



Petrochemical Industries
Design & Engineering Co.

PROJ. NO. : 1203

SABALAN METHANOL PROJECT

COVER SHEET



OWNER :

**SABALAN PETROCHEMICAL
INDUSTRIES CO.**

PROJ. NO. : 89/S-G/102

ENGINEERING STANDARD SPECIFICATION FOR

HVAC Design Criteria

**APPROVED
FOR CONSTRUCTION**
SABALAN METHANOL PROJECT / 1203

DOCUMENT NO : **1203-00-HV-ESS-780**

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ATTACHMENTS:

1. Indoor Design Conditions for Various Buildings/Rooms
2. Assessment Chart of Ventilation Requirements for Analyzer House (according to IEC 79-16)

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1. Purpose

This specification together with the referenced codes and standards define the minimum requirement, basis of design and main equipments to be used for the Heating, Ventilating, Air-Conditioning and pressurizing system of buildings in Sabalan Methanol Project including the following buildings:

- Main Control Building
- Main Substation
- Laboratory
- Administration
- Analyzer

2. Codes and Standards

IPS	IRANIAN PETROLEUM STANDARD
IPS-E-AR-100-2001 IPS-E-AR-120-2004 IPS-E-AR-130-2002 IPS-E-AR-160-2004 IPS-E-AR-180-2003 IPS-G-SF-900-2005	Engineering Standard For Building Heating System Engineering Standard For Building Air Conditioning Systems Engineering Standard For Humidification And Dehumidification System Engineering Standard For Venting, Ventilation And Pressurizing System Engineering Standard For Cold Stores And Ice Plants General Standard For Noise Control And vibration
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS
ASHRAE-2005 ASHRAE-2007 ASHRAE-2008 ASHRAE-2006 15-2004 34-2004 52.1-1992 52.2-1999 55-2004 62.1-2004	ASHRAE Handbook Fundamentals ASHRAE Handbook HVAC Applications ASHRAE Handbook HVAC Systems and Equipment ASHRAE Handbook Refrigeration Systems and Applications Safety Standard for Refrigeration Systems Designation and Safety Classification of Refrigerants Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size Thermal Environmental Conditions for Human Occupancy Ventilation for Acceptable Indoor Air Quality
ARI	AIR-CONDITIONING AND REFRIGERATION INSTITUTE
365-2002 410-2001 430-1999 700-2006	Commercial and Industrial Unitary Air-Conditioning Condensing Units Forced-Circulation Air-Cooling and Air-Heating Coils Central Station Air Handling Units Specification for Fluorocarbon Refrigerants
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
45-2004 90A-2002 90B -2006 91-2004	Standard on Fire Protection for Laboratories Using Chemicals Standard for the Installation of Air-Conditioning and Ventilating Systems Standard for the Installation of Warm Air Heating and Air-Conditioning Systems Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids

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NFPA (Cont.)	NATIONAL FIRE PROTECTION ASSOCIATION
92A-2006	Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences
101-2006	Life Safety Code
110-2005	Standard for Emergency and Standby Power Systems
900-2007	Building Energy Code
5000-2006	Building Construction and Safety Code
API	AMERICAN PETROLEUM INSTITUTION
API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2
SMACNA	SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
2004	HVAC Systems-Duct Design,
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY OF TESTING AND MATERIALS
IMC	INTERNATIONAL MECHANICAL CODE
INBC	IRANIAN NATIONAL BUILDING CODE
IEC-79-16	ARTIFICIAL VENTILATION FOR THE PROTECTION OF ANALYZER(S) HOUSES

3. Over View

3.1. Site Location and Conditions

The subject plant is located at Bandar Assaluyeh North of Persian Gulf, south of IRAN.

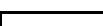
Elevation	34 m above sea level
Longitude	50.5° E
Latitude	28.5° N
Design wind velocity	125 Km/h
Prevailing wind direction	From NW

3.2. HVAC Conditions

3.2.1. Ambient Design Condition

Summer design dry bulb temperature	48°C
Summer coincident wet bulb	33°C
Summer daily temperature range	7°C
Winter design dry bulb temperature	5°C
Winter coincident wet bulb temperature	5°C

- All equipment installed outdoor and exposed to direct sunlight shall be designed for environment atmosphere conditions and direct sun exposure of 85 °C (touch temperature).
- All air cooled condenser installed outdoor shall be designed to be suitable for operation at an ambient air temperature up to 48 °C and down to 5°C

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3.2.2. Indoor Design Condition

Air conditioning system & airflow ventilation rate should be sufficient to satisfy not only air removal specification, but also to maintain overpressure and temperature specifications. It should be also capable to avoid wind penetration in order to meet the requirements of a conditioned space, simultaneous control of temperature, humidity, cleanliness, contamination and air distribution should be considered in design & selection of HVAC equipment. Indoor design conditions and air change rate for specific areas shall be according to attachment 1.

3.3. Air Filtration Requirements

3.3.1. Fresh Air Filtration Requirements

Outdoor air intakes of occupied personnel buildings in the vicinity of operating process areas shall be continuously monitored for the presence of toxic or flammable gases. The HVAC control system shall shut the outdoor air dampers in response to an outdoor gas detection signal.

Minimum filtration efficiency shall be as follows:

Bldg	Filter Stage	Filter Type	Efficiency
CR, LAB, ANALYZER*,ADMIN	Sand Trap Louver		90% efficiency for particles from 150 to 170 μ m at 1 m/s of face air velocity
	Pre-Filter	Aluminum washable filter	60% efficiency by gravimetric method of ASHRAE Standard 52.1
	Final Filter	Pleated Filter	65% efficiency by dust spot method of ASHRAE Standard 52.1
SUB	Sand Trap Louver		90% efficiency for particles from 150 to 170 μ m at 1 m/s of face air velocity
	Pre-Filter	Aluminum washable filter	60% efficiency by gravimetric method of ASHRAE Standard 52.1

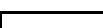
*The ventilation system shall comply with IEC 79-16 and be assessed according to Attachment-2. So Analyzer filtration depends on its category according to Attachment-2. If no air is mechanically extracted from the room, no outdoor air is taken.

3.3.2. Re-Circulated Air Filtration Requirements

Minimum filtration efficiency shall be as follows:

Bldg	Filter Stage	Filter Type	Efficiency
CR, LAB, ANALYZER*,ADMIN	Pre-Filter	Aluminum washable filter	Pre-Filter with 60% efficiency by weight method
	Final Filter	Pleated Filter	Final Filter with 65% efficiency of dust spot method (EU 6)
SUB	Final Filter	Aluminum washable filter	80-85% efficiency arrestance (EU 3)

Dust filter efficiency ratings are based on ASHRAE Standard 52.1.

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3.4. Air Velocities

Air velocities in “HVAC” systems shall not exceed the followings:

a. Unmanned Area:	Maximum Allowable
Return main ducts	7.63 m/sec. (1500 fpm)
Supply main ducts	10.16 m/sec. (2000 fpm)
Supply grilles	4.06 m/sec. (800 fpm)
Return or Exhaust grilles	3.05 m/sec. (600 fpm)
b. Manned Area:	
Return main ducts	5.08 m/sec. (1000 fpm)
Supply main ducts	7.62 m/sec. (1500 fpm)
Supply grilles	3.05 m/sec. (600 fpm)
Return or Exhaust grilles	2.54 m/sec. (500 fpm)
c. General Equipment:	
Cooling coils	2.79 m/sec. (550 fpm)
Heating coils	3.81 m/sec. (750 fpm)
Exhaust Louvers	3.50 m/sec.(690 fpm)
Inlet Louvers	2.50 m/sec.(495 fpm)
Door or Wall louver (Door undercut)	1.50 m/sec. (300 fpm)
Fresh air intake louver: (For dusty storm area)	1.5 – 2.03 m/sec. (300 - 400 fpm)
Residual air velocity at 0.5 m above floor shall be less than	0.1 m/s (20 fpm).

3.5. Noise Level

The maximum sound pressure levels generated by HVAC systems at 1m above the floor and at 1m horizontal distance from any equipment or air intake / outlet when all systems are in operation shall be in accordance the following table.

Area Description	Maximum Allowable Sound Pressure Level (dB(A))
HVAC Rooms	85 dB(A)
Electrical Substations,	60 dB(A)
Battery rooms	60 dB(A)
Process Instrument Room and others technical rooms without occupancy	60 dB(A)
Process Instrument Room and others technical rooms with occupancy (Control rooms)	50 dB(A)

3.6. Calculation Method

3.6.1. Cooling and Heating Load Calculations

The heat loss and cooling load calculations shall be performed using valid and well known software program. The room-by-room load calculations shall be submitted.

The psychometric chart indicating the entering and leaving coil dry bulb and wet bulb temperatures shall be included.

Peak cooling calculation will be performed at the summer design dry and wet bulb temperatures coincident with the highest one-day solar loading of the year for the site latitude.

3.6.2. Fresh Air Make-Up Calculation

Make-up air quantity shall take into account:

- The minimum fresh air quantity in respect with rooms occupancy
- The exhaust air requirement,
- The indoor overpressure with respect to outdoor, where applicable,
- Battery rooms min. air flow rate shall be determined as indicated in Attachment 1.
- In the others rooms the minimum fresh air quantity shall conform to requirements indicated in Attachment 1.

3.6.3. Heat Transmission Coefficients (U Values)

The heat transmission coefficients shall be calculated according to ASHRAE calculation method and architectural specification. Heat transmission coefficients at walls, roofs with adequate thermal insulation will be considered as a basis for cooling & heating loads calculations

3.6.4. Infiltration

For the buildings which provided by central HVAC (air system type) for the purposes of heating and cooling calculations, it may be assumed that no infiltration shall occur due to the fact that the buildings shall be mechanically ventilated.

3.7. Pressurization and Air Renewal (AC) Rate

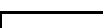
A minimum pressurization level as shown in table Attachment 1 shall be maintained, regardless of outdoor conditions.

Air intakes and exhaust shall be positioned so as to minimize the effects of wind and be separated from each other by at least 4.5m.

3.8. Overcapacity

Over capacity for HVAC equipment shall be in accordance as follow:

Equipment type	Margin Factor
DX Cooling Coil	10%
Electric heating coil	10%
Compressors	10%
Fans	10%
Air Cooled Condenser coil	10%

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3.9. Fire and Gas Requirements

HVAC systems shall be integrated with project safety designs and fire fighting philosophies. As well, regard shall be given to the following points:

3.9.1. Gas Dampers

Gas detection shall be provided at all outdoor air intakes for air handling units.

The detection of gas shall initiate alarms and protective sequences dependent upon the concentration of lower explosion limit (LEL) gas in the air. Fire and gas systems shall send a signal to the HVAC control panels upon detection of gas, and panels shall initiate sequences for closing the fresh air dampers in the HVAC system and de-energizing the exhaust fan of the building. Sequencing shall not include the shutdown of the HVAC system.

The closure of outdoor air intake dampers (gas dampers) shall be realized by direct signals from the fire and gas systems to the damper actuator.

3.9.2. Fire & Smoke Dampers

For buildings that use a fire-resistant design, fire dampers shall be provided at all firewalls or slab penetrations to maintain the integrity of the wall, roof or slab. Smoke dampers or combination smoke and fire dampers shall be installed in ducts where required by the safety department.

Fire dampers shall be a thermal-fuse type and rated for a minimum of 1.5 hours against fire.

Fire & smoke dampers shall be a motorized type and rated for a minimum of 1.5 hours against fire.

Control panels, including fire and gas system control panels, shall receive damper status information (open/close) from fire dampers and from gas damper limit switches.

Fired zone equipment shut down sequence shall be initiated after receiving fire signal.

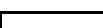
3.9.3. Fire Alarm

HVAC air handling units will automatically shut down when fire alarm system is activated in accordance with NFPA 90A and NFPA 101.

3.10. Duct Work Insulation Thickness

The insulating thickness shall be used as following table:

Location Of Duct	Supply Air	Fresh Air	Return Air	Exhaust Air
Air Conditioned Areas	25 mm	25 mm	Not Insulated	Not Insulated
Suspended Ceiling Void Above Air Conditioned Areas	25 mm	Not Insulated	25 mm	Not Insulated
Non-Air Conditioned Areas	25 mm	Not Insulated	25 mm	Not Insulated
Exposed To Ambient Air Conditions	50 mm	Not Insulated	25 mm	Not Insulated

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3.11. Refrigerant Type

Refrigerant gas shall be a non-CFC/non-HCFC type

3.11.1. Central HVAC

A chlorine free refrigerant such as R134-A shall be used in Central HVAC units & packages.

3.11.2. Split Room Air Conditioners

Refrigerant shall be R134A or R407c; however for small units which cooling capacity is lower than 10 kW. Refrigerant R22 may be agreed.

3.12. Electrical Utilities

3.12.1. Power Characteristics

The electrical system voltage levels throughout the plant shall be as follows:

System		Voltage (Volt)	Phase No.
Distribution	Low Voltage	400 / 230	3+N
Instrumentation and Control		110	AC- 1 PH
Instrumentation (Shut Down)		110	AC-1 PH

The frequency of the whole electrical system shall be 50Hz.

The voltage to the motors shall conform to the following:

Motor size	Voltage (Volt)	Phase No.
Lass than 0.2 kW	230	1
0.2 kW and up to 150kW	400	3

3.13. HVAC Control Systems

Air conditioning, ventilation and pressurization systems shall be monitored by HVAC local control panels in each building.

Panels shall contain electrical power distribution modules (e.g., motor starters, feeders,...), as well as separate control modules and conform to project electrical and instrumentation specifications.

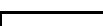
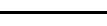
HVAC control systems must operate at maximum ambient temperature (up to 48°C max. recorded temperature) without damage.

HVAC control systems shall meet the following functions:

- Control and monitor pressurization and ventilation.
- Control and monitor room temperature and humidity conditions.
- Monitor status conditions (e.g., on, off) and faults for each component of HVAC systems.
- Monitor alarms.
- Monitor overall system operability.

HVAC control panels shall have the capability to receive signals from fire and gas control systems to protect concerned area.

The HVAC control system has been indicated in job specification for HVAC control system.

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4. General Requirement

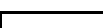
4.1. HVAC System Description

4.1.1. MAIN CONTROL ROOM

- (a) Whole building shall be air conditioned and pressurized at no less than 50 Pa higher than atmosphere.
- (b) The following two zones of central HVAC System shall be provide.
 - Zone 1: Instrument Boards, Control Room and Switchgear Room
 - Zone 2: Personnel Area
- (c) Zone 1 system shall comprise two (100% x 2) sets of air-cooled Direct Expansion (DX) type packaged air conditioner with single air duct system.
- (d) Zone 2 system shall comprise one set of air-cooled DX type packaged air conditioner with single air duct system.
- (e) Cooling and dehumidification shall be made by means of DX coil in packaged air conditioner.
- (f) Packaged air conditioner for Zone 1 system shall be controlled according to the representative room temperature, such as Control Room, Instrument Boards, and Switchgear Room.
- (g) Packaged air conditioner for Zone 2 system shall be controlled according to the return air temperature requirement.
- (h) Each room temperature shall be controlled by means of electric re-heater installed in supply air duct. Electric re-heaters shall be operated by room thermostats or room temperature sensors.
- (i) Humidifying shall be made by means of the electric humidifier installed in the packaged air conditioner or supply air duct, if any. Humidifier shall be operated by humidistat installed in the return air duct.
- (j) One set of outdoor intake fan shall be introduced into packaged air conditioners for both Zone 1 and Zone 2 through filter unit.
- (k) Pantry and toilet shall be mechanically ventilated to extract odors and to reduce humidity.
- (l) Battery Room shall be mechanically ventilated. Outdoor intake shall be made directly from outside atmosphere and provide with sand trap louver and air filters.
- (m) All packaged air conditioners shall be fitted with air flow alarm, which shall actuate immediately upon automatic change over when a running unit fails.
- (n) The air flow alarm and room high temperature alarm shall be integrated as a HVAC system common alarm.
- (o) All of openings in the external walls and roof for air intake and exhaust shall be protected to prevent ingress of debris into the building due to explosion in Plant, by provision of explosion protection valve in the openings.
- (p) All of HVAC systems do not require continuing operation, when plant explosion.

4.1.2. LABORATORY & ADMINISTRATION

- (a) Laboratory and administration shall be air conditioned and slightly pressurized higher than atmosphere.
- (b) The following two central HVAC Systems shall be provide.
 - Laboratory: Second floor
 - Admin: First floor
- (c) Each HVAC system shall comprise two (100% x 2) sets of air cooled DX packaged air conditioner with single air duct system.

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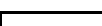
- (d) The polluted air shall not be re-circulated into the other area.
- (e) Cooling and dehumidification shall be made by means of DX coil in the packaged air conditioner.
- (f) Packaged air conditioner shall be controlled according to the room temperature requirement.
- (g) Each room temperature shall be controlled by means of electric re-heater installed in the supply air duct. Electric re-heaters shall be operated by room thermostats or room temperature sensors.
- (h) Humidifying shall be made by means of electric humidifier installed in the packaged air conditioner or supply air duct, if any. Humidifier shall be operated by humidistat installed in the return air duct.
- (i) One set of outdoor intake fan shall be introduced into packaged air conditioners through filter unit.
- (j) Locker room and toilet shall be mechanically ventilated to extract odors and to reduce humidity.
- (k) Fume hoods and canopy hoods shall be mechanically extracted to atmosphere by means of one set of extract fan with central exhaust duct. The exhaust fan shall be suitable for the hazardous area condition.
- (l) Fume hoods shall be of air curtain type and served with outdoor air from the outdoor air intake fan unit which consists of a fan and filters.

4.1.3. SUBSTATIONS

- (a) HVAC system shall comprise two (100% x 2) sets of air cooled DX type packaged air conditioner with single air duct system, or two (100% x 2) sets of air cooled DX split direct blown packaged air conditioner without duct system.
- (b) Cooling and dehumidification shall be made by means of DX coil in packaged air conditioner.
- (c) Packaged air conditioner shall be controlled according to the room temperature requirement of switchgear room.
- (d) No humidification shall be provided.
- (e) Battery Room shall be ventilated. Outdoor intake shall be made directly from outside atmosphere and provided with the sand trap louver and filters.
- (f) No air is mechanically extracted from the rooms under central HVAC system, then no outdoor intake fan is taken into the central HVAC system.
- (g) All of HVAC system do not require continuing operation, when plant explosion.

4.1.4. ANALYZER HOUSES

- (a) Analyzer Houses shall be air-conditioned.
- (b) Category for Analyzer House shall be assessed according Attachment-2.
- (c) HVAC system for Category-A2/B2/C2 shall comprise one (1) set of air-cooled DX type packaged air conditioner with single air duct system.
- (d) HVAC system for category-A1/B1/C1/D1/D2 shall comprise one (1) set of air-cooled DX type window air conditioner without air duct system.
- (e) Cooling and dehumidification shall be made by means of DX coil in the air conditioner.
- (f) Air conditioner shall be controlled according to the room temperature requirement.
- (g) Electric re-heater shall be installed in the air conditioner or supply air duct, if any. Electric re-heaters shall be operated by room thermostats or room temperature sensors.
- (h) The ventilation system shall comply with IEC 79-16 and be assessed according to Attachment-2.

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- (i) Outdoor intake fan, if required to dilute explosive gas, shall have a stand-by fan.
- (j) If no air is mechanically extracted from the room, no outdoor air is taken.

4.2. Fresh air

All occupants shall be provided with fresh ventilation air in accordance with table Attachment 1 of this document.

Fresh air shall be provided from safe area to maintain safe, clean and healthy environment in all areas. Gas detector shall be provided on fresh air intake. In case of flammable/toxic gas detection, motorized damper mounted on the air handling unit's fresh air intake shall be closed and the HVAC system continue to work with no fresh air and de-energize all the exhaust fans.

4.3. Battery Room

Supply air to battery rooms shall be introduced at a low elevation (150 mm above floor) and exhausted directly outdoors by a fan mounted at ceiling height. No air shall be returned from the battery rooms.

Exhaust air flow rate shall be as listed in table Attachment 1 as a minimum.

All exhaust fans in the battery room shall be spark-proof type and if the fan motor is in the air stream it shall be explosion proof type. Redundant exhaust fan shall be provided and shall be interlocked with a flow switch to disable the high-rate charging function of the batteries if exhaust flow is stopped. Battery room exhaust fans shall be controlled by a field hand/off/auto switch.

The air ducts and louvers in battery room shall be of hot dipped galvanized construction. HVAC and exhaust air units shall be in shut-off position when fire and gas detection system is actuated.

4.4. Co2 Room

Exhaust air from Co2 rooms shall be exhausted directly outdoors by a fan mounted at a low elevation (500 mm above floor) and intake air shall be introduced by intake air louver mounted at a high elevation (500 mm below ceiling). Intake air louver shall be equipped with sand trap louver.

Exhaust air flow rate shall be as listed in table Attachment 1 as a minimum.

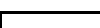
4.5. Control System

A direct digital controller (DDC) microprocessor based control panel integral with the air handling units will provide control of all unit functions.

The unit will be a standalone controller with the capability to interface with the F&G system in turn, send common status and alarm signals to the plant DCS for monitoring.

4.6. Blast Resistant

The Control buildings will be 'Blast Resistant' therefore all the exterior walls will be designed from blast-proof construction. All the air passed through these walls shall be equipped with Explosion Protection Valves to prevent the blast wave effects.

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5. Duct System Design Basis

5.1. Duct Sizing

Duct work shall be sized considering the velocity and friction rate design limits suggested by ASHRAE. The design of the duct system must take into account the space available, allowable noise levels, Duct leakage, thermal and noise insulation, effect of air contaminants on duct materials, fire and smoke control and pressure losses due to friction and turbulence.

The common methods of air duct system design which are recommended for use are as follows:

5.1.1. Equal Friction Method

In the equal friction method, ducts are sized for a constant pressure loss per unit length. When energy cost is high and installed ductwork cost is low, a low friction rate design is more economical. For low energy cost and high duct cost, a higher friction rate is more economical. After initial sizing, calculate the total pressure loss for all duct sections, and then resize sections to balance pressure losses at each junction. This method is used for exhaust and return air ducts design.

5.1.2. Static Regain Method

In this method the static pressure increase (static regain) at each take-off, offsets the pressure loss of the succeeding sections of ductwork. This method is specially suited to supply systems having long runs with many registers and diffuser located at take-offs. With this design procedure, approximately the same static pressure exists at the entrance of each branch, simplifying outlet selection. This method is used for supply air duct design.

5.1.3. Constant Velocity Method

This method is generally applied to exhaust systems.

• Ductwork Dimensions

The ductwork dimensions shown on the relevant layout drawings represent the nominal inside dimensions Width x Height.

• Transitions or Changes Slope

All transitions or changes in duct size shall increase as gradually as space permits with a slope of not more than 1:3 where possible.

Ducting design shall be based on low velocity ducting with equal percent friction method for exhaust and return ducts or static regain method for supply ducts.

The aspect ratio should be preferably no greater than 3 to 1, and where this is not possible the duct shall be externally stiffened with angle section steel and internal splitters provided.

5.1.4. Space Pressure

All spaces defined in the HVAC Mechanical Design Criteria shall be over pressure by good arrangement of supply, return and exhaust rate.

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5.1.5. Fire and Smoke Management

Because duct systems can convey smoke, hot gases, and fire from one area to another and can accelerate a fire within the system; fire dampers shall be used where ever a duct pass through a fire rated wall.

5.1.6. System and Duct Noise

The maximum sound pressure levels generated by HVAC systems at 1m above the floor and at 1m horizontal distance from any equipment or air intake/outlet when all systems are in operation shall not exceed 40 dbA in all rooms except HVAC rooms, where the noise level up to 85 dbA is acceptable.

For outdoor equipment acceptable sound pressure level is up to 85 dbA at 1m distance from equipment.

Attachments



Attachment 1: Indoor Design Conditions for Various Buildings/Rooms

Attachment 2: Assessment Chart of Ventilation Requirements for Analyzer House (according to IEC 79-16)

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Attachment-1 : INDOOR DESIGN CONDITIONS FOR VARIOUS BUILDINGS / ROOMS																
Building / Room Name	Dry Bulb Temperature (°C)						Relative Humidity (%) *5						Over Pressure (Pa)	Outdoor Air for People	Ventilation Rate	Remarks
	Summer			Winter			Summer			Winter						
	Min.	Max.	Design Point	Min.	Max.	Design Point	Min.	Max.	Design Point	Min.	Max.	Design Point				
	*1	*2	*3	*1	*2	*3	*1	*2	*3	*1	*2	*3				
	°C	°C	°C	°C	°C	°C	%	%	%	%	%	%	Pa	l/s.p		
Main Control Room																
<Zone-(1)>																
Auxiliary Room	23	27	25	21	23	22	45	55	50	40	50	45	50	-	-	
Control Room	23	27	25	21	23	22	45	55	50	40	50	45	50	10	-	
Engineering Room	23	27	25	21	23	22	45	55	50	40	50	45	50	10	-	
UPS Room	23	27	25	21	23	22	45	55	50	40	50	45	50			
Battery Room	-	32	32	-	-	-	-	*5	-	-	*5	-	-	-	*4a	
HVAC Room	-	45	45	-	45	-	-	*5	50	-	*5	-	-	-	*4c	
<Zone-(2)>																
Supervisor Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Office	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Instrument Maintenance Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Electrical Maintenance Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Calibration Shop	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Chemical Store Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Tea Room	23	27	25	21	23	22	45	55	50	40	50	45	-		*4c	
Mess Room	23	27	25	21	23	22	45	55	50	40	50	45	-		*4c	
Locker Room	-	-	-	-	-	-	-	-	-	-	-	-	-		*4c	
Toilet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
Shower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
Corridor	23	27	25	21	23	22	45	55	50	40	50	45	-	-	-	
Airlock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Laboratory & Yard Office																
Laboratory (Second Floor)																
Laboratory	23	27	25	21	23	22	45	55	50	40	50	45	-	10	*4d	*6, *8
Chemical Store	23	27	25	21	23	22	45	55	50	40	50	45	-	10	*4c	
Instrument Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	*4d	*6, *8
Gas Chromatograph Room	23	27	25	21	23	22	45	55	50	40	50	45	-	10	*4d	*6, *8
Office	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
Glass Storage	23	27	25	15	23	22	45	55	50	40	50	45	-	10	-	
Balance Room	23	27	25	15	23	22	45	55	50	40	50	45	-	10	-	
Record Room	23	27	25	15	23	22	45	55	50	40	50	45	-	10	-	
Tea Room	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
Locker	-	-	-	-	-	-	-	-	-	-	-	-	-	10	*4c	
Toilet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
Shower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
Corridor	23	27	25	21	23	22	45	55	50	40	50	45	-	-	-	
HVAC Room	-	45	45	-	45	-	-	*5	50	-	*5	-	-	-	*4c	

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02 Attachment-1 : INDOOR DESIGN CONDITIONS FOR VARIOUS BUILDINGS / ROOMS

02. Attachment 2: INDOOR DESIGN CONDITIONS OF THE BUILDING ROOMS																	
Building / Room Name		Dry Bulb Temperature (°C)						Relative Humidity (%) *5						Over Pressure (Pa)	Outdoor Air for People	Ventilation Rate	Remarks
		Summer			Winter			Summer			Winter						
		Min.	Max.	Design Point	Min.	Max.	Design Point	Min.	Max.	Design Point	Min.	Max.	Design Point				
		*1	*2	*3	*1	*2	*3	*1	*2	*3	*1	*2	*3				
		°C	°C	°C	°C	°C	°C	%	%	%	%	%	%	Pa	l/s.p		
	Airlock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Yard Office (First Floor)																	
	Office, Manager, Secretary	23	27	25	21	23	22	45	55	50	40	50	45	-	10	-	
	Tea Room	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
	Toilet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4c	
	Corridor, Stair	23	27	25	21	23	22	45	55	50	40	50	45	-	-	-	
Substations																	
	MCC for LV Switchgears	-	32	32	-	35	-	-	*5	50	-	*5	-	30	-	-	
	MCC for MV Switchgears	-	32	32	-	35	-	-	*5	50	-	*5	-	30	-	-	
	Cable Cellar	-	32	32	-	35	-	-	*5	50	-	*5	-	30	-	-	
	Battery Room	-	32	32	-	-	-	-	*5	-	-	*5	-	-	-	*4a	
Analyzer Houses																	
	Analyzer Room	23	27	25	21	23	22	45	55	50	40	50	45	*7	10	*4b	

*1 : Lowerst limit to be maintained under the outdoor designconditions

*2 : Highest limit to be maintained under the outdoor design condition

*3 : Design point taken for heating and cooling load calculation

*4 : Unit of outdoor air and ventilation

l/s : Litre per second

l/(s.p) : Litre per second per person

l/(s.m2) : Litre per second per square metre

Ach/h : Air changes per hour

*4a Capable to dilute the hydrogen concentration to 25% of LEL.

*4b In accordance with IEC 79-16

*4c Accordance ASHRAE Application Standard, 62-1 (Ventilation for Acceptable Indoor Air Quality)

*4d Locally ventilated via draft chambers, canopy hoods

*5 : No condensation to be performed.

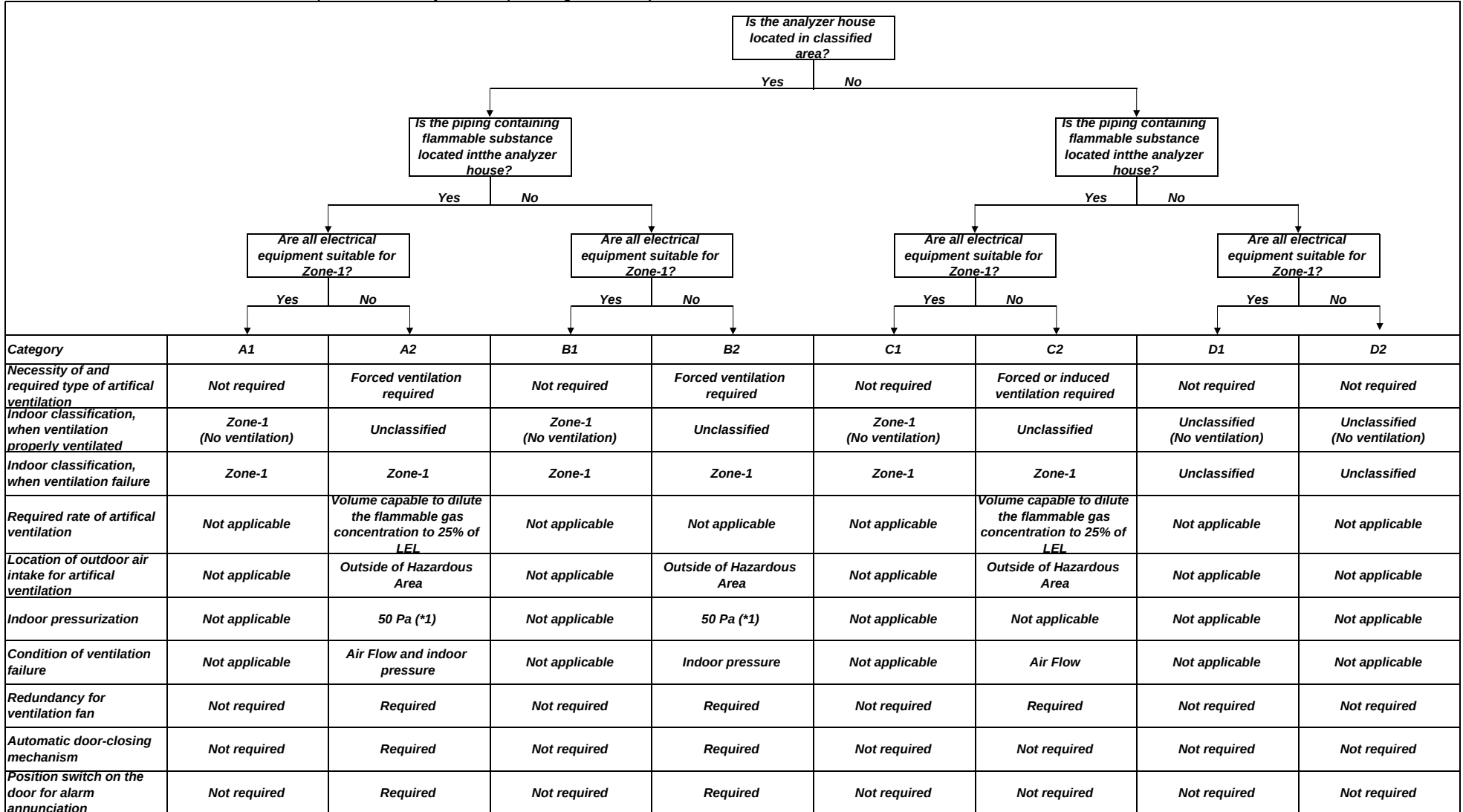
*6 : Room air shall not be recirculated to common air supply system.

*7 : 25Pa, if the analyzer house is located within the classified area and the indoor electrical equipment is not suitable for Zone 1 area classification

*8 : Hold for Fume Hoods and Canopy Hoods quantity and flow rate.

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Attachment-2: Assessment Chart of Ventilation Requirements for Analyzer House (according to IEC 79-16)



***1 : A minimum overpressure of 50 Pa with respect to outside atmosphere should be maintained at all points inside the room and its associated ducts which leaks are liable to occur, all doors and windows being closed.**