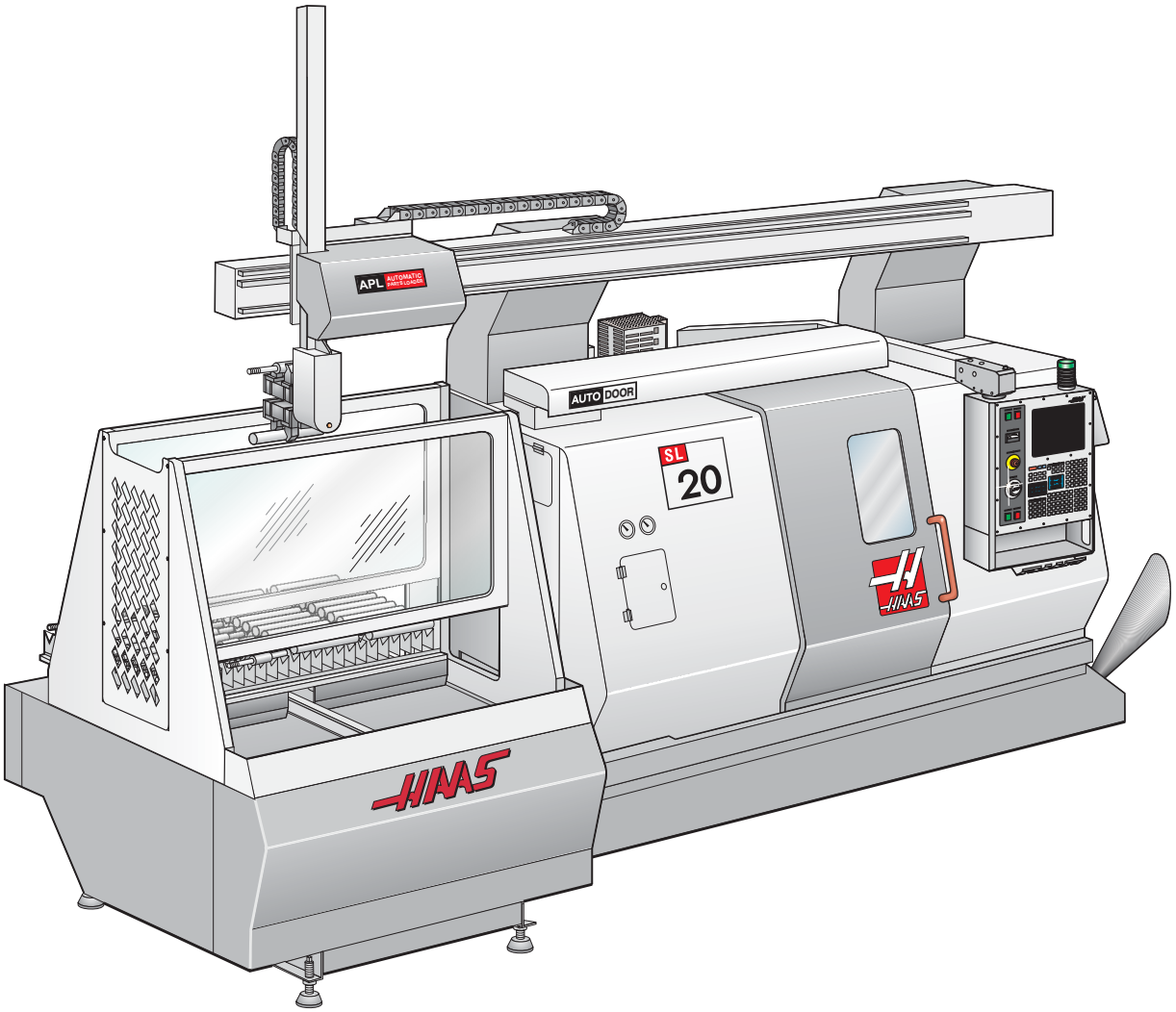
Operator's Addendum

Automatic Parts Loader



Larger/Longer Workpieces

The SL-20 APL can be configured for a single long part application using the optional single part gripper assembly. This will allow the automatic loading and turning of individual larger/longer workpieces.

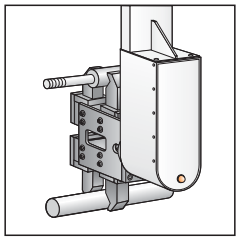
Specifications

APL: Table Size 48” x 24”
Load Table Capacity - 1000 lbs.

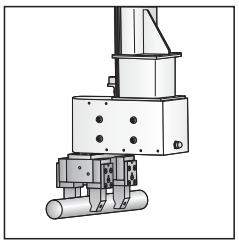
Double Gripper / Double Part * :
15 lbs. each, standard gripper can hold two parts (30 lbs. max)
5.25” Maximum part diameter
16” Maximum part length

Optional Two-Clamp Shaft Gripper (single part / double gripper) ***:**
30 lbs. Maximum part weight
4” Maximum part diameter
16” Maximum part length

Raw Material Reference Data
Standard Gripper Configuration (type 2 - two parts):
2 parts, 15 lbs. each
4.0” dia. x 4.25” long, 15 lbs. Steel
4.0” dia. x 12” long, 15 lbs. Aluminum
3.5” dia. x 16” long, 15 lbs. Aluminum
3.0” dia. x 7.7” long, 15 lbs. Steel
2.5” dia. x 11.0” long, 15.3 lbs. Steel
2.0” dia. x 16.0” long, 14.2 lbs. Steel

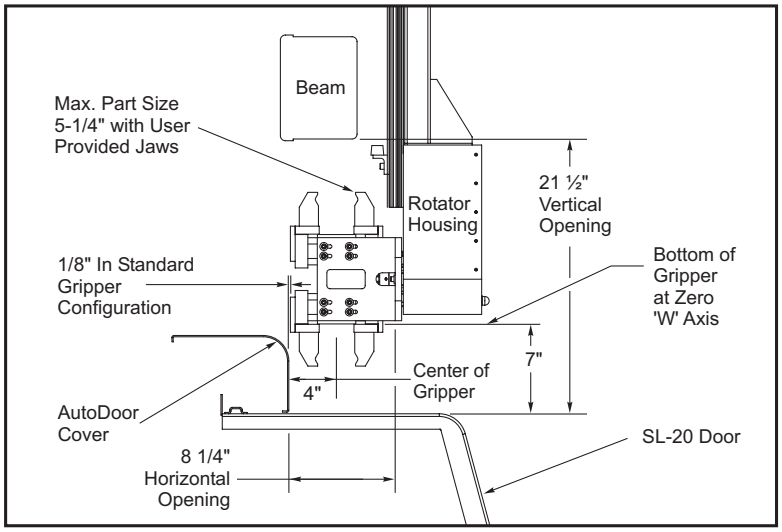


Optional Gripper Configuration (type 1 - one part):
1 part, 30 lbs. each
3.0” dia. x 15.0” long, 30 lbs. Steel
4.0” dia. x 8.5” long, 30 lbs. Steel
6.0” dia. x 16” long, 20 lbs. Aluminum



*** The part-gripping jaws may require special user-defined shapes for irregular shaped parts.**

Part Clearances



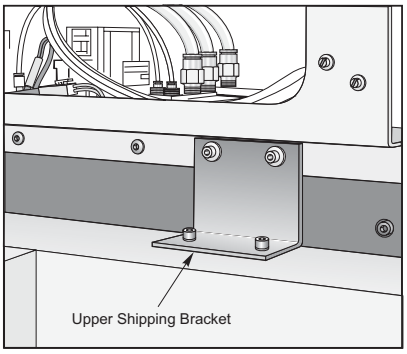
Note: The APL uses power and air from the SL-20. See the SL series Reference Manual for the SL-20 power and air requirements.

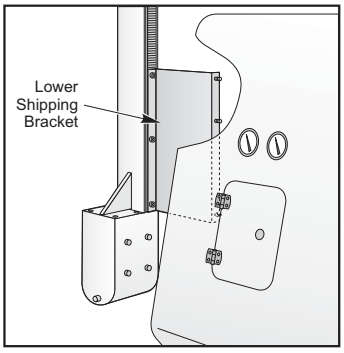
Basic Set-Up

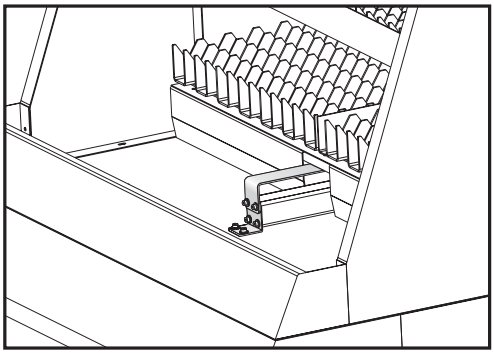
WARNING

Do not power up the SL-20 and zero the axes with the APL shipping brackets in place.

1. Remove both the upper and lower APL shipping brackets. The lower bracket attaches the ram to the side of the SL-20 sheet metal.







2. Replace the screws in the side of the lathe sheet metal with plated button-head screws (1/4 x 20) and reinstall SHCS in the ram rack gear. The rack screws do not require washers.
3. The upper bracket attaches the carriage plate to the APL beam. Remove and replace the screws in the carriage plate.
4. Remove the shipping bolts from the beam.
5. Remove APL parts table (V-axis) shipping bracket. Reinstall the two M6 screws into the top of the linear actuator front mounting bracket.
6. Check to be sure that all packing material has been removed. Refer to the Maintenance section and lubricate the rack gears and linear guide runner blocks.
7. Attach the APL parts table control cable, with the APL still clear of the SL-20. Zero the SL- 20 APL axes.

Caution: If the part storage table has been placed next to the SL-20, be sure that the gripper and rotator are clear between the front and rear screens.

ALIGNING THE SL-20 APL

1. Level the SL-20 as described in the SL-series Reference manual.

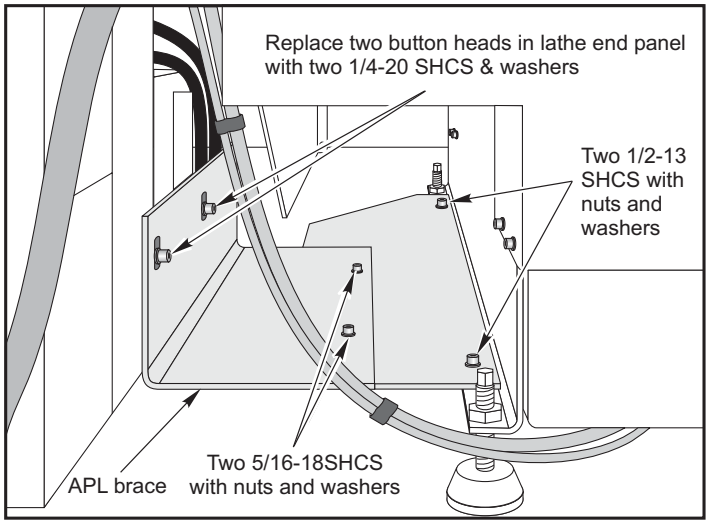
2. Position the APL parts table 5.5” away, and 22” in front of the SL-20 sheet metal (at the contour). Use the APL brace as an alignment guide.

3. Leveling and squaring the parts table is accomplished by indicating the front edge of the table and sweeping the U axis left to right and the V-axis front to back with an indicator attached. The table should be perpendicular and parallel to the U axis +/- .020" end to end. The table level is adjusted with the four leveling pads at the base.

4. The front to back location is fine-tuned by moving the parts table so that the first part (front left of table) is located under the gripper. It is leveled by attaching an indicator to the lowered gripper and running the V axis front to back.

5. Final alignment and level is verified by aligning the U and V axes over the first part on the table and then moving to the U and V locations over the last part.

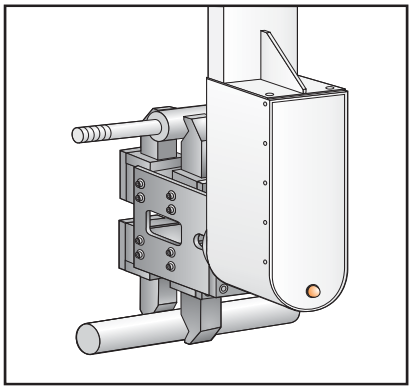
Note: Refer to macro variable section for determining last part location. (Number of U positions and number of V positions)



6. After aligning the parts table, install the APL brace and tighten all the bolts.

Gripper Configuration

Standard Gripper Configuration (Type II)



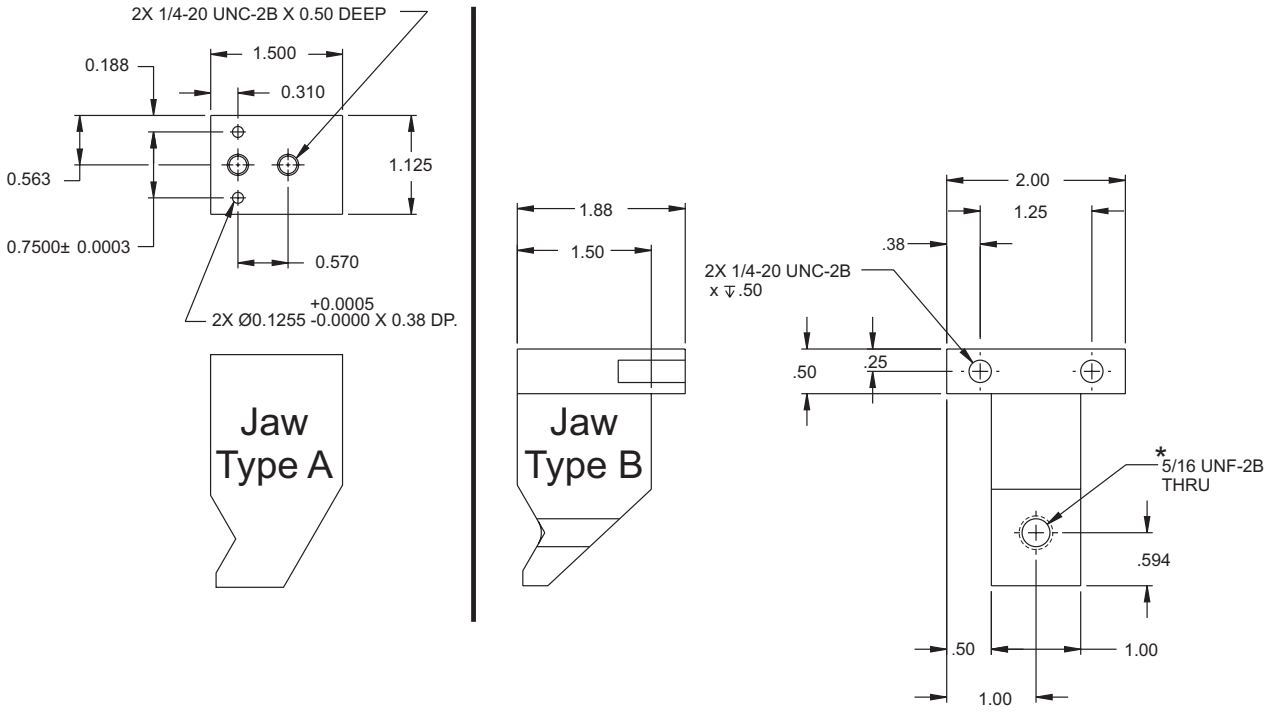
The standard gripper configuration has the ability to reverse a part in order to machine the opposite end. The standard gripper can load raw material and retrieve a finished part in one pass.

The standard gripper jaw configuration can be used to run parts ranging from 2.00" diameter to 2.88" diameter. Other diameters or shapes will require the user to provide gripper jaws.

Gripper stroke is .75" (19mm) per side

The following drawing shows the dimensions for the gripper jaw to the gripper flange interface.

Note: There are two different types of APL grippers jaws, verify the type you have before machining or requesting new ones.



Note: The standard grippers are provided with 5/16-24 UNF cup point setscrews which keeps the part from slipping during rotation.

Programming the APL

Overview

The APL comes with 6 templates, programs O5000-O5004 and O5008. These programs are designed to help the programmer position parts in and out of the spindle by following step by step instructions. As the system and program becomes more familiar these example macro programs can be adjusted for better efficiency. The example macro programs use G-codes, M codes and macro variables to control the parts loader.

Zero position for the APL axes:

U-axis (Ram) left over PSM (Parts Storage Module)
V-axis (Part table) at back of PSM
W-axis (Ram) up under carriage

CAUTION: SL-20s that are equipped with an APL have an Auto Door. The Auto Door will automatically close when the Cycle Start button is pressed. See Auto Door in the options section of the SL-Series Operator's Manual for additional information.

Note: Set up the V-holders and stop plates for the parts on the PSM. Allow space in the V-axis to allow the open gripper to come down between parts. Place excluder clips as required to avoid misplacing raw material on subsequent table setups for this part.

Operation Notes

- The Macro Control Programs must have the look ahead limited to one (G103 P1).
- ZERO RETURN / AUTO ALL AXES will work in this order:
  1. W-axis up.
  2. U-axis to left.
  3. V-axis away from front.
  4. Standard Lathe Axes order.

Quick Start Guide

A set of macro programs is delivered with the Haas APL. These programs are programs O5000-O5005. Go to the program list page and load the job control program O5000. This program will select the correct sub program (O5001-O5004) to run depending on your job configuration. 23 macro variables are used to specify your setup. Table 1 and setup diagram 1 describes these macro variables. A step by step guide for determining the values for these macro variables follow.

At this point the programmer has prepared and debugged his machining programs and should have at least 2 pieces of raw material, one part machined from the first side and one finished part on hand. The parts tray should have been adjusted for the raw material gripper and the finished part gripper.

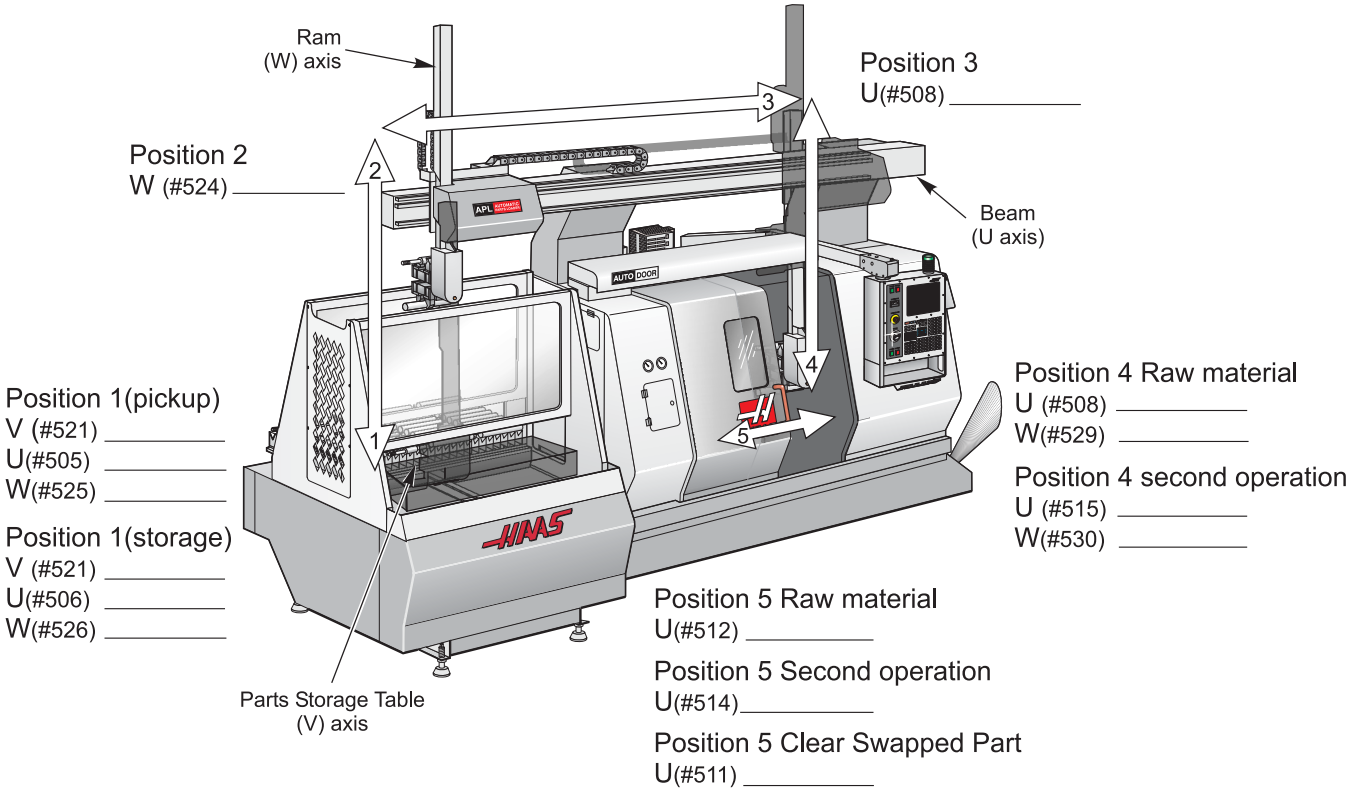
In order to setup the APL it is necessary to jog the APL's axes to a number of positions and enter these positions into Macro variables. The instructions will refer to the Macro variables as (#xxx); xxx being the Macro variable, for example, #508. All the positions are critical to proper operation of the part loading and unloading program (procedure). To set up automatic parts loading open the door of the lathe and home the tool turret.

Example Macro Programs

O5000	Main program based on macro variables for head type and number of sides machined picks the appropriate program to run.
O5001	Single Head with only one side of part being machined.
O5002	Single Head with both sides of part being machined.
O5003	Double Head with only one side of part being machined.
O5004	Double Head with both sides of part being machined.
O5008	Double Head with only one side of part being machined; used for stacking

Note: The APL always picks up raw material in one jaw and finished parts in the other. This means that similar positions are programmed twice in order to properly pick up the parts. As finished pieces are shaped differently, different gripper clamping and gripper position may be necessary.

It may be helpful to put a piece of tape on one of the jaws to remind you which jaw is the raw material jaw and which is the finished part, or second operation jaw.



As the values for the Macro Variables are entered into the control, enter the values in the chart on the previous page as well. Having the chart filled out will be useful when referring back to previously entered variables.

1. Set Macro Variable #516 to 2 for a double sided gripper or 1 for a single sided gripper. Set Macro Variable #500 'Sides to be machined'. Enter either a '1' or a '2'.

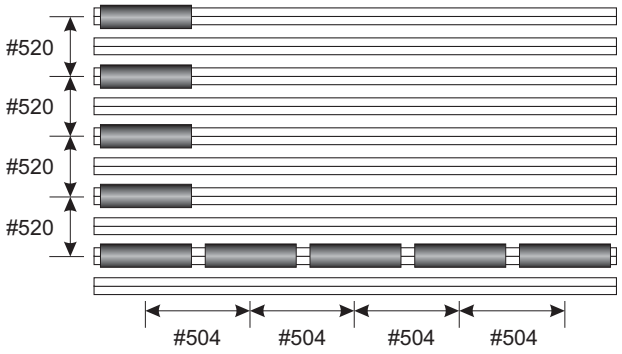
2. Set macro variable #503 to the number of parts along the U axis and #519 to the number of parts along the V direction.

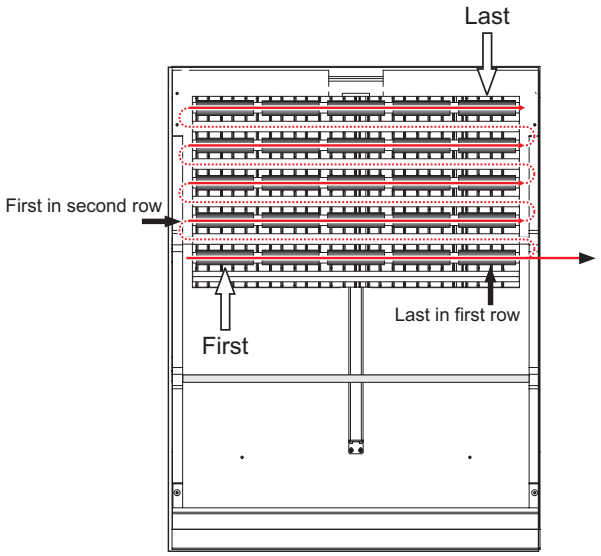
3. Create a program with a dwell of 2 seconds followed by an M99 (e.g. G04 P2.0; M99;) and enter the program # for this program into #501 and #517. This will be a place holder for your real cutting programs.

4. Command the raw material gripper so that it is pointing down and open by going to MDI and run the following:

M165;
G164 P0;

5. Jog the gripper into a position where it will pick up the first piece. The first piece is the left-most piece closest to the operator on the table. It will be necessary to move all of the APL's axes in order to safely pick up a part. Move the table back and forth, V-axis, The ram up and down, W-axis, and the carriage left and right, U-axis. When jogging into position be careful not to hit anything with any of the axes. For example, the grippers must go **between** the 'sharktooth' part holders to properly pick up a part.





6. Once you are in position the grippers are opened and closed using M166 and M165. If necessary, fine tune the positions.
Record your position in the macro variables #521, #505 and #525 (using the values found on the POS-MACH display).
Leave a raw part in the jaws.

7. Set the U axis increment between parts. Jog to the right-most part on the table and put the APL into position to pick this piece up. Record the position of the U axis. Subtract this value from the value entered in #505 and divide by the number of U positions –1

(#505 – current U position) / (#503 –1)

Enter this value in #504 and under U Increment on the diagram (this value should be **negative**).

8. Set the V axis increment between parts. Jog to the rear most part on the table and put the APL into position to pick this piece up. Record the position of the V axis. Subtract this value from the value entered in #521 and divide by the number of V positions –1

(#521 – current V position) / (#519 –1)

Enter this value in #520 and under V Increment on the diagram (this value should be **negative**).

9. Jog the W-axis up to a position where it will clear the lathe once the carriage starts to travel. Record the position of the W-axis in #524. This is usually zero (0).

10. Jog the U-axis to a position above the lathe door opening, where the ram can safely enter the lathe. Record the position of the U-axis into #508. This is the position that the APL will hold a part while waiting for machining to complete. The APL will move down from this position to begin putting the part into the spindle.

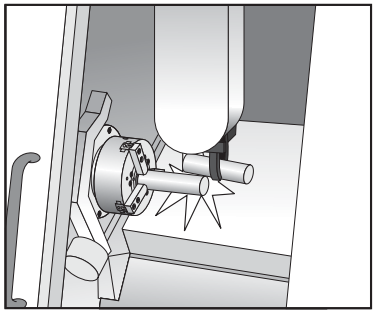
11. Jog the W-axis down into the lathe. Watch closely to make sure the ram or the part will not hit anything as it travels. You may have to move the turret or tailstock out of the way. The W axis must go down so that the part is lined up with the spindle center without moving the U axis. Be sure that your parts program leaves this path clear when it is finished. If necessary adjust the U-axis accordingly and correct the value of #508 recorded in the previous step.

12. Jog the U and W axis until the part is in the chuck where you want to close the jaws. Record the U position into #512 and the W position into #529. After placing a part in the spindle the APL will close the chuck, open the grippers (M165) and return the U and W axes to the position defined in #508 and #524 above. **Position the ram outside of the lathe and close the door.** Run program O5004 in single block mode.

13. It is recommended that you remove any parts from the jaws, load raw material in the first two positions on the parts table and single block through the program with rapids at 25% to check material loading and test the pickup and chuck loading portion of the program. Stop the program by pressing reset when the first part is loaded and the APL has picked up the second part and returned to the waiting position over the lathe door.

14. Replace the raw part in the chuck with a part that has the first side machined. The positions for removing this part from the chuck will now be defined.

15. Jog the W axis down until the **upper grippers** are lined up with the part in the spindle. Be sure that the material in the lower gripper does not hit the part in the chuck. Adjustments to #508 may be needed to assure clearance.



16. Jog the U axis to the position where you will grab the half finished part. Fine tune the U and W positions for picking the part out of the chuck. Record the U position into #515 and the W position into #530.

17. Close the upper gripper and open the chuck. Jog the U axis to the position listed in #508 and the W axis to the position listed in #524 above.

18. If you are only machining one side continue at step 20. If you are machining 2 sides enter the following into MDI and press CYCLE START to turn the part over.
M164 P4

19. Jog U to the position in #515, and W to place the half finished part into the spindle. Record the W position in # 528. Close the chuck and open the gripper (M167).

20. Jog the APL to the wait position over the door. Put a finished part in the chuck.

21. Jog U and W to the position to remove the finished part from the chuck. Record the U position in #514. The W position should match #529. Close the grippers (M168), open the chuck and jog out of the lathe.

22. Be sure that the V-axis is in the position for the first part (#521). Jog U and W into position to put the finished part back into the first position on the part table. Record the U position in #506 and the W position in #526.

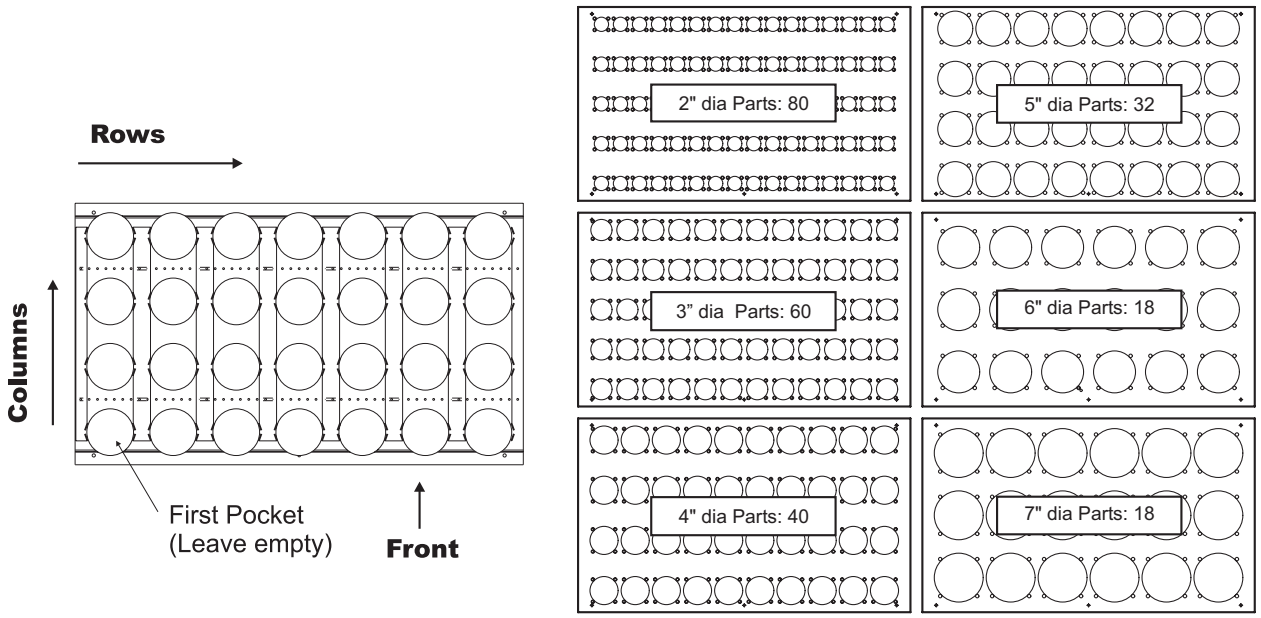
23. Set #501 to the first operation program number, and #517 to the second operation program number.

Note: Macro Variable 3203 (Flipper Wait Pos) can be set to locate the grippers in a position that will avoid other workpieces or fixtures as the part enters the turning center. Enter a value, between 0 and 7 to set the position.

You are now ready to run parts. Remove all parts from the grippers and chuck. Load material on the parts tray. And run program O5000. It is recommended that you run with reduced rapids and watch the first 3 parts run closely before allowing unattended operation.

Macro Program 5008 for Stacked parts

This program allows parts to be stacked in an APL and is used in conjunction with the previous programming instructions. The minimum number of parts usable with this program is two rows in two columns, stacked two parts high. The first pocket must be left empty to allow for the replacement of parts as they are finished.



APL table, Top view

Certain hardware changes must be made for the Macro 5008 option. Replace the standard "sharktooth" part holders on the table with the part stacking guides. The standard gripper assembly must be replaced with the stacking gripper assembly.

Macro Variables for Stacked Parts

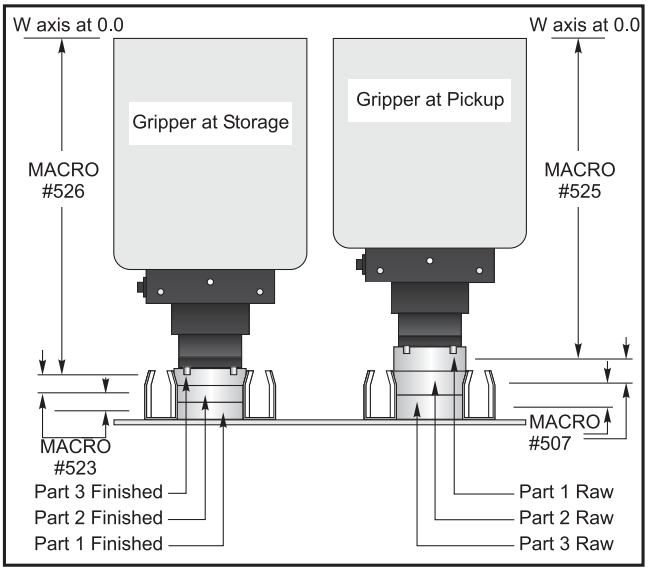
518 - Determines the total number of parts stacked in a pocket.

525 - Sets the pickup position for the first part in the "W" direction.

526 - Sets the storing position for the last part in the "W" direction.

507 - Picks up the raw part at current height. This should be a negative number.

523 - Drops off the finished part at current height. This should be a negative number.



Profile of Pickup and Storage Operation

APL M Codes

M164 Rotate APL Grippers
This code is used to rotate the APL grippers. A Pn code is required to designate the desired position. The grippers can be positioned to any of 8 positions 45 degrees apart. Position 0 sets gripper 1 (raw material) pointed down. Position 4 Points gripper 2 (finished parts) down.

M165 Open APL GRIPPER 1 (Raw Material)
This code opens the raw material gripper or the optional single part gripper.

M166 Close APL GRIPPER 1 (Raw Material)
This code closes the raw material gripper or the optional single part gripper.

M167 Open APL GRIPPER 2 (Finished Parts)
This code opens the finished parts gripper.

M168 Close APL GRIPPER 2 (Finished Parts)
This code closes the finished parts gripper.

APL G Codes

G159 Background Pickup/Part Return
This code is used to initiate automatic background pickup of raw material and return of finished parts. It uses the following macro variables to control the pickup and drop-off positions and what action will be done. These macro variables must be set before calling G159.

3200 U pickup location
3201 V pickup location
3202 W pickup location
3208 U drop off location
3209 V drop off location
3205 W drop off location
3207 Command
Possible values for command:
1. Pick up raw material using 2 position gripper
2. Put away finished part using 2 position gripper
3. Pick up raw material and put away finished part using 2 position gripper
4. Pick up raw material using optional single part gripper
5. Put away part using optional single part gripper
6. Put away finished part and pick up raw material using optional single part gripper

3213 U wait position

G160 APL Axis Command Mode On
This code opens the autodoor, and waits for any background motion to complete. Once background motion has been completed the control is placed in APL axis command mode. U,V and W Feed and rapid commands are directed to the APL U,V and W axes. While in G160 mode the door must remain fully open. If the door should be partially closed alarm 127 Door Fault will be generated.

G161 APL Axis Command Mode Off
This command returns U and W commands to their normal meaning of X and Z incremental moves. Once G161 is commanded the door can be closed.

CAUTION: Use caution when in G160 mode. Remember that a command of U-1.0 will send the APL robot over the parts table possibly crashing the APL ram into the side of the machine. It will not move the X axis –1.0 inches.

Parameters

315 bit 9 APL
This parameter should be set to 1 when a Haas Lathe APL is installed. Otherwise, it should be set to zero.

581 APL FLIPPER SETTLE
This parameter specifies the rotational time for the gripper after the switch is encountered and should be set to 100. Units are milliseconds.

582 APL FLIPPER TIME OUT
This parameter specifies the allowed rotational time when searching for the home switch and should be set to 2000. Units are milliseconds.

583 APL MAX POSITIONS
This parameter specifies the number of switch positions in rotation and should be set to 7.

584 APL GRIP OPEN TIME
This parameter specifies the maximum allowable time for opening the gripper and should be set to 500. Units are milliseconds.

585 APL GRIP CLOSE TIME
This parameter specifies the maximum allowable time for closing the gripper and should be set to 500. Units are milliseconds.

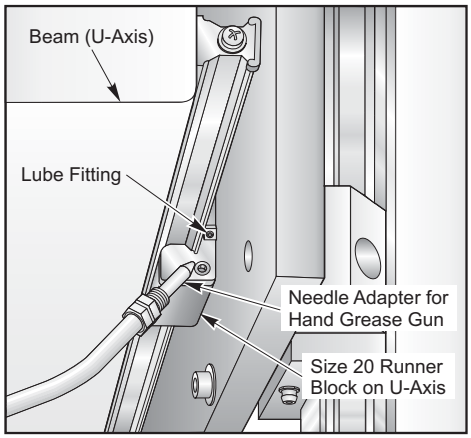
Recovery

If you encounter a problem and need to restart, remove any parts from the grippers and chuck and set the program pointer to the restart position in program O5004. The following instructions illustrated how to recover from a problem.

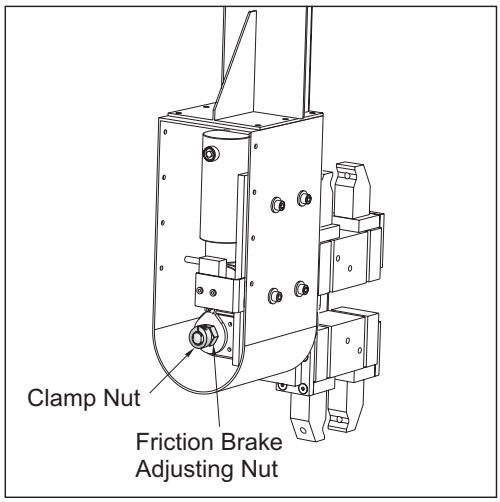
1. Change Setting 53 JOG W/O ZERO RETURN to ON. Unclamp the chuck, and handle jog the part out of the machine.
2. Execute commands to release the part in the gripper. Ensure the Auto Door does not close. Do not drop the part.
3. Change setting 53 JOG W/O ZERO RETURN to OFF.

- Lube the linear guide runner blocks (U and W axes) monthly with general purpose lithium grease.

NOTE: A needle type adaptor is required for the size 20 block on the U axis.



- If excessive shaking occurs during part rotation, loosen the clamp nut on the friction brake at the end of the spindle and tighten the nut applying pressure to the brake pad to 70 **inch** pounds. Retighten the clamp nut.



- Apply a thin film of general purpose grease to the U and W axes rack gear monthly

- Clean chips and debris from the roller surface of the front storage table.

Part Location – Worksheet

Macro Variable Number	Macro Variable Name	Value	Macro Variable Number	Macro Variable Name	Value
500	Sides to be Machined		516	APL Head Type	
501	Program Number for Side 1		517	Program Number for Side 2	
502	Total Number of Parts	*Set Automatically*	518	Number of Parts Stacked in a Pocket	
503	Number of U Positions		519	Number of V Positions	
504	U Storage Increment (Should be Negative)		520	V Storage increment (should be negative)	
505	Leftmost U position to pick up part		521	Forwardmost V Position to Pick-up and Storage	
506	Leftmost U position to Store Part		522	*Available for User Function*	
507	Stack Height Increment to Pick up Raw Part		523	Stack Height Increment to Store Finished Part	
508	U Up/Down Position for Motion in Machine		524	W Position to Clear Top of Machine	
509	*Available for User Function*		525	W Position to Pick-up Raw Material	
510	*Available for User Function*		526	W Position to store Finished Part	
511	U Position to Clear Swapped Part		527	*Available for User Function*	
512	U Position to Put Part in Chuck		528	W Position to Align Chuck with High Gripper on Bottom	
513	*Available for User Function*		529	W Position to Align Chuck with Low Gripper on Bottom	
514	U Position for Second Half of Chuck		530	W Position to Align Chuck with Low Gripper on Top	
515	Position U to Finish Second Half in Chuck		531	*Available for User Function*	

Copy this page for use with future job set-ups

Note: The Macro Variables need to be set as per the following instructions. It is recommended that you choose a reduced jog rate and single block through at least 3 pieces before running jobs unattended.