



# Weldon CNC Grinder Operation Manual FANUC 30i B Series

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## 1) INTRODUCTION

Introducing Weldon Solution's Precision CNC Cylindrical Grinders. These rugged machines produce extremely accurate parts at high production rates and have versatility, a rare quality in grinders. They are capable of grinding tapers, chamfers, radii, contours, fillets, shoulders, and straight surfaces in one continuous operation on the same work piece. Weldon grinders are ideal for grinding multi-diameter shafts, reamers, punches, many types of contoured rolls, and an endless list of special parts.

This manual explains general operation procedures for machines equipped with the Fanuc 30i, 31i or 32i CNC control. Each programmer will develop his own techniques to suit his needs, as he becomes more familiar with the machine and its sophisticated computer control system. It is suggested that the manual be read in its entirety prior to attempting to program the system, as the system is a unique marriage of control and grinder.

The Fanuc 30i series controls are designed for simultaneously controlling multiple machine axes. The control is a solid-state integrated circuit controller/processor system. The control is designed to operate from manual commands, keyboard input data, or a stored program.

## 2) **CONTROL FEATURES**

### **Programming Features**

- ◆ Inch/metric programming
- ◆ Full linear and circular interpolation
- ◆ Constant RPM programming
- ◆ Constant SFPM programming (optional)
- ◆ Feed per minute programming
- ◆ Feed per revolution programming (optional)
- ◆ Macro subroutines
- ◆ Parametric (macro variable) programming
- ◆ Decimal point optional programming
- ◆ Absolute/incremental programming
- ◆ Single block/dry run operational modes
- ◆ Optional stop/block delete capability
- ◆ Software overtravel checking
- ◆ Versatile interface (allows for easy addition of gauging, machine monitoring, robotics, etc.)
- ◆ Background program editing
- ◆ Automatic offset update
- ◆ Automatic recognition of EIA or ISO coding
- ◆ Program number search/display

### **Control Features**

- ◆ 10.5" high resolution color LCD
- ◆ Built-in diagnostics
- ◆ 160m program storage
- ◆ storage available to 1280m (optional)
- ◆ RS 232 interface
- ◆ PMCIA Memory Card interface
- ◆ USB Memory interface.
- ◆ distributed microprocessor based

### **Axis Management Features**

- ◆ Manual pulse generator
- ◆ A/C digital servo drives
- ◆ 0.000010" resolution feedback

### 3) **GRINDING WHEEL SAFETY**

This subject is covered in detail in the ANSI B7.1 Safety Requirements for the Use, Care and Protection of Abrasive Wheels. This summary is to acquaint you with a general guide to safe practices. It is recommended that all personnel involved with grinding become familiar with B7.1 and the other pertinent booklets listed at the end of this section.

#### **The Nature of Bonded Abrasive Wheels.**

Bonded abrasive wheels vary greatly in strength depending on the following factors:

- 1) The grit size. Fine wheels are stronger than coarse ones.
- 2) The ratio of thickness to diameter. Naturally the thicker the wheel in proportion to its diameter the greater will be its resistance to failure from side stresses (this does not apply to stresses from centrifugal force).
- 3) The physical properties of the bond. In general, resinoid, rubber and shellac bonds resist failures due to centrifugal force and to side stresses better than do vitrified bonds.
- 4) The amount of bond. The greater the amount of bond in a wheel of given volume the stronger the wheel will be.
- 5) The shape of the wheel. Everything else being equal, the straight wheel is the strongest shape.

One fact that usually is overlooked is that the strength of a given wheel is definitely limited by the requirements of the job it has to do. For snagging castings, wheels with a relatively high percentage of resinoid bond are required. Such wheels are durable and will stand quite a lot of abuse (but they are by no means unbreakable). On the other hand, cylinder or cup wheels for surface grinding of hardened steel with broad contact must, of necessity, be soft and, therefore, more fragile. A hard, durable wheel on such a job would be useless. It would ruin the steel. Consideration of these two extremes should convince the reader of the absolute necessity of strictly following the rules on operating speeds.

It is recognized that the abrasive wheel is a relatively fragile tool, which is operated at a high speed as compared to most other cutting tools. Therefore, some extra precaution is necessary. There are laws in every state prescribing safety procedures, and, in general, they agree with ANSI B7.1 and OSHA.

#### **Keep in mind the following General Safety rules:**

- 1) Packages of wheels should be inspected for possible damage in shipment immediately on arrival and they should be carefully handled, rung and stored (complete instructions will be found in the booklet "Handling, Storage and inspection" and in the section 2 of ANSI B7. 1.
- 2) Guards or protection hoods must be used on all wheels except certain small sizes, cones (Types 16 and 1 7), plugs (Types 18 and 1 9) and mounted wheels. For details of construction see the ANSI B7.1 Safety Requirements and OSHA regulations.
- 3) Frequently, guards are omitted in the operation of straight and cup wheels on portable grinders. They are even more necessary on portable than on other grinders. The omission of guards is not condoned by grinding wheel manufacturers, nor by insurance companies, nor by state or federal inspectors.

- 4) Do not overspeed the wheel. Permissible speed for wheels in SFPM (variously called "surface feet per minute," "surface speed" or "peripheral speed") are given in table 33 on page 111 in ANSI B7.1.
- 5) Be sure that the wheel fits the spindle properly. Obviously it should not have to be forced onto the spindle; the spindle might warm up and expand slightly, setting up stresses and possibly causing a rupture. Neither should the fit be sloppy. The clearance should be a few thousandths - .002" to .003" for small holes and up to .010" to .012" for large ones.
- 6) Be sure that the flanges comply with the specifications called for in ANSI B7.1 as to diameter (not less than 1/3 of diameter of the wheel), minimum dimensions at various points, proper relief, bearing area, kind of stock, etc. Above all, both flanges must be alike in diameter and bearing area. Mounting wheels between unlike flanges is one of the most common causes of wheel failure.
- 7) Cone and plug type wheels should be mounted as described in "Portable Grinding Wheels - Safe and Efficient Operation" and in ANSI B7.1.

## **GENERAL GUIDE TO SAFE PRACTICES**

Grinding wheels improperly used are dangerous, but grinding is a safe operation if the few basic rules listed below are followed. These rules are based on material contained in the ANSI B7.1 Safety Requirements for the "Use, Care and Protection of Abrasive Wheels".

### **HANDLING**

All grinding wheels are relatively fragile and must be handled with care. This applies to all types of bonds -vitrified, organic, or metal.

#### **Do:**

- 1) Inspect all wheels upon receipt.
- 2) Use pallets or trucks to transport.
- 3) Support firmly at all times.
- 4) Place wheels carefully in racks.

#### **Do Not:**

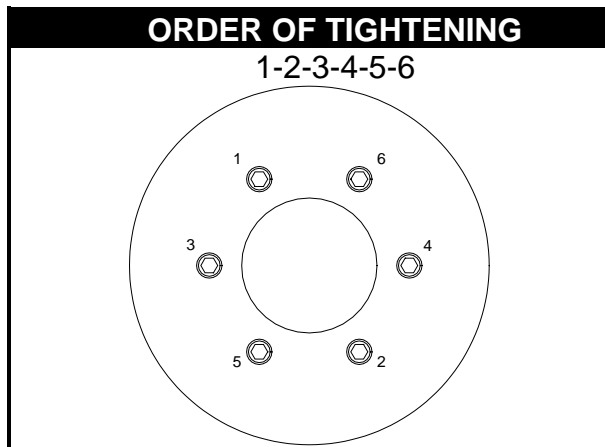
- 1) Leave wheels packed in absorbent material.
- 2) Roll wheels on floor.
- 3) Lean wheel against equipment.
- 4) Place tools or parts on top of wheels.

### **MOUNTING**

Correct mounting procedures are essential to the efficient and safe operation of the wheel. It is important that personnel performing this function are fully competent.

#### **Do:**

- 1) Visually inspect all wheels before mounting for possible damage.
- 2) Check machine speed against the established maximum safe operating speed marked on the wheel.
- 3) "Ring" wheel to determine if it is free from cracks.
- 4) Use one clean blotter on each side of wheel.
- 5) Check mounting flanges for equal and correct diameter (generally 1/3 diameter of wheel).
- 6) Tighten multi-screw flanges uniformly to the machine manufacturer's suggested torque.



**Do Not:**

- 1) Mount a cracked wheel or one that has been dropped or has become damaged.
- 2) Use wheels whose maximum r.p.m. is less than the r.p.m. of the machine spindle.
- 3) Force a wheel onto the machine or alter the size of the mounting hole - if the wheel doesn't fit the machine, get one that will.
- 4) Use flanges of unequal diameter or relief, nor those, which are not clean, flat and free of burrs.
- 5) Over-tighten flange retaining nuts.
- 6) Over-tighten wheel adapter lockscrew/locknut.
  - a) Tightening is always in the opposite direction of wheel rotation

**USE**

Given the correct wheel, mounted in accordance with approved procedure, safe operation depends largely on the treatment to which the wheel is subject during use.

**Do:**

- 1) Ensure that guards and work rests are properly adjusted and secure before starting machine.
- 2) Always use a safety guard covering at least one-half the grinding wheel.
- 3) Allow a newly mounted wheel to run at operating speed with guard in place at least one minute before starting to dress or grind.
- 4) Always wear protective glasses or some type of eye protection when grinding.
- 5) Always dress or make grinding contact gently.
- 6) Re-dress the wheel when necessary.
- 7) Turn off the coolant before stopping the wheel to avoid creating an out of balance condition.

**Do Not:**

- 1) Ever exceed the maximum operating speed established for the wheel.
- 2) Start the machine until the guard is in place.
- 3) Stand directly in front of the wheel when the machine is started.
- 4) Jam the work into the wheel, nor use excessive pressure or infeed.
- 5) Force grinding so that the motor slows noticeably or the work gets hot.
- 6) Grind on the side of the wheel (see ANSI B7.1 for exception).
- 7) Allow stationary wheels to rest in fluids.
- 8) Apply pressure to wheels to stop them.



- 9) Continuously use glazed wheels without dressing.
- 10) Use wheels for purposes other than those for which they are designed.

## **STORAGE**

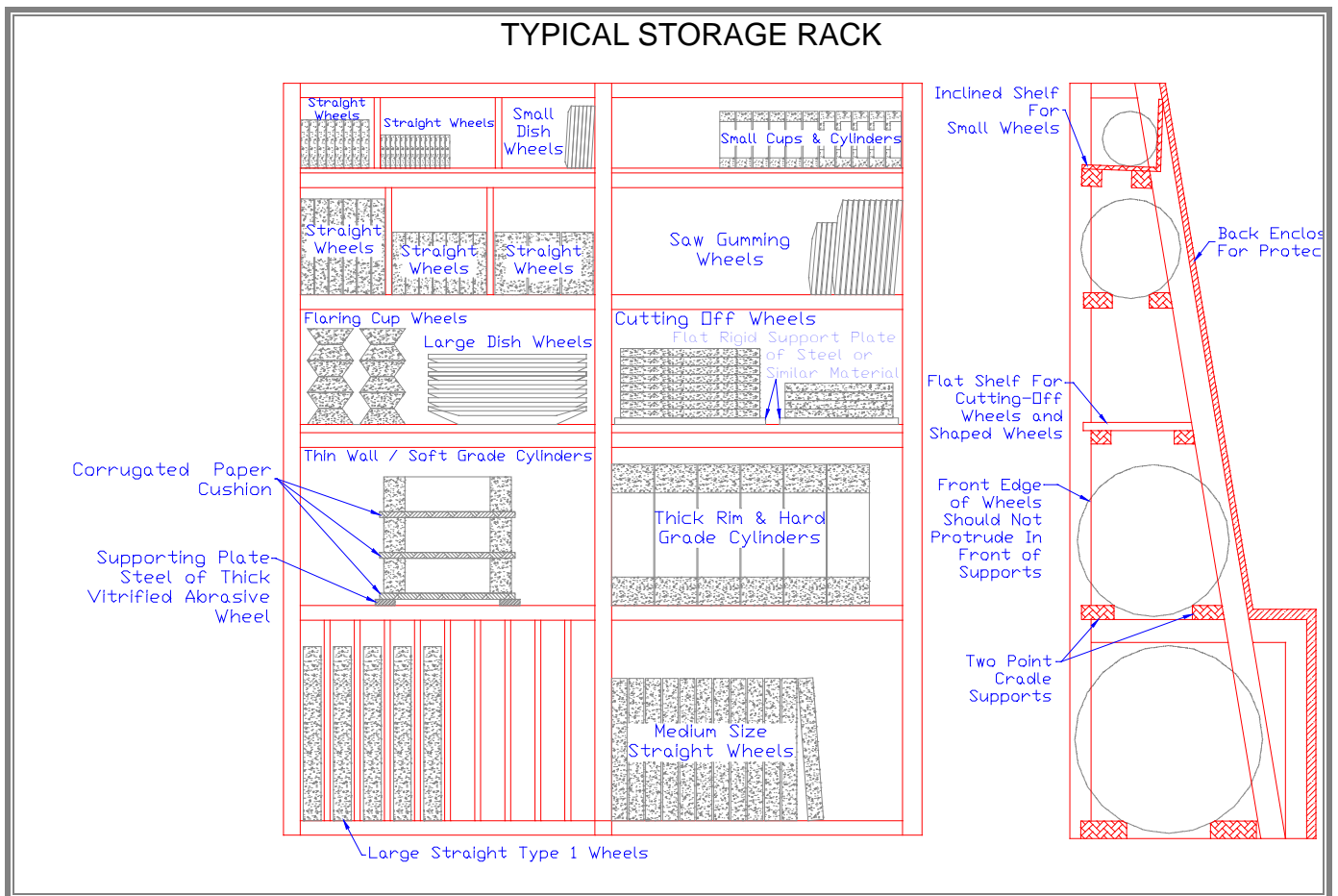
Suitable racks, cradles and drawers should be provided to store the various types of wheels used. The drawing below indicates a typical rack, storing a range of wheels.

### **Do:**

- 1) Store wheels correctly supported.
- 2) Stack thin wheels flat.
- 3) Ensure storage in dry conditions.

### **Do Not:**

- 1) Store in damp or humid conditions.
- 2) Subject wheels to dramatic change in temperature.
- 3) Subject wheels to temperatures at or approaching freezing.



**For Further Information.** The following booklets are available from Norton Company, Advertising Literature Section, 1 New Bond St., Worcester, MA 01606:

- Form 254 - ANSI Safety Requirements for the Use, Care, and Protection of Abrasive Wheels.
- Form 352 - Safety Recommendations for Grinding Wheel Operation
- Form 353 - Mounting Technique for Wheel Sleeves on Cylindrical Grinding Machines
- Form 462 - Cutting-Off Wheels
- Form 474 - A Primer on Grinding Wheel Safety
- Form 535 - Handling, Storage, & Inspection of Grinding Wheels
- Form 931 - Special Speeds for Grinding Wheels
- Form 1406 - Portable Grinding Machines, Safe and Efficient Operation
- Form 1420 - Mounted Wheel Wall Chart
- Form 1877 - Mounted Wheels - Safe Speeds
- Form 2229 - High Speed - Heavy Duty Grinding Machines – Swing Frames and Floor Stand
- Form 2677 - Safety Guide for Portable Grinding Wheel Users
- Form 2678 - Safety Guide for Grinding Wheel Users
- Form 2872 - Mounted Wheels (Maximum Operating Speeds)

#### 4) FORMATS

a) Dwell Format:

G04 X2.5 = 2.5 sec. dwell

G04 P25000 = 2.5 sec. dwell

b) Motion Interpolation:

G01 = straight line

G02 = clockwise

G03 = counter clockwise

c) Coordinate Setting Format:

G92 X [#5021- (X zero pos.)] Z [#5022 – (Z zero pos.)]

## 5) OPERATION

### A. MANUAL OPERATION

#### 1. Manual Reference Point Return (REF)

OBJECTIVE                      Return the machine axis to zero.

INFORMATION                 The position at reference is zero.

#### STEP

#### PROCEDURE

MANUAL mode                 Push MAN pushbutton on operator control station.

REFERENCE mode             Push REF pushbutton on operator control station

'X' AXIS                        Push 'X+' axis pushbutton (X axis reference)

'X' axis will return to its zero position.

'Z' AXIS                        Push 'Z+' axis pushbutton (Z axis reference)

'Z' axis will return to its zero position.

#### 2. Continuous Jog (HIGH & LOW)

OBJECTIVE                      To manually jog the 'X', 'Z' or 'C' axis.

INFORMATION                 The axis moves continuously while a pushbutton is pressed.  
The axis may be moved in either HIGH or LOW jog.  
The manual feedrate override switch will affect the rate of jog.

#### STEP

#### PROCEDURE

MANUAL mode                 Push MAN pushbutton on operator control station.

LOW or HIGH jog             Push LOW/JOG or HIGH/JOG pushbutton on the operator control station.

X-, X+, Z-, Z+, C-, C+     Push and hold either X-, X+, Z-, Z+, C-, or C+ pushbutton.

Pushbuttons                    The appropriate axis will move in indicated direction.

### 3. Incremental Jog - Manual Pulse Generator (MPG)

OBJECTIVE	To manually jog the 'X', 'Z' or 'C' axis an incremental amount with the manual pulse generator (MPG).
INFORMATION	By rotating the manual handle, the 'X', 'Z' or 'C' axis moves incrementally the predetermined distance and the direction corresponding to the direction of rotation. A clockwise rotation of the handle moves the axis in a minus direction, while a counterclockwise rotation moves the axis in a plus direction.
<u>STEP</u>	<u>PROCEDURE</u>
MANUAL mode	Push MAN pushbutton on operator control station.
MPG	Push MPG pushbutton on operator control station.
'X', 'Z' or 'C' axis	Select desired axis on the MPG remote handle.
Incremental amount	Select the desired incremental amount on the MPG remote. <b>x1</b> =.00001", <b>x10</b> =.0001", or <b>x100</b> =.001" for 'X' & 'Z' axis. <b>or</b> <b>x1</b> =.0001mm, <b>x10</b> =.001mm, or <b>x100</b> =.01mm for 'X' & 'Z' axis. <b>or</b> <b>x1</b> = .001 deg., <b>x10</b> =.01 deg., or <b>x100</b> =.1 deg. for 'C' axis.
JOG	Turn the handle in the direction necessary to move the axis in the required direction.

## B. MANUAL DATA INPUT (MDI)

OBJECTIVE	Manual data input.
INFORMATION	Commands that are normally given by a program can be given by the operator through MDI. These functions may be axes positioning, workhead on/off, coolant on/off, wheel on/off, etc. Any 'M' or 'G' code that is available can be activated thru MDI. A command of multiple blocks can be input from the CRT/MDI panel to the MDI operation buffer memory. All MDI commands are deleted after execution.
<u>STEP</u>	<u>PROCEDURE</u>
MDI mode	Push MDI pushbutton on the operator control station.
Program screen	Push the PROGRAM (Soft key under CRT) until a blank screen is displayed.
COMMAND	Type in the command to be input followed with an EOB (end of block) character. The typed command is entered in the key-input buffer first. Press the INSERT key; the command is transmitted to the MDI operation buffer memory. The content of the MDI operation buffer memory is displayed on the CRT.
CYCLE START	Press the "CYCLE START" pushbutton. The command will be executed.

## C. AUTOMATIC OPERATION EXECUTION

### 1. Automatic Operation from CNC Memory

OBJECTIVE	To Execute a Program from CNC Memory
INFORMATION	N/A
<u>STEP</u>	<u>PROCEDURE</u>
Program Storage	If the desired program is not in memory, follow directions in this manual for "PROGRAM STORAGE".
Select Program	Follow directions in this manual for "SELECTING A PROGRAM".
AUTO Mode	Push AUTO pushbutton on the operator control station.
Cycle Start	Press "CYCLE START" pushbutton. If "SINGLE BLOCK" is selected, one line of the program is executed for each push of the "CYCLE START" pushbutton.

### 2. Automatic Operation from an External Memory Device (Fanuc Option)

OBJECTIVE	To Execute a Program from an external memory device.
INFORMATION	Device must be inserted into control. I/O Channel must be set to the appropriate device. 4 = PCMCIA Memory Card 17 = USB Memory
<u>STEP</u>	<u>PROCEDURE</u>
Select Program	Follow directions in this manual for "SELECTING A PROGRAM".
Auto Mode	Push AUTO pushbutton on the operator control station.
Cycle Start	Press "CYCLE START" pushbutton. If "SINGLE BLOCK" is selected, one line of the program is executed for each push of the "CYCLE START" pushbutton.

## D. AUTOMATIC OPERATION STOP

OBJECTIVE To stop AUTO program execution.

INFORMATION The AUTO operation can be stopped by the program or by the operator's intervention.

### STEP

### PROCEDURE

Program Stop (M00) Cycle operation is stopped after a block containing M00 is executed. All existing modal information remains unchanged. All machine functions, such as wheel on, coolant on, etc. remain the same as before the M00.

CYCLE START To continue the AUTO operation, push the CYCLE/START pushbutton.

### STEP

### PROCEDURE

Optional Stop (M01) Cycle operation is stopped after a block containing M01 is executed, if the operator activated the 'Optional Stop' pushbutton on the control station prior to the program encountering the M01 code.

CYCLE START To continue the AUTO operation, push the CYCLE/START pushbutton.

### STEP

### PROCEDURE

Program End (M02,M30) Both of these codes indicate the program end. Both (M02,M30) codes cause the AUTO operation to be stopped and the NC unit to be reset. The M30 also rewinds the program to the beginning.

### STEP

### PROCEDURE

FEEDHOLD When the FEEDHOLD pushbutton on the operator's panel is pressed during motion, the axes motion is stopped. All other machine functions remain the same.

CYCLE START To continue AUTO operation, push the CYCLE START pushbutton.



STEP

PROCEDURE

CLEAR

The automatic operation can be ended by the CLEAR pushbutton on the operator's panel. This pushbutton stops all axes motion, turns off the wheel, coolant, workhead and rewinds the program to the beginning.

STEP

PROCEDURE

DRY RUN

This button causes ALL feedrates to default to a preset rate, usually ten inches per minute. It is used for program debugging and is not intended to be used during grinding operations.

STEP

PROCEDURE

Emergency Stop

This button on the operator's panel is used to immediately stop the machine at the time of emergency. This button is locked when pressed, and is unlocked by twisting it. The E-STOP button interrupts the current to all motors and places the control in ALARM status. The cause of the abnormality must be removed before releasing the emergency stop.

## 6) SELECTING A PROGRAM

### A. Selecting a program from CNC Memory.

OBJECTIVE To select a program for execution from CNC Memory.

INFORMATION One program must be selected from the Folder of programs before program execution is possible.

#### STEP

#### PROCEDURE

Program Selection

Select EDIT mode

Press the PROGRAM key.

Press FOLDER (Soft key under CRT).

Cursor to the correct folder and press the INPUT key.

Cursor to the desired program.

Press (OPRT). (Soft key under CRT).

Press MAIN/PROGRM. (Soft key under CRT).

--- OR ---

Program Selection

Select AUTO mode.

Press PROGRAM key.

Type the program number.

Press PROGRAM/SEARCH.(Soft key under CRT) or arrow down.

Note: Only the current "Foreground Folder" will be searched for the specified program.

## B. Selecting a program from an External Memory Device “DNC” (Fanuc Option)

OBJECTIVE To select a program for execution from external memory device.

INFORMATION One program must be selected from the list of programs before program execution is possible.

### STEP

### PROCEDURE

Connection

Device must be inserted into control.  
I/O Channel must be set to the appropriate device.  
4 = PCMCIA Memory Card  
17 = USB Memory

Program Selection

Select REMOTE mode.  
  
Select MDI mode.  
  
Press the PROGRAM key.  
  
Press the FOLDER (Soft key under CRT).  
  
Press the (OPRT) (Soft key under CRT).  
  
Press the DEVICE/CHANGE (Soft key under CRT).  
  
Press the MEMORY/CARD (Soft key under CRT).  
  
Cursor to desired program.  
  
Press DNC/SET (Soft key under CRT).

## 7) REWINDING A PROGRAM

OBJECTIVE To rewind a program.

INFORMATION To execute a program, it is necessary to rewind the program to its beginning.  
In REMOTE mode the screen will not update to show program rewound.

### STEP

### PROCEDURE

Rewind Program

Select AUTO mode.

Press the PROGRAM key until program page is displayed.

Press (OPRT) (Soft key under CRT).

Press REWIND (Soft key under CRT).

--- OR ---

Press CLEAR pushbutton on operator panel.  
(Must be in AUTO or EDIT mode only.)

--- OR ---

Select EDIT mode.

Press RESET key.

## 8) SEQUENCE NUMBER SEARCH

OBJECTIVE	To search for a sequence number in a program.
INFORMATION	To begin a program somewhere other than the beginning, search is used to step to the appropriate sequence number.
<u>STEP</u>	<u>PROCEDURE</u>
Sequence Search	Select AUTO mode.  Press PROGRAM key until program page is displayed.  Press (OPRT) (Soft key under CRT).  Type "N" then the line number you're searching for. (Number will appear on the CRT). Press SEQ NO/SEARCH (Soft key under CRT).

## 9) CNC PROGRAM CREATING & UPLOADING

OBJECTIVE	To store a program in the control.
INFORMATION	A program can be stored into the control by manually entering it through the keyboard, by the use of a computer and communications software or from an external memory device. Programs will be stored in the current "Foreground Folder" shown at the top of the "Program Folder" page.

### A. THROUGH KEYBOARD:

<u>STEP</u>	<u>PROCEDURE</u>
Program Storage	Select EDIT mode.  Press the PROGRAM key until program page is displayed.  Turn on the MEMORY PROTECT key switch.  Type letter O followed by the program number.  Press the INSERT key. The program is stored in memory. It is necessary to edit the program in order to enter the desired commands into the program. A program must be ended with an M02 or M30 code, while a macro must be ended with an M99.

## **B. FROM A COMPUTER:**

<u>STEP</u>	<u>PROCEDURE</u>
Connection	Connect the computer to the control with an RS232 cable. I/O Channel must be set to a "0".
Upload Program	Press the PROGRAM key.  Select EDIT mode.  Turn on the MEMORY PROTECT key switch.  Press the (OPRT) (Soft key under CRT)  Press the ARROW RIGHT (⇒) (Soft key under CRT) until you see the F/INPUT soft key.  Press the F/INPUT (Soft key under CRT)  Press the EXEC (Soft key under CRT)  Send program(s) from the connected computer.

### C. FROM A MEMORY DEVICE:

<u>STEP</u>	<u>PROCEDURE</u>
Connection	Device must be inserted into control. I/O Channel must be set to the appropriate device. 4 = PCMCIA Memory Card 17 = USB Memory
Upload Program	Select EDIT mode.  Turn on the MEMORY PROTECT key switch.  Press the PROGRAM key.  Press FOLDER (Soft key under CRT).  Press (OPRT) (Soft key under CRT).  Press DEVICE/CHANGE (Soft key under CRT).  Press MEMORY/CARD or USB/MEM (Soft key under CRT).  Press the ARROW RIGHT (⇒) (Soft key under CRT) until you see the F/INPUT soft key.  Press the F/INPUT (Soft key under CRT).  Cursor to the desired program.  Press F GET (Soft key under CRT).  Press F SET (Soft key under CRT).  Press EXEC (Soft key under CRT).

## 10) CNC PROGRAM DOWNLOADING

OBJECTIVE	To send a program from the control.
INFORMATION	A program can be sent to a computer with communication software or to a memory device.

### A. TO A COMPUTER:

<u>STEP</u>	<u>PROCEDURE</u>
Connection	Connect the computer to the control with an RS232 cable. I/O Channel must be set to a "0".
Download Program	Press the PROGRAM key.  Select EDIT mode.  Press the FOLDER (Soft key under CRT). Cursor to the desired program. Press the (OPRT) (Soft key under CRT). Press the ARROW RIGHT (Soft key under CRT)(⇒). Press the F/OUTPUT (Soft key under CRT). Press the P GET (Soft key under CRT). Press the P SET (Soft key under CRT). Press the EXEC (Soft key under CRT) after preparing the computer to receive the program. *Note: To download <u>ALL files</u> within the folder, do not press P GET or P SET, <u>only EXEC</u> .

### B. TO A MEMORY DEVICE:

<u>STEP</u>	<u>PROCEDURE</u>
Connection	Device must be inserted into control. I/O Channel must be set to the appropriate device. 4 = PCMCIA Memory Card 17 = USB Memory
Download Program	Follow steps in "A. TO A COMPUTER".  *Note: <b>OVERWRITE?</b> may be displayed if a program of the same number is present on the device. Press YES or CANCEL (Soft keys under CRT).



## 11) PROGRAM EDITING

OBJECTIVE	To edit a program.
INFORMATION	Programs can be edited only with the MEMORY PROTECT key switch on.
<u>STEP</u>	<u>PROCEDURE</u>
Edit program	<p>Press the PROGRAM key until program is displayed.</p> <p>Select EDIT mode.</p> <p>Turn on the MEMORY PROTECT key switch.</p> <p>The PAGE UP (↑) or PAGE DOWN (↓) pushbutton moves the cursor up or down a page.</p> <p>The CURSOR UP (↑) or CURSOR DOWN (↓) pushbutton moves the cursor up or down a word.</p> <p>Move the CURSOR to the position to be edited by using the CURSOR LEFT, RIGHT, DOWN, or UP pushbuttons.</p> <p>Place the CURSOR on a word to be ALTERED or on a word after which a word is to be INSERTED or on a word which is to be DELETED.</p>
Insert a change	<p>INSERT will enter a new word or words after the current cursor position.</p> <p>Key in the new word.</p> <p>Press INSERT key.</p> <p>When inserting a new program line, follow the insert instructions and remember to end the line with an EOB character.</p>
Alter	<p>ALTER will replace a word with a new word or words.</p> <p>Key in the new word.</p> <p>Press ALTER key.</p>
Delete a word	Press DELETE key.
Delete a line	Press EOB key. Press DELETE key.

## 12) BACKGROUND EDITING (\*\* OPTIONAL \*\*)

OBJECTIVE	To background edit a program.
INFORMATION	Background editing allows a program that is not selected in memory to be edited. Programs can be edited while another program is in operation. The program to be edited cannot be in operation. Background editing only functions with the MEMORY PROTECT key switch on. Only the current "Background Folder" will be searched for the specified program. If the program does not exist, a new program is created.
<u>STEP</u>	<u>PROCEDURE</u>
Background edit	Press the PROGRAM key.  Turn the MEMORY PROTECT key switch on.  Press (OPRT) (Soft key under CRT)  Press the ARROW RIGHT (⇒) (Soft key under CRT) if needed.  Press BG/EDIT (Soft key under CRT).  Type "O" followed by the program number.  Push EDIT/EXEC (Soft key under CRT).  Edit the displayed program according to PROGRAM EDITING instructions.  Press BG END (Soft key under CRT) to end editing.

### 13) PROGRAM DELETION

OBJECTIVE	To delete a program from memory.
INFORMATION	Programs can only be deleted with the MEMORY PROTECT key switch on.
<u>STEP</u>	<u>PROCEDURE</u>
Program deletion	Press PROGRAM key.  Select EDIT mode.  Turn on the MEMORY PROTECT key switch.  Press letter O and type the program number to be deleted.  Press the DELETE key or soft key.  Press EXEC (Soft key under CRT).  Note: To delete all the programs in memory: Type “-9999” for the program number.  To delete a range of programs: Type two program numbers separated with a comma.

## 14) DATA DISPLAY AND SETTING

### A. TOOL OFFSET:

OBJECTIVE                      To display and set tool offsets.

INFORMATION                 N/A

#### STEP                              PROCEDURE

Enter a Tool Offset            Press the OFS/SET key.

Press OFFSET (Soft key under CRT).

Move the cursor to the desired offset number by using the PAGE UP (↑) or PAGE DOWN (↓) key or the CURSOR UP (↑) or CURSOR DOWN (↓) key.

Type in the new offset value (+ or -) and press the INPUT key.

--- OR ---

Type in offset value change (+,-) and press +INPUT (Soft key under CRT).

#### STEP

Clear all offsets

#### PROCEDURE

Press the OFS/SET key.

Press the OFFSET (Soft key under CRT).

Press the (OPRT) (Soft key under CRT).

Press ERASE (Soft key under CRT).

Press ALL (Soft key under CRT).

Press EXEC (Soft key under CRT).

## B. CUSTOM MACRO:

OBJECTIVE	To display and set custom macro variable data.
INFORMATION	Local variables - #1 to #33 - cleared on power off & reset  (STANDARD) Common variables 1 - #100 to #149 - cleared on power off Common variables 2 - #500 to #531 - not cleared on power off  (OPTIONAL) Common variables 1 - #150 to #199 - cleared on power off Common variables 2 - #532 to #999 - not cleared on power off
<u>STEP</u>	<u>PROCEDURE</u>
Set a Variable Value	Press the OFS/SET key.  Press the ARROW RIGHT (⇒) (Soft key under CRT)  Press the MACRO (Soft key under CRT).  Move the cursor to the number of the desired macro variable by using the cursor movement keys.
Enter new value	Type the NEW value.  Press INPUT (Soft key under CRT)

## 15) DISPLAY

### A. PROGRAM:

OBJECTIVE To display program information.

INFORMATION N/A

STEP PROCEDURE

Display PROGRAM Press the PROG key.

### B. PROGRAM CHECK:

OBJECTIVE To display PROGRAM & POSITION information.

INFORMATION

1. Four lines of the active program.
2. Relative, Absolute and Machine position.
3. Distance to go.
4. Active G, F, S, M, and T codes.
5. Actual feed.
6. Parts Count, Run Time and Cycle Time

STEP PROCEDURE

Display PROGRAM CHECK Press the PROG key :  
Press PROG key until information is displayed.

### C. NEXT:

OBJECTIVE To display NEXT information.

INFORMATION

1. Current block of program.
2. Next block of program.

STEP PROCEDURE

Display NEXT Info Press the PROG key.  
Press the NEXT (Soft key under CRT).

#### **D. POSITION:**

OBJECTIVE To display POSITION information.

INFORMATION There are three current position display screens:  
RELATIVE current position in the relative coordinate system.  
ABSOLUTE current position in the absolute coordinate system.  
ALL overall position in both coordinate systems along with the machine position and Distance To Go.

#### STEP

#### PROCEDURE

Display POSITION

Press the POS key.

Press the ABSOLUTE, RELATIVE, or ALL (Soft key under CRT) of the desired screen.

#### **E. PRESET REL. POS:**

OBJECTIVE Preset relative position to zero.

INFORMATION N/A

#### STEP

#### PROCEDURE

Preset RELATIVE  
POS to zero

Press POS key.

Press RELATIVE (Soft key under CRT)  
Press the (OPRT) (Soft key under CRT).  
Press ORIGIN (Soft key under CRT).  
Press the ALL AXIS (Soft key under CRT) to zero all axes.

--- OR ---

Press the specific axis letter (X,Z,C) to zero only that axis  
Press EXEC (Soft key under CRT)

## 16) MACHINE STARTUP/SHUTDOWN/LOCKOUT

### A. MACHINE STARTUP:

OBJECTIVE Starting up the machine after power up.

INFORMATION N/A

STEP PROCEDURE

Machine startup Switch the electrical main disconnect ON.

Push  POWER ON pushbutton on operator control station.

Pull out the E-STOP if it is pushed in.

Push blue the SYSTEM RESET pushbutton after it has become illuminated.

Select and cycle appropriate program.

### B. MACHINE SHUTDOWN:

OBJECTIVE Machine shut down.

INFORMATION N/A

STEP PROCEDURE

Machine shutdown Insure machine is not in cycle and wheels are not rotating.

Push  POWER OFF pushbutton on operator control station.

Switch the electrical main disconnect OFF if machine will not be operated for an extended period of time.

### C. MACHINE LOCKOUT:

OBJECTIVE Machine lock out.

INFORMATION Lockout for wheel changing and maintenance items.

STEP PROCEDURE

Machine lockout Put a pad lock and a red lockout tag through the main disconnect lever. The red tag should have the date, time, contact person with phone number, and cause of lockout



## 17) TAPER ADJUSTMENT (Between Centers Only)

OBJECTIVE Removing taper from a piece part.

INFORMATION Taper can be physically adjusted with the footstock when parts are ground between centers. The center in the footstock is designed to rotate in an eccentric manner. By rotating the center, the tail end of the part will be moving either toward or away from the OD wheel, depending upon the direction of rotation. The amount of eccentricity is +/- .003".

### STEP

### PROCEDURE

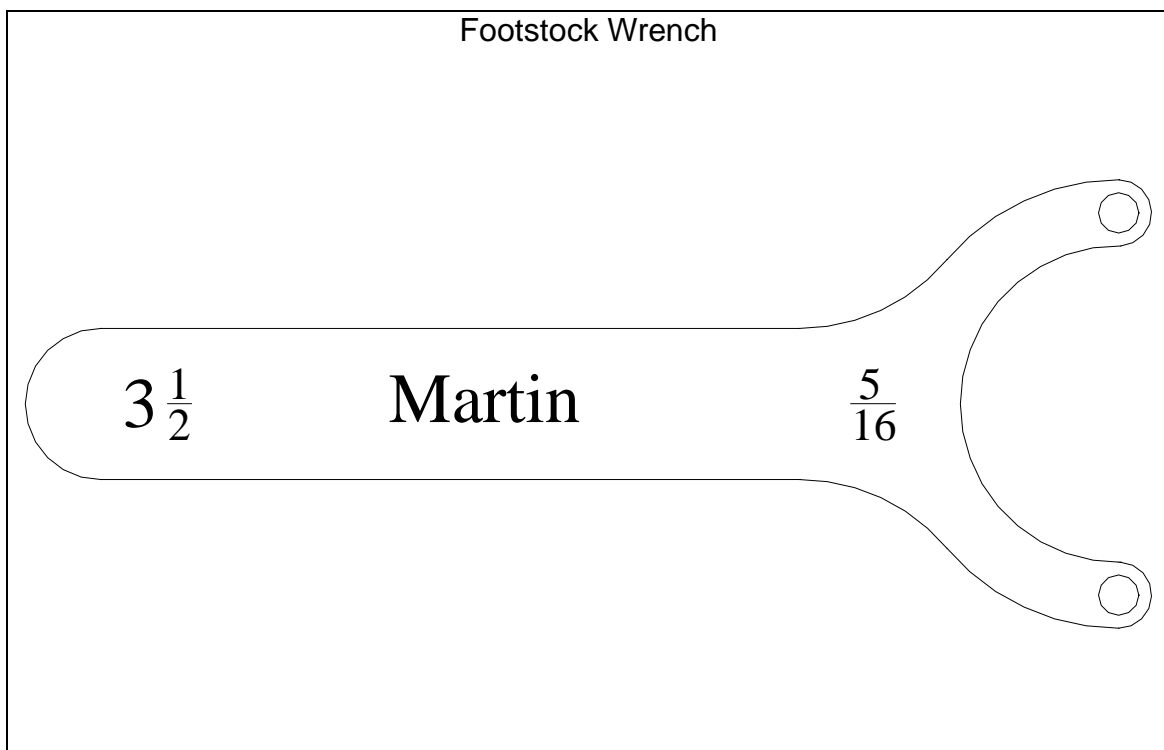
Remove taper

With the special wrench provided with the footstock, loosen the collar on the right side of the footstock with the spanner end of the wrench if the one-inch nut on end of footstock cannot be turned.

Rotate the one-inch nut on the right side of the footstock.

Generally, an operator will set an indicator against the right end of the piecepart before adjusting for taper. After using an indicator several times, the operator will understand which direction to rotate the footstock center and how much rotation yields a certain amount of taper adjustment.

Tighten the collar on the right side of the footstock with the spanner wrench if loosened.



## 18) MOUNTING A WHEEL ON A HUB

OBJECTIVE To mount a wheel onto a wheel adapter.

INFORMATION Eccentricity must be avoided when mounting a wheel on a flange. When neither side of the wheel has a label, a suitably soft absorbent paper with a thickness of approximately .030 in. should be placed between the two sides of the wheel and the flange.

### STEP PROCEDURE

Mounting wheel A visual inspection will disclose any obvious cracks in the wheel, but before being mounted, a wheel should be given a "ring" test, in which the wheel is suspended from a hook and tapped lightly with a hammer. An acceptable wheel will give a clear ring.

Clean both flange mounting surfaces and remove any nicks or burrs and install new blotters.

Lightly tighten the flange bolts to an equal degree of tightness and then use a torque wrench to firmly tighten each set of two opposing bolts until all of the bolts are tight. The torque wrench should be set based on the bolt chart below.

<u>Bolt</u>	<u>Torque</u>
3/8"-16	35 ft-lbs
1/2"-13	70 ft-lbs
M10-1.5	55 ft-lbs

When a new wheel is used, the bolts can loosen during operations due to the compression of the paper between the wheel and the flange. The bolts should therefore be retightened once after the initial 8 to 16 hours of operation.

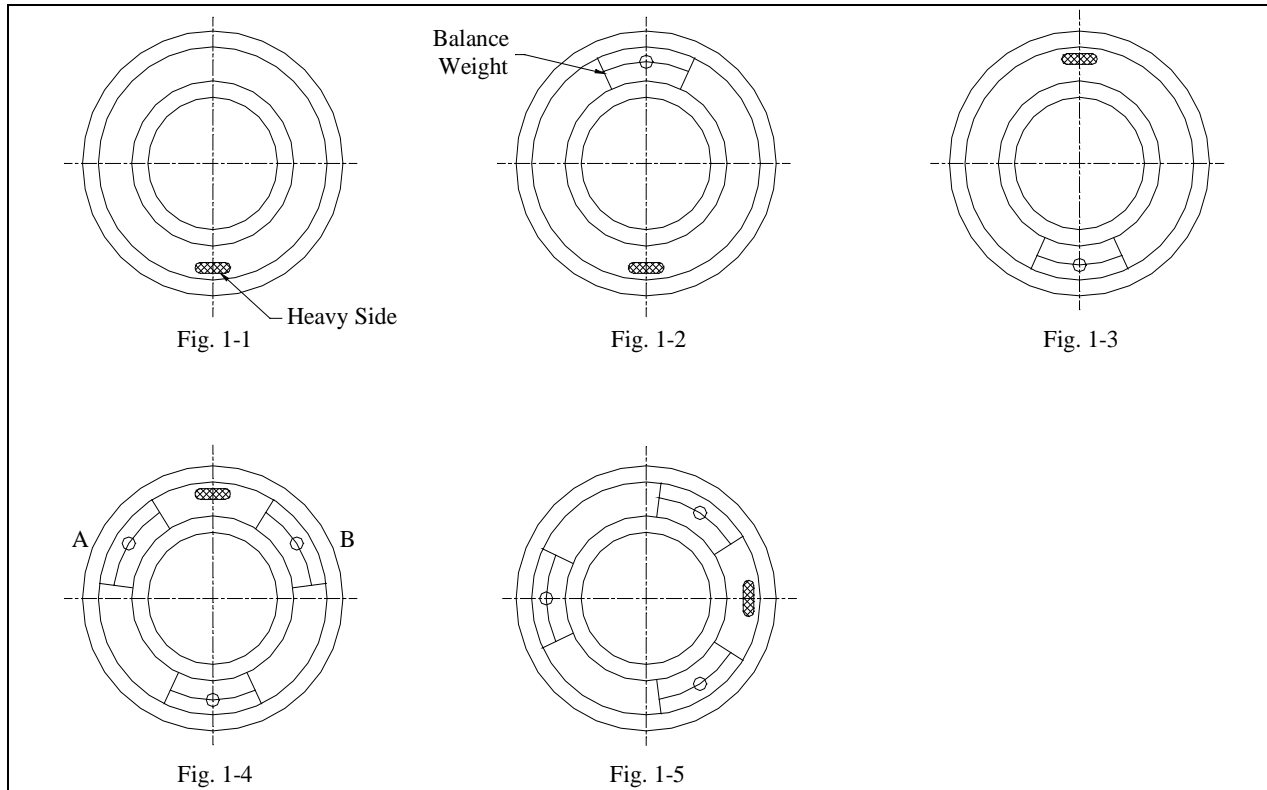
Always be sure to establish static balance for a new wheel.

## 19) STATIC BALANCING A WHEEL

OBJECTIVE	To static balance a wheel assembly.
INFORMATION	<p>Wheel balance is essential to insure part surface finish, part roundness, and to reduce premature wheel bearing failure.</p> <p>Wheel balance should be checked periodically since a wheel that has initially been balanced can become slightly imbalanced as its diameter becomes smaller.</p> <p>If a wheel is separated from its flange and stored separately, it will be necessary to balance it in the same manner that is described below.</p>
STEP	PROCEDURE
Wheel balancing	<ol style="list-style-type: none"><li>1. Place the balancing stand in a horizontal position, place the mounted wheel and flange on the balancing arbor, and then gently place the assembly on the balancing stand. There should not be any weights on the flange.</li><li>2. Allow the wheel to rotate and stop. When there is an imbalance, the wheel will turn and stop at a position where the heavy side of the wheel assembly is at the bottom, as shown in Figure 1-1.</li><li>3. Place a weight on the flange at a position that is directly opposite the heavy side, as shown in Figure 1-2. This weight should never be moved from this position.</li><li>4. Allow the wheel to rotate and stop. The weight should finish at the bottom of the wheel as shown in Figure 1-3.</li><li>5. Place the remaining two weights to positions "A" and "B", as shown in Figure 1-4, which are both at an equal angle in relation to the heavy side of the wheel assembly.</li><li>6. Turn the wheel by hand and then release it. Repeat this action several times.</li></ol> <p>Balance has been established when the wheel stops at random positions. The weights must be positioned so that the balance is maintained even when the wheel is rotated by 90 degrees, as shown in Figure 1-5. If the wheel does not stop at random positions, move the weights to positions 'A' and 'B' – away from the heavy side.</p> <ol style="list-style-type: none"><li>7. Tighten the weights firmly in position after confirming that the proper balance has been established.</li></ol>

8. Mount the wheel and the wheel flange on the machine and perform a truing operation. Stop the coolant after the truing operations have been completed and allow the wheel to remain rotating for approximately 10 minutes in order to remove all of the moisture from the wheel (including the moisture in the pores of the wheel).

9. Remove the wheel from the machine and perform the static-balance operation once again by following steps (1) to (7) above.



## 20) MOUNTING/DE-MOUNTING A WHEEL ONTO THE GRINDER

OBJECTIVE	To mount/de-mount a wheel assembly onto the grinder.
INFORMATION	<p>Caution must be exercised in regard to the thread directions for the flange-bolt and the flange-removal tool since they differ on left-hand mounted and right-hand mounted machines.</p> <p>Extreme caution must be exercised to avoid damaging the wheel or wheel spindle when mounting or de-mounting flanges because of the relatively heavy weights of the flange and wheel.</p>
<u>STEP</u>	<u>PROCEDURE</u>
Mounting a wheel.	<p>Wipe the wheel spindle clean and remove any rust or burrs.</p> <p>Place the flange &amp; wheel assembly on the wheel spindle, pushing it into position by hand. It should lock on the taper.</p> <p>Screw the flange-bolt in by hand.</p> <p>Firmly tighten the bolt by using the hex wrench that is provided with the machine.</p>
<u>STEP</u>	<u>PROCEDURE</u>
De-mounting a wheel.	<p>Remove the flange bolt by using the hex wrench that is provided with the machine.</p> <p>Screw on the flange-removal tool by hand.</p> <p>Firmly screw in the flange-removal tool into the wheel flange . Install the breaker bar through the removal tool and strike with a dead-blow hammer to remove the flange from the wheel spindle.</p>

## 21) DRESSING A WHEEL - MANUALLY

OBJECTIVE To dress a wheel manually.

INFORMATION The proper traversing speed for a dressing operation depends on the grinding wheel grain size, rotational speed, the configuration for the tip of the diamond and the required quality of the finished work surface. Speeds of .010 to .020 in/rev (20 to 30 in/min) are generally used when rough grinding is to be performed and speeds of .002 to .007 in/rev (4 to 10 in/min) are generally used when precision grinding is to be performed.

Be sure to supply an adequate amount of coolant in a steady manner throughout the entire course of a dressing operation to prevent the diamond from heating. Supply the coolant from the start of an operation since starting the coolant midway through the operation will result in a sudden cooling action that may cause the diamond to break.

### STEP

### PROCEDURE

Manually dress

Bring the tip of the diamond toward the periphery of the wheel while rotating the wheel by hand.

Use the Manual Pulse Generator to lightly contact the wheel and diamond at the highest part of the wheel. A slight mark may be left on the wheel.

Close door and turn wheel on.

Do not yet infeed the diamond, instead, feed it to the right and left at a low speed so that the diamond tip removes any dust or other foreign matter adhering to the wheel surface.

Move diamond off one side or the other of the wheel.

Infeed by 0.0005 in. Exercise caution at this time that the amount of infeed does not exceed 0.001 in.

Traverse across the wheel surface with low jog. Use the feedrate override switch to increase or decrease the feedrate.

Repeat the two previous operations until a light and continuous sound is emitted throughout the entire course of the dressing operation.

## 22) WHEEL SPEED

OBJECTIVE	To understand manufacturer's wheel speed ratings.
INFORMATION	Always check wheel manufacturer's MAX wheel revolutions per minute (RPM) printed on the wheel. It may also have max surface speed. This is the max RPM only at the manufactured diameter.

### **DO NOT EXCEED MANUFACTURER'S MAXIMUM WHEEL SPEED!!**

The manufacturer's maximum wheel speed in Surface Feet Per Minute (SFPM) must not be exceeded. As a wheel becomes smaller due to dressing, the wheel RPM may be safely increased as long as the maximum SFPM is not exceeded.

### STEP

### PROCEDURE

Calculate wheel SFPM

Determine wheel surface feet per minute (SFPM) from RPM.

Measure wheel diameter.

Calculate wheel SFPM with this formula:

$$\text{SFPM} = (\text{RPM} \times \text{Wheel Diameter} \times 3.14) / (12)$$

Example:

$$\text{RPM} = 2030 \quad \text{Wheel Diameter} = 16.00''$$

$$\begin{aligned} \text{SFPM} &= (2030 \times 16 \times 3.14) / (12) \\ &= (101987) / (12) \\ &= 8500 \end{aligned}$$

Note:-To convert meters per second to feet per minute:

$$\text{SFPM} = (\text{meters per second}) \times 196.85$$

To convert feet per minute to meters per second:

$$\text{SMPS} = \text{SFPM} / 196.85$$

### STEP

### PROCEDURE

Calculate wheel RPM

Determine wheel RPM from surface feet per minute (SFPM).

Measure wheel diameter.

Calculate wheel RPM with this formula:

$$\text{RPM} = (\text{SFPM} \times 12) / (\text{Wheel Diameter} \times 3.14)$$

## 23) SQUARING A WORKHEAD

OBJECTIVE To square a workhead on the grinder.

INFORMATION This process insures that the workhead is square to the 'Z' axis and parallel to the 'X' axis. The workhead being square is important to reduce taper on a piecepart when chucking is involved, and is important when centers are used so that the centers are seated properly in the part.

The workhead should be lifted from the table so that all mounting surfaces can be cleaned and lightly stoned. Cleanliness is essential.

A magnetic base with an indicator is required.

### STEP

### PROCEDURE

Square workhead

1. Mount a magnetic base with an indicator on the 'X' axis. The tip of the indicator should be close to the centerline height of the workhead.
2. Jog the indicator against the face of the workhead. Use the face with the largest diameter. Use the portion of the face which is closest to the operator.
3. Set 'zero' on the indicator.
4. Jog or MDI an incremental 'Z' plus distance so that the indicator is off of the face of the workhead. A typical distance is 1". This distance needs to be greater if a center is mounted in the workhead taper.
5. Jog or MDI an incremental 'X' plus distance so that the indicator is positioned in front of the same workhead face which was used in step 2, but now is on the side away from the operator.
6. Jog or MDI the incremental minus 'Z' distance which was used in step 4. If the workhead is square, the indicator will now read 'zero'. If the indicator is not zero, the workhead needs moved. Loosen the hold-down bolts and the alignment blocks and tap the workhead in the direction to correct for the out-of-square condition.
7. Re-zero the indicator.
8. Repeat Step 4.



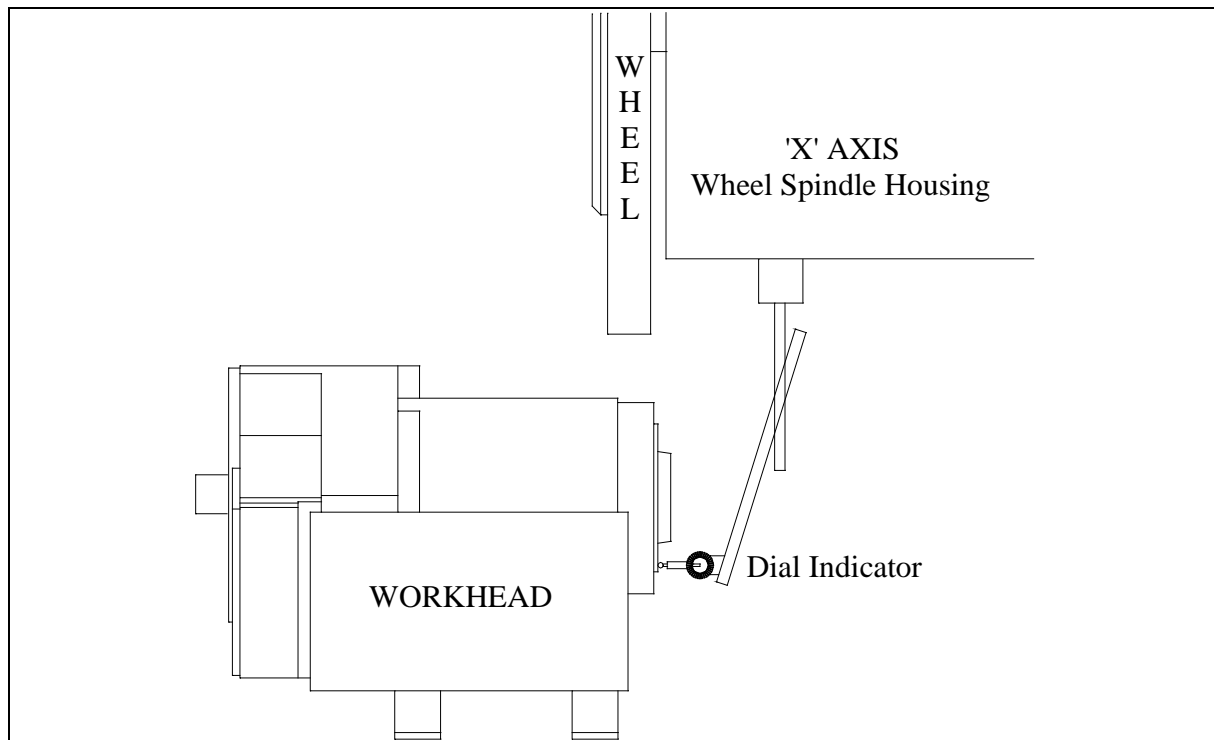
9. Jog or MDI an incremental 'X' minus distance so that the indicator is positioned in front of the same workhead face which was used in Step 2.
10. Continue to jog or MDI back and forth on the face of the workhead after tapping the workhead until the indicator reads, 'zero' on both face readings.
11. Tighten both hold-down bolts.

## INFORMATION

The following program can be used instead of using jog or MDI commands to check the squareness of the workhead. The indicator must be positioned on the workhead face which is closest to the operator at the beginning of this program.

### O1234 (SQUARE WORKHEAD)

N10 G94 G01 W1.0 F50	(retracts indicator from workhead face)
N20 U6.5	(moves indicator to face away from operator)
N30 W-.990	(moves indicator near workhead face)
N40 W-.010 FI	(moves indicator against workhead face)
N50 M00	(program stop until next Cycle Start)
N60 W1.0 F50	(retracts indicator from workhead face)
N70 U-6.5	(moves indicator to face near operator)
N80 W-.990	(moves indicator near workhead face)
N90 W-.010 FI	(moves indicator against workhead face)
N100 M30	(program stop and rewind)



## 24) BULB TEST

### OBJECTIVE

To test all light bulbs on operator panel and (optional) status lights.

### STEP

Test all bulbs

### PROCEDURE

Press CLEAR & SYSTEM/RESET buttons on operator panel at the same time.

## 25) APPENDIX

### A. M CODES

M00	Program Stop
M01	Optional Stop
M02	End of Program
M03	Workhead Run Counter Clockwise
M04	Workhead Run Clockwise
M05	Workhead Stop
M06	Auxiliary Coolant On
M07	ID Coolant On
M08	OD Coolant On
M09	Coolant Off
M10	Switch Workhead to Positioning Mode
M11	Buffer Cancel
M12	Adaptive Control On
M13	Adaptive Control Off
M14	Gap Elimination On
M15	Gap Elimination Off
M25	Spindle Orient
M30	End of Program and Rewind to Beginning
M48	Bypass Override Off
M49	Bypass Override On
M50	OD Wheel On
M51	OD Wheel Off
M52	ID Wheel On
M53	ID Wheel Off
M54	Rotary Dresser On (Forward)
M55	Rotary Dresser Off
M60	Gauge Extend and Activate
M61	Gauge Retract and Deactivate
M62	Flag Extend and Activate
M63	Flag Retract and Deactivate
M64	Probe / Lateral Locator Extend and Activate
M65	Probe / Lateral Locator Retract and Deactivate
M66	Footstock extend
M67	Footstock retract
M68	Fast Lube Cycle
M69	Normal Lube Cycle
M70	High pressure coolant On
M71	High Pressure coolant Off
M72	Rotary Dresser On (Reverse)
M74	Internal Lower
M75	Internal Raise
M76	Wheel spindle speed variation On
M77	Wheel spindle speed variation Off
M78	Steadyrest extend
M79	Steadyrest retract

## APPENDIX

M82	Chuck Open
M83	Chuck Close
M84	Dittle run
M85	Dittle stop
M86	Dittle Set 1
M87	Dittle Set 2
M88	Dittle Set 3
M89	Dittle Set 4
M90	Close automatic operator door
M91	Open automatic operator door
M93	Check Probe / Lateral Locator is Not Tripped
M94	Check Probe / Lateral Locator is Tripped
M96	Custom macro interrupt on
M97	Custom macro interrupt off
M98	Sub-program call
M99	End of Sub-Program (Macro)

## B. G CODES (System C)

G00	Positioning - Rapid Traverse
G01♦	Linear Interpolation
G02	Circular Interpolation - Clockwise
G03	Circular Interpolation – Counter-Clockwise
G04	Dwell
G12.1	Polar Coordinate Interpolation Mode On
G13.1♦	Polar Coordinate Interpolation Mode Off
G18♦	Z-X Plane Selection
G31	Skip Function
G40♦	Tool Nose Radius Compensation Cancel
G41	Tool Nose Radius Compensation Left
G42	Tool Nose Radius Compensation Right
G65	Program Call
G70	Inch Data Input
G71	Metric Data Input
G90♦	Absolute Programming
G91	Incremental Programming
G92	Coordinate System Setting
G94♦	Per Minute Feed
G95	Per Revolution Feed
G96	Constant Surface Speed
G97♦	Direct RPM

♦ Default G-Code

## APPENDIX

### C. SPECIAL G-CODES & VARIABLES

G14 Activate Weldon chopping

ex. G14 W [d] F [r]

d = Chopping Distance

r = Chopping Feedrate

G15 De-activate Weldon chopping

**(Variables #140-#149 are reserved for special functions)**

#140=

#141=

#142 = Adaptive Load target  
( % of load )

#143 = Gap elimination sensitivity  
( % of load for trip )

#144 = Variable speed dresser RPM

#145 = OD wheel spindle RPM

#146 = ID wheel spindle RPM

#147 = Coolant pump volume

#148 =

#149 =

# APPENDIX

## D. RS-232 COMMUNICATION SETTINGS & WIRING

The following parameter settings are required for proper operation of the control to communicate with a computer via RS-232:

<u>Parameter</u>	<u>Setting</u>	<u>Description</u>
#20	0	I/O Channel
#100	00001000	
#101	10000000	
#102	0	Device Type
#103	10	Baud Rate:
		1 = 50      7 = 600
		2 = 100     8 = 1200
		3 = 110     9 = 2400
		4 = 150    10 = 4800
		5 = 200    11 = 9600
		6 = 300    12 = 19200

