OPERATOR’S MANUAL

CONQUEST® T42
CONQUEST T42-L
CONQUEST T42SP
CNC Lathes

Equipped with the
GE Fanuc 18T Control
- NOTICE -
Damage resulting from misuse, negligence, or accident is not covered by the Hardinge Machine Warranty.

Information in this manual is subject to change without notice.

This manual covers the operation of Hardinge CONQUEST® T42 series lathes equipped with the GE Fanuc 18T control and absolute encoders.

In no event will Hardinge Inc. be responsible for indirect or consequen-
tial damage resulting from the use or application of the information in this manual.

Reproduction of this manual, in whole or in part, without written permission of Hardinge Inc. is prohibited.

CONVENTIONS USED IN THIS MANUAL

- WARNINGS -
Warnings must be followed carefully to avoid the possibility of personal in-
jury or damage to the machine, tooling, or workpiece.

- CAUTIONS -
Cautions must be followed carefully to avoid the possibility of damage to the
machine, tooling, or workpiece.

- NOTES -
Notes contain supplemental information.

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READ COMPLETE INSTRUCTIONS CAREFULLY BEFORE OPERATING MACHINE

When this instruction book was printed, the information given was current. However, since we are constantly improving the design of our machine tools, it is possible that the illustrations and descriptions may vary from the machine you received.

- WARNING -

Occupational Safety and Health Administration (OSHA) Hazard Communication Standard 1910.1200, effective September 23, 1987, and various state “employee right-to-know laws” require that information regarding chemicals used with this equipment be supplied to you. A complete list of the chemicals used with this machine, their reference data sheet numbers, and their suppliers appears as an insertion at the end of this manual. Refer to the applicable section of the Material Safety Data Sheets supplied with your machine when handling, storing, or disposing of chemicals.

Machine should only be used with a bar feed approved by Hardinge Inc.

HARDINGE SAFETY RECOMMENDATIONS

Your Hardinge machine is designed and built for maximum ease and safety of operation.

However, some previously accepted shop practices may not reflect current safety regulations and procedures, and should be re-examined to insure compliance with the current safety and health standards.

Hardinge Inc. recommends that all shop supervisors, maintenance personnel, and machine tool operators be advised of the importance of safe maintenance, setup, and operation of all equipment. Our recommendations are described below. READ THESE SAFETY RECOMMENDATIONS BEFORE PROCEEDING ANY FURTHER.

READ THE APPROPRIATE MANUAL OR INSTRUCTIONS before attempting operation or maintenance of the machine. Make sure you understand all instructions.

CONSULT YOUR SUPERVISOR when in doubt as to the correct way to do a job.

DON’T OPERATE EQUIPMENT unless proper maintenance has been regularly performed and the equipment is known to be in good working order.

DON’T REMOVE any warning or instruction tags from machine.

DON’T OPERATE EQUIPMENT if unusual or excessive heat, noise, smoke, or vibration occurs. Report any excessive or unusual vibration, sounds, smoke, or heat as well as any damaged parts.

MAKE SURE equipment is properly grounded. Consult National Electric Code and all local codes.

DISCONNECT MAIN ELECTRICAL POWER before attempting repair or maintenance.

DON’T REACH into any control or power case area unless electrical power is OFF.

DON’T TOUCH ELECTRICAL EQUIPMENT when hands are wet or when standing on a wet surface.
ALLOW ONLY AUTHORIZED PERSONNEL to have access to enclosures containing electrical equipment.

DON'T ALLOW the operation or repair of equipment by untrained personnel.

REPLACE BLOWN FUSES with fuses of the same size and type as originally furnished.

ASCERTAIN AND CORRECT cause of a shutdown caused by overload heaters before starting machine.

WEAR SAFETY GLASSES AND PROPER FOOT PROTECTION at all times. When necessary, wear respirator, helmet, gloves, and ear muff or plugs.

KEEP AREA AROUND THE MACHINE well lighted and dry.

KEEP CHEMICAL AND FLAMMABLE MATERIAL away from electrical or operating equipment.

HAVE THE CORRECT TYPE OF FIRE EXTINGUISHER handy when machining combustible material and keep chips clear of the work area.

DON'T USE a toxic or flammable substance as a solvent cleaner or coolant.

MAKE SURE PROPER GUARDING is in place and all doors are closed and secured.

TO REMOVE OR REPLACE the collet closer it is necessary to remove the guard door at left end of the machine. Make certain the guard door is replaced before starting the machine.

DON'T ALTER THE MACHINE to bypass any interlock, overload, disconnect, or other safety device.

DON'T OPEN GUARD DOORS while any machine component is in motion. Make certain that all people in the area are clear of the machine when opening the guard door.

MAKE SURE chucks, closers, fixture plates, and all other spindle-mounted work-holding devices are properly mounted and secured before starting machine.

MAKE CERTAIN all tools are securely clamped in position before starting machine.

REMOVE ANY LOOSE PARTS OR TOOLS left on machine or in the work area before operating machine. Always check machine and work area for loose tools and parts especially after work has been done by maintenance personnel.

REMOVE CHUCK WRENCHES before starting the machine.

BEFORE PRESSING THE CYCLE START PUSH BUTTON, make certain that proper functions are programmed and that all controls are set in the desired modes.

KNOW WHERE ALL stop push buttons are located in case of an emergency.
CHECK THE LUBRICATION OIL LEVEL and the status of indicator lights before operating the machine.

MAKE CERTAIN that all guards are in good condition and are functioning properly before operating the machine.

INSPECT ALL SAFETY DEVICES AND GUARDS to make certain that they are in good condition and are functioning properly before the cycle is started.

CHECK THE TURRET POSITION before pressing the Cycle Start push button.

CHECK SETUP, TOOLING AND SECURITY OF WORKPIECE if the machine has been OFF for any length of time.

DRY CYCLE a new setup to check for programming errors.

MAKE CERTAIN you are clear of any “pinch point” created by moving slides before starting the machine.

DON’T OPERATE any equipment while any part of the body is in the proximity of a potentially hazardous area.

DON’T REMOVE CHIPS with hands. Use a hook or similar device and make certain that all machine movements have ceased.

BE CAREFUL of sharp edges when handling newly machined workpieces.

DON’T REMOVE OR LOAD workpieces while any part of the machine is in motion.

DON’T OPERATE ANY MACHINE while wearing rings, watches, jewelry, loose clothing, neckties, or long hair not contained by a net or shop cap.

DON’T ADJUST tooling or coolant hoses while the machine is running.

DON’T LEAVE tools, workpieces or other loose items where they can come in contact with a moving component of the machine.

DON’T CHECK finishes or dimensions of workpiece near running spindle or moving slides.

DON’T JOG SPINDLE in either direction when checking threads with a thread gage.

DON’T ATTEMPT to brake or slow the machine with hands or any makeshift device.

ANY ATTACHMENT, TOOL, OR MACHINE MODIFICATION not obtained from Hardinge Inc., must be reviewed by a qualified safety engineer before installation.

USE CAUTION around exposed mechanisms and tooling especially when setting up. Be careful of sharp edges on tools.

DON’T USE worn or defective hand tools. Use the proper size and type for job being performed.
USE ONLY a soft-faced hammer on turret tools and fixtures.

DON'T USE worn or broken tooling on machine.

MAKE CERTAIN that all tool mounting surfaces are clean before mounting tools.

INSPECT ALL CHUCKING DEVICES daily to make sure they are in good operating condition.

REPLACE DEFECTIVE CHUCK before starting machine.

USE MAXIMUM ALLOWABLE gripping pressure on the chuck. Consider weight, shape and balance of workpiece.

USE LIGHTER THAN NORMAL feedrates and depth of cut when machining a workpiece diameter that is larger than the gripping diameter.

DON'T EXCEED the rated capacity of machine.

DON'T LEAVE the machine unattended while it is operating.

DON'T CLEAN the machine with an air hose.

DON'T OVERFILL tote pans.

KEEP TOTE PANS a safe distance from machine.

DON'T LET STOCK project past the back end of the collet closer or machine spindle without being adequately covered and properly supported.

FOLLOW each bar feed manufacturer's guidelines. For performance and safe application, size and use feed tube bushings, pushers, and spindle liners according to bar feed information.

MAKE CERTAIN that any bar feed mechanism is properly aligned with spindle. If floor-mounted type, it must be securely bolted to floor.

UNLESS OTHERWISE NOTED, all operating and maintenance procedures are to be performed by one person. To avoid injury to yourself and others, be sure that all personnel are clear of the machine when opening or closing the coolant guard door and any access covers.

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CHAPTER 1 - OPERATOR CONTROL PANELS

CONTROL DISPLAY SCREEN AND MANUAL DATA INPUT PANEL

The Control Display and Manual Data Input panel, shown in Figures 1.1 and 1.2, consists of a control display screen (9” color) with its associated soft keys and a Manual Data Input keyboard.

CONTROL DISPLAY SCREEN

SOFT KEYS

The soft keys have various functions, depending on the application. The soft key functions are displayed at the bottom of the control display screen.

LEFT-HAND SOFT KEY

This key is used to return to the initial state after a function has been accessed by pressing one of the soft keys.

RIGHT-HAND SOFT KEY

This key is used to display further soft key functions which are not currently displayed.

MANUAL DATA INPUT KEYBOARD

ALTER

This key permits changes to be made to an existing entry in an active program while in Edit mode. Refer to “Edit Mode” in Chapter 3.

CUSTOM/GRAPH

If the control is equipped with the optional graphics feature, pressing this key allows the operator to graphically display the tool path while the program is being executed. Unless Machine Lock and Dry Run modes are active, machine motion will occur.

Refer to the GE Fanuc operator’s manual for a description of the Graphics feature.

CAN (Cancel)

This key is used to cancel or delete the last character or symbol which has been entered into the input buffer. It is also used, together with the appropriate function key, to clear the data displayed on the screen.

CURSOR CONTROL KEYS

The ➔ and ◄ cursor control keys will move the cursor forward or backward through the program one data word at a time.

The ↓ and ↑ cursor control keys will move the cursor forward or backward through the program one data block (program line) at a time.
Figure 1.1 - Control Display and Data Input Panel (U.S. Domestic Machines)

Figure 1.2 - Control Display and Data Input Panel (CE Mark Machines)
DATA INPUT KEYS

The data input keys are the top four rows of keys on the Manual Data Input panel. These keys are used to manually enter data into the control. These keys input alphabetic, numeric, and other characters. In addition to these keys, the Alter, Insert, Delete, and Cancel keys are active. Data entered with the data input keys is indicated on line 14 of the display screen.

Each data input key is capable of inputting two distinct characters. The address or numeric input is switched through the use of the Shift key. Refer to page 1-14 for information on the Shift key.

The Arrows on the 2, 4, 6, and 8 keys are used with the optional Graphics Function to magnify the graphics display. Refer to the GE Fanuc operator’s manual for a description of the Graphics feature.

The Rapid Traverse (zigzag) symbol on the 5 key has no function.

DELETE

This key is used for deleting part programs or any portion of a part program. Refer to “Edit Mode” in Chapter 3.

HELP

The Help key allows the operator to gain access to an on-line help system. For additional information, refer to “On-Line Help System”, page 1-18.

INPUT

The Input key is used to set data, which has been entered into the input buffer area, into the appropriate area in the control memory. Refer to “Manual Data Input” in Chapter 3.

INSERT

This key allows additional commands to be inserted in a program line while in Edit mode. Refer to “Edit Mode” in Chapter 3.

MESSAGE

This key allows the operator to display either alarm messages, operator messages, or the alarm message history.

OFFSET SETTING

Allows the display and setting of the following values:

- Control System Variables
- Work shift
- X and Z axis Tool Offset Values

For additional information on control system variables, refer to “To Review Control Status”, in Chapter 2.

For additional information, refer also to “Chapter 4 - Work Shift and Tool Offsets”.

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The Page keys are used to display information which requires more than one display page. Pressing Page ↓ or Page ↑ causes the control to display the next or previous page.

**POS (Position)**

Using the Position key together with the Page key, positional data can be displayed in one of three ways:

1. In the absolute mode of the work coordinate system by pressing the Absolute soft key.
2. In the relative coordinate system by pressing the Relative soft key.
3. In the overall mode, indicating relative, absolute, machine coordinate, and distance to go, by pressing the All soft key.

**PROG (Program)**

Allows the operator to perform the following:

- In Edit mode - display and edit programs.
- In Manual Data Input mode - Input and display Manual Data Input data.
- In Automatic mode - display the part program.

**RESET**

- **CAUTION** -

  *If this key is pressed while a part program is being executed, axis and spindle motion will stop.*

  This key may be activated at any time. The M and G codes are reset to the power-up default status. Active tool offsets are canceled. Reset is also used to clear an alarm state after a fault has been corrected.

**SHIFT**

Each of the data input keys has one large and one small character. By pressing the shift key, the user can switch between the two characters on the data input key. Pressing the Shift key will alternate the screen cursor between “_” and “^”. The “_” cursor indicates that the large character in the center of the data input key will be input. The “^” cursor indicates that the small character in the lower right corner of the data input key will be input.
- WARNING -

Exercise caution when accessing control functions that allow parameter editing. Making incorrect changes in the parameter tables may disable the machine or cause undesirable machine behavior.

The System key allows access to the machine parameter and diagnostic information. This key also toggles the display between the Parameter and Diagnostic screens.

The Parameter soft key allows display and setting of machine parameters.

The Diagnostic soft key allows display of machine diagnostic information.

The PMC soft key allows display of the following PMC information:

- Ladder
- Diagnostics
- Parameters

The System soft key allows display of the control hardware and software configuration.

The Operator soft key provides the capability of searching, editing, uploading, or downloading machine parameters.
INDEPENDENT FRONT PANEL CONTROLS

POWER PUSH BUTTONS

CONTROL ON
Pressing CONTROL ON push button “A”, Figure 1.3, applies power to the control.

CONTROL OFF
Pressing CONTROL OFF push button “B” removes power from the control.

SPINDLE LOAD METERS

Main Spindle Meter

- CAUTION -
Continuous machining in the yellow band MUST BE LIMITED to 30 minutes, followed by 30 minutes of idle time.
Continuous machining in the red band IS NOT PERMITTED.

Spindle load meter “C”, Figure 1.3, displays the percentage of recommended full load current being drawn at the operating speed on the main spindle. As a protective measure, the main spindle drive module will automatically limit the maximum current to the spindle motor to 150% of recommended full load current during continuous machining.

Sub-Spindle Meter [Option]

- CAUTION -
Continuous machining in the yellow band MUST BE LIMITED to 10 minutes, followed by 10 minutes of idle time.
Continuous machining in the red band IS NOT PERMITTED.

Spindle load meter “D”, Figure 1.3, displays the percentage of recommended full load current being drawn at the operating speed on the sub-spindle.

Figure 1.3 - Control ON/OFF Push Buttons and Spindle Load Meters
OPERATOR CONTROL PANEL

The operator control functions described in this section are listed numerically. Refer to Figures 1.4 and 1.5 for the location of the various switches, push buttons, and indicator lights.

AUTO (Automatic) [#1]

Press this push button to select automatic mode. Automatic mode allows execution of the active part program and modification of part programs using the Back Edit function. The indicator light is illuminated when automatic mode is active. Refer to Chapter 3 for a complete explanation of automatic mode.

SINGLE (Single Block) [#2]

Press this push button to select Single mode. Single mode provides the operator with the ability to execute one block of data each time the Cycle Start push button is pressed. Canned cycles are executed one pass at a time. The indicator light is illuminated when Single mode is active. Refer to the Programmer’s Manual (M-320) for a complete description of the Canned Cycles.

MDI (Manual Data Input) [#3]

Press this push button to select Manual Data Input mode. Manual Data Input mode allows manual input of a temporary program block. The indicator light is illuminated when Manual Data Input mode is active. Refer to Chapter 3 for a complete explanation of Manual Data Input mode.

JOG [#4]

Press this push button to select Jog mode. Jog mode allows non-programmed movement of the axes. The indicator light is illuminated when Jog mode is active. Refer to Chapter 3 for a complete explanation of Jog mode.

BLOCK SKIP [#5]

Press this push button to alternately activate and deactivate Block Skip mode. When this mode is active, the control will ignore any data block preceded by a slash (/) code. The indicator light is illuminated when Block Skip is active.
Figure 1.4 - Operator Control Panel
(U.S. Domestic Machines)

Figure 1.5 - Operator Control Panel
(CE Mark Machines)
OPTION STOP [#6]

- CAUTION -

It is the responsibility of the part programmer to program M03, M04, M13, or M14 to restart the spindle and coolant when program execution is resumed after an Option Stop.

Press this push button to alternately activate and deactivate Option Stop mode. This function causes the control to stop execution of the part program AFTER executing an active block which contains an M01 code. The M01 code is ignored when Option Stop is not active. This function may be activated before or during execution of the block containing the M01 code. The indicator light is illuminated when Option Stop is active. When a block containing an M01 code is encountered and this function is active, the following occurs:

- The block is executed.
- All slide motion and spindle motion stops.
- The coolant pump turns OFF and Feed Hold turns ON.

Option Stop can be activated in Dry Run mode. To resume program execution, press the Cycle Start push button. The Feed Hold push button light will turn OFF.

MACHINE LOCK [#7]

This push button is not functional.

DRY RUN [#8]

- NOTE -

This mode must be OFF for normal machine operation.

Press this push button to alternately activate and deactivate Dry Run mode. When this mode is active, programmed feedrates are ignored and cutting moves are performed at a Jog feedrate of 50 inches per minute. The indicator light is illuminated when Dry Run is active.

REPEAT MODE [#9]

Press this push button to alternately activate and deactivate Repeat mode. This function causes the active part program to cycle continuously. The indicator light is illuminated when Repeat is active.

AUX FUNC (Auxiliary Function) [#10]

- NOTE -

The Auxiliary Function push button is only active on machines equipped with the optional sub-spindle.

The control must be in Jog mode to enable the Auxiliary Function push button.

The Auxiliary Function push button alternately locks and unlocks the sub-spindle draw tube. The draw tube is locked in position for the purpose of installing or removing spindle tooling. The indicator light is illuminated when the draw tube is locked in position.

Refer to Chapter 14 or 15 for information on installing or removing sub-spindle tooling.
PROGRAM PROTECT KEY [#11]

This switch is a two position, key operated switch. For normal operation, this switch should be turned to the ON position. When this switch is turned to ON, parameters cannot be edited and part programs cannot be edited or deleted. When this switch is turned to OFF, parameters can be edited and part programs can be edited or deleted. The key should be removed except when part program or parameter editing is required. The key cannot be removed from the switch when Program Protect is turned OFF.

EDIT [#12]

Press this push button to activate Edit mode. Edit mode allows the operator or programmer to edit a stored program when the Program Protect key switch is in the OFF position. To deactivate Edit mode, select another operating mode. The indicator light is illuminated when Edit mode is active. Refer to Chapter 3 for a complete explanation of Edit mode.

MAIN [#13]

- NOTE -

The MAIN push button is only active on machines equipped with the optional sub-spindle.

This push button selects the main spindle as the spindle to be controlled by the push buttons in the Spindle areas of the machine control panel.

SUB [#14]

- NOTE -

The SUB push button is only active on machines equipped with the optional sub-spindle.

This push button selects the sub-spindle as the spindle to be controlled by the push buttons in the SPINDLE areas of the machine control panel.

FLOOD [#15]

This push button controls standard coolant operation. If coolant flow has been activated by a programmed M08 (Coolant ON Command), M13 (Spindle Forward/Coolant ON Command), or M14 (Spindle Reverse/Coolant ON Command), pressing this push button will stop the coolant flow. If coolant flow has not been activated by the program, pressing this push button will start coolant flow even though an M08, M13 or M14 has not been programmed. However, if the program is repeated the push button will not be active. The indicator light is illuminated when Flood is active.

HI PRESS (High Pressure) [#16]

- NOTE -

The high pressure coolant system will only operate when the spindle is running.

With the High Pressure Coolant option turned ON and with the spindle running, pressing this latching type push button allows the operator to manually turn the high pressure coolant flow ON and OFF. If high pressure coolant has been activated from the part program by an M10 (High Pressure Coolant ON Command), pressing this push button will turn the High Pressure Coolant OFF. The indicator light is illuminated when high pressure coolant is active.

Refer to “To Turn ON Purchased Options”, in Chapter 9.
AIR BLAST [#17]
With the Air Blast option turned ON, pressing this push button allows the operator to manually activate and deactivate the air blast. If the air blast has been activated by an M36 (Air Blast ON Command), pressing this push button will turn the air blast OFF. The indicator light is illuminated when Air Blast is active.

Refer to “To Turn ON Purchased Options”, in Chapter 9.

EXTEND (Part Catcher Extend) [#21]
Press this push button to move the part catcher to the part pickup (extend) position. Jog mode must be active.

RETRACT (Part Catcher Retract) [#22]
Press this push button to move the part catcher to the Home (Retract) position. Jog mode must be active.

FREE [#25]
Press this push button to alternately activate and deactivate Spindle Free. When Spindle Free is activated, the spindle hydraulic brake is released and the operator may rotate the spindle by hand when Cycle Start is NOT active. The indicator light is illuminated when Spindle Free is active.

JOG [#26]
When Jog mode is active, press AND HOLD this push button to activate Spindle Jog. When Spindle Jog is activated, the spindle jogs in the clockwise direction at 30 revolutions per minute. The spindle will stop when this push button is released.

CW [#27]
This push button is used to select the direction for non-programmed clockwise spindle motion (as viewed from the headstock end of the machine) when the machine is in Jog mode. The spindle speed is controlled with the Decrease [#29] and Increase [#30] push buttons. The indicator light is illuminated when this function is active.

CCW [#28]
This push button is used to select the direction for non-programmed counterclockwise spindle motion (as viewed from the headstock end of the machine) when the machine is in Jog mode. The spindle speed is controlled with the Decrease [#29] and Increase [#30] push buttons. The indicator light is illuminated when this function is active.
These push buttons have two applications:

1. Controlling spindle speed for non-programmed clockwise or counterclockwise spindle motion:
   a) Press the Jog push button to put the machine in Jog mode.
   b) If the machine is equipped with the optional sub-spindle, select the desired axis by pressing the appropriate key (Main or Sub-Spindle).
   c) Press the CW or CCW push button to select the desired direction of rotation.
   d) Initiate spindle rotation by pressing the Increase push button and release to begin spindle motion. The first time this switch is pressed and released, the spindle speed will begin rotating at approximately 25 rpm.

      Use the Increase key to increase spindle speed. The spindle speed will increase by approximately 25 rpm each time this key is pressed.

      Press the Decrease push button to slow the spindle.

   e) To stop spindle motion, press the Reset key or press and hold the Decrease push button until spindle motion ceases.

2. Override programmed spindle speed while spindle is active in Auto mode:

   Press the Decrease push button and release to decrease the spindle speed in ten percent increments to a minimum of 50%. The Decrease indicator light is illuminated when actual spindle speed is lower than the programmed spindle speed.

   Press the Increase push button and release to increase the spindle speed in ten percent increments to a maximum of 120%. The Increase indicator light is illuminated when actual spindle speed is higher than the programmed spindle speed.

   Press the Decrease and Increase push buttons simultaneously to cancel the override function. The spindle speed will return to the programmed rate.

IN POSITION [#31]

This indicator light is illuminated when the tool probe is in the proper position for probing the tool.

COVER ON [#32]

This indicator light is illuminated when the tool probe is retracted and the probe cover is in place.
FEEDRATE 2 OVERRIDE [#34]

- NOTE -
Feedrate 2 Override switch is only present on machines equipped with the optional end-working turret or ball screw driven sub-spindle.

The Feedrate 2 Override switch controls the LA axis on machines equipped with the optional end-working turret when Automatic, Manual Data Input, or Single mode is active. The operator can modify programmed feedrates from 0% - 150%. A setting of “0” will stop G00 or G01 motion.

AXIS SELECT [#35, #36, #37]
Press the appropriate push button to select the X, Z, or LA axis for incremental movement through the use of the manual pulse generator [#40].

INCREMENT SELECT [#38, #39]
Selects the increment value for each graduation on the manual pulse generator handle. The value depends on whether the machine tool is operating in English or Metric mode.

MANUAL PULSE GENERATOR [#40]
The manual pulse generator allows the operator to jog the selected axis by specific increments. The axis to be jogged is selected with the Axis Select push buttons and the increment is selected with the Increment Select push buttons. Pressing an Axis Select push button will automatically switch the machine control to Jog mode. The indicator lights for the selected axis and increment will be illuminated.

TURRET INDEX 1 [#44]

- CAUTION -
The operator must be sure no interference exists between main turret, workpiece, spindle, tailstock, optional sub-spindle, or optional end-working turret before manually indexing a turret.

- NOTE -
The control must be in Jog mode to allow the Turret Index 1 push button to function.

Press the Turret Index 1 push button to command the main (upper) turret to index to the station selected with the Station rotary switch.
TURRET INDEX 2 [#46]

- CAUTION -

The operator must be sure no interference exists between main turret, workpiece, spindle, or optional end-working turret before manually indexing a turret.

- NOTE -

The control must be in Jog mode to allow the Turret Index 2 push button to function.

The Turret Index 2 push button is only active on machines equipped with the optional end-working turret.

Press the Turret Index 2 push button to command the end-working (lower) turret to index to the station selected with the Station rotary switch.

STATION [#47]

This rotary switch enables the operator to select the turret station to be indexed to the active position when one of the Turret Index push buttons are pressed.

SUB-SPINDLE CHUCK OPEN [#49]

This indicator light is illuminated when the sub-spindle workholding device is in the open position (release workpiece).

SUB-SPINDLE CHUCK OPEN/CLOSE [#50]

Pressing this push button while Cycle Start is NOT active will cause the workholding device in the sub-spindle to alternately open and close. The appropriate indicator light [#49 or #51] will be illuminated.

SUB-SPINDLE CHUCK CLOSE [#51]

This indicator light is illuminated when the sub-spindle workholding device is in the closed position (grip workpiece).

MAIN SPINDLE COLLET/CHUCK OPEN [#52]

This indicator light is illuminated when the main spindle workholding device is in the open position (release workpiece).

MAIN SPINDLE COLLET/CHUCK OPEN/CLOSE [#53]

Pressing this push button while Cycle Start is NOT active will cause the workholding device in the main spindle to alternately open and close. The appropriate indicator light [#52 or #54] will be illuminated.

MAIN SPINDLE COLLET/CHUCK CLOSE [#54]

This indicator light is illuminated when the main spindle workholding device is in the closed position (grip workpiece).
RAPID OVERRIDE [#55]

This rotary switch allows the operator to modify the machine Rapid Traverse rate in steps from Low to 100%. It is active in Positioning Mode (G00). It is also active during execution of return passes for automatic cycles G71, G72, G73, G74, G75, and G76 and canned cycles G90, G92, and G94. The % Rapid Override switch controls the X, Z, and LA axes.

LA FWD (Lower Axis Forward) [#56]

This indicator light is for tailstock or optional hydraulic driven sub-spindle operation only. The Lower Axis Forward indicator light is illuminated when the tailstock or sub-spindle reaches the forward position, as set by the machine operator. Refer to “Chapter 6 - Tailstock” for information on setting the forward tailstock position. Refer to “Chapter 14 - Sub-Spindle (Hydraulic Axis Drive)” for information on setting the forward sub-spindle position.

LA HOME (Lower Axis Home) [#57]

This indicator light is illuminated when the lower axis reaches the Y axis reference or “Home” position.

-LA [#58]

The -LA push button is a momentary type switch that allows the operator to jog the tailstock, optional sub-spindle, or optional end-working turret in the -Z direction (toward the spindle).

HOLD [#59]

This push button allows the operator to stop the linear travel of the tailstock or hydraulic driven sub-spindle when Jog mode is active.

+LA [#60]

The +LA push button is a momentary type switch that allows the operator to jog the tailstock, optional sub-spindle, or optional end-working turret in the +Z direction (away from the spindle).

X HOME [#61]

This indicator light is illuminated when the cross slide reaches the X axis reference position. The cross slide is at the reference position when the turret reference point is 6.25 inches [158.75mm] from the spindle centerline. The control is set for diameter programming; therefore, the cross slide position is displayed as 12.50 inches [317.50mm].

Z HOME [#62]

This indicator light is illuminated when the upper carriage reaches the Z axis reference position. On CONQUEST® T42 and T42SP machines, the carriage is at the reference position when the turret reference point is 14 inches [355.6mm] from the spindle face. On CONQUEST T42-L machines, the carriage is at the reference position when the turret reference point is 24 inches [609.6mm] from the spindle face.
- NOTE -

The group of push buttons designated +X, -X, +Z, and -Z are active in Jog mode. The jog feedrate can be adjusted from 0 to 37.5 ipm [952 mm/min] using the Feedrate 1 override switch. Pressing the Traverse push button [#65] in conjunction with a direction push button will cause the selected axis to move at approximately 236 in/min [6000 mm/min].

+X [#63]

The +X push button is a momentary type switch that allows the operator to jog the cross slide in the +X direction (away from the operator). Active in Jog mode.

-Z [#64]

The -Z push button is a momentary type switch that allows the operator to jog the carriage in the -Z direction (toward the main spindle). Active in Jog mode.

TRAV (Traverse) [#65]

This push button is a momentary type switch. Pressing this push button while simultaneously pressing one of the Jog directional push buttons causes the selected axis to move at approximately 236 in/min [6000 mm/min]. See “Jog Mode” in Chapter 3.

+Z [#66]

The +Z push button is a momentary type switch that allows the operator to jog the carriage in the +Z direction (away from the main spindle). Active in Jog mode.

-X [#67]

The -X push button is a momentary type switch that allows the operator to jog the cross slide in the -X direction (toward the operator). Active in Jog mode.

SLOW RELEASE [#68]

This push button is a momentary type switch. Pressing this push button releases the Edit Slow feature. Refer to Chapter 3 for information on Edit Slow mode.

ZERO RETURN [#69]

- NOTE -

CONQUEST® T42 and T42SP machines do not have an adjustable midpoint. The Zero Return function is not required to move the tailstock to the “Home” position.

On CONQUEST T42-L machines, this push button activates Zero Return, which allows the tailstock or to be moved past the adjustable midpoint to the “Home” position. When the tailstock is in the “Home” position, the Lower Axis Home indicator light will be ON.
FEEDRATE 1 OVERRIDE [#70]

The % Feedrate 1 switch controls:
- X and Z axes.
- LA axis on machines equipped with the optional ball screw driven sub-spindle.
- LA axis on machines equipped with the optional end-working turret when Jog mode is active.

The Feedrate 1 Override switch has a dual function. Depending on which mode has been selected, the functions are as follows:

In Jog mode, the jog feedrate can be modified in predefined steps from 0 - 37.5 in/min.

In all other modes, the operator can modify programmed feedrates from 0% - 150%. A setting of “0” will stop G01, G02, & G03 motion.

FEED HOLD [#71]

This push button is a latching type switch that allows the operator to stop all programmed slide motion. However, the active spindle speed is not affected. Feed Hold can be activated while in Automatic, Single Block, or Dry Run modes. Cycle Start turns OFF when Feed Hold is activated. To resume normal operation after a feed hold, press Cycle Start. This push button is illuminated when Feed Hold is active. The Hold push button [#59] in the Lower Axis section of the control panel also performs the same function.

CYCLE START [#72]

This push button is a latching type switch that initiates program execution when the control is in Automatic mode or Single mode. An additional function of this switch is to execute Manual Data Input commands. This push button is illuminated when Cycle Start is active.

E-STOP RESET [#73]

- NOTE -

The condition that caused the machine to go into emergency stop MUST be corrected before emergency stop can be cleared.

This push button, when pressed and held, also allows the machine operator to jog the axes out of an overtravel condition.

This push button is used to reset the control once the Emergency Stop push button has been released or the problem that caused the Emergency Stop condition has been corrected.

To return the control to normal operation:

1. Correct the problem that caused the Emergency Stop condition.
2. If necessary, release the Emergency Stop push button by pulling it out and holding until the hydraulic pump starts.
3. Press the Emergency Stop Reset push button.

EMERGENCY STOP [#74]

This push button is a latching-type switch. When pressed, programmed slide motion and spindle rotation is stopped. The message “Emergency Stop” is displayed on the control display screen.
ON-LINE HELP SYSTEM

The on-line help system provides information and instructions relating to P/S alarms, methods of operation, and parameter tables.

P/S Alarms

- NOTE -

Only the more difficult to understand P/S alarms are supported by the on-line help system.

Information and remedies concerning specific P/S alarms is supplied.

Methods of Operation

Information concerning CNC machining operations.

Parameter Table

Displays ranges of parameter numbers based on parameter functions.

ACCESSING THE ON-LINE HELP SYSTEM

Press the HELP key to access the on-line help system. The following menu will be displayed:

1. Alarm Detail
2. Operation Method
3. Parameter Table

- NOTE -

When viewing “Operation Method” or “Parameter Table” screens, the help system will display two numbers in the upper right-hand corner of the screen; for example, “1/4”. The upper number indicates the current page number and the lower number indicates the total number of pages for that particular topic.

Alarm Detail

1. Press the Alarm soft key.
2. Key in the alarm number and press the Select soft key. The alarm number and a detailed explanation will be displayed.
3. Repeat step 2 as needed.
4. Exit the on-line help system. Refer to “Exiting the On-Line Help System”.

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Operation Method
1. Press the Operator soft key.
2. Key in the topic number and press the Select soft key. The selected topic and a detailed explanation will be displayed.
3. Repeat step 2 as needed.
4. Exit the on-line help system. Refer to “Exiting the On-Line Help System”.

Parameter Table
1. Press the Parameter soft key. Page 1 of 4 will be displayed.
2. Use the Page ↓ and Page ↑ keys to view the various pages, as needed.
3. Exit the on-line help system. Refer to “Exiting the On-Line Help System”.

EXITING THE ON-LINE HELP SYSTEM
Press the HELP key again or press any of the following function keys to exit the on-line help system:
- Custom/Graph
- Message
- Offset/Setting
- Position
- Program
- System
CHAPTER 2 - POWER-UP PROCEDURE

- CAUTION -
The recommended operating temperature range is 50° to 114° F [7° to 46° C].

BASIC MACHINE POWER-UP

- NOTE -
It is important that the power-up procedure is followed as described to ensure safe, accurate, and repeatable machine operation.

1. Turn main disconnect switch “A”, Figure 2.1, ON.

2. Turn main air valve “B”, Figure 2.2 or Figure 2.3, ON.

- NOTE -
Refer to “Chapter 8 - Operator Maintenance” for information on draining the air filter bowls and refilling the lubricator and coolant tank.

3. Drain air filter bowls “C” and “D”.

4. Check lubricant and coolant levels. If necessary, add lubricant and coolant.

(Continued on next page)
When pressing Control ON push button “E”, Figure 2.4, DO NOT press any other push buttons or keys until the position or alarm screen is displayed. Some push buttons and keys are used for control maintenance or special operation commands.

5. Press Control ON push button “E”, Figure 2.4, and wait until the control display screen is ON.
6. Pull the Emergency Stop push button [74] out and hold until the hydraulic pump starts.
7. Press the Emergency Stop Reset push button [73].
8. Open and close the coolant guard door to perform the guard door switch verification and clear the verification alarm.

**POWER-DOWN PROCEDURE**

1. Be sure “Cycle Start” is not active. The Cycle Start push button light will be OFF.
2. Be sure the program has been completed and that the spindle and slides are stationary.
3. Press the Emergency Stop push button [74].
4. Press Control OFF push button “F”, Figure 2.4.
5. Turn main air valve “B”, Figure 2.2, or Figure 2.3, OFF
6. Turn main disconnect “A”, Figure 2.1, OFF.
TO REVIEW CONTROL STATUS

The following descriptions refer to the control status displays. Refer to Chapter 1 for additional information on the manual data input keyboard:

POSITION KEY

There are three (3) pages of position display data. After the Position key is pressed, the position display page that was last active will appear on the control display screen. To access the other position display pages, press the appropriate soft key. The three position display pages are as follows:

1. ALL (Overall Position Display): This page shows the active program number and block number are displayed in the upper right-hand corner of the control display screen if the control is in Automatic mode.
   a) Relative: The axis position on the Relative Coordinate System. Position is displayed as U and W coordinates.
   b) Absolute: Axis position on the Work Coordinate System. After power-up, the origin of the Work Coordinate System is the intersection of the spindle face and the spindle centerline. Position is displayed as X and Z coordinates. This origin can be relocated by any one of the following:

      Active set of tool offsets
      Position Reset operation
      Workshift offset
   c) Machine: Displays the axis position in relation to the “Home” (Reference Zero) position. Refer to Appendix One for information on “Home” (Reference Home) positions.
   d) Distance to Go: This is the distance remaining between current axis position and the programmed axis position. This register is displayed only while the control is in Automatic or Manual Data Input mode.

2. Absolute Position Display. Refer to part “b” under “ALL (Overall Position Display)”.

3. Relative Position Display. Refer to part “a” under “ALL (Overall Position Display)”.

PROGRAM KEY

Press the Program soft key to display the active program number, and active block sequence number and eleven blocks of the active program on the control display screen. To display other pages of the program, select Edit mode and use the page keys to read through the program.

During execution of the active part program, the cursor will be positioned under the sequence number of the active block. To return to the start of the program, press the following keys in the sequence shown:

1. Reset
2. Letter “O”
3. Cursor ↑
OFFSET SETTING key

When the Offset Setting key is pressed, the Offset and Setting soft keys are displayed. From the first Offset Setting screen, press the soft key expansion key once to display the Macro soft key. From the first Offset Setting screen, press the soft key expansion key twice to display the Work Shift soft key.

Offset Soft Key

Press the Offset soft key to access the geometry and wear soft keys.

Geometry: Consists of four pages of Geometry offsets, eight offsets on each page.

Wear: Consists of four pages of Wear offsets, eight offsets on each page.

One of the two chapters will be displayed on the control display screen. The displayed page will be the page which was active when the Offset display was last deactivated. To display the other chapter, press the corresponding soft key. Use the Page keys to view other pages within a chapter.

The tool geometry and wear offset chapters each consist of four pages, which display the following information:

- X and Z Tool Offsets (32 pair)
- Tool nose radius values
- Tool nose orientation numbers

Use the Page keys to view other pages. The Tool Offset pages are formatted as follows:

Offset Page 01: Offset Numbers 01-08
Offset Page 02: Offset Numbers 09-16
Offset Page 03: Offset Numbers 17-24
Offset Page 04: Offset Numbers 25-32
Setting Soft Key

Press the Setting soft key to access the system variables page, which allows the operator or programmer to assign the system variables listed below. To modify these variables, move the cursor to the variable which is to be modified, enter the desired value, and press the INPUT key.

PARAMETER WRITE = _(0:DISABLE 1: ENABLE)
TV CHECK = _(0:OFF 1:ON)
PUNCH CODE = _(0:EIA 1:ISO)
INPUT UNIT = _(0:MM 1:INCH)
I/O CHANNEL = _(0-3:CHANNEL NO.)
SEQUENCE NO. = _(0:OFF 1:ON)
TAPE FORMAT = _(0:NO CNV 1:ON)
SEQUENCE STOP = _(PROGRAM NO.)
SEQUENCE STOP = _(SEQUENCE NO.)

PARAMETER WRITE
This parameter allows the control parameters to be edited. When set to “0”, parameter editing is disabled. When set to "1", parameter editing is enabled. Refer to Chapter 3 for information on editing machine parameters.

TV CHECK
This parameter allows the activation or deactivation of parity checking. When set to “1”, parity is checked from the beginning of each block to the beginning of the next block. When set to "0", vertical parity checking is disabled.

PUNCH CODE
This parameter allows the selection of EIA or ISO data input format through the RS-232 serial port. When set to “0”, the data input format is set to EIA. When set to "1", the data input format is set to ISO.

INPUT UNIT
This parameter allows the selection of metric or inch operating mode. When set to “0", the operating mode is Metric. When set to "1", the operating mode is set to Inch.

I/O CHANNEL
This parameter allows the selection of the logical I/O to be used by the control. The valid selections for the I/O port assignments are 0, 1, or 2. Refer to Chapter 7 for a complete explanation of I/O port selection.

SEQUENCE NO.
This parameter allows the selection of “automatic sequence number insertion”. When active, sequence numbers will be automatically inserted into a program which is entered into memory from the manual data input keyboard. When set to "0", automatic sequence number insertion is inactive. When set to "1", automatic sequence number insertion is active.

TAPE FORMAT
Not Active
SEQUENCE STOP (2 entries)

These two entries are used together to provide the machine operator with the capability of stopping automatic part program execution after the program block specified has been completed.

The first entry (Program No.) identifies the program to be monitored.

The second entry (Sequence No.) identifies the sequence number (N word) of the last block to be executed by the CNC control during normal automatic operation. Once this block is executed, the CNC control will stop program execution.

Press the Cycle Start push button [72] to resume program execution.

Macros Soft Key

Press the Macros soft key to display the macro variable registers.

Work Shift Soft Key

Press the Work Shift soft key to display the workshift offset registers.

SYSTEM KEY

Press the System key to access the following information:

- Machine parameters and diagnostics
- PMC parameters, ladder, and diagnostics
- Control system configuration

One of four chapters will be displayed on the control display screen. The displayed page will be the page which was active when the key was last deactivated. If necessary, press the soft key to display the desired chapter. Use the page keys to view other pages within a chapter.

Parameter Soft Key

Press the Parameter soft key to display machine parameters. These parameters establish many of the characteristics, specifications, and functions of the machine tool. The page that was active when the parameter chapter was last exited will be displayed. To view other pages within the chapter, press the Page key to move to the desired page. Refer to Chapter 3 for information on editing machine parameters.

Diagnostic Soft Key

Press the Diagnostic soft key to display the machine diagnostics chapter. The page that was active when the diagnostics chapter was last exited will be displayed. Use the Page keys to view other pages within the chapter.

PMC Soft Key

Press the PMC soft key to display the PMC information screen. The purpose of this screen is to view the PMC ladder, parameters, and diagnostics.

System Soft Key

Press the System soft key to display the control system information screen.
MESSAGE KEY

If “ALM” is displayed at the bottom right-hand corner of the control display screen during machine operation, press the Message key. After the Message key is pressed, one of the three chapters will be displayed. To display one of the other chapters, press the appropriate soft key.

Alarm Soft Key

Alarm Message chapter. This chapter displays alarms that create a feed hold condition. One alarm will be displayed on the control display screen at a time. The display is formatted to indicate which tool station has generated the alarm. Descriptions of each alarm are given in the alarm list in Appendix 2.

Message Soft Key

Operator Message chapter. Operator messages do not initiate a feed hold condition. They call the operator’s attention to a specific machine condition.

History Soft Key

The GE Fanuc 18T control is capable of storing the last 25 alarms generated by the machine control. There are a maximum of five pages, with up to five alarms per page. Use the Page keys to display next or previous page.

- NOTE -

Alarm and Operator messages caused by an error generated in Background Edit mode will have no affect on a part program that is executing in the foreground.
- NOTES -
CHAPTER 3 - OPERATIONAL MODES AND EDITING

AUTOMATIC MODE

- CAUTION -

Before executing any part program in Automatic mode, it is recommended that the program be cycled through one time in Single mode. Refer to the instructions for “Running a Part Program for the First Time”, page 3-9.

Automatic mode allows selection and execution of the active part program. When Automatic mode is active and the Program key is pressed, the following soft keys are displayed on the control display screen:

Program
Check
Current
Next
Operator

SINGLE MODE

Single mode allows the operator to execute one block of data each time the Cycle Start push button [72] is pressed. Canned cycles are executed one pass at a time. Single mode is activated by the Single push button [2].

Refer to the CONQUEST® T42 Lathe Programmer’s Manual (M-320) for a complete description of the Canned Cycles.

EDIT MODE

Edit mode allows creation of new part programs or modification of existing part programs held in memory. There are two ways to search through the program: Word Scan and Word Search.

WORD SCAN

The Word Scan function permits the operator to search through the program one word or one line at a time.

- NOTE -

The cursor is displayed below the address character of the selected word.

1. Use the cursor ← and → keys to move the cursor word by word on the screen.
2. Use the cursor ↑ and ↓ keys to move the cursor line by line on the screen.
3. Continue pressing the cursor keys to make a continuous search.
4. Press the Page ↑ or Page ↓ key to display the preceding or following pages and search for the first word of that page.
WORD SEARCH

Word Search permits a specified word to be searched for from the current cursor position using the following procedure:

1. Key in the data word to be searched for.
2. Press the cursor down key to search forward or cursor up to search backward. If the data word entered in step 1 is located, the cursor will be displayed below the first character in the data word.

TO EDIT A PROGRAM

- NOTE -

When Edit mode is active and the Program Protect key [11] is turned OFF, Edit Slow mode is automatically activated. Refer to page 3-4 for information on Edit Slow mode.

1. Press the Edit push button [12].

- NOTE -

The Program Protect key [11] MUST be turned to OFF to allow creating, editing, or deleting of part programs.

2. Turn the Program Protect key [11] to OFF.

3. Press the Reset key.

4. Activate the program as follows:
   a) Press the Program key.
   b) Key in the letter “O” followed by the number for the desired program.
      Example: O1111
   c) Press the cursor down key.

5. Search for the word to be modified using the Word Scan or Word Search function.

6. Alter, insert, or delete the word/block/program as described in the sections that follow.

- CAUTION -

If the Reset key is not pressed before selecting Automatic mode and the part program is executed, the program will begin executing at the point in the program where the cursor was located when Edit mode was exited.

7. Press the Reset key to “rewind” the part program back to the beginning.

8. Turn the Program Protect key [11] to ON.
To Alter a Word

- NOTE -
The cursor MUST be positioned under the word to be altered.

1. Use the Word Scan or Word Search function to locate the data word to be changed.
2. Key in the letter address and the new value.
3. Press the Alter key.

To Insert a Word

- NOTE -
The cursor MUST be positioned under the word immediately preceding the location of the new data word.

1. Use the Word Scan or Word Search function to find the data word or End of Block immediately preceding the point in the program where the new data word will be inserted.
2. Key in the data word to be inserted.
3. Press the Insert key.

To Delete a Word

- CAUTION -
The cursor MUST be positioned under the word which is to be deleted.

1. Use the Word Scan or Word Search function to find the data word which is to be deleted.
2. Press the Delete key.

To Delete Up to an End of Block
1. Position the cursor at the point where the deletion is to begin.
2. Press the EOB key; then, press the Delete key.

- NOTE -
The data between the cursor and the next End of Block character will be deleted. The cursor will move to the address character of the next data word in the program.
To Delete Data Blocks

- NOTE -

In the procedure which follows, all data from the cursor to, and including, the block specified by the sequence number will be deleted. The cursor will move to the next sequence number in the program.

1. Position the cursor at the point where the deletion is to begin.
2. Key in the sequence number (N word) where the deletion is to end.
3. Press the Delete key.

To Delete a Program

1. Press the Program key.
2. Key in the letter “O” and the number of the program to be deleted.
   Example: O1111
3. Press the Delete key. The selected program will be deleted.

EDIT SLOW MODE

Edit Slow mode disables the Rapid Override switch [55] and forces G00 positioning moves to be performed at 39 in/min [990 mm/min]. This will occur whenever Edit mode is selected and the Program Protect key [11] is in the OFF position.

This mode will remain active until the Slow Release push button [68] is pressed or an M30 (End of Program) is read by the machine control.

JOG MODE

Jog mode permits non-programmed movement of the axes. Jog mode is activated by pressing the Jog push button [4]. While in Jog mode, press the Axis direction push buttons to obtain the desired X, Z, or LA axis movement. The Feedrate 1 Override switch [70] has a direct affect on the X, Z, and LA axis jog speeds. The LA axis drives the end-working turret or ball screw driven sub-spindle.

The jog feedrate for the X, Z, and LA axes (optional end-working turret or ball screw driven sub-spindle) is approximately 25 in/min [635 mm/min] when the corresponding feedrate override switch is set to 100% and approximately 37.5 in/min [952 mm/min] when the corresponding switch is set to 150%. The Traverse push button [65] will increase normal jog speeds on the X, Z, and LA axes. When the Traverse push button [65] is pressed along with one of the axis push buttons, the feedrate override switches are ignored and the selected axis moves at approximately 236 in/min [6000 mm/min]. Refer also to Handle mode, page 3-6.

Pressing the Spindle Jog push button [26] while Jog mode is active will cause the spindle to rotate in the forward direction (clockwise as viewed from the collet closer) at approximately 40 revolutions per minute as long as the push button is held.
MANUAL DATA INPUT MODE

Manual Data Input mode allows the operator to input a single block of non-stored data into the Manual Data Input memory. The data can then be executed by pressing the Cycle Start push button [72]. Once the data in the Manual Data Input memory has been executed, it is erased from memory.

TO USE MANUAL DATA INPUT:

- NOTE -
Pressing the Reset key clears the Manual Data Input buffer.

1. Press the Manual Data Input push button [3].
2. Press the Program key.
3. Press the Reset key.
4. Enter the data into the Manual Data Input buffer using the data input keys. Each data block must end with a valid End of Block character.

- NOTE -
If an error is made while keying in the data and the Insert key has not been pressed, press the Cancel key and key in the correct data.

5. Press the Insert key to input and display the data from step 4 into the Manual Data Input memory.

- NOTE-
To alter data after it has been entered into the Manual Data Input memory, place the cursor on the word, key in the correct data, and press the Alter key. If it is necessary to delete a word, place the cursor on the word and press the Delete key.

The collet closer must be in the closed position before an Manual Data Input command can be executed.

6. Close the coolant guard door and press the Cycle Start push button [72] to execute the data.
HANDLE MODE

Handle mode permits the cross slide or carriage to be moved incrementally whenever Cycle Start is not active. The axis to be moved is selected by pressing either the X, Z, or LA push button in the Handle area of the operator control panel. The movement increment is selected with the increment push buttons. The selected axis will move incrementally when the handwheel is rotated. The direction and distance is determined by the direction and amount of rotation of the handwheel.

- NOTE -
When moving the X axis with the machine in diameter mode, physical axis motion will be one half the selected increment.

TO EXECUTE AN INCREMENTAL JOG:

1. Press the Jog push button [4].

- NOTE -
The X, Z, and LA axis direction keys are also active and may be used to jog the axes. Refer to “Jog Mode”, page 3-4.

2. In the Handle area of the operator control panel, press the X, Z, or LA push button to select the desired axis.

3. Press the appropriate push button to select the desired increment. Each mark on the handwheel represents one unit increment.

4. To view axis position on the control display screen:
   a) Press the Position key.
   b) Press the Page key until the desired position display appears on the control display screen.

5. Turn the handwheel [40] in the desired direction (+ or -). Observe the axis position registers to determine when the axis has been moved the required distance.
   • If the X axis was selected in step 2, turn the handwheel in the plus direction to move the cross slide away from the spindle centerline and turn the handwheel in the minus direction to move the cross slide toward the spindle centerline.
   • If the Z axis was selected in step 2, turn the handwheel in the plus direction to move the carriage away from the face of the main spindle and turn the handwheel in the minus direction to move the carriage toward the face of the main spindle.
   • If the LA axis was selected in step 2, turn the handwheel in the plus direction to move the end-working turret away from the face of the main spindle and turn the handwheel in the minus direction to move the end-working turret toward the face of the main spindle.
CHUCKING MODES

- NOTE -
There is no default chucking mode. The chucking mode(s) active at power-down will be active at power-up.

M28 - MAIN SPINDLE, EXTERNAL CHUCKING

M28 commands the control to use the main spindle collet closer with external-gripping style work-holding devices.

M29 - MAIN SPINDLE, INTERNAL CHUCKING

M29 commands the control to use the main spindle collet closer with internal-gripping style work-holding devices.

M69 - SUB-SPINDLE, EXTERNAL CHUCKING

M69 commands the control to use the sub-spindle collet closer with external-gripping style work-holding devices.

M70 - SUB-SPINDLE, INTERNAL CHUCKING

M70 commands the control to use the sub-spindle collet closer with internal-gripping style work-holding devices.

ESTABLISHING CHUCKING MODES

To establish a chucking mode, use the following procedure:

1. Check to be sure the collet close indicator light [54] is ON. (Place a workpiece in the collet and press the collet push button [53], if necessary.)
2. Press the Manual Data Input push button [3].
3. Press the Program soft key.
4. At the Manual Data Input keyboard, enter the appropriate M code:
   M28 - Main Spindle, External Chucking
   M29 - Main Spindle, Internal Chucking
   M69 - Sub-Spindle, External Chucking
   M70 - Sub-Spindle, Internal Chucking
5. Press the EOB key.
6. Press the Insert key.
7. Close the machine guard door and press the Cycle Start push button [72].
8. At the Manual Data Input keyboard, press the Reset key. The selected chucking mode will be activated.
SAFE START SUBPROGRAMS

The Safe Start subprograms have been developed by Hardinge Inc. to provide machine safety and to help simplify programming. For more information on the Safe Start programming format, refer to the CONQUEST® T42 Lathe Programmer’s Manual (M-320).

- CAUTION -
If the machine is to be run in metric mode, the Z entry (pullback) in subprogram O2 must be converted to a metric value.

Safe start subprograms O1 and O2 are to be loaded permanently into the control memory. These programs are used to reactivate start-up modes, for example: positioning mode, deactivate Tool Nose Radius Compensation, establish ipm feed, and move the turret to the safe index position. Subprogram O999 is used to deactivate the tool offset and command the turret to the safe index position.

The X axis safe index value should be equal to the X axis reference position. Refer to Appendix One for information on the X axis reference position.

The Y and Z axis safe index values should be equal to the longest tool on the respective turret plus 1.00 inch [25.4 mm].

PROGRAMS

TO ENTER A PROGRAM FROM THE KEYBOARD

- NOTE-
Refer to Chapter 1 of the CONQUEST T42 Lathe Programmer’s Manual (M-320) for a description of the data words used with this machine.

Refer to Chapter 7 of this manual for information on loading part programs from tapes or disks.

1. Press the Edit push button [12].
2. Turn the Program Protect key [11] to OFF.
3. Press the Program key.
4. Key in the letter O and the program number at the Manual Data Input panel. Example: O1111
5. Press the Insert key.
6. Press the EOB key.
7. Press the Insert key.
8. Enter each data block as follows:
   a) Key in the letter addresses and values.
   b) Press the EOB key.
   c) Press the Insert key.
9. Turn the Program Protect key [11] to ON.
TO ACTIVATE A STORED PROGRAM

1. Press the Automatic push button [1].
2. Press the Program key.
3. Key in the letter “O” followed by the number for the desired program.
   Example: O100
4. Press the cursor \( \downarrow \) key.

RUNNING A PART PROGRAM FOR THE FIRST TIME

- CAUTION -
Before executing any part program, be sure that all offsets are correct and that no interference exists in the working area of the machine tool.

Operator should check and if necessary alter the coordinate values programmed in Safe Index Subprogram O999 to be certain that they are sufficient. Refer to “To Edit a Program”, page 3-2 for instructions to edit an active program.

When Cut-off and Feed Stock are the first operations on bar work, the operator must make certain that the stock face is placed flush with the collet face before starting the cycle. This will ensure that the turret tooling will not come in contact with workpiece and cause damage to either the turret tooling or the workpiece.

When testing an operation that uses a self-releasing tap or die holder, activate Automatic mode immediately before the block containing the spindle reversal. After the Option Stop (M01) is read at the end of the tap or die operation, activate Single mode to test the remainder of the program.

1. Press the Reset key.
2. Press the Program key.
3. Activate the desired program.
4. Press the Single push button [2].
5. Close the guard door.
6. Press the Check soft key.

- NOTE -
Program Check displays the Absolute Position and Distance to Go to complete the move.

7. Press the Option Stop push button [6].

- NOTE -
Single mode is used for first part set up (Block-by-Block execution). Automatic mode is used to run part programs in automatic mode.

8. Turn the Rapid Override switch [55] to LOW.
9. Turn the Feedrate Override switches [34 and 70] to 10%.
NOTE
Setting the Rapid Override switch [55] to LOW causes non-cutting linear moves (G00) to be made at 39 in/min [990 mm/min].

Turning Feedrate 1 Override switch [70] to “0” stops X and Z axis motion. When the switch is turned to another setting axis motion will resume.

Turning the Feedrate 2 Override switch [34] to “0” stops LA axis motion. When the switch is turned to another setting axis motion will resume.

10. Press the Cycle Start push button [72] to execute each block of data.

TO STOP A PROGRAM RUNNING IN AUTOMATIC MODE

CAUTION
Pressing either the Reset key or the Emergency Stop push button [74] while a program is running in Automatic mode will leave the tool against the workpiece if performed at the wrong time. DO NOT stop the program with a tool against the workpiece unless absolutely necessary. Damage to the workpiece and/or tooling may result.

There are several ways to stop a program running in Automatic mode:

1. Program a stop command in the part program where it is to be stopped.
2. Press the Feed Hold push button [71].

NOTE
Automatic operation can be restarted by pressing the Cycle Start push button [72] when the Feed Hold push button [71] has been used.

3. Press the Reset key.
4. Press the Emergency Stop push button [74].

TO RESTART A STOPPED PROGRAM

If the program was stopped by pressing the Emergency Stop push button [74] perform steps 1 through 7.

If the program was stopped by pressing the Reset key, perform steps 4 through 7.

1. Pull the Emergency Stop push button [74] out and hold until the hydraulic pump starts.
2. Press the Emergency Stop Reset push button [73].
3. Press the Reset key.
4. Key in the letter “O”; then, press the cursor key. The control will go to the beginning of the program.
5. If it is necessary to restart the program at a point other than the beginning:

   - **CAUTION** -
   Be sure the block selected in the next step is a safe starting point for the desired operation.

   a) Key in the letter “N” and the block number for the restart point. For example, “N5”.
   b) Press the cursor \( \downarrow \) key. The control will search the program for the block specified in the previous step.

6. Press the Cycle Start push button [72]. Program execution will resume at the block specified in step 5.

**DRY RUN AND MACHINE LOCK MODES**

   - **CAUTION** -
   If Machine Lock is not activated with Dry Run, slide motion will occur at a jog feedrate that is controlled using the Feedrate Override switch. The operator must make certain that no interference exists between the tooling, workpiece, or spindle before running the machine in Dry Run.

   - **NOTE** -
   Feedrate override has a direct affect on the Dry Run feedrate. When Dry Run mode is active, axis motion will occur at a feedrate of 35.5 in/min \([900 \text{ mm/min}]\) when the feedrate override is set to 100%. When the feedrate override is set to zero, axis motion and program execution are inhibited.

   Cycle Start must be inactivate before Dry Run and Machine Lock modes can be activated. Activating Dry Run and Machine Lock modes together allows the operator to execute part programs without axis or spindle motion.

**TO ACTIVATE DRY RUN AND MACHINE LOCK**

1. Press the Automatic push button [1].
2. Activate the program.
3. Press the Machine Lock push button [7] and Dry Run push button [8].
4. Close the coolant guard door.
5. If it is desired to run the program block-by-block, press the Single push button [2].

   - **NOTE** -
   If Single mode is active, the Cycle Start push button [72] must be pressed for each program block.

6. Press the Cycle Start push button [72].

**TO EXIT DRY RUN AND MACHINE LOCK**

2. Turn the control OFF, wait a few seconds; then, turn the control ON.
BACKGROUND EDIT

The Background Edit function enables the operator or programmer to edit or create a part program while a second program is being executed by the machine tool. An alarm or warning in Background Edit mode does not affect the program being executed in the foreground or vice-versa.

TO ACTIVATE BACKGROUND EDIT MODE

2. Press the Program key.
3. Press the Operator soft key.
4. Press the Background Edit soft key.

- NOTE -

The editing functions which may be performed in Background Edit mode are the same as the foreground editing functions. Descriptions of the foreground editing functions begin on page 3-3.

TO EDIT AN EXISTING PROGRAM

1. Activate Background Edit mode.
2. Key in the letter “O” and the desired program number.
3. Press the cursor key.

TO CREATE A NEW PROGRAM FROM THE KEYBOARD

1. Activate Background Edit mode.
2. Key in the letter “O” and the desired program number.
3. Press the Insert key.
4. Press the EOB key.
5. Press the Insert key.
6. Refer to “To Enter a Part Program from the Keyboard”, page 3-8.

TO END BACKGROUND EDITING

- CAUTION -

If the Reset key is pressed while Background Edit is active, the part program that is being executed will stop and the offset will be canceled. The operator must escape Background Edit (Press the Background End soft key) to return to the main program. With the main program displayed, the operator must jog the turret to a safe area and restart the program at the beginning of the tool operation.

1. Press the Background End soft key.
2. Turn the Program Protect key [11] to the ON position.
EDITING MACHINE PARAMETERS

- CAUTION -

Use extreme caution when editing machine parameters. Making incorrect changes in the parameter table may disable the machine or cause undesirable machine behavior.

1. Press the Offset Setting key.
2. Press the Setting soft key.
3. If necessary, use the page up/down keys to display the Setting page that contains the Parameter Write field.
4. If necessary, use the cursor keys to move the cursor to the Parameter Write field.
5. Press the Manual Data Input push button [3].
7. Key in the number “1” to enable parameter editing.
8. Press the Input key.

- NOTE -

The control is placed in P/S alarm No. 100.

9. Press the System key.
10. Press the Parameter soft key.
11. Use the page and/or cursor keys to position the cursor on the parameter to be modified.
12. Key in the new parameter value.
13. Press the Input key.
14. Repeat steps 11 through 13 as needed.
15. Press the Offset Setting key.
16. Press the Setting soft key.
17. If necessary, use the page up/down keys to display the Setting page that contains the Parameter Write field.
18. If necessary, use the cursor keys to move the cursor to the Parameter Write field.
19. Key in the number “0” (zero) key to disable parameter editing.
20. Press the Input key.

(Continued on next page)
22. Press the Reset key to cancel P/S alarm No. 100.

- NOTE -
Depending on which parameters have been modified, the control may output P/S alarm No. 000. If this alarm message is displayed, it will be necessary to re-initialize the control using the following procedure:

a) Press the Emergency Stop push button [74].

b) Press the Control OFF push button.

c) Wait approximately ten seconds.

d) Press the Control ON push button.

e) Pull the Emergency Stop push button [74] out and hold until the hydraulic pump starts.

f) Press the Emergency Stop Reset push button [73].

DISPLAYING THE PROGRAM DIRECTORY

Use the following procedure to display program memory:

1. Press the Edit push button [12].

2. Press the Program key.

3. Press the Library soft key. The program library (directory) will be displayed.
CHAPTER 4 - WORK SHIFT AND TOOL OFFSETS

WORK SHIFT (Zero Offset)

The work shift offset shifts the origin of the work coordinate system. Work Shift values (Z) are stored in the Work Shift file. The value stored in this file is active at all times.

- CAUTION -

The Work Shift file contains an X and a Z shift register. The X axis register in the Work Shift file should be set to zero at all times.

The value entered into the Z axis Work Shift file must be a negative number.

The values stored in the Work Shift file are added to the Absolute Position registers, thus shifting the origin of the work coordinate system by the amount stored in the Work Shift file. For example, if the Z axis is at 14 inches and the operator stores Z-2.5 in the Work Shift file, the Absolute Position registers would then display Z11.5 [14 +(- 2.5)].

Immediately after a Work Shift value is stored, the control adds it to the Absolute Position registers. The registers will remain modified until the Work Shift offset values are set to zero by the operator or from the part program.

Typically, the part length is stored as the Z Work Shift offset and the X Work Shift offset IS NOT USED (set to zero). Since the Work Shift value is added to the Absolute Position registers, the part length is stored as a negative Z value. With the part length stored in the Work Shift file, the origin of the Absolute coordinate system is the intersection of the part face and the spindle centerline.

- NOTE -

Refer to the CONQUEST® T42 Lathe programmer’s manual (M-320) for information on storing a work shift from the part program.

TO MANUALLY ESTABLISH Z AXIS WORK SHIFT

1. Load a workpiece into the collet or step chuck at the desired length.
2. Press the Jog push button [4].
3. Jog the turret to a safe index area.

- CAUTION -

The machine operator must make certain that no interference exists between the spindle, spindle tooling, turrets, turret tooling, tailstock, sub-spindle, or workpiece before manually indexing the turret.

4. Turn the Station switch [47] to the number of an empty turret station.
5. Press the Turret Index 1 push button [44] or the Turret Index 2 push button [46] to index the appropriate turret to the selected turret station.

- NOTE -

If an empty station is not available, remove the tooling from any convenient station.

6. Set the appropriate feedrate override switch [34 or 70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].
7. Jog the turret to within 1 inch [25 mm] of the face of the workpiece.
8. Press the Z push button [36] or the LA push button [37] to select the desired axis.
9. Press an increment push button [38 or 39] to select the desired handwheel increment.
10. Place a shim or scale against the face of the workpiece; then, turn the handwheel [40] in the minus (-) direction and move the turret toward the face of the workpiece until a slight drag is felt when moving the shim between the turret and workpiece.
11. Press the Offset Setting key to display the offset pages.
12. Press the right hand soft key until the Work Shift soft key is displayed.
13. Press the Work Shift soft key to display the Work Shift registers.
14. If not already set to “0” (zero), set the X value under Shift Value to ”0" as follows:
   a) Use the cursor keys to move the cursor to the X data field under Shift Value.
   b) At the Manual Data Input keyboard, key in the number “0” (zero).
   c) Press the Input soft key.
15. Use the cursor keys to move the cursor to the Z data field under Measurement.
16. At the Manual Data Input keyboard, key in the number “0” (zero). The Input soft keys will automatically be displayed.
17. Press the Input soft key. The Z axis Work Shift will be recorded in the Z Shift Value register as a negative value.

   - NOTE -
   The W value at the bottom of the screen will register zero.

Work Shift Example:

   Assume that the X and Z Axis Work Shift offsets are both set to zero and that the Absolute Position registers display X0. Z6. When step 17 is performed, Z-6. is entered into the Work Shift file and the Absolute Position registers will display X0. Z0.

18. Enter the shim thickness as positive (+) value and press the Input+ soft key.
19. Turn the handwheel in the plus (clockwise) direction to move the turret at least 1 inch [25 mm] from the face of the workpiece.
20. Jog the turret to a safe position for indexing.
TOOLING
(MAIN TURRET)

SQUARE SHANK TOOLS
For optimum performance, CONQUEST® T42 series lathes are designed to use qualified square shank tool holders. Since these tools are length, width, and height qualified, both set-up time and downtime due to tool replacement are greatly reduced.

Qualified Tool Holders
Qualified tool holder dimensions are held to ±.003 inch [.076 mm]. A left-hand square shank qualified tool holder is illustrated in Figure 4.1. Refer to Table 4.1 for qualified tool holder dimensions.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>English (in.)</th>
<th>Metric (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.750</td>
<td>20.000</td>
</tr>
<tr>
<td>B</td>
<td>0.750</td>
<td>20.000</td>
</tr>
<tr>
<td>C</td>
<td>4.500</td>
<td>125.000</td>
</tr>
<tr>
<td>F</td>
<td>0.770</td>
<td>19.600</td>
</tr>
<tr>
<td>G</td>
<td>0.020</td>
<td>0.500</td>
</tr>
<tr>
<td>H</td>
<td>0.750</td>
<td>20.000</td>
</tr>
</tbody>
</table>

Table 4.1 - Qualified Tooling Dimensions

Figure 4.1 - Qualified Tool Holder
Installing Square Shank Tooling

- NOTE -

When using square shank tooling, Hardinge recommends the exclusive use of left-hand tools. This insures that all cutting forces will be directed into the machine base, resulting in maximum tool life.

The wedge clamp can be located on either side of the tool slot centerline to accommodate both right-hand and left-hand tools. Referring to Figure 4.2, note that the larger side of the upper wedge should bear against the tool shank with the arrow pointing toward the tool shank.

1. Mount the wedge clamp on the top plate in the correct orientation for the tool to be installed.

2. Install the tool holder on the top plate and tighten the wedge clamp screws. This will automatically set the tool tip to the correct height as long as qualified tooling is used.

ROUND SHANK TOOLS

Round shank tools 1¼ inches or 32 millimeters in diameter can be mounted directly into the optional English or Metric round shank tool holders, respectively. Round shank tools in specific sizes ranging from 1/32 inch [1 millimeter] up to 3/4 inch [20 millimeters] can be mounted in the round shank tool holders using the Hardinge Double-Angle Toolholder Collet and Toolholder System. Round shank tools in specific sizes ranging from 1/2 inch [12 millimeters] up to 1 inch [25 millimeters] can be mounted in the round shank tool holders using Hardinge HDC-10 bushings.

Tool Setting Gauge

The tool setting gauge is used to place the tool nose of round shank tools such as boring bars and internal threading tools on center with the spindle centerline.

The tool slot centerline of the active station and the spindle centerline are the same distance from the top surface of the machine ways. Therefore, if the tool nose is positioned on the tool slot centerline, it will be on center with the spindle centerline as shown Figure 4.3.

The tool setting gauge mounts in the tool slot and provides a physical projection of the tool slot centerline. Once the tool setting gauge is mounted on the turret, the tool is rotated to bring the tool nose against the gauge.
Installing Round Shank Tools on the Main Turret

1. If not already installed, loosely mount wedge clamp “A”, Figure 4.3, on the top plate in the correct orientation for the tool to be installed.

2. Mount the round shank tool holder on the turret.

3. If required, install the appropriate tool cartridge in the round shank tool holder.

4. Insert the tool in the holder or tool cartridge and adjust the tool to length. Align the flat on the Hardinge Double-Angle Toolholder Collet or the slot in Hardinge HDC-10 bushings and the flat on the tool shank with one of the groups of three set screws “C”, Figure 4.4.

   - NOTE -
   Orientation of the gauge for setting left-hand tools is shown in Figure 4.3.

5. Insert tool setting gauge “B”, Figures 4.3 and 4.4, in the turret tool slot with one of the chamfered edges toward the bottom of the slot.

6. Carefully position the tool setting gauge so the tool nose can be rotated to touch the inner face of the gauge; then, tighten wedge clamp “A”, Figure 4.3.

   - CAUTION -
   Be careful not to damage the tool nose.

7. Rotate the tool until the tool nose touches the inner face of the tool setting gauge.

   - CAUTION -
   When the set screws are fully tightened there is the possibility that the tool may rotate. This will damage the tool nose if it is against the tool setting gauge.

   - NOTE -
   To secure the tool, tighten the group of three set screws that align with the tool and tool holder as described in step 4.

8. Snug, but do not fully tighten any group of three set screws “C”, Figure 4.4, to hold the tool in place.

9. Loosen wedge clamp “A”, Figure 4.3, swing the tool setting gauge out of the way, and tighten the wedge clamp.

10. Fully tighten three set screws “C”, Figure 4.4, to secure the tool.

11. Loosen the wedge clamp and carefully position the tool setting gauge to check that the tool nose is still on center. If it has moved, repeat steps 6 through 10.

12. Remove the tool setting gauge from the turret and tighten the wedge clamp.

Figure 4.4 - Tool Setting Gauge
(Side View)
TOOL OFFSETS

The Tool Offset file is made up of two types of offsets: Tool Geometry Offsets and Tool Wear Offsets. The control has the capacity to store 32 sets of each offset type (Offsets 01 through 32) in separate files.

- CAUTION -

Information stored in the Geometry and Wear Offset files is NOT automatically converted into the correct units when a programmed G20 or G21 command switches programming resolution from inch to metric or vice versa. Offsets in the desired unit of measure should be entered after the control has been set to the proper mode, inch (G20) vs metric (G21). If a G20 or G21 is programmed after the tool offsets are entered, the decimal point will be shifted one place to the left or right. If start-up mode is G20 (inch) and the program switches to G21 (metric), the offset decimal point will shift one place to the right. If start-up mode is G21 (metric) and the program switches to G20 (inch), the offset decimal point will shift one place to the left.

The following information is stored in the Tool Geometry Offset file:

X Tool Dimension (Main Turret)

Diameter distance from the X axis tool touch-off point to the main turret reference point. Sign is determined by the direction from the tool nose reference point to the turret reference point.

Y Tool Dimension (End-Working Turret)

Distance from the Y axis tool touch-off point to the face of the tool bushings in the end-working turret. Sign is determined by the direction from the tool nose reference point to the face of the tool bushings.

Z Tool Dimension (Main Turret)

Distance from the Z axis tool touch-off point to the main turret reference point. Sign is determined by the direction from the tool nose reference point to the turret reference point.

- NOTE -

For a description of the tool nose reference point, refer to “Chapter 2 - Tool Nose Radius Compensation”, in the CONQUEST® T42 Lathe programmer’s manual (M-320).

For a description of turret reference points, refer to “Chapter 5 - Work Coordinate System”, in the CONQUEST T42 Lathe programmer’s manual (M-320).

Tool Orientation:

The orientation code describes the location of the center of the tool nose in relation to the tool nose reference point.

Tool Nose Radius Value:

The distance from the cutting edge to the center of the tool nose radius.

The Tool Wear Offset file allows the operator to enter minor dimensional changes for each tool to compensate for tool wear. The Tool Wear Offset files coincide with the Geometry Offset files. When a tool offset is activated, the control looks at the corresponding Tool Wear offset and performs the necessary corrections to compensate for tool wear.
The Tool Offset files allow the operator to easily make corrections resulting from tool changes, thus large-scale modifications to the part programs are eliminated.

Tool Offsets are activated by the last two digits in the T word. The first two digits specify the turret station. The data word format for the T word is T4.

A suggested method for numbering the offsets that will assign a number related to the turret station is as follows:

<table>
<thead>
<tr>
<th>TURRET STATION</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST OFFSET</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>SECOND OFFSET</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>

Offsets 13 through 20 are extra and can be used if needed.

**TO STORE TOOL GEOMETRY OFFSETS IN MEMORY**

- NOTE -
Refer to the CONQUEST® T42 Lathe programmer’s manual (M-320) for information on storing a work shift from a program.

Tool offset values can be entered manually from the keyboard or from a program.

**SETTING TOOL OFFSETS FOR NON-CENTER WORKING TOOLS ON THE MAIN TURRET**
(Square Shank Tools, Boring Bars, etc.)

1. Load a workpiece of known diameter and length into the collet or chuck.
2. If it has not already been done, set the Work Shift Offset following the procedure beginning on Page 4-1.
4. Set the Feedrate 1 Override switch [70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].
5. Jog the turret to a safe position for indexing.
6. Select the desired turret station using the Station switch [47].
7. Press the Turret Index 1 push button [44] to index the turret to the selected station.
8. Mount the tool onto the turret.
9. Jog the tool tip to within 1 inch [25 mm] of the face of the workpiece held in the main spindle.
10. Press the Z Handle push button [36].
11. Select the desired handwheel increment by pressing the appropriate increment push button [38 or 39].
12. Place a shim or scale against the face of the workpiece and turn the handwheel in the negative direction to gently touch the tool tip to the shim so that a slight drag is felt when moving the shim.

13. Press the Offset Setting key.

14. Press the Offset soft key to access the Tool Offset pages.

15. If not already displayed, press the Geometry soft key to display the Tool Geometry Offset pages.

16. Use the page and cursor keys to position the cursor at the Z axis field for the desired offset.

17. Key in the number “Z0” (zero).

18. Press the Measure soft key. The Z axis offset value for the tool will now be displayed under the appropriate offset number, as selected in step 16.

19. Enter the shim thickness as negative (-) value and press the Input+ soft key.

20. Turn the handwheel in the positive (+) direction to clear the workpiece.

21. Use the cursor keys to position the cursor at the X axis field for the desired offset.

22. Press the X Handle push button [35].

23. If touching off an O.D. working tool, turn the handwheel in the plus direction to place the tool tip beyond the O.D. of the part as shown in Figure 4.5.

   If touching off an I.D. working tool, turn the handwheel in the minus direction to place the tool tip inside of the part O.D. as shown in Figure 4.5.

24. Press Z Handle push button [36].

25. If touching off an O.D. working tool, turn the handwheel in the minus direction until the tool tip is beyond the face of the workpiece in the minus Z direction.

   If touching off an I.D. working tool, turn the handwheel in the minus direction to move the tool tip to within .125 inch [3.2mm] of the workpiece face.

26. Press the X Handle push button [35].

![Figure 4.5 - O.D. and I.D. Tool Touch-Off Points](image-url)
27. Place the shim against the O.D. of the workpiece and turn the handwheel in the appropriate direction until the tool tip gently makes contact with the shim, as shown in Figure 4.5.

28. Key in the diameter of the workpiece as a positive value.
   
   Example: Diameter = 2.125  
   Input = X2.125

29. Press the Measure soft key. The X axis offset value for the tool will now be displayed under the appropriate offset number.

30. Compensate for shim thickness:
   
   If touching off an O.D. working tool and the control is set for diameter programming, enter twice the shim thickness as a negative (-) value and press the Input+ soft key.

   If touching off an O.D. working tool and the control is set for radius programming, enter the shim thickness as a negative (-) value and press the Input+ soft key.

   If touching off an I.D. working tool, no shim compensation is needed.

31. Press the X Handle push button [35] and turn the handwheel in the + direction to clear the diameter of the workpiece by at least 1 inch [25 mm] in the +X direction.

32. Press the Z Handle push button [36] and turn the handwheel in the + direction to clear the face of the workpiece by at least 1 inch [25 mm] in the +Z direction.

33. Jog the turret to a safe position for indexing.

34. Index the turret to the next tool station which is to be set.

35. Repeat steps 7 through 34 as required for other tools.
SETTING TOOL OFFSETS FOR CENTER-WORKING TOOLS ON THE MAIN TURRET

- CAUTION -

This procedure is to be used for center-working tools such as drills, taps, and reamers ONLY.

The X axis Wear Offset must always set to zero for center-working tools.

1. If it has not already been done, set the Work Shift Offset following the procedure beginning on Page 4-1.


3. Set the Feedrate 1 Override switch [70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].

- CAUTION -

The machine operator must be sure that no interference exists between the spindle, spindle tooling, tailstock, turrets, turret tooling, sub-spindle, or workpiece before manually indexing the turret.

4. Jog the turret to a safe position for indexing.

5. Select the desired turret station using the Station switch [47].

6. Press the Turret Index 1 push button [44] to index the turret to the selected station.

7. Mount the tool in the tool holder at the length desired.

8. Jog the tool tip to within 1 inch [25 mm] of the face of the workpiece held in the spindle.

9. Press the Z Handle push button [36].

10. Select the desired handwheel increment by pressing the appropriate increment push button [38 or 39].

11. Place a shim against the face of the workpiece and turn the handwheel in the negative (-) direction to gently touch the tool tip to the shim until a slight drag is felt when moving the shim.

12. Press the Offset Setting key.

13. Press the Offset soft key to access the Tool Offset pages.

14. Press the Geometry soft key to access the Geometry Offset pages.

15. Use the page and cursor keys to position the cursor at the X axis field for the desired offset.
Hardinge drill holders are qualified at 1.25 inches [38.1 mm] from the hole center to the turret face. Hardinge boring bar holders are qualified at 2.00 inches [50.8 mm] from the hole center to the turret face.

16. If the control is set for diameter programming, enter twice the tool holder dimension as a positive (+) value and press the Input soft key.

If the control is set for radius programming, enter the tool holder dimension as a positive (+) value and press the Input soft key.

Example: The Hardinge Drill Tool Holder (Part No. SG-0011944-A) is qualified 1¼ inches to the hole center. On machines that are set for diameter programming, the X offset will be 2.500.

17. Use the cursor keys to position the cursor at the Z axis field for the desired offset.

18. Key in “Z0” (zero).

19. Press the Measure soft key. The Z axis offset value for the tool will now be displayed under the appropriate offset number, as selected in step 14.

20. Enter the shim thickness as a negative (-) value and press the Input+ soft key.

21. Turn the handwheel in the positive (+) direction to clear the workpiece.

22. Repeat steps 4 through 23 as required for other center-working tools.

Resetting Wear Offsets

23. Press the left-hand soft key to return to the offset selection soft keys.

24. Press the Wear soft key to access the Wear Offset pages.

25. Reset the X Wear offset for each tool that was just installed:

   a) Use the page and cursor keys to position the cursor at the X axis field for the desired offset.

   b) Key in “0” (zero) and press the Input soft key.
ENTRING TOOL NOSE RADIUS VALUE AND ORIENTATION

- NOTE -

If Tool Nose Radius Compensation is to be used, the tool nose radius value and the tool quadrant must be entered for each tool which uses Tool Nose Radius Compensation.

1. Press the Offset Setting key.
2. Press the Offset soft key to access the Tool Offset pages.
3. Press the Geometry soft key to display the tool geometry offsets.
4. Use the page and cursor keys to position the cursor at the R data field for the desired offset.
5. Enter the tool nose radius value and press the Input soft key.

- NOTE-

The “T” value defines the orientation of the tool tip and has a range from 0 through 9. Refer to Figure 4.6.

6. Use the cursor keys to position the cursor at the T data field for the desired offset.
7. Enter the tool orientation code number and press the Input soft key.
8. Repeat steps 4 through 7 for each tool, as required.

Figure 4.6 - Tool Nose Radius Orientation Codes
ADJUSTING TOOL WEAR OFFSETS

Tool wear offset adjustments are made by adding to or subtracting from an existing offset value using positive or negative values and the Input+ soft key.

Tool Wear Offsets that are intended to adjust the position of the tool nose in the -X, -Y, or -Z direction are entered as NEGATIVE values. Tool Wear Offsets that are intended to adjust the position of the tool nose in the +X, +Y, or +Z direction are entered as POSITIVE values.

ADJUSTING X AND Z AXIS TOOL WEAR OFFSETS

1. Press the Offset Setting key to display the offset pages.
2. Press the Offset soft key to access the Tool Offset pages.
3. Press the Wear soft key to display the Wear Offset page.
4. Use the page and cursor keys to position the cursor at the X axis field for the desired offset.
5. Enter the X axis wear value as follows:
   - If the control is set for Diameter Programming, enter the wear offset as a diameter value.
   - If the control is set for Radius Programming, enter one half the measured (diameter) wear offset value.
6. Press the Input+ soft key.
7. Use the cursor keys to position the cursor at the Z axis field for the desired offset.
8. Enter the Z axis wear value.
9. Press the Input+ soft key.
10. Repeat steps 4 through 9 for each tool as required.

ADJUSTING Y AXIS TOOL WEAR OFFSETS

1. Press the Offset Setting key to display the offset pages.
2. Press the right hand soft key until the Offset B soft key is displayed.
3. Press the Offset B soft key.
4. Use the page and cursor keys to position the cursor at the Wear field for the desired offset.
5. Enter the wear value.
6. Press the Input+ soft key.
7. Repeat steps 2 through 6 for each tool as required.

RULES FOR ADJUSTING WEAR OFFSETS

1. Negative (-) offset values MUST be signed.
2. Wear Offset values may not exceed .50000 inch [12.7000 mm].
ACTIVATING TOOL OFFSETS

Tool offsets are activated by a T word having the format T4. The first two numbers select the turret station that is to be indexed to the cutting position. The last two numbers specify which tool offsets in the tool geometry and wear offset tables are to be used with the selected turret position.

Example: N0120 T0616 ;

In data block N0120, turret station 6 will be indexed to the cutting position and the tool offsets stored on line 16 in the tool geometry and wear offset tables will be activated.

The leading zero in the T word may be omitted:

T0101 = T101

- CAUTION -

If tool offsets are not to be called up with a turret index, the last two numbers in the T word MUST be “00” (Example: T0100). If no numbers are programmed in the last two places, the control will use the numbers programmed in the first two places as the tool offset and the turret will not index (Example: T01 will be interpreted by the control as T0001).

- NOTE -

When a T0 is commanded, the offset is canceled.

Tool offset cancellation (T0) will occur in the next programmed axis movement for the X and Z axes. The next programmed X axis movement will cancel the X axis offset and move the turret reference point to the programmed X axis position. The next programmed Z axis movement will cancel the Z axis offset and move the turret reference point to the programmed Z axis position.

When a T word with a tool offset is programmed in a block containing axis motion, the tool offset motion is computed with the programmed axis position, causing the slide(s) to move directly to the corrected axis position at the programmed feedrate.

When a T word with a tool offset is programmed in a block without axis motion, the tool offset move will occur in the next block containing axis motion. The tool offset motion is computed with the programmed axis position, causing the turret reference point to move directly to the corrected axis position at the programmed feedrate.

Tool offsets are deactivated when the machine is first powered up or when the Reset key is pressed.
SETTING TOOL OFFSETS FOR LIVE TOOLING OPTION

The optional Live Tooling feature allows milling, drilling, and tapping operations to be performed on either the diameter or face of the workpiece. The method used to establish the tool offset values for live tooling are similar to the method used for standard tooling. Up to six live tooling attachments can be mounted at the even-numbered stations (2, 4, 6, 8, 10, and 12) on the turret top plate.

SETTING END-WORKING TOOL OFFSETS

- NOTE-

End-working drill/mill and tapping attachments place the tool centerline 1.5 inches [38.1 mm] from the X axis turret face. When establishing tool offsets, this dimension must be doubled for machines that have been set for Diameter Programming.

This procedure assumes that the live tooling attachment has already been mounted on the turret top plate and the tooling has been installed in the attachment. Refer to Chapter 11 for information on installing live tooling.

1. If it has not already been done, set the Work Shift Offset following the procedure beginning on page 4-1.

2. Load a workpiece of known diameter and length into the collet closer or chuck.


4. Set the Feedrate 1 Override switch [70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].

- CAUTION -

The machine operator must be sure that no interference exists between the spindle, spindle tooling, tailstock, turrets, turret tooling, or workpiece before manually indexing the turret.

5. Jog the turret to a safe position for indexing.

6. Select the desired turret station using the Station switch [47].

7. Press the Turret Index 1 push button [44] to index the main turret to the selected station.

8. Jog the tool to within 1 inch [25 mm] of the workpiece being held in the spindle.

9. Press the Z Handle push button [36].

10. Select the desired handwheel increment by pressing the appropriate increment push button [38 or 39].

11. Place a shim against the part face and turn the handwheel in the minus direction until the tool tip gently touches the shim and a slight drag is felt when the shim is moved.

12. Press the Offset Setting key.

13. Press the Offset soft key to access the Tool Offset pages.

14. Press the Geometry soft key to display the Tool Geometry Offset pages.

15. Use the page and cursor keys to position the cursor at the X axis field for the desired offset.
16. Key in:
   “3.” if the machine is set for Inch Diameter Programming
   “1.5” if the machine is set for Inch Radius Programming
   “76.2” if the machine is set for Metric Diameter Programming
   “38.1” if the machine is set for Metric Radius Programming

17. Press the Input soft key.
18. Use cursor keys to position the cursor at the Z axis field for the desired offset.
19. Key in “Z0” (zero).
20. Press the Measure soft key.
21. Enter the value of the shim thickness as a negative (-) value and
22. Press the Input+ soft key. The Z Axis tool offset value will be reduced by the value entered.
23. Turn the handwheel in the plus direction to clear the workpiece.
24. Repeat steps 5 through 23 for each tool as required.

**Resetting Wear Offsets**
25. Press the left-hand soft key to return to the offset selection soft keys.
26. Press the Wear soft key to access the Wear Offset pages.
27. Reset the X Wear offset for each tool that was just installed:
   a) Use the page and cursor keys to position the cursor at the X axis field for the desired offset.
   b) Key in “0” (zero) and press the Input soft key.
SETTING OFFSETS FOR CROSS-WORKING TOOLS

- NOTE -

Cross-working drill/mill and tapping attachments place the tool centerline 1.5 inches [38.1 mm] from the Z axis turret face. This dimension is used as the Z tool Offset value.

This procedure assumes that the live tooling attachment has already been mounted on the turret top plate and the tooling has been installed in the attachment. Refer to Chapter 11 for information on installing live tooling.

1. If it has not already been done, set the Work Shift Offset following the procedure beginning on page 4-1.

2. Load a workpiece of known diameter and length into the collet closer or chuck.


4. Set the Feedrate 1 Override switch [70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].

- CAUTION -

The machine operator must be sure that no interference exists between the spindle, spindle tooling, tailstock, turrets, turret tooling, or workpiece before manually indexing the turret.

5. Jog the turret to a safe position for indexing.

6. Select the desired turret station using the Station switch [47].

7. Press the Turret Index 1 push button [44] to index the main turret to the selected station.

8. Jog the tool until it is positioned over the workpiece O.D.

9. Press the X Handle push button [35].

10. Select the desired handwheel increment by pressing the appropriate increment push button [38 or 39].

11. Place a shim against the part O.D. and turn the handwheel in the minus direction until the tool tip gently touches the shim and a slight drag is felt when the shim is moved.

12. Press the Offset Setting key.

13. Press the Offset soft key to access the Tool Offset pages.

14. Press the Geometry soft key to display the Tool Geometry Offset pages.

15. Use the page and cursor keys to position the cursor at the X axis field for the desired offset.

16. Key in the diameter of the workpiece as a positive value.

   Example: Diameter = 2.125

   Input = X2.125

17. Press the Measure soft key.
18. Compensate for shim thickness:
   If the control is set for diameter programming, enter twice the shim thickness as a negative (-) value.
   If the control is set for radius programming, enter the shim thickness as a negative (-) value.
19. Press the Input+ soft key. The X Offset will be decreased by the amount specified in step 21.
20. Use the cursor keys to position the cursor at the Z axis field for the desired offset.
21. Key in:
   "1.5" if the machine is set for Inch Programming.
   "38.1" if the machine is set for Metric Programming.
22. Press the Input soft key.
23. Turn the handwheel in the plus direction to clear the workpiece.
24. Repeat steps 5 through 23 for each tool as required.

**Resetting Wear Offsets**
25. Press the left-hand soft key to return to the offset selection soft keys.
26. Press the Wear soft key to access the Wear Offset pages.
27. Reset the Z Wear offset for each tool that was just installed:
   a) Use the page and cursor keys to position the cursor at the Z axis field for the desired offset.
   b) Key in "0" (zero) and press the Input soft key.
SETTING TOOL OFFSETS FOR THE END-WORKING TURRET

The method used to establish the tool offset values for the end-working turret is similar to the method used for standard tooling. Up to six tools can be mounted on the turret top plate, designated stations 1 through 6.

1. If it has not already been done, set the Work Shift Offset following the procedure beginning on page 4-1.
2. Press the Position key to display the axis position registers.
4. Set the Feedrate 1 Override switch [70] to the desired setting. A setting of 150% will equal a jog feedrate of approximately 37.5 in/min [952 mm/min].

- CAUTION -

The machine operator must be sure that no interference exists between the spindle, spindle tooling, turrets, turret tooling, or workpiece before manually indexing the turret.

5. Jog the end-working turret to a safe position for indexing.
6. Select the desired turret station using the Station switch [47].
7. Press the Turret Index 2 push button [46] to index the turret to the selected station.
8. Jog the tool tip to within 1 inch [25 mm] of the face of the workpiece held in the main spindle.
9. Press the LA Handle push button [37] to select the lower axis.
10. Select the desired handwheel increment by pressing the appropriate increment push button [38 or 39].
11. Place a shim against the face of the workpiece and turn the handwheel in the negative (-) direction to gently touch the tool tip to the shim until a slight drag is felt when moving the shim.
12. Record the Y axis value displayed in the axis position registers.
13. Subtract the thickness of the shim used in step 11 from the value recorded in step 12 to obtain the Y axis tool offset.
14. Press the Offset Setting key to display the offset pages.
15. Press the right hand soft key until the Offset B soft key is displayed.
16. Press the Offset B soft key.
17. Use the cursor keys to position the cursor at the Wear field for the desired offset.
18. Key in “0” (zero) and press the Input soft key.
19. Use the cursor keys to position the cursor at the Geometry field for the desired offset.
20. Key in the value calculated in step 13 and press the Input key.
21. Turn the handwheel in the positive (+) direction to clear the workpiece.
22. Repeat steps 5 through 21 as required for other center-working tools.
CHAPTER 5 - COLLET CLOSER

CONQUEST® T42 series lathes are equipped with a .5 inch [12.7 mm] stroke, hydraulically actuated collet closer. If repairs to the collet closer assembly are required, the ENTIRE ASSEMBLY must be removed and returned to the factory. Refer to the CONQUEST T42 Lathe Maintenance Manual (M-322) for information on removing or installing the collet closer assembly.

The hydraulic collet closer can be programmed for bar feed operation or it can be operated manually for machine setup and chucking operations.

FREE SPINDLE

A “Free Spindle” condition allows the spindle to be turned by hand. To obtain a free spindle, proceed as follows:

- NOTE -
To obtain a free spindle, the control must be ON and the spindle must not be rotating.

1. Power up the machine as described in Chapter 2.
2. Press the control Reset key.
3. Press the Spindle Free push button [25].

HYDRAULIC PRESSURE CONTROL

The chucking force is controlled by hydraulic oil pressure. The hydraulic pressure controls are located at the back of the machine. Knob “A”, Figure 5.1, is used to adjust the hydraulic pressure applied to the collet closer.

Gauge “B” registers the collet closer hydraulic pressure in psig and bars. Refer to Table 5.1 to determine the approximate gripping force that will be applied to the workpiece for a given pressure. A check valve system positively holds the closer open or closed, whichever is active, in the event of an hydraulic pressure failure.

- CAUTION -
DO NOT exceed the maximum pressure setting, as shown in Table 5.1.

- NOTE -
It is the responsibility of the machine operator or set-up person to properly adjust the collet closer hydraulic pressure, based on the type of material to be machined and the configuration of the workpiece.

To Adjust the Hydraulic Pressure:

1. Loosen the knurled lock nut behind knob “A”, Figure 5.1.
2. Turn knob “A” clockwise or counterclockwise to decrease or increase the collet closer hydraulic pressure.
3. Tighten the knurled lock nut to secure the setting.
<table>
<thead>
<tr>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge Pressure (psig)</td>
<td>Chucking Force (lbs)</td>
</tr>
<tr>
<td>100</td>
<td>1270</td>
</tr>
<tr>
<td>200</td>
<td>2540</td>
</tr>
<tr>
<td>300</td>
<td>3810</td>
</tr>
<tr>
<td>400</td>
<td>5080</td>
</tr>
<tr>
<td>500</td>
<td>6350</td>
</tr>
</tbody>
</table>

Table 5.1 - Collet Closer Chucking Force
MAIN COLLET CLOSER OPERATION

AUTOMATIC OPERATION

For automatic operation, program M21 to open the collet and M22 to close the collet. The M21 (Open Collet) command may be executed while the spindle is running. M21 will remain active until it is canceled by an M22 (Close Collet) command. While M21 is active, the Open indicator light [52] will be flashing and the Main Spindle Collet/Chuck push button [53] will not be active. A programmed M22 (Collet Close) command will remain active until it is canceled by an M21 (Open Collet) command.

MANUAL OPERATION

- NOTE -

Manual operation of the collet closer is not possible while Cycle Start is active.

When the bar feed option is turned OFF, the collet closer can be manually operated in any mode. When the bar feed option is turned ON, the machine must be in Jog mode to manually operate the collet closer. Use the Main Spindle Collet/Chuck push button [53] to operate the collet closer manually.

CHUCKING MODES

There is no default chucking mode. The current chucking mode will remain active until canceled by the appropriate command (M28 or M29).

- NOTE -

Turning the optional barfeed software ON while internal chucking mode is active will automatically cancel internal chucking mode and activate external chucking mode on the main spindle.

Refer to Chapter 3 for information on switching chucking modes.

CLEANING THE SPINDLE

As a general rule, the spindle and spindle draw tube should be cleaned between setups or monthly if a long-run job is on the machine. However, when the machine is run more than one shift per day or certain types of materials are being machined, it may be necessary to clean the spindle and spindle draw tube more often. Use the spindle tooling removal and installation procedures that follow for cleaning the draw tube and spindle.
SPINDLE TOOLING

REMOVING SPINDLE TOOLING

- CAUTION -
Do not operate the collet closer when a collet or step chuck is mounted in place without gripping a piece of stock or a plug of the correct size.

1. Power the machine up using the procedure outlined in Chapter 2.
2. Press the control Reset key.
3. Press the Jog push button [4].

- WARNING -
When a bar feed is being used, it must be disabled before removing or installing spindle tooling. Refer to the instructions supplied with the bar feed system.

4. If the Close indicator light [54] is ON, press the Main Spindle Collet/Chuck push button [53].
5. At the left end of the machine, unlatch and remove draw tube access door “C”, Figure 5.2.
6. If present, remove spindle draw tube plug “F”, Figure 5.3.
7. Completely loosen six screws “D”.

- NOTE -
Six screws “D”, Figure 5.3, must be completely disengaged from the collet closer liner before draw tube “E” can be rotated.

Removal of a jaw chuck or step chuck may require the assistance of a second person.

8. Rotate draw tube “E”, Figure 5.3, counterclockwise to disengage it from the workholding device.

Figure 5.2 - Draw Tube Access Door

Figure 5.3 - Spindle Draw Tube
9. Remove the workholding device from the spindle.

10. Close the main coolant guard door.

11. Slide the draw tube out of the spindle approximately 16 inches [406 mm].

12. From the collet closer end of the draw tube, use an air line to blow chips and coolant out of the spindle.

13. Completely remove the draw tube from the back of the spindle.

14. Clean the spindle and draw tube.

15. Lightly lubricate the entire draw tube with Mobiltemp® SHC® 32 grease.

- CAUTION -
When replacing the draw tube, be sure not to dislodge the O-ring located inside the spindle.

16. Carefully replace the draw tube in the spindle.

17. If the O-ring is dislodged from the groove inside the spindle when the draw tube is replaced:
   a) Remove the draw tube and the O-ring from the spindle.
   b) Clean the O-ring.
   c) Lightly lubricate the O-ring with Mobiltemp SHC 32 grease.
   d) From the front of the spindle, replace the O-ring in the groove using a wooden dowel rod.
   e) Carefully replace the draw tube in the spindle.

18. If spindle tooling is to be installed at this time, proceed to “Installing Spindle Tooling”, beginning on page 5-6.
   If spindle tooling is not to be installed at this time, replace draw tube plug “F”, Figure 5.3, and draw tube access door “C”, Figure 5.2.
INSTALLING SPINDLE TOOLING

Two procedures are outlined in this section. The first procedure, which begins below, covers the installation of collets and step chucks. The second procedure, beginning on page 5-7, covers the installation of jaw chucks.

Collet or Step Chuck

This procedure assumes that any previously used spindle tooling has already been removed. If there is spindle tooling to be removed, perform the steps outlined under “Removing Spindle Tooling”, beginning on page 5-4.

If previously used spindle tooling has just been removed, proceed to step 6.

- CAUTION -
Do not operate the collet closer when a collet or step chuck is mounted in place without gripping a piece of stock or a plug of the correct size.

1. Power the machine up using the procedure outlined in Chapter 2.
2. Press the control Reset key.
3. Press the Jog push button [4].

- WARNING -
When a bar feed system is being used, it must be disabled before removing or installing spindle tooling. Refer to the instructions supplied with the bar feed system.

4. Unlatch and remove draw tube access door “C”, Figure 5.2.
5. If present, remove spindle draw tube plug “F”, Figure 5.3.

- NOTE -
The collet and spindle bore MUST be clean.

6. Clean the spindle bore and the collet or step chuck and closer to be installed.

- WARNING -
To insure operator safety:
- DO NOT use cast iron step chucks.
- DO NOT use a step chuck without a step chuck closer.

- NOTE -
Installation of a step chuck may require the assistance of a second person.

7. If installing a step chuck in the spindle, place the step chuck closer against the spindle and install the mounting screws securely.
8. Align the keyway in the collet with the key in the spindle and slide the collet into the spindle until it makes contact with the draw tube.
9. Carefully push the draw tube against the back of the collet while rotating the draw tube clockwise to start the threads of the collet into the threads of the draw tube.
- NOTE -
Adjustment of the collet or step chuck may require the assistance of a second person.

10. Select the largest diameter workpiece which is to be chucked and position this part in the collet or step chuck.

11. Rotate the draw tube clockwise until the workpiece is gripped tightly; then, back the draw tube off ¼ to ½ turn.

12. Align six draw tube screws “D” with their mounting holes and tighten.

13. Press the Main Spindle Collet/Chuck push button [53] to close the collet and test the gripping force on the workpiece.
   If the gripping force is satisfactory, then go to step 14.
   If the gripping force is more or less than desired, adjust knob “A”, Figure 5.1, to any setting between 100 and 500 psig (6.9 and 34.5 bars). Refer to Table 5.1.

- CAUTION -
If the machine will not be operated with a bar feed system, spindle draw tube plug “F”, Figure 5.3, should be installed in the back of the spindle to prevent coolant and chips from entering the spindle drive motor compartment.

14. Install spindle draw tube plug “F”, Figure 5.3, if a bar feed system will not be used.

15. Replace draw tube access door “C”, Figure 5.2.

Jaw Chuck
This procedure assumes that any previously used spindle tooling has already been removed. If there is spindle tooling to be removed, perform the steps outlined under “Removing Spindle Tooling”, beginning on page 5-4.

If previously used spindle tooling has just been removed, proceed to step 6.

- CAUTION -
Do not operate the collet closer when a collet or step chuck is mounted in place without gripping a piece of stock or a plug of the correct size.

1. Power the machine up using the procedure outlined in Chapter 2.

2. Press the control Reset key.

3. Press the Jog push button [4].

- WARNING -
When a bar feed system is being used, it must be disabled before removing or installing spindle tooling. Refer to the instructions supplied with the bar feed system.

4. Unlatch and remove draw tube access door “C”, Figure 5.2.

5. If present, remove spindle draw tube plug “F”, Figure 5.3.
- NOTE -
The jaw chuck and spindle bore MUST be clean.

6. Clean the jaw chuck and spindle bore.
7. Place the chuck in the spindle and install the mounting screws securely.
8. Carefully push the draw tube against the back of the chuck while rotating the draw tube clockwise to start the threads of the chuck into the threads of the draw tube.
9. Thread the draw tube onto the 3 jaw chuck as far as possible.
10. Align six draw tube screws “D” with their mounting holes and tighten.
11. Place a workpiece into the chuck and press the Main Spindle Collet/Chuck push button [53] to close the chuck and test the gripping force on the workpiece.
   If the gripping force is satisfactory, then go to step 12.
   If the gripping force is more or less than desired, adjust knob “A”, Figure 5.1, to any setting between 100 and 500 psig (6.9 and 34.5 bars). Refer to Table 5.1.

- CAUTION -
If the machine will not be operated with a bar feed system, spindle draw tube plug “F”, Figure 5.3, should be installed in the back of the spindle to prevent coolant and chips from entering the spindle drive motor compartment.

12. Install spindle draw tube plug “F”, Figure 5.3, if a bar feed system will not be used.
13. Replace draw tube access door “C”, Figure 5.2.
CHAPTER 6 - TAILSTOCK

CONQUEST® T42 series lathes feature a hydraulically operated, programmable tailstock. The hydraulic system is located at the rear of the machine. The tailstock gives added support when machining long parts and reduces part deflection. This allows for closer tolerances, better surface finishes, and higher speeds and feeds than would otherwise be possible.

- CAUTION -

Check and, if necessary, adjust the tailstock force before using the tailstock for machining operations. Refer to “Checking and Adjusting Tailstock Force”, page 6-14.

Always make certain the turret is in a safe index position before moving the tailstock toward the spindle.

The tailstock assembly is advanced and retracted by means of a hydraulic cylinder. Tailstock motion can be controlled automatically from the part program or manually using push buttons on the operator control panel.

There are two rates of motion:

1. The rapid traverse rate (approximately 300 in/min [7620 mm/min])

2. The adjustable feedrate.

- NOTE -

The tailstock can only be moved toward the spindle at the rapid traverse rate when the machine is in Automatic or Manual Data Input mode with the main guard door closed.

The tailstock has an eccentric bushing which will accept a live center with a #3 Morse taper.

The tailstock incorporates a “safety shear” feature to prevent damage to the tooling, turret, tailstock, and linear ways in the event that the turret contact the tailstock. If contact is made between the tailstock and turret, the “safety shear” feature allows the tailstock to be pivoted away from the turret. Refer to the CONQUEST T42 Lathe Maintenance Manual (M-322) for instructions on aligning the tailstock.

Tailstock overtravel protection in the forward direction is provided by a rapid to feed limit switch and a hard stop. If no stock is present in the collet, the feed dog will travel past the limit switch. This causes the switch to trip, putting the control in a feed hold condition.

TRAVEL SPECIFICATIONS

The tailstock travel specifications are shown in Figure 6.1. Tailstock Home (Retract) is a fixed position. The forward (extend) position can be adjusted to suit the workpiece length. The maximum part length during tailstock operation is as follows:

<table>
<thead>
<tr>
<th>Workholding Device</th>
<th>CONQUEST® T42 &amp; T42SP Lathes</th>
<th>CONQUEST T42-L Lathes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collet</td>
<td>14.00 [355.6]</td>
<td>24.00 [609.6]</td>
</tr>
<tr>
<td>6&quot; Chuck w/ Hardened Jaws</td>
<td>9.41 [239.0]</td>
<td>19.41 [493.0]</td>
</tr>
<tr>
<td>8&quot; Chuck w/ Hardened Jaws</td>
<td>8.88 [225.5]</td>
<td>18.88 [479.5]</td>
</tr>
</tbody>
</table>
TURNING THE TAILSTOCK FUNCTION ON OR OFF

- CAUTION -

It is recommended that the tailstock function be turned OFF when running jobs that do not require the tailstock. This will force the tailstock to the fixed home position and eliminate the possibility of unwanted tailstock motion.

TAILSTOCK ON

Be sure the tailstock function is turned ON before attempting to run a program that commands tailstock motion. If the tailstock function is turned OFF and the control reads an M84 (Tailstock Forward), M85 (Tailstock Retract), or M86 (Tailstock Home) command, program execution and machine motion will stop and an alarm message will be displayed.

To clear the alarm and restart the program:

1. Press the control Reset key.
2. Turn the tailstock function ON according to the procedure outlined below.
3. Reset the program at the beginning of the current operation.

TAILSTOCK OFF

When the tailstock feature is turned OFF, the tailstock MUST be positioned at the fixed home position. Refer to “Tailstock Movement”, page 6-6, for information on moving the tailstock to the fixed home position. The Lower Axis Home indicator light [57] will be OFF.
If the tailstock function is turned OFF and the tailstock is NOT at the fixed home position, an alarm message will be displayed when the Cycle Start push button [72] is pressed. To clear this alarm:

1. Press the control Reset key.
2. Simultaneously press the Zero Return [69] push button and the +LA push button [60]. Release the Zero Return and +LA push buttons when the tailstock begins to move.

The tailstock will move to the fixed home position. At this point, the associated M codes and the Lower Axis push buttons will be disabled.

**ON/OFF PROCEDURE**

1. Press the Emergency Stop push button [74]. Be sure it latches in the down position.
2. Press **and hold** the Emergency Stop Reset push button [73].
3. Check the Lower Axis Home indicator light [57]:
   - If the light is **ON**, the tailstock function is **ON**.
   - If the light is **OFF**, the tailstock function is **OFF**.
4. If necessary, press the +LA push button [60] to switch the state of the tailstock function (ON or OFF).
5. Release the Emergency Stop Reset push button.
6. Release the Emergency Stop push button.
7. Press the Emergency Stop Reset push button.
TAILSTOCK POSITIONS

There are two tailstock positions recognized by the control on CONQUEST® T42 and T42SP lathes.

There are three tailstock positions recognized by the control on CONQUEST T42-L lathes.

FIXED HOME POSITION

Refer to “Tailstock Movement”, page 6-6, for information on moving the tailstock to this position. The Lower Axis Home indicator light will be ON when the tailstock is at the fixed home position. This position is NOT adjustable. Refer to Figure 6.1.

CONQUEST T42 and T42SP Lathes

The fixed home position is located approximately 17.50 inches [444.5 mm] from the spindle face.

CONQUEST T42-L Lathes

The fixed home position is located approximately 27.50 inches [698.5 mm] from the spindle face.

ADJUSTABLE HOME POSITION (RETRACT)

- NOTE -

CONQUEST T42 and T42SP lathes are NOT equipped with a tailstock adjustable home position.

When first learning to run the machine, it may be desirable to set the adjustable home to the same position as the fixed home.

The adjustable home position is typically located between the forward position and the fixed home position. This position is intended to minimize tailstock motion, resulting in lower cycle times. The machine operator establishes the adjustable home position by locating the adjustable home limit switch dog as needed. Refer to “Tailstock Set Up”, page 6-8, for information on setting the adjustable home position.

Refer to “Tailstock Movement”, page 6-6, for information on moving the tailstock to this position. The Lower Axis Home indicator light will blink when the tailstock is in the adjustable home position.

FORWARD POSITION

The machine operator establishes the forward position by locating the rapid-to-feed limit switch dog as needed. Refer to “Tailstock Set Up”, page 6-8, for information on setting the forward position.

Refer to “Tailstock Movement”, page 6-6, for information on moving the tailstock to this position. The Lower Axis Forward indicator light will be ON when the tailstock is in the forward position.
TAILSTOCK SAFETY INTERLOCKS

There are three safety interlocks associated with the tailstock. These interlocks are designed to reduce the possibility of crashes that result from incorrect tailstock positioning.

CYCLE START INTERLOCK

To activate Cycle Start while in Automatic, Manual Data Input, or Single mode, the tailstock MUST be in one of the following positions:

1. Fixed Home position
2. Adjustable Home Position (Retract)
3. Forward Position

If the tailstock is not in one of these three positions, an alarm will be generated by the control when the Cycle Start push button [72] is pressed.

To clear the alarm, move the tailstock to the desired position. Refer to “Tailstock Movement”, page 6-6, for information on moving the tailstock.

ENABLE/DISABLE INTERLOCK

When the tailstock function is turned OFF, the tailstock MUST be located at the fixed Home position. If the tailstock function is turned OFF and the tailstock is not at the fixed home position, an alarm will be generated by the control when the Cycle Start push button [72] is pressed.

To move the tailstock to the fixed home position:

1. Press the control Reset key.
2. Simultaneously press the Zero Return push button [69] and the +LA push button [60] to move the tailstock to the fixed home position.

When the tailstock function is turned ON, the tailstock must be located in either the Forward, Adjustable Home, or Fixed Home position before Cycle Start can be activated. Refer to page 6-2 for information on turning the tailstock function ON or OFF.

RAPID-TO-FEED INTERLOCK

While in Automatic, Manual Data Input, or Single mode, M84 commands RAPID tailstock motion toward the machine spindle. The operator MUST set the rapid-to-feed dog so that the tailstock center will FEED onto the workpiece. Refer to “Tailstock Set Up”, page 6-8, for information on setting the rapid-to-feed dog.

When properly set, the rapid-to-feed dog will remain on the limit switch while the tailstock is in the forward position. The Lower Axis Forward indicator light will be ON.

Tailstock overtravel protection in the forward direction is provided by the rapid-to-feed limit switch and the hard stop. If no stock is present in the collet, the rapid-to-feed dog will travel past the switch. This causes the switch to trip, which will generate an alarm and put the control in a feed hold condition.

To clear the alarm:

1. Press the control Reset key.
2. Press the +LA push button [60] to move the tailstock to the adjustable home position at the rapid traverse rate.
TAILSTOCK MOVEMENT

MANUAL MOVEMENT

Generally, the machine control must be in Jog mode to manually control tailstock motion. The notable exception is during “between-center” work. If M30 (End of Program) is active while in Automatic mode, it is possible to manually jog the tailstock without switching to Jog mode. Be aware that activating Jog mode will cancel this feature until another M30 is read by the control while in Automatic mode.

The +LA push button [60] will jog the tailstock away from the main spindle. The -LA push button [58] will jog the tailstock toward the main spindle.

While in manual mode, the tailstock will always FEED toward the machine spindle and RAPID away from the machine spindle.

Initiating Manual Movement

CONQUEST® T42 & T42SP Lathes

- When the tailstock is at the home position and the -LA push button [58] is pressed, the tailstock will FEED toward the forward position (-Z direction).
- When the tailstock is at the forward position and the +LA push button [60] is pressed, the tailstock will RAPID to the home position (+Z direction).

CONQUEST T42-L Lathes

- When the tailstock is at either home position and the -LA push button [58] is pressed, the tailstock will FEED toward the forward position (-Z direction).
- When the tailstock is at the forward position and the +LA push button [60] is pressed, the tailstock will RAPID toward the home positions (+Z direction) and stop at the first home position encountered.

Stopping Manual Movement

Manual tailstock motion can be stopped by pressing Emergency Stop, Hold push button [59], or control Reset.

EMERGENCY STOP

To initiate tailstock motion after an Emergency Stop:

1. Release the Emergency Stop push button [74].
2. Press the Emergency Stop Reset push button [73].
3. Press the control Reset key.
4. Activate Jog mode and press the +LA push button [60]. The tailstock will RAPID toward the home positions (+Z direction) and stop at the first home position encountered.

HOLD or RESET

To initiate tailstock motion after a Hold or control Reset, press the +LA push button [60]. The tailstock will RAPID toward the home positions (+Z direction) and stop at the first home position encountered.
PROGRAMMED MOVEMENT

Initiating Programmed Movement

- NOTE -

The machine control MUST be in Automatic, Manual Data Input, or Single mode to command tailstock motion using M codes.

M84 Tailstock Forward

When the tailstock is at the fixed home or adjustable home position and M84 is read by the control, the tailstock will rapid forward (toward the machine spindle) until the rapid-to-feed switch is engaged. At that point, the tailstock will slow to the preset feedrate and feed onto the workpiece.

M85 Tailstock Retract

When the tailstock is in the forward position and M85 is read by the control, the tailstock will move at rapid traverse rate to the first home position encountered.

M86 Tailstock Home

When an M86 is read by the control, the tailstock will move to the fixed home position at the rapid traverse rate.

Stopping Programmed Movement

Programmed tailstock motion can be stopped by pressing Emergency Stop, Feed Hold [71], or control Reset.

EMERGENCY STOP

To initiate programmed tailstock motion after an Emergency Stop:
1. Release the Emergency Stop push button [74].
2. Press the Emergency Stop Reset push button [73].
3. Press the control Reset key.
4. Activate Jog mode and move the tailstock to a home position.
5. Reset the program to the beginning of the current operation.
6. Activate Automatic mode and press the Cycle Start push button [72].

FEED HOLD

To initiate programmed tailstock motion after a Feed Hold, press the Cycle Start push button [72].

RESET

To initiate programmed tailstock motion after a control Reset:
1. Activate Jog mode and move the tailstock to a home position.
2. Reset the program to the beginning of the current operation.
3. Activate Automatic mode and press the Cycle Start push button [72].
TAILSTOCK SET-UP

CONQUEST® T42 & T42SP LATHES

- NOTE -
Refer to page 6-10 for information on setting up the tailstock on CONQUEST T42-L lathes.

1. Power-up the machine as described in Chapter 2.
2. Activate Jog mode.
3. If necessary, use the +LA push button [60] to move the tailstock to provide sufficient clearance for installing spindle tooling.
4. Install the desired work-holding fixture in the main spindle as described in Chapter 5.
5. Place a workpiece in the work-holding device and press the Main Spindle Collet/Chuck push button [53].
6. Loosen knob “B”, Figure 6.2, move the feed dog to the extreme left position, and secure knob “B”.
7. Press the -LA push button [58]. The tailstock assembly will feed toward the main spindle and stop after the rapid-to-feed limit switch is tripped.

- NOTE -
If the tailstock assembly makes contact with the mechanical hard stop before reaching the desired position, it will be necessary to adjust the hard stop to provide the additional travel. Refer to “Adjusting the Mechanical Hard Stop”, page 6-12. Adjustment will also be necessary when a previous job is longer or shorter than the one that is being set up.

8. Press the -LA push button [58] to feed the tailstock onto the workpiece.

Figure 6.2 - Mechanical Hard Stop and Feed Dog Adjustment
9. Loosen knob “B”, Figure 6.2, and move the feed dog to the right until contact is made with the limit switch; then, move the rapid-to-feed dog up onto the limit switch approximately 3/8 inches [9.5 mm] and tighten knob “B” to secure the setting.

10. Press the +LA push button [60] to home the tailstock assembly. The +LA and Lower Axis Home indicator lights will be illuminated when the tailstock is in the Home position.

- CAUTION -

The tailstock rapid traverse rate is 300 ipm (7.6 mpm). To stop rapid traverse motion of the tailstock assembly, press Feed Hold [71], Emergency Stop [74], or the control Reset key.

11. Advance the tailstock to check the rapid-to-feed point:

a) Close the main guard door.

b) Press the Manual Data Input push button [3].

c) Press the Manual Data Input soft key.

d) Key in M84 (Tailstock Forward), press the EOB key; then, press the Insert key.

e) Press the Cycle Start push button [72]. The tailstock will rapid to the rapid-to-feed point, then feed against the workpiece.

12. Retract the tailstock to the Home position:

a) Key in M85 or M86 (Tailstock Home), press the EOB key; then, press the Insert key.

b) Press the Cycle Start push button [72]. The tailstock will rapid to the Home position.

![Figure 6.3 - Tailstock Set Up](image-url)
1. Power-up the machine as described in Chapter 2.
2. Activate Jog mode.
3. If necessary, use the +LA push button [60] to move the tailstock to provide sufficient clearance for installing spindle tooling.
4. Install the desired work-holding fixture in the main spindle, as described in Chapter 5.
5. Place a workpiece in the workholding device and press the Main Spindle Collet/Chuck push button [53].

- NOTE -
To help differentiate between the adjustable home dog and the rapid-to-feed dog, there is a dimple in the face of adjustable home dog knob “F”, Figure 6.4.
6. Loosen knob “F”, Figure 6.4, and move the adjustable home dog to the extreme left position; then secure knob “F”.
7. Loosen knob “G” and move the rapid-to-feed dog to the extreme right position; then secure knob “G”.

- NOTE -
If the tailstock assembly makes contact with the mechanical hard stop before reaching the desired position, it will be necessary to adjust the hard stop to provide the additional travel. Refer to “Adjusting the Mechanical Hard Stop” page 6-12. Adjustment will also be necessary when a previous job is longer or shorter than the one that is being set up.
8. Press the -LA push button [58]. The tailstock center will feed onto the workpiece.

- NOTE -
When the feed dog is moved past the limit switch you will feel it drop off the switch.
9. Loosen knob “G”, Figure 6.4, and move the rapid-to-feed dog to the left, going past the limit switch.
10. Move the rapid-to-feed dog to the right until contact is made with the limit switch; then, move the rapid-to-feed dog up onto the limit switch approximately 3/8 inches [9.5 mm] and tighten knob “G”, Figure 6.4. Refer also to Figure 6.3.

- NOTE -
If the adjustable home dog remains in the extreme left position, the tailstock will operate from the workpiece to the fixed home position. In this case, the Lower Axis Home indicator light [57] will blink when the tailstock is at the fixed home position.
11. If desired, loosen knob “F”, Figure 6.4, and move the adjustable home dog to the right to relocate the adjustable home to a more suitable position. Tighten knob “F”.
12. Press the +LA push button [60] to move the tailstock to the adjustable home position. The Lower Axis Home indicator light [57] will blink when the tailstock is in the adjustable home position.
13. Close the main guard door.
14. Press the Manual Data Input push button [3].
15. Press the Manual Data Input soft key.
16. At the Manual Data Input keyboard, key in “M84”, press the EOB key; then, press the Insert key.
17. Press the Cycle Start push button [72]. The tailstock should rapid traverse to a position near the face of the workpiece and feed the remaining distance.
18. Check the following:
   - The Lower Axis Forward indicator light [56]. The indicator light should be ON when the tailstock is in the forward position. If the indicator light is not ON, repeat this procedure.
   - The control display screen for alarm messages. If an alarm message is displayed, repeat this entire procedure.
19. At the Manual Data Input keyboard, key in “M85”, press the EOB key; then, press the Insert key.
20. Press the Cycle Start push button [72]. The tailstock should rapid traverse to the adjustable home position.
21. Verify that the adjustable home position is appropriate or adjust as necessary.
22. Press the control Reset key.
ADJUSTING THE MECHANICAL HARD STOP

The mechanical hard stop is a safety feature that is used to prevent the tailstock assembly from making contact with the spindle tooling. The hard stop can be adjusted to provide whatever length is necessary between the live center mounted in the tailstock and the face of the workpiece mounted in the spindle.

Prerequisites:
- Control is turned ON.
- Cycle Start is not active.
- Jog mode is active.

CONQUEST® T42 & T42SP Lathes

1. Loosen lock nut “A”, Figure 6.2, with a 3/4 inch wrench.
2. Place a 1/4 inch hex wrench through the locknut and into the adjusting screw.
3. Turn the adjusting screw clockwise (toward operator) to move the hard stop away from the spindle and counterclockwise (toward machine bed) to move the hard stop toward the spindle.

- NOTE -
The hard stop should be adjusted so that contact is made approximately 1/8 inch (3.2 mm) after expected contact between the live center and the workpiece.

4. Position the hard stop so that it is beyond the contact point of the live center and workpiece.
5. Adjust the feed dog as outlined under “Tailstock Set-Up”, page 6-8.
6. Turn the hard stop adjustment screw clockwise until resistance is met with the tailstock assembly.
7. Turn the adjustment screw counterclockwise 1/4 to 1/2 turn.
8. Tighten lock nut “A”, Figure 6.2, to secure the setting.

CONQUEST T42-L Lathes

- NOTE -
To adjust the position of hard stop “E”, Figure 6.4, turn knob “C” clockwise to move the hard stop toward the spindle and counterclockwise to move the hard stop away from the spindle.

1. Loosen the lock screw in bracket “D”, Figure 6.4.
2. Use knob “C” to position the hard stop so that it is beyond the contact point of the live center and workpiece in the -Z direction.
3. Adjust the rapid-to-feed dog as outlined under “Tailstock Set-Up”, page 6-8.
4. Place a workpiece in the collet or step chuck and press the Main Spindle Collet/Chuck push button [53].
5. Jog the tailstock to the forward position.
6. Turn knob “C”, Figure 6.4, counterclockwise until the hard stop makes contact with the tailstock.
7. Turn knob “C” clockwise until there is approximately 1/4 inch [6.4 mm] between hard stop “E” and the tailstock assembly.

8. Tighten the lock screw in bracket “D”.

**ADJUSTING TAILSTOCK FEEDRATE**

1. Set the rapid-to-feed switch and mechanical hard stop as described in the preceding instructions.

2. Activate Jog mode.

3. Press the +LA push button [60] to Home the tailstock.

4. Press the -LA push button [58] to move the tailstock toward the spindle and observe the current tailstock feedrate. The tailstock will move toward the spindle at the adjustable feedrate.

5. If the tailstock feedrate needs to be changed, turn knob “J”, Figure 6.5, in the required direction to increase or decrease the feedrate as desired.

6. Repeat steps 3 through 5 until the desired feedrate is achieved.

Figure 6.5 - Hydraulic Pressure Gauges
CHECKING AND ADJUSTING TAILSTOCK FORCE

The force applied to the workpiece is controlled by hydraulic oil pressure which is regulated by valve “H”, Figure 6.5. Gauge “I” indicates the force in pounds per square inch and bars. Table 6.1 lists the approximate force in pounds and dekanewtons which will be applied to the workpiece for a given gauge pressure.

1. Set the rapid-to-feed switch and forward stop as described in the preceding instructions.
2. Activate Jog mode.
3. Use the -LA push button [58] to engage the tailstock with the workpiece.
4. Check the tailstock hydraulic pressure on gauge “I”, Figure 6.5. If the tailstock hydraulic pressure needs to be adjusted, go to step 5. If the tailstock hydraulic pressure does not need to be adjusted, go to step 7.

- CAUTION -
Recommended tailstock pressure is 350 psig (24 bars). For maximum operating safety and to ensure that the hydraulic tailstock functions correctly, never set the tailstock pressure below 150 psig [10.3 bars].

5. Loosen the knurled lock nut on valve “H” and turn the adjusting nut in the required direction until the desired pressure registers on gauge “I”. Refer to Table 6.1.
6. Tighten the lock nut on valve “H”.
7. Press the +LA push button [60] to Home the tailstock.

<table>
<thead>
<tr>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge Pressure (psig)</td>
<td>Applied Force (lb.)</td>
</tr>
<tr>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>200</td>
<td>190</td>
</tr>
<tr>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>400</td>
<td>570</td>
</tr>
<tr>
<td>500</td>
<td>700</td>
</tr>
</tbody>
</table>

Table 6.1 - Applied Tailstock Force
CHAPTER 7 - INPUT/OUTPUT DEVICES

DATA COMMUNICATIONS PROTOCOL

Data communications protocol consists of three basic types of information: parity, baud rate, and stop bits. The baud rate and stop bits are controlled by parameters, which may be modified as required.

TAPE PARITY CHECK

Tapes punched in EIA format (EIA Standard RS-244-B) contain an odd number of holes in each character and tapes punched in ASCII (ISO), (EIA Standard RS-358-B) contain an even number of holes in each character. This characteristic of having an odd or even number of holes punched in every character is called parity.

The control accepts tape punched in either code, but each tape must be programmed in only one of the accepted codes.

The control automatically determines the particular type of coding by decoding the first End of Block (;) character on the tape. Each character is checked for parity as it is read by the tape reader or computer.

Refer to the appropriate manual to set the tape punch, tape reader, or computer to the desired parity.

BAUD RATE

Baud rate is the speed at which data is transmitted from one device to another. To successfully transmit data between two devices, it is necessary to have both devices set to the same baud rate.

The baud rate is set by three different parameters, depending on which I/O port is active. Refer to the I/O setting on Setting Page #1 to determine which I/O port is active. Refer to “I/O Port Assignment”, Page 7-2.

Refer to the appropriate manual to set the tape punch, tape reader, or computer to the desired baud rate.

STOP BITS

The GE Fanuc 18T control is capable of operating with 1 or 2 stop bits, depending on the requirement. The number of stop bits active in the machine control is controlled by three different parameters, depending on which I/O port is active. These parameters may be modified as required. Refer to “I/O Port Assignment”, page 7-2.

Refer to the appropriate manual to set the tape punch, tape reader, or computer to the desired number of stop bits.
CHECKING AND MODIFYING COMMUNICATIONS PARAMETERS

Use the following procedure to check communications protocol parameters:

1. Press the System key.
2. Press the Parameter soft key.
3. Use the Page keys to display the parameter page to be viewed.

Use the following procedure to check and modify communications protocol parameters as needed:

1. Press the Offset Setting key.
2. Press the Setting soft key.
3. If necessary, use the Page keys to display the Setting page that contains the Parameter Write field.
4. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
5. Press the Manual Data Input push button [3].
6. Key in the number 1 (one).
7. Press the Input key. Parameter editing will be enabled.
8. Press the System key.
9. Press the Parameter soft key.
10. Use the Cursor and Page keys to position the cursor on the parameter to be modified.
11. Key in the new parameter value.
12. Press the Input key.
13. Repeat steps 10 through 12, as needed.
14. Press the Offset Setting key.
15. Press the Setting soft key.
16. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
17. Key in the number 0 (zero).
18. Press the Input key. Parameter editing will be disabled.

I/O PORT ASSIGNMENT

The standard configuration for CONQUEST® T42 series lathes is equipped with one physical RS-232 port. When the machine tool is configured in this manner, two independent port assignments are available to allow the operator or programmer to establish two different I/O port configurations for the same physical I/O port. These two configurations are designated as channels "0" and "1".

Instead of changing the associated parameters to reassign the baud rate and stop bits, it is possible to select a different I/O port assignment and have the changes implemented by the control automatically. Refer to “I/O Channel”, in Chapter 2, for information on setting the desired I/O port assignment.

When the machine tool is equipped with a second physical RS-232 port (optional), a third I/O port configuration is available. This configuration is designated as channel “2”. When channel "2" is selected as the active port, the external device (tape punch, tape reader, or computer) will be connected to the second physical RS-232 port.

Refer to “I/O Port Parameter Settings”, on the next page, for a listing of the parameter settings for the I/O port assignments.
I/O PORT PARAMETER SETTINGS

Refer to “Checking and Modifying Communications Parameters”, starting on Page 7-2, for information on modifying the parameter settings for the three I/O ports. These parameters may be modified as required.

BAUD RATE PARAMETER SETTINGS

<table>
<thead>
<tr>
<th>I/O Port</th>
<th>Parameter No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>103</td>
</tr>
<tr>
<td>1</td>
<td>113</td>
</tr>
<tr>
<td>2</td>
<td>123</td>
</tr>
</tbody>
</table>

The valid parameter settings are as follows:

<table>
<thead>
<tr>
<th>Setting No.</th>
<th>Baud Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>110</td>
</tr>
<tr>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>300</td>
</tr>
<tr>
<td>7</td>
<td>600</td>
</tr>
<tr>
<td>8</td>
<td>1200</td>
</tr>
<tr>
<td>9</td>
<td>2400</td>
</tr>
<tr>
<td>10</td>
<td>4800</td>
</tr>
<tr>
<td>11</td>
<td>9600</td>
</tr>
<tr>
<td>12</td>
<td>19200</td>
</tr>
</tbody>
</table>

STOP BIT PARAMETER SETTINGS

<table>
<thead>
<tr>
<th>I/O Port</th>
<th>Parameter No.</th>
<th>Bit No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>101</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>111</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>121</td>
<td>0</td>
</tr>
</tbody>
</table>

The valid parameter settings are “0” for 1 Stop Bit and "1" for 2 Stop Bits.

- NOTE -

The Stop Bit parameter settings are displayed as one bit in an 8 bit binary number (0 or 1). The bits are read “0” to ”7”, from right to left.
DATA TRANSFER TO THE CONTROL

UPLOADING CONTROL PARAMETERS INTO MEMORY

- CAUTION -

Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

1. Verify the machine control communications protocol as outlined under “Checking and Modifying Communication Protocol”, page 7-2.
2. Refer to the appropriate manual to set the tape reader or computer to the desired communications protocol.
3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.
4. Press the Offset Setting key.
5. Press the Setting soft key.
6. If necessary, use the Page keys to display the Setting page that contains the Parameter Write field.
7. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
8. Press the Manual Data Input push button [3].
9. Key in the number 1 (one).
10. Press the Input key. Parameter editing will be enabled.
11. Press the System key.
12. Press the Parameter soft key.
13. Press the Operator soft key.
14. Press the Edit push button [12].
15. Press the soft key expansion key until the Read soft key is displayed.
16. Press the Read soft key.
17. Press the Execute soft key.
18. Set the tape reader or computer to transmit data to the machine control.
19. After the control parameters have been uploaded, press the Manual Data Input push button.
20. Press the Offset Setting soft key.
21. Key in the number 0 (zero).
22. Press the Input key. Parameter editing will be disabled.
23. Remove power from the external device; then, disconnect the RS-232 cable from the machine control.
24. Replace the magnetic access cover.
25. Turn the control OFF and wait approximately 10 seconds.
26. Turn the control ON.

Figure 7.1 - Serial Port
UPLOADING PART PROGRAMS INTO MEMORY

- CAUTION -
Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

2. Refer to the appropriate manual to set the tape reader or computer to the desired communications protocol.
3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.
4. Press the Edit push button [12].
5. Press the Program key.
6. Turn the Program Protect key [11] to OFF.
7. Press the soft key expansion key until the Read soft key is displayed.

- NOTE -
If the program has no program number or if the program number is to be altered, key in the letter “O” and the desired program number.

8. Key in the letter “O” and the program number. Example: O1111
9. Press the Read soft key.
10. Press the Execute soft key.
11. Set the tape reader or computer to transmit data to the machine control.

- NOTE -
When the program has been completely loaded into the control, it will appear as the active program on the control display screen.

12. After the part programs have been uploaded, turn the Program Protect key to ON.
13. Remove power from the external device; then, disconnect the RS-232 cable from the machine control.
14. Replace the magnetic access cover.
UPLOADING TOOL OFFSETS INTO MEMORY

- CAUTION -

Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

1. Verify the machine control communications protocol as outlined under “Checking and Modifying Communication Protocol”, page 7-2.

2. Refer to the appropriate manual to set the tape reader, or computer to the desired communications protocol.

3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.

4. Press the Edit push button [12].

5. Press the Offset Setting key.

6. Press the Offset soft key.

7. Press the Operator soft key.

8. Press the soft key expansion key until the Read soft key is displayed.

9. Press the Read soft key.

10. Press the Execute soft key.

- NOTE -

The offset data will load directly into the offset registers.

11. Set the tape reader or computer to transmit data to the machine control.

12. Remove power from the external device; then, disconnect the RS-232 cable from the machine control.

13. Replace the magnetic access cover.
DATA TRANSFER FROM THE CONTROL

DOWNLOADING CONTROL PARAMETERS FROM MEMORY

- CAUTION -
Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

1. Verify the machine control communications protocol as outlined earlier under “Checking and Modifying Communication Protocol”, page 7-2.
2. Refer to the appropriate manual to set the tape punch or computer to the desired communications protocol.
3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.
4. Connect the interface cable to the output device and the serial port on the control.
5. Set the tape punch or computer to receive data.
6. Press the Edit push button [12].
7. Press the System key.
8. Press the Parameter soft key.
10. Press the soft key expansion key until the Punch soft key is displayed.
11. Press the Punch soft key.
12. Press the Execute soft key.

- NOTE -
To stop the parameters from downloading, press the Reset key. Once the Reset key has been pressed, it is not possible to download the rest of the parameters without starting this procedure from the beginning.

13. After the control parameters have been downloaded, remove power from the external device and disconnect the RS-232 cable from the machine control.
14. Replace the magnetic access cover.
DOWNLOADING PART PROGRAMS FROM MEMORY

- CAUTION -

Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

1. Verify the machine control communications protocol as outlined under “Checking and Modifying Communication Protocol”, page 7-2.
2. Refer to the appropriate manual to set the tape punch or computer to the desired communications protocol.
3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.
4. Connect the interface cable to the output device and the serial port on the control.
5. Set the tape punch or computer to receive data.
6. Press the Edit push button [12].
7. Press the Program key.
8. Key in the letter “O” and the program number. Example: O1111
9. Press the soft key expansion key until the Punch soft key is displayed.
10. Press the Punch key.
11. Press the Execute soft key.

- NOTE -

When outputting to a tape punch, the control will automatically output 3 feet of leader and trailer tape. To shorten the leader or trailer length, press the Cancel push button while the leader or trailer is being punched, respectively.

To stop the part program from downloading, press the Reset key. Once the Reset key has been pressed, it is not possible to download the rest of the part program without starting this procedure from the beginning.

12. After the part programs have been downloaded, remove power from the external device and disconnect the RS-232 cable from the machine control.
13. Replace the magnetic access cover.
DOWNLOADING TOOL OFFSETS FROM MEMORY

- CAUTION -
Always connect the RS-232 cable before applying power to the external device and always remove power from the external device before disconnecting the RS-232 cable.

1. Verify the machine control communications protocol as outlined under “Checking and Modifying Communication Protocol”, page 7-2.
2. Refer to the appropriate manual to set the tape punch or computer to the desired communications protocol.
3. Remove the magnetic access cover, which is located on the side of the control display housing, and connect the interface cable from the tape reader or computer to serial port “A”, Figure 7.1.
4. Connect the interface cable to the output device and the serial port on the control.
5. Set the tape punch or computer to receive data.
6. Press the Edit push button [12].
7. Press the Offset Setting key.
8. Press the Offset soft key.
9. Press the Geometry soft key to display the Geometry offset page.
10. Press the Operator soft key.
11. Press the soft key expansion key until the Punch soft key is displayed.
12. Press the Punch key.
13. Press the Execute soft key.

- NOTE -
To stop the tool offsets from downloading, press the Reset key. Once the Reset key has been pressed, it is not possible to download the rest of the tool offsets without starting this procedure from the beginning.

14. After the tool offsets have been downloaded, remove power from the external device and disconnect the RS-232 cable from the machine control.
15. Replace the magnetic access cover.
CHAPTER 8 - OPERATOR MAINTENANCE

Operator maintenance is normally confined to cleaning the machine and maintaining the lubrication oil, hydraulic fluid, and coolant levels. It is a good practice to check all fluid levels at the beginning of each shift. The operator should also check the cooling fans periodically to see that they are free of obstructions and functioning properly. For more extensive maintenance procedures, refer to the CONQUEST® T42 Lathe Maintenance Manual (Manual No. M-322).

MACHINE AIR SYSTEM

The machine is equipped with a regulator and two-stage filter system to regulate and filter the incoming air supply. The filter/regulator assembly is located at the back of the machine. The type of filter/regulator assembly will vary, depending on whether the machine is equipped with the air blast option. Refer to the appropriate section that follows according to your machine configuration.

AIR LINE FILTER/REGULATOR

- CAUTION -

The air filter bowl should be drained at least once a day. If more frequent draining is required, it may be necessary to install an air dryer in the air line.

To Drain the Air Filter Bowls

Machines Not Equipped with Air Blast Option:

1. Turn main air valve “A”, Figure 8.1, ON.
2. Unscrew valve “B” only enough to drain the bowl of the standard air filter. Close the valve when the air filter bowl has finished draining.
3. Unscrew valve “C” only enough to drain the bowl of the coalescing air filter. Close the valve when the air filter bowl has finished draining.

Machines Equipped with Air Blast Option:

1. Turn main air valve “F”, Figure 8.2, ON.
2. Press drain valve “G” sideways to drain the bowl of the standard air filter. Release the valve when the air filter bowl has finished draining.
3. Press drain valve “H” sideways to drain the bowl of the coalescing air filter. Release the valve when the air filter bowl has finished draining.
To Adjust the Machine Air Pressure

The recommended range for machine air pressure is 70 psig [4.8 bars] to 90 psig [6.2 bars]. Machine air pressure is displayed on gauge “E”, Figure 8.1 or gauge “K”, Figure 8.2. If necessary, adjust the regulator to set the machine air pressure to within the recommended range.

- NOTE -

The machine is equipped with an air pressure sensor that will force the machine into Emergency Stop if the air pressure falls below 60 psig [4.1 bars].

Machines Not Equipped with Air Blast Option:
1. Turn main air valve “A”, Figure 8.1, ON.
2. Lift knob “D” to unlock; then, rotate the knob clockwise or counterclockwise to increase or decrease machine air pressure, respectively.
3. Press knob “D” down to lock the setting.

Machines Equipped with Air Blast Option:
1. Turn main air valve “F”, Figure 8.2, ON.
2. Loosen locking nut “I”; then, rotate knob “J” clockwise or counterclockwise to increase or decrease machine air pressure, respectively.
3. Tighten locking nut “I” to secure the setting.

MAIN LUBRICATOR

The main lubricator, shown in Figure 8.3, supplies lubricant to the ball screw nuts and linear way bearing cartridges. When the lubrication level sensor detects a low lubrication oil condition, an operator message is displayed and the control goes into Single mode (block-by-block) operation. Refer to the Maintenance Manual (Manual No. M-322) for complete information on the lubrication system.

To Fill the Main Lubricator
1. Open cap “M”, Figure 8.3.
2. Fill the lubricator reservoir with Mobil Vac-tra® No. 2 oil to the top of sight gauge “L”.
3. Close cap “M”.

Figure 8.3 - Main Lubricator
HYDRAULIC SYSTEM

The hydraulic system provides pressure to operate the collet closer, spindle brake, turret, and tailstock or optional hydraulic-driven sub-spindle. The reservoir should be filled whenever the hydraulic fluid level drops below sight gauge “N”, Figure 8.4. The reservoir should be drained, cleaned, and filled with fresh hydraulic fluid after every 1000 hours of operation. Refer to the Maintenance Manual (Manual No. M-322) for instructions on draining and cleaning the hydraulic system.

To Fill the Hydraulic System Reservoir

1. Power down the machine as outlined in Chapter 2.
2. Remove cap “O”, Figure 8.4, and SLOWLY fill the reservoir with Mobil DTE-13M Lite® hydraulic fluid until sight gauge “N” is filled.
3. Replace cap “O”.

- NOTE -

It is recommended that the machine not be powered up for at least 10 minutes after oil has been added to the hydraulic tank. This will allow any air bubbles present in the oil to dissipate.

To Adjust the Hydraulic System Pressure

- NOTE -

The machine is equipped with a pressure sensor that will force the machine into Emergency Stop if the hydraulic oil pressure falls below 60 psig [4.1 bars].

The recommended hydraulic system pressure is approximately 500 psig [34.5 bars]. The hydraulic system pressure is displayed on gauge “P”, Figure 8.5. The indicator in gauge “P” should always be in the green area on the indicator dial while the machine is turned ON. If necessary, turn adjusting nut “Q” to set the hydraulic system pressure to approximately 500 psig [34.5 bars], as follows:

1. Loosen the lock nut behind adjusting nut “Q”, Figure 8.5.
2. Turn adjusting nut “Q” clockwise or counterclockwise to decrease or increase hydraulic system pressure, respectively.
3. Tighten the lock nut.
COOLANT SYSTEM

Hardinge machine tools are designed using the latest technology and highest quality materials available. However, due to the ever-increasing number of coolant selections available, it is important to test material compatibility with each and every coolant. For additional information regarding coolant selection, coolant maintenance, and the coolant facilities on this machine, refer to the CONQUEST® T42 Lathe Maintenance Manual (Manual No. M-322).

- CAUTION -

Whenever water-soluble coolants are used, it is important to use the manufacturer’s recommended mix ratio (concentration). It is also important to maintain the coolant by keeping the proper concentration level when coolant is added to compensate for evaporation. Another important factor is coolant pH (acidity). Typically, the coolant pH should be in the range of 8.5 to 9. When the pH drops below 8.5 the rust inhibitors in the coolant start depleting, which can result in corrosion of machine components. Also, the quality of the water should be tested by the coolant manufacturer so that the proper coolant additives can be administered. Failure to follow these recommendations could result in damage to the machine, seals, and paint.

If the coolant you have selected starts to react (cause material to rust, pit, swell, soften, crack, blister, etc.) with any portion of the machine tool, Hardinge suggests that you discontinue use and contact your coolant representative for alternative coolants.

It should also be noted that certain chemicals react with different metals. Hardinge recommends that you consult with your coolant representative to assure that the material you are cutting does not react with the coolant you have selected.

The coolant level should not be allowed to fall below the sight gauge on the coolant tank. The coolant tank should be drained and cleaned at least every six months or whenever the type or brand of coolant is changed. More frequent cleaning may be required if the material being machined contaminates the coolant. Refer to the Maintenance Manual (Manual No. M-322) for instructions on draining and cleaning the coolant system.

To fill the coolant tank, open the front coolant guard door and pour the required amount of coolant directly into the chip pan. Fill the coolant tank to the “FULL” line on the sight gauge tag. Either water-based or oil-based coolant may be used.

Refer to the following table for coolant system capacities:

<table>
<thead>
<tr>
<th>Machine Model</th>
<th>Coolant Tank Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gallons [Liters]</td>
</tr>
<tr>
<td></td>
<td>without Chip Conveyor</td>
</tr>
<tr>
<td>CONQUEST T42 and T42SP Lathes</td>
<td>26 [100]</td>
</tr>
<tr>
<td>CONQUEST T42-L Lathes</td>
<td>29 [110]</td>
</tr>
</tbody>
</table>
CHIP REMOVAL
(Machines Without an Optional Chip Conveyor)

1. Power down the machine as outlined in Chapter 2.

2. If coolant was ON, wait a few minutes to allow any coolant that was in use to drain back into the tank.

3. At the right end of the machine, remove way lubrication tramp oil pan “R”, Figure 8.6.

4. Disconnect quick-disconnect fitting “S” by pressing back the knurled ring, and separate the coolant hose from the fitting on coolant tank “T”.

5. Move the coolant tank to a convenient area to remove the chips.

- WARNING -
Do not remove chips with your bare hands.

6. Rake or shovel the chips into a suitable container.

7. Return the coolant tank to its opening under the front of the machine and reconnect the coolant hose to the tank.

8. Place way lubrication tramp oil pan “R” back into position.

9. Check inside the work area to make certain that coolant will drain back into the coolant tank properly.

WAY LUBRICATION TRAMP OIL PAN

- WARNING -
Dispose of used oil in accordance with all applicable government guidelines.

The way lubrication oil drains from the machine bed and is collected in pan “R”, Figure 8.6, which is located at the right end of the machine next to the coolant tank. The pan should be removed and emptied once a day. Dump the oil into a suitable container and slide the pan back into position.

Figure 8.6 - Tramp Oil Pan
PART CATCHER [Option]

With the part catcher option turned ON, parts can be removed from the machine without interrupting the cycle or opening the guard door. Refer to “To Turn Purchased Options ON or OFF”, page 9-5, for information on turning the Part Catcher option ON or OFF.

The part catcher can be activated from the part program using the M26 Part Catcher Extend command and M25 Part Catcher Retract command. The part catcher can also be operated manually in Jog mode by pressing the Part Catcher Extend and Retract push buttons.

When the part catcher is commanded to extend, arm “C”, Figure 9.1, moves into position beneath the spindle centerline to catch the part. When the retract command is executed, arm “C” moves to the retract position and deposits the workpiece in the part chute, which is mounted on the coolant guard door. The part can then be removed from the machine by opening door “E”, Figure 9.2.

PART CATCHER POSITION ADJUSTMENT

If necessary, the machine operator can adjust the position of part catcher arm “C”, Figure 9.1, in relation to the machine headwall. The position adjustment knob is located at “D”, Figure 9.2.

Retrieving from the Main Spindle

1. Loosen locking bushing “B”, Figure 9.1, by turning it counterclockwise, as viewed from the end of the machine.
2. Rotate knob “A” in the appropriate direction to adjust the position of the part catcher.
3. Tighten locking bushing “B” by turning it clockwise, as viewed from the end of the machine.
Retrieving from the Sub-Spindle

- NOTE -

Refer to Chapter 15 for additional information on ball-screw driven sub-spindle operation.

1. Press the Jog push button [4].

- CAUTION -

Be sure to take an active work shift into consideration when positioning the sub-spindle for part catcher set-up.

2. Use Jog or Manual Data Input mode to position the sub-spindle 13.125 inches [333.38 mm] from the main spindle. Refer to Figure 9.3.

3. Loosen locking bushing “B”, Figure 9.1, by turning it counterclockwise, as viewed from the end of the machine.

4. Rotate knob “A” in the appropriate direction to adjust the position of the part catcher to retrieve parts from the sub-spindle at the current sub-spindle position.

5. Tighten locking bushing “B” by turning it clockwise, as viewed from the end of the machine.

6. Move the sub-spindle to a safe position to begin program execution.

NOTE: All dimensions shown in Inches [Millimeters].

Figure 9.3 - Sub-Spindle Positioning for Part Retrieval
PART CATCHER SPEED ADJUSTMENT

There are two screws, labeled A and B, located on face of part catcher valve “F”, Figure 9.4. These are the speed adjustment screws for the part catcher. Adjust the part catcher operating speed as follows:

1. Home all axes.
2. Press the Jog push button [4].
3. Have a helper alternately press the Part Catcher Extend push button [21] and Retract push button [22] to extend and retract the part catcher arm while the speed adjustments are being performed.
4. Turn the screw labeled A clockwise to decrease the extend speed and counterclockwise to increase the extend speed.
5. Turn the screw labeled B clockwise to decrease the retract speed and counterclockwise to increase the retract speed.

HIGH PRESSURE COOLANT SYSTEM [Option]

The High Pressure Coolant System option is used when special coolant-fed tools are mounted on the turret. When the High Pressure Coolant System is operating, the standard machine coolant system is disabled. The pump unit is located externally from the machine and draws coolant from the machine’s coolant reservoir. The coolant is then pumped to the special tools when they are in the cutting position.

The spindle must be running (M03 or M04) before activating High Pressure Coolant. With the option turned ON, high pressure coolant can be manually activated and deactivated by pressing the High Pressure push button [16] or activated and deactivated from the part program using the M10 “High Pressure Coolant ON” and M11 “High Pressure Coolant OFF” commands.

Refer to “To Turn Purchased Options ON or OFF”, page 9-5, for information on turning the High Pressure Coolant option ON or OFF.
THREAD CUTTING CYCLE RETRACT [Option]

This optional feature allows the operator to retract the tool from the workpiece during a threading pass. The tool retracts to an X coordinate equal to the X coordinate of the start point of the threading cycle, then moves to the start point. The tool will follow the same basic retract movement that it would follow at the end of the thread.

To retract the tool, press the Feed Hold push button [71]. The tool will be retracted from the workpiece when the current lead is completed. The tool will NOT finish the threading pass.

To restart the threading cycle, press Cycle Start push button [72]. The control will execute the threading cycle as programmed. The tool will re-execute the pass which was interrupted by Feed Hold.

The CNC control will synchronize the re-entry of the tool with the thread on the workpiece. This will assure the thread will be properly formed when the threading cycle is completed.

- NOTE -

The Thread Cutting Cycle Retract option is NOT functional during G32 Threadcutting.

AIR BLAST [Option]

The air blast directs air to parts held in the spindle. With the option turned ON, the air blast can be activated manually by pressing the Air Blast push button [17]. The air blast can also be activated and deactivated from the part program using the M36 and M37 codes respectively. Refer to “To Turn Purchased Options ON or OFF”, below, for information on turning the Air Blast option ON or OFF.

TO ADJUST THE MAIN AIR BLAST POSITION

1. Loosen set screw “G”, Figure 9.5.
2. Move the air blast assembly to the desired distance from the machine headwall.
3. Tighten set screw “G”.
4. Adjust the copper tubes to direct the air blast to the workpiece.

Figure 9.5 - Air Blast Assembly
TO TURN PURCHASED OPTIONS ON OR OFF

The following options must be turned ON before they can be activated: Air Blast, Bar Feed, High Pressure Coolant, and Part Catcher. Table 9.1 lists the optional functions and the push buttons used to turn these functions ON or OFF. Turn the required options ON or OFF as follows:

Prerequisites: Control is turned ON.
Cycle Start is not active.

1. Press the Emergency Stop push button [74].
2. Press **and hold** the Emergency Stop Reset push button [73].
3. Check the indicator light for the appropriate push button under the Special Modes section on the control panel. Refer to Table 9.1.
   - If the light is ON then the option is turned ON.
   - If the light is OFF then the option is turned OFF.
4. Press the appropriate push button, listed in Table 9.1, until the desired condition is achieved.
5. Release the Emergency Stop Reset push button.
6. Release the Emergency Stop push button.
7. Press the Emergency Stop Reset push button.

<table>
<thead>
<tr>
<th>Purchased Option</th>
<th>Push Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Blast</td>
<td>Dry Run</td>
</tr>
<tr>
<td>Bar Feed</td>
<td>Block Skip</td>
</tr>
<tr>
<td>High Pressure Coolant</td>
<td>Machine Lock</td>
</tr>
<tr>
<td>Part Catcher</td>
<td>Option Stop</td>
</tr>
</tbody>
</table>

Table 9.1 - Push Buttons for Purchased
ENGLISH/METRIC MODE

The Setting page is used to establish whether the GE Fanuc 18T control is to power-up and operate in English mode or Metric mode. This section outlines the procedure for selecting the desired operating mode.

Through the use of the G20 (Inch Mode) and G21 (Metric Mode) commands, it is possible to operate in either mode regardless of which mode has been selected on the Setting page. However, the use of these two G codes will not automatically adjust the position registers to display the position values in the proper units (inches vs millimeters).

- CAUTION -

Part programs should usually be written in the same format as selected on the Setting page. Programs not written in the same format as established on the Setting page MUST contain the appropriate English/Metric G code, G20/G21 respectively. When required, this G code must be programmed by itself in the first data block.

- NOTE -

The work shift and tool offsets are automatically changed to the appropriate units when the operating mode is changed.

ESTABLISHING ENGLISH/METRIC MODE

1. Press the Offset Setting function key.
2. Press the Setting soft key.
3. If necessary, use the Page keys to display the Setting page that contains the Input Unit field.
4. If necessary, use the cursor keys to position the cursor at the Input Unit field.
5. Press the Manual Data Input push button [3].
6. Key in the appropriate number (0:MM 1:INCH).
7. Press the Input key.
8. Press the Control OFF push button.
9. Wait a few seconds; then, press the Control ON push button. The machine will power up in the desired operating mode.
PARTS COUNTER [Option]

The Parts Counter shows the total number of times a program has been run during automatic operation. The Parts Counter is increased by one (1) each time an End of Program (M02/M30) is read by the control.

TO ACCESS THE PARTS COUNTER DISPLAY

1. Press the Position key. The Parts Counter is displayed at the bottom of the page.

TO RESET THE PARTS COUNTER TO ZERO

1. Press the Offset Setting key.
2. If the Setting Timer page is not displayed:
   a) Press the Setting soft key.
   b) Use the page keys to display the Setting Timer page.
3. Press the Manual Data Input push button [3].
5. Press the Oprt soft key.
6. Move the cursor to the number to be reset.
7. Key in “0” (zero) and press the INPUT soft key.
8. Repeat steps 6 and 7 as needed.

- NOTE -

Part Required must be set to zero for continuous cycling of bar work.
Y AND Z AXIS THRUST LIMITATION

INTRODUCTION
The Y and Z axis servo drives are capable of delivering levels of thrust that exceed the limits of the machine tool. Therefore, Y and Z axis thrust must be limited or machine life may be reduced. There is reference material available for the programmer that provides approximate thrust values based on drill diameter, spindle speed, feedrate, and the type of material being machined. Hardinge recommends the MACHINING DATA HANDBOOK from Metcut Research Associates, Inc.

- NOTE -
The axis thrust limit is not easily exceeded unless large diameter twist drills are being run with heavy feedrates.

The Y and Z axis thrust is limited to 1,500 pounds-force [6,670 newtons].

MONITORING Y OR Z AXIS THRUST
It is possible to monitor axis thrust as a percentage of how much current the Y or Z axis servo motor is drawing compared to the maximum amount of current that the motor can draw.

- CAUTION -
The percentage of maximum current must not exceed the following limits:

<table>
<thead>
<tr>
<th>AXIS</th>
<th>LIMIT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>89</td>
</tr>
<tr>
<td>Z</td>
<td>71</td>
</tr>
</tbody>
</table>

If the percentage of maximum current on the Y axis exceeds 89%, the following message will be displayed:

“2503 Y AXIS OVERLOAD, ADJ. FEEDRATE”

If the percentage of maximum current on the Z axis exceeds 71%, the following message will be displayed:

“2502 Z AXIS OVERLOAD, ADJ. FEEDRATE”

The percentage of maximum current is displayed under “CURRENT (%)” on the Y or Z axis “SV. TUN” page. Refer to the position indicator shown in Figure 9.6.

To Access the Y or Z Axis Servo Tune Page

- CAUTION -
DO NOT modify any of the parameters displayed on the “Servo Setting” and Servo Motor Tuning" screens. If any of the parameters are modified, reload the machine parameters from the diskette supplied with the machine tool. Refer to Chapter 7 for information on loading machine parameters.

1. Press the System key.
2. Press the Parameter soft key.
3. If necessary, press the right hand soft key to display the Servo Parameter soft key.
4. Press the Servo Parameter soft key.

5. Press the Servo Tune soft key.

6. If necessary, use the page keys to access the Servo Motor Tuning page for the Y or Z axis.

7. Observe the value shown to the right of “CURRENT (%)” while performing the machining operation where axis thrust is a concern. Refer to the position indicator shown in Figure 9.6.

**ADJUSTING Y OR Z AXIS THRUST**

- **NOTE** -

This procedure is to be performed during the operation that causes the axis overload.

When performing machining operations where axis thrust is a concern, it is possible to minimize cycle time by adjusting the programmed feedrate to bring the value under “CURRENT (%)” as close to the limit without exceeding the limit.

If the value displayed under “CURRENT (%)” on the Y or Z axis Servo Tune page exceeds the limit, reduce axis thrust according to the following procedure:

1. If Y axis thrust is being adjusted, turn the Feedrate 2 Override switch [34] down by 10%.

2. If Z axis thrust is being adjusted, turn the Feedrate 1 Override switch [70] down by 10%.

(Continued on next page)
2. Run the operation that caused the axis overload and observe the value displayed under “CURRENT (%)” on the Y or Z axis Servo Tune page.

If the value displayed under “CURRENT (%)” on the Y or Z axis Servo Tune page still exceeds the limit, repeat steps 1 and 2.

If the value displayed under “CURRENT (%)” on the Y or Z axis Servo Tune page is under the limit, adjust the programmed feedrate in the part program according to the setting of feedrate override switch.

EXAMPLE

Assuming that feedrate override switch had to be set to 80% to allow the operation to be performed:

1. Multiply the programmed feedrate by “.8”.
2. Modify the programmed feedrate for the operation to match the number calculated in step 1.
CHAPTER 10 - TOOL LIFE MANAGEMENT [Option]

GENERAL INFORMATION

INTRODUCTION

The basic concept of Tool Life Management is that after a specific number of parts or a specific amount of machining time, the control will automatically begin using another tool in place of the current tool being used for a particular operation.

Tools are assigned to specific groups, as designated by the programmer. The control will monitor the measurement value assigned to each tool group and automatically switch to the next tool in the group when the counter for that tool group reaches the measurement value specified by the programmer.

TOOL LIFE MEASUREMENT UNITS

Tool life can be measured using one of the two following methods:

1. Number of parts (machined by the tool)
2. Amount of machining time (on the tool)

Only one of these methods may be used at a time. “Number of parts” will be the active measurement unit when the machine is shipped from the factory. Refer to “Determining the Measurement Unit”, page 10-5, for information on verifying or switching the active measurement unit.

An alarm message will be displayed when any tool group has reached its programmed tool life and an “M30” (End of Program) is read by the control. At that point, the machine operator will replace the tooling and reset the counter relating to the affected tool group. Refer to "Resetting a Tool Group Counter", page 10-6.

NUMBER OF PARTS

When this type of measurement is used, the control will increment the tool group counter for the active tool each time the tool group is called by the part program.

AMOUNT OF MACHINING TIME

When this type of measurement is used, the control will run the tool group counter for the current tool whenever G01, G02, or G03 is active.
TOOL LIFE MANAGEMENT PROGRAM

When using Tool Life Management, tools and offsets are assigned to specific groups. These groups are established by the programmer through the use of a Tool Life Management program, which is independent of the part program. The Tool Life Management program will define the parameters required for Tool Life Management.

The Tool Life Management program defines the following parameters:

1. Group numbers.
2. Tool life value for each group.
3. Tool stations and offsets for each group.

- CAUTION -

When the Tool Life Management program is executed, all Tool Life Management counters will be reset to 0 (zero).

When using Tool Life Management, the machine operator MUST load and execute the Tool Life Management program BEFORE executing the part program for the first time.

Refer to “Programming”, beginning on page 10-7, for information on the Tool Life Management program and how to incorporate Tool Life Management information in the part program.

BAR FEED OPERATION

There are no special considerations for running bar jobs. When running a bar job and using Tool Life Management, the programmer will program an M30 at the end of the part program and the machine operator will activate Repeat mode to cause the part program to loop.

Refer to “Chapter 1 - Operator Control Panels” for information on Repeat mode.
OPERATION

- NOTE -
Refer also to “General Information”, beginning on page 10-1.

DETERMINING MAXIMUM GROUPS AND GROUP SIZES

The maximum number of tool groups and maximum number of tools per group are established by parameter 6800, bits 0 and 1. Be sure that bits 0 and 1 are set to appropriate values to allow for the necessary number of tool groups and tools per group to be programmed in the Tool Life Management Program. Refer to “Tool Life Management Program”, beginning on page 10-7, for more information on the Tool Life Management Program.

The bits in parameter 6800 are numbered as follows:

```
7 6 5 4 3 2 1 0
```

Set bits 0 and 1 according to the following chart:

<table>
<thead>
<tr>
<th>Bit 1</th>
<th>Bit 0</th>
<th>Max No. of Groups</th>
<th>Max Tools per Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>64</td>
<td>4</td>
</tr>
</tbody>
</table>

When the machine is shipped from the factory, the maximum number of groups and maximum tools per group will be set to 16.

To Verify Maximum Groups and Group Sizes

1. Press the System key.
2. Press the Parameter soft key.
3. Use the Page keys to display the page that contains parameter 6800.
4. Compare bits 0 and 1 to chart above to determine the maximum groups and group sizes.

To Set Maximum Groups and Group Sizes

1. Press the Offset Setting key.
2. Press the Setting soft key.
3. If necessary, use the Page keys to display the Setting page that contains the Parameter Write field.
4. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
5. Press the Manual Data Input push button [3].
6. Key in the number 1 (one).
7. Press the Input key. Parameter editing will be enabled.
8. Press the System key.
9. Press the Parameter soft key.
10. Use the Page and Cursor keys to position the cursor at parameter 6800.
11. Record the current number in parameter 6800.
12. Key in the entire parameter value with bits 0 and 1 set to the appropriate values.
13. Press the Input key.
14. Press the Offset Setting key.
15. Press the Setting soft key.
16. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
17. Key in the number 0 (zero).
18. Press the Input key. Parameter editing will be disabled.
DETERMINING THE MEASUREMENT UNIT

The two types of measurement units available are “Number of Parts” and “Amount of Machining Time”. To verify which measurement unit is active, it is necessary to view parameter 6800, bit 2. To switch the type of measurement unit to be used with Tool Life Management, it is necessary to modify parameter 6800, bit 2.

The bits in parameter 6800 are numbered as follows:

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

To Verify the Measurement Unit

1. Press the System key.
2. Press the Parameter soft key.
3. Use the Page keys to display the page that contains parameter 6800.
   - If parameter 6800, bit 2 is set to 0, “Number of Parts” is active.
   - If parameter 6800, bit 2 is set to 1, “Amount of Machining Time” is active.

To Switch the Measurement Unit

1. Press the Offset Setting key.
2. Press the Setting soft key.
3. If necessary, use the Page keys to display the Setting page that contains the Parameter Write field.
4. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
5. Press the Manual Data Input push button [3].
6. Key in the number 1 (one).
7. Press the Input key. Parameter editing will be enabled.
8. Press the System key.
9. Press the Parameter soft key.
10. Use the Page and Cursor keys to position the cursor at parameter 6800.
11. Record the current number in parameter 6800.
12. Key in the entire parameter value with bit 2 set to the appropriate value.
13. Press the Input key.
14. Press the Offset Setting key.
15. Press the Setting soft key.
16. If necessary, use the cursor keys to position the cursor at the Parameter Write field.
17. Key in the number 0 (zero).
18. Press the Input key. Parameter editing will be disabled.
RESETTING A TOOL GROUP COUNTER

Resetting the control or turning the control OFF will have NO AFFECT on the tool group counters. When all of the tools in a tool group have reached the tool life specified in the Tool Life Management program and an M30 “End of Program” is read, the following alarm message will be displayed:

1503 TOOL GROUP LIFE END

The expired tool groups will be listed near the bottom of the Tool Life Management screen on the control display. The control can display more than one tool group number at a time, when applicable. Resetting the counter for the expired tool group(s) will clear the alarm and allow machine operation.

- NOTE -

It is not necessary to change machine modes to reset tool group counters.

Use the following procedure to reset the tool group counter(s):

1. Press the Offset Setting key.
2. Press the right-hand soft key.
3. Press the Tool Life soft key.

- NOTE -

Each time a cursor control key is pressed, the cursor will move to the next tool group in the corresponding direction.

4. Use the cursor control keys to move the cursor to the desired tool group.
5. Using the data input keys, enter -9999 and press the INPUT key. The tool group counter at the cursor position will be reset to 0 (zero).
6. Repeat steps 4 and 5 to reset additional tool group counters, as needed.
PROGRAMMING

- NOTE -
M30 must be programmed for “End of Program” when using Tool Life Management. Do not program M02 for “End of Program”.

Refer also to “General Information”, beginning on page 10-1.

TOOL LIFE MANAGEMENT PROGRAM

Program Format

O____;
N__G10 L3 ;
Define Tool Group 1
N__P1 L__ ;
N__ T____ ;
N__ T____ ;
N__ T____ ;
Define Tool Group 2
N__P2 L__ ;
N__ T____ ;
N__ T____ ;
N__ T____ ;
Define Tool Group 3
N__P3 L__ ;
.
.
N__ G11 ;
N__ M30 ;

Data Word Definitions

O____ = Program Number
N____ = Block Number
G10 = Begin Tool Data Input
L3 = Memory Location for Tool Life Management Data (DO NOT ALTER)
P____ = Tool Group Number
L_______ = Tool Life Value Data Word
T______ = Turret Station and Offset Number
G11 = End Tool Data Input
M30 = End of Program
**P Word - Tool Group Number**

The P word is used to specify the group number to be assigned to each group of tooling. The numerical value for the data word must be a whole number. Decimal point programming is not allowed.

Examples:  
P1 (Tool Group 1)  
P12 (Tool Group 12)

Refer to “Determining Maximum Groups and Group Sizes”, beginning on page 10-3, for information on verifying or setting the maximum number of tool groups allowed.

**L Word - Tool Life Value Data Word**

The L word is used to specify tool life for each tool group in the Tool Life Management program. The numerical value for the data word must be a whole number. Decimal point programming is not allowed.

Examples:  
L25 (Tool life equals 25)  
L200 (Tool Life equals 200)

The following chart shows the minimum and maximum values that may be used with the L word when programming Tool Life Management.

<table>
<thead>
<tr>
<th>Measurement Unit</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Parts</td>
<td>1</td>
<td>9999</td>
</tr>
<tr>
<td>Machining Time (minutes)</td>
<td>1</td>
<td>4300</td>
</tr>
</tbody>
</table>

Refer to “Determining the Measurement Unit”, beginning on page 10-5, for information on verifying or setting the measurement unit to be used.

**T Word - Turret Station and Offset Number**

The standard T word format is used when defining turret stations and tool offsets in the Tool Life Management program.

Refer to “Chapter 4 - Work Shift and Tool Offsets” for information on defining turret stations and tool offsets.
Sample Tool Life Management Program

In this sample program we will assume that the measurement unit is set to “Number of Parts”. Refer to “Determining the Measurement Unit”, beginning on page 10-5, for information on verifying or switching the active measurement unit.

O7500 ;  
N1 (Operator Message) ;  
N10 G10 L3 ;  
Define Tool Group 1 N20 P1 L10 ;  
N30 T0101 ;  
N40 T0212 ;  
N50 T0313 ;  
Define Tool Group 2 N60 P2 L3 ;  
N70 T0303 ;  
N80 T0131 ;  
Define Tool Group 3 N90 P3 L30 ;  
N100 T0919 ;  
N110 G11 ;  
N120 M30 ;

DATA BLOCK DEFINITIONS:

Block N1 contains an operator message.

Block N10 contains the “Begin Tool Data Input” command (G10) and the memory location (L3) where the data will be stored.

Block N20 contains the number of the first tool group (Group 1) and the measurement value for each group 1 tool (value = 10).

Blocks N30 through N50 contain the turret station and tool offset data for the tools assigned to group 1.

Block N60 contains the number of the second tool group (Group 2) and the measurement value for each group 2 tool (value = 3).

Blocks N70 and N80 contain the turret station and tool offset data for the tools assigned to group 2.

Block N90 contains the number of the third tool group (Group 3) and the measurement value for each group 3 tool (value = 30).

Block N100 contains the turret station and tool offset data for the tool assigned to group 3.

Block N110 contains the “End Tool Data Input” command (G11).

Block N120 contains the “End of Program” command (M30).
PART PROGRAM

Tool Commands

Tool stations and offsets were assigned to tool groups in the Tool Life Management program. Refer to “Tool Life Management Program”, beginning on page 10-7. The tool groups are called from the part program using the T word. The data word format for the T word is T4. Decimal point programming is not allowed.

ACTIVATE A TOOL GROUP

T_ _99 T Word Format (99 activates the specified tool group)
T0199 Activate Tool Group 1
T1299 Activate Tool Group 12

DEACTIVATE A TOOL GROUP

T_ _88 T Word Format (88 deactivates the specified tool group)
T0188 Deactivate Tool Group 1
T1288 Deactivate Tool Group 12

Sample Part Program Structure using Tool Life Management

O1278 ;
G20 or G21 ; Establish English or Metric mode
N _ _ (___________) ; Sequence Search Number and Operator Message
N _ _ G97 S1000 M13 ; 1000 RPM and Direction, Coolant ON
N _ _ M98 P1 ; Call: Safe Start Subprogram
N _ _ T0199 ; Activate Tool Group 1
N _ _ X _ Z _ ; Move to Activate Tool Offsets

- MACHINE PART -
N _ _ T0188 ; Deactivate Tool Group 1
N _ _ M98 P1 or P2 ; Call: Safe O.D or I.D. End Subprogram
N _ _ M01 ; Option Stop
N _ _ (___________) ; Sequence Search Number and Operator Message
N _ _ G97 S1000 M13 ; 1000 RPM and Direction, Coolant ON
N _ _ M98 P1 ; Call: Safe Start Subprogram
N _ _ T0299 ; Activate Tool Group 2
N _ _ X _ Z _ ; Move to Activate Tool Offsets

- MACHINE PART -
N _ _ T0288 ; Deactivate Tool Group 2
N _ _ M98 P1 or P2 ; Call: Safe O.D or I.D. End Subprogram
N _ _ M01 ; Option Stop
.
.
N _ _ M30 ; End of Program
Combining Tool Commands

Some tools may be expected to last the full life of a particular job. In this case it would be desirable to program the individual tool in the part program, rather than go to the trouble of assigning the tool to a tool group and defining the tool group life high enough to run for the full life of the job.

It is possible to combine standard tool commands and Tool Life Management commands in the same part program. Standard tool commands may be programmed in operations that precede or follow operations using Tool Life Management commands. The only restriction is that the active tool or tool group must be canceled before another tool or tool group can be called.

Sample Part Program Structure using Combined Tool Commands

```
O1278 ;
G20 or G21 ; Establish English or Metric mode
N__ (_)________; Sequence Search Number and Operator Message
N__ G97 S1000 M13 ; 1000 RPM and Direction, Coolant ON
N__ M98 P1 ; Call: Safe Start Subprogram
N__ T0101 ; Index to Turret Station 1 and Call Offset 1
N__ X_Z_; Move to Activate Tool Offsets
- MACHINE PART -
N__ M98 P1 or P2 ; Call: Safe O.D or I.D. End Subprogram
N__ M01 ; Option Stop
N__ (_)________; Sequence Search Number and Operator Message
N__ G97 S1000 M13 ; 1000 RPM and Direction, Coolant ON
N__ M98 P1 ; Call: Safe Start Subprogram
N__ T0199 ; Activate Tool Group 1
N__ X_Z_; Move to Activate Tool Offsets
- MACHINE PART -
N__ T0188 ; Deactivate Tool Group 1
N__ M98 P1 or P2 ; Call: Safe O.D or I.D. End Subprogram
N__ M01 ; Option Stop
.
.
N__ M30 ; End of Program
```

PROGRAMMING NOTES

1. Decimal point programming is NOT allowed with the P or L data words.
2. The same turret station and/or tool offset may be assigned to more than one tool group.
3. Turret stations may NOT be assigned to the same tool group more than once, regardless of the tool offset to be used.
CHAPTER 11 - LIVE TOOLING [Option]

INTRODUCTION

This chapter covers the installation and operator maintenance of the optional live tooling attachments for CONQUEST® T42 series lathes. Each machine is equipped with either an English or Metric top plate. It is important to be aware of which top plate is on the machine since this will determine which live tooling attachments will be used (English or Metric).

The live tooling attachments are factory set to be on center within ±0.0010 inches [±0.025 mm] when they are mounted on the turret top plate and located against the left side of the tool slot, as viewed from the tool tip. The attachments can be adjusted up to ±0.0030 inches [±0.076 mm] for more accurate tool alignment. Refer to “Adjusting Live Tooling Attachments for Center”, page 11-6, for information on aligning live tooling with the tool slot centerline.

TYPES OF ATTACHMENTS

The four types of live tooling attachments are identified by type and axis of operation. The drill/mill attachments are designed to use 100 series double-angle collets to grip the tools. The tapping attachments are designed to use Hardinge TT tap holder collets to grip the tools.

Cross-Working Drill/Mill Attachment:
This attachment locates the center of the drill or milling tool on the tool slot centerline, with the spindle of the attachment aligned with the X axis.

Cross-Working Tapping Attachment:
This attachment locates the center of the tap on the tool slot centerline, with the spindle of the attachment aligned with the X axis.

End-Working Drill/Mill Attachment:
This attachment locates the center of the drill or milling tool on the tool slot centerline, with the spindle of the attachment aligned with the Z axis.

End-Working Tapping Attachment:
This attachment locates the center of the tap on the tool slot centerline, with the spindle of the attachment aligned with the Z axis.

LIVE TOOLING LIMITATIONS

Mill/Drill Attachments
The drill/mill attachments are designed to accommodate Inch tools with a shank size up to and including 9/16 inch and Metric tools with a shank size up to and including 14 millimeters.

Tapping Attachments
The tapping attachments are designed to accommodate Inch taps up to and including 5/16 inch and Metric taps up to and including 8 millimeters. Maximum shank size is 3/8 inch [10mm].

Maximum RPM
The live tooling attachments have a maximum spindle speed of 4000 rpm, as measured at the tool tip.
INSTALLING LIVE TOOLING ATTACHMENTS

- NOTE -

A maximum of six live tooling attachments can be mounted on the 12 station live tooling top plate at one time. A maximum of five live tooling attachments can be mounted on the ten station live tooling top plate at one time. All turret stations can be used for standard tooling; however, only the odd-numbered turret stations can be used for live tooling attachments.

For consistency, the 12 station top plate is shown in all live tooling illustrations.

MOUNTING THE ATTACHMENT

1. Power-up the machine according to the appropriate procedure outlined in Chapter 2, “Power-Up Procedure”.

2. Press the Reset key.


    - CAUTION -
    The machine operator must be sure that no interference exists between the end-working turret, spindle, spindle tooling, sub-spindle, tailstock, main turret, turret tooling, or workpiece before manually indexing the turret.

4. Move the main turret to a safe position for indexing.

    - WARNING -
    Stay clear of the turret and turret tooling when indexing the main turret. Physical injury can result.

5. For ease of installation, manually index the main turret to position the desired tool station two positions above the active position:

   a) Set the Station switch [47] to the station to be indexed to the active position.

   b) Press the Turret Index 1 push button [44].

6. To be sure the live tooling attachment seats properly on the top plate, thoroughly clean the top plate, the live tooling attachment, and live tooling stop “A”, Figure 11.1.

7. Loosen the screw in the middle of plug “B” and remove plug “B” from live tooling stop “A”.

8. Remove gear guard “G”, Figure 11.4 or “K”, Figure 11.5, from the rear of the live tooling attachment.

Figure 11.1 - Tool Stop and Plugs
When mounting the live tooling attachment, carefully mesh the gear on the live tooling attachment with the gear in live tooling stop “A”, Figure 11.1.

9. Mount the live tooling attachment in the tool slot, as shown in Figure 11.2. Be sure the attachment is located against the left side of the tool slot, as viewed from the tool tip.

- NOTE -

The four screws used to mount the live tooling attachment are shipped in a bag supplied with the attachment.

10. Install and tighten two mounting screws “D”, Figure 11.3.

11. Install and tighten two mounting screws “C”, Figure 11.2.

12. If necessary, remove cap “J”, Figure 11.4, or collet cap “N”, Figure 11.5, and install the proper collet for the tool to be used. Replace the cap, but DO NOT TIGHTEN.
INSTALLING/REMOVING TOOLS

Drill/Mill Attachments

When installing or removing tooling, there are two methods available to prevent the spindle in the drill/mill attachment from turning when tightening or loosening cap “J”, Figure 11.4. The lock button used in the first method will engage one of the two slots in the shaft of the live tooling attachment.

1. Insert the appropriate tooling in the attachment and set roughly to length, relative to the edge of the turret top plate.

2. Tighten cap “J”, Figure 11.4, using one of the following methods:
   a) Mount the pin spanner wrench on cap “J”, press IN on lock button “H”, and turn cap “J” in the clockwise direction to tighten.

   or

   b) Mount the open wrench on the flats at “I”, mount the pin spanner wrench on cap “J”, and turn cap “J” in the clockwise direction to tighten.

Reverse the procedure to remove the tooling.

Tapping Attachments

When installing or removing tooling, there are two methods available to prevent the spindle in the tapping attachment from turning when tightening or loosening cap “N”, Figure 11.5. The lock button used in the first method will engage one of the two slots in the shaft of the live tooling attachment.

1. Insert the tooling into the attachment.

2. Tighten cap “N”, Figure 11.5, using one of the following methods:
   a) Mount the open wrench on cap “N”, press IN on lock button “L”, and turn cap “N” in the clockwise direction to tighten.

   or

   b) Mount the open wrench on cap “N”, mount the pin spanner wrench on body “M”, and turn cap “N” in the clockwise direction to tighten.

Reverse the procedure to remove the tooling.
SETTING LIVE TOOLING OFFSETS

Live tooling offsets are set in the same manner as standard tooling. However, there are some considerations to be aware of that will simplify setting the tool offsets for center-working tools mounted in live tooling attachments. These considerations are outlined below.

Refer to Chapter 4 for information on setting live tooling offsets.

Cross-Working Attachments

Cross-working attachments are qualified on the Z axis. The centerline of the spindle in the cross-working attachment will always be located 1.50 inches [38.1 mm] in the -Z direction from the face of the turret top plate. This offset value is valid for both drill/mill and tapping attachments.

Figure 11.6 illustrates a cross-working drill/mill attachment mounted on the turret top plate.

End-Working Attachments

End-working attachments are qualified on the X axis. The centerline of the spindle in the end-working attachment will always be located 1.50 inches [38.1 mm] in the -X direction from the side of the turret top plate. This offset value is valid for both drill/mill and tapping attachments.

On machines set for diameter programming, this will result in an X tool geometry offset of 3.00000 inches [76.2000 mm]. On machines set for radius programming, this will result in an X tool geometry offset of 1.50000 inches [38.1000 mm].

Figure 11.7 illustrates an end-working drill/mill attachment mounted on the turret top plate.
TOOL NOSE RADIUS COMPENSATION

For typical live tooling applications, Tool Nose Radius Compensation is not required. Tool Nose Radius Compensation may be required for live tooling during C-Axis operations. Refer to the CONQUEST® T42 Lathe programmer’s manual (Manual No. M-320) for information on Tool Nose Radius Compensation or C-Axis.

ADJUSTING LIVE TOOLING ATTACHMENTS FOR CENTER

- NOTE -

The following procedure can be used on all live tooling attachments designed for use on CONQUEST T42 series lathes.

Use the following procedure if it becomes necessary to realign the centerline of the live tooling attachment with the centerline of the tool slot.

1. Position an indicator against the left side of the live tooling attachment, as viewed from the tool tip.
2. Zero the indicator.
3. Loosen two mounting screws “C”, Figure 11.2, and two mounting screws “D”, Figure 11.3, only enough to allow lateral movement of the live tooling attachment.

- NOTE -

Alignment screws “E” and “F”, Figure 11.3, are located on the front face of the live tooling attachment.

4. Loosen the alignment screw that is located on the side that the attachment should move toward.
5. Tighten the other alignment screw until the desired amount of adjustment is obtained.
6. Carefully tighten the adjustment screw loosened in step 4 while observing the indicator.
7. Carefully tighten two mounting screws “D”, Figure 11.3, while observing the indicator.
8. Carefully tighten two mounting screws “C”, Figure 11.2, while observing the indicator.
9. Repeat steps 3 through 8 as needed to obtain the desired adjustment.
OPERATOR MAINTENANCE

- CAUTION -
The live tooling attachments mounted on the machine should be lubricated on a daily basis. Failure to lubricate live tooling attachments as recommended can result in excessive wear, which will reduce the effective life of the attachments.

1. Press the Reset key.

- WARNING -
Stay clear of the turret and turret tooling when indexing the turret. Physical injury can result.

3. Index the turret to position the live tooling attachment in a convenient position:
   a) Set the Station switch [47] to the station to be indexed to the active position.
   b) Press the Turret Index 1 push button [44].
4. Wipe coolant, chips, and other contaminants from grease fitting “O”, Figure 11.5.
5. Apply Mobiltemp SHC® 32 grease at grease fitting “O” until grease appears at the front spindle seal, which is located where the spindle exits the body of the live tooling attachment.

REMOVING LIVE TOOLING ATTACHMENTS

1. Move the main turret to a safe position for indexing.

- WARNING -
Stay clear of the turret and turret tooling when indexing the main turret. Physical injury can result.

2. For ease of removal, manually index the main turret to position the desired tool station two positions above the active position:
   a) Set the Station switch [47] to the station to be indexed to the active position.
   b) Press the Turret Index 1 push button [44].
3. Thoroughly clean the top plate, the live tooling attachment, and the live tooling stop.
4. Remove two mounting screws “C”, Figure 11.2, and two mounting screws “D”, Figure 11.3.
5. Remove the live tooling attachment from the turret top plate.
6. Replace plug “B”, Figure 11.1, in live tooling stop “A” and tighten the screw in the middle of plug “B”.

- CAUTION -
To protect the gear on the live tooling attachment, ALWAYS mount gear guard “G”, Figure 11.4, or “K”, Figure 11.5, on the rear of the live tooling attachment when the attachment is not installed on the turret top plate.

7. Mount gear guard “G”, Figure 11.4, or “K”, Figure 11.5, on the rear of the live tooling attachment.
CHAPTER 12 - END-WORKING TURRET [Option]

INTRODUCTION

CONQUEST® T42 series lathes equipped with the end-working turret are capable of performing more sophisticated turning applications due to the greater number and variety of tooling that can be employed.

Be sure that the end-working turret is in the home position when running applications that do not require the end-working turret.

The travel specifications for the end-working turret are shown in Figure 12.1.

Figure 12.1 - End-Working Turret Travel Specifications

Travel Specification Notes:
1. Dimensions are shown as inches [millimeters].
2. All measurements for Y are from the face of the main spindle.
3. Full programmable travel on the Y axis is 15.310 [388.87 mm].
CONTROLLING END-WORKING TURRET MOVEMENT

- CAUTION -

When moving the main turret, be aware of the position of the end-working turret and the minimum recommended clearance of 1.25 inches [31.8 mm] from the centerline of the active tool station on the end-working turret. Refer to Figure 12.2.

Exercise extreme care when setting the Feedrate 2 Override switch [34] to a value greater than 100%. Read the information in the section entitled “Index On The Fly”, below, BEFORE adjusting programmed Y axis feedrates above 100%.

OVERRIDE SWITCHES

FEEDRATE 1 OVERRIDE

The Feedrate 1 Override switch [70] controls the end-working turret when the machine in Jog mode. This override switch allows the machine operator to adjust the jog feedrate for the end-working turret from 0 to 37.5 in/min.

FEEDRATE 2 OVERRIDE

The Feedrate 2 Override switch [34] controls the end-working turret when the machine in Automatic, Manual Data Input, or Single mode. This override switch allows the machine operator to adjust the programmed feedrate for the end-working turret from 0% to 150% when the machine is in Automatic, Manual Data Input, or Single mode. A setting of “0” will stop the programmed motion of the end-working turret.

INDEX ON THE FLY

The end-working turret is designed for “index on the fly” operation. When an index command is read by the CNC control, the control acts on the index command, but also continues reading and acting on the rest of the part program. If a lower axis move is read by the control before the turret index is completed, the end-working turret will move while it is indexing.

Increasing the programmed feedrate through the use of the Feedrate 2 Override switch [34] will reduce the required traverse time to the workpiece, possibly allowing the tool to reach the workpiece before the turret index is complete.

Refer to Chapter 1 for additional information on the operator control panel.
MANUALLY MOVING THE TURRET

1. Press the Jog push button [4].
2. Set the Feedrate 1 Override switch [70] to the desired setting.
3. Use the -LA push button [58] or the +LA push button [60] to jog the end-working turret in the desired direction.

INDEXING THE END-WORKING TURRET

- CAUTION -
DO NOT attempt to use the end-working turret to machine the workpiece when station 7 is in the active position. This turret station is for clearance purposes ONLY.

There are six tool stations available for machining on the end-working turret, assigned 1 through 6. A seventh station is available for increasing clearance between the main and end-working turrets when operation of the end-working turret is not required. Turret station 7 is located halfway between stations 6 and 1. Refer to Figure 12.2.

The end-working turret can be manually indexed from the Operator control panel only while the machine is in Jog mode. Refer to Chapter 14 in the CONQUEST® T42 Lathe Programmer’s Manual (M-320) for information on programming the end-working turret.

To Index the Turret:
1. Press the Jog push button [4].
2. Jog the turret to a safe index position. If necessary, refer to “Manually Moving the Turret”, page 12-3.
3. Turn the Station selector switch [47] to the desired turret station.
4. Press the Turret Index 2 push button [46].

STOPPING PROGRAMMED Y AXIS MOVEMENT

Press the Feed Hold push button [71] to stop programmed Y axis motion of the end-working turret. The Hold push button [59] has no effect on the end-working turret.

To resume programmed motion, press the Cycle Start push button [72].
TOOLING TYPES

The end-working turret is designed to be used for center-working tools only. The following types of tooling can be mounted on the end-working turret:

- Adjustable Boring Bars
- Drills
- Reamers
- Stock Stops
- Tapping Attachments
- Tailstock Centers

TOOLING RANGE

The end-working turret is set up from the factory with either English or Metric bushings permanently mounted on the top plate. The permanently mounted English bushings have an internal diameter of 1-1/4 inches. The permanently mounted Metric bushings have an internal diameter of 32 millimeters. Be sure to use the appropriate tool holders or bushings (English or Metric) for the type of top plate on your machine.

Round shank tools 1-1/4 inches or 32 millimeters in diameter can be mounted directly onto the English or Metric top plates, respectively. Round shank tools in specific sizes ranging from 1/32 inch [1 millimeter] up to 3/4 inch [20 millimeters] can be mounted on the end-working top plate using the Hardinge Double-Angle Toolholder Collet and Toolholder System. Round shank tools in specific sizes ranging from 1/2 inch [12 millimeters] up to 1 inch [25 millimeters] can be mounted on the end-working top plate using Hardinge HDC-10 bushings.

INSTALLING TOOLING

It may be desirable to index the turret station to receive the tooling to be indexed toward the front of the machine. If necessary, refer to “Indexing the End-Working Turret”, page 12-3.

1. If required, install the appropriate tool holder in the bushing on the end-working turret top plate. Refer to “Tooling Range”, above, to determine if a tool holder is required.

2. Depending on the type of tool holder used, align the flat on the Hardinge Double-Angle Toolholder Collet or the slot in Hardinge HDC-10 bushings and the flat on the tool shank with the set screws in the turret top plate.

3. Insert the tool in the tool holder and adjust the tool to length.

4. Tighten the set screws in the turret top plate to secure the tool in position.

5. Adjust the tool geometry offsets and reset the tool wear offsets to zero.

TOOL OFFSETS

Tool Offsets are established and activated for end-working turret operations in a manner similar to that for main turret operations. Refer to Chapter 4 for information on setting the tool geometry offsets and tool wear offsets for the end-working turret.
INTRODUCTION

The optional end-working turret part catcher is mounted on station 2. Part catcher cones or posts thread onto the adapter mounted on the end-working turret top plate.

Refer to Figure 12.3 for an overall view showing a part catcher cone mounted on the end-working turret top plate.

Refer to Figure 12.4 for an overall view showing a part catcher post mounted on the end-working turret top plate.

CUSTOM APPLICATIONS

Although the standard cones and post supplied with the part catcher option are designed to handle a variety of part configurations, not all parts can be accommodated. Part catcher cones and posts can be produced by the customer to unload unique or specialized parts from the machine spindle.

Refer to Figures 12.5 and 12.6 for critical dimensions that must be held during the manufacture of a part catcher cone or part catcher post.
NOTES:
1. All dimensions are shown in inches.
2. Critical dimensions are shown in bold text.

Figure 12.5 - Sample Part Catcher Cone

NOTES:
1. All dimensions are shown in inches.
2. Critical dimensions are shown in bold text.

Figure 12.6 - Sample Part Catcher Post
CHAPTER 13 - THERMAL GROWTH COMPENSATION

- NOTE -
This chapter applies only to CONQUEST® T42SP Super-Precision® CNC Lathes.

INTRODUCTION

- CAUTION -
The actual thermal compensation function is performed by macro program O9027, which uses macro variables 142, 144, 145, 146, 147, 148, 527, 528, 529, 530, and 531. DO NOT alter these macro variables or use them for any other macro programs.

When thermal compensation is required, it must be activated BEFORE Tool Nose Radius Compensation (G41 or G42) is activated. DO NOT activate thermal compensation after Tool Nose Radius Compensation has been activated. Undesirable axis motion may occur.

- NOTE -
When general precision work is to be performed on a CONQUEST T42SP Super-Precision lathe, it is not necessary to program the M88 Command.

CONQUEST T42SP Super-Precision lathes are designed with a thermal compensation feature. This feature allows the programmer to command the CNC control, through the part program, to compensate for thermal growth as the machine tool warms up. Thermal compensation cannot be commanded while the CNC control is in Manual Data Input mode.

The programmer commands the CNC control to initiate thermal compensation through the use of the M88 command, which can be programmed as many times as needed in the part program. Each time the control reads the M88 command, compensation is performed according to the M88 command line.

The M88 command line may consist of only the M88 command or the M88 command with optional parameters. When M88 is programmed without optional parameters, predefined default values will be in effect. Refer to “Programming the Compensation Feature”, on the next page, for information on the optional parameters and default values.

When executing programs with short cycle times, it may be sufficient to program the M88 command once in the part program. In this case, the M88 command line is programmed on the line immediately following the program number.

When executing programs with longer cycle times, it may be desirable to program more than one M88 command in the part program. In this case, the M88 command is programmed at the beginning of each finishing tool operation.
PROGRAMMING THE COMPENSATION FEATURE

COMMAND STRUCTURE

Thermal compensation is activated using the following command:

M88 N<n> R<n>

- **M88** Activates the compensation function.
- **N<n>** (Optional parameter) indicates how often thermal compensation is to take place. <n> can be any whole number ≥ “2.”. The decimal point MUST be programmed.
  
  If the N word is omitted, the CNC control assumes “1.”.
- **R1.** (Optional parameter) indicates that the control is operating in radius mode. The decimal point MUST be programmed.
  
  Diameter mode is the default mode. Omit the R word when the control is operating in diameter mode.

Examples

Example #1:

O1234 ; Program Number
M88 ; Compensation feature is activated. Thermal compensation will occur every time the M88 command is read by the CNC control. Compensation is performed in diameter mode.

Example #2:

O1234 ; Program Number
M88 N2. ; Compensation feature is activated. Thermal compensation will occur every second time the M88 command is read by the CNC control. Compensation is performed in diameter mode.

Example #3:

O1234 ; Program Number
M88 N3. R1. ; Compensation feature is activated. Thermal compensation will occur every third time the M88 command is read by the CNC control. Compensation is performed in radius mode.
OPERATOR INFORMATION

PART PROGRAM INTERRUPTION
The control Reset key and Emergency Stop push button have no effect on the M88 compensation feature. Part program execution is resumed in the normal manner.

LIMIT VALUES
There are two limit values established in the CNC control that relate to the thermal compensation feature:

Limit value #1 sets a non-critical limit which, when exceeded by the calculated compensation value, causes a minimum compensation to take place. This minimum compensation will continue to occur until the calculated compensation value does not exceed limit value #1. Once the calculated compensation value becomes $\leq$ limit value #1, full compensation will occur.

Limit value #2 sets a critical limit which, when exceeded by the calculated compensation value, forces an alarm condition and causes an alarm message to be displayed on the control display screen. No compensation will be performed and part program execution will stop. Refer also to “Alarm Message”, below.

ALARM MESSAGE
The compensation feature uses the following alarm message to alert the machine operator that one of two alarm conditions has occurred:

504 X COMPENSATION SYS. FAIL

The possible alarm conditions are:

1. The compensation hardware has malfunctioned.
2. The required correction value that was calculated by the CNC control exceeds a predefined critical limit (limit value #2). Refer also to “Limit Values”, above.

If one of these alarm conditions occurs, no compensation will be performed and the control will go into an alarm condition. Part program execution will stop. Pressing the control Reset push button will clear the alarm message; however, the alarm will continue to occur each time the CNC control reads the M88 command line until the problem causing the alarm is corrected. Refer also to “Enabling Machine Operation”, below.

- NOTE -
To correct this alarm condition, it will be necessary to contact the Hardinge Service Department.

Enabling Machine Operation
Machine operation is possible after this alarm condition has occurred by removing the M88 command line from the part program. Refer to the Chapter 3 for information on editing part programs. However, be aware that thermal compensation will not be active and the desired level of accuracy may not be achieved.
CHAPTER 14 - SUB-SPINDLE [Option]  
(Hydraulic Axis Drive)  

- NOTE -  
Refer to Chapter 15 for information on the optional ball screw driven sub-spindle.

FUNCTION

The sub-spindle allows parts to be machined at both ends without stopping the machine to end-for-end the workpiece. This reduces cycle times by eliminating part handling by the operator. Drilling, boring, turning and facing operations can be performed on parts which are chucked in the sub-spindle. Depending on the machining sequence which is selected, the first side of the workpiece is machined in either the main spindle or the sub-spindle. The workpiece is then transferred to the other spindle to complete machining of the second side. The sub-spindle travel specifications are shown in Figure 14.1.

OPERATION

Forward and backward motion of the sub-spindle assembly is driven by the machine’s hydraulic system. When a programmed M84 (Sub-Spindle Forward) command is executed in Automatic, Manual Data Input, or Single mode or when the -LA push button [58] is pressed in Jog mode, hydraulic pressure causes the assembly to move toward the main spindle. Execution of an M85 (Sub-Spindle Retract) command in Automatic, Manual Data Input, or Single mode or pressing the +LA push button [60] in Jog mode causes the sub-spindle assembly to move to the home position.

- NOTE -  
The sub-spindle can only be moved toward the main spindle at the rapid traverse rate when the machine is in Automatic or Manual Data Input mode with the main coolant guard door closed.

There are two rates of motion:
1. The rapid traverse rate (approximately 300 ipm [7620 mm/min]).
2. The adjustable feedrate. Refer to page 14-8 for information on setting the adjustable feedrate.

Figure 14.1 - Sub-Spindle Travel Specifications
MAIN GUARD DOOR SAFETY INTERLOCK

CONQUEST® T42 series lathes equipped with the sub-spindle option incorporate a safety interlock feature which does not allow the main coolant guard door to be opened after power is removed from the machine tool.

The purpose of this safety interlock is to prevent potential personal injury in the event of a power failure. The sub-spindle is not equipped with an external brake. If a power failure occurs, the sub-spindle would coast to a stop, rather than stop immediately.

FREE SPINDLE

A “Free Spindle” condition allows the sub-spindle to be turned by hand. The sub-spindle is in a “Free Spindle” condition whenever it is not being driven by the sub-spindle motor.

SUB-SPINDLE TOOLING

This section covers the installation and removal of spindle tooling, such as collets, step chucks, and jaw chucks.

- CAUTION -

Manual lock pin “A”, Figure 14.2, is NOT interlocked with the machine control. DO NOT attempt to rotate the sub-spindle while this lock pin is engaged.

Whenever possible, workholding devices mounted in the sub-spindle should be plugged to prevent chip buildup in the sub-spindle draw tube.

- NOTE -

When installing or removing step chuck closers or 3 jaw chucks, manual lock pin “A”, Figure 14.2, is used to lock the sub-spindle. This will facilitate the tightening or loosening of the bolts that secure the closer or the jaw chuck to the spindle. Manual lock pin “A” is spring loaded and will disengage when released.

When setting up for a workpiece transfer from the sub-spindle to the main spindle, the work-holding device used in the main spindle must have some means of stopping the forward travel (toward the main spindle) of the sub-spindle assembly. For example, a chuck, step chuck, or a collet with a solid stop or spring-loaded stop must be used.

When setting up for a workpiece transfer from the main spindle to the sub-spindle, the work-holding device used in the sub-spindle should have some means of stopping the forward travel (toward the main spindle) of the sub-spindle assembly. For example, a chuck, step chuck, or a collet with a solid stop or a spring-loaded stop should be used. The adjustable solid stop can be used to properly position the sub-spindle if a solid stop or a spring-loaded stop is not available.

Figure 14.2 - Sub-Spindle Manual Lock Pin
INSTALLING SUB-SPINDLE TOOLING

Collets

1. Press the control Reset push button.
2. Activate Jog mode.
3. Press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device. The Open indicator light [49] will turn ON.
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.
6. Align the keyway in the collet with the key in the sub-spindle and carefully insert the collet into the sub-spindle.

- NOTE -

The sub-spindle collet adjusting tool shown in Figure 14.3 is equipped with a spring-loaded sleeve, which covers the end of the tool that is inserted into one of the blind holes near the spindle drive button. This spring-loaded sleeve prevents the tool from being left on the face of the sub-spindle.

7. Insert the collet adjusting tool into one of the blind holes in the spindle face, as shown in Figure 14.3, and rotate the sub-spindle in the appropriate direction to install the collet.
8. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.
9. Insert a workpiece in the workholding device.
10. Press the Sub-Spindle Chuck push button [50] to close the sub-spindle workholding device and verify that the collet grips the workpiece properly.

Figure 14.3 - Sub-Spindle Collet Adjusting Tool
Step Chucks

1. Press the control Reset push button.

2. Activate Jog mode.

3. Press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device. The Open indicator light [49] will turn ON.

4. Position the step chuck closer against the sub-spindle face and align the screw holes in the step chuck closer with the screw holes in the face of the sub-spindle.

5. Press AND HOLD manual lock pin “A”, Figure 14.2, while installing the step chuck closer mounting bolts.

6. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.

7. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.

8. Align the keyway in the step chuck with the key in the sub-spindle and carefully insert the step chuck into the sub-spindle.

9. Manually rotate the sub-spindle in the appropriate direction to install the step chuck.

10. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.

11. Insert a workpiece in the step chuck.

12. Press the Sub-Spindle Chuck push button [50] to close the sub-spindle workholding device and verify that the collet grips the workpiece properly.
Jaw Chucks

1. Press the control Reset push button.
2. Activate Jog mode.
3. Press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device. The Open indicator light [49] will turn ON.
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.
6. Align the keyway in the jaw chuck with the key in the sub-spindle and carefully insert the chuck into the sub-spindle.
7. Manually rotate the sub-spindle in the appropriate direction to install the workholding device.
8. Align the screw holes in the jaw chuck with the screw holes in the face of the sub-spindle.
9. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.
10. Press AND HOLD manual lock pin “A”, Figure 14.2, while installing the jaw chuck mounting bolts.
11. Insert a workpiece in the 3 jaw chuck.
12. Press the Sub-Spindle Chuck push button [50] to close the sub-spindle workholding device and verify that the collet grips the workpiece properly.

REMOVING SUB-SPINDLE TOOLING

Collets

1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device and remove the workpiece.
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
6. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 14-25 for information on the sub-spindle wiper.
7. Insert the collet adjusting tool into one of the balancing holes in the spindle face, as shown in Figure 14.3, and rotate the sub-spindle in the appropriate direction to remove the collet.
Step Chucks

1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device and remove the workpiece.
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
6. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 14-25 for information on the sub-spindle wiper.
8. Manually rotate the sub-spindle in the appropriate direction to remove the step chuck.
9. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.
10. Press AND HOLD manual lock pin “A”, Figure 14.2, while removing the step chuck closer mounting bolts.

Jaw Chucks

1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device and remove the workpiece.
4. Press AND HOLD manual lock pin “A”, Figure 14.2, while removing the jaw chuck mounting bolts.
5. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
6. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
7. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 14-25 for information on the sub-spindle wiper.
8. Manually rotate the sub-spindle in the appropriate direction to remove the jaw chuck.
SETTING SUB-SPINDLE TRAVEL

Sub-Spindle travel is used primarily for performing workpiece transfers between the main spindle and the sub-spindle.

Prerequisites:
- Control is turned ON.
- Cycle Start is not active.
- Appropriate spindle tooling is installed.

SETTING UP FOR WORKPIECE TRANSFER

1. Power-up the machine as described in Chapter 2.
2. Activate Jog mode.
3. Press the Main Spindle Collet/Chuck push button [53] to open the main spindle workholding device. The Open indicator light [52] will turn ON.
4. Press the Sub-Spindle Chuck push button [50] to open the sub-spindle workholding device. The Open indicator light [49] will turn ON.
5. Loosen knob “B”, Figure 14.4, move the knob to the extreme left position, and secure the knob.
6. Place the workpiece in the appropriate spindle to the required length.
7. Press the Main Spindle Collet/Chuck push button [53] or Sub-Spindle Chuck push button [50] to clamp the workpiece.
8. Press the -LA push button [58] to feed the sub-spindle toward the main spindle until the empty workholding device is positioned to grip the workpiece for workpiece transfer, as shown in Figure 14.5.
9. Press the Hold push button [59] to stop sub-spindle motion.
If the sub-spindle assembly makes contact with the mechanical hard stop before reaching the desired position, it will be necessary to adjust the hard stop to provide the additional travel. See “To Adjust the Mechanical Hard Stop”, page 14-10. Adjustment will also be necessary when a previous job is longer or shorter than the one that is being set up.

10. Loosen knob “B”, Figure 14.4, and move the feed dog to the right, until the limit switch rides up onto the feed dog, as shown in Figure 14.5 .

11. Tighten knob “B” to secure the setting.

12. Press the +LA push button [60] to home the sub-spindle assembly. The Lower Axis Home indicator light [57] will turn ON when the sub-spindle is in the HOME position.

- CAUTION -

The sub-spindle rapid traverse rate is 300 ipm [7.6 mpm]. To stop rapid traverse motion of the sub-spindle, press Feed Hold [71], Emergency Stop [74], or the control Reset key.

13. Advance the sub-spindle to check the rapid-to-feed point:
   a) Close the main guard door.
   b) Activate Manual Data Input mode.
   c) Press the Manual Data Input soft key.
   d) Key in M84 (Sub-Spindle Forward), press the EOB key; then, press the Insert key.
   e) Press the Cycle Start push button [72]. The sub-spindle will rapid to the rapid-to-feed point, then feed onto the workpiece.

14. Retract the sub-spindle to the Home position:
   a) Key in M85 (Sub-Spindle Home), press the EOB key; then, press the Insert key.
   b) Press the Cycle Start push button [72]. The sub-spindle will rapid to the Home position.

ADJUSTING SUB-SPINDLE FEEDRATE

14. Press the +LA push button [60] to home the sub-spindle.

15. Press the -LA push button [58] to move the sub-spindle toward the main spindle and observe the current sub-spindle feedrate. The sub-spindle will move toward the main spindle at the adjustable feedrate.

16. If the sub-spindle feedrate needs to be changed, turn knob “E”, Figure 14.6, in the required direction to increase or decrease the feedrate, as desired.

17. Repeat steps 14 through 16 until the desired feedrate is achieved.
ADJUSTING SUB-SPINDLE FORCE

- CAUTION -

The hydraulic pressure for sub-spindle linear travel should not be adjusted below 200 psi (13.8 bars). Refer to table 14.1.

17. Press the -LA push button [58] to move the sub-spindle toward the main spindle.
18. Loosen lock nut “F”, Figure 14.7, with 3/4 inch wrench.
19. Place a 1/4 inch hex wrench through the locknut and into the adjusting screw.
20. Turn the hard stop adjustment screw clockwise until resistance is met with the sub-spindle assembly.
21. Press the +LA push button [60] to home the sub-spindle assembly. The Lower Axis Home indicator light [57] will turn ON when the sub-spindle is in the HOME position.
22. Turn the adjustment screw clockwise 1/4 to 1/2 turn.
23. Tighten lock nut “F”, Figure 14.7, to secure the setting.
24. Press the -LA push button [58] to move the sub-spindle against the hard stop.
25. Observe the hydraulic pressure value displayed on gauge “D”, Figure 14.6.
26. If necessary, adjust knob “C” to set gauge “D” to any desired pressure from 200 to 500 psi (13.8 to 34.4 bars). Refer Table 14.1 for approximate applied force.

<table>
<thead>
<tr>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>100</td>
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<td>200</td>
<td>180</td>
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<td>400</td>
</tr>
<tr>
<td>400</td>
<td>570</td>
</tr>
<tr>
<td>500</td>
<td>700</td>
</tr>
</tbody>
</table>

Table 14.1 - Applied Sub-Spindle Force
ADJUSTING THE MECHANICAL HARD STOP

- NOTE -

The mechanical hard stop is a safety feature that is used to prevent the sub-spindle tooling from making contact with the main spindle tooling. The hard stop can be adjusted to provide whatever length is necessary between the sub-spindle assembly and the main spindle.

27. Press the +LA push button [60] to home the sub-spindle assembly. The Lower Axis Home indicator light [57] will turn ON when the sub-spindle is in the HOME position.

28. Loosen lock nut “F”, Figure 14.7, with 3/4 inch wrench.

29. Place a 1/4 inch hex wrench through the locknut and into the adjusting screw.

30. Turn the adjusting screw counterclockwise (toward machine bed) to adjust the hard stop toward the main spindle.

- NOTE -

The hard stop should be adjusted so that contact is made approximately 1/8 inch (3.2 mm) after expected contact with the workpiece.

31. Position the hard stop so that it is beyond the contact point of the sub-spindle workholding device and workpiece.

32. Press the -LA push button [58] to move the sub-spindle toward the main spindle.

33. After the sub-spindle has stopped moving, turn the hard stop adjustment screw clockwise until resistance is met with the sub-spindle assembly.

34. Press the +LA push button [60] to home the sub-spindle assembly. The Lower Axis Home indicator light [57] will turn ON when the sub-spindle is in the HOME position.

35. Turn the adjustment screw counterclockwise 1/4 to 1/2 turn.

36. Tighten lock nut “F”, Figure 14.7, to secure the setting.

Figure 14.7 - Mechanical Hard Stop Adjustment
SUB-SPINDLE COLLET CLOSER

The sub-spindle on CONQUEST® T42 series lathes is equipped with a .5 inch [12.7 mm] stroke, hydraulically actuated collet closer. If repairs to the collet closer assembly are required, the ENTIRE ASSEMBLY must be removed and returned to the factory. Refer to the CONQUEST T42 Lathe Maintenance Manual (M-322) for information on removing or installing the sub-spindle collet closer assembly.

HYDRAULIC PRESSURE CONTROL

- NOTE -

The sub-spindle collet closer has an operational pressure range of 50 psig [3.45 bars] to 500 psig [34.5 bars].

The sub-spindle collet closer chucking force is controlled by hydraulic oil pressure. The hydraulic pressure controls are located at the back of the machine. The sub-spindle collet closer pressure adjustment knob is located on the back of manifold “G”, Figure 14.8.

Gauge “H” registers the collet closer hydraulic pressure in psig and bars. Refer to Table 14.2 to determine the approximate gripping force that will be applied to the workpiece for a given pressure. A check valve system positively holds the closer open or closed, whichever is active, in the event of an hydraulic pressure failure.

- CAUTION -

DO NOT exceed the maximum pressure setting, as shown in Table 14.2.

- NOTE -

It is the responsibility of the machine operator or set-up person to properly adjust the collet closer hydraulic pressure, based on the type of material to be machined and the configuration of the workpiece.

To Adjust the Hydraulic Pressure:

1. Loosen the knurled lock nut behind the pressure adjustment knob.
2. Turn the pressure adjustment knob clockwise or counterclockwise to decrease or increase the collet closer hydraulic pressure.
3. Tighten the knurled lock nut to secure the setting.
SUB-SPINDLE COLLET CLOSER OPERATION

Automatic Operation

For automatic operation, program M56 to open the collet and M57 to close the collet. The M56 (Open Collet) and M57 (Collet Close) commands can be executed while the spindle is running. M56 will remain active until it is canceled by an M57 (Close Collet) command. While M56 is active, the Open indicator light [49] be flashing and the Sub-Spindle Chuck push button [50] will not be active. A programmed M57 (Collet Close) command will remain active until it is canceled by an M56 (Open Collet) command.

Manual Operation

The collet closer can be manually operated whenever the machine is in a Reset or program stop (M00, M01, or M30) condition. Use the Sub-Spindle Collet/Chuck push button [50] to alternately open and close the sub-spindle collet closer.

Chucking Modes

There is no default chucking mode. The current chucking mode will remain active until canceled by the appropriate command (M69 or M70).

The sub-spindle collet closer can be commanded to use either external or internal chucking. Refer to Chapter 3 for information on establishing the sub-spindle chucking mode.

<table>
<thead>
<tr>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge Pressure (psig)</td>
<td>Chucking Force (lbs)</td>
</tr>
<tr>
<td>100</td>
<td>1206</td>
</tr>
<tr>
<td>200</td>
<td>2412</td>
</tr>
<tr>
<td>300</td>
<td>3619</td>
</tr>
<tr>
<td>400</td>
<td>4826</td>
</tr>
<tr>
<td>500</td>
<td>6000</td>
</tr>
</tbody>
</table>

Table 14.2 - Sub-Spindle Collet Closer Chucking Force
TO FIND SUB-SPINDLE WORK SHIFT VALUE

- CAUTION -
When machining operations involving both spindles are performed, two work shifts must be programmed throughout the part program. Both the main and sub-spindle work shifts must be recorded and entered into the part program.

1. Place a workpiece of the correct size in the sub-spindle workholding device.
2. Press the Sub-Spindle Chuck push button [50].
3. Activate Jog mode.
4. Use the axis directional push buttons to jog the turret to a safe index position.

- CAUTION -
The operator must make certain that no interference exists between the turret tooling and the main spindle, workpiece, or sub-spindle before manually indexing the turret.

5. Index the turret to an empty turret station.
6. Jog the turret to position the front face of the turret top plate near the workpiece face.
7. Press the Z Handle push button [36].
8. Select the desired increment by pressing a handwheel increment push button [38 or 39].
9. Place a shim or scale against the face of the workpiece.
10. Rotate the Handwheel [40] in the direction required until the front face of the top plate is a shim or scale distance from the workpiece face as shown in Figure 14.9.
11. Press the Offset Setting key.
12. Press the right-hand soft key until the Work Shift soft key is displayed.
13. Press the Work Shift soft key.
14. Use the cursor keys to move the cursor to the Z data field under Measurement.
15. Key in the number “0” (zero). The Input soft keys will automatically be displayed.
16. Press the Input key. The Z axis Work Shift will be displayed in the Z Shift Value register as a negative value.
17. Record the value displayed in the Z Shift Value register.

Figure 14.9 - Sub-Spindle Work Shift Offset
- CAUTION

DO NOT alter the value displayed in the Z SHIFT VALUE register. The Z offset value calculated in step 18 will be entered into the part program.

18. Subtract the shim thickness and face stock from the value recorded in step 17. Record this calculated value.

19. Jog the turret to a safe index area.

- CAUTION -

The work shift file contains an X and Z SHIFT VALUE register. It is strongly recommended that the X SHIFT VALUE be set to zero at all times.

The Z SHIFT VALUE must be programmed as a NEGATIVE value.

20. Enter the sub-spindle work shift calculated in step 18 at the beginning of each operation in the part program that involves machining on the sub-spindle. Refer to the following format:

```
N_ (__________); Operator Message
N___G10 P0 X0 Z-_____ ; Set Work Shift
.
.
.
```

G10: Offset setting command.
P0: Selects the Work Shift offset as the offset file to be modified.
X: Offset value on the X axis (Absolute value).
Z: Offset value on the Z axis (Absolute value).

21. Enter the main spindle work shift at the beginning of each operation in the part program that involves machining on the main spindle. Refer to Chapter 4 for information on the main spindle work shift.
TURRET TOOLING FOR SUB-SPINDLE OPERATIONS

SQUARE SHANK TOOLING

- CAUTION -

Turret tooling MUST NOT extend more than 3 inches from the turret top plate on the X axis.

Tool Mounting Position

Square shank tooling for main spindle operations is mounted on the -Z face of the turret top plate and square shank tooling for sub-spindle operations is mounted on the +Z face of the turret top plate. Refer to Figure 14.10.

Tool Shank Modification

- CAUTION -

Failure to modify the length of the tool holder shank can result in poor surface finish.

The length of the tool slots used for sub-spindle operations is 2-9/32 inches [58 mm]. Due to the length of the tool slots, it will be necessary to shorten the shank of the tool holder to position the tool tip at a distance of 1-1/4 inches [31.8 mm] from the edge of the turret top plate.

The final length of the tool, after modification, will be 3-17/32 inches [89.8 mm] from the tool tip to the end of the tool shank. Refer to Figure 14.11.
Mounting Tools

- NOTE -

When using square shank tooling for sub-spindle operations, Hardinge recommends the exclusive use of right-hand tools. This insures that all cutting forces will be directed into the machine base, resulting in maximum tool life.

The wedge clamp can be located on either side of the tool slot centerline to accommodate both right-hand and left-hand tools. Referring to Figure 14.12, note that the larger side of the upper wedge should bear against the tool shank with the arrow pointing toward the tool shank.

1. Mount the wedge clamp on the top plate in the correct orientation for the tool to be installed.
2. Install the tool holder on the top plate and tighten the wedge clamp screws.

ROUND SHANK TOOLING

The Model SG-4 Tool Setting Gauge is used for setting round shank sub-spindle tools, such as boring bars, on center with the spindle centerline.

Prerequisites:

- Control is turned ON.
- Operator knows how to manually index the turret.
- Operator knows how to install tool holders on the turret.

- CAUTION -

DO NOT use round shank tool holder adapter plates on machines equipped with the sub-spindle option. Use of the adapter plates can result in interference between the round shank tool holders and the sub-spindle.

The operator must make certain that no interference exists between the turret tooling and the main spindle, workpiece, or sub-spindle before manually indexing the turret.

1. Index the turret to the desired station.
2. Mount tool holder “J” on the turret as shown in view #1 of Figure 14.13.
3. Refer to the illustration and complete steps 4 through 14.
4. Place setting bar “N” in the tool holder and tighten set screws “I” so that there is a slight drag on the setting bar when it is rotated in the holder.
5. Loosen thumb screw “M” enough to allow locating bar “L” to slide.
6. Place the machined side of tool setter support “K” flat against the side of the tool holder.
7. Rotate setting bar “N” until the machined flat is in line with the flat surface of locating bar “L”, as shown in view #2.

8. Tighten thumb screw “M” when the following conditions are met:
   a) The machined side of tool setter support “K” is flat against the side of the tool holder.
   b) The flat on setting bar “N” is perpendicular to locating bar “L”. Refer to view #2.

9. Loosen set screws “I” and remove setting bar “N”.

- CAUTION -

Be sure that there is sufficient clearance between the sub-spindle tooling and the turret.

10. Place the tool in the tool holder at the desired length.

11. Tighten set screws “I” just enough to apply a slight drag on the tool shank.

12. Place the machined side of tool setter support “K” against the side of tool holder.

13. Rotate the tool until the tool tip touches locating bar “L”.

14. Tighten set screws “I” to secure the setting.

15. Repeat steps 1 through 14 for additional tools as necessary.

Figure 14.13 - Sub-Spindle Round Shank Tool Setting Gauge
TO STORE SUB-SPINDLE TOOL GEOMETRY OFFSETS

Prerequisites: Sub-spindle tools are mounted at the correct stations and adjusted to height. The Work Shift Offset has been established. Refer to Page 14-13.

- CAUTION -

This procedure must be performed whenever a new tool is installed on the top plate.

- NOTE -

All turret tool offsets are measured from the turret reference point, which is located at the intersection of the front face of the turret top plate and the centerline of the tool slot in the active position.

1. Measure and record the O.D. of the workpiece which will be used to touch the tools off.
2. Activate Jog mode.
3. Jog the turret to a safe index area.

- CAUTION -

The operator must make certain that no interference exists between the turret tooling and the main spindle, workpiece, or sub-spindle before manually indexing the turret.

4. Index the turret to the desired station by turning the Station switch [47] to the station number and pressing the Turret Index 1 push button [44].
5. Jog the tool tip to within 1 inch [25 mm] of the face of the workpiece held in the sub-spindle.
6. Press the Z Handle push button [36].
7. Select the desired increment by pressing a handwheel increment push button [38 or 39].
8. Place a shim or scale against the face of the workpiece.

- NOTE -

The shim or scale used to touch the tools off must be the same thickness as the one used to establish the work shift offset.

9. Rotate the Handwheel [40] in the required direction to touch the tool tip to the scale or shim.
10. Press the Offset Setting key.
11. Press the Offset soft key to access the tool offset pages.
12. If not already displayed, press the Geometry soft key to display the tool geometry offset pages.
13. Use the page and cursor keys to position the cursor at the Z axis field for the desired offset.
14. Press the Operator soft key.
15. Key in the Z0 (zero).
16. Press the Measure soft key. The Z axis offset for the tool will now be displayed under the appropriate offset number, as selected in step 13.
17. Rotate the handwheel [40] in the negative (-) direction to clear the workpiece.
18. Use the cursor keys to position the cursor at the X axis field for the desired offset.
19. Press the X Handle push button [35].

20. If touching off an O.D. working tool, turn the handwheel in the plus direction to place the tool tip beyond the O.D. of the workpiece as shown in Figure 14.14.

   If touching off an I.D. working tool, turn the handwheel in the minus direction to place the tool tip inside of the workpiece O.D. as shown in Figure 14.14.

21. Press the Z Handle push button [36].

22. If touching off an O.D. working tool, turn the handwheel in the minus direction until the tool tip is beyond the face of the workpiece in the plus Z direction.

   If touching off an I.D. working tool, turn the handwheel in the plus direction to move the tool tip to within .125 inch [3.2mm] of the workpiece face.

23. Press the X Handle push button [35].

24. Place the shim against the O.D. of the workpiece and turn the handwheel in the appropriate direction until the tool tip gently makes contact with the shim, as shown in Figure 14.14.

25. Key in the diameter of the workpiece as a positive value.

   Example: Diameter = 2.125
            Input = X2.125

26. Press the Measure soft key. The X axis offset value for the tool will now be displayed under the appropriate offset number.
27. Compensate for shim thickness:

If touching off an O.D. working tool and the control is set for diameter programming, enter twice the shim thickness as a negative (-) value and press the Input+ soft key.

If touching off an O.D. working tool and the control is set for radius programming, enter the shim thickness as a negative (-) value and press the Input+ soft key.

If touching off an I.D. working tool, no shim compensation is needed.

28. Press the X Handle push button [35] and turn the handwheel in the + direction to clear the diameter of the workpiece by at least 1 inch [25 mm] in the +X direction.

29. Press the Z Handle push button [36] and turn the handwheel in the minus (-) direction to clear the face of the workpiece by at least 1 inch [25 mm] in the -Z direction.

30. Jog the turret to a safe position for indexing.

31. Index the turret to the next tool station which is to be set.

32. Repeat steps 5 through 31, as required, for other tools.

**SAFE INDEX COORDINATES**

- **CAUTION** -

The Z axis coordinate defined in subprogram O998 MUST be programmed as a NEGATIVE number.

When machining on the sub-spindle, the safe index coordinates are defined by subprogram O998. The X axis safe index coordinate should be set to the X axis home position and the Z axis safe index coordinate should be set to the length of the longest tool PLUS 1 inch [25.4 mm]. Refer to Figure 14.15.

![Diagram of safe index coordinates](image-url)
MAIN AND SUB-SPINDLE MACHINING SET-UP AND OPERATION

Main and sub-spindle machining involves three separate procedures:

I. Set-up and machine the first side.

II. Transfer the workpiece from one spindle to the other.

III. Set-up and machine the second side.

- CAUTION -
WORKSHIFT When machining operations involving both spindles are performed, two work shifts must be called out through the part program. Both the main and sub-spindle work shifts must be recorded for insertion into the part program.

Z AXIS VALUES For sub-spindle machining, negative Z values will be clearing moves outside the workpiece face. Positive Z values will be inside the workpiece face.

SAFE START AND SAFE END PROGRAMS The operator should be aware that programs O1 and O2 are used for the main spindle ONLY. To avoid crash situations, programs O3 and O4 must be used for the sub-spindle. O3 must be used to start all sub-spindle tool operations and to end all outside diameter work. O4 must be used to end all sub-spindle inside diameter work.

SAFE INDEX PROGRAMS The operator should be aware that program O999 is used for the main spindle ONLY. To avoid crash situations, program O998 must be used for the sub-spindle.

Prerequisites: Control is turned ON and part program is loaded and active. Refer to Chapters 3 and 7.

Tools are mounted on the turret top plate at the correct stations. Refer to Chapter 4 and page 14-15.

Operator knows how to establish the work shift offset and tool offsets for the main spindle. Refer to Chapter 4.

Operator knows how to edit part programs. Refer to Chapter 3.

Operator knows how to set up the workpiece transfer from one spindle to the other. Refer to page 14-7.

Operator knows how to establish the sub-spindle work shift value. Refer to Page 14-13.

Operator knows how to establish the sub-spindle tool geometry offsets. Refer to page 14-18.

Safe Start and Safe End Programs O1, O2, O3, and O4 are loaded into the control and are called out in the part program.

Safe Index Programs O998 and O999 are entered into the control.

Workholding device is installed on the main spindle and adjusted to grip the workpiece. Refer to Chapter 5.
SAMPLE MACHINE SET-UP

The sample machine set-up on pages 14-22 through 14-24 illustrates how a machine could be set up for main spindle machining, followed by sub-spindle machining.

- CAUTION -

If the machine is to be operated in Metric mode, the Z pull back value in program O4 must be converted to the metric value.

The sub-spindle rapid traverse rate is 300 ipm (7.6 mpm). To stop forward or reverse motion of the sub-spindle assembly, press the Hold [59] or Feed Hold [71] push button.

The hydraulic pressure for the sub-spindle should not be adjusted below 200 psi (13.8 bars). Refer to Table 14.1.

When a bar feed is being used, the face of the bar should be flush with the collet face since the program begins with a feed stock operation.

I. Set Up and Machine Main Spindle Operation

1. Loosen knob “B”, Figure 14.4, move the feed dog to the extreme left position, and retighten the knob.

2. Place a workpiece of the correct size in the main spindle workholding device at the desired length.

3. Press the Main Spindle Collet/Chuck push button [53].

4. Establish the work shift offset for the main spindle. Record this dimension.

5. Find the tool geometry offsets for the turret tooling used for the main spindle.

6. Subtract the shim thickness and face stock to be removed from the value recorded in step 4 and record this dimension for insertion into the part program.

- CAUTION -

The X Safe Index coordinate defined in subprogram O999 should be equal the X Home position. The Z Safe Index coordinate should equal the LONGEST tool plus 1.000 inch [25.4mm] minimum. Refer to Chapter 4 for additional information.

The Z Safe Index coordinate defined in subprogram O999 MUST be programmed as a POSITIVE number.

7. Check the coordinates in Safe Index Sub-Program O999 to be sure that they are adequate.

   If Adequate Then Go to step 8.
   Inadequate Edit sub-program O999 to provide extra clearance. Refer to Chapter 3.

8. Select the part program which is to be executed.
9. If a bar job is being run, press the Repeat mode push button [9].
   If a bar job is not being run, go to step 10.

   - CAUTION -
   For safe operation, the main spindle work shift must be programmed at the start of each main spindle operation.

10. Enter the work shift in the program at the start of each main spindle operation.

   - NOTE -
   The work shift is entered in the G10 P0 Z-____ block.

11. Press the Reset key and make certain the program is at the beginning.

12. Press the Check soft key.

   - NOTE -
   This will cause the active program to be displayed as well as the Distance To Go to complete the move.


14. Adjust the Feedrate 1 Override switch [70] to the desired percentage.

   - CAUTION -
   Do not use Single Block for releasing the Tap and Die Holder Operation.

15. Press the Single push button [2].

16. Press Option Stop push button [6].

17. Close the guard door.

18. Press the Cycle Start push button [72] for each block and machine the first side.

   - CAUTION -
   If a bar feed job is being run, do not perform the cut-off operation until the workpiece transfer is set-up.

II. Workpiece Transfer
   19. Set up the workpiece transfer.

III. Set Up and Machine Sub-Spindle Operation
   20. Execute the cut-off operation block.

   21. Establish the work shift offset for the sub-spindle. Record this dimension.

   22. Establish the X and Z tool geometry offsets for the sub-spindle tooling on the turret.

   (Continued on next page)
23. Subtract the shim or scale thickness and face stock from the value recorded in step 21. Program this dimension as the Z axis work shift at the beginning of each sub-spindle operation. The work shift is entered in the G10 P0 Z-____ block.

24. Check the Sub-Spindle Safe Index coordinates in subprogram O998. They should read X12.5 Z-____. Refer to page 14-20.

- CAUTION -

The X Safe Index coordinate defined in subprogram O998 should be equal the X Home position. The Z Safe Index coordinate should equal the LONGEST tool plus 1.000 inch [25.4 mm] minimum. Refer to Figure 14.15.

The Z Safe Index coordinate defined in subprogram O998 MUST be programmed as a NEGATIVE number.

25. Press the Program key.

26. Activate the main workpiece program.

27. Press the Reset key.

28. Press the Check soft key.

29. Press the Edit push button [12].

30. Key in the letter N and the sequence number of the first sub-spindle machining operation.

31. Press Cursor ↓.

32. Press the Single push button [2].

33. Press the Option Stop push button [6].

34. Set the Feedrate 1 Override switch [70] to the desired percentage.

35. Set the Rapid Override switch [55] to Low.

36. Close the guard door.

37. Press the Cycle Start push button [72] to execute each block of data.
SUB-SPINDLE DRAW TUBE WIPER

The air system supplies air to the sub-spindle for the purpose of pushing wiper “O”, Figure 14.16, toward the face of the sub-spindle. This motion is used for clearing chips from the sub-spindle bore.

When a workpiece is not present in the sub-spindle, this motion will cause chips in the sub-spindle bore to be expelled. Deactivate the sub-spindle air supply after the chips have been forced out of the sub-spindle.

Wiper “O” is designed with a 1/2-20 tapped hole in the face. In the event that the chip build-up is too great to allow the air pressure to push the wiper forward, the operator can use a threaded rod to pull the wiper forward to expel the chips.

Refer to the CONQUEST® T42 Lathe Maintenance Manual (M-322) for information on safely removing and installing the sub-spindle draw tube wiper.

AIR FLOW ADJUSTMENT

Flow control valve “P”, Figure 14.17, allows the operator to control the rate of travel of wiper “O”, Figure 14.16. The greater the flow rate of air, the faster the wiper will move.

Rotate the knob on flow control valve “P”, Figure 14.17, clockwise or counter-clockwise (as viewed from the bottom) to decrease or increase the air flow rate, respectively.

ACTIVATING/DEACTIVATING AIR BLAST/WIPER

- WARNING -

The sub-spindle air supply must NEVER be activated when the wiper is in the draw tube and a collet or chuck is not installed in the sub-spindle. The air pressure may cause the wiper to be expelled from the sub-spindle draw tube.

With the option turned ON, the main air blast and the air supply to the draw tube wiper can be activated manually by pressing the Air Blast push button [17]. The main air blast is activated and deactivated from the part program respectively by the M36 and M37 codes. The air supply to the draw tube wiper is activated and deactivated from the part program respectively by the M46 and M47 codes.
TO TURN THE AIR BLAST/WIPER OPTION ON AND OFF

Prerequisites:  Control is turned ON.
                Cycle Start is not active.

1. Press the Emergency Stop push button [74].

2. Press **and hold** the Emergency Stop Reset push button [73].

3. Check the indicator light next to the Dry Run push button [8].
   - If the light is ON then the option is turned ON.
   - If the light is OFF then the option is turned OFF.

4. Press the Dry Run push button [8] until the desired condition is achieved.

5. Release the Emergency Stop Reset push button [73].

6. Release the Emergency Stop push button [74].

7. Press and release the Emergency Stop Reset push button [73].
CHAPTER 15 - SUB-SPINDLE [Option]
(Ball Screw Axis Drive)

- NOTE -
Refer to Chapter 14 for information on the optional hydraulic driven sub-spindle.

FUNCTION

The sub-spindle allows parts to be machined at both ends without stopping the machine to
end-for-end the workpiece. This reduces cycle times by eliminating part handling by the operator.
Drilling, boring, turning and facing operations can be performed on parts which are chucked in
the sub-spindle.

Depending on the machining sequence which is selected, the first side of the workpiece is
machined in either the main spindle or the sub-spindle. The workpiece is then transferred to the
other spindle to complete machining of the second side. The sub-spindle travel specifications are
shown in Figures 15.1 and 15.2.

CONTROLLING SUB-SPINDLE MOVEMENT

SUB-SPINDLE AXIS DRIVE MODES

The sub-spindle axis drive is equipped with three operational modes:

- Drive OFF (M66 command)
- Drive Low Torque (M67 command)
- Drive Normal Torque (M68 command)

Low Torque mode is only intended for short compensation moves performed at low speed
during workpiece transfers. These compensation moves must not exceed 0.100" [2.5 mm] in
length or 10 in/min [254 mm/min] in speed. Perform all standard Y axis motion with Normal
Torque mode active.

Normal Torque mode can be activated by programming an M68 command or by pressing the
control Reset key, located on the Manual Data Input panel.

Refer to Chapter 17 in the CONQUEST® T42 Lathe Programmer’s Manual (M-320) for addi-
tional information on the sub-spindle axis drive modes.

AUTOMATIC, MANUAL DATA INPUT, OR SINGLE MODE

- NOTE -
When Y axis motion is programmed by itself, the sub-spindle moves at the pro-
grammed feedrate. When Y axis motion is programmed with X and/or Z axis mo-
tion, the sub-spindle moves at a compensated feedrate to cause the sub-spindle to
complete the move at the same time as the other axes.

Linear motion of the sub-spindle assembly, designated the Y axis, is performed by a servo
drive system that is controlled by the CNC control. The Y and V data words are used to com-
mand direction and distance when moving the ball screw driven sub-spindle in Automatic, Man-
ual Data Input, or Single mode. The face of the sub-spindle is the sub-spindle reference point.

The maximum programmable feedrate (G01 active) is 394 in/min [10,000 mm/min].

(Continued on page 15-3)
NOTES:
1. Dimensions shown as inches [millimeters].
2. All measurements are from the face of the main spindle.
3. Full travel between software limits is 15.480 [393.19 mm].

Figure 15.1 - Sub-Spindle Travel Specifications
(1.600 Offset Sub-Spindle)

NOTES:
1. Dimensions shown as inches [millimeters].
2. All measurements are from the face of the main spindle.
3. Full travel between software limits is 15.480 [393.19 mm].

Figure 15.2 - Sub-Spindle Travel Specifications
(0.460 Offset Sub-Spindle)
The machine is forced into a Feed Hold condition when Automatic, Manual Data Input, or Single mode is active and any interlocked door is opened or cover removed. The Feed Hold condition is released when the door is closed or cover replaced. Press the Cycle Start push button [72] to resume program execution.

**Y Data Word**

The Y data word commands an absolute move referenced against the Z0 (zero) position of the machine coordinate position. Positive Y coordinates are to the right of Z0 and negative Y coordinates are to the left of Z0. The Z0 position will be equal to the face of the main spindle unless modified through the Work Shift offset. Refer to Chapter 4 for information on the Work Shift offset.

**V Data Word**

The V data word commands an incremental move referenced against current position of the sub-spindle reference point. Positive incremental commands move the sub-spindle away from the main spindle. Negative incremental commands move the sub-spindle toward the main spindle.

Programming “G28 V0.” will command the sub-spindle to the home position at rapid traverse rate (394 in/min [10,000 mm/min]), regardless of the current position of the sub-spindle.

**Override Switch**

The Feedrate 1 Override switch [70] allows the machine operator to adjust the programmed feedrate of the sub-spindle from 0% to 150%, up to a maximum feedrate of 394 in/min [10,000 mm/min].
JOG MODE

Axis Direction Keys

When the -LA push button [58] is pressed in Jog mode, the servo drive system causes the sub-spindle to move toward the main spindle at a jog feedrate of 25 in/min [635 mm/min] when the Feedrate 1 Override switch [70] is set to 100%. Refer to “Feedrate Override Switch”, below.

When the +LA push button [60] is pressed in Jog mode, the servo drive system causes the sub-spindle to move toward the sub-spindle Home position at a jog feedrate of 25 in/min [635 mm/min] when the Feedrate 1 Override switch [70] is set to 100%. Refer to “Feedrate Override Switch”, below.

FEEDRATE OVERRIDE SWITCH

The Feedrate 1 Override switch [70] allows the machine operator to adjust the jog feedrate of the sub-spindle from 0 to 37.5 in/min [952 mm/min].

RAPID TRAVERSE

The Traverse push button [65] allows the machine operator to jog the sub-spindle on the Y axis at approximately 120 in/min [3048 mm/min], regardless of the setting of the Feedrate 1 Override switch [70].

MOVING THE SUB-SPINDLE

1. Activate Jog mode.
2. Set the Feedrate 1 Override switch [70] to the desired setting.
3. Press the -LA push button [58] or +LA push button [60] to jog the sub-spindle in the desired direction.

Handle Control

The handwheel [40] can be used to move the sub-spindle incrementally on the Y axis whenever Cycle Start is not active. The Y axis is selected by pressing the LA push button [37]. The movement increment is selected by pressing the appropriate increment push button [38 or 39]. The sub-spindle will move incrementally when the handwheel is rotated. The direction and distance is determined by the direction and amount of rotation of the handwheel.

MOVING THE SUB-SPINDLE

1. Activate Jog mode.
2. Press the LA push button [37] to select the sub-spindle (Y axis).
3. Press the appropriate increment push button [38 or 39] to select the desired jog increment.
4. To view axis position on the control display:
   a) Press the Position key.
   b) Press the Page key until the desired position display appears on the control display.
5. Turn the handwheel in the desired direction (+ or -). Observe the axis position display to determine when the axis has been moved the required distance.
   - Turn the handwheel in the plus (+) direction to move the sub-spindle away from the face of the main spindle.
   - Turn the handwheel in the minus (-) direction to move the sub-spindle toward the face of the main spindle.
SAFETY INTERLOCKS

CYCLE START

Cycle Start is inhibited when the main spindle and sub-spindle workholding devices are both open. At least one workholding device must be closed before Cycle Start can be activated.

MAIN GUARD DOOR

CONQUEST® T42 series lathes equipped with the sub-spindle option incorporate a safety interlock feature which does not allow the main coolant guard door to be opened after power is removed from the machine tool.

The purpose of this safety interlock is to prevent potential personal injury in the event of a power failure. The sub-spindle is not equipped with an external brake. If a power failure occurs, the sub-spindle would coast to a stop, rather than stop immediately.

FREE SPINDLE

A “Free Spindle” condition allows the sub-spindle to be turned by hand. The sub-spindle is in a “Free Spindle” condition whenever it is not being driven by the sub-spindle motor.

SUB-SPINDLE TOOLING

This section covers the installation and removal of spindle tooling, such as collets, step chucks, and jaw chucks.

- CAUTION -

Manual lock pin “A”, Figure 15.3, is NOT interlocked with the machine control. DO NOT attempt to rotate the sub-spindle while this lock pin is engaged.

Whenever possible, workholding devices mounted in the sub-spindle should be plugged to prevent chip build-up in the sub-spindle draw tube.

- NOTE -

Correct adjustment of collets or step chucks is important for proper part transfer between the main spindle and the sub-spindle.

When installing or removing step chuck closers or 3 jaw chucks, manual lock pin “A”, Figure 15.3, is used to lock the sub-spindle. This will facilitate the tightening or loosening of the bolts that secure the closer or the jaw chuck to the spindle. Manual lock pin “A” is spring loaded and will disengage when released.

INSTALLING SUB-SPINDLE TOOLING

Collets

1. Press the control Reset key.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] to activate the Open indicator light [49].
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.
6. Align the keyway in the collet with the key in the sub-spindle and carefully insert the collet into the sub-spindle.

   - NOTE -

The sub-spindle collet adjusting tool shown in Figure 15.4 is equipped with a spring-loaded sleeve, which covers the end of the tool that is inserted into one of the blind holes near the spindle drive button. This spring-loaded sleeve prevents the tool from being left on the face of the sub-spindle.

7. Insert the collet adjusting tool into one of the blind holes in the spindle face, as shown in Figure 15.4, and rotate the sub-spindle in the appropriate direction to install the collet.

8. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.

9. Insert a workpiece in the workholding device.

10. Press the Sub-Spindle Chuck push button [50] to close the collet and verify that the collet grips the workpiece properly.

**Step Chucks**

1. Press the control Reset push button.

2. Activate Jog mode.

3. If necessary, press the Sub-Spindle Chuck push button [50] to activate the Open indicator light [49].

4. Position the step chuck closer against the sub-spindle face and align the screw holes in the step chuck closer with the screw holes in the face of the sub-spindle.

5. Press AND HOLD manual lock pin “A”, Figure 15.3, while installing the step chuck closer mounting bolts.

6. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.

7. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.

8. Align the keyway in the step chuck with the key in the sub-spindle and carefully insert the step chuck into the sub-spindle.

9. Manually rotate the sub-spindle in the appropriate direction to install the step chuck.

10. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.

11. Insert a workpiece in the step chuck.

12. Press the Sub-Spindle Chuck push button [50] to close the step chuck and verify that the step chuck grips the workpiece properly.

Figure 15.3 - Sub-Spindle Manual Lock Pin
Jaw Chucks

1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] to activate the Open indicator light [49].
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until an automatic lock pin engages the sub-spindle draw tube.
6. Align the keyway in the jaw chuck with the key in the sub-spindle and carefully insert the chuck into the sub-spindle.
7. Manually rotate the sub-spindle in the appropriate direction to install the workholding device.
8. Align the screw holes in the jaw chuck with the screw holes in the face of the sub-spindle.
9. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.
10. Press AND HOLD manual lock pin “A”, Figure 15.3, while installing the jaw chuck mounting bolts.
11. Insert a workpiece in the 3 jaw chuck.
12. Press the Sub-Spindle Chuck push button [50] to close the jaw chuck and verify that the jaw chuck grips the workpiece properly.

Figure 15.4 - Sub-Spindle Collet Adjusting Tool
REMOVING SUB-SPINDLE TOOLING

Collets
1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] and remove the workpiece.
4. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
6. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 15-22 for information on the sub-spindle wiper.
7. Insert the collet adjusting tool into one of the balancing holes in the spindle face, as shown in Figure 15.4, and rotate the sub-spindle in the appropriate direction to remove the collet.

Step Chucks
1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] and remove the workpiece.
4. Press Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
5. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
6. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 15-22 for information on the sub-spindle wiper.
7. Manually rotate the sub-spindle in the appropriate direction to remove the step chuck.
8. Press the Auxiliary Function push button [10] or the control Reset push button to disengage the automatic sub-spindle draw tube lock pin.
9. Press AND HOLD manual lock pin “A”, Figure 15.3, while removing the step chuck closer mounting bolts.

Jaw Chucks
1. Press the control Reset push button.
2. Activate Jog mode.
3. If necessary, press the Sub-Spindle Chuck push button [50] and remove the workpiece.
4. Press AND HOLD manual lock pin “A”, Figure 15.3, while removing the jaw chuck mounting bolts.
5. Press the Auxiliary Function push button [10] to lock the sub-spindle draw tube in position. The indicator light next to the push button will turn ON.
6. Slowly rotate the sub-spindle manually until a lock pin engages the sub-spindle draw tube.
7. If necessary, activate the sub-spindle draw tube wiper to expel any chips present from the sub-spindle bore. Refer to page 15-22 for information on the sub-spindle wiper.
8. Manually rotate the sub-spindle in the appropriate direction to remove the jaw chuck.
SUB-SPINDLE COLLET CLOSER

The sub-spindle on CONQUEST® T42 series lathes is equipped with a .5 inch [12.7 mm] stroke, hydraulically actuated collet closer. If repairs to the collet closer assembly are required, the ENTIRE ASSEMBLY must be removed and returned to the factory. Refer to the CONQUEST T42 Lathe Maintenance Manual (M-322) for information on removing or installing the sub-spindle collet closer assembly.

HYDRAULIC PRESSURE CONTROL

- NOTE -

The sub-spindle collet closer has an operational pressure range of 50 [3.45 bars] psig to 500 psig [34.5 bars].

The sub-spindle collet closer chucking force is controlled by hydraulic oil pressure. The hydraulic pressure controls are located at the back of the machine. sub-spindle collet closer pressure is controlled with adjustment knob “B”, Figure 15.5.

Gauge “C” registers the collet closer hydraulic pressure in psig and bars. Refer to Table 15.1, page 15-10, to determine the approximate gripping force that will be applied to the workpiece for a given pressure. A check valve system positively holds the closer open or closed, whichever is active, in the event of an hydraulic pressure failure.

- CAUTION -

DO NOT exceed the maximum pressure setting, as shown in Table 15.1, page 15-10.

- NOTE -

It is the responsibility of the machine operator or set-up person to properly adjust the collet closer hydraulic pressure, based on the type of material to be machined and the configuration of the workpiece.

To Adjust the Hydraulic Pressure:

1. Loosen the knurled lock nut behind pressure adjustment knob “B”, Figure 15.5.

2. Turn pressure adjustment knob “B” clockwise or counterclockwise to decrease or increase the collet closer hydraulic pressure.

3. Tighten the knurled lock nut to secure the setting.

Figure 15.5 - Sub-Spindle Collet Closer Pressure Adjustment
SUB-SPINDLE COLLET CLOSER OPERATION

- CAUTION -
Do not operate the sub-spindle collet closer when a collet or step chuck is mounted in place without gripping a piece of stock or a plug of the correct size.

Automatic Operation
For automatic operation, program M56 to open the collet and M57 to close the collet. The M56 (Open Collet) and M57 (Collet Close) commands may be executed while the spindle is running. M56 will remain active until it is canceled by an M57 (Close Collet) command. While M56 is active, the Open indicator light [49] will be flashing and the Sub-Spindle Chuck push button [50] will not be active. A programmed M57 (Collet Close) command will remain active until it is canceled by an M56 (Open Collet) command.

Manual Operation
The collet closer can be manually operated whenever the machine is in a Reset or program stop (M00, M01, or M30) condition. Use the Sub-Spindle Chuck push button [50] to operate the sub-spindle collet closer manually.

Chucking Modes
There is no default chucking mode. The current chucking mode will remain active until canceled by the appropriate command (M69 or M70).

The sub-spindle collet closer can be commanded to use either external or internal chucking. Refer to Chapter 3 for information on establishing the sub-spindle chucking mode.

<table>
<thead>
<tr>
<th>Gauge Pressure (psig)</th>
<th>Chucking Force (lbs)</th>
<th>Gauge Pressure (bar)</th>
<th>Chucking Force (daN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1206</td>
<td>6.9</td>
<td>538</td>
</tr>
<tr>
<td>200</td>
<td>2412</td>
<td>13.8</td>
<td>1076</td>
</tr>
<tr>
<td>300</td>
<td>3619</td>
<td>20.7</td>
<td>1615</td>
</tr>
<tr>
<td>400</td>
<td>4826</td>
<td>27.6</td>
<td>2152</td>
</tr>
<tr>
<td>500</td>
<td>6000</td>
<td>34.5</td>
<td>2678</td>
</tr>
</tbody>
</table>

Table 15.1 - Sub-Spindle Collet Closer Chucking Force
TO FIND SUB-SPINDLE WORK SHIFT VALUE

- CAUTION -
When machining operations involving both spindles are performed, two work shifts must be programmed throughout the part program. Both the main and sub-spindle work shifts must be recorded and entered into the part program.

- NOTE -
The face of the sub-spindle is the sub-spindle reference point.

1. Determine the Y axis coordinate location at which sub-spindle machining will take place. Refer to Figure 15.6.

2. Determine the distance from the face of the workpiece to the face of the sub-spindle (workpiece extension).

3. Subtract the workpiece extension from the coordinate determined in step 1 to obtain the work shift value. Record the work shift value.

   Example: 17.000 - 3.000 = 14.000

- CAUTION -
The work shift file contains an X and Z SHIFT VALUE register. It is strongly recommended that the X SHIFT VALUE be set to zero at all times.

   The Z SHIFT VALUE must be programmed as a NEGATIVE value.

4. Enter the sub-spindle work shift calculated in step 3 at the beginning of each operation in the part program that involves machining on the sub-spindle. Refer to the following format:

   N_ (__________);       Operator Message
   N___G10 P0 X0 Z-_____ ; Set Work Shift
                        Machining
                        "

   G10: Offset setting command.
P0: Selects the Work Shift offset as the offset file to be modified.
X: Offset value on the X axis (Absolute value).
Z: Offset value on the Z axis (Absolute value).

5. Enter the main spindle work shift at the beginning of each operation in the part program that involves machining on the main spindle. Refer to Chapter 4 for information on the main spindle work shift.
TURRET TOOLING FOR SUB-SPINDLE OPERATIONS

SQUARE SHANK TOOLING

- CAUTION -

Turret tooling MUST NOT extend more than 3 inches from the turret top plate on the X axis.

Tool Mounting Position

Square shank tooling for main spindle operations is mounted on the -Z face of the turret top plate and square shank tooling for sub-spindle operations is mounted on the +Z face of the turret top plate. Refer to Figure 15.7.

![Figure 15.7 - Turret Top Plate (Sub-Spindle Machines Only)](image)

Tool Shank Modification

- CAUTION -

Failure to modify the length of the tool holder shank may result in poor surface finish.

The length of the tool slots used for sub-spindle operations is 2-9/32 inches [58 mm]. Due to the length of the tool slots, it will be necessary to shorten the shank of the tool holder to position the tool tip at a distance of 1-1/4 inches [31.8 mm] from the edge of the turret top plate.

The final length of the tool, after modification, will be 3-13/32 inches [89.8 mm] from the tool tip to the end of the tool shank. Refer to Figure 15.8.

![Figure 15.8 - Tool Length Calculation](image)
Mounting Tools

- NOTE -

When using square shank tooling for sub-spindle operations, Hardinge recommends the exclusive use of right-hand tools. This insures that all cutting forces will be directed into the machine base, resulting in maximum tool life.

The wedge clamp can be located on either side of the tool slot centerline to accommodate both right-hand and left-hand tools. Referring to Figure 15.9, note that the larger side of the upper wedge should bear against the tool shank with the arrow pointing toward the tool shank.

1. Mount the wedge clamp on the top plate in the correct orientation for the tool to be installed.
2. Install the tool holder on the top plate and tighten the wedge clamp screws.

ROUND SHANK TOOLING

The Model SG-4 Tool Setting Gauge is used for setting round shank sub-spindle tools, such as boring bars, on center with the spindle centerline.

Prerequisites: Control is turned ON.
Operator knows how to manually index the turret.
Operator knows how to install tool holders on the turret.

- CAUTION -

DO NOT use round shank tool holder adapter plates on machines equipped with the sub-spindle option. Use of the adapter plates may result in interference between the round shank tool holders and the sub-spindle.

The operator must make certain that no interference exists between the turret tooling and the main spindle, workpiece, or sub-spindle before manually indexing the turret.

1. Index the turret to the desired station.
2. Mount tool holder “E” on the turret, as shown in view #1 of Figure 15.10.
3. Refer to the illustration and complete steps 4 through 14.
4. Place setting bar “I” in the tool holder and tighten set screws “D” so that there is a slight drag on the setting bar when it is rotated in the holder.
5. Loosen thumb screw “H” enough to allow locating bar “G” to slide.
6. Place the machined side of tool setter support “F” flat against the side of the tool holder.
7. Rotate setting bar “I” until the machined flat is in line with the flat surface of locating bar “G”, as shown in view #2.
8. Tighten thumb screw “H” when the following conditions are met:
   a) The machined side of tool setter support “F” is flat against the side of the tool holder.
   b) The flat on setting bar “I” is perpendicular to locating bar “G”. Refer to view #2.
9. Loosen set screws “D” and remove gauge “I”.

   - CAUTION -
   Be sure that there is sufficient clearance between the sub-spindle tooling and the turret.

10. Place the tool in the tool holder at the desired length.
11. Tighten set screws “D” just enough to apply a slight drag on the tool shank.
12. Place the machined side of tool setter support “F” against the side of tool holder.
13. Rotate the tool until the tool tip touches locating bar “G”.
14. Tighten set screws “D” to secure the setting.
15. Repeat steps 1 through 14 for additional tools as necessary.

---

Figure 15.10 - Sub-Spindle Round Shank Tool Setting Gauge

---

15-14 M-321A
TO STORE SUB-SPINDLE TOOL GEOMETRY OFFSETS

Prerequisites: Sub-spindle tools are mounted at the correct stations and adjusted to height. The Work Shift Offset has been established. Refer to page 15-11.

- CAUTION -
This procedure must be performed whenever a new tool is installed on the top plate.

- NOTE -
All turret tool offsets are measured from the turret reference point, which is located at the intersection of the front face of the turret top plate and the centerline of the tool slot in the active position.

1. Measure and record the O.D. of the workpiece that will be used to touch the tools off.
2. Activate Jog mode.
3. Jog the turret to a safe index area.

- CAUTION -
The operator must make certain that no interference exists between the turret tooling and the main spindle, workpiece, or sub-spindle before manually indexing the turret.

4. Index the turret to the desired station by turning the Station switch [47] to the station number and pressing the Turret Index 1 push button [44].
5. Jog the tool tip to within 1 inch [25 mm] of the face of the workpiece held in the sub-spindle.
6. Press the Z Handle push button [36].
7. Select the desired increment by pressing a handwheel increment push button [38 or 39].
8. Place a shim or scale against the face of the workpiece.
9. Rotate the handwheel [40] in the required direction to touch the tool tip to the scale or shim.
10. Press the Offset Setting key.
11. Press the Offset soft key to access the tool offset pages.
12. If not already displayed, press the Geometry soft key to display the tool geometry offset pages.
13. Use the page and cursor keys to position the cursor at the Z axis field for the desired offset.
14. Press the Operator soft key.
15. Key in the Z0 (zero).
16. Press the Measure soft key. The Z axis offset for the tool will now be displayed under the appropriate offset number, as selected in step 13.
17. Enter the shim thickness as positive (+) value and press the Input+ soft key.
18. Rotate the handwheel [40] in the negative (-) direction to clear the workpiece.
19. Use the cursor keys in the negative (-) direction to clear the workpiece.
20. Press the X Handle push button [36].
21. If touching off an O.D. working tool, turn the handwheel in the plus direction to place the tool tip beyond the O.D. of the workpiece as shown in Figure 15.11.

If touching off an I.D. working tool, turn the handwheel in the minus direction to place the tool tip inside of the workpiece O.D. as shown in Figure 15.11.

22. Press the Z Handle push button [36].

23. If touching off an O.D. working tool, turn the handwheel in the minus direction until the tool tip is beyond the face of the workpiece in the plus Z direction.

If touching off an I.D. working tool, turn the handwheel in the plus direction to move the tool tip to within .125 inch [3.2mm] of the workpiece face.

24. Press the X Handle push button [35].

25. Place the shim against the O.D. of the workpiece and turn the handwheel in the appropriate direction until the tool tip gently makes contact with the shim, as shown in Figure 15.11.

26. Key in the diameter of the workpiece as a positive value.

Example: Diameter= 2.125

Input= X2.125

27. Press the Measure soft key. The X axis offset value for the tool will now be displayed under the appropriate offset number.
28. Compensate for shim thickness:

If touching off an O.D. working tool and the control is set for diameter programming, enter twice the shim thickness as a negative (-) value and press the Input+ soft key.

If touching off an O.D. working tool and the control is set for radius programming, enter the shim thickness as a negative (-) value and press the Input+ soft key.

If touching off an I.D. working tool, no shim compensation is needed.

29. Press the X Handle push button [35] and turn the handwheel in the + direction to clear the diameter of the workpiece by at least 1 inch [25 mm] in the +X direction.

30. Press the Z Handle push button [36] and turn the handwheel in the minus (-) direction to clear the face of the workpiece by at least 1 inch [25 mm] in the -Z direction.

31. Jog the turret to a safe position for indexing.

32. Index the turret to the next tool station which is to be set.

33. Repeat steps 5 through 32, as required, for other tools.

**SAFE INDEX COORDINATES**

- **CAUTION** -

The Z axis coordinate defined in subprogram O998 MUST be programmed as a NEGATIVE number.

When machining on the sub-spindle, the safe index coordinates are defined by subprogram O998. The X axis safe index coordinate should be set to the X axis home position and the Z axis safe index coordinate should be set to the length of the longest tool PLUS 1 inch [25.4 mm]. Refer to Figure 15.12.
Main and sub-spindle machining involves the following procedures:

- Set offsets and machine the first side.
- Set offsets and machine the second side.

**- CAUTION -**

**WORK SHIFT** When machining operations involving both spindles are performed, two work shifts must be called out through the part program. Both the main and sub-spindle work shifts must be recorded for insertion into the part program.

**Z AXIS VALUES** For sub-spindle machining, negative Z values will be clearing moves outside the workpiece face. Positive Z values will be inside the workpiece face.

**SAFE START AND SAFE END PROGRAMS** The operator should be aware that programs O1 and O2 are used for the main spindle ONLY. To avoid crash situations, programs O3 and O4 must be used for the sub-spindle.

O3 must be used to start all sub-spindle tool operations and to end all outside diameter work.

O4 must be used to end all sub-spindle inside diameter work.

**SAFE INDEX PROGRAMS** The operator should be aware that program O999 is used for the main spindle ONLY. To avoid crash situations, program O998 must be used for the sub-spindle.

**Prerequisites:**

Control is turned ON and part program is loaded and active. Refer to Chapters 3 and 7.

Safe Start and Safe End Programs O1, O2, O3, and O4 are loaded into the control and are called out in the part program.

Safe Index Programs O998 and O999 are entered into the control.

Operator knows how to edit part programs. Refer to Chapter 3.

Workholding device is installed on the main spindle and adjusted to grip the workpiece properly. Refer to Chapter 5.

Workholding device is installed on the sub-spindle and adjusted to grip the workpiece properly. Refer to page 15-5.

Tools are mounted on the turret top plate at the correct stations. Refer to Chapters 4 and page 15-12.

Operator knows how to establish the work shift offset and tool offsets for the main spindle. Refer to Chapter 4.

Operator knows how to establish the work shift offset for the sub-spindle. Refer to page 15-11.

Operator knows how to establish the tool offsets for the sub-spindle. Refer to page 15-15.
SAMPLE MACHINE SET-UP

The sample machine set-up on pages 15-19 through 15-21 illustrates how a machine could be set up for main spindle machining, followed by sub-spindle machining.

- CAUTION -
If the machine is to be operated in Metric mode, the Z pull back value in program O4 must be converted to the metric value.

When a bar feed is being used, the face of the bar should be flush with the collet face since the program begins with a feed stock operation.

Set Up and Machine Main Spindle Operation
1. Place a workpiece of the correct size in the main spindle workholding device at the desired length.
2. Press the Main Spindle Collet/Chuck push button [53].
3. Establish the work shift offset for the main spindle. Record this dimension.
4. Find the tool geometry offsets for the turret tooling used for the main spindle.
5. Subtract the shim thickness and face stock to be removed from the value recorded in step 3 and record this dimension for insertion into the part program.

- CAUTION -
The X Safe Index coordinate defined in subprogram O999 should be equal the X Home position. The Z Safe Index coordinate should equal the LONGEST tool plus 1.000 inch [25.4mm] minimum. Refer to Chapter 4 for additional information.

The Z Safe Index coordinate defined in subprogram O999 MUST be programmed as a POSITIVE number.
6. Check the coordinates in Safe Index Sub-Program O999 to be sure that they are adequate.
   If Adequate Then Go to step 7.
   Inadequate Edit sub-program O999 to provide extra clearance. Refer to Chapter 3.
7. If necessary, select the part program that is to be executed.
8. If a bar job is being run, press the Repeat Mode push button [9].
   If a bar job is not being run, go to step 9.

- CAUTION -
For safe operation, the main spindle work shift must be programmed at the start of each main spindle operation.
9. Enter the work shift in the program at the start of each main spindle operation.

- NOTE -
The work shift is entered in the G10 P0 Z-____ block.
10. Press the control Reset key and make certain the program is at the beginning.

11. Press the Check soft key.

   **NOTE**

   This will cause the active program to be displayed as well as the Distance To Go to complete the move.

12. Set the Rapid Override switch [55] to Low.

13. Adjust the Feedrate 1 Override [70] switch to the desired percentage.

   **CAUTION**

   Do not use Single Block for a releasing Tap and Die Holder Operation.


15. Press the Option Stop push button [6].

16. Close the guard door.

17. Press the Cycle Start push button [72] for each block and machine the first side.

### Set Up and Machine Sub-Spindle Operation

18. Execute the part transfer operation.

19. Establish the work shift offset for the sub-spindle. Record this dimension.

20. Establish the X and Z tool geometry offsets for the sub-spindle tooling on the turret.

   **CAUTION**

   To insure safe operation, the work shift for the sub-spindle must be entered at the start of each Sub-Spindle operation.

   The Z SHIFT VALUE must be programmed as a NEGATIVE value.

21. Subtract the shim or scale thickness and face stock from the value recorded in step 19. Program this dimension as the Z axis work shift at the beginning of each sub-spindle operation.

   The work shift is entered in the G10 P0 Z-____ block.

   **CAUTION**

   The X Safe Index coordinate defined in subprogram O998 should be equal the X Home position. The Z Safe Index coordinate should equal the LONGEST tool plus 1.000 inch [25.4 mm] minimum. Refer to Figure 15.12.

   The Z Safe Index coordinate defined in subprogram O998 MUST be pro-grammed as a NEGATIVE number.

22. Check the Sub-Spindle Safe Index coordinates in subprogram O998.

   They should read X12.5 Z-____. Refer to page 15.17 for information on calculating the Z safe index coordinate.

   If the coordinates are Correct Then Go to step 23. Incorrect Edit the program to enter the correct values.

23. Press the Program key.
24. Activate the main workpiece program.
25. Press the control Reset key.
26. Press the Check soft key.
27. Press the Edit push button [12].
28. Key in the letter N and the sequence number of the first sub-spindle machining operation.
29. Press Cursor ↓.
30. Press the Single push button [2].
31. Press the Option Stop push button [6].
32. Set the Feedrate 1 Override switch [70] to the desired percentage.
33. Set the Rapid Override switch [55] to Low.
34. Close the guard door.
35. Press the Cycle Start push button [72] to execute each block of data.
SUB-SPINDLE DRAW TUBE WIPER

The air system supplies air to the sub-spindle for the purpose of pushing wiper “J”, Figure 15.13, toward the face of the sub-spindle. This motion is used for clearing chips from the sub-spindle bore.

When a workpiece is not present in the sub-spindle, this motion will cause chips in the sub-spindle bore to be expelled. Deactivate the sub-spindle air supply after the chips have been forced out of the sub-spindle.

Wiper “J” is designed with a 1/2-20 tapped hole in the face. In the event that the chip build-up is too great to allow the air pressure to push the wiper forward, the operator can use a threaded rod to pull the wiper forward to expel the chips.

Refer to the CONQUEST® T42 Lathe Maintenance Manual (M-322) for information on safely removing and installing the sub-spindle draw tube wiper.

AIR FLOW ADJUSTMENT

Flow control valve “K”, Figure 15.14, allows the operator to control the rate of travel of wiper “J”, Figure 15.13. The greater the flow rate of air, the faster the wiper will move.

Rotate the knob on flow control valve “K”, Figure 15.14, clockwise or counter-clockwise (as viewed from the bottom) to decrease or increase the air flow rate, respectively.

ACTIVATING/DEACTIVATING AIR BLAST/WIPER

- WARNING -

The sub-spindle air supply must NEVER be activated when the wiper is in the draw tube and a collet or chuck is not installed in the sub-spindle. The air pressure may cause the wiper to be expelled from the sub-spindle draw tube.

With the option turned ON, the main air blast and the air supply to the draw tube wiper can be activated manually by pressing the Air Blast push button [17]. The main air blast is activated and deactivated from the part program respectively by the M36 and M37 codes. The air supply to the draw tube wiper is activated and deactivated from the part program respectively by the M46 and M47 codes.
TO TURN THE AIR BLAST/WIPER OPTION ON AND OFF

Prerequisites: Control is turned ON.
Cycle Start is not active.

1. Press the Emergency Stop push button [74].
2. Press **and hold** the Emergency Stop Reset push button [73].
3. Check the indicator light next to the Dry Run push button [8].
   - If the light is ON then the option is turned ON.
   - If the light is OFF then the option is turned OFF.
4. Press the Dry Run push button [8] until the desired condition is achieved.
5. Release the Emergency Stop Reset push button [73].
6. Release the Emergency Stop push button [74].
7. Press and release the Emergency Stop Reset push button [73].
APPENDIX ONE

Notes:
1. All dimensions are shown in Inches [Millimeters].
2. All measurements for X are diameter values from the spindle centerline.
3. All measurements for Z are from the face of the main spindle.
4. Full programmable travel on the X axis is 10.998 [279.35], measured on the diameter.
5. Full programmable travel on the Z axis is 13.900 [353.06].

Figure A1.1 - Turret Travel Specifications
(CONQUEST® T42 and T42 Super-Precision® Machines)
Notes:
1. All dimensions are shown in Inches [Millimeters].
2. All measurements for X are diameter values from the spindle centerline.
3. All measurements for Z are from the face of the main spindle.
4. Full programmable travel on the X axis is 10.998 [279.35], measured on the diameter.
5. Full programmable travel on the Z axis is 23.900 [607.06].

Figure A1.2 - Turret Travel Specifications
(CONQUEST® T42-L Machines)
Figure A1.3 - 12 Station Turret Top Plate Dimensions
(3/4" Tooling)
NOTE: Inch [Millimeter] Dimensions

Figure A1.4 - 12 Station Turret Top Plate Dimensions
(20mm Tooling)
Figure A1.5 - 10 Station Turret Top Plate Dimensions
(3/4" Tooling)

NOTE: Inch [Millimeter] Dimensions
Figure A1.6 - 10 Station Turret Top Plate Dimensions
(20mm Tooling)
Figure A1.7 - Tailstock Travel Specifications
(CONQUEST® T42 and T42SP Super-Precision® Machines)

Figure A1.8 - Tailstock Travel Specifications
(CONQUEST T42-L Machines)
Figure A1.9 - Sub-Spindle Travel Specifications with Work Envelope for Main Spindle Turret Tooling (Hydraulic Axis Drive)

Figure A1.10 - Sub-Spindle Travel Specifications with Work Envelope for Sub-Spindle Turret Tooling (Hydraulic Axis Drive)
Figure A1.11 - Sub-Spindle Travel Specifications with Work Envelope for Main Spindle Turret Tooling
(1.60 Offset Ball Screw Axis Drive)

Figure A1.12 - Sub-Spindle Travel Specifications with Work Envelope for Sub-Spindle Turret Tooling
(1.60 Offset Ball Screw Axis Drive)
Figure A1.13 - Sub-Spindle Travel Specifications with Work Envelope for Main Spindle Turret Tooling (0.46 Offset Ball Screw Axis Drive)

Figure A1.14 - Sub-Spindle Travel Specifications with Work Envelope for Sub-Spindle Turret Tooling (0.46 Offset Ball Screw Axis Drive)
Figure A1.15 - End-Working Turret Travel Specifications

NOTE: Inch [Millimeter] Dimensions
Figure A1.16 - Work Envelope with 16C Collet

1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.
Figure A1.17 - Work Envelope with 16C "S-16" Master Step Chuck and Extra-Depth Step Chuck

1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.
1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.

Figure A1.18 - Work Envelope with 16C HQC-42 Quick Change Collet
Figure A1.19 - Work Envelope with 16C Thru-Hole Jaw Chucks

† CHUCK DEPTH
   6" Chuck = 5.09"
   8" Chuck = 5.62"

‡ Z AXIS TRAVEL
   CONQUEST® T42 & T42SP Machines:
   6" Chuck = 9.31"
   8" Chuck = 8.78"
   CONQUEST T42-L Machines:
   6" Chuck = 19.31"
   8" Chuck = 18.78"

4.75 (Reference)
1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.

Figure A1.20 - Work Envelope with 20C Collet
1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.

Figure A1.21 - Work Envelope with 20C "S-20" Master Step Chuck and Extra-Depth Step Chuck
Figure A1.22 - Work Envelope with 20C HQC-65 Quick Change Collet

1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.
1 CONQUEST® T42 and T42SP machines.
2 CONQUEST T42-L machines.

Figure A1.23 - Work Envelope with 20C Thru-Hole Jaw Chucks
SPINDLE TORQUE / HORSEPOWER CURVES

Ten Horsepower Main Spindle Motor
Standard Torque

Base Speed = 1250 rpm
All values are 30 minute ratings

Ten Horsepower Main Spindle Motor
High Torque Option

Base Speed = 750 rpm
All values are 30 minute ratings

Spindle Torque, (Ft-Lbs)
Spindle Power, (HP)

Spindle Speed, (rpm)
Fifteen Horsepower Main Spindle Motor
High Torque Option

Base Speed = 1100 rpm
All values are 30 minute ratings

Fifteen Horsepower Main Spindle Motor
High Speed Option

Base Speed = 1500 rpm
All values are 30 minute ratings
Five Horsepower Sub-Spindle Motor

Standard Torque

Base Speed = 1500 rpm
All values are 30 minute ratings

Spindle Speed, (rpm)
Spindle Torque, (Ft-Lbs)
Spindle Power, (HP)

0 400 800 1200 1600 2000 2400 2800 3200 3600 4000 4400 4800 5200 5600 6000
# APPENDIX TWO

## G CODES

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<td>Rapid Traverse Positioning Mode</td>
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<td>1</td>
<td>Linear Interpolation</td>
</tr>
<tr>
<td>G02</td>
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<td>Clockwise Circular Interpolation</td>
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<td>G107</td>
<td>-</td>
<td>Activate Cylindrical Interpolation [Option]</td>
</tr>
<tr>
<td>G112</td>
<td>-</td>
<td>Activate Polar Interpolation [Option]</td>
</tr>
<tr>
<td>G113</td>
<td>-</td>
<td>Cancel Polar Interpolation [Option]</td>
</tr>
</tbody>
</table>
STANDARD M CODES

M00  Program Stop
M01  Optional Stop
M02  End of Program
M03  Spindle Forward
M04  Spindle Reverse
M05  Spindle Stop/Coolant OFF
M08  Coolant ON
M09  Coolant OFF
M13  Spindle Forward/Coolant ON
M14  Spindle Reverse/Coolant ON
M17  Headwall Coolant ON
M18  Headwall Coolant OFF
M21  Open Main Collet
M22  Close Main Collet
M28  External Chucking Mode (Main Collet Closer)
M29  Internal Chucking Mode (Main Collet Closer)
M30  End of Program
M31  Program Rewind and Restart
M42  No Corner Rounding - Exact Stop
M43  Corner Rounding
M44  Main Turret Bi-Directional Index Enabled
M45  Main Turret Bi-Directional Index Disabled
M48  Enable Feedrate and Spindle Speed Overrides
M49  Disable Feedrate and Spindle Speed Overrides
M58  Enable Constant Surface Speed
M59  Disable Constant Surface Speed
M98  Subprogram Call
M99  Subprogram End
OPTIONAL M CODES

AIR BLAST:
M36 Main Spindle Air Blast ON
M37 Main Spindle Air Blast OFF

C-AXIS:
M23 C-Axis Enabled
M24 C-Axis Disabled

END-WORKING TURRET:
M60 Synchronization Code
M78 Enable Lower Axis Feedrate Override
M79 Disable Lower Axis Feedrate Override
M81 Execute Sub-Routine #1
M82 Execute Sub-Routine #2
M83 Execute Sub-Routine #3

GUARD DOOR:
M38 Guard Door Open
M39 Guard Door Closed

HIGH PRESSURE COOLANT:
M10 Coolant ON
M11 Coolant OFF

LIVE TOOLING:
M51 Live Tooling Forward
M52 Live Tooling Reverse
M53 Live Tooling Forward / Coolant ON
M54 Live Tooling Reverse / Coolant ON
M55 Live Tooling Stop
M71 Simultaneous Live Tooling/Main Spindle (Forward)
M72 Simultaneous Live Tooling/Main Spindle (Reverse)

PART CATCHER:
M25 Part Catcher Retract
M26 Part Catcher Extend

ROBOT:
M62 Robot Request No.1
M63 Robot Request No.2

(Continued on next page)
STEADY REST:
M93  Steady Rest Open
M94  Steady Rest Closed

SUB-SPINDLE:
M07  Sub-Spindle Phase Sync with Main Spindle
M32  Sub-Spindle Sync with Main Spindle
M33  Sub-Spindle Forward RPM
M34  Sub-Spindle Reverse RPM
M35  Sub-Spindle Stop
M46  Sub-Spindle Wiper Air ON
M47  Sub-Spindle Wiper Air OFF
M56  Sub-Spindle Collet Open
M57  Sub-Spindle Collet Close
M66  Sub-Spindle Drive OFF (Ball Screw Drive)
M67  Sub-Spindle Drive Low Torque (Ball Screw Drive)
M68  Sub-Spindle Drive Normal Torque (Ball Screw Drive)
M69  External Chucking Mode
M70  Internal Chucking Mode
M84  Sub-Spindle Forward (Hydraulic Drive)
M85  Sub-Spindle Home (Hydraulic Drive)

THERMAL COMPENSATION:
M88  Activate Thermal Compensation

TAILSTOCK:
M84  Tailstock Forward
M85  Tailstock Home
### PMC GENERATED ALARMS

<table>
<thead>
<tr>
<th>Alarm Number</th>
<th>Alarm Message</th>
<th>Cause(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>Hydraulic OVL (OL-1, OL-4)</td>
<td>Hydraulic motor overload (OL-1) on contactor (MS1) tripped. Hydraulic heat exchanger overload (OL-4) on contactor (MS1) tripped. (On Super-Precision® lathes only) The control is put in an alarm condition and the machine in Emergency Stop.</td>
</tr>
<tr>
<td>1001</td>
<td>Collet/Chuck P-SW Fault</td>
<td>Collet Close/Open pressure switches are faulty. Main spindle pressure switch inputs indicate same state for more than 3.5 seconds. The control is put in an alarm condition.</td>
</tr>
<tr>
<td>1002</td>
<td>Sub Spindle Chuck P-SW Fault</td>
<td>Sub-spindle collet Close/Open pressure switches are faulty. Sub-spindle pressure switch inputs indicate same state for more than 3.5 seconds. The control is put in an alarm condition.</td>
</tr>
<tr>
<td>1003</td>
<td>Turret Unclamped</td>
<td>Main turret top plate not properly seated. Turret index time exceeds two seconds. Turret proximity switch is faulty. The control is put in an alarm condition. Turret index has been interrupted by Reset or Emergency Stop. To clear the fault: 1. Clear the Emergency Stop, if necessary. 2. Press and hold the Zero Return push button. 3. Press the Turret 1 Index push button. The turret will index to station #1 and seat. Alarm will clear.</td>
</tr>
<tr>
<td>1004</td>
<td>Main Spindle Brake Fault</td>
<td>Spindle brake pressure switch input contradicts the state of the brake solenoid valve. (Spindle free lamp indicates status of brake solenoid). The control is put in an alarm condition.</td>
</tr>
<tr>
<td>1005</td>
<td>Tailstock Fault</td>
<td>Tailstock overtraveled beyond the rapid-to-feed dog. The control is put in an alarm condition.</td>
</tr>
<tr>
<td>1007</td>
<td>Barfeed Fault</td>
<td>Bar Feed tube out of position. Hydraulic motor protection relay trip condition. The control is put in an alarm condition.</td>
</tr>
</tbody>
</table>
1008 Spindle Unit Fault  Spindle drive/motor overload condition. The control is put in an alarm condition and the machine in Emergency Stop.

1009 Battery Level Low  Low voltage condition on control memory battery back-up. DO NOT POWER DOWN THE MACHINE!

Refer to the CONQUEST® T42 lathe maintenance manual (M-322) for instructions to replace the battery.

1012 Coolant Pump Overload (OL-2)  Coolant pump motor overload (OL-2) on contactor (MS2) tripped. The control is put in an alarm condition and the machine in Emergency Stop.

1017 Main Air Pressure Low  Low air pressure to machine. The control is put in an alarm condition and the machine in Emergency Stop.

1020 Chuck Open  Spindle collet/chuck is open.

1022 End of Bar (Cycle Strt Inhb)  End of bar condition exists. The control is put in an alarm condition.

1025 Tailstock Breakaway Switch  Tailstock breakaway limit switch has been tripped. The control is put into an alarm condition and the machine in Emergency Stop.

Refer to the CONQUEST T42 lathe maintenance manual (M-322) for information on resetting the tailstock.

1027 Invalid M-code Programmed  M word is programmed for an option not available/enabled on the machine.

M word is not defined in the control.

M word format error.

1031 Tool Touch Probe LS Fault  Tool touch probe Up/Down limit switches indicate same state (logic “0”). Fault is generated if tool probe travel time exceeds 5.0 seconds. The control is put in an alarm condition.

1034 Collet Setup Wrong Stopped  Illegal collet setup during a sub-spindle operation. For example, both collets are open. Not allowed.

1040 Low Hydraulic Pressure  Machine hydraulic pressure has dropped below 60 psig [4.1 bars].

The control is put in an alarm condition and the machine in Emergency Stop.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1044</td>
<td>X Torque Limiter, Check Zero</td>
<td>The X axis torque limiter has tripped. The control is put into an alarm condition and the machine in Emergency Stop. Refer to the CONQUEST® T42 lathe maintenance manual (M-322) for information on resetting the torque limiter.</td>
</tr>
<tr>
<td>1045</td>
<td>Z Torque Limiter, Check Zero</td>
<td>The Z axis torque limiter has tripped. The control is put into an alarm condition and the machine in Emergency Stop. Refer to the CONQUEST T42 lathe maintenance manual (M-322) for information on resetting the torque limiter.</td>
</tr>
<tr>
<td>1501</td>
<td>Move Tlstk into Clear Area</td>
<td>Tailstock out of position. Move tailstock to either the retract position or the fixed home position. Cycle Start is inhibited.</td>
</tr>
<tr>
<td>1502</td>
<td>Lube System Failure</td>
<td>Lubrication system fault. The machine is put into a reset condition. All axis motion stops, coolant and air blast are automatically turned OFF. Check and repair lubrication system.</td>
</tr>
<tr>
<td>1503</td>
<td>Tool Group Life End !</td>
<td>All of the tools in one or more tool groups have reached the tool life specified in the Tool Life Management program and an M30 “End of Program” has been read by the control. Refer to Chapter 10 for instructions on resetting the tool group counter(s).</td>
</tr>
<tr>
<td>1504</td>
<td>Part Catcher Not At Home</td>
<td>Part catcher is not in the retract position. Cycle Start and tailstock motion is inhibited until the part catcher is in the retract position.</td>
</tr>
<tr>
<td>1505</td>
<td>Illegal Use of Part Chute</td>
<td>Illegal sequence of parts catcher M codes. Position of parts catcher is checked before execution of M25 or M26 command.</td>
</tr>
</tbody>
</table>

(Continued on next page)
1802 Turret 2 Unclamped
End-working turret top plate is not properly seated. Turret index time exceeds two seconds. Turret proximity switch is faulty. The control is put in an alarm condition.

Turret index has been interrupted by Reset or Emergency Stop.

To clear the fault:
1. Clear the Emergency Stop, if necessary.
2. Press and hold the Zero Return push button.
3. Press the Turret 2 Index push button.

The turret will index to station #1 and seat. Alarm will clear.

1803 Battery Low in Ram Turret Control
Low voltage condition on control memory battery back-up. DO NOT POWER DOWN THE MACHINE!

Refer to the CONQUEST® T42 lathe maintenance manual (M-322) for instructions to replace the battery.

1804 General Alarm in Ram Trt Control
General end-working turret control hardware failure.

1805 Lower Axis Overtravel
Lower axis overtravel condition. The control is put in an alarm condition and the machine in Emergency Stop.

1806 TT Cover OFF Auto Inhibited
Cover for tool touch probe is removed while the machine is in Automatic, Manual Data Input, or Single mode. Machine must be in Jog mode when cover is removed.

1807 Live Tool Drive Failure
General live tooling hardware failure.

1808 Ram Turret M or T Code Error
Illegal M or T code programmed in a G101, G102, or G103 subroutine or a G110 program block.

1809 Door Opened in Sync Mode
Main guard door opened during a sub-spindle “sync” mode operation.

1810 Y Must Be W/G101,102,103,110
End-working turret motion must be programmed within a G101, G102, G103 subroutine or with the G110 “one-shot command”.

1811 Verify Door Sw[s]
Machine power-up message. Open and close the main coolant guard door to perform the guard door switch verification and clear the verification alarm.
<table>
<thead>
<tr>
<th>Message Number</th>
<th>Message</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>T_T Probe not at Home Pos.</td>
<td>Tool touch probe is not in the home position. Cycle Start is inhibited until the probe is in the home position.</td>
</tr>
<tr>
<td>2019</td>
<td>Guard Door Open</td>
<td>Coolant guard door is open. Cycle Start is inhibited until the guard door is closed.</td>
</tr>
<tr>
<td>2023</td>
<td>Lube Low Refill !</td>
<td>Low lubrication oil level. The Single Block indicator light begins blinking as a warning to the operator. Refer to Chapter 8 for instructions on refilling the lubricator. If the lubricator is not refilled within 25 minutes, the Single Block indicator light turns ON and the control forces Single Block mode.</td>
</tr>
<tr>
<td>2026</td>
<td>Invalid T-code Programmed</td>
<td>The T word exceeds the maximum number of turret stations on the top plate. T word format error.</td>
</tr>
<tr>
<td>2027</td>
<td>Invalid M-code Programmed</td>
<td>M word is programmed for an option not available/enabled on the machine. M word is not defined in the control. M word format error.</td>
</tr>
<tr>
<td>2029</td>
<td>“B” Code or Hardware Error</td>
<td>B word orient angle is greater than 360 degrees. B word is programmed for an option not available/enabled on the machine. B word format error.</td>
</tr>
<tr>
<td>2031</td>
<td>Jog Mode Req'd To Open Collet</td>
<td>For machines equipped with bar feed option and option is turned ON, Jog mode must be selected before manually opening the collet.</td>
</tr>
<tr>
<td>2050</td>
<td>An Access Door is Open</td>
<td>An interlocked access door is open. Cycle start is inhibited until the door is closed.</td>
</tr>
<tr>
<td>2090</td>
<td>Super-Precision Measuring System Failure</td>
<td>General measuring system hardware failure. (Only on Super-Precision® lathes)</td>
</tr>
<tr>
<td>2091</td>
<td>Mist Collector Motor Overload</td>
<td>Coolant mist collector overload has tripped.</td>
</tr>
<tr>
<td>2092</td>
<td>Chip Conveyor Motor Overload</td>
<td>Coolant chip conveyor overload has tripped.</td>
</tr>
<tr>
<td>2112</td>
<td>Part Count Satisfied</td>
<td>The part count specified has been completed. Part program execution is halted.</td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2501</td>
<td>Lube Fail, 5 Min To Shutdown!</td>
<td>Lubrication system hardware failure. The operator has 5 minutes to move the tooling off the workpiece. Check lubrication system pressure switches and lubrication lines. For more information, refer to the CONQUEST® T42 lathe maintenance manual (M-322).</td>
</tr>
<tr>
<td>2502</td>
<td>Z Axis Overloaded Adj Feedrate</td>
<td>The Z axis thrust is limited to 1,500 pounds [6,672 N]. This limit has been exceeded. The machine is put into a feed hold condition. Turn Feedrate 1 Override switch down by 10% and press Cycle Start. Repeat until message clears. Adjust the feedrate in the part program by the percentage that was required to clear the message.</td>
</tr>
<tr>
<td>2503</td>
<td>Y Axis Overloaded Adj Feedrate</td>
<td>The Z axis thrust is limited to 1,500 pounds [6,672 N]. This limit has been exceeded. The machine is put into a feed hold condition. Turn Feedrate 1 Override switch down by 10% and press Cycle Start. Repeat until message clears. Adjust the feedrate in the part program by the percentage that was required to clear the message.</td>
</tr>
<tr>
<td>2611</td>
<td>New Tool Used on Part</td>
<td>A tool in the currently active tool group has reached the tool life specified in the Tool Life Management program. The next tool in the active tool group has been selected.</td>
</tr>
</tbody>
</table>
“Performance Has Established Leadership for Hardinge”®

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