CUSTOMER SERVICE DEPARTMENT
OFFICE (417) 869-6474
FAX NUMBER: (417) 862-0968

OPERATION AND MAINTENANCE MANUAL

AIR HANDLING UNITS

ALL REQUESTS FOR FACTORY ASSISTANCE MUST BE ACCOMPANIED BY THE SPECIFIC UNIT'S SERIAL NUMBER.

Table of Contents

1.0 General

This manual has been prepared as a guide for installing, operating and maintaining Loren Cook heating and cooling equipment. Due to the fact that each piece of Loren Cook equipment is custom manufactured, it is not possible to generate detailed manuals for each; therefore, this manual is generic in content and may or may not include components that are unique to your equipment. This manual may be included as part of a custom manual. If such is the case, you should consult the appropriate section relating to any questions you may have. Otherwise, you should contact your Loren Cook sales representative or Loren Cook directly for any specific information required.

1.1 Receiving the Equipment

Inspect the complete unit for shipping damage. If damage is present, you have the right to either accept or reject the shipment. If the receiving contractor or the receiving agent for the contractor elects to receive the equipment in a damaged condition it then becomes the contractor's responsibility to note the extent of the damage on the delivering freight bill of lading in the presence of the delivering agent (driver) of the delivering freight carrier. It then becomes the contractor's responsibility to file a freight claim with the delivering freight carrier in accordance with the ICC regulations. It also then becomes the responsibility of the receiving contractor to work with the delivering carrier to have the equipment repaired to the satisfaction of Loren Cook so the warranty may remain valid. Loren Cook must also be notified of shipping damage.

1.2 Shipped Loose Parts

Check the packing list and inspect the equipment for the shipped loose parts. The packing list will note the description and quantity of the loose parts included. The packing list will also note in what section of the unit each shipped loose part is located. All air filters are shipped as loose parts.

1.3 Visual Inspection of Equipment

Visually, inspect the equipment exterior and interior for damage incurred during shipment. Any damage discovered must be noted on the shipping documents prior to releasing the trucking company. Any damage not noted will not be able to be claimed after the acceptance of delivery. The equipment type and arrangement should also be verified that it is as ordered when it arrives at the job site. If a discrepancy is found, contact the Loren Cook Sales Representative, or the Loren Cook factory immediately.

2.0 Storage

2.1 Short-Term Storage

Short-term storage is considered six (6) months or less from date of shipment. Storage maintenance during this time period is usually, but not necessarily, limited to the following:

1. Make sure the equipment is received, unloaded and set in a level, supported position per guidelines listed in the Rigging section.
2. Make sure all access doors are tightly closed and that all access openings into the unit are sealed, such as air supply and air return openings, pipe chase openings, fresh air openings, exhaust air openings, electrical connection openings and other access openings of the unit's cabinet that may permit entry of snow, ice, rain water, dust, dirt, mud and other construction debris, or birds and rodents that may enter the interior of the unit.
3. The unit must also be protected when setting on the ground level to prevent damage to the exterior of the cabinet by construction vehicles and personnel.

2.2 Long-Term Storage

Long-term storage is considered to be any period longer than six (6) months from date of shipment. If long-term storage is anticipated, contact the Loren Cook sales office at time of order entry for the proper instruction for long-term storage. It is mandatory that a detailed record be maintained during this long-term storage period, including, but not limited to, proper sealing of the cabinet, rotation of the blowers and bearings and protection of all motors from moisture. Note: Under certain conditions, it may be necessary to remove the motors from the unit and/or add heat to the motor. This record must be available to Loren Cook should a failure occur during the warranty period. There is a time limit of one year from date of shipment that any unit may be kept in long-term storage. At the end of the one year period, the unit must be in operation.

Note: Failure to perform the long-term storage requirements and properly log these required procedures will void the warranty.

3.0 Air Filters

Loren Cook utilizes the nominal 2 inch pleated 30 % efficiency filter as the primary filter. It is also used as a pre- filter in conjunction with high efficiency filters. This filter is installed in two types of filter racks. Filter quantities are selected to meet certain air flow and pressure drop requirements, which appear on the submittal sheets under *static pressure analysis***.**

3.1 Slide Type Filter Rack

This type filter rack, as the name implies, utilizes two horizontal channels in which the filters are captured between. The racks could be provided in a V, W or flat configuration. The filters are loaded into the frame through a removable side plate, or on the face, where a portion of the channel side has been removed. Frequently, spacers are used to make up the difference between the length of the rack, which is governed by the opening size and the length of standard size filters.

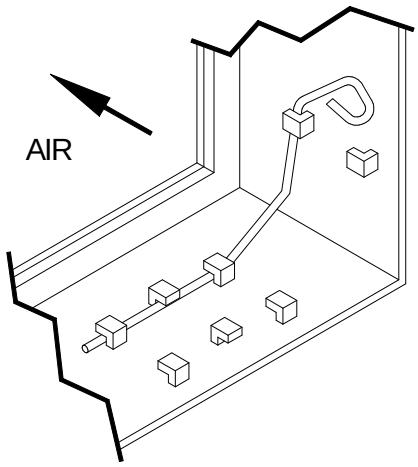
3.2 Type 8 Style Frames *(Standard)*

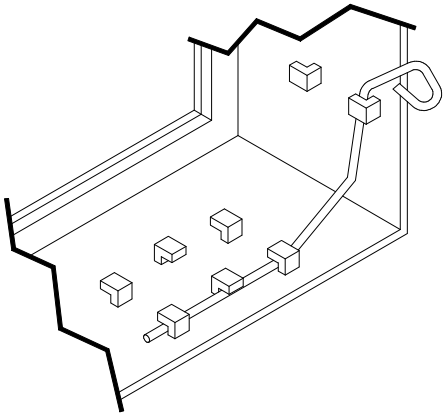
This individual sized frame surrounds each filter and is grouped together to form the desired filter area. The frame is provided in 24" x 24" and 12" x 24" sizes. The type 8 frame accommodates a variety of filters ranging from the standard 2 inch filter, to full size, or header type high-efficiency filters and/or a combination of pre and high-efficiency filters. In addition to the above, some high efficiency, or special purpose filter frames may be incorporated into the equipment. These filter frames may vary greatly in design and style of loading. Loren Cook provides manufacturer's data sheets with the equipment.

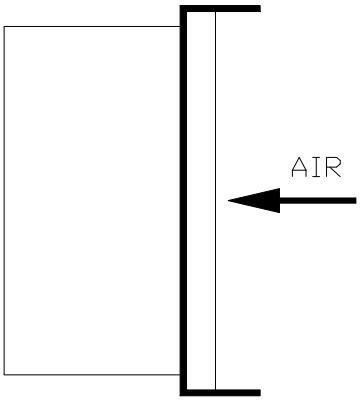
3. Filter / Holding Frame / Application

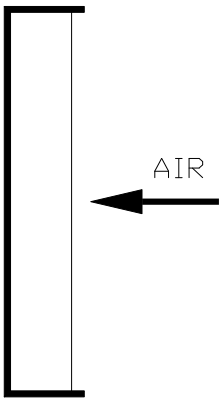
Pre filter	Pleated/Panel/ Rigid/Bag/Filter	Filter Clip	# of Clips per Filter	Filter Access	Page #	Figure #
none	2" Panel/pleated	C-70	4	Up/Downstream	2	1
none	4" Panel/pleated	C-86	4	Upstream	3	2
none	4" Panel/Pleated	C-77	4	Downstream	5	3
none	6" Rigid w/PH	C-70	4	Upstream	2	4
none	12" Rigid w/PH	C-70	4	Upstream	2	4
none	Bag w/ PH	C-70	4	Upstream	2	4
none	6" Rigid w/o PH	C-90	4	Up/Downstream	6	5
none	12" Rigid w/o PH	C-99	4	Up/Downstream	6	5
2"	6" or 12" Rigid w/PH	C-86	4	Upstream	3	6
2"	Bag w/ PH	C-86	4	Upstream	3	6
4"	6" or 12" Rigid w/PH	C-89	4	Upstream	4	7
4"	Bag w/ PH	C-89	4	Upstream	4	7
2"	6" Rigid w/o PH	C-90	4	Upstream	6	5
		C-79-1	4		7	8
4"	6" Rigid w/o PH	C-90	4	Upstream	6	5
		C-79-2	4		7	8
2"	12" Rigid w/o PH	C-99	4	Upstream	6	5
		C-79-1	4		7	8
4"	12" Rigid w/o PH	C-99	4	Upstream	6	5
		C-79-2	4		7	8

PH=Peripheral Header









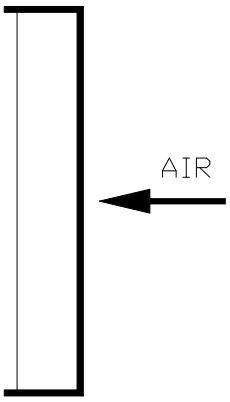


Figure 4
C-70 Clip location for 6" & 12"Rigid & Bag filters with peripheral header for upstream access

Figure 1
C-70 Clip location for 2" filter for up or downstream access

C-70 Filter Clip Application

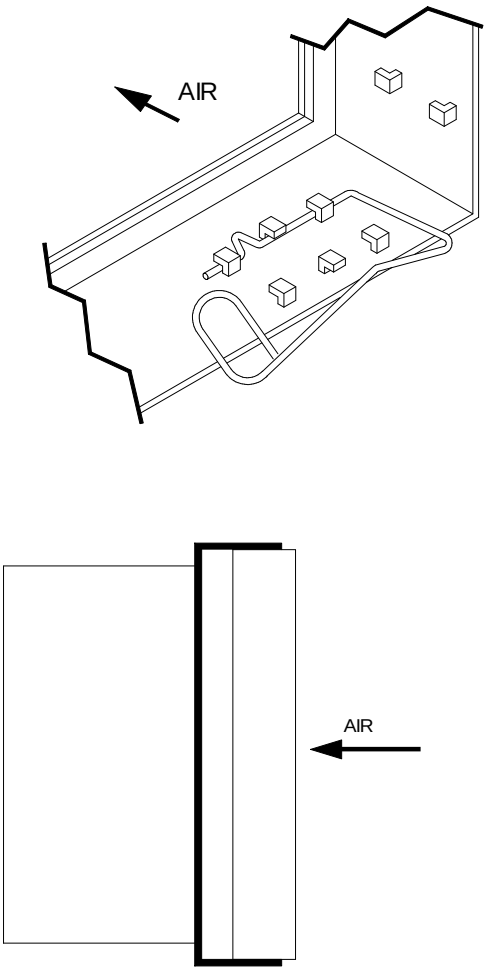


Figure 6
C-86 Clip location for 6" & 12" Rigid &
Bag filters with peripheral header &
2" pre-filter for upstream access

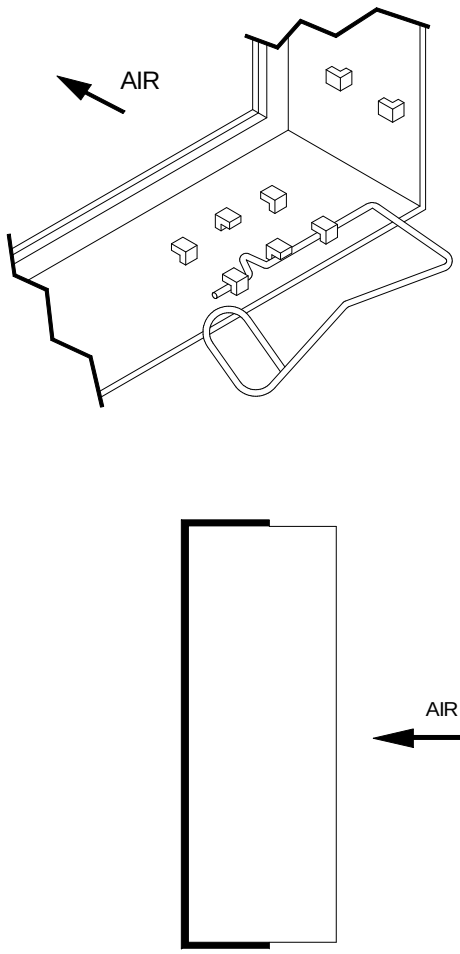


Figure 2
C-86 Clip location for 4" filter
for upstream access

C-86 Filter Clip Application

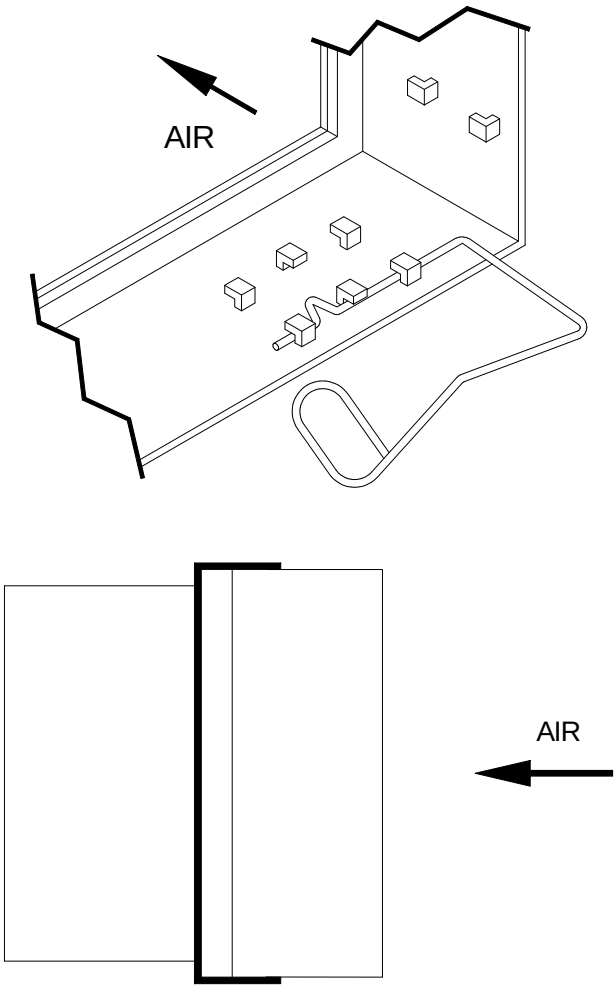


Figure 6
C-89 Clip location for 6" & 12" Rigid &
Bag filters with peripheral header
& 4" pre-filter for upstream access

C-89 Filter Clip Application

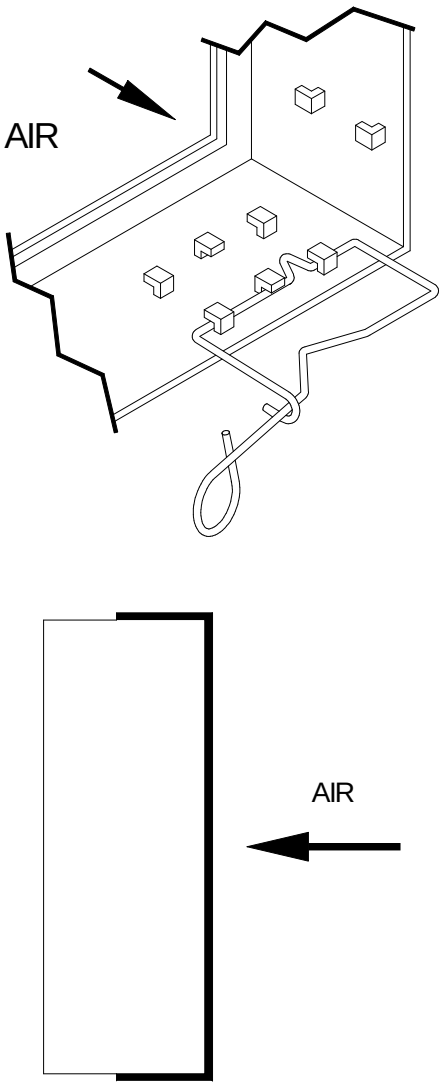


Figure 3
C-77 Clip location for 4" filter
for downstream access

C-77 Filter Clip Application

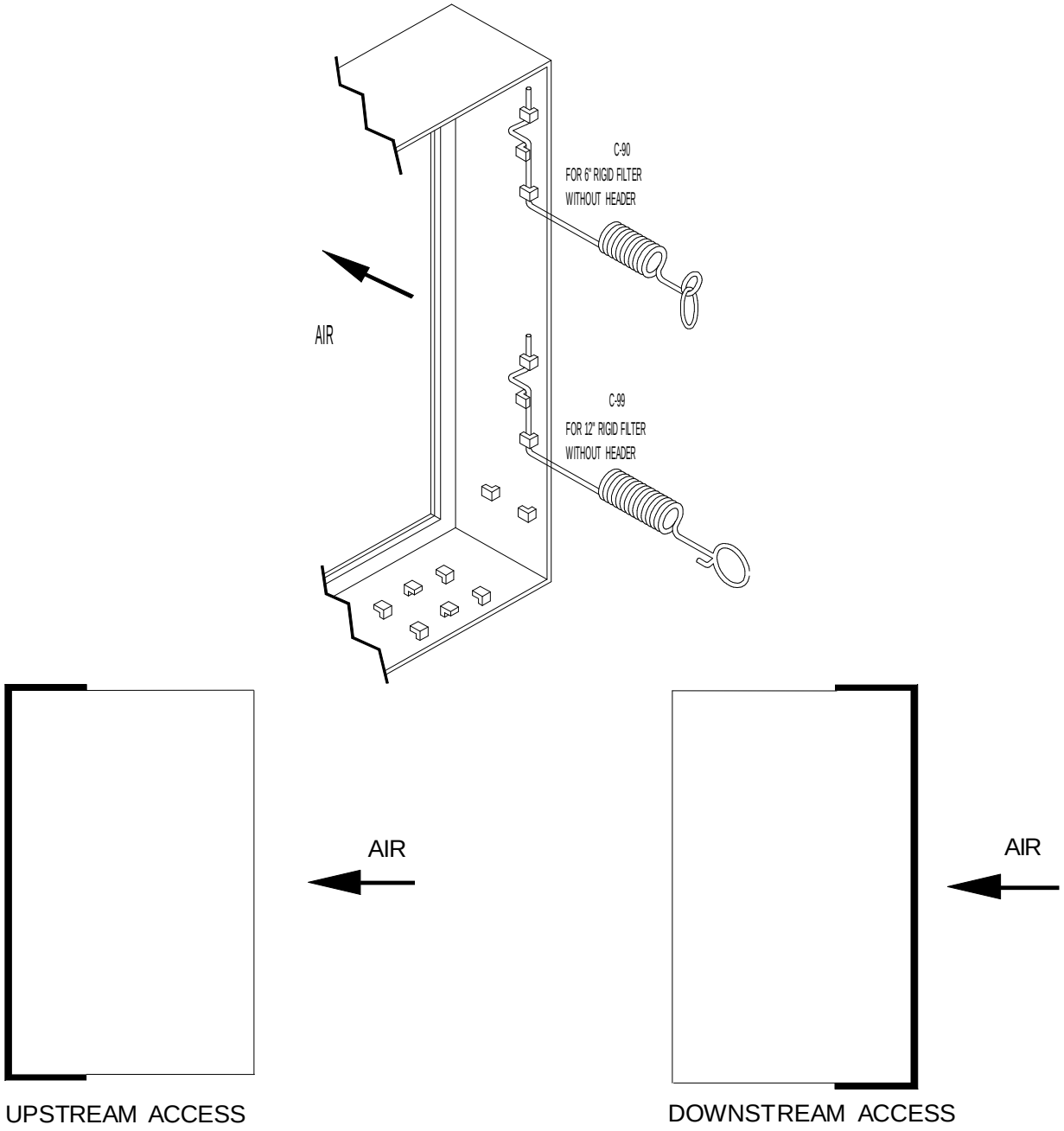


Figure 5
C-90 & C-99 Clip location for 6" & 12" Rigid filter without peripheral header for up & downstream access

C-90 & C-99 Filter Clip Application

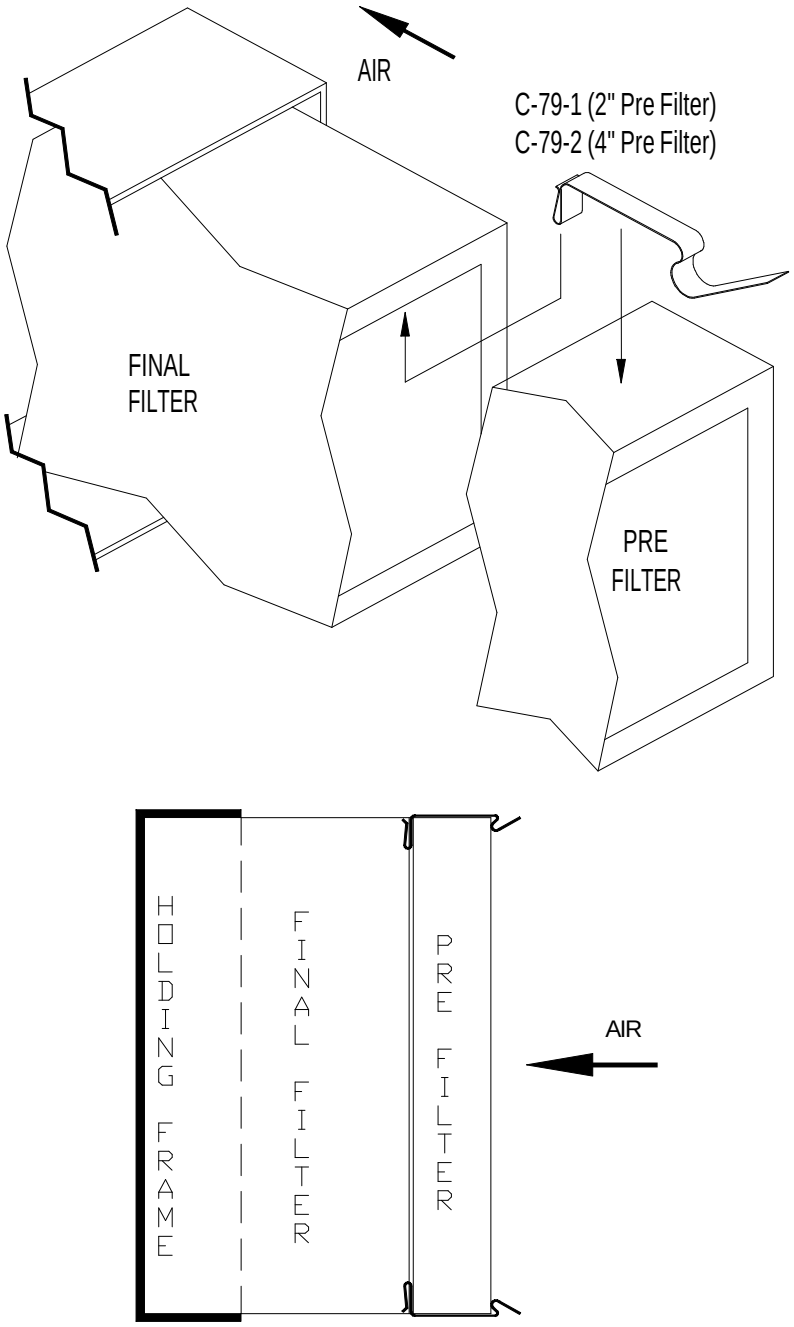


Figure 8
C-79-1 & C-79-2 Filter Clip location for 2" & 4" Pre filter used with 6" & 12" Rigid filter without peripheral header for upstream access

C-79 Filter Clip Application

4.0 Blowers

See the product specific I, O&M.

5.0 Air Balance

Velocity - When air moves at a given velocity in a duct, it creates a pressure corresponding to the velocity; this velocity pressure (Vp) is a measure of kinetic energy in the fluid. Velocity pressure is always exerted in the direction of air flow. The relationship between the velocity pressures may be expressed by the following formulas:

$$Vp = \frac{V}{4005}$$

$$V = 4005\ Vp$$

It is therefore a simple matter to determine the velocity (fpm) of an air stream if the Vp can be measured. For example if a Pitot tube manometer hook up reads 0.250 in water, we substitute for the above equation:

$$(4005)(0.250) = 2002\text{fpm}$$

5.1 Static Pressure

Independent of its velocity, air, when confined within an enclosure such as a duct or tank, will exert itself perpendicularly to the walls of the enclosure. This is the compressive pressure existing in the fluid, and it is known as the static pressure (Sp). Unlike velocity pressure, which is always positive, static pressure, when it is above atmospheric pressure will be positive, but when below atmospheric pressure will be negative. The discharge side of a fan in a supply system will read a positive pressure, the inlet side of the fan in an exhaust system will read a negative or minus pressure.

5.2 Velocity Pressure

The manometer does not sense the actual velocity pressure directly, but by using the Pitot tube hook-up with the static opening connected to the low pressure side of the gauge and the total pressure opening connected to the high pressure side of the gauge, the manometer will read the difference between the two, or the velocity pressure.

$$Vp = Tp - Sp$$

5.3 Total Pressure

Static pressure is exerted whether air is at rest or in motion. Velocity pressure and static pressure change in the duct work with every change in the duct configuration, but the total pressure, on the other hand, remains constant. Hence, as the velocity pressure decreases, the static pressure increases and vice versa, because the static pressure is always the difference between the total pressure and the velocity pressure. It should be remembered, however, that in an actual duct system, the internal friction will cause a loss of total pressure. The static pressure in an exhaust system is always below atmospheric pressure, and it is customary among ventilation engineers to omit the minus sign affecting the static (gauge pressure). It is known, of course, that the total pressure is higher than the static pressure by the amount of velocity pressure.

When the unit is designed for connection to a duct system and the installing contractor assembles ducts, elbows, registers, grilles, etc. to the outer and/or inlet of the unit, the static pressure drop through the external duct work is called external static pressure. Fans selected must be capable of moving the desired air flow through the entire air moving system including the unit (internal Sp) and also the duct system (external Sp).

At a given flow rate the internal static pressure losses plus the external static pressure losses equal the system static pressure or the summation static pressure. These pressures are of great importance when troubleshooting for causes of reduced capacity, vibration, and noise.

Changes in the cross sectional are of duct (contractions or enlargements) cause changes in the velocity of the air flowing through the duct. When velocity decreases, the velocity pressure also decreases. Some of the

velocity energy is lost as a result of the design of the duct where the area changes. Some of the velocity energy is converted into static pressure energy in the continuing duct work. This conversion of velocity energy to static pressure is called static regain.

When contacting Loren Cook for assistance, the following information will be required:

1. **Unit's Serial Number** (Located on nameplate & submittal)
2. Job Name (Not Contractor)
3. Unit's Model No.
4. Customer's Unit Identification
5. Design Data and Actual Data.
    A. Fan RPM
    B. Unit SP (Across Fan)
    C. Unit CFM
    D. Pressure Drop of Water through Cooling Coil - (PSIG) (Needs to be FOOT of HEAD).
    E. Air Pressure Drop Across Coil - (In. of Water)
    F. Temperature Differential Across Cooling Coil (°F)
    G. Voltage
    H. Amperes
6. Fan or Motor RPM (Use a Tachometer, Stroboscope, or Revolution Counter).

5.4 Troubleshooting Air Side

An air moving system consists of the entire air circuitry through which air flows. Included in the system are such components as duct work, fittings, branch ducts, dampers, heat exchangers, filters, coils, elbows, registers, grilles, and other items through which air flows or which offer obstruction to air flow.

While differences in temperature and humidity may cause air movement, it may be considered very slight in comparison to the positive circulation required in an air conditioning system. To accomplish this air movement, a fan has two functions to perform:

1. To produce sufficient pressure or head to accelerate the mass of air from a state of rest to the required velocity.
2. To produce sufficient pressure to overcome any resistance to the flow of air.

The determination of these pressures is a very important part of troubleshooting an air conditioning system. The generally accepted standard instrument for measuring these unit pressures is the Pitot tube. The pitot tube is used in conjunction with an Inclined Manometer, Magnahelic Gauge, or a tube Manometer.

When the Pitot tube is used in conjunction with these instruments, one is able to read velocity pressure (Vp), static pressure (Sp), and total pressure (Tp) within the system.

5.5 Pitot Tube

The pitot consists of an impact tube within a larger static tube. When the impact tube is pointed directly into the air stream, the small static pressure holes are perpendicular to the air stream and are not affected by air velocity.

To read velocity pressure, the total pressure tap at the end of the Pitot tube is connected to one leg of a manometer and the static pressure tap at the side of the Pitot tube is connected to the other leg of the manometer.

5.6 Inclined Manometer

This instrument, also known as a draft gauge, is a simple, foolproof device, which responds directly to the air pressure exerted against it (transmitted from the pitot tube), and reads directly in inches of water. Ranges for these instruments vary, and the technician should have one or more instruments to cover the range of 0 to 8 inches of water.

5.7 Magnahelic Pressure Gauge *(Standard)*

"Magnahelic" is not a generic term but is registered by Dwyer Instrument Company. The magnahelic gauge is a diaphragm operated gauge that has several advantages over a liquid manometer; (1) it need not be leveled to 0 and can be used easily on a ladder or unleveled surface. (2) When hooked up to the Pitot tube, it need not be purged of air bubbles as the liquid manometer may. (3) There is less chance of parallax error reading in the dial face. (4) It is easily transported without the chance of losing the liquid charge. Unless extreme accuracy is required, this instrument may replace the manometer for average air conditioning work, and like the manometer, is available in a variety of ranges. The dial is only 4 inches in diameter and therefore has a limited scale; several instruments are required to cover the normal ranges encountered in average air conditioning jobs.

5.8 "U" Tube Manometer

Pressure is defined as force per unit area - and the best way to measure air pressure is to balance a column of liquid of known weight against the air pressure and measure the height of liquid columns so balanced. The units of measure commonly used are, inches of mercury (in Hg), using mercury as the fluid and inches of water (in WG.) using water or oil as the fluid. Instruments employing this principle are called manometers. The simplest form is the basic well known U-tube manometer. This device indicates the difference between two pressures or between a single pressure and atmosphere, when one side is open to the atmosphere. If a U-tube is filled to the half way point with water and air pressure exerted on one of the columns, the fluid will be displaced. Thus one leg of water column will rise while the other falls. The difference in height "h" which is the sum of the readings above and below the half way point indicates the pressure in inches of water column. The U-tube manometer is a primary standard because the difference in height between the two columns is always a true indication of the pressure regardless of variations in the internal diameter of the tubing.

6.0 Coils

A Loren Cook unit may be equipped with chilled water, chilled/hot water energy recovery coils.

6.1 Airflow and Pressure Drops

Air flow for chilled water and direct expansion coils, must not exceed 500 feet per minute to prevent condensate water from being pulled off the coil and outside the condensate drain pan.

The static pressure drop across each coil will change with the number of rows deep, number of passes, fins per inch and other design conditions. Consult the written submittal for each unit on this job.

6.2 Hot Water Coils *(Summer Conditions)*

The temperature rise of the air leaving the coil is also dependent on the airflow across the coil, the gallons of water flow through the coil, and the entering water temperature into the coil. Consult the submittal for each specific job for the above information.

$$BTUH = 500 \times GPM \times TD$$

The static pressure drop across each coil will change with the number of rows deep, number of passes, fins per inch and other design conditions.

6.3 Freeze Protection of Coils

All chilled water, hot water, and steam coils can be damaged during freezing weather. Precautionary measures must be taken to prevent freezing such as:

1. Draining each coil and related piping, making sure that all low areas also drain.
2. After draining, flush coils with an antifreeze solution such as ethylene glycol. A solution of 50% ethylene glycol and 50% water will protect from freezing to approximately 35°F below zero at sea level.
3. In case of unit shut down during winter operation, such as unit power failure, night shutdown, and weekend shutdown, the controls must be installed so the valves will go to the full heat position, all fresh air dampers and exhaust dampers go to the full closed position, and all return dampers go to the full open position. The water circulation pumps must keep circulating water through the coils and/or auxiliary heat must be maintained within the unit cabinet.

6.4 Piping & Control

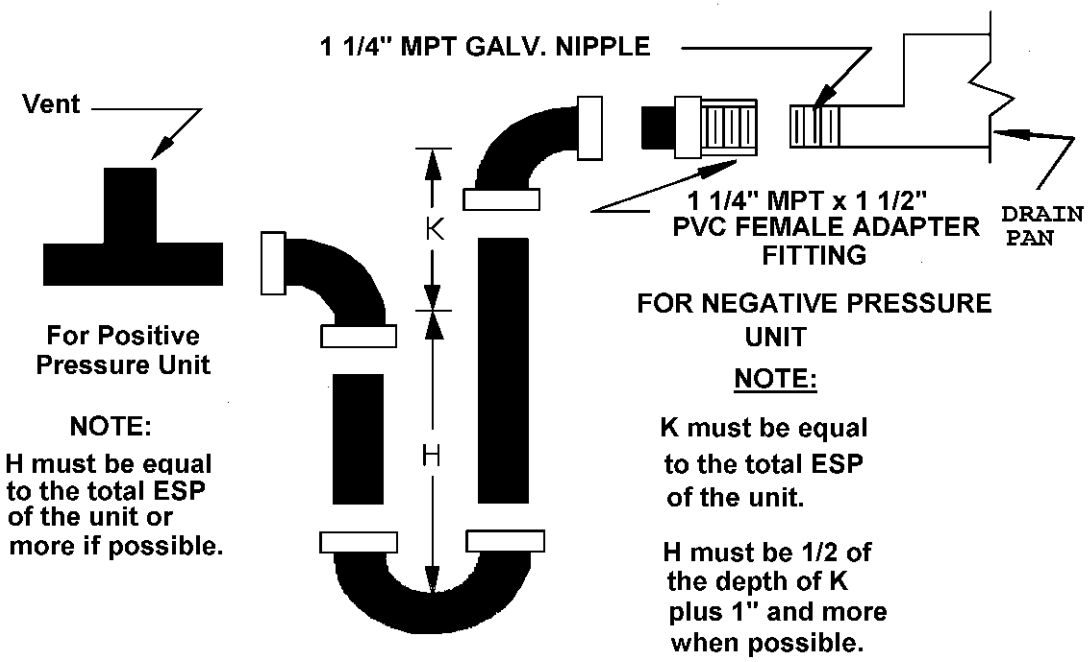
Consult the job specification for the specific piping requirements for each unit.

6.5 Condensate Drain

The majority of evaporator coils are located in the units so that the supply air is drawn through them. This results in the condensate being induced to the area of low static pressure. Unless some means of pressure equalization is provided in the condensate drain, the air rushing through the drain will cause the condensate to accumulate in the drain pan. As the unit continues to operate, the accumulated water will be picked up by the in-rushing air and carried with the air over the side of the drain pan causing possible water leaks into the supply duct and/or through the bottom of the unit causing water damage in the building. A minimum trap should be installed to prevent this condensate water buildup. See illustration below. On initial start-up, it may be necessary to fill the trap manually or, after the unit has operated sufficiently for a small amount of condensate to collect in the drain pan, turn off the unit and the trap will automatically fill.

Winter Operation
Special care is to be taken to prevent freezing during winter operation when conditions are at or below freezing. See local codes for procedures and applications used unique to the region the equipment is installed to prevent freezing and possible damage.

Note: If lengthy drain lines are used to drain the condensation into roof drains, it may be necessary to use anti-slime tablets in drain pan to prevent clogging.



7.0 Dampers

With the custom design nature of the Loren Cook equipment, your unit may contain outside air, supply air, return air, exhaust air, face, by-pass isolation or any other type dampers in various configurations. Be sure to review the contract submittal and sequence of operation in order to fully understand the operation of your equipment.

Caution: Dampers, operators, controls, and linkage must be checked prior to applying power to the operators to ensure that nothing will obstruct the operation of the dampers. Do not over-drive damper operators as this may cause damage to the dampers.

7.1 Fresh Air, Return Air and Exhaust Air Damper Motors

One or more damper motors operate outside air, return air, and exhaust air dampers which function in response to mixed air thermostat or through mixed air lock-out to minimum position. Spring return on damper motors close outside air dampers, close exhaust dampers, and opens return air dampers when there is no power to the motors.

7.2 Damper Maintenance

The damper is a component that is engineered to give years of trouble-free operation, but as with any mechanical device, some maintenance is required. A regularly scheduled inspection including the following items should be made to maximize the damper assembly life and keep leakage at a minimum.

1. The motor operates the load properly.
2. The motor responds properly to the controller.
3. The motor returns the damper to the starting position whenever power to the motor is interrupted.
4. There is no binding or stalling of the motor as the motor travels through its entire range.
5. Check all linkage for binding and confirm free travel.
6. Check all bolts on side linkage for tightness.
7. Check side seals for wear and or deterioration, replace if required.
8. Check side seals for build-up of dirt and other matter, clean if required.*
9. Check blade seals for all dirt accumulation, wear and or deterioration, clean or replace if required.**

* Side seals maybe cleaned with soap and water or mineral spirits depending on the composition of the build-up. "Goof Off" marketed by Atlanta Sundries and available at many hardware stores, is an excellent clearer for this purpose.

** Blades and seals should be cleaned with soap and water only.

Notes:
1. To simplify checkout procedure, it is suggested that an auxiliary potentiometer be substituted for the controller. This may be obtained through your local controls supplier.
2. The applicable MSDS sheet should be read and understood prior to using cleaning chemicals.
3. Items 4 and 5 should be checked during initial run in period, because of the presence of construction dust and material in the air stream.

Limited Warranty

Loren Cook Company warrants that your Loren Cook fan was manufactured free of defects in materials and workmanship, to the extent stated herein. For a period of one (1) year after date of shipment, we will replace any parts found to be defective without charge, except for shipping costs which will be paid by you. This warranty is granted only to the original purchaser placing the fan in service. This warranty is void if the fan or any part thereof has been altered or modified from its original design or has been abused, misused, damaged or is in worn condition or if the fan has been used other than for the uses described in the company manual. This warranty does not cover defects resulting from normal wear and tear. To make a warranty claim, notify Loren Cook Company, General Offices, 2015 East Dale Street, Springfield, Missouri 65803-4637, explaining in writing, in detail, your complaint and referring to the specific model and serial numbers of your fan. Upon receipt by Loren Cook Company of your written complaint, you will be notified, within thirty (30) days of our receipt of your complaint, in writing, as to the manner in which your claim will be handled. If you are entitled to warranty relief, a warranty adjustment will be completed within sixty (60) business days of the receipt of your written complaint by Loren Cook Company. This warranty gives only the original purchaser placing the fan in service specifically the right. You may have other legal rights which vary from state to state.

LOREN COOK COMPANY

Corporate Offices: 2015 E. Street Springfield, MO 65803 417.869.6474

WWW.LORENCOOK.COM

ENERGY RECOVERY PLENUM OPERATION AND MAINTENANCE MANUAL – November 2013