



HAAS SERVICE AND OPERATOR MANUAL ARCHIVE

Automatic Pallet Changer Operators Manual 96-0012G RevG English June 2003

- This content is for illustrative purposes.
- Historic machine Service Manuals are posted here to provide information for Haas machine owners.
- Publications are intended for use only with machines built at the time of original publication.
- As machine designs change the content of these publications can become obsolete.
- You should not do mechanical or electrical machine repairs or service procedures unless you are qualified and knowledgeable about the processes.
- Only authorized personnel with the proper training and certification should do many repair procedures.

**WARNING: Some mechanical and electrical service procedures can be extremely dangerous or life-threatening.
Know your skill level and abilities.**

All information herein is provided as a courtesy for Haas machine owners for reference and illustrative purposes only. Haas Automation cannot be held responsible for repairs you perform. Only those services and repairs that are provided by authorized Haas Factory Outlet distributors are guaranteed.

Only an authorized Haas Factory Outlet distributor should service or repair a Haas machine that is protected by the original factory warranty. Servicing by any other party automatically voids the factory warranty.



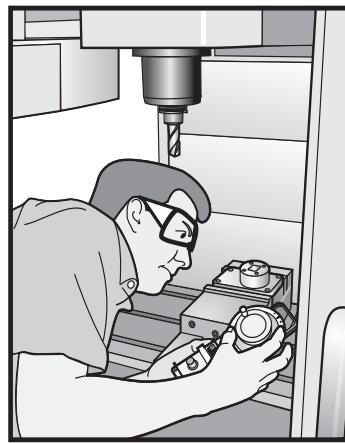
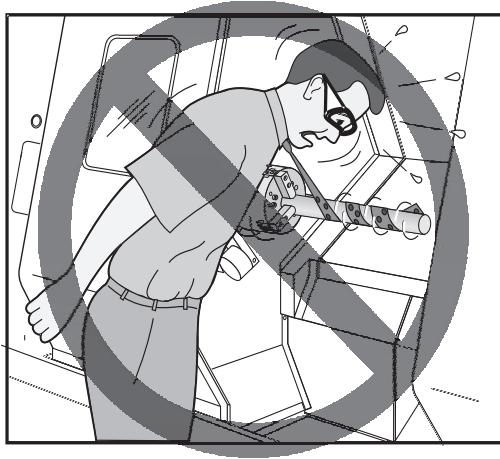
Haas Technical Publications

Manual_Archive_Safety_Pages Rev A

June 6, 2013

HAAS SAFETY PROCEDURES

THINK SAFETY!



DON'T GET CAUGHT UP IN YOUR WORK

All milling and 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.



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.
- ◆ 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. Rotating cutting tools can cause severe injury. When a program is running, the mill table and spindle head 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 your 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.
- ◆ **This machine can cause bodily injury.**
- ◆ **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.**
- ◆ **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 machine at high feeds/feed may be ejected and puncture the safety door. Machining oversized or marginally clamped parts is not safe.**
- ◆ **Windows must be replaced if damaged or severely scratched - Replace damaged windows immediately.**
- ◆ **The spindle head can drop without notice. Personnel must avoid the area directly under the spindle head.**
- ◆ **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.

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.

NEVER OPERATE THIS MACHINE WITH THE DOORS OPEN





MILL 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.
Follow safe clamping practices. Inadequately clamped parts can be thrown with deadly force.
Securely clamp workpieces and fixtures.



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.

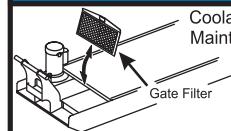


Moving parts can crush.
The tool changer will move in and crush your hand.
Never place your hand on the spindle and press ATC FWD, ATC REV, NEXT TOOL, or cause a tool change cycle.

- 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.

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NOTICE



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.



LATHE WARNING DECALS

DANGER



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



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.

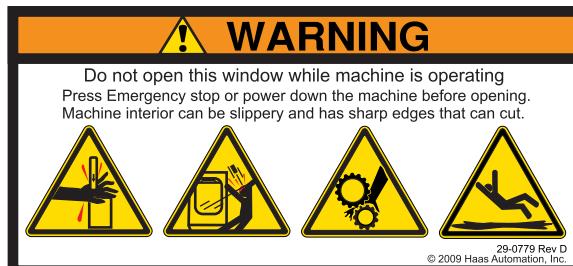
Do not use toxic or flammable liquids as a coolant.

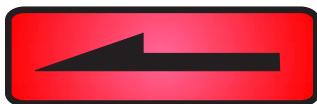
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OTHER SAFETY DECALS

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





1.0 AUTOMATIC PALLET CHANGER (APC)

1.1 OVERVIEW

IMPORTANT!

Read this entire section before attempting to install or run the APC. Serious injury or damage to the machine could result from not following these procedures.

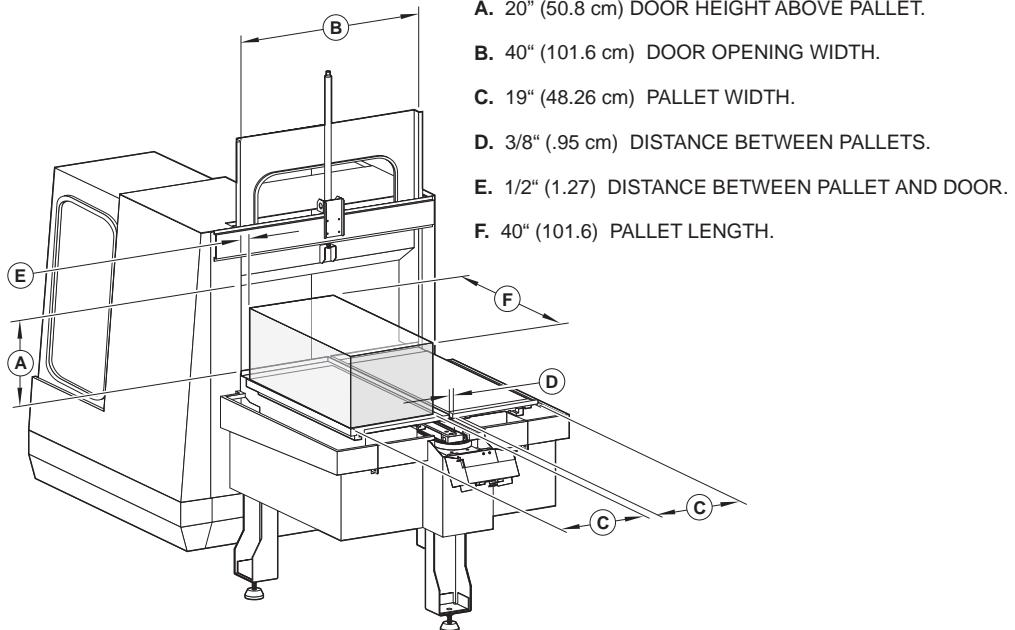
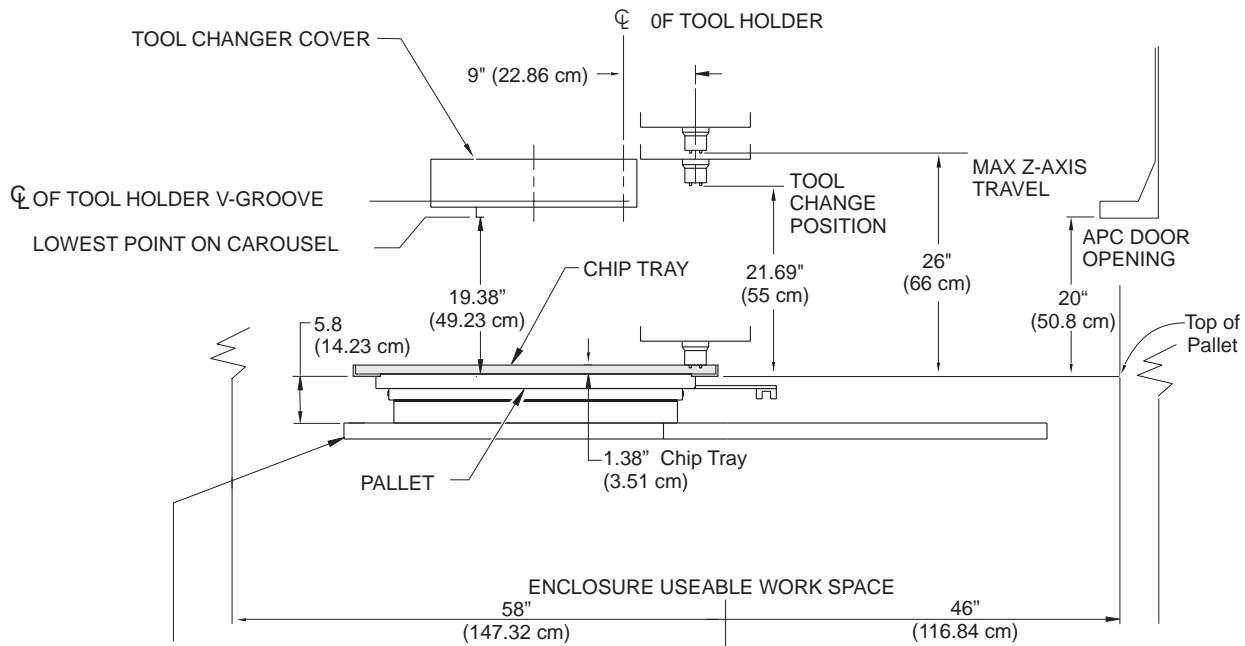
The HAAS Automatic Pallet Changer (APC) is used to automatically load and unload pallets into a HAAS VF-3 or VF-4. The APC is controlled by the VMC control, and uses the same air and power supplies. A simple M code (M50) is all that is required to change pallets.

The APC assembly consists of the base, which serves as the "home" position for the two pallets, and a receiver assembly, which is bolted to the VMC table and holds the pallets in place during machining operations. The VMC unit contains air lines for clamping pallets, and a special automatic door in the side of the VMC enclosure allows for loading and unloading of pallets. The APC has its own operator's panel, which includes CYCLE START, FEED HOLD, PALLET READY, and EMERGENCY STOP buttons.

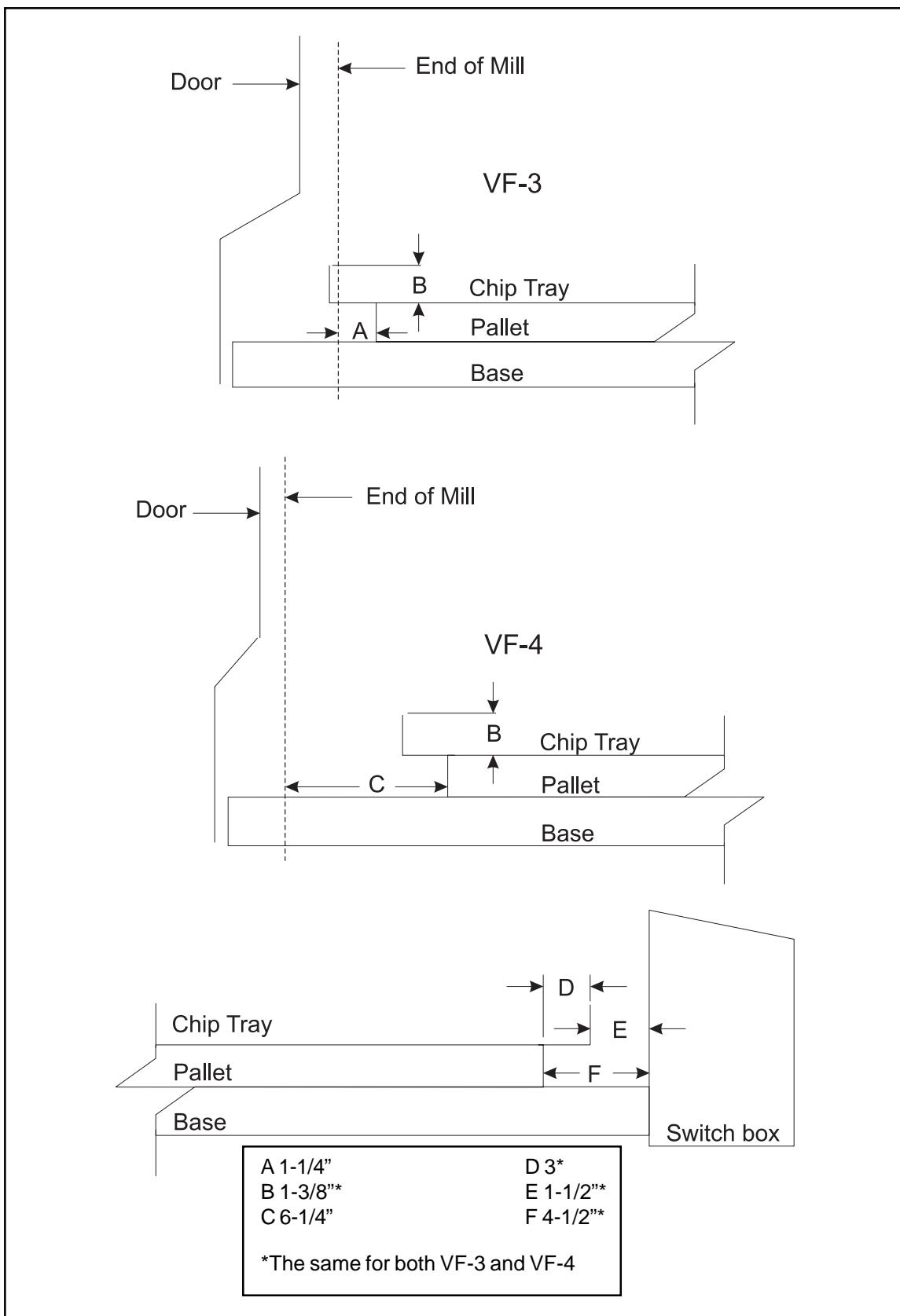
The APC can be programmed to load a pallet or change pallets by calling an M50. When a pallet change is programmed, the VMC table moves to the right and adjacent to the empty pallet position on the APC base. The receiver assembly then unclamps the pallet. The automatic door opens, the table moves to the unload position, and the pallet is pulled into its home position. The VMC table moves over to the other pallet position, the next pallet is pushed onto the receiver, and the pallet is clamped into position. The table then returns to its programmed position and the door closes.

Pallet movement is accomplished through the use of a drive motor and chain. The drive motor has a nonadjustable slip clutch that prevents damage to the motor if the pallet change is physically blocked.

NOTE: The machine will beep during a pallet change. This is an audible warning signal, and not an alarm.

**1.2 APC WORKING DIMENSIONS****APC DIMENSIONS****APC WORK ENVELOPES**

MILL TABLE (AT HOME POSITION)
SIZE: VF-3 48" x 18", (121.92 cm x 45.72 cm)
TRAVEL: VF-3 40" x 20", (101.60 cm x 50.80 cm)


APC PALLET CLEARANCES




2.0 MAINTENANCE SCHEDULE

The following is a list of required regular maintenance for the HAAS Automatic Pallet Changer. These specifications, **especially the daily routine maintenance**, must be followed in order to keep your machine in good working order and to protect your warranty.

PERIODIC MAINTENANCE

INTERVAL MAINTENANCE PERFORMED

IMPORTANT!! Damage or misalignment may result from neglect of daily maintenance.

DAILY

Clean chips, coolant, and other debris from the APC and receiver areas. Pay special attention to the receiver clamping bars, and the pallet clamping rails and wipers. Clean chips and coolant from receiver pallet clamped switch. Apply a light coat of grease and work the grease into the plunger. **Do not over grease.**

WARNING:

Excessive chip buildup will require more frequent chip cleanup.

Clean the two locating pins in the receiver base and the corresponding bushings in the pallets. Apply a very light coat of general purpose grease to the pins and bushings, if needed.

Clean excessive chips and coolant from pallet drive chain.

WEEKLY

Remove the two 1/4" screws from the control panel and rotate to open position. Clean chips and coolant from the drive sprocket and limit switch. Apply a light coat of general purpose grease and work the grease into the switch plungers. Check air gauge/regulator at the VMC lube/air panel for 85 psi.

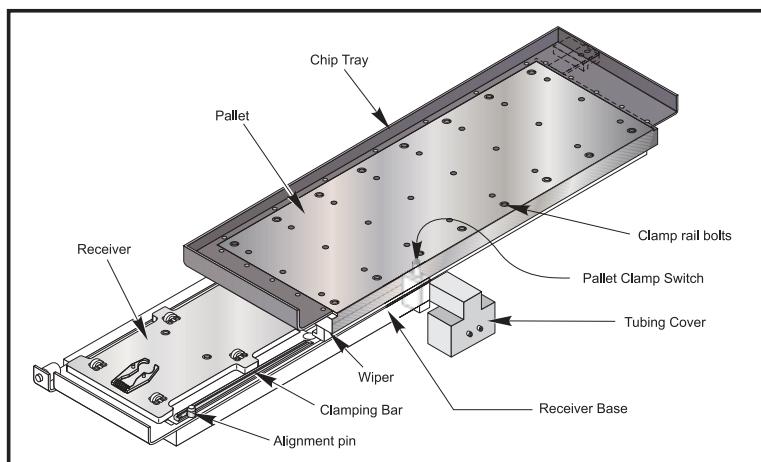
Check condition of wipers. There are two wipers on each pallet.

INTERVAL

MAINTENANCE PERFORMED

MONTHLY

Check door for proper operation, both up and down. Clean and grease door side guide rails as required.





3.0 INSTALLATION

TOOLS REQUIRED:

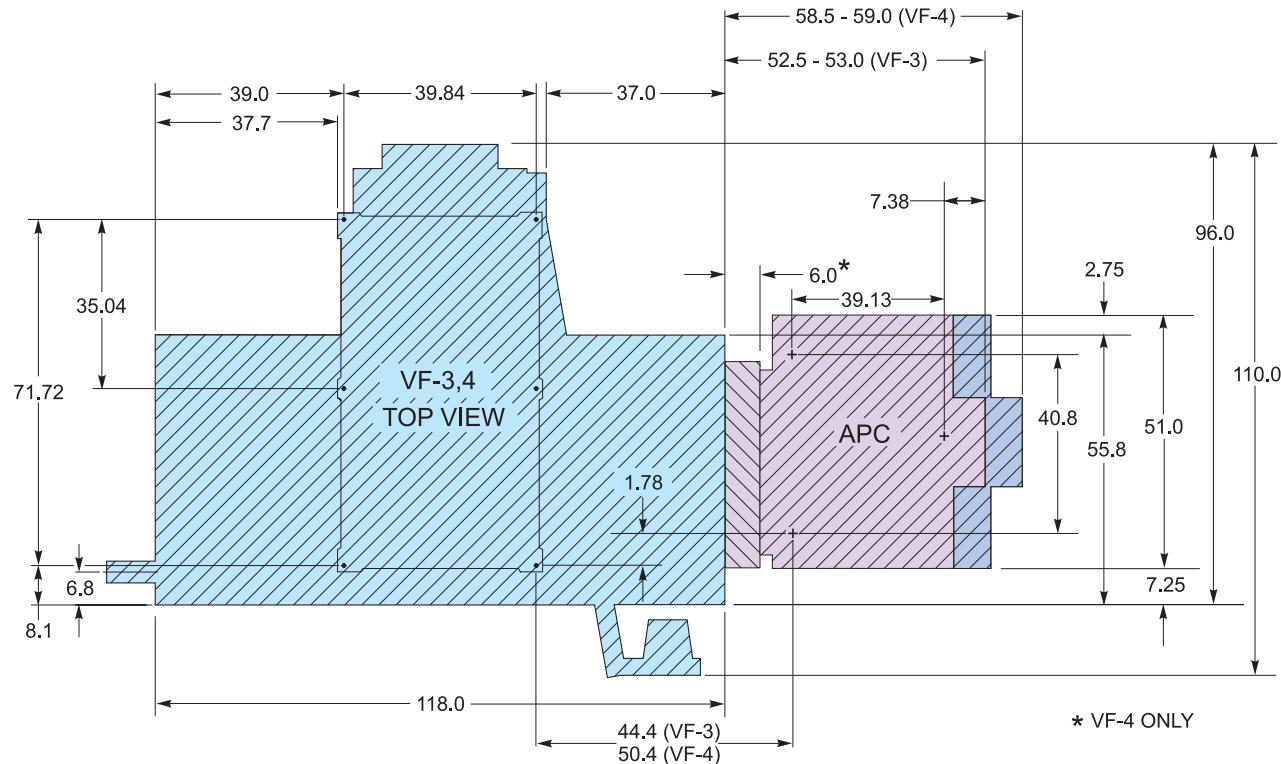
- Machinists' level (2)
- 6' straightedge
- Allen wrenches
- Forklift capable of lifting 5,000 lbs, with forks at least 6' long
- **Included** - APC chain rotation tool (P/N 20-0102)
- **Included** - APC jumper

Prior to installing your VMC, make certain that there is enough floor space on the right-hand side of the VMC to place the APC. The APC will add approximately $52\frac{1}{2}$ " ($58\frac{1}{2}$ " for the VF-4) to the width of the VMC. Ensure that all the air and power requirements for the VMC have been met.

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: less than 90% relative humidity, non-condensing	
Altitude: 0-7000 ft.	

3.1 VF/APC FOOTPRINT



VF 3/4 WITH APC FOOTPRINT

**3.2 ROUGH LEVELING / ALIGNMENT**

In this section, the APC will be set in place and roughly aligned to the VMC. When the alignment procedure is complete, the rollers on the VMC receiver and on the APC base will be at the same height and aligned with each other. In the "Fine Tuning" section, the APC will be aligned more precisely by adjusting variables in the VMC control.

1. Remove the APC from its shipping crate. Remove all tie-downs and strapping materials. Remove the pallet shipping bolts and install the socket set screw plugs with Loctite (see Figure 3.1). Lift off the pallets and set them aside. Remove the door air cylinder and the cable bundle from their storage positions in the APC pan.

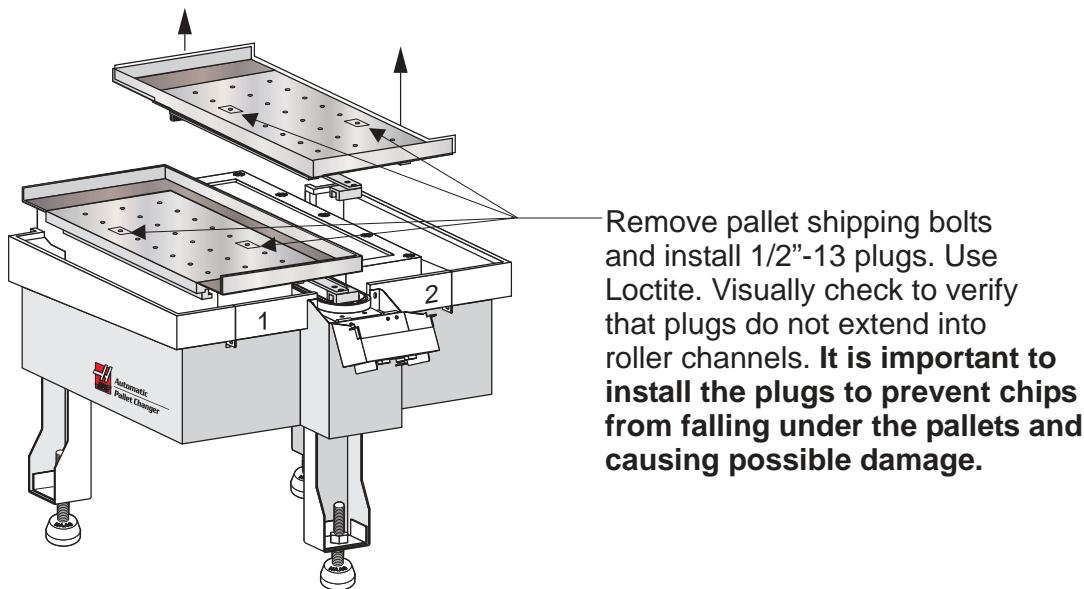


Figure 3.1 Removal of Shipping Bolts

CAUTION!

The pallets have wipers on the bottom of the clamp rails at the VMC end. These wipers should overhang any temporary storage position.

2. **Important!** Before installing the APC, ensure the VMC has been installed and leveled. Also make sure the APC jumper is installed in the "5th Axis" port on the side of the VMC control cabinet (see Figure 3.2).

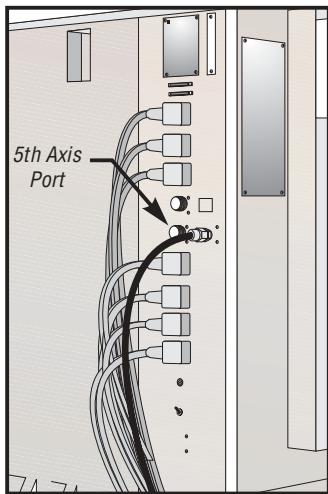


Figure 3.2 Fifth Axis port on the side of the VMC control cabinet

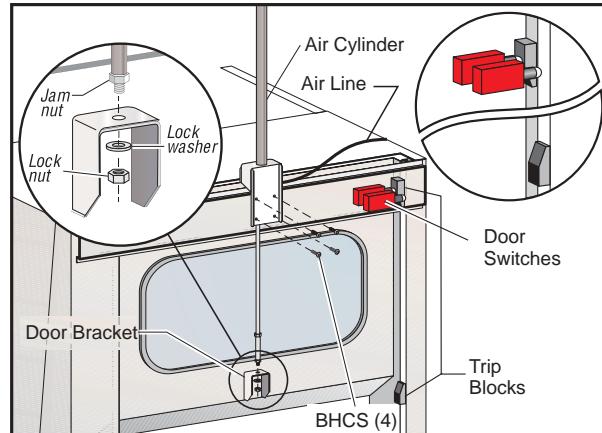


Figure 3.3 Air cylinder installation.

Installing Door Air Cylinder

3. Remove the lock nut and washer from the end of the air cylinder rod, but leave the jam nut in place. Connect the automatic door air cylinder and bracket to the machine with four 1/4"-20 BHCS, as shown in Figure 3.3.
4. Insert the air cylinder rod into the door bracket, then attach the lock nut and washer to the bottom of the cylinder rod.
5. Install the door switches and bracket onto the VMC with two SHCS each. Insert the door air line into the fitting at the base of the air cylinder.
6. POWER ON the VMC and ZERO RETURN all axes. Verify that the VMC operates normally.
7. In MDI mode, command an M17. The table will unclamp (raise) and the automatic door will open. The door and table will stay up. Clean all shipping protectant from the rollers, alignment pins and clamp bars.

NOTE: M14 will move the table slowly in case a pallet is present.

Positioning the APC

8. Raise the APC with the forklift and install the leveling screws into the legs. As a preliminary height setting, turn the screws until the length of screw extending above the APC leg is the same as the length of VMC leveling screw extending above the VMC base. Set the leveling pads (3) in place.
9. Set the APC in place on the leveling pads, so that it is centered in the VMC door opening (see Figure 3.4). Ensure that the lip of the APC enclosure is centered in the VMC drip trough (see Figure 3.5).

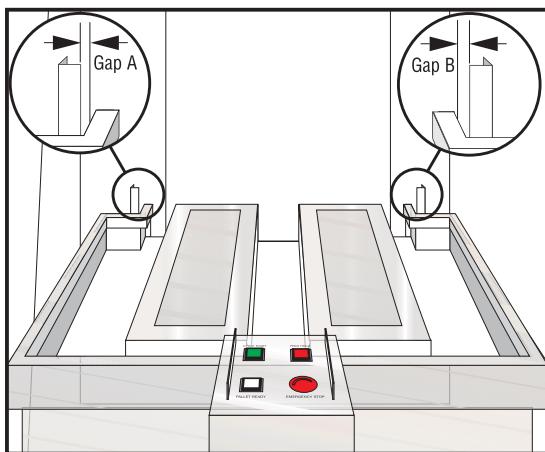


Figure 3.4 Gaps A and B should be equal.

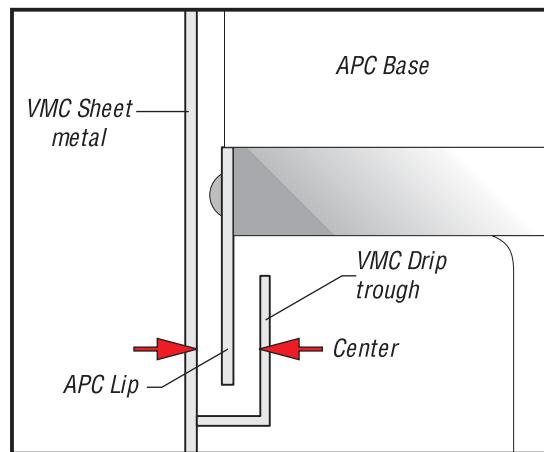


Figure 3.5 The APC lip should be centered in the VMC drip trough.

10. Attach the APC brace to the VMC and the APC with six screws (four 3/8" screws in the APC legs and two 1" screws in the VMC base), but DO NOT TIGHTEN (see Figure 3.6). The VF-3 uses the two holes in the brace that are closest to the VMC, while the VF-4 uses the two holes farthest from the VMC.

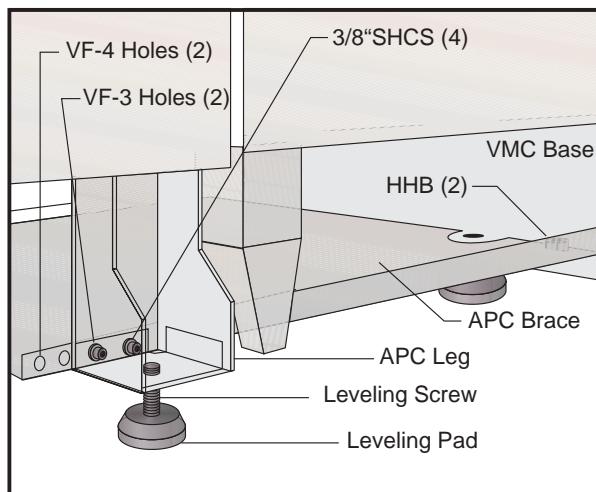


Figure 3.6 Installing the APC brace (shown).

11. In MDI mode, command an M14. The table will move to the pallet #1 load position. (The front right corner of the VMC).
12. Place the straightedge on top of the rollers of both the VMC receiver (unclamped) and the APC, to check the APC height (see Figure 3.7). Make sure that the straightedge is on top of at least two rollers on both the unclamped receiver and the APC in order to get an accurate reading. Adjust the leveling screws in the APC legs until the straightedge lays completely flat on all rollers.

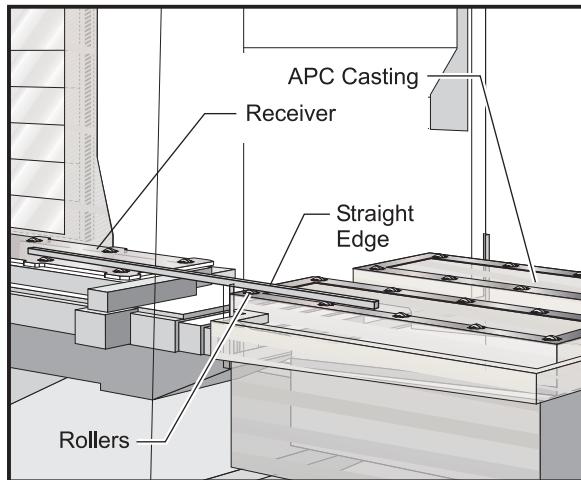


Figure 3.7 APC roller alignment setup.

13. Place the straightedge against the side of the rollers on the VMC receiver and the APC, to ensure that the rollers are aligned in the Y-axis. The straightedge must extend past at least two rollers on both the APC and VMC to get an accurate reading.

If the rollers are not parallel, the APC must be moved. The APC can be moved slightly by tapping on the leveling pads with a hammer.

NOTE: If the rollers are parallel, but are not aligned, the adjustments will be made later in the "Fine Tuning" section.

14. In MDI mode, command an M15. The table will move to the pallet #2 load position (right rear corner of the VMC). Repeat Steps 12 and 13 with the table in this position.
15. Tighten down the four 3/8 SHCS and two hex-head bolts (see Figure 3.6) on the APC brace **evenly**, so the APC is not pulled out of alignment. Recheck the level and all alignments.

Setting up the APC

16. Open the hinged APC operator's panel cover by removing the two BHCS (see Figure 3.8).

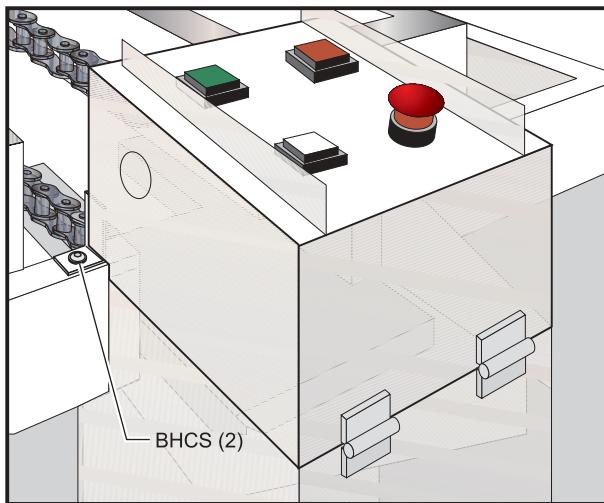


Figure 3.8 APC operator's panel cover.

17. Ensure that the drive roller on the APC chain is centered under the control box, as shown in Figure 3.9. If not, use the chain position adjustment tool to rotate it into this position.

To use this tool, place it into the center of the drive sprocket with the key in the sprocket's keyway (see Figure 3.10). Note that the tool only goes about 1/4" into the sprocket. Push down and turn the tool with a wrench in order to position the chain.

Important! Remember to remove the adjustment tool when finished.

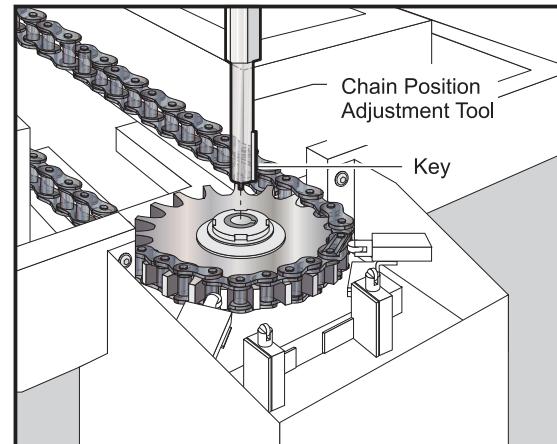
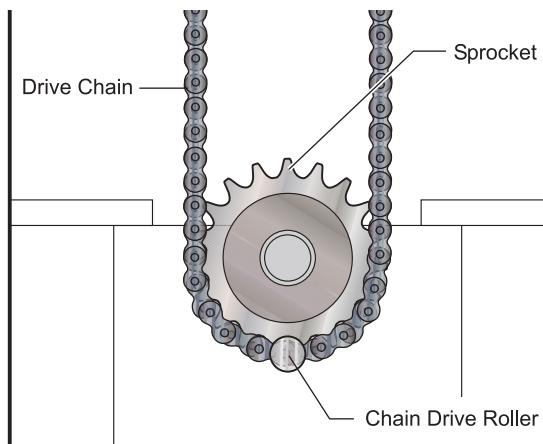


Figure 3.9 Chain drive roller positioning.

Figure 3.10 Chain position adjustment tool placement.

18. Insert two 1/2"-13 eyebolts into each pallet (see Figure 3.11). Attach straps or chains to the eyebolts, and use a forklift or hoist to lift each of the pallets onto the APC. Ensure that each pallet is placed with its drive leg pawl under the APC operator's panel, and that the APC rollers fit into the grooves on the bottom of the pallets (see Figure 3.12).

NOTE: Be careful not to set the pallets on top of the chain drive roller. If necessary, rotate the chain slightly using the chain position adjustment tool.

**CAUTION!**

Use extreme caution when moving the pallets; each pallet weighs 300 lbs., and can cause serious injury. Be careful not to damage the pallets or the APC rollers.

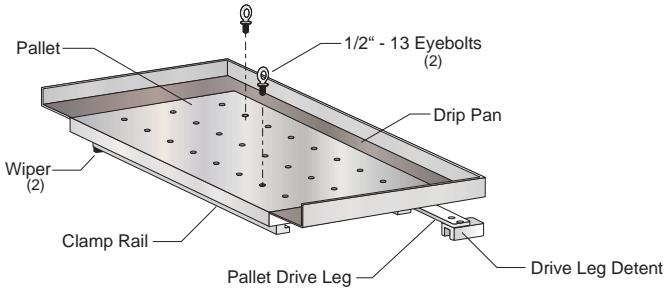


Figure 3.11 Lifting eyebolt locations.

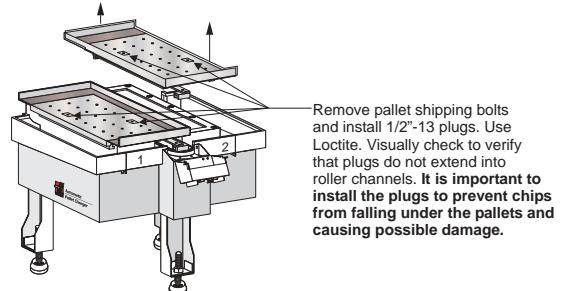


Figure 3.12 Pallet placement.

19. Pull the pallets onto the friction blocks and against the hard stop (see Figure 3.13). Rotate the chain slightly, using the chain position adjustment tool, to allow each drive leg detent to clear the chain drive roller.

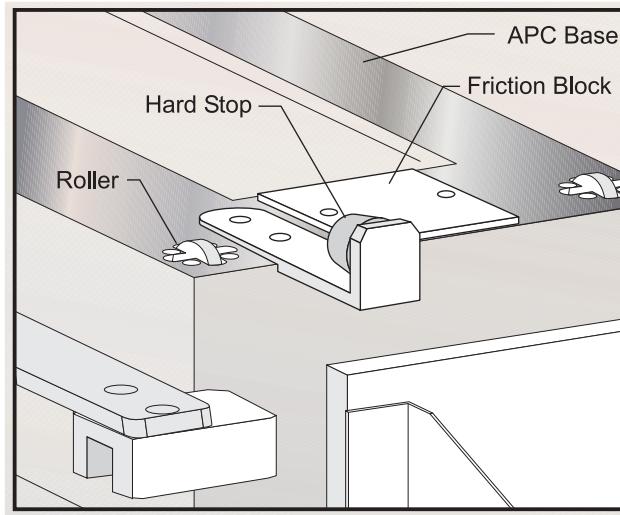


Figure 3.13 View of APC base showing friction block and hard stop.

20. Power OFF the VMC.

WARNING!

This will cause the automatic door to fall. Keep hands clear.

21. Remove the jumper from the Fifth Axis (B) port on the side of the VMC control cabinet (see Figure 3.2), and insert the APC amphenol connector into this port. Tie-wrap the cable to the door switch cable and the air hoses at the rear of the VMC.
22. Screw the air blast hose into the APC. Remove the piece of tubing from the top fitting of the VMC lube/air panel cross fitting, and replace it with the APC air hose (see Figure 3.14).

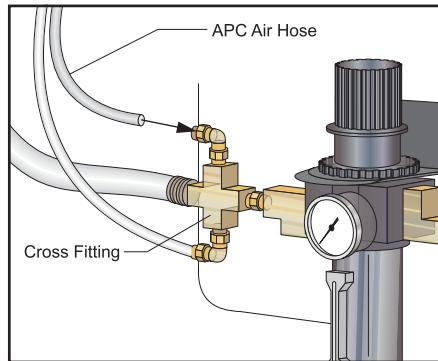
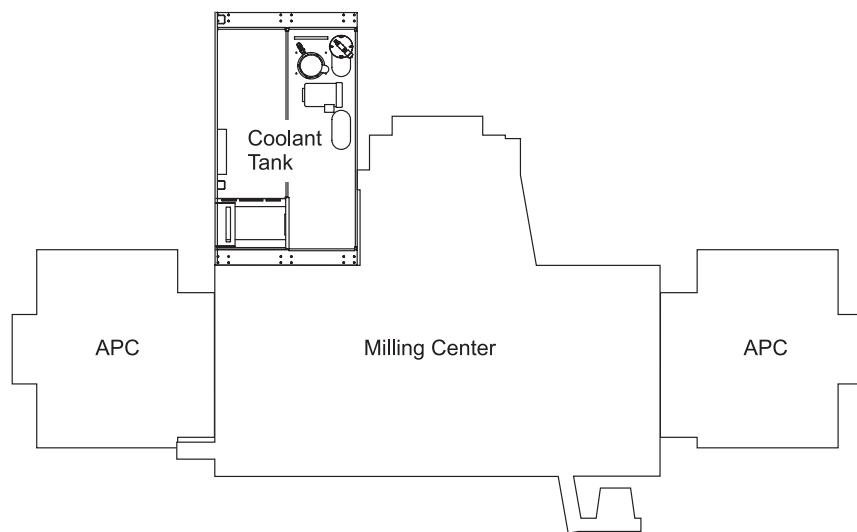


Figure 3.14 APC air hose connection to VMC air/lube cross fitting.

- 23.** Position the coolant tank as shown.



Coolant Tank Placement

SIDE DOORS FOR EXPORT MACHINES



APC with Safety Doors

For machines equipped with safety doors, be sure that doors are closed properly. The APC will not function if the doors are not secure.



3.3 FINE TUNING

The APC was set up, run, and adjusted at the factory. Due to slight variations when disassembling and reassembling, it will be necessary to fine tune the APC to ensure that the pallets load and unload as smoothly as possible.

NOTE: It is normal to hear a 'clunking' sound during pallet loading and unloading.
Unless it is excessive, do not mistake this noise for misalignment.

SETTINGS

The following settings control the location of the VMC table during pallet changes. Fine-tuning consists of adjusting settings 121-129, and settings 146-154, and the height of the APCs. For instance, 121 controls the X position that the VMC table will move to in order to load pallet 1. If the receiver does not clamp the pallet due to misalignment of the locating pins and the pallet bushings, this value can be changed to move the receiver closer to or farther from the APC. The drive pin on the chain should drop the pallet directly over the locating pins. Similarly, if the pallet is misaligned in the Y-axis, causing the pallet to shift to one side during loading and unloading, variable 122 can be modified.

The following settings can be modified to adjust the table location for loading and unloading of pallets:

- 121 APC PAL. 1 LOAD X = Pallet 1 load X position
- 122 APC PAL. 1 LOAD Y = Pallet 1 load Y position
- 123 APC PAL. 1 UNLOAD X = Pallet 1 unload X position
- 124 APC PAL. 1 UNLOAD Y = Pallet 1 unload Y position
- 125 APC PAL. 2 LOAD X = Pallet 2 load X position
- 126 APC PAL. 2 LOAD Y = Pallet 2 load Y position
- 127 APC PAL. 2 UNLOAD X = Pallet 2 unload X position
- 128 APC PAL. 2 UNLOAD Y = Pallet 2 unload Y position
- 129 APC PAL. 1 AND 2 SAFE X = For clearance of pallets 1 and 2 drive legs from right APC door

ADDITIONAL SETTINGS FOR FMS

- 146 APC PAL. 3 LOAD X = Pallet 3 load X position
- 147 APC PAL. 3 LOAD Y = Pallet 3 load Y position
- 148 APC PAL. 3 UNLOAD X = Pallet 3 unload X position
- 149 APC PAL. 3 UNLOAD Y = Pallet 3 unload Y position
- 150 APC PAL. 4 LOAD X = Pallet 4 load X position
- 151 APC PAL. 4 LOAD Y = Pallet 4 load Y position
- 152 APC PAL. 4 UNLOAD X = Pallet 4 unload X position
- 153 APC PAL. 4 UNLOAD Y = Pallet 4 unload Y position
- 154 APC PAL. 3 AND 4 SAFE X = For clearance of pallets 3 and 4 drive legs from left APC door

To unload a pallet without loading another pallet, run M90 or M50 P0. This can be done in order to clean or maintain the receiver.



The settings can be viewed on the Settings page of the VMC display. The Page UP and Page DOWN keys may then be used to locate the correct list of settings. To scroll through this list, use the cursor up and cursor down keys. Refer to the VMC Operators Manual for instructions on how to modify these settings.

1. POWER ON the VMC. Release the E-STOP button and press RESET.
2. In MDI mode, command an M17, then an M14, to position the VMC table.
3. Manually push the pallet adjacent to the receiver from the APC to the receiver. If necessary, use the chain position adjustment tool to rotate the chain until the chain drive roller clears the drive leg.

NOTE: M14 will align the receiver with Pallet #1 (the pallet nearest the front of the VMC).
M15 will align the receiver with Pallet #2 (the pallet nearest the rear of the VMC).

4. Push the pallet between the receiver and the APC a number of times. As the pallet goes over the receiver rollers, note if the Y or Z axis is out of alignment.

If the alignment is slightly off in the Y-axis, handle jog the table in the Y-axis (in increments of .001) until pallet loading and unloading is smooth. Record the final Y-axis position in settings 122 and 124. These two settings should be set to the same value initially, and may be adjusted separately later if either loading or unloading is not smooth.

If alignment appears to be incorrect in the Z-axis (height), adjust it by turning the leveling screws until pallet loading and unloading is smooth.

5. Push the pallet back onto the APC. In MDI mode, command an M15 to move the pallet to load position #2. Repeat Steps 3 and 4 above for pallet #2.
The APC height and the Y-axis alignment (settings 122,124,126,128) are now set.
6. In MDI mode, command an M18 to clamp the pallet and close the automatic door.

NOTE: The message "PEND MOVE (Y)" will appear and motion will stop during an M18. press "Y" to continue motion.

7. The X-axis alignment must now be checked. To do this, perform the following steps :

To stop a pallet change in order to adjust the settings, press FEED HOLD at any time. This will cause the pallet change to stop after the present step is completed. Pressing CYCLE START will restart the program. If E-STOP is pressed during a pallet change, the motors will stop instantly, and the machine will have to be reset. If one of the chain location switches is not tripped at this time, the chain position will also have to be reset using the chain position adjustment tool.

WARNING

If a pallet change sequence is stopped for any reason (e.g. E-Stop, power outage, or low air supply), both the pallet and chain locations must be checked before operating the VMC. See the Power Outage / E-Stop Recovery section of this manual.

Under no circumstances attempt to operate the VMC until the pallet drive arm is disengaged from the pallet drive pin on the chain.



Place a program in MDI that consists of an M36 (flash "Pallet Ready" light), an M50 (pallet change), and an M99 (repeat).

Press CYCLE START and the PALLET READY light will flash.

Press PALLET READY, and the pallet will start to load. **Important!** When the chain starts to move, immediately press FEED HOLD. This will cause the pallet to load, but not to be clamped.

When the pallet has stopped, check that the bushing in the bottom of the pallet is directly over the locating pin in the receiver (within $\pm .09$). If the pin and bushing are not aligned, the load position of the receiver will have to be changed.

If the pallet makes a noise when it stops, then the locating stub on the bottom of the pallet has hit against the locating fingers on the Pallet Clamp Plate. Change the value of the X Load Position by adjusting setting 121 for pallet 1, and setting 125 for pallet 2. Typically the load and unload positions will be the same for both pallets.

Nudge the pallet to align the pin and bushing then press CYCLE START. The pallet should clamp fully down.

Repeat the X-axis alignment process until the pin and bushing are aligned.

A perfectly aligned pallet will move straight up and down when clamping and unclamping. Pallets using some of the $\pm .09$ tolerance on location will appear to settle left or right when moving up and down with the clamping action. This settling does not affect the final alignment of the pallets. The pallet position tolerance is $\pm .0005$.

NOTE: The machine will beep during a pallet change. This is an audible warning signal, and not an alarm.

8. To confirm the correct X-axis pallet load positions, run the program that consists of an M36, M50, and M99 again. Note any places that the process does not run smoothly, press FEED HOLD, and change one of the settings to adjust this misalignment.

NOTE: Make sure to confirm the alignment at both pallet load positions. After confirmation, the settings should be written down or saved to disk.



4.0 PROGRAMMING

4.1 Program Commands

The APC is controlled by a program in CNC memory. M codes are used in the parts program to control the APC. The pallet change routine is run by using an M50 code in the parts program. In order for M50 to work the APC load and unload coordinate must be set (settings 121 through 128). Make sure that the X coordinate safe distance, setting 129, is set to -33.000.

The APC can be programmed to run one program on both pallets, or a different program on each pallet. The "Sample Programs" section consists of two basic programs: the first sample program runs the same part on both pallets, and the second program runs a different part on each pallet.

The APC has its own operator's panel, which includes CYCLE START, FEED HOLD, and EMERGENCY STOP buttons that perform the same functions as those on the VMC control panel. This panel also includes a PALLET READY button, which is used for APC functions. Refer to figure 4.1.

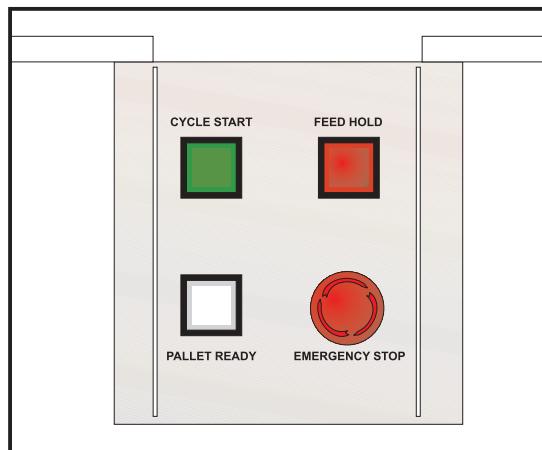


Figure 4.1 APC operator's control panel (top view).

If the pallet ready key has not been pressed, the APC will flash the "PALLET READY" light at the completion of the user's part program, and wait until the PALLET READY button has been pressed before performing the pallet change. This feature prevents a pallet change from occurring before the operator is ready. The PALLET READY button can be pressed at any time and will be recognized when the next program is finished and a pallet change is required.

Important! If alignment adjustments are necessary during operation, refer to the "Installation" section and modify the appropriate settings.



PROGRAMMING FOR FMS

Using an M50 code in the parts program runs the pallet change routine. In order for M50 to work correctly the APC load and unload coordinate must be set for each pallet (settings 121 through 128 and 146-153). Make sure that the X coordinate safe distances, setting 129 and setting 154, are set correctly. See Table for correct X coordinate safe distances.

Safe Distance Settings Table

<u>Pallets 1 & 2</u>		<u>Pallets 3 & 4</u>
Setting 129		Setting 146
X safe distance (inches)		X safe distance (inches)
VF-3	-33.000	-7.00
VF-4	-43.000	-7.00

The APC can be programmed to run the same parts program on all pallets, or a different program on each pallet. See "Sample Programs" for some of the options available for pallet change programming.

For the Dual APC to perform automatic pallet sequencing and part program selection, each pallet must be "scheduled" and must have a parts program assigned to it. Scheduling is done in two ways. A pallet can be scheduled with its SCHEDULE PALLET button on the operator's panel. Pushing the button schedules the pallets in the sequence they are pushed.

The pallets can also be scheduled from the Pallet Schedule Table (PST) display. This display can be found by pressing the CURNT COMDS key and then pressing the PAGE UP or PAGE DOWN keys until the Pallet Schedule Table page is reached. The pallets can be scheduled from this display by using the arrow keys to highlight the "Load Order" box for the pallet. With the cursor in the correct box, enter a number 1,2,3, or 4 by keying the number and then the WRITE key. If there is already a priority number for that pallet, the "Load Order" numbers of the other pallets will be updated as necessary. A pallet that is in the receiver will have an asterisk in the "Load Order" column.

The home position for each pallet is as follows: Pallet 1, tp the right and closest to the control pendant. Pallet 2, to the right and furthest from the control pendant. Pallet 3, to the left and furthest from the control pendant. Pallet 4 to the left and closest to the control pendant.

As mentioned above, a pallet must have a parts program assigned to it. Assigning a part program is also done in the PST display. The arrow keys are used to highlight the "Program Number" box for the pallet. The program number is entered by keying the number and then pressing the WRITE key. For example, keying **O123**, then **WRITE** will put the program number O00123 into the table.

If a parts program encounters an M50 (without a P code) and none of the SCHEDULE PALLET buttons have been pressed, the VMC control will pause operation, the beacon will blink green, and the message "NONE SCHEDULED" will appear on the screen. The VMC will wait until a SCHEDULE PALLET button has been pressed, or the PST has been updated, before performing the pallet change. This feature prevents a pallet change from occurring before the operator is ready. The SCHEDULE PALLET button can be pressed at any time and will be recognized when the next pallet change is required.

Pallets can also be changed without automatic sequencing or PST inputs. This is done using M50 with a P code. M50 P1 will load pallet #1 without checking to see if it is scheduled. M36 P1 before the M50 P1 will check that pallet #1 is ready. If the SCHEDULE PALLET button has been pressed, the pallet #1 will be loaded. If the SCHEDULE PALLET button for pallet #1 has not been pressed, the indicator light on the button will flash and the VMC control will flash "SCHEDULE PAL#1".



There are 30 different pallet status values to use. The first four: UNSCHEDULED, SCHEDULED, LOADED, and COMPLETED, are fixed and cannot be changed. The remaining 26 can be modified and used as needed.

Changing or adding status text can be done in the PST. Use the arrow keys to move the table cursor to the "PALLET STATUS" column. Press the F1 key. A selection menu will appear over the "PALLET STATUS" column. (Pressing F1 again or RESET will close the menu.) The number to the left of the text is the status number. This number can be used with the M49 command to set the status from the part program. The items in the menu can be selected with the UP and DOWN arrow keys, or the handle jog dial. Change the text by pressing the letter keys then F3. change as many status items as desired. Note: all pallets use the same list of status items. Pressing F1 closes the menu without changing the status of any of the pallets.

Resetting a status item to USER is done by selecting an item from the menu and selecting F4. All status items can be reset at the same time with the ORIGIN key.

Changing the status of an individual pallet can be done from the PST or with the M49 command. In the PST, move the table cursor to the "PALLET STATUS" column for the pallet desired. Press F1 for the status item menu. Use the arrow keys to move to the correct status. Press F2 or WRITE. The menu will vanish and the pallet status will be changed (some restrictions apply). See the description of the M49 command and the following examples for setting the pallet status from a program.

System macro variables have been added as follows. Note that these are read only, except for Pallet Priority and Status, which can be written to when pallets are unloaded.

#3028 Number of pallet loaded on receiver	#7701-#7704 Program number assigned to pallet
#7501-#7504 Pallet Priority	#7801-#7804 Pallet usage count
#7601-#7604 Pallet Status	

Important! If alignment adjustments are necessary during operation, refer to the "Installation" section and modify the appropriate settings.



4.2 M CODES

Only one **M** code may be programmed per block of a program. The following **M** codes are specifically used to program the APC:

M14 Move APC table to pallet 1 load position

M15 Move APC table to pallet 2 load position

Using M14 and M15 on the Quad APC requires a P-code. M14 sends the receiver to pallet unload positions, M15 sends the receiver to the pallet load positions, based on the pallet number specified by the P code and settings 122-128 and 146-153.

M17 Unclamp APC pallet and Open APC door (maintenance use only)

M18 Clamp APC pallet and close APC door (maintenance use only)

M36 Flash "Pallet Ready" Light

For the dual pallet APC, M36 is placed before M50 in the G-code program to check that the next pallet is ready to load. When the pallet ready button on the operator's panel is pushed, the pallet change proceeds. On the Quad APC, M36 requires a P-code to specify which pallet should be checked for readiness. If other pallets are scheduled at a higher priority, the operator will be prompted to unschedule them.

M46 Jump If Pallet Loaded

This M code causes control to be transferred to the line number specified by the P code if the pallet specified by the Q code is currently loaded.

Example: M46Qn Pnn Jump to line nn in the current program if pallet n is loaded, otherwise go to the next block.

M48 Check Validity of Current Program

This M code generates alarm 909 if the current program is not listed in the Pallet Schedule Table. It generates alarm 910 if the pallet that is currently loaded is not listed in the Pallet Schedule Table for the current program.

M49 Set Status of Pallet

This M code sets the status of the pallet specified by the P code to the value specified by the Q code. The possible Q codes are 0-Unscheduled 1-Scheduled 2-Loaded 3-Completed 4 through 29 are user definable. The pallet status is for display purposes only. The control does not depend upon it being any particular value, but if it is 0, 1 2 or 3, the control will update it as appropriate.

Example: M49Pnn Qmm Sets the status of pallet nn to a value of mm.

Without a P-code, this command sets the status of the currently loaded pallet.

M50 Perform Pallet Change

Using an M50 on the dual pallet APC cycles the pallet changer to the next pallet. M50 can have a P-code which specifies a pallet, or no P-code which cycles the pallets. On the Quad APC, an M50 with no P-code will load the next scheduled pallet. If none are scheduled, the message NONE SCHEDULED will be displayed and program execution will pause until one is scheduled or RESET is pressed. M50 P0 will unload a pallet from the receiver without loading another. M50 with a P-code loads the specified pallet. M50 gets scheduling information from the Pallet Schedule Table

M50 P0 Perform pallet change

M50 P1 Load Pallet 1

M50 P2 Load Pallet 2

M90 Perform Pallet Unload Only

CAUTION!

When commanding M Codes, always command M17 to open the door before commanding M14 or M15 to position the table to a pallet load/unload position. With a pallet present on the receiver the pallet drive leg will interfere with door movement.

**FMS G CODES**

G188: Calls the parts program for the loaded pallet based on the PST entry for the pallet

SETTINGS**146 APC PAL. 3 LOAD X**

This is the APC pallet #3 X axis load position. It should be set at the time the Quad APC is installed. Units are inch/mm.

147 APC PAL. 3 LOAD Y

This is the APC pallet #3 Y axis load position. It should be set at the time the Quad APC is installed. Units are inch/mm.

148 APC PAL. 3 UNLOAD X

This is the APC pallet #3 X axis unload position. It should be set at the time the Quad APC is installed. Units are inch/mm.

149 APC PAL. 3 UNLOAD Y

This is the APC pallet #3 Y axis unload position. It should be set at the time the Quad APC is installed. Units are inch/mm.

150 APC PAL. 4 LOAD X

This is the APC pallet #4 X axis load position. It should be set at the time the Quad APC is installed. Units are inch/mm.

151 APC PAL. 4 LOAD Y

This is the APC pallet #4 Y axis load position. It should be set at the time the Quad APC is installed. Units are inch/mm.

152 APC PAL. 4 UNLOAD X

This is the APC pallet #4 X axis unload position. It should be set at the time the Quad APC is installed. Units are inch/mm.

153 APC PAL. 4 UNLOAD Y

This is the APC pallet #4 Y axis unload position. It should be set at the time the Quad APC is installed. Units are inch/mm.

154 APC PAL. 3 & 4 SAFE X

This is the receiver X axis position where it is safe to open the door. It should be set at the time the Quad APC is installed. Units are inch/mm.



4.3 SAMPLE PROGRAMS

Example #1:

Basic program using the "Pallet Ready" light on the APC. This program will run the same part program on each pallet.

Oxxxx	Program number
M36	(Flash "Pallet Ready" light - wait until PALLET READY button pressed to continue)
M50	(Perform pallet change after "Pallet Ready" button is pressed)
Part Program	(USER's PART PROGRAM)
M99	(Repeat program: see VF Series Operator's Manual for a more detailed description of M99)

Example #2:

Basic pallet change program that tracks which part is to be machined on each pallet. Pallet #1 has a different machine operation than pallet #2

Oxxxxxx	Program number
M36	(Flash "Pallet Ready" light - wait until PALLET READY button pressed to continue)
M50	(Perform pallet change after "Pallet Ready" button is pressed)
M96 Q27 Pxx	This line will check to see if pallet #1 is on the machine. If it is then it will jump to line xx. If the pallet is not on the machine, then it will continue to the next line. Q27 checks to see if pallet #1 is on the machine. (See VF Series Operator's Manual for a more detailed description of M96.)
M99	(Repeat program)
Nxx	Line number
Part program for Pallet #1	User's part program for Pallet #1
M99	(Subroutine return: see VF Series Operator's Manual for a more detailed description of M99)
Nxxx	Line number
Part program for Pallet #2	User's part program for Pallet #2
M99	(Subroutine return: see VF Series Operator's Manual for a more detailed description of M99)

NOTE: M99 at the end of the program will cause continuous operation. M30 at the end of a program will cause the control to wait for the operator to press Cycle Start.



Example #3: This is another method for achieving the same results as example 2.

M36	(Flash "Pallet Ready" light - wait until PALLET READY button pressed to continue)
M50 P1	(Load Pallet #1)
M98 Pxx	(Control jumps to program #xx and runs this program. (See VF Series Operator's Manual for a more detailed description of M98.)
M36	
M50 P2	(Load Pallet #2)
M98 Pxxx	(Control jumps to program #xxx and runs this program. (See VF Series Operator's Manual for a more detailed description of M98.)
M99	(Repeat program: see VF Series Operator's Manual for a more detailed description of M99)

FMS SAMPLE PROGRAMS

Example #1:

Basic pallet change program that loads the next scheduled pallet and runs the correct parts program. The next pallet and the correct program are determined from the PST. Below is a sample of a Pallet Schedule Table (Sample Table 1). The table indicates that pallets #2, #3 and #4 are scheduled and that pallet #1 is unscheduled (column 3 "Pallet Status"). The pallets will be processed in the order #3, #4 and finally #2 (column 2 "Load Order") with the program indicated in column 5, "Program Number". The "Program Comment" is captured from the program listed in column 5.

Pallet Schedule Sample Table 1

Pallet Number	Load Order	Pallet Status	Pallet Usage	Program Number	Program Comment
1	0	UNSCHEDULED	12	O06012	(CUT SLOT)
2	3	SCHEDULED	13	O05870	(DRILL AND TAP)
3	1	SCHEDULED	22	O04990	(ROUGH AND FINISH TOG)
4	2	SCHEDULED	8	O06012	(CUT SLOT)

O00001	Program number
M50	(Perform pallet change to next scheduled pallet)
G188:	Calls the parts program for the loaded pallet based on the PST entry for the pallet
M99	(Loop to top of main program)
O04990	
Part program	(User's part program)
M99	(Return from subroutine)
O05870	
Part program	(User's part program)
M99	(Return from subroutine)
O06012	
Part program	(User's part program)
M49 Q12	Set current pallet status to 12 actual string defined by operator, in this case status number 12 is defined as "LAST PALLET"
M99	(Return from subroutine)

Description: The first loop through program O00001 will load pallet #3 (M50) and run program O04990 (G188 selects program from PST for pallet #3). The PST will then resemble Sample Table 2. The asterisk for pallet #3 in the "Load Order" column indicates that this pallet is in the mill.

Pallet Schedule SampleTable 2

Pallet Number	Load Order	Pallet Status	Pallet Usage	Program Number	Program Comment
1	0	UNSCHEDULED	12	O06012	(CUT SLOT)
2	2	SCHEDULED	13	O05870	(DRILL AND TAP)
3	*	LOADED	23	O04990	(ROUGH AND FINISH TOG)
4	1	SCHEDULED	8	O06012	(CUT SLOT)

Description: The second loop through program O00001 will load pallet #4 (M50) and run program O06012 (G188 selects program from PST for pallet #4). While pallet #4 is being machined, the PST will then resemble Sample Table 3.

Table Pallet Schedule Sample Table 3

Pallet Number	Load Order	Pallet Status	Pallet Usage	Program Number	Program Comment
1	0	UNSCHEDULED	12	O06012	(CUT SLOT)
2	1	SCHEDULED	13	O05870	(DRILL AND TAP)
3	0	COMPLETED	23	O04990	(ROUGH AND FINISH TOG)
4	*	LOADED	9	O06012	(CUT SLOT)

Description: The third loop through program O00001 will load pallet #2 and run program O05870. While program O05870 is running, the PST will resemble Sample Table 4.

Table Pallet Schedule Sample Table 4

Pallet Number	Load Order	Pallet Status	Pallet Usage	Program Number	Program Comment
1	0	UNSCHEDULED	12	O06012	(CUT SLOT)
2	*	LOADED	14	O05870	(DRILL AND TAP)
3	0	COMPLETED	23	O04990	(ROUGH AND FINISH TOG)
4	0	LAST PALLET	9	O06012	(CUT SLOT)

Description: In the fourth loop, the M50 will detect that no pallets are scheduled. The beacon light will flash green and program O00001 will pause until the operator schedules a pallet or presses RESET. A pallet can be scheduled by pressing any of the SCHEDULE PALLET buttons at either of the two pallet changer station panels. Pallet scheduling can also be done from the control in the PST page of the current commands display.

Example #2:

Basic pallet change program that tracks which part is to be machined on each pallet. Each pallet has a different machine operation. Note that the P code for M46 is a line number in the current program, not a subroutine number.

Oxxxxx
M50
M46 Q1 Pxx1

Program number
(Perform pallet change after SCHEDULE PALLET button is pressed or PST is updated)
This line will check to see if pallet #1 is on the machine. If it is then it will jump to line xx1. If the pallet is not on the machine, then it will continue to the next line. (See description of M46.)



M46 Q2 Pxx2	(If pallet #2 is loaded, program will jump to line xx2, otherwise it will go to the next line)
M46 Q3 Pxx3	(If pallet #3 is loaded, program will jump to line xx3, otherwise it will go to the next line)
M46 Q4 Pxx4	(If pallet #4 is loaded, program will jump to line xx4, otherwise it will go to the next line)
M99 Pxxxx	(Jump to line Nxxxx: see VF Series Operator's Manual for a more detailed description of M99)
Nxx1	(Line number)
Part program for Pallet #1	(User's part program for Pallet #1)
M99 Pxxxx	(Jump to line Nxxxx: see VF Series Operator's Manual for a more detailed description of M99)
Nxx2	(Line number)
Part program for Pallet #2	(User's part program for Pallet #2)
M99 Pxxxx	(Jump to line Nxxxx)
Nxx3	(Line number)
Part program for Pallet #3	(User's part program for Pallet #3)
M99 Pxxxx	(Jump to line Nxxxx)
Nxx4	(Line number)
Part program for Pallet #4	(User's part program for Pallet #4)
Nxxxx	(Line number)
M99	(Repeat program: see VF Series Operator's Manual for a more detailed description of M99)

Example #3:

This is an alternate method to Example #2 that uses subroutine calls, but does not jump if the pallet is unscheduled.

M36 P1	(Flash "NO PALLET SCHEDULED" on display, flash green beacon, flash light on SCHEDULE PALLET button for pallet #1 until button is pushed or pallet is scheduled in PST)
M50 P1	(Load Pallet #1)
M98 Pxxx1	(Control jumps to program Oxxx1 and runs this program. See VF Series Operator's Manual for a more detailed description of M98.)
M36 P2	(Wait for pallet to be scheduled)
M50 P2	(Load Pallet #2)
M98 Pxxx2	(Control jumps to program Oxxx2 and runs this program.)
M36 P3	(Wait for pallet to be scheduled)
M50 P3	(Load Pallet #3)
M98 Pxxx3	(Control jumps to program Oxxx3 and runs this program.)
M36 P4	(Wait for pallet to be scheduled)
M50 P4	(Load Pallet #4)
M98 Pxxx4	(Control jumps to program Oxxx4 and runs this program.)
M99	(Repeat program: see VF Series Operator's Manual for a more detailed description of M99)

Note: M99 at the end of a program will cause continuous operation. M30 at the end of a program will cause the control to wait for the operator to press Cycle Start.

**SYSTEM VARIABLES**

The following system (macro) variables are available for dual APC. These variable are generally read-only. Pallet priority (#7501-#7504) and pallet status (#7601-#7604) are read-write during some conditions, but read-only for others. For example both are read-only while the pallet is loaded. These variable are maintained in memory during power off.

VARIABLES

#3028
#7501-#7504
#7601-#7604
#7701-#7704
#7801-#7804

USAGE

Number of pallet loaded on receiver
Pallet priority
Pallet status
Part program numbers assigned to pallets
Pallet usage count

**5.0 TROUBLESHOOTING****5.1 MACHINE SEQUENCE**

The machine performs the following sequences when these M codes are commanded.

M14 - GO TO PALLET #1 LOAD POSITION (Used for machine installation only)

Move table into pallet #1 load position.

M15 - GO TO PALLET #2 LOAD POSITION (Used for machine installation only)

Move table into pallet #2 load position.

M17 - UNCLAMP PALLET AND OPEN AUTOMATIC DOOR (Used for machine installation only)

If table is near door, move table away from door.

Unclamp pallet.

Open automatic door.

Check Door Open switch - If door not open, generate alarm #638.

Check Receiver Unclamp switch - If receiver not unclamped, generate alarm #632.

M18 - CLAMP PALLET AND CLOSE AUTOMATIC DOOR (Used for machine installation only)

Clamp pallet.

Check Receiver Clamp switch - If receiver not clamped within the amount of time set in parameter #316, generate alarm #633.

Close automatic door.

Check Door Open switch - If door not closed, generate alarm #639.

M36 - HOLD UNTIL "PALLET READY" BUTTON IS PRESSED

When "PALLET READY" button is pressed, enable an M50 pallet change (see below).

M50 - PERFORM PALLET CHANGE**Prepare for Pallet Change:**

Turn coolant OFF.

Turn Through the Spindle Coolant OFF (if applicable).

Stop the spindle.

Enable APC motor.

Turn beeper ON. (The 'beeper' refers to the audible APC warning signal, and not to an alarm condition.)

Read all 3 pallet position switches (one switch for Receiver Clamp/Unclamp and two switches for Pallet Home / Location) to determine empty position.

Read Switches:

If both pallets are home on APC, move to load pallet position in setting 121, 122, or 125,126.

If a pallet is on the receiver, determine the unload position.

Move the table to the correct unload position.

Open the automatic door.

**Execute Pallet Change (with a pallet on the receiver):**

Unclamp receiver.

Start chain drive (unload pallet).

Stop chain drive when pallet hits stop switch. (If M50 P0 or M90, this finishes the sequence)

Move table to appropriate load position.

Start chain drive (load pallet).

Stop chain drive when Chain Switch Block trips the Chain Stop switch.

Clamp receiver.

Move table away from automatic door.

Return to Normal Operation:

Turn beeper off.

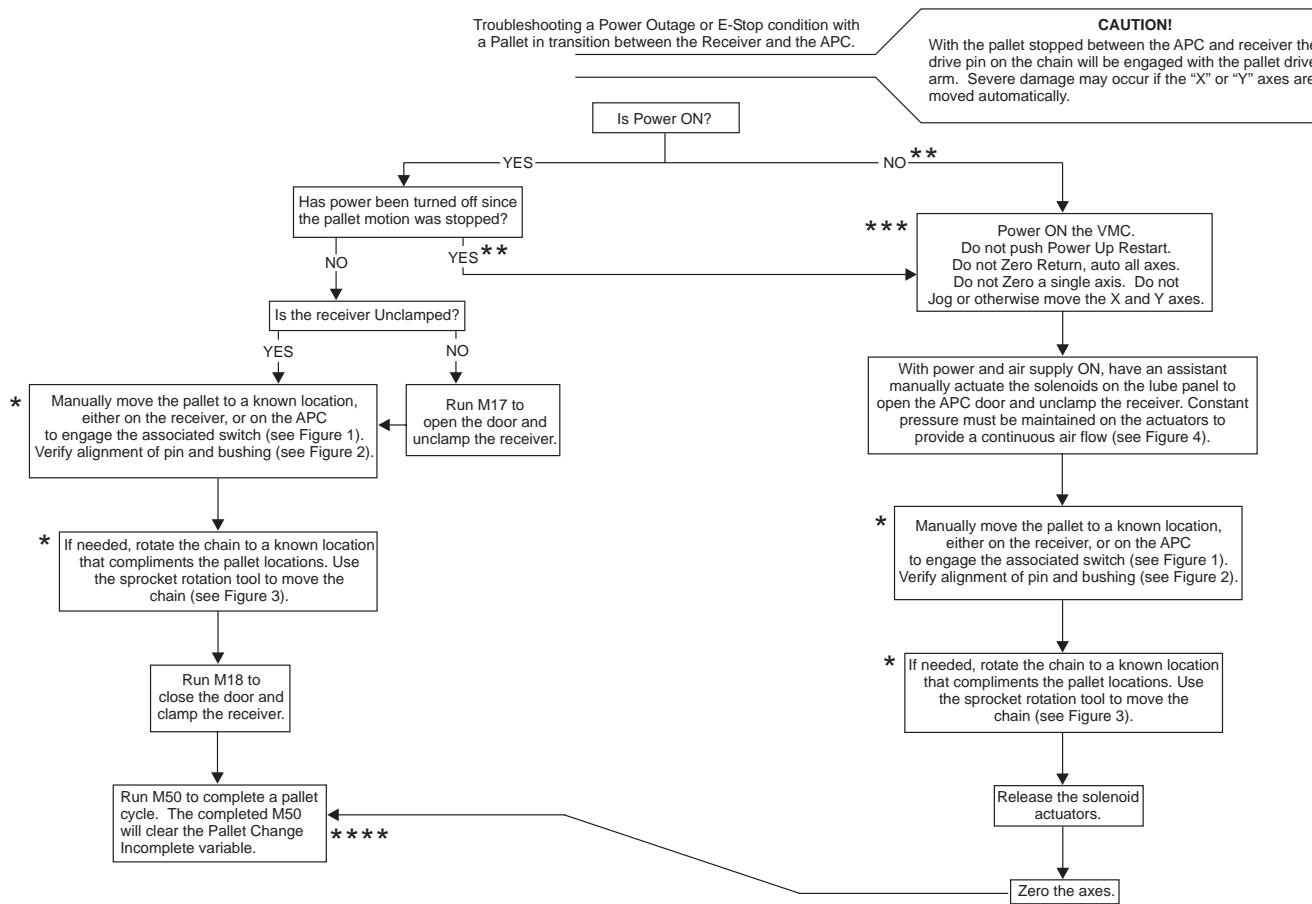
Disable chain drive.

Close automatic door.

NOTE: The M50 pallet change must be successfully completed before normal VMC operation can continue.

If the M50 pallet change is interrupted, software switches will not allow normal VMC operation. Another M50 must be run to reset the switches. If this puts the wrong pallet into the VMC then an additional M50 must be run.

The operator must exercise caution when running multiple M50 commands to position pallets. The operator must be aware of incomplete fixturing, tool, and personnel locations.

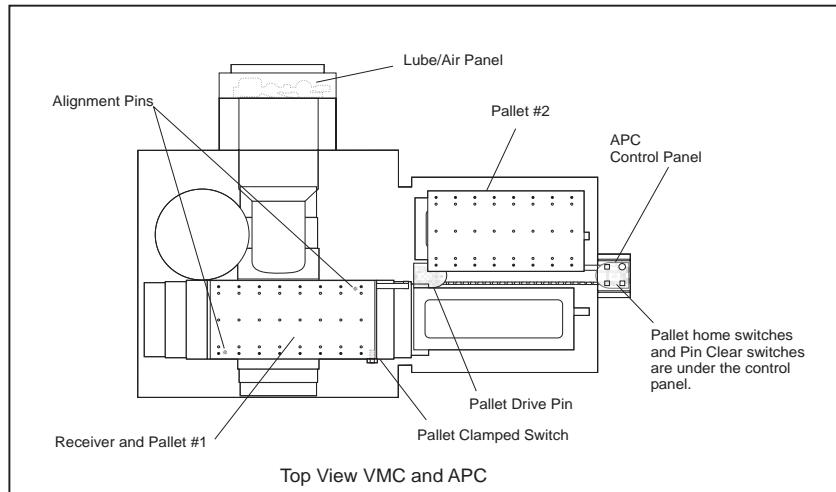
**5.2 RECOVERY FROM POWER OUTAGE OR E-STOP****Recovery from a power outage or an E-Stop initiated during a pallet change:**

* There are 5 switches involved in the location of the pallets and chain.
1 pallet switch on the receiver (Pallet Clamp Switch).
2 pallet switches on the APC (Pallet Home Switches).
2 chain switches on the APC (Pin Clear Switches).

** If the power to the VMC has been shut down either intentionally or by power outage, damage may occur to the APC pallet, the receiver, or the drive chain if the X or Y axes are moved in the VMC at power ON.

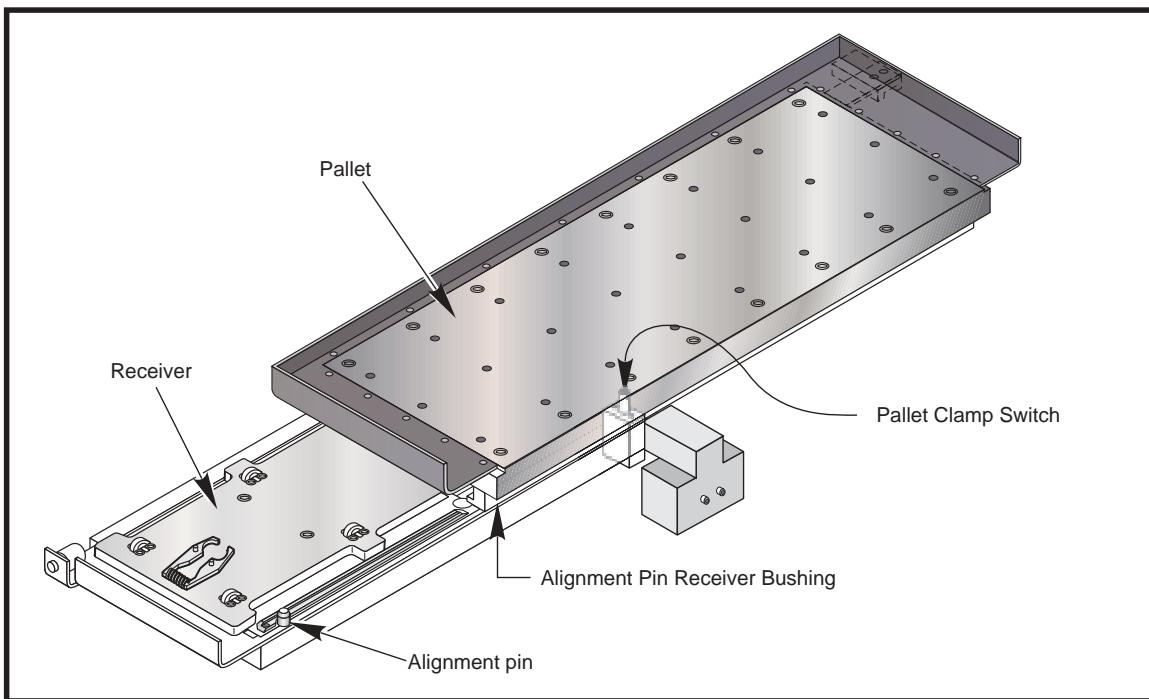
*** At power ON the VMC will investigate the pallet and chain location and alarm if either an unknown chain location or unknown pallet location are detected.

**** At the beginning of the APC M50, a Pallet Change Incomplete variable is set to 1 and reset to 0 at the end. The VMC will not operate properly if a pallet change (M50) has not been completed.

**Figure 1**

Pallet known locations. Pallet 1 is on the receiver and engaging the Pallet Clamped switch (Pallet must be clamped to trip this switch).

Pallet 2 is on the APC and engaging the Pallet Home Switch under the control panel.

**Figure 2**

Alignment Pin and Bushing alignment must be verified when manually positioning a pallet on the receiver.

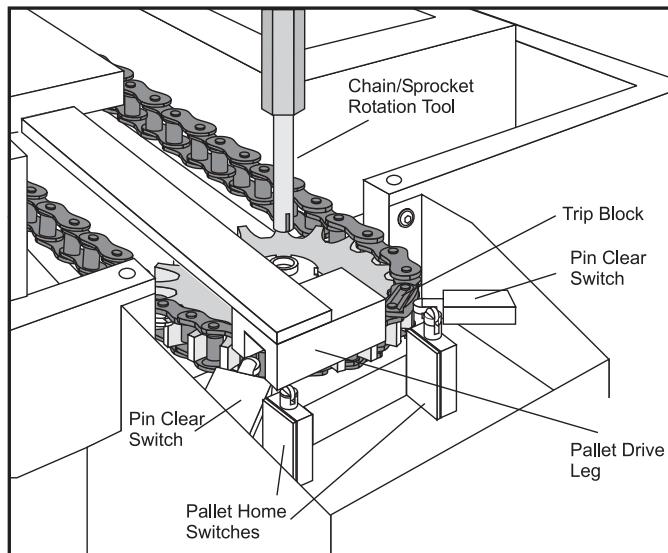


Figure 3
With pallet 2 clamped on the receiver, the trip block must be engaging the switch as shown.

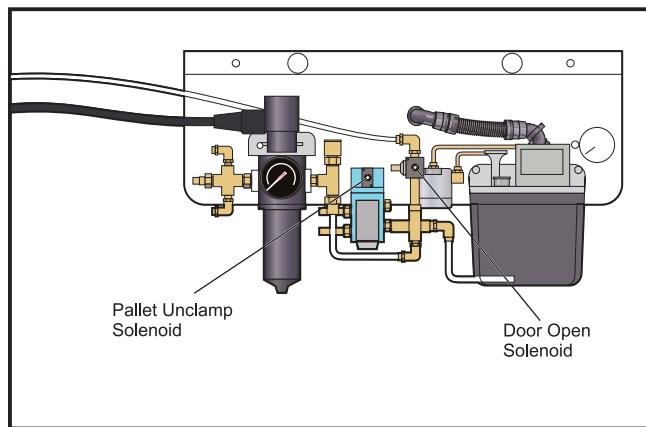


Figure 4
Press and hold the solenoid actuation buttons (small white buttons) to keep air pressure flowing to unclamp the receiver and hold the door open. If the buttons are released the door will close and the receiver will clamp.



6.0 ALARMS / FAULTS

If a fault occurs during operation, the red beacon on the VMC will flash and a message will be displayed on the screen. An alarm code will be placed in the VMC's alarm history and will be available for future reference.

EMERGENCY STOP or a machine fault not associated with the APC inputs or program will halt all motors. Pressing the RESET button will clear these faults.

Important! If E-STOP was pressed during a pallet change, the control may not know the location of the pallets or chain, depending on when E-STOP was pressed, and alarm #641 will be generated. In this case, refer to the Recovery Sequence flowchart in the Troubleshooting section.

When an alarm occurs, correct the problem, then run a single M50 in MDI mode to reset the APC.

The following is a list of the alarms associated with the APC:

630 APC Door SW Fault-Switch Not equal to Solenoid

The APC door switch indicates the door is open but the solenoid shows the door has been commanded to close. Either the door has failed to close and is stuck, or the switch itself is broken or stuck. Also the door switch wiring may have a fault. Check switch, then cable. After correcting the condition, run an M50 to continue machining.

631 APC-PALLET NOT CLAMPED OR HOME

Do not attempt to move X or Y axes of mill until APC is in safe condition. CAUTION—The APC is not in a safe operating condition. One pallet is at home but the other pallet is neither clamped nor at home. Locate the unclamped pallet and return to home if possible. If drive pin is engaged or pallet is partially clamped, go to the lube/air panel at rear of mill and continuously press both white buttons in center of solenoid air valves while an assistant pulls the pallet off the receiver. After correcting the condition, run an M50 to continue machining.

632 APC Unclamp Error

The pallet did not unclamp in the amount of time allowed. This can be caused by a bad air solenoid, a blocked or kinked air line, or a mechanical problem. After correcting the condition, the M50 must be rerun to continue machining.

633 APC Clamp Error

The pallet did not clamp in the amount of time allowed by parameter 316. This alarm is most likely caused by the VMC table not being in the correct position. This can be adjusted using the setting for the X position (#121, #125) as described in the "Installation" section. If the pallet is in the correct position but not clamped, push the pallet against the hard stop and run an M18.

If the pallet is clamped, but not correctly, run an M17 to unclamp, push the pallet to the correct position, and run an M18 to clamp the pallet. Less common causes could be that the slip clutch is slipping, the motor is at fault, or an air solenoid is blocked or kinked, or an air line is blocked or kinked. After correcting the condition, run an M50 rerun to continue machining.

634 APC Mislocated Pallet

A pallet is not in the proper place on the APC. The pallet must be pushed back against the hard stop by hand. After correcting the condition, the M50 must be rerun to continue machining.

635 APC PAL num Conflict Rec and CH

The pallet number conflict receiver and Pallet changer:

The pallet number in memory does not agree with the actual pallet in use. Run an M50 to reset this variable.

636 APC Unload Switch Missed PAL 1

Pallet #1 did not return from the receiver to the APC in the allowable amount of time. This can be caused by the chain switch block missing the limit switch, or from another mechanical problem, such as clutch slippage. After correcting the condition, run an M50 to continue machining.

**637 APC Unload Switch Missed PAL 2**

Pallet #2 did not return from the receiver to the APC in the allowable amount of time. This can be caused by the chain switch block missing the limit switch, or from another mechanical problem, such as clutch slippage. After correcting the condition, run an M50 to continue machining.

638 APC Door Not Open

The automatic door did not open (in the time allowed by Parameter 319 "APC door close time") or may have fallen during an APC function. This can be caused by a bad air solenoid, a blocked or kinked air line, or a mechanical problem. After correcting the condition, the M50 must be rerun to continue machining.

639 APC Door Not Closed

The automatic door did not close (in the time allowed by Parameter 319 "APC door close time") when necessary after an APC function has been performed. This can be caused by a bad air solenoid, a blocked or kinked air line, or a mechanical problem. After correcting the condition, the M50 must be rerun to continue machining.

640 APC Missing Pallet @ Receiver

Pallet change sequence was halted because receiver switch was not activated. Pallet is either unclamped or not on the receiver. Ensure the pallet is correctly located on receiver (against hardstop) then run M18 to clamp the pallet. After correcting the condition, the M50 must be rerun to continue machining.

641 APC Unknown Chain Location

Neither Chain Location switch is tripped, so the control cannot locate the chain position. This can occur if a pallet change is interrupted for any reason, such as an alarm or an E-STOP. To correct this problem, the pallets and chain must be moved back into a recognized position, such as both pallets home or one pallet home and one on the receiver. The chain position adjustment tool must be used to rotate the chain into position. The pallets must be pushed into place by hand. After correcting the condition, run an M50 to continue machining.

642 APC Incorrect Chain Location

Chain not in position to load or unload pallets when necessary. To correct this, the mislocated pallet must be moved back into the proper position by hand. After correcting the condition, run an M50 to continue machining.

905 NO P Code In M14, M15, M36

In M14, M15, M36 must put pallet number in a P code.

906 Invalid P Code In M14, M15, M36

The P code must be the pallet number of a valid pallet without a decimal point, and must be a valid integer number.

907 APC Unload-Switch Missed PAL 3

Pallet #3 did not return from the receiver to the APC in the allowable amount of time. This can be caused by the chain switch block missing the limit switch, or from another mechanical problem, such as clutch slippage.

908 APC Unload-Switch Missed PAL 4

Pallet #4 did not return from the receiver to the APC in the allowable amount of time. This can be caused by the chain switch block missing the limit switch, or from another mechanical problem, such as clutch slippage.

909 APC-Program Not Listed

The main program attempted to run a subprogram that is not listed in the Pallet Schedule Table for the loaded pallet. To run the subprogram, enter the program name into the Program Name column of the Pallet Schedule Table, for the pallet you want to operate on. Or, remove the M48 from the subprogram. Verify that the subprogram and the pallet are compatible.

910 APC Program Conflict

The subprogram you are trying to run is not assigned to the loaded pallet. Another program is assigned to this pallet in the Pallet Schedule Table. Either enter the program name that you want to run into the Program Name column of the Pallet Status Table, or remove the M48 from the subprogram you want to use. Verify that the subprogram and the pallet are compatible.



911 APC PAL Load/Unload At Zero

One or more of the pallets on the Automatic Pallet Changer has a load or unload position set to zero. This indicates that the APC set up procedure was incomplete. Establish the correct load and unload positions for all pallets and enter the positions in the appropriate settings. See Operator's manual for your APC model for correct setting numbers.

912 APC No P Code Or Q Code For M46

M46 must have a P code and a Q code. The P code must be the name of a program stored in memory. The Q code is the number of the pallet to run the program on.

Alarm 913 APC No P Code or Q Code For M49

M49 must have a Q code. The Q code is the status to give the pallet.

Alarm 914 APC Invalid P Code

The P code must be the name of a program stored in memory. The program name must not have a decimal point. Remove any decimal points from the program name.

Alarm 915 APC Illegal Nesting G188 or M48

G188 is only legal in main program. M48 is only legal in a program listed in the Pallet Schedule Table or a first level subprogram.

Alarm 916 APC Negative PAL Priority Index

Software Error; Call your dealer.

Alarm 917 APC Number Of Pallets Is Zero

Parameter 606 must have a value if parameter 605 is not zero. Set parameter 606 to the number of pallets in your FMS system.

Alarm 918 APC Load Switch Missed PAL 1

Pallet #1 did not complete its move from the APC to the receiver in the allowable time. Pallet change sequence was halted because receiver switch was not activated. Pallet is either unclamped or not on the receiver. Ensure the pallet is correctly located on receiver (against hard stop) then run M18 to clamp the pallet. After correcting the condition, run an M50 to continue machining.

Alarm 919 APC Load Switch Missed Pal 2

Pallet #2 did not complete its move from the APC to the receiver in the allowable time. Pallet change sequence was halted because receiver switch was not activated. Pallet is either unclamped or not on the receiver. Ensure the pallet is correctly located on receiver (against hard stop) then run M18 to clamp the pallet. After correcting the condition, run an M50 to continue machining.

Alarm 920 APC Load Switch Missed PAL 3

Pallet #3 did not complete its move from the APC to the receiver in the allowable time. Pallet change sequence was halted because receiver switch was not activated. Pallet is either unclamped or not on the receiver. Ensure the pallet is correctly located on receiver (against hard stop) then run M18 to clamp the pallet. After correcting the condition, run an M50 to continue machining.

Alarm 921 APC Load Switch Missed PAL 4

Pallet #4 did not complete its move from the APC to the receiver in the allowable time. Pallet change sequence was halted because receiver switch was not activated. Pallet is either unclamped or not on the receiver. Ensure the pallet is correctly located on receiver (against hard stop) then run M18 to clamp the pallet. After correcting the condition, run an M50 to continue machining.

Alarm 922 APC Table Not Declared

Software calling invalid tables. Software Error; Call your dealer.

**PALLET SPECIFICATIONS****Weight** 300 lbs.**Thickness** 1 1/2"**Bolt Holes** 5 inch spacing, 1/2"-13 X 3/4 DP threads

CAUTION! Drilled holes in pallet should be less than 1" deep.

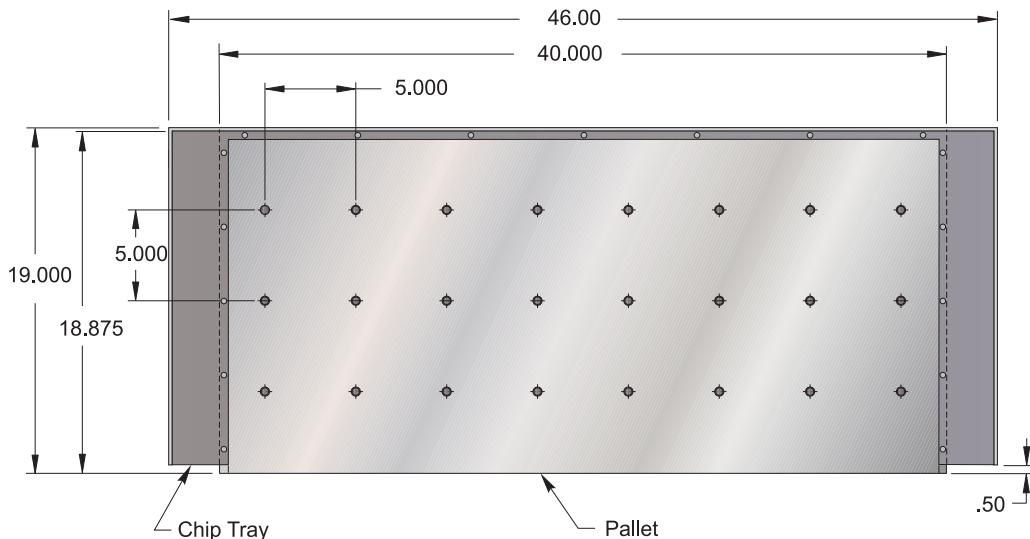


Figure 7.1 Pallet bolt hole pattern and spacing.

CAUTION! For pallet loads over 250 lbs, the load should be distributed evenly around the center of the pallet to avoid tipping the pallet during loading and unloading.
