OPERATING MANUAL

for
CINCINNATI
ARROW E/DART 500/750 (ERM)
ARROW 500/750/1000/1250C (ERM)
ARROW 1250/1500/2000 (ERD)
VERTICAL MACHINING CENTERS
with
ACRAMATIC   2100E CNC CONTROL
Release 3.0

PUBLICATION NO. 91203809--001

IMPORTANT

Carefully read the instructions and safety precautions given in this manual. Do not attempt to operate this machine until you have thoroughly read and understood the material contained in this manual and all other applicable manuals.

At the time of writing, the book was completely up--to--date. However, due to continual improvements in design, it is possible that descriptions contained herein may vary to a slight extent from the system delivered to you. This merely implies that the system has been improved to better fulfill your requirements. You are encouraged to contact the nearest Cincinnati Machine representative for clarification.

Patents Notice

The machine and attachments and parts thereof illustrated and described in this book are manufactured under and protected by issued and pending British and Foreign Patents and copyright is reserved in any original design feature thereof and in the contents of this book and every part thereof.

Cincinnati Machine

A **UNOVA** Company

FOREWORD

The purpose of this manual is to provide the necessary information to enable suitably experienced personnel, to operate the CINCINNATI MACHINE ARROW E/DART (ERM) and ARROW (ERD/ERM) Vertical Machining Centers, when fitted with ACRAMATIC A2100 control.

Information contained in this manual is not warranted and is subject to change without notice.

The manual has not been prepared to enable inexperienced personnel to operate the machine without further training.

The owner/user is responsible for the training of inexperienced personnel and for providing the background necessary for experienced personnel to safely operate these machines.

The chapter on general safety precautions should be observed at all times during machine operation and maintenance. Read this chapter before reading the remaining chapters in this manual and operating the machine.

Any questions pertaining to the operation of the machine should be directed to:

Field Service Department
Cincinnati Machine UK Limited,
P.O. Box 505,
Kingsbury Road,
Birmingham, B24 0QU
England
Tel: 0121-351-3821
Fax: 0121-313-1184

Cincinnati Machine
 Marketing Company,
Cincinnati,
Ohio 45209-9988
USA.

Main Tel: (513) 841-8100
Service Tel: (513) 841 3000
Service Fax: (513) 841 8871

Table of Contents

Table of Contents

Chapter 2
System Information 2-1

Table of Contents

Table of Contents

Table of Contents

Chapter 4
General Setup Guide 4-1

How Do I... 4-9

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Chapter 5
Other Setup Information 5–1

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Chapter 1
Safety Precautions

Important

These safety precautions for this CINCINNATI machine have been prepared to assist the operator, programmer and maintenance personnel in practicing good shop safety procedures.

Operator and maintenance personnel must read and understand these precautions completely before operating, setting up, running, or performing maintenance on the machine.

These precautions are to be used as a guide to supplement safety precautions and warnings in the following:

a.   All other manuals pertaining to the machine.

b.   Local, plant, and shop safety rules and codes.

c.   National safety laws and regulations.

General Safety Instructions And Considerations

Personal Safety

Machine owners, operators, setup men, maintenance, and service personnel must be aware of the fact that constant day-to-day safety procedures are a vital part of their job. Accident prevention must be one of the principal objectives of the job regardless of what activity is involved.

Know and respect your machinery. Read and practice the prescribed safety and checking procedures. Make sure that everyone who works for, with, or near you fully understands and - more importantly - complies with the following safety precautions and procedures when operating this machine.

Sudden movements, loud noises, horseplay, etc., must be avoided. These distractions may result in unsafe conditions for those working near the machinery.

Observe and follow safety instructions such as "NO SMOKING", "High Voltage", "DANGER", etc., in your working area.

Accidents can occur that result in serious personal injury to yourself or others due to clothing and other articles becoming entangled in cutters, hand wheels, levers, or moving machine elements. The following suggestions, if followed, will help you to avoid such accidents: Neckties, scarfs, gloves (except as worn for protection when handling sharp edged cutting tools or rough, sharp or hot parts, see *TOOL SAFETY*) loose hanging clothing, and jewelry such as watches, rings, or necklaces must not be worn around moving machinery. Restrain long hair with a cap or net. Wear gloves only when handling rough, sharp, or hot parts.

Use safety protective equipment. Wear clean approved eye or face protection. Safety-toe shoes with slip-proof soles can help you avoid injury. Keep your protective equipment in good condition.

Never operate or service this equipment if affected by alcohol, drugs or other substances or conditions which decrease alertness or judgment.

> **WARNING**
>
> **Read related safety precautions before operating this machine. Failure to follow safety instructions may result in serious personal injury.**

> **WARNING**
>
> **In order to clearly show details of this machine, some covers, shields, guards, barriers, devices, or doors have either been removed or shown in an "open" position. All such protective components must be installed in position before operating this machine. Failure to follow this instruction may result in serious personal injury.**

Work Area Safety

Always keep your work area clean. Dirty work areas with such hazards as oil, debris, or water on the floor may cause someone to fall to the floor, into the machine, or onto other objects resulting in serious personal injury.

Make sure your work area is free of hazardous obstructions and be aware of protruding machine members.

Return tools and similar equipment to their proper storage place immediately after use. Keep work benches neat, orderly, and clean.

Report unsafe working conditions to your supervisor or safety department. Items such as: worn or broken flooring, ladders, and handrails, unstable or slippery platforms, or scaffolds must be reported and repaired before use. Do not use skids, work pieces, stock, machines, tote pans, and boxes as makeshift climbing aides.

Tool Safety

Sharp edged cutting tools must be handled with gloves or a shop cloth. Inspect cutting tools before use and reject defective tools.

See **WARNING 1**.

Remove hand tooling such as wrenches, measuring equipment, hammers, and other miscellaneous parts from the machine immediately after usage.

Lifting And Carrying Safety

Contact supervision if you have any questions or are not sure about the proper procedures for lifting and carrying.

Before lifting or carrying an object, determine the weight and size by referring to such things as tags, shipping data, labels, marked information, or manuals.

Use power hoists or other mechanical lifting and carrying equipment for heavy, bulky, or hard to handle objects. Use hookup methods recommended by your safety department and know the signals for safely directing a crane operator.

Never place any part of your body under a suspended load or move a suspended load over any part of another person's body. Before lifting, be certain that you have a safe spot for depositing the load. Never work on a component while it is hanging from a crane or other lifting mechanism.

If in doubt as to the size or type of lifting equipment, method, and procedures for lifting, contact Cincinnati Machine before proceeding to lift the machine or its components.

Always inspect slings, chains, hoists, and other lifting devices prior to use. Do not use lifting devices found to be defective or questionable.

Never exceed the safety rated capacity of cranes, hoists, slings, eyebolts, and other lifting equipment. Follow, National and local, standards and instructions applicable to any lifting equipment you use.

Before inserting an eyebolt, be certain that both the eyebolt and the hole have the same size and type threads. To attain safe working loads, at least 90% of the threaded portion of a standard forged eyebolt must be engaged.

Installation And Relocation Safety

Before lifting the machine, consult the machine manual or Cincinnati Machine for proper methods and procedures.

An electrician must read and understand the electrical schematics prior to connecting the machine to the power source. After connecting the machine, test all aspects of the electrical system for proper functioning. Always make sure the machine is grounded properly. Place all selector switches in their OFF or neutral (disengaged) position. The doors of the main electrical cabinet must be closed and the main disconnect switch must be in the OFF position after the power source connection is complete.

Always lock the main disconnect device in the OFF position if the machine is left unattended, unless machine is part of an unmanned manufacturing system and in a production cycle.

When the machine is installed, be sure that the motors rotate in the proper indicated direction.

Setup And Operation Safety

Read and understand all the safety instructions before setting up, operating, or servicing this machine. Assign only qualified personnel, instructed in safety and all machine functions, to operate or service this machine.

Operators and maintenance personnel must carefully read, understand, and fully comply with all machine mounted warning and instruction plates. Do not paint over, alter, or deface these plates or remove them from the machine. Replace all plates which become illegible. Replacement plates can be purchased from Cincinnati Machine.

Safety guards, shields, barriers, covers, and protective devices must be connected or in place before operating the machine.

All safety features, disengagements, and interlocks must be in place and functioning correctly prior to operation of this equipment. Never bypass or wire around any safety device.

When setting up or adjusting a workpiece or fixture, be certain it is a safe distance away from the cutting tool. Always retract the workpiece a safe distance from the cutting tool when loading and unloading.

The spindle must be stopped before adjusting the coolant discharge nozzle.

Never brake or slow down moving machinery with your hand or with some makeshift device. Never use machine power to remove a nut from any shaft. The spindle and slides must be stopped when measuring work pieces, changing tools, or removing chips and grit. Remove chips and grit with a chip rake or brush, not with your hands.

Keep all parts of your body off the machine table, table edge, out of the path of moving units, trip dogs, trip plungers, and out of the "machining area" during machining operations. Never lean on a machine or reach over or through a machine – you can become entangled in tooling and other moving elements or you may accidentally activate start buttons, feed controls, rapid traverse controls, power work holding control, or similar devices.

During operation, be attentive to the machining process. Excessive vibration, unusual sounds, etc., can indicate problems requiring your

immediate attention. Watch for conditions such as packed chips or grit which can cause breakage of tooling or machine elements.

Shut off power to the machine when leaving the operating area or at the end of your work period. Never leave the machine running unattended, unless it has been designed to do so. Turn the master disconnect device to the OFF position before cleaning the machine at the end of the working day or when guards or covers are removed that expose hazardous areas.

Maintenance Safety

See **DANGER** notice.

Do not attempt to perform maintenance on this machine until you read and understand all the safety instructions.

Assign only qualified service or maintenance personnel **trained by Cincinnati Machine**, to perform maintenance and repair work on this machine. They should consult the service manual before attempting any service or repair work and when in doubt contact Cincinnati Machine. Use only Cincinnati Machine replacement parts; others may impair the safety of the machine. Before performing maintenance or service work, Warning or Danger signs must be placed conspicuously about the machine. Before detaching counterweights or driving mechanisms, vertical sliding members must be blocked properly. See the Service Manual for proper dismantling procedures.

Before removing or opening any electrical enclosure, cover, plate, or door, be sure that the Main Disconnect Switch is in the OFF position. If any tool is required to remove a guard, cover, bracket, or any basic part of this machine, place the Main Disconnect Switch in the OFF position, lock it in the OFF position. If possible, post a sign at the disconnect switch indicating that maintenance is being performed.

Whenever maintenance is to be performed in an area away from the disconnect and the disconnect is not locked, tag all start button stations with a "DO NOT START" tag. Adequate precautions, such as locks on circuit breakers, warning notices, or other equally effective means must be taken to prevent electrical equipment from being electrically activated when maintenance work is being performed.

Before attempting to adjust, repair, or perform maintenance on electrical circuits connected with yellow wires, first find the source of power, turn it off, and lock it in the OFF position. Machine tool interlock control circuits connected with yellow wires are powered from a source away from the machine and carry voltage even when the machine's main disconnect device is turned to the OFF position.

When removing electrical equipment, place number or labeled tags on those wires not marked. If wiring, is replaced, be sure it is of the same type, length, size, and has the same current carrying capacity.

Close and securely fasten all guards, shields, covers, plates, or doors before power is reconnected.

An electrical technician must analyze the electrical system to determine the possible use of power retaining devices such as capacitors. Such power retaining devices must be disconnected, discharged, or made safe before maintenance is performed.

WARNING

Failure to follow instructions on this page may result in serious personal injury.

Working space around electrical equipment must be clear of obstructions. Provide adequate illumination to allow for proper operation and maintenance.

DANGER

HIGH VOLTAGE

Lethal voltages are present in the magnetics and electrical control cabinets when the MACHINE MAIN DISCONNECT is 'ON'. Current and voltage measurements should be attempted only by qualified electrical maintenance personnel.

Before working on any electrical circuits, turn the machine Main Disconnect Device 'OFF' and lock It.

Capacitors in the Servo Drives require up to 20 minutes to completely discharge. Always verify that discharge is complete using a known working and calibrated voltmeter before commencing work on these units.

Unless expressly stated in applicable Cincinnati Machine documentation or by the appropriate Cincinnati Machine Field Service Representative, do NOT work with electrical power 'ON'. If such express statement of advice exists, working with electrical power 'ON' should be performed by a Cincinnati Machine Field Service Representative. The customer and subsequent transferees must determine that any other person performing work with electrical power 'ON' is trained and technically qualified.

FAILURE TO FOLLOW THIS INSTRUCTION MAY RESULT IN DEATH OR SERIOUS PERSONAL SHOCK INJURY.

Materials Used With This Product

Various materials may be used with this product. Before using/mixing/diluting materials with this product, contact the manufacturer/authorized supplier of the material to determine that the material is suitable for the intended application and request a Material Safety Data Sheet (MSDS) from the material manufacturer.

LIFTING DEVICES

GENERAL

The use of lifting devices is subject to certain hazards that cannot be met by mechanical means but only by the exercise of intelligence, care, and common sense. It is, therefore, essential to have competent and careful operators, physically and mentally fit, thoroughly trained to the safe operation of the equipment and the handling of the loads. Serious hazards are overloading, dropping or slipping of the load caused by improper hitching or slinging, standing or crawling under a load, swinging loads, obstruction to the free passage of the load, using equipment for a purpose or a manner for which it was not intended or designed..

EYEBOLTS

A straight lift is preferred when using eyebolts. An angular lift places additional stresses on an eyebolt, above that of the load to be hoisted.

If the situation necessitates an angular lift, the safe working load for angular lifts shown in Fig. 1 and Fig. 2 should be used.

When multiple eyebolt provisions are designed into a lift, it is recommended (in most applications) that a spreader bar be used. (See Fig. 9 which illustrates a typical spreader bar arrangement.)

No greater stress should be allowed than that given under Safe Working Load in Fig. 1 and Fig. 2.

To obtain greatest strength from an eyebolt, it must fit reasonably tight in the hole with at least 90% of the threaded length engaged.

Eyebolts should never be welded or subjected to heat in excess of 900°F [480° C].

Eyebolts should never be painted or otherwise coated when used for lifting, as such coating will very likely cover up flaws.

Eyebolts should be routinely inspected for defects and if any defects are found, they should be destroyed by melting, crushing, or cutting clear across the eye.

STRAIGHT SHANK INCH (ANSI/ASME B18.15)				
THREAD	.375‑16	.500‑13	.625‑11	1.000‑8
SAFE WORKING LOAD	LBS. [KG]			
90 DEGREES	1000 [453]	1840 [834]	2940 [1333]	7880 [3573]
60 DEGREES	375 [170]	805 [365]	1340 [607]	3670 [1664]
30 DEGREES	200 [90]	470 [213]	805 [365]	2390 [1083]
PART NUMBER	3449	870	21312	19489
IDENTIFICATION PLATE NUMBER	3338325	3338326	3338327	3338328
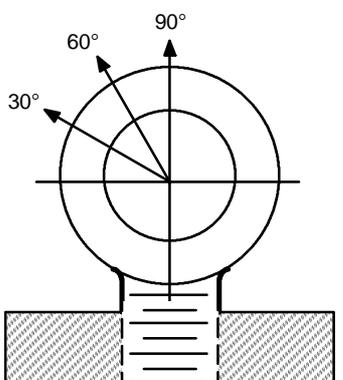
STRAIGHT SHANK INCH

Fig. 1
Preferred Inch Lifting Eyebolts

SHOULDER METRIC (ISO 3266-1984)				
THREAD	M12	M16	M20	M30
SPOT DIAMETER	32 mm 1.25 in.	37 mm 1.50 in.	42 mm 1.65 in.	67 mm 2.63 in.
SAFE WORKING LOAD	[KILOGRAMS] LBS.			
90 DEGREES	[400] 882	[630] 1389	[1000] 2205	[2500] 5512
45 DEGREES	[100] 220	[160] 352	[250] 551	[625] 1378
PART NUMBER	6014453-3	6014453-4	6014453-5	6014453-8
IDENTIFICATION PLATE NUMBER	3338329	3338330	3338331	3338332
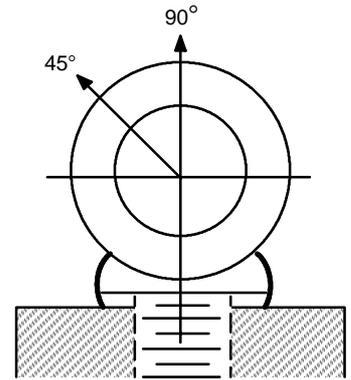
SHOULDER METRIC

Fig. 2
Preferred Metric Lifting Eyebolts
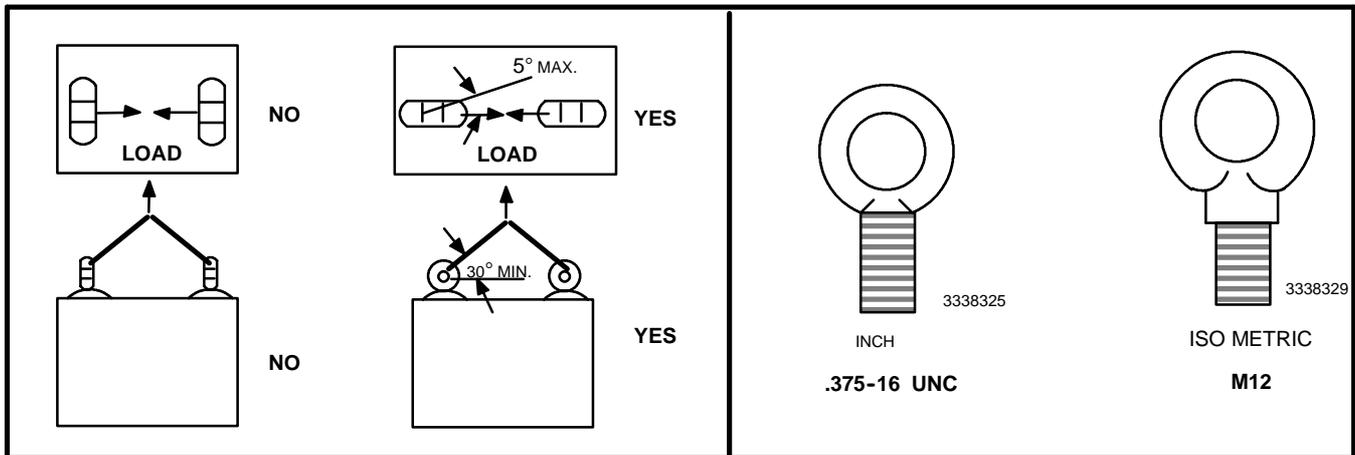
Fig. 3
Eyebolt Loading

Fig. 4
Eyebolt I.D. Plates - Inch and Metric

NO 21 (.032) GAGE ALUMINUM.- NO. AL 5052 ALLOY. ETCHED AREAS TO BE BLACK BAKED ENAMEL. ETCHED DEPTH TO BE .003 TO .005 INCHES --- OR --- NO. 21 (.032) GAGE

ALUMINUM WITH METALPHOTO PROCESS. ALL LETTERING TO BE HELVETICA MEDIUM.
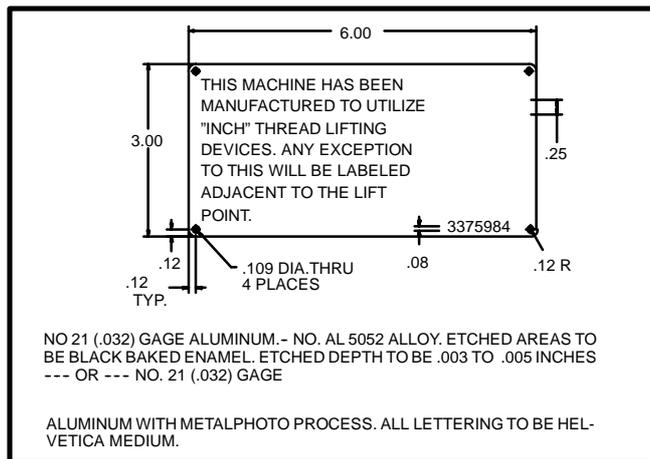
Fig. 5
Instruction Plate - Inch (Part Number 3375984)

NO 21 (.032) GAGE ALUMINUM.- NO. AL 5052 ALLOY. ETCHED AREAS TO BE BLACK BAKED ENAMEL. ETCHED DEPTH TO BE .003 to .005 INCHES --- OR --- NO. 21 (.032) GAGE ALUMINUM

WITH METALPHOTO PROCESS. ALL LETTERING TO BE HELVETICA MEDIUM.

SURFACE GRAIN TO RUN PARALLEL TO LETTERING WITH SATIN FINISH.
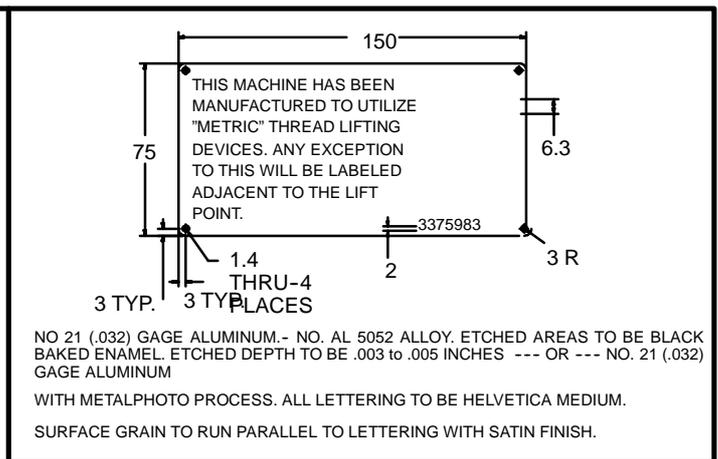
Fig. 6
Instruction Plate - Metric (Part Number 3375983)
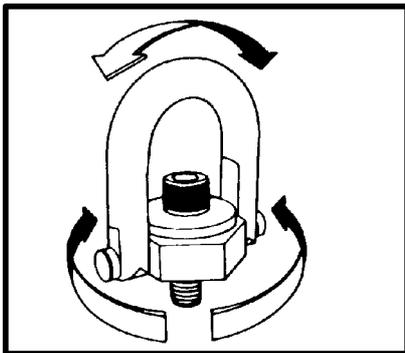
Fig. 7
Hoist Ring

HOIST RINGS

Hoist Rings are superior to eyebolts for angular lifting.

Be certain the thread projection is in accordance with the manufacturer's recommendation.

Do not recut any damaged threads on hoist rings.

To obtain the safe working load, torque to the recommended values shown in the table below.

Observe all other safety precautions normally practiced on eyebolts.

CM HOIST RING PART NO.	THREAD SIZE	THREAD TORQUE		MAX. WT EACH RING (90°)		MAX. WT EACH RING (60)		MAX. WT EACH RING (45)		MAX. WT EACH RING (30)		CM IDENT. PLATE PART. NO.
		Ft-Lb	N-m	Lb	kg	Lb	kg	Lb	kg	Lb	kg	
3346225 1	.375-16	12.0	16.3	1000	450	866	390	707	318	500	225	5013055 001
3346225 2	.500-13	28.0	38	2500	1130	2165	975	1767	795	1250	562	5013055 002
3346225 3	.625-11	60.0	81.3	4000	1810	3464	1559	2828	1273	2000	900	5013055 003
3346225 4	1.000-8	230.0	312	10000	4500	8660	3897	7071	3182	5000	2250	5013055 004
3346225 6	M12X1.75	27.0	36.6	2204	991	1908	859	1558	701	1102	496	5013055 006
3346225 7	M16X2	59.0	80	3857	1736	3340	1503	2726	1227	1928	868	5013055 007
3346225 8	M20X2.5	100.0	136	4736	2132	4103	1846	3349	1507	2369	1066	5013055 008
3346225 9	M30X3.5	229.0	310	9257	4166	8016	3607	6544	2945	4628	2083	5013055 009

CM HOIST RING PART NO.	THREAD SIZE	THREAD TORQUE		MAX. WT EACH RING (90°)		MAX. WT EACH RING (90°)		MAX. WT EACH RING (90°)				CM IDENT. PLATE PART. NO.
		Ft-Lb	N-m	Lb	kg	Lb	kg	Lb	kg	Ft-Lb	N-m	
3346225 1	.375-16	12.0	16.3	1000	450	1000	450	1000	450			5013055 001
3346225 2	.500-13	28.0	38	2500	1130	2500	1130	2500	1130			5013055 002
3346225 3	.625-11	60.0	81.3	4000	1810	4000	1810	4000	1810			5013055 003
3346225 4	1.000-8	230.0	312	10000	4500	10000	4500	10000	4500			5013055 004
3346225 6	M12X1.75	27.0	36	2204	991	2204	991	2204	991			5013055 006
3346225 7	M16X2	59.0	80	3857	1736	3857	1736	3857	1736			5013055 007
3346225 8	M20X2.5	100.0	136	4736	2132	4736	2132	4736	2132			5013055 008
3346225 9	M30X3.5	229.0	310	9257	4166	9257	4166	9257	4166			5013055 009

Fig. 8
Hoist Ring Table

NOTE F=FORCE W=WEIGHT

Cincinnati Machine 91203809-001

SPREADER BARS AND LIFTING BEAMS
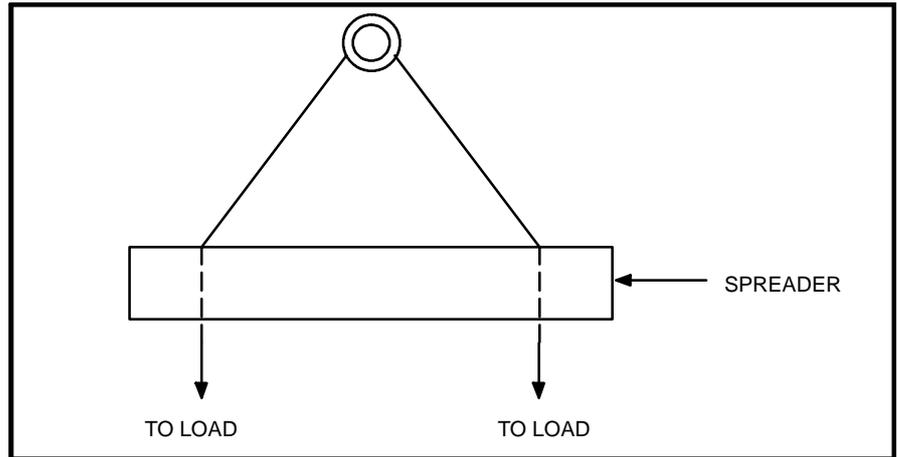
Fig. 9
Spreader Bar - Typical

Spreader bars are used when multiple eyebolts are designed into a lift. Always observe the following safety precautions when using a spreader bar or lifting beam

Do not exceed the safe working load.

Use the spreader or beam to handle parts or components only for which it was designed.

Inspect it before each use.

Do not alter or weld anything to bar or beam.

Store properly to avoid damage.

CHAIN

Select a chain with the suitable characteristics and capacity for the load. See above. Always observe the following safety precautions.

Do not shorten chains with knots, bolts, or any non-approved method.

Never use damaged chain.

Hitch chain securely to the load.

Pad sharp corners with material of sufficient strength to withstand load and protect chain.

SIZE OF CHAIN		SINGLE CHAIN 90°	DOUBLE SLING CHAINS TYPE D			TRIPLE SLING CHAINS TYPE T			QUAD SLING CHAINS TYPE Q		
			60°	45°	30°	60°	45°	30°	60°	45°	30°
9/32 in.	lbs.	3 250	5 625	4 600	3 250	8 400	6 900	4 875	8400	6900	4 875
.7.2 mm	kg.	1 475	2 550	2 085	1 475	3 810	3 130	2 210	3 810	3 130	2 210
3/8 in.	lbs.	6 600	11 400	9 300	6 600	17 100	13 950	9 900	17 100	13 950	9 900
9.5 mm	kg.	2 995	5 170	4 220	2 995	7 750	6 330	4 490	7750	6 330	4 490
1/2 in.	lbs.	11 250	19 700	15 900	11 250	29 250	23 850	16 875	29 250	23 850	16 875
712.7 mm	kg.	5 100	8 845	7 210	5 100	13 270	10 820	7650	13 270	10 820	7650
5/8 in.	lbs.	16 500	28 600	23 300	16 500	42 900	34 950	24 750	42 900	34 950	24 750
15.9 mm	kg.	7 480	12 970	10 570	7 480	19 460	15 850	11 230	19 460	15 850	11 230
3/4 in.	lbs.	23 000	39 800	32 500	23 000	59 700	48 750	34 500	59 700	48 700	34 500
19.1 mm	kg.	10 430	18 050	14 740	10 430	27 080	22 110	15 650	27 080	22 110	15 650
7/8 in.	lbs.	28 750	49 800	40 700	28 750	74 700	61 050	43 125	74 700	61 050	43 125
22.6 mm	kg.	13 040	22 590	18 460	13 040	33 880	27 690	19 560	33 880	27 690	19 560
1 in.	lbs.	38 750	67 100	54 800	38 750	100 650	82 200	58 125	100 660	82 200	58 125
25.4 mm	kg.	17 580	30 440	24 860	17 580	45 650	37 290	26 260	45 650	37 290	26 260
1 1/4 in.	lbs.	57 500	99 600	81 300	57 500	149 400	121 950	86 250	149 400	121 950	86 250
31.8 mm	kg.	26 080	45 180	36 880	26 080	67 770	55 320	39 120	67 770	55 320	39 120
1 1/2 in.	lbs.	80 000	138 500	113 000	80 000						
38.1 mm	kg.	36 290	62 820	51 260	36 290						
1 3/4 in.	lbs.	100 000	73 200	41 000	100 000						
44.5 mm	kg.	45 360	78 560	63 960	45 360						
2 in.	lbs.	130 000	225 000	183 000	130 000						
50.8 mm	kg.	26 750	102 060	83 000	26 750						

Fig. 10
Steel Alloy Chains

Keep hands and fingers from between the chain and load.

Avoid shock loading – particularly when working at temperatures below 40° F [4° C].

Never pull chain from under load when load is resting on chain.

Correct kinks and twisting in chain before lifting.

Lift from center of hooks. Avoid lifting from the point.

Assure that load is free to move before lifting. Keep clear of all obstructions.

When using a basket hitch, balance load and assure that chain legs contain or support load from the sides above the center of gravity.

Store chains in an area where they will not be subject to mechanical damage or corrosive action.

CABLE SLINGS

Select the appropriate size wire rope and hitch. See Table below

CABLE SIZE	ESTIMATED RATING CAPACITY (For Exact Rating Check Sling Tag)	VERTICAL	CHOKER HITCH	BASKET HITCH	60°	45°	30°
1/4 in.	lbs.	980	740	1400	1700	1400	980
6.4 mm	kg.	445	335	635	770	635	445
1/2 in.	lbs.	3600	2800	5200	6400	5200	3600
712.7 mm	kg.	1630	1270	2360	2900	2360	1630
3/4 in.	lbs.	7800	5800	11100	13600	11100	7800
19.1 mm	kg.	3450	2630	5035	6170	5035	3450
1 in.	lbs.	13400	1000	18800	22000	18800	13400
25.4 mm	kg.	6080	4540	8530	9980	8530	6080
1 1/4 in.	lbs.	19600	14800	28000	34000	28000	19600
31.8 mm	kg.	8890	6710	12700	15420	12700	6710
1 1/2 in.	lbs.	28000	20000	40000	48000	40000	28000
38.1 mm	kg.	12700	9070	18140	21770	18140	12700
1 3/4 in.	lbs.	38000	28000	54000	66000	54000	38000
44.5 mm	kg.	17240	12700	24490	29940	24490	17240
2 in.	lbs.	50000	36000	70000	86000	70000	50000
50.8 mm	kg.	22680	16330	31750	39000	31750	22680

Fig. 11
Wire Rope Slings

Guide loads with a tag line when practical.

When using multiple leg sling, select longest one possible.

Examine for damaged or worn area.

Attach securely to load.

Pad sharp corners to protect wire rope.

Center load in the base (bowl) of the hook to prevent hook point loading.

Do not kink, twist, or loop legs.

Keep hands and fingers from between wire rope and load.

Stand clear of attached load.

Start lift slowly to avoid shock injury.

Do not pull wire rope from under a load when the load is resting on it.

Do not shorten sling by knotting, by wire rope clips, or by any other means.

Do not inspect wire rope by passing bare hands over the body. Broken wire, if present, may puncture the hands.

Keep wire rope well-lubricated to prevent corrosion.

Use gloves at all times when handling.

SYNTHETIC MATERIAL SLINGS

Select the sling with the suitable characteristics and capability for the load and environment. See Fig. 12

AS THE SLING TO LOAD ANGLE DECREASES, SO DOES THE RATED CAPACITY OF A SLING.

SLING-TO-LOAD ANGLE IS ALWAYS THE ANGLE BETWEEN THE SLING LEG AND THE HORIZONTAL SURFACE.

USE THIS CHART FOR ALL TYPE SLINGS; ROPE, CHAIN, OR NYLON.

SLING TO LOAD ANGLE

90°
75°
60°
45°
30°

RATED SLING CAPACITY-ONE LEG		
SLING LIFTING EFFICIENCY	If Sling Capacity at 90° is... (LB. [KG])	Then Actual Sling Capacity is ... (LB. [KG])
100.0 %	1000 [454]	1000 [454]
96.6 %	1000 [454]	968 [439]
86.6 %	1000 [454]	866 [390]
70.7 %	1000 [454]	707 [320]
50.0 %	1000 [454]	500 [225]

Fig. 12
Sling Load Angle Chart

When using a choker hitch, the sling shall be long enough to assure that the choking action is on the webbing.

Slings used in a basket hitch shall have the load balanced.

Do not drag slings over the floor or any abrasive surface.

Do not twist or tie knots in slings.

Never pull sling from load when the load is resting on it.

Protect sling from sharp corners and abrasive surfaces.

Do not drop slings.

Store slings in an area where they will not be subject to mechanical or chemical damage.

Do not use where acid conditions exist.

Do not use polyester and polypropylene slings where caustic conditions exist.

Do not use polyester and nylon slings at temperatures in excess of 180° F nor polypropylene slings at temperatures in excess of 200° F.

Do not use aluminum fittings where caustic conditions exist.

P TYPE HOOKS

P type hooks are a proprietary design and should be considered for heavy (machine and unit) lifts.

Fig. 14 gives dimensional data, safe working loads and screw torque values for P type hooks.

The use of these hooks must be shown on the assembly drawing, listed in the Bill of Material and shown in the lifting section of the Service Manual.

Fig. 13
"P" Type Lifting Hooks

PART NO.	LIFTING CAPACITY LBS. [KG]	A INCH	B INCH	C INCH	D INCH	E INCH	F INCH	SCREW NO.	QTY.	SCREW TORQUE LB./FT.	SCREW TORQUE N-m
402517	1800 [818]	2.00	9.75	4.50	3.00	2.50	---	2415	2	160	217
296513	2500 [1136]	1.75	10.63	4.00	2.50	4.00	---	2415	2	160	217
296514	3500 [1590]	2.00	12.25	4.50	3.00	2.50	5.00	2415	3	160	217
402335	5000 [2273]	2.25	12.25	4.50	3.00	5.00	---	180139	2	370	502
296515	8000 [3636]	2.25	15.75	4.50	3.00	4.00	7.88	180139	3	370	502
	WHEN DESIGNING METRIC SIZES SEE THE CURRENT LIFTING MANUAL										

Fig. 14
"P" Type Lifting Hooks

S HOOKS

The use of S hooks in conjunction with some of the other lifting devices dictates additional safety rules which must always be practiced.

Never use more than one S hook in a single chain link or hook.

Inspect the S hook before each use and if damaged destroy by cutting into two pieces.

Never exceed the safe working load which should be stamped on each hook.

Do not paint, weld, or expose an S hook to high heat.

Do not use when either or both S hooks are opened more than 15% of the normal throat opening or twisted more than 10° from the plane of the unbent hook.
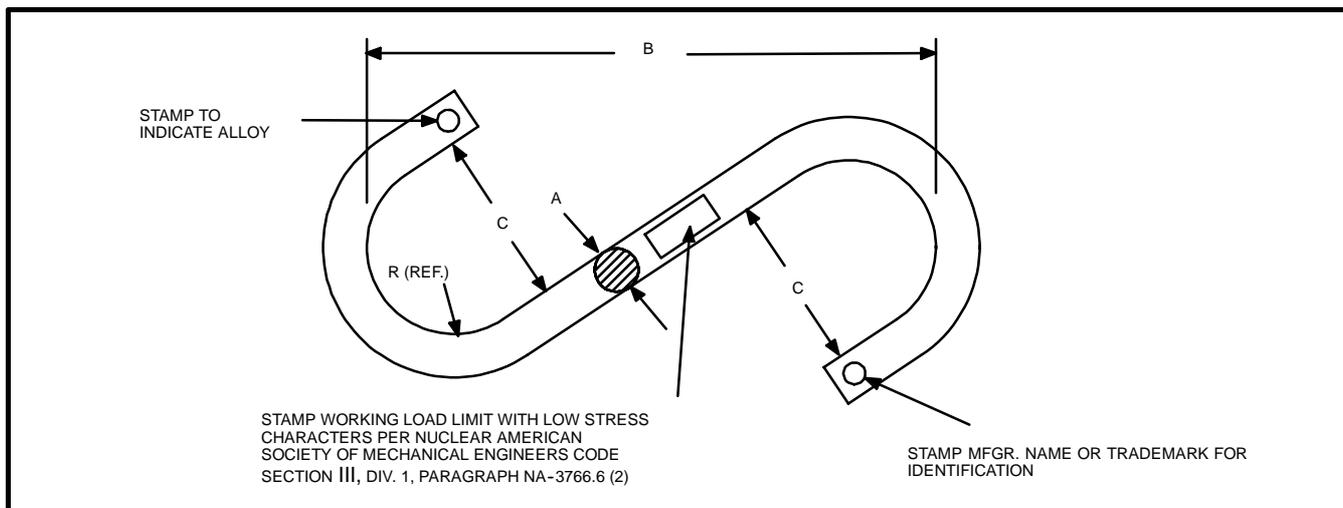
Fig. 15
"S" Hooks

PART NO.	MAX. WORKING LOAD		MANUFACTURER AND CODE NUMBER	ALL DIMENSIONS IN INCHES (See Fig 16.)				S-HOOK WEIGHT
	LBS.	KG		A	B	C	R	LBS.
3590535-5	650	294	CM Chain 562250	0.500	7.50	2.00	1.00	0.80
			Amer. Chain & Cable 5933-00800	0.500	5.50	1.50	0.75	0.63
3590535-7	1 015	460	CM Chain 562262	0.625	9.00	2.50	1.25	1.60
			Amer. Chain & Cable 5933-01000	0.625	7.00	1.88	0.94	1.30
3590535-8	1 465	664	CM Chain 562275	0.750	10.50	3.00	1.50	2.60
			Amer. Chain & Cable 5933-01200	0.750	8.25	2.25	1.12	2.10
3590535-9	1 990	902	CM Chain 562287	0.875	12.00	3.50	1.75	4.20
			Amer. Chain & Cable 5933-01400	0.875	9.62	2.62	1.31	3.40
3590535-10	2 600	1179	CM Chain 562300	1.000	13.00	4.00	2.00	6.00
			Amer. Chain & Cable 5933-01600	1.000	11.00	3.00	1.50	5.10
3590535-12	3 290	1492	CM Chain 562310-B	1.125	15.00	4.50	2.25	8.70
			Amer. Chain & Cable 5933-01800	1.125	12.12	3.38	1.69	7.00
3590535-14	4 065	1843	CM Chain 562325-B	1.250	16.00	5.00	2.50	11.70
			Amer. Chain & Cable 5933-02000	1.250	13.75	3.75	1.88	10.00
3590535-15	4 915	2229	CM Chain 562337-B	1.375	17.00	5.50	2.75	15.40
			Amer. Chain & Cable 5933-02200	1.375	14.88	4.12	2.06	13.00
3590535-16	5 850	2653	CM Chain 562350-B	1.500	18.00	6.00	3.00	19.50
			Amer. Chain & Cable 5933-02400	1.500	16.50	4.50	2.25	17.50
3590535-18	9 500	4309	Amer. Chain & Cable 5933-02800	1.750	19.25	5.25	2.62	28.00
3590535-20	12 500	5669	Amer. Chain & Cable 5933-03200	2.000	22.00	6.00	6.00	41.00
3590535-25	19 000	8618	Amer. Chain & Cable 5933-04000	2.500	27.50	7.50	9.75	79.00

Fig. 16
"S" Hooks

U TYPE HOOKS

U type hooks are a proprietary design and should be considered for heavy (machine and unit) lifts.

Fig. 17 and Fig. 18 give dimensional data, safe working loads and screw torque values for U type hooks.

The use of these hooks must be shown on the assembly drawing, listed in the Bill of Material and shown in the lifting section of the Service Manual.
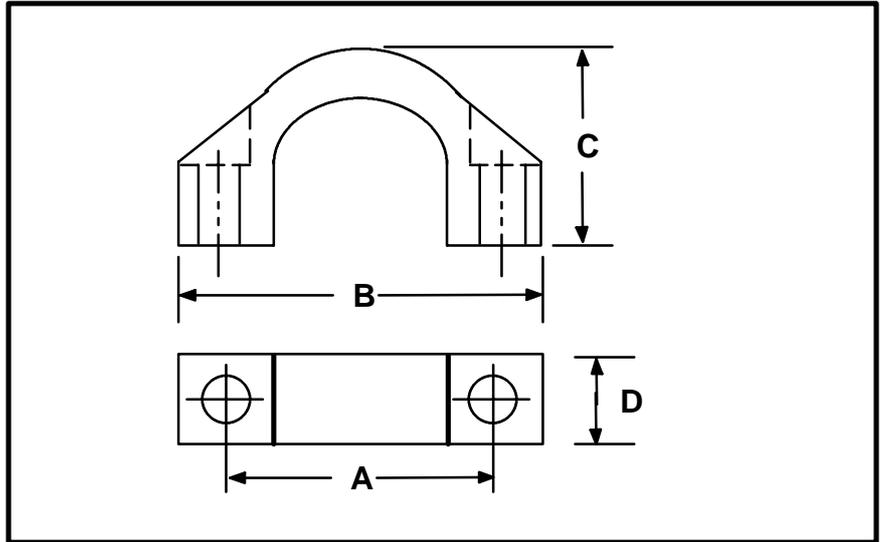
Fig. 17
"U" Type Lifting Hooks

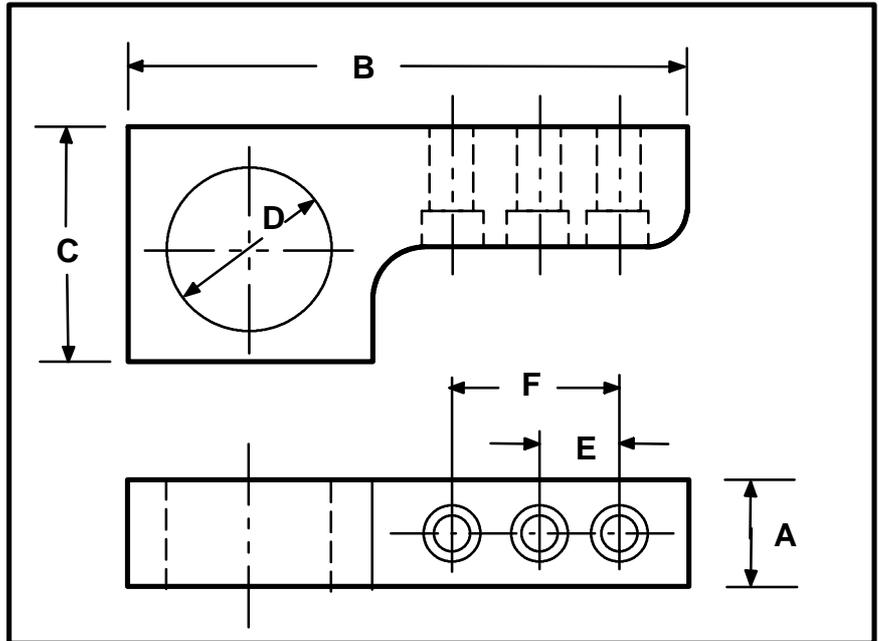| PART NO.	LIFTING CAPACITY		A	B	C	D			SCREW TORQUE	SCREW TORQUE
	LB.	[KG]	in	in	in	in	SCREW NO.	QTY.	LB./FT.	N-m
303427	1 500	[680}	2.75	4.00	2.25	1.25	3248	2	45	61
303429	3 500	[1587]	3.25	4.50	2.50	1.50	2400	2	90	122
301269	6 000	[2720]	4.00	6.00	3.75	2.00	2415	2	160	217
301270	8 000	[3600}	5.00	6.50	3.88	2.25	180139	2	570	502
301271	12 000	[5442]	6.00	8.00	4.50	2.50	308196−3	2	735	997
301272	16 000	[7256]	7.00	9.50	5.30	3.00	308197−4	2	1290	1749
311105	25 000	[11 337]	7.00	14.25	6.00	3.50	308197−4	2	1290	1749
	LB.	[KG]	mm	mm	mm	mm	SCREW NO.	QTY.	N-m	LB./FT.
990819	1 500	[680]	75	107	60	32.0	1234074	2	41	30
3988405	3 000	[1360]	90	120	65	38.0	1234100	2	108	80
3990821	6 000	[2720]	105	155	95	50.0	1400264	2	230	170
5024235	8 000	[3600]	130	180	103	57.2	1400400	2	407	300
5025776	14 000	[6500]	170	250	133	76.2	6010088−3	2	1356	1000
5026032	22 500	[10 200]	300/180	380	159	88.9	6010088−3	4	1356	1000

Fig. 18
"U" Lifting Hook Table

GENERAL SAFETY LIFTING INFORMATION

All hooks or cranes or any other type lifting device should be equipped with a safety latch (see Fig. 19) similar to the one manufactured by the Harrington Co., Plymouth Meeting, Pennsylvania.
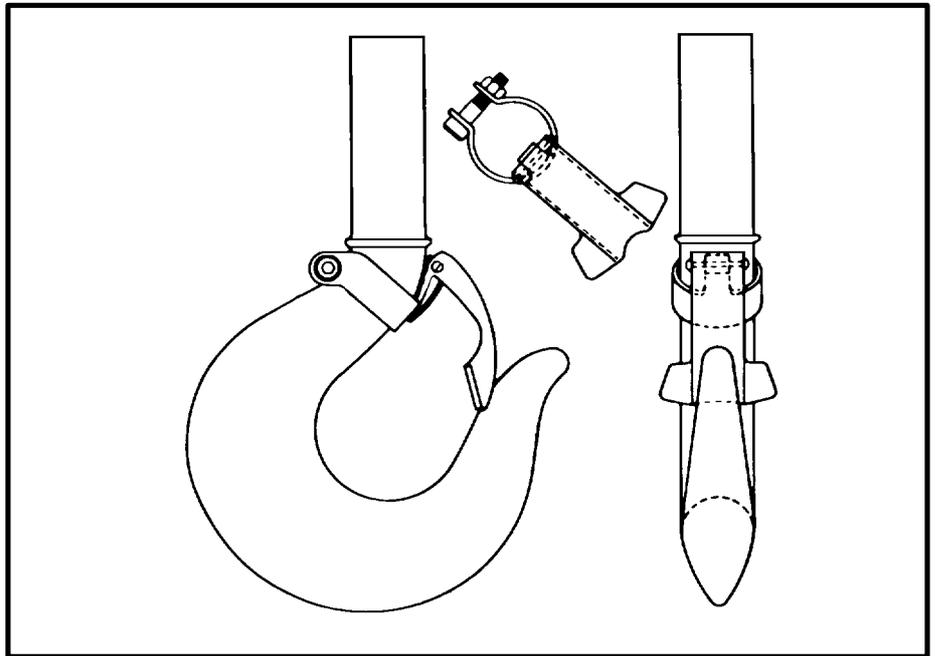
Fig. 19
Safety Latch

Illustrations or descriptions of any special lifting devices or techniques required for servicing components of a specific machine are found in the section dealing with the particular component.

Always contact the nearest Cincinnati Machine representative if there are any questions regarding the lifting of any machine components.

Fluids Used With Machine Tools

General Considerations

Various fluid products, such as cutting fluids, lubricants, etc., are used with this machine tool. The correct type and quantity is identified by instruction plates on the machine and/or written instructions in the supplied manual(s).

Before using fluids or related products not specifically approved or recommended with this machine tool, the owner/user should contact the authorized supplier, closest Cincinnati Machine regional field office for assistance in determining if the product is suitable for the particular application.

Lubricants

Only those lubricants (oils and greases) tested and approved by Cincinnati Machine, should be used in Cincinnati machine tools. For information concerning latest lubricants manual, contact Cincinnati Machine service department.

Cutting Fluids

Before filling the machine, ensure that the product is suitable for the application. Frequently, check for storage, tank unit or hose leaks.

Water mixed fluids that contain emulsifiers must be protected from freezing.

Cutting fluid products should be tailored to each machine tool application and workpiece requirement for maximum efficiency. See **WARNING**.

For assistance in determining the correct cutting fluid, contact nearest Cincinnati Machine Service Department.

Sources Of Information – USA

Before using any fluid product with this machine tool, the owner/user should request a Technical Data Product Safety Sheet (for example: OSHA Form 20 or a similar technical data information sheet) from the product manufacturer. This data should include the following:

Fire and Explosion Hazard Data	Chemical and Trade Name
	Acute Toxicity Properties
Spill or Leak Procedures	Hazardous Ingredients
Special Protective Information	Physical Data
Special Precautions	Recommended Dilutions

> **WARNING**
>
> **CUTTING FLUIDS**
>
> **When soluble coolants are used, it is important to ensure that recommended concentration levels are maintained.**
>
> **Failure to follow this Instruction can cause corrosion of safety critical parts, resulting in machine damage and/or personal injury.**

Listed below are some other sources which can be contacted to obtain additional up-to-date information concerning the safe use, handling, storage and disposal of products, materials, chemicals or substances.

Occupational Safety and Health Act (OSHA) Public Law	Resource Conservation and Recovery Act (RCRA) Public Law
Department of Transportation (DOT) Hazard Classification— The Transportation Safety Act	National Institute for Occupational Safety and Health (NIOSH)
Product Safety Data Sheet Toxic Substances Control Act (TSCA) Public Law	Cincinnati Machine P.O. Box 9013 Cincinnati, Ohio 45209
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Public Law	American National Standards Institute, Inc. (ANSI)
Environmental Protection Agency	American Conference of Governmental Industrial Hygienists, Threshold Limit
Federal Hazardous Substances Act	Values
	Clean Water Act

After receiving the data, analyze and perform the necessary procedures to assure the safe handling, storage, use and disposal of the product. Emergency/First Aid procedures and training should be readily available to personnel handling or using products which may be hazardous (flammable), harmful (toxic) and/or reactive (unstable)

The owner/user should become familiar with and keep informed on all regulated materials or substances. Copies of the latest regulated material may be obtained from agencies, such as NIOSH, Registry of Toxic Effects for Chemical Substances, U.S. Department of Health Education and Welfare, Public Health Service, Center for Disease Control, and the National Institute for Occupational Safety and Health.

Usage Information

Products must not be mixed with other products unless permission and/or instructions have been granted by the manufacturer(s). Product concentrates must be mixed and diluted exactly as instructed by the manufacturer for a particular approved application.

All product CAUTION, WARNING and DANGER labels, tags and printed instructions accompanying the products must be read and followed This instruction shall remain with the product at all times. Additional product instruction labels, signs, etc., should be acquired and displayed with concentrates that are purchased in bulk and then dispensed in small or diluted quantities

Cutting Fluids – Preventative Maintenance

See Cautions 1 and 2

Cutting fluids are designed to cool and lubricate the tool tip while in a cut. There are many types of cutting fluids, some of which may cause various problems on a machining center tool, such as corrosion, bacteria build-up, solid formations of chips and cutting debris, etc. if incorrectly applied.

The user should be aware of these potential problems, and guard against them.

Two types of cutting fluids can be used on this machine, semi-synthetics, and emulsions. Each has its own advantages and disadvantages and the user should consider all of them when making a product selection.

Water Quality

Water is the major ingredient in a water-based cutting fluid. Its importance in product performance cannot be ignored.

Corrosion, residue, scum, rancidity, foam, excess concentrate use, in fact almost any cutting fluid performance problem may be caused by the quality of the water used in making the mix.

Too Soft

When the mix water has a total hardness of less that 75ppm, the cutting fluid may foam - especially in applications where there is agitation. Foam causes problems when it overflows the reservoir, the machining center, the return trenches, etc. Foam may also interfere with settling type separators, obscure the workpiece, and diminish the cooling capacity of a water-based cutting fluid. Generally, all products foam more readily in soft water.

Too Hard

Hard water, when combined with some water-based cutting fluids, promotes the formation of insoluble soaps. The dissolved minerals in the water combine with anionic emulsifiers in the cutting fluid concentrate to form these insoluble compounds that appear as a scum in the mix. Such scum coats the sides of the reservoir, clogs the pipes and filters, covers machining centers with a sticky residue, and may cause sticking gauges, pushbuttons, selector switches, and other similar devices.

Hard water can promote corrosion of machine components and should always be eliminated. De-ionized water will help deal with the problem of hard water, provided advice has been sought.

Cleaning The Coolant Reservoir

The system requires periodic attention and servicing. The reservoir should be drained and cleaned periodically to remove sediments and prevent conditions that lead to deterioration of the coolant. The reservoir can be cleaned by removing the used fluid before adding and circulating a commercial cleaner or as required by adding a suitable cleaner to the used coolant in the machining center during a shut-down period while the machine is cycling. Specific cleaning procedures should be supplied on the label of each cleaning product.

CAUTION 1

COOLANTS

It is not recommended that neat mineral oils be used as a cutting fluid for this machine.

Failure to heed this warning could seriously impair the efficiency of both the coolant and swarf removal systems.

CAUTION 2

COOLANTS

It is not recommended that coolants having a high demulsification factor, be used with this machine.

Such coolants must be checked for compatability with the oils and greases recommended for use with this machine.

Failure to follow this instruction can lead to lubrication problems, resulting in damage to the machine.

Lifespan

The lifespan of cutting fluids varies widely and depends on many factors. The basic type of coolant, the hardness of the water, the types of metal in the coolant tank, the cleanliness of the system, and the amount of tramp oil in the fluid, all are factors that affect lifespan.

Tramp Oil

Tramp oils need to be controlled. Tramp oils in the coolant mix cause a varying degree of degradation of the coolant quality.

Minimize the leakage of oils into the system through proper maintenance of seals and lubricant systems. If excess quantities of oils leak into the system, the metalworking fluid performance can be reduced. Lubricating and hydraulic oils contain food for bacteria. They may also blanket the fluid, excluding air, and thereby provide ideal conditions for the growth of odor producing bacteria. If allowed to build up, extraneous oil causes smoking and increases residue around the machining center area.

The elimination of tramp oils is even more important if chemical cutting fluids are used. Hydraulic oil is a contaminant that must be kept out of the cutting fluid. **Hydraulic oils, and particularly some of the additives formulated into them, can cause serious damage to the machine tool and cutting fluid when mixed with water.**

If tramp oil build-up should become a problem, various commercial devices are available to remove it.

Filtering

The cleanliness of the coolant is very important in regards to the reliability of the various coolant valves, tubing, etc. This Machining Center is equipped with a coolant filter system. It is good practice to ensure that any filters are kept in good operating condition.

Rust Prevention

When a machining center tool is sitting idle for a period, the possibility of corrosion increases. There are certain precautions that the user must take to prevent damage to the precision ground surfaces on this machine tool. Under certain conditions, damage can occur within as little time as a day or two; therefore, it is important that proper precautions be carried out.

If the machining center is going to sit idle for a period, it is important to wipe all the coolant off the slideways and then protect them with a good rust-preventive. On the horizontal axes of the machining center, it may be necessary to run the slides back and forth a number of times, wiping the ways each time, until no coolant is seen originating from under the slide.

After the coolant is clear from under the slide, spray the rust-preventive on the ways and move the slide again, taking the rust-preventive back under the slide.

Printed Circuit Board Handling Instructions

General

All integrated circuits are susceptible to electro-static discharge damage. Because of this condition, special procedures must be used when handling circuit boards containing integrated circuits, even though there is no completely foolproof system of protecting integrated circuits. Metal oxide semi-conductor (MOS) assemblies manufactured byVickers Electronic Systems Division Incorporated are supplied with a caution sticker. Refer to the sticker and the information concerning cautions and warnings in the supplied literature.

NOTE: It is important to emphasize that electro-static discharge to a PC Board may not completely destroy an assembly component, but severely de-grade this component to a point where intermittent failures may occur.

If static discharge occurs at sufficient magnitude (2kV or greater) damage or degradation will usually occur if recommended handling procedures are not used. Personnel handling equipment in a low humidity environment can generate static potentials in excess of 10kV. Do not touch any integrated circuit assemblies at the pins, leads or edge connectors, since most damage is done at these points. See **WARNING 1**.
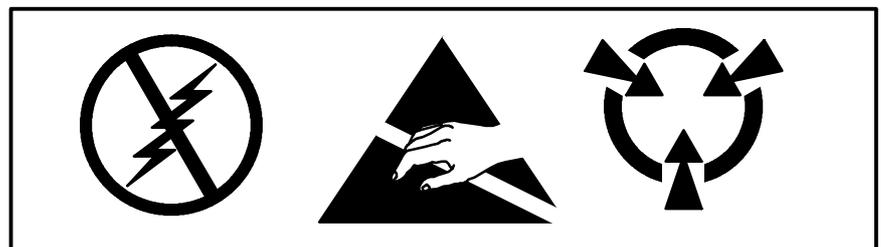
Recommended Handling Procedure

Before removing or replacing any PC Board, a qualified technician must disconnect all electrical power, including battery back-up devices. Refer to the machine dedicated electrical diagrams. See **WARNING 2**.

A recommended procedure before handling printed circuit boards is as follows:

1. Attach a grounded "wrist strap" in contact with the skin. This strap should have a resistor value of 1 megohm (1/2 watt) in series with the person and grounded to leak off electro-static discharge.

2. When working with static control devices (for example: a bag or pad), touch the device with your grounded hand. This action will place you and the static control device assembly at the same electro-static potential.

Store and transport the printed circuit boards in static control bags. Use "shorting bars" or conductive foam materials. Do not use a suspected static damaged printed circuit board. See **WARNING 3**.

Below are examples of electro-static caution symbols which may appear in areas of concern (for example: packing, shipping or receiving). These symbols signify that the "Recommended Handling Procedures" must be used and/or follow any special supplied instruction.

Safety Features

Perimeter Guarding

A complete set of perimeter guards is supplied and fitted to this machine. See **WARNING 1.**

OPERATOR ACCESS TO THE MACHINE is gained at the following point:-

Operator Doors – for loading and unloading components and for setting up purposes.

Operator Sliding Door(s)

See **WARNING 2.**

With the door(s) closed and machine power on, a safety switch is actuated that allows automatic machine movements to be executed.

It is not possible to open the operator door/s while the machine is in automatic cycle, due to the latching mechanism of the switch.

With the door(s) open and machine power on, the following conditions apply:

1. Spindle rotation is inhibited.

2. Power feed of the X, Y, Z axes are limited to 2m/min maximum.

The following functions are also available for selection.

1. Coolant Start

2. Manual clamp/unclamp of the spindle drawbar.

Cincinnati Machine 91203809-001

Feed Hold Push Button

Provides logical and safe interruption of the active machine cycle when actuated.

Emergency Stop Push Button

See **CAUTION.**

Provides fastest practical elimination of machine movements (spindle, axes and mechanisms etc.).

Electrical Isolation Device

A lockable isolation switch is provided on the main electrical cabinet. See **DANGER.**

Air Supply Isolation Valve

A pneumatic isolation valve is required to be provided by the customer to allow for the removal of air power from the machine.

Metric Lifting Points

This machine has been manufactured to utilise "METRIC" thread lifting devices. Any exception to this will be labelled adjacent to the lift point.

Machine Related Safety And Usage Notes

Axis Overtravel Condition

Care should be taken when power feeding an axis out of axis overtravel condition, to ensure that the direction selected brings the axis away from the overtravel condition. If the wrong direction is selected it is possible to drive the axis further into overtravel which could result in damage to the machine.

Through Spindle Coolant Option

See **WARNING 1.**

Unique tool studs are used with this machine. Refer to Chapter 2 for tool stud information.

Tooling Taper - Spindle

To ensure smooth withdrawal of the cutting tool from the spindle, it is recommended that the spindle taper be cleaned and lightly lubricated, at regular intervals.

Inter-drilled Tooling

Inter-drilled tooling should be used whenever Through Spindle Coolant is selected. See **WARNING 1**.

Drive Key Spindle Unit

The drive key is an integral part of the balanced spindle unit and as such must not be removed. See **CAUTION**.

Safe Operation Of Multi-part Tooling

See **WARNING 2.**

Tool Drum Positioning

The operator must ensure that the Tool Drum rotor is positioned so that Pocket Number 1 is adjacent to the spindle, when the Tool Drum is in its "AT SPINDLE" position.

Failure to follow this procedure may result in a Tool Drum misalignment, resulting in the automatic selection of the wrong tools, with possible damage to the machine and/or personal injury to the machine operator.

Tool Storage Drum

All positions of the storage drum should be filled, i.e. 21 positions.

Where cutting tools are not required, dummy tools, consisting of toolholder and stud only, should be used.

Tool Storage Drum - Pocket Wear

Every 3 months check tool pockets for visible wear. If excessive wear is noted, change affected pocket and check alignment to spindle (see SERVICE MANUAL).

> **WARNING 1**
>
> **THROUGH SPINDLE COOLANT AND SOLID TOOLING**
>
> **If through spindle coolant is selected with a solid tool in the spindle, the tool may be ejected from the tool holder with considerable force.**
>
> **Failure to follow this instruction may result in serious personal injury.**

> **CAUTION**
>
> Removing the key will upset the balance of the unit. Refitting this key will not guarantee that the balance of the unit is returned to acceptable limits.
>
> Failure to follow this instruction may result in damage to equipment.

> **WARNING 2**
>
> **SAFE OPERATION OF MULTI PART TOOLING**
>
> **The maximum spindle speed of this machine may exceed the recommended speed of the multi tip tools.**
>
> **Never operate at speeds higher than those specified by tooling manufactures.**
>
> **Failure to follow this instruction may result in serious personal injury.**

Loading Tools into Spindle

ANSI –   Ensure NON DIMPLED Drive Slot engages with Spindle drive key.

ISO/DIN – Ensure Drive Slot OPPOSITE angled cut out (notch) engages with Spindle drive key.

Loading Tools into Storage Drum Pockets

ANSI –   Ensure DIMPLED Drive Slot engages with pocket locator.

ISO/DIN – Ensure Drive Slot ADJACENT to angled cut out (notch) engages with pocket locator.

Levelling

In order to support the Electrical Cabinet during machine transit and lifting, an anchor bracket is bolted to the top of the cabinet and machine column.

CAUTION: The machine as received will have these bolts fully tightened.

Before attempting to level the machine ensure that:

1. The electrical cabinet lower support strut and its associated adjusting screws are in place under the R.H. end of the cabinet and the adjusting screw is in contact with its support pad – only applicable to ARROW 1000/1250 (ERM) machines.

2. The anchor bracket is released by slackening off (but NOT removing, see **WARNING**) the four mounting screws between the bracket and the top of the cabinet until they are hand tight.

Bolting to Foundation

In order to obtain optimum performance from the machine, it must be bolted down.

WARNING

UPPER ANCHOR BRACKET RELEASE

Ensure cabinet is properly attached to lower support, before releasing this bracket.

Failure to follow this instruction may result in serious personal injury.

WARNING

Improper handling of lithium batteries may cause the batteries to explode, spraying caustic metal, and causing severe chemical burns.
Failure to follow this instruction may result in serious personal injury.

Lithium Batteries

Lithium batteries contain the hazardous chemical lithium -an extremely active chemical requiring special handling and disposal. The following guidelines should be observed when handling lithium batteries:

S   Lithium batteries are not rechargeable.

S   Do not allow lithium batteries to be heated above 212 degrees F (100 degrees C).

S   Do not incinerate lithium batteries.

S   Do not expose lithium batteries to water. Water may cause a violent reaction.

S   Do not try to disassemble lithium batteries. Direct contact with the metal causes severe chemical burns.

Because of the hazardous nature of lithium, disposal must be made according to applicable federal, state, and local regulations.

Chapter 2
System Information

Fig. 20
Arrow Vertical Machining Center

Introduction

The CINCINNATI MACHINE DART and ARROW range of Machining Centers are general purpose cold metal cutting machines, which use rotating tools.

The machine has three sliding axes and tool changing capability all under numerical control.

The machine, integrated with the control, comprises the system and is referred to as a Machining Center.

The machining center has been designed to automatically change tools in order to carry out milling, drilling, tapping, boring and reaming operations.

All functions of the machine may be controlled by the NC program, with the minimum of operator attention being required.

The perimeter guarding provided, ensures the safety of personnel against moving parts, coolant, swarf and broken tooling, when the above operations are being undertaken. See **WARNING**. See also *GUARD STRENGTH*.

WARNING

MISUSE OF THE MACHINE

The machine must not be adapted to carry out any form of TURNING or GRINDING operations, as its design and construction does not allow for these to be performed safely.

Failure to heed this warning could result in serious personal injury if not death.

Machine Information

The basic machine consists of the following units:

Fixed base
Sliding Saddle (Y-Axis)
Spindle Carrier (Z-Axis)
Fixed Column
Table (X-Axis)
Tool Storage Unit
Computer Numerical Control Station
Electrical Cabinet
Chip/Coolant Tray
Perimeter Guards

Main Base Unit . . . . The main base is the foundation of the Machining Center structure. In addition to providing rigidity and support for the sliding members, machine alignment is maintained through the precision levelling of this structure.

Column Unit . . . . The column is bolted to the main base. The two slide ways affixed to the column provide support for the travelling spindle carrier.

Spindle Carrier Unit . . . . The travelling spindle provides vertical (Z-Axis) movement. It also contains the necessary components to drive the spindle through the speed range in one (1) RPM increments. The spindle is powered by an AC motor. Motor speed selection is accomplished via CNC.

The spindle has a No. 40 taper (standard) and a keyed drive for tool holders. The built-in automatic power drawbar locks the tool holder in the spindle.

Saddle Unit . . . . The sliding saddle, besides providing the Y-Axis travel, supports the table.

Table . . . . The sliding table provides the X-Axis travel and is the actual work surface.

Tool Changer Unit . . . . The automatic tool storage/changer unit comprises a tool storage drum that is bolted to the column and moves to and from the spindle to exchange and store tools. Up to 21 tools may be stored in the drum. Tools are selected in random order and the drum rotates in a direction that results in the shortest path to the selected tool.

Swarf/Coolant Tank Unit/s . . . . There will:
either be two units, one positioned each side of the machine and interconnected by means of a large dia tube,
or a single unit positioned across the front of the machine.

The machine and control are integrated to comprise an efficient manufacturing system. Thus, machining cycles can be completely automatic, including tool selection, tool positioning, selection of spindle speeds and cutting feeds, coolant control with other related auxiliary functions and/or combinations of control. The machine and controls are completely compatible, each taking advantage of the capabilities of the other.

Machine Location

See Caution

EMC Directive Requirements

This machine satisfies the EMC Directive by conforming to generic emissions and immunity standards for the INDUSTRIAL ENVIRONMENT ONLY.

Install the Machining Center in a clean, well lighted area. Ambient temperatures should remain relatively constant to maintain accurate alignment between components, and there should be enough air space around the machining center to dissipate heat built up during operation. Avoid particularly a location near shipping doors, etc. where air temperatures in winter can fluctuate widely.

Ensure there will be enough room around the machining center to access its components for maintenance and operation. Suitable lifting devices will be required for assembly, servicing , and loading/unloading of workpieces.

NC Control

The machine operating station is mounted and positioned at the front of the machine guarding, Protect the control from dust and extremes of temperature and humidity.

A machine pendant control, flexibly connected to the operating staiton, can be either hand held or magnetically attached to the machine guarding.

> **CAUTION**
>
> Avoid locating the machining center near welding , electrical, or magnetic generating equipment. Possible generating electrical noise may result in machine control interference.
>
> Failure to follow this instruction may result in damage to machine components.

Axis Orientation

Fig. 21
Vertical Machining Center - Axis Orientation
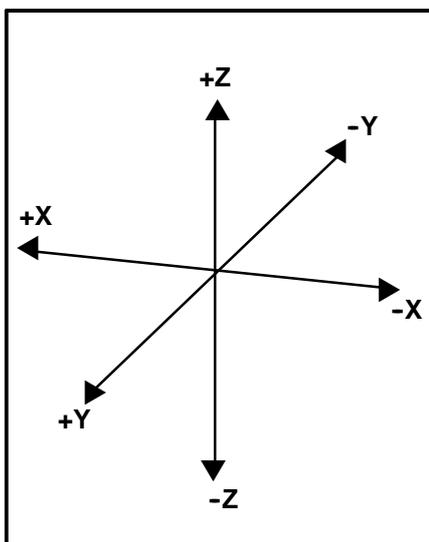
Carrier (Spindle) vertical movement = Z axis

Saddle horizontal movement = Y axis

Table horizontal movement = X axis

The axis orientation photograph enables the operator to affix in his mind the conventional slide directions of movement for the vertical machining center. The photograph is for axis orientation only and does not represent the mechanical zero reference points for these axes.

Guard Strength

For Machines with 6000 RPM Spindles
The guards of this machine are designed to prevent access to hazardous moving parts and to contain the ejection of tool or workpiece fragments up to a calculated maximum energy level of 60 Joules. This is equivalent to a mass of 50 grams ejected from a cutter diamter of 153 millimetres rotating at 6000 revolutions per minute,for standard speed machines.

For Machines with 8000 and 10000 RPM Spindles
The guards of this machine are designed to prevent access to hazardous moving parts and to contain the ejection of tool or workpiece fragments up to a calculated maximum energy level of 100 Joules. This is equivalent to a mass of 50 (32) grams ejected from a cutter diamter of 153 millimetres rotating at 8000 (10000) revolutions per minute,for standard speed machines.

Note: Figures for High speed machines are shown in brackets.

See **WARNING 1.**

Noise

Noise level for this machine is within a maximum of 78 dB(A).

The operating conditions used to determine this figure were as follows:

1. Machine correctly installed, clear of all nearby reflecting surfaces with all guards fitted and closed.

2. Noise Measurement positions 1.6m high at operator's work-station and at 1.5m increments along a peripheral path 1.0m from the outer surface of the machine.

3. Noise levels measured using an integrating sound level meter.

4. Machine warmed prior to testing by running for at least 30 minutes at a spindle speed of 66% of max RPM.

5. Noise levels measured at each position under the following conditions:

    a. Spindle running at maximum speed, i.e. no-load test. Sound Pressure Levels recorded in dB(A) using SLOW setting and corrected for background level.

    b. Machine under standard operating conditions (see below). Equivalent Continuous Sound Level recorded in L(Aeq) and corrected for background level.

WARNING 1

GUARD STRENGTH

For safe use of this machine the guards must be in place and properly maintained. Care must be taken to ensure that cutters are applied within their designed safe speed and that any separate component parts of cutters are securely clamped prior to application.

Failure to follow this guidance may result in serious personal injury; if not death.

---

6. Standard operating conditions:

Work-piece:	Free-cutting mild steel, 140-150 Brinell
Tooling:	Indexable insert milling cutter
	Approach angle 45_
	No of inserts: 5
	Diameter: 70mm
	Side Rake: -7_
	Back Rake: 20_
Spindle speed:	570 rev/min
Feedrate:	712 mm/min in X
Depth of cut:	4mm
Width of cut:	60mm
Metal removal:	165 cm^3/min (app 7.5kW)

7. Corrected noise levels at each position and under running light and operating conditions will not exceed the specified limit of 78 dB(A) or 78 L(Aeq).

The operating conditions described herein are representative of the product and reflect prevailing usage.

Noise levels, under different operating conditions, may vary from the figures quoted.

See **WARNING**.

Work-piece/Work Holding Device Loading/Unloading

Work-piece/ Work Holding Device loading and unloading should be undertaken with the machine table positioned centrally in the X axis and in its maximum forward position in the Y axis (Y+). Local lifting regulations must be observed.

Fumes And Coolant Misting

Extraction equipment can be fitted to the machine. When machining materials which might produce fumes or result in coolant misting, note should be taken of local health and safety regulations.

Fire Hazard

The machine has not been designed to cater for materials which, as a result of the machining application, could combust. It is the owner's/user's responsibility in these circumstances to conform with local safety regulations for handling and machining such materials.

Should further advice be required on any of the above items the request should be forwarded to one of the offices detailed at the front of this manual.

WARNING

NOISE LEVEL

It is possible that prolonged use of the machine under extreme conditions, could generate noise of a level deemed to be injurious to the hearing of operators or bystanders. Under such circumstances the use of hearing protection is required.

Failure to heed this warning could result in serious personal injury.

Arrow E/Dart (ERM) Specification

	Units	500	750
Axis Travel Ranges, X,Y,Z			
Longitudinal (table X axis)	mm	510	762
Cross (saddle Y axis)	mm	510	510
Vertical (spindle carrier Z axis)	mm	510	510
Range, spindle gauge line to work surface . . . . minimum	mm	127	127
maximum	mm	637	637
Table X-Axis			
Work surface dimensions . . . . length	mm	700	950
width	mm	520	520
Load capacity	kg	350	455
Spindle Carrier, Z-Axis			
AC Drive Motor (continuous rated)	kW	3.7	3.7
Spindle speed range . . . . minimum	rpm.	60	60
maximum	rpm.	6000	6000
Speed selection		1 rpm increments	
Tool holder		#40 ANSI/ASME B5.50-1985 std.	
		#40 ISO 7388/1-1983(E) std.	
		#40 DIN 69 871-1986 (part 1) std	
		#40 BT40 MAS 403-1982 (option)	
Linear Axis Feedrates and Thrust			
Rapid traverse rate . . . . X,Y,Z	m/min	16	16
Axis thrust (duty rated) . . . . X,Y	kN	2	2
Z	kN	7	7
Accuracies			
Uni-directional positioning per linear axis over full travel	mm	0.004	0.004
Uni-directional repeatability per linear axis over full travel	mm	0.001	0.001
Automatic Storage/Changer Unit			
Storage capacity . . . . Number of tools		21	21
Tool selection method		Bi-directional rotation of tool drum	
Tool and holder weight . . . . maximum	kg	6.8	6.8
Tool drum load (evenly spaced) . . . . maximum	kg	68	68
Tool length . . . . maximum	mm	385	385
Tool diameter (adjacent pockets full)	mm	80	80
Tool diameter (adjacent pockets empty)	mm	160	160
Automatic tool change time (metal to metal)	s	8	8

Arrow E/Dart (ERM) Specification

	Units	500	750
CNC System			
Model and type		ACRAMATIC 2100E	
Manufacturer		Vickers E.S.D., Inc.	
Number of contouring axes		X, Y, Z	
Lubrication System			
Axes ballscrew nuts . . . . grease		P 64	P 64
Spindle bearing lubrication . . . . air/oil		Automatic Oil Lube P 38	
Coolant System			
Coolant delivery system		Flood through nozzles Through spindle (optional)	
Pump . . . . without through spindle coolant		25l/min	@ 1 bar
with through spindle coolant		27l/min	@ 10 bar
Tank capacity	l	178	178
Air requirement			
Air supply pressure	bar	5.5	5.5
Continuous volume . . . . standard machine ANR	dm^3/s	6.6	6.6
Electrical Power Requirement			
Spindle drive unit	kVA	6.0	6.0
Axis drive units (including 4th axis)	kVA	8.0	8.0
Tool drum	VA	50	50
Tool change motor	VA	225	225
Coolant pump – standard	kVA	1.8	1.8
Through spindle coolant pump (120 psi)	kVA	3.7	3.7
Through spindle coolant pump (80 psi)	kVA	1.7	1.7
Control gear	VA	750	750
Miscellaneous	VA	400	400
Lubrication pump (if fitted)	VA	24	24
Machine Weight/Floor Space			
Machine net weight approx.	kg	3050	3300
Overall machine height (max)	m	2.7	2.7
Overall floor space – width . . . . without swarf augers	m	2.6	3.4
– width . . . . with swarf augers	m	2.2	2.8
– depth . . . . (cabinet doors open)	m	2.92	2.92

Arrow (ERM) Specification

	Units	500	750
Axis Travel Ranges, X,Y,Z			
Longitudinal (table X axis)	mm	510	762
Cross (saddle Y axis)	mm	510	510
Vertical (spindle carrier Z axis)	mm	510	510
Range, spindle gauge line to work surface (STD) . . . . minimum	mm	127	127
maximum	mm	637	637
Raised Z axis . . . . minimum	mm	227	227
maximum	mm	737	737
Table X-Axis			
Work surface dimensions . . . . length	mm	700	950
width	mm	520	520
Load capacity	kg	500	750
Spindle Carrier, Z-Axis			
AC Drive Motor (continuous rated) . . . . (standard)	kW	5.5	5.5
Spindle speed range . . . . (standard)	rpm.	60–6000	60–6000
A/C Drive Motor (continuous rated) . . . . (optional)	kW.	9.0	9.0
	rpm	60–8000	60–8000
	rpm	60–10000	60–10000
	rpm	30–5000	30–5000
Speed selection		1 rpm increments	
Tool holder		#40 ANSI/ASME B5.50-1985 std. #40 ISO 7388/1-1983(E) std. #40 DIN 69 871-1986 (part 1) std #40 BT40 MAS 403-1982 (option)	
Linear Axis Feedrates and Thrust			
Rapid traverse rate . . . . X,Y,Z	m/min	24	24
Axis thrust (continuous) . . . . X,Y	kN	2.5	2.5
Z	kN	6.0	6.0
Accuracies			
Uni-directional positioning per linear axis over full travel	mm	0.004	0.004
Uni-directional repeatability per linear axis over full travel	mm	0.001	0.001
Automatic Storage/Changer Unit			
Storage capacity . . . . Number of tools		21	21
Tool selection method		Bi-directional rotation of tool drum	
Tool and holder weight . . . . maximum	kg	6.8	6.8
Tool drum load (evenly spaced) . . . . maximum	kg	68	68
Tool length . . . . maximum	mm	385	385
Tool diameter (adjacent pockets full)	mm	80	80
Tool diameter (adjacent pockets empty)	mm	160	160
Automatic tool change time (metal to metal)	s	7.0	7.0

Arrow (ERM) Specification

	Units	500	750
CNC System			
Model and type		ACRAMATIC 2100E	
Manufacturer		Vickers E.S.D., Inc.	
Number of contouring axes		X, Y, Z	
Lubrication System			
Axes ballscrew nuts . . . . grease		P 64	P 64
Spindle bearing lubrication . . . . air/oil		Automatic Oil Lube P 38	
Coolant System			
Coolant delivery system		Flood through nozzles Through spindle (optional)	
Pump . . . . without through spindle coolant		25l/min	@ 1 bar
with through spindle coolant		27l/min	@ 10 bar
Tank capacity	l	178	178
Air requirement			
Air supply pressure	bar	5.5	5.5
Continuous volume . . . . standard machine ANR	dm^3/s	6.6	6.6
Electrical Power Requirement			
Spindle drive unit (5.5/7.5 kW spindle)	kVA	12	12
Spindle drive unit (9/11 kW spindle)	kVA	25	25
Axis drive units (including 4th axis)	kVA	12	12
Tool drum	VA	50	50
Tool change motor	VA	225	225
Coolant pump – standard	kVA	1.8	1.8
Through spindle coolant pump (120 psi)	kVA	3.7	3.7
Through spindle coolant pump (80 psi)	kVA	1.7	1.7
Conveyor motors (total)	VA	920	920
Control gear	VA	750	750
Miscellaneous	VA	400	400
Lubrication pump (if fitted)	VA	24	24
Machine Weight/Floor Space			
Machine net weight approx.	kg	3050	3300
Overall machine height (max)	m	2.7	2.7
Overall floor space – width . . . . without swarf augers	m	2.6	3.4
– width . . . . with swarf augers	m	2.2	2.8
– depth . . . . (cabinet doors open)	m	2.92	2.92

Arrow (ERM) Specification

	Units	1000	1250C
Axis Travel Ranges, X,Y,Z			
Longitudinal (table X axis)	mm	1020	1270
Cross (saddle Y axis)	mm	510	510
Vertical (spindle carrier Z axis)	mm	560	560
Range, spindle gauge line to work surface (STD) . . . . minimum	mm	127	127
maximum	mm	687	687
Increased Z range . . . . minimum	mm	127	127
maximum	mm	847	847
Table X-Axis			
Work surface dimensions . . . . length	mm	1120	1370
width	mm	600	600
Load capacity	kg	1000	1250
Spindle Carrier, Z-Axis			
AC Drive Motor (continuous rated) . . . . (standard)	kW	5.5	5.5
Spindle speed range . . . . (standard)	rpm.	60–6000	60–6000
A/C Drive Motor (continuous rated) . . . . (optional)	kW.	9.0	9.0
	rpm	60–8000	60–8000
	rpm	60–10000	60–10000
	rpm	30–5000	30–5000
A/C Drive Motor (continuous rated) . . . . (optional)	kW.	11.0	11.0
	rpm	60–8000	60–8000
Speed selection		1 rpm increments	
Tool holder		#40 ANSI/ASME B5.50-1985 std.	
		#40 ISO 7388/1-1983(E) std.	
		#40 DIN 69 871-1986 (part 1) std	
		#40 BT40 MAS 403-1982 (option)	
Linear Axis Feedrates and Thrust			
Rapid traverse rate . . . . X,Y,Z	m/min	24	24
Axis thrust (continuous) . . . . X,Y	kN	2.5	2.5
Z	kN	6.0	6.0
Accuracies			
Uni-directional positioning per linear axis over full travel	mm	0.004	0.004
Uni-directional repeatability per linear axis over full travel	mm	0.001	0.001
Automatic Storage/Changer Unit			
Storage capacity . . . . Number of tools		21	21
Tool selection method		Bi-directional rotation of tool drum	
Tool and holder weight . . . . maximum	kg	6.8	6.8
Tool drum load (evenly spaced) . . . . maximum	kg	68	68
Tool length . . . . maximum	mm	305	305
Tool diameter (adjacent pockets full)	mm	80	80
Tool diameter (adjacent pockets empty)	mm	160	160
Automatic tool change time (metal to metal)	s	7.0	7.0

Arrow (ERM) Specification

	Units	1000	1250C
CNC System			
Model and type		ACRAMATIC 2100E	
Manufacturer		Vickers E.S.D., Inc.	
Number of contouring axes		X, Y, Z	
Lubrication System			
Axes ballscrew nuts . . . . grease		P 64	P 64
Spindle bearings . . . . air/oil		Automatic - Oil Lube P38	
Coolant System			
Coolant delivery system		Flood through nozzles Through spindle (optional)	
Pump . . . . without through spindle coolant		25l/min	@ 1 bar
with through spindle coolant		27l/min	@ 10 bar
Tank capacity	l	178	178
Air requirement			
Air supply pressure	bar	5.5	5.5
Continuous volume . . . . standard machine ANR	dm^3/s	6.6	6.6
Electrical Power Requirement			
Spindle drive unit 5.5/7.5kW	kVA	12	12
Spindle drive unit 9/11kW	kVA	25	25
Spindle drive unit 11/13kW	kVA	40	40
Axis drive units (including 4th axis)	kVA	12	12
Tool drum	VA	50	50
Tool change motor	VA	225	225
Coolant pump – standard	kVA	1.8	1.8
Through spindle coolant pump (120 PSI)	kVA	3.7	3.7
Through spindle coolant pump (80 PSI)	kVA	1.7	1.7
Conveyor motor No. 1	VA	460	460
Conveyor motor No. 2	VA	460	460
Control gear	VA	750	750
Miscellaneous	VA	400	400
Chiller unit (if supplied)	VA	500	500
Machine Weight/Floor Space			
Machine net weight approx.	kg	4545	5000
Overall machine height (max) – Std column	m	2.75	2.75
Overall machine height (max) – Extended column	m	2.90	2.90
Overall floor space width – without TSC, without swarf conveyor	m	3.10	3.70
width – with TSC, without swarf conveyor .	m	3.60	4.10
width – with TSC, with swarf conveyor	m	5.20	5.50
depth – cabinet doors open, no conveyor . . .	m	3.35	3.35
depth – cabinet doors open, with conveyor .	m	3.50	3.50

Arrow (ERD) Specification

	Units	1250	1500	2000
Longitudinal (table X axis)	mm	1270	1524	2032
Cross (saddle Y axis)	mm	762	762	762
Vertical (spindle carrier Z axis)	mm	770	770	770
Range, spindle gauge line to work surface . . . . minimum	mm	175	175	175
maximum	mm	945	945	945

Table X-Axis

	Units	1250	1500	2000
Work surface dimensions . . . . length	mm	1504	1754	2254
width	mm	765	765	765
Load capacity	kg	2000	2500	3000

Spindle Carrier, Z-Axis

	Units	1250	1500	2000
AC Drive Motor (continuous rated) . . . . (standard)	kW	5.5	5.5	5.5
Spindle speed range . . . . (standard)	rpm.	60-6000	60-6000	60-6000
AC Drive Motor (continuous rated) . . . . (optional)	kW	9.0	9.0	9.0
	rpm.	60-8000	60-8000	60-8000
	rpm	60-10000	60-10000	60-10000
	rpm.	30-5000	30-5000	30-5000
Number of speeds		Programmable in 1 rpm increments		
Tool Holder Type		#40 ANSI/ASME B5.50-1985 std.		
		#40 ISO 7388/1-1983(E) std.		
		#40 DIN 69 871-1986 (part 1) std		
		#40 BT40 MAS 403-1982 (option)		

Linear Axis Feedrates and Thrust

	Units	1250	1500	2000
Feedrates . . . . X,Y,Z	mm/min	3-15000	3-15000	3-15000
Rapid traverse rate . . . . X,Y,Z	m/min	24	24	24
Axis thrust (continuous) . . . . X,Y	kN	4	4	4
Z	kN	10	10	10

Accuracies

	Units	1250	1500	2000
Uni-directional positioning Z axis over full travel	mm	0.004	0.004	0.004
Uni-directional positioning X and Y axis over full travel	mm	0.003	0.003	0.003
Uni-directional repeatability per linear axis over full travel . . .	mm	0.001	0.001	0.001

Automatic Storage/Changer Unit

	Units	1250	1500	2000
Storage capacity . . . . Number of tools		21	21	21
Tool selection method		Random by programmed tool station number or tool ID		
Tool and holder weight . . . . maximum	kg	6.8	6.8	6.8
Tool drum load (evenly spaced) . . . . maximum	kg	68	68	68
Tool length . . . . maximum	mm	385	385	385
Tool diameter (adjacent stations full)	mm	80	80	80
Tool diameter (adjacent stations empty)	mm	160	160	160
Automatic tool change time (metal to metal)	s	7.0	7.0	7.0

Arrow (ERD) Specification	Units	1250	1500	2000
CNC System				
Model and type		ACRAMATIC A2100E		
Manufacturer		VICKERS E.S.D., INC.		
Number of contouring axes		X, Y and Z		
Lubrication System				
Axes ballscrew nuts . . . . grease		P 64	P 64	P64
X,Y,Z axis way bearings . . . . grease		P 64	P 64	P64
Spindle bearings . . . . air/oil		Automatic – Oil Lube P38		
Coolant System				
Coolant delivery system		Flood through nozzles Through spindle (optional)		
Pump . . . . without through spindle coolant		20l/min	@ 1 bar	
with through spindle coolant		27l/min	@ 10 bar	
Tank capacity . . . . with or without Swarf Conveyor	l	730	730	730
Air requirement				
Air supply pressure	bar	5.8	5.8	5.8
Continuous volume . . . . standard machine ANR	dm^3/s	6.6	6.6	6.6
Electrical Power Requirement				
Spindle drive unit	kVA	21	21	21
Axis drive units	kVA	31	31	31
Tool drum motor – indexer	kVA	0.9	0.9	0.9
Tool drum motor – linear	kVA	0.5	0.5	0.5
Standard coolant pump	kVA	0.88	0.88	0.88
Through spindle coolant pump	kVA	6.8	6.8	6.8
Conveyor motor 2 off – OPTION	kVA	0.88	0.88	0.88
Control gear	kVA	0.75	0.75	0.75
Sundries	kVA	0.40	0.40	0.40
Chiller unit (if supplied)	kVA	1.5	1.5	1.5
Machine Wash Motor – OPTION	kVA	2	2	2
Machine Weight/Floor Space				
Machine net weight approx.	kg	8800	9500	11000
Overall machine height from floor	m	3.6	3.6	3.6
Overall floor space . . . . without swarf conveyor (approx.)	m	3.7 x 3.5	4.2 x 3.5	5.4 x 3.5
with swarf conveyor (approx.)	m	3.7 x 3.8	4.2 x 3.8	5.4 x 3.8

MACHINE ARROW E / DART ARROW	X AXIS TRAVEL
500	510
750	762

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

COOLANT NOZZLE TAP POS.

X AXIS TRAVEL

Z AXIS TRAVEL 510

GAUGE LINE

385 MAX TOOL

160 MAX TOOL

520 TOOL CHANGE POS.

135 MIN

127 MIN GAUGE LINE

SWARF TRAY SHOWN IN FORWARD POSITION. (BOTH SIDES)

812
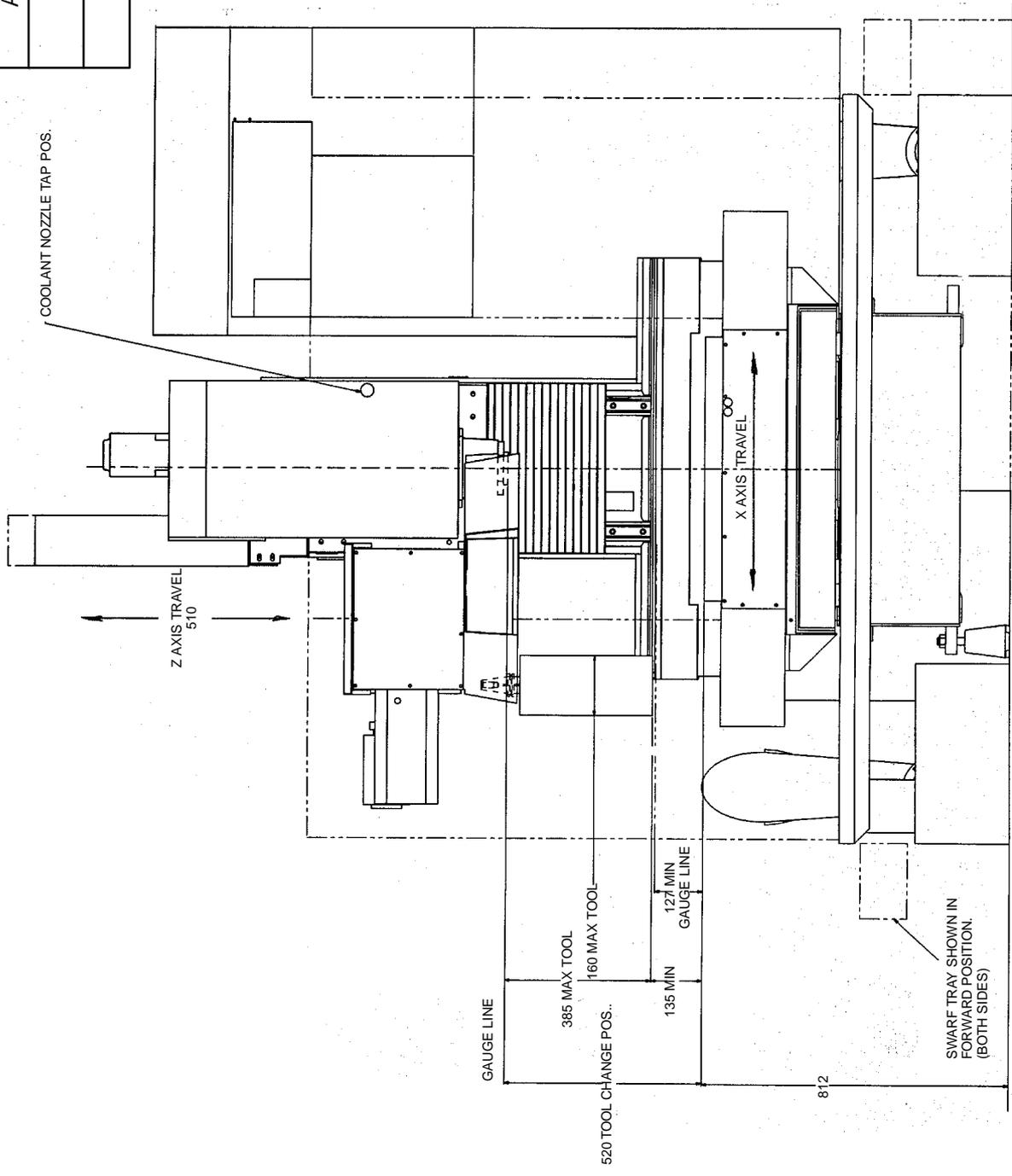
Fig. 22
Range Drawing for Arrow E / Dart / Arrow 500, 750 (ERM) Machines -
Front View

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

MACHINE	AXIS TRAVEL	
ARROW E / DART ARROW	Y	Z
500	510	510
750	510	510

485 SWARF CHUTE AUGER OPTION.

Note: Raised machine information NOT applicable to ARROW E/DART machines

132.

58

471.

521.

Y AXIS TRAVEL.

143.

127.

GAUGE LINE.

520 T/C HEIGHT (STANDARD MACHINE)
620 T/C HEIGHT (RAISED MACHINE)
127 MIN (STD MACHINE)
637 MAX (STD MACHINE)
227 MIN (RAISED MACHINE)
737 MAX (RAISED MACHINE)

812.
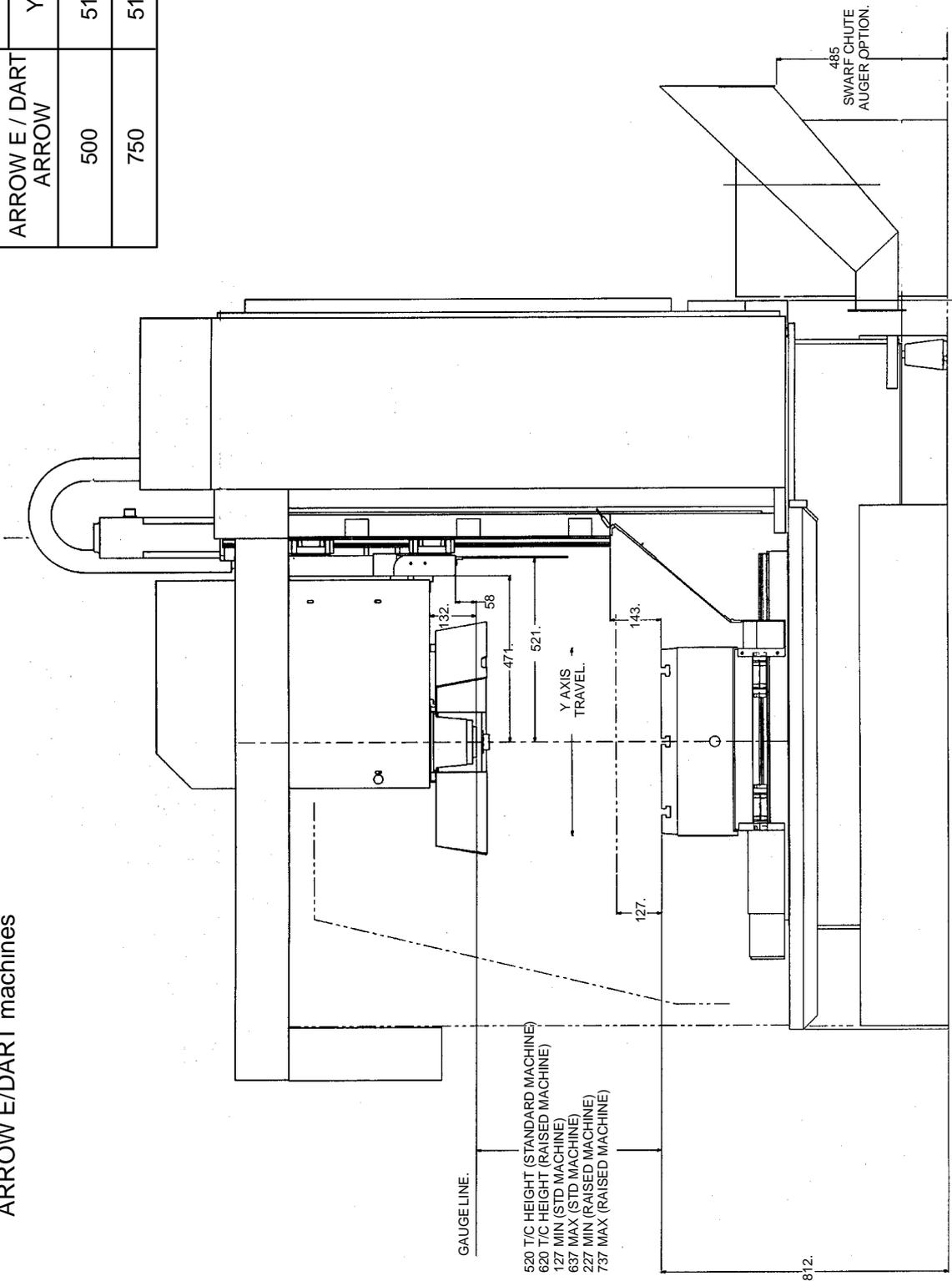
Fig. 23
Range Drawing for Arrow E / Dart / Arrow 500, 750 (ERM) Machines -
Right Hand Side View

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine
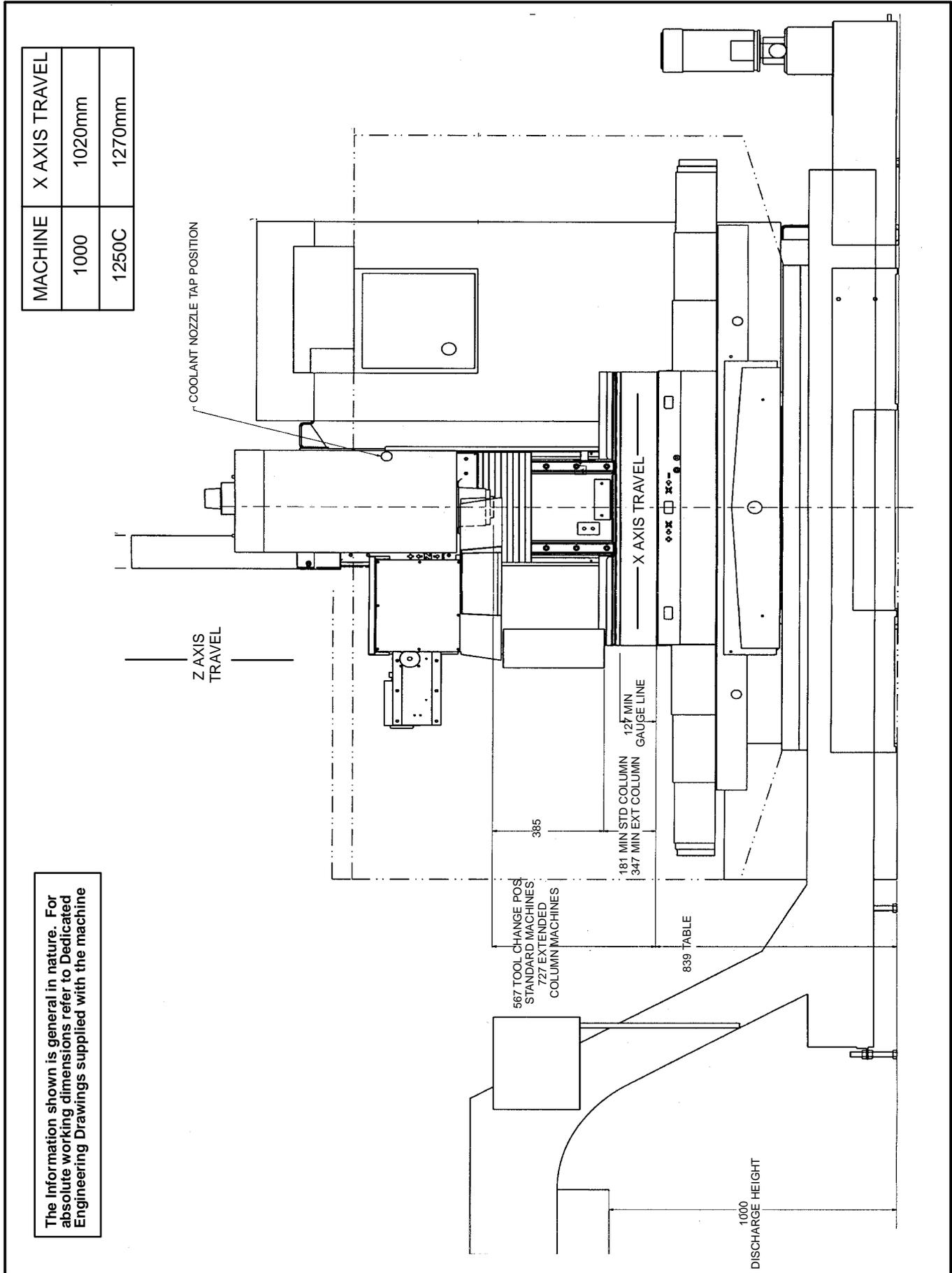
MACHINE	X AXIS TRAVEL
1000	1020mm
1250C	1270mm

COOLANT NOZZLE TAP POSITION

Z AXIS TRAVEL

X AXIS TRAVEL

127 MIN GAUGE LINE

385

181 MIN STD COLUMN
347 MIN EXT COLUMN

567 TOOL CHANGE POS. STANDARD MACHINES
727 EXTENDED COLUMN MACHINES

839 TABLE

1000 DISCHARGE HEIGHT

Fig. 24
Range Drawing for Arrow (ERM) 1000, 1250C Machines – Front View

AXIS TRAVEL

MACHINE	Y	Z STD	Z EXTD
1000	510mm	560mm	720mm
1250C			

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

57.5

127.5

471.4

525

34.6

5.4

255 TRAVEL

48.8

539 Z SCALE OPTION

Y AXIS TRAVEL

200

GAUGE LINE

567 T/C HEIGHT (STD MACHINE)
727 T/C HEIGHT (EXT MACHINE)
127 MIN 687 MAX (STD MACHINE)
127 MIN 847 MAX (EXT MACHINE)

127 MIN GAUGE LINE

839

SWARF TRAY SHOWN IN OUT POSITION. MACHINES WITHOUT CONVEYOR ONLY.

Fig. 25
Range Drawing for Arrow (ERM) 1000, 1250C Machines –
Right Hand Side View

Cincinnati Machine 91203809-001

DART/ARROW (ERM)Table Dimensions

Tool Broken Sensor Mounting Hole

(See Chart for Dimensions)
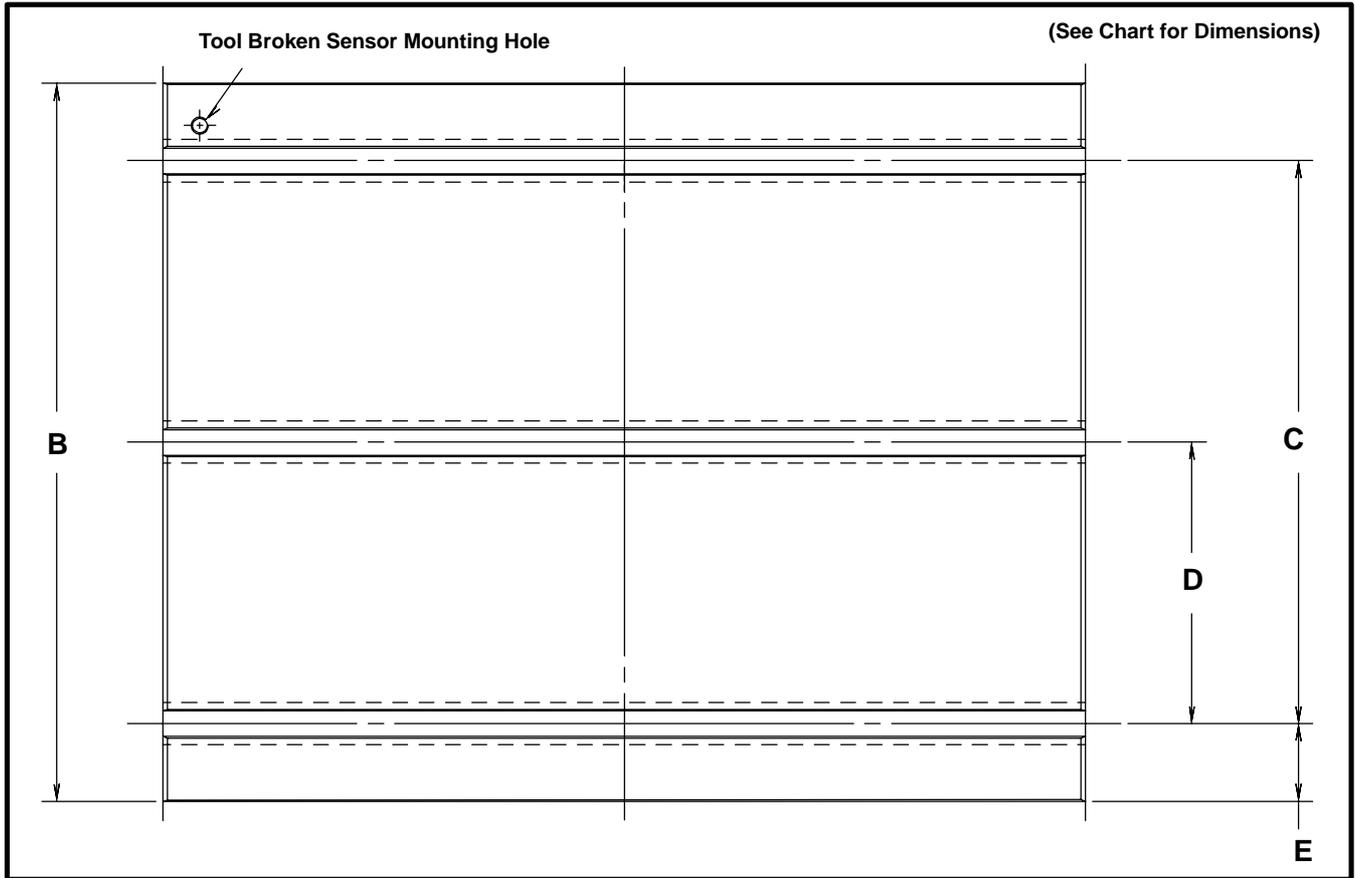
Fig. 26
Table Dimensions

Machine	A	B	C	D	E	No of Slots
Arrow 500	700	520	400	200	60	3
Arrow 750	950	520	400	200	60	3
Arrow 1000	1120	610	400	200	105	3
Arrow 1250C	1370	610	400	200	105	3
Arrow E/Dart 500	700	520	400	200	60	3
Arrow E/Dart 750	950	520	400	200	60	3

FRONT AND REAR SLOTS

CENTRE SLOT
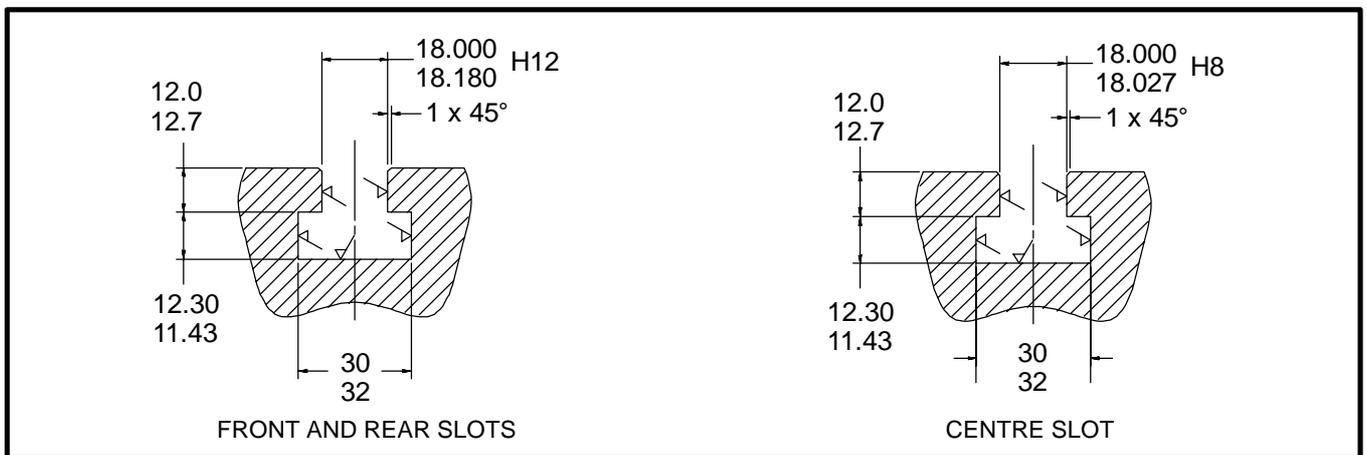
Fig. 27
Bolt and Tenon Slot Dimensions - Typical

SWARF CONVEYOR OPTION.

R,H TOOLCHANGER OPTION.
(42 TOOL MACHINE)
SHOWN IN PARK POSITION.

ELEC ISOLATOR.
(MOUNTED ON CABINET DOOR)

ELEC CABINET
(A2100 SHOWN)

SPINDLE
CENTRE LINE

SPINDLE CENTRE LINE

SWARF CONVEYOR
OPTION.

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

STANDARD L,H TOOLCHANGER.
(21 TOOLS)
SHOWN IN TOOLCHANGE POSITION.

Fig. 28
Range Drawing for Arrow (ERD) 1250, 1500, 2000 – Plan View
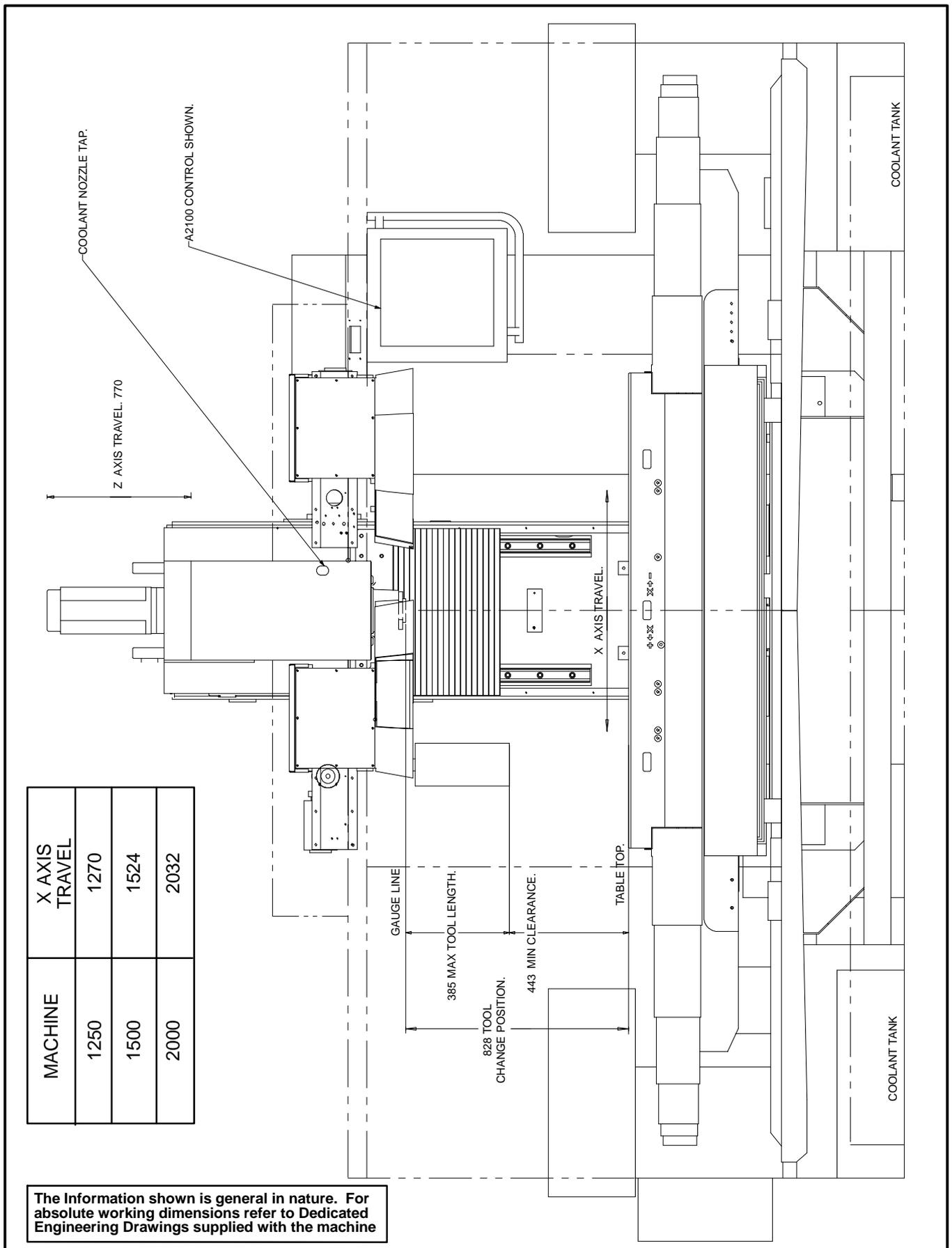
COOLANT NOZZLE TAP.

A2100 CONTROL SHOWN.

Z AXIS TRAVEL. 770

X AXIS TRAVEL.

COOLANT TANK

COOLANT TANK

GAUGE LINE

385 MAX TOOL LENGTH.

828 TOOL CHANGE POSITION.

443 MIN CLEARANCE.

TABLE TOP.

MACHINE	X AXIS TRAVEL
1250	1270
1500	1524
2000	2032

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

Fig. 29
Range Drawings for Arrow (ERD) 1250, 1500, 2000 – Front View

SPINDLE CENTRE LINE.

Air Supply Panel

Air Supply

127.5

79

710

770

Y axis travel 762

Swarf Conveyor Option

1000

FLOOR
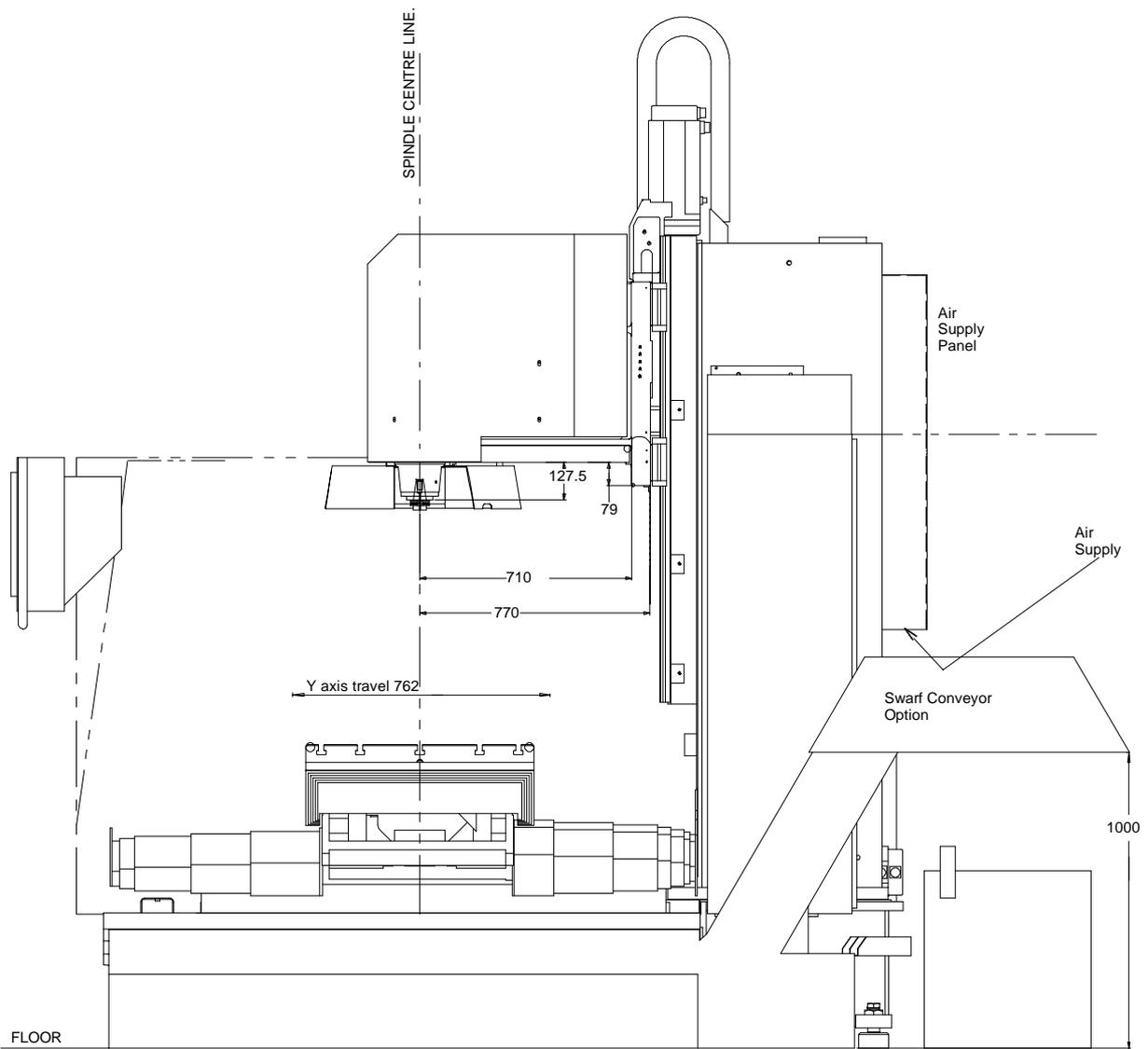
MACHINE	AXIS TRAVEL	
	Y	Z
1250	820	770
1500	820	770
2000	820	770

The Information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine

**Fig. 30
Range Drawing for Arrow (ERD) 1250, 1500, 2000 Machines -
Right Hand End View**

ARROW (ERD)Table Dimensions
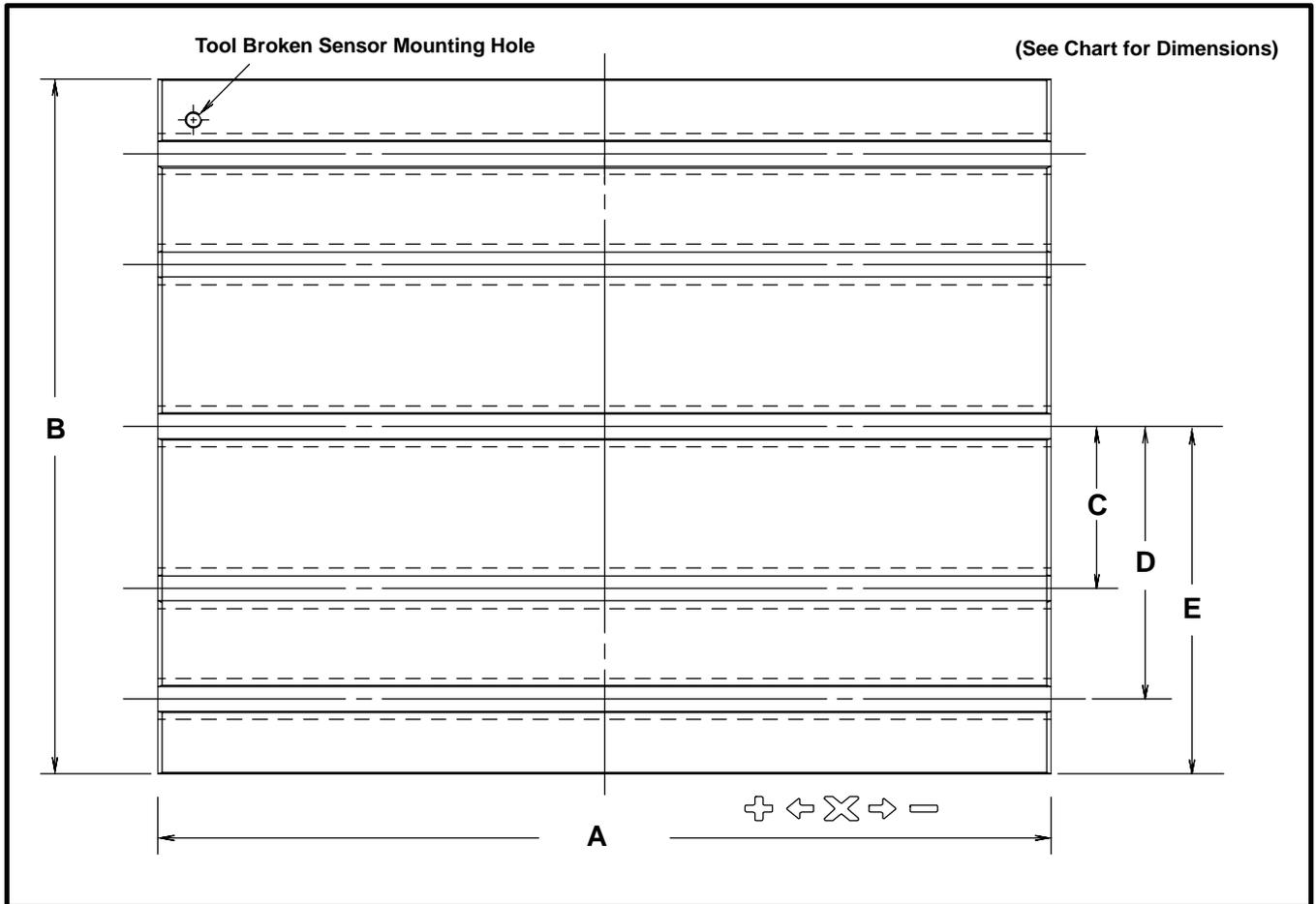
Fig. 31
Table Dimensions

Machine	A	B	C	D	E	No of Slots
Arrow 1250	1524	765	200	330	382	5
Arrow 1500	1778	765	200	330	382	5
Arrow 2000	2286	765	200	330	382	5
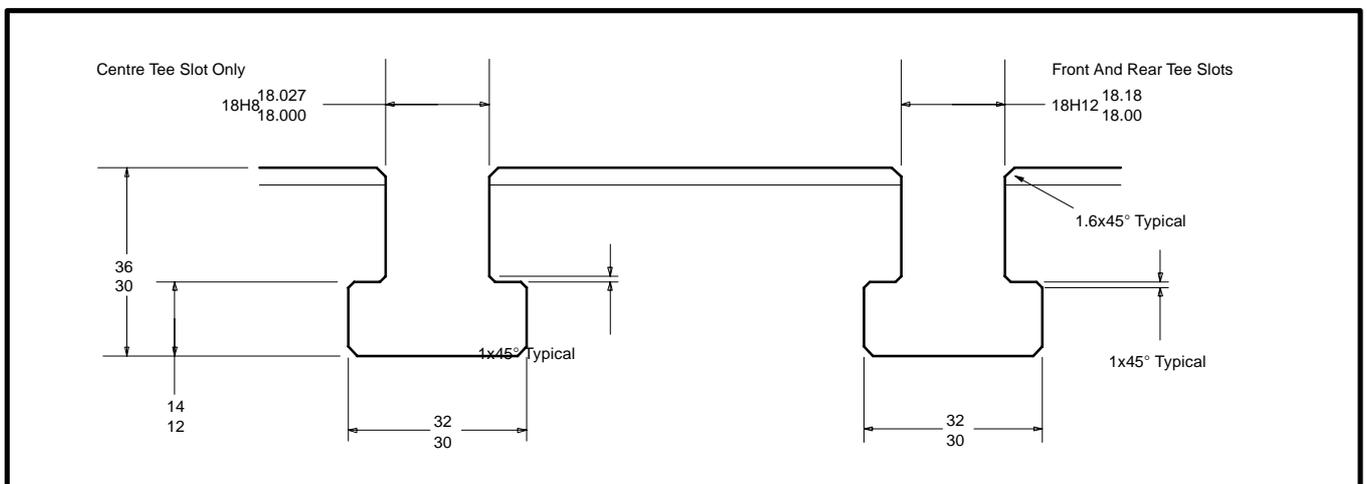
Fig. 32
Bolt and Tenon Slot Dimensions

Tool Holder And Retention Stud
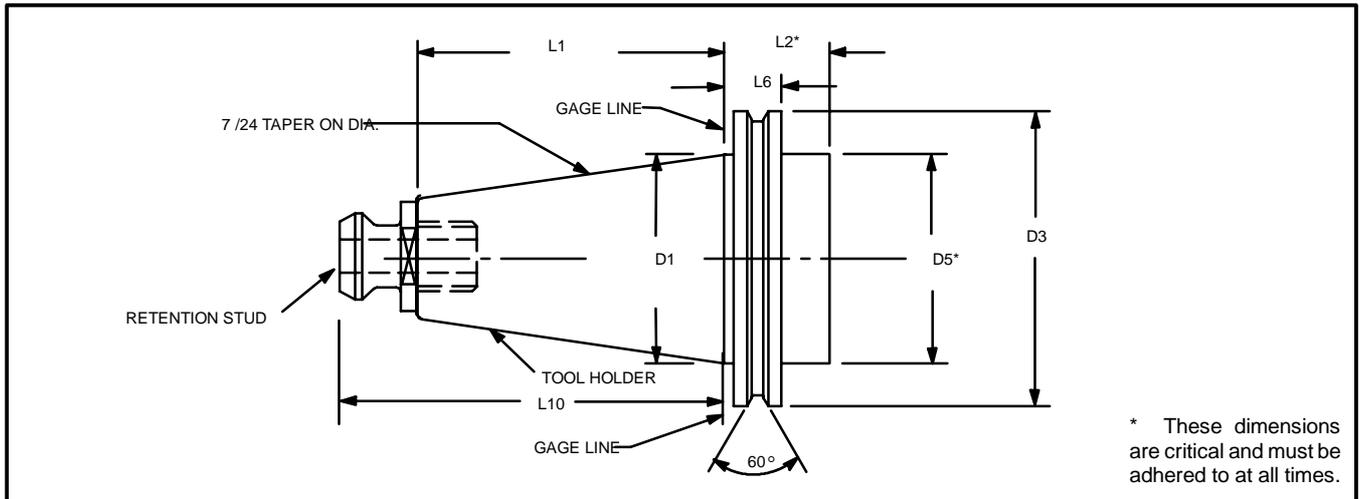
Fig. 33
Tool Holder and Retention Stud

Machine (Dim=mm)	L1	L2	L6	L10	D1	D3	D5
Arrow/Dart machines	68.4 -68.10	35	19.10-19.00	105.05-104.50	44.85	63.55 - 63.45	44.70 - 44.20

	Arrow/Dart			
	Retention Stud Part No - ANSI	**Retention Stud Part No. - ISO-DIN**		
Inch Thread	1265674			
Metric Thread	1265673	1265675		
Torque to	40 ft lbs [54 Nm]	40 ft lbs [54 Nm]		

For use with or without Through Spindle Coolant

The information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine.

WARNING

TOOL HOLDER RETENTION STUDS

Use only tool holder retention studs manufactured or approved by Cincinnati Machine. Non-approved studs may be of inferior quality resulting in a failure which could cause the tool holder to be prematurely discharged from the spindle.

TOOL HOLDERS - ANSI

When using ANSI tool holders, use only tool holders made to comply with ANSI/ASME STD B 5.50 1985 V FLANGE with this machine.

Failure to follow this instruction may result in serious damage to the machine and/or personal injury.

TOOL HOLDERS ISO-DIN

When using ISO-DIN holders, use only tool holders made to comply with ISO 7388/1-1983 (E) STANDARD with this machine.

Failure to follow this instruction may result in serious damage to the machine and/or personal injury.

JMTBA-BT Tool Holder And Retention Stud
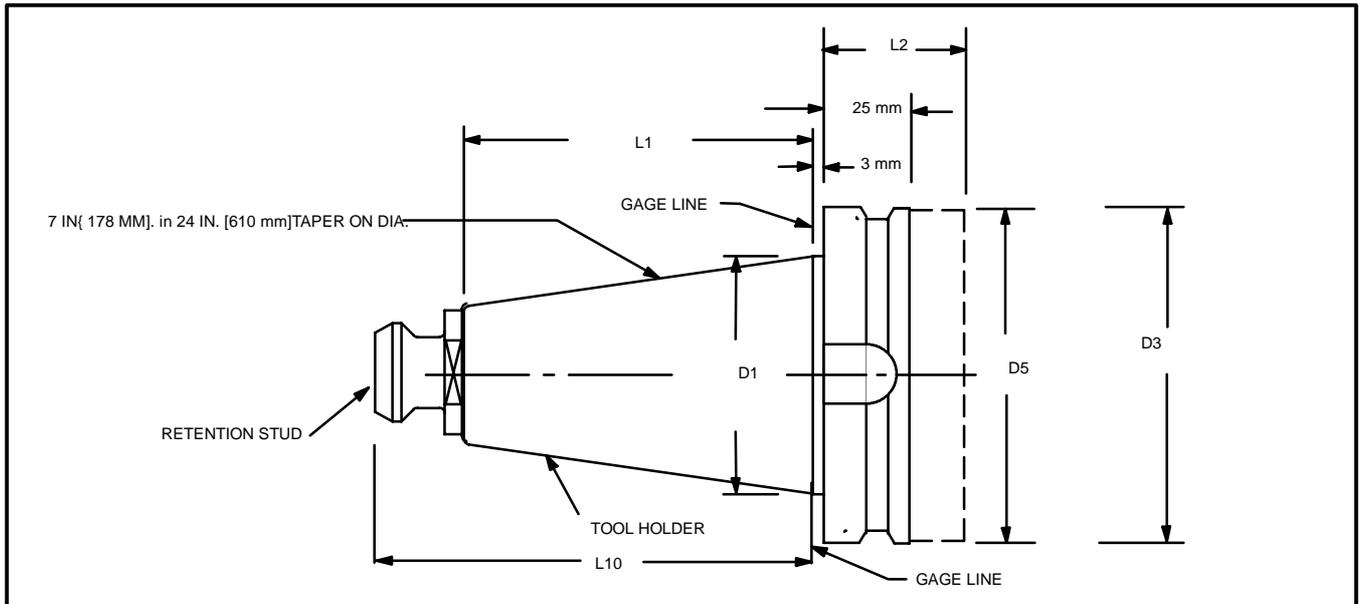
Fig. 34
JMTBA_BT Tool Holder and Retention Stud

Machine (Dim=mm)	L1	L2	L6	L10	D1	D3	D5
Arrow/Dart machines	65.4 -65.10	35	19.10-19.00	104.90-104.34	44.85	63.55 - 63.45	44.70 - 44.20

ARROW/DART BT RETENTION STUD
Metric Thread Part Number 1265672
Torque to 40 ft lbs [54 Nm]

For use with or without Through Spindle Coolant

The information shown is general in nature. For absolute working dimensions refer to Dedicated Engineering Drawings supplied with the machine.

WARNING

TOOL HOLDER RETENTION STUDS

Use only tool holder retention studs manufactured or approved by Cincinnati Machine. Non-approved studs may be of inferior quality resulting in a failure which could cause the tool holder to be prematurely discharged from the spindle.

TOOL HOLDERS

Use only tool holders made to comply with MAS 403 -1982 BT 40/50 STANDARD with this machine.

Failure to follow this instruction may result in serious damage to the machine and/or personal injury.

Motor Rating

The spindle of this machining centre is driven by an electric motor rated at a constant torque when operated below the base speed of the motor and constant power when operated above base speed. When operated below base speed, the power available depends upon the spindle speed.

The MTD (Machine Tool Duty) rating of the motor is based upon the amount of power delivered in a given amount of time. The following chart shows spindle motor Continuous and MTD ratings.

Machine Model	Spindle Speed RPM	Continuous Rating	MTD Rating
ARROW E/ DART (ERM)	60 – 6000	3.7 kW	5.5 kW
ARROW (ERD / ERM)	60 – 6000 Standard	5.5 kW	7.5 kW
	60 – 8000 60 – 10000 30 – 5000 Optional	9 kW	11 kW

Spindle Speed RPM	Speed Range (RPM)	
60 – 6000 (STD)	From	To
Constant Torque	60	750
Continuous Power	751	4500
60 – 8000 (OPTIONAL) 60 – 10000 (OPTIONAL)	From	To
Constant Torque	60	750
Continuous Power	751	6000
30 – 5000 HI–TORQ (OPTIONAL)	From	To
Constant Torque	30	375
Continuous Power	376	3000

6000rpm. Spindle
Arrow E/Dart Machine - Standard Speed Range

Constant Power (5.5)

Duty Rated

Constant Torque

Constant Power (3.7)

Continuous

3.0

2.2

750

3500

POWER (kW)
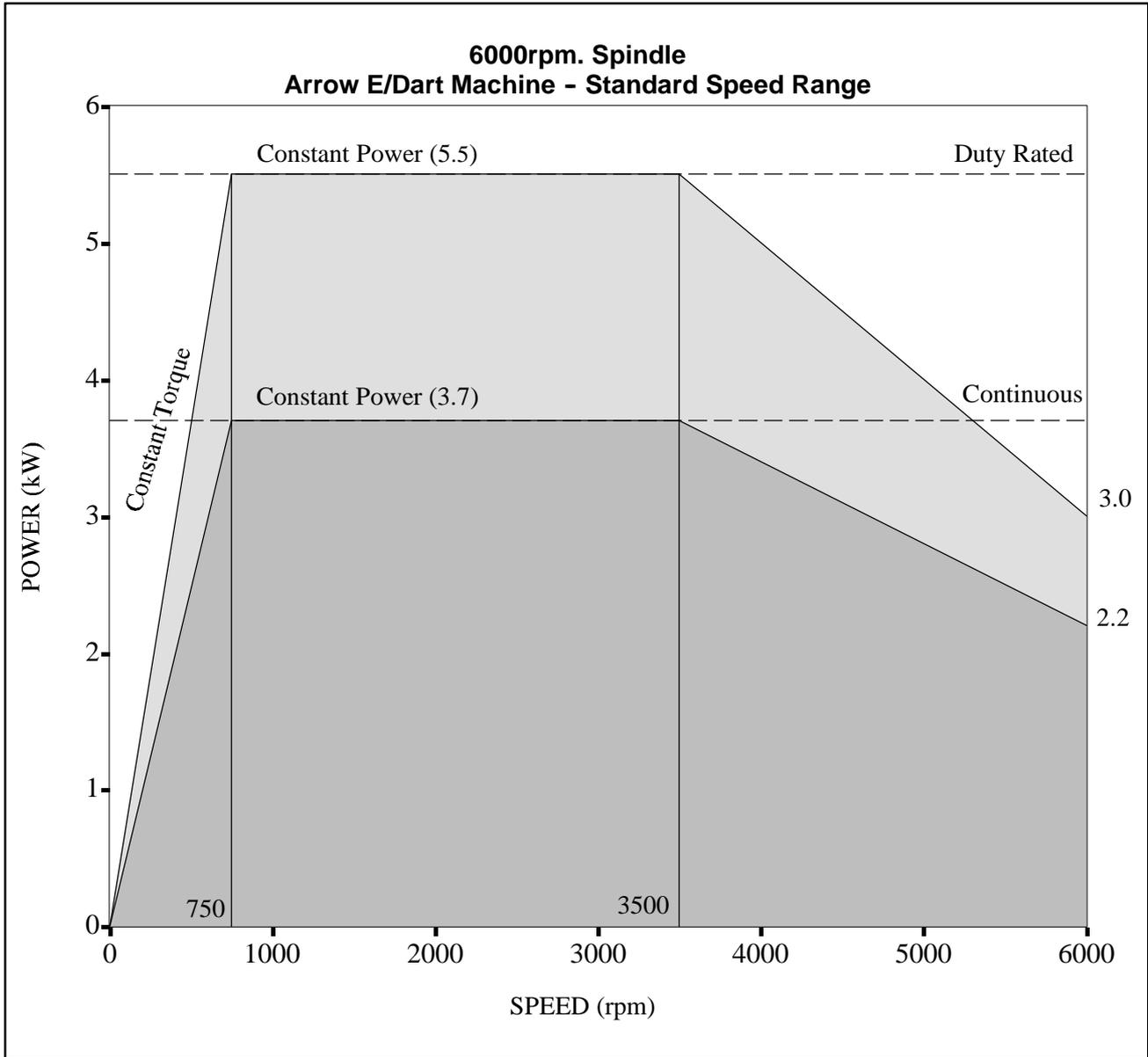
SPEED (rpm)

Fig. 35
Spindle power characteristics (Arrow E/Dart Machine - Standard Speed Range)
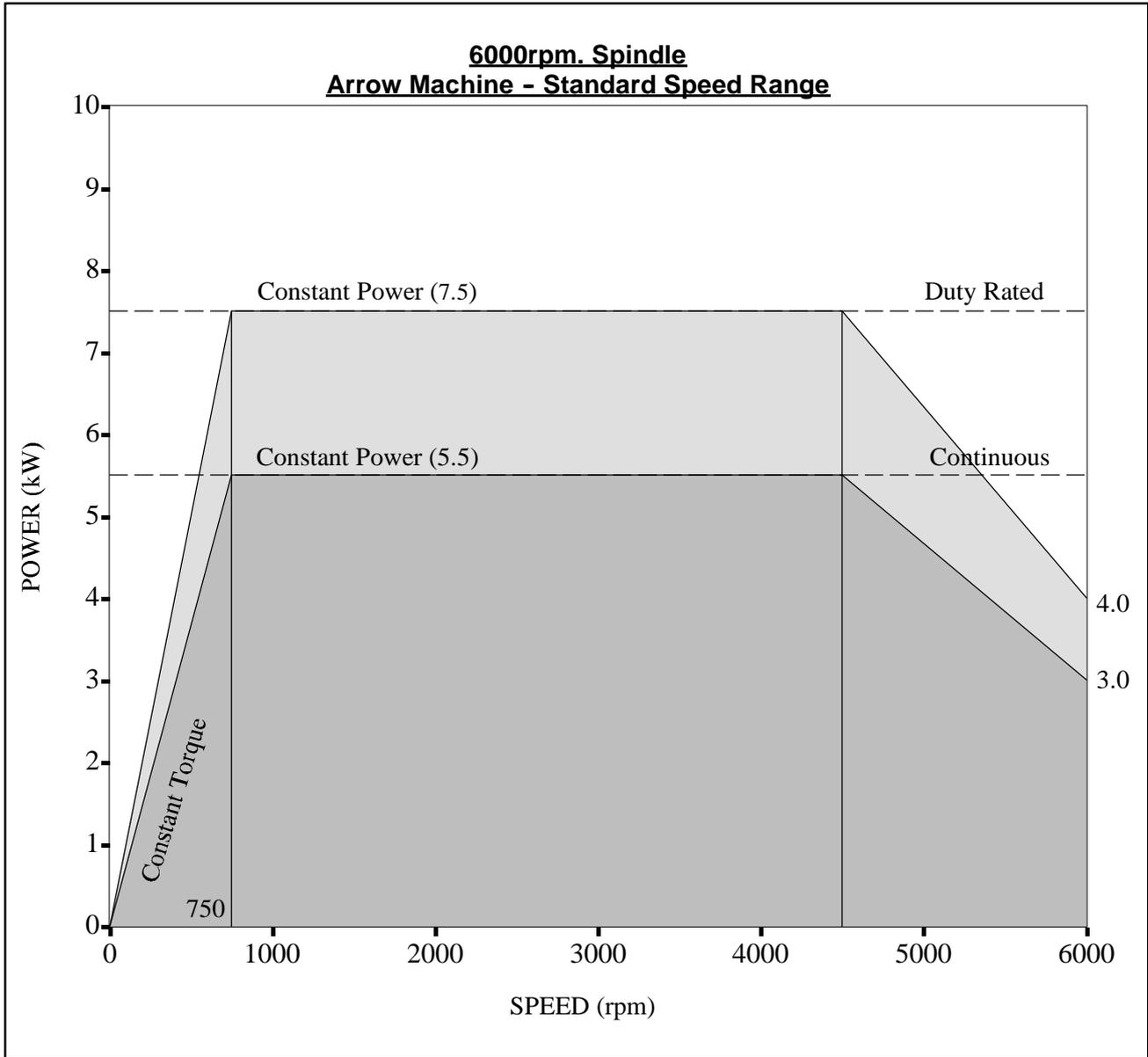
Fig. 36
Spindle power characteristics (Arrow Machine - Standard Speed Range)
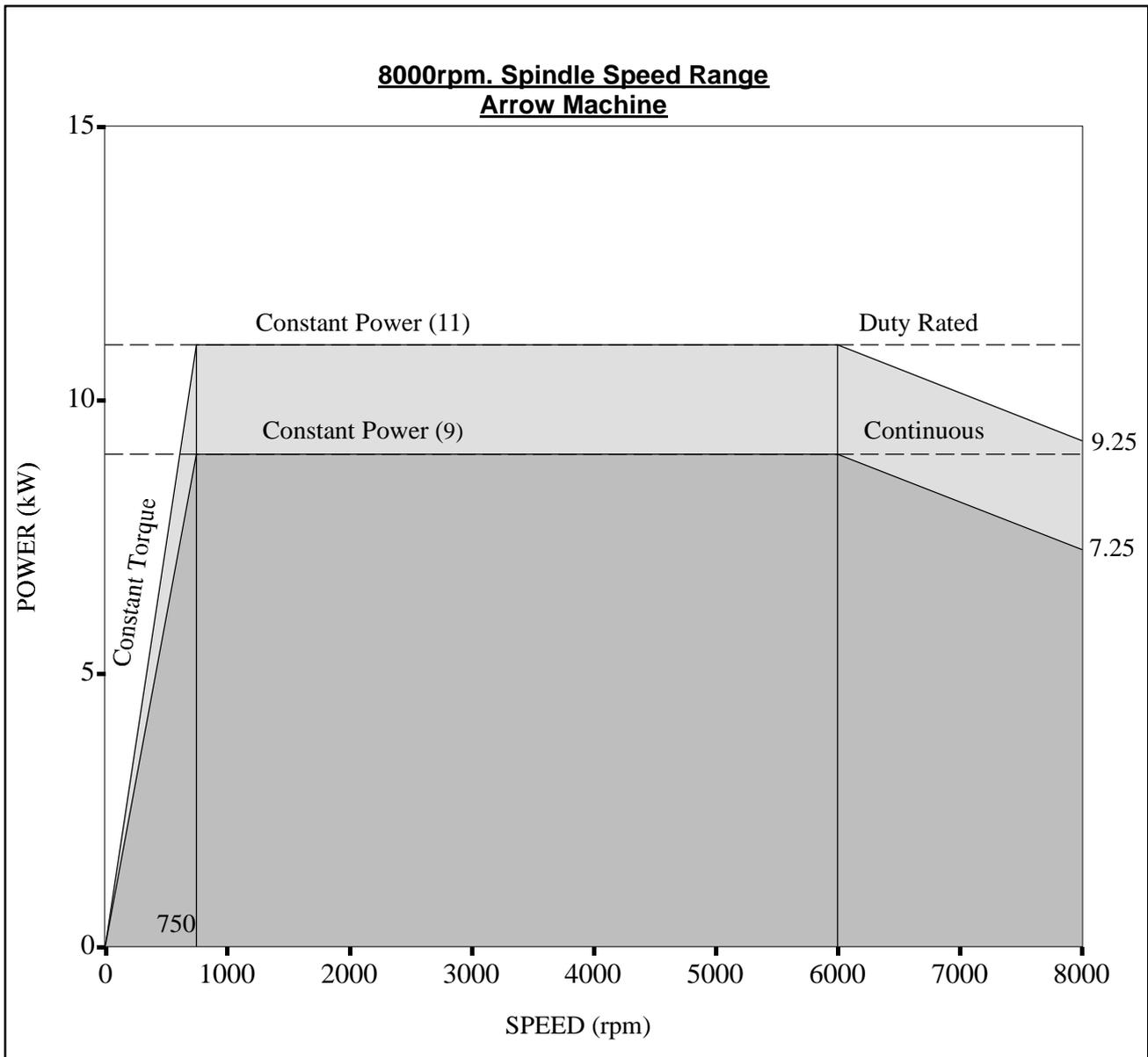
Fig. 37
Spindle power characteristics (8000 rpm Speed Range)
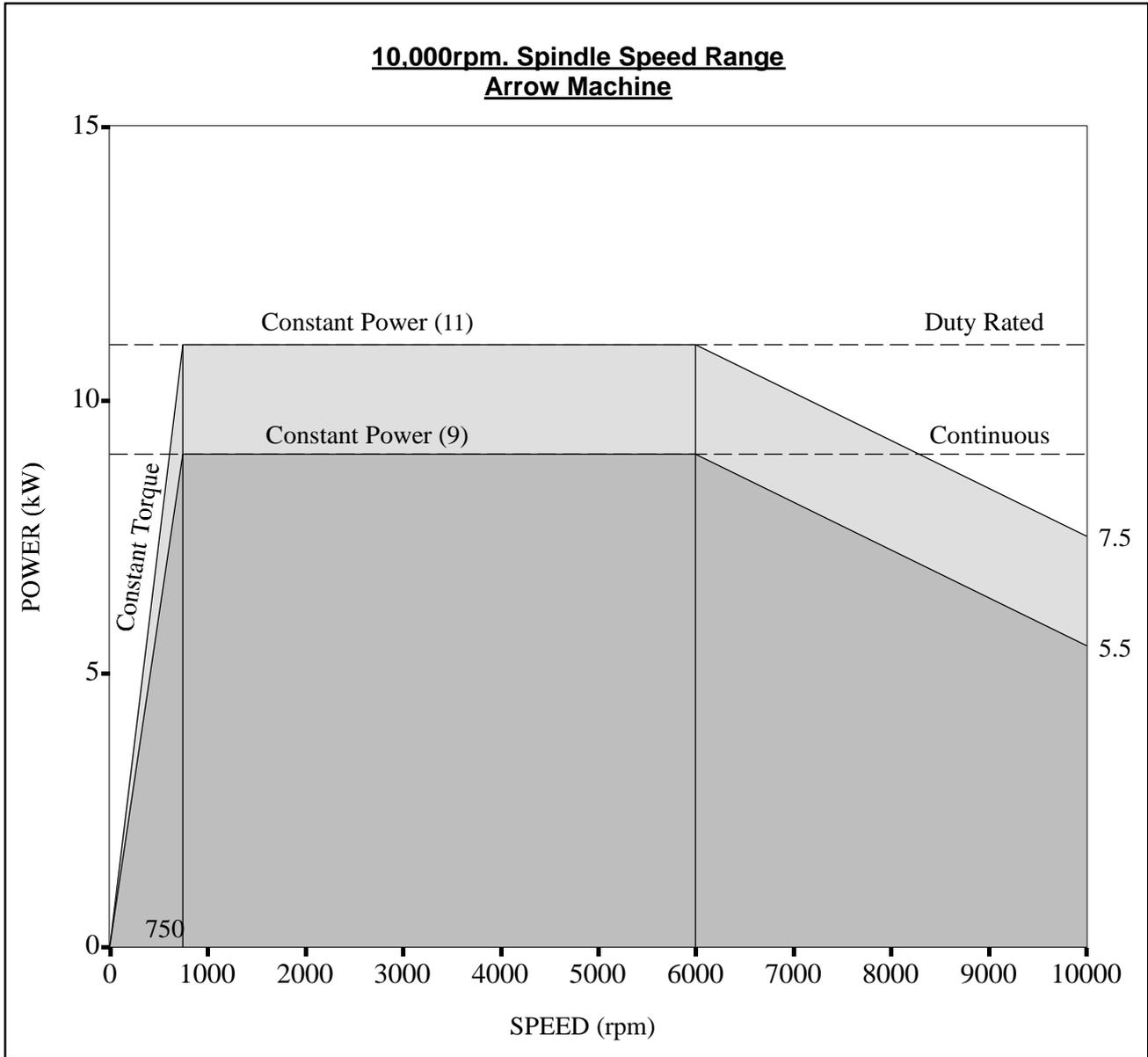
Fig. 38
Spindle power characteristics (10000 rpm Speed Range)

5000rpm. Spindle
Arrow Machine – High Torque Speed Range
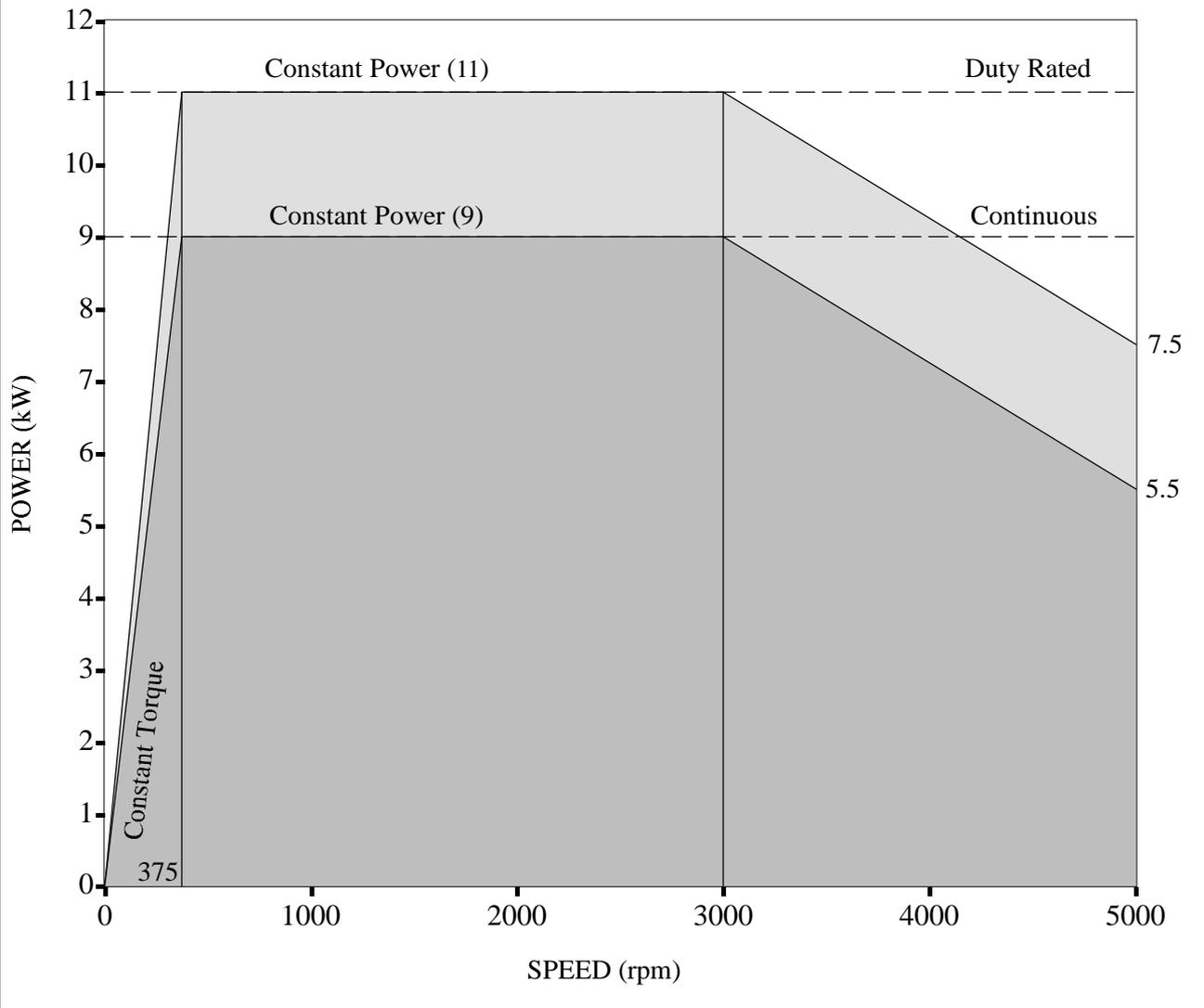
Fig. 39
Spindle power characteristics (High Torque Speed Range)

Chapter 3
Control Introduction

Most of the ACRAMATICR 2100E Operating controls are located in the front Operator Station. Machine operator controls are located in the hand held Pendant control, which is mounted magnetically to the front of the machine. Optional keyboard usage is also accessed at the front of the machine.

Arrow Vertical Machining Center

Operator Station
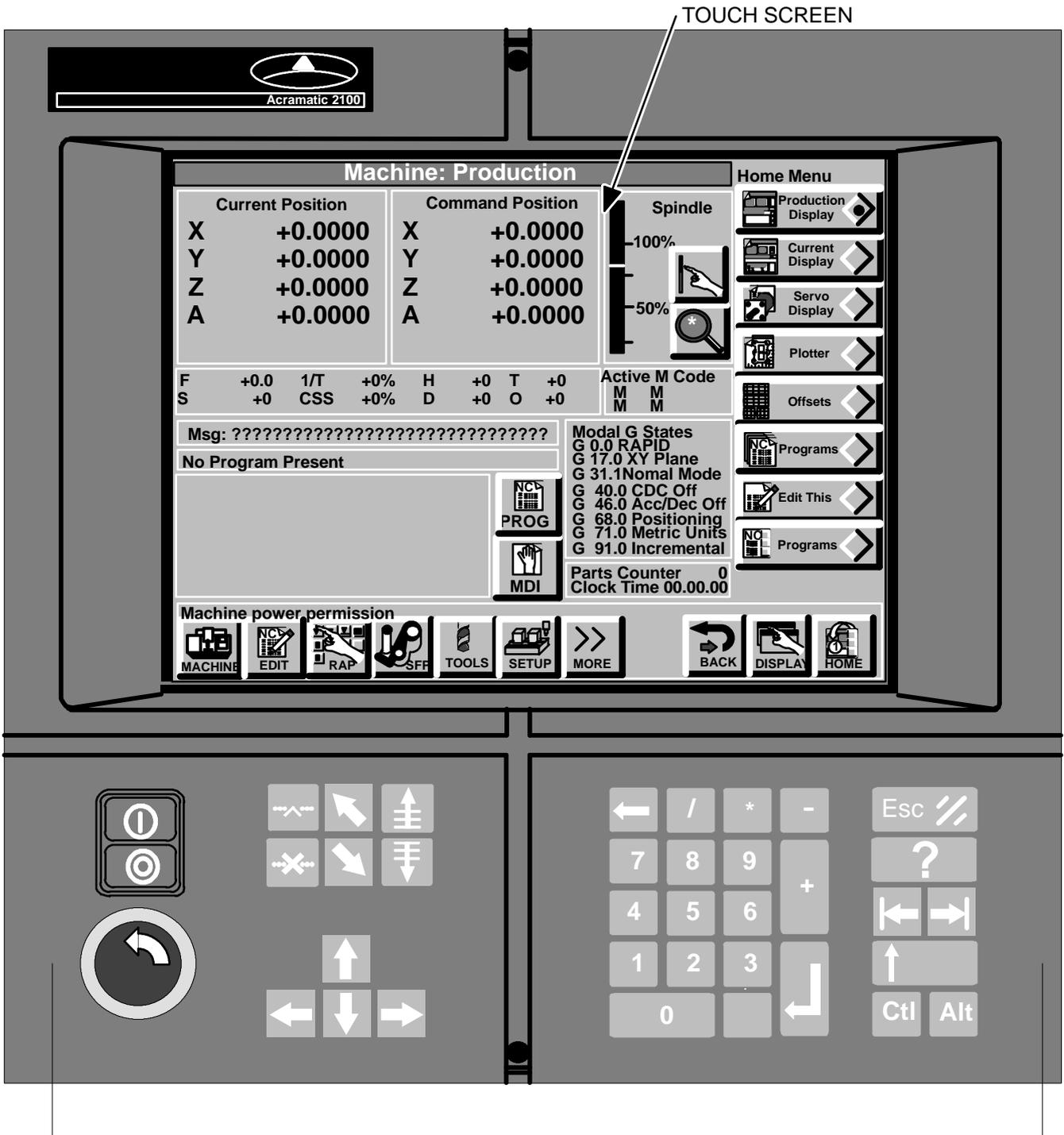
TOUCH SCREEN

OSA KEYPAD

Operator interaction for A2100E takes place through the touch screen, Operator Station Assembly (OSA) Keypad, and machine pendant.

A2100E provides an operator interface which is graphical in nature and provides all levels of interaction.

Operator Station Assembly (OSA) Keypad

A2100 provides a full set of numeric and cursor control keys directly below the screen. These keys provide the operator with the capability to navigate and modify any data tables within the control, without the requirement of selecting the on-screen keyboard.

Symbol descriptions for the OSA keypad are as follows:

A2100 OSA BUTTONS
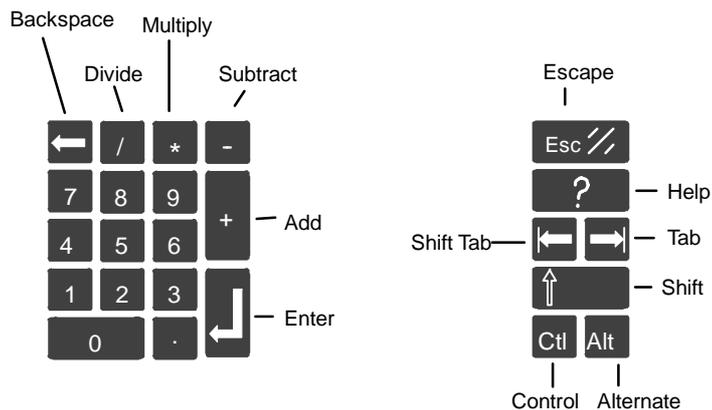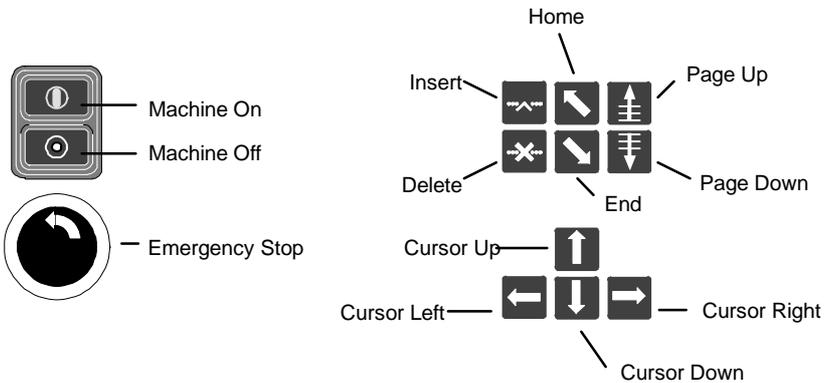
Machine On

Pressing this push button activates the machine control. The Main Power Disconnect Switch must first be in the ON position.

The control will perform various tests, diagnostics and a system load of the operating software. Several minutes are required

If the message 'Axes unaligned' is reported and the operator must align the machine.

In the event of an axis contacting a final overtravel switch, hold

 depressed while operating the Power Feed controls.

NOTE: Direction of travel selected is important - SEE WARNING.

Pressing once starts the control and activates startup diagnostics.

When these are completed, an operator message will appear on the screen to press Machine On again. This will activate the machine hydraulic system.

WARNING

In the event of an overtravel, ensure that the correct direction of travel is selected when over-riding the overtravel switch. Failure to follow this instruction may result in serious personal injury.

Home

Insert   Page Up

Delete   Page Down

End

Cursor Up

Cursor Left   Cursor Right

Cusor Down

Backspace   Multiply

Divide   Subtract

Add

Enter
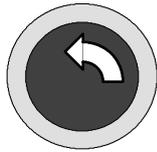
Machine Off

Pressing this button shuts off the machine components first and then the control.

Information in the control such as stored NC programs and tool data are retained in memory through a power-down condition. However, the data should be checked when the control is turned back on if Machine Off was depressed while inputting this information.

For a sequential shut off, wait until the NC cycle has stopped, press the Emergency Stop button, then press .

Emergency Stop

This push button is pressed to immediately stop machine cycle and operation in the event of an emergency.

When this push button is depressed, the feed of all axes is stopped immediately, if the spindle is rotating, it will stop, a data reset will be generated, and a message will appear on the screen.

The Emergency Stop must be twisted in the direction of the arrow (on push button) in order to release it from its depressed state before the machine can be restarted.

If the Emergency Stop is pressed while the axes are at rest (not in motion), automatic re-alignment will occur when this button is released to turn on machine power. If the Emergency Stop is pressed while the axes are in motion, the operator must perform a machine realignment.
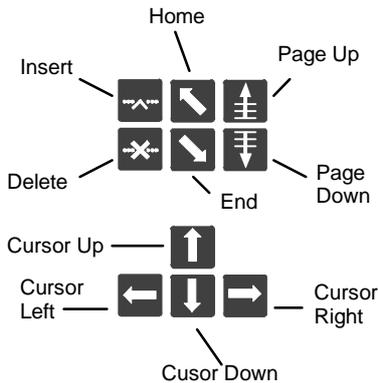
Page And Position keys

The page keys (Home, Page Up, Page Down, End) are used to select different pages (screens) of displayed data tables or directories. During edit and program search operations, these keys select different pages containing program blocks of the active NC Program. Insert and delete key functions are also included to correct typing mistakes, insert or delete text characters.
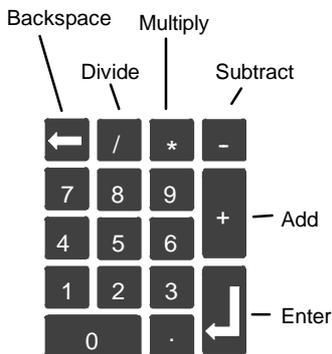
The cursor keys (Up, Right, Down, Left) are used to position the cursor forward or backward a single row (line) during data table or program storage directory viewing/entry and editing.

Numeric Keys

This group of keys consists of digits 0 to 9, a decimal point, divide, multiply, subtract, addition, backspace and enter. Their primary use is for inputting numeric values into data tables and during MDI block entry or program edit. These keys perform similar functions to those found on typing keyboards. Enter is used to end or place keyed-in values into the control functions. .
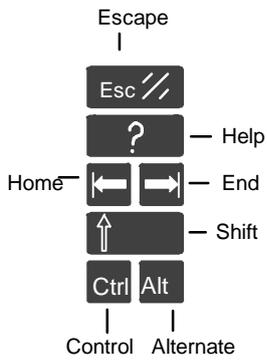
Escape, Help, Control, Alternate

The Escape keys primary use is to exit (terminate) a lower-level legend and return to the next higher level within the same control mode. Escape is not used to completely exit a mode and enter into another, that is the function of the mode keys. The Escape key is inhibited whenever a control process (such as program load, save or transfer) is currently in process. Escape is also used to erase input values that have not been entered.

Home and End keys move the cursor/user to the beginning or end of the current program/mode/document. Shift, when pressed with other keys allows entry of various upper portion of key characters, cursor movements an other functions which are described later.

Control (Ctrl) is used to protect against accidental activation of certain menu buttons/keys. These menu keys, when pressed alone, do not activate their current functions but instead cause the "Ctrl required" to be posted on the screen. Only when depressed along with the Ctrl key do these menu keys perform their function.

Alternate (Alt) is used with rebooting or other Computer/control operating functions which will be described later, if required.

The Control Screen

The touch screen display in the control is split into the display area, function menu area, button bar area, and status bar area.

Display Area   Function Buttons

Production Menu Display Example

Status Bar

General Mode Button Bar   Button Bar Area   Mode Specific Button Bar

Function Menu
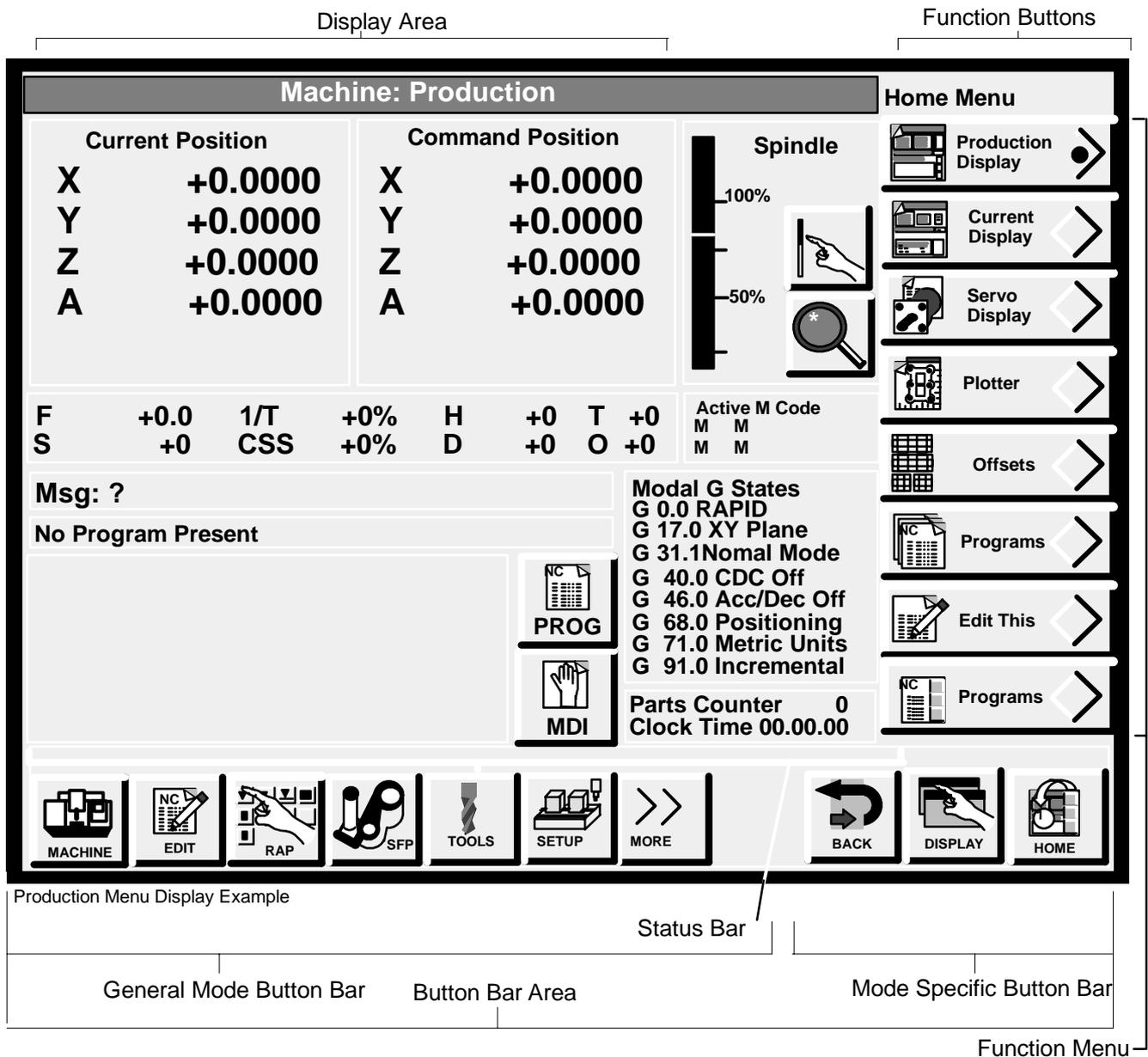
Display Areas

The display area is the main viewing location where the majority of Acramatic 2100 information takes place. All axis information, program information and other visual feedback to the operator is provided here.

Selection of a display area takes place by pressing mode buttons (positioned at the lower portion of the screen) or menu buttons within an active display. After a display is activated, mode and menu button combinations are used to select additional pop up menus, or change the present display area completely.

The mode buttons (screen sensitive touch areas) provides access to each mode and the method to change between them. The mode specific buttons provides buttons that are designed for each mode.

Within the machining mode, several menus are provided for various operations including plotter execution, table access, MDI block editing, general operations and others. The main menu in this mode can be configured by the user. This allows the user to add any menu selection from another menu in the machining mode to the configurable menu. This menu is considered the "Home" menu that provides the most used or desired menu functions to the operator.

The and buttons allow the operator to quickly select between the part PROGRAM and MDI.

How Menu Buttons Function

A2100 provides a single level menu within each mode of operation. Each menu provides a selection of screen displays or functions to be performed. Some display buttons may be inactive because the present state of the system does not allow the function to be invoked. In those cases, the buttons are "grayed-out"; that is, presented in subdued colors, to indicate that the function is not presently active.

The function menu area provides the user with a set of buttons (positioned at the right of the screen area) that allow changes to the display area within the current mode of operation.

Menus can be changed in one of two ways: by selecting a new menu from the existing menu, or by selecting on the mode specific button bar.

As you select different display modes, menu buttons will change characteristics based on the display activated, or pop up menu selection.

Some menu buttons will contain a graphic triangle square or check mark.

Generally this symbol indicates a new set of menu buttons can be activated for the current display. After a menu button is touched, a black dot will appear in the graphic triangle or square .

This type of menu button will usually require the Green Arrow button to be touched to activate selection.

When a menu button displays no graphic triangle, the display will changed when touched.

Production Menu Display

The standard production display provides specific information for the current program or MDI block. This display shows the current and commanded position coordinates, current program block number, current states of active offsets, a portion of the active program or MDI block, the current feed and speed overrides, and the active and next tool identifiers. This display also shows the state of common modal G codes.

Current Menu Display

The standard current display provides the current machine coordinates, zero shift, program current and command coordinates, current feed and speed overrides and a portion of the active program or MDI block.

Status Bar

Information contained in this display area continually updates as NC programs blocks are executed.

F +0.0 FPM +150% H +0 T +0
S RPM +115% D +0 O +0

Active M Code
M M
M M

MSG:

RPT

```
G0  G70  X20  Y20  Z20  T1  M6
G0  G96  X10  Y5  S500  M3  M7
G81  G94  Z2  R10  F50
X20
X30
G0  X25  Y25  Z20  M30
```

NC
PROG
MDI

Modal G States
G 0.0 RAPID
G 17.0 XY Plane
G 31.1Nomal Mode
G 40.0 CDC Off
G 45.0 Acc/Dec Off
G 60.0 Positioning
G 70.0 Inch Units
G 90.0 Absolute

Parts Counter 0
Clock Time 00.00.00

Status Bar

General Mode Button Bar

MACHINE
NC
EDIT
RAP
SFP
TOOLS
SETUP
MORE
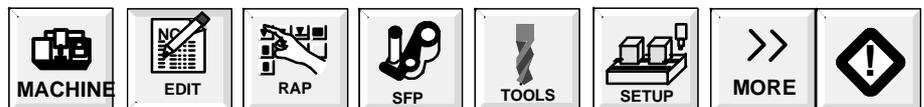
General mode touch screen buttons are used to provide selections between control modes of operation. The modes include: machining, editing, shop floor programming, tooling, multiple setup, configuration, and diagnostics.

When a mode is activated, the button color will change to dark gray indicating the selection is activated. Additional mode selections are seen when MORE is activated.

Machine

This button activates the Production Machine Mode. Various display areas will show machine axis command and current positions, feedrate, spindle speed, status of program or manual data input entry. From this mode the specific mode Display button is used to activate the Select a Display window.

Edit

Activating the Edit mode button allows the user to perform a variety of operations on part programs. Such as, Cutting and Copying text, Inserting Programs, Translating Programs, and Resequencing Programs.

```
Edit - Untitled                            Unchanged    Insert

:0001 G0 X0 Y0 Z20 B0 M6 T1101
 (MSG, LOAD TOOL #1101 - DRILL .68" HOLE)
X15 Y10 Z20 B0 S208 M3
G81 R11 Z1.25 M8 F50
```

Programs
Save
Run This Program
Clear

Q W E R T Y U I O P ←
A S D F G H J K L Enter
Cap Z X C V B N M MORE CLOSE

More Features
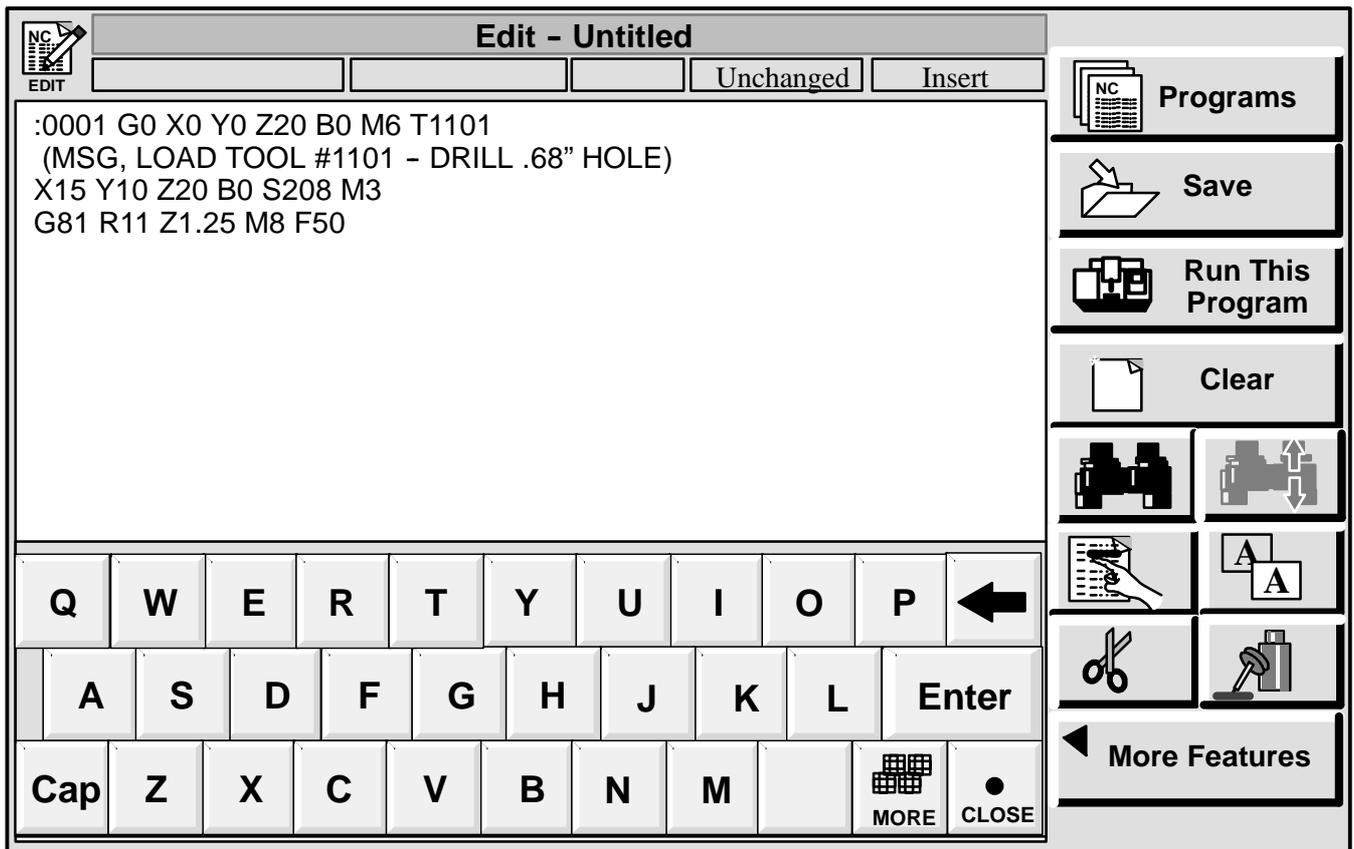
Edit Display Example

EDIT Menu Buttons

Another feature of Edit is the Dual Display screen. This feature allows multiple editing operations to be performed on two independent data sets.

When Edit operations are performed (such as cut, copy, and paste) data is transferred to the control clipboard. From the clipboard data can be manipulated to a variety of locations. The clipboard is a temporary data storage that holds only one piece of information at a time.
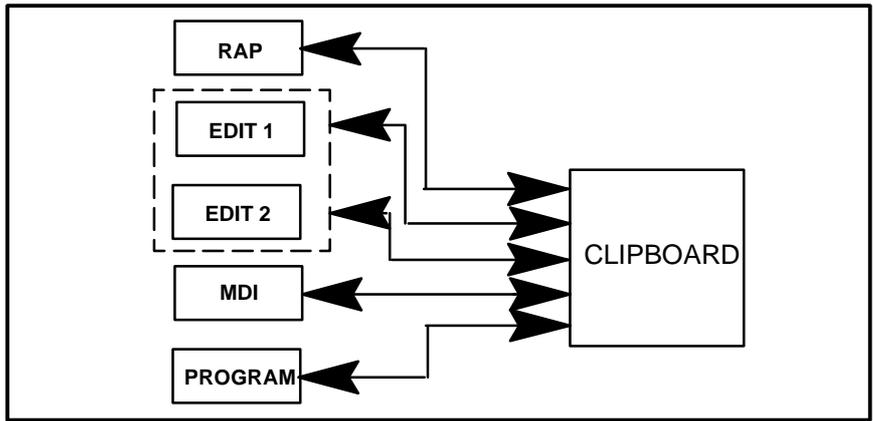
Edit Clipboard

For an example, EDIT will be used to enter the following part program. The part program consists of 4 processes:

DRILL with .68" drill

ROUGH BORE with .8" bore

FINISH BORE with 1" bore

HELICAL MILLING with 1" end mill

Touch enter the following blocks:

:0001 G0 X0 Y0 Z20 B0 M6 T1101

(MSG, LOAD TOOL #1101 – DRILL .68" HOLE)

X15 Y10 Z20 B0 S208 M3

G81 R11 Z1.25 M8 F50

Make sure you pressed [ENTER] after the last block. Use the arrow keys to position the cursor to the left of the ":" (colon) in the first block you entered.

Touch the Select Text button.

Press the down arrow key four times. Note how the four blocks are highlighted.
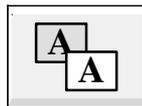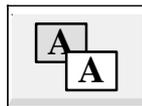
Touch the Copy button.

Touch the Paste button.

Edit the inserted blocks as follows:

>   :0002 G0 X0 Y0 Z20 B0 M6 T1102
>
>   (MSG, LOAD TOOL #1102 – ROUGH BORE .8" HOLE)
>
>   X15 Y10 Z20 B0 S1239 M3
>
>   G85 R11 Z1.25 M8 F70

Position the cursor to the line following G85.

Touch ⬛ the Paste button.

Edit the inserted blocks as follows:

>   :0003 G0 X0 Y0 Z20 B0 M6 T1103
>
>   (MSG, LOAD TOOL #1103 – FINISH BORE 1" HOLE)
>
>   X15 Y10 Z20 B0 S1553 M3
>
>   G85 R11 Z1.25 M8 F35

Position the cursor to the line following G85.

Touch ⬛ the Paste button.

Edit the inserted blocks as follows:

>   :0004 G0 X0 Y0 Z20 B0 M6 T1104
>
>   (MSG, LOAD TOOL #1104 – HELICAL MILLING)
>
>   X13 Y10 Z11.2 B0 S2674 M3
>
>   G1 F75 Z11 M8

Key in the following blocks:

>   G3 G17 X17 Z10.496 K1.008 I15 J10
>
>   G1 Z11.2
>
>   G0 X0 Y0 Z20 M2

◀ More Features
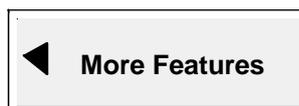
Touch ⬛. The entire part program should now be in the EDIT BUFFER. Touch the More Features button.

Resequence

Touch ⬛. to add sequence numbers to the part program.

At this time you should have the following in the EDIT BUFFER:

```
:0001 G0 X0 Y0 Z20 B0 M6 T1101

N010 (MSG, LOAD TOOL #1101 – DRILL .68" HOLE)

N020 X15 Y10 Z20 B0 S208 M3

N030 G81 R11 Z1.25 M8 F50

:0002 G0 X0 Y0 Z20 B0 M6 T1102

N040 (MSG, LOAD TOOL #1102 – ROUGH BORE .8" HOLE)

N050 X15 Y10 Z20 B0 S1239 M3

N060 G85 R11 Z1.25 M8 F70

:0003 G0 X0 Y0 Z20 B0 M6 T1103

N070 (MSG, LOAD TOOL #1103 – FINISH BORE 1" HOLE)

N080 X15 Y10 Z20 B0 S1553 M3

N090 G85 R11 Z1.25 M8 F35

:0004 G0 X0 Y0 Z20 B0 M6 T1104

N100 (MSG, LOAD TOOL #1104 – HELICAL MILLING)

N110 X13 Y10 Z11.2 B0 S2674 M3

N120 G1 F75 Z11 M8

N130 G3 G17 X17 Z10.496 K1.008 I15 J10

N140 G1 Z11.2

N150 G0 X0 Y0 Z20 M2
```

RAP (Resident Assistant Programmer)

This mode button provides the capability for the operator/programmer to program machining features and simple tasks. RAP is a graphical assistant used to enter G code programs. When a icon is selected, RAP prompts the user for specific data to satisfy the process.

RAP can be used in MDI to generate single block or single cycle motion, or it can be used to generate multiple block NC program segments which can be pasted into NC programs using the program editor. In either case no knowledge of programming syntax, G code or M codes is required. The operator is presented with graphical symbols representing the various functions and then once selected is prompted for specific data required to satisfy the function.
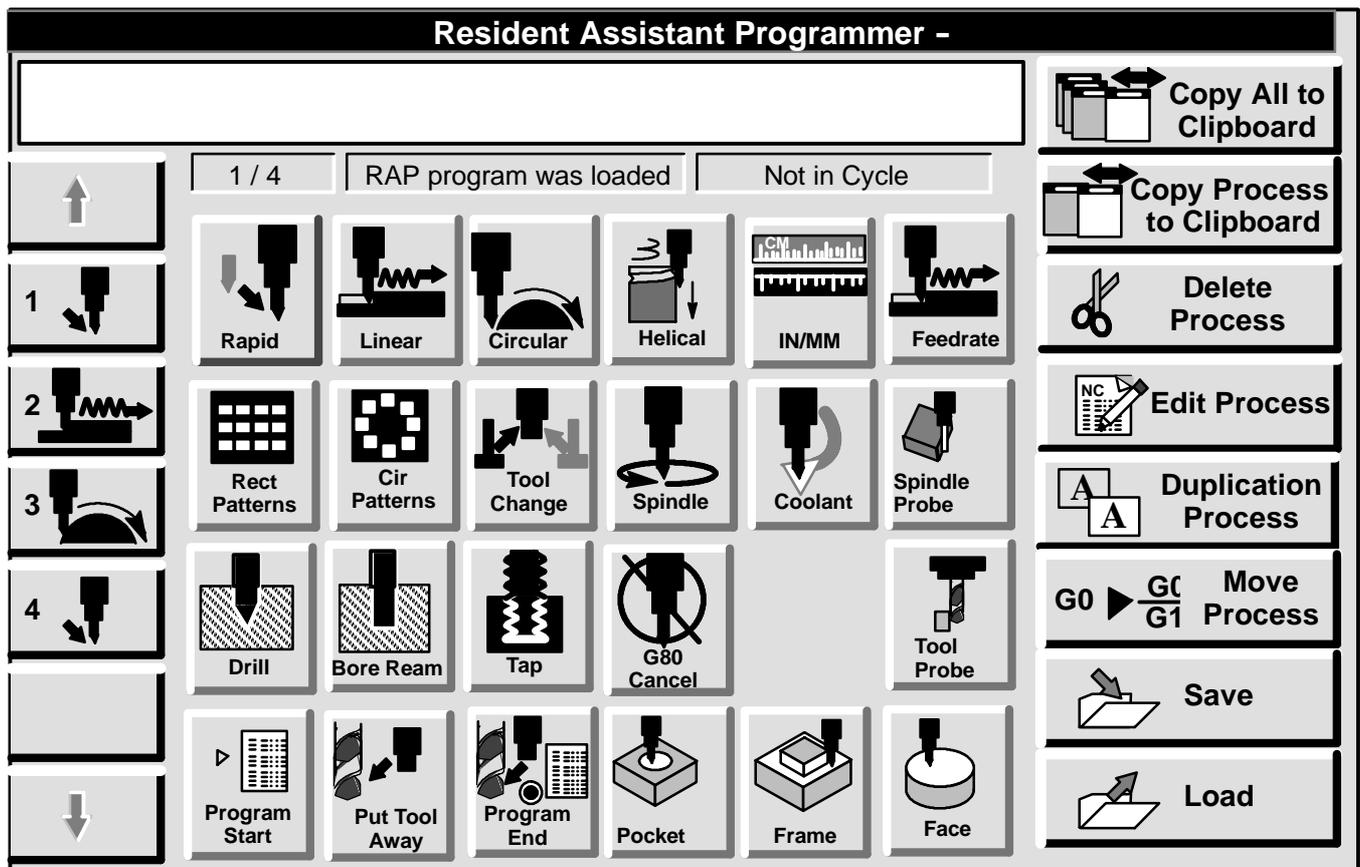
Resident Assistant Programmer Example

RAP display areas are as follows:

PROCESS SELECTION – Are graphic tile (icon) symbols which define a RAP process.

RAP MENU BUTTONS – Perform operations on the process list

RAP PROCESS LIST – Is a vertical scroll list used to collect tiles that define a RAP session. One or more tiles collected in the RAP Process List form a session.

RAP Process Selections
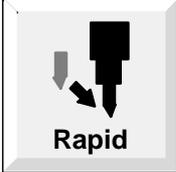
RAP Title	Description
Rapid	**G0 Rapid Traverse**
Linear	**G1 Linear Interpolation**
Circular	**G2 [cw], G3 [ccw] Circular**
Helical	**G2 [cw], G3 [ccw] Circular (Special Case)**
IN?MM	**G70 [inch], G71 [metric]**
Feedrate	**G93 I/T Feedrate** **G94 Feed per Min.** **G95 Feed per Tooth**
Rect Patterns	**G38 Rectangular Patterns**
Cir Patterns	**G39 Circular Patterns**
Tool Change	**M6 Tool Change**
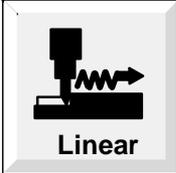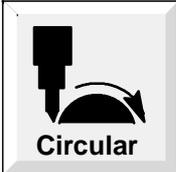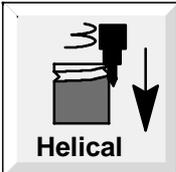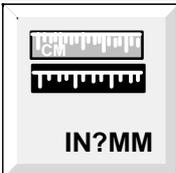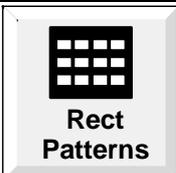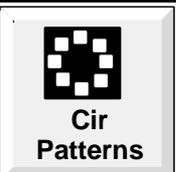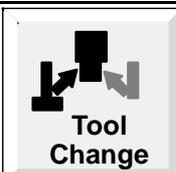
RAP Title	Description
Spindle	**G97 Spindle Speed [S = RPM] G97.1 Spindle Speed [S= Surface Speed]**
Coolant	**M7 [Coolant #2] M8 [Coolant #1] M9 [Coolant Off] M27 [Coolant #3 On] M28 [Coolant #4 On] M29 [Coolant #5 On]**
Spindle Probe	**G72 Set Stylus and Tip Dim G73 Set Probe Stylus Dim G74 Set Probe Length G75 Internal Corner G76 External Corner G77 Locate Surface G78 Bore Buss G79 Pocket or Web G51 Vector Probe**
Drill	**G81 Drill Cycle G82 Drill Dwell G83 Deep Hole Drill**
Bore Ream	**G85 Bore/Ream Cycle G86 Bore/Ream – Retract G87 Back Bore Cycle G88 Web Drill/Bore Cycle G89 Bore/Ream Dwell**
Tap	**G84 Tap Cycle G84.1 Tap Cycle (Solid)**
G80 Cancel	**G80 Cancel Fixed Cycle**
Tool Probe	**G68 Set Tool Size G69 Check Tool Size**
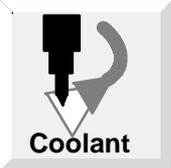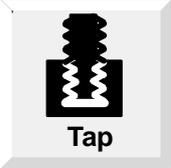
RAP Title	Description
Put Tool Away	**M30**
Program End	**M2**
Pocket	**G23 Rect. Pocket Center** **G23.1 Rect. Pocket Corner** **G26.1 Circular Pocket**
Frame	**G24 Rect. Inside Center** **G24.1 Rect. Inside Corner** **G25 Rect. Outside Center** **G25.1 Rect. Inside Corner** **G27 Circular Inside Frame** **G27.1 Circ. Outside Frame**
Face	**G22 Rect. Face Center** **G22.1 Rect. Face Corner** **G26 Circular Face**
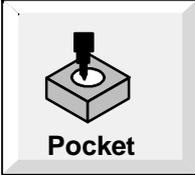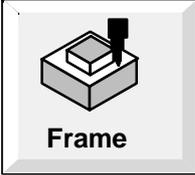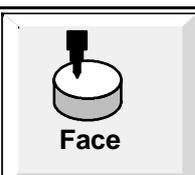
SFP (Shop Floor Programming)

Activation of this button provides the optional Shop Floor Programming mode that is used to generate and maintain part programs. This feature displays menu items, manages part program data, executes additional data associated with the generation of part programs and is separate from the operating system.

Also SFP has background/foreground capability which allows a machining process to occur while creating a part program with this feature. Refer to the separate Shop Floor Programming documentation for additional information.

Tools

Touching this button activates the tooling mode management system which provides the operator with a process oriented view of the tooling.

Enter the following data in the tables:

Number	Pocket	Tool ID	Type	Length	Nom Diameter
1	1	+1101	Drill	+6.00000	+0.06800
2	2	+1102	Bore	+6.50000	+0.80000
3	3	+1103	Bore	+6.50000	+1.00000
4	4	+1104	Finish End Mill	+7.25000	+1.00000

Number	Pocket	Diam Offset	Tip Angle	Flute Length	# Teeth
1	1	+0.00000	+112.000	+5.50000	1
2	2	+0.00000	+0.000	+6.50000	1
3	3	+0.00000	+0.000	+6.00000	1
4	4	+0.00000	+0.000	+2.00000	4

Number	Pocket	Threads/Inch	Material	Size (Pockets)
1	1	0	High Strength Steel	1 (Prev 0 Next 0)
2	2	10	Carbide Insert	1 (Prev 0 Next 0)
3	3	0	Carbide Insert	1 (Prev 0 Next 0)
4	4	0	Carbide Insert	1 (Prev 0 Next 0)

Number	Pocket	Material	Size (Pockets)	Load Method
1	1	High Strength Steel	1 (Prev 0 Next 0)	Auto Load
2	2	Carbide Insert	1 (Prev 0 Next 0)	Auto Load
3	3	Carbide Insert	1 (Prev 0 Next 0)	Auto Load
4	4	Carbide Insert	1 (Prev 0 Next 0)	Auto Load

Multi-Setup

Touching this button activates the optional Multi-setup mode management system which provides the operator with additional offsets and a process that can assist with part dominant programming.

More (Additional Mode Selections)

Additional mode selection can be accessed by touching this button.

Multiple log files or journals are separated into two categories. The first category includes the system journals; startup history, alarm recording and system fails.

System Journals		
Custom Journal 1	1995/2/6 12:00:00	6:6

Event Category	Code	Time
ASCII Output	Program "[MSG."Block	1995/2/6 12:00:00
ASCII Output	Program "[MSG."Block	1995/2/6 12:00:00
ASCII Output	Program "[MSG."Block	1995/2/6 12:00:00
ASCII Output	Program "[MSG."Block	1995/2/6 12:00:00

Buttons: Alarms Journals, System Journals, Custom Journal 1, Custom Journal 2, Expand, Search, Print, Purge

System Journals Example

The second category includes two user journals to allow recording specific events that may occur. These events may be going in and out of cycle, tool changes, program start, program completion, etc. They are stored with all associated information.

The programming Journal[JRN] block allows the NC program to write messages to one or more of the Journals to record significant events with the associated time. These events could include time stamped changes in shift, job, or the program, tool changes, operation beginning and end, entries before and after program stop or optional stop blocks.

Specific events can be defined and recorded within the two user journals and a selection list is presented with entry time stamp. User journals can be printed or saved to a device. User journals require setup level password to purged and remove old entries. Cursor keys are used to move through the entries.

Diagnostics

Diagnostics

Touching this button causes the Diagnostic Manager screen to be displayed.

Diagnostic Manager					
Hardware Diagnostics Startup Status					
Name	**Part Number**	**#**	**Result**	**Select**	
High Density I/O		**1**	**Missing**	**Enabled**	
Bridge Board [RT]	**3-542-1217A**	**1**	**Passed**	**Enabled**	

Startup Diagnostics

Extended Diagnostics

Interactive Diagnostics

Expand Results

Enable Diagnostics

Start Diagnostics

Repeat Continuous

Diagnostics History

Three areas of Diagnostics are provided which include:

Startup Diagnostics
Tests can be performed without action by the operator, and are performed on every machine/control startup.

Extended Diagnostics
Perform testing which is not practical to perform on every startup, due to the length of time required. These are provided for testing and trouble-shooting as required.

Interactive Diagnostics
Require action by the user during the test, such as providing a desired input from a keyboard or touch screen. These would be run as required to diagnose some control component
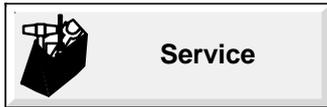
Service

Service

This touch button is provided for use by qualified service personnel and should not be used by machine operators. Various service functions include installation of control software, event reviewer, enablers, etc.

ol Serial Number: XXXXXX

Machine Application Software
Description:
P/N:
Installed:

NC Extension Software
Description:
P/N:
Installed:

Base System Software
Description:
P/N:
Installed:

Install Software

Un–Install Software

Service Tools

Enable Floppy Drive

Workstation Event Viewer

Write Workstation CMOS

Setup Kollmorgen Spindle Drive

Backup & Restore Machine Data

Enable Remote Access

Command Window

ProgramWare

ProgramWare

Enable Remote ProgramWare

Runoff

Write Control S/N

System Configuration

System Configuration

This touch button provides access to the machine setup and configuration parameters such as run time preferences, operator preferences, etc. that are generally setup once and changed only on an infrequent basis.

When the Configuration window is activated, a variety of icon menu buttons are displayed. Icons which can be selected from the Configuration window are determined by the password level you currently have active. An icon that is not selectable will appear light gray in color. To select Program Defaults, activate the NC programming touch target. This target becomes active when the Setup level password is selected.

Security	CNC Communication Setup	Printers	Touchscreen
NC Programming	Storage Devices	Network	Keyboard
Tool	M 70 M 70's	Public Interface	Mouse and Trackball
Machine Application	Purchased Option	Date / Time	
Axes	Add On Software	International	
Servo	Window COM Ports	Display	Servo TDI
Error Compensation			Realtime Schedule
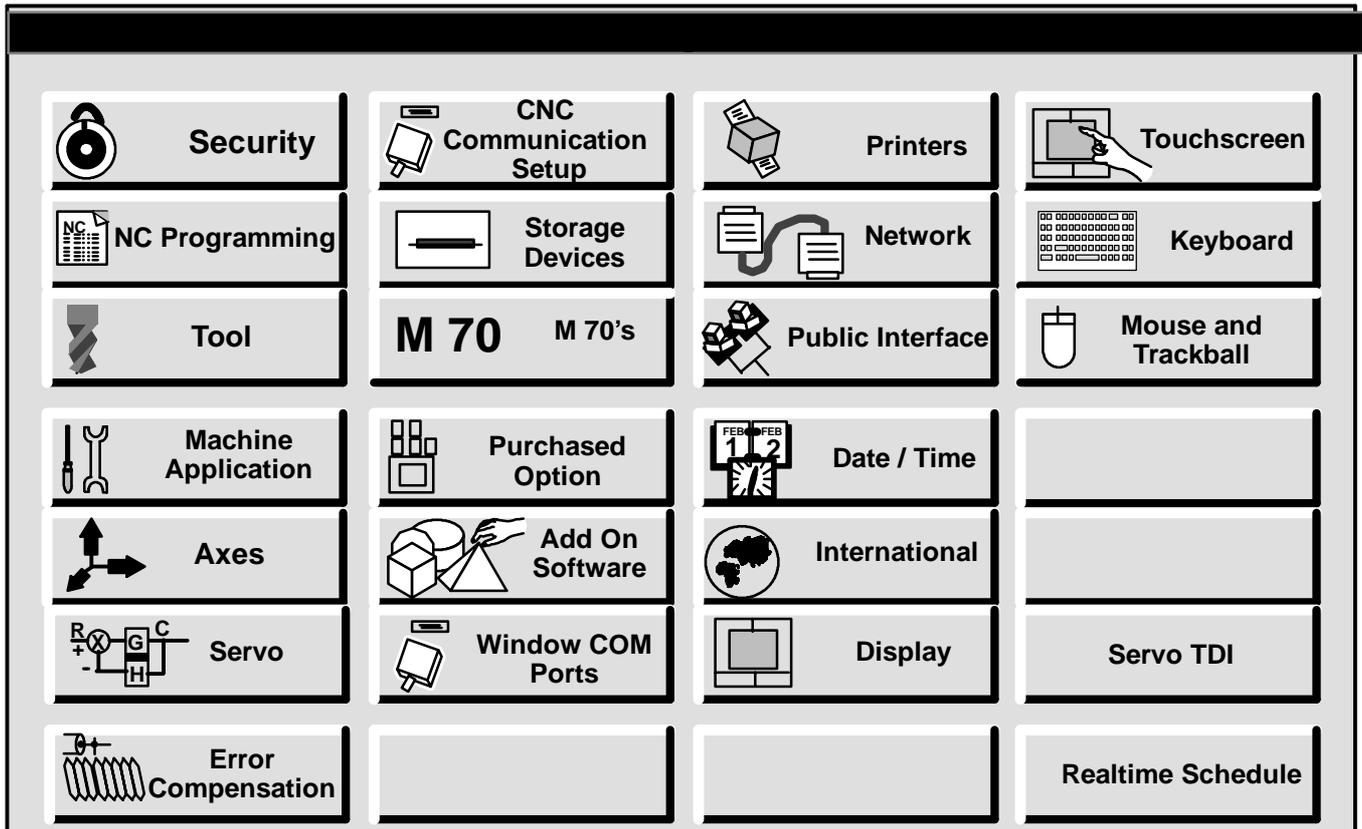
Various compensations (Axis Error Compensation, Backlash, etc.) are included as are other tables and parameters that are not often modified.

File Manager

File Manager

This touch button provides access to the general computer file management functions.

	File Operations
Create Directory ✓	Copy
	Delete
	Rename
	Create Directory
	Format A
	Keyboard

Filename

Directory

Show Files of Type
All files (*.*)

Drive:
C
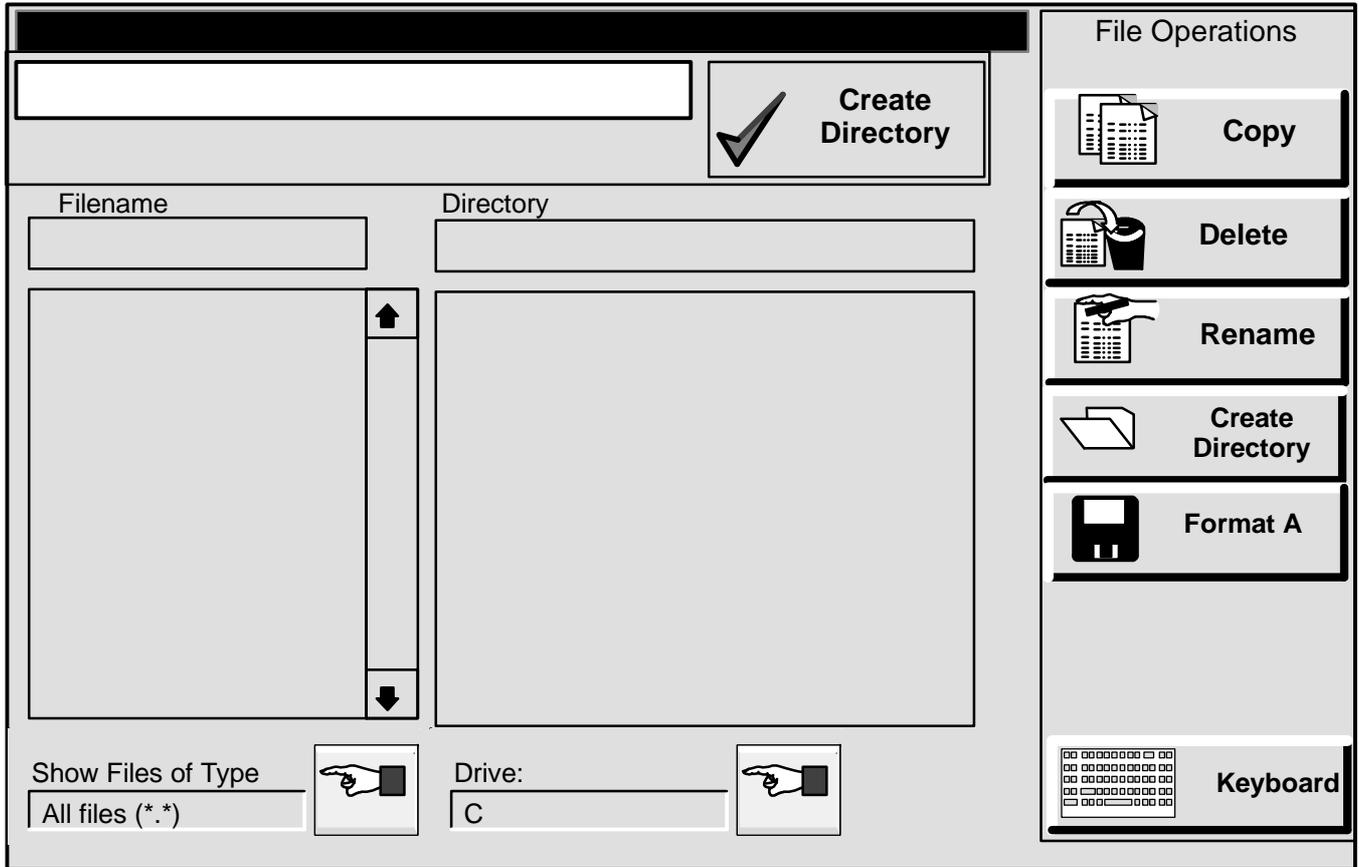
Mode Specific Button Bar

These buttons provide specific functions for a given control mode.

Back

BACK

Selects the previous mode of operation. The BACK button is not functional in certain modes of operation.

Display

DISPLAY

Selects additional displays or is used to customize the display and activation of the menu buttons in the active mode.

Home

HOME

Reverts the current display to the machine mode, Home menu display.

Touch Screen and Keyboards

A2100 control provides a touch screen and screen-side keys as part of its standard interface. The touch screen allows the user to move throughout the system without the requirement for any other keys.

The touch screen provides the capability to display an "on-screen keyboard" when alpha-numeric data entry is required. Two on-screen keyboards are part of the standard interface. One is available while editing an NC program or MDI, and provides the set of keys needed for program entry. The second on-screen keyboard is a full "qwerty" keyboard that makes available all keys. This keyboard is available at data entry into the system is required.
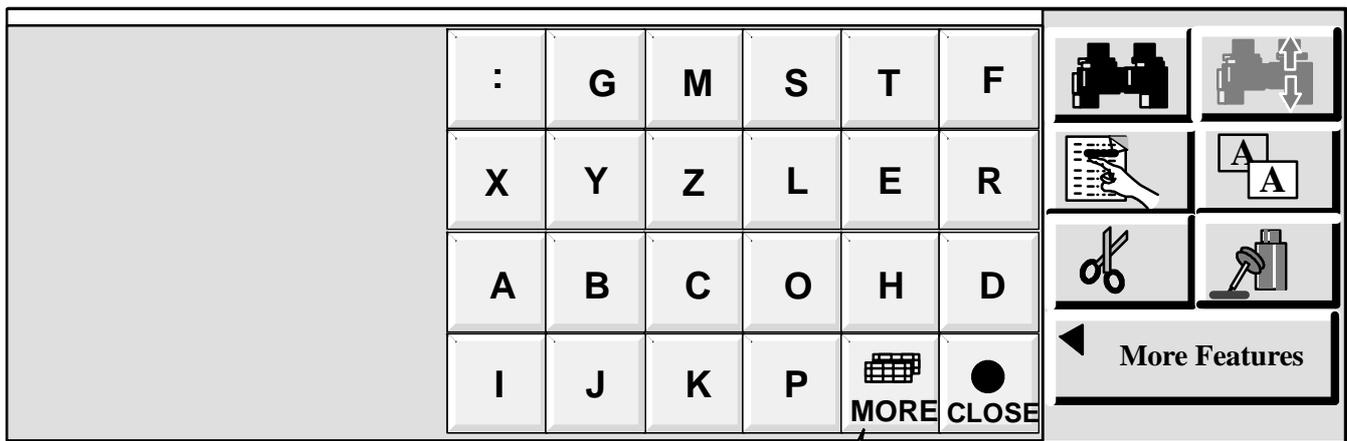
Program Entry Keys
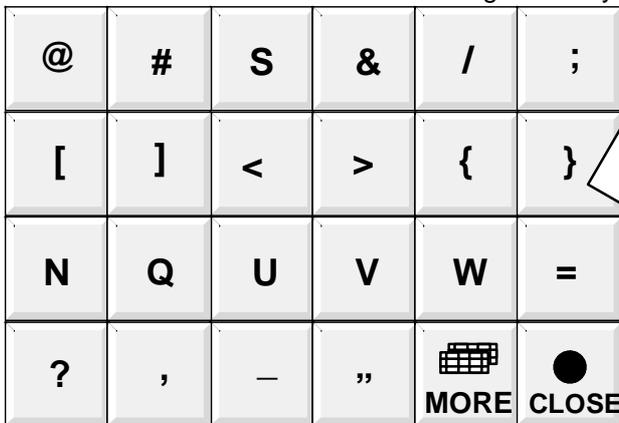
Program Entry Keys
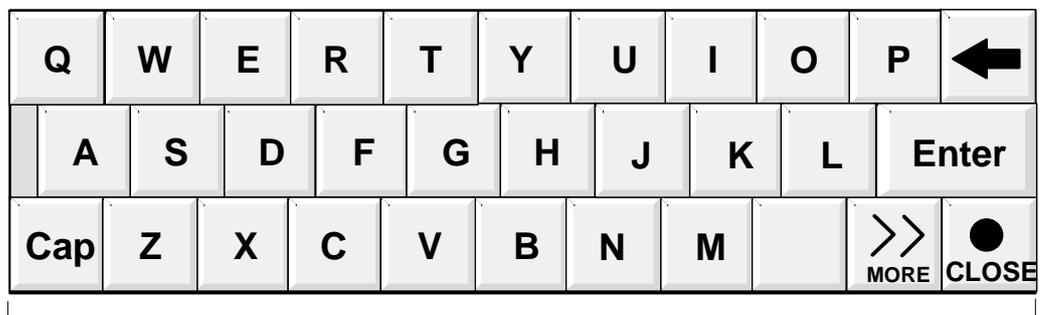
On-Screen QWERTY Keyboard

Optionally available with A2100 is a 101 style PC keyboard that provides a full features available at all times.

Plotter Display

The plotter display provides a plane selectable graphical view of the machining process. Isometric three D scalable part views are provided. This display provides tool icons together with a scaled trail of the cutter path. Machine limits, program origin and a scaled ruler are also available.

The plotter continues to record points while the plotter display is not displayed, allowing the user to change displays and switch back to the plotter display and not lose data.

The plotter also provides a redraw capability that allows the user to quickly redraw all the previously displayed data in any of the available views and including new zoom scaling.

Change Plotter Setup

Y X (cube)	Z Y (cube)	Z X (cube)

Options

Z Y X (cube)

Center on Tool

X: +2500
Y: +12.50
Z: +20.00
⊢──→ +50.00
|‖‖| 10.0 in

Plotter Options

Draw Limits ✔

Draw Tool With Color ▷

Draw Origin ✔

Line Only ▷

Draw Rulers ✔

Draw Tool W/O Color ◆

Tool #
X Z
N0001   **Display Status** ✔

Tool Color List ✔

● **Close**
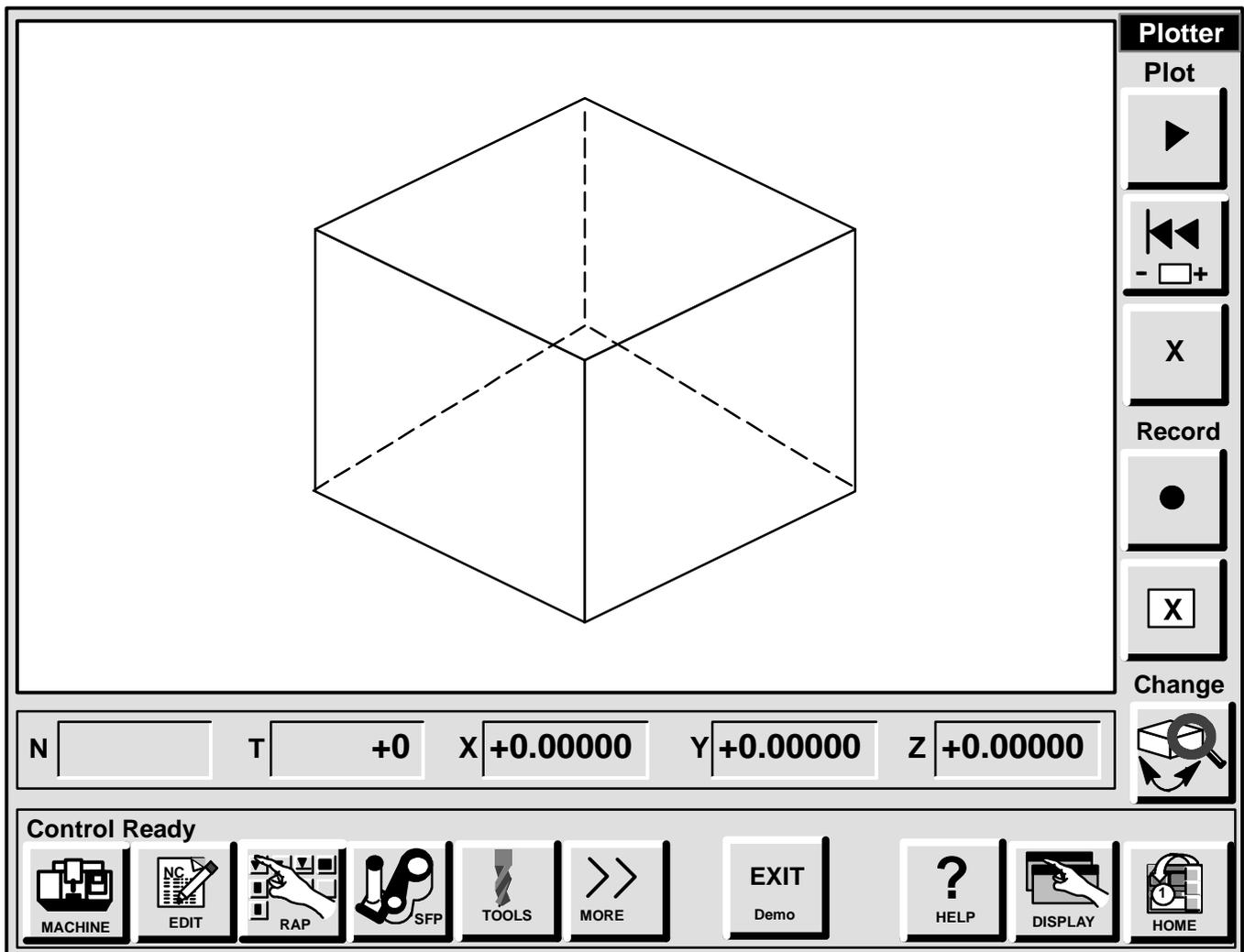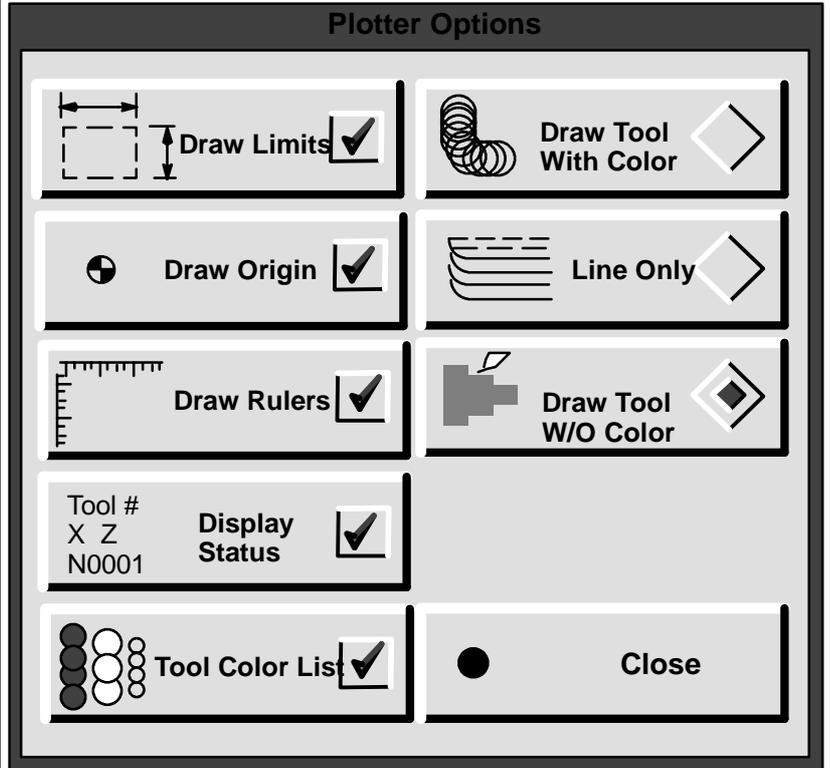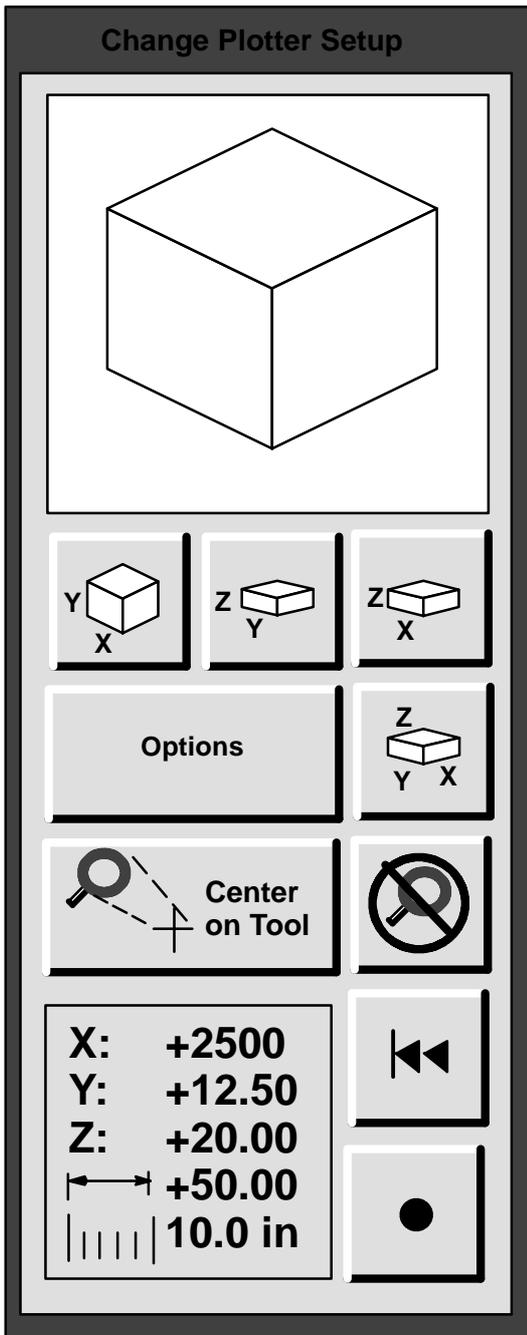
Help Information

On line help information is available for most menu buttons and can be activated as follows:

With control power applied, press and hold the Ctrl button.

Touch and hold any display button. Help text will appear as illustrated below. To activate help information on another display button, continue holding the CTRL button, then touch another display button.

Machine Mode

Is used to activate the Production Machine Mode. From this display the DIS-PLAY button is used to activate additional Axis Display information.

Touch [DISPLAY] to select additional information

Display Groups buttons

Are used to select additional displays. The Select Axis Display will update as each Display Group button is touched.

Menus

These buttons can be used to change menu selections for a selected display, or change the Select Display field.

Use your scroll bar to view additional information on the Display Group buttons

Select a Display

Display Groups

- Axis Displays ◆
- Offset Displays ▷
- Other Displays ▷

Select Axis Display

Production
Current
To Go
4 View
Limits
Servo
Servo Setup
Program Debug

Menus

Home Menu ▷	Plotter Menu
Coordinate Setup Menu ◆	Table Menu
Axis Setup Menu ▷	Drawing View Menu
Program Functions Menu ▷	Cycle Parameters Menu
Counter/ Time Menu ▷	More Menu Selections

Setup Home Display	✓	X

Touching one of the Display Group buttons will change the Select Axis Display information area.
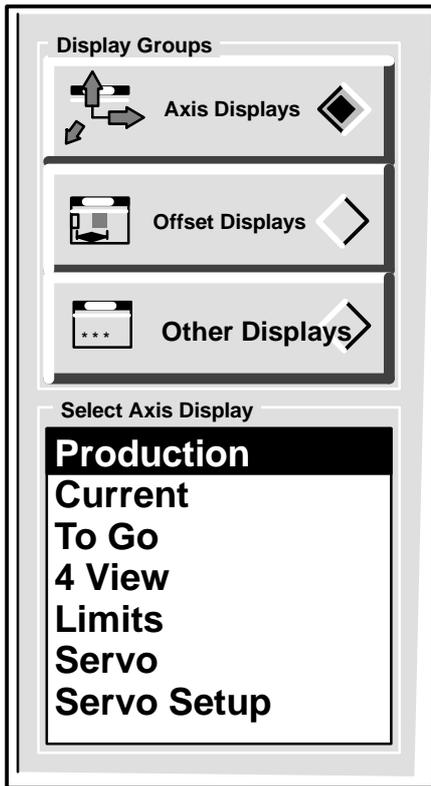
Axis Displays

To activate a display, simply highlight selection, and press the Green Arrow button.

To cancel this display press the Red X or make another selection.

Production

The production display provides specific information for the current program (or MDI block). This display shows the current and commanded position in program coordinates, the current program block number, current state of active offsets, a portion of the active program (or MDI block), the current feed and speed overrides, and the active and next tool identifiers. This display also shows the state of common modal G codes.

Current

The current display provides the current machine coordinates, and zero shift. In addition, the program current and command coordinates are also shown. The current feed and speed overrides and a portion of the active program (or MDI block) are also shown.

To Go

The distance to go display provides the absolute distance still to be traveled for each axis for the current span. The current feed and speed overrides and a portion of the active program (or MDI block).

4-View

The multi-view display shows the absolute program coordinates, local program coordinates, machine coordinates and distance to go for each axis.

Limits

This display provides the operator with the Current Position, Machine Position, spindle Speed limits, and Forbidden Zone information.

Servo

This display is provides a variety of information about your servo system.

Servo Setup

This display is used to setup and display your servo system information on each of the servo ports.

Program Debug

This display is used to debug part programs.

Select Offset Displays

Pallet Offsets
Multi Setup Offsets
Fixture Offsets
Prog. Coord Offsets
Prog. Tool Offsets
Machine Offsets
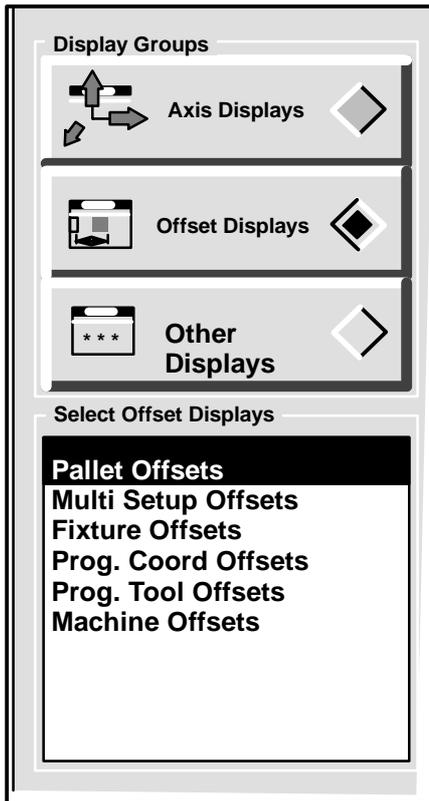
Offset Displays

To activate a display, simply highlight selection, and press the Green Arrow button.

To cancel this display press the Red X or make another selection.

Pallet Offsets Display

Pallet offsets is used to correct for the inaccuracy of registration when a pallet is loaded onto a machine, and to allow a coordinate system to be defined that has its origin somewhere other than where machine coordinates are defined.

Pallet offsets allow the operator to establish a relationship between a reference point on the pallet and the center of rotation of the rotary axis of the machine.

Multi Setup Offsets

Allows the programmer to program a part without regard to its orientation at the machine.

This display provides several part setups, each with a Part Coordinate System and an independent set of Fixture Offsets, and Programmable Coordinate Offsets.

Fixture Offsets

Are offsets X, Y, Z, U, V and W axis offsets which adjust for off-center mounting of a fixture workpiece. They can be used with a single part mounted on a machine table or for on of several parts attached to a pallet.

Prog. Coord Offsets

Programmable offsets are generally used with an NC program to adjust for variations in the setup or part material. These variations are either measured by the operator or obtained automatically by probing the part surface. Programmable offsets are for the linear axes only and do not change with the rotary axis position.

Prog. Tool Offsets

This display shows programmable tool offset data elements. Programmable Tool Offset data is comprised of two fields: tool length and CDC value. These values are added to the current tool offsets which are active at the time the tool offset code is programmed.

Machine Offsets

This display provides the operator with a means of entering and modifying the linear axis offsets contained in the Machine Offsets table.

Machine Offsets are not part of the pallet/part coordinate system offset hierarchy.

Display Groups

Axis Displays

Offset Displays

Other Displays

Select Other Displays

Programs
System Registers
Variables
View Drawing
Plotter
Cycle Parameters
Program Parameters
Process Control Data
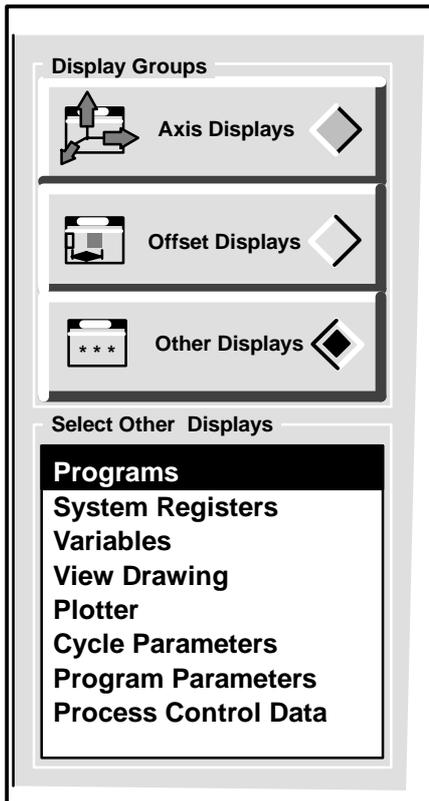
Other Displays

To activate a display, simply highlight selection, and press the Green Arrow button.

To cancel this display press the Red X or make another selection.

Program Display

The program display shows the active NC program in a read–only manner. If the machine is not in cycle, the user may reposition the execution point of the program using standard cursor keys and search.

Message

Is used to display a list of message you can enter or modify.

System Registers

System I/O and other internal registers are displayed by selecting this display. The system registers display shows the active NC program in a read-only manner. If the machine is not in cycle, the user is able to select a system register and enter a value in it.

Variables Display

The values in this display are arithmetic expressions which can be numbers or variables. A variable is a symbol that refers to a particular location that contains the value to be used in an expression.

View Drawing Display

A2100 provides a drawing display that shows a BMP or DXF (but not CGM) format graphic display as requested by the user, or as selected from a program draw block. The display can be selected at anytime and shows the last drawing requested to be displayed. The current drawing can be erased from the display at any time. All drawings to be displayed must be registered in the program directory.

Plotter Display

This display, as previously shown, provides a graphical view of the machining process. Features include: Chuck and Stock definition, three D scalable part view, color coded tool type icon display with scaled cutter path, machine limits, program origin and scaled ruler, redraw with zoom.

Cycle Parameters

The Cycle Parameters display presents a table through which the operator can enter and modify parameters associated with fixed cycles.

Program Parameters

This display presents a table through which the operator can enter and modify parameters associated with each NC program.

Process Control Data Display

The control provides a scratch-pad for the collection of data in a part program that may be referenced by the part program, displayed on the operator station screen and copied to a printer. This scratch-pad also provides a means of communicating data from the part program to the Public Interface.

Tables – General

A2100 provides multiple tables having similar functionality and manipulation. Cursor keys page up, page down, home, end, allow movement around the table.

Certain tables allow sorting and filtering. The tooling table allows filtering of a given type, such that no other tools are displayed; and sorting by size, so all tools are shown in order of their size.

Table operations allow movement of the value of one field to another by using cut or copy and paste. By selecting a table field followed by copy, then selecting another field followed by paste, the second field is updated with the same value that is present in the first field.

Data entry fields are provided at the top of all tables to display and allow entry of data for any field within the table. This entry field is automatically updated with the current value of the selected table field.

Table columns have default fields which are applied when reset is selected. These values may be changed and be applied the next time the reset is selected.

Backup and restore capabilities allows the selection of the data device directly from the table. This can be any I/O device recognized by the control for file transfers such as floppy disk, communications port, etc.

Coordinate Offsets

Coordinate offsets allow the user to shift the machine coordinates so that they correspond to the physical location of a reference point on the machine (typically an edge or center point of a workpiece).

The control provides the operator with several different offset types each with its own unique characteristics and purpose. To quickly manage offsets, a powerful setup application called Workpiece Manager is resident in your control. Refer to Chapter 4 of this document for detailed information.

Coordinate Offset Types

The offsets listed below make up the pallet/part coordinate system and are listed in order of hierarchy:

- PALLET OFFSETS

- SETUP OFFSETS

- FIXTURE OFFSETS

- N.C. PROGRAM OFFSETS

Each offset builds on the other, the hierarchy is illustrated below:

Control offset interaction is as follows:

Pallet Offsets + Multiple Setup Offsets + Fixture Offsets + NC Program Offsets = Part Location.

Note: if you do not wish to use an offset, place 0 values in the offset table.
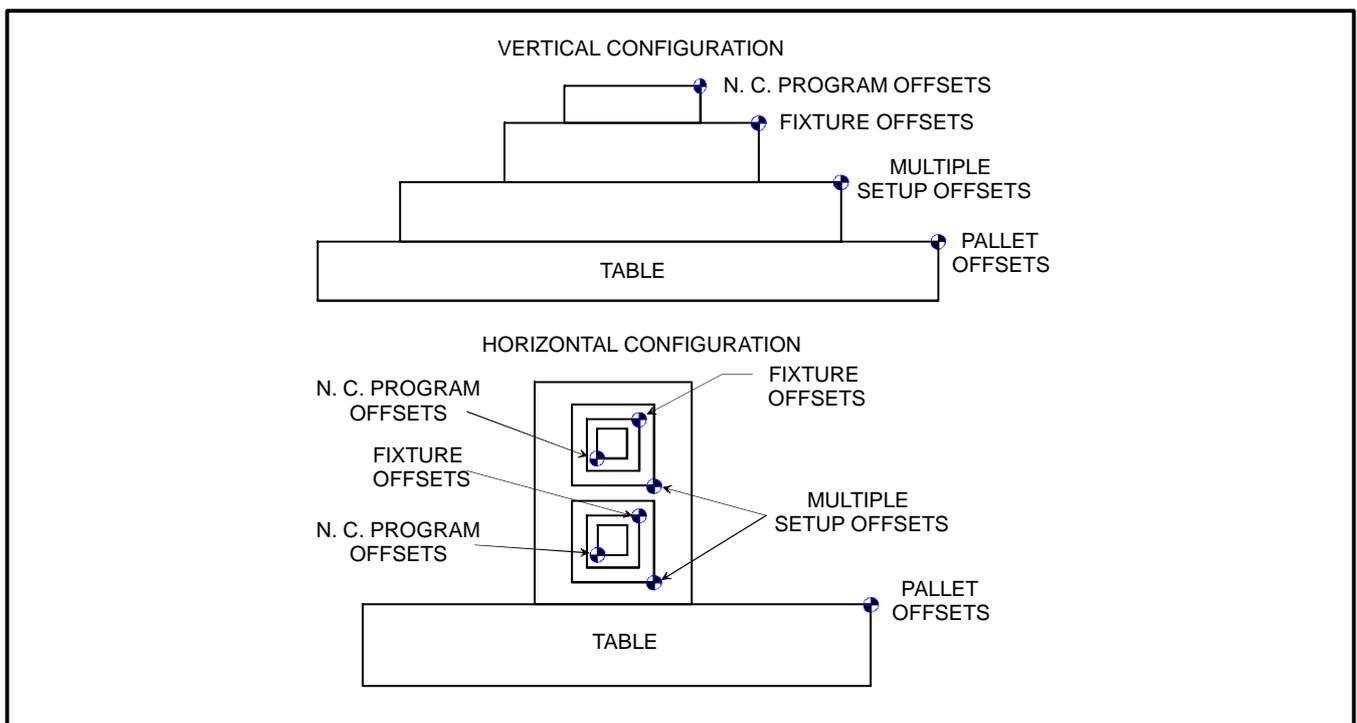
Fig. 40
Offsets

Words and Codes Associated with Offsets

The table below is for quick reference only

Offset Type	Words and Code
Pallet Offsets	G92.2 can be used to record machine coordinates in the active pallet offset table.
Multiple Setup Offsets	G92.1 can be used to record machine coordinate in the active setup offset table.
Fixture Offsets	The H word in the part program is used to invoke fixture offsets
NC Program Offsets	The D word in the part program is used to invoke NC program offsets

Entering Values to Offset Tables

All offset values may be entered in the following manner:

- Enter using Workpiece Manager (See Chapter 4 for detailed information)

- Manually through the operator key pad, or the on screen key pad

- Entered through the calculator on the offset display page by using the calculator fetch button

- Entered through probe cycles

In addition, pallet offsets may be entered by MDI by using the G92.2 command. Multiple Setup offsets may be entered by using the G92.1 command, or by selecting the coordinate setup menu from the machine mode display page.

Pallet Offsets

Pallet Offsets are generally used for one of two purposes:

• To correct for inaccuracies in pallet registration when a pallet is loaded onto a machine

• To allow a coordinate system to be defined that has its origin somewhere other than the machine coordinate origin.

Basic Procedure for Setting Pallet Offsets

In the illustration below A and B are:

A = Machine Align Point
B = Desired X0, Y0 Reference Point
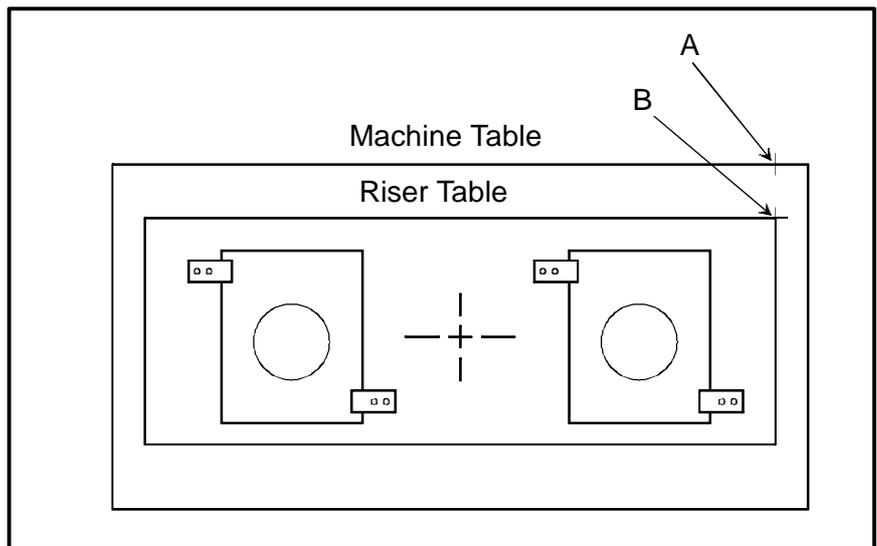
Fig. 41
Pallet Offset Example

To set pallet offset proceed as follows:

Touch, press or set the following	Comments
Move machine table so that the centerline of the spindle is at the desired reference point B	
Programmable Offsets	The NC Program Table will be displayed
Select Table	
Pallet Offsets	The Pallet Offset Table will be displayed
Check to see that no offsets are currently active	

Touch, press or set the following	Comments
⟫	
Fetch	**Calculator** 0 Available Fetch Items Current Programed X Current Programed Y Current Programed Z **Current Machine X** Current Machine Y Current Machine Z Current Spindle Speed Current Tool Diameter Current Tool Length Current Tool Flute Length Fetch ✔ Cancel ✘
Save	The current machine coordinates for X will be stored in the Pallet Offset X field.
Repeat procedure for Y axis, and also Z axis if desired.	On a cycle start command, the pallet offset will be invoked, and X0 Y0 will be at the desired reference point. **Note:** All absolute moves will now be made relative to Pallet Offset zero, rather than Machine zero

Alternative Method for Setting Pallet Offsets

Touch, press or set the following	Comments
Move machine table so that the centerline of the spindle is at the desired reference point B	
HOME	
MDI	G92.2 X0 Y0
Cycle Start	The reference point machine coordinate will be recorded in the active pallet offset and the current Machine Position will now read X0.0000 Y0.0000

Multiple Setup Offsets

Setup Offsets provide each setup with its own part coordinate system, and with an independent set of fixture offsets and NC program offsets.

Multiple Setup Offsets are unique in that they are selected through the pendant. This procedure is explained in greater detail in chapter 4 Workpiece Manager.

Basic Procedure for Setting Multiple Setup Offsets

In the illustration below A and B are:

A = Machine Zero
B = Workpiece Reference Point X0 Y0
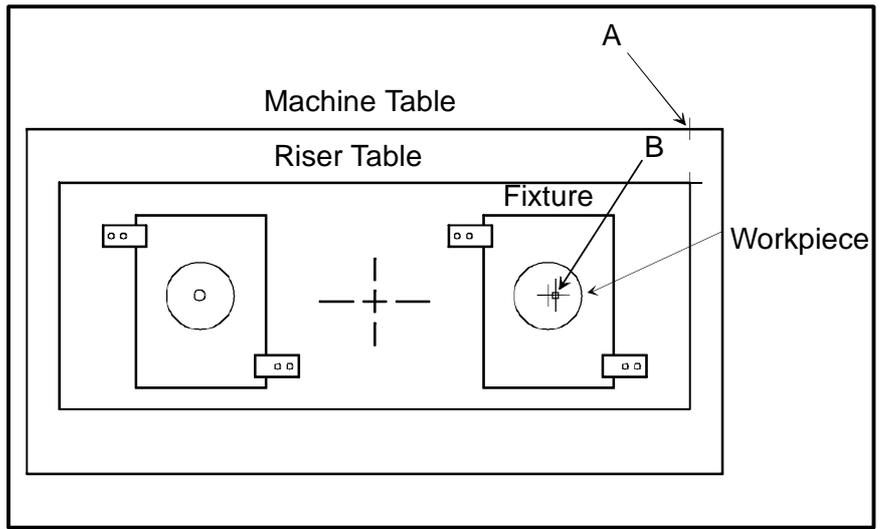
Fig. 42
Multiple Setup Offsets Example

To set pallet offset proceed as follows:

Touch, press or set the following	Comments
Move machine table so that the centerline of the spindle is at the desired reference point B	
Programmable Offsets	The NC Program Table will be displayed
Select Table	
Multi Setup Offsets	The Multiple Setup Offset Table will be displayed
Check to see that no offsets are currently active	

Touch, press or set the following	Comments
Fetch	
Save	The current machine coordinates for X will be stored in the Pallet Offset X field.
Repeat procedure for Y axis, and also Z axis if desired.	On cycle start command, the Multi-setup offset will be invoked, and X0, Y0 will be at the desired reference point. **Note:** All absolute moves will now be made relative to Multi-setup rather than machine zero, if pallet offsets are 0. If Pallet Offsets are present, the absolute move to the Multi-setup will be from the pallet offset rather than Machine zero.

Alternative Method for Setting Multi-Setup Offsets

Touch, press or set the following	Comments
Move machine table so that the centerline of the spindle is at the desired reference point B	
HOME	
MDI	G92.1 X0 Y0
Cycle Start	The reference point machine coordinate will be recorded in the active pallet offset and the current Machine Position will now read X0.0000 Y0.0000

Fixture Offsets (H word)

Like setup offsets, fixture offsets can be used to locate the reference position for a workpiece. Whether that position is on the workpiece itself or on the work holding device.

Fixture offsets are invoked through the part program by the H word. For example, a program line of:

G90 G0 X0 Y0 H1

would command an absolute rapid move in X and Y axis to the 0,0 position as defined by fixture offset 1.

Note: When activated, fixture offsets remain active until canceled by, a color block, an H0 command, or NC Program Offsets D word.

Basic Procedure for Setting Fixture Offsets

In the illustration below A and B are:

A = Machine Zero
B = Workpiece Reference Point X0 Y0
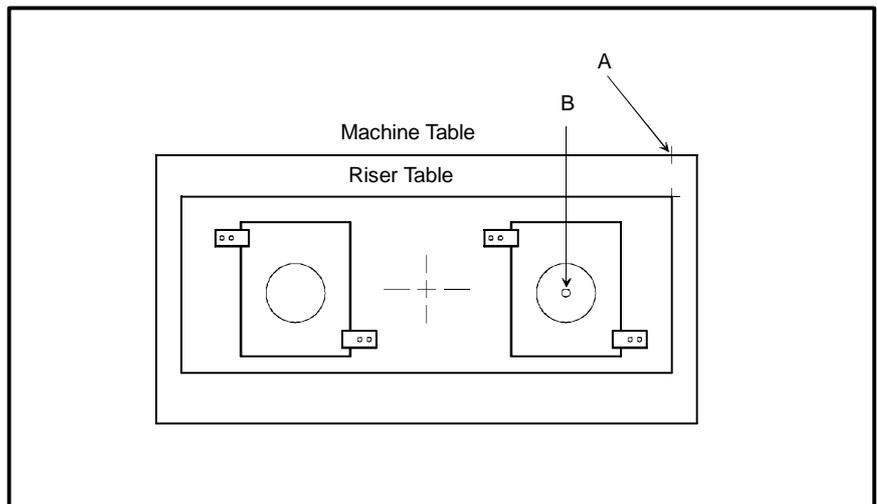
Fig. 43
Fixture Offset Example

To set fixture offset proceed as follows:

Touch, press or set the following	Comments
Move machine table so that the centerline of the spindle is at the desired reference point B	
Programmable Offsets	The NC Program Table will be displayed
Select Table	
Fixture Offsets	The Fixture Offset Table will be displayed

Touch, press or set the following	Comments
Check to see that no offsets are currently active	
Fetch	
Save	The current machine coordinates for X will be stored in the Fixture Offset X field.
Repeat procedure for Y axis, and also Z axis if desired.	On cycle start command, the Fixture offset will be invoked, and X0, Y0 will be at the desired reference point. **Note:** All absolute moves will now be made relative to the Fixture rather than machine zero, if pallet offsets and Multi-setups are 0. If Pallet Offsets are present, the absolute move to the fixture will be from the pallet offset rather than Machine zero. If Pallet Offsets is 0 and Multi-setups are present, the absolute move to the fixture will be from the multi-setup offset rather than Machine zero.

NC Program Offsets (D word)

NC Program offsets (also called programmable coordinate offsets) are generally used in combination with another offset to adjust for variations in stock size or in finished part dimensions.

Note: These offset reference points are based on any other offsets present.

NC program offsets are invoked by the part program by the D word.
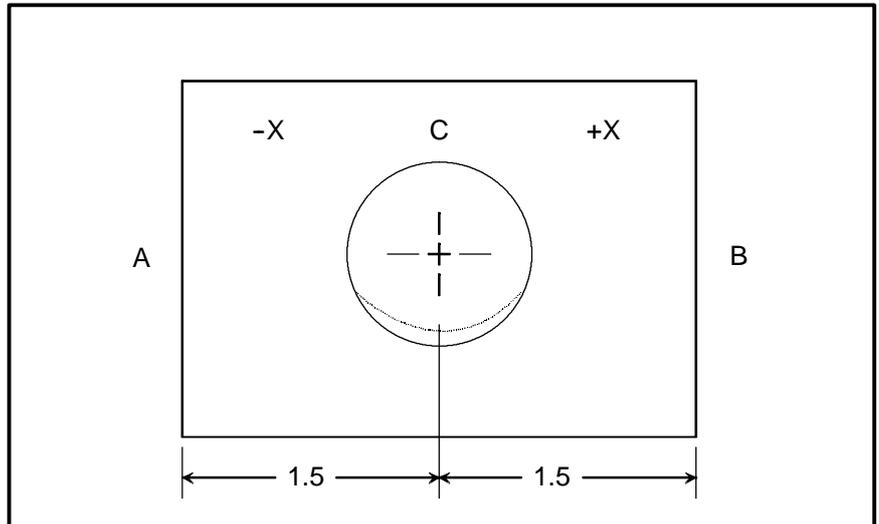
Fig. 44
NC Program Offsets Example

In the example above each end (A & B) of the work piece is to be machined so that Bore C is centered. If upon inspection, the bore is found to be off center so that the +X side is 1.495, an NC program offset of X-.005 will correct the part.

Enter -.005 in NC Program Offsets table record 1

The offset would be activated as follows:

G90 G0 X0 Y0 D1

Combining Offsets

Operators may sometimes find it helpful to use offsets in combination with one another, in effect stacking one offset on top or another. Offsets may be combined according to the following hierarchy:

- Pallet Offsets

- Multi-Setup Offsets

- Fixture Offsets

- NC Program Offsets

For example, in the illustration below points A and B are assumed to be known reference points. Point A is the corner of a riser plate and B is a bore hole in the center of the plate.
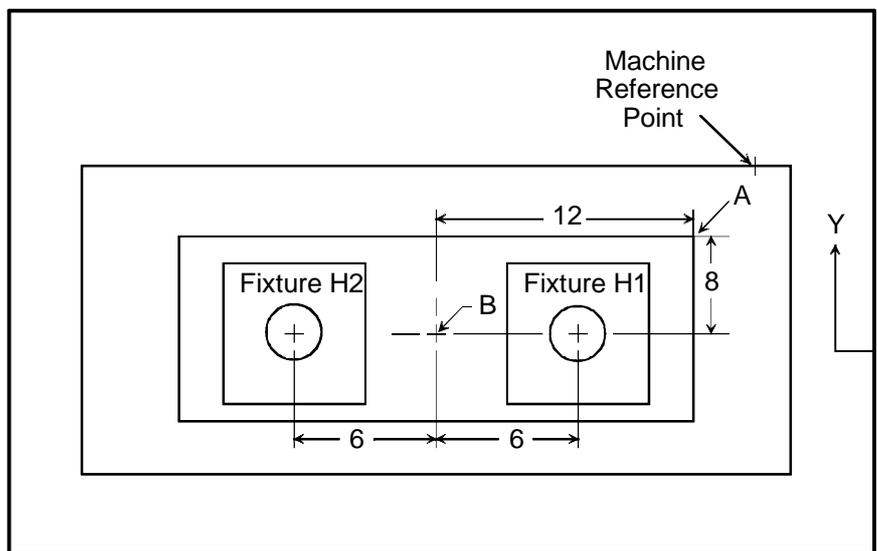
Fig. 45
Offset Combination Example

The spindle would first be positioned at point A, and the machine coordinates would be entered in pallet offset 1 (if pallet 1 is the active pallet) for X and Y. This point will now be X0 Y0.

Next, the spindle will be positioned at point B, which is X-12.000 and Y-8.000 from point A. The operator will select a setup offset from the pendant and will enter the current programmed position X-12.000 and Y-8.000 in the proper multi-setup offset. Point B will now be X0 Y0, and point A will be X+12.000 and Y+8.000.

Next the spindle will be positioned at point H1, which is X+6.000 and Y0 from the setup offset point B. The operator will enter the current programmed positioned of X+6.000 into fixture offset 1. When the spindle is positioned at Point H2, X-6.000 can be entered in fixture offset 2. When these offsets are activated through the H1 or H2 command, the point H1 or H2 will become X0, Y0.

Offset Table Field Descriptions

Many of the offset table fields are read only, which means, Workpiece Manager or other public interface will set status. These fields will be so noted in the descriptions which follow.

To view offsets tables proceed as follows:

Touch, press or set the following	Comments
HOME	If the home menu is displayed proceed
Programmable Offsets	
Select Table	The Select Table will displayed. See Select Table Display descriptions. To increment table selection use the arrow position keys.
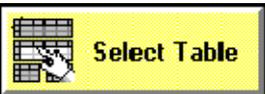
Select Table Display Buttons

Buttons	Description
Offsets Group	When touched, all offset tables will be displayed.
Pallet Offsets	When touched, only the Pallet Offsets table will be displayed.
Multi Setup Offsets	When touched, only the Multi-Setup Offsets table will be displayed.
Fixture Offsets	When touched, only the Fixture Offsets table will be displayed.
Programmable Offsets	When touched, only the Programmable Offsets table will be displayed.
Diagram	This button is used to present a diagram of a selected offset table. The diagrams presented for each offset are based on horizontal configurations. You must have the Offsets Group menu selected to activate this button. When touched, the picture diagram presented will depict the currently selected offset table. When you touch to select another offset type the picture presented will update based on your offset table selection.
Select Active Offsets	When touched, active offsets are highlighted for individual offset tables or the offset group selection.

Pallet Offset Table Definitions

Table Field	Description
X +0.00000 +0.00000 / **Y** +0.00000 +0.00000 / **Z** +0.00000 +0.00000	Contains linear axis pallet offset data
A +0.0000 / **B** +0.0000 / **C** +0.0000	Contains rotary axis pallet offset data
Offsets Rotate? No	Field selections are Yes and No

No will added axes offets to the active pallet
Yes will recalculate axes offsets to determine pallet location.

Default selection is normally "No" |
Rotary Position +0.0000	Sets degree position of pallet work faces. This value is normally set 0.
Pallet State Present	Read only status established by Workpiece manager or other interface media.
Pallet Status Unscheduled	Read only status established by Workpiece manager or other interface media.
Pallet Order +1	Read only status established by Workpiece manager or other interface media.
Pallet ID +111	Read only status established by Workpiece manager or other interface media.
Pallet Location +1	Read only status established by Workpiece manager or other interface media.
Unload? Wait	Read only status established by Workpiece manager or other interface media.
Task Name Local Task 01	Read only status established by Workpiece manager or other interface media.
Aux 1 +0.00000	Read only status established by Workpiece manager or other interface media.

Multi‑Setup Offset Table Definitions

Table Field	Description
X **Y** **Z** +0.00000 +0.00000 +0.00000 +0.00000 +0.00000 +0.00000	Contains axis Multi‑Setup offset data
A **B** **C** +0.0000 +0.0000 +0.0000	Contains rotary axis offset data
Order +0	Read only status established by Workpiece manager or other interface media. Identifies execution order of setup
Setup State Absent	Read only status established by Workpiece manager or other interface media.
Part Status Pending	Read only status established by Workpiece manager or other interface media.
Program ID +0	Read only status established by Workpiece manager or other interface media.
Repeat # +0	Read only status established by Workpiece manager or other interface media.
Complete # +0	Read only status established by Workpiece manager or other interface media.
Aborted # +0	Read only status established by Workpiece manager or other interface media.

Fixture Offset Table Definitions

Table Field	Description
X **Y** **Z** +0.00000 +0.00000 +0.00000 +0.00000 +0.00000 +0.00000	Contains axis fixture offset data
Offsets Rotate? No	Field selections are Yes and No No will added fixture offets to the rotary axis or active pallet Yes will recalculate axes offsets to determine fixture locations relative to a rotary axis or pallet. Default selection is normally "No"
Rotary Position +0.0000	Sets degree position of fixture relative to a rotary axis or pallet work faces. This value is normally set 0.

NC Program Offset Table Definitions

Table Field	Description
X **Y** **Z** +0.00000 +0.00000 +0.00000 +0.00000 +0.00000 +0.00000	Contains axis NC Program Offset data

Tool Mode

TOOLS

Touching this button permits the operator access to the Tool Mode and the associated tooling graphics, see **Tool Manager Display Example.**

Additional information concerning the Tool Mode can be found in the accompanying **Programming Manual**.

Tool Menu

Tool Manager			View

Serial Number   DRL# 1 1/8

Number   1   Pocket   1   Type   Drill   Tool ID   +30125012

Material
High Speed Steel

Length   +101.6000

Flute Length
+88.9000

Nom Diameter
+3.1750

Diam. Offset
+0.0000

Tip Angle
+118.000

Num of Teeth   1   Size   ! (Prev 0 Next 0)   Load   Auto Load   Threads/Inch   0

Spindle Dir   Either Directio   Max RPM   +0.0   Override %   100   Migrating   Off

Probe X   +0.0000   Max Feedrate   +0.0   Override %   100

Probe Y   +0.0000   Torque Limit   +0.0   Alternate ID   +0

Single   **Magazine**

Active Tool Set

Tool File

.25   .1
Inch   **Metric**

Find Tool

Show Tool

Copy Table

Modify Tool

Number				
				1

789 456 123

Number	Pocket	Tool ID	Serial Number	Type
1	1	30125012	DRL#J-1/8	Drill
2	2	30250012	DRL#J-1/4	Drill
3	3	#0500012	DRL#J-1/2	Drill

Entries 0	Active Tool Set	Sort: By Number	Filters: OFF

Tool Manager Display Example

The control's tool management system provides the operator with an process oriented view of tooling. Tooling data is created and stored within the "Tool File". During job setup, tooling information is moved to the active tool storage (magazine and manual rack) from the Tool File.

The tool management system is divided into two categories, Tool File and Active Tool Set. Within each of these displays the operator can activate information on an individual tool, or information about the machine storage matrix. Each selection (Single or Magazine) presents a graphic image with a multitude of selectable data.

Active Tool Set

The Active Tool Set contains tools which are made active in the Tool Magazine. Members of the active tool set can be referenced by Record # or Tool ID. In a non-migrating tool system, Tool Record Number and Pocket Number are the same.

Manually loaded tools that are loaded for a particular job are considered as part of the active tool set.

Tool File

The master tool record is kept in the Tool File. This record contains specific tool data about particular tools as well as each tool's history. For tool tracking, each tool has both an external and internal unique identifier. The external unique ID is the Tool Serial Number which can be assigned by an operator, cell controller, or automatic tool chip reader. The internal ID is not visible to the user and exists only to allow unique identification of tooling records for data modification by an NC program.

Tool Loading and Unloading

Tools are loaded on to the machine by making an entry in the Tool File active and assigning a tool pocket. This action can be accomplished by the operator or by automatic or semi-automatic subsystems. The operator interface provides a pick and place operation from the Tool File to the Tool Magazine. There is also the ability to support multiple tool load processes, Load and Auto Measure (Tool Probe), Load into Spindle and Measure Manual, and Load into Magazine Direct.

Tool Table Display Fields

One unique feature of the Tool Manager is selectable Display Fields. This display is as follows:

```
┌─────────────────────────────────────────────┐
│            Tool Table Display                │
│  ┌──────────────────┐  ┌──────────────────┐  │
│  │  Tool Sort By:   │  │  Display Fields  │  │
│  │                  │  │                  │  │
│  │  Add Tool    ◇   │  │ Serial Number ☐  │  │
│  │                  │  │                  │  │
│  │  Tool ID     ◇   │  │ Tool Handling ☐  │  │
│  │                  │  │                  │  │
│  │  Tool Type   ◇   │  │ Tool Geometry ☐  │  │
│  │                  │  │                  │  │
│  │  Tool Number ◇   │  │ Tool Setup    ☐  │  │
│  │                  │  │ and Usage        │  │
│  │  Serial Number ◈ │  │ Tool History  ☐  │  │
│  │                  │  │                  │  │
│  │  Tool Graphier   │  │ Tool Field Select│  │
│  │  ┌───────────┐   │  │                  │  │
│  │  │ Enable ☑  │   │  │  ●    Close      │  │
│  │  │ Display   │   │  │                  │  │
│  │  Fixed Columns ☐ │  │                  │  │
│  └──────────────────┘  └──────────────────┘  │
└─────────────────────────────────────────────┘
```
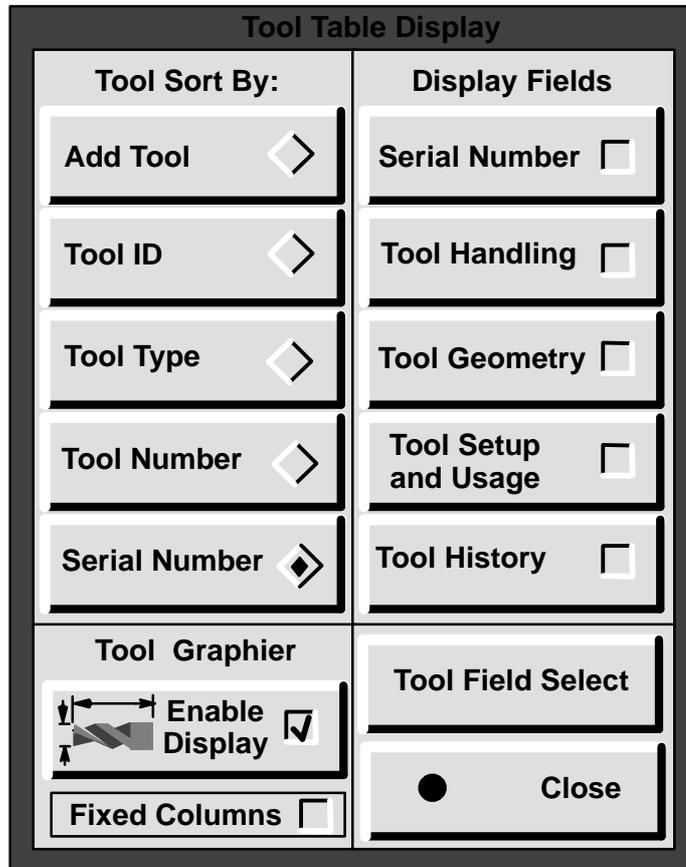
The operator can select specific cells to be displayed, or expand the display to any cell combination. As you touch each menu selection under the Display Fields group, the Tool Manager will configure your display. After your selection is complete simply touch the CLOSE menu button. If you wish to change your display, simply touch the DISPLAY menu button and make a selection.

Serial Number

Inserts the tool Serial Number cell.

Tool Handling

Activates tool handling information such as Size (Pocket), Load Methods (Auto-Manual-Cradle) and Tool Migration.

Tool Geometry

Activates additional tool geometry information such as Material, Tip Angle, Flute Length, #Teeth, Holder Orient, Holder Orient, Max Feed/Tooth, Max Spindle RPM and Thread Length

Tool Setup and Usage

Activates Tool Set and Usage tool cell information such as, Spindle Direction, Spindle Override, Feedrate Override, ,, X Probe Offset, and Y Probe Offset.

Tool History ⬜

Tool History

Activates Tool History cell information such as, Tool Status, Count Monitor, Limit Count, Accumulate Count, Time Monitor, Limit Time, and Accumulate Time.

Tool Sort By

These menu buttons will sort the tools in the table based on the sort selection you highlight. As menu buttons are touched display cells configure to the sort selection.
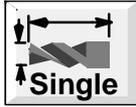
Single

Single

Presents a graphic picture of a selected tool in either Active Tool Set or Tool File mode.

Tool Manager will display the highlighted tool.

If no tool is displayed, the highlighted tool may have an UNKNOWN tool

type. Use **Tool Field Select** | **Find Tool** to select
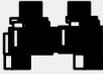
tool type.
Use position arrow buttons to increment through tool Type list.

Find

Column	Value		
Serial Number	=		**Go To Previous**
			Go To Next
			● **Close**
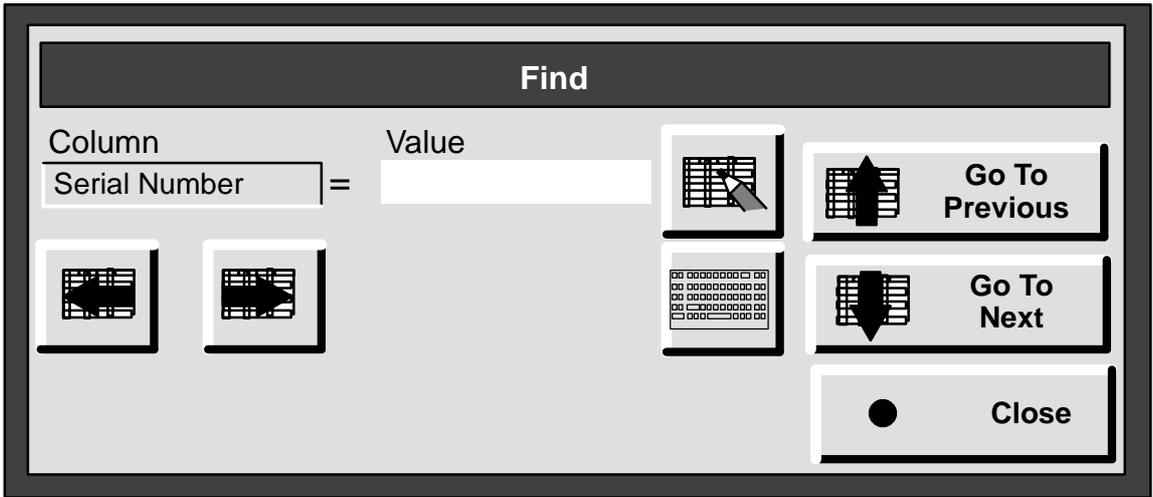
Under Display Fields touch desired menu buttons. As each button is touched Tool Manager will update your display.

NOTE: When a single tool attribute field is touched, the table cursor will reposition to that selected field. You can also quickly change the single tool selection by highlighting information in the table cell.

Tool Magazine

Is the physical storage device on the machine. Each pocket presented in the graphic represents a storage pocket on the machine.

The magazine graphic will appear as follows: Notice pocket 5 in the following example. The tool in this pocket would be highlighted to indicate it is currently loaded in the spindle. The spindle is represented by the graphic display box positioned to the right in the following illustration.

NOTE: If the Rotate Chain touch targets are not displayed, simply touch the Magazine menu button again. To increment the chain display simply touch either of the Rotate Chain arrows. This action is graphical only, and does not rotate the physical machine storage chain.

Tool Manager Example

Inch/Metric Selection

This function is used to change all tool display information (either Active Tool Set or Tool File) to Inch or Metric.

When either Inch or Metric menu button is pressed, Tool Manager will configure all cell information to your selection. This selection remains active until you change it.

Program Management

Program and file handling capabilities include directory services, edit capabilities, loading and saving, activation and Manual Data Input (MDI).

Directory Services (Registry, Import, Export)

500 NC Programs can be stored or registered within the program directory. The tabular display contains a list of all known NC programs with attributes. The control provides 1200 feet of standard program store with additional increments up to a total of 175,000 feet.

Program attributes provide specific program information and how it is to be used. Various program information is displayed in directory fields such as Program Name, Identifier, Type, Access, Validation, Size, Created, Modified, ExPath, ExMode, Group, PCnt, RCnt.

The user can notify the control of the existence of an NC program and its associated attributes without the requirement of loading the program into the control. This is useful when connected to network drives where the network drives store the program to be executed. The user is able to register the program and its attributes, allowing the program to run in the same manner as an NC program stored in the control.

Directory Fields →

Program Name	ID	Type	Access	Validation
MC 0130	0	A2100-274	Open	None
Helix	0	A2100-274	Open	Unknown
TEST	0	A2100-274	Open	Unknown
APC Lab	0	A2100-274	Open	Unknown

NC Part Programs

| 4 | 1/30/95 10:48:00 AM | Storage Available: 19,999,999 | 10000K |

Program Directory	Description
Program Name	32 Character Alpha Numeric
ID	5 Digit Program Identifier
Size	Number of Characters in program
Modified	Date the program was last modified.
Type	Type of program: EIA-274, A850, A950, FANUC, BCL, ACL, COMPLIED, SFP, ASCII, BMP, UNKNOWN.
ExMode	Indicates type of mode program is being run in: standard or continuous.
Access	Provides selection of access privileges for edits, deletes and execution of the program.
Run Count	
Group	User defined name of group for the NC program. Used for search and filter capabilities.
Created	Date the program was created.
File Specification	

Machine Pendant

DART, ARROW

+X   +0.0000   F132%
+Y   +0.0000   S 87%
+Z   +27.28917   0%
PROGRAM COORDINATES

F1   F2   F3   F4

= = >   ESC ///

X   Y   Z

A

- Y   +

+ X   - X

B

I →   + Y   _

−   0   +

10   90

20   80

30   70

40   60

50

100%   **100%**

F ⋀⋀⋀   S
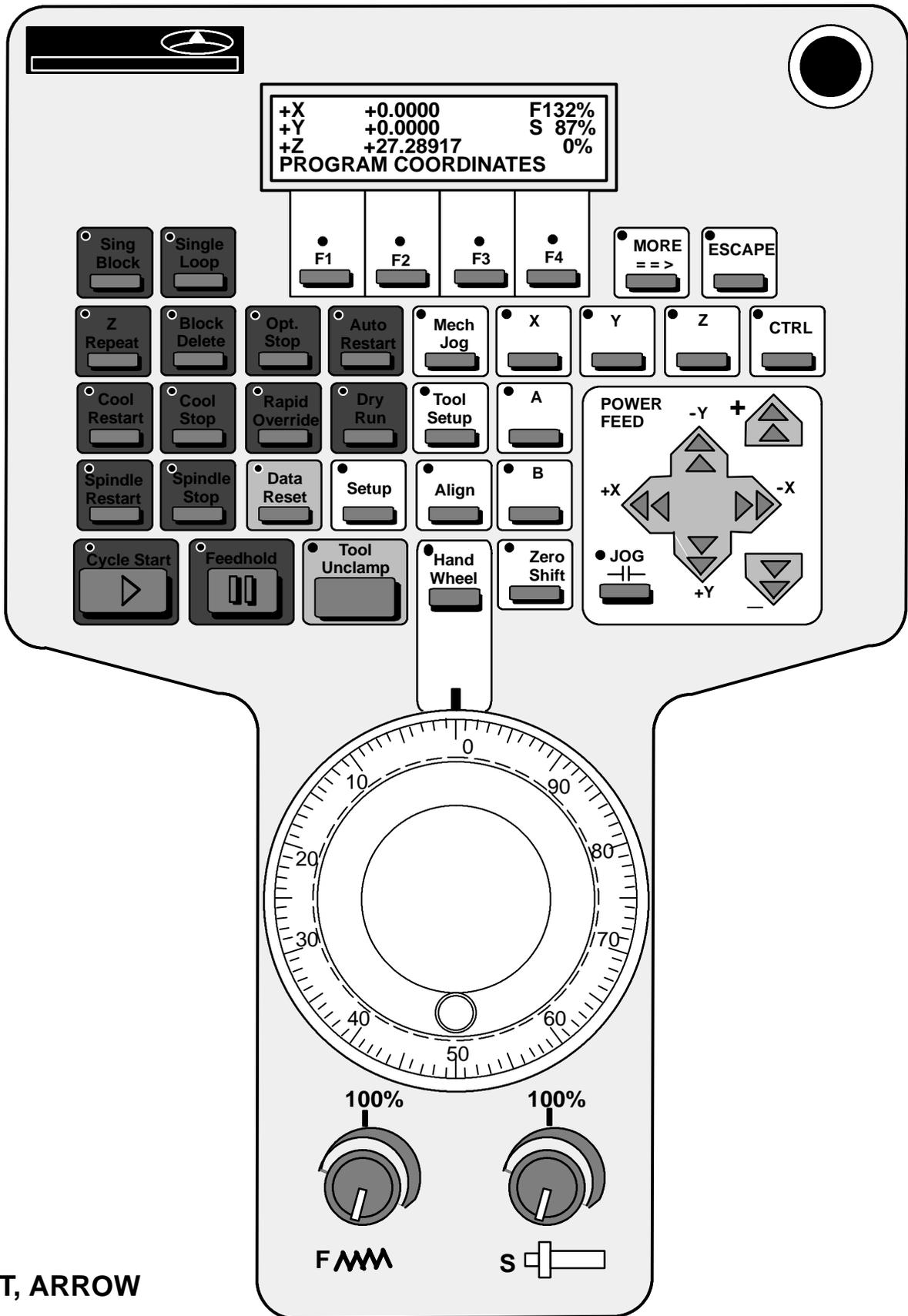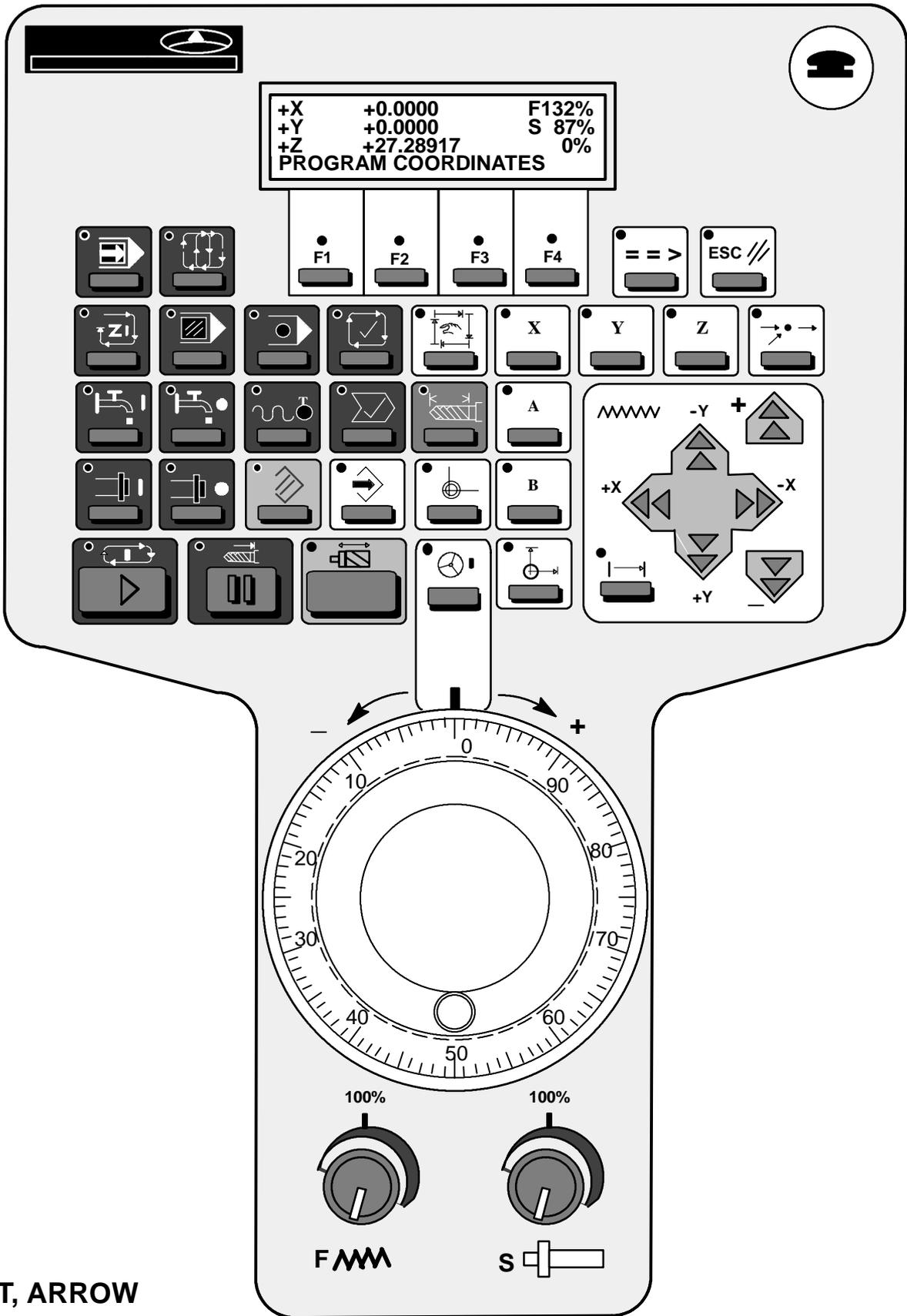
DART, ARROW
ISO

Introduction

A2100E provides a small operating pendant for machine operations. The pendant provides full machine functionality including handwheel, feedrate and spindle speed override pots, push buttons with LED status indicators, and powerfeed controls. The pendant allows the operator to have access to the workpiece and setup functions without having to move from the machine to the control. The LCD display on the pendant provides NC program coordinates for the selected axis, and supports additional functionality with the menu keys. The Machine Pendant consists of the following components:
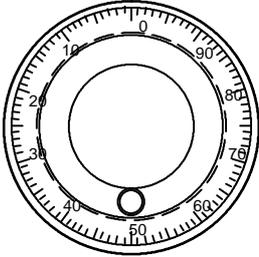
Handwheel

A single handwheel is provided that operates on a selected axis and produces feedback for each increment. Handwheel increments follow the inch/metric state of program input.

Spindle Speed And Feedrate Override

These two dials (potentiometers) are provided for spindle speed and feedrate overrides. The display screen will update as an override is increased and decreased.
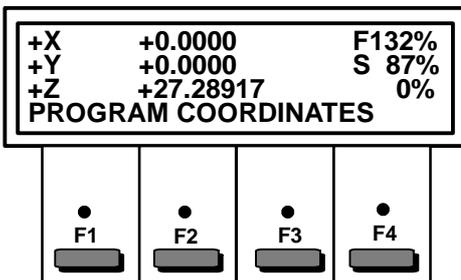
LCD Display

A 20 character by four line display is provided. The LCD display Menu Screen provides axis position for a selected axes, feedrate and spindle speed override values, menu key labels, and other definable functions.

Below the LCD display are four buttons labeled F1 thru F4. These "function" buttons are used to interact with the display fields. Their functions will vary based on the operation being performed.

Another display characteristic is multi level selections. Arrows positioned at the left and right sides of the field heading will be displayed when an additional selection is available.

This control, when rotated, varies the brightness of the LCD display. It is located on the front of the control or the side of the hand held pendant.

Emergency Stop

This push button is depressed to immediately stop machine cycle and operation in the event of an emergency. To release from depressed state, pull outwards and twist.

When this push button is pressed machine power drops, stopping the feed of all axes and spindle. Control power will remain on and a message is displayed on the control screen, "MACHINE OFF E-STOP."

The EMERGENCY STOP must be released before the machine can be restarted.

If EMERGENCY STOP is pressed while the axes are not in motion an automatic realignment is possible when the button is released.
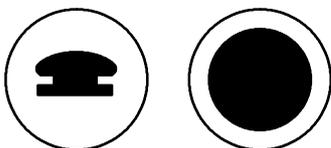
If EMERGENCY STOP is pressed while the axes are in motion, the operator must perform a machine realignment.

Single Block

When this button's LED is illuminated, one block of the active NC program is executed each time CYCLE START is pressed. At the end of each program block, the machine is placed in a feed hold condition. This button may also be pressed and illuminated to stop the NC cycle at the end of the current program block.

Single Loop

This feature affects the operation of G80 - G89 fixed cycles.

When activated, allows the operator to execute one pass of an automatic repeat cycle each time the Z Repeat button is pressed.

Z Repeat

Activates Z axis motion of an NC data block containing a Fixed Cycle function G80 thru G89. The fixed cycle Z-axis motion is repeated each time this button is pressed.

Block Delete

Allows the operator to skip program blocks, or information within an active NC program block. These blocks appear in the program as follows:

/ or /2 through /9 skip whole block
// or //2 through //9 skip information following

See BLOCK DELETE PROCEDURE for additional information.
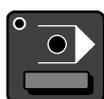
Optional Stop

Allows the operator to suspend (Optional Stop) the NC cycle each time an optional stop code M1 is encountered in the active program.

Auto Restart

Auto Restart is a control mode that can be selected only during cycle execution. This allows the operator to indicate that the next setup is ready for machining, and to permit a multiple step job to continue. The operator can turn Auto Restart off at any time. The control turns Auto Restart off at End of Job.
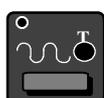
Rapid Override

Permits a reduced rapid traverse rate to be used during the execution of any rapid traverse move when activated.

Pressing this button for the first time will activate the LED and override feature. Pressing this button a second time will cancel this feature.

Cincinnati Machine 91203809-001

Dry Run

Dry Run is used to rapidly check out axes positioning of an NC program. Spindle and coolant are both turned off during a dry run operation, but tool change mechanism cycles remain active.
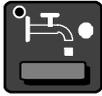
Cool Stop

Stops the current coolant flow.

Cool Restart

Pressing this button will restart coolant flow as designated by the last entered Miscellaneous M code function if a tool change has not been programmed..

Pressing this button will manually start or stop coolant flow to the active tool and to override any programmed coolant start or stop command.

Spindle Stop

This button is used to suspend spindle rotation.
-- With the machine in cycle it will only be operative after a Feedhold has been actioned.
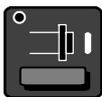
Spindle Restart

Is active only if the spindle is completely stopped, and was stopped by the Spindle Stop button and Data Reset has not been executed since the stop.

Spindle rotation is activated by pressing this button if the following conditions exist.

RPM and Spindle Direction has been programmed, and a tool change has not been programmed after that.

Data Reset

Used to re-initialize the control system.

1. All control stores modified by input data are reset.

2. Axis position readout on the screen display is updated to reflect current position.

3. Machine alignment is retained.

4. Data Reset only works when the control is not in cycle.

5. The interpolation mode is set to default.

6. The Feed Rate Mode is set to default, and the Feed Rate F code is set to a value of zero.

7. The sequence number N is erased

8. The I, J, K circular interpolator values and the fixed cycle R plane are set to a not- programmed state. Plane select is set to XY, G17.

9. The axis high and low limit values are set to system generated values. The current program identification is not altered.

SETUP MENU

Activates machine setup modes. This button enables the operator to select the features required for setting up the machine via the small display screen and keys F1, F2, etc. The following functions appear on the small display screen when the button is pressed. If this screen is not active, press the MORE key until this screen appears.
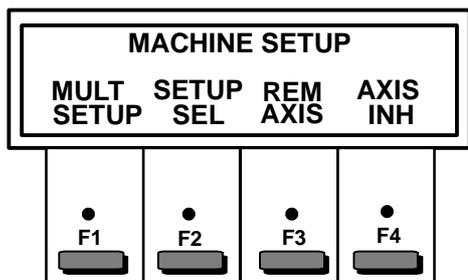
Multi Setup

Selects Multi Setup Mode. This feature will be described later.

Setup Sel

Selects which Offset Coordinate System will be Active. This feature will be described later.

Rem Axis

This feature controls the removable rotary axis if the machine is so equipped. The button is only active if the rotary axis is present. Features under the button are only active if the rotary axis is operator removable.

The rotary A-axis (and B-axis, if supplied) are selected to be 'present' or 'removed' in this feature.

Axis Inhibit

This feature inhibits axis motion when an axis command is processed. The feature under this button allows the user to inhibit the motion of any combination of linear and rotary axes supported by the system.
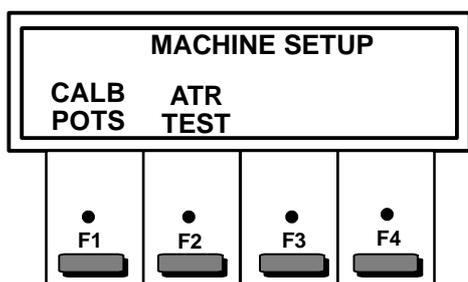
Calibrate Pots

The F1 key is used to perform a calibration of the feedrate and spindle override potentiometers. Set the Potentiometers at 100% and then press the button.

ATR Test

This function is not used in this application.
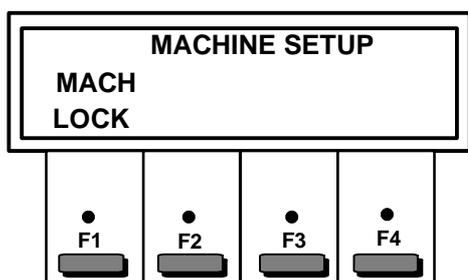
Mach Lock

This selection locks out all machine functions except program and table edit and door open/close.

Inhibit Coolant

This selection ignores all spindle coolant start (M code) commands.

MACHINE SETUP

INHIBIT   SERVICE
COOL WASH   DATA

F1   F2   F3   F4
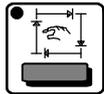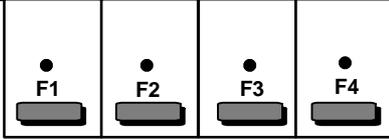
Inhibit Wash

This selection turns off the Swarf Wash system. The wash feature is described at the end of the chapter.

Service Data

This selection displays an information page which continuously updates and shows the current 'Machine ON Time' and the current 'Spindle Running Time'.

Mech Jog

Mechanism Jog

Accesses selected machine mechanism jog functions. The following Tool Magazine and machine mechanism jog functions appear on the small display screen when the button is pressed. If this screen is not active, press the MORE key until the screen appears.

< = = = MECHANISM JOG = = = >

SPINDLE   Z AXIS
CW   CCW   RETRCT

F1   F2   F3   F4
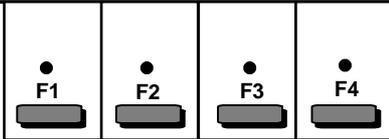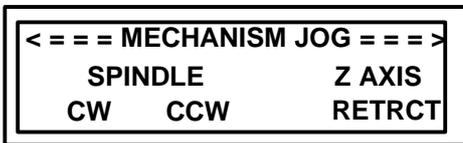
Spindle CW/CCW

This selection displays an information page which continuously updates and shows the current 'Machine ON Time' and the current 'Spindle Running Time'.

Z Axis Retract

Spindle retracts (to upper limit) whilst button is held pressed.

< = = = MECHANISM JOG = = = >

TOOL DRUM 1
SPDL   PARK   INC   DEC

F1   F2   F3   F4
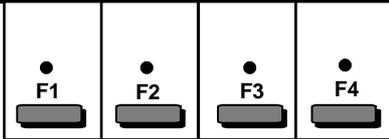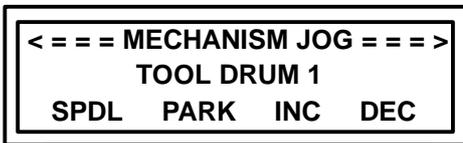
Tool Drum Spdl/Park

Drum advances to Spindle, or retracts to Park when F-button is held pressed.

Tool Drum Inc/Dec

Drum rotates (CW/CCW) when F-button is held pressed.

Note: A "Tool Drum 2" Mechanism Jog screen is provided for machines supplied with two tool drums. Press the MORE key until the screen appears.
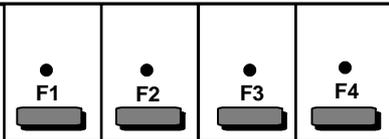
< = = = MECHANISM JOG = = = >

AUGER
START STOP REV

F1   F2   F3   F4

Auger Start/Stop/Rev

Requires "PROG" mode active and operator door closed. Reverse ON when F-button is held pressed.
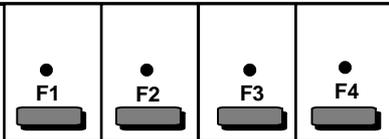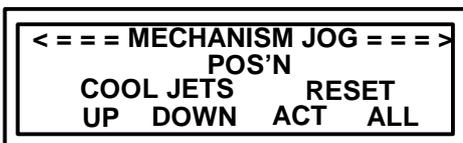
Coolant Jets Up/Down

The Automatic Coolant Jets mechanism (if supplied) is incremented to the next position Up on each press of the F1 button, or Down on each press of the F2 button. The F1 and F2 buttons provide the user with a means of adjusting the Coolant Jets position at any time.

< = = = MECHANISM JOG = = = >

POS'N
COOL JETS   RESET
UP DOWN ACT   ALL

F1   F2   F3   F4

The Coolant Jets Position is automatically calculated by the system evaluating the active tool length and the nominal diameter plus diameter

offset entries from the Tool Data Table. The F1 and F2 buttons are used (as necessary), to adjust the evaluated Coolant Jets Position to a more suitable (resultant) position. The resultant position of the Coolant Jets is shown in the "Pos'n" data field of the pendant display, and retained with the associated tool until tool data is changed; or the adjustment increment is cancelled using the F3 or F4 buttons.

Reset Act/All

Pressing the F3 button cancels the resident user adjustment increment (F1/F2 button operation) from the Coolant Jets Position for the active tool. Pressing the F4 button (no tool in spindle), cancels the resident user adjustment increment of the Coolant Jets for all tools.

Note: Miscellaneous functions (M8.1 - M8.8) provide programmed control of the Coolant Jets mechanism. See Chapter 7 of the Programming Manual.

Tool Setup

Provides facilities for Tool Tram and Tool Length setup.
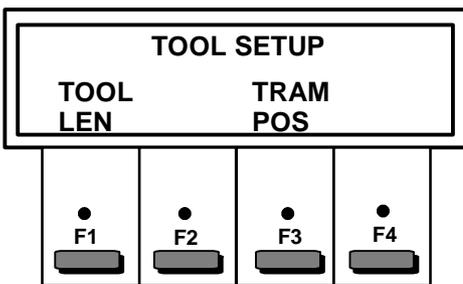
Tool Len

This selection accesses the Set Length LCD screen to set tool length automatically on the machine. For procedure, see 'How Do I' Set Tool Length.

Tram Pos

This button accesses the Set Tram LCD screen. Setting a 'Tram Surface' enables the user to set tool lengths automatically on the machine. For procedure, see 'How Do I' Set Tram Surface.
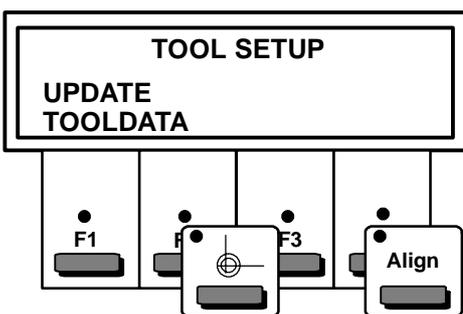
Update Tooldata

This selection allows edits to the active tool data to be applied to the active tool without the need to return to a 'tool change' block. for procedure, see 'How Do I' Update Tooldata.

ALIGN MENU

This button enables the operator to align the axes of the machine. Light indicates machine mechanisms are aligned. The following functions appear on the small display screen when the button is pressed If this screen is not active, press the MORE key until this screen appears.
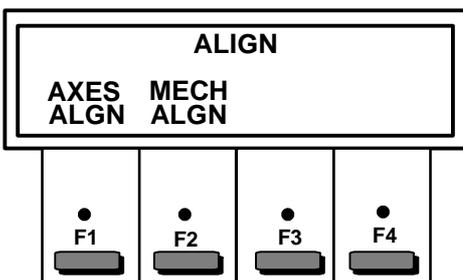
Axis Algn –

If the LED below AXES ALIGN is off, the machine axes are not aligned. Press and hold the F1 key to move the X axis to the align Target Point Align (TPA) switch first, followed by the Z axis being moved to its TPA switch (if the machine has an optional axes, such as W, it will also move to its TPA switch.) then the machine alignment sequence will occur. When the axes

are aligned the main spindle aligns. After the alignment sequence is completed, the Align Menu LED will be on. Tool Changer equipment uses MECH ALIGN to align .
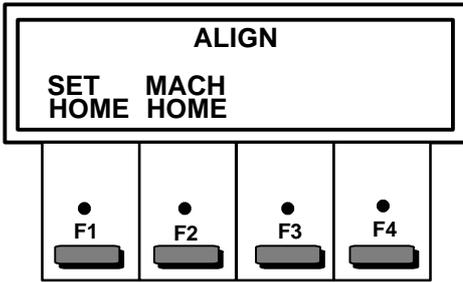
Set Home –

Pressing the F1 key establishes the current X, Y, Z axis coordinates as the Machine home position. If the LED below SET HOME is not illuminated a machine home position has not been established.

Mach Home

Pressing the key below machine home causes the slides to move to their machine home position. If a home position has not been established, the slides will move to the machine's Grid Align point. If the LED below MACH HOME is illuminated, the slides are at their home position.
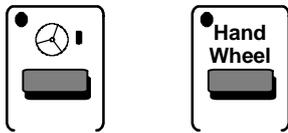
Handwheel

This button is used to activate the handwheel. When activated, X, Y, Z, A, and B buttons are used to select desired handwheel axis for movement, as shown below:

X Axis

Selects the machine X axis.
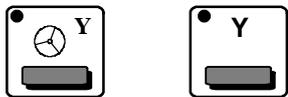
Y Axis

Selects the machine Y axis.
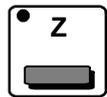
Z Axis

Selects the machine Z axis.

A Axis

Selects the optional machine A axis.
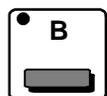
B Axis

Selects the optional machine B axis.
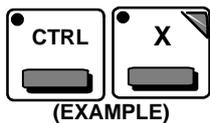
Control +X, Control +Y, Control +Z, Control +A, Control +B

Pressing any these two button combination allows the Pendant display to be changed in the following manner:
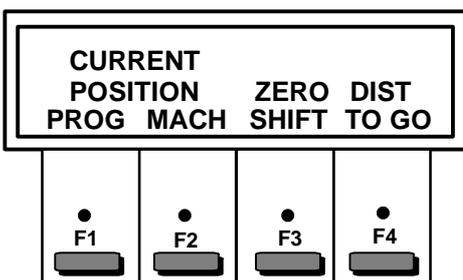
Pressing the key below CURRENT POSITION PROG causes axis information on the LED to be displayed in program coordinates.

Pressing the key below CURRENT POSITION MACH causes axis information on the LED to be displayed in machine coordinates.

Pressing the key below ZERO SHIFT causes the total amount of zero shift for each axis to be displayed on the LED.

Pressing the key below DIST TO GO causes axis information on the LED to be displayed in the absolurte distance still to be travelled for the current span.

The remaining selections under this feature, can be used to display servo drive information.
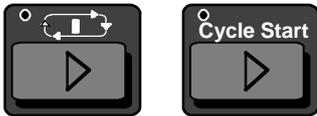
Cycle Start

Pressing this button initiates or continues cycle operation of the machine tool control system. It initiates the execution of the manuually entered block in MDI mode. It initiates continuous execution of the part program. Cycle Start is also used to resume cycle operation when a feedhold condition exists. The machine is in cycle when its LED is illuminated.

Feed Hold

Feed Hold suspends execution of the NC cycle.

During all NC operations except fixed cycles, a Feed Hold will cause all axis motion to immediately stop. Movement can be restarted by pressing the Cycle Start push button.
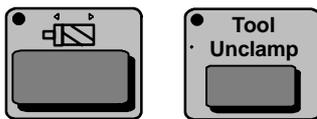
Tool Unclamp

This button is used to manually release the tool holder from the spindle. The drawbar will stay in the open position (unclamped) as long as the button is held depressed. This button is operable only when spindle rotation is stopped, the machine is out of cycle, the operator doors are open, and the tool setup function group is active.

Zero Shift

When this button's LED is illuminated all powerfeed/Inch jog and handwheel moves are in zero shift mode.
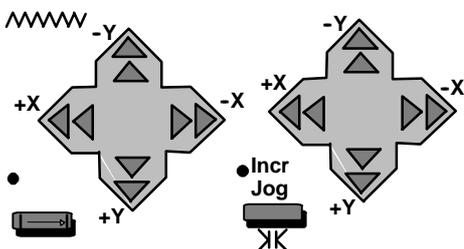
Axis Power Feed

This combination of buttons is used to powerfeed the X and Y axes.

Incr Jog or ⟼ With Incremental Jog mode selected, LED illuminated, pressing the axes buttons will cause incremental movement of the axes to take place.

NOTE: With the operator door open the traverse rate is limited to 40% of max feed rate Jog increments are selected via the F1, F2 keys etc.

Increment Axis Forward (Z, A, B only)

This button is used to powerfeed the Z axis in a forward direction (if Z has been selected) or rotate the A or B axis (if supplied) in a clockwise direction.

Increment Axis Reverse (Z, A, B only)

This button is used to powerfeed the Z axis in a direction (if Z has been selected) or rotate the A or B axis (if supplied) in a counter-clockwise direction.
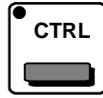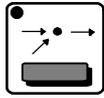
Control Button

This button is required to be pressed when performing a variety of operations.
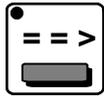
More Text

Advances the pendant LCD display. More is active when arrows are displayed at the top of the pendant LCD display.
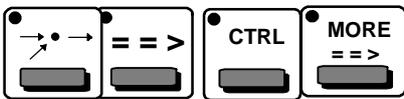
Control + More Text

Reverses the pendant LCD display. Control + More is active when arrows are displayed at the top of the pendant LCD display.

Escape

Returns the pendant LCD display to a previously selected display.
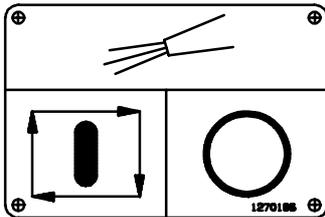
Tool Drum Air Blast – Selector Switch

This pneumatic 2 position selector switch, is mounted in the cover plate above the tool drum guarding.

The switch is only accessible with the tooldrum in its DRUM TO SPINDLE position.
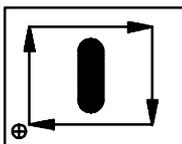
Air Blast – On (normal operating position)

With the selector switch in this position, the air blast will operate continuously whenever the tool drum is in its DRUM TO SPINDLE position.
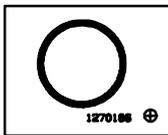
Air Blast – Off – see CAUTION

With the selector switch in this position, the air blast feature is turned off at all times.

NOTE: The air blast can be removed to enable tool drum loading and setting to be carried out.

CAUTION

Tool Drum Air Blast.

Always ensure that the AIR BLAST switch is returned to its normal ON position prior to Automatic Operation of the machine.

Failure to follow this instruction could lead to jamming of the turret indexing mechanism.

or

ON
I

0
OFF

Main Electrical Cabinet

MAIN ELECTRICAL CABINET

MAIN POWER DISCONNECT SWITCH

SERIAL DATA PORT

DISK DRIVE

(Arrow Location)

1. **MAIN POWER DISCONNECT SWITCH**

   The switch is located on the rear door of the electrical cabinet. It is used to turn the machine power ON or OFF.

   When the switch is in the ON position: power is supplied to the machine electrical components.

   When the switch is in the OFF position: power is disconnected to the machine and control components with the exception of yellow incoming wiring and the free standing auto-transformer unit (if fitted). See Warning DANGER. Refer to the *Service Manual* for further instructions regarding the MAIN POWER DISCONNECT switch.

   The RESET position of the Main Power Disconnect switch is used to reset the Main Power Circuit Breaker located inside the electrical cabinet.

   No method of machine operation requires that the operator open the electrical cabinet doors. Only properly trained and technically qualified electrical maintenance personnel must open the electrical cabinet doors. See DANGER.

   Before servicing the machine or control, always place the switch in the off position. Lock and tag this switch with a 'DO NOT START' sign.

2. **SERIAL DATA PORT** (DATA LINE RS 232)

   The data input/output port is located on the electrical cabinet. The port is configured as a 25 pin D type female socket with a hinged cover.

   The port can be used to interface serial data input output devices, such as a paper tape punch, data printer or floppy disk unit, etc.

3. **DISK DRIVE** (optional)

   The disk drive is located on the side of the electrical cabinet. Use only 3.5-inch DOS compatible floppy disks. The drive accepts two types of formatted disk:

           720 K (double density)
           1.44 MB (high density)

WARNING

Always wear safety glasses when using the Wash Gun. Do not place eyes in front of Wash Gun; coolant may be discharged into the eyes causing injury or loss of sight.

Failure to follow this instruction may result in serious personal injury.

Optional Operating Devices

Wash Gun

The Wash Gun (if supplied) is used by the operator to flush swarf into the machine swarf collection tray, or swarf conveyor system (if supplied). The wash gun facility may be used when,

- The machine is not in-cycle.
- The operator door is open.
- The Coolant Restart push button is pressed ON.

The wash gun is active for a period of 30 seconds after which the Coolant Restart push button must be pressed to restore the coolant supply to the wash gun.

NOTE: Coolant supply to the Wash Gun is maintained during automatic machine cycle if a spindle coolant ON code (M8, M13, M14 or M27 - if supplied) has been processed by the control, see WARNING. The Wash Gun is not intended for use during automatic cycle of the machine.

Swarf Conveyor

The machine may be supplied with an optional swarf conveyor unit complete with its own control station. On those machines equipped with two conveyor systems, a single control station is mounted on one of the conveyor units with duplicated controls to enable manual operation of both conveyors.
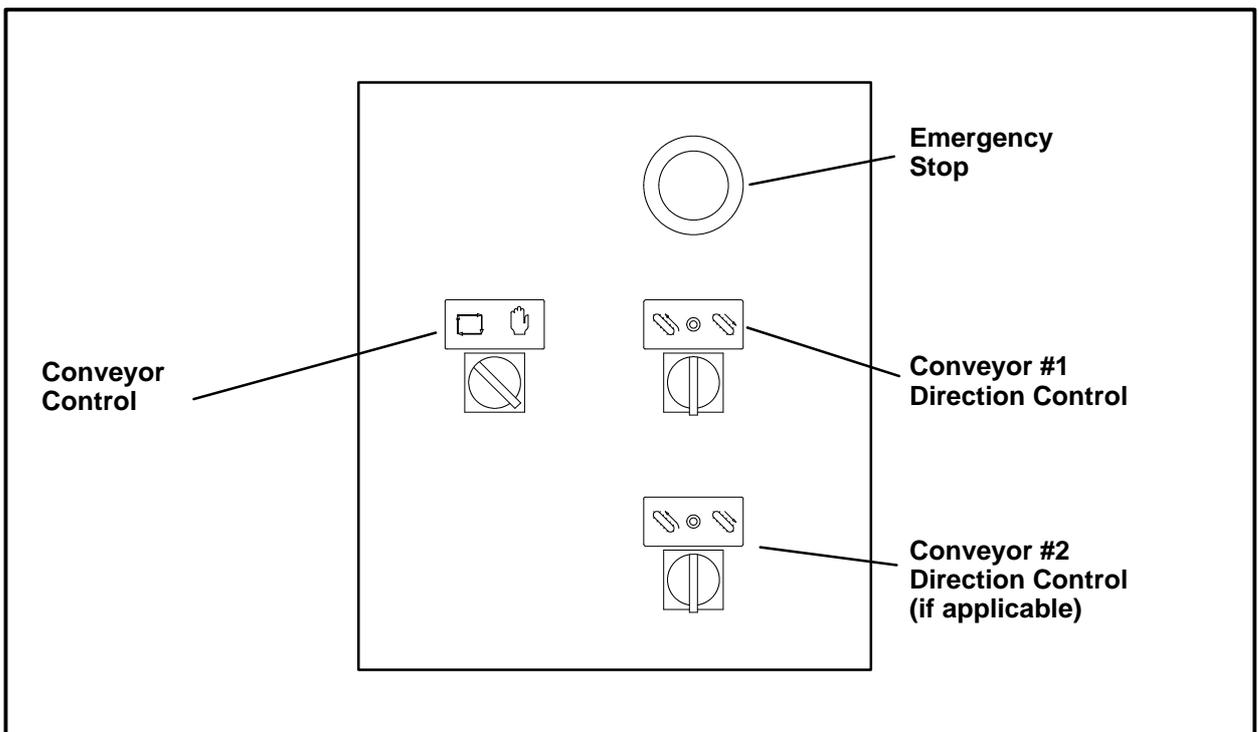
Fig. 46
Swarf Conveyor Control Panel
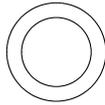
Emergency Stop - (Red Push Button with Latch)

Pressing this push button causes an immediate slide and spindle stop, followed by the removal of drive power. Any mechanisms in operation will stop immediately. The push button remains depressed (latched) when actuated. Twisting the push button releases the Emergency Stop button.

The push button is active at all times.

If a second swarf conveyor is supplied, it will be equipped with an Emergency Stop push button.
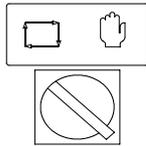
Swarf Conveyor Control - Auto/Manual - (Selector Switch)

The swarf conveyor control switch is shown in AUTO selection. In AUTO selection, the swarf conveyor will commence rotation in its normal direction of rotation when:

- the operator door is closed.
- the NC 'PROG' operating mode button is selected ON.
- the CYCLE START push button is pressed.

The conveyor(s) will rotate for a preset time, then remain stationary for a preset time. The duration of both time periods are retained in the System Configuration table. The cycle is repeated until the conveyor is stopped by either an external or programmed command.

Programming the Swarf Conveyor OFF (M92) code terminates the Swarf Conveyor ON timed period and restarts the conveyor ON/OFF auto cycle, commencing with the conveyor OFF timed period.

The conveyor will stop if,

- a Program Stop (M00) or End of Program (M02/M30) code is processed.
- an Optional Stop (M01) code is processed with the OPTIONAL STOP push button selected ON.
- the FEED HOLD push button is pressed.
- on completion of an NC cycle with the SINGLE BLOCK push button selected ON.
- the EMERGENCY STOP push button is pressed.
- an access panel (if any) is removed from the enclosure guarding.
- the AUTO/MAN selector switch is set to MANUAL.

In the MAN (manual) selection, the swarf conveyor will remain stationary unless the conveyor direction selector switch is set to Forward or Reverse. In MAN selection the swarf conveyor may be rotated with the operator door open, see WARNING.

Conveyor Direction - (Selector Switch, spring centred)

This switch is a jog facility operative only when the conveyor AUTO/MAN selector switch is set to MANUAL.

With the conveyor direction switch held in the Forward (elevating) position, the conveyor will rotate in its normal operating direction; when held in the Reverse position the conveyor will rotate in the opposite direction. When released, the switch will spring back to the OFF (centre) position.
See WARNING.

WARNING

Do not enter inside the enclosure guarding of the machine unless the Emergency Stop push button has been pressed. This removes power from the swarf conveyor and axis drives.

Failure to follow this instruction may result in serious personal injury or death.

Swarf Management System (Swarf Wash)

The Swarf Management System (if supplied), comprises an arrangement of coolant spray nozzles situated within the machine guard enclosure, and designed to automatically wash swarf into the associated swarf conveyor(s).

Swarf Wash is turned on automatically when the following are satisfied:

- – the operator door is closed.
- – the NC 'PROG' operating mode button is selected ON.
- – the machine is set in-cycle by pressing the Cycle Start button.

Once the machine is in-cycle, the Swarf Wash is turned ON by:

- – a programmed M90 (Swarf Wash ON) code, if the system has previously processed a programmed M61 (Swarf Wash OFF) command in automatic cycle via NC 'PROG' mode.

- – following the completion of an M6 (Tool Change) cycle -unless an M61 (Swarf Wash OFF) is active prior to the tool change command.

Swarf Wash is turned OFF when any of the following occur:

- – the NC'PROG' mode is de-selected.
- – the machine is not in-cycle and the operator door is open.
- – the control processes an M02, M30 or M61 code.
- – for the duration of an M06 (tool change) cycle.
- – For the duration of a Renishaw Surface Sensing Probe cycles, or Renishaw Tool Sensor (Tool Setting) Probe cycles.
- – the control is selected in Single Block or Dry Run mode.
- – the Inhibit Wash button is selected ON.
- – The EMERGENCY STOP push button is pressed.

Chapter 4
General Setup Guide

WARNING

Do not attempt to setup or operate the machine using the following procedures until a representative of Cincinnati Machine is present during initial machine installation.

Failure to follow this instruction may result in personal injury and damage to machine components.

The following general guide should be used to setup the machine/workpiece/program in the order shown. This setup guide contains references to other following How Do I ... procedures and other information contained in the Operating manual and Programming manual. Since each workpiece contains different requirements and programming, decisions must be made whether all of the following procedures are required. Some non-operator procedures, once set, do not require further attention.

This general guide has not been prepared to enable inexperienced personnel to set-up and/or operate the machine without preceding training.

Setup The Machine	
Touch, press or set the following	**Comments**
Switch Power On	
	Place Main Electrical Disconnect Switch device in the ON position. Actual switch appearance may vary slightly, but its function will be the same.
	Allow control to run diagnostics. Refer to procedure "Switch On Power".
	Press again to initiate machine power on sequence. Read the "Use Emergency Stop Push Button" procedure.
	Activates default selections for modal functions

Configure System	
System Configuration	Calibrate Display Screen, refer to procedure "Calibrate The Display Screen". Refer to and set "NC Programming Execution" and "Activate Security".
Axis Setup Menu	Refer to and set procedures "Select Axes Display" and "Inhibit An Axes".
Setup Home Menu	If desired, set-up Home Menu. See "Change Home Menu".

Align Machine

⊕ (button)	Align (button)	Starts machine alignment. Button LED illuminates.
AXES ALGN F1	THEN **MECH ALGN** F2	Machine axes align. Refer to procedure "Align the Machine", Axes Alignment Procedure and Automatic Realignment. Tool changer mechanism align. Refer to "Mechanism Alignment Procedure".
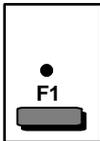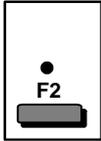
Perform Operating Station Functions
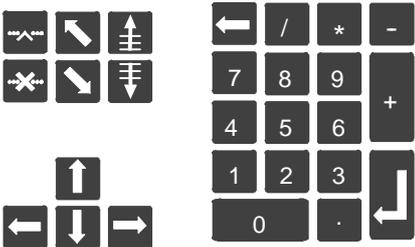
(keypad and arrow key icons)	Refer to "Correct Typing Mistakes", "Select Text", "Perform Operator Station Keypad Operations" procedures.
Keyboard	Key-in data as required, refer to "Keying In Data" and "Search For/Replace With" procedures.
(A/A, copy, scissors icons)	Refer to "Edit Cut, Copy, And Paste" and perform these functions as required.
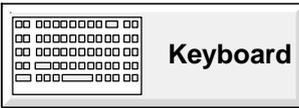
Perform Operating Functions

Adjust coolant tank and spindle flow valves, if required. Check fluid level.
Set swarf unit controls, clean-out if needed.
Calibrate optional Surface Sensing Spindle Mounted Probe, if present and used within the program.
Set Tool Sensor (Table Mounted Probe) and elevating modules.

Create Manual Data Input

MDI (button)	Create manual data input, as required, refer to "Create A Manual Data Input Program", "Copy A MDI Program To Edit", and "Save MDI Program To Program Directory".

Set / Load Tooling

TOOLS	Refer to procedures "Display Tool Table Fields", "Display Tool Sort", "Display Single Tool", "Display Tool Magazine", "Activate A Tool From Tool File", "Remove Tool From Magazine Display", "Find A Tool", "Inch/Metric Tool Selection", "Show Tool", "Create New Tool File", "Move New Tool File to Active Tool Set".
	Load tools into magazine, see "Load Tools" and "Load/Unload Authorized / Unauthorized Tool Into Spindle" if program requires manually loaded tools. Load Probe, if present.
Active Tool Set ◆ **OR** **Tool File** ◆	Set up Tool Tables and offsets. See "Modify Data In Tool Table". **NOTE:** Programs loaded from disk or PC may contain tool and offset tables.
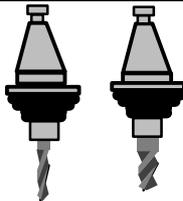
Power Feed / Jog Axes

Use the Powerfeed (coarse increments) and then Handwheel (small increments) controls to position the spindle face close to the tram gauge block or tram surface.
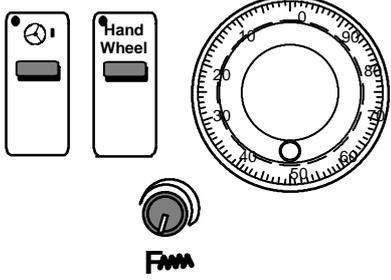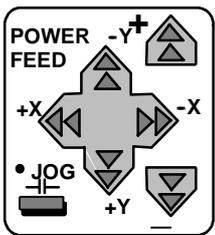
Refer to procedures "Position Set", "Jog An Axis", "Power Feed An Axis" and "Jog Mechanism". Also "Override An Overtravel Limit".

Setup Part

- Secure workholding device(s) to table or pallet(s). Using a dial indicator, attached to the spindle, parallel the surfaces that will make clamping contact with the workpiece(s). Make alignment adjustments as needed before bolting workholding device(s) into final secured position(s).
- Set jog increments and feedrate.
- Clamp workpiece(s) in work holding device, pallet, vice, fixture, etc.

Set Tram Surface

NOTE: See "Set Tram Surface" setup procedure and "Display Tool Tram Surface".
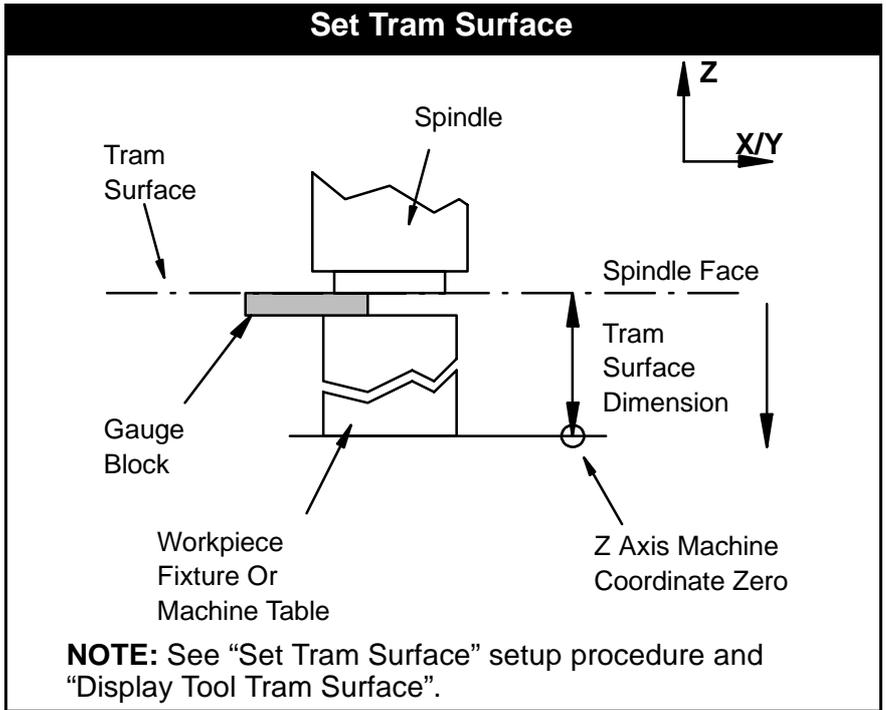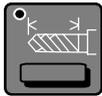
Set Tool Lengths
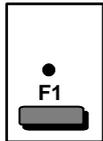
Tool Setup THEN **SET LEN** / **F1**	Tool Set Up. See "Set Tool Lengths" procedure. Set length of each tool.

Find A Program

NC Programs / **Find Program**	If the program is stored in the control, locate and load the correct proven program. Refer to procedure "Find A Program".

Load Part Program

EDIT **DISPLAY** **Dual Display**	If the program is stored outside of the control memory, load the program into the control. Refer to procedure "Copy Programs To Dual Display", and "Program Translation".
Transfer Program	Refer to procedure "Load A Part Program from Diskette."
	Load program from a Personal Computer (PC), refer to procedure "Connect A PC to the A2100 Control System".

Create Part Program

RAP **OR** **SFP**	If the program doesn't exist: Create a Rap session, if the program consists of simple tasks. Refer to procedures "Create A Rap Session", "Saving A Rap Session", "Moving A Rap Session", "Create NC Program With RAP", "Duplicating A RAP Process", "Execute A RAP Process", "Insert X, Y, Z Values In RAP". **- OR -** Create Shop Floor Program, refer to separate manual for information.

Edit Part Program

	If corrections, additions, modifications, etc. to the program are required refer to back to Perform Operating Station Functions of this procedure. Also refer to "Copy A Program To Edit".
10 -- 20 ---- 30 ---- 40 ---- **Resequence**	Refer to "Resequence A Program" after edit.
Block Delete	Refer to procedure "Delete A Program Block" and "Deselect A Deleted Program Block".
Save	After edit, refer to procedures: "Save Program Edits".
Delete Program	Refer to "Delete A Program", if programs are to be removed from the control.
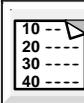
Position Set

Zero Shift	– Position Set G92 the X & Y Axis zero point(s) to the workpiece's zero reference programming plane(s). Use a Edge Finder tool or similar device. – Position Set G92 the Z Axis zero point to the workpiece's zero reference programming plane. – Refer to the "Position Set G92" procedure.

Create Multiple Setup	
SETUP	Create a new multiple setup by working sequentially through the procedures (below) shown in bold type. Associated procedures are listed for data acquisition and for changing the functionality of the set up.
Define Setups	"**Start Multiple Setup**" "Understand The Multiple" "Display Setup Area" "**Create And Manipulate Multiple Setup**" "Add One Setup To Multiple Setup" "Delete Setup From Multiple Setup" "**Repositioning Setups in Multiple Setup**" "Definition Page Method" "Multi-Setup Offsets Table Method" "Apply Probe Cycle To A Multiple Setup – Example 1" "Run A Probe Cycle" "Delete Probe Cycle" "Modify Probe Cycle Code" "**Apply Programs To A Multiple Setup**" "**Save Multiple Setups**" "Load Multiple Setups" "Delete Multiple Setups"
Define Operations	"**Start Multiple Setup Operational Page**" "Understand The Operation Page" "Change A Multiple Setup Status" "Customize How All Setups Are Activated" "Activate A Multiple Setup" "Clearing The Setups & Order Status List" "Find What Programs Are Applied To Multiple Setups"

Copy Program

NC **Programs** ⟩	Refer to procedure "Copy Program To Diskette".
Active Tool Set ◆	Refer to procedure "Copy Active Tool Set To Diskette", "Copy Tool File To Diskette", "Copy Offset Tables To Diskette".
Tool File ◆	
Offset Displays ⟩	
To Backup File	

Plot Program

Plotter ⟩	Activate the program to be plotted, refer to the procedure "Plot A Program" and "Track Tool Movement With Plot".

Operating Checks

Visually verify program by reading and understanding each line of data. Align control to beginning of first program starting block.	
Visually verify System Journals: alarm recordings, system fails, user journal programming (JRN) blocks. React accordingly.	
T **Rapid Override**	Touch to activate minimum rapid traverse rate.
F ΛΛΛ	Adjust feedrate override to minimum counter-clockwise setting.
Dry Run **Cycle Start** ▷	G92 or manually Zero Shift the Z Axis to a position clear of the workpiece surface or remove the workpiece from the workholding device. Perform a Dry Run procedure to check-out axes positioning of program. Press Cycle Start to begin the Dry Run.

Run a Part Program

S ⊏⊐	**F** 〰	
〜〜 **T**	**Rapid Override**	- Set the Rapid Override, Spindle Override and Feedrate Override to their normal or desired operating positions.
⊟	**Sing Block**	- If G92 or manual Zero Shift was set for Dry Run, reposition Axes to their program start positions.
	Single Loop	- Touch activate the Single Block to execute the program, block by block, each time the Cycle Start is pressed.
●	**Opt. Stop**	- Touch activate the Single Loop, Optional Stop and Auto Restart, if required or desired.
●	**Auto Restart**	
Cycle Start ▷	**Cycle Start** ▷	
Run This Program ⟩ **Cycle Start** ▷	**Cycle Start** ▷	Refer to procedure "Run A Part Program". The program is active and ready for execution when the Cycle Start button on the pendant is pressed.
RAP **Cycle Start** ▷	**RAP** **Cycle Start** ▷	Run a Rap session if Rap was used to develop the program. Refer to previous mentioned procedure "Executing A Rap Session". Press Cycle Start for each process tile.
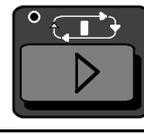
How Do I...

Information in this chapter is intended to be used as a quick reference guide for every day procedures used to start the machine, load tools and set up the machine and run a part program. Information presented under How Do I...is not detailed in its content. Many of the techniques presented assume the machine and control have completed all startup and alignment procedures. Touch, press or set the following touchscreen buttons, push buttons, controls, etc., momentarily and release unless instructed otherwise. Some controls and procedures shown may not be present in all application or are used with optional equipment.

Security levels also prevent some procedures unless proper passwords are entered first. The picturettes, icons, and screen displays may vary slightly in appearance and size for the purpose of illustration and clarity.

These step-by-step guides should be followed unless circumstances, additional equipment, safety considerations, manufacturing or assembly changes dictate safe variations.

Master Controls

Switch On Power	
The following procedure assumes that the machine was powered down in an orderly manner. If the machine experienced a sudden loss of power, follow any diagnostic alarm procedure that appears during power up.	
Touch, press or set the following	**Comments**
– OR –	Place the main isolation Electrical Disconnect Switch in the ON position.
	This performs a Control Power–On sequence (3.5 minutes approximately). The screen displays the message "CONTROL INITIALIZED", when complete.
	Press again to initiate the Machine Power–On sequence. Screen displays "MACHINE UNALIGNED" when complete. Completion enables the power feed and machine alignment controls.
	If the Emergency Stop push button is locked in its pressed–in state, the message "MACHINE OFF–E/STOP" is displayed. The machine "Switch On Power" status is achieved by rotating and releasing the Emergency Stop push button and then pressing the Power–On push button.

NOTE: Initialization

When the power to the NC control is turned on, the control assumes its initialized state by automatically activating default selections for modal functions. These functions are as follows: G40 CDC Off, G45 ACC/DEC On, *G1 Linear Interpolation, *G90 Absolute, *G71 Metric, *G17 X,Y Plane, *G61 Contouring, *G94 Feed per Minute, *G97 Spindle RPM mode, *G150 Scaling Off Span Control is normal, No Pattern is Active.

*These selections are configurable. See "NC Programming Execution".

Default selections for modal functions are also activated by pressing the Data Reset button, or by the control processing a colon (:) code, or an M02 or M30 (End of Program) code.
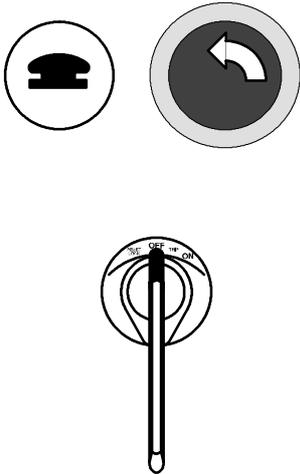
Switch-Off Power
During normal machine operation use Emergency Stop to power-off machine.

Touch, press or set the following	Comments
	This removes power from both the machine drives and the control system. All data resident in the system is automatically recorded and saved into the system memory for a subsequent automatic re-alignment.

NOTE: If the Emergency Stop push button is depressed, the message "MACHINE OFF-E/STOP" is displayed. This removes power from the machine slides and halts axis motion and mechanism movements immediately. Power to the control remains on.

NOTE: Sudden power loss to the installation, or placing the Main Disconnect Switch in the Off position, results in the loss of power, machine alignment and of any data being entered at that instant. The alert "SUDDEN POWER LOSS" is displayed on the screen.

Use Emergency Stop Push Button	
Touch, press or set the following	Comments
	This push button is pressed to immediately stop machine cycle and operation in the event of an emergency. If depressed, the message "MACHINE OFF-E/STOP" is displayed, removing power from the machine slides, halting axis motion and mechanism movements. Power to the control remains on. If Emergency Stop is pressed while the axes are not in motion, an automatic realignment is possible when the button is released. If Emergency Stop is pressed while the axes are in motion, the operator must perform a Machine Alignment.
The Emergency Stop must be released by twisting it counter-clockwise before the machine can be restarted.	

Machine Alignment

Align the Machine

Alignment is the process of synchronizing the control system with the machine. The process defines the coordinate position of a pre-set point on each machine axis, and identifies pocket number one in the tool storage mechanism.

Touch, press or set the following	Comments
⊕ / **Align**	Starts machine Alignment. Button LED illuminates. The LCD display is shown below.
= = > / **MORE = = >**	Press, if the LCD below does not appear, to view additional features/displays.
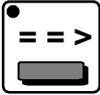
```
AXES    MECH
ALGN    ALGN
```

F1   F2   F3   F4

Axes Alignment Procedure

Pre-requisites

–   Ensure Machine Power On sequence is completed.

–   Ensure Axes Inhibit is turned off.

–   Ensure Tool Mechanism is located at its parked position. See Mechanism Alignment Procedure.
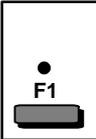
AXES ALGN F1	Axes Align. Press and Hold button. See CAUTION.
	The axes move in turn to their extreme positions, i.e.: Z Axis – extreme up position Y Axis – either extreme rear position, or extreme forward position (dependant on machine model) X Axis – extreme right position Axis motion ceases if F1 button is released.

CAUTION
Machines aligning the Y axis at the extreme rear position.

The workpiece, fixtures, work holding devices cannot over-hang (protrude) the rear of the table in the Y Axis. Any overhanging objects will interfere with the Z Axes slide/ guarding. Failure to follow this instruction may result in damage to equipment.

Align the Machine	
Touch, press or set the following	**Comments**
	Screen display shows : "AXES MOVING TO TPA POSITION" "AXES ALIGNING" when axes have reached align switches. F1 button may be released. Button LED illuminates at end of sequence. "AXES ALIGNED – (Mechanism Unaligned)".
Mechanism Alignment Procedure	
Pre-requisites – Ensure Tool Storage Mechanism is located at its parked position. If necessary, refer to Jog mechanisms – Jog Drum to park. – Ensure the Active Tool Number shows T0 on the screen display. Remove tool from spindle. If necessary use procedure – Unload Tool from Spindle. – Ensure the Mechanism Inhibit feature is turned OFF.	
MECH ALGN ● **F2** ▭	Mechanism Align "Is Drum 1 positioned at pocket 1" is displayed. F2 button LED flashes.
NOTE: Pocket 1 must be visible in the aperture of the Tool Storage mechanism cover – If necessary, refer to Jog Mechanisms –"Tool Drum Inc/Dec".	
MECH ALGN ● **F2** ▭	Tool storage mechanism is aligned. F2 button LED illuminates continuously. The message "Tool Drum 1 aligned at Pocket 1" is displayed on the screen.
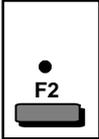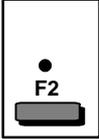
Automatic Realignment	
Touch, press or set the following	**Comments**
Automatic Realignment of the machine axes is achieved at machine power ON provided the control power status is retained ON. Essentially, this means that if the machine power is removed by pressing the EMERGENCY STOP push button when the machine is not in-cycle, it is possible to achieve Automatic Realignment of the machine axes by simply pressing the MASTER START push button.	
An Automatic Realignment of machine axes will not occur if the EMERGENCY STOP push button is pressed when the axes are in motion, or if Control Power is removed.	
A separate mechanism alignment MECH ALIGN will be required following a successful Automatic Realignment of the machine axes.	

Axes Functions

Jog the X or Y Axis	
Touch, press or set the following	**Comments**
	Located on pendant. LED must be illuminated.
	Press until increments (.0001, .001, .01, .1) are displayed.
F1 or F2 or F3 or F4	Press desired F increment key.
	Jog the desired axis.

Jog the Z, A, or B Axis	
Touch, press or set the following	**Comments**
	Located on pendant. LED must be illuminated.
	Press until increments (.0001, .001, .01, .1) are displayed.
F1 or F2 or F3 or F4	Press desired F increment key.
	Select the desired axis.
	Jog the desired axis.

Power Feed the X or Y Axis	
Touch, press or set the following	**Comments**
JOG ⊣⊢ Hand Wheel ⊢→⊣ ⊘	Located on pendant. Must **NOT** be activated. LEDs must be OFF.
-Y ▲ +X ◀◀ ▶▶ -X ▼ +Y	Feed the desired X or Y axis.
F 〰	Increase or decrease feedrate percentage.
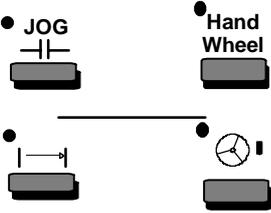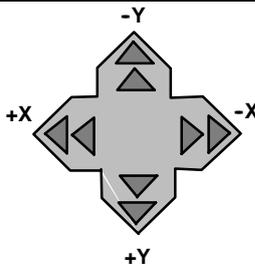
Power Feed the Z, A or B Axis	
Touch, press or set the following	**Comments**
JOG ⊣⊢ Hand Wheel ⊢→⊣ ⊘	Located on pendant. Must **NOT** be activated. LEDs must be OFF.
Z or A or B	Select the desired axis.
+ ▲ ▼ _	Feed the desired axis.
F 〰	Increase or decrease feedrate percentage.
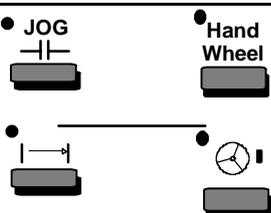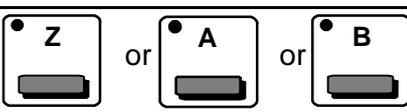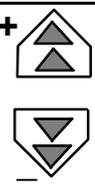
Move an Axis with the Handwheel	
Touch, press or set the following	**Comments**
Hand Wheel	Must be activated. LEDs must be ON.
X or **Y** or **Z** or **A** or **B**	Select the desired axis.
= = > MORE **= = >**	Press until increments (.0001, .001, .01, .1) in. or (.001, .01, .1, 1.0) mm are displayed.
F1 or F2 or F3 or F4	Press desired F increment key.
- +	Turn in desired direction. Each click moves selected slide the selected increment.

Override An Overtravel Limit	
Touch, press or set the following	**Comments**
An axis has contacted a final overtravel switch.	
⬛	Hold depressed to retain drive power on.
⬛	Press Data Rest to remove power feed inhibit.
Use power feed controls to return axis within its working range – see **WARNING**.	

Jog Mechanisms	
Touch, press or set the following	**Comments**
[hand/jog icon button] [Mech Jog button]	Access mechanism and machine jog functions.
[= = > button] [MORE = = > button]	Select desired machine mechanism jog function on pendant display.

< = = = MECHANISM JOG = = = >
 SPINDLE   Z AXIS
 CW   CCW   RETRCT
 	
 [F1] [F2] [F3] [F4]
	Spindle CW/CCW
	    Spindle rotates (CW or CCW) whilst F-button is held pressed.
	
	 Z Axis Retrct
	    Spindle retracts to upper limit whilst F-button is held pressed.
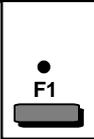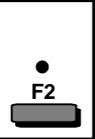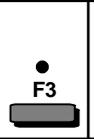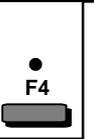
< = = = MECHANISM JOG = = = >
 TOOL DRUM 1
 SPDL   PARK   INC   DEC
 	
 [F1] [F2] [F3] [F4]
	Tool Drum Spdl/Park
	    Drum advances/retracts when F-button is held pressed.
	
	 Tool Drum Inc/Dec
	    Drum rotates (CW/CCW) when F-button is held pressed.

< = = = MECHANISM JOG = = = >
 AUGER
 START   STOP   REV
 	
 [F1] [F2] [F3] [F4]
	Auger Start/Stop/Rev
	    Requires "PROG" mode active and operator door closed.
	    Reverse ON when F-button is held pressed.

< = = = MECHANISM JOG = = = >
 POS'N
 COOL JETS   RESET
 UP   DOWN   ACT   ALL
 	
 [F1] [F2] [F3] [F4]
	Cool Jets Up/Down
	    User adjustment facility increments Auto Coolant Jets mechanism Up or Down, by pressing desired F-button.
	
	 Reset Act/All
	    User adjustment increment for active tool or all tools are reset by pressing desired F-button.
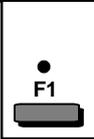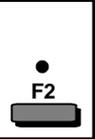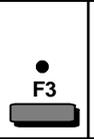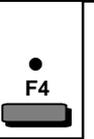
Data Entry

Keying In Data	
Touch, press or set the following	**Comments**
	Use the optional plug-in keyboard, if present, to enter alpha-numerical and symbol data, move cursor, paging, etc.
	Use the control keypads to enter numerical data, delete, insert and move the cursor.
OR	
The touch screen provides the capability to display an "on-screen keyboard" when alpha-numeric data entry is required. Two on-screen keyboards are part of the standard interface. One is available while editing an NC program or MDI, and provides the set of keys needed for program entry. The second on-screen keyboard is a full "qwerty" keyboard that makes available all keys. This keyboard is available when data entry into the system is required.	
EDIT	For example, in Edit mode.
DISPLAY	
The following display will appear:	
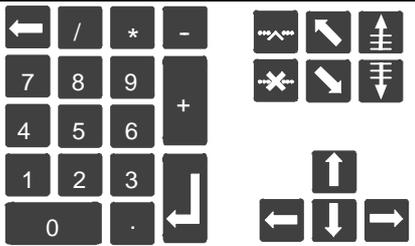
Keying In Data	
Touch, press or set the following	**Comments**
QWERTY **OR** NC	
● Close	
One of the following displays will appear:	

NC Program Entry Keys

:	G	M	S	T	F
X	Y	Z	L	E	R
A	B	C	O	H	D
I	J	K	P	MORE	X

@	#	S	&	/	;
[	]	<	>	{	}
N	Q	U	V	W	=
?	,	–	,,	MORE	X

– OR –

On-Screen QWERTY Keyboard

Q	W	E	R	T	Y	U	I	O	P	←
	A	S	D	F	G	H	J	K	L	Enter
Cap	Z	X	C	V	B	N	M		≫ MORE	X

OR

	In other modes, such as MDI, it will be necessary to touch other icons such as NC Program Functions Menu to activate the NC program entry keys.

OR

Keyboard – OR –	When one of these icons appear, touch it to gain access to the on-screen NC program entry keyboard. Key-in the data.

Correcting Typing Mistakes	
Mistakes made while entering data can be corrected by using one of the methods in the following table. However, if a change to more than a few characters is needed, select the text and edit it.	
Touch, press or set the following	**Comments**
←	Delete the character (or selected text) to the left of the cursor.
✖	Delete the character (or selected text) to the right of the cursor.
⋯∧⋯	Insert characters at the cursor.
⋯∧⋯	Erase character and insert new at the cursor.

Select Text	
Text can be selected by using the Operator Station Keypad or edit menu buttons. Position cursor to left of character, and press ⋯∧⋯	
NOTE: Text can be selected by touching the screen. To deselect a character simply press ⋯∧⋯ To deselect multiple character simply press an arrow button.	
Touch, press or set the following	**Comments**
Ctrl and ⇧ and →	Next Word
Ctrl and ⇧ and ←	Previous Word
⇧ and ↓	Next Line
⇧ and ↑	Previous Line
⇧ and ↘	End of Line
⇧ and ↖	Beginning of Line

Select Text	
Touch, press or set the following	**Comments**
⬆ and ⬇	End of Program
⬆ and ⬆	Beginning of the Program
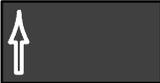
Perform Operator Station Keypad Operations	
Moving the insertion point through the edit buffer:	
Touch, press or set the following	**Comments**
⬆ and ⬇ or ⬆ **- OR -** ⬆ and ⬇ or ⬆ **- OR -** ⬇ or ⬆ **- OR -** ⬇ or ⬆	Scroll until the place to edit is visible.
👆	Touch the new location.

Perform Operator Station Keypad Operations	
Select text using key combinations. **To Extend Selections:**	
Touch, press or set the following	**Comments**
⇧ and →	One character to the right
⇧ and ←	One character to the left
Ctrl and ⇧ and →	To end of a word
Ctrl and ⇧ and ←	To start of a word
⇧ and ↘	To end of a line
⇧ and ↖	To start of a line
⇧ and ↓	One line down
⇧ and ↑	One line up
⇧ and ⤓	One screen down
⇧ and ⤓	One screen up
Ctrl and ⇧ and ↘	To end of a document
Ctrl and ⇧ and ↖	To start of a document

Perform Operator Station Keypad Operations	
To Move Selection:	
Touch, press or set the following	**Comments**
←	One character to the left
→	One character to the right
↑	One line up
↓	One line down
Ctrl and ←	One word to the left
Ctrl and →	One word to the right
↘	To the end of a line
↖	To the beginning of a line
⤓	Down one page
⤒	Up one page
Ctrl and ↘	To the end of edit buffer
Ctrl and ↖	To the start of edit buffer
To change offset table data field value by amount entered:	
↑ and +	Incremental Change to a table data field
↑ and −	Decremental Change to a table data field

MDI Functions

Create A Manual Data Input (MDI) Program

Touch, press or set the following	Comments
HOME	
MDI	Display must be either Production, Current, To Go or Program.
Ctrl and ⬆ and ⬊	Press simultaneously. This will highlight all current blocks.
✖	Deletes highlighted blocks.
Key in desired MDI Blocks. Refer to "Keying In Data" procedure.	
▷ Cycle Start ▷	To execute MDI.
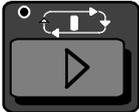
Copy A MDI Program To Edit

This procedure will assume an assembled MDI program is present and active.
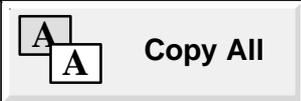
Touch, press or set the following	Comments
MDI	
NC Program Functions Menu ◇	
A A Copy All	The entire MDI program will be transferred to the clipboard.
NC EDIT	
	The MDI program will be displayed.

Tool Functions

Display Tool Table Fields	
Touch, press or set the following	**Comments**
TOOLS	
Active Tool Set ◆ **OR** Tool File ◆	The Tool Management system is divide into two categories, Active Tool Set and Tool File. Touch the desired type. The Active Tool Set table defines the tools on the machine. The Tool File defines tools available in a central storage unit/crib.
DISPLAY	
The following display will appear:	

Tool Table Display

Tool Sort By:	Display Fields
Add Tool ⟨⟩	Serial Number ☐
Tool ID ⟨⟩	Tool Handling ☐
Tool Type ⟨⟩	Tool Geometry ☐
Tool Number ⟨⟩	Tool Setup and Usage ☐
Serial Number ⟨◆⟩	Tool History ☐

Tool Graphics	
Enable Display ☑	Tool Field Select
Fixed Columns ☐	● Close

Touch each desired menu to be displayed or expand the display to any cell combination, the Tool Manager will reconfigure the display.

● Close	To change the display again, touch the DISPLAY menu button and make a selection.

Display Tool Sort	
Touch, press or set the following	**Comments**
TOOLS	
Active Tool Set ◆ OR **Tool File** ◆	The Active Tool Set table defines the tools on the machine. The Tool File defines tools available in a central storage unit/crib.
DISPLAY	
Enable Display ☑	Touch until check mark appears.

The following display will appear:
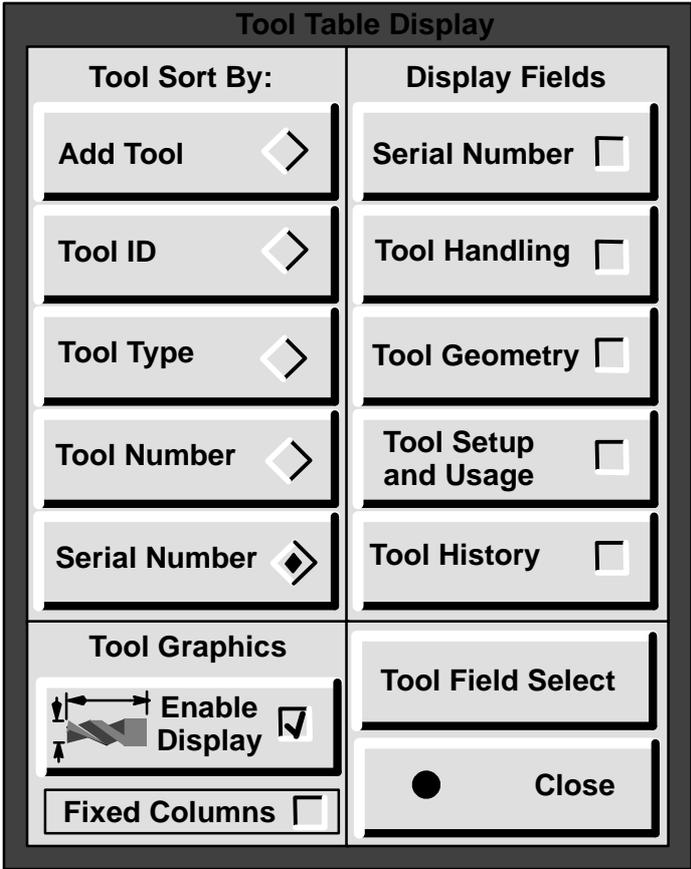
Tool Table Display

Tool Sort By:	Display Fields
Add Tool ◇	**Serial Number** ☐
Tool ID ◇	**Tool Handling** ☐
Tool Type ◇	**Tool Geometry** ☐
Tool Number ◇	**Tool Setup and Usage** ☐
Serial Number ◈	**Tool History** ☐

Tool Graphics

Enable Display ☑

Fixed Columns ☐

Tool Field Select

● **Close**

Touch each desired menu to be displayed or expand the display to any cell combination, the Tool Manager will reconfigure the display.

Display Tool Sort

Touch, press or set the following	Comments
[Single] [Magazine]	Now Active.
● Close	To change the display again, touch the DISPLAY menu button and make a selection.

Display Single Tool

Assumed Display Tool Table Fields and Display Tool Sort have been activated. See procedures.

Touch, press or set the following	Comments
TOOLS	
Active Tool Set ◆ OR Tool File ◆	The Active Tool Set table defines the tools on the machine. The Tool File defines tools available in a central storage unit/crib.
Single	Highlighted tool will be displayed. The table cursor will position to selected field. Highlight information in the table cell will quickly change single tool selection.

Display Active or Resource Tool Fields

Touch, press or set the following	Comments
TOOLS	
Active Tool Set ◆ OR Tool File ◆	The Active Tool Set table defines the tools on the machine. The Tool File defines tools available in a central storage unit/crib.
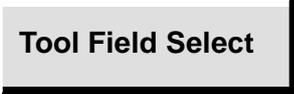
Display Active or Resource Tool Fields	
Touch, press or set the following	**Comments**
DISPLAY	
Tool Field Select	Select specific fields for display.

Display Tool Magazine	
Touch, press or set the following	**Comments**
Assumed Display Tool Table Fields and Display Tool Sort have been activated. See procedures.	
TOOLS	
Active Tool Set ◆ OR **Tool File** ◆	The Active Tool Set table defines the tools on the machine. The Tool File defines tools available in a central storage unit/crib.
Magazine	The right-hand graphic displays the tool currently located in the spindle, example #5.
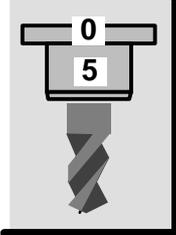
The following display will appear:

Tool Manager

ID: + 301 ... **View Pockets** ...0012 + 2000250 + 2000500   +0

1	2	3	4	5	0 / 5
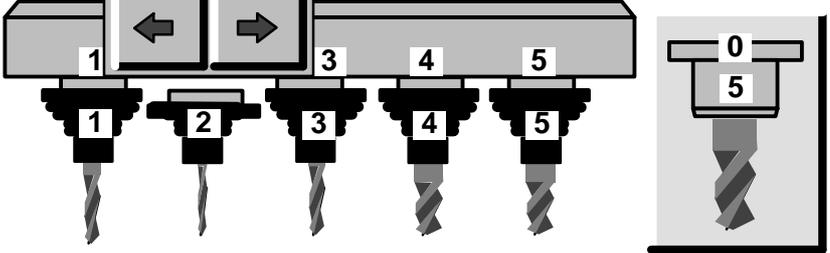
Type:

| Drill | Drill | Drill | RoughEndMill | RoughEndMill | Unknown |

Display Tool Magazine	
Touch, press or set the following	**Comments**
Magazine	**Note:** If View Pockets touch targets are not shown, touch again.
View Pockets	These buttons do not rotate the actual machine tool storage magazine.
● **Close**	
	Touch desired pocket graphic to select tool information.
Note: To remove Magazine display, touch then	
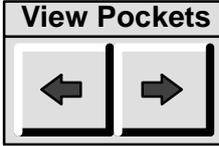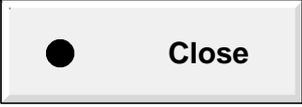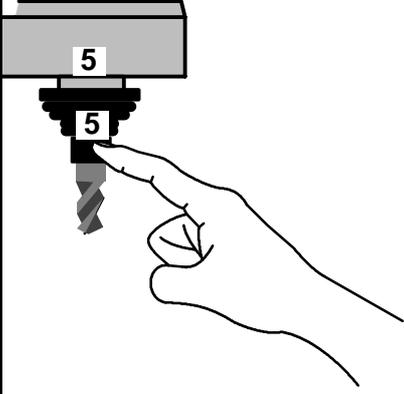
Activate A Tool From Tool File	
Touch, press or set the following	**Comments**
TOOLS	
Magazine	**Note:** If Magazine cannot be selected, touch: DISPLAY then Enable Display ☑ then ● Close
Tool File ◆	Under Type, touch screen to highlight the desired tool, for example, Finish End Mill. Use arrow position keys or "Find Tool" procedure.
View Pockets ← → 2 0 3 4	Touch View Pockets until desired pocket is displayed. Example: Pocket 2 without a tool displayed. If View Pockets is not displayed touch Magazine menu button again.
Modify Tool	
Select Tool	
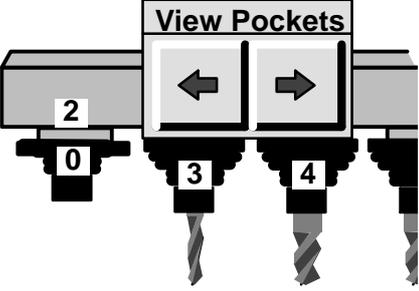
Activate A Tool From Tool File

Touch, press or set the following	Comments
The following display will appear:	

Select Tool

Tool Identifier:
+2130

Tool Type:
Finish End Mill

Serial Number:

Assign To:

Tool Number: 2   Tool Pocket: 2

✓ Select Tool   ✗ Cancel

Touch, press or set the following	Comments
Touch Pocket Number – will highlight. Input number and press Enter key.	
✓ Select Tool	Refer to Active File and verify entry.
Active Tool Set ◆	Touch to view tool in active tool area.
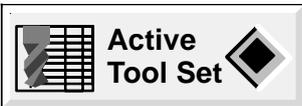
Remove Tool From Magazine Display

Touch, press or set the following	Comments
TOOLS	
Magazine	**Note:** If Magazine cannot be selected, touch: DISPLAY then Enable Display ☑
Active Tool Set ◆	Under Type, highlight Finish End Mill. Use arrow position keys or "Find Tool" procedure.

Remove Tool From Magazine Display	
Touch, press or set the following	**Comments**
	Touch View Pockets until desired pocket is displayed. If View Pockets is not displayed touch Magazine menu button again.
	Touch pocket to highlight.
Modify Tool	
The following display will appear:	
Modify Tool Add Tool Remove Tool Copy Tool Define Tool Select Tool	**Copy Tool** **NOTE:** Touching Copy Tool will allow sending the tool tables either to a printer, or saving the data to a back-up disk. This feature also allows retrieving tool tables from a disk. **Copy Tool Table** To Printer To Backup File From Backup File

Remove Tool From Magazine Display

Touch, press or set the following	Comments
🚫 **Remove Tool**	

The following display will appear:

Remove Tool

Tool Number: [2] **Tool Identifier:**
[+3333]

Tool Pocket: [2]

Serial Number:
[   ]

✓ **Remove Tool**   ✗ **Cancel**
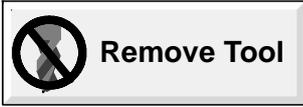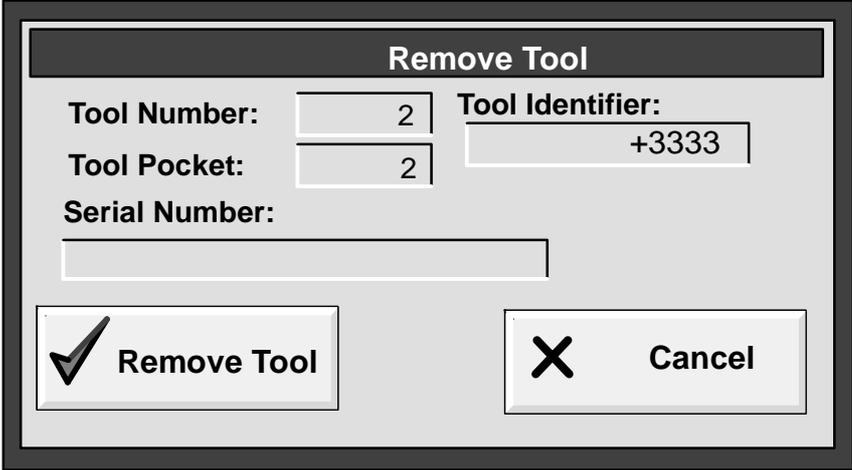
✓ **Remove Tool**	
View Pockets ⬅ ➡ 2 0 3 4	Tool should be removed from display and Active Tool Set.
Active Tool Set ◆	Touch to view tool was removed in Active Tool area.

Find A Tool	
Touch, press or set the following	**Comments**
TOOLS	
Active Tool Set ◆ OR Tool File ◆	
Find Tool	
The following display will appear:	

Find

Column: Type = Value: Counter Sink

Go To Previous

Go To Next

● Close

◀ or ▶	Select desired cell column.
[keyboard icon]	Key-in "find" information.

If Type Cell was selected, an assortment of selections will be displayed. Touch to highlight or use arrows to select tool. If arrows position buttons are used, touch [icon] to insert selection.

Find A Tool

Touch, press or set the following	Comments
[Go To Previous] or [Go To Next]	If message "was not found" is displayed, touch these buttons again. If message reappears select new find information.
● Close	To exit.
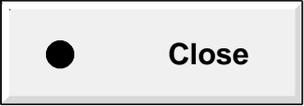
Inch / Metric Tool Selection

Touch, press or set the following	Comments
TOOLS	
[Inch 1/4] or [Metric .1]	Select desired mode.
[Active Tool Set ◆] or [Tool File ◆]	All tool display information will change to the selected mode.

Show Tool

Touch, press or set the following	Comments
TOOLS	Example: Show all drill entries in Master Tool File.
[Tool File ◆] or [Active Tool Set ◆]	Under Tool field, touch to highlight Drill.

Show Tool	
Touch, press or set the following	**Comments**
TO Show Tool	
The following display will appear:	

Show Tools

Filter:	Display Fields
Tool Identifier ⟩	+0
Tool Type ⟨⟩	Drill
Tool Material ⟨⟩	Unknown
Flute Length ⟨⟩	+0.00000
Nom Diameter ◆⟩	+0.00000
Usage Status ⟩	Good

Show Tools | Find Tool | ● Close

Tool Type ◆	
● Close	To exit. Tool Manager will now show all drill entries in the Tool File.

Create New Tool File Entry	
Touch, press or set the following	**Comments**
TOOLS	
Single	
Tool File ◆	Touch, if not active.
◀ Modify Tool	
Define Tool	When touched, creates a new file in the display table. Enter pertaining tool file information such as Tool ID, Type, Nom Diameter, Tool Length, Pocket Location No. etc.
	Touch to view and touch again to enter selection. Cutting tools up to 95mm diameter are subject to migration from their original pocket location in the tool storage magazine. The tool in the spindle will be returned to the pocket location of the tool being loaded into the spindle. The system updates the pocket location field in the Tool Location Table when a tool is returned to the tool storage magazine.
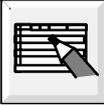
Create New Tool File	
Touch, press or set the following	**Comments**

Tool Manager

Serial Number DRL# 1 1/8

Number 1   Pocket   1   Type   Drill   Tool ID +30125012

Material   ←— Length +101.6000 —→   Flute Ler

High Speed Steel   +88.90(

Nom Diameter   Diam. C

    +3.1750   +0.0000

Tip Angle

    +118.000

Num of Teeth   1 Size ! (Prev 0 Nex) Load Auto Load Threads/

Spindle Dir Either Direc Max RPM +0.0 Override % 100 Migratir

Probe X   +0.0000 Max Feedrate +0.0 Override % 100

Probe Y   +0.0000 Torque Limit   +0.0 Alternate ID

Number		
1		

Number	Pocket Tool ID	Serial Number	Type
2	2	30125012 DRL#J−1/8	Drill
3	3	30250012 DRL#J−1/4	Drill
0	0		

Entries	0	Active Tool Set	Sort: By Number	Filt

Move New Tool File to Active Tool Set	
Touch, press or set the following	**Comments**
Active Tool Set ◆	
⊘ **Remove Tool**	Remove tool from a pocket in the magazine, if tool storage is full. An empty tool pocket is required before a new tool file can be added. See procedure: "Remove Tool From Magazine Display". When tools having a diameter greater than 95mm are to be used, adjacent tool pockets must be left empty. Migration of these larger tools in the tool magazine is not allowed unless an oversized tool in the spindle is to be exchanged for another oversized tool, otherwise tools larger than 95mm in diameter must remain at their originally allocated tool pocket position in the tool storage magazine.
◀ **Modify Tool**	
The following display will appear:	
Modify Tool **Add Tool** ⊘ **Remove Tool** **Copy Tool** **Define Tool** **Select Tool**	
Select Tool	Display appears with pertaining tool data.

Move New Tool File to Active Tool Set

Touch, press or set the following	Comments
The following display will appear:	

Select Tool

Tool Identifier: +2130

Tool Type: Finish End Mill

Serial Number:

Assign To:

Tool Number: 2   Tool Pocket: 2

✔ Select Tool   ✕ Cancel

Touch, press or set the following	Comments
	Enter empty tool pocket number, example: 2.
✔ Select Tool	Refer to Active File and verify entry.

Modify Data In Tool Data Table

Touch, press or set the following	Comments
NC Program Method	
	Tool data may be modified by the program input via manual Data Input or NC Part Program using the System Variable Table name [$Tool_Data]. Refer to Programming Manual, (Appendix A) for Tool Data Table Field Names and associated program value definitions, where applicable.

Modify Data In Tool Data Table	
Touch, press or set the following	**Comments**
Tool Data Table Method	
TOOLS	From Home menu.
	Locate the desired string of Tool Data using the position arrow buttons, or touch screen, or via the Find Tool procedure. Use position arrow buttons to select Data Field. Key in data and press the enter key.

Load Authorized Tool Into Spindle	
Touch, press or set the following	**Comments**
[HOME button icon]	Authorized Tool, i.e. a tool with an Active Tool Number greater than zero.
[MDI button icon]	
NC Program Functions Menu	
	Input G0 Txxx M6. (Txxx is the Tool Identification Number.) Refer to the procedure "Keying In Data".
[spindle button icon] [Cycle Start button icon]	Z axis retracts to tool change position. If tool is resident in tool storage magazine, the mechanism will automatically load tool into spindle. OR If tool is to be manually loaded into spindle, the system retracts the Z axis to the tool change position, and posts the message, "Open Operator Door".
If message "Open Operator Door" appears:	
Open Operator Door	The system displays message, "Load Manual Tool".
[button icon] [Tool Unclamp button icon]	Press and hold button. Grasp correct tool by body and insert fully into spindle. Ensure tool is correctly orientated – see Orientation figure. Release button.
Close Operator Door	
[spindle button icon] [Cycle Start button icon]	

Fig. 47
Orientation

Fig. 48
Orientation

Load Unauthorized Tool Into Spindle	
Touch, press or set the following	**Comments**
Un-authorized Tool, i.e. a tool displaying Active Tool Number T0.	
Open Operator Door	
Tool Setup	Enables "Tool Unclamp" function button.
Tool Unclamp	Press and hold button. Grasp correct tool by body and insert fully into spindle. Ensure tool is correctly orientated – see Orientation figure. Release button.
Close Operator Door	
Cycle Start	

Unload Authorized Tool From Spindle	
Touch, press or set the following	**Comments**
HOME	Authorized Tool, i.e. a tool with an Active Tool Number greater than zero.
MDI	
NC Program Functions Menu	
	Input M30. Refer to the procedure "Keying In Data".
Cycle Start	Z axis retracts to tool change position. If tool was loaded from tool storage magazine, it will be returned to the magazine. OR If tool was manually loaded into spindle, the system retracts the Z axis to the tool change position, and posts the message, "Open Operator Door".
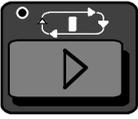
Cincinnati Machine 91203809-001

Unload Authorized Tool From Spindle	
Touch, press or set the following	**Comments**
If message "Open Operator Door" appears:	
Open Operator Door	The system displays message, "Unload Spindle Tool".
	Support tool body with protected hand. Press and hold button. The tool is released from spindle. Release button.
Close Operator Door	
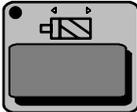
Unload Un-authorized Tool From Spindle	
Touch, press or set the following	**Comments**
Un-authorized Tool, i.e. a tool displaying Active Tool Number T0.	
Open Operator Door	
	Enables "Tool Unclamp" function button.
	Support tool body with protected hand. Press and hold button. The tool is released from spindle. Release button.
Close Operator Door	
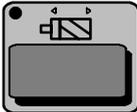
Load/Unload Tool Storage Magazine	
Touch, press or set the following	**Comments**
Machine must not be in cycle, the spindle must be stopped and the coolant off.	
[icon] **Mech Jog**	Access mechanism and machine jog functions.
= = > **MORE = = >**	Select Z axis retract (Z retracts to upper limit) legend on pendant display – see below.
< = = MECHANISM JOG = = > **SPINDLE** **Z AXIS** **CW CCW** **RETRCT** F1 F2 F3 F4	
F4	Z axis retracts to upper range limit.
= = > **MORE = = >**	Select Tool Drum Jog legends on pendant display – see below.
< = = MECHANISM JOG = = > **TOOL DRUM 1** **SPDL PARK INC DEC** F1 F2 F3 F4	
F1	Press and hold to advance Tool Drum to spindle.
F3 OR **F4**	Rotates Tool Drum. Press and hold until desired pocket is visible in Tool Drum access aperture.
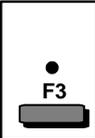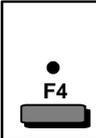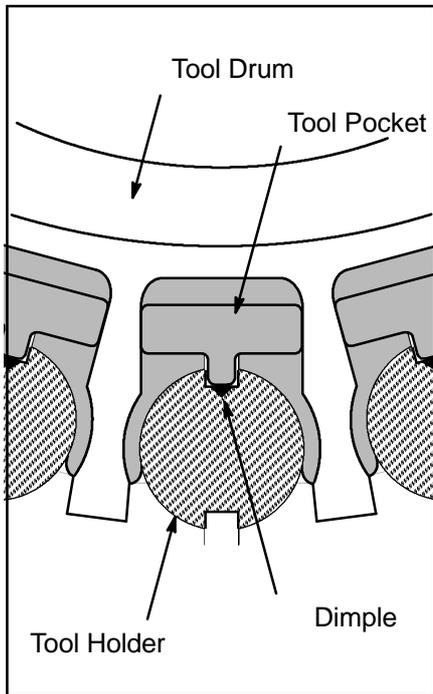
Fig. 49
Orientation

Load/Unload Tool Storage Magazine

Touch, press or set the following	Comments
Open Operator Door	
Load Tool into pocket – Grasp tool body and shank with protected hands and locate tool in pocket. Ensure tool is correctly oriented – see Orientation figure. or **Unload Tool from pocket** – Grasp tool body and shank with protected hands, pull tool to remove from pocket.	
Close Operator Door	
F2	Press and hold to retract Tool Drum to park.
TOOLS	Update Tool Data status.
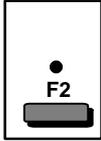
Set Tram Surface

Touch, press or set the following	Comments
The Tram Surface is the reference surface of a precision gauge block mounted on the workpiece or fixture or from the machine table surface. The Tram Surface value is used by the system to calculate tool length in the Set Tool Length procedure.	
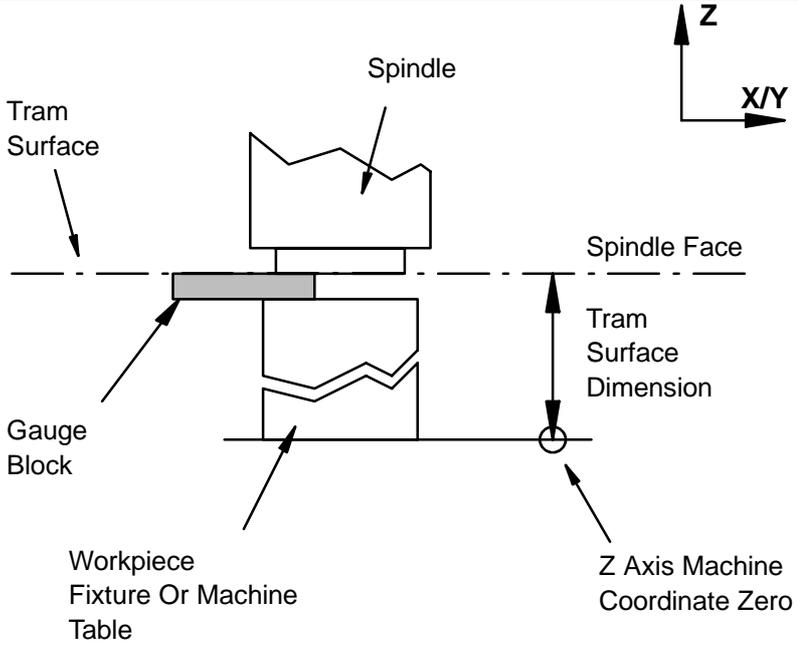
If the Tram Surface level is changed (e.g. gauge block thickness is altered) the Tram Surface must be reestablished, using the following procedure:

Set Tram Surface	
Touch, press or set the following	**Comments**
Pre requisites: – Align Axes and Mechanism – see Align The Machine. – Remove tool from spindle – see Unload Tool From Spindle. – Ensure that T0 (Tool zero) is the Active Tool displayed on the screen. See Caution 1.	
NOTE: Axis Offsets and existing tool length offsets may remain active during the Tram Surface Set procedure.	
Use the Powerfeed and Handwheel controls to position the spindle face to the gauge block – See Caution 2. 	
	Tool Set Up. Button LED illuminates. The LCD display (below) shows current program coordinate Z position of spindle nose.
TOOL SETUP **Z +13.00000** **TOOL LEN TRAM POS** F1 F2 F3 F4	
TRAM POS F3	Access Set Tram Surface menu on LCD displayed below. Previous Tram Surface position +18.00000 is displayed in machine coordinates.
TOOL SETUP **+18.00000** **SET TRAM ∧ TRAM POSITION** F1 F2 F3 F4	

Set Tram Surface

Touch, press or set the following	Comments
SET TRAM ● F1	LCD display (below) shows reestablished value of Tram Surface (+13.00000) in machine coordinates.
TOOL SETUP **+13.00000** SET TRAM ∧ TRAM POSITION ● F1 ● F2 ● F3 ● F4	
Tool Setup	Tool Setup. Button LED is extinguished. Tool Setup mode is turned off.
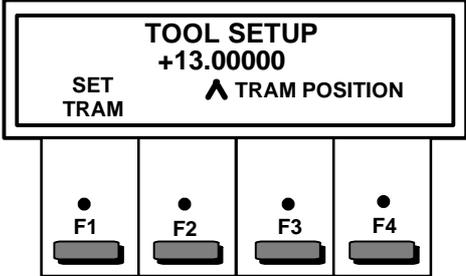
WARNING

After selecting/touching PROBING, touching either RESET TO DEFAULT or RESET ALL TO DEFAULT will reset the current Tram Set values and others to zero. This action could cause the setup values to be lost and the setup positions to be incorrect. Reset the tram values and any others that were default. Failure to follow this instruction may result in serious personal injury.

Display Tool Tram Surface

Touch, press or set the following	Comments
HOME	
DISPLAY	
Cycle Parameters Menu ◆	
✓	
Probing	Check that Inch or Metric mode is correct. Tram Surfaces machine coordinate is displayed in table. See WARNING.
HOME	

Set Tool Length	
Touch, press or set the following	**Comments**
This facility enables the length of a tool to be measured on the machine. Prerequisites: – Load tools into vacant pockets in tool storage magazine – see "Load Tools into Tool Storage Magazine". – Ensure that all Tool Identification Numbers and Tool Pocket Numbers are registered in the Active Tool Set of the Tool Data Table. – Ensure Tram Surface has been set for this Tool Length Set operation – see "Set Tram Surface".	
Close Operator Door	
	Key in Txxx M6 (where xxx is desired tool identification number). Refer to the procedure "Keying In Data".
Cycle Start	Cycle Start. Tool loaded automatically from storage magazine to the spindle.
Open Operator Door	
	Use Powerfeed and Handwheel controls to position the tool end point to the Tram Surface – see "Power Feed an Axis". See Caution.
Tool Setup	Tool Set Up. Press if not selected. Button LED illuminates. The LCD display shows program coordinate of previous tool end point.
TOOL SETUP **Z +13.00000** TOOL TRAM LEN POS F1 F2 F3 F4	

Caution

Do not feed the tool into the Tram Surface gauge block. Move the Z axis and then slide gauge between the tool end point and workpiece/fixture or machine table.

Failure to obey this CAUTION may result in damage to equipment.

Set Tool Length	
Touch, press or set the following	**Comments**
TOOL LEN ● **F1**	Access Set Tool Length menu on LCD display. The display shows the previous tool length (eg. +8.50000) resident in the selected tool table register. See LCD display shown below.
<==== TOOL SETUP ====> **+8.50000** **SET LEN** ∧ **ACT LENGTH** ● ● ● ● **F1** **F2** **F3** **F4**	
● **F1**	Calculates Actual Tool Length. LCD display (below) shows Actual Tool Length of tool in spindle (eg. +10.75000) stored in tool table.
<==== TOOL SETUP ====> **+10.75000** **SET LEN** ∧ **ACT LENGTH** ● ● ● ● **F1** **F2** **F3** **F4**	
Key-in Txxx M6	Repeat procedure for remaining tools.
● **Tool Setup**	Tool Setup. Button LED extinguishes. Tool Setup mode is turned off.
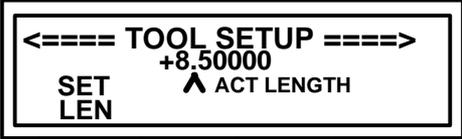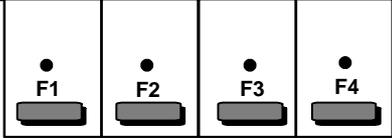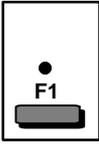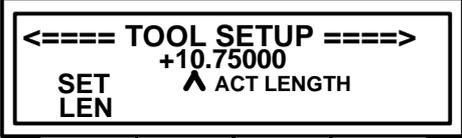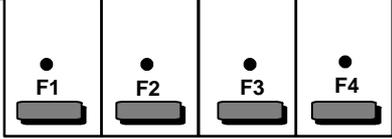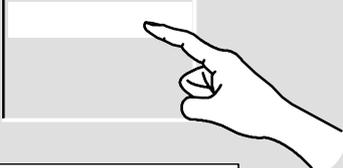
Update Tool Data	
Touch, press or set the following	**Comments**
Normally it is the processing of a tool change colon block (:Txxx M6) which activates the tool data for the active tool. The "Tool Data Update" feature allows edits to the active tool data to be applied to the active tool without the need to return to a ":Txx M06" block in the part program.	
Machine must not be in-cycle.	
TOOLS	Update Tool Data for the active tool.
Tool Setup	Tool Setup. Press if not selected. Button LED illuminates.
= = > **MORE = = >**	Select the pendant display shown below.
< = = TOOL SETUP = = > UPDATE TOOLDATA F1 F2 F3 F4	
F1	Active tool data is updated. Control displays message "Tool Data has been updated".
Tool Setup	Tool Setup mode deselected. Button LED is extinguished.
Cycle Start or **Z Repeat**	Cycle Start. Resumes auto cycle from next programmed block or Z Repeat. Repeats the active Fixed Cycle at the current position, if in Single Block mode.
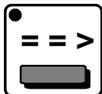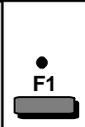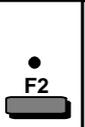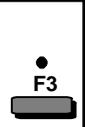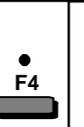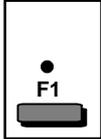
Coordinate Reset	
Touch, press or set the following	**Comments**
HOME	Perform the following procedure after Grid Alignment.
DISPLAY	
Coordinate Setup Menu ◆❯	
✓	
✱ Reset Part Coordinates	**Reset Part Coordinates:** Cancels the offsets defined and modified by position set (G92) and Zero Shift. The display is changed to show the current axis positions with no Position Set or Zero Shift offsets. **Note:** The multi-setup stored offset values are not affected by this feature.
● **The operation makes the part coordinate system and the base coordinate system to be equal. If the Pallet and Coordinate System offsets are present , they are the base system; otherwise Machine Coordinates are. This operation removes the effects of a Position Set and Zero Shift.** ✓ **OK** ✗ **Cancel**	
✓ **OK** OR ✗ **Cancel**	

Set Position	
Touch, press or set the following	**Comments**
This procedure establishes program zero for the X, Y, and Z axis only for a designated offset coordinate system. Program zero is to be established at the centre of the plate in the X and Y axes and at the bottom surface of the plate in the Z axis. It is only for reference purposes. Due to the numerous workpiece configurations, tooling and setup possibilities, this procedure is to be used as a guide. In this procedure, a qualified tool will be used to establish a locating surfaces on the workpiece. This position is then redefined by executing a Set Position (automatic G92.1). Perform this procedure after grid alignment.	
Top view – Example Workpiece **Side View**	
HOME	
Offsets	View Multi Setup table values and write down a setup number that has no values (example: 2).
⇒ **Setup**	
= = > **MORE = = >**	Select Machine Setup legends on pendant display – see below.
MACHINE SETUP MULT SETUP REM AXIS SETUP SEL AXIS INH **F1** **F2** **F3** **F4**	

Set Position	
Touch, press or set the following	**Comments**
SETUP **SEL** ● **F2**	
#2 ● **F2** **(EXAMPLE)**	Press function key associated with setup picked earlier (example: Setup 2).
	Use the power feed controls to position the edge finder or indicator to, but not touching, the workpiece surface.
	Either the Incremental Jog or handwheel can be used to bring the edge finder or indicator in contact with the locating surface. For this example, the handwheel will be used.
.0001 ● **F1**	Press F1 to select **.0001** movement.
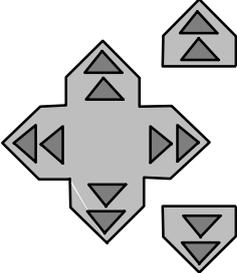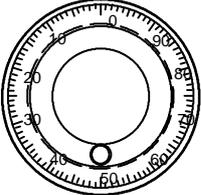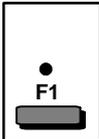
Set Position	
Touch, press or set the following	**Comments**
Set X Axis Program Zero Point to centre of workpiece	
	– Load a .50 in. diameter edge finder/tool holder into the spindle. – Offset, by hand, the lower portion of the edge finder horizontally from the spindle centerline. – Position X, Y, Z axes so the edge finder is in close proximity to the left side edge of the workpiece as shown. – Enter S400M3. – Press Cycle Start. Spindle speed 400 rpm, spindle On clockwise. – Using the handwheel and small increments, manually jog the axes until the edge finder tool registers the edge of the workpiece. Visually, the lower portion of the edge finder will be parallel and concentric with the upper portion. – Select the Z axis and feed the spindle up away from the workpiece until the edge finder is clear of the work. – Determine the location of the edge finder spindle centerline relative to the desired program zero position in the X axis. For example, add .250 in. (half of the .50 in edge finder's diameter) to this value. (Example: −2.062 "−0.25" = −2.312.)
DISPLAY	
Coordinate Setup Menu	
Set Position	

Set Position	
Touch, press or set the following	**Comments**

Axis **Current Position** **Set Position** X + 4.0000 Y + 8.00 Z +10.0000 [✓ Set Position] [✗ Cancel]	
Touch X Set Position screen area until highlighted.	
7 8 9 4 5 6 1 2 3 0 .	Key in desired value of current position. In this example: "−2.312".
⏎	
[✓ Set Position]	
Warning: The Position Set operation saves the new axis offset in the Multiple Setup Offsets table. The value is written to the entry representing the active setup. As a result, any existing offset value in the table for the selected axis will be lost. [✓ Set Position] [✗ Cancel]	
[✓ Set Position]	NOTE: Same as executing "G92.1 X −2.312".

Set Position	
Touch, press or set the following	**Comments**
Set Y Axis Program Zero Point to centre of workpiece	
Y Axis — Edge Finder — Back side edge	– In MDI, enter M5 and press Cycle Start, spindle should stop. – Offset, by hand, the lower portion of the edge finder horizontally from the spindle centerline. – Enter S400M3. – Press Cycle Start. Spindle speed 400 rpm, spindle On clockwise. – Manually jog the X, Y and Z axes until the edge finder is close to the back edge of the workpiece. – Using the handwheel and small increments, move the Y Axis until the edge finder registers (makes contact, lower portion visually concentric and parallel with upper) the back side of the workpiece. – Select the Z axis and feed the spindle up away from the workpiece until the edge finder is clear of the work. – Determine the location of the edge finder spindle centerline relative to program zero in Y axis. For example, add.250 in. (half of the .50 in edge finder diameter) to this value. Example: 2.00 "+0.25" = 2.250.
DISPLAY	
⊕▬ **Coordinate Setup Menu** ◆〉	
✓	
⊕ **Set Position**	

Set Position	
Touch, press or set the following	**Comments**

Axis **Current Position** **Set Position** X + 6.130 − 2.312 Y + 10.330 Z +10.0000 ✓ **Set Position** ✗ **Cancel**	
Touch Y Set Position screen area until highlighted.	
7 8 9 4 5 6 1 2 3 0 .	Key in desired value of current position. In this example: "+2.250".
↵	
✓ **Set Position**	
Warning: The Position Set operation saves the new axis offset in the Multiple Setup Offsets table. The value is written to the entry representing the active setup. As a result, any existing offset value in the table for the selected axis will be lost. ✓ **Set Position** ✗ **Cancel**	
✓ **Set Position**	NOTE: Same as executing "G92.1 Y +2.250".

Caution

Do not feed the spindle face/ tool tip into the gauge block. Move the Z axis a small increment and then slide the gauge block between the spindle face or tool tip and the workpiece/fixture or machine table until a proper precision slip–fit is achieved. Move the gauge block clear before moving the Z axis. Failure to follow this instruction may result in damage to machine components.

Set Position	
Touch, press or set the following	**Comments**
Set Z Axis Program Zero point to bottom of Workpiece	
  Top of Example Workpiece 6.00" gauge 1.00" Bottom of workpiece vice	– In MDI, enter T1 M6 and press Cycle Start. – Place 6.0000 in. height gauge block on top surface of example workpiece. Manually jog Z axis until end of .50 in. diameter qualified endmill is close to top surface of work. Qualified refers to the fact the tool data is known to the control, including tool length, tool number, etc. – Using the handwheel and small increments, move Z axis until the non rotating tool barely touches top of gauge block – see **Caution**. A slip snug fit between the tool tip and top of the gauge block is required. Remove gauge block from work area. – Determine the location of the tool end point relative to the desired program zero position in the Z axis. (Example : 6.00 "+1.00" = 7.00). **NOTE:** If the spindle mounted Probe is present and calibrated properly, it can also be used/programmed to locate and zero set the X,Y, and Z axes. **NOTE:** Also refer to the Coordinate Setup Menu: Set Position, and Reset Part Coordinates.
DISPLAY	
Coordinate Setup Menu ◆	
✓	
⊕ **Set Position**	

Set Position	
Touch, press or set the following	**Comments**
 Axis　**Current Position**　　**Set Position** X　　　+ 6.130　　　　　− 2.312 Y　　　+ 8.150　　　　　+ 2.250 Z　　　+10.0000 ✓ **Set Position**　　　✗ **Cancel**	
Touch Z Set Position screen area until highlighted.	
7 8 9 4 5 6 1 2 3 0 .	Key in desired value of current position of tool end point. In this example: "+7.000".
⏎	
✓ **Set Position**	
 ⬤ **Warning: The Position Set operation saves the new axis offset in the Multiple Setup Offsets table. The value is written to the entry representing the active setup. As a result, any existing offset value in the table for the selected axis will be lost.** ✓ **Set Position**　　　✗ **Cancel**	
✓ **Set Position**	NOTE: Same as executing "G92.1 Z +7.000"
To verify G92.1 from the Home Menu.	
▦ **Offsets** ◇	The Multiple Setup table will appear showing the resultant Z Axis Offset value.

G92 Position Set – Z Axis	
Touch, press or set the following	**Comments**
The following example procedure is for reference purposes. Due to the numerous workpiece configurations, tooling and set-up possibilities this procedure is to be used as a guide.	
This example procedure establishes program zero for the Z Axis only, follow the same steps for establishing the X and Y positions	
HOME	
	Display must be Current to show difference.

Machine: Production

Current Position		Command Position	
X	+0.0000	X	+0.0000
Y	+0.0000	Y	+0.0000
Z	+0.0000	Z	+0.0000

NOTE: If the Current Position and machine Command Position have the same X, Y, and Z values, no G92 Position Set is present.

MDI	Assumed: – Workholding device(s) is secured to table or pallet(s). – Surfaces that make clamping contact with the workpiece(s) are parallel to machine axes. Jog increments and feedrate are set. – Workpiece(s) clamped in work holding device, pallet, vice, fixture, etc. T1 is a 1.00 in. diameter qualified endmill.

G92 Position Set – Z Axis	
Touch, press or set the following	**Comments**
Top of Example Workpiece 6.00" gauge 1.00" Bottom of workpiece vice	– In MDI, enter T1 M6 and press Cycle Start. – Place 6.0000 in. height gauge block on top surface of example workpiece. Manually jog Z axis until end of .50 in. diameter qualified endmill is close to top surface of work. Qualified refers to the fact the tool data is known to the control, including tool length, tool number, etc. – Using the handwheel and small increments, move Z axis until the non rotating tool barely touches top of gauge block – see **Caution**. A slip snug fit between the tool tip and top of the gauge block is required. Remove gauge block from work area. Press Data Reset. In MDI enter G92 Z7, press Cycle Start. The Zero Point is now set to the bottom of the workpiece. **NOTE:** If the spindle mounted Probe is present and calibrated properly, it can also be used/programmed to locate and zero set the X,Y, and Z axes. **NOTE:** Also refer to the Coordinate Setup Menu: Set Position, and Reset Part Coordinates.

Establish The Home Set Position G28 P4

Touch, press or set the following	Comments
When G28 P4 Home Position code is used in the blocks of the active program, the operator must establish the home set position before starting the cycle. This position is the location of the spindle in absolute machine coordinates and therefore does not shift due to program zero shifting. Once the operator has defined the location, it remains in effect until redefined (by this procedure) or until grid align is lost. The Home Set position may be located to place the spindle out of the way for part loading, unloading, gauging, etc.	
	Display must be either Production, or Current.
Data Reset	Press if control state is not at End of Program.
-Y **+** **+X** **-X** **+Y** **_**	Use power feed to position the axes to the desired Home Set position.
Align Menu	
SET HOME F1	Press F1. The current absolute machine coordinates of spindle are now defined as the Home Set position.

Program Activation

The following procedure assumes that the Part Program was already transferred into the Program Store area of the control. Refer to the "Program and File Management" procedures later in this manual for transfer methods.

Find A Program	
Touch, press or set the following	**Comments**
NC Programs 〉	Highlight the desired program.
Find Program	
The following display will appear:	
OR	Select desired cell or key in find information. Refer to the procedure "Keying In Data".
Go To Previous OR Go To Next	When "find information" is located, cursor will be positioned and highlighted at cell containing information.
Was not found	If the message "was not found" appears, touch OK, then touch either "Go To" button again. If message reappears, select new "find information".
● Close	To exit. If program is ready to execute, go to the "Run A Part Program" procedure.

Activate A Part Program	
Touch, press or set the following	**Comments**
NC ▤▤▤ **Programs** ◇	Highlight the desired program. To see a program, refer to the procedure "Find A Program".
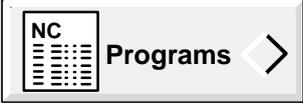
Program Block Delete Feature

Select "Delete A Program Block" Function	
Touch, press or set the following	**Comments**
This procedure establishes which program blocks will be skipped if the Program Block Delete feature is used.	
CTRL →•→	Press and Hold.
Block Delete	Touch this button to select information to be skipped. Release both buttons once information selected.
MORE ==> ==>	Advances block number pendant display.
Select the F1 through F4 buttons to select delete number. The corresponding green LED will illuminate. F1 F2 F3 F4 **NOTE:** If Block Delete is highlighted without a number, all / blocks, and // information is skipped.	
ESCAPE ESC //	When program execution begins, information corresponding to delete number selection will be skipped.
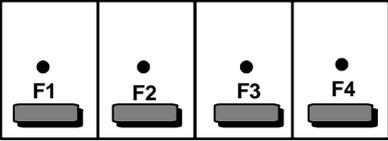
Deselect A "Deleted Program Block" Function	
Touch, press or set the following	**Comments**
CTRL →•→	Press and hold.
Block Delete	Touch this button to select information to be skipped. Release both buttons once information selected.
MORE ==> ==>	Select active deleted block number.
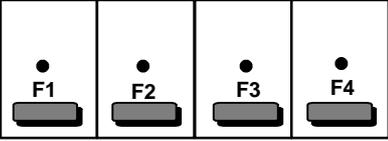
Deselect A "Deleted Program Block" Function	
Touch, press or set the following	**Comments**
F1 F2 F3 F4	Press corresponding F Button number, the LED will be extinguished.
ESCAPE ESC ///	When program execution begins, information corresponding to previous deleted number selection will be included.
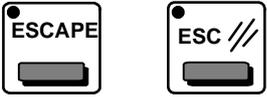
Running the Active Part Program

Operating Checks	
Visually verify program by reading and understanding each line of data. Align control to beginning of first program starting block.	
Visually verify System Journals: alarm recordings, system fails, user journal programming (JRN) blocks. React accordingly.	
Touch, press or set the following	**Comments**
[icon] [Rapid Override]	Touch to activate minimum rapid traverse rate.
[F knob]	Adjust feedrate override to minimum counter-clockwise setting.
[icon] [Dry Run] [icon] [Cycle Start]	Zero Shift the Z Axis to a position clear of the workpiece surface or remove the workpiece from the workholding device.
	Perform a Dry Run procedure to check-out axes positioning of program. Press Cycle Start to begin the Dry Run.

Run a Part Program	
[S knob] [F knob] [icon] [Rapid Override] [icon] [Sing Block] [icon] [Opt. Stop] [icon] [Auto Restart] [icon] [Cycle Start]	Set the Rapid Override, Spindle Override and Feedrate Override to their normal or desired operating positions.
	If Zero Shift was set for Dry Run, reposition axes to their program start positions or cancel Zero Shift with Coordinate Reset.
	Touch activate the Single Block to execute the program, block by block, each time the Cycle Start is pressed.
	Touch activate the Single Loop, Optional Stop and Auto Restart, if required or desired.

Workpiece Manager

Overview

The machining system must be provided with certain data, such as, part location referenced from a fixed point. To quickly manage part location and machining order, Workpiece Manager presents Pallet, Setup, and Fixture offset data graphically, thus eliminating the need to deal with cumbersome tables.

What Workpiece Manager Can Do

*   Graphic presentation provides quick visual check of the machining process.

*   Track and maintain multiple pallet automatic sequence.

*   Define and edit multiple setups or fixtures positioned randomly or in patterns.

*   Display to show part locations on multiple faces.

*   Provide additional information on adjusting offset setup location to match actual part location.

*   Programming flexibility, you can apply one program to all parts, or a different program to each part.

*   Redefine parts to machine and the machining sequence.

*   Generate probing cycles and define the sequence of operation.

*   Modify probe MDI cycle.

What You Should Know

*   If your machine is configured with an A or B axis, the first motion block in the NC program must contain a rotary axis word (A0 or B0) to get the proper workface presented to the spindle. Refer to About Rotary Axis Offsets in this chapter for further information.

*   Requirements to go into cycle in Workpiece Manager are:

    A setup must be selected.

    A program must be active, and multiple setup must be on.

Note: The Make This Setup Active button fulfils all requirements except selecting the program. A message box is displayed to inform you of conditions not fulfilled.

*   Workpiece Manager turns on multiple setup mode when a setup is activated, to turn multiple setup mode off, the operator must deactivate multiple setup mode through the pendant.

How Pallet, Setup, and Fixture Offsets Interact

Workpiece manager does not require you to use each offset. You determine what offsets to use for the given application. However, it is important to understand the interaction that takes place between Pallet, Setup, and Fixture offsets. Each offset builds on the other, the hierarchy is:

1. Pallet offsets = Absolute distance from the machine reference.

2. Multiple Setup Offsets = Incremental distance from the Pallet Offset.

3. Fixture Offset = Incremental distance from the active Offset.

The control formulates offset interaction as follows:

Pallet Offsets + Multiple Setup Offsets + Fixture Offsets = Part Location

NOTE: Only one set of Pallet offsets are supplied if the machine is not configured with the multiple pallets option.
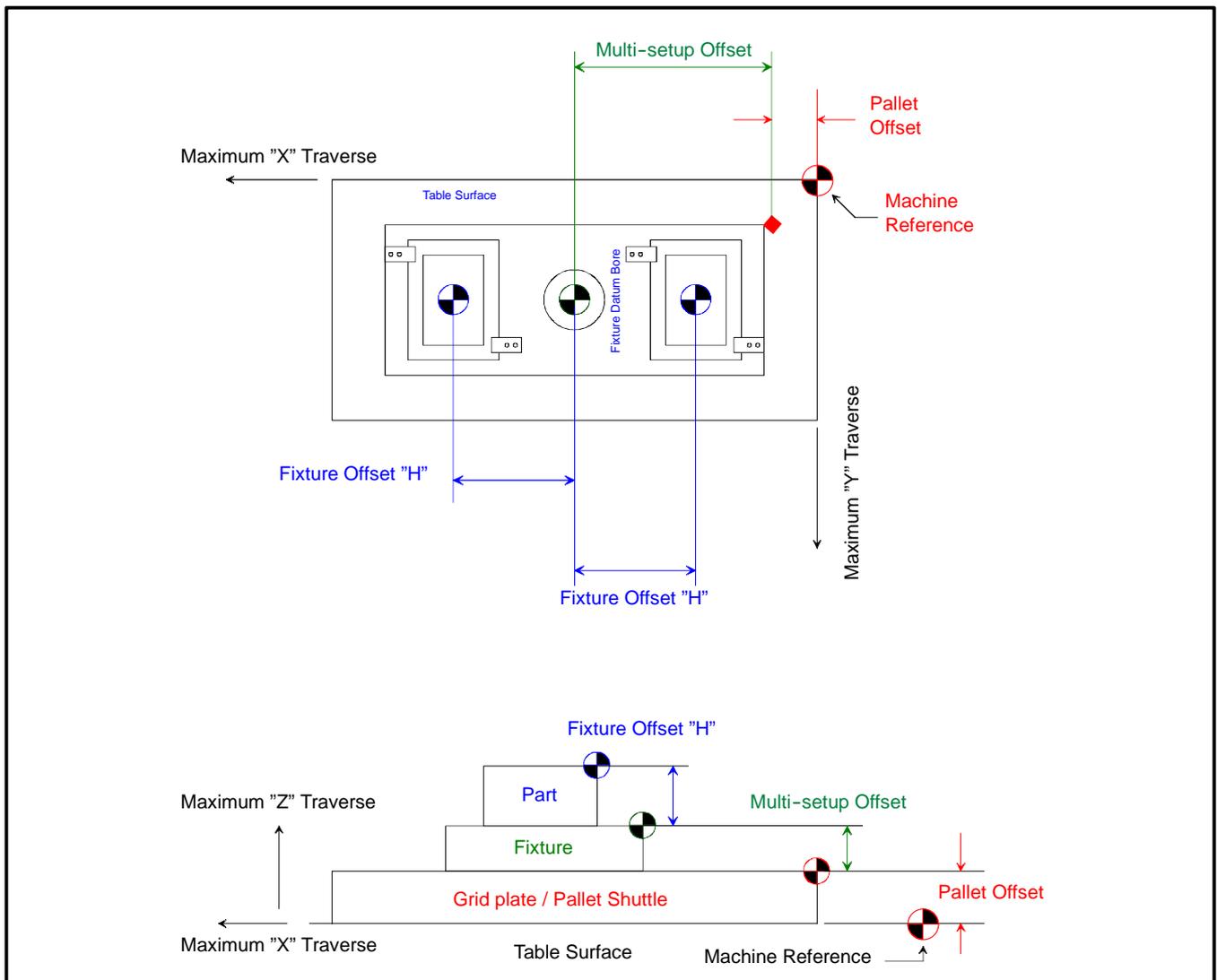
Fig. 50
Offset Interaction

To Start Workpiece Manager

Touch the **Setup** mode button. The view level displayed will depend on your previous exit condition. The View Level button is used to activate offset selections: View Fixture, View Setups, or View Pallets.

Note: If your machine is not configured with the multiple pallets option, the View Pallets button will not be displayed.
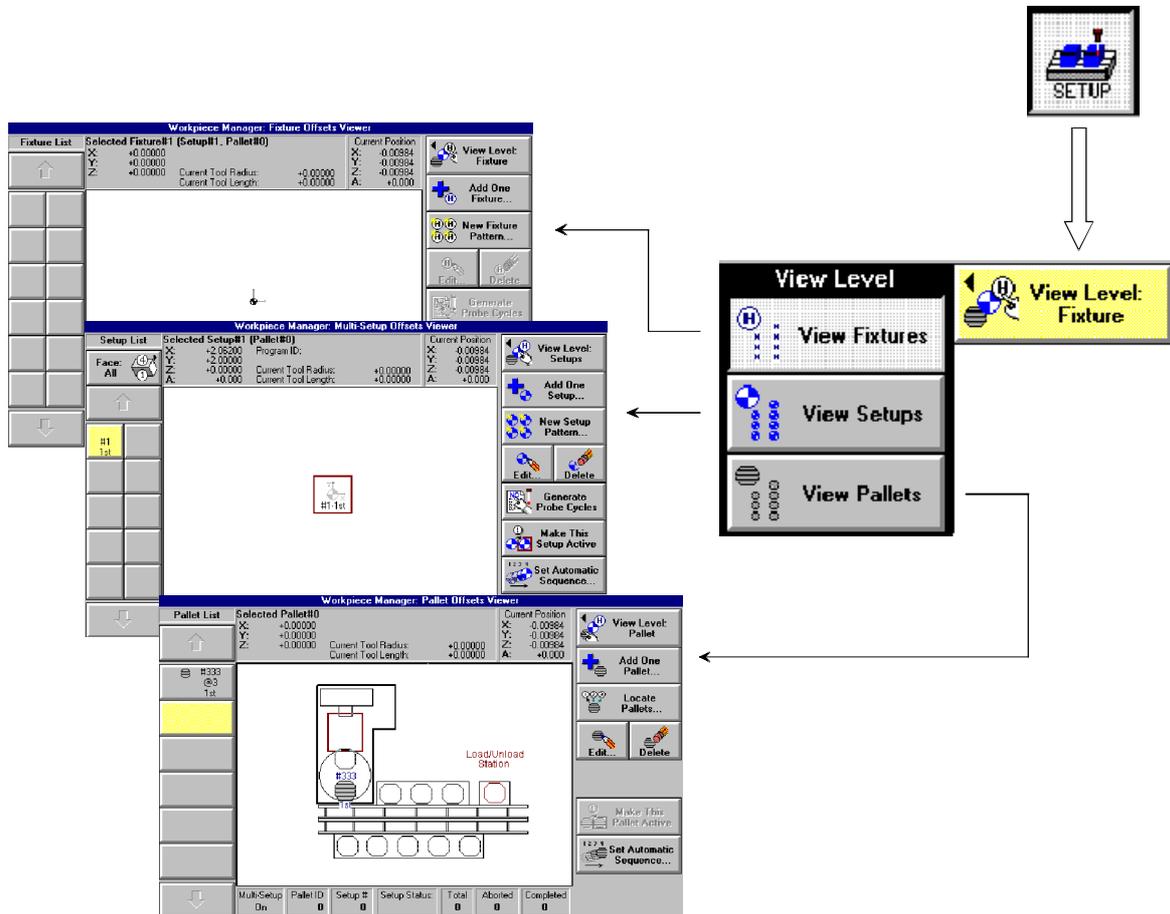
About The Viewer Menus

In general, all View Level Menus (Fixtures, Setups, and Pallets) share common menu structure. They are as follows:

Note: For sample purposes the Fixture Offsets Viewer is illustrated.

Key Words	Definition
A	The offset list identifies selection and pending status of a defined Fixture, Setup, or Pallet.
B	**Offset Coordinate** provides information about the currently selected Fixture, Setup, or Pallet.
C	**Current Position** provides current machine position information.
D	**Offset Graphic Display** presents graphic icons of defined Fixture, Setup, or Pallet in their relative position.
E	**Function Buttons** provide operational actions based on the View Level selection.
F	**Status Bar** presents current information during the machining process.
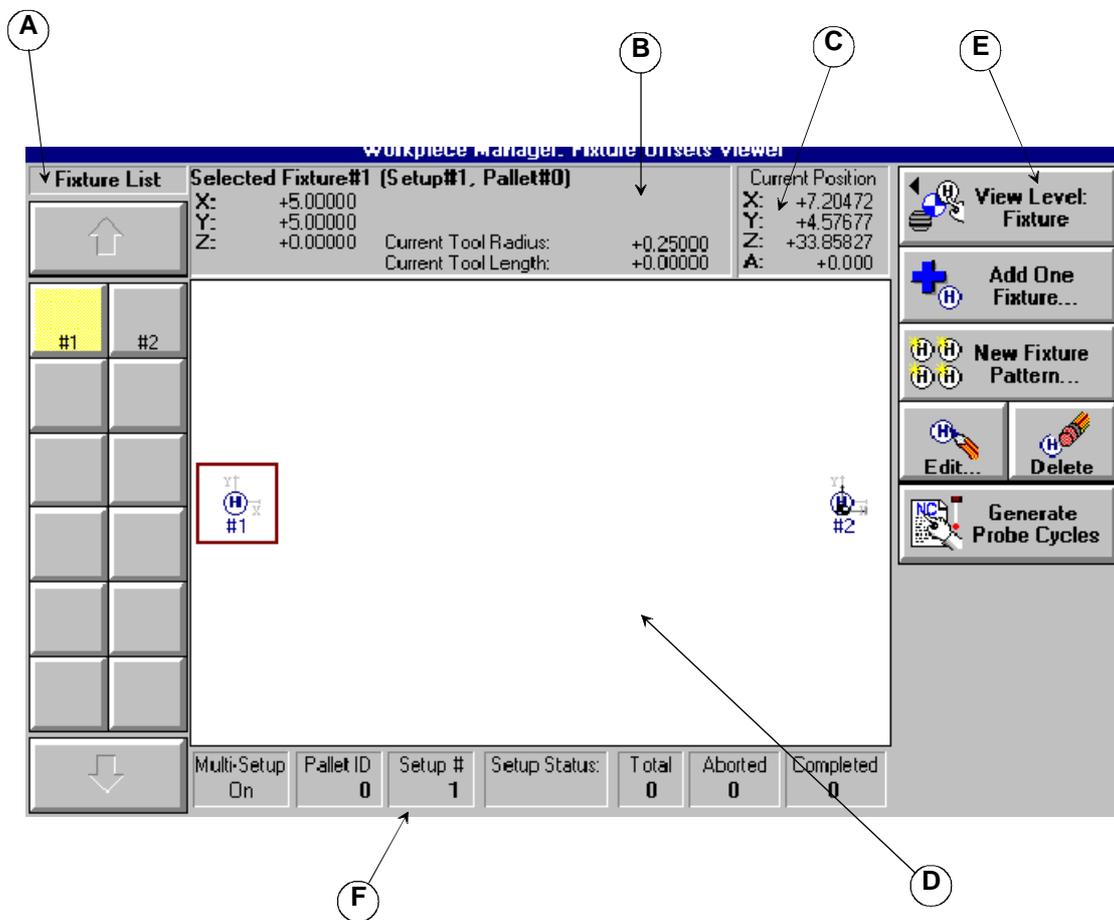
About the Status Bar

The status bar is positioned at the bottom of all view levels. During the machining process information presented in the status bar is constantly updated. The function of each status field is listed in the table below.

Note: If your machine is configured with multiple pallets, bold text identifies a pallet being machined as indicated below. When not bold, this means the active pallet is not selected.

Multi-Setup	Pallet ID	Setup #	Setup Status:	Total	Aborted	Completed
On	112	2	**Pending**	4	0	0

Status Bar Field	Comments
Multi–Setup On/Off	On/Off selection is made at the Pendant.
	If **Off** is displayed, only the active setup of the active pallet is executed at cycle start.
	If **On** is displayed, active pallet setups are executed at cycle start.
Pallet ID	Identifies the pallet in machining position.
Setup #	Identifies current active setup.
Setup Status:	Indicates active setup status. Pending means program execution will take place on this setup when cycle start is pressed.
Total	Indicates total number of setups marked present on the active pallet.
Aborted	Identifies total number of Aborted setups.
Completed	Indicates total number of completed setups machined.

View Level Display Options	
You can customize any **View Level** selection. To select options start Workpiece Manager and proceed as follows:	
Touch, press or set the following	**Comments**
	The Display Options menu will be displayed.
Scaling Method:	**Auto Zoom**: Sets the Graphic Display Area to show all defined set-ups **Show Machine Limits**: Configures the Graphic Display Area to show machine limits. Setups or fixtures not positioned within the machine limits will not be displayed. After either selection, you must touch **Close** to activate selection.
Offset Types:	The Offset Types menu buttons is used to disable **View Level** selections. For example, to view only **Setups**, touch **Show Pallets*** and **Show Fixtures** to remove the black check. Touch **Close**. The **Multi-Setup Offset Viewer** will be displayed. Also, the View Level Setups menu button cannot be activated. * Button displayed when machine is configured with Multiple Pallets option.
List Order Method:	**List Order Method** customizes your Offset List. You can arrange this list by setup order numbers or list setups by the defined machining order. To select method, simply touch the desired menu button, then touch **Close**.
	When touched, a table listing pallet or setup information appears, such as: Order number, Index number, Program Name and ID applied to a setup, State and Status of each setup, or Pallet information depending on your view selection.
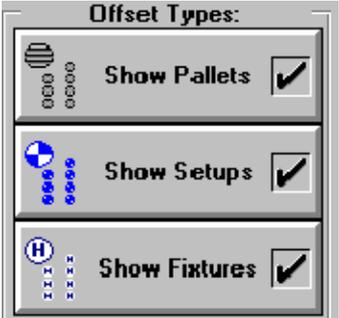
View Level Display Options	
Touch, press or set the following	**Comments**
Display Faces ✔	When selected (black check) the Offset Graphic Display area re-configures to show multiple pallet or rotary axis faces, and any defined information on each face.
● Close	This is used to activate a display option.

Fixture Offsets

From the Fixture Offsets Viewer you can perform the following operations:

• Easily locate and edit fixture positions.

• Apply probe cycles to locate fixtures.

• Quickly re-define fixture locations.

View Level Fixture	
To select the View Level Fixture proceed as follows:	
Touch, press or set the following	**Comments**
	The icon graphic is determined by machine configuration, vertical or horizontal. The icon presented here is for a vertical machining center.
	The Fixture Offsets Viewer is activated.
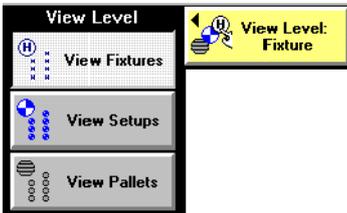
Working Only with Fixtures	
To work only with fixtures, turn off other offset selections as follows:	
Touch, press or set the following	**Comments**
	Touch to de-select Show Pallets and Show Setups Offsets, then touch **Close**. The View Level button will be grayed out indicating no selections are available if the multiple option is not present.

About Fixture Icons

Each time you add or redefine fixture position, workpiece manager presents an icon in the offset display area as follows:
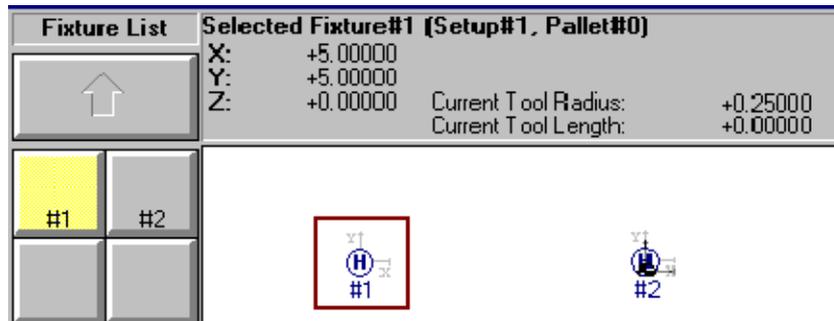
In the illustration above, two fixtures are present on the machining surface, #1 and #2. The H in each icon circle indicates fixture, and the number below refers to the fixture offset table record number. You would use this number in your part program to access fixture offset data.

For example, G0 H2 ; selects #2 fixture offset coordinates.

The red box around fixture #1 indicates it is selected. This means any action you take will be applied to fixture #1. To select fixture #2, simply touch the display icon, or #2 in the Fixture List. Also, when a fixture is selected, the Offset Coordinate area will update with the selected fixture information.

About Fixture Buttons

When Fixture view is activated, the following buttons appear.

Function Button	Description
View Level: Fixture	Used to select another View Level (Setup or Pallet view).
Add One Fixture...	Used to define a new fixture on the machining surface.
New Fixture Pattern...	Used to define a set of fixtures configured in a line or grid pattern on the machining surface.
Edit...	Used to modify or add a fixture location.
Delete	Remove selected fixture data, or remove all fixture data.
Generate Probe Cycles	Activates probe cycle features to locate a fixture.
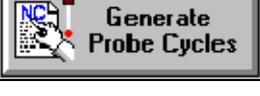
Fixture Pattern

The Fixture Pattern feature is a very quick way to define fixtures which are set in a line or grid pattern on the machine surface. For example:
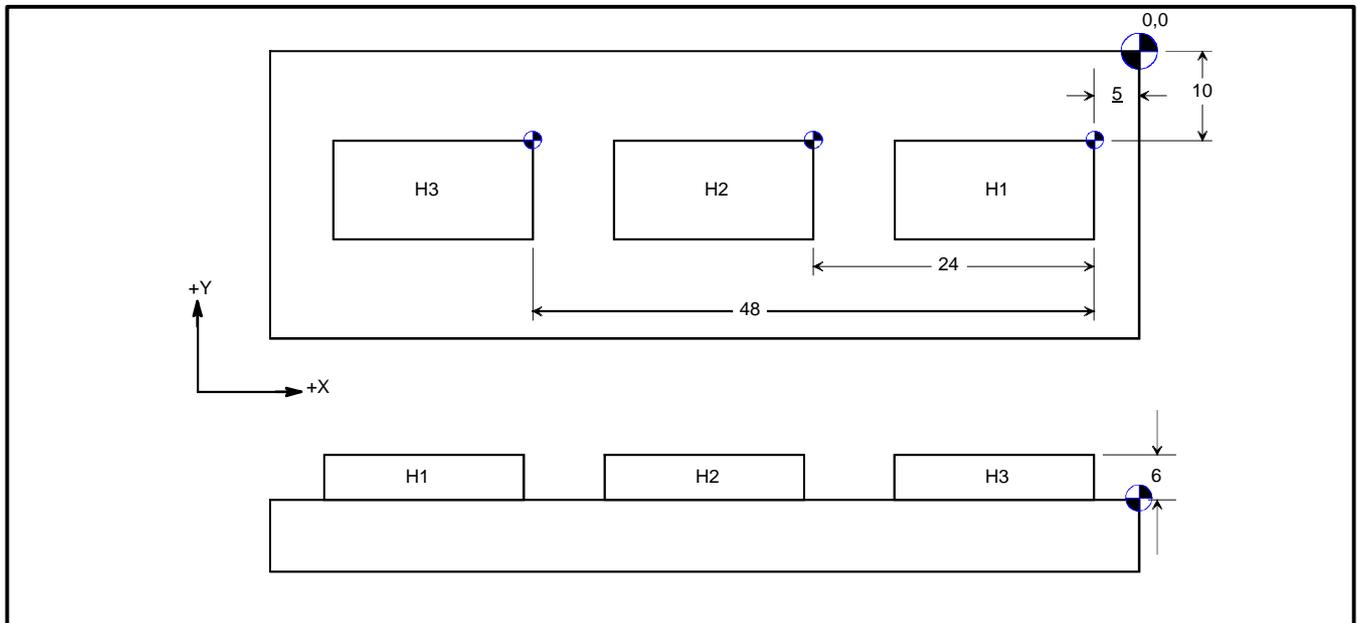
Fig. 51
Fixture Pattern Example

Using the Fixture Pattern Feature	
Touch, press or set the following	**Comments**
View Level: Fixture	Select Fixture level.
New Fixture Pattern… (Data Entry) OK	The data shown below was taken from the illustration above. Each field may be selected by using the tab buttons. When the approximate fixture pattern is defined, an edge finder or probe cycle can be used to locate fixture #1 machine position.

Defining Fixture Machine Coordinates

After fixtures are defined, you must find their machine coordinates. To do this, the Fixture Offsets Viewer provides two selections, Use Edge Finder or Use Probe.

Note: Use Probe can not be used without the probe option.

Fixture Location with Edge Finder	
Touch, press or set the following	**Comments**
The procedure used here can be applied to randomly placed fixtures or fixtures defined as patterns. For sample purposes, illustration dimensions from the previous page will be referenced.	
Edit...	
Use Edge Finder	
Get Edge Finder Offset — Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table, press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** — Spindle RPM +500 — CW CCW OFF — Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. — Cancel
− +	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.

Fixture Location with Edge Finder

Touch, press or set the following	Comments
−4.97500 ✔ **OK**	Touch to select side position then OK.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
Get Current Y Y −9.89500 ✔ **OK**	Touch to select side position then OK.
⬆ Previous ⬇ Next	Can be used to return to previous or go to next Fixture.
✔ **Commit Changes**	

Fixture Location With Probe Cycles

Refer to Probe Cycle Introduction (Optional) for procedures.

Deleting A Fixture

To remove a fixture proceed as follows:

Note: This procedure will assume the Fixture Offsets Viewer is active with defined fixtures.

Deleting a Fixture	
Touch, press or set the following	**Comments**
(OR)	You can select a fixture by touching either the Fixture List or graphic display area itself. Note: In this example fixture #2 is selected.
YES	

Editing an Existing Fixture	
Touch, press or set the following	**Comments**
(OR)	You can select a fixture by touching either the Fixture List or graphic display area itself. Note: This procedure assumes the fixture offset viewer is active. In this example fixture #2 is selected.
	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
(Data Entry)	Enter Spindle speed and direction.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.

Editing an Existing Fixture	
Touch, press or set the following	**Comments**
Get Current X X -4.97500 ✔ OK	Touch to select side position then OK. **Edge Finder Is ...** On -X Side On +X Side ✔ OK ✗ Cancel
(Handwheel dial graphic) − +	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
Get Current Y Y -9.89500 ✔ OK	Touch to select side position then OK. **Edge Finder Is ...** On +Y Side On -Y Side ✔ OK ✗ Cancel

Adding a Fixture	
Touch, press or set the following	**Comments**
	For Example, assume the following fixtures have been defined.
Add One Fixture...	
Use Edge Finder	
Get Edge Finder Offset Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** Spindle RPM +500 CW CCW OFF Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. Cancel
– +	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.
Get Current X ✕ -4.97500 **OK**	Touch to select side position then OK. **Edge Finder Is ...** On -X Side On +X Side OK Cancel

Adding a Fixture	
Touch, press or set the following	**Comments**
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
	Touch to select side position then OK.

Setups

Overview

View Setups is used to manage parts on the working surface. From setup level you can:

- Define setups on a tombstone face or multiple faces.

- Add setups to worktable or edit existing setups.

- Apply one program to all setups for the selected face.

- Apply different programs to each setup on the selected face.

- Apply probe cycle to locate a setup.

- View all faces on a pallet or each face individually.

- Define automatic sequence of execution.

View Level Setup	
To select the View Level Setup proceed as follows:	
Touch, press or set the following	**Comments**
	The icon graphic is determined by machine configuration, vertical or horizontal. The icon presented here is for a vertical machining center.
	The Setup Offsets Viewer is activated.
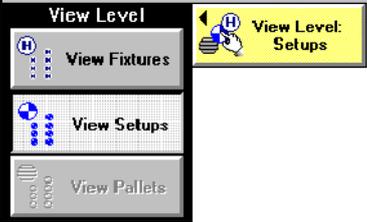
Selecting Offset Types	
To select Offset Types proceed as follows:	
Touch, press or set the following	**Comments**
	Remember the offset hierarchy. If pallets are present, their offsets first effect all setups and fixture offsets. If pallet offsets are 0, no effect on the other offsets takes place. If you elect to use setups, define their offsets before fixture offsets since they effect all fixture offsets. Following these basic rules will eliminate offset inaccuracies.

Setup Definitions

Term	Definition
Face	Work surface side of a rotary table fixture or tombstone.
Setup	Parts mounted on the work surface.
Active Setup	Program execution will take place on this setup when cycle start is pressed.
Selected Setup	Setup is selected for edits. Visual indications are: setup is highlighted in the Setup List, and a red box surrounds icon in the display area.
Automatic Sequence	Defines order of setup execution at cycle start.
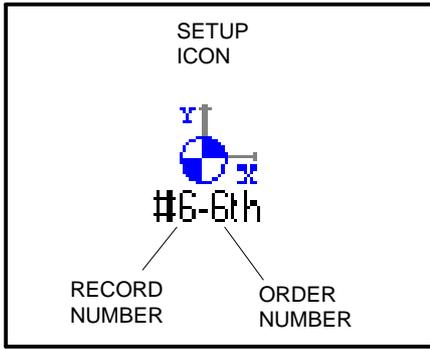
Fig. 52
Setup Icon

About Setup Icons

Each setup on the work surface is identified by a circular icon. The graphic presentation and numbers on each icon will vary based on the process defined.

The first number under each icon identifies the *Record Number* in the Multi Setup Offsets table. The *Order Number* identifies order of execution.

Icons are color coded to identify operational states. These states are as follows:

    Dark Gray = setup is not ready for execution.
    Black = setup execution was completed.
    Blue = setup is ready for execution.
    Green = setup is currently being executed.
    Red = indicates the setup operation was aborted.

The red box around setup #3 indicates it is selected. This means any action you take will be applied to setup #3. To select another setup, simply touch the display icon, or Setup List. Also, when a setup is selected, the Offset Coordinate area will update with the selected setup information.

About Setup List Icons

During the machining process, setup list icons change conditions. These conditions are as follows:

Icon	Comment
#4 4th	The blue clock indicates a setup is ready for execution.
#1 1st	The black check indicates setup completion.
#2 2nd	The red symbol identifies an aborted setup.
#3 3rd	The green arrow on the left identifies the active setup. The green arrow on the right identifies the setup which has started.

Incrementing The Setup List

If you have defined more then 12 setups, the selected setup may not appear on the setup list. To increment the setup list touch either Up or Down arrow. The dots next to a black arrow identify the arrow to press to scroll buttons toward the selected setup.
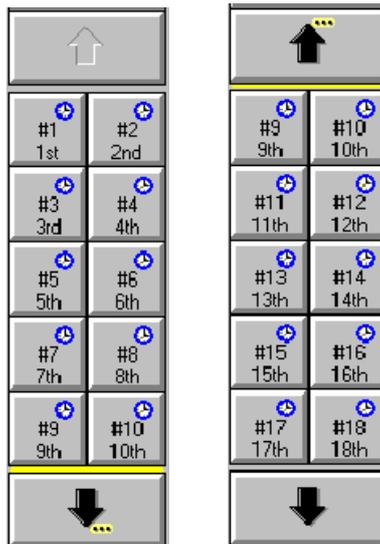
About Setup Buttons

When Multi–Setup view is activated, the following buttons appear.

Function Button	Description
View Level: Setups	Used to select another View Level (Pallet or Fixture view).
Add One Setup...	Used to define a new setup on the machining surface.
New Setup Pattern...	Used to define setups configured in a line or grid pattern on the machining surface.
Edit...	Used to modify a setup location.
Delete	Remove selected setup data, or remove all setup data.
Generate Probe Cycles	Activates probe cycle features to locate a fixture.
Make This Setup Active	Activates setup for cycle execution. This button also turns Multiple Setup mode on.
Set Automatic Sequence...	Used to define machining order, and select which setups to run and which to ignore.
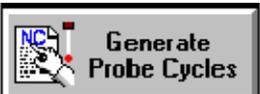
Setup Pattern

The Setup Pattern feature is a very quick way to define setups positioned in a line or grid pattern on the machine surface. For example:
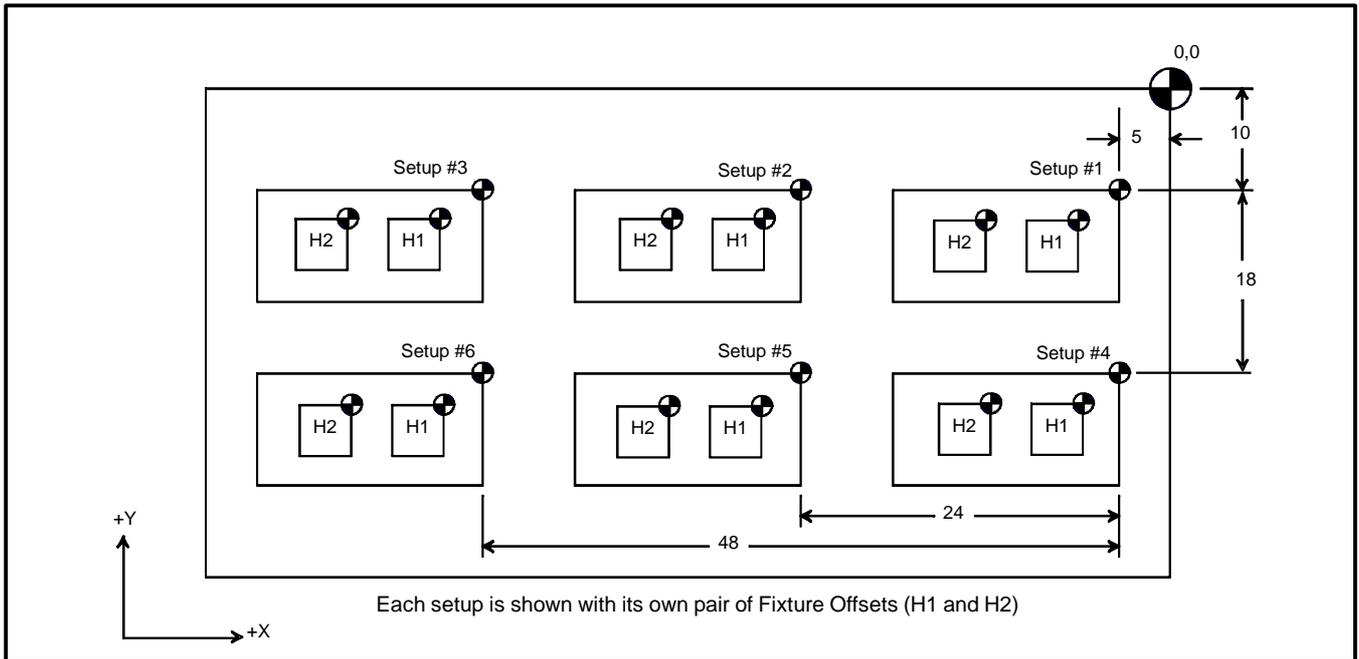
Fig. 53
Setup Pattern Example

Using the Setup Feature	
Touch, press or set the following	**Comments**
View Level: Setups	Select Setup level.
New Setup Pattern... (Data Entry) ✓ OK	The data shown below was taken from the illustration above. Each field may be selected by using the tab buttons. +24.00000 +18.00000 −5.00000 −18.00000 Face: All After data is entered, use procedure to apply one program for all setups.

Apply One Program for All Setups	
To apply the same program to a defined setup pattern proceed as follows:	
Touch, press or set the following	**Comments**
New Setup Pattern...	
	Select Program.
Use This Program	
PART 3407 Select Program For Face 1 OK Cancel	The Setup menu will be displayed with the program selection above the button (see Example on left). Touch OK. The Setup Viewer menu will be displayed with the program name in the Offset Coordinate display area.

Note: You can define different programs to each setup through Edit. Refer to "Editing Setups" for procedure.

Defining Setup Machine Coordinates (One at a time)

After setups are defined, you must find their machine coordinates. To do this, setup viewer provides two selections, Use Edge Finder or Use Probe.

Note: If you do not have the probe option Use Probe is not available.

Setup Location with Edge Finder	
Touch, press or set the following	**Comments**
The procedure used here can be applied to randomly placed setups or setups defined as patterns. For sample purposes, illustration dimensions from the previous page will be referenced.	
	If setup #1 is not selected, touch to select.
	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
 (Data Entry) 	Enter Spindle speed and direction.
	Position edge finder to setup 1.

Setup Location with Edge Finder	
Touch, press or set the following	**Comments**
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.
Get Current X −4.97500 OK	Touch to select side position then OK.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
Get Current Y −9.89500 OK	Touch to select side position then OK.
	Can be used to return to previous or go to next Setup.
Commit Changes	
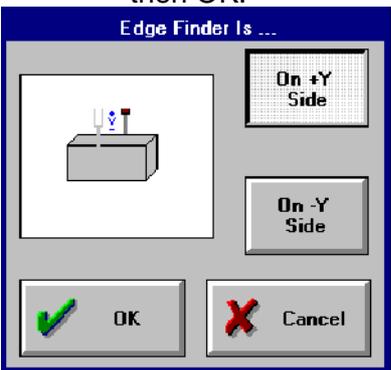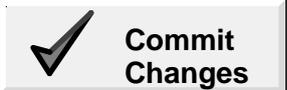
Setup Location With Probe Cycles

Refer to Probe Cycle Introduction (Optional) for procedures.

Activating a Setup for Program Execution

The term "activating a setup" means, at cycle start, program execution begins on this setup.

You can activate a setup two ways, through the pendant, or at the Multi-Setup Offsets Viewer.

Activating a Setup from the Setup Viewer	
Touch, press or set the following	**Comments**
	In this example, setup #1 is shown selected. If necessary touch to select.
	To identify the active setup, the pendant F1 green LED will be illuminated, and the setup list icon #1 will appear with a green check.

Activating a Setup at the Pendant	
Touch, press or set the following	**Comments**
	Select Machine Setup legends on pendant display– see below.
MACHINE SETUP MULT SETUP REM AXIS SETUP SEL AXIS INH 	
MULT SETUP 	
SETUP SEL 	

Activating a Setup at the Pendant	
Touch, press or set the following	**Comments**
#2 ● **F2** ▭ **(EXAMPLE)**	Press function key associated with setup written down earlier. The LED will illuminate. (Example: Setup 2.)
HOME	

Setting the Machining Sequence

Normally a defined pattern will start the machining sequence at setup 1. However, should a change be required, workpiece manager can:

• Reorder the machining sequence.

• Disable a setup.

• Change a setup status.

Basic Overview of Icons During Cycle Execution

During cycle execution, setup icons interact as follows:

Note: Cycle execution will always begin with the Active Setup.

Icons	Comment
	Setup #1 is first to be executed and is the Active Setup selected. The origin icon is blue in color.
▶ ■ #1 1st	Identifies cycle execution in progress. The origin icon is light green in color.
▶ ☑ #1 1st	Cycle execution is completed. The origin icon is black in color.

Reorder Setup Machining Sequence	
Touch, press or set the following	**Comments**
`1 2 3 4` Set Automatic Sequence...	
Reorder Setups	
	For this example, touch #2, see example below. Notice Setup #1 and #2 have changed order of execution.
Previous Number / Next Number	Can be used to select an order number.

Changing a Setup Status	
Touch, press or set the following	**Comments**
Reorder Setups	
#3 3rd #2 2nd #1 1st #6 6th #5 5th #4 4th ● Close	Touch to switch between ready and not ready. If the setup you selected was blue meaning **Ready**, the selection will change to gray in color **Not Ready**. This setup will be skipped when cycle execution begins. If the setup you selected was gray meaning **Not Ready**, the selection will change to blue in color **Ready**. This setup will be acted on when cycle execution begins. To change status simply repeat procedure.

Activate Setup Options

<table>
<tr><td colspan="2" align="center">**Activate Setup Options**</td></tr>
<tr><td align="center">**Touch, press or set
the following**</td><td align="center">**Comments**</td></tr>
<tr><td colspan="2">You can quickly change the status of setups as follows:</td></tr>
<tr><td align="center">Set Automatic Sequence...</td><td></td></tr>
<tr><td align="center">Enable by Status...</td><td></td></tr>
<tr><td align="center">Activate Setup Options

Mark Setups like those checked below, or Mark All Setups as 'Ready to Run'

Apply to — Selected Setups / All Setups
For Setups Marked — Absent / Aborted / Completed ✔</td><td>Under **For Setups Marked** (Column 2), touch to select the state you would like made active (Absent, Aborted, and Completed). In left illustration setups marked **Completed** will be marked "Ready to Run".

Under **Apply to** Setups (Column 1), touch to select those setups to be marked "Ready to Run". Touch the **Selected Setups** button to allow setups with a check to be marked "Ready to Run". Touch the **All Setups** button for all setups to be marked "Ready to Run".</td></tr>
<tr><td align="center">✔ Activate Setups</td><td></td></tr>
<tr><td align="center">✘ Cancel</td><td></td></tr>
</table>

Editing Setups

- From the edit menu you can add setups or modify an existing setup location.

- Change the NC program applied to a setup.

Edit Existing Setup	
Touch, press or set the following	**Comments**
Note: This procedure will assume the Setup Offsets Viewer is active with defined Setups. If you reposition a setup on the machining surface, new machine coordinates can be quickly redefined as follows: **Note:** Changing setup offsets will require fixture offsets to be changed.	
	Touch to select. (Example shown: Setup 2.)
Edit...	
(Optional)	Select for additional information. When selected, use the position arrow button to scroll the information text.
Use Edge Finder	
Get Edge Finder Offset — Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** Spindle RPM +500 CW CCW OFF Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. Cancel

Edit Existing Setup	
Touch, press or set the following	**Comments**
	Position edge finder to setup 2.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.
	Touch to select side position then OK.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
	Touch to select side position then OK.

Add a Setup	
Touch, press or set the following	**Comments**
For example, assume the following setup pattern has been defined and a new setup is to be added. #3-3rd #2-2nd #1-1st #6-6th #5-5th #4-4th	
Add One Setup...	
Use Edge Finder	
Get Edge Finder Offset Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** Spindle RPM +500 CW CCW OFF Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. ✖ Cancel
(directional arrows)	Position edge finder to setup 2.
(handwheel, − and +)	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.

Add a Setup	
Touch, press or set the following	**Comments**
Get Current X × +19.97500 ✓ OK	Touch to select side position then OK. Edge Finder Is ... On -X Side On +X Side ✓ OK ✗ Cancel
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set "Y axis.
Get Current Y Y −9.89500 ✓ OK	Touch to select side position then OK. Edge Finder Is ... On +Y Side On -Y Side ✓ OK ✗ Cancel
The Setup Offsets Viewer menu will be displayed. Notice, setup 7 is added and was selected first and machine coordinates are defined. 	
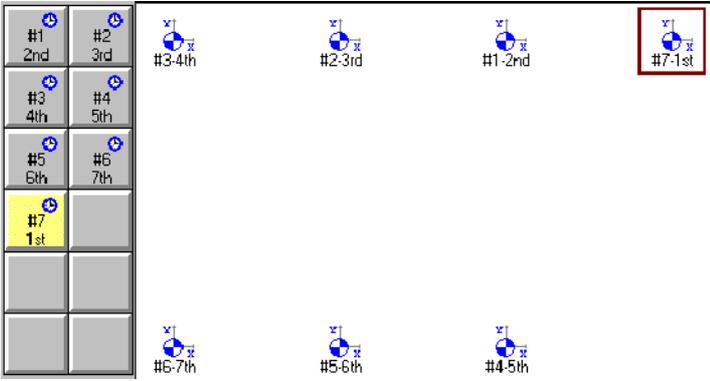
Deleting a Setup	
Touch, press or set the following	**Comments**
You can select a setup by touching either the Setup List or graphical display area itself. 	
The pattern will appear as follows: 	

Changing a Setup Program	
Touch, press or set the following	**Comments**
	From The Setup Viewer touch to select setup.
	When the Select Program menu appears highlight program selection.
	The program applied will appear in the **Offset Coordinate** display when selected.

Managing Multiple Machining Work Faces

If your machine is configured with a rotary axis or pallets, workpiece manager provides the following features:

- Apply setup patterns on multiple faces.

- Apply NC programs to each face, or to individual setups on each face.

- Define the number of faces.

- Selection of CW or CCW to define indexing direction.

Automatic Rotation of A or B axis

If it is desired to have workpiece manager automatically rotate the A or B axis:

1. Be sure the faces are properly defined, i.e. Face #1 = 0 degrees, Face #2 = 90 degrees, etc.

2. Make sure that the defined setup is located on the correct face and that the desired part program is associated with the setup.

3. Part program must contain a "A0" or an "B0" command. This will reference the multiple setup offset table to find the correct degree of rotation necessary to present the workpiece reference surface to the spindle.

In the illustration, four setups are established in the multiple setup offset field. For automatic rotation an NC program command of B0 will cause the work holder to rotate to the active setup.

For example with setup 3 active:

M26 ; Retract Z axis to upper limit.
G90 B0 ; Rotates the work holder so that the active setup 3 is presented to the spindle.
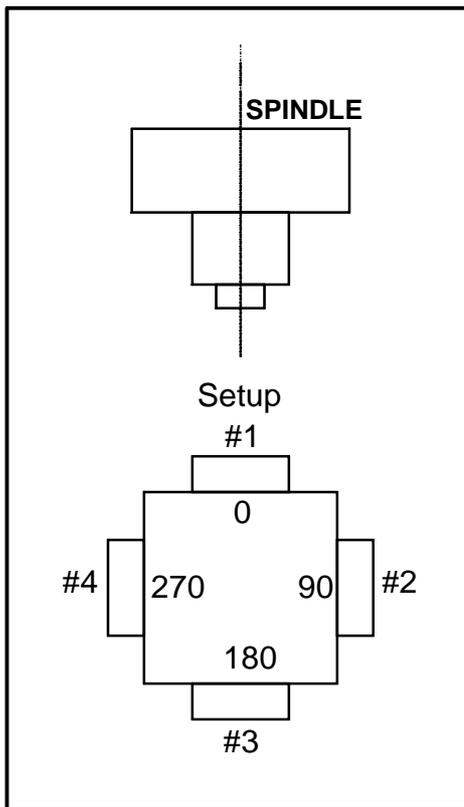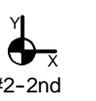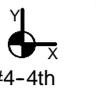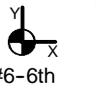
Fig. 54
Setup Rotation

How Can I Display Multiple Work Face	
Touch, press or set the following	**Comments**
Display Faces ☑	
✔ OK	
The Offset Graphic Display will present all rotary faces. The grid presented below is for a vertical configuration. ① ② ③ ④	

Defining Work Faces and Sides	
Touch, press or set the following	**Comments**
Edit...	
Face: 1	
Define Faces	
Touch each field and enter side and angle values. CW and CCW buttons define rotations. **Define Faces** — Define the sides and angles — Number of Faces 4, Numbering Scheme CW / CCW, Face 1 Angle +0.0000, Face 2 Angle +90.0000, Face 3 Angle +180.0000, Face 4 Angle +270.0000 — Make Default / OK / Cancel	
Make Default	
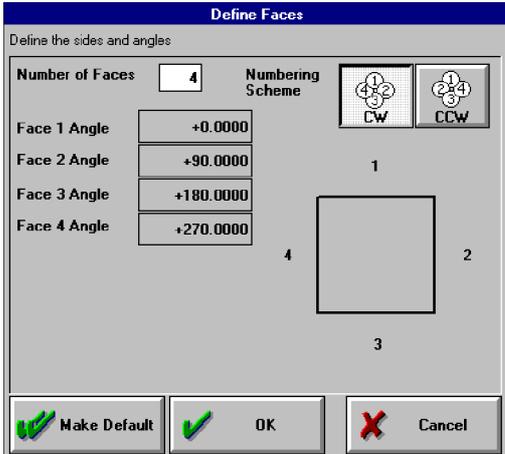
Selecting a Face	
Touch, press or set the following	**Comments**
Edit...	
Face: 1	Note: the face graphic displayed will vary based on your defined work selection. **Select Work Face(s)** ① 0° ④ 270° ② 90° ③ 180° Define Faces
Face: 2 (example)	
✔ OK	

Apply Setup Pattern to all Faces	
Touch, press or set the following	**Comments**
New Setup Pattern...	Assumes Setup viewer is active.
Enter data. You can select each field by using the tab buttons.	
New Setups **Setup Pattern [ALL FACES]** Setups Per Row: 1 Spacing Between Setups +12.00000 Total Rows: 2 Spacing Between Rows: +10.00000 **First Setup Location** Coordinate: X: +0.00000 Y: +0.00000 Z: +0.00000 Position: Total Setups: 8 Face: All SETUP PRG Select Program For ALL Setups OK Inch Metric Clear Face Cancel	
Face: All	
Select All	If necessary, touch to highlight.
Select Program For ALL Setups	Touch to highlight desired program.
Use This Program	
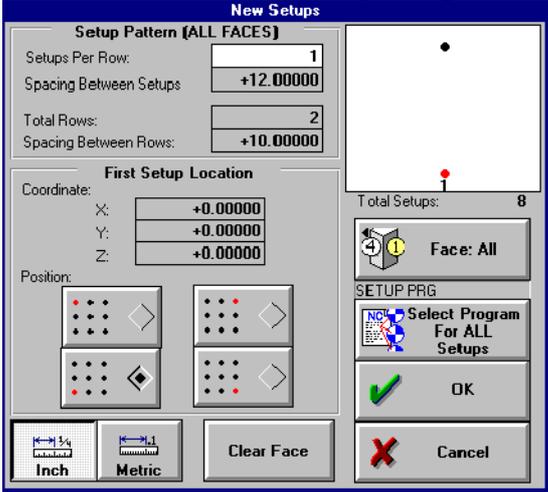
Apply Setup Pattern to all Faces

Touch, press or set the following	Comments
✓ **OK**	

The setup pattern you defined for all faces will be displayed. Also the Offset coordinate menu area will display the applied program.

Adding another Setup to a Work Face

Touch, press or set the following	Comments
Edit...	
	Select the work face. Refer to "Selecting a Face".
Add Another Setup	Refer to "Add a Setup".

Rotating to a Work Face	
Touch, press or set the following	**Comments**
Edit...	
Rotate...	
Rotate Work Holder Rotate to Face: ① 0° ④ 270° ② 90° ③ 180° Press Cycle Start to retract the Z axis and ROTATE the A Axis to 90°. ✗ Cancel	Touch to highlight.
Cycle Start	Z axis retracts and then the axis rotary (A or B) rotates.
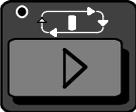
Pallet View

Overview

The View Pallet Offsets Viewer is used to manage pallets. From this viewer you can perform the following operations:

- Add pallets.

- Locate pallets, select pallets to run, reorder pallet sequence.

- Edit pallet locations.

- Delete a pallet.

- Make a pallet active.

- Set pallet automatic sequence.

NOTE: Labels and screen displays which follow are "examples" and may vary from machine to machine.

Pallet Viewer	
To select the Pallet Viewer proceed as follows:	
Touch, press or set the following	**Comments**
	The icon graphic is determined by machine configuration; vertical or horizontal. The icon presented here is for a horizontal machining center configuration.
	The Pallet Viewer is activated.
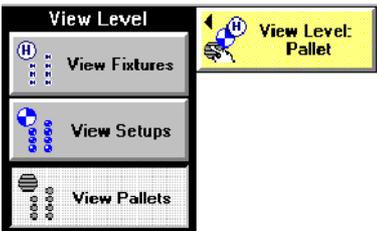
How Can I Limit Views	
To select Offset Types proceed as follows:	
Touch, press or set the following	**Comments**
	Remember the offset hierarchy. If pallets are present, their offsets first effect all setups and fixture offsets. If pallet offsets are 0, no effect on the other offsets takes place. If you elect to use setups, define their offsets before fixture offsets since setups effect all fixture offsets. Following these basic rules will eliminate offset inaccuracies.

About Pallet Icons

Each pallet is identified by a hexagonal icon. The graphic presentation and numbers associated with each icon will vary based on the process defined.

The top number is the pallet identification number
The center number identifies the pallet location
The bottom number is the order of pallet execution
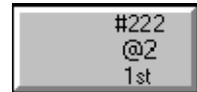
Icons are color coded to identify operational states. These states are as follows:

    Page = Pallet is not physically present.
    Gray Pallet = Pallet is not ready.
    Black Check = Pallet execution was completed.
    Blue Clock = Pallet is ready for execution.
    Green Arrow = The pallet is currently being executed.
    Red Symbol = Indicates pallet operation was aborted.
    Yellow Box = Indicates pallet operation was suspended.

The red box around pallet #111 indicates it is selected. This means any action you take will be applied to pallet #111. To select another pallet, simply touch the display icon or Setup List. Also, when a pallet is selected, the Offset Coordinate area will update with the selected pallet information.
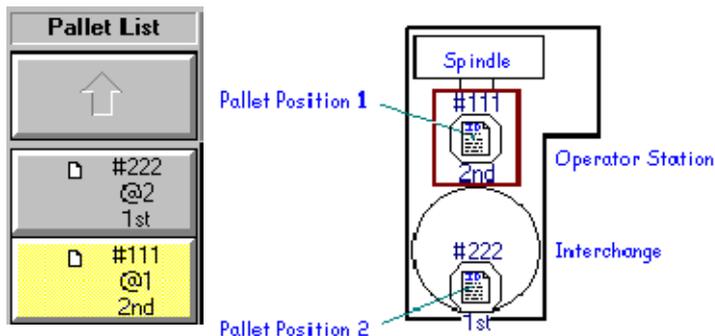
Note: You can activate help information by pressing and holding the Ctrl key, then touch a Pallet List icon.

About Pallet List Icons

During operations the Pallet List icons change according to conditions. These conditions are as follows:

Icon	Comment
⊕ #111 @1 1st	The blue clock indicates a pallet is pending ready for execution.
☑ #111 @1 1st	The black check indicates pallet completion.
⊘ #222 @2 2nd	The red symbol identifies an aborted pallet. One or more setups did not successfully complete.
▣ #111 @1 1st	The green arrow identifies the pallet has started cycle.
▣ #111 @1 1st	The yellow box indicates a pallet is suspended. The feed hold button was pressed during cycle execution.
◐ #111 @1 1st	The green arrow in the red circle indicates an error during program execution (but another setup is running).
✔ #111 @1 1st	A black check in the red circle indicates pallet completion but an error has occurred.
⊜ #111 @1 1st	This icon indicates an unscheduled pallet. The pallet will not be moved into machining position in automatic operation.
▯ #333 @3 2nd	Indicates data is defined but the pallet has not arrived, or is not physically present.
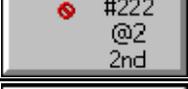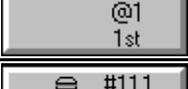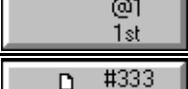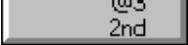
About Pallet Buttons

When Pallet Setup view is activated, the following buttons appear.

Function Button	Description
View Level: Pallet	Used to select another View Level (Setup or Fixture View).
Add One Pallet...	Used to define a new pallet.
Locate Pallets...	Used to locate pallet positions, select a pallet to run, and reorder the pallets.
Edit...	Used to modify or add a pallet.
Delete	Remove selected pallet information.
Make This Pallet Active	Activates a pallet for cycle execution.
Set Automatic Sequence...	Used to define machining order, and manage pallet status.

Adding Pallets

Touch, press or set the following	Comments
Add One Pallet	

From the following menu, enter Pallet ID data and Location data. The tab buttons may be used to access each field.

If you are not using pallet offsets leave X, Y and Z values at 0 and touch OK to return to the pallet menu.

If you are using pallet offsets, continue below:

Get Edge Finder Offset Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table press "Get Edge Finder Offset". If not, touch to highlight field and enter edge finder radius value.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** Spindle RPM +500 CW CCW OFF Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. Cancel

Adding Pallets	
Touch, press or set the following	**Comments**
	Position edge finder to setup 2.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set X axis.
Get Current X X +9.97500 ✔ **OK**	Touch to select side position then OK.
	Use Handwheel and small increments to manually jog axes until the edge finder tool registers to set Y axis.
Get Current Y Y +9.89500 ✔ **OK**	Touch to select side position then OK.
✔ **OK**	The Pallet Offsets Viewer menu will be displayed with the added pallet selected.

Locating Pallets	
Touch, press or set the following	**Comments**
Set Automatic Sequence...	
Locate Pallets	
Note: The graphic presented is dependant on configuration, it represents physical pallet locations.	
	Use the arrow keys to select a location number. Then touch the pallet button. In the example below pallet #3333 has changed location from @3 to location @6.
If you select a pallet location already defined, the Pallet Data Exchange Options menu is displayed.	
Set Both Locations	Swaps pallet locations.
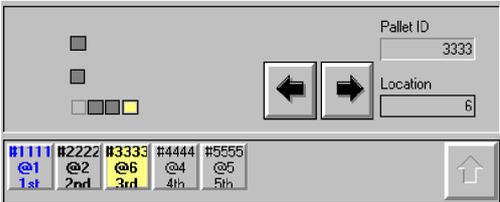
Changing Pallet Data and Location

One of the unique features of workpiece manager is the ability to synchronize data with pallet location. How pallet locations are handled is normally defined by the machine tool builder in one of two ways:

- Pallets can be defined at location 0, which means only data associated with the pallet is retained. No physical location is assigned, and no graphic symbol is presented.

- Pallet locations are defined, and a graphic symbol is presented.

In general, workpiece manager provides the flexibility to swap pallet data. For example, assume you have the 10 pallet option, but your machine configuration can only handle two pallets at a time. With workpiece manager you can maintain data for the remaining 8 pallets, then if a stored pallet is switched with a previously located pallet, you can swap data to correspond with the pallet's physical location.

Swapping Pallet Data 0 Locations	
Touch, press or set the following	**Comments**
Assume you have two pallets physically mounted on the machine, and 6 "on the shelf" pallets defined at location 0. You remove the pallet at machine location 2 and install "on the shelf" pallet 444. To swap data and define physical machine position proceed as follows:	
Locate Pallets...	
Note: the graphic presented is dependant on configuration, it represents physical pallet locations.	
Location 2	Touch arrow button until Location 2 is displayed.
#444	

Swapping Pallet Data 0 Locations	
Touch, press or set the following	**Comments**
Pallet Data Exchange Options The pallet records indicate a pallet already in location 2 (ID #111). What is the actual location of this pallet? Not Available to the Machine. Set the Location to 0. [Set Both Locations] [Cancel]	
Set Both Locations	Pallet #444 is physically located at machine position 2. Also, all data associated with the pallet is available.

Swapping Pallet Data with Defined Locations	
Touch, press or set the following	**Comments**
Assume you have two pallets physically mounted on the machine, and 8 pallets with defined locations. You remove the pallet at machine location 2 and install pallet ID #444. To swap data and define physical machine position proceed as follows:	
☷ Locate Pallets...	
Note: the graphic presented is dependant on configuration, it represents physical pallet locations.	
← → Location 2	Touch arrow button until Location 2 is displayed.
#444 @4 4th	
Pallet Data Exchange Options The pallet records indicate a pallet already in location 2 (ID #111). What is the actual location of this pallet? ⊟→ Not Available to the Machine. Set the Location to 0. ⊟⇄⊟ Location numbers are swapped. Set ID #111 to location @4. ✓ Set Both Locations ✗ Cancel	
⊟⇄⊟	
✓ Set Both Locations	Pallet #444 is physically located at machine position 2. Also, all data associated with the pallet is available.

Reorder Machine Pallet Sequence	
Touch, press or set the following	**Comments**
With View Pallets active proceed as follows to redefine the pallet machining sequence: **Note**: If a pallet icon is not displayed, it is either not physically present (page icon shown) or the location number is set to "0".	
Set Automatic Sequence...	
Reorder Pallets	
Assume the following pallet order. You would like to make pallet #3333 third in machining order. 	
Previous Number Next Number	Use these buttons to select 3rd.
#3333 @2 2nd	
The machining order has now changed. Notice that pallet #5555 is now 2nd in the machining process. 	
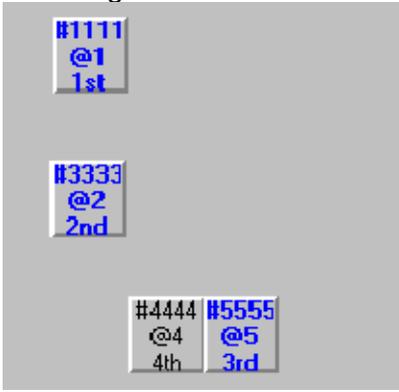
Selecting a Pallet to Run	
Touch, press or set the following	**Comments**
When you select a pallet to run, that pallet is automatically loaded into the machining position by its order number if multiple setup is On. Activate the View Pallet menu and proceed as follows: **Note**: If a pallet icon is not displayed, it is either not physically present (page icon shown) or the location number is set to "0".	
Set Automatic Sequence…	
Select Pallets to Run	
Icons which appear as empty pallets are not ready for execution. Touch a pallet to switch its status between 'Ready' and 'Not Ready' #1111 @1 2nd #2222 @2 1st #3333 @3 3rd #4444 @4 4th #5555 @5 5th Enable All / Enable by Status… / Disable All / Close	
Enable All	This may be used to mark pallets ready to run but only if setups are defined on each pallet.
#3333 @3 3rd (example)	Touch to select. The pallet will turn blue in color.
● **Close**	#3333 @3 3rd — In the pallet list the associated icon will be marked pending.
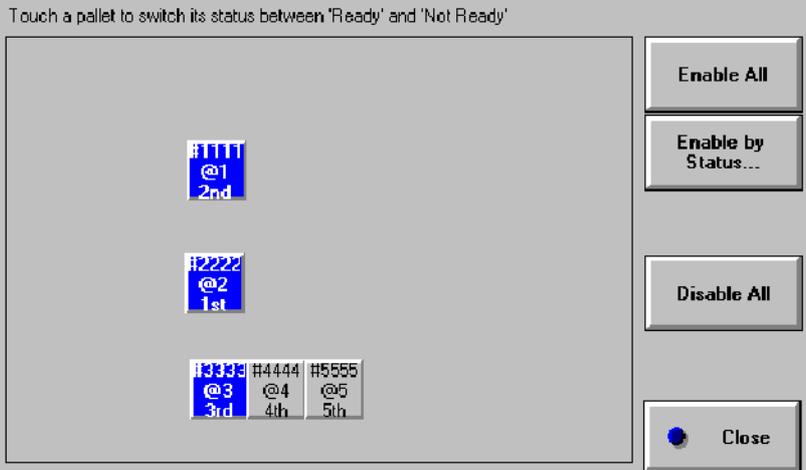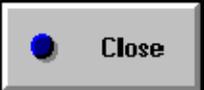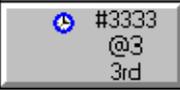
How Do I Disable Pallets	
Touch, press or set the following	**Comments**
With the View Pallets menu active you can quickly disable pallets as follows:	
⟨ 1 2 3 4 ⟩ **Set Automatic Sequence…**	
Disable All	#5555 @5 5th All pallets not in the machining position are marked "Not Ready".

Pallet View Tips

You can quickly browse setups for multiple pallets as follows:

Instead of:

1. Selecting a pallet.

2. Touching the View Level button.

3. Touching Setups.

You activate the View Pallets display and use the Shift key to sequence down through the pallet hierarchy.

1. Hold Shift key and touch on a pallet to see setups.

2. Hold Shift key and touch on a setup to see its fixtures.

3. Press Shift key while a fixture is highlighted to display its setups.

Applying Probe Cycles

Overview

One of the unique features of workpiece manager is the ability to automatically generate probe cycles for locating either fixtures or setups you have defined. If you have the spindle probe option, you can perform the following operations:

- Probe internal corners.

- Probe external corners.

- Probe holes and a surface.

- You can select how probe cycles are applied to individual setups/fixtures, or all setups/fixtures.

- You can quickly modify probe cycle code.

- Copy generated probe cycle code and save to file.

Activating the Probe Menu	
The Generate Probe Cycles button is selected from either View Fixtures or View Setup levels. Note: For sample purposes, setups will be selected to apply probe cycles. All procedures defined for setups can be directly applied to fixtures. It is assumed that a pallet has been loaded into the machining area.	
Touch, press or set the following	**Comments**
	Select Machine Setup legends on pendant display– see below.

Activating the Probe Menu	
Touch, press or set the following	**Comments**
MULT SETUP ● F1	
SETUP SEL ● F2	
#2 ● F2 **(EXAMPLE)**	Press function key associated with setup shown earlier. The LED will illuminate. (Example: Setup 2).
NC Generate Probe Cycles	
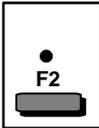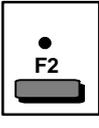
About the Probe Menu

The Probe Menu is divided into the following areas:

Key Words	Definition
A	**Current Position** provides current machine position information. The offset list identifies selection and pending status of a defined Fixture, Setup, or Pallet.
B	**New Coordinate** presents new coordinate data after probe cycle execution.
C	This display area is used to modify a probe cycle. Each time a setup is touched, the display will update with the probe cycle code defined for that setup.
D	**Function Buttons** provide operational actions selection.
E	**Graphic Display** presents graphic icons of defined Fixtures, or Setups in their relative position.
F	**Execution Buffer** displays the MDI probe cycle to be executed.
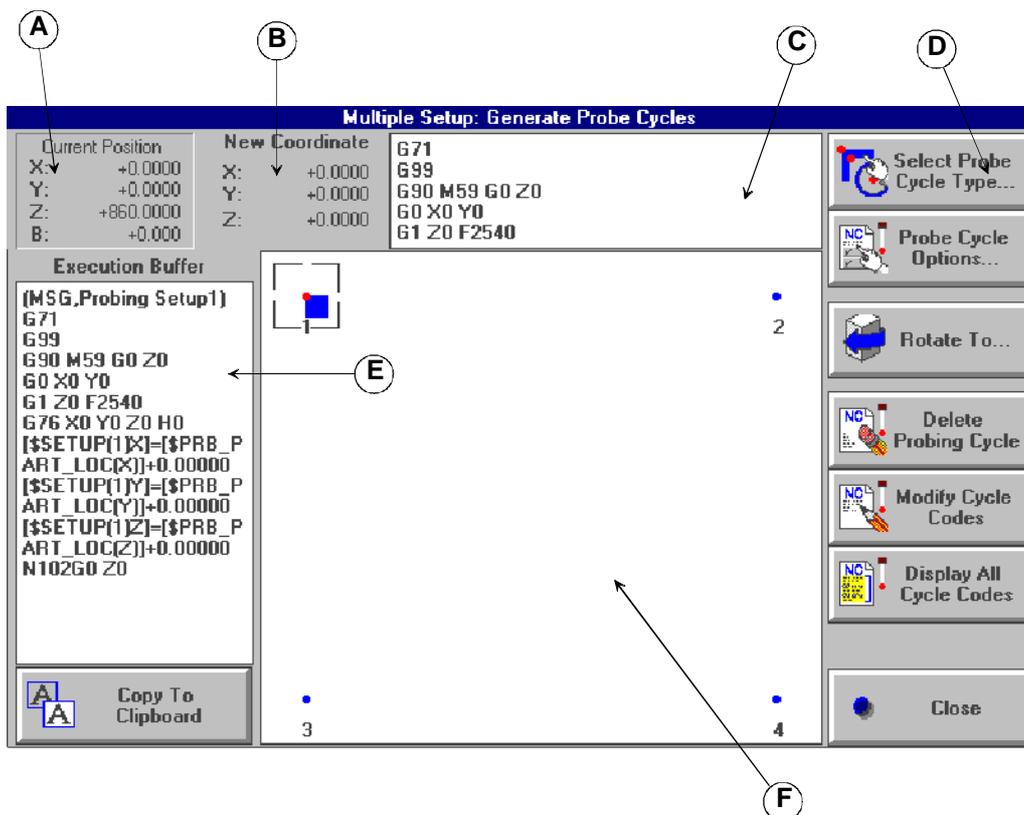
About Probe Icons

The graphic presentation for icons are as follows:

Note: The graphic symbols presented below will vary based on your probe cycle selection type.

Icon	Definition
• 2	Identifies a setup or fixture not selected and no probe cycles applied.
⌐ • ⌐ 2	The gray box around a setup or fixture indicates selection.
■ 1	Identifies an setup or fixture not selected and with an applied probe cycle.
⌐ ■ ⌐ 1	The gray box around a setup or fixture with a graphic symbol in it identifies selection with an applied probe cycle.

About Probe Buttons

During operations the Pallet List icons change conditions. These conditions are as follows:

Icon	Comment
Select Probe Cycle Type...	Activates the probe cycle type selection menu. From this menu you can also select how a probe cycle is applied, to all setup or fixtures, or one setup or fixture. Your selection generates the following G codes. **Internal Corner** selections generate G75 probe cycles. **External Corner** selections generate G76 probe cycles. **Surface** selection will generate a G77 probe cycle. **Hole** selection will generate a G78 probe cycle. **Probe Cycle Parameters:** <u>Z Retract Increment</u> defines Z axis retract distance after probing execution. <u>Standoff Distance</u> is the distance between the initial probe stylus position and the nominal corner location. <u>Hole Diameter</u> is used to define the diameter of an existing hole.
Probe Cycle Options...	Is used to select run method, and manage cycle execution.
Rotate To...	Is used to select a work holder face.
Delete Probing Cycle	Used to delete an applied probe cycle.
Modify Cycle Codes	Use this button to modify the MDI program prior to its execution.
Display All Cycle Codes	Used to display all probe cycle applied to setups or fixtures for the selected work face.
Copy To Clipboard	Used to copy Execution Buffer information to clipboard for edit purposes.
Close	Exits the probe cycle menu.

Applying Probe Cycles

Note: For example purposes, an external probe cycle will be generated.

Touch, press or set the following	Comments
Select Probe Cycle Type	

Probe Cycle Type Selection

Internal Corners

External Corner

Hole

New Coordinate

X +0.00000
Y: +0.00000
Z: +0.00000

Probe Cycle Parameters

Z Retract Increment +0.00000
Standoff Distance +3.00000
Hole Diameter +0.00000

For One Setup **For All Setups** **Cancel**
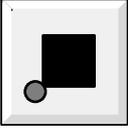
	Touch correct External Corner tile for present part conditions.

Applying Probe Cycles

Touch, press or set the following	Comments

New Coordinate

X:	+0.00000
Y:	+0.00000
Z:	+0.00000

Probe Cycle Parameters

Z Retract Increment	+5.00000
Standoff Distance	+1.00000
Hole Diameter	+0.00000

Insert data in the Probe Cycle Parameters or New Coordinate fields, touch field to highlight, then key in data and press Enter.

Probe Cycle Parameters:

    Z Retract Increment defines Z axis setup retract distance. Retract distance is set to +5.00000 inches for this example.

    Standoff Distance is the distance between initial probe stylus position and the nominal corner location. Stand off distance is set to +1.00000 inch for this example. The target location will be 1 inch from the nominal corner in the +X, +Y and +Z axis directions.

    Hole Diameter is used to define the diameter of an existing hole.

New Coordinate:

    Fields **X**, **Y**, and **Z** are used to offset probe hit positions.

✓ For One Setup	The Generate Probe Cycle page will appear with the Setup 1 icon displayed – see below.

Multiple Setup: Generate Probe Cycles

Current Position:

X: +13.85427
Y: +17.92123
Z: +30.25000

New Coordinate

X: +0.000000
Y: +0.000000
Z: +0.000000

G99
G90 M59 G0 Z11.1944
GO X1.5 F100 Y1.0
G1 Z7.1944
G76 X2.5 Y2.0 Z6.1944

Execution Buffer

```
(MSG, Probing Setup 1)
G99
G90 M59 G0 Z11.1944
G0 X1.5 F100
Y1.0
G1 Z7.1944
G76 X2.5 Y2.0
Z6.1944
[$SETUP(1)X]=[$PRB_P
ART_LOC(X)]+0
[$SETUP(1)Y]=[$PRB_P
ART_LOC(Y)]+0
[$SETUP(1)Z]=[$PRB_P
ART_LOC(Z)]+0
N102G0Z11.1944
```

A̲A̲ Copy To Clipboard	

Selecting Probe Cycle Run Options
With the probe menu active, and probe cycles applied, cycle execution method can be selected as follows:

Touch, press or set the following	Comments
NC Probe Cycle Options...	

Run Probe Cycle Options

Cycle Select

Current Cycle ◇	Run One at a Time ◆
All Defined Cycles ◆	Run Continuously ◇

Run Method

✔ **Change Options**   ✗ **Cancel**

Cycle Select
> **Current Cycle** is used to probe only the currently selected setup.
> **All Defined Cycles** means all probe cycles will be executed based on the Run Method selected.

Run Method
> **Run One at a Time** means Cycle Start is required after each probe cycle.
> **Run Continuously** means when Cycle Start is pressed, probe cycle selections will run continuously on all defined setups for the face selected.
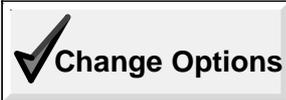
✔ Change Options	The Generate Probe Cycle page will appear with the Setup 1 icon displayed – see below.

Deleting a Probe Cycle

With the probe menu active, and probe cycles applied, a probe cycle can be deleted as follows:

Touch, press or set the following	Comments
	Touch to select setup.

Yes	
or	
Yes To All	

Modifying a Probe Cycle	
With the probe menu active, and probe cycles applied, a probe cycle can be modified as follows:	

Touch, press or set the following	Comments
1 2	Touch to select setup.
Modify Cycle Codes	


```
G70
G99
G90 M59 G0 Z0
G0 X0 Y0
G1 Z0 F100
G76 X0 Y0 Z0 H0
[$SETUP(1)X]=[$PRB_PART_LOC(X)]+0.0
0000
[$SETUP(1)Y]=[$PRB_PART_LOC(Y)]+0.0
0000
[$SETUP(1)Z]=[$PRB_PART_LOC(Z)]+0.0
0000
N102G0 Z0
```
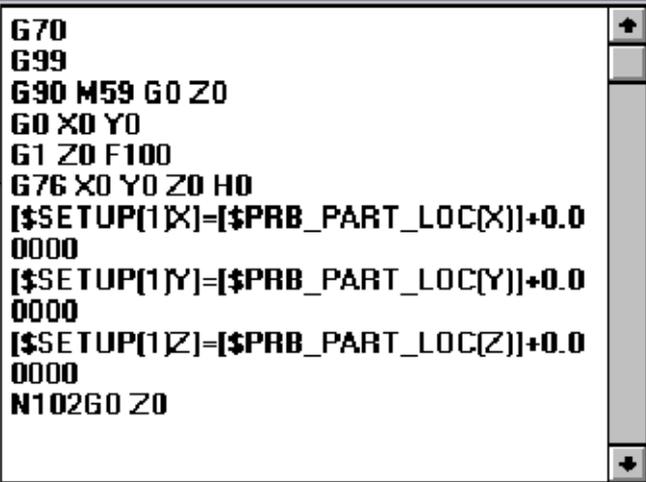
Touch area of the cycle to be modified or use arrow position keys to move cursor, then key in data.

Modify Cycle Codes	Complete process.

Display all Probe Cycles	
With the probe menu active, and probe cycles applied, all probe cycles on the machining face can be displayed as follows:	
Touch, press or set the following	**Comments**
1 2	Assume the setup is active and you are at the Generate Probe Cycles menu.
Display All Cycle Codes	

```
1:
G70
G99
G90 M59 G0 Z0
G0 X0 Y0
G1 Z0 F100
G76 X0 Y0 Z0 H0
[$SETUP(1)X]=[$PRB_PART_LOC(X)]+0.0
0000
[$SETUP(1)Y]=[$PRB_PART_LOC(Y)]+0.0
0000
[$SETUP(1)Z]=[$PRB_PART_LOC(Z)]+0.0
0000
N102G0 Z0

2:
G70
G99
G90 M59 G0 Z0
G0 X0.1574 Y0
G1 Z0 F100
G75 X0.1574 Y0 Z0 H0
[$SETUP(2)X]=[$PRB_PART_LOC(X)]+0.0
0000
[$SETUP(2)Y]=[$PRB_PART_LOC(Y)]+0.0
0000
[$SETUP(2)Z]=[$PRB_PART_LOC(Z)]+0.0
```

Storing Probe Cycle Data

With the probe menu active, and probe cycles applied, probe cycle data can be copied from the Execution Buffer to the clipboard and then stored to file using Edit. Proceed as follows:

Execution Buffer

```
(MSG,Probing Setup1)
G70
G99
G90 M59 G0 Z0
G0 X0 Y0
G1 Z0 F100
G76 X0 Y0 Z0 H0
[$SETUP(1)X]=[$PRB_P
ART_LOC(X)]+0.00000
[$SETUP(1)Y]=[$PRB_P
ART_LOC(Y)]+0.00000
[$SETUP(1)Z]=[$PRB_P
ART_LOC(Z)]+0.00000
N102G0 Z0
```

Touch, press or set the following	Comments
ᴬ ᴬ Copy To Clipboard	Touch to select setup.
EDIT	
(probe icon)	Probe cycle code will appear in the edit window.
Save 〉	

MULTIPLE SETUP FEATURE AND DESCRIPTION

Introduction

The multiple setup allows several parts to be processed at the same time without loading or unloading the machine and without operator intervention once the run has been started. This feature is a three step process:

Defining the Multi–Setup either by using Workpiece Manager or by manually entering data into the Multi–Setup table.

Defining the Offsets.

Running the Multi–Setup.

The example shown in this section uses many features described in depth in the chapter "Workpiece Manager".

NOTE: The following illustrations will be used throughout the procedure for example purposes. It is assumed the table layout is fixtured with four setups of identical workpieces. See below.
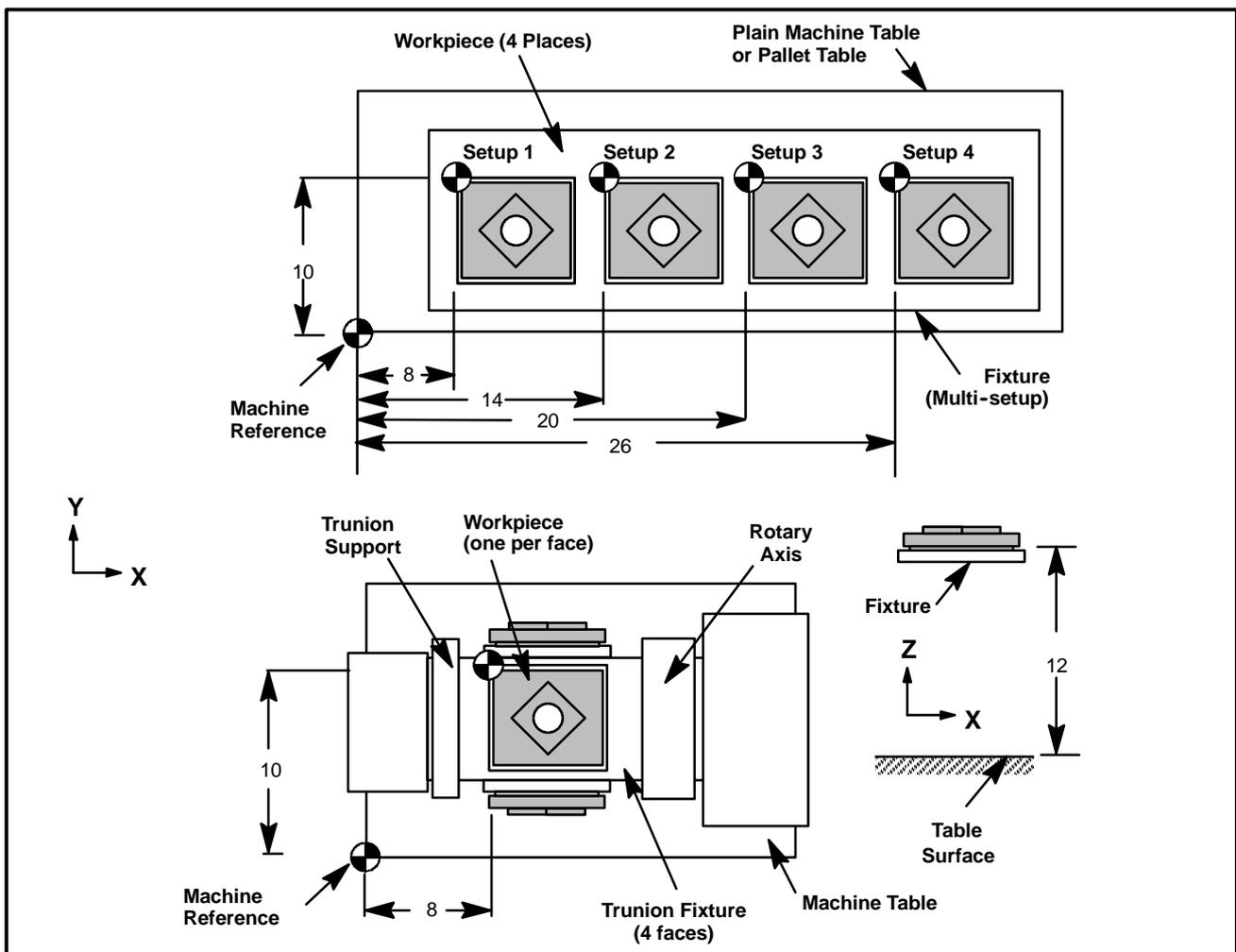
Fig. 55
Multi–Setup Example

The equipment which may be supplied with the machining centre will have some bearing as to the manner in which a Multiple Setup is arranged. Workpieces may be located about a plain machine table, or be clamped onto a pallet table associated with an Automatic Workchanger System (AWS), or may be attached to fixtures arranged radially around a rotating trunion powered from a programmable Rotary Axis. Multi‑Setups for all configurations are illustrated in the figure above and described in the procedures which follow.

Defining the Multi Setup: Step 1	
It is assumed the machine is aligned, and all workpieces shown in the example on the previous page are loaded on a plain machine table, a pallet table advanced from an automatic workchanger (AWC), or a trunion fixture driven from a rotary axis device, as applicable. For AWC applications it is assumed that: – Pallet 1 is clamped on the machine (see the chapter "How Do I Load Pallets onto the Machine"). – The workpiece manager defines Pallet 1 "present" at "Location 1" (on Machine) and 1st in Run Order; and Pallet 2 at "Location 2" (on AWC) and "2nd" in Run Order. (See Chapter 4 for Workpiece Manager setup.)	

Touch, press or set the following	Comments
SETUP	(Single pallet applications only) For table type (single pallet) machines, the setup view level or fixture view level displayed depends on what was last being displayed. Any residing setup data in the Multi‑Setup Offsets table will generate a setup.
SETUP	(AWC applications only) The Pallet viewer is activated.
	(AWC applications only)

Defining the Multi Setup: Step 1

Touch, press or set the following	Comments
Pallet List #1 @1 1st #2 @2 2nd	(AWC applications only) Touch to activate Pallet #1 if not activated. Button Legends show: – Pallet #1 – "present" – ID – "@1" on machine – Run Order – "1st"
View Level: Setups	When the setup level is displayed, the pallet number being defined is displayed in the top information line.

Defining the Multi Setup: Step 2a (Plain Table/Pallet Table Applications)

Touch, press or set the following	Comments
The setup pattern dialog box is displayed.	

New Setups

Setups Pattern

Setups Per Row
Spacing Between Setups +0.00000

Total Rows
Spacing Between Rows +0.00000

First Setup Location

Coordinates: X: +0.00000
Y: +0.00000
Z: +0.00000

Position:

Inch   Metric

4 1 **Face: All**

NC **Select Program for All Setups**

✓ **OK**

X **Close**
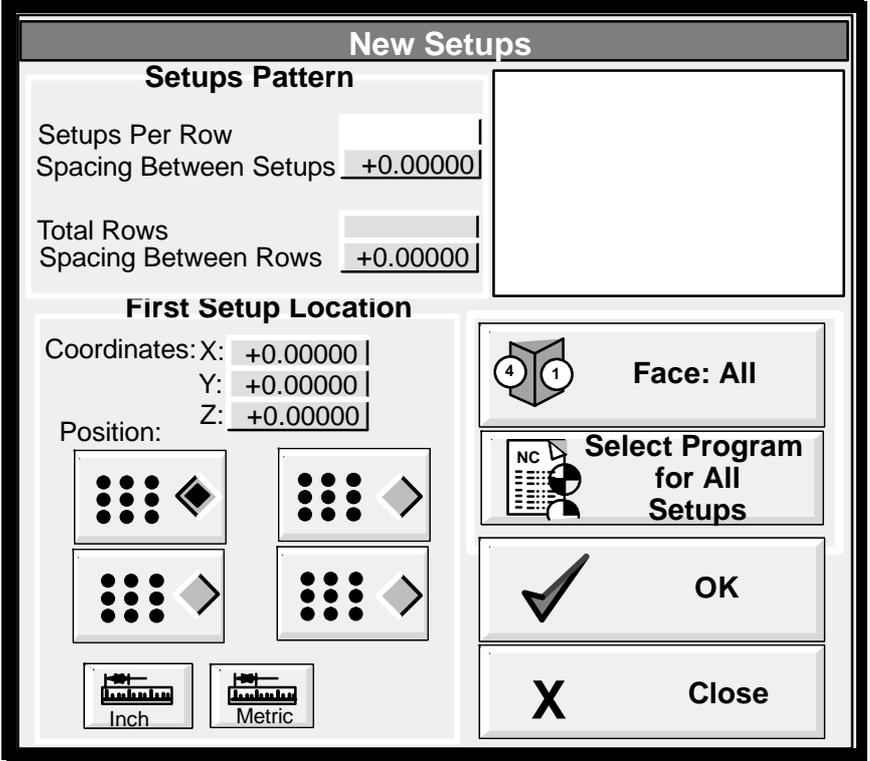
▦◆	In first setup location, touch desired pattern to locate setup 1.

Defining the Multi Setup: Step 2a
(Plain Table/Pallet Table Applications)

Touch, press or set the following	Comments

Setups Pattern
 	
Setups Per Row   4
Spacing Between Setups +6.00000
 	
Total Rows: 1
Spacing Between Rows +0.00000
 	
First Setup Location
 	
Coordinates:
    X: +8.00000
    Y: +10.00000
Positions: Z: +12.00000
	Under Setups Pattern, key in data and press the Enter key. In this example since there are four parts loaded in line along the X axis, four setups per row and 1 row will be used.
	
	The Coordinate X, Y, and Z data fields are used to position the pattern from machine zero. The pattern position is based on the #1 setup. To insert data in each field, touch to highlight, key in data for X then Y, then Z, and press the Enter key.
	
	In this example, the reference position of the pattern at Setup 1 is nominally: X8, Y10, Z12.
	
	When all data is complete the display should look like the example shown below.

Example

Touch, press or set the following	Comments
Defining the Multi Setup: Step 2b (Rotary Axis Applications)	
Face: 1	Press Face 1 button (if trunion fixture has previously been defined with multiple faces, display will read "Face All").
Define Faces	

Enter the number of faces. Touch each field for side and angle values. CW and CCW buttons define rotations. Below is a typical example of data entered for a four sided trunion fixture.

Define Faces

Define the sides and angles

Number of Faces	4	Numbering Scheme	CW	CCW
Face 1 Angle	+0.0000			
Face 2 Angle	+90.0000		1	
Face 3 Angle	+180.0000			
Face 4 Angle	+270.0000	4		2
			3	

Make Default   OK   Cancel

Make Default	

When entry is complete, all four faces of the fixture will be displayed, see below. (See the chapter "Workpiece Manager" if Faces are not displayed.)

	1
	2
	3
	4

New Setup Pattern...	

Touch, press or set the following	Comments

Defining the Multi Setup: Step 2b
(Rotary Axis Applications)

	In first setup location, touch desired pattern to locate setup 1.

Setups Pattern

Setups Per Row   1

Spacing Between Setups   +0.00000

Total Rows: 1

Spacing Between Rows   +0.00000

First Setup Location

Coordinates:

    X: +8.00000

    Y: +10.00000

Positions: Z: +12.00000

Under Setups Pattern, key in data and press the Enter key. In this example one part is being loaded on each face, therefore one setup per row and 1 row will be used.

The Coordinate X, Y, and Z data fields are used to position the pattern from machine zero. The pattern position is based on the #1 setup. To insert data in each field, touch to highlight, key in data for X then Y, then Z, and press the Enter key.

In this example, the reference position of the pattern at Setup 1 is nominally: X8, Y10, Z12.

When all data is complete the display should look like the example shown below.

Example

New Setups

Setups Pattern

Setups Per Row   4

Spacing Between Setups   +6.00000

Total Rows: 1

Spacing Between Rows   +0.00000

    1   2   3   4

    ●   ●   ●   ●

First Setup Location

Coordinates:

    X: +8.0000

    Y: +10.0000

Positions: Z: +12.0000

Face: All

Select Program for All Setups

OK

Cancel

Inch   Metric

Touch, press or set the following	Comments
Defining the Multi Setup: Step 3	
④ ① Face: All	Selecting this button legend in the New Setup box display permits subsequent NC program selection to apply to all setups.
NC Select Program for All Setups	

NC Part Programs

Program Name	ID	Type	Access
MC 013	123	A2100-274	Open
Helix	0	A2100-274	Open
TEST	0	A2100-274	Open
APC Lab	0	A2100-274	Open

← →

| 4 | 1/30/95 10:48:00 AM | Storage Available: 19,999,999 | 10000K |

Touch desired program to apply to all Setups.
NOTE: The program must contain a program ID number (example: 123).

✓ Use This Program	
NC Select Program for All Setups ✓ OK	The new Setup menu will be displayed with the program selection MC013 above the Select Program button (see example on left). Touch OK to complete the Multi Setup definition.

Defining the Offsets	
It is assumed the machine is aligned and all workpieces shown in the example above are loaded in the workholding devices on the plain table, pallet table or rotary trunion fixture. Also that an edge finder has been loaded into the spindle and the edge finder nominal tool diameter has been loaded into the tool data table. In the Workpiece Manager – SETUP mode must be displayed.	
Touch, press or set the following	**Comments**
[→] [Setup]	
[= = >] [MORE = = >]	Select Machine Setup legends on pendant display– see below.
MACHINE SETUP MULT SETUP REM AXIS SETUP SEL AXIS INH [F1] [F2] [F3] [F4]	(Note: This display may vary depending on Machine Application.)
MULT SETUP [F1]	Activates the Multi Setup feature.
[↑] [#1 1st] [#2] [#3 3rd] [#4 4th]	Select the setup whose offsets will be defined (example shown: #1).
[Edit...]	
[Rotate...]	(Rotary Axis Applications)
[Cycle Start]	(Rotary Axis Applications) Z axis retracts and then the rotary axis (in this case A axis) rotates to the selected setup position. The system will automatically redefine the primary face of the setup to be A0.000.

Defining the Offsets	
Touch, press or set the following	**Comments**
Use Edge Finder	
Get Edge Finder Offset Edge Finder Offset +0.25000	If active tool edge finder radius is in the tool table press "Get Edge Finder" Offset. If not, touch to highlight field and enter edge finder radius value.
Set X Axis	
(power feed control arrows)	Use the power feed controls to position the edge finder or indicator to, but not touching the workpiece surface.
Spindle... (Data Entry) Cycle Start	Enter Spindle speed and direction. **Start Spindle** Spindle RPM +500 CW CCW OFF Press Cycle Start to Start Spindle. Spindle Stop/Restart may be used after spindle is running. Cancel
(hand wheel dial)	Either Incremental Jog or Hand Wheel can be used to bring the the edge finder or indicator in contact with the locating surface. For this example, the hand wheel will be used.
.0001 ● F1	Press F1 to select **.0001** movement.
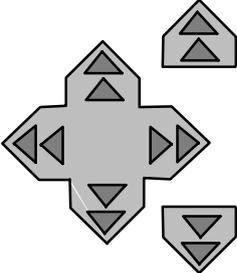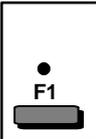
Defining the Offsets	
Touch, press or set the following	**Comments**
	Using the handwheel and small increments, manually jog the axes until the edge finder tool registers (makes contact, lower portion visually concentric and parallel with upper) the edge of the workpiece. – Select the Z axis and feed the spindle up away from the workpiece until the edge finder is clear of the workpiece.

X Axis Move

Primary (top) face of Example Workpiece

Edge Finder

Bottom of work-piece

vice

Edge Finder offset

Edge Finder concentric & Parallel

Before Work Contact & After Excessive Contact

After Work Contact

(Example X axis location)

Desired Position of Program Zero

Back edge

X Axis

Edge Finder

Left Edge – X Axis Location

Defining the Offsets	
Touch, press or set the following	**Comments**
Get Current X +8.00000	Touch to access edge finder display.
Edge Finder Is ... On -X Side On +X Side ✓ OK ✗ Cancel ✓ OK	Touch to select side position. In this example "On –X side" was selected.
Get Current X +7.97504	Displays the machine coordinate position of the left edge of the workpiece (example: +7.97504).
(calculator)	Select the calculator, the X value (+7.97504) will automatically be loaded into the calculator's register.
2.062" Operator position →	Determine the drawing dimension from the left edge to the desired position of program zero in X axis. Add or subtract that value from the current position shown in the calculator. In this example 2.062 in. would be added to the current position in the calculator (example: +, then 2.062, then =).
Save	(On Calculator)
●	(On Calculator)
Get Current X +10.03704	Displays the machine coordinate of the desired position of program zero in X.
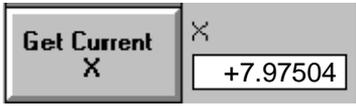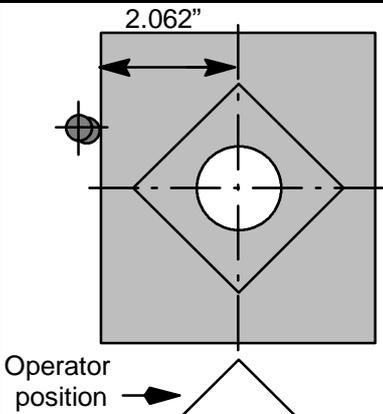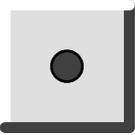
Defining the Offsets	
Touch, press or set the following	**Comments**
✓ OK	The machine coordinate for the desired position of program zero in X is stored in the Multi Setup X field.

Defining the Offsets	
Touch, press or set the following	**Comments**
Set Y Axis	
	Use the power feed controls to position the edge finder or indicator to, but not touching the workpiece surface.
Edge Finder offset 	Offset, by hand, the lower portion of the edge finder horizontally from the spindle centerline.
 (Data Entry) 	Enter Spindle speed and direction.
Y Axis Edge Finder Back edge Left Edge Desired position of program Zero Back Edge – Y Axis Location	– Manually jog the X, Y and Z axes until the edge finder is close to the top edge of the workpiece as it's positioned on the workpiece. – Using the handwheel and small increments, move the Y Axis until the edge finder registers (makes contact, lower portion visually concentric and parallel with upper) the back edge of the workpiece. – Select the Z axis and feed the spindle up away from the workpiece until the edge finder is clear of the workpiece.
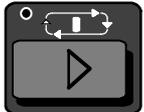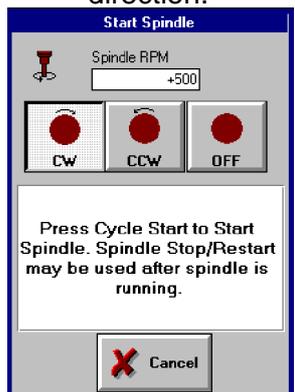
Defining the Offsets	
Touch, press or set the following	**Comments**
Get Current Y — Y +10.00000	Touch to access edge finder display.
Edge Finder Is ... / On +Y Side / On -Y Side / OK / Cancel / **OK**	Touch to select side position. In this example "On +Y side".
Get Current Y — Y +9.89506	Displays the machine coordinate position of the workpiece back edge, example +9.89506.
(calculator)	Select the calculator, the Y value (+9.89506) will automatically be loaded into the calculator's register.
2.000" / Operator position	Determine the drawing dimension from the back edge to the desired position of program zero in Y axis. Add or subtract that value from the current position shown in the calculator. In the example shown 2.000 in. would be subtracted from the current position (example: −, then 2, then =).
Save	(On Calculator)
●	(On Calculator)
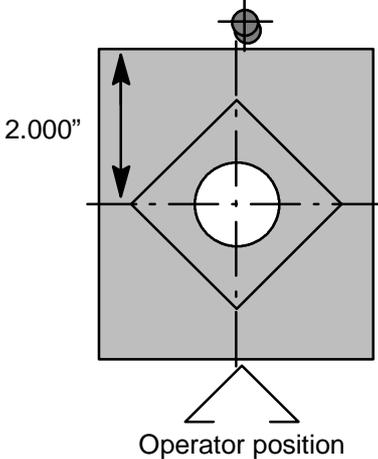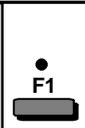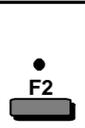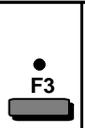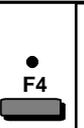
Defining the Offsets	
Touch, press or set the following	**Comments**
Get Current Y — Y [+7.89506]	Displays the machine coordinate position of the desired position of program zero in Y.
✓ **OK**	The machine coordinate for the desired position of program zero in Y is stored in the Multi Setup Y field.
[spindle icon] [Spindle Stop]	
Set Z Axis Zero point to bottom of Workpiece	

<table>
<tr><td rowspan="2">

</td></tr>
</table>

Example Workpiece thickness

6.00" gauge

1.00"

Z axis program zero

12.00" nominal

Z axis machine zero

vice

-- In MDI, enter T1 M6 and press Cycle Start.

-- Place a 6.0000 in. height gauge block on top surface of example workpiece. Manually jog Z axis until end of .50 in. diameter qualified end mill is close to top surface of work. Qualified refers to the fact the tool data is known to the control, including tool length, tool number, etc.

-- Using the handwheel and small increments, move Z axis until the non rotating tool barely touches top of gauge block -- see **Caution**. A slip snug fit between the tool tip and top of the gauge block is required. Remove gauge block from work area.

In this example:
-- Assume the machine coordinate position of the tool endpoint to be Z +19.06250
-- The Z axis reference point for the setup is nominally 12.0 in.

NOTE: If the spindle mounted Probe is present and calibrated properly, it can be used/programmed to locate and zero set the X,Y, and Z axes.

[SETUP icon]

Defining the Offsets	
Touch, press or set the following	**Comments**
View Level: Setups	When the setup level is displayed, the pallet number being defined will be displayed in the top information line.
#1 1st #2 #3 3rd #4 4th	Select the setup whose offsets will be defined (example shown: #1).
Edit...	
Get Comp Z — Z +12.00000	Touch to update the data field value. The new value is the current machine position minus the Z axis reference position value (example: 19.06250−12.0= +7.06250).
Get Comp Z — Z +7.06250	Displays updated value (7.06250) in Get Comp Z data field.
	Select the calculator, the Z value (7.06250) will automatically be loaded into the calculator's register.
Example Workpiece thickness — 6.00" gauge — 1.00" — vice	Subtract the known gauge length and workpiece thickness from the current value in the calculator, then add the Z axis reference position value (example: +7.06250−7.0000 +12.0 = +12.06250).
Save	(On Calculator)
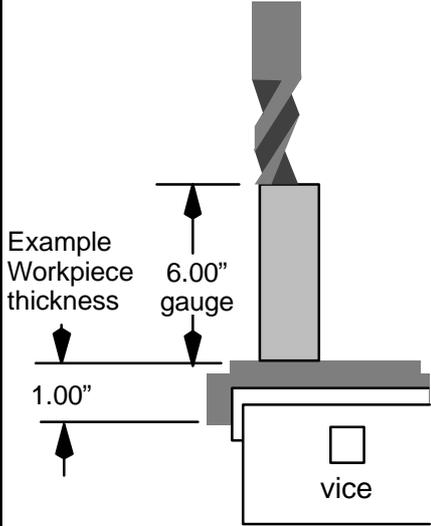
Defining the Offsets	
Touch, press or set the following	**Comments**
● (button)	(On Calculator)
✓ OK	The machine coordinate for the desired position of program zero in Z is stored in the Multi Setup Z field.
Previous / Next	Can be used to return to previous or go to next Setup.
The following display will appear.	

Setup Definition

? **Do you want to keep the changes**

✓ Commit Changes   🚫 Discard Changes   ✗ Cancel
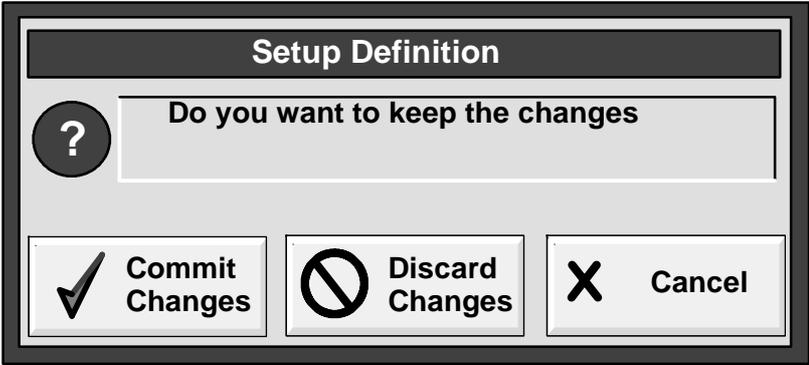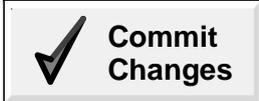
✓ **Commit Changes**	Completes data entry for the selected setup. The screen returns to the Multi-Setup Viewer for the next Setup defined in Step 2 of the procedure.

Run Defined Multi Setup

Touch, press or set the following	Comments
HOME	
Offsets	

Multi Setup Offsets: Pallet 1

	Order	Setup State	Part Status	Program ID
1	0	Absent	Pending	
2	1	New	Pending	10
3	3	Last	Pending	20
4	2	New	Pending	10

View offsets Table. Make sure all axis offset data is correct. Shift table fields until fields shown above are displayed. Determine which Setup is to be run first. (It will have a "1" in the Order field. See example.) If necessary change the setup state to Active New or Active, and all other setups to Absent. Make sure Part Status is set to "Pending" and proper program is specified in Program ID field. If necessary edit table data or use Multi Setup tool to redefine setup process.

Touch, press or set the following	Comments
Setup	
= = > MORE = = >	Select Machine Setup legends on pendant display– see below.
MACHINE SETUP MULT SETUP REM AXIS SETUP SEL AXIS INH F1 F2 F3 F4	
MULT SETUP F1	
SETUP SEL F2	

Run Defined Multi Setup	
Touch, press or set the following	**Comments**
#2 **(EXAMPLE)**	Press function key associated with setup written down earlier. (Example: Setup 2)
	The order of execution will start with Setup 2. The part program associated with the setup will be loaded automatically. The table will update with the current setup being executed. After each setup is completed, the status of the setup will be set to Complete. To re-run the setup set the part status to Pending.
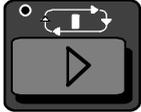
Chapter 5
Other Setup Information

How Do I...

Information in this chapter is intended to be used as a quick reference guide for procedures that are not normally required for every day operation.

Information presented under How Do I...is not detailed in its content. Many of the techniques presented assume the machine and control have completed all startup and alignment procedures. Touch, press or set the following touchscreen buttons, push buttons, controls, etc., momentarily and release unless instructed otherwise. Some controls and procedures shown may not be present in all application or are used with optional equipment.

Security levels also prevent some procedures unless proper passwords are entered first. The picturettes, icons, and screen displays may vary slightly in appearance and size for the purpose of illustration and clarity.

These step-by-step guides should be followed unless circumstances, additional equipment, safety considerations, manufacturing or assembly changes dictate safe variations.

Select Axes Display	
NOTE: If a servo failure is encountered, axis display fields may not appear on the screen. To reactivate axis display fields proceed as follows:	
Touch, press or set the following	**Comments**
HOME	
DISPLAY	
Axis Setup Menu ⟩	
✓	
X + 0.0 Y Z **Select Axes**	
Y **Z** **X** **A** **B**	Touch each axis button that is to be displayed. The button will turn color from gray to yellow.
● **Close**	
HOME	Touch to return to Home menu screen.

Inhibit an Axis Using the Screen	
Touch, press or set the following	**Comments**
HOME	
DISPLAY	
Axis Setup Menu	
✓	
↗ Z	Under the Inhibit menu, touch desired axis menu button(s) to inhibit. Example shown: Z Axis (display will change color to light gray).
↗ Z	To reactivate axis, touch the Axis again.
HOME	Touch to return to Home menu screen.

Inhibit an Axis Using the Pendant	
[→] [Setup]	
[= = >] [MORE = = >]	Select Machine Setup legends on pendant display– see below.
MACHINE SETUP MULT SETUP REM AXIS SETUP SEL AXIS INH F1 F2 F3 F4	
F4	
MACHINE SETUP SEL AXIS INHIBIT X Y Z F1 F2 F3 F4	
X F4 **(EXAMPLE)**	Select desired axis to be inhibited (example shown: X). The LED below the axis will illuminate to show the axis is inhibited.

Plotter

Plotter Screen Setup	
Touch, press or set the following	**Comments**
Part Program Plotter	Activate the program to be plotted, refer to the procedure Run A Part Program.
	Selects Change Plotter Set Up.
The following display will appear:	
NOTE: To resize display area, touch a corner of plotter grid and drag finger across screen until the total plot display is framed. To reposition the entire viewing frame, touch center of grid and drag.	
	Select desired axis, example ZX axis shown.
	Cancels zoom and displays entire machining area.
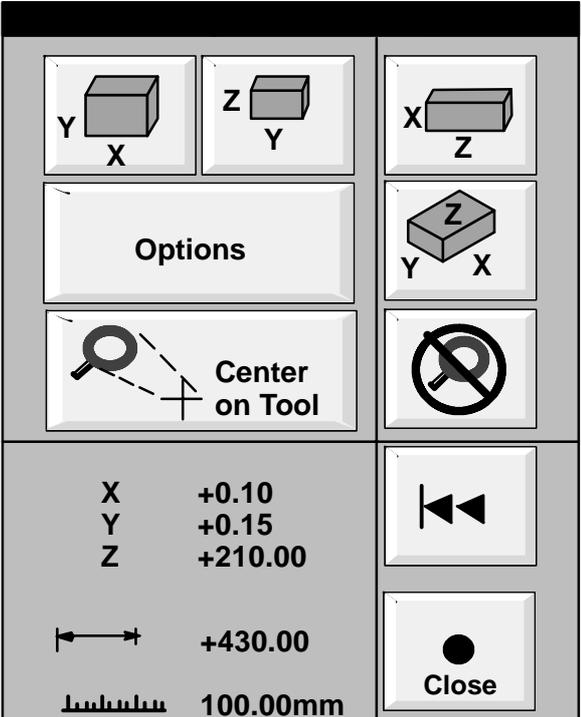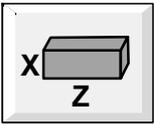
Plotter Screen Setup

Touch, press or set the following	Comments
Options	To activate a plotter options, touch desired menu button. When a block check or dot is displayed, the option is active.
	The Tool Color List menu button activates an additional menu that list tool colors.
	When setting of the options is completed, touch the Close menu button.
	When the Change Plotter Setup window appears, touch Close to display the plotter window.

The Plotter Options menu will display as follows. From this menu you can dictate what is presented when a part is plotted.

Plotter Options
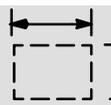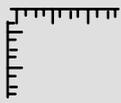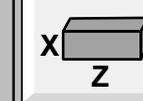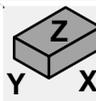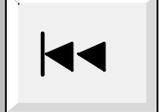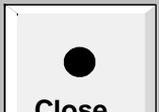
Draw Limits ✔	**Draw Tool With Color** ◇
Draw Origin ✔	**Line Only** ◇
Draw Rulers ✔	**Draw Tool W/O Color** ◈
Tool # X Z N0001 **Display Status** ✔	
Tool Color List ✔	● **Close**

Plot A Program	
Touch, press or set the following	**Comments**
Part Program Plotter	Activate the program to be plotted, refer to the procedure Run A Part Program.
●	Touch (highlighted green dot) to record cycle.
(magnifier icon)	Selects Change Plotter Setup.
● Close	Closes plotter setup.
Cycle Start	
▮◀◀ −▬+	This button when highlighted, will permit the operator station minus or plus key to increase or decrease the displayed plot speed.
▶	Pauses and reactivates tracking.
X	Deletes the stored plotter points used for redraw.
X	Clears the plotter screen.
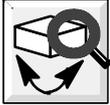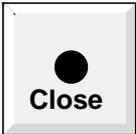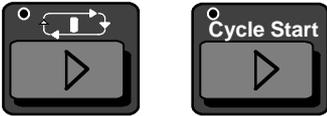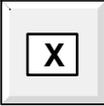
Track Tool Movement With Plot	
Touch, press or set the following	**Comments**
Part Program Plotter	
●	When green dot is highlighted, records cycle.
	Selects Change Plotter Set Up.
Change Plotter Set Up Y, X, Z, Y, X, Z Options Z, Y, X Center on Tool X +0.10 Y +0.15 Z +210.00 ┣━━┫ +430.00 100.00mm Close	
Center on Tool	Power feed an axis. The plotter display will track the tool movement.
● Close	Closes cycle.
▶	Pauses and reactivates tracking.

Program and File Management

Create Directory	
Touch, press or set the following	**Comments**
`>> MORE`	
`File Manager`	
`Create Directory`	
Drive: `C` 👉	Touch C: or A: if it is not highlighted.
`Keyboard`	Create a Directory ☐ ✓ Create Directory
✓ `Create Directory`	The created directory will appear in the File Manager Directory list.
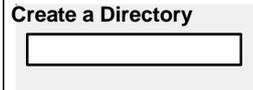
Transfer a Part Program into the Program Store Area of the Control	
Touch, press or set the following	**Comments**
`HOME`	
`NC Programs`	A list of all registered programs will appear.
`Transfer Program`	
`Transfer Program In`	The following appears.
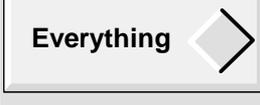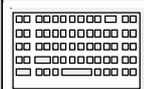
Transfer a Part Program into the Program Store Area of the Control	
Touch, press or set the following	**Comments**

TransferTo Program Store

Program [   ]

From File [A:]

Floppy Drive ◆	Other Drive ◆	Comm Ports ◆

Date:Time

Browse	Keyboard	Advance

✓ Start Transfer	✗ Cancel

Floppy Drive ◆	Select transfer location (example: Floppy Drive).
[floppy diskette icon]	If floppy drive is selected: insert the 1.44MB diskette into the floppy disk drive.
Browse	Highlight desired program.

Select NC Program File

Filename: Directory: **A:**

- -

mc-013.nc   **A:**

mc-013.nc	A: └ 200 └ 300	Keyboard
		✓ OK
		✗ Cancel

Drive:

a:

Transfer a Part Program into the Program Store Area of the Control

Touch, press or set the following	Comments
✔ OK	
✔ Start Transfer	Example: mc–013.nc is copied to the hard disk program area and registered as a part program. After transfer, verify program name is in list of programs.

Copy (Backup) A Program To Diskette

Touch, press or set the following	Comments
HOME	
NC Programs ⟩	Highlight the desired program. For an example, part program CAM.1 will be copied to a floppy diskette.
◀ Transfer Program	
Transfer Program Out	
(floppy diskette)	Insert the formatted 1.44MB diskette into the floppy disk drive.
	Key in A:\CAM.1 or use the optional keyboard to enter the data. Refer to the procedure "Keying In Data".

Copy (Backup) A Program To Diskette

Touch, press or set the following	Comments
Transfer From Program Store Program **CAM.1** To File **A:\CAM.1** Floppy Drive ◆ Other Drive ◇ Comm Ports ◆ Date:Time Browse Keyboard Advance ✓ Start Transfer ✕ Cancel	
⊞ **MORE**	To advance additional keyboard selection display.
💾 Floppy Drive ◆	Touch if not selected.
✓ Start Transfer	When the backup process is complete, the NC Program will be displayed.

Copy (Backup) Tool File or Active Tool Data To Diskette

Touch, press or set the following	Comments
TOOLS	
Tool File ◆ **(or)** Active Tool Data ◆	Select which file is to be backed up; the entire tool file or just the active tool data.

Copy (Backup) Tool File or Active Tool Data To Diskette	
Touch, press or set the following	**Comments**
Copy Table	
To Backup File	
Backup	Touch if not selected.
Active Tool Data	Touch if not selected.
	Insert the formatted 1.44MB diskette into the optional floppy disk drive.
	Key in A:TOOLACT.BCK for an example file name or use the optional keyboard to enter the data. Refer to the procedure "Keying In Data".
Start Backup	When the backup process is complete, the Tool Manager will be displayed.

Restore Active Tool Set from Diskette	
Touch, press or set the following	**Comments**
TOOLS	
Active Tool Set ◆	For an example, TOOLACT.BCK will be copied from a floppy diskette.
Copy Table	
From Backup File	Touch if not selected.
Restore	
Active Tool Data ◆	Touch if not selected.
Restore	Touch if not selected.
	Insert the formatted 1.44MB diskette into the optional floppy disk drive.
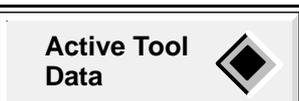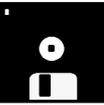
Restore

┌─ Operation ─┐ ┌─ Data ─┐

 Backup   **Active Tool Data** ◆   ✓ **Start Restore**
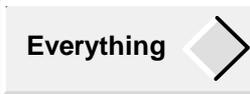
 Restore   **Everything** ◇   ✗ **Cancel**
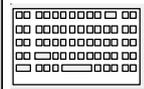
From file

A:TOOLACT.BCK
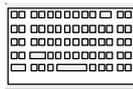
Browse   **Keyboard**

Restore Active Tool Set from Diskette

Touch, press or set the following	Comments
	Key in A:TOOLACT.BCK example file name or use the optional keyboard to enter the data. Refer to the procedure "Keying In Data".
✓ Start Restore	When the backup process is complete, the Tool Manager will be displayed.

Copy (Backup) Offset Tables To Diskette

Touch, press or set the following	Comments
DISPLAY	
Offset Displays ⟩	For an example, Machine Offsets will be copied to a floppy diskette.
Display Groups ⬆➡ Axis Displays ⟩ 🔲 Offset Displays ◆ * * * Other Displays ⟩ **Select Offset Displays** **Pallet Offsets** **Multi Setup Offsets** **Fixture Offsets** **Prog. Coord Offsets** **Prog. Tool Offsets** **Machine Offsets**	Select desired Offset Display, example: Machine Offsets.
✓	
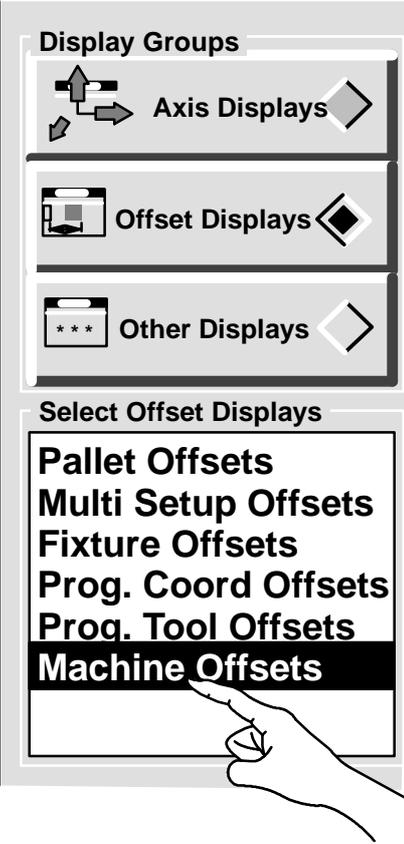
Copy (Backup) Offset Tables To Diskette	
Touch, press or set the following	**Comments**
Copy Table	
To Backup File	
Backup	Touch if not selected.
Backup Operation — Data — **Backup** **Machine Offsets Table** ◆ ✓ **Start Backup** **Restore** **All Operations Data** ▸ ✗ **Cancel** **To file** **A:MACHOFF.BCK** **Browse** ▦ **Keyboard** **Append to File** ▭	
Machine Offsets Table ◆	Touch if not selected.
	Insert the formatted 1.4MB diskette into the optional floppy disk drive.
	Key in A:MACH.OFF..BCK for an example file name or use the optional keyboard to enter the data. Refer to the procedure "Keying In Data".
✓ **Start Backup**	When the backup process is complete, the Machine Offsets Table will be displayed.

Copy (Backup) A Program from Program Store

Touch, press or set the following	Comments
HOME	
NC Programs ▷	Highlight the desired program. For example, part program MC0130 will be copied to a PC (Personal Computer).

NC Part Programs

Program Name	ID	Type	Access	Validation
MC 0130	0	A2100-274	Open	None
Helix	0	A2100-274	Open	Unknown
TEST	0	A2100-274	Open	Unknown
APC Lab	0	A2100-274	Open	Unknown

← →

| 4 | 5/30/95 10:48:00 AM | Storage Available: 19,999,999 ▮10000K |

◀ **Transfer Program**	
Transfer **Transfer Program In** **Transfer Program Out** **Print Directory** **Print Program**	If desired, touch "Print Directory" or "Print Program" to make copies. Hook-up to printer is required.

Copy (Backup) A Program from Program Store	
Transfer Program Out	

Transfer From Program Store

Program **C: \MC0130**

To File **: COM 1**

Floppy Drive	Other Drive	Comm Ports

Date:Time

Browse	Keyboard	Advance

Start Transfer	Cancel

Comm Ports	Select transfer destination (Example: COM PORT).
Keyboard	To advance additional keyboard selection display. Key in nome of program, example CAM.1 or use the optional keyboard to enter the data. Refer to the procedure "Keying In Data".
Start Transfer	Hook-up PC to serial port on side of operator station. Start PC and set PC to receive program. When the backup process is complete, the NC Program will be displayed on the PC directory.

Copy Files	
Touch, press or set the following	**Comments**
>> MORE	
File Manager	

Copy Files

Touch, press or set the following	Comments
Copy	
Select the source (From) directory and file first.	
Drive: C	Also, touch Drive selection. In this example a file will be copied from C drive to the optional floppy disk.
In the filename list touch to highlight file. To scroll through the filename list use the cursor keys. The file selected will appear in the From: field.	
Insert floppy disk into drive. Touch the To: field to highlight.	
A: C: A:	Touch A: to highlight. Copy File(s) From: C\ XAXIS CMP To: A: ✓ Copy
Copy	The copied file will appear in the directory Filename: list.
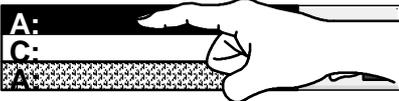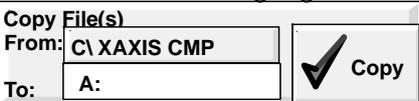
Rename Files
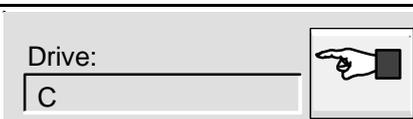
Touch, press or set the following	Comments
>> MORE	
File Manager	
Rename	
Select the source (From) directory and file first.	
Drive: C	Select Drive:

Rename Files

Touch, press or set the following	Comments
Be careful when renaming .CMP files. The realtime CPU reads these error compensation files at power up. An alarm message may be displayed. Touch desired Directory.	In the Filename: list file to be renamed. The file selected will appear in the From: field.
[Keyboard]	Rename File(s) From: **C\ COMPTST.CMP** To: [✓ Rename]
[✓ Rename]	The copied file will appear in the directory Filename: list.
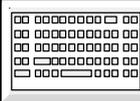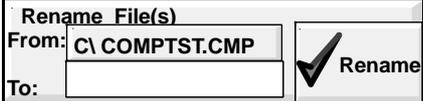
Delete Files or Directory

In the file manager, files and directories can be deleted. When a directory is deleted, all files and subdirectories are deleted. Be careful when deleting files and directories, files and directories once accidentally deleted cannot be recovered.

Touch, press or set the following	Comments
[>> MORE]	
[File Manager]	
[Delete]	
Drive: C	Select Drive:
Touch desired Directory.	In the Filename: list file to be deleted. The file selected will appear in the Delete File(s): field.
[✓ Delete]	

Delete Files or Directory

In the file manager, files and directories can be deleted. When a directory is deleted, all files and subdirectories are deleted. Be careful when deleting files and directories, files and directories once accidentally deleted cannot be recovered.

Touch, press or set the following	Comments
File Manager	
? Delete the selected file? ✓ **Yes** ⃠ **No**	
✓ **Yes**	Touch Yes to delete selected file.

Delete A Program

Touch, press or set the following	Comments
HOME	
NC Programs 〉	Highlight the program to be deleted.
Delete Program	
Delete	

Execute a Part Program via Continuous Load

Touch, press or set the following	Comments
HOME	
NC Programs 〉	A list of all registered programs will appear.

Execute a Part Program via Continuous Load	
Touch, press or set the following	**Comments**
◀ **Transfer Program**	
Transfer Program In	
Transfer to Program Store	
Program [ ] From File [ ] **Floppy Drive** ◆ **Other Drive** ◆ **Comm Ports** ◆ **Browse** **Keyboard** **Advanced** ✔ **Start Transfer** ✖ **Cancel**	
Comm Ports ◆	
Advanced - -	
The following display will appear:	

Execute a Part Program via Continuous Load	
Touch, press or set the following	**Comments**

Advanced Transfer to Program Store

Program

From File

Program ID	
Group	
Program Type	
Program Access	
Execution Path	
Execution Mode	

Floppy Drive ◇ Other Drive ◇ Comm Ports ◇

Browse Keyboard Non Advanced

Examine Program Attributes

✓ Start Transfer ✗ Cancel

Register External ☐ Run Without Loading ☐

Execution Mode **Standard**	Touch "Standard" to access the mode menu.
Continuous **Standard** **Continuous**	Touch "Continuous" to select Continuous load mode.
Run Without Loading ✓	
✓ **Run Without Loading**	Hook-up PC to serial port on side of electrical cabinet. Start PC and set PC to commence transmission of Part Program to the A2100 control. Note: Press the "Close" button on the Program Directory Menu to clear this screen, if it appears on the screen display.
▷ **Cycle Start** ▷	Part Program commences execution under "Continuous Load" control.

Activate A Program From External Source

Touch, press or set the following	Comments
When a program is activated from an external source it is registered in the program manager. The term registered means the program name and characteristics appear in the program manager. The program path from the external source is established, but the file itself is not loaded to your hard drive. **NOTE:** If the program you are activating exceeds 900KB, its Exec Mode must be changed from Standard to Countinuous befoer it can be executed. This procedure assumes all external communications have been established with the control system.	
HOME	
NC Programs	A list of all registered programs will appear.
Transfer Program	
Transfer Program In	An other dialogue box will appear.
Advanced	

The following display will appear:

Advanced Transfer to Program Store

Program
From File

Floppy Drive   Other Drive   Comm Ports

Browse   Keyboard   Non Advanced

Start Transfer   Cancel

Program ID
Group
Program Type
Program Access
Execution Path
Execution Mode

Examine Program Attributes

Register External   Run Without Loading

The Examine Program Attributes touch button displays additional information about the selected program.

Register External ☑	

Activate A Program From External Source	
Start Transfer ✓	The NC Programs manager will be displayed with the program highlighted. At this point the program is a "registered program".
	To view the file path, use arrow position keys to select the File Specification field in the NC Part Program list.
	If the program exceeds 900 KB it must be labeled Continuous before it can be executed.
	Use the arrow position keys to select the Exec Mode column inline with the program. Note the newly registered program is marked Standard. If this is a large program you will need to change the Exec Mode selection to Continuous.
Modify Directory	Touch to modify directory.
Exec Mode **Continuous** **Standard** **Continuous**	In Exec Mode Window touch to expand window selection. **Touch Continuous.** The program is now registered for Continuous load when executed.
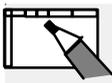
Program Editor

Search For/Replace With	
Touch, press or set the following	**Comments**
Dual Display ☐	Load program into Edit. See "Copy Program To Dual Display" procedure.
Select desired on‑screen keyboard. Refer to "Keying In Data" procedure.	
Programs ⟩ Edit Program	
The following display will appear:	
Search text backwards	
Search for: **Replace with:** **G3** Search Backward Replace Search Forward Replace All ✕ Cancel	
	Touch to activate desired operation field, ie: Search for / Replace with. Example: "Search for" is shown selected.

	Input data via on-screen keyboard, or use optional separate keyboard. Enter "Search for" information, example: G3.
NC ⬆ **Search Backward** **OR** **NC** ⬇ **Search Forward**	Search to find entered character string. In the example the first G3 encountered will be highlighted.
Replace with:	Enter replacement characters.
Replace	

Edit Cut, Copy, And Paste	
Touch, press or set the following	**Comments**
Select text.	
A A	Copy text.
🖻	Paste copied or cut text.
✂	Cut text.
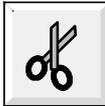
Copy Programs To Dual Display	
Programs may be pasted to the single or dual edit display from MDI, RAP or the Program Directory.	
Touch, press or set the following	**Comments**
NC **EDIT**	
DISPLAY	

Copy Programs To Dual Display

Touch, press or set the following	Comments
Dual Display ☐	One of the dual displays will appear white. This identifies the current active area. To switch, touch the screen.
Select desired on-screen keyboard. Refer to "Keying In Data" procedure.	
● **Close**	
NC **Programs** 〉	Highlight program.
NC **Edit Program**	The Edit menu will appear with the selected program in the active edit display.
[touch display icon]	Touch the other display area. It will turn white to indicate it is active.
NC **Programs** 〉	Highlight another program from the NC Part Programs.
NC **Edit Program**	The selected program will appear in the active edit display. Cut and Paste operations may now occur.
NOTE: To return the edit display to a single field, proceed as follows:	
[touch display icon]	Highlight one of the edit displays by touching the screen.
Clear 〉	
DISPLAY	
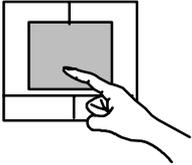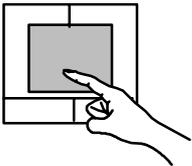
Copy Programs To Dual Display

Touch, press or set the following	Comments
Dual Display ☐	
● Close	
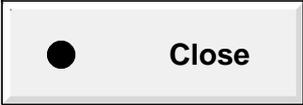
Copy A Program To Edit

Touch, press or set the following	Comments
EDIT	
NC Programs ▷	
OR ← → ↓ ↑	Select desired program by touching the screen listing or by using the arrow position buttons.
NC Edit Program	The Edit menu will appear with the selected program displayed.

Resequence A Program

After a edit operation of a part program has been completed, blocks in the program can be resequenced in increments of 10 by following this procedure.

Touch, press or set the following	Comments
EDIT DISPLAY	Edit display active.
◀ More Features	
10 --▷ 20 ---- 30 ---- 40 ---- Resequence	
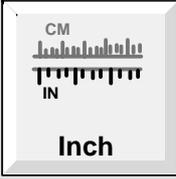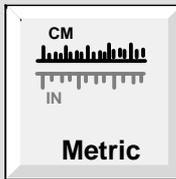
Resequence A Program	
Touch, press or set the following	**Comments**
Optional selection Resequence Colon Blocks ☐	Touch this button (black check appears in box) to add sequence numbers to all colon blocks.
10 -- 20 ---- 30 ---- 40 ---- **Start Resequence**	

Save Program Edits	
This procedure assumes an edit to a program has been completed.	
Touch, press or set the following	**Comments**
EDIT	
DISPLAY	
The following display will appear:	
Display Change None ◆ Dual Display ☐ QWERTY ▷ NC ▷ ● Close	
QWERTY	
● Close	
Save ▷	
The following display will appear:	

Save Program Edits	
Touch, press or set the following	**Comments**
Save **New Name** DRILL [ ] **Clear After Save** ✓ **Save** ✕ **Cancel**	
Enter new program name/number, example: DRILL. Refer to "Keying In Data" procedure.	
✓ **Save** **OR** [ ] **Clear After Save** **THEN** ✓ **Save**	Touch Save and the Edit menu will display the new program and name. OR Touch Clear After Save and then Save, the Edit screen will not contain the new program or name.

RAP Functions

RAP (Resident Assistance Programmer) is a graphical aid to writing part programs or part program segments. Procedures shown in this section assume that the person using the RAP feature understands basic programming concepts. If necessary, read the programming manual for information on programming concepts.

<table>
<tr><td colspan="2" align="center">Create A Rap Session</td></tr>
<tr><td colspan="2">Tiles collected in the RAP Process List form a session. A session can consist of one or more tiles which define an individual process. The following example contains two linear moves.</td></tr>
<tr><td align="center">Touch, press or set the following</td><td align="center">Comments</td></tr>
<tr><td align="center">RAP</td><td></td></tr>
<tr><td align="center">Linear</td><td>Press "5" to enter X End Point.</td></tr>
<tr><td align="center">(Optional)
●</td><td>Press for more information about the function.</td></tr>
<tr><td align="center">CM
In/MM</td><td></td></tr>
<tr><td colspan="2" align="center">The following display will appear:

Set Inch / Metric Mode

CM / IN **Inch**   CM / IN **Metric**

✂ **Delete**   ✕ **Cancel**</td></tr>
</table>

Create A Rap Session	
Touch, press or set the following	**Comments**
CM IN **Inch**	Choose either Inch or metric, in this example Inch is used.
(Optional) Abs/Inc	Press to change move type, if move type being displayed is not correct for operation.
The following display will appear:	

Set Abs / Inch Mode
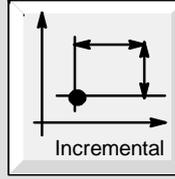
Absolute	Incremental
✂ **Delete**	✕ **Cancel**

Absolute	Choose either Absolute or Incremental, in this example Absolute is used.
LInear Feed G1 Diameter X (Abs) 5.0000 Endpoint Y (Abs)	Highligt desired axis. (Example X axis.) The picture will show the type of move. Key in value (example: 5.0000).
Feedrate	
The following display will appear:	

Create A Rap Session

Touch, press or set the following	Comments
Set Feedrate Mode **Rate:** | **+0.00000** **Feedrate Mode** Inverse Time | Feed Per Min | Feed Per Tooth ✂ Delete | ✓ OK | ✗ Cancel	
Feed Per Min	Choose either Inverse Time, or Feed Per Minute or Feed Per Tooth, in this example Feed Per Min.
+20.00000	Key in 20 for Feedrate. Refer to the procedure "Keying In Data". Press ENTER.
✓ OK	

The Block at the top of the screen should now be:

Resident Assistant Programmer

G1 G94 G70 G90 X5 F20

1 / 4	RAP program was loaded	Not in

⟳ ▷	Cycle Start ▷	Pressing this button will cause Process 1 tile button to highlight orange indicating execution of the cycle. X axis will position 5.0 in. in the plus direction.

Cincinnati Machine 91203809-001

Edit A Rap Process	
After a Rap Process List has been creates, edits can be performed to each procedd. To edit a process:	

Touch, press or set the following	Comments
RAP	Touch to highlight the desired tile in the Process List.
Edit Process	Touch Edit Process or simply touch the process if it is already highlighted. The RAP screen will display the process selection.
	Touch a selection to edit and enter data.
OK	Saves the RAP session to the NC Program Directory.
	Pressing this button will cause Process 2 tile button to highlight orange indicating execution of the cycle.
	X axis will position 10.0 in. in the plus direction. Process 1 tile will then highlight yellow indicating it is again ready for cycle execution.
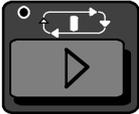
Saving A Rap Session	
When a RAP session is completed, save all tiles in the process list to the RAP session directory.	
Touch, press or set the following	**Comments**
Save ⟩	
The following display will appear:	
Save A Session — **Name** — RAP PROGRAM — ✓ Save — Keyboard — ✗ Close	
	The Name field will be highlighted. If a session name is present, simply key-in desired name, example: Linear Moves. This action will remove the resident session name. Refer to the procedure "Keying In Data".
✗ Close	To remove keyboard.
✓ Save	Saves the RAP session to the RAP session Directory.

Moving A Rap Session	
Tiles collected in the RAP Process List form a session. A session can consist of one or more tiles which define an individual process. The following Moving procedure assumes a RAP session assembly has been completed and the RAP Process List appears as shown.	
Touch, press or set the following	**Comments**
G0 ▶ $\frac{G0}{G1}$ Move Process	
	A red direction arrow will appear to the right of tile 3. Tile 3 is highlighted and in this example tile 4 is used to reposition a moved tile back to the bottom position in the process list.
	Tile 3 will now be positioned at the top of the list relabeled 1. To move this process back to it's original position, touch tile 4.
G0 ▶ $\frac{G0}{G1}$ Move Process	To deactivate.
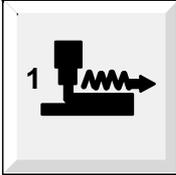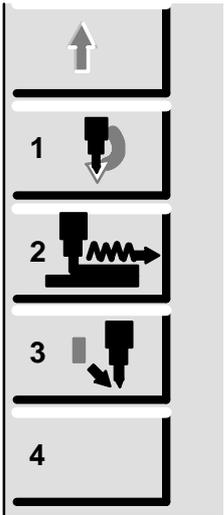
Create An NC Program One Block At A Time With RAP

Assumes RAP Process List is completed. Procedure copies one RAP tile into an NC program one block at a time.
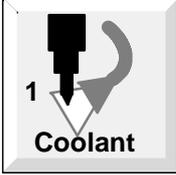
Touch, press or set the following	Comments
1 ▽ **Coolant**	Cursor to select tile – DO NOT PRESS.
⬌ **Copy One to Clipboard**	Screen will display current process was copied.
[NC EDIT] then [tool icon]	
Process List **2** ⋀⋀⋀→	Touch second title #2 in list.
[NC EDIT] then [tool icon]	
3 ↓ **Rapid**	Touch third title #3 in list.
[NC EDIT] then [tool icon]	Each copied process will be pasted under the previous block of information.
Save ⟩	
✓ **Save**	Saves the RAP session to the NC Program Directory.
	The Name field will be highlighted. If a session name is present, key-in desired name. example: Linear Moves. This action will remove the resident session name. Refer to the procedure "Keying In Data".
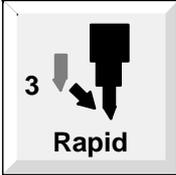
Create An NC Program With RAP	
Assumes RAP Process List is completed and displayed. Procedure copies entire RAP process into an NC program.	
Touch, press or set the following	**Comments**
Copy All to Clipboard	Screen will display Current process was copied.
NC EDIT then	
Save ❯	
	The Name field will be highlighted. If a session name is present, key-in desired name. example: Linear Moves. This action will remove the resident session name. Refer to the procedure "Keying In Data".
✓ **Save**	Saves the RAP session to the NC Program Directory.

Duplicating A RAP Process

Assumes RAP Process List is completed and displayed.

Touch, press or set the following	Comments
2 (tile icon)	Touch title that needs to be duplicated, example: title #2.
A A Duplicate Process	The entire Process will be duplicated and positioned below the previous selection.
(tile list: arrow, 1, 2, 3, 4)	Duplicated Tile 2 will now be positioned below previous selection.
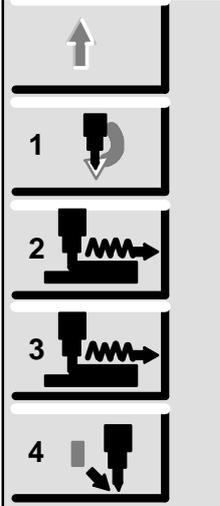
Loading A Rap Process

Tiles collected in the RAP Process List form a session. A session can consist of one or more tiles which define an individual process. To load a process:

Touch, press or set the following	Comments
RAP	
Load (folder icon)	
Load (check mark)	Saves the RAP session to the NC Program Directory.

Executing A RAP Process

Assumes RAP Process List is completed and displayed.

Touch, press or set the following	Comments
1 Coolant	This first Process 1 tile button will highlight yellow when touched indicating it is selected. If desired any title can be touched and executed.
Cycle Start	Pressing this button will cause Process 1 tile button to highlight orange indicating execution of the cycle. Process 2 tile button will highlight yellow indicating it is ready for cycle execution.
Cycle Start	Pressing this button will cause Process 2 tile button to highlight orange indicating execution of the cycle. X axis will position in the plus direction. Process 3 tile will then highlight yellow indicating it is ready for cycle execution.
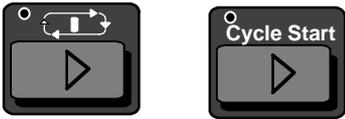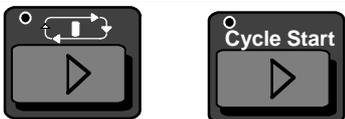
Insert Axes Values in RAP

Assumes RAP Process List is completed and displayed. This procedure permits inserting X, Y, and Z current machine values.
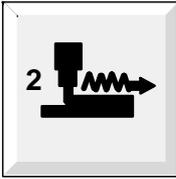
Touch, press or set the following	Comments
2	Touch title that needs insertion of Axes values, example: title #2. It will highlight yellow when touched indicating it is selected.
Edit Process	
NOTE: RAP Edit mode can be activated by touching a tile twice.	
Get Current X, Y, Z Values	The current X, Y, Z values will be entered in the selected process block and displayed.

Using The Program Translator

This control is equipped with a translator that will convert many Fanuc, A850SX and A950 part programs into a program that can be used by the Acramatic 2100. The procedures in this step illustrate the operations needed to translate the programs. Refer to the programming manual for a detailed description of this feature.

Set-up Translator	
Touch, press or set the following	**Comments**
EDIT	It will be assumed program has been transfered into control storage buffer.
More Features	
The following display will appear:	
More Features Resequence Translate	
Translate	Proven standard part program types may be: FanucRSeries 0-MC, FanucRSeries 0-TC, A850SX and A950. FanucR is a trademark for Fanuc LTD.
The following display will appear:	
Translate Active Edit Program **Translation Type** A850SX Fanuc A950	Translate the active edit program with the selected translation type. The translation will be placed in the alternate edit buffer as an untitled untitled program. Setup ? ✔Translate ✖Cancel
NOTE: A950 translation is not available with Current Release.	

Set-up Translator	
Touch, press or set the following	**Comments**
Fanuc ◆	Touch this button to select the desired Translation type. (Example: Fanuc.)
? (Optional)	Press when displayed to get on line help on a feature.
Setup	
Translate Active / **Parameters**	If FanucR translation is to be accomplished, check that the setup parameters have been entered. Refer to Programming manual "Fanuc Setup".
Active Edit Pr / **G Subroutine**	Touch G Code (G Subroutine) display.
The following display will appear. Enter 999 into the G-code number column if there are no unique G cods to be translated. See following.	
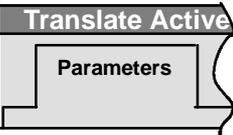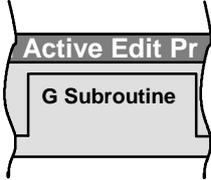
Translate Active Edit Program

Parameters	**G Subroutines**	M Codes	System Registers

G _ Code Number

999

G - Code Number	Translation Text
999	
0	
0	
0	
0	
0	
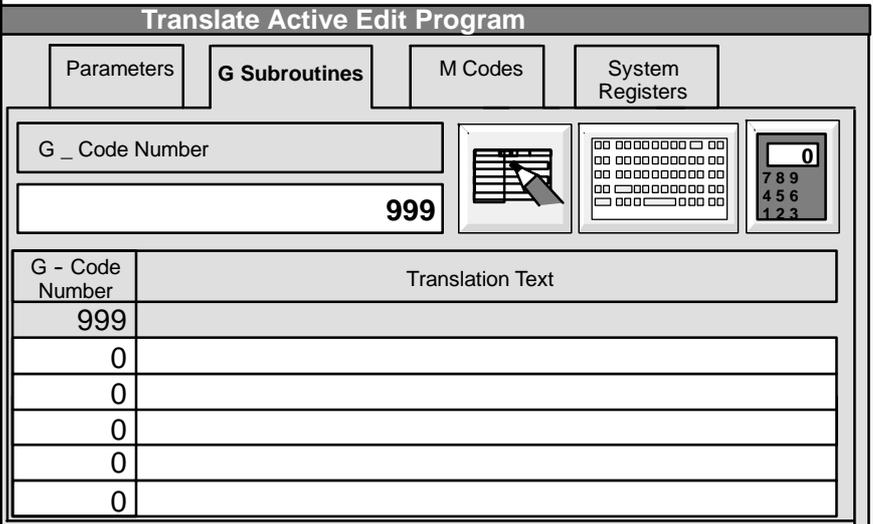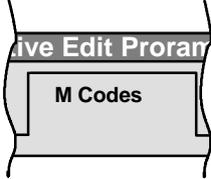
ive Edit Proram / **M Codes**	Touch M Code Display.
The following display will appear:	

Set-up Translator	
Touch, press or set the following	**Comments**

Translate Active Edit Program

Parameters	G Subroutines	**M Codes**	System Registers

M _ Code Number

0

M – Code Number	Translation Text
0	
0	
0	
0	
0	
0	

	Comment
M – Code Number	Touch M code table value to be changed or added.
Keyboard	Key in M code number in Source Program to be translated.
Translation Text	Touch translation text field opposite M code.
Keyboard	Enter Translation data.
M – Code Number 999	When all translations have been made, enter 999 in last data field to Speed up the translation process.

Below are some sample values:

M – Code Number	**Translation Text**
01	M01
21	$(INV, X1)$
49	M48
999	

The following feature is only used with Fanuc Part programs.

Set-up Translator	
Touch, press or set the following	**Comments**
System Registers	Touch system register table.
The following display will appear.	

Translate Active Edit Program

Parameters	G Subroutines	M Codes	**System Registers**

System Reg. Number

0
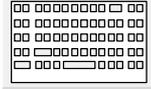
System Reg. Number	Translation Text
0	
0	
0	
0	
0	
0	

System Reg. Number	Touch system register table cell to be changed or added.
Keyboard	Enter System Register Number.
Translation Text	Touch translation text cell opposite number.
Keyboard	Enter Translation data.
System Reg. Number 9999	When all translations have been made, enter 9999 in last data field to speed up the translation process.

Set-up Translator	
Touch, press or set the following	**Comments**
Below are some sample values:	

System Register No.	Translation Text
5001	$CURPOS_PGM(X)$
5002	$CURPOS_PGM(Y)$
5003	$CURPOS_PGM(Z)$
9999	---

✓ **Commit Changes**	
✗ **Cancel**	

Translate Part Program	
Touch, press or set the following	**Comments**
NC Programs ▷	It will be assumed that the Part Program is present in program directory.
Edit This Program ▷	
◀ **More Features**	
The following display will appear:	
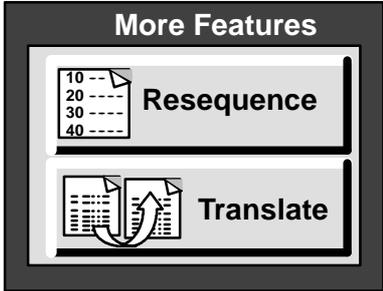
More Features

Resequence

Translate

Translate	Proven standard part program types may be: FanucRSeries 0-MC, FanucRSeries 0-TC, A850SX and A950. FanucR is a trademark for Fanuc LTD.
The following display will appear:	

Translate Part Program	
Touch, press or set the following	Comments

Translate Active Edit Program

Translation Type

A850SX 〈

Fanuc 〈

A950 〈

Translate the active edit program with the selected translation type. The translation will be placed in the alternate edit buffer as an untitled program.

Setup   ?

✓Translate   ✗Cancel

NOTE: A950 translation is not available with Current Release.

✓Translate	The translation starts from the beginning of the program and will be stored in the second buffer. If successful, the program should be saved to a new filename by the editor.

NC EDIT

Edit – Untitled

			Unchanged	Insert

(Original Part Program Text)

(Translated Text In A2100 Format)

Q W E R T Y U I O P ←

A S D F G H J K L Enter

Cap Z X C V B N M ≫MORE Χ

Miscellaneous

Calibrate The Display Screen	
Touch, press or set the following	**Comments**
	View screen from normal level location.
Ctrl Alt	Press and hold both. They are located on the Operator's control station. **NOTE:** The same procedure can be accomplished by pressing **System Configuation** and **Touchscreen** area.
Touchscreen	Touch the display screen anywhere.
	Touch and hold center of target located in upper left portion of display until OK appears.
	Touch center of target positioned in lower right portion of screen until OK appears. Calibration completed.
HOME	Touch to return to Home menu screen.
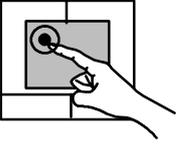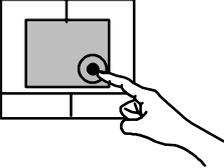
Change Home Menu	
Touch, press or set the following	**Comments**
HOME	
DISPLAY	
The following display will appear:	

Change Home Menu

Select a Display

Display Groups

	Axis Displays ◆
	Offset Displays 〉
	Other Displays 〉

Select Axis Display

Production
Current
To Go
4 View
Limits
Servo
Servo Setup

Menus

	Home Menu 〉		Plotter Menu
	Coordinate Setup Menu ◆		Table Menu
	Axis Setup Menu 〉		Drawing View Menu
	Program Functions Menu 〉		Cycle Parameters Menu
	Counter/ Time Menu 〉		More Menu Selections

| | Setup Home Display | ✓ | ✗ |

	Axis Displays ◆
	Offset Displays 〉
	Other Displays 〉

Touch one of the three display groups.

One of the following display groups will appear:

Display Groups

	Axis Displays ◆
	Offset Displays 〉
	Other Displays 〉

Select Axis Display

Production
Current
To Go
4 View
Limits
Servo
Servo Setup

Display Groups

	Axis Displays 〉
	Offset Displays ◆
	Other Displays 〉

Select Offset Displays

Pallet Offsets
Multi Setup Offsets
Fixture Offsets
Prog. Coord Offsets
Prog. Tool Offsets
Machine Offsets

Display Groups

	Axis Displays 〉
	Offset Displays 〉
	Other Displays ◆

Select Other Displays

Programs
System Registers
Variables
View Drawing
Plotter
Cycle Parameters
Program Parameters
Process Control Data
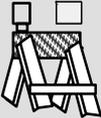

| | Setup Home Menu |

Change Home Menu

The following display will appear:

Start Modification?

? **Do you want to modify your home menu?**
NOTE: Prompts will appear at bottom of
the screen to assist you.

✓ **Modify**   ✗ **Cancel**

✓ **Modify**

The following display will appear:

Modifying Home Menu | **Which button do you want to modify? Choose the HOME button [bottom right] or any home menu button.**
NOTE: 2nd column buttons are optional and won't appear if left blank. | ✗ **Cancel**

HOME

HOME   In this example: Home Menu.

Redefine or Remove?

? **Do you want toredefine your home menu buttton Row 4, Column 1, or remove it**

✓ **Redefine**   🚫 **Remove**   ✗ **Cancel**

✓ **Redefine**

The following display will appear:

Change Home Menu

Select button function

What do you want the button to do? Select a function from the buttons on the left, below.

Production Display

Current Display

Counter/ Time

To Go Display

Offsets

NC Part

Edit This

NC Program Display

─── Button Functions ───

Change Display Only ⟩	if possible, leave menu unchanged
Change Menu Only ⟩	if possible, leave display unchanged
Change Display and Menu Only ⟩	✓ OK
Perform an Action ⟩	✗ Cancel

Modifying Home Menu — Select what you want the HOME button to do and press the green check.

✓ OK	Select the function desired, then touch OK.

When the Select a Display window appears, touch desired menu button. The green arrow button becomes active.

✓	

Change Home Menu
Key in desired menu button name or touch Save to use current selection caption.

Ready to Save

Choose a Caption
The Button text will read "Cycle Parameters Functions", or type in your own text below:

Press Save to assign this menu to the home menu, or press Cancel.

✓ Save	✗ Cancel

Ⓢ Stop	When the Continue Modifying Home Menu window appears, touch Stop to discontinue changes.

NC Programming Execution (system configuration)	
Touch, press or set the following	Comments
Used to set part program default conditions. Functions in this window are selectable from the **Setup** password level. Refer to Appendix B for a definition of what each selection does.	
≫ MORE	
System Configuration	
NC Programming	
The following display will appear: Touch **General** field if Modes or Circular is selected.	

NC Programming Execution (system configuration)

Touch, press or set the following	Comments
NC Program Execution	
General · Modes · Circular	
Colon Block	
Colon Required ☑	
CDC	
Report CDC Errors ☑	
Report Alarms	
Report PRT Alarms ☑	
Inch 1/4 · Metric .1	
Backup Restore	
At Colon Block	
Reset Fixture Offsets ☑	
Constant Feedrate ☐	
Report WTF Alarms ☑	
Print	
Reset Programmable Offsets ☑	
Glide On/Off ☑	
Report COM Alarms ☑	
Commit Changes	
Reset Programmed Rotation ☑	
Cancel	
Touch the desired menu buttons to activate or deactivate.	
✓ **Commit Changes**	After Menu selection is finished, touch this button to commit changes.
✗ **Cancel**	To abort selections, touch cancel.
Touch **Modes** field if General or Circular is selected. Modes is used to set Default Modal G Codes when Data Reset is activated, or end of program is encountered.	
NC Program Execution	
General · **Modes** · Circular	
Default Modal G Code	
👉 **G 0 – Rapid**	
G18 – ZX Plane	
G60 – Positioning	
G71 – Metric (mm)	
G70 – English	
G90 – Absolute	
Inch 1/4 · Metric .1	
Backup Restore	
Print	
Commit Changes	
Cancel	
G18 – ZX Plane	Touch to highlight desired field.
👉 **G17 – XY Plane** / **G18 – ZX Plane** / **G19 – XY Plane**	Touch to activate selections and then touch desired selection.

NC Programming Execution (system configuration)

Touch, press or set the following	Comments
✓ **Commit Changes**	After selection is finished, touch this button to commit changes.
✗ **Cancel**	To abort selections, touch Cancel.

Touch **Circular** if General or Modes is selected. Circular is used to set the Circular G2/G3 Endpoint Tolerance, and select Center Specification part program functions.

NC Program Execution

General	Modes	**Circular**	

Circular (G2/G3)

Endpoint Tolerance

+0.2540

Center Specification

G90/91 Switchable

| ⊢■─1/4 **Inch** | ⊢■─.1 **Metric** |

Backup / Restore

Print

✓ **Commit Changes**

✗ **Cancel**

Touch, press or set	Comments
G90/91 Switchable	Center Specification: Touch to highlight desired field.
👆	Touch to activate selections and then touch desired selection.
✓ **Commit Changes**	After selection is finished, touch this button to commit changes.
✗ **Cancel**	To abort selections, touch cancel.

Activate Security Level

Touch, press or set the following	Comments
≫ **MORE**	
System Configuration	
The following display will appear (partial view):	

Activate Security Level	
Touch, press or set the following	Comments

Configuration

🔓 Security	📠 Serial Comm Ports	📦
NC Programming	📞 Communications	▭
Tool	Public Interface	
Machine Application	Purchased Option	FEB 1 / FEB 2
Axes	Add On Software	🌍
R G C +⊗ -H Servo		
Error Compensation		

🔓 Security	

The following display will appear:

Security

Password	Function Locks	Program Privileges	

Current Level =Service

Enter Password:

| `|` |

Reset Passwords

Change Passwords

Keyboard

Backup

Restore

Print

✔ OK

✖ Cancel

Activate Security Level	
Touch, press or set the following	**Comments**
To Reset Passwords:	
IF **Reset Passwords** **IS TOUCHED**	The Reset Password menu button is used to return password names to their default settings (Setup, Service). When this button is touched, the reset which occurs will depend on the current level you are in. For example, if the Service level is active, both Setup and Service will be returned to their default settings. However, if you are in the Setup level, only Setup will be reset, the Service level will not be effected.
Reset Passwords **OR** **Change Passwords**	**Password Levels** **Current=Operator:** Operator level is the default and does not have a password. This level is used for standard machining operations and control usage. **Current=Setup:** The setup level allows modification of tooling tables, NC programming defaults and part related offset tables. **Current=Service:** Provides access to service related functions and machine setup parameters. Functions under the Service password also include all Setup level password functions.
To Change Passwords:	
IF **Change Passwords** **IS TOUCHED**	Password changes are applied to the Current Level. For example, on the previous screen illustration, the Current Level selected is Service.
Keyboard	Key in New Password. Refer to the procedure "Keying In Data". **NOTE: Always document new passwords.**
Enter	When the Verify field appears, reenter password name and again press the Enter button.

User M Codes (M70 - 79) Execution [Option]	
Touch, press or set the following	**Comments**
`>> MORE`	
[System Configuration icon] **System Configuration**	
Configuration	
Security	
NC Programming	
Tool	
M 70 — M 70's	
Machine Application	
Purchased Option	
Axes	
Add On Software	
Servo	
Window COM Ports	
Error Compensation	
M 70 **M70's**	
The following display will appear:	

User M Codes (M70 - 79) Execution [Option]

Touch, press or set the following	Comments

M70 Series

General

M70

Turn Off Method
M Code

Hold Program □

Executed
Start Of Span ❯
End Of Span ◆

Signal
Normally On □
Normally Off ◆

Pulse Width
+ 0 msec

Time Before Alarm
+ 0 sec

Backup

Restore

Print

OK

Cancel

Turn Off Method

M Code

Pulsed
Feedback 0
Feedback 1
Feedback 2
Feedback 3
Feedback 4
Feedback 5
Feedback 6
Feedback 7
Feedback 8
Feedback 9

On □

Off ◆

Select desired field.
Refer to Appendix B for definitions.

Note: Feedback 0 thru 9:
Only select one feedback per M Code. However one input can be used for each M code if so desired.

KEYBOARD TRACKBALL

SPEAKER

COM 1

COM 1 Port
Located on right side of Operator control

Connect a PC to the A2100E Control System

Data (Part Programs, Tooling data, etc.) can be transferred to and from the A2100 control system via the RS232 serial port. This can be connected to a PC (Personal computer) using the following guidelines. The RS232 port will often be referred to as COM1: within the A2100 file transfer dialogue.

Data cable connections using full Hardware Handshaking.

P.C. RS232 data port
9 PIN D TYPE

Machine RS232 data port
25 PIN D TYPE

P.C.	Pin			Pin	Machine
TD	3			3	RD
RD	2			2	TD
RTS	7			5	CTS
CTS	8			4	RTS
SG	5			7	SG
DSR	6			6	DSR
DCD	1			8	DCD
DTR	4			20	DTR
FG					
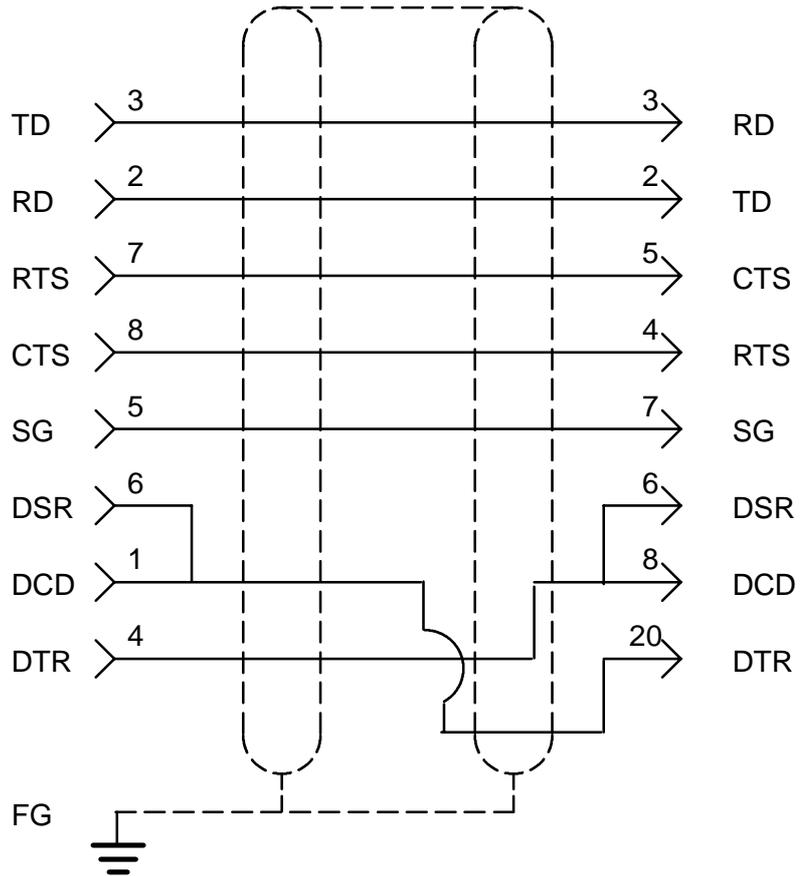
For a PC with a 9 pin RS232 data port

Connect a PC to the A2100E Control System

P.C. RS232 data port
25 PIN D TYPE

Machine RS232 data port
25 PIN D TYPE
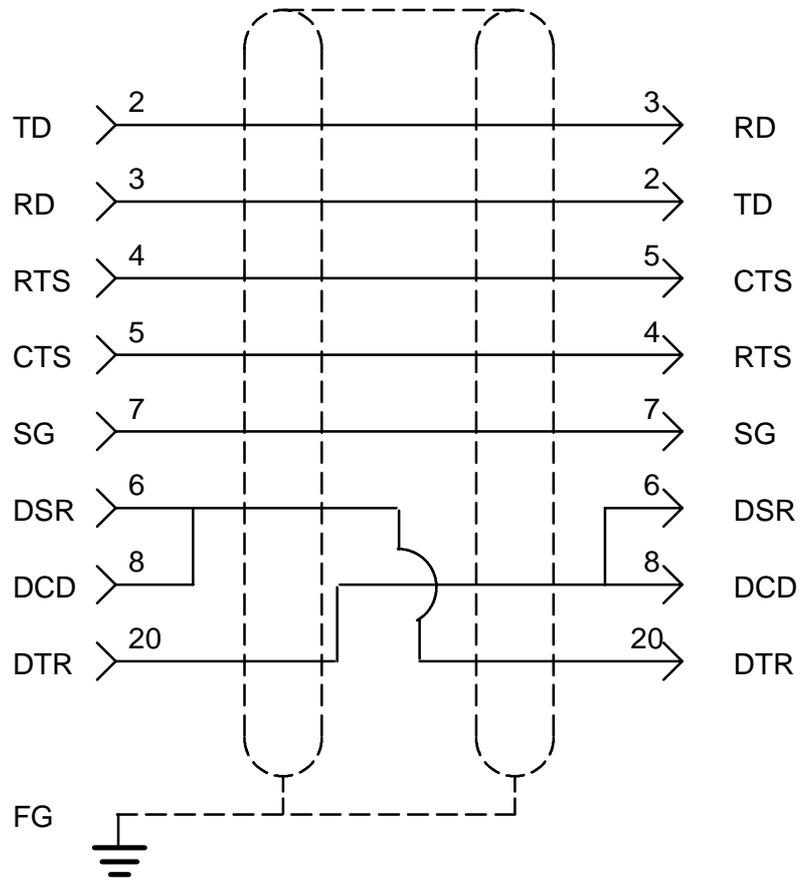
For a PC with a 25 pin RS232 data port

The RS232 transmission configuration can be changed via the

Serial Comm Ports

Serial Communication Port setting applet under the **More** menu to control the following transmission parameters:

Handshaking	Hardware or Software (Xon/Xoff)
Baudrate*	110 to 256,000
Data bits	6, 7, 8
Stop bits	1, 1.5, 2
Parity	Odd, Even, Mark, Space

* **NOTE:** Although the Baudrate is selectable up to 256 KBaud it is recommended that the maximum Baudrate be limited to 19.2 KBaud.

Connect a PC to the A2100E Control System

Communications

Device Data	**Hardware Data**	Protocol Data

Hardware
COM1 – Connected

Data Rate:	9600	CTS Output:	Enable
Data Bits:	8	DSR Output:	Enable
Stop Bits:	1	DSR Sense:	Enable
Parity:	None	Xon Xoff:	Disable
DTR Control:	Handshake	Xon Character Code:	17
RTS Control:	Handshake	Xoff Character Code:	19

- Backup
- Restore
- Print
- ✓ Commit Changes
- ✗ Cancel

For Full Hardware Handshaking the following Communication port set-up is recommended.

Data Rate	9600	CTS Output	Enable
Data Bits	8	DSR Output	Enable
Stop Bits	1	DSR Sense	Enable
Parity	None	Xon Xoff	Disable
DTR Control	Handshake	Xon Character Code	17
RTS Control	Handshake	Xoff Character Code	19

	Data File Format
	Files transmitted to and from the control system use the ASCII character set. The End of Line sequence must be Line Feed – Carriage Return (Hex 0D, 0A). Refer to Device Data and Protocol Data and make any needed selections.
HOME	
NC Programs	
Transfer Program In	
Comm Ports ◆	
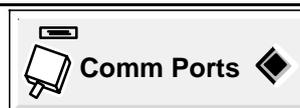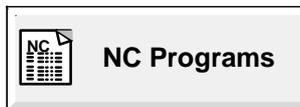
Connect a PC to the A2100E Control System	
✔ OK	
✔ Start Transfer	Highlight desired program on PC and send program. Assign name to program being entered. After transfer, verify program name is in list of control programs.

Search Program For Cycle Execution	
Touch, press or set the following	**Comments**
Search to alignment (:) block ⬇ or ⬆ **- OR -** ⤓ or ⤒	To begin NC program execution the active program must be synchronized. The program is synchronized whenever it is searched/positioned to an alignment (:) block. An alignment block is the first NC block used to cycle the machine and is normally programmed at the beginning of each different operation within the programmed cycle.
M02	The active program is automatically aligned to first block (alignment block) and synchronization occurs for the start of the next cycle.

Resume Cycle After Losing Synchronization	
Touch, press or set the following	**Comments**
	Search program to nearest alignment (:) block.
	– Depress DATA RESET with cycle stopped. – In Milling cycle applications the cutter must retrace its programmed path until encountering the work surface at the original point of interruption. – In Hole Making cycle applications in which a number of holes have been previously machined and need to be ignored, the operator may select a skip cycle mode. Select both the Single Block and Single Loop functions. – Power feed the Axes to place tooling clear of work/fixtures. – If program contains G92, See WARNING. –Ensure machine and tool Changer is in a safe condition to resume the NC cycle. – Press CYCLE START and observe screen for any message/instructions. – Depress CYCLE START again, if necessary.

Format A Diskette	
This feature requires the floppy disk option. Formatting prepares a floppy disk so that the file information can be stored on it and retrieved from it. When you format a disk, File Manager removes all the information from it and writes new directory information to it.	
Touch, press or set the following	**Comments**
⟩⟩ **MORE**	
▤ **File Manager**	
Insert floppy into Drive A:	Usually the format capacity of the floppy disk drive is 1.44MB.

Format A Diskette	
Touch, press or set the following	**Comments**
[floppy disk icon] **Floppy A**	

Format A: **Insert Floppy into Drive A:**   **WARNING: Data on disk will be lost!**   [✓] **Format A**

Change Program Parameters	
Changes can be made to parameters associated with each NC program. **Only experienced personnel, totally familiar with with the machine operation and programming, may be permitted to make these type of changes.** Exact information and illustration may vary somewhat from that shown depending on machine type, application and options supplied. The NC program will access these parameters when ever the correct notation appears. **NOTE:** Values shown are for reference only and do not represent any particular machine application. Example: [&<param>]where <param> is the letter A through Z. For this example the following program will be used to modify program parameters. :G0 G1 X[&X] Y[&Y] Z[&Z] F[&F] M2	
Touch, press or set the following	**Comments**
[HOME icon] HOME	
[DISPLAY icon] DISPLAY	
The following display will appear:	

Change Program Parameters

Select a Display

Display Groups
- Axis Displays
- Offset Displays
- Other Displays

Select Axis Display
Production
Current
To Go
4 View
Limits
Servo
Servo Setup

Menus
- Home Menu
- Coordinate Setup Menu
- Axis Setup Menu
- Program Functions Menu
- Counter/ Time Menu
- Plotter Menu
- Table Menu
- Drawing View Menu
- Cycle Parameters Menu
- More Menu Selections

Setup Home Display

Other Displays	
Other Displays	Touch to change.
✓	
Program / System Registers / Variables / View Drawing / Plotter / Cycle Parameter / Process Control Da	Touch to highlight.
✓	The Program Parameters Table will be displayed.

Change Program Parameters

Modify Parameters

A	+0.00000	P	+0.00000	
B	+0.00000	Q	+0.00000	**Reset Selected**
C	+0.00000	R	+0.00000	
D	+0.00000	S	+0.00000	
E	+0.00000	T	+0.00000	**Reset All**
F	+520.00000	U	+520.00000	
G	+0.00000	V	+0.00000	
H	+0.00000	W	+0.00000	
I	+0.00000	X	+0.00000	
J	+0.00000	Y	+0.00000	
K	+0.00000	Z	+0.00000	
L	+0.00000	G9	+0.00000	
M	+0.00000	G50	+0.00000	
N	+0.00000	G58	+0.00000	
O	+0.00000	Resrv	+0.00000	

The Program Parameters Table will be displayed. From the above sample program place values in the appropriate fields.

In the table touch X to highlight. Key in the value and press the ENTER button. The value entered will turn blue in color. Repeat this procedure for each changing letter in the program.

When a program contains the parameter notation, the modified parameters will be acted on.

NOTE: Modified Parameter entries remain in effect until changed. Each time a program is selected to run, the following message will be displayed.

If Yes is touched, all Program Parameter Table entries return to the default state Not Programmed.

If No is touched, Program Parameter Table entries remain in effect.

Program Parameters Present

The program parameters contain modifications. Do you wish to reset the program parameters to their default settings?

✓ **Yes**   ⊘ **No**

Change Cycle Parameters

Changes can be made to parameters associated with each NC Cycle operations. This table is supplied with a set of configurable default values established at machine installation. Values in this table can be overridden programmatically or entered at the machine. **Only experienced personnel, totally familiar with with the machine operation and programming, may be permitted to make these type of changes.** Exact information and illustration may vary somewhat from that shown depending on machine type, application and options supplied.

Touch, press or set the following	Comments
HOME	
DISPLAY	

The following display will appear:

Select a Display

Display Groups

- Axis Displays ◆
- Offset Displays ❯
- Other Displays ❯

Select Axis Display

Production
Current
To Go
4 View
Limits
Servo
Servo Setup

Menus

- Home Menu ❯
- Coordinate Setup Menu ◆
- Axis Setup Menu ❯
- Program Functions Menu ❯
- Counter/ Time Menu ❯
- Plotter Menu
- Table Menu
- Drawing View Menu
- Cycle Parameters Menu
- More Menu Selections

- Setup Home Display ✓ ✗

Cycle Parameters Menu	Touch to highlight Cycle Parameters Menu.
✓	
Drilling	Touch to highlight Cycle Parameters Table button if table is not active.

Change Cycle Parameters

NC Program Execution

| Drilling | Probing | Mililling | |

Drilling Cycle Parameters	Program Reference	Base Value	Programmable Value
Gauge Height Incg	GAGE_HT_INCH	+0.00000	+0.10000
Gauge Height Metric	GAGE_HT_MM	+0.00000	+0.11811
Hole Depth Program Mode	HOLE_DPTH	+0	+3
G82 Finish Depth	G82_FIN_DEPTH	+0.00000	+0.00000
G82 Finish Feed Factor	G82_FEED_FAC	+0	+100
G82 Dwell Time	G82_DWELL	+0.00	+0.50
G83 Retract Distance	G83_RET_DIST	+0.00000	+0.04921
G83 Short Retract Distance	G83_SHRT_RET	+0.00000	+0.39370
G83 Relief Amount	G83_RELIEF	+0.00000	+0.04921
G84 Dwell Time	G84_DWELL	+0.00	+0.50
G84 Chip Break Spindle Rev	G84_CHIP_BRK	+0	+1
G86 Bottom Retract Distance	G85_BOT_RET	+0.00000	+0.04921
G87 Dwell Time (seconds)	G87_DWELL	+0.00	+0.50
G87 Bottom Retract Distance	G87_BOT_RET	+0.00000	+0.04921
G87 Backbore Clearance	G87_BK_CUR	+0.00000	+1.96850
G88 Breakthrough Distance	G88_BRK_DIST	+0.00000	+0.39370
G89 Dwell Time (seconds)	G89_DWELL	+0.00	+0.50

NOTE: Changes made to the Cycle Parameters Table remain in effect until changed at the machine or in the program. When the Reset All To Default, or Reset To Default menu buttons are touched, configurable default values in the Base Value column will be copied to the Programmable Value column:

G80
J1
M2

Individual Cycle Parameters can be reset to the configurable default value by programming J81 through J89. The following example program segment will reset G84 Dwell Time to the configurable default value.
....
G80
J84
M2

Set Parts Counter

DISPLAY	
Counter/ Time Menu ⟩	
✓	
Parts Counter ◆	

Set Parts Counter
The following display will appear:
NOTE: Items shown will vary with machine type/options.

Part Counters

Part Counter Display

	Part Count	Required Parts	
Total ◆	+0	--- +55	Reset Total
Pallet ❯	+0	--- +0	Reset Pallet
Setup ❯	+0	--- +0	Reset Setup
		● Close	
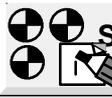
To enter a value in the Required Parts field, touch to highlight, enter number, and press Enter.

To reset a current Part Count several options are provided.

Reset Total:
    The total part count is zeroed.

Rest Pallet:
    Part count for the current active pallet is zeroed.

Rest Setup:
    Part count for setups marked active are zeroed.

● Close

The Total Parts count entered will appear in the display status area of the screen.

Modal G States
G 0.0 RAPID
G 17.0 XY Plane
G 31.1 Nomal Mode
G 40.0 CDC Off
G 46.0 Acc/Dec Off
G 68.0 Positioning
G 71.0 Metric Units
G 91.0 Incremental

Total Parts   +0   +55 ⬅
Stopwatch   00:00:02

Touch to clear window.

Cincinnati Machine 91203809-001

Page 5-69

Probe Calibration	
Touch, press or set the following	**Comments**
The Probe must be calibrated before it can be used. Two Probe cycles, G72 and G74, are used to calibrate the Probe Stylus dimensions and length. Once this procedure has been performed, the probe will locate parts along the X, Y and Z axes. Prior to calibrating the probe, ensure that the Tool Data Table contains: an approximate length and PROBE as tool type. The following example procedure is for reference purposes. Due to the numerous workpiece configurations, tooling and set-up possibilities this procedure is to be used as a guide. Refer to the Programming manual for additional probe information.	

G72 Set Stylus and Tip Dimensions	
Touch, press or set the following	**Comments**
HOME	
MDI	
 Probe Body Optical Transmitter Stylus	The exact centerline and diameter of a bored hole must be known prior to performing the following procedure. This can be accomplished by making a finished boring cut with a boring bar, by tramming an existing bore with a dial indicator, or by utilizing an existing bored hole that is at a predetermined location on the table or fixture. The stylus should be as close as possible to the spindle centerline and the reference bore should be as large as feasible.

G72 Set Stylus and Tip Dimensions	
Touch, press or set the following	**Comments**
Vice	– Load the Probe into the spindle [TxxxM6]. Using your finger, lightly tap the stylus. The message "Unexpected Hit Probe Cycle" should appear on the screen. If this message doesn't appear, the Probe isn't functioning properly. DO NOT use the Probe until the cause of malfunctioning is found and corrected. If the message does appear, clear the alert or press Data Reset to extinguish the alarm and rearm the Probe. – Position the spindle center line to the exact centerline of the reference bore and feed the stylus tip until it is fully within the bore.
	– In MDI, enter G72Pxxx, where Pxxx is the exact diameter of the reference bore. – Press Cycle Start, the Probe will begin the calibration cycle making a series of X and Y moves to determine the stylus size and amount that is offset from the true spindle centerline. When the G72 begins, all previous data concerning stylus size and Offset is erased, so be sure not to interrupt the cycle once it has begin, unless an emergency situation is encountered.
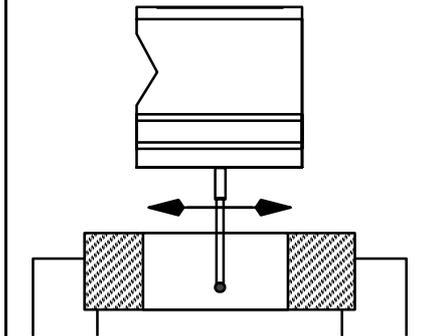
G72 Set Stylus and Tip Dimensions	
Touch, press or set the following	**Comments**
	The G72 will enter four pieces of information into the control that can be checked to ensure proper calibration has taken place: X+ probe tip radius, X− probe tip radius, Y+ probe tip radius, Y−probe tip radius. **NOTE** These dimensions are all within a few tenths (.0001 in.) of each other. If there seems to be a greater variance, recalibrate the Probe. Also, in the Tool Table, the X and Y Probe offset values reflect the amount that the tip of the stylus is offset from the spindle centerline. The stylus tip dimensions are stored in Cycle Parameter Table entries: +X Stylus Tip Dimension −X Stylus Tip Dimension +Y Stylus Tip Dimension −Y Stylus Tip Dimension This completes the stylus calibration in the X, Y planes.

G74 Set Probe Length	
Touch, press or set the following	**Comments**
The following example procedure is for reference purposes. Due to the numerous workpiece configurations, tooling and set-up possibilities this procedure is to be used as a guide. Refer to the Programming manual for additional probe information.	
HOME	
MDI	

Caution 1

If T0 is not displayed, an erroneous Tool Length Set could occur resulting in subsequent damage to the workpiece, fixture and machine.

Caution 2

Do not feed the spindle face/tool tip into the set-up gauge block. Move the Z axis a small increment and then slide the gauge block between the spindle face or tool tip and the workpiece/fixture or machine table until a proper precision slip-fit is achieved. Move the gauge block clear before moving the Z axis. Failure to follow this instruction may result in damage to machine components.

G74 Set Probe Length	
Touch, press or set the following	**Comments**
Set Z Axis Position	
Spindle Face · Gauge Block · Table	Prior to using the Probe G74, an exact Z axis position of a surface must be known. To determine the exact position of a surface, perform the following: - Remove tool from spindle. See *Unload Tool From Spindle.* - Ensure that T0 (Tool Zero) is the Active Tool displayed on the screen. See **Caution 1.** - Power feed the non rotating spindle face in X and Y axes over the surface to be used to set the probe, example 6.000 in. gauge block height. - Place 6.0000 in. height gauge block on top surface of table or workpiece. Manually jog Z axis until spindle face is close to top surface of gauge block. - Using the handwheel and small increments, move Z axis until the spindle face barely touches top of gauge block - see **Caution 2**. A snug slip fit (feel) between the spindle and the top of the gauge block is required. - Record the current Z axis position displayed on the control screen.
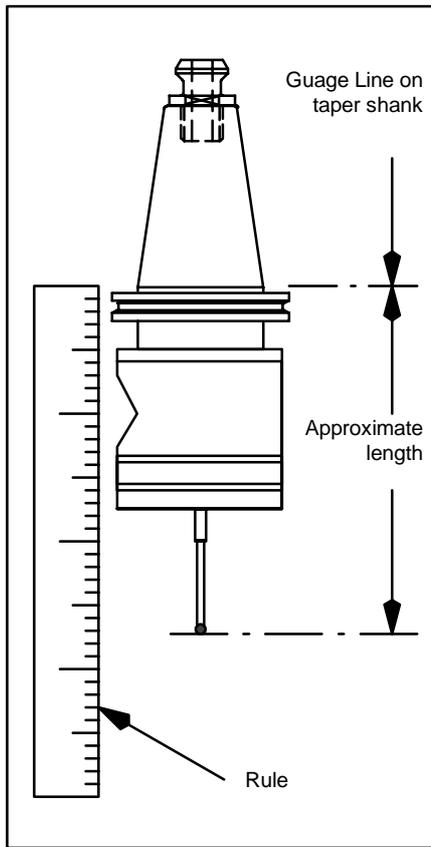
Probe length approximation

G74 Set Probe Length

Touch, press or set the following	Comments
Gauge Block — Table Surface	– Setup the Probe, refer to manufacturers documentation. – Load the Probe/holder into the Spindle, TxxM6. – Enter against the appropriate record in the tool table; – 'Probe' as the Tool Type. – An approximate length of the probe within 0.1" (3mm). See figure. – Position probe in X and Y axes so the probe tip is in close proximity over the top surface of the gauge block. – In MDI, Enter G74 Zxxx, where xxx is the Z axis coordinate of the top of the gauge block. – Press Cycle Start. The Probe will move the Z axis slide to "find" the surface, and the dynamic length of the probe will be determined and automatically stored in the Tool Length column in the Tool Data table. The length calibration is complete. – The Z coordinate need not be programmed if the top surface of the gauge block also represents the specified Tram Surface value in the Cycle Parameter table.

Appendix A
Program Reference Data

ADDRESS	USAGE
Type I Block Word Addresses	
N	Sequence Number
:	Sequence Number (Alignment Block)
G	Preparatory Code (Command)
XYZUVW	Linear Axis Command Word
ABC	Rotary Axis Command Word
,C	Chamfer blend
I	Axis Interpolation Parameter: With G2/G3, X circle center With G24–G27, G38–G39, Cycle specific actions With G75–G79, nominal axis position With G150/G151, Scaling reference point
J	Axis Interpolation Parameter: With G2/G3, Y circle center With G75–G79, nominal axis position With G24–G27, G38–G39, G80–89, Cycle Specific definitions With G150/G151, Scaling reference point
K	Axis Interpolation Parameter: With G2/G3, Z circle center With G75–G79, nominal axis position With G24–G27, G38–G39, G80–89, Cycle Specific definitions With G150/G151, Scaling reference point
PQR	Cutter Diameter Compensation normal vector
F	Feedrate Dwell Time Change in threadlead per revolution
P	With G2/G3, Circle Arc Radius With G28, Return to Reference Point With G24–G27 Cycle specific actions With G36 Pattern activation parameter With G68–G69, tool probe cycle type
Q	With probe cycles, single/double hit With G24–27, Cycle type
R	Fixed Cycle Clearance Plane CSS initial radius With G38–G39, G68–G69, Cycle specific actions
,R	Blend radius With G24/G24.1 Frame corner radius
E	Polar Coordinate Programming Angle With probe cycles, control response to probe
L	Polar Coordinate Radial Distance
O	Tool Length/Diameter Compensation Selector With G24–27 G38–G39, Cycle specific definitions
D	Programmable Offset Selector With G38–G39, Cycle specific actions,
,D	Slowdown modifier
H	Fixture Offset Selector
M	Miscellaneous Function

Type I Block Word Addresses

S	Spindle Speed Spindle orientation angle Dwell Duration in Spindle Revolutions With G92/G92.1 max allowable Spindle Speed in RPM With G38–G39, Cycle specific actions
T	Tool Number
U	With G24–27, Cycle specific definitions
V	With G24–27, Cycle specific definitions
W	With G24–G27, G38–G39, G81–G89, Final retract distance

Type II Block Listing

MNEMONIC	NAME	USAGE
ALM	Report Alarm	Report an Alarm
ATR	Automatic Tool Recovery	Specifies Program Start Point for exception Handling (Option)
CHN	Chain to Program	Loads and executes another NC program
CLS	Call Subroutine	Call NC program subroutine
COM	Communications	Send message to host system
DAI	Data Acquisition Initialization	Set up for data to acquisition feature
DAS	Data Acquisition Save	Writes acquired data to active file
DFS	Define Subroutine	Defines start of NC program subroutine
DWG	Drawing	Selects and displays a drawing
ENS	End Subroutine	Defines the end of an NC program subroutine
FIL	File Specification	Specifies destination file for subsequent block
INP	Operator Input	Request numeric input from operator (Option)
INV	Axis Invert	Specifies axis invert status
JRN	Write to Journal	Writes a timestamped record to a system journal
MSG	Message	Displays a message for the operator
PAG	Page	Specifies paging for print output (Option)
PGM	Program	Specifies program name and attributes
PRT	Print	Writes a line to a printer (Option)
OPR	Operator Query	Request YES/NO answer from operator (Option)
ROT	Rotate	Rotates NC program coordinates in selected plane
SHI	Set High Limit	Sets high axis limits
SLO	Set Low Limits	Sets low axis limits
WTF	Write To File	Write message to the selected file (Option)

G Code Table Listing

Any program block can contain at most one code from each group. All codes except those in the Non-modal and Non-modal modifier group are *modal*, i.e., once a value is programmed it is effective until it is changed by programming another code from the same group. Each modal group has a default state, most of which are configurable. The codes marked "*" in the table are configurable reset states. Groups whose reset state is not configurable (such as CDC, which must default to "off" or G40, have the fixed default state shown with a double asterisk, "**"). The default state is made active at control power on, by a Data Reset, and at End of Program. Additionally, each modal group is also reset to its default state when an Alignment Block (: word) is encountered. Non-modal codes marked "Non-modal modifier" are permitted in blocks containing motion and modify the motion (G9) or the interpretation of the axis word values (G50, G98, and G98.1).

G Code		Group
G0*	Rapid Traverse (linear)	Interpolation
G1*	Linear Interpolation	Interpolation
G2	Circular/Helical CW	Interpolation
G2.01	Circular/Helical CW (absolute)	Interpolation
G2.02	Circular/Helical CW (incremental)	Interpolation
G3	Circular/Helical CCW	Interpolation
G3.01	Circular/Helical CCW (absolute)	Interpolation
G3.02	Circular/Helical CCW (incremental)	Interpolation
G4	Dwell	Non-modal
G7.1	Cylindrical Interpolation	Interpolation
G8	Suppress Interpolation	Interpolation
G9	Exact Stop	Non-modal Modifier
G12	Contouring Rotary Axis Unwind	Non-modal
G13.1**	Cylindrical Interpolation Off	Interpolation
G15.1*	Polar Coordinate Programming (bolt circle)	Polar Program Mode
G15.2*	Polar Coordinate Programming (part contour)	Polar Program Mode
G17*	XY Plane Select	Plane Select
G18*	YZ Plane Select	Plane Select
G19*	ZX Plane Select	Plane Select
G22, 22.1	Milling Cycle Rectangular Face	Interpolation
G23, 23.1	Milling Cycle Rectangular Pocket	Interpolation
G24, 24.1	Milling Cycle Rectangular Inside Frame	Interpolation
G25, 25.1	Milling Cycle Rectangular Outside Frame	Interpolation
G26	Milling Cycle Circular Face	Interpolation
G26.1	Milling Cycle Circular Pocket	Interpolation
G27	Milling Cycle Circular Inside Frame	Interpolation
G27.1	Milling Cycle Circular Outside Frame	Interpolation
G28	Auto Return to Reference Point	Non-modal
G29	Auto Return From Reference Point	Non-modal
G36	Move to Next Operation Location	Non-modal
G36.1	Test for End of Pattern	Non-modal
G37*	Cancel Pattern	Pattern Cycles
G38	Rectangular Pattern	Pattern Cycles
G39	Circle Pattern	Pattern Cycles

G Code		Group
G40**	Cutter Diameter Compensation OFF	CDC
G41	Cutter Diameter Compensation On LEFT	CDC
G42	Cutter Diameter Compensation On RIGHT	CDC
G43	PQR Cutter Diameter Compensation On	CDC
G45*	Acceleration/Deceleration ON	Acceleration/Deceleration
G45.01, 45.02, 45.03	User Specific Acceleration	Acceleration/Deceleration
G45.1	Acceleration/Deceleration ON (Die Roughing)	Acceleration/Deceleration
G45.2	Acceleration/Deceleration ON (Die Finishing)	Acceleration/Deceleration
G46*	Acceleration/Deceleration OFF	Acceleration/Deceleration
G50	Pallet Coordinates	Non–modal Modifier
G51	Probe Multiple Axes	Non Modal
G51.1	Vector Probe Surface and Set Offsets	Non Modal
G51.2	Rotary Axis measurement	Non Modal
G51.3	Angle Measurement in X or Y Plane	Non Modal
G51.4	Measure feature to feature XY Plane	Non Modal
G51.5	Measure feature to Feature Z Plane	Non Modal
G52	Local Coordinate System	Local Coordinates
G60*	Positioning Mode	Cornering
G61*	Contouring Mode	Cornering
G61.1	Automatic Corner Speed Override (Left)	Cornering
G61.2	Automatic Corner Speed Override (Right)	Cornering
G68	Tool Probe Cycle Set Tool Length	Non–modal
G69	Tool Probe Cycle Check Tool Length	Non–modal
G70*	Inch Programming	Inch/Metric
G71*	Metric Programming	Inch/Metric
G72	Set Stylus and Tip Dimension	Non–modal
G73	Set Probe Stylus Tip Dimension	Non–modal
G74	Set Probe Length	Non–modal
G75	Locate Internal Corner	Non–modal
G76	Locate External Corner	Non–modal
G77	Locate Surface	Non–modal
G77.1	Stock Allowance	Non–modal
G78	Locate and Measure Bore or Boss	Non–modal
G79	Measure Pocket or Web	Non–modal
G80	Reset Fixed Cycle	Interpolation Hole Making Cycle
G81	Drill Cycle	Interpolation Hole Making Cycle
G82	Counterbore/Spot Drill with Dwell Cycle	Interpolation Hole Making Cycle
G83	Deep Hole Drill (Peck Drill) Cycle	Interpolation Hole Making Cycle
G84	Tap Cycle (Conventional)	Interpolation Hole Making Cycle
G84.1	Rigid Tap Cycle	Interpolation Hole Making Cycle
G85	Bore/Ream Cycle	Interpolation Hole Making Cycle
G86	Bore Cycle	Interpolation Hole Making Cycle
G87	Back Bore Cycle	Interpolation Hole Making Cycle
G88	Web Drill/Bore Cycle	Interpolation Hole Making Cycle
G89	Bore/Ream with Dwell Cycle	Interpolation Hole Making Cycle
G90*	Absolute Dimension Input	Absolute/Incremental
G91*	Incremental Dimension Input	Absolute/Incremental
G92	Position Set	Non–modal
G92.1	Position Sets Setup Offset	Non–modal
G92.2	Position Sets Pallet Offset	Non–modal
G93	Inverse Time Feedrate (1/T)	Feedrate

G Code		Group
G94*	Feed Per Minute Feedrate Mode	Feedrate
G95*	Feed Per Revolution Feedrate Mode	Feedrate
G96	Constant Surface Speed	Spindle
G97*	Constant Spindle Speed (S = RPM)	Spindle
G97.1*	Constant Spindle Speed (S = Surface Speed)	Spindle
G98	Machine Coordinates (tool tip)	Non-modal Modifiers
G98.1	Machine Coordinates	Non-modal Modifiers
G99	Position Set Cancel	Non-modal
G150**	Scaling OFF	Scaling
G151	Scaling ON	Scaling

M Code Table Listing

In the Table below, each M code is shown as a member of a group. At most one M code from each group can appear in a block. Two or more M codes from the same group in the same block cause an alarm. For example, it is valid to code M3, M8, and M5 in one block M3 and M8 start the spindle and coolant before axis motion begins, and M5 stops the spindle and coolant after axis motion completes. M codes for which no group is shown are independent, and can appear together in a block.

M Code Listing				
M CODE	**GROUP**	**FUNCTION**	**START/ END OF BLOCK**	**MODAL**
0	Prog Control	Program Stop	End	No
1	Prog Control	Optional Stop	End	No
2	Prog Control	End of Program (do not put tool away)	End	No
3	Spindle Start	Spindle ON CW	Start	Yes
4	Spindle Start	Spindle ON CCW	Start	Yes
5	Spindle Stop	Spindle and Coolant OFF	End	Yes
6	Tool Control	Tool Change	End	No
8		External Flood Coolant ON	Start	Yes
8.1 thru 8.8	Coolant Jets	Coolant Jets Position Control (option)	Start	Yes
9		Coolant OFF	End	Yes
10/10.x		Clamp Rotary Axis #1 -4	End	Yes
11/11.x		Unclamp Rotary Axis # 1 – 4)	Start	Yes
13	Spindle Start	Spindle ON CW, External Flood Coolant ON	Start	Yes
14	Spindle Start	Spindle ON CCW, External Flood Coolant ON	Start	Yes
19	Spindle Stop	Oriented Spindle Stop	End	Yes
26		Spindle Axis Full Retract	End	No
27		Through Spindle Coolant	Start	Yes
30	Prog Control	End of Program (put tool away)	End	No
34		Enable Data Acquisition	Start	Yes
35		Disable Data Acquisition	End	Yes

		M Code Listing		
M CODE	**GROUP**	**FUNCTION**	**START/ END OF BLOCK**	**MODAL**
41	Spindle Mode	Select Spindle Constant Power Mode	Start	Yes
42	Spindle Mode	Select Spindle Constant Torque Mode	Start	Yes
48	Override	Feedrate & Spindle Speed Override Enable	Start	Yes
49	Override	Feedrate & Spindle Speed Override Disable	Start	Yes
58	Probe	Disarm Spindle Probe (Option)	Start	Yes
59	Probe	Arm Spindle Probe (Option)	Start	Yes
60 61	Swarf Wash	Swarf Wash ON Swarf Wash OFF	Start Start	Yes Yes
70 thru 79	User	User Definable M Codes (Option)	Start	
83		Part Complete		
91 92	Swarf Convey- or	Swarf Conveyor ON Swarf Conveyor OFF	Start Start	Yes Yes

Drilling Cycle Parameter Table

Fixed Cycle	Program Reference	Range	Comments
Gage Height Drilling Inch Gage Height Drilling Metric	GAGE_HT_INCH GAGE_HT_MM	0 to ±9.99999 inch 0 to ±99.9999 mm	Clearance amount added to work surface reference plane (R word).
G81 Hole Depth Programming	HOLE_DEPTH	0 = ABS + tip 1 = INCR + tip 2 = ABS (no tip) 3 = INCR (no tip)	Incremental (INCR) is dimension from the reference plane Absolute (ABS) is dimension of the hole bottom
G82 Counter bore/Spot Drill Finish Depth	G82_FIN_DPTH	0 to ±99.99999inch 0 to ±999.9999 mm	Amount of stock left for finishing
G82 Counter bore/Spot Drill Finish Depth Factor	G82_FEED_FAC	0 to 999%	Is percentage times the programmed feed rate
G82 Counter bore/Spot Drill Dwell Time	G82_DWELL	0 to 99.99 seconds	Defines dwell time in seconds
G83 Deep Hole Drill (Peck Drill) Retract Distance	G83_RET_DIST	0 to ±99.99999inch 0 to ±999.9999 mm	Rapid retract distance to break chip. Used with J word 1 or 11
G83 Deep Hole Drill (Peck Drill) Short Retract Distance	G83_SHRT_RET	0 to ±99.99999inch 0 to ±999.9999 mm	Incremental Rapid retract distance below reference plane to clear chips. Used with J word 2 or 12
G83 Deep Hole Drill (Peck Drill) Relief Amount	G83_RELIEF	0 to ±99.99999inch 0 to ±999.9999 mm	Rapid retract distance above previous drilled depth. Used with J word 3 or 13
G84 Conventional Tap Dwell Time	G84_DWELL	0 to 99.99 seconds	Dwell in time before reversing spindle
G84 Rigid Tap Chip Break Spindle Rev.	G84_CHIP_BRK	0 to 999 revolution	Number of revolutions used to break chip in G84.1 rigid tap cycle. If K word is non−zero, and P word is absent, this value is used.
G86 Bore Cycle, Dead Spindle Bottom Retract Distance	G86_BOT_RET	0 to ±99.99999inch 0 to ±999.9999 mm	Defines feed retract clearance plane from hole bottom
G87 Back bore Dwell Time	G87_DWELL	0 to 99.99 seconds	Defines dwell time before retraction to G87 Bottom Retract Distance
G87 Back bore Bottom Retract Distance	G87_BOT_RET	0 to ±99.99999inch 0 to ±999.9999 mm	Defines incremental feed distance away from spindle
G87 Back bore Clearance	G87_BK_CLR	0 to ±99.99999inch 0 to ±999.9999 mm	Defines additional distance to move at lower clearance plane if K word is not programmed
G88 Breakthrough Distance	G88_BRK_DIST	0 to ±99.99999inch 0 to ±999.9999 mm	Value added to upper K word depth plus drill length if Hole Depth Mode parameter is 0 or 1 and tool type is Drill and both Nominal Diameter and Tool Angle are non−zero.
G89 Dwell Time	G89_DWELL	0 to 99.99 seconds	Defines Bore Ream bottom hole dwell before retraction to clearance plane.

Milling Cycle Parameter Table

Cycle	Program Reference	Range	Usage
Gage Height Drilling/Milling Inch Gage Height Drilling/Milling Metric	GAGE_HT_INCH GAGE_HT_MM	0 to 99.9999 inch 0 to 999.9999 mm	Clearance amount added to work surface reference plane (R word).
Milling Cycle Depth Programming	MIL_DEPTH	0 or 1	Controls spindle axis machining depth Setting this field to 0 selects absolute bottom surface programming Setting this field to 1 selects incremental milling cycle depth programming

G22, G22.1 Face Cycle Cut Width	FAC_CUT_WDTH	0 to 99 %	Specifies the width of cut (in percentage) for each pass across the face. If P word is absent this value is used.
G22, G22.1 Face Cycle Finish Stock	FAC_FIN_STK	0 to ±9.9999 inch 0 to ±9.9999 mm	Specifies the amount of finish stock to be left operations that leave finish stock. If J word is absent this value is used.
G22, G22.1 Face Cycle XY Clearance	FAC_XY_CLR	0 to ±9.99999 inch 0 to ±9.9999 mm	Specifies clearance space around the face for off work moves. Clearance is calculated by Twice the tool diameter plus twice the Face Cycle XY Clearance value.
G23, G23.1 Pocket Cycle Cut Width	POC_CUT_WDTH	0 to 99 %	Specifies the width of cut (in percentage) for each pass around the pocket. If P word is absent this value is used.
G23, G23.1 Pocket Cycle Side Finish Stock	POC_SFIN_STK	0 to ±9.99999 inch 0 to ±9.9999 mm	Specifies the amount of finish stock to be left on the sides of the pocket.. If I word is absent this value is used.
G23, G23.1 Pocket Cycle Bottom Finish Stock	POC_BFIN_STK	0 to ±9.99999 inch 0 to ±9.9999 mm	Specifies the amount of finish stock to be left on the bottom of the pocket.. If J word is absent this value is used.
G23, G23.1 Pocket Cycle Plunge Feed Rate	POC_PLUNG_FR	0 to ±9.99999 inch 0 to ±9.9999 mm	Specifies spindle axis cut depth feed rate. This value is used if L word = 0 or not programmed, and the E word is absent.
G24, G24.1 Rectangular Inside Frame Cycle Cut Width	FRA_CUT_WDTH	0 to 99 %	Specifies the width of cut (in percentage) for each pass around the frame. If P word is absent this value is used.

Tool Data Table		
Tool Data	**Program Field Name**	**Description**
Tool number	RECORD_NUM	This program field is READ ONLY
Tool pocket	POCKET	Three digit number defining tool pocket. Range 0 to 999
Tool identifier	IDENTIFIER	Ten digit numeric Tool ID in the range 0 to 9999999999.
Tool serial number	SERIAL_NO	32 character alphanumeric field. Note that this field is not accessible from the NC program
Tool class	CLASS	Specifies tool category, and is: ROTATING = 0 FIXED = 1 MISC = 2 Required with SFP Option

Tool Data Table

Tool Data	Program Field Name	Description
Tool type	TYPE	Specifies the type of tool. The following are the defined types: UNKNOWN = 0 ROUGH_END_MILL = 1 FINISH_END_MILL = 2 BALL_END_MILL = 3 FACE_MILL = 4 SHELL_MILL = 5 SPOT_FACE_MILL = 6 KEY_CUTTER = 7 FLY_CUTTER = 8 THREAD_MILL = 9 DRILL = 10 SPOT_DRILL = 11 COUNTER_SINK = 12 REAMER = 13 TAP = 14 RIGID_TAP = 15 BORE = 16 BACKBORE = 17 PROBE = 18 SPECIAL_1 = 19 SPECIAL_2 = 20 SPECIAL_3 = 21 SPECIAL_4 = 22 SPECIAL_5 = 23 SPECIAL_6 = 24 SPECIAL_7 = 25 SPECIAL_8 = 26 SPECIAL_9 = 27 Required for SFP Option
Tool length	LENGTH	Valid range for tool length is ± 999.9999 mm Must be Nonzero with SFP Option
Nominal tool diameter – Rotating Tools	NOM_DIA	Valid range for tool diameter is 0 to 999.9999 mm Must be Nonzero with SFP Option
Tool tip angle	TIP_ANGLE	Angle from tool centerline in degrees, range is 0-359.999
Diameter Offset – Rotating Tools	DIA_OFFSET	Used for CDC compensation, range is ± 999.9999 mm
Tool flute length	FLUTE_LENGTH	Flute length in range of 0 to ± 999.9999 mm Must be Nonzero with SFP Option
Number of teeth	TEETH	Used in feed per tooth calculations. Range 1-99 teeth, 1 tooth specifies FPR mode. Must be nonzero with SFP Option
Threads per inch	TPI	Threads per inch for tap. Range 1-99 (TPI) Must be Nonzero for Tool Type Tap or Rigid Tap with SFP Option

Tool Data Table		
Tool Data	**Program Field Name**	**Description**
Material	MATERIAL	Defines tool material type: UNKNOWN = 0 HSS = 1 HSS_TIN_COATED = 2 CARBIDE_INSERT = 3 CARBIDE_COATED = 4 CARBIDE_SOLID = 5 DIAMOND = 6 CERAMIC = 7 OTHER = 8
Load method – Rotating Tools	LOAD_METHOD	Defines tool load method: AUTO = 0 MANUAL = 1 CRADLE = 2
Tool size – Rotating Tools	SIZE	For migrating tool feature, the number of adjacent pockets required: PREV_0_NEXT_0 = 0 PREV_0_NEXT_1 = 1 PREV_0_NEXT_2 = 2 PREV_1_NEXT_0 = 3 PREV_1_NEXT_1 = 4 PREV_1_NEXT_2 = 5 PREV_2_NEXT_0 = 6 PREV_2_NEXT_1 = 7 PREV_2_NEXT_2 = 8
Migrating mode – Rotating Tools	MIGRATING	Specifies whether or not tool is returned to original pocket. INACTIVE = 0 ACTIVE = 1
Spindle direction	SPDL_DIR	Spindle direction may be: DIR_STOP = 0 DIR_CW = 1 DIR_CCW = 2 DIR_EITHER = 3 Required with SFP Option
Feedrate override	FDRT_OVR	Tool feedrate override expressed in percent; 0 to 999 %
Spindle override	SPEED_OVR	Spindle speed override; valid range 0 to 999 %
Maximum RPM	MAX_RPM	Maximum Spindle RPM from 0.0 to 99999.9
Maximum Feed/Tooth	MAX_FEED	Maximum Feed/Tooth for this tool 0 to 99999 mmpm
Tool status	TOOL_STATUS	Tool status is: <u>GOOD</u> = 0 <u>WORN</u> = 1 BROKEN = 2 NEW = 3
Tool cycle time	CYCLE_TIME	Accumulated cycle time, range is 0 to 9999.99 min (Option)
Cycle time limit	CYC_TIME_LIM	Tool cycle time limit, range is 0 to 9999.99 min (Option)
Cycle time mode	CYC_TM_MODE	Indicates whether cycle time should accumulate (Option) TIME_INACTIVE = 0 TIME_ACTIVE = 1
Tool usage count	USAGE_COUNT	Number of uses in the range of 0 to 99999 (Option)
Tool usage count limit	USAGE_LIMIT	Max number of uses per tool (0 to 99999) (Option)

Tool Data Table		
Tool Data	**Program Field Name**	**Description**
Tool usage count mode	USAGE_MODE	Indicates whether usage count should accumulate (Option) COUNT_INACTIVE = 0 COUNT_ACTIVE = 1
Alternate Tool	ALT_TOOL	Alternate tool used if programmed tool is worn. Note that this field is not accessible from the NC program
Tool Reference Number	REF_NUMBER	Unique Tool Reference number
X and Y probe offset – Rotating Tools	X_PRB_OFFSET Y_PRB_OFFSET	Probe offset in range of ± 999.9999 mm
Shank Diameter	See SFP Manual	Must be Nonzero with SFP Option
Top Corner Radius	See SFP Manual	Required with SFP Option Can be 0
Corner Radius	See SFP Manual	Required with SFP Option Can be 0
Draft Angle	See SFP Manual	Required with SFP Option Can be 0
Non Cut Diameter	See SFP Manual	Required with SFP Option Can be 0
Y Fixed Offset	Y_FIX_OFFSET	Y Axis Fixed Offset for the tool, range ± 9999.9999mm
Gear Ratio – Rotating Tools	GEAR_RATIO	Tool gear ratio for rotating tools on turning centers. Range +/– 999.999

References to the tool data table generally refer to the data for tools in the control tool data table. However, references to [$TOOL_DATA(0)<field name>] refer to the data for the tool in the spindle.

Probe Cycle Parameter Table

Cycle	Program Reference	Range	Usage
Probe Approach Feed rate	PRB_APPR_FRT	0 to 999.9999 inchpm 0 to 9999.999 mmpm	Specifies probe approach feed rate for first probe contact.
Dimensions Probe Measurement Feed rate	PRB_MEAS_FRT	0 to 999.9999 inchpm 0 to 9999.999 mmpm	Specifies probe approach feed rate on a second measurement move following the initial hit. This value is selected when the Q word = 0 or absent.
Rotating Tool Retract Distance	FIX_PRB_RRET	0 to 99.99999 inch 0 to 999.9999 mm	Specifies spindle running retract distance following the initial probe hit.
Probe Gage Height	PROBE_GH	0 to 9.99999 inch 0 to 99.0000 mm	Specifies retract distance after a probe hit.
+X Stylus Tip Dimension	X_POS_TIP	0 to 9.99999 inch 0 to 99.9999 mm	Specifies stylus tip offset for the probe used.
–X Stylus Tip Dimension	X_NEG_TIP	0 to 9.99999 inch 0 to 99.9999 mm	Specifies stylus tip offset for the probe used.
+Y Stylus Tip Dimension	Y_POS_TIP	0 to 9.99999 inch 0 to 99.9999 mm	Specifies stylus tip offset for the probe used.
–Y Stylus Tip Dimension	Y_NEG_TIP	0 to 9.99999 inch 0 to 99.9999 mm	Specifies stylus tip offset for the probe used.
Tram Surface	TRAM_SURFACE	0 to 99.99999 inch 0 to 999.9999 mm	Reference from machine table surface or fixture. Usually established with precision gage blocks.
Fixed Probe Tram Surface	FIX_PRB_TRAM	0 to 99.99999 inch 0 to 999.9999 mm	Specifies top position of fixed probe stylus.
Fixed Probe Clearance Height	PRB_PRB_CLR	0 to 999.99999 inch 0 to 9999.9999 mm	Is the value added to the Probe Tram surface above the top of the Probe.

System Table Names

TABLE	<NAME>
Pallet Table	[$PALLET]
Multiple Setup Table	[$SETUP]
Fixture Offsets	[$FIXTURE]
Programmable Coordinate Offsets	[$PROG_OFFSET]
Programmable Tool Offsets	[$TOOL_OFFSET]
Machine Offsets	[$MACH_OFFSET]
Cycle Parameters	[$CYCLE_PARAMS]
Tool Data	[$TOOL_DATA]
Process Control Data	[$PROCESS_DATA]

Parameter Variable Table Listing		
VARIABLE NAME	**MODAL GROUP**	**STATES**
&INTERP	Interpolation	0 – Rapid (G0) 1 – Linear (G1) 2 – Circular CW (G2) 3 – Circular CCW (G3)
&PLANE	Plane select	0 – XY (G17) 1 – ZX (G18) 2 – YZ (G19)
&CORNERING	Cornering	0 – Positioning mode (G60) 1 – Contouring mode (G61) 2 – Corner Speed Override Left (G61.1) 3 – Corner Speed Override Right (G61.2)
&CDC	Tool Nose Radius Compensation	0 – TNRC Off (G40) 1 – Auto CDC Left (G41) 2 – Auto CDC Right (G42) 3 – PQR CDC (G43)
&FEEDRATE	Feedrate	0 – Inverse time (G93) 1 – Feed per Minute (G94) 2 – Feed per tooth/Rev (G95)
&SPINDLE	Spindle speed	0 – Constant Surface Speed (G96) 1 – RPM Mode (G97) 2 – Surface Speed Per Minute (G97.1)
&INCH	Inch/metric	1 (true) – Inch Input (G70) 0 (false) – Metric input (G71)
&ABSOLUTE	Abs/Inc	1 (true) – Absolute Input (G90) 0 (false) – Incremental input (G91)
&ACC_DEC	AccDec	0 – Acc/Dec off (G46) 1 – Acc/Dec On (general machining (G45)
&DIAMETER	Radius/Diameter	1 (true) – Diameter Programming Mode (G62) 0 (false) – Radius Programming Mode (G63)
&SCALING	Scaling	1 (true) – Scaling On (G151) 0 (false) – Scaling Off (G150)
&PATTERN	Pattern	0 – No pattern active (G37) 1 – Rectangular pattern active (G38) 2 – Circular pattern active (G39)
&POLAR_PGM	Polar prog. mode	0 – Bolt circle (G15.1) 1 – Part contour (G15.2)

Pallet Table

Pallet Data	Program Field Name	Value	
X axis offset	X	Range of 99999.9999 mm	
Y axis offset	Y	Range of 99999.9999 mm	
Z axis offset	Z	Range of 99999.9999 mm	
A axis offset	A	Range of 359.9999 degrees	
B axis offset	B	Range of 359.9999 degrees	
C axis offset	C	Range of 359.9999 degrees	
Offsets Rotate	ROTATES	1 – YES 0 – NO	
Rotary Position	ROTARY_POS	Range of 359.9999 degrees	
Pallet State	STATE	Control Display Absent, Present Last, New	Prog Value 0 1 2 3
Pallet Status	STATUS	Control Display Pending Started, Aborted Complete Setup Aborted	Prog Value 0 1 2 3 4
Pallet order	ORDER	0 through 50	
Pallet identifier	PALLET_ID	0 to 9999	
Pallet location	LOCATION	0 to 9999	

Multiple Setup Table

Part Offset Data	Program Field Name	Description	
X, Y, Z, U, V, W axis offsets	X, Y, Z, U, V, W	Range of 99999.9999 mm	
A, B, C axis offsets	A, B, C	Range of 359.9999 degrees	
Part State	SETUP_STATE	Control Display Absent, Active Active New, Absent New	Prog Value 0 1 2 3
Part Status	PART_STATUS	Control Display Pending Started, Aborted Completed Started * Error Suspended Suspended * Error Completed * Error	Prog Value 0 1 2 3 4 5 6 7
NC Program ID	NC_PROG_ID	0 through 99999	

Fixture Offsets Table (Used with H Word)

Fixture Offset Data	Program Field Name	Description
X, Y, Z, U, V, W axis offset	X, Y, Z, U, V, W	Range of 99999.9999 mm
Rotates	ROTATES	<u>Control Display</u> <u>Prog Value</u> NO 0 YES 1
Rotary Position	ROTARY_POS	Range of 99999.9999 mm

Tool Offsets Table (Used with O Word)

Programmable Tool Offset Data	Program Field Name	Description
Length	LENGTH	Range of 99999.9999 mm
CDC Value	DIAMETER	Range of 99999.9999 mm
Values in this table are always incremental offsets.		

Programmable Offsets Table (Used with D Word)

Programmable Offset Data	Program Field Name	Description
X, Y, Z, U, V, W axis offset	X, Y, Z, U, V, W	Range of 99999.9999 mm

Machine Offsets Table (Used with D WORD and G98,G98.1)

Machine Offset Data	Program Field Name	Description
X, Y, Z, U, V, W axis offset	X, Y, Z, U, V, W	Range of 99999.9999 mm

Process Control Data Table

Process Control Data	Program Field Name	Description
X, Y, Z, I, J, K, A, B, C field	X, Y, Z, I, J, K, A,B. C	Range of 99999.9999 mm

Other System Variables

<NAME>	Definition	Program Field Name	Description
[$ANGLE_ERROR]	[PRB_A_ANGLE] or [PRB_B_ANGLE] angle exceeds B word tolerance	A, B	FALSE = 0 TRUE = 1
[$BLOCK_COUNT]	Count of NC Blocks executed since the last time Cycle Start was Pressed		
[$CURPOS_MCH]	Current Position in machine coordinates	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$CURPOS_PGM]	Current Position in program coordinates	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$CUR_FIXTURE]	Active Fixture Offset	H	0 – 32
[$CUR_PALLET]	Active Pallet Number		1 – 10, 1 – 25, or 1 – 50
[$CUR_SETUP]	Active Setup Number		1 – 64
[$DATA_CAPTURE]	Array of floating point computed values		
[$EXCEPTION]	Auto Tool Recovery/ contains a value identifying which condition caused the exception		Tool status is: Broken 1 Worn Tool 2 Oversize Tool 3
[$HIGH_LIMIT]	The maximum coordinate of the machine axis travel for each axis	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$LOW_LIMIT]	The minimum coordinate of the machine axis travel for each axis	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$MAX_STOCK]	Is data for maximum stock amount for the current set of measurements (G77.1)		
[$MIN_STOCK]	Is data for minimum stock amount for the current set of measurements (G77.1)		
[$NEXT_POCKET]	Pocket number of next tool (the tool programmed but not yet loaded)		1 – maximum number of pockets in the tool matrix.
[$NEXT_TOOL]	Unique tool reference number of next tool (the tool programmed but not yet loaded)		
[$OUT OF TOL]	Variable is set to true (1) when tool does not hit probe or tool is out of tolerance		FALSE 0 TRUE 1
[$PATTERN_END]	Variable is set to FALSE (0) when a pattern sensitive subroutine is entered and when a G36 is executed. It is true (1) when a G36.1 code is processed after the last pattern operation has been performed.		Pattern variable is: FALSE (G36) 0 TRUE (G36.1) 1
[$PRB_ANGL_ERR]	The error between the measured and expected angle between two features (G51.4 and G51.5)		
[$PRB_AVG_DIA]	Measured average diameter of a bore or boss after a G78 probe cycle		0 – 99999.9999 mm

Other System Variables

<NAME>	Definition	Program Field Name	Description
[$PRB_DIA_ERR]	Probe Tool Error contains the tool diameter deviation as measured by the fixed probe in a G69 cycle		0 – 99999.9999 mm
[$PRB_PART_LOC]	Probe Part Location is the coordinates of the measured part feature for G75–79 probe cycles.	X,Y,Z	0 – 99999.9999 mm
[$PROBE_POS_MC]	Location of the most recent probe hit in machine coordinates	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$PROBE_POS_PC]	Location of the most recent probe hit in program coordinates	X, Y, Z, U, V, W, A, B, C	0 – 99999.9999 mm
[$PRB_TOOL_ERR]	Probe Tool Error contains the tool length deviation as measured by the fixed probe in a G69 cycle		0 – 99999.9999 mm
[$PRB_WIDTH]	Measured width of a pocket or web after a G79 probe cycle		0 – 99999.9999 mm
[$PRB_A_ANGLE]	Angle between two measured points in the Y axis plane, R word specifies rotary A axis	R	
[$PRB_B_ANGLE]	Angle between two measured points in the X axis plane, P word specifies rotary B axis	P	
[$PRB_INCL_ANG]	Angle data used by G51.4 and G51.5 for second measurement positioning		
[$PRB_X_ANGLE]	Is the computed X axis side of the corner when P word is programmed (G75 and G76)	P	
[$PRB_X_DIA]	Measured X axis diameter of a bore or boss after a G78 probe cycle.		0 – 99999.9999 mm
[$PRB_Y_ANGLE]	Is the computed Y axis side of the corner when R word is programmed (G75 and G76)	R	
[$PRB_Y_DIA]	Measured Y axis diameter of a bore or boss after a G78 probe cycle		0 – 99999.9999 mm
[$PROBE_HIT]	Probe Hit is set to true (1) by the G75-79 probe cycles if a probe hit occurs during the probe cycle. Following a probe cycle, this value is true if the probe hit the part and false (0) if no probe hit occurred		Probe hit is: FALSE 0 TRUE 1
[$RECORD_NO]	Tool Data/ Record number of the tool in the spindle or –1 if no tool is in the spindle.		Tool Table Number
[$SIZE_ERROR]	True position value plus tool offset	X,Y,Z	
[$TOL_EXCEEDED]	Measured size error exceeds U word value		FALSE = 0 TRUE = 1
[$TOOL_PRB_LOC]	Measured Tool Probe Location	X,Y	0 – 99999.9999 mm
[$TRUE_POS_ERR]	True vector error position of X,Y and Z axes	X,Y,Z	

Other System Variables			
<NAME>	**Definition**	**Program Field Name**	**Description**
[$VARIATION]	Is the difference between lowest and highest measured surface location (G77.1)		
[$X_POS_ERROR]	Difference between I word and measured X axis position	X	
[$Y_POS_ERROR]	Difference between J word and measured Y axis position	Y	
[$Z_POS_ERROR]	Difference between K word and measured Z axis position	Z	

Arithmetic Functions

FUNCTION NAME	ARGUMENT RANGE	VALUE RETURNED
SIN	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$ ARG IN DEGREES	SINE OF ARG WHERE: $-1 <= SIN\ (ARG) <= +1$
COS	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$ ARG IN DEGREES	COSINE OF ARG WHERE: $-1 <= COS\ (ARG) <= +1$
TAN	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$ EXCEPT FOR VALUES OF ARG CLOSE TO ODD MULTIPLES OF 90	TANGENT OF ARG WHERE: $-1.7 \times 10^{308} \leq TAN\ (ARG) \leq +1.7 \times 10^{308}$
ARCSIN	$-1 <= ARG <= +1$	ARCSINE OF ARG WHERE: $-90 <= ASN\ (ARG) <= +90$
ARCCOS	$-1 <= ARG <= +1$	ARCCOSINE OF ARG WHERE: $-90 <= ACS\ (ARG) <= +90$
ARCTAN	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$	ARCTANGENT OF ARG WHERE: $-90 <= ATN\ (ARG) <= +90$
ABS	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$	ABSOLUTE VALUE OF ARG WHERE: $0 < ABS\ (ARG) \leq +1.7 \times 10^{308}$
SQR	$0 \leq ARG \leq +3.37 \times 10^{38}$	SQUARE ROOT OF ARG WHERE: $0 <= SQR\ (ARG) \leq +1.7 \times 10^{308}$
RND	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$	Rounded Integer value of ARG. RND (4.5) = 5
INT	$-1.7 \times 10^{308} \leq ARG \leq +1.7 \times 10^{308}$	Integer Value ARG. Integer Portion of ARG. INT (4.9) = 4

Appendix B
System Configuration

Overview

The Acramatic 2100 can be configured through activation of various System Configuration parameters. When the Configuration window is activated, a variety of icon menu buttons are displayed. The following are the various items that may affect operation of the NC program.

Security

Is used to select and change password levels.

The control provides multiple password levels to restrict access to some areas of the system. All passwords are encrypted within the system and require verification. The following password levels exist in order of decreasing restrictions:

Operator

Operator level is the default and does not have a password. This level is used for standard machining operations and control usage.

Name = Setup

The setup level allows modification of tooling tables, NC programming defaults and part related offset tables.

There is also a service level password that is under the control of the Machine Tool Builder.

NC Programming Execution

Is used to set part program default conditions. Defaults listed in this window can only be changed at the machine site. The following is a brief description of the NC Program Execution features:

Colon Block – Colon Required

When checked indicates part program execution must begin on a colon (:) block. No check means program execution can be anywhere in the part program.

At Colon Block

Any checks in these menu buttons will cause the selected item to be reset when a colon block in the part program is encountered.

Reset Fixture Offsets

When checked, H word is canceled when a colon block is encountered. When not checked, the H word value is not canceled when a colon block is encountered.

Reset Programmable Offsets

When checked, D word is canceled when a colon block is encountered. When not checked, the D word value is not canceled when a colon block is encountered.

Reset Programmed Rotation

When checked, ROT type II block is canceled when a colon block is encountered. When not checked, the ROT type II block is not canceled when a colon block is encountered.

Cutter Diameter Compensation (CDC)

Report CDC Error

When checked, CDC errors will be displayed and reported in the Alarms Journal. When not checked, CDC errors will not be displayed or reported in the Alarms Journal.

Constant Feedrate

When checked, CDC maintains a constant feedrate for circular interpolation blocks depending on the cutter size. An oversized cutter will move slower when machining the outside of a circular arc and an undersized cutter will move slower when machining the inside of a circular arc. Programmed feedrates are increased or decreased within the feedrate limits to maintain a constant feedrate.

When not checked, constant feedrate is not maintained. Circular interpolation blocks execute at the programmed feedrate.

Glide On/Off

When checked, the CDC Glide On/Glide Off algorithm is executed.

CDC offset X = d * next span direction cosine Y
CDC offset Y = d * next span direction cosine X

where d = cutter radius deviation

Glide on axis CDC offsets are calculated when cutter diameter compensation is activated. Glide off offsets are calculated when CDC is deactivated. Glide off offsets are also generated in the case where, because of reversal of the programmed path direction, the CDC modal state is changed from cutter left to cutter right or vice versa.

For glide on offsets when the next span is a linear span, the axis compensated commands define an intersection point of the line parallel to the next span and a line perpendicular to the end point of the current span. If the next span is a circular span, the axis compensated commands define the intersection between an arc concentric with the programmed arc and a line from the programmed center point and the end point of the programmed arc.

Cutter Left

programmed path
with CDC glide on/off applied
d = cutter radius deviation

1 = current position   3 = next end point
2 = first end point   4 = glide on point
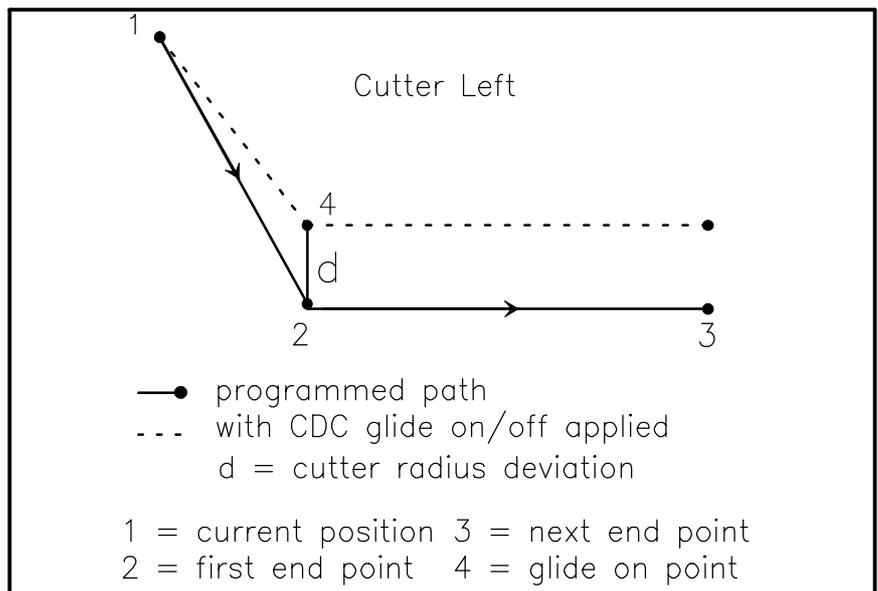
When not checked, CDC Glide On/Glide Off is not performed. The cutter radius deviation bisects the angle between two spans.
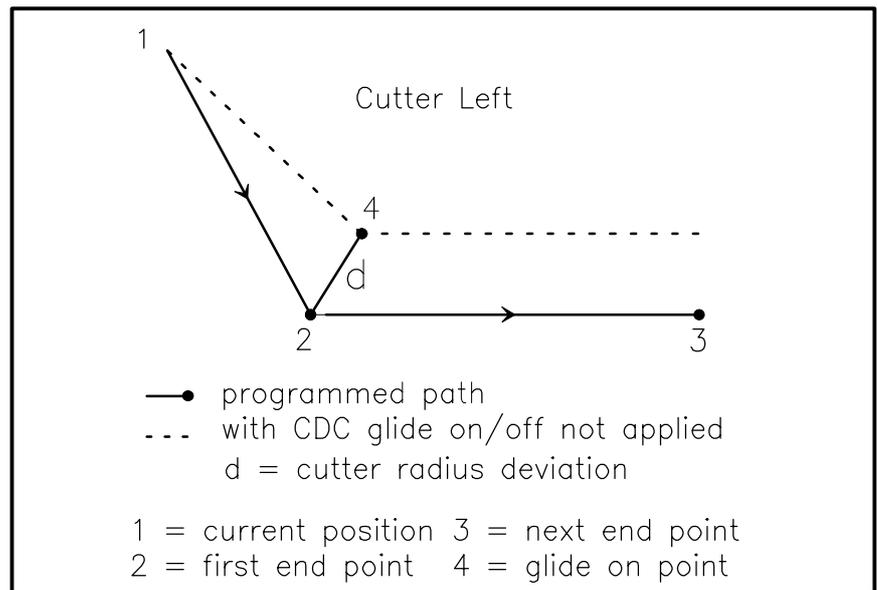
Report Alarms

Report PRT Alarms

When checked, printer errors encountered when executing PRT blocks stop cycle and alarms will be displayed and reported in the Alarms Journal.

When not checked, printer errors encountered when executing PRT blocks are ignored and alarms will not be displayed or reported in the Alarms Journal.

Report WTF Alarms

When checked, any errors encountered when executing FIL, WTF and, DAT blocks stop cycle and alarms will be displayed and reported in the Alarms Journal.

When not checked, file errors encountered when executing FIL, WTF, and DAT blocks are ignored and alarms will not be displayed or reported in the Alarms Journal. The file data may be lost.

Report COM Alarms

When checked, any errors encountered when executing a COM block will stop cycle, and alarms will be displayed and reported in the Alarms Journal.

When not checked, communication errors when executing a COM block are ignored and alarms will not be displayed or reported in the Alarms Journal.

Fixture Offset Axis of Rotation

Fixture Offsets will be applied to the rotary axis selection. When this field is blank, rotary axis Fixture Offsets are not applied.

Modes

Is used to set the Modal G Code Default state used when Data Reset is activated, a colon block is executed, or end of program is encountered.

Default Modal G Codes selections are as follows:

    G0 – Rapid
    G1 – Linear

    G18 – ZX Plane
    G17 – XY Plane
    G19 – YZ Plane

    G60 – Positioning
    G61 – Contouring

    G71 – Metric (mm)
    G70 – English (Inch)

    G91 – Incremental
    G90 – Absolute

    G15.2 – Part Contour
    G15.1 – Bolt Circle

    G94 – Feed per Minute
    G95 – Feed per Tooth

    G97 – Spindle RPM
    G97.1 – Spindle Surface Speed
    G96 – Spindle CSS

Circular

Endpoint Tolerance

Data in this field defines the allowable end point tolerance; that is, the amount by which the starting and ending radius values are allowed to differ. If this value is exceeded, the alarm will be posted.

To change Circular Endpoint Tolerance touch to highlight field. Key in desired tolerance using the OSA keypad.

Center Specification

Always Absolute – Sets circular center dimension (I,J,K) are always absolute.

Always Incremental – Sets circular incremental.

G90/G91 Switchable – Circular center dimensions follow G90/G91.

Linear

Collinear Angle

(Not used in this release.)

M70 − 79 User M Codes Execution (Option)

Many applications require the addition of relatively simple equipment to a machine tool, and require the added equipment to be controlled from the NC program. The User M Code option makes available the M70 series of M codes for this purpose. To accommodate the common uses for programmable outputs, the User M Codes can be configured in several ways:

- the M code can be active at Start of Block or End of Block

- the output signal can be pulsed, maintained until an external signal is received, or turned off by a second M code;

- NC program execution can be held until the function is complete (a fixed time or signaled by an external input signal) or NC program execution can be allowed to continue;

- the output signal can be configured to be normally on or normally off;

- an alarm can be reported if the external acknowledgment is not received within a specified time.

For user M codes configured as maintained or toggled, the pulse width configuration value establishes a minimum duration. That is, if a nonzero pulse width is specified, the output signal remains asserted for the specified time duration, and then further remains until the acknowledgment signal (for maintained) or the reset M code (for toggled) occurs.

Each M user M code can be specified to hold cycle or not. If hold cycle is specified, NC program execution is held until:

- the pulse width elapses for pulsed outputs

- the pulse width elapses and the acknowledgment signal is received for maintained outputs

- the pulse width elapses and the reset M code is executed for toggled outputs

Finally, each user M code configured as maintained can report an alarm if the acknowledgment signal is not receive within a specified maximum time. This is useful to detect a failure in the external equipment and report the condition rather than simply remaining in cycle waiting indefinitely for the acknowledgment.

The user M codes are configurable independently. Each user M code has an assigned output signal. The acknowledgment signal, pulse width, start of block or end of block activation, whether or not the NC program is held, and the allowable time to acknowledge are configurable.

Turn Off Method

Each M code can be individually configured to be *toggled. pulsed*, or *maintained.*

M Code

A toggled M code asserts its output signal when the associated M code is executed. The signal is turned off by executing the corresponding reset M code, which is the base M code with a ".1" suffix. For example, if M72 is configured as a toggled M code, the signal is turned on by programming an M72 and turned of by programming M72.1.

Pulsed

A pulsed M code asserts its output signal for a fixed time each time that M code is executed. Each of the M70 User M codes has its own pulse duration.

Feedback 0 thru 9

A maintained M code asserts its output signal when the M code is executed, and the signal remains asserted until the assigned input signal is asserted by external circuitry. This arrangement assures that the external device has time to respond to the M code output signal.

NOTE: Only select one feedback per M code. However one input can be used for each M code if so desired.

Hold Program

When checked (On), means Program Execution will wait for feedback, or if pulsed selected, will wait for pulse to time out.

When not checked (Off), means Program Execution will continue on, not waiting for feedback or pulse.

Executed

Only one selection is active either Start Of Span, or End Of Span.

Start Of Span

When active means the M Code is Executed before axis motion.

End Of Span

When active means the M Code is Executed after axis motion.

Signal

Only one selection is active either Normally On, or Normally Off.

Normally On

When active means the M Code output contact is opened.

Normally Off

When active means the M Code output contact is closed.

Pulse Width

If M Code is pulsed selected, this value is the width of the output.

Time Before Alarm

This value (in seconds) is the duration waiting for feedback after which an alarm is reported.

Index

Index

Index

Index

Index

Index

Index

Index