SECTION 1

INTRODUCTION

The ORAC you have purchased utilizes the latest advances in microprocessor technology. These advances combined with Denfords programming aids and computer technology give you, the user, the very latest in CNC training. You will find the keyboard is simple to understand, simple to utilize and simple for editing purposes.

The keyboard itself provides switches which are completely sealed, combining the best of touchtone with pressure techniques thereby ensuring that no erroneous information is entered into the system. All programming may be accomplished at the machine by the operator or at a Desk Top Computer, transferring the completed programs to ORAC through the RS 232 C link.

As with any CNC machine, the programmer should know how to use good machining practice and be familiar with shop orientated terms. The manual has been written under these assumptions.

To oil the X-slide screw, remove the grommit in the cross slide cover and apply oil. To oil the Z axis screw, pull back both spiral spring covers at the apron ends, and apply oil. Also lubricate through the point on the top of the apron.

OIL BOTH BALLSCREWS WEEKLY. FAILURE TO DO THIS COULD RESULT IN SEIZURE.

Add grease sparingly to the Headstock bearings through Grease Nipples at back of Headstock.

All slideways should be lightly oiled daily before movement of the saddle and the tailstock.

	SHELL	CASTROL
OIL	VITREA 68	PERFECTO NN
GREASE	ALVANIA Nº 3	SPHEEROL AP3

Equivalents of all lubricants are available from other manufacturers.

SECTION 34

RS232 DATA FORMAT

ORAC DATA FORMAT

For maximum compatibility with all computer types ORAC works exclusively with standard ASCII text. This format is used for internal editing and external (via RS232 link) communication.

ORAC works with a file made up of text pages. Each page represents a single machining function and contains all parameters associated with it.

Each page is preceded by the ascii START-OF-TEXT character (hexadecimal 02), and is terminated by a record-separator character (hexadecimal 1E).

The whole file starts with an ascii START-OF-HEADER character (hexadecimal 01) and is terminated by an ascii END-OF-TRANSMISSION character (hexadecimal 04).

PAGES

Each page must have the word "PAGE" as the first work on the first line. All words and numbers on the same line must be separated by one (or more) ascii space characters (hexadecimal 20). All lines must be separated by the ascii carriage-return and line-feed characters (hexadecimal 0D,0A).

Following the word "PAGE" on the top line (and separated by a space) must be the page number (01 to 99). Pages must follow in numerical order.

Lastly on the top line must be the page heading (e.g. AUX-INPUTS, START-DO-LOOP etc.). These headings must be written exactly as in ORAC and contain no spaces. For example, "POINT-TO-POINT. G00,G01". Note that the number 0 and the O are not interchangeable.

The rest of each page is made up of "key-words", for example, X,Z, FEEDRATE, TOOL-NO, SPINDLE-SPEED.

Keywords must also be written exactly as on the ORAC display and contain no embedded spaces.

The order in which the keywords appear on a page is not critical. However, all relevant keywords must be present and must be the first word of any line.

On the same line as each keyword must be the associated numerical value. The numberical value must be separated from the keyword by at least one space.

All numerical values are ascii characters (e.g. 1 is hexadecimal 31).

RS232 COMMUNICATION

ORAC allows selection of 300, 1200 and 2400 BAUD rates (bits per second).

ORAC allows transmission of the standard file format (previously described) or printer-format. The printer format suppresses the transmission of SOH, STX, RS, and EOT control characters. It also provides a listing heading and separates pages with 4 LINE-FEED characters.

ORAC senses the RS232 DTR line (pin 20) before transmitting each character i.e. this line represents a busy-line. If the external computer or printer is not ready to accept data it sets DTR to -12V.

In the reverse direction ORAC will set DSR (pin 6) line to +12V when ready to input data.

Each word transmitted consists of:-

8 Data bits,
1 Stop bit,
No Parity bits.

ORAC RS232 INTERFACE

ORAC is connected in the 'MODEM' configuration - pin numbers refer to the standard 25 way D-type connector. Only six pins on the connector are used.

PIN NO.	DESIGNATION	DESCRIPTION
1	GND	Protective Ground.
2	TXD	Data is transmitted on this line from an external device to ORAC.
3	RXD	Data is transmitted on this line from ORAC to an external device.
6	DSR	This line is used by ORAC to indicate to an external device that it is ready to receive data.
7	GND	Signal Ground.
20	DTR	This line is monitored by ORAC when transmitting data. ORAC checks this line is high (+12V) before sending each character.

SECTION 5

MAINTENANCE

Routine inspection and maintenance of the machine should be carried out to the following schedule:-

PERIOD	MAINTENANCE REQUIRED
DAILY	Lubricate oil nipples. Wipe slides and ways and coat with a thin film of oil. Clean out swarf.
WEEKLY	Clean machine thoroughly. Check nuts and bolts for slackness. LUBRICATE BOTH BALLSCREWS.
SIX MONTHLY	Check adjustment of saddle and side strips. Grease Headstock bearings.
ANNUALLY	Check machine allignments and accuracy. Check headstock bearing adjustments.

TOP SLIDE STRIP ADJUSTMENT

Take up for wear on the top slide gib strip by loosening the 3 lock nuts and adjust the screws to give slight drag, then tighten the lock nuts.

CROSS SLIDE - STRIP ADJUSTMENT

Take up for wear on the cross slide gib strip by loosening the 3 lock nuts on the side of the cross slide and slowly tighten up the screws. Once tight release half a turn and tighten up the lock nuts.

SECTION 6

TAILSTOCK AND CHUCK MOUNTING

CHUCK MOUNTING

ORAC is set up prior to despatch with the chuck already in position.

For remounting the chuck, first ensure that the spindle nose and the back mounting plate of the chuck is clean and free from dust or protective covering.

Locate the three studs through the holes in the spindle nose and fix a spring washer and M8 Nut to each of the studs and tighten accordingly. (SEE FIG.3)

TAILSTOCK

The tailstock barrel has a No.2 MT bore and may be locked in position by turning the locking handle (A) on the top of the tailstock in a clockwise direction.

The tailstock is locked by means of a bed clamp B, operated by tightening the nut in the centre of the tailstock base. (SEE FIG.4)

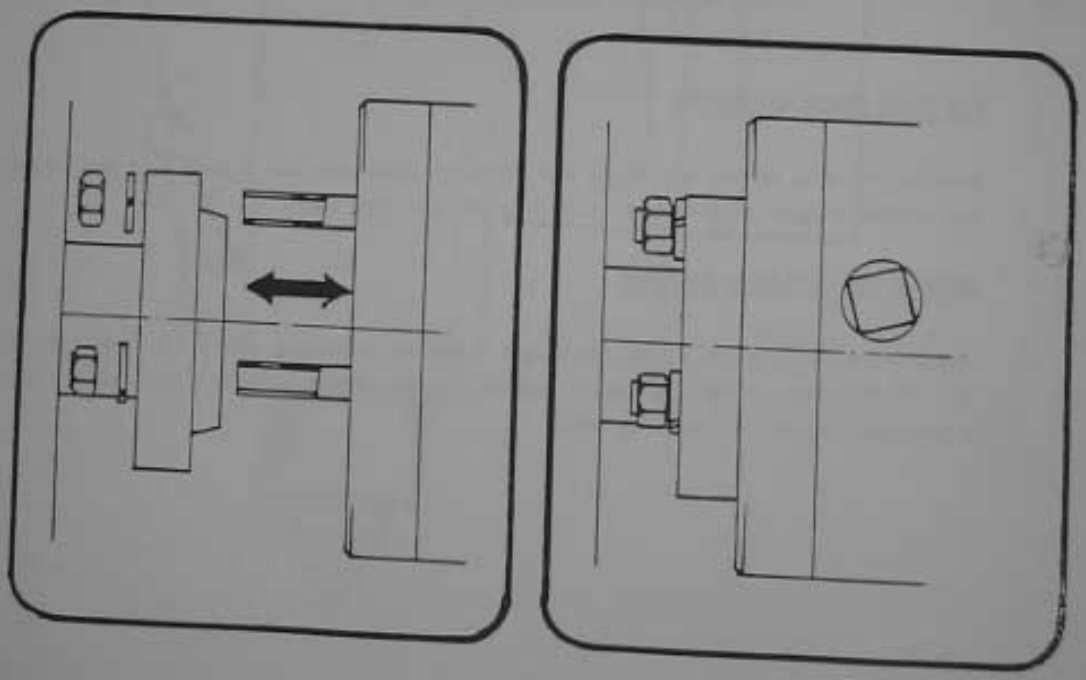


FIG.3

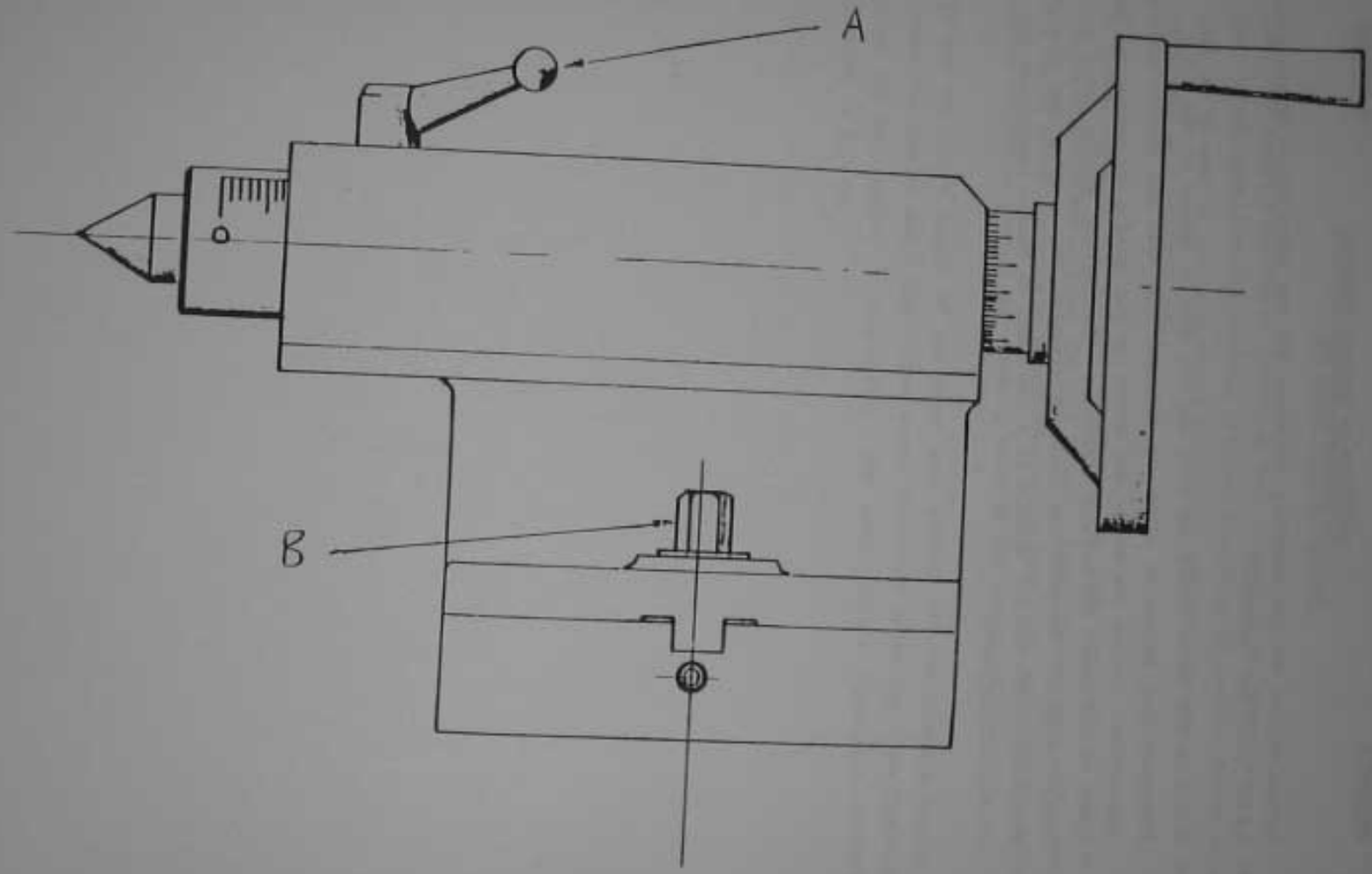


FIG.4

SECTION 7

OPERATION OF SPINDLE CONTROLS

Having carried out the necessary procedure for the installation of the machine it is now ready for operation.

Switch on the mains supply and wait for the menu to appear on the V.D.U. If the Emergency Stop Button is locked in position, the axis and spindle controls are inoperative. Unlock the button and switch on the spindle by depressing the round green Button under the spindle controls. The initial spindle speed will be a cogging effect. Increase the speed by pressing the + under the spindle speed controls. First run the spindle at a low speed to ensure lubrication and freedom of all running parts.

SECTION 6

THE QUICK CHANGE TOOLPOST

ORAC will accept a maximum of 9 pairs of tool offsets in its memory with a 0 (zero) tool offset cancelling all previous offsets; therefore the maximum number of tools that can be used in the quick change toolpost in any one programme is 9 with tool 0 being used as a reference tool.

To change tools in the toolpost either pull or push the clamping lever to the central position and lift out the tool holder. Insert the new tool holder ensuring the height adjusting screw is firmly down on the base body, and clamp the holder by either pulling or pushing the clamping lever to the locked position.

To set the centre height of the lathe tool slacken off the clamping handle, and loosen the locking nut - then either screw the height adjusting screw clockwise to raise the tool holder or vise-versa. The manufacturers repeatable accuracy on clamping is 0.01 mm.

SECTION 9

MACHINE AXIS FORMAT

FIG.5 illustrates the plan view of ORAC. The Z axis runs along the length of the bed and the X axis along the cross slide at 90° to the bed. The plus and minus signs indicate the direction of the tool.

FIG.5A ABSOLUTE

(Z axis) To the left hand side of Z0 towards the chuck is negative.
To the right hand side of Z0 away from the chuck is positive.

(X axis) X0 is on the centre line of the spindle. Away from X0 towards the splash guard the movement is negative and towards the operator from X0 is positive.

FIG.5B INCREMENTAL

(Z axis) Towards the chuck is negative.
Away from the chuck is positive.

(X axis) Away from the operator is negative.
Towards the operator is positive.

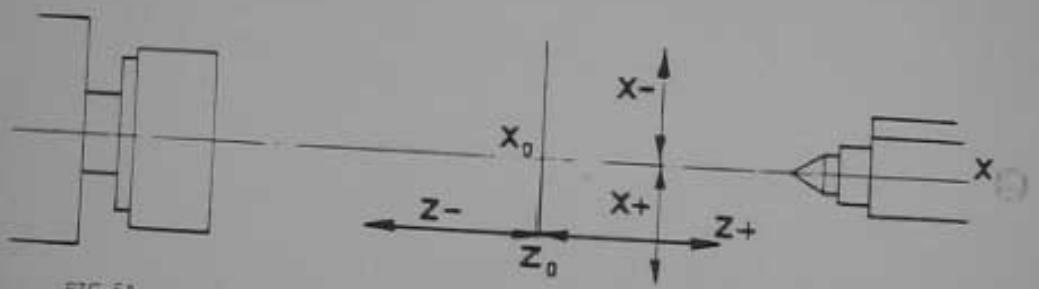


FIG.5A

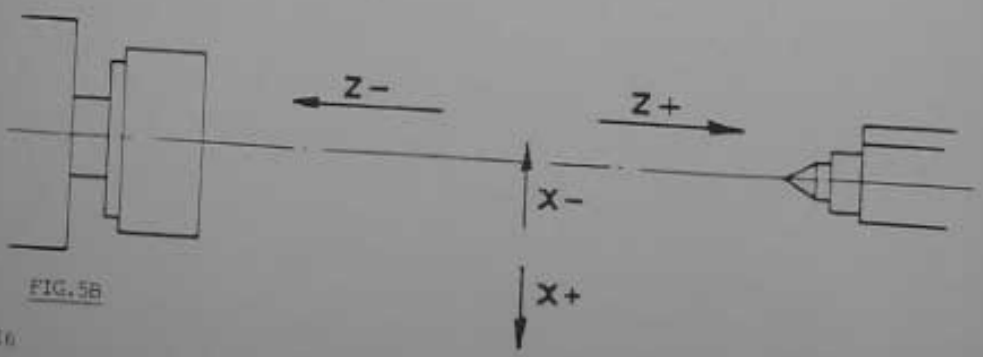


FIG.5B

SECTION 10

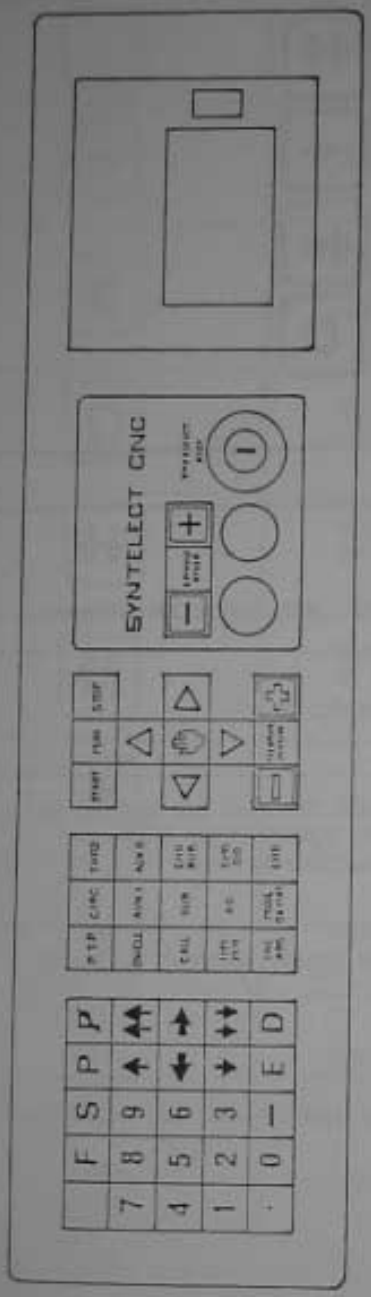
THE VISUAL DISPLAY UNIT (V.D.U.)

The Visual Display Unit (referred to as the screen) assists the operator in programming by giving a visual display of all information entered, and guiding you through the program.

The screen will also display the block which is actually being executed at that particular time.

The information on the screen can be displayed on a larger screen by connecting up a T.V. monitor to ORAC via the coaxial link at the rear of the machine.

THE DATA INPUT SECTION



DATA INPUT.

SECTION 2

CONTROL SYSTEMS

Since the industrial revolution engineers have striven to produce automatic machines. The initial need was to speed up operations and to produce long production runs of the same components economically also taking the drudgery out of repetetive work. This type of machine has been with us for a long time from simple cam auto's to sequence control machines using a plugboard or dial setting to achieve the operational sequence and desired dimensions.

The sequence control machines were the forerunner of the present NC (numerical control) and C.N.C. (computer numerical control) machines. However, the sequence control machines required quite lengthy setting up which restricted their use to long production runs to recoup the down time spent in setting.

This was one of the reasons for developing NC machines which could be utilized a simple operation, such as drilling a series of holes in a fixed position at pre-set centre distances, to a much more sophisticated set up which involved a multi-control sequence of operations.

The first NC machines were drilling machines which allowed no carriage movement whilst the tool was cutting. Once this type of operation had been successfully achieved by NC then the need arose to produce machines to allow the travel of the slides during cutting operations, i.e. milling, turning and profiling and also tool changes built into the program. This type of NC machine was usually controlled by a punched tape which was read by a tape reader on the machine. This transferred the information on the tape by a series of electrical impulses to the control system, which in turn moved the slides and tools to the program supplied.

Two types of systems are used to control the NC function:

(1) Closes loop control

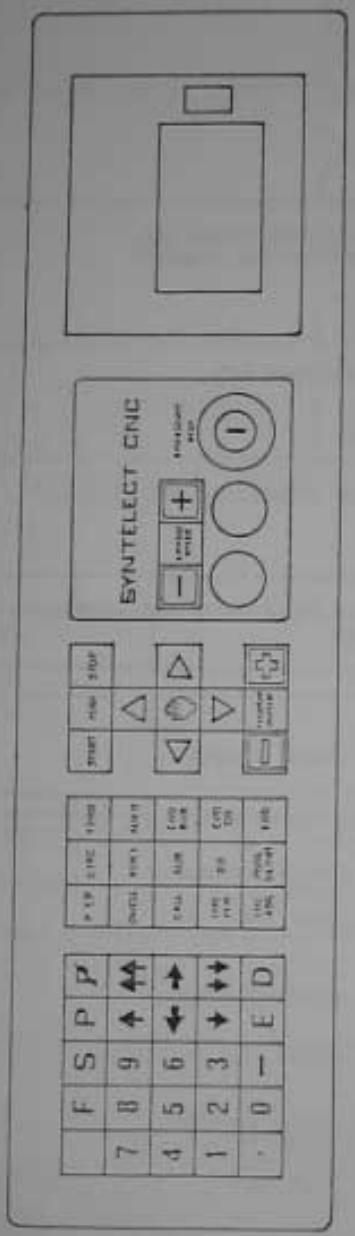
(2) Open loop control

KEY	FUNCTION
0 TO 9	a) NUMERICAL DATA KEYS. b) INSTRUCTION SELECTION KEYS USED DURING PROGRAMMING.
F	FUNCTION KEY: USED AS INSTRUCTED ON VDU.
S	SPACE KEY: USED DURING PROGRAM ENTERING AND EDITING TO DELETE A CHARACTER. WITH THE CURSOR UNDER THE APPROPRIATE NUMBER OR LETTER PRESS S.
P	PAGE INSERT KEY: USED DURING PROGRAM EDITING TO INSERT A NEW PAGE. (SEE SECTION 23 PAGE 63)
P	PAGE DELETE KEY: USED DURING PROGRAM EDITING TO DELETE A PAGE. (SEE SECTION 23 PAGE 62)

KEY	FUNCTION
.	DECIMAL POINT KEY.
−	MINUS SIGN KEY.
E	ENTER KEY: USED IN CONJUNCTION WITH ALMOST ALL PROGRAMMING AND IS USED TO CONFIRM AND TRANSFER INFORMATION INTO THE MEMORY.
D	DELETE KEY: USED TO DELETE SELECTED DATA. (SEE SECTION 23 PAGE 62)
	PAGE FORWARD KEY: USED DURING PROGRAMMING AND EDITING TO MOVE ON TO NEXT PAGE.
	PAGE REVERSE KEY: USED DURING PROGRAMMING AND EDITING TO MOVE BACK TO PREVIOUS PAGE.
	CURSOR KEY: MOVES FLASHING CURSOR UPWARDS.
	CURSOR KEY: MOVES FLASHING CURSOR DOWNWARDS.
	CURSOR KEY: MOVES FLASHING CURSOR TO LEFT.
	CURSOR KEY: MOVES FLASHING CURSOR TO RIGHT.

SECTION 12

THE FUNCTION SECTION



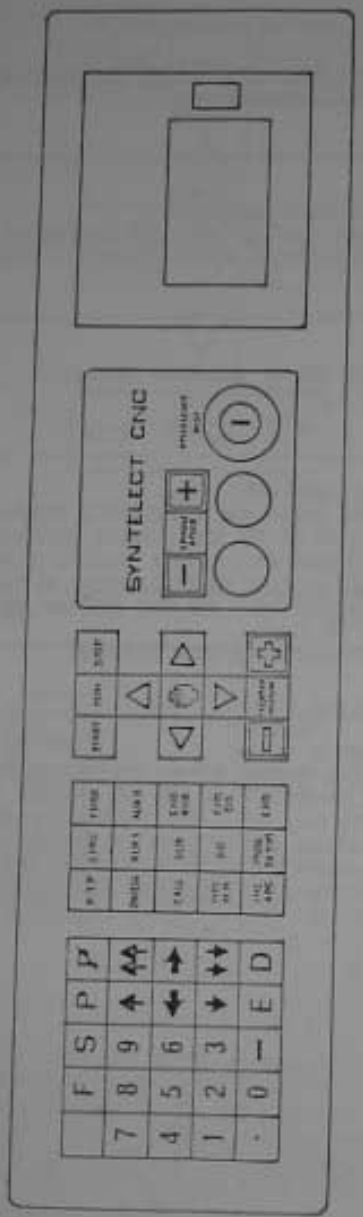
FUNCTION.

FUNCTION SECTION

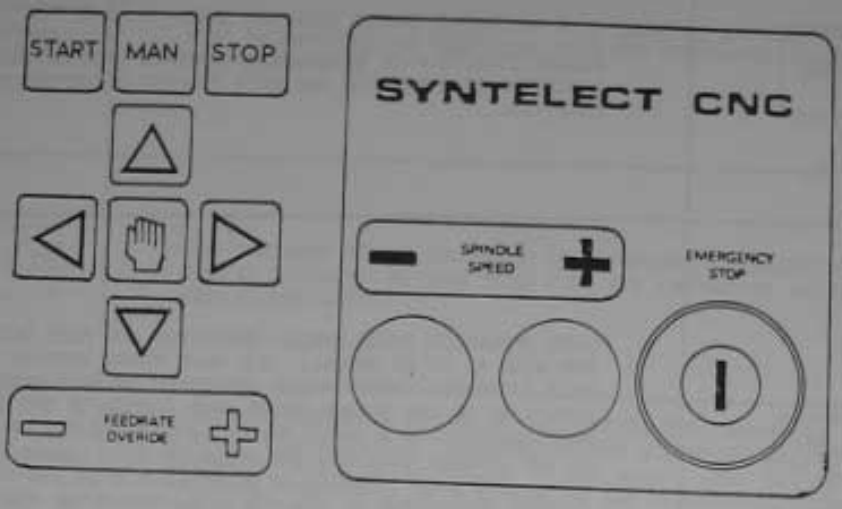
KEY	FUNCTION
PTP	POINT TO POINT OPERATION: THIS INSTRUCTION MOVES THE TOOL IN EITHER THE X (FACING) OR Z (TURNING) DIRECTIONS INDIVIDUALLY. OR X AND Z DIRECTIONS SIMULTANEOUSLY (TAPER TURNING) I.e. LINEAR INTERPOLATION. (SEE SECTION 18.2 PAGE 40 FOR DETAILED INSTRUCTION)
CIRC	CIRCULAR INTERPOLATION. THIS INSTRUCTION ENABLES CRAC TO CUT IN A CIRCULAR MOTION. (SEE SECTION 18.3 PAGE 41 FOR DETAILED INSTRUCTION)

KEY	FUNCTION
THRD	THREAD CUTTING: THIS INSTRUCTION PROVIDES A THREADING CYCLE FOR EXTERNAL AND INTERNAL THREADS. (SEE SECTION 18.4 PAGE 44 FOR DETAILED INSTRUCTION)
DWELL	DWELL PERIOD: THIS INSTRUCTION ALLOWS A TIMED DWELL PERIOD TO BE PROGRAMMED BETWEEN MACHINING OPERATIONS, AND THE MACHINE WILL REMAIN STATIONARY AT ITS PRESENT POSITION. (SEE SECTION 18.5 PAGE 48)
AUX I	AUXILLIARY INPUTS: THIS INSTRUCTION ALLOWS THE PROGRAM TO BE HALTED BETWEEN MACHINING OPERATIONS. THE EXECUTE PROGRAM WILL ONLY PROCEED BEYOND THIS POINT IF ANY OF THE 4 AUXILLIARY INPUTS PROGRAMMED TO RECEIVE AN INPUT SIGNAL ARE ACTIVATED. (SEE SECTION 18.6 PAGE 49 FOR DETAILED INSTRUCTION)
AUX O	AUXILLIARY OUTPUTS: THIS INSTRUCTION ALLOWS ANY OF THE 4 AUXILLIARY OUTPUT RELAYS TO BE OPERATED TO CONTROL EXTERNAL FUNCTIONS. (SEE SECTION 18.7 PAGE 50 FOR DETAILED INSTRUCTION)
CALL	CALL SUBROUTINE: THIS INSTRUCTION ALLOWS A SUBROUTINE TO BE CALLED FOR EXECUTION. (SEE SECTION 18.8 PAGE 51 FOR PROGRAM FORMAT)
SUB	SUBROUTINE START: THIS INSTRUCTION ALLOWS A SUBROUTINE TO BE CONSTRUCTED AND ALLOCATED AN IDENTITY NUMBER. THE SUBROUTINE FORMAT IS EXPLAINED IN SECTION 18.8 PAGE 51.
END SUB	END SUBROUTINE PROGRAM: THIS INSTRUCTION ENDS THE SUBROUTINE. ALL FUNCTIONS ENTERED BETWEEN 'SUB' AND 'END SUB' CONSTITUTE THE SUBROUTINE. (SEE SECTION 18.8 PAGE 52)

KEY	FUNCTION
DO	START DO LOOP: THIS INSTRUCTION IS USED FOR STARTING A REPETITIVE SEQUENCE (SEE SECTION 18.9 PAGE 55 FOR PROGRAM FORMAT)
END DO	END DO LOOP: THIS INSTRUCTION ENDS THE DO LOOP SEQUENCE. ALL FUNCTIONS ENTERED BETWEEN 'DO' AND 'END DO' CONSTITUTE THE SEQUENCE TO BE EXECUTED THE REQUIRED NUMBER OF TIMES (COUNT).
END	END PROGRAM: THIS INSTRUCTION DEFINES THE END OF THE MAIN PROGRAM. (SEE SECTION 18.10 PAGE 57)
INS / MM	UNITS SELECTION: INCH OR MILLIMETRES. THIS INSTRUCTION SELECTS THE UNITS FOR SUBSEQUENCE PROGRAM PAGES. ALTERNATIVE DEPRESSION OF THE KEY CHANGES THE UNITS FROM INCH TO MILLIMETRES TO INCH etc. (THIS FEATURE OF ORAC ENABLES US TO PROGRAM EITHER IN INCH OR MILLIMETRES WITHIN THE SAME PROGRAM.) ENSURE THAT THE UNITS FOR THE PROGRAM ARE SELECTED AT EITHER BLOCK 1 OR 2. (SEE SECTION 25 PAGE 67 FOR UNITS FOR TOOL OFFSETS)
INC / ABS	INCREMENTAL/ABSOLUTE FORMAT: THIS INSTRUCTION SELECTS THE PROGRAM FORMAT FOR SUBSEQUENT PROGRAM PAGES. ALTERNATE DEPRESSION OF THE KEY CHANGES THE FORMAT FROM INC. TO ABS. TO INC. etc. THIS FEATURE OF ORAC ENABLES US TO PROGRAM IN EITHER ABSOLUTE OR INCREMENTAL WITHIN THE SAME PROGRAM. IT IS EXTREMELY HELPFUL WHEN DRAWINGS ARE DIMENSIONED WITH A COMBINATION OF INCREMENTAL AND ABSOLUTE CO-ORDINATES. ENSURE THAT THE FORMAT FOR THE PROGRAM IS SELECTED AT EITHER BLOCK 1 OR 2.
PROG DATUM	PROGRAM DATUM: THIS INSTRUCTION ALLOWS THE CO-ORDINATES OF THE PROGRAM DATUM TO BE ENTERED AND THESE VALUES ARE ALWAYS TAKEN FROM THE CENTRE LINE OF THE SPINDLE ON X AND FROM THE END OF THE WORKPIECE ON Z. EVEN THOUGH INCREMENTAL MAY HAVE BEEN SELECTED FOR THE FORMAT THE PROGRAM DATUM SHOULD ALWAYS BE ENTERED IN BLOCK No.3 AND ENTERED IN THE UNITS PREVIOUSLY SELECTED IN BLOCK 1 OR 2.



MANUAL CONTROLS.



KEY	FUNCTION
START	STARTS AND RESTARTS THE OPERATING SEQUENCE WHEN EXECUTING A PROGRAM. ENSURE BEFORE STARTING OR RESTARTING A PROGRAM THAT THE SPINDLE IS RUNNING.
STOP	a) STOPS THE OPERATING SEQUENCE WHEN EXECUTING A PROGRAM. TO RESTART THE PROGRAM PRESS THE SQUARE GREEN START BUTTON. b) INPUTS POSITIONAL INFORMATION FOR '2o PLANE' AND 'X DIA.' WHEN USED AS INSTRUCTED IN THE 'TOOL OFFSET' SETTING UP MODE. (SEE SECTION 25 PAGE 66) c) STOPS MANUAL OPERATING SEQUENCE AND RETURNS TO EITHER THE MAIN MENU OR THE TOOL OFFSET MENU.

KEY	FUNCTION
MAN	ALLOWS SELECTION OF MANUAL AXIS CONTROL ONCE AUTOMATIC EXECUTION OF A PROGRAM HAS BEEN STOPPED USING THE SQUARE RED STOP KEY.
	ONCE OPERATING UNDER MANUAL OPERATION YOU MUST DECIDE WHAT YOU WISH TO DO IN MANUAL. YOU HAVE THREE OPTIONS. THE FIRST FEED INDICATED UNDER MANUAL OPERATION IS FAST FEED. THIS IS INDICATED IN THE BOTTOM RIGHT HAND CORNER OF THE SCREEN. THE FAST FEEDRATE IS A RAPID MOVE AT 47 INCHES/MIN OR 1200 MM/MIN. IF YOU DEPRESS THIS KEY THE FEEDRATE WILL CHANGE FROM FAST TO SLOW. THE SLOW FEEDRATE IS 6 INCHES/MIN OR 150 MM/MIN. A FURTHER DEPRESSION OF THE KEY WILL CHANGE THE FEEDRATE TO STEP. THIS IS A JOG OF 0.01 MM OR 0.0004 INCHES. EACH TIME YOU DEPRESS THE KEY THE FEEDRATE WILL CHANGE FROM FAST TO SLOW TO STEP. CONSTANT DEPRESSION OF THE KEY WILL CONTINUALLY CHANGE THE INDICATED FEEDRATE. (SEE SECTION 25 PAGE 66 FOR TOOL OFFSET FEEDRATES)
	X TRAVERSE: IN AND OUT.
	Z TRAVERSE: LEFT AND RIGHT. PRESS THE KEY POINTING TO THE LEFT TO MOVE THE TOOL TOWARDS THE CHUCK AND TO THE RIGHT TO MOVE AWAY FROM THE CHUCK. SIMILARLY PRESS THE KEY POINTING UPWARDS TO MOVE THE TOOL TOWARDS THE CENTRE LINE OF THE SPINDLE AND DOWNWARDS TO MOVE THE TOOL AWAY FROM THE CENTRE LINE. WHEN IN MANUAL FAST OR SLOW MOVEMENT WILL OCCUR ONLY AS LONG AS YOU KEEP CONSTANT DEPRESSION ON THE APPROPRIATE ARROW BUTTONS. CARE SHOULD BE TAKEN WHEN APPROACHING AN OBSTRUCTION, SUCH AS A WORKPIECE, BECAUSE THE MACHINE NEEDS A SHORT DISTANCE TO DECELERATE.

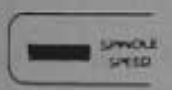
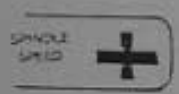
KEY	FUNCTION
	WHEN OPERATED DURING EXECUTION OF A PROGRAM, REDUCES THE AXIS FEED IN OPERATION AT THAT TIME FROM ITS PROGRAMMED VALUE TO SOME LOWER VALUE.
	WHEN OPERATED DURING EXECUTION OF A PROGRAM, INCREASES THE AXIS FEED IN OPERATION AT THAT TIME FROM ITS PROGRAMMED VALUE TO SOME HIGHER VALUE.
	WITH BOTH THE ABOVE OVERRIDE FACILITIES, THE PROGRAMMED AND OVERIDE FEEDRATES ARE DISPLAYED ON THE SCREEN DURING EXECUTION. AFTER THE COMPLETED EXECUTION OF THE BLOCK, WITH THE OVERRIDDEN FEEDRATE, THERE WILL BE A RETURN TO THE PROGRAMMED VALUE. THE OVERRIDE RANGE IS FROM 0% TO 110%. THE DISPLAY ONLY INDICATES THE FEEDRATE IN UNITS OF TEN. HENCE A FEEDRATE OF 50 MM/MIN WITH MAXIMUM POSITIVE OVERRIDE OF 10% WILL STILL ONLY INDICATE 50 MM/MIN EVEN THOUGH THE ACTUAL VALUE WILL BE 55 MM/MIN.
	WHEN OPERATED DURING THE EXECUTION OF A PROGRAM, REDUCES THE SPINDLE SPEED FROM THE PROGRAMMED VALUE. KEY HELD DOWN UNTIL REQUIRED SPEED IS ACHIEVED, THEN RELEASED, AND SPEED REMAINS AT THAT SET LEVEL UNTIL A CHANGE IN A SUBSEQUENT BLOCK.
	WHEN OPERATED DURING THE EXECUTION OF A PROGRAM, INCREASES THE SPINDLE SPEED FROM THE PROGRAMMED VALUE. KEY HELD DOWN UNTIL REQUIRED SPEED IS ACHIEVED, THEN RELEASED, AND SPEED REMAINS AT THE SET LEVEL UNTIL A CHANGE IN A SUBSEQUENT BLOCK. UNLIKE FEEDRATE OVERRIDE THE NEW SPINDLE SPEED IS NOT INDICATED ON THE V.D.U.
	GREEN BUTTON STARTS SPINDLE

Fig. 1. Block diagram (simplified) of an NC CLOSED LOOP CONTROL

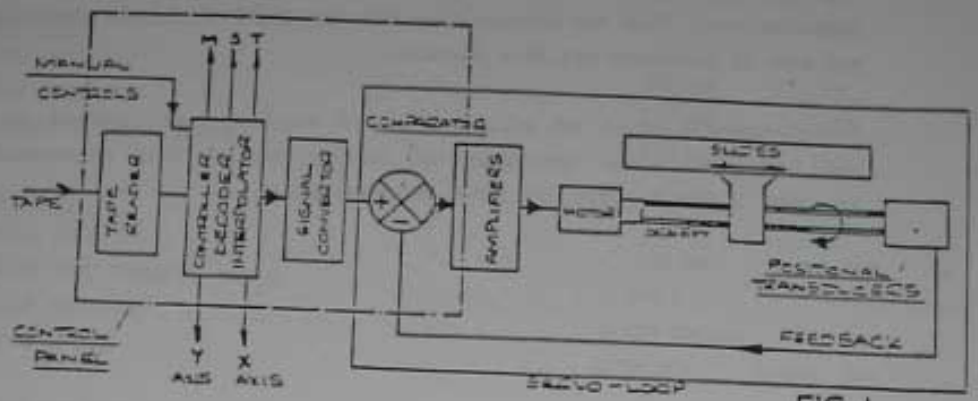


FIG. 1

This is a very complex control which is used where a very high degree of accuracy is required i.e. in such machines as jig borers, machining centres, etc.

Fig. 2. NC System using OPEN LOOP CONTROL

Since no feedback is used this eliminates the need for a zero system. This system uses stepping motors which require pulses to rotate i.e. a fixed number of pulses per rev means 1 pulse rotates the motor a fixed number of degrees (a step) and which moves the slides a fixed increment using an accurately pitched screw.

Fig. 2. OPEN LOOP CONTROL

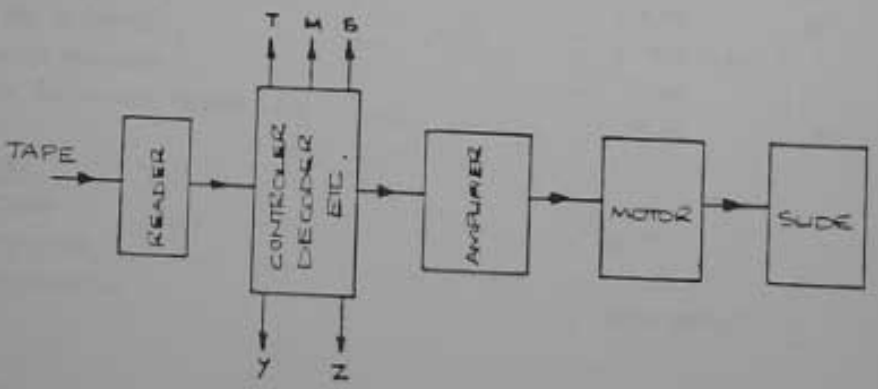


FIG. 2

This is a much simpler system and is used on the ORAC CNC lathe.

KEY	FUNCTION
	RED BUTTON STOPS SPINDLE. WARNING: THE DEPRESSION OF SPINDLE STOP IN MID PROGRAM STOP THE SPINDLE, HOWEVER, THE AXIS WILL CONTINUE TO RUN.
	EMERGENCY STOP. STOPS BOTH SPINDLE AND AXIS DRIVES. BUTTON LOCKS DOWN WHEN OPERATED AND CAN ONLY BE RESET WITH KEY.

DEPRESSION OF THE EMERGENCY STOP BUTTON, WITH THE KEY IN THE VERTICAL POSITION, WILL LOCK THE BUTTON DOWN, AND THE V.D.U. WILL DISPLAY MANUAL OPERATION WITH THE APPROPRIATE X AND Z CO-ORDINATES. TO OPERATE THE MACHINE IN MANUAL MODE WAIT A MINIMUM OF 3 SECONDS AND UNLOCK THE BUTTON BY TURNING THE KEY TO THE RIGHT.

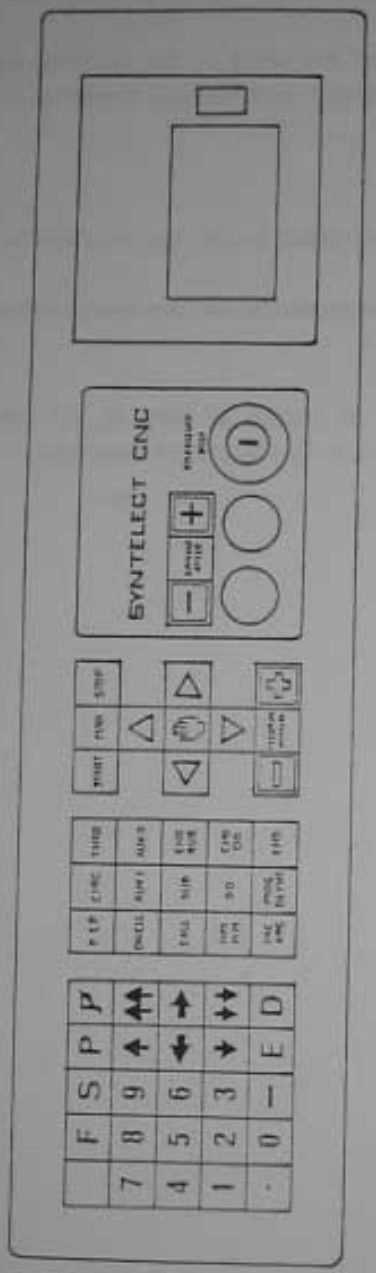
IF THE KEY IS TURNED TO THE RIGHT ON DEPRESSION IT WILL NOT LOCK DOWN, BUT WILL RETURN TO ITS ORIGINAL POSITION AND THE V.D.U. WILL DISPLAY: MANUAL OPERATION WITH THE APPROPRIATE X AND Z CO-ORDINATES. HOWEVER, THE MACHINE MAY BE INOPERATIVE DUE TO THE RELAYS NOT HAVING TIME TO RESET. TO OPERATE THE MACHINE, LOCK IN THE BUTTON AND HOLD FOR 3 SECONDS BEFORE RELEASE.

WHEN THE EMERGENCY STOP IS OPERATED, POSITIONAL INFORMATION WILL BE LOST AND RE-EXECUTION MUST COMMENCE FROM PAGE 01 OF THE PROGRAM.

TO RETURN TO THE MAIN MENU PRESS THE SQUARE RED STOP KEY UNDER THE MANUAL SECTION OF THE CONTROL PANEL.

SECTION 14

CASSETTE SECTION



DATA CASSETTE.

OPERATION OF THE DATA CASSETTE IS ENTIRELY AUTOMATIC DURING BOTH THE "LOAD" AND "SAVE" MODES OF OPERATION.

THE ONLY OPERATOR REQUIREMENT IS TO ENSURE THAT WHEN PROMPTED VIA THE V.D.U. TO CHECK "CASSETTE LOADED" - THAT A TAPE CASSETTE IS ACTUALLY LOADED INTO THE MACHINE.

TO LOAD A CASSETTE, PUSH UPWARDS ON THE BUTTON AT THE RIGHT OF THE CASSETTE HOLDER WHEN THE DOOR OPENS, INSERT THE TAPE WITH THE EXPOSED TAPE SURFACE DOWNWARDS. WHEN FULLY INSERTED CLOSE THE DOOR.

THE CASSETTE CARRIES 2 FUNCTIONS:

1. IT IS USED TO STORE PROGRAMMES AND OFFSETS BY TRANSFERRING THE INFORMATION FROM THE MEMORY TO THE CASSETTE.
2. IT IS USED TO LOAD PROGRAMMES AND OFFSETS BY TRANSFERRING INFORMATION FROM THE CASSETTE TO THE MEMORY.

FOR DETAILED OPERATION SEE SECTIONS 21 AND 22 PAGES 60 AND 61 FOR PROGRAM TRANSFERS. AND SECTIONS 25.3 AND 25.4 PAGES 70 AND 71 FOR OFFSET TRANSFERS.

PROGRAMMING

SECTION 15

CLEARING THE MEMORY

Once ORAC has been switched on at the mains the memory will be clear.

There are 3 ways to clear ORAC'S memory if there is a program already loaded:

1. Return to the menu, and then depress 5 to enter a new program into memory and then E. ORAC will assume a new program is going to be entered into memory, and so will clear the existing program.

2. Return to the menu and load a program from cassette by depressing 1 on the keyboard and then E, place a cassette into the holder and press E to acknowledge that you have indeed loaded a cassette. Once the screen displays PROGRAM TRANSFER COMPLETE, the existing program in ORAC'S memory will be replaced with the new program taken from the cassette.

   NOTE In both of the above cases, only ORAC'S program memory is cleared. The tool offsets stored in memory will remain until replaced.

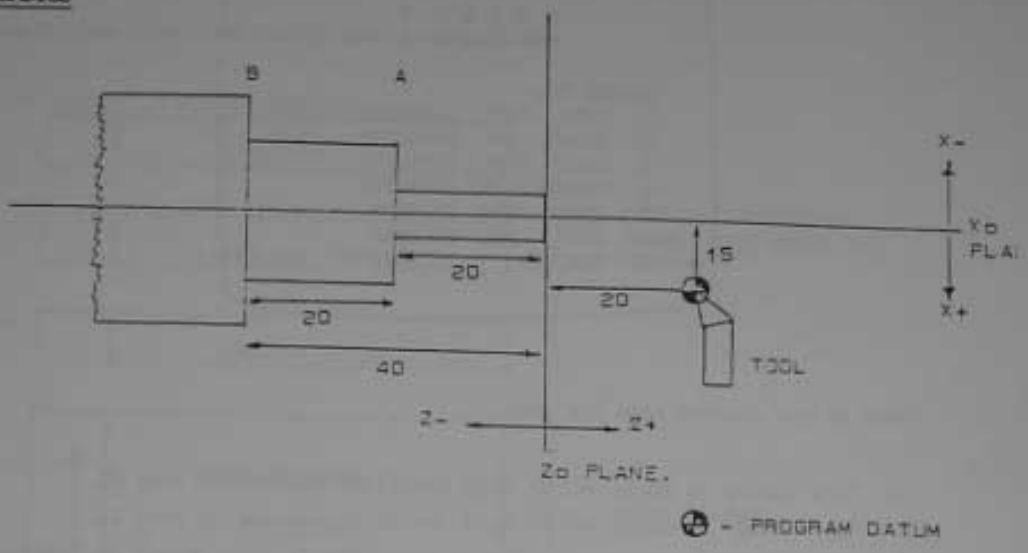
3. Memory is also lost when the mains supply to the machine is turned off, however, this should not be used as a method of clearing memory.

SECTION 16

BASIC PRINCIPLES

PROGRAMMING:

BASICS



THE ABOVE DIAGRAM ILLUSTRATES THE TERMS Zo; Xo; PROGRAM DATUM; ABSOLUTE AND INCREMENTAL AS USED IN THE WRITING OF PROGRAMS FOR CNC MACHINES.

Zo IS TAKEN AS THE END OF THE WORKPIECE.

Xo IS TAKEN AS THE CENTRE LINE OF THE SPINDLE.

THE PROGRAM DATUM IS SHOWN 20 MM FROM THE Zo PLANE AND 15 MM FROM THE Xo PLANE. ITS POSITION IS EXPRESSED AS Z20;X15: WHEN PROGRAMMING IN ABSOLUTE UNITS AND USING THE PROGRAM DATUM FOR REFERENCE, THEN THE FACE "A" IS POSITIONED AT Z,-20: THE FACE "B" IS POSITIONED AT Z,-40:

NOTE ALL ABSOLUTE Z MEASUREMENTS TO THE LEFT OF Zo ARE -VE.

ALL ABSOLUTE Z MEASUREMENTS TO THE RIGHT OF Zo ARE +VE.

SIMILARLY FOR DIMENSIONS ON EITHER SIDE OF THE Xo PLANE AS SHOWN.

WHEN INCREMENTAL PROGRAMMING IS USED, THE (STILL WORKING FROM THE PROGRAM DATUM);

THE FACE "A" IS POSITIONED AT Z,-40:

THE FACE "B" IS POSITIONED AT Z,-60:

ALL INCREMENTAL Z MEASUREMENTS TOWARDS THE CHUCK ARE -VE.

ALL INCREMENTAL Z MEASUREMENTS AWAY FROM THE CHUCK ARE +VE.

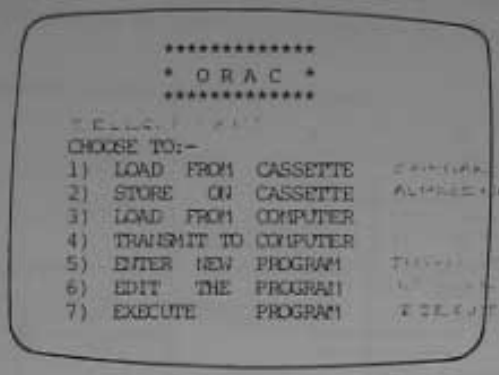
ALL INCREMENTAL X MEASUREMENTS TOWARDS THE CENTRE LINE ARE -VE.

ALL INCREMENTAL X MEASUREMENTS AWAY FOR THE CENTRE LINE ARE +VE.

SECTION 17

THE MAIN MENU

Once the mains have been switched on the screen displays:



This is the program menu for ORAC.

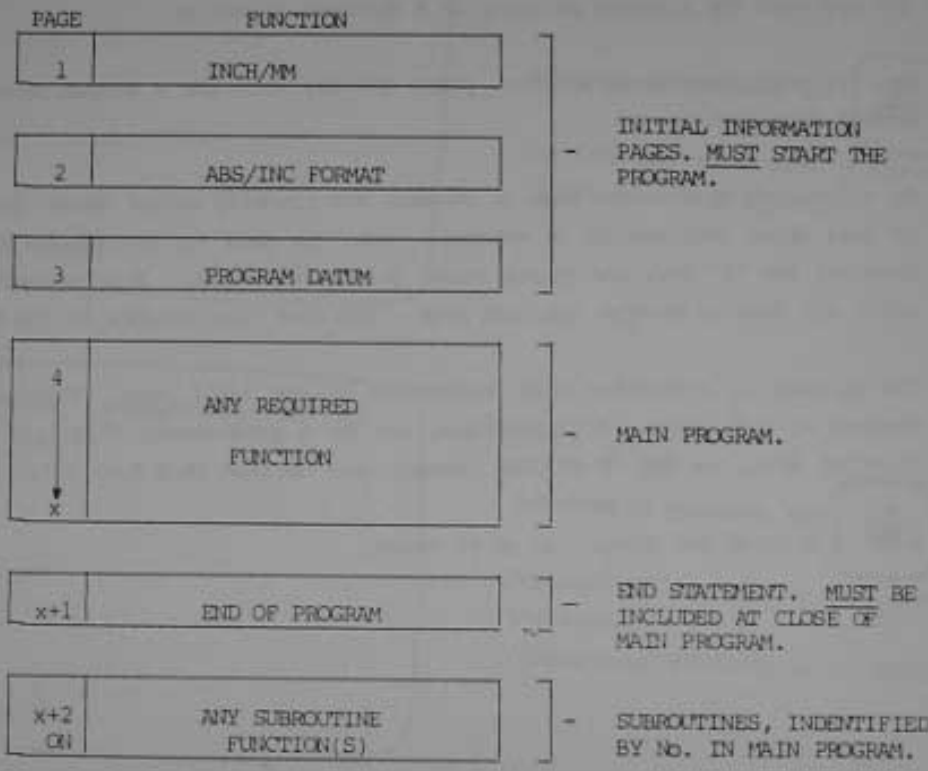
1. This choice is explained in full detail in Section 21 Page 60.
2. This choice is explained in full detail in Section 22 Page 61.
3. Loading from a Computer - this is explained in full detail in Section 31 Page 96.
4. Transmitting to a Computer - this is explained in full detail in Section 32 Page 97.
5. To Enter a new program see Section 18 Page 37.
6. To Edit a program in memory see Section 23 Page 62.
7. To Execute a program see Section 24 Page 64.

SECTION 18

ENTERING A NEW PROGRAM

To Enter a new program into ORACS memory depress key 5 on the Data input section of the keyboard, followed by E. This will bring you to Page 01 on the screen.

The Program structure should now be as follows:



The first 2 pages of any program must contain either INCH or MILLIMETRE units and INCREMENTAL or ABSOLUTE format. The 3rd Page of any program should ALWAYS be the PROGRAM DATUM.

Subsequent pages of Program can then be chosen in any sequence to suit the tool movements required to produce the finished workpiece.

Once a page of information is complete, advance to the following page by pressing the key with the 2 arrows pointing in a downward direction.

To view pages previously entered, press the key with the 2 arrows pointing in the upward direction.

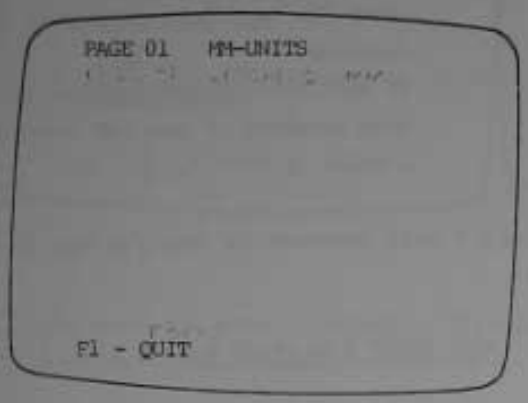
As a function on each new page is chosen, the flashing cursor shows the next piece of data which requires to be entered. When the data is entered and confirmed by pressing the 'E' key, the cursor moves to the next line. This sequence continues until all data is entered for that page. You must then advance to the next page.

The program is terminated with depression of the 'END' key. This will end the program at that point. If subroutines are to be programmed, this will be built up starting after the END OF PROGRAM Command (See Section 18.8 Page 51).

N.B. A program can contain up to 99 pages.

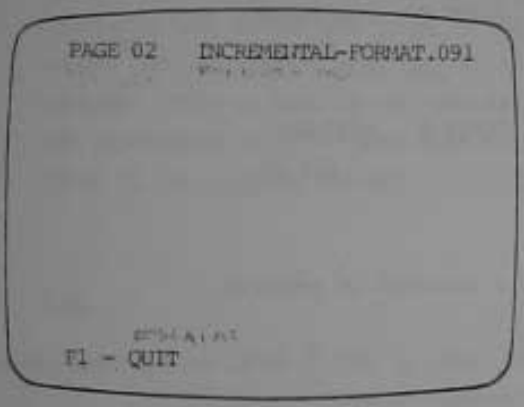
EXAMPLES OF PAGES USING EACH FUNCTION

1.



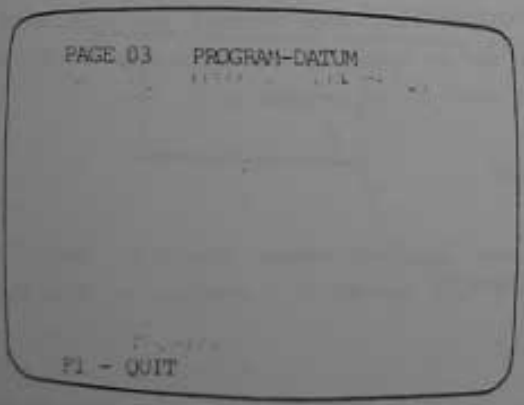
Selected by pressing the INS / MM key.

For INCH units the page is the same. (Substitute INCH for MM.)



Selected by pressing the INC / ABS Key.

For ABSOLUTE format the page appears the same.
(Substitute ABSOLUTE for INCREMENTAL.)



Selected by pressing the PROG / DATUM key.

The PROGRAM DATUM values are taken from the centre line of the spindle on X and from the end of the workpiece on Z.

The PROGRAM DATUM must always be entered at page 3.

CNC (COMPUTER NUMERICAL CONTROL)

With the advent of the silicon chip, computers no longer need to be huge expensive installations. This has brought them into the field of machine control where space and ease of operation are at a premium.

A mini-computer using the silicon chip and magnetic tape, instead of paper tape, has instigated a new generation of control systems with advantages which are included in the new ORAC CNC BENCH TRAINING LATHE.

1"
½"
¼"

'32"

RPM

TPI

in
in

m

PAGE 04 POINT-TO-POINT.G00,G01

X

Z

FEEDRATE

TOOL-NO

SPINDLE-SPEED

F1 - QUIT

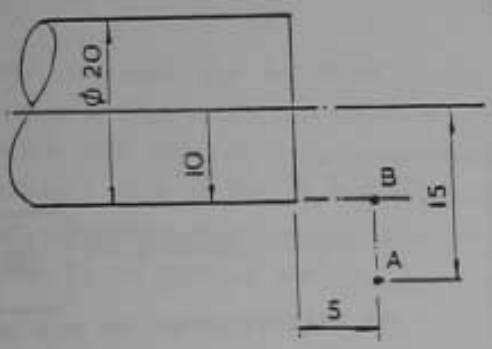
Selected by pressing the **P.T.P.** key.

Key in the required X and Z values using the Data Input Section of the keyboard.

If working in incremental and only X axis movement is required enter in a Z value of 0.

If working in Absolute format and only X axis movement is required key in the Z value the same as the previous page.

e.g.



FROM POINT A TO POINT B

POINT A X15 Z5

POINT B INCREMENTAL
X-5 Z 0

POINT B ABSOLUTE
X10 Z5

The above also applies when only Z axis movement is required.

For programming LINEAR INTERPOLATION (i.e. X and Z axis moving simultaneously) simply enter in the different X and Z co-ordinates.

Once the appropriate X and Z co-ordinates have been entered you must give that particular movement a FEEDRATE. This can be taken as any value from 0-1200 mm/min in increments of 10 or from 0-47 INCHES/MIN in increments of 1.

NOTE: DO NOT OVERRIDE THE FAST FEEDRATE.

A TOOL NUMBER must now be entered. Use any tool number from 1-9. NOTE: TOOL 0 should always be programmed as the last tool number in a program, as this tool has no offsets on X or Z.

Finally enter a SPINDLE SPEED. This can be entered as any value from 0-2000 in increments of 10.

3.

PAGE 05 CIRCULAR-INT..G02,G03

X

Z

RADIUS

SENSE CW CCW

TOOL-NO

SPINDLE-SPEED

F1 - QUIT

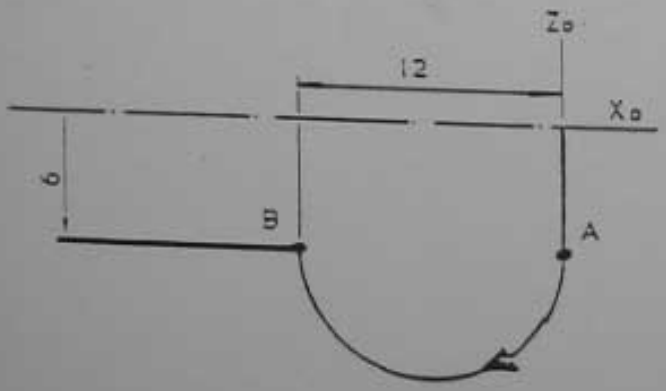
Selected by pressing the CIRC key.

The X and Z values being requested, are for the END co-ordinates of the arc. The tool has already been positioned at the start of the arc in the previous page. The X and Z values can be entered in either Absolute or Incremental.

You must now enter a RADIUS. This can be entered as a value between 2 mm and 3000 mm/0.075" and 120".

ORAC will allow for the RADIUS to give circle centre point outside the machine axis limits so long as the end point is inside the limits. By only having to program a Radius ORAC eliminates the time consuming process of calculating the exact circle centres. This is done by the computer. It is, however, important that a RADIUS is not programmed which is less than half the distance between the start and the end point of the circular motion.

E.g.



PT. A

X6 Z0

PT. B

X6 Z-12

The straight line distance between point A and B is 12.

Therefore the smallest radius which can be programmed is 6.00 mm. A CIRCULAR INTERPOLATION page, as follows, would produce semi-circular form.

X 6.0 Z-12.0 RAD 6.0 CW

Once a radius has been programmed it is now required to give the tool movement a SENSE OF DIRECTION. In the above example a clockwise direction of rotation has to be programmed. This is achieved by deleting the letters CCW (abbreviation for counter clockwise). Do this by moving the flashing cursor using the single arrowed key pointing to the right under one of the letters CCW and then depress the 'D' key.

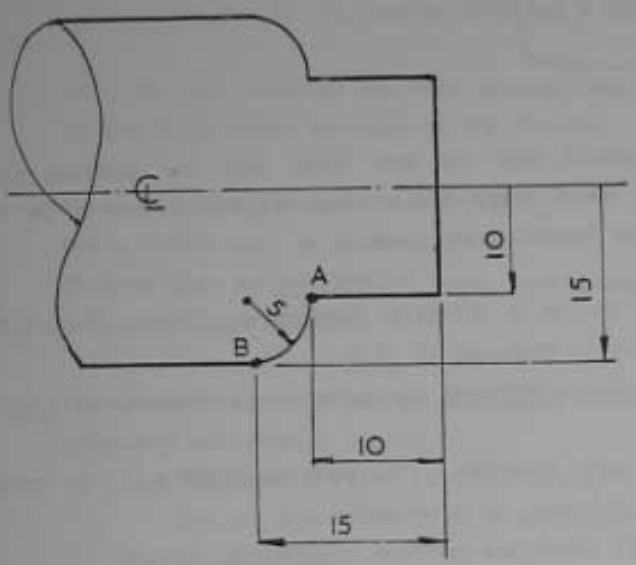
This deletes CCW and you are left with the letters CW. If on further studying the page, an error has been made and the program required CCW tool movement, simply press the "CIRC" key and enter the full page again this time pressing the 'D' key with the flashing cursor under the letters CW.

You must now enter a FEEDRATE for the tool movement, and this should not be less that 40 mm/min or 1.5 inches/min.

Complete the page by entering the appropriate TOOL NUMBER and SPINDLE SPEED.

NOTE Any minor are being programmed i.e. between 0° and 180° either CW or CCW can be entered in one page of information. Any major arcs, i.e. greater than 180° should be constructed using 2 minor arcs in 2 separate pages.

EXAMPLES



ABSOLUTE PROGRAMMING

With the tool already at the position A

X 10.0 Z-10.0

The page for circular interpolation is as follows:

X 15.0 Z-15.0

RAD 5.0 SENSE CW

INCREMENTAL PROGRAMMING

With the tool position at A the page for circular interpolation is as follows:

X 5.0 Z-5.0

RAD 5.0 SENSE CW

4. THREADING

```
PAGE 08   THREADING..G33
 IN/OUT-SIDE.DIAM
 ROOT-DIAMETER
 CUT.(INCR)..X
 LENGTH..Z

PITCH
STARTS
TOOL-NO
SPINDLE-SPEED

F1 - QUIT
```

Selected by pressing the THRD key.

The page before SCREWCUTTING should take the tool level with the diameter to be screwcut and contain a spindle speed ready for the appropriate thread to be cut. (See GRAPH for spindle speeds for screwcutting page 47.)

Press the "THRD" key and key in the IN OR OUT-SIDE DIAMETER e.g. for a 12 mm I.S.O. METRIC COARSE EXTERNAL THREAD key in diameter of 12.0.
e.g. for a 12 mm I.S.O. metric coarse INTERNAL thread key in a diameter of 9.85.

Press the E key and key in the ROOT DIAMETER. The ROOT DIAMETER will, of course, determine whether the thread is internal or external.
i.e. A smaller root diameter will therefore produce an EXTERNAL thread.
A larger root diameter will produce an INTERNAL thread.

Press the E key to enter this information. The size of the cuts necessary to take the tool to the root diameter is now entered (i.e. CUT (INCR)...X). This can be any value smaller than the depth of thread and is an INCREMENTAL VALUE.

E.G. 12 mm External thread

12 mm OUTSIDE DIAMETHER
9.85 ROOT DIAMETER

therefore total depth of cut is $\frac{12-9.85}{2} = 1.075$

say 1.07

So any CUT size taken as an incremental value on the 'X' axis can now be entered less than 1.07.

This value is obviously dependant on the material. A value of 0.03 mm, for example, would be appropriate if cutting mild steel.

If the CUT SIZE is not divisible exactly into the total depth of cut ORAC will do the necessary calculations to round up the last cut.
E.G.

1.07 ≡ 35 cuts of 0.03 and a final cut 0.02.

Once the root diameter has been reached ORAC is programmed to take two further cuts at the final depth to clean up the thread.

Press the E key to enter the cut size.
Now a LENGTH must be entered.
This is also an INCREMENTAL value always taken towards the chuck whether a -ve or +ve value is programmed.

Press the E key to enter the LENGTH OF THREAD. Now key in the PITCH size. This value has programming limits.

The minimum PITCH is 0.35 mm/.014"
The maximum PITCH is 3.50 mm/0.138"

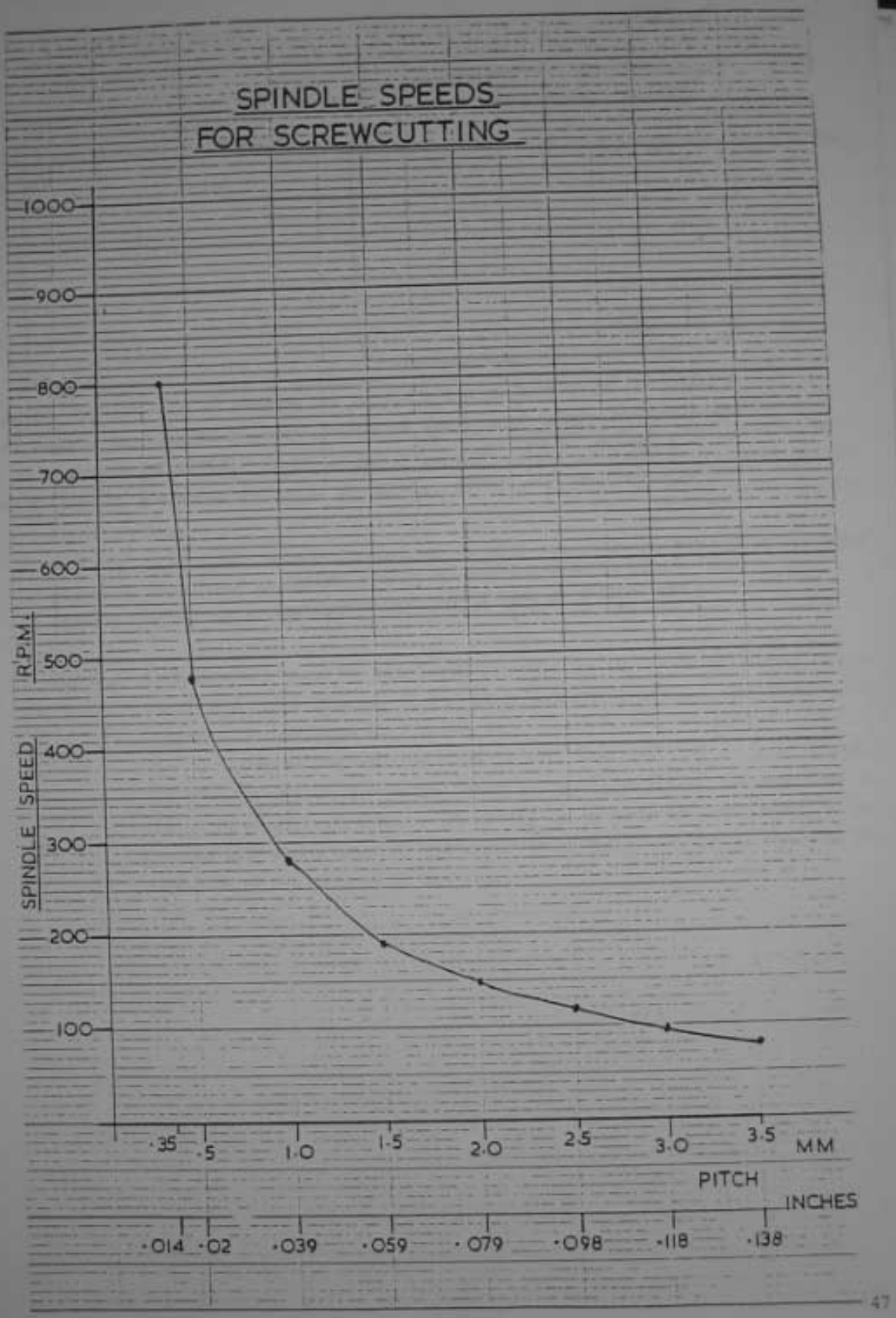
The value for the PITCH in both Metric and Imperial is entered as a decimal to a maximum of 2 and 3 decimal places respectively. Any size of pitch programmed above the maximum value and below the minimum value will result in stoppage of execution of the program and return to the manual operation page will result.
Press the E key to enter the PITCH.
The number of STARTS used in a program is always 1.
Key in a TOOL NUMBER and press E.
A SPINDLE speed is finally entered.

The value for the spindle speed depends on the pitch entered. The smaller the pitch, the faster the spindle speed.

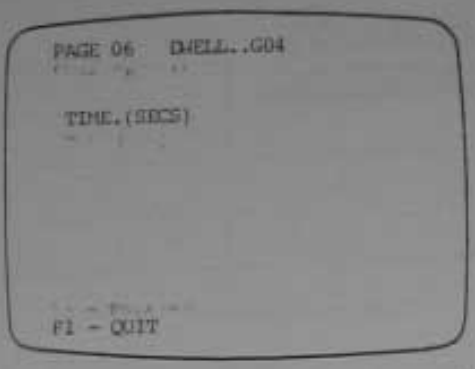
A general ratio of pitch to spindle speed is shown on the Graph of SPINDLE SPEED AGAINST PITCH (see page 47).
NOTE: The feedrate override will have no effect during execution of the screwcutting cycle.
Spindle speed override will affect the traverse of the cycle.
i.e. Increase of spindle speed will increase the feedrate and visa versa.

It is bad practice to effect a spindle speed override whilst in the screwcutting cycle because too high an increase could result in a return to the "MANUAL OPERATION" page. The red stop button under the manual section of the keyboard will have no effect whilst taking a pass along the material, however, it will stop execution on the return pass. To restart the execution press the square green start button under the manual section of the control panel and the tool will drop in at the correct point on the thread.

If on execution, the cut size on the X axis is too large, you must return to the menu by stopping the execution as explained above, and depressing the reset key underneath the right hand side of the machine. You are then in a position to edit the program.


SPINDLE SPEEDS
FOR SCREWCUTTING
SPINDLE SPEED R.P.M.
1000
900
800
700
600
500
400
300
200
100
·35
·5
1·0
1·5
2·0
2·5
3·0
3·5
MM
PITCH
INCHES
·014
·02
·039
·059
·079
·098
·118
·138

5. DWELL

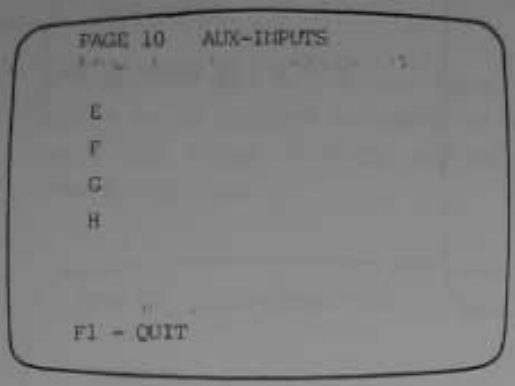


Selected by pressing the DWELL key

A DWELL can be entered at any stage in the program to stop the tool movement at certain point, maybe in a recess or a spot face. This value is entered in seconc up to a maximum of 99. During the execution of a DWELL the seconds will be counting down on the screen. Once at zero the execution of the program wil continue.

NOTE: DO NOT program a DWELL for a tool change.
See SECTION 25 PAGE 72 for tool changing.

6. AUXILLIARY INPUTS



Selected by pressing the AUX.1 key.

The 4 AUXILLIARY INPUTS, E F G H, can be programmed as a 'wait' or a 'hold' function by entering a control symbol in the program adjacent to the input letter. Entering a '0' (zero) causes the program to hold awaiting an input signal to that input terminal.
Entering a '1' (one) causes the program to hold awaiting the removal of an input signal to that input terminal.
Leaving a space means that any signal present should be ignored.

EXAMPLE A microswitch could be positioned in some way as to be activated by the guard, and wired into one of the input terminals, say E. (See section 33)
Program '0' into input E.
When the program reaches this page it will stop awaiting an input signal. i.e. The closure of the guard. Once it has received it the execution of the program will continue. If a '1' is programmed into input E the program will stop, awaiting the guard to be taken off the microswitch for execution of the program to continue.

SECTION 3

TECHNICAL SPECIFICATION

CAPACITIES:

SWING OVER BED	200 mm	8"
SWING OVER	115 mm	4½"
DISTANCE BETWEEN CENTRES	400 mm	15¾"

HEADSTOCK:

SPINDLE BORE	20 mm	25/32"
SPINDLE NOSE INTERNAL TAPER	No.3	
SPINDLE BEARINGS	TAPER ROLLER	
SPINDLE SPEEDS	STEPLESS	0-2000 RPM

THREADS AND FEEDS:

SCREWCUTTING PITCHES	.35-3.5mm	8-70 TPI
X AND Z AXIS SCREWS	BALLSCREWS	
RAPID TRAVERSE	1200 mm/min	47"/min
FEEDRATES	INFINATELY VARIABLE UP TO 1200 mm/min	47"/min

LINEAR AND CIRCULAR INTERPOLATION:

TAPERS	20:1	1:20
RADII	2 mm TO	3000 mm

CARRIAGE AND BED:

BED LENGTH	660 mm	26"
BED WIDTH	116 mm	4½"
GROUND AND HARDENED	2 VEES-2 FLATS	
CROSS SLIDE MOVEMENT	95 mm	
TOP SLIDE TO SPINDLE CENTRE LINE	19 mm	¾"

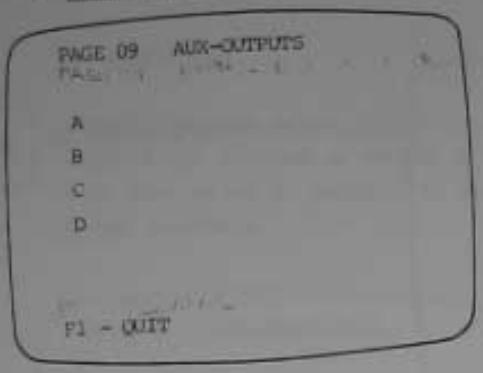
TAILSTOCK:

BARREL TAPER	No.2
BARREL MOVEMENT	50 mm
BARREL GRADUATIONS	MILLIMETRES

MOTORS:

MAIN DRIVE MOTOR	0.37 KW	380-420 V	1.3A	AC
STEPPER MOTOR X	200 STEPS/REV	DC	2.9 V	3.1A
STEPPER MOTOR Z	200 STEPS/REV	DC	2.9 V	3.1A

7. AUXILLIARY OUTPUTS



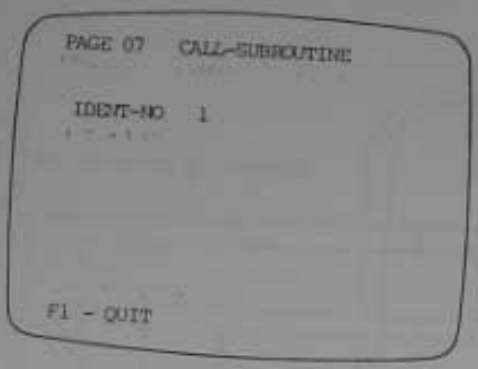
Selected by pressing the AUX.O key

The 4 output relays, A B C D, can be used to control auxiliary equipment by entering either a '1' (one) or '0' (zero) adjacent to the relay letter.
Entering a '1' (one) causes the relay to switch on.
Entering a '0' (zero) causes the relay to switch off.
Leaving a space means no change in state.

EXAMPLE It is possible to control spray mist coolant through the AUXILLIARY OUTP due to the fact that it is controlled electrically. Connect up to a output terminal, say 'B' and program a '1' opposite B at the output pag Once this page is reached in the program the coolant will turn on. turn the coolant off at a later stage in the program, call up t auxiliary output page and program a '0' opposite B.

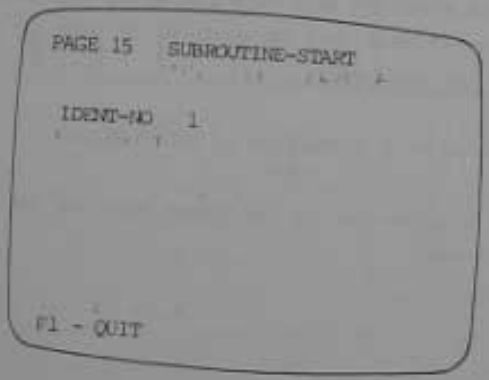
8. SUBROUTINES

A SUBROUTINE must be put into memory after the end of the main program and then called to be utilized as needed by the program. A SUBROUTINE is like a canned cycle that is put in memory with an identifying number and then can be called at several locations.



Selected by pressing the CALL key.

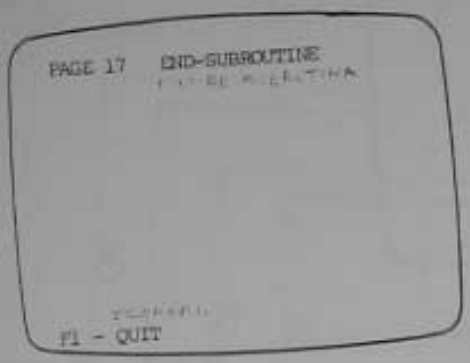
This function is used to CALL up a SUBROUTINE in a program. The numbers entered opposite the IDENT-NO should correspond to the number given to the SUBROUTINE outside the main program. A SUBROUTINE can be called as many times as is necessary up to a maximum of 99.



Selected by pressing the SUB key.

This function signifies the START of a SUBROUTINE and should only be programmed after the main program has been completed.
i.e. If the main program is 10 pages long the subroutine should start at page 11 or any subsequent page.

The identity number is given to the subroutine so more than one subroutine can called up using the "CALL" key. The identity number for a subroutine should be maximum of 2 digits. Three or more digits would register as a program error. T page after SUBROUTINE START should be incremental - a subroutine in absolute wou be executed in the same place each time.



Selected by pressing the END SUB ke

This function will END THE SUBROUTINE. The page before END OF SUBROUTINE sho always carry the necessary format for the continuation of the program.
e.g. If the page in the program after the call of a subroutine has been programm as an absolute dimension, it will only be executed as such if absolute programmed at the end of the subroutine.

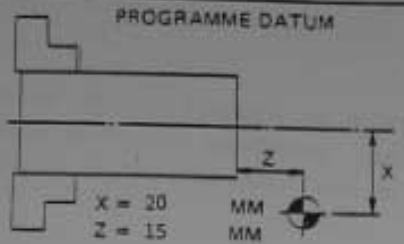
N.B. ALWAYS start the programming of a subroutine in INCREMENTAL.

Always end the programming of a subroutine in the format used for the rest of program.
e.g. of a subroutine build up.

40
38
32
30
18
12
10
Z_o
X_o
20 DIA
30 DIA

DRAWING No.	SUBROUTINE
DESCRIPTION	
CASSETTE I/D	
MATERIAL	
PROGRAMME BY	AMD
DATE	18-5-83

BELOW IS AN EXAMPLE OF A THREAD CUTTING PAGE



ORA

TOOLING.

No.	TOOL REF
0	
1	REF POS TOOL
2	
3	
4	
5	
6	
7	
8	
9	

PAGE _____ THREAD DIA _____ ROOT DIA _____ CUT. INCR...X _____ LENGTH Z (INCR) _____ PITCH

STARTS _____ TOOL No _____ SPINDLE SPEED _____

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPI SPE
		X	Z	X	Z					
01	MM									
02	ABS									
03	PROG DAT	20	15							
04	PTP	16	-12					1000	1	600
05	CALL 1									
06	PTP	16	-32					1000	1	600
07	CALL 1									
08	PTP	20	15					1000	0	600
09	END									
10										
11										
12	SUB 1									
13	INCR									
14		-6	0							
15		6	0					40	1	
16		0	-8					1000	1	600
17		-6	0					1000	1	600
18		6	0					40	1	600
19	ABS							1000	1	600
20	END SUB									

9. DO-LOOPS

When the operator desires the same operation or series of operations to be done several times the DO-LOOP is of great importance. The operator need only program the first complete sequence, he may then repeat this as many times as he desires up to a maximum of 99.

The manner in which this is accomplished is as follows:
Depress Do 'N' where N is the count or the number of times the routine is to be repeated. Advance to the next page. The information now programmed will be repeated the desired number of times. After entering this information end the DO-LOOP by depressing the "END DO" key.

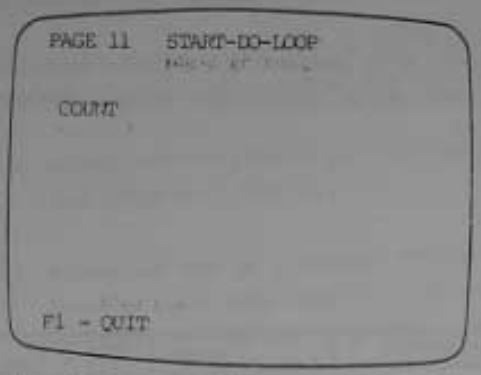
Example: Suppose a bar of diameter 20 mm requires turning down to a finish diameter of 10 mm, 25 mm long, this can be accomplished using a DO-LOOP.

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDL SPEED
		X	Z	X	Z					
01	MM									
02	ABS									
03	PROG DAT	10	5							
04	PTP	10	0.5					1000	1	1000
	DO 5									
06	INCR									
07	PTP			-1.0	0			1000	1	1000
08	PTP			0	-25.5			100	1	1000
09	PTP			0.5	0			1000	1	1000
10	PTP			0	25.5			1000	1	1000
11	PTP			-0.5	0			1000	1	1000
12	END DO									

In this DO-LOOP the tool moves towards the centre line 1 mm. A cut is then turne towards the chuck 25.5 mm, giving a turned length of 25 mm. The tool then retract 0.5 mm to avoid leaving trail lines, and returns to its Z start position. The too then returns to its X start position.

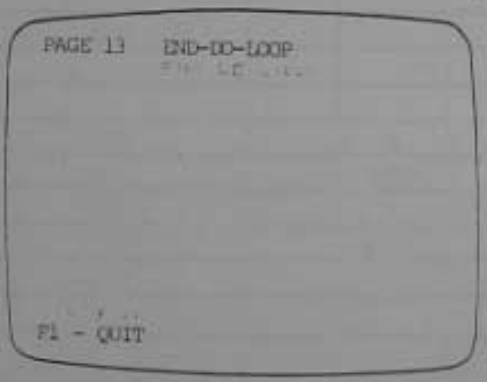
This operation is repeated 5 times leaving the bar the desired 10 mm diameter Please note the time savings involved: Rather than having to program eac individual pass and tool retraction etc. by using point to point commands whic would have taken a total of 20 pages, the same was done in a DO-LOOP using only pages.

Instructions in a DO-LOOP are usually INCREMENTAL.



Selected by pressing the DO key

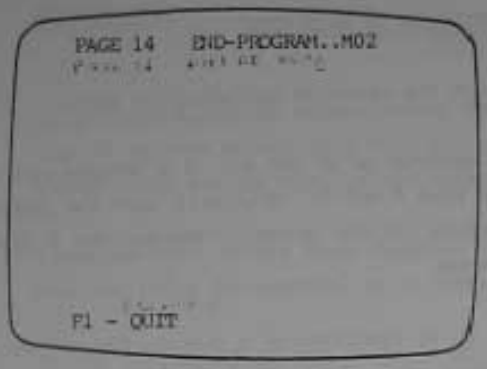
This function signifies the start of a DO-LOOP. The Count is the number of tim the series of operations is to be repeated. Any value from 1-99 can be entere Any value above 99 would register as a program error.



Selected by pressing the END DO key

This function signifies the END of DO-LOOP. It is worthwhile remembering at th stage that unless altered, the format is still in incremental.

10.



Selected by pressing the END key.

This function signifies the end of the program. However, subroutines can still be programmed after the main program has been completed.

If the completion of a program has now been made it will be necessary to return to menu. (See SECTION 19 PAGE 58.)

NOTE: Before the end of a program ensure that TOOL 0 is programmed in the last point to point page along with the program Datum X and Z positions. This is necessary because any other tool programmed will carry an offset and thus re-execution will start from a different position.

SECTION 19

RETURNING TO MAIN MENU

There are 3 different ways in which the operator can return to menu.

1. If midway through entering a program or at the end of a program you can retur to the main menu by pressing keys F and I. This will list the program error and show the total at the bottom of the screen. Depress the E key and thi will return you to the main menu.

2. If at any stage in the build up or execution of a program you can return to th main menu be pressing the reset key under the right hand side of the contro panel. This WILL NOT cancel the program.

3. On depression of the emergency stop button the control automatically drop to the MANUAL OPERATION mode. Once in this mode you can return to the main me by depressing the square red stop key under the manual section of the keyboar

SECTION 20

PROGRAM ERRORS

On quitting a program either midway through or at the end by pressing F and I, a list of program errors is given, and the screen displays the pages at which these errors occur and the total at the bottom of the screen.

A program error refers to an omission of a value in the build up of a program. It does not refer for example, to an oversized dimension or a high feedrate.

On the displaying of the program errors make a note of the pages and edit the program accordingly. Press E and this will return you to the main menu. If program errors are still present, on Execution of the program the number of errors and the pages will again be displayed after the depression of keys 7 and E. The operator cannot, however, proceed with the execution of the program because on the depression of the E key, the screen will return to the main menu. It is therefore necessary to correct all the errors via the edit mode before execution can take place.

CNC CONSOLE

- 0.01 mm 0.0005"

MACHINE DIMENSIONS (OVERALL):

RIABLE

LENGTH	920 mm	36"
HEIGHT	540 mm	21"
WIDTH	560 mm	22"
WEIGHT	140 kg	310 lbs

SECTION 22

TO STORE A PROGRAM ON CASSETTE

If a program in memory requires storing on a cassette, firstly return to the main menu. Now press keys 2 then E. The screen then displays

CASSETTE LOADED?

Place the cassette into the holder with the side to be used for storing the program face out. Close the holder and depress the E key. The screen will now ask for the identity number of the new program.

Enter a 1 to 4 digit number and press E. With the entering of the fourth digit the cassette will automatically rewind and store the program on cassette.

If the program previously on cassette has been altered and is now being replaced on the same cassette, give it a different I.D. Number, to avoid complications the next time the cassette is used. A program previously on cassette will be erased by the storage of a new program even if they are of different lengths.

To Abort a storage of a program once the cassette has started to rewind depress the reset button under the right hand side of the control unit. This will result in a return to the main menu.

Once the program has been stored on the cassette the screen will display

"program transfer complete".

If you require to store a program indefinitely on cassette, remove the black pin located in the corner of the cassette, for which ever side is being used. Now write the identity number given to that program on the cassette for future reference.

SECTION 23

EDITING A PROGRAM

Once a program is in memory and requires EDITING firstly return to the main menu Now select editing mode by depressing keys 6 then E. Page one will now b displayed on the screen. To advance through the pages of the program press the ke with the 2 arrows in the downward direction. Each time the key is depressed th page will advance by one.

CHANGING DATA

Once at the page which requires altering take the cursor down to the required line This can be done using either the E key or the single arrowed keys. With th cursor at the required line, take it under the value which is to be altered.

This value can now be altered in 3 different ways.

E.G.

1. If the current value of say 100 is to be changed to 250, take the cursor und the 1 in 100 and now key in the new value of 250. This will automatically written over the top and the new value will now be displayed.
2. If the current value of say 250 is to be changed to 25, take the cursor und the 0 in 250 and press the 'S' key. This will put a 'SPACE' in place of t zero and 25 will currently be displayed.
3. If the current value of say 150 is to be changed to say 1900, this can altered using either method 1 or by taking the cursor under any number value 150 and pressing the 'D' key to delete the full value. Once deleted enter t new information of 1900.

TO CHANGE THE FUNCTION OF A PAGE

Select the required page and then depress the new function key. This wi automatically delete the existing page and the new function will be displaye Enter the data applicable to that page in the normal manner.

DELETING A PAGE

Select the required page and depress the 'P' key (PAGE DELETE). That informati will automatically be cleared form memory. This will result in all the followi pages having their page number decreased by one automatically.

E.G. If page 10 is to be deleted, carry out the instruction on the previous page. Page 11 will now become page 10, page 12 will now become page 11 and so on.

INSERTING A PAGE

Once you have completed a program it sometimes becomes necessary to add a page somewhere in the middle of the program. For example, if you had a 50 page program, and you found that in between pages 20 and 21 you wanted to insert another page, ORAC is equipped to handle this situation. In order to accomplish this select page 21 and the data present in that page will be displayed. At this point press the 'P' key (page insert key). Page 21 will still be displayed, however, there will be no data present. The information previously at page 21 will now have been moved forward to page 22. To enter the new information into page 21 depress the appropriate function key and enter the information in the normal manner.

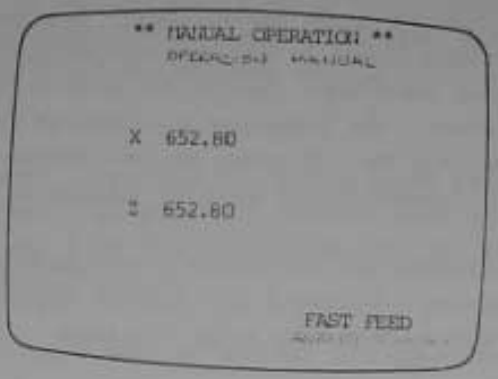
When it is decided that the program is satisfactory, exit from the edit routine by depressing keys F followed by 1. Check no program errors are present and depress E. This will now return you to the main menu.

SECTION 24

EXECUTING A PROGRAM

Once a program has been loaded into memory and all editing is complete you are n ready to machine the part. Unlock the emergency Stop Button and depress keys 7 an

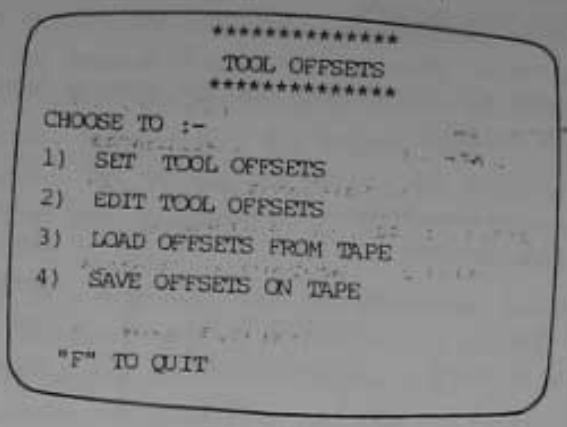
The total number of progras errors are now displayed. With no errors in t program depress E and the screen will display:



The tool can now be moved under manual control on both axis using the axis - buttons located under the manual section of the keyboard. The initial feedrate f the jogs is indicated on the screen as FAST FEED. The feedrate can be changed depressing the "RAPID" key. See section 13 PAGE 26 for manual controls.

NOTE Until tool offsets have been set the actual values displayed for X and Z gi no indication of actual tool position. Once in manual control aft setting of the tools is complete the display indicates the actual position Both axis in absolute units, taken from X zero and Z zero.

To proceed with the execution of the program, press the square red 'STOP' key unc the manual section of the keyboard. This stops manual operation and the TO OFFSET menu will be displayed.



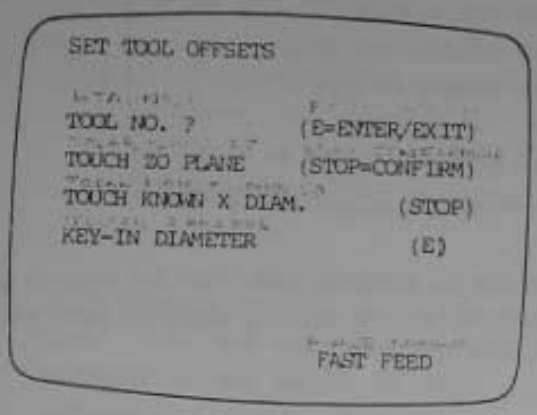
In order for the machine to produce an accurate part from the program the computer must know the difference in position of the cutting edges of each tool in both X and Z axis.

The control system can store up to 9 pairs of tool offsets. Tool 0 is designated as a reference tool. All other offsets are relative to this tool.

SECTION 25

1. TO SET TOOL OFFSETS

For setting all the offsets for the program depress keys 1 then E. The page is displayed as shown.



Key in the tool number and press E for Enter. If it is required to return to the menu omit the number and simply press E for Exit.

The first tool number will be TOOL 0. Depress 0 then 'E'.

Touch on the Zo Plane with the tool. This is normally taken as the end of the workpiece. Do this using the axis jog buttons. The feedrate is indicated on the bottom right hand corner of the screen. The initial feedrate if FAST, however, is advisable to approach the job on SLOW and the STEP feed. If necessary face the work using the jog buttons. Once satisfied that the tool is set at the end of the workpiece press the square red 'STOP' key. The Z axis is now set at zero for this tool.

To set the X axis touch on a known X diameter, again using the axis jog buttons.

NOTE THE FEEDRATE INDICATE ON THE SCREEN MAY NOT BE THE ACTUAL FEEDRATE THAT IS ACTIVE. PRESS THE 'HAND' KEY TO BRING THE CURSOR DOWN TO THE FEEDRATE. THIS IS NOW THE ACTIVE FEEDRATE.

If the diameter is not true use the jog buttons to turn a diameter.

Once the diameter has been turned take the tool away from the work on the Z axis only, leaving the tool level with the diameter. To set the position of the tool on the X axis, press 'STOP'.

Stop the spindle and measure the diameter. Now key in the diameter in the SAME units as chosen for the Program Datum. If the wrong value is entered, take the cursor back under the numbers and overwrite as in the edit mode. When satisfied that the value is correct depress 'E'. The setting page will appear again for the setting of the next tool. Set the offsets for all the tools as explained and then return to the tool offset menu by pressing 'E' for Exit.

NOTE: Tool 0 is chosen as a reference tool and should not be used as a tool during a program. The reference tool is set so that a program using several tools can easily be re-executed for the following batch by taking the offsets off tape and then setting the reference tool, as ALL offsets are taken relative to this tool.

It is possible however, in a single tool program to use tool one as this reference tool. I.E. Set tool 0 as previously explained using tool 1. It is then not necessary to set tool 1 as this is the same tool and therefore will have no difference in position to tool 0.

When satisfied with the offsets and with the tool offset menu on the screen, you can edit the offsets.

2. EDITING THE TOOL OFFSETS

Depress keys 2 then E. The offsets for each tool relative to tool 0 will now b shown as below.

```
**  TOOL  OFFSET  EDIT  **
          X        Z
TOOL.0   000.00  000.00
TOOL.1  -002.35  000.10
TOOL.2   010.15 -020.75
TOOL.3   001.00  000.10
TOOL.4   000.00  000.00
TOOL.5   000.00  000.00
TOOL.6   000.00  000.00
TOOL.7   000.00  000.00
TOOL.8   000.00  000.00
TOOL.9   000.00  000.00

"F" TO QUIT
```

The offsets are displayed in the uni selected for the program Datum.

The offsets shown in the example can be interpreted as overleaf:

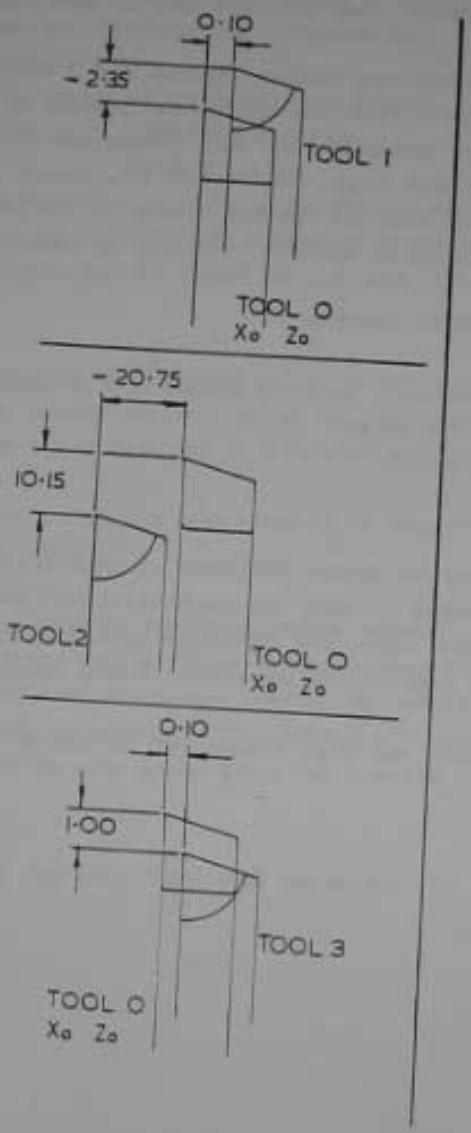
If after producing several components a diameter is oversize, a tool offset can edited to compensate for the tool wear.

If say tool 2 was used to finish turn this diameter and it was found to be 1 oversize, the offset value on the X axis must be INCREASED by 0.5 mm giving a n value of 10.65 mm. Using the single arrowed keys take the cursor to the line f tool 2 and key in the new value 10.65 under the X axis column.

If say tool 1 was the tool being used and the diameter was 1 mm oversize, t offset value on the X axis would have 0.5 mm added to it giving a new value -1.85 mm.

The editing procedure explained above should be applied in exactly the same way f altering the lengths of components.

Once it has been established that the offsets are satisfactory return to the TO OFFSET menu again by pressing 'F' to Quit, as instructed on the screen.


0·10
-2·35
TOOL 1
TOOL 0
Xo Zo
-20·75
10·15
TOOL2
TOOL 0
Xo Zo
0·10
1·00
TOOL 3
TOOL 0
Xo Zo

CNC CONSOL:

RESOLUTION	- 0.01 mm	0.0005"
FEEDRATE INFINATELY VARIABLE UP TO	1200 mm/min	47"/min
RAPID TRAVERSE	1200 mm/min	47"/min
SPINDLE SPEEDS	0-2000 R.P.M.	INFINATELY VARIABLE
TOOL OFFSETS UP TO 10 PAIRS		
PROGRAM LENGTH UP TO 99 BLOCKS		
PROGRAM AND TOOL OFFSET STORAGE ON MINI CASSETTE		
PROGRAM DISPLAY	- 5" V.D.U.	
KEYBOARD	- TOUCH TONE	
CONTROL SYSTEM	- SYNTELECT	
AUXILIARY OUTPUTS	- 4	
AUXILIARY INPUTS	- 4	
DATA INPUT	- ALPHA/NUMERIC KEYBOARD	
FORMAT	- ABSOLUTE AND INCREMENTAL	
DO LOOP AND SUB-ROUTINE FACILITY		
COMPUTER DATA LINK	- RS 232 C	
TOOL COMPENSATION VIA TOOL OFFSET EDIT FACILITY		
SINGLE PHASE INPUT	220/250V/50 HZ	
	110/115V/60 HZ	

SAFETY FEATURES

KEY OPERATED ISOLATOR SWITCH
DIAGNOSTIC FAULT FINDER
TOTALLY ENCLOSED CHUCK GUARD
AXIS LIMIT SWITCHES

3. LOADING OFFSETS FROM TAPE

If a program to be executed, has offsets that have previously been stored o cassette, it can be re-executed by taking the offsets from tape and setting tool O (Providing, of course, that the tools have not been moved in the holders.)

With the tool offset menu current, depress keys 3 then E. The screen will displa "CASSETTE LOADED?". Place the appropriate cassette in the holder and press E. Th operation is now automatic, the tape rewinds and then moves forward to load th Data. When the tape stops, the Cassette I.D. Number is displayed, along with th Checksum. Check that the Identity number is the same as the one given to th offsets when stored on cassette. Confirm by depressing 'E' and the screen wil display

"DATA TRANSFER COMPLETE"

If this does not occur, an error message will be observed such as

"INSUFFICIENT MEMORY"

"CHECKSUM ERROR"

"ABORTED"

(In both loading and saving functions, if error messages occur, then the operatic should be repeated in case the malfunction was caused, for example, by a li transient or some other none repetitive interference. If continued error messag occur then the cassette has most probably been damaged.)

Once offset data has been transferred to memory the tool offset menu will displayed.

4. TO SAVE THE OFFSETS ON TAPE

Once all the tool offsets have been set it may be necessary to store these offsets on tape to be used the following day. Depress keys 4 then E. The screen will display CASSETTE LOADED?

Place a cassette in the holder and depress the E key.

The screen will display CASSETTE LOADED? OK
CASSETTE ID NO.

Key in an Identity Number up to 4 digits and depress the E key. With the entering of the fourth digit the cassette will automatically rewind and store the offsets on cassette. The offsets can be stored on the same side of the cassette as the program.

The Checksum Number will be displayed on the screen when the E key is depressed. This, as with the program storage, gives an indication of the memory used in storing the offsets and is displayed as a Hexadecimal number.

When the transfer of the offsets onto cassette is complete, the screen will display "DATA TRANSFER COMPLETE"

Note that the tape transport mechanism starts automatically, first rewinding the tape back to the start, then operating in the forward direction and recording the offset Data. If for some reason that Data is not transferred onto the tape, this last message will be displayed as "TOOL OFFSETS NOT VALID" or "ABORTED". Repeat the procedure and if the same occurs try a new cassette as the existing one is most likely damaged.

Once the information has been transferred the screen will return to the tool offset menu.

To continue with the execution of the program depress 'F' to Quit as instructed o the screen.

It is improtant to note that before depressing 'F' to Quit the offset routin remove the last tool set. Failure to do so could result in the axis moving to t program datum and colliding with the work.

The axis will now move to the program datum and this position will be displayed o the screen. If, however, on completion of the offsets, the axis happen to positioned at the program Datum, then X and Z will be displayed with no position because no movement has occurred.

Page number 4 will be displaying these positions as well as the current feedrat and the desired tool number. The spindle speed will be displayed once the progr has started.

Pages 1, 2 and 3 have already been executed.

Before starting the execution of the program, ensure that the correct tool fitted as indicated in the display. Now start the spindle with the round green k under the spindle controls, and then start the cycle by pressing the square gre key under the manual section of the keyboard.

The machine will execute the program page by page, changing speeds and feeds programmed, and only stopping for tool changes, a Dwell, or whilst waiting for programmed input to occur.

When a tool change occurs the axis and spindle stop, and the next tool num displayed on the screen indicated by the flashing cursor. To restart the progr change the tool and start the spindle. With the spindle running depress the sta button under the manual section of the keyboard. The tool offset is automatical set for the new tool before execution continues.

On the completion of the penultimate page, the machine will stop and request for tool change to tool 0. Take out the current tool and continue with the executi back to program Datum. It is not necessary to place tool 0 in the holder as it h no particular function.

When the program is finally complete, the screen will display "LAST PAGE", and th return to the main menu.

SECTION 26

EXECUTING THE 2ND OFF

On completion of a program it may be necessary to repeat the same component several times. It is therefore necessary to have the same length of bar extended from the chuck jaws. Tool 0 can be used as a bar stop.

Therefore with the finished component still in the chuck program a tool change away from the work to Tool 0. The axis will stop and await confirmation. Insert Tool 0 and program this tool to travel to Xo Zo where a further tool change should be programmed, to say Tool 1. At this point tool 0 is at Zo with no offsets, and the spindle and axis will stop awaiting a tool change. At this point take out the finished component and insert the new blank, pulling it out to touch Tool 0 (the Bar Stop) and tighten the chuck. The new bar now has exactly the same Zo as the finished component. Take out tool 0 and start the rest of the cycle. Remember to return to the program Datum with tool 0 in the last page.

To start the re-execution of the program depress 7 then E.
Depress E if no errors are present.
Depress the stop key to stop manual operation.

If all the sizes on the completed component were correct, and it is not necessary to edit the tool offsets, depress 'F' to Quit. The screen will display page 4 and the current X and Z positions.

Start the spindle and then the cycle.

SECTION 27

TOOL BREAKAGE

During the execution of a program it is possible that the tool could break or cau a bad surface finish by shattering due to excessive tool wear.

To overcome this problem simply stop the execution by depressing the square r stop key under the manual section of the keyboard. It will now be necessary take the tool away from the work in order to be able to change tip or to remo from the holder to regrind. This can be done using the axis jog buttons. Depre "MAN" under the manual section, and "MANUAL OPERATION" will be displayed, alo with the current X and Z dimensions. Now by depressing the appropriate axis j buttons the tool can be brought away from the work. Carry out whatever necessary with the tool and stop manual operation be depressing the "STOP" ke The TOOL OFFSET MENU will now be displayed.

If a tool has been reground, it may be necessary to reset the tool offset. Car out the procedure as explained in section 25 page 66. When satisfied with t tool, depress 'F' to Quit the offset routine.

The axis will now return to the start of the movement in which the tool was damac and continue its execution.

NOTE: Ensure the spindle is running before depressing 'F' to Quit the offs routine.

SECTION 28

THE RESET BUTTONS

You will notice on the front panel there are 2 'RESET' labels. These are to indicate the buttons located below the front panel. The reset button on the right hand side of the control panel situated below the cassette unit can be depressed at any stage during a program build up or execution and will result in a return to the main menu, WITHOUT LOSS OF MEMORY. If depressed during the execution of the program it is advisable to reset tool 0 again.

The reset button located below the manual controls is used for resetting the limit switches on the axis of the machine. (Located at either end on the X axis and at the Headstock end on the Z axis.) If, during manual operation of the axis or during the exectuion of a program, the X axis (and Z axis on some systems) hits the limit switches then the screen will display "MANUAL OPERATION" and the axis and spindle are inoperative. To reset the switches depress the reset button and hold, while at the SAME TIME depressing the axis jog button to move the axis away from the limit switch. Once this has been accomplished the reset key can be released. If this occurs during the execution of a program, re-execution must commence from page 1.

SECTION 29

GUIDELINES

Following these guidelines will assist the operator, and reduce costly programmi errors.

1. Start each program with the units or format in pages 1 and 2 and follow the with the Program Datum.

2. Do-loops and Subroutines should usually be programmed incrementally.

3. Remember to return to the format used for the rest of the program at the e of a Do-loop or Subroutine.

4. Subroutines must be entered after the end of the program.

5. Subroutines cannot be contained within subroutines or Do-loops. (I.E. Nested

6. Do-loops cannot be nested within Do-loops or Subroutines.

7. Do not override the maximum feedrate of 1200 mm/min 47"/min.

8. Ensure that the feedrate programmed is compatible with the units selected.

9. The minimum feedrate for circular interpolation should be 40 mm/min 1.5 inches/min.

10. Any minor arc (less than 180°) either CW or CCW can be programmed in one Major arcs (greater than 180°) should be constructed using two minor arcs.

11. Do not program a radius which is less than the value to join the X & poin specified.

12. Units and/or format may be changed during the pages of a program.

13. Metric Ballscrews are used in ORAC, so therefore its prime units are MM.

14. If keywords on pages are accidently deleted (e.g. FEEDRATE) this will cause program error to be displayed when the program is compiled. This can only corrected by re-entering the page function and all the Data again.

15. Too high a spindle speed or too coarse a pitch in the threading cycle will cause automatic rejection during execution and a return to "MANUAL OPERATION" will result, and the program must be re-executed from the start.

16. To ensure accurate repetitive re-execution of a program, reference tool 0 should be programmed in the last point to point page as this carries no tool offsets on the X and Z axis.

17. No point to point pages should be programmed without a movement on X or Z. e.g. If already at X15 Z10 the following page cannot contain both these values (above in absolute format - same applies for incremental format).

18. Taper turning on ORAC is done using the point to point function. The maximum ratio between the 2 axis is 35:1. I.E. 1 mm on X to 35 mm on Z and visa versa.

19. Write the program down and update the written copy as you are editing.

20. Program the tools in sequence, always starting at number 1. Keep the written program and record the tool description on it.

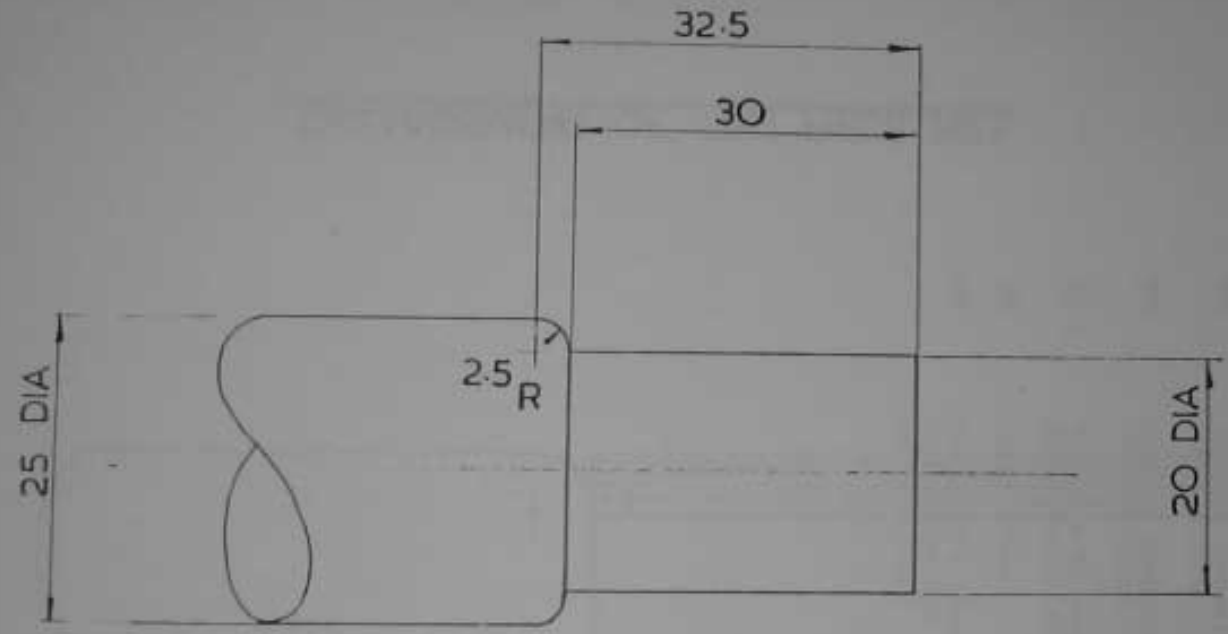
21. Ensure, before turning a diameter during the setting of the X axis offset, that the cursor is flashing below the feedrate. Any other feedrate displayed without the flashing cursor may not be the active feedrate.

22. Ensure the emergency stop button is unlocked before depressing the 'F' key to quit the offset routine.

23. THINK!

SECTION 30

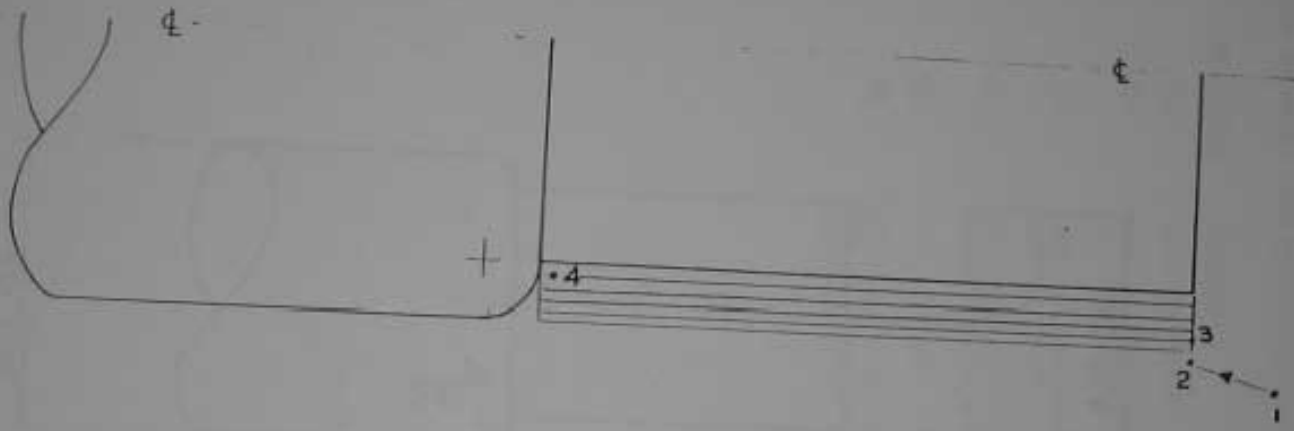
PROGRAMMING EXAMPLES



TEST PIECE Nº 1

STANDARD EQUIPMENT

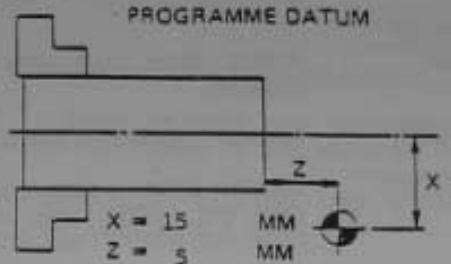
RS 232 LINK FOR COMPUTER OR PRINTER.
QUICK CHANGE TOOLPOST AND HOLDER.
SELF CENTRING 3 JAW CHUCK.
SET OF OUTSIDE JAWS.
SAFETY GUARDS.
INSTRUCTION MANUAL AND PARTS LIST.
MAP LIGHT.
STEREO CASSETTE DECK.
2 HI-FREQUENCY SPEAKERS AND HEADPHONE OUTLET.
AUDIO INSTRUCTION TAPE.
VIDEO INSTRUCTION FILM.
SOLAR CALCULATOR.
CO AXIAL T.V. SOCKET FOR V.D.U.
LATHE MAINTENANCE TOOLS.
MINI MAGNETIC CASSETTE FOR PROGRAM STORAGE.
2 FUSES.
MACHINE PLUG.
TEST PROGRAM WITH COMPONENT.



ENLARGEMENT OF TEST PIECE Nº 1

DRAWING No.	TEST PIECE 1
DESCRIPTION	
CASSETTE I/D	
MATERIAL	M/S AL
PROGRAMME BY	AMD
DATE	

BELOW IS AN EXAMPLE OF A THREAD CUTTING PAGE



ORAC

TOOLING

No.	TOOL REF
0	
1	R.H. KNIFE TOOL
2	
3	
4	
5	
6	
7	
8	
9	
10	

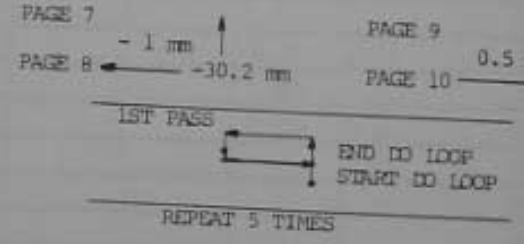
PAGE ____ THREAD DIA ____ ROOT DIA ____ CUT. INCR...X ____ LENGTH Z (INCR) ____ PITCH ____

" STARTS ____ TOOL No ____ SPINDLE SPEED ____

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
	MM									
02	ABS									
03	PROG DAT	15	5							
04	PTP	13	0.2					1000	1	800
05	DO 5									
06	INCR									
07	PTP			-1	0			1000	1	800
08	PTP			0	-30.2			90	1	800
09	PTP			0.5	0			1000	1	800
10	PTP			0	30.2			1000	1	800
11	END DO									
12	ABS									
13	PTP	10.1	-29.9					1000	1	1000
	PTP	10	-30					100	1	1000
15	CIRC	12.5	-32.5			2.5	CW	50	1	900
16	PTP	15	0					1000	1	900
17	PTP	15	5					1000	0	900
18	END									

TEST PIECE 1

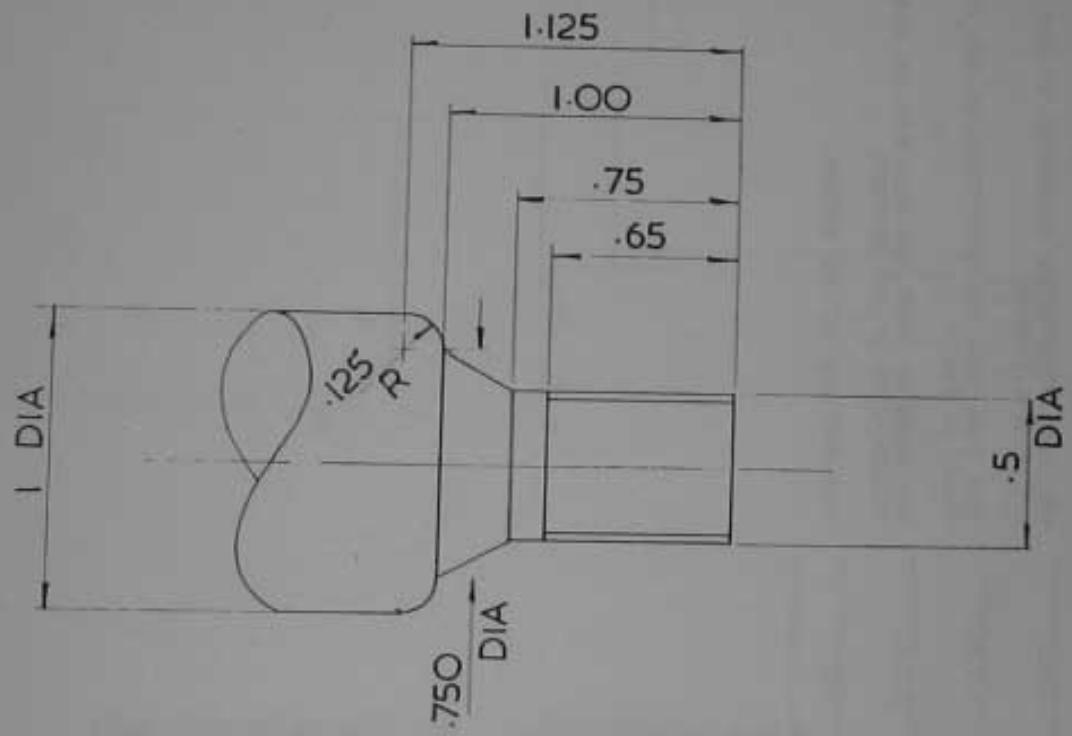
Page No.	Function	
01	METRIC	METRIC UNITS HAVE BEEN SELECTED AND WILL EFFECT UNTIL CHANGED.
02	ABSOLUTE	ABSOLUTE FORMAT SELECTED AND WILL EFFECT UNTIL CHANGED.
03	PROG. DAT.	PROGRAM DATUM SHOULD NOW BE SET WITH THE 'X' VALUE TAKEN FROM THE CENTRE LINE OF THE SPINDLE AND THE 'Z' AXIS FROM THE END OF THE WORKPIECE. 'X' 15.0 MM 'Z' 5.0 MM (1).
04	P.T.P.	POINT TO POINT SELECTED TO MOVE THE TOOL TO A POSITION NEARER THE WORKPIECE READY FOR TURNING - (2).
05	DO 5	THE START OF A DO LOOP IS NOT BEING CALLED. A COUNT IS ENTERED OF 5. EACH PAGE OF INFORMATION ENTERED FROM THIS PAGE UNTIL A PAGE CONTAINING END DO FUNCTION WILL BE REPEATED 5 TIMES.
06	INCREMENTAL	INCREMENTAL FORMAT SELECTED.
07	P.T.P.	THIS PAGE MOVES THE TOOL IN A DIRECTION TOWARDS THE CENTRE LINE OF THE SPINDLE OF ONE MILLIMETRE TO POSITON (3).
08	P.T.P.	THE TOOL IS PROGRAMMED TO MOVE TOWARDS THE CHUCK 30.2 MM GIVING A TURNED LENGTH OF 30 MM.
09	P.T.P.	THE TOOL NOW WITHDRAWS 0.5 MM TO CLEAR THE WORK.
10	P.T.P.	THE TOOL IS PROGRAMMED TO RETURN TO 'Z' POSITION OF PAGE 7.
11	END DO	THIS WILL END THE DO LOOP AFTER 5 PASSES HAVE BEEN COMPLETED. EACH PASS HAVING A DEPTH OF 0.5 MM. I.E.



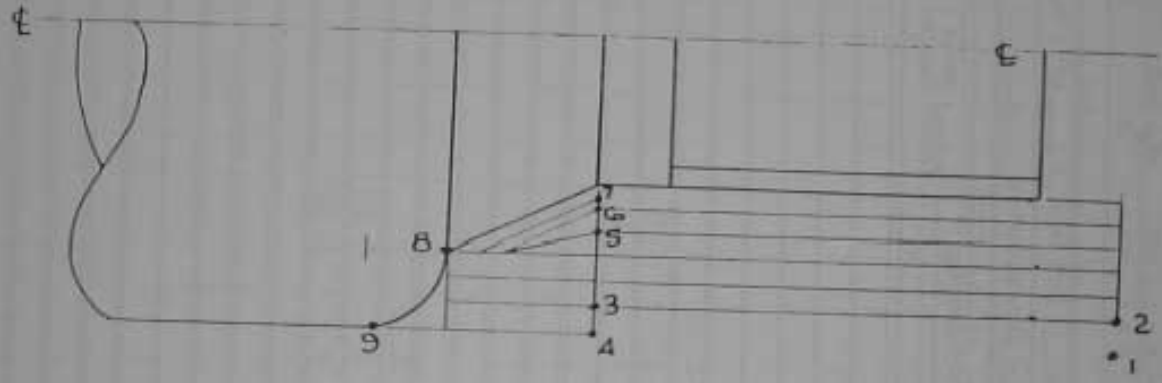
/CONTINUED

TEST PIECE 1 /CONTINUED

Page No.	Function	
12	ABSOLUTE	ABSOLUTE FORMAT NOW SELECTED.
13	P.T.P.	A POINT TO POINT PAGE WILL NOW MOVE THE TOOL JUST SHORT OF THE CORNER OF THE SHOULDER JUST TURNED. POSITION (4).
14	P.T.P.	THIS POINT TO POINT PAGE MOVES THE TOOL DIRECTLY INTO THE CORNER AT A SLOW FEED.
15	CIRC.	CIRCULAR INTERPOLATION PROGRAMMED TO GIVE A RADIUS OF 2.5 MM IN A QUADRANT.
16	P.T.P.	THIS PAGE TAKE THE TOOL CLEAR OF THE WORK READY TO CHANGE TO TOOL 0.
17	P.T.P.	THIS POINT TO POINT PAGE WILL TAKE THE TOOL BACK TO THE PROGRAM DATUM AT FAST TRAVERSE.
18	END	THIS PAGE WILL END THE PROGRAM.



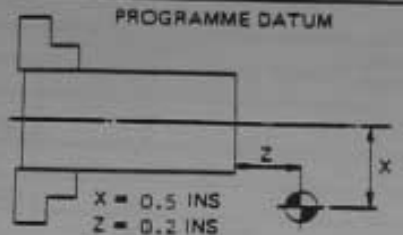
TEST PIECE Nº 2



ENLARGEMENT OF TEST PIECE Nº 2

DRAWING No.	
DESCRIPTION	TEST PIECE 2
CASSETTE I/D	
MATERIAL	M/S AL
PROGRAMME BY	AMD
DATE	

BELOW IS AN EXAMPLE OF A THREAD CUTTING PAGE



ORAC

TOOLING

No.	TOOL REF
- 1	[illegible]
- 2	[illegible]
- 3	
- 4	
- 5	
- 6	
- 7	
- 8	

PAGE ____ THREAD DIA ____ ROOT DIA ____ CUT. INCR...X ____ LENGTH Z (INCR) ____ PITCH ____

" STARTS ____ TOOL No ____ SPINDLE SPEED ____

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
01	INCH									
02	ABS									
03	PROG DAT	0.5	0.2							
04	DO 5									
05	INCR									
06	PTP			-0.050	0			30	1	900
07	PTP			0	-0.95			4	1	900
08	PTP			0	0.95			30	1	900
09	END DO									
10	ABS									
11	PTP	0.5	-0.750					30	1	1000
12	DO 3									
13	INC									
14	PTP			-0.041	0			30	1	10[illegible]
15	PTP			0	-0.250			3	1	1000
16	PTP			0	0.250			30	1	1000
17	END DO									
18	ABS									
19	PTP	0.325	-0.750					20	1	1200
20	PTP	0.375	-0.95					3	1	1200
21	PTP	0.325	-0.75					30	1	1200
22	PTP	0.280	-0.75					30	1	1300
23	PTP	0.375	-0.95					3	1	1300
24	PTP	0.280	-0.75					30	1	1300
25	PTP	0.255	-0.75					30	1	1300
26	PTP	0.375	-0.99					3	1	1300
27	PTP	0.255	-0.75					30	1	1300

SHEET No. 2 TEST PIECE 2

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
28	PTP	0.25	-0.75					30	1	1300
29	PTP	0.375	-1.0					3	1	1300
30	CIRC	0.5	-1.125			0.125	CW	3	1	1400
31	PTP	1	0.1					30	1	1600
32	PTP	0.25	0.1					30	2	130
33	THRD	DIA = 0.5		ROOT DIA = 0.393			X(INCR) .004			
	LENGTH	-0.75		PITCH = 0.083			STARTS = 1		TOOL = 2	130
34	PTP	0.5	0.2					30	0	130
35	END									

TEST PIECE 2 /CONTINUED

Page No.	Function	
19	P.T.P	THE TOOL NOW MOVES TO POSITION (5) TO COMMENCE PRODUCING THE TAPER IN A SERIES OF CUTS.
20	P.T.P.	THE TOOL PRODUCES A TAPER FLUSH WITH THE DIAMETER.
21	P.T.P.	TOOL MOVES BACK TO POSITION (5).
22	P.T.P.	PROGRAMMED MOVEMENT TO POSITION (6).
23	P.T.P.	PRODUCES A TAPER FLUSH WITH THE DIAMETER.
24	P.T.P.	TOOL MOVES BACK TO POSITION (6).
25	P.T.P.	PROGRAMMED MOVEMENT TO POSITION (7) 0.005" OFF THE DIAMETER.
26	P.T.P.	PRODUCES A TAPER LEAVING SOME MATERIAL FOR A FINISHING CUT.
27	P.T.P.	TOOL NOW RETURNS TO POSITION (7).
28	P.T.P.	TOOL FEEDS IN READY FOR FINISHING CUT ALONG THE TAPER.
29	P.T.P.	PRODUCES FINAL TAPER FINISHING AT POSITION (8).
30	CIRC.	THE TOOL CIRCULAR INTERPOLATES AT A RADIUS OF .125" TO PRODUCE A QUADRANT FINISHING AT POSITION (9).
31	P.T.P.	THE TOOL IS WITHDRAWN FROM THE WORKPIECE READY FOR A TOOL CHANGE.
32	P.T.P.	ONCE THE TOOL CHANGE HAS BEEN MADE RE-START THE CYCLE AND THE TOOL MOVES IN READY FOR SCREWCUTTING AT A REDUCED SPINDLE SPEED.
33	THRD.	THE THREAD IS PRODUCED WITH A SERIES OF 0.004" CUTS.
34	P.T.P.	THE TOOL NOW RETURNS TO THE PROGRAM DATUM.
35	END	THIS FUNCTION ENDS THE PROGRAM.

SECTION 4

INSTALLATION AND LUBRICATION

INSTALLATION

LIFTING

Although ORAC can be lifted by up to 3 to 4 persons, it is advisable to use some recommended lifting apparatus.

If using a lifting device, slide steel bars through the two channels underneath the machine about 50" in length and secure a rope around the 4 ends of the bar.

Recommended cross section of Bar:- $1\frac{3}{8}" \times \frac{3}{4}"$

ERECTION ON SITE

ORAC can be mounted at any desk top situation. It is unnecessary to bolt ORAC to a base, however, if this is so required push a bar through each of the channels underneath the machine and secure through either end of the bars.

CLEANING

Before wiring the machine to the mains supply, first remove all anti-corrosive coatings from the slideways and working parts including all bright surfaces, using a kerosene based cleaner. After cleaning, oil all bright surfaces with a light machine oil. Regular cleaning and oiling will ensure a long life for the machine with the minimum of maintenance.

ELECTRICAL SUPPLY CONNECTION

The regular electrical mains power supply to the machine is single phase 240 V 50 HZ. Three Phase is NOT suitable for this product and cannot be supplied.

Connect the mains supply to the supplied adaptor.

N.B. The machine should only be commissioned by a qualified electrical Engineer.

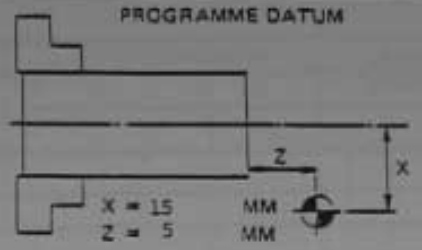
LUBRICATION

All oiling and greasing points have been fitted prior to despatch. Before the machine is switched on, oil both ballscrews with the recommended lubricant.

TEST PIECE Nº3

DRAWING No.	
DESCRIPTION	TEST PIECE 3
CASSETTE I/D	
MATERIAL	M/S AL
PROGRAMME BY	AMD
DATE	

BELOW IS AN EXAMPLE OF A THREAD CUTTING PAGE



ORAC

TOOLING.

No.	TOOL REF
1	
2	
3	
4	
5	
6	
7	
8	
9	

PAGE ____ THREAD DIA ____ ROOT DIA ____ CUT. INCR...X ____ LENGTH.Z (INCR) ____ PITCH ____

" STARTS ____ TOOL No ____ SPINDLE SPEED ____

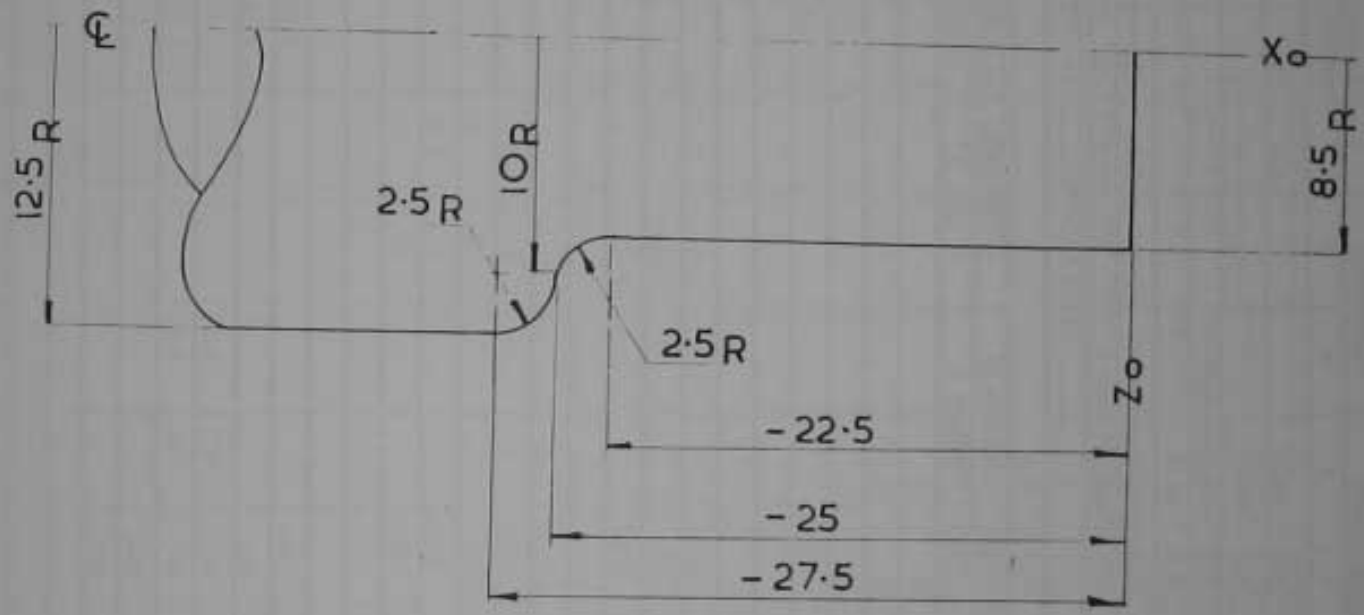
PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
01	ABS									
02	MM									
03	PROG DAT	15	5							
04	PTP	12.5	0.5					1000	1	1200
05	DO 7									
06	INC									
07	PTP			-0.5	0			1000	1	1200
08	PTP			0	-35.5			110	1	1200
09	PTP			0	35.5			1000	1	1200
10	END DO									
11	ABS									
12	PTP	9.0	0.2					1000	1	1200
13	DO 5									
14	INC									
15	PTP			-0.5	0			1000	1	1300
16	PTP			0	-15.2			110	1	1300
17	PTP			0	15.2			1000	1	1300
18	END DO									
19	ABS									
20	PTP	5.5	0					200	1	1300
21	PTP	6.5	-3					50	1	1400
22	PTP	5.5	0					300	1	1400
23	PTP	4.5	0					200	1	1400
24	PTP	6.5	-3					50	1	1400
25	PTP	4.5	0					300	1	1400
26	PTP	3.5	0					300	1	1400
27	PTP	6.5	-3					50	1	1400

SHEET No. 2 TEST PIECE 3

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPIND SPEE
		X	Z	X	Z					
28	PTP	3.5	0					300	1	1400
29	PTP	2.5	0					300	1	1400
30	PTP	6.5	-3					50	1	1400
31	PTP	2.5	0					300	1	1400
32	PTP	1.0	0					200	1	1400
33	CIRC	6.5	-6.0			6.0	CW	50	1	1400
34	PTP	6.5	-15.0					200	1	1400
35	PTP	8.0	-15.0					200	1	1400
36	PTP	9.0	-19.0					50	1	1400
37	PTP	8.0	-15.0					200	1	1400
38	PTP	7.0	-15.0					200	1	140
39	PTP	9.0	-19.0					50	1	1400
40	PTP	7.0	-15.0					200	1	1400
41	PTP	6.5	-15.0					200	1	1400
42	PTP	8.5	-19.0					50	1	1400
43	PTP	8.5	-26.0					50	1	1400
44	PTP	8.5	-19.0					200	1	1400
45	PTP	7.5	-26.0					50	1	1400
46	PTP	8.5	-19.0					200	1	1400
47	PTP	6.5	-26.0					50	1	1400
48	PTP	8.5	-19.0					200	1	1400
49	PTP	5.5	-26.0					50	1	1400
50	PTP	7.5	-26.0					200	1	1400
51	PTP	8.5	-32.0					50	1	140
52	PTP	7.5	-26.0					200	1	1400
53	PTP	5.5	-26.0					200	1	1400
54	CIRC	8.0	-35.0			8.0	CW	50	1	1400
55	PTP	11.5	-35.0					200	1	1400
56	PTP	12.5	-39.0					50	1	1400
57	PTP	11.5	-35.0					200	1	1400
58	PTP	10.5	-35.0					200	1	1400
59	PTP	12.5	-39.0					50	1	1400
60	PTP	10.5	-35.0					200	1	1400
61	PTP	9.5	-35.0					200	1	1400
62	PTP	12.5	-38.0					50	1	1400
63	PTP	12.5	0					1000	1	1400
64	PTP	0	0					200	1	1400

SHEET No. 3 TEST PIECE 3

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
65	CIRC	6.0	-6.0			6.0	CW	40	1	1400
66	PTP	6.0	-15.0					40	1	1400
67	PTP	8.0	-19.0					40	1	1400
68	PTP	5.0	-26.0					40	1	1400
69	CIRC	8.0	-35.0			8.0	CW	40	1	1400
70	CIRC	12.5	-40.0			7.0	CW	40	1	1400
71	PTP	15.0	5					1000	1	1400
72	PTP	6.0	2.0					1000	2	150
73	THREAD	O/D = 12		RD = 9.85		CUT(INCR) X = 0.04			LENGTH =	-15.0
		PITCH = 1.75		STARTS 1		TOOL 2		SPINDLE SPEED 150		
74	PTP	15	2					1000	2	150
75	PTP	15	5					1000	0	150
76	END									



TEST PIECE Nº 4

DRAWING No.	
DESCRIPTION	TEST PIECE 4
CASSETTE I/D	
MATERIAL	M/S AL
PROGRAMME BY	AMD
DATE	

BELOW IS AN EXAMPLE OF A THREAD CUTTING PAGE

ORAC

TOOLING

No.	TOOL REF
1	
2	
3	
4	
5	
6	
7	
8	
9	

PAGE ____ THREAD DIA ____ ROOT DIA ____ CUT. INCR...X ____ LENGTH Z (INCR) ____ PITCH ____

" STARTS ____ TOOL No ____ SPINDLE SPEED ____

PAGE	FUNCTION	ABSOLUTE		INCREMENTAL		RADIUS	SENSE CW/CCW	FEED RATE	TOOL	SPINDLE SPEED
		X	Z	X	Z					
01	MM									
02	ABS									
03	PROG DAT	15	5							
04	PTP	13	0.5					1000	1	800
05	DO 3									
06	INC									
07	PTP			-1.0	0			1000	1	800
08	PTP			0	-25.5			80	1	800
09	PTP			0	25.5			1000	1	800
10	END DO									
11	DO 2									
12	PTP			-1.0	0			1000	1	1000
13	PTP			0	-23			100	1	1000
14	PTP			0.5	0			1000	1	1000
15	PTP			0	23			1000	1	1000
16	END DO									
17	ABS									
18	PTP	8.6	-22.4					1000	1	1000
19	PTP	8.5	-22.5					100	1	1000
20	CIRC	10	-25			2.5	CCW	40	1	1000
21	CIRC	12.5	-27.5			2.5	CW	40	1	1000
22	PTP	15	0					1000	1	1000
23	PTP	15	5					1000	0	1000
24	END									

SECTION 31

TO LOAD FROM A COMPUTER

If it is required to load ORACS memory form some external device, for example a computer or a paper tape reader unit, this can be done through the RS232C serial Data link located at the rear of the machine. Connection is made via a standard 25 way 'D' type connector. (For connection and data format see RS232 Data Format, section 33 page 99.)

Once ORAC, and for example a computer, are both connected, depress button 3 then E. Three separate Baud rates are now displayed

1. 300 Baud.
2. 1200 Baud.
3. 2400 Baud.

This is the rate at which ORAC will accept information, and it must be set at same rate as the computer is transmitting. Make your selection by depressing the appropriate number and then E.

The screen will now display "READY" below the Baud rates.

Use the computer to transmit the information to ORAC. When all the information is in ORACS memory the screen will diplay "TRANSFER COMPLETE".

SECTION 32

TO TRANSMIT TO A COMPUTER

Once a program is in ORACS memory, it can be transmitted to external devices, through the RS232C serial Data link. These devices could be computers, printers, paper tape punch units etc. Make the connection with the device (as explained in section 34 page 100) and with the memory in ORAC loaded, depress 4 then E. The screen will now ask for a choice to be made between

1. FILE FORMAT.
2. PRINTER FORMAT.

File format should be selected when connecting up to a computer, and printer format when connecting to a printer. The latter format provides a listing heading and separate pages with 4 line feed characters between the pages.

File format should also be selected when using a paper type punch unit as a form of program storage.

Make your selection by depressing 1 or 2 and then E. Three different Baud rates are now displayed on the screen

1. 300 Baud.
2. 1200 Baud.
3. 2400 Baud.

This is the rate at which ORAC transmits information, and it must be set at the same rate as the external device will accept. Make your selection and depress E.

"OK?" will now be displayed on the screen. Set up the device to accept information, and when all is OK depress E. The program will now be transmitted at the set rate, and on completion "TRANSFER COMPLETE" will be displayed on the screen for 2 seconds after which the main menu will return.

NOTE: The memory of ORAC is not cleared when a program has been transmitted.

For further information on the external devices mentioned in section 31 and 32 please contact us at our Brighouse Headquarters.

EXAMPLE OF PRINTOUT FROM * ORAC *

PROGRAM LISTING

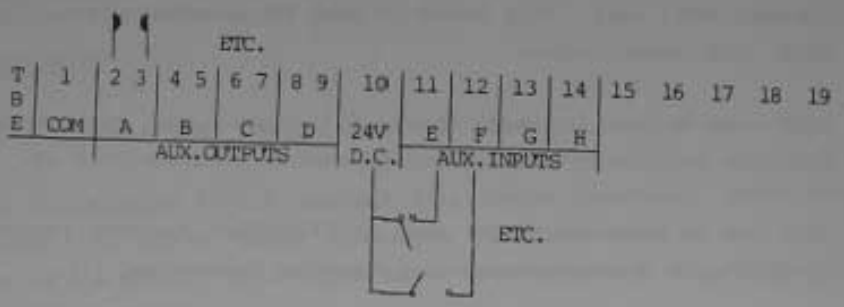
```
TITLE .....................
I.D. ............

PAGE 01  INCH-UNITS

PAGE 02  INCREMENTAL-FORMAT.G91

PAGE 03  THREADING..G33
 IN/OUT-SIDE.DIAM  2
 ROOT-DIAMTER  1.99
 CUT.(INCR)..X  0.01
 LENGTH..Z  -1

PITCH  0.10
STARTS  1
TOOL-NO  1
SPINDLE-SPEED  100

PAGE 04  DWELL..G04

 TIME.(SECS)  05

PAGE 05  THREADING..G33
 IN/OUT-SIDE.DIAM  2
 ROOT-DIAMETER  1.99
 CUT.(INCR)..X  0.01
 LENGTH..Z  -1

PITCH  0.04
STARTS  1
TOOL-NO 1
SPINDLE-SPEED  100

PAGE 06  DWELL..G04

 TIME.(SECS)  05

PAGE 07  POINT-TO-POINT.G00,G01

   X  0.562
   Z  0.562

 FEEDRATE  10
 TOOL-NO  1
SPINDLE-SPEED  1000

PAGE 08  CALL-SUBROUTINE
```

SECTION 33

EXTERNAL CONNECTIONS

THE TERMINAL STRIP FOR THE AUXILLIARY INPUTS AND OUTPUTS IS SITUATED INSIDE AT THE REAR OF THE MACHINE.

AUXILLIARIES:



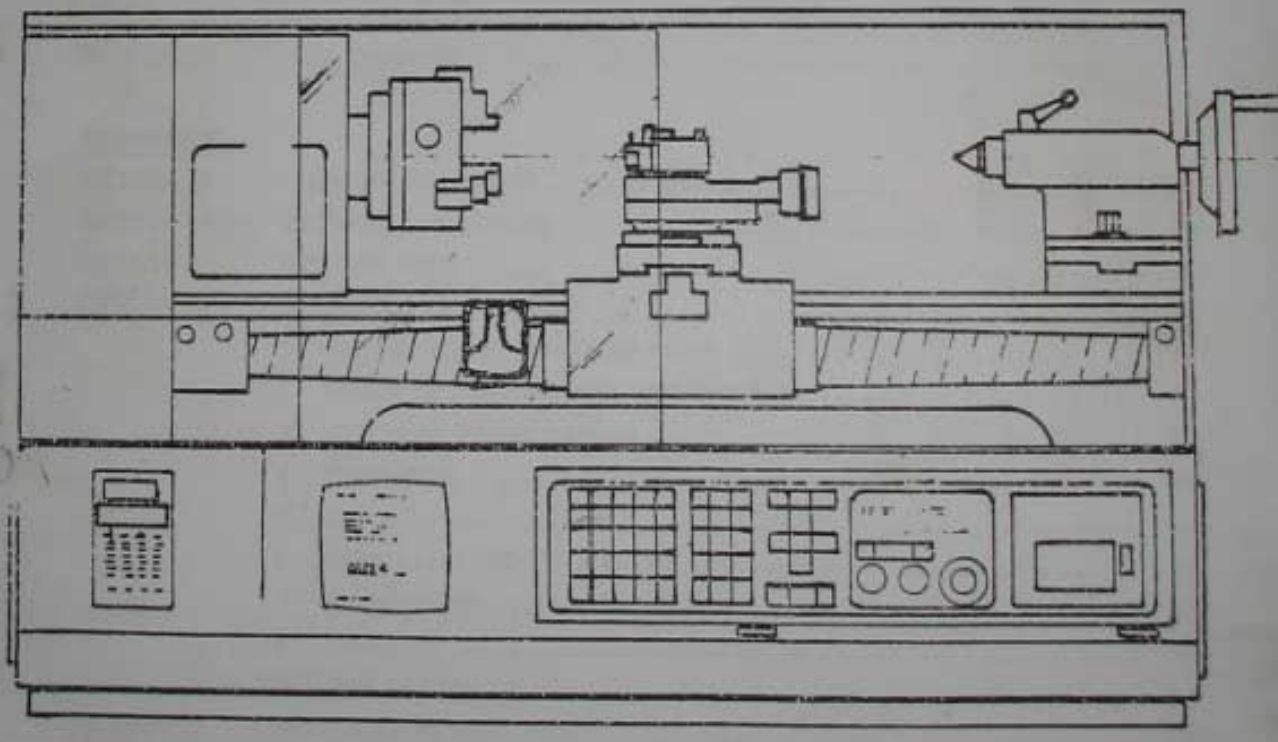
OUTPUTS; ON THE TERMINAL STRIP RELAY 'A' CONTACTS ARE CONNECTED ACROSS TERMINALS '2' AND '3'. THEY ARE NORMALLY OPEN CONTACTS RATED AT 3A RESISTIVE, 240V AC MAX. SIMILAR CONTACTS FOR RELAYS B, C AND D, ARE CONNECTED AS SHOWN.

INPUTS; THE INPUT SIGNALS CAN COME FROM SWITCHES CONNECTED AS SHOWN, USING THE INTERNAL 24V DC SUPPLY FROM TERMINALS 10.

T.V. SOCKET; A SOCKET IS PROVIDED ON THE REAR PANEL FOR THE CONNECTION OF A UHF 625 LINE STANDARD U.K. T.V. SET VIA AN INTERNAL MODULATOR IN * ORAC *. SIMPLY CONNECT THE SOCKET TO THE AERIAL INPUT ON THE T.V., TUNE T.V. UNTIL PICTURE IS OBTAINED (APPROX. CH. 36).

ORAC

PROGRAMMING INSTRUCTION
AND
MAINTAINANCE MANUAL



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LUBRICATION NOTICE

1 MAKE SURE YOU FOLLOW THE MACHINE TOOLS RECOMMENDED INSTRUCTIONS.

2 USE THE RECOMMENDED GREASE FOR THE HEADSTOCK AND OIL FOR THE BALLSCREWS.

3 OIL THE BALLSCREWS WEEKLY.

4 DO NOT OPERATE UNTIL LUBE INSTRUCTIONS HAVE BEEN FOLLOWED.