



Lathe Operator's Manual

96-8700 Rev AL July 2011



Haas Automation, Inc., 2800 Sturgis Road, Oxnard, CA 93030 | HaasCNC.com

Rev AL-1 03-2012

Original instructions



**HAAS AUTOMATION, INC.
LIMITED WARRANTY CERTIFICATE**

Covering Haas Automation, Inc. CNC Equipment

Effective January 1, 2009

Haas Automation Inc. ("Haas" or "Manufacturer") provides a limited warranty to all new mills, turning centers and rotary machines (collectively, "CNC Machines") and its components (except those listed below under Limits and Exclusions of Warranty) ("Components") that are manufactured by Haas and sold by Haas or its authorized distributors as set forth in this Certificate. The warranty set forth in this Certificate is a limited warranty and it is the only warranty by Manufacturer and is subject to the terms and conditions of this Certificate.

Limited Warranty Coverage

Each CNC Machine and its Components (collectively, "Haas Products") are warranted by Manufacturer against defects in material and workmanship. This warranty is provided only to the final purchaser and end-user of the CNC Machine (a "Customer"). The period of this limited warranty is one (1) year. The warranty period commences on the date the CNC Machine is delivered to the Customer's facility. Customer may purchase an extension of the warranty period from Haas or an authorized Haas distributor (a "Warranty Extension").

Repair or Replacement Only

Manufacturer's sole liability, and customer's exclusive remedy, with respect to any and all Haas products shall be limited to repairing or replacing, at the discretion of manufacturer, the defective Haas product under this warranty.

Disclaimer of Warranty

This warranty is manufacturer's sole and exclusive warranty and is in lieu of all other warranties of whatever kind or nature, express or implied, written or oral, including, but not limited to, any implied warranty of merchantability, implied warranty of fitness for a particular purpose, or other warranty of quality or performance or noninfringement. All such other warranties of whatever kind are hereby disclaimed by manufacturer and waived by customer.

Limits and Exclusions of Warranty

Components subject to wear during normal use and over time, including, but not limited to, paint, window finish and condition, light bulbs, seals, chip removal system, etc., are excluded from this warranty. Manufacturer's specified maintenance procedures must be adhered to and recorded in order to maintain this warranty. This warranty is void if Manufacturer determines that (i) any Haas Product was subjected to mishandling, misuse, abuse, neglect, accident, improper installation, improper maintenance, improper storage, or improper operation or application, (ii) any Haas Product was improperly repaired or serviced by Customer, an unauthorized service technician, or other unauthorized person, (iii) Customer or any person makes or attempts to make any modification to any Haas Product without the prior written authorization of Manufacturer, and/or (iv) any Haas Product was used for any non-commercial use (such as



personal or household use). This warranty does not cover damage or defect due to an external influence or matters beyond the reasonable control of Manufacturer, including, but not limited to, theft, vandalism, fire, weather condition (such as rain, flood, wind, lightning, or earthquake), or acts of war or terrorism.

Without limiting the generality of any of the exclusions or limitations described in this Certificate, this warranty does not include any warranty that any Haas Product will meet any person's production specifications or other requirements or that operation of any Haas Product will be uninterrupted or error-free. Manufacturer assumes no responsibility with respect to the use of any Haas Product by any person, and Manufacturer shall not incur any liability to any person for any failure in design, production, operation, performance or otherwise of any Haas Product other than repair or replacement of same as set forth in this warranty above.

Limitation of Liability and Damages

Manufacturer will not be liable to customer or any other person for any compensatory, incidental, consequential, punitive, special, or other damage or claim, whether in an action in contract, tort, or other legal or equitable theory, arising out of or related to any Haas product, other products or services provided by manufacturer or an authorized distributor, service technician or other authorized representative of manufacturer (collectively, "authorized representative"), or the failure of parts or products made by using any Haas product, even if manufacturer or any authorized representative has been advised of the possibility of such damages, which damage or claim includes, but is not limited to, loss of profits, lost data, lost products, loss of revenue, loss of use, cost of down time, business good will, any damage to equipment, premises or other property of any person, and any damage that may be caused by a malfunction of any Haas product. All such damages and claims are disclaimed by manufacturer and waived by customer. Manufacturer's sole liability, and customer's exclusive remedy, for damages and claims for any cause whatsoever shall be limited to repair or replacement, at the discretion of manufacturer, of the defective Haas product as provided in this warranty.

Customer has accepted the limitations and restrictions set forth in this Certificate, including, but not limited to, the restriction on its right to recover damages, as part of its bargain with Manufacturer or its Authorized Representative. Customer realizes and acknowledges that the price of the Haas Products would be higher if Manufacturer were required to be responsible for damages and claims beyond the scope of this warranty.

Entire Agreement

This Certificate supersedes any and all other agreements, promises, representations or warranties, either oral or in writing, between the parties or by Manufacturer with respect to subject matter of this Certificate, and contains all of the covenants and agreements between the parties or by Manufacturer with respect to such subject matter. Manufacturer hereby expressly rejects any other agreements, promises, representations or warranties, either oral or in



writing, that are in addition to or inconsistent with any term or condition of this Certificate. No term or condition set forth in this Certificate may be modified or amended unless by a written agreement signed by both Manufacturer and Customer. Notwithstanding the foregoing, Manufacturer will honor a Warranty Extension only to the extent that it extends the applicable warranty period.

Transferability

This warranty is transferable from the original Customer to another party if the CNC Machine is sold via private sale before the end of the warranty period, provided that written notice thereof is provided to Manufacturer and this warranty is not void at the time of transfer. The transferee of this warranty will be subject to all terms and conditions of this Certificate.

Miscellaneous

This warranty shall be governed by the laws of the State of California without application of rules on conflicts of laws. Any and all disputes arising from this warranty shall be resolved in a court of competent jurisdiction located in Ventura County, Los Angeles County or Orange County, California. Any term or provision of this Certificate that is invalid or unenforceable in any situation in any jurisdiction shall not affect the validity or enforceability of the remaining terms and provisions hereof or the validity or enforceability of the offending term or provision in any other situation or in any other jurisdiction.



Warranty Registration

Should you have a problem with your machine, please consult your operator's manual first. If this does not resolve the problem, call your authorized Haas distributor. As a final solution, call Haas directly at the number indicated below.

Haas Automation, Inc.
2800 Sturgis Road
Oxnard, California 93030-8933 USA
Phone: (805) 278-1800
FAX: (805) 278-8561

In order to record the end-user customer of this machine for updates and for product safety notices, we must have the machine registration returned immediately. Please fill out completely and mail to the above address to ATTENTION (VF-1, GR-510, VF-6, etc. — whichever is applicable) REGISTRATIONS. Please include a copy of your invoice to validate your warranty date and to cover any additional options you may have purchased.

Company Name: _____ **Contact Name:** _____

Address: _____

Dealer: _____ **Date Installed:** ____/____/____

Model No. : _____ **Serial Number:** _____

Telephone: (____) _____ **FAX:** (____) _____

The equipment contains a pre-set automatic shut off feature that causes the equipment to automatically cease operation after 800 hours of use. This feature protects the buyer from theft. Unauthorized use of machine is kept to a minimum as the machine will stop running programs once the allotted time runs out. Operation may be resumed by use of the access code; contact your dealer for codes.



Customer Satisfaction Procedure

Dear Haas customer,

Your complete satisfaction and goodwill are of the utmost importance to both Haas Automation, Inc., and the Haas distributor where you purchased your equipment. Normally, any concerns you may have about the sales transaction or the operation of your equipment will be rapidly resolved by your distributor.

However, if your concerns are not resolved to your complete satisfaction, and you have discussed your concerns with a member of the dealership's management, the General Manager or the dealership's owner directly, please do the following:

Contact Haas Automation's Customer Service Center by calling 800-331-6746 and ask for the Customer Service Department. So that we may resolve your concerns as quickly as possible, please have the following information available when you call:

- Your name, company name, address and phone number
- The machine model and serial number
- The dealership name, and the name of your latest contact at the dealership
- The nature of your concern

If you wish to write Haas Automation, please use this address:

Haas Automation, Inc.
2800 Sturgis Road
Oxnard, CA 93030

Att: Customer Satisfaction Manager
e-mail: Service@HaasCNC.com

Once you contact the Haas Automation Customer Service Center, we will make every effort to work directly with you and your distributor to quickly resolve your concerns. At Haas Automation, we know that a good Customer-Distributor-Manufacturer relationship will help ensure continued success for all concerned.



Customer Feedback

If you have any concerns or questions in regard to the Haas Operator's manual, please contact us via our e-mail, pubs@haascnc.com. We look forward to any suggestions you may have.

Certification



All Haas CNC machine tools carry the ETL Listed mark, certifying that they conform to the NFPA 79 Electrical Standard for Industrial Machinery and the Canadian equivalent, CAN/CSA C22.2 No. 73. The ETL Listed and cETL Listed marks are awarded to products that have successfully undergone testing by Intertek Testing Services (ITS), an alternative to Underwriters' Laboratories.



The ISO 9001:2008 certification from ISA, Inc. (an ISO registrar) serves as an impartial appraisal of Haas Automation's quality management system. This achievement affirms Haas Automation's conformance with the standards set forth by the International Organization for Standardization, and acknowledges the Haas commitment to meeting the needs and requirements of its customers in the global marketplace.

The Information contained in this manual is constantly being updated. The latest updates and other helpful information is available online as a free download in .pdf format (go to www.HaasCNC.com and click on "Manual Updates under the "Customer Service" drop-down menu in the navigation bar).



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Safety

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Declaration of Conformity

Product: CNC Lathes (Turning Centers)

***Including all options factory installed or field installed by a certified Haas Factory Outlet (HFO)**

Manufactured By: Haas Automation, Inc.
2800 Sturgis Road, Oxnard, CA 93030 805-278-1800

We declare, in sole responsibility, that the above listed products, to which this declaration refers, comply with the regulations as outlined in the CE directive for Machining Centers:

- Machinery Directive 2006/42/EC
- Electromagnetic Compatibility Directive 2004/108/EC
- Low Voltage Directive 2006/95/EC
- Additional Standards:
 - EN 60204-1:2006/A1:2009
 - EN 614-1:2006+A1:2009
 - EN 894-1:1997+A1:2008
 - EN 954-1 Safety of machinery - Safety - related parts of control systems part 1: General principles for design: (1997)
 - EN 14121-1:2007

RoHS: COMPLIANT by Exemption per producer documentation. Exempt by:

- a) Large scale stationary industrial tool
- b) Monitoring and control systems
- c) Lead as an alloying element in steel

Person authorized to compile technical file:

Patrick Goris

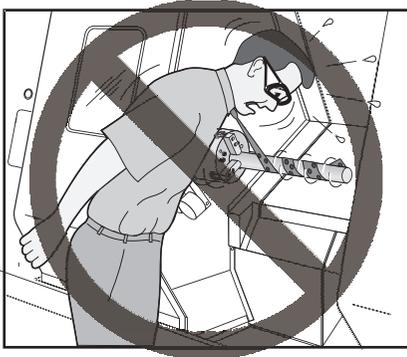
Address: Haas Automation Europe
Mercuriusstraat 28
B-1930 Zaventem
Belgium



HAAS SAFETY PROCEDURES

Safety

THINK SAFETY!



DON'T GET CAUGHT UP IN YOUR WORK

All turning machines contain hazards from rotating parts, belts and pulleys, high voltage electricity, noise, and compressed air. When using CNC machines and their components, basic safety precautions must always be followed to reduce the risk of personal injury and mechanical damage.

Important — This machine is to be operated only by trained personnel in accordance with the Operator's Manual, safety decals, safety procedures and instructions for safe machine operation.

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General Product Use Specifications and Limits

Environmental (Indoor use only)*		
	Minimum	Maximum
Operating Temperature	41° F (5° C)	122° F (50° C)
Storage Temperature	-4° F (-20° C)	158° F (70° C)
Ambient Humidity	20% relative, non-condensing	90% relative, non-condensing
Altitude	Sea Level	6000 ft. (1829 m)

Noise		
	Minimum	Maximum**
Emitted from all areas of machine during use at a typical operator's position	70 dB	Greater than 85dB

*Do not operate the machine in explosive atmospheres (explosive vapors and / or particulate matter)

**Take precautions to prevent hearing damage from machine/machining noise. Wear ear protection, alter cutting application (tooling, spindle speed, axis feed, fixturing, programmed path) to reduce noise, and / or restrict access to machine area during cutting.



READ BEFORE OPERATING THIS MACHINE:

- ◆ Only authorized personnel should work on this machine. Untrained personnel present a hazard to themselves and the machine, and improper operation will void the warranty.
- ◆ Check for damaged parts and tools before operating the machine. Any part or tool that is damaged should be properly repaired or replaced by authorized personnel. Do not operate the machine if any component does not appear to be functioning correctly. Contact your shop supervisor.
- ◆ Use appropriate eye and ear protection while operating the machine. ANSI approved impact safety goggles and OSHA approved ear protection are recommended to reduce the risks of sight damage and hearing loss.
- ◆ Do not operate the machine unless the doors are closed and the door interlocks are functioning properly. When a program is running, the tool turret can move rapidly at any time in any direction.
- ◆ The Emergency Stop button is the large, circular red switch located on the Control Panel. Pressing the Emergency Stop button will instantly stop all motion of the machine, the servo motors, the tool changer, and the coolant pump. Use the Emergency Stop button only in emergencies to avoid crashing the machine.
- ◆ The electrical panel should be closed and the key and latches on the control cabinet should be secured at all times except during installation and service. At those times, only qualified electricians should have access to the panel. When the main circuit breaker is on, there is high voltage throughout the electrical panel (including the circuit boards and logic circuits) and some components operate at high temperatures. Therefore, extreme caution is required. Once the machine is installed, the control cabinet must be locked and the key available only to qualified service personnel.
- ◆ Consult your local safety codes and regulations before operating the machine. Contact you dealer anytime safety issues need to be addressed.
- ◆ DO NOT modify or alter this equipment in any way. If modifications are necessary, all such requests must be handled by Haas Automation, Inc. Any modification or alteration of any Haas Milling or Turning Center could lead to personal injury and/or mechanical damage and will void your warranty.
- ◆ It is the shop owner's responsibility to make sure that everyone who is involved in installing and operating the machine is thoroughly acquainted with the installation, operation, and safety instructions provided with the machine BEFORE they perform any actual work. The ultimate responsibility for safety rests with the shop owner and the individuals who work with the machine.



- ◆ Do not operate with the door open.
- ◆ Do not operate without proper training.
- ◆ Always wear safety goggles.
- ◆ The machine is automatically controlled and may start at any time.
- ◆ Improperly or inadequately clamped parts may be ejected with deadly force.
- ◆ Do not exceed rated chuck rpm.
- ◆ Higher rpm reduces chuck clamping force.
- ◆ Unsupported bar stock must not extend past draw tube end.
- ◆ Chucks must be greased weekly and regularly serviced.
- ◆ Chuck jaws must not protrude beyond the diameter of the chuck.
- ◆ Do not machine parts larger than the chuck.
- ◆ Follow all of the warnings of the chuck manufacturer regarding the chuck and work holding procedures.
- ◆ Hydraulic pressure must be set correctly to securely hold the work piece without distortion.
- ◆ The electrical power must meet the specifications in this manual. Attempting to run the machine from any other source can cause severe damage and will void the warranty.
- ◆ Do not press POWER UP/RESTART on the control panel until after the installation is complete.
- ◆ Do not attempt to operate the machine before all of the installation instructions have been completed.
- ◆ Never service the machine with the power connected.
- ◆ Improperly clamped parts at high velocity may puncture the safety door. Reduced rpm is required to protect the operator when performing dangerous operations (e.g. turning oversized or marginally clamped parts). Turning oversized or marginally clamped parts is not safe.
- ◆ Windows must be replaced if damaged or severely scratched - Replace damaged windows immediately.
- ◆ Do not process toxic or flammable material. Deadly fumes can be present. Consult material manufacturer for safe handling of material by-products before processing.



- ◆ **Do not reset a circuit breaker until the reason for the fault is investigated. Only Haas-trained service personnel should troubleshoot and repair the equipment.**

- ◆ **Follow these guidelines while performing jobs on the machine:**

Normal operation - Keep the door closed and guards in place, while machine is operating.

Part loading and unloading – An operator opens the door or guard, completes task, closes door or guard before pressing cycle start (starting automatic motion).

Tool loading or unloading – A machinist enters the machining area to load or unload tools. Exit the area completely before automatic movement is commanded (for example, next tool, ATC/Turret FWD/REV).

Machining job set-up – Press emergency stop before adding or removing machine fixtures.

Maintenance / Machine Cleaner– Press emergency stop or power off the machine before entering enclosure.

Do not enter the machining area anytime the machine is in motion; severe injury or death may result.

Unattended Operation

Fully enclosed Haas CNC machines are designed to operate unattended; however, your machining process may not be safe to operate unmonitored.

As it is the shop owner's responsibility to set up the machines safely and use best practice machining techniques, it is also their responsibility to manage the progress of these methods. The machining process must be monitored to prevent damage if a hazardous condition occurs.

For example, if there is the risk of fire due to the material machined, then an appropriate fire suppression system must be installed to reduce the risk of harm to personnel, equipment and the building. A suitable specialist must be contacted to install monitoring tools before machines are allowed to run unattended.

It is especially important to select monitoring equipment that can immediately perform an appropriate action without human intervention to prevent an accident, should a problem be detected.



SETUP MODE

All Haas turning centers are equipped with a lock on the operator door and a key switch on the side of the control pendant to lock and unlock Setup Mode. Generally, Setup Mode lock/unlock status affects how the machine operates when the door is opened.

This feature replaces the following settings and parameters within the control:

- Setting 51, Door Hold Override
- Parameter 57 bit 7, Safety Circuit
- Parameter 57 bit 31, Door Stop Sp
- Parameter 586, Max Door Open Sp RPM.

Setup mode should be locked out (the keyswitch in the vertical, locked position) at most times. In locked mode, the enclosure door is locked closed during the execution of a CNC program, spindle rotation or axis movement. The door automatically unlocks when the machine is not in cycle. Most machine functions are unavailable with the door open.

When unlocked, setup mode allows a skilled machinist more access to the machine to set up jobs. In this mode, machine behavior is dependent on whether the door is opened or closed. With the door closed in setup mode, opening the door will stop motion and reduce spindle speed. The machine will allow several functions in setup mode with the door open, usually at reduced speed. The following charts summarize the modes and allowed functions.

DO NOT ATTEMPT TO OVERRIDE SAFETY FEATURES. DOING SO WILL MAKE THE MACHINE UNSAFE AND VOID THE WARRANTY.

Robot Cells

A machine in a robot cell is allowed to run, unrestricted, with the door open while in Lock/Run mode.

This open-door condition is only allowed provided a robot is communicating with the CNC machine. Typically an interface between the robot and the CNC machine addresses the safety of both machines.

A robot-cell integrator will be able to test the open-door conditions of the CNC machine and assure the safety of the robot cell

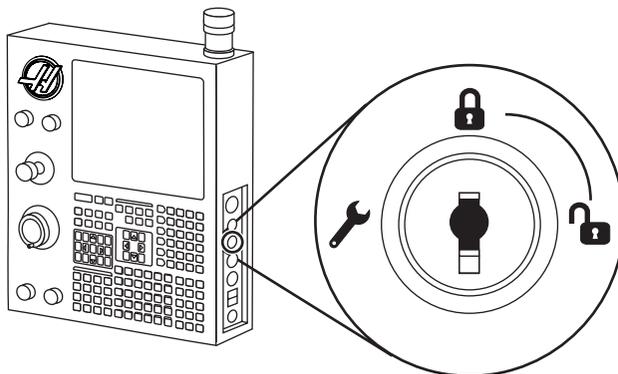


Machine Behavior with Door Open

MACHINE FUNCTION 	LOCKED 	UNLOCKED 
Maximum Rapid	Not allowed.	25%
Cycle Start	Not allowed, no machine motion or program execution.	With the Cycle Start button held down, machine motion is initiated provided the commanded spindle speed does not exceed 50 RPM.
Spindle CW/CCW	Yes, but user must press and hold FWD/REV key. Max. 50 RPM	Yes, but maximum 50 RPM.
Tool Change	Not allowed.	Not allowed.
Next Tool feature	Not allowed.	Allowed with the Next Tool key pressed and held.
Opening door while program is running.	Not allowed. Door is locked.	Yes, but axis motion will stop and the spindle will slow to a maximum 50 RPM.
Conveyor motion	Not allowed.	Yes, but user must press and hold conveyor button.



Safety



	100%	Press and Hold FWD / REV 50 RPM  
	100%	50 RPM



<p>G00 G01</p>		
	100%	0%
	25%	25%

	100%	
	100%	



USES AND GUIDELINES FOR PROPER MACHINE OPERATION

All turning machines contain hazards from rotating cutting tools, belts and pulleys, high voltage electricity, noise, and compressed air. When using turning machines and their components, basic safety precautions should always be followed to reduce the risk of personal injury and mechanical damage. **READ ALL APPROPRIATE WARNINGS, CAUTIONS, AND INSTRUCTIONS BEFORE OPERATING THIS MACHINE.**

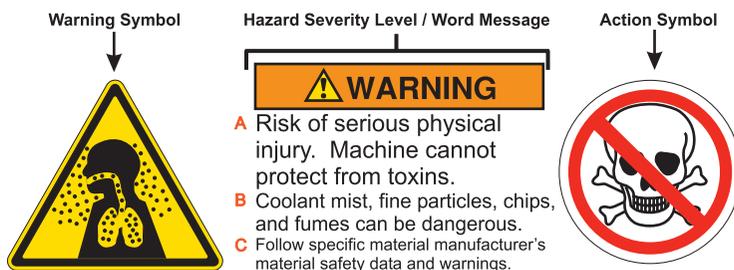
MODIFICATIONS TO THE MACHINE

DO NOT modify or alter this equipment in any way. If modifications are necessary, all such requests must be handled by Haas Automation, Inc. Any modification or alteration of any Haas machining center could lead to personal injury and/or mechanical damage and will void your warranty.

SAFETY DECALS

To help ensure that CNC tool dangers are quickly communicated and understood, hazard symbol decals are placed on Haas Machines in locations where hazards exist. If decals become damaged or worn, or if additional decals are needed to emphasize a particular safety point, contact your dealer or the Haas factory. **Never alter or remove any safety decal or symbol.**

Each hazard is defined and explained on the general safety decal, located at the front of the machine. Particular locations of hazards are marked with warning symbols. Review and understand the four parts of each safety warning, explained below, and familiarize yourself with the symbols on the following pages.



Warning Symbol - Identifies the potential hazard and reinforces the word message.

Word Message - Clarifies or reinforces the intent of the warning symbol.

A: Hazard.

B: Consequence if warning is ignored.

C: Action to prevent injury. Also refer to Action Symbol.

Hazard Severity Level - Color-coded to indicate risk in ignoring a hazard.

Red + "DANGER" = Hazard WILL cause death or serious injury if ignored.

Orange + "WARNING" = Hazard COULD cause death or serious injury if ignored.

Yellow + "CAUTION" = Hazard MAY cause minor to moderate injury if ignored.

Blue + "NOTICE" = Indicates an action to prevent damage to the machine.

Green + "INFORMATION" = Details about machine components.

Action Symbol: Indicates actions to prevent injury. Blue circles indicate mandatory actions to avoid harm, red circles with diagonal slashes indicate prohibited actions to avoid harm.



MILL WARNING DECALS

⚠ DANGER			
	<p>Electrocution hazard. Death by electric shock can occur. Turn off and lock out system power before servicing.</p>		
	<p>Risk of serious physical injury. Machine cannot protect from toxins. Coolant mist, fine particles, chips, and fumes can be dangerous. Follow specific material manufacturer's material safety data and warnings.</p>		
	<p>Risk of fire and explosion. Machine is not designed to resist or contain blasts or fire. Do not machine explosive or flammable materials or coolants. Refer to specific material manufacturer's material safety data and warnings.</p>		
	<p>Severe injury can occur. Moving parts can entangle, trap, and cut. Sharp tools or chips can cut skin easily. Ensure the machine is not in automatic operation before reaching inside.</p>		
	<p>Risk of eye and ear injury. Flying debris into unprotected eyes can cause loss of sight. Noise levels can exceed 70 dBA. Must wear safety glasses and hearing protection when operating or in the area of machine.</p>		
<p>Safety windows may become brittle and lose effectiveness when exposed to machine coolants and oils over time. If signs of discoloration, crazing, or cracking are found, replace immediately. Safety windows should be replaced every two years.</p>			
⚠ WARNING			
	<p>Severe injury can occur. Moving parts can entangle and trap. Always secure loose clothing and long hair.</p>		
	<p>Impact hazard. Machine components can crush and cut. Do not handle any part of the machine during automatic operation. Always keep clear of moving parts.</p>		
<p>• Do not allow untrained personnel to operate this machine. • Do not alter or modify machine in any way. • Do not operate this machine with worn or damaged components. • No user serviceable parts inside. Machine must be repaired or serviced by authorized service technicians only.</p>			
NOTICE			
	<p>Coolant Tank Maintenance Clean the filter screen weekly. Remove the coolant tank cover and clean out any sediment inside the tank weekly. Do not use plain water, permanent corrosion damage will result. Rust inhibiting coolant is required. Do not use toxic or flammable liquids as a coolant.</p>		

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29-0769 Rev E



LATHE WARNING DECALS

⚠ DANGER



Electrocution hazard. Death by electric shock can occur. Turn off and lock out system power before servicing.



Automatic Machine may start at any time. Injury or death could be caused by untrained operator. Read and understand operator's manual and safety signs before using this machine.



Risk of serious physical injury. Machine cannot protect from toxins. Coolant mist, fine particles, chips, and fumes can be dangerous. Follow specific material manufacturer's material safety data and warnings.



Risk of serious bodily injury. The enclosure may not stop every type of projectile. Double-check job set up before beginning any machining operations. Always follow safe machining practices. Do not operate with doors or windows open or guards removed.



Risk of fire and explosion. Machine is not designed to resist or contain blasts or fire. Do not machine explosive or flammable materials or coolants. Refer to specific material manufacturer's material safety data and warnings.



Risk of bodily injury. Serious cuts, abrasions, and physical injury may result from slips and falls. Avoid using the machine in wet, damp, or poorly lit areas.



Severe injury can occur. Moving parts can entangle, trap, and cut. Sharp tools or chips can cut skin easily. Ensure the machine is not in automatic operation before reaching inside.



Risk of eye and ear injury. Flying debris into unprotected eyes can cause loss of sight. Noise levels can exceed 70 dBA. Must wear safety glasses and hearing protection when operating or in the area of machine.



Safety windows may become brittle and lose effectiveness when exposed to machine coolants and oils over time. If signs of discoloration, crazing, or cracking are found, replace immediately. Safety windows should be replaced every two years.

⚠ WARNING



Severe injury can occur. Moving parts can entangle and trap. Always secure loose clothing and long hair.



Risk of serious bodily injury and impact hazard. Unsupported bar can whip with deadly results.



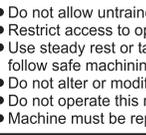
Risk of serious bodily injury. Inadequately clamped parts can be thrown with deadly force. High RPM reduces chuck clamping force. Do not machine using an unsafe setup or exceed rated chuck RPM.



Do not extend barstock past end of drawtube without adequate support. Do not apply excessive machining forces, doing so can dislodge the bar from support. Do not allow the carriage or tool to strike the steady rest or tailstock; the part may come loose. Do not over tighten steady rest.

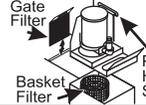


Moving parts can cut. Sharp tools can cut skin easily. Do not handle any part of the machine during automatic operation. Do not touch rotating work pieces.



- Do not allow untrained personnel to operate this machine.
- Restrict access to open frame lathes.
- Use steady rest or tailstock to support long bars and always follow safe machining practices.
- Do not alter or modify machine in any way.
- Do not operate this machine with worn or damaged components.
- Machine must be repaired or serviced by authorized technicians only.

NOTICE



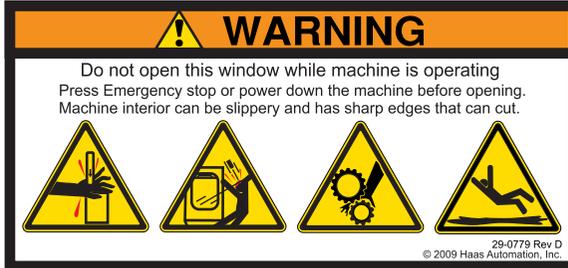
Clean the filter screen weekly. Remove the coolant tank cover and clean out any sediment inside the tank weekly. Do not use plain water, permanent corrosion damage will result. Rust inhibiting coolant is required. Do not use toxic or flammable liquids as a coolant.

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OTHER SAFETY DECALS

Other decals may be found on your machine, depending on the model and options installed:





DECLARATION OF WARNINGS, CAUTIONS, AND NOTES

Throughout this manual, important and critical information is prefaced with the word “Warning”, “Caution” and “Note”

Warnings are used when there is an extreme danger to the operator and/or to the machine. Take all steps necessary to heed the warning given. Do not continue if you cannot follow the warning instructions. An example warning is:

WARNING! Never put hands between tool changer and spindle head.

Cautions are used when there is the potential for minor personal injury or mechanical damage, for example:

CAUTION! Power down the machine before performing any maintenance tasks.

Notes give additional information to the operator about a particular step or procedure. This information should be taken into consideration by the operator as the step is performed to ensure there is no confusion, for example:

NOTE: If machine is equipped with the optional extended Z-clearance table, follow these guidelines:

FCC COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

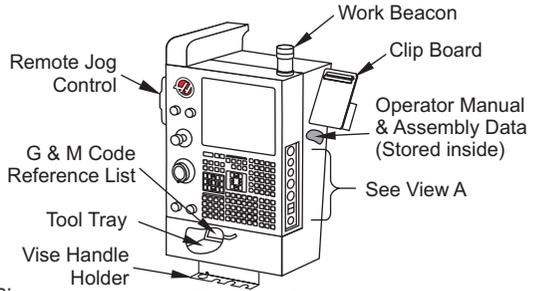




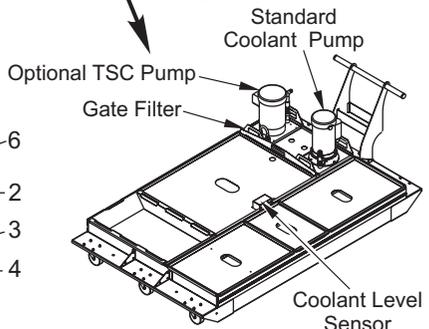
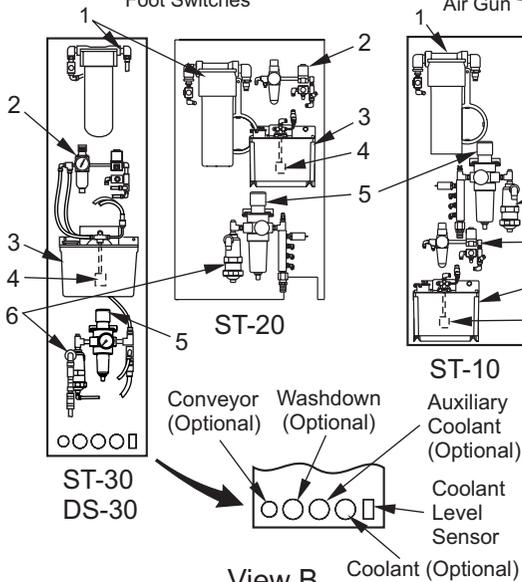
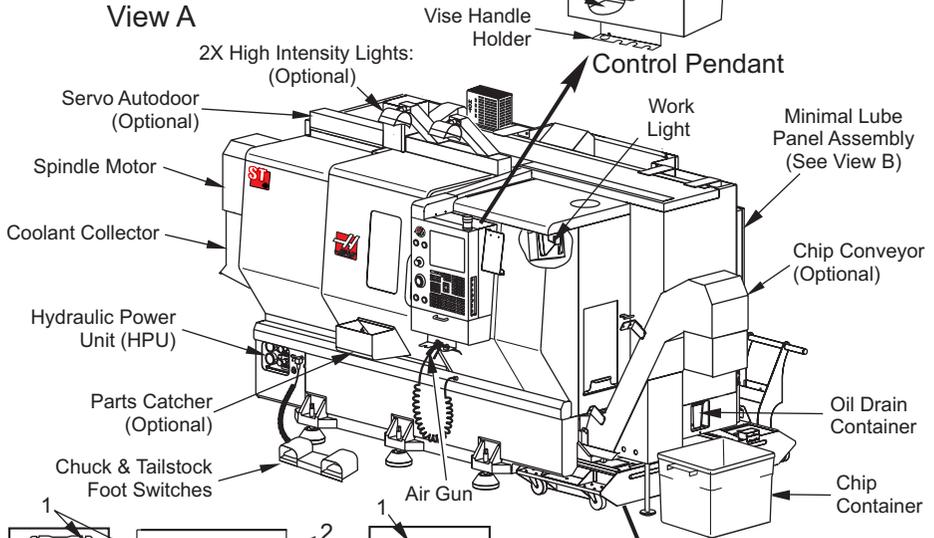
INTRODUCTION

The following is a visual introduction to a Haas turning center. Some of the features shown will be highlighted in their appropriate sections.

Pendant Side Panel Symbols	
	USB
	Second Home
	Write to Memory (Lock/Unlock)
	Autodoor Override
	Setup Mode (Lock/Unlock)
	Light Toggle (x2)



Introduction



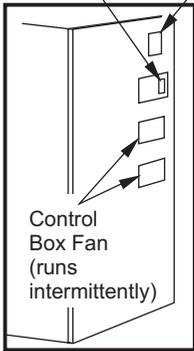
Coolant Tank (Optional 95 Gallon Shown)

Minimal Lube Panel Legend	
1	Grease Reservoir Assembly
2	Spindle Air and Pump Control
3	Spindle Oil Tank Pump Assembly
4	Spindle Pump Assembly
5	Main Regulator Air Manifold Assembly
6	Water Separator Assembly

View B Views Rotated for Clarity (Doors Removed)



Main Circuit
Breaker Switch

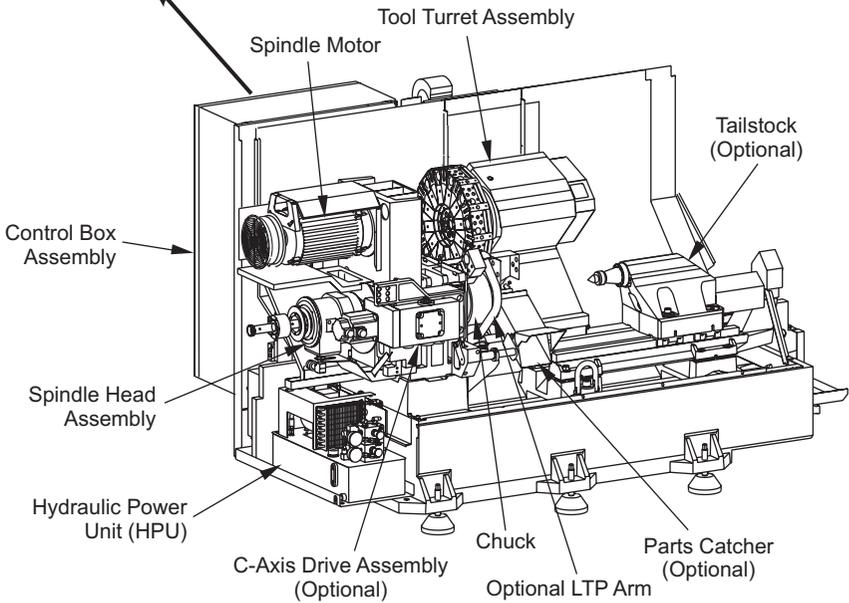


Control
Box Fan
(runs
intermittently)

DATA PLATE

Model
Serial Number
Date of Manufacture
Voltage
Phase
Hertz
Full Load
Largest Load
Short Circuit Interrupting Capacity
Wiring Diagram
Short Circuit Current 5,000 Amps RMS Symmetrical
Arc Flash Rating 208-240 VAC Models HRC-1,
360-480 VAC Models HRC-2
Over current protection provided
at machine supply terminals.
NEMA Type 1 Enclosure - For Indoor Use Only.
Made in USA

View Rotated for Clarity

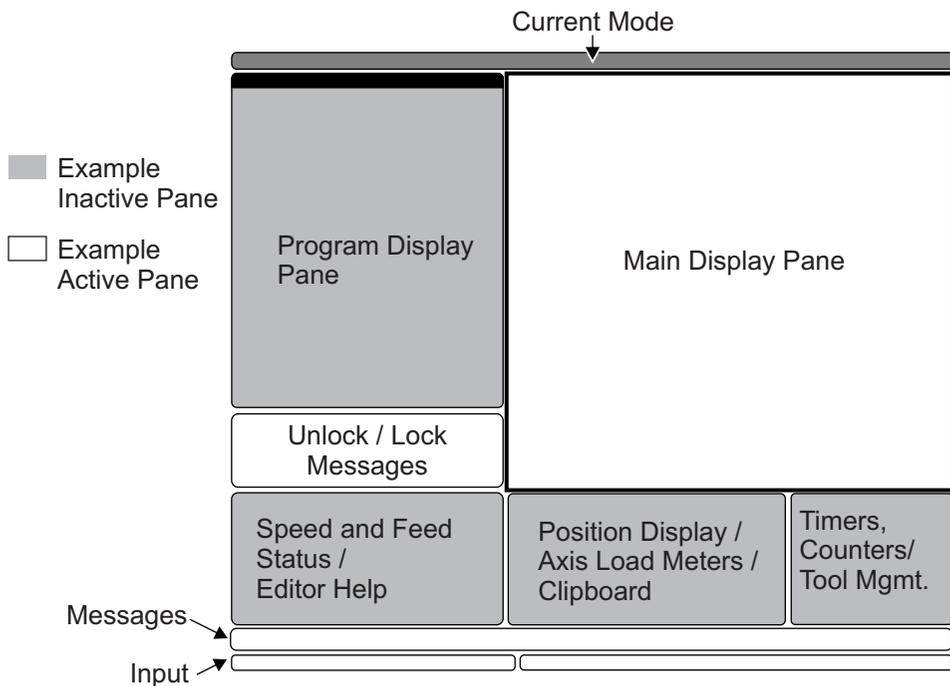


Outer Enclosure Removed (ST-20 Shown)



CONTROL DISPLAY AND MODES

The control display is organized into panes that vary depending on the current control mode, and on what display buttons are used. The following illustration shows the basic display layout:



Interaction with data can be carried out only within the currently active pane. Only one pane is active at any given time, and it is indicated with a white background. For example, to work with the Tool Offsets table, first make the table active by pressing the Offset button until it displays with a white background, then make changes to the data. Changing the active pane within a control mode is typically done with the display button.

Control functions are organized into three modes: Setup, Edit, and Operation. Each mode provides all of the necessary information to perform tasks that fall under the mode, organized to fit in one screen. For example, Setup mode displays both the work and tool offset tables, and position information. Edit mode provides two program editing panes and access to the VQCP and IPS/WIPS systems (if installed).

Access modes using the mode buttons as follows:

Setup: ZERO RET, HAND JOG keys. Provides all control features for machine setup.

Edit: EDIT, MDI/DNC, LIST PROG button. Provides all program editing, management, and transfer functions.



Operation: MEM button. Provides all control features necessary to make a part.

The current mode is shown in the title bar at the top of the display.

Note that functions from other modes can still be accessed from within the active mode by using the display buttons. For example, while in Operation mode, pressing OFFSET will display the offsets tables as the active pane; toggle the offset display using the OFFSET button. pressing PROGRAM CONVRS in most modes will shift to the edit pane for the current active program.

NAVIGATING TABBED MENUS

Tabbed menus are used in several control functions, such as Parameters, Settings, Help, List Prog, and IPS. To navigate these menus, use the arrow button to select a tab, then press Enter to open the tab. If the selected tab contains sub-tabs, use the arrow buttons and Enter to select the appropriate one.

To go up one tab level, press Cancel.

CONTROL PENDANT INTRODUCTION

The keyboard is broken up into eight sections: Function buttons, Jog buttons, Override buttons, Display buttons, Cursor button, Alpha button, Mode button and Number button. In addition there are miscellaneous buttons and features located on the pendant and keyboard which are described briefly.



Pendant Front Panel Controls

-  **Power On** - Turns the machine on.
-  **Power Off** - Turns the machine off.
-  **Emergency Stop** - Large red button with a yellow bezel. Press to stop all axis motion, disable servos, stop the spindle and tool changer, and turn off the coolant pump. Turn to reset.
-  **Jog Handle** - This is used to jog axes (select in Hand Jog Mode). Also used to scroll through program code or menu items while editing.
-  **Cycle Start** - Starts a program. This button is also used to start a program simulation in Graphics mode.
-  **Feed Hold** - Stops all axis motion. Press Cycle Start to cancel. Note: The spindle will continue to turn during cutting.



PENDANT SIDE PANEL CONTROLS



USB - Plug compatible USB devices into this port.



Memory Lock - Keyswitch. Toggle to the lock position to protect programs and settings from alteration. Unlock to allow changes.



Setup Mode - Keyswitch. Locks and unlocks machine safety features for setup purposes (see the “Setup Mode” in the Safety section of this manual for details)



Second Home - Press this button to rapid all axes to the coordinates specified in G54 P18.



Autodoor Override - Press this button to open or close the Auto-door (if equipped).



Worklight - These switches toggle the internal worklight and High Intensity Lighting (if equipped).

Keyboard Beeper - Located at the top of the parts tray. The volume can be adjusted by turning the cover.

FUNCTION KEYS

F1- F4 Keys – These keys have different functions depending upon which mode of operation you are in. For example, F1-F4 will cause a different action in Editing mode, than Program mode, than Offset mode. See the specific mode section for further descriptions and examples.

X Dia Mesur (X Diameter Measure) – Used to record X-axis tool shift offsets on the offset page during part setup.

Next Tool – Used to select the next tool from the turret (usually used during part setup).

X/Z – Used to toggle between X-axis and Z-axis jog modes during part setup.

Z Face Mesur (Z Face Measure) – Used to record Z-axis tool shift offsets on the offset page during part setup.

JOG KEYS

Chip FWD (Chip Auger Forward) - Starts optional chip auger in the “Forward” direction, moving chips out of the machine.

Chip Stop (Chip Auger Stop) - Stops auger movement.

Chip REV (Chip Auger Reverse) - Starts the optional chip auger in the “Reverse” direction, which is useful in clearing jams and debris from auger.



XI-X and ZI-Z (axis keys) - Allows the operator to manually jog axis by holding down the individual key or pressing the desired axes and using the jog handle.

Rapid - When pressed simultaneously with one of the above keys (X+, X-, Z+, Z-), that axis will move in the selected direction at maximum jog speed.

<- **TS** – Pressing this key moves the tailstock towards the spindle.

TS Rapid – Increases the speed of the tailstock when pressed simultaneously with one of the other tailstock keys.

-> **TS** – Pressing this key moves the tailstock away from the spindle.

XZ (2-Axis) Jogging

The lathe X and Z axes can be jogged simultaneously using the X and Z jog keys. Holding any combination of +/-X and +/-Z jog keys will cause two axis jogging. Releasing both jog keys will result in the control reverting to X-axis jog mode. If only a single key is released, the control will continue jogging the single axis of the key still held. Note: Normal tailstock restricted zone rules are active while engaged in XZ jogging.

Y-Axis lathes

Press the Y key on the alpha keypad and then the jog key. Jog the Y-axis with the jog handle.

VERRIDE KEYS

These keys give the user the ability to override the speed of non-cutting (rapid) axes motion, programmed feeds and spindle speeds.

-10 - Decreases current feedrate by 10%.

100% - Sets control overridden feedrate to programmed feedrate.

+10 - Increases current feedrate by 10%.

-10 - Decreases current spindle speed by 10%.

100% - Sets overridden spindle speed to programmed speed.

+10 - Increases current spindle speed by 10%.

Hand Cntrl Feed (Handle Control Feedrate) - Pressing this key allows the jog handle to be used to control the feedrate in $\pm 1\%$ increments.

Hand Cntrl Spin (Handle Control Spindle) - Pressing this key allows the jog handle to be used to control spindle speed in $\pm 1\%$ increments.

FWD - Starts the spindle in the Forward (clockwise) direction. This key is disabled on CE (export) machines.



REV - Starts the spindle in the Reverse (counterclockwise) direction. This key is disabled on CE (export) machines.

The spindle can be started or stopped with the FWD or REV keys any time the machine is at a Single Block stop or the FEED HOLD key has been pressed. When the program is restarted with Cycle Start, the spindle will be turned back on to the previously defined speed.

STOP - Stops the spindle.

5% / 25% / 50% / 100% Rapid - Limits machine rapids to the value on the key. The 100% Rapid key allows maximum rapid.

Override Usage

The feedrate can be varied from 0% to 999% of the programmed value while in operation. This is done with the feedrate +10%, -10% and 100% key. The feedrate override is ineffective during tapping cycles. Feedrate override does not change the speed of any auxiliary axes. During manual jogging, the feedrate override will adjust the rates selected from the keypad. This allows for fine control of the jog speed.

The spindle speed can also be varied, from 0% to 999%, using the spindle overrides. It is also ineffective for tapping cycles. In the Single Block mode, the spindle may be stopped. It will automatically start up upon continuing the program with the Cycle Start button.

By pressing the Handle Control Feedrate key, the jog handle can be used to control feedrate from in $\pm 1\%$ increments.

Rapid moves (G00) may be limited to 5%, 25%, or 50% of maximum using the keypad. If the 100% rapid is too fast, it may be set to 50% of maximum by Setting 10.

In the Settings page, it is possible to disable the override keys so that the operator cannot select them. These are Settings 19, 20 and 21.

The FEED HOLD button acts as an override button as it sets the rapid and feed rates to zero when it is pressed. The Cycle Start button must be pressed to proceed after a Feed Hold. The door switch on the enclosure also has a similar result but will display "Door Hold" when the door is opened. When the door is closed, the control will be in Feed Hold and Cycle Start must be pressed to continue. Door Hold and Feed Hold do not stop any auxiliary axes.

The operator can override the coolant setting by pressing the COOLNT key. The pump will remain either on or off until the next M-code or operator action (see Setting 32).

Overrides can be reset to defaults with an M06, M30 and/or pressing RESET (See Settings 83, 87,88).



DISPLAY KEYS

Display keys provide access to the machine displays, operational information and help pages. They are often used to switch active panes within a function mode. Some of these keys will display additional screens when pressed more than once.

Prgm/Convr - Selects the active program pane in most modes. In EDIT:MDI mode, press to access VQC and IPS (if installed).

Posit (Position) - Selects the positions pane, located in the lower center of most screens. Displays the current axis positions. Toggle between relative positions by pressing the POSIT key. To filter the axes displayed in the pane, type the letter for each axis you want to display and press WRITE/ENTER. Each axis position is displayed in the order you indicate.

Offset - Press to toggle between the two offsets tables. Select the Tool Offsets table to display and edit tool length geometry, radius offsets, wear offsets, and coolant position. Select the Work Offsets table to display and edit the G-code specified work offset locations used in programs.

Currt Comds (Current Commands) - Press PAGE UP / PAGE DOWN to cycle through menus for Maintenance, Tool Life, Tool Load, Advanced Tool Management (ATM), Barfeeder, System Variables, Clock settings and timer / counter settings.

Alarm / Mesgs (Alarms / Messages) - Displays the alarm viewer and message screens. There are three alarm screens, the first shows the currently active alarms (first press of the Alarm/Mesgs key). Press the Right Arrow key to view Alarm History. Use the Up and Down Arrow keys to scroll through alarm history entries, and press F2 to write to a disk.

Pressing Right Arrow again switches to the Alarm Viewer screen. This screen shows one alarm at a time with its description. The default will be the last alarm in the alarm history. Scroll through the alarms by pressing the Up and Down Arrow keys, or enter an alarm number and press Enter or the Up/Down arrow keys to display the name and description.

Pressing ALARM/MESGS a second time will display a page for user messages and notes. Use the keypad to enter messages for other operators/programmers or write notes for a current project. If there is a message, it will display every time the machine is powered on, until it is erased. See Message section for more details.

Param / Dgnos (Parameters / Diagnostics) - Displays parameters that define the machine's operation. Parameters are organized by category in a tabbed menu, or to find a known parameter, type in the number and press the up or down arrow. Parameters are set at the factory and should not be modified except by authorized Haas personnel.



A second press of the PARAM / DGNOS key will display the first page of diagnostic data. This information is mainly used for troubleshooting by a certified Haas service technician. The first page of diagnostic data is discrete inputs and outputs. Pressing Page Down will display additional pages of diagnostic data.

Setng / Graph (Settings / Graphics) - Displays and allows changing of user settings. Like Parameters, Settings are organized by category in a tabbed menu. To find a known setting, type in the number and press the up or down arrow.

Pressing the SETNG / GRAPH key a second time enables Graphics mode. In Graphics mode, you can view the generated tool path of the program and, if necessary, debug the program before running it (See Graphics Mode in the Operation section)

Help / Calc (Help / Calculator) - Displays help topics in a tabbed menu. Available help includes brief descriptions of G and M codes, definitions of control features, troubleshooting and maintenance issues. The help menu also includes several calculators.

Pressing the HELP/CALC key within some modes will call a pop-up help window. Use this window to access help topics relevant to the current mode, and also to execute certain functions as noted in the menu. To access the tabbed menu described above from a pop-up help window, press HELP/CALC a second time. Press HELP/CALC a third time to return to the display that was active when HELP/CALC was pressed the first time.

CURSOR KEYS

Cursor Keys give the user the ability to move to various screens and fields in the control and are used in the editing of CNC programs.

Home - This key will move the cursor to the top-most item on the screen; in editing, this is the top left block of the program.

Up/Down Arrows - moves up/down one item, block or field.

Page Up/Down - Used to change displays or move up/down one page when viewing a program.

Left Arrow - Used to select editable items when viewing a program; moves cursor to the left. It is used to scroll through setting selections and moves the zoom window left when in graphics mode.

Right Arrow - Used to select editable items when viewing a program; moves cursor to the right. It is used to scroll through setting selections and moves the zoom window right when in graphics mode.

End - This key moves the cursor to the bottom-most item on the screen. In editing, this is the last block of the program.



ALPHA KEYS

The alpha keys allow the user to enter the letters of the alphabet along with some special characters. Some of the special characters are entered by first pressing the “Shift” key.

Shift - The SHIFT key provides access to additional characters on the keyboard. The additional characters are seen in the upper left of the alpha and number keys. Pressing SHIFT and then the character will enter that character on the data entry line. When entering text, upper case is the default; to enter lower case characters, press and hold the SHIFT key.

EOB - This is the End-Of-Block character. It is displayed as a semicolon (;) on the screen and it signifies the end of a program line.

() - Parentheses are used to separate CNC program commands from user text comments. They must always be entered as a pair. Note: Any time an invalid line of code is received through the RS-232 port while receiving a program, it is added to the program between parenthesis.

/ - The right slash is used in the Block Delete feature and in Macro expressions. If this symbol is the first symbol in a block and a Block Delete is enabled, then that block is ignored at run time. The symbol is also used for division (divide by) in macro expressions (see the Macro section).

[] - Square brackets are used in macro functions. Macros are an optional software feature.

MODE KEYS

Mode keys change the operational state of the CNC machine tool. Once a mode key is pressed, the keys in the same row are made available to the user. The current mode is always displayed on the top line just to the right of the current display.

Edit- Selects edit mode. This mode is used to edit programs in the control's memory. Edit mode provides two editing panes: one for the currently active program, and another for background editing. Switch between the two panes by pressing the EDIT key. **Note:** While using this mode in an active program, press F1 to access help pop-up menus.

Insert - Pressing this key will enter commands into the program at the cursor. This key will also insert the text from the clipboard to the current cursor location, and is also used to copy blocks of code in a program.

Alter - Pressing this key will change the highlighted command or text to the newly entered commands or text. This key will also change the highlighted variables to the text stored in the clipboard, or move a selected block to another location.



Delete - Deletes the item that the cursor is on, or delete a selected program block.

Undo - Undoes up to the last 9 edit changes, and deselects a highlighted block.

MEM (Memory) - Selects the memory mode. This page displays the current program that is selected in the control. Programs are run from this mode, and the MEM row contains keys that control the manner in which a program is executed.

Single Block - Turns single block on or off. When single block is on, only one block of the program is executed, for every press of Cycle Start.

Dry Run - This is used to check actual machine movement without cutting a part (see the Dry Run section in the Operation Chapter).

Opt Stop (Optional Stop) - Turns on and off optional stops. Also see G103.

When this feature is On and an M01 (optional stop) code is programmed, the machine will stop when it reaches the M01. The machine will continue once Cycle Start is pressed. However, depending on the look-ahead function (G103), it may not stop immediately (See block look ahead section). In other words, the block look-ahead feature may cause the Optional Stop command to ignore the nearest M01.

If OPTIONAL STOP is pressed during a program it will take effect on the line after the highlighted line when OPT STOP is pressed.

Block Delete - Turns On/Off block delete function. Blocks with a slash (“/”) as the first item are ignored (not executed) when this option is enabled. If a slash is within a line of code, the commands after the slash will be ignored if this feature is enabled. BLOCK DELETE will take effect two lines after it is pressed, except when cutter compensation is used; in this case, block delete will not take effect until at least four lines after the highlighted line. Processing will slow down for paths containing block deletes during high-speed machining. BLOCK DELETE will stay active when power is cycled.

MDI/DNC - MDI mode is the “Manual Data Input” mode where a program can be written but it is not entered into memory. DNC mode “Direct Numeric Control”, allows large programs to be “drip fed” into the control so it can be executed (See DNC mode section)

Coolnt (Coolant) - Turns the optional coolant on and off. The optional HPC (High Pressure Coolant) is activated by pressing SHIFT followed by COOLNT. Note that as HPC and regular coolant share a common orifice, they cannot both be on at the same time.

Spindle Jog - Rotates the spindle at the speed selected in Setting 98 (Spindle Jog RPM).



Turret FWD - Rotates the tool turret forward to the next sequential tool. If Tnn is entered on the input line, the turret will advance in the forward direction to tool nn.

Turret REV - Rotates the tool turret backward to the previous tool. If Tnn is entered on the input line, the turret will advance in the reverse direction to tool nn.

Handle Jog - Selects axis jogging mode .0001, .1 - 0.0001 inches (metric 0.001mm) for each division on the jog handle. For dry run, .1 inches/min.

.0001/1, .001/1., .01/10., .1/100. - The first number (top number), when in inch mode, selects that amount to be jogged for each click of the jog handle. When the lathe is in MM mode the first number is multiplied by ten when jogging the axis (e.g. .0001 becomes 0.001mm). The second number (bottom number) is used for dry run mode and is used to select the speed feedrate and axis motions.

Zero Ret (Zero Return) - Selects Zero Return mode, which displays axis location in four different categories, they are; Operator, Work G54, Machine and Dist (distance) to go. You can page up or down to view each category in a larger format by itself.

All - Returns all axes to machine zero. This is similar to Power Up/Restart except a tool change will not occur. This can be used to establish the initial zero position. This will not work on toolroom lathes, secondary spindle lathes, or automatic parts loader (APL).

Origin - Sets selected displays and timers to zero.

Singl (Single) - Returns one axis to machine zero. Press the desired axis letter and then press the Singl Axis key. This can be used to move a single axis to the zero position.

HOME G28 - Returns all axes to machine zero in rapid motion. Home G28 will also home a single axis in the same manner if you enter an axis letter and press the home G28 key. **CAUTION!** There is no warning message to alert of any possible collision.

List Prog (List Programs) - Displays the programs stored in the control.

Select Prog - Makes the highlighted program, in the program list, the current program. Note that the current program will have an "A" preceding it in the program list.

Send - Transmits programs out the RS-232 serial port (see RS-232 section).

Recv - Receives programs from the RS-232 serial port (see RS-232 section).

Erase Prog - Erases the cursor selected program in List Prog mode or the entire program when in MDI mode.



NUMERIC KEYS

The numeric keys give the user the ability to enter numbers and a few special characters into the control.

Cancel - The Cancel key is used to delete the last character entered.

Space - Used to format comments placed into programs or in the message area.

Write/Enter - General purpose enter key.

- (Minus sign) - Used to enter negative numbers.

. **(Decimal Point)** - Used for decimal precision.

WORK BEACON

The beacon light provides quick visual confirmation of the machine's current status. There are four different beacon states:

Off: The machine is idle.

Solid Green: The machine is running.

Flashing Green: The machine is stopped, but is in a ready state. Operator input is required to continue.

Flashing Red: A fault has occurred, or the machine is in Emergency Stop.

POSITION DISPLAYS

Positions Pane - Located at the lower center of the screen, the positions pane displays current axis positions relative to four reference points (Operator, Work, Machine and Distance-to-go). Press the POSIT key to activate the positions pane, and press it again to cycle through the available position displays. When the pane is active, you can change the axes displayed by typing the axis letters in the desired order and then pressing WRITE/ENTER. For example, typing "X" will display only the X-axis. Typing "ZX" will display those axes in the order indicated. A larger positions display is available by pressing CURNT COMDS, then PAGE UP or PAGE DOWN until the positions display is shown.

Operator Display - This display is used to show the distance the operator has jogged any of the axes. This does not represent the actual distance the axis is from machine zero, except when the machine is first powered on. Axes can be zeroed by typing the axis letter and pressing the Origin key.

Work Display - This displays the position of X, Y and Z in relation to the part; not machine zero. On power-up, it will display the value in work offset G54



automatically. The position can only be changed by entering values in work offsets G55 through G59, G110 through G129, or by commanding a G92 in a program.

Machine Display - This displays the axes' positions relative to machine zero.

Distance To Go - This display shows the distance remaining before the axes reach their commanded position. When in hand jog mode, this position display can be used to show a distance moved. Zero this display by changing modes (MEM, MDI) and then switching back to hand jog.

OFFSETS DISPLAY

There are two offsets tables, the Tool Geometry/Wear table and the second is the Work Zero offset table. Depending on the mode, these tables may appear in two separate display panes, or they may share a pane; use the OFFSET key to toggle between tables

Tool Geometry/Wear - This table displays tool numbers and tool length geometry. Press the left cursor arrow when the cursor is in the first column of the tool geometry table to access the tool wear table.

To enter values into these fields key in a number and press F1. Keying in a number and pressing F2 will set the negative of the entered value into the offsets. Entering a value and pressing WRITE/ENTER will add the value to what is currently entered. To clear all the values on the page press ORIGIN; the lathe will prompt "Zero All (Y/N)" press Y to zero all or press N to leave all the values unchanged.

Work Zero Offset - This table displays the values entered so that each tool knows where the part is located. A value can be set for each axis. Use the arrow keys to scroll to each column or the Page Up or Down key to access the other offsets in the Work Zero section.

In order for each tool to locate the part, the tools used in a program must be "Touched off" the part (See the Operations section).

A value can also be entered by typing in a number and pressing F1, or the value can be added to an existing value by pressing WRITE/ENTER. Keying in a number and pressing F2 will set the negative of the entered value into the offsets. To clear all the values on the page press ORIGIN, the lathe will prompt the operator with "Zero All (Y/N) press Y to zero all or press N to leave all the values unchanged.



CURRENT COMMANDS DISPLAY

The following are several Current Command pages in the control. Press the Current Commands key and use the Page Up/Down keys to navigate through the pages.

Program Command Check Display - Current command information persists throughout most modes. Spindle information such as speed, load, direction, surface feet per minute (SFM), chip load and current transmission gear (if equipped) is shown in the lower-left display pane in all modes except Edit.

Axis positions are shown in the lower-center display pane. Cycle through the coordinate system (operator, work, machine, or distance to go) using the POSIT key. This pane also displays load data for each axis in some displays.

The coolant level is displayed near the upper-right of the screen.

Current Display Command - This read-only display lists active program codes in the upper center of the screen.

Access the following screens by pressing CURNT COMDS, then PAGE UP or PAGE DOWN to cycle among displays.

Operation Timers Display - This display shows the current power-on time, cycle start time (the amount of total time the machine has been running a program), and the feed time (total amount of time the machine has been feeding). These times may be reset to zero by using the cursor up and down keys to highlight the desired title and pressing ORIGIN.

Listed below these times are two M30 counters, these counters are used for counting completed parts. They may be set to zero independently to provide for the number of parts per shift and total parts.

Further, two macro variables can be monitored within this display.

Macro Variables Display - This display shows a list of the macro variables and their present values. As the control runs the program, the variables will be updated. In addition the variables may be modified in this display; refer to the "Macros" section for more information.

Active Codes - Lists active program codes. It is an expanded display of the program code display described above.

Positions Display - Provides a larger view of current machine positions, with all reference points (operator, machine, work, distance to go) displayed at once. You can also handle jog axes from this screen.

Maintenance - This page allows the operator to activate and deactivate a series of checks (see Maintenance section).

Tool Life Display - This display shows the time the tool is used in a feed (Feed-Time), the time the tool is in the cutting position (Total-Time), and the



number of times the tool has been selected (Usage). This information is used to assist in predicting tool life. The values in this display can be reset to zero by highlighting the value and pressing ORIGIN. The maximum value is 32767; once this value is reached, the control will start back at zero.

This display may also be used to generate an alarm when a tool has been used a specific number of times. The last column is labeled "Alarm"; entering a number in that column will cause the machine to generate an alarm (#362 Tool Usage Alarm) when that count is reached.

Tool Load Monitor and Display - The operator can enter the maximum amount of tool load, in %, that is expected for each tool. The operator can select the appropriate action to be taken when this load is exceeded. This display provides for the entry of this alarm point and also displays the largest load that tool has seen in a previous feed.

The tool load monitor function operates whenever the machine is in a feed operation (G01, G02, or G03). If the limit is exceeded the action specified in Setting 84 will occur (see settings section for a description).

Axis Load Monitor - Axis load is 100% to represent the maximum continuous load. Up to 250% can be shown, however an axis load above 100%, for an extended period of time, can lead to an overload alarm.

ALARMS/MESSAGES DISPLAY

Alarms

Select the Alarms display by pressing ALARM / MESGS. There are three types of Alarms screens. The first shows any current alarms. Pressing the Right Arrow key switches to the Alarm History screen, which shows the previously received alarms. Pressing Right Arrow again switches to the alarm viewer screen. This screen shows one alarm at a time with its description. You can then scroll through all the alarms by pressing the Up and Down Arrow keys. To view Alarm details for a known alarm number, type the number while the alarm viewer is active, then press WRITE/ENTER or the left/right cursor key.

Note: The Cursor and Page Up and Page Down keys can be used to move through a large number of alarms.

Messages

Press ALARM/MESGS twice to select the Message Display. This is an operator message display and has no other effect on operation of the control. Use the keypad to enter the messages. The cancel and space keys can be used to remove existing messages and the Delete key can be used to remove an entire line. Data is automatically stored and maintained even in a power-off state. The message display page will come up during power-up if there are no new alarms present.



SETTING/GRAPHIC DISPLAY FUNCTION

The Settings are selected by pressing SETNG/GRAPH. There are some special functions in the settings which change the way the lathe behaves; refer to the “Settings” section for a more detailed description.

The Graphics function is selected by pressing SETNG/GRAPH twice. Graphics is a visual dry run of your part program without the need to move the axes and risk tool or part damage from programming errors. This function may be considered more useful than the Dry Run mode, because all of your work offsets, tool offsets, and travel limits can be checked before running the machine. The risk of a crash during setup is greatly reduced.

Graphics Mode Operation

To run a program in Graphics, a program must be loaded and the control must be in either MEM, MDI or Edit mode. From MEM or MDI, press SETNG/GRAPH twice to select the Graphics Mode. From Edit mode, press CYCLE START while the active program edit pane is selected to start a simulation.

The Graphics display has a number of available features.

Key Help Area The lower left of the graphics display pane is the function key help area. Function keys that are currently available are displayed here with a brief description of their usage.

Locator Window The lower right part of the pane displays the whole table area and indicates where the tool is currently located during simulation.

Tool Path Window In the center of the display is a large window that represents a top view of the X and Z axes. It displays tool paths during a graphics simulation of the program. Rapid moves are displayed as dotted lines, while feed motion is displayed as fine continuous lines. (Note: Setting 4 can disable the rapid path.) The places where a drilling canned cycle is used are marked with an X. Note: Setting 5 can disable the drill mark.

Adjusting Zoom Press F2 to display a rectangle (zoom window) indicating the area to be magnified. Use PAGE DOWN to decrease the size of the zoom window (zooming in), and use PAGE UP to increase the size of the zoom window (zooming out). Use the Cursor Arrow keys to move the zoom window to the desired location and press WRITE/ENTER to complete the zoom and rescale the tool path window. The locator window (small view at the bottom right) shows the entire table with an outline of where the Tool Path window is zoomed. Tool Path window is cleared when zoomed, and the program must be re-run to view the tool path.

The scale and position of the Tool Path window is saved in Settings 65 through 68. Leaving graphics to edit the program and then returning to Graphics will keep the previous scaling in effect.

Press F2 and then the Home key to expand the Tool Path window to cover the entire work area.



Z Axis Part Zero Line This feature consists of a horizontal line displayed on the Z-axis bar at the top-right corner of the graphics screen to indicate the position of the current Z-axis work offset plus the length of the current tool. While a program is running, the shaded portion of the bar indicates the depth of Z-axis motion. You can watch the position of the tool tip relative to the Z-axis part zero position as the program runs.

Control Status The lower left portion of the screen displays control status. It is the same as the last four lines of all other displays.

Position Pane The position pane displays axes locations just as it would during a live part run.

F3 / F4 Use these keys to control simulation speed. F3 decrements speed, F4 increments speed.

SCREEN CAPTURE

The control can capture and automatically save a snapshot of the current screen to an attached USB device or the hard drive. If no USB device is connected and the machine does not have a hard drive, no image will be saved.

Press SHIFT then F1 to capture the screen using the default filename 'snapshot.bmp'. This will overwrite any screen capture previously taken using the default name.

Optionally, you can enter a filename on the input line before capturing the screen. The control adds the *.bmp file extension automatically.

DATE AND TIME

The control contains a clock and date function. To view the time and date, press CURNT COMDS, then PAGE UP/DOWN until the date and time appears.

To make adjustments, press Emergency Stop, type the current date (in MM-DD-YYYY format) or current time (in HH:MM format), and press WRITE/ENTER. Reset Emergency Stop when finished.

TABBED HELP / CALCULATOR FUNCTION

Press HELP/CALC to display the tabbed help menu. If pressing HELP/CALC calls a pop-up help menu, press HELP/CALC again to access the tabbed menu. Navigate tabs using the Cursor Arrow keys. Press WRITE/ENTER to select tabs, and press CANCEL to back up one tab level. The main tab categories and their sub-tabs are described here:



Help

The on-screen help system includes content from the entire operator's manual. Selecting the Help tab displays the table of contents. Highlight a topic using the Cursor Arrow keys and press WRITE/ENTER to view the topic contents. Select from subtopic menus in the same way.

Scroll through the page using the jog handle or the Up/Down Cursor Arrow keys. Use the Left/Right Cursor Arrow keys to move to the next topic. Press HOME to return to the main table of contents.

Press F1 to search manual contents, or press CANCEL to exit the Help tab and select the Search tab.

Search

Use the Search tab to look for help content by keyword. Type your search term in the text field and press F1 to execute the search. The results page displays topics that contain your search term; highlight a topic and press WRITE/ENTER to view.

Drill Table

Displays a drill size table featuring decimal equivalents and tap sizes.

Calculator

Calculator functions are available under the third Help tab. Select the calculator from the lower tabs and press WRITE/ENTER to use it.

All of the Calculator functions will do simple add, subtract, multiply, and divide operations. When one of the functions is selected, a calculator window appears with the possible operations (LOAD, +, -, *, and /). LOAD is initially highlighted, and the other options can be selected with the left and right cursor arrows. Numbers are entered by typing them in and pressing WRITE/ENTER. When a number is entered and LOAD is selected, that number will be entered into the calculator window directly. When a number is entered when one of the other functions (+ - * /) is selected, that calculation will be performed with the number just entered and any number that was already in the calculator window. The calculator will also accept a mathematical expression such as $23*4-5.2+6/2$, evaluating it (doing multiplication and division first) and placing the result, 89.8 in this case, in the window.

Note that data cannot be entered in any field where the label is highlighted. Clear data in other fields until the label is no longer highlighted in order to change the field directly.

Function Keys: The function keys can be used to copy and paste the calculated results into a section of a program or into another area of the Calculator feature.

F3: In EDIT and MDI modes, F3 will copy the highlighted triangle/circular milling/tapping value into the data entry line at the bottom of the screen. This is useful when the calculated solution will be used in a program.

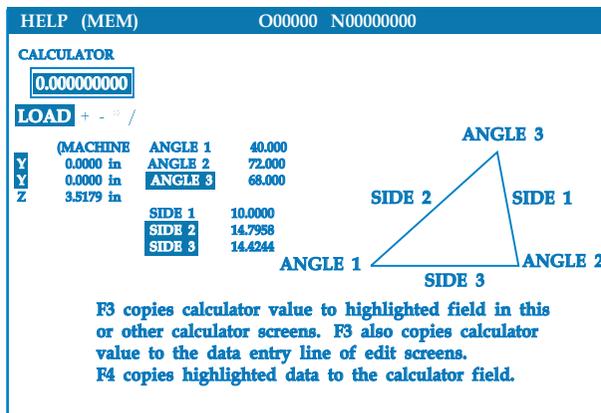


In the Calculator function, pressing F3 copies the value in the calculator window to the highlighted data entry for Trig, Circular or Milling/Tapping calculations.

F4: In the Calculator function, this key uses the highlighted Trig, Circular or Milling/Tapping data value to load, add, subtract, multiply, or divide with the calculator.

Trigonometry Help Function

The Trigonometry calculator page will help solve a triangular problem. Enter the lengths and the angles of a triangle and when enough data has been entered, the control will solve for the triangle and display the rest of the values. Use the Cursor Up/Down buttons to select the value to be entered with WRITE/ENTER. For inputs that have more than one solution, entering the last data value a second time will cause the next possible solution to be displayed.



Circular Interpolation Help

The Circular calculator page will help solve a circle problem. You enter the center, radius, angles, start and end points; when enough data has been entered, the control will solve for the circular motion and display the rest of the values. Use the Cursor Up/Down keys to select the value to be entered with Write. In addition, it will list alternate formats that such a move could be programmed with a G02 or G03. The formats can be selected using the Cursor Up/Down keys, and press F3 to import the highlighted line into the program being edited.



```

HELP (MEM)          O00000 N00000000
CALCULATOR
0.000000000 CENTER X      13.0000
                CENTER Y      20.0000
LOAD + - * /     START X       4.0000
                START Y      10.0000
(MACHINE)       END X         7.0000
X 0.0000 in    END Y         32.0416
Y 0.0000 in    RADIUS        13.4536
Z 3.5179 in    ANGLE          111.527
                DIRECTION     CW
                16 19. J10.
                16 R13.4536
                16 19. J10
G91 G2 X3. Y22.0416 R13.4536

```



For inputs that have more than one solution, entering the last data value a second time will cause the next possible solution to be displayed. To change the CW value to the CCW value, highlight the CW/CCW column and press WRITE/ENTER.

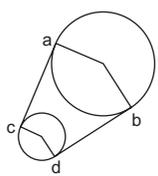
Circle-Line Tangent Calculator

This feature provides the ability to determine points of intersection where a circle and a line meet as tangent. Enter two points, A and B, on a line and a third point, C, away from that line. The control will calculate the point of intersection. The point is where a normal line from point C will intersect with the line AB, as well as the perpendicular distance to that line.

```

CIRCLE-CIRCLE TANGENT
CIRCLE1 X 5.0000
CIRCLE1 Y 6.0000
RADIUS 1 4.0000
CIRCLE2 X 0.0000
CIRCLE2 Y 0.0000
RADIUS 2 2.0000
TANGT A X 1.3738
          Y 7.6885
TANGT B X 7.3147
          Y 2.7378
TANGT C X -1.8131
          Y 0.8442
TANGT D X 1.1573
          Y -1.6311
Type: STRAIGHT
*****
Use F and T to form G-code.
F1 for alternate solution

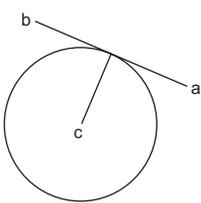
```



```

CIRCLE-LINE TANGENT
POINT A X 5.0000
          Y 3.0000
POINT B X 1.0000
          Y 4.0000
POINT C X 0.0000
          Y 0.0000
RADIUS 4.1231
TANGT PT X 1.0000
TANGT PT Y 4.0000

```



Circle-Circle Tangent Calculator

This feature provides will determine points of intersection between two circles or points. The user provides the location of two circles and their radii. The control then calculates the intersection points that are formed by lines tangent to both circles. Note that for every input condition (two disjointed circles), there are up to eight intersection points. Four points are from drawing straight tangents and four points by forming cross tangents. The F1 key is used to toggle between the two diagrams. When "F" is pressed, the control will prompt for the from and to points (A, B, C, etc.) that specify a segment of the diagram. If the segment is an arc, the control will also prompt for C or W (CW or CCW). G code is then displayed at the bottom of the screen. When "T" is entered, the



previous to point becomes the new From point and the control prompts for a new To point. To enter the solution (line of code), go to MDI or Edit and press F3, as the G-code is already on the input line.

Drill/Tap Chart

A Drill and Tap Chart is available in the tabbed help menu.

COOLANT LEVEL GAUGE

The coolant level is displayed in the CURNT COMDS screen and in the upper right of the screen in MEM mode. A vertical bar shows the status of the coolant. The display will flash when the coolant reaches a point that could cause intermittent coolant flow.

RUN STOP JOG CONTINUE

This feature allows the operator to stop a running program, jog away from the part, and then resume program execution. The following is an operation procedure:

1. Press FEED HOLD to stop the running program.
2. Press X or Z followed by HANDLE JOG. The control will store the current X and Z positions. Note: Axes other than X and Z cannot be jogged.
3. The control will display the message "Jog Away". Use the jog handle, remote jog handle, jog and jog-lock keys to move the tool away from part. The spindle can be controlled by pressing CW, CCW, STOP. If necessary, tool inserts can be changed. Caution: When the program is continued, the old offsets will be used for the return position. Therefore, it is unsafe and not recommended to change tools and offsets when the program is interrupted.
4. Jog to a position as close as possible to the stored position, or to a position where there will be an unobstructed rapid path back to the stored position.
5. Return to the previous mode by pressing MEM, MDI, or DNC. The control will only continue if the mode that was in effect when stopped is re-entered.
6. Press CYCLE START. The control will display the message Jog Return and rapid X and Y at 5% to the position where FEED HOLD was pressed, then return the Z-axis. Caution: The control will not follow the path used to jog away. If FEED HOLD is pressed during this motion, the mill axes motion will pause and display the message "Jog Return Hold". Pressing CYCLE START will cause the control to resume the Jog Return motion. When the motion is completed, the control will again go into a feed hold state.
7. Press CYCLE START again and the program resumes normal operation. Also see Setting 36 Program Restart.



M-NET

M-Net is a network protocol for communication between machine tools, robots, and shop computers over a Local Area Network (LAN) and the Internet. Commercially developed applications use M-Net to send, receive, compile and report data between devices on the network.

Software vendors can provide more information about their M-Net applications.

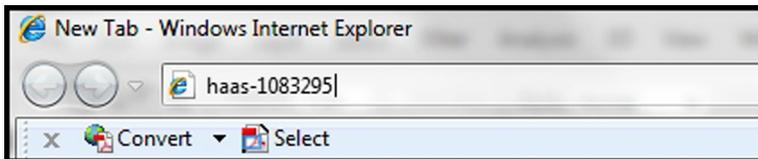
ALARM NOTIFICATIONS

Haas machines include a basic application to send an alert to an email address or cellular telephone when an alarm occurs. Setting up this application requires some knowledge about your network; ask your system administrator or Internet Service Provider (ISP) if you do not know the correct settings.

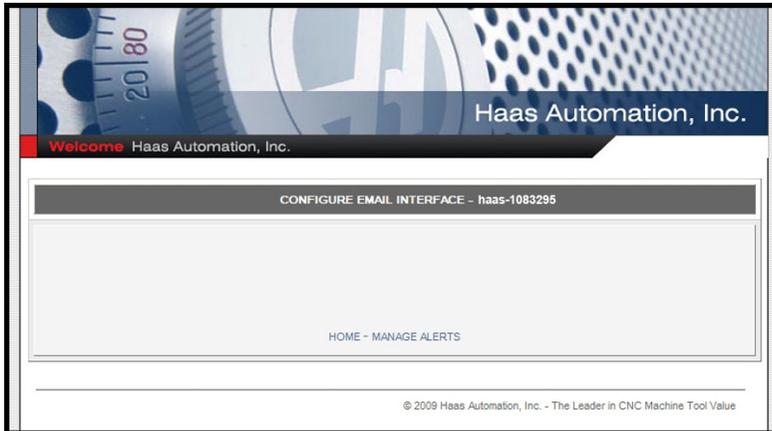
Before setting up alerts, make sure the machine has an established connection to your Local Area Network, and that Setting 900 defines a unique network name for the machine. This feature requires the Ethernet option and software version 11.01 or later.

Setting up Alerts

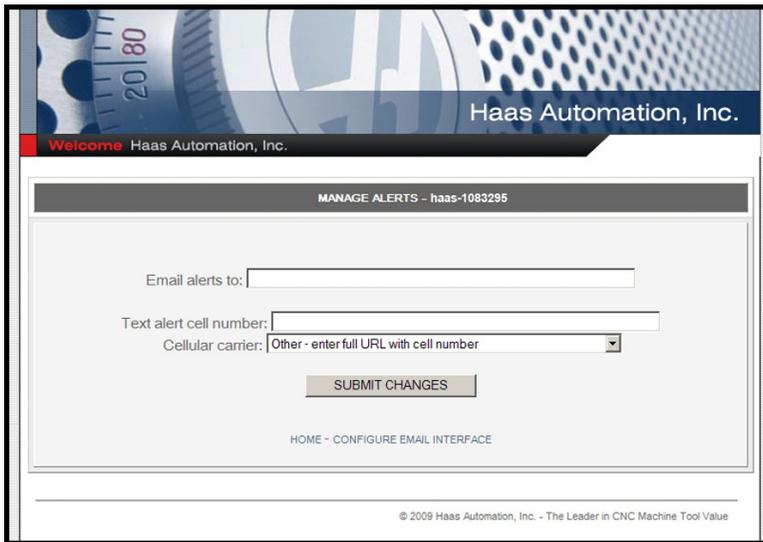
1. Using an Internet browser on another device connected to the the network, type the machine's network name (Setting 900) into the browser address bar and press Enter.



2. A popup message may appear with a request to set a cookie in your browser. This will happen each time you access the machine using a different computer or browser, or after an existing cookie has expired. Click "OK" to proceed.
3. The home screen displays, with the setup options at the bottom of the screen. Click "Manage Alerts".



4. At the “Manage Alerts” screen, enter the email address and/or cellular phone number where you want to receive alerts. If entering a cellular phone number, select your carrier from the pull-down menu under the cell number field. Click the “submit changes” button when finished.



Note: If your cellular carrier is not listed in the menu, ask your carrier to provide your account’s email address through which you can receive text messages. Enter this address in the email field.



5. Click "Configure Email Interface".

Haas Automation, Inc.

Welcome Haas Automation, Inc.

CONFIGURE EMAIL INTERFACE - haas-1083295

DNS IP address:

SMTP server name:

SMTP server port:

Authorized EMAIL account:

SUBMIT CHANGES

HOME - MANAGE ALERTS

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6. Fill in the fields with your email system's information. Ask your system administrator or ISP if you do not know the correct values. Click the "submit changes" button when finished.

Note: Haas Automation service personnel cannot diagnose or repair problems with your network.

- a. In the first field, enter the IP address for your domain name server (DNS).
 - b. In the second field, enter your simple mail transfer protocol (SMTP) server name.
 - c. The third field, SMTP server port, is already populated with the most common value (25). Change this only if the default setting does not work.
 - d. In the last field, enter an authorized email address, which the application will use to send the alert.
7. Press Emergency Stop to generate an alarm to test the system. An email or text message should arrive at the designated address or telephone number with details about the alarm.

SPINDLE VIBRATION DETECTION

An unbalanced part in the spindle generates an alarm if it causes vibration beyond parameter-controlled limits. Make sure the workpiece is securely and properly clamped.



MEMORY LOCK KEY SWITCH

Locks memory to prevent accidental or unapproved program editing by unauthorized personnel. It can also be used to lock settings, parameters, offsets and macro variables.

OPTIONS

200 Hour Control Option Try-Out

Options that normally require a unlock code to activate (Rigid Tap, Macros, Intuitive Programming System (IPS)) can now be activated and deactivated as desired simply by entering the number “1” instead of the unlock code to turn it on. Enter a “0” to turn off the option. An option activated in this manner will be automatically deactivated after a total of 200 power-on hours. Note that the deactivation only occurs when power to the machine is turned off, not while it is running. An option can be activated permanently by entering the unlock code. Note that the letter “T” will be displayed to the right of the option on the parameter screen during the 200 hour period.

To enter a 1 or 0 into the option, press the Emergency Stop button in and turn setting 7 (Parameter Lock) off. When the option reaches 100 hours the machine will give an alarm warning that the try out period is almost over. To permanently activate an option contact your dealer.

USB and Ethernet

Store and transfer data between your Haas machine(s) and a network. Program files are easily transferred to and from memory, and allows DNC of large files.

Macros

Create subroutines for custom canned cycles, probing routines, operator prompting, math equations or functions, and family-of-parts machining with variables.

Auto Door

The auto door option opens the machine doors automatically via the part program. This reduces operator fatigue, and allows for unattended operation when used with a robot.

Auto Jet Blast

The Auto Jet Blast keeps your workpiece clean. With the doors closed, an M-code activated air blast clears chips and coolant from the chuck and workpiece.

Tool Presetter

The automatic tool-probe arm swings down for fast tool setting. Touch the tool tip to the probe and offsets are automatically entered.



High Intensity Lighting

Halogen lights provide bright, even illumination of the work area for part inspection, job setup and change-overs — ideal for jobs like mold making. Lights turn on and off automatically when doors open and close, or can be activated manually via a switch on the pendant.

Steady Rest Provision (SL-40 only)

The steady rest mounting platform provides increased support for long-shaft or narrow-shaft operations. Industry-standard mounting holes accept most after-market steady-rest grippers.

M-Function Relays

Adds extra relays to increase productivity. These additional M code outputs may be used for activating probes, auxiliary pumps, part loaders, etc.

Tailstock

The fully programmable hydraulic tailstock can be activated via the part program or controlled directly by the operator with the standard foot switch.

Parts Catcher

The optional part chute rotates into position to catch the finished part and directs it into a bin located on the front door. There is no need to stop the machine and open the door to retrieve parts.

Barfeeder

Designed to boost productivity and streamline turning operations, this servo driven bar feeder is exclusively for Haas CNC lathes. Unique features make setup and operation simple, like a large access door for spindle liner change-out, and a single adjustment for setting bar diameter.

Live Tooling (Standard on Y-axis lathes)

The live tooling option allows you to drive standard VDI axial or radial driven tools to perform such secondary operations as drilling or tapping, both on the face of the part and around the diameter. The main spindle provides indexing in precise increments for part positioning and repeatability. These operations also apply to Y-axis models. Refer to the Y-axis programming section for more information.

C-Axis (Standard on Y-axis)

The C-axis provides high-precision, bi-directional spindle motion that is fully interpolated with X and/or Z motion. Cartesian-to-polar interpolation allows programming of face contouring operations using traditional X and Y coordinates.

Spindle Orientation

The Spindle Orientation option allows spindle positioning to a specific, programmed angle, using the standard spindle motor and the standard spindle encoder for feedback. This option provides inexpensive, accurate (0.1 degree) positioning.



Auxiliary Filter

This 25-micron #2 bag-type filter system removes contamination and minute particles from the coolant before they can be recirculated through the coolant pump. The filter is mandatory for machines equipped with high-pressure coolant when machining cast iron, cast aluminum and other abrasive materials, and may be used on non-HPC machines as well.

Remote Jog Handle

The patented Haas Enhanced Remote Jog Handle with LCD features a 2.8" color graphic display, keypad, a triple-knob motion-control system, and a built-in LED inspection light. You can set tool and work offsets, jog up to 9 axes, display machine position, show the current program running, and much more – all from the jog handle.





OPERATION

This chapter reviews the machine features and options. Use this chapter to set-up the machine, load workpieces and prepare tooling.

MACHINE POWER-UP

Turn the machine on by pressing the Power-On button on the pendant.

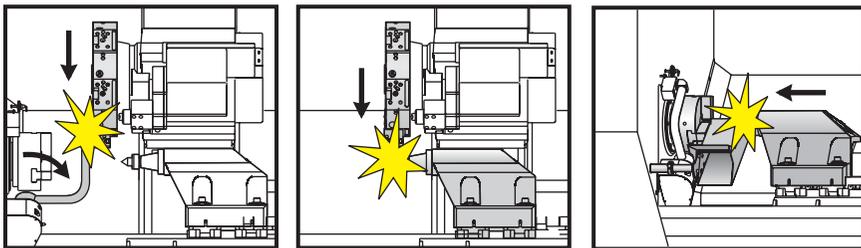
The machine will go through a self test and then display either the Messages screen, if a message was left, or the Alarms screen. In either case the mill will have one or more alarms present (102 SERVOS OFF).

Follow the directions in the 'mode status box' on the left side of the display. Generally the doors will need to be cycled and E-STOP pressed and cleared before the 'Power Up' or 'Auto All Axes' operations become available. For more information on safety lock features, refer to the "Safety" section in this manual.

Press the Reset button to clear each alarm. If an alarm cannot be cleared the machine may need servicing; if this is the case call your dealer.

Once the alarms are cleared the machine needs a reference point to start all operations from; this point is called "Home". To home the machine, press the Power-Up Restart key.

Watch the following areas at power up. Machine crashes will occur if these components are not properly positioned during machining cycles. This applies to the tool probe, parts catcher, tailstock and tool turret.



Y-Axis Lathes: Always command the Y-axis home prior to homing the X axis. If the Y-axis is not at the zero position (spindle centerline) the X-axis may not be able to return home. The machine may give an alarm or message (Y axis is not at home).

**WARNING! Automatic motion will begin once this key is pressed.
Keep away from the inside of the machine and the tool changer.**

Note that pressing the Power-Up/Reset key will automatically clear alarm 102 if it was present.

After home is found the Current Commands page is displayed, and the machine is now ready to run.



PROGRAMMING INTRODUCTION

Manual Data Input (MDI)

Manual Data Input (MDI) is a means to command automatic CNC moves without using a formal program.

Press MDI/DNC to enter this mode. Programming code is entered by typing in the commands and pressing WRITE/ENTER at the end of each line. Note that an End of Block (EOB) will be automatically inserted at the end of each line.

```
PROGRAM - MDI
G97 S1000 M03 ;
G00 X2. Z0.1 ;
G01 X1.8 Z-1. F0.012 ;
X1.78 ;
X1.76 ;
X1.75 ;
```

To edit the MDI program, use the keys to the right of the Edit key. Cursor to the point that is changing, then the different edit functions can be used.

To enter an additional command to the line, type the command and press WRITE/ENTER.

To change a value, use the arrow key or the jog handle to highlight the command, enter the new command and press ALTER.

To delete a command, highlight the command and press DELETE.

The Undo key will reverse changes (up to 9 times) that have been made to the MDI program.

The data in MDI is retained after exiting MDI mode and when the machine is turned off. To clear the current MDI commands press the Erase Prog key.

Numbered Programs

To create a new program, press List Prog to enter the program display and the list of programs mode. Enter a program number (**O**nnnnn) and press SELECT PROG or WRITE/ENTER. If the program exists, it will be selected. If it does not yet exist, it will be created. Press EDIT to show the new program. A new program will consist of only the program name and an End of Block (;). Numbered programs are retained when the machine is turned off

Basic Editing of MDI and Numbered Programs

The only difference between an MDI program and a numbered program is the O code. To edit an MDI program, simply press MDI/DNC. To edit a numbered program, select it, then press Edit.



Type in the program data and press enter. Program data falls into three categories, addresses, comments, or EOBs.

```
EDIT: EDIT
PROGRAM EDIT 000741 (CYCLE START TO SIMULATE) PROGRAM EDIT 000741
G00 X0 Z0.1 ;
G74 Z-0.345 F0.03 K0.1 ;
;
G00 X2. Z0.1 ;
G74 X1. Z-4. I0.2 K0.75 D255 ;
G00 X3. Z0.1
```

To add program code to an existing program, highlight the area the additional code will go in front of, type in the data, and press INSERT. More than one code; such as **X** and **Z**, can be entered before pressing INSERT.

Address data is a letter followed by a numeric value. For example: G04 P1.0. The G04 commands a dwell (pause) and the P1.0 is the length (1 second) of the dwell.

Comments can be either alpha or numeric characters, but must be prefaced with parentheses. For example: (1 second dwell). Comments can be a maximum of 80 characters.

Lower-case text can be entered between parentheses (comments). To type lower case text, press SHIFT first (or hold it in) and then the letter or letters.

End of Blocks are entered by pressing EOB and are displayed as a semicolon (;). These are used like a carriage return at the end of a paragraph. In CNC programming, an EOB is entered at the end of a string of program code.

An example of a line of code using the three types of commands would be: G04 P1. (1 second dwell);

There is no need to enter spaces between commands. Spaces are automatically entered between elements for ease of reading and editing.

To alter characters, highlight a portion of the program using the arrow keys or the jog handle, enter the replacement code, and press ALTER.

To remove characters or commands, highlight them and press DELETE.

Use UNDO to reverse any changes. The Undo key will work for the last nine entries.

There is no save command. The program is saved as each line is entered.

Converting an MDI program to a numbered program

An MDI program can be converted to a numbered program. To do so, cursor to the beginning of the program (or press HOME), enter a program name (programs need to be named using the format **O**nnnnn; the letter “O” followed



by up to 5 numbers) and press Alter. This will add the program to the list of programs and clear MDI. To re-access the program, press LIST PROG and select it.

Searching the program

While in Edit or Mem mode the cursor up and down keys can be used to search the program for specific codes or text. To search for particular character(s), enter the character(s) on the data entry line (i.e. G40) and press the cursor up or down keys. The cursor up key will search for the entered item backward (toward the start of the program) and the cursor down key will search forward (toward the end of the program).

Deleting Programs

To delete a program, press List Prog. Use the cursor up or down keys to highlight the program number (or type in the program number) and press the Erase Prog key. To delete multiple programs, highlight each program to be deleted and press Write to select them. Press the Erase Prog key to delete the files.

Highlighting ALL at the end of the list and pressing the Erase Prog key will delete all the programs in the list. There are some important programs that you will receive with your machine; they are O02020 (spindle warm up) and O09997, O09999 (Visual Quick Code). You will want to save these programs before erasing all programs. Note that the Undo key will not recover programs that are deleted.

Renaming Programs

After creating a program, the program number can be renamed by changing the name (Oxxxxx), in Edit mode, on the first line and pressing the Alter key.

Maximum Program Numbers

If the maximum number of programs (500) is in the control's memory, the message "Dir Full" will display and the program cannot be created.

Program Selection

Enter the program directory by pressing LIST PROG; this will display the stored programs. Scroll to the desired program and press SELECT PROG to select the program. Entering the program name and pressing SELECT PROG will also select a program.

Once SELECT PROG is pressed, the letter "A" appears next to the program name. This program is now active and will be run when the mode is changed to Mem and CYCLE START is pressed. It is also the program that you will see on the Edit display.

The active program will remain active after the machine is turned off.



CNC DATA TRANSFER

Numbered programs can be copied from the CNC control to a personal computer (PC) and back again. It is best if the programs are saved to a file that ends in “.txt”. That way, they will be recognized by any PC as a simple text file. Programs can be transferred by many different methods such as RS-232, and USB. Settings, offsets and macro variables can be transferred between the CNC and a PC in a similar manner.

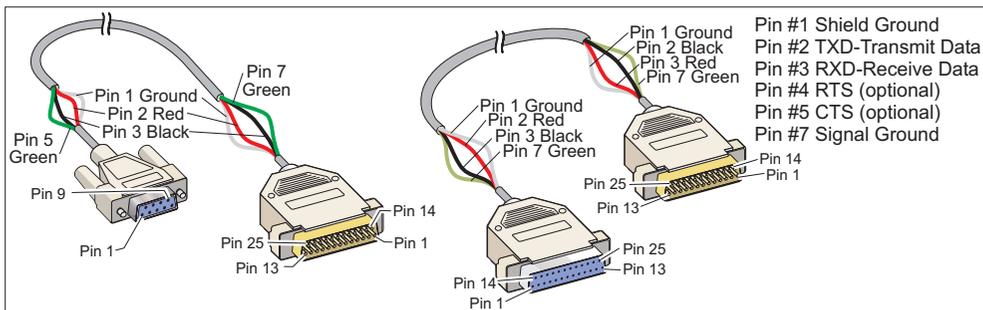
Unknown G-Code received by the CNC is converted into a comment, stored in the program, and an alarm is generated. However, the data will still be loaded into the control. This will occur when trying to load Macros without the Macro option installed.

RS-232

RS-232 is one way of connecting the Haas CNC control to another computer. This feature enables the programmer to upload and download programs, settings and tool offsets from a PC.

Programs are sent or received through the RS-232 port (Serial Port 1) located on side of the control box (not the operator’s pendant).

A cable (not included) is necessary to link the CNC control with the PC. There are two styles of RS-232 connections: the 25-pin connector and the 9-pin connector. The 9-pin connector is more commonly used on PCs.



WARNING! One of the biggest causes of electronic damage is a lack of a good ground on both the CNC lathe and the computer. The lack of grounding will damage the CNC, or the computer, or both.

Cable length

The following lists baud rate and the respective maximum cable length.

Baud rate	Max. cable length (ft)
19200	50
9600	500
4800	1000
2400	3000



The settings between the CNC control and the other computer must match. To change the setting in the CNC control, enter the Settings page (press SETNG/GRAPH) and scroll to the RS-232 settings (or enter "11" and press the up or down arrow). Use the up/down arrows to highlight the settings and the left and right arrows to change the values. Press WRITE/ENTER when the proper selection is highlighted.

The settings (and defaults) that control the RS-232 port are:

- | | |
|-----------------------------|---------------------------|
| 11 Baud Rate (9600) | 24 Leader to Punch (None) |
| 12 Parity (Even) | 25 EOB Pattern (CR LF) |
| 13 Stop Bits (1) | 37 Number Data Bits (7) |
| 14 Synchronization Xon/Xoff | |

There are a number of different programs that can link with the Haas control. An example is the Hyper Terminal program that is included with most Microsoft Windows installations. To change the settings on this program go to the "File" drop down menu at the top left. Choose the "Properties" selection from the menu and then press the "Configure" key. This will open up the port settings; change these to match what is in the CNC control.

To receive a program from the PC, push LIST PROG. Move the cursor to the word All and push RECV RS-232. The control will receive all main and sub programs until it receives a "%" indicating end of input. All programs sent to the control from the PC must begin with a line containing a single "%" and must end with a line containing a single "%". Note that when using All, the programs must have a Haas formatted program number (Onnnnn). If there is not a program number, type in a program number before pushing RECV RS-232 and the program will be stored under that number, or select an existing program for input and it will be replaced.

To send a program to the PC, use the cursor to select the program and push SEND RS-232. You can select All to send all of the programs in the memory of the control. A setting (Setting 41) can be turned on to add spaces to the RS-232 output and improve the readability of your programs.

Parameters, settings, offsets, and macro variables pages may also be sent individually via RS-232 by selecting the LIST PROG mode, selecting the desired display screen, and pushing SEND. They can be received by pushing RECV and selecting the file on the PC that is to be received.

The file can be viewed on a PC by adding ".txt" to the file name from CNC control. Open the file on a PC. If an abort message is received, check the set-up between the lathe and the PC and the cable.



FILE NUMERIC CONTROL (FNC)

A program can be run from its place on the network or from a storage device (USB memory device, or hard drive). To run a program from such a location, go to the Device Manager screen (Press LIST PROG), highlight a program on the selected device and press SELECT PROG. The program will be displayed in the active program pane, and an “FNC” next to the program name in List Prog indicates that it is the currently active FNC program. Sub-programs can be called using an M98, provided that the subprogram is in the same directory as the main program. Additionally, the subprogram must be named using the Haas naming convention with case sensitivity, e.g. O12345.nc.

WARNING: The program can be modified remotely, and the change will take affect the next time the program is run. Subprograms may be changed while the CNC program is running.

Program editing is not allowed in FNC. The program is displayed and can be browsed through, but not edited. Editing can be done from a networked computer or by loading the program into memory.

To run a program in FNC:

1. Press LIST PROG, then navigate to the tabbed menu for the appropriate device (USB, hard drive, Net Share).
2. Cursor down to the desired program and press SELECT PROG. The program will appear in the Active Program pane and can be run directly from the memory device.

To Exit FNC, highlight the program again and press SELECT PROG, or select a program in CNC memory.

DIRECT NUMERIC CONTROL (DNC)

Direct Numeric Control (DNC) is another method of loading a program into the control. It is the ability to run a program as it is received through the RS-232 port. This feature differs from a program loaded through the RS-232 port in that there is no limit to the size of the CNC program. The program is run by the control as it is sent to the control; the program is not stored in the control.



```

PROGRAM (DNC)          N00000000
WAITING FOR DNC . . .

DNC RS232

```

DNC Waiting for Program

```

PROGRAM (DNC)          N00000000
%
O01000 ;
(G-CODE FINAL QC TEST CUT) ;
(MATERIAL IS 2x8x8 6061 ALUMINUM) ;
;
(MAIN) ;
;
M00 ;
(READ DIRECTIONS FOR PARAMETERS AND SETTINGS) ;
(FOR VF-SERIES MACHINES W/4TH AXIS CARDS) ;
(USE / FOR HS, VR, VB, AND NON-FORTH MACHINES) ;
(CONNECT CABLE FOR HA5C BEFORE STARTING
THE PROGRAM) ;
(SETTINGS TO CHANGE) ;
(SETTING 31 SET TO OFF) ;
;
;
DNC RS232
DNC END FOUND

```

Program received from DNC

DNC is enabled using Parameter 57 bit 18 and Setting 55. Turn the parameter bit on (1) and change Setting 55 to On. It is recommended that DNC be run with Xmodem or parity selected because an error in transmission will then be detected and will stop the DNC program without crashing. The settings between the CNC control and the other computer must match. To change the setting in the CNC control, enter the Settings page (press SETNG/GRAPH) and scroll to the RS-232 settings (or enter 11 and press the up or down arrow). Use the up/down arrows to highlight the variables and the left and right arrows to change the values. Press Enter when the proper selection is highlighted. The recommended RS-232 settings for DNC are:

- 11 Baud Rate Select: 19200
- 12 Parity Select: NONE
- 13 Stop Bits:1
- 14 Synchronization: XMODEM
- 37 RS-232 Date Bits: 8

DNC is selected by pressing MDI/DNC twice at the top of the page. DNC requires a minimum of 8k bytes of user memory available. Checking the amount of free memory on the bottom of the List Programs page.

The program sent to the control must begin and end with a %. The data rate selected (Setting 11) for the RS-232 port must be fast enough to keep up with the rate of block execution of your program. If the data rate is too slow, the tool may stop in a cut. Start sending the program to the control before CYCLE START is pushed. Once the message "DNC Prog Found" is displayed, press CYCLE START.

USB / HARD DRIVE / ETHERNET DEVICE MANAGER

The Haas control incorporates a device manager which shows the available memory devices on the machine in a tabbed menu.

Enter the Device Manager by pressing LIST PROG. Navigate the tabbed menu using the arrow keys to select the appropriate device tab and press WRITE/ ENTER.



When browsing a list of programs within a device tab, use the up/down arrow keys to highlight programs and press A to add the highlighted program to the selection.

Note: External USB hard drives only work when they are formatted as FAT or FAT32. NTFS formatted devices will not work. To find out what your devices is formatted as; connect it to your PC, right click on the drive in Windows Explorer and select Properties.

The following example shows the directory for the USB device. The selected program in memory is shown with an “A”. The selected file will also show in the active program display.

Tabbed Menu Navigation

Cursor Arrows: Navigate Tabs
WRITE/ENTER: Select a Tab
CANCEL: Move Back One Tab Level

Program Selection

Cursor Arrows: Move Selection cursor
WRITE/ENTER: Add Program to Selection (A Check Mark is Placed)
SELECT PROG: Makes the Selected Program the Active Program (“A”) or Selects Program for FNC
INSERT: Create New Folder in Current Directory (Type Folder Name, then Insert)
ALTER: Rename Folder or Program

Help Mode

Press **HELP/CALC** to Access the Pop-Up Help Menu. Navigate Using Cursor Arrow Keys. Choose Options for Selected Programs (Copy, Delete, Etc.)

Active Program
Active Tab
Highlighted Program

MEMORY	USB DEVICE	HARD DRIVE	NET SHARE	USB DEVICE 2
CURRENT DIRECTORY: USB DEVICE1				
← (USB DEVICE)				
✓	011133 (WORK ORDER 7)	1153	10-29-07	11:13:25
Ⓜ	012234 (WORK ORDER 11)	784	11-12-07	08:20:00
✓	FITTING			
✓	PROJECT 2			
	ALL			
			<DIR>	

3 PROGRAMS 88% FREE (889260 KB)

Use CURSOR keys to navigate listing and CANCEL to go back to devices. Press HELP for Help listing.

✓ : FILES IN SELECTION
Ⓜ : ACTIVE PROGRAM (001254)

Operation

Navigating Directories

To enter a sub-directory, scroll to the sub-directory and press WRITE/ENTER.

To leave a sub-directory, go to the top of the sub-directory and press Enter or press CANCEL. Both options will return to the device manager.

Create Directories

Create a new folder by entering a name and pressing INSERT.

To create a new Sub-directory, go to the directory where the new sub-directory will be located, enter a name and press INSERT. Sub-directories are displayed with their name followed by “DIR”.

Copying Files

Highlight a file and press WRITE/ENTER to select it. A check mark appears next to the file name. Choose a destination and press F2 to copy the file.

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Note that files copied from the control's memory to a device will have the extension ".NC" added to the end of the file name. However the name can be changed by entering a new name, at the destination directory, and then pressing F2.

Duplicating a File

An existing file can be duplicated using the Device manager. Select a file by pressing WRITE/ENTER, then press CANCEL to return to the top level tabbed menu. Select the destination device tab, press WRITE/ENTER, then select the destination directory on the device if applicable. Press F2 to duplicate the selected file, or type a new name and then press F2 to rename the file in the destination directory.

File Naming Convention

File names should be kept to a typical eight-dot-three format. For example: program1.txt. However, some CAD/CAM programs use ".NC" as a file extension, which is acceptable.

Files developed in the control will be named with the letter "O" followed by 5 digits. For example O12345.NC.

Renaming

To change the name of a file, highlight the file, type a new name and press ALTER.

Deleting

To delete a program file from a device, highlight the file and press ERASE PROG.

On-Screen Help

On-Screen help is available by pressing HELP/CALC. Select functions from the popup menu and press WRITE/ENTER to execute, or use the hot key listed. To exit the Help screen, press CANCEL to return to the device manager.

ADVANCED TCP/IP

To set up network communications, enter the specific values for your network into the the CNC control's network settings (refer to settings 900-916 in the Settings chapter of this manual). Press F1 once all the settings have been updated for your control and network system, this will initiate the network.

Use only letters (A-Z case insensitive), digits (0-9), dashes (-) and periods for the network names settings 900 and 907).



NETWORKING TROUBLESHOOTING

The most common errors are caused by an incorrect username or password, incorrect permissions or an expired password.

If accessing the NET SHARE tab and the message "COULD NOT CONNECT TO NETWORK" appears, additional troubleshooting information is available in the file "error.log", located in the ADMIN folder on the hard drive (this file can be viewed in FNC). If no ADMIN folder exists on the hard drive; create it then retry accessing remote share to generate the log file.

Hardware Check

If the software has been updated and you would like to check the Ethernet hardware version; power up the machine and wait for the NOT READY message to disappear from the List/Prog menu. Press PARAM/DGNOS twice, then PAGE DOWN. At the bottom of the page is the FV version; it should be 12.001 or higher.

Operation

Microsoft Network Administration

Verify in Network Neighborhood that the file serving computer can be seen on the network from another computer. Double Click on the server name icon in Network Neighborhood. Verify that the folder is seen for that computer name (The folder name should be the name entered in Setting 139) on the CNC. Verify the file serving computer privileges to this folder are shared. (Not READ ONLY; which is a typical default).

Verifying the networking is functioning (available only on TCP/IP networks)
Turn DHCP to OFF.

Enter the Static IP address-Setting 902 and Subnet Mask-Setting 903 press F1. Go to a computer on the network. Go to DOS (E.g. MS DOS Command Prompt) and at the DOS prompt type in "Ping" and the same information which was typed into Setting 902.

Example: C:>PING 192.168.1.2

Various data times will be displayed. If network time-out error occurs, verify the settings and check the data cable(s).

MACHINE DATA COLLECTION

Machine Data Collection is enabled by Setting 143, which allows the user to extract data from the control using a Q command sent through the RS-232 port (or by using an optional hardware package). This feature is software-based and requires an additional computer to request, interpret and store data from the control. Certain Macro variables can also be set by the remote computer.

Data Collection Using the RS-232 Port

The control only responds to a Q command when Setting 143 is ON. The following output format is used:



STX, CSV response, ETB, CR/LF, 0x3E

STX (0x02) marks the start of data. This control character is for the remote computer.

CSV is the Comma Separated Variables, one or more data variables separated by commas.

ETB (0x17) is the end of the data. This control character is for the remote computer.

CR/LF tells the remote computer data segment is complete and to move to the next line.

0x3E Displays the prompt.

If the control is busy, it outputs "Status, Busy". If a request is not recognized, the control outputs "Unknown" and a new prompt. The following commands can be used:

Q100 - Machine Serial Number	Q301 - Motion Time (total)
>Q100	>Q301
S/N, 12345678	C.S. TIME, 00003:02:57
Q101 - Control Software Version	Q303 - Last Cycle Time
>Q101	>Q303
SOFTWARE, VER M16.01	LAST CYCLE, 000:00:00
Q102 - Machine Model Number	Q304 - Previous Cycle Time
>Q102	>Q304
MODEL, VF2D	PREV CYCLE, 000:00:00
Q104 - Mode (LIST PROG, MDI, etc.)	Q402 - M30 Parts Counter #1 (resettable at control)
>Q104	>Q402
MODE, (MEM)	M30 #1, 553
Q200 - Tool Changes (total)	Q403 - M30 Parts Counter #2 (resettable at control)
>Q200	>Q403
TOOL CHANGES, 23	M30 #2, 553
Q201 - Tool Number in use	Q500 - Three-in-one (PROGRAM, Oxxxxx, STATUS, PARTS, xxxxx)
>Q201	>Q500
USING TOOL, 1	STATUS, BUSY
Q300 - Power-on Time (total)	Q600 Macro or system variable
>Q300	>Q600 801
P.O. TIME, 00027:50:59	MACRO, 801, 333.339996



The user has the ability to request the contents of any macro or system variable by using the Q600 command, for example, "Q600 xxxx". This will display the contents of macro variable xxxx on the remote computer. In addition, macro variables #1-33, 100-199, 500-699, 800-999 and #2001 thru #2800 can be "written to" using an "E" command, for example, "Exxxx yyyyyy.yyyyyy" where xxxx is the macro variable and yyyyyy.yyyyyy is the new value. Note that this command should only be used when there are no alarms present.

Data Collection Using Optional Hardware

This method is used to provide machine status to a remote computer, and is enabled with the installation of an 8 Spare M-code relay board (all 8 become dedicated to below functions and cannot be used for normal M-code operation), a power-on relay, an extra set of Emergency Stop contacts, and a set of special cables. Contact your dealer for pricing information on these parts.

Once installed, output relays 40 thru 47, a power-on relay and the Emergency Stop switch are used to communicate the status of the control. Parameter 315 bit 26, Status Relays, must be enabled. Standard spare M-codes are still available for use.

The following machine statuses will be available:

- * E-STOP contacts. This will be closed when the E-STOP key is pushed.
- * Power ON - 115 VAC. Indicates the control is turned ON. It should be wired to a 115 VAC coil relay for interface.
- * Spare Output Relay 40. Indicates that the control is In-Cycle (running.)
- * Spare Output Relay 41 and 42:
 - 11 = MEM mode & no alarms (AUTO mode.)
 - 10 = MDI mode & no alarms (Manual mode.)
 - 01 = Single Block mode (Single mode)
 - 00 = other modes (zero, DNC, jog, list prog, etc.)
- * Spare Output Relay 43 and 44:
 - 11 = Feed Hold stop (Feed Hold.)
 - 10 = M00 or M01 stop
 - 01 = M02 or M30 stop (Program Stop)
 - 00 = none of the above (could be single block stop or RESET.)
- * Spare Output Relay 45 Feed Rate Override is active (Feed Rate is NOT 100%)
- * Spare Output Relay 46 Spindle Speed Override active (Spindle Speed is NOT 100%)
- * Spare Output Relay 47 Control is in EDIT mode



PART SETUP

It is necessary to properly secure the part in the chuck. See the chuck or collet manufacturer's manual for the proper procedure for fixturing a workpiece.

TOOLING

The **Tnn** code is used to select the tool to be used in a program.

Jog Mode

Jog Mode allows you to jog each of the axes to a desired location. Before jogging the axes it is necessary to home (beginning axes reference point) the axes.

To enter jog mode press HANDLE JOG, then press the desired axis (e.g. X, Z, etc.) and either use the handle jog keys or the jog handle to move the axis. There are different increment speeds that can be used while in jog mode; .0001, .001, .01 and .1.

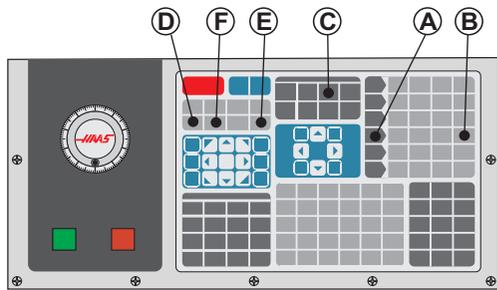
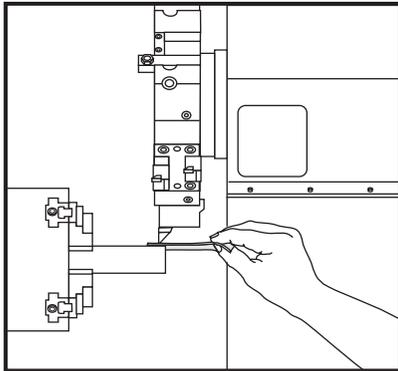
Y-axis lathes: Press the Y key on the alpha keypad and then the jog key. Jog the Y-Axis with the jog handle.

Setting the Tool Offset

The next step is to touch off the tools. Doing this defines the distance from the tip of the tool to the side of the part. Enter the Tool Geometry offset page. This should be the first page in the offsets screens; if not, use the page up key until the Tool Geometry page is selected, and press X DIA MEAS. The control will send a prompt to enter the diameter of the part. If the diameter is known, enter the value. You can also touch off the face of the part and press Z FACE MEAS. This sets the work coordinate offset for the Z-axis.

Offsets can also be entered manually by choosing one of the offsets pages, moving the cursor to the desired column, typing a number and pressing WRITE/ENTER or F1. Pressing F1 will enter the number in the selected column. Entering a value and pressing WRITE/ENTER will add the amount entered to the number in the selected column.

1. Load a tool into the tool turret.
2. Press the HANDLE JOG key (A)
3. Press .1/100. (B) (The lathe will move at a fast rate when the handle is turned).
4. Toggle between the X and Z jog keys until the tool is touching the side of the part at about a 1/8 of an inch from the front edge.
5. Place a sheet of paper between the tool and the part. Carefully move the tool as close as possible while still able to move the paper.



6. Press OFFSET (C), until the Tool Geometry table is displayed.
7. Press X DIA MESUR (D). The control will then prompt for the diameter of the part. This will take the X position located in the bottom left of the screen and the diameter of the part and put it with the position of the tool.
8. Back the tool from the part and position the tool tip so that it is touching the face of the stock.
9. Press Z FACE MEAS (E). This will take the current Z position and write it to the tool offset.
10. The cursor will move to the Z-axis location for the tool.
11. Press NEXT TOOL (F).

Repeat all of the previous steps for each tool in the program.

See the Live Tooling section for information on setting up driven tools.

Hybrid Turret VDI to BOT Centerline Offset

Press HAND JOG and enter the Tool Geometry offset page. Select the centerline value row of and press F2.

ST 20/30 - Type in a value of 5.825 (inches) and press WRITE/ENTER to offset the BOT tool position the correct amount from the VDI positions. 5.825 is a rough centerline. Physically measure for the correct centerline, then adjust accordingly.

SL-40 - Type in a value of 5.520 and press WRITE/ENTER to offset the BOT-tool position the correct amount from the VDI positions. 5.520 is a rough centerline. Physically measure for the correct centerline, then adjust accordingly (within a range of 5.512 - 5.528).

Additional Tooling Setup

There are other tool setup pages within Current Commands. Press CURNT COMDS and then use the Page Up/Down keys to scroll to these pages.



The first is the page with “Spindle Load” at the top of the page. The programmer can add a tool load limit. The control will reference these values and they can be set to do a specific action should the limitation be reached (see Setting 84).

The second page is the Tool Life page. On this page there is a column called “Alarm”. The programmer can put a value in this column which will cause the machine to stop once the tool has been used that number of times.

Setting Part (Work piece) Zero

Part Zero is a user defined reference point that the CNC control will use to program all moves from.

1. Select Tool #1 by pressing MDI/DNC, enter “T1” and press TURRET FWD.
2. Jog X and Z until the tool is just touching the face of the part.
3. Press Z FACE MEAS to set part zero. a

FEATURES

Graphics Mode

A safe way to troubleshoot a program is by running it in Graphics mode. No movement will occur on the machine, instead the movement will be illustrated on the screen.

Graphics mode can be run from Memory, MDI, DNC or Edit modes. To run a program press the SETNG/GRAPH key until the Graphics page is displayed. In Edit mode, press CYCLE START from the active program pane to enter Graphics mode. To run DNC in graphics, you must select DNC first, then go to graphics display and send your program to the machine’s control (See the DNC section). There are three helpful display features in Graphics mode that can be accessed by pressing one of the function keys (F1, F2, F3 and F4). F1 is the help key, which will give a short description of each of the functions possible in Graphics mode. F2 is the zoom key, which will zoom-in on an area of the graphics screen by using the arrow keys, Page Up and Page Down to control the zoom level, and pressing the Write key. F3 and F4 are used to control the simulation speed. Note that not all machine functions or motions are simulated in graphics.

Dry Run Operation

The Dry Run function is used to check a program quickly without actually cutting parts. Dry Run is selected by pressing DRY RUN while in MEM or MDI mode. When in Dry Run, all rapids and feeds are run at the speed selected with the jog speed keys.

Dry Run can only be turned on or off when a program has completely finished or RESET is pressed. Dry Run will still make all of the requested tool changes. The override keys can be used to adjust the Spindle speeds in Dry Run. Note:



Graphics mode is just as useful and may be safer as it does not move the axes of the machine before the program is checked (see the previous section on the Graphics function).

Running Programs

To run a program one must be loaded on the machine. Once a program is entered and the offsets are set, run the program by pressing CYCLE START. It is suggested that the program is run in Graphics mode before doing any cutting.

Background Edit

Background Edit will allow editing of one program while another program is running.

To activate Background Edit while a program is running, press EDIT until the background edit pane (on the right side of the screen) is active. Press SELECT PROG to select a program to background edit (it must be a program loaded in Memory) from the list and press WRITE/ENTER to begin background editing. To select a different program to background edit, press SELECT PROG from the background edit pane and choose a new program from the list.

All of the changes made during Background Edit will not affect the running program, or its subprograms. The changes will go into affect the next time the program is run. To exit background edit and return to the running program, press PRGRM CONVRs.

CYCLE START may not be used while in Background Edit. If the program contains a programmed stop (M00 or M30) exit Background Edit (press F4) and then press CYCLE START to resume the program.

NOTE: All keyboard data is diverted to the Background Editor, when a M109 command is active and Background Edit is entered, Once an edit is complete (by pressing Prgm/Convrs) keyboard input will return to the M109 in the running program.

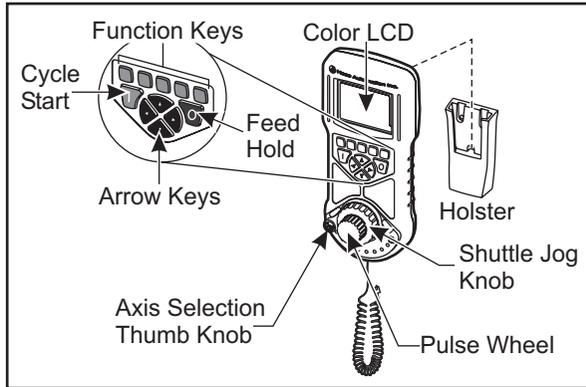
Axis Overload Timer

When a spindle or an axis current is overloaded, a timer will start and display in the POSITION pane. The starts at 1.5 minutes and counts down to zero. An axis overload alarm (SERVO OVERLOAD) displays when the time has expired to zero.



REMOTE JOG HANDLE

The Enhanced Color Remote Jog Handle (RJH) features a color liquid crystal display (LCD) and controls for increased functionality. It also features a high-intensity LED flashlight.



Refer to the section on offsets and machine operation for more information on those topics.

LCD: Displays machine data and the RJH interface.

Function Keys (F1-F5): Variable-function keys. Each key corresponds to a label at the bottom of the LCD screen. Pressing a function key will perform or toggle the corresponding menu. Toggled functions are highlighted when on.

Cycle Start: Starts programmed axis motion.

Feed Hold: Stops programmed axis motion.

Arrow Keys: Used to navigate between menu fields (up/down) and to select pulse jog rates (left/right).

Pulse Wheel: Jogs a selected axis by the selected increment. Works like the jog handle on the control.

Shuttle Jog: Rotates up to 45 degrees CW or CCW from center, and returns to center when released. Used to jog axes at variable speeds. The farther the shuttle jog is rotated from the center position, the faster the axis moves. Allow the shuttle knob to return to center to stop motion.

Axis Select: Used to select any of the available axes for jogging. The selected axis is displayed at the bottom of the screen. The far right position of this selector is used to access the auxiliary menu.

Removing the unit from the cradle powers it on. In Hand Jog, jogging control is turned over from the pendant to the RJH-C (The hand wheel on the pendant is disabled).



Place the RJH back in its cradle to power it off and return jogging control to the pendant.

The pulse knob and shuttle knob function as scrollers to change the value of a user-definable field such as tool offset, length, wear, etc.

Built-in “Panic” Function: Press any key during axis motion to instantly stop the spindle and all axis motion. Pressing Feed Hold while the spindle is in motion and the control is in Handle Jog mode will stop the spindle. The message “BUTTON PRESSED WHILE AXIS WAS MOVING—RESELECT AXIS” appears on the display. Move the axis selection knob to a different axis to clear.

If the axis selection knob is moved while the shuttle jog is turned, the message “**Axis selection changed while axis was moving—Reselect Axis**” appears on the display, and all axis motion stops. Move the axis selection knob to a different axis to clear the error.

If the shuttle jog knob is turned from its centered position when the RJH is removed from its cradle, or when the control mode is changed to a mode with motion (for instance, from MDI to Handle Jog mode), the message “**Shuttle off center—No Axis selected**” appears on the display and no axis motion will occur. Move the axis selection knob to clear the error.

If the pulse jog knob is rotated while the shuttle jog knob is in use, the message “**Conflicting jog commands— Reselect Axis**” appears on the display, and all axis motion stops. Move the axis selection knob to a different axis to clear the error, then back to re-select the previously selected axis.

NOTE: If any of the above errors fail to clear when the axis selection knob is moved, there may be a problem with the shuttle jog knob. Contact Haas service for repair/replacement.

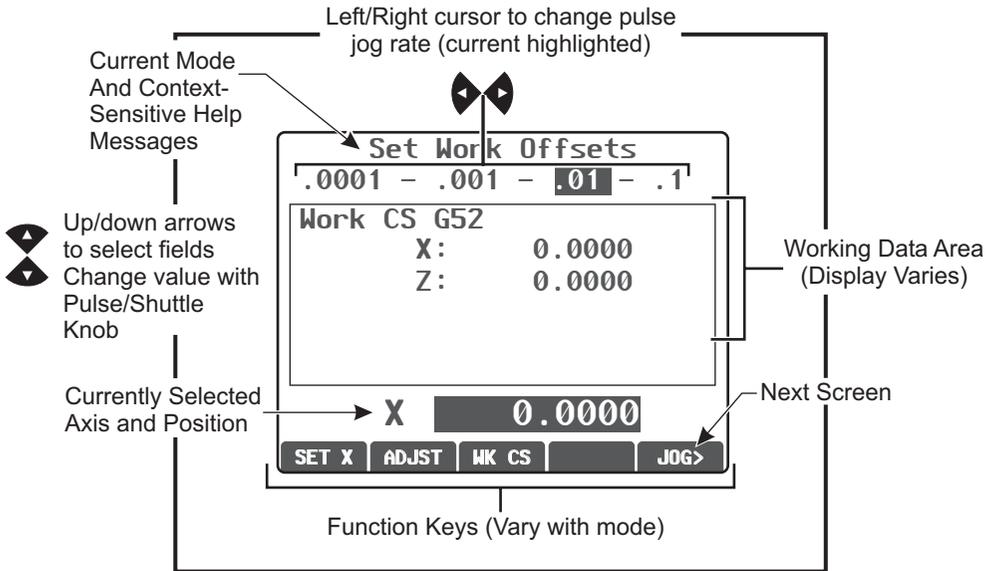
If contact between the RJH and the control is broken (cable cut or disconnected, etc.), all axis motion stops. When reconnected, the message “**RJH / Control Communication Fault—Reselect Axis**” appears on the RJH display. Move the axis selection knob to clear the error. If the error does not clear, place the RJH in its cradle, wait for it to power off, and then remove from the cradle.

NOTE: This error can also indicate a fault in the SKBIF, the RJH-E, or the wiring. If the error persists, further diagnosis and repair may be necessary.



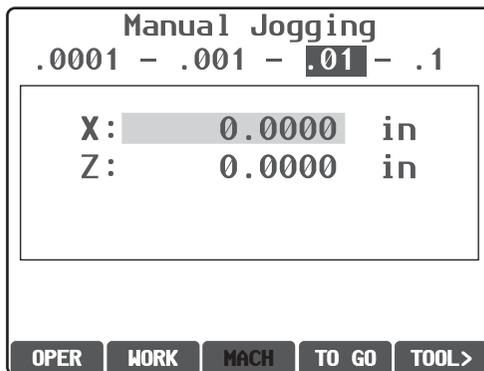
RJH Menus

The RJH uses four program menus to control manual jogging, set tool length offsets, set work coordinates, and display the current program. The four screens display information differently, but navigating and changing options are always controlled in the same way, as noted in this illustration.



RJH Manual Jogging

This menu contains a large display of the current machine position. Turning the shuttle jog or pulse knob will move the currently selected axis. Select the jog increment using the left/right arrow keys. The current position coordinate system is highlighted in the function key area of the screen and can be changed by pressing a different function key. To zero the operator position, press the function key under OPER to select the position, then press the function key again (it now reads ZERO).





RJH Tool Offsets

Use this menu to set and check tool offsets. Select fields using the function keys and change values using the pulse knob. Select axes using the thumb knob. The axis line (at the bottom of the display) must be highlighted to jog that axis. Press SET to record the current axis position into the offset table, and use the arrow keys to select the Radius and Tip settings. To make adjustments to table values, select ADJUST, use the pulse or shuttle knob to select the amount to increase or decrease the value (use the left and right arrows to change the increment), then press ENTER to apply the adjustment.

Set Tool Offsets				
.0001 - .001 - .01 - .1				
Tool: 1				
X: 0.0000				
Z: 0.0000				
Radius: 0.0000				
Tip: 1				
X 0.0000				
SET	ADJUST	NEXT	PREV	WORK>

CAUTION! Stay clear of the turret when changing tools.

RJH Work Offsets

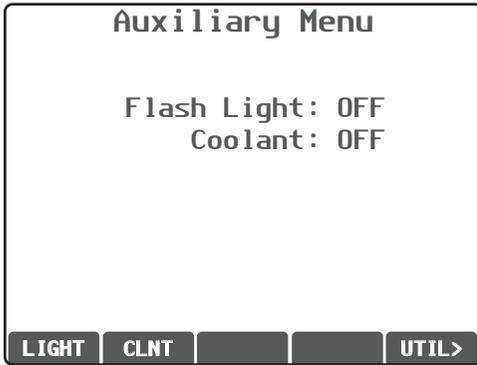
Select WK CS to change the work offset G code. Manually jog the selected axis with the shuttle or pulse knob when the axis field at the bottom of the screen is highlighted. Press SET to record the current position of the axis into the work offset table. Move the axis selector to the next axis and repeat the process to set that axis. To make adjustments to a set value, move the axis selector to the desired axis. Press ADJUST and use the pulse knob to increase or decrease the adjustment value, then press ENTER to apply the adjustment.

Set Work Offsets				
.0001 - .001 - .01 - .1				
Work CS G52				
X: 0.0000				
Z: 0.0000				
X 0.0000				
SET X	ADJUST	WK CS		JOG>

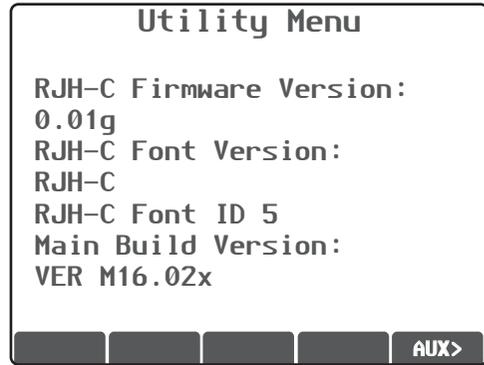


Auxiliary Menu

The RJH auxiliary menu features controls for machine coolant and the RJH flashlight. Access the menu by moving the axis selector to the far right position (indicated by a page icon molded into the RJH case). Toggle the available features by pressing the corresponding function key.



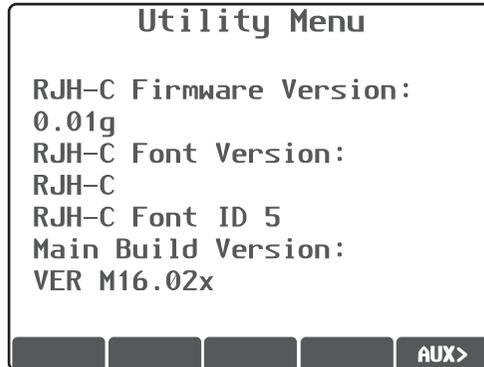
Auxiliary Menu



Utility Menu

Utility Menu

Press UTIL from the auxiliary menu to access the utility menu for technical diagnosis information, and press AUX to return to the Auxiliary Menu.



Program Display (Run Mode)

This mode displays the currently running program. Enter run mode by pressing MEM or MDI on the control pendant. The tab options at the bottom of the screen provide controls for coolant on/off, single block, optional stop, and block delete. Toggled commands such as COOL will appear highlighted when turned on. The CYCLE START and FEED HOLD buttons function just as the buttons on the pendant. Return to jogging by pressing HAND JOG on the control pendant, or place the RJH back in the cradle to continue running the program from the pendant.



RUN-STOP-JOG-CONTINUE

This feature allows the operator to stop a running program, jog away from the part, and then resume program execution. The following is an operation procedure:

1. Press FEED HOLD to stop the running program.
2. Press X or Z followed by HANDLE JOG. The control will store the current X and Z positions. Note: Axes other than X and Z cannot be jogged.
3. The control will display the message “Jog Away”. Use the jog handle, remote jog handle, jog and jog-lock keys to move the tool away from part. The spindle can be controlled by pressing CW, CCW, and STOP. If necessary, tool inserts can be changed.

Caution: When the program is continued, the old offsets will be used for the return position. Therefore, it is unsafe and not recommended to change tools and offsets when the program is interrupted.

4. Jog to a position as close as possible to the stored position, or to a position where there will be an unobstructed rapid path back to the stored position.
5. Return to the previous mode by pressing MEM or MDI/DNC. The control will only continue if the mode that was in effect when stopped is re-entered.
6. Press CYCLE START. The control will display the message Jog Return and rapid X and Y at 5% to the position where FEED HOLD was pressed, then return the Z-axis. Caution: The control will not follow the path used to jog away. If FEED HOLD is pressed during this motion, the mill axes motion will pause and display the message “Jog Return Hold”. Pressing CYCLE START will cause the control to resume the Jog Return motion. When the motion is completed, the control will again go into a feed hold state.
7. Press CYCLE START again and the program resumes normal operation. Also see Setting 36 Program Restart.

PROGRAM OPTIMIZER

This feature allows an operator to override spindle speed and axes feed within a program as the program is running. Once the program is finished the changed program lines are highlighted and can be permanently changed or reverted back to the original values.

In addition the operator can store notes by typing a comment into the input line and pressing enter.

Operation

As the program is running the operator can type notes, adjust spindle rpm, and axis feeds. At the end of a program (in Memory [MEM] mode) press F4 to go to the Program Optimizer screen.



Use the right/left and up/down arrows, page up/page down and home/end keys to scroll through overrides and comments. Press ENTER on the one to edit and a pop-up window will appear with selections for that column (see figure). The programmer can make a number of changes using the commands in the menu.

In addition a section of code can be highlighted (cursor to start of selection, press F2, scroll to end of selection and press F2). Go back to the Program Optimizer (press Edit) and press enter, this will allow the operator to alter all the feeds or speeds in the highlighted section.

The screenshot displays the 'EDIT: EDIT' screen with the following components:

- ACTIVE PROGRAM - 000001**: A code editor window showing G-code. A section of code is highlighted in blue, including lines for tool changes and feed/speed settings.
- Feed % Spindle % Coolant Notes**: A table with columns for Feed %, Spindle %, Coolant, and Notes. The table contains two rows of data: F 110% S 110% and F 140% S 60%. A callout box points to the table with the text: "Press Write to display menu and Write again to select menu item."
- FEED AND SPEED OVERRIDE**: A pop-up menu with the following options:
 - Alter previous FEED
 - Insert previous FEED on current line
 - Alter FEED on current line
 - Alter all FEEDs up to previous tool
 - Alter all FEEDs down to next Tool
 - Press CANCEL to exit.A callout box explains: "Alters the previous FEED with the current override percentage from the highlighted location in the optimizer."
- Program Optimizer Screen**: A label at the bottom of the override menu.
- EDITOR HELP (PRESS F1 TO NAVIGATE)**: A help menu with the following content:
 - HELP-HOW TO USE THE EDITOR
 - CONTENTS
 - 1) General
 - 2) Dual-screen design
 - 3) Pop-up menu
 - 4) Context sensitive help
 - 1) General
 - The HAAS editor adds functionality
- CLIPBOARD**: An empty clipboard area.
- INPUT:**: An input field at the bottom of the screen.



ADVANCED TOOL MANAGEMENT

Active Window Label

ADVANCED TOOL MANAGEMENT		CURRENT GROUP: 12345	TOOL 1 IN POSITION
(TOOL GROUP)		PRESS F4 TO CHANGE ACTIVE WINDOW	
GROUP ID: 12345	GROUPS 1 of 1	USAGE :	0
<PREVIOUS> <NEXT> <ADD> <DELETE>		FEED TIME :	0
<RENAME> <SEARCH>		TOTAL TIME :	0
GROUP USAGE : IN ORDER		TOOL LOAD :	0 TL ACTION : ALARM
DESCRIPTION :			
TOOL#	EXP	LIFE	
0			
0			
0			
0			
0			
0			
GEOMETRY X		GEOMETRY Z	RADIUS
WEAR X		WEAR Z	TIP
FEED TIME		TOTAL TIME	USAGE
			LOAD
WRITE/ENTER to display the previous tool group's data.			

Tool Group Window

Allowed Limits Window

Tool Data Window

Help Text

Advanced Tool Management (ATM) allows the user to set up and access duplicate tools for the same or a series of jobs.

Duplicate or backup tools are classified into specific groups. The programmer specifies a group of tools instead of a single tool in the G-code program. ATM tracks usage of individual tools in each tool group and compares it to user defined limits. Once a limit has been reached (e.g. number of times used, or tool load) the lathe will automatically choose one of the other tools in the group the next time that tool is needed.

When a tool expires, the beacon flashes orange and the tool life screen automatically displays.

The Advanced Tool Management page is located in the Current Commands mode. Press Current Commands and page up once to access the Advanced Tool Management page.

Navigation

The ATM interface uses three separate windows where data is entered: The tool group window, allowed limits window, and the tool data window (this window includes both the tool list on the left and tool data on the right).

F4 – Switch between windows.

Cursor Arrow Keys – Move between fields in the active window.

Write / Enter – Enter, modify or clear values, depending on the item selected.

The lower area of the screen displays help information for the item currently selected in the active window.



Operation

1) Tool Group Setup

To add a tool group, press F4 until the Tool Group window is active. Highlight <ADD> using the cursor arrow keys, enter a five-digit tool group ID number between 10000 and 30000. Press F4 again to add data for the tool group to the Allowed Limits window. Add tools to the group in the Tool Data window.

2) Tool Group

Defines the tool groups used in the programs.

GROUP ID – Displays the group ID number.

PREVIOUS – Highlight <PREVIOUS> and press Enter to change the display to the previous group.

NEXT – Highlight <NEXT> and press Enter to change the display to next group.

ADD – Highlight <ADD>, enter a five-digit number between 10000 and 30000, and press Enter to add a new tool group.

DELETE – Use <PREVIOUS> or <NEXT> to scroll to the group to delete. Highlight <DELETE> and press Enter. Press 'Y' at the prompt to complete the deletion; press 'N' to cancel.

RENAME - Highlight <RENAME>, enter the new five-digit group number between 10000 and 30000 and press enter to assign the new group ID to the currently selected group.

SEARCH - To search for a group, highlight <SEARCH>, enter a group number and press enter.

GROUP USAGE – Enter the order in which the tools in the group are called. Use the left and right cursor keys to select how the tools are used.

DESCRIPTION – Enter a descriptive name for the tool group.

3) Allowed Limits

The Allowed Limits window contains the user-defined limits that determine when a tool is worn out. These variables apply to every tool in the group. Leaving any variable set to zero causes it to be ignored.

USAGE – Enter the maximum number of times a tool may be used.

FEED TIME – Enter the total amount of time, in minutes, a tool may be used in a feed.

TOTAL TIME – Enter the total time, in minutes, a tool may be used.

TOOL LOAD – Enter the maximum tool load (in percent) for the tools in the group.



TL ACTION – Enter the automatic action to be taken when the maximum tool load percentage is reached. Use the left and right cursor keys to select the automatic action.

4) Tool Data

Tools Table

The left-hand section of the tool data window displays a table of tools in the current group. Use the cursor arrow keys to highlight and modify a value.

TOOL # – Enter a tool number by turret position, with or without an offset, just like a normal lathe T call in a program.

EXP – An expired tool is indicated with an asterisk (*) in this column. A tool can be manually expired by entering an asterisk in this column. Highlight an asterisk and press WRITE/ENTER to clear it.

LIFE – Percentage of life remaining for each tool in the group.

Tool Data

The right-hand section of the tool data window displays information about the tool currently selected in the tools table.

The following values are taken from the main Tool Geometry table (Press Offset to access) and are read-only in Advanced Tool Management (except wear offset values)

GEOMETRY X
GEOMETRY Z
RADIUS
TIP
WEAR X – Writable
WEAR Z – Writable

The following values are generated by ATM as it monitors tool use. This information is writable. Highlight a value using the cursor arrow keys to enter a new number or press Origin to clear the value.

FEED TIME
TOTAL TIME
USAGE
LOAD

5) Tool Group Usage

Program Example



%

O0135

T10000

(use tool group 10000)

G97 S1200 M03

G00 G54 X2. Z.05

G71 P1 Q6 D0.035 U0.03 W0.01 F0.01

N1 G01 X1.5 Z-0.5 F0.004

N2 X1. Z-1.

N3 X1.5 Z-1.5

N4 Z-2.

N5 G02 X0.5 Z-2.5 R0.5

N6 G1 X2.

G00 X0. Z0. T100

T20000

(use tool group 20000)

G97 S1500 M03

G70 P1 Q6

G53 X0

G53 Z0

M30

%

Macros

Macro variables 8550-8567 enable a G code program to obtain individual tool information. When an individual tool ID number is specified using macro 8550, the control will return the individual tool information in macro variables 8551-8567. Additionally, a user can specify an ATM group number using macro 8550. In this circumstance, the control will return the individual tool information for the current tool in the specified ATM tool group using macro variables 8551-8567. See the description for variables 8550-8567 in the Macros chapter for macro variable data information. The values in these macros provide data that is also accessible from macros 2001, 2101, 2201, 2301, 2701, 2801, 2901, 5401, 5501, 5601, 5701, 5801, and 5901. Macros 8551-8567 provide access to the same data, but for tools 1-50 for all data items. Any future increase in the total number of tools will be accessible through 8551-8567.



Tips & Tricks

Comment out tool details to keep them in the program while using ATM groups. These tool details can include tool numbers in the group, tool type, operator instructions, etc. For example:

```
...
G00 G53 X0 Z#508
(T100 PRIMARY TOOL ATM GROUP          Comment: tool and tool group
10000)
(T300 SECONDARY TOOL SAME             Comment: secondary tool
GROUP)
G50 S3500 T10000 (T101)               Comment out T call and replace
                                       with tool group

G97 S550 (T101) T10000
G97 S1200 M08
G00 Z1.
X2.85
...
```

SUBROUTINES

Subroutines (subprograms) are usually a series of commands that are repeated several times in a program. Instead of repeating the commands many times in the main program, subroutines are written in a separate program. The main program has a single command that “calls” the subroutine program. A subroutine is called using M97 or M98 and a P address. The P code is the same as the program number (Onnnnn) number of the subroutine.

The subroutines can include an **L** or repeat count. If there is an **L**, the subroutine call is repeated that number of times before the main program continues with the next block.

TOOL TURRET OPERATIONS

Low air pressure or insufficient volume will reduce the pressure applied to the turret clamp/unclamp piston and will slow down the turret index time or will not unclamp the turret.

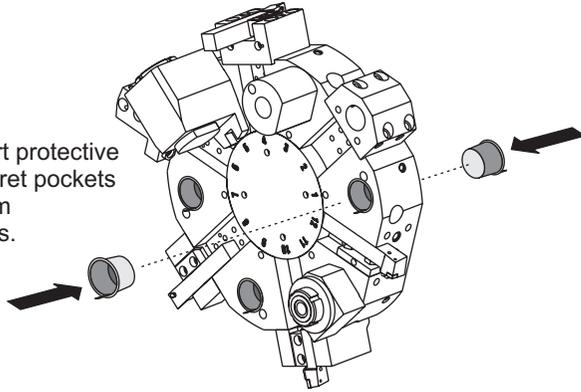
To load or change tools, select MDI mode, and then press TURRET FWD or TURRET REV and the machine will index the turret on tool position. The turret will bring the entered tool around to the cutting position, if Tnn is entered prior to pressing TURRET FWD or TURRET REV.

Note: Y-axis lathes will return the turret to the zero position (Spindle centerline) after a tool change.



IMPORTANT: Insert protective caps into empty turret pockets to protect them from accumulating debris.

IMPORTANT: Insert protective caps into empty turret pockets to protect them from accumulating debris.

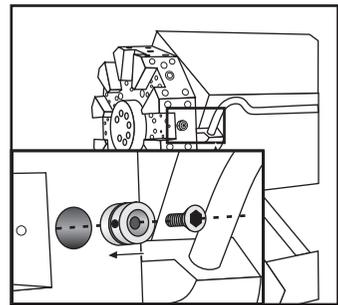
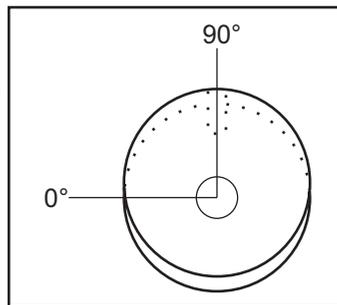


Bolt on turrets are equipped with eccentric locating buttons that allow for fine alignment of ID tool holders to spindle center line.

Mount the tool holder to the turret and align the tool holder to the spindle in the X-axis. Measure the alignment in the Y-axis. If necessary remove the tool holder and use a narrow tool in the cam button hole, to rotate the eccentric to correct misalignment.

The following table gives the result for specific positions of the cam button.

Rotation	Result
0°	No change
15°	.0018"
30°	.0035"
45°	.0050"
60°	.0060"
75°	.0067"
90°	.0070"





TOOL FUNCTIONS

The Tnn00 code is used to select the next tool (nn) and offset (00). The use of this code differs slightly depending on Setting 33 FANUC or YASNAC coordinate system.

FANUC Coordinate System

T-codes have the format Txxyy where xx specifies the tool number from 1 to the value in Parameter 65; and yy specifies the tool geometry and tool wear indices from 1 to 50. The tool geometry X and Z values are added to the work offsets. If tool nose compensation is used, yy specifies the tool geometry index for radius, taper, and tip. If yy = 00 no tool geometry or wear is applied.

YASNAC Coordinate System

T-codes have the format Tnn00, nn has different meanings depending on whether the T-code is inside or outside a G50 block. The 00 value specifies the tool wear from 1 to 50. If tool nose compensation is used, 50+00 specifies the tool shift index for radius, taper, and tip. If 00+00, no tool wear or tool nose compensations are applied.

Outside a G50 block, nn specifies the tool number from 1 to the value in Parameter 65.

Inside a G50 block, nn specifies the tool shift index from 51 to 100. The tool shift X and Z values are subtracted from the work offsets (and thus are of opposite sign than the tool geometries used in the FANUC coordinate system).

Tool Offsets Applied by T0101, FANUC vs YASNAC

Setting a negative tool wear in the tool wear offsets will move the tool further in the negative direction of the axis. Thus, for O.D. turning and facing, setting a negative offset in the X-axis will result in a smaller diameter part and setting a negative value in the Z-axis will result in more material being taken off the face.

Note: There is no X or Z motion required prior to performing a tool change and it would waste time in most cases to return X or Z to the home position. However, if the work piece or fixture is quite large, position X or Z prior to a tool change in order to prevent a crash between the tools and the fixture or part.

Low air pressure or insufficient volume will reduce the pressure applied to the turret clamp/unclamp piston and will slow down the turret index time or will not unclamp the turret.

After POWER UP/RESTART and ZERO RET, the control will ensure that the tool turret is in a normal position. To load or change tools, select MDI mode, and then press TURRET FWD or TURRET REV and the machine will index the turret on tool position. The Currnt Comds display will show what tool is currently in position.

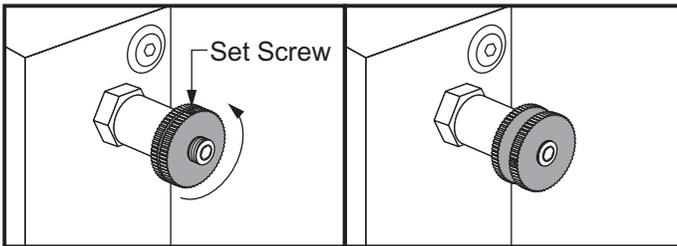


DRAWTUBE OPERATION

The hydraulic unit provides the pressure necessary to clamp a part.

Clamping Force Adjustment Procedure

1. Go to Setting 92 on the Settings page and choose either 'I.D.' or 'O.D. Clamping'. Do not do this with a program running.
2. Loosen the locking knob at the base of the adjustment knob.
3. Turn the adjustment knob until the gauge reads the desired pressure.
4. Tighten the locking knob.



Drawtube Warnings

Warning! Check the workpiece in the chuck or collet after any power loss. A power outage can reduce the clamping pressure on the workpiece, which may shift in the chuck or collet. Setting 216 will turn off the Hydraulic pump after the time specified from the setting

Never attach dead length stops to the hydraulic cylinder, damage will result.

Do not machine parts larger than the chuck.

Follow all of the warnings of the chuck manufacturer.

Hydraulic pressure must be set correctly.

See the "Hydraulic System Information" on the machine for safe operation.

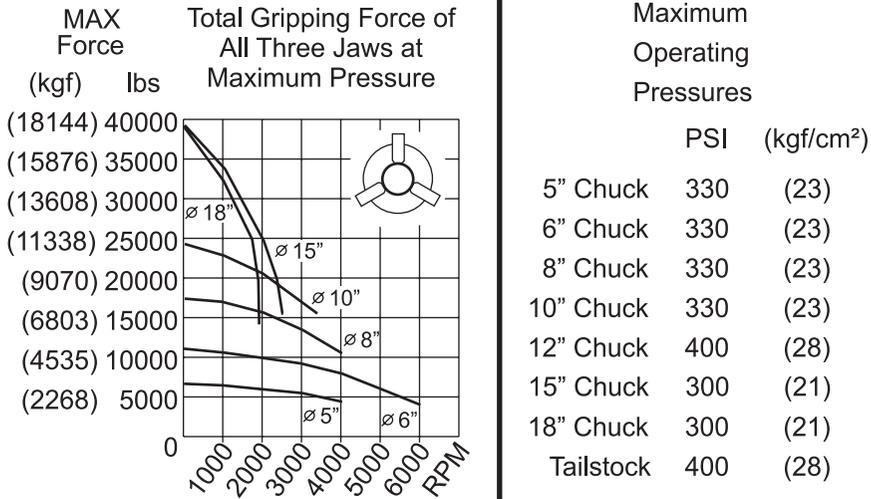
Setting a pressure beyond the recommendations will damage the machine and/or inadequately hold the workpiece.

Chuck jaws must not protrude beyond the diameter of the chuck.

Improperly or inadequately clamped parts will be ejected with deadly force.

Do not exceed rated chuck RPM.

Higher RPM reduces chuck clamping force. See the following chart.



NOTE: Chucks must be greased weekly and kept free from debris.

CHUCK AND COLLET REPLACEMENT

Chuck Removal

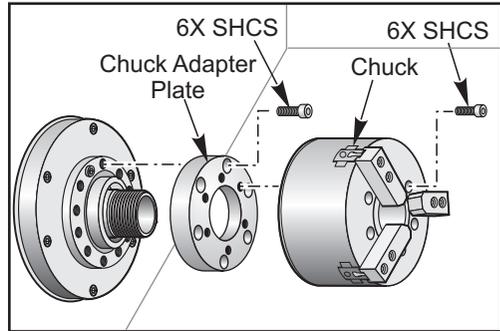
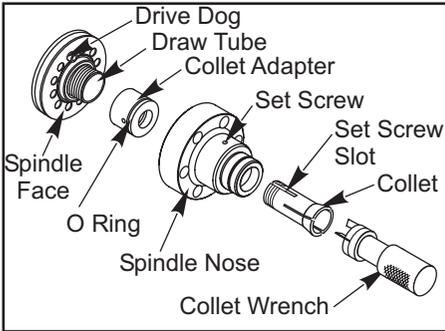
1. Move both axes to their zero positions. Remove the chuck jaws.
2. Remove the three (3) screws that mount the center cup (or plate) from the center of the chuck and remove the cup.
3. Clamp the chuck and remove the six (6) SHCS that mount the chuck to the spindle nose or adaptor plate.

Warning! The chuck is heavy. Be prepared to use lifting equipment to support the chuck as it is removed.

4. Unclamp the chuck. Place a chuck wrench inside the center bore of the chuck and unscrew the chuck from the drawtube. If equipped, removed adapter plate.

Collet Removal

1. Loosen the set screw on the side of the spindle nose. Using the collet wrench, unscrew the collet from the spindle nose.
2. Remove the six (6) SHCS from the spindle nose and remove it.
3. Remove the collet adapter from the drawtube.



Chuck Installation

NOTE: If necessary, install an adapter plate before installing the chuck

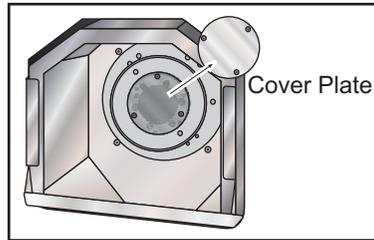
1. Clean the face of the spindle and the back face of the chuck. Position the drive dog at the top of the spindle.
2. Remove the jaws from the chuck. Remove the center cup or coverplate from the front of the chuck. If available, install a mounting guide into the drawtube and slide the chuck over it.
3. Orient the chuck so that one of the guide holes are aligned with the drive dog. Use the chuck wrench to thread the chuck onto the drawtube.
4. Screw the chuck all the way onto the drawtube and back it off 1/4 turn. Align the drive dog with one of the holes in the chuck. Tighten the six (6) SHCS.
5. Install the center cup or plate with three (3) SHCS .
6. Install the jaws. If necessary replace the rear cover plate. This is located on the left side of the machine.

Collet Installation

1. Thread the collet adapter into the drawtube.
2. Place the spindle nose on the spindle and align one of the holes on the back of the spindle nose with the drive dog.
3. Fasten the spindle nose to the spindle with six (6) SHCS.
4. Thread the collet onto the spindle nose and align the slot on the on the collet with the set screw on the spindle nose. Tighten the setscrew on the side of the spindle nose.

DRAW TUBE COVER PLATE

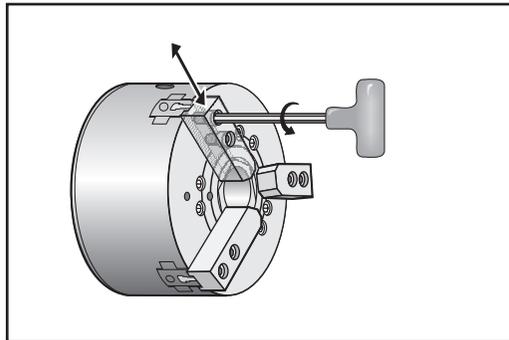
It is necessary to remove the cover plate at the far end of the drawbar when using a barfeeder. Replace the cover plate anytime bar stock is not being fed automatically.



RE-POSITIONING CHUCK JAWS

Re-position chuck jaws when the jaw stroke travel cannot generate sufficient clamp force to hold the material, e.g., when changing to a smaller diameter stock.

The part will not be sufficiently clamped if there is not extra stroke before bottoming out the jaws.



1. Use a hex key to loosen the two SHCS attaching the jaw to the chuck.
2. Slide jaw to new position and re-tighten the two SHCS.
3. Repeat procedure for remaining two jaws. Jaws must remain concentric.

TAPER COMPENSATION

Deflection of the part occurs if it is not supported precisely in the center, or if it is too long and unsupported. This causes the cut to be too shallow so the resultant part is under-cut. This can apply to O.D and I.D cutting. Taper Compensation provides the ability to compensate by adding in a calculated value to the X movement based on the position of the Z cut. The zero point of the taper is defined to be the 0.0 of the work-zero coordinate of Z. The taper is entered on the tool shift page as a 5 place number and stored in an array indexed by tool, which is called "Taper" on the Tool Shift/Geometry page. The value entered should be the deflection in the X-axis divided by the length in the Z-axis, over which the deflection occurs. The range of this value is between 0 and .005; this value represents a slope.





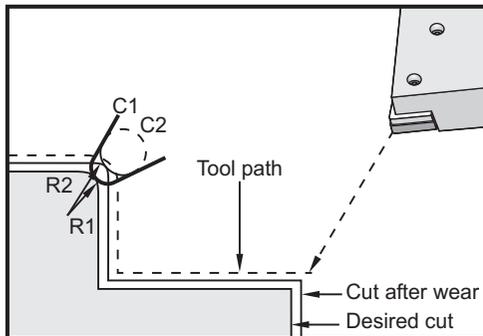
TOOL NOSE COMPENSATION

Introduction

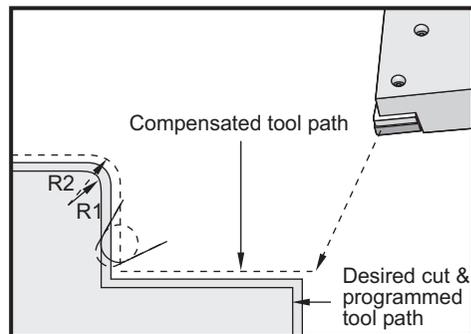
Tool Nose Compensation is a feature that allows the user to adjust a programmed tool path in response to different cutter sizes or for normal cutter wear. The user can do this by entering minimal offset data at run-time without any additional programming effort.

Programming

Tool Nose Compensation is used when the tool nose radius changes, and cutter wear is to be accounted for with curved surfaces or tapered cuts. Tool Nose Compensation generally does not need to be used when programmed cuts are solely along the X- or Z-axis. For taper and circular cuts, as the tool nose radius changes, under or overcutting can occur. In the figure, suppose that immediately after setup, C1 is the radius of the cutter that cuts the programmed tool path. As the cutter wears to C2, the operator might adjust the tool geometry offset to bring the part length and diameter to dimension. If this were done, a smaller radius would occur. If tool nose compensation is used, a correct cut is achieved. The control will automatically adjust the programmed path based on the offset for tool nose radius as set up in the control. The control will alter or generate code to cut the proper part geometry.



Tool Path for 2 Cutter Radii



Path Generated when TNC is used

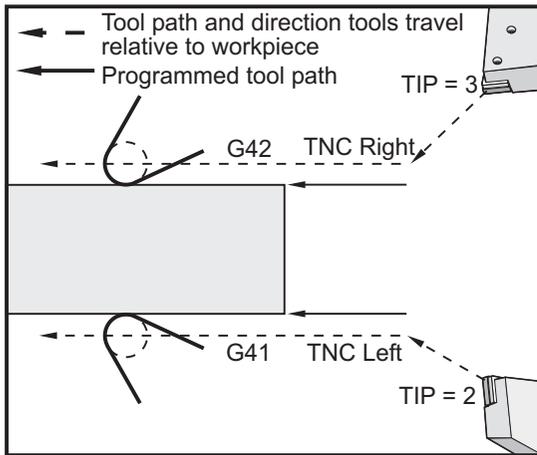
Note that the second programmed path coincides with the final part dimension. Although parts do not have to be programmed using tool nose compensation, it is the preferred method because it makes program problems easier to detect and resolve.

TOOL NOSE COMPENSATION CONCEPTS

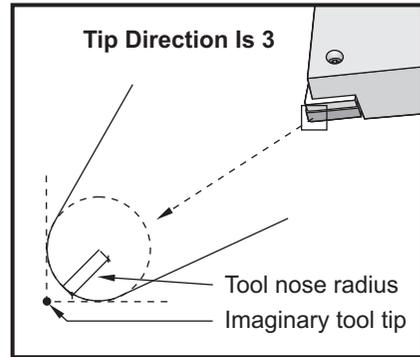
Tool nose compensation works by shifting the Programmed Tool Path to the right or to the left. The programmer will usually program the tool path to the finished size. When tool nose compensation is used, the control will compensate for the diameter of the tool based on special instructions written into the program. Two G-code commands are used to do this for compensation within a two-dimensional plane. G41 commands the control to shift to the left of the



programmed tool path, and G42 commands the control to shift to the right of the programmed tool path. Another command, G40, is provided to cancel any shift made by tool nose compensation.



Shift Direction



Imaginary Tool Tip

The shift direction is based on the direction of the tool movement relative to the tool, and which side of the part it is on. When thinking about which direction the compensated shift will occur in tool nose compensation, imagine looking down the tool tip and steering the tool. Commanding G41 will move the tool tip to the left and a G42 will move the tool tip to the right. This means that normal O.D. turning will require a G42 for correct tool compensation, while normal I.D. turning will require a G41.

Tool nose compensation assumes that a compensated tool has a radius at the tool tip that it must compensate for. This is called the Tool Nose Radius. Since it is difficult to determine exactly where the center of this radius is, a tool is usually set up using what is called the Imaginary Tool Tip. The control also needs to know which direction the tool tip is relative to the center of the tool nose radius, or the Tip direction. The tip direction should be specified for each tool.

The first compensated move is generally a move from a non-compensated position to a compensated position and is therefore unusual. This first move is called the "Approach" move and is required when using tool nose compensation. Similarly, a "Depart" move is required. In a depart move, the control moves from a compensated position to a non-compensated position. A depart move occurs when tool nose compensation is cancelled with a G40 command or Txx00 command. Although approach and depart moves can be precisely planned, they are generally uncontrolled moves and the tool should not be in contact with the part when they occur.



USING TOOL NOSE COMPENSATION

The following are the steps used to program a part using TNC:

Program the part to finished dimensions.

Approach and Departure – Ensure that there is an approach move for each compensated path and determine which direction (G41 or G42) is used. Ensure that there is also a departure move for each compensated path.

Tool Nose Radius and Wear – Select a standard insert (tool with radius) to be used for each tool. Set the tool nose radius of each compensated tool. Clear the corresponding tool nose wear offset to zero for each tool.

Tool Tip Direction – Input the tool tip direction for each tool that is using compensation, G41 or G42.

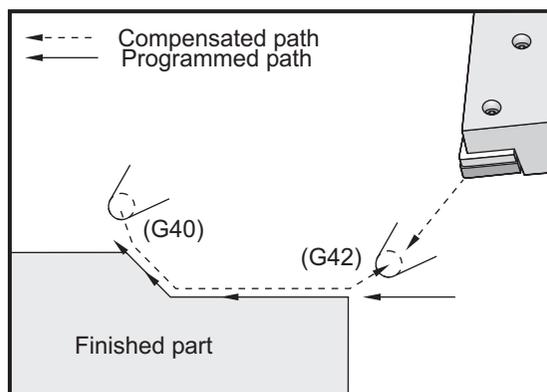
Tool Geometry Offset – Set the tool length geometry and clear the length wear offsets of each tool.

Check Compensation Geometry – Debug the program in graphics mode and correct any tool nose compensation geometry problems that may occur. A problem can be detected in two ways: an alarm will be generated indicating compensation interference, or the incorrect geometry will be seen generated in graphics mode.

Run and Inspect First Article – Adjust compensated wear for the setup part.

APPROACH AND DEPARTURE MOVES FOR TOOL NOSE COMPENSATION

The first X or Z motion in the same line that contains a G41 or G42 is called the “Approach” move. The approach must be a linear move, that is a G01 or G00. The first move is not compensated, yet at the end of the approach move the machine position will be fully compensated. See the following figure.

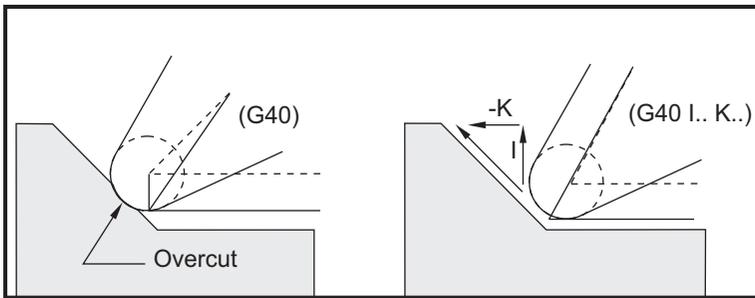


Approach and Departure Moves



Any line of code with a G40 will cancel tool nose compensation and is called the “Departure” move. The departure must be a linear move, that is a G01 or G00. The start of a departure move is fully compensated; the position at this point will be at a right angle to the last programmed block. At the end of the departure move the machine position is not compensated. See the previous figure.

The following figure shows the condition just prior to cancelling tool nose compensation. Some geometries will result in over or undercutting of the part. This is controlled by including an I and K address code in the G40 cancellation block. The I and K in a G40 block define a vector that is used to determine the compensated target position of the previous block. The vector is usually aligned with an edge or wall of the completed part. The following figure shows how I and J can correct undesired cutting in a departure move.



Use of I and K in a G40 block

TOOL NOSE RADIUS OFFSET AND WEAR OFFSET

Each turning tool that uses tool nose compensation requires a tool Nose Radius. The tool tip (tool nose radius) specifies how much the control is to compensate for a given tool. If standard inserts are being used for the tool, then the tool nose radius is simply the tool tip radius of the insert.

Associated with each tool on the geometry offsets page is a Tool Nose Radius Offset. The column labeled “Radius” is the value for the tool nose radius of each tool. If the value of any tool nose radius offset is set to zero, no compensation will be generated for that tool.

Associated with each radius offset is a Radius Wear Offset, located on the wear offset page. The control adds the wear offset to the radius offset to obtain an effective radius that will be used for generating compensated values.

Small adjustments (positive values) to the radius offset during production runs should be placed in the wear offset page. This allows the operator to easily track the wear for a given tool. As a tool is used, the insert will generally wear so that there is a larger radius at the end of the tool. When replacing a worn tool with a new one, the wear offset should be cleared to zero.

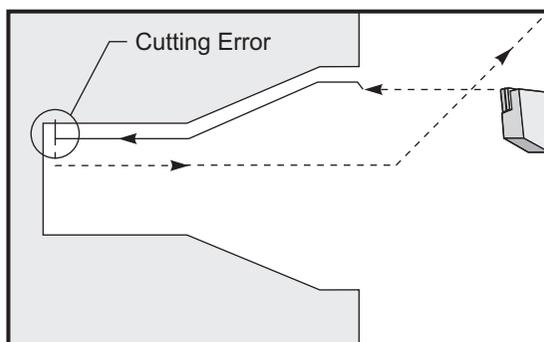


It is important to remember that tool nose compensation values are in terms of radius rather than diameter. This is important when tool nose compensation is cancelled. If the incremental distance of a compensated departure move is not twice the radius of the cutting tool; overcutting will occur. Always remember that programmed paths are in terms of diameter and allow for twice the tool radius on departure moves. The Q block of canned cycles that require a PQ sequence can often be a departure move. The following example illustrates how incorrect programming will result in overcutting.

Example

Setting 33 is FANUC:	X	Z	Radius	Tip
Tool Geometry 8:	-8.0000	-8.0000	0.0160	2

```
%  
O0010 ;  
G28 ;  
T808 ; (Boring bar)  
G97 S2400 M03 ;  
G54 G00 X.49 Z.05;  
G41 G01 X.5156 F.004 ;  
Z-.05 ;  
X.3438 Z-.25  
Z-.5 ;  
X.33; (Move less than .032. Required to avoid cut-in with a departure move before TNC  
is cancelled.)  
G40 G00 X.25 ;  
Z.05 ;  
G53 X0;  
G53 Z0;  
M30 ;  
%
```



Invalid Program using TNC and G70



TOOL NOSE COMPENSATION AND TOOL LENGTH GEOMETRY

The length geometries of tools that use tool nose compensation are set up in the same manner as tools not using compensation. Refer to the “Tooling” section of this manual for details on touching off tools and recording tool length geometries. When a new tool is set up, the geometry wear should be cleared to zero.

Often a tool will exhibit uneven wear. This occurs when particularly heavy cuts occur on one edge of the tool. In this case it may be desirable to adjust the X or Z Geometry Wear rather than the Radius Wear. By adjusting X or Z length geometry wear, the operator can often compensate for uneven tool nose wear. Length geometry wear will shift all dimensions for a single axis.

The program design may not allow the operator to compensate for wear by using length geometry shift. Which wear to adjust can be determined by checking several X and Z dimensions on a finished part. Wear that is even will result in similar dimensional changes on the X and Z axes, and suggests that the radius wear offset should be increased. Wear that affects the dimensions on one axis only suggests length geometry wear.

Good program design based on the geometry of the part being cut should eliminate uneven wear problems. Generally, rely on finishing tools that use the entire radius of the cutter for tool nose compensation.

TOOL NOSE COMPENSATION IN CANNED CYCLES

Some canned cycles ignore tool nose compensation, expect a specific coding structure, or perform their own specific canned cycle activity (also see the “Canned Cycles” section).

The following canned cycles will ignore tool nose radius compensation. Cancel tool nose compensation before any of these canned cycles.

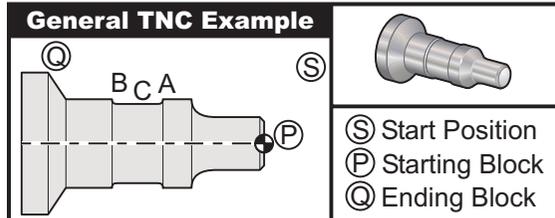
- G74 End face grooving cycle, peck drilling
- G75 O.D./I.D. grooving cycle, peck drilling
- G76 Thread cutting cycle, multiple pass
- G92 Thread cutting cycle, modal



EXAMPLE PROGRAMS USING TOOL NOSE COMPENSATION

Example 1

General Tool Nose Compensation using standard interpolation modes G01/G02/G03.



Preparation

Turn Setting 33 to FANUC.

Set up the following tools

T1 Insert with .0312 radius, roughing

T2 Insert with .0312 radius, finishing

T3 .250 wide grooving tool with .016 radius/same tool for offsets 3 and 13

Tool	Offset	X	Z	Radius	Tip
T1	01	-8.9650	-12.8470	.0312	3
T2	02	-8.9010	-12.8450	.0312	3
T3	03	-8.8400	-12.8380	.016	3
T3	13	"	-12.588	.016	4

Program Example

```

%
O0811 (G42 Test BCA)
N1 G50 S1000
T101

G97 S500 M03
G54 G00 X2.1 Z0.1
G96 S200
G71 P10 Q20 U0.02 W0.005 D.1 F0.015

N10 G42 G00 X0. Z0.1 F.01
G01 Z0 F.005
X0.65
X0.75 Z-0.05
Z-0.75
G02 X1.25 Z-1. R0.25
G01 Z-1.5
G02 X1. Z-1.625 R0.125

```

Description

(Example1)

(Tool 1, Offset 1. Tip direction for offset 1 is 3)

(Move to point S)

(Rough P to Q with T1 Using G71 and TNC. Define part path PQ sequence) (P)(G71 Type II, TNC right)

(A)



G01 Z-2.5
G02 X1.25 Z-2.625 R0.125 (B)
G01 Z-3.5
X2. Z-3.75
N20 G00 G40 X2.1 (TNC Cancel)
G97 S500
G53 X0 (Zero for tool change clearance)
G53 Z0
M01
N2 G50 S1000
T202
G97 S750 M03 (Tool 2, Offset 2. Tip direction is 3)
G00 X2.1 Z0.1 (move to point S)
G96 S400
G70 P10 Q20 (Finish P to Q with T2 using G70 and
TNC)

G97 S750
G53 X0 (Zero for tool change clearance)
G53 Z0
M01
N3 G50 S1000
T303 (Tool 3, Offset 3. Tip direction is 3)
G97 S500 M03 (Groove to point B Using Offset 3)
G54 G42 X1.5 Z-2.0 (Move to point C TNC right)
G96 S200
G01 X1. F0.003
G01 Z-2.5
G02 X1.25 Z-2.625 R0.125 (B)
G40 G01 X1.5 (TNC cancel - Groove to point A using
offset 4)

T313 (Change offset to other side of tool)
G00 G41 X1.5 Z-2.125 (Move to point C - TNC approach)
G01 X1. F0.003
G01 Z-1.625
G03 X1.25 Z-1.5 R0.125 (A)
G40 G01 X1.6 (TNC cancel)
G97 S500
G53 X0
G53 Z0
M30
%

Note that the suggested template of the previous section for G70 is used. Also note that compensation is enabled in the PQ sequence but is cancelled after G70 is completed.



Example 2

TNC with a G71 roughing canned cycle

Preparation

Turn Setting 33 to FANUC.

Tools

T1 Insert with .032 radius, roughing

Tool Offset Radius Tip

T1 01 .032 3

Program Example

%

O0813

G50 S1000

T101

G00 X3.0 Z.1

G96 S100 M03

G71 P80 Q180 U.01 W.005 D.08 F.012

N80 G42 G00 X0.6

G01 Z0 F0.01

X0.8 Z-0.1 F0.005

Z-0.5

G02 X1.0 Z-0.6 I0.1

G01 X1.5

X2.0 Z-0.85

Z-1.6

X2.3

G03 X2.8 Z-1.85 K-0.25

G01 Z-2.1

N180 G40 G00 X3.0 M05

G53 X0

G53 Z0

M30

%

Description

(Example 3)

(Select tool 1)

(Rapid to start point)

(Rough P to Q with T1 using G71 and TNC. Define Part Path PQ sequence)

(P) (G71 Type I, TNC right)

(Start of finish part path)

(Q) (End of part path)

(TNC cancel)

(Zero X for tool change clearance)

Note that this part is a G71 Type I path. When using TNC it is very unusual to have a Type II path, as the compensation methods can only compensate the tool tip in one direction.



Example 3

TNC with a G72 roughing canned cycle. G72 is used instead of G71 because the roughing strokes in X are longer than the Z roughing strokes of a G71. It is therefore more efficient to use G72.

TNC with G72 Example		Preparation												
		Setting 33 FANUC Tools T1 insert with .032 radius, roughing T2 insert with .016 radius, finishing												
		<table border="1"> <thead> <tr> <th>Tool</th> <th>Offset</th> <th>Radius</th> <th>Tip</th> </tr> </thead> <tbody> <tr> <td>T1</td> <td>01</td> <td>.032</td> <td>3</td> </tr> <tr> <td>T2</td> <td>02</td> <td>.016</td> <td>3</td> </tr> </tbody> </table>	Tool	Offset	Radius	Tip	T1	01	.032	3	T2	02	.016	3
Tool	Offset	Radius	Tip											
T1	01	.032	3											
T2	02	.016	3											

Program Example

```

%
O0813
G50 S1000
T101
G00 X3.0 Z.1
G96 S100 M03
G71 P80 Q180 U.01 W.005 D.08 F.012

N80 G42 G00 X0.6
G01 Z0 F0.01
X0.8 Z-0.1 F0.005
Z-0.5
G02 X1.0 Z-0.6 I0.1
G01 X1.5
X2.0 Z-0.85
Z-1.6
X2.3
G03 X2.8 Z-1.85 K-0.25
G01 Z-2.1
N180 G40 G00 X3.0 M05
G53 X0
G53 Z0
M30
%
```

Description

(Example 3)

(Select tool 1)
(Rapid to start point)

(Rough P to Q with T1 using G71 and TNC. Define Part Path PQ sequence)
(P) (G71 Type I, TNC right)
(Start of finish part path)

(Q) (End of part path)
(TNC cancel)
(Zero X for tool change clearance)



Example 4

TNC with a G73 roughing canned cycle. G73 is best used when you want to remove a consistent amount of material in both the X and Z axes.

Preparation

Turn Setting 33 to FANUC

Tools

T1 Insert with .032 radius, roughing

T2 Insert with .016 radius, finishing

Tool	Offset	Radius	Tip
T1	01	.032	3
T2	02	.016	3

Program Example

Description

%

O0815

(Example 4)

T101

(Select Tool 1)

G50 S1000

G00 X3.5 Z.1

(Move to point S)

G96 S100 M03

G73 P80 Q180 U.01 W0.005 I0.3 K0.15 D4 F.012 (Rough P to Q with T1 using G73 and TNC)

N80 G42 G00 X0.6

(Part path PQ sequence, G72 Type I, TNC right)

G01 Z0 F0.1

X0.8 Z-0.1 F.005

Z-0.5

G02 X1.0 Z-0.6 I0.1

G01 X1.4

X2.0 Z-0.9

Z-1.6

X2.3

G03 X2.8 Z-1.85 K-0.25

G01 Z-2.1

N180 G40 X3.1

(Q)

G00 Z0.1 M05

(TNC Cancel)

(*****Optional Finishing Sequence*****)

G53 X0

(Zero for tool change clearance)

G53 Z0

M01

T202

(Select tool 2)

N2 G50 S1000

G00 X3.0 Z0.1

(Move to start point)

G96 S100 M03

G70 P80 Q180

(Finish P to Q with T2 using G70 and TNC)

G00 Z0.5 M05

G28

(Zero for tool change clearance)

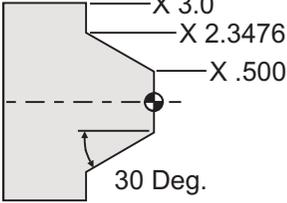
M30

%



Example 5

TNC with a G90 modal rough turning cycle

TNC with G90 Example				
	Preparation			
	Setting 33 FANUC			
	Tools	T1 insert with .032 radius, roughing		
	Tool	Offset	Radius	Tip
	T1	01	.032	3

Program Example

```
%  
O0816  
T101  
G50 S1000  
G00 X4.0 Z0.1  
G96 S100 M03  
(ROUGH 30 DEG. ANGLE TO X2. AND Z-1.5 US-  
ING G90 AND TNC)  
G90 G42 X2.55 Z-1.5 I-0.9238 F0.012  
X2.45  
X2.3476  
G00 G40 X3.0 Z0.1 M05  
G53 X0  
G53 Z0  
M30  
%
```

Description

(Example 5)
(Select tool 1)

(Move to start point)

(Optional Additional Passes)

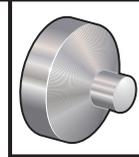
(TNC Cancel)
(Zero for tool change clearance)



Example 6

TNC with a G94 modal rough turning cycle

TNC with G94 Example									
	<p>Preparation</p> <p>Setting 33 FANUC</p> <p>Tools</p> <p>T1 insert with .032 radius, roughing</p> <table border="1"> <thead> <tr> <th>Tool</th> <th>Offset</th> <th>Radius</th> <th>Tip</th> </tr> </thead> <tbody> <tr> <td>T1</td> <td>01</td> <td>.032</td> <td>3</td> </tr> </tbody> </table>	Tool	Offset	Radius	Tip	T1	01	.032	3
Tool	Offset	Radius	Tip						
T1	01	.032	3						



Program Example

```

%
O0817
G50 S1000
T101
G00 X3.0 Z0.1
G96 S100 M03
G94 G41 X1.0 Z-0.5 K-0.577 F.03

Z-0.6
Z-0.7
G00 G40 X3. Z0.1 M05
G53 X0
G53 Z0
M30
%
```

Description

(Example 6)

(Select tool 1)
(Move to start point)

(Rough 30° angle to X1. and Z-0.7 using G94 and TNC)
(Optional additional passes)

(TNC Cancel)
(Zero for tool change clearance)

Tool Nose Compensation

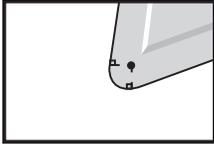
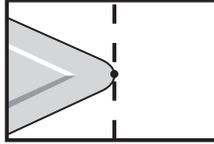
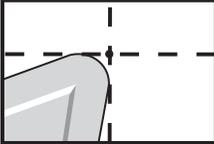
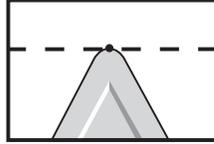
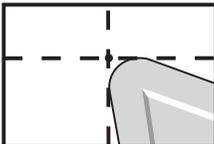
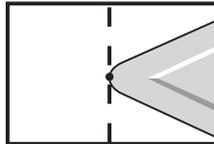
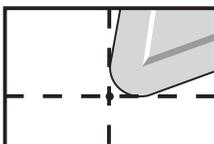
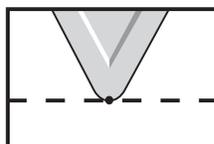
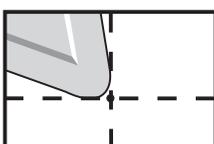
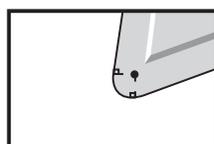
IMAGINARY TOOL TIP AND DIRECTION

It is not easy to determine the center of a tool radius on a lathe. The cutting edges are set when a tool is touched off to record tool geometry. The control can calculate where the center of the tool radius is by using the edge information, the tool radius, and the direction the cutter is expected to cut in. The X- and Z-axis geometry offsets intersect at a point, called the Imaginary Tool Tip, that aids in determining the tool tip direction. The Tool Tip Direction is determined by a vector originating from the center of the tool radius and extending to the imaginary tool tip, see the following figures.

The tool tip direction of each tool is coded as a single integer from 0 to 9. The tip direction code is found next to the radius offset on the geometry offsets page. It is recommended that a tip direction be specified for all tools using tool nose compensation. The following figure is a summary of the tip coding scheme along with cutter orientation examples.



Note that the tip indicates to the setup person how the programmer intends to measure the tool offset geometry. For example, if the setup sheet shows tip direction 8, the programmer intends the tool geometry to be at the edge of and on the centerline of the tool insert.

Tip Code	Imaginary Tool Tip Orientation	Tool Center Location	Tip Code	Imaginary Tool Tip Orientation	Tool Center Location
0		Zero (0) indicates no specified direction. It is usually not used when Tool Nose Compensation is desired.	5		Direction Z+: Tool edge
1		Direction X+, Z+: Off tool	6		Direction X+: Tool edge
2		Direction X+, Z-: Off tool	7		Direction Z-: Tool edge
3		Direction X-, Z-: Off tool	8		Direction X-: Tool edge
4		Direction X-, Z+: Off tool	9		Same as Tip 0



PROGRAMMING WITHOUT TOOL NOSE COMPENSATION

Manually Calculating Compensation

When programming a straight line in either X or Z axes the tool tip touches the part at the same point where you touched your original tool offsets in X and Z axes. However, when you program a chamfer or an angle, the tip does not touch the part at those same points. Where the tip actually touches the part is dependent upon the degree of angle being cut and also the size of the tool insert. Overcutting or undercutting will occur when programming a part without any compensation.

The following pages contain tables and illustrations demonstrating how to calculate the compensation in order to program the part accurately.

Along with each chart are three examples of compensation using both types of inserts and cutting along three different angles. Next to each illustration is a sample program and explanation of how the compensation was calculated.

Refer to the illustrations on the following pages.

The tool tip is shown as a circle with X and Z points called out. These points designate where the X diameter and Z face offsets are touched off.

Each illustration is a 3" diameter part with lines extending from the part and intersecting at 30°, 45° and 60° angles.

The point at which the tool tip intersects the lines is where the compensation value is measured.

The compensation value is the distance from the face of the tool tip to the corner of the part. Notice that the tool tip is slightly offset from the actual corner of the part; this is so the tool tip is in the correct position to make the next move and to avoid any overcutting or undercutting.

Use the values found on the charts (angle and radius size) to calculate the correct tool path position for the program.

TOOL NOSE COMPENSATION GEOMETRY

The following figure shows the various geometries of tool nose compensation. It is organized into four categories of intersection. The intersections can be: 1) linear to linear, 2) linear to circular, 3) circular to linear, or 4) circular to circular. Beyond these categories the intersections are classified into angle of intersection and approach, mode to mode, or departure motions.

Two FANUC compensation types are supported, Type A and Type B. The default compensation is Type A.



Linear-to-Linear (Type A)

Angle: <90

	Approach	Mode to Mode	Departure
G41			
G42			

Angle: $\geq 90, <180$

	Approach	Mode to Mode	Departure
G41			
G42			

Angle: >180

	Approach	Mode to Mode	Departure
G41			
G42			

Linear-to-Circular (Type A)

Angle: <90

	Approach	Mode to Mode	Departure
G41			Not Permitted
G42			Not Permitted

Angle: $\geq 90, <180$

	Approach	Mode to Mode	Departure
G41			Not Permitted
G42			Not Permitted

Angle: >180

	Approach	Mode to Mode	Departure
G41			Not Permitted
G42			Not Permitted



Circular-to-Linear (Type A)

Angle: <90

	Approach	Mode to Mode	Departure
G41	Not Permitted		
G42	Not Permitted		

Angle: $\geq 90, <180$

	Approach	Mode to Mode	Departure
G41	Not Permitted		
G42	Not Permitted		

Angle: >180

	Approach	Mode to Mode	Departure
G41	Not Permitted		
G42	Not Permitted		



Tool Radius And Angle Chart (1/32 RADIUS)

The X measurement calculated is based on part diameter.

ANGLE	Xc CROSS	Zc LONGITU- DINAL	ANGLE	Xc CROSS	Zc LONGITUDI- NAL
1.	.0010	.0310	46.	.0372	.0180
2.	.0022	.0307	47.	.0378	.0177
3.	.0032	.0304	48.	.0386	.0173
4.	.0042	.0302	49.	.0392	.0170
5.	.0052	.0299	50.	.0398	.0167
6.	.0062	.0296	51.	.0404	.0163
7.	.0072	.0293	52.	.0410	.0160
8.	.0082	.0291	53.	.0416	.0157
9.	.0092	.0288	54.	.0422	.0153
10.	.01	.0285	55.	.0428	.0150
11.	.0011	.0282	56.	.0434	.0146
12.	.0118	.0280	57.	.0440	.0143
13.	.0128	.0277	58.	.0446	.0139
14.	.0136	.0274	59.	.0452	.0136
15.	.0146	.0271	60.	.0458	.0132
16.	.0154	.0269	61.	.0464	.0128
17.	.0162	.0266	62.	.047	.0125
18.	.017	.0263	63.	.0474	.0121
19.	.018	.0260	64.	.0480	.0117
20.	.0188	.0257	65.	.0486	.0113
21.	.0196	.0255	66.	.0492	.0110
22.	.0204	.0252	67.	.0498	.0106
23.	.0212	.0249	68.	.0504	.0102
24.	.022	.0246	69.	.051	.0098
25.	.0226	.0243	70.	.0514	.0094
26.	.0234	.0240	71.	.052	.0090
27.	.0242	.0237	72.	.0526	.0085
28.	.025	.0235	73.	.0532	.0081
29.	.0256	.0232	74.	.0538	.0077
30.	.0264	.0229	75.	.0542	.0073
31.	.0272	.0226	76.	.0548	.0068
32.	.0278	.0223	77.	.0554	.0064
33.	.0286	.0220	78.	.056	.0059
34.	.0252	.0217	79.	.0564	.0055
35.	.03	.0214	80.	.057	.0050
36.	.0306	.0211	81.	.0576	.0046
37.	.0314	.0208	82.	.0582	.0041
38.	.032	.0205	83.	.0586	.0036
39.	.0326	.0202	84.	.0592	.0031
40.	.0334	.0199	85.	.0598	.0026
41.	.034	.0196	86.	.0604	.0021
42.	.0346	.0193	87.	.0608	.0016
43.	.0354	.0189	88.	.0614	.0011
44.	.036	.0186	89.	.062	.0005
45.	.0366	.0183			



Circular-to-Circular (Type A)

Angle: <90

	Approach	Mode to Mode	Departure
G41	Not Permitted		Not Permitted
G42	Not Permitted		Not Permitted

Angle: $\geq 90, <180$

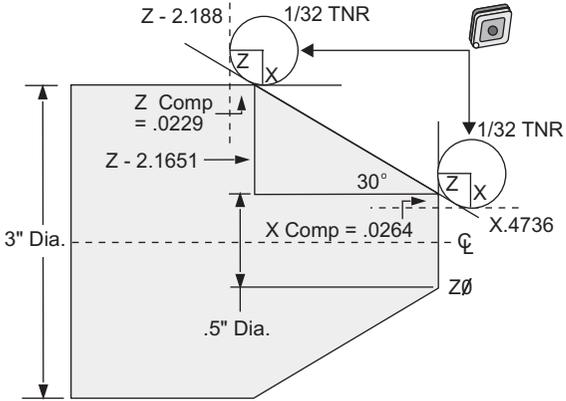
	Approach	Mode to Mode	Departure
G41	Not Permitted		Not Permitted
G42	Not Permitted		Not Permitted

Angle: >180

	Approach	Mode to Mode	Departure
G41	Not Permitted		Not Permitted
G42	Not Permitted		Not Permitted

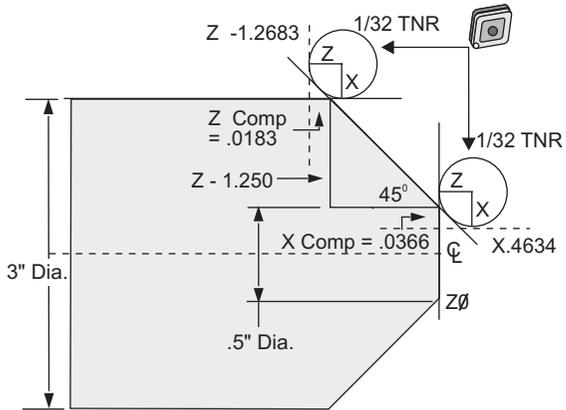


Tool Nose Radius Calculation Diagram



Program	
Code	Compensation (1/32 TNR)
G0 X0 Z.1	
G1 Z0	
X.4736	(X.5 - 0.0264 Comp)
X 3.0 Z-2.188	(Z-2.1651 + 0.0229 Comp)

Note: Compensation Value For 30° Angle

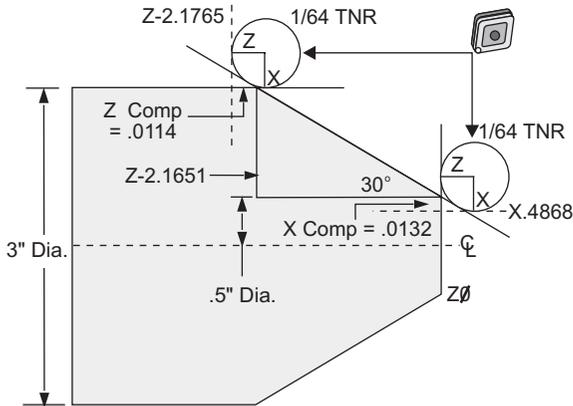


Program	
Code	Compensation (1/32 TNR)
G0 X0 Z.1	
G1 Z0	
X.4634	(X.5 - 0.0366 Comp)
X 3.0 Z-1.2683	(Z-1.250+ 0.0183 Comp)

Note: Compensation Value For 45° Angle

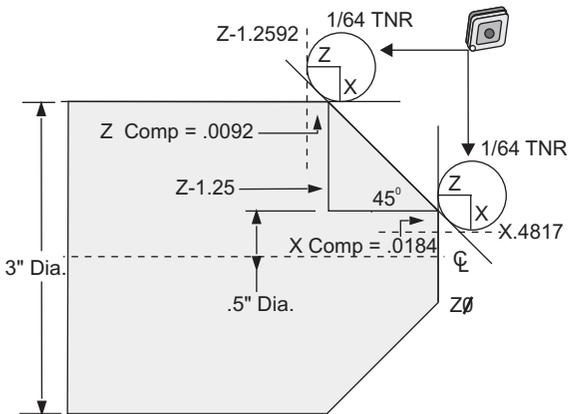


Tool Nose Radius Calculation Diagram



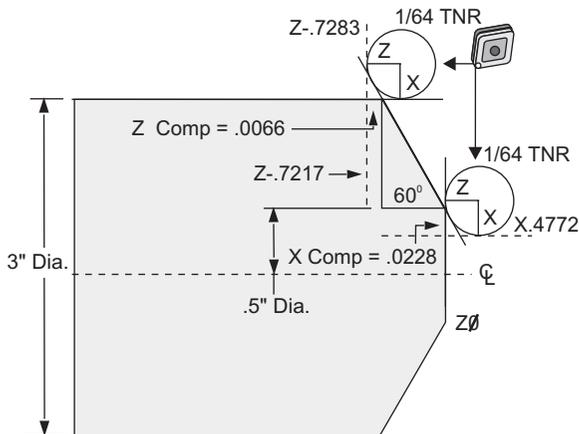
Program	
Code	Compensation (1/64 TNR)
G0 X0 Z.1	
G1 Z0	
X.4868	(X.5 - 0.0132 Comp)
X 3.0 Z-2.1765	(Z-2.1651 + 0.0114 Comp)

Note: Using Compensation Values For 30°



Program	
Code	Compensation(1/64 TNR)
G0 X0 Z.1	
G1 Z0	
X.4816	(X.5 - 0.0184 Comp)
X 3.0 Z-1.2592	(Z-1.25 + 0.0092 Comp)

Note: Using Compensation Values For 45°



Program	
Code	Compensation (1/64 TNR)
G0 X0 Z.1	
G1 Z0	
X.4772	(X.5 - 0.0228 Comp)
X 3.0 Z-.467	(Z-.7217 + 0.0066 Comp)

Note: Using Compensation Values For 60°

Tool Nose
Compensation



Tool Radius And Angle Chart (1/64 Radius)

The X measurement calculated is based on part diameter.

ANGLE	Xc CROSS	Zc LONGITU- DINAL	ANGLE	Xc CROSS	Zc LONGITUDI- NAL
1.	.0006	.0155	46.	.00186	.0090
2.	.0001	.0154	47.	.0019	.0088
3.	.0016	.0152	48.	.0192	.0087
4.	.0022	.0151	49.	.0196	.0085
5.	.0026	.0149	50.	.0198	.0083
6.	.0032	.0148	51.	.0202	.0082
7.	.0036	.0147	52.	.0204	.0080
8.	.0040	.0145	53.	.0208	.0078
9.	.0046	.0144	54.	.021	.0077
10.	.0050	.0143	55.	.0214	.0075
11.	.0054	.0141	56.	.0216	.0073
12.	.0060	.0140	57.	.022	.0071
13.	.0064	.0138	58.	.0222	.0070
14.	.0068	.0137	59.	.0226	.0068
15.	.0072	.0136	60.	.0228	.0066
16.	.0078	.0134	61.	.0232	.0064
17.	.0082	.0133	62.	.0234	.0062
18.	.0086	.0132	63.	.0238	.0060
19.	.0090	.0130	64.	.024	.0059
20.	.0094	.0129	65.	.0244	.0057
21.	.0098	.0127	66.	.0246	.0055
22.	.0102	.0126	67.	.0248	.0053
23.	.0106	.0124	68.	.0252	.0051
24.	.011	.0123	69.	.0254	.0049
25.	.0014	.0122	70.	.0258	.0047
26.	.0118	.0120	71.	.0260	.0045
27.	.012	.0119	72.	.0264	.0043
28.	.0124	.0117	73.	.0266	.0041
29.	.0128	.0116	74.	.0268	.0039
30.	.0132	.0114	75.	.0272	.0036
31.	.0136	.0113	76.	.0274	.0034
32.	.014	.0111	77.	.0276	.0032
33.	.0142	.0110	78.	.0280	.0030
34.	.0146	.0108	79.	.0282	.0027
35.	.015	.0107	80.	.0286	.0025
36.	.0154	.0103	81.	.0288	.0023
37.	.0156	.0104	82.	.029	.0020
38.	.016	.0102	83.	.0294	.0018
39.	.0164	.0101	84.	.0296	.0016
40.	.0166	.0099	85.	.0298	.0013
41.	.017	.0098	86.	.0302	.0011
42.	.0174	.0096	87.	.0304	.0008
43.	.0176	.0095	88.	.0308	.0005
44.	.018	.0093	89.	.031	.0003
45.	.0184	.0092			



PROGRAMMING

CNC controls use a variety of coordinate systems and offsets that allow control of the location of the tooling point to the part. This section describes interaction between various coordinate systems and tooling offsets.

Effective Coordinate System

The effective coordinate system is the sum total of all coordinate systems and offsets in effect. It is the system that is displayed under the label “Work” on the positions display. It is also the same as the programmed values in a G code program assuming no Tool Nose Compensation is being performed. Effective Coordinate = global coordinate + common coordinate + work coordinate + child coordinate + tool offsets.

FANUC Work Coordinate Systems - Work coordinates are an additional optional coordinate shift relative to the global coordinate system. There are 26 work coordinate systems available on a Haas control, designated G54 through G59 and G110 through G129. G54 is the work coordinate in effect when the control is powered on. The last used work coordinate stays in effect until another work coordinate is used or the machine is powered off. G54 can be deselected by ensuring that the X and Z values on the work offset page for G54 are set to zero.

FANUC Child Coordinate System - A child coordinate is a coordinate system within a work coordinate. Only one child coordinate system is available and it is set through the G52 command. Any G52 set during the program is removed once the program finishes at an M30, Reset or power down.

FANUC Common Coordinate System - The common (Comm) coordinate system is found on the second work coordinate offsets display page just below the global coordinate system (G50). The common coordinate system is retained in memory when power is turned off. The common coordinate system can be changed manually with G10 command or by using macro variables.

YASNAC Work Coordinate Shift - YASNAC controls discuss a work coordinate shift. It serves the same function as the common coordinate system. When Setting 33 is set to YASNAC, it is found on the work offsets display page as T00.

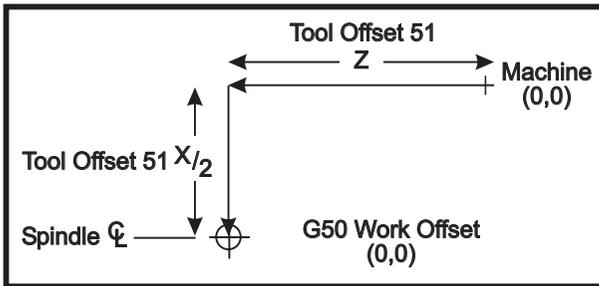
YASNAC Machine Coordinate System - The effective coordinates take the value from machine zero coordinates. Machine coordinates can be referenced by specifying G53 with X and Z in a motion block.

YASNAC Tool Offsets - There are two offsets available: Geometry offsets and Wear offsets. Geometry offsets adjusts for different lengths and widths of tools, so that every tool comes to the same reference plane. Geometry offsets are usually done at setup time and remain fixed. Wear offsets allow the operator to make minor adjustments to the geometry offsets to compensate for normal tool wear. Wear offsets are usually zero at the beginning of a production run and



may change as time progresses. In a FANUC compatible system, both geometry and wear offsets are used in the calculation of the effective coordinate system.

Geometry offsets are not available; they are replaced with tool shift offsets (50 tool shift offsets numbered 51 - 100). YASNAC tool shift offsets modify the global coordinate to allow for varying tool lengths. Tool shift offsets must be used prior to calling for the use of a tool with a G50 Txx00 command. The tool shift offset replaces any previously calculated global shift offset and a G50 command overrides a previously selected tool shift.



```
000101
N1 G51 (Return to Machine Zero)
N2 G50 T5100; (Offset for Tool 1)
:
:
%
```

G50 YASNAC Tool Shift

Automatic Setting of Tool Offsets

Tool offsets are recorded automatically using the X DIA MESUR or the Z FACE MESUR key. If the common, global, or currently selected work offset have values assigned to them, the recorded tool offset will differ from actual machine coordinates by these values. After setting up tools for a job, all tools should be commanded to a safe X, Z coordinate reference point as a tool change location.

Global Coordinate System (G50)

The global coordinate system is a single coordinate system that shifts all work coordinates and tool offsets away from machine zero. The global coordinate system is calculated by the control so the current machine location becomes the effective coordinates specified by a G50 command. The calculated global coordinate system values can be seen on the work coordinate offsets display just below auxiliary work offset 129. The global coordinate system is cleared to zero automatically when the CNC control is powered on. The global coordinate is not changed when RESET is pressed.



TIPS AND TRICKS

Programming

Short programs looped many times will not reset the chip conveyor if the intermittent feature is activated. The conveyor will continue to start and stop at the commanded times. See Settings 114 and 115.

The screen displays the spindle and axis loads, the current feed and speed, positions, and the currently active codes while a program runs. Changing display modes will change the information displayed.

To clear offsets and macro variables, press ORIGIN at the Offsets (Macros) screen. The control will display the prompt: Zero All (Y/N). If "Y" is entered all the Offsets (Macros) in the area being displayed will be set to zero. The values in the Current Commands display pages can be cleared as well. The Tool Life, Tool Load, and Timer registers can be cleared by selecting the one to clear and press ORIGIN. To clear everything in a column, scroll to the top of the column, onto the title, and press ORIGIN.

Selecting another program quickly can be accomplished simply by entering the program number (Onnnnn) and pressing arrow up or down. The machine must be in either Mem or Edit mode. Searching for a specific command in a program can be done as well in either Mem or Edit. Enter the address code (A, B, C etc.), or the address code and the value. (A1.23), and press the up or down arrow key. If the address code is entered without a value, the search will stop at the next use of that letter.

Transfer or save a program in MDI to the list of programs, by positioning the cursor at the beginning of the MDI program, enter a program number (Onnnnn), and press Alter.

Program Review - Program Review allows the operator to cursor through and review the active program on the right side of the display screen, while also viewing the same program as it is running on the left side of the screen. To enter Program Review, press F4 while the edit pane containing the program is active.

Background Edit - This feature allows programming editing while a program is running. Press EDIT until the background edit pane (on the right side of the screen) is active. Select a program to edit from the list and press WRITE/ENTER. Press SELECT PROG from this pane to select another program. Edits are possible as the program runs, however, edits to the running program will not take effect until the program ends with an M30 or RESET.

Graphics Zoom Window - F2 will activate the zoom window when in graphics mode. PAGE DOWN zooms in and PAGE UP expands the view. Use the arrow keys to move the window over the desired area of the part and press WRITE/ENTER. Press F2 and HOME to see full table view.



Copying Programs - In Edit Mode, a program can be copied into another program, a line, or a block of lines in a program. Start defining a block with the F2 key, then cursor to the last program line to define, press F2 or WRITE/ENTER to highlight the block. Select another program to copy the selection to. Cursor to the point where the copied block will be placed and press Insert.

Loading Files - Load multiple files by selecting them in the device manager, then press F2 to select a destination.

Editing Programs - Pressing F4 while in Edit mode will display another version of the current program to in the right-hand pane. Different portions of the programs can be edited alternately by pressing EDIT to switch from one side to the other. The program will be updated once switched to the other program.

Duplicating a Program - Using the List Prog mode, an existing program can be duplicated. To do this select the program number you wish to duplicate, type in a new program number (Onnnnn) and press F2. This can also be done through the popup help menu. Press F1, then select the option from the list. Type the new program name and press WRITE/ENTER.

Several programs can be sent to the serial port. Select the desired programs from the program list by highlighting them and pressing WRITE/ENTER. Press SEND RS232 to transfer the files.

Offsets

Entering offsets: Pressing WRITE/ENTER will add the entered number to the cursor-selected value. Pressing F1 will take the entered number and overwrite the cursor selected offset register. Pressing F2 will enter the negative value into the offset.

Pressing OFFSET will toggle back and forth between the Tool Length Offsets and Work Zero Offset panes.

Settings and Parameters

The jog handle is used to scroll through settings and parameters, when not in jog mode. Enter a known parameter or setting number and press the up or down arrow key to jump to it.

This control can turn itself off using settings. These settings are: Setting 1 to turn off after machine is idle for nn minutes, and Setting 2 to turn off when M30 is executed.

Memory Lock (Setting 8) when **On**, memory edit functions are locked out. When **Off**, memory can be modified.

Dimensioning (Setting 9) changes from Inch to MM. This will change all offset values too.

Reset Program Pointer (Setting 31) turns on and off the program pointer returning to the program beginning.



Scale Integer F (Setting 77) is used to change the interpretation of a feed rate. A feed rate can be misinterpreted if there is not a decimal point in the Fnn command. The selections for this setting can be "Default", to recognize a 4 place decimal. Another selection is "Integer" which will recognize a feed rate for a selected decimal position, for a feed rate that does not have a decimal.

Max Corner Rounding (Setting 85) is used to set the corner rounding accuracy required by the user. Any feed rate up to the maximum can be programmed, without the errors ever getting above that setting. The control will slow at corners only when needed.

Reset Resets Override (Setting 88) turns on and off the Reset key setting the overrides back to 100%.

Cycle Start/Feed hold (Setting 103) when On, Cycle Start must be pressed and held to run a program. Releasing Cycle Start generates a Feed Hold condition.

Jog Handle to Single Block (Setting 104) allows the jog handle to be used to step through a program. Reversing the jog handle generates a Feed Hold condition.

Offset Lock (Setting 119) prevents the operator from altering any of the offsets.

Macro Variable Lock (Setting 120) prevents the operator from altering any of the macro variables.

Operation

Memory Lock Key Switch - prevents the operator from editing programs and from altering settings when in the locked position.

Home G28 button - Returns all axes to machine zero. To send just one axis to machine home, enter the axis letter and press HOME G28. To zero out all axes on the Pos-to-Go display, while in handle jog, press any other operation mode (Edit, Mem, MDI, etc.) then back to Handle Jog. Each axis can be zeroed independently to show a position relative to the selected zero. To do this go to the Pos-Oper page, enter handle jog mode, position the axes to the desired position and press ORIGIN to zero that display. In addition a number can be entered for the axis position display. To do this, enter an axis and number, for example, X2.125 then ORIGIN.

Tool Life - Within the Current Commands page there is a tool life (usage) monitor. This register counts each time the tool is used. The tool life monitor stops the machine once the tool reaches the value in the alarms column.

Tool Overload - Tool load can be defined by the Tool Load monitor; this will change normal machine operation if it reaches the tool load defined for that tool. When a tool overload condition is encountered four actions can be set by Setting 84.

Alarm - Generate an alarm



Feedhold - Stop the feed

Beep - Sounds an audible alarm

Autofeed - Automatically increase or decrease the feed rate

Spindle speed can be verified by checking the Curnt Comds “Act” display. Live tooling spindle axis RPM is also displayed on this page.

Select an axis for jogging by entering that axis name on the input line and pressing HAND JOG.

The Help display has all the G and M codes listed. They are available within the first tab of the Help tabbed menu.

The Jogging speeds of 100, 10, 1.0 and 0.1 inches per second can be adjusted by the Feed Rate Override keys. This gives an additional 10% to 200% control.

Calculator

The number in the calculator box can be transferred to the data entry line by pressing F3 in Edit or MDI mode. This will transfer the number from the calculator box to the Edit or MDI input buffer (Enter a letter, X, Z, etc. for the command to use with the number from the calculator).

The highlighted Trig, Circular, or Milling data can be transferred to load, add, subtract, multiply, or divide in the calculator by selecting the value and pressing F4.

Simple expressions can be entered into the calculator. For example $23*4-5.2+6/2$, will be evaluated when the WRITE/ENTER key is pressed and the result (89.8 in this case) displayed in the calculator box.

INTUITIVE PROGRAMMING SYSTEM (IPS)

Introduction

The optional Intuitive Programming System (IPS) software simplifies the development of full CNC programs.

To enter the IPS menu press MDI/DNC, then PROGRM CONVRS. Navigate through the menus, using the left and right arrow keys. To select the menu press WRITE/ENTER. Some menus have sub-menus, which again use the left and right arrow keys and WRITE/ENTER to select a sub-menu. Use the arrow keys to navigate through the variables. Key in a variable using the number pad and press WRITE/ENTER. To exit the menu press CANCEL.

To exit the IPS menus press any of the Display keys, except OFFSET. Press MDI/DNC, then PROGRM CONVRS to return to the IPS menus.

Note that a program entered through the IPS menus is also accessible in MDI mode.



Automatic Mode

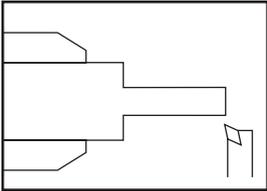
Tool and Work offsets must be set before an automatic operation can be run. Enter the values for each tool used on the Setup screen. The tool offsets will be referenced when that tool is called in the automatic operation.

On each of the interactive screens the user will be asked to enter data needed to complete common machining tasks. When all the data has been entered, pressing CYCLE START will begin the machining process.

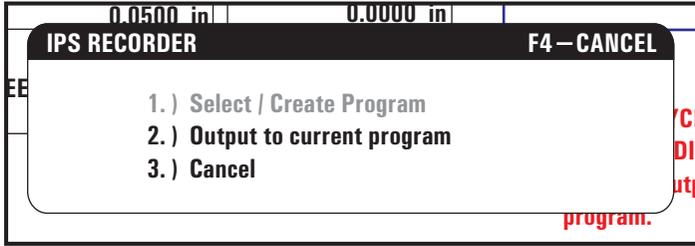
IPS Recorder

The IPS recorder provides a simple method to place G-code generated by IPS into new or existing programs.

1. To access IPS, press MDI/DNC, then PROGRAM/CONVRS. Refer to your Intuitive Programming System Operator Manual (ES0609, available electronically from the Haas Automation website) for more information on using IPS.
2. When the recorder is available, a message appears in red in the lower right corner of the tab:

MANUAL	SETUP	TURN & FACE	AMFER AND RADIUS	DRILL & TAP	READING	ROOVING	QC
TOOL NUMBER 1	DIA TO CUT 0.0000 in	MAX RPM 1000					
WORK OFFSET 54	Z DIMENSION 0.0000 in	SFM 200					
Z START PT 0.0000 in	DEPTH OF CUT 0.0500 in	FILLET RADII 0.0000 in					
OUTSIDE DIA. 0.0000 in	FEED PER REV 0.0100 in	TOOL NOSE 0.0315 in					
<p style="color: red;">Press <CYCLE START> to run in MDI or <F4> to record output to a program.</p>							
RAPID	FEED	OD TURN	ID TURN	FACE	PROFILE		

3. Press F4 to access the IPS recorder menu. Choose menu option 1 or 2 to continue, or option 3 to cancel and return to IPS. F4 also returns to IPS from any point within IPS recorder.

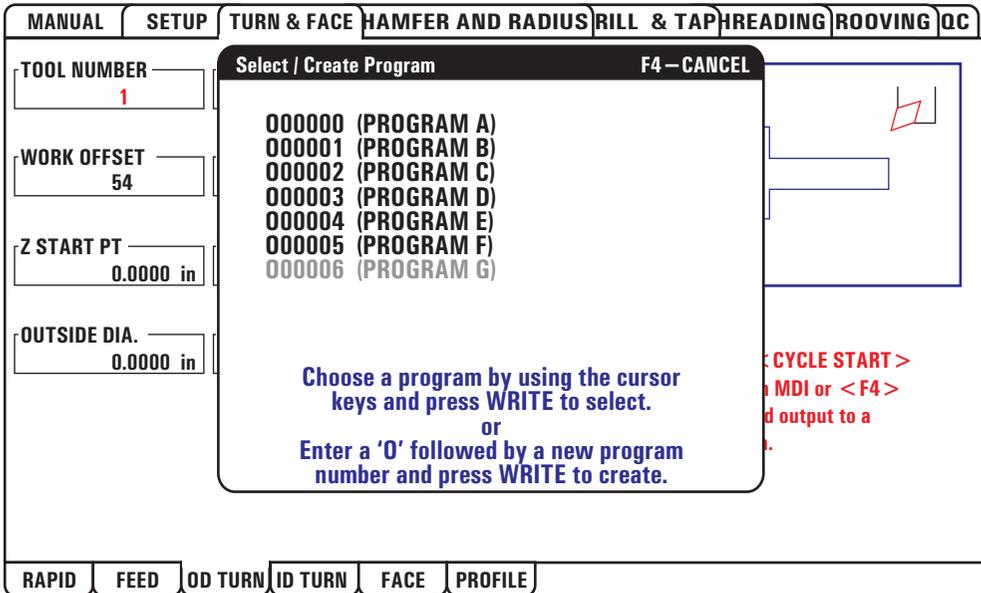


IPS Recorder Menu

Menu Option 1: Select / Create Program

Select this menu option to choose an existing program in memory or to create a new program into which the G-code will be inserted.

1. To create a new program, input the letter 'O' followed by the desired program number and press WRITE/ENTER. The new program is created, selected, and displayed. Press WRITE/ENTER once more to insert the IPS G-code into the new program.
2. To select an existing program, enter an existing program number using the O format (Onnnnn), then press WRITE/ENTER to select and open the program. To choose from a list of existing programs, press WRITE/ENTER without input. Use the cursor arrow keys to choose a program and press WRITE/ENTER to open it.



3. Using the arrow keys, move the cursor to the desired insertion point for the new code. Press WRITE/ENTER to insert the code.



Menu Option 2: Output to Current Program

1. Select this option to open the currently selected program in memory.
2. Use the arrow keys to move the cursor to the desired insertion point for the new code. Press WRITE/ENTER to insert the code.

Turning the Option On and Off

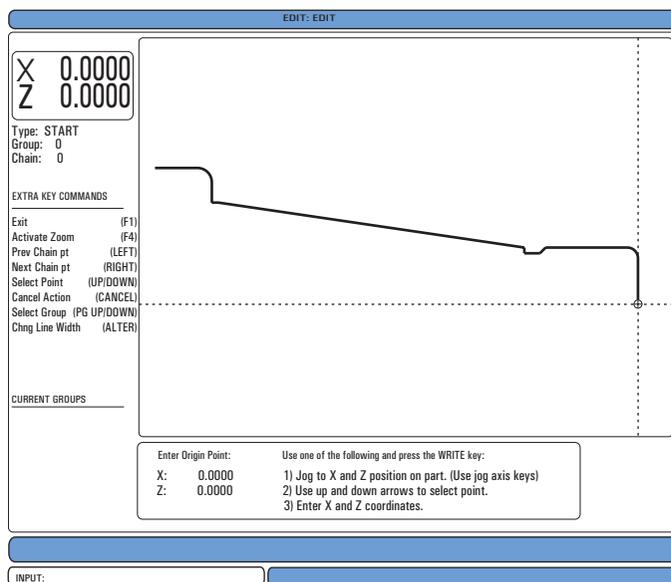
Toggle the IPS option off and on using parameter 315 bit 31 (Intuitive Prog Sys). Lathes with the option can be returned to the traditional Haas program displays by turning this parameter bit to 0.

To do this, Press PARAM/DGNOS. Enter “315” and press the down arrow. Use the left and right arrow, or jog handle to scroll to the last parameter bit (Intuitive Prog Sys). Press the Emergency Stop button, type “0” (zero) and press enter.

To re-activate the IPS option, scroll to the parameter bit as previously described, press the Emergency Stop button, type “1” and press Enter. You will need the activation code; see the parameter list that shipped with the machine or contact your dealer.

DXF FILE IMPORTER

This feature can quickly build a CNC G code program from a .dxf file. This is accomplished with three steps:





The DXF importer feature provides an on-screen help throughout the process. The step outline box shows which steps are completed by turning the text green at each completed step. The keys needed are defined beside the steps. Additional keys are identified in the left hand column for advanced use. Once a tool-path is completed it can be inserted into any program in memory. This feature will identify repetitive tasks and automatically execute them, for example, finding all the holes with the same diameter. Long contours are also automatically joined.

NOTE: DXF importer is only available with the IPS option.

Start by setting up the cutting tools in IPS. Selecting a .dxf file and press F2. The control will recognize a DXF file and import it into the editor

1. Set the origin of the part.

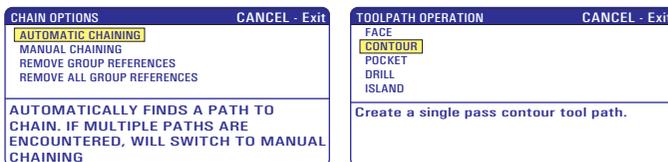
This can be done by using one of three methods.

- a. Point Selection
- b. Jogging
- c. Enter Coordinates

The jog handle or arrow keys are used to highlight a point; press WRITE/ENTER to accept the highlighted point as the origin. This is used to set the work coordinate information of the raw part.

2. Chain / Group

This step finds the geometry of the shape(s). The auto chaining function will find most part geometry. If the geometry is complex and branches off a prompt will display so the operator can select one of the branches. The automatic chaining will continue once a branch is selected.



Use the jog handle or arrow keys to choose the starting point of the tool path. Press F2 to open the dialog box open. Choose the option that best suits the desired application. The Automatic Chaining function is typically the best choice as it will automatically plot the tool path for a part feature. Press WRITE/ENTER. This will change the color of that part feature and add a group to the register under “Current group” on the left hand side of the window.

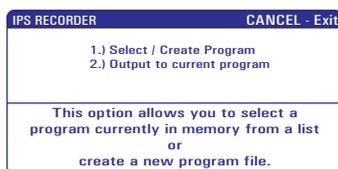


3. Select Tool Path

This step applies a tool-path operation to a particular chained group. Select group and Press F3 to choose a tool path. Use the jog handle to bisect an edge of the part feature; this will be used as a entry point for the tool. Once a tool-path is selected, the IPS (Intuitive Programming System) template for that path will display.

Most IPS templates are filled with reasonable defaults. They are derived from tools and materials that have been set up. Note: The cutting tools should have been previously set up in IPS.

Press F4 to save the tool path once the template is completed; either add the IPS G-code segment to an existing program or create a new program. Press EDIT to return to the DXF import feature to create the next tool path.



LIVE IMAGE

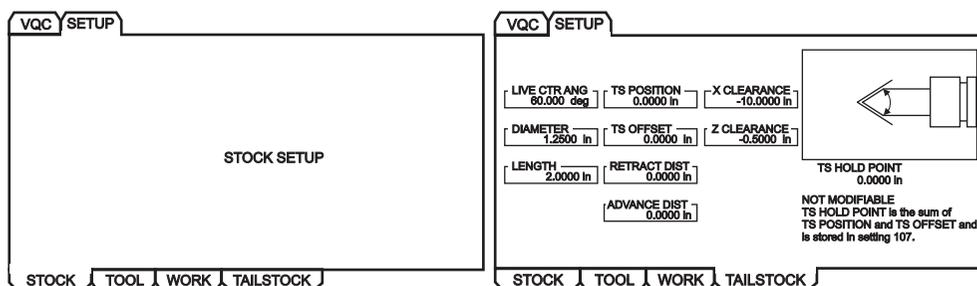
This feature allows an operator to view a real time simulation of a part as it is cut. Live Imaging of a part requires that the operator setup stock and tools before running the part program.

Setup

Stock Setup - Data values for stock and jaw dimensions are stored in the Stock Setup screen. Live Image applies this stored data to each tool.

NOTE: Turn Setting 217 ON (as shown in Settings) to show the chuck jaws in the display.

1. Press MDI/DNC, then PRGRM CONVRS to enter IPS JOG mode.





2. Use the right/left arrow keys to select the SETUP tab and press WRITE/ENTER. Use the right/left arrow keys to select the STOCK tab and press WRITE/ENTER to display the Stock Setup screen.

VQC		SETUP	
STOCK ORIENT.	STOCK	JAWS	
STOCK ORIENT. ◀ MN SPINDLE ▶	STOCK DIA. 6.0000 in	JAW THKNS 1.5000 in	
RAPID PT. N/A	STOCK LENGTH 6.0000 in	JAW HEIGHT 3.5000 in	
CLAMPING PT. N/A	STOCK FACE 0.0500 in	STEP HEIGHT 2.0000 in	
MACHINE PT. N/A	HOLE SIZE 0.0000 in	CLAMP STOCK 0.2500 in	

STOCK TOOL WORK TAILSTOCK

Screens are navigated by using the left/right/up/down arrow keys to navigate through variables. To enter the information requested by a parameter selection, use the number pad, then press WRITE/ENTER. To exit a screen, press CANCEL.

The Stock Setup screen displays stock and chuck jaw parameters that may be changed to run a particular part.

Once the values are entered press F4 to save the stock and jaw information to the program. Select one of the choices and press enter. The control will enter the new lines of code at the cursor. Ensure the new code is entered at the line after the program number.

Program Example

```
%  
O01000;  
;  
G20 (INCH MODE) ; (Start of Live Image information)  
(STOCK);  
([0.0000, 0.1000] [[6.0000, 6.0000]] ; ([Hole Size, Face] [Diameter, Length])  
(JAWS);  
([1.5000, 1.5000] [0.5000, 1.0000]) ; ([Height, Thickness] [Clamp, Step Height]) (End of  
Live Image Information)  
M01 ;  
;  
[Part Program]
```

The advantage of entering the Stock Settings into the program is that these settings may be saved with the program, and the Stock Setup screen does not require further data entry when the program is run in the future.

Further settings for Live Image, such as X and Z Offset, Rapid Path and Feed Path Live Image and Show Chuck Jaws are accessed by pressing SETNG/GRAPH, typing in the first LIVE IMAGE setting (202) and pressing the up arrow. See the settings chapter for more information.



GENERAL PROGRAM CONTROL PANEL SYSTEM MAINTENANCE POWER SETTINGS LIVE IMAGE

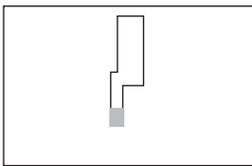
LIVE IMAGE		
202	LIVE IMAGE SCALE (HEIGHT)	1.1050
203	LIVE IMAGE X OFFSET	0.0000
205	LIVE IMAGE Z OFFSET	0.0000
206	STOCK HOLE SIZE	0.0000
207	Z STOCK FACE	0.0500
208	STOCK OD DIAMETER	6.5000
209	LENGTH OF STOCK	6.0000
210	JAW HEIGHT	3.5000
211	JAW THICKNESS	2.5000
212	CLAMP STOCK	0.2500
213	JAW STEP HEIGHT	2.0000
214	SHOW RAPID PATH LIVE IMAGE	OFF
215	SHOW FEED PATH LIVE IMAGE	OFF
217	SHOW CHUCK JAWS	ON
218	SHOW FINAL PASS	OFF
219	AUTO ZOOM TO PART	OFF
220	TS LIVE CENTER ANGLE	OFF
221	TAILSTOCK DIAMETER	OFF
222	TAILSTOCK LENGTH	OFF

Tool Setup - Tool data is stored in offsets in the IPS tabs. Live Image uses this information to draw and simulate the tool in the cut. Required dimensions can be found in a tooling supplier's catalog or by measuring the tool.

1. From the stock setup tab, press CANCEL, select the TOOL tab and press WRITE/ENTER.
2. Select the tool number, type and enter the specific parameters required for that tool (i.e., offset number, length, thickness, shank size, etc.).

NOTE: Setup parameter entry boxes are grayed out if they do not apply to the selected tool.

VQC SETUP

TOOL 9	Z WEAR 0.0000 in	TL THICKNESS 1.2500 in	 <p>Selected Tool: 9 Active Tool: 9</p> <p>Press [TURRET FWD] or [TURRET REV] to change the selected tool. Press [NEXT TOOL] to make selected tool active.</p>
TOOL TYPE CUT OFF	RADIUS 0.0000 in	INSRT THCKNES 0.1250 in	
OFFSET NUM 9	TIP 0	TOOL ANGLE N/A	
X OFFSET -10.0000 in	TOOL SHANK 1.0000 in	INSERT HEIGHT 3.0000 in	
X WEAR 0.0000 in	TOOL LENGTH 6.5000 in	FROM CENTER N/A	
Z OFFSET -11.0000 in	STEP HEIGHT 4.0000 in	DIAMETER N/A	

STOCK
TOOL
WORK
TAILSTOCK

NOTE: Tool offset data may be entered for up to 50 tools.



The following section shows part of a lathe program that is cutting a piece of stock. The program and the appropriate tool setting illustrations follows:

```
O01000 ;
;
;
;
;
T101 ;
G54 ;
G50 S4000
G96 S950 M03 ;
M08 ;
G00 X6.8 ;
Z0.15 ;
G71 P80103 Q80203 D0.25 U0.02 W0.005 F0.025 ;
N80103 ;
G00 G40 X2.
G01 X2.75 Z0. ;
G01 X3. Z-0.125 ;
G01 X3. Z-1.5 ;
G01 X4.5608 Z-2.0304 ;
G03 X5. Z-2.5606 R0.25 ;
G01 X5. Z-3.75 ;
G02 X5.5 Z-4. R0.25 ;
G01 X6.6 Z-4. ;
N80203 G01 G40 X6.8 Z-4. ;
G00 X6.8 Z0.15 ;
M09 ;
M01 ;
G53 X0;
G53 Z0;
M30 ;
```

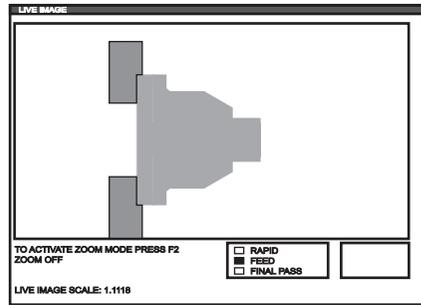
VQC SETUP		
TOOL 1	Z WEAR 0.0000 in	TL THICKNESS 1.2500 in
TOOL TYPE OD TURN	RADIUS 0.0320 in	INSRT THCKNES N/A
OFFSET NUM 1	TIP 3	TOOL ANGLE 80 deg
X OFFSET -10.0000 in	TOOL SHANK 1.0000 in	INSERT HEIGHT N/A
X WEAR 0.0000 in	TOOL LENGTH 4.0000 in	FROM CENTER N/A
Z OFFSET -11.0000 in	STEP HEIGHT 1.2500 in	DIAMETER N/A

Selected Tool: 1
Active Tool: 1

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

T101 Settings



Part Worked from T101 Settings



Sample Tool Setup Screens

VQC SETUP

TOOL 2 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE DRILL RADIUS 0.0000 in INSR THCKNES N/A

OFFSET NUM 2 TIP 7 TOOL ANGLE 175 deg

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT N/A

X WEAR 0.0000 in TOOL LENGTH 6.0000 in FROM CENTER N/A

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER 2.0000 in

Selected Tool: 2
Active Tool: 2

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

Drill

VQC SETUP

TOOL 3 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE ID BORE RADIUS 0.0320 in INSR THCKNES N/A

OFFSET NUM 3 TIP 2 TOOL ANGLE 80 deg

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT N/A

X WEAR 0.0000 in TOOL LENGTH 6.0000 in FROM CENTER 1.0000 in

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER 1.5000 in

Selected Tool: 3
Active Tool: 3

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

ID Bore

VQC SETUP

TOOL 5 Z WEAR 0.0000 in TL THICKNESS 1.2500 in

TOOL TYPE OD GROOVE RADIUS 0.0000 in INSR THCKNES 0.1250 in

OFFSET NUM 5 TIP 0 TOOL ANGLE N/A

X OFFSET -10.0000 in TOOL SHANK 1.0000 in INSERT HEIGHT 0.3500 in

X WEAR 0.0000 in TOOL LENGTH 4.0000 in FROM CENTER N/A

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER N/A

Selected Tool: 5
Active Tool: 5

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

OD Groove

VQC SETUP

TOOL 6 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE ID GROOVE RADIUS 0.0000 in INSR THCKNES 0.1250 in

OFFSET NUM 6 TIP 0 TOOL ANGLE N/A

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT N/A

X WEAR 0.0000 in TOOL LENGTH 6.0000 in FROM CENTER 1.0000 in

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER N/A

Selected Tool: 6
Active Tool: 6

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

ID Groove

VQC SETUP

TOOL 7 Z WEAR 0.0000 in TL THICKNESS 1.2500 in

TOOL TYPE OD THREAD RADIUS 0.0000 in INSR THCKNES N/A

OFFSET NUM TIP 0 TOOL ANGLE 60 deg

X OFFSET -10.0000 in TOOL SHANK 1.0000 in INSERT HEIGHT 0.1250 in

X WEAR 0.0000 in TOOL LENGTH 4.0000 in FROM CENTER N/A

Z OFFSET -11.0000 in STEP HEIGHT 1.2500 in DIAMETER N/A

Selected Tool: 7
Active Tool: 7

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

OD Thread

VQC SETUP

TOOL 8 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE ID THREAD RADIUS 0.0000 in INSR THCKNES N/A

OFFSET NUM 8 TIP 0 TOOL ANGLE 60 deg

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT 0.1250 in

X WEAR 0.0000 in TOOL LENGTH 6.0000 in FROM CENTER 1.0000 in

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER 1.5000 in

Selected Tool: 8
Active Tool: 8

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

ID Thread

VQC SETUP

TOOL 2 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE TAP RADIUS 0.0000 in INSR THCKNES N/A

OFFSET NUM 2 TIP 7 TOOL ANGLE N/A

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT N/A

X WEAR 0.0000 in TOOL LENGTH 4.0000 in FROM CENTER N/A

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER 0.6250 in

Selected Tool: 2
Active Tool: 2

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

Tap

VQC SETUP

TOOL 3 Z WEAR 0.0000 in TL THICKNESS N/A

TOOL TYPE FACE GROOVE RADIUS 0.0000 in INSR THCKNES 0.1250 in

OFFSET NUM 3 TIP 7 TOOL ANGLE N/A

X OFFSET -10.0000 in TOOL SHANK N/A INSERT HEIGHT 0.3500 in

X WEAR 0.0000 in TOOL LENGTH 4.0000 in FROM CENTER 1.0000 in

Z OFFSET -11.0000 in STEP HEIGHT N/A DIAMETER 1.5000 in

Selected Tool: 3
Active Tool: 3

Press [TURRET FWD] or [TURRET REV] to change the selected tool.
Press [NEXT TOOL] to make selected tool active.

STOCK TOOL WORK TAILSTOCK

Face Groove

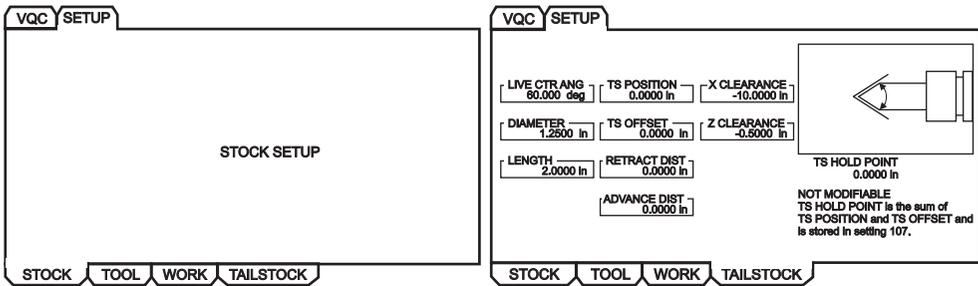


Tailstock Setup

Data values for tailstock parameters are stored in offsets in the Tailstock Setup screen.

NOTE: Tailstock tab is only visible when the machine has a tailstock.

1. Press MDI/DNC, then PRGRM CONVRS to enter IPS JOG mode.



2. Use the right/left arrow keys to select the SETUP tab and press WRITE/ENTER. Use the right/left arrow keys to select the TAILSTOCK tab and press WRITE/ENTER to display the Tailstock Setup screen.

LIVE CTR ANG, DIAMETER and LENGTH match settings 220-222. X CLEARANCE matches setting 93. Z CLEARANCE matches setting 94. RETRACT DIST matches setting 105. ADVANCE DIST matches setting 106. TS HOLD POINT is a combination of TS POSITION and TS OFFSET and matches setting 107.

To change data, enter a value on the input line and press WRITE/ENTER to add the entered value to the current value, or press F1 to overwrite the current value with the entered value.

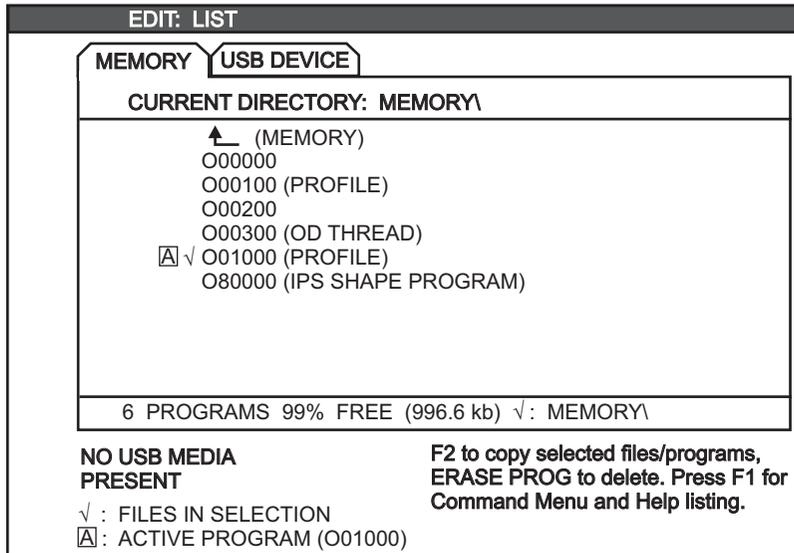
When highlighting TS POSITION, pressing Z FACE MEAS takes the value of the B axis and places it in TS POSITION. When highlighting X CLEARANCE, pressing X DIA MEAS takes the value of the X axis and places it in X CLEARANCE. When highlighting Z CLEARANCE, pressing Z FACE MEAS takes the value of the Z axis and places it in Z CLEARANCE.

Pressing ORIGIN when highlighting X CLEARANCE sets clearance to max travel. Pressing ORIGIN when highlighting Z CLEARANCE sets clearance to zero.



Operation

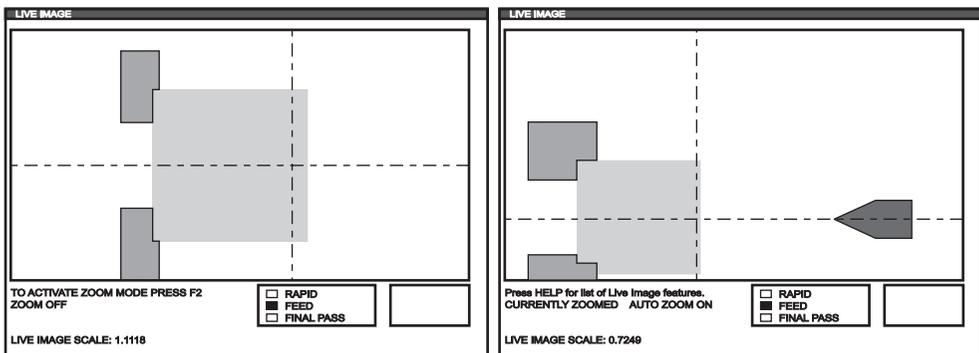
1. Select the desired program by pressing LIST PROG to display the EDIT: LIST screen. Select the MEMORY tab and press WRITE/ENTER to display CURRENT DIRECTORY: MEMORY\ screen.



2. Select a program (i.e., O01000) and press WRITE/ENTER to choose it as the active program.

Run Part

1. Press MEM, then CURNT COMDS, then PAGE UP. When the screen appears, press ORIGIN to display the Live Image screen with stock drawn.



Press F2 to enter ZOOM mode. Use PAGE UP and PAGE DOWN to zoom the display and the direction keys to move the display. Press WRITE/ENTER when the desired zoom is achieved. Press ORIGIN to return to zero zoom, or press F4 to auto zoom to the part. Press F1 to save a zoom and press F3 to load a zoom setting.



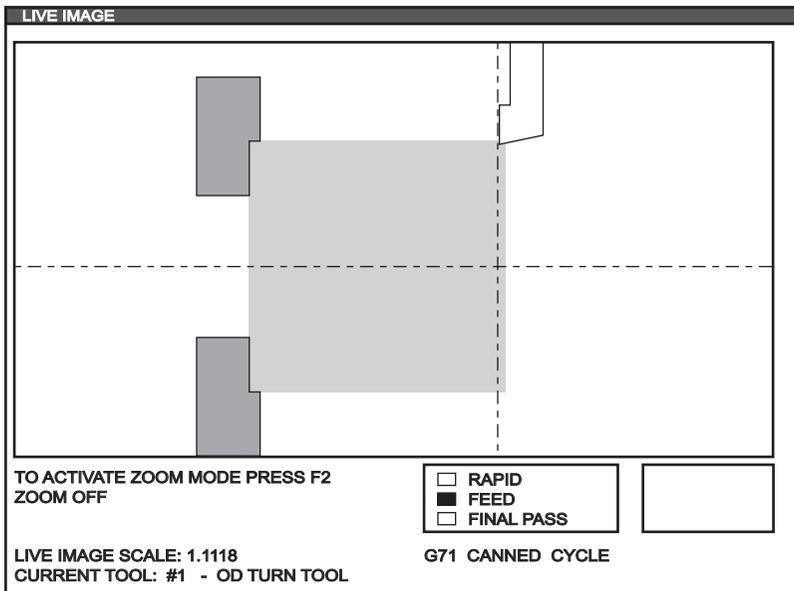
Press HELP for a pop-up containing a list of Live Image features.

LIVE IMAGE HELP	CANCEL - Exit
SAVE ZOOM SETTINGS	(F1)
TOGGLE ZOOM MODE	(F2)
RESTORE ZOOM SETTINGS	(F3)
TURN ON/OFF AUTO ZOOM	(F4)
ZOOM OUT	PAGE UP)
ZOOM IN	(PAGE DOWN)
MOVE ZOOM WINDOW	(ARROW KEYS)
SELECT ZOOM SIZE	(WRITE)
CLEAR IMAGE	(HOME)
RESET LIVE IMAGE	(ORIGIN)

Stores zoom settings to be restored later by pressing F3.

2. Press CYCLE START. A warning will pop up on the screen. Press CYCLE START again to run the program. When a program is running and tool data has been set up, the Live Image screen shows the tool working the part in real time as the program runs.

NOTE: When the barfeeder reaches G-Code 105, the part is refreshed.



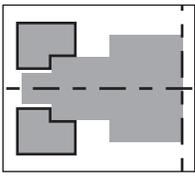
NOTE: Data displayed on the screen while the program is running includes: program, main spindle, machine position and timers and counters.



Flipping a Part

A graphical representation of a part that has been flipped manually by the machinist is depicted by adding the following comments to the program following an M00. Press F4 to enter Live Image code to the program.

VQC		SETUP	
STOCK ORIENT.	STOCK	JAWS	
STOCK ORIENT. ◀ FLIP PART ▶	FLIP DIA. 2.0000 in	JAW THKNS N/A	
RAPID PT. N/A	FLIP LENGTH 3.0000 in	JAW HEIGHT N/A	
CLAMPING PT. N/A	STOCK FACE 0.0500 in	STEP HEIGHT N/A	
MACHINE PT. N/A	HOLE SIZE N/A	CLAMP STOCK N/A	



STOCK	TOOL	WORK	TAILSTOCK
-------	------	------	-----------

Live Image will redraw the part with a flipped orientation, and with the chuck jaws clamped at a position specified by x and y within the comment “(CLAMP) (x y)” if the comments “(FLIP PART)” and “(CLAMP)(x y)” follow the M00 STOP PROG instruction in the program.

```

O00000 ;
[Code for first operation of Live Image]
[Code for first operation of machined part]
M00 ;
G20 (INCH MODE); (Start of Live Image Information for flipped part)
(FLIP PART) ;
(CLAMP) ([2.000, 3.0000]) ; ([Diameter, Length]) (End of Live Image Information flipped
part)
;
M01 ;
;
[Part Program for the second operation];

```



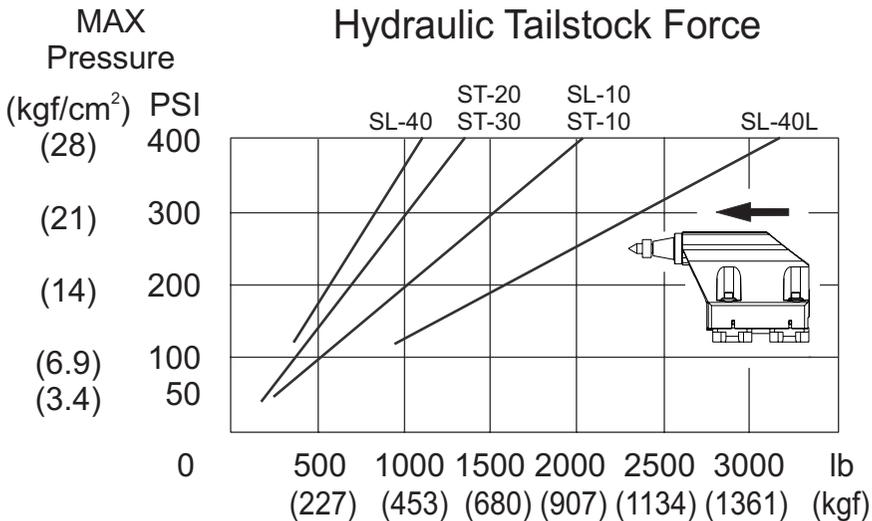
TAILSTOCK

The tailstock is a hydraulically actuated cast iron option (not field installable) which runs along two linear guides. Tailstock motion is controlled through program code, in jog mode, or by a foot switch (also see “SL-10 Tailstock Operation” at the end of this section).

The tailstock is designed to travel to position at 2 rates. High pressure is called “rapid” and can be programmed with G00. Low pressure is called “feed” and can be programmed with G01. It is used to hold the part. An F code is required for feed mode (even if previously invoked) but it does not affect the actual feed rate.

Recommended hydraulic tailstock operating pressure is 120 psi.

CAUTION! If tailstock hydraulic pressure is set lower than 120 psi, it may not function reliably. It is important to verify tailstock and turret clearance before operating the machine or serious damage may occur. Adjust Settings 93 and 94 as necessary. Feed Hold will not stop the hydraulic tailstock.



Setting a Restricted Zone for the Tailstock

Setting 93 (Tail ST. X Clearance) and Setting 94 (Z/TS Diff @ X Clearance) are used to ensure that the tailstock does not collide with the turret or any tools in the turret. The restriction zone is a rectangular area in the lower right hand area of the lathe's work space. The restriction zone will change so that the Z axis and tailstock maintain a proper distance from each other when below a specified X axis clearance plane. Setting 93 specifies the clearance plane and Setting 94 specifies the Z and B axis (tailstock axis) separation to maintain. If a programmed motion crosses the tailstock protected area, an alarm is generated. Keep in mind that a restricted zone is not always desired (e.g. when setting up). To cancel a enter a 0 in Setting 94 and maximum X machine travel in Setting 93.



Setting a Value for the X Clearance Plane:

1. Place the control in MDI mode.
2. Select the longest tool that protrudes furthest on the X-axis plane in the turret.
3. Place the control in jog mode.
4. Select the X-axis for jogging and move the X-axis clear of the tailstock.
5. Select the tailstock (B-axis) for jogging and move the tailstock beneath the selected tool.
6. Select the X-axis and approach the tailstock until the tool and tailstock are about 0.25 inches apart.
7. Enter this value for Setting 93 in the X-axis “machine” position on the display. Back the tool away in the X axis a small amount before entering the value in Setting 93.

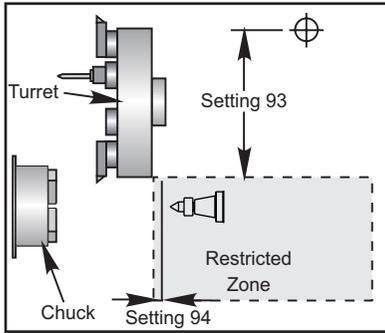
Setting a Separation for Z and B Axis Below the X Clearance Plane:

1. Place the control in Zero Ret and Home G28 all axes.
2. Select the X-axis and move the turret in front of the tailstock center tip.
3. Move the Z-axis so that the rear of the tool turret is within about 0.25 inches of the tailstock tip.
4. Enter this value for Setting 94 in the Z-axis “machine” position on the display.

Tailstock Settings

Default values for these settings, as shipped from the factory, will prevent the tailstock from running into the tool turret, provided the tool turret is empty. You will need to change the protection settings for any job you perform to avoid turret collisions based on tooling and part size. It is recommended that you test the limits after changing these settings.

When set correctly, these settings will stop any motion that would cause the tailstock to hit the tool turret. The following figures illustrates Settings 94, 94 105, 106, and 107; see the Settings chapter for more information.



Tailstock Restricted Zone

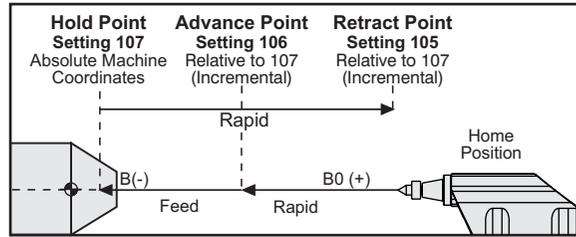


Diagram of Settings 105, 106, and 107

Setting 93 is the X-axis machine clearance plane that the X-axis cannot move past when the difference between the Z and B axes positions is less than Setting 94. When the Z- and B-axis location difference is greater than Setting 94, the X-axis is allowed to move to its travel limit. As long as the proper Z- and B-axis distance is maintained, the X-axis can move to its full travel. Likewise, if the X-axis is at its full travel, or below the clearance plane designated by Setting 93; it is not possible to reduce the Z- and B-axis difference below Setting 94.

Tailstock Foot Pedal Operation

Pressing the tailstock foot pedal will command either an M21 or M22, depending on current position. These means if the tailstock is left of the retract point, pressing the foot pedal will move the tailstock toward the retract point (M22). If tailstock is right of the retract point, the foot pedal will also move the tailstock toward the retract point (M22). If tailstock is at retract point, pressing the foot pedal will move the tailstock toward the hold point (M21).

If the foot pedal is pressed while tailstock is moving, the tailstock will stop and a new sequence must begin.

Jogging the Tailstock

In Jog mode, the keys “TS ←” and “TS →” are used to jog the tailstock at low pressure (feed). By selecting TS Rapid and pressing TS ← or TS → keys the tailstock will move at the rapid speed. The control reverts to the last jogged axis when the keys are released

Alarms/Messages

If a part is being held and tailstock motion is detected an alarm is generated. This will stop the program and turn off the spindle. This alarm is also generated if the tailstock reaches the hold point during a low pressure feed, indicating that the part has fallen out.



SL-10 Tailstock Operation

The optional Haas tailstock for the SL-10 is a hydraulically actuated quill which moves within a manually positioned headstock. The tailstock is manually positioned and held in place with the lock-lever. Tailstock motion is controlled through program code, in jog mode, or by the foot switch.

The SL-10 tailstock consists of a fixed head, and a moveable center rod. Therefore, the only moving part is the tailstock center. Pressing POWERUP/ RESTART or AUTOALL AXES will not cause the tailstock center to physically move. It is the operator's responsibility to move it out of the way to avoid a collision. Tailstock center movement using the jog handle and remote jog handle is unavailable. The tailstock center is always considered to be at zero; as the control will not know where the tailstock center is.

SL-10 Tailstock Foot pedal Operation

Pressing the foot pedal will advance or retract the foot pedal. However, pressing and holding the pedal for 5 seconds, will retract the tailstock all the way and maintain retract pressure to ensure the tailstock does not creep forward. Use this method to stow the tailstock anytime it is not in use.

The tailstock position can change over time if it is left at a position that is not fully retracted or not in contact with a part. This is due to normal hydraulic system leakage.

WARNING! It is important to verify tailstock and turret clearance before operating machine or serious damage could occur. Adjust Setting 93, Tail ST. X Clearance and Setting 94, Z/TS Diff @ X Clearance as necessary.

WARNING! Feed Hold will not stop the hydraulic tailstock. The Emergency Stop button is the only way to stop the tailstock.

Tailstock Programming

M21 will cause the tailstock quill to extend toward the spindle, and M22 will cause the tailstock quill to retract away from the spindle. When an M21 is commanded, the tailstock center will be commanded to move toward the spindle and maintain continuous pressure. Note that the program will not wait while this is completed; instead, the next block will be executed immediately. A dwell should be commanded to allow the tailstock center movement to complete, or the program should be run in Single Block mode. When an M22 is commanded, the tailstock center will move away from the spindle, and then stop.

CAUTION! Do not use an M21 in the program if the tailstock is positioned manually. If this is done, the tailstock will back away from the part and then reposition against the part, which may cause the workpiece to drop.



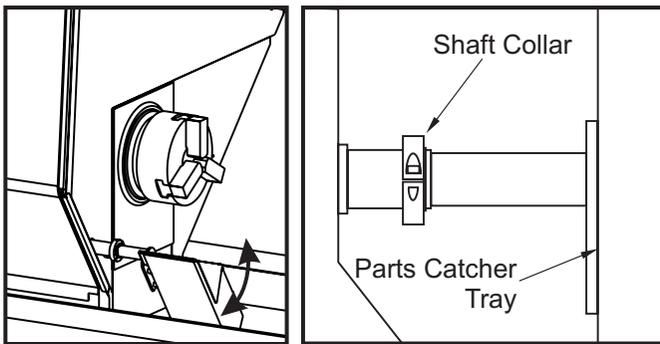
PARTS CATCHER

This option is an automatic part retrieval system designed to work with bar feed applications. It is commanded using M Codes (M36 to activate and 37 to deactivate). The parts catcher rotates to catch finished parts and direct them into the bin mounted on the front door.

Operation

The parts catcher must be properly aligned before operation.

1. Power on the machine. In MDI mode, activate the parts catcher (M36).
2. Loosen the screw in the shaft collar on the outer parts catcher shaft.



3. Slide the parts catcher tray into the shaft far enough to catch the part and clear the chuck. Rotate the tray to open the sliding cover of the parts collector mounted in the door and tighten the shaft collar on the part catcher shaft.

WARNING! Check the Z-axis, X-axis, tool and turret position during part catcher actuation to avoid possible collisions during operation.

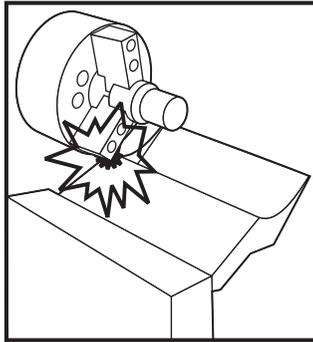
NOTE: The operator door must be closed when actuating the part catcher.

4. When programming the part catcher in a program you must use a G04 code between M53 and M63 to pause the catcher pan in the open position long enough to cut off the part and allow it to fall into the collector.



SL-10 Warning

Large chuck jaws may interfere with the operation of the parts catcher. Be sure to check the clearances before operating the parts catcher.

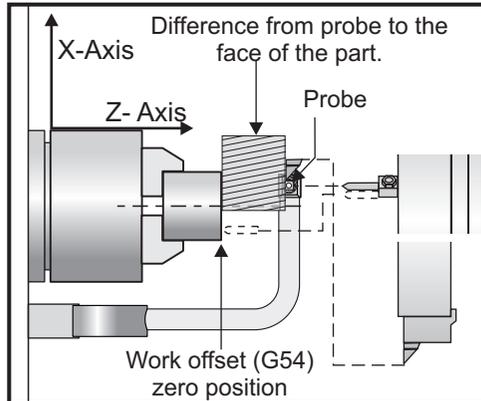


TOOL PRESETTER

The Tool Pre-Setter allows an operator to quickly set up a machine with the necessary tool and work offsets rather than having to manually record the tool offsets. Each tool has to be “touched-off” on the probe (a known point in space) to record the tool’s location. When the locations are recorded, the tool’s location relative to the part has to be recorded. At this point the user only has to touch-off one tool on the parts zero position, and the machine adjusts the work offsets for every tool. These tool and work offsets are used in order to tell the machine where the part is in relation to the “home” position, and how far a tool has to travel to get to the part.

When the probe is down, the machine will not allow any programs to be run and the axes can only be moved using the handle jog feature. The “Tool Offset” dimension will be recorded in the offset page under the corresponding offset number G52-G59 (G54 is typically used unless otherwise specified).

NOTE: There are up to 200 offset values available so that multiple offsets can be recorded for a single tool. In a program, an example would look like: “T417” which would select tool number 4 with offset number 17, etc.



Operation

IMPORTANT: Automatic storing of the machine's position can only be performed when the jog keys are used. Once the probe is touched, the control will beep, the turret will halt, and the position of the tool will be stored. The operator will not be able to continue jogging towards the probe. This prevents the operator from damaging the probe and ensures greater accuracy.

NOTE: If the operator jogs the tool tip into the probe too fast, the probe may slip off the tool tip.

The axis last jogged will be disabled; use the other axis to jog the turret away from the probe. All axes will then be re-enabled. If this does not work, raise the probe arm to its home position. If this is not possible, the prox switch that senses that the arm in the upright position can be activated, which will re-enable all axes, and the tool can be jogged away.

WARNING! When changing tools, always jog the tool a safe distance away from the probe to avoid crashing the tool into the arm. It is highly recommended to keep Setting 132 ON

Setting Tool Geometry and Tool Shift Offsets Using the Probe

1. Setting 33, Coordinate System, controls whether the current tool offsets obtained while using the tool setter are stored in Tool Geometry (FANUC) or Tool Shift (YASNAC).
2. Index the turret to the tool to probe.
3. Jog the tool to a safe position and lower the arm.

Touching off I.D. or O.D. Tools

4. Jog the turret in the X direction until the tool tip is close to the probe (use .001" jog speed). Press the X-axis key until the tool touches the probe.



NOTE: Once the tool tip touches the probe, the control will beep and not allow the operator to continue jogging in that direction. When retouching a tool, Setting 64 needs to be off to ignore the value on G54.

IMPORTANT! The jog keys must be used to automatically store the position of the tool. The jog handle can also be used; however, the values will have to be manually entered into the control.

5. Next, jog the tool in the Z direction until it touches the probe. That value is then stored in the Offsets page.

Touching Off Radial Live tools:

When touching off live tools use the previous procedure. However it is necessary to add the radius of the tool to the negative value on the Z-axis column so that the center of the tool coincides with the face of the part.

Example: If you have a 1/2" (12mm) Diameter Endmill, add 1/4" (6mm) to the Z offset for that tool.

The added value **MUST** be negative.

Touching Off Axial Live tools:

When touching off axial tools no special procedure is necessary. Follow the normal steps to set Z-axis.

To set the Centerline Offset for Both VDI and HYBRID turrets press HAND JOG and enter the Tool Geometry offset page. Press F2 to enter the proper X-axis value for Centerline Offset.

Touching off Drills, Taps or Center Cutting Tools

1. Index the turret to the tool to probe.
2. Jog the tool in the Z direction until it touches the probe (Use .001" jog speed). That value is then stored in the selected Z-axis tool offset.
3. To set the Centerline Offset for Both VDI and HYBRID turrets do the following:

Press HAND JOG and enter the Tool Geometry offset page. Press F2 to enter the proper X-axis value for Centerline Offset.

Setting Work Zero Offsets

Before running your program, the machines Work Zero Offsets (G52-129) must be entered.

1. In the Offsets page, select the desired work offset.
2. Index the turret to the desired tool and touch off the face of the part.
3. Press Z FACE MESUR to reference the rest of the tools to the face of the part.



Lathe Tool Pre-setter Alignment

1. Install a turning tool in the tool 1 station of the tool turret and clamp a piece of material in the spindle to be able to turn a diameter on the material.
2. Use the turning tool in station 1 to take a small cut on the diameter of the material clamped in the spindle.
3. Jog the turning tool away from the part in the Z-axis only - do not jog the X-axis away from the diameter. The tool position is needed to set the geometry offset for the tool in station 1 using the X DIA MEASUR key.
4. Measure the diameter of the cut made on the work piece with a micrometer and press X DIA MEASUR. Enter the diameter that was measured.
5. Write down the Geometry Offset for tool number 1. Go to the settings page and change setting 59 and 63 to 0 (zero).
6. Pull down the Tool Pre-setter and touch tool #1 to the probe. Subtract the new Geometry Offset value for tool 1 from the Offset value you had written down previously. Enter this value into setting 59.
7. Measure the tool probe width and multiply it by two. Subtract that value from Setting #59, and enter this new value into setting 60 (X- probe offset).
8. Enter 0 (zero) for setting 61. The value for setting 62 is the probe width as a negative number and setting 63 is the probe width as a positive number.

Once the tool probe is properly aligned, the values from X DIA MEASUR and the value from the probe will be the same.

AUTOMATIC TOOL SETTING PROBE

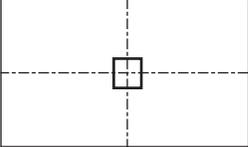
Overview

The tool setting system is used to set tool offsets by touching off tooling on a probe. The probe is first set up for tooling in manual mode, where initial tool measurements are made. After this setup, automatic mode is available to reset offsets when inserts are changed. Tool break detection is also available to monitor tool wear and breakage. The software generates G code which can be inserted into lathe programs to enable probe use during automatic operation.

Operation

To access the auto tool probe menu, first press MDI/DNC and then PRGRM CONVRS to access the IPS tabbed menu set. Use the right cursor key to navigate to the PROBE tab and press WRITE/ENTER. Use the up / down cursor arrow keys to move between menu options.



MANUAL	SETUP	TURN & FAC	CHAMFER & RADII	DRILL & TA	THREAD	GROOV	V	PROBE
OP MODE MANUAL	X OFFSET 0.0000 in	 <p>This mode is used to manually enter the X and Z offset using the probe. The direction is governed by the TOOL TIP DIR selection.</p> <p>F1 – Lower / Raise probe arm.</p>						
TOOL NUMBER 1	Z OFFSET 0.0000 in							
TOOL OFFSET 1								
TOOL TIP DIR 0								
TOLERANCE 0.0000 in								
Alarm Messages		Help Messages						

Initial Probe Menu

Menu Item	Explanation
OP MODE	Use the left and right cursor arrow keys to choose between Manual, Automatic, and Break Detect modes.
TOOL NUMBER	The tool number to be used. This value automatically sets to the current tool position in Manual mode. It can be changed in Automatic and Break Detect Modes.
TOOL OFFSET	Enter the tool offset number that is being measured.
TOOL TIP DIR	Use the left and right cursor arrow keys to choose the tool nose vector V1-V8. See “Tool Tip Direction” for more information.
TOLERANCE	Sets the measurement difference tolerance for Break Detect mode. Not available in other modes.
X OFFSET, Z OFFSET	Displays the offset value for the specified axis. Read only.

Manual Mode

Tools must be touched off in manual mode before automatic mode can be used.

1. Enter the probe menu by pressing MDI/DNC, then PRGRM CONVRS, and selecting the Probe tab. Press F1 to lower the probe arm.
2. Select the tool to be touched off using TURRET FWD or TURRET REV.
3. Select Op Mode “Manual” using the left / right cursor arrow keys, then press WRITE/ENTER or the down cursor arrow key.
4. The tool offset option is set according to the currently selected tool position. Press WRITE/ENTER or the down cursor arrow key.
5. Type the tool offset number to be used, then press WRITE/ENTER. The offset number is entered and the next menu option, Tool Tip Dir, is selected.



6. Use the left / right cursor arrow keys to select a tool tip direction, then press WRITE/ENTER or the down cursor arrow key. See the “Tool Tip Direction” section for more information on this topic.
7. Use the jog handle to move the tool tip to within approximately 0.25” (6 mm) of the tool probe in the direction indicated by the on-screen tool tip direction diagram. Note that if the tool tip is too far from the probe, the tool will not reach the probe and the operation will alarm out.
8. Press CYCLE START. The tool tip is touched off and offsets are recorded and displayed. A G code program for the operation is generated in MDI and is used for tool movement.
9. Repeat steps 1-7 for each tool to be touched off. Be sure to jog the tool turret away from the probe before selecting the next tool position.
10. Press F1 to raise the tool arm.

Automatic Mode

Once the initial tool measurement has been made in manual mode for a particular tool, automatic mode can be used to update that tool's offsets in the event of tool wear or a replacement insert.

1. Enter the probe menu by pressing MDI/DNC and then PRGRM CONVRs, and selecting the Probe tab. Select Op Mode “Automatic” using the left / right cursor arrow keys, then press WRITE/ENTER or the down cursor arrow key.
2. Type the tool number to be measured, then press WRITE/ENTER.
3. Type the tool offset number to be used, then press WRITE/ENTER.
4. The tool tip direction is preselected based on the direction set in manual mode for the tool offset.
5. Press CYCLE START. The tool tip is touched off and offsets are updated and displayed. A G code program for the operation is generated in MDI and is used for tool movement.
6. Repeat Steps 1 through 4 for each tool to be touched off.

BREAK DETECT MODE

Break detect mode compares the current measurement of the tool against the recorded measurement, and applies a user-defined tolerance value. If the difference in measurements is greater than the defined tolerance, an alarm is generated and the operation stops.

1. Enter the probe menu by pressing MDI/DNC and then PRGRM CONVRs, and selecting the Probe tab. Select Op Mode “Break Det.” using the left/ right cursor arrow keys, then press WRITE/ENTER or the down cursor arrow key.



2. Type the tool number to be measured, then press WRITE/ENTER.
3. Type the tool offset number to be used, then press WRITE/ENTER.
4. The tool tip direction is automatically selected based on the direction set in manual mode for the tool offset. Press the down cursor arrow key.
5. Type the desired tolerance value and press WRITE/ENTER.
6. Press CYCLE START. The tool tip is touched off. If the tolerance value is exceeded, an alarm is generated. A G code program for the operation is generated in MDI that can be copied into a program in memory to detect broken tools during automatic operation. To copy this program, press F4 and select the destination for the program (A new program or current program in memory).
7. Repeat steps 1 through 6 for each tool to be checked.

Tool Tip Direction

See the illustration within the Imaginary Tool Tip and Direction (Tool Nose Compensation section). Note that the Automatic tool setting probe only uses codes 1-8.

TOOL PROBE CALIBRATION

Use the following procedure if the tool probe must be calibrated:

1. Install a turning tool in the tool 1 station of the tool turret and clamp a piece of material in the spindle to be able to turn a diameter on the material.
2. Use the turning tool in station 1 to take a small cut on the diameter of the material clamped in the spindle.
3. Jog the turning tool away from the part in the Z-axis only - do not jog the X-axis away from the diameter. The tool position is needed to set the geometry offset for the tool in station 1 using X DIA MEASUR.
4. Measure the diameter of the cut made on the work piece with a micrometer and press X DIA MEASUR. Type the diameter you measured and press ENTER.
5. Write down the Geometry Offset for tool number 1. Go to the settings page and change setting 59 and 63 to 0 (zero).
6. Press F1 to lower the Tool Pre-setter arm, and touch tool #1 to the probe. Subtract the new Geometry Offset value for tool 1 from the Offset value you had written down previously. Enter this value into setting 59.
7. Measure the tool probe width and multiply it by two. Subtract that value from Setting #59, and enter this new value into setting 60 (X- probe offset).



8. Enter 0 (zero) for setting 61. The value for setting 62 is the probe width as a positive number and setting 63 is the probe width as a positive number. Once the tool probe is properly aligned, the values from X Dia Measure and the value from the probe will be the same.

TOOL PROBE ALARMS

The following alarms are generated by the tool probe system and displayed in the alarm messages section of the display. They can only be cleared by resetting the control.

Arm Not Down – The probe arm is not in position for the operation. Enter the probe menu by pressing MDI/DNC and then PRGRM CONVRs, and selecting the Probe tab. Press F1 to lower the probe arm.

Calibrate First – The probe must be calibrated using the procedure described previously.

No Tool Offset – A tool offset must be defined.

Illegal Tool Offset Number – Tool offset “T0” is not allowed. If using the ‘T’ input on the cycle call line check that the value is not zero; otherwise, this alarm may occur if no tool or tool offset was selected in MDI before running the cycle.

CAUTION: Make sure the turret is safely away from the probe before indexing the turret.

Illegal Tool Nose Vector – Only vector numbers 1 through 8 are allowed. See the Tool Tip Direction diagram in the TNC section of this manual for tool nose vector definitions.

Probe Open – This alarm occurs when the probe is in an unexpected open (triggered) condition. Make sure the tool is not in contact with the probe before beginning an operation.

Probe Fail – This alarm occurs when the tool fails to contact the probe within the defined travel. Check that the probe has been calibrated. In manual probe mode, jog the tool tip to within 0.25” (6 mm) of the probe.

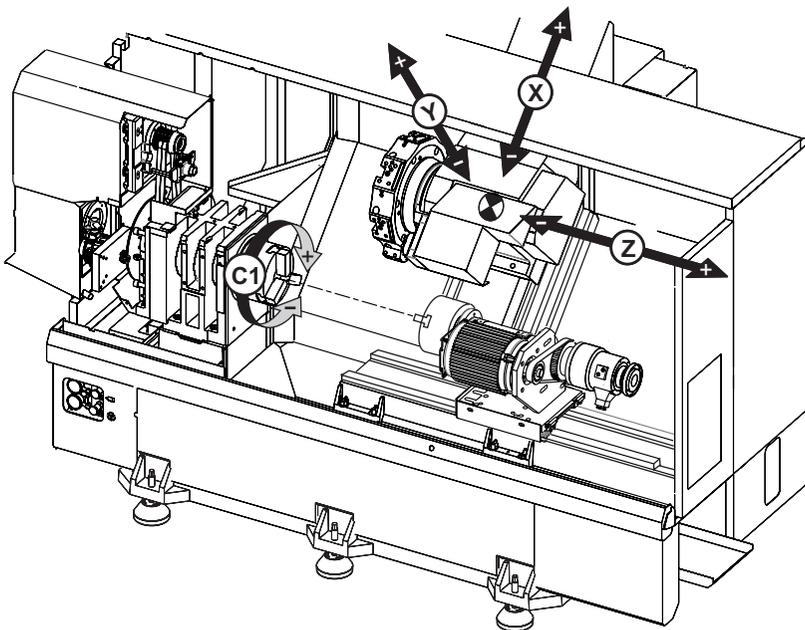
Broken Tool – This alarm is generated when the tool length error exceeds the defined tolerance.



DUAL SPINDLE LATHES (DS-SERIES)

The DS-30 is a lathe with two spindles. The first is the main spindle which is operated like the main spindle on a 2-axis lathe. The other spindle, the “secondary spindle”, replaces the typical tailstock and has its own set of M codes. Positioning is programmed as the B-axis.

Dual spindle lathes have the ability to synchronize the main and secondary spindle. This means when the main spindle is commanded to an RPM the secondary spindle will turn at the same speed. This is called, “synchronous control”. During synchronous control both spindles will accelerate, maintain constant speed and decelerate together. Therefore a single part can be held on both ends for maximum support and minimum vibration. In addition, part transfer between the main and secondary spindle can be done without stopping the spindles.



Dual-spindle lathe shown with optional Y-axis

Both spindles will orient before going to the programmed speed, when using G199 (Engage Synchronous Spindle Control) mode.

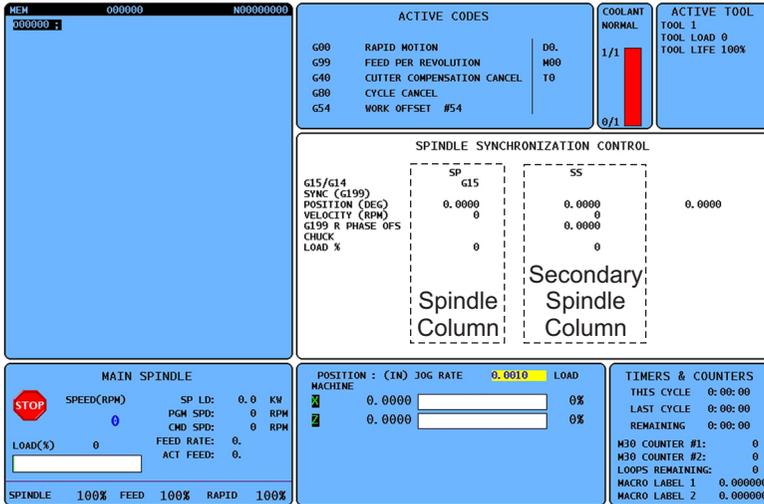
When Reset or E-stop is pressed, the control will remain in synchronous mode until all spindle motion is stopped. To exit synchronous mode, enter a G198 command in MDI and press cycle start.

Secondary spindle program structure is the same as the main spindle. Main spindle M-codes and canned cycles are supported in the G14 (secondary spindle) mode. See the G-code section.



Description of Synchronized Control Display.

The spindle synchronization control display is available on the CURNT COMDS display. Press “Page Up” from the main (Operation Timers and Setup) current Command page.



The SP column is the main spindle status, and the SS column is the status of the secondary spindle. The third column shows miscellaneous status. On the left is a column of row titles. The following describes each row.

SYNC (G199) - When G199 appears in the row, spindle synchronization is active.

POSITION (DEG) - This row shows the current position, in degrees, of both the spindle and the secondary spindle. Values range from -180.0 degrees to 180.0 degrees. The third column indicates the current difference, in degrees, between the two spindles. When both spindles are at their respective zero marks, then this third column will indicate zero. When a program commands a phase offset with G199 and an R value, then the third column will show the progress toward the R phase. When the spindles are synchronized and aligned in agreement with the R value, the third column will show the same value of R.

The value in the third column is the difference between SP and SS.

If this value is negative it represents how much the Secondary Spindle is lagging the main spindle when it is commanded in the FWD (M03) direction.

If this value is positive, It then represents how much SS is leading SP when SP is commanded in the FWD (M03) direction. Then the relative orientation of the spindle and secondary spindle will be maintained at that amount (phase), in G199, regardless of command direction.



VELOCITY (RPM) - This row shows the actual RPM of the main spindle and the secondary spindle.

G199 R PHASE OFS. - This is the programmed R value for G199. When G199 is not commanded this row is blank, otherwise it contains the R value in the most recently executed G199 block.

CHUCK - This column shows the clamped or unclamped status of the work holding (chuck or collet). This row is empty when clamped, or shows "UN CLAMPED" in red when the work holding is open.

LOAD % - This shows the current load percent for each spindle.

Secondary Spindle Programming

G199 places the dual spindle lathe (DS series) into synchronous mode. Disengage synchronous control using G198. Setting 122 selects between OD and ID clamping of the secondary spindle. The B axis specifies absolute motions for the secondary spindle axis, and spindle speed functions are controlled by the P address code. The P address code specifies spindle speed from 1 RPM to maximum speed. Three M codes are used to start and stop the secondary spindle. M143 starts the spindle forward, M144 starts the spindle in reverse and M145 stops the spindle.

G14 Secondary Spindle Swap / G15 Secondary Spindle Swap Cancel - The active spindle during G199. When G15 (default) is used the main spindle is being controlled and the secondary spindle is following. When G14 is used, the secondary spindle is the commanded spindle. This is shown by "G15" in the SP column or "G14" in the SS column. Only one will be displayed at a time.

Programming Example

```
%  
O01100  
(Main spindle O.D. turning)  
  
(ADD G4 P.5 AFTER M15)  
(M119 BEFORE G14)  
  
N1 G54 G18 G99  
M155 (Disengage C axis)  
G50 S2200 T200  
G97 S1800 M03  
T202( 0.0312 RAD. 80-DEG. Diamond)  
G00 X3.1 Z2.  
Z0.1 M08  
G96 S95  
G01 X2.92 Z0.005 F.01  
G01 X2.98 Z-0.03  
G01 Z-3.5  
G01 X3.1  
G97 S424  
G00 G53 X-1.M09
```



G53 Z-11.M05(Main spindle stop)
M01

(Clean secondary spindle jaws before hand off)

G53 G00 X-1. Z-11.(Safe tool change position)
M12 (Auto air jet on)
M110 (Secondary spindle chuck clamp)
G97 M04 S500
M143 P500 (Secondary spindle forward)
M111 (Secondary spindle chuck clamp unclamp)
M13 (Auto air jet off)

(Hand off part from main spindle to secondary spindle)
G199 (Spindle synchronization on)
G00 B-33.(Rapid secondary spindle)
G04 P0.3 (Dwell)
G01 B-37.481 F100.0(Feed secondary spindle onto part)

M110 (Secondary spindle chuck clamp)
G04 P0.3
M11 (Main chuck unclamp)
G04 P0.3

G00 B-19.(Position secondary spindle in position for machining)
G198(Cancel spindle synchronization)
M05 (Main spindle stop)
G53 G00 X-1.
G53Z-11.
M01

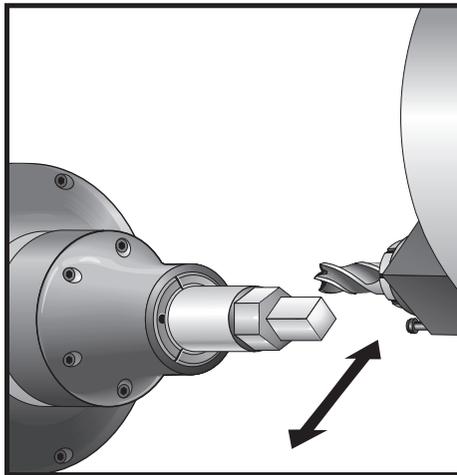
(Secondary spindle O.D. Turning - G55 used)

N21 G55 G18 G99
(O.D. turn secondary spindle)
T222(Turret station #2 offset 22)
G14(Main spindle/ secondary spindle swap activate Z axis mirroring)
G50 S2500
G97 S1600 M03
G00 X3.1 Z0.2
G00 Z0.1 M08
G96 S950
G00 X3.1 Z0.05
G01 X2.92 Z0.005 F.01
G01 X2.98 Z-0.03
G01 Z-3.5
G01 X3.1
G97 S424
G00 G53 X0 M09
G53 Z0
G15(Main spindle/secondary spindle swap cancel Z axis mirroring)
M30
%

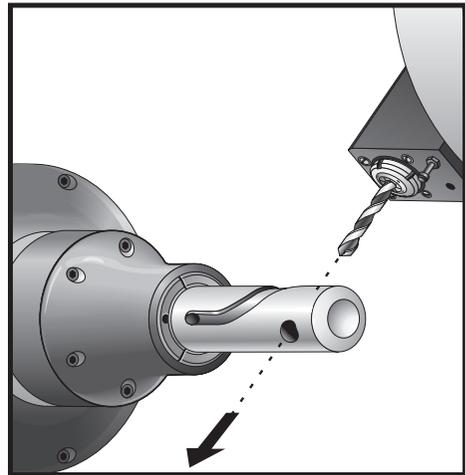


LIVE TOOLING AND C AXIS

This option is not field installable.



Axial Tool



Radial Tool

LIVE TOOLING INTRODUCTION

The live tooling option allows the user to drive VDI axial or radial tools to perform such operations as milling, drilling or slotting. Milling shapes is possible using the C-axis and / or the Y Axis.

Programming Notes

The live tool drive will automatically turn itself off when a tool change is commanded.

For the best milling accuracy, use the spindle clamp M Codes (M14 - Main Spindle / M114 - Secondary Spindle) before machining. The spindle will automatically unclamp when a new main spindle speed is commanded or Reset is pressed.

Maximum live tooling drive speed is 3000 RPM.

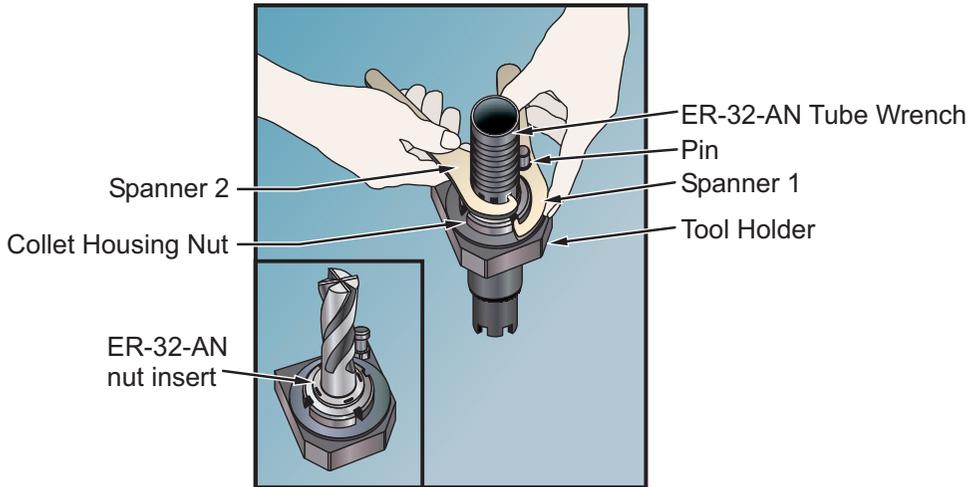
Haas live tooling is designed for medium duty milling, e.g.: 3/4" diameter end mill in mild steel max.

LIVE TOOLING CUTTING TOOL INSTALLATION

1. Insert the tool bit into the ER-AN nut insert. Thread the nut insert into the collet housing nut.
2. Place the ER-32-AN tube wrench over the tool bit and engage the teeth of the ER-AN nut insert. Snug the ER-AN nut insert by hand using the tube wrench.



3. Place Spanner 1 over the pin and lock it against the collet housing nut. It may be necessary to turn the collet housing nut to engage the spanner.
4. Engage the teeth of the tube wrench with Spanner 2 and tighten.



LIVE TOOL MOUNTING IN TURRET

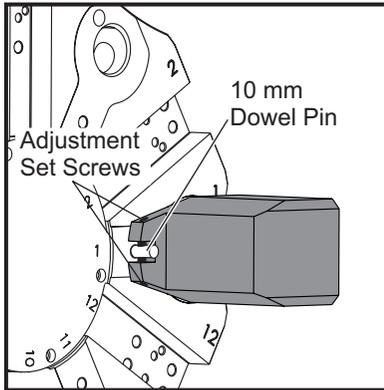
Radial live tool holders can be adjusted for optimum performance during milling with the Y-Axis. The body of the tool holder can be rotated in the tool pocket relative to the X-axis. This allows for adjustment of the parallelism of the cutting tool with the X-axis.

Adjustment set screws are standard on all radial live tool heads. A 10mm dowel pin is required for alignment.

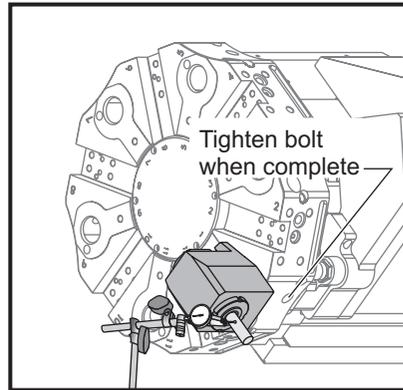
Mounting and alignment

- 1) Install 10mm Dowel Pin on the turret.
- 2) Mount Radial Live Tool and snug adjustment set screws against the dowel pin at a visually even and centered position.

Snug the VDI allen bolt to allow for some movement and adjustment of the tool. Ensure the back face of the toolholder is flush with the face of the turret.



Adjust Alignment with Set Screws



Indicate Dowel Pin or Gauge Pin

- 3) Position the Y-axis at zero.
- 4) Install a dowel pin or gauge pin on the holder like you would install the cutting tool. Make sure the tool sticks out at least 1.25" (32mm). This will be used to run the indicator across it to insure parallelism to X-axis.
- 5) Set an indicator with a magnetic base on a rigid surface (for example, the tailstock base). Position the indicating tip on the end point of the pin and zero the indicator dial.
- 6) To sweep the indicator along the pin to measure the parallelism between the pin and X-axis.
- 7) Adjust set screws mentioned on # 2 and keep indicating across the top of pin until tool is properly aligned and parallel to X-axis.
- 8) Tighten VDI allen bolt to recommended torque.
- 9) Repeat steps # 1 to # 8 for every radial tool used in set-up.

Setting Live Tool Offsets

Touching off of the X-axis offset manually or with a tool presetter is performed in the same manner as any other tool on the turret.

Touching-Off Radial Live tools

When touching off radial live tools use the following procedure.

Example: If using a $\frac{1}{2}$ " (12mm) diameter end mill, add $\frac{1}{4}$ " (6mm) to the Z offset for that tool. The added value **MUST** be negative (radial tools only).

1. Press the HANDLE JOG key.
2. Press .1/100. (The lathe will move at a fast rate when the handle is turned).
3. Toggle between the X and Z jog keys until the tool is close to the side of the part.



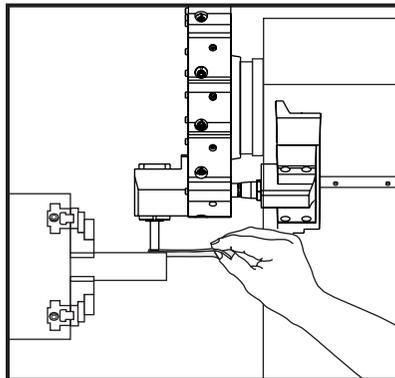
4. Place a sheet of paper between the tool and the part. Carefully move the tool as close as possible until there is contact but you are still able to move the paper.
5. Press Offset, until the Tool Geometry table is displayed.
6. Press X Dia Mesur. The control will then prompt for the diameter of the part. This will take the X position located in the bottom left of the screen and the diameter of the part and put it with the position of the tool.
7. Back the tool from the part and position the tool tip so that it is touching the face of the stock.
8. Press Z Face Meas. This will take the current Z position and write it to the tool offset.

It is necessary to add the radius of the tool to the negative value on the Z-axis column. The new value makes the center of the tool coincide with the face of the part.

9. The cursor will move to the Z-axis location for the tool.
10. Press Next Tool.

Repeat the previous steps for each live tool.

Offset Values can be entered manually by choosing one of the offsets pages, moving the cursor to the desired column, typing a number and pressing Write/Enter or F1. Pressing F1 will enter the number in the selected column. Entering a value and pressing Write/Enter will add the amount entered to the number in the selected column.



Touching-Off Axial Live tools

When touching off axial tools no special procedure is necessary. Follow the steps described previously for the Z-axis. Touch off and follow the steps described to set the X-axis value. Do not add the radius of the tool.



Live Tooling M Codes

Also see the M-Code Chapter.

M19 Orient Spindle (Optional)

An M19 will orient the spindle to the zero position. A P or R value can be to orient the spindle to a specific position (in degrees.) Degrees of accuracy - P rounds to the nearest whole degree, and R rounds to the nearest hundredth of a degree (x.xx) The angle is viewed in the Current Commands Tool Load screen.

M119 will position the secondary spindle (DS lathes) the same way.

M133 Live Tool Drive Forward

M134 Live Tool Drive Reverse

M135 Live Tool Drive Stop

M19 Programming Example:

Bolt Hole Circle 3 holes @ 120° on 3" BHC

%

O0050

T101

G54

G00 X3.0 Z0.1

G98 (Feed per minute)

M19 P0 (Orient spindle)

M14 (Turn on main spindle brake)

M133 P2000 (Turn on live tool forward)

G01 Z-0.5 F40.0

G00 Z0.1

M19 P120 (Orient spindle)

M14 (Turn on main spindle brake)

G01 Z-0.5

G00 Z0.1

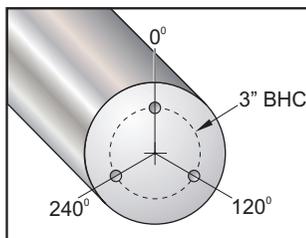
M19 P240 (Orient spindle)

M14 (Turn on main spindle brake)

G01 Z-0.5

G00 Z0.1

M15 (Turn off main spindle brake)





Same example using C-axis instead of optional M19

Bolt Hole Circle 3 holes @ 120° on 3" BHC

%

O0051

T101

G54

G00 X3.0 Z0.1

G98

M154 (C-Axis engage)

C0.0

M133 P2000 (Live Tooling Drive Forward)

G81 Z-0.5 F40.0

C120.0

C240.0

G00 G80 Z0.1

M155 (C-Axis Disengage)

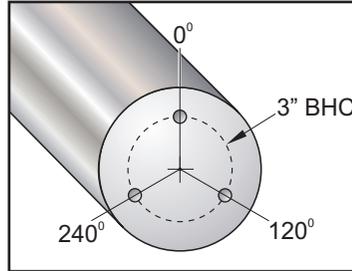
M135 (Live tool drive)

G53 X0

G53 Z0

M30

%



C-Axis

Introduction

The C-axis provides high-precision bi-directional spindle motion that is fully interpolated with X and/or Z motion. Spindle speeds from .01 to 60 RPM can be commanded.

C-Axis operation is dependant on the mass, diameter and length of the work-piece and/or the workholding (chuck). Contact the Haas Applications Department if any unusually heavy, large diameter, or long configuration is used.

CARTESIAN TO POLAR TRANSFORMATION

Cartesian to Polar coordinate programming that converts X,Y position commands into rotary C-axis and linear X-axis moves. Cartesian to Polar coordinate programming greatly reduces the amount of code required to command complex moves. Normally a straight line would require many points to define the path, however, in Cartesian, only end points are necessary. This feature allows face machining programming in the Cartesian coordinate system.

Programming notes:

Programmed moves should always position the tool centerline.

Tool paths should never cross the spindle centerline. If necessary re-orient the program so the cut does not go over the center of the part. Cuts that must cross spindle center can be accomplished with two parallel passes on either side of spindle center.



Cartesian to Polar conversion is a modal command (see the G-code section).

CARTESIAN INTERPOLATION

Cartesian coordinate commands are interpreted into movements of the linear axis (turret movements) and spindle movements (rotation of the work piece).

Example Program

```
%  
O00069  
N6 (Square)  
G59  
T1111 ( Tool 11, .75 Dia. Endmill, cutting on center)  
M154  
G00 C0.  
G97 M133 P1500  
G00 Z1.  
G00 G98 X2.35 Z0.1 (Position)  
G01 Z-0.05 F25.  
G112  
G17 (Set to XY plane)  
G0 X-.75 Y.5  
G01 X0.45 F10. (Point 1)  
G02 X0.5 Y0.45 R0.05 (Point 2)  
G01 Y-0.45 (Point 3)  
G02 X0.45 Y-0.5 R0.05 (Point 4)  
G01 X-0.45 (Point 5)  
G02 X-0.5 Y-0.45 R0.05 (Point 6)  
G01 Y0.45 (Point 7)  
G02 X-0.45 Y0.5 R0.05 (Point 8)  
G01 X0.45 (Point 9) Y.6  
G113  
G18 (Set to XZ plane)  
G00 Z3.  
M30  
%
```

Operation (M codes and Settings)

M154 C-axis engage

M155 C-axis disengage

Setting 102, Diameter, is used to calculate the feed rate.

The lathe will automatically disengage the spindle brake when the C-axis is commanded to move and to reengage it afterwards if the M codes is still active.

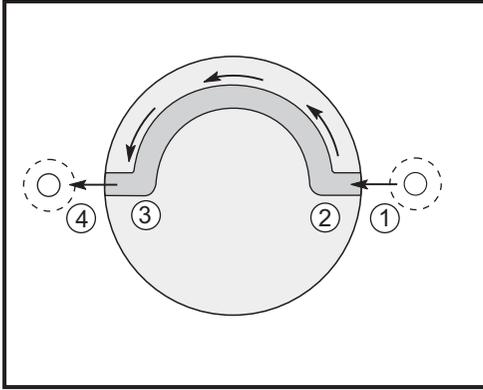
C-Axis incremental moves are possible using the "H" address code as shown in the following example.

G0 C90.; (C-axis moves to 90. deg.)



H-10.; (C-axis moves to 80. deg. from the previous 90 deg position)

Sample Programs



Example #1

```

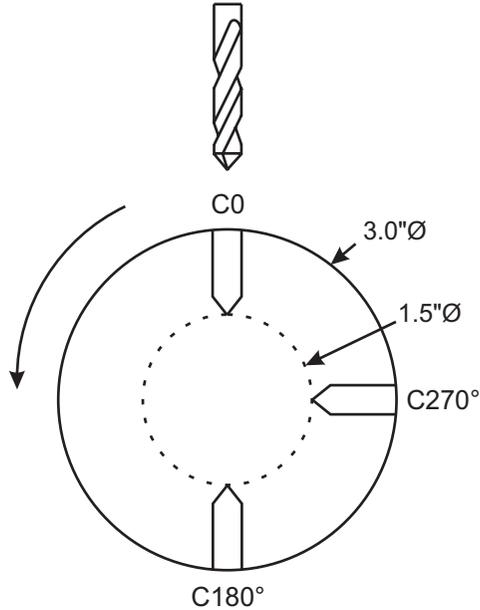
%
O0054
T101
G54
M133 P2000 (Live Tool On)
M154 (Engage C-axis)
G00 G98 (feed/min) X2.0 Z0
C90
G01 Z-0.1 F6.0 (position 1)
X1.0 (position 2)
C180. F10.0 (position 3)
X2.0 (position 1)
G00 Z0.5
M155
M135
G53 X0
G53 Z0
M30

```

(LIVE DRILL - RADIAL)

```

T101
G19
G98
M154 (Engage C-axis)
G00 G54 X6. C0. Y0. Z1.
G00 X3.25 Z0.25
G00 Z-0.75
G97 P1500 M133
M08
G00 X3.25 Z-0.75
G00 C0.
G19 G75 X1.5 I0.25 F6.
G00 C180.
G19 G75 X1.5 I0.25 F6.
G00 C270.
G19 G75 X1.5 I0.25 F6.
G00 G80 Z0.25 M09
M135
M155
M09
G00 G28 H0.
G00 X6. Y0. Z3.
G18
G99
M00
M30
%
```





TOOL RADIUS CUTTER COMPENSATION USING G112 WITH G17 (XY) PLANE

Tool Radius Cutter Compensation shifts the programmed tool path so that the centerline of the tool is moved to the left or right of the programmed path. The Offset page is used to enter the amount that the tool path is shifted in the radius column. The offset is entered as a radius value for both the geometry and the wear columns. The compensated value is calculated by the control from the values entered in the Radius. When using G112, Cutter Radius Compensation is only available in G17 (XY) plane. The tool tip does not need to be defined.

Tool Radius Cutter Compensation using Y-Axis in G17 (X-Y motion) and G19 (Z-Y motion) Planes.

Tool Radius Cutter Compensation shifts the programmed tool path so that the centerline of the tool is moved to the left or right of the programmed path. The Offset page is used to enter the amount that the tool path is shifted in the radius column. The offset is entered as a radius value for both the geometry and the wear columns. The compensated value is calculated by the control from the values entered in the Radius. Cutter radius compensation using Y-axis MUST NOT include C-axis in any of the synchronized motion. Tool tip does not need to be defined.

- **G41 will select cutter compensation left.**
- **G42 will select cutter compensation right.**
- **G40 cancels cutter compensation.**

Offset values entered for the radius should be in positive numbers. If the offset contains a negative value, cutter compensation will operate as though the opposite G code was specified. For example, a negative value entered for a G41 will behave as if a positive value was entered for G42.

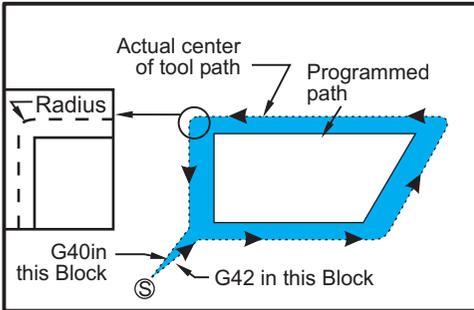
When selecting Yasnac for Setting 58, the control must be able to position the side of the tool along all of the edges of the programmed contour without over cutting the next two motions. A circular motion joins all of the outside angles.

When selecting Fanuc for Setting 58, the control does not require that the tool cutting edge be placed along all edges of the programmed contour, preventing over-cutting. Outside angles less than or equal to 270° are joined by a sharp corner and outside angles of more than 270° are joined by an extra linear motion. The following diagrams show how cutter compensation works for the two values of Setting 58.

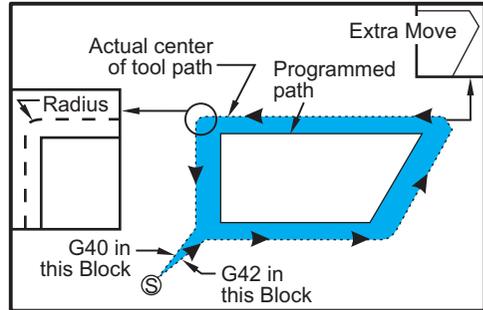
NOTE: When canceled, the programmed path returns to being the same as the center of the cutter path. Cancel cutter comp (G40) before ending a program.



G42 Cutter Compensation - (YASNAC)



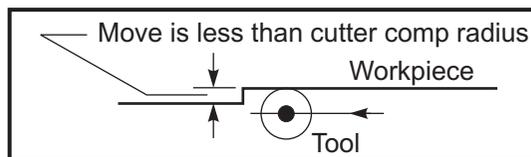
G42 Cutter Compensation - (FANUC)



Entry and Exit

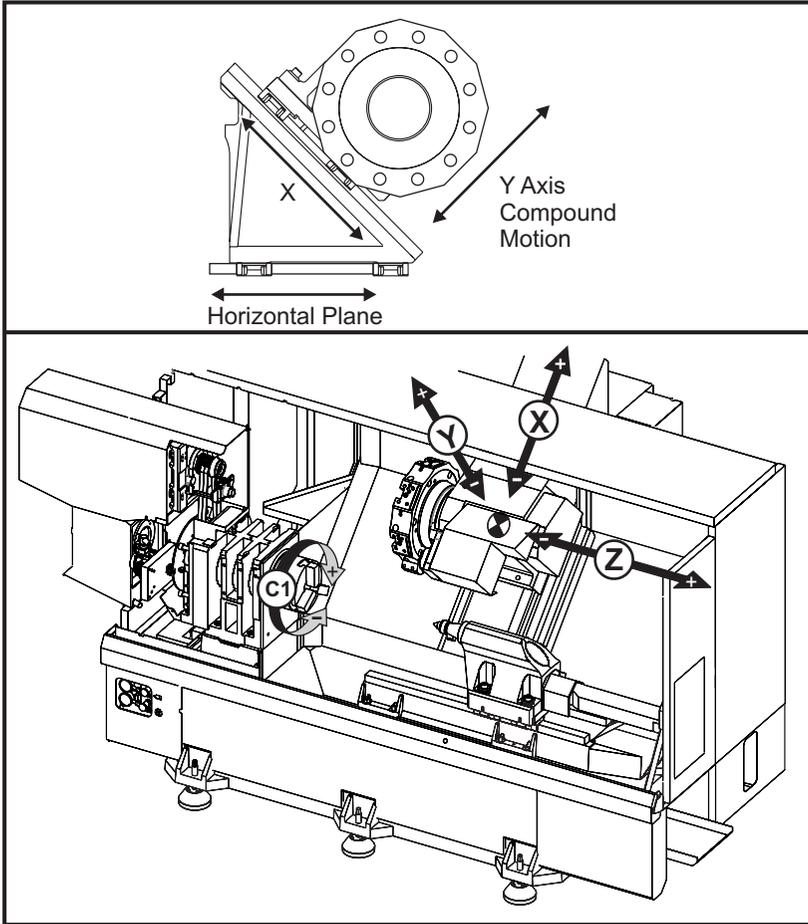
Cutting should not be performed when entering and exiting cutter compensation or when changing from left side to right side compensation. When cutter compensation is turned on, the starting position of the move is the same as the programmed position, but the ending position will be offset, to either the left or right of the programmed path, by the amount entered in the radius offset column. In the block that turns off cutter compensation, compensation will be turned off as the tool reaches the end of block position. Similarly, when changing from left to right or right to left side compensation, the starting point of the move needed to change cutter compensation direction will be offset to one side of the programmed path and end at a point that is offset to the opposite side of the programmed path. The result of all this is that the tool moves through a path that may not be the same as the intended path or direction. If cutter compensation is turned on or off in a block without any X-Y move, there is no change made to the tool position until the next X or Y move is encountered.

When turning on cutter compensation in a move that is followed by a second move at an angle of less than 90°, there are two ways of computing the first motion, type A or type B (Setting 43). The first, type A, moves the tool directly to the offset start point for the second cut. The diagrams on the following pages illustrate the differences between type A and type B for both Fanuc and Yasnac settings (Setting 58).



Improper Cutter Compensation Application

Note that a small cut of less than tool radius and at a right angle to the previous motion will only work with the Fanuc setting. A cutter compensation alarm will be generated if the machine is set to the Yasnac setting.



Y-Axis Travel Envelopes

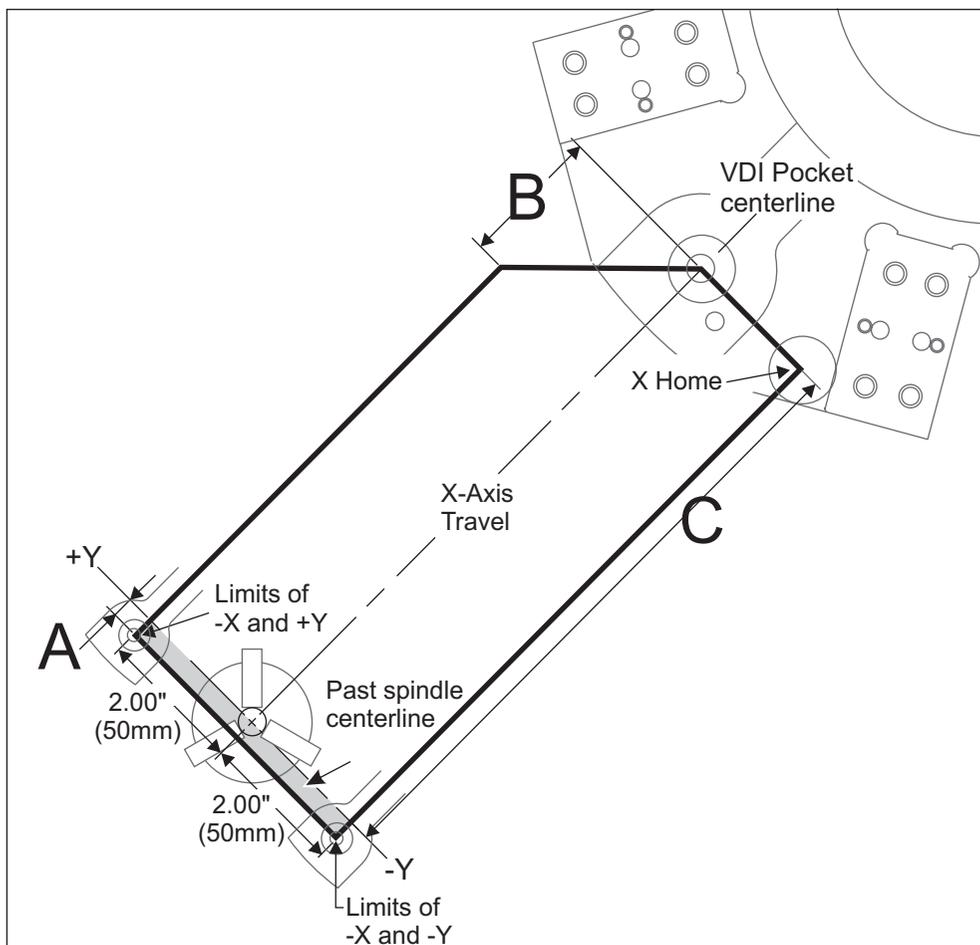
The next few pages illustrate the travel envelopes of the Y-axis lathes. The Y-axis travel limits are shown on the following pages relative to the VDI tool pocket centerline and the spindle centerline. The size and position of the available work envelope changes with the length of radial live tools.

..When setting up tooling consider the following:

- Work piece diameter
- Tool extension (radial tools)
- Required Y-axis travel from the centerline

Y-axis lathe with VDI turret

For standard axial tool holders, the centerline of the cutting tool will be available in the following work envelope illustration. The position of the work envelope will shift when using radial live tools. The length the cutting tool extends from the centerline of the tool pocket is the distance the envelope shifts. The following illustration demonstrates the work envelope in relation to the center of the VDI tool pocket.



Dimensions from VDI pocket centerline for Axial tools				
	ST-20Y with VB / VDI	ST-20SSY with 24-tool Hybrid	ST-30Y/DS-30Y with VB / VDI	ST-30SSY / DS-30SSY with 24-tool Hybrid
A	0.30" (8 mm)	1.61" (41 mm)	1.55" (39 mm)	2.86" (80 mm)
B	2.00" (50 mm)	2.00" (50 mm)	2.00" (50 mm)	2.00" (50 mm)
C	9.00" (228 mm)	7.69" (195 mm)	10.95" (278 mm)	9.64" (245 mm)
Maximum Cutting Diameter for Axial Tools				
	14.00 (356 mm)	11.38" (289 mm)	17.90" (455 mm)	15.28" (388 mm)

Operation and Programming

The Y-axis is an additional axis on the lathes (if so equipped) that can be commanded and behaves in the same manner as the standard X and Z axis. There is no activation command necessary for Y-axis. It is available at all times when machine is in run or set-up mode.

The lathe will automatically return the Y-axis to spindle centerline after a tool change. Make sure the turret is correctly positioned before commanding rotation.



Standard Haas G and M codes are available when programming with Y-axis. Please refer to G and M code section of this manual for more information.

Plane selection commands are necessary for Y-axis live tooling operations. This applies to both Axial live tools (tool centerline parallel to the Z-axis) and radial live tools (tool centerline parallel to the X-axis). Please refer to G17, G18 and G19 code explanations on the G-code section of this operator manual.

Mill type cutter compensation can be applied in both G17 and G19 planes when performing live tool operations. Cutter compensation rules must be followed to avoid unpredictable motion when applying and canceling the compensation. The Radius value of the Tool being used must be entered in the Radius column of the tool geometry page for that tool. The tool tip is assumed as "0" and no value should be entered.

Programming recommendations:

1) Command Axis home or to a safe tool change location in rapids using G53. Both axis can be commanded at the same time regardless of the positions of Y-axis and X-axis in relation to each other. All axes will move at the MAX possible speed toward commanded position and will not finish at the same time.

If commanding the Y and X axes home using G28 the following conditions must be met and the described behavior expected.

- If X-axis is commanded home while the Y-axis is above spindle centerline (positive Y-axis coordinates), alarm 317 (Y over travel range) will be generated. Command Y-axis home first, then X-axis.
- If X-axis is commanded home and the Y-axis is below spindle centerline (negative Y axis coordinates), the X-axis will home and Y will not move.
- If both X-axis and Y-axis are commanded home using G28 X0 Y0 and the Y-axis is below spindle centerline (negative Y axis coordinates), the Y-axis will home first and the X-axis will follow.

2) Clamp the main and/or secondary spindles (if so equipped) anytime live tooling operations are being performed and C-axis is not being interpolated.

Note that the brake will unclamp automatically anytime C-axis motion for positioning is commanded. Refer to C-axis, Live Tooling and M-code section for more information.

3) The following canned cycles can be used with Y-axis. Refer to the G-code section of this manual for more information.

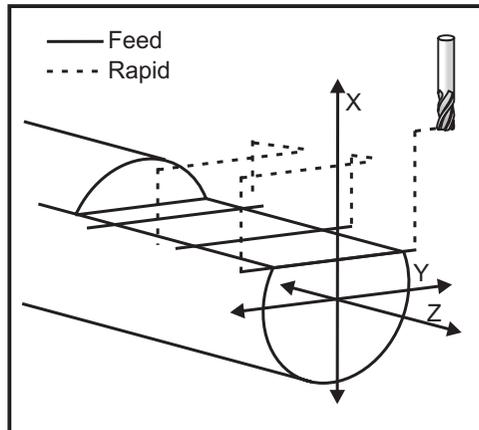
G17 Plane (Axial) Only Cycles:
Drilling: G74, G81, G82, G83,
Boring: G85, G89,
Tapping: G95, G186,
G19 Plane (Radial) Only Cycles:



Drilling: G75 (a grooving cycle), G241, G242, G243,
Boring: G245, G246, G247, G248
Tapping: G195, G196

Program Example

```
%  
O02003  
N20  
(MILL FLAT ON DIAMETER 3.00 DIAMETER .375 DEEP)  
T101 (.750 4 FLUTE ENDMILL)  
G19 (SELECT PLANE)  
G98 (IPM)  
M154 (ENGAGE C-AXIS)  
G00 G54 X6. C0. Y0. Z1. (RAPID TO A POSITION)  
G00 C90. (ROTATE C AXIS TO 90 DEGREES)  
M14 (BRAKE ON)  
G97 P3000 M133  
G00 X3.25 Y-1.75 Z0. (RAPID POSITION)  
G00 X2.25 Y-1.75  
M08  
G01 Y1.75 F22.  
G00 X3.25  
G00 Y-1.75 Z-0.375  
G00 X2.25  
G01 Y1.75 F22.  
G00 X3.25  
G00 Y-1.75 Z-0.75  
G00 X2.25  
G01 Y1.75 F22.  
G00 X3.25  
G00 X3.25 Y0. Z1.  
M15 (BRAKE OFF)  
M135 (LIVE TOOL OFF)  
M155 (DISENGAGE C-AXIS)  
M09  
G00 G28 H0.  
G00 X6. Y0. Z3.  
G18 (RETURN TO NORMAL PLANE)  
G99 (IPR)  
M01  
M30  
%
```





MACROS (OPTIONAL)

This control feature is optional; contact your dealer for information.

INTRODUCTION

Macros add capabilities and flexibility to the control that are not possible with standard G-code. Some possible uses are families of parts, custom canned cycles, complex motions, and driving optional devices.

A Macro is any routine/subprogram that may be run multiple times. A macro statement can assign a value to a variable or read a value from a variable, evaluate an expression, conditionally or unconditionally branch to another point within a program, or conditionally repeat some section of program.

Here are a few examples of the applications for Macros. Rather than give macro code here, we will outline the general applications for which Macros may be used.

Simple Patterns that are Repeated Over and Over Again in the Shop-

Patterns that recur over and over again can be defined using macros and stored. For example:

- **Family of parts**
- **Soft jaw machining**
- **User defined “canned” cycles (such as custom grooving cycles)**

Automatic Offset Setting Based on the Program - With macros, coordinate offsets can be set in each program so that setup procedures become easier and less error-prone.

Probing - Probing enhances the capabilities of the machine in many ways. Below is just a hint of the possibilities.

- **Profiling of a part to determine unknown dimensions for later machining.**
- **Tool calibration for offset and wear values.**
- **Inspection prior to machining to determine material allowance on castings.**

Useful G and M Codes

M00, M01, M30 - Stop Program

G04 - Dwell

G65 Pxx - Macro subprogram call. Allows passing of variables.

M96 Pxx Qxx - Conditional Local Branch when Discrete Input Signal is 0

M97 Pxx - Local Sub Routine Call

M98 Pxx - Sub Program Call

M99 - Sub Program Return or Loop

G103 - Block Lookahead Limit. No cutter comp allowed

M109 - Interactive User Input (see “M Codes” section)



Settings

There are 3 settings that can affect macro programs (9000 series programs), these are 9xxxx progs Lock (#23), 9xxx Progs Trace (#74) and 9xxx Progs Single BLK (#75).

Lookahead

Look ahead is an issue of great importance to the macro programmer. The control will attempt to process as many lines as possible ahead of time in order to speed up processing. This includes the interpretation of macro variables. For example,

```
#1101 = 1
G04 P1.
#1101 = 0
```

This is intended to turn an output on, wait 1 second, and then turn it off. However, lookahead will cause the output to turn on then immediately back off while the dwell is being processed. G103 P1 can be used to limit lookahead to 1 block. To make this example work properly, it must be modified as follows:

```
G103 P1 (See the G-code section of the manual for a further explanation of G103)
;
#1101=1
G04 P1.
;
;
;
;
#1101=0
```

Round Off

The control stores decimal numbers as binary values. As a result, numbers stored in variables can be off by 1 least significant digit. For example, the number 7 stored in macro variable #100, may later be read as 7.000001, 7.000000, or 6.999999. If your statement was, "IF [#100 EQ 7]...", it may give a false reading. A safer way of programming this would be, "IF [ROUND [#100] EQ 7]...". This issue is usually only a problem when storing integers in macro variables where you do not expect to see a fractional part later.

OPERATION NOTES

Macro variables can be saved or loaded through the RS-232, or USB much like settings and offsets. Refer to the Control Data Transfer section.

Variable Display Page

The macro variables are displayed and can be modified through the current commands display. To get to the pages, press CURNT COMDS and use the page up/down key.

As the control interprets a program, the variable changes are displayed on the variable display page and results can be viewed. The macro variable is set by



entering a value and then pressing WRITE/ENTER. Macro Variables can be cleared by pressing ORIGIN. Entering the macro variable number and pressing the up/down arrow will search for that variable.

The variables displayed represent the values of the variables during the running of the program. At times, this may be up to 15 blocks ahead of the actual machine actions. Debugging a program is easier when inserting a G103 at the beginning of a program to limit block buffering, then removing it after debugging is completed.

Macro Arguments

The arguments in a G65 statement are a means of sending values to and setting the local variables of a called macro subroutine. The following two tables indicate the mapping of the alphabetic address variables to the numeric variables used in a macro subroutine.

Alphabetic Addressing

Address:	A	B	C	D	E	F	G	H	I	J	K	L	M
Variable:	1	2	3	7	8	9	-	11	4	5	6	-	13
Address:	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Variable	-	-	-	17	18	19	20	21	22	23	24	25	26

Alternate Alphabetic Addressing

Address:	A	B	C	I	J	K	I	J	K	I	J
Variable:	1	2	3	4	5	6	7	8	9	10	11
Address:	K	I	J	K	I	J	K	I	J	K	I
Variable:	12	13	14	15	16	17	18	19	20	21	22
Address:	J	K	I	J	K	I	J	K	I	J	K
Variable:	23	24	25	26	27	28	29	30	31	32	33

Arguments accept any floating point value to four decimal places. If the control is in metric, it will assume thousandths (.000). In the Example below, local variable #7 will receive .0004. If a decimal is not included in an argument value, such as: G65 P9910 A1 B2 C3, the values are passed to macro subroutines according to the following table:

Integer Argument Passing (no decimal point)

Address:	A	B	C	D	E	F	G
Variable:	.001	.001	.001	1.	1.	1.	-
Address:	H	I	J	K	L	M	N
Variable:	1.	.0001	.0001	.0001	1.	1.	-
Address:	O	P	Q	R	S	T	U
Variable:	-	-	.0001	.0001	1.	1.	.0001
Address:	V	W	X	Y	Z		
Variable:	.0001	.0001	.0001	.0001	.0001		



All 33 local macro variables can be assigned values with arguments by using the alternate addressing method. The following example shows how one could send two sets of coordinate locations to a macro subroutine. Local variables #4 through #9 would be set to .0001 through .0006 respectively.

Example: G65 P2000 I1 J2 K3 I4 J5 K6

The letters G, L, N, O and P cannot be used to pass parameters to a macro subroutine.

Macro Variables

There are three categories of macro variables: system variables, global variables, and local variables. Constants are floating point values placed in a macro expression. They can be combined with addresses A...Z or they can stand alone when used within an expression. Examples of constants are .0001, 5.3 or -10.

Local Variables

Local variables range between #1 and #33. A set of local variables is available at all times. When a call to a subroutine with a G65 command is executed, the local variables are saved and a new set is available for use. This is called “nesting” of the local variables. During a G65 call, all of the new local variables are cleared to undefined values and any local variables that have corresponding address variables in the G65 line are set to the G65 line values. Below is a table of the local variables along with the address variable arguments that change them.

Variable:	1	2	3	4	5	6	7	8	9	10	11
Address:	A	B	C	I	J	K	D	E	F		H
Alternate:							I	J	K	I	J
Variable:	12	13	14	15	16	17	18	10	20	21	22
Address:		M				Q	R	S	T	U	V
Alternate:	K	I	J	K	I	J	K	I	J	K	I
Variable:	23	24	25	26	27	28	29	30	31	32	33
Address:	W	X	Y	Z							
Alternate:	J	K	I	J	K	I	J	K	I	J	K

Note that variables 10, 12, 14-16 and 27-33 do not have corresponding address arguments. They can be set if a sufficient number of I, J and K arguments are used as indicated above in the section about arguments. Once in the macro subroutine, the local variables can be read and modified by referencing the variable numbers 1-33.

When the **L** argument is used to do multiple repetitions of a macro subroutine, the arguments are set only on the first repetition. This means that if local variables 1-33 are modified in the first repetition, the next repetition will have access only to the modified values. Local values are retained from repetition to repetition when the **L** address is greater than 1.



Calling a subroutine via an M97 or M98 does not nest the local variables. Any local variables referenced in a subroutine called by an M98 are the same variables and values that existed prior to the M97 or M98 call.

Global Variables

Global variables are variables that are accessible at all times. There is only one copy of each global variable. Global variables occur in three ranges: 100-199, 500-699 and 800-999. The global variables remain in memory when power is turned off.

Occasionally, there have been some macros written for factory installed options that use the global variables. For example, probing, pallet changers, etc. When using global variables, be sure they are not in use by another program on the machine.

System Variables

System variables give the programmer the ability to interact with a variety of control conditions. By setting a system variable, the function of the control can be modified. By reading a system variable, a program can modify its behavior based on the value in the variable. Some system variables have a Read Only status; this means that the programmer cannot modify them. A brief table of currently implemented system variables follows with an explanation of their use.

VARIABLES	USAGE
#0	Not a number (read only)
#1-#33	Macro call arguments
#100-#199	General purpose variables saved on power off
#500-#599	General purpose variables saved on power off
#600-#699	General purpose variables saved on power off
#700-#749	Hidden variables for internal use only
#750-#751	Serial port #2 data collection
#800-#999	General purpose variables saved on power off
#1000-#1063	64 discrete inputs (read only)
#1064-#1068	Max. axis loads for X, Y, Z, A, and B-axes on MOCON1
#1080-#1087	Raw analog to digital inputs (read only)
#1090-#1098	Filtered analog to digital inputs (read only)
#1094	Coolant Level
#1098	Spindle load with Haas vector drive (read only)
#1100-#1139	40 discrete outputs
#1140-#1155	16 extra relay outputs via multiplexed output
#1264-#1268	Max. axis loads for U, V, W, SS, and TT on MOCON2
#2001-#2050	X axis tool shift offsets
#2101-#2150	Z axis tool shift offsets
#2201-#2250	Tool nose radius offsets
#2301-#2350	Tool tip direction
#2701-#2750	X axis tool wear offsets
#2801-#2850	Z axis tool wear offsets
#2901-#2950	Tool nose radius wear offsets
#3000	Programmable alarm
#3001	Millisecond timer



VARIABLES	USAGE
#3002	Hour timer
#3003	Single block suppression
#3004	Override control
#3006	Programmable stop with message
#3011	Year, month, day
#3012	Hour, minute, second
#3020	Power on timer (read only)
#3021	Cycle start timer
#3022	Feed timer
#3023	Present cycle time
#3024	Last cycle time
#3025	Previous cycle time
#3026	Tool in spindle (read only)
#3027	Spindle RPM (read only)
#3030	Single Block
#3031	Dry Run
#3032	Block Delete
#3033	Opt Stop
#3901	M30 count 1
#3902	M30 count 2
#4001-#4020	Previous block group codes
#4101-#4126	Previous block address codes

Note: Mapping of 4101 to 4126 is the same as the alphabetic addressing of "Macro Arguments" section; e.g. the statement x1.3 sets variable #412 4 to 1.3.

VARIABLES	USAGE
#5001-#5006	Previous block end position
#5021-#5026	Present machine coordinate position
#5041-#5046	Present work coordinate position
#5061-#5069	Present skip signal position - X, Z, Y, A, B, C, U, V, W
#5081-#5086	Present tool offset
#5201-#5206	Common offset
#5221-#5226	G54 work offsets
#5241-#5246	G55 work offsets
#5261-#5266	G56 work offsets
#5281-# 5286	G57 work offsets
#5301-#5306	G58 work offsets
#5321-#5326	G59 work offsets
#5401-#5450	Tool feed timers (seconds)
#5501-#5550	Total tool timers (seconds)
#5601-#5650	Tool life monitor limit
#5701-#5750	Tool life monitor counter
#5801-#5850	Tool load monitor (maximum load sensed so far)
#5901-#6000	Tool load monitor limit
#6001-#6277	Settings (read only)
#6501-#6999	Parameters (read only)

Note: The low order bits of large values will not appear in the macro variables for settings and parameters.



VARIABLES

#7001-#7006 (#14001-#14006)
#7021- #7026 (#14021-#14026)
#7041-#7046 (#14041-#14046)
#7061-#7066 (#14061-#14066)
#7081-#7086 (#14081-#14086)
#7101-#7106 (#14101-#14106)
#7121-#7126 (#14121-#14126)
#7141-#7146 (#14141-#14146)
#7161-#7166 (#14161-#14166)
#7181-#7186 (#14181-#14186)
#7201-#7206 (#14201-#14206)
#7221-#7226 (#14221-#14221)
#7241-#7246 (#14241-#14246)
#7261-#7266 (#14261-#14266)
#7281-#7286 (#14281-#14286)
#7301-#7306 (#14301-#14306)
#7321-#7326 (#14321-#14326)
#7341-#7346 (#14341-#14346)
#7361-#7366 (#14361-#14366)
#7381-#7386 (#14381-#14386)

#8550 Tool / Tool Group ID

#8552 Maximum recorded vibrations

#8553 X axis tool shift offsets

#8554 Z axis tool shift offsets

#8555 Tool nose radius offsets

#8556 Tool tip direction

#8559 X axis tool wear offsets

#8560 Z axis tool wear offsets

#8561 Tool nose radius wear offsets

#8562 Tool feed timers

#8563 Total tool timers

#8564 Tool life monitor limit

#8565 Tool life monitor counter

#8566 Tool load monitor maximum load sensed so far

#8567 Tool load monitor limit

#14401-#14406

#14421-#14426

#14441-#14446

#14461-#14466

#14481-#14486

#14501-#14506

#14521-#14526

#14541-#14546

#14561-#14566

#14581-#14586

•
•
•

#14781-#14786

•
•

USAGE

G110 (G154 P1) additional work offsets

G111 (G154 P2) additional work offsets

G114 (G154 P3) additional work offsets

G115 (G154 P4) additional work offsets

G116 (G154 P5) additional work offsets

G117 (G154 P6) additional work offsets

G118 (G154 P7) additional work offsets

G119 (G154 P8) additional work offsets

G120 (G154 P9) additional work offsets

G121 (G154 P10) additional work offsets

G122 (G154 P11) additional work offsets

G123 (G154 P12) additional work offsets

G124 (G154 P13) additional work offsets

G125 (G154 P14) additional work offsets

G126 (G154 P15) additional work offsets

G127 (G154 P16) additional work offsets

G128 (G154 P17) additional work offsets

G129 (G154 P18) additional work offsets

G154 P19 additional work offsets

G154 P20 additional work offsets

G154 P21 additional work offsets

G154 P22 additional work offsets

G154 P23 additional work offsets

G154 P24 additional work offsets

G154 P25 additional work offsets

G154 P26 additional work offsets

G154 P27 additional work offsets

G154 P28 additional work offsets

G154 P29 additional work offsets

G154 P30 additional work offsets

G154 P40 additional work offsets



#14981-#14986	G154 P50 additional work offsets
•	
•	
•	
#15181-#15186	G154 P60 additional work offsets
•	
•	
•	
#15381-#15386	G154 P70 additional work offsets
•	
•	
•	
#15581-#15586	G154 P80 additional work offsets
•	
•	
•	
#15781-#15786	G154 P90 additional work offsets
•	
•	
•	
15881-15886	G154 P95 additional work offsets
15901-15906	G154 P96 additional work offsets
15921-15926	G154 P97 additional work offsets
15941-15946	G154 P98 additional work offsets
15961-15966	G154 P99 additional work offsets

Variables #750 and #751

These macro variables collect the input from serial port 2. The programmer can test for data queued in the serial port 2 buffer, and collect the data for processing. Macro variable #750 informs the programmer if data is waiting in the RS232 port 2. A value of 1 means that the receive buffer has data queued, otherwise a value of 0 is returned. Macro variable 751 collects the first character from the input buffer, when data is queued; therefore, buffer content is first checked to see if it is empty; if not, the value of the next character queued is returned.

1-Bit Discrete Inputs

Inputs designated as “Spare” can be connected to external devices and used by the programmer.

1-Bit Discrete Outputs

The Haas control is capable of controlling up to 56 discrete outputs. However, a number of these outputs are already reserved for use by the Haas controller.

CAUTION! Do not use outputs that are reserved by the system. Using these outputs may result in injury or damage to your equipment.

The user can change the state of these outputs by writing to variables designated as “spare”. If the outputs are connected to relays, an assignment of “1” sets the relay. An assignment of “0” clears the relay. Referencing these outputs will return the current state of the output and this may be the last assigned value or the last state of the output as set by some user M code. For example, after verifying that output #1108 is “spare”:



```
#1108 = 1;                (Turns #1108 relay on)
#101 = #3001+1000;        (101 is 1 second from now)
WHILE [#101 GT #3001] AND [#1109 EQ 0] D01
END1                      (Wait here 1 second or until relay #1109 goes
                          high)
#1108 = 0;                (Turns #1108 relay off)
```

If the control is not equipped with the M-code relay board, M21 through M28 will be mapped from #1132-#1139. If the M-code relay board is installed, see the 8M-option section for information and instructions.

NOTE: Always test or dry run programs that have been developed for macros that are using new hardware.

Maximum Axis Loads

The following variables are now used to contain the maximum load values for each axis. They can be cleared by cycling power to the machine or by setting the macro to zero in a program (for example, #1064=0;).

1064 = X axis	1264 = C axis
1065 = Y axis	1265 = U axis
1066 = Z axis	1266 = V axis
1067 = A axis	1267 = W axis
1068 = B axis	1268 = T axis

Tool Offsets

Use the following macro variables to read or set the following geometry, shift or wear offset values:

#2001-#2050	X-axis geometry/shift offset
#2101-#2150	Z-axis geometry/shift offset
#2201-#2250	Tool nose radius geometry
#2301-#2350	Tool tip direction
#2701-#2750	X-axis tool wear
#2801-#2850	Z-axis tool wear
#2901-#2950	Tool nose radius wear

Programmable Messages

#3000 - Alarms can be programmed. A programmable alarm will act just like Haas internal alarms. An alarm is generated by setting the macro variable #3000 to a number between 1 and 999.

#3000 = 15 (Message placed into alarm list) - When this is done, "Alarm" flashes at the bottom of the display and the text in the next comment is placed into the alarm list. The alarm number (in this example, 15) is added to 1000 and used as an alarm number. If an alarm is generated in this manner all motion stops and the program must be reset to continue. Programmable alarms are always numbered between 1000 and 1999. The first 34 characters of the comment will be used for the alarm message.



Timers

Haas macros can access two timers. These timers can be set to a value by assigning a number to the respective variable. A program can then later read the variable and determine the time passed since the timer was set. Timers can be used to imitate dwell cycles, determine part-to-part time or wherever time-dependent behavior is desired.

#3001 Millisecond Timer - The millisecond timer is updated every 20 milliseconds and thus activities can be timed with an accuracy of only 20 milliseconds. At Power On, the millisecond timer is reset. The timer has a limit of 497 days. The whole number returned after accessing #3001 represents the number of milliseconds.

#3002 Hour Timer - The hour timer is similar to the millisecond timer except that the number returned after accessing #3002 is in hours. The hour and millisecond timers can be set independent of each other.

System Overrides

#3003 - Variable 3003 is the Single Block Suppression parameter. It overrides the Single Block function in G-code. In the following example Single Block is ignored when #3003 is set equal to 1. After M3003 is set = 1, each G-code command (lines 2-4) are executed continuously even though the Single Block function is on. When #3003 is set equal to zero, Single Block will operate as normal. That is, the user must press Cycle Start start each line of code (lines 6-8).

```
#3003=1;
G54 G00 G90 X0 Z0;
G81 R0.2 Z-0.1 F20 L0;
S2000 M03;
#3003=0;
T02 M06;
G83 R0.2 Z-1. F10. L0;
X0. Z0.;
```

Variable #3004

The first bit disables the Feed Hold button. If feed hold is not used during a section of code, set variable #3004 to 1 before the specific lines of code. After that section of code set #3004 to 0 to restore the function of the Feed Hold button. For example:

Approach code	(Feed Hold allowed)
#3004=1;	(Disables Feed Hold button)
Non-stoppable code	(Feed Hold not allowed)
#3004=0;	(Enables Feed Hold button)
Depart code	(Feed Hold allowed)



The following is a map of variable #3004 bits and the associated overrides.

E = Enabled D = Disabled

#3004	FEED HOLD	FEED RATE OVERRIDE	EXACT STOP CHECK
0	E	E	E
1	D	E	E
2	E	D	E
3	D	D	E
4	E	E	D
5	D	E	D
6	E	D	D
7	D	D	D

#3006 Programmable Stop

Stops can be programmed which act like an M00. The control stops and waits until Cycle Start is pressed. Once Cycle Start is pressed, the program continues with the block after the #3006. In the following example, the first 15 characters of the comment are displayed on the lower left part of the screen.

```
IF [#1 EQ #0] THEN #3006=101(comment here);
```

#4001-#4021 Last Block (Modal) Group Codes

The grouping of G codes permits more efficient processing. G codes with similar functions are usually under the same group. For example, G90 and G91 are under group 3. These variables store the last or default G code for any of 21 groups. By reading the group code, a macro program can change the behavior of the G-code. If 4003 contains 91, then a macro program could determine that all moves should be incremental rather than absolute. There is no associated variable for group zero; group zero G codes are Non-modal.

#4101-#4126 Last Block (Modal) Address Data

Address codes A-Z (excluding G) are maintained as modal values. The information represented by the last line of code interpreted by the lookahead process is contained in variables 4101 through 4126. The numeric mapping of variable numbers to alphabetic addresses corresponds to the mapping under alphabetic addresses. For example, the value of the previously interpreted **D** address is found in #4107 and the last interpreted I value is #4104. When aliasing a macro to an M-code, you may not pass variables to the macro using variables 1-33; instead, use the values from 4101-4126 in the macro.

#5001-#5005 Last Target Position

The final programmed point for the last motion block can be accessed through variables #5001-#5005, X, Y, Z, A, and B, respectively. Values are given in the current work coordinate system and can be used while the machine is in motion.



Axis Position Variables

#5021 X-axis	#5024 A-axis
#5022 Z-axis	#5025 B-axis
#5023 Y-axis	#5026 C-axis

#5021-#5026 Current Machine Coordinate Position

The current position in machine coordinates can be obtained through #5021-#5025, X, Z, Y, A, and B, respectively. The values cannot be read while the machine is in motion. The value of #5023 (Z) has tool length compensation applied to it.

#5041-#5045 Current Work Coordinate Position

The current position in the current work coordinates can be obtained through #5041-5045, X, Y, Z, A, B and C, respectively. The values cannot be read while the machine is in motion. The value of #5043 (Z) has tool length compensation applied to it.

#5061-#5069 Current Skip Signal Position

The position where the last skip signal was triggered can be obtained through #5061-#5069, X, Y, Z, A, B, C, U, V, and W respectively. Values are given in the current work coordinate system and can be used while the machine is in motion. The value of #5063 (Z) has tool length compensation applied to it.

#5081-#5086 Tool Length Compensation

The current total tool length compensation that is being applied to the tool is returned. This includes tool geometry referenced by the current modal value set in the T code plus the wear value.

#6996-#6999 Parameter access using macro variables

It is possible for a program to access parameters 1 to 1000 and any of the parameter bits, as follows:

- #6996: Parameter Number
- #6997: Bit Number (optional)
- #6998: Contains value of parameter number in variable 6996
- #6999: Contains bit value (0 or 1) of parameter bit specified in variable 6997.

NOTE: Variables 6998 and 6999 are read-only.

Usage

To access the value of a parameter, the number of that parameter is copied into variable 6996, after which, the value of that parameter is available using macro variable 6998, as shown:

- #6996=601 (Specify parameter 601)
- #100=#6998 (Copy the value of parameter 601 to variable #100)



To access a specific parameter bit, the number of that parameter is copied into variable 6996 and the bit number is copied to macro variable 6997. The value of that parameter bit is available using macro variable 6999, as shown:

```
#6996=57 (Specify parameter 57)
#6997=0 (Specify bit zero)
#100=#6999 (Copy parameter 57 bit 0 to variable #100)
```

NOTE: Parameter bits are numbered 0 through 31. 32-bit parameters are formatted, on-screen, with bit 0 at the top-left, and bit 31 at the bottom-right.

Offsets

All tool work offsets can be read and set within a macro expression. This allows the programmer to preset coordinates to approximate locations, or to set coordinates to values based upon the results of skip signal locations and calculations. When any of the offsets are read, the interpretation lookahead queue is stopped until that block is executed.

#5201-#5206	G52 X, Z, Y, A, B, C Offset Values
#5221-#5226	G54 " " " " " " "
#5241-#5246	G55 " " " " " " "
#5261-#5266	G56 " " " " " " "
#5281-#5286	G57 " " " " " " "
#5301-#5306	G58 " " " " " " "
#5321-#5326	G59 " " " " " " "
#7001-#7006	G110 X, Z, Y, A, B, C Offset Values
#7021-#7026	" " " " " " "
#7381-#7386	G129 X, Z, Y, A, B, C Offset Values

Variable Usage

All variables are referenced with a number sign (#) followed by a positive number; such as: #1, #101, and #501. Variables are decimal values that are represented as floating point numbers. If a variable has never been used, it can take on a special "undefined" value. This indicates that it has not been used. A variable can be set to undefined with the special variable #0. #0 has the value of undefined or 0.0 depending on the context it is used in. Indirect references to variables can be accomplished by enclosing the variable number in brackets #[expression]. The expression is evaluated and the result becomes the variable accessed. For example:

```
#1=3;
#[#1]=3.5 + #1;
```

This sets the variable #3 to the value 6.5.

Variables can be used in place of G-code address where "address" refers to the letters A..Z.

In the block **N1 G0 X1.0**; the variables can be set to the following values: #7 = 0; #1 = 1.0; and the block replaced by: **N1 G#7 X#1**; The values in the variables at runtime are used as the address values.



#8550-#8567

These variables provide information on tooling. Set variable #8550 to the tool or tool group number, then access information for the selected tool / tool group using the read-only macros 8551-8567. If specifying a tool group number, the selected tool will be the next tool in that group.

ADDRESS SUBSTITUTION

The usual method of setting control addresses A-Z is the address followed by a number. For example: **G01 X1.5 Z3.7 F.02**; sets addresses G, X, Z, and F to 1, 1.5, 3.7, and 0.02 respectively, and thus instructs the control to move linearly, G01, to position X = 1.5 Z = 3.7 at a feed rate of 0.02 inches per revolution. Macro syntax allows the address value to be replaced with any variable or expression.

The previous statement can be replaced by the following code:

```
#1 = 1;
#2 = .5;
#3 = 3.7;
#4 = 0.02;
```

G#1 X[#1+#2] Z#3 F#4; The permissible syntax on addresses A..Z (exclude N or O) is as follows:

address, - , variable	A-#101
address[expression]	Z[#5041+3.5]
address - [expression]	Z-[SIN[#1]]

If the value of the variable does not agree with the range of the address, then the usual control alarm will result. For instance, the following code would result in an invalid G code alarm because there is no G143 code: #1 = 143; G#1;

When a variable or expression is used in place of an address value, the value is rounded to the least significant digit. If #1 = .123456, then G1 X#1 would move the machine tool to .1235 on the X-axis. If the control is in the metric mode, the tool would be moved to .123 on the X-axis.'

When an undefined variable is used to replace an address value, that address reference is ignored. For example, if #1 is undefined then the block **G00 X1.0 Z#1**; becomes **G00 X1.0**, no Z movement takes place.

Macro Statements

Macro statements are lines of code that allow the programmer to manipulate the control with features similar to any standard programming language. Included are functions, operators, conditional and arithmetic expressions, assignment statements, and control statements. Functions and operators are used in expressions to modify variables or values. Operators are essential to expressions, while functions make the programmer's job easier.



Functions

Functions are built-in routines that the programmer has available to use. All functions have the form “function_name [argument]”. Functions can be passed any expression as arguments. Functions return floating point decimal values. The function provided with the Haas control are as follows:

FUNCTION	ARGUMENT	RETURNS	NOTES
SIN[]	Degrees	Decimal	Sine
COS[]	Degrees	Decimal	Cosine
TAN[]	Degrees	Decimal	Tangent
ATAN[]	Decimal	Degrees	Arctangent, same as FANUC ATAN[]/[1]
SQRT[]	Decimal	Decimal	Square root
ABS[]	Decimal	Decimal	Absolute value
ROUND[]	Decimal	Decimal	Round off a decimal
FIX[]	Decimal	Integer	Truncate fraction
ACOS[]	Decimal	Degrees	Arccosine
ASIN[]	Decimal	Degrees	Arcsine
#[]	Integer	Integer	Variable Indirection
DPRNT[]	ASCII text		External Output

Notes on Functions

The function “Round” works differently depending on the context that it is used. When used in arithmetic expressions, any number with a fractional part greater than or equal to .5 is rounded up to the next whole integer; otherwise, the fractional part is truncated from the number.

```
#1= 1.714 ;
#2= ROUND[#1] ; (#2 is set to 2.0)
#1= 3.1416 ;
#2= ROUND[#1] ; (#2 is set to 3.0)
```

When round is used in an address expression, the argument “Round” is rounded to the addresses significant precision. For metric and angle dimensions, three-place precision is the default. For inch, four-place precision is the default. Integral addresses such as T are rounded normally.

```
#1= 1.00333 ;
G0 X[ #1 + #1 ] ;
(X moves to 2.0067) ;
G0 X[ ROUND[ #1 ] + ROUND[ #1 ] ] ;
(X moves to 2.0066) ;
G0 C[ #1 + #1 ] ;
(Axis moves to 2.007) ;
G0 C[ ROUND[ #1 ] + ROUND[ #1 ] ] ;
(Axis moves to 2.006) ;
```

Fix vs. Round

#1=3.54; #2=ROUND[#1]; #3=FIX[#1]. #2 will be set to 4. #3 will be set to 3.



Operators

Operators can be classified into: Arithmetic operators, Logical operators, and Boolean operators.

Arithmetic operators consist of the usual unary and binary operators. They are:

+	- Unary plus	+1.23
-	- Unary minus	-[COS[30]]
+	- Binary addition	#1=#1+5
-	- Binary subtraction	#1=#1-1
*	- Multiplication	#1=#2*#3
/	- Division	#1=#2/4
MOD	- Remainder	#1=27 MOD 20 (#1 contains 7)

Logical operators are operators that work on binary bit values. Macro variables are floating point numbers. When logical operators are used on macro variables, only the integer portion of the floating point number is used. The logical operators are: OR - logically OR two values together, XOR - exclusively OR two values together, AND - logically AND two values together

```
#1=1.0; 0000 0001
#2=2.0; 0000 0010
#3=#1 OR #20000 0011
```

Here the variable #3 will contain 3.0 after the OR operation.

```
#1=5.0;
#2=3.0;
IF [#1 GT 3.0] AND [#2 LT 10] GOTO1
```

Here control will transfer to block 1 because #1 GT 3.0 evaluates to 1.0 and #2 LT 10 evaluates to 1.0, thus 1.0 AND 1.0 is 1.0 (true) and the GOTO occurs.

Note that care must be taken when using logical operators so that the desired result is achieved.

Boolean operators always evaluate to 1.0 (True) or 0.0 (False). There are six Boolean operators. These operators are not restricted to conditional expressions, but they most often are used in conditional expressions. They are:

- EQ - Equal to
- NE - Not Equal to
- GT - Greater Than
- LT - Less Than
- GE - Greater than or Equal to
- LE - Less Than or Equal to

The following are four examples of how Boolean and Logical operators can be used:



Example

```
IF [#1 EQ 0.0] GOTO100;  
  
WHILE [#101 LT 10] DO1;  
  
#1=[1.0 LT 5.0];  
IF [#1 AND #2 EQ #3] GOTO1
```

Explanation

Jump to block 100 if value in variable #1 equals 0.0.
While variable #101 is less than 10 repeat loop DO1..END1.
Variable #1 is set to 1.0 (TRUE).
If variable #1 logically ANDed with variable #2 is equal to the value in #3 then control jumps to block 1.

Expressions

Expressions are defined as any sequence of variables and operators surrounded by the square brackets “[” and “]”. There are two uses for expressions: conditional expressions or arithmetic expressions. Conditional expressions return False (0.0) or True (any non zero) values. Arithmetic expressions use arithmetic operators along with functions to determine a value.

Conditional Expressions

In the Haas control, All expressions set a conditional value. The value is either 0.0 (False) or the value is nonzero (True). The context in which the expression is used determines if the expression is a conditional expression. Conditional expressions are used in the IF and WHILE statements and in the M99 command. Conditional expressions can make use of Boolean operators to help evaluate a True or False condition.

The M99 conditional construct is unique to the Haas control. Without macros, M99 in the Haas control has the ability to branch unconditionally to any line in the current subroutine by placing a P code on the same line. For example: **N50 M99 P10**; branches to line N10. It does not return control to the calling subroutine. With macros enabled, M99 can be used with a conditional expression to branch conditionally. To branch when variable #100 is less than 10 we could code the above line as follows: **N50 [#100 LT 10] M99 P10**;

In this case, the branch occurs only when #100 is less than 10, otherwise processing continues with the next program line in sequence. Above, the conditional M99 can be replaced with: **N50 IF [#100 LT 10] GOTO10**;

Arithmetic Expressions

An arithmetic expression is any expression using variables, operators, or functions. An arithmetic expression returns a value, and are usually used in assignment statements, but are not restricted to them. Examples of arithmetic expressions:

```
#101=#145*#30;  
#1=#1+1;  
X[#105+COS[#101]];  
#[#2000+#13]=0;
```

Assignment Statements

Assignment statements allow the programmer to modify variables. The format



of an assignment statement is: expression = expression . The expression on the left of the equal sign must always refer to a macro variable, whether directly or indirectly. The following macro initializes a sequence of variables to any value. Here both direct and indirect assignments are used.

```
O0300                                (Initialize an array of variables) ;
N1 IF [#2 NE #0] GOTO2                (B=base variable) ;
#3000=1                               (Base variable not given) ;
N2 IF [#19 NE #0] GOTO3               (S=size of array);
#3000=2                               (Size of array not given) ;
N3 WHILE [#19 GT 0] DO1 ;
#19=#19-1                             (Decrement count) ;
#[#2+#19]=#22                        (V=value to set array to) ;
END1 ;
M99 ;
```

The preceding macro could be used to initialize three sets of variables as follows:

```
G65 P300 B101. S20    (INIT 101..120 TO #0) ;
G65 P300 B501. S5 V1 (INIT 501..505 TO 1.0) ;
G65 P300 B550. S5 V0 (INIT 550..554 TO 0.0) ;
```

The decimal point in B101., etc. would be required.

Control Statements

Control statements allow the programmer to branch, both conditionally and unconditionally. They also provide the ability to iterate a section of code based on a condition.

Unconditional Branch (GOTO n and M99 P n) - In the Haas control, there are two methods of branching unconditionally. An unconditional branch will always branch to a specified block. M99 P15 will branch unconditionally to block number 15. The M99 can be used whether or not macros is installed and is the traditional method for branching unconditionally in the Haas control. GOTO15 does the same as M99 P15. In the Haas control, a GOTO command can be used on the same line as other G-codes. The GOTO is executed after any other commands like M codes.

Computed Branch (GOTO $\#n$ and GOTO [expression]) - Computed branching allows the program to transfer control to another line of code in the same subprogram. The block can be computed as the program is running, using the GOTO [expression] form, or may be passed in through a local variable, as in the GOTO $\#n$ form.

The GOTO will round the variable or expression result that is associated with the Computed branch. For instance, if #1 contains 4.49 and GOTO#1 is executed, the control will attempt to transfer to a block containing N4. If #1 contains 4.5, then execution will transfer to a block containing N5. The following code skeleton could be developed to make a program that adds serial numbers to parts:



O9200 (Engrave digit at current location.)
;
(D=Decimal digit to engrave);
IF [[#7 NE #0] AND [#7 GE O] AND [#7 LE
9]] GOTO99;
#3000=1 (Invalid digit)
;
N99
#7=FIX[#7] (Truncate any fractional part)
;
GOTO#7 (Now engrave the digit)
;
N0 (Do digit zero)
...
M99
;
N1 (Do digit one)
;
M99
;
N2 (Do digit two)
;
...
;
(etc.,...)

The previous subroutine will engrave digit five with the following call: **G65
P9200 D5;**

Computed GOTOs using expression could be used to branch processing based on the results of reading hardware inputs. An example might look like the following:

```
GOTO[#1030*2]+#1031];  
NO (1030=0, 1031=0);  
...  
M99;  
N1 (1030=0, 1031=1);  
...  
M99;  
N2 (1030=1, 1031=0);  
...  
M99;  
N3 (1030=1, 1031=1);  
...  
M99;
```

The discrete inputs always return either 0 or 1 when read. The GOTO[expression] will branch to the appropriate G-code based on the state of the two discrete inputs #1030 and #1031.



Conditional Branch (IF and M99 Pnnnn)

Conditional branching allows the program to transfer control to another section of code within the same subroutine. Conditional branching can only be used when macros are enabled. The Haas control allows two similar methods for accomplishing conditional branching.

IF [conditional expression] GOTO n

As discussed, “conditional expression” is any expression that uses any of the six Boolean operators EQ, NE, GT, LT, GE, or LE. The brackets surrounding the expression are mandatory. In the Haas control, it is not necessary to include these operators. For example: IF [#1 NE 0.0] GOTO5; could also be: IF [#1] GOTO5;.

In this statement, if the variable #1 contains anything but 0.0, or the undefined value #0, branching to block 5 will occur; otherwise, the next block will be executed.

In the Haas control, a conditional expression can also be used with the M99 Pnnnn format. For example: G0 X0 Z0 [#1EQ#2] M99 P5;. Here, the conditional is for the M99 portion of the statement only. The machine tool is instructed to X0, Y0 whether or not the expression evaluates to True or False. Only the branch, M99, is executed based on the value of the expression. It is recommended that the IF GOTO version is used if portability is desired.

Conditional Execution (IF THEN)

Execution of control statements can also be achieved by using the IF THEN construct. The format is **IF [conditional expression] THEN statement;**

Note: To preserve compatibility with FANUC syntax “THEN” may not be used with GOTO n.

This format is traditionally used for conditional assignment statements such as: **IF [#590 GT 100] THEN #590=0.0;**

Variable #590 is set to zero when the value of #590 exceeds 100.0. In the Haas control, if a conditional evaluates to False (0.0), then the remainder of the IF block is ignored. This means that control statements can also be conditioned so that we could write something like: **IF [#1 NE #0] THEN G1 X#24 Z#26 F#9;** This executes a linear motion only if variable #1 has been assigned a value. Another example is: **IF [#1 GE 180] THEN #101=0.0 M99;** This says that if variable #1 (address A) is greater than or equal to 180, set variable #101 to zero and return from the subroutine.

Here is an example of an “IF” statement that branches if a variable has been initialized to contain any value. Otherwise, processing will continue and an alarm will be generated. Remember, when an alarm is generated, program execution is halted.



```
N1 IF [#9NE#0] GOTO3 (TEST FOR VALUE IN F) ;  
N2 #3000=11(NO FEED RATE) ;  
N3 (CONTINUE) ;
```

Iteration/Looping (**WHILE DO END**)

Essential to all programming languages is the ability to execute a sequence of statements a given number of times or to loop through a sequence of statements until a condition is met. Traditional G coding allows this with the use of the **L** address. A subroutine can be executed any number of times by using the **L** address.

```
M98 P2000 L5;
```

This is limited since you cannot terminate execution of the subroutine on condition. Macros allow flexibility with the **WHILE-DO-END** construct. For example:

```
WHILE [conditional expression] DOn;  
  
statements;  
  
ENDn;
```

This executes the statements between **DOn** and **ENDn** as long as the conditional expression evaluates to True. The brackets in the expression are necessary. If the expression evaluates to False, then the block after **ENDn** is executed next. **WHILE** can be abbreviated to **WH**. The **DOn-ENDn** portion of the statement is a matched pair. The value of **n** is 1-3. This means that there can be no more than three nested loops per subroutine. A nest is a loop within a loop

Although nesting of **WHILE** statements can only be up to three levels, there really is no limit since each subroutine can have up to three levels of nesting. If there is a need to nest to a level greater than 3, the segment containing the three lowest levels of nesting can be made into a subroutine, thereby overcoming the limitation.

If two separate **WHILE** loops are in a subroutine, they can use the same nesting index. For example:

```
#3001=0 (WAIT 500 MILLISECONDS);  
WH [#3001 LT 500] DO1;  
END1;  
-Other statements-  
#3001=0 (WAIT 300 MILLISECONDS) ;  
WH [#3001 LT 300] DO1 ;  
END1 ;
```

You can use **GOTO** to jump out of a region encompassed by a **DO-END**, but you cannot use a **GOTO** to jump into it. Jumping around inside a **DO-END** region using a **GOTO** is allowed.



An infinite loop can be executed by eliminating the WHILE and expression, for example:

```
DO1;
-statements-
END1;
```

Executes until the Reset key is pressed.

CAUTION! The following code can be confusing: WH [#1] D01; END1;

In the above example, an alarm results indicating no “Then” was found; “Then” refers to the D01. Change D01 (zero) to DO1 (letter O).

G65 Macro Subroutine Call

G65 is the command that calls a subroutine with the ability to pass arguments to it. The format follows: **G65 Pnnnn [Lnnnn] [arguments];**

Anything italicized in square brackets is optional. The G65 command requires a P address corresponding to a program number currently in the control’s memory. When the L address is used the macro call is repeated the specified number of times. In Example 1, subroutine 1000 is called once without conditions passed to the subroutine. G65 calls are similar to, but not the same as, M98 calls. G65 calls can be nested up to 9 times, which means, program 1 can call program 2, program 2 can call program 3 and program 3 can call program 4.

Example 1:	G65 P1000;	(Call subroutine 1000 as a macro)
	M30;	(Program stop)
	O1000;	(Macro Subroutine)
	...	
	M99;	(Return from Macro Subroutine)

Aliasing

Aliasing is a means of assigning a G code to a G65 P##### sequence. For example: **G65 P9010 X.5 Z.05 F.01 T1;** can be written as: **G06 X.5 Z.05 F.01 T1;**

Here, we have substituted an unused G code, G06, for G65 P9010. In order for the above block to work we must set the parameter associated with subroutine 9010 to 06 (Parameter 91). Note that G00 and G65 can not be aliased. All other codes between 1 and 255 can be used for aliasing.

Program numbers 9010 through 9019 are reserved for G code aliasing. The following table lists which Haas parameters are reserved for macro subroutine aliasing.



G-Code Aliasing Haas Parameter	O Code	M-Code Aliasing Haas Parameter	M Macro Call
91	9010	81	9000
92	9011	82	9001
93	9012	83	9002
94	9013	84	9003
95	9014	85	9004
96	9015	86	9005
97	9016	87	9006
98	9017	88	9007
99	9018	89	9008
100	9019	90	9009

Setting an aliasing parameter to 0 (zero) disables aliasing for the associated subroutine. If an aliasing parameter is set to a G-code and the associated subroutine is not in memory, then an alarm will be given.

Macros allow additional capabilities to communicate with peripheral devices. One can do digitizing of parts, provide runtime inspection reports, or synchronize controls with user provided devices. The commands provided for this are POPEN, DPRNT[] and PCLOS.

Communication preparatory commands

POPEN and PCLOS are not required on the Haas mill. It has been included so that programs from different controls can be sent to the Haas control.

Formatted output

The DPRNT statement allows the programmer to send formatted text to the serial port. Any text and any variable can be printed to the serial port. The form of the DPRNT statement is as follows:

DPRNT [text #nnnn[wf]...] ;

DPRNT must be the only command in the block. In the previous example, "text" is any character from A to Z or the letters (+,-,/,*, and the space). When an asterisk is output, it is converted to a space. The #nnnn[wf] is a variable followed by a format. The variable number can be any macro variable. The format [wf] is required and consists of two digits within square brackets. Remember that macro variables are real numbers with a whole part and a fractional part. The first digit in the format designates the total places reserved in the output for the whole part. The second digit designates the total places reserved for the fractional part. The total places reserved for output cannot be equal to zero or greater than eight. Thus the following formats are illegal:

[00] [54] [45] [36] /* not legal formats */

A decimal point is printed out between the whole part and the fractional part. The fractional part is rounded to the least significant place. When zero places are reserved for the fractional part, then no decimal point is printed out. Trailing zeros are printed if there is a fractional part. At least one place is reserved for the whole part, even when a zero is used. If the value of the whole part has



fewer digits than have been reserved, then leading spaces are output. If the value of the whole part has more digits than has been reserved, then the field is expanded so that these numbers are printed.

A carriage return is sent out after every DPRNT block.

DPRNT[] Examples

Code	Output
N1 #1= 1.5436;	
N2 DPRNT[X#1[44]*Z#1[03]*T#1[40]] ;	X1.5436 Z 1.544 T 1
N3 DPRNT[***MEASURED*INSIDE*DIAMETER***] ;	MEASURED INSIDE DIAM- ETER
N4 DPRNT[] ;	(no text, only a carriage return)
N5 #1=123.456789 ;	
N6 DPRNT[X-#1[25]] ;	X-123.45679;

Execution

DPRNT statements are executed at block interpretation time. This means that the programmer must be careful about where the DPRNT statements appear in the program, particularly if the intent is to print out.

G103 is useful for limiting lookahead. If you wanted to limit lookahead interpretation to one block, you would include the following command at the beginning of your program: (This actually results in a two block lookahead: **G103 P1**);). To cancel the lookahead limit, change the command to G103 P0. G103 cannot be used when cutter compensation is active.

Editing

Improperly structured or improperly placed macro statements will generate an alarm. Be careful when editing expressions; brackets must be balanced.

The DPRNT[] function can be edited much like a comment. It can be deleted, moved as a whole item, or individual items within the bracket can be edited. Variable references and format expressions must be altered as a whole entity. If you wanted to change [24] to [44], place the cursor so that [24] is highlighted, enter [44] and press the write key. Remember, you can use the jog handle to maneuver through long DPRNT[] expressions.

Addresses with expressions can be somewhat confusing. In this case, the alphabetic address stands alone. For instance, the following block contains an address expression in X: **G1 X [COS[90]] Z3.0**; CORRECT

Here, the **X** and brackets stand alone and are individually editable items. It is possible, through editing, to delete the entire expression and replace it with a number: **G1 X 0 Z3.0**; WRONG. This block will result in an alarm at runtime. The correct form looks as follows: **G1 X0 Z3.0**; CORRECT.

Note that there is no space between the X and the Zero (0). Remember when you see an alpha character standing alone, it is an address expression.



FANUC-STYLE MACRO FEATURES NOT INCLUDED IN HAAS CONTROL

This section lists the FANUC macro features that are not available on the Haas control.

M Aliasing Replace G65 Pnnnn with Mnn PROGS 9020-9029.

G66	Modal call in Every Motion Block
G66.1	Modal call call in every block
G67	Modal cancel
M98	Aliasing, T Code Prog 9000, Var #149, enable bit
M98	Aliasing, S Code Prog 9029, Var #147, enable bit
M98	Aliasing, B Code Prog 9028, Var #146, enable bit
SKIP/N	N=1..9
#3007	Mirror Image On flag each axis
#4201-#4320	Current block modal data
#5101-#5106	Current servo deviation

Names for Variables for Display Purposes

ATAN []/[]	Arctangent, FANUC version
BIN []	Conversion from BCD to BIN
BCD []	Conversion from BIN to BCD
FUP []	Truncate fraction to ceiling
LN []	Natural Logarithm
EXP []	Base E exponentiation
ADP []	Re-scale VAR to whole number
BPRNT []	

The following can be used as an alternative method for achieving the same results for a few unimplemented FANUC macro features.

GOTO-nnnn

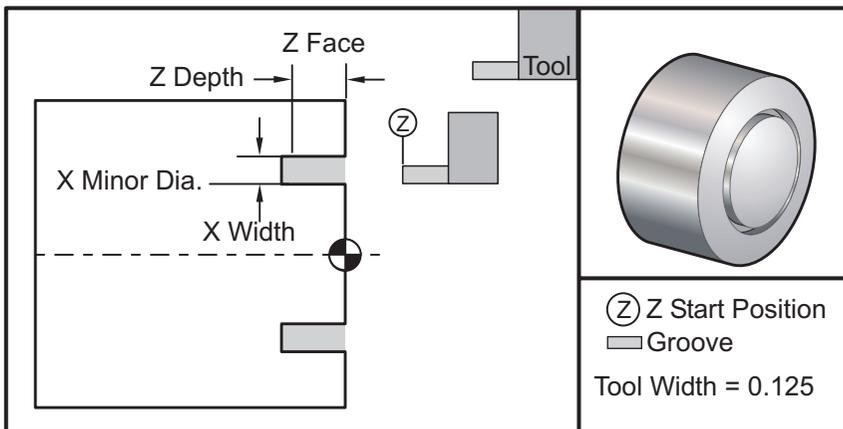
Searching for a block to jump in the negative direction (i.e. backwards through a program) is not necessary if you use unique N address codes. A block search is made starting from the current block being interpreted. When the end of the program is reached, searching continues from the top of the program until the current block is encountered.



EXAMPLE PROGRAM USING MACROS

The following example will cut a face groove in a part using easily-edited variables.

```
%  
O0010 (MACRO G74)  
G50 S2000  
G97 S1000 M03 T100  
G00 T101  
#24 = 1.3 (X MINOR DIAMETER)  
#26 = 0.14 (Z DEPTH)  
#23 = 0.275 (X GROOVE WIDTH)  
#20 = 0.125 (TOOL WIDTH)  
#22 = -0.95 (Z START POSITION)  
#6 = -1. (ACTUAL Z FACE)  
#9 = 0.003 (FEED RATE IPR)  
G00 X [ #24 + [ #23 * 2 ] - [ 20 * 2 ] ] Z#126  
G74 U - [ [ #23 - #20 ] * 2 ] W - [ #26 + ABS [ #6 - #22 ] ] K [ #20 * 0.75 ] I [ #20 * 0.9 ]  
F#9  
G00 X0 Z0 T100  
M30  
%
```



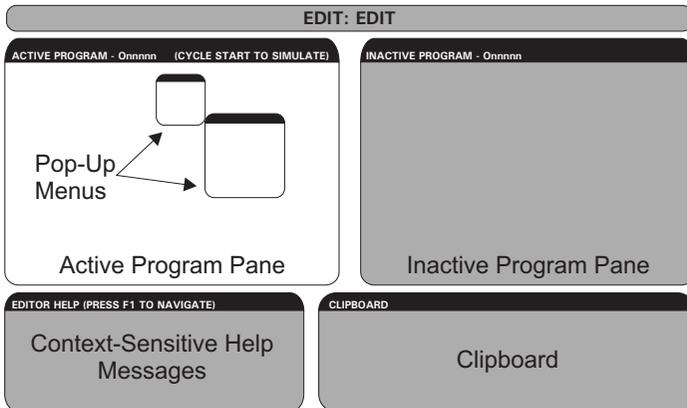


EDIT MODE

Edit gives the user the ability to edit programs using popup menus.

Press EDIT to enter edit mode. Two editing panes are available; an active program pane and an inactive program pane. Switch between the two by pressing EDIT.

To edit a program, enter the program name (Onnnnn) from the active program pane and press SELECT PROG; the program will open in the active window. Pressing F4 will open another copy of that program in the inactive program pane if there is not a program there already. You can also select a different program in the inactive program pane by pressing SELECT PROG from the inactive program pane and selecting the program from the list. Press F4 to exchange the programs between the two panes (make the active program inactive and vice versa). Use the jog handle or the down/up arrows keys to scroll through the program code.



Basic Edit Mode Layout

Press F1 to access the Popup Menu. Use the Left and Right cursor arrow keys to select from the topic menu (HELP, MODIFY, SEARCH, EDIT, PROGRAM), and use the Up and Down arrow keys or handle jog to select a function. Press WRITE/ENTER to execute from the menu. A context-sensitive help pane in the lower left provides information on the currently selected function. Use Page Up/Down to scroll through the help message. This message also lists hot keys that can be used for some functions.



THE PROGRAM MENU

Create New Program

This menu item will create a new program. To do so, enter a program name (Onnnnn) (that is not already in the program directory) and press Enter to create the program. *Hot Key - Select Prog*

Select Program From List

Choose this menu item to edit a program that exists in memory.

When this menu item is selected, the programs in the control are displayed. Scroll through the list by using the cursor keys or the jog handle. Pressing ENTER or SELECT PROG will select the highlighted program to replace the program list with the selected program. *Hot key - Select Prog*

Duplicate Active Program

This selection will copy the current program. The user will be prompted to enter a program (Onnnnn) number for the duplicate program.

Delete Program From List

This menu item will delete a program from the program memory. **Hot Key - Erase Prog**

Swap Editor Programs

Puts the active program in the inactive program pane and the inactive program in the active program pane. *Hot Key-F4*

Switch To Left Or Right Side

This will switch between the active and inactive program for editing. Inactive and active programs remain in their respective panes. *Hot Key - Edit*

THE EDIT MENU

Undo

The last edit operation will be undone, up to the last 9 editing operations. *Hot Key - Undo*

Select Text

This menu item will select lines of program code to set the start point of the text selection. Then use the cursor keys, home, end, page up/down, or the jog handle to scroll to the last line of code to be selected and Press F2 or Write/Enter. The selected text will be highlighted. To deselect the block, press UNDO. *Hot Key - F2 to begin selection, F2 or Write to end selection*

Move Selected Text

This feature works with the "Select Text" feature. Scroll the cursor arrow to desired part of code and press the WRITE/ENTER key to move the selected text to its new location. The selected text will be moved to the point following the cursor (>).



Copy Selected Text

To select text, scroll the cursor arrow (>) to a portion of text and press the WRITE/ENTER key. The text copied will be highlighted. Scroll the cursor arrow to the part of text you want to insert the copied text into. Press F2 or WRITE/ENTER to insert the copied text to the point following the cursor (>). Hot Key - Select Text, Position Cursor and Press Write

Delete Selected Text

To select text, scroll the cursor arrow (>) to a portion of text and press WRITE/ENTER. The text copied will be highlighted. Once highlighted, press WRITE/ENTER to delete the text. If no block is selected, the currently highlighted item is deleted.

Cut Selection To Clipboard

All selected text will be moved from the current program to a new program called the clipboard. Any previous contents of the clipboard are deleted.

COPY SELECTION TO CLIPBOARD

All selected text will be copied from the current program to a new program called the clipboard. Any previous contents of the clipboard are deleted.

PASTE FROM CLIPBOARD

The contents of the clipboard are copied into the current program at the line following the current cursor position.

THE SEARCH MENU

Find Text

This menu item will search for text or program code in the current program.

Find Again

This menu item will search again for the same program code or text.

Find And Replace Text

This menu item will search the current program for specific text or program and optionally replace each (or all) with another G-Code item.

THE MODIFY MENU

Remove All Line Numbers

This menu item will automatically remove all unreferenced N-Codes (line numbers) from the edited program. If a group of lines is selected only these lines will be affected.

Renumber All Lines

This menu item will either renumber all selected blocks in the program or, if a group of lines is selected the renumber feature will affect those lines only.



Renumber By Tool

Searches for T (tool) codes, highlights all the program code up to the next T code and renumbers the N code (line numbers) in the program code.

Reverse + & - Signs

This menu item will reverse the signs of the numeric values. Press the enter key to start the process and then enter the axes (e.g. X, Y, Z etc.) that is to change. When using this feature be cautious if your program contains a G10 or G92 (See the G Code section for a description).

OTHER KEYS

INSERT	INSERT can be used to copy selected text in a program to the line after where you place the cursor arrow point.
ALTER	ALTER can be used move selected text in a program to the line after where you place the cursor arrow point.
DELETE	DELETE can be used to delete selected text in a program.
UNDO	If a block has been selected, pressing UNDO will simply exit a block definition.

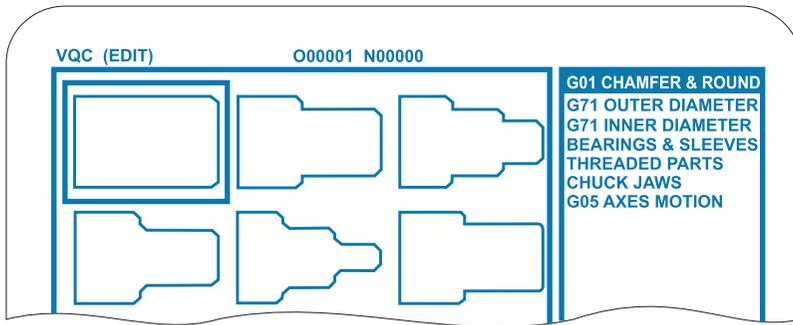


VISUAL QUICK CODE

To start Visual Quick Code (VQC), press MDI/DNC, then PROGRAM CONVRS. Select VQC from the tabbed menu.

Selecting a Category

Use the arrow keys to select the parts category whose description closely matches the desired part and press WRITE/ENTER. A set of illustrations of the parts in that category will appear.



Selecting a Part Template

Use the arrow keys to select a template on the page. Pressing WRITE/ENTER will display an outline of the part and wait for the programmer to enter values to make the selected part.

Entering the Data

The control will prompt the programmer for information about the selected part. Once the information is entered, the control asks where to place the G-code:

- 1) Select/Create a Program – A window will open prompting selection of a program name. Highlight the program and press WRITE/ENTER. This will add the new lines of code to the selected program. If the program already contains code, VQC enters the new code at the beginning of the program; before the existing code. The user has the option to create a new program by entering a program name and pressing WRITE/ENTER to add the lines of code to the new program.
- 2) Add to Current Program – The code generated by VQC will be added after the cursor.
- 3) MDI – The code will output to MDI. Note that anything in MDI will be overwritten.
- 4) Cancel – The window will close and the program values will be displayed.

NOTE: The program will also be available for editing in Edit mode. It is a good idea to check the program by running it in Graphics mode.



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G CODES - PREPARATORY FUNCTIONS

G codes are used to command specific actions for the machine: such as simple machine moves or drilling functions. They also command more complex features which can involve optional live tooling and the C-axis.

G-codes are divided into groups. Each group of codes is commands for a specific subject. For example, Group 1 G-codes command point-to point moves of the machine axes, Group 7 are specific to the Cutter Compensation feature.

Each group has a dominant G-code; referred to as the **default** G-code. A default G-code means they are the one in each group the machine uses unless another G-code from the group is specified. For example programming an X, Z move like this, X-2. Z-4. will position the machine using G00. (Note that proper programming technique is to preface all moves with a G-code.)

Default G-codes for each group are shown on the Current Commands screen. If another G code from the group is commanded (active), that G-code is displayed on the Current Commands screen.

G-codes commands can be modal or non-modal. A **modal** G-code means that once commanded, the G-code will stay in effect until the end of the program or until another G-code from the same group is commanded. A **nonmodal** G-code is only affects the line it is in; the program line after will not be affected by the previous line's nonmodal G-code. **The Group 00 codes are non-modal; the other groups are modal.**

Programming Notes

Group 01 G codes will cancel the Group 09 (canned cycles) codes; for example, if a canned cycle (G73 through G89) is active, the use of G00 or G01 will cancel the canned cycle.

Canned Cycles

A canned cycle is used to simplify programming of a part. Canned cycles are defined for most common Z-axis repetitive operations, such as drilling, tapping, and boring. Once selected, a canned cycle is active until canceled with G80. When active, the canned cycle is executed every time an X-axis motion is programmed. X-axis motions are executed as rapid commands (G00) and the canned cycle operation is performed after the X-axis motion.

Using Canned Cycles

Modal canned cycles remain in effect after they are defined and are executed in the Z-axis, for each position of the X-axis. Note that X-axis positioning moves, during a canned cycle will be rapid moves.

The operation of a canned cycle will vary according to whether incremental (U,W) or absolute (X, Z) axis moves are used.



If a loop count (Lnn code number) is defined within the block, the canned cycle will repeat that many times with an incremental (U or W) move between each cycle. Enter the number of repeats (L) each time a repeated operation is needed; the number of repeats (L) is not remembered for the next canned cycle.

Spindle control M codes should not be used while a canned cycle is active.

Canned Cycles with Live Tooling

The canned cycles G81, G82, G83, G85, G89, can be used with live tooling, and G241, G242, G243, G245 and G249 can be used with live tooling. Some programs must be checked to be sure they turn on the main spindle before running the canned cycles. Note that G86, G87 and G88 are not usable with live tooling.

G00 Rapid Motion Positioning (Group 01)

- *B B-axis motion command
- *C C-axis motion command
- *U X-axis incremental motion command
- *W Z-axis incremental motion command
- *X X-axis absolute motion command
- *Y Y-axis absolute motion command
- *Z Z-axis absolute motion command

* indicates optional

This G code is used to move the machines axis at the maximum speed. It is primarily used to quickly position the machine to a given point before each feed (cutting) command (All moves are done at full rapid speed). This G code is modal, so a block with G00 causes all following blocks to be rapid motion until another Group 01 code is specified.

Programming note: Generally, rapid motion will not be in a straight line. Each axis specified is moved at the same speed, but all axes will not necessarily complete their motions at the same time. The machine will wait until all motions are complete before starting the next command.

G01 Linear Interpolation Motion (Group 01)

- F Feed rate
- *B B-axis motion command
- *C C-axis motion command
- *U X-axis incremental motion command
- *W Z-axis incremental motion command
- *X X-axis absolute motion command
- *Y Y-axis absolute motion command
- *Z Z-axis absolute motion command
- A Optional angle of movement (used with only one of X, Z, U, W)
- ,C Distance from center of intersection where the chamfer begins
- ,R Radius of the circle

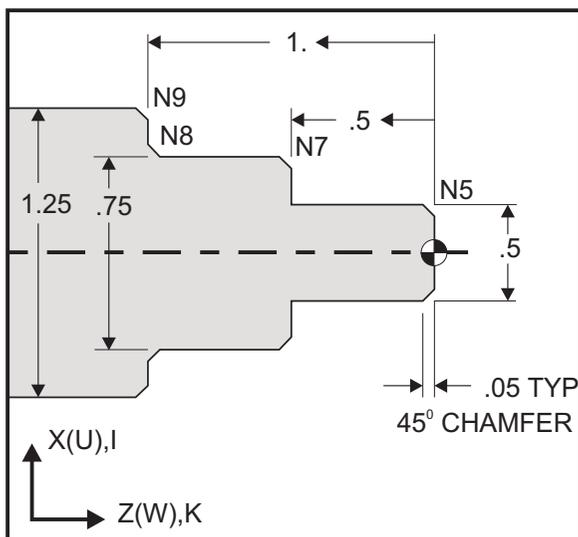
This **G** code provides for straight line (linear) motion from point to point. Motion can occur in 1 or 2 axes. All axes will start and finish motion at the same time.



The speed of all axes is controlled so that the feed rate specified is achieved along the actual path. The C-axis may also be commanded and this will provide a helical (spiral) motion. C-axis feed rate is dependent on the C-axis diameter setting (Setting 102) to create a helical motion. The F address (feedrate) command is modal and may be specified in a previous block. Only the axes specified are moved. The auxiliary axes **B**, **U**, **V**, and **W** can also be moved with a G01 but only one axis is moved at a time.

Corner Rounding and Chamfering

A chamfer block or a corner rounding block can be automatically inserted between two linear interpolation blocks by specifying ,C (chamfering) or ,R (corner rounding). Note that both of these variables use a comma symbol (,) before the variable). There must be a terminating linear interpolation block following the beginning block (a G04 pause may intervene). These two linear interpolation blocks specify a theoretical corner of intersection. If the beginning block specifies a ,C (comma C) the value following the C is the distance from the corner of intersection where the chamfer begins and also the distance from that same corner where the chamfer ends. If the beginning block specifies an ,R (comma R) the value following the R is the radius of a circle tangent to the corner at two points: the beginning of the corner rounding arc block that is inserted and the endpoint of that arc. There can be consecutive blocks with chamfer or corner rounding specified. There must be movement on the two axes specified by the selected plane (the active plane X-Y (G17), X-Z (G18) or Y-Z (G19). For chamfering a **90° angle only**, a K value can be substituted where ,C is used.



Chamfering

```
%
O0001 (Chamfering)
N1 G50 S1500
N2 G00 T101 G97 S500 M03
N3 G00 X0 Z0.25
N4 G01 Z0 F0.005
N5 G01 X0.50 K-0.050
N6 G01 Z-0.50
N7 G01 X0.75 K-0.050
N8 G01 Z-1.0 I0.050
N9 G01 X1.25 K-0.050
N10 G01 Z-1.5
N11 G00 X1.5 Z0.25
M30
%
```

The following G-code syntax automatically includes a 45° chamfer or corner radius between two blocks of linear interpolation which intersect a right (90 degree) angle.



Chamfering Syntax
G01 X(U) x Kk
G01 Z(W) z li

Corner Rounding Syntax
G01 X(U) x Rr
G01 Z(W) z Rr

Addresses

I = chamfering, Z to X (X axis direction, +/-, "Radius" value)

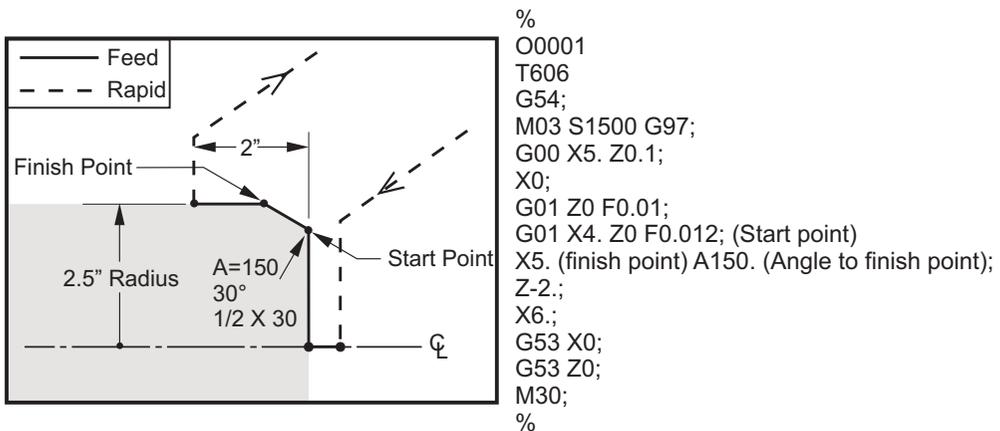
K = chamfering, X to Z (Z axis direction, +/-)

R = corner rounding (X or Z axis direction, +/-, "Radius" value)

Note: A -30 = A150; A -45 = A135

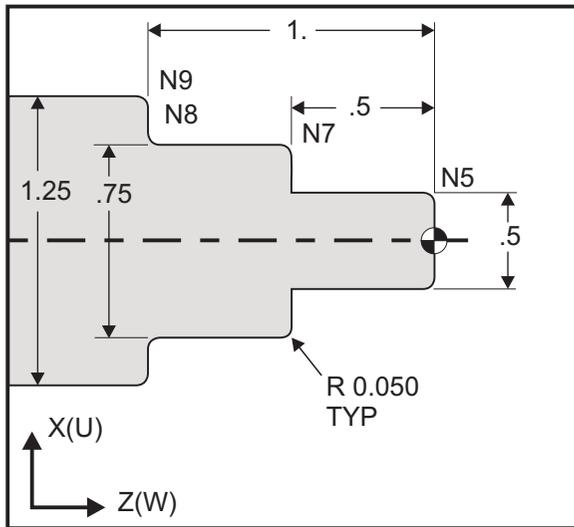
G01 Chamfering with A

When specifying an angle (A), command motion in only one of the other axes (X or Z), the other axis is calculated based on the angle.





Corner Chamfering



```

%
O0005 (Corner Rounding)
T101;
N1 G50 S1500;
N2 G00 G97 S500 M03;
N3 X0 Z0.25;
N4 G01 Z0 F0.005;
N5 G01 X0.5 R-0.050;
N6 G01 Z-0.50;
N7 G01 X0.75 R-0.050;
N8 G01 Z-1.0 R0.050;
N9 G01 X1.25 R-0.050;
N10 G01 Z-1.5;
N11 G00 X1.5 Z0.25;
G53 X0;
G53 Z0;
M30;
%
```

Notes: 1) Incremental programming is possible if Ub or Wb is specified in place of Xb or Zb, respectively. So its actions will be as follows:

$$X(\text{POS}_{\text{current}} + i) = U_i, Z(\text{POS}_{\text{current}} + k) = W_k, X(\text{POS}_{\text{current}} + r) = U_r,$$

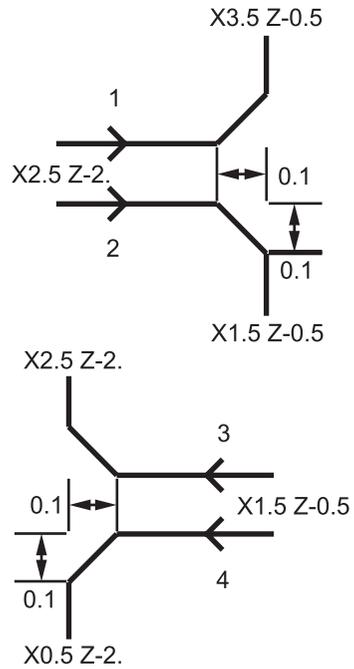
$$Z(\text{POS}_{\text{current}} + r) = W_r.$$

2) $\text{POS}_{\text{current}}$ indicates current position of X or Z axis. 3) I, K and R always specify a radius value (radius programming value)



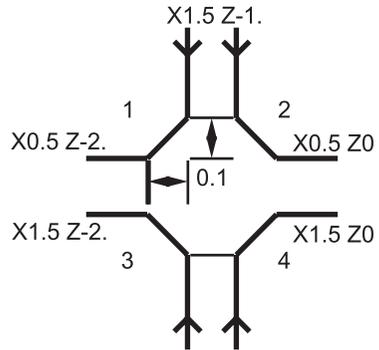
Chamfering Code/Example Movement

- | | | |
|-------------|---|---|
| 1. Z+ to X+ | X2.5 Z-2;
G01 Z-0.5 I0.1;
X3.5; | X2.5 Z-2;
G01 Z-0.6;
X2.7 Z-0.5;
X3.5; |
| 2. Z+ to X- | X2.5 Z-2;
G01 Z-0.5 I-0.1;
X1.5; | X2.5 Z-2;
G01 Z-0.6;
X2.3 Z-0.5;
X1.5; |
| 3. Z- to X+ | X1.5 Z-0.5;
G01 Z-2. I0.1;
X2.5; | X1.5 Z-0.5
G01 Z-1.9;
X1.7 Z-2.;
X2.5; |
| 4. Z- to X- | X1.5 Z-0.5;
G01 Z-2. I-0.1;
X0.5; | X1.5 Z-0.5;
G01 Z-1.9;
X1.3 Z-2.
X0.5; |



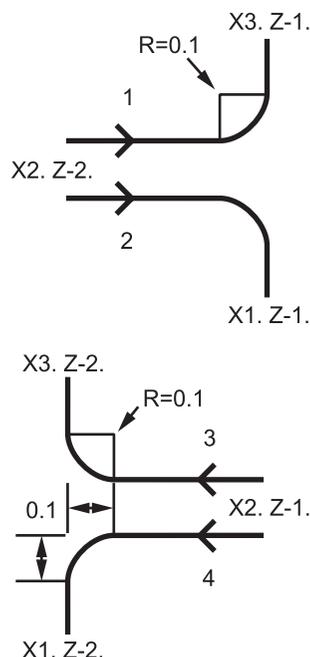
Corner Rounding Code Example Movement

- | | | |
|-------------|---|---|
| 1. X- to Z- | X1.5 Z-1.1;
G01 X0.5 K-0.1;
Z-2.; | X1.5 Z-1.1;
G01 X0.7;
X0.5 Z-1.1;
Z-2. |
| 2. X- to Z+ | X1.5 Z-1.1;
G01 X0.5 K0.1;
Z0.; | X1.5 Z-1.1;
G01 X0.7;
X0.5 Z-0.9;
Z0.; |
| 3. X+ to Z- | X0.5 Z-1.1;
G01 X1.5 K-0.1;
Z-2.; | X0.5 Z-1.1;
G01 X1.3;
X1.5 Z-1.1;
Z-2. |
| 4. X+ to Z+ | X0.5 Z-1.1;
G01 X1.5 K0.1;
Z0.; | X0.5 Z-1.1;
G01 X1.3;
X1.5 Z-0.9;
Z0.; |

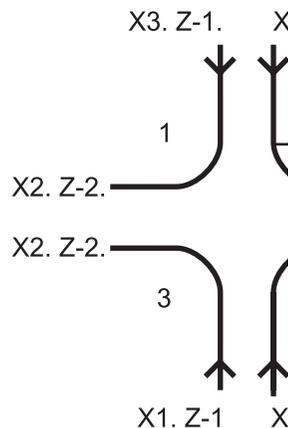




Corner Rounding	Code Example	Movement
1. Z+ to X+	X2. Z-2.; G01 Z-1 R.1; X3.;	X2. Z-2.; G01 Z-1.1; G03 X2.2 Z-1. R0.1; G01 X3.;
2. Z+ to X-	X2. Z-2.; G01 Z-1. R-0.1; X1.;	X2. Z-2.; G01 Z-1.1; G02 X1.8 Z-1 R0.1; G01 X1.;
3. Z- to X+	X2. Z-1.; G01 Z-2. R0.1; X3.;	X2. Z-1.; G01 Z-1.9; G02 X2.2 Z-2. R0.1; G01 X3.;
4. Z- to X-	X2. Z-1.; G01 Z-2. R-0.1; X1.;	X2. Z-1.; G01 Z-1.9.; G03 X1.8 Z-2.; G01 X1.;



Corner Rounding	Code Example	Movement
1. X- to Z-	X3. Z-1.; G01 X0.5 R-0.1; Z-2.;	X3. Z-1.; G01 X0.7; X0.5 Z-1.1; Z-2.
2. X- to Z+	X3. Z-2.; G01 X0.5 R0.1; Z0.;	X3. Z-2.; G01 X0.7; X0.5 Z-0.9; Z0.;
3. X+ to Z-	X1. Z-1.; G01 X1.5 R-0.1; Z-2.;	X1. Z-1.; G01 X1.3; X1.5 Z-1.1; Z-2.
4. X+ to Z+	X1. Z-2.;	X1. Z-2.;



Rules:

- 1) Use K address only with X(U) address. Use I address only with Z(W) address.
- 2) Use R address with either X(U) or Z(W), but not both in the same block.
- 3) Do not use I and K together on the same block. When using R address, do not use I or K.

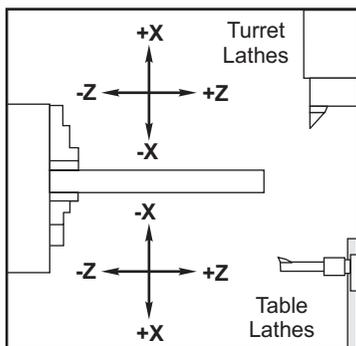


- 4) The next block must be another single linear move that is perpendicular to the previous one.
- 5) Automatic chamfering or corner rounding cannot be used in a threading cycle **or in a Canned cycle**.
- 6) Chamfer or corner radius must be small enough to fit between the intersecting lines.
- 7) Use only a single X or Z-axis move in linear mode (G01) for chamfering or corner rounding.

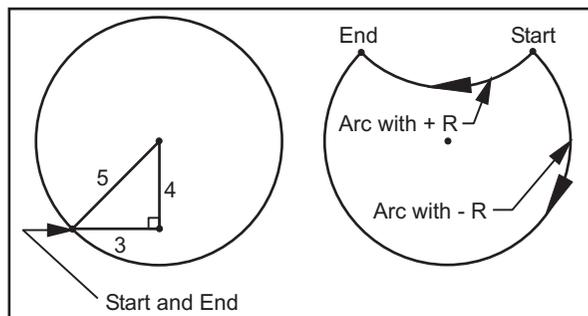
G02 CW Circular Interpolation Motion / G03 CCW Circular Interpolation Motion (Group 01)

F	Feed rate
*I	Distance along X-axis to center of circle
*J	Distance along Y-axis to center of circle
*K	Distance along Z-axis to center of circle
*R	Radius of arc
*U	X-axis incremental motion command
*W	Z-axis incremental motion command
*X	X-axis absolute motion command
*Y	Y-axis absolute motion command
*Z	Z-axis absolute motion command
C	Distance from center of intersection where the chamfer begins
R	Radius of the circle
* indicates optional	

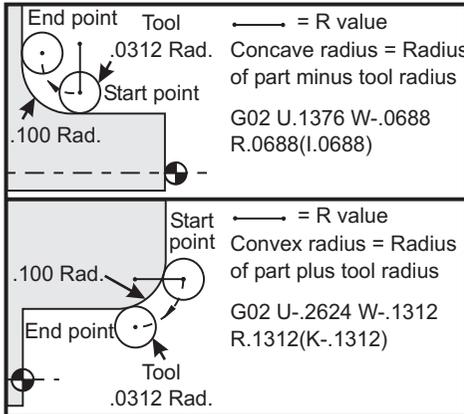
These G codes are used to specify a circular motion (CW or CCW) of the linear axes (Circular motion is possible in the X and Z axes as selected by G18). The X and Z values are used to specify the end point of the motion and can use either absolute (U and W) or incremental motion (X and Z). If either the X or Z is not specified, the endpoint of the arc is the same as the starting point for that axis. There are two ways to specify the center of the circular motion; the first uses I or K to specify the distance from the starting point to the center of the arc; the second uses R to specify the radius of the arc (maximum 7740 inches).



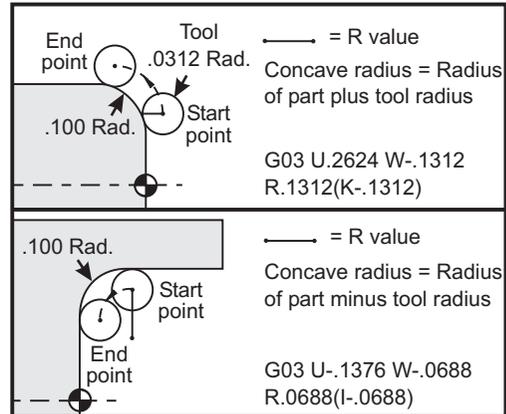
Axis Definitions



G02



G02



G03

R is used to specify the center of the circle. R is the distance from the starting point to the center of the circle. With a positive R, the control will generate a path of 180 degrees or less; to generate a radius of over 180 degrees, specify a negative R. X or Z is required to specify an endpoint if different from the starting point.

The following line will cut an arc of less than 180 degrees:

G01 X3.0 Z4.0

G02 Z-3.0 R5.0

I and K are used to specify the center of the arc. When I and K are used, R may not be used. The I or K is the signed distance from the starting point to the center of the circle. If only one of I or K is specified, the other is assumed to be zero.

G04 Dwell (Group 00)

P The dwell time in seconds or milliseconds

G04 is used to cause a delay or dwell in the program. The block containing G04 will delay for the time specified by the **P** code. For example G04 P10.0. This will delay the program for 10 seconds. Note the use of the decimal point G04 P10. is a dwell of 10 seconds; G04 P10 is a dwell of 10 milliseconds.

G09 Exact Stop (Group 00)

The G09 code is used to specify a controlled axes stop. It only affects the block in which it is commanded; it is non-modal, it does not affect the following blocks. Machine moves will decelerate to the programmed point before another command is processed.

G10 Set Offsets (Group 00)

G10 allows the programmer to set offsets within the program. Using G10 replaces the manual entry of offsets (i.e. Tool length and diameter, and work coordinate offsets).



L Selects offset category.

L2 Work coordinate origin for COMMON and G54-G59

L10 Geometry or shift offset

L1 or L11 Tool wear

L20 Auxiliary work coordinate origin for G110-G129

P Selects a specific offset.

P1-P50 References geometry, wear or work offsets (L10-L11)

P51-P100 References shift offsets (YASNAC) (L10-L11)

P0 References COMMON work coordinate offset (L2)

P1-P6 G54-G59 references work coordinates (L2)

P1-P20 G110-G129 references auxiliary coordinates (L20)

P1-P99 G154 P1-P99 reference auxiliary coordinate (L20)

Q Imaginary tool nose tip direction

R Tool nose radius

*U Incremental amount to be added to X-axis offset

*W Incremental amount to be added to Z-axis offset

*X X-axis offset

*Z Z-axis offset

* indicates optional

Programming Examples

G10 L2 P1 W6.0 (Move coordinate G54 6.0 units to the right);

G10 L20 P2 X-10.Z-8. (Set work coordinate G111 to X-10.0, Z-8.0);

G10 L10 P5 Z5.00 (Set geometry offset of Tool #5 to 5.00);

G10 L11 P5 R.0625 (Set offset of Tool #5 to 1/16");

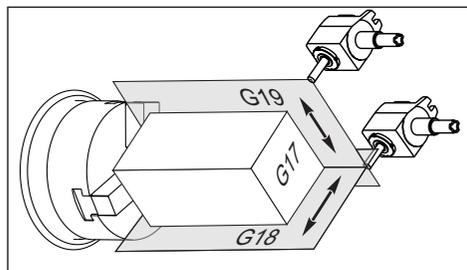
G14 Secondary Spindle Swap / G15 Cancel (Group 17)

G14 causes the secondary spindle to become the primary spindle and will react to commands normally used for the main spindle. For example, M03, M04, M05 and M19 will affect the secondary spindle, and M143, M144, M145 and M119 will cause an alarm. Note that G50 will limit the secondary spindle speed, and G96 will set the secondary spindle surface feed value. These G-codes will adjust the secondary spindle speed when there is motion in the X-axis. G01 Feed Per Rev will feed based on the secondary spindle.

The G14 command will automatically activate Z-axis mirroring. If the Z-axis is already mirrored (Setting 47 or G101) the mirror function will be canceled. G14 is canceled by a G15, an M30, reaching the end of a program, and by pressing Reset.

G17 XY Plane

This code defines the plane in which G02 and G03 circular motion will be performed. Programming tool nose radius compensation G41 or G42 will apply mill-style cutter compensation in the G17 plane, regardless of whether G112 is active or not. Plane selection codes are modal and remain in effect until another plane is selected.



Program format with tool nose compensation

```
G17 G01 X_ Y_ F_
```

```
G40 G01 X_ Y_ I_ J_ F_
```

G18 Plane Selection (Group 02)

This code defines the plane in which G02 and G03 circular motion will be performed. Programming tool nose radius compensation G41 or G42 will apply compensation required for the nose radii of turning tools.

G19 YZ Plane (Group2)

This code defines the plane in which G02 and G03 circular motion will be performed. Programming tool nose radius compensation G41 or G42 will apply mill-style cutter compensation in the G19 plane. Plane selection codes are modal and remain in effect until another plane is selected.

G20 Select Inches / G21 Select Metric (Group 06)

The G codes G20 (inch) and G21 (mm) codes are used to ensure that the inch/metric selection is set correctly for the program. Selection between inch and metric programming should be done using Setting 9.

G28 Return To Machine Zero, set optional G29 Reference point (Group 00)

The G28 code is used to return all axes to machine zero, unless an axis (or axes) is specified, in which case only that axis (or axes) is returned to machine zero. G28 cancels tool length offsets for the following lines of code.

G29 Return from Reference Point (Group 00)

The G29 code is used to move the axes to a specific position. The axes selected in this block are moved to the G29 reference point saved in G28, and then moved to the location specified in the G29 command.

G31 Skip Function (Group 00)

This G-code is optional and requires a probe.

F	Feed rate
U*	X-axis incremental motion command
W*	Z-axis incremental motion command
A	A-axis absolute motion command



- B B-axis absolute motion command
- C C-axis absolute motion command
- X X-axis absolute motion command
- Y Y-axis absolute motion command
- Z Z-axis absolute motion command

* indicates optional

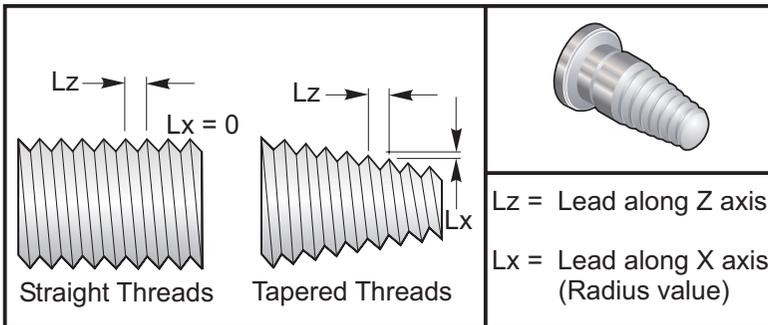
This G-code moves the axes to the programmed position. It applies only to the block in which G31 is specified. The specified move is started and continues until the position is reached or the probe receives a signal (skip signal). The control will beep when the end of travel is reached.

Do not use Cutter Compensation with a G31. Also see M78 and M79.

G32 Thread Cutting (Group 01)

- F Feed rate
- Q Thread Start Angle (optional). See example on the following page.
- U/W X/Z-axis incremental positioning command. (Incremental thread depth values are user specified)
- X/Z X/Z-axis absolute positioning command. (Thread depth values are user specified)

Note: Feed rate is equivalent to thread lead. Movement on at least one axis must be specified. Tapered threads have lead in both X and Z. In this case set the feed rate to the larger of the two leads. G99 (Feed per Revolution) must be active.



G32 Definition of Lead (Feed Rate) for Straight and Tapered Threads

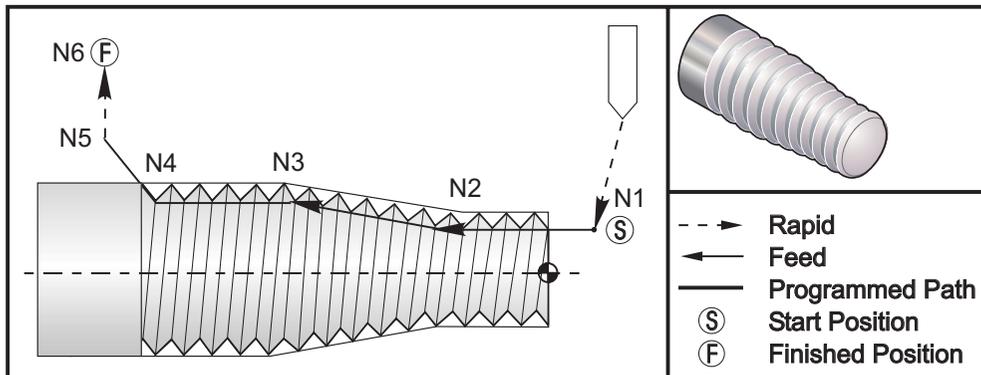
G32 differs from other thread cutting cycles in that taper and/or lead can vary continuously throughout the entire thread. In addition, no automatic position return is performed at the end of the threading operation.

At the first line of a G32 block of code, axis feed is synchronized with the rotation signal of the spindle encoder. This synchronization remains in effect for each line in a G32 sequence. It is possible to cancel G32 and recall it without losing the original synchronization. This means multiple passes will exactly follow the previous tool path (The actual spindle RPM must be exactly the same between passes).



Note: Single Block Stop and Feed Hold are deferred until last line of a G32 sequence. Feed Rate Override is ignored while G32 is active, Actual Feed Rate will always be 100% of programmed feed rate. M23 and M24 have no affect on a G32 operation, the user must program chamfering if needed. G32 must not be used with any G-Code Canned Cycles (i.e.: G71). Do Not change spindle RPM during threading.

Caution! G32 is Modal. Always cancel G32 with another Group 01 G-code at the end of a threading operation. (Group 01 G-Codes: G00, G01, G02, G03, G32, G90, G92, and G9)



Straight-to-Taper-to-Straight Thread Cutting Cycle

Note: Example is for reference only, multiple passes are usually required to cut actual threads.

G32 Program Example

Comments

...	
G97 S400 M03	(Constant Surface Speed Cancel)
N1 G00 X0.25 Z0.1	(Rapid to Start Position)
N2 G32 Z-0.26 F0.065	(Straight thread, Lead(Lz) = 0.065)
N3 X0.455 Z-0.585	(Straight thread blends to tapered thread)
N4 Z-0.9425	(Taper thread blends back to straight thread)
N5 X0.655 Z-1.0425	(Escape at 45 degrees)
G00 X1.2	(Rapid to Finish Position, cancel G32)
G00 Z0.1	

Q option example:

G32 X-1.99 Z-2. Q60000 F0.2;	(60 degree cut)
G32 X-1.99 Z-2. Q120000 F0.2;	(120 degree cut)
G32 X-1.99 Z-2. Q270123 F0.2;	(270.123 degree cut)

The following rules apply to the use of Q:

1. The start angle (Q) is not a modal value. It must be specified every time it is used. If no value is specified then a zero (0) angle is assumed.



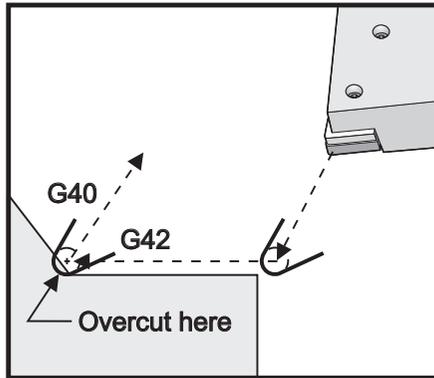
- The angle of threading increment is 0.001 degrees. Do not use a decimal point. A 180° angle must be specified as Q180000 and a 35° angle as Q35000.
- The Q angle must be entered as a positive value from 0 to 360000.

G40 Tool Nose Compensation Cancel (Group 07)

- *X X axis absolute location of departure target
- *Z Z axis absolute location of departure target
- *U X axis incremental distance to departure target
- *W Z axis incremental distance to departure target
- * indicates optional

G40 cancels G41 or G42. Programming Txx00 will also cancel tool nose compensation. Cancel tool nose compensation before the end of a program.

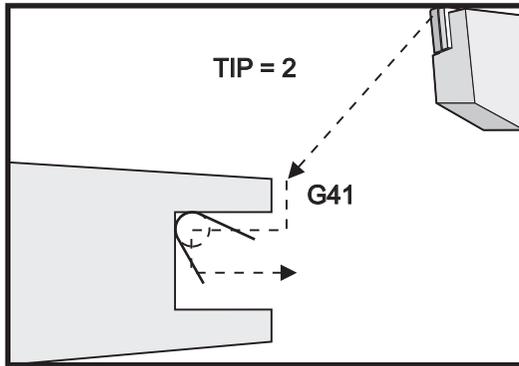
The tool departure usually does not correspond with a point on the part. In many cases overcutting or undercutting can occur.



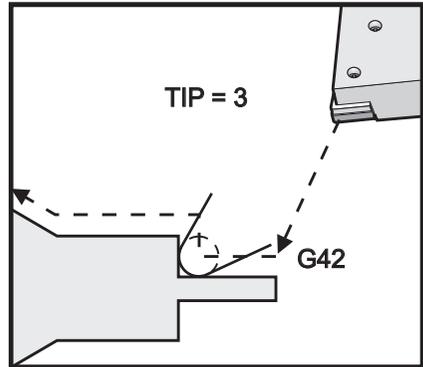
G40

G41 Tool Nose Compensation (TNC) Left / G42 TNC Right (Group 07)

G41 or G42 will select tool nose compensation. G41 moves the tool to the left of the programmed path with the tool.



G41



G42

G50 Set Global coordinate Offset FANUC, YASNAC (Group 00)

- U Incremental amount and direction to shift global X coordinate.
- X Absolute global coordinate shift.
- W Incremental amount and direction to shift global Z coordinate.
- Z Absolute global coordinate shift.
- S Clamp spindle speed to specified value
- T Apply tool shift offset (YASNAC)

G50 can perform several functions. It can set the global coordinate, it can shift the global coordinate, and it can limit the spindle speed to a maximum value. Refer to the “Coordinate Systems and Offsets” section for a discussion of these.

To set the global coordinate, command G50 with an X or Z value. The effective coordinate will become the value specified in address code X or Z. Current machine location, work offsets and tool offsets are taken into account. The global coordinate is calculated and set.

Example: G50 X0 Z0 (Effective coordinates are now zero);

To shift the global coordinate system, specify G50 with a U or W value. The global coordinate system will be shifted by the amount and direction specified in U or W. The current effective coordinate displayed will change by this amount in the opposite direction. This method is often used to place the part zero outside of the work cell.

Example: G50 W-1.0 (Effective coordinates will be shifted left 1.0);

To set a YASNAC style work coordinate shift, specify G50 with a T value (Setting 33 must be set to YASNAC). The global coordinate is set to the X and Z values in the Tool Shift Offset page. Values for the T address code are, Txxyy where xx is between 51 and 100 and yy is between 00 and 50. For example, T5101 specifies tool shift index 51 and tool wear index 01; it does not cause tool number 1 to be selected. To select another Txxyy code must be used outside the G50 block. The following two examples illustrate this method to select Tool 7 using Tool Shift 57 and Tool Wear 07.

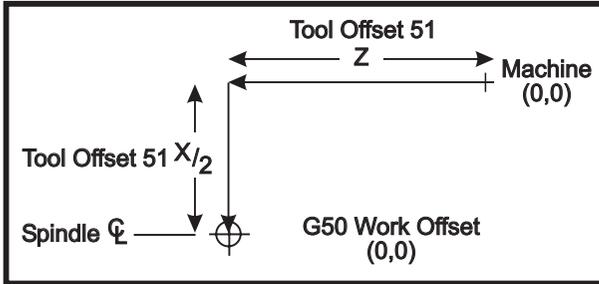


Example 1

G51; (Cancel Offsets)
 T700 M3; (Change to Tool 7, Turn on Spindle)
 G50 T5707; (Apply Tool Shift and Tool Wear to Tool 7)

Example 2

G51; (Cancel Offsets)
 G50 T5700; (Apply Tool Shift)
 T707 M3; (Change to Tool 7 and apply Tool Wear)



```
000101
N1 G51 (Return to Machine Zero)
N2 G50 T5100; (Offset for Tool 1)
.
.
.
%
```

G50 YASNAC Tool Shift

G50 Spindle Speed Clamp

G50 can be used to limit the maximum spindle speed. The control will not allow the spindle to exceed the S address value specified in the G50 command. This is used in constant surface feed mode (G96).

This G code will also limit the secondary spindle on DS-Series machine.

```
N1 G50 S3000 ; (Spindle rpm will not exceed 3000 rpm)
N2 G97 M3 ; (Enter constant surface speed cancel, spindle on)
```

NOTE: To cancel this command, use another G50 and specify the maximum spindle RPM for the machine.

G51 Cancel Offset (YASNAC) (Group 00)

G51 is used to cancel any existing tool wear and work coordinate shift and return to the machine zero position.

Work Coordinate Systems

The Haas CNC lathe control supports both YASNAC and FANUC coordinate systems. Work coordinates together with tool offsets can be used to position a part program anywhere within the work area. Also see the Tool Offsets section.

G52 Set Local Coordinate System FANUC (Group 00)

This code selects the user coordinate system.

G53 Machine Coordinate Selection (Group 00)

This code temporarily cancels work coordinates offsets and uses the machine coordinate system.



G54-59 Select Coordinate System #1 - #6 FANUC (Group 12)

These codes select one of the six user coordinate systems stored within the offsets memory. All subsequent references to axes' positions will be interpreted in the new coordinate system. Work coordinate system offsets are entered from the Offsets display page.

G61 Exact Stop Modal (Group 15)

The G61 code is used to specify exact stop. Rapid and interpolated moves will decelerate to an exact stop before another block is processed. In exact stop, moves will take a longer time and continuous cutter motion will not occur. This may cause deeper cutting where the tool stops.

G64 Exact Stop Cancel G61 (Group 15)

The G64 code is used to cancel exact stop. Selects normal cutting mode.

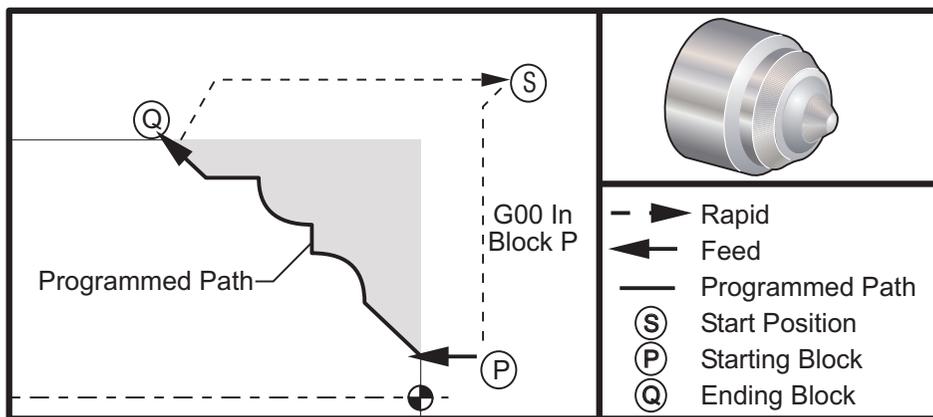
G70 Finishing Cycle (Group 00)

The G70 Finishing cycle can be used to finish cut paths that are rough cut with stock removal cycles such as G71, G72 and G73.

P Starting Block number of routine to execute

Q Ending Block number of routine to execute

G18 Z-X plane must be active



G70

Programming Example

```

G71 P10 Q50 F0.012 (rough out N10 to N50 the path)
N10
F0.014
...
N50
...
...
...
G70 P10 Q50 (finish path defined by N10 to N50)

```



The G70 cycle is similar to a local subprogram call. However, the G70 requires that a beginning block number (P code) and an ending block number (Q code) be specified.

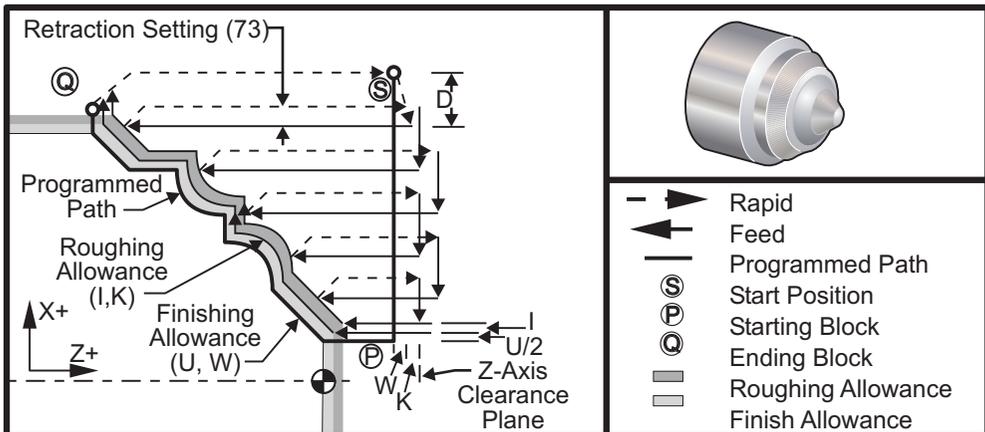
The G70 cycle is usually used after a G71, G72 or G73 has been performed using the blocks specified by P and Q. Any F, S or T codes with the PQ block are effective. After execution of the Q block, a rapid (G00) is executed returning the machine to the start position that was saved before the starting of the G70. The program then returns to the block following the G70 call. A subroutine in the PQ sequence is acceptable providing that the subroutine does not contain a block with an N code matching the Q specified by the G70 call. This feature is not compatible with FANUC or YASNAC controls.

G71 O.D./I.D. Stock Removal Cycle (Group 00)

- *D Depth of cut for each pass of stock removal, positive radius
- *F Feed rate to use throughout G71 PQ block
- *I X-axis size and direction of G71 rough pass allowance, radius
- *K Z-axis size and direction of G71 rough pass allowance
- P Starting Block number of path to rough
- Q Ending Block number of path to rough
- *S Spindle speed to use throughout G71 PQ block
- *T Tool and offset to use throughout G71 PQ block
- *U X-axis size and direction of G71 finish allowance, diameter
- *W Z-axis size and direction of G71 finish allowance
- *R1 YASNAC select Type II roughing

* indicates optional

G18 Z-X plane must be active



G71

This canned cycle roughs material on a part given the finished part shape. Define the shape of a part by programming the finished tool path and then use

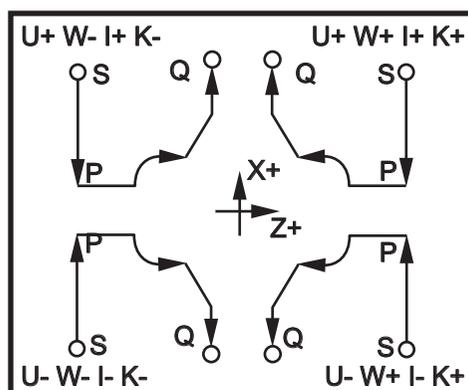


the G71 PQ block. Any F,S or T commands on the G71 line or in effect at the time of the G71 is used throughout the G71 roughing cycle. Usually a G70 call to the same PQ block definition is used to finish the shape.

Two types of machining paths are addressed with a G71 command. The first type of path (Type I) is when the X-axis of the programmed path does not change direction. The second type of path (Type II) allows the X-axis to change direction. For both Type I and Type II the programmed path the Z-axis cannot change direction. Type I is selected by having only an X-axis motion in the block specified by P in the G71 call. When both an X-axis and Z-axis motion are in the P block then Type II roughing is assumed. When in YASNAC mode, Type II roughing is selected by including R1 on the G71 command block.

Any one of the four quadrants of the X-Z plane can be cut by specifying address codes D, I, K, U, and W properly.

In the figures, the start position S is the position of the tool at the time of the G71 call. The Z clearance plane is derived from the Z-axis start position and the sum of W and optional K finish allowance.



G71 Address Relationships

Type I Details

When Type I is specified by the programmer it is assumed that the X-axis tool path does not reverse during a cut. Each roughing pass X-axis location is determined by applying the value specified in D to the current X location. The nature of the movement along the Z clearance plane for each roughing pass is determined by the G code in block P. If block P contains a G00 code, then movement along the Z clearance plane is a rapid mode. If block P contains a G01 then movement will be at the G71 feed rate.

Each roughing pass is stopped before it intersects the programmed tool path allowing for both roughing and finishing allowances. The tool is then retracted from the material, at a 45 degree angle by the distance specified in setting 73. The tool then moves in rapid mode to the Z-axis clearance plane.



When roughing is completed the tool is moved along the tool path to clean up the rough cut. If I and K are specified an additional rough finish cut parallel to the tool path is performed.

Type II Details

When Type II is specified by the programmer the X axis PQ path is allowed to vary (for example, the X-axis tool path can reverse direction).

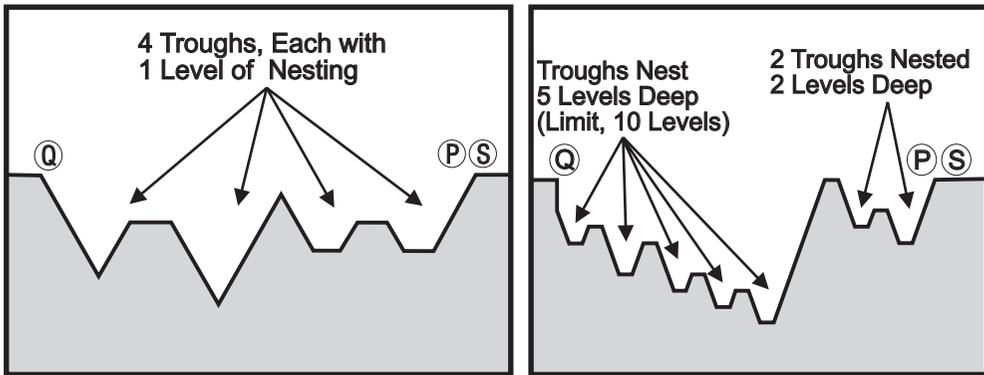
The X axis PQ path must not exceed the original starting location. The only exception is the ending Q block.

Type II roughing, when Setting 33 is set to YASNAC, must include R1 (with no decimal) on the G71 command block.

Type II, when Setting 33 is set to FANUC, must have a reference move, in both the X and Z axis, in the block specified by P.

Roughing is similar to Type I except after each pass along the Z axis, the tool will follow the path defined by PQ. The tool will then retract parallel to the X axis by a distance defined in Setting 73 (Can Cycle Retraction). The Type II roughing method does not leave steps in the part prior to finish cutting and typically results in a better finish.

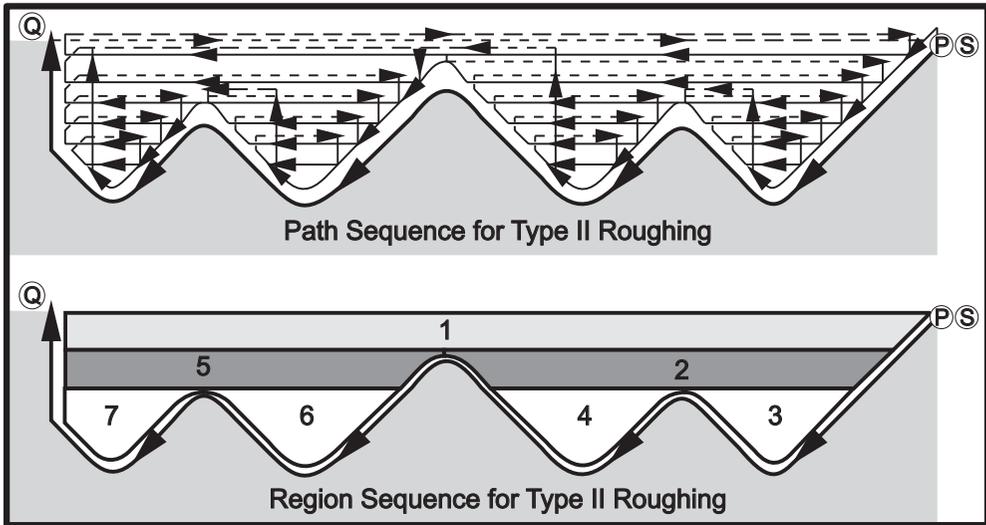
Troughs



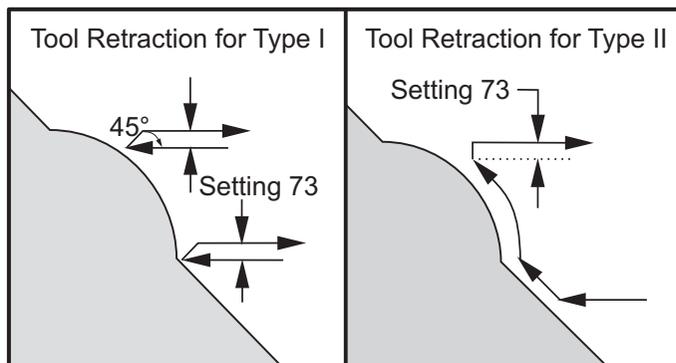
Troughs on the Same Level

Nested Troughs

A trough can be defined as a change in direction which creates a concave surface in the material being cut. If successive troughs are on the same level, there can be an unlimited number of troughs. When troughs are within troughs (nested), there can be no more than 10 levels of trough nesting. The following figures illustrate the sequence of roughing cuts (Type I and II) for PQ paths with multiple troughs. All material above troughs is roughed first, followed by the troughs themselves in the direction of Z.



Path Sequence for Type II Roughing



Type I and II Tool Retraction

NOTE: An effect of using a Z finish or roughing allowance is the limit between the two cuts on one side of a trough and the corresponding point on the other side of the trough. This distance must be greater than double the sum of the roughing and finish allowances.

For example, if G71 Type 2 path contains the following:

...
 X-5. Z-5.
 X-5.1 Z-5.1
 X-3.1 Z-8.1
 ...

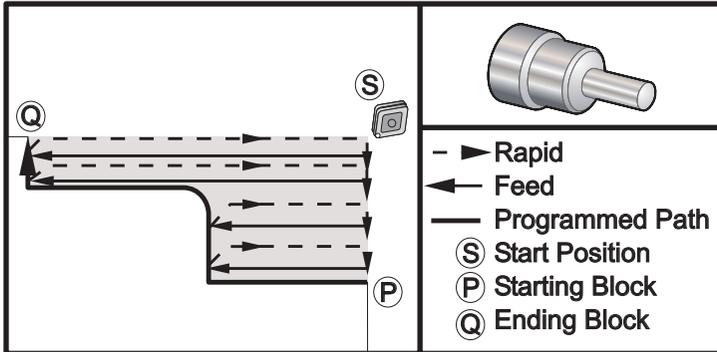
The greatest allowance that can be specified is 0.999, since the horizontal distance from the start of cut 2 to the same point on cut 3 is 0.2. If a larger allowance is specified, overcutting will occur.

G & M Codes
Settings



Cutter compensation is approximated by adjusting the roughing allowance according to the radius and tip type of the tool. Therefore, the limitations that apply to the allowance also apply to the sum of the allowance and the tool radius.

NOTE: If the last cut in the P-Q path is a non-monotonic curve (using a finish allowance) add a short retraction cut; do not use W.



G71 Basic G Code Example

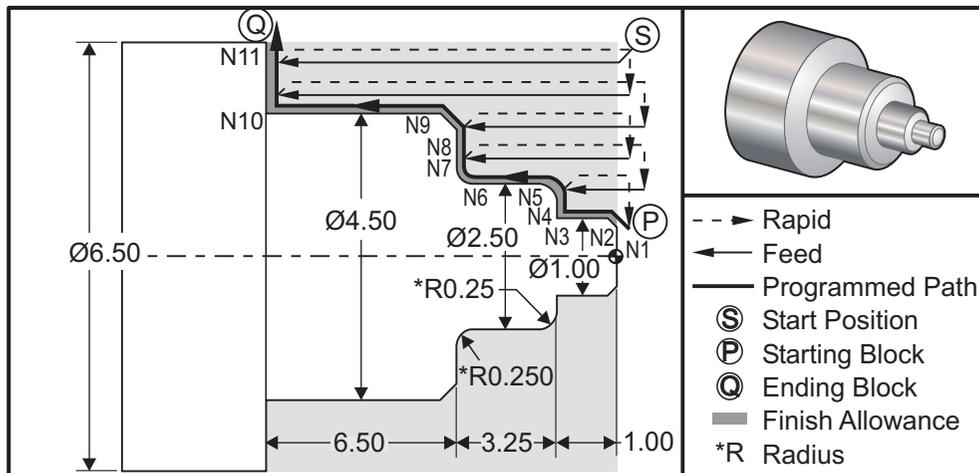
Program Example

```
%  
O0070  
T101  
G50 S2500  
G97 S509 M03  
G00 G54 X6. Z0.05  
G96 S800  
G71 P1 Q2 D0.15 U0.01 W0.005 F0.014  
N1 G00 X2.  
G01 Z-3. F0.006  
X3.5  
G03 X4. Z-3.25 R0.25  
G01 Z-6.  
N2 X6.  
G70 P1 Q2  
M09  
G53 X0 M05  
G53 Z0  
M30  
%
```

Description

(G71 Roughing Cycle)

(FINISH PASS)



G71 Type I O.D./I.D. Stock Removal Example

Program Example

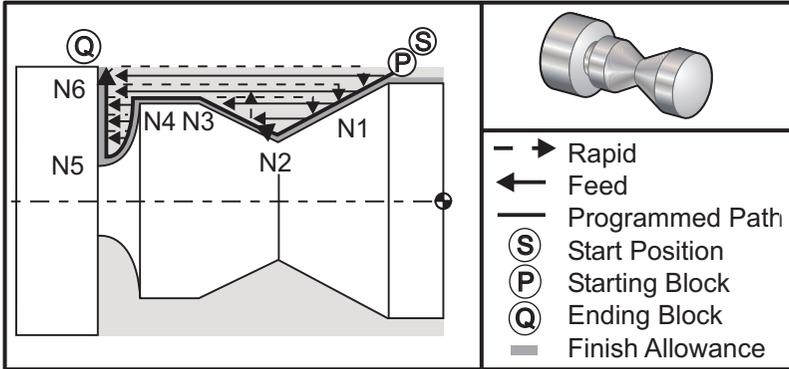
```

%
O0071
T101 (CNMG 432)
G00 G54 X6.6 Z.05 M08
G50 S2000
G97 S636 M03
G96 S750
G71 P1 Q11 D0.15 U0.01 W0.005 F0.012
N1 G00 X0.6634 P
N2 G01 X1. Z-0.1183 F0.004
N3
N4
N5 G03 X2.5 Z-1.2812 R0.2812
N6 G01 Z-3.0312
N7 G02 X2.9376 Z-3.25 R0.2188
N8 G01 X3.9634
N9 X4.5 Z-3.5183
N10 Z-6.5
N11 X6.0 Q
G00 X0 Z0 T100
T202
G50 S2500
G97 S955 M03
G00 X6. Z0.05 M08
G96 S1500
G70 P1 Q11
G00 X0 Z0 T200
M30
%
```

Description

(FANUC G71 TYPE I EXAMPLE)
 (Tool change & apply offsets)
 (Rapid to Home Position)
 (Set Max RPM 2000)
 (Spindle On)
 (Constant surface speed On)
 (Define rough cycle)
 (Begin definition)
 (Finish pass .004" Feed)
 Z-1.
 X1.9376

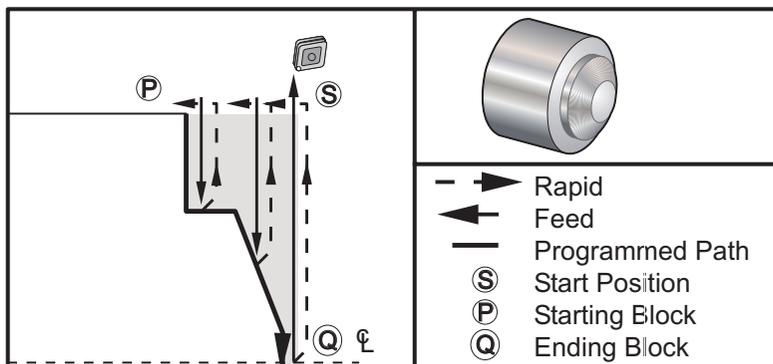
 (End definition)
 (Rapid to tool change position)
 (Finish tool)



G71 Type II O.D./I.D. Stock Removal Example

Program Example

```
%  
O0135  
T101  
G97 S1200 M03  
G00 G54 X2. Z.05  
G71 P1 Q6 D0.035 U0.03 W0.01 F0.01  
N1 G01 X1.5 Z-0.5 F0.004  
N2 X1. Z-1.  
N3 X1.5 Z-1.5  
N4 Z-2.  
N5 G02 X0.5 Z-2.5 R0.5  
N6 G1 X2.  
G00 X0. Z0. T100  
T202  
G97 S1500 M03  
G70 P1 Q6  
G53 X0  
G53 Z0  
M30  
%
```



G72 Basic G Code Example

Program Example

```

%
O0069
T101
G50 S2500
G97 S509 M03
G54 G00 X6. Z0.05
G96 S800
G72 P1 Q2 D0.075 U0.01 W0.005 F0.012
N1 G00 Z-0.65
G01 X3. F0.006
Z-0.3633
X1.7544 Z0.
X-0.0624
N2 G00 Z0.02
G70 P1 Q2 (Finish Pass)
M05
G53 X0
G53 Z0
M30
%
```

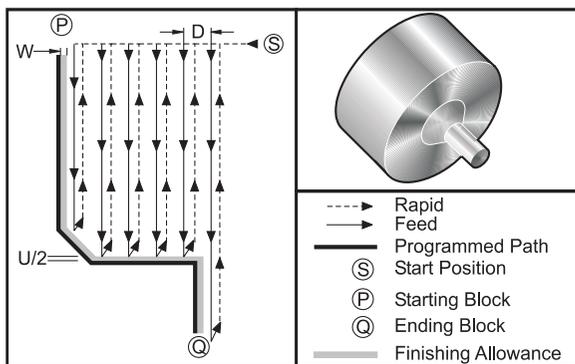
G71 I.D. Stock Removal Example

NOTE: Be sure the start position of the tool is positioned below the diameter of the part you wish to start roughing out, before defining a G71 on an I.D. with this cycle.



G72 End Face Stock Removal Cycle (Group 00)

- *D Depth of cut for each pass of stock removal, positive
- *F Feed rate to use throughout G72 PQ block
- *I X-axis size and direction of G72 rough pass allowance, radius
- *K Z-axis size and direction of G72 rough pass allowance
- P Starting Block number of path to rough
- Q Ending Block number of path to rough
- *S Spindle speed to use throughout G72 PQ block
- *T Tool and offset to use throughout G72 PQ block
- *U X-axis size and direction of G72 finish allowance, diameter
- *W Z-axis size and direction of G72 finish allowance
- * indicates optional
- G18 Z-X plane must be active

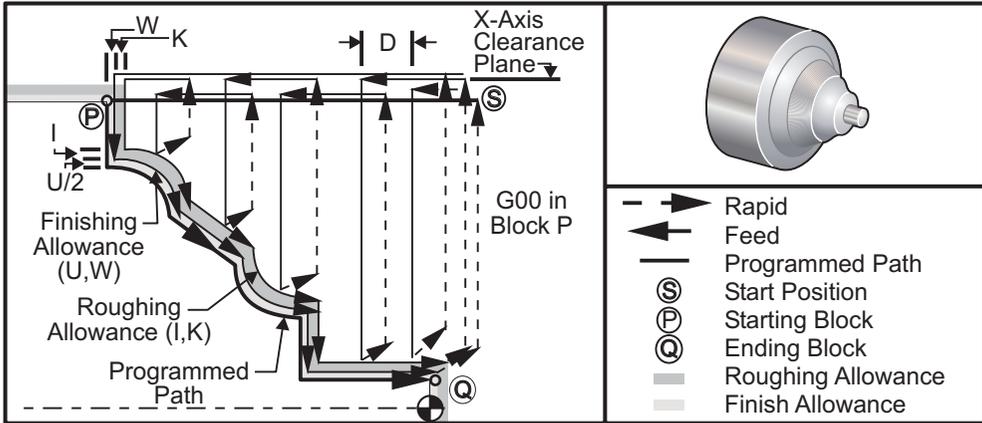


```

%
O00100 (END FACE)
T101
G54
G50 S2500
G96 S500 M03
G00 X4.05 Z0.2
G72 P101 Q102 U0.03 W0.03 D0.2 F0.01
N101 G00 Z-1.
G01 X1.5 X1. Z-0.75
G01 Z0
N102 X0
G70 P101 Q102
G00 X4.05 Z0.2
M30
%
```

This canned cycle will remove material on a part given the finished part shape. It is similar to G71 but removes material along the face of a part. Define the shape of a part by programming the finished tool path and then use the G72 PQ block. Any F,S or T commands on the G72 line or in effect at the time of the G72 is used throughout the G72 roughing cycle. Usually a G70 call to the same PQ block definition is used to finish the shape.

Two types of machining paths are addressed with a G72 command. The first type of path (Type I) is when the Z-axis of the programmed path does not change direction. The second type of path (Type II) allows the Z-axis to change direction. For both the first type and the second type of programmed path the X-axis cannot change direction. If Setting 33 is set to FANUC, Type I is selected by having only an X-axis motion in the block specified by P in the G72 call. When both an X-axis and Z-axis motion are in the P block then Type II roughing is assumed. If Setting 33 is set to YASNAC, Type II is specified by including R1 on the G72 command block (Refer to Type II details).

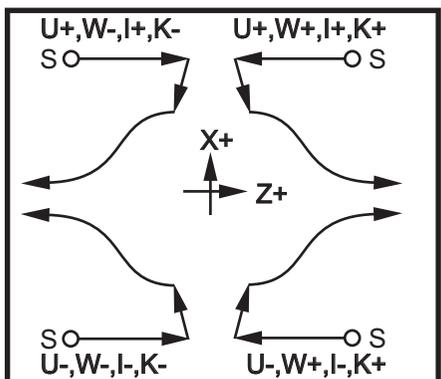


G72 End Face Stock Removal Cycle

The G72 consists of a roughing phase and a finishing phase. The roughing and finishing phase are handled slightly differently for Type I and Type II. Generally the roughing phase consists of repeated passes along the X-axis at the specified feed rate. The finishing phase consists of a pass along the programmed tool path to remove excess material left by the roughing phase but to leave finish material for a G70 block with perhaps a finishing tool. The final motion in either type is a return to the starting position S.

In the previous figure the start position S is the position of the tool at the time of the G72 call. The X clearance plane is derived from the X-axis start position and the sum of U and optional I finish allowances.

Any one of the four quadrants of the X-Z plane can be cut by specifying address codes I, K, U, and W properly. The following figure indicates the proper signs for these address performance in the associated quadrants.



G72 Address Relationships



Type I Details

When Type I is specified by the programmer it is assumed that the Z-axis tool path does not reverse during a cut.

Each roughing pass Z-axis location is determined by applying the value specified in D to the current Z location. The nature of the movement along the X clearance plane for each roughing pass is determined by the G code in block P. If block P contains a G00 code, then movement along the X clearance plane is a rapid mode. If block P contains a G01 then movement will be at the G72 feed rate.

Each roughing pass is stopped before it intersects the programmed tool path allowing for both roughing and finishing allowances. The tool is then retracted from the material, at a 45 degree angle by the distance specified in Setting 73. The tool then moves in rapid mode to the X-axis clearance plane.

When roughing is completed the tool is moved parallel to the tool path to clean up the rough cut. If I and K are specified an additional rough finish cut parallel to the tool path is performed.

Type II Details

When Type II is specified by the programmer the Z axis PQ path is allowed to vary (for example, the Z-axis tool path can reverse direction).

The Z axis PQ path must not exceed the original starting location. The only exception is on the Q block.

Type II roughing when Setting 33 is set to YASNAC, must include R1 (with no decimal) on the G71 command block.

Type II, when Setting 33 is set to FANUC, must have a reference move, in both the X and Z axis, in the block specified by P.

Roughing is similar to Type I except after each pass, along the X axis, the tool will follow the path defined by PQ. The tool will then retract parallel to the Z axis by the distance defined in Setting 73 (Can Cycle Retraction). The Type II roughing method does not leave steps in the part prior to finish cutting and typically results in a better finish.

A side effect of using a X finish or roughing allowance is the limit between the two cuts on one side of a trough and the corresponding point on the other side of the trough. This distance must be greater than double the sum of the roughing and finish allowances.



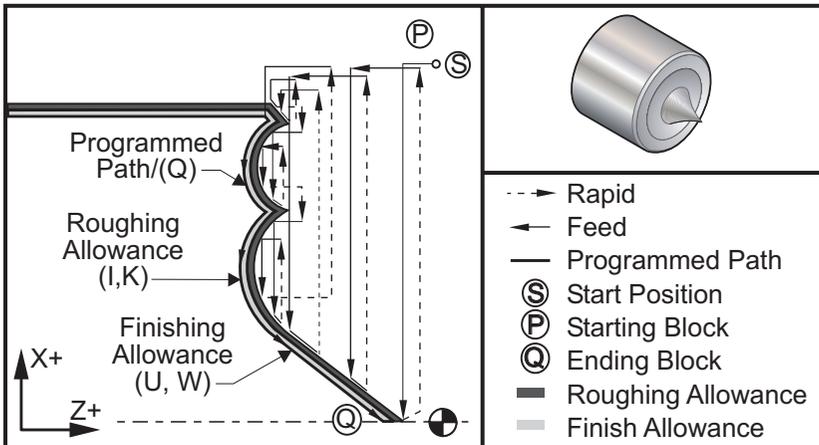
For example, if G72 type 2 path contains the following:

```
...
X-5. Z-5.
X-5.1 Z-5.1
X-8.1 Z-3.1
...
```

The greatest allowance that can be specified is 0.999, since the horizontal distance from the start of cut 2 to the start point on cut 3 is 0.2. If a larger allowance is specified, overcutting will occur.

Cutter compensation is approximated by adjusting the roughing allowance according to the radius and tip type of the tool. Thus, the limitations that apply to the allowance also apply to the sum of the allowance and the tool radius.

CAUTION! If the last cut in the P-Q path is a non-monotonic curve, using a finish allowance, add a short retraction cut (do not use U)



G72 End Face Removal

Program Example

```
%
00722
T101
S1000 M03
G00 G54 X2.1 Z0.1
G72 P1 Q2 D0.06 I0.02 K0.01 U0.0 W0.01 S1100 F0.015
N1 G01 Z-0.46 X2.1 F0.005
X2.
G03 X1.9 Z-0.45 R0.2
G01 X1.75 Z-0.4
G02 X1.65 Z-.4 R0.06
G01 X1.5 Z-0.45
G03 X1.3 Z-0.45 R0.12
G01 X1.17 Z-0.41
G02 X1.03 Z-0.41 R0.1
```

Description

(G72 Roughing Cycle)

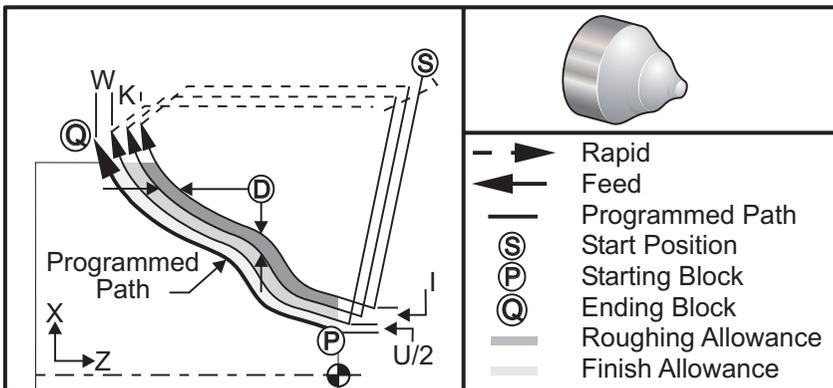


G01 X0.9 Z-0.45
 G03 X0.42 Z-0.45 R0.19
 G03 X0.2 Z-0.3 R0.38
 N2 G01 X0.01 Z0
 G70 P1 Q2
 M05
 G53 X0
 G53 Z0
 M30
 %

(Finish Pass)

G73 Irregular Path Stock Removal Cycle (Group 00)

- D Number of cutting passes, positive number
- *F Feed rate to use throughout G73 PQ block
- I X-axis distance and direction from first cut to last, radius
- K Z-axis distance and direction from first cut to last
- P Starting Block number of path to rough
- Q Ending Block number of path to rough
- *S Spindle speed to use throughout G73 PQ block
- *T Tool and offset to use throughout G73 PQ block
- *U X-axis size and direction of G73 finish allowance, diameter
- *W Z-axis size and direction of G73 finish allowance
- * indicates optional
- G18 Z-X plane must be active



G73 Irregular Path Stock Removal Cycle

The G73 canned cycle can be used for rough cutting of preformed material such as castings. The canned cycle assumes that material has been relieved or is missing a certain known distance from the programmed tool path PQ.



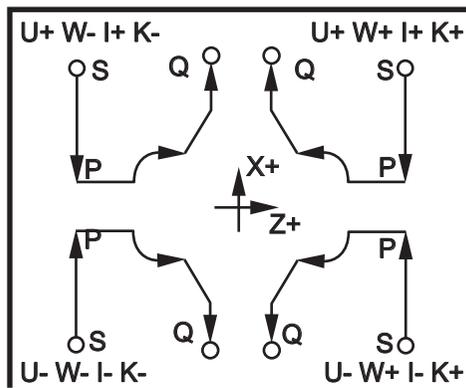
Machining starts from the current position (S), and either rapids or feeds to the first rough cut. The nature of the approach move is based on whether a G00 or G01 is programmed in block P. Machining continues parallel to the programmed tool path. When block Q is reached a rapid departure move is executed to the Start position plus the offset for the second roughing pass. Roughing passes continue in this manner for the number of rough passes specified in D. After the last rough is completed, the tool returns to the starting position S.

Only F, S and T prior to or in the G73 block are in effect. Any feed (F), spindle speed (S) or tool change (T) codes on the lines from P to Q are ignored.

The offset of the first rough cut is determined by $(U/2 + I)$ for the X axis, and by $(W + K)$ for the Z axis. Each successive roughing pass moves incrementally closer to the final roughing finish pass by an amount of $(I/(D-1))$ in the X axis, and by an amount of $(K/(D-1))$ in the Z axis. The last rough cut always leaves finish material allowance specified by $U/2$ for the X axis and W for the Z axis. This canned cycle is intended for use with the G70 finishing canned cycle.

The programmed tool path PQ does not have to be monotonic in X or Z, but care has to be taken to insure that existing material does not interfere with tool movement during approach and departure moves.

The value of D must be a positive integral number. If the D value includes a decimal, an alarm will be generated. The four quadrants of the ZX plane can be machined if the following signs for U, I, W, and K are used.

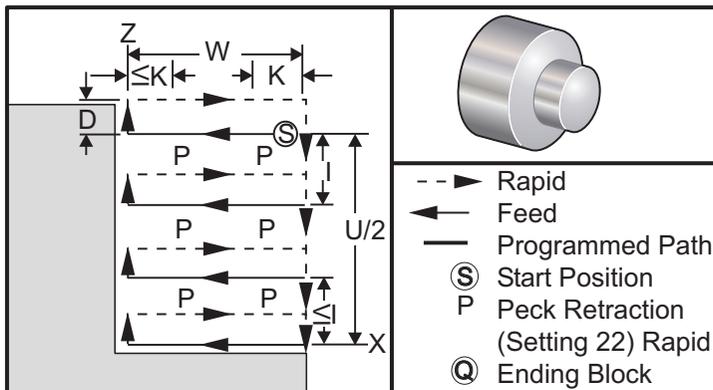


G71 Address Relationships



G74 End Face Grooving Cycle (Group 00)

- *D Tool clearance when returning to starting plane, positive
- *F Feed rate
- *I X-axis size of increment between peck cycles, positive radius
- K Z-axis size of increment between pecks in a cycle
- *U X-axis incremental distance to furthest peck (diameter)
- W Z-axis incremental distance to total pecking depth
- *X X-axis absolute location of furthest peck cycle (diameter)
- *Y Y-axis absolute location
- Z Z-axis absolute location total pecking depth
- * indicates optional

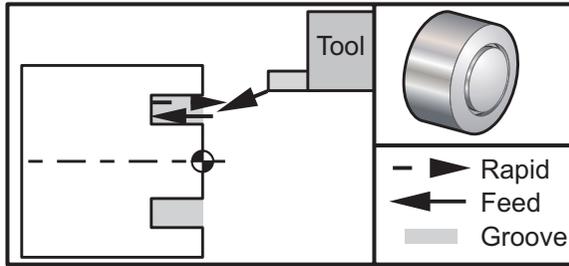


G74 End Face Grooving Cycle, Peck Drilling

The G74 canned cycle is used for grooving on the face of a part, peck drilling, or turning.

A minimum of two pecking cycles will occur, if an X, or U, code is added to a G74 block and X is not the current position. One at the current location and then at the X location. The I code is the incremental distance between X axis pecking cycles. Adding an I will perform multiple pecking cycles between the starting position S and X. If the distance between S and X is not evenly divisible by I then the last interval will be less than I.

When K is added to a G74 block, then pecking will be performed at each interval specified by K, the peck is a rapid move opposite the direction of feed with a distance as defined by Setting 22. The D code can be used for grooving and turning to provide material clearance when returning to starting plane S.



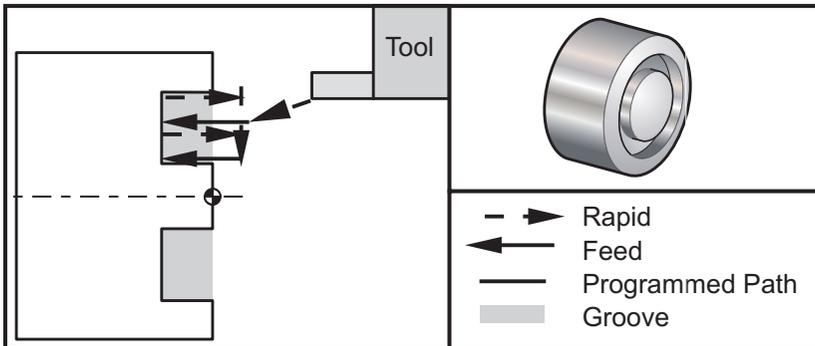
G74 End Face Grooving Cycle

Program Example

```
%  
O0071  
T101  
G97 S750 M03  
G00 X3. Z0.05  
G74 Z-0.5 K0.1 F0.01  
G53 X0  
G53 Z0  
M30  
%
```

Description

(Rapid to Start position)
(Feed Z-.5 with a .100" peck)



G74 End Face Grooving Cycle (Multiple Pass)

Program Example

```
%  
O0074  
T101  
G97 S750 M03  
G00 X3. Z0.05  
G74 X1.75 Z-0.5 I0.2 K0.1 F0.01  
G53 X0  
G53 Z0  
M30  
%
```

Description

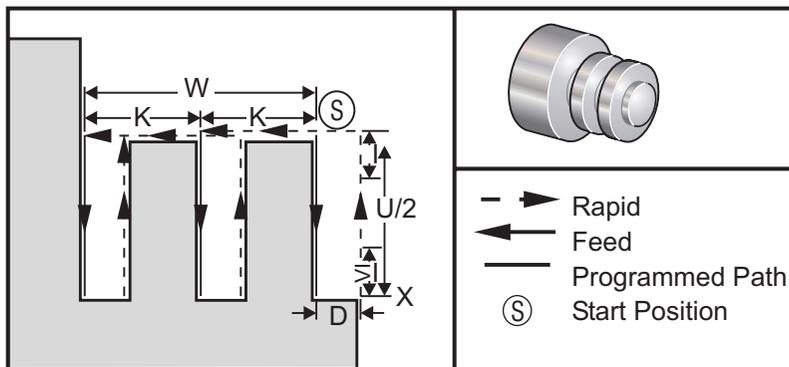
(Rapid to Start position)
(Face grooving cycle multiple pass)



G75 O.D./I.D. Grooving Cycle (Group 00)

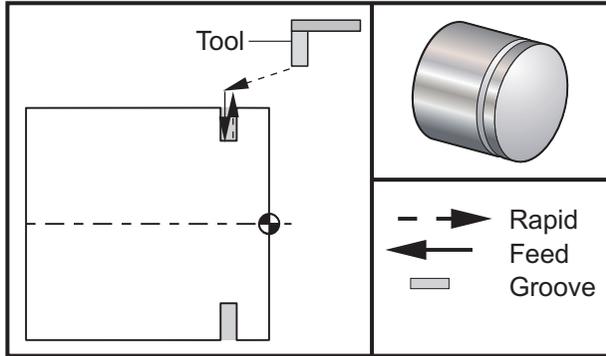
- *D Tool clearance when returning to starting plane, positive
- *F Feed rate
- *I X-axis size of increment between pecks in a cycle (radius measure)
- *K Z-axis size of increment between peck cycles
- *U X-axis incremental distance to total pecking depth
- W Z-axis incremental distance to furthest peck cycle
- *X X-axis absolute location total pecking depth (diameter)
- *Y Y-axis absolute location
- Z Z-axis absolute location to furthest peck cycle
- * indicates optional

G75 is also used for radial peck drilling with live tooling.



G75 O.D./I.D. Grooving Cycle

The G75 canned cycle can be used for grooving an outside diameter. When an Z, or W, code is added to a G75 block and Z is not the current position, then a minimum of two pecking cycles will occur. One at the current location and another at the Z location. The K code is the incremental distance between Z axis pecking cycles. Adding a K will perform multiple, evenly spaced, grooves. If the distance between the starting position and the total depth (Z) is not evenly divisible by K then the last interval along Z will be less than K. Note that chip clearance is defined by Setting 22.



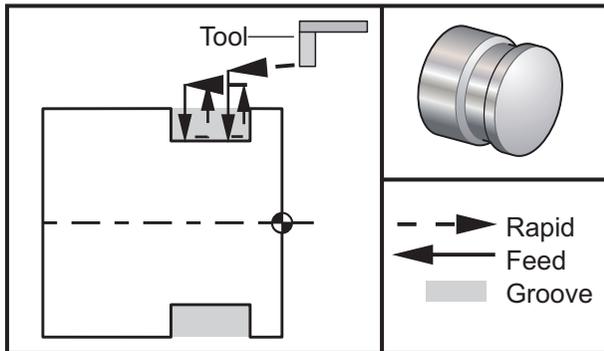
Program Example

```
%  
O0075  
T101  
G97 S750 M03  
G00 X4.1 Z0.05  
G01 Z-0.75 F0.05  
G75 X3.25 I0.1 F0.01  
G00 X5. Z0.1  
G53 X0  
G53 Z0  
M30  
%
```

Description

(Rapid to Clear position)
(Feed to Groove location)
(O.D./I.D. Peck grooving single pass)

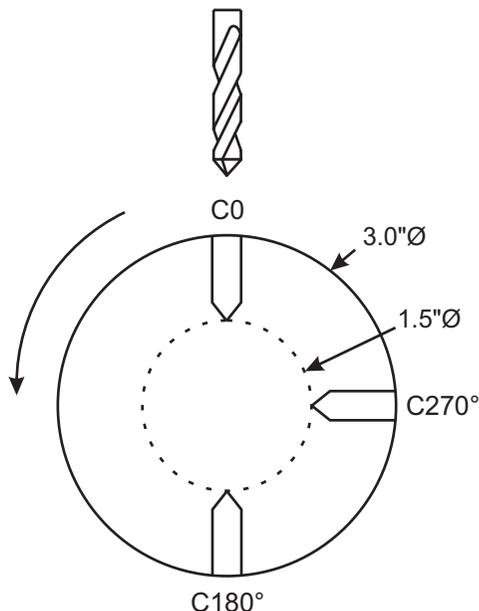
The following program is an example of a G75 program (Multiple Pass):





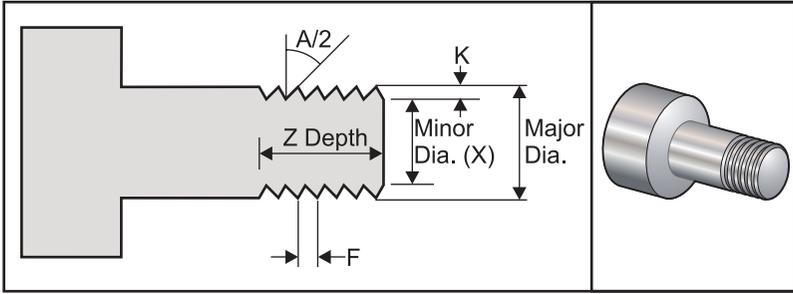
Program Example

```
(LIVE DRILL - RADIAL)
T101
G19
G98
M154 (Engage C-axis)
G00 G54 X6. C0. Y0. Z1.
G00 X3.25 Z0.25
G00 Z-0.75
G97 P1500 M133
M08
G00 X3.25 Z-0.75
G00 C0.
G19 G75 X1.5 I0.25 F6.
G00 C180.
G19 G75 X1.5 I0.25 F6.
G00 C270.
G19 G75 X1.5 I0.25 F6.
G00 G80 Z0.25 M09
M135
M155
M09
G00 G28 H0.
G00 X6. Y0. Z3.
G18
G99
M00
M30
%
```

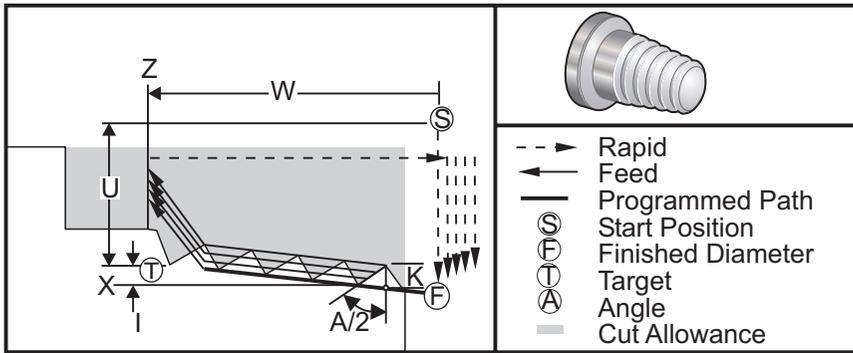


G76 Threading Cycle, Multiple Pass (Group 00)

- *A Tool nose angle (value: 0 to 120 degrees) Do not use a decimal point
 - D First pass cutting depth
 - F(E) Feed rate, the lead of the thread
 - *I Thread taper amount, radius measure
 - K Thread height, defines thread depth, radius measure
 - *P Single Edge Cutting (load constant)
 - *Q Thread Start Angle (Do not use a decimal point)
 - *U X-axis incremental distance, start to maximum thread Depth Diameter
 - *W Z-axis incremental distance, start to maximum thread length
 - *X X-axis absolute location, maximum thread Depth Diameter
 - *Z Z-axis absolute location, maximum thread length
- * indicates optional



Settings 95 / 96 determine chamfer size / angle; M23 / 24 turn chamfering on / off.



The G76 canned cycle can be used for threading both straight or tapered (pipe) threads.

The height of the thread is defined as the distance from the crest of thread to the root of the thread. The calculated depth of thread (K) will be the value of K less the finish allowance (Setting 86, Thread Finish Allowance) is this amount.

The thread taper amount is specified in I. Thread taper is measured from the target position X, Z at point T to position F. Note that a conventional O.D. taper thread will have a negative I value.

The depth of the first cut through the thread is specified in D. The depth of the last cut through the thread can be controlled with Setting 86.

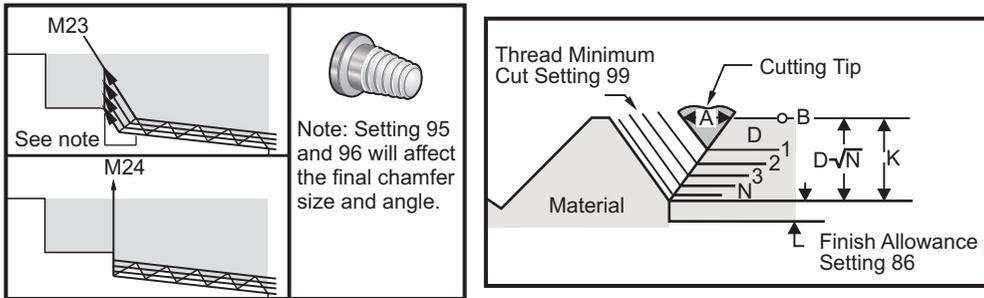
The tool nose angle for the thread is specified in A. The value can range from 0 to 120 degrees. If A is not used, 0 degrees is assumed.

The F code specifies the feed rate for threading. It is always good programming practice to specify G99 (feed per revolution) prior to a threading canned cycle. The F code also indicates the thread pitch or lead.

At the end of the thread an optional chamfer is performed. The size and angle of the chamfer is controlled with Setting 95 (Thread Chamfer Size) and Setting 96 (Thread Chamfer Angle). The chamfer size is designated in number of



threads, so that if 1.000 is recorded in Setting 95 and the feed rate is .05, then the chamfer will be .05. A chamfer can improve the appearance and functionality of threads that must be machined up to a shoulder. If relief is provided at the end of the thread then the chamfer can be eliminated by specifying 0.000 for the chamfer size in Setting 95, or using M24. The default value for Setting 95 is 1.000 and the default angle for the thread (Setting 96) is 45 degrees.



G76 using an "A" Value

Four options for G76 Multiple Thread Cutting are available

- P1:** Single edge cutting, cutting amount constant
- P2:** Double edge cutting, cutting amount constant
- P3:** Single edge cutting, cutting depth constant
- P4:** Double edge cutting, cutting depth constant

P1 and P3 both allow for single edge threading, but the difference is that with P3 a constant depth cut is done with every pass. Similarly, P2 and P4 options allow for double edge cutting with P4 giving constant depth cut with every pass. Based on industry experience, double edge cutting option P2 may give superior threading results.

D specifies the depth of the first cut. Each successive cut is determined by the equation $D \cdot \sqrt{N}$ where N is the Nth pass along the thread. The leading edge of the cutter does all of the cutting. To calculate the X position of each pass you have to take the sum of all the previous passes, measured from the start point the X value of each pass



G97 S1200 M03 (Groove tool)
G54 G00 X1.625 Z0.5 M08
G96 S800
G01 Z-1.906 F0.012
X1.47 F0.006
X1.51
W0.035
G01 W-0.035 U-0.07
G00 X1.51
W-0.035
G01 W0.035 U-0.07
X1.125
G01 X1.51
G00 X3. Z0.5 M09
G53 X0
G53 Z0
M30
%

Example Using Start Thread Angle (Q)

G76 X1.92 Z-2. Q60000 F0.2 D0.01 K0.04 (60 degree cut)
G76 X1.92 Z-2. Q120000 F0.2 D0.01 K0.04 (120 degree cut)
G76 X1.92 Z-2. Q270123 F0.2 D0.01 K0.04 (270.123 degree cut)

The following rules apply to the usage of Q:

1. The start angle, Q, must be specified every time it is used. If no value is specified then a zero (0) angle is assumed.
2. Do not use a decimal point. The angle of threading increment is 0.001 degrees. Therefore, a 180° angle must be specified as Q180000 and an angle of 35° as Q35000.
3. The Q angle must be entered as a positive value from 0 to 360000.

Multiple Start Threading Example

Multiple threads can be cut by changing the start point for each threading cycle.

The previous example has been modified to now create a multiple start thread. To calculate the additional start points the feed (F0.0714) is divided by the number of start points (3) $.0714 / 3 = .0238$. This value is then added to the initial Z-axis start point (line 2) in order to calculate the next start point (line 4). Add the same amount again to the previous start point (line 4) to calculate the next start point (line 6).

(1) M08
(2) G00 X1.1 Z0.5 (Initial Start Point)
(3) G76 X0.913 Z-0.85 K0.042 D0.0115 (Threading cycle)
F0.0714
(4) G00 X1.1 Z0.5238 (Next Start Point [$.5 + .0238 = 5.238$])



- (5) G76 X0.913 Z-0.85 K0.042 D0.0115 (Threading cycle)
F0.0714
(6) G00 X1.1 Z0.5476 (Last Start Point [.5238 + .0238 = 5.476])
(7) G76 X0.913 Z-0.85 K0.042 D0.0115 (Threading cycle)
F0.0714

G80 Canned Cycle Cancel (Group 09*)

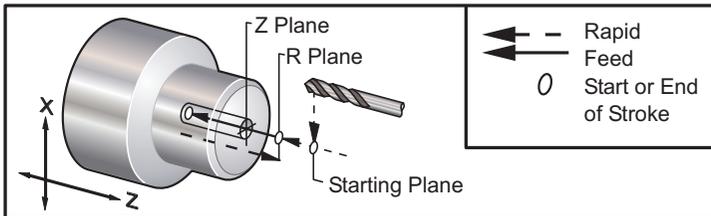
This G code is modal in that it deactivates all canned cycles. Note that use of G00 or G01 will also cancel a canned cycle.

G81 Drill Canned Cycle (Group 09)

- *C C-axis absolute motion command (optional)
- F Feed Rate
- *L Number of repeats
- R Position of the R plane
- *W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis absolute motion command
- *Z Position of bottom of hole

* indicated optional

Also see G75 for radial drilling and tapping with live tooling



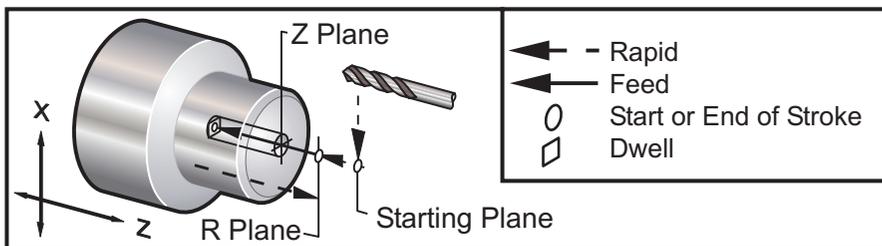
G81 Drill Canned Cycle

G82 Spot Drill Canned Cycle (Group 09)

- *C C-axis absolute motion command (optional)
- F Feed Rate
- *L Number of repeats
- P The dwell time at the bottom of the hole
- R Position of the R plane
- W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Position of bottom of hole

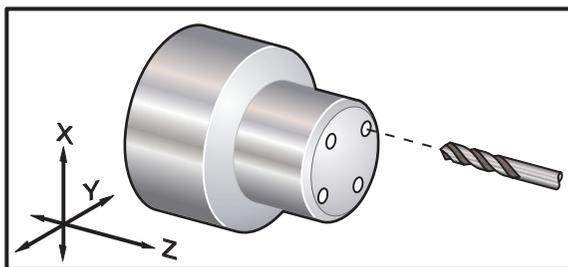
* indicates optional

This G code is modal in that it activates the canned cycle until it is canceled or another canned cycle is selected. Once activated, every motion of X will cause this canned cycle to be executed.



G82 Spot Drill Canned Cycle

Program Example



G82 Y-Axis Drill Canned Cycle

(LIVE SPOT DRILL - AXIAL)

T1111

G17

(Call reference plane)

G98

(Feed per minute)

M154 (ENGAGE C-AXIS)

G00 G54 X6. C0. Y0. Z1.

G00 X1.5 Z0.25

G97 P1500 M133

M08

G17 G82 G98 C45. Z-0.25 F10.

C135.

C225.

C315.

G00 G80 Z0.25 M09

M155

M135

M09

G00 G28 H0.

(Unwind C-axis)

G00 X6. Y0. Z1.

G18

(return to XZ plane)

G99

Inches per minute

M01

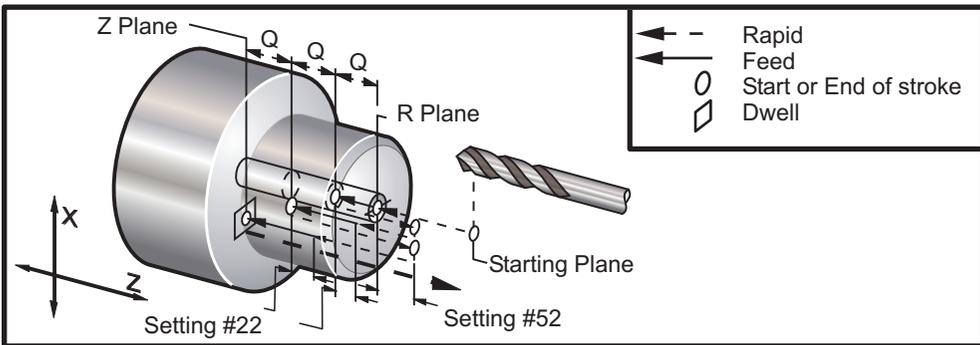
M30

%



G83 Normal Peck Drilling Canned Cycle (Group 09)

- *C C-axis absolute motion command (optional)
- F Feed Rate
- *I Size of first cutting depth
- *J Amount to reduce cutting depth each pass
- *K Minimum depth of cut
- *L Number of repeats
- *P The dwell time at the bottom of the hole
- *Q The cut-in value, always incremental
- R Position of the R plane
- *W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Position of bottom of hole
- * indicates optional



G83 Peck Drilling Canned Cycle

Programming Notes: If I, J, and K are specified, a different operating mode is selected. The first pass will cut in the value of I, each succeeding cut will be reduced by amount J, and the minimum cutting depth is K. Do not use a Q value when programming with I, J, K.

Setting 52 changes the way G83 works when it returns to the R plane. Usually the R plane is set well outside the cut to insure that the chip clearing motion allows the chips to clear the hole. However, this is wasted motion when first drilling through this “empty” space. If Setting 52 is set to the distance required to clear chips, the R plane can be put much closer to the part being drilled. When the clear move to R occurs, the Z will be moved past R by this value in setting 52. Setting 22 is the amount to feed in Z to get back the same point at which the retraction occurred.



Program Example

```
T101
G97 S500 M03
G00 X0 Z1. M08
G99
G83 Z-1.5 F0.005 Q0.25 R0.1
G80
M09
G53 X0
G53 Z0
M30
%
```

Program Example (Live Tool)

```
(LIVE PECK DRILL - AXIAL)
T1111
G17
G98
M154 (Engage C-Axis)
G00 G54 X6. C0. Y0. Z1.
G00 X1.5 Z0.25
G97 P1500 M133
M08
G17 G83 G98 C45. Z-0.8627 F10. Q0.125
C135.
C225.
C315.
G00 G80 Z0.25
M155
M135
M09
G28 H0. (Unwind C-Axis)
G00 G54 X6. Y0. Z1.
G18
G99
M01
M30
%
```

G84 Tapping Canned Cycle (Group 09)

- F Feed Rate
- R Position of the R plane
- *W Z-axis incremental distance
- *X X-axis motion command
- *Z Position of bottom of hole
- * indicates optional

Programming Notes: It is not necessary to start the spindle CW before this canned cycle. The control does this automatically.

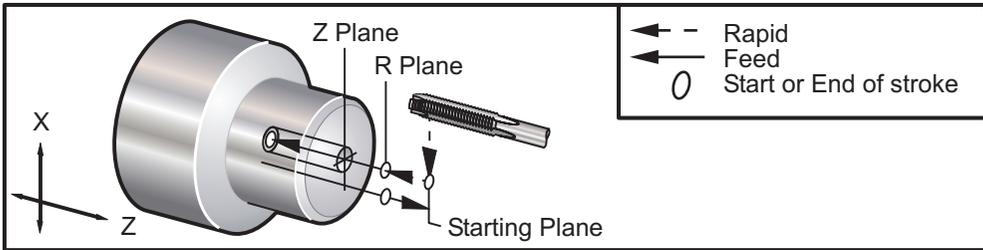


The feed rate for tapping is the lead of the thread. This is found by dividing 1 by the number of threads.

Example: 20 pitch $1/20 = .05$ Feedrate
 18 pitch $1/18 = .0555$ Feedrate
 16 pitch $1/16 = .0625$ Feedrate

For Metric taps, divide the pitch by 25.4

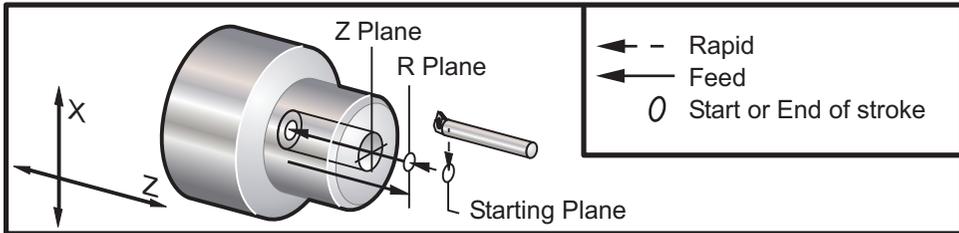
Example: M6 x 1 = F.03937
 M8 x 1.25 = F.0492



G84 Tapping Canned Cycle

G85 Boring Canned Cycle (Group 09)

F Feed Rate
*L Number of repeats
R Position of the R plane
*U X-axis incremental distance
*W Z-axis incremental distance
*X X-axis motion command
*Y Y-axis motion command
*Z Position of bottom of hole
* indicates optional



G85 Boring Canned Cycle

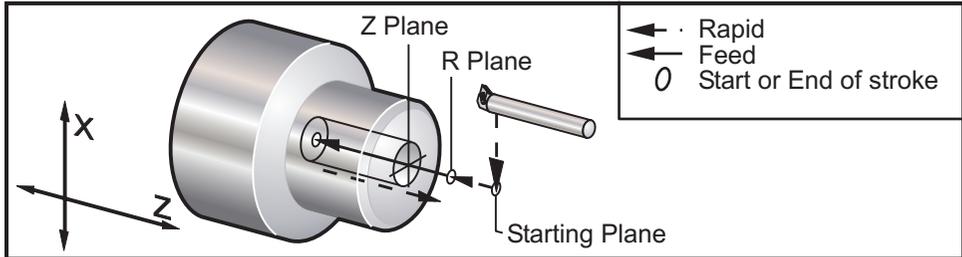
G86 Bore and Stop Canned Cycle (Group 09)

F Feed Rate
*L Number of repeats
R Position of the R plane
*U X-axis incremental distance
*W Z-axis incremental distance
*X X-axis motion command
*Y Y-axis motion command



- *Z Position of bottom of hole
- * indicates optional

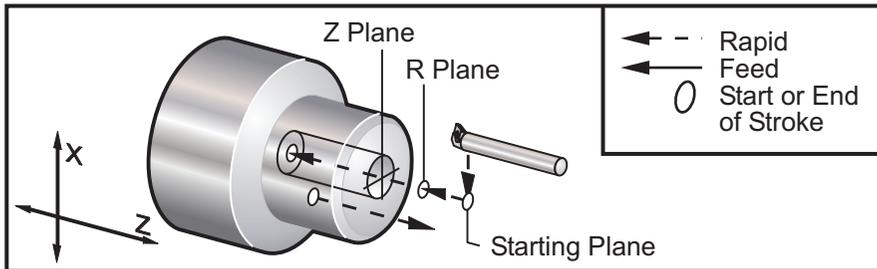
Programming Note: The spindle will stop once the tool reaches the bottom of the hole. The tool will be retracted once the spindle has stopped.



G86 Bore & Stop Canned Cycle

G87 Bore and Manual Retract Canned Cycle (Group 09)

- F Feed Rate
- *L Number of repeats
- R Position of the R plane
- *U X-axis incremental distance
- *W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Position of bottom of hole
- * indicates optional



G87 Bore & Manual Retract Canned Cycle

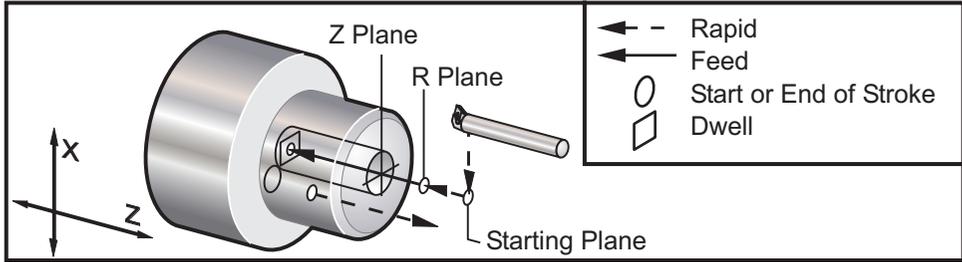
G88 Bore and Dwell and Manual Retract Canned Cycle (Group 09)

- F Feed Rate
- *L Number of repeats
- P The dwell time at the bottom of the hole
- R Position of the R plane
- *U X-axis incremental distance
- *W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Position of bottom of hole



* indicates optional

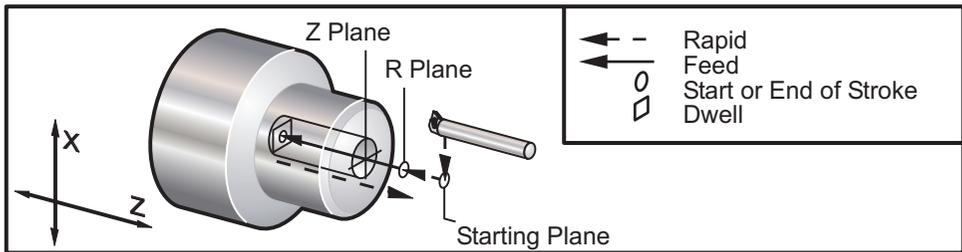
Programming Note: The tool will dwell at the bottom of the hole for the value of P, then the spindle stop. The tool will need to be retracted manually.



G88 Bore, Dwell & Manual Retract Canned Cycle

G89 Bore and Dwell Canned Cycle (Group 09)

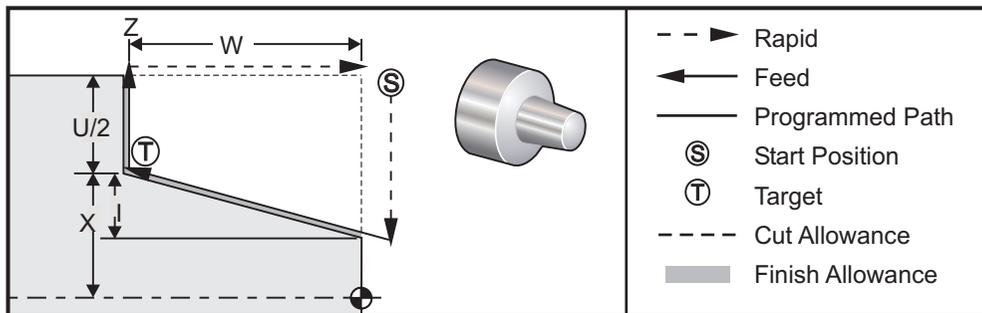
- F Feed Rate
- *L Number of repeats
- P The dwell time at the bottom of the hole
- R Position of the R plane
- *U X-axis incremental distance
- *W Z-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Position of bottom of hole
- * indicates optional



G89 Bore & Dwell Canned Cycle

G90 O.D./I.D. Turning Cycle (Group 01)

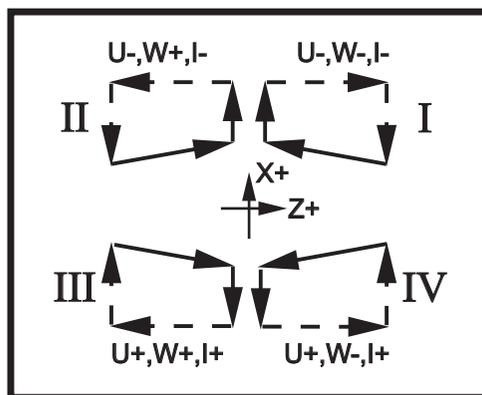
- F(E) Feed rate
- *I Optional distance and direction of X axis taper, radius
- *U X-axis incremental distance to target, diameter
- *W Z-axis incremental distance to target
- X X-axis absolute location of target
- Z Z-axis absolute location of target
- * indicates optional



G90 is used for simple turning, however, multiple passes are possible by specifying the X locations of additional passes.

Straight turning cuts can be made by specifying X, Z and F. By adding an I value, a taper cut can be made. The amount of taper is referenced from the target. That is, I is added to the value of X at the target.

Any of the four ZX quadrants can be programmed using U, W, X, and Z; the taper can be positive or negative. The following figure gives a few examples of the values required for machining in each of the four quadrants.



G90-92 Address Relationships

G92 Threading Cycle (Group 01)

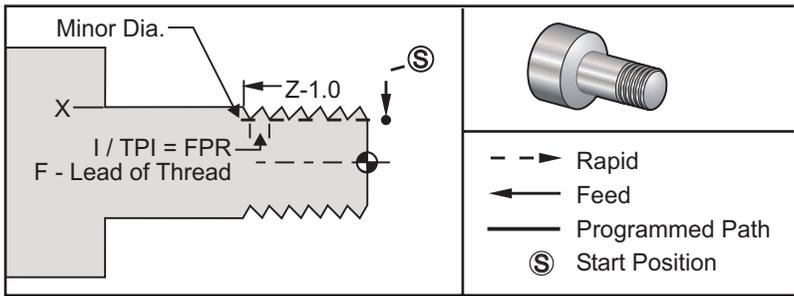
- F(E) Feed rate, the lead of the thread
- *I Optional distance and direction of X axis taper, radius
- *Q Start Thread Angle
- *U X-axis incremental distance to target, diameter
- *W Z-axis incremental distance to target
- X X-axis absolute location of target
- Z Z-axis absolute location of target
- * indicates optional

Programming Notes: Setting 95 / 96 determine chamfer size / angle M23 / 24 turn chamfering on/off.



G92 is used for simple threading, however, multiple passes for threading are possible by specifying the X locations of additional passes. Straight threads can be made by specifying X, Z and F. By adding an I value, a pipe or taper thread can be cut. The amount of taper is referenced from the target. That is, I is added to the value of X at the target. At the end of the thread, an automatic chamfer is cut before reaching the target; default for this chamfer is one thread at 45 degrees. These values can be changed with Setting 95 and Setting 96.

During incremental programming, the sign of the number following the U and W variables depends on the direction of the tool path. For example, if the direction of a path along the X-axis is negative, the value of U is negative.



Program Example

```
%
O0156
T101
G54;
G50 S3000 M3
G97 S1000
X1.2 Z.2
G92 X.980 Z-1.0 F0.0833
X.965 (2ND PASS)
X.955 (3RD PASS)
X.945 (4TH PASS)
X.935 (5TH PASS)
X.925 (6TH PASS)
X.917 (7TH PASS)
X.910 (8TH PASS)
X.905 (9TH PASS)
X.901 (10TH PASS)
X.899 (11TH PASS)
G53 X0;
G53 Z0;
M30;
%
```

Description

(1"-12 THREAD CUTTING PROGRAM)

(RAPID TO CLEAR POSITION)
(SET UP THREAD CYCLE)
(SUBSEQUENT CYCLES)

Example Using Start Thread Angle Q

```
G92 X-1.99 Z-2. Q60000 F0.2; (60 degree cut)
G92 X-1.99 Z-2. Q120000 F0.2; (120 degree cut)
```



G92 X-1.99 Z-2. Q270123 F0.2; (270.123 degree cut)

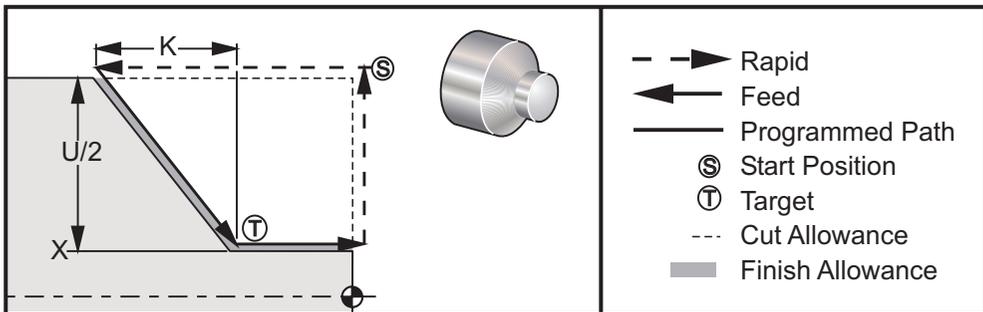
The following rules apply to the usage of Q:

1. The start angle, Q, must be specified every time it is used. If no value is specified then a zero (0) angle is assumed.
2. The angle of threading increment is 0.001 degrees. Do not use a decimal point in the entry; for example, a 180° angle must be specified as Q180000 and an angle of 35° as Q35000.
3. The Q angle must be entered as a positive value from 0 to 360000.

In general, when multi-threads are being performed it is a good practice to achieve the depth of the threads at a uniform level across all the threading angles. One way to achieve this is to make a sub-program that will only cause the Z-axis to move for the different angles of threading. After the sub-program has finished change the X-axis depth and call the sub-program again.

G94 End Facing Cycle (Group 01)

- F(E) Feed rate
- *K Optional distance and direction of Z axis coning
- *U X-axis incremental distance to target, diameter
- *W Z-axis incremental distance to target
- X X-axis absolute location of target
- Z Z-axis absolute location of target
- *indicates optional



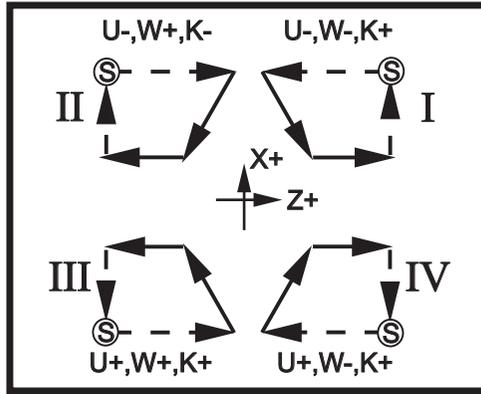
G95 End Face Turning Cycle

Straight end facing cuts can be made by just specifying X, Z and F. By adding K a cone-shaped face can be cut. The amount of coning is referenced from the target. That is K is added to the value of X at the target.

Any of the four ZX quadrants can be programmed by varying U, W, X, and Z. The coning can be positive or negative. The following figure gives a few examples of the values required for machining in each of the four quadrants.



During incremental programming, the sign of the number following the U and W variables depends on the direction of the tool path. If the direction of a path along the X-axis is negative, the value of U is negative.



G94 Address Relationships

G95 Live Tooling Rigid Tap (Face) (Group 09)

- *C C-axis absolute motion command (optional)
- F Feed Rate
- R Position of the R plane
- W Z-axis incremental distance
- X Optional Part Diameter X-axis motion command
- *Y Y-axis motion command
- Z Position of bottom of hole

G95 Live Tooling Rigid Tapping is similar to G84 Rigid Tapping in that it uses the F, R, X and Z addresses, however, it has the following differences:

- The control must be in G99 Feed per Revolution mode in order for tapping to work properly.
- An S (spindle speed) command must have been issued prior to the G95.
- The X axis must be positioned between machine zero and the center of the main spindle, do not position beyond spindle center.

Program Example

```
(LIVE TAP - AXIAL) (1/4 x 20 Tap)
T1111
G17
G99
M154 (ENGAGE C-AXIS) (Engage C-Axis)
G00 G54 X6. C0. Y0. Z1.
G00 X1.5 Z0.5
M08
S500
G17 G95 C45. Z-0.5 R0.5 F0.05
C135.
```



C225.
C315.
G00 G80 Z0.5 M09
M135
M155
G28 H0. (Unwind C-Axis)
G00 G54 X6. Y0 Z1.
G18 (Return to XZ plane)
G99 (Inches per minute)
M01
M30
%

G96 Constant Surface Speed ON (Group 13)

This commands the control to maintain a constant cutting speed. This means the spindle speed increases as the workpiece gets smaller. Surface speed is based on the distance of the tool tip to the spindle center (radius of cut). The current S code is used to determine the surface speed. The value of S indicates inches per revolution of the spindle when Setting 9 is set to Inch, while S indicates millimeters per revolution of the spindle when Setting 9 is set to Metric.

Warning

It is safest to specify a maximum spindle speed for the Constant Surface Speed feature. Use G50 to set a maximum spindle RPM.

Not setting a limit will allow the spindle speed to increase as the tool reaches the center of the part. The excessive speed can throw parts and damage tooling.

G97 Constant Surface Speed OFF (Group 13)

This commands the control to NOT adjust the spindle speed based on the radius of cut and used to cancel any G96 command. When G97 is in effect, any S command is revolution per minute (RPM).

G98 Feed Per Minute (Group 10)

This command changes how the F address code is interpreted. The value of F indicates inches per minute when Setting 9 is set to Inch, and F indicates millimeters per minute when Setting 9 is set to Metric.

G99 Feed Per Revolution (Group 10)

This command changes how the F address is interpreted. The value of F indicates inches per revolution of the spindle when Setting 9 is set to Inch, while F indicates millimeters per revolution of the spindle when Setting 9 is set to Metric.



G100 Disable Mirror Image (Group 00)

G101 Enable Mirror Image (Group 00)

X Optional X-axis command

Z Optional Z-axis command

At least one is required.

Programmable mirror image can be turned on or off individually for the X and/or Z axis. The bottom of the screen will indicate when an axis is mirrored.

These **G** codes should be used in a command block without any other **G** codes and will not cause any axis motion. G101 will turn on mirror image for any axis listed in that block. G100 will turn off mirror image for any axis listed in the block. The actual value given for the **X** or **Z** code has no effect; G100 or G101 by itself will have no effect. For example, G101 X 0 turns on X-axis mirror. Note that settings 45 through 48 may be used to manually select mirror image.

G102 Programmable Output to RS-232 (Group 00)

*X X-axis command

*Z Z-axis command

* indicates optional

Programmable output to the first RS-232 port send the current work coordinates of the axes to another computer. Use this G code in a command block without any other G codes; it will not cause any axis motion.

Programming note: Optional spaces (Setting 41) and EOB control (Setting 25) are applied.

Digitizing of a part is possible using this G code and a program which steps over a part in X-Z and probes across in Z with a G31. When the probe hits, the next block could be a G102 to send the X and Z position out to a computer which could store the coordinates as a digitized part. Additional software for the personal computer is required to complete this function.

G103 Limit Block Lookahead (Group 00)

Maximum number of blocks the control will look ahead (Range 0-15), for example: G103 [P.]

This is commonly referred to, as “Block Look-ahead”, and describes what the control is doing in the background during machine motions. The control prepares future blocks (lines of code) ahead of time. While the current block is executing, the next block has already been interpreted and prepared for continuous motion.

When G103 P0 is programmed, block limiting is disabled. Block limiting is also disabled if G103 appears in a block without a P address code. When G103 Pn is programmed, look-ahead is limited to n blocks.

G103 is also useful for debugging macro programs. Macro expressions are done during look-ahead time. For example, by inserting a G103 P1 into the program, macro expressions will be performed one block ahead of the currently executing block.



G105 Servo Bar Command

Bar Feed Command. See the Haas bar feeder manual.

G110, G111 and G114-G129 Coordinate System (Group 12)

These codes select one of the additional user coordinate systems. All subsequent references to axes positions will be interpreted in the new coordinate system. Operation of G110 to G129 are the same as G54 to G59.

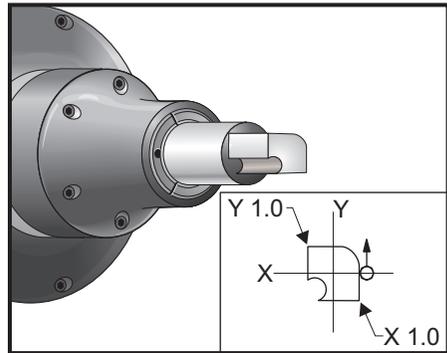
G112 XY to XC interpretation (Group 04)

The G112 Cartesian to Polar coordinate transformation feature allows the user to program subsequent blocks in Cartesian XY coordinates, which the control automatically converts to polar XC coordinates. While it is active, G17 XY plane is used for G01 linear XY strokes and G02 and G03 for circular motion. X, Y position commands are converted into rotary C-axis and linear X-axis moves.

Note that mill-style Cutter Compensation becomes active when G112 is used. Cutter Compensation (G41, G42) must be canceled (G40) before exiting G112.

G112 Program Example

%	G2X-.375Y-.75R.375
T0101	G1Y-1.
G54	G3X-.25Y-1.125R.125
G17	G1X.75
G112	G3X.875Y-1.R.125
M154	G1Y0.
G0G98Z.1	G0Z.1
G0X.875Y0.	G113
M8	G18
G97P2500M133	M9
G1Z0.F15.	M155
Y.5F5.	M135
G3X.25Y1.125R.625	G28U0.
G1X-.75	G28W0.H0.
G3X-.875Y1.R.125	M30
G1Y-.25	%
G3X-.75Y-.375R.125	



G113 G112 Cancel (Group 04)

G113 cancels the Cartesian to Polar coordinate conversion.

G154 Select Work Coordinates P1-99 (Group 12)

This feature provides 99 additional work offsets. G154 with a P value from 1 to 99 will activate the additional work offsets. For example G154 P10 will select work offset 10 from the list of additional work offset. Note that G110 to G129 refer to the same work offsets as the G154 P1 through P20; they can be selected by using either method. When a G154 work offset is active, the heading in the upper right work offset will show the G154 P value.

G154 work offsets format

#14001-#14006 G154 P1 (also #7001-#7006 and G110)



#14021-#14026 G154 P2 (also #7021-#7026 and G111)
#14041-#14046 G154 P3 (also #7041-#7046 and G112)
#14061-#14066 G154 P4 (also #7061-#7066 and G113)
#14081-#14086 G154 P5 (also #7081-#7086 and G114)
#14101-#14106 G154 P6 (also #7101-#7106 and G115)
#14121-#14126 G154 P7 (also #7121-#7126 and G116)
#14141-#14146 G154 P8 (also #7141-#7146 and G117)
#14161-#14166 G154 P9 (also #7161-#7166 and G118)
#14181-#14186 G154 P10 (also #7181-#7186 and G119)
#14201-#14206 G154 P11 (also #7201-#7206 and G120)
#14221-#14221 G154 P12 (also #7221-#7226 and G121)
#14241-#14246 G154 P13 (also #7241-#7246 and G122)
#14261-#14266 G154 P14 (also #7261-#7266 and G123)
#14281-#14286 G154 P15 (also #7281-#7286 and G124)
#14301-#14306 G154 P16 (also #7301-#7306 and G125)
#14321-#14326 G154 P17 (also #7321-#7326 and G126)
#14341-#14346 G154 P18 (also #7341-#7346 and G127)
#14361-#14366 G154 P19 (also #7361-#7366 and G128)
#14381-#14386 G154 P20 (also #7381-#7386 and G129)
#14401-#14406 G154 P21
#14421-#14426 G154 P22
#14441-#14446 G154 P23
#14461-#14466 G154 P24
#14481-#14486 G154 P25
#14501-#14506 G154 P26
#14521-#14526 G154 P27
#14541-#14546 G154 P28
#14561-#14566 G154 P29
#14581-#14586 G154 P30
#14781-#14786 G154 P40
#14981-#14986 G154 P50
#15181-#15186 G154 P60
#15381-#15386 G154 P70
#15581-#15586 G154 P80
#15781-#15786 G154 P90
#15881-#15886 G154 P95
#15901-#15906 G154 P96
#15921-#15926 G154 P97
#15941-#15946 G154 P98
#15961-#15966 G154 P99



G159 Background Pickup / Part Return

Automatic Parts Loader (APL) Command. See the Haas APL manual.

G160 APL Axis Command Mode On

Automatic Parts Loader Command. See the Haas APL manual.

G161 APL Axis Command Mode Off

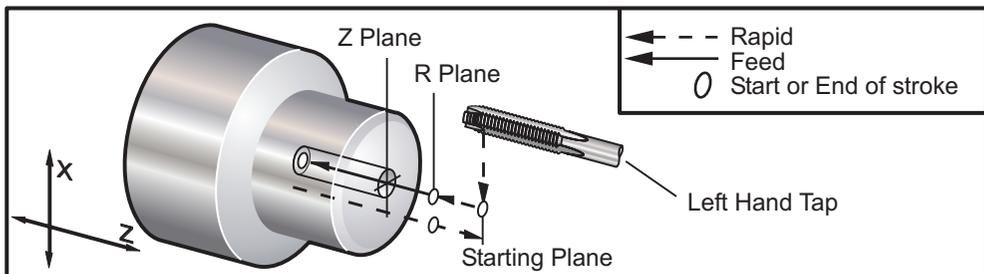
Automatic Parts Loader Command. See the Haas APL manual.

G184 Reverse Tapping Canned Cycle For Left Hand Threads (Group 09)

- F Feed Rate in inches (mm) per minute
- R Position of the R plane
- *W Z-axis incremental distance (optional)
- *X X-axis motion command (optional)
- *Z Position of bottom of hole (optional)

Programming Notes: When tapping, the feedrate is the lead of the thread. See example of G84.

It is not necessary to start the spindle CCW before this canned cycle; the control does this automatically.

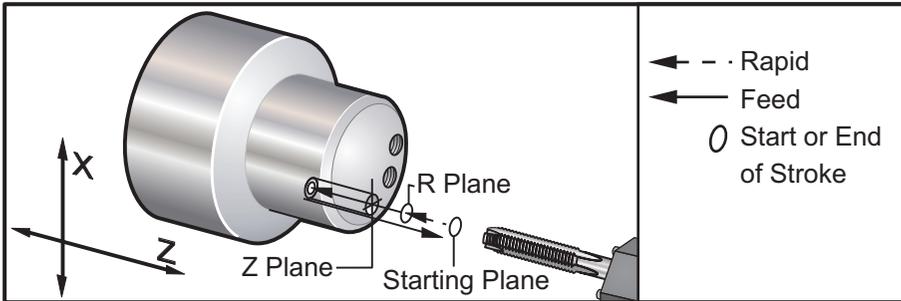


G184 Tapping Canned Cycle



G186 Reverse Live Tool Rig Tap (For Left Hand Threads) (Group 09)

F	Feed Rate
C	C-axis position
R	Position of the R plane
W	Z-axis incremental distance
X	Optional Part Diameter X-axis motion command
Y	Optional Y-axis motion command
Z	Position of bottom of hole



G95 . G186 Live Tooling Rigid Tapping (Face)

It is not necessary to start the spindle CW before this canned cycle; the control does this automatically. See G95 Program example

The feed rate for tapping is the lead of the thread. This is found by dividing 1 by the number of threads.

Example:	20 pitch
1/20	=
.05 Feedrate	
18 pitch	1/18
=	.0555 Feedrate
	16 pitch
1/16	=
.0625 Feedrate	

For Metric taps, divide the pitch by 25.4

Example:	M6 x 1
=	F.03937
	M8 x 1.25
=	F.0492

G187 Accuracy Control (Group 00)

Programming G187 is as follows:

G187 E0.01	(to set value)
G187	(to revert to setting 85 value)

The G187 code is used to select the accuracy with which corners are machined. The form for using G 187 is G187 Ennnn, where nnnn is the desired accuracy.



G195 Live Tool Radial Tapping (Diameter) (Group 00)

- F Feed Rate per revolution (G99)
- *U X-axis incremental distance
- *X X-axis motion command
- *Y Y-axis motion command
- *Z Z position prior to drilling

*indicates optional

Program Example

```
(LIVE TAP - RADIAL)
T101
G19
G99
M154 (Engage C-Axis)
G00 G54 X6. C0. Y0. Z1.
G00 X3.25 Z0.25
G00 Z-0.75
G00 C0.
S500
G19 G195 X2. F0.05
G00 C180. Index C-Axis
G19 G195 X2. F0.05
G00 C270. Index C-Axis
G19 G195 X2. F0.05
G00 G80 Z0.25 M09
M135
M155
M09
G00 G28 H0.
G00 X6. Y0. Z3.
G18
G99
M01
M30
%
```



G196 Reverse Live Tool Radial Tapping (Diameter) (Group 00)

F Feed Rate per revolution (G99)

*U X-axis incremental distance

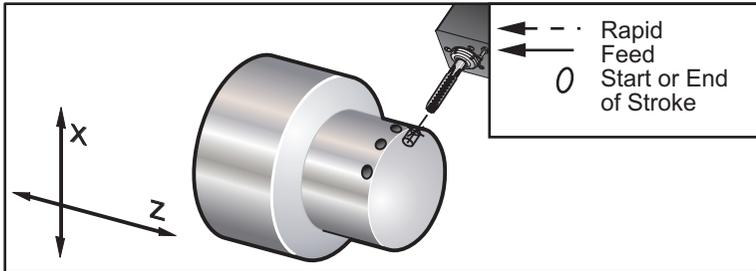
*X X-axis motion command

*Y Y-axis motion command

*Z Z position prior to drilling

*Indicated optional

These G codes perform live tooling radial or vector tapping on a lathe; they do not permit an "R" plane.



G195 / G196 Live Tooling Rigid Tapping (Diameter)

Below is a program example of G195

```
O00800
N1 T101 (RADIAL 1/4-20 TAP)
G99 (Necessary for this cycle)
G00 Z0.5
X2.5
Z-0.7
S500 (rpm should look like this, cw direction)**
M19PXX (Orient spindle at desired location)
M14(Lock spindle up)
G195 X1.7 F0.05 (thread down to X1.7)
G28 U0
G28 W0
M135 (Stop Live tooling spindle)
M15 (Unlock Spindle brake)
M30
%
```

G198 Disengage Synchronous Spindle Control (Group 00)

Disengages synchronous spindle control and allows independent control of the main spindle and the secondary spindle.

G199 Engage Synchronous Spindle Control (Group 00)

*R Degrees, phase relationship of following spindle to commanded spindle (optional).

This G code synchronizes the RPM of the two spindles. Position or speed commands to the following spindle, usually the secondary spindle, are ignored, when spindles are in synchronous control. However, M codes on the two spindles are controlled independently.



The spindles will remain synchronized until synchronous mode is disengaged using G198.

An R value, on the G199 block, will position the spindle that is following, to a specified number of degrees, relative to the 0 mark on the commanded spindle. The following table includes examples of R values in G199 blocks.

G199 R0.0; (The following spindle's origin (0-mark) matches the commanded spindle's origin (0-mark))

G199 R30.0; (The following spindle's origin (0-mark) is positioned +30 degrees from the commanded spindle's origin (0 mark)).

G199 R-30.0; (The following spindle's origin (0-mark) is positioned -30 degrees from the commanded spindle's origin (0-mark)).

When an R value is specified on the G199 block, the control first matches the velocity on the following spindle to that of the commanded spindle, then adjusts the orientation (R value in the G199 block). Once the specified R orientation is achieved the spindles are locked in synchronous mode until disengaged with a G198 command. This can also be achieved at zero RPM.

Programming example of G199

```
(Part cut off in synchronous spindle control)
G53 G00 X-1. Y0 Z-11.
T1010
G54
G00 X2.1 Z0.5
G98 G01 Z-2.935 F60. (inches per minute)
M12 (Air blast on)
M110 (Secondary spindle chuck clamp)
M143 P500 (Secondary spindle to 500 RPM)
G97 M04 S500 (Main spindle to 500 RPM)
G99
M111 (Secondary spindle chuck unclamp)
M13 (Air blast off)
M05 (main spindle off)\
M145 (Secondary spindle off)
G199 (Synch spindles)
G00 B-28. (Rapid secondary spindle to face of part)
G04 P0.5
G00 B-29.25 (Feed secondary spindle into part)
M110 (secondary spindle chuck clamp)
G04 P0.3
M08
G97 S500 M03
G96 S400
G01 X1.35 F0.0045
```



X-.05
G00 X2.1 M09
G00 B-28.0
G198 (Synch spindle off)
M05
G00 G53 B-13.0
G53 G00 X-1. Y0 Z-11.
M01
(Secondary spindle)
(Finish face)
(G14 example)
N11 G55 G99 (G55 for secondary spindle work offset)
G00 G53 B-13.0
G53 G00 X-1. Y0 Z-11.
G14
T626 (Tool #6 Offset #26)
G50 S3000
G97 S1300 M03
G00 X2.1 Z0.5
Z0.1 M08
G96 S900
G01 Z0 F0.01
X-0.06 F0.005
G00 X1.8 Z0.03
G01 Z0.005 F0.01
X1.8587 Z0 F0.005
G03 X1.93 Z-0.0356 K-0.0356
G01 X1.935 Z-0.35
G00 X2.1 Z0.5 M09
G97 S500
G15
G53 G00 X-1. Y0 Z-11.
M01

G200 Index on the Fly (Group 00)

- U Optional relative move in X to tool change position
- W Optional relative move in Z to tool change position
- X Optional final X position
- Z Optional final Z position
- T Required tool number and offset number in standard form

This G code will cause the lathe to change tools while performing a rapid move away from and back to the part, to save time.

Example: G200 T202 U0.5 W0.5 X8. Z2.

U and W specify a relative motion in X and Z, which is performed as the tool turret unseats. X and Z specify the position to move to as the tool turret re-seats. Both motions are rapid.

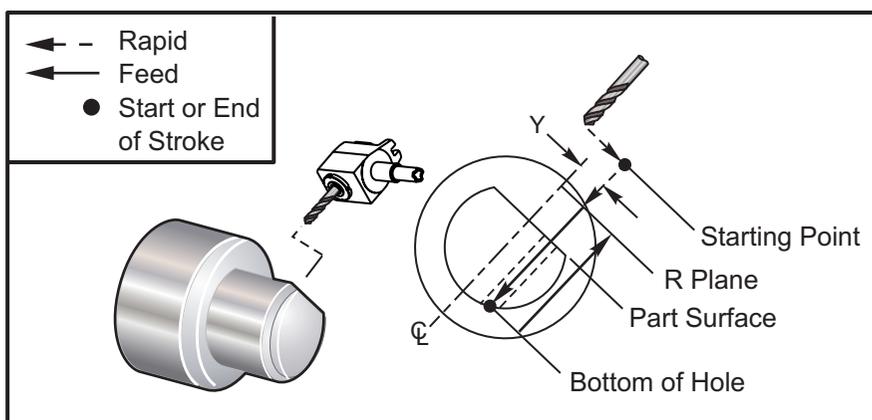


G211 Manual Tool Setting / G212 Auto Tool Setting

These two G codes are used in probing applications for both automatic and manual probes (SS and ST lathes only). See Automatic Tool Setting Probe Operation for more information.

G241 Radial Drill Canned Cycle (Group 09)

- C C-axis absolute motion command
- F Feed Rate
- R Position of the R plane (diameter)
- *X Position of bottom of hole (diameter)
- *Y Y-axis absolute motion command
- *Z Z-axis absolute motion command
- * indicates optional



G241 Radial Drill Canned Cycle

(G241 - RADIAL DRILLING)

G54	(Work Offset G54)
G00 G53 Y0	(Home Y-axis)
G00 G53 X0 Z-7.	
T303	
M154	(Engage C Axis)
M133 P2500	(2500 RPM)
G98	(IPM)
G00 X5. Z-0.75 Y0	
G241 X2.1 Y0.125 Z-1.3 C35. R4. F20.	(Drill to X 2.1)
X1.85 Y-0.255 Z-0.865 C-75.	
G00 G80 Z1.	
M135	(Stop live tool spindle)
G00 G53 X0. Y0.	
G00 G53 X0 Z-7.	
M00	

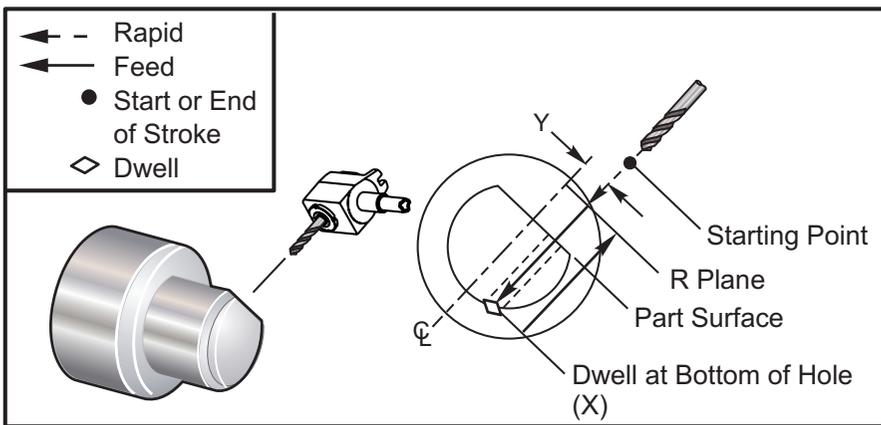


G242 Radial Spot Drill Canned Cycle (Group 09)

- C C-axis absolute motion command
- F Feed Rate
- P The dwell time at the bottom of the hole
- R Position of the R plane (Diameter)
- *X Position of bottom of hole (Diameter)
- *Y Y-axis motion command
- *Z Z-axis motion command

* indicates optional

This G code is modal. It remains active until it is canceled (G80) or another canned cycle is selected. Once activated, every motion of Y and/or Z will execute this canned cycle.



G242 Radial Spot Drill Canned Cycle

Program Example

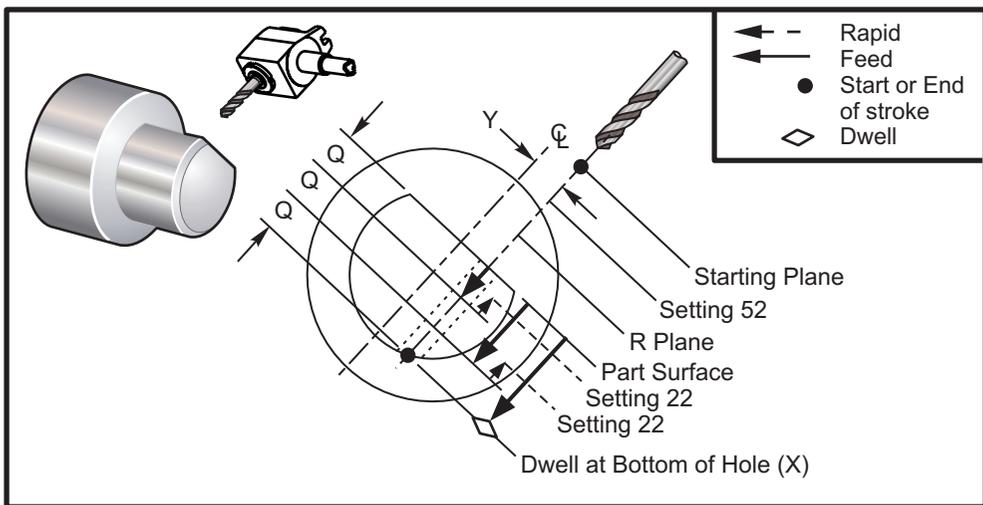
(G242 - RADIAL SPOT DRILLING)

```
G54 (Work offset G54)
G00 G53 Y0 Home Y-axis)
G00 G53 X0 Z-7.
T303
M154 (Engage C Axis)
M133 P2500 (2500 RPM)
G98 (IPM)
G00 X5. Z-0.75 Y0
G242 X2.1 Y0.125 Z-1.3 C35. R4. P0.5 F20. (Drill to X 2.1)
X1.85 Y-0.255 Z-0.865 C-75. P0.7
G00 G80 Z1.
M135 (Stop live tool spindle)
G00 G53 X0. Y0.
G00 G53 X0 Z-7.
M00
```



G243 Radial Normal Peck Drilling Canned Cycle (Group 09)

- C C-axis absolute motion command
- F Feed Rate
- *I Size of first cutting depth
- *J Amount to reduce cutting depth each pass
- *K Minimum depth of cut
- *P The dwell time at the bottom of the hole
- *Q The cut-in value, always incremental
- R Position of the R plane (Diameter)
- *X Position of bottom of hole (Diameter)
- *Y Y-axis absolute motion command
- *Z Z-axis absolute motion command
- * indicates optional



G243 Radial Normal Peck Drilling Canned Cycle

Programming Notes: If I, J, and K are specified, a different operating mode is selected. The first pass will cut in the value of I, each succeeding cut will be reduced by amount J, and the minimum cutting depth is K. Do not use a Q value when programming with I, J, K.

Setting 52 changes the way G243 works when it returns to the R plane. Usually the R plane is set well outside the cut to insure that the chip clearing motion allows the chips to clear the hole. However, this is wasted motion when first drilling through this “empty” space. If Setting 52 is set to the distance required to clear chips, the R plane can be put much closer to the part being drilled. When the clear move to R occurs, the Z will be moved past R by this value in setting 52. Setting 22 is the amount to feed in X to get back the same point at which the retraction occurred.



Program Example

(G243 - RADIAL PECK DRILLING USING Q)

```
G54 (Work offset G54)
G00 G53 Y0 (Home Y-axis)
G00 G53 X0 Z-7.
T303
M154 (Engage C Axis)
M133 P2500 (2500 RPM)
G98 (IPM)
G00 X5. Z-0.75 Y0
G243 X2.1 Y0.125 Z-1.3 C35. R4. Q0.25 F20. (Drill to X 2.1)
X1.85 Y-0.255 Z-0.865 C-75. Q0.25
G00 G80 Z1.
M135 (Stop live tool spindle)
G00 G53 X0. Y0.
G00 G53 X0 Z-7.
M00
```

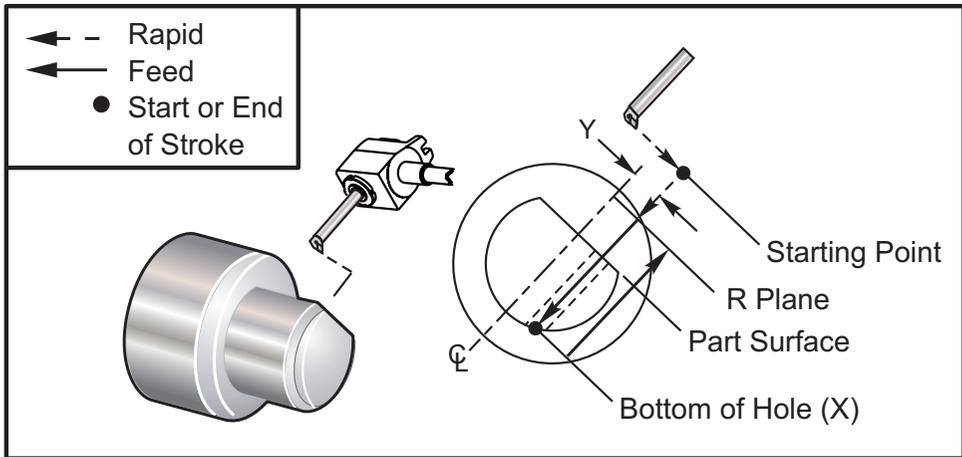
(G243 - RADIAL WITH I,J,K PECK DRILLING)

```
G54 (Work offset G54)
G00 G53 Y0 (Home Y-axis)
G00 G53 X0 Z-7
T303
M154 (Engage C Axis)
M133 P2500 (2500 RPM)
G98 (IPM)
G00 X5. Z-0.75 Y0
G243 X2.1 Y0.125 Z-1.3 I0.25 J0.05 K0.1 C35. R4. (Drill to X 2.1)
F5.
X1.85 Y-0.255 Z-0.865 I0.25 J0.05 K0.1 C-75.
G00 G80 Z1.
M135
G00 G53 X0. Y0.
G00 G53 Z-7.
M00
```



G245 Radial Boring Canned Cycle (Group 09)

- C C-axis absolute motion command
- F Feed Rate
- R Position of the R plane (Diameter)
- *X Position of bottom of hole (Diameter)
- *Y Y-axis absolute motion command
- *Z Z-axis absolute motion command
- * indicates optional



G245 Radial Boring Canned Cycle

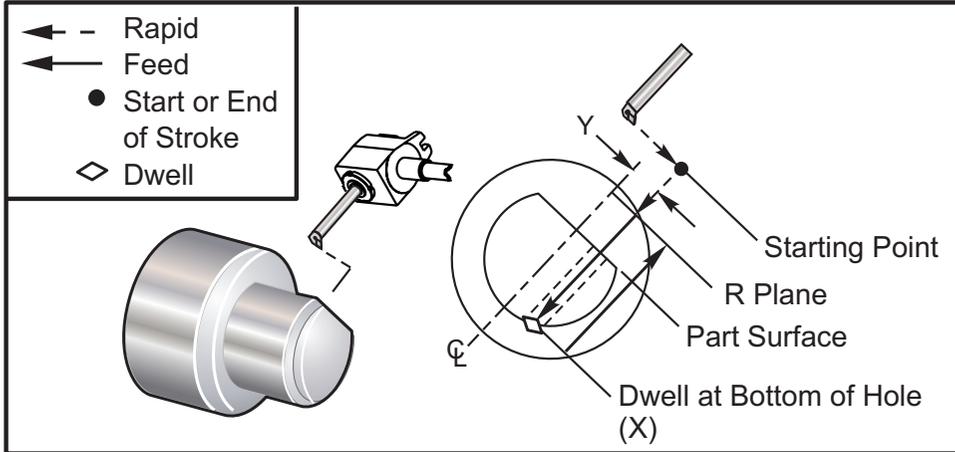
(G245 - RADIAL BORING)

G54	(Work offset G54)
G00 G53 Y0	(Home Y-axis)
G00 G53 X0 Z-7.	
T303	
M154	(Engage C Axis)
M133 P2500	(2500 RPM)
G98	(IPM)
G00 X5. Z-0.75 Y0	
G245 X2.1 Y0.125 Z-1.3 C35. R4. F20.	(Drill to X 2.1)
X1.85 Y-0.255 Z-0.865 C-75.	
G00 G80 Z1.	
M135	(Stop live tool spindle)
G00 G53 X0. Y0.	
G00 G53 X0 Z-7.	
M30	



G249 Radial Bore and Dwell Canned Cycle (Group 09)

- C C-axis absolute motion command
- F Feed Rate
- P The dwell time at the bottom of the hole
- R Position of the R plane
- *X Position of bottom of hole
- *Y Y-axis motion command
- *Z Z-axis motion command
- * indicates optional



G249 Radial Bore and Dwell Canned Cycle

(G249 - RADIAL BORING & DWELL)

G54

G00 G53 Y0

G00 G53 X0 Z-7.

T303

M154

(Engage C Axis)

M133 P2500

G98

G00 X5. Z-0.75 Y0

G249 X2.1 Y0.125 Z-1.3 C35. P1.35 R4. F20.

X1.85 Y-0.255 Z-0.865 C-75. P1.65

G00 G80 Z1.

M135

G00 G53 X0. Y0.

G00 G53 X0 Z-7.

M30



M CODES (MISCELLANEOUS FUNCTIONS)

M-Codes are non axes moving commands for the machine. The format for an M code is the letter “M” followed by two numbers, for example M03.

Only one M code may be programmed per line of code. All M codes take effect at the end of the block.

M Code List

M00 Stop Program	M61-M68 Optional User M turn OFF
M01 Optional Program Stop	M69 Clear Output Relay
M02 Program End	M76 Disable Displays
M03 Spindle Forward	M77 Enable Displays
M04 Spindle Reverse	M78 Alarm if skip signal found
M05 Spindle Stop	M79 Alarm if skip signal not found
M08 Coolant On	M85 Open Automatic Door (optional)
M09 Coolant Off	M86 Close Automatic Door (optional)
M10 Clamp Chuck	M88 Turns On High Pressure Coolant (optional)
M11 Unclamp Chuck	M89 Turns Off High Pressure Coolant (optional)
M12 Auto Air Jet On (Optional)	M93 Start Axis Pos Capture
M13 Auto Air Jet Off (Optional)	M94 Stop Axis Pos Capture
M14 Spindle Brake On	M95 Sleep Mode
M15 Spindle Brake Off	M96 Jump if no Input
M17 Turret Rotation Always Forward	M97 Local Sub-Program Call
M18 Turret Rotation Always Reverse	M98 Sub Program Call
M19 Orient Spindle (Optional)	M99 Sub Program Return Or Loop
M21-M28 Optional User Functions	M104 Extend Probe ArmI
M21 Tailstock Forward	M105 Retract Probe Arm
M22 Tailstock Reverse	M109 Interactive User Input
M23 Thread Chamfer ON	M110 Secondary Spindle Chuck Clamp
M24 Thread Chamfer OFF	M111 Secondary Spindle Chuck Unclamp
M30 Prog End and Rewind	M114 Secondary Spindle Brake On
M31 Chip Conveyor Forward	M115 Secondary Spindle Brake Off
M33 Chip Conveyor Stop	M119 Secondary Spindle Orient
M36 Parts Catcher Up (Optional)	M121-128 Optional User M
M37 Parts Catcher Down (Optional)	M133 Live Tooling Drive Forward (optional)
M38 Spindle Speed Variation On	M134 Live Tool Drive Reverse (optional)
M39 Spindle Speed Variation Off	M135 Live Tool Drive Stop (optional)
M41 Low Gear (if equipped w/transmission)	M143 Secondary Spindle Forward (optional)
M42 High Gear (if equipped w/transmission)	M144 Secondary Spindle Reverse (optional)
M43 Turret Unlock (Service Use Only)	M145 Secondary Spindle Stop (optional)
M44 Turret Lock (Service Use Only)	M154 C-axis engage (optional)
M51-M58 Optional User M turn ON	M155 C-axis disengage (optional)
M59 Set Output Relay	



M00 Stop Program

M00 stops a program. It stops the axes, spindle, turns off the coolant (including optional High Pressure Coolant). The next block (block after M00) will be highlighted when viewed in the program editor. Pressing Cycle Start will continue program operation from the highlighted block.

M01 Optional Program Stop

M01 works the same as M00, except the Optional Stop feature must be on.

M02 Program End

M02 ends a program. Note that the most common way of ending a program is with an M30.

M03 Spindle Forward

M04 Spindle Reverse

M05 Spindle Stop

M03 turns spindle on in the forward direction. M04 turns spindle on in the reverse direction. M05 stops the spindle.

Spindle speed is controlled with an S address code; for example, S1500 will command a spindle speed of 1500 RPM.

M08 Coolant On

M09 Coolant Off

M08 turns on the optional coolant supply and M09 turns it off (also see M88/89 for High Pressure Coolant).

NOTE: Coolant status is checked only at the start of a program, so a low coolant condition will not stop a program that is already running.

M10 Clamp Chuck

M11 Unclamp Chuck

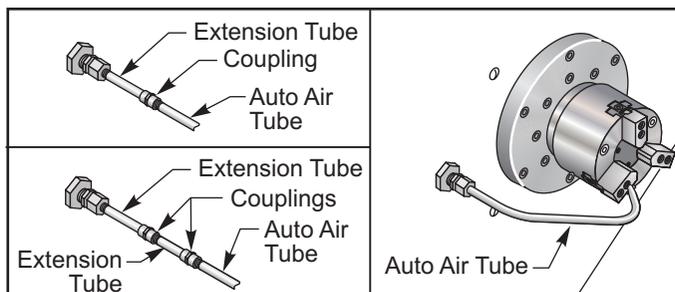
M10 clamps the chuck and M11 unclamps it. If the spindle is turning, it will be stopped before the chuck is unclamped.



M12 Auto Jet Blast (Optional)

M13 Auto Jet Blast (Optional)

M12 and M13 activate the optional Auto Air Jet. M12 turns the air blast on and M13 turns the air blast off. Additionally, M12 Pnnn (nnn is in milliseconds) will turn it on for the specified time, then turn off automatically.



M14 Main Spindle Brake On

M15 Main Spindle Brake Off

These M Codes are used for machines equipped with the optional C-Axis. M14 applies a caliper-style brake to hold the main spindle, while M15 releases the brake.

M17 Turret Rotation Always Forward

M18 Turret Rotation Always Reverse

M17 and M18 rotate the turret in the forward (M17) or reverse (M18) direction when a tool change is made. M17 and M18 work with other M-codes in the same block. The following M17 program code will cause the tool turret to move forward to tool 1 or reverse to tool 1 if an M18 is commanded.

Forward: N1 T0101 M17;

Reverse: N1 T0101 M18;

An M17 or M18 will stay in affect for the remainder of the program. Note that Setting 97, Tool Change Direction, must be set to M17/M18.

M19 Orient Spindle (P and R values are an optional feature)

M19 adjusts the spindle to a fixed position. The spindle will only orient to the zero position without the optional M19 spindle orient feature.

The optional Orient Spindle function allows P and R address codes. For example, M19 P270 will orient the spindle to 270 degrees. The R-value allows the programmer to specify up to four decimal places; for example, M19 R123.4567.

Spindle orientation is dependant on the mass, diameter and length of the work-piece and/or the workholding (chuck). Contact the Haas Applications Department if any unusually heavy, large diameter, or long configuration is used.



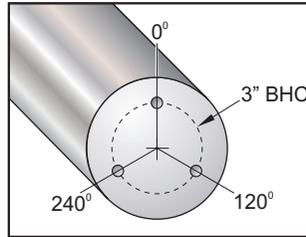
Programming Example

Bolt Hole Circle3 holes @ 120° on 3" BHC

```

%
O0050
T101
G54
G00 X3.0 Z0.1
G98 (Feed per minute)
M19 P0 (Orient spindle)
M14 (Turn on main spindle brake)
M133 P2000 (Turn on live tool forward)
G01 Z-0.5 F40.0
G00 Z0.1
M19 P120 (Orient spindle)
M14 (Turn on main spindle brake)
G01 Z-0.5
G00 Z0.1
M19 P240 (Orient spindle)
M14 (Turn on main spindle brake)
G01 Z-0.5
G00 Z0.1
M15 (Turn off main spindle brake)

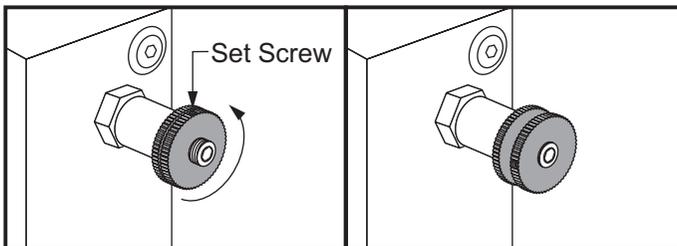
```



M21 Tailstock Forward

M22 Tailstock Reverse

M21 and M22 position the tailstock. M21 uses Settings 105, 106, and 107 to move to the Tailstock Hold Point. M22 uses Setting 105 to move the tailstock to the Retract Point. Adjust pressure using the valves on the HPU.



M21-M28 Optional User M Function with M-Fin

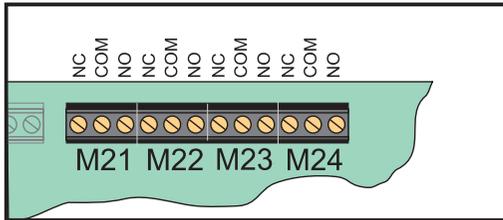
The M codes M21 through M28 are optional for user-defined relays. Each M code activates one of the optional relays. The Reset button will stop any operation that is waiting for a relay-activated accessory to finish. Also see M51-58 and M61-68.

Some or all of the M21-25 (M21-M22 on Toolroom, Office and Mini mills) on the I/O PCB may be used for factory-installed options. Inspect the relays for existing wires to determine which have been used. Contact your dealer for more details.

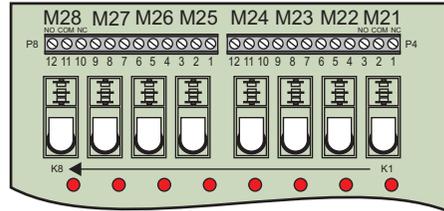
Only one relay is activated at a time. A typical operation is to command a barfeeder. The sequence is: Run the machining portion of a CNC part program. Stop CNC motion and command the barfeeder through the relay. Wait for a finish (stop) signal from the barfeeder. Then continue the CNC part program.



M-Code Relays - These outputs can be used to activate probes, auxiliary pumps or clamping devices etc. The auxiliary devices are electrically connected to the terminal strip for the individual relay. The terminal strip has a position for, Normally Open (NO), Normally Closed (NC) and Common (CO).



Main I/O PCB M-Code Relays



*Optional M-Code Relay Board
(Mounted above Main I/O PCB)*

Optional 8M-Code Relays - Additional M-Code relay functions can be purchased in banks of 8. A maximum of two 8M-code relay boards can be installed in the machine, for a total of 16 additional outputs. A total of 4 banks of 8 relays are possible in the Haas system, numbered from 0-3. Banks 0 and 1 are internal to the main I/O PCB. Bank 1 includes the M21-25 relays at the top of the I/O PCB. Bank 2 addresses the first 8M option PCB. Bank 3 addresses the second 8M option PCB.

NOTE: Bank 3 may be used for some Haas installed options and may not be available. Contact the Haas factory for more details.

Only one bank of outputs may be addressable with M-codes at a time. This is controlled by Parameter 352 "Relay Bank Select". Relays in the non-activated banks are only accessible with macro variables or M59/69. Parameter 352 is shipped set to "1" as standard.

NOTE: With any probing option (with the exception of LTP), Parameter 352 must be set to '1'. When the 8M option is installed, access its relays using M59/69.

M23 Thread Chamfer ON M24 Thread Chamfer OFF

M23 commands the control to execute a chamfer at the end of a thread executed by G76 or G92. M24 commands the control not to perform chamfering at the end of the threading cycles (G76 or G92). An M23 remains in effect until changed by M24, likewise for M24. Refer to Settings 95 and 96 to control the chamfer size and angle. M23 is the default at power-up and when the control is reset.



M30 Program End and Reset

M30 stops a program. It stops the spindle and turns off the coolant and the program cursor will return to the start of the program. M30 cancels tool length offsets.

M31 Chip Conveyor Forward

M33 Chip Conveyor Stop

M31 starts the optional chip conveyor motor in the forward direction; the direction that moves the chips out of the machine. The conveyor will not turn if the door is open. It is recommended that the chip auger be used intermittently. Continuous operation will cause the motor to overheat.

M33 stops Conveyor motion.

M36 Parts Catcher Up (Optional)

M37 Parts Catcher Down (Optional)

M36 activates the optional parts catcher. M37 deactivates the optional parts catcher. M36 rotates the parts catcher into position to catch a part. M37 rotates the parts catcher out of the work envelope.

M38 Spindle Speed Variation On

M39 Spindle Speed Variation Off

Spindle Speed Variation (SSV) allows the operator to specify a range within which the spindle speed will continuously vary. This is helpful in suppressing tool chatter, which can lead to undesirable part finish and/or damage the cutting tool. The control will vary the spindle speed based on Settings 165 and 166. For example, in order to vary spindle speed +/- 50 RPM from its current commanded speed with a duty cycle of 3 seconds, set Setting 165 to 50 and Setting 166 to 30. Using these settings, the following program will vary the spindle speed between 950 and 1050 RPM after the M38 command.

M38/39 Program Example

```
O0010;  
S1000 M3  
G4 P3.  
M38 (SSV ON)  
G4 P60.  
M39 (SSV OFF)  
G4 P5.  
M30
```

The spindle speed will continuously vary with a duty cycle of 3 seconds until an M39 command is found. At that point the machine will come back to its commanded speed and the SSV mode will be turned off.

A program stop command such as M30 or pressing the Reset key also turns SSV Off. If the RPM swing is larger than the commanded speed value, any negative RPM values (below zero) will translate into an equivalent positive value. The spindle, however, will not be allowed to go below 10 RPM when SSV mode is active.



Constant Surface Speed: When Constant Surface Speed (G96) is activated (which will calculate spindle speed) the M38 command will alter that value using Settings 165 and 166.

Threading Operations: G92, G76 and G32 will allow the spindle speed to vary in SSV mode. This is **not** recommended due to possible thread lead errors caused by mismatched acceleration of the spindle and the Z-axis.

Tapping cycles: G84, G184, G194, G195 and G196 will be executed at their commanded speed and SSV will not be applied.

M41 Low Gear

M42 High Gear

On machines with a transmission, M41 selects low gear and M42 will select high gear.

M43 Turret Unlock

M44 Turret Lock

For Service use only.

M51-M58 Set Optional User M Codes

The M51 through M58 codes are optional for user interfaces. They will activate one of the relays and leave it active. Use M61-M68 to turn these off. The Reset key will turn off all of these relays. See M121-M128 for details on the M-Code relays.

M59 Set Output Relay

This M code turns on a relay. An example of its usage is **M59 Pnn**, where “nn” is the number of the relay being turned on. An M59 command can be used to turn on any of the discrete output relays in the range from 1100 to 1155. When using Macros, M59 P1103 does the same thing as using the optional macro command #1103 = 1, except that it is processed at the end of the line of code.

NOTE: 8M #1 uses addresses 1140-1147.

M61-M68 Clear Optional User M Codes

The M61 through M68 codes are optional for user interfaces. They will turn off one of the relays. Use M51-M58 to turn these on. The Reset key will turn off all of these relays. See M121-M128 for details on the M-Code relays.

M69 Clear Output Relay

This M code turns off a relay. An example of its usage is **M69 Pnn**, where “nn” is the number of the relay being turned off. An M69 command can be used to turn off any of the output relays in the range from 1100 to 1155. When using Macros, M69 P1103 does the same thing as using the optional macro command #1103 = 0, except that it is processed at the end of the line of code.



M76 Disable Display

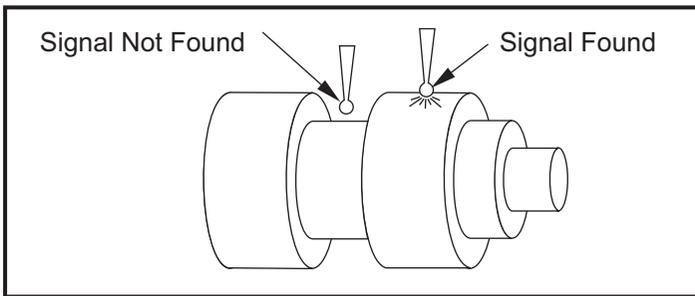
M77 Enable Display

M76 and M77 are used to disable and enable the screen display. This M-Code is useful during the running of a large complicated program as refreshing the screen takes processing power that otherwise may be necessary to command the moves of the machine.

M78 Alarm if Skip Signal Found

M79 Alarm if Skip Signal Not Found

This M-code is used with a probe. M78 generates an alarm if a programmed skip function (G31) receives a signal from the probe. This is used when a skip signal is not expected, and may indicate a probe crash. M79 generates an alarm if a programmed skip function (G31) did not receive a signal from the probe. This is used when the lack of the skip signal means a probe positioning error. These codes can be placed on the same line as the skip G-code or in any block after.



M85 Open Automatic Door (Optional)

M86 Close Automatic Door (Optional)

M85 opens the Auto Door and M86 closes it. The control pendant beeps when the door is in motion.

M88 High Pressure Coolant On (Optional)

M89 High Pressure Coolant Off (Optional)

M88 turns on the high pressure coolant option, an M89 turns the coolant off. Use M89 to turn off High Pressure coolant during program execution before rotating the tool turret.

Warning! Turn off High Pressure Coolant before performing a tool change.

M93 Start Axis Pos Capture

M94 Stop Axis Pos Capture

These M codes permit the control to capture the position of an auxiliary axis when a discrete input changes to a 1. The format is **M93 Px Qx**. P is the axis number. Q is a discrete input number from 0 to 63.



M93 causes the control to watch the discrete input specified by the Q value, and when it goes to a 1, it captures the position of the axis specified by the P value. The position is then copied to hidden macro variables 749. M94 stops the capture. M93 and M94 were introduced to support the Haas Bar Feeder, which uses a single axis controller to the V auxiliary axis. P5 (V axis) and Q2 must be used for the bar feeder.

M95 Sleep Mode

Sleep mode is a long dwell. Sleep mode can be used when the user wants the machine to begin warming itself. So it is ready to use when the operators arrives. The format of the M95 command is: **M95 (hh:mm)**.

The comment immediately following M95 must contain the hours and minutes for which the machine sleeps. For example, if the current time were 6pm and the user wanted the machine to sleep until 6:30am the next day, the following command would be used; M95 (12:30). The line(s) following M95 should be axis moves and spindle warm-up commands.

M96 Jump If No Input

P Program block to go to when conditional test is met
Q Discrete input variable to test (0 to 63)

This code tests a discrete input for 0 (off) status. This is useful for checking the status of automatic work holding or other accessories that generate a signal for the control. The Q value must be in the range 0 to 63, which corresponds to the inputs on the diagnostic display (The upper left input is 0 and the lower right is input 63. When this program block is executed and the input signal specified by Q has a value of 0, the program block Pnnnn is performed (the Pnnnn line must be in the same program). Example:

```
N05 M96 P10 Q8          (Test input #8, Door Switch, until closed);  
N10                    (Start of program loop);  
.  
.  
.  
.  
N85 M21                (Execute an external user function)  
N90 M96 P10 Q27        (Loop to N10 if spare input [#27] is 0);  
N95 M30                 (If spare input is 1 then end program);
```

M97 Local Sub-Program Call

This code calls a subroutine referenced by a line number (N) within the same program. A code is required and must match a line number within the same program. This is useful for subroutines within a program as it does not require a separate program. The subroutine must end with an M99. An **Lnn** code in the M97 block will repeat the subroutine call that **nn** times. Example:



O0001
M97 P1000 L2 (L2 command will run the N1000 line twice)
M30
N1000 G00 G90 G55 X0 Z0 (N line that will run after M97 P1000 is run)
S500 M03
G00 Z-.5
G01 X.5 F100.
G03 ZI-.5
G01 X0
Z1. F50.
G91 G28 X0
G28 Z0
G90
M99

M98 Sub Program Call

This code is used to call a subroutine, the format is M98 Pnnnn (Pnnnn is the number of the program being called). The subprogram must be in the program list, and it must contain M99 to return to the main program. An **Lnn** count can be put on the line containing M98 and will cause the subroutine to be called **nn** times before continuing to the next block.

O0001 (Main Program number)
M98 P100 L4; (Call sub-program, sub -program number, loop 4 times)
M30 (End of program)
O0100 (Sub-program Number)
G00 G90 G55 X0 Z0 (N line that will run after M97 P1000 is run)
S500 M03
G00 Z-.5
G01 X.5 F100.
G03 ZI-.5
G01 X0
Z1. F50.
G91 G28 Z0
G90
M99

M99 Sub-Program Return or Loop

This code is used to return to the main program from a subroutine or macro, the format is M99 Pnnnn (Pnnnn is the line in the main program to return to). It will cause the main program to loop back to the beginning without stopping when used in the main program.



Programming Notes - You can simulate Fanuc behavior by using the following code:

calling program:	Haas	Fanuc
	O0001	O0001

	N50 M98 P2	N50 M98 P2
	N51 M99 P100	...
	...	N100 (continue here)
	N100 (continue here)	...
	...	M30
	M30	
subroutine:	O0002	O0002
	M99	M99 P100

M99 With Macros - If the machine is equipped with the optional macros, you can use a global variable and specify a block to jump to by adding **#nnn = dddd** in the subroutine and then using **M99 P#nnn** after the subroutine call.

M104 Extend Probe Arm

M105 Retract Probe Arm

The optional tool setting probe arm is extended and retracted using these M-Codes.

M109 Interactive User Input

This M code allows a G-code program to place a short prompt (message) on the screen. A macro variable in the range 500 through 599 must be specified by a P code. The program can check for any character that can be entered from the keyboard by comparing with the decimal equivalent of the ASCII character (G47, Text Engraving, has a list of ASCII characters).

The following sample program will ask the user a Yes or No question, then wait for either a "Y" or an "N" to be entered. All other characters will be ignored.

N1 #501= 0.	(Clear the variable)
N5 M109 P501	(Sleep 1 min?)
IF [#501 EQ 0.] GOTO5	(Wait for a key)
IF [#501 EQ 89.] GOTO10	(Y)
IF [#501 EQ 78.] GOTO20	(N)
GOTO1	(Keep checking)
N10	(A Y was entered)
M95 (00:01)	
GOTO30	
N20	(An N was entered)
G04 P1.	(Do nothing for 1 second)
N30	(Stop)
M30	



The following sample program will ask the user to select a number, then wait for a 1, 2, 3, 4 or a 5 to be entered; all other characters will be ignored.

```
%
O01234 (M109 Program)
N1 #501= 0 (Clear Variable #501)
(Variable #501 will be checked)
(Operator enters one of the following selections)
N5 M109 P501 (1,2,3,4,5)
IF [ #501 EQ 0 ] GOTO5
(Wait for keyboard entry loop until entry)
(Decimal equivalent from 49-53 represent 1-5)
IF [ #501 EQ 49 ] GOTO10 (1 was entered go to N10)
IF [ #501 EQ 50 ] GOTO20 (2 was entered go to N20)
IF [ #501 EQ 51 ] GOTO30 (3 was entered go to N30)
IF [ #501 EQ 52 ] GOTO40 (4 was entered go to N40)
IF [ #501 EQ 53 ] GOTO50 (5 was entered go to N50)
GOTO1 (Keep checking for user input loop until found)
N10
(If 1 was entered run this sub-routine)
(Go to sleep for 10 minutes)
#3006= 25 (Cycle start sleeps for 10 minutes)
M95 (00:10)
GOTO100
N20
(If 2 was entered run this sub routine)
(Programmed message)
#3006= 25 (Programmed message cycle start)
GOTO100
N30
(If 3 was entered run this sub routine)
(Run sub program 20)
#3006= 25 (Cycle start program 20 will run)
G65 P20 (Call sub-program 20)
GOTO100
N40
(If 4 was entered run this sub routine)
(Run sub program 22)
#3006= 25 (Cycle start program 22 will be run)
M98 P22 (Call sub program 22)
GOTO100
N50
(If 5 was entered run this sub-routine)
(Programmed message)
#3006= 25 (Reset or cycle start will turn power off)
#1106= 1
N100
M30
%
```



M110 Secondary Spindle Chuck Clamp

M111 Secondary-Spindle Chuck Unclamp

These M codes will clamp and unclamp the secondary spindle chuck. OD / ID clamping is set with Setting 122.

M114 Secondary Spindle Brake On

M115 Secondary Spindle Brake Off

M114 applies a caliper-style brake to hold the secondary spindle, while M115 releases the brake.

M119 Secondary Spindle Orient

This command will orient the secondary spindle (DS lathes) to the zero position. A P or R value can be added to position the spindle to a specific position. A P value will position the spindle to that whole degree (e.g. P120 is 120°). A R value will position the spindle to a fraction of a degree (e.g. R12.25 is 12.25°). The format is: M119 Pxxx/M119 Rxx.x. The spindle angle is viewed in the Current Commands Tool Load screen.

M121-M128 Optional User M

The M121 through M128 codes are optional for user interfaces. They will activate one of relays 1132 through 1139, wait for the M-fin signal, release the relay, and wait for the M-fin signal to cease. The Reset key will terminate any operation that is hung-up waiting for M-fin.

M133 Live Tool Forward

M134 Live Tool Reverse

M135 Live Tool Stop

M133 turns the live tool spindle in the forward direction. M134 turns the live tool spindle in the reverse direction. M135 stops the live tool spindle.

Spindle speed is controlled with a P address code. For example, P1200 would command a spindle speed of 1200 RPM.

M143 Secondary Spindle Forward

M144 Secondary Spindle Reverse

M145 Secondary Spindle Stop

M143 turns the secondary spindle in the forward direction. M144 turns the secondary spindle in the reverse direction. M145 stops the secondary spindle

The sub spindle speed is controlled with an P address code, for example, P1200 will command a spindle speed of 1200 RPM.

M154 C-Axis Engage

M155 C-Axis Disengage

This M code is used to engage or disengage the optional C-axis motor.



SETTINGS

The setting pages contain values that control machine operation and that the user may need to change. Most settings can be changed by the operator. They are preceded by a short description on the left and the value on the right. In general, settings allow the operator or setup person to lock out or turn on specific functions.

The settings are organized into pages of functionally similar groupings. This will make it easier for the user to remember where the settings are located and reduces the amount of time spent maneuvering through the settings display. The list below is separated into page groups with the page title as the heading.

Use the vertical cursor keys to move to the desired setting. Depending on the setting, you may change it by entering a new number or, if the setting has specific values, press the horizontal cursor keys to display the choices. Press the Write key to enter or change the value. The message near the top of the screen tells you how to change the selected setting.

The serial number is Setting 26 on this page and is protected from user change. If you need to change this setting, contact Haas or your dealer. The following is a detailed description of each of the settings:

1 - Auto Power Off Timer

This setting is used to power-down the machine when it has not been used for some time. The value entered in this setting is the number of minutes the machine will remain idle until it is powered down. The machine will not be powered down while a program is running, and the time (number of minutes) will start back at zero anytime a key is pressed or the jog handle is used. The auto-off sequence gives the operator a 15-second warning before power down, at which time pressing any key will stop the power down.

2 - Power Off at M30

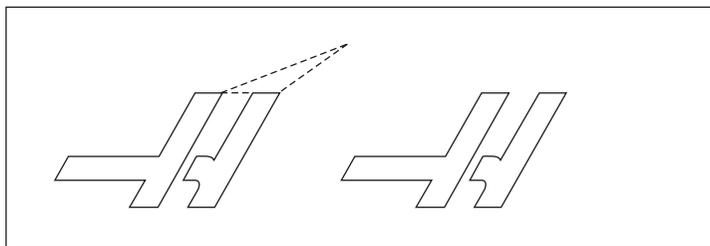
Powers down the machine at the end of a program (M30) if this setting is set to "On". The machine will give the operator a 30-second warning once an M30 is reached; pressing any key will interrupt the sequence.

3 - 3D Graphics

3D Graphics.

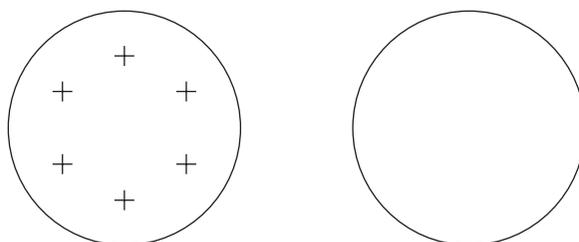
4 - Graphics Rapid Path

This setting changes the way a program is viewed in the Graphics mode. When it is Off, rapid (non-cutting) tool motions do not leave a path. When it is On, rapid tool motions leave a dashed line on the screen.



5 - Graphics Drill Point

This setting changes the way a program is viewed in Graphics mode. When it is On, motion in the Z-axis will leave an X mark on the screen. When it is Off, no additional marks are shown on the graphics display.



6 - Front Panel Lock

When set to "On", this Setting disables the Spindle CW / CCW keys and ATC FWD / ATC REV keys.

7 - Parameter Lock

Turning this setting On will stop the parameters from being changed, except for parameters 81-100. Note that when the control is powered up, this setting is on.

8 - Prog Memory Lock

This setting locks out the memory editing functions (Alter, Insert, etc.) when it is set to On.

9 - Dimensioning

This setting selects between inch and metric mode. When it is set to Inch, the programmed units for **X**, **Y**, and **Z** are inches, to 0.0001". When it is set to Metric, programmed units are millimeters, to 0.001mm. All offset values are converted when this setting is changed from inches to metric, or vice versa. However, changing this setting will not automatically translate a program stored in memory; you must change the programmed axis values for the new units.

When set to Inch, the default G code is G20, when set to Metric, the default G code is G21.



	INCH	METRIC
Feed	inches/min.	mm/min.
Max Travel	+/- 15400.0000	+/-39300.000
Min. Programmable Dimension	.0001	.001
Feed Range	.0001 to 300.000 in/min.	.001 to 1000.000

Axis Jog Keys		
.0001 Key	.0001 in/jog click	.001 mm/jog click
.001	.001 in/jog click	.01 mm/jog click
.01	.01 in/jog click	.1 mm/jog click
.1 Key	.1 in/jog click	1 mm/jog click

10 - Limit Rapid at 50%

Turning this setting On will limit the machine to 50% of its fastest non-cutting axis motion (rapids). This means, if the machine can position the axes at 700 inches per minute (ipm), it will be limited to 350 ipm when this setting is On. The control will display a 50% rapid override message, when this setting is on. When it is Off, the highest rapid speed of 100% is available.

11 - Baud Rate Select

This setting allows the operator to change the rate at which data is transferred to/from the first serial port (RS-232). This applies to the upload/download of programs, etc., and to DNC functions. This setting must match the transfer rate from the personal computer.

12 - Parity Select

This setting defines parity for the first serial port (RS-232). When set to none, no parity bit is added to the serial data. When set to zero, a 0 bit is added. Even and Odd work like normal parity functions. Make sure you know what your system needs, for example, XMODEM must use 8 data bits and no parity (set to "None"). This setting must match the transfer rate from the personal computer.

13 - Stop Bit

This setting designates the number of stop bits for the first serial port (RS-232). It can be 1 or 2. This setting must match the transfer rate from the personal computer.

14 - Synchronization

This changes the synchronization protocol between sender and receiver for the first serial port (RS-232). This setting must match the transfer rate from the personal computer.

When set to RTS/CTS, the signal wires in the serial data cable are used to tell the sender to temporarily stop sending data while the receiver catches up.



When set to **XON/XOFF, the most common setting**, ASCII character codes are used by the receiver to tell the sender to temporarily stop.

The selection DC Codes is like XON/XOFF, except that paper tape punch or reader start/stop codes are sent.

XMODEM is a receiver-driven communications protocol that sends data in blocks of 128 bytes. XMODEM has added reliability as each block is checked for integrity. XMODEM must use 8 data bits and no parity.

Settings 16-21

These settings can be turned on in order to stop unfamiliar operators from altering the machine's functions and causing damage to the machine or work-piece.

16 - Dry Run Lock Out

The Dry Run feature will not be available when this setting is turned On.

17 - Opt Stop Lock Out

The Optional Stop feature will not be available when this setting is On.

18 - Block Delete Lock Out

The Block Delete feature will not be available when this setting is On.

19 - Feedrate Override Lock

The feedrate override keys will be disabled when this setting is turned On.

20 - Spindle Override Lock

The spindle speed override keys will be disabled when this setting is turned On.

21 - Rapid Override Lock

The axis rapid override keys are disabled when this setting is turned On.

22 - Can Cycle Delta Z

This setting specifies the distance the Z-axis is retracted to clear chips during a G73 canned cycle. The range is 0.0 to 29.9999 inches (0-760 mm).

23 - 9xxx Progs Edit Lock

Turning this setting on will stop the 9000 series of programs from being viewed, edited or deleted. 9000 series programs cannot be uploaded or downloaded with this setting on. Note that 9000 series programs are usually macro programs.

24 - Leader To Punch

This setting is used to control the leader (the blank tape at the beginning of a program) sent to a paper tape punch device connected to the first RS-232 port.



25 - EOB Pattern

This setting controls the EOB (End of Block) pattern when data is sent and received to/from serial port 1 (RS-232). This setting must match the transfer rate from the personal computer.

26 - Serial Number

This is the serial number of your machine. **It cannot be changed.**

28 - Can Cycle Act w/o X/Z

Turning this setting On will cause the commanded canned cycle to complete without an X or Z command. The preferred method of operation is with this setting On.

When this setting is Off, the control will stop if a canned cycle is programmed without an X or Z axis move.

31 - Reset Program Pointer

When this setting is Off, the Reset key will not change the position of the program pointer. When it is On, the Reset key will move the program pointer to the beginning of the program.

32 - Coolant Override

This setting controls how the coolant pump operates. The "Normal" selection allows the operator to turn the pump on and off manually or with M-codes. The "Off" selection will generate an alarm if an attempt is made to turn the coolant on manually or from a program. The "Ignore" selection will ignore all programmed coolant commands, but the pump can be turned on manually.

33 - Coordinate System

This setting changes the way tool shift offsets work. It can be set to either Yasnac or Fanuc. This setting changes the way a Txxxx command is interpreted and the way the coordinate system is specified. If it is Yasnac, tool shifts 51 to 100 are available on the offsets display and G50 T5100 is allowed. If it is FANUC, tool geometry for tools 1 to 50 is available on the offsets display and G54 style work coordinates are available.

36 - Program Restart

When this setting is On, restarting a program from a point other than the beginning will direct the control to scan the entire program to ensure that the tools, offsets, G and M codes, and axis positions are set correctly before the program starts at the block where the cursor is positioned. The following M codes will be processed when Setting 36 is enabled:

M08 Coolant On	M37 Parts Catcher Off
M09 Coolant Off	M41 Low Gear
M14 Clmp Main Spndl	M42 High Gear
M15 Unclmp Main Spndl	M51-58 Set User M
M36 Parts Catcher On	M61-68 Clear User M



When it is Off the program will start without checking the conditions of the machine. Having this setting Off may save time when running a proven program.

37 - RS-232 Data Bits

This setting is used to change the number of data bits for serial port 1 (RS-232). This setting must match the transfer rate from the personal computer. Normally 7 data bits should be used but some computers require 8. XMODEM must use 8 data bits and no parity.

38 - Aux Axis Number

This is a numeric entry between 0 and 1. It is used to select the number of external auxiliary axes added to the system. If it is set to 0, there are no auxiliary axes. If it is set to 1, there is a V-axis.

39 - Beep @ M00, M01, M02, M30

Turning this setting On will cause the keyboard beeper to sound when an M00, M01 (with Optional Stop active), M02 or an M30 is found. The beeper will continue until a key is pressed.

41 - Add Spaces RS-232 Out

When this setting is On, spaces are added between address codes when a program is sent out via RS-232 serial port 1. This can make a program much easier to read/edit on a personal computer (PC). When it is set to Off, programs sent out the serial port have no spaces and are more difficult to read.

42 - M00 After Tool Change

Turning this setting On will stop the program after a tool change and a message will be displayed stating this. The Cycle Start button must be pressed to continue the program.

43 - Cutter Comp Type

This setting controls how the first stroke of a compensated cut begins and the way the tool is cleared from the part being cut. The selections can be A or B; see the cutter compensation section for examples.

44 - Min F in Radius TNC %

(Minimum feedrate in radius tool nose compensation percent) This setting affects the feed rate when cutter compensation moves the tool towards the inside of a circular cut. This type of cut will slow down to maintain a constant surface feed rate. This setting specifies the slowest feed rate as a percentage of the programmed feed rate (range 1-100).

45 - Mirror Image X-axis

47 - Mirror Image Z-axis

When one or more of these settings is On, axis motion will be mirrored (reversed) around the work zero point. See also G101, Enable Mirror Image, in G-codes section.



50 - Aux Axis Sync

This changes the synchronization between sender and receiver for the second serial port. The second serial port is used for auxiliary axes. The settings between the CNC control and the auxiliary axes must be the same.

Selecting “RTS/CTS” will tell the sender to temporarily stop sending data while the receiver catches up.

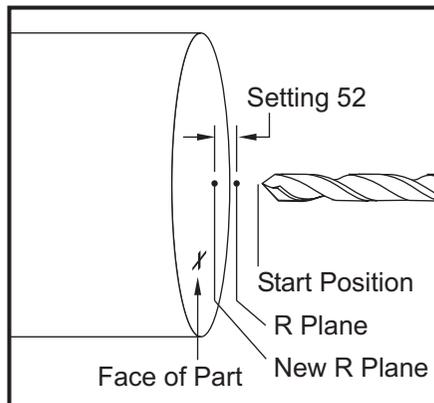
Selecting “XON/XOFF” uses ASCII character codes from the receiver to tell the sender to temporarily stop. **XON/XOFF is the most common setting.**

The “DC Codes” selection is like XON/XOFF, with the exception that start/stop codes are sent.

The “XMODEM” selection is receiver-driven, which sends data in blocks of 128 bytes. XMODEM gives the RS-232 communication added reliability because each block is checked for integrity.

52 - G83 Retract Above R

Range 0.0 to 30.00 inches or 0-761mm). This setting changes the way G83 (peck drilling cycle) behave. Most programmers set the reference (R) plane well above the cut to ensure that the chip clearing motion actually allows the chips to get out of the hole. However this wastes time as the machine will “drill” through this empty distance. If Setting 52 is set to the distance required to clear chips, the R plane can be put much closer to the part being drilled.



53 - Jog w/o Zero Return

Turning this setting On allows the axes to be jogged without zero returning the machine (finding machine home). This is a dangerous condition as the axis can be run into the mechanical stops and the possibly damage the machine. When the control is powered up, this setting automatically returns to Off.

54 - Aux Axis Baud Rate

This setting allows the operator to change the data rate for the second serial port (Auxiliary axis). This setting needs to match the value in the auxiliary axis control.



55 - Enable DNC from MDI

Turning this setting “On” will make the DNC feature available. DNC is selected, in the control by pressing the MDI/DNC key twice. The DNC Direct Numeric Control feature is not available when set to “Off”.

56 - M30 Restore Default G

When this setting is On, ending a program with M30 or pressing Reset returns all modal G codes to their defaults.

57 - Exact Stop Canned X-Z

The rapid XZ motion associated with a canned cycle may not achieve an exact stop when this setting is Off. Turning this setting On will ensure that the XZ motion comes to an exact stop.

58 - Cutter Compensation

This setting selects the type of cutter compensation used (FANUC or YASNAC). See the cutter compensation section.

59 - Probe Offset X+

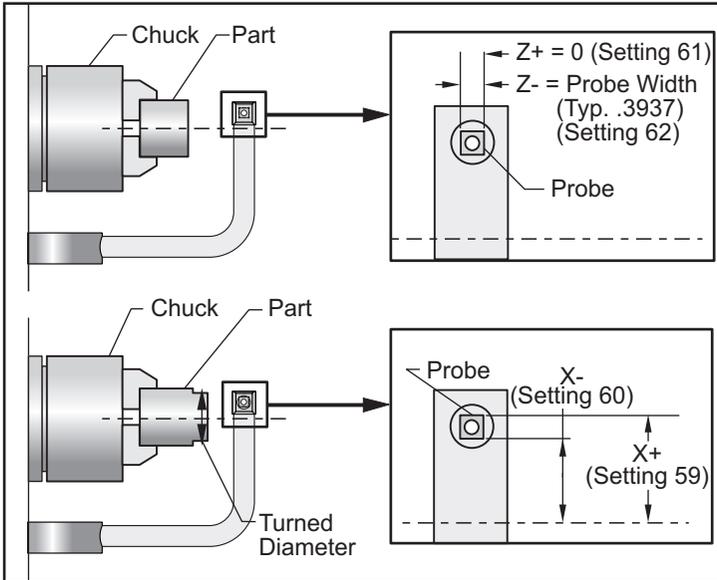
60 - Probe Offset X-

61 - Probe Offset Z+

62 - Probe Offset Z-

These settings are used to define the displacement and size of the spindle probe. These four settings specify the travel distance and direction from where the probe is triggered to where the actual sensed surface is located. These settings are used by G31, G36, G136, and M75 codes. The values entered for each setting can be either positive or negative numbers.

Macros can be used to access these settings, see the Macro section for more information.



63 - Tool Probe Width

This setting is used to specify the width of the probe used to test tool diameter. This setting only applies to the probing option; it is used by G35.

64 - T. Ofc Meas Uses Work

This setting changes the way the Tool Offset Mesur (Tool Offset Measure) key works. When this is On, the entered tool offset will be the measured tool offset plus the work coordinate offset (Z-axis). When it is Off, the tool offset equals the Z machine position.

65 - Graph Scale (Height)

This setting specifies the height of the work area that is displayed on the Graphics mode screen. The default value for this setting is the maximum height, which is the entire machine work area. Using the following formula can set a specific scale:

$$\text{Total Y travel} = \text{Parameter 20} / \text{Parameter 19}$$

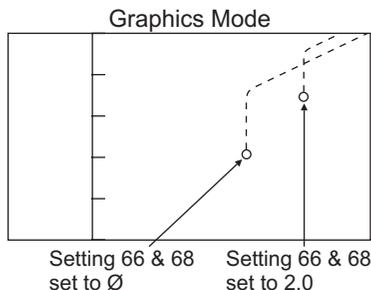
$$\text{Scale} = \text{Total Y travel} / \text{Setting 65}$$

66 - Graphics X Offset

This setting locates the right side of the scaling window relative to the machine X zero position (see the Graphics section). Its default is zero.

68 - Graphics Z Offset

This setting locates the top of the zoom window relative to the machine Z zero position (see the Graphics section). Its default is zero.



69 - DPRNT Leading Spaces

This is an On/Off setting. When set to Off, the control will not use leading spaces generated by a macro DPRNT format statement. Conversely, when set to On, the control will use leading spaces. The following example illustrates control behavior when this setting is OFF or ON.

#1 = 3.0 ;	OUTPUT	
G0 G90 X#1 ;	OFF	ON
DPRNT[X#1[44]] ;	X3.0000	X 3.0000

Notice the space between the "X" and the 3 when the setting is On. Information can be easier to read when this setting is On.

70 - DPRNT Open/CLOS DCode

This setting controls whether the POPEN and PCLOS statements in macros send DC control codes to the serial port. When the setting is On, these statements will send DC control codes. When it is Off, the control codes are suppressed. Its default value is On.

72 - Can Cycle Cut Depth

Used with canned cycles G71 and G72, this setting specifies the incremental depth for each pass during rough cutting. It is used if the programmer does not specify a D code. Valid values range from 0 to 29.9999 inches or 299.999 mm. The default value is .1000 inches.

73 - Can Cycle Retraction

Used with canned cycles G71 and G72, this setting specifies the retraction amount after a roughing cut. It represents the tool to material clearance as the tool returns for another pass. Valid values range from 0 to 29.9999 inches or 299.999 mm. The default value is .0500 inches.

74 - 9xxx Progs Trace

This setting, along with Setting 75, is useful for debugging CNC programs. When Setting 74 is On, the control will display the code in the macro programs (O9xxxx). When the setting is Off, the control will not display the 9000 series code.



75 - 9xxxx Progs Singls BLK

When Setting 75 is On and the control is operating in Single Block mode, then the control will stop at each block of code in a macro program (O9xxxx) and wait for the operator to press Cycle Start. When Setting 75 is Off, the macro program is run continuously, the control will not pause at each block, even if Single Block is on. The default setting is On.

When Setting 74 and Setting 75 are both On, the control acts normally. That is, all blocks executed are highlighted and displayed, and when in Single Block mode there is a pause before each block is executed.

When Setting 74 and Setting 75 are both Off, the control will execute 9000 series programs without displaying the program code. If the control is in Single Block mode, no single-block pause will occur during the running of the 9000 series program.

When Setting 75 is On and Setting 74 is Off, then 9000 series programs are displayed as they are executed.

76 - Foot Pedal Lock Out

This is an On/Off setting. When it is Off, the foot pedal operates normally. When it is On, any action at the foot pedal is ignored by the control.

77 - Scale Integer F

This setting allows the operator to select how the control interprets an F value (feedrate) that does not contain a decimal point. (It is recommended that programmers always use a decimal point.) This setting helps operators run programs developed on a control other than Haas. For Example F12:

Setting 77 Off	0.0012units/minute
Setting 77 On	12.0 units/minute

There are 5 feedrate settings:

INCH		MILLIMETER	
DEFAULT	(.0001)	DEFAULT	(.001)
INTEGER	F1 = F1	INTEGER	F1 = F1
.1	F1 = F.0001	.1	F1 = F.001
.01	F10 = F.001	.01	F10 = F.01
.001	F100 = F.01	.001	F100 = F.1
.0001	F1000 = F.1	.0001	F1000 = F.1

81 - Tool at Auto Off

When the Power Up/Restart key is pressed, the control will change to the tool specified in this setting. If zero (0) is specified, no tool change occurs at power up. The default setting is 1.

82 - Language

Languages other than English are available in the Haas control. To change to another language, choose a language and press Enter.



83 - M30/Resets Overrides

When this setting is On, an M30 restores any overrides (feedrate, spindle, rapid) to their default values (100%).

84 - Tool Overload Action

This setting causes the specified action (Alarm, Feedhold, Beep, Autofeed) to occur anytime a tool becomes overloaded (see the Tooling section).

Choosing "Alarm" will cause the machine to stop when the tool is overloaded.

When set to "Feedhold", the message "Tool Overload" will be displayed and the machine will stop in a feedhold situation when this condition occurs. Pressing any key will clear the message.

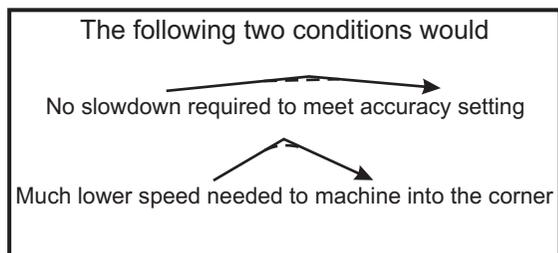
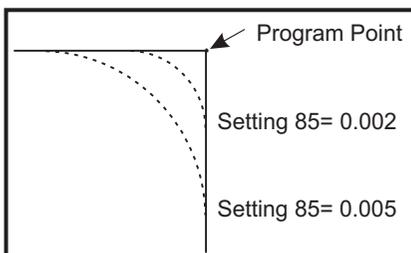
Selecting "Beep" will cause an audible noise from the control when the tool is overloaded.

When set to "Autofeed", the lathe automatically limits the feedrate based on the tool load. **Autofeed Notes:** When tapping (rigid or floating), the feed and spindle overrides will be locked out, so the Autofeed feature will be ineffective (the control will appear to respond to the override keys, by displaying the override messages). The Autofeed feature should not be used when thread milling or auto reversing tapping heads, as it may cause unpredictable results or even a crash.

The last commanded feedrate would be restored at the end of the program execution, or when the operator presses Reset or turns off the Autofeed feature. The operator may use the keyboard feedrate override keys while the Autofeed feature is selected. These keys will be recognized by the Autofeed feature as the new commanded feedrate as long as the tool load limit is not exceeded. However, if the tool load limit has already been exceeded, the control will ignore the feedrate override keys.

85 - Maximum Corner Rounding

Defines the machining accuracy of rounded corners within a selected tolerance. The initial default value is 0.05 inch. If this setting is zero (0), the control acts as if an exact stop is commanded in each motion block.





86 - Thread Finish Allowance

Used in G76 canned threading cycle, this setting specifies how much material will be left on the thread for finishing after all passes of the cycle. Values range from 0 to .9999 inches. The default value is 0.

87 - TNN Resets Override

This is an on/off setting. When M06 is executed and this setting is on, any overrides are canceled and set to their programmed values.

88 - Reset Resets Overrides

This is an On/Off setting. When it is On and the Reset key is pressed, any overrides are canceled and set to their programmed values or defaults.

90 - Graph Z Zero Location

This setting adjusts for extreme values in tool geometry or shift values. In graphics, tool offsets are ignored so that the cutting paths of different tools are displayed in the same location. Setting this to an approximate value of machine coordinates for the programmed part zero will void any Z Over Travel Range alarms that you may encounter in graphics. The default is -8.0000.

91 - Graph X Zero Location

This setting adjusts for extreme values in tool geometry or shift values. In graphics, tool offsets are ignored so that the cutting paths of different tools are displayed in the same location. Setting this to an approximate value of machine coordinates for the programmed part zero will void any x Over Travel Range alarms that you may encounter in graphics. The default is -8.0000.

92 - Chuck Clamping

This setting determines chuck clamping direction. Set to O.D., the chuck is considered clamped when the jaws are moved to the spindle center. Set to I.D., the chuck is considered clamped when the jaws are moved away from the spindle center.

93 - Tailstock X Clearance

This setting works with Setting 94 to define a tail stock travel restriction zone that limits interaction between the tail stock and the tool turret. This setting determines the X-axis travel limit when the difference between the Z-axis location and the tail stock location falls below the value in Setting 94. If this condition occurs and a program is running then an alarm is generated. When jogging, no alarm is generated, but travel will be limited. Units are in inches.

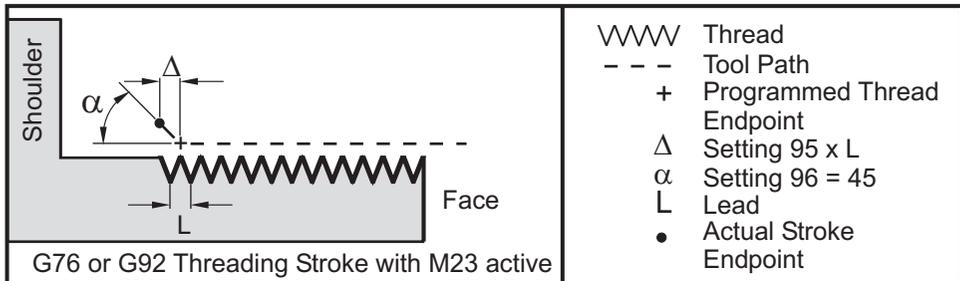
94 - Tailstock Z Clearance

This setting is the minimum allowable difference between the Z-axis and the tail stock (see Setting 93). Units are in inches. A value of -1.0000 means that when the X-axis is below the X clearance plane (Setting 93), the Z-axis must be more than 1 inch away from the tail stock position in the Z-axis negative direction. The default value for this setting is zero. Units are in inches.



95 - Thread Chamfer Size

This setting is used in G76 and G92 threading cycles when an M23 is commanded. When command M23 is active, threading strokes end with an angled retraction, as opposed to pulling straight out. The value in Setting 95 is equal to the number of turns (chamfered threads) desired. Note that Settings 95 and 96 interact with each other. Valid range: 0 to 29.999 (Multiple of current thread lead, F or E).



96 - Thread Chamfer Angle

See Setting 95. Valid range: 0 to 89 degrees (No decimal point allowed)

97 - Tool Change Direction

This setting determines the default tool change direction. It may be set to either Shortest or M17/M18.

When "Shortest" is selected, the control will turn the direction necessary to reach the next tool with the least movement. The program can still use M17 and M18 to fix the tool change direction, but once this is done it is not possible to revert back to the shortest tool direction other than Reset or M30/M02.

Selecting M17/M18, the control will move the tool turret either always forward or always reverse based on the most recent M17 or M18. When Reset, power on, or M30/M02 is executed, the control will assume M17 as the tool turret direction during tool changes, always forward. This option is useful when a program must avoid certain areas of the tool turret due to odd-sized tools.

98 - Spindle Jog RPM

This setting determines the spindle rpm for the Spindle Jog key. The default value is 100 RPM.

99 - Thread Minimum Cut

Used in G76 canned threading cycle, this setting sets a minimum amount of successive passes of the thread cut. Succeeding passes cannot be less than the value in this setting. Values can range from 0 through .9999 inch. The default value is .0010 inches.



100 - Screen Saver Delay

When the setting is zero, the screen saver is disabled. If setting is set to some number of minutes, then after that time with no keyboard activity the IPS screen will be displayed. After the second screen saver delay, the Haas logo will be displayed that will change position every 2 seconds (deactivate with any key press, handle jog or alarm). The screen saver will not activate if the control is in Sleep, Jog, Edit, or Graphics mode.

101 - Feed Override -> Rapid

Pressing Handle Control Feedrate, with this setting On, will cause the jog handle to affect both the feedrate and the rapid rate overrides. Setting 10 affects the maximum rapid rate.

102 - C Axis Diameter

This setting supports the C-axis. See the C-axis Section. The default value is 1.0 inches and the maximum allowable value is 29.999 inches.

103 - CYC START/FH Same Key

The Cycle Start button must be pressed and held to run a program when this setting is On. When Cycle Start is released, a feed hold is generated.

This setting cannot be turned on while Setting 104 is on. When one of them is set to On, the other will automatically turn off.

104 - Jog Handle to SNGL BLK

The jog handle can be used to single-step through a program when this setting is On. Reversing the jog handle direction will generate a feed hold.

This setting cannot be turned On while Setting 103 is on. When one of them is set to On, the other will automatically turn off.

105 - TS Retract Distance

The distance from the Hold Point (Setting 107) the tail stock will retract when commanded. This setting should be a positive value.

106 - TS Advance Distance

When the tail stock is moving toward the Hold Point (Setting 107), this is the point where it will stop its rapid movement and begin a feed. This setting should be a positive value.

107 - TS Hold Point

This setting is in absolute machine coordinates and should be a negative value. It is the point to advance to for holding when M21 is commanded. Usually this is inside of a part being held. It is determined by jogging to the part and adding some amount to the absolute position.

109 - Warm-Up Time in MIN.

This is the number of minutes (up to 300 minutes from power-up) during which the compensations specified in Settings 110-112 are applied.



Overview – When the machine is powered on, if Setting 109, and at least one of Settings 110, 111, or 112, are set to a nonzero value, the following warning will be displayed:

CAUTION! Warm up Compensation is specified!

Do you wish to activate

Warm up Compensation (Y/N)?

If a 'Y' is entered, the control immediately applies the total compensation (Setting 110, 111, 112), and the compensation begins to decrease as the time elapses. For instance, after 50% of the time in Setting 109 has elapsed, the compensation distance will be 50%.

To “restart” the time period, it is necessary to power the machine off and on, and then answer “yes” to the compensation query at start-up.

CAUTION! Changing Setting 110, 111, or 112 while compensation is in progress can cause a sudden movement of up to 0.0044 inch.

The amount of remaining warmup time is displayed on the bottom right hand corner of the Diagnostics Inputs 2 screen using the standard hh:mm:ss format.

110 - Warmup X Distance

112 - Warmup Z Distance

Settings 110 and 112 specify the amount of compensation (max = ± 0.0020 " or ± 0.051 mm) applied to the axes. Setting 109 must have a value for settings 110 and 112 to have an affect.

113 - Tool Change Method

This setting is used for the TL-1 and TL-2 lathes. See the Toolroom Lathe manual.

114 - Conveyor Cycle (minutes)

115 - Conveyor On-time (minutes)

Settings 114 and 115 control the optional chip conveyor. Setting 114 (Conveyor Cycle Time) is the interval that the conveyor will turn on automatically. Setting 115 (Conveyor On-Time) is the amount of time the conveyor will run. For example, if setting 114 is set to 30 and setting 115 is set to 2, the chip conveyor will turn on every half an hour, run for 2 minutes, then turn off.

On-time should be set no greater than 80% of cycle time. Note the following:

Pressing CHIP FWD (or M31) will start the conveyor in the forward direction and activate the cycle.

The CHIP STOP key (or M33) will stop the conveyor and cancel the cycle.

118 - M99 Bumps M30 CNTRS

When this setting is On, an M99 will add one to the M30 counters (these are visible on the Curnt Comnds displays). Note that an M99 will only increase the counters as it occurs in a main program, not a sub-program.



119 - Offset Lock

Turning the setting On will not allow the values in the Offset display to be altered. However, programs that alter offsets will still be able to do so.

120 - Macro Var Lock

Turning this setting On will not allow the macro variables to be altered. However, programs that alter macro variables will still be able to do so.

121 - Foot Pedal TS Alarm

When M21 is used to move the tail stock to the hold point and hold a part, the control will generate an alarm if a part is not found and the hold point is reached. Setting 121 can be switched to On and an alarm will be generated when the foot pedal is used to move the tail stock to the hold point and no part is found.

122 - Secondary Spindle Chuck Clamping

This feature supports Secondary-spindle lathes. Its value can be either O.D. or I.D.; similar to Setting 92 for the main spindle.

131 - Auto Door

This setting supports the Auto Door option. It should be set to On for machines with an autodoor. Also see M85/86 (Autodoor Open/Close M-codes).

The door will close when Cycle Start is pressed and will open when the program reaches an M00, M01 (with Optional Stop turned on) or M30 and the spindle has stopped turning.

132 - Jog or Home Before TC

When this setting is Off, the machine behaves normally. When it is On and Turret Fwd, Turret Rev, or Next Tool is pressed while one or more axes is away from zero, it is assumed that a crash is likely and a message is displayed instead of doing the tool change. However, if the operator had pressed Handle Jog prior to the tool change, it is assumed that the axis had just been jogged to a safe position and will perform the tool change.

133 - REPT Rigid Tap

This setting ensures that the spindle is oriented during tapping so that the threads will line up when a second tapping pass, in the same hole, is programmed.

142 - Offset Chng Tolerance

This setting generates a warning message if an offset is changed by more than the amount entered for this setting. The following prompt will be displayed: "XX changes the offset by more than Setting 142! Accept (Y/N)?" if an attempt is made to change an offset by more than the entered amount (either positive or negative), If "Y" is entered, the control updates the offset as usual; otherwise, the change is rejected.

If "Y" is entered, the control updates the offset as usual, otherwise, the change is rejected.



143 Machine Data Collect

This setting enables the user to extract data from the control using a Q command sent through the RS-232 port, and to set Macro variables by using an E command. This feature is software-based and requires an additional computer to request, interpret and store data from the control. A hardware option also allows the reading of machine status. See CNC Data Transfer in the Operation Programming section for detailed information.

144 - Feed Override->Spindle

This setting is intended to keep the chip load constant when an override is applied. When this setting is On, any feedrate override will also be applied to the spindle speed, and the spindle overrides will be disabled.

145 - TS at Part for CS

(Tail stock at part for Cycle Start) When it is Off, the machine behaves as before. When this setting is On, the tail stock must be pressing against the part at the moment Cycle Start is pressed or a message is displayed and the program will not start.

156 - Save Offset with PROG

The control will save the offsets in the same file as the programs with this setting On, under the heading O999999. The offsets will appear in the file before the final % sign.

157 - Offset Format Type

This setting controls the format in which offsets are saved with programs.

When it is set to A the format looks like what is displayed on the control, and contains decimal points and column headings. Offsets saved in this format can be more easily edited on a PC and later reloaded.

When it is set to B, each offset is saved on a separate line with an N value and a V value.

158,159,160 - XYZ Screw Thermal COMP%

These settings can be set from -30 to +30 and will adjust the existing screw thermal compensation by -30% to +30% accordingly.

162 - Default To Float

When this setting is On, the control will add a decimal point to values entered without a decimal point (for

certain address codes.) When the setting is Off, values following address codes that do not include decimal points are taken as machinists notation (i.e., thousandths or ten-thousandths.) This setting will exclude the A value (tool angle) in a G76 block. Thus, the feature applies to the following address codes:

	Value entered	With Setting Off	With Setting On
In Inch mode	X-2	X-.0002	X-2.
In MM mode	X-2	X-.002	X-2.



This feature applies to the following address codes:

X, Y, Z, A, B, C, E, F, I, J, K, U, W

A (except with G76) If a G76 A value containing a decimal point is found during program execution, alarm 605 Invalid Tool Nose Angle is generated.

D (except with G73)

R (except with G71 in YASNAC mode)

Note that this setting affects the interpretation of all programs entered either manually or from disk or via RS-232. It does not alter the effect of setting 77 Scale Integer F.

163 - Disable .1 Jog Rate

This setting disables the highest jog rate. If the highest jog rate is selected, the next lower rate is automatically selected instead.

164 - Powerup SP Max RPM

This setting is used to set the maximum spindle RPM each time the machine is powered on. It will essentially cause a G50 Snnn command to be executed at power on time, where nnn is the value from the setting. If the setting contains zero, or a value equal to or greater than parameter 131 MAX SPINDLE RPM, Setting 164 will have no effect.

165 - SSV Variation

Specifies the amount by which to allow the RPM to vary above and below its commanded value during the use of the Spindle Speed Variation feature. Positive value only.

166 - SSV CYCLE (0.1) SECS

Specifies the duty cycle, or the rate of change of Spindle Speed. Positive value only.

167-186 - Periodic Maintenance

There are 14 items that can be monitored, as well as six spare items, in the periodic maintenance settings. These settings will allow the user to change the default number of hours for each item when it is initialized during use. If the number of hours is set to zero, the item will not appear in the list of items shown in the maintenance page of current commands.

187 - Machine Data Echo

Turning this setting on will display the data collection Q commands on the PC screen.

196 - Conveyor Shutdown

This specifies the amount of time to wait without activity prior to turning off the chip conveyor turn off. Units are minutes.

197 - Coolant Shutdown

Specifies the amount of time to wait without activity prior to Flood, Shower, and Through-Spindle Coolant turn off in mills. Units are minutes.



198 - Background Color

Specifies the background color for inactive display panes. Range is 0 to 254.

199 - Backlight Timer

Specifies the time in minutes after which the machine display backlight will turn off when there is no input at the control (except in JOG, GRAPHICS, or SLEEP mode or when an alarm is present). Press any key to restore the screen (CANCEL is preferred).

201 - Show Only Work and Tool Offsets In Use

Turning this setting on will display only the Work and Tool offsets used by the running program. The program must be run in the graphics mode first to activate this feature.

202 - Live Image Scale (Height)

Specifies the height of the work area that is displayed in the live image screen. The maximum size is automatically limited to the default height. The default shows the machine's entire work area.

203 - Live Image X Offset

Locates the top of the scaling window relative to the machine X zero position. The default is zero.

205 - Live Image Z Offset

Locates the right side of the scaling window relative to the machine X zero position. The default is zero.

206 - Stock Hole Size

Demonstrates the I.D. of the part. This setting can be adjusted by entering a value in HOLE SIZE in the STOCK SETUP tab in IPS.

207 - Z Stock Face

Controls the Z stock face of the raw part that will be displayed in live image. This setting can be adjusted by entering a value in STOCK FACE in the STOCK SETUP tab in IPS.

208 - Stock OD Diameter

This setting controls the diameter of the raw part that will be displayed in live image. This setting can also be adjusted from IPS.

209 - Length of Stock

Controls the length of the raw part that will be displayed in live image. This setting can be adjusted by entering a value in STOCK LENGTH in the STOCK SETUP tab in IPS.

210 - Jaw Height

This setting controls the height of the chuck jaws that will be displayed in live image. This setting can also be adjusted from IPS.



211 - Jaw Thickness

Controls the thickness of the chuck jaws that will be displayed in live image. This setting can be adjusted by entering a value in JAW THICKNESS in the STOCK SETUP tab in IPS.

212 - Clamp Stock

Controls the clamp stock size of the chuck jaws that will be displayed in live image. This setting can be adjusted by entering a value in CLAMP STOCK in the STOCK SETUP tab in IPS.

213 - Jaw Step Height

Controls the height of the chuck jaws step that will be displayed in live image. This setting can be adjusted by entering a value in JAW STEP HEIGHT in the STOCK SETUP tab in IPS.

214 - Show Rapid Path Live Image

Controls the visibility of a red dashed line that represents a rapid path in live image.

215 - Show Feed Path Live Image

Controls the visibility of a solid blue line that represents a feed path in live image.

216 - Servo and Hydraulic Shutoff

This setting will turn the servomotors and hydraulic pump, if equipped, off after the specified number of minutes has elapsed without activity, such as running a program, jogging, key presses, etc. The default is 0.

217 - Show Chuck Jaws

Controls the display of the chuck jaws in live image.

218 - Show Final Pass

Controls the visibility of a solid green line that represents a final pass in live image. This is shown if the program has been previously run or simulated.

219 - Auto Zoom to Part

Controls whether or not live image will auto zoom the part to the bottom left corner. Turn on or off by pressing F4.

220 - TS Live Center Angle

Angle of the tailstock's live center measured in degrees (0 to 180). Used for Live Image only. Initialize with a value of 60.

221 - Tailstock Diameter

Diameter of the tailstock's live center measured in inch or metric (depending on setting 9), times 10,000. Used for the Live Image only. Default value is 12500. Use positive value only.



222 - Tailstock Length

Length of the tailstock's live center measured in inch or metric (depending on setting 9) times 10,000. Used for Live Image only. Default value is 20000. Use positive value only.

224 - Flip Part Stock Diameter

Controls the new diameter location of the jaws after flipping the part

225 - Flip Part Stock Length

Controls the new length location of the jaws after flipping the part.

226 - SS Stock Diameter

Controls the diameter of the part where the secondary spindle clamps it.

227 - SS Stock Length

Controls the length of the secondary spindle from the left of the part.

228 - SS Jaw Thickness

Controls the secondary spindle jaw thickness.

229 - SS Clamp Stock

Controls the secondary spindle clamp stock value.

230 - SS Jaw Height

Controls the secondary spindle jaw height.

231 - SS Jaw Step Height

Controls the secondary spindle jaw step height.

232 - G76 Default P Code

The default P code value to use when a P code does not exist in a G76 line, or when the P code used has a value less than 1 or greater than 4. Possible values are P1, P2, P3, or P4.

233 - SS Clamping Point

Controls the clamping point (the location on the part where the secondary spindle clamps it) for display purposes in Live Image. This value is also used to create a G code program that will perform the desired secondary spindle operation.

234 - SS Rapid Point

Controls the rapid point (the location to which the secondary spindle rapids before clamping a part) for display purposes in Live Image. This value is also used to create a G code program that will perform the desired secondary spindle operation.



235 - SS Machine Point

Controls the machining point (the location where the secondary spindle machines a part) for display purposes in Live Image. This value is also used to create a G code program that will perform the desired secondary spindle operation.

236 - FP Z Stock Face

Controls the flip part stock face for display purposes in Live Image. This value is also used to create a G code program that will perform the desired secondary spindle operation.

237 - SS Z Stock Face

Controls the secondary spindle stock face for display purposes in Live Image. This value is also used to create a G code program that will perform the desired secondary spindle operation.

238 - High Intensity Light Timer (minutes)

Specifies the duration in minutes that the High Intensity Light option (HIL) remains turned on when activated. The light turns on when the door is opened and the work light switch is on. If this value is zero, then the light will not turn off automatically.

239 - Worklight Off Timer (minutes)

Specifies the duration in minutes that the internal worklight remains turned on when the worklight switch is toggled. If this value is zero, then the light will not turn off automatically.

240 - Tool Life Warning

The percentage of remaining tool life at which to trigger a tool life warning. Tools with remaining life below Setting 240 are highlighted in orange.

241 - Tailstock Hold Force

Force to apply to a part by the servo tailstock. Unit is newton in metric mode and pound-force in standard mode, as per setting 9. Valid range is 0 to max hold force.

900 - CNC Network Name

The control name you would like to show up on the network.

901 - Obtain Adress Automatically

Retrieves a TCP/IP address and subnet mask from a DHCP server on a network (Requires a DHCP server). When DHCP is on, TCP/IP, SUBNET MASK and GATEWAY entries are no longer required and will have "****" entered. Also note the ADMIN section at the end to get the IP address from DHCP. The machine must be turned off and back on for changes to this setting to take effect.



NOTE: To get IP settings from DHCP: At the control, go to List Prog. Arrow down to the Hard Drive. Press the right arrow key for the Hard Drive directory. Type in ADMIN and press Insert. Select ADMIN Folder and press Write. Copy the IPConfig.txt file to disk or USB and read it on a Windows computer.

902 - IP Address

Used on a network with static TCP/IP addresses (DHCP off). The network administrator will assign an address (example 192.168.1.1). The machine must be turned off and back on for changes to this setting to take effect.

NOTE: The address format for Subnet Mask, Gateway and DNS is XXX.XXX.XXX.XXX (example 255.255.255.255) do not end the address with a period. The max address is 255.255.255.255; no negative numbers.

903 - Subnet Mask

Used on a network with static TCP/IP addresses. The network administrator will assign a mask value. The machine must be turned off and back on for changes to this setting to take effect.

904 - Gateway

Used to gain access through routers. The network administrator will assign an address. The machine must be turned off and back on for changes to this setting to take effect.

905 - DNS Server

The Domain Name Server or Domain Host Control Protocol IP address on the network. The machine must be turned off and back on for changes to this setting to take effect.

906 - Domain/Workgroup Name

Tells the network which workgroup or domain the CNC control belongs to. The machine must be turned off and back on for changes to this setting to take effect.

907 - Remote Server Name

For Haas machines with WINCE FV 12.001 or higher, enter the NETBIOS name from the computer where the share folder resides. IP address is not supported.

908 - Remote Share Path

The name of the shared network folder. After a host name is selected, to rename the path, enter the new and press the WRITE key.

NOTE: Do not use spaces in the PATH field.



909 - User Name

This is the name used to logon to the server or domain (using a user domain account). The machine must be turned off and back on for changes to this setting to take effect. **User Names are case sensitive and cannot contain spaces.**

910 - Password

This is the password used to logon to the server. The machine must be turned off and back on for changes to this setting to take effect. **Passwords are case sensitive and cannot contain spaces.**

911 - Access To CNC Share (Off, Read, Full)

Used for the CNC hard drive read/write privileges. OFF stops the hard drive from being networked. READ allows read- only access to the hard drive. FULL allows read/write access to the drive from the network. Turning off both this setting and Setting 913 will disable network card communication.

912 - Floppy Tab Enabled

This turns access to the USB floppy drive off/on. When set to OFF, the USB floppy drive will not be accessible.

913 - Hard Drive Tab Enabled

Turns access to the hard drive off/on. When set to OFF, hard drive will not be accessible. Turning off both this setting and CNC Share (Setting 911) will disable network card communication.

914 - USB Tab Enabled

Turns access to the USB port off/on. When set to OFF the USB port will not be accessible.

915 - Net Share

Turns access to the server drive off/on. When set to OFF access to the sever from the CNC control is not possible.

916 - Second USB Tab Enabled

Turns access to the secondary USB port off/on. When set to OFF the USB port will not be accessible.



MAINTENANCE

Haas machines require basic preventive maintenance at regular intervals. Refer to this chapter and your machine's addendum (if provided) to check the tasks you need to do, and when you should do them.

GENERAL REQUIREMENTS

Operating Temperature Range 41°F to 104°F (5 to 40°C)
Storage Temperature Range -4°F to 158°F (-20 to 70°C)
Ambient Humidity: 20% – 95% relative humidity, non-condensing
Altitude: 0-7000 ft.

ELECTRICITY REQUIREMENTS

Important! Refer to local code requirements before wiring machines.

All machines require:

Three phase 50 or 60Hz power supply.
Line voltage that does not fluctuate more than +/-10%

15 HP System	Voltage Requirements	High Voltage Requirements
SL-10, ST-10	(195-260V)	(354-488V)
Power Supply	50 AMP	25 AMP
Haas Circuit Breaker	40 AMP	20 AMP
If service run from elec. panel is less than 100' use:	8 GA. WIRE	12 GA. WIRE
If service run from elec. panel is more than 100' use:	6 GA. WIRE	10 GA. WIRE
20 HP System	Voltage Requirements	High Voltage Requirements
¹ SL-20, TL-15, ST-20	(195-260V)	(354-488V)
Power Supply	50 AMP	25 AMP
Haas Circuit Breaker	40 AMP	20 AMP
If service run from elec. panel is less than 100' use:	8 GA. WIRE	12 GA. WIRE
If service run from elec. panel is more than 100' use:	6 GA. WIRE	10 GA. WIRE
30-40 HP System	Voltage Requirements	High Voltage ²
TL-15BB, ST-30, SS-20, SS-30		
¹ SL-40, SL-40BB	(195-260V)	(354-488V)
Power Supply	100 AMP	50 AMP
Haas Circuit Breaker	80 AMP	40 AMP
If service run from elec. panel is less than 100' use:	4 GA. WIRE	8 GA. WIRE
If service run from elec. panel is more than 100' use:	2 GA. WIRE	6 GA. WIRE



55HP System

¹SL-40, SL-40BB, SL-40L
Power Supply

Voltage Requirements
(195-260V)
150 AMP

High Voltage Requirements
(354-488V)

Must use an external transformer

Haas Circuit Breaker 125 AMP
If service run from elec. panel is less than 100' use: 1 GA. WIRE
If service run from elec. panel is more than 100' use: 0 GA. WIRE

WARNING! A separate earth ground wire of the same conductor size as the input power is required to be connected to the chassis of the machine. This ground wire is required for operator safety and for proper operation. This ground must be supplied from the main plant ground at the service entrance, and should be routed in the same conduit as the input power to the machine. A local cold water pipe, or ground rod adjacent to the machine cannot be used for this purpose.

Input power to the machine must be grounded. For wye power, the neutral must be grounded. For delta power, a central leg ground or one leg ground should be used. The machine will not function properly on ungrounded power. (This is not a factor with the External 480V Option.)

The rated horsepower of the machine may not be achieved if the imbalance of the incoming voltage is beyond an acceptable limit. The machine may function properly, yet may not deliver the advertised power. This is noticed more often when using phase converters. A phase converter should only be used if all other methods cannot be used.

The maximum leg-to-leg or leg-to-ground voltage should not exceed 260V, or 504V for high-voltage machines with the Internal High Voltage Option.

¹ The current requirements shown in the table reflect the circuit breaker size internal to the machine. This breaker has an extremely slow trip time. It may be necessary to size the external service breaker up by 20-25%, as indicated by "power supply", for proper operation.

² The high-voltage requirements shown reflect the Internal 400V configuration which is standard on European machines. Domestic and all other users must use the External 480V option.

AIR REQUIREMENTS

The CNC Lathe requires a minimum of 100 psi at 4 scfm at the input to the pressure regulator on the back of the machine. This should be supplied by at least a two horsepower compressor, with a minimum 20-gallon tank, that turns on when the pressure drops to 100 psi. At least a 3/8" I.D. hose is recommended. Set the main air regulator to 85 psi.



The recommended method of attaching the air hose is to the barb fitting at the back of the machine with a hose clamp. If a quick coupler is desired, use at least a 3/8”.

NOTE: Excessive oil and water in the air supply will cause the machine to malfunction. The air filter/regulator has an automatic bowl dump that should be empty before starting the machine. This must be checked for proper operation monthly. Also, excessive contaminants in the air line may clog the dump valve and cause oil and/or water to pass into the machine.

NOTE: Auxiliary air connections should be made on the unregulated side of the air filter/regulator.

WINDOWS/GUARDING

Polycarbonate windows and guarding can be weakened by exposure to cutting liquids and chemicals that contain amines. It is possible to loose up to 10% of the remaining strength annually. If degradation is suspected, window replacement should occur at no more than a two year interval.

Windows and guarding should be replaced if damaged or severely scratched - Replace damaged windows immediately

MAINTENANCE SCHEDULE

The following is a list of required regular maintenance for the Haas SL-Series Turning Centers. Listed are the frequency of service, capacities, and type of fluids required. These required specifications must be followed in order to keep your machine in good working order and protect your warranty.

Interval	Maintenance Performed
Daily	<ul style="list-style-type: none"> • Check coolant level. Check way lube lubrication tank level. • Clean chips from way covers and bottom pan. • Clean chips from turret, housing, rotating union and extension tube. Make sure the drawtube cover plate is installed either on the rotating union or on the chuck opening. • Check hydraulic unit oil level (DTE-25 only). Capacity: 8 gallons (10 gallons for SL-30B and up).
Weekly	<ul style="list-style-type: none"> • Check for proper operation of auto drain on filter regulator. • Check air gauge / regulator for 85 psi. • Clean exterior surfaces with mild cleaner. Do not use solvents. • Clean out small chip catch pan in coolant tank.
Monthly	<ul style="list-style-type: none"> • Inspect way covers for proper operation and lubricate with light oil, if necessary. • Remove pump from the coolant tank. Clean sediment from inside the tank. Reinstall pump. • Inspect the grease and oil reservoirs and add grease or oil as needed.

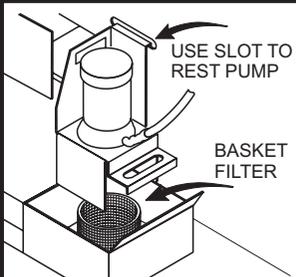
CAUTION! Disconnect the coolant pump from the controller and Power Off the control before working on the coolant tank.



- Dump the oil drain bucket. Check Gearbox oil level (if applicable). If oil is not visible at the bottom edge of the sight gauge, remove the end panel and add DTE-25 through the top filler hole until it is visible in the sight gauge.
 - Check for dust buildup on electrical cabinet vector drive vents (beneath power switch). If buildup exists, open cabinet and wipe vents with a clean cloth rag. Apply compressed air as necessary to remove dust accumulation.
- Six Months
- Replace coolant and thoroughly clean the coolant tank.
 - Replace hydraulic unit oil filter.
- Annually
- Check all hoses and lubrication lines for cracking.
 - Replace gearbox oil.
 - Clean oil filter inside Lube Air Panel Oil Reservoir and clean residue from bottom of filter.

CAUTION! Do not use a wash-down hose on the Haas lathe; doing so may cause damage to the spindle.

NOTICE



CLEAN THE GATE FILTER REGULARLY

DO NOT USE PLAIN WATER, PERMANENT CORROSION DAMAGE WILL RESULT. RUST INHIBITING COOLANT IS REQUIRED.

DO NOT USE TOXIC OR FLAMMABLE LIQUIDS AS A COOLANT.

Poor Coolant flow can be caused by a dirty filter. To clean the filter, turn off the coolant pump, lift the coolant tank lid and remove the filter. Clean and reinstall filter.

LUBRICATION

System	Lubricant	Quantity
Way lube and pneumatics	Mobil Vactra #2	2-2.5 qts
Transmission	Mobil SHC 625	2.25 liters
Turret	Mobil DTE-25	2 pints



PERIODIC MAINTENANCE

A periodic maintenance page is within the Current Commands screens titled "Maintenance". Access the screen by pressing CURNT COMDS and using Page Up or Page Down to scroll to the page.

An item on the list can be selected by pressing the up and down arrow keys. The selected item is then activated or deactivated by pressing Origin. If an item is active, the remaining hours will be displayed, a deactivated item will display, "—" instead.

The maintenance item time is adjusted by using the left and right arrows. Pressing the Origin key will reinstate the default time.

Items are tracked either by the time accumulated while power is on (ON-TIME) or by cycle-start time (CS-TIME). When the time reaches zero the message "Maintenance Due" is displayed at the bottom of the screen (a negative number of hours indicates the hours past due).

This message is not an alarm and does not interfere with machine operation. After the necessary maintenance has been performed, the operator can select that item on the "Maintenance" screen, press the Origin key to deactivate it, then press Origin again to reactivate it with the default number of hours remaining.

Refer to settings 167-186 for additional maintenance defaults. Note that settings 181-186 are used as spare maintenance alerts by keying-in a number. The maintenance number will display on the Current Commands page once a value (time) is added to the setting.

CHUCK MAINTENANCE

Ensure all moving part are thoroughly greased

Check for excessive wear on jaws.

Check T-nuts for excessive wear.

Check front retaining bolts for damage.

Chucks should be broken in according to the manufactures' specifications.

Disassemble and inspect chuck once a year.

Refer to chuck manual for disassembly procedures.

Check for excessive wear.

Check for galling or burnishing.

Clean guide ways of contamination, chips and coolant

Lubricate chuck before reassembly.



CAUTION! Lack of grease significantly reduces clamping force and can result in chatter, improper clamping, or thrown parts.

Chuck Jaws

Each chuck jaw requires two strokes of grease every 1000 clamp/unclamp cycles, or at least once a week. Use the provided grease gun for chuck lubrication. The Lubrication type is Molybdenum Disulfide Grease (20%-25% moly content).

MINIMAL LUBRICATION SYSTEM

The Minimal Lubrication System consists of two sub-systems to optimize the amount of lubrication to the machine components. The system supplies lubrication only when it is needed; thus reducing both the amount of lubrication oil required for a machine, as well as the chance of excess oil contaminating coolant.

- (1) A grease system to lubricate the linear guides and ballscrews
- (2) An air/oil system to lubricate the spindle bearings.

The Minimal Lubrication system is located next to the control cabinet. A locked door protects the system.

Operation

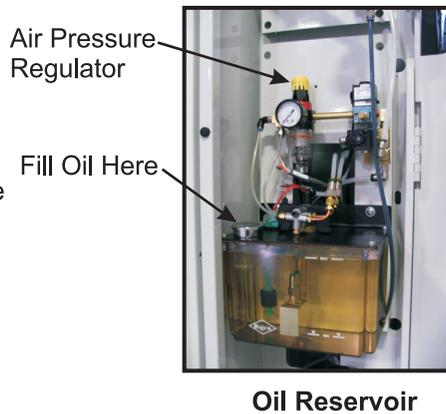
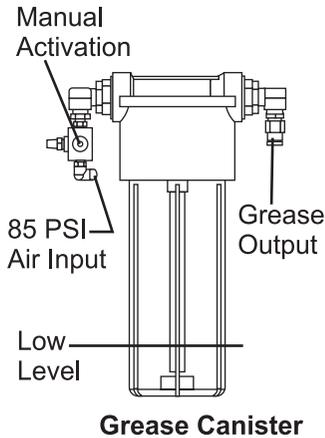
Grease System - The minimal lubrication for the linear guides and ballscrews is a grease system.

The grease system injects lubrication based on the distance of axis travel instead of time. Grease is injected once any of the axes has traveled the distance defined in parameter 811. This grease is distributed equally to each of the lubrication points for all axes.

A full grease canister should last approximately one year.

Air/Oil System - The minimal lubrication system for the spindle is an air/oil mixture. The air/oil system injects lubrication based on the number of actual revolutions of the spindle. A timed air/oil injection cycle is also used for low speed spindle operation to ensure an adequate amount of lubrication to the spindle.

A single tank of oil should last a minimum of 1 year of continuous spindle operation.



Maintenance

Grease Canister Refill:

Note: Make sure to check the grease level regularly. If the reservoir becomes completely empty, do not refill the reservoir and do not operate the machine. Contact your dealer to have the system purged and primed before you operate the machine.

Use Mobilith SHC 007 grease to refill the grease canister.

You can also order a refill bag using Haas part number 93-1933.

1. Disconnect machine air.
2. Use the provided wrench to loosen and remove the grease canister.
3. Cut a corner off of the grease refill bag to use all of the grease, or tear off the top of the bag at the perforation to use some of the grease and then reseal the bag.



Tear the bag at the perforation (resealable) or cut a corner



4. Refill the canister from the grease bag.



5. Screw the reservoir back in and tighten with the wrench. The head has a stop to prevent over-tightening.
6. Connect machine air.

If a grease system alarm occurs, take steps to resolve the problem in a reasonable amount of time. If the alarm is ignored for a long period of time, damage to the machine will result.

Filling the Oil Reservoir:

1. Clean the top of the tank.
2. Open the fill cap and pour DTE-25 oil into the reservoir until the level reaches the maximum fill line.

Oil system alarms: Alarm 805 is the oil system alarm. If an alarm occurs take steps to resolve the problem in a reasonable amount of time. If the alarm is ignored for a long period of time, damage to the machine will result.

Air/oil system: Validation of the oiling system: While the spindle is turning at low speed, depress the manual override key on the solenoid operated air valve for 5 seconds, then release. Oil will be seen in very small amounts at the fitting between the air mixer copper line to the air hose. It may take several seconds before being able to see traces of the oil.

COOLANT AND COOLANT TANK

Machine coolant must be water-soluble, synthetic oil based or synthetic based coolant/lubricant. **Using mineral cutting oils will damage rubber components throughout the machine and void the warranty.**

Coolant must have rust inhibitors. Do not use pure water as a coolant; machine components will rust.

Do not use flammable liquids as coolant.

Acidic and high alkaline fluids will damage components throughout the machine.

See safety section and labeling concerning flammable and explosive fluids and materials.

The coolant tank must be thoroughly cleaned periodically, especially for mills equipped with High Pressure Coolant.

Coolant Overview

As the machine runs the water will evaporate which will change the concentration of the coolant. Coolant is also carried out with the parts.



A proper coolant mixture is between 6% and 7%. To top-off coolant only more coolant or deionized water should be used. Be sure that the concentration is still within the range. A refractometer can be used to check the concentration.

Coolant should be replaced at regular intervals. A schedule should be set and held to. This will avoid a build up of machine oil. It will also ensure that coolant with the proper concentration and lubricity will be replaced.

WARNING! When machining castings, sand from the casting process and the abrasive properties of cast aluminum and cast iron will shorten coolant pump life unless a special filter is used in addition to the standard filter. Contact Haas Automation for recommendations.

Machining of ceramics and the like voids all warranty claims for wear and is done entirely at the customer's risk. Increased maintenance schedules are absolutely required with abrasive swarf. The coolant must be changed more often, and the tank thoroughly cleaned of sediment on the bottom.

Shortened pump life, reduction of coolant pressure and increased maintenance are normal and to be expected in abrasive environments and is not covered by warranty.

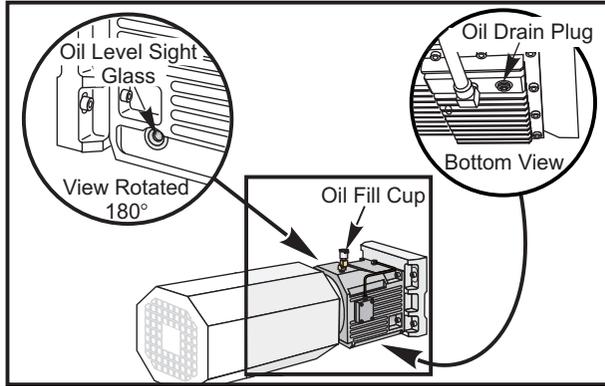
TRANSMISSION OIL

Oil Check

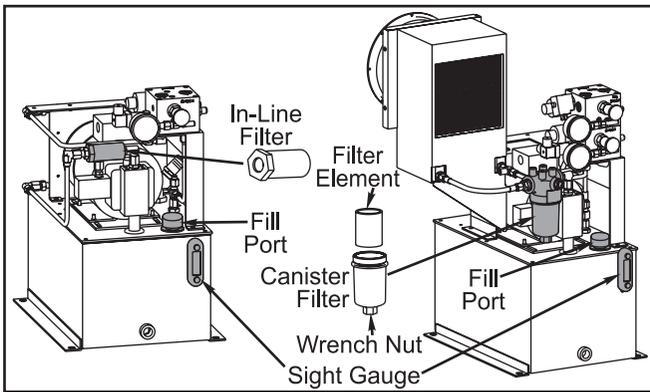
Check the oil level at the sight glass through the opening in the side of the machine as shown in the illustration. Fill as needed through the fill port on top of the gear box.

Oil Change

1. Remove the sheet metal necessary to gain access to the transmission, and remove the fourteen (14) SHCS from the oil pan and remove it. Inspect the magnetic drain-plug for signs of metal particles.
2. Wipe down the oil pan and reinstall it with a new gasket. Blow downward with an air hose in the vicinity of the access plate to prevent dirt and metal particles from entering the gear case. Remove the access plate.
3. Fill the gear case with 2¼ liters of Mobil SHC-625 gear oil. Check the sight glass. The level should be ¾ of the way up when full. Fill as needed.
4. Install access plate with new gasket, and run a spindle warm-up and check for leaks.



HYDRAULIC POWER UNIT (HPU)



Checking the Oil Level

Observe that the oil level is above the fill line in the sight gauge of the HPU. If not, use the fill port to supply DTE-25 oil to the unit. Fill the unit until oil is observed at the top of the sight glass.

Oil Filter Replacement

In-Line: Unscrew the filter at both ends, remove it from the unit and replace it with a new in-line filter. Discard the old filter.

Canister: Unscrew the canister using the wrench nut at the bottom, remove the filter element and replace it with a new one. Tighten the canister using the wrench nut. Discard the old filter element.

NOTE: If a barfeeder or automatic parts loader is connected to the lathe, remove it to gain access to the Hydraulic Power Unit.



Filters and Replacement Elements

Filter Manufacturer	Oil Filter Part Number	Replacement Element Part Number
Pall	58-1064	58-1065
Hydac	58-1064	58-6034
Flow Ezy	58-1064	58-1067

CHIP AUGER

During normal operation, most chips are discharged from the machine at the discharge tube. However, very small chips may flow through the drain and collect in the coolant tank strainer. To prevent drain blockage, clean this trap regularly. Should the drain become clogged and cause coolant to collect in the machine's pan, stop the machine, loosen the chips blocking the drain, and allow the coolant to drain. Empty the coolant tank strainer, then resume operation.

Machining Remnants

The end of bar remnant must be collected the same way parts are when using a bar feeder. Remove the remnant by hand or, if using the parts catcher, program it to collect the remnant. Discharge tubes or auger pans that have remnants pushed through them will not be covered under the warranty.

AUXILIARY FILTER ELEMENT REPLACEMENT

Change the filter bag when the filter gauge displays a vacuum level of -5 in. Hg or more. Do not allow the suction to exceed -10 in. Hg or pump damage may occur. Replace with a 25-micron rated filter bag (Haas P/N 93-9130).

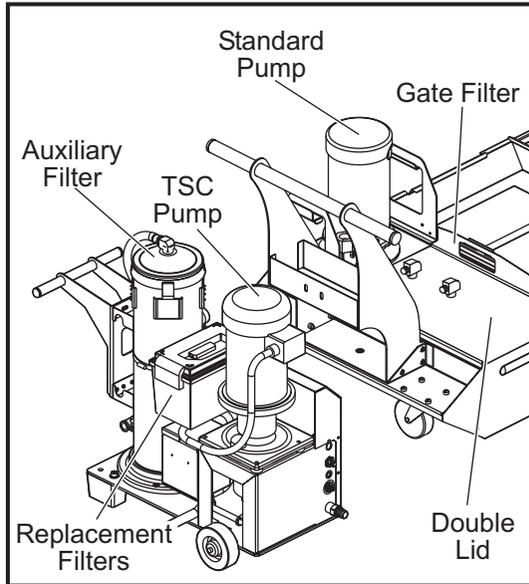
Loosen the clamps and open the lid. Use the handle to remove the basket (the filter element will be removed with the basket). Remove the filter element from the basket and discard. Clean the basket. Install a new filter element and replace the basket (with element). Close the lid and secure the clamps.



1000 PSI HPC MAINTENANCE

HPC1000 Maintenance

Before doing any maintenance to the 1000psi system, disconnect the power source; unplug it from the power supply.



TSC1000 / HPC1000

Check the oil level on a daily basis. If the oil is low, add oil through the fill cap on the reservoir. Fill the reservoir about 25% full with 5-30W synthetic oil.

Auxiliary Filter Element Replacement

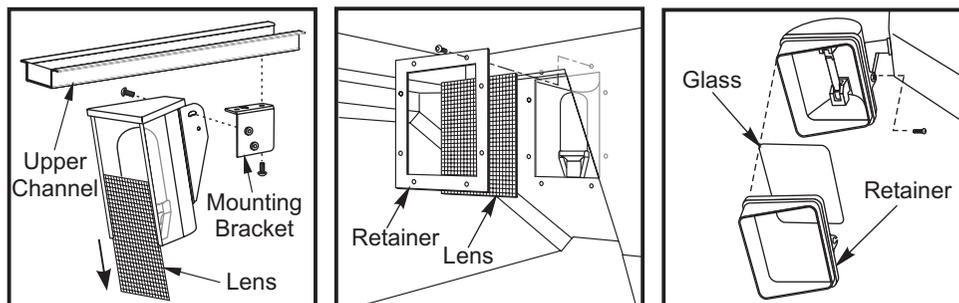
Change the filter bag when the filter gauge displays a vacuum level of -5 in. Hg or more. Do not allow the suction to exceed -10 in. Hg or pump damage may occur. Replace with a 25-micron rated filter bag (Haas P/N 93-9130).

Loosen the clamps and open the lid. Use the handle to remove the basket (the filter element will be removed with the basket). Remove the filter element from the basket and discard. Clean the basket. Install a new filter element and replace the basket (with element). Close the lid and secure the clamps.



WORKLIGHT

Before doing any work on the lathe, turn off power to the machine at the main breaker.



NOTE: The power for the worklight comes from the GFI circuit. If the worklight does not turn on, check this first, it can be reset at the side of the control panel.





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