2013

JUKER

Juker AHU's by *ECAS*

OPERATION & MAINTENANCE MANUAL

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LIST OF ACRONYMS/ABBREVIATION

ECAS	**:**	Egyptian Company for Air Systems
AHU	**:**	Air Handling Unit
Kg	**:**	Kilogram
mm	**:**	millimeter
m^3	**:**	Cubic meter
m^2	**:**	Meter square
m	**:**	Meter
cm	**:**	Centimeter
µm	**:**	Micrometer
h	**:**	Hour
Pa	**:**	Pascal
Kw	**:**	Kilo watt
W	**:**	Watt
V	**:**	Volt
RPM	**:**	Repetition Per Minute
˚C	**:**	Degree Celsius
AAF	**:**	American Air Filters
AHRI	**:**	Air conditioning, Heating and Refrigeration Institute
S&P	**:**	Soler and Palau
PVC	**:**	Polyvinyl chloride

WHO : World Health Organization

SBS : Sick Building Syndrome

HEPA : High efficiency particulate air-filter

ULPA : Ultra low penetration air-filter

EN779 : New European Standard for Coarse and Fine Filters

HVAC : Heating, Ventilation and Air Conditioning

IAQ : Indoor Air Quality

H : Height

W : Width

D : Depth

HX : Heat exchanger

DX : Direct expansion

BMS : Building Management System

CW : Clockwise

CCW : Counter clockwise

AMCA : Air Movement and Control Association

OEM : Original Equipment Manufacturer

AC : Alternative current

DC : Direct current

IC : International cooling

IP : International protection

ISO	**:**	International Organization for Standardization
ɳ	**:**	Efficiency
Q	**:**	Air volume
V	**:**	Velocity
Pd	**:**	Dynamic Pressure
Pt	**:**	Total Pressure
N	**:**	Fan speed
db	**:**	Decibel

Chapter One

1 EGYPTIAN COMPANY FOR AIR SYSTEMS

ECAS designs, engineers and supplies air handling units including industrial fans, drive motors, heat exchangers, air filters and air humidifiers. Established over 10 years ago as an engineering firm, ECAS has grown to become the leading company for air systems in the Egyptian market with nearly 60 employees.

Figure 1- 2(ECAS Factory "Borg Al-Arab")

Our equipment may be found in virtually every industry but particularly in those such as in power generation, petrochemicals, mining, steelmaking and cement manufacture where the most arduous air handling duties are to be found.

In addition, it's widely used in hotels, air ports, pharmaceutical industries, hospitals, laboratory, clean rooms, food processing industries, restaurants and precision manufacturing industries.

Our products are known throughout the world for their high levels of performance, reliability and state-of-the-art technology. We are constantly investing resources in product development to provide market-leading products that make our customers' processes more effective and more profitable.

At the core of the business lays ECAS Technology, working at the forefront of engineering, and with unique expertise in Industrial Fans,

Figure 1- 2(ECAS Factory "Borg Al-Arab")

Insulation Panels, Fan Sections, Air Curtains, Volume Control Dampers, Motor Tensioning Sliders, Pre-insulated Duct Systems, Sound attenuators, Pre-Filters, Sand Traps and at last but not least Air Handling Units.

We provide customer support when and where it is needed. Combining our knowledge with our extensive applications experience gained by our engineers on sites allows us to support our customers, not just from initial project inception but throughout the entire operating life of the plant.

Chapter Two

2 JUKER AIR HANDLING UNITS

From the start, we were determent that products we supply should be differentiated, cost effective and with highest quality, delivered through a team of energetic employees who take care of every detail from selection, sizing, throughout installation, commissioning to life service and maintenance.

From the very first beginning, we were selective in choosing our partners who have adopted state-of-the-art manufacturing methods to provide us with superior products that we will be proud of and share us the same believes, objectives and values.

Today we represent several worldwide, well-known international companies. Their names are the industry benchmark for quality in design, engineering and manufacturing. Their products offer the most comprehensive air filtration solution available in the world. Therefore we guarantee the quality and performance of the used components in all our Air Handing Unit including;

- **Air Filters:** American Air Filter company "AAF" or approved equal Filters
- **Coils:** ECAS manufactured coils based on AHRI standards
- **Fans:** Soler and Palau "S&P", metric fans, Spain
- **Motors:** European manufactured motors
- **Insulation Panels:** ECAS manufactured Panels or Prefabricated Panels

Today, our best reward when our customers contact us that they take in consideration that we will provide honest, objective, thoughtful and experienced advice.

2.1 AHU COMPONENTS

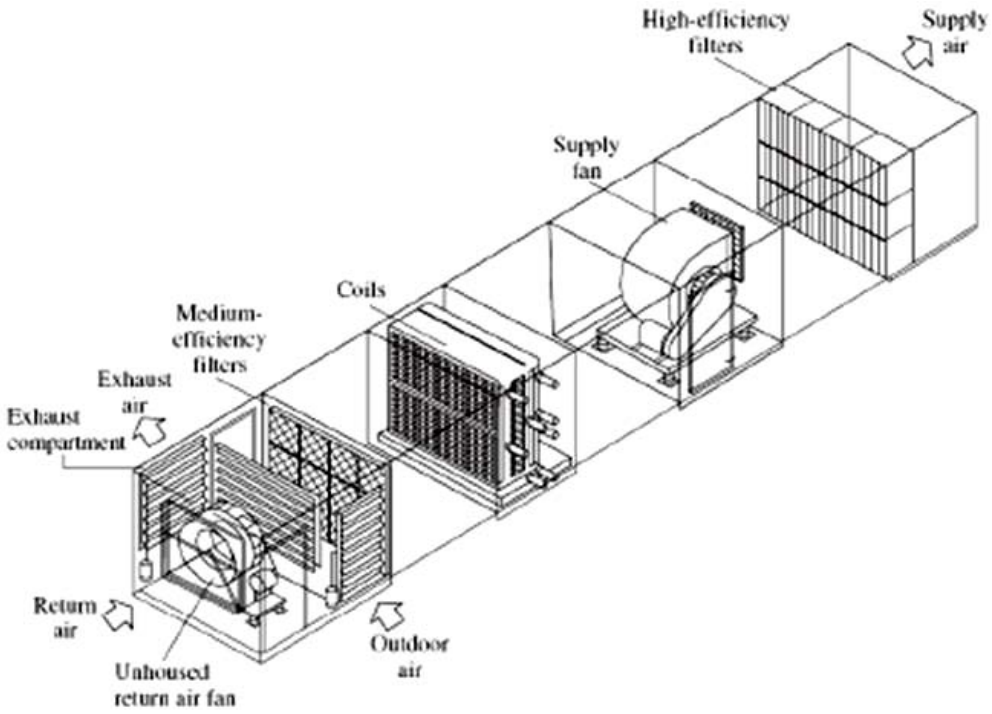


Figure 2- 3(Air handling unit component)

ECAS air handling units series, offers an ideal solution for civil, industrial and hygiene air conditioning plants, considering the mechanical characteristics of the structure and its internal clean ability, quality and accuracy of performances. Available in various models with air flow rates ranges from 1,500 to 80,000 m³/h.

The technical characteristics and the efficiency of the selection program, full interactive enable ECAS to offer one of the most advanced series of units in its class in the Middle East.

2.1.1 Air Handling Units Casing

The casing is composed of self supporting frame constructed from extruded aluminium profiles with their natural colour, assembled by special fine accessories to be easily cleanable and to give accurate alignment and as well corrosion resistant structure.

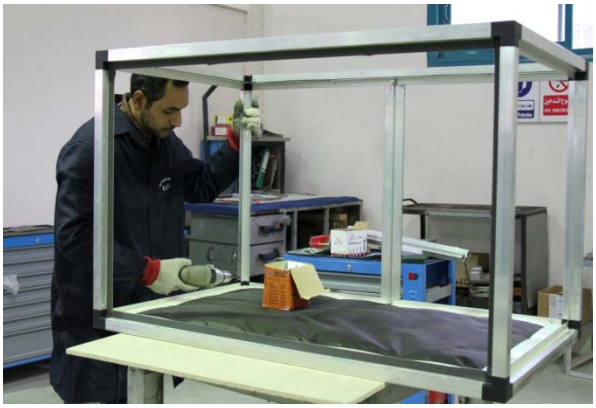



Figure 2- 2(Air handling unit casing)

2.1.2 AHU Structure

The chassis are made from rigid aluminium extruded bars connected by means PA 6 with 30% fibreglass special joints UL94-V0 fire resistance class. The double room in aluminium section ensures the housing of panel screws.

Three versions are available:

- ❖ Cleanable structure
- ❖ Thermal cut structure
- ❖ Base type structure

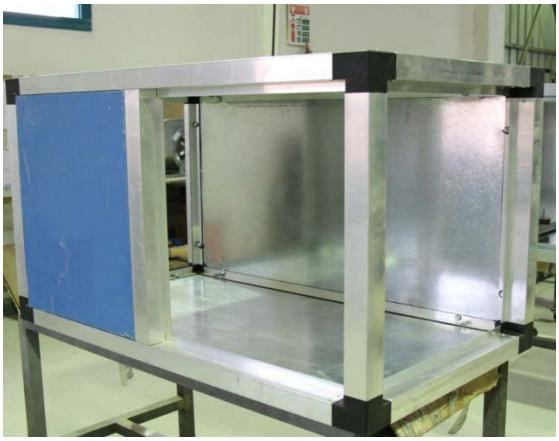


Figure 2- 2(Air handling unit casing)

2.1.3 AHU Insulation Panels

The panels are manufactured from galvanized steel, Aluminium or Stainless steel with various panel thicknesses either 25 mm with a density of 37 Kg/m³ or 45 mm with a density of 42 Kg/m³. The galvanized panels are either all galvanized or plastified/galvanized.

Double skin panels; has many forms of insulation material starting from the rock wool insulation going through the injected polyurethane panels which have better insulation factor than rock wool, in addition the P3isomac aluminum panels with a density of 47 Kg/m³ in which it has the higher insulation factor and much more advantages.

Figure 2- 3(Prefabricated insulated panel)

Galvanized screws inserted in nylon sleeves are used to fix the panel to the frame and air tightness is assured by an exclusive rubber seal under the panel.

P3isomac panels Advantages:

Thermal insulation: P3isomac panels are made of polyurethane foam that, due to the high number of closed cells (exceeding 95%), has a specific heat conductivity value of 0.024 W/m² °C. Compared to traditional foam panels, P3isomac panels provide a thermal insulation that is both uniform and continuous in every way.

Sound insulation: The sandwich structure of the panels (sheet/ expanded polyurethane/ sheet) and the high density of the foam ensure a high level of soundproofing.

Mechanical resistance: Zinc coated steel or aluminum coating provide high resistance to mechanical strain, responding in an efficient way to both traction and extension.

Life time: Thanks to the sandwich structure and the quality of the outer coating, P3isomac panels guarantee a noteworthy resistance towards erosion, deformation and corrosion.

Conformity: The TSC system for the production of P3isomac panels, guarantees a perfect continuity of thickness and a perfect adhesion between the coating sheet and the polyurethane foam.

Fastening the panels: The special PVC frame borders allow the panels to be fastened either from the inside or the outside. Thus, eliminating the problem of condensation by the thermal bridge created by the screws.

Inspection Access Doors: Constructed of sandwich panels as described above fixed to the casing frame by air tightening hinges and closed with plastic handles designed with a progressive threaded closing device. Mechanically secured exclusive rubber door seal ensures air tightness.

Figure 2- 4(Air handling unit inspection door)

On request the AHU can be equipped with:

- Bulkhead lights, with or without external switch.
- Unit support constructed of strong steel profiles with holes for unit lifting.
- Drain pan, either single or double panel insulation.
- All units can be easily supplied in separate divided sections or completely knocked down for transport, site, space or erection requirements.

2.1.4 Mixing Box

In order to maintain indoor air quality, mixing the right amount of fresh air with return air can be used to approach the desired supply air temperature and to improve the efficiency. A mixing box is therefore used which has dampers controlling the ratio between the return, outside, and exhaust air.

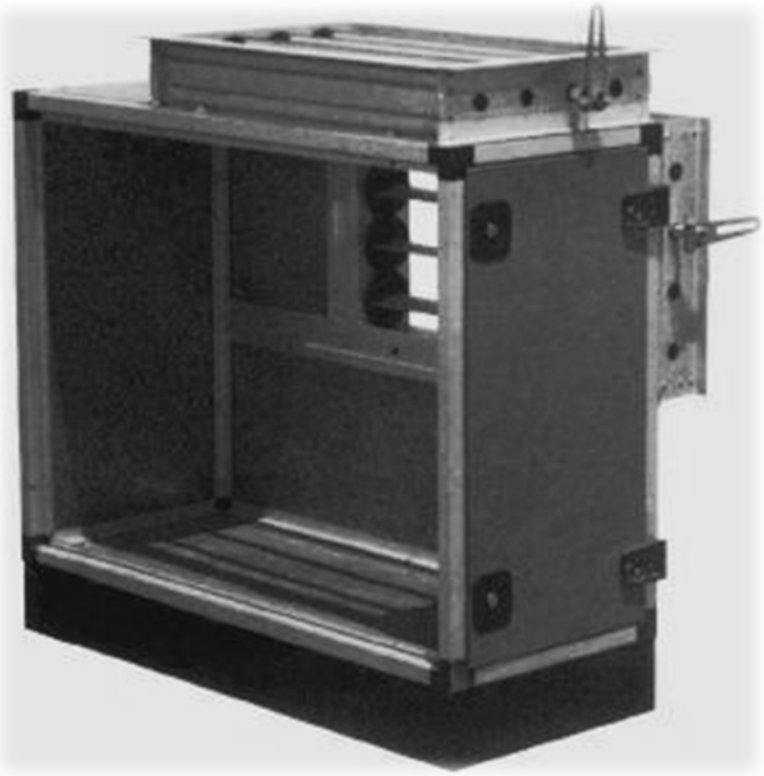


Figure 2- 5(Air handling unit mixing box)

The box could be manufactured with up to 3 dampers to provide mixing control of fresh, re-circulated and exhaust air streams.

The dampers are available in extruded aluminium profile blades with tight of shut edge seal. The dampers blades are gear wheel driven.

2.1.5 Volume Control Damper

Is a valve or plate that prevent or regulates the flow of air inside a duct or air handler units. A damper may be used to cut off central air conditioning (heating or cooling) to an unused room. Its operation can be manual or automatic on request. Manual dampers are turned by a handle on the outside of a duct. Automatic dampers are used to regulate airflow constantly and are operated by electric or pneumatic motors.

Figure 2- 6(Air handling unit volume control damper)

2.1.6 Air Filters

Air filtration is a topic affecting everyone's lives, whether it is for occupational safety requirements, environmental or home health concerns. Control of airborne particulates in indoor environments is critical to develop quality products, protect employees from contact with hazardous materials, or prevent health problems from prolonged exposure to allergens. How airborne particulates are controlled varies from industry to industry and from an occupational setting to a home environment.

According to the World Health Organization, 30% of commercial buildings show signs of Sick Building Syndrome (SBS). SBS is characterized by headaches, nausea, irritated nasal passages, itchy eyes, and skin irritation among building occupants.

Purpose of Filters:

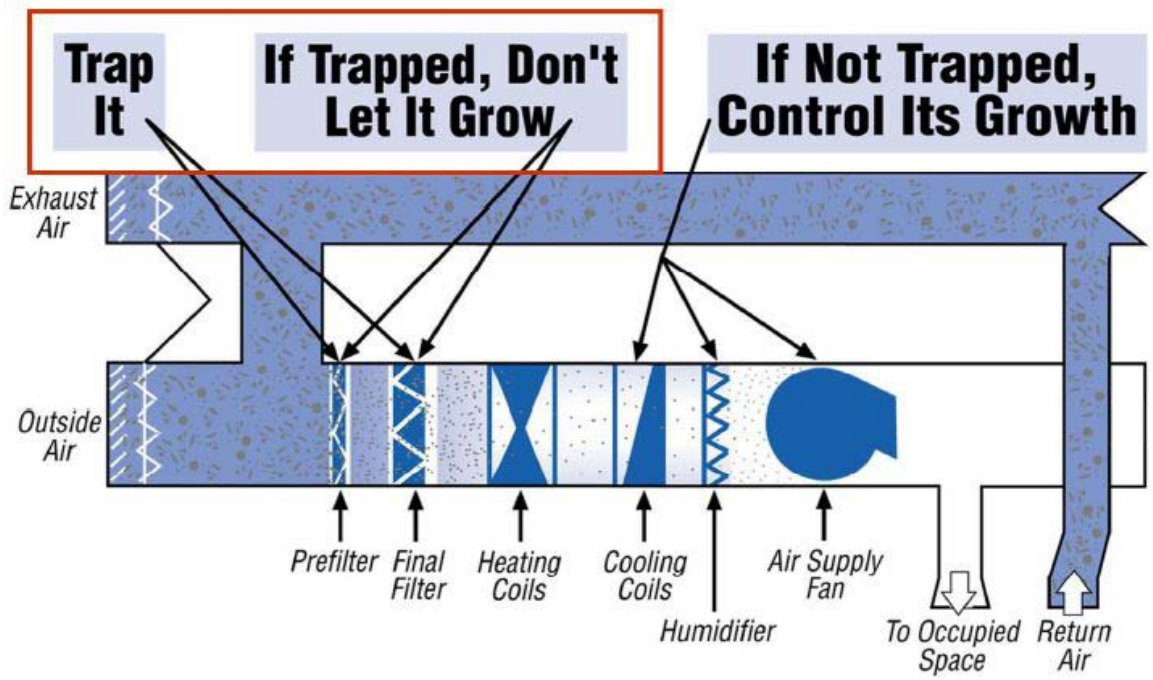


Figure 2- 7(purpose of filters)

Air Filters types:

- Sand trap
- Pre-filter
- Bag filter
- Carbon filter
- Hepa filter

Air Filters selection depends on:

1. Degree of air cleanliness required
2. Disposal of dust after it is removed from the air
3. Amount and type of dust in the air to be filtered
4. Operating resistance to air flow (pressure drop)
5. Space available for filtration equipment
6. Cost of maintaining or replacing filters
7. Initial cost of the system

Rating Filters: there are three operating characteristics that distinguish the various types of filters;

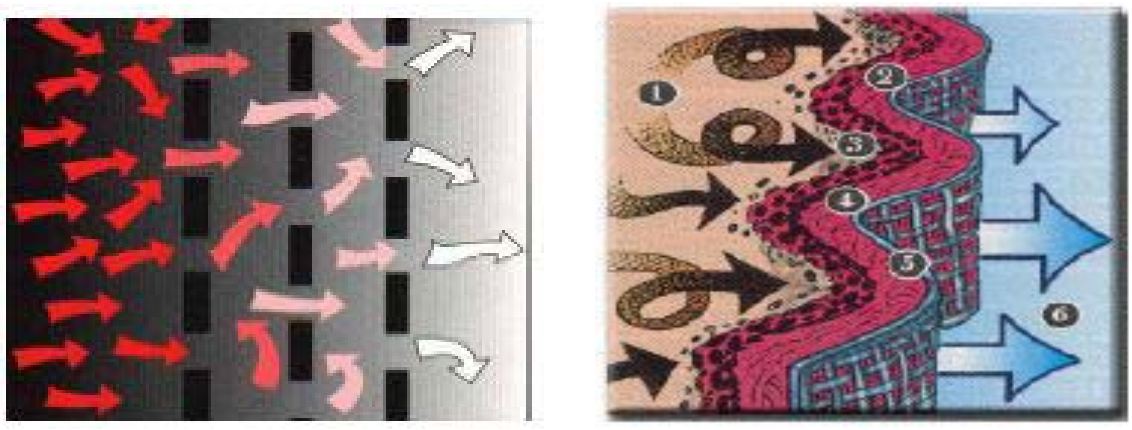


Figure 2- 8(Purpose of filters)

1- **Efficiency:** the ability of the filter to remove particulates matter from an air stream.

2- **Air flow resistance:** is the pressure drop across the filter at a given air flow rate.

3- **Dust-holding capacity:** the amount of particulate type that filters can hold when it is operated at a specified air flow rate.

Particles larger than 2.5 mm are classified as coarse dust while that less than 2.5 mm are considered as fine dust.

Type	Eurovent class	New Class	Efficiency	Measured by
Coarse dust filter	EU1	G1	<65	Synthetic dust weight arrestance
	EU2	G2	>65, <80	
	EU3	G3	>80, <90	
	EU4	G4	>90	
Fine dust filter	EU5	F5	40, <60	Atmospheric dust spot efficiency
	EU6	F6	>60, <80	
	EU7	F7	>80, <90	
	EU8	F8	90<95	
	EU9	F9	>95	
High efficiency particulate air filter (HEPA)	EU10	H10	85	Sodium chloride or liquid aerosol
	EU11	H11	95	
	EU12	H12	99.5	
	EU13	H13	99.95	
	EU14	H14	99.995	
Ultra Low Penetration Air Filter (ULPA)	EU15	U15	99.9995	Liquid aerosol
	EU16	U16	99.99995	
	EU17	U17	99.999995	

Figure 2- 9(Air filter ratings)

AAF Filter Selection per Filter classification:

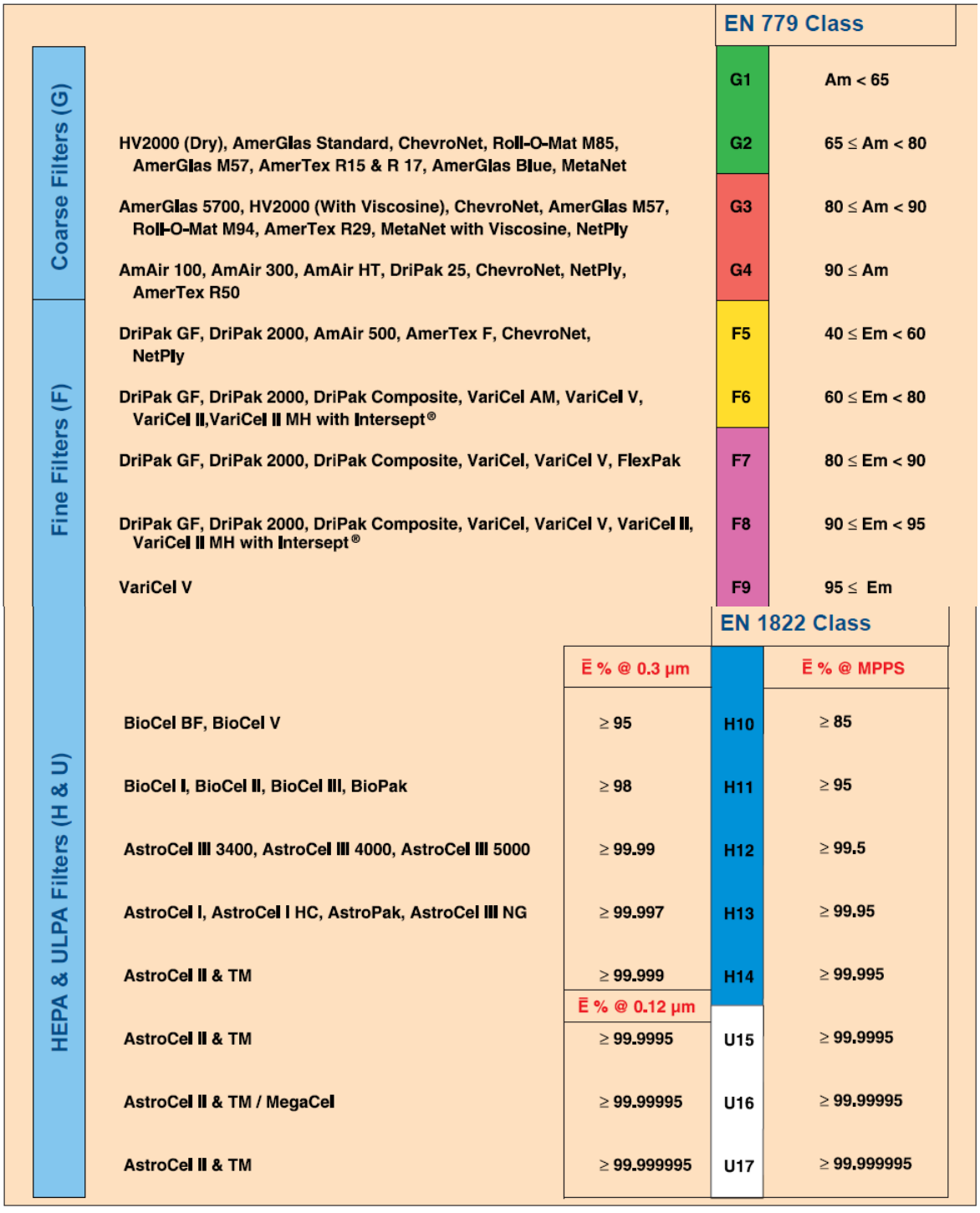


Figure 2- 10(American air filter ratings)

3.1.5.1 Sand Trap Louver

The sand trap louver is used as pro-filter for the protection of air conditioning plants in areas exposed to extreme levels of industrial pollution. It has high degree of separation of sand and large dust particles, even in cases of high dust concentrations.

The vertically arranged sections and holes for sand drainage to ensure that the sand trap louver is self cleaning and maintenance free. The sand trap louver is designed to separate large particles at low air velocities, thus avoiding excessive dust loading of conventional filters. It is not intended as a substitute for conventional supply air filtration plant.

Figure 2- 11(Sand trap louver)

3.1.5.2 Pre-Filters

Synthetic air filters are widely used in commercial and industrial HVAC systems to protect the cooling and heating coils from becoming coated with dust and lint. They can be used as pre-filters to more expensive higher efficiency filters.

MetaNet Pre-Filters: Are washable metal air filters used in heavy duty industrial applications, ventilation and air conditioning systems. They reduce maintenance cost as they are high dust holding capacity and long service life, washable, light and easy to install. According to EN779, their average arrestance is 75% - 85%. The filters are available in the classification range G2 according to the EN779 standard.

Figure 2- 12(MetaNet Pre-filter)

Owing to their excellent dust holding capacity and ability to perform in high moisture conditions they are particularly suitable for use as grease filters in kitchen hoods. Their ability to reduce grease deposits on fixtures and duct work has many cost saving benefits:

- reduces frequency of duct cleaning maintenance
- reduces the risk of fire
- prolongs the life span of fans and motors
- promotes health and safety in kitchens

NetPLy & ChevroNet Pre-Filters: They have a sturdy, long-lasting galvanized steel frame which offers great resistance in harsh operating conditions. Due to their lightweight and compact size (47 mm and 95 mm depth) they are relatively inexpensive to ship and easy to handle and install. If required, both filters can be supplied with a stainless steel or aluminium frame and can be manufactured to any size.

Figure 2- 13(NetPLy & ChevroNet Pre-filter)

Choice of Media

NetPLy and ChevroNet filters can be supplied with either of two types of synthetic media: AmerTex F or AmerTex R.

AmerTex F30 is a strong, multi-layered media, folded into uniformly shaped pleats to ensure an even dust loading over the surface of the filter which is necessary for high efficiency filtration. AmerTex F30 is classified F5 in accordance with EN 779.

AmerTex R synthetic media is available in 3 grades: R15, R29 and R35. The media is pleated and has a densely bonded structure, allowing dirt to be collected uniformly over the entire depth of the filter. Uniform dirt loading maximizes media usage, resulting in a more gradual rise in resistance, higher dust holding capacity and longer service life. The three grades of media are classified G2 - F4 in accordance with EN 779.

Filter cleaning:

ChevroNet can be blow cleaned with compressed air, but only once or twice during it's the natural lifetime. NetPLy can be regenerated with a solution of water and detergent or with compressed air, but on a limited basis.

3.1.5.3 Bag Filters

Bag Filters are designed to be used in areas requiring a high degree of air cleanliness. The filter consists of a series of individual pockets supported by a rigid metal header frame. Frame available in Galvanized Steel while the filter media available in Synthetic fine media.

DriPak 2000 with Intercept Bag Filters: Like most pocket filters DriPak 2000 With Intercept biostatic preservative displays excellent dust holding capacity on both inert and microbial particulates. Unlike most pocket filters though, DriPak 2000 has been treated with a unique biostatic preservative called Intercept which inhibits the growth of those fungi and bacteria documented to affect indoor air quality.

Figure 2- 14(NetPLy & ChevroNet Pre-filter)

This preservative prevents the growth of organisms on the filter media, protecting it throughout its service life. Intercept also inhibits odors' resulting from microbial growth. The combined characteristics of the DriPak 2000 filter media and Intercept biostatic preservative make this a superior indoor air quality filter compared to an untreated filter.

Treated media versus untreated media:

	Treated media	Untreated media
Dust	√	√
Inhabits Bacteria Growth	√	
Inhabits Fungi Growth	√	
Control Microbial Odours	√	

Moreover, DriPak 2000 synthetic filter media has many advantages over glass fiber media. In wet and humid conditions, DriPak 2000 synthetic filter media is also more resilient than glass fiber media: it does not tear or rupture as easily in difficult operating conditions. DriPak 2000 with Intercept® is available in the EN779 classification ranges F7 and F8 and is an ideal way to upgrade a HVAC installation and improve the quality of indoor air.

Technical Data

Rated Face Velocity[1] (m/s)	Actual Size[4] (wxhxd) (mm)	Number of Pockets	Gross Media Area (m^2)	Rated Airflow Capacity (m^3/h)	Rated Initial[2/3] Resistance (Pa)
90-95% Average Efficiency[2] - F 8					
3.2	592x592x700	9	8.0	4250	160
	287x592x700	4	3.6	2125	160
	490x592x700	7	6.2	3550	160
2.5	592x592x635	8	6.7	3400	135
	287x592x635	4	3.3	1700	135
	490x592x635	6	5.0	2850	135
1.25	592x592x508	6	4.1	1700	90
	287x592x508	3	2.0	850	90
	490x592x508	5	3.4	1400	90

Figure 2- 15(DriPak 2000 bag filter technical data)

3.1.5.4 Activated Carbon Filters

The benefits of activated carbon filters are widely acknowledged by the building services and medical professions. The improved environmental conditions which result from the control of odours and noxious vapours range from reduced fatigue, improved efficiency and fewer IAQ complaints to higher employee productivity.

In addition, the use of activated carbon filters in HVAC systems enables fresh air makeup to be kept to a minimum hence reducing heating and cooling costs and saving energy.

Figure 2- 16(Activated carbon Pre-filter)

To maximize the efficiency and service life of activated carbon it is necessary to protect it from unnecessary dust and particulate loading. The use of a pre-filter such as an AAF AmerGlas panel filter is recommended as this will prevent a rise in pressure drop and will maintain filtration efficiency.

3.1.5.5 Hepa Filter

To better understand why HEPA filters are used in the biological safety cabinet industry, it is necessary to explore particle sizes, types of filters available for home and occupational use, efficiency and penetration, filter standards and performance testing.

Particles are generated or become airborne with everyday human activity. Because many people spend the majority of their time indoors at work or home, the quantity of particles floating in the air are of great concern.
For example, a sedentary person in a standing or sitting position generates approximately 100,000 particles per cubic foot. Moving from a sitting to a standing position generates 2.5 million particles per cubic foot.
Moderate activity generates 30 million particles per cubic foot. Industrial processes in manufacturing or machine shops generate billions of particles per cubic foot.

Airborne particles vary in size depending upon the source. A strand of human hair is a good reference point when considering the relative size of large and small airborne particles.

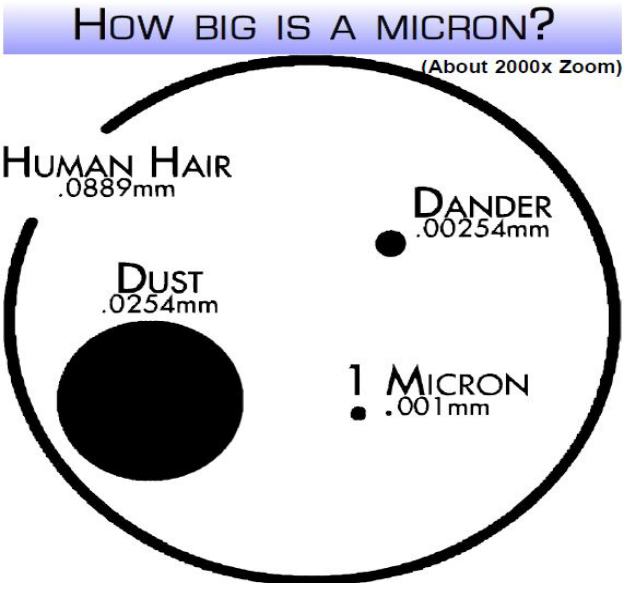


Figure 2- 17(How big a micron)

A filter's efficiency rating describes the relationship between particles retained or trapped by the filter to the number of particles entering the filter. For example a 99.97% efficient filter indicates that 99.97% of particles entering the filter are removed from the air by the filter.

To further describe efficiency, a filter is also rated by the size of particles at which it is most susceptible to particles passing through it, or its weakest point of particle penetration. Filter penetration is defined as the ratio of particles that pass through the filter media without being trapped to the number of particles that actually enter the filter.

As air passes through a HEPA filter, the air is not simply strained as many presume, rather a number of actions take place. First, as the air comes into contact with the bends and folds of the pleated filter media, the volume of airflow breaks off into numerous smaller air streams as its own velocity and the velocity of the air upstream forces the air through the filter.

Some particles become trapped because they are larger than the pores of the filter media, and cannot pass through. This takes place throughout the filter media while for large particles greater than 1.0 micron, the primary collection mechanism is impaction. For small particle entrapment in the 1.0 micron or smaller particle size range, diffusion is the primary collection mechanism.

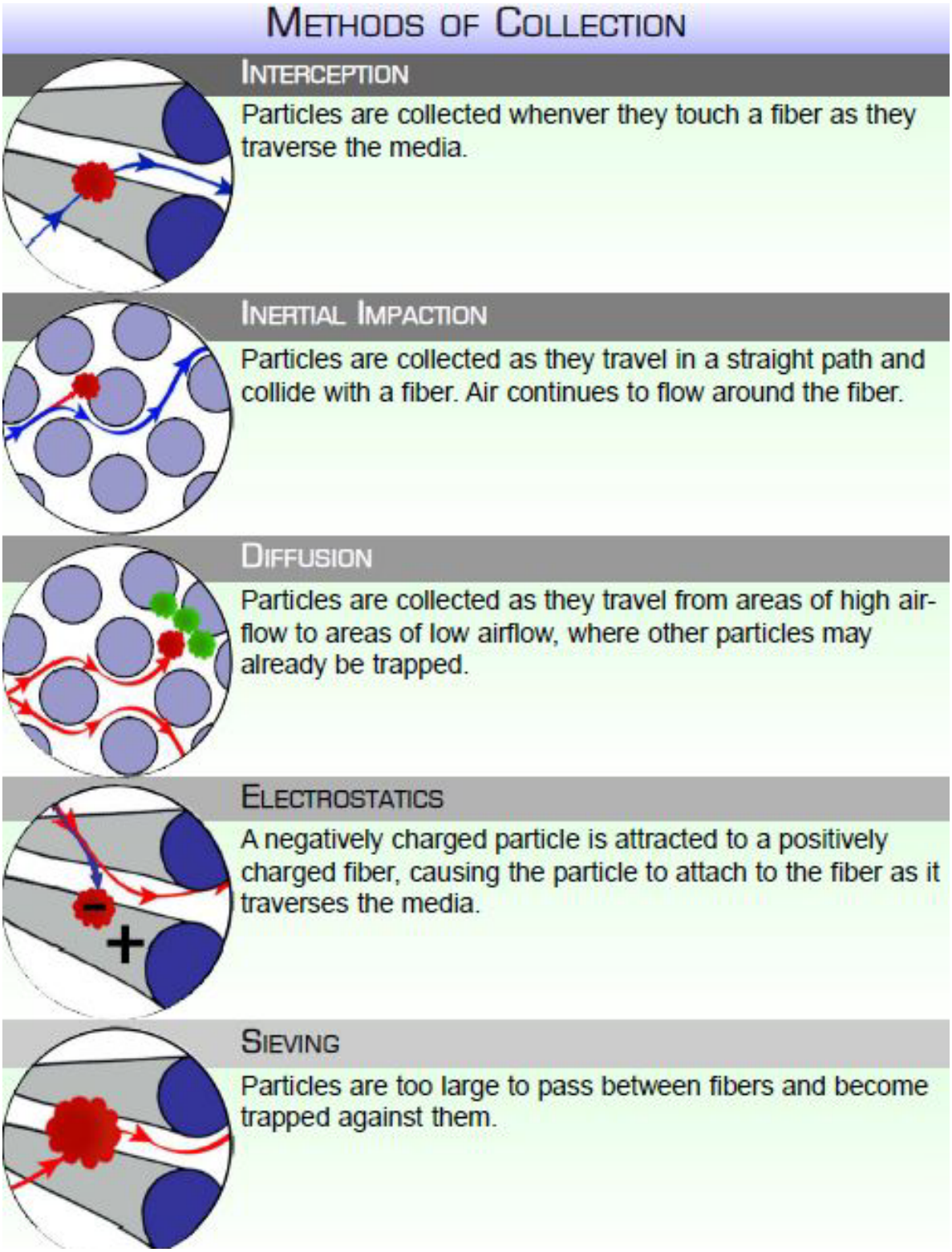


Figure 2- 18(Methods of collection)

AstroCel® III 3400 HEPA Filter: Is classified H12 or H13 in accordance with EN1822. The filter displays excellent efficiency on fine particulate matter and is designed for use in high air volume applications up to 3400 m³/h.

Due to its high capacity the filter has several benefits: in new installations, fewer filters are required to handle the same volume of air compared to HEPA filters of the same size with a lower capacity. As a result, less installation space is required and installation time is significantly reduced. In existing installations, the filter's high media area ensures a low pressure drop which reduces energy costs. More benefits, non-shedding construction.

Figure 2- 19(AstroCel® III 3400 HEPA Filter)

Resistance Vs Velocity

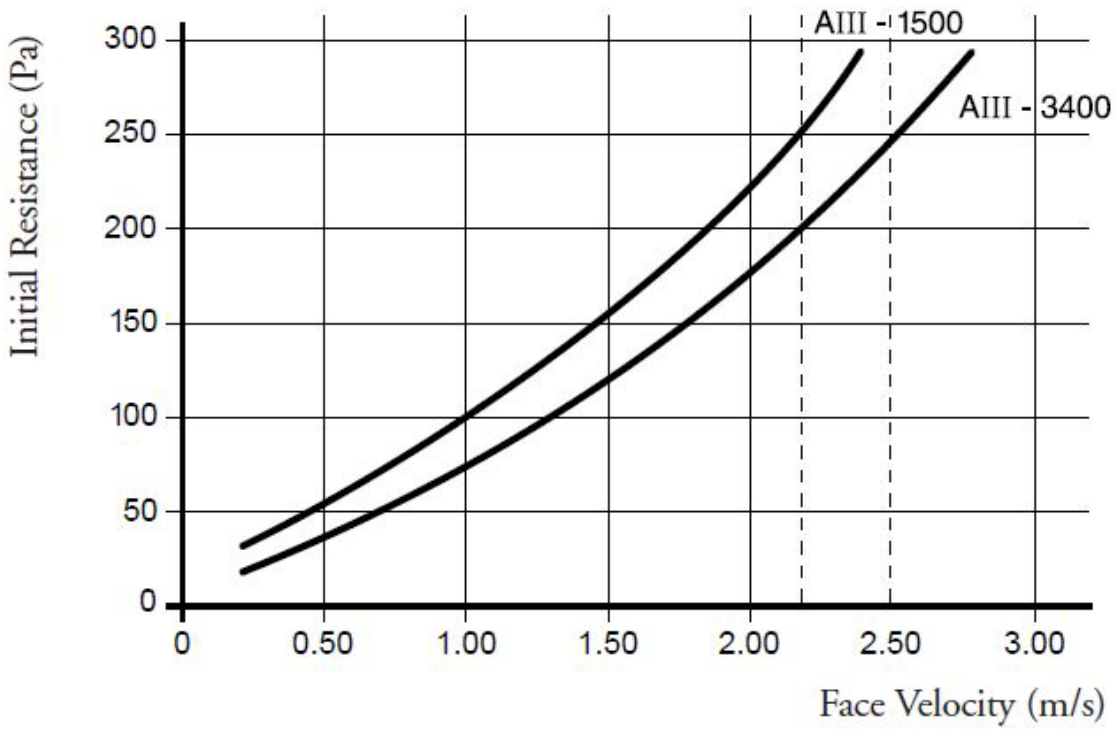


Figure 2- 20(Resistance Vs Velocity)

Notes:

- Recommended final resistance 750 Pa.

- Temperature limits 70°C.

- Initial resistance at nominal airflow: 250 Pa.

Standard Sizing and Rating

Size in mm without gasket			Nominal airflow
H	W	D	m^3/h
610	305	292	1500
610	610	292	3400

Efficiency

Efficiency	Efficiency EN1822	
@ 0.3 µm	@ MPPS	
99.97%	H12	99.5%
99.99%	H13	99.95%

2.1.7 Cooling and Heating Coils

One of the widest uses of heat exchangers is for central air conditioning units. Liquid to air, or air to liquid HVAC coils are modified cross flow arrangement.

On the liquid side, the common fluids for heating coils are hot water and steam while for cooling coils, chilled water and refrigerant. Chilled water is supplied from a chiller that is potentially located very far away, but refrigerant must come from a nearby condensing unit. When a refrigerant is used, the cooling coil is the evaporator in the vapor-compression refrigeration cycle.

Coils tubes are typically manufactured from copper, with copper or aluminum fins to aid heat transfer. Cooling coils will also employ tub to get rid of the condensate.

Figure 2- 21(Cooling coil)

The hot water or steam is provided by a central boiler, and the chilled water is provided by a central chiller. Downstream temperature sensors are typically used to monitor and control 'off coil' temperatures, in conjunction with an appropriate motorized control valve prior to the coil.

Due to the many variables involved, selecting optimal heat exchangers is challenging. Hand calculations are possible, but much iteration is typically needed. As such, heat exchangers are most often selected via computer programs, either by system designers or engineers.

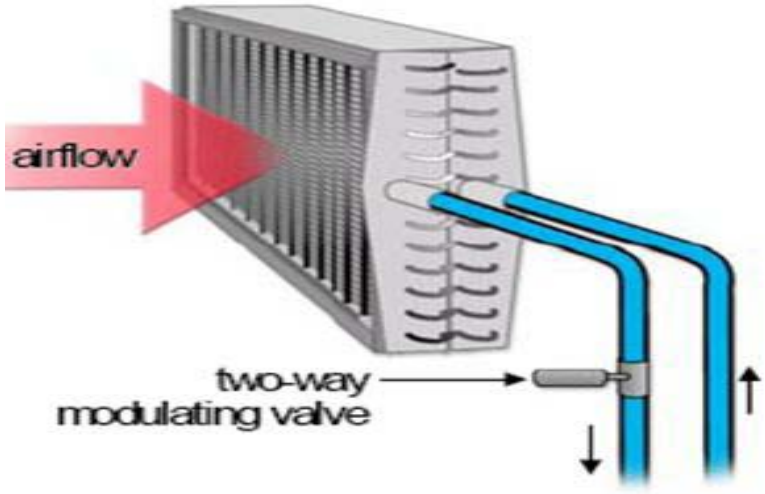


Figure 2- 22(Heat exchanger)

In order to select an appropriate heat exchanger, the system designers (or equipment vendors) would firstly consider the design limitations for each heat exchanger type. Although cost is often the first criterion evaluated, there are several other important selection criteria which include;

- High/ Low pressure limits & Pressure Drops across the exchanger
- Thermal Performance & Temperature ranges
- Product Mix (liquid/liquid, particulates or high-solids liquid)
- Clean ability, maintenance and repair
- Materials required for construction

Choosing the right heat exchanger (HX) requires some knowledge of the different heat exchanger types, as well as the environment in which the unit must operate. Typically in the manufacturing industry, several differing types of heat exchangers are used for just the one process.

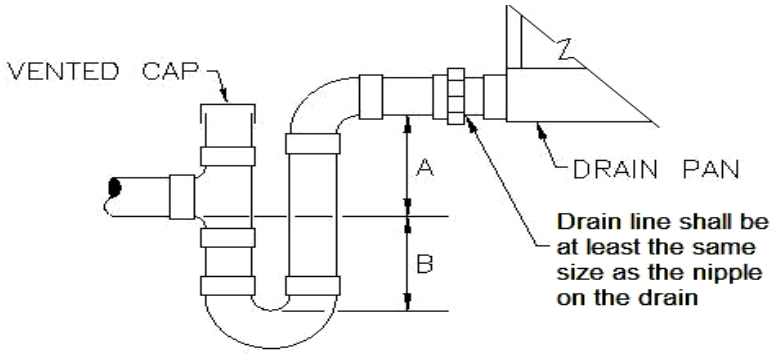
2.1.8 Condensate Drain Pan

Most cooling processes dehumidify the air, which can generate considerable amounts of condensate. Thus, cooling elements that dehumidify have drain pans that drain this condensate away from the cooling element to prevent indoor air quality problems and water damage to the unit and the area located below the cooling coil.

Figure 2- 23(Condensate drain trap)

Since there is generally a pressure difference between the interior and the exterior of the unit, draining the condensate is not as convenient as simply making a hole in the bottom of the drain pan.

Generally, a trap with a siphon mechanism is required to ensure consistent drainage of condensate from the drain pan. Without the water seal provided by the trap, air flowing through the drain line into the unit can interfere with the drainage process and cause the drain pan to overflow, especially when there is a significant pressure difference between the inside and outside of the unit casing at the cooling element location. The AHU should be placed on base frame so it’s applicable to install the drain line.



DESIGNER'S NOTE:

AHU TYPE	A	B
DRAW THRU	2" + X	X + 1"
BLOW THRU	2" MIN.	2X

WHERE X = STATIC PRESSURE IN DRAIN PAN

Figure 2- 24(Condensate drain trap calculations)

The 'A' distance must be greater by 2" than the static pressure while distance 'B' must be slightly greater than the atmospheric to avoid external air to enter the unit.

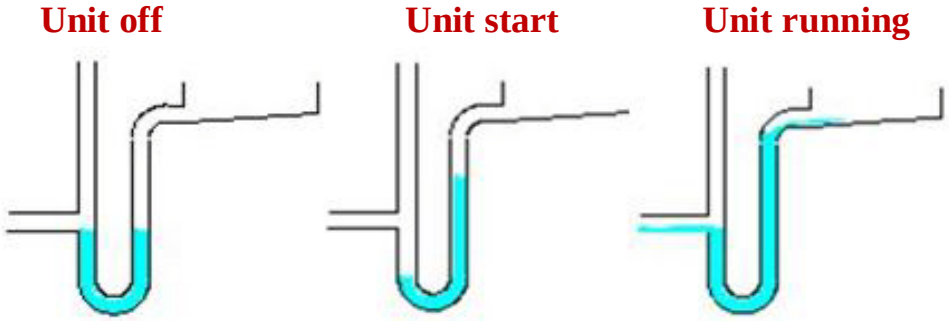


Figure 3- 25(Condensate drain trap process)

At the beginning, water level on both side at the trap equalize as the pressure inside the unit is equal to the pressure outside the unit. As the unit starts, the level of the leaving side drops by the amount of pressure drop through the unit to the drain pan location. While the unit is running, additional condensates in the drain line, leads the level in both sides to rise until the level on the leaving side reaches the discharge line. The condensate can now drain from the unit through the seal created by the trap.

2.1.9 Humidification and Dehumidification

According to **the Environmental Protection Agency**, the recommended humidity for indoor environments should range between 30% and 50% relative humidity. The term “relative humidity” simply means the amount of water vapor the air contains compared to the maximum amount it could hold at any given temperature. Indoor humidity can be controlled in two ways: it could be lowered by a properly sized air conditioning system with installed dehumidifier; or humidity can be raised by using a humidifier.

Air conditioning and heating equipment affect humidity. In addition to cooling indoor air, the conditioning of air has to do with removing humidity. If an air conditioning system has too much cooling capacity, it cools too quickly and cycles on and off in short intervals. This does not allow enough time to “condition” the air by removing the humidity. As a result, excessive moisture in the air described as a “clammy” feeling. In contrast, a properly sized and working air conditioner will adjust the humidity during its cooling cycles.

In the winter, furnaces can remove too much moisture from the air which in turn generates static electricity. This cause lint and objects to adhere your clothes, makes your hair stand on end when you brush it, or gives you a shock when you touch certain objects after walking on carpet or sliding on a sofa.

For many areas in EGYPT, there are times of the year when your indoor environment does not need heating or cooling to be in a comfortable range, but it need humidity control. Some of the more advanced air conditioning systems have provisions to accommodate this along with fresh air ventilation. Another alternative is a separate dehumidifier or possibly a humidifier.

2.1.9.1 Humidifiers

Evaporative Humidifier

Raising the humidity by passing air through a wetted matrix is a simple and safe way to humidify with the added benefits of very low running costs and evaporative cooling.

Evaporative humidifiers are installed in AHU after the heat exchangers. Water is supplied to the top of a fully bonded particle free matrix and flows down its corrugated surface. Dry air passes through this moist material picking up water vapor, raising the humidity as it does so. This process consumes very little energy, far less than steam humidifiers or even cold water atomizers.

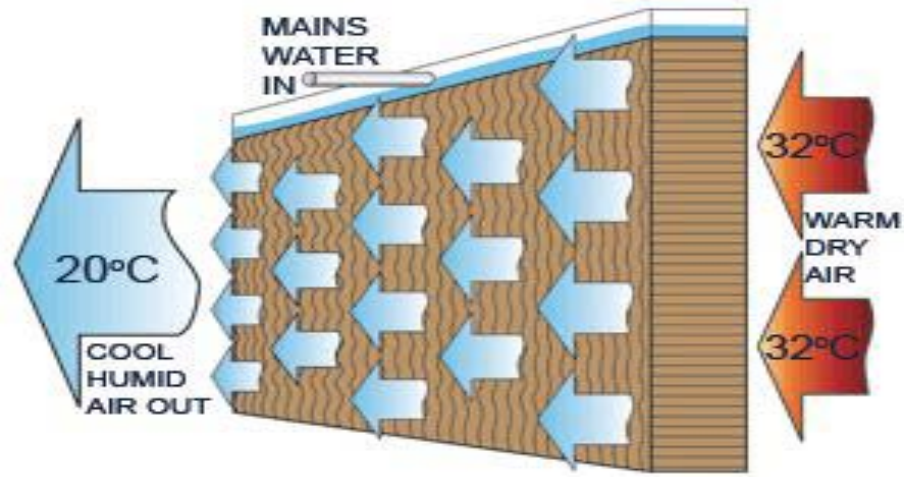


Figure 2- 26(Evaporative humidifiers)

The water that doesn't evaporate assists in washing the matrix material and flows into a stainless steel tank at the base of the unit before being re-circulated up on to the matrix again.

Our evaporator's offers up to 12°C of cooling and a very economical alternative or supplement to mechanical chillers. As the air passes over the cool, wet surface of the evaporative matrix, there is a transfer of energy as the

water evaporates. Evaporative cooling is not a substitute for air conditioning as there are still some instances where direct mechanical cooling is required. However, it provides free-cooling and reduces the overheads of DX chiller units, as well as in winter when the air is cool and dry.

Steam Humidifier

The steam humidifier delivers pure, sterile steam for raising the humidity in air handling units, air conditioning ducts or directly in a room. Eight capacities are available from 5-90kg of steam per hour. The units can be used in a master/slave system with a maximum output of 990kg/h using one master unit and 10 slaves. All 11 units would be fully proportional to ensure equal wear.

Figure 2- 27(Steam humidifier)

The humidifier has been designed to make maintenance quick and simple. One button drains the unit, then simply unclips the cylinder and replace with a new one. It has microprocessor control to provide responsive control over output. An easy-to-read backlit digital display panel shows what the unit is doing at any time. Three menus provide information on real-time humidifier performance, humidifier configuration and the opportunity to change the operating parameters of the unit.

The unit is very versatile, accepting all common modulating signals from humidity controllers or building management systems and, for standalone situations, there's an integral humidity controller. Standard on every unit is remote feedback for BMS users. Information on steam production and when maintenance is due is supported by a five fault alarm system indicating water supply failure, inlet drain valve failure and two-way contactor fault alarm, which shuts down the humidifier.

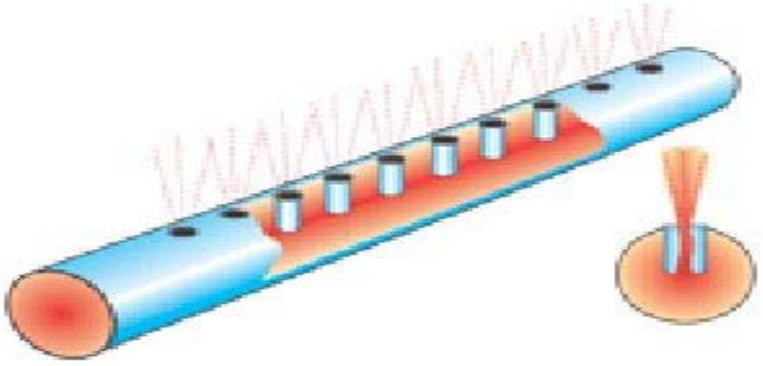


Figure 2- 28(Steam humidifier nozzles)

All units can accept a wide range of water quality and the software includes an adjustable anti-foaming system. Disposable or cleanable cylinders are available throughout the range, all with solid stainless steel electrodes for long life.

To protect against water stagnation, the cylinders automatically drain after periods of inactivity. This adjustable feature prevents contamination and represents best practice in steam humidifier design.

The humidifier is approved for direct connection to a mains water supply.

The unit is suited to wall or frame mounting and installation is made easy with a mounting template, single power supply and easily accessible internals.

2.1.9.2 Dehumidifiers

Condensation, mould, and warped wood are some of the high humidity problems that our dehumidifiers help you prevent. Whether you need to update an existing HVAC system or design/build a new one.

By working with our expert mechanical designers and installers; on your new or existing building, you will maintain ideal levels of humidity, no matter what the conditions outdoors. We provide you with an HVAC system with the right design, airflow and controls to make your building work better.

Dehumidifiers remove excess humidity by drawing moist air over a cold refrigerated coil. The moisture in the air condenses into droplets as it passes over the cold surfaces in the dehumidifier and into a container. "Dried" air then returns to the room at approximately its original temperature.

Methods of dehumidification

- Chilled water
- Direct Expansion coils
- Desiccant

Direct Expansion coils

In a direct-expansion (DX) unitary system, the evaporator is in direct contact with the air stream, so the cooling coil of the airside loop is also the evaporator of the refrigeration loop. The term “direct” refers to the position of the evaporator with respect to the airside loop.

The term "expansion" refers to the method used to introduce the refrigerant into the cooling coil. The liquid refrigerant passes through an expansion

device (usually a valve) just before entering the cooling coil (the evaporator). This expansion device reduces the pressure and temperature of the refrigerant to the point where it is colder than the air passing through the coil.

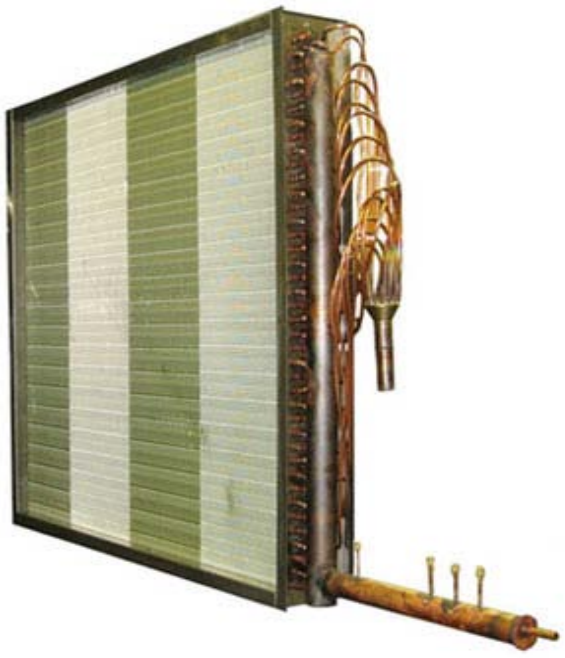


Figure 2- 29(DX coil)

One of the most common reasons for selecting a DX system, especially a packaged DX system, is that, in a smaller building, it frequently has a lower installed cost than a chilled-water system because it requires less field labour and has fewer materials to install. DX coils can be located on the roof of a building or even within the perimeter wall of the building.

Additionally, if the tenants are paying the utility bills, multiple packaged DX units may make it easier to track energy use, as only the specific unit serving that tenant would be used to meet the individual cooling or heating requirements.

2.1.10 Industrial Fans

Are machines whose primary function is to provide a large flow of air to various processes for many applications. This is achieved by rotating a specific number of blades, connected to a hub and shaft, and driven by a motor. The flow rates of these fans range from approximately 200 to 50,000 cubic meters per hour.

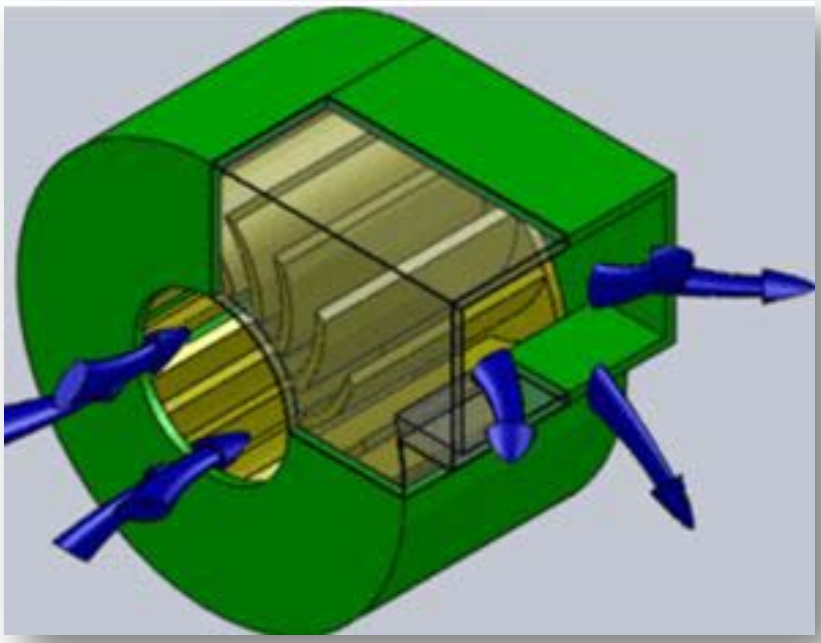


Figure 2- 30(Single backward fan)

3.1.8.1 Fans Applications: There are many uses for the continuous flow of air that industrial fans generate, including ventilation, particulate transport, exhaust, cooling, air-cleaning, and drying, to name a few. The industries served include electrical power production, pollution control, metal manufacturing and processing, cement production, mining, petrochemical, food processing, cryogenics, and clean rooms.

Fan Rotation and discharge

The direction of rotation is determined from the drive side of the fan

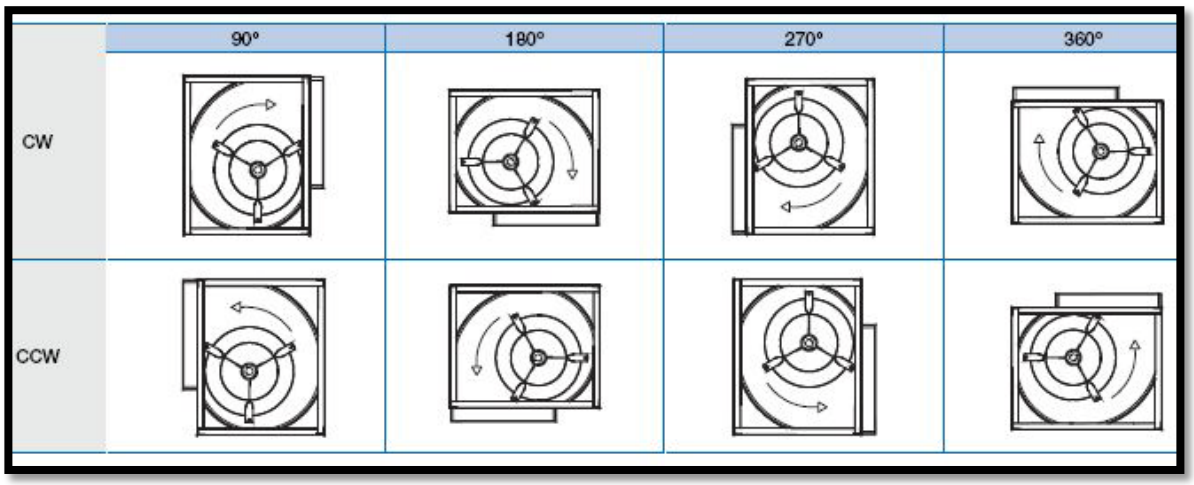


Figure 2- 31(Fan rotation and discharge)

Fan total pressure calculation

Total pressure = Dynamic pressure + Static pressure

Fan dynamic pressure

Dynamic Pressure and outlet air velocity are calculated on the full air discharge area including that of the cut- off area, and therefore “ducted outlet” conditions. In the case of “free outlet “the velocity pressure is higher and the new value is obtained by multiplying the velocity pressure of the “ducted outlet” from the curves, by the correction factor “K”.

Fan static pressure

To determine fan characteristics it is absolutely necessary to calculate the pressure drops, expressed in Pa, of the different sections forming the unit and to add them to the required external pressure drop.

Most industrial fans are categorized into one of two general types;

- **Centrifugal Fans**
- **Axial Fans**

3.1.8.2 Centrifugal Fans

As the name suggests, the centrifugal design uses the centrifugal force generated by a rotating disk, with blades mounted at a specific angles to the disk, to impart movement to the air and increase its pressure. The assembly of the hub, disk and blades is known as the fan wheel, and often includes other components with aerodynamic or structural functions.

Figure 2- 32(Centrifugal fan)

The centrifugal fan wheel is typically contained within scroll-shaped fan housing, resembling the shell of the nautilus sea creature with a central hole. The air or gas inside the spinning fan is thrown off the outside of the wheel, to an outlet at the housing's largest diameter. This simultaneously draws more air into the wheel through the central hole.

Centrifugal Fans Sub Categories:

Airfoil Fans: Used for a wide range of applications in many industries, fans with hollow, airfoil-profiled blades are designed for use in airstreams where high efficiency and quiet operation are required. They are used extensively for continuous service at ambient and elevated temperatures in forced and induced draft applications in the metals, chemical, power generation, paper, rock products, glass, resource recovery, incineration and other industries throughout the world.

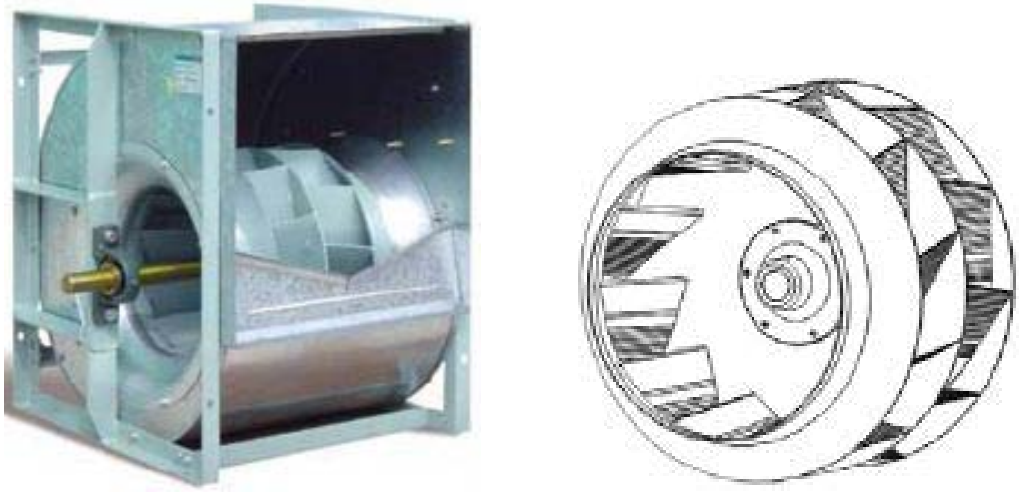


Figure 2- 33(Airfoil fans)

Fan characteristic:

- The highest efficiency of all centrifugal fans, up to 83%
- The highest speed of all centrifugal fans
- Suitable for higher static pressure, up to 3200 Pa
- Manufactured from 9 to 16 airfoil blades curved away from the direction of rotation.
- Deep blades for efficient expansion with the blade passages
- Suitable for large AHU

Forward Curve Fans: This “squirrel cage” impeller generates the highest volume flow rate (for a given ideal speed) of all the centrifugal fans. Therefore, it often has the advantage of offering the smallest physical package available for a given application. This type of fan is commonly used in high-temperature furnaces.

Figure 2- 34(Forward curve fans)

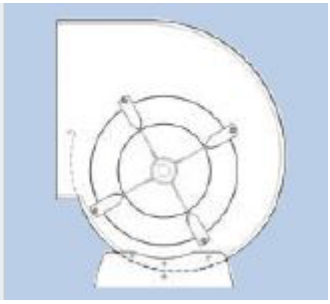
The FDA series from S & P: Is centrifugal fans with forward curved Impellers and with double inlet flow. The fans are suitable for supply or extract applications in commercial, process and industrial HVAC systems.

Type / Operating limit: Each fan type has its maximum operating speed and power due to its mechanical design. The operating limit of BDB series - fan type is design to meet the requirement of class I, II and III limit as defined in AMCA standard 99-2408-69.

The FDA series is available in type S, C, T and X.

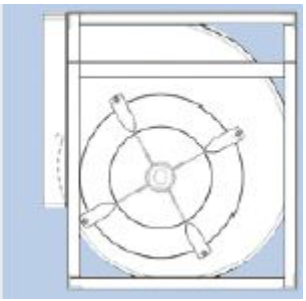
Type S: This type is supplied with mounting feet and can be mounted in three different orientations. The construction is mainly for OEM application which only subject to testing and approval.

Fan size	160 to 710
Volume	1.000 to 50.000 m³/h
Total Pressure	up to 1.400 Pa



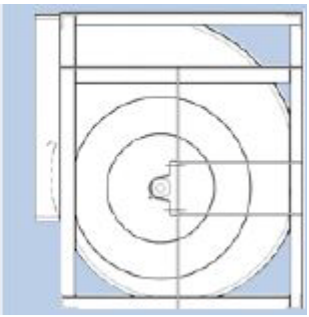
Type C: This type has a frame fitted on both sides of the fan which gives better strength and rigidity. It allows mounting in four different orientations.

Fan size	160 to 710
Volume	1.000 to 50.000 m³/h
Total Pressure	up to 1.400 Pa



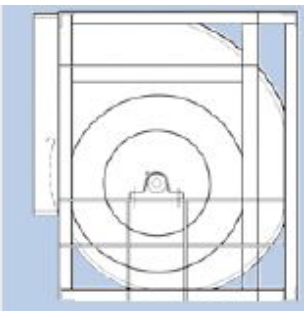
Type T: This type has a welded frame giving increased stiffness and rigidity required for higher operating performance.

Fan size	250 to 1.000
Volume	2.500 to 100.000 m³/h
Total Pressure	up to 1.600 Pa



Type X: The structure is similar to type T but utilizes enhanced bearings to support higher dynamic load necessary for the increased performance.

Fan size	560 to 1.000
Volume	15.000 to 130.000 m³/h
Total Pressure	up to 1.800 Pa



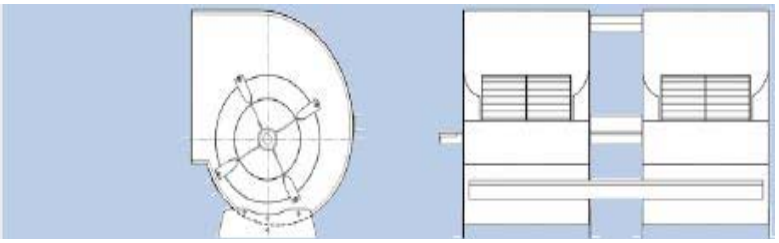
FDA Twin Fan: FDA Series are also available in twin fan version, with two double inlet fans monted on the same shaft. To slect for twin fans, use the curves of single fan with the following factors:

- Volume x 2
- Absorbed Power x 2.15
- Speed x 1.05
- Noise + 3 dB

This series is available in Type S2, C2 or T2

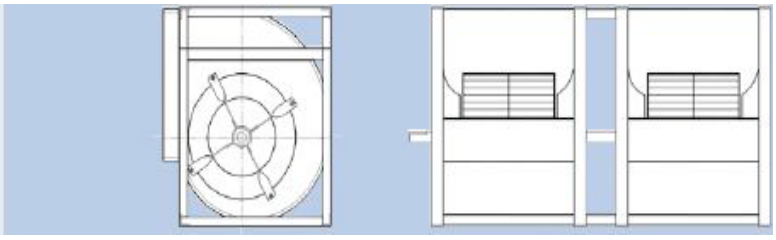
Type S2

Fan size	250 to 500
Volume	5.000 to 50.000 m³/h



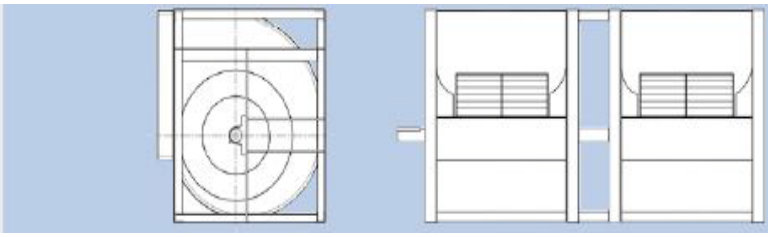
Type C2

Fan size	250 to 500
Volume	5.000 to 50.000 m³/h



Type T2

Fan size	355 to 630
Volume	10.000 to 80.000 m³/h



Technical Specifications

Wheel: The wheel of FDA series has forward curved blades manufactured in galvanized sheet steel.

Housing: For all sizes, the housing is manufactured in galvanized sheet steel with the housing fixed to the side plates in “Pittsburg lock” form system.

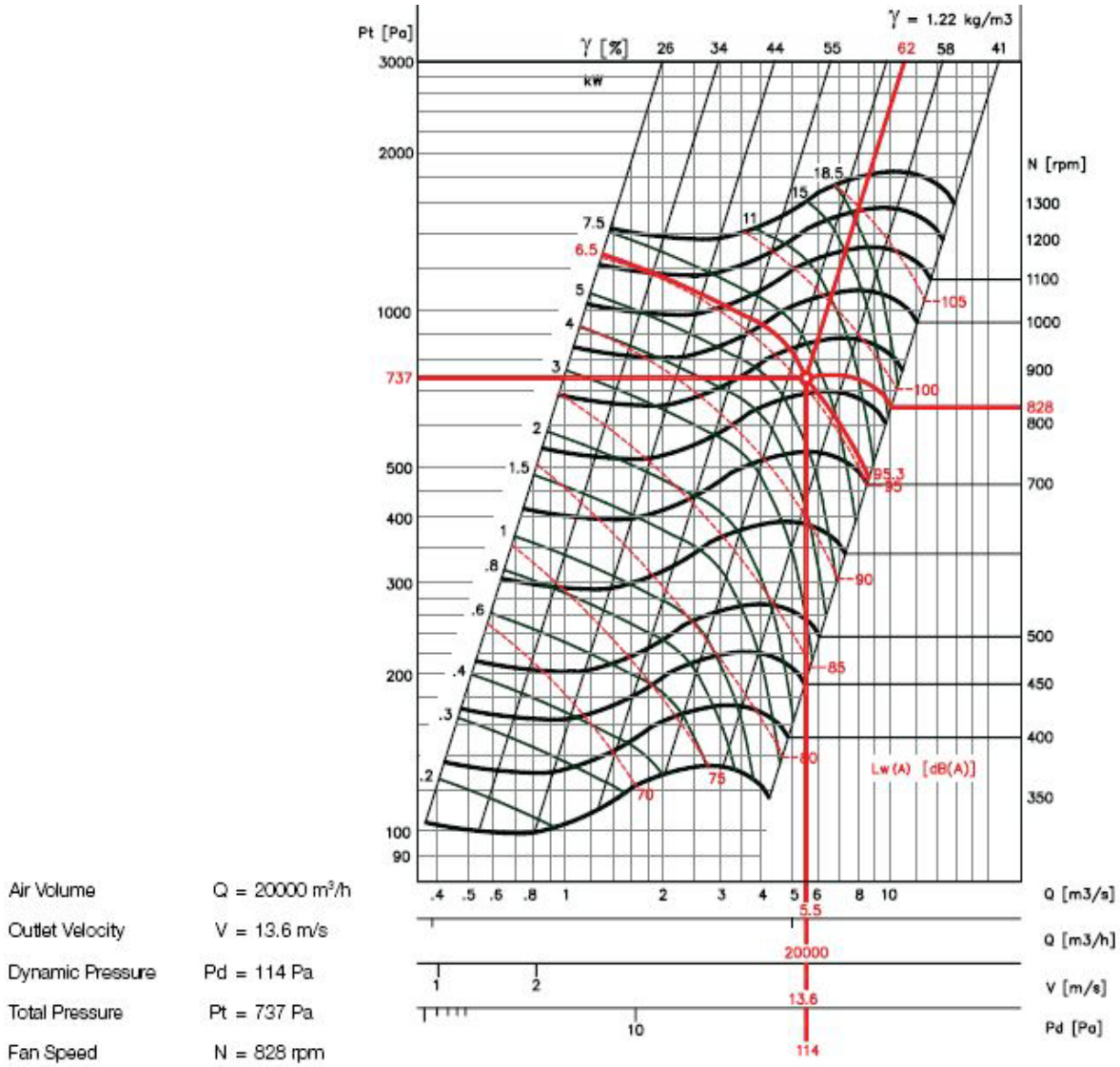
Frame: The frame is manufactured with galvanized angular bars for type “C”. For type “T” and “X”, they are manufactured with sections of steel and finished with polyester powder coating.

Shaft: Shafts are manufactured from C45 carbon steel using an automatic process for positioning and cutting of the keyways. All dimensional tolerances of the shaft are fully checked to ensure a precision fit and then coated with an anti-corrosion varnish after assembly.

Bearings: Bearings used are either deep groove ball bearing type with an eccentric locking collar or an adapter sleeve, or spherical roller bearings type sealed at both sides for different duty application. The bearings are lubricated for life and maintenance-free. If re-lubrication is necessary, it is recommended to use lithium base grease suitable for all temperatures within the operational limits.

Balancing Quality: All wheels are statically and dynamically balanced to ISO1940 and AMCA 204 – G2.5 standards.

Example of Selection:



Air Volume	Q	= 20000 m³/h
Outlet Velocity	V	= 13.6 m/s
Dynamic Pressure	Pd	= 114 Pa
Total Pressure	Pt	= 737 Pa
Fan Speed	N	= 828 rpm
Absorbed Power	W	= 6.5 kW
Total Efficiency	η	= 62 %
Sound Power Level	Lw(A)	= 95.3 dB(A)

Figure 2- 35(Example of selection)

FDA 160

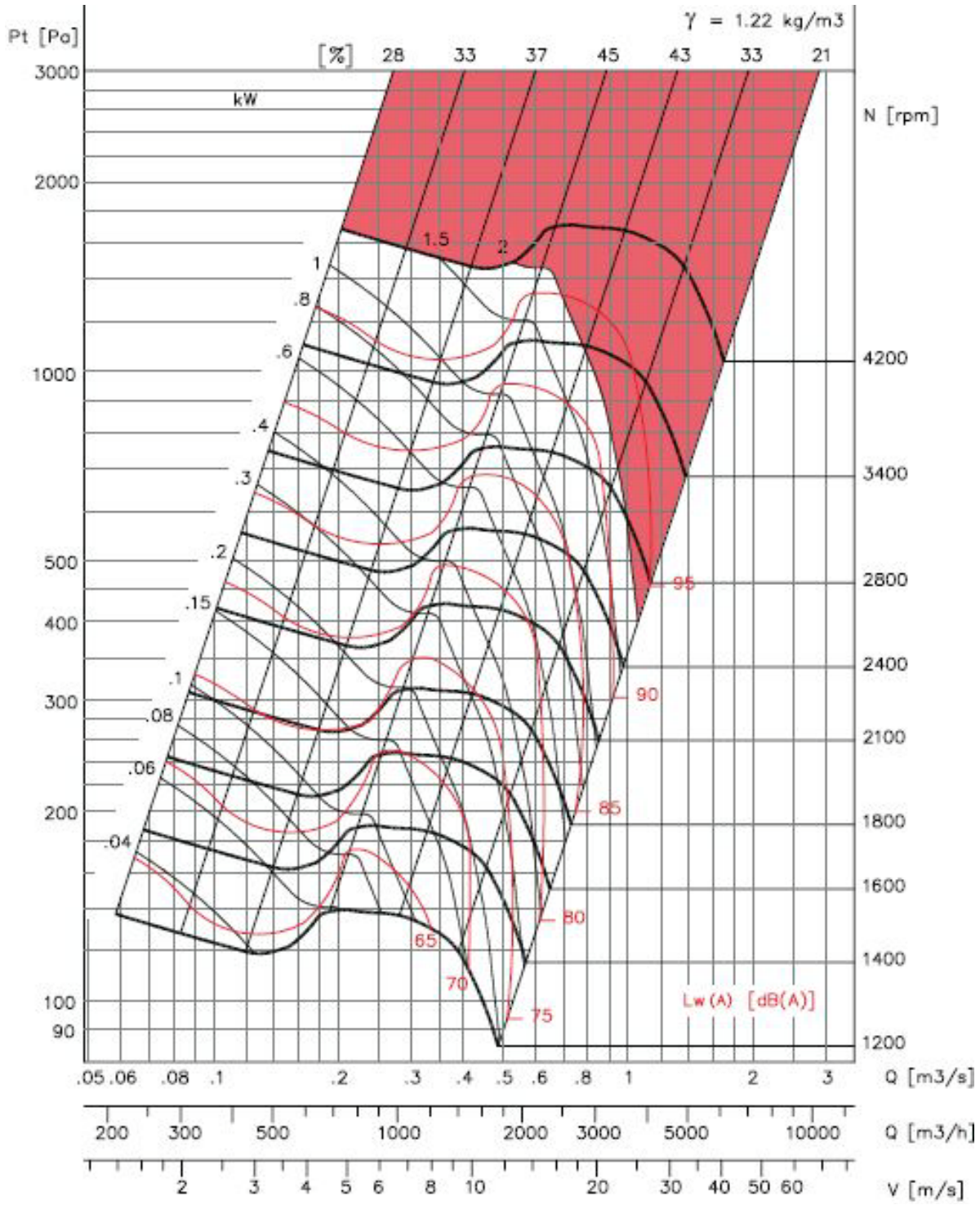


Figure 2- 36(FDA 160 Data sheet)

FDA 1000

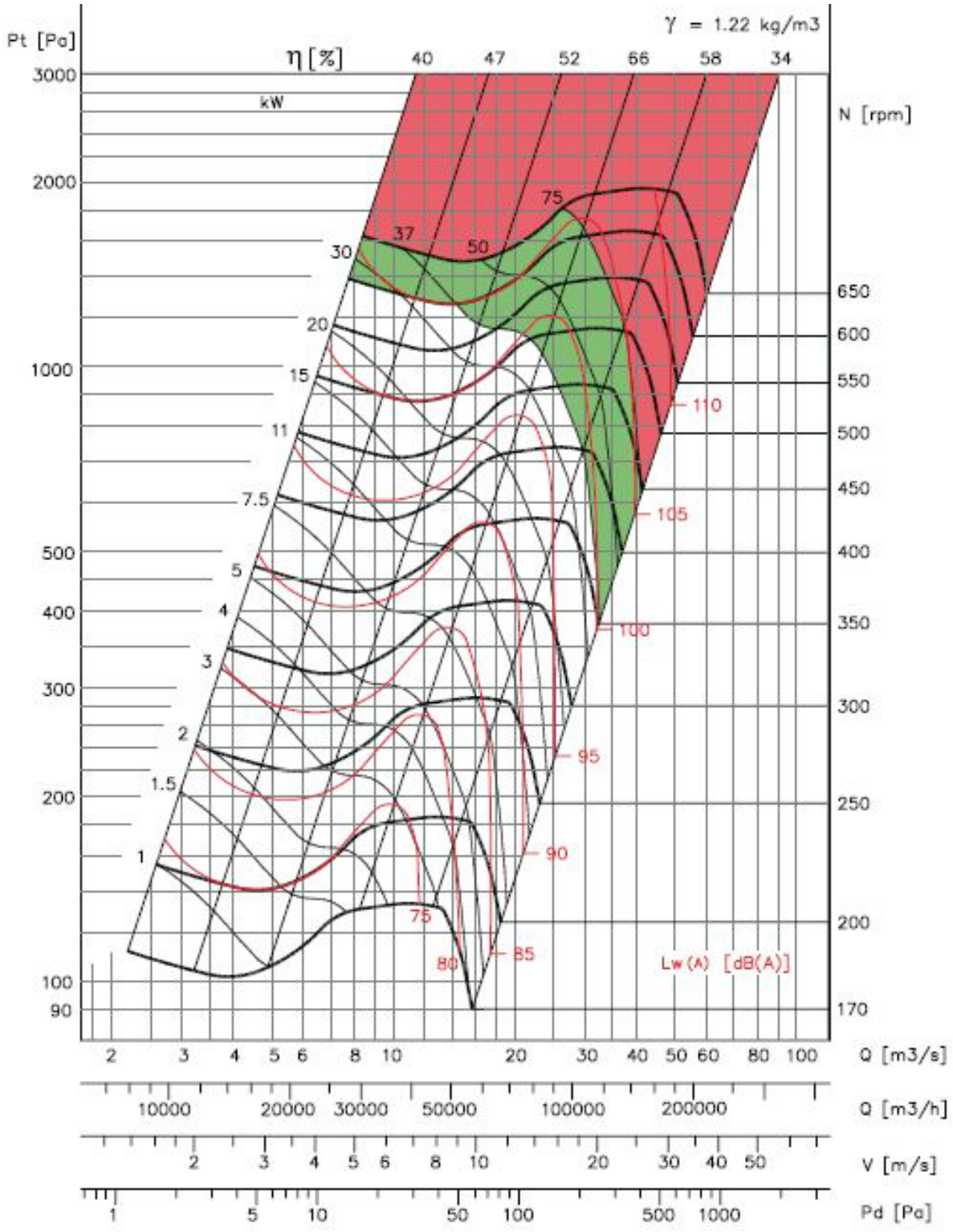


Figure 2- 37(FDA 1000 Data sheet)

Backward Curve Fans: These fans have efficiencies nearly as high as the airfoil design. An advantage is that their single-thickness, curved plate blades prevent the possibility of dust particle buildup inside the blade, as may occur if advanced wear perforates a hollow airfoil blade. The robust design allows high tip-speed operation, and therefore this fan is often used in high-pressure applications.

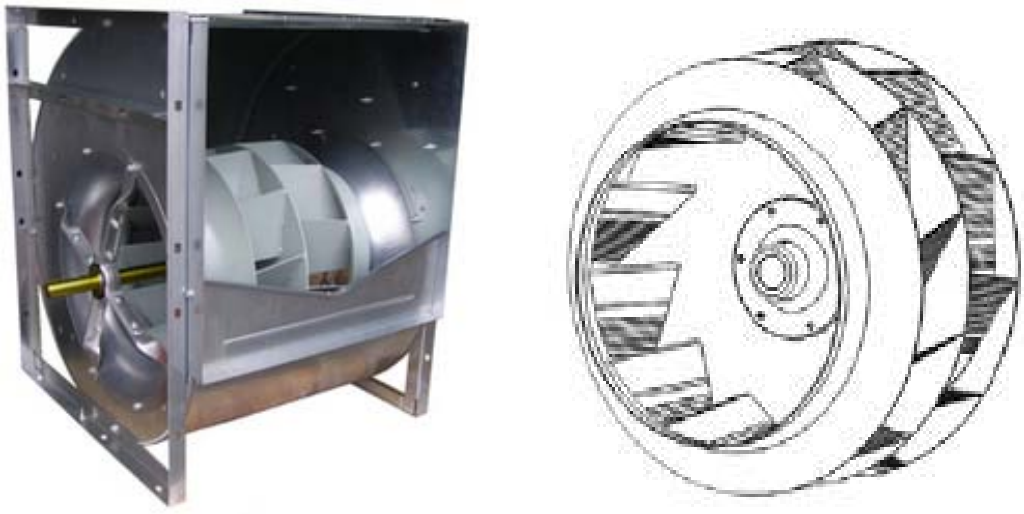


Figure 2- 38(Backward curve fans)

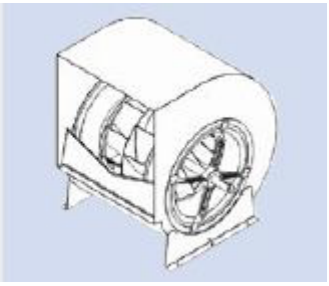
The BDB series from S & P: The BDB series are centrifugal fans with high efficiency non-overloading backward curved impellers and designed to have double inlet flow. The fans are suitable for supply or extract applications in commercial, process and industrial HVAC systems.

Type / Operating limit: Each fan type has its maximum operating speed and power due to its mechanical design. The operating limit of BDB series - fan type is design to meet the requirement of class I, II and III limit as defined in AMCA standard 99-2408-69.

The BDB series is available in type S, C, T, X or Z.

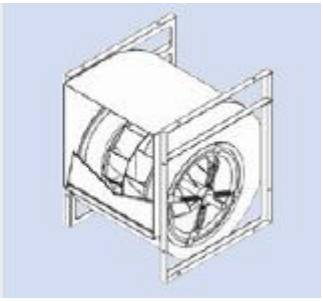
Type S: This type is supplied with mounting feet and can be mounted in three different orientations.

Fan size	315 to 710
Volume	1.900 to 50.000 m³/h
Total Pressure	up to 2.000 Pa



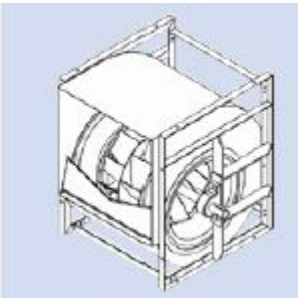
Type C: This type has a frame fitted on both sides of the fan which gives better strength and rigidity. It allows mounting in four different orientations.

Fan size	315 to 710
Volume	1.900 to 50.000 m³/h
Total Pressure	up to 2.000 Pa



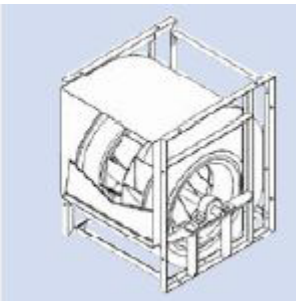
Type T: This type has a welded frame giving increased stiffness and rigidty reguired for highher opertaing performance.

Fan size	315 to 1.400
Volume	1.900 to 190.000 m³/h
Total Pressure	up to 2.500 Pa



Type X/Y: Its structure is simmilar to type T but utilites enhanced bearings to support higher dynamic load necessary for the incresed performance.

Fan size	315 to 1.400
Volume	1.900 to 260.000 m³/h
Total Pressure	up to 3.200 Pa



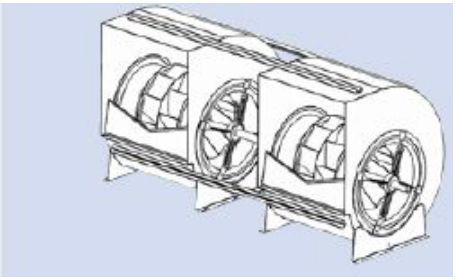
BDB Twin Fan: BDB Series are also available in twin fan version, with two double inlet dans monted on the same shaft. To slect for twin fans, use the curves of single fan with the following factors:

- Volume x 2
- Absorbed Power x 2.15
- Speed x 1.05
- Noise + 3 dB

This series is available in Type S2, C2 or T2.

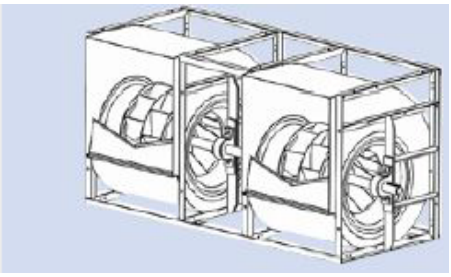
Type S2

Fan size	315 to 500
Volume	5.000 to 50.000 m³/h



Type T2

Fan size	355 to 630
Volume	10.000 to 80.000 m³/h



Performances of twin fan series are not AMCA licensed.

Technical specifications

Wheel: The wheel of the BDB series is made of cold rolled sheet steel backward curved blades with polyester powder coating finish.

Housing: For all sizes except 12350 and above, the housing is manufactured in galvanized sheet steel with the housing fixed to the side plates in “pittsburg lock” form system. While housing for 1250 and 1400 are manufactured in mild steel finishd with polyester powder coating.

Frame: The frame is manufactured with galvanized angular bars for type “C”. For type “T” and “X”, they are manufactured with sections of steel and finished with polyester powder coating.

Shaft: Shafts are manufactured from C45 carbon steel using an automatic process for positioning and cutting of the keyways. All dimensional tolerances of the shaft are fully checked to ensure a precision fit and then coated with an anticorrosion varnish after assembly.

Bearings: Bearings used are either deep groove ball bearing type with an adaptor sleeve or spherical roller bearings type sealed at both sides for different duty application. The bearings are lubricated for life and maintenance-free. If relubrication is necessary, it is recommended to use a lithium base grease suitable for all temperatures within the operational limits.

Balancing Quality: All wheels are statically and dynamically balanced to ISO1940 and AMCA 204 – G2.5 standards.

Accessories

Casing drain: This option is available when using fans exposed to the atmosphere or operating in high humidity conditions.

Inspection doors: The inspection door can be supplied upon request. It can be supplied in one of the three positions (P3, P4 & P5).

Guards: Inlet guards, discharge guards and non-drive end shaft guards are available on request.

Coating: Special powder paint coating of various thickness can be supplied on request.

Fan Rotation and Discharge: The rotation and discharge of the fan is in accordance with AMCA standard 99-2406-83. The direction of rotation is determined from the drive side of the fan:

CW - clockwise rotation
CCW - counter-clockwise rotation

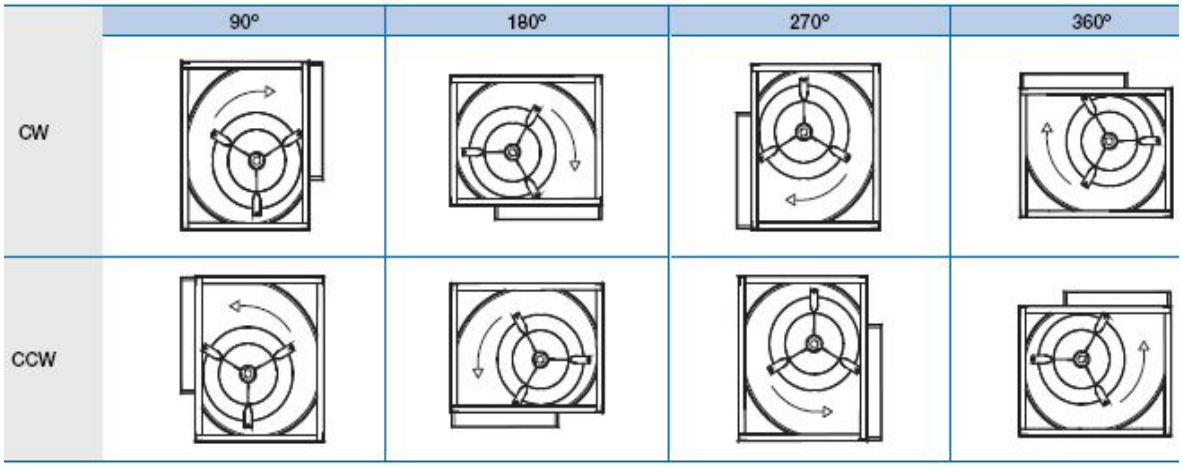
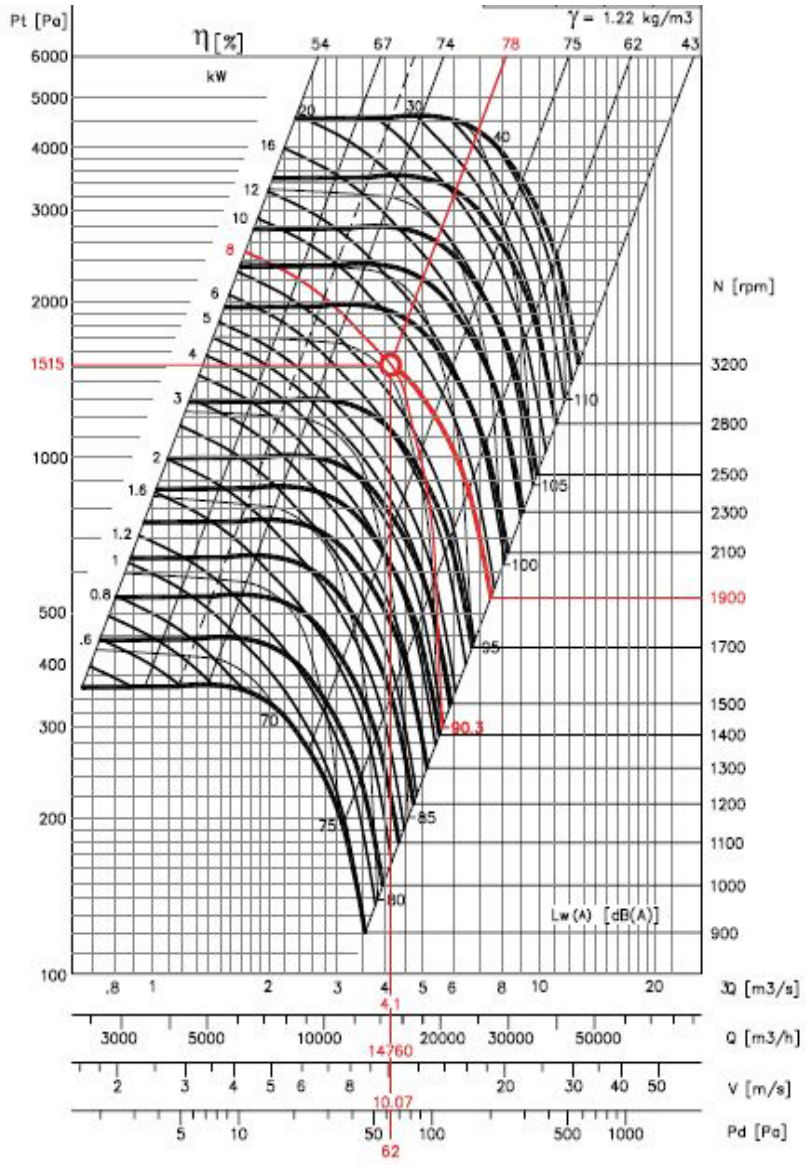


Figure 2- 39(Fan rotation and discharge)

Example of Selection:



Air Volume	Q = 14760 m³/h
Outlet Velocity	V = 10.07 m/s
Dynamic Pressure	Pd = 62 Pa
Total Pressure	Pt = 1515 Pa
Fan Speed	N = 1900 rpm
Absorbed Power	W = 8 kW
Total Efficiency	η = 78 %
Sound Power Level	Lw(A) = 90.3 dB(A)

- Performance shown is for Installation type B - free inlet, ducted outlet. Performance ratings do not include the effects of appurtenances in the airstream. Power rating kW does not include drive losses.
- The A-weighted sound ratings shown have been calculated per AMCA standard 301. Values shown are for inlet Lwi(A) sound power levels for installation type B - free inlet, ducted outlet. Ratings do not include the effect of duct end corrections.

Figure 2- 40(Example of selection)

BDB / 1000XM

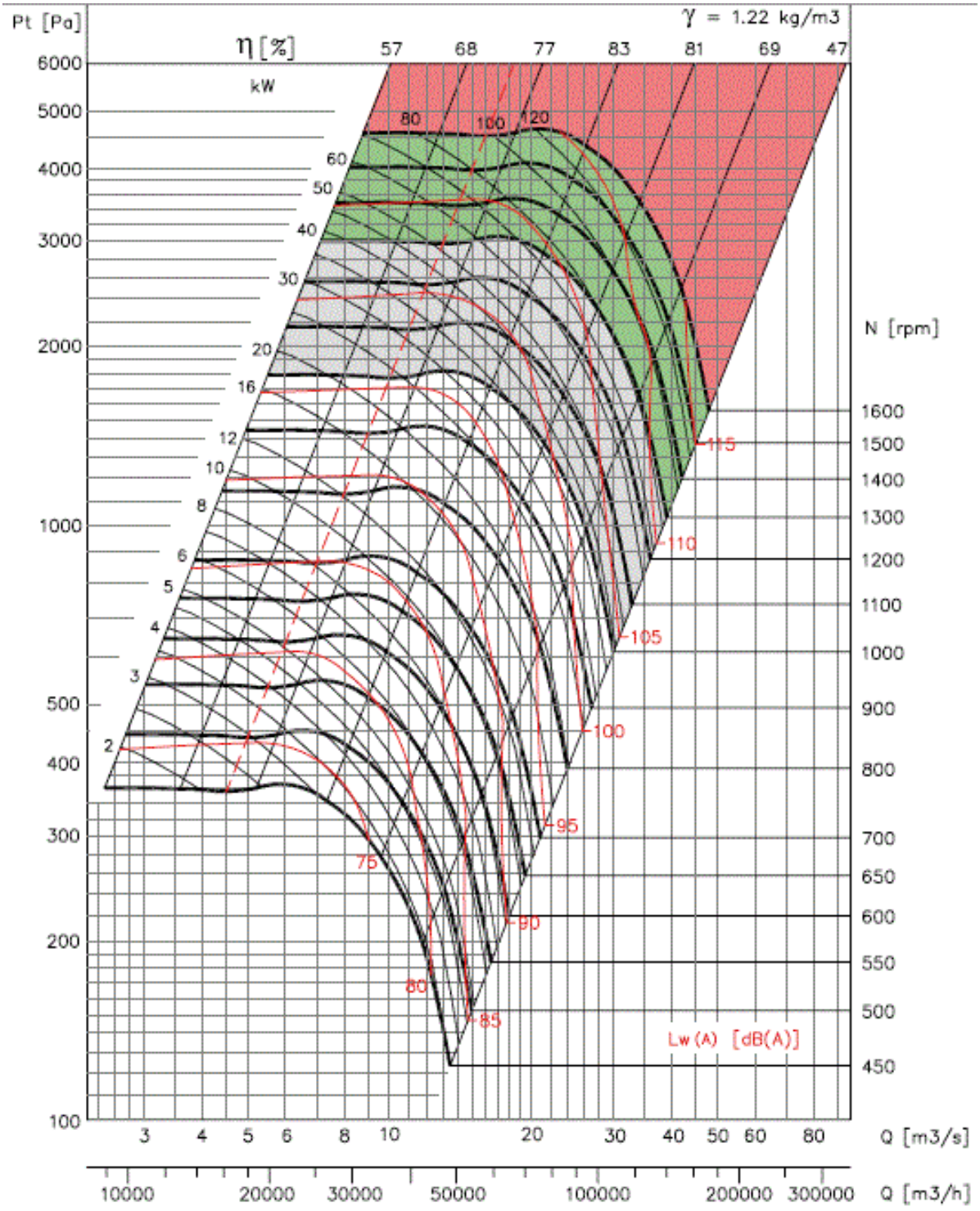
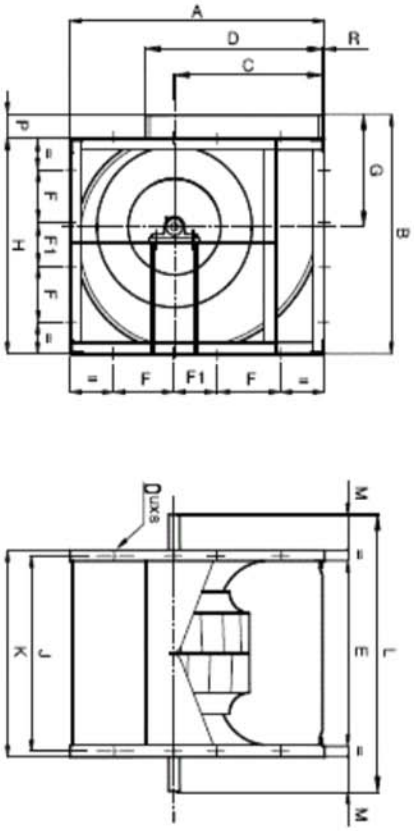


Figure 2- 41(BDB / 1000XM Data sheet)

BDB / 1000XM

BDB 450-1000 'XM'



Model	A	B	C	D	E	F	F1	G	H	J	K	L	M	P	R	ød	uxs
450	827	726	496	568	568	200	111	322	681	608	648	946	149	45	5	45	13x18
500	918	800	538	638	638	245	120	352	750	678	718	1066	174	50	5	50	13x18
560	1030	892	603	714	714	280	125	390	844	764	814	1138	162	48	7	55	13x18
630	1157	998	679	800	800	328	110	434	945	850	900	1286	193	53	6	60	13x18
710	1302	1120	765	898	898	360	150	484	1057	948	998	1390	196	63	7	65	17x22
800	1468	1254	862	1006	1006	405	171	540	1180	1056	1106	1498	196	74	7	65	17x22
900	1648	1408	971	1130	1130	455	189	604	1319	1180	1230	1660	215	89	7	70	17X22
1000	1810	1540	1066	1266	1266	500	200	656	1450	1316	1366	1845	239.5	90	9	80	17x22

All Dimensions in mm.

Figure 2- 42(BDB / 1000XM Data sheet)

2.1.11 Syncronous Electric Motors

A synchronous electric motor is an AC motor distinguished by a rotor spinning with coils passing magnets at the same rate as the alternating current and resulting magnetic field which drives it. In another way it has zero slip under usual operating conditions. Contrast this with an induction motor, which must slip to produce torque.

Mechanical Design:

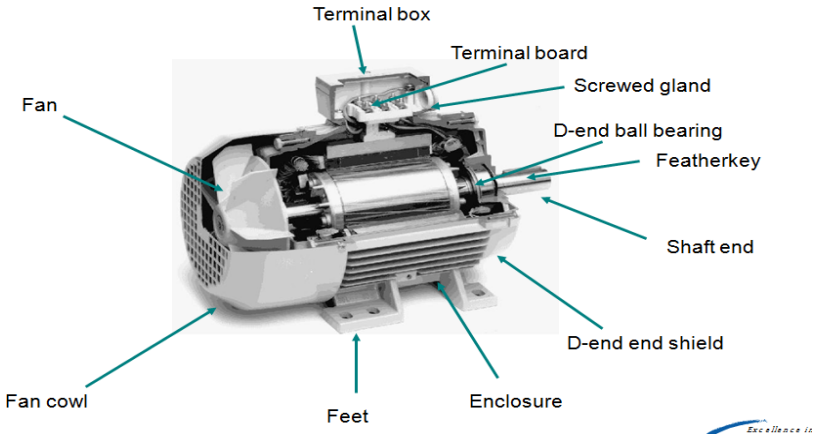


Figure 2- 43(Synchronous electric motor components)

Electrical Design:

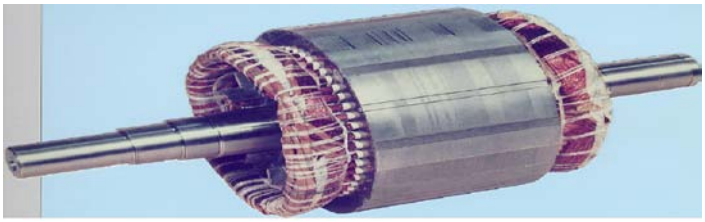


Figure 2- 44(Synchronous electric motor design)

Synchronous motors typically are (essentially) two-phase motors with a phase-shifting capacitor for one phase. They start like induction motors, but when slip rate decreases sufficiently, the rotor (a smooth cylinder) becomes temporarily magnetized. Its distributed poles make it act like a permanent-magnet-rotor synchronous motor.

The rotor material, like that of a common nail, will stay magnetized, but can also be demagnetized with little difficulty. Once running, the rotor poles stay in place; they do not drift.

Conection Systems: **Delta connection** **Star connection** **Star- Delta conection**

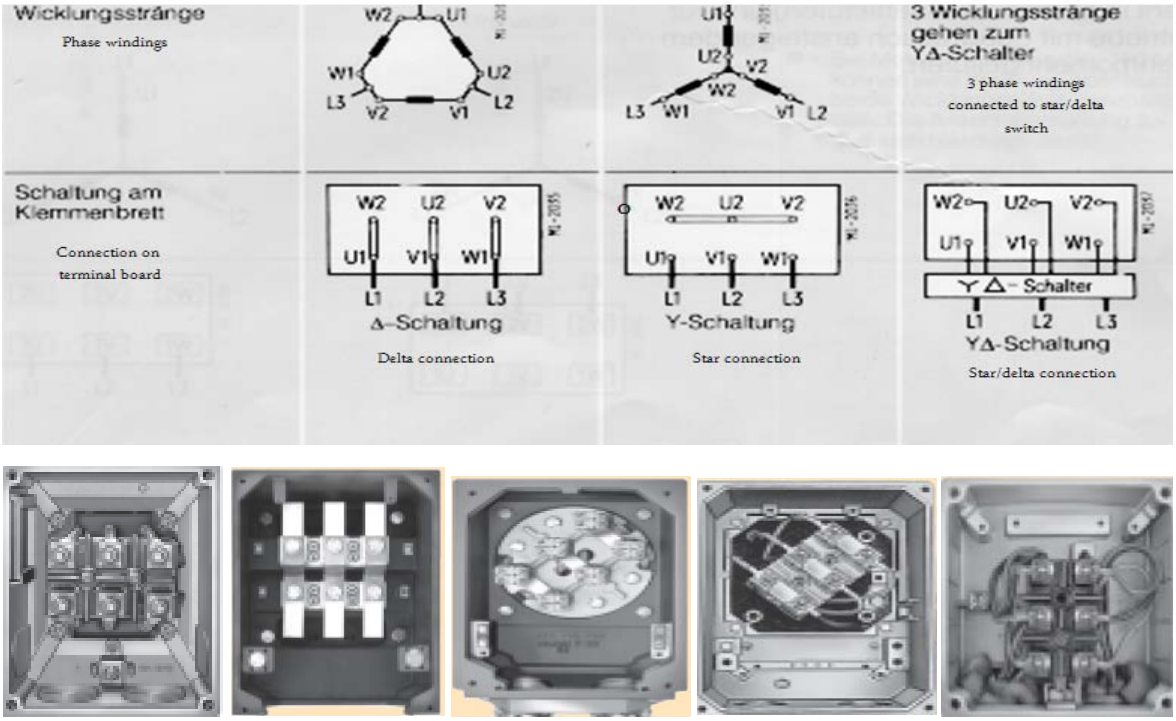


Figure 2- 45(Synchronous electric motor connections)

Number of Poles & Synchronous Motor Speed:

$$n_s = \frac{f \times 120}{p}$$

nS	= synchronous motor speed
f	= system frequency
p	= number of pole pairs

No. of poles	No. of pole pairs	n_S at 50 Hz	n_S at 60 Hz
2	1	3000 min^{-1}	3600 min^{-1}
4	2	1500 min^{-1}	1800 min^{-1}
6	3	1000 min^{-1}	1200 min^{-1}
8	4	750 min^{-1}	900 min^{-1}

Figure 2- 46(Synchronous electric motor poles and speed)

Degree of protection (IP): The selection of the appropriate degree of protection is a necessary requisite for the optimum operation and working life of the motor and depends on the motor's surrounding conditions. The types of protection as per IEC 34-5 are specified by the characteristic symbol "IP" (international protection) and a combination of 2 digits: The first digit indicates protection against accidental contact and infiltration by foreign objects; the second digit specifies the protection against liquid.

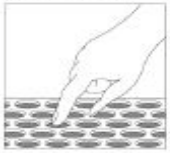
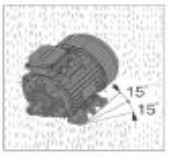
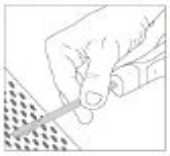
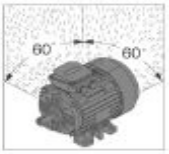
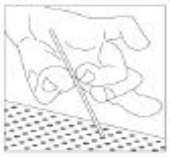
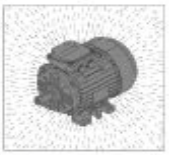
PROTECTION AGAINST CONTACT WITH FOREIGN SOLID OBJECTS			PROTECTION AGAINST INFILTRATION BY LIQUIDS		
1st Characteristic Digit		Description	2nd Characteristic Digit		Description
0		Unprotected	0		Unprotected
1		Protected against solid bodies of greater than 50 mm size	1		Protected against vertically falling drops of water
2		Protected against solid bodies of greater than 12 mm size	2		Protected against vertically falling drops of water up to 15°
3		Protected against solid bodies of greater than 2,5 mm size	3		Protected against the rain up to 60°
4		Protected against solid bodies of greater than 1 mm size	4		Protected against the rain from every direction
5		Protected against Dust deposit	5		Protected against sprays from every direction
6		Totally protected against dust deposit	6		Protected against temporary flooding
			7		Protected against submersion between 0.15 and 1 meter
			8		Protected against submersion at established pressure and time

Figure 2- 47(Motors degree of protection)

Most Important Degrees of Protection

IP 55 (*frame surface cooled motor 1LA /1LG*)

- Complete protection against accidental contact
- Protection against foreign bodies (dust deposits)
- Protection against water jets from all directions

IP 23 (*motor with open-circuit cooling 1LL*)

- Protection against accidental contact (with fingers)
- Protection against foreign bodies (solid bodies greater than 12 mm)
- Protection against water (spraying water up to 60° with respect to vertical)

Most Important Cooling Methods

With fan:

IC 01 open-circuit cooled motor with self-ventilation 1LL8

IC 411 frame surface cooled motor with self-ventilation 1LA/1LG

IC 416 frame surface cooled motor with built-on separately driven fan

Without fan:

IC 410 non-ventilated motor, 1LP (half the rated output of 1LA /1LG)

IC 411 separately cooled motor, 1PP (rated output same as 1LA /1LG) e.g. in the air flow of the fan it drives

2.1.12 Vibration Dampers

Fans and other rotating machines not only generate airborne noise, but also vibrations which need to be dampened. Otherwise these vibrations can lead to structural damages due to material fatigue. Also increased wear and tear and structural noise is increased. The vibration isolators can prevent or at least minimize the effects of these kind of vibrations. They are selected to fit with the weights and frequencies involved. Just as is the case with silencers to minimize airborne noise it is recommended to purchase the fan and the vibration isolators together to minimize co-ordination problems.

For smaller fans rubber isolators are used, while larger fans normally are mounted with totally enclosed metal vibration isolators. For special applications we offer a range of open, metal spring vibration mounts. In addition we can supply vibration isolation matts etc.

ANTI-Vibration Pads: Are made from high quality electrometric rubber specially compounded to resist ageing, oil and water. These pads are designed and constructed with alternate rib height to offer additional vibration isolation under both high and low weight loads. The pads are constructed from **RIBBED RUBBER + CORK + RIBBED RUBBER**.

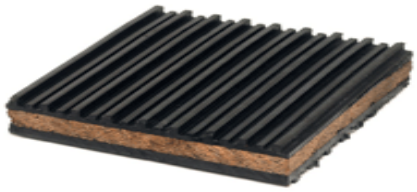


Figure 2- 48(Anti vibration pad)

Cork is an ideal material for thermal insulation to prevent transmission of heat, to reduce noise levels or to provide vibration insulation for running machinery.

Rubber Mounts: For the elastic mounting of light to medium heavy devices we offer our rubber mounts. The series consists of various types with a maximum load of 350 kg/mount and a static deflection of 11 mm. The unique design with the totaly encapsuled steel mounting plates provide the mounts with a very high stability and resistance to mechanical damage.

Figure 2- 49(Rubber mounts)

Open Spring Mounts: For many applications, e. g. simple mounting of machines, industrial fans etc. we recommend an open metal spring isolator. This type could resist up to 300 kg static pressure per spring with a maximum deflection of 15 mm.

Figure 2- 50(Open spring mounts)

Enclosed Metal Isolators: For medium heavy to heavy devices up to 1600 kg per damper. The isolators consist of a machine made bottom cup spot welded to a base plate, pre-punched for holding down bolts, and fitted into the cup would be steel helical springs mounted on a neoprene high frequency vibration isolation pad. The springs would be held at the top by a pressure plate levelled by a set screw operating through a tapped insert in the machine made top cup. The top cup would be jig formed to its base to enclose a neoprene snubbing ring to ensure lateral stability.

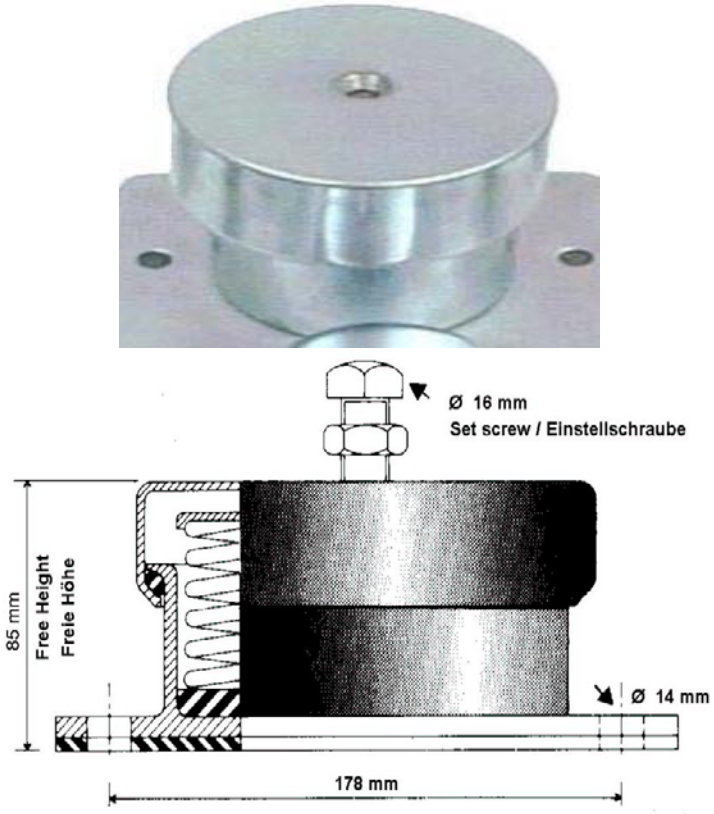


Figure 2- 51(Enclosed metal isolator)

In the case of installing suspended units, the supports must not be screwed directly in to the ceiling; vibration damping must always be placed between the supports and the ceiling.

2.1.13 Adjustable Motor Mountings

The adjustable motor mountings are studied to solve belt tensioning problems in power transmissions. Their compact construction and the special fixing holes will assure an easier mounting, calibration and pulleys alignment either in assembling or disassembling process.

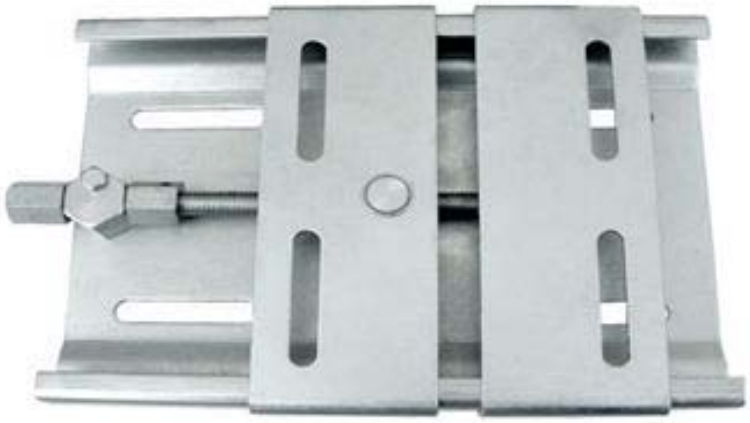


Figure 2- 52(Adjustable motor mounting)

The particular planning will allow frequent tensioning regulations as the easy belts substitution without electric motor removal. The motor movement is drived by a regulation screw easily handled with a spanner.

Motor Sliders Range: Our adjustable motor mountings consist of six sizes for electric motors applicable for wide range of electric motors as each unit is designed to be capable with more than motor. Thus, it will be more efficient when increasing the elcetric motor power which in turn saves money.

Motor Sliders Material & Treatment: Our adjustable motor mountings are all made from heavy duty galvanized steel sheet to be well loaded and painted to be protected from rust corrosion.

2.1.14 Duct Atenuators

Duct attenuators are specially made for use in situations where it is necessary to reduce the noise in “air moving” applications such as air conditioning or ventilation systems, fan and blower inlets and outlets, dust control equipment, motor cooling fans and enclosure ventilation as it’s becoming more and more important for which laws have been decreed to combat acoustic pollution.

The technology for the control of noise purposes is by using appropriate silencers. In practice this allows reducing sound pressure level to be obtained in accordance with laws and the requirements of project specifications no matter how rigorous they may be.

Figure 2- 53(Duct attenuator)

ECAS can offer on request a qualified service for the following needs; a study of client’s problems with an analysis of starting data and the final objective required.

Silencers are selected due to technical and constructional requirement together with attenuation levels and dimensions based on the conditions specified by the client.

ECAS SQ Series Silencers: Are constructed from heavy gauge galvanized sheet metal casing with a minimum thickness of 1 mm, containing a number of splitters filled with rock wool (density not less than 40 kg/m^3) with a high acoustical absorbent coefficient and lined with glass fiber in order to prevent flaking with an air velocity up to 20 m/s. The absorbent material has a fire certification class 1 in accordance with D.M 26-6-1984.

Figure 2- 54(ECAS SQ Series Silencers)

These acoustic insulators divides the silencer into separate longitudinal airways. The standard construction of ECAS duct attenuator remain it integrity up to maximum pressure of 2000 Pa and continuous temperature exposure up to 260 ºC.

Sound is attenuated by the acoustic infill in the splitters when the air passes through these airways. The special aerodynamic design of the splitters has the best sound attenuation and pressure drop.

Frontal Dimension of the Silencers:

SQ-A = 300*300 mm (B*H) with air passage P= 100 mm

SQ-B = 350*300 mm (B*H) with air passage P= 150 mm

SQ-C = 400*300 mm (B*H) with air passage P= 200 mm

They can be in a square or rectangular section with various dimensions and lengths and contain acoustic panels regularly spaced by determined thickness.

2.1.15 Supply Plenum

Plenums are the central distribution or collector unit for HVAC systems. The return plenum carries the air from several large return grills to a central air handler. The supply plenum directs air from the central unit to the rooms and corridors.

Trunk and Branch system: is a large main supply trunk is connected directly to the air handler or an extension to the supply plenum. Smaller branch ducts and runouts are connected to the trunk. The trunk and branch system is adaptable to most houses, but it has more places where leaks can occur. It provides air flows that are easily balanced and can be easily designed to be located inside the conditioned space of the house.

There are several variations of the trunk and branch system. An extended plenum system uses a main supply trunk that is one size and is the simplest and most popular design. The length of the trunk is usually limited to about 24 feet because otherwise the velocity of the air in the trunk gets too low and air flow into branches and runouts close to the air handler becomes poor. Therefore, with a centrally located air handler, this duct system can be installed in homes up to approximately 50 feet long.

A reducing plenum system uses a trunk reduction periodically to maintain a more uniform pressure and air velocity in the trunk, which improves air flow in branches and runouts closer to the air handler.

Chapter Three

3 AHU LOADING, UNLOADING AND ASSEMBLY

ECAS disclaims all liability for damage sustained by the air treatment units during loading, unloading and transportation.

3.1 AHU LOADING

We therefore recommend that special precautions be taken, including;

- The load must be firmly secured to ensure its integrity during transportation.
- Handling must be performed without exerting force on projecting accessories.
- Do not overturn the sections as u may otherwise break internal supports, components and dampers.
- If a forklift truck is used during the loading, unloading and handling operations, the forks of the truck must be at least the same length as the unit to ensure stability as shown in the fig. Below.

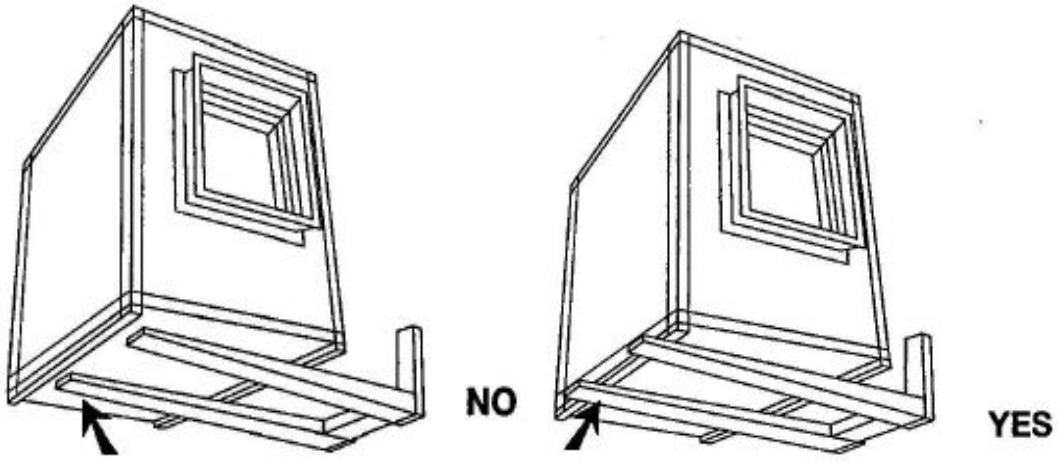


Figure 3- 1(Air handling unit loading)

- Do not subject the unit to violent impacts as you may damage its integrity.

- If the air treatment unit is fitted with a continuous steel base, handling may be accomplished with a crane, using cables firmly secured to rods (sufficient for the stress involved) passing through the holes provided in the base and by using spacers to protect the structure as shown in the fig. Below.

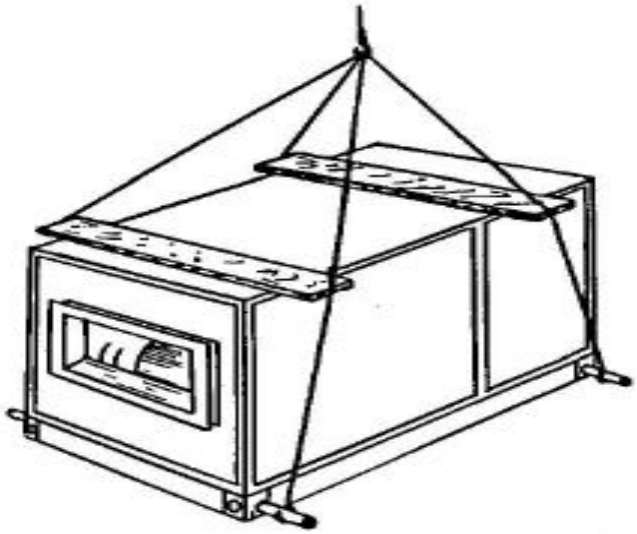


Figure 3- 2(Air handling unit loading)

- During transportation, protect the unit from atmospheric agents. Special care must be taken if the unit is supplied disassembled or designed for internal use.

3.2 PRESERVATION ON SITE

In order to keep the air treatment unit in good and efficient condition on site, the following steps must be taken first:

- Prior to installation, position the unit and the accessories in a place affording the best possible protection against accident knock, dust and atmospheric agents

- Carefully cover the inlets and outlets to prevent foreign matter from entering the unit and damaging the internal components

- Extract the pre-filters from the unit and put them in a protected place to preserve their filtration efficiency. This is why superior efficiency filters are delivered packed; they must be kept in their packages until it's put in to service.
- Check the hydraulic connections are protected by the relevant caps as they were on delivery with heat exchangers.

3.3 AHU BASE

The permanent installation of the air treatment unit may be made;

- Directly on the floor, fig. (A)

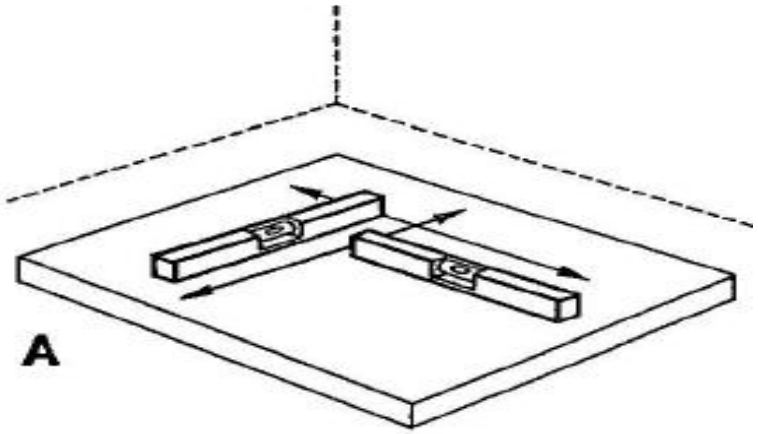


Figure 3- 3(Air handling unit base)

- On a concrete bed, fig. (B)

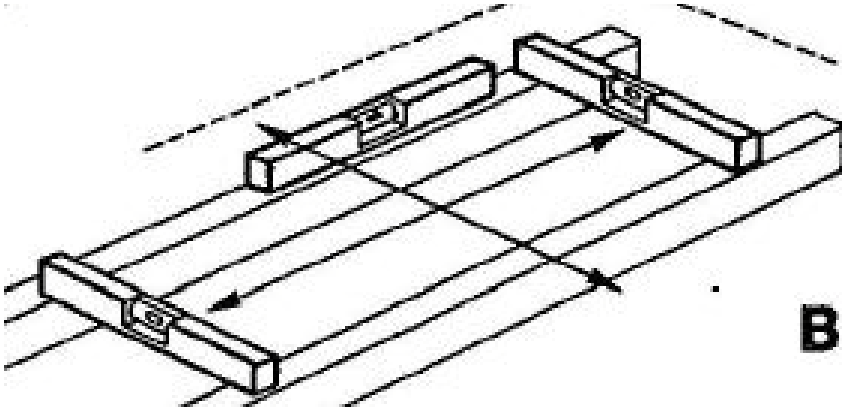


Figure 3- 4(Air handling unit base)

- On a steel section bed, fig. (C)

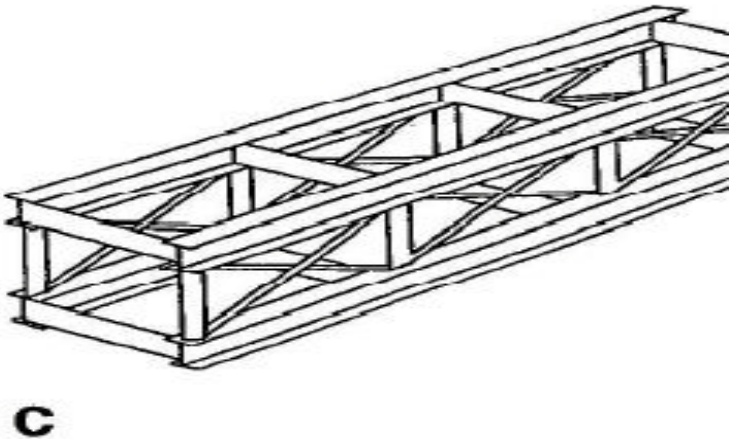


Figure 3- 5(Air handling unit base)

- On a suspended base, fig. (D)

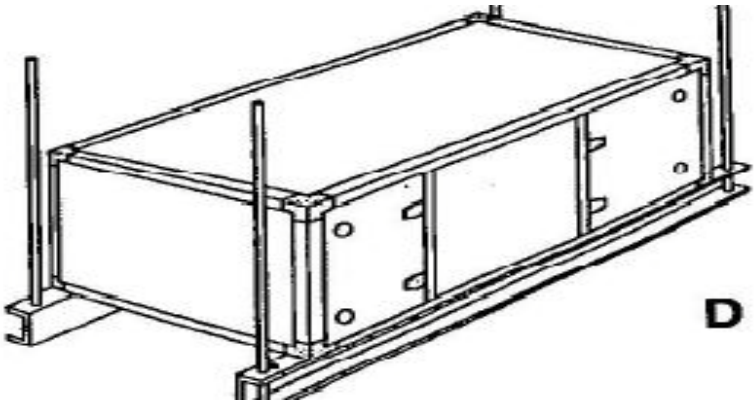


Figure 3- 6(Air handling unit base)

Both floor and the beds must be capable of withstanding machine weight to within the required safety margins.

The air treatment unit must be positioned on a horizontal surface so as to prevent;

- Damage to the fan motor units caused be uneven weights on the vibration dampers
- Malfunctioning of the condensate drains
- Difficulty in opening and closing the inspection doors.

The horizontal alignment of the support surface must be checked with a spirit level; adjustments may be made using steel shims.

3.4 AHU ASSEMBLY

If the air handling unit is broken down in to two or more sections, the following procedures should be done;

- Check the module assembly order on the ECAS working drawing.
- Clean the steel section at the point of connection and fit the self adhesive sealing strip as shown to ensure no air leakage.

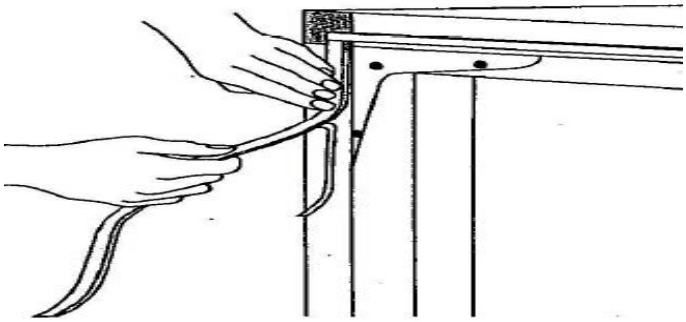


Figure 3- 7(Air handling unit assembly)

- Set the individual sections side by side using a spirit level to check that the assembled parts are perfectly aligned and leveled.

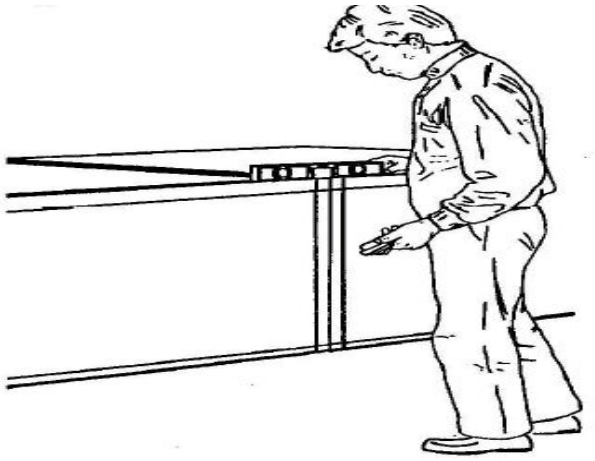


Figure 3- 8(Air handling unit assembly)

- Fasten the sections together with screws in the holes provided. The holes are located at the inside corners and also in the midway. The screw fastening areas can be usually be accessed from the inspection doors. Otherwise, you must remove the panels next to the area involved.
- In case of installing the AHU outdoor, in addition to the steps listed above, the points of connection of the individual models must also be sealed with waterproofing silicone.

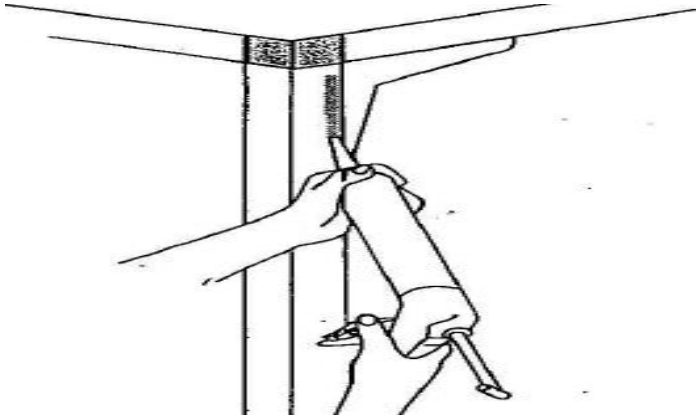


Figure 3- 9(Air handling unit assembly)

- Special care must be taken with the roofing to afford protection against elements; the two edges will be joined by means of a bayonet system, assisted by silicone treatment or a specific seal.

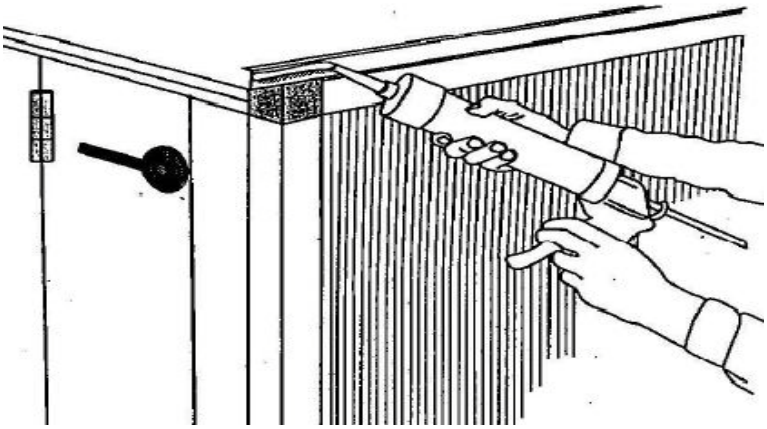


Figure 3- 10(Air handling unit assembly)

3.4.1 Heat Exchanger Installation

- Remove all protective plugs and covers from the connecting flanges prior to installation of the heat exchanger.
- Mount the heat exchanger level and square on a flat surface in order for the pipe connections to be made without forcing.
- Do not weld anything to the heat exchanger.
- Mount one support in a fixed position, while the other one is mounted in such a way that it is able to slide in the direction of the longitudinal axis of the heat exchanger. The heat exchanger will thus be able to expand under thermal stress.
- Before connecting the pipes to the heat exchanger flanges, make sure that the gasket surface is clean and free from scratches and other defects. Always use new gaskets, of the correct type and tighten the bolts crosswise.
- Take care when lifting the heat exchanger: use the lifting lugs (not all Leminar heat exchangers are fitted with them). Otherwise use at least two hoops around the shell of the heat exchanger for lifting purposes.
- Install the heat exchanger and the piping in such a manner that there is still enough room to disassemble (part of) the heat exchanger (tube bundle, drain plugs, etc.).
- Make sure that, when the heat exchanger is in service, the condensate can’t flow back from the condensate discharge pipe into the heat exchanger. Mount a one-way valve in the condensate discharge pipe. A good condensate discharge will further be promoted by mounting a steam trap.

3.4.2 Fan installation

“S&P” and **“f.lli Ferrari”** fans standard procedures is to test run and balance signature for all manufactured fans. Your fan will be correctly aligned, lubricated, and shipped assembled; ready for mounting on a properly designed system.

It is best for the equipment to be installed and operated upon receipt. As this is not always possible;

- The equipment should be stored in dry and protected area.
- The fan shaft should be protected with oil base coatings; the bearing must be kept clean, dry, and lubricated to fill voids and prevent condensation from accumulating.
- Cover and seal bearings to prevent accumulation.
- Remove V-belts and store in dry and protected area, in a plastic wrap.
- The fan rotor must be kept clean, dry and free from corrosive or erosive elements.
- The fan rotor should be rotated frequently to circulate lubricants in the fan bearing and to prevent bearing failure.
- Don’t store equipment with vibration isolators installed.
- Cover the entire fan and the motor with plastic wrap.

The process encountered during shipment, handling, and rigging can however, disturb the factory settings. Before operating the fan, be sure the start up check list are satisfied.

3.4.3 Drive Motor installation

Motor Inspection: Check the following points upon receipt;

1. Are the nameplate ratings identical with what you ordered
2. Are dimensions in compliance with your specifications
3. Is there any damage
4. Are all accessories and instruction manuals in good order
5. Please ensure that the arrow head indicator really indicates direction of rotation
6. If there are any specific requirements, please ensure they are in conformity with your specifications

Motor Storage

When motors are not in operation, the following precautionary procedures should be undertaken to assure best performance;

a) Storage area

1. High and dry, well ventilated without direct sun, dust or corrosive gas
2. Not located near to a boiler or freezer
3. Entirely free form vibration and easy for movements
4. Motors should be put on pallets to prevent moisture

b) Bearing protection

1. If the motor has been provided with a shaft shipping brace to prevent shaft movement during transportation. This prevents axial rotor movement that might damage the bearings. It must be removed before operating the motor.

2. Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with a good grade of rust inhibiting oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. While the shaft is rotating, it should be pushed to both extremes of the endplay.
3. Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage.

Motor Installation

a) **Installed motor environment:** Standard environment and site conditions for the installation of motors are usually set as follows;

1. Ambient temperature: -10 to 40 ºC.
2. Humidity: Relative humidity below 90% RH for totally enclosed types, and below 80 % RH for semi-enclosed types.
3. Elevation: below 1000 meters or 3300 feet.
4. Harmful gases, liquids, dusts, high moisture should be absent.
5. Foundations should be strong and free of vibration.
6. Installation area should be well ventilated.
7. The installation space should be large enough to facilitate heat transfer and maintenance work.

If there are any special environmental conditions, please inform ECAS prior ordering.

b) Motor foundation: For best motor performance, it is advisable to use a sole plate or common bed;

1. Client base/foundations must be even and leveled to avoid tension on the panels and frames when coupling sections together
2. Select an appropriate foundation surface for the sole plate or common bed, which will be, considered the ultimate level.
3. The base should be sturdy and rigid to keep it flat and level.
4. Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.

3.4.4 Vibration damping

In order to ensure effective protection against vibrations, the air treatment unit must be installed as the following;

- Suitable dampers in material designed to withstand the weight involved must be placed between the machine and the support surface
- The unit not be fastened directly with screws but by means of brackets

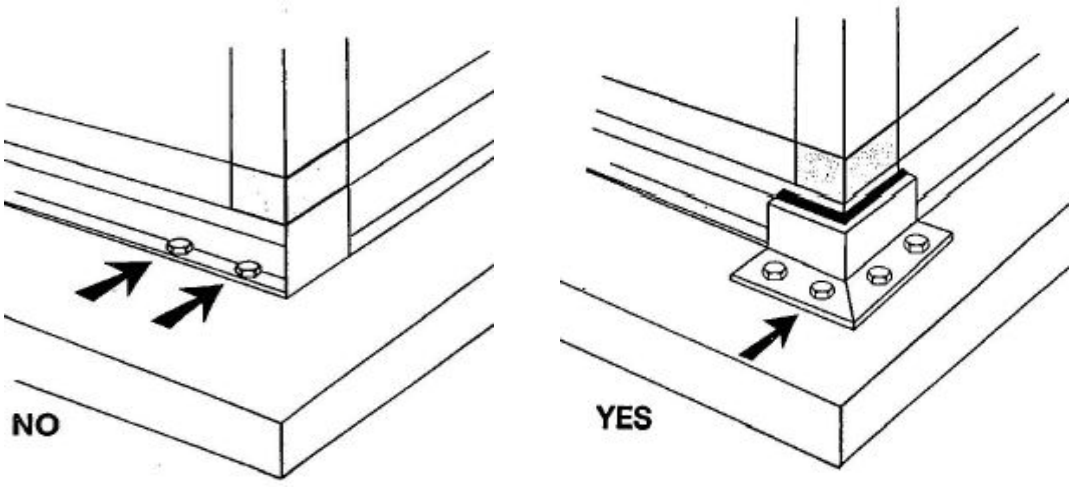


Figure 3- 11(Air handling unit vibration damping)

Chapter Four

4 AHU CONNECTION & START UP

4.1 AHU STARTUP

Mechanical startup procedures and tests are generally performed as a quality control measure to ensure manufacturer and project specifications were met during installation and start up of the equipment and/or system prior to bringing the equipment online.

These starts up testing procedures incorporate worldwide industry standards. This assures the equipment and associated systems are working in order and are in compliance with the design.

In this procedures, the below equipment/systems start up procedures are discussed;

- Electrical Connections Check
- Equipments Check
- Heat Exchanger Check
- Fan Check
- Drive Motor Check
- Duct System Check

4.2 FACILITY ENGINEER / PROJECT ENGINEER

Facility Engineer coordinates the final inspection with appropriate parties. FE oversees/participate in the start up, test and inspection process to ensure the specification and procedures are followed with an inspector from the contractor to be witness on the testing process and report it.

4.3 GENERAL PREPARATION FOR THE START UP TEST

Before starting, obtain the latest specifications and the approved shop drawings of the complete system and its associated equipment. Compare installed equipment and materials to construction drawing and compare the installation for compliance to the design and completeness including all terminations being made; proper voltage at the power source, hangers and seismic protection installed and connection to the controls. Obtain the manufactures recommended procedure for testing the equipment where appropriate.

4.3.1 Electrical Connections Check

1. **Y starting:** Star connection is widely used for low power motors.

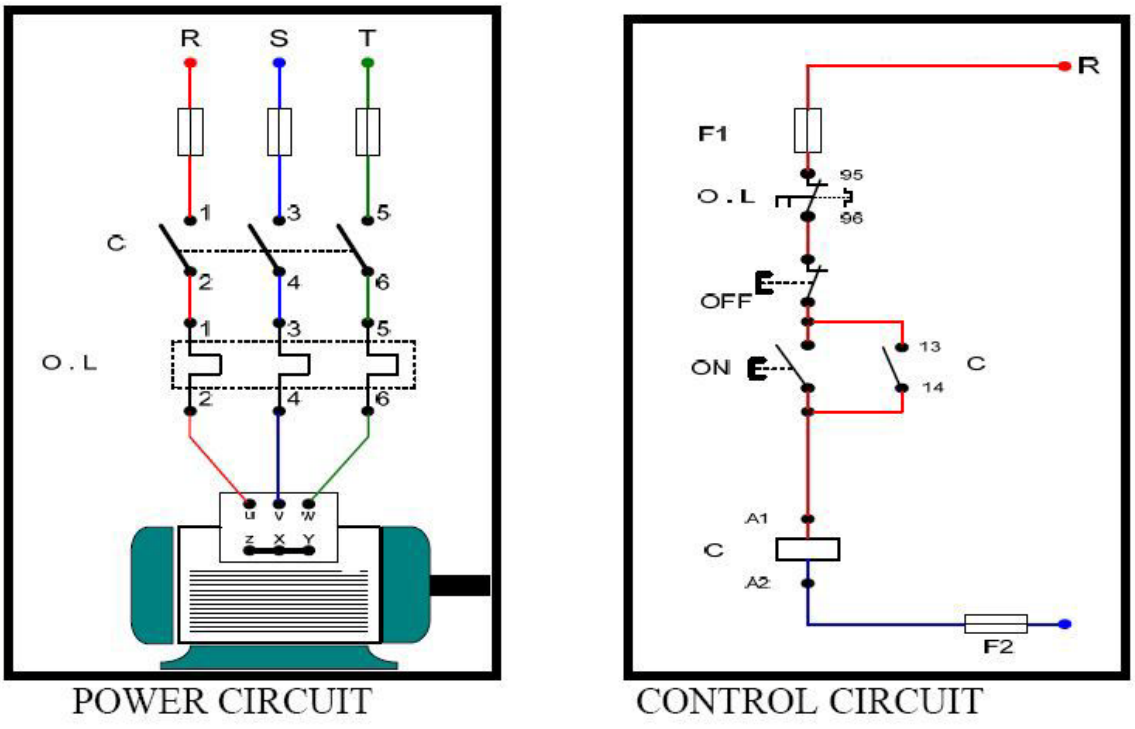
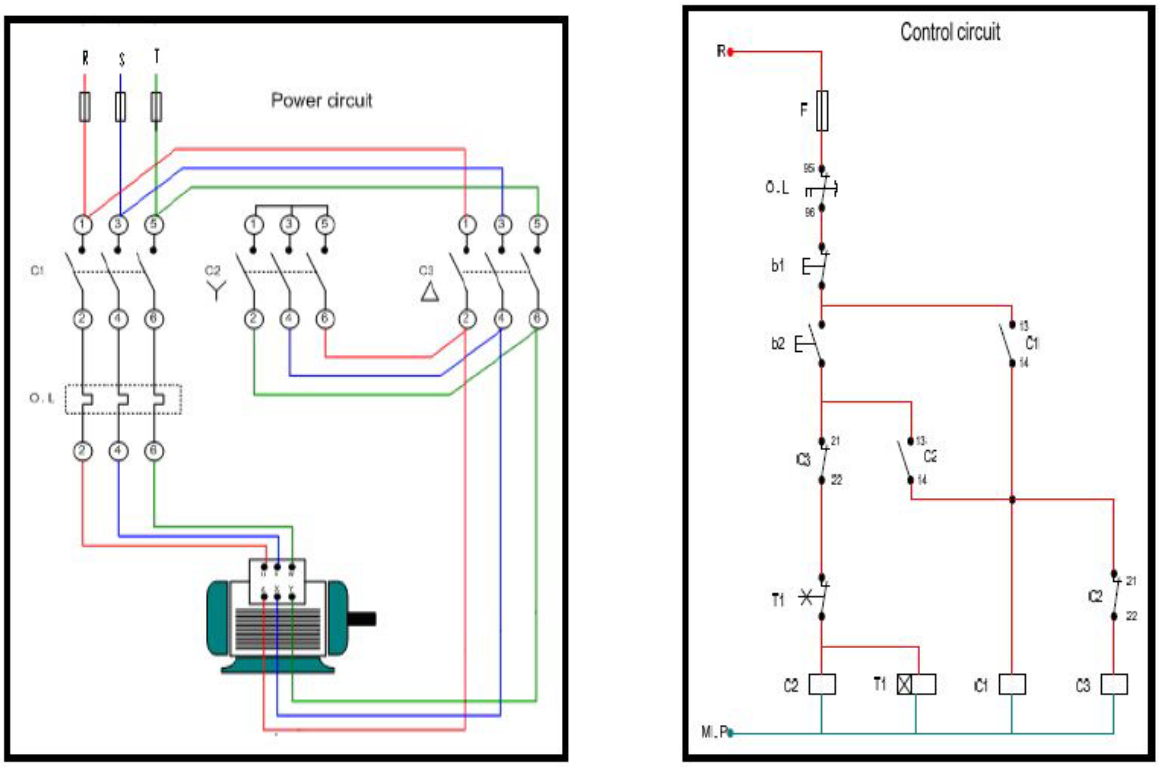


Figure 4- 1(Star connection)

2. **Δ starting:** Delta connections are widely used for medium and large size motor.

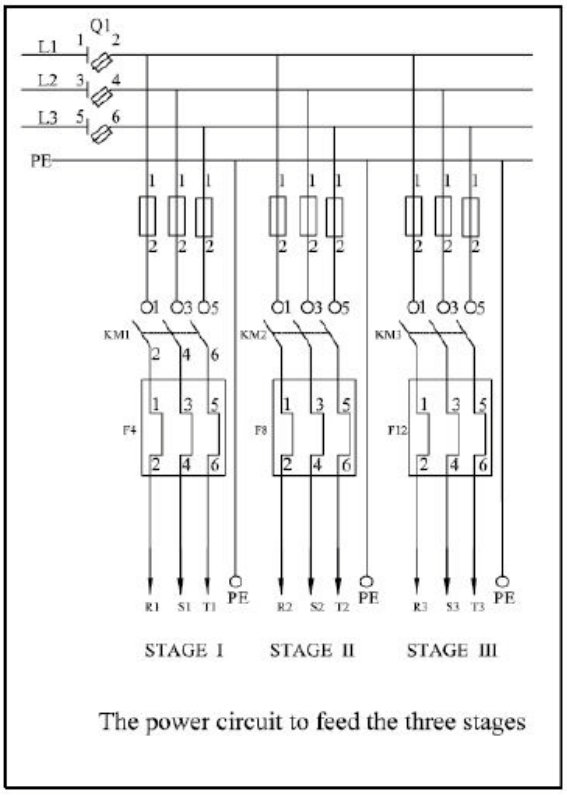


SEE NAMEPLATE FOR VOLTAGE AND CONNECTIONS

Figure 4- 2(Delta connection)

Inspect the motor control board and check that the motor protection devices are sized for the maximum amperage corresponding to the rated value. If the protection devices are sized for amperage exceeds the rated value, you must make sure that the working range is sufficient.

3. Electrical Heater connections:



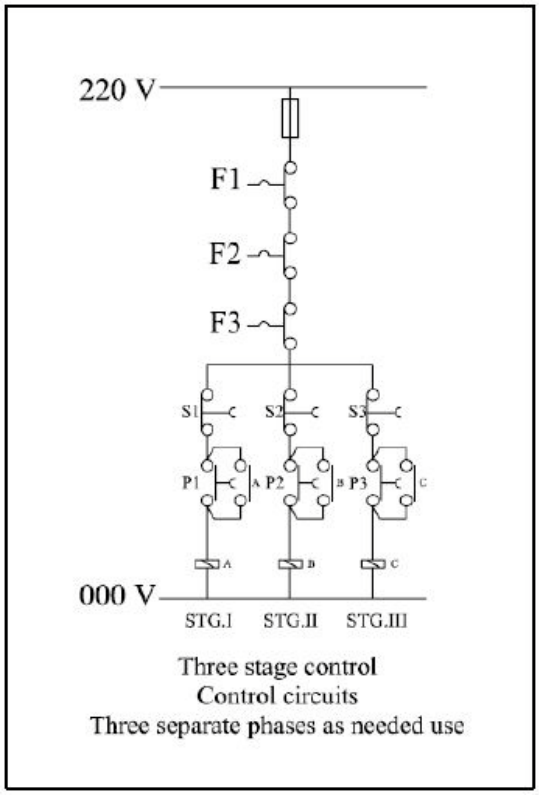


Figure 4- 3(Electrical heater connection)

4.3.2 Equipment Check

Check to see that all the packing materials have been removed. There is wide range of measurement devices used in the HVAC systems for testing the unit performance.

4.3.3 Heat Exchanger Check

- Always store the heat exchanger in a dry room, free of large temperature changes.
- At receipt check the packaging, the heat exchanger and report any damage to the heat exchanger
- Compare the data on the nameplate on the drawing

Start up: Do not exceed the design temperatures and design pressures as stated on the nameplate and specification sheet. Avoid abrupt temperature fluctuations; these can cause leaking of tube or other connections.

- Make sure that the cold medium circulation is established first, followed by the gradual introduction of the hot medium.
- Vent both circuits.
- Vent both circuits again when the operating temperatures and pressures are reached.
- Check for leakage.
- Do not deviate from the flows as stated on the specification sheet. Higher or lower velocities can cause erosion or corrosion respectively.
- Avoid standstill: at non-conditioned circuits this may cause corrosion. In case of standstill follow the instructions for shut down periods.

4.3.4 Fan Check

Preparation for Start up:

1. Prior start up, purge and clean the bearings, re-lubricate them.
2. Remove any rust from the drive components, and inspect the drive belts condition.
3. Manually rotate the fan impeller and check for proper running clearances.
4. Check all drive set screws and motor mounting bolts for tightness.
5. Prior the installation of the V belts, run the motor for ten minutes and confirm proper current draw and mechanical operation.
6. Follow the start up procedures that follows in this manual.

Pre start up check list: Before initial start up or after servicing, perform this check list;

1. Confirm all fasteners are secure. All foundation anchor bolts, locking collars, wheel retaining set screws, bearing set screws and sheave mounting bolts must be properly tightened. The maximum torque allowed for these fasteners is shown on the following table.

STUD SIZE (In.)	TORQUE(FT.-LBS.)
1/4	4
5/16	8
3/8	12
1/2	30
5/8	60

2. Check V- belts drive alignment
3. Check bearing alignment and lubrication
4. Rotate the fan wheel by hand to check that it turns freely and doesn't strike the housing or inlet cone. **DO NOT START THE FAN IF ANY METAL TO METAL RUBBING SOUNDS ARE DETECTED.**
5. Confirm all electrical connections are as described in the previous chapter.
6. Make sure all access door and bolted covers are sealed and tight. Doors, covers and inlet cones are held by nuts threaded onto weld studs.
7. Variable inlet vanes or dampers (if supplied) must move freely.
8. Duct connection must be imposing loads on the fan. Expansion joints should be used when movement is expected from thermal growth or if the fan is mounted on vibration isolators. All ducts and connections must be sealed air tight. All connections must be installed so the air flow, into and out of the fan is not obstructed.

Start up procedure: After the above considerations are satisfied, read all special instructions that apply and follow this procedure;

1. "Bump" the motor to determine proper direction of fan wheel rotation. Arrow on the fan shows the correct fan rotation. If rotation must be changed, reverse any two motor leads on the three (3) phase motors. For single phase motors, refer to the motor wiring diagram.
2. Energize the stator circuit and allow the fan to accelerate to full speed. Generally motors are sized so that the operating fan speed is obtained in fifteen (15) seconds. Larger diameter fans and narrow width high pressure blowers may take more seconds to achieve rated speed.
3. The drive V-belts will "squeal" briefly at start up. Higher horsepower fan drives may actually generate a small amount of smoke as the drive V-belts are suddenly activated at start up.
4. Observe the fan and motor as the fan runs at operating speed. Unusual vibration or overheating of the bearings should be investigated**. NOTE;** its typical for anti friction bearings to exhibit a running surface temperature in excess of 73 ºC. This surface will be too hot to touch, but it not causes the alarm. Refer to the engineering data supplied for your fan for specific information regarding bearing temperature.
5. Check the fan after it has run for approximately eight (8) hours without installing the air filters to make sure that the duct system is well cleaned. Stop the fan and recheck all alignments, inspect the bearings, retighten all hold down bolts, retention drive V-belts and tighten all set screws then install the air filters and allows the unit to run with its normal performance to make sure it's achieving the target by measuring some parameters.

4.3.5 Drive Motor Check

Start up examination

a) Connections

1. Make sure all wiring is correct.
2. Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
3. Ensure all connections are properly insulated for the voltage and temperature they will experience.
4. Ensure the capacity of fuses, switches, magnetic switches and thermo relays, etc. are appropriate and the contactors are in good condition.
5. Make sure the frame and terminal box are grounded.
6. Make sure that the starting method is correct.
7. Make sure switches and starters are set at their right positions.
8. Motor heaters must be switched off when the motor is running.

b) Power source

1. Ensure the capacity of the power source is sufficient.
2. Ensure the supply voltage and frequency ratings are identical to those on the nameplate.
3. Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

c) Bearing lubrication

1. For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. On self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. Refer to the lubrication nameplate for the recommended viscosity.
2. Motors that have been designed with anti-friction bearings for use with an oil mist lubrication system have been packed at the factory with a small amount of grease for short test runs. Continuous running should not be considered unless the oil mist system is installed and operating.
3. Grease lubricant type:
    - The bearings have been well greased at the factory before delivery. However, re-greasing is required if a significant period has elapsed between manufacture and use or in storage
    - All motors with ZZ bearings will have SHELL Alvania R3 (*Lithium base grease*).
    - All motors with open bearings will have Polyrex EM (Polyurea base grease).

Starting operation:

a) Starting load:

Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load, which is then gradually increased, proportional to the square of the speed and at last reaches 100% load at full load speed.

b) Starting:

Too frequent starts can be harmful to the motors. The following restrictions should be observed;

1. Two starts are generally permissible when the motor is cold.
2. Motor can be started only once when it is at normal running temperature.

ATTENTION!

If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately. Investigate thoroughly and take corrective action before attempting a restart.

Possible reasons for not starting are:

1. Too low a voltage at the motor terminals.
2. The load is too much for the rotor to accelerate.
3. The load is frozen up mechanically.
4. All electrical connections have not been made.
5. Single-phase power has been applied.
6. Any combination of the above.

c) Rotation direction:

1. Most our motors are bi-directional. However, when some special types, such as high speed 2-Pole motors and certain large capacity motors, those with a non-reversing ratchet, etc., should rotate in one direction
2. Ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.

3. To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases will reverse the motor direction

d) Power source & voltage current:

1. Ensure that the voltage and the frequency of the power source are identical to the ratings shown on the nameplate.
2. Voltage variation should be confined to within ±10% of the rating and the three phase voltages should be in full balance
3. Ensure the motor phase currents, when without load, are within ±5% of the average values.

e) Bearing temperature rise:

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperature stabilizes.

ATTENTION! If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and an investigation should be made before it is operated again.

Recommended limits on bearing temperature are as follows;

Sleeve Bearings	• By permanently installed detector • By temporary detector on top of the bearing sleeve near the oil ring	**90 °C** **85 °C**
Anti-Friction Bearings	• By permanently installed detector • By temporary detector measuring the outside of the bearing housing	**100 °C** **95 °C**

Figure 4- 4(Recommended limits on bearing temperature)

4.3.6 Duct System Check

Is a performance based test that uses the calibrated fan to pressurize the duct system and measure the air flow throughout the fan in a simultaneous manner. The air flow and its effect will be measured to determine the right action that should be taken. When the forced-air either in heating or cooling systems is tighter, lesser volume of air needed from the fan, a modification should be done to the AHU to overcome the system pressure drop.

Disadvantage of Air Leaks

Leaks in forced air duct systems are now recognized as a major source of energy waste in both new and existing houses. Studies indicate that duct leakage can account for as much as 25% of total house energy loss, and in many cases has a greater impact on energy use than air infiltration through the building shell. Just as important, duct leakage can prevent heating and cooling systems from doing their job properly, resulting in hot or cold rooms, and humidity problems. Worse yet, duct leaks can create air quality problems by pulling pollutants and irritants directly into the house.

Figure 4- 5(Ducting system leak)

Duct leakage testing procedure is set up to measure and diagnose duct leak problems. Knowing the specific problem and exact location of the problem will definitely pave the way towards an efficient system.

Here are just a few of the problems resulting from duct leakage

- Leaks in the supply ductwork cause expensive conditioned air to be dumped into the attic, crawlspace or garage instead of into the house.
- Return leaks pull outside air (hot in summer, cold in winter) into the duct system reducing both efficiency and capacity. In humid climates, moist air being drawn into return leaks can overwhelm the dehumidification capacity of air conditioning systems causing homes to feel clammy even when the air conditioner is running.
- Heat pumps are particularly susceptible to comfort complaints from duct leakage, especially during the heating season. Duct leaks can cause the air coming from heat pumps to feel like-warm or even cold during the winter. In addition, leaky ductwork has been found to greatly increase the use of electric strip heaters in heat pumps during the heating season.
- Leaks in return ductwork draw air into the house from crawlspaces, garages and attics bringing with it dust, mold spores, insulation fibers and other contaminants.
- Household depressurization from duct leaks and imbalanced duct systems can cause spillage of combustion products (from furnaces, water heaters and fireplaces) into the house.

There's different types of performance testing systems are used to measure duct leakage;

A Duct Blaster is used to directly pressure the duct system for air leaks; much the same way a plumber pressure tests water pipes for leaks.

The Duct Blaster fan is first connected to the duct system at the air handler cabinet, or a return grille. After temporarily sealing all remaining registers and grills, the Duct Blaster fan is turned on to force air through all holes and cracks in the ductwork.

Figure 4- 6(Duct blaster)

The fan speed is increased until a standard test pressure is achieved in the duct system. A precise leakage measurement is then made using an airflow and pressure gauge connected to the Duct Blaster system.

Estimates of efficiency losses from duct leakage can then be made from the leakage measurements. A theatrical fog machine can be used along with the Duct Blaster to inject a non-toxic fog into the duct system to visually demonstrate the location and extent of leakage in the ductwork.

Chapter Five

5 AHU MAINTENANCE MANUAL

To insure trouble free operation and long life, a regular schedule of preventive maintenance and lubrication must be followed. Frequency of inspection and lubrication depend upon the operating conditions and the time period the air handling unit is used. We recommend daily observation after the unit is first installed at the site, to determine the inspection and lubrication requirements.

Do not make any repairs to the unit during the warranty period without ECAS prior authorization or the warranty is avoided.

Caution: before performing any inspection, make sure that the unit is totally shut down and the hot systems are cooled down.

ECAS recommends that its customers carry out preventive maintenance on the air treatment units' in order to ensure long term efficiency.

These units require minimum maintenance work and have been designed to make each operation as easy and safe as possible.

5.1 ECAS MAINTENANCE AGREEMENT

On request, ECAS is willing to study preventive and annual maintenance agreements on its Air Handling Units so as to provide the costumer an excellent efficiency, purity and hygiene throughout the machines working life.

5.2 FILTRATION SECTION

The filtration section requires the most frequent maintenance in order to;

- ❖ Ensure that the air is filtered with the required efficiency in the conditioned environment
- ❖ To prevent unit components from being damaged

5.2.1 Synthetic Pre-filters

These are cells measuring 50 or 100 mm in thickness, which offer the advantage of being reconditioned able.

The reconditioning can be performed using two different methods, depending on the type of dust treated:

- ❖ In the case of dry dusts, a compressed air jet is directed against the filter in the opposite direction to normal operation.
- ❖ In the case of wet dusts, the filtration diaphragm is washed (without removing it from the frame), if necessary use domestic detergents.

To avoid damaging the filter the temperature of the water must not exceed 50 ^{o}C. Do not use solvents or caustic soda. Let the diaphragm dry the evaporation and refit it only when it is perfectly dry.

ECAS advises you to check the filters condition on a weekly basis.

The pre-filters must be reconditioned every 7-20 days depending on the type of the environment being conditioned. After 7-10 reconditioning operations, the diaphragm deteriorates and its original characteristics will be impaired; it should be therefore been replace.

5.2.2 Metal filters

These are filters of considerable strength and long service life (especially if the mesh is stainless steel). You should inspect them visually to decide when they need replacing. These filters must be reconditioned at least once a week since they generally treat extremely impure air (greasy and highly laden with particles).

The reconditioning consists in washing the filters, if necessary with solvents and caustic soda mixtures.

The filtration diaphragm may be dried with warm air or compressed air.

5.3 FAN SECTION

5.3.1 Fan

In order to keep the fan in perfect working order, we recommend you to check the following at least once a month:

- The cleanliness of the screw and wheel; remove any deposits
- Damage and corrosion to the fan components; remedy with zinc powder paint
- The tightness of the parts comprising the fan section
- Seal of the vibration-damping joint fitted to the fan delivery inlet
- Cleaning and lubrication of any DAPO control air locks. Lubrication of this part must be preformed every six months

- Absence of abnormal noise due to deterioration of the bearings. If necessary, replace them. The fans mounted on the ECAS units are fitted either with oil less bearings (design life 200 hours) or pedestal bearings, depending on the operating conditions. The pedestal bearings require periodic lubrication. The lubrication intervals subject to the environmental conditions and the maximum temperature range during operation.

Environmental condition	**Temperature range ºC**	**Lubrication intervals**
Clean	Up to 50	6-12 months
	50 to 70	2-4 months
	70 to 100	2-6 weeks
	100 and more	1 week
Dirty	Up to 70	1-4 weeks
	70 to 100	1-2 weeks
	100 and more	1-7 days
Maximum humidity		1 week

Figure 5- 1(Recommended lubrication intervals)

Recommended grease:

MOBILUX3 (MOBIL), ALVANIA GREASE3 (SHELL), NEACON3 (ESSO)

5.3.2 MOTOR

In order to maintain the motor in perfect working order, ECAS recommends the following monthly checks;

- ❖ Cleanliness; remove any deposits
- ❖ Absence of abnormal noise due to deterioration of the bearings

Powerful motors fitted with grease nipples require periodic lubrication. The greasing intervals, under normal operating conditions are shown in the following table.

Greasing motor bearing

Motor RPM	3000	1500	1000	750
Grease intervals (Hrs.)	5000	10000	20000	25000

Figure 5- 2(Greasing motor bearing)

The bearing must be greased more frequently in harsh operating conditions.

5.3.3 Belt Drive

In order to ensure optimum drive efficiency and to avoid damaging the fan motor unit, the belt drive must be kept in perfect working order.

The following must be checked every month:

- The operating condition and dirtiness of the drive; remove any deposits
- Damage to the drive (cracks on belts and pulleys, frayed belt edges, worn belts and pulleys). If necessary replace the damaged parts
- Belt tension

In order to determine the drive belt tension,

- you must establish a centre distance (I) and block the drive
- using a spring-operated torque wrench, apply a force (P) on the midway point of the belt (perpendicular to it) to obtain a deflection equal 1/64 of the centre distance (approximately 16 mm/m)

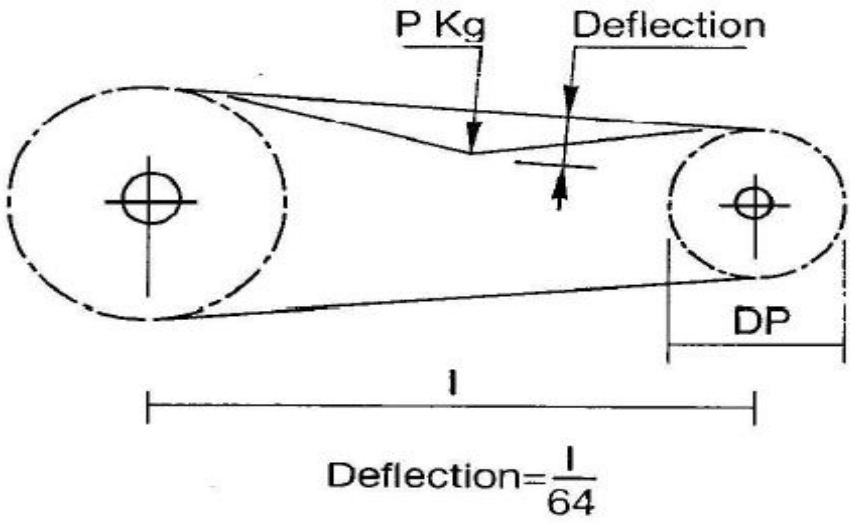


Figure 5- 3(Belt tension)

If the tension is not correct, the following will occur:

- ❖ If the belt is slack, it will wear rapidly and the drive system will be inefficient.
- ❖ If the belt is too taut, the motor and fan bearings will be damaged.

Whenever the belts are tensioned, you must check that the drive belts are aligned using an ordinary ruler

- Perfect alignment of the drive

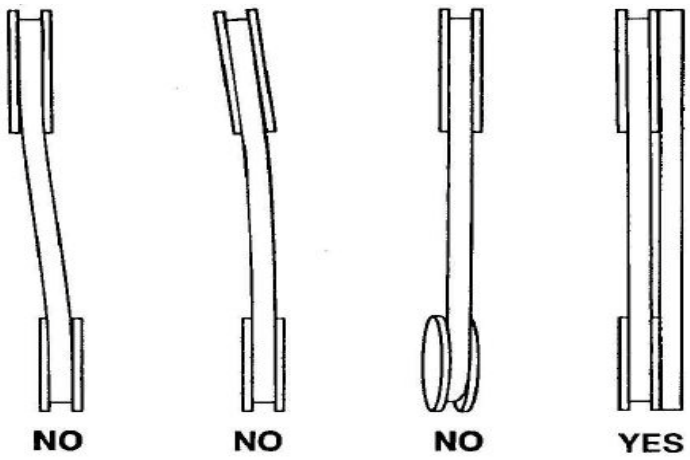


Figure 5- 4(Drive alignment)

Drive with multiple race pulleys

- ❖ In the case of drives with several belts, the belts must be replaced at the same time. This means that there must not be belts presenting different states of wear in the same driven system.
- ❖ The number of belts must always match the number of races
- ❖ In this type of drive system, the belt slack must be on the same side, as shown before they are tensioned.

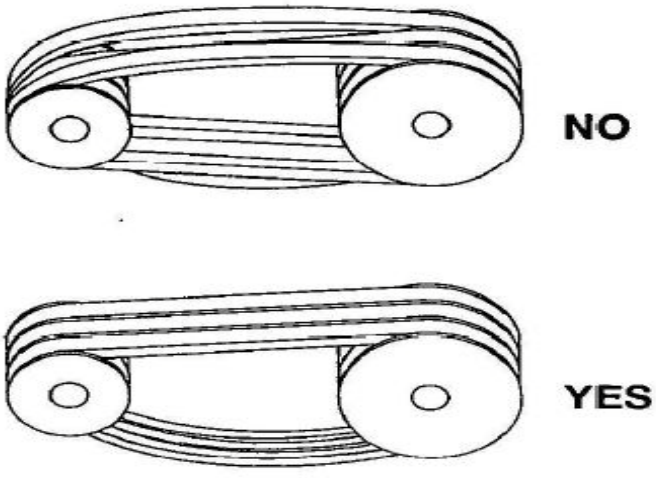


Figure 5- 5(Drive with multiple race pulleys)

5.4 AHU ACCESSORIES

5.4.1 External air intake grills

These must be cleaned frequently to remove any deposits obstructing the air passage which would be comprise the efficiency of the entire system

5.4.2 Drip separator

Every month check that there are no deposits of dust or scale that would impair separation efficiency.

Clean the separator as follows;

- ❖ Extract the drip separator from the air handling unit, removing the panels and the screws
- ❖ Completely dismantle the drip separator and clean each single fin
- ❖ Restore its normal operating condition, taking care not to bend the fins during separator removal and reassembly.

5.4.3 Silencer

The silencers installed on ECAS AHU are of the sound proof panel type. They do not require any particular maintenance. Any dust that forms on them should be removed with an ordinary vacuum cleaner.

Trouble shooting

If you are questioning the performance of your unit, check the table below before calling for service. To use this table, match your problem with the symptoms. For each symptom, there is the most likely cause and the suggested solution.

Symptom		Cause	Solution
Motor Trouble Shooting			
1.	**Vibration and noise**	Loose hold down bolts	Tighten
		Armature unbalanced	Replace with new one
2.	**Motor laboring**	Low or high voltage	Check supply voltage
3.	**High temperature**	Overload	Clean dirt from windings
4.	**Armature rub against stator**	Worn bearings	Replace bearings
5.	**Low insulation resistance**	Moisture	Check resistance with megohm meter
Fan Trouble Shooting			
1.	**Capacity or pressure below rating**	Total system resistance is higher than design	Increase fan speed. Consult the factory before proceeding
		Speed is too low	Check drive system
		Dampers not properly adjusted	Reset to correct position
		Poor fan inlet or outlet conditions	Increase speed, provide turning vanes or baffles in

			duct work
		Filters are dirty or clogged	Replace or clean
		Air leaks in system	Repair duct work
		Damaged wheel	Repair, followed by balancing. Contact factory before proceeding
		Rotation direction incorrect	Reverse electricity
2.	**Vibration and noise**	Misalignment of drive belts, sheaves, or coupling	Refer to applicable sections to correct
		Unstable foundation	Refer to applicable sections to correct
		Foreign material in fan causing unbalance	Clean the propeller from dirt/dust
		Worn bearings	Replace per applicable sections to correct
3.	**Vibration and noise**	Damaged wheel or motor	Replace or repair and balance the wheel after installation
		Broken or loose bolts	Tighten or replace
		Bent shaft	Replace with new piece
		Belts loose or tight	Re-install the correctly
		Fan wheel or drive unbalanced	Balance in place
		120 cycle magnetic hum due to electrical input	Check input line for high or unbalanced voltage
		Fan delivering more than	Reduce speed, close dampers

		rated capacity	
		Loose dampers	Tighten or replace
		Speed too high or fan rotating in wrong direction	Reduce speed, check electrical connections, reinstall fan wheel
		Vibration transmitted to fan from other source	Poor installation. Refer to applicable manual section
4.	**Overheated bearings**	Too much grease in bearings	Clean and re-grease per applicable section
		Poor alignment	Realign
		Bent shaft	Replace with new piece
		Dirt in bearings	Clean and re-grease per applicable section
		Excessive belt tension	Realign and tension per applicable section
5.	**Driver overloaded**	Speed too high	Recheck driver selection
		Volume flow rate below required	Fan improperly specified as a result, system resistance is higher than design
		Rotating wrong direction	Correct per applicable section
		Wheel wedging or binding	Reinstall wheel
		Motor wired wrong	Rewire per applicable
6.	**Excessive flow**	Filter are not in place	Check filters
		Fan speed higher than designed	Reduce fan speed

		System is less (static pressure) than expected	Reduce fan speed
7.	**Fan does not operate**	Wrong voltage	Check voltage
		Blown fuses	Check and replace the fuses
		Overloaded protector has broken circuit	Check and repair
		Broken belts	Replace the belts

Figure 5- 6(Air handling unit troubleshooting table)

Chapter Six

6 SAFETY RECOMMENDATION

ECAS has fitted its air handling units with every possible safety features to prevent accidents, especially during start-up and maintenance.

6.1 SAFETY REALATED FEATURES OF AHU

SOME OF THESE SAFETY FEATURES ARE LISTED BELOW;

- Inspection doors that can only be opened with a key. Installed for the fan section as the occurrence of rotating parts and drives.
- The housing protecting the rotating parts and drives can only be removed with a key.
- On huge units, in which the operation purposes an electrical knife switch is fitted standard inside the unit. The purpose of the switch is to prevent the fan motor assembly from being activated when someone is inside the unit.
- The outside of the structure has rounded edges.
- Elimination of sharp edged steel sheet parts inside and outside the unit.
- Use of self tapping screws with non projecting tip inside sections and panels.

6.2 SAFETY NOTICES APPLIED TO THE UNITS

The inspection doors of the AHU carry safety notices drawing the operator's attention to the danger connected with the moving parts and warning him to disconnect the system power before opening the inspection door.

6.3 PRACTICAL ACCIDENT – PREVENTION TIPS

- Open the inspection doors only when the fan is at a standstill.
- Before carrying out maintenance work on the fan motor unit, make sure that the motor cannot be restarted by accident.
- Before working on the motor, make sure that it has cooled completely.
- In order to protect your hands, use a lever to remove the belts.
- Block the fan wheel before carrying out maintenance work on it, since (especially when the belt is removed) the updraft caused by the ducting could make it turn and cause injury.

Chapter Seven

7 ECAS WARRANTY POLICY

ECAS guarantees' their products for 12 months from delivery date.

The warranty covers the normal operation of the individual components installed in our unit, such as motors, fans, heat exchangers, humidifiers and other parts.

It should be stressed that the warranty covers manufacturing defects in these parts, while their efficiency is categorically excluded since this is determined by the characteristics of the air moving and hydraulic systems and by the design, and does not therefore fall within our sphere of responsibility.

ECAS therefore undertakes to replace any individual component that malfunction as rapidly as possible and subject to stocks. The part should be sent prepaid to our headquarters and the replacement will be sent carriage forward.

Please note too that the warranty does not include the services of our personnel for the replacement of the part on site; the cost is entirely for the installer's account. On receipt of the returned material deemed to be defective, an inspection will be carried out to establish whether the part reveals abnormalities justifying application of the warranty. If it is established that the defect is attributable to external factors, it will be charged to the customer. It should further noted that the warranty shall not apply in the case of tampering or if the failure results from incorrect installation or connection.

Chapter Eight

8 AHU TECHNICAL DATA SHEETS

Project :			**Contractor :**		
AHU Order No. :			**AHU Model :**		
General Dim. "mm" :	T.L =	, T.W =	, T.H =		
Weight "Kg" :	Kg		**Shipment in Pieces :**		
Frame Type / Size :			**Panel Type / Thickness :**		
Base Frame Type / Size :	Painted steel / H100		**Drain Pan Type :**		
Supply Fan Model :	BDB /		**Specifications :**		m^3/h Pa RPM
Supply Fan Pulley :	SP - ϕ x		**Bush :** /	**Belts :** **Qty. :**	
Supply Fan Motor :	KW V / Poles		**Motor pulley :** SP - ϕ x	**Bush :** /	
Electric Heater :	**Type & Capacity :**	No. Of Stages: ..... / ..... KW / 380 V / 50 Hz			
Cooling Coil :	**Type & Capacity :** **Coil inlet / outlet** **Code :**	..... / ..... KW (..... T.O.R) ..... Tubes, ... Fins. In & Out supply water ....."			
Drain Pan :	..... x ..... cm / Drain outlet ....."				

Dampers	:	**1)**	**Dimension "cm"**	:	..... x ..... (%)	**Type**	:	Fresh Air
	:	**2)**	**Dimension "cm"**	:	..... x..... (%)	**Type**	:	Return Air
Filters	:	**1)**	**Dim.**	:	595*595*50 mm	**Quantity / Type**	:	..... /Pre-Filter G3
	:	**2)**	**Dim.**	:	595*295*50 mm	**Quantity / Type**	:	..... / Pre-Filter G3
	:	**3)**	**Dim.**	:	24*24*22 inch	**Quantity / Type**	:	..... /Bag Filter F7
	:	**4)**	**Dim.**	:	24*12*22 inch	**Quantity / Type**	:	..... / Bag Filter F7
		5)	**Dim.**	:	610*610*292 mm	**Quantity / Type**	:	...../ HEPA H13
		6)	**Dim.**	:	610*305*292 mm	**Quantity / Type**	:	...../ HEPA H13

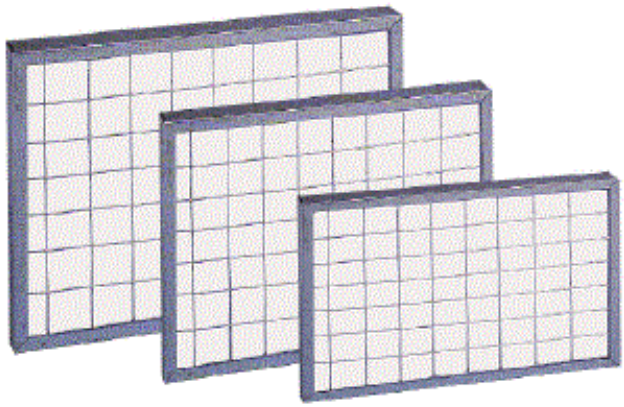
AHU TECHNICAL DATA SHEETS

8.1 AIR FILTERS TECHNICAL DATA SHEET

a) Synthetic Pre-filters

Washable Filter Panels

For air condition and ventlation systems



☑ Washable type ☑ Low resistance to air flow ☑ High dust hold capacity ☑ Excellent performance

panel filter is made from high quality synthetic fibers with an exlusive bonding technology which ensures a high number of fibers per square inch.

panel filter is a light weight filter that has relatively low initial resitances to air flow, high dust holding capacity and filter classification is G3 & G4 according to EN 779.

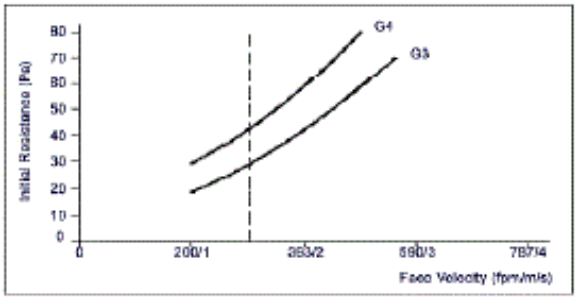
panel filter is used in air handling units, air conditioning systems, industrial ventilation systems and suited for high moisture applications.

panel filter is used as prefilter to protect and increase life expactance of medium and high efficiency filters in multi-stage filteration systems.

Specification

EN 779 class	G3	G4
Average arrestance	80-85%	87-92%
EUROVENT 4/5 class	EU 3	EU 4
Final pressure drop	200 Pa	200 Pa
Max. operating temperature	100 °C	100 °C
Rated capacity ($m^3/hr/m^2$)	5400	5400

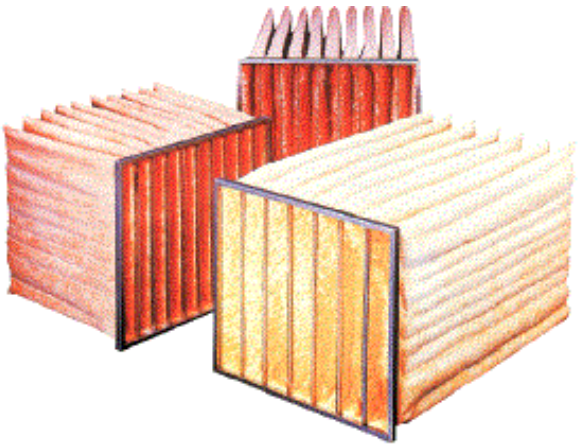
Flow velocity Vs resistance



Efficiency	Filter class	Nominal Size Inch	Actual Size mm	Part Number	Initial pressure drop (in.W.G) at 300 FPM
80-85%	G3	24x24x2	592x592x47	FA2-R-24242	0.2
		20x25x2	495x622x47	FA2-R-20242	0.2
		20x20x2	495x495x47	FA2-R-20202	0.2
		16x25x2	395x622x47	FA2-R-16252	0.2
		16x20x2	395x495x47	FA2-R-16202	0.2
		12x24x2	300x592x47	FA2-R-12242	0.2
		24x24x1	592x592x22	FA1-R-24241	0.1
		20x25x1	495x622x22	FA1-R-20241	0.1
		20x20x1	495x495x22	FA1-R-20201	0.1
		16x25x1	395x622x22	FA1-R-16251	0.1
		16x20x1	395x495x22	FA1-R-16201	0.1
		12x24x1	300x592x22	FA1-R-12241	0.1
87-92%	G4	24x24x2	592x592x47	FA2-R-24242	0.3
		20x25x2	495x622x47	FA2-R-20242	0.3
		20x20x2	495x495x47	FA2-R-20202	0.3
		16x25x2	395x622x47	FA2-R-16252	0.3
		16x20x2	395x495x47	FA2-R-16202	0.3
		12x24x2	300x592x47	FA2-R-12242	0.3
		24x24x1	592x592x22	FA1-R-24241	0.17
		20x25x1	495x622x22	FA1-R-20241	0.17
		20x20x1	495x495x22	FA1-R-20201	0.17
		16x25x1	395x622x22	FA1-R-16251	0.17
		16x20x1	395x495x22	FA1-R-16201	0.17
		12x24x1	300x592x22	FA1-R-12241	0.17

b) Pocket Filters

Medium & High Efficiency
Extended Surface Air Filter



Description

pocket filters are made of multi layer micro fine synthetic fibers.
Longitudinal ultrasonic welded spacers are incorporated into each pocket to control the inflation of each pocket and guarantee a uniform flow throughout the media.
Media design ensures a low initial resistance to air flow, high dust holding capacity and long service life for the filter.

pocket filters Media are tested in accordance with EN779.

pocket filters are available in four efficiencies.
To insure proper installation and easy identification, each efficiency has its own color code as shown in table below.

Efficiency	Filter class	Color code
90-95%	F8	Yellow
80-85%	F7	Pink
60-65%	F6	Green

- Recommended final resistance is 450 Pa
- Filter can be operated from 67% to 133% of rated face velocity
- Headers are 22mm
- Special sizes are available upon request

Application

pocket filters can be applied in air conditioning, heating, ventilating and HVAC systems.


Automotive


Pharmaceutical & Hospital


Industrial


Commercial

Efficiency	Filter class	Size inch	No of Pockets	Part Number	CFM 375/500/625 FPM	Initial pressure drop (in.W.G) 500 FPM
90-95%	F8	24x24x36	10	FBC9-242436-10	2000/2500/3000	0.33
		24x24x36	8	FBC9-242436-08	2000/2500/3000	0.36
		24x24x36	6	FBC9-242436-06	1500/2000/2500	0.38
		24x24x22	8	FBC9-242422-08	1500/2000/2500	0.52
		24x24x22	6	FBC9-242422-06	1000/1500/2000	0.45
		20x24x22	5	FBC9-202422-05	1000/1200/1400	0.37
		20x24x22	4	FBC9-202422-04	1000/1200/1400	0.39
		20x24x36	5	FBC9-202436-05	1600/2000/2400	0.33
		20x24x36	4	FBC9-202436-04	1200/1600/1800	0.36
		12x24x22	4	FBC9-122422-04	500/750/1000	0.45
		12x24x22	3	FBC9-122422-03	500/750/1000	0.45
		12x24x36	5	FBC9-122436-05	1000/1250/1500	0.33
		12x24x36	4	FBC9-122436-04	1000/1250/1500	0.36
		12x24x36	3	FBC9-122436-03	1000/1250/1500	0.37
80-85%	F7	24x24x36	10	FBC8-242436-10	2000/2500/3000	0.24
		24x24x36	8	FBC8-242436-08	2000/2500/3000	0.24
		24x24x36	6	FBC8-242436-06	1500/2000/2500	0.25
		24x24x22	8	FBC8-242422-08	1500/2000/2500	0.45
		24x24x22	6	FBC8-242422-06	1000/1500/2000	0.35
		20x24x22	5	FBC8-202422-05	1000/1200/1400	0.25
		20x24x22	4	FBC8-202422-04	1000/1200/1400	0.27
		20x24x36	5	FBC8-202436-05	1600/2000/2400	0.24
		20x24x36	4	FBC8-202436-04	1200/1600/1800	0.27
		12x24x22	4	FBC8-122422-04	500/750/1000	0.35
		12x24x22	3	FBC8-122422-03	500/750/1000	0.35
		12x24x36	5	FBC8-122436-05	1000/1250/1500	0.24
		12x24x36	4	FBC8-122436-04	1000/1250/1500	0.27
		12x24x36	3	FBC8-122436-03	1000/1250/1500	0.29
60-65%	F6	24x24x36	10	FBC6-242436-10	2000/2500/3000	0.23
		24x24x36	8	FBC6-242436-08	2000/2500/3000	0.23
		24x24x36	6	FBC6-242436-06	1500/2000/2500	0.23
		24x24x22	8	FBC6-242422-08	1000/1500/2000	0.32
		24x24x22	6	FBC6-242422-06	1000/1500/2000	0.32
		20x24x22	5	FBC6-202422-05	1000/1200/1400	0.23
		20x24x22	4	FBC6-202422-04	1000/1200/1400	0.25
		20x24x36	5	FBC6-202436-05	1600/2000/2400	0.23
		20x24x36	4	FBC6-202436-04	1600/2000/2400	0.25
		12x24x22	4	FBC6-122422-04	500/750/1000	0.32
		12x24x22	3	FBC6-122422-03	500/750/1000	0.32
		12x24x36	5	FBC6-122436-05	1000/1250/1500	0.23
		12x24x36	4	FBC6-122436-04	1000/1250/1500	0.25
		12x24x36	3	FBC6-122436-03	1000/1250/1500	0.26

c) HEPA Filters

HV(High Volume) Hepa Filter

SPECIFICATION :

- Series : V-bank Series.
- Frame : Galvanized sheet metal.
- Separators : Hot Melt.
- Media : Glass Fiber or Synthetic fiber media.
- Sealant : Polyurethane.
- Efficiency :

MPPS : ≥95%(H11) ;
DOP : ≥99.9%@0.3μm
MPPS : ≥99.95%(H13) ;
DOP : ≥99.99%@0.3μm
MPPS : ≥99.995%(H14) ;
DOP : ≥99.999%@0.3μm

- Temperature : ≤ 70°C
- Humidity : ≤ 100 % RH
- Recommended final pressure drop : ≤ 600Pa

APPLICATIONS :

These filters can be used in almost any application.
Power generating facilities.
It can stand turbulant air flow, repeated fan shutdown, desert and marine installations.

ADVANTAGE :

These filters extended media surface creates a very low resistance to air flow and low pressure drop to save energy consumption. Very high volume dust holding capacity and large variations in air flow and pressure drop.

DESCRIPTION :

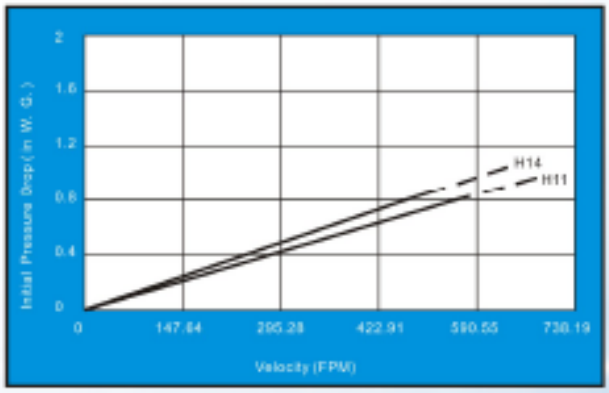
This Mini-pleated V-bank filters use glass fiber media with efficiency in H11, H13, H14 the frames can be galvanized steel or aluminum.

DIMENSIONS AND PERFORMANCE DATA:

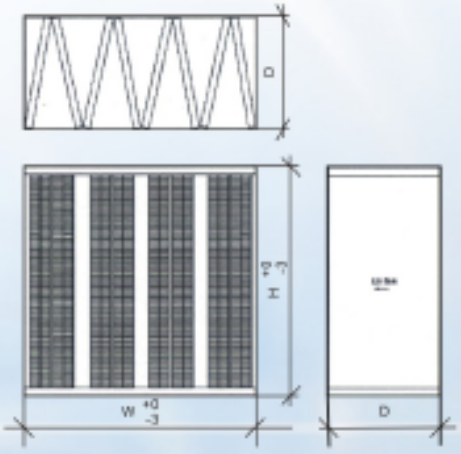
ITEM NO.	NOMINAL SIZE W×H×D(inches)	ACTUAL SIZE W×H×D(in.) W×H×D(mm)	MEDIA AREA sq.ft./sq.m.		EFFICIENCY En1822	AIR-FLOW/INTIAL RESISTANCE CFM/W.G CMM/Pa	
			Standard Capacity	High Capacity		Standard Capacity	High Capacity
375912-1	24×24×12	24×24×11 1/2×5v 610×610×292×5v	264.6 24.5	353.2 32.7	H11	1800/0.6 51.0/150	2000/0.8 56.6/200
375954	24×24×12	24×24×11 1/2×6v 610×610×292×6v	311.1 28.8	414.7 38.4		1800/0.52 51.0/130	2000/0.72 56.6/180
375953	12×24×12	12×24×11 1/2×3v 305×610×292×3v	173.9 16.1	230.5 21.3		900/0.52 25.5/130	1000/0.72 28.3/180
375916-1	24×24×12	24×24×11 1/2×5v 610×610×292×5v	264.6 24.5	353.2 32.7	H13	1800/1.0 51.0/250	2000/1.2 56.6/300
375956	24×24×12	24×24×11 1/2×6v 610×610×292×6v	311.1 28.8	414.7 38.4		1800/0.92 51.0/230	2000/1.12 56.6/280
375955	12×24×12	12×24×11 1/2×3v 305×610×292×3v	173.9 16.1	230.5 21.3		900/0.92 25.5/230	1000/1.12 28.3/280
375920-1	24×24×12	24×24×11 1/2×5v 610×610×292×5v	264.6 24.5	353.2 32.7	H14	1800/1.0 51.0/250	2000/1.2 56.6/300
375958	24×24×12	24×24×11 1/2×6v 610×610×292×6v	311.1 28.8	414.7 38.4		1800/0.92 51.0/230	2000/1.12 56.6/280
375957	12×24×12	12×24×11 1/2×3v 305×610×292×3v	173.9 16.1	230.5 21.3		900/0.92 25.5/230	1000/1.12 28.3/280
FACE VELOCITY : STANDARD VELOCITY : 472.44 FPM HIGH VELOCITY : 590.55 FPM							

*1.Extra sizes are available on request.
*2.Pressure drop +/- 15 %.

INITIAL RESTRICTION vs. FACE VELOCITY



ENGINEERING DRAWING

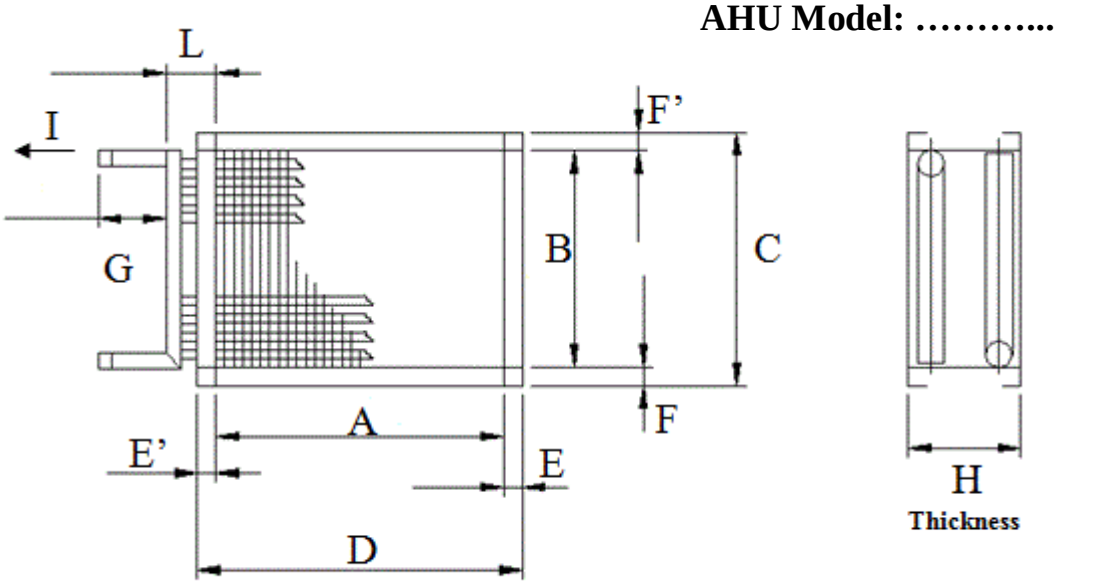


8.2 COILS TECHNICAL DATA SHEET

a) Cooling coil

AHU Order No.: ……..

AHU Model: ……...



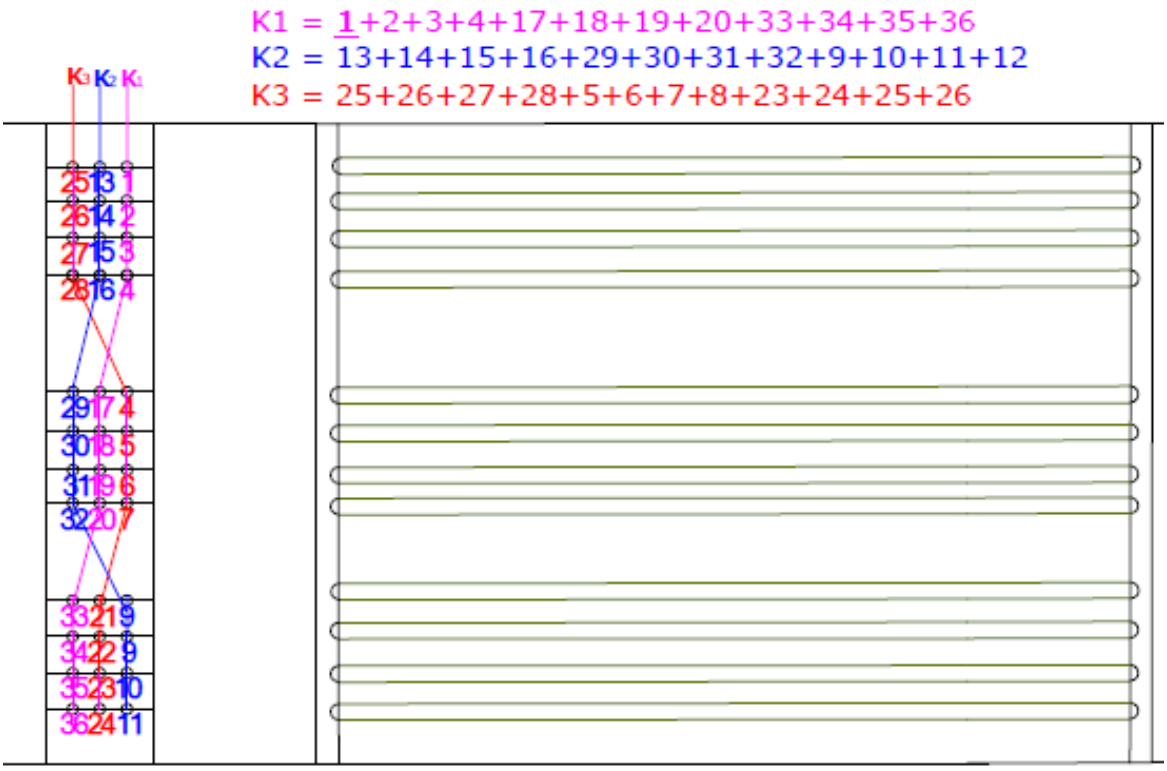
Cooling Refrigerant: Water

❖ Cooling Load	:	T.O.R
❖ Number of Rows	:	Rows
❖ Number of Tubes	:	Tubes

Coil Dimensions

A	=		cm
D	=		cm
E=E'=F=F'	=		cm
B	=		cm
C	=		cm
I	=	"	inch
H	=		cm
G	=		cm

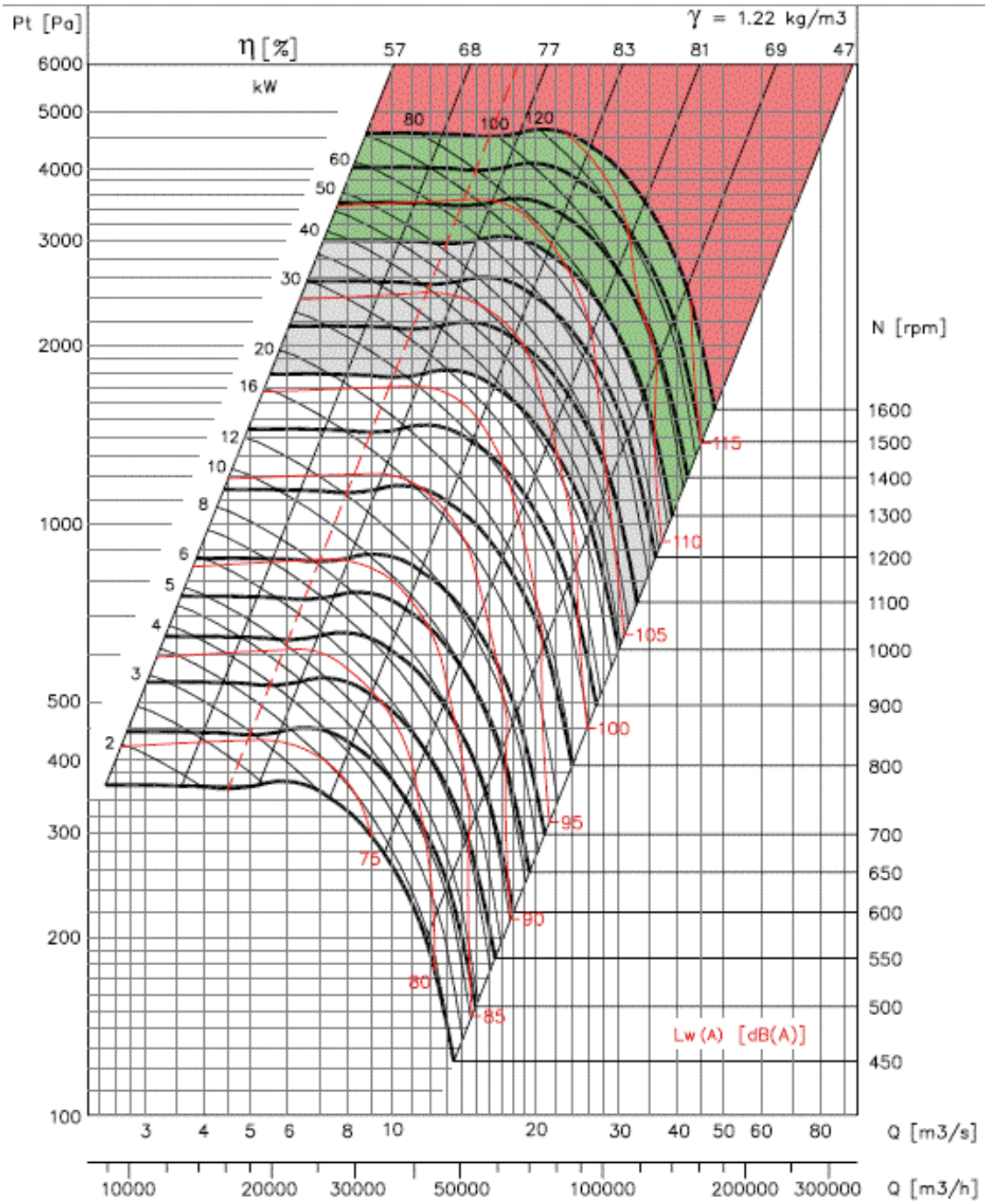
b) Electric heater



Electric heater details		
Consist of: - ……. rod, …. stage, 1 group		
❖ Total capacity	=	Kw
❖ Electric heater rod length	=	m
❖ Electric heater rod capacity	=	Kw/each

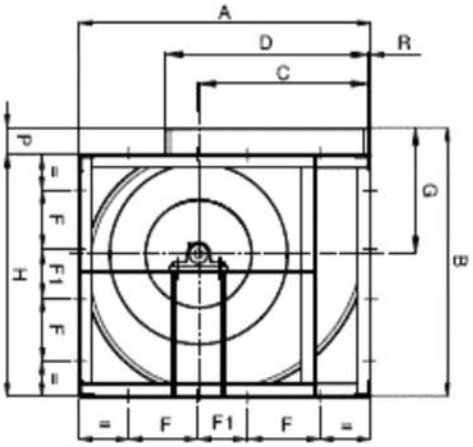
8.3 FAN TECHNICAL DATA SHEET

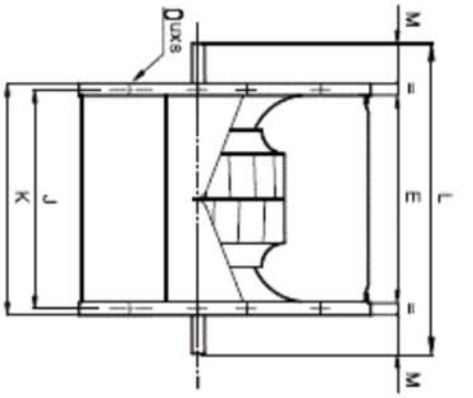
BDB / 1000XM



BDB / 450-1000 XM Dimensions

BDB 450-1000 'XM'

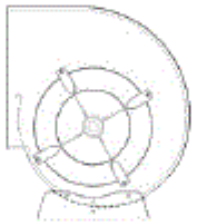
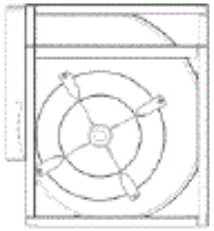
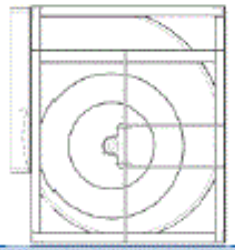
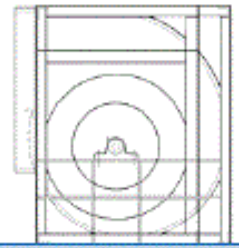
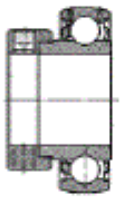
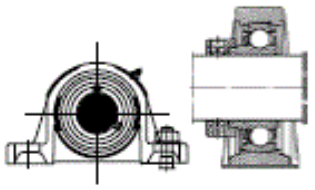
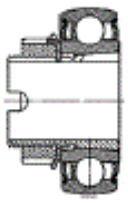
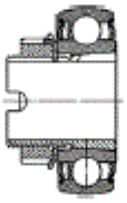
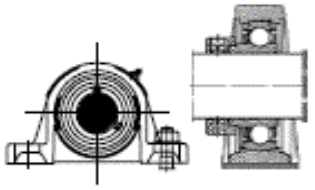
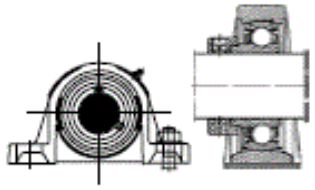
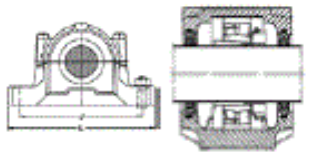
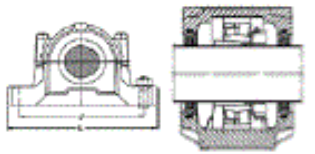




Model	A	B	C	D	E	F	F1	G	H	J	K	L	M	P	R	ød	uxs
450	827	726	486	568	568	200	111	322	681	608	648	946	149	45	5	45	13x18
500	918	800	538	638	638	245	120	352	750	678	718	1066	174	50	5	50	13x18
560	1030	892	603	714	714	280	125	390	844	764	814	1138	162	48	7	55	13x18
630	1157	998	679	800	800	328	110	434	945	850	900	1286	193	53	6	60	13x18
710	1302	1120	765	898	898	360	150	484	1057	948	998	1390	196	63	7	65	17x22
800	1468	1254	862	1006	1006	405	171	540	1180	1056	1106	1498	196	74	7	65	17x22
900	1648	1408	971	1130	1130	455	189	604	1319	1180	1230	1660	215	89	7	70	17X22
1000	1810	1540	1066	1266	1266	500	200	656	1450	1316	1366	1845	239.5	90	9	80	17x22

All Dimensions in mm.

Bearings Duty

	Mounted in a rubber housing		Mounted on cast iron supports with grease point	
Fan Type	S	C	T	X
				
Bearing Duty	SL Light Duty	CL Light Duty	TL Light Duty	-
				
	SM Medium Duty	CM Medium Duty	TM Medium Duty	XM Medium Duty
				
	eg. Model FDA 450 C M		TX Extra Heavy Duty	XX Extra Heavy Duty
	Model FDA 450 C M Fan Bearing Duty (L, M, X) Fan type (S, C, T, X, Z) Fan Size (315, 355, 400,...1400)			

BDB Fans Operational Limits

			315	355	400	450	500	560	630	710	800	900	1000	1120	1250	1400
Maximum Absorbed Power	S-C	kW	4	5	6	8	10	12	14	18						
	T	kW	8	11	14	18	20	25	30	40	22	30	35	45	50	70
	X	kW	16	22	28	35	45	50	60	80	50	60	80	100	120	160
	Z	kW									100	120	160	180	200	250
	S2-C2	kW	5	6.5	6.5	7.5	7.5									
	T2	kW		15	15	18	22	22	25							
Maximum Fan Speed	S-C	rpm	3100	2700	2500	2200	1900	1700	1500	1350						
	T	rpm	4100	3500	3200	2900	2500	2200	2000	1800	1200	1050	1000	850	780	680
	X	rpm	5100	4500	4100	3600	3200	2800	2500	2200	1600	1400	1300	1100	1000	900
	Z	rpm									2000	1750	1600	1400	1250	1100
	S2-C2	rpm	2400	2200	1800	1600	1200									
	T2	rpm		2800	2400	2200	2000	1550	1300							
Temperature Range Min. -20°C	S-C	Max.oC	85	85	85	85	85	85	85	85						
	T-X	Max.oC	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	S2-C2	Max.oC	85	85	85	85	85									
	T2	Max.oC		100	100	100	100	100	100							
Fan weight	S	kg	26	37	42	58	74	95	118	174						
	C	kg	27	41	45	62	81	110	141	199						
	T	kg	40	53	67	89	118	158	197	251	299	368	474	687	967	1362
	X	kg	49	65	82	94	124	166	212	271	323	397	512	755	1064	1430
	S2	kg	46	66	76	103	129									
	C2	kg	53	76	91	117	148									
	T2	kg		106	132	147	182	235	296							

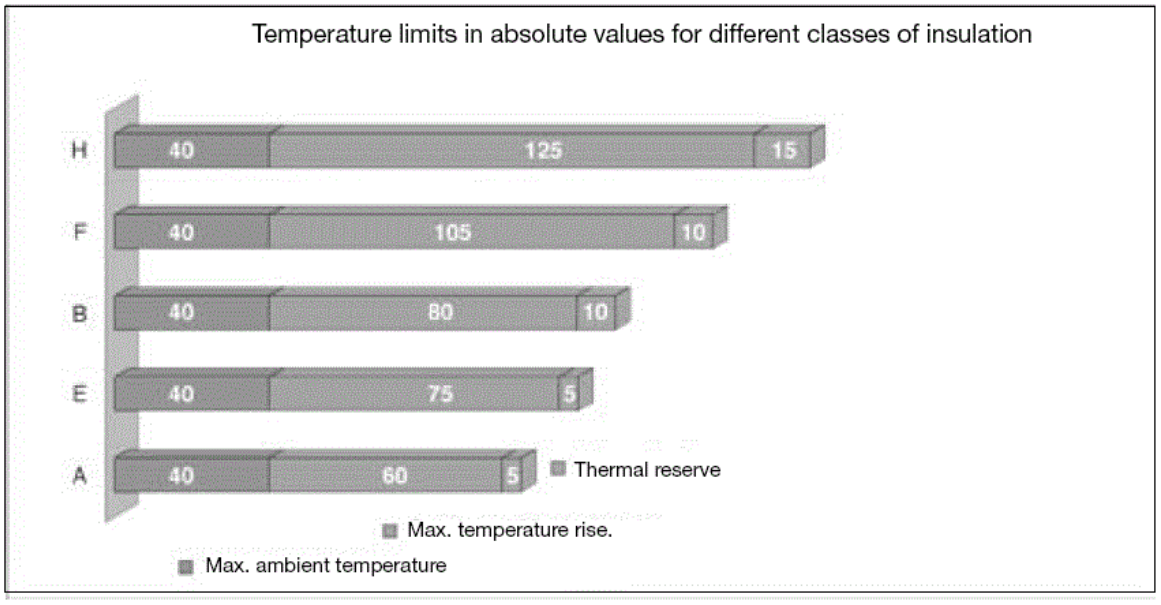
8.4 MOTOR TECHNICAL DATA SHEET

Motor insulation:

The chemical and physical characteristics of the insulation material are fundamental to the optimum operation and duration of any electric motor, and for this reason a temperature limit corresponding to the insulation material used must be determined; for this reason, each insulation material used must ensure the reliable operation of the motor within its own absolute temperature limits.
Insulation material quality is defined by IEC 34-1 Standards in distinct insulation classes for each of which an absolute temperature limit has been established..

Class A 105° **Class F 155°** **Class B 130°**
Class E 120° **Class H 180°**

As specified by international standard, temperature is measured in °C, (degrees Celsius) while the difference in temperature is measured in K (1°C = 1K). For Class F, for example, the temperature increase cannot exceed 105K provided that the room temperature does not exceed +40°C. This value is valid when applied to the resistance measurement method. This means that the resistance of the winding at room temperature is measured first and then a thermal test is performed on the motor at rated power, after which the resistance of the winding is measured again. The temperature increase is calculated with the following formula:
$\Delta T=[(R2-R1)/R1]\ (235+T1) + (T1-T2)$
where:
R^1: low temperature resistance measured at room temperature T';
R^2: high temperature resistance measured at room temperature T";
235: constant for copper windings.
This method requires the determination of the average temperature increase.
For this purpose 10K, for example, provides an additional thermal margin between the winding's average temperature and the temperature at its hottest point.
All **Vemat** motors are produced using copper wire for the winding in class H and Class F insulation material.
Each winding is provided with a careful hot polymerising resin treatment that grants remarkable resistance against both humidity and sudden changes in room temperature, while the paint treatment employs special protective paint (tropical insulation) that gives the motor elevated protection against the most extreme weather conditions.



All **Vemat** motors come standard-equipped with Class F insulation and Class B operating over-temperature, and therefore the temperature of the stator windings is considerably reduced and the motor's average working life is extended as a result.

All motors come standard-equipped with Class F insulation; Class H available on request.

Series VTB" Electrical characteristics:

MOTOR TYPE	Power		Rotation speed	Rated current		Efficiency	Power factor	Characteristic data			Moment of inertia	Weight		
								Current	Torque			IM B3	IM B5	IM B3 B5
	[KW]	[HP]	[Gir/1']	230 Volt [A]	400 Volt [A]	η [%]	cos φ	I_a/I_n	M_s/M_n	M_{max}/M_n	J [Kgm²]	[Kg]	[Kg]	[Kg]
4 POLES 60/60 Hz 1500/1800 RPM														
VTB 56-4A	0,06	0,08	1400	0,60	0,35	61,0	0,66	3,3	2,0	2,1	0,000145	2,7	2,9	3,0
VTB 56-4B	0,09	0,12	1400	0,65	0,38	61,0	0,66	3,2	2,1	2,0	0,000198	2,9	3,1	3,2
VTB 63-4A	0,12	0,18	1380	0,90	0,50	54,0	0,70	3,2	2,0	2,0	0,000240	3,6	3,8	3,9
VTB 63-4B	0,18	0,25	1380	1,30	0,75	54,0	0,70	3,2	2,0	2,0	0,000307	4,2	4,4	4,5
VTB 63-4C	0,25	0,33	1400	1,35	0,80	55,0	0,70	3,2	2,0	2,0	0,000400	4,5	4,6	4,6
VTB 71-4A	0,25	0,33	1380	1,50	0,85	65,0	0,72	3,8	2,0	2,0	0,000810	4,8	5,0	5,1
VTB 71-4B	0,37	0,50	1370	1,90	1,10	65,0	0,72	3,7	2,0	2,0	0,000770	6,3	6,4	6,5
VTB 71-4C	0,55	0,75	1380	2,50	1,50	65,0	0,72	3,8	2,0	2,0	0,000900	6,8	6,9	6,9
VTB 90-4A	0,55	0,75	1380	2,60	1,50	71,0	0,78	3,8	1,7	1,8	0,001578	7,7	7,9	8,1
VTB 90-4B	0,75	1,00	1400	3,50	2,00	75,0	0,80	4,5	1,8	1,9	0,001874	9,0	9,1	9,2
VTB 90-4C	1,1	1,5	1400	4,50	3,00	75,0	0,80	4,3	1,9	1,9	0,00230	9,5	9,6	9,6
VTB 90S-4	1,10	1,50	1400	4,70	2,80	76,7	0,80	4,9	2,2	2,6	0,00230	14,0	15,0	15,5
VTB 90L-4	1,50	2,00	1410	6,10	3,50	79,0	0,78	5,3	2,5	2,6	0,00280	16,5	17,4	17,7
VTB 90LB-4	2,20	3,00	1400	8,50	4,90	79,0	0,80	4,7	2,5	2,6	0,00500	17,0	17,5	17,5
VTB 100L-4A	2,20	3,00	1425	8,90	5,00	81,0	0,80	6,1	2,5	2,6	0,00580	25,0	26,5	27,5
VTB 100L-4B	3,00	4,00	1415	11,7	6,80	81,5	0,81	6,1	2,6	2,7	0,00650	26,0	27,7	29,0
VTB 112M-4	4,00	5,50	1435	15,5	8,90	84,1	0,82	6,3	2,6	3,0	0,01180	34,0	35,5	36,0
VTB 112MB-4	5,50	7,50	1420	200	12,0	82,0	0,81	5,5	2,7	3	0,01600	37,0	38,0	38,0
VTB 132S-4	5,50	7,50	1450	19,8	11,5	85,0	0,84	6,9	2,2	3,1	0,02900	60	62	62
VTB 132MA-4	7,50	10,0	1450	26,5	15,0	86,0	0,85	6,7	2,4	3,1	0,03500	70	73	73
VTB 132MB-4	9,00	12,50	1450	35,0	20,0	85,0	0,83	6,7	3	3,2	0,03400	75	76	76
VTB 132MC-4	11,00	15,00	1450	40,0	24,0	85,0	0,83	6,9	3	3,2	0,03500	78	79	79
VTB 160M-4	11,0	15,0	1460	36,4	20,9	89,0	0,85	7,0	2,3	3,1	0,061	105	115	118
VTB 160L-4	15,0	20,0	1460	48,2	27,7	89,5	0,87	7,3	2,4	3,2	0,075	125	135	138
VTB 180M-4	18,5	25,0	1470	57,0	32,8	90,5	0,90	6,8	2,4	2,9	0,135	165	175	178
VTB 180L-4	22,0	30,0	1465	67,5	38,8	91,0	0,90	7,3	2,7	2,8	0,155	175	185	188
VTB 200L-4	30,0	40,0	1472	92,5	53,0	92,5	0,88	7,1	2,9	2,5	0,310	265	265	275
VTB 225S-4	37,0	50,0	1476	114	65,5	92,6	0,88	6,3	2,1	2,2	0,440	320	320	330
VTB 225M-4	45,0	60,0	1480	137	79,6	93,7	0,89	7,0	2,4	2,3	0,530	345	345	355
VTB 250M-4	55,0	75,0	1478	162	93,0	93,4	0,90	7,3	2,4	2,6	0,790	425	425	440
VTB 280S-4	75,0	100	1486	222	127	94,7	0,91	7,3	2,5	2,5	1,370	565	565	592
VTB 280M-4	90	125	1484	260	149	94,9	0,91	7,5	2,6	2,6	1,630	635	635	652
VTB 315S-4	110	150	1490	322	185	94,4	0,91	7,0	2,2	2,4	1,670	720	720	760
VTB 315M-4A	132	180	1487	386	223	94,8	0,90	8,1	2,6	2,7	1,940	750	750	790
VTB 315M-4B	160	220	1484	465	267	95,0	0,90	8,3	3,0	2,7	2,080	795	795	835
VTB 355M-4	250	340	1489	739	424	95,5	0,89	6,7	2,2	3,0	6,900	1640	1640	1700
VTB 355L-4	315	430	1488	919	528	95,6	0,90	6,7	2,0	3,0	8,000	1750	1750	1810

• Full load data

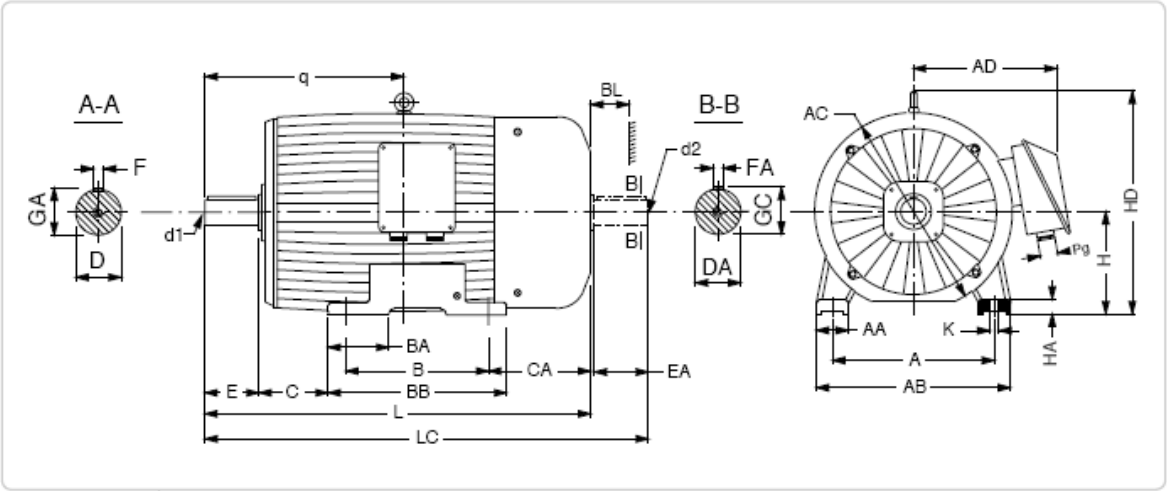
DEFINITIONS

Pa = Absorbed power	[kW]	I_N = rated current	[A]
Pn = Rated power (delivered)	[kW]	I_L = Starting current	[A]
Vn = Input voltage	[V]	M_N = rated torque	[Kgm]
Nn = Speed (with load)	[rpm]	M_L = Starting torque	[Kgm]
Cos φ = Power factor		M_{MAX} = Pull-in torque	[Kgm]
η = Efficiency		J = Moment of inertia	[Kgm²]

I COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV ■ISO 9001/2000■ rawing:

THREE-PHASE ASYNCHRONOUS MOTORS WITH SQUIRREL CAGE ROTOR
Completely sealed IP55 Eurovoltage.
Assembly values comply with IEC - UNEL - MEC recommendations.

VTB - VDV Series
Size of frame: from 200 to 280.
Support-foot mounted motors as per UNEL 13113
B3, B6, B7, B8, V5, V6 as per DIN 42950
IM1001, IM1051, IM1061, IM1071, IM1011, IM1031 as per IEC.



Motor SIZE	Number of poles	Power KW	Assembly values in mm											Dimensional values in mm												
									Shaft																		
			A	B	C	H	K	Pg	D DA	E EA	F FA	GA GC	d1 d2	AA	AB	AC	AD	BA	BB	BL min	CA	HA	HD	L	LC	q
200L	2A	30																								
	2B	37																								
	4	30	318	305	133	200	19	36	55m6	110	18h9	59	M20	80	400	450	355	100	360	30	265	32	485	610	923	395
	6A	18,5				-0,5																				
	6B	22																								
	6	15																								
	4	37							60m6	140	18h9	64														
S	6	18,5		286					55	110	16	59							355					660	975	430
	2	45							55m6	110	18h9	59														
225			356		149	225	19	36	48	110	14	51,5	M20	85	445	505	375	110		35	290	34	535	655	970	415
	4	45		311		-0,5			60m6	140	18h9	64							360							
M	6	30							55	110	16	59												685	1000	445
	8	22																								
	2	55							60m6	140	18h9	64														
									55	110	16	59													1102	
250M	4	55	406	349	168	250	24	42	65m6	140	18h9	69	M20	90	495	540	415	120	420	45	335	36	590	980		480
	6	37				-0,5			60	140	16	64													1132	
	8	30																								
	2	75							65m6		18h9	69														
									60		16	64														
S	4	75		368					75m6		20h9	79,5									350					
	6	45							65		16	69														
	8	37	457		190	280	24	42		140			M20	100	560	620	450	165	520	45		40	660	1040	1188	515
280	2	90				-0,5			65m6		18h9	69														
									60		16															
	4	90		419					75m6		20h9	79,5									299					
M	6	55							65		16	69														
	8	45																								

NOTE
The technical data, dimensional values and all other information provided in this catalogue must not be considered legally binding; we reserve the right to modify data without notice.

COMPANY
WITH QUALITY SYSTEM
CERTIFIED BY DNV
ISO 9001/2000

VEMAT electric motors

APPENDIX

We are constantly investing resources in product development to provide market-leading products that make our customers' processes more effective and more profitable. At the core of the business lays ECAS Technology, working at the forefront of engineering, and with unique expertise in purifying air industries. In this chapter, ECAS new products will be submitted.

1. ECAS CERTIFICATES

GUARDIAN INDEPENDENT CERTIFICATION

CERTIFICATE OF REGISTRATION

The Management System of

EGYPTIAN CO. FOR AIR SYSTEMS (ECAS)

6, 15 Block 11, New Borg El Arab City, 4th Industrial Zone, Alexandria - Egypt

has been assessed and complying with

ISO 9001:2008

for the following activities

Manufacturing and Assembly of Air Handling Units, Fans, Air Ducts and Electric Panels Casings

Date of Issue: 06 February 2012 **Date of Expiry: 05 February 2015**

Initial Certification: 06 February 2012

Certificate No. 686430

The validity of this certificate can be verified from the following website

www.gicg.co.uk

Guardian Independent Certification Ltd
Registered in England
Sovereign House 212-224 Shaftesbury Avenue London England WC2H 8HQ

Accredited by Member of the IAF MLA

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

UKAS QUALITY MANAGEMENT 045

132848

CERTIFICATE OF REGISTRATION

The Management System of

EGYPTIAN CO. FOR AIR SYSTEMS (ECAS)

6, 15 Block 11, New Borg El Arab City, 4th Industrial Zone, Alexandria - Egypt

has been assessed and complying with

OHSAS 18001:2007

for the following activities

Manufacturing and Assembly of Air Handling Units, Fans, Air Ducts and Electric Panels Casings

Date of Issue: 13 January 2012 **Date of Expiry: 12 January 2015**

Initial Certification: 13 January 2012

Certificate No. 686668

The validity of this certificate can be verified from the following website
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Registered in England
Sovereign House 212-224 Shaftesbury Avenue London England WC2H 8HQ

JAS-ANZ registration no. G3590606UL, www.jas-anz.org/register

JAS-ANZ

111688

GUARDIAN INDEPENDENT CERTIFICATION

CERTIFICATE OF REGISTRATION

The Management System of

EGYPTIAN CO. FOR AIR SYSTEMS (ECAS)

6, 15 Block 11, New Borg El Arab City, 4th Industrial Zone, Alexandria - Egypt

has been assessed and complying with

ISO 14001:2004

for the following activities

Manufacturing and Assembly of Air Handling Units, Fans, Air Ducts and Electric Panels Casings

Date of Issue: 13 June 2012 **Date of Expiry: 12 June 2015**

Initial Certification: 13 June 2012

Certificate No. 686410

The validity of this certificate can be verified from the following website

www.gicg.co.uk

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Sovereign House 212-224 Shaftesbury Avenue London England WC2H 8HQ

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JAS-ANZ registration no. E3520506UL, www.jas-anz.org/register

JAS-ANZ

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

112679

جامعة الإسكندرية كلية الهندسة
ALEXANDRIA UNIVERSITY
FACULTY OF ENGINEERING

ENGINEERING CENTER
المركز الهندسي - كلية الهندسة

شهادة اعتماد و صلاحية

يشهد المركز الهندسي للخدمة العامة بكلية الهندسة – جامعة الإسكندرية بأنه بناءً على طلب الشركة المصرية لأنظمة الهواء قد تم مراجعة الرسومات الهندسية لزوم الانتاج المكونات و الأجزاء التى تتضمنها هذه المعـــدات و ذلك طبقاً لما يتم تصنيعه بمصنع الشركة ببرج العرب و هذه المعدات هى كالتالى :

البند	المواصفات	الأعتماد
١	وحدات مناولة هواء من النوع الأفقي مزدوجة الجدار و مكونـــة مـــن قطاعات للفلاتر و ملفات التبريد و ملفات التسخين و المراوح و الفلاتر الذبائية.	معتمدة
٢	وحدات تهوية صندوقة – وهى عبارة عن مراوح لدفع أو سحب الهـــواء داخل صندوق مزدوج أو مفرد الجدار و مزودة بفلاتر أو غير مـــزودة و تتضمن مروحة من النوع الطارد المركزى .	معتمدة
٣	ستائر هوائية لحجز و منع الأتربة و الحشرات و لمنع التسرب الحرارى يتم تركيبها على الأبواب و المداخل بالأطوال المختلفة .	معتمدة
٤	مراوح طاردة مركزية بريش أمامية أو خلفية و تدار بسيور و يتم تجميعها على قاعدة حديد و المحرك الكهربائى.	معتمدة

و أن هذه الرسومات تم أعتمادها بمعرفتنا و هي مقبولة فنياً و هذه شهادة منا بذلك.

و مرفق الأتي :

- الرسومات التي تم إعتمادها.

١ – أ.د محمود بسيونى سعيد

توقيع اللجنة د/ محمود [illegible]

الأعتماد

المركز الهندسي للخدمة العامة

ENGINEERING CENTER
المركز الهندسي - كلية الهندسة

تحريراً في

خاتم شعار الجمهورية

رقم بريدى ٢١٥٤٤ الإسكندرية – جمهوريـــة مصر العربية – تليفون ٥٩٢٣٢٤٦ (٢٠٣+) تليفون وفاكس ٥٩١٧٢٠٣ (٢٠٣+)
Post No. 21544 Alexandria,Egypt - Tel (+203) 5923246 Tel & Fax :(+203) 5917203