



MODEL CHV24-8

Self Contained, Side or Vertically Mounted
Hydraulically Driven
Air Conditioning and Heating Unit

- **INSTALLATION**
- **OPERATION**
- **MAINTENANCE**

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INSTALLATION, OPERATION & MAINTENANCE

MACBONE MODEL CHV24-8

(Serial numbers 001 and up)

PRODUCT DESCRIPTION

The *MacBone* Series CHV24, 24,000 BTU/hr., cooling, heating, dehumidifying and pressurizing unit, is a vertical or “side-mounted”, unitary, or self-contained unit, with a closed, precharged refrigeration circuit, driven by a single, integral, hydraulic motor. Heating is derived from the circulation of hot engine coolant, engine oil or hydraulic oil through the unit. Heating capacity is 30,000 BTU/Hr. at a fluid flow rate of 1.5 GPM at 140° F. The design concept is derived from the need for an air conditioning unit for industrial applications where the unit can be quickly removed for service without involving the sealed refrigeration circuit. Cooling is provided by a thermostatically controlled automotive type compressor, using refrigerant 134A. The condenser fan and evaporator blower share a common shaft, driven by the hydraulic motor with sufficient power to produce substantial condenser air flow even with a filter on the outside coil, thus insuring reliable performance even in a heavily dust laden environment. Substantial power delivered to the inside air blower also assures delivery of full system capacity under all conditions. Induction of about 5% outside air through a washable filter provides some cab pressurization to exclude dust and other larger particle contaminants from entering the cab environment. The addition of a MacBone external cab pressurizer, model P150-1 or P150-V, will increase outside air filtration and air volume to about 14%. Two places are provided to quickly install the P150-1 or the P150-V with the remote mount filter canister.

Hydraulic drive input is usually, but not necessarily, from a pump driven by the vehicle's engine and utilizing the vehicle's hydraulic reservoir. Required flow is a constant 10 GPM at a variable pressure from 600 to 1400 PSIG. System pressure relief, provided by the installer, should be set at 1650 PSI. Electrical input of 3.5 amps, at 12 or 24 VDC, is used only to activate the compressor clutch. There are no electrically driven fans or blowers in the MacBone design. All CHV24-8 models accept either 12 or 24 V.D.C.

For the CHV24 series units, a required subbase with shock mounts is supplied with the unit. All units, measure 37.5” wide (horizontal dimension) by 26.5” high and protrude 12.75” from the surface on which they are mounted. There is no protrusion inside the space being cooled. The total weight is 188 pounds. Hydraulic lines are #8, supply and return, up to 40'. The motor has an external case drain to protect its shaft seal and this drain is intended to be returned directly to the hydraulic tank by a #6 line. Seven 1/2 inch SAE mounting bolts provide for quick removal for service or replacement. The dual V belt drive system has an automatic tensioner and operates in a closed, ventilated area. Recommended operating time before overhaul is 6000 hours. Recommended unit life is four overhaul cycles. Note, however, that at the end of the 2006 season, we are finding units four to five years old in need of drive belts only. We also note that four overhaul cycles will not be the limit.

UNCRATING

The *MacBone* Series CHV24 shipping pallet usually contains the following:

1. The CHV24 Series unit complete with 3 primary shock mounts.
2. The subbase, complete with an additional 4 shock mounts to which the unit will be secured.
3. CHV24 Installation and Operational Manual.
4. Supply and return air ducts with air seal trim packed in a card board box.

Remove the pallet straps and packing. Remove the box with the air ducts.

From the accessible side of the subbase, with a $\frac{3}{4}$ wrench, remove the 3 bolts which secure the subbase to the unit. For access to 4 additional such bolts, remove the power section cover first, which is held in place by 5 screws. Remove the evaporator section cover next, which is held in place by 12 screws. Using the green lifting eye, remove the unit from the subbase. Inside the unit, locate and remove the 4 additional bolts which secure the unit to the subbase.

SUBBASE AND AIR DUCT INSTALLATION

GENERAL: The subbase is designed to be secured to the wall of the cab to be cooled. The wall surface must be flat and strong enough to support the 188 pound total weight of the CHV24 Series air conditioning unit, subbase, air ducts and accessories. The removable air conditioning unit weighs 145 lbs.

LOCATION: When installed, the area around the unit must be open on the condenser filter end and across the front air holes to allow air flow to and from the condenser.

When installed, holes will be cut in the cab wall to match the rectangular return air hole and the square discharge air hole in the subbase. Be sure this cutting will not sever vital structures. Since the system controls are accessed by reaching into the return air area, this area must be accessible from the cab. The supply air, at full fan speed, is discharged at very high velocity, so the discharge air should not be located where it will blow directly onto an operator's station.

IMPORTANT

Since most all vertical units will be installed below the cab window level, the discharge and return air ducts will be low in the cab, possibly resulting in stratification of the cooled air in large cabs. In smaller cabs, stratification is usually not a problem. Stratification means the cold air, being heavier than warm air, and being discharged and returned at knee level, will tend to cool only the lower level of the cab. To address this phenomenon, either the discharge air must be deflected or ducted to the ceiling, or the return air ducted so as to draw from the ceiling. The MacBone model ST24-D, 90° curved deflector, installed on the discharge duct and oriented so as to deflect the discharge air upward will usually take care of the stratification problem. If not, contact us for other solutions which have been field tested.

Note: If the return air area cannot be placed within reach of the operator, remotely mounted controls, can be placed anywhere. Please contact MacBone, toll free, at 888-MACBONE (622-2663) for proper set up of the basic valves and switches for your specific application.

SECURING: When a suitable location has been selected, drill the subbase and the wall for four to six through bolts which will secure the subbase to the wall.

I M P O R T A N T

For best security, place at least one mounting bolt within several inches of each of the four rubber shock mounts and in the upper right and left corners, **BUT DO NOT** allow any portion of the bolt head or washer to be closer than one inch from the edge of either the return air or supply air hole. This restricted area is reserved for the air duct securing flanges and is painted red. Use additional mounting bolts as appropriate.

On the larger surface of the subbase, which is to be mated to the vertical wall, run a bead of caulking, like silicone, around the outside edge, around the return air and supply air holes and around each of the bolt holes you drilled.

Now secure the subbase with the securing bolts inserted **FROM THE OUTSIDE**. Fastener heads must not exceed 1/2" in height to insure they will not hit the bottom of the unit when the unit is secured to the subbase. If the nuts must be out, cut the bolts flush with the tops of the nuts.

Using whatever tools it takes, cut the return and discharge air holes through the wall to conform to the holes in the subbase. You may wish to cut these holes before securing the subbase. If you cut the holes first, it's OK to make them 1/4" larger all around.

AIR DUCTS: Before placing the CHV24 Series unit onto the subbase, the supply and return air ducts must be placed through the subbase from the outside toward the inside of the cab. The rubber edge trim remains outside of the cab. These ducts are essential since they provide the necessary air seal between the unit and the cab. Without them, dust laden outside air will come in and cooled air will leak out. It is important that you use sealer under the duct flanges. Remember, the rubber trim goes between the air duct and the unit to maintain a weather seal between the subbase and the unit.

The two ducts are available in standard lengths of 1" increments. To determine the optimum length, measure from the subbase surface to the surface inside the cab. Specify this length with the initial order; otherwise, 1" ducts will be shipped with the unit. Ducts longer than the optimum length are OK, but they should not be shorter.

Each duct is secured onto two studs protruding from the subbase. The securing nut and washer are furnished on the studs. Use caulking between the duct flange and the subbase.

ORDERING AIR DUCTS

GENERAL: Each unit has two air ducts and each is vitally important to the operation of the unit. Without the ducts, which provide a seal between the cab and the unit, return and discharge air will leak to the outside, resulting in substantial loss of capacity.

SPECIFYING: We keep return and discharge ducts on hand, ready to be trimmed to the length you need. The ducts should not be any longer than required to reach the surface of the cab wall. If they are too long, they become knee knockers. If much too short, air can leak into the wall structure. Measure the distance from the subbase surface to the wall surface and specify this as the duct length. Specify this length for each duct. If no length is specified with the order, 1" ducts will be supplied.

MODEL CHV24-8 INSTALLATION

GENERAL: With the subbase and air ducts in place, the unit will be secured to the subbase shock mounts with seven 1/2" SAE x 1/2" long hex head cap screws and lock washers which were removed earlier. Needed to complete the installation, will be a 12 or 24 VDC power supply, controlled by the engine ignition or power switch, a 10 GPM, constant volume, variable pressure hydraulic oil supply, # 8 hydraulic supply and return lines, 1650 PSI relief valve, # 6 case drain line, and #8 hot oil or hot water lines, if the heating feature is to be utilized.

MOUNTING THE UNIT: Lower the unit onto the subbase so that the 4 mounting holes in the unit chassis, line up with the 4 shock mounts on the vertical portion of the subbase and the 3 shock mounts on the bottom of the unit line up with the 3 mounting holes in the bottom of the subbase. Using the 7 1/2 SAE hex bolts and lock washers removed earlier, secure the unit to the seven shock mounts. Grease the threads and torque to 25 foot pounds. Do not fail to use the lock washers.

HYDRAULIC CONNECTIONS

The *MacBone* series CHV24-8 units require continuous oil flow at a constant volume of 10 GPM, at a variable pressure between 600 to 1400 PSIG. A competent hydraulics engineer or MacBone engineering must be consulted to specify the hydraulic oil system components. Constant volume at variable pressure is unusual and is frequently misunderstood. To avoid motor shaft seal blowouts, the hydraulic motor has an external case drain, which must be routed directly to the reservoir. With this external case drain, motor backpressure is not a factor, so #8 supply and return hoses are recommended. A relief valve ahead of the *MacBone* unit must be installed and set at 1650 PSI. If unit return oil will be used to power any downstream devices, consult MacBone engineering for limitations.

The SUPPLY hose connects to the fitting on the rear of the motor located closest to the cab wall. The RETURN hose connects to the other fitting on the rear of the motor marked with a blue "RETURN ONLY" tag. The #6 JIC case drain exits downward and is on the motor. Route the hoses from the unit to the hydraulic oil tank and 10 GPM system hydraulic pump as appropriate.

HEATER CONNECTIONS: Model CHV24-8 units incorporate a heater coil designed to use either engine hot water or hot oil. The #8 JIC male inlet and outlet connections are located to the left of the hydraulic line connections. Either connection may be the inlet or outlet.

If engine hot water is to be used, route 2 hoses to the appropriate taps on the engine where differential pressure will provide water flow to the unit.

If hot oil is to be used, we recommend a minimum flow rate of 1.5 GPM at 150° F, and a max pressure of 100 PSI. For more information on this, please call MacBone engineering.

ELECTRICAL CONNECTIONS

All MacBone units have 12 VDC compressor clutch coils. For 24 VDC operation, power to the clutch passes through a power resistor, which reduces the voltage to the clutch to 12 VDC. Power should be supplied to the MacBone unit, fused to protect the wire, from the vehicle's engine control switch so that when the vehicle's engine is shut down, power to the MacBone unit is shut down also. Otherwise, the MacBone compressor clutch will drain the machine's battery.

Input + DC power for the MacBone unit is connected to the 5/16" red terminal on the MacBone Voltage Sensing Module located next to the system controls. Either +12 VDC or +24 VDC may be connected to this terminal. The MacBone Voltage Module will automatically determine the supply voltage and apply it properly to provide the required 12 VDC to the clutch. The ground is provided through a grounding spring mounted to the bottom of the MacBone unit chassis on the control panel end. Make sure that the grounding spring contacts the MacBone unit subbase and that the subbase is grounded to the machine. Without a ground, the clutch will not engage and unit will not cool.

SYSTEM CHECKOUT

Before re-installing the evaporator section cover, check system operation as follows: Push the cooling toggle switch away from you. Set both control handles in the horizontal position. Turn the thermostat fully clockwise. Turn the ignition or machine power switch on and off and confirm hearing the compressor clutch click in and out or confirm seeing the clutch disk, on the front of the clutch pulley, move in and out.

Note: If the temperature is below 60° F; the thermostat will not close so you will have to put a jumper wire across the two thermostat terminals to activate the compressor clutch circuit.

Next, keeping both control handles in the horizontal position, start the engine which drives the system's hydraulic pump and leave at idle. If the oil is cold, the unit may turn over slowly. As the oil warms up, the unit will probably stop.

With the engine still at idle, bring the unit on by turning the blue handle from horizontal, slowly toward vertical. As unit speed comes up, be sure all the components are operating freely and that the unit operates smoothly and quietly. CONFIRM that the motor pulley turns clockwise when facing the motor shaft. If not, the hydraulic drive system must be reviewed and corrected.

--C A U T I O N--

If you observe the operation of the unit with the cover off, stay clear of the condenser fan and belt drive system.

! IMPORTANT---IMPORTANT---IMPORTANT !

If all seems well, slowly increase engine speed to full operating RPM. At full RPM, unit motor speed should be 2000 +/- 50 RPM. Motor speed must never exceed 2200 RPM. This is a good point to check with a strobe tachometer. If the motor speed is not 2000 +/- 50 RPM, refer the problem to your hydraulic system design technician. If the temperature is above 60°F, the unit should now be cooling. If below 60°F, use a jumper across

the thermostat terminals to engage the compressor for cooling so it can be checked out. Turn off the cooling by pulling the toggle switch down.

Now move the red handle to the vertical position to allow engine water or hot oil to flow through the heating coil. When the engine water or oil warms up, the unit will heat if the flow and temperature are sufficient. If heating is not obtained there is probably no flow.

If all looks and sounds well, and the unit cools and heats, remove the jumper from the thermostat, if used, install the evaporator cover section with the (12) screws you removed and then the power section cover with the (5) screws removed earlier. From the cab, make sure the compressor toggle switch is in towards you (off) and set the blue and red handles to horizontal. The MacBone system is now secure and ready for subsequent operation.

SYSTEM OPERATION

GENERAL: The *MacBone* unit's electrical requirement comes from the vehicle's engine control or ignition switch at 12 or 24 VDC. Ideally, hydraulic drive oil is supplied by a dedicated pump driven by the engine. Full *MacBone* unit speed may require full engine speed unless a variable volume oil pump is employed.

INITIAL STARTUP: Place the cooling toggle switch to the off position which is toward the operator. Place both the RED and BLUE control handles in the horizontal position. Turn on the ignition. Start the engine. If the hydraulic oil is cold, the unit may roll over slowly.

After engine warm-up, bring the engine up to full operating speed. Slowly turn the BLUE control handle toward vertical, which will control the speed of the unit. The faster the unit runs the more cooling capacity it will have. You may run the unit at any speed at any time.

FOR COOLING: With the unit at half to full speed, push the cooling toggle away from the cab and turn the thermostat knob fully clockwise. As the cab cools to the desired temperature, turn the thermostat counterclockwise until you hear the compressor cycle off. The thermostat will now cycle the compressor to maintain that temperature. You may change the unit speed at any time with the blue handle.

FOR HEATING: Pull the cooling toggle switch toward the cab to off. Adjust the airflow with the BLUE handle. Move the RED control handle toward vertical to allow hot water to pass through the coil. The thermostat does not control the heat output. Heat output is controlled manually by adjusting the red handle: horizontal is off; vertical is maximum. Again, you may change the unit speed at any time with the blue handle and change heat output at any time with the RED handle.

TO STOP: Return both the red and blue handles to the horizontal position to shut the unit down. Before powering down the engine, we recommend that you shut down the unit, however this is not necessary. **NO OPERATIONAL SEQUENCE OF ANY SORT WILL DO ANY DAMAGE TO THE *MACBONE* UNIT.**

SPECIAL FEATURE: On chilly, damp days or whenever humid conditions require dehumidification, operate the cooling cycle for dehumidification and, at the same time, open the heat valve to keep the temperature comfortable. This feature is of particular value when on-board equipment is sensitive to humid conditions.

SERVICE

FILTER CLEANING: (See diagram on page 13) The condenser coil filter, or "outside" filter, is located on the end of the unit and is washable and reusable several times before replacement is required. To remove the filter, pull the filter out at the bottom and slide it down from under the weather cover and the cross bar. Use the reverse procedure to reinstall. The evaporator or "inside" filter, which is also washable and reusable, is located just outboard of the control handles and is accessible by removing the evaporator section cover which is secured with (12) self tapping screws, or can be folded and removed and replaced through the return air inlet.

--NOTE--

Use care in removing and replacing air filters as not to damage or bend any coil fins. Bent fins reduce air conditioning performance. When power washing, leave filters in place, then clean them.

The outside air filter, which is washable and reusable, is located in the same area as the inside filter and is secured with washers and two wing nuts.

The drive section filter which is washable and reusable is identical to the outside air filter and is secured with (2) wing nuts. This filter is located just ahead of the condenser fan and covers the hole in the motor bulkhead which allows condenser fan air to ventilate the belt drive section of the unit.

- - W A R N I N G - -

THE STANDARD *MACBONE* INSIDE AND OUTSIDE AIR FILTERS ARE COARSE AND WILL FILTER OUT ONLY DEBRIS AND LARGE PARTICLES. IF THE MACHINE'S OPERATING ENVIRONMENT CONTAINS AIRBORNE PARTICLES, HAZARDOUS TO THE HEALTH OF THE MACHINE'S OPERATORS, THE STANDARD FILTERS MUST BE REPLACED WITH TYPES DESIGNED TO MEET DEFINED AIR QUALITY STANDARDS. CONTACT *MACBONE* ENGINEERING FOR FILTER TYPES AND AVAILABILITY.

OUTSIDE OR CONDENSER FILTER: Blow or wash clean as required. As this filter clogs, the system head pressure will rise and system capacity will drop. Ultimately, the high-pressure refrigerant relief valve will open and begin to periodically vent refrigerant. If you have reason to believe this has happened, check the refrigerant per the next paragraph.

- - W A R N I N G - -

REFRIGERANT CHARGING MUST BE DONE BY A LICENSED AND PROPERLY EQUIPPED TECHNICIAN

REFRIGERANT CHECK: Refrigerant used is R-134A with a full charge of 2 lb., plus or minus 10%. A sight glass is located along the lower inside edge of the unit next to the hose connection area. While observing the glass, have someone turn the unit to the cooling mode. The glass should run clear within

30 seconds. If it does not clear, refrigerant is needed. Evacuate and recharge to 2 lb. or recharge to a clear glass plus 4 ounces.

LUBRICATION: The bearings in the hydraulic drive motor are supply oil lubricated. The compressor bearings are lubricated internally and the idler bearings are sealed, leaving only the two fan shaft bearings to be field lubricated. Lube these two bearings ONCE PER YEAR, stopping at the first sign of grease emerging from the bearing seals. No other lubrication is required or recommended.

BELTS: The (2) belts are Goodyear AX46, *MacBone* part no. D5010-46. A suitable replacement is the Gates AX46. The MacBone unit belt drive utilizes a spring loaded, backside idler so non-notched belts are not recommended. While the Gates AX46 is a suitable replacement, the Goodyear AX46 will provide better performance because its notches are closer together and not so deep. Belt replacement should be made annually or at 1500 hours, whichever comes first. To remove the old belts, cut the belts in half and discard. Do not try removing belts by rolling them off the pulleys; cut them.

To install the new belts, proceed as follows after becoming familiar with the belt diagram on page 14:

1. **TOOLS REQUIRED:**
3/8 drive ratchet w/ 6" extension
3/8 drive sockets; 1/2" and 9/16".
1/4" end wrench
2. **EXTEND** the idler tension spring by turning the 9/16 bolt on top of the spring clockwise until the spring-nut reaches its uppermost position, which allows the spring to extend and relax.
3. With the 1/4" end wrench, remove the (4) 1/4" hex head screws which hold the blower air inlet ring in place. Set the ring and (4) screws aside.
4. With the 1/2" ratchet, loosen and then completely remove the set bolt, located just behind the blower, which secures the blower shaft coupling to the fan shaft.
5. Move the coupling/blower assembly off the shaft and place the (2) new belts through the gap.
6. Replace the coupling on the shaft and line the setbolt hole up with the détente drilled in the shaft. Install the set bolt and torque to 10 foot pounds.

SUGGESTION

As you finger tighten the set bolt, rock the coupling gently to be sure you can feel the set bolt entering the drilled détente.

7. Replace the blower inlet ring. Tighten the 1/4" screws snugly but don't strip them out.

--CAUTION--

DO NOT FAIL TO REINSTALL THE INLET RING. AIR FLOW AND COOLING CAPACITY WILL BE SEVERELY REDUCED IF THE INLET RING IS LEFT OFF.

SUGGESTION

We have tried every possible belt replacement procedure and have concluded the following is by far the best way to get the new belts pulled onto the pulleys.

8. Place one belt around the innermost compressor pulley groove, then OVER the motor pulley, then UNDER the idler, then start it OVER the fan shaft pulley. Now roll the belt into place onto the innermost fan shaft pulley groove by using the condenser fan blade to rotate the fan shaft. Install the second belt the SAME way in the outermost groove.
9. With the 9/16 socket, turn the idler spring bolt counterclockwise, to compress the idler spring. Using a business card as a gauge, compress the spring until the card is snug between the mid spring coils. This first adjustment should be checked after a day of operation and reset if necessary. Though this adjustment may be checked and corrected from time to time; it is, after the first readjustment, good for the life of the belts. Never tighten the spring so tight that the coils touch.
10. Finally, the idler tracking must be checked and possibly adjusted. To do this, the idler pulley can be adjusted from left to right on the idler shaft by rotating the idler adjusting, self locking, nut which is screwed onto the idler shaft. The idler is kept tight against the adjusting nut by a spring on the other side of the idler. Looking at the condenser fan from the shaft side, rotate the fan by hand in the clockwise direction. Adjust the idler pulley nut tighter or looser until the drive belts track evenly on the idler pulley. If the belts are not adjusted to track evenly, the idler will make excessive noise and will wear prematurely.

SPEED CONTROL VALVE: A ball valve, controlled by the blue handle, is the hydraulic motor bypass valve. With use, the stem packing will begin to weep so it must be inspected periodically and tightened as necessary using a 9/16" open-end wrench.

HELPFUL HINTS FROM THE FIELD

The device with the knob on it, next to the cooling toggle switch, is a comfort thermostat, NOT a freezestat. DO NOT INSERT THE THERMOSTAT SENSING TUBE INTO THE EVAPORATOR COIL FINS. Leave it coiled around the thermostat as originally assembled.

The electrical module which changes 24 volts to 12 volts for the MacBone unit compressor clutch, WILL NOT WORK ON A 2-WAY RADIO or any other device except the MacBone unit. Wish it would but IT WON'T.

The hydraulic oil supply should be 10 GPM for a unit motor speed of 2000 RPM with the blue handle in the vertical position and the engine at full speed. Every GPM less changes the unit motor speed 200 RPM less and capacity by about 2400 BTU's/HR less. Never exceed 2200 RPM which is obtained at 11 GPM. At 2000 RPM on the motor, the fan shaft runs at 2400 RPM. At 2200, the fan shaft is 2640

RPM. The fan red line or possible blade hub disintegration speed is 3000 RPM, which occurs at a motor speed of 2500 RPM or drive oil flow at 12.5 GPM.

When changing belts, it helps to have a small hand when putting the first belt under the compressor's innermost pulley groove.

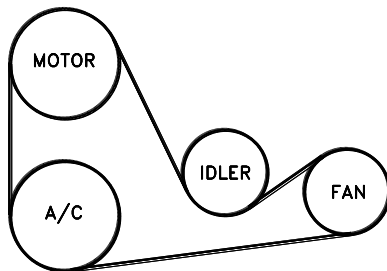
The discharge air is very sensitive to being restricted, so please do not attach any sort of grill, duct, deflector or anything else to the discharge without consulting MacBone engineering. Restricted air flow results in diminished cooling capacity.

The hydraulic bypass control valve, which is controlled by the blue handle, has a packing gland which must be checked periodically to be sure it is snug and not leaking hydraulic fluid. The packing gland nut is tightened with a 9/16" wrench and can be done through the unit's side under the hose connection.

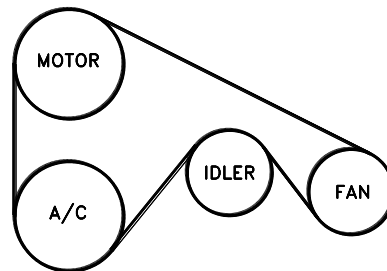
BELT DRIVE SYSTEM

(2) GOODYEAR AX46, MACBONE PT# D5010-46

Substitute: GATES AX46. Use only notched belts.

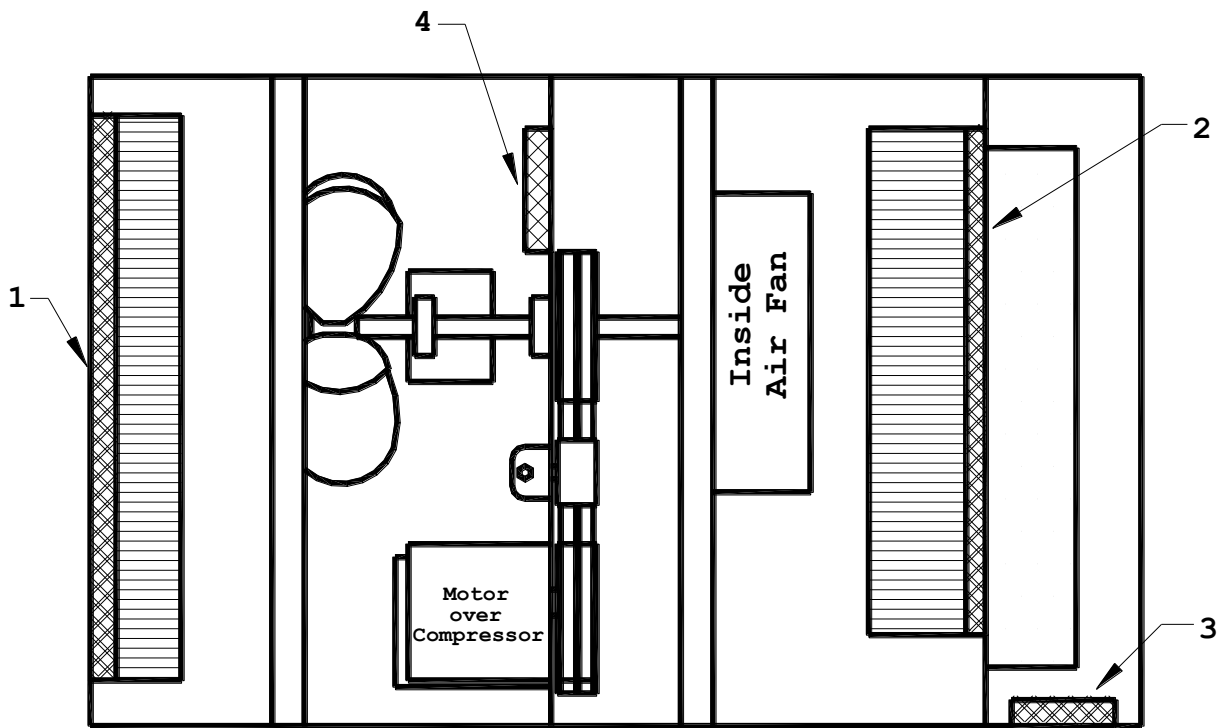


THE RIGHT WAY



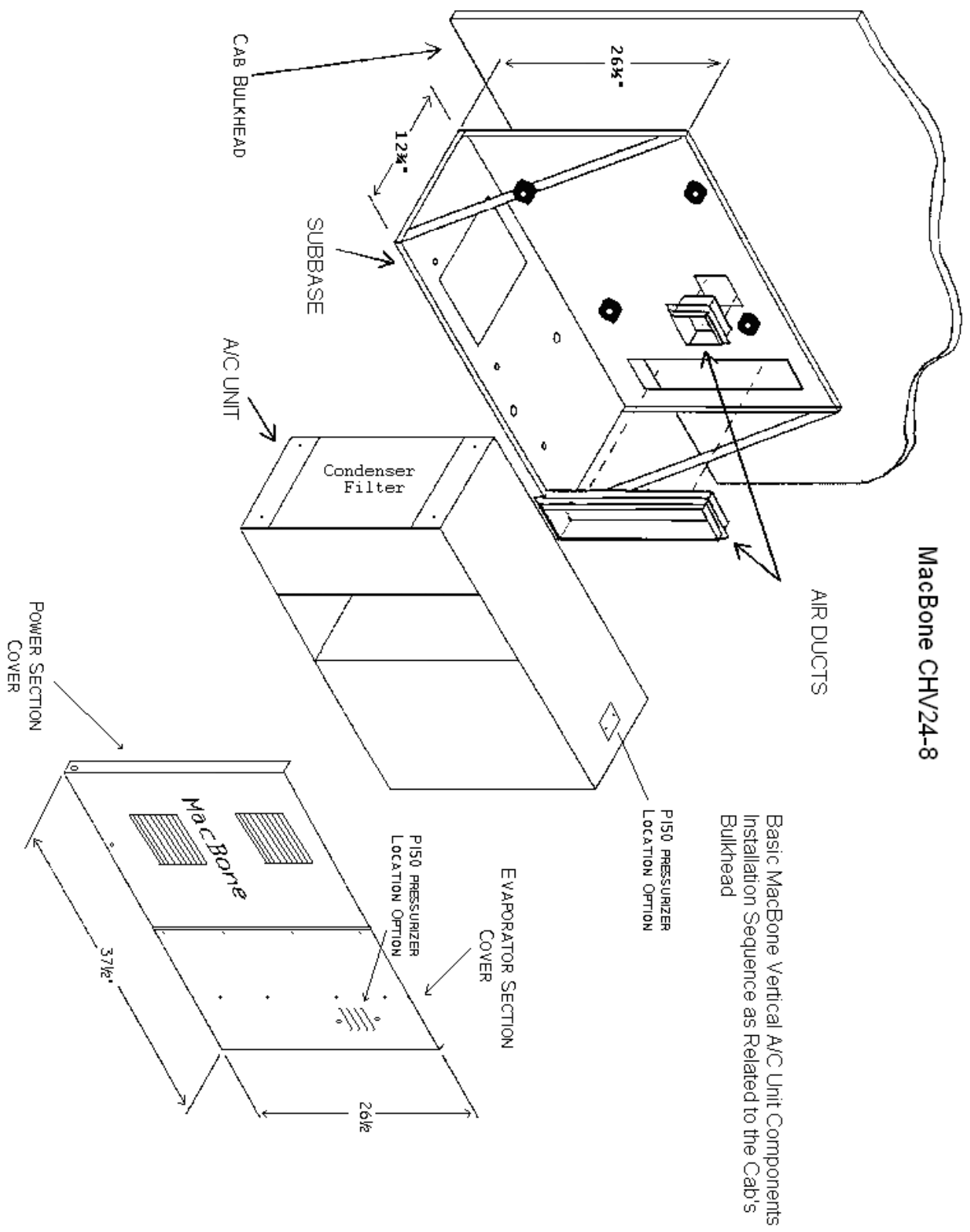
THE WRONG WAY

AIR FILTER LOCATIONS



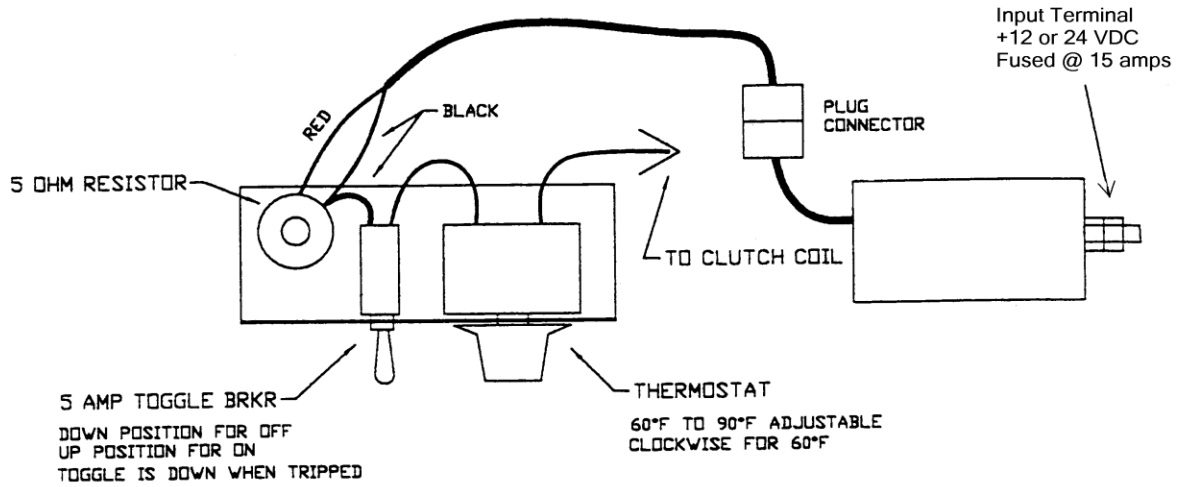
1	Condenser air filter	Part#	A4101-01	11"x 20"x 1"
2	Inside air return filter	Part#	A4101-05	7"x 23½"x ½"
3	Outside air intake filter	Part#	A4101-03	5"x 6"x 1"
4	Drive air filter	Part#	A4101-03	5"x 6"x 1"

MacBone CHV24-8

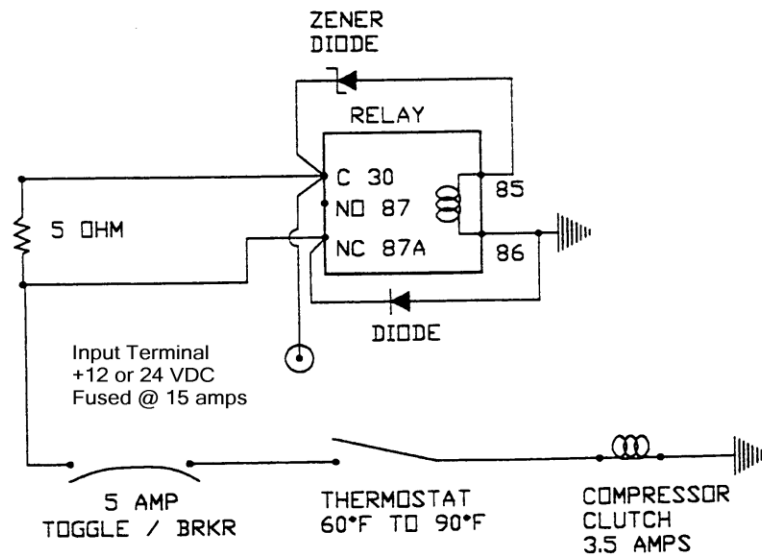


Basic MacBone Vertical A/C Unit Components
 Installation Sequence as Related to the Cab's
 Bulkhead

WIRING



BASIC WIRING



WIRING SCHEMATIC

SPECIFICATIONS

Color: Equipment yellow. Other colors are available on request.

Size: Installed on the subbase with the top in place: 37 1/2" wide by 26 1/2" high x 12 3/4" deep from the cab wall outward.

Weight: Basic unit, 145# (66 kg). Unit with subbase, air ducts and top, 188# (85 kg).

Capacity: 24,000 BTU's/Hr. cooling at a unit motor speed of 2000 RPM at standard rating conditions. 30,000 BTU's/Hr. heating with supply oil or water at 150° at 1.5 GPM.

Air Flow: Nominal 800 CFM delivered from the unit.

Electrical: 3.5 AMPS at 12 or 24 VDC.

Hydraulic Pump: Net pump output should be 10 GPM, 600 to 1400 PSI, constant volume, variable pressure. A dedicated pump is the only efficient way. Call MacBone engineering for other possible options.

Unit Motor: Motor displacement is 1.0000000000000 cubic inch/rev. and requires 10 GPM to operate at 2000 RPM. Drives compressor and fans through a dual V Belt drive, tensioned by a spring loaded idler.

Hydraulic Lines: Supply and return hoses, 1/2" I.D. (#8). Case drain, 3/8" I.D. (#6).

Refrigerant: R-134A, approximately 1 lb, 10 oz.

Drive Belts: (2) "A" section (1/2" wide) belts, Goodyear AX46.

Speed Control: Variable, manually operated.

Heat Control: Variable, manually operated.

Cooling Control: Thermostat, operator adjustable from 60°F to 90°F.

Air Filters: The inside or evaporator air filter is 7 1/4" x 23 1/2" x 1/2". The outside or condenser air filter is 11" x 20" x 1". Filters are washable and reusable or may be replaced with locally available filter material.

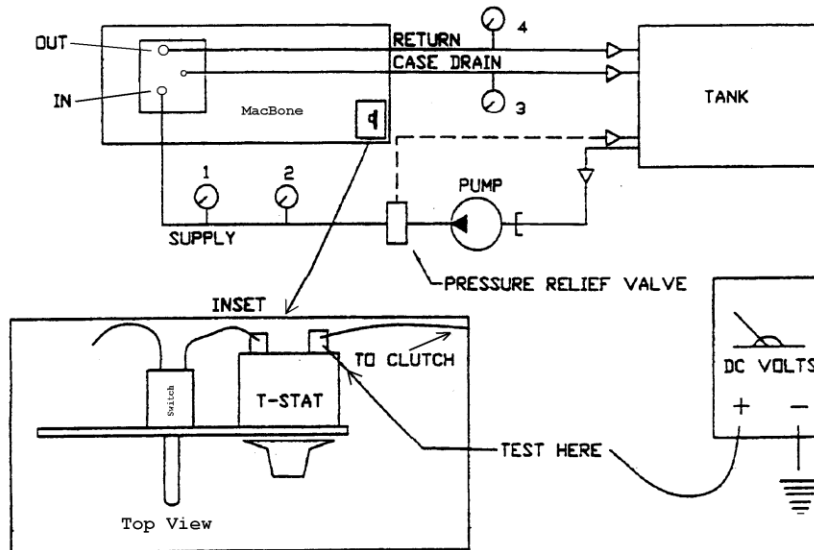
Lubrication: Fan shaft bearings are greased annually.

Service: Weekly, air filters should be cleaned. Monthly, the speed control valve stem packing nut should be tightened if leaking. Annually, the unit should be removed for cleaning, inspection of the (4) shock mounts and duct seals, lubrication of the fan shaft bearings and belt replacement.

Overhaul: Factory replacement of all wear-limited components should be considered after 6000 hours of operating time.

Materials: All sheet metal parts are galvanized steel with exterior surfaces baked poly powder coated. All fasteners are grade 5 plated steel with self-locking nuts. Coils are copper tubes with aluminum fins. Refrigerant and heating fluid lines are copper with sleeved and flared or silver soldered joints. Hydraulic lines are steel, SAE 100R2 type, with a 4,000 PSI working pressure.

MACBONE A/C UNIT HYDRAULIC & ELECTRICAL TROUBLESHOOTING



- Oil Flow Rate:** -Blue handle in vertical position.
 -Engine at full operating RPM. -First reading taken with compressor not engaged.
 -Reading taken at position 1. -Second reading taken with compressor engaged.

Design flow rate is 10 GPM at all times but may be from 6 GPM to 11 GPM. For every 1 GPM below 10 GPM, cooling capacity drops by 10%. Full capacity is 24,000 BTU'S/HR @ 10 GPM. Over 11 GPM can result in shortened unit life and 12.5 GPM is red line.

- Unit Pressure Drop:** -Blue handle in vertical position.
 -Engine at full operating RPM.
 -First reading taken with compressor not engaged.
 -Second reading taken with compressor engaged.
 -Readings taken at position 2 and 4.

Unit pressure drop is supply pressure minus return pressure. If return is absolutely known to return directly back to the tank, return pressure may be assumed to be zero, otherwise, install a test gauge at position 4 compressor not engaged, expect a pressure drop of 200 to 600 PSIG. Compressor engaged, look for 1300 to 1500 PSIG.

- Case Drain Back Pressure:** -Blue handle in vertical position
 -Engine at full operating RPM

- Clutch engaged and unit cooling
- Reading taken at position 3.

Back pressure must not exceed 25 PSIG.

4. Clutch Voltage:
- Control panel switch in on position.
 - Thermostat turned clockwise until it stops.
 - Electrical energized.
 - Engine running; battery voltage 12.5 to 14, or 25 to 28

Clutch voltage is measured from chassis ground (negative) to the thermostat terminal further most from the cooling toggle switch.

Expect voltages ranging from 10.5 to 14.0 VDC.

0 – 5.0	VDC	The compressor clutch will not engage.
5.0 – 10.5	VDC	The clutch will slip, overheat and fail.
10.5 – 14.0	VDC	The compressor will run normally.

5. Clutch Coil Resistance:
- D.C. power to the unit OFF
 - Cooling switch OFF

Clutch coil resistance is measured from ground to the thermostat terminal furthestmost from the cooling control switch.

Expect resistance readings from 3.6 to 4.0 OHMS.

6. Power Resistor resistance: - DC power to the unit OFF

Follow the red wire from the top of the power resistor to the 3 pole plug. Disconnect the plug and measure the D.C. resistance between the black and red pins in the plug with only 2 pins. Expect be 4.7 to 5.0 OHMS.

Test Report

Conduct these tests and with this report in hand, call 1-888-MacBone (1-888-622-2663) for review and assistance.

MacBone Data Plate:

Test Date: _____

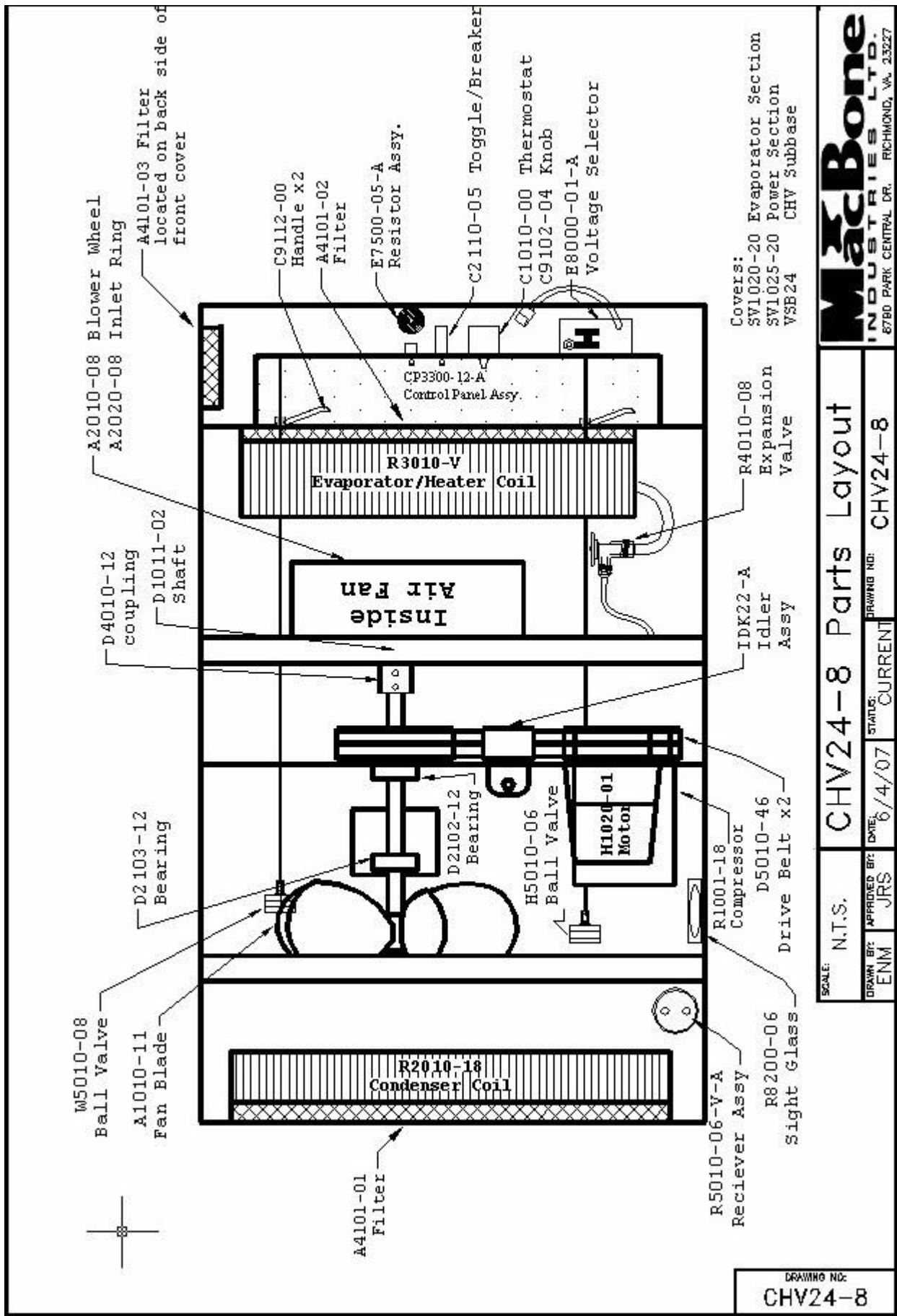
Production Number _____

Test Made by:

Model Number _____

Serial Number _____

	Clutch Disengaged	Clutch Engaged
1. Oil flow rate:	_____ <u>GPM</u>	_____ <u>GPM</u>
2. Unit pressure drop:	_____ <u>PSIG</u>	_____ <u>PSIG</u>
3. Case drain pressure:	_____ <u>PSIG</u>	_____ <u>PSIG</u>
4. Motor Speed:	_____ <u>RPM</u>	_____ <u>RPM</u>
5. Clutch voltage:	_____ <u>VDC</u>	_____ <u>VDC</u>
6. Clutch coil resistance:	_____ <u>OHMS</u>	
7. Resistor resistance	_____ <u>OHMS</u>	



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