

MATERIAL AND EQUIPMENT STANDARD

FOR

FANS, FILTERS AND AIR DISTRIBUTION UNITS

AND SYSTEMS

ORIGINAL EDITION

OCT. 1996

This standard specification is reviewed and updated by the relevant technical committee on Jul. 2001(1) and Aug. 2006(2) and Sep. 2012(3). The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

This Standard provides material specification for different types of air fans, air filters and air distribution outlet devices. The material description of units covers those that are manufactured by renowned international manufacturers, rated and tested by various authoritative international bodies.

The body of the specifications allows the use of any equipment meeting the performance specifications. The specifications are intended to be inclusive of many components which may not be required, hence it is up to the discretion of the design or procurement engineer to eliminate those added items that may not be required for the specific needs of the project being addressed.

Since the type of controls are of several different standards used in the industry, recommendations by acceptable and approved manufacturers shall be used to meet differing requirements of the codes or the equipment.

1. SCOPE

This Standard covers the minimum requirements of material construction and delivery of fans, air filters, air distribution devices and dampers and louvers of ventilating and pressurizing systems in the HVAC&R field, suitable for commercial and industrial building applications and spaces used in oil, gas and petrochemical industries.

Centrifugal process fans and cast iron housing fans are not covered in this Standard. Due to the various subjects involved, this Standard is divided into the following parts:

- Part I:** Specification Requirements for Ventilating Fans.
- Part II:** Specification Requirements for Air Filters.
- Part III:** Specification Requirements for Air Distribution Outlet Devices.
- Part IV:** Specification Requirements for Dampers and Louvers.
- Part V:** General Administrative and Procedural Requirements.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Jul. 2001. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 152 on Jul. 2001. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2006. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No. 294 on Aug. 2006. These modifications are included in the present issue of IPS.

Note 3:

This standard specification is reviewed and updated by the relevant technical committee on Sep. 2012. The approved modifications by T.C. were sent to IPS users as amendment No. 3 by circular No. 365 on Sep. 2012. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the company and the vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

AMCA (AIR MOVEMENT AND CONTROL ASSOCIATION, INC.)

AMCA 99-2408	"Performance Class of Centrifugal Fans"
AMCA 99-2404-2003	"Drive Arrangements for Centrifugal Fans"
AMCA 99-2410-2003	"Drive Arrangements for Tubular Centrifugal Fans"
AMCA 99-3404-2003	"Drive Arrangements for Axial Fans"
ANSI/AMCA 210-2007	"Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating" (Addenda A

	2001)	
ANSI/AMCA 300-2008	"Reverberant Room Method for Sound Testing of Fans"	
AMCA Publication 501-2009	"Application Manual for Air Louvers"	
AMCA Publication 502-2006 (R 2009)	"Damper Application Manual for Heating, Ventilating, and Air Conditioning"	
AMCA 99-0401-1986	"Classifications for Spark Resistant Construction"	
ASHRAE (AMERICAN NATIONAL STANDARDS INSTITUTE /AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS, INC.)		
ASHRAE 52-1992	"Methods of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter"	
UL (UNDERWRITER'S LABORATORIES)		
UL 555	"Fire Damper"	
UL 555S	"Standard for Safety Smoke Damper"	
DIN (DUTCHES INSTITUT FUR NORMING)		
DIN 53438 Part 1, 2, 3-1984	"Testing of Combustible Materials"	
ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)		
ISO 3741-2010	"Acoustics- Determination of Sound Power Levels and sound energy levels of noise sources using sound pressure – precision methods for reverberation test rooms"	
ISO 5219	"Laboratory Aerodynamic Testing and Rating of Air Terminal Devices"	
ISO 9000-2005	"Quality Management Systems- Fundamentals and Vocabulary"	
NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)		
NFPA 90A-2012	"Standard for the Installation of Air-Conditioning and Ventilating Systems"	
NFPA 92A-2012	"Standard for Smoke Control Systems"	
IPS (IRANIAN PETROLUME STANDARD)		
IPS-E-GN-100	"Engineering Standard for Units"	

3. DEFINITIONS AND TERMINOLOGY**3.1 Air-Curtain Unit**

A mechanical air-moving device designed to produce an air curtain.

3.2 Air Inlet Device (or Opening)

A device through which air is withdrawn from or discharged into a conditioned space (grilles registers, diffusers and slots may be used as air inlets).

3.3 Blower

An air distribution fan used to force air under pressure is known as the blower.

3.4 Damper

A device used to vary the volume of air passing through an outlet, inlet or duct; or generally through a confined cross section by varying the cross sectional area.

3.5 Diffuser

A supply air terminal device, usually placed in the ceiling, generally of circular, square or rectangular form, and composed of divergent deflecting members.

3.6 Fan

A device for moving air by two or more blades or vanes attached to a rotating shaft.

3.7 Filter (Air)

A device to remove gases and solid from a mixture of gases.

3.8 Grille

An air terminal device with multiple passages for the air.

3.9 Louver

An assembly of sloping vanes intended to permit air to pass through and to inhibit transfer of water droplets. Louvers are installed in exterior walls visible to the public and comes in fixed and adjustable types.

3.10 Register

Combination of grille and damper assembly over an air opening.

3.11 Ventilator

As defined by ASHRAE it is a device for replacing the air of inside a room by outside air.

3.12 Sound Attenuators

Components inserted into the air distribution system and is intended to reduce airborne noise propagated along the ducts.

4. UNITS

This Standard is based on International System of Units(SI), as Per [IPS-E-GN-100](#) except where otherwise specified.

5. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or order, the following priority shall apply:

- | | |
|----------------------------|--|
| 1) First Priority: | The Purchase Order |
| 2) Second Priority: | The data/requisition sheets and drawings referred to |
| 3) Third Priority: | This Standard specification |

All conflicting requirements shall be referred to the Company in writing. The Company will issue confirmation document if needed for clarification.

PART I**SPECIFICATION REQUIREMENTS FOR VENTILATING FANS****6. FAN EQUIPMENT REQUIREMENTS****6.1 Operating Capacity Limitations**

The air capacity and static pressure limitations mentioned below are recommended for the following type of fans:

6.1.1 General fans

6.1.1.1 Small ceiling mounted exhaust fans from 0.0236 to 0.24 m³/s (50 to 500 CFM).

6.1.1.2 Cabinet-type centrifugal fans for medium capacity and low static with direct drive operation from 0.5 to 1.42 m³/s (1000 to 3000 CFM) and pressure up to 250 Pa (1 inch of water). The interior of these fans shall preferably be acoustically lined.

6.1.1.3 Air curtain (fly fan) shall be suitable for direct mounts above doorways to protect from entry of outside air or insects.

6.1.2 In-Line centrifugal fans

6.1.2.1 For low to medium capacity, direct drive operation from 0.1 to 2.12 m³/s (200 to 4500 CFM) and pressure up to 373 Pa (1.5 inch) of water.

6.1.2.2 For medium to large capacity, belt drive operation from 0.85 to 10.4 m³/s (1800 to 22000 CFM) and pressure up to 625 Pa (2.5 inch) of water.

6.1.2.3 For medium to very large capacity, belt drive operation for central station type equipment for high static application, suitable for 0.5 to 50 m³/s (1000 to 100,000 CFM) and pressure up to 2500 Pa (10 inch) of water.

6.1.2.4 Tubeaxial type of fans, belt drive for corrosive fumes from 2.40 to 18.8 m³/s (1000 to 100,000 CFM) and pressure up to 375 Pa (1.5 inch) of water.

6.1.3 Wall exhaust fans

6.1.3.1 For small to medium capacity, direct drive centrifugal type from 0.15 to 3 m³/s (300 to 6000 CFM) and pressure up to 250 Pa (1 inch) of water.

6.1.3.2 For medium to large capacity, centrifugal type (with backward curved airfoil blades) belt drive operation from 0.8 to 18.8 m³/s (1700 to 40,000 CFM) and pressure up to 250 Pa (1 inch) of water.

6.1.3.3 For low to medium capacity, propeller fan with direct drive operation generally for high noise area, from 0.25 to 2.4 m³/s (500 to 5000 CFM) and pressure up to 125 Pa (0.5 inch) of water.

6.1.3.4 For medium to large capacity slow speed propeller type belt drive fan for supply or exhaust in public area, from 2.4 to 25 m³/s (5000 to 53,000 CFM) and pressure up to 190 Pa (0.75") of water.

6.1.4 Roof exhaust fans

6.1.4.1 Small to medium capacity propeller type, direct drive 0.38 to 2.6 m³/s (800 to 5500 CFM) up to 125 Pa (½ inch) of water.

6.1.4.2 Medium to large capacity, propeller type, belt drive, steel or aluminum dome, 1.8 to 23.6 m³/s (3800 to 50,000 CFM) up to 500 Pa (2") of water.

6.1.4.3 Commercial grade, centrifugal type belt drive, 0.33 to 18.9 m³/s (700 to 40,000 CFM) up to 500 Pa (2 inches) of water. The direct drive suitable from 0.15 to 1 m³/s (300 to 2000 CFM) up to 250 Pa (1") of water.

6.1.5 Roof supply ventilators

6.1.5.1 Medium to large capacity, propeller type, belt drive, steel or aluminum dome, 1.8 to 21.7 m³/s (3800 to 46,000 CFM) up to 250 Pa (1 inch) of water.

6.1.5.2 Medium to large capacity, industrial grade, galvanized steel propeller type, belt or direct drive 2.3 to 18.9 m³/s (4800 to 40,000 CFM) up to 500 Pa (2 inches) of water.

6.1.6 Utility fans

6.1.6.1 Small to medium capacity, single inlet end suction, centrifugal type, direct drive for central station application with nominal available static pressure.

6.1.6.2 Low to large capacity, centrifugal belt drive, up discharge for use on (restaurant hood) commercial kitchens, 0.75 to 13.2 m³/s (1600 to 28,000 CFM) and pressure up to 500 Pa (2 inches) of water.

6.1.6.3 Medium to very large capacity, SWSI end suction, centrifugal type belt drive for central station applications with high static pressure as recommended per job application.

6.1.6.4 For heavy duty general purpose commercial or industrial application, the fans shall be belt-driven with adjustable pitch, type SWSI and DWDI Class I through IV from 7 to 118 m³/s (15,000 to 250,000 CFM) and pressure up to 4000 Pa (16 inches) of water and up to 427°C (800°F) air temperature.

SWSI : Single width single inlet

DWDI : Double width double inlet.

6.2 Electric Motors

All electric motors shall be high-efficiency type with preferably 1450 rpm with open drip-proof enclosures. Motors located on all fan units shall be mounted on rubber supports, or the fan shall be independently supported on spring isolators. Motors located in the conditioned space shall be selected for quiet operation and shall not produce an objectionable "motor noise" in the space. All electric components shall meet UL test method. The electrical characteristics shall be as mentioned in the data sheet.

6.3 Fan Quality

The following salient features shall prevail:

- a) All products shall be first-line quality, of grade and type shown on the drawings and specified, accepted by the engineer in writing.

- b)** All products shall be in current production with no notice having been given that such product is to be drastically changed, modified, or discontinued from current production by them manufacturer proposed.
- c)** The supplier, by submitting, certifies that equipment being proposed is proper for the application intended and that it has the capacity and performance called for.
- d)** All fans and their housing shall preferably be AMCA-rated tested to meet the requirements of AMCA Standard 210 and/or Standard 300, or authoritative international body.

6.4 Drive Arrangements

Exact arrangements shall be specified, but the following requirements to meet AMCA Standards shall comply:

AMCA 99 - 2404

AMCA 99 - 2410

AMCA 99 - 3404

6.5 Hazardous Area

6.5.1 General

The classification for spark resistant construction shall comply to AMCA Standard 90-0401-86. The classification for explosion proof construction shall conform to NEC Standard. These shall accordingly apply to centrifugal axial and propeller fans and power roof exhausters.

6.5.2 Spark resistant construction

6.5.2.1 All parts of the fan in contact with the air or gas being handled shall be made of nonferrous material. Steps must also be taken to assure that the impeller, bearings, and shaft are adequately attached and/or restrained to prevent a lateral or axial shift in these components.

6.5.2.2 The fan shall have a nonferrous impeller and nonferrous ring about the opening through which the shaft passes. Ferrous hubs, shafts, and hardware are allowed, provided construction is such that a shift of impeller or shaft will not permit two ferrous parts of the fan to rub or strike. Steps must also be taken to assure that the impeller, bearings, and shaft are adequately attached and/or restrained to prevent a lateral or axial shift in these components.

6.5.2.3 The fan shall be so constructed that a shift of the impeller or shaft will not permit two ferrous parts of the fan to rub or strike.

Notes:

- 1) No bearings, drive components or electrical devices shall be placed in the air or gas stream unless they are constructed or enclosed in such a manner that failure of that component cannot ignite the surrounding gas stream.**
- 2) For this Standard, nonferrous material shall be any material with less than 5% iron or any other material with demonstrated ability to be spark resistant.**
- 3) The use of aluminum or aluminum alloys in the presence of steel which has been allowed to rust requires special consideration.**
- 4) The user shall electrically ground all fan parts.**

6.5.3 Explosion-proof construction

6.5.3.1 The units shall be preassembled and pre-tested industrial grade centrifugal blower modules designed for positive air exhaust from rooms and small buildings located in hazardous areas.

6.5.3.2 The housing shall be aluminum with corrosion resistant finish and suitable for either thru-the-wall or roof mount.

7. SPECIFICATION REQUIREMENTS

7.1 General Fans

7.1.1 Ceiling exhaust fan

7.1.1.1 General product specification

- a)** Fan shall be centrifugal type, with motor and fan enclosed in an insulated metal box to reduce noise level.
- b)** Fan shall be AMCA-certified for the capacity called for in the data sheet, at a noise level to match the equipment named and at a noise level normal for the location.
- c)** Exhaust fans shall be designed for mounting in the ceiling of the area served, with a finished appearance on the exposed side and shallow mounting depth.

7.1.1.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a)** Fan shall be equipped with a back-draft damper and manual variable electronic speed control with time delay to keep fan in operation after lights in area have been turned off. Length of delayed operation shall depend on length of time lights have been on.
- b)** Fans located in ceilings with fire ratings shall be provided with a fire damper adapter to provide such rating.

7.1.2 Exhaust fan / light combination

7.1.2.1 General product specification

- a)** Unit shall be combination light/fan, with plug-in adapter for each. Fan shall be quiet centrifugal type with rubber mounting and back-draft damper.
- b)** As an accessory item the exhaust hood shall be aluminum wall type for wall, hooded vent type for pitched roof, or gravity vent type for low slope roof.

7.1.3 Air curtain (fly fan)

7.1.3.1 General product specification

- a) Fans shall meet AMCA and UL requirements and have a long axis to provide air discharge over a narrow slot outlet for air distribution to cover the door width. It shall provide an effective air barrier for complete protection against insects, dusts and fumes.
- b) Fan shall be centrifugal type, directly connected to the motor shafts. Motor shall be permanently lubricated with automatic thermal overload protection as shown in the data sheet.
- c) Provide no less than four adjustable nozzles (deflector blades) to allow air distribution required. Terminal velocity at the discharge point shall be approximately 12.7 m/s (2500 ft/min) with 4.1 m/s, (800 ft/min) terminal velocity at 2.5 m (10 ft) distance. Width of airstream at 2.5 m (10 ft) distance shall be approximately 4.1 m/s (800 ft/min).
- d) An attractive housing, shall be designed for mounting above the door to be protected. Multiple units (as shown on drawings) may be provided on wide openings.
- e) The heated versions shall be available in gas, electric, steam and hot water coil design.

7.1.3.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) A manual switch, as well as door-operated switch to activate the air curtain when the door is opened. An On- Off automatic switch shall be provided for manual or automatic operation. Switch shall be mounted near the door, as directed.
- b) Door switch shall be coordinated with the door supplier for a neatly concealed installation where possible motor starter or switch as required by the codes and the installation.

7.1.4 Cabinet-Type centrifugal fan

7.1.4.1 General product specification

- a) Cabinet fan shall consist of direct-shaft-driven centrifugal fan(s) mounted in an insulated enclosure. Fan and motor shall be isolated by rubber supports to reduce noise. A back-draft damper in outlet and white egg-crate removable inlet grille having 85% free area shall be provided.
- b) Capacity shall be as shown in the data sheet with sound level as shown or no greater than model called for by AMCA.

7.1.4.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Speed control provided by solid-state speed control.
- b) Duct and grille adapters, as are standard with the cabinet fan.
- c) Where ceiling is fire-rated, a three-hour fire protection between the grille and the duct adapter shall be provided. The fire damper assembly shall meet the UL requirements or authoritative international body.

7.2 Wall Mount Fans

7.2.1 Centrifugal-Belt drive (exhaust fan)

7.2.1.1 General product specification

- a) Wall exhaust fan shall be spun aluminum, designed for mounting on a wall and discharging away from the wall.
- b) The aluminum centrifugal fan shall be mounted on a large-diameter shaft supported by two ball bearings and connected to the motor by belt drive. The motor drive pulley shall be variable-pitch. The motor shall be supported on adjustable heavy steel brackets, and the entire fan assembly shall be supported on rubber or springs.
- c) The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.2.1.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) A bird screen in the fan discharge.
- b) A disconnect switch located under the fan housing.
- c) Back-draft damper mounted in the throat of the curb.
- d) An automatic belt tensioner.

7.2.2 Centrifugal direct-drive (exhaust fan)

7.2.2.1 General product specification

- a) Wall exhaust fan shall be spun aluminum enclosure, designed for mounting directly on a wall and discharging the air away from the wall.
- b) The aluminum centrifugal fan shall be mounted on the motor shaft and the motor housing supported on rubber or springs.
- c) The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.2.2.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) A bird screen in the fan discharge.
- b) Back-draft damper mounted in the throat of the intake.
- c) A solid-state motor speed control as recommended by the manufacturer.

Note:

A disconnect switch or removable plug shall be located by the user under the fan housing.

7.2.3 Propeller-Type wall fan

7.2.3.1 General product specification

- a) Fan shall be slow-speed propeller type for supply (SF) or exhaust fan (EF) as indicated in the data sheet. The fan shall be mounted on a large-diameter shaft supported by two pillow-block-type sealed bearings.
- b) Fan motor shall be mounted in rubber cradle on an adjustable base.
- c) Drive shall consist of one or more belts as required for the power.
- d) Where multiple belts are required, they shall be matched from the same production run. The drive pulley shall be adjustable-pitch type. All pulleys shall be keyed to the shaft and the keys held by set screws.
- e) Fan frame shall be heavy steel, welded to rigidly support the fan and motor.
- f) Fan capacity and static pressure shall be as called for in the data sheet.

7.2.3.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Fan, motor, and belts shall be protected by a heavy-duty guard with provisions for access to the motor and drive. In areas where the fan will be subject to hard treatment, the guard shall be made of a welded frame covered with expanded metal. The back or side must be hinged for access.
- b) Shutters and/or louvers.

7.2.4 Wall or window fans

7.2.4.1 General product specification

- a) Fan shall be propeller type, directly connected to the motor for supply or exhaust, as indicated in the data sheet.
- b) Fan motor shall be supported by the metal guard and the guard supported on rubber to eliminate noise.
- c) Fan speed shall not exceed that shown in the data sheet, with operation of the fan not exceeding the recommended noise level for the area served.
- d) Fan shall be rated for air quantity and static pressure as shown in the data sheet. Motor power shall not exceed the listed ratings.

7.2.4.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Fan guard shall be furnished and installed.
- b) Gravity-Type shutters on the discharge of exhaust fans.
- c) Supply fans shall be provided with a weatherproof louver and gravity shutters on the intake.
- d) A suitable speed control to adjust the capacity of the fan.
- e) A switch and pilot light (or combination) to control the fan, if the fan switch is not located in the area served and visible.

- f) Fans serving toilet rooms for exhaust shall be provided with a combination light switch and fan controller that will cause the fan to operate for a period of time after the lights are turned off (depending on how long the lights have been on).

7.3 Utility Fans

7.3.1 Centrifugal type-belt drive

7.3.1.1 General product specification

- a) Fan shall be single-inlet centrifugal type mounted on large-diameter steel fan shaft supported by two bearings. Bearing shall be self-aligning pillow block, grease-lubricated ball type, selected for 400,000 hours of operation at maximum rating of the fan. Grease fittings shall be provided with tubes for greasing without having to remove the protective housing.
- b) Motor shall be high-efficiency, open drip-proof type, selected for no less than the maximum fan power required. The motor shall be mounted on a heavy steel adjustable base plate, securely held in position by large steel tensioning bolts.
- c) Drive shall consist of adjustable variable-pitch motor pulley and a fixed pulley on the fan shaft. Both pulleys shall be keyed to their shafts, with the keys locked by set screws.
- d) Belts shall be selected for 200% of motor rating and of size and number recommended by the belt manufacturer. Where two or more belts are used, they shall be matched set bearing the same lot number.
- e) Fan wheel shall be forward-curved, backward-curved, or airfoil design as required for the airflow and pressure. Fan shall be selected at a point near maximum efficiency for lowest noise generation and lowest power requirements.
- f) The fan selected shall not exceed the sound power levels shown in the data sheet or, if not shown, the normal recommended by the manufacturer for the airflow and pressure shall apply.
- g) The construction of the fan shall be the class recommended by the manufacturer of the airflow and static pressure.
- h) The fan speed and power required shall not exceed that shown in the data sheet.
- i) Fan wheel and housing shall be constructed of heavy-gage steel, fabricated by welding, and properly braced for heavy service. All surfaces shall be protected from rust by appropriate coating for the service shown.
- j) Protective coatings, if required for laboratory hood or other severe duty, shall be applied to all surfaces, inside and outside, as required for chemical corrosion protection.

7.3.1.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Outlet shutters formed of aluminum or stainless steel shall be installed on all fans discharging directly to the outdoors, unless otherwise shown.
- b) Fans located in outside air directly shall be provided with intake hoods and shutters to prevent entry of moisture and to prevent draft when not in operation.
- c) Fans located in protected areas with open intakes shall be provided with an inlet guard to prevent entry of trash and to protect persons in the area.
- d) Fan base shall be supported with vibration isolation as recommended by the manufacturers.

Notes:

- 1) Duct connections provided by the user shall preferably be flexible type, appropriate for the service involved, the location and exposure limits.**
- 2) Fans exhausting noxious materials shall be provided with exhaust stacks by the user.**
- 3) Fans located outside and exposed to weather shall be provided with a weather cover by the user to protect the motor.**

7.3.2 Centrifugal type-direct drive**7.3.2.1 General product specification**

- a) Fan shall be single-inlet, end-suction centrifugal type mounted directly on the motor shaft. Fan may be used for supply or exhaust as indicated in the data sheet.**
- b) Fan wheel shall be forward-curved, selected at a point of high efficiency for the air quantity and pressure shown in the data sheet. The motor speed and power required shall not exceed the listed ratings.**
- c) Fan wheel and housing shall be constructed of heavy-gage steel, fabricated by welding, and properly braced for heavy service. All surfaces shall be protected from rust by appropriate coating for the service shown.**

7.3.2.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the auxiliary equipment available as specified in Clause 7.3.1.2 of this Standard.

7.3.3 Centrifugal-Belt drive up-discharge fan (for restaurant hood of commercial kitchens)**7.3.3.1 General product specification**

- a) Roof exhaust fan shall be spun aluminum enclosure, discharging vertically away from the base and mounted on an aluminum curb cap. The base shall provide a drain trough and drain connection to accumulate any liquid and to provide means of removal.**
- b) The aluminum housed centrifugal fan shall be mounted on a large-diameter shaft supported by two ball bearings and connected to the motor by belt drive. The motor drive pulley shall be variable-pitch. The motor shall be supported on adjustable heavy steel brackets, and the entire fan assembly shall be supported on rubber or springs. The motor compartment shall be isolated from the fumes being exhausted and shall be cooled by vent duct connecting to the fresh air.**
- c) The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.**

7.3.3.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) A shroud extension to ensure discharge of contaminated air 1 m (40 in.) above the roof.**
- b) A belt tensioner to automatically maintain correct tension on the drive belt(s).**
- c) A mounting pedestal to house a back-draft damper above the roof and to provide access**

to the damper through the side of the pedestal (not needed on restaurant applications).

- d)** A prefabricated curb of aluminum to match and line up with the fan. Curb shall be smooth metal designed for this service. A hinge adapter to allow the fan to be raised for access to the duct below the fan.
- e)** A shaft seal and heat shield to protect the motor compartment from heat and fumes.
- f)** A disconnect switch located under the fan housing.

7.4 Power Roof Ventilators

7.4.1 Centrifugal belt-drive (exhaust fan)

7.4.1.1 General product specification

- a)** Roof exhaust fan shall be spun aluminum enclosure mounted on an aluminum curb cap. (Fiberglass type dome enclosure may be supplied as alternative).
- b)** The aluminum centrifugal fan shall be mounted on a large-diameter shaft supported by two ball bearings and connected to the motor by belt drive. The motor-drive pulley shall be variable-pitch. The motor shall be supported on adjustable heavy steel brackets, and the entire fan assembly shall be supported on rubber or springs.
- c)** The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.4.1.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a)** A prefabricated curb of aluminum to match and line up with the fan. Curb shall be sound-attenuating type, if noted on the drawings, or as required to meet the sound level given in the data sheet.
- b)** A bird screen in the fan discharge.
- c)** A disconnect switch located under the fan housing.
- d)** A back-draft damper mounted in the throat of the curb.

Note:

A suitable duct companion flanges shall be provided by the user for round duct connections.

7.4.2 Centrifugal direct-drive (exhaust fan)

7.4.2.1 General product specification

- a)** Roof exhaust fan shall be spun aluminum enclosure mounted on an aluminum curb cap.
- b)** The aluminum centrifugal fan shall be mounted on the motor shaft and the motor housing supported on rubber or springs.
- c)** The capacity of the fan and the noise rating shall be as shown in the data sheet.. The motor power and speed given shall not exceed the listed ratings.

7.4.2.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of auxiliary equipment available as specified in Clause 7.3.1.2 of this Standard. Also inclusive shall be a solid-state motor speed control as recommended by the manufacturer.

Note:

A disconnect switch or removable plug located under the fan housing shall be provided by the user.

7.4.3 Centrifugal up blast (exhaust fan)

7.4.3.1 General product specification

- a) Fan shall be centrifugal type, selected at the conditions shown in the data sheet. Motor power shall not exceed the listed ratings.
- b) Fan shall be supported on the motor shaft for directly connected models or on a large-diameter shaft belt connected to the motor with variable-pitch drive pulley. Motor and drive shall be out of the air-stream and accessible for servicing without entering the duct system.
- c) Fan and motor bearings shall be grease-lubricated, with grease fittings brought out to accessible locations.
- d) Housing shall be heavy-gage aluminum, except motor supports shall be steel for strength and rigidity.
- e) An access panel shall be provided on the side of the housing for access to the motor in direct-driven unit. Cooling shall be provided by breathing tubes for direct-driven units.
- f) Motors shall be high-efficiency type with internal thermal overload protection.
- g) An electrical junction box shall be mounted on the exterior of the unit with all wiring brought out to this box. Explosion-proof fittings for units where required shall be provided.

7.4.3.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Unit shall be supported by curb mounted on the roof.
- b) Controls shall be as specified under the control section for On-Off automatic operation. Where units are selected with a reduced air quantity, the fan may be provided with a solid-state electronic speed controller mounted in an accessible location. Fans "over capacity" shall be adjusted to the specified airflow against the actual system static.
- c) Units shall be provided with weather protection for exposed drive belts and motors by weather covers.
- d) Units mounted for direct up-blast discharge shall be provided with a discharge head having butterfly –type dampers allowing vertical discharge.
- e) Units mounted vertically, requiring intake of outdoor air into the fan for discharge downward, shall be provided with a mushroom-type intake head with bird screen.

Note:

A suitable duct companion flanges shall be provided by the user for round duct connections.

7.4.4 Propeller-Up blast (exhaust fan)

7.4.4.1 General product specification

- a)** Ventilators shall be industrial-grade roof exhausters designed to remove hot and dirty air. Ventilator shall be constructed from heavy-gage galvanized steel with an epoxy finish or heavy-gage aluminum.
- b)** The fan blades shall be mounted on the motor shaft and the motor shall be supported by heavy steel supports. The motor shall be a totally enclosed type designed for this service.
- c)** The butterfly dampers shall be aluminum, center-hinged, and held closed by magnets and shall be opened by the air stream. The leaving air stream shall repel most of the water when the fan is in operation, and drain gutters shall take away the water when the fan is off and the dampers are closed by gravity.
- d)** A heavy-gage wind band shall protect the fan from side currents and direct the air vertically.
- e)** The entire unit shall be supported on a heavy-gage reinforced base designed to fit on a roof curb.
- f)** Fan capacity and operating static pressure shall be as shown in the data sheet. The fan power and speed shall not exceed the listed ratings. Where noise criterion is given, it shall not be exceeded, but where noise level is not given, the fan shall be selected for a normal noise level suitable for the application.

7.4.4.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a)** Curb for mounting of fan shall be approved by the roofing contractor if installed on a metal roof. Seals around the curb shall be supplied by the roofer to match the profile of the metal roof.
- b)** Motor control shall be provided for overload protection and for start/stop operation.

7.4.5 Propeller-Belt drive (supply fan)

7.4.5.1 General product specification

- a)** Roof ventilator shall be heavy-gage galvanized steel housing, reinforced and structurally supported. (The manufacturer shall have the option to furnish all aluminum constructions.)
- b)** The propeller fan shall be mounted on a large-diameter shaft supported by two ball bearings and connected to the motor by belt drive. The motor drive pulley shall be variable-pitch. The motor shall be supported on adjustable heavy steel brackets, and the entire fan assembly shall be supported on rubber or springs.
- c)** The housing shall be designed for air intake with preferably 50.8 mm (2 inch) thickness filters held in the housing and removable without tools. Filters shall be cleanable type with expanded metal mesh and woven wire cloth.
- d)** The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.4.5.2 Auxiliary equipment

The manufacturer shall provide a prefabricated curb of aluminum to match and line up with the fan. Curb shall be sound-attenuating type, if specified, or as required to meet the sound level given in the data sheet.

Note:

A suitable disconnect switch located under the fan housing shall be provided by the user.

7.4.6 Propeller-Belt drive (exhaust fan)**7.4.6.1 General product specification**

- a)** Roof ventilator shall be heavy-gage galvanized steel housing, reinforced and structurally supported.
- b)** The steel propeller fan shall be mounted on a large-diameter shaft supported by two ball bearings and connected to the motor by belt drive. The motor drive pulley shall be variable-pitch. The motor shall be supported on adjustable heavy steel brackets, and the entire fan assembly shall be supported on rubber or springs.
- c)** The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.4.6.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a)** A prefabricated curb of aluminum to match and line up with the fan. Curb shall be sound-attenuating type, if specified, or as required to meet the sound level given in the data sheet.
- b)** A bird screen in the fan discharge.
- c)** A back-draft damper mounted in the throat of the curb.

Note:

A disconnect switch or removable plug located under the fan housing shall be provided by the user.

7.4.7 Propeller-Direct drive (exhaust fan)**7.4.7.1 General product specification**

- a)** Roof exhaust fan shall be spun aluminum enclosure mounted on an aluminum curb cap.
- b)** The aluminum propeller fan shall be mounted on the motor shaft and the motor housing supported on rubber or springs.
- c)** The capacity of the fan and the noise rating shall be as shown in the data sheet. The motor power and speed given shall not exceed the listed ratings.

7.4.7.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of auxiliary equipment available as specified in Clause 7.3.1.2 of this Standard.

Note:

A disconnect switch or removable plug located under the fan housing shall be provided by the user.

7.5 In-Line Centrifugal Fans**7.5.1 Belt-Drive exhaust fan****7.5.1.1 General product specification**

- a) Fan shall be centrifugal type, selected for quiet operation and good efficiency at the conditions shown in the data sheet. Motor power shall not exceed the specified rating.
- b) Fan shall be supported on a large-diameter shaft belt connected to the motor with variable-pitch drive pulley. Motor and drive shall be out of the air stream and accessible for servicing without entering the duct system.
- c) Fan and motor bearings shall be grease-lubricated, with grease fittings brought out to accessible locations.
- d) Housing shall be heavy-gage aluminum, except motor supports shall be steel for strength and rigidity.
- e) Access to belt and driven pulley through tube shall be provided.
- f) Motors shall be high-efficiency type with internal thermal overload protection.
- g) An electrical junction box shall be mounted on the exterior of the unit with all wiring brought out to this box. Explosion-proof fittings for units where required shall be provided.

7.5.1.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of the following auxiliary equipment available:

- a) Supports for units shall be standard with the manufacturer for the application: either legs, angles, or casing brackets.
- b) Vibration isolators for all supports.
- c) A back-draft dampers of the gravity type for units discharging to the outside or against any pressure from other sources.
- d) Controls shall be as specified under the control section for On-Off automatic operation. Where units are selected with a reduced air quantity, the fan may be provided with a solid-state electronic speed controller mounted in an accessible location. Fans "over capacity" shall be adjusted to the specified airflow against the actual system static as installed.
- e) Units in exposed locations shall be provided with weather protection for exposed drive belts and motors.

7.5.2 Direct-Drive exhaust fan**7.5.2.1 General product specification**

- a) Fan shall be direct-drive centrifugal type, selected for quiet operation and high efficiency at the conditions shown in the data sheet. Motor power shall not exceed the specified ratings.
- b) Fan shall be supported on the motor shaft. Motor shall be out of the air stream and

accessible for servicing through access panels.

c) Motor bearings shall be grease-lubricated, with grease fittings brought out to accessible locations.

d) Housing shall be heavy-gage aluminum, except motor supports shall be of steel for strength and rigidity.

e) Cooling shall be provided by breathing tubes.

f) Motors shall be high-efficiency type with internal thermal overload protection.

g) An electrical junction box shall be mounted on the exterior of the unit, with all wiring brought out to this box. Explosion-proof fittings for units where required shall be provided.

7.5.2.2 Auxiliary equipment

The manufacturer shall have the minimum requirements of auxiliary equipment available as specified in Clause 7.5.1.2 of this Standard.

PART II
SPECIFICATION REQUIREMENTS FOR AIR FILTERS

8. AIR FILTER SPECIFICATION REQUIREMENTS**8.1 General**

8.1.1 The air filters covered in this Standard shall be furnished complete with accessories, holding frames, filter retainers, adapters fasteners and hard wares where required. It shall be suitable for placement on any air handling system or shall be self-contained in banks of filter units furnished as a stand-alone or integrated units, used in the HVAC industry.

8.1.2 The filters shall be available for upstream or downstream arrangements.

8.1.3 Each filter shall be available in wide ranges of air capacity, sizes and executions. Where required, the filters shall be tested through sodium flame and/or *DOP test method.

*** DOP = Dioctyl Phthalate**

8.2 Classification of Filter Units**Notes:**

- 1) The throwaway air filters shall be those that are thrown away (frame and the media) after use. The disposable filters are those whose elements only are discarded after use.**
- 2) The washable air filters are those washed periodically after use and upon the technician's discretion disposed off or thrown away.**
- 3) The permanent air filters are those washed periodically after use and remains as a permanent filter in the system.**
- 4) Continuous visual indication or electrical signaling of filter condition shall be furnished when required, by filter manufacturers.**

8.2.1 Low efficiency filters

- a) These filters shall be in 25 mm (1 inch) thick throwaway type with dust-holding capacity of 120 to 360 grams per 1000 cfm cell and shall be based on ASHRAE atmospheric dust spot efficiency of 5 to 15%.**
- b) Replaceable-media-type filter units, having the above capacity shall be preferred when provided with aluminum frames and a metal media holder.**
- c) The throwaway filters shall be designed for a maximum face velocity of 1.5 m/s (300 fpm).**

8.2.2 Medium efficiency filters

- a) Filters shall be 25 mm (1 inch), 50 mm (2 inch), or 76 mm (3 inch) thick, as shown on the drawings. Filters shall be disposable type with efficiency of 25 to 30% when tested under ASHRAE Test Standard 52-76, with average arrestance of 90 to 92% by the same standard.**
- b) Filter media shall be pleated, non woven cotton fabric with a welded wire supporting grid**

and a support frame of rigid, high-wet-strength beverage board.

c) Holding frame for filters shall be 1.5 mm (16-gage) galvanized steel with gaskets and spring clips for a positive seal.

d) Pressure loss through the filter at 2.5 m/s (500 fpm) face velocity shall not exceed 130 Pa (0.45 in.) of water for 25 mm thickness, 62 Pa (0.28 in.) of water for 50 mm (2 inch) thickness, and 40 Pa (0.35 in.) of water for 76 mm (3 inches) thickness.

8.2.3 High efficiency filters

a) Filters shall be up to 30 cm (12") thick, throwaway type with efficiency of 90 to 95% when tested under the

ASHRAE Test Standard 52-76 and shall have an arrestance of 99% under this Standard.

b) Filter media shall be high-density microfine glass fibers laminated to non woven synthetic backing.

c) Media support grid shall be welded wire grid bonded to the filter media.

d) Enclosing frame shall be galvanized steel with the filter pack bonded to the frame to prevent air leaks.

e) High-Efficiency filters shall be provided with medium-efficiency pre filters to prolong the life of the main filter. Pre filter shall have approximately 30% efficiency.

f) Static pressure loss through the high-efficiency filters shall not exceed 161 Pa (0.65 in.) of water at a face velocity of 2.5 m/s (500 fpm). Final resistance of a dirty filter can be as high as 372 Pa (1.5 inch) of water.

8.2.3.1 Auxiliary components

The manufacturer shall have available the minimum requirements of the following auxiliary components:

a) Filter housings shall be provided to match the filters and provide for sealing the filters in place to prevent air bypass.

b) Side access housings shall be provided with locking gasketed doors on both sides and shall have extruded aluminum rails to hold the main filters and the pre filters.

Note:

Care shall be taken by the user that no more dust is generated in the space than is absolutely necessary so that the filters are not loaded prior to owner's acceptance of the building.

8.3 Filter Types

8.3.1 Panel filters (cartridge type)

8.3.1.1 The filter assembly shall consist of a holding frame, sealer frame, media retainer, and disposable or permanent filter element. The element shall be fully supported against the direction of air flow and becomes totally rigid when installed. The filter can be installed in built-up filter banks by utilizing the standard holding frame or can be installed in side access housings.

8.3.1.2 The filter element shall be of the high performance, deep pleated, disposable type and shall be a non-woven cotton fabric material with synthetic backing. The filter shall be tested in accordance with ASHRAE test method.

8.3.1.3 The permanent type shall be all metal filter cell consisting strips of galvanized woven screen. The disposal type shall be of fiberglass media, which is reinforced by a laminated synthetic backing.

8.3.1.4 For the average arrestance by the weight test method, the filtering efficiency shall be 99%, at 635 Pa (2.5" WG) recommended final resistance and temperature limits up to 150°C (302°F).

8.3.1.5 Media retainer shall be of welded steel construction and shall be designed in such a manner that it supports the multiple pleats of the filter element against the direction of airflow. The media retainer shall be PVC coated and designed to totally eliminate the possibility of oscillation.

8.3.1.6 Holding frames shall be factory fabricated of 1.5 mm (16 gage) galvanized steel and shall be equipped with gasket and four spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without the use of tools.

8.3.1.7 Sealer frames shall be fabricated of 1.00 mm (20 gage) galvanized steel and shall be equipped with gasketing material on the rear flange of the sealer frame.

Note:

Two complete sets of spare filters shall be supplied for use during the construction and testing and balancing period. A complete set of new filters shall be installed by the user after testing and balancing.

8.3.2 Roll filters (moving curtain filters)

8.3.2.1 It shall be an automatic horizontal or vertical renewable-media type air filter, constructed of heavy gage galvanized or corrosion resistant steel consisting of a base unit to support the roll media and mechanical and electrical components to automatically renew the air filter media surface. It shall be a continuous belt on moving rolls to bring clean filter area into the air stream.

8.3.2.2 The filters shall be of sub-assembly construction for on-the-job assembly. Each filter shall be complete with initial loading of filter media, basic frame assembly, dispensing (top) unit, rewind (bottom) unit, totally enclosed drive motor with built-in thermal overload protection and integral gear reducer where required. It shall be provided with matching flat surfaces for easy connection to ductwork.

8.3.2.3 The basic frame assembly shall consist of vertical guide rods to guide the filter media supported by horizontal rails. The rails shall be drilled to accept the guide rods which hold the filter media against both sides. At the top and bottom, a roller shall be attached to the ends of the braces; the media shall be stretched between these two rollers.

8.3.2.4 Dispensing unit shall consist of two upper side panels which hold the spool of clean media mounted in pivots. This unit shall include a media run-out switch and a metering switch for a time control.

8.3.2.5 Rewind (bottom) unit shall consist of two lower side panels housing the media rewind spool driven by a motor reducer with chain and sprocket transmission.

8.3.2.6 The media shall be of glass fiber with progressive density in thickness of 50 mm(2"). The density of media shall be graduated both by increasing the number and decreasing the diameter of the fibers from front to rear of the media to provide progressively more efficient air cleaning. The media shall be impregnated with viscosine, dirt catching, non migrating gel. Glass wire strands are bonded to the media every 15 cm, running the full length of the roll. The standard media shall have an arrestance of 80-85% according to ASHRAE (Air Filter Test Standard) 52 and meets the Class EU 3 (Eurovent 4/5) requirements. The initial resistance shall be 45 Pa (0.18" w .g.) at airflow of 2.5 m/s (500 fpm) and the recommended final resistance shall be 130 Pa 0.52 w .g.) at a maximum operating temperature of 80°C (176°F).

8.3.2.7 Different types of control units, the minimum requirements of which shall include an "end-of-media" warning light and a "manual operation" push button. These control units shall not be limited to: solid state timer control static pressure control, infrared sensor control and static pressure override controller.

Note:

The manufacturer shall have available manual type of roll filters with location of hand crank on either side and suitable for upstream or downstream services.

8.3.3 Automatic viscous filters

8.3.3.1 It shall be a multi-duty self-cleaning automatic viscous air filter using relating metal panels as the filtering media. The filtering surface shall consist of closely overlapping panels arranged to form a dense continuous curtain. The panels shall be die-stamped from sheet metal with knurled louvers turned at an angle in the direction of the airflow. The panels shall overlap each other to create various deflections when air is passing through each curtain.

8.3.3.2 The air filter shall consist of the required number of sections to clean the specified amount of air and shall be complete with mechanical drives, automatic timers, sludge buckets and scrapers, and an initial filling of viscosine charging liquid (to increase arrestance and dust holding capacity).

8.3.3.3 It shall be made available for the following position arrangements:

- a) Standard indoor or outdoor application for smooth air flow.
- b) Reinforced indoor or outdoor application for pulsating air flow.

8.3.3.4 It shall be available with minimum requirements of the following accessories:

- a) Intake protection to protect the curtain face against exposure to the elements.
- b) Plenum chamber between the filter and clean air intake duct.
- c) An automatic cleaner to maintain the cleanliness of the viscosine.
- d) A heating element for the oil reservoir (to maintain proper viscosity of visco sine) when air temperatures goes below 5°C (41°F).

8.3.3.5 The performance data shall meet the following requirements:

- a) ASHRAE Dust Arrestance Test: 77%.
- b) Eurovent - Class: ----- EU2/EU3.
- c) Average Departing resistance:

at 2.5 m/s (500 fpm)	200 Pa (803" WG)
at 2.0 m/s (400 fpm)	130 Pa (0.52" WG)

Note:

Its uses range from general ventilation filters (hospitals, offices, universities) and also for application in steel, chemical, cement works and as air intake filters for specialized applications in engines, compressors and gas turbines.

8.3.4 High efficiency *(HEPA/ULPA) filters

8.3.4.1 High efficiency absolute filter media shall be made from submicron glass fibers, formed into a high density paper, or all-glass water proof media. Continuous sheets shall be pleated to provide a high ratio of media to face area, resulting in a low velocity through the media, essential for ultra high efficiency filtration. Media shall be waterproof and fire retardant.

8.3.4.2 Pleats of filter media shall be held apart by corrugated aluminum separators that permit maximum usage of the media at minimum resistance. The media pack shall be thoroughly sealed to the inside of the cell with a cold cured resin to prevent bypass leakage around the pack. The

sealant shall totally encapsulate media edges and separators, closing off all leak paths.

8.3.4.3 Filters shall be provided with a gasket ensuring an air tight seal between filter and frame. For standard application a one piece closed cell neoprene gasket shall be used and for temperatures up to 260°C (500°F) a silicon gasket shall be used.

8.3.4.4 The media pack shall be placed in a casing made of wood or metal, depending on the type of filter required or the application for which the filter will be used. To prevent any leak around the periphery of the filter, the media pack shall be sealed in the casing with cold curing resin.

8.3.4.5 Every filter shall be individually tested in accordance with BS Standard 3928 to guarantee the minimum overall efficiency stated on the filter. To eliminate pinhole leaks, all filters with frame sides shall be standard leak tested. The filters shall be guaranteed to be leak-free for minimum overall efficiency to 99.999% on 0.12 µm for ULPA filters, and to 99.99% on 0.3 µm for HEPA filters.

***HEPA = High Efficiency Particulate Air**

***ULPA = Ultra-Low Penetration Air**

Note:

High efficiency absolute filters with broad range of applications in clean rooms and other areas shall be used where contamination control is critical, for example in pharmaceutical plants, photo and film manufacturing, electronics, hospitals, laboratories and food processing units.

8.3.5 Activated carbon filters

8.3.5.1 This filter shall be of high grade activated carbon, with high adsorption ability and effective on various *VO Cs and able to provide high performance odor adsorption and permit the recirculation (all or part) of ventilating air, saving heating costs in the winter and cooling costs in the summer. The filter shall be able to operate at the same velocity as the particulate filter in the system.

8.3.5.2 The filter shall be a self contained unit, fabricated of heavy gage galvanized steel suitably braced. It shall incorporate extruded aluminum tracks designed to accommodate filter panels. Special gaskets shall be provided around each access door to insure an air tight seal. Each filter housing shall have the following sections with two access doors to permit cell replacement from either side:

- a) Each filter housing shall have pre-filter section to hold panel type pre-filters.
- b) Final filter panel shall be full flow high velocity, activated carbon filter type.

8.3.5.3 The activated carbon shall be contained in removable cells constructed of high heat, medium impact polystyrene plastic, to withstand corrosion. The cells shall contain internal separators to minimize the settling of the carbon and shall be capable of being refilled by the Company.

8.3.5.4 When the activated carbon in the cells has reached its practical saturation, these may be reactivated by:

- 1) A factory exchange of cells.
- 2) Refilling the cells locally with fresh carbon.

Notes:

- 1) Additional information about determining the durability of carbon and adsorption ability of activated carbon for various materials shall be provided by the manufacturer.

2) These filters are effective means of gas, vapor or odor control encountered at airports, petrol stations, large car parks, large kitchens, hospitals etc.

8.3.6 Electronic (electrostatic) air filters or precipitators

8.3.6.1 The electronic air filter shall be able to remove sub-micron particulate such as cigarette smoke oil mist and vapor, as well as ordinary atmospheric dust. It shall be rated at an ASHRAE efficiency of 90 to 97% effective in handling the smaller fraction of the contaminant spectrum.

8.3.6.2 It shall be designed for improved energy effectiveness at constant flow rates and low resistance, all of which shall remain constant during the life of the filter. It shall operate at lower pressure drop as compared to high efficiency filters providing savings in fan horsepower and be compatible with air handling components.

8.3.6.3 It shall be designed with minimum six electronic collector cells needing no individual wiring. The copper bus bar contactors at the end of each cell shall ensure a positive connection with bus bars in the unit.

8.3.6.4 The tungsten ionizing wires, exposed to the full length of the cell shall be held in place by spring clips at the top and bottom.

8.3.6.5 The glass-filled polyester insulators, rated for 40,000 volt each, shall be located outside the air stream at the end of the cells.

VOC = Volatile Organic Compounds

8.3.6.6 These units shall preferably be available in the following dimensions and capacity:

- maximum overall height up to 457 cm (15 ft)
- maximum overall length up to 550 cm (18 ft)
- maximum capacity from 3380 m³/hr (2000 CFM) to 23500 m³/hr (150000 CFM)

8.3.6.7 The collector cells shall be powered by high voltage solid state power pack, including the minimum requirements of the following safety features and operational read-out capabilities:

- double overload protection
- on-off switch
- magnetic circuit breaker
- door safety switch
- neon glow lamps

8.3.6.8 The unit shall be available for the following servicing arrangements:

a) Side access for outside duct servicing. Its housing shall feature a rugged pan and post construction with a flush exterior and extra large mounting flanges.

b) Front access for upstream and/or downstream servicing used as pre-filters for roll-o-matic or other high efficiency filter. Its framing system shall be designed to support individual cells in the air stream with an absolute minimum of blank-off, maximum structural rigidity and complete cell accessibility.

Notes:

1) The manufacturer shall provide the required ratings on efficiency, initial and final resistance, cell velocity, ionizer voltage and plate voltage.

2) Typical application where electronic precipitators can be used are, general offices, plant ventilation, hospital areas, airport terminals, museums, libraries, laboratories, restaurants etc.

8.3.7 Grease filters

8.3.7.1 Washable filters shall be designed for general grease collection applications and shall be manufactured from a folded woven metal mat interspersed with layers of expanded metal mesh and fitted into an integral stainless steel panel.

8.3.7.2 Disposable grease filters for applications where the exhaust air has a particularly high grease content (such as in the grilling of steaks and chops) shall be manufactured from a high efficiency media for the collection of grease inserted into a releasable metal frame.

8.3.7.3 Grease filter housing shall be lightweight stainless steel construction available in the following types:

- a) Single angle units for use in wall mounted canopies with a top exit.
- b) Double-Sided vee-bank units used on island canopy installations, preferably supplied with washable type filters.

8.3.7.4 Filter housing shall be supplied pre-drilled to a standard pattern to aid installation on site, and can be bolted together to give the required size of installation. To avoid contamination and flare-ups, a deep removable drip tray beneath each unit shall be furnished to prevent collected grease from dripping or running back onto the heat source.

8.3.8 Bag or bacteria filters

8.3.8.1 Bag filters shall be high performance extended area in multilayer with disposable type filters. Each filter shall consist of high density gloss microfiber media with a chemically bonded backer, individual pockets and a corrosion resistant galvanized steel enclosing frame. The filter unit shall be completely factory assembled and the filter efficiency shall be tested according to ASHRAE Standard 52. The average are stance shall not be less than 96% in this Standard.

8.3.8.2 The filter pockets shall be chemically adhered around the periphery of the galvanized steel retainers. Retainers shall have rolled edges to reduce possible cuts to media.

8.3.8.3 Where holding frames are specified for built up banks, they shall be factory fabricated of 1.5 mm (16 gage) galvanized steel and shall be equipped with gaskets and four heavy duty sealing fasteners.

8.3.8.4 Where side access housings are specified, they shall be factory fabricated and assembled with not less than 1.5 mm (16 gage) galvanized steel, incorporating two access doors, extruded aluminum tracks and individual holding frames designed to accommodate a wide range of standard size filters.

8.3.9 Paint - shop filters

8.3.9.1 This filter shall be able to capture paint over spray and prevent it from being discharged into spray booth exhaust system, for maximum continuous operating temperature of 100°C (212°F).

8.3.9.2 The paint-shop filter shall be a graduated density media, manufactured in a layered formation from a continuous gloss filament. The inlet face of paint-shop shall be color coded to correctly identify the air flow direction. Paint shop media shall be easy to install and adapted to suit most spray booth installations.

8.3.9.3 The filter shall have fire retardant synthetic media complying to DIN 53438. It is preferred to fit a wire supporting grid across the rear of the filter holding frame.

8.3.10 Dust source housing filters

8.3.10.1 This filter shall be a sturdily constructed unit, incorporated with inertial separators and operating as a self cleaning filter. The dust louver housing shall be manufactured from galvanized sheet steel. It shall consist of dust louver pockets of steel, galvanized bird-screens, and a galvanized sheet steel manifold. The filters shall be able to handle airborne particulate concentrations as encountered in heavy industrial environments. (The housing shall be equipped, when required with a direct drive centrifugal fan for left or right hand discharge. A flexible connection shall match the fan to the secondary air (contaminants) manifold of the dust louver housing).

8.3.10.2 The dust louver housing shall incorporate means for reversing the air flow within the separator and a secondary air circuit for exhausting the separated particulate. The pockets, with dust chutes and secondary air manifold shall be factory assembled to a modular design. The depth of the housing shall be sufficient to fully enclose the inertial separator pockets and secondary air manifold. The outlet air end of the housing shall have a flange, turned inward to present a smooth external surface. The flange shall be pre-drilled for convenient attachment to ductwork or adjacent equipment.

8.3.10.3 The inertial separator shall consist of a bank made of welded Corten steel (stainless steel), V-shaped pockets, fitted with galvanized steel (stainless steel) wire mesh bird-screens at the sides of the V and a secondary air outlet slot at the apex.

8.3.10.4 The secondary air circuit shall be manifolded together into a common galvanized steel exhaust duct complete with secondary air fan. This shall be sized to exhaust an air volume of between 7% and 10% of the primary air stream, together with the separated airborne particulate.

8.3.10.5 The air cleaning efficiency of the inertial separators shall be not less than 92% using the *AFI test procedure when handling its rated air volume at an air resistance of 250 Pa.(1 inch w .g.). The preferred operating range shall be between 175 Pa (0.70 inch) and 275 Pa (1.1 inch w.g.).

Notes:

- 1) Typical application for dust filters include: prefiltration for air conditioning and ventilation systems in heavy industrial atmosphere, prefiltering in areas with severe atmospheric conditions, sand filtering and filtration of the inlet air of all types of buildings, such as offices, hospitals, theatres etc.
- 2) The primary air flow is the total air volume discharged from the clean air side of the dust louver. The secondary air flow is the volume required to convey the separated contaminants from the dust louver to a discharge point.
- 3) The dust filters shall allow high efficiency without increasing static pressure thus providing for savings in initial system cost and louver horsepower motors.

* AFI = Air Filtration Institute

PART III**SPECIFICATION REQUIREMENTS FOR AIR DISTRIBUTION OUTLET DEVICES****9. SPECIFICATION REQUIREMENTS FOR AIR DISTRIBUTION OUTLET DEVICES****9.1 General**

9.1.1 Unless otherwise mentioned, all air outlets covered in this Standard shall be of high quality, suitable for mounting on duct works with maximum allowable noise to 32 dB of "A" scale.

9.1.2 The manufacturers shall provide all auxiliaries as mentioned in the data sheet. The net airflow rate, drop throw, noise level, border type, material finish and type of balancing devices shall be mentioned for each type of air outlet devices..

9.1.3 The performance data shall comply to laboratory tests conducted in accordance with ISO 5219 and ISO 3741 and *ADC Test Code 1062 GRD84 standard requirements.

9.1.4 Where fire dampers are specified, these shall be interlocking blade type, meeting the requirements of, UL with open area equal to the duct area. The fusible links shall not affect operations of damper.

9.1.5 Where door louvers (or grilles) are mentioned it shall be the inverted "V" (no-vision) type with telescoping frame for mounting on door panels with natural aluminum (pale) color. (The door louver shall be installed by the general contractor).

9.1.6 All air diffusing unit shall be suitable for tight pattern and those for ceiling shall provide uniform blanket of air to protect ceiling from smudging.

9.2 Grilles and Registers (Wall, Ceiling, Floor or Sill Outlets)

9.2.1 It shall be constructed of all steel or all aluminum available for supply, return and exhaust application and suitable for flushed level surface mountings on walls, floor and ceilings.

9.2.2 It shall be available with single or double or fixed deflection, bars spaced at 19 mm ($\frac{3}{4}$ ") or 13 mm ($\frac{1}{2}$ ") spacing with adjustable or fixed horizontal or vertical bars. The extruded frame for surface mounting shall be able to provide 70% free area. The opposed blade damper shall have a screwdriver adjustment accessible through the face of the register. The screw holes in the border shall be countersunk for smooth appearance.

9.2.3 The blades shall be formed to a specially contoured cross section. The ends of each blade shall be mounted in friction pivots allowing individual blade adjustment without loosening or rattling. The front blades shall be parallel to long dimension and rear blade parallel to short dimension.

9.2.4 It shall be baked enamel finish. The metal surfaces shall be degreased phosphatized and dried, then dried followed by oven baking.

9.2.5 The grilles and registers shall be available preferably in sizes from 152 mm × 102 mm (6" × 4") through 1219 mm × 914 mm (48" × 36") in 25 mm (1") increments.

9.2.6 Reversible core type shall be extruded aluminum core with blades 6 mm ($\frac{1}{4}$ ") spacing mounted in a similar metal frame and borders 32 mm ($1\frac{1}{4}$ ") or 19 mm ($\frac{3}{4}$ ") wide. The core shall be removable and reversible to provide for 5 or 15 degrees of spread. For deflection purposes concealed rear blades shall be furnished.

9.2.7 Linear registers shall be suitable for wall, sill or floor consisting of extruded-aluminum core with 3 mm ($\frac{1}{8}$ ") bars, or 6 mm ($\frac{1}{4}$ ") or 13 mm ($\frac{1}{2}$ ") spacing with 0 or 15 degree deflection. Frame shall be heavy gage of the same metal with border for surface mounting, recess mounting or casting in concrete. The frame width shall be 19 mm ($\frac{3}{4}$ "), 30 mm ($1\frac{1}{8}$ ") or 6 mm ($\frac{1}{4}$ "). The accessory equipment shall include: hinged access door, blank off plates, screens, mitered corner,

opposed blade damper, direction changer, straightening vanes etc.

* ADC = Air Diffusion Council

9.2.8 Ceiling return and exhaust registers shall be constructed of extruded-aluminum, at maximum velocity of 3.5 m/s (700 fpm) and maximum pressure drop of 25 Pa (0.1") static pressure. It shall be available in any of the following closest equivalent type:

a) Egg-Crate type: to approximate-blade size of 13 × 13 × 13 mm (½" × ½" × ½") in extruded aluminum frame for surface mounting, 90% free area.

b) Angle blade type: extruded-aluminum blades on 19 mm (¾") spacing in extruded-aluminum frame for surface mounting, 70% free area.

c) Strength blade type: extruded-aluminum and frame and blades on 13 mm (½") spacing for surface mounting, 70% free area.

d) Heavy-Duty type: suitable for gymnasium and industrial application with steel bars 3 mm (0.12 inch) thick on 17 mm (0.66 inch) spacing, welded steel frame with blade reinforcing on 150 mm (6 inch) centers, 70% free area.

9.2.9 The floor register shall be with a key-operated damper and a net free area of approximately 40%. The capacity shall be based at an outlet velocity of 4 m/s (800 fpm).

9.3 Ceiling Diffusers

9.3.1 General

9.3.1.1 All products shall be compatible and able to integrate into narrow tee or other standard version of ceiling system, where required.

9.3.1.2 It shall be constructed of steel or aluminum designed to protect ceilings from streaking and smudging. It shall be either flush fixed or step-down with uniform 360° discharge pattern.

9.3.2 Square diffusers

9.3.2.1 It shall be multi-core with round neck cores die-stamped in one-piece construction and with smooth clean surfaces.

9.3.2.2 It shall be available in 1-2-3 or 4 way horizontal to vertical fixed and adjustable discharge pattern. The dampers shall be adjusted by the screw driver without removing the inner core.

9.3.2.3 The face panel shall be with 1.3 mm (18 gage) steel with edges formed to a radius for a solid crisp appearance.

9.3.2.4 The architectural design shall satisfy engineering criteria and harmonize with the ceiling system without sacrificing performance.

9.3.2.5 Special design for variable air volume shall be available providing constant mixing and constant throw values while still varying the air flow to the space. The dampers shall be available to operate pneumatic actuators with a 34 to 70 k Pa (5-10 p s i) spring range.

9.3.3 Round diffusers

9.3.3.1 These diffusers shall be available preferably in sizes 150 mm (6") through 1000 mm (40") neck size, adjustable from horizontal to vertical discharge pattern.

9.3.3.2 Gasket around the outer edge shall guard against leakage and ceiling smudging.

9.3.3.3 A safety chain shall be provided, where required, to prevent dropping inner cores after removal.

9.3.4 Linear diffusers

These shall be available in straight, curved or custom-design linear shapes in various finishes.

9.3.4.1 Slot type

9.3.4.1.1 It shall possess acoustical performance and constructed preferably of extruded aluminum with pattern controllers in steel. It shall be available for supply or return air, vertical or horizontal throw in ½", ¾" and 1" slot from one up to eight slots in required lengths or lengths up to 2 meters (6 ft) suitable for field cuts, where specified. A ¾" through 6" single slot shall also be available, where specified.

9.3.4.1.2 The pattern controllers shall be provided for adjusting for full 180° in direction and volume of discharge air.

9.3.4.1.3 The ends shall be either with border, open end or with end cap as mentioned in the data sheet.

9.3.4.1.4 The diffuser unit shall be with mitered corners complete with mounting frame assembly, including trimming, cutting and hanging assembly.

9.3.4.2 Plenum slot type

9.3.4.2.1 For variable air volume performance, the plenum shall be constructed of steel with internal section insulated or un insulated designed for standard T-bar ceiling system.

9.3.4.2.2 The choice of ½", ¾", 1" and 1" slot width with 1, 2, 3 or 4 slots shall be available with accessories such as plaster frame and mounting hardware.

9.3.4.2.3 The pattern controller blades shall be factory installed available to be set for left, right, horizontal or vertical air flow after the diffuser is installed.

9.3.4.3 Bar type

9.3.4.3.1 The bar type linear diffuser shall be suitable for side wall, sill or floor installations and furnished as complete welded assemblies in standard lengths 300 to 1830 mm (from 1 ft through 6 ft).

9.3.4.3.2 It shall be constructed of extruded aluminum and available in ¼" and ½" spacing, in bar widths of 1/8" and ¼" for 0° to 15° deflection.

9.3.4.3.3 All deflection bars shall be fixed and paralleled to the long dimension.

9.3.4.3.4 The diffusers shall be designed with mitered corners and provided with accessories such as directional blades, single or opposed blade damper and installation hardware.

9.3.4.4 Louver type

9.3.4.4.1 It shall be constructed of extruded aluminum in multi-cores suitable for supply or return air, in one-way or two-way discharge pattern, fixed louvered for ceiling or sidewall.

9.3.4.4.2 It shall be available in 300 to 1830 mm (1 to 6 ft) in length and provided with accessories such as directional blades, opposed blade dampers and installation hard wares.

9.3.4.5 Light troffer type

9.3.4.5.1 It shall be constructed of steel material suitable for either supply or return air, and be able to block light leakage from the ceiling space.

9.3.4.5.2 Diffusers shall be available in both double side and single side type, in lengths of 600 mm, 900 mm, and 1200 mm (24, 36 and 48 inches).

9.3.4.5.3 The air opening of the diffuser shall fit the light troffers and its slot shall be regressed placed inconspicuously at the edge of the light troffer. Lighting and air distribution shall be through a single ceiling penetration.

9.3.4.5.4 Choice of top inlet or side inlet in round or oval shapes shall be available for various duct sizes. Choice of internally or externally insulated or un insulated construction shall be made available.

9.3.5 Perforated ceiling diffusers**9.3.5.1 Non-Fire rated type**

9.3.5.1.1 It shall be constructed of aluminum or steel suitable for supply, return or exhaust application either in drop face or flush face (step down or flush fixed) type.

9.3.5.1.2 It shall have adjustable discharge, horizontal or vertical patterns (adjustable before or after installation).

9.3.5.1.3 The deflectors shall be in 1, 2, 3, or 4 way type. The perforated face shall preferably be with 3/16" d I a. holes on ¼" staggered centers.

9.4.5.1.4 The inlet collar (neck) can be square or round with ample depth available for easy connection to duct.

9.3.5.2 Fire rated type

9.3.5.2.1 It shall be classified fix as rated ceiling diffuser assemblies (listed in Underwriters Laboratory Fire Resistance Directories). The design shall meet both UL time-vrs-temperature test criteria and NFPA 90A requirements.

9.3.5.2.2 It shall be for use in 3 hour or less fire rated exposed grid on suspend ceiling.

9.3.5.2.3 All other description mentioned in Clause 9.3.5.1 shall comply.

9.4 Balancing Devices

9.4.1 It shall be suitable for manual operation or with pneumatic or electrical operator as indicated in

the drawing or mentioned in the data sheet:

9.4.2 All air outlets shall be available with the following applicable air balancing devices designed for quick access and adjustment, engineered for the least possible noise, turbulence and air resistance.

- Sliding radiant blade damper for round necks.
- Opposed blade damper for round necks.
- Butterfly damper with round necks.
- Opposed and double blade damper for square and rectangular necks.
- Dampers with grids for round necks, square necks and rectangular necks.
- Equalizing grid for round necks ,square necks and rectangular necks.
- Turning vanes for square necks and rectangular necks.
- Volume extractors at 25 mm (1") and 50 mm (2") spacing.

PART IV**SPECIFICATION REQUIREMENTS FOR DAMPERS AND LOUVERS****10. SPECIFICATION REQUIREMENTS FOR DAMPERS AND LOUVERS****10.1 General Dampers****10.1.1 General**

Depending on the materials used, the blade type, environmental conditions and fabrication method, the basic type of construction shall be per AMCA publication 502 or authoritative international bodies.

10.1.2 Material

Typical materials based on AMCA requirements for frames, blades and blade stops shall be aluminum extrusions, formed cold rolled steel, galvanized steel and at times stainless steel as specified in the purchase order.

10.1.3 Construction

The construction for damper types and alloys of commonly used materials accepted to this Standard shall conform to the items listed below or its closest equivalent (upon consulting engineer's approval).

- | | |
|------------------------------------|---|
| a) Aluminum extrusion: | ASTM B221, alloy 6063-T5 or T52. |
| b) Aluminum sheet: | ASTM B209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producers to provide the required finish. |
| c) Cold rolled steel sheet: | ASTM A366, Class 1, with matte finish. |
| d) Galvanized steel sheet: | ASTM A526 and A527 with ASTM A525, G60 or G90 zinc coating. |
| e) Stainless steel sheet: | ASTM A167 or 240 AISI type 302/304, with 2B finish. |

10.1.4 Fabrication method

10.1.4.1 The method used shall depend on the material, the quantities required and the shapes desired.

10.1.4.2 Preferred method of fabrication shall be formed shapes and roll forming shapes. (Various components shall be factory assembled for ease of shipment).

10.1.4.3 Due to specific operation requirement of each, field assembly at job site should be performed in accordance with the manufacturer's instructions.

10.1.5 Structural design

10.1.5.1 The most common factors to be considered shall be the maximum air pressure differential in the closed position and in some cases seismic loading.

10.1.5.2 Sufficient structural support should be provided at the damper location and installed in such a manner that these do not interfere with the damper's operation.

10.1.6 Accessories

10.1.6.1 The provision of accessories shall be to the damper manufacturer's responsibilities to be purchased and mounted to enhance its applicability.

10.1.6.2 The accessories shall range from manual, pneumatic and electrical actuators (operators), jumper bracket fusible link, blade levers, (for actuator support) and jack shafting (supplied when multiple damper assemblies are to be operated with a single actuator).

10.1.6.3 Controls such as pressure switches and leak-free solenoid valves shall also be considered as accessories. The solenoid valve shall be used with a pneumatic actuator or positioner to establish the damper's blade position.

10.2 Combination Fire and Smoke Dampers**10.2.1 General**

10.2.1.1 As smoke being the number one cause of fire related deaths, and poses a significant danger and hindrance to fire fighters, its control during building fires is therefore vital to human life safety, and shall be considered a major consideration in building design.

10.2.1.2 The dynamic smoke management system shall be incorporated simultaneously pressurizing escape routes and refuge areas throughout the building.

10.2.1.3 The areas favored for pressurization are stair towers, lobbies, hallways and in some cases elevator shafts. These system shall be applied for hospitals, apartment buildings, office high rises etc.

10.2.1.4 The damper shall be tested and qualified under UL requirements or meet the qualification of an authoritative international body.

10.2.1.5 The electric or pneumatic actuators shall be supplied by the damper manufacturer and installed at time of damper fabrication. Damper and actuator assembly shall be factory cycled ten times to assure operation. Where specified, heavy gage caulked sleeve in required size shall be supplied by the damper manufacturer.

10.2.2 Material specification

10.2.2.1 The damper frame shall be 1.5 mm (16 gage) minimum galvanized steel rollfor med into a structural hat channel shape with tabbed corners for reinforcement. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame.

10.2.2.2 The blades shall be airfoil shaped double skin construction with 1.6 mm (14 gage) equivalent thickness. The blade edge seals shall be silicone rubber and galvanized steel mechanically locked in blade edge and shall withstand 232°C (450°F).

10.2.2.3 The jamb seals shall be stainless steel flexible metal compression type. Blade action shall be in parallel or opposed position as shown in the data sheet.

10.2.2.4 Each damper shall be 1½ hour fire rate to meet the requirements of UL Standard 555 and shall be classified as a leakage rated damper to meet the requirements of UL Standard 555S, no higher than leakage Class 1 (4 c fm/ft at 1" w .g. and 8 c fm /ft at 4" w .g.).

10.2.2.5 The electric/pneumatic actuators shall be qualified under UL 555S or authoritative international body to an elevated temperature of 121°C (250°F), 176.7°C (350°F), 232°C(450°F) depending upon the actuator.

10.2.2.6 The damper must be operable while temperature is above 121°C (250°F) and shall be equipped with thermally reopenable temperature system, to electrically and mechanically lock the damper in a closed position when duct temperature's exceed 74°C(165°F) or 100°C (212°F) as specified, and still allow appropriate authority to override the thermal system and operate the damper as may be required for smoke control functions.

10.2.2.7 The thermal system package shall be inclusive of two damper position indicator switches each controlling the electrical signal to the indicating lamps on the remote control panel to positively indicate the status of the damper assembly as full-open or full-closed.

10.2.2.8 The thermal system and position indicator switches shall be capable of interfacing electrically with smoke detectors, building fire alarm systems, and remote indicating control stations, as specified The thermal system shall be equipped with high limit temperature sensor meeting the requirements of NFPA 92A (by returning damper to fire protection mode when temperatures reach its specified degrees (250°F, 350°F, 450°F), which is considered the operational limit of the damper and actuator assembly).

10.2.2.9 For dampers with pneumatic actuators, the air supply shall be controlled by an electric-pneumatic (E-P) valve, to be furnished by the damper manufacturer.

10.3 Louvers

10.3.1 General

The types of construction used in the louvre industry shall depend on the material used, the blade type, environmental conditions, and fabrication methods.

10.3.2 Material

Items mentioned in Clause 10.1.2 shall apply, except the material shall be based on AMCA Publication 501.

10.3.3 Construction

Items mentioned in Clause 10.1.3 shall apply.

10.3.4 Fabrication Method

Depending on the material, the quantities required and the shapes desired, the methods used shall be as follows:

a) Extruded shapes

Extruding is a preferred method of producing complicated aluminum shapes.

b) Formed shapes

Fabricated by roll forming machines or press brakes, this method is recommended for conventional shapes and heavy duty (specialty) materials, using parts which are formed on fabricating equipment.

c) Fixed louver

The assembling of fixed louvers shall be with screws, rivets, welding or any combination of these method,(choice of manufacturer shall be given due importance).

d) Adjustable louver

Depending on the design requirements, assembling the blades on adjustable louver shall be of steel or aluminum blade axles inserted in sleeve or ball bearing located within the jamb member. (Choice of manufacturer shall be given due importance).

e) Large continuous line louvers

Architectural or continuous line louvers may be shipped as an assembled section, or as parts to be assembled per manufacturer's instructions at jobsite.

10.3.5 Structural support

The common factors to be considered shall be wind loads, thermal expansion, snow load consideration and in earthquake zone belt zones, seismic loading, (sufficient structural support should be provided at the building "opening" to mount the louvers and meet any load conditions noted above. The Company shall provide the prevailing data s to the manufacturer).

10.3.6 Accessories

10.3.6.1 A louver accessory is considered any auxiliary component used with a louver to implement its function, facilitate its installation, enhance its use, or any combination thereof. (The accessories shall be independent of the main louver, but connected to it at some stage of assembly or field installation).

10.3.6.2 According to requirements in the purchase order, the classified accessories shall be as follows:

- Sills and flashing (to provide specific contours of an opening).
- Sub frame (removable hinged or latched type).
- Actuator (electric, pneumatic or hydraulic devices).
- Mullion covers/batten plates (to cover, conceal or strengthen joints).
- Screen and grilles (to prevent insects and vandalism).
- Blank-off panels (for architectural appearance).
- Filters (with self contained frames).
- Gaskets and seals (to prevent leakage).
- Security bars (for perpendicular installation to the louver blade).

PART V
GENERAL ADMINISTRATIVE
AND
PROCEDURAL REQUIREMENTS

11. GENERAL ADMINISTRATIVE AND PROCEDURAL REQUIREMENTS

11.1 Labeling

11.1.1 All units except air outlet devices on order shall be suitably labeled with engraved stainless on non-corrosive alloy nameplate, showing all data as called for in the relevant standards and order including the following:

- Manufacturer's name and date of fabrication.
- Type, size and serial number.
- Power supply characteristics, where applicable.
- Input/output characteristics (capacity etc.).
- Rating and class of insulation of motors on ventilating fans.
- Purchase order number and factory order number and date.

11.1.2 The name plate on ventilating fans and filter units including dampers and louvers (where applicable) shall be fixed in an easily visible and non removable part of the frame. A second plate reserved for purchaser shall be screwed to the unit engraved as following:

For example:

+ NIOC No. ----- +

11.2 Inspection / Quality Control and Quality Records

11.2.1 Inspection / quality control and test

11.2.1.1 The purchaser's inspector or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the equipment, to carry out necessary inspection at any stage of work.

11.2.1.2 Approval by the Purchaser's inspector or assigned representative shall not relieve the Vendor of his commitments under the terms of this specification or any associated order.

11.2.1.3 The supplier shall make available technical data, test facilities and samples that the purchaser's representative may require for verification in conjunction with pertinent equipment.

11.2.1.4 The equipment should be replaced if measurement, data s and inspection reveal any discrepancies between quoted figures resulting in Purchase order and those measured actually.

11.2.1.5 Test certificates and test reports shall refer to the serial number of the equipment tested and bear the purchaser's name, order number and manufacturer's name and seal.

11.2.2 Quality control records

The suppliers shall maintain appropriate inspection and test records to substantiate conformance with specified requirements. Preference shall be given to those ISO-certified suppliers that apply ISO-9000 version of quality management and quality assurance.

11.2.3 Test method

11.2.3.1 The following inspection and test method shall be executed, where specified, for the fans at the factory:

- Shop inspection.
- Shaft run out check.
- Assembly and fit-up check.
- Initial and final alignment.
- Performance test.
- Vibration and balancing test.
- Sound level test.

11.2.3.2 For air filters, data s on test method shall be based on ASHRAE (Eurovent 4/4 and/or 4/5) and each unit shall be supported with the following technical data s (irrespective of status of data sheets):

- Nominal depth mm (inch).
- Actual depth mm (inch).
- Rated capacity $\text{m}^3\text{h}/\text{m}^2$ (cfm/ft²).
- Recommended face velocity m/s (fpm).
- Average arrestance, (%).
- Average efficiency (%).
- Rated initial resistance Pa (inch).
- Recommended final resistance Pa (inch).
- Flame retardency per DIN 53438.
- Maximum continuous operating temperature °C(°F).
- Media coloring.
- Stocking facilities (for media replacements).

11.3 Packing and Shipment

11.3.1 Due attention must be given to protection against corrosion during transit, and trays of renewable desiccant (silica gel) or similar dehydrating compound shall be provided.

11.3.2 All resilient mounted components such as fans, motors etc. shall be secured by wedges of suitable clamps before packing.

11.3.3 The method of cleaning, preserving and the details of packing including moisture elimination, cushioning, blocking and crating shall be such to protect the product against all damages or defects which may occur during handling, sea shipment to the port and rough road haulage to site and extended tropical open air storage.

11.3.4 Accessory items forming an integral part of the equipment should be wrapped in

polyethylene sheathing and packed preferably in separate boxes and shipped loose to prevent damage. Alternatively the ancillary items shall be fixed securely to the solid top skid of equipment and adequate precautions taken to ensure that the item do not damage or loosen in transit.

11.4 Vendor's Data

11.4.1 Drawings and data

The supplier shall provide the purchaser relevant drawings and technical data s in the English and/or Persian language at no extra cost to the purchaser.

11.4.2 Technical documents

The technical documents shall be furnished according to the following stages.

11.4.2.1 At quotation stage

Comprehensive catalogs, technical data, outline drawings, applicable performance curves, proposed test procedure, service facilities, etc., of equipment offered and its components offered. All ratings shall be at site conditions.

11.4.2.2 At ordering stage

- a) Equipment connections and wiring diagrams, dimensional and installation drawings for filters and ventilating fans, dampers and louvers.
- b) Service operation and maintenance manual.
- c) Reference list showing the successful continuous operation for at least three years and the location of the equipment offered, in major international installations.
- d) Commissioning and two years spare parts list.

11.5 Guarantee

11.5.1 Clearance of defect

The equipment must carry the manufacturer's one year performance guarantee, on all parts and further four years guarantee on electric motors. The air filter manufacturer shall guarantee the arrestance, efficiency and filter capabilities for the job site conditions.

11.5.2 Replacement of defective parts

All defective parts shall be replaced by the supplier in shortest possible time free of charge including dismantling, reassembling at site and all transportation cost. The above mentioned period shall not be later than 18 months from the date of dispatch from manufacturer's works.

11.5.3 After sale technical services

11.5.3.1 Commissioning

11.5.3.1.1 The supplier shall quote if required for provision of services of competent engineer(s) and

or technician(s) to assist in installation, commissioning and test-run for the filtration and ventilation equipment and system at site on a per diem basis.

11.5.3.1.2 The quoted rates shall be irrespective of duration and frequency and the supplier shall guarantee the services of the engineer(s) and technician(s) on the specified date within a minimum of four weeks advance notice by the purchaser.

11.6 Spare Parts

11.6.1 The spare parts shall comply with specification and tests of the original equipment and shall be fully interchangeable with the original parts without requiring modification at site.

11.6.2 The spare parts shall be preserved to prevent deterioration during shipment and storage in tropical climate.

11.6.3 Two full set of filters of proper size for every unit shall be furnished, export packed on the job for the owner's use. These shall be stored in the equipment room in which they will be used, as far as possible, or turned over to the owner where such storage is not possible. These filters shall be for the owner's use and are not to be used (by the contractor) in making any filter changes required by the contract documents during the warranty period.

11.6.4 The Vendor shall guarantee the provision of spare parts for a minimum period of 10 years from date of dispatch of materials and/or equipment.

11.7 Coordination Responsibility with Other

11.7.1 In case the equipment ordered should be mounted on, aligned, connected, adjusted, or tested with the equipment of other manufacturer(s), the supplier shall coordinate with the participating manufacturer(s) and obtain all dimensional and technical in formations allowing for any interconnecting equipment and tests that may be required.

11.7.2 The supplier shall be responsible for correct and timely communication with the participating manufacturer(s) and for any delay and/or cost claims arising from such communications.

11.7.3 Copies of all correspondence including those with sub-vendors shall be furnished to the purchaser.

Languages:

All correspondence, submittals, layouts, documents, certificates including test procedures and edited specifications shall be submitted in the English and/or Persian language.

12. DATA SHEETS

1) SITE DATA SHEET

A) AMBIENT TEMPERATURE:

- Summer	Max. _____ °C (°F) DB _____ °C (°F) WB
	Min. _____ °C (°F) DB _____ °C (°F) WB
- Winter	Max. _____ °C (°F) DB _____ °C (°F) WB
	Min. _____ °C (°F) DB _____ °C (°F) WB
- Site Elevation	_____ Meter above Seal Level
- Site Latitude	_____

B) WIND VELOCITY: kph (mph) _____ Wind Load _____ kg/m²

C) ENVIRONMENT: Dusty, Hazardous

D) AVAILABLE SERVICE:

- Power Supply _____ Volt _____ Phase _____ Hz

E) AREA CLASSIFICATION: _____

F) LOCATION: c Indoors c Outdoors c Heated c Unheated

G) OTHER CONDITIONS: _____

Note:

Earthquake belt of Iran is located in UBC zone 3.

2) AIR FILTER DATA SHEET

A) GENERAL

Project _____ Location _____
 Order No. _____ Factory _____ Customer _____
 Service _____ Item No. _____ Fabricated Date _____
 Manufacturer _____ Model _____ Qty. _____

Notes:

c Indicates information to be completed by Purchaser.

b Indicates information to be completed by manufacturer.

B) PROCESS DATA

c Air Handled _____
 b Corrosive and Toxic Compounds _____
 c Airflow Capacity _____ m³/hr (c fm) at _____ m/s (fpm)
 c Particulates _____ p pm
 c Max. Size of Particles to be Held _____ mm
 b Efficiency of Particles Held _____ %
 c Operating Temp.: Min. ____ °C Normal ____ °C Max. ____ °C(°F)
 c Operating Press: Pa (inch-w g) Max. ____ Normal _____

C) DESIGN DATA

b Design Pressure _____ bar (p s i)

b Design Temperature _____ °C(°F)

D) MECHANICAL CHARACTERISTICS

b Filter Media _____ b Media Area _____ m² (s q ft)

b No. of Filter for Multiple Unit _____

b Insulation Type and Thickness : _____

b Filter Mesh Size _____

b Max. Resistance at Capacity Pa (inch-w g) • Medium • High • Final

c Connections: Size / Rating _____ Inlet _____ Outlet

b Nominal Size : mm _____ W _____ H _____ D

b Actual Size : mm _____ W _____ H _____ D

E) MATERIALS

b Housing _____ b Fasteners _____

b Flanges _____ b Hard wares _____

b Gaskets _____

G) INSTRUMENTS

b Differential Pressure Switch : Mfr _____ Size and Type _____

b Air Filter Gage : Mfr _____ Size and Type _____

b Safety Provisions: Mfr _____ Size and Type _____

H) PHYSICAL DATA

b Shipping Weight kg (lb) _____ Net _____ Gross

b Shipping Volume m³(ft³) _____ Net _____ Gross

b Dimensions: L _____ W _____ H _____ mm (inches)

3) VENTILATING AIR FAN DATA SHEET

A) GENERAL

Project _____ Location _____

Order No. _____ Factory _____ Customer _____

Manufacturer _____ Model No. _____ Serial No. _____

Date of _____ Fabrication _____ Inspection _____

B) MECHANICAL CHARACTERISTICS

Fan Type _____ Arrangement _____

Location _____ Services _____ Fan No. _____
 Wheel (Impeller) Type _____ Wheel Diameter _____
 Airflow Capacity m³/h (c fm) _____ Normal _____ Rated
 Static Pressure Pa (inch-w g) Internal _____ Total _____
 Max. Speed _____ RPM _____ TIP
 Drive _____ Direct _____ Belt
 Max. Outlet Velocity m/s (fpm) _____
 Unit Mounted _____ Roof _____ Floor _____ Ceiling
 Sound Classification dB (A) _____ NC _____ Power
 b Material _____ Housing _____ Impeller
 Bearings _____ Pillow Block _____ Ball
 Operating Temp. °C (°F) _____ Min. _____ Max.

C) ACCESSORIES

Dampers _____ Motorized _____ Self-Release
 Belt Guard _____ Fan Guard _____
 Firestal _____ Auto Lock On Failure _____
 Inlet Guide Vanes _____ Roof Curbs _____
 Vibration Eliminators _____ Spring _____ Rubber-In-Shear
 Painted Finishes _____ Decorative _____ Protective

D) SALIENT FEATURES

E) ELECTRICAL

Motor _____ Mounted _____ Loose _____ by Others
 Motor Type _____ ODP _____ TEFC _____ TEAO
 Motor Protection _____ Overload _____ Insulation Class
 Motor Capacity HP _____ Rated _____ Nominal
 Power BHP _____ Fitted _____ Absorbed
 Electrical _____ V _____ PH _____ Hz

F) PHYSICAL DATA

Fan Alone kg (lbs) _____ with Accessories _____
 Shipping Weight kg (lbs) _____ Gross _____ Net
 Shipping Volume m³ (ft³) _____ Gross _____ Net
 Dimensions _____ Boxed _____ Unboxed

4) DAMPER AND LOUVER DATA SHEET

A) GENERAL

Project _____ Location _____
Order No. _____ Factory _____ Customer _____
Manufacturer _____ Model No. _____ Serial No. _____
Date of _____ Fabrication _____ Inspection _____

B) MECHANICAL CHARACTERISTICS

Type _____ Damper _____ Louver _____
Material Designs _____ Damper _____ Louver _____
Location Conditions _____ Inlet _____ Outlet _____
No. of Blades _____ Damper _____ Louver _____
Blade Shapes _____ Damper _____ Louver _____
Blade Type _____ Damper _____ Louver _____
Blade Action _____ Parallel _____ Opposed _____
Installed On _____ Masonry _____ Metal Frame _____ Wood Frame _____

C) COMBINATION SMOKE AND FIRE DAMPER

Type _____ Dynamic _____ Static _____ Combination _____
Style _____ Rectangular _____ Round _____
Classification _____ UL 555 _____ UL 555 _____ Others _____
Operation _____ Fusible Link _____ Firestat _____ Reset _____
Installed on _____ Masonry Frame _____ Steel Frame _____
Location Conditions _____ Wall _____ Floor _____ Ceiling _____
Fire Ratings _____ 1½ hr. _____ 3 hrs. _____
No. of Blades _____ Single _____ Multiple _____ Free Area _____
Blade Action _____ Parallel _____ Opposed _____
Actuators _____ Electric _____ Pneumatic _____
Sleeves _____ Integral _____ Caulked _____

D) ACCESSORIES

Actuators _____ Manual _____ Electric _____ Pneumatic _____
Blade Levers _____ Included _____ Excluded _____
CO₂ Release _____ Included _____ Excluded _____
Pressure Switch _____ Included _____ Excluded _____
Solenoid Valve _____ Included _____ Excluded _____
Paint Finishes _____ Protective _____ Decorative _____ Others _____

E) SALIENT FEATURES

F) PHYSICAL DATA

Damper kg (lb) _____ Alone _____ with Accessories

Louver kg (lb) _____ Alone _____ with Accessories

Fire & Smoke kg (lb) _____ Alone _____ with Accessories

Shipping Weight kg (lb) _____ Gross _____ Net

Shipping Volume m³ (ft³) _____ Gross _____ Net

Dimensions _____ Boxed _____ Unboxed