1. INSTALLATION, OPERATION

2. OPERATION AND MAINTENANCE MANUAL

2.1. SHIPPING

Units are normally shipped Ex-Works. They are inspected prior to despatch for goods condition and carefully loaded in containers with no crating/boxing. Hence, in case of transit damage, the forwarder must be informed immediately. All claims must be directed to the forwarding/insurance agents and SAIVER take no responsibility.

When units are shipped FOB port, they are either containerised or crated and delivered FOB to forwarders. Immediately upon receipt on site, inspection should be made and any damages must be reported by telex to SAIVER as well as to the forwarding/insuring agents within 24 hrs of receipt.

2.2. OFF LOADING

Special care must be taken to ensure that units are offloaded from the containers. Rough handling can result in damage to aluminium frame work and double skin panels. It is possible to lift the sections by slings or by forklift.

Slings, preferable nylon, must be place around the structural base frame as shown in fig 2.2-1.

fig 2.2-1

fig 2.2-2

fig 2.2-3

Before lifting the section, It must be ensured that the slings are properly located so they don't slide from their slot (see fig 2.2-2 and fig 2.2-3).

If everything is all right, then the section can be elevated and taken away (see fig 2.2-4).

fig 2.2-4

In the case in which is utilised a lifting tube, it must be inserted into the specific hole as shown in fig 2.2-5.

fig 2.2-5

Then the sling, which is equipped with a particular loop, must be connected to the tube as shown in fig 2.2-6 and fig 2.2-7.

fig 2.2-6

fig 2.2-7

After that, the section can be lifted (see fig 2.2-8 and fig 2.2-9).

fig 2.2-8

fig 2.2-9

It is necessary to utilise slings opportunely sized on the ground of the section weight.

The larger and heavier units should be lifted using a forklift with sufficiently long extended forks to prevent damaging the underside of the unit.

It is strongly recommended that offloading and installation operation are carried out by specialists with necessary equipment and proper tools. SAIVER cannot accept responsibility for any damage sustained during offloading and installation.

2.3. SHORT DELIVERY/DEFECTS

All items must be checked against purchase order, SAIVER drawing and the packing list for correctness and any claims for non compliance or short supply or any manufacturing defects must be reported to SAIVER by telex within three days of receipt.

2.4. INSTALLATION

Prior to installation, it must be ensured that adequate access exists for connecting all supplies, disposal of condensate/overflows, inspection, maintenance and for replacement of renewal parts such as filters, belts, bearings etc.
Installation of units must be in accordance with good engineering practise. Structural base for the units must be level and rigid.

Further it must be ensured that the base is high enough from the floor to allow the installation of condensate drain with necessary trap for easy flow as show in fig 2.4-1. It is suggested to take advice for locating the suspension points for ceiling hung units.

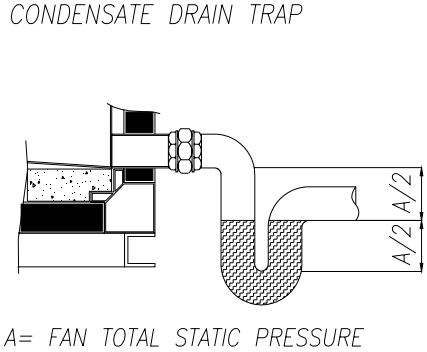

fig 2.4-1

2.5. ASSEMBLY

Units are normally designed to make best use of containers (shipping) volume in two or more sections depending on the design of units. However all the sections are externally marked and their sequence of assembly can be easily identified from the enclosed drawings.
Once all the sections are located, they can be easily aligned and locked together.

fig 2.5-1

First of all, between the sides of the sections that shall be connected, it must be inserted a continuous foam gasket for airtight seal as illustrated in fig 2.5-1.

Push the sections towards one another, making sure that they are lined up with one another.

Consequently the sections are locked together by stainless steel bolts located in factory predrilled assembly holes (see fig 2.5-2 and fig 2.5-3) into the corner brackets on the inside of the frame. Make sure that they are firmly in position.

Necessary stainless steel bolts and foam gaskets are supplied in a bag, normally located within the respective section.

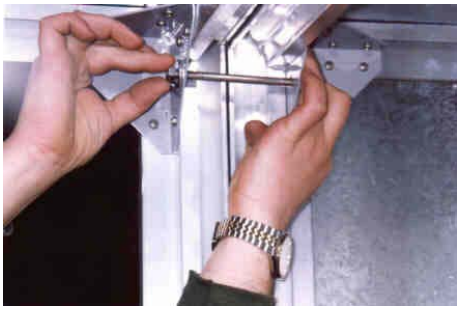

fig 2.5-2

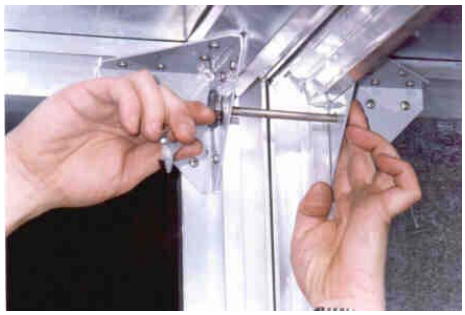

fig 2.5-3

It must be noted that, during installation and assembly, there is a possibility of misalignment if individual sections are not carefully handled. Do not use excessive force to align because it may deform the aluminium structural framework.

In the case it is not possible to access the inside of the casing, the connection can be made either by opening an inspection door or by removing a wall panel.

While SAIVER take no responsibility for consequences due to mishandling etc, will try to assist to ensure that units are properly installed. In case services of factory personnel are required for assembly the same can be provided at extra cost.

2.6. SETTING UP OF COMPONENTS

Duct connection: when duct flanges are connected to damper frames, it must be ensured that the fixing bolts are of correct length and do not obstruct the movement of damper lever/linkages.

2.6..1. DAMPERS

All dampers must be checked for free movement prior to proceeding further.

1) *Manually operated dampers* can be adjusted to obtain the required airflow, by loosening the bakelite knob and then turning the control lever. Bakelite knob must be tightened after setting up at the desired location on locking quadrant.

2) *Motorised dampers* are supplied with the linkage rod for connection to the actuator. It must be ensured that the actuator motors (not supplied by SAIVER) are rigidly fixed to the structural framework of the unit and not to the double skinned panels. Care must be taken to ensure that the actuator does not attempt to push the damper beyond fully open or fully closed positions.

2.6..2. FILTERS

Check the type and quality of filters is in accordance with the drawing.

1) *Panel Filters*: with flat or corrugated media are normally fitted within the unit prior to shipping.

2) *Bag Filters*: along with *pre-Filters* (if any) are normally shipped in closed carton boxes, as supplied by filter manufacturer, to avoid any collection of dust and loss of efficiency prior to commissioning. Each Bag Filter is housed within a special holding frame with necessary locking spring to ensure proper sealing. A bank of such special frames (quantity depends on the type and air flow) is assembled within the peripheral aluminium framework of each Bag Filter Section. Entire assembly along with Pre-Filter must be locked with four springs to ensure no leakage of air.

3) *Automating roll Filters* have two headers, one houses the clean spool, while the other dirty spool, which is driven by a geared motor and chain drive actuated by differential pressure (D.P.) switch. Normally filter media and D.P. switch are supplied loose for site installation. For assembly, filter media roll is mounted on the clean spool header, taken along the guide channel through working section and locked to the dirty (driving) spool. D.P. switch must be installed and connected to the control panel as shown in the circuit diagram.

4) *Absolute Filters* are shipped in sealed carton boxes, as supplied by filter manufacturer. They are housed in a special purpose made of aluminium frame with corner brackets and locking devices for each cell. While assembly special care must be taken to ensure that each filter cell is properly seated within the assembly frame and perfectly sealed against the neoprene foam gasket with no possibility of air leakage.

5) *Other type of Filters* such as Actuated Carbon, inertial (sand) Filters, if installed, will be supplied with manufacturer's instructions along with the units.

2.6..3. HEAT EXCHANGER COILS

All coils are leak tested and checked prior to assembly. Fins are checked for proper condition prior to shipping. However during handling and installation they might be slightly bent and hence they must be checked and combed out if necessary. Do not remove plastic protective covers from the header connections until the system is ready for hook up. System layout should take into consideration of possible coil withdrawal. All connecting pipework must be properly insulated.

1) *Water Coils*: system design, pipe connections and valve arrangement must be in accordance with good engineering practice. Flow and return connections are clearly identified on the unit panels and pipe work must be connected accordingly, preferably through flexible couplings to avoid transmission of any vibration from the piping to coil. Excessive tightening torque might damage the coils. Pipework must be supported independently to the coil and/or the unit.

   Use a pipe wrench to restrain the pipe connections of the heat exchanger when tightening the external pipe connections (see fig 2.6-1).

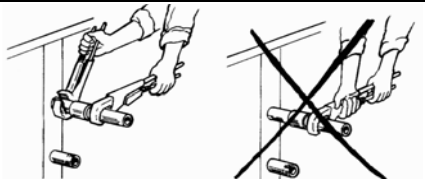

fig 2.6-1

   Plugged drain and vents are provided for each coil and their use must be limited to the respective coil. They must not be used for draining or venting the other part of the system. Sufficient antifreeze chemicals must be added to the circulating water in cooling coils, when there is a possibility of they being exposed to temperatures below 2°C.

It is recommended that the water flow is shut off when the fan is switched off.

Normally, each heating coil should be provided with its own circulation pump. This ensures an even circulation of the water in the air heater, regardless of the position of the control valve; and provides the following important benefit:
appreciably less risk of freezing, due to the fact that the water velocity in the coil is always sufficiently high.

2) *Direct Expansion Coils*: all direct expansion coils will be supplied with a refrigerant distributor suitable for brazed connections. No expansion valves are supplied by SAIVER. The refrigerant pipe work must be design and installed in accordance with good engineering practise and include necessary shut-off devices, dehydrators, solenoid valves, oil traps etc. Selection, sizing, installation and setting of thermostatic expansion valve should be in accordance with the recommendation of Condensing Unit manufacturer. Flow of nitrogen gas must be maintained through the coil while brazing to avoid formation of oxide film inside, which might clog the suction strainers affecting on the system operation adversely.

3) *Steam Coils*: these are similar to that of water coils, but in addition special care in take for collection and disposal of condensate within the coils. Condensate connections to the steam trap must be of same size as the coil outlet. Care must be taken to prevent entry of condensate in the main into the coil by trapping it independently on a coil bypass. The steam trap is normally sized 3 times the design flow.

4) *Condensate Drains*: All chilled water coils must be individually trapped and connected to drain with adequate pitch for easy flow. It is recommended to install a trap as shown in fig 2.4-1. Depending on the ambient temperature and plant location, it is recommended to insulate the condensate drain pipework.

5) *Electric Heater Batteries*: If not properly wired and controlled electric Heater Batteries can be dangerous by causing serious injury or fires or even DEATH.

Electric Heater Batteries are supplied in the form of sheathed elements assemble in aluminium framework. Double skinned panels are normally drilled for cable entry. Prior to connecting, heater battery assembly must be checked for conformity to local regulations. All wiring must be in accordance with local standards. In order to protect the elements from overheating and possible START OF FIRE, an airflow switch with necessary control must be installed to cut the power supply OFF to the heater elements.

Heater Battery must be interlocked with fan motor. Power supply must be SWITCHED OFF prior to removal of access door and not be switched ON until the access cover is replaced.

2.6..4. HUMIDIFIERS

Check the type of humidifier and ensure that the necessary Water/Steam/Electric power supplies are available for connection.

1) *Electric Pan Humidifier* contains an electric resistance or a bank of resistance in the form of sheathed elements, normally suitable for 3 phase power supply.

All wiring must be carried out in accordance with local standards with necessary controls. Connect water supply with shut-off valves. Ensure that overflow is connected to the drainage with a necessary trap.

Important

Check and clean if necessary the terminal screws etc, to ensure that there is no short circuiting between the resistance and the cover plate or the humidifier body.

2) *Steam (Pan) Humidifier* must be connected to the steam supply with shut-off valves, inlet strainer, solenoid valve etc. Condesate drain must be complete with a trap.

3) *Steam (Injection) Humidifier* is normally supplied with inlet strainer, modulating valve, condensate trap, steam injection manifold with condensate collector and discharge pipe. Ensure that the supply steam pressure is maintained within the limits marked on the modulating valve assembly and connected with a shut-off valve.

4) *Air Washer* is a closed circuit humidification system complete with water sump, inlet strainer, centrifugal pump assembly, isolating valves, water distribution system made of nylon tubes and self cleaning adjustable nozzles. Feed/Make-up water supply must be connected to the float valve with a shut-off valve. Overflow and drain connection must be complete with a trap. A common drain line may be used for overflow and drain connections, provided a shut-off valve is installed to isolate the drain connection. Connect power supply to the pump motor in accordance with local standards with necessary controls. Check the pump impeller for free rotation.

5) *Electronic Steam Humidifiers* are packaged type and manufactured by others. Please refer to manufacturer instructions for details on installation and maintenance.

6) *Eliminators*: There is a remote possibility of eliminator blades being displaced from their position during the transit/installation. In case of such occurrence, they must be set in position, which is a simple operation. Further it must be ensured that no foreign matter obstruct the airflow through the eliminator.

2.6..5. SUPPLY AND RETURN FAN ASSEMBLIES

Anti-vibration mounts, on which fan & motor assembly is suspended, are locked prior to shipping to avoid damage during transit (see fig 2.6-2). Once the unit is in position and fan outlet is connected to ductwork, A.V. Mounts must be released.

fig 2.6-2

Check the type and voltage of motor. If information is made available, cable entry holes through the double skinned panels can be factory drilled. However it is a simply operation to carry out the same on site, but ensure that no holes drilled and no connections are made through access door. It is recommended to use flexible armoured conduit between the panel and motor terminal box. All conduiting/wiring must be carried out in accordance with local standards.
Check the type of start (direct on line/star delta) meets with the local electrical regulations. Provide starter/controls/overload protecting devices/interlocks as required. Manufacturer instruction, which are supplied along with the motor, must be carefully studied and followed. Duct work must be connected and insulated in accordance with good engineering practise. Depending on specified noise levels, attenuators are to be selected and installed as per the recommendations of acoustic specialists. It is recommended to protect all lining and attenuation materials with smooth perforated metallic sheets to avoid migration of fibres into occupied areas/blockage and subsequent replacement of filters frequently.

2.6..6. ROOF CANOPY

Normally roof canopy is supplied loose to avoid damage during transit for assembly and installation on site. When units are supplied with bottom inlet and/or discharge, it must be ensured that proper flashing is carried out around base frame to avoid possible ingress of water.

2.7. DRIVE

2.7..1. BELT TENSION

The belts must be correctly tensioned to ensure good contact with the pulley. If insufficiently tensioned, the belts may slip, and if excessively tensioned, the motor and fan bearings may be overloaded.

When correctly tensioned (see fig 2.7-1), the belt deflection L will be 15 mm per metre of distance between centres c/c when a force P_1 (N) is applied and $P < P_1 < 1.5\ P$, where the force P is dependent on the belt type as shown in Table A.

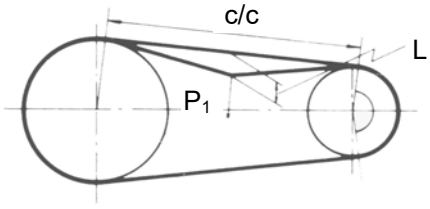

fig 2.7-1

The deflection should be measured preferable by means of tensiometer.

Table A

		Force P		
Belt section	**diameter of smaller pulley (mm)**	**0 ÷ 10 m/s (N)**	**10 ÷ 20 m/s (N)**	**20 ÷ 30 m/s (N)**
SPZ	67 ÷ 95	12 ÷ 18	10 ÷ 16	8 ÷ 14
	> 96	19 ÷ 26	17 ÷ 24	15 ÷ 22
SPA	100 ÷ 140	22 ÷ 32	18 ÷ 26	15 ÷ 22
	> 141	33 ÷ 48	27 ÷ 40	23 ÷ 34
SPB	160 ÷ 265	38 ÷ 56	32 ÷ 50	28 ÷ 42
	> 266	57 ÷ 72	51 ÷ 64	43 ÷ 58
SPC	224 ÷ 355	72 ÷ 102	60 ÷ 90	50 ÷ 80
	> 356	103 ÷ 132	91 ÷ 120	81 ÷ 110

2.7..2. CHANGE OF PULLEYS

SAIVER take no responsibility for the consequences, if the pulleys are changed without their written consent.

2.8. MAINTENANCE

In general air handling unit do not require special attention other then routine cleaning and maintenance work. Following is the recommended schedule of maintenance, when units operate at normal conditions. However actual conditions of use/operation will dictate the interval of checking/replacement of the filters, belts etc.

2.8..1. ONCE IN A WEEK

- Check filter condition at weekly intervals. Clean, wash or renew/replace if necessary.

2.8..2. ONCE IN A MONTH

- Check fan belt tension and adjust if necessary.
- Check the condition of spray nozzles and float valve in air washer.
- Check the condition of drain for free flow.
- Check the condition of resistance in electric Pan Humidifier.
- Check the condition of access door hinges and lubricate if necessary.

2.8..3. ONCE IN SIX MONTHS

- Check the fan motor running current.
- Check function controls and their effect on A.H. Unit components.
- Check fan and motor bearings.
- Check electric heater battery elements.
- Add water and flush condensate drain pan, trap and drain line.
- Check circulating pump and motor in air washer.
- Check the condition of inlet strainers.
- Check the condition of chilled/hot water.
- Add chemicals if necessary.

2.8..4. ONCE IN A YEAR (PREFERABLY AT THE START OF SEASON)

- Check the operation of dampers.
- Check the filter frame for proper sealing.
- Replace synthetic media in panel filters.
- Check the access doors for easy operation and proper locking.
- Check the controls and operation of Roll Filters.
- Check the coils and fin condition. Wash with water spray, if necessary.
- Check the condition of all insulating, regulating valves etc in the system.
- Vent the water coils.
- Check motor and fan bearing lubrication.
- Replace belts.
- Check all wiring, controls, isolating devices, terminal connections etc.

While attending to the above maintenance schedules, following must be noted.

2.8..5. FILTERS

It is important to check the condition of filters once a week. When the pressure drop across the filter exceed the maximum pressure drop given in SAIVER drawing, the filter must be attended immediately. Dirty filters reduces the air flow and hence the capacity. *Do not operate the system without filters.* In case the media is synthetic or metallic, they can be cleaned or washed. However it is recommended to replace synthetic media once in every year and metallic media once in every two years. Other filters such as Throw Away Panels, Bag, Absolute, Roll Filters must be replaced with new cells of identical media and efficiency.

2.8..6. HEAT EXCHANGER COILS

It is recommended to drain the water when the system is shut down. In case required coils can be withdrawn as follows:

- Disconnect the coil from the water connection.

- Remove the side (Doubled Skin) panel.
- Remove the bolts by which coil frame is fixed to the unit frame.
- Withdraw the coils. coil can be reinstalled by the following the above procedure in reverse.

2.8..7. SUPPLY AND RETURN FAN SECTIONS

Bearing lubrication

Normally fans are fitted with grease packed ball bearings Series: SY and type: UCP with minimum anticipated running life of (see Table B):

Table B

Fan with speed up to 1000 RPM	25000 hrs
Fan with speed between 1500 ÷ 2000 RPM	20000 hrs
Fan with speed between 2000 ÷ 3000 RPM	15000 hrs

Fans normally installed for high pressure /heavy duty application will have Series: 2300 ball bearings housed in plummer block type: SNA. The recommended intervals are as follow (see Table C)

Table C

BEARING HOUSING	FAN SPEED (RPM)					
	500	1000	1500	2000	2500	3000
SNA 607	25	25	18	17	13	10
SNA 608	25	25	18	15	12	9
SNA 609	25	25	18	14	11	8
SNA 610	25	21	16	12	8	5
SNA 611	25	18	15	11	7	3
SNA 612	25	17	13	9	4	-
SNA 613	25	17	12	8	2	-
SNA 615	25	15	10	5	1	-
SNA 616	25	13	8	2	-	-
SNA 617	25	12	6	1	-	-

(hrs x 1000)

Impeller removal

For some reason, if it is required to take the impeller out for cleaning, following procedure is recommended:

Forward Curved Fan

- Loosen motor mounting bolts and remove the motor.
- Remove belts and bearings.
- Loosen the fan fixing screw and withdraw the shaft.
- Unbolt the flexible connection on fan discharge.
- Turn the fan assembly by 90.
- Take out the impeller from the fan discharge opening. Handle carefully while cleaning, to avoid any damage to blades.

Backward Curved Fan

- Loosen motor mounting bolts and remove the motor.
- Remove belts and bearings.
- Unbolt and remove the flange of bearing supporting ring frame.
- Remove the aluminium inlet cone.
- Withdraw the impeller along with the shaft.
- Inlet cones and impellers are made of aluminium. They must be handled carefully.

2.8..8. CLEANING OF DOUBLED SKIN PANELS

All panels are double skinned and they can be easily detached from the framework by removing screw with simple hand tools. They can be cleaned or washed. However it must be ensured that they are completely dry prior to refixing. Do not drop any heavy weights or sharp edge tools etc. It might damage the plasticised finish or puncture the aluminium panels.

NOTE

If any further information is required, please contact SAIVER, who will be very pleased to assist.