OPERATION AND SERVICE MANUAL

BUS AIR CONDITIONING SYSTEMS

MODEL SERIES EF# AND CS#
OMEGA SPLIT SYSTEMS (EVAPORATOR AND CONDENSER IN SEPARATE LOCATIONS)

FOLLOW ALL SAFETY AND OPERATION PRECAUTIONS

INSTALLER: REGISTER THE WARRANTY ON LINE AT WEB SITE www.omega-usa.com

OWNER/END USER: CONFIRM THE WARRANTY INFORMATION AND ENTER "IN SERVICE DATE" ON LINE AT SAME SITE.

Failure to comply may void warranty. Maintain Service Records. (See back cover.)

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P/N 57-21002 Revision E 11 07 Available for review on line in PDF format.

Limited warranty and warranty disclaimer for Omega Environmental Technologies, Inc. School and Transit Air Conditioning Systems

Omega Environmental Technologies (OET) hereby warrants its "State of the Art" Air Conditioning System ("PRODUCT") to the original purchaser ("PURCHASER") when installed in a motor coach vehicle application either in the United States of America or Canada. Warranty offered herein applies only to defects in workmanship and materials, with the decision to repair or replace parts covered herein to be at the sole discretion of Omega Environmental Technologies.

Warranty Period

The warranty period starts the day the Omega Product is installed on or in a commercial coach or school bus. The warranty period is a minimum of 24 months (2 Years). This warranty period applies to the compressor. The Evaporator and Condenser coils are warranted for 60 months (5 Years). This warranty period is not limited by mileage or operating hours.

Warranty Coverage

This warranty specifically covers all major components of the product either manufactured by, or under the specifications set forth by OET, such as but not limited to, compressor, evaporator assembly and condenser assembly. The cost of replacing the refrigerant is covered only if the loss of refrigerant was due to a defective part covered under warranty. Any item repaired or replaced under warranty will remain under warranty until the end of the original warranty period, or for 90 days for the date of repair or replacement, whichever is longer.

Items Not Covered By Warranty

Omega Environmental Technologies products improperly installed, modified in any way, without prior written approval from OET, disassembled or tampered with by anyone other than OET, and products damaged by misuse, negligence, abuse, accident, corrosion, fire, water, vandalism or explosion are excluded from warranty. Product damaged by the original purchaser or any other third party, including a vehicle dealer or service facility while performing work, is not warranted by OET. Service items requiring either replacement or adjustment such as but not limited to filters, belts, lubricants, etc. are not covered under warranty. This warranty does not apply to any OET system or replacement product not properly serviced according to the manufacturer recommendation and/or specification. Any cost incurred by the purchaser including damage to or loss of vehicle, or any part thereof, for transporting the vehicle to an OET dealer or authorized service center, loss of time or operating revenue or cost of using an alternate replacement vehicle is not covered. Product failures as the result of an act of God, such as, but not limited to, lightning, earthquake, windstorm, tornado, hurricane or flood are not covered. Omega Environmental Technologies reserves the right to improve future product design, without retrofitting existing products in the field to match the new specifications.

Obtaining Warranty Service

To obtain warranty service for Omega Environmental Technologies units, the product purchased must be returned to any authorized OET distributor or service center. All warranty claims must be within the warranty period. Any person applying for warranty service shall provide proper documentation that they are the original owner and the date warranty commenced.

Complete Warranty

The warranty described in this document is the complete warranty for this product and is in lieu of all other warranties, either expressed or implied, including without limitation any implied warranty of merchantability of fitness or ability to successfully perform a specific purpose or job application. OET hereby waives any obligation, liability, right, claim or demand in contract, tort (including negligence), strict liability, patent infringement, or otherwise with respect to the OET product furnished.

Authority To Change Or Modify

The warranty described and defined herein can only be changed or modified by Omega Personnel. This includes all terms, conditions, limitations, rights or obligations. Should OET offer a different warranty in the future, it shall only apply to products sold when in effect, and the terms. Conditions, and limitations of this warranty will not be transferable or subject to upgrading.

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SAFETY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. The recommended precautions, cautions and warnings must be understood and applied during operation, service and maintenance of the equipment covered herein.

FIRST AID

An injury, no matter how slight, should never go unattended. Refrigerants can cause damage to skin and eyes. Always obtain first aid or medical attention immediately in the event of an accident.

OPERATING SAFETY PRECAUTIONS

Keep hands, clothing and objects clear of any moving components, including evaporator blowers, condenser fans, and compressor drive belts and pulleys. Beware of unannounced starting of evaporator blowers, condenser fans, or compressor clutch engagement.

In case of severe vibration of unusual noise, stop the system, report to maintenance dept, have service performed by qualified personnel.

When A/C system is operating, the high side pressure components, fittings and lines or hoses will be hot enough to burn skin. Do not attempt to touch or grab onto these components either during or thereafter until they have cooled. High pressure lines, hoses, etc. are not to be pulled on or "wiggled" while they contain pressure or premature failure might occur. Same applies to low side components except they are cold during operation. If a leak were caused by disturbing either, then the temperature will drop INSTANTLY and may cause bodily harm.

If suspicious smell perceived, like hot or burning materials, then immediately, turn off any switch associated with problem system and do not try to re-operate. Tag or tape off any controls, have system diagnosed by qualified personnel.

Do not bypass any electrical safety devices. Do not simply reset or bridge any overload device, properly diagnose with ohm meter and ampere meter. Do not use any sort of jumper wire in any electrical circuit.

CAUTION: Avoid breathing any refrigerant vapor or lubricant vapor. Exposure to these, especially PAG oil mist, may irritate your eyes, nose, or throat.

SPECIFIC CAUTION: DO NOT ALLOW OILS TO DRIP INTO OR ON PLASTIC DRAIN PAN OR ANY PLASTIC PART OF THESE SYSTEMS AS MATERIAL WILL ABSORB AND BECOME BRITTLE AND PRONE TO CRACK. USE ONLY APPROVED CLEANERS OR MILD SOAP AND WATER TO CLEAN ANY PLASTIC COMPONENTS.

WARNING: In case of electrical fire, extinguish with CO2, DO NOT USE WATER. Turn off system. Disconnect the battery ground cable if at all possible. Do not risk injury to save replaceable machinery.

SERVICE AND MAINTENANCE PRECAUTIONS and WARNINGS

All operation safety precautions apply.

SPECIFIC WARNING: Do not oil blower motor shaft if replacing plastic wheel, clean shaft of any oil present. Replace spring clips with new part.

SPECIFIC CAUTION: Do not allow oils to drip into or on plastic drain pan or any plastic part of these systems as material will absorb and become brittle and prone to crack.

USE THE CORRECT TYPE OF REFRIGERANT and OIL LISTED FOR A/C SYSTEM. Always wear protective eye wear and gloves when working with refrigerants and oils.

Always use mineral oil to lubricate O-rings and threads of fittings. CAUTION: Always wear gloves when working with PAG or Ester oils as to prevent irritation of skin. WARNING: These oils can also damage vehicle paint, plastic parts, engine drive belts and rubber components like coolant and vacuum hoses. PAG oil will absorb moisture and become very acidic and corrosive.

CAUTION: Follow hose and fitting manufactures recommendations for replacing hose end fittings. Oil is to be wiped cleaned from inside and outside of end section of hose for Bead-Lock style fittings. For E-Z Clip, oil the fittings nipple (mineral oil on o-rings).
Familiarize yourself with the proper operation of any service equipment you will be using. Always follow manufactures instructions for recovery/recycling equipment. Failure to do so could cause personal injury or damage to the equipment. Consult any manual or authorized service center prior to repairing any equipment. Always unplug unit before attempting any maintenance. Removing internal fittings and filters can release pressurized refrigerant. Slowly release any pressure and wear appropriate safety gloves and eye protection.

CAUTION: Use only Department of Transportation (DOT) approved cylinder for storing used or recycled refrigerant. Approved cylinders are stamped DOT 4BA or DOT 4BW. Store in approved cooler locations, avoid heat. WARNING: High heat can raise internal pressure to dangerous levels. US law requires certification for use and handling of refrigerants. The use only UL approved heat blankets to raise the pressure of cylinder to aid transfer to system during charging. Do not leave unattended or plugged in for more time then is required to perform service.

CAUTION: Never use compressed "shop" air to leak or pressure test an A/C system. Under certain conditions, pressurized mixtures of R134a and air are combustible. In addition shop air will inject excess moisture into the system.

CAUTION: Do not use open flame around refrigerants. Avoid combustion engine operation when refrigerant leak is detected near intake area. If accident occurs leave area immediately.
WARNING: DO NOT BREATHE ENGINE EXHAUST OF COMBUSTED REFRIGERANT FUMES.

CAUTION: Turn off switches and disconnect battery ground cable when working on electrical motors, controls, or if shorting with tool is even a remote possibility.

CAUTION: Completely disconnect battery if arc welding on vehicle!

CAUTION: Even if someone has told you what is wrong with an A/C system always perform a visual inspection prior to connecting gauge set. If there is any chance that someone has used the wrong refrigerant or failed to evacuate system then fully dehydrate and recharge with correct refrigerant to avoid personal injury due to unpredictable high pressures developing in system.

CAUTION: Nitrogen to be used with pressure regulator only. Normally set a 125 psi or less, 250 psi maximum. DO NOT EXCEED NORMAL OPERATING PRESSURES DURING ANY SERVICE PROCEDURE!

WARNING: Do not use oxygen in or near refrigeration system as explosion may occur.

WARNING: Serious damage results when liquid refrigerant is sucked into the compressor. Exercise caution when adding refrigerant to suction side of system.

INTRODUCTION FROM OMEGA ENGINEERING DEPT

Routine maintenance of return air filters, compressor drive belts tension, condenser fins and fans will greatly enhance the cooling performance of these A/C systems. The service issues that place a refrigeration service mechanic in a separate category are addressed in this manual in a separate section. Basic understanding of vapor compression refrigeration cycle is essential. Most all refrigeration service relies on the basic principals for proper diagnosis and service procedures. Although this manual is not intended to be a basics text, it does cover a lot of basic service information that is worth review. You will also find specific service recommendations, specifications for OMEGA bus systems as well as some unique excerpts based on field experiences from our staff. Hopefully operators, service writers and mechanics will all read pertinent sections. We especially invite everyone to read the trouble shooting section and find it both entertaining as well as informative.

The number one failure, in terms of difficulty, is locating the leak that has caused the loss of refrigerant from today's A/C systems. Locating leaks is now more difficult with R-134a and the synthetic oils required then it was with R-12. First off, the R-134a molecule is smaller and more "slippery" than R-12. Secondly PAG and Ester oils evaporate, thus the tell tale oil of a leak may or may not be found. Leaks in coil bodies are extremely rare, however leaks at brazed joints do occur and when the coil is encased or shrouded finding the leak can be quite a challenge. GOOD LEAK DETECTION DEVICES ARE REQUIRED. OMEGA HIGHLY RECOMMENDS THE ADDITION OF UV DIES TO ASSIST IN LOCATING LEAKS.

The number one failure in terms of difficulty to diagnostic is or can be electrical problems. Once more the basic principals are not covered in this manual. What is provided is clear and concise wiring diagram(s) for the systems we manufacture. We use ground switching exclusively for controlling relays for blower speeds because of the inherent safety in avoiding shorts in the control circuits and to minimize voltage drop in long run feed wires. Using this technique also relieves the blower switch from having to carry high blower current and thus only milli amps pass through the switch to control the relays. OMEGA does provide installation training and strict guidelines for installation of systems. However systems are installed in an after-market forum and installation centers are responsible for the many details involved in each application. You may find subtle differences in small things like pressure switch location or hose and wiring routing etc.

We offer the following tips. A simple test light may be used for ground switching diagnostics in some cases by putting the clamp lead to a known positive battery source. However the test light approach may fall short if voltage drop due to current load or corrosion is the issue. Good grounding is just as important as supply voltage as it completes the circuit. We strongly recommend that each system be thoroughly checked when new. Make note of install particular voltage drops and current draws. Our tip is to use a black marker and simply write the numbers on the major component (on the metal inside the evaporator cover) and on the wiring diagram of this manual that should stay with the bus and/or kept on file for the fleet.

INTRODUCTION FROM SERVICE PARTS DEPT

In the following pages and at the end of this booklet you will find part numbers for service items and replacement parts for the OMEGA Bus Systems. We hope you never need to replace a single component, however we know that hard working fleet units accumulate run time hours rapidly and A/C systems require maintenance and service as a result of demanding operating environments. PLEASE NOTE THAT A LOT OF THE COMPONENTS ARE GENERIC (INDUSTRY WIDELY USED) ITEMS AND ARE THEREFORE AVAILABLE WITH CROSS REFERENCE TO OTHER MANUFACTURES UNITS. WE INVITE YOU TO CHECK WITH OUR KNOWLEDGEABLE STAFF FOR ALL YOUR REPLACEMENT PARTS NEEDS. WE PRIDE OURSELVES IN PROVIDING QUALITY PARTS WITH RAPID SERVICE.

BASIC MODEL NUMBERS AND SPECIFICATIONS

SCHOOL BUS EVAPORATOR UNITS

MODEL	TYPE	BLWR(S) RATED @zero static	@13.5VDC	BASIC DESCRIPTION	RATED BTU
27-19522					
EF1	FB F/R/SM	750 CFM	14.2 AMPS	ONE MTR/ DOUBLE SHAFT	40,000
27-19520					
EF2	FB F/R/SM	1150 CFM	22.4 AMPS	TWO MTR/ DOUBLE SHAFT	52,000
27-19526					
EF3	FB F/R/SM	1315 CFM	37.2 AMPS	ONE MTR/ DOUBLE SHAFT &TWO MTR/ SINGLE SHAFT	54,000
27-42014					
EF4	IN-WALL	1140 CFM	31.2 AMPS	TWO MTR/ DOUBLE SHAFT	45,000

SCHOOL BUS CONDENSER UNITS

MODEL	TYPE	FAN(S) RATED	@13.5VDC	BASIC DESCRIPTION
24-30105				
CS1	SKIRT MTG	2490 CFM	18.4 AMPS	TWO 14" FANS 2Row COND
CS2	SKIRT MTG	2280 CFM	18.2 AMPS	TWO 14" FANS 4Row COND --NLA
CS3	SKIRT MTG	2950 CFM	18.5 AMPS	THREE 11"HD 6Row COND --NLA
NOTE: ABOVE MODEL MAY BE STACKED TWO HIGH				
CS4	SKIRT MTG	1930 CFM	12 AMPS	THREE 9" FANS 4Row COND --NLA
CS5	SKIRT MTG	2950 CFM	26 AMPS	THREE 11" HDP 6Row COND --NLA
24-41531				
CS6	SKIRT MTG	2950 CFM	26 AMPS	THREE 11" HDP 4Row Sub-Cool COND
NOTE: ABOVE MODEL MAY BE STACKED TWO HIGH				

OPERATION

See Operation Safety at front of manual.

NORMAL OPERATING INSTRUCTIONS

The system may have either a rotary knob blower switch and push button A/C switch or a touch pad (membrane) control. The control is always located within reach of the driver area. With either control package the operation is straight forward. Engine must be running for A/C system to operate. Operators should be encouraged to follow the simple guidelines that follow.

1) To avoid needless voltage/current draw spikes on the vehicle voltage regulator and battery charging system, ***check that the cooling system blower is OFF PRIOR TO STARTING ENGINE.***
2) The blower switch or pad area should be set to LOW FIRST, THEN FIVE TO TEN SECONDS LATER, GENTLY PUSH ON THE A/C BUTTON, Then as desired, to each higher speed similarly pausing between each speed.
3) Turning the unit off should follow the reverse procedure. OPERATOR SHOULD FULLY TURN OFF UNIT PRIOR TO TURNING OFF ENGINE, PUSHING THE A/C BUTTON IN A SECOND TIME TO DISENGAGE.
4) If possible, operate the blower only after using A/C. Ten to fifteen minutes would be great, even better, thirty minutes after using A/C then run blower only for same amount of time. This will dry any remaining moisture off the coil and greatly reduce odor potential. Running the blower with out A/C button on at the end of the run even for a few minutes is a good idea anytime of year.

THE ABOVE PROCEDURES IS DOUBLY IMPORTANT IF A SECOND EVAPORATOR IS TIED IN AS A SLAVE ON THE SAME CONTROL PACKAGE ! FAILURE TO STEP UP THROUGH THE SPEEDS AND A/C ON FUNCTION COULD TRIP THE OVER CURRENT SAFETY CIRCUIT BREAKER AND DISABLE THE SYSTEM. **OMEGA does not recommend slave tie in of controls.**

If two control packages are installed and the second unit is desired on, then the **second unit should not be turned on at the same instant.** Rather the operator should pause and turn second unit on separately following same "ramp up procedure", failure to do so can disable the system. Maintenance will be asked to fully check wiring any time safety circuit breaker is tripped, this could delay trip departures and incur expensive repairs.

If A/C is accidentally turned off, then wait 2-3 minutes before turning it back on. This will add life to system as compressor need not start against higher head pressure, the clutch will wear less and the drive belt will be less stressed at least for that one time.

NOTES:
If the system is tied into any other OEM/automotive control, then refer to vehicle owners manual.

The A/C system has a preset anti-freeze up thermostat that will cycle the clutch and condenser fans on and off to prevent frost freeze up (loss of air flow occurs) and potential liquid slugging damage to the compressor. It would be rare that an operator would notice this cycling. However this should be considered normal if it occurs during extended run times. IF HOWEVER THIS CYCLING OCCURS ON MODERATELY WARM DAYS DURING A SHORT RUN TIME, THEN THE SYSTEM MAY NEED A MAINTENANCE CHECK for loss of refrigerant. If unattended then maximum cooling will not be available on hot days.

The system also has a dual setting pressure switch on the refrigerant high pressure side line. If the system has a massive loss of charge (or is below 32 degrees) the compressor will not engage. Above approximately 28 psi the switch has continuity (closed). This low setting is referred to "last resort charge loss protection". The system should not be operated anytime it is not working well and you suspect loss of charge. In addition the switch has a high pressure setting at 400 psi, if the

system pressure rises to an unhealthy level then the switch opens to prevent further operation until returns to operating range. It is possible for the unit to cycle on this switch, this would occur at an extreme case of high temperature operation, possibly a failed condenser fan or obstruction at condenser inlet grille. If cycling is noticed then report all known factors to maintenance.

PRE-TRIP INSPECTION :
*After starting listen for abnormal noise from engine and condenser areas. PARTICULAR ATTENTION SHOULD BE OBSERVED TO CONFIRM NORMAL LEVEL OF NOISE TO CONFIRM CONDENSER FANS OPERATION.
*The blower speeds should be stepped through and confirm airflow at each speed.

OFF SEASON *OPERATE SYSTEM WEEKLY OR AT LEAST MONTHLY*. WITH ENGINE FULL WARM DURING THE WARMEST PART OF THE DAY, OPERATE SYSTEM FOR 5-10 MINUTES TO CIRCULATE REFRIGERANT AND OIL. THIS WILL ADD LONGEVITY TO THE COMPRESSOR SHAFT SEAL. If possible, operate the blower only, thirty minutes or so later to dry any remaining moisture off the coil and reduce odor potential.

PREVENTATIVE MAINTENANCE

PLEASE READ ALL SECTIONS THAT FOLLOW FOR TIPS AND INSIGHT, THIS MANUAL IS NOT A SUBSTITUTE FOR INITIAL FULL TRAINING IN A/C SYSTEM DIAGNOSIS OR REFRIGERANT HANDLING.

NEWLY INSTALLED

The warranty card should be properly completed by installation center/installer. E-MAIL REGISTRATION INFORMATION at OMEGA WEB SITE. (REQUIRED for 2004 forward.)

NEW SYSTEMS ARE TO BE THOROUGHLY CHECK BY THE INSTALLER PRIOR TO DELIVERY. However, it is very prudent to inspect the newly installed system for compliance to contract specifications. The metal system component ID plate should be examined for completeness and readability upon delivery, rather than several years later when the system develops a problem.

OMEGA RECOMMENDS TAMPER PROOF HEAT-SHRINK SERIALIZED TUBING BE INSTALLED OVER SERVICE CAPS. EITHER BY INSTALLER OR MAINTENANCE DEPT. Properly installed they will deter refrigerant theft and assure mechanic that system has not been contaminated. Omega P/N 41-10710

A system that the belt chirps when first engaged or squeals during start up needs belt tension checked. This can be considered as normal that it might occur as belt is run-in, but it should be corrected as soon as possible. See belt tension guidelines in maintenance section. (Follow up with visual inspection any time the hood is raised especially at engine oil service intervals. The compressor mount should be examined carefully for the presence of all bolts and braces.)

The installation center is 100% responsible for the quality of workmanship in installing these systems. It is prudent to check engine compartment hose routing for adequate clearance from hot exhaust, any moving parts like steering shaft, and ABSOLUTELY NO POSSIBLE CONTACT WITH ANY BRAKE SYSTEM COMPONENT OR LINE. HOSES TO COMPRESSOR SHOULD HAVE ADEQUATE CURVATURE TO ALLOW FOR ENGINE ROCK DURING OPERATION. CHECK HOSE ROUTING AND SUPPORT UNDER THE VEHICLE. Note that hoses may sag over a period of time and therefor may require clamping adjustment.

THE EVAPORATOR COVER SHROUD SHOULD FIT SNUG UP TO UNIT. PUSH UP IN THE MIDDLE OF THE COVER AND IT SHOULD NOT DEFLECT MORE THAN 1/2". The cover needs to fit well to have blowers pull air through the cooling coil.

Omega provides installation training assistance however, assumes no responsibility for installer errors, omissions, mistakes, or workmanship in regards to installation or judgement of suitability of unit installed beyond the published data provided here within this manual.

PRE-TRIP INSPECTION:
*After starting listen for abnormal noises from the evaporator, condenser and engine areas. Particular attention should be observed to confirm normal sound level of condenser fans in operation.
*The blower speeds should be stepped through from low to high and confirm air flow at each speed.

PERIODIC AND SCHEDULED MAINTENANCE
Schedule based on full season usage, it may be adjusted depending on actual usage.

WEEKLY:
*For the first month of service of new system: Check compressor belt tension per instructions in maintenance section.
*Check condenser inlet grill and coil fins for obstructions, damage or excessive dirt. Operate system and confirm all fans are operational.
*Look at fittings/hose connections for oil/dirt traces that would indicate refrigerant leakage and report any abnormalities to maintenance.

MONTHLY:
*Perform all listed above plus below.
*Remove and clean or replace evaporator return air filter. See maintenance section.
*Inspect drain pan and clean as required, check drainage hoses are clear and drain freely.
*Check condenser fans operation.

QUARTERLY:
*Perform all above plus below.
*Inspect evaporator and condenser coils clean as required.
*Check hoses and wiring routed under vehicle and in engine compartment for support. Correct any wear, chaffing, or hose age sagging problem found.
*Check torque of compressor mounting bolts.
*Check voltage and current draw of components. Investigate any component that has changed since last recorded/marked reading. If investigating, then first check supply voltage at battery.

OFF SEASON (FALL/WINTER/SPRING)
*Perform all listed above (esp. Quarterly items) plus below.
*Inform driver/operators about *WEEKLY or at least MONTHLY* operation listed above in operation section. {WITH ENGINE FULL WARM DURING THE WARMEST PART OF THE DAY, OPERATE SYSTEM FOR 5-10 MINUTES TO CIRCULATE REFRIGERANT AND OIL. THIS WILL ADD LONGEVITY TO THE COMPRESSOR SHAFT SEAL. If possible, operate the blower only, thirty minutes or so later to dry any remaining moisture off the coil and reduce odor potential.
*If your region uses road salt in the winter; install Optional Winter Road Splash Cover on condenser package.

ON/PRE-SEASON ANNUALLY
*Check for Optional Winter Road Splash Cover on condenser package. Remove if present.
*Perform all preventative maintenance listed previously.
*SEE SPRING CLEANING CHECKLIST. Fully operate system and check performance. (REFRIGERATION MAINTENANCE TO BE PERFORMED ONLY BY QUALIFIED PERSON WITH "PROPERLY PREPARED" GAUGE SET TO AVOID SYSTEM CONTAMINATION. OMEGA HIGHLY RECOMMENDS TAMPER PROOF HEAT-SHRINK TUBING BE REINSTALLED OVER THE SERVICE CAPS.)
*CHECK DUAL PRESSURE SWITCH CONTINUITY/OPERATION .

PLEASE MAKE COPIES AS NEEDED. FILL IN INFORMATION & ADD TO MAINTENANCE FILE.

OMEGA BUS A/C SYSTEM MAINTENANCE CHECKLIST

CUSTOMER NAME_____ **PHONE**_____ **DATE**_____

Model/Serial#(EVAP)_____/_____ **M/S#(COND)**_____/_____**M/S# COMP**_____

R134a Data Plate Charge_____**After Performance Check Amount Added**_____

REFRIGERANT I.D. ANALYSIS R134a_____**% R-12**_____**% AIR**_____**% H/C or OTHER**_____**%**

GAUGE / TEMPERATURE READINGS BUS Mileage_____

INITIAL HIGH SIDE_____**psi LOW SIDE**_____**psi @**_____**RPM**

POST-REPAIR HIGH SIDE_____**psi LOW SIDE**_____**psi @** _____**RPM**

AMBIENT TEMPERATURE INITIAL_____**AFTER COND TEMP**_____ **POST REPAIR Amb/Cond**_____/_____

LOUVER TEMP INITIAL_____**RETURN AIR TEMP**_____**DELTA*T**_____ **POST REPAIR DELTA T**_____

ATTACH COPY OF CHARGE DETERMINATION WORK SHEET

COMPONENT Check Mark for OK -or- Make Comment	COMPONENT Check Mark for OK -or- Make Comment
1. BELT(S) (Record #s Here)	**10. EXPANSION VALVE**
Condition	Leaks / Fitting Connections
Tension	OPERATION CHECK
2. BELT TENSIONER (if installed) CHECK	Insulation
3. PULLEY / IDLER PULLEYS	**11. FAN SHROUDS / FAN CLUTCH / SEALS**
Alignment / Spacing	Mounting
Bearing / Noise	Cracks / Fractures / Leaks
4. COMPRESSOR	**12. ELECTRIC COOLING / CONDENSER FANS**
Leaks	Mounting
Mounting Bolts TORQUE / Alignment Check	Operation
Noise if Abnormal	Noise
5.COMPRESSOR CLUTCH	Electrical Connections for Corrosion
Air Gap Spacing Record (Example 0.035")	Damaged Blades
Pulley Bearing / Noise	**13. EVAPORATOR CORE**
Field Coil - Resistance	Leaks / Fitting Connections
Electrical Connections	Drain Tubes
6. CONDENSER	Evaporator Mtg Brackets/Rivits/Bolts
Leaks	Odor / Cleanliness
Mounting Brkts Check for Cracks & Bolts	**14. AIR FILTER**
Cleanliness	CLEAN or REPLACED
Sight Glass / Moisture Indicator	**15. LOUVERS**
Fins / Bent / Damage	Damaged / Missing
7. RECEIVER DRIER	**16. DASH CONTROLS / SWITCHES**
Mounting	All Speeds Check & Lighting Check
Fittings / Leaks	Knob & BUTTON or PAD Operation
8. SERVICE PORT CAPS Tamper Sleeves	**17. BLOWER MOTOR OPERATION**
Record Serial No.s	Noise
9. A/C HOSES & LINES	Resistance Check
Fittings / Connections Leak Check	**18. A/C BLOWERS RELAYS**
Rub Through	Proper Function
Mounting Brackets	Burned / Loose Terminals

TROUBLE SHOOTING THIS SECTION IS FOR BOTH OPERATORS AND MECHANICS
(Also please read introduction at front of manual.)

Trouble shooting includes collecting enough information to locate the cause of the problem, and correcting the problem. This often means more than just fixing the obvious malfunction rather going further to fix the hidden cause.

Begin by gathering information provided by the operator, this usually is vague like "It don't work." or "It don't cool." This same type of information may be on the work order. This type of sketchy information normally will result in the repair diagnostics taking longer.

Please allow the following set of examples.

In the first scenario, using a vague work order, the bus A/C system is checked out for performance and every thing is fine. The mechanic spends a full hour and the bus is returned to service bus (unfixed).

The same bus comes back sometime later with the same complaint. At the time of the second request for service, the operator and service writer get together and provide more concise information. The work order reads; "the blower speeds all work, and the unit works fine at the beginning of each daily run, but cooling and air flow are way off at the end of several hours of running". Provided with this information and understanding the function of the thermostat then the mechanic does a quick check/change of that component and the freezing up is fixed.

In the next example the operator says "there is sometimes a squealing noise under the hood". The service writer fills in "A/C belt is slipping". The mechanic does not hear the noise when he runs the system but, he tightens the A/C belt anyway just like the work order said. The bus is returned to service and comes back the next day with the same complaint. This time a different operator says "there is sometimes a squealing noise under the hood and it usually happens when the steering wheel is turned hard". This time the right belt gets adjusted (the power steering belt).

Another bus service ticket says "A/C belt squealing", this time the mechanic checks the system over and finds mud splash on condenser fins. The coil is cleaned to fix the root cause as well as replacing the belt as it had indeed suffered damage. This is trouble shooting, taking time to look beyond the obvious.

In the previous example; Did the mechanic also check that both fans were turning with correct voltage. Did he also check that a rock had not smashed one of the pipes? If he did then, he was trouble shooting.

Next case "insufficient cooling" is the complaint. The mechanic checks and sure enough the air filter is dirty so it is cleaned. End of story, not quite. The performance of the evaporator is still low. The system sight glass is also check and it is milky with bubbles and, the high side pressure is also low. The inspection continues until a leak is located, the o-ring is changed and the system is recharged adding back the amount of oil that was recovered with the refrigerant. Now the bus is really fixed.

Next example; it is time for the beginning of season scheduled maintenance. The service proceeds and the performance appears a little low but the gauge readings are fine. By performing a through inspection it is discovered that the tube after the receiver drier is cold and wet with condensate. Referring to the basics, when the refrigerant flow is restricted the pressure and temperature is lowered, that’s what happens at the TXV right? Well in this case the partially clogged receiver drier is "throttling back the flow", the reduced pressure before the valve does not allow it to function properly. There is no substitute for full proper training and experience when trouble shooting A/C problems.

In the preceding paragraphs of examples it was shown that the better a problem is understood the more easily the correction can be made. In the shop, the better a person understands the inner workings of a vapor compression refrigeration system, the quicker and more correctly will the root cause of a problem be diagnosed. One survey revealed the following percentages for A/C components that required maintenance in a particular fleet. Belts 32%, Compressor/clutch 26% , Condenser 12% , Add Refrigerant 12% , Refrigerant Lines/Fittings 11% , Valves 7% . In this survey electrical problems were not included.

Electrical trouble shooting normally starts at the end of a wire, be it a component or a connector. Check the wiring diagram to find the components that are involved in the malfunction, start with whatever seems easiest or most likely. Check for continuity through the component(s). If that doesn't work then check for power or ground, trace which ever leg is not reading correctly.

Example Problem: The clutch slips when engaged, it looks like it has been getting hot and there is rust dust all over it.

Discussion: A clutch requires at least 12 volts to operate and work best with full voltage of alternator. The supply voltage should be checked, maybe the coil is internally shorting thus less inductive load more current draw and thus lowering voltage. Maybe the clutch relay was not installed and thus the current has to travel the entire length of the wire from the thermostat, this wire is sized for control circuit and the long length will result in excessive voltage drop when conducting clutch current. Maybe the clutch relay contacts have corroded which causes resistance and lowered the voltage.

Solution: All the items mentioned in the discussion are checked, which ever electrical problem(s) that are found are corrected. The mechanical part of the clutch is cleaned up, the air gap is checked the engagement surfaces are examined. It may be determined that the clutch is fine or that a new clutch is also installed, either way the root cause of the problem is found rather than just replacing the malfunctioning component.

Knowledge of basics, experience and full fledged trouble shooting is what it takes to keep systems operating correctly.

ABNORMAL COMPRESSOR NOISE WHEN CLUTCH IS NOT ENGAGED.

POSSIBLE CAUSE	ACTION	REMEDY
Drive belt	Check tension and inspect. Strobe light check belt bounce and clearances.	Adjust or replace belt.
Faulty clutch bearing	Remove drive belt, turn clutch by hand, Listen and feel for bearing roughness.	Remove clutch bearing or complete pulley rotor.
Idler pulley bearing	Check idler pulley bearing.	If rough replace idler.
Scrapping sound from clutch	Inspect for dirt/grit trapped behind front plate. Check supply voltage Inspect for correct air gap space all around Remove and inspect for deep scoring.	Remove and clean Correct for low voltage. May be corrected with pry Replace clutch.
Loose or missing compressor mounting bolt(s)	Inspect and torque bolts, if any are loose check mount holes and welds for damage.	Replace any damaged bolts Repair as required.
Loose or out of balance engine crank pulley	Remove and inspect, retighten bolts Check center machined fit	Torque bolts, Replace pulley.
Alternator, water pump air pump, or other	Locate the other engine driven component with listening scope or other device.	Replace component.

ABNORMAL COMPRESSOR NOISE WHEN CLUTCH IS ENGAGED.

POSSIBLE CAUSE	ACTION	REMEDY
A/C Hose Resonating	Check for any body or panel contact.	Add padding or clamp.
Excessive discharge Pressure.	Check for Poor air flow at condenser. Spray water on condenser, listen for less noise. Check pressures with gauge set. Recover/Recharge W/o Non-Condensables.	Clean coil, replace bad fan. Correct over charge (See Note on Charge Determination Work sheet)

Compressor clutch.	Inspect clutch. Check field coil, c-clip loose.	Repair to lock coil in place.
Liquid Refrigerant Entering Compressor.	Check Suction Fitting for Frost or unusually Cold Fitting with high suction pressure.	Replace TXV, Recharge with Proper Charge.
Compressor failing.	See Compressor Replacement Procedure.	Add oil and retry or replace.

SERVICE EXPERIENCE TIPS:

In rare but significant cases, oil has transferred out of the compressor and collected in the condenser and impeded refrigerant flow. Significant because the system performance was way low and the problem is difficult to diagnose. The symptoms draw a conclusion of bad TXV. However having changed the valve twice the solution had to be found elsewhere in the system. (I don't remember who suggested it, and was surprised with the results.) In desperation I suppose, the hot condenser was sprayed with cold water (with system running). The theory is that rapidly condensing the refrigerant dislodges the oil accumulation and forces it to circulate returning to the compressor.

In several other similar cases the water quenching did not work. While system was open for TXV change, the condenser was "back flushed" with nitrogen. Special hoses were made so the exit hose was directed into a five gallon bucket. The condenser was purged and a "slug" of oil was splattered all over the inside of the bucket (use lid on bucket). At first the flow seemed restricted, then as the pressure built up the oil moved and slammed into the bucket relieving the pressure and finally was free flowing.

Even more rarely the "oil slug" was cleared from the evaporator coil. The oil amount was estimated and added back to the compressor suction port and the vehicles were never returned for additional service.

The how, when and why of this oil transfer and collecting are not definable at this time. The above cases are mentioned as possible solutions when dealing with a problematic system and the routine solutions have not corrected the performance problem. KNOWING THE TYPICAL PERFORMANCE OF A SYSTEM CAN BE VERY VALUABLE IN SPOTTING THESE TYPES OF ANOMALIES.

TROUBLE SHOOTING, EXTENDED FULL SYSTEM GUIDE

Unit Not Air Conditioning Well: POSSIBLE CAUSE

1) Dirty return air filter, evap. air flow blockage, faulty blower motor
2) Air leakage around coil, cover not fit correctly up to seals inside
3) Dirty condenser coil, cond. air flow blockage, faulty fan motor or blade
4) Under charge, Loss of Refrigerant
5) TXV stuck open, eroded valve seat or needle
6)TXV stuck closed, head charge loss, restricted flow (ice, wax, debris)
7) Restricted receiver drier
8) Other system blockage, dented pipe, pinched hose, collapsed liner
9) Slow compressor speed, too small compressor for system
10) Belt slippage, clutch slippage
11) Non-condensable air in system
12) Severe over charged
13) Too much oil in system
14) Faulty compressor

RELATED READINGS

Low Suction Pressure	See 1, 4, 6, 8, 13
High Head Pressure	See 3, 7, 8, 11,12
Low Head Pressure	See 2, 4,5, 8, 10, 14
High Suction Pressure	See 5, 9,10, 12, 14

MAINTENANCE EQUIPMENT **(Items may be optional depending on level of service.)**

Protective Eye Ware, Insulated Gloves, eye wash station, first aid kit all other safety equipment
Torque Wrenches
Schrader Valve Service Tool [OMEGA P/N 41-91290]
Belt Tension Gauge [P/N 41-93862
Straight Edge Ruler and Dial Caliper
Dual Thermocouple Digital Thermometer
Manifold Gauge Set with Hoses and End Couplers for R-134a service ports [P/N 41-89772]
Complete Recovery/Recycle Machine with closed loop flush kit option, Drilled out TXV Block Valve
Vacuum Pump, two stage 7 CFM minimum (capable of. 500 to 25 micron vacuum)[P/N 41-90057]
Vacuum Pump Oil 22 oz service change for above [P/N 41-90022]
or Vacuum Pump, two stage 5 CFM minimum (capable of 500 to 25 micron vacuum)[P/N 41-90056]
Vacuum Pump Oil 16 oz service change for above [P/N 41-90016]
Micron Vacuum Gauge
Nitrogen Bottle/Cylinder with Pressure Regulator and Gauges
R-134a Refrigerant Supply Cylinder
Heater Wrap Pad/Blanket for Refrigerant Cylinder Pressure Elevation
Accurate Weight Scale [P/N 41-15220]
Oil Injector, Capable of adding Oil and Dye to Closed System with Pressure
UV-Dye Additive or Oil with Dye
UV Light Source and Protective Eye Ware
Correct Viscosity Compressor Oil [See OEM Oil Charge List]
Solvent Flush Kit and Supplies [P/N 41-91046]
Power Flushing system [P/N 41-01490]
OZ /ML/CC Graduated Beaker or Cup for measuring oil
Small Container/Dispenser with Mineral Oil (R-12 compressor oil)
Soap and Water Solution Spray Bottle (min), Radiant Leak Detector Solution (better)
Electronic Leak Detector and replacement tips [P/N 41-15202]
DVOM (Digital Volt Ohm Meter) and Ampere Meter (Single wire clamp)
Selection of Electrical End Connectors, Ring Terminals, Star Washers, Etc.
High Grade Electrical Contact Cleaner
Electrical Tape, Tie Wraps
Heavy Duty Anti-Chafe Material "Mill Hose" (Similar to Fire Hose)
Fin Comb
Foaming Coil Fins Cleaner (Omega P/N 41-19990)
Odor Eliminator (CLEAN AIR BRAND P/N 41-00001 2.5 oz Spray can)
(CLEAN AIR BRAND P/N 41-00003 1 gallon with Sprayer/Hose)
REPLACEMENT PARTS see parts brake downs at end of booklet
O-RING SELECTION see parts brake downs at end of booklet

MAINTENANCE SERVICE PROCEDURES

NOTE: FOR REFRIGERATION RELATED SERVICE CONTINUE TO THAT SECTION

MAINTENANCE PROCEDURES GENERAL NOTES:

FOLLOW ALL SAFETY AND OPERATIONAL PRECAUTIONS

WARNING: THE UNIT MAY CYCLE ON THE FANS AND COMPRESSOR UNEXPECTEDLY AS CONTROL REQUIREMENTS DICTATE. BEWARE OF UNANNOUNCED STARTING, REMOVE POWER PRIOR TO TOUCHING COMPONENTS THAT NORMALLY MOVE.

REFERENCE FOR COMPRESSOR AND MOUNT BOLTS (CHECK QUARTERLY)
TORQUE SPECIFICATIONS - BOLTS INTO ALUMINUM OR CAST IRON THREADS
Note: Max value based on oil in threads and on head bearing surface.(Clean/dry values would be slightly higher.)

S.A.E. BOLTS TORQUE IN FOOT-LBS
(GRADE 8 HIGHLY RECOMMENDED FOR ALL ENGINE MOUNTED BOLTS)
Follow any information from mount manufacture if available.

BOLT SIZE-Thread Pitch	Grade 2 (not for compressor mounting)	Grade 5		**GRADE 8**	
		Aluminum	Cast Iron	Aluminum	Cast Iron
1/4-20 UNC		6	7	**9**	**11**
5/16-18 UNC		12	15	**18**	**22**
3/8-16 UNC		20	30	**34**	**40**
7/16-14UNC		35	45	**50**	**58**
7/16-20 UNF		(40)	50	**(55)**	**65**
1/2-13 UNC		55	70	**70**	**92**
1/2-20 UNF		(60)	75	**(95)**	**110**
5/8-11 UNC		110	135	**150**	**190**
5/8-18 UNF		(120)	155	**(170)**	**215**

METRIC BOLTS TORQUE IN FOOT-LBS

BOLT SIZE	Grade 8.8		Grade 10.9		**Grade 12.9**	
	Aluminum	Cast Iron	Aluminum	Cast Iron	Aluminum	Cast Iron
M6 x 1.0	5	7	8	9	**8**	**9**
M8 x 1.25	13	18	18	23	**21**	**27**
M10 x 1.5	22	30	35	45	**40**	**50**
M12 x 1.75	40	55	60	75	**75**	**95**
M14 x 2.0	65	85	95	120	**110**	**145**
M16 x 2.0	110	130	135	175	**165**	**210**

TORQUE SPECIFICATIONS REFRIGERANT FITTINGS (always use longer backup wrench)

Fitting Size	Threads	Tubing O.D. / Hose I.D.	FLARE Fitting Torque ft-lb	O-RING Fitting Torque ft-lb	
				Aluminum	Steel
#4	7/16-20	1/4 / na	10 - 15	5 - 7	5 - 10
#6	5/8-18	3/8 / 5/16	20 - 25	10 - 13	10 - 15
#8	3/4-16	1/2 / 13/32	35 - 40	15 - 20	15 - 22
#10	7/8-14	5/8 / 1/2	50 - 60	21 - 27	22 - 30
#12	1-1/16-12	3/4 / 5/8	70 - 80	28 - 33	28 - 36
Switches		na	5 - 10	5 - 7	5 - 10

COMPRESSOR DRIVE BELT MAINTENANCE

There are several factors that have major effects on compressor drive belts life expectancy and reliability. Belt alignment and proper tension are the two most critical and controllable by the installer and end user. When improperly installed and/or maintained drive belts can cause significant damage to equipment as well as pose a safety issue. Other factors include belt clearance, temperature/heat of use and fluids damage.

Alignment includes angular and parallel both should be obtained as close as possible. Tolerance in mounting holes, welded plates and plate flatness can cause misalignment. When originally installed the mounting bolts may have been loosed and the pulleys aligned. Later service work may require the same type of adjusting or shimming. Short run life on a belt might indicate that a particular vehicle needs alignment checked.

A high quality straight edge and a precise measuring instrument like a dial caliper will be required to adequately check alignment. Lay the straight edge across the pulley that protrudes the most, usually the drive pulley on the engine, measure to the edge of the belt and then compare to relative measurement of second pulley for parallel/offset alignment. Further check top, bottom, front, and back to check angular alignment. Make any correction required to achieve the best belt life. Check idlers in the same manner as they too can wear on a belt.

Drive belt tension if to light will promote slippage that will cause heat. Over tension will stress bearings of driven component as well as early belt failure. All belts require a "run-in period" during the first 10-12 hours of run time a belt will stretch more then the rest of its service life. It is important therefore to re-tension per guidelines below.

DRIVE BELT TENSION GUIDELINES

Check the tension when the belt is hot from running. If it is below the threshold value, then allow it to cool and adjust to re-tension value. If installing a new belt start with that value with belt cold.

DRIVE		Re-Tension If Below(Threshold)	Re-Tension Run In Belt To	New Belt Initial Tension Lbs
Compressor	A grove	80	105	130
Alternator	A grove	70	90	110
Poly-Rib Belt & Serpentine	6 Ribs or More	90	110	145
Poly-Rib Belt & Serpentine With Spring Tensioner ----NON ADJUSTABLE				

Please follow belt manufacture guidelines regarding gauge selection, operation, calibration and any specification that may contradict above values.

RETURN AIR FILTER, RELAY BANK and THERMOSTAT SERVICE

SPECIFIC CAUTION: Do not allow oils to drip into or on plastic drain pan or any plastic part of these systems as material will absorb and become brittle and prone to crack.

Follow maintenance schedule, or clean as required. Series Model EF1, EF2, & EF3 the main cover must be removed. Model EF3 remove smaller end louvers first. Relay bank is now accessible. Remove four screws and allow drain pan to hang down (clean as required). Thermostat is now accessible for service if needed. Rotate filter end catches and slip filter frame down and out. Use mild soap and water with brush to clean, carefully use shop air to dry, apply spray filter enhance directly to screen as desired (per manufactures directions). Note if thermostat probe was pulled out of coil, then reinstall between coil fins right next to original location to re-establish full contact. Carefully reinstall all components.

ODOR, CAUSE AND REMOVAL (This is a service matter, not a warranty issue.)

Odor is caused by naturally occurring bacteria growing in any water remaining in the evaporator housing, drain pan, drain hoses and perhaps on coil. Because of the low temperature of the air, limited discharge flow (that might otherwise flush growth away) and in the absence of sunlight an ideal situation for the growth of bacteria and fungi is unavoidable created. To remove the odor, remove the microbiology. By properly cleaning components of dirt formed from dust that holds water the colony will not have it's first foothold. Washing with white vinegar is probably the most effective method of removing the contaminants. A popular effective option between complete cleanings is to routinely use a spray A/C deodorizer that will freshen by chemically neutralizing nature's little troopers. (Also see operation procedures to run blowers only to dry unit.)

BLOWER MOTOR ASSEMBLY and SPEED RESISTOR(S) REPLACEMENT

Disconnect battery ground cable.
Follow same procedure as return air filter service. Disconnect wiring, remove failed component, install replacement. Check operation especial correct direction of rotation of blower motor. (Permanent magnet D.C. motors will reverse if positive and negative wires are exchanged, air delivery will be low.)

CONDENSER FAN ASSEMBLY(s)
Disconnect battery ground cable.
If one fan motor has worn out to the point of failure, please consider replacing them both so as to avoid other damage due to high pressure in the near future. Check operation, especial correct direction of rotation of fan motor. (Permanent magnet D.C. motors will reverse if positive and negative wires are exchanged, do not rely on wire colors alone.)

REFRIGERATION SERVICE PROCEDURES

FOLLOW ALL SAFETY AND OPERATIONAL PRECAUTIONS

WARNING: THE UNIT MAY CYCLE ON THE FANS AND COMPRESSOR UNEXPECTEDLY AS CONTROL REQUIREMENTS DICTATE. BEWARE OF UNANNOUNCED STARTING, REMOVE POWER PRIOR TO TOUCHING COMPONENTS THAT NORMALLY MOVE.

WARNING: NEVER USE SHOP AIR FOR LEAK TESTING. IT HAS BEEN DETERMINED THAT PRESSURIZED REFRIGERANT AND AIR RICH MIXTURES CAN BE COMBUSTIBLE WHEN EXPOSED TO AN IGNITION SOURCE.

ALWAYS USE MINERAL OIL TO LUBRICATE O-RINGS AND FITTING THREADS. PAG OIL IN THE SYSTEM WILL ABSORB MOISTURE AND BECOME VERY ACIDIC AND CORROSIVE, DO NOT USE IT ON EXTERNAL PARTS.

USING ONLY THE COMPOUND GAUGE OF THE SERVICE SET FOR DETERMINATION OF VACUUM LEVEL IS NOT RECOMMENDED BECAUSE OF ITS INHERENT INACCURACY.

VACUUM PUMPS REQUIRE ROUTINE OIL CHANGE TO MAINTAIN FULL PUMP DOWN CAPABILITIES. A TWO STAGE VACUUM PUMP IS REQUIRED TO ACHIEVE VACUUM IN THE 1000 MICRON AND BELOW RANGE.

WEAR EYE PROTECTION AND GLOVES ANY TIME REFRIGERANT HANDLING IS INVOLVED!

PLEASE READ ALL SECTIONS THAT FOLLOW FOR TIPS AND INSIGHT, THIS MANUAL IS NOT A FULL SUBSTITUTE FOR INITIAL TRAINING IN A/C SYSTEM DIAGNOSIS OR REFRIGERANT HANDLING.

PREPARING MANIFOLD GAUGE SET FOR USE

If the manifold gauge set is new or was open to atmosphere then it will require evacuation to remove air to avoid contamination of system. Close both high and low side end couplings. Open both the high side and low side manifold valves. Connect the gauge set to the vacuum pump and fully evacuate. Assuming the gauge set will next be connected to a charged system for service or annual maintenance check, then next connect the service line with self sealing end fitting to refrigerant supply cylinder. Slowly open cylinder valve to allow vapor only into the gauge set until the low side pressure is 40 to 60 psi, close cylinder valve. Close both manifold valves and the set is now ready to connect to a charged system.

With a four hose manifold set the procedure is nearly the same except the cylinder and vacuum pump will both be connected and all hoses will be evacuated, close the valve to the vacuum pump and then refrigerant vapor charge the other three hoses.

MANIFOLD GAUGE SET USAGE

The manifold set is used to connect to system and thus determine system operating pressures, add refrigerant, evacuate and in rare cases equalize high and low side pressures. The standard three hose version requires extra care in exchanging yellow (service) hose from cylinder to recovery machine to vacuum pump. The more convenient four hose version has the advantage of allowing two service items to be connected at he same time. Usually the cylinder remains connected and the recovery machine or vacuum pump are not used at the same time. When it is time to exchange them the hose connection will have only a vacuum (or very little pressure).

With the system OFF connect the service couplings to the service ports. With all manifold valves closed, rotate the end coupling valve red knob to move the plunger forward to open the service port schrader valve. The high side pressure gauge will now indicate system pressure. It will dependent on the average ambient temperature of the system (not on the quantity of liquid in the system even if the system is low of charge just as long as there is some present to produce enough vapor present). Next open the low side end coupling valve, the low side pressure gauge should read the same as the high side (system has been off long enough to equalize). Too verify open both manifold valves, check pressures again. Any difference is GAUGE ERROR and should be noted, usually as correction to wider scale high side gauge. Closes manifold valves before proceeding.

With manifold gauges attached the system may now be run for annual pressure reading check, see the system performance chart for procedure.

If some service is determined to be required then proceed with full diagnosis of system prior to adjusting charge of refrigerant. First see "leak check" and then "adjusting the charge" below.

After testing is complete, to prevent trapping liquid refrigerant in the manifold/hose set and robbing charge from system, entire set must be brought to suction operating pressure. First close the high side end coupling (red knob fully counterclockwise). Next slowly open both manifold valves, allow both gauges to equalize at suction pressure. Close the low side end coupling (blue knob fully counterclockwise), close both manifold valves. Remove the low side coupling with system still running, however high side will be hot and at high pressure at service port so it is best to wait until system is turned off and cooled down before removing the high side end coupling.

REFRIGERANT LEAK CHECK - SYSTEM WITH PRESSURE

If pressure reading were diagnosed to require adjustment, then most likely it was determined that some loss of refrigerant has occurred. So depending on the amount that needs to be added, how severe is the problem? Was it a very small amount that could be called normal permeation or a larger amount indicative that a repair is required? In either case the correct thing to do is to carefully go over the system and fix any leak that can be identified! It is only going to get worse. Fix any leak that can be identified.

1) OMEGA highly recommends UV dye in all A/C systems. Use UV protective/enhancement eye ware, and thoroughly examine entire system with UV light.
2) Soap and/or radiant dye solutions may be sprayed, brushed or poured on specific locations like end fittings. In certain cases like a large leak, electronic leak detectors will not function correctly and thus solution testing may be necessary.
3) Electronic leak detectors are often convenient for checking the general area of a coil as well as end fittings. Proper usage requires slow and deliberate motion. Refrigerants are heavier than air and will tend to collect in the bottom of the drain pan if not disturbed by surrounding air movement. Follow instructions provide by equipment manufacture.

If no leaks can be found and the system was diagnosed to need adjustment and if the amount finally added is less than half a pound then dye should be added and the unit should be rechecked in the next quarterly. If a pound or more is added later (see Charge Determination), then dye should be added and the system should be leak check again after thirty minutes to one hour of run time.

REFRIGERANT LEAK CHECK - SYSTEM WITHOUT PRESSURE

If the system had dye then the UV light method is straight forward. A system without dye should also be entirely looked over first with a bright light. If any thing obvious or highly suspicious is found then repair it prior further pressure testing.

If nothing is visually obvious, then next step of the preferred method, is to charge the system with only enough refrigerant vapor to attempt build up to 30 / 40 psi and then add nitrogen to raise pressure to 150 / 200 psi. There will be enough refrigerant for electronic leak detector to work and enough pressure for solution bubbles to form. Do not operate system!

Remove the test gas, locate and fix leak(s), replace filter drier, evacuate/dehydrate unit.

EVACUATION / DEHYDRATION (Double Nitrogen Flush and One Time Deep Vacuum)
Note: Pag oil is very hydroscopic (absorbs water) DO NOT use oil from previously open containers.
Both Polyalkylene Glycol (PAG) and Poly Ester (POE) oil will pull moisture right out of the air. Moisture causes a chemical reaction which creates ACID. Evacuation will not remove the moisture and will not reverse the chemical process.

Moisture is always present in atmospheric air. The presence of moisture in a refrigeration system will have undesirable effects. Freezing up at metering devices, acid and acid sludge formation and resulting in metal corrosion shorten the service life of an improperly serviced unit. A double dry nitrogen flush evacuation should be performed after any catastrophic loss of refrigerant or any major component is replaced (evaporator, condenser, or compressor). By following good procedure (capping lines) and/or limiting exposure time, a single evacuation will normally suffice for minor service like o-ring leak repair. Regardless a new receiver drier should be installed any time system is breached.

Keep the system ambient temperature above sixty degrees Fahrenheit to speed the evaporation of any moisture. At lower temperatures ice may form before moisture removal is complete. Remember also that the system will cool down as result of lowering the internal pressure. Off season service should be performed in heated shop, alternate heat source such as heat lamps will also help. At least plan to perform evacuation during the warmest part of the day. (To get really technical see the note below.)

For repair service, first having recovered any refrigerant, have vacuum pump service hooked up and ready to evacuate as soon as work is complete. Make the drier replacement the last activity and immediately start vacuum pump.

Normally evacuate from both sides (manifold valves both open). Open valves slowly to prevent large inrush of air purging oil out of pump vent. By hand, turn compressor over several times once full vacuum is achieved.

For double nitrogen flush, close low side manifold valve when adding nitrogen through high side. Close high side manifold valve, connect vacuum pump and evacuate by opening low side valve. By hand, turn compressor over several times once full vacuum is achieved. After full evacuation (depending on vacuum pump, 10 to 30 minutes), close low side manifold valve and stop vacuum pump and assure system holds vacuum for a minimum of five minutes. (some pressure rise may be observed on a micron gauge; say about 500 microns, but this would be completely unperceivable on a compound gauge). If system does not hold vacuum, then diagnose leak with preferred method above (partial refrigerant). Upon successful vacuum hold test, repeat dry nitrogen purge through high side procedure again, only this time loosen low side hose at manifold and allow nitrogen to flow through system to flush out any moisture that vaporized (boiled off) during vacuum hold test. Final evacuation to dehydrate the system should be to below 1000 microns.

Alternatively a single, double, or triple refrigerant flush will work similarly except recover the "flush through refrigerant" for proper recycling. If the system has been open or empty for a long time, then evacuation times should be extended and triple flush with full evacuations between is required. Single flush/evacuation (30min) is 90% efficient, Double 97%, Triple flush/evacuation 99% effective moisture removal.

One time deep vacuum is for new systems (not previously charged) and minor short duration breach repaired systems. By hand, turn compressor over several times once full vacuum is achieved.

After full evacuation (depending on vacuum pump, 15 to 30 minutes), close low side manifold valve and stop vacuum pump and assure system holds vacuum for a minimum of five minutes. (some pressure rise may be observed on a micron gauge; say about 500 microns, but this would be completely unperceivable on a compound gauge). If system does not hold vacuum, then diagnose leak with preferred method above (partial refrigerant). Upon successful vacuum hold test, restart pump for another 10 to 20 minutes. Final evacuation of the system should be performed at above 60 degrees temperature.

Note: VACUUM TO WATER VAPORIZATION TEMPERATURE
Compound gauge readings (inches of Hg is read as inches of mercury vacuum)
@28.92 inches of Hg [96.6% vacuum] =25,400 microns; boiling point of water is 79^0F
@29.13 inches of Hg [97.4% vacuum] =20,000 microns; boiling point of water is 72^0F
@29.80 inches of Hg [99.4% vacuum] = 4,500 microns; boiling point of water is 32^0F
@29.88 inches of Hg [99.86%] = 1,000 microns = 1 mm of Hg Absolute Pressure

RECOVERY NOTES

Prior to recover drain oil from collection container that may have settled since last use, note this amount. Learn the characteristics of your machine. If it retains oil, then consider adding the value to the amount collected. After recovery record amount collected for add back calculations.

The machine may cycle off and then back on in about five minutes or more. In fact as refrigerant continues to come out of solution from the PAG oil in the system it will raise pressure. This slow process may be observed when a component is removed, capped and checked for pressure later. It sure makes a mess when the bubbling oil comes out of an evaporator or condenser that has been rapidly removed and set aside.

A complete recovery could take numerous hours. If time were not an issue or if a person could plan the work schedule, then recovery should be done during lunch or even better yet at the end of the day and then start machine again in the morning.

Recover refrigerant per machine manufactures instructions and stay informed with current industry journals for any legislation changes.

ADDING REFRIGERANT FULL CHARGE (RECOVERED AND EVACUATED SYSTEM)
Note: If using a charging station, routinely calibrate it per manufactures instructions.

Set up and pre heating of the supply cylinder is assumed to have taken place during evacuation. Place R-134a supply cylinder on weight scale that was set at zero and correct units are displayed. (Lbs or Kg). Take note that an empty 30lbs cylinder weights about 5 1/3 lbs, and the heater belt should also be on the cylinder, so be prepared with enough refrigerant to compete the charge based on engraved plate attached to vehicle by installer. After final evacuation close both/all manifold valves. Check that the cylinder valve is open and positioned correctly to dispense liquid. Depending on condition and type of gauge/hose set, supply hose should be filled up to manifold valve, if the hose was empty then the scale will show how much refrigerant was required to fill it. Re-zero the scale.

With the a/c system off, charge with liquid refrigerant into the high side only. The heated cylinder will cool slightly as its elevated pressure forces fluid into a/c system. Shut off manifold valve when scale indicates the full charge. (Using this method eliminates the possibility of non-condensable gas entering the system coming from the top vapor of a recovered/recycled cylinder.)

Start engine, warm up, and engage clutch. Perform and operational test deemed appropriate. See next section on charge determination.

When ready to disconnect, to prevent trapping liquid refrigerant in the manifold/hose set and robbing charge from system, entire set must be brought to suction operating pressure. First close the high side end coupling (red knob fully counterclockwise). Next slowly open both manifold valves, allow both gauges to equalize at suction pressure. Close the low side end coupling (blue knob fully counterclockwise), close both manifold valves. Remove the low side coupling with system still running, however high side will be hot and at high pressure at service port so it is best to wait until system is turned off and cooled down before removing the high side end coupling.

OPTIMUM CHARGE DETERMINATION

The main goal is to provide maximum cooling and can be measured directly as temperature drop across the evaporator (Delta-T). With R-12 the procedure was easy, clear the sight glass and add a little to get sub-cooled liquid supply to the expansion valve. Now with R-134a this approach must be modified as the high side pressure can exceed optimum for system maximum flow rate. So the sight glass is now used mainly for moisture eye reference.

A system that is otherwise sound but is low on refrigerant will produce a better Delta-T as refrigerant is added (system must stabilize between incremental additions). Recording all temperature readings and both high and low pressures will help to see the trend. Notice that single point thermocouples have a difficult time in moving air streams, recording high to low swings is required. The method also requires near maximum heat load conditions for best results. It should be performed with windows open to reduce re-circulation air effects and to attempt to have steady state inlet air temperature and humidity.

Another charging method is to measure the ambient air temperature at the condenser inlet, enter the temperature/pressure chart, read the corresponding pressure value and adjust system charge to obtain same high side gauge reading. This procedure does not assure maximum cooling performance.

Omega recommends a combination of the two methods. The engine should be running at about 3/4 of max road speed RPM. Incrementally add charge to obtain the best evaporator performance. Have the pressure value on hand and consider it as the maximum except if the delta-T performance is still getting significantly better. As an example: two degrees better delta-T for a 5 to 10 psi rise above the chart value. If the system were way undercharged to start, you will see that the delta-T at first gets rapidly better with each add, but then improves only slightly as correct charge is approached. At the same time the high side pressures don't change much at first, but began to increase in larger steps.

When the initial charge is about right and little delta-T change is observed with first add and high side is close to chart value, then the system is ready. If the high side jumps up and is now 30 to 40 psi above the chart value then even if the evaporator performance got slightly better then for sure it's time to stop adding refrigerant, shut off system and recover last increment added.

The proceeding is for system service when exact amount of refrigerant in system is not known. If the system were being fully recharged after service then the data plate riveted under the hood

should be stamped with charge weight. In this case charge to that amount and verify high side value from chart. **Typical charge weight will be about 5.2 lbs for EF1, 2, or 3 Evaporator with CS1 systems and 6.5 lbs is typical for systems with CS6 and second (slave) unit.**

(OPTIMUM) CHARGE DETERMINATION WORKSHEET R134a

CAUTION: DO NOT CONTINUE TO OPERATE SYSTEM WITH LOW SIDE PRESSURE LESS THAN 10 PSI, begin with enough refrigerant to prevent compressor damage.
Compressor/Engine RPM at 3/4 max road speed RPM. Evaporator main cover on and louvers all open. Open windows for max heat load and attempt to maintain steady state entering air temperatures. Check/calibrate gauges (see manifold gauge set usage) and thermocouples comparative readings, note any Correction Factor difference to be added or subtracted. It is normal (especially during light load operation) for the "TXV to hunt" for setting, thus suction pressures often range or swing. This can also produce swings in high side pressures. Record ranges or swings in readings. NOTE: If system is operated 30 deg above charge temp, then recheck & readjust charge. Example: If charged at 70 deg to 130psi then at 100 deg expect 250psi. Whenever possible, charge at hottest condition close to max expected during operation and obtain best overall performance.

Amb Temp Into Cond. deg F	Guide Line Desired High Pressure	Max High Press. See Note Above	(. lbs) Start or Unknown Record Delta-T High/Low Pressures	Added 0.2 (If known Total now . lbs) DT & H/L	Added 0.2 (If known Total now . lbs) DT & H/L	Added 0.2 (If known Total now . lbs) DT & H/L	Added 0.2 (If known Total now . lbs) DT & H/L
PLEASE MAKE COPY OF THIS FORM, FILL IN ALL INFORMATION & ADD TO MAINTENANCE FILE.							
62	110						
64	115						
66	120						
68	125						
70	130						
72	135/150						
74	140/155						
76	145/160						
78	150/165						
80	155/170						
82	160/175						
84	165/180						
86	170/185						
88	175/190						
90	180/195	210					
92	185/200						
94	190/205						
96	195/210						
98	200/215						
100	205/220	250					
102	210/225						
104	215/230						
106	220/235						
109	230/245	300					
112	240/255						
115	250						
118	265						
120	275	360					
124	290						
128	305						

132	320						
		360	High pressure switch cut out range 28 kg/cm3+/-10% = 400psig+/-40				
		440					

ADJUSTING REFRIGERANT CHARGE

Note: If using a charging station, routinely calibrate it per manufactures instructions.

Overcharging is to be avoided if at all possible. If it has occurred it is likely on a system that is now operating in a much hotter ambient then when the system was initially charged. It is also possible that a mistake was made or equipment malfunctioned (not calibrated is really an operator problem not a malfunction of the equipment per say). Many charging stations use a strain gage weight scale that requires calibration any time they are moved, especially if a nearly full cylinder is sitting on the weight platform. A bump or jolt from rolling over a floor seam or electric cord is often enough to affect the machine calibration.

Following all proper steps covered in previous sections. Adjusting charge is simply either adding or removing refrigerant from system utilizing gauge set.

Adding is normally done with system running and will typically be adding charge to obtain best evaporator performance while keeping head pressure in acceptable range. Refrigerant vapor is added through low side. You may turn the supply cylinder over (valve up for vapor) or more simply, slowly open low side manifold valve, do not allow suction pressure to rise too rapidly and no more than 40 to 50 psi. Adding refrigerant gradually prevents the possibility of "liquid slugging damage" to compressor. Allow sufficient time for the system to stabilize after each adjustment. Normally five to ten minutes is sufficient for each two tenth (0.2 Lbs=3.2 oz) added incrementally. Check and record performance in chart form for each add to keep track and confirm final total.

Any time the cause is not known for head pressure in an elevated range, then the system should be thoroughly checked for any other problem. In this rare case that charge needs adjusting down, then the system is turned off for vapor recover following machine instructions. It would be possible to weigh the recovery tank and observe the amount transferred. The alternative is to perform short intervals of recovery with system on performance checks each time.

COMPRESSOR REPLACEMENT

Normally a compressor is not to be replaced unless it is not pumping the suction side down or is locked up. Do not mistakenly replace a compressor when in fact the system is over or under charged. The high side pressure may not raise if the system has a flow blockage or restriction. A lack of flow will prevent the working fluid (refrigerant) energy transfer that results in high side pressure.

THERE IS ONE FAULT THAT MAY BE MISDIAGNOSED AS A BAD COMPRESSOR, AND THAT IS IF THE EXPANSION VALVE IS STUCK OPEN OR PARTIALLY OPEN! IN THIS EVENT, THE SUCTION PRESSURE WILL BE HIGHER THAN NORMAL AND THE HEAD PRESSURE WILL BE BELOW NORMAL. **See the following section REPLACING TXV Block Valve - Defective valve diagnosis.**

Two other indicators of poor compressor performance include rapid pressure equalization when turned off and an inability to pull a vacuum if the suction hose were pinched off (this old procedure is not recommended as liner of hose may be damaged).

Compressors may be one of four basic types, regardless they are all designed as vapor pumps. As such it should transfer enough refrigerant to lower suction pressure to below 40 psi when properly sized to system and turned at road speed RPM.

A noisy compressor that still pumps “well”, may just need a oil level service or removal oil level check. (See trouble shooting for other possible noise related problems.) Use an oil injector to **slowly** add several oz of oil into suction port, up to 50% of OEM charge for compressor model. If “removal checked” and the compressor is oil "dry" but clean, add recovered amount plus 50% of OEM charge back into suction port and follow all appropriate procedures to recharge.

If the compressor is inoperative and the system still has refrigerant pressure, recover the refrigerant with approved machine. Record amount of oil collected.

Remove compressor and drain oil into measuring cup. Examine oil, if the compressor broke and locked up right away, then oil will likely appear mostly clean and perhaps with some small metal particles. In this case a nitrogen back flush of condenser and hose from compressor is still recommended. The receiver drier should have collected any other debris.

If however the oil appears black or dirty, then all the system components should be individually nitrogen "back flushed" (reverse direction to regular flow) first. (Solvent flush may also be used to back flush and will often dislodge particles oil stuck in the condenser, then the trick is to fully remove the solvent with nitrogen. Carefully follow instructions provided with these types of products.) The only proper way to final flush the system is to use refrigerant in a closed loop system. Closed loop flushing kits are available, and some recovery/recycle machines have "flush kit" options.

If the system was judged to be acceptably clean, then drain new compressor and add back the amount drained from old compressor or 50% of OEM oil charge whichever is greater plus amount collected in recovery machine.

If system was flushed and the receiver drier is the only other component being replaced, then check OEM charge amount and add oil to compressor to achieve total amount listed on data plate.

Oil is to be poured into compressor suction port.

Remove both caps from ports of compressor, verify that compressor is indeed "pre-oil charged", rebuilt compressors are often shipped dry. Add correct amount of oil. By hand turn the compressor clutch drive plate at least ten times to distribute oil inside compressor. and assure that it is not overfilled. Install new o-ring and reconnect suction fitting. Again turn compressor by hand to assure oil distribution. Remove and replace receiver drier replacing all o-rings (lubricated with mineral oil). Evacuate and recharge per proceeding sections.

ADDING OIL WHEN COMPONENT IS REPLACED. (when reusing same compressor)

THIS IS PERHAPS THE MOST DIFFICULT DECISION FACED BY THE SERVICE TECHNICIAN
Research has proven that too much oil in a system will degrade the performance, but a system without enough oil will likely have a premature compressor failure.

The first thing that makes sense is that any time a major component is replaced then oil should be added to make up for the loss. Consider refrigerant as a major component.

During recovery/removal of R-134a from the system, oil in mixture is also removed. Refer to specific machine instructions regarding oil collection. It is often noticed that the oil collected and then drained from machine foams up as the refrigerant in solution is exposed to less pressure. Allowing time for correct and accurate measurement of oil removed is vital. Complete drainage of machine collecting system may require repeated attempts. Some machines have an internal recycle mode that may need to be performed to completely separate the oil from the recovered refrigerant.

Adding back new oil to replace that amount of oil collected in the recovery process initially seams quite obvious. Normally with a system whose known service history is simple and for routine service, like TXV replacement or leaking o-ring replacement, that is the best assumption.

For condenser, evaporator, and hose replacement, determining or estimating the correct amount of oil to be added back for these components could follow these guidelines;

1) Check the data plate for total amount listed for the system. (Bus system is typically 5 to 8 oz more than the compressor OEM charge.) Fill in blank at right with amount. _____
2) Subtract the amount recovery collected. -_____

3) Remove the compressor and drain it, Again subtract this amount. -_____
THIS REMAINDER REPRESENTS THE MISSING OIL THAT IS DISTRIBUTED =~T____
THOUGH OUT THE SYSTEM IN FILM FORM ON INTERIOR SURFACES.

4) Add up the total internal volume, the Figure out the percentage of internal wetted volume that the replaced component contributed to the total wetted volume and add the drier percentage as it will also be replaced.

Work Sheet: Percentage of internal wetted volume for replaced components.

Model CS1	Condenser	#11.2 =____	[Fill in blank with # for each item used
Model CS2	Condenser	#22.3 =____	in the actual system. Use filled in #s for
Model CS3	Condenser	#15.5 =____	vertical Addition to get #Total at bottom.]
Model CS4	Condenser	#12.3 =____	If condenser is being replaced, then
Model CS5	Condenser	#15.5 =____	after Total is added, get @Decimal-
Model CS6		#14.0=_____	(Percent) for Cond.# **/** #Total=@ **.**___
Model EF1, EF2, EF3	Evaporator	#14.3 =____	
Model EF4	Evaporator	#10.0 =____	If Evap is being replaced, then
2nd Evaporator (add to total volume)		=____	after Total is added, get @Decimal
			Evap. # Divided by #Total =@ **.**___
2nd Evap: Extra hose for liquid, use info below)		=____	
2nd Evap: Extra hose for suction, use info below)		=____	
Hose for liquid (Cond to Receiver-Drier & TXV)			After Total is added, get Decimal
#6 Hose 13/32"	0.104 x length ____ft	=#____	for any hose that is replaced
or #8 Hose 1/2"	0.131 x length ____ft	=#____	hfl# divided by #Total =@ **.**___
Hose for discharge (Comp to Cond)			
#8 Hose 1/2"	0.131 x length ____ft	=#____	hfd# divided by #Total =@ **.**___
or #10 Hose 5/8"	0.163 x length ____ft	=#____	
Hose for Suction (Evap to Comp)			hfs# divided by #Total =@ .___
#10 Hose 5/8"	0.163 x length ____ft	=#____	
or #12 Hose 7/8"	0.229 x length ____ft	=#____	
Receiver Drier	2.6	=+2.6	R/D #(2.6)**/** #Total=(@ **.**___)

Add # for each component that is in the system for #Total____ [Add all vertically from above]

4-)cont. Figure out the Decimal for any component(s) being replaced ADD to the Decimal for the receiver drier (as it will always be changed).@ **.**___+@ **.**____+@ **.**____+(@ **.**____) = ^Total **.**____

5-)Multiply step 4)^Total by step 3)~Total for final amount oil missing. ^T____**x** ~T____oz=____oz

6-)Add step 5) amount to 2) recovered amount plus 3)amount drained from compressor.

5) ____ oz + 2) _____ oz + 3) _____ oz = _____oz { -_____=_____}

Final Answer Total 6) This is the system total calculated amount of new oil required.

{ If also replacing compressor, Note that a new compressor has oil in it and thus, subtract OEM charge from the total calculated and this is the final add amount.}

As you can clearly see, this could really be a complicated situation and would require close attention to all the math in the above calculations. **So the simplified recommendation for typical bus installation is to add back all the recovered oil plus amount(s) listed below for each component that is being replaced.**

Hose(s) #6 0.05oz per ft, #8 0.063oz/ft, #10 0.078oz/ft, #12 0.11oz/ft			_____
Model EF1, EF2, EF3	Evaporator coil	1.5 oz/45cc	_____
Model EF4 Evaporator coil		1.1 oz/33cc	_____
Model CS1 Condenser		2.0 oz/60cc	_____
Model CS2 Condenser		3.5 oz/100cc	_____
Model CS3, & CS5 Condenser		2.5 oz/75cc	_____
Model CS4, & CS6 Condenser		1.75 oz/50cc	_____
Receiver Drier		0.5 oz/15cc	+ 0.5 oz / 15 cc
Recovered amount			+_____
		TOTAL	=_____

Total amount to be poured into compressor suction port, not the component!

Disconnect the suction fitting at the compressor, add calculated amount of oil back to system, by hand turn the compressor clutch drive plate at least ten times to distribute oil inside

compressor. and assure that it is not overfilled. Install new o-ring and reconnect suction fitting. Again turn compressor by hand to assure oil distribution. Remove and replace receiver drier replacing all o-rings (lubricated with mineral oil). Evacuate and recharge per proceeding sections.

COMPRESSOR OEM OIL AMOUNTS LIST

Model	BRAND/OIL TYPE (Viscosity)	OEM AMOUNT
A-6	DELCO 15-118/PAG (150)	295cc / 10oz
SD 510	SANDEN SP 20/PAG (100)	150cc / 5.1oz
SD 709	SANDEN SP 20/PAG (100)	150cc / 5.1oz
SD 7H15	SANDEN SP 20/PAG (100)	135cc / 4.56oz
TM 16HD	1L PAG-ZXL 100/PAG (46)	150cc / 5.1oz
TM 21HX	1L PAG-ZXL 100/PAG (46)	180cc / 6.1oz
TM26 (NLA)	1L PAG-ZXL 100/PAG (46)	500cc / 16.9oz
TM 31HD	1L PAG-ZXL 100/PAG (46)	500cc / 16.9oz
UP/UX170	UNIDAP 7/PAG (46)	160cc / 5.4oz
UP/UX200	UNIDAP 7/PAG (46)	180cc / 6.1oz
UX 260	UNIDAP 7/PAG (46)	500cc / 16.9oz
UX 310	UNIDAP 7/PAG (46)	600cc / 20.3oz

Note: PAG oil is very hydroscopic (absorbs water), DO NOT use oil from previously open containers. Both Polyalkylene Glycol (PAG) and Poly Ester (POE) oil will pull moisture right out of the air. Moisture causes a chemical reaction which creates ACID. Evacuation will not remove the moisture and will not reverse the chemical process. KEEP COMPRESSOR CAPPED UNTIL READY TO CONNECT TO LINES AND INSTALL NEW RECEIVER DRIER, BEGIN EVACUATION ASAP.

REPLACING RECEIVER DRIER

The receiver drier (w/filter) is located at the condenser. Recover refrigerant following procedure above. Have new component and o-rings at hand to limit open system exposure time. Carefully loosen fitting connections. Remove and replace receiver drier replacing all o-rings (lubricated with mineral oil). Receiver Drier Add .5 oz of correct oil plus recovered amount.

REPLACING HIGH PRESSURE SWITCH

This component may be on a fitting at the condenser or "spliced in" on the liquid supply hose after the condenser before the TXV. With system still pressurized, check for continuity. The switch is depressing a schrader valve and may be replaced with out dropping the refrigerant charge. The switch may be checked with a special setup of a schrader valve to the nitrogen regulator. Spec. for P/N 29-30123 Dual Switch: Open until approximately 28psi, closed until 400psi +/-40psi.

REPLACING TXV (Thermostatic Expansion Valve)
SPECIFIC CAUTION: Do not allow oils to drip into or on plastic drain pan or any plastic part of these systems as material will absorb it and become brittle and prone to crack.

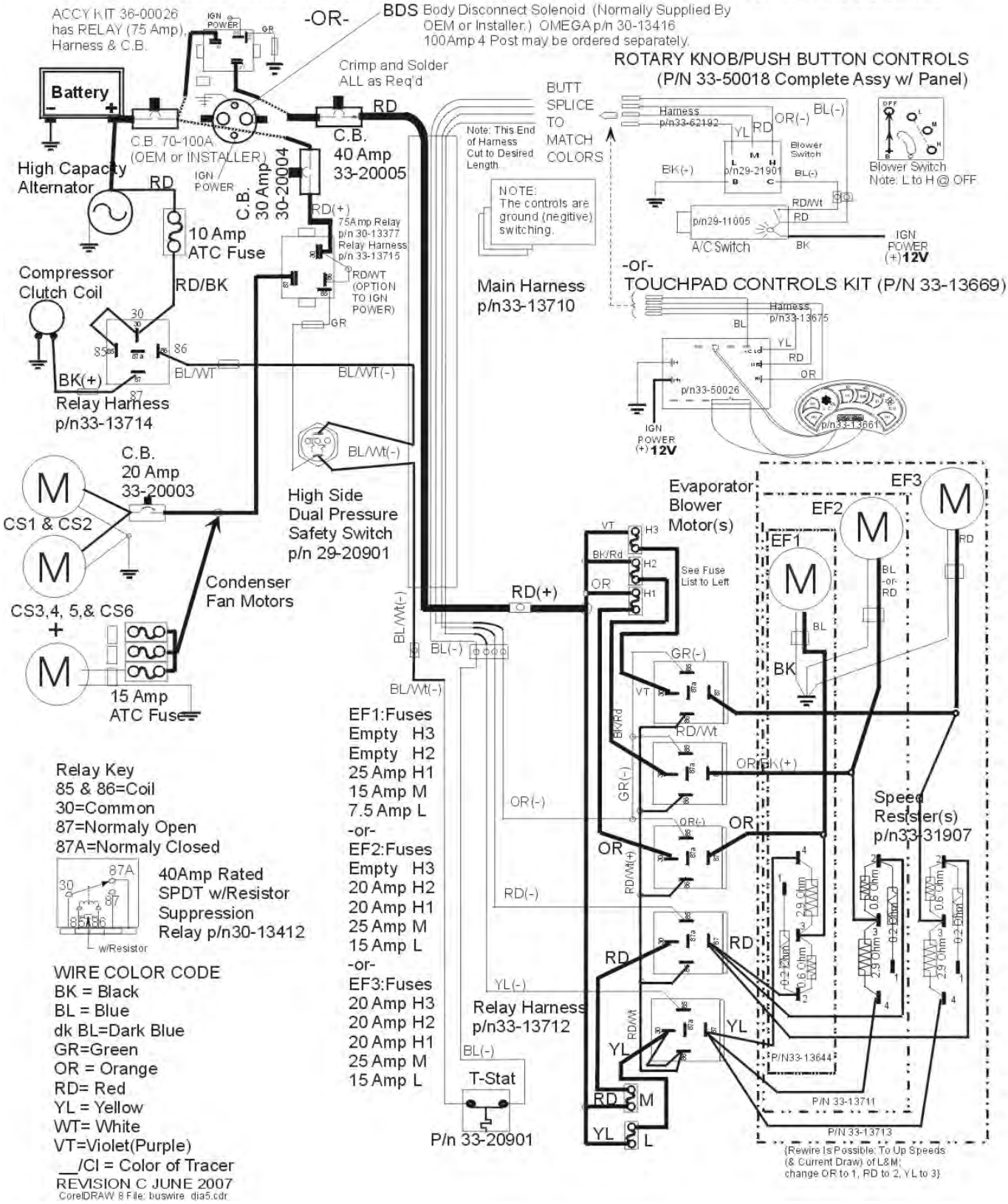
The block valve is located at the evaporator coil. Unit cover must be removed and valve should be diagnosed as needing replacement before proceeding. **Defective valve diagnosis:** First make a temporary blower "close off" out of cardboard to draw air through evaporator coil and tape in place. Operate system on low blower and hand warm the (bare) disc head of the valve while observing (may require an assistant) the gauge set. The suction pressure should raise as the valve opens up, discontinue warming immediately to prevent liquid slugging the compressor. Next operate the system on high and cool the (bare) disc head (cooling the head may be accomplished by spraying the head with nitrogen, evaporator deodorizer aerosol or applying ice) observing the gauge set. The suction pressure should drop as the valve closes, discontinue head cooling immediately to prevent system from operating below ten psi as this will starve the compressor of return oil and possible overheat with out the refrigerant vapor cooling effect. If the valve responded then perhaps it is not the problem after all. Having exercised the valve, observe system operation after system has stabilized. If the valve did not respond then it should be replaced. Recover refrigerant. Have new component and o-rings at hand to limit open system exposure

time. Carefully loosen all fitting connections. Remove and replace valve replacing all o-rings (lubricated with mineral oil). Reproduce any insulation that was on original valve and fittings.

END

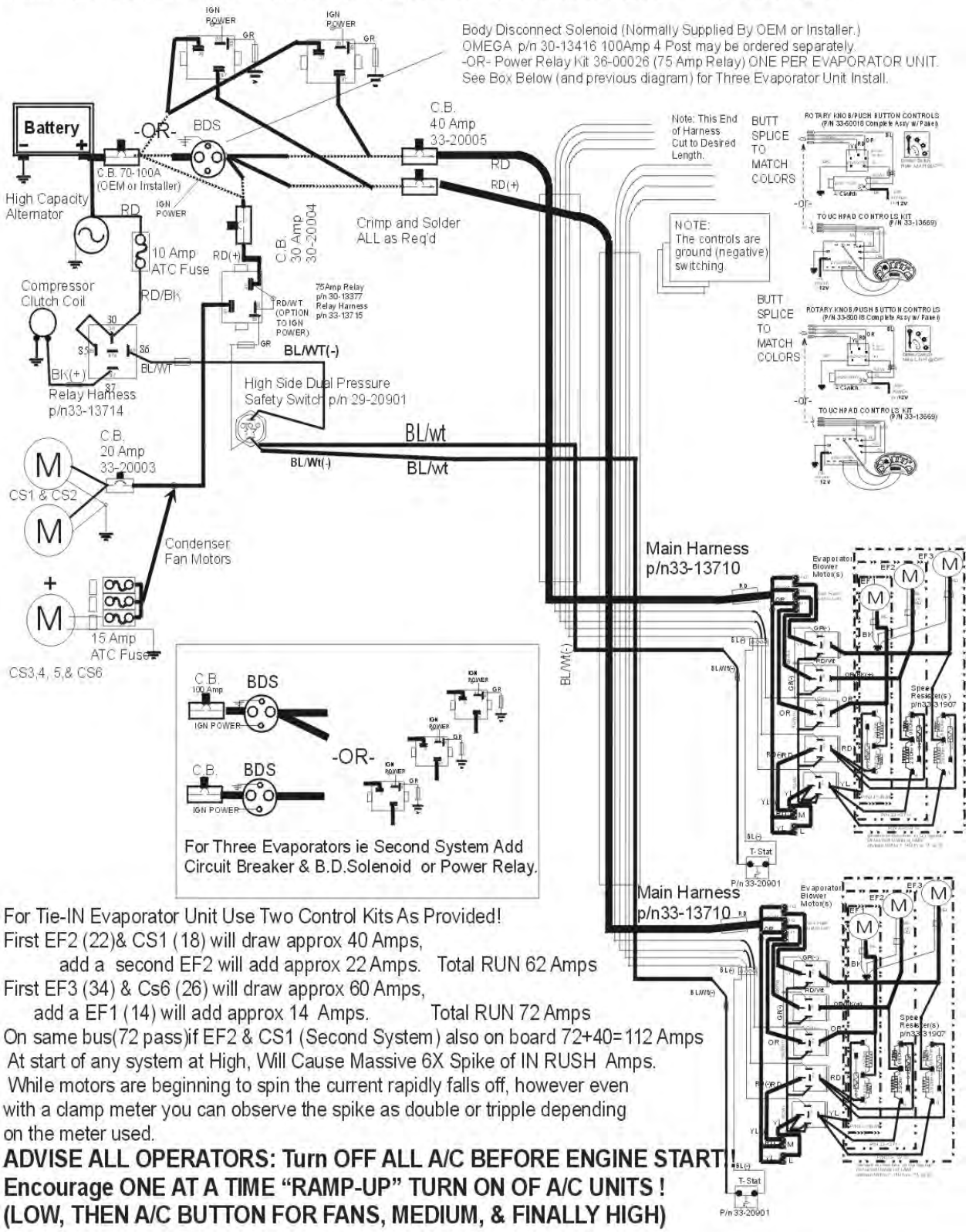
"RECOMMENDED"* ELECTRICAL WIRING DIAGRAM MODELS EF1C, EF2C,&EF3C

*SYSTEMS ARE AFTERMARKET INSTALLED & INSTALLER OPTIONS SHOULD FOLLOW THESE GUIDELINES



"RECOMMENDED*" SECOND UNIT TIE-IN WITH ONE COMPRESSOR

*SYSTEMS ARE AFTERMARKET INSTALLED & INSTALLER OPTIONS SHOULD FOLLOW THESE GUIDELINES



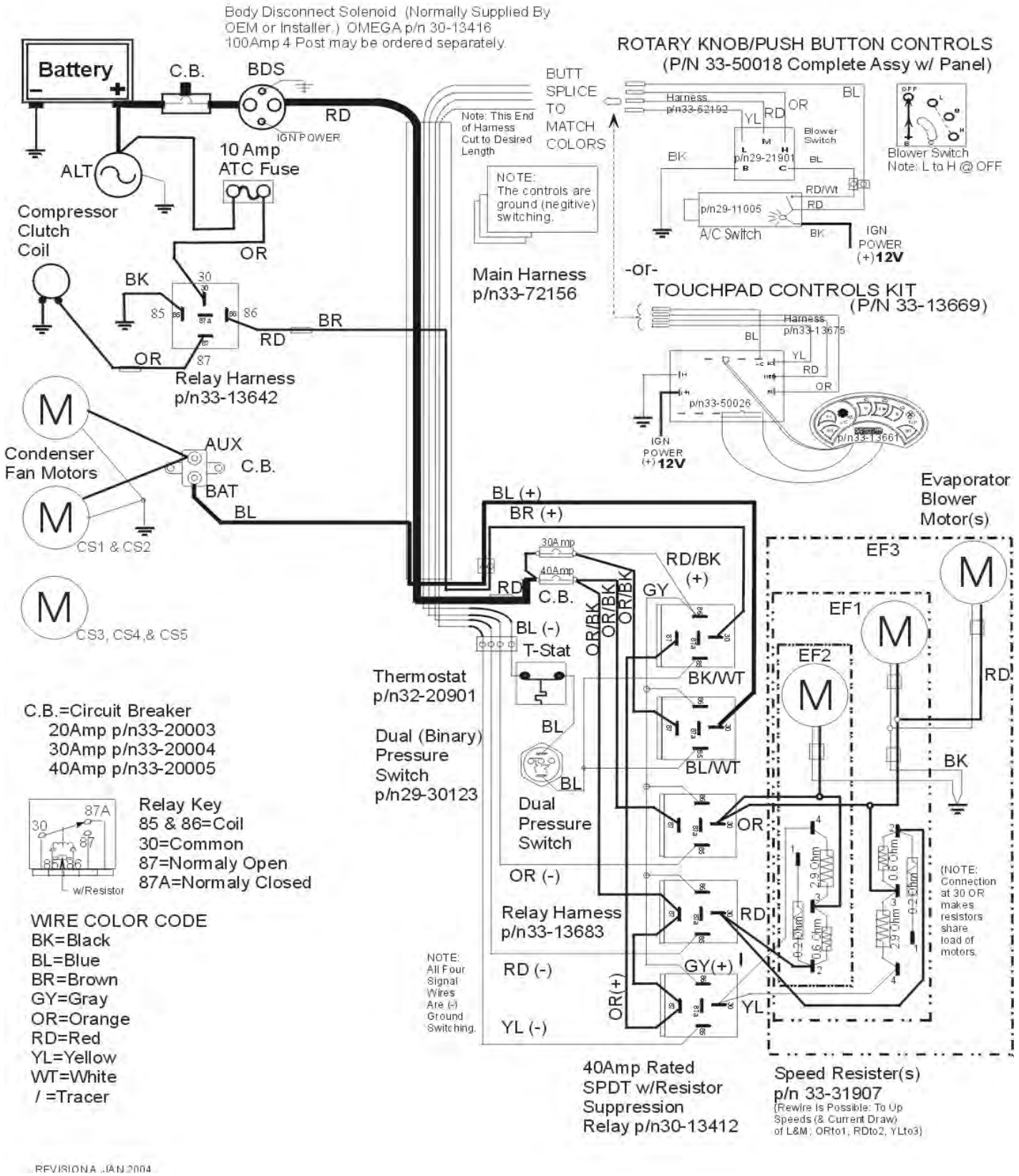
For Tie-IN Evaporator Unit Use Two Control Kits As Provided!
First EF2 (22)& CS1 (18) will draw approx 40 Amps,
add a second EF2 will add approx 22 Amps. Total RUN 62 Amps
First EF3 (34) & Cs6 (26) will draw approx 60 Amps,
add a EF1 (14) will add approx 14 Amps. Total RUN 72 Amps
On same bus(72 pass)if EF2 & CS1 (Second System) also on board 72+40=112 Amps
At start of any system at High, Will Cause Massive 6X Spike of IN RUSH Amps.
While motors are beginning to spin the current rapidly falls off, however even with a clamp meter you can observe the spike as double or tripple depending on the meter used.

ADVISE ALL OPERATORS: Turn OFF ALL A/C BEFORE ENGINE START!
Encourage ONE AT A TIME "RAMP-UP" TURN ON OF A/C UNITS !
(LOW, THEN A/C BUTTON FOR FANS, MEDIUM, & FINALLY HIGH)

REVISION C JUNE 2007 Approx = Actual Results Will Depend on Bus Alternator and Voltage Regulator Ability to Sustain Voltage.

OLDER UNITS (Included for Service Reference)

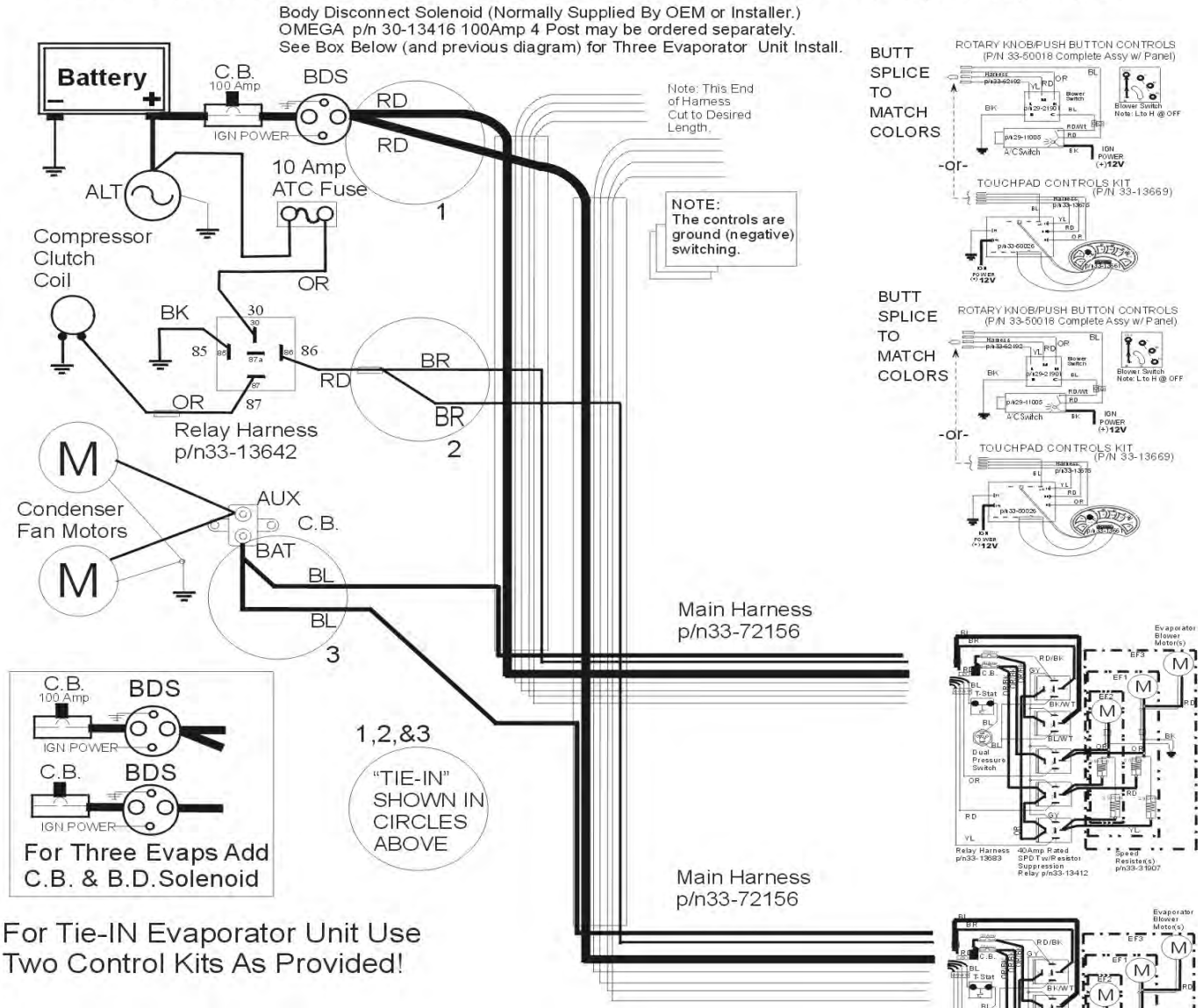
ELECTRICAL WIRING DIAGRAM MODELS EF1, EF2,&EF3



REVISION A JAN 2004

OLDER UNITS (included for service reference)

SECOND UNIT TIE-IN WITH ONE COMPRESSOR
ELECTRICAL WIRING DIAGRAM MODELS EF1, EF2,&EF3



For Tie-IN Evaporator Unit Use
Two Control Kits As Provided!

First EF1 & CS1 will draw approx 38 Amps,
second EF1 will add approx 22 Amps.
Total 60
First EF3 & CS1 will draw approx 55 Amps,
second EF3 will add approx 34 Amps.
Total 89
Rapid Start of first system alone to High, Will Cause Spike of 65+Amps.
Encourage "ONE AT A TIME-RAMP (L-A/C-M-H) START UP"!!!!!

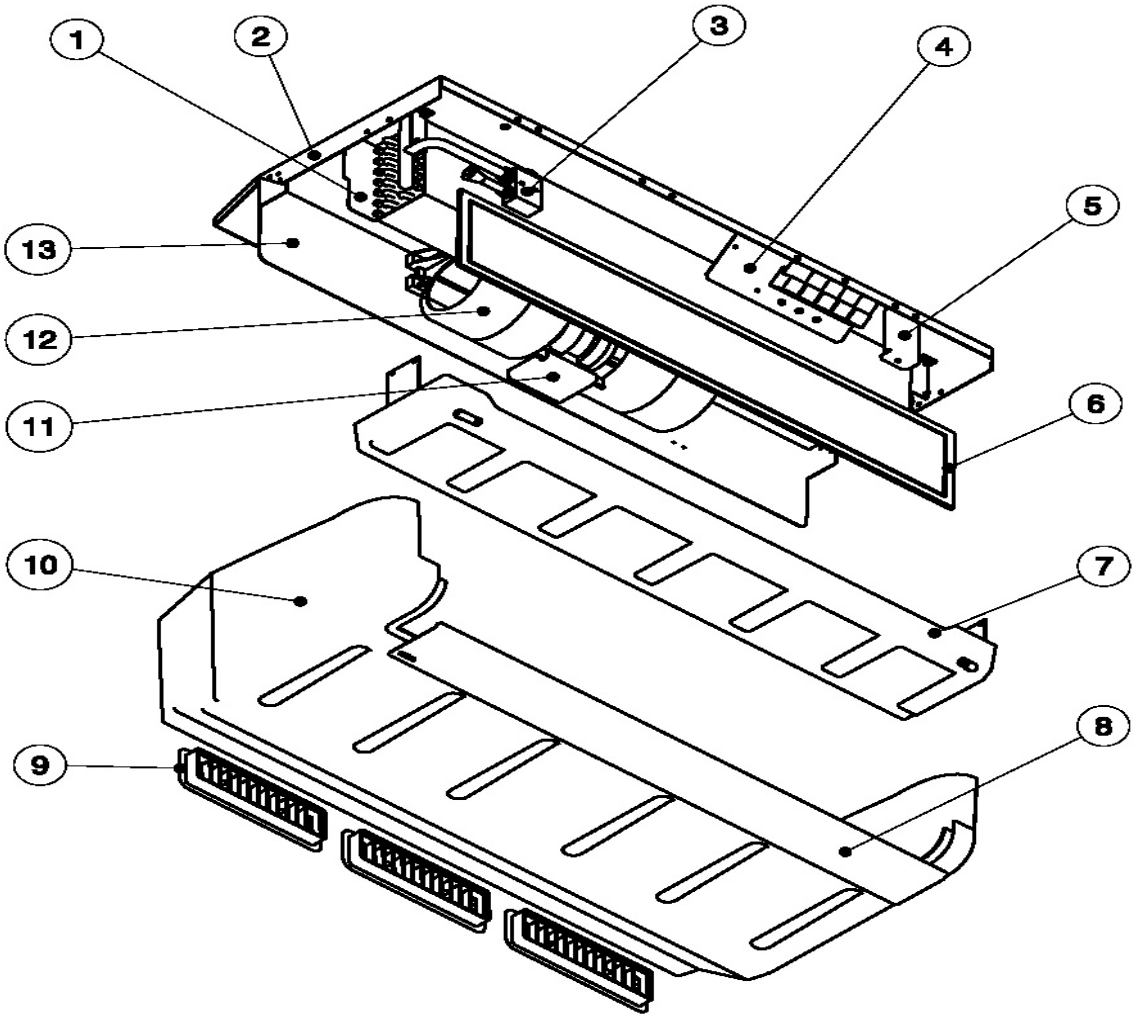
Approx = Actual Results Will Depend on Bus Alternator and Voltage Regulator Ability to Sustain Voltage.

REVISION A JAN 2004

BY MODEL - ILLUSTRATED PARTS LIST

Single Dual Blower 22" x 41"

MODEL EF1



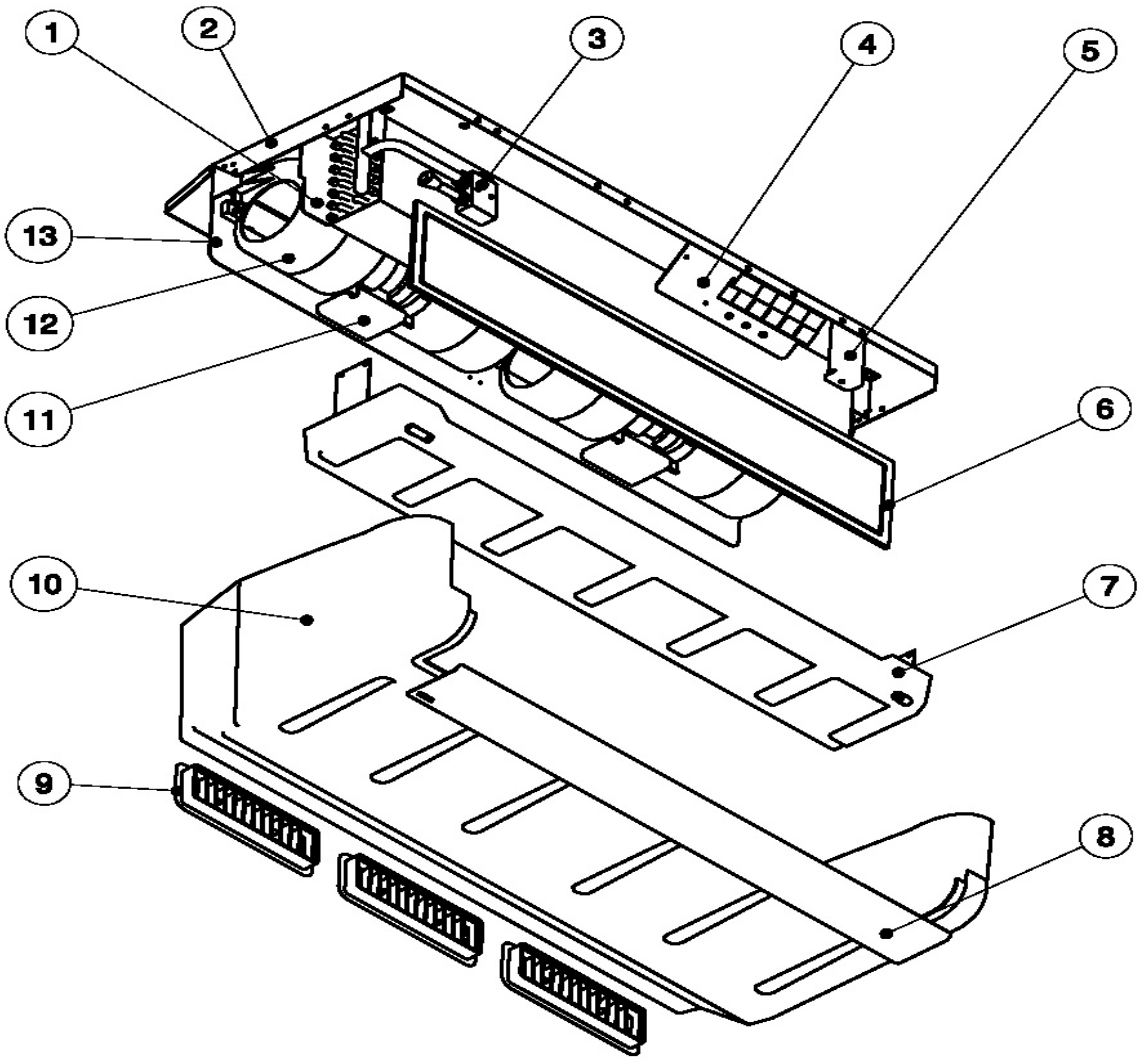
MODEL EF1 EVAPORATOR, ONE DUAL BLOWER

ITEM	P/N	DESCRIPTION	QTY.
1A	27-19503	EVAPORATOR COIL	1
1B	40-32429	VOLARA TAPE 1/8 X 2	6.85 FT
1C	40-32423	FOAM TAPE 1/2 X 3/4	1.5 FT
1D	40-32436	TAPE VOLARA 1/8 X 1/2	1.2 FT
2	40-42910*	TOP TRAY FOR BUS UNIT	1
3	31-30902	EXP VALVE, BLOCK 2-1/2 TON (EF2 or EF3 single)	1
3 (opt)	(31-30927)**	EXP VLV, BLOCK 2 TON (EF1 single, EF2 or EF3 tee in)	
3 (opt)	(31-30957)**	EXP VLV, BLOCK 1-1/2 TON (EF1 tee in)	
4A	40-40123*	BRACKET, RELAY MOUNTING	1
		-Electrical Components Are On Wiring Diagram-	
6	40-32502	AIR FILTER ASSY	1
7	28-41400	DRAIN PAN ASSY (W/BRKTS, FOAM COVER & PORTS)	1
8	40-41520	FRESH AIR RETURN GRILL METAL	1
9	28-94107	EURO LOUVER 3.82" X 10.11"	3
10	28-41520	SHROUD, MAIN COVER 3 LOUVER	1
11	40-43053	BRACKET, BLOWER SUPPORT	1
12	26-19912	BLOWER, DUAL SCROLL 12V (Complete Assy)	1
13	40-42840-A	WALL FOR SINGLE MOUNT MOTOR	1

*4/19/05 ** 10/10/07

Two Dual Blowers 22" x 41"

MODEL EF2



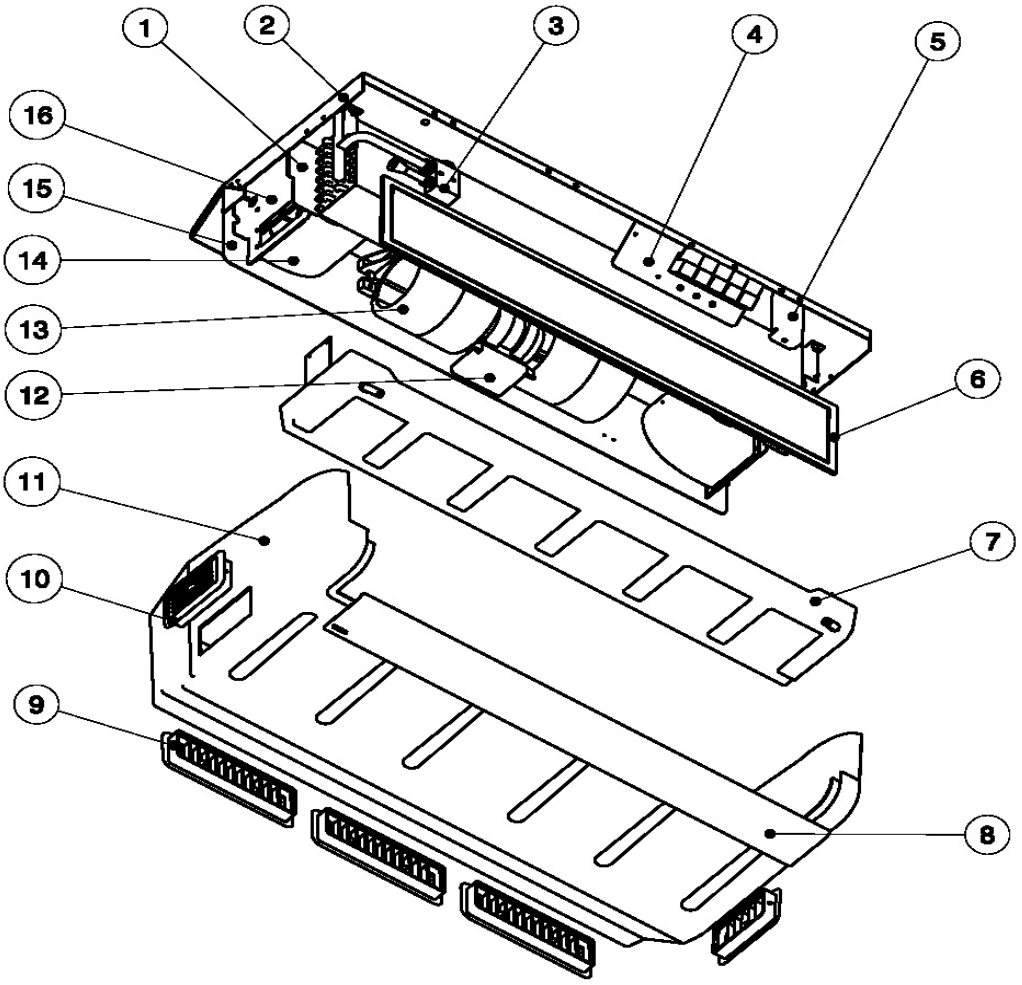
MODEL EF2 EVAPORATOR, TWO DUAL BLWRS

ITEM	P/N	DESCRIPTION	QTY.
1A	27-19503	EVAPORATOR COIL	1
1B	40-32429	VOLARA TAPE 1/8 X 2	6.85 FT
1C	40-32423	FOAM TAPE 1/2 X 3/4	1.5 FT
1D	40-32436	TAPE VOLARA 1/8 X 1/2	1.2 FT
2	40-42910*	TOP TRAY FOR BUS UNIT	1
3	31-30902	EXP VALVE, BLOCK 2-1/2 TON	1
3 (opt)	(31-30927)**	EXP VLV, BLOCK 2 TON (EF1 single, EF2 or EF3 tee in)	
3(opt)	(31-30957)**	EXP VLV. BLOCK 1-1/2 TON (EF1 tee in)	
4	40-40123*	BRACKET, RELAY MOUNTING	1
		-Electrical Components Are On Wiring Diagram-	
6	40-32502	AIR FILTER ASSY	1
7	28-41400	ASSY, DRAIN PAN W/BRKTS, FOAM COVER & PORTS	1
8	40-41520	FRESH AIR RETURN GRILL METAL	1
9	28-94107	EURO LOUVER 3.82" X 10.11"	3
10	28-41520	SHROUD, MAIN COVER 3 LOUVER	1
11	40-43053	BRACKET, BLOWER SUPPORT	2
12	26-19912	BLOWER, DUAL SCROLL 12V (Complete Assy)	2
13	40-42911*	WALL DUAL BLOWER MOUNTING	1

*4/19/05 ** 10/10/07

'Drivers Pack", Two End Blowers and Dual Center Blower 22" x 41"

MODEL EF3

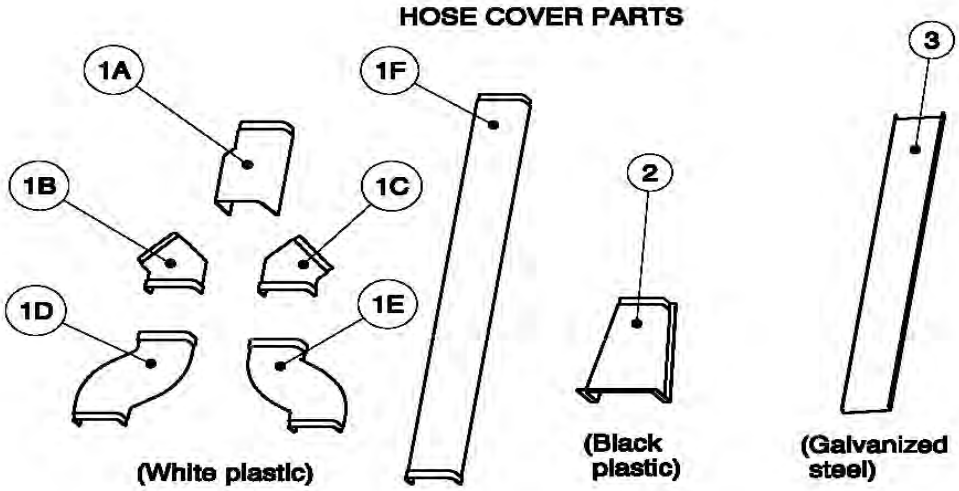


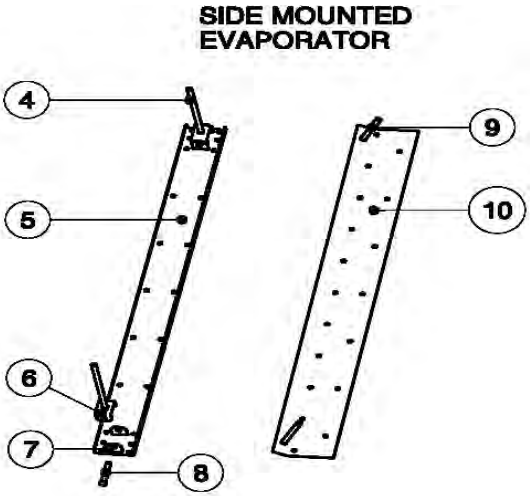
MODEL EF3 EVAPORATOR, DUAL WITH DRIVERS PKG

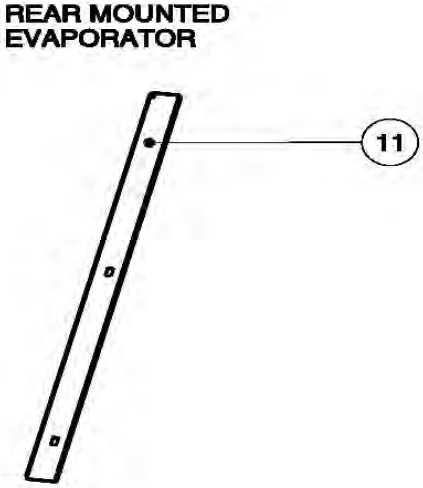
ITEM	P/N	DESCRIPTION	QTY. REQ'D
1A	27-19503	EVAPORATOR COIL	1
1B	40-32429	VOLARA TAPE 1/8 X 2	6.85 FT
1C	40-32423	FOAM TAPE 1/2 X 3/4	1.5 FT
1D	40-32436	TAPE VOLARA 1/8 X 1/2	1.2 FT
2	40-42910*	TOP TRAY FOR BUS UNIT	1
3	31-30902	EXP VALVE, BLOCK 2-1/2 TON	1
3 (opt)	(31-30927)**	EXP VLV, BLOCK 2 TON (EF1 single, EF2 or EF3 tee in)	
3 (opt)	(31-30957)**	EXP VLV, BLOCK 1-1/2 TON (EF1 tee in)	
4	40-40123*	BRACKET, RELAY MOUNTING	1
		Electrical Components Are On Wiring Diagram	1
6	40-32502	AIR FILTER ASSY	1
7	28-41400	ASSY, DRAIN PAN W/ BRKTS, FOAM COVER & PORTS	1
8	40-41520	FRESH AIR RETURN GRILL METAL	3
9	28-94107	EURO LOUVER 3.82" x 10.11"	2
10	28-94110	EURO LOUVER 3.82" x 5.64"	1
11	28-41526	SHROUD, MAIN COVER 5 LOUVER	1
12	40-43053	BRACKET, BLOWER SUPPORT	1
13	26-19912	BLOWER, DUAL SCROLL 12V (Complete Assy)	1
14	26-19953	BLOWER, SINGLE SCROLL 12V (Complete Assy)	2
15	40-42840-A	WALL FOR SINGLE MOUNT MOTOR	1
16	40-42858*	BRKT AUX MOTOR BUS DVRS PKG	(2)*
		*Replaced by 40-40124 with key slot for wires	1
		*and 40-40125 w/o key slot	1
		*40-40126 Brkt with studs for Blwr Mtg	4

*4/19/05 ** 10/10/07

INSTALLATION ACCESSORIES



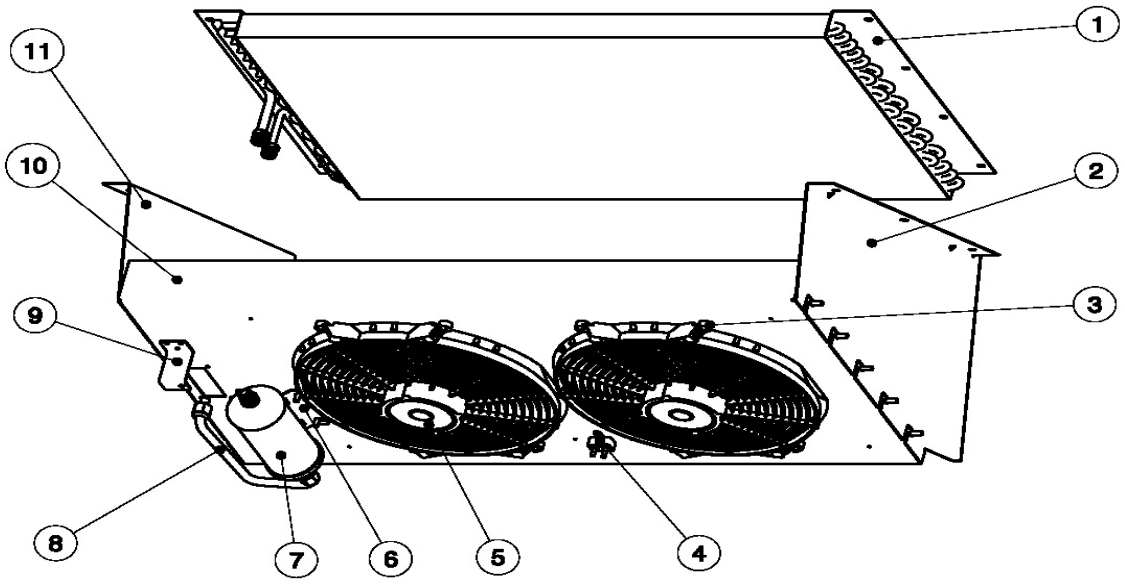




EVAPORATOR INSTALLATION

ITEM	P/N	DESCRIPTION	QTY. REQ'D
1	28-41521	HOSE COVER SET, 6 WHITE PIECES	1 SET
1A	{part of set}	COVER, EVAP. ADAPTER	{1}
1B	{part of set}	COVER, RIGHT 45 DEG ADAPTER	{1 optional use}
1C	{part of set}	COVER, LEFT 45 DEG ADAPTER	{1 optional use}
1D	{part of set}	COVER, LEFT DIR CHANNEL	{1 optional use}
1E	{part of set}	COVER, RIGHT DIR CHANNEL	{1 optional use}
1F	{part of set}	COVER, STRAIGHT 40" X 4" X 2.5"	{1}
2	28-51524	COVER, FLOOR BOOT BLACK	1
NS	**28-71713****	FLOOR GROMMET 3" PLASTIC	1
3	40-42836	SUPPORT BRACKET FOR BUS HOSE COVER	1
SIDE MOUNTED EVAPORATOR, Front Bracket Components AISLE			
4	40-42827	BRKT, FREEBLOW SIDE WALL (FRONT)	1
5	40-42814	BRACKET RAIL LINK "B"	2
6	40-62839	CLEVIS PIN 5/16" X 1.875	2
not shown	40-62845	COTTER KEY .079 DIA (USED W/ CLEVIS PIN 40-62839)	1
7	40-42851	BOLT, CARRIAGE 5/16"-18 X 6"	2
8	40-42813	BRACKET RAIL LINK "A"	2
not shown	40-62813	FLAT WASHER, 10mm	2
not shown	40-62849	WASHER FLAT 5/16 FLAT SAE	2
not shown	40-62850-K	NUT KEPS 5/16"-18 Hex	6
		Rear Bracket Components SIDE	
9	40-67057*	BOLT, CARRIAGE 3/8"-16 X 1-1/2"	4
10	40-42909*	BRKT, RAIL FREEBLOW SIDE MNT (REAR)	1
not shown	40-67058*	FLAT WASHER, ½"	4
not shown	40-67036*	FLAT WASHER, 3/8" SAE	4
not shown	40-67037*	NUT KEPS, 3/8"-16 Hex	8
REAR MOUNTED EVAPORATOR			
9	40-62846	BOLT, CARRIAGE 5/16"-18 X 3"	4
11	40-42838	BRKT, REAR HD SUPPORT LONG	2
not shown	40-62813	FLAT WASHER, 10mm	4
not shown	40-62849	FLAT WASHER 5/16" SAE	4
not shown	40-62850-K	NUT KEPS, 5/16"-18 Hex	6
Misc.		NOTE: ELECTRICAL, SEE WIRING DIAGRAM	
	29-21901	Knob, Fan (for Rotary Blower Switch Control)	1
	40-52701	Clamp, 1" Rubber Dipped (Use for Main Wire Harness)	16
	40-32477	Edge Trim Seal 5/8" Rubber (By the Foot)	8.33 Ft
	40-03501-25	Std. # 6 O-Ring HNBR Green (By the 25 each package)	A/R
	40-03502-25	Std. # 8 O-Ring HNBR Green (By the 25 each package)	A/R
	40-03503-25	Std. # 10 O-Ring HNBR Green (By the 25 each package)	A/R
	40-03504-25	Std. # 12 O-Ring HNBR Green (By the 25 each package)	A/R
		O-Ring for Flare Fitting Drier (Packaged with new drier.)	
	28-71704-M	Drain Tee 1/2'	1
	34-32401	Drain Hose 1/2" 1/16" wall	8 Ft
	40-20804	Drain clamp 1/2" White Reusable	3
	28-71713	Grommet, Floor Hose 3" Plastic	1
	40-02506	Tie Wrap 14" (Sold By 1000 per package)	50ea
		*4/19/05 **9/12/06	

MODEL CS1

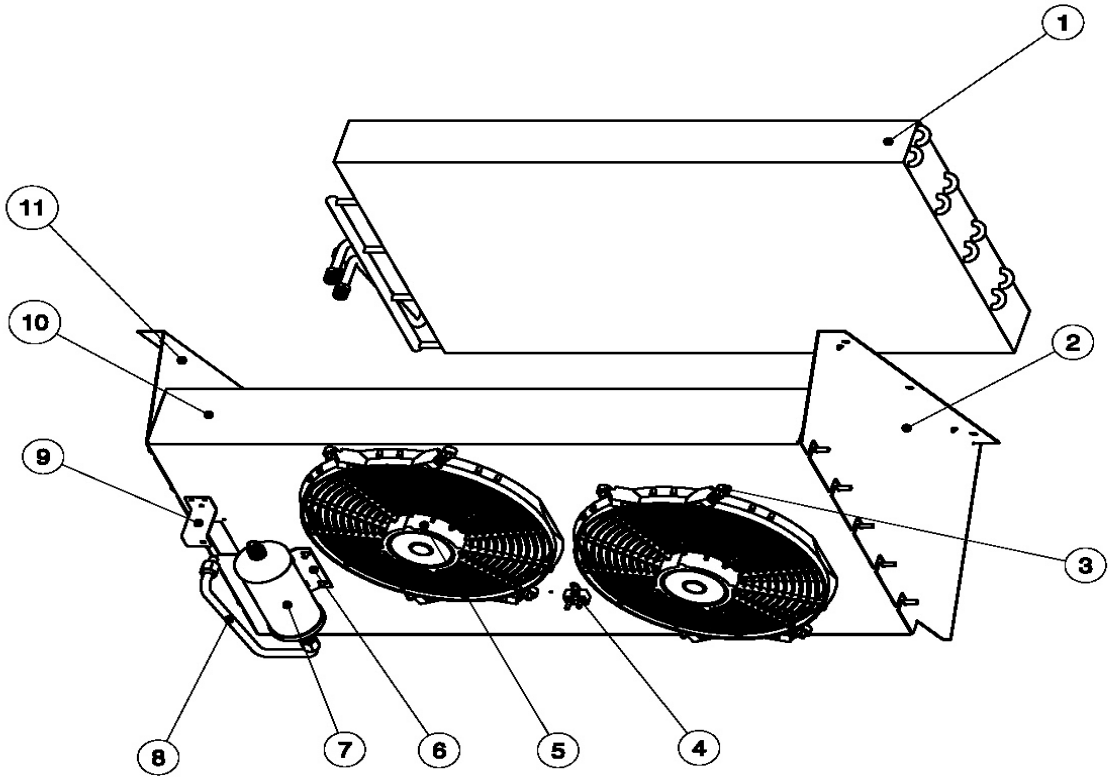


MODEL CS1 CONDENSER, 2-FAN 14" 2-ROW COND

ITEM	P/N	DESCRIPTION	QTY. REQ'D
1	24-30006	CONDENSER BUS 20" X 34" MIO	1
2	40-40127*	BRACKET, CONDENSER END #1 LEFT	1
3	28-00003	FLUSH MOUNTS FOR FANS 90 DEG	8
4	33-20004	CIRCUIT BREAKER 30 AMP	1
5	25-14854-D	FAN 14" 12V PULLER W/WATER RESISTANT HP MTR	2
6	40-42830	DRIER BRKT "M" FOR 24-30105	1
7	**37-10860**	**DRIER, INLINE FILTER** (w/o Sight Glass)	1
8	35-13403*	HARD LINE, COND TO DRIER CEU (picture wrong)	1
9	40-42837	BRKT CONDENSER HARD LINE SUPPORT	1
10	40-42828	CONDENSER SHROUD	1
11	40-40128*	BRACKET, CONDENSER END #2 RIGHT	1
not shown	28-42831	PLASTIC COVER BUS CONDENSER	1

*4/19/05

MODEL CS2

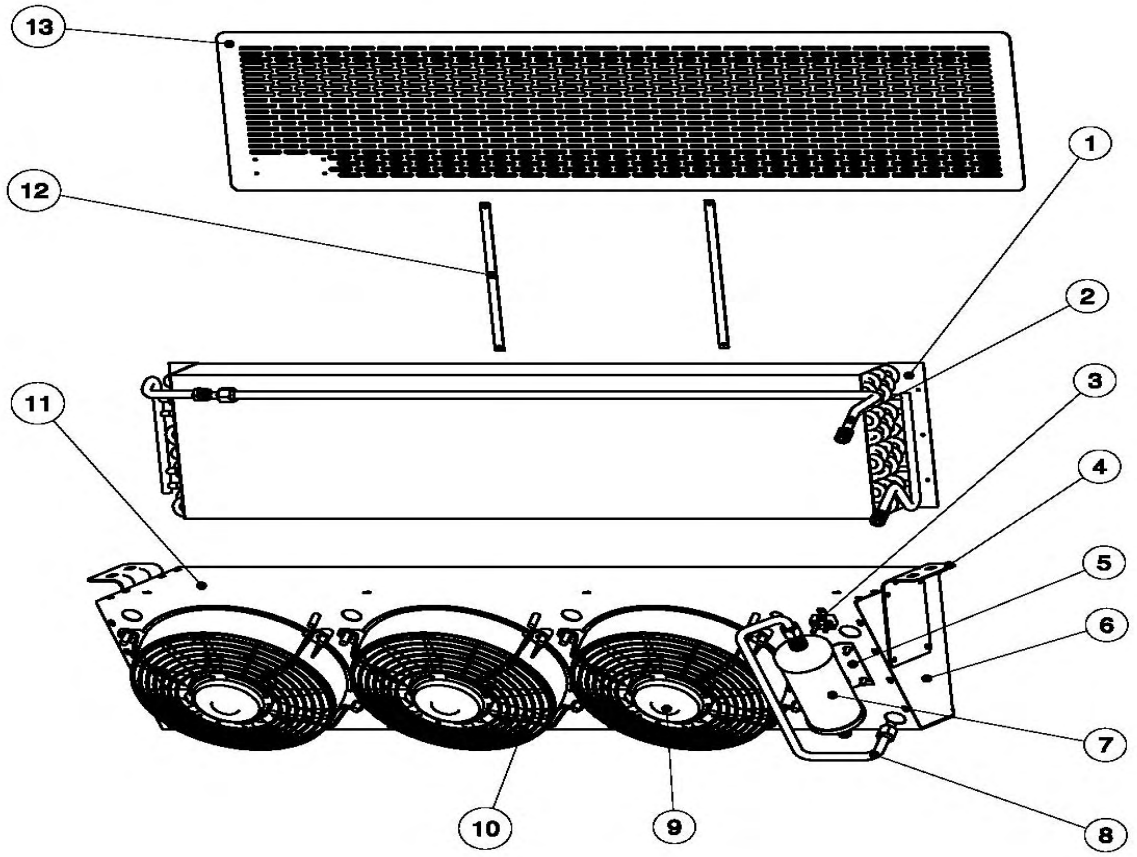


MODEL CS2 CONDENSER, 2-FAN 14" 4-ROW COND

ITEM	P/N	DESCRIPTION	QTY.
1	24-41523	COIL, CONDENSER FOUR ROW	1
2	40-40127*	BRACKET, CONDENSER END #1 LEFT	1
3	28-00003	FLUSH MOUNTS FOR FANS 90 DEG	8
4	33-20004	CIRCUIT BREAKER 30 AMP	1
5	25-14854-D	FAN 14" 12V PULLER W/WATER RESISTANT HP MTR	2
6	40-42830	DRIER BRKT "M" FOR 24-30105	1
7	**37-10860**	**DRIER, INLINE FILTER** (w/o Sight Glass)	1
8	35-13403*	TUBE ASS'Y, COND TO DRIER CEU (picture wrong)	1
9	40-42837	BRKT CONDENSER HARD LINE SUPPORT	1
10	40-40025	HOUSING, CONDENSER FAN	1
11	40-40128*	BRACKET, CONDENSER END #2 RIGHT	1

* 4/19/05

MODEL CS3



MODEL CS3 CONDENSER, 3-FAN 11"

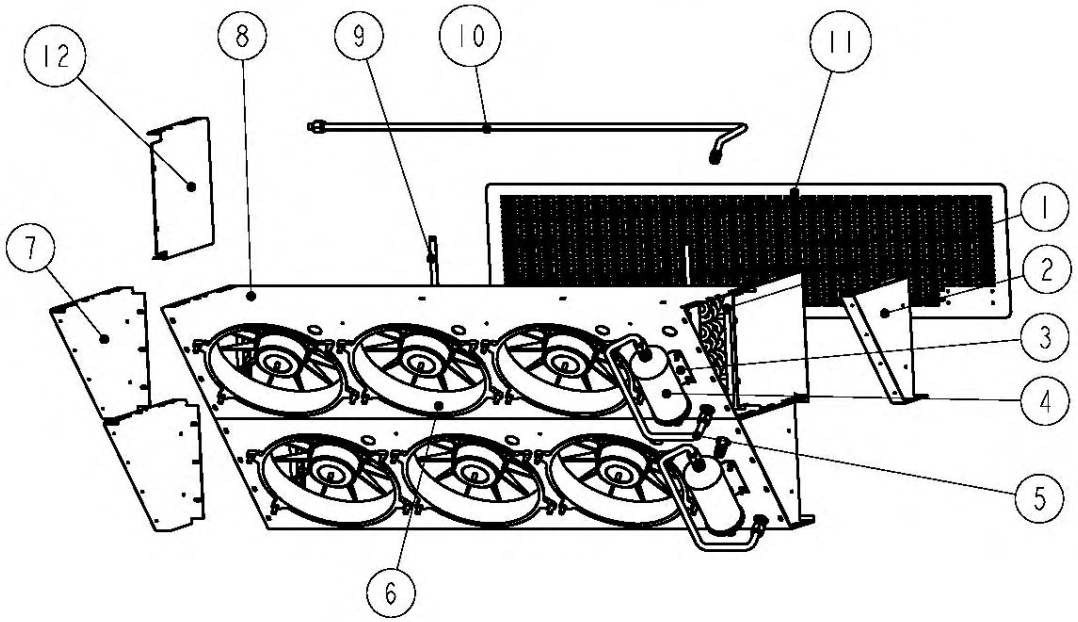
ITEM	P/N	DESCRIPTION	QTY
1A	24-41525	COIL, THREE FAN CONDENSER	1
1B	40-32429	VOLARA TAPE 1/8 X 2' ADHESIVE 50' PER ROLL	13 FT
2	35-60005	TUBE, CONDENSER INLET	1
		-All Electrical Components On Wiring Diagram	
4	40-40031	BRACKET, MOUNTING CONDENSER	2
5	40-42830	DRIER BRKT "M" FOR 24-30105	1
6	40-40029-B	END-PLATE, CONDENSER	1
7	**37-10860**	**DRIER, INLINE FILTER** (w/o Sight Glass)	1
8	35-60004	TUBE, CONDENSER OUTLET TO DRIER	1
9	25-11122	FAN, 11' HIGH PROFILE PULLER	3
10	40-40026	FAN GUARD, THREE FAN CONDENSER	3
11	40-40030	SHROUD, FAN / CONDENSER	1
12	40-40004	SUPPORT, CONDENSER METAL	2
13	40-40084	GRILLE ASSY-BUS CONDENSER WITH OMEGA LOGO	1
not shown	40-40029-A	END-PLATE, CONDENSER	1
not shown	40-40043	BRACKET, CONDENSER LINE	1

MODEL CS5 & CS6 CONDENSER, 3FAN 11"
(Internal Configuration-Fans Inside Cover.)

ITEM	P/N	DESCRIPTION	QTY
1A CS5	24-41525	COIL, 6 ROW 4 CIRCUIT	1
1A CS6	24-41530**	COIL 10 X41X4 ROW SINE WAVE 3 TO 1 SUB-COOL	1
1B	40-32429	VOLARA TAPE 1/8 X 2' ADHESIVE 50' PER ROLL	13 FT
2	40-40117	END-PLATE, CONDENSER	1
3	40-42830	DRIER BRKT "M" FOR 24-30105	1
4	**37-10860**	**DRIER, INLINE FILTER** (w/o Sight Glass)	1
NS	33-13697*	HARNESS WP THREE FUSE	1
NS		FUSE 15 AMP ATC	3
5	35-60056*	TUBE, CONDENSER OUTLET TO DRIER	1
6	25-11131*	FAN, 11' HIGH PROFILE PULLER MP	3
NS	40-40081	FAN GUARD, THREE FAN CONDENSER	3
7	40-40118	END-PLATE, CONDENSER	1
8	40-40119	SHROUD, FAN / CONDENSER	1
9	40-40004	STRAP SUPPORT COND	2
10 CS5	35-60056	TUBE, CONDENSER INLET	1
10 CS6	35-60061	TUBE, JACK COMP FEED TO COND TOP	1
11	40-40084	GRILLE ASSY-BUS CONDENSER WITH OMEGA LOGO	1
		OPTIONAL FOR STACKING	
12	(40-40120)	BRKT. STACKER MOUNTING/CLOSE-OFF	2

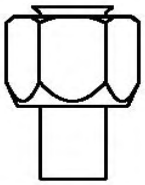
*4/19/05 ** 7/ 17/07

MODEL CS5 (SHOWN STACKED)

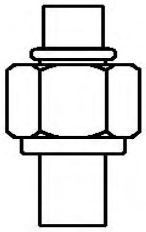


FITTING IDENTIFICATION

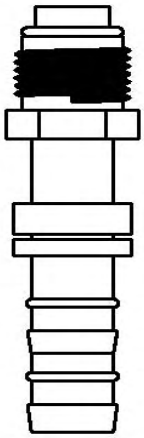
FEMALE FLARE (FF)



FEMALE O-RING (FOR)

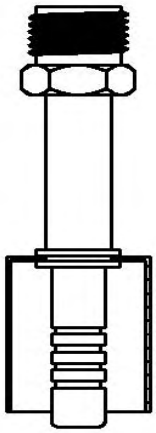


MALE O-RING (MOR)



EZ CLIP FITTING

MALE INSERT O-RING (MIO)



BEADLOCK FITTING

HOSE FITTINGS, BULK HOSE, PRESSURE SWITCH, & misc Parts

BEAD-LOCK	EZ-CLIP System	FITTINGS Note:LP=long pilot, SP=short pilot (esp at TXV)	TYPICAL LOCATION / USAGE
35-S1326-3	35-EZ1326-3	Ftg, 90° #8 FOR X #10 With R134A Charge Port 16mm	COMPRESSOR Discharge High Side Service
35-S1327-3	35-EZ1327-3	Ftg, 90° #10 FOR X #12 With R134A Charge Port 13mm	COMPRESSOR SUCTION Low Side Service
35-S1326	35-EZ1326	Ftg, 90° #8 FOR X #10 hose	Condenser INLET
35-S1122	35-EZ1122	Ftg, 90° #8 FEMALE FLARE X #8 hose	Condenser OUTLET (ON DRIER)
35-S1122-1	35-EZ1122-1	Ftg, 90° #8 FEMALE FLARE W/PORT 7/16”-20 flare w/ schrader	COND Out (On Drier); Port for Press. SW
35-S1305	35-EZ1305	Ftg, STRAIGHT #6 FOR SP X #8 hose	TXV IN, Used With Hardline
35-S1405	35-EZ1405	Ftg, STRAIGHT #6 MOR SP X #8 hose	TXV IN w/o Hardline Option
35-S1307	35-EZ1307	Ftg, STRT #10 FOR SP X #12 hose	TXV OUT, Used With Optional Hardlines
35-S1407	35-EZ1407	Ftg, STRT #10 MOR SPX #12 hose	TXV OUT w/o Hardline Opt.
35-S6102-1	35-EZ6102-1	SPLICER, Straight #8 x #8 W/PORT 7/16-20 flare w/ schrader	HIGH SIDE; Has Port for Pressure Switch
35-S6103-1	35-EZ6103-1	SPLICER, Straight #10 x #10 W/PORT 7/16-20 flare w/ schrader	Optional Location; High Side W/ SW Port
35-S6202	35-EZ6202	TEE SPLICER #8 X #8 X #8 hose	LIQUID LINE/ TEE-IN SLAVE Evaporator
35-S6204	35-EZ6204	TEE SPLICER #12 X #12 X #12 hose	SUCTION LINE/TEE-IN SLAVE Evaporator
35-S1316-3	35-EZ1316-3	Ftg, 45° #8 FOR LPX #10 W/ R134A Charge Port 16mm	Option: Comp or Cond High Side Service
35-S1317-3	35-EZ1317-3	Ftg, 45° #10 FOR LPX #12 With R134 Charge Port 13mm	Option: Comp Low Side Service
		HOSES	
34-13401	34-70009	HOSE, #8 (13/32” ID)	LIQUID LINE
34-13402	34-70010	HOSE, #10 (1/2” ID)	Discharge
34-13403	34-70011	HOSE, #12 (5/8” ID)	SUCTION
40-42704		Clamp, Hose Routing 2-3/8"	Hose Routing
	40-52702	Clamp, Double Hose Rubber Lined	Hose Routing
		PRESSURE SWITCH	
29-30123	SAME P/N	SWITCH DUAL PRESSURE SAFETY ON @28 PSI OFF AT 400 PSI	Port Either On Drier Ftg Or Liquid Splicer
		OPTIONAL HARDLINES	
35-13337	SAME P/N	HARDLINE SET, LONG	Evap, Between TXV and Hose Ftgs (Early Models)
35-13338	SAME P/N	HARDLINE SET, SHORT	Evap, Between TXV and Hose Ftgs (Early Models)
		E-Z CLIP TOOL KIT	
	41-12139	E-Z CLIP Kit W/ Tools & Accessories	

OMEGA reserves the right to deny warranty coverage on claims due to lack of maintenance or neglect. Claims in question must be supported by maintenance records if requested by OMEGA.

Example or Suggested Format Below, Owner/Operator Option if service dept has other proper records procedure and form in place.

PERIODIC AND SCHEDULED MAINTENANCE LOG

See Pages 9 and 10 for Instructions

Record Models and Serial #s____

INITIAL/NEWLY INSTALLED CHECK (In Service) DATE_____________

Performed By (Print Full Name)_________________for (School District___________________

Signed Name______________________

Weekly for First Month:(Name)___________________ DATE _________Sign_______________

Weekly for First Month:(Name)___________________ DATE _________Sign_______________

Weekly for First Month:(Name)___________________ DATE _________Sign_______________

Monthly (Name)___________________________DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Quartery (Name)_________________________ DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Quartery (Name)_________________________ DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

**Off Season (Name)_______________________ DATE ________ Sign___________________

**Winterized____________________________________

Pre-Season Annually (Name)____________________DATE_______Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Quartery (Name)_________________________ DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Monthly (Name)___________________________DATE __________ Sign___________________

Quartery (Name)_________________________ DATE __________ Sign___________________

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Monthly (Name)___________________________DATE __________ Sign___________________

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ETC.