



HAAS SERVICE AND OPERATOR MANUAL ARCHIVE

Automatic Pallet Changer Operators Manual 96-0012 RevC English June 2001

- 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.**

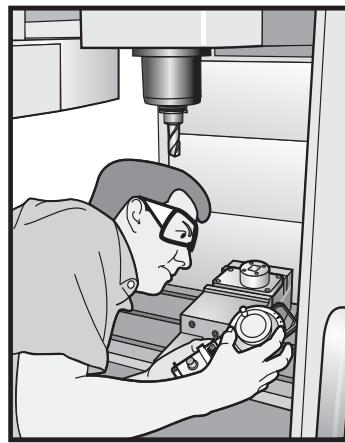
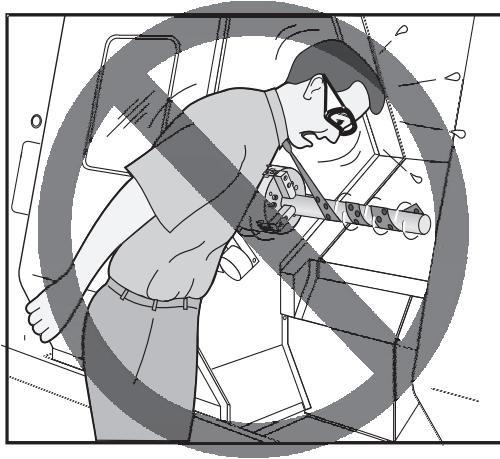
All information herein is provided as a courtesy for Haas machine owners for reference and illustrative purposes only. Haas Automation cannot be held responsible for repairs you perform. Only those services and repairs that are provided by authorized Haas Factory Outlet distributors are guaranteed.

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 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.

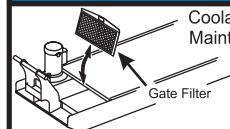


Moving parts can crush.
The tool changer will move in and crush your hand.
Never place your hand on the spindle and press ATC FWD, ATC REV, NEXT TOOL, or cause a tool change cycle.

- 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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25-0769 Rev E

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



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



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



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



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



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



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



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



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

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

WARNING



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



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



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



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



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



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

NOTICE



Clean the filter screen weekly.

Remove the coolant tank cover and clean out any sediment inside the tank weekly.

Do not use plain water, permanent corrosion damage will result. Rust inhibiting coolant is required.

Do not use toxic or flammable liquids as a coolant.

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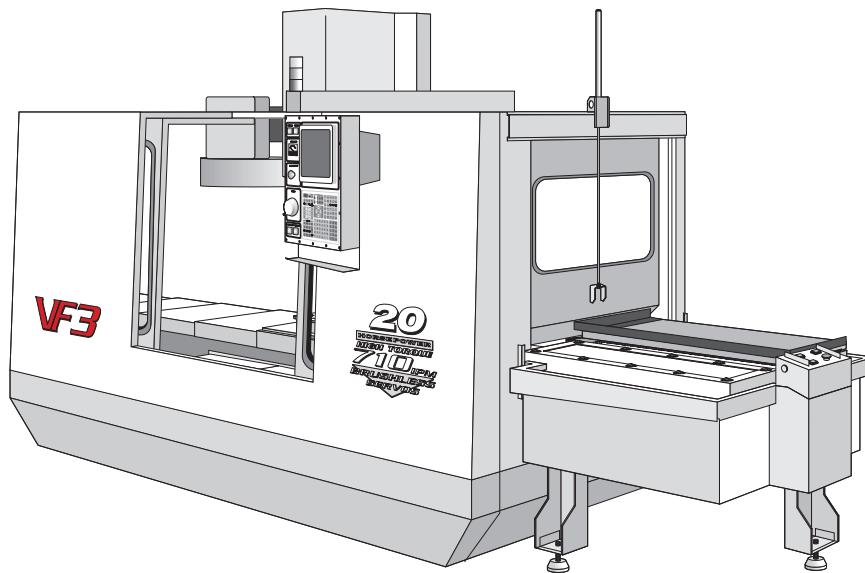
OTHER SAFETY DECALS

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





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 19" x 40" 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.

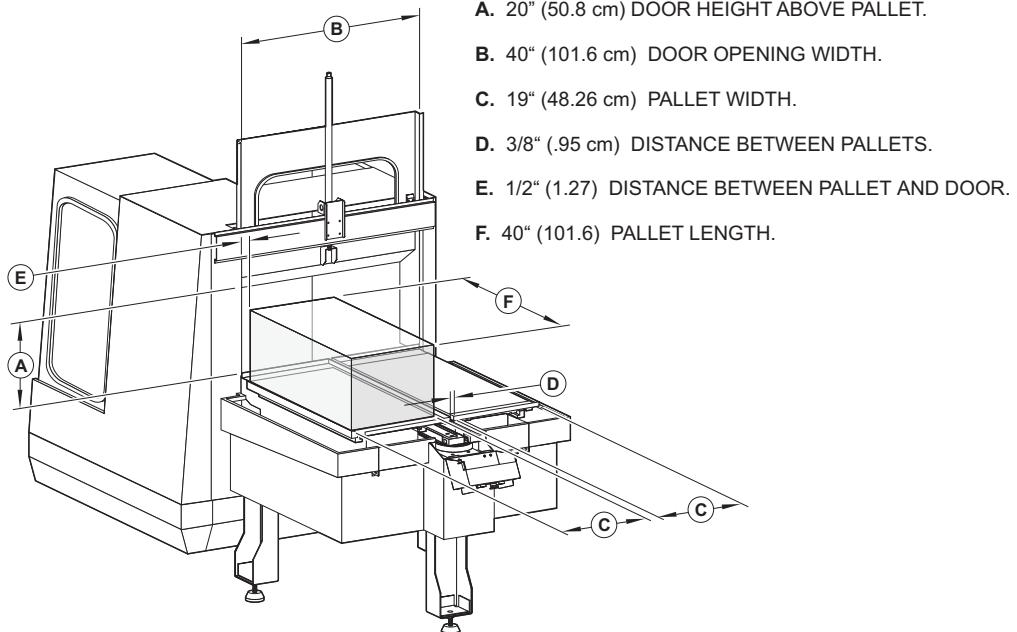
Pallet movement is accomplished through the use of a drive motor and chain. The drive motor has a nonadjustable slip clutch that prevents damage to the motor if the pallet change is physically blocked.

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

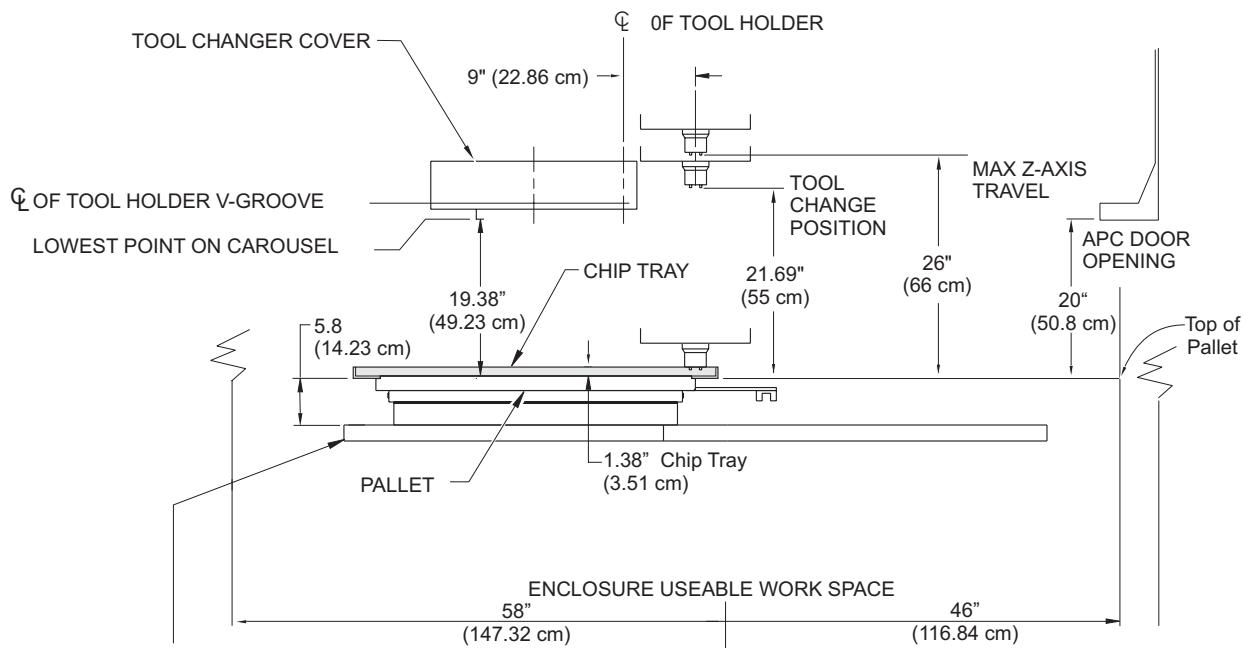


1.2 APC WORKING DIMENSIONS

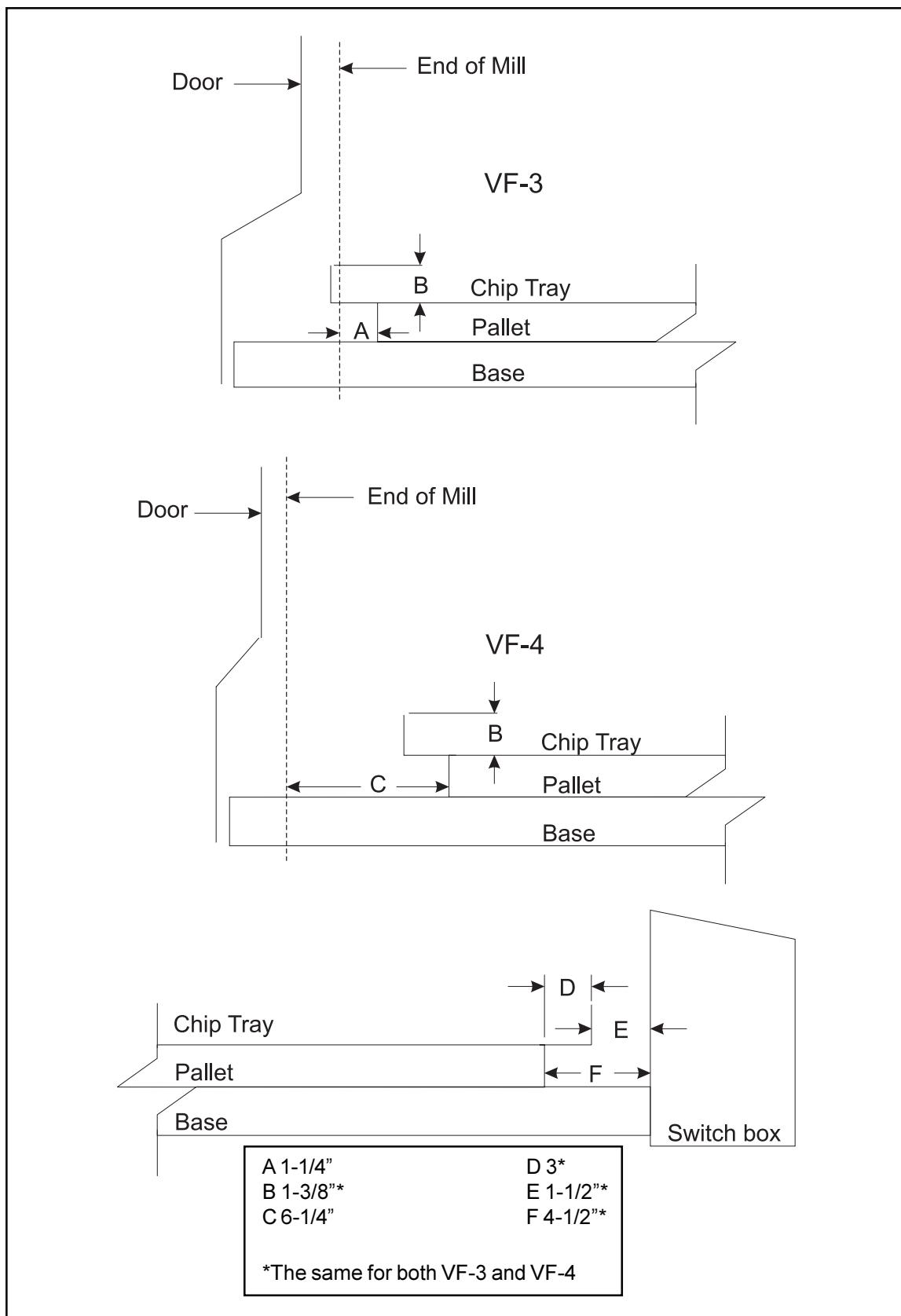
APC DIMENSIONS



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)

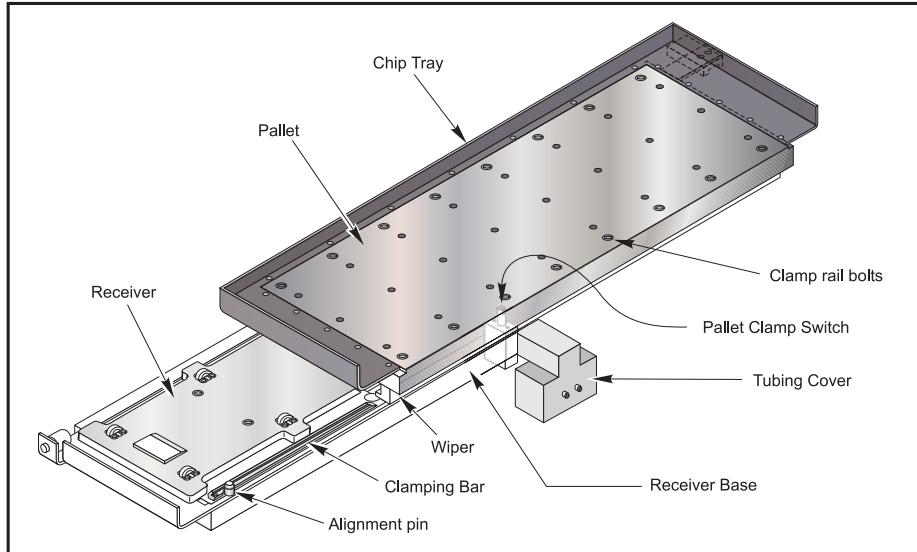
**APC PALLET CLEARANCES**

**2.0 MAINTENANCE SCHEDULE**

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

PERIODIC MAINTENANCE

INTERVAL	MAINTENANCE PERFORMED
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 into plunger. Do not over grease.
	WARNING: Excessive chip buildup will require more frequent chip clean-up.
	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 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:

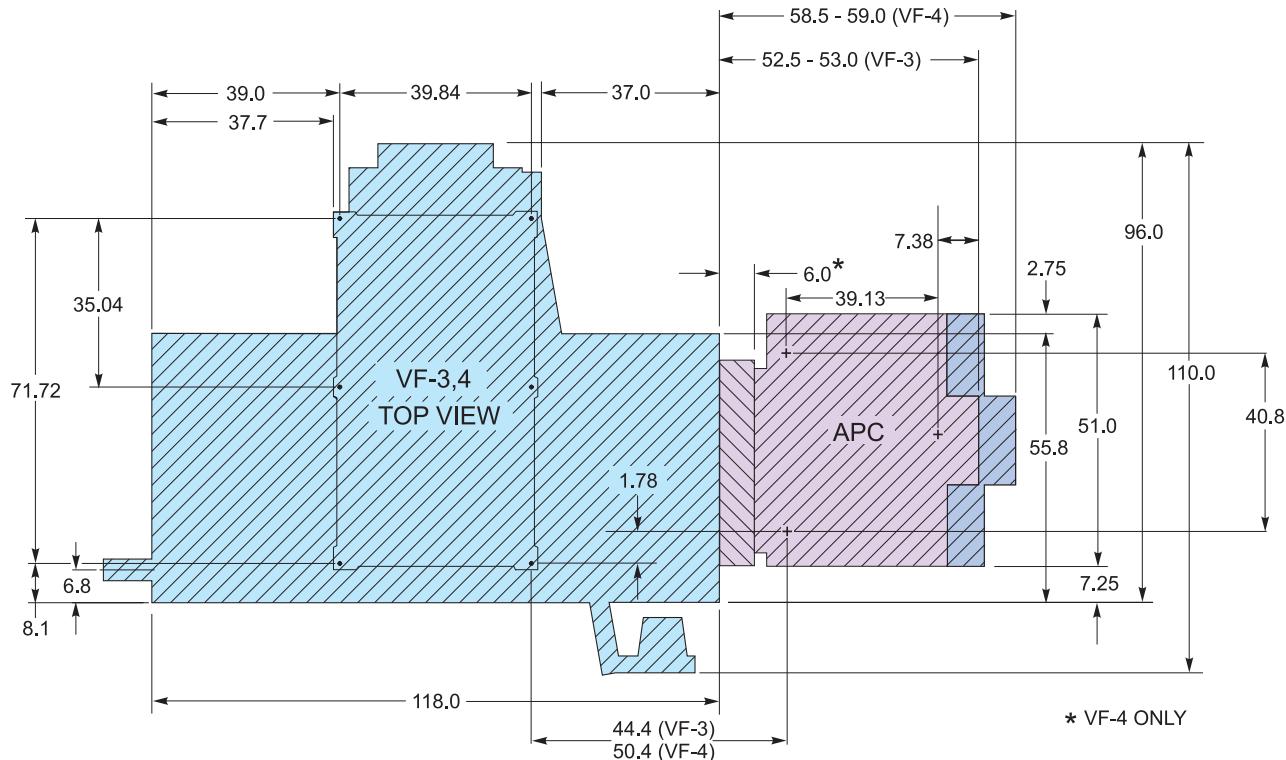
- Machinists' level (2)
- 6' straightedge
- Allen wrenches
- Forklift capable of lifting 5,000 lbs, with forks at least 6' long
- **Included** - APC chain rotation tool (P/N 20-0102)
- **Included** - APC jumper

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.	

VF/APC FOOTPRINT



VF 3/4 WITH APC FOOTPRINT

**3.1 M CODES FOR APC SETUP**

The following **M** codes are used during the APC Installation procedure. These **M** codes are not intended to be used to program the APC at any other time.

- | | |
|-----|--|
| M14 | Go to pallet #1 load position |
| M15 | Go to pallet #2 load position |
| M17 | Unclamp pallet and open automatic door |
| M18 | Clamp pallet and close automatic door |

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.

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 2.1). 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.

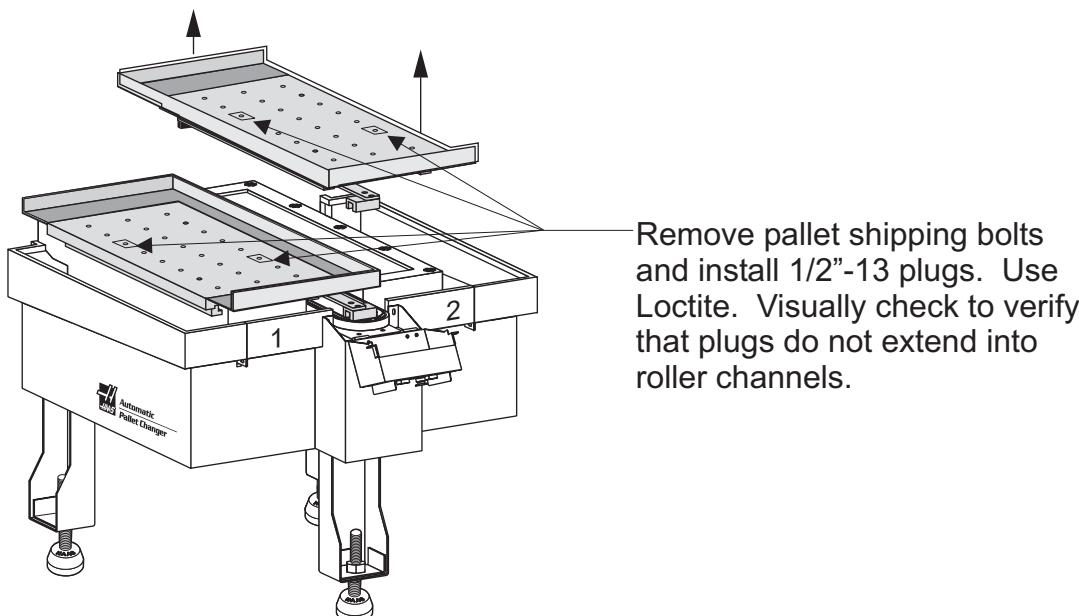


Figure 2.1 Removal of Shipping Bolts



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 2.2).

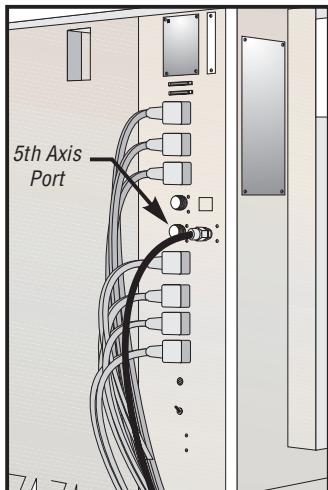


Figure 2.2 Fifth Axis port on the side of the VMC control cabinet

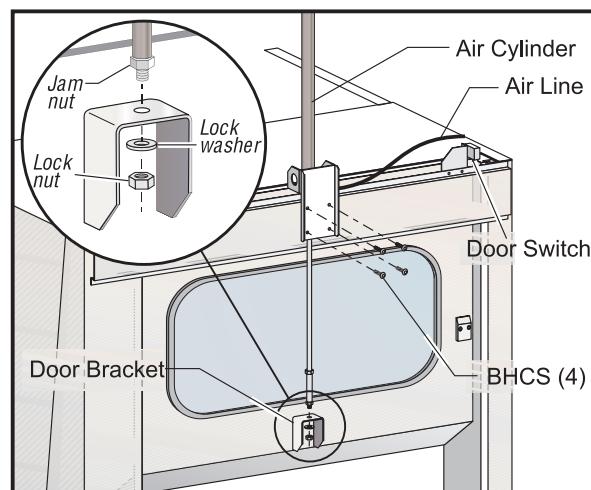


Figure 2.3 Air cylinder installation.

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 2.3.
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 switch and bracket onto the VMC with two SHCS. Ensure the switch is pointing towards the door. 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.
8. In MDI mode, command an M14. The table will move to the pallet #1 load position. (The front right corner of the VMC).

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



9. 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.

10. Set the APC in place on the leveling pads, so that it is centered in the VMC door opening (see Figure 2.4). Ensure that the lip of the APC enclosure is centered in the VMC drip trough (see Figure 2.5).

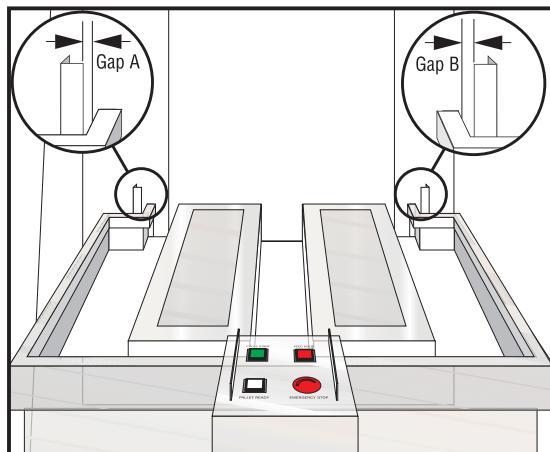


Figure 2.4 Gaps A and B should be equal.

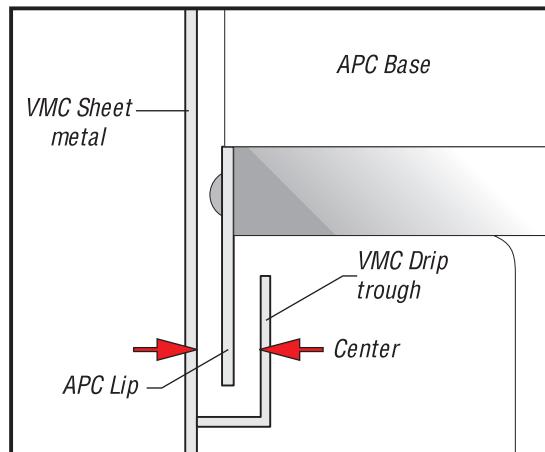


Figure 2.5 The APC lip should be centered in the VMC drip trough.

11. 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 2.6). 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.

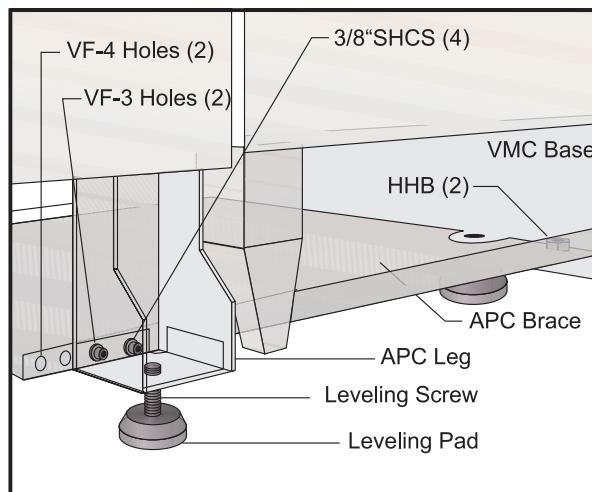


Figure 2.6 Installing the APC brace (VF-3 shown).



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 2.7). 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.

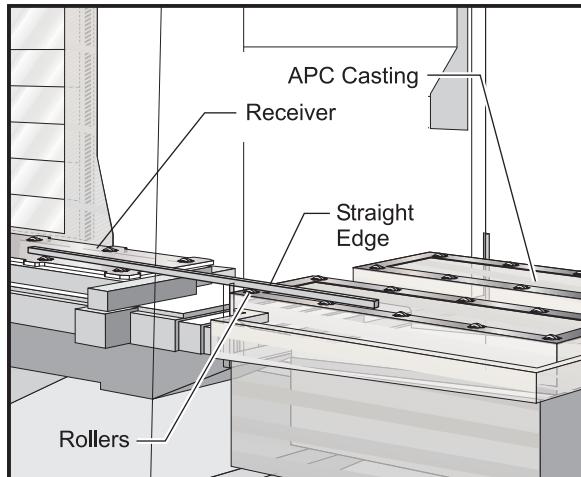


Figure 2.7 APC roller alignment setup.

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 2.6) on the APC brace **evenly**, so the APC is not pulled out of alignment. Recheck the level and all alignments.



16. Open the hinged APC operator's panel cover by removing the two BHCS (see Figure 2.8).

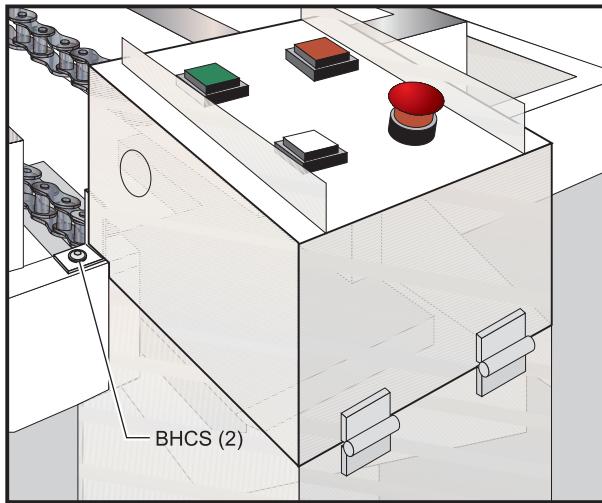


Figure 2.8 APC operator's panel cover.

17. Ensure that the drive roller on the APC chain is centered under the control box, as shown in Figure 2.9. 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 2.10). 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.

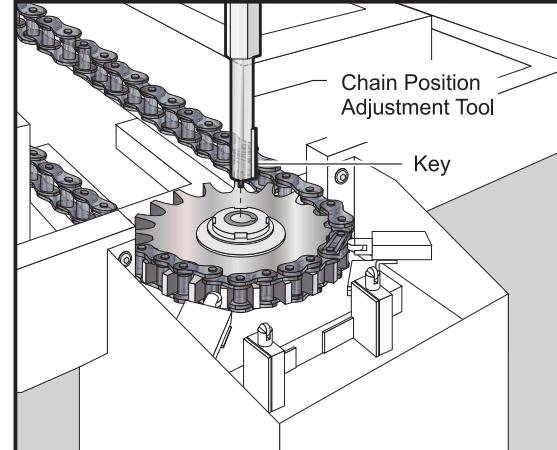
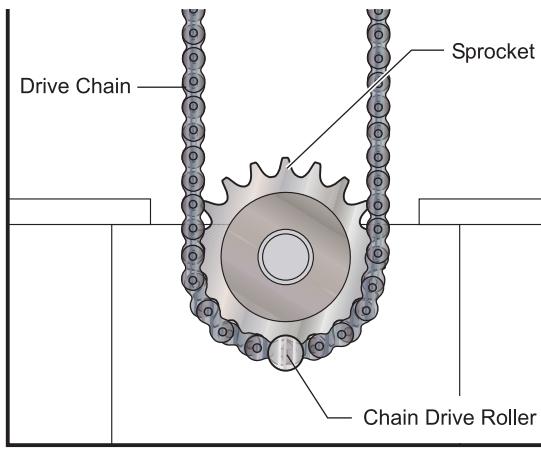


Figure 2.9 Chain drive roller positioning.

Figure 2.10 Chain position adjustment tool placement.



- 18.** Insert two 1/2"-13 eyebolts into each pallet (see Figure 2.11). 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 2.12).

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.

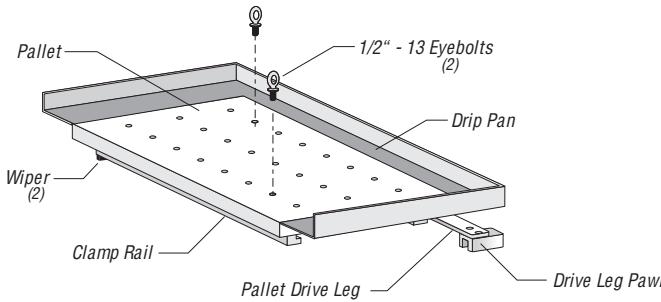


Figure 2.11 Lifting eyebolt locations.

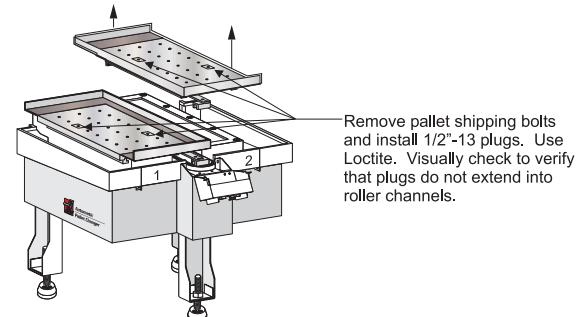


Figure 2.12 Pallet placement.

- 19.** Pull the pallets onto the friction blocks and against the hard stop (see Figure 2.13). Rotate the chain slightly, using the chain position adjustment tool, to allow each drive leg pawl to clear the chain drive roller.

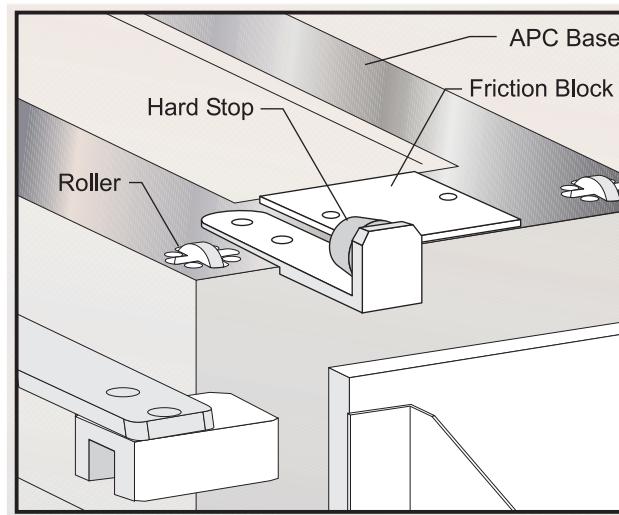


Figure 2.13 View of APC base showing friction block and hard stop.



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 2.2), 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 2.14).

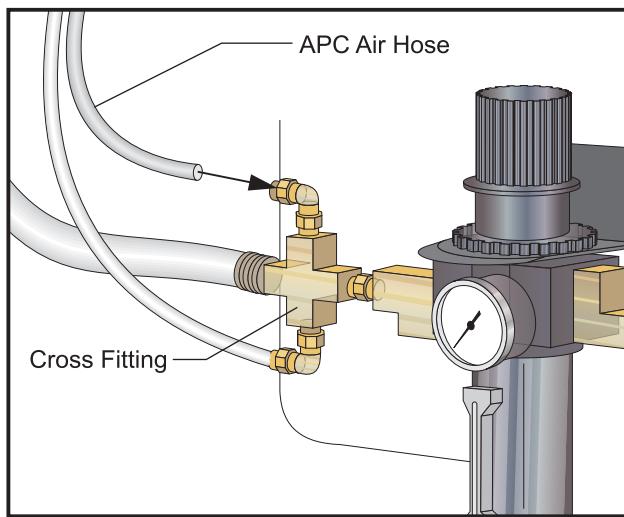


Figure 2.14 APC air hose connection to VMC air/lube cross fitting.



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.

MACRO VARIABLES

The following macro variables control the location of the VMC table during pallet changes. Fine tuning consists of adjusting variables #500-507 and the height of the APC. For instance, #500 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 #501 can be modified.

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

# 500 =	X pallet 1 load position
# 501 =	Y pallet 1 load position
# 502 =	X pallet 1 unload position
# 503 =	Y pallet 1 unload position
# 504 =	X pallet 2 load position
# 505 =	Y pallet 2 load position
# 506 =	X pallet 2 unload position
# 507 =	Y pallet 2 unload position

Macro Variable #510 can be set to zero in order to leave both pallets on the APC. This can be done in order to clean or maintain the receiver.

Macros must be enabled in order to use these statements. The macro variables can be viewed on the CURNT COMDS (Current Commands) page of the VMC display. The PAGE UP and PAGE DOWN keys may then be used to locate the correct list of macro variables. To scroll through this list, use the Cursor Right and Left buttons. Refer to the VMC Operators Manual for instructions on how to modify these variables.

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 pawl.

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 macro variables #501 and #503. These two variables 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, adjust the APC height 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 (macro variables #501, 503, 505, and 507) are now set.

6. In MDI mode, command an M18 to clamp the pallet and close the automatic door.

NOTE: The message "PEND MOVE - CY/ST" will appear and motion will stop during an M18. The CYCLE START button must be pressed 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 macro variables, 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 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 +/- .09). If the pin and bushing are not aligned, the load position of the receiver will have to be changed.

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

Before starting another pallet change, change the macro variable for the load position of the next pallet. Use '500' for pallet 1, or '504' for pallet 2. Typically the load and unload positions will be the same for both pallets.



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 macro variables to adjust this misalignment.

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



4.0 PROGRAMMING

4.1 PROGRAM COMMANDS

These instructions are for hardcoded macro-programmed Automatic Pallet Changers.

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) and the X coordinate safe distance must be set (setting 129).

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 3.1.

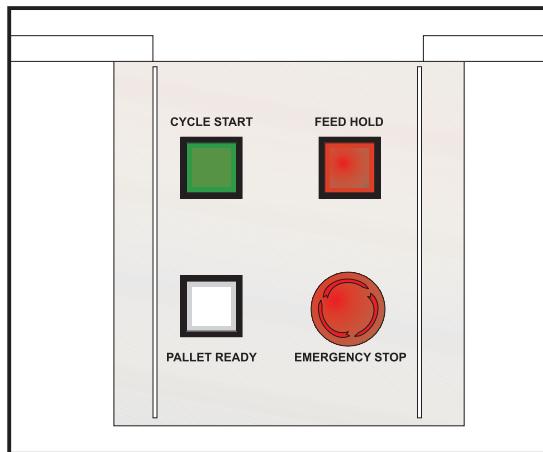


Figure 3.1 APC operator's control panel (top view).

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.



4.2 M CODES

Only one **M** code may be programmed per block of a program. All **M** codes are effective or cause an action to occur at the end of the block. The following **M** codes are used to program the APC:

M14	Move APC table to pallet 1 load position
M15	Move APC table to pallet 2 load position
M17	Unclamp APC pallet and Open APC door
M18	Clamp APC pallet and close APC door
M50	Perform pallet change
M90	Perform Pallet Unload Only

4.3 SAMPLE PROGRAMS

Example #1:

Basic program using the "Pallet Ready" light on the APC.

Oxxxxx	
M36	(Flash "Pallet Ready" light - wait until PALLET READY button pressed to continue)
M50 P1	(Perform pallet change after "Pallet Ready" button is pressed) (P1 will load pallet 1, P2 will load pallet 2, P0 unload - both pallets returned to the APC)
-	(USER's PART PROGRAM)
-	
M99	(Repeat program)

Example #2:

Basic pallet change program that tracks which part is to be machined on each pallet.

Oxxxxx	
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	(USER's PART PROGRAM FOR PALLET #1)
M96 Q26 Pxx	(USER's PART PROGRAM FOR PALLET #2)
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:

Oxxxxx	
M36	(Flash "Pallet Ready" light - wait until PALLET READY button pressed to continue)
M50 P1	(Load Pallet #1)
M98 Pxx	(USER's PART PROGRAM FOR PALLET #1)
M36	
M50 P2	(Load Pallet #2)
M98 Pxx	(USER's PART PROGRAM FOR PALLET #1)
M99	

**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.

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 LIMIT SWITCHES

The APC contains limit switches and a proximity sensor that monitor machine operation:

Door Open Switch - Senses when the door is in the fully up position.

Receiver Clamp/Unclamp Proximity Sensor- Senses whether or not the receiver is in the down (clamped) position.

Pallet Stop / Location Switches (2) (Home) - Sense whether each pallet is home (on the APC). When a pallet is being unloaded, the chain drive will stop when this switch is tripped.

Chain Stop / Location Switches (2) (pin clear) - Sense the chain location, and whether it is in the correct position to perform an operation. After a pallet has been loaded, the chain drive will stop when this switch is tripped.

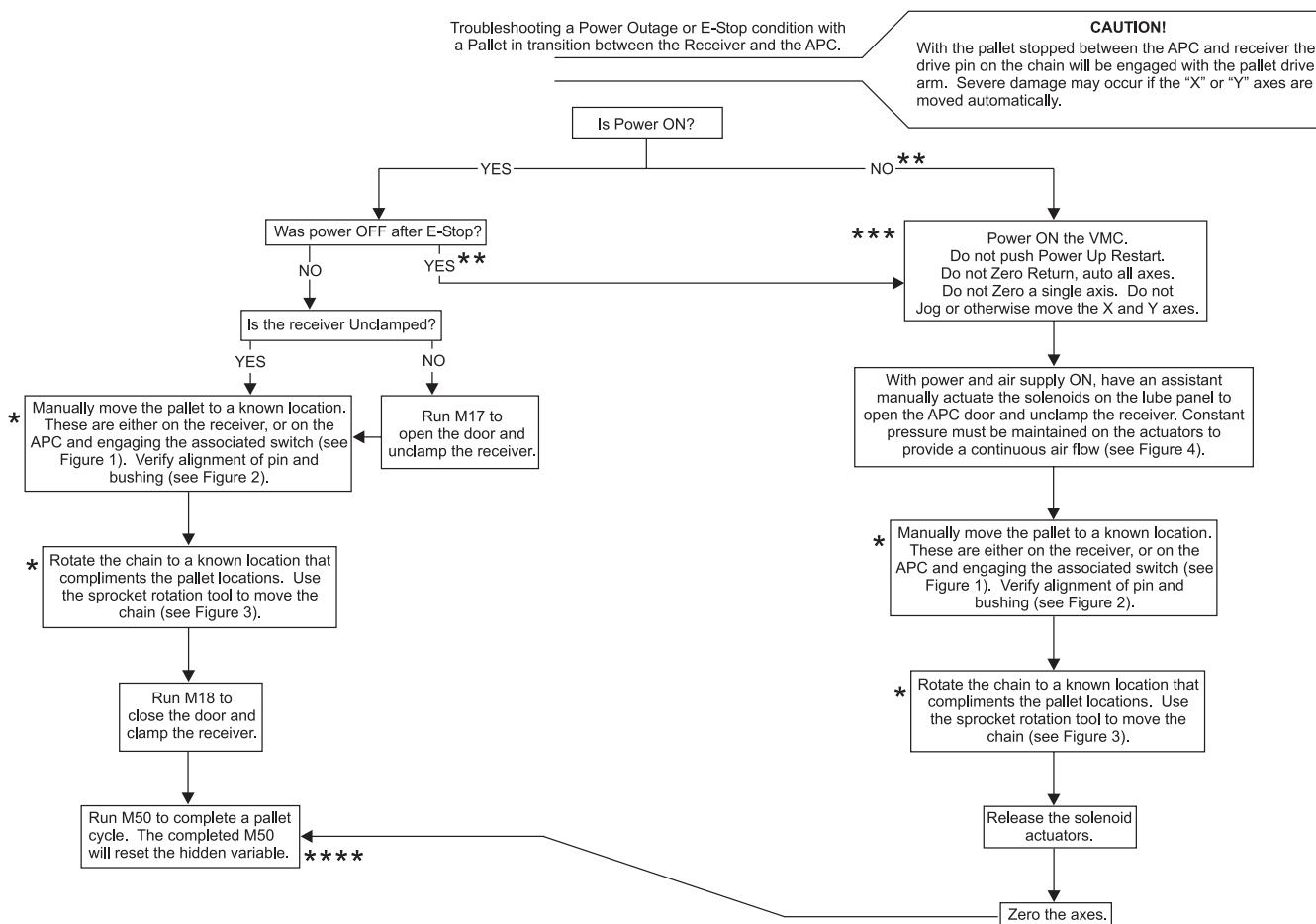
WARNING!

Do not move the limit switches for any reason.



5.3 RECOVERY FROM POWER OUTAGE OR E-STOP

Recovery from a power outage or an E-Stop initiated during a pallet change:



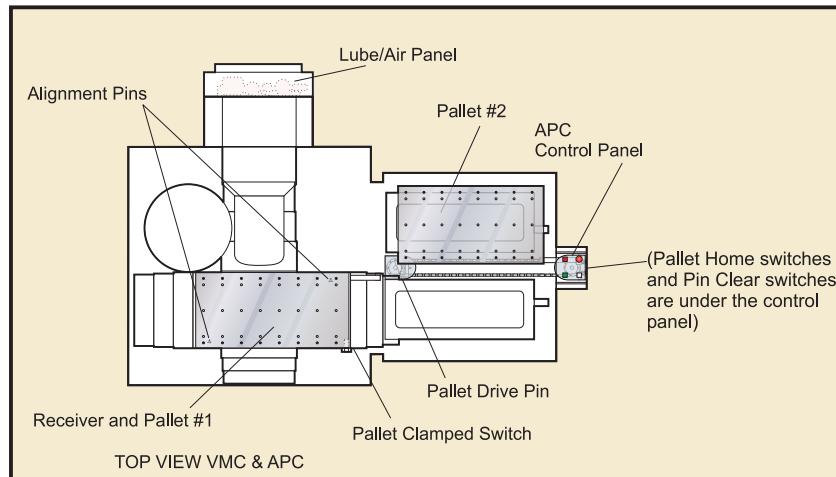


Figure 1
Pallet known locations. Pallet 1 is on the receiver and engaging the Pallet Clamped switch. Pallet 2 is on the APC and engaging the Pallet Home Switch under the control panel.

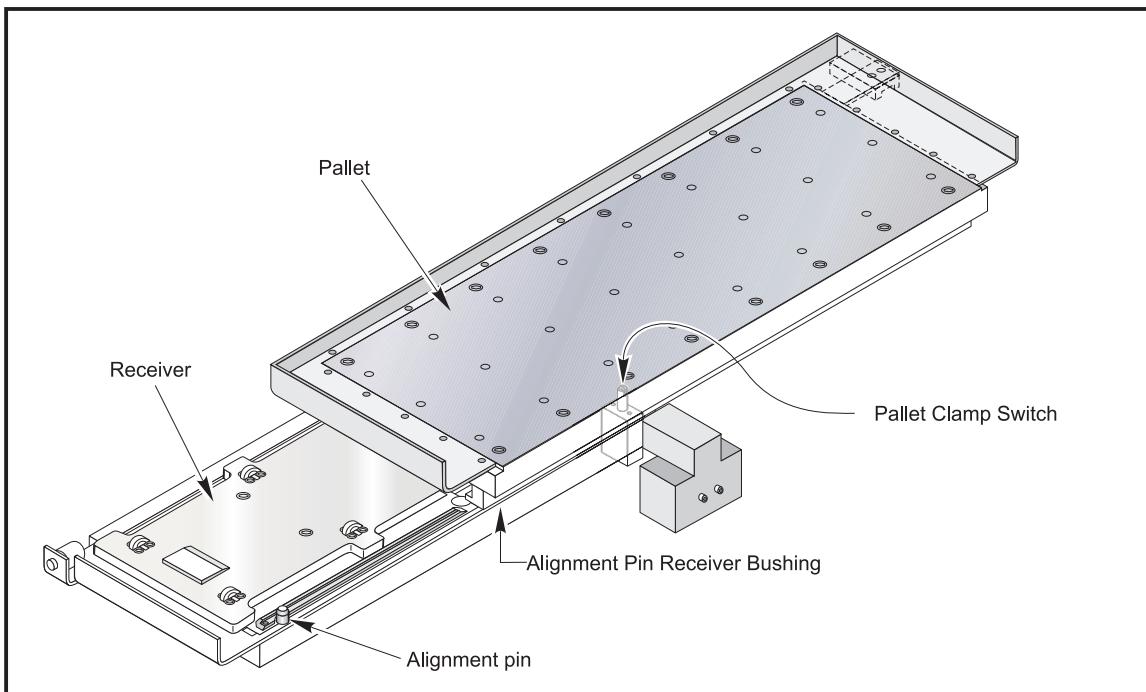


Figure 2
Alignment Pin and Bushing alignment must be verified when manually positioning a pallet on the receiver.

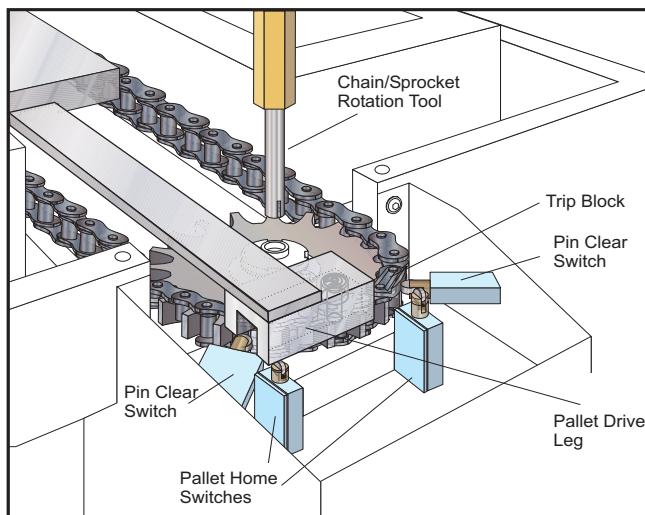


Figure 3
With pallet 2 clamped on the receiver, the trip block must be engaging the switch as shown.

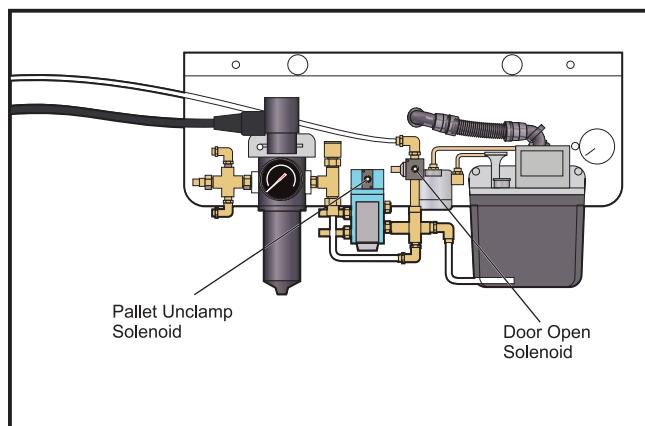


Figure 4
Press and hold the solenoid actuation buttons (small white buttons) to keep air pressure flowing to unclamp the receiver and hold the door open. If the buttons are released the door will close and the receiver will clamp.



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 #1011 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:

NOTE: Machines with software version 10.02 or later will have corresponding Alarm numbers shown in parenthesis.

180 Pallet Not Clamped (631)

Before machining a part, the VMC checks to make sure the pallet is in the correct position and is fully clamped. This alarm will be generated if either of these is not true, or if the pallet change macro has not been completed. The pallet change macro can be interrupted by pressing E-stop, Reset, or Feed Hold.

This alarm indicates that the VMC table is not in the correct position, a pallet change was not completed, or E-STOP was pressed.

If the pallet is clamped, run an M50 to reset the machine. If the pallet is in the correct position but not clamped, push the pallet against the hard stop, run an M18 to clamp the pallet, then run an M50 to reset the machine. If the pallet is clamped, but not correctly, run an M17 to unclamp, push the pallet to the correct position, run an M18 to clamp the pallet, then run an M50 to reset the machine.

Less common causes for this alarm could be that the slip clutch is slipping, the motor is at fault, an air solenoid is bad, or an air line is blocked or kinked.

1002 Unclamp Error (632)

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.

1003 Clamp Error (633)

The pallet did not clamp in the amount of time allowed by the M50 macro. This alarm is most likely caused by the VMC table not being in the correct position. This can be adjusted using the macro variables for the X position (#500, 504) 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, an air solenoid is bad, or an air line is blocked or kinked.

**1004 Mislocated Pallet @ APC (634)**

A pallet is not in the proper place on the APC. The pallet must be pushed back against the hard stop by hand.

1005 Pal No Conflict Rec & Ch (635)

The incorrect pallet number is entered in macro variable #510. Run an M50 to reset this variable.

1006 Switch Missed Pal 1 (636)

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.

1007 Switch Missed Pal 2 (637)

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 another mechanical problem, such as clutch slippage.

1008 Door Not Open (638)

The automatic door did not open (in the allowable time) when necessary to perform an APC function. This can be caused by a bad air solenoid, a blocked or kinked air line, or a mechanical problem.

1009 Door Not Closed (639)

The automatic door did not close (in the allowable 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.

1010 Missing Pallet @ Receiver (640)

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.

1011 Unknown Chain Location (641)

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.

1012 Incorrect Chain Location (642)

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.



7.0 TECHNICAL REFERENCE

PALLET SPECIFICATIONS

Weight 300 lbs.

Thickness 1 $\frac{1}{2}$ "

Bolt Holes 5 inch spacing, 1/2"-13 X 3/4 DP threads

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

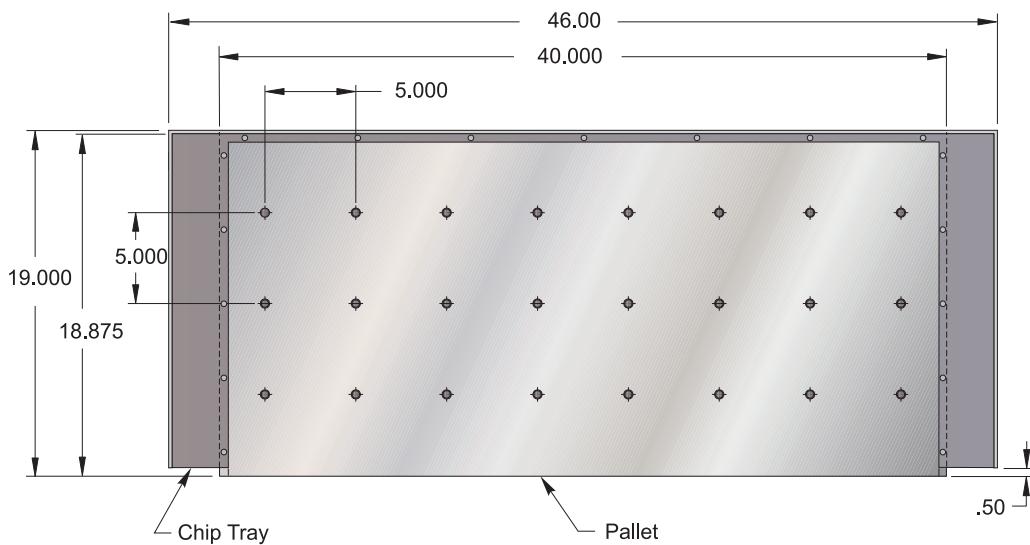


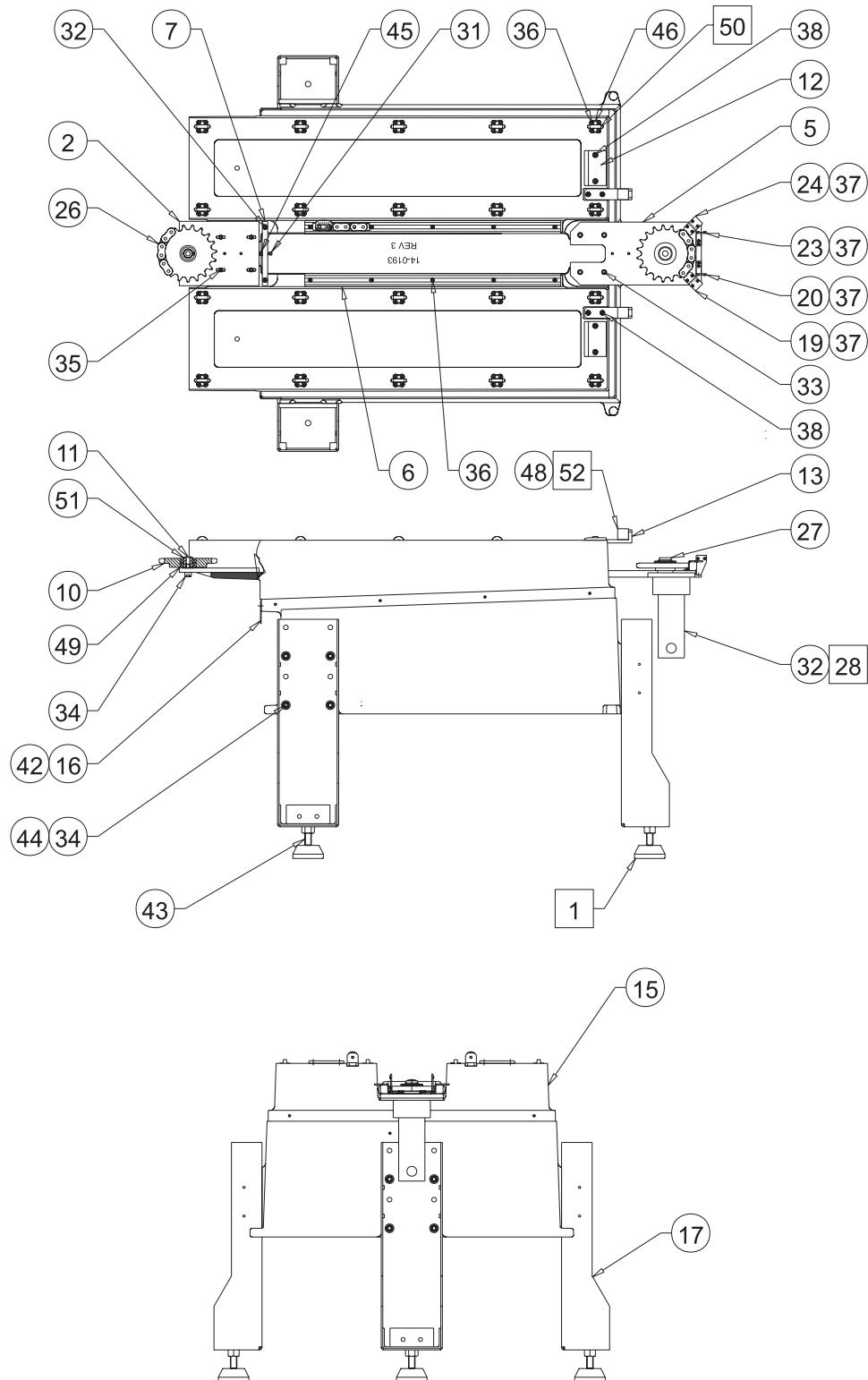
Figure 6.1 Pallet bolt hole pattern and spacing.

CAUTION!

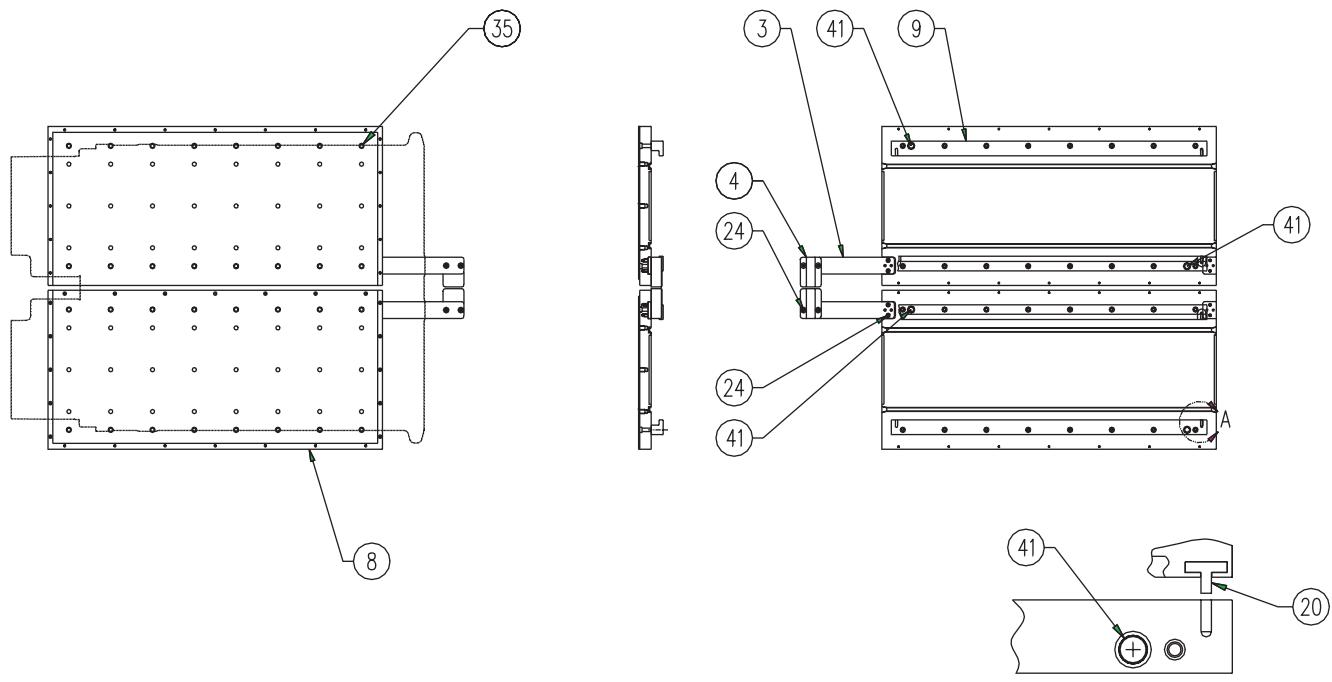
For pallet loads over 250 lbs, the load should be distributed evenly around the center of the pallet to avoid tipping the pallet during loading and unloading.



8.0 ASSEMBLY DRAWINGS



APC Assembly



DETAIL A
SCALE 1:2

APC Assembly



APC Assembly

ITEM	QTY.	PART NO.	TITLE
1.	3	14-7068	CASTING, LEVEL PAD
2.	1	20-0046	SUPPORT, IDLER SPROCKET
3.	2	20-0048	DRIVE LEG, APC
4.	2	20-0049	DETENT, APC
5.	1	20-0050	SUPPORT, MOTOR, APC
6.	2	20-0051	GUIDE, CHAIN, APC
7.	1	20-0052	TENSIONER BLOCK
8.	2	20-0053	PALLET
9.	4	20-0054	CLAMPING RAIL
10.	1	20-0057	IDLER SPROCKET
11.	1	20-0060	JOURNAL, IDLER SPROCKET
12.	2	20-0065	FRiction BLOCK
13.	2	20-0066	PALLET STOP, APC
14.	4	20-0071	WIPER, APC
15.	1	20-0193	BASE, MACHINED
16.	1	25-0066	SHIELD, SPLASH, LOW PROFILE
17.	3	25-0072	LEG, APC
18.	2	25-0077	PALLET, SKIRT, REAR
19.	1	25-0082	SWITCH BRACKET, CHAIN, LOW
20.	1	25-0085	SWITCH BRACKET, ARM #1
21.	2	25-0095	PALLET DRIP PAN
22.	4	25-0100	BRACKET, WIPER
23.	1	25-0101	SWITCH BRACKET ARM #2
24.	1	25-0102	SWITCH BRACKET, CHAIN, HIGH
25.	2	25-0105	PALLET SKIRT, FRONT
26.	1	30-0054	CHAIN ASSEMBLY, APC
27.	1	30-0055	SLIP CLUTCH ASSEMBLY
28.	1	32-1800	SHUTTLE MOTOR, 507-01-110AH
29.	8	40-0017	FHCS, 5/16-18 X 3/4"
30.	8	40-16081	BHCS, 6-32 X 5/16"
31.	1	40-1614	SHCS, 1/4-20 X 1 1/4
32.	2	40-1617	FHCS, 1/4-20 X 1"
33.	4	40-1636	SHCS, 3/8-16 X 1 1/4
34.	13	40-1654	SHCS, 1/2-13 X 1"
35.	4	40-1667	SHCS, 5/16-18 X 1 1/4
36.	124	40-1703	FHCS, 10-32 X 1/2
37.	8	40-1850	SHCS, 10-32 X 3/8"
38.	8	40-1920	FHCS, 1/4-20 X 5/8
39.	2	40-1950	SHCS, 10-32 X 3/4
40.	32	40-1961	SHCS, 3/8-16 X 2"
41.	4	40-1970	FHCS, 1/4-28 X 1"
42.	3	40-1981	FBHCS, 1/4-20 X 1/2
43.	3	44-1700	SSS, CUP PT. 3/4-10 X 4:"
44.	12	45-1666	WASHER, FLAT 1/2 I.D.
45.	1	46-1625	NUT, HEX, BLACK OX, 1/4-20
46.	20	48-0012	DOWEL PIN, 12mm X 30 mm LG.
47.	32	49-16201	BHCS, 10-32 X .38
48.	4	51-0030	BUSHING, DRILL .6260 I.D.
49.	2	51-2836	BEARING, RADIAL, #60052RS
50.	20	51-4000	BEARING, RADIAL12 X 32 X 10MM
51.	1	56-0085	RETAINING RING 5100-100
52.	2	59-1057	BUMPER, PALLET