	.895	.948	1.00	1.05
	½	.425	.632	.468	.695	.511	.758	.553	.821	.596	.885	.648	.948	.680	1.01	1.07	1.14	1.20	1.26
	⅝	.497	.738	.546	.811	.596	.885	.645	.958	.695	1.06	.745	1.11	.795	1.18	1.25	1.33	1.40	1.47
	¾	.567	.843	.624	.926	.681	1.02	.738	1.10	.794	1.18	.852	1.26	.906	1.35	1.43	1.52	1.60	1.68
	⅞	.709	1.05	.781	1.16	.852	1.27	.923	1.37	.993	1.48	1.06	1.58	1.14	1.69	1.79	1.90	2.00	2.10
	1	.851	1.26	.936	1.39	1.04	1.52	1.11	1.64	1.19	1.77	1.28	1.90	1.36	2.02	2.15	2.27	2.40	2.52
	1¼	.993	1.48	1.09	1.62	1.19	1.77	1.29	1.92	1.39	2.06	1.49	2.22	1.59	2.36	2.51	2.65	2.80	2.95
FEED	1⅛	1.21	1.79	1.33	1.97	1.45	2.15	1.57	2.33	1.69	2.51	1.81	2.69	1.93	2.87	3.05	3.22	3.40	3.58
	1¼	1.42	2.11	1.56	2.32	1.70	2.53	1.84	2.74	1.99	2.95	2.13	3.16	2.27	3.37	3.58	3.79	4.00	4.22
	1½	1.70	2.53	1.87	2.78	2.04	3.04	2.22	3.28	2.38	3.54	2.56	3.79	2.72	4.04	4.30	4.55	4.80	5.06
	1¾	1.99	2.95	2.18	3.24	2.38	3.54	2.58	3.83	2.78	4.13	2.98	4.43	3.18	4.72	5.01	5.31	5.60	5.90
MACHINE	2⅛	2.42	3.58	2.66	3.94	2.90	4.30	3.13	4.66	3.38	5.02	3.62	5.37	3.86	5.73	6.08	6.45	6.80	7.17
	2½	2.84	4.22	3.12	4.63	3.40	5.06	3.69	5.47	3.97	5.90	4.26	6.32	4.54	6.74	7.16	7.58	8.00	8.42
	3	3.40	5.06	3.74	5.56	4.08	6.07	4.43	6.57	4.77	7.08	5.11	7.58	5.45	8.08	8.60	9.10	9.60	10.1
	3½	3.97	5.90	4.37	6.49	4.77	7.08	5.16	7.67	5.56	8.25	5.96	8.85	6.35	9.44	10.1	10.6	11.2	11.8
	4¼	4.82	7.16	5.30	7.88	5.79	8.60	6.27	9.31	6.75	10.0	7.24	10.8	7.72	11.5	12.2	12.9	13.6	14.3
	5	5.67	8.43	6.24	9.27	6.81	10.2	7.38	11.0	7.94	11.8	8.51	12.6	9.08	13.5	14.3	15.2	16.0	16.8
	6¼	7.09	10.5	7.80	11.6	8.52	12.6	9.22	13.7	9.93	14.7	10.6	15.8	11.4	16.9	17.9	19.0	20.0	21.0
	7½	8.51	12.6	9.36	13.9	10.4	15.2	11.1	16.4	11.9	17.7	12.8	19.0	13.6	20.2	21.5	22.7	24.0	25.2
	8¾	9.92	14.8	10.9	16.2	11.9	17.7	12.9	19.2	13.9	20.6	14.9	22.2	15.9	23.6	25.1	26.5	28.0	29.5
	10	11.3	16.8	12.5	18.5	13.6	20.2	14.7	21.9	15.9	23.6	17.0	25.3	18.1	26.9	28.6	30.3	32.0	33.7
FEED	12	15.6	20.2	15.0	22.2	16.4	24.3	17.7	26.3	19.1	28.3	20.4	30.4	21.8	32.4	34.4	36.4	38.4	40.4
	14½	16.4	14.4	18.1	26.8	19.8	29.3	21.4	31.8	23.0	34.2	24.7	36.7	26.3	39.1	41.5	44.0	46.4	48.8
	18	20.4	30.3	22.5	33.4	24.5	36.4	26.6	39.4	28.6	42.4	30.6	45.5	32.7	48.5	51.5	54.6	57.6	60.7
	21½	24.4	36.2	26.8	39.8	29.3	43.5	31.7	47.1	34.2	50.7	36.6	54.4	39.0	58.0	61.5	65.2	68.8	72.5
	26	29.5	43.8	32.4	48.2	35.4	52.6	38.4	56.9	41.3	61.3	44.2	65.7	47.2	70.0	74.5	78.8	83.2	87.6
	31	35.2	52.2	38.7	57.5	42.2	62.7	45.7	67.8	49.2	73.1	52.8	78.4	56.3	83.5	88.8	94.0	99.2	104
RATE	36	40.8	60.7	44.9	66.7	49.0	72.8	53.2	78.8	57.2	84.9	61.3	91.0	65.4	97.0	103	109	115	121
	42	47.7	70.8	52.4	77.8	57.2	85.0	62.0	92.0	66.7	99.1	71.5	106	76.3	113.0	120	127	134	142
	50	56.7	84.3	62.4	92.7	68.1	101.0	73.8	110.0	79.4	118.0	85.1	127	90.8	135.0	143	152	160	168
	60	68.1	101.0	74.9	111.0	81.7	121.0	88.5	132.0	95.3	142.0	104.0	152	109.0	162.0	172	182	192	202

FEEDS OBTAINED ON CIRCULAR MILLING TABLES CORRESPONDING TO DIAMETER OF WORK AND INDICATED FEED — FOR ⅛"-90" PER MIN. FEED RANGE

Dia. Work→		1"		2"		3"		4"		5"		6"		7"		8"		9"	
Size Table*→		16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"
INDICATED FEED	⅛	.042	.063	.085	.128	.128	.190	.170	.253	.213	.316	.255	.380	.298	.442	.340	.506	.384	.570
	7/32	.049	.074	.099	.148	.149	.222	.198	.295	.248	.369	.298	.443	.348	.518	.398	.590	.446	.665
	¼	.064	.095	.128	.190	.192	.285	.255	.380	.320	.475	.383	.570	.447	.663	.510	.760	.575	.855
	9/32	.078	.116	.156	.232	.234	.348	.312	.464	.390	.580	.468	.695	.547	.810	.624	.929	.700	1.04
	5/16	.092	.137	.184	.275	.277	.412	.368	.550	.462	.686	.553	.823	.647	.958	.740	1.10	.830	1.14
	3/8	.106	.158	.213	.316	.319	.475	.425	.632	.532	.790	.638	.950	.745	1.11	.850	1.26	.957	1.42
	1⅛	.128	.190	.256	.380	.383	.570	.510	.760	.640	.950	.765	1.14	.893	1.32	1.02	1.52	1.15	1.71
	1⅜	.149	.222	.298	.444	.446	.664	.595	.884	.744	1.10	.892	1.32	1.04	1.54	1.19	1.77	1.34	1.99
	1⅝	.184	.275	.370	.550	.553	.822	.737	1.10	.923	1.37	1.11	1.64	1.29	1.92	1.48	2.20	1.66	2.47
	1⅞	.213	.316	.426	.632	.638	.950	.850	1.26	1.32	1.58	1.28	1.89	1.49	2.21	1.70	2.53	1.92	2.85
	2¼	.255	.380	.510	.760	.767	1.14	1.02	1.52	1.28	1.90	1.53	2.27	1.78	2.66	2.04	3.04	2.30	3.41
	2⅝	.296	.443	.596	.886	.893	1.33	1.19	1.77	1.49	2.22	1.78	2.66	2.08	3.10	2.38	3.54	2.68	3.98
	3¼	.369	.548	.738	1.10	1.11	1.65	1.47	2.19	1.85	2.75	2.22	3.29	2.58	3.84	2.95	4.40	3.32	4.94
	3⅝	.426	.633	.850	1.27	1.28	1.90	1.70	2.53	2.13	3.16	2.55	3.80	2.98	4.43	3.40	5.07	3.83	5.70
	4⅛	.510	.760	1.02	1.52	1.53	2.28	2.04	3.04	2.55	3.80	3.06	4.55	3.57	5.32	4.09	6.08	4.60	6.83
	5⅛	.596	.885	1.19	1.78	1.79	2.66	2.38	3.54	2.98	4.43	3.58	5.32	4.17	6.20	4.77	7.08	5.36	7.98
MACHINE	6½	.739	1.10	1.48	2.20	2.21	3.29	2.94	3.40	3.69	5.48	4.43	6.58	5.17	7.67	5.90	8.78	6.64	9.88
	7½	.850	1.26	1.70	2.53	2.55	3.80	3.40	5.06	4.26	6.32	5.10	7.58	5.96	8.85	6.80	10.1	7.66	11.4
	9	1.02	1.52	2.04	3.04	3.06	4.56	4.08	6.08	5.12	7.60	6.12	9.10	7.15	10.6	8.18	12.8	9.20	13.6
	11	1.25	1.86	2.50	3.72	3.74	5.58	4.98	7.42	6.24	9.28	7.48	11.1	8.73	13.0	10.0	14.8	11.2	16.7
	13	1.48	2.19	2.96	4.39	4.42	6.58	5.90	8.77	7.38	11.0	8.84	13.2	10.3	15.3	11.8	17.5	13.3	19.7
	15¾	1.71	2.58	3.46	5.15	5.20	7.73	6.90	10.3	8.66	12.8	10.4	15.4	12.1	18.0	13.8	20.6	15.6	23.2
FEED	19	2.15	3.20	4.32	6.40	6.47	9.62	8.60	12.8	10.8	16.0	12.9	19.2	15.1	22.4	17.3	25.6	19.4	28.8
	22	2.50	3.72	5.00	7.44	7.48	11.1	9.96	14.8	12.5	18.6	15.0	22.2	17.5	26.0	20.0	29.6	22.5	33.4
	27	3.06	4.55	6.12	9.10	9.20	13.7	12.2	18.2	15.3	22.8	18.4	27.3	21.4	31.8	24.5	36.5	27.5	41.0
	31	3.52	5.24	7.04	10.5	10.5	15.7	14.0	20.9	17.6	26.2	21.1	31.4	24.7	36.6	28.2	41.8	31.7	47.0
	39	4.42	6.58	8.86	13.2	13.3	19.8	17.7	25.3	22.2	32.9	26.5	39.5	31.0	46.0	35.4	52.6	39.8	59.2
	45	5.10	7.60	10.2	15.2	15.3	22.8	20.4	30.3	25.6	38.0	30.6	45.5	35.8	53.0	40.8	60.8	46.0	68.3
RATE	54	6.10	9.10	12.3	18.2	18.4	27.3	24.5	36.5	30.7	45.5	36.7	54.6	42.9	63.7	49.0	73.0	55.2	82.0
	63	7.13	10.2	14.3	21.3	21.5	31.9	28.6	42.5	35.8	53.2	42.9	63.8	50.0	74.3	57.2	85.0	64.3	95.8
	78	8.95	13.3	18.0	26.7	26.9	40.0	35.8	53.4	44.9	66.7	53.8	80.0	62.8	93.0	71.8	106	81.8	120
	90	10.2	15.2	20.4	30.4	30.6	45.6	40.8	60.8	51.2	76.0	61.3	91.0	71.5	106	81.8	122	92.0	137

FEEDS OBTAINED ON CIRCULAR MILLING TABLES CORRESPONDING TO DIAMETER OF WORK AND INDICATED FEED — FOR ⅜"-90" PER MIN. FEED RANGE

Dia. Work ▸		10"		11"		12"		13"		14"		15"		16"		17"	18"	19"	20"
Size Table* ▸		16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	16"	20" and 24"	20" and 24"	20" and 24"	20" and 24"	20" and 24"
INDICATED FEED MACHINE FEED RATE	3/8	.425	.632	.467	.696	.510	.760	.552	.822	.595	.884	.637	.950	.680	1.01	1.08	1.14	1.20	1.27
	7/8	.496	.737	.545	.812	.595	.885	.645	.960	.693	1.03	.743	1.11	.793	1.18	1.15	1.32	1.40	1.48
	9/8	.640	.950	.700	1.04	.768	1.14	.830	1.23	.892	1.33	.955	1.42	1.02	1.52	1.61	1.70	1.80	1.90
	11/8	.780	1.16	.857	1.28	.937	1.39	1.01	1.50	1.09	1.62	1.17	1.74	1.24	1.85	1.97	2.08	2.20	2.32
	13/8	.922	1.37	1.01	1.51	1.11	1.64	1.20	1.78	1.29	1.92	1.38	2.06	1.47	2.19	2.33	2.46	2.60	2.75
	15/8	1.06	1.58	1.17	1.74	1.28	1.90	1.38	2.05	1.48	2.21	1.59	2.37	1.70	2.53	2.68	2.84	3.00	3.16
	17/8	1.28	1.90	1.40	2.08	1.53	2.27	1.66	2.47	1.78	2.66	1.91	2.85	2.04	3.04	3.22	3.41	3.60	3.80
	21/8	1.49	2.22	1.64	2.43	1.78	2.65	1.93	2.87	2.06	3.10	2.23	3.32	2.38	3.54	3.76	3.97	4.20	4.43
	23/8	1.84	2.74	2.03	3.02	2.22	3.29	2.40	3.56	2.57	3.84	2.76	4.11	2.95	4.40	4.66	4.93	5.20	5.48
	27/8	2.13	3.16	2.33	3.48	2.55	3.79	2.76	4.10	2.97	4.42	3.18	4.74	3.40	5.03	5.38	5.68	6.00	6.32
	31/8	2.55	3.80	2.80	4.18	3.07	4.55	3.32	4.93	3.56	5.30	3.83	5.70	4.08	6.08	6.45	6.82	7.20	7.60
	33/8	2.98	4.42	3.27	4.88	3.57	5.30	3.87	5.75	4.16	6.20	4.46	6.63	4.76	7.10	7.52	7.95	8.50	8.85
	35/8	3.69	5.48	4.05	6.03	4.43	6.58	4.80	7.12	5.16	7.67	5.53	8.22	5.90	8.78	9.30	9.84	10.4	11.0
	37/8	4.26	6.32	4.67	6.96	5.10	7.60	5.52	8.22	5.94	8.85	6.38	9.50	6.80	10.1	10.7	11.4	12.0	12.6
	41/2	5.12	7.60	5.60	8.35	6.13	9.10	6.63	9.85	7.13	10.6	7.65	11.4	8.16	12.1	12.9	13.6	14.4	15.2
	51/4	5.96	8.86	6.54	9.75	7.15	10.6	7.73	11.5	8.32	12.4	8.92	13.3	9.50	14.2	15.0	15.9	16.8	17.7
	61/2	7.38	11.0	8.20	12.1	8.85	13.2	9.58	14.2	10.3	15.3	11.0	16.4	11.8	17.5	18.6	19.7	20.8	21.9
	71/4	8.50	12.6	9.34	13.9	10.2	15.2	11.0	16.4	11.9	17.7	12.8	19.0	13.6	20.2	21.5	22.7	24.0	25.3
	9	10.2	15.2	11.2	16.7	12.2	18.2	13.3	19.7	14.3	21.2	15.3	22.8	16.3	24.3	25.8	27.3	28.8	30.4
	11	12.5	18.6	13.7	20.4	15.0	22.2	16.2	24.1	17.4	26.0	18.7	27.8	19.9	29.7	31.5	33.4	35.2	37.1
	13	14.8	21.9	16.2	24.1	17.7	26.3	19.2	28.5	20.6	30.7	22.1	32.9	23.5	35.1	37.3	39.4	41.6	43.9
	15¾	17.3	25.7	19.0	28.3	21.8	30.8	22.5	33.5	24.2	36.0	25.9	38.6	27.7	41.2	43.7	46.3	48.8	51.4
	19	21.6	32.0	23.7	35.3	25.9	38.5	28.0	41.7	30.1	44.8	32.3	48.1	34.5	51.3	54.4	57.6	60.8	64.2
	22	25.0	37.1	27.4	40.9	30.0	44.5	32.4	48.3	34.9	52.0	37.4	55.7	40.0	59.3	63.0	66.7	70.4	74.3
	27	30.6	45.5	33.6	50.2	36.8	54.6	39.8	59.2	42.8	63.7	45.9	68.3	49.0	73.0	77.3	81.8	86.4	91.0
	31	35.2	52.2	38.6	57.5	42.2	62.8	45.6	68.0	49.2	73.0	52.7	78.3	56.2	83.8	88.8	94.0	99.2	104
	39	44.2	65.8	48.6	72.4	53.2	79.0	57.5	85.5	61.8	92.0	66.3	98.5	70.8	105	112	118	125	132
	45	51.0	76.0	56.2	83.5	60.7	91.0	66.3	98.5	71.3	106	76.5	114	81.5	121	129	136	144	152
	54	61.3	91.0	67.2	100	73.5	109	79.5	118	85.5	128	91.8	136	97.8	146	155	164	173	182
	63	71.5	106	78.5	117	85.8	128	93.0	138	100	148	107	159	114	170	181	191	202	212
	79	89.7	133	98.5	183	108	160	116	173	125	186	134	200	143	213	226	239	253	267
	90	102	152	112	167	122	182	133	197	143	212	153	228	163	243	258	273	288	304

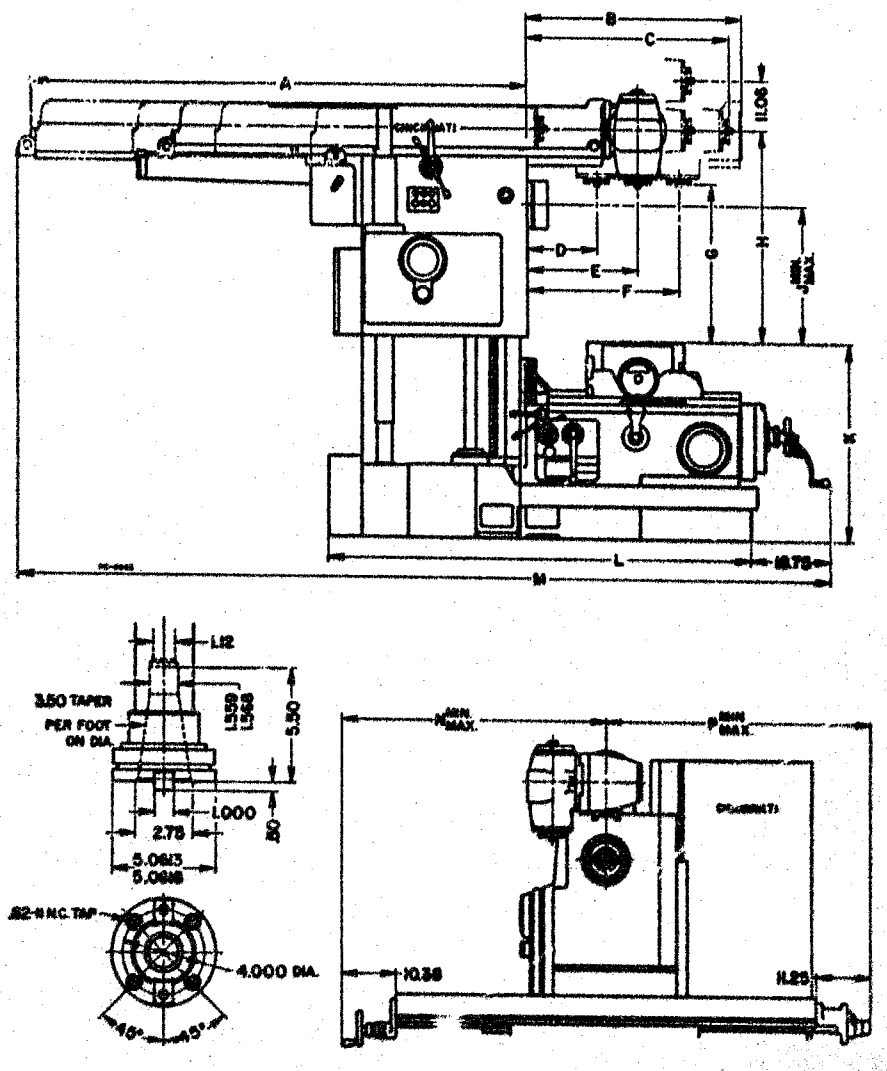


Figure 58
Dimensions—Dependent Overhead Spindle

Machine Size		A	B	C	D	E	F	G		H		J	K	L	M	N		P	
								Min.	Max.	Min.	Max.	Min.				Min.	Max.	Min.	Max.
320-II	330-II	84.63"	40.25"	37.81"	11.13"	18.63"	28.13"	5.44"	27.44"	18.19"	38.19"	2.00"	24.00"	39.00"	79.13"	150.63"	28.00"	32.00"	32.50"	66.50"
420-II	430-II	84.63"	40.25"	37.81"	11.13"	18.63"	28.13"	5.44"	27.44"	18.19"	38.19"	2.00"	24.00"	39.00"	79.13"	150.63"	28.00"	70.00"	32.50"	74.50"
425-II	435-20	101.38"	44.25"	41.31"	14.25"	22.75"	31.25"	7.56"	31.56"	18.31"	42.31"	3.00"	27.00"	39.50"	87.63"	169.88"	30.00"	72.00"	36.50"	78.50"
525-II	535-20	101.38"	44.25"	41.31"	14.25"	22.75"	31.25"	7.56"	31.56"	18.31"	42.31"	3.00"	27.00"	39.50"	87.63"	169.88"	30.00"	88.00"	36.50"	86.50"
625-II	635-20	101.38"	44.25"	41.31"	14.25"	22.75"	31.25"	7.56"	31.56"	18.31"	42.31"	3.00"	27.00"	39.50"	87.63"	———	30.00"	90.00"	36.50"	98.50"
725-II	750-20	101.38"	44.25"	41.31"	14.25"	22.75"	31.25"	7.56"	31.56"	18.31"	42.31"	3.00"	27.00"	39.50"	87.63"	———	30.00"	102.00"	36.50"	108.50"

DEPENDENT OVERHEAD SPINDLE

The overhead spindle is geared into the main spindle of the carrier. This offers several important design advantages—it enables the spindle to pull full horsepower cuts and permits the entire standard range of 24 spindle speeds to be used. The spindle speeds, which are in geometric progression, include speeds of 16-1600 R.P.M. on the 320-18 through 430-18 machine and speeds of 14-1400 R.P.M. on the 425-20 through 750-20 machines.

A shift lever for engaging the Dependent Overhead Spindle is located on the gear housing at the rear of the spindle carrier. Shift the lever to the left to engage and to the right to disengage. When required, both the Dependent Overhead Spindle and the horizontal spindle can be used at once, but as a safety precaution it is best to disengage the D.O.S. when not in use.

The three gear contact positions of the Dependent Overhead Spindle are marked on the overarm scale. Before clamping the Dependent Overhead Spindle in position check the scribed line on the overarm scale "line-up" with the scribed line on the gear housing.

The head is carried on a pair of swivel mounts each of which can be swiveled a full 360 degrees for completely universal positioning of the spindle. A zero positioning pin is provided for each swivel.

Spindle nose is No. 50 Milling Machine Standard, the same as the machine spindle nose, thereby permitting quick interchange of cutters between dependent spindle and machine spindle.

HAND QUILL FEED DEVICE

This unit mounts either directly to the face of the Dependent Overhead Spindle as shown in Figure 59, or to a 90° housing. Very useful in permitting operator to drill holes at any desired angle. The 3" maximum vertical movement of the quill which has a No. 40 N.S. taper spindle, is controlled by the handwheel on the front of the spindle housing. Spindle speeds are the same as those listed under specifications for the Dependent Overhead Spindle (Page 58).

Figure 59
Hand Quill Feed Device

HEAVY DUTY VERTICAL MILLING ATTACHMENT

This attachment will permit you to perform heavy duty vertical milling operations on the VERCIPOWER Milling Machine. Attachment spindle is the same size as the machine spindle to permit interchangeability of shell end mill arbors, collet adapters, etc. Spindle speeds are ⅔ spindle speeds of the machine. The spindle may be swiveled 90° (45° either way from the vertical) in a plane parallel to the face of the machine column.

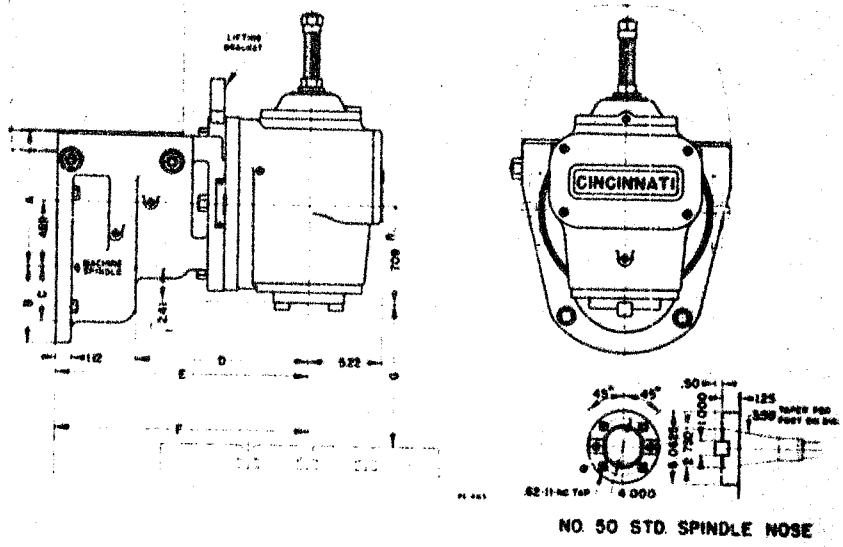


Figure 60
Dimensions—Heavy Duty Vertical Milling Attachment

Machine Size		Style	A	B	C	D	E	F Min.	F Max.	G Min.	G Max.
320-18	330-18	Plain	8.63"	5.38"	3.88"	10.38"	16.13"	12.63"	24.63"	.50"	21.50"
420-18	430-18	Plain	8.63"	5.38"	3.88"	10.38"	16.13"	12.63"	26.63"	.50"	21.50"
425-20	450-20	Plain	9.63"	6.13"	5.75"	12.38"	18.69"	13.75"	27.75"	.75"	24.59"
525-20	550-20	Plain	9.63"	6.13"	5.75"	12.38"	18.69"	13.75"	29.75"	.75"	24.59"
625-20	650-20	Plain	9.63"	6.13"	5.75"	12.38"	18.69"	13.75"	31.75"	.75"	24.59"
725-20	750-20	Plain	9.63"	6.13"	5.75"	12.38"	18.69"	13.75"	31.75"	.75"	24.59"

NOTE—When ordering an attachment give serial number stamped on face of the spindle carrier or on the front right hand end of table of machine on which it is to be used.

HEAVY DUTY UNIVERSAL MILLING ATTACHMENT

This attachment will adapt your VERCIPOWER Milling Machine to a wide variety of milling operations requiring universal angular positioning of the cutter spindle. Attachment spindle is same size as machine spindle. Spindle speeds are ⅔ spindle speed of the machine. Each of the swivels permit full 360° adjustment so that the cutter can be positioned in any desired angular position.

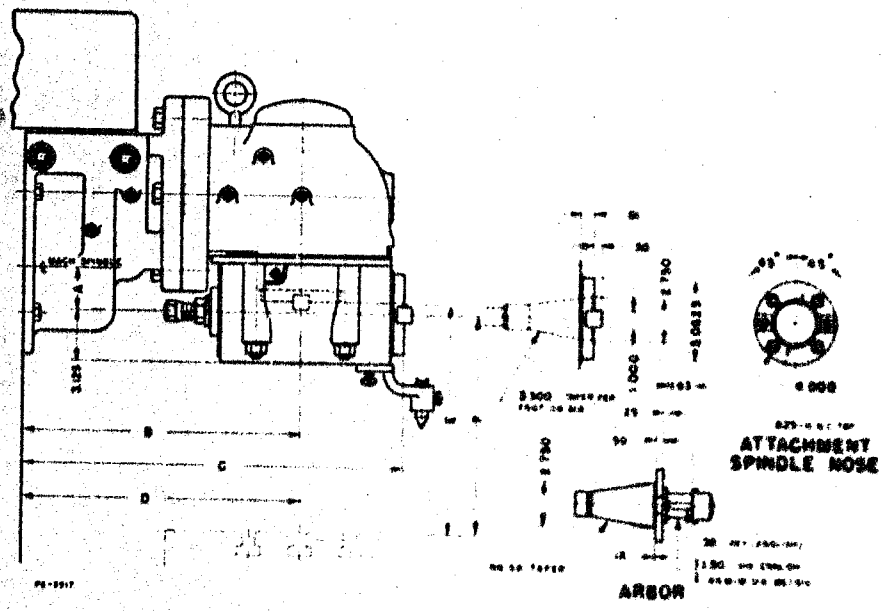


Figure 61
Dimensions—Heavy Duty Universal Milling Attachment

Machine Size		Style	A	B	C	D		E		F	
						Min.	Max.	Min.	Max.	Min.	Max.
320-18	330-18	Plain	2.56"	17.63"	24.19"	12.63"	24.63"	.50"	21.31"	3.13"	19.44"
420-18	430-18					12.63"	26.63"	.50"	21.31"		19.44"
425-20	450-20	Plain	2.56"	20.19"	26.75"	13.75"	29.75"	.50"	23.31"	3.13"	21.44"
525-20	550-20					13.75"	29.75"	.50"	23.31"		21.44"
625-20	650-20	Plain	2.56"	20.19"	26.75"	13.75"	31.75"	.50"	23.31"	3.13"	21.44"
725-20	750-20					13.75"	31.75"	.50"	23.31"		21.44"

NOTE—When ordering an attachment give serial number on face of the spindle carrier or on the front right hand end of table of machine on which it is to be used.

HIGH SPEED UNIVERSAL MILLING ATTACHMENT

This attachment provides higher speeds for use with small to medium sized cutters for jobs requiring vertical or angular positions of the cutter. These attachments are for comparatively light work and are not suitable for face milling operations.

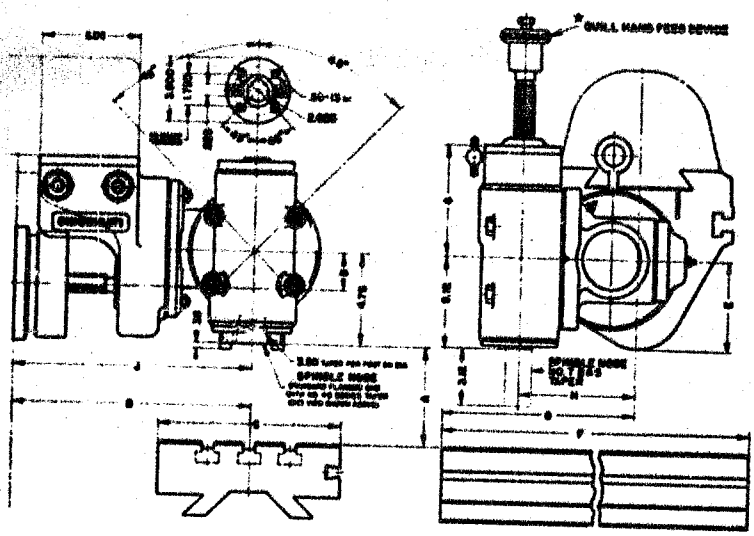


Figure 62
Dimensions—High Speed Universal Milling Attachment

Machine Sizes		Style	A Min.	A Max.	B Min.	B Max.	C	D	E
320-18	330-18	Plain	.38"	20.44"	12.63"	24.63"	18.00"	1.50"	6.38"
420-18	430-18	Plain	.38"	20.44"	12.63"	26.63"	18.00"	1.50"	6.38"
425-20	450-20	Plain	.38"	23.63"	13.75"	27.75"	20.00"	1.75"	6.38"
525-20	550-20	Plain	.38"	23.63"	13.75"	29.75"	20.00"	1.75"	5.56"
625-20	650-20	Plain	.38"	23.63"	13.75"	31.75"	20.00"	1.75"	5.56"
725-20	750-20	Plain	.38"	23.63"	13.75"	31.75"	20.00"	1.75"	5.56"

Machine Sizes		Style	F	G Min.	G Max.	H	J Min.	J Max.	
320-18	330-18	Plain	72.00"	16.50"	50.75"	8.69"	12.56"	19.56"	
420-18	430-18	Plain	80.00"	16.50"	58.75"	8.69"	12.56"	19.56"	
425-20	450-20	Plain	86.50"	19.25"	61.25"	9.56"	13.13"	20.13"	
525-20	550-20	Plain	94.50"	19.25"	69.25"	9.56"	13.13"	20.13"	
625-20	650-20	Plain	104.50"	19.25"	79.25"	9.56"	13.13"	20.13"	
725-20	750-20	Plain	116.50"	19.25"	91.25"	9.56"	13.13"	20.13"	

The attachment is driven from the machine spindle by means of a splined shaft, fitting into an adapter mounted in the spindle nose. This method of driving provides a 7" range of cross adjustment for the attachment, a useful feature on large work.

Spindle speeds are 1.475 x speed indicated on the machine speed dial. The spindle swivels a full 360° in a plane parallel to the face of the column, 90° (45° each way from vertical) in a plane at right angles to the face of the column. Spindle nose of attachment is No. 40 National Standard.

Lubrication. The High Speed Universal Milling Attachment must be lubricated daily while in use. In the grease nipple for the lower spindle bearing, use only medium sponge short fibre grease, sodium soap base. There are three other grease nipples on the attachment proper. Periodically apply cup grease.

METHOD OF CALCULATING MACHINING TIME

The actual cutting time for milling any piece of work may be calculated from the following formula:

$$T = \frac{L + A + O}{F}$$

T = Actual Milling Time in Minutes.
L = Length of Cut in Inches.
A = Approach of Cutter in Inches.
O = Over-travel of Cutter in Inches.
F = Feed in Inches per Minute.

The approach of the cutter is the distance the table must move the work into the cutter before full cutting depth or width is attained. (Dimension "A" in Figures 65A, 65B, and 66).

The over-travel of the cutter is the distance the table must travel in power feed minus the total length of the cut. It is a safety factor to allow for variations in the length of the work piece and in clamping.

The feed is the most important factor, but there are such wide variations in feed depending upon the cutter, material, and the method of holding the work that the judgment of the set up man or operator must be relied upon to determine the correct feed. A discussion of feeds and speeds is contained in our booklet "Milling Machine Practice", a copy of which may be obtained from the factory.

Example: Suppose a cast-iron bracket is to be milled on one side, under the following conditions of feed, length of cut, etc. Calculate the actual cutting time.

Length of Cut.....8"
Width of Cut.....4"
Diameter of End Mill.....6"
Over-travel .....assume ¼"
Feed .....11" per minute

Then L = 8"
A = .77" (See table entitled "Approach of Cutter for End Mills and Face Mills", page 66.)
O = ¼"
F = 11"

And $T = \frac{.8 + .77 + .25}{11} = .82$ minutes

Total time, floor to floor = .82 + Handling Time + Time to Clear Work of Cutters.

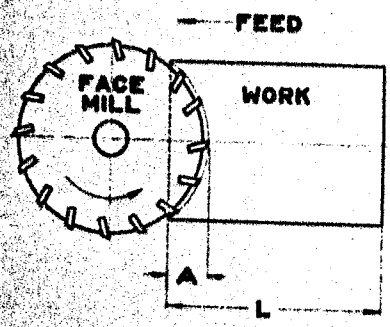


Figure 65A
Approach of Cutter (A) for Face and End Mills, with Center of Cutter Approximately in Line with Center of Work.

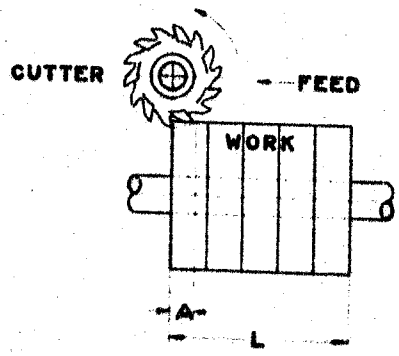


Figure 65B
Approach of Cutter (A) for Slab Milling, Keywaying, Gear Cutting, Sawing, etc.

Example: Suppose a gang of five gear blanks are to be milled between the centers of a 10" Dividing Head, under the following conditions of feed, depth of cut, etc. Calculate the actual cutting time.

Width of Gear Face	1"
Whole Depth of Tooth	.270"
Diameter of Cutter	2¾"
Over-travel	assume ⅛"
Feed	9" per minute

Then $L = 5''$ (Five gears, each 1" wide).
$A = .79''$ (See table entitled "Approach of Cutter for Spiral Mills, Keyway, Cutters, Saws, etc.", page 67).
$O = \frac{1}{8}''$
$F = 9''$

$$\text{And T per tooth} = \frac{5 + .79 + .125}{9} = .66 \text{ minutes}$$

Total time floor to floor:

$$= \frac{(.66 \times \text{No. of teeth}) + (\text{indexing time for one tooth} \times \text{No. of teeth} - 1.)}{5}$$

$$+ \frac{\text{handling time} + \text{time to clear work of cutters.}}{5}$$

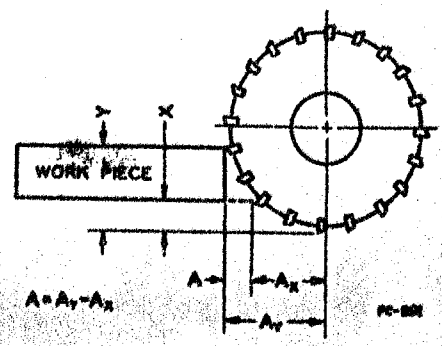


Figure 66
Approach of Cutter (A) for Face and End Mills, with Center of Cutter Offset from Center of Work

Example: If we have a part which requires a cut with an end mill or a face mill, and the center-line of the work does not coincide with the center of the cutter Figure 66, the approach cannot be read directly from the table. Assuming an extreme condition, suppose we have an 8" diameter face mill taking a 2½" width of cut, and that one edge of the work is 1½" from the periphery of the cutter (dimension "X" in Figure 66), while the opposite edge is 4" from the periphery (dimension "Y" = 1½" + 2½"). Then the approach of the cutter is the difference between the approach for a 4" depth of cut and a 1½" depth of cut. In the table entitled "Approach of Cutter for Spiral Mills, Keyway Cutters, Saws, etc", the approach for an 8" cutter at a 4" depth is 4", while at a 1½" depth, it is 3.12". The difference between 4" and 3.12" equals .88", the correct approach in this particular case.

APPROACH OF CUTTER FOR END MILLS AND FACE MILLS

(Center of Cutter Approximately in Line with Center of Work)

Diam. of Mill	WIDTH OF CUT											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
1	.50											
1½	.19											
2	.13	1.00										
2½	.10	.50										
3	.09	.37	1.50									
4	.07	.27	.68	2.00								
5	.05	.24	.50	1.00	2.50							
6	.04	.18	.40	.77	1.34	3.00						
7½	.04	.14	.32	.59	.96	1.51	2.63					
8	.03	.13	.29	.54	.88	1.36	2.07	4.00				
10	.02	.10	.23	.43	.56	1.00	1.43	2.00	2.82	5.00		
12	.02	.08	.19	.35	.81	1.13	1.13	1.53	2.04	2.69	3.60	6.00

How to Read the Table: Follow down the column headed "Diam. of Mill" until you come to the diameter of cutter which you are using. Follow across to the right until you come to the column under the width of cut which the cutter is taking. The figure given is the approach of the cutter.
Example: 10" diameter face mill; 8" width of cut; approach of cutter is 2".

C80 Digital Readout System

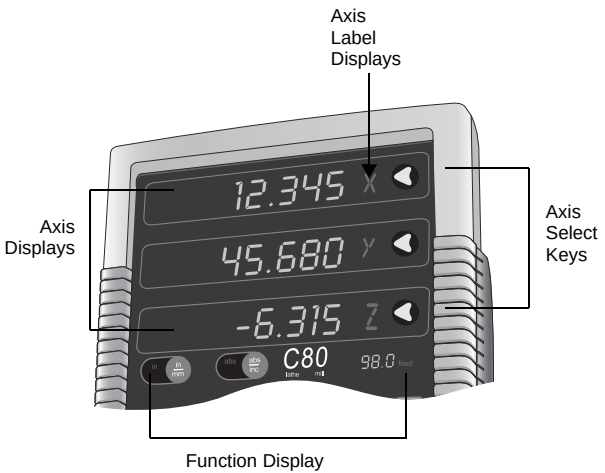
Instruction Manual

Newall Measurement Systems Ltd

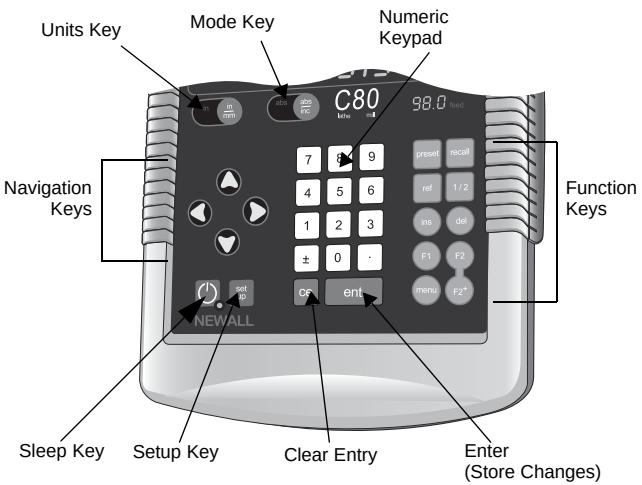
Notes

N

Display



Keypad



Contents

This chapter details the specifications for the C80.

Electrical

EMC compliance

BS EN 61000-6-4:2001

BS EN 61000-6-2:2001

Power supply unit (supplied)

100 – 240V (47 – 63Hz)

External switch-mode

Conforms to Low Voltage Directive

EN 60 950-1:2001

Physical

Height

265mm (10.43”)

Width

180mm (7.09”)

Depth

(not including connectors)

50mm (1.97”)

Weight

2.9kg (6.38lb)

Environmental

Operating temperature

0 to 45°C

Storage temperature

–20 to 70°C

Environmental conditions

Indoor Use, IP20 (IEC 529)

Relative humidity

Maximum 80% for temperatures up to 31°C decreasing linearly to 33% at 45°C

Disposal

At the end of its life, you should dispose of the C80 system in a safe manner applicable to electronic goods.

Do not burn.

The casework is suitable for recycling. Please consult local regulations on disposal of electrical equipment.

Input

Spherosyn or Microsyn encoders.

Resolutions

Spherosyn or Microsyn 10

(menu selection)

5µm (0.0002”)

10µm (0.0005”)

20µm (0.001”)

50µm (0.002”)

Microsyn 5

(menu selection)

1µm (0.00005”)

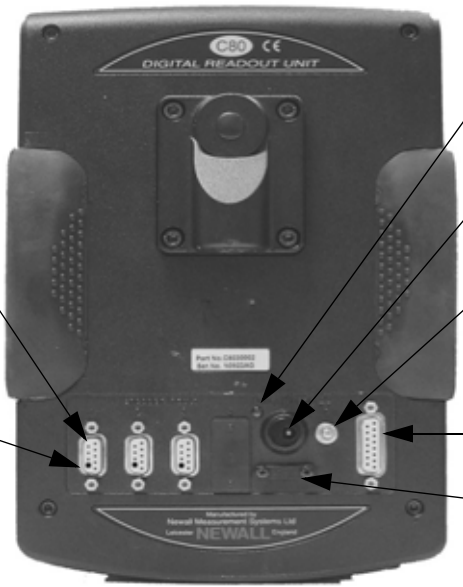
2µm (0.0001”)

5µm (0.0002”)

10µm (0.0005”)

This chapter shows the cable connections for the C80.

Cable connections



Power Indicator Lamp

2.5mm Power Inlet
15 Vdc ±10% @1A

Equipotential Terminal
(Should be grounded to machine, using the lead provided)

Encoder Inputs
9-way 'D'
(All plugs should be screwed finger tight)

Blanking Plug
(Do not remove these, as they prevent you accidentally connecting incorrect encoders)

RS232 Connection

Cable Anchor
(The power cable should be secured)

You can only use the **C80** with Newall Spherosyn and Microsyn analogue encoders.

You need to ensure that:

- You secure all the cables to prevent the connectors from dropping into hazardous positions (for example the floor or coolant tray) when you unplug them.
- You route all the cables to prevent them from being caught on moving parts.
- The **C80** is grounded to the machine, using the braided grounding lead provided, before you turn on the machine supply.
- You turn off the power by disconnecting the power supply connector, before you connect the encoder.

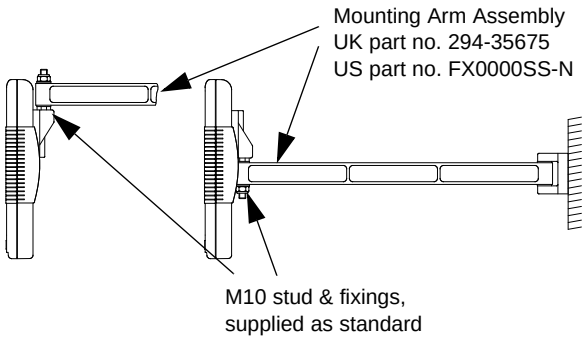
Do not connect this unit directly to the mains supply.

If your Newall encoder is not fitted with a D-type connector, then you can buy an adaptor cable (part no. 307-80980). Contact your supplier for details.

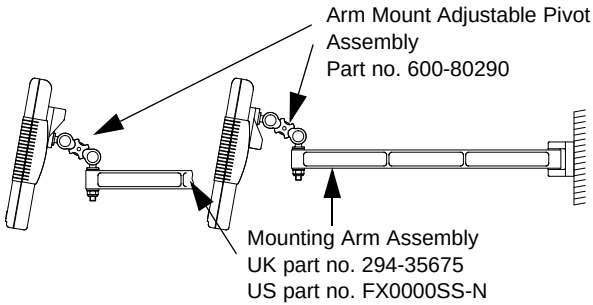
This chapter shows the various options for mounting the C80.

You can mount the **C80** in a variety of ways. The one that you use depends on the mounting assemblies that you purchased with the unit:

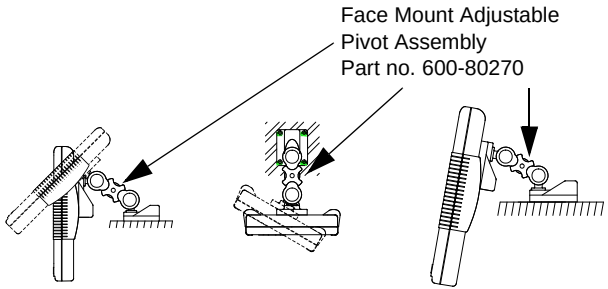
Arm mounting (non-adjustable)



Arm mounting (adjustable)

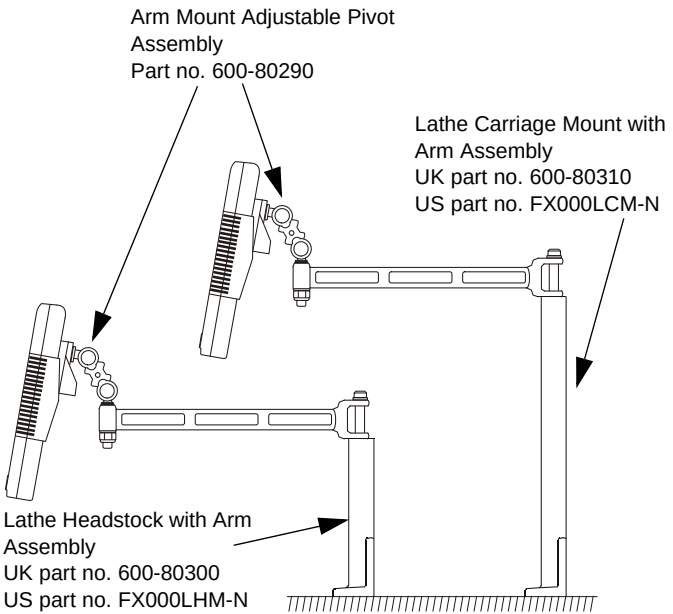


Face mounting (adjustable)

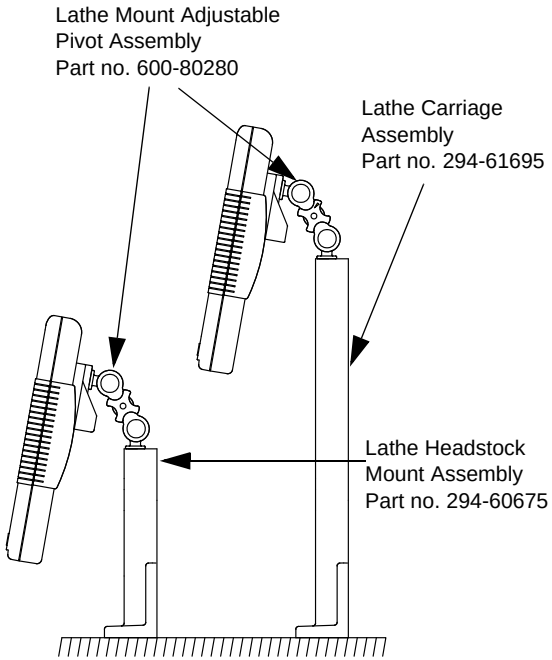


Lathe mounting (adjustable)

with arm assembly



Lathe mounting (adjustable)



This chapter explains how to interpret the display and use the keypad.

You should refer to the diagrams at the front of this manual for information on the layout of the display and keypad.

Display

Axis displays

The three **Axis** displays normally show the positions of the X, Y and Z axes.

The three **Axis Label** displays normally show X, Y and Z, (in **Lathe Mode** X, Z and Z').

Function display

While any axis is moving, the **Function** display shows the Feedrate of the fastest moving axis. The feed indicator next to the display is illuminated. The feedrate is displayed in mm/sec (to a resolution of 0.5) or inches/min (to a resolution of 1.0).

If the lathe indicator is illuminated, then the lathe functions are available; if the mill indicator is illuminated, then the mill functions are available; if the lathe and mill indicators are illuminated, then both the mill and lathe functions are available.

During Setup and Special Functions, the displays may show information other than that described on this page. See the Set up and Special functions chapters of this manual for further information.

Using the keypad

You use the keypad to enter data and control information for the **C80**. The keys can have different functions depending on the operating mode, but in normal operation the keys work as follows:

Unit Key. Toggles the display units between inches and millimetres.

Mode Key. Toggles the **C80** between Absolute Mode and Incremental Mode.

Absolute mode

In this mode, the **C80** displays the positions of the three axes relative to a fixed datum.

Incremental mode

In this mode, the **C80** displays each position relative to the last position. This is also known as point-to-point use.

> **At the beginning of each working session, set the datum in Absolute Mode, then switch the C80 to Incremental Mode. By using the C80 in this way, you can return the machine to its absolute datum at any time, simply by switching back to Absolute Mode.**

Sleep mode

Press the [**Sleep Key**] to temporarily turn off the displays and the keypad.

While the unit is in **Sleep Mode**, all the settings are preserved, but the positions of the three axes are updated.

If you move any of the axes while in **Sleep Mode**, the centre display shows '**d i SPLACd**'.

If someone touches any of the keys, the centre display shows '**t o u c h Ed**'.

> **See the Set up and Special functions chapters of this manual for more explanation of the use of the Navigation and Function Keys.**

This chapter describes how to set up the C80.

Setup mode

Normally, you only need to set up the **C80** once. You may find that the factory default settings are suitable so you do not need to change them.

To enter **Setup Mode:**

1. Leave any **Special Function** that is running.
2. Press [**set up**].
   The centre display shows '**SEt Up**'.
3. Press the up or down navigation key to cycle through the list of options.

The following table lists the options. The following sections describe each of the options in detail.

Option	Default	Display
Machine Type	Generic	gEnEr i c
Encoder Type	all axes: Spherosyn	SPHEroSn
Encoder Resolution	all axes: 0.005mm	0.005
Radius / Diameter	all axes: Radius	rAD
Direction	all axes: 1	d i r. 1
Error Compensation	all axes: Off	Err OFF
Linear Compensation	see note below	
Segmented Compensation	see note below	
Axis Summing	X and Z' axes	Add i t i on
RS232 Options	None	nOnE
Serial Rate	1.0	1.0
Baud Rate	9600	9600
Parity	None	nOnE
Zero Approach On / Off	all axes: Off	ZErO OFF
Zero Approach Limit	see note below	
Taper Display Axis	X axis	tAPEr On
Reset		rESEt
Store		StorE

The options available depend on the setting of other options. For example, the **Zero Approach Limit** *option is not present if Zero Approach is off.*

ⓘ *The following instructions are important and should be followed carefully.*

When you have finished setting all the options:

1. Press the down navigation key until '**S t o r E**' appears in the middle display.
2. Press [**ent**] to store any changes that you have made. The middle display shows '**S t o r Ed**' for a few seconds as your settings are stored.

The **C80** leaves **Setup Mode**.

Alternatively, you can press [**set up**] at any time to leave the **Setup Mode** and abandon any changes.

Machine type

You use this option to choose whether the special functions for **Mill** or **Lathe** are available.

There are three possible settings:

Generic	**gEnEr i c**	all functions available
Mill	**m i LL**	mill functions only
Lathe	**LAtHE**	lathe functions only

Press the **Select Key** next to the '**t**' to cycle through these settings.

Encoder

ⓘ *The* **Encoder** *settings must match the actual encoder in use, or the C80 will not display correctly.*

Encoder type

There are three possible settings for each axis:

Spherosyn	**SPHEroSn**
Microsyn 10	**uSn 10**
Microsyn 5	**uSn 5**

Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to cycle through these settings.

Encoder resolution

The **Resolution** settings available for each axis depend on the encoder type and the [**in/mm**] setting.

	Display		**Spherosyn**	**Microsyn 10**	**Microsyn 5**
µm	**mm**	**in**			
1	0.001	0.00005			X
2	0.002	0.0001			X

	Display		Spherosyn	Microsyn 10	Microsyn 5
µm	mm	in			
5	0.005	0.0002	X	X	X
10	0.01	0.0005	X	X	X
20	0.02	0.001	X	X	
50	0.05	0.002	X	X	

Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to cycle through the available settings for each axis.

Radius / diameter

The **Diameter** setting is useful for lathes, and other turning applications to display the diameter reading rather than the radius.

When you select the **Diameter** setting the **C80** displays double the actual movement on any axis.

There are two settings for each axis:

Radius	**rAd**
Diameter	**diA**

Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to cycle through these settings.

Direction

You use the **Direction** setting to match the **C80** to the actual direction of travel of any axis.

There are two settings for each axis: '**dir. 0**' and '**dir. 1**'.

Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to cycle through these settings.

The **Direction** *setting is arbitrary. You should set it to whichever option makes most sense for the machine.*

The **Direction** *depends on where the scale is mounted.*

Error compensation

Your digital readout (DRO) system helps you to improve productivity. It decreases the number of scrapped parts, as you no longer have to be concerned about making mistakes related to counting the revolutions on the dials. Your DRO system also helps to eliminate some errors related to ballscrew backlash.

Your DRO system will operate to its published accuracy, provided all components are in working order and properly installed. Field calibration is not necessary.

Accuracy problems with machined parts may be caused by machine error, DRO system error, or a combination of both. The first step in determining the source of error is to check the DRO system. You do this by comparing the movement of the Newall reader head to the position reading shown on the display. You

need a high accuracy standard, such as a laser interferometer. You can use a dial indicator to check short distances, but a laser provides the best results. If you have to use a dial indicator, be sure it is the highest available accuracy.

To check the accuracy of the DRO system:

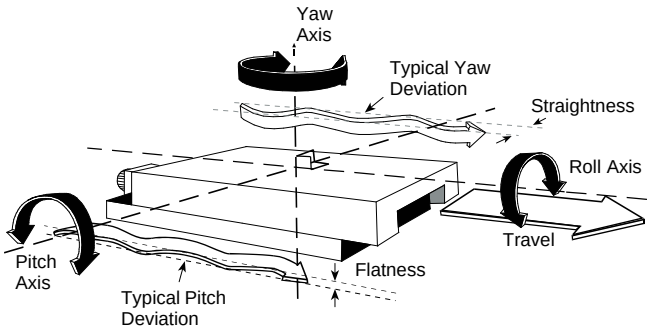
1. Place the target of the laser or the needle of the dial indicator directly on the Newall reader head.
   It is absolutely critical that you take the readings directly from the Newall reader head.
   If you have to use a dial indicator, be sure that the needle of the indicator is perpendicular to the reader head and not angled.
   If you take readings anywhere else on the machine, machine errors may distort the results.
2. When the reader head moves, the movement registers on the laser / indicator and DRO display.
3. Set the laser / dial indicator and DRO display position displays to 0.
4. Make a series of movements and compare the position readings between the laser / dial indicator and the DRO display.
   If the readings match within the accuracy specificed, then you know that the DRO system is operating properly. If this is the case, you can proceed to the next step: evaluating the machine errors. If the readings do not match, you must repair the DRO system before proceeding with error compensation.

To evaluate machine errors:

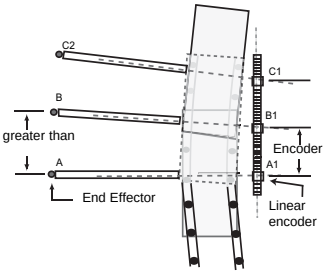
1. Put the laser target / dial indicator on the part of the machine where the machining is done.
2. Make a series of movements and compare the position readings between the laser / dial indicator and the DRO display.
   The difference between the laser / dial indicator reading and the reading on the DRO display is your machine error.
3. Plot the machine error along the entire axis of travel to determine the nature of the error.
   If it is a linear error, you can use linear error compensation. If the error is not linear, you should use segmented error compensation.

There are many types of machine error, including pitch, roll, yaw, flatness, straightness, and Abbe error. The diagrams below demonstrate these errors.

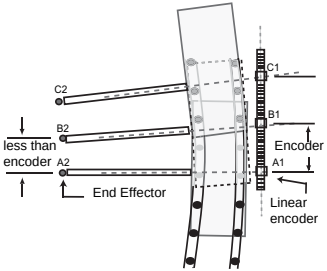
Way errors



Abbé error



Shown with encoder on *concave* side of bearing path



Shown with encoder on *convex* side of bearing path

There are three settings for each axis:

Off	**Err OFF**
Segmented Compensation	**SEG Err**
Linear Compensation	**Lin Err**

Press the **Select Key** next to the '**X**', '**Y**' or '**Z**' to cycle through these settings.

Once you have set the error compensation you want to use on all the axes, press the down navigation key. The middle display changes to '**Err SEt**'.

If you set one or more axes to **Segmented Error Compensation**, or **Linear Error Compensation**, then your next set up option is to configure the compensation for each of those axes.

If you apply **Error Compensation***, then you must ensure that it is absolutely correct. If it is not correct, then errors could be increased rather than reduced.*

Once you have set up the Error Compensation, we advise you to check its effect in normal operation.

Segmented error compensation

In this mode, you can break down the scale travel for each axis into as many as 99 user-defined segments, with each segment having its own correction factor. The correction factors are

calculated by the **C80** by comparison against known standards that you supply.

When you apply power, the display for any axis that is set to use **Segmented Compensation** shows '**r ESE t**'.

If the machine has not been moved since the power was turned off, press [**ce**], and the **C80** restores the last positions that were recorded.

Alternatively, you can set each axis close to the **Reference Point**, to within: 6.3mm (0.25") for a Spherosyn encoder or 2.5mm (0.1") for a Microsyn encoder, and press the **Select Key** next to the '**X**', '**Y**' or '**z**'. The **C80** re-establishes alignment with the correction parameters.

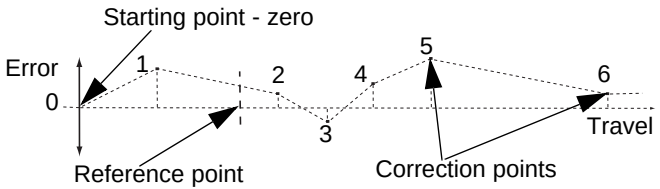
You need not apply Segmented Compensation over the entire scale length. You can apply it to a length of high importance, or to just one segment.

To ensure that you apply the correct compensation, you should always reset the datum when you turn on the C80.

If you set one or more axes to Segmented Error Compensation, then you need to carry out the following procedure to configure the compensation for each of those axes.

Identifying the correction parameters

The scale travel is broken down into a number of segments that you define, each with its own correction factor, measured against a high-accuracy standard. You need to identify the following parameters:



You measure each **Correction Point** with respect to the **Starting Point**, zero. You usually set this close to one end of the scale. You can set the **Reference Point** anywhere along the scale. It does not need to coincide with either the absolute datum or any of the correction points. However, you may find it convenient to make the absolute datum and the reference point the same.

Setting the correction points

As you follow the procedure you must ensure that you always approach the **Starting Point**, **Correction Points** and **Reference Point** from the same direction. If you do not, then the size of the tool or probe renders the measurement inaccurate.

1. Set one or more axes to **Segmented Compensation** as described in Error compensation on page 5-3.
   The display shows '**E r r SE t**'.

2. Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to enter the setup procedure for that axis.
   The display changes to '**SEt ZEro**'.
3. Set the machine to the point you have chosen as your **Starting Point**, and zero the high-accuracy standard at this point.
4. Press [**ent**].
   The display changes to '**goto 1**'.
5. Set the machine to the point you have chosen to be **Correction Point 1**.
6. Press [**ent**].
   The display changes to '**EntSd 1**'.
7. Enter the distance from the **Starting Point**, as measured by the standard.
   For example: Press [**6**] [**7**] [**8**] [**.**] [**9**] [**ent**] to enter a **Correction Point** of 678.9.
   The **C80** calculates and displays the correction factor for this point.
8. Press the down navigation key to go to the next point.
9. Repeat steps 5 to 8 for each **Correction Point**.
10. When you have entered all the correction points, press [**abs/inc**].
    The display changes to '**gotO rEf**'.
11. Set the machine to the point you have chosen as the **Reference Point**.
12. Press **ent**.
    The display returns to '**Err SEt**'.
13. If required, press the Select Key next to '**X**', '**Y**' or '**z**' to enter the error compensation for another axis.

You can define up to 99 segments per axis.

To use **Segmented Error Compensation**, you need to have a high accuracy standard, such as a laser measuring system.

Segmented Error Compensation initially defaults to **Off**, with no points set.
If you set **Segmented Error Compensation** to **Off** after you have set the **Correction Points**, then the data is retained, but not applied. When you next set the **Segmented Error Compensation** to **On**, the data is re-applied.

You must carry out this procedure in strict sequence, and in full, for it to be valid.

You can press the **Select Key** at steps 1 to 8 to display the current uncorrected position relative to the Starting Point.

Do not worry about the direction of the standard measurement. For example, 678.9 and –678.9 are treated the same.

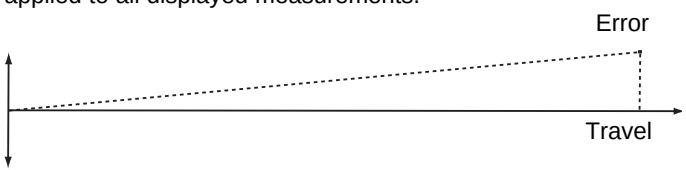
You can press [**ce**] to clear an entry one character at a time.

Once you have pressed [**ent**] to complete an entry, you can press [**ce**] to take you back one step at a time.

Linear error compensation

In this mode, you can apply a single constant correction factor for each axis to all displayed measurements. You calculate the correction factor, and specify it in parts per million (ppm). The values can be between –9999 and +9999.

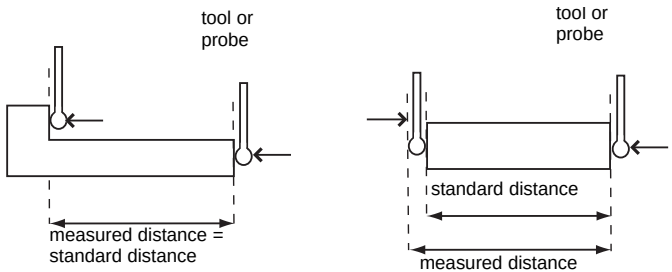
In this mode a single constant correction factor for each axis is applied to all displayed measurements.



If you set one or more axes to **Linear Error Compensation**, then you need to carry out the following procedure to configure the compensation for each of those axes.

Calculating the correction factor

As you follow the procedure you must ensure that you either use a stepped standard, and approach each edge from the same direction; or if you must approach each edge from opposite directions, then subtract the width of the tool or measuring probe from the value displayed on the **C80**.



For example: To check the scale against a standard which is exactly 500mm wide:

1. Set the tool or probe to one edge of the standard, and press the **Select Key** for the axis that you need to correct. The display shows '**0.000**'.
2. Set the tool or probe to the other edge of the standard. The display shows '**499.800**'.
3. Calculate the correction factor:
   error = 500.000 – 499.8 = 0.2mm
   Correction Factor = error/standard = 0.2/500 x 1,000,000 = +400 ppm (parts per million)

For this example you need to increase the value displayed on the **C80** to match the standard, as this is a positive correction factor. If the display had shown 500.2 for the same standard, the correction factor would be negative, –400 ppm.

Setting the correction factor

To set the correction factor:

1. Set one or more axes to **Linear Error Compensation** as described in Error compensation on page 5-3.
   The display shows '**Err SEt**'.
2. Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to enter the setup procedure for that axis.
   The display shows '**LC 0**', or a previously entered value.
   For example: Press [**4**] [**0**] [**0**] [**±**] [**ent**] to enter a **Correction Factor** of –400 ppm.
3. Press [**ent**] again.
   The display returns to '**Err SEt**'.
4. If required, press the **Select Key** next to the '**X**', '**Y**' or '**z**' to enter the setup procedure for another axis.

You cannot establish the **Correction Factor** while in **Setup Mode**. You need to carry out the measurements in **Normal Operating Mode**, then enter **Setup Mode** to set the **Correction Factor**.

The value you set must be in the range –9999 to 9999.

If you make a mistake while entering a number, pressing [**ce**] clears the entry one character at a time.

RS232 options

RS232 was added as a standard feature to the C80 in March 2005.

The **C80** DRO can offer basic RS232 communications via a dedicated hardware RS232 compatible port.

You select the baud rates for communications from the following options:

300, 1200, 2400, 4800, 9600, 14400, 19200, 38400

There are three RS232 modes:

No RS232. This is the default condition. All the RS232 functions are disabled and there are no outputs.

Continuous Output. From the menu structure you define the frequency of the output. The options are 0.1 – 60.0 in steps of 0.1 second.

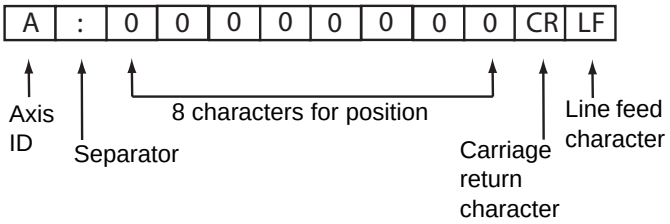
Keyed Output. For this option the axes data is transmitted when you press the [**ent**] key, without having pressed the preceding keys. Thus you do not need to use a function key.

Output data format

The output data from the RS232 is as follows:

- The current axis data for the axes available on the system are transmitted

- For two axis systems, only two axes of data will be transmitted
- The data packet structure of 12 characters is defined as follows:



The **Axis ID** is the character shown in the axis 15-segment display at the time of printing. The exception is that for three-axis Lathe applications a lower case ‘z’ is used to denote the compound Z’-axis. An upper case ‘Z’ is used to denote the standard Z-axis.

System settings

Baud rate = Configurable CR
(300, 1200, 2400, 4800, 9600, 14400, 19200, 38400)

Data bits = 8

Parity bit = Configurable (Even, Off, None)

Stop bits = 1

Flow control = None

Default system settings

Serial option = None

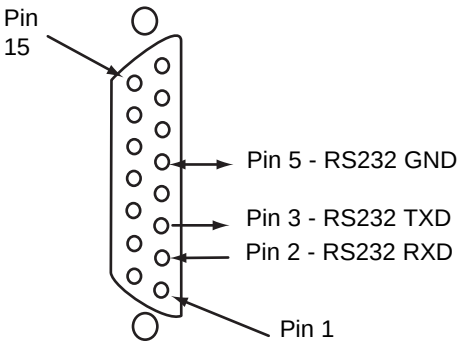
Serial rate = 1.0 (i.e. once per second)

Baud rate = 9600

Parity bit = None

Connections

You connect the RS232 to the **C80** via a 15-pin D-type connector at the rear of the display.



All other connections are reserved and should be left unconnected or the unit may be damaged.

Operation

You configure the RS232 output from the setup menu, using the following settings:

- '**SEriAL**' refers to the mode of operation. This can be '**ConStAnt**', '**SingLE**' or '**nOnE**'. You press the left or right navigation key to cycle through the options.

- '**SEr rAtE**' refers to the rate at which RS232 data is generated when in constant mode. It shows a value (in seconds) in the second axis window. You press the arrow button next to the value to change the serial rate. You can select values in the range 0.1 – 60.0 in 0.1s increments. The maximum serial rate is limited by the baud rate, as shown in the following table.

Baud Rate	Maximum Serial Rate (s)
300	2.0
1200	1.0
2400	1.0
4800	1.0
9600	0.5
14400	0.5
19200	0.5
38400	0.5

- '**bd rAtE**' relates to the baud rate of the RS232 communications. The second axis window shows the current value. You press the left or right navigation key to select a value.

- '**PArItY**' refers to the parity mode of the RS232 communications. The second axis window shows the current setting. This can be '**EUEn**'. '**Odd**' or '**nOnE**'. You press the left or right navigation key to scroll through the options.

Axis summing

This setting works in conjunction with the **Summing** function.

Two of the axis displays show '**Addition**'.

Press the **Select Keys** to switch between the two settings, **X,Z** and **Z,Z'**.

Zero approach

This flashes the **Axis Label** display when one or more axes are approaching zero.

For example: If you set the **Zero Approach** for the X axis, with a **Zero Approach Limit** of 1.25, then the axis label display flashes for values from '**-1.250X**' to '**1.250X**'. When the axis is within 0.05mm (0.002") for a Spherosyn encoder or 0.025mm (0.001") for a Microsyn encoder, the display stops flashing.

Zero approach on / off

There are two settings for each axis:

Zero Approach On	**ZErO On**
Zero Approach Off	**ZEro OFF**

Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to cycle through these settings.

Zero approach limit

You use this setting to choose how close to zero the axis needs to be for the display to flash.

To set the **Zero Approach Limit**:

1. Set the **Zero Approach On**.
2. Press the down navigation key.
   The displays for the selected axes change to '**0000**' or a previously entered value.
3. Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to choose which axis to edit.

   For example: To enter a limit of 1.25, press [**1**] [**.**] [**2**] [**5**] [**ent**].
4. If necessary, press the **Select Key** next to the '**X**', '**Y**' or '**z**' to enter the limit for another axis.

Taper display axis

This setting works in conjunction with the **Taper** function.

One of the axis displays shows '**tAPEr On**' while the other two displays show '**tAPr OFF**'.

Press the **Select Keys** to choose which axis displays the **Taper** function.

Reset

This restores all settings to their factory defaults, and you should, therefore, only use it if absolutely necessary.

The middle display shows '**rESEt**'.

Press [**ent**] or the **Select Key** next to the '**r**' to select the **Reset** function.

While all the stored settings are being erased, the top display shows '**C l EA r I n g**', and the middle display shows '**0**', '**0 0**', etc.

When **Reset** has finished the middle display returns to '**r ESE t**'.

The **C80** remains in **Setup Mode**.

Use **Reset** *with caution, as you will lose all your stored settings.*

Reset *takes approximately 15 seconds.*

Store

ⓘ *This is an important section, you should read it carefully.*

This stores all your settings, then returns to **Normal Operating Mode**.

The middle display shows '**S t o r E**'.

Press [**ent**] or the **Select Key** next to the '**S**' to select the **Store** function.

The middle display shows '**S t o r Ed**' for a few seconds, as your settings are stored.

The **C80** leaves **Setup Mode**.

Alternatively, you can press [**set up**] at any time to leave **Setup Mode** and abandon any changes.

This chapter describes the standard functions for the C80.

Setting the datum for each axis

Setting the zero

To zero one display at the current position, press the **Select Key** by the axis to set it to zero.

All readings are now relative to this new zero point.

Using Zero redefines the datum. You cannot restore the old datum.

Setting the preset

To preset one display to a known value:

1. Press [**preset**].
2. Press the **Select Key** by the axis to preset it.
3. Enter the value.

If you make a mistake while entering a number, you can press [**ce**] *to clear the entry one character at a time.*

Recalling the last value

To quickly recall the last preset value for an axis:

1. Press [**recall**].
2. Press the **Select Key** to preset the axis.

All readings are now relative to this new value.

Digifind

If you lose a datum, either due to movement following a power failure, or after you have entered a fixed point by mistake, you can re-establish it using Digifind.

Using Digifind

The absolute datum for each axis should be marked permanently on the machine.

1. Set the axis close to the marked datum, to within:
   6.3mm (0.25”) for a **Spherosyn** encoder or
   2.5mm (0.1”) for a **Microsyn** encoder.
2. Switch the **C80** to **Absolute Mode**.
   Digifind only works in absolute mode.
3. Press [**ref**].
4. Press the **Select Key** to restore the axis.

The display updates to show the exact distance from the datum.

Centerfind

Centerfind halves the distance displayed on the selected axis, so that you can find the centre of a workpiece. It works in either **Absolute** or **Incremental Mode**.

Using Centerfind

For example, to find the centre of a workpiece that is 100mm wide:

1. Set the tool to one edge of the workpiece.
2. Press the **Select Key** to centre the axis.
   The display shows '**0.000**'.
3. Set the tool to the other edge of the workpiece.
   The display shows '**100.000**'.
4. Press [**1/2**].
   The display shows '0' in all axes.
5. Press the **Select Key** to centre the axis.
   The display now shows '**50.000**'.
6. Move the tool until the display shows '**0.000**'.

This is the centre of the workpiece.

No compensation for tool diameter (width) is provided for this function.

Using the centerfind feature in incremental mode preserves the absolute mode datum setting.

This chapter describes the C80's special functions.

In addition to the **Standard Functions** described on page 6-1, the **C80** has a number of inbuilt **Special Functions**, that you access using the [**F1**], [**F2**] and [**F2**$^{+}$] keys.

Most **Special Functions** work specifically in the **Mill** or **Lathe** modes, but the **Generic** functions can work with either.

Most **Special Functions** require only one function key to operate. You can allocate them to either [**F1**] or [**F2**].

The functions marked [**F2**] require two function keys. You can only allocate these to [**F2**] and [**F2**$^{+}$].

The **Generic** option also includes all the **Mill** and **Lathe Special Functions**.

Each of the **Special Functions** listed here is described in detail later in the Mill functions, Lathe functions and Generic functions chapters.

Mill functions

The **Special Functions** in **Mill** mode are:

Special Function	Display
Bolt Hole Circle	bOLt HOL
Arc	ArC
Line Hole	LinE
Polar Coordinates	PoLAr

Lathe functions

The **Special Functions** in **Lathe** mode are

Special Function	Display	
Tool Offsets	tool	F2
Taper	taper	
Summing	sum	
Vector	Vector	

Generic functions

The **Special Functions** in **Generic** mode are

Special Function	Display	
Sub Datum and Job Numbers	Sdm	F2

Menu function

You can only use two **Special Functions** at a time.

To find out which function is allocated to each key:

1. Press [**menu**] to see the Menu.
   The display shows:
   '**bolt HOl 1**'
   '**ArC 2**'
2. Press [**menu**] again to turn the Menu off.

Using a function

To use a function press [**F1**], [**F2**] or [**F2**$^{+}$], according to the instructions given later in this guide.

Allocating a function to a key

To allocate a function to a key:

1. Press [**menu**].
2. Press the **Select Key** next to the '**1**' or '**2**' to choose which function key to edit.
3. Press the up or down navigation key to cycle through the list of **Special Functions**.
4. Press [**ent**] to allocate the selected **Special Function** to the function key.

If certain functions are running when you press [**menu**]*, then in place of the function name, the display shows '***turn Off***'.*

If you want to allocate a function, press [**menu**] *again to turn the* **Menu** *off. If you want to allocate a different function to that function key, then you need to turn the function off before trying again.*

This chapter describes the special functions available in Mill mode.

Mill functions are available when you have configured the **C80** for either **Mill** or **Generic** operation.

Bolt hole circle

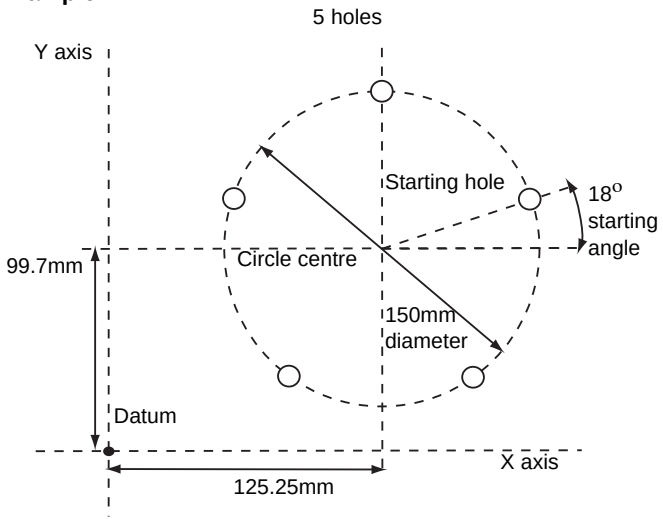
You cannot use arc contouring and bolt hole circle functions at the same time.

This function is also known as Pitch Circle Diameter (PCD).

This function calculates the locations of the holes, given the following parameters:

1. Plane (**X**,**Y**; **X**,**Z** or **Y**,**Z**)
2. Circle Centre location
3. Circle Diameter
4. Number of Holes (up to 99)
5. Starting Angle (measured anti-clockwise from three o'clock)

Example



Setting the parameters

1. Press [**F1**] or [**F2**] to turn the function on.
   For three axis units only.
   The function display shows '**p**', and the axis displays show the **Plane** in which the holes are to be machined.
2. Press the up or down navigation key to cycle through the three settings **X**,**Y**; **X**,**Z** or **Y**,**Z**.
3. Press the right navigation key to move to the next step.
   The function display shows '**c**', and the axis displays show the coordinates of the **Circle Centre**.
4. Press the **Select Key** next to the '**X**', '**Y**' or '**z**', to edit each value as required.
5. Press the right navigation key to move to the next step.
   The function display shows '**d**', and the top axis display shows the **Circle Diameter**.
6. Enter a new value if required.
   For example: Press [**1**] [**5**] [**0**] [**ent**] to enter a diameter of 150.
7. Press the right navigation key to move to the next step.
   The function display shows '**n**', and the top display shows the **Number of Holes**.
8. Enter a new value if required.
   For example: Press [**5**] [**ent**] if you want to machine 5 holes.
9. Press the right navigation key to move to the next step.
   The function display shows '**a**', and the top display shows the **Starting Angle**.
10. Enter a new value if required.
    For example: Press [**1**] [**8**] [**ent**] to enter a value of 18 degrees.
11. Press the right navigation key to finish setting the parameters.
    The function display shows '**0 1**'.

Machining the holes

The two axis displays for the selected plane now show the distance to the first hole.

1. To position the tool ready for machining the hole, move the axes until both displays show zero.
   The function display shows the number of the hole to be machined.
2. Press the left or right navigation key to move between the holes, or enter the hole number. For example: Press [**4**] [**ent**] to move directly to hole 4.
3. When all the holes have been machined, press [**F1**] or [**F2**] to turn the function off.

If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

Once you have pressed [**ent**] to complete an entry, you can press the navigation keys to move backwards and forwards one step at a time.

To turn the function off, finish making any entry, then press the function key again.

The axis that is not involved in the Bolt Hole Circle function reads as normal.

Arc contouring

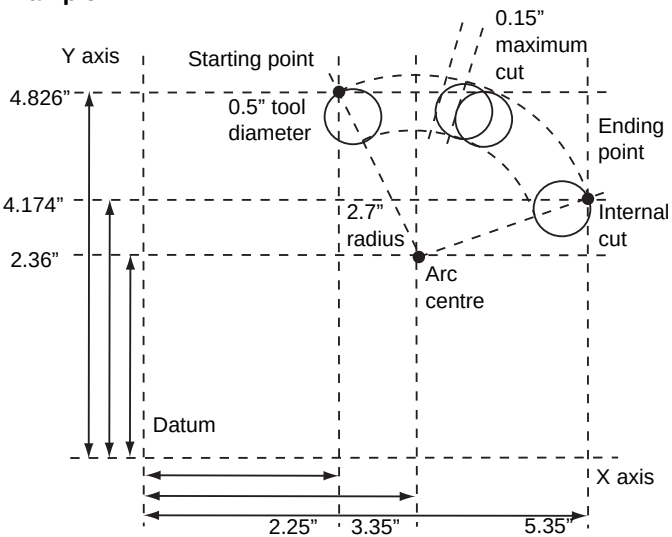
You cannot use arc contouring and bolt hole circle functions at the same time.

This function calculates the locations of the points along the line of the arc, given the following parameters:

The maximum number of points is 100 and the angle must be less than 180 degrees.

1. Plane (**X**,**Y**; **X**,**Z** or **Y**,**Z**)
2. Arc Centre location
3. Arc Radius
4. Starting Point
5. Ending Point
6. Tool Diameter
7. Internal or External Cut (machined to the inside or the outside of the arc)
8. Maximum Cut (the smaller the cut, the more points calculated)

Example



Setting the parameters

1. Press [**F1**] or [**F2**] to turn the function on.
   (For three axis units only)
   The function display shows '**p**', and the axis displays show the **Plane** in which the holes are to be machined.
2. Press the up or down navigation key to cycle through the three settings **X**,**Y**; **X**,**Z** and **Y**,**Z**.
3. Press the right navigation key to move to the next step.
   The function display shows '**C**', and the axis displays show the coordinates of the **Arc Centre**.
4. Press the **Select Key** next to the '**X**', '**Y**' or '**z**', to edit each value as required.
5. Press the right navigation key to move to the next step.
   The function display shows '**r**', and the top display shows the **Arc Radius**.
6. Enter a new value if required.
   For example: Press [**2**] [**.**] [**7**] [**ent**] to enter an arc radius of 2.7.
7. Press the right navigation key to move to the next step.
   The function display shows '**s t**', and the axis displays show the coordinates of the **Starting Point**.
8. Press the **Select Key** next to the '**X**', '**Y**' or '**z**', to edit each value as required.
9. Press the right navigation key to move to the next step.
   The function display shows '**e n d**', and the axis displays show the coordinates of the **Ending Point**.
10. Press the Select Key next to the '**X**', '**Y**' or '**z**' to edit each value as required.
11. Press the right navigation key to move to the next step.
    The function display shows '**t d**', and the top display shows the **Tool Diameter**.
12. Enter a new value if required.
    For example: Press [**.**] [**5**] [**ent**] to enter a diameter of 0.5.
13. Press the right navigation key to move to the next step.
    The function display shows '**I e**', and the top axis display shows whether the cut is to be machined to the internal or the external radius of the arc.The display shows **Internal** '**r a d - t OO l**' or **External** '**r a d t OO l**'.
14. Press the up or down navigation key to cycle through the settings.
15. Press the right navigation key to move to the next step.
    The function display shows '**C u t**', and the top display shows the **Maximum Cut**.
16. Enter a new value if required.
    For example: Press [**.**] [**1**] [**5**] [**ent**] to enter a maximum cut of 0.15.

17. Press the right navigation key to finish setting the parameters.
The function display shows '**01**'.

Machining the arc

The two axis displays for the selected plane now show the distance to the Arc starting point.

1. To position the tool ready for machining the arc, (starting point) move the axes until both displays read zero.
The function display shows the number of the hole to be machined.
2. Press the left or right navigation key to move between the positions.
3. When the Arc machining is complete, press [**F1**] or [**F2**] to turn the function off.

If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

Once you have pressed [**ent**] to complete an entry, you can press the left and right navigation keys to move backwards and forwards one step at a time.

If you enter a **Starting Point** or **Ending Point** that is inconsistent with the **Centre** and **Radius** settings, then the **Centre** and **Radius** settings override the inconsistent settings.

The axis that is not involved in the Arc function reads as normal.

You must machine the arc progressively. You cannot jump between points on the arc.

You should move away from the line of the Arc between points to avoid over cutting.

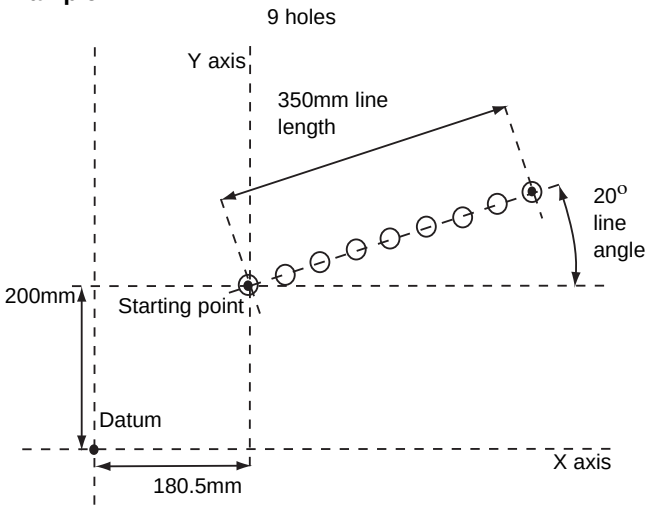
Line hole

This function calculates the locations of the holes, given the following parameters:

1. Plane (**X**,**Y**; **X**,**Z** or **Y**,**Z**)
2. Starting Point
3. Line Length
4. Number of Holes (up to 99)
5. Line Angle

The axis that is not involved in the line hole function reads as normal.

Example



Setting the parameters

1. Press [**F1**] or [**F2**] to turn the function on.
   (For three axis units only)
   The function display shows '**p**', and the axis displays show the **Plane** in which the holes are to be machined.
2. Press the up or down navigation key to cycle through the three settings **X**,**Y**; **X**,**Z** or **Y**,**Z**.
3. Press the right navigation key to move to the next step. The function display shows '**s t**', and the axis displays show the coordinates of the **Starting Point**.
4. Press the **Select Key** next to the '**X**', '**Y**' or '**z**', to edit each value as required.
5. Press the right navigation key to move to the next step. The function display shows '**l e n**', and the top display shows the **Line Length**.
6. Enter a new value if required.
   For example: Press [**3**] [**5**] [**0**] [**ent**] to enter a line length of 350.
7. Press the right navigation key to move to the next step. The function display shows '**n**', and the top display shows the **Number of Holes**.
8. Enter a new value if required.
   For example: Press [**9**] [**ent**] if you want to machine 9 holes.
9. Press the right navigation key to move to the next step. The function display shows '**a**', and the top display shows the **Line Angle**.
10. Enter a new value if required.
    For example: Press [**2**] [**0**] [**ent**] to enter a value of 20 degrees.

11. Press the right navigation key to finish setting the parameters.
The function display shows '**0 1**'.

Machining the holes

The two axis displays for the selected plane now show the distance to the first hole.

1. To position the tool ready for machining the hole, move the axes until both displays read zero.
The function display shows the number of the hole to be machined.
2. Press the left or right navigation key to move between the holes, or enter the hole number. For example: Press [**4**] to move directly to hole 4.
3. When all the holes have been machined, press [**F1**] or [**F2**] to turn the function off.

If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

Once you have pressed [**ent**] to complete an entry, you can press the left and right navigation keys to move backwards and forwards one step at a time.

To turn the function off, finish making any entry, then press the function key again.

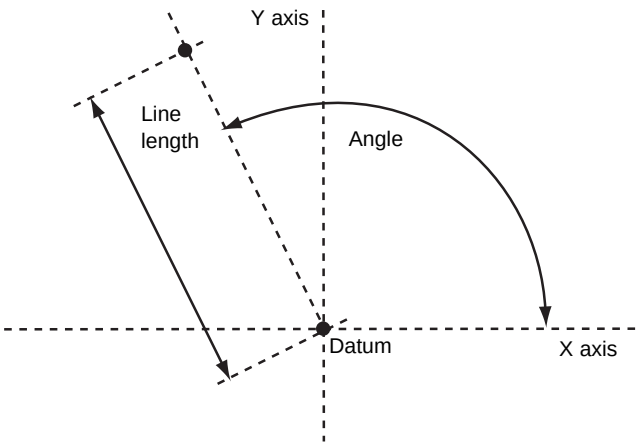
Polar coordinates

This function converts the position of two selected axes into Polar coordinates.

The **C80** normally uses the **Cartesian Coordinate System**, in which the position of a point in any plane is defined by two coordinates (**X**,**Y**; **X**,**Z** or **Y**,**Z**).

In the **Polar Coordinate System**, an imaginary line is drawn between the position of the point and the datum.The Polar coordinates displayed are the length of the line (P), and its angle, measured anti-clockwise from three o'clock.

Example



Using the Polar coordinates function

1. Press [**F1**] or [**F2**] to turn the function on.
   The axis label displays for two of the axes show '**P**' and '**a**'.
2. Press the left or right navigation key to cycle through the three **Plane** settings '**X**','**Y**', '**X**','**z**' or '**Y**','**z**'.
3. Press [**ent**] to accept the setting.

The axis that is not involved in the Polar Coordinates function displays as normal.

This chapter describes the special functions available in Lathe mode.

Lathe functions are available when you have configured the **C80** for either **Lathe** or **Generic** operation.

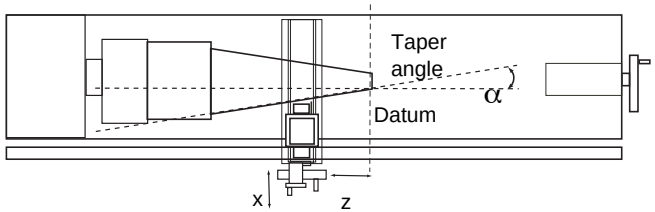
The conventional way to set up a lathe is:
X Axis – cross travel
Z Axis – longitudinal travel
Z' Axis – compound travel.

If you set the **Machine Type** to **Generic**, then the axes are labelled:
Axis 1 – X
Axis 2 – Y
Axis 3 – Z

Taper

You use this function to turn or measure a turned, tapered part.

One of the axes displays the **Taper** angle. This is the angle between the present machine position and the datum, in the X,Z plane.



We recommend that you use this function in **Incremental Mode***, as it involves changing the datum.*

The axes that do not show the **Taper** angle display as normal.

Setting the parameters

You select which axis is to display the Taper angle in **Setup Mode**.

To enter **Setup Mode**:

1. Leave any **Special Function** that is running.
2. Press [**set up**].
   The centre display shows '**s e t Up**'.
3. Press the up or down navigation key to choose '**t a p e r**'.
4. Press the **Select Key** next to the '**X**', '**Y**' or '**z**' to choose which axis shows '**t a p e r On**'.
5. Press the up or down navigation key to choose '**s t o r e**'.
6. Press [**ent**] to store the change.

Using the taper function

1. Touch the tool to one end of the taper.
2. Press the **Select Keys** next to the '**X**' and '**Z**', to set the datum.
3. Press [**F1**] or [**F2**] to turn the function on.
4. Touch the tool to one end of the taper.
   The axis display marked '**a**' shows the taper angle.
5. Press [**F1**] or [**F2**] to turn the function off.

Tool offsets

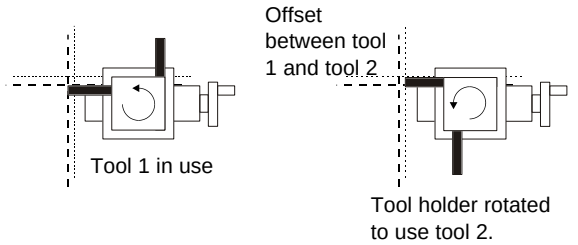
With this function you can program the **C80** with **Tool Offsets** for as many as 99 different tools, to save having to reset the datum every time you change tools.

You should set the **C80** *to* **Incremental Mode** *before using* **Tool Offsets***. By doing this, you can return the machine to its absolute datum, by switching back to* **Absolute Mode***.*

This function is designed primarily for use in **Lathe Mode**, but you can also use it in **Generic Mode**.

You can only set offsets for the first two axes, which on a lathe are the **X** and **Z** axes. In the examples opposite, the **X** axis is set to the diameter of the part, and the **Z** axis is zeroed at the face.

The **Tool 1 Offset** is special, because it is tied to the **Machine Datum**, as explained below.



Tool set mode

You press [**F2**] to access this mode, and use it to set the offsets for each tool.

To turn off **Tool Set Mode**, press [**F2**].

Setting the **Tool 1 Offset** *in this mode affects the* **Machine Datum***. Similarly, a change to the* **Machine Datum** *changes the* **Tool 1 Offset***. We therefore recommend that you set the* **C80** *to* **Incremental Mode** *before using this function.*

Setting each tool offset in this mode is independent of all the others, so a change to the **Machine Datum** *or to the* **Tool 1 Offset** *does not affect the other tool offsets.*

Tool usage mode

You press [**F2**$^{+}$] to access this mode, and use it once you have set all the offsets.

To turn off **Tool Usage Mode**, press [**F2**$^{+}$].

Changing to the **Machine Datum** *while in this mode changes all the offsets. This can be useful if the same set of tools is to be used on parts of varying sizes.*

Setting the tool offsets

1. Press [**F2**] to turn on the **Tool Set Mode**.
2. Press the right navigation key to select the Datum Tool (Generally Tool No. 1).
   The function display shows the tool number '**0 1**'.
3. Take a skim cut along the outside diameter of the part or touch the tool to the surface of the part (if cylindrical).
4. Move the tool away from the part, taking care not to move the X axis.
5. Measure the diameter of the part using a suitable gauge.
6. Press the **Select Key** next to the '**X**' and enter the diameter of the part as measured using the numbers on the keypad, then press [**ent**].
7. Take a facing cut or touch the end of the part with the tool.
8. Move the tool away from the part, taking care not to move the Z axis.
9. Press the **Select Key** next to the '**z**' and press [**ent**] to zero the axis.
   You have now established the **Tool Offsets Datum**.
10. Press the right navigation key to move to the next tool.
11. Touch the tool to the surface of the part.
12. Move the tool away from the part, taking care not to move the X axis.
13. Measure the diameter of the part using a suitable gauge.
14. Press the **Select Key** next to the '**z**' and enter the diameter of the part as measured, using the numbers on the key pad, and then press [**ent**].
15. Touch the end of the part with the tool.
16. Move the tool away from the part, taking care not to move the Z axis.
17. Press the **Select Key** next to the '**z**' and press [**ent**] to zero the axis.
18. Repeat steps 10 to 17 for each tool to be set.
19. Press [**F2**] to turn off the **Tool Set Mode**.

Using the tool offsets

1. Press [**F2**$^{+}$] to turn on the **Tool Usage Mode**.
2. Press the left or right navigation key to select the tool. The function display shows the tool number '**01**', '**02**' etc., to '**99**'.
3. Press [**F2**$^{+}$] to turn off the **Tool Usage Mode**.

Editing tool offsets for worn or replacement tools

1. Press [**F2**$^{+}$] to turn on the **Tool Usage Mode**.
2. Press the left or right navigation key to select a known good tool.
3. Set the axis datum as described in steps 3 to 7 for Setting the tool offsets on page 9-3. All the offsets are now aligned with the correct **Machine Datum**.
4. Press [**F2**$^{+}$] to turn off the **Tool Usage Mode**.
5. Press [**F2**] to turn on the **Tool Set Mode**.
6. Set the offsets for each tool as described in steps 10 to 17 for Setting the tool offsets on page 9-3.
7. Press [**F2**] to turn off the **Tool Set Mode**.

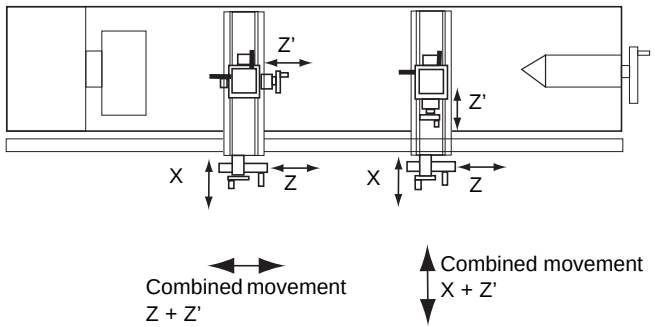
If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

To turn the function off, finish making any entry, then press the function key again.

Summing

You use this function to add the movement of the Z' axis to the movement of either the X axis or the Z axis.

The **Summing** function is useful when the compound is set to align with either of those two axes. If the compound is set at an angle, see Vectoring on page 9-5.



Setting the parameters

You select the axes to be added together in **Setup Mode**.

To enter **Setup Mode**:

1. Leave any **Special Function** that is running
2. Press [**set up**].
   The centre display shows '**s e t Up**'.
3. Press the up or down navigation key to choose '**a d d i t i o n**'.
4. Press the left or right navigation key to choose which axes are to be added: **X+Z'** or **Z+Z'**.
5. Press the up or down navigation key to choose '**s t o r e**'.
6. Press [**ent**] to store the change.

Using the summing function

Press [**F1**] or [**F2**] to turn the function on.

Press [**F1**] or [**F2**] to turn the function off.

For X + Z'

The X display shows the Sum of the two selected axes and the axis identifier shows '**s**'.

The Z display shows the Z axis as normal.

The Z' display shows the Z' axis as normal.

For Z + Z'

The X display shows the X as normal.

The Z display shows the Sum of the two selected axes and the axis identifier shows '**s**'.

The Z' display shows the Z' axis as normal.

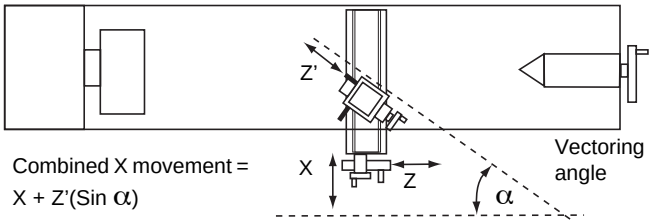
You can zero or preset any of the axes in the usual way.The Sum display alters to take account of the new value.

You may need to change the direction of Z' in Setup to ensure that the axes sum and not subtract.

Vectoring

You use this function to combine the movement of the X and Z axes with the angle of the compound. Vectoring is only available on 3 axis units.

The **Vectoring** function is useful when the compound is set at an angle. If the compound is set to align with either the X or the Z axes, see Summing on page 9-4.



Using the vectoring function

1. Press [**F1**] or [**F2**] to turn the function on.
   The '**X**' display shows **Angle**, and the centre display shows the **Vectoring Angle**.
2. Enter a new value if required.
   For example: Press [**3**] [**5**] [**ent**] to enter a vectoring angle of 35 degrees.

The X display shows the combined X axis movement.

The Z display shows the combined Z axis movement.

The Z' display shows the Z' axis as normal.

Press [**F1**] or [**F2**] to turn the function off.

You can zero or preset any of the axes in the usual way. The Vectoring displays alter to take account of the new value.

If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

To turn the function off, finish making any entry, then press the function key again.

This chapter describes the special functions available in Generic mode.

In **Generic** mode all **Lathe** and **Mill** functions are also available.

The conventional way to set up a lathe is:
X Axis – cross travel
Z Axis – longitudinal travel
Z' Axis – compound travel.

If you set the **Machine Type** to **Mill** or **Generic**, then the axes are labelled:
Axis 1 – X
Axis 2 – Y
Axis 3 – Z

Sub-datums

All **Sub-Datums** are relative to the **Absolute Datum**, so if you change the **Absolute Datum**, the **Sub-Datums** change accordingly.

The **Sub-Datum** function always works in **Absolute Mode**. If the **C80** is in **Incremental Mode** when the **Sub-Datum** function is turned on, then it switches to **Absolute Mode**.

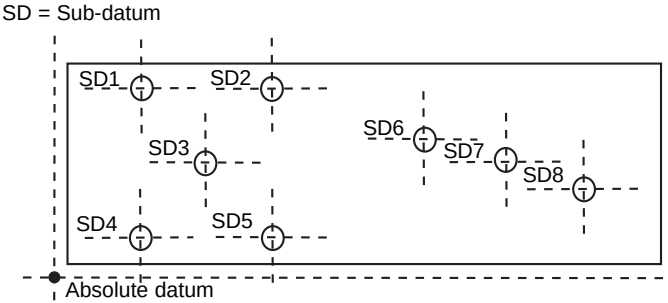
You can use other functions, such as **Bolt Hole Circle** in conjunction with **Sub-Datums**, to produce a repeated pattern of holes about different **Sub-Datum** positions.

With the **Sub-Datum** function you can store as many as 99 machining steps in the **Sub-Datum Memory**.

When you use the **Sub-Datum** function, the **Absolute Datum** of the machine is replaced by each **Sub-Datum** in turn, so you can work to zero for each step instead of having to constantly refer to a printed list of coordinates.

Example

SD = Sub-datum



Sub-datum memory

SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8	...	...	...	...

Turning the function on and off

1. Press [**F2**] to turn the function on.
   The display shows:
   '**sub dat**'
   '**job no.**'.
2. Press the **Select Key** next to the '**s**'.
   The display changes to '**sd no.**'.
3. Enter the number of the **Sub-Datum** that you want to go to.
   For example: Press [**1**] [**ent**] to go to **Sub-Datum 1**.
   The function display shows the **Sub-Datum** number '**01**', '**02**' up to '**99**'.
4. Press the left or right navigation key to step from one **Sub-Datum** to the next.
5. Press [**abs/inc**] to turn the function off.

Setting a sub-datum

Go to the **Sub-Datum** that is to be set, then use either of these two methods:

Teach method

1. Move the machine to the position to be stored as the **Sub-Datum**.
2. Press [**F2**$^{+}$].
   All displays show '**0.000**'.

This sets the **Sub-Datum**.

Preset method

You do not need to move the machine.

1. Press [**preset**].
2. Press the **Select Key** next to the first axis that you want to set.
3. Enter the position of the **Sub-Datum** relative to the absolute datum.
4. Press [**F2**].
   The display shows the distance from the current machine position to the **Sub-Datum**.
5. Set any other axes that need to be set.

Inserting a sub-datum

1. Go to the point where the new **Sub-Datum** is to be inserted.
2. Press [**ins**].
   The display shows:
   '**ins sub**'
   '**ins job**'.
3. Press the **Select Key** next to the '**s**'.

Pressing any other key cancels the operation.

After a short time delay, all the following **Sub-Datum** numbers are incremented by one, and the display shows the current machine position.

4. Set the new **Sub-Datum** as described in Setting a sub-datum on page 10-2.

Deleting a sub-datum

1. Go to the Sub-Datum that you want to delete.
2. Press [**del**].
   The display shows '**d e l s u b**'.
3. Press the **Select Key** next to the '**s**'.

Pressing any other key cancels the operation.

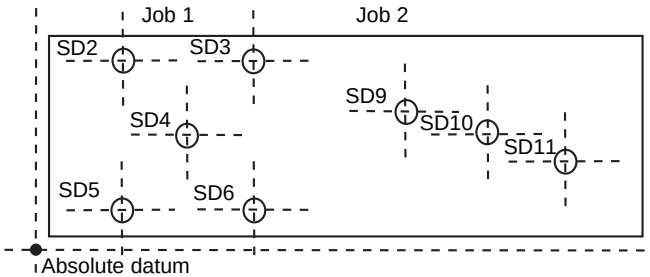
After a short time delay all the following **Sub-Datum** numbers are decremented by one, and the display shows the next **Sub Datum**.

Jobs

You use this function to divide the stored **Sub-Datums** into groups so that you can identify a number of individual **Jobs**.

When you insert **Job** markers all the following **Sub-Datum** numbers are incremented to account for the presence of the markers in memory. This is because of the way in which the **Sub-Datum Memory** is used.

Example



Sub-datum memory

Start Job 1	SD2	SD3	SD4	SD5	SD6	End Job	Start Job 2	SD9	SD10	SD11	...

Inserting a job marker

1. Go to the point where you want to insert the new **Job** marker.
2. Press [**ins**].
   The display shows:
   '**i n s s u b**'
   '**i n s j o b**'.
3. Press the **Select Key** next to the '**j**'.

Pressing any other key cancels the operation.

The display changes to:
‘insert’
‘job’.

For a start job marker

1. Press [**ent**] to confirm.
   The display changes to ‘Job no.’.
2. Enter the number of the **Job** that you want to add.
   For example: Press [**1**] [**ent**] to insert the marker for **Start Job 1**.

All the following **Sub-Datum** numbers are incremented by one, and the display shows the new **Start Job** marker.

For an end job marker

1. Press the up or down navigation key.
   The display changes to ‘end jOb’.
2. Press [**ent**] to confirm.

All the following **Sub-Datum** numbers are incremented by one, and the display shows the new **End Job** marker.

Deleting a job marker

1. Go to the **Job** marker that you want to delete.
2. Press [**del**].
   The display shows ‘del sub’.
3. Press the **Select Key** next to the ‘s’.

Pressing any other key cancels the operation.

All the following **Sub-Datum** numbers are decremented by one, and the display shows the next **Sub-Datum**.

Finding a job

1. Press [**F2**].
   The display shows:
   ‘sub dat’
   ‘Job no.’.
2. Press the **Select Key** next to the ‘J’.
   The display changes to ‘Job no.’.
3. Enter the number of the **Job** that you want to find.
   For example: Press [**2**] [**ent**] to find **Job 2**.
   If you enter an invalid Job number, the display shows **Job 1**.
4. Press the up or down navigation key to choose a valid job number.
5. Press [**ent**] to continue.

The display shows the **Start Job** marker.

Once the function is on, you can go from one **Sub-Datum** to another, by either of these two methods:
Press [**F2**], then the **Select Key** by the ‘S’. Enter the number of the **Sub-Datum** that you want to go to.

Press the left or right navigation key to step from one **Sub-Datum** to the next.

If you make a mistake while entering a number, you can press [**ce**] to clear the entry one character at a time.

To find the first **Sub-Datum** of the **Job**, press the right navigation key.

To turn the function off, finish making any entry, then press the function key again.

This chapter describes some of the errors that might occur, and ways that you might be able to solve them.

Symptom	Solution
The display is blank.	• The **C80** may be in **Sleep Mode**. Press the **Sleep Mode** key. • Check that the power supply is correctly connected to a working mains outlet. • Check that the power supply cables are not damaged. • Check that the power supply voltage is 15Vdc ±10%. • Disconnect all encoder cables. A defective encoder can prevent the **C80** from working. • Check the power supply indicator on the rear of the **C80** display to ensure that it is illuminated.
The display works, but resets from time to time without any keys being pressed.	Either the supply voltage is too low, or the power supply or mains supply has an intermittent fault. • Check that the power supply voltage is 15Vdc ±10%. • Check that all the connections are secure.
The display works, but gives erratic readings, the last digit jitters or the measurements jump to new figures unexpectedly.	There may be a poor earth (ground) connection. Both the **C80**, and the machine on which it is installed, must have proper earth (ground) connections (see Cable connections on page 2-1). There may be a problem with the encoder.
The unit does not respond to any key presses.	Disconnect the **C80** from its power supply, wait 15 seconds and then reconnect.

Symptom	Solution
'**no Sig**' or '**SIG FAIL**' appears in the display.	This indicates that the unit is not receiving a proper signal from the encoder. • Check that the encoder connections are secure. • Check that there is no damage to the connectors or to the encoder. • Switch the **C80** off and back on again. • Swap the encoder to another axis to confirm whether the encoder or the **C80** is at fault. See To swap encoders to trace a fault: on page 11-3.
Readings are incorrect.	• Check the **Encoder Type** to ensure it is correct. • Check the **Radius / Diameter** setting. The **Diameter** setting causes the axis to read double. • Check the **Error Compensation** factors. • If using the **Segmented Error Compensation**, verify the datum position. • Swap the encoder to another axis to confirm whether the encoder or the **C80** is at fault. See To swap encoders to trace a fault: on page 11-3. • Check that there is no damage to the encoder or its cable. • Check that the encoder is fixed firmly and aligned correctly, as described in the Spherosyn / Microsyn Installation manual. • Check that there is no binding on the scale. With the scale brackets slightly loosened, you should be able to slide the scale back and forth with minimal resistance. • If you have a Spherosyn scale, check that the scale is not bent, by removing it and rolling it on a flat surface.

If the solutions suggested above do not solve your problem, contact Newall for further instruction.

To swap encoders to trace a fault:

1. Check that the two axes are set to the correct encoder types.
2. Disconnect the **C80** power supply.
3. Move the encoder from the malfunctioning axis to a working axis.
4. Reconnect the **C80** power supply and turn on.

If the fault stays with the same encoder, then the encoder is at fault. If the fault does not follow with the encoder the **C80** is at fault.

Providing you have not moved the machine more than 6.3mm (0.25”) for a Spherosyn Encoder or 2.5mm (0.1”) for a Microsyn Encoder, switching the power off and back on again does not lose the datum position.

This chapter describes how to clean your **C80** without damaging it.

You should follow these instructions carefully to avoid damaging the C80.

To clean your **C80**:

1. Disconnect the power supply from the **C80**.
2. Apply a small amount of mild soap to a lint-free cloth. Use this to wipe over the case and keypad, taking care not to allow fluid into the connectors.

Do not use corrosive or abrasive cleaning materials.

Do not use compressed air.

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NEWALL

Spherosyn & Microsyn Linear Encoders

Installation Guide

CONTENTS

1.0 INTRODUCTION

This manual will provide mounting instructions for Newall's Spherosyn and Microsyn Linear Encoders. It is important that you read and understand this manual prior to beginning the installation.

If at any time during the installation you should have any questions, contact Newall or your local authorised representative.

1.1 Brackets

Due to the variety of machine types and applications, it will be necessary to design, make and fit custom brackets for the encoder assembly. If brackets are needed make certain they are rigid enough not to allow any flexing or distorting while the machine is in operation. Newall offers a variety of bracket kits to aid in the installation. Contact Newall or your local authorised representative for details.

1.2 Preparation

Prior to beginning the installation the machine should be studied to determine where the Encoder(s) will be fitted.

For best results, it is recommended that the Encoder be fitted as close to the machine lead screw or axial drive shaft as possible.

Spherosyn: Overall Length = Travel + 258mm (10.2")
Microsyn: Overall Length = Travel + 173mm (6.8")

Outboard mounting of the scale support brackets will add approximately 20mm (3/4") to the stated travel. (Refer to Appendix A & B)

For a more compact installation, scale travels of 300mm (12") or less may be fitted by supporting one end of the scale only by use of a single end mounting block. (Refer to Figure 5.4 and 5.10)

The moving member of the Encoder assembly can be either the Reader Head or the Scale.

Cable routing from the Reader Head should be examined (See Section 7). Each Reader Head is provided with either a 3.5 metre (11'), 7 metre (22') or 10 metre (33') of armoured cable. Extension cables are available in 1 metre (3'), 2 metre (6'), 3.5 metre (11.5'), 5 metre (16.5') and 10 metre (32') lengths. Contact Newall or your local authorised representative for details.
For Encoders larger than 1500mm (60") travel, a setup tube (blank scale) is recommended.

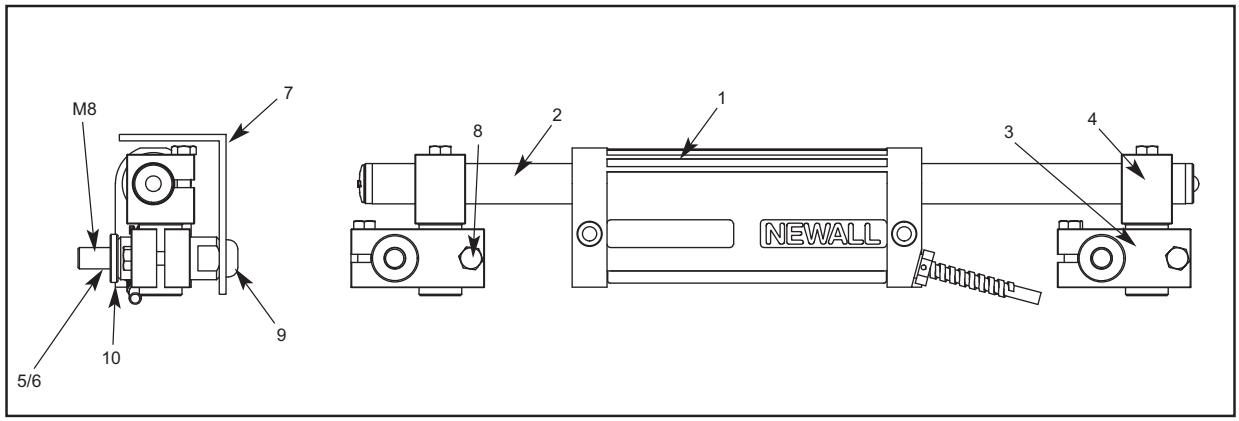
1.3 Warnings

If for any reason the machine axis travel is greater than the actual scale travel it is recommended that 'mechanical stops' are fitted to the machine to avoid damage caused by over travel. Newall will not accept responsibility for Scale and Reader Head damage caused by machine over travel.

Both the Reader Head and the Scale are precision made components and it is important that they are handled with care. By design the Encoders can withstand the rigours of the harsh workshop environment. However, permanent damage can occur through bending or severe impact.

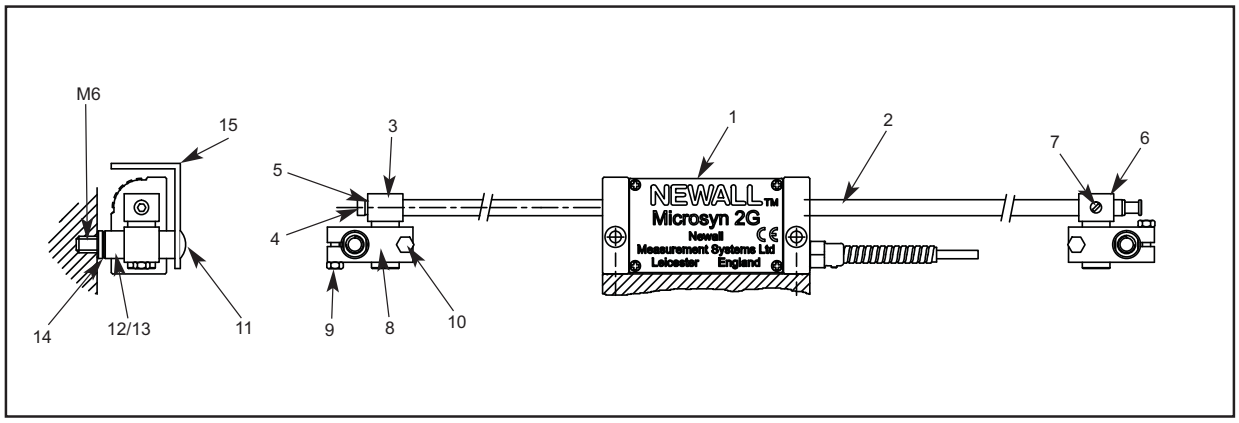
It is important that the Scale be kept at least 13mm (0.5") away from any magnetic bases on indicators or magnetic chucks.

2.0 SPHEROSYN ENCODER ASSEMBLY (<2.5m/100")



Item	Description	Qty	Item	Description	Qty
1	Spherosyn Reader Head	1	6	Support Pillar Long	2
2	Spherosyn Scale	1	7	Scale Cover	1
3	Scale Support Link	2	8	M5 x 20 Hex Head	6
4	Scale Anchor Pin	2	9	M8 x Socket Button Head	2
5	Support Pillar Short	2	10	Spacer Washer	2

3.0 MICROSYN ENCODER ASSEMBLY



Item	Description	Qty	Item	Description	Qty
1	Microsyn Reader Head	1	8	Support Link	2
2	Microsyn Scale	1	9	M3 x 12 Hex Screw	4
3	Scale Anchor pin	1	10	M3 x 12 SHCS	4
4	M3 x 16 SHCS	1	11	M6 x 10 Socket Button Head	2
5	M3 Spring Washer	1	12	Support Pillar Short	2
6	Scale Support Pin	1	13	Support Pillar Long	2
7	M4 x 5 Nylon Set Screw	1	14	Spacer Washer	2
			15	Scale Cover	1

4.0 MOUNTING THE READER HEAD

4.1 Spherosyn

Mount the Reader Head together with its bracket(s) to the machine and secure the assembly parallel with axis travel to within +/-0.05mm (0.002"). (Refer to Figure 4.1)

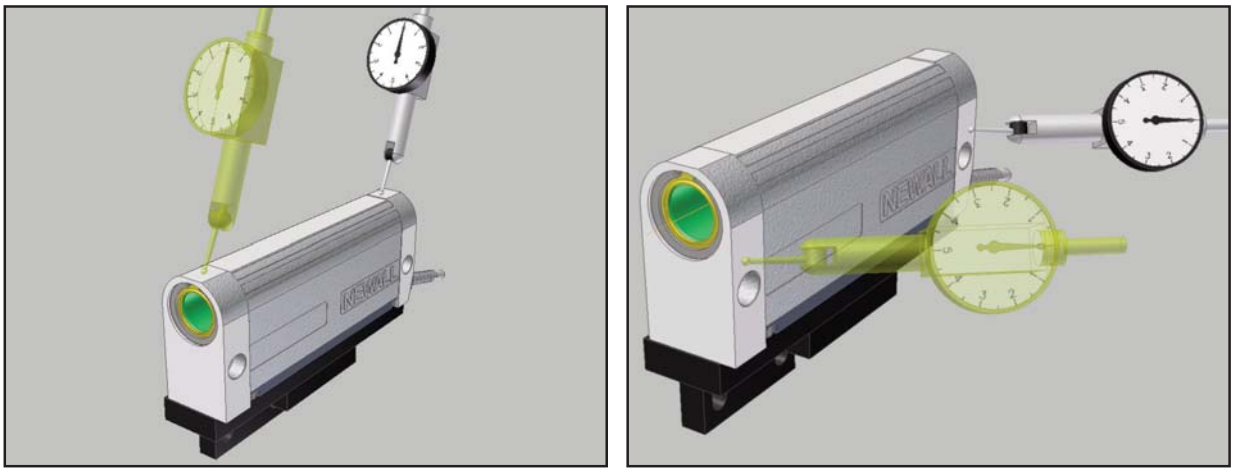


Figure 4.1 - Alignment of the Spherosyn Reader Head

Final adjustments can be carried out by use of laminated shims, which are included with each encoder assembly. Each layer of shim is equivalent to 0.05mm (0.002").

4.2 Microsyn

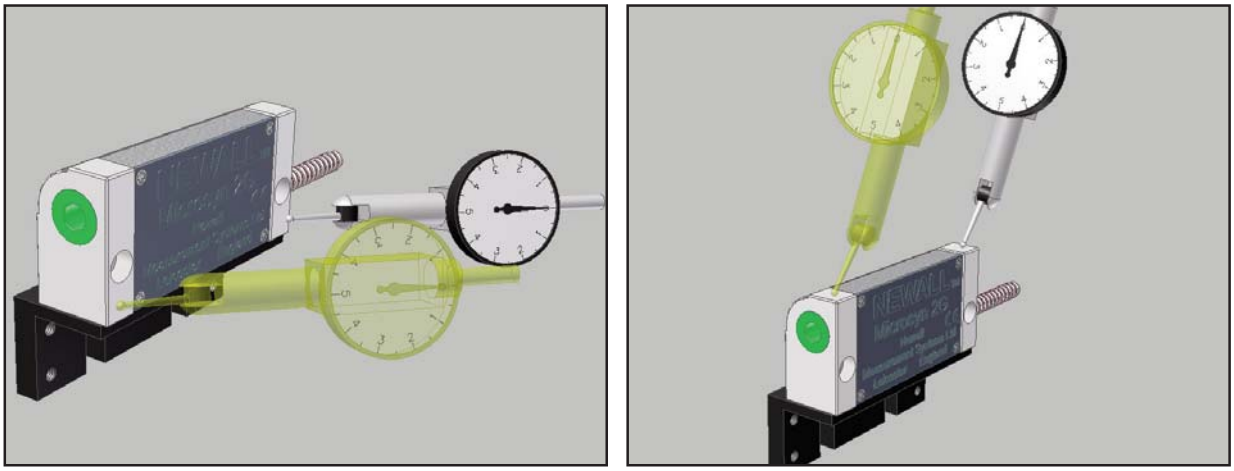


Figure 4.2 - Alignment of the Microsyn Reader Head

Mount the Reader Head together with its bracket(s) to the machine and secure the assembly parallel with axis travel to within 0.05mm (0.002"). (Refer to Figure 4.2)

5.0 MOUNTING THE SCALE

5.1 Spherosyn

5.1.1 Double End Mounting

Note: Refer to section 5.1.3 for mounting scales in excess of 2.5 metres.

Each end of the Spherosyn Scale is different and can be identified by the red cap screw at the 'tensioner end' and a nylon snap rivet at the 'fixed end'.

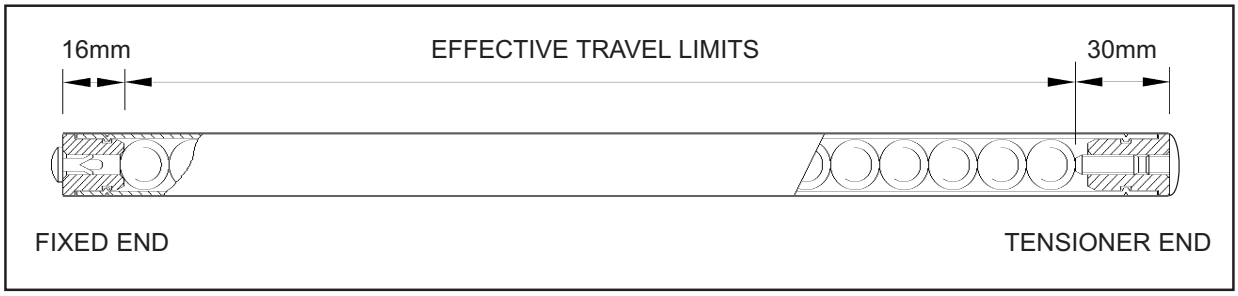


Figure 5.1 - Spherosyn Scale

NOTES:

(A) Erroneous readings will occur if the Reader Head is allowed to travel beyond the Effective Travel Limits. (Refer to Figure 5.1)

(B) The pre-load on the balls are factory set via the set screw at the tensioner end. Do not tamper with or adjust the set screw as this will alter the calibration and accuracy specification of the scale. (Refer to Figure 5.1)

Once the Reader Head is secured and correctly aligned, the scale support brackets can now be fitted. The scale support brackets consist of the support pin, the support link and the pillar(s).

Traverse the machine to its maximum position toward the non-cable entry side of the Reader Head. Maximum position means all available travel, including hand winding past any electrical limits or trip dogs.

Carefully slide the blank scale (or Spherosyn scale if less than 1500mm (60") travel), allowing for a sufficient amount of scale to project from the Reader Head in order to fit the scale support brackets.

Assemble the scale support link to the scale support pin leaving approximately 3mm (1/8") gap between the bottom of the pin shoulder and the top of the link.

Slide the link/pin assembly onto the scale to approximately 5mm (0.2") away from the end of the Reader Head.

Transfer punch through the support link and into the machine casting. It is important that the support link is kept square to its mounting surface at all times.

Remove the link/pin assembly and the scale from the Reader Head. Drill and tap M8 x 18mm deep into the machine casting as marked by the transfer punch. Fit the pillar(s) to the machine casting by using one of the methods shown in Figure 5.3. The pillar should fit square and flush to the machine surface.

A maximum of two support pillars may be screwed together to allow for sufficient adjustment of the scale. If two pillars are insufficient to enable the scale to be mounted, then additional brackets will be necessary. These brackets must be sufficiently rigid to eliminate any axial movement of the scale.

Loosely fit the support link/pin assembly onto the pillar and pass the scale through the Reader Head and into the support pin. While gently sliding the scale forward and back 25 - 50mm (1" - 2") through the support pin, carefully tighten the hex screws on the support link, ensuring that the scale slides smoothly through the Reader Head and into the support pin. If any interference is detected then fully loosen the hex screws on the support link and repeat this step.

Note: Do not force the Scale through the Support Pin

IMPORTANT WARNING:

THE CENTRE LINE BORE OF THE READER HEAD MUST BE IN DIRECT ALIGNMENT WITH THE CENTRE LINE BORE OF THE SUPPORT PIN. PERMANENT DAMAGE TO SCALE AND/OR ERRONEOUS READER WILL OCCUR IF THIS WARNING IS NOT FOLLOWED. REFER TO FIGURE 5.2

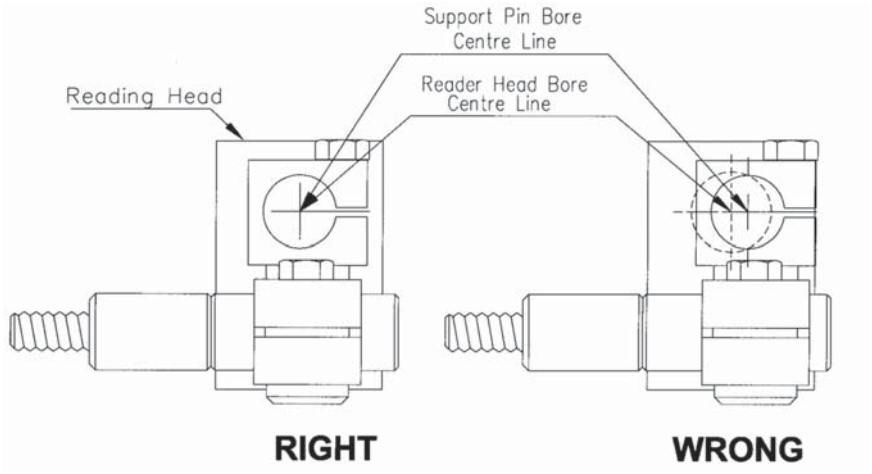


Figure 5.2 - Reader Head and Bracket Alignment

Remove the scale from the Reader Head and traverse the machine to its full extent in the **opposite direction**. Full extent means hand winding past electrical limits.

Assemble the scale support link to the scale support pin leaving approximately 3mm (1/8") gap between the bottom of the pin shoulder and the top of the link.

Slide the link/pin assembly onto the scale making certain that there is sufficient clearance between the Reader Head and the support link to prevent damage to the Reader Head cable. Do not secure the support pin to the scale at this time.

Transfer punch through the support link and into the machine casting. It is important that the support link be kept square to its mounting surface at all times.

Remove the link/pin assembly and the scale from the Reader Head. Drill and tap M8 x 18mm deep into the machine casting as marked by the transfer punch. Fit the pillar(s) to the machine casting by using one of the methods shown in figure 5.3. The pillar shoulder fits square and flush to the machine surface.

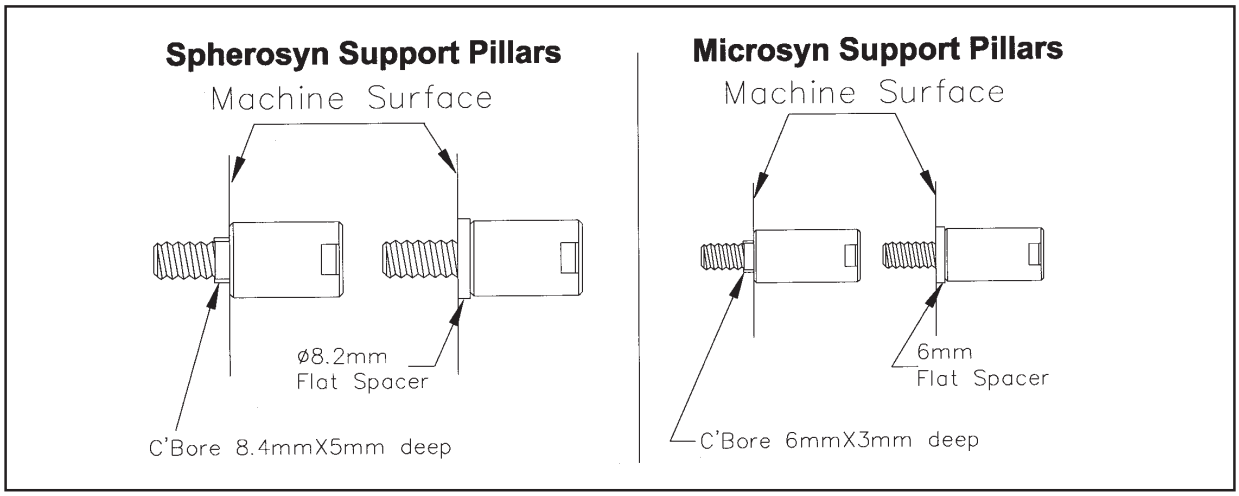


Figure 5.3 - Support Pillars

A maximum of two support pillars may be screwed together to allow for sufficient adjustment of the scale. If two pillars are insufficient to enable the scale to be mounted, then additional brackets will be necessary. These brackets must be sufficiently rigid to eliminate any axial or radial movement of the scale.

Loosely fit the support link/pin assembly onto the pillar and pass the scale through the Reader Head and into the support pin. While gently sliding the scale forward and back 25 - 50mm (1" - 2") through the support pin, carefully tighten the hex screws on the support link, ensuring that the scale slides smoothly through the Reader Head and into the support pin. If any interference is detected then fully loosen the hex screws on the support link and repeat this step.
Repeat the above steps at the other end of the machine. Then carefully slide the Spherosyn Scale through the support pin, through the Reader Head and into the opposite support pin. Tighten the hex screws on the anchor pins.

5.1.2 Single End Mounting

Note: The maximum total length of the scale must not exceed 610mm (24") when using a single end mounting kit. The single end mounting kit is sold separately, ask for UK part number 600-63610, USA part number 294-23010-M.

Remove the white rivet from the fixed end of the scale.

After the Reader Head has been installed slide the scale through the Reader Head and insert the fixed end of the scale into the single end mounting block. (Refer to Figure 5.4)

Once the position for the single end mounting block has been determined mark the machine casting using the slot in the mounting block as the guide . Drill and tap M6 x 12mm deep. Fit the mounting block using the M6 socket head cap screw and washer.

Check the alignment by gently sliding the scale through the head and in and out of the mounting block, adjustments may be carried out by altering the M5 jacking screws. When the alignment is complete secure the scale by inserting the M5 screw and washer through the mounting block and into the fixed end of the scale.

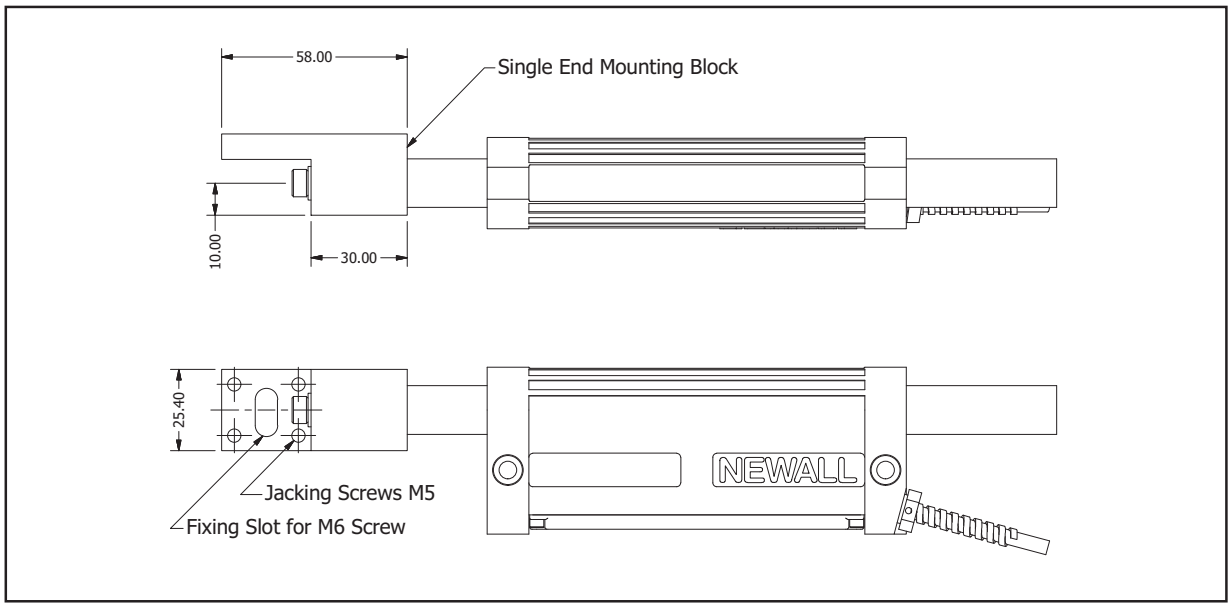


Figure 5.4 - Spherosyn Single End Mounting

5.1.3 Scales in Excess of 2.5 Metres (100”)

Traverse the machine to fullest extent of travel including hand winding past any electrical limits or trip dogs.

Insert the short blank length of Spherosyn tube into the Reader Head, allowing for a sufficient amount of scale to project from the Reading Head in order to fit the scale mounting brackets.

Assemble the angle bracket to the scale clamp (Refer to Figure 5.5). The jacking plate is included in each bracket kit, this will only be required if the machine mounting face is not a machined surface. Slide the assembly onto the scale allowing approximately 10mm clearance from the end of the Reader Head.

Mark the position of the jack plate (if required) or the angle support bracket. Drill and tap the necessary fixing holes and assemble the bracket to the machine.

Remove the blank tube and the bracket assembly from the Reader Head. Drill and tap M8 x 18mm fixing holes. Fit the jack plate (if required) and secure to the machine. Assemble the scale clamp and the angle bracket to the jack plate but do not secure. Traverse the Reader Head as near to the bracket assembly as possible. Slide the blank tube through the Reader Head into the scale clamp. Adjust the brackets into position and carefully tighten the screws. Check that the blank tube slides through the Reader Head and into the scale clamp smoothly without any fouling or interruption.

Remove the blank tube and traverse the machine to the full extent in the opposite direction. Remember the "full extent" is the absolute maximum travel up to the mechanical "dead stops".

Check the overall length of the actual scale and measure from the outside edge of the scale clamp already fitted to the machine and mark the position of the scale on to the machine.

Slide the Spherosyn blank tube into the Reader Head, assemble the remaining scale bracket assembly including the jacking plate (if required) and slide onto the tube.

Set the outside edge of the scale clamp level with the mark that indicates the overall length of the Spherosyn Scale and mark the fixing position for the bracket assembly.

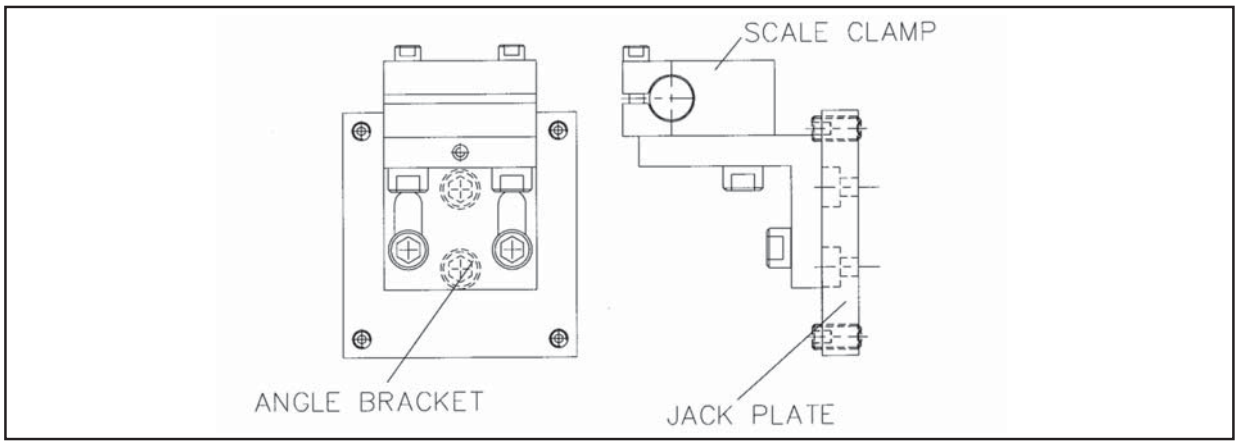


Figure 5.5 - Long Scale Support Bracket Assembly

5.1.4 Center Supports for Scales in Excess of 2.5 Metres (100") Travel

See data sheet supplied with center supports kit 600-84605

5.2 Microsyn Scale

There are two accuracy grades of the Microsyn Encoder , 5µm and 10µm. The 5µm scale can be identified by the black end plug fitted at the tensioner end. The 10µm scale has an anodised clear plug fitted at the tensioner end. The fixed end of the scale has an M3 tapped hole, which will be fitted to the anchor pin when installed.

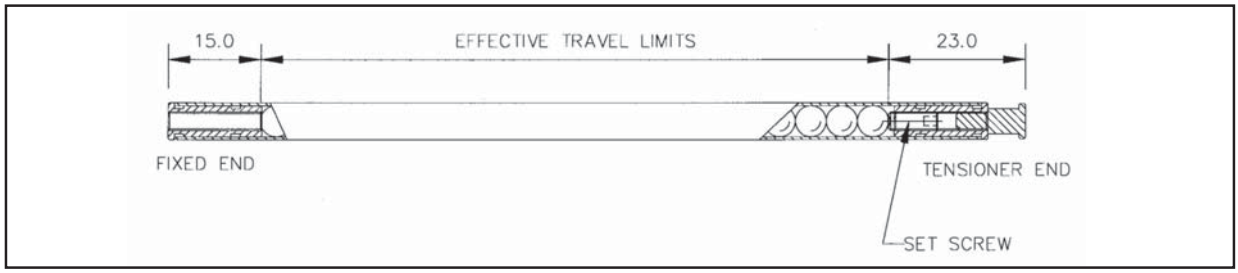


Figure 5.7 - The Microsyn Scale

NOTES:

(A) Erroneous readings will occur if the Microsyn Reader Head is allowed to travel beyond Effective Travel Limits. (Refer to Figure 5.7)

(B) The pre-load on the balls are factory set via the set screw at the tensioner end. Do not tamper with of adjust the set screw as this will alter the calibration and accuracy specification of the scale and void the warranty.

The scale support brackets kit consists of the Anchor Pin, Support Pin , Support Link, and Pillar(s). (Refer to Figure 5.8) In order to avoid the risk of damage to the scale during installation all Microsyn encoders include a set up bar. The set up bar is of the same diameter as the Microsyn Scale and will be used to align the brackets to the Reader Head.

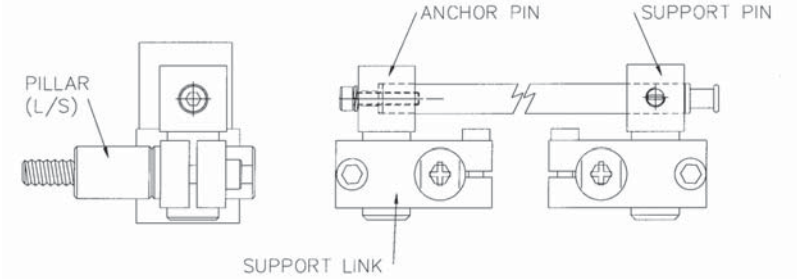


Figure 5.8 - Microsyn Scale Support Bracket

Traverse the machine to its maximum position toward the non-cable entry side of the Reader Head. Maximum position means all available travel, including hand winding past any electrical limits or trip dogs.

Carefully slide the Microsyn Scale set-up bar through the Reader Head, allowing for sufficient scale to project from the Reader Head in order to fit the scale support brackets.

Assemble the support link to the anchor pin leaving approximately 3mm (1/8") gap between the bottom of the anchor shoulder and the top of the link.

Slide the link/anchor assembly onto the scale set-up bar to approximately 5mm (0.2") away from the end of the Reader Head.

Transfer punch through the support link and into the machine casting. It is important that the support link be kept square to its mounting surface at all times.

Remove the link/anchor assembly and the scale set-up bar from the Reader Head. Drill and tap M6 x 12mm deep hole into the machine casting as marked by the transfer punch. Fit the pillar(s) to the machine casting by using one of the methods shown in Figure 5.3. The pillar shoulder fits square and flush to the machine surface.

A maximum of two support pillars may be screwed together to allow for sufficient adjustment of the scale.
If two pillars are insufficient to enable the scale to be mounted, then additional brackets will be necessary. These brackets must be sufficiently rigid to eliminate any axial movement of the scale.

Loosely fit the support link/anchor assembly onto the pillar and pass the scale set-up bar through the Reader Head and into the anchor pin. While gently sliding the scale set-up bar in and out of the anchor pin, carefully tighten the cap screws on the support link, ensuring that the scale set-up bar slides smoothly through the Reader Head and into the anchor pin. If any interference is detected then fully loosen the cap screws on the support link and repeat this step.

Remove the scale set-up bar from the Reader Head and traverse the machine to its full extent in the opposite direction. Full extent means hand winding past electrical limits.

Assemble the scale support link to the support pin leaving approximately 3mm (1/8") gap between the bottom of the mounting shoulder and the top of the link. (Refer to Figure 5.8)

Slide the link/pin assembly onto the scale set-up bar making certain that there is sufficient clearance between the Reader Head and the support link to prevent damage to the Reader Head cable. Do not secure the support pin to the scale at this time.

Transfer punch through the support link and into the machine casting. It is important that the support link be kept square to its mounting surface at all times.

Remove the link/pin assembly and the scale from the Reader Head. Drill and tap M6 x 12mm deep into the machine casting as marked by the transfer punch. Fit the pillar(s) to the machine casting by using one of the methods shown in Figure 5.3. The pillar shoulder fit square and flush to the machine surface.

Loosely fit the support link/pin assembly onto the pillar and pass the scale set-up bar through the Reader Head and into the support pin. While gently sliding the set-up bar forward and back 25 - 50mm (1" - 2") through the support mounting, carefully tighten the screws on the support link, ensuring that the scale set-up bar slides smoothly through the Reader Head and into the support pin. If any interference is detected then fully loosen the screws on the support link and repeat this step.

IMPORTANT WARNING

THE CENTRE LINE BORE OF THE READER HEAD MUST BE IN DIRECT ALIGNMENT WITH THE CENTRE LINE BORE OF THE SUPPORT PIN. PERMANENT DAMAGE TO SCALE AND/OR ERRONEOUS READER WILL OCCUR IF THIS WARNING IS NOT FOLLOWED. REFER TO FIGURE 5.9

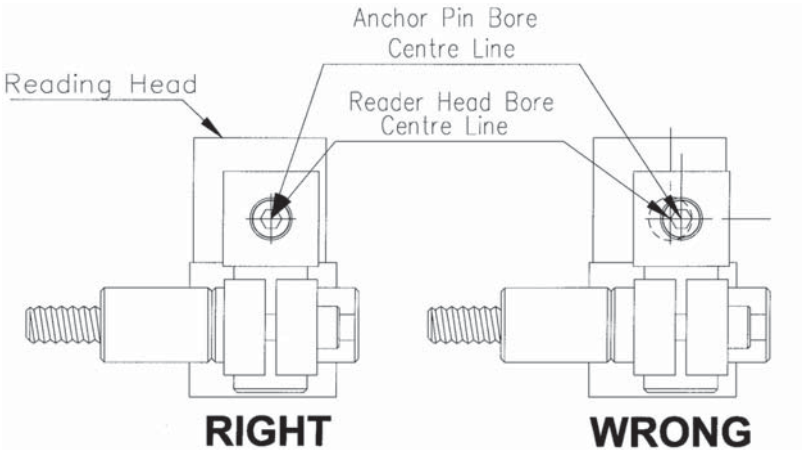


Figure 5.9 - Reader Head and Bracket Alignment

Carefully slide the Microsyn Scale through the support pin, ensuring the fixed end is inserted first, through the Reader Head and into the anchor pin.

Using the M3 x 16 skt cap screw and spring washer, secure the scale to the anchor pin. It is **important** that the nylon set screw on the support pin be only "pinched" to the scale at the tensioner end. DO NOT OVER TIGHTEN THE NYLON SET SCREW ON THE SUPPORT PIN.

5.2.1 Single End Mounting

For installations requiring a lower profile assembly, there is an alternative method for fixing the scale at one end only by way of the single end mounting block assembly (Refer to Figure 5.10). The Microsyn single end mounting kit is sold separately, part number **600-65340**.

Note: The maximum total length of scale should not exceed 450mm (18") when using the single end mounting block.

Once the Reader Head has been installed slide the scale through the head and insert the fixed end of the scale into the single end mounting block. (Refer to Figure 5.10)

Once the position for the single end mounting block has been determined mark the machine casting with the slot in the block . Drill and tap a M5 x 12mm deep hole. Fit the bracket using the M5 skt head cap screw and washer. Check the alignment by gently sliding the scale through the head and in and out of the mounting block, adjustments may be carried out by altering the M3 jacking screws. When the alignment is complete secure the scale by inserting the M3 screw and spring washer through the mounting block and into the fixed end of the scale.

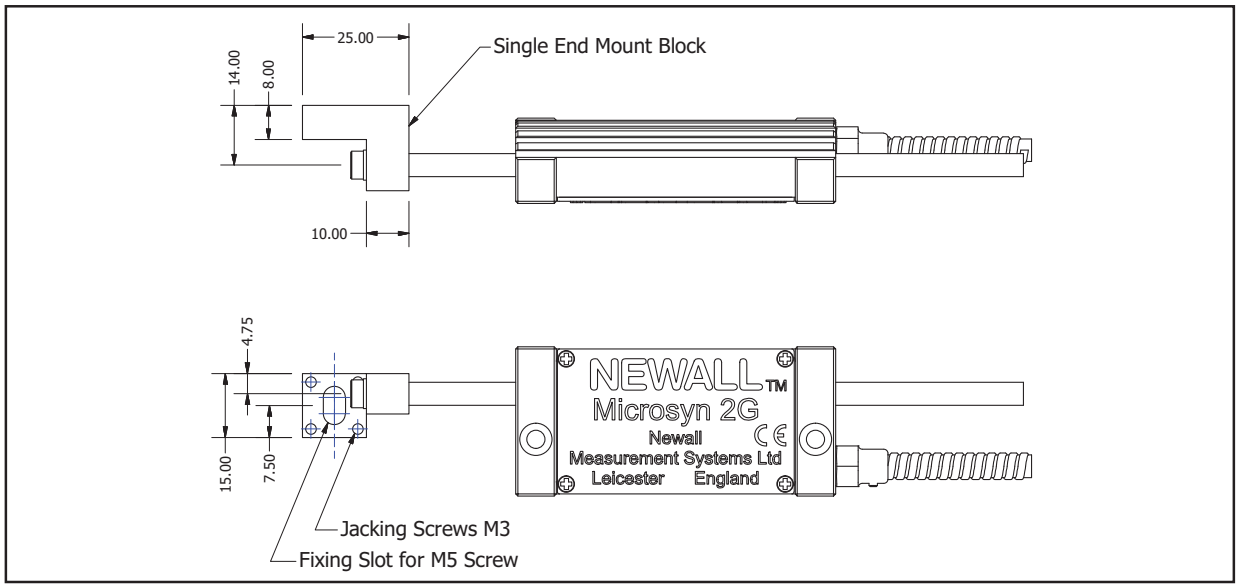


Figure 5.10 - Microsyn Single End Mounting

6.0 FITTING THE SCALE GUARD

Each Encoder includes a protective guard. This aluminium guard is intended to protect the scale from impact damage. The guard can be attached to the machine casting or by means of the scale support pillars. (Refer to Figure 6.1)

To fit the guard to the support pillars, measure and mark off the distance between the centre of each pillar. For Spherosyn drill two 8.5mm, for Microsyn 7mm holes at either end of the guard. The guard can be attached to the pillars by using the button head screws provided. After the guard is attached, move the machine axis to both extents of its travel ensuring that the guard does not interfere with or rub against the Reader Head.

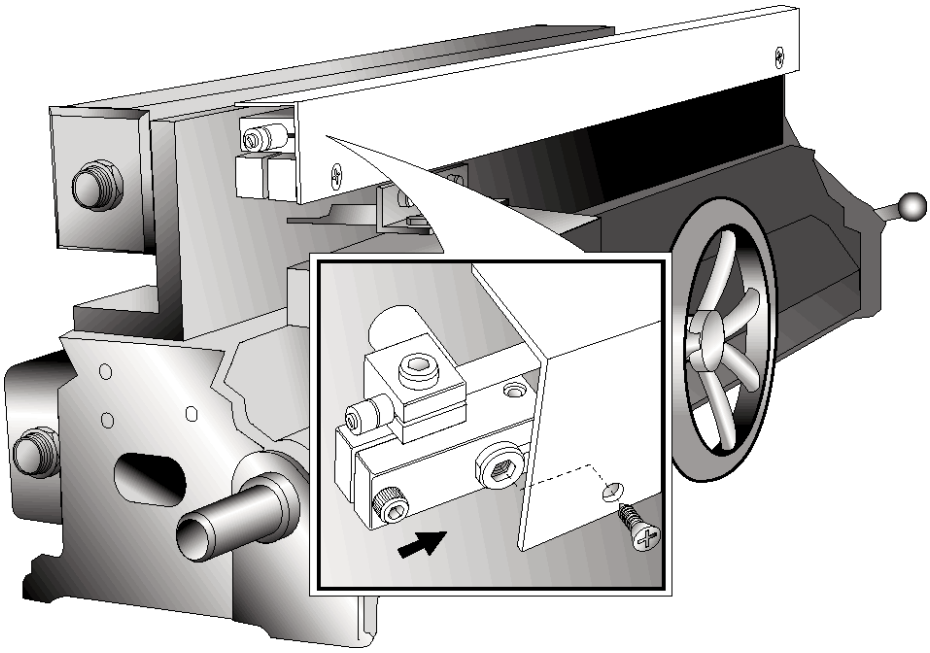


Figure 6.1 - Fitting the Scale Guard (example shown using a Spherosyn Scale)

7.0 CABLE ROUTING

The most important and the most over looked aspect of fitting the Encoder is proper cable routing. Dangling and loose cables can be snagged or broken causing irreparable damage. Care should be taken in order to ensure that the cables are secured to the machine and that cable loops do not interfere with any part of the machine or the Encoder movements. "P" clips and thread forming screws are provided to route the cables from the Reader Head to the digital readout unit.

Note: The armoured cable is an integral part of the Reader Head. If the cable becomes damaged, then it would have to be replaced complete with the Reader Head.

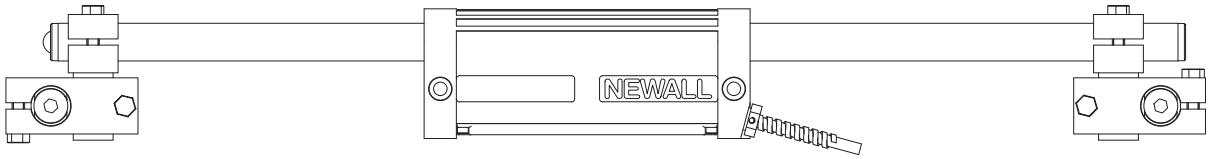
If extension cables are used, do not allow the plug and socket junction to lie in the swarf tray or in the direct flow of coolant or oil.

In order to avoid problems associated with electrical noise and interference, do not allow the cables to lie across electrical motors, fuse boxes or electrical pumps.

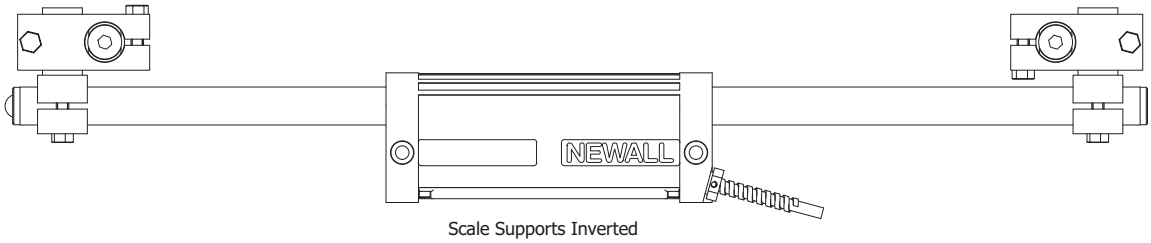
8.0 FINAL CHECK

Prior to putting the Encoder into operation, slowly traverse the machine axis to both extents of its travel checking at all times that the cables are secure and that machine over travel cannot occur. Newall will not accept responsibility for Encoder malfunction caused by over travel or damaged cables.

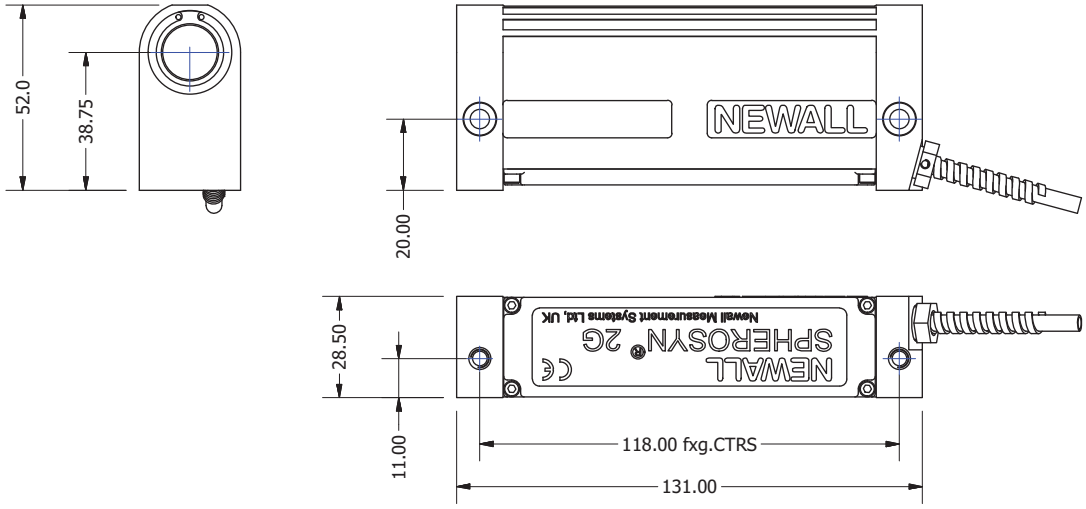
Appendix A - SPHEROSYN



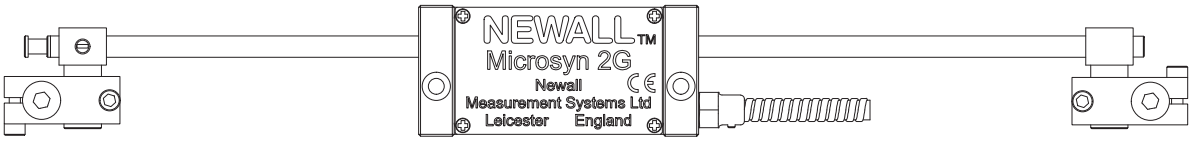
Outboard Scale Support Mounting



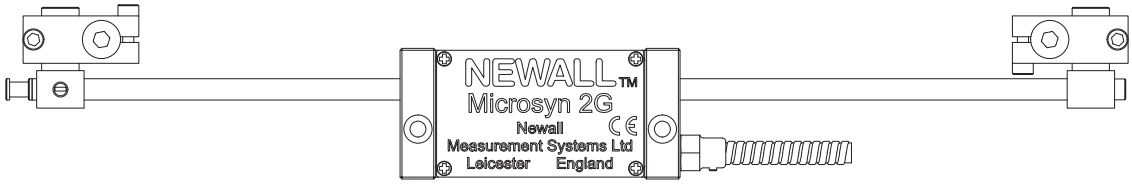
Scale Supports Inverted



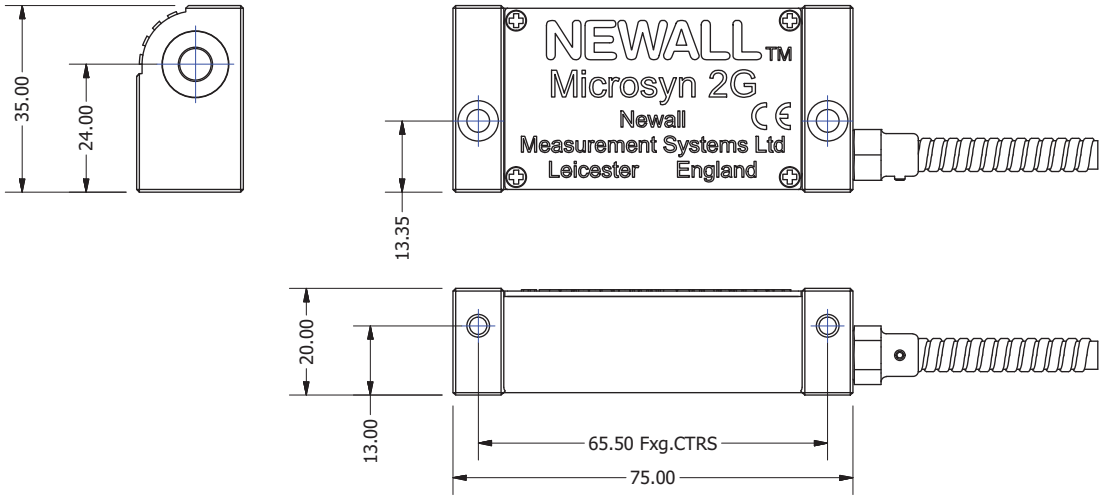
Appendix B - MICROSYN



Outboard Scale Support Mounting



Scale Supports Inverted



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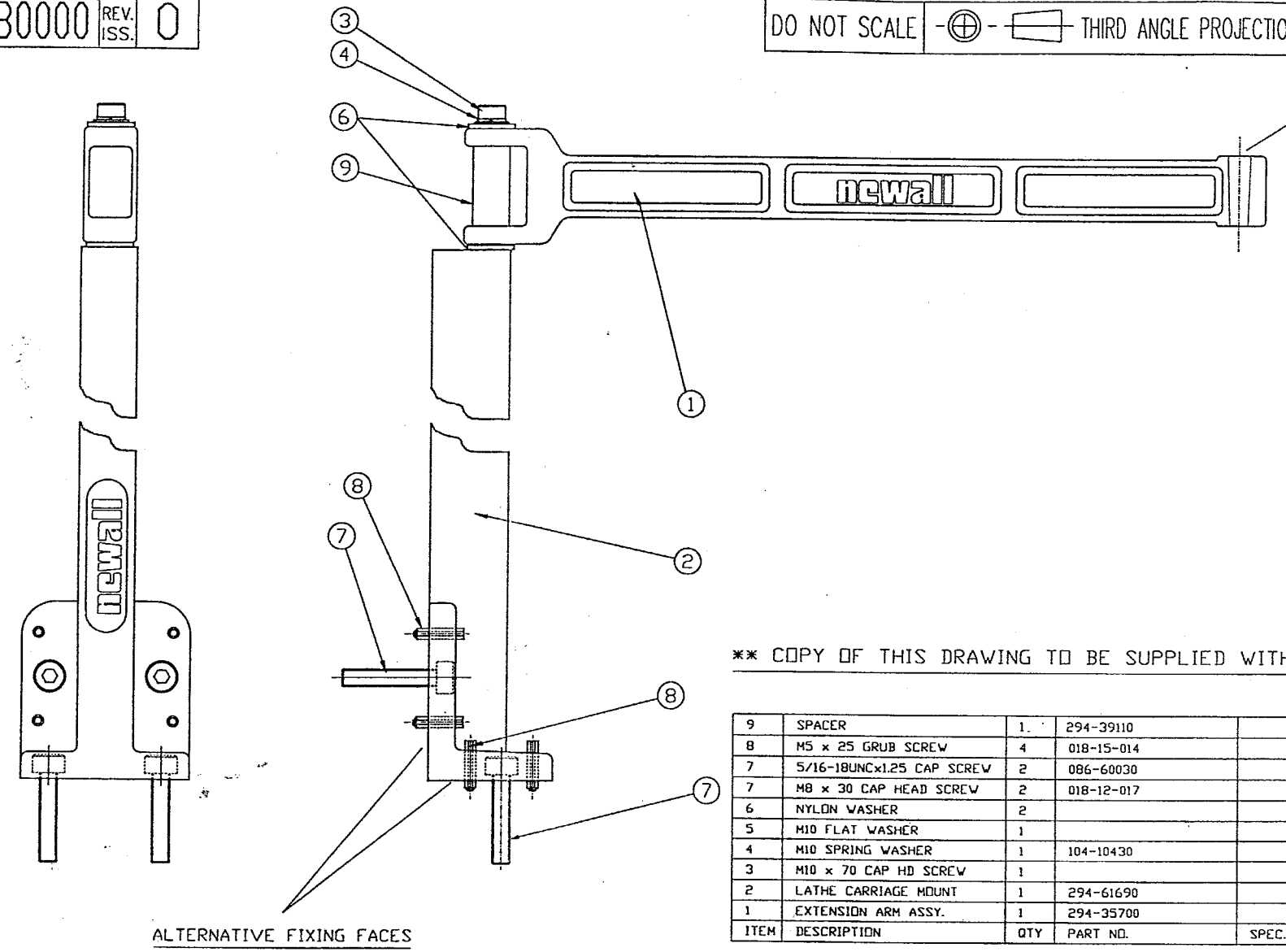
DO NOT SCALE | THIRD ANGLE PROJECTION | IF IN DOUBT ASK



** COPY OF THIS DRAWING TO BE SUPPLIED WITH KIT **

ITEM	DESCRIPTION	QTY	PART NO.	SPEC.
9	SPACER	1	294-39110	
8	M5 x 25 GRUB SCREW	4	018-15-014	
7	5/16-18UNCx1.25 CAP SCREW	2	086-60030	
7	M8 x 30 CAP HEAD SCREW	2	018-12-017	
6	NYLON WASHER	2		
5	M10 FLAT WASHER	1		
4	M10 SPRING WASHER	1	104-10430	
3	M10 x 70 CAP HD SCREW	1		
2	LATHE CARRIAGE MOUNT	1	294-61690	
1	EXTENSION ARM ASSY.	1	294-35700	

REV.ISS.	DATE	C.N.No.	ALTERATION

TITLE. *EXTENSION ARM AND LATHE CARRIAGE MOUNT ASSEMBLY*

MATERIAL/FINISH. SEE ABOVE

SCALE NTS

UNLESS OTHERWISE STATED:- DIMENSIONS ARE IN M.M.

TOLERANCES:- 0 DECIMAL PLACES ±0.' 1 DECIMAL PLACE ±0. 2 DECIMAL PLACES ±0. ANGULAR ±1

DRAWN J.DRIVER 20-7-00

CHECKED

APPROVED

Leicester newall England

SHEET 1 of 1

DRAWING NUMBER 316-80000 REV. ISS. 0

023-80450 May 2004

C-SERIES REFERENCE CARD

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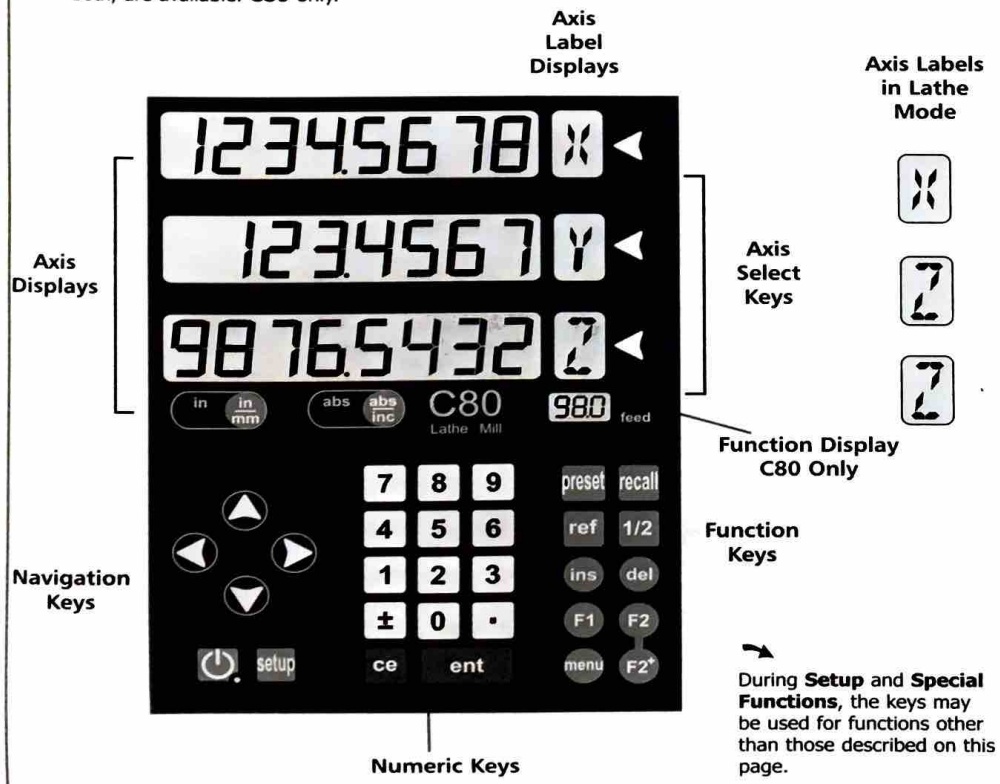
Understanding the Displays

- The three **Axis** displays normally show the positions of the X, Y and Z axes.
- The two **Axis Label** displays show X, Y or X ,Z , the three axis normally shows X, Y and Z, (in Lathe Mode X, Z and Z').
- While any axis is moving, the **Function** display shows the **Feedrate** of the fastest moving axis, and the **feed** indicator next to the display will illuminate. **C80** only **Feedrate** is displayed in mm/sec or inches/min
- The **lathe** and **mill** indicators will be illuminated depending on whether the lathe or mill functions or both, are available. **C80** only.



During **Setup** and **Special Functions**, the keys may be used for functions other than those described on this page.

Using the Keypad

In normal operation, the keys are used as follows:

- Press in/mm to toggle the displays between **inches** and **millimetres**.
- Press abs/inc to toggle the **C80** between **absolute mode** and **incremental mode**.

Sleep Mode

- Press ⏻ to temporarily turn off the displays and the keypad.
  While the unit is in **sleep mode**, all settings are preserved, but the positions of the three axes are updated. If any of the axes are moved while in **Sleep Mode**, the centre display will show dISPLACd, and if any of the keys are touched, the centre display will show touchEd.

Zero

- *To zero one display at the current position:*
  Press the **Select Key** ◀ for the axis to be zeroed. All readings will now be relative to this new zero point.

Preset

- *To preset one display to a known fixed value:*
  Press preset, then the **Select Key** ◀ for the axis to be preset, then enter the value.
  For Example: Press preset ◀ ± 1 9 · 6 ent to enter the value -19600. All readings will now be relative to this new value.
- If you make a mistake while entering a number, pressing ce will clear the entry one character at a time.

Recall

- *To quickly recall the last preset value for an axis:*
  Press recall, then the **Select Key** ◀ for the axis to be preset. All readings will now be relative to this new value.

Centrefind

- Centrefind works by halvng the distance displayed on the selected axis in either Absolute or Incremental mode. In Absolute mode a new Datum will be established
  For Example: X axis display shows 100000
  Press 1/2 X ◀ The X display now shows 50000

Using Digifind

*In the event that a datum is lost, either due to movement following a power failure, or after a fixed point has been entered by mistake, it can easily be re-established, using **Digifind**.*

In order to use Digifind, the absolute datum for each axis should be marked permanently on the machine.

- Set the axis close to the marked datum - to within:
  6.3mm (0.25") for a Spherosyn encoder or
  2.5mm (0.1") for a Microsyn encoder.
- Press ref, then the **Select Key** ◀ for the axis to be restored. The display will update to show the exact distance from the datum.

Digifind works only in **Absolute** mode.

The Menu Function

Only two **Special Functions** are available for use at any one time.

To find out which function is allocated to each key:

- Press menu to see the **Menu**.

  The display shows, for example, `bOLt HOL` 1
  `ArC` 2

- Press menu again to turn the **Menu** off.

To use a function:

- Press F1, F2 or F2*, acording to the instructions given later in this guide.

To allocate a function to a key:

- Press menu.
- Press the **Select Key** next to the 1 or 2 to choose which function key to edit.
- Press ▲ or ▼ to cycle up and down the list of **Special Functions**.
- Press ent to allocate the selected **Special Function** to the function key.

- Most **Special Functions** are designed to work specifically with **Mill** or **Lathe**, while **Generic** functions are designed to work with either.
- Most **Special Functions** require only one function key for operation, and can be allocated to either F1 or F2.
- The functions marked F2 require two function keys and can be allocated only to F2 and F2*.

Mill Functions

Special Function	Display	
Bolt Hole Circle	`bOLt HOL`	
Arc	`ArC`	
Line Hole	`LinE`	
Polar Coordinates	`PoLAr`	

Lathe Functions

Tool Offsets	`toOL`	F2
Taper	`tAPEr`	
Summing	`Sunn`	
Vector	`UEctor`	

Generic Functions

Sub Datum and Job Numbers	`Sdnn`	F2

Setup Parameters

To enter **Setup Mode**, first exit from any **Special Function** that is running, then press setup.

The centre display shows `SEt UP` .Press ▲ or ▼ to cycle up and down the list of options.

Option	Default	Display	Note
Machine Type	Generic	`GEnEr ic`	Menu holds both Mill and Lathe Functions
Encoder Type	all axes: Spherosyn	`SPHEroSn`	Ensure correct encoder type selected
Encoder Resolution	all axes: 0.005mm	`0005`	Each axes cann be individually selected
Radius / Diameter	all axes: Radius	`rAd`	Diameter displays double the movement
Direction	all axes: 1	`dir 1`	Used to set positive direction of travel
Error Compensation	all axes: Off	`Err OFF`	See Manual for detailed information
Axis Summing	X and Z' axes	`Add it ion`	See Manual for detailed information
Zero Approach Off	all axes: Off	`2Er0 OFF`	See Manual for detailed information
Taper Display Axis	X axis	`tAPEr`	See Manual for detailed information
Add Function		`Add Func`	See Manual for detailed information
Delete Function		`dEL Func`	See Manual for detailed information
Reset		`rESEt`	WARNING : Returns unit to factory default settings
Store		`StOrE`	Saves changes made to Setup

Note: Pressing setup at any time will exit from **Setup Mode** and abandon any changes made.

- **Machine Type**

Generic mode	`GEnEr ic`	all functions available
Mill mode	`nn iLL`	mill functions only
Lathe mode	`LAtHE`	lathe functions only

Press the **Select Key** ◀ next to the t to cycle between the three settings.

- **Encoder Type**

Spherosyn	`SPHEroSn`	Set during installation
Microsyn 10	`uSn 10`	Set during installation
Microsyn 5	`uSn 5`	Set during installation

Press the **Select Key** ◀ next to the X, Y or Z to cycle between the three settings for each axis.

- **Encoder Resolution**

Displayed resolution will depend on the encoder type and the status of the in/mm setting.

Spherosyn	`SPHEroSn`	5µm (0.0002"), 10µm (0.0005"), 20µm (0.01"), 50µm (0.002")
Microsyn 10	`uSn 10`	5µm (0.0002"), 10µm (0.0005"), 20µm (0.01"), 50µm (0.002")
Microsyn 5	`uSn 5`	1µm 0.00005"), 2µm (0.0001"), 5µm (0.0002"), 10µm (0.0005")

- **Radius / Diameter**

Radius	`rAd`	Axis will show actual movement
Diameter	`diA`	Axis will display double actual movement

Press the **Select Key** ◀ next to the X, Y or Z to cycle between the two settings for each axis.

- **Direction**

Direction 1	`dir. 1`	Changing an axis direction from 1 to 0 or vise-versa will reverse the positive direction of count for that axis.
Direction 0	`dir. 0`	

Press the **Select Key** ◀ next to the X, Y or Z to cycle between the two settings for each axis.