Don Hart's Radiator

(*Hart Heat Transfer Products, Inc.*)

Standard Vertical & Horizontal

Radiator Series

Owner's Manual

PO Box 758 · Waller, Texas 77484
20123 FM 362 Rd · Waller, Texas 77484
USA
800-321-4278 · Radiators@DonHart.com

Inspection and Installation

Upon receiving the equipment, all items should be checked against the bill of lading to insure that everything has been received. The entire unit should then be carefully inspected for damage. Any visible or concealed damage should be immediately reported to the carrier and a damage claim filed. Also, the unit nameplate should be checked to make sure the unit construction matches the order specifications. Any discrepancy should be immediately called to the attention of Hart Heat Transfer Products, Inc. or it's local representative.

When an electrical motor driven fan is supplied on the unit the electrical characteristics should also be checked against order specifications.

Handling and Moving

The exact method of handling and moving a unit depends upon the size and weight of the unit, final location, available equipment and other variables. To facilitate ease of handling and shipping, larger units have lifting brackets. Each horizontal radiator assembly is supplied with lifting eyes at all four corners. The radiator assembly should be lifted at these points **only**. Damage to unit could occur if not handled properly. Forklifts **should not** be used under fan drive assembly or any support structure under the radiator frame.

Location and Mounting

Precaution should be taken to ensure a free flow of air to and from the radiator, and also to prevent recirculation of the heated exhaust air from the radiator back into the intake stream. It is also important to locate the radiator no closer that one fan diameter from a wall, roof structure, another radiator, on any other obstruction, which would restrict air movement.

The unit should be bolted to a level, solid foundation, isolated from outside sources of vibration and shock. Resonant vibration transmitted from foundation to radiator frame, through the fan assembly can cause the fain to fail and self-destruct. Hart Heat Transfer Products, Inc. cannot be responsible for this kind of failure.

Engine Coolant

Before filling the radiator ensure that the engine water jackets and piping are clean. Fill the radiator with good clean water. Using good clean water is essential for long radiator life and performance. Water should be neutral or slightly alkaline with a pH of 8 or more. Coolant water should be treated with a reputable corrosion inhibitor. If permanent type antifreeze is used, care should be taken that inhibitor and antifreeze solution are chemically compatible. Soluble oils are not recommended. Coolant maintenance is discussed later.

Fan Position

A fan shroud is used on radiator to improve fan efficiency and to prevent air recirculation. The fan must be correctly located in this shroud to obtain optimum fan performance. For fan positioning for radiator shipped without a mounted fan from Hart Heat Transfer Products refer to Fig. 1. All radiator radiators shipped with a fan supplied by Hart Heat Transfer Products, Inc. have the fan properly positioned.

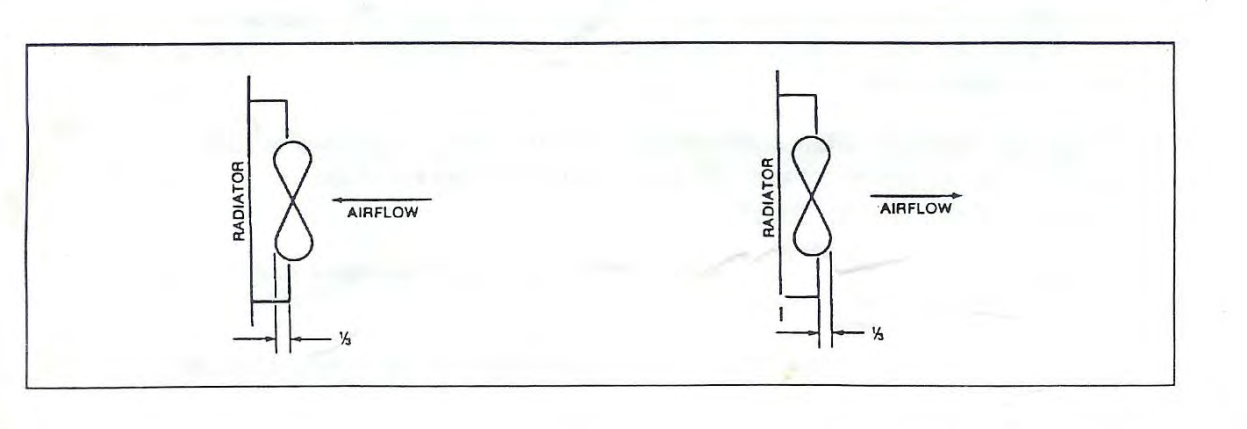
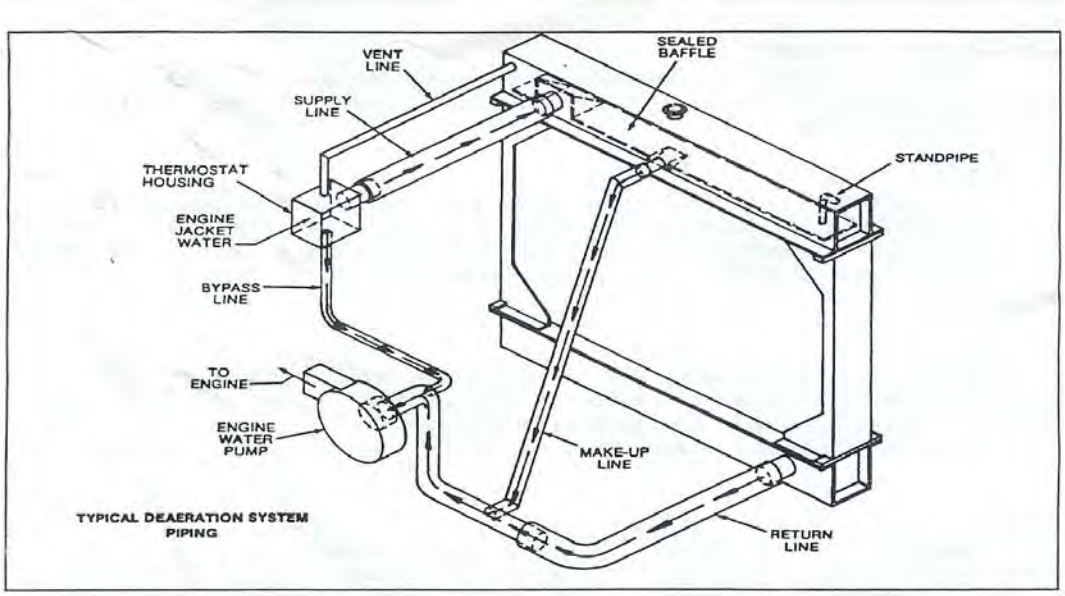


Fig. 1

Piping

Piping connections to the radiator should be externally supported, not hung on the radiator. It is advisable to use flexible connections when connecting piping to radiator assembly. Piping should be of ample size, and with as few bends or elbows as possible. Use long sweep elbows or long bends.

Some radiators are supplied with a Deaeration system installed in the radiator top tank. Entrained air in a cooling system could possible cause serious damage to an internal combustion engine. The most common cause of this entrained air is turbulence in the radiator top tank. An internal baffled upper tank Deaeration system used on these radiators eliminates excessive top tank turbulence and provides a means of vent out entrained air.



The Deaeration consists of:

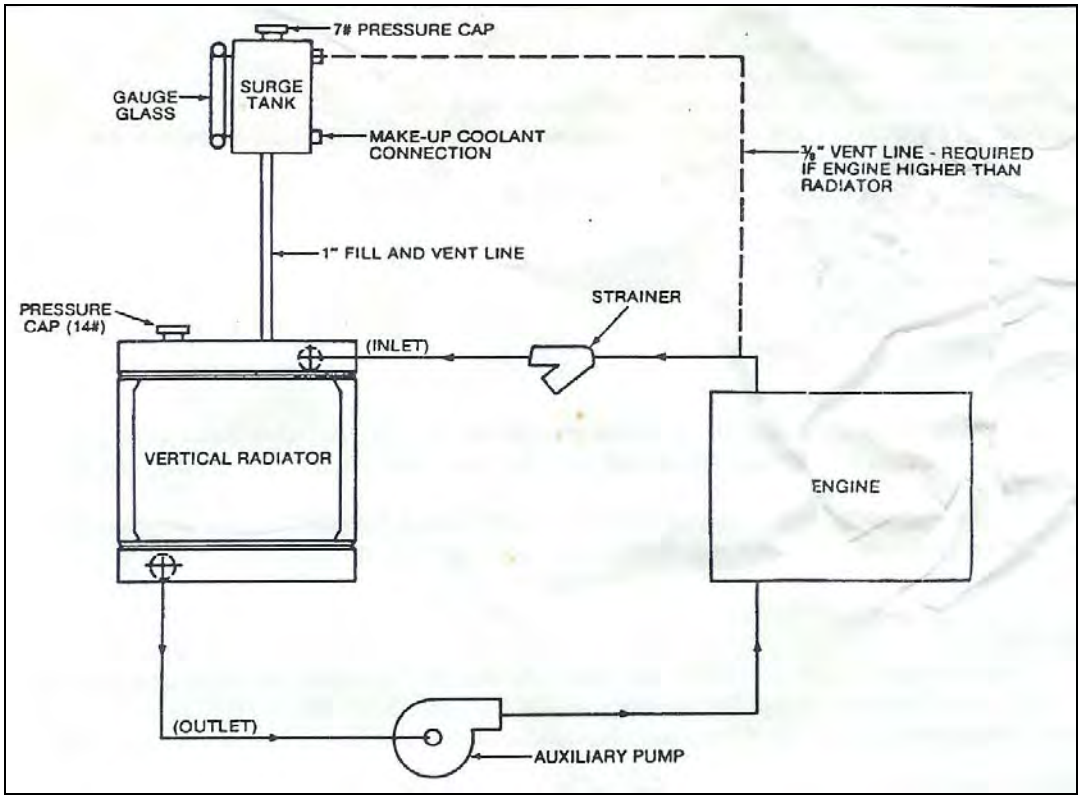
a) A solid baffle sealed all around which cuts the top tank into an upper and lower section. Coolant flowing back from the engine is forced below this baffle where it continues thru the cooling section tubes or thru the makeup line.

b) Standpipes. The standpipes allow approximately 5% of the cooling the calm upper section of the top tank where any entrained air can easily vet out of the coolant. Deaerated water is then returned to the coolant flow thru.

c) The makeup line. The makeup line connects to the suction side of the engine coolant pump therefore assuring the pump of a positive head.

d) Vent lines should be run from the engine thermostat housing to the upper vent connections

If using a radiator without a Deaeration system in the top tank it may be desirable to use a separate surge tank for deaerating the coolant flow.



Surge Tank Schematic

When a remote radiator is used to cool an engine, and the radiator is of the vertical core type, and is not at the highest point in the coolant system, a separate tank located in an elevated position should be used for vent, surge, and filling the radiator system. This surge tank should have a gauge glass, overflow tube, and pressure cap. Vent and makeup coolant connections should be provided on the surge tank.

The main line from the bottom of the surge tank should be connected to the top tank of the radiator. The elevation of the surge tank should be great enough to overcome line restrictions between the radiator and pump. The arrangement above arrangement of above allows for deaeration of the radiator and engine, and results in a positive pressure at the pump suction inlet. For systems protection a strainer should be used in the coolant line before in enters the radiator to catch dirt, scale, and core sand.

Start-UP, Operation & Maintenance

Before putting the radiator into service, the following check list should be completed.

1. Make sure the cooling fan shroud opening is in accordance with recommendations.
2. Check the units mounting bolts.
3. Check fan for rotational freedom.
4. Check V-Belts for alignment and tension.
5. Fill with coolant and check connections for tightness and leaks.
6. If a fan driven electric motor is supplied, make sure electrical connections are secure and that power source matches motor nameplate.
7. Make sure no foreign material is loose in air stream or in fan itself.
8. Make sure that all guards on installed.
9. Check that motor is wired or plumbed correctly for proper fan rotation.
10. Check for:
    a. Fan clearance
    b. Excessive vibration
    c. Excessive noise
    d. Leaks

If any problem arises, shut off operation immediately. Even if everything seems OK, shut down operation after a brief period and recheck belt, set screws and bolt tightness to make sure they have not become loosened thru usage.

Further operation should continue 8-12 hours during which fan electric motor amperage draw can be observed if necessary. Then unit should again be stopped for another recheck. Refer to maintenance procedures for lubrication recommendations.

V-Belts

Periodic checks must be made on the belts to be sure that the proper tension is maintained and that belts are not becoming worn. Belt dressing should NEVER BE USED TO PREVENT Slippage. The dressing material causes the fabrics and rubber compounds in the belt to physically deteriorate.

WARNING – DO NOT OVER TIGHTEN BELTS

Proper belt tension is ESSENTIAL for normal belt and bearing life. Tension should be applied only until slippage is eliminated. Follow drive manufactures recommendation for the required amount of belt deflection on any given V-belt drive setup. During the initial 48 hour run-in period, the belts will become loosened due to:

1. The initial stretch being taken out of the belts, and;
2. The soft rubber material on the belt surfaces being abraded away causing the belts to run lower in the sheaves.

Therefore, new belts must be readjusted after 48 hours running time.

Sheave Alignment (If Supplied)

Proper sheave alignment is essential for normal for normal V-belt and bearing life. Align fan sheave and drive sheave by using a straight edge across the sides of the sheaves. If sheave are skewed, loosen the sheave bushings or fan bearing housing and reposition as necessary.

Electric Motor Lubrication (If Supplied)

Electric motor should be lubricated with lithium-based grease such as Shell Cyprina #3 every six months of continuous operation. If unit is used only intermittently lubricate every 5000 hours of use. Care should be taken to not mix petroleum grease with silicone grease in motor bearings. Also make sure that grease is suitable for the class of insulation the nameplate bears.

Fan Bearing Lubrication (If Separate Bearing is Supplied)

Fan bearing frequency of re-greasing will vary depending on the hours of operation, temperature, and surrounding conditions. Typically for offshore applications, bearings should be greased every week or daily as determined by inspection. Use grease with the same or equivalent to Mobilux EP2, Shell Alvania EP2, or Texaco RB@ is recommended.

Coolant Maintenance

Industry experts estimate that about 40% of engine downtime is caused by cooling system problems. Understanding the common problems and implementing proven preventative maintenance practices allow fleet managers to significantly reduce their operating costs. The four major problems relating to cooling systems are:

- Corrosion
- Cavitation-erosion
- Scale deposits
- Green goo or drop out

One of most common and costly results of improper cooling system maintenance is the perforation of wet-sleeve liners. The perforation is caused by repetitive pitting of the liner resulting from liner vibration. As the fuel inside ignites, the liner vibrates within the block. The outside wall of the liner actually moves away from the coolant causing a near vacuum for an instant. This low-pressure causes the surrounding coolant to boil, forming tiny bubbles. The liner then returns to its position with extremely high velocity, pressing against the bubbles with a violent force. The bubbles implode (collapse) against the liner wall surface at pressures up to 60,000 PSI! The collapse of these bubbles blast small holes in the steel liner. This pitting process will repeat, digging tiny tunnels through the liner. Eventually, the liner wall will be perforated all the way through, allowing coolant to enter the combustion side of the cylinder. If coolant enters the combustion side of the cylinder, as expensive in-frame overhaul is required. Liquid coolant doesn't compress; when a piston fires with coolant in the combustion chamber, it can be blocked by the coolant, preventing it from making an entire stroke. This usually results in a bent rod and can cause a cracked block. Secondly, coolant can leak down into the engine oil. This results in overheating of lubricated moving parts and can destroy an engine.

Use "Fully-Formulated" Coolant

"Fully formulated" coolant contains nitrite. The nitrite will form a thin protective oxide film on the coolant side of the liner wall. This oxide film, which is formed by reaction of the nitrite with liner wall, acts as a protective barrier to prevent corrosion and cavitation (pitting) from occurring.

In a properly protected system that contains a “fully formulated” coolant, the imploding bubbles attack the protective film. The film quickly heals over the liner drawing nitrite from the coolant. In an improperly protected system, the bare metal surface area is immediately exposed to cavitation forming a corroded pit in the metal.

Maintain Your Coolant with a Supplemental Coolant Inhibitors (SCAs)

A good corrosion inhibitor should contain the following critical components for proper corrosion protection:

- pH buffer. This will help maintain optimum coolant pH (8.5 to 11). Borate, for example, is one of the best pH buffers available. It helps hold a coolant’s pH within the optimum range for providing corrosion protection for iron and steel components.
- Silicate. This is the best corrosion inhibitor for protecting aluminum metal surfaces.
- Nitrite. Nitrite provides the best protection available for cavitation/corrosion (liner pitting).
- Tolytriazole (TT) and mercaptobenzothiazole (MBT). These inhibitors provide protection for soft metals (lead, copper, brass).
- Nitrate – provides aluminum and ferrous metals protection (iron and steel).

Corrosion in Cooling Systems

Corrosion is the natural tendency of metals to revert back to their ore form. Cast iron, for example, will form reddish-brown iron oxide (common rust) on engine surfaces. A number of conditions in a cooling system will affect the degree and rate at which metal surfaces corrode. These include, coolant pH, the concentration of dissolved oxygen and carbon dioxide in a coolant, metal surface deposits, metal stress, coolant temperature, acids formed in the combustion process of the fuel, and the corrosion inhibitors present. Corrosion weakens metals, and the component will eventually fail.

One major factor on the corrosion rate of the metals is the coolant’s pH. Shifts in coolant pH will affect the metals that corrode and the rate of each metal’s corrosion. The pH scale runs from 0 to 14. A coolant becomes more acidic closer to zero; and more alkaline toward 14. Conventional coolant ph should be maintained between 8.5 and 11. If a coolant’s pH drops below 8.5, it may become aggressive to ferrous metals (cast iron and steel), aluminum, copper and brass. If it increases above 11, it will become aggressive to aluminum and solder in a cooling system. Maintaining optimum pH in a coolant is a critical function of a quality coolant additive (SCA). It is important to use coolant additive package containing a pH buffer to insure the optimum pH range of the coolant.

Cooling System Scale

A diesel engine generates enough heat to warm a seven-room house during the winter. It must shed some of this heat to operate efficiently and prevent severe engine component damage. Two-thirds of this heat is lost through the exhaust and through the engine work. The remaining third must be pulled from the engine by the cooling system. It is critical that all cooling system heat exchanger surfaces remain clean. Hard water scale can block a cooling system’s ability to transfer heat resulting in overheating. Only $^{1}/_{16}$ inch of scale will reduce cooling system heat transfer efficiency by 40%.

Calcium and Magnesium

Most cooling system water contains calcium and/or magnesium from drinking water supplies. Water that contains over 100 ppm of these minerals is considered “hard water”. It is wonderful to drink, but these minerals can form scale in engine cooling systems. As the concentration of these minerals increases, so does the probability that you will have cooling system scale problems. The level of dissolved solids in coolant water is generally referred to as the “total hardness” reported in parts per million (ppm). Cooling system additives that contain anti-scale chemicals can allow the use of moderately hard water. It

is best to use water that is at least as good as the recommended water quality listed in the ASTM standards.

ASTM Water Quality Recommendation (from D-4885):

	Ppm (max.)	***Grains Per Gallon (max.)***
Chlorides	40	2.5
Sulfates	100	5.8
Total Dissolved Solids	340	20
Total Hardness (calcium and magnesium)	170	10

How Scale Forms

The potential for scale formation on hot metal cooling system surfaces is affected by a number of dynamic conditions. Some of the mechanisms and parameters that affect the formation of these deposits:

- *Water hardness* – the harder the water being used in an engine coolant, the greater the amount of scale formation.
- *Temperature* – as coolant temperatures increase, hardness salts (calcium and magnesium) in solution become less soluble and increase their propensity to plate out on hot metal cooling systems surfaces.
- *Flow characteristics* – scale generally forms on the hot side of a cooling system and in areas of low or turbulent flow.
- *Entrapped air* – any air bubble formation in a coolant area (bubbling around a hot source) increases the tendency for scale to form in that area.
- *pH* – increases in pH will increase the potential for scale deposits.

Damage to water pump seals.

Calcium and magnesium have the tendency to combine with the phosphates found in old-fashioned antifreeze and some additive packages. They form calcium and magnesium phosphate scale on heat transfer surfaces, especially on water pump seal faces. These deposits can destroy the flatness of a seal face, preventing the water pump seal from sealing. The result can be destruction of the water pump bearings.

Cooling system problems that result from overheating caused by scale:

- *Cracked heads and warped engine blocks.*
- *Oil temperature running abnormally high.*
- *Failure of the cooling system fan to turn on.*

Safety

Inspection and maintenance of unit should only be done after the proper lockout procedures have been followed. Moving parts and fan rotation can cause serious injury of death. Buyer of radiator assembly will establish the proper lock out criteria and ensure that personnel performing inspection or maintenance of the unit are properly trained in the lock out procedures. Hart Heat Transfer Products, Inc. will not be responsible for injuries occurred during inspection or maintenance.

WARNING: KEEP ALL BODY PARTS AWAY FROM MOVING or ROTATING PARTS.

INSTRUCTION MANUAL
FOR
CC Ball Bearing
Fan and Blower Pillow Blocks

INSTALLATION

1. Clean shaft and bore of bearings.
2. Loosen setscrews so that they do not protrude into bore.
3. Slip Pillow Block into position and tighten setscrews on one end to recommended torque in table below.
4. On the other end, push on the bearing inner ring while pulling on the shaft. Simultaneously tighten setscrews to recommended torque.
5. Retorque setscrews after 24 hours of operation.

Set Screws		Hold Down Bolts	
Size	Wrench-Torque (lb.-in.)	Size	Wrench-Torque (lb.-in.)
10-32	33	$^3/_8$-16	240
$^1/_4$-28	87	$^1/_2$-13	600
$^5/_{16}$-28	165	$^5/_8$-11	1200
$^3/_8$-28	290		

LUBRICATION

Storage or Special Shutdown — If exposed to wet or dusty conditions or to corrosive vapors, extra protection is necessary: Add grease until it shows at the seals; rotate the bearing to distribute grease; cover the bearing. After storage or idle period, add a little fresh grease before running.

High Speed Operation — In the higher speed ranges too much grease will cause over-heating. The amount of grease that the bearing will take for a particular high speed application can only be determined by experience — see "Operating Temperature" below. If excessive grease in the bearing causes over-heating, it will be necessary to remove grease fitting to permit excess grease to escape. The bearing has been grease at the factory and is ready to run. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

Operation in Presence of Dust, Water or Corrosive Vapors — Under these conditions the bearing should contain as much grease as speed will permit since a full bearing with consequent slight leakage is the best protection against entrance of foreign material. In the higher speed ranges too much grease will cause over-heating — see "High Speed Operation" above. In the lower speed ranges it is advisable to add extra grease to a new bearing before putting into operation. Bearings should be greased as often as necessary (daily if required) to maintain a slight leakage at the seals.

Normal Operation — This bearing has been greased at the factory and is ready to run. The following table is a general guide for relubrication . However, certain conditions may require a change of lubricating periods as dictated by experience. See "High Speed Operation" and "Operation in Presence of Dust, Water or Corrosive Vapors" above.

Operating Temperature — Abnormal bearing temperature may indicate faulty lubrication. Normal temperature may range from "cool to warm to the touch" up to a point "too hot to touch for more than few seconds", depending on bearing size and speed, and surrounding conditions. Unusually high temperature accompanied by excessive leakage of grease indicates too much grease. High temperature with no grease showing at the seals, particularly if the bearing seems noisy, usually indicates too little grease. Normal temperature and a slight showing of grease at the seals indicate proper lubrication.

Kind of Grease — Many ordinary cup greases will disintegrate at speed far below those at which Dodge bearings will operate successfully if proper grease is used. Dodge bearings have been lubricated at the factory with No. 2 consistency lithium base grease which is suitable for normal operating conditions. Relubricate with lithium base grease or a grease which is compatible with original lubricant and suitable for ball bearing service. In unusual or doubtful cases the recommendation of a reputable grease manufacturer should be secured.

Special Operating Conditions—Refer acid, chemical, extreme or other special operating conditions to RELIANCE ELECTRIC, Greenville, South Carolina

Lubrication Guide

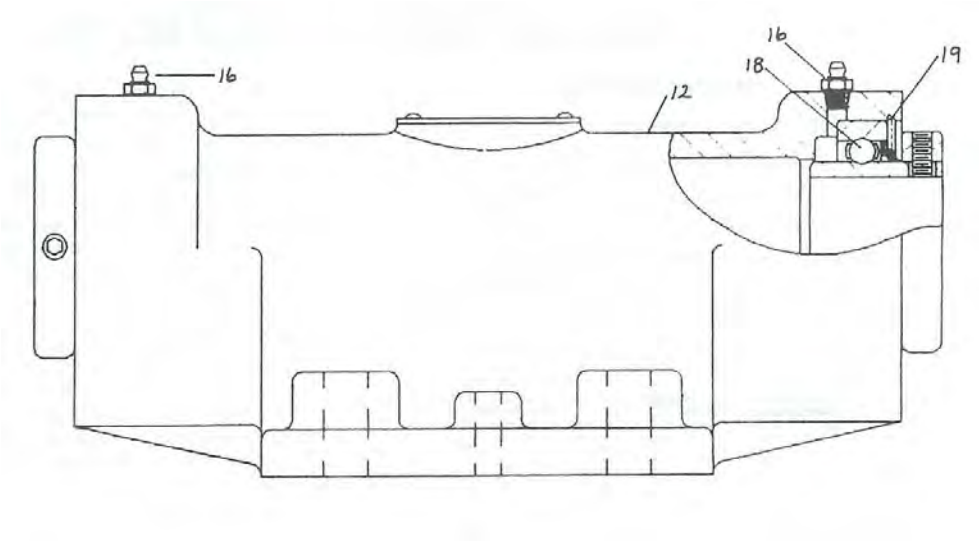
Read Preceding Paragraphs Before Establishing Lubrication Schedule.

Hours Run per Day	Suggested Lubrication Period in Weeks							
	1 to 250 RPM	251 to 500 RPM	501 to 750 RPM	751 to 1000 RPM	1001 to 1500 RPM	1501 to 2000 RPM	2001 to 2500 RPM	2501 to 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	1	1
24	10	5	3	2	1	1	1	1

WARNING: Because of the possible danger to person(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed. Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Reliance Electric nor are the responsibility of Reliance Electric.

Dodge / Roper Ct., P.O. Box 499 / Greenville, South Carolina 29602 / 803-297-4800

NOTE: The two digit numbers are for reference only. Order parts by the six digit numbers in the Part List. Each six digit number is a complete identification of the part or assembly



Reference Number	Name of Part	Number Required	Part Numbers for Various Shaft Sizes					
			$^{15}/_{16}$, 1	$1^{1}/_{8}$, $1^{3}/_{16}$	$1^{1}/_{4}$,$1^{3}/_{8}$,$1^{7}/_{16}$	$^{11}/_{16}$, $1^{3}/_{4}$	$1^{15}/_{16}$	$2^{3}/_{16}$
12	Housing	1	134150	134151	134152	134153	134154	134155
14	Snap Wire	2	134180	134181	134182	134183	134184	134185
16	Lubrication Fitting	2	405015	405015	405015	405015	405015	405015

Reference Number	Name of Part	Number Required	Part Numbers for Various Shaft Sizes					
			$^{15}/_{16}$	1	$1^{1}/_{8}$	$1^{3}/_{16}$	$1^{1}/_{4}$	$1^{3}/_{8}$
18	Ball Bearing with Collar and Screws	2	134161	134162	134164	134165	134166	134168

Reference Number	Name of Part	Number Required	Part Numbers for Various Shaft Sizes					
			$1^{7}/_{16}$	$1^{11/}_{16}$	$1^{3}/_{4}$	$1^{15}/_{16}$	$2^{3}/_{16}$	.....
18	Ball Bearing with Collar and Screws	2	134169	134170	134171	134172	134174	.....

SERVICE MANUAL

Series, 6AL, 8AL

Installation, Operation, and Maintenance Instructions

Upon receipt, carefully inspect package for any indications of mishandling or damage in transit and indicate any damage on the carrier's Bill of Lading.

The Series 6AL and 8AL fans up to 84" in diameter are normally shipped fully assembled from the factory with the blades pre-set to the proper blade angle if the design conditions are specified.

The Series 8AL fans greater than 84" in diameter are shipped unassembled with the blades and hub match-marked for easy assembly. The proper blade angle is stamped on the hub nameplate if design conditions are specified.

Warning

Before installation of fan, be certain that all electrical fan controls are locked in the OFF position. Inadvertent operation during installation could case serious injury to personnel or equipment.

Assembly Of Fan

Follow steps 1 to 6 if fan is to be assemble or blade angle needs to be adjusted. Hub may be assembled to shaft first if desired.

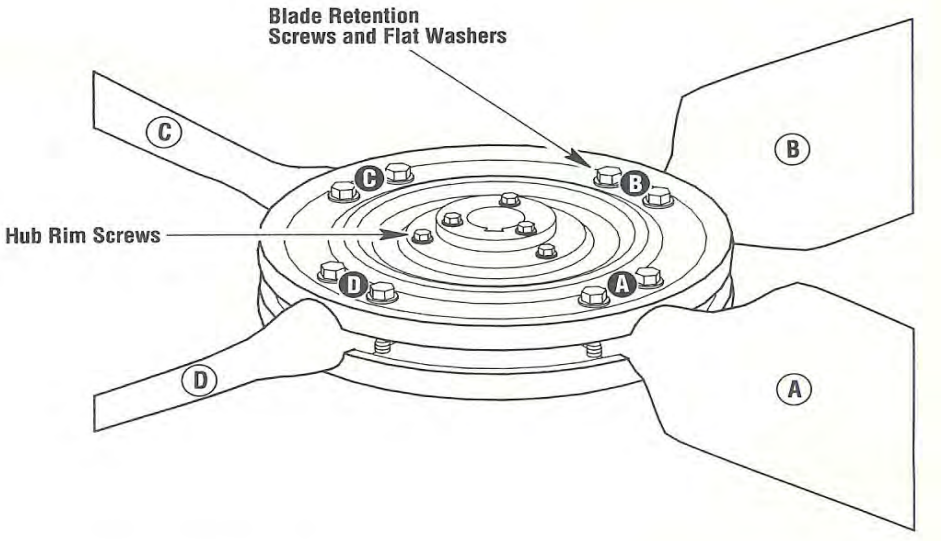
Step 1: Loosen Three Hub Rim Screws

Do not remove. Rim must be loose in order to insert blades.

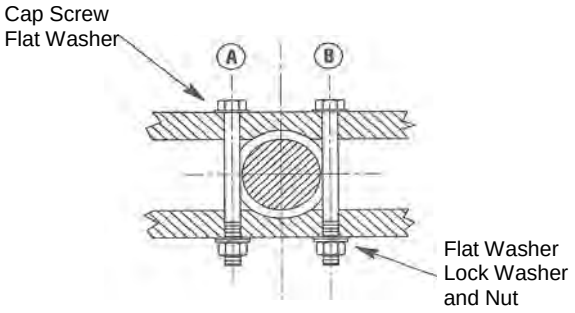
Step 2: Assemble Blades

Blades are match-marked for each hub socket by letters. Insert each blade shank into the correct hub socket and assemble screws with flat washers under screw head. Retention screws must be located through the grooves of the blade shank.

NOTE: Entire hub rim may be removed for blade assembly where space will not permit blade assembly with hub rim in place. Support blade assembly with hub in place. Support blade ends until all blades are in place and hub rim is assem-



Washington Aluminum Company
1330 Knecht Avenue
Baltimore, Maryland 21229-5511
(410) 242-1000
Fax: (410) 247-4890

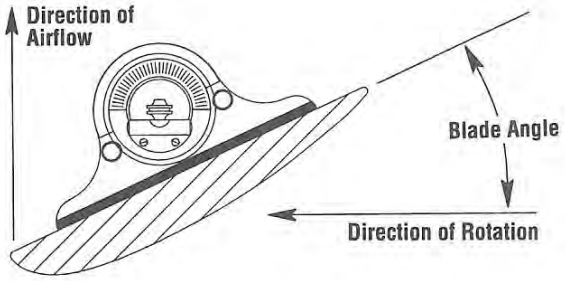


Step 3:
Assemble Plain Washers, Lock Washers And Nuts

Tighten nuts until all blades are horizontal but not tight enough that blades cannot be rotated for blade angle setting.

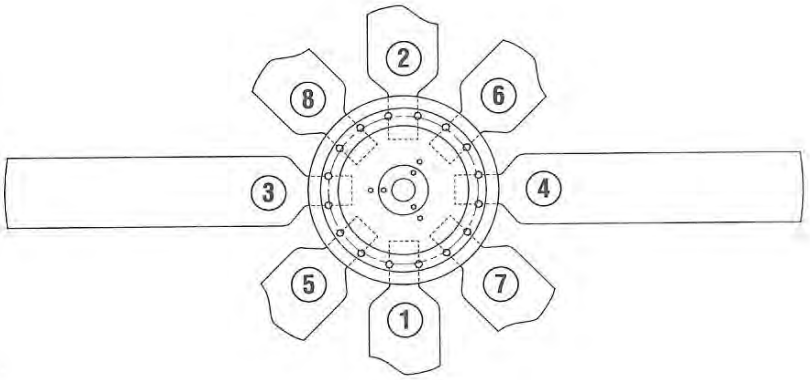
Step 4:
Set Blade Angle

Place protractor 1: (25mm) inboard of blade tip and rotate each blade to the desired angle. If the fan is operated in a vertical plane (drive shaft horizontal), blade angle can only be set when blades are rotated to horizontal position (3 o'clock or 9 o'clock). While each blade is at the correct blade angle, tighten screws only enough to hold blade in set position (over-tightening will cause adjacent blades to become tight, thus preventing positioning of blades for setting blade angle). Allowable tolerance is ± 1/2 degree.



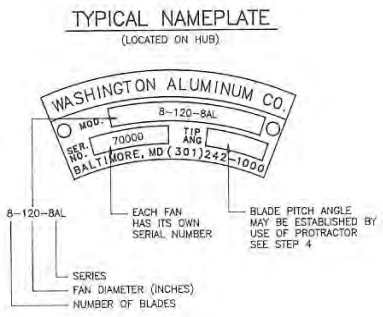
Step 5:
Torque Blade Screws

Being careful not to disturb blade angle setting and referring to diagram, take part turns on each "A" and "B" screw until both are tight to 75 ft.-lbs. (10Kg-M) torque for each blade (USE CALIBRATED CLICK-TYPE TORQUE WRENCH). Blade tightening shall follow the number pattern shown. Follow same sequence for blade quantities other that eight. Use only hardware supplied with the fan. Torque from nut side only. Recheck all nuts after first tightening until all are up to 75 ft.-lbs. (10Kg-M). Recheck tip angle on blades.



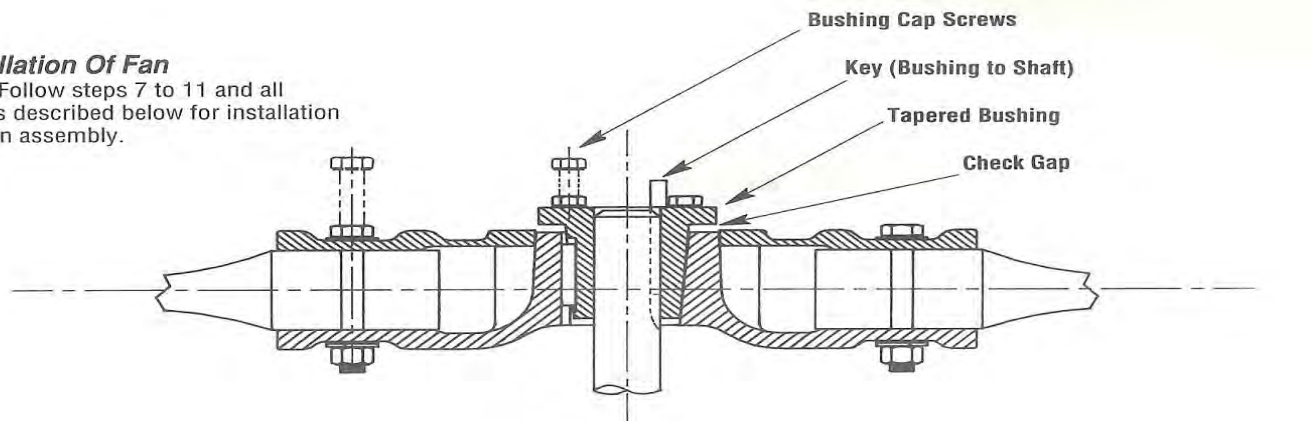
Step 6:
Tighten Hub Rim Screws

Torque three hub rim srews to 30 ft.-lbs. (4Kg-M).



Installation Of Fan

Follow steps 7 to 11 and all checks described below for installation of a fan assembly.



Step 7:
Clean Drive Shaft

Clean drive shaft using emery cloth as applicable.

Step 8:
Remove Tapered Bushing

Remove three cap screws and tapered bushing from fan hub. Using petroleum solvent, remove anti-corrosion coating from tapered bushing and hub bore. Use safety precautions stated in the solvent manufacturer's Material Safety Data Sheet.

Step 9:
Reinstall Tapered Bushing

Reinstall tapered bushing (and key, if provided) in hub bore. Finger tighten three bushing cap screws evenly. DO NOT APPLY ANY LUBRICANT TO THE BUSHING OR HUB.

Step 10:
Lift Fan Or Hub into Position

Align keyways on the drive shaft and tapered bushing. Install key in keyway. Place hub on shaft with bushing flange toward the end of the shaft.

Ste*p 11:*
Tighten Bushing Cap Screws

After locating the fan at the desired position on the shaft, torque the three bushing cap screws to 30 ft.-lbs. (4Kg-M). Care must be taken to avoid cocking the bushing on the shaft. The gap between the bushing flange and the hub must remain even at all times. Only use hardware provided with the fan.

Proper torque is important. Under-torquing may allow the fan to become loose on the shaft, while over-torquing may fracture the hub, bushing cap screws or strip out the hub threads. A minimum of 1/32" gap should exist between the bushing flange and the hub surface after all cap screws are fully torqued. DO NOT OPERATE THE FAN IF THIS GAP IS LESS THAN 1/32".

A locking collar or similar device is recommended and should be mounted on the drive shaft to prevent fan slippage during operation.

Warning

Do not stand or support scaffolding on blades.

Checking Tip Clearance

Check tip clearance of each blade. The recommended blade tip clearance is 1/2% of the fan diameter. Excessive tip clearance will cause a loss of air delivery. Rotate fan and check clearance around entire fan ring. Fan ring, shroud, cooling tower stack, guards, etc., should be sturdy and properly installed to prevent fan from striking during operation. Clearance less than that shown may be desirable but may not be practical.

Checking Blade Track

Check the blade track by holding a pencil on the flat side of the blade at the trailing edge and marking the wall of the fan ring. When all blades are rotated to the same position and marks made on the fan ring, a pattern of the track is clearly visible. If the distance between the scribe marks exceeds 1/2", check the seating of the blades in the hub sockets, the squareness of the fan on the drive shaft, and the blade angle of each of the blades.

Operational Check

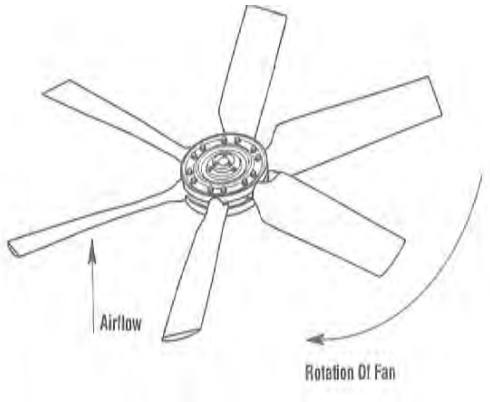
Check the motor and drive system for correct mounting. Check belt tension, if applicable. Ensure the area is clear of all scaffolding, tools, personnel and debris. Install an appropriate fan guard. Remove safety from the operating controls and turn the fan drive on. If no operating difficulties are encountered, operate the fan and check the following conditions.

a. Vibration level of fan, drive and supporting structures. Fan should not be operated under extreme vibratory conditions.

b. Noise level of fan. Excessive noise may indicate lack of lubricant, misalignment, faulty or loose mounting or defective equipment.

c. Direction of air flow for cooling. Ensure that the direction of the air flow and fan rotation is correct.

d. Fan load on electric motor. Current draw should not exceed the rated amperage draw on the motor.



Torque Check

Turn fan off and safety all controls in the OFF position. After the fan has completely stopped, check the torque values noted in steps 5,6 and 11. If screws tensions have decreased, determine the cause and take corrective action.

100 Hour Torque Check.

After approximately one hundred hours of fan operation, recheck the torque values of all the cap screws as above.

Vibration

All fan assemblies, regardless of who manufactured the fan, have a natural frequency which should be considered for compatibility with the drive and structural support. Vibrations at or near resonance of structural elements can create high stresses and may lead to eventual failure. Structural supports, drive, fan stack and fan natural frequencies should be such that they will not induce resonance. Where environmental or other conditions then to deteriorate structural supports, vibration monitor switches may be used to shut down or provide warning of prevailing conditions.

Corrosion

Environmental conditions can cause structural and fan components to deteriorate over a period of time. During periodic inspections, all fasteners should be inspected and when necessary replaced. Fasteners are considered expendable items and should be inspected at least twice per year. Where sever corrosion conditions exist, special protective coatings can be used. For assistance, recommendations or replacement parts contact: Washington Aluminum Company, Baltimore Maryland.

FAN PARTS LIST – SERIES 6AL

Dimensions: 54" (1372mm) to 84" (2134mm) diameter

Part Number	Part Description	Quantity Per Fan
G40087	Blade 6" wide, Right Hand (must specify fan dia. in inches)	Count Blades In Fan
47086	Hub (Must be ordered as complete unit) Hub & Hub Rim (Specify # Of Blades)	1
10324	Tapered Bushing (Specify Shaft Size)	1
10344	Lockwasher 3/8"	6
10345	Capscrew 3/8-16 X 1 1/2" Gr. 5	6
10213	Flatwasher 3/8"	3
10360	Capscrew 1/2-13 X 4 1/4" Gr.8	2 Per Blade
10182	Lockwasher 1/2"	2 Per Blade
10226	Flatwasher 1/2"	4 Per Blade
10290	Nut 1/2-13	2 Per Blade

FAN PARTS LIST – SERIES 8AL

Dimensions: 54" (1372mm) to 120" (3048mm) diameter

Part Number	Part Description	Quantity Per Fan
G40086	Blade 8" Wide, Right Hand (must specify fan dia. in inches)	Count Blades In Fan
G40086L	Blade 8" Wide, Left Hand (must specify fan dia. in inches)	Count Blades In Fan
47086	Hub (Must be ordered as complete unit) Hub & Hub Rim (Specify # Of Blades)	1
10324	Tapered Bushing (Specify Shaft Size)	1
10344	Lockwasher 3/8"	6
10345	Capscrew 3/8-16 X 1 1/2" Gr.5	6
10213	Flatwasher 3/8"	3
10360	Capscrew 1/2-13 X 4 1/4" Gr. 8	2 Per Blade
10182	Lockwasher 1/2"	2 Per Blade
10226	Flatwasher 1/2"	4 Per Blade
10290	Nut 1/2"	2 Per Blade

Blades should be replaced in pairs and assembled diametrically opposite to maintain fan balance. Must specify right or left hand blades.

Don Hart's Radiator
20123 FM 362 Rd
Waller, Texas 77484

LIMITED WARRANTY

Don Hart's Radiator, hereafter called the "Company", warrants its commercial or industrial products against defects in material and workmanship under normal use and service for a period of one year from date of shipment from its premises. It is imperative that the Company's serial tags remain on all products. *Removal of the serial tag will void the warranty.* All merchandise to be returned for warranty must bear a Company-issued Return Authorization Number on all shipping documents. *Warranty returns without a Return Authorization Number will be refused.*

All obligations and liabilities under this warranty are limited to repairing or replacing, at the Company's option, such defective products or parts returned, carrier charges prepaid, to the Company's address, **20123 FM 362 Rd, Waller, Texas, U$A, 77484**. All such repairs or replacements of the returned products or parts are subject to inspection on the Company's premises. No liability is assumed for costs relating to removal or installation.

Warranty on components or accessories furnished by suppliers to the Company shall be limited to the warranty of the respective component or accessory supplier. The Company shall not be liable for any contingent, incidental, or consequential damages for alleged failure of its products, components, or accessories.

If the Company, at the buyer's request, renders field service and the fault is found not to be with the Company's product, component, or accessory, the buyer shall pay for the time and expenses of the field representative(s).

This warranty does not cover failure resulting from improper installation, mounting, design, application, vibration, acts or freaks of nature, improper coolant mixtures, improper chemical cleaning, or failure due to corrosion. The Company's products are not packaged or protected for long periods of operation or storage in generally corrosive atmospheric conditions.

Changes or repairs attempted or made in the field by the buyer without written consent from the Company automatically voids this warranty.

The Company, whose policy is one of continuous improvement, reserves the right to improve its products through changes in design or material without being obligated to incorporate such changes in products of prior manufacture.

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