GROUP H

# VENTILATION, AIR-CONDITIONING AND HEATING – DESIGN STANDARD

(PAGES 171-226)

## 1. GENERAL PROVISIONS

1.1 This Standard is applied for design of ventilation, air-conditioning and heating for newly-built or renovative constructions.

1.2 This Standards is not applied for:

a. Types of:

- Testing house or works or special construction;
- Specialized house or works (underground tunnel, with explosive or radio-active isotopes, etc.);
- Works of underground mine exploition;
- Short-term residential and industrial buildings (or in seasons);

b. Design of ventilation system to protect against smoke for residential and industrial buildings in cases of fire;

c. Design of air-conditioning, cooling, heating systems used in technological and electric equipments (Vacuum cleaning system), house cleaning and equipments, dry system, cooling system, dust disposal for materials and finished production, delivery system of finished production and industrial waste, wind blowing system for engine-cooling and electric equipments, etc...);

d. Design of protecting shade for technological equipments or work stage (at areas of originating toxic gas in production), connection point to local wind loading sytem.

1.3 This Standard shall provide the technical solutions in order to ensure the hygiene standards, fire protection and safety techniques which must be followed in design of ventilation, air-conditioning and heating for houses and buildings.

1.4 When design of ventilation, air-conditioning and heating, the technological, architectural and structural solutions must be suitably combined in order to ensure the hygienic requirements, technical regulations and economic saving.

1.5 Equipments, pipe, wind conduit placed in production rooms with erosion environment, as well as air carrying equipments with gas, dust, erosion steam must be made from anti-erosion or with cover layer to protect against erosion.

For expansion container, or other types of water tank need to have protection layer against erosion both inside and outside.

1.6 The engines used for ventilation, air-conditioning and heating must be selected in accordance with requirements of power supply for factory, residential and industrial buildings or clearly specified in this design.

1.7 For residential and industrial buildings under group A, B, C and F and public buildings, it is necessary to facilitate the cutting from control panel, control cabinet or from press button of ventilation, air-conditioning, heating system in rooms of fire, except the air supply to transfer rooms of production compartment under group A, B and F shall be uninterrupted air supply system in case of fire.

For residential and industrial buildings under group C, it is acceptable to cut only the serving systems for separate lines or areas with area of not smaller than 2,500m$^2$.

For residential and industrial buildings and compartments with automatic fire alarm and fire protection system, these systems must be connected with ventilation, air-conditioning, heating systems to automatically cut these systems during the operation of fire alarm and fire protection system.

1.8 In design of ventilation, air-conditioning and heating system, the earthing requirements must be clearly defined for the whole ventilation, air-conditioning and heating equipments, metal air piping, metal pipes serving production compartments and production rooms under group A, B and F as well as air pipes, pipes and systems for discharging explosive susbtances from local air exhaust mechanism.

a. By connecting this system on its whole length to an uninterrupted circuit;

b. By connecting each system with at least 2 points to earthing system of lightning equipments and system according to current Standard.

1.9 For heating surface of pipes, air piping, ventilation, air-conditioning and heating equipments, located at production rooms (including technical floors), where these heating surfaces may cause fire and/or explosion, they must be provided with insultated cover to reduce the temperature of surface of insulated layer to safety level regardless of demand for surplus heat usage from these surfaces.

1.10 Equipments (fan, dust filter film, lock valve, etc...) air piping, deafener, insulated materials, filling materials made from products with high possibility of originating toxic gas grade 1 and grade 2 in case of fire as well as during its operation.

*Note: If toxic features of materials are not available, before used in design, the testing on these areas are necessary*.

1.11 Deafener of ventilation and air-conditioning systems must be made from incombustible materials.

1.12 The solutions on space-plan of residential and industrial buildings under group A, B and F where possibility of forming explosive and flammable substances (steam, air and dust) may be occurred, as well as residential and industrial buildings with toxic source and surplus heat releasing more than 20 kcal/m$^3$.h must be constructed in a way that no formation of unaired area and “bag” is produced in the buildings.

1.13 Windows and skylights must be araread and calculated to expel the transmission of toxic gas from this rooms to others. These entrance, if located within people reach, a manual open/close mechanism must be provided beside other mechanical ones.

1.14 When design of air piping together with other structures made from construction materials (masonry brick, etc..), the measures on tightness realiability of pipes and measures on reduction of inside surface roughness and sanitation condition must also be planned when necessary.

1.15 In design, construction and installation and technology, fixed and movable lifting facilites (pulley, winch, crane – in case of big equipments) must be provided at rooms with ventilation, air-conditioning and heating equipments for repair and technical appraisal of dynamic mechanism of equipments (fan, engine, etc...) if the weight of 1 equipment unit exceeds 50 kg.

*Note: No need of transport-lifting equipments is foreseen if transport-lifting appliance in technology line of the factory and production room can be used to serve the ventilation, air-conditioning and heating systems.*

1.16 The selection of ventilation, air-conditioning and heating systems, selection of equipments, structure and materials for these systems must be implemented on basis of local material sources and production, to avoid the distant delivery of materials.

1.17 In design of ventilation, air-conditioning and heating systems for residential buildings, factory and buildings with demand for manpower provision for operation and repair in accordance with guidances, regulations on these fields and current regulations.

1.18 In design of ventilation, air-conditioning and heating systems for residential and industrial buildings which placed on settleable and sliding soil, the protection measures against wet subgrade under the building must be outlined by draining water in underground ditch, underground pit as well as other water collection points.

## 2. Microclimatic condition and cleanness of inside atmospheric environment and inside calculated climatic parameters.

2.1 For residential and public buildings (administration, classroom, etc...), subsidiary house in industrial enterprises or industrial buildings with inside technology line without special requirements on parameters of atmospheric environment, then mainly the solutions on architecture and construction physics shall be used to design the shielded enclosure in order to keep heat and avoid cold wind in winter; to ensure the aeration by natural ventilation, cross wind in summer, combined with table fan and ceiling fan, etc..in accordance with TCVN 4605: 1988 on "Technical heat, shielded enclosure – Design standard" in order to ensure the comfort of inside environment.

2.2 In case the technical methods on ventilation, air-conditioning and heating are used to ensure the environmental comfort, the parameters on comfortable microclimate shall be referred to Appendix I.

For residential building, comfortable microclimate limit shall be referred to Appendix 2.

2.3 In case ventilation and natural ventilation can not ensure the comfortable microclimate, in order to balance the increase of environmental temperature, air movement speed must be increased to maintain the heat feeling figure in allowable limit. For every $1^oC$ temperature increase, the wind velocity must increase 0.5 - lm/s, but not exceeding 3 - 4m/s for residential building and 5 - 6m/s for industrial building.

Above limit for endurance possibility may accept $t = 37,5^oC$ with moisture of $\varphi$ =80% in static condition.

2.4 Comfortable microclimate in Appendix 1 are set for people with normal clothes domestic staying period of over 2 hours.

If the domestic staying period is shorter, temperature index in this Appendix can be increased (equivalent to hot season) to $0.4^0C$ for each amplitude exceeding $30^0C$ of outside calculated atmospheric temperature (but not exceeding comfortable limit for natural microclimate according to Appendix 2).

2.5 The Microclimatic condition (temperature, average moisture, wind velocity) in breeding facilities and agricultural buildings, as well as in agricultural maintenance houses (seed store, cold storage, etc..), approved dedicated technology standards shall be taken into account.

2.6 Microclimatic condition at regular working places of the production room with radiation intensity of more than 300 kcal/$m^2$.h, it can only be partly ensured by guided methods stated in article 3.I.7

2.7 Allowable limit concentration of toxic gas (gas, air, dust, etc.) in working environment of production space belonging to enterprises or other buildings shall be limited in Appendix 4.

Outside working hours, standard microclimatic condition may not be maintained if this does not violate other approved standards.

2.8 When calculation of air distribution through ventilation, air-conditioning and heating systems, extreme value (maximum or minimum) of wind velocity $W_x$, temperature $t^o_x$, and atmospheric moisture $\varphi_x$ must be ensured to be within the allowable limit of hygienic standards at imported wind section to working or serving areas; for air swirling flow, working people's chest shall be taken into consideration.

*Notes:*

1. *Toxic gas concentration in air supply to building, determined air supply intake shall not exceed 30% of allowable limit concentration.*
2. *Direct impact area of flow shall be regulated to be flow area with wind velocity from maximum $W_x$ to $0.5W_x$.*
3. *When air distribution opening is placed in working area, the average temperature and moisture and velocity outside working area may not need to follow the standard in following cases:*

   *a. at distance of 1m from air supply opening if supply flow is horizontal or inclined.*

   *b. at distance of 0.5m from air supply opening if supply flow blows vertically upwards.*

2.9 When calculation of air distribution to ensure the microclimate at working place and area with regular impact of outside-scope people on blowing flow, the speed of $0,5W_x$ shall be taken as a criterion, while temperature and moisture shall be arithmetical average of these quantities at imported flow to working area.

*Note: When design of these systems, the guidelines of article 2.8 must be taken into account.*

2.10 Working and serving areas in residential, public and supporting buildings of 2m height from floor and mainly with seating people in these space (theatre, working room, lecture hal, etc.) can be taken as 1.5m from floor.

Working area in industrial buildings can be taken according to industrial design standards and technology requirements.

2.11 Outdoor calculated climatic parameters shall be taken according to TCVN 4088: 1985 and treated under grade I, II, III applied for special grade of the building (Appendix 3).

Calculated parameters under grade I used to design the buildings with special importance when allowable time can not ensure the calculated heat and moisture regimes, must be small (under 50h/year).

Calculated parameters under grade II used to design almost residential and industrial buildings when allowable time can not ensure the calculated heat and moisture regimes, must be within the area of 200 - 300h/year. These parameters can be used to calculate ventilation, air-conditioning and heating system under grade II (in winter).

Calculated parameters under grade III used to design the buildings when time period can not ensure the heat regime, shall be reach to 400 - 500 h/year.

# 3. Ventilation, air-conditioning and heating

## *3.1 General instructions*

3.1.1. Ventilation and air-conditioning systems must be designed in a way to ensure the cleanness of atmospheric environment and inside microclimatic condition of the buildings in accordance with standards in terms of sanitation, technology and comfort.

3.1.2. Natural ventilation (including cyclic room aeration) must be organized, if not having influence on technology process, heat feeling of people or protection of materials and equipments in the building.

3.1.3. Mechanical ventilation must be designed if microclimatic conditions and hygienic requirements can not be ensured by natural ventilation.

In rooms with presence of people, if without air-conditioning system, ceiling or table fans must be provided as support for natural ventilation if not having influence on requirements in terms of technology and sanitation.

*Note: Number of fans araread in rooms must be adequate to ensure the wind velocity according to heat feeling. In case of unavailability of calculated data, 1 fan can be selected for every 16-25m$^2$ of floor area. The fan must be with velocity changing regime to meet the using demand.*

*Distance from air vane to floor surface shall not smaller than 2.3m.*

3.1.4. Mechanical and natural mixing ventilation must be designed if possible and one part of natural ventilation can be used for air supply and exhaust.

3.1.5. Air-conditioning must be designed to:

a. Ensure the sanitation and microclimatic conditions in accordance to the Standard, when these conditions can not ensured either by mechanical or natural ventilation, or vapour cooling (adiabatic process);

b. Ensure and maintain the microclimatic condition and air fresh in the building or a part of the building according to technology requirements;

c. Ensure and maintain the comfortable microclimatic conditions or intermediate conditions between comfortable or allowable conditions in production room as stated in Appendix I, 2, if these articles are economically suitable.

d. Ensure and maintain the microclimatic condition and air fresh as regulated for residential and public buildings or subsidiary house when necessary.

*Notes:*

1. *If Standards and Codes on technology do not fix the microclimatic parameters, it must be ensured that when design of air-conditioning system, the optimum microclimatic parameters shall be taken.*
2. *The accuracy for preservation of comfortable microclimatic condition, if without special requirements, should be kept at ±10C according to temperature and ±7% according to moisture (around place of temperature and moisture sensor).*

   *The accuracy for preservation of comfortable temperature during operation of local air-conditioning or local mixer with sensor head having direct impact, can be kept at ± 2$^o$C.*

3.1.6. When radiation source on people reach intensity from 150 to 300 kcal/m$^2$.h and radiation area during its operation exceeding 0.2m$^2$ air temperature according to Appendix 1 and 2 can not be ensured, air velocity can be increased according to requirement of article 2.3.

To ensure above-mentioned microclimatic conditions, local blowing fan shall be provided.

3.1.7. Air-bathing supply system to regular working place must be provided:

a. When radiation intensity exceeds 300 kcal/$m^2$.h: outdoor air supply to ensure the environmental parameters (temperature and wind velocity) according to "Hygienic standards for design of industrial buildings".

b. For trial production process causing pervasion of toxic gas without possibility to design safety hood and local inspiration: outdoor air supply to ensure the environmental parameters (temperature, wind velocity, toxic concentration) according to Appendix I, 2 and 4 of this standards.

*Note: When design of air-bathing systems, protection measures against sliding blowing of toxic gas to nearby working rooms must also be planned.*

3.1.8. Air-ventilation only needs to be combined with air-conditioning or technological demands, if any. In case there is a need of heating (cold resistance) for climatic zone AI, AII (prefer to TCVN 4088: 1985), FS is necessary.

3.1.9. When calculation of ventilation, air-conditioning and heating systems, basing on type and objective to:

a. Calculate the parameters under grade III – when design of general ventilation systems (by natural or mechanical expulsive force) to play function of eliminating surplus heat or moisture, including simple cooling cases by adiabatic process.

b. Calculate the parameters under grade III in hot season and parameters under grade II in cold season of the year – when design of general ventilation to eliminate the toxic gas under grade I, 2, 3, 4 or to balance the exhaust air volume through local inspiration or inspiration through technology line (fire process, delivery by compressed air, dry, etc.), inluding design of cooling ventilation by adiabatic evaporation (water injection in room, in piping or in spray booth) as well as air-bathing by outdoor air.

c. Calculate the parameters under grade II – design of air-conditioning;

d. Calculate the parameters under grade II for cold season – design of air-heating as well as air screen or heat screen;

e. Calculate the parameters under grade I – only design of air-conditioning with based technology requirements.

*Notes:*

*1. When design of ventilation and air-conditioning systems, only a part of daily time shall be used (only for night or some fixed hours in day) or some months in year, other parameters can be taken in stead of foregoing guidances.*

*2. Air volume needed to dilute explosive concentration in indoor atmospheric environment must be determined according to outside atmospheric parameter under grade I and II for calculation of the system.*

3.1.10. Natural room-crossing ventilation must be organized especially at night to cool the building roof including top ceiling floor and technical floors if allowed by operation condition.

3.1.11. For crane cabin in production rooms with high surplus heat, and radiation intensity exceeding 330 kcal/$m^2$.h, or when toxic concentration in air around cabin exceeding allowable limited concentration, air-ventilation or air-conditioning must be provided. For cabin located in production rooms under grade A, B and F as well as toxic gas under grade I, 2 releasing but without filtering facilities in air, air-bathing supply systems or air-conditioning by outdoor dust-filtered air must be designed.

Total circulation can be used when atmospheric environment around cabin without toxic gas or only toxic gas under grade 3, 4 with lower concentration than allowable limit.

3.1.12. Ventilation, air-conditioning and heating systems shall be designed with antivibration and antinoise methods to ensure the allowable noise standards.

3.1.13. In rooms with area of more than 40$m^3$ for each working people and with window or skylight, if without toxic gas or unpleasant smell emitted, natural ventilation through window or skylight can be acceptable.

*Note: The concept "without unpleasant smell emitted" should be understood as volume of noxious substances emitted at the same time from technological equipments shall not increase the noxious concentration in the environment which exceed the allowable limit.*

3.1.14. When design of ventilation, air-conditioning and heating systems, the pervasion condition of inside temperature, moisture and noxious substance (pervasion method and distribution) as well as building use condition must be taken into account. When design, the preventive measures against the pervasion of inside noxious gas and air transmission from rooms with high concentration of noxious gas to rooms with little or without noxious gas.

3.1.15. In design, it is popular to combine supplied ventilation and air-conditioning with air-heating systems.

For residential and public buildings and auxiliary house of enterprises, where occurs only one shift, the combination between supplied ventilation and air-conditioning with air-heating systems must be implemented with adequate basis.

### *3.2 Ventilation, air-conditioning and heating systems.*

3.2.1. The center supplied and exhausted ventilation or air-conditioning systems in production rooms without natural ventilation must be designed by at least two exhaust systems and two supply systems to ensure not under 50% of exchanged air volume during pause of one system.

When design only one supply system or one exhaust system or one group of air-conditioners, the provision of standby fan with automatic-operated electric motor is needed when main fan stops running or connected through header with neighbouring systems to ensure at least 50% of exchanged air flow rate when this fan system stops running.

*Note: The buildings and rooms are considered to be naturally ventilated if outdoor air is only supplied by mechanical ventilation or air-conditioning sytems and without dedicated opening for airy purpose. The parts of the building which are not naturally ventilated (aerated) are distant from outside wall with airy opening of over 30m.*

3.2.2. In case air supply and exhaust fans stop working while open/close openings connected with other rooms ensuring adequate air supply and exhaust, the separated rooms without natural aeration due to technological conditions are permitted not to be installed with standby fans as stated in article 3.16 and be available with stand-by equipments for replacement of fan in the event of failure during 24 hours.

3.2.3. The air-condioning systems (both center and local) with the task of maintenance of indoor microclimatic parameters through the year and all day long must be designed with at least 2 nos of AC.

The AC capacity must be defined in a way that when one AC is out of order, the remaining air flow must ensure not smaller than 50% of calculated flow, and cooling capacity shall ensure indoor temperature at superior limit of comfortable zone (t=29.40$^{o}$C) when outdoor air temperature is equal to calculated temperature according to article 3.1.9.

*Note: When all basis technology requirements are available for the stability of indoor parameters all day long and through the year, standby air-conditioner shall be acceptable.*

3.2.4. For rooms with possibility of short-term toxic gas inside (kitchen in the building, classroom, etc.), ventilation system with exchange air increasing structure for each short-term period shall be designed if there arises a real demand for environmental guaranty in accordance with standard.

3.2.5. Air-bathing supply systems are not allowed to be combined with supplied ventilation system.

3.2.6. For residential and public building and auxiliary house, ventilation shall be designed but draught resistance method is also needed.

For multi-storey building (with or without air-conditioning system), vertical air shaft used for kitchen and toilet must be provided with mechanical vacuum fan.

3.2.7. Natural ventilation systems in production rooms with surplus heat in summer must be calculated according to difference on heat pressue equivalent to difference between indoor and outdoor temperature at parameter III, including air temperature increase according to height of production room.

When calculation of natural ventilation, the impact of mechanical ventilation and impact of wind resistance must also be considered.

3.2.8. Natural ventilation systems of production rooms without surplus heat in summer through the year must be calculated according to wind impact.

Calculated velocity in summer of the year shall be extracted according to TCVN 4088: 1985.

3.2.9. Local ventilation or center ventilation systems must be designed to discharge burned products of radiation heater using combustible gas to ensure the air environmental cleanness in working or serving area.

3.2.10. For dryer grade II or local dryer devices in air-conditioning system, water with invariable heat parameter must be provided.

3.2.11. Local inspiration and center exhaust ventilation must be separated each other.

3.2.12. Local inspiration system and technology equipments must be constructed separately, in case exhausted air contains following:

a. Chemical reactants or mechanical mixture between them may increase temperature and may cause fire and/or explosion (combination of calcium carbide with steam, aluminium powder with steam, etc.) or create explosive combination;

b. The substances when mixing may cause more harmful mixture or chemicals.

*Note: In design tasks on technology plan, regulations and allowable process must be clearly defined to joinl local inspiration system of explosive and combustible substances.*

3.2.13. Once explosive and combustible substances from local inspiration systems may possibly be deposited or condensated in air duct or ventilation equipments (example: local inspiration system of painting chamber v. v...), a separate design must be provided for each room or each equipment unit.

3.2.14. Ventilation, air-conditioning and heating systems must be design separately for each room group isolated by fire wall; and production room under group A, B, C and F must be constructed separately for each floor.

The center systems are allowed to design for adjacent room groups (on same floor) under one of production group A, B, C and F of different floors (except combustible materials and products or incombustible materials and products in combustible packing) when following conditions are concurrently occurred:

a. The same technology process;
b. The combustible or explosive substances of the same type are used in production rooms under group A, B or F or production rooms are all under group C;
c. The production rooms are located not exceeding 3 next floors;
d. Air duct of production room under group A, B, C and F are executed in accordance with requirements of articles 3.l0.23 and 3. l0.24.

3.2.15. Ventilation, air-conditioning and heating systems should be centerly designed for production rooms under group D and E on the same floor or different floors on the same area limited by fire wall.

3.2.16. Air exhaust systems from areas around explosive equipments (production rooms under group A, B and F) in production rooms under group C, D or E, must be separately designed from center exhaust ventilation system of these production rooms.

3.2.17. Ventilation, air-conditioning and heating systems are generally designed with the same quantity regardless of auxiliary production rooms of the same type located on the same floor or different floors.

The separate systems shall be designed according to separate direction of design standards for auxiliary or industrial buildings.

3.2.18. The center ventilation and air-conditioning systems served production rooms under group C are allowed to serve simultenously the single rooms on main production plan (team leader's room, etc.)

3.2.19. The mechanical ventilation system must be designed separately for liquid and inflammable gas store of each group A, B, C or F by standby exhaust fan enclosed with automatic closing motor in case main fan stops working.

In case steam or gas released from these stores to environment is lighter than air and air volume is variable in accordance with standard or technology condition but not exceeding double of room volume each hour, then the natural exhausting method can be acceptable for each separate store.

3.2.20. Ventilation, air-conditioning and heating systems are allowed to design for a room group of one-storey production rooms or store with exit, for any combination of grouop a, B, C or f, when total area of these rooms does not exceed l,l00 $m^2$ in seperation area of fire wall.

In this case, standby fan shall be provided for exhausting system to autmotically operate in case main fan stops working. Air duct must be designed in accordance with requirements of article 3.l0.20.

3.2.21. Exhausting system for liquid and combustible air stores under production group A, B, C or F shall apply natural ventilation if allowed by the standards.

For stores under group A, B or F and with volume of liquid and inflammable gas exceeding l0 tons, mechanical exhausting must be designed beside the natural exhausting system according to the standard.

3.2.22. For hole with the depth exceeding 0.5m in production rooms under group A, B or F, mechanical air supply must be araread in case burned gas or steam and/or flammable gas are used. For holes with regular working people, mechanical exhausting system are needed.

*Note: The center ventilation system of production room can be used to ventilate the above holes or recess.*

3.2.23. In production rooms of group A, B and F and rooms with toxic gas under grade 1,2,3 and if bordered with other production or auxiliary rooms, flow rate if supply system must be less than 5% compared with flow rate of exhaust system.

Above regulation shall not be needed in case contiguous rooms are separated by sealed partition without door or other openings.

3.2.24. Ventilation equipments, air duct and/or heat duct, etc..must be covered with thermal insulation on surface if temperature of heat carrying substance (air, water, steam, etc..) must be kept less variable than allowable limits. Thermal insulation cover on the surface must also be needed to exclude the dew on the surface or decreace of radiation temperature of the surface, piping, air duct, etc..

Temperature detecting device of above thermal insulation layer must be less than $lm^2$.h.0C/kcal if without other requirements.

Thermal insulation layer of air-conditioning equipments, cold air duct, chiller duct (chilled water) must be with protection layer from water and moisture.

*Note: The thermal insulation of circulated air duct of air-conditioning system must be proven with foundation.*

3.2.25. Thermal insulation layer of ventilation, air-conditioning equipments, air duct in production rooms of group A, B and F as well as thermal insultation of air duct and equipments located in top ceiling floor, basement must be made from incombustible materials, except cover painting are allowed to use flammable materials. For remaining cases, fire-retardant materials can be used. At horizontal crossing with wall, partition, ceiling with fire rate over 0.75h, thermal insulation should not be used but sealed with incombustible materials at leakage.

In structure of thermal insulation, the cold surface of air-conditioning system (chiller duct, air duct, air-conditioning equipments, etc..), moisture-proof layer can be made from flammable materials and covered with glass fibre for chiller duct and air duct and inflammable materials for air-conditioner.

3.2.26. Additional spray booth, injection humidifier and nose must use qualified water as domestic water.

When calculation of water flow for spray booth, evaporation water, water swept by wind and water used for discharge of spray booth bottom must also be calculated.

The replacement and discharge of water in the system must be implemented at little loading phase of water supply piping.

3.2.27. Out-door air intake must be provided for least polluted places of the building.

3.2.28. External air intake of mechanical ventilation systems must be placed at height not less than 2m from ground to bottom of air intake, and not less than 1m in case air intake is placed in area with grass cover.

For natural ventilation system, air intake shall be araread in accordance with article 3.4.7.

3.2.29. External air intake of mechanical ventilation systems can be put separately from the building if toxic concentration nearby exceeds 30% of allowable limit concentration for working area. In case of toxic gas as dust, air intake can be put near the building, however, dust filter must be provided if dust concentration at air intaking point exceeds 30% of allowable limit concentration for working area.

Other toxic sources must also be filtered if adequate filter is availble and it is permitted by FS.

3.2.30. External air intake is permitted to be araread on roof with following conditions:

a. In case technology discharge pipes and discharge pipes of toxic gas from local exhausting systems are unavailable on roof or these pipes are located outside of aerodynamics stagnant air zone caused by arrived air flow, or discharged air from dust-causing equipments has been filtered to concentration as stated in article 3.2.42.

b. In case toxic concentration at external air intake does not exceed 30% of allowable limit concentration regulated for working area of production rooms.

*Notes: On flat roof with slope of 25%, external air intake is allowed at height of not less than 3m compared with adjacent roof surface or skylight, in case air intake is 20m distant from external wall.*

3.2.31. When requirements of 3.2.30 are ensured, external air intake can be located at the same height with exhaust vent of center ventilation system in case the horizontal distance between air intake and exhaust vent exceeds 10 times of equivalent diameter (according to area) of nearest air exhaust, but not less than 20m.

For smaller distance from air intake to vertical exhaust vent of center ventilation system, it is permitted to ararea external air exhaust within circle with radius as equal as the height of top edge of air intake plus at least 2m.

3.2.32. External air intake must be fitted at places where evaded from fire ash or prevented with fire ash as well as air, gas originated during operation process or in the event of failure of storage tank, container or pipe.

3.2.33. External air intake of ventilation, air-conditioning and heating systems of production room of group A, B and F is allowed to generally construct with any combination but it must be separated from air intake supplying to production rooms of group C, D and E and support room of production.

3.2.34. External air intake supplying air to electric equipment rooms nearby production room of group A, B and F in which burned gas (including condensated gas) is used, must be araread at places where explosive and burned combinations of atmospheric gas are eliminated.

3.2.35. Outdoor air and circulated air must be filtered before supplying to inside building:

a. For air-ventilating system.

b. For ventilation, air-conditioning and heating systems for residential, public building and supporting house for production must be with foundations.

c. For ventilation, air-conditioning and heating systems of production rooms – with technical requirements and in case dust concentration in outdoor or circulated air exceed 30% of allowable dust limit concentration for working area.

In mechanical air supply and air-heating for residential and public buildings as well as supporting house for enterprise shall not need to filter dust if ventilation flow rate is mainly supplied through skylights by natural ventilation.

It is not necessary to filter dust in mechanical ventilation and air-heating systems of residential and public building and supporting house in case external air intake is located in greent tree area.

3.2.36. Tam khong khi and direct air supply systems to breathing zone of working people (mask, anti-toxic helmet and face of people, etc..) must be filtered dust.

3.2.37. The advanced technology methods are requested to apply to reduce toxic volume releasing to surrounding environment as well as to reduce necessary ventilation flow rate.

3.2.38. Exhausted air to environment from ventilation system through air exhaust shafts and throats, ventilated skylights, etc. In case toxic substances are contained inside, prediction and calculation of toxic dispersion must be done in condition that their concentration shall not exceed:

a. Instant maximum toxic concentration – for environment around residential area.

b. 30% of allowable limit concentration in working area of production room – for outside area of production room, where arareament of internal air intake of ventilation and air-conditioning systems as well as natural ventilation air intakes.

3.2.39. In protection calculation of atmospheric environment against pollution by exhaust vents of ventilation system in residential area and enterprises, it should be taken into account the total maximum exhaust volume of toxic substances in exhaust air volume, strength of these substances in environment due to industrial pollution according to technology data as well existing concentration in construction area.

*Note: The toxic dispersion calculation in atmospheric environment caused by ventilated exhaust flow shall be put into ventilation structure design of the building or formed a separate chapter of technology design.*

3.2.40. In case toxic substances and bad adour are contained in exhaust air from local exhausting system, before discharging to surrounding environment, they must be filtered to ensure the requirements in articles 3.2.38; 3.2.39 and 3.2.42 as well as other approved specified standards.

For toxic substances contained in exhaust air after filtering, and in case filtering means are not available, dispersion methods in environment must be proposed in accordance with requirements in the articles 3.2.38; 3.2.39 and 3.2.42.

In case technical means of filtering exhaust air are not available, the construction and installation of filtering devices must be planned in enterprises or building in the future.

When exhaust air with toxic substances is not great or their concentration in exhaust air is small, filtering may be unecessary in case spatial dispersion method in most unfavourable conditions (wind direction and pressure, rainfall, atmospheric pressure, etc..) can still ensure baove requirements.

3.2.41. For toxic substances with possibility of long-term existence in space and big impact with the environment (Re gas and group, atomic radioactivity, etc.) must be extirpated by technical means.

If technical extirpating means are not available, technology process must be planned or asked for preliminary approval from authorized environmental protection unit.

3.2.42. Allowable dust concentration in exhaust air to surrounding environment must be calculated by $mg/m^3$ and must be determined by following formulas:

a. In case exhaust air volume to exterior is bigger than 15 thousand cubic meter per hour: C1 = 100K.

b. In case exhaust air volume as same as or smaller than 15 thousand cubic meter per hour: C2 = (160 - 4L) K.

K - Coefficient, depent on allowable dust concentration in environment of working area, dependent on allowable dust concentration in environment of working area, taken as Appendix No. 6.

L - Exhaust air flow (thousand $m^3/h$)

*Notes:*

1. *In case dust concentration in exhaust air does not exceed quantity C1and C2, exhaust air can be down without filtering;*

2. *Dust filtering effects of grain size 20M or more must reach at least 90%.*

3.2.43. Exhaust vent from local dust cleaning system containing explosive and combustible substances or toxic substances under grade I and 2 or substances with bad odors must be positioned higher than stagnant air zone of the building by ong cao or exhausted by high speed current.

Exhaust air flow containing explosive and combustible substances or toxic substances or substances with bad odors shall not be exhausted to area with positive pressure caused by wind. The exhaust flow of explosive and combustible substances shall not be exhausted to area near exhaust flow of burned products.

Toxic gas can be exhausted to stagnant air zone of the building, if calculation result shows that exhaust concentration in environment is within the regulated limits of article 3.2.38.

3.2.44. The air exhaust by natural pressure (graivity pressure), or residual pressure inside due to mechanical ventilation systems must be araread through windows, skylights, air exhaust throat with stable intake structure and independent on wind direction and pressure, except FS confirm the necessity of mechanical intake and exhaust methods (fan on roof,etc.).

Air exhaust shafts, Air exhaust throat and roof fan must be provided with regulated valve that are controlled from working area.

Exhaust air is permitted through skylight sufferred from wind in condition of center ararangment for both sides of vertical walls so as that total area of window opening at each side can ensure adequate exchange air volume.

Mechanical exhaust air systems can be exhausted through door opening on external wall with air exhaust shafts through the roof.

In special case, air exhaust can be made from ventilation system by exhausting them through vents and windows on wall, so as that toxic substances and substance with bad odours shall not returned the room or other rooms or adjacent buildings.

3.2.45. Exhaust flow of center ventilation system of production room group A, B and F must be designed and calculated to ensure the requirements of article 3.2.28.

Above exhaust flow must be fitted at height not less than 1m compared with highest point of roof and or not less than 20m horizontally distant from external air intake or 6m higher than external air intake in case horizontal distance of less than 20m.

Air exhaust pipes or shafts of more than 2 ventilation systems for any productions must be separately designed in case stagnancy of flammable substances are occurred in one of these systems or exhaust air mixture of two systems may form an explosive combination. When requested by technical requirements to connect to a air exhaust shafts with above multi-systems, partition of inflammable materials must be provided from connection point to exhaust vent of air exhaust shafts or exhaust pipes.

3.2.46. Air exhaust shaft or exhaust pipe from local or center ventilation systems containing explosive compounds or compounds with bad odors or toxic compounds must be designed without air exhaust throat (cone hat, hoof, etc..)

### *3.3 Determination of air volume for ventilation and air-conditioning – conditions of air circulation use.*

3.3.1. Air volume needed for rooms to ensure atmospheric environment parameters in working or serving areas must be based on heat, humidity, or toxic volume releasing to rooms with consideration to their irregular distribution on height or on plan, as well as air exhaust through ventilation, local exhaust or other technical systems (dry, fuel burning, etc.). The calculation must be done according to formulas stated in article 13.

*Notes:*

1. *For buildings with natural ventilation and without need of ensuring microclimatic parameters or tightness, it can be allowed not to balance exhaust volume by air supply system.*
2. *It is not permitted to determine ventilation flow needed to be ensured by air exchange multiple, except regulations in standard documents has been approved in accordance with the rule.*

   *When data on toxic volume releasing to production room is not available, ventilation flow can be determined by approved air exchange multiple in accordance with branch- level standards.*
3. *Floor area in room served by air-conditioning system must be determined by calculation. In case heat volume releasing in room is irregularly distributed, floor area must be based on area with regular heat distribution.*
4. *When design of air-conditioning, it is needed to employ the maximum difference on air supply and air temperature inside room.*

3.3.2. In case room with burned steam or gas which may form an explosive combination, the calculation must be done to check the supplied air volume (exchange flow) in a way that this air and steam strength inside the room shall not exceed 5% lower explosive limit at outdoor air parameters used in calculation of the system.

Air volume supplied through ventilation systems is taken by maximum quantity in article 3.3. I and 3.3.2.

3.3.3. When determination of air flow in ventilation, air-conditioning and heating systems, heat equivalent from supply and circulation fans (the atmospheric heating on air fan in pipe network) must be taken into consideration.

3.3.4. When design, the increase of air flow or system quantity must also be planned in case increase of production strength or production enlargement.

3.3.5. If there is no special requirements on air parameters, when design of mechanical ventilation systems, dew and fog phenomenon must be calculated and checked when cold wind without treatment is supplied inside.

3.3.6. Minimum outdoor air volume supplied inside through ventilation and air-conditioning systems must be taken as Appendix 7.

3.3.7. When design of ventilation for production rooms, air circulation must be proposed in winter and when design of air-conditioning, air circulation must be planned fro all seasons to save cooling and heat with condition that these shall not reverse the instructions as stated in articles 3.3.8 - 3.3.10.

The air circulation possibility in public and supporting houses must be determined according to design standards of this building.

Air circulation is only permitted for a room scope only.

The systems with air circulation must be provided with a control equipment of outdoor air supply so as that the supplied volume must not be below the standard.

The air-conditioning with central air circulation must be designed to facilitate the changes on mixture rate between circulated air and outdoor air basing on outdoor atmospheric parameters. In these cases, a separated circulation fan must be provided.

3.3.8. A ventilation or air-conditioning and heating systems shall not circulate air if it is found to contain:

a. Toxic and harmful substances under level l, 2 and 3, except rooms where toxic volume contained in technology equipments is so minor that their simultaneous pervasion to the environment shall not make excessive toxic strength compared to allowable limit for working area.

b. Harmful bacteria, viruses and fungi;

c. Substances that produce bad odour;

In above rooms or space, outside working hours, it is only permitted to circulate air in case production process may relate to toxic gas of level 3 and 4, or complete exclusion of pervasion possibility of remaining toxic gas of level 1, 2.

3.3.9. A ventilation or air-conditioning and heating systems shall be circulated air from other rooms where toxic substances and substances producing bad odour shall not be released.

In production rooms, air circulation may be permitted from other rooms where toxic substances are under level 4 and their strength in taken air shall not exceed 30% allowable limit strength for working area.

To circulate air, dedicated doors or openings shall not be designed so air may releas naturally from this room to others, while the balance of supplied air flow and organized circulation between related rooms must be ensured by these ventilation systems.

3.3.10. In production rooms under group A, B and F, air circulation shall not be permitted in ventilation, air-conditioning and heating systems as well as air circulation from local exhausting system of explosive and combustible substances in production rooms of other group including inside and outside working hours.

3.3.11. For air-heating uncombined with ventilation, air circulation may be permitted in scope of one production room where unavailability of toxic substance that may produce fire when contacted with heat exchange surface of air-dry devices.

Air from other production rooms can be taken for heating if the requirements in article 3.3.8 and 3.3.9 are met.

*3.4 Air supply for room.*

3.4.1. Air supplied from ventilation, air-conditioning and heating systems of supporting houses must be directly conducted to area with regular presence of people. Air supply shall be designed as follows:

a. Partial air from mechanical supply system shall be supplied to corridor or adjacent rooms of industrial buildings in case these rooms are laboratories. Air volume supplied to adjacent rooms and corridor shall be taken additional 10% total air exchange flow of main industrial buildings, but not exceeding 1.5 times of air exchange multiple (unless industrial buildings with room masterplan of block and production rooms as stated in the article 3.2.23).

b. Air supply to corridor of residential and public buildings as well as supporting houses if ventilated air for these is only regulated in terms of air inspiration and not exceeding 1.5 times of air exchange (except toilet).

*Note: Air exhaust openings or door are not permitted to design at shielded enclosure between rooms or between corridor and rooms.*

3.4.2. Supplied air for area of more than 30m far from windows or natural ventilation doors on external wall must be implemented by mechanical lathing method.

3.4.3. Buffer chambers of production rooms under groups A, B and F where availability of flammable steam and gas, must be supplied air not less than 5 times of air exchange but not less than 250$m^3$/h, and not less than 500$m^3$/h for buffer chambers with volume over l00$m^3$. Air must be supplied above door and communicated to production room and with downward blowing direction. If buffer chamber with number of door more than 2, for every additional door, the additional air supply volume is 250$m^3$/h.

Supply air for a buffer chamber or a group of buffer chamber must be supplied from a separate system with automatic-close standby fan (enclosed with motor) when main fan stops working.

Air supply is permitted from a system for multi buffer chamber of the same group or many different groups on fire safety.

Buffer chamber belonging to production room with area less than 50$m^2$ can be supplied with air from ventilation system of this room with following conditions:

a. Availability of standby fan with automatic close structure when main fan stops working.

b. Air duct with automatic cut-off valve in case of fire.

*Note:*

1. *Air pressure in buffer chamber compared to production room while pressure of used buffer chamber not exceeding 3kg/$m^2$or 5kg force for one door.*

2. *Air supply must be designed for buffer chamber belonging to production rooms with flammable and combustible dust under production groups A, B and F if required by technology design standards.*

3.4.4. When transmission of toxic substances under grade 1, 2 needs to be isolated from this room to others, or when microclimatic parameters in room must be ensured, air supply for buffer chamber must be based on instructions of the article 3.4.3 if there is no special requirement.

Air supplied to buffer chamber originates from ventilation, air-conditioning systems used for these production rooms, it is not necessary to install standby fan.

3.4.5. Temperature, moisture and air exhaust speed from air intakes must be determined by calculation in a way that specified microclimatic condition is ensured in working or serving area with the least number of air intakes. Atmospheric temperature exhausted from diffusers within working or serving areas neither exceeding 45$^{o}$C nor below 5$^{o}$C (unless otherwise proven by investigation data on both model and on reality that air supply capability is at higher or lower above values)

When design of air distribution in the room, it should be taken into account the direction speed and air volume in air flow caused by the operation of technology equipments. (according to technology's data).

3.4.6. Calculation on supplied air distribution is needed so as to avoid local increase of air speed or temperature in working area in case above effect leads to the increase of released toxic quantity to room.

3.4.7. Air supplied for room under natural ventilation condition must be well-organized to create maximum cooling effect for people in summer and to avoid cold wind in winter.

When design of natural ventilation, it is needed to calculate the ventilation openings (skylight, shutter, etc..) in building architecture used for above-mentioned ventilation purpose, but not less than 20% total area of light opening. This air flow must be directed so as to achieve cooling or cold resistance for people.

3.4.8. In winter, when outdoor air is taken to compensate the mechanical air exhaust volume, the cold resistance method must be taken into account, especially for zone A of climatic zoning map in TCVN 4088: 1985.

3.4.9. When taking air, beside natural ventilation in winter, preventive methods against excessive increase of temperature in working area, dew and frog inside the building, on surface of equipments, shielded enclosure, etc..

3.4.10. Air supplied by mechanical ventilation and air-conditioning for rooms with surplus existing heat and accompanied by steam or toxic substances released must be directly implemented on working or serving areas.

Vertical top-down supplied flow from diffusers at height not exceeding 6m, as well as horizontal or cross supplied flow at height of below 4m are considered direct supply to working area.

3.4.11. Air needs to be supplied through perforated distribution pipes placing higher working areas for rooms:

a. With released dust;

b. With heavier steam and gas than released air, if this process is not enclosed with great heat releas.

c. With inconsiderable surplus existing heat, in case exhausted air passes through local inspiration systems or center ventilation system with low-positioned inspiration mouth;

d. With inconsiderable moisture together with inconsiderable surplus existing heat volume (moisture and heat ratio of over 2000 kcal/kg); or with inconsiderable released humid volume; Belonging to residential, public building and enterprise's subsidiary buildings;

e. Subsidiary block located on floor area of the main production room.

*Notes:*

*1. In article 3.4.11, if foundations are available, partial air is permitted to be supplied through diffuser in working area.*

2. *For article 3.4.11 c, f: air supply is allowed through perforated pipes in working area in case supply flow is upwards and exhausted through the shortest way out of working area.*
3. *In large rooms of public buildings, air can be supplied to serving area (according to "below supply, above exhaust" map).*

3.4.12. For rooms with great humidity volume released out together with heat (Humidity-heat ratio below 2000 kcal/kg), supplied air must be conducted through diffusers.

a. Placing higher than working area, with minimum flow when distribution of dispersed moisture and steam temperature released below $40^0$C and without considerable sensible heat;

b. Placing in working area, when atmospheric temperature is nearly as same as inside temperature and placing higher if supplied air is dried and wet air concentrates from wet sources with temperature over $40^0$C.

3.4.13. Air supply needs to be organized near working place if it is located nearby toxic sources (welding, painting, etc..) and if local local inspiration can not be organized.

3.4.14. Air supply must be organized to avoid air transmission phenomenon from area with great toxic strength to area with little toxic strength.

3.4.15. Air-bathing vents must be designed in order to turn around vertical axis and change exhaust angle not less than $30^0$C, together with minimum swivelling air flow.

3.4.16. Supplied air flow must be organized in room in order not to cause interference for activities of local inspiration system, or cause air flow to influence to people's work.

3.4.17. Wind speed at exhaust vent must be selected according to noise resistance in the building.

3.4.18. For residential and public buildings, hospital and buildings of the same type, it is necessary to limit air supply speed below 3m/sec.

3.4.19. Manual control mechanism of ordinary systems must be positioned at the level not exceeding l.8m compared to working floor.

3.4.20. When design of air supply and exhaust for rooms which are regulated by air-conditioning system, if with adequate conditions, it can be different from artilces 3.4.l0 -3.4.19 and articles 3.5.9 - 3.5.l1.

### *3.5 Air Inspiration and exhaust systems*

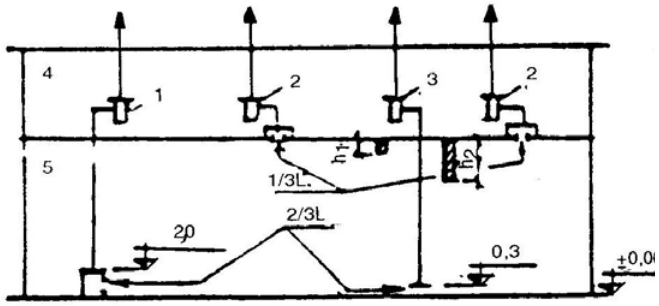
3.5.1. The air Inspiration and exhaust system through local and center ventilation systems must be provided directly through originating sources of toxic gas or the most polluted areas in room so that the polluted air flow shall not cross the breathing or exchange areas of working people.

3.5.2. In order to exhaust the toxic, flammable and explosive substances (gas, steam, dust) as well as heat and steam from originating sources, local inspiration must be provided.

3.5.3. Necessary air volume for exhaust of toxic, flammable and explosive substances through local systems, or inspiration speed, negative pressure in shielded hood, at opening of equipment shaft, etc..shall be taken as technology data.

*Note: Local inspiration mechanism must be structure composition of technology equipments.*

3.5.4. In rooms with toxic, inflammable or explosive gas or steam where their self-weight is heavier than that of the air, while existing heat shall not be enough to create stable convection current in all seasons, air exhaust must be installed as follows (Figure 1):




***Hình 1.*** *Sơ đồ hút thải khí cháy nổ có γ lớn hơn γ không khí.*
*1. Hệ thống hút cục bộ ; 2. Hệ thống hút thải chung ; 3. Hệ thống hút thải chung cho vùng dư của gian sản xuất ; 4. Gian máy thông gió ; 5. Gian sản xuất $h_1 \leq 0,4m$ ; $h_2 > 0,4m$.*

a) Exhausting 2/3 ventilated air volume at lower area which is calculated to dilute above gas/steam volume including air volume supplied for local inspiration system at height less than 2m and center exhaust ventilation system at height of 0.3m.

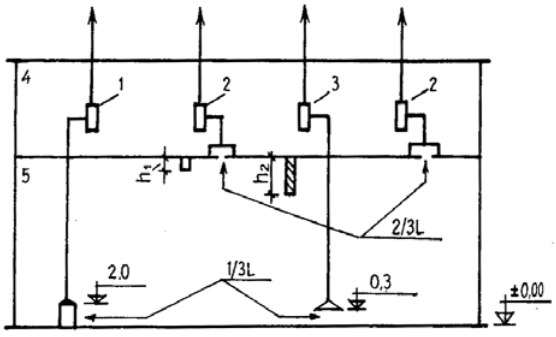
b) Exhausting remaining l/3 ventilated air volume at top area (above 2m compared to floor), but not less than 1 time of air exchange multiple, inspired from below the ceiling. If this gas can be combined with air to create an explosive mixture, exhaust vent must not be lower than 0.4m compared to the ceiling.

c) Exhausting an additional air volume (beside necessary volume needed for dillution of gas and steam) enough to eliminate the surplus moisture and heat or other toxic substances at area with their highest concentration, or highest environmental temperature.

*Notes:*

1. *For rooms with height of more than 6m, the minimum exhausted air volume for upper area, hut tu sat tran, it can be determined according to the index 6m³/h per 1m²of floor area.*
2. *In warehouses with many spans where only toxic gas (without explosive or flammable substances) is available, the above distribution is only applied for spans with released toxic gas.*

3.5.5. In flammable or explosive steam/air rooms self-weight of which is less than that of the air or in case of greater self-weight but stable air - heat flow remains in every season, inspiration and exhaust process shall be performed as follows (Figure 2).




***Hình 2.*** *Sơ đồ hút thải khí cháy nổ có γ nhỏ hơn γ không khí.*
*1. Hệ thống hút cục bộ ; 2. Hệ thống hút thải chung ; 3. Hệ thống hút thải chung cho vùng dưới của gian sản xuất ; 4. Gian máy thông gió ; 5. Gian sản xuất $h_1 \leq 0,4m$ ; $h_2 > 0,4m$.*

a. Exhausting more than 2/3 air volume used for steam and gas elimination, including air volume exhausted through the local exhaust system, center ventilation system but not less than one time of air exchangemultiple; if explosive mix with air is possibly produced, it shall be exhausted at not less than 0.4m from the ceiling;

b. Exhausting 1/3 remaining including air volume exhausted through the local exhaust system under 2m high and the center ventilation system at 0.3m above floor;

c. Exhausting an additional air volume (not including air for steam, gas elimination) if required to remove excessive humid heat and other toxics from the maximum concentration area.

*Note: Note in points 3,4,5 shall be included in the design of exhaust systems*.

3.5.6. For Inspiration and exhaust systems of toxic and harmful substances grade 1 and grade 2 as well as explosive substances, electric motors of exhaust fans shall be continuously connected with magnetic operation of technological equipment so as to ensure no performance when discharge fans fail to operate.

In case the production process can not stop working, when shutting down inspiration systems or even when stopping production process but a volume of released toxic and harmful air exceeds the indications in the note of Article 3.1.13, or explosive substance appears, then standby fans together with motors for the local inspiration system shall be provided to automatically operate when the main exhaust fan system stops operating.

3.5.7. Common exhausted ventilation systems take resposibility of exhausting explosive air and steam in the production rooms under group A, C and F shall be designed with mechanical vacuum fans.

Allowance shall be given for natural ventilation in case of disparity of gravitation field pressure or mixed ventilation if requirements in article 3.5.4 and 3.5.5 are met.

3.5.8. The local inspiration systems of explosive substances as well as common Inspiration and exhaust systems shall ensure that explosive concentration of steam and gas does not exceed 5% and they shall be equipped with auto-standby fans when the main fan stops operating.

3.5.9. Air exhaust through common Inspiration and exhaust systems is performed from the upper part of the room (at higher level than the working zone or service zone) for the following facilities:

a) Residential and public buildings as well as subsidiary buildings of the enterprise;

b) Production houses with surplus existing heat and humidity, including articles 3.5.4 & 3.5.5;

c) Production houses where dust and heat are released from the concentrating source at high temperature (moulding workshops and similar workshops of same excessive heat).

*Note: Air exhaustis allowed beneath auditoriums or similar rooms*.

3.5.10. Air exhaust through the common Inspiration and exhaust systems in production workshops with dust but without concentrated heat source at high temperature shall be performed beneath the workshop.

3.5.11. Air exhaust through common Inspiration and exhaust systems shall be performed beneath the production workshop, near the heat source at low temperature (engine of knitting machines or similar machines). Air shall be exhausted equally on the floor surface if it sounds economically and air is supplied from the upper part of the workshop.

3.5.12. Air movement rate at exhaust intakes and circulation openings shall be selected in order to meet the requirement of anti-noise inside the building.

Air rate at air intakes of systems inside dwelling houses, hospitals, office buildings and similar buildings shall not exceed 3m/sec.

### *3.6 Emergency ventilation*

3.6.1. Emergency ventilation system shall be provided in the production rooms where sudden increase in the volume of harmful, explosive or flammable substances is produced according to the technological requirements in design or the approved standard materials.

3.6.2. Airflow of emergency ventilation shall be based on calculation in the technological part of the design or fixed according to requirement of the approved standard materials.

The volume of air exchange is produced by the simultaneous operation of both the normal and emergency ventilation systems.

If the airflow calculation or required instructions on volume of air exchange of emergency ventilation are missing in the design of technology, it shall be ensured that total volume of air change of both the normal and emergency ventilation systems shall not be less than 8 times the total volume of the room in one hour in the event of simultaneous operation with the major systems.

For pump and compressor rooms under group A, B and F, it shall ensure 8 times air exchange per hour by the emergency ventilation system without consideration to the normal ventilation.

*Note: Safety grade of power supply to the emergency ventilation system shall be determined in the technological design.*

3.6.3. Emergency ventilation system positioned in the production rooms under group A, B and F shall be mechanical ventilation using explosion - proof fans equipped with engines meeting requirements on electric work.

In the production rooms under group C, D and E, allowance shall be given for emergency ventilation to use natural gravitation force but it shall ensure the airflow at any parameter of outdoor air.

If air is not allowed to be exhausted by fan due to its environmental property, an emergency ventilation system by spray pump shall be established; for one storey production houses with skylight, it is allowed to design an emergency ventilation system to supply air to the house if exhaust air in case of emergency is lighter than natural air.

3.6.4. If a local ventilation system or a center ventilation system functions as emergency ventilation with sufficient airflow, it shall be provided with a standby fan (with separate engine) ensuring airflow of emergency ventilation.

If airflow of the above mentioned system is less than that of emergency ventilation, a standby fan (with separate engine) and an emergency ventilation system with additional airflow shall be provided or a seperate emergency ventilation system with emergency airflow shall be established.

Standby fans shall be automatically started when the main fan stops operating.

3.6.5. In order to ensure emergency ventilation, it is allowed to use one or many local ventilation system(s) or center ventilation systems provided with standby fans. If these systems have sufficient airflow for emergency ventilation but without standby fans, provisions are required or an emergency ventilation system ensuring volume of air exchange shall be established

Emergency ventilation system shall be automatically started if any ventilation system stops operating.

If total volume of the main ventilation system (without standby fan) is less than the required volume of emergency ventilation, standby fans shall be provided to the main systems (with separate engine) and an emergency ventilation system compensating the deficient airflow shall be supplemented or only one emergency ventilation system ensuring sufficient volume for emergency ventilation is designed if the system with maximum airflow stops operating.

Standby fans (in all cases) shall be automatically started if the main fan fails to operate.

3.6.6. Air intakes used for exhausting air through the emergency ventilation system shall be positioned at places where possibly accumulate toxic or flammable and explosive substances most.

When gas spreads, the toxic gas is heavier than the room air (in consideration to temperature of the air environment), air vents shall be provided at 0.3 - 1m from the floor. If the toxic gas is lighter than the room air, air vents shall be provided at the upper part.

As for flammable and explosive steam/air, air vents shall be designed close to the ceiling or not under 0.4m from the ceiling (to the upper edge of the opening).

When the major ventilation systems are used for emergency ventilation, toxic gas in case of emergency shall be exhausted through air vents according to the technical requirement of the major ventilation systems.

3.6.7. Air exhausting in emergency ventilation shall be performed through uncovered exhaust ducts and wells if exhaust holes of the major ventilation systems are unable to discharge.

In the design of mechanical emergency ventilation, it is allowed to install jet fans on the outside shielding structure (on opening of doors or windows, etc…) and discharge air through exhaust ducts and wells.

3.6.8. In exhaust ducts or air exhaust mechanism of different types or on air ducts of the emergency ventilation system, auto-open valves during the operation of the system shall be provided.

3.6.9. Air exhaust vents of the emergency ventilation system (exhaust holes, well openings, etc…) for Exhausting air from the emergency ventilation system shall not be positioned at crowded places or at entrances.

Exhaust vent shall be designed at over 3m high above the adjacent land, not lower than 20m and higher than 6m (if the distance is under 20m) from air intakes of the air supply system for air-condition or heating by air.

Exhaust vents shall be higher positioned than industrial equipment production and installation grounds, if the grounds are under 20m far from exhaust openings.

Exhaust vents of the emergency ventilation system containing flammable and explosive air shall be positioned not under 20m far from fire sources (hotbeds, chimneys…).

Air exhaust shall be designed in consideration to the maximum distribution of toxic and harmful or flammable and explosive substances in the environment.

Air must not be exhausted to the adjacent land where is not well-aired.

3.6.10. Additional air supply system for making up the air volume exhausted through the emergency ventilation system is not required.

### *3.7 Curtains*

3.7.1. Curtains are designed in the following cases:

a) Doors and openings of technological doors: in case of adequate basis;

b) For doors of production and technology houses provided with air-condition system, it requires to compare the following options:
   - Curtains
   - Doors to anterooms, revolving doors…
   - Creating positive pressure in the lobby to make up the loss air through doors.
   - Other proposed options

c) For technological equipment (cold storage…), it shall follow special instructions for this type of equipment.

### *3.8 Equipment - Air conditioners - Electric motors*

3.8.1. Fans, dust filters, air conditioners, electric motors, etc…during the design of ventilation and air condition shall be chosen according to the requirements of Chapter 1.

*Note: Operating mode of fans shall be chosen in a way that its output shall not exceed 10% compared to the maximum output. In order to avoid the attenuation effect of property line of fans, elbows, turning branches shall not be arranged on exhaust line in front of 5D fan. If it is unavoidable, the decrease of fan output shall be included in the calculation..*

3.8.2. Fans shall be chosen according to specificity by the manufacturer meeting the national standards. Depending on pressue, it is divided as follows

- Low pressure: under 1000 kg/m2
- Medium pressure: l00 - 300 kg/m2
- High pressure: 300 - 1200 kg/m2

Fans are used in the environmental conditions as follows: environmental temperature when being transported through fans under 80$^{o}$C; adhesive substances (if any), dust, solid particles not over 100mg/m$^3$.

In order to transport erosion air, anti-rust fans shall be used. In the flammable and explosive environment, explosion proof fans are used. In case of air exhaustcontaining dust, loose particles with concentration over 100mg/m$^3$ or containing fibre dust, dust fan shall be used. When temperature of air environment exceeds 800C, special heat resistant fan shall be used.

3.8.3. When selecting fans, especially fans for the local exhaust system, the additional air volume going into the exhaust duct system and leaked air volume shall be calculated by combining increased volume factor compared to the calculation volume of fans as follows:
1,1 - For metal, plastic or amiang concrete air duct system 50m long;

1,15 - For ducts made of other materials or for metal, plastic, amiang concrete ducts over 50m long.

*Note:*

1. *For the exhaust or blow ventilation system which is positioned outside the operation range of the system, the length of the duct shall be based on the length of the exhaust and push duct; and for the local exhaust system, it shall be calculated from the farest point to the fan.*
2. *Leaked air volume inside the air-conditioners, heaters and other equipment shall be based on machine profile of the manufacturer. In case of missing, volume of leaked or loss air through closed valves Lk can be determined by the following formula:*

$$L_k = L_{max} \sqrt{\frac{\xi_{km} + \xi_c}{\xi_{k,d} + \xi_c}}$$

*Where:*

$L_{max}$ - Maximum airflow going through the valve: m3/h;

$\xi_{k,d}$ , $\xi_{km}$ - Hydraulic resistance factor of the valve in on/off state (dynamic pressure for open valve). In case of missing, $\xi_{km}$ = 0,2 will be used but $\xi_{k,d}$ will be based on the appendix No.8;

$\xi_c$ - Hydraulic resistance factor of the system or of the controlled duct network is determined as the ratio between resistance of the system (or of the network) with dynamic pressure on the open section of open valve;

3.8.4. In case of heating by air, existing heat sources in the building (steam, hot water…) can be used. If other energy sources like electricity are required, sufficient basis shall be given.

3.8.5. If hot water is used for air dryers, air dryers connected directly to the water line should be used to save energy.

Air dryers can be connected parallel with the water line and in series with the air line.

Stop valve of air dryers shall be securely sufficient to adjust heat power as required.

3.8.6. Ventilation equipment, dust filters, air valves and other subsidiaries of the air supply system, air condition and heating system by air used for the production rooms under group A, B and F; of flammable exhaust and discharge systems arranged in the production rooms under other groups shall be fire and explosion protection.

3.8.7. Ventilation equipment, dust filters, air valves and other subsidiaries of the air supply system, air condition and heating system by air are used for the production rooms under group A, B and F arranged in technical room specially used for ventilation equipment can be made of normal material on condition that self-close check valve shall be installed in the position where air ducts are led outside the technical range…..

Ventilation equipment located on the duct network (stop valves, etc…) of the air supply systems in the production rooms under group A, B and F shall be fire and explosion protection.

3.8.8. Electric motors, electric equipment and electric controllers used for ventilation – air condition shall meet the requirements of "Regulations on installation of electrical equipment".
Fire and explosion safety grade according to regulation on installation of electric equipment as well as technological equipment and structure located directly in special rooms for ventilation – air condition equipment shall be specified in the technological and electrical part of the design.

*Note: When selecting fan motor, power factor according to appendix 9 shall be considered*.

3.8.9. Fan motors in the production rooms under group A, B and F shall be connected with jet fan.

Electric motor of the above systems serves for the production rooms but they are located in the ventilation room allowing transition with fans by wedge belts. At least 4 wedge belts shall be used for the inspiration and exhaust system.

3.8.10. Fan motors of the air exhaust system for the production rooms under group A, B and F can be the normal ones if they are located in rooms seperated with fan room by fire resistant diaphragm walls.

Engine room shall be supplied with air for heat elimination but it shall not be less than 3 times volume exchange multiple per hour.

3.8.11. If there is no violation to the technological requirement or if wet filter using water does not cause any flammable and explosive hazard, wet filter should be used to filt dust released from Inspiration and exhaust systems.

3.8.12. Jet fans located on walls, windows shall be installed with stop valves that are controlled indoors.

Jet fans of the emergency ventilation system shall be provided with auto check valves.

Protection net shall be installed on the intakes and exhaust holes of jet fans if fans are not connected directly to the duct system.

3.8.13. If the dryer is provided with auto-adjusting valves, then:

a) Valves shall be positioned on the supply line, if the heat source is produced from water steam.

b) Valves shall be positioned on the return water line if the heat source is produced from water. If water pressure when valve is shut off and exceeds load pressure of the dryer, it shall be positioned on the supply line.

3.8.14. Normal valves and airflow adjusting equipment can be used in case of non-corrosive air environment, or they have to be protected by an anti-corrosive cover in case of corrosive environment.

3.8.15. When selecting air distribution mechanism and calculation inside the building, specific data of air changing volume according to the length of blowing flow should be used.

3.8.16. Air distribution mechanism shall be normally established together with flow direction mechanism that allows the change of airflow going into the room in accordance with its property.

3.8.17. Airflow adjusting mechanism shall be established if enough condition.

For dwelling houses, nursery schools, disease treatment agents and public works, air distribution mechanism and air vents equipped with adjusting valve shall be provided.

For kitchens and kitchen rooms using gas, valves on the air vents shall not be completely closed.

### *3.9 Arrangement of ventilators and air conditioners.*

3.9.1. Ventilators, air conditioners, heaters shall be arranged beyond the service range of the system or in separate rooms, in technical floor or outside the building in the following cases:

a) If ventilators are used for the production rooms under group A, B and F at any capacity, in consideration with the requirement of Article 3.9.4 and 3.9.5.

b) If ventilators are used for the production rooms under group C and the capacity of a system exceeds 40 thousand m3/h;

c) If the noise of equipment in a room exceeds the allowed standard level;

d) If it is not allowed to locate ventilators in the production room by the technological requirement;

e) If there is space available in the basement or the roof floor;

f) If ventilators - air conditioner are used for subsidiary rooms of the production enterprise or for rooms of the residential houses, public buildings, except for small, local ventilation systems or local air conditioners and if their noise does not exceed the specified level.

3.9.2. System equipment requiring regular operation, monitoring and maintenance shall be positioned in areas of less access (eg: material storage…), except for air equipment for these areas.

3.9.3. Ventilators and air conditioners shall not be positioned in rooms where air is not allowed to be circulated.

3.9.4. Ventilators, local exhaust system, flammable and explosive inspiration and exhaust system as well as emergency ventilation system shall be positioned outdoors.

These systems are allowed to be positioned in rooms served by themselves or in the ventilation rooms but they shall ensure the requirements of this standard.

In the flammable and explosive areas of the production rooms under group C, D and E, local ventilation equipment from the technological equipment of these areas is allowed to be installed.

3.9.5. Air supply and discharge equipment of ventilation and air condition system for the production rooms under group A, B and F and local exhaust system for discharge of flammable and explosive gas shall not be positioned in the basement.

3.9.6. Ventilators, air conditioners positioned outside the building shall be covered to avoid stagnant dew inside equipment.

Handrails shall be designed surrounding equipment positioned on the sub-floors.

If equipment is positioned from 1.2m above, sub-floors shall be constructed and the equipment shall be roofed if required.

In order to ensure service and operation of the equipment, fixed stair shall be provided or movable stair or other mechanism can be used if adequate condition.

3.9.7. If ventilators are positioned inside the building, on the sub-floors or on mezzanine, access for operation and maintenance is required. As for small equipment, movable mechanism can be used for service and maintenance.

3.9.8. Dust filter for air supply system shall be operated at the beginning of the air treatment process and shall be protected from rain water.

3.9.9. Secondary dust filter shall be positioned near the air distribution mechanism into the room. Air shall go through the primary dust filter before going through the secondary filter.

3.9.10. Wet filter used for filtering exhaust air from the production rooms under group A, B and F or local exhaust air filter containing flammable and explosive substances shall be positioned inside the production room if it is not contrary to the technological requirements.

The dust filter can be positioned in the ventilation room.

Sediment exists in dust filters shall be exhausted outside the building.

Protection for dust filters (if any) shall be provided outside the production room.

3.9.11. Dry filters during the discharge of flammable and explosive substances (flammable dust, fibre and wastes with explosive limitation equal to/less than 65g/m3) shall be equipped with explosion proof valves opened to the outdoor.

These filters shall be able to mechanically discharge dust into the means of transport.

3.9.12. Dry filters on the local exhaust duct line for discharge of flammable and explosive dust at any enterprise as well as dry filters for flammable wastes at the fibre treatment enterprise shall be provided in front of fans.

3.9.13. If dry filters for flammable dust (but non-explosive) and flammable fibre, wastes with explosion limitation of under 65g/m3 are positioned inside the building, they and exhaust fans (of dust extraction system) shall be arranged in a separate area from other ventilators.

The dry filters can be positioned in one area with equipment of extraction systems of the same dust filting function.

The dry filters can be positioned in the basement on condition that they shall be able to mechanically or manually discharge dust if total volume of dust or fibre, wastes in the room does not exceed 200kg.

3.9.14. Dry filters for explosive dust shall be positioned outside the building.

Dry filters can be placed on the same exhaust fan in a separate area from other indoor ventilators (except for the basement) or in the room adjacent to the production building (except for the basement) when the filters can continuously discharge the accumulated dust.

3.9.15. If the air volume going through cyclic dry filters and dry dust exhaust filters does not exceed 15.000 $m^3/h$ and the dust accumulated in the container does not exceed 60kg, the filters can be positioned in the workshops served by themselves in a seperate room (except for the basement) from other ventilators.

3.9.16. When wet filters and explosive dust filters are positioned outside the building and other facilities, they shall be placed at not less than 10m from the outside walls or in a separate house.

Ventilator house equipped with the above mentioned dry filter can be positioned near the outdoor dust filter.

*Note: Limitations on mode of dust discharge and dust volume in the space as stated in Articles 3.9.14 and 3.9.15 are not applied for Article 3.9.16*.

3.9.17. Outdoor dry dust filters and flammable dust filters (non-explosive) shall be positioned adjacent to the wall (with fire resistance grade I and II) of the production rooms where it serves if:

- There is no window over the whole height of the wall and at the distance of 2m beyond the range of dust filter (horizontal).
- Or skylight shall be steel framed glass partition that can not be opened or it shall be constructed of glass block.

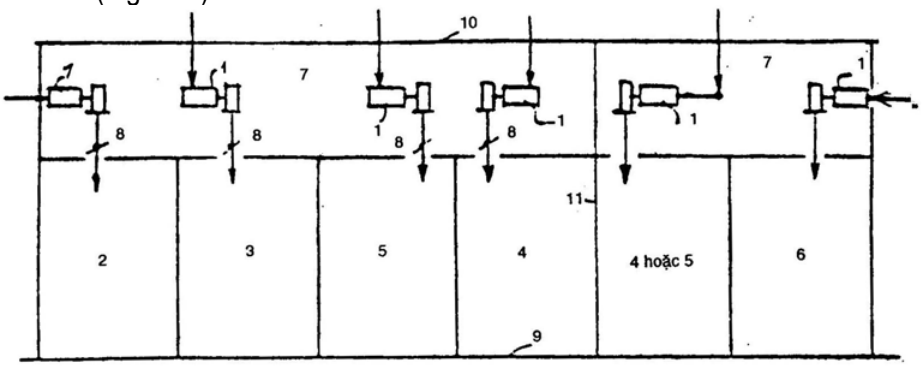
When the above conditions are not met, or the partition wall has the fire resistance grade II, IV and V, filters shall be positioned 10m far from the building.

3.9.18. Equipment of the air supply, air-condition and heating system by air serving for houses and production rooms without using air conditioner can be positioned in the same room.

Ventilators of subsidiary buildings of the enterprise and other ventilators serving for the production rooms under group D and E can be positioned in the same room.

Ventilators serving for relaxing room, office of the manager and technicians in the same production area.

If a part of ventilator serving for the production rooms under group A, B or F produce toxic gas grade 1, 2, then position of all air ducts going through the wall shall be provided with auto-close check valve (Figure 3).




***Hình 3.** Sơ đồ bố trí thiết bị thông gió, điều tiết không khí và sưởi ấm bằng không khí không dùng tuần hoàn.*

*1. Air supply system (ventilation, air condition…). 2. Production room under group A, B or F or toxic and harmful air grade 1, 2. 3. Production room under group C.4. Production room under group D. 5. Production room under group E.6. Subsidiary room. 7. Ventilator room. 8.Auto check valve. 9. Floor. 10. Roof. 11. Partition*

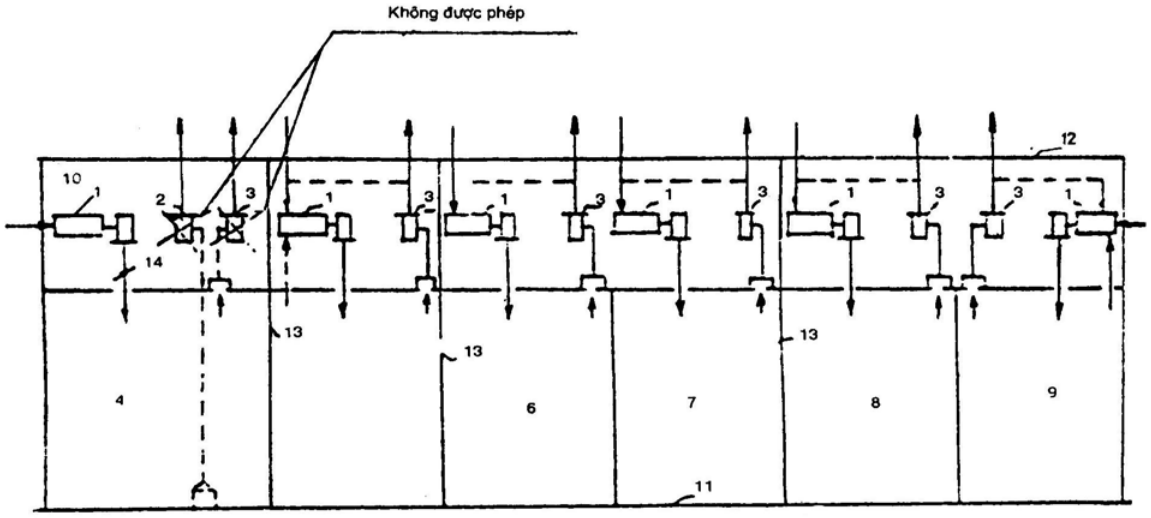
3.9.19. Ventilators, air conditioners and heaters by air with air circulation shall be positioned based on the following principle (Figure 4):

a) In separate rooms if they serve for the production rooms under group C;

b) In the same room if they serve for the production rooms under group D and E or for group E and other subsidiary rooms.

Equipment and air condition mechanism shall not be positioned in the same room with equipment of the air supply, air condition or heating system by air for the production rooms under group A, B or F or for the production rooms generating toxic and harmful air grade 1, 2 or 3.

3.9.20. Equipment of the air supply, air condition and heating system by air for the production rooms under group A, B and F or for the production rooms generating toxic and harmful air grade 1, 2 or 3 shall not be positioned in the same room with the air inspiration and exhaust equipment (Figure 4).




***Hình 4. Sơ đồ bố trí thiết bị thông gió, điều tiết không khí và sưởi ấm bằng không khí có tuần hoàn***

***1. Hệ thống cấp gió vào (thông gió, điều tiết không khí. sưởi...) 2. Hệ thống hút cục bộ. 3. Hệ thống hút thải chung hoặc hút thải tuần hoàn. 4. Gian sản xuất nhóm A, hay B, hay F hoặc có độc hại cấp 1, 2 hoặc 3 bốc ra. 5. Gian sản xuất nhóm C. 6. Gian sản xuất nhóm D 7,8. Gian sản xuất nhóm E. 9. Gian phụ trợ của xí nghiệp. 10. Phòng máy thông gió. 11. Sàn 12. Mái. 13. Vách ngăn. 14. Van một chiều tự động.***

*Figure 4. Layout of ventilator, air conditioner and heater by air*

*1. Air supply system (ventilation, air condition, heating…) 2. Local exhaust system 3. Common or circulating extraction and discharge system 4. Production room under group A, B or F or with toxic and harmful air of grade 1, 2 or 3; 5. Production room under group C. 6. Production room under group D. 7,8. Production room under group E. 9. Subsidiary room. 10. Ventilator room. 11. Floor. 12. Roof. 13. Partition. 14. Auto check valve*

3.9.21. Equipment of the air supply, air condition and heating system by air can be positioned in the same room with the common extraction and discharge equipment (Figure 4):

a) Serving for the production rooms under group C;

b) Serving for the production room under group B and E;

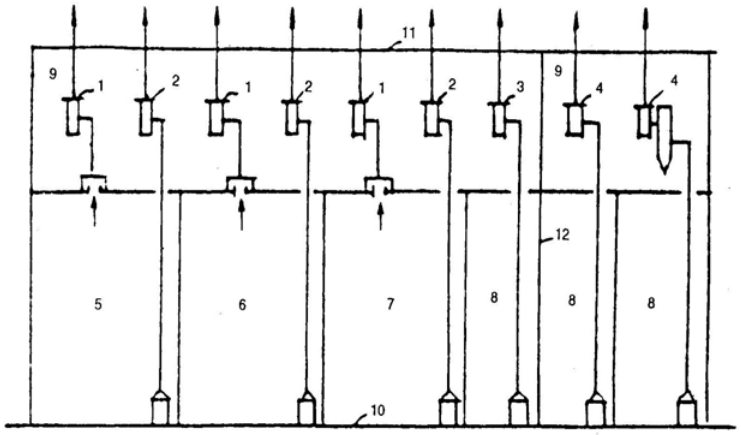
c) Serving for the production room under group E and subsidiary rooms (except for relaxing room, smoking room and similar rooms).

3.9.22. Ventilators of public buildings shall be seperated from ventilators of dwelling houses or rooms.

Equipment of Inspiration and exhaust systems shall not be positioned in the same room with equipment of the air supply system, air condition and heating system of dwelling houses, public buildings, except for exhaust fans of the air circulation supply system.

3.9.23. Inspiration and exhaust system of the production rooms under group A, B and F and the local flammable and explosive extraction system can be positioned in the same room with ventilators (Figure 5).

Flammable, explosive air exhaustequipment (fans, spray pump…) shall be positioned in a separate room if sediment is produced in the air duct or in the filter.




*Hình 5. Sơ đồ bố trí hệ thống thông gió hút thải cho các gian sản xuất nhóm A, B và F và hệ thống hút cục bộ khí dễ nổ hoặc chất cháy.*

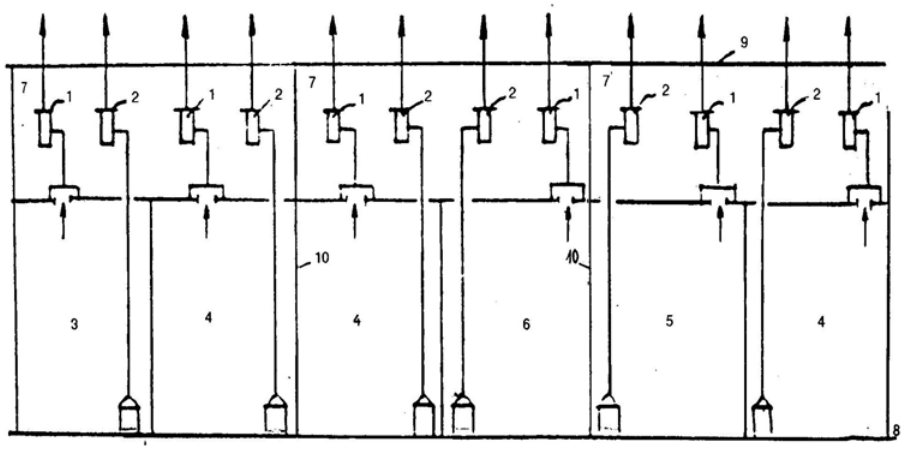
*1. Hệ thống hút thải chung. 2. Hệ thống hút cục bộ. 3. Hệ thống hút cục bộ chất dễ nổ và dễ cháy không lắng đọng trong đường ống dẫn gió và thiết bị thông gió. 4. Hệ thống hút cục bộ chất dễ nổ và dễ cháy dễ lắng đọng trong ống và thiết bị thông gió. 5. Gian sản xuất nhóm A. 6. Gian sản xuất nhóm B. 7. Gian sản xuất nhóm F. 8. Gian sản xuất nhóm bất kì có điểm thải cục bộ chất dễ nổ, dễ cháy. 9. Gian máy thông gió. 10. Sàn. 11. Mái. 12. Vách.*

3.9.24 Trong cùng gian máy thông gió cho phép bố trí thiết bị của các hệ thống hút cục bộ cùng thiết bị thông gió hút thải chung đối với các gian (hình 6)

a) Thuộc nhóm sản xuất D và E ;

b) Thuộc nhóm sản xuất E và các phòng phụ trợ ;

c) Thuộc nhóm sản xuất C và E.




*Hình 6. Sơ đồ bố trí hệ thống thông gió hút thải cho gian sản xuất nhóm C, D, E và các gian phụ trợ của sản xuất.*

*1. Hệ thống thông gió hút thải chung. 2. Hệ thống thông gió hút cục bộ. 3. Gian sản xuất nhóm D. 4. Gian sản xuất nhóm E. 5. Gian sản xuất nhóm C. 6. Gian phụ trợ của sản xuất. 7. Gian máy thông gió. 8. Sàn. 9. Mái. 10. Vách.*

*Figure 5. Layout of extraction and discharge ventilation system for the production rooms under group A, B and F, local exhaust system of flammable and explosive air or substances.*

*1. Common inspiration and exhaust system. 2. Local exhaust system. 3. Local exhaust system of flammable and explosive air that is unaccumulated in the air duct and ventilation equipment. 4. Local exhaust system of flammable and explosive air that is accumulated in the air duct and ventilation. 5. Production room under group A. 6. Production room under group B. 7. Production room under group F. 8. Production room under any group with the discharge point of flammable and explosive substances. 9. Ventilator room. 10. Floor. 11. Roof. 12. Partition.*

3.9.24. Equipment of the local exhaust system can be positioned in the same room with equipment of the common inspiration and exhaust system of the rooms (Figure 6)

a) Under group D and E;
b) Under group E and subsidiary rooms;
c) Under group C and E.

*Figurer 6. Layout of inspiration and exhaust system for the production rooms under group C, D, E and other subsidiary production rooms.*

*1. Common inspiration and exhaust system. 2. Local exhaust system. Production room under group D. 4. Production room under group E. 5. Production room under group C. 6. Subsidiary production room. 7. Ventilator room. 8. Floor. 9. Roof. 10. Partition*

### *3.10 Air duct*

3.10.1. Material of the air duct shall be selected upon the transport environment (according to appendix 16) in consideration to the requirements of fire and explosion proof safety.

3.10.2. Air ducts and collecting ducts made of assemble boards (such as concrete, slag concrete, gypsum…) which are installed parallel to each other shall be constructed with partition for each duct and without transition flange for the whole length of the structure (wall, partition, floor…) at the penetration position into the structure.

3.10.3. Incombustible structure of the building and facilities can be used to separate air ducts on condition that it shall ensure the fire resistance and anti-corrosion for the construction structure.

Combustible structure shall not be used for the above purpose.

Construction structure of the building and facilities functioning as partition of air ducts shall not be used if condensed steam exists in the transport environment.

3.10.4. Air ducts can be put inside the fire walls if they ensure the required fire resistance.

3.10.5. Air ducts shall be made of incombustible material for the production rooms under group A, B, C and F as well as for the transport of air, mixed air - dust at temperature over 80oC or containing flammable and explosive substances.

3.10.6. Air ducts made of incombustible material shall be applied for dwelling houses, public buildings, and subsidiary rooms of the industrial enterprise, except for the one storey building - where retardant materials can be used for air ducts.

3.10.7. For residential and public buildingss as well as rooms of subsidiary buildings, crossing air ducts over walls and partitions shall be over 0.75 hour fire resistant rated; collecting ducts shall 0.5 hour fire resistant rated or covers shall be provided for duct walls to ensure the above mentioned fire resistance rate.

If air ducts are combined into one group, it shall be protected by partition walls with lower fire resistance rate or positioned in the wells with partitions at 0.5 hour fire resistant rated.

3.10.8. Air ducts positioned inside the ventilator room, in the technical floor and basement shall be composed of incombustible material.

Flexible ducts and washers can be made of combustible material.

3.10.9. Air ducts (except for collecting ducts and transition pipes) made of fire retardant materials can be used in the production house under group D and E, as well as for the one storey subsidiary building of the enterprise, dwelling houses or public buildings.

Collecting ducts and transition pipes for the above buildings and facilities with fire resistance grade I - V shall be made of incombustible material, but for transition pipes crossing over floor with fire resistance grade III - V shall be constructed with fire resistant partitions in 0.5 hour.

Air ducts used for theatre, cinema, auditorium and crowded activity rooms shall be designed as required in Article 3.10.7.

3.10.10. Air ducts made of incombustible material in case of enough condition can be made of combustible material (if it is neccesary to follow the anti-rusty requirement and other requirements) for a room without crossing over brick and concrete walls.
When combustible or fire retardant ducts (plastic or other material) are required to be installed through other rooms, each duct shall be sheathed to ensure the fire resistance in 0.5 hour.

3.10.11. Where the transition pipes cross over the floor, joints shall be sealed by incombustible material with the thickness ensuring the fire resistance as of the floor floor.

3.10.12. Where air ducts crossing over the floor are made of combustible or retardant material with the temperature over 80$^{o}$C in the air environment, partitions from incombustible insulation material shall be made. Insulation thickness shall be determined based on the calculation.

3.10.13. Air distribution mechanism of the air supply system as well as air intakes of the inspiration and exhaust system can be constructed of combustible materials.

Air distribution mechanism or air ducts (perforated air distribution duct) as well as air exhaust ducts designed with slide shall be made of fire resistant material specified for the air duct.

3.10.14. In principle, air ducts of the ventilation, air condition and heating system by air shall be circular shaped.

Air ducts of rectangular or other shapes in case of enough condition can be allowed.

When designing air ducts, mechanize manufacture shall be taken into consideration.

Dimension of rectangular steel, cement or plastic air ducts can be refered to appendix 11.

3.10.15. Airflow transferred in the extraction and discharge of flammable and explosive gas or dust shall be calculated so that the concentration of transport environment does not exceed 50% of the explosition limitation.

3.10.16. Air duct of the inspiration and exhaust systems of air mixed with hydro shall be ascending according to the movement direction of the airflow.

3.10.17. Wet air or condensed mixed air ducts shall be vertically or slopingly positioned. If the ducts are positioned in the environment with lower temperature than that of the condensed mixed air, slope design and discharge mechanism of condensed water or insulation sheathing shall be forseen.

Slope of the air duct shall be mainly determined according to the movement of the airflow and with the value at approximately 0,005 - 0,01.

Attentions shall be given to the measures for avoiding stagnant dew inside and outside the pipe wall when air ducts are positioned in the dwelling houses, public buildings as well as in the subsidiary buildings of the enterprise

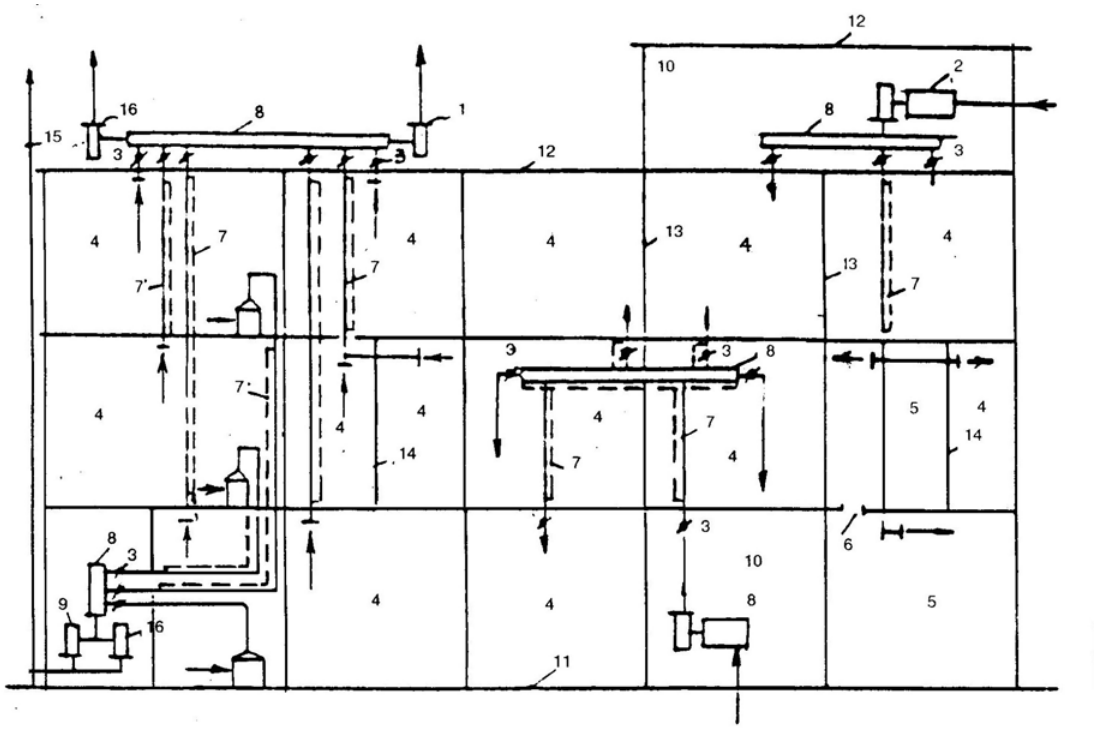
3.10.18. Hydraulic power of the duct shall be calculated to ensure the difference of lost pressure not less than 10% on the separate branches.

If pressure elimination mechanism is required to balance the loss among branches, it shall be clearly presented in the design.

If it is necessary to change the air volume on the separate duct branches during the operation, besides pressure elimination mechanism, adjusting valves shall be installed.

3.10.19. Air duct shall be seperately designed for each production group A, B and F.

Air ducts for the production rooms under one of the above mentioned groups are positioned in the same floor but not over 3 continuous floors that allows to connect with one collecting duct (if not opposite to Article 3.2.14) positioned outside the building and facilities, or in the ventilator room or in not more than two adjacent rooms served by one system (Figure 7).



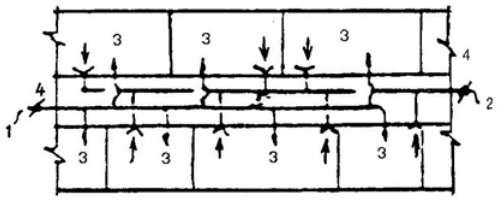
***Hình 7** : Sơ đồ đường ống dẫn gió cho các gian sản xuất nhóm A, hoặc B, hoặc C, hoặc F*
*1. Hệ thống hút thải thông gió chung. 2. Hệ thống cấp gió hay điều tiết không khí. 3. Van một chiều tự động. 4. Gian sản xuất thuộc nhóm A hoặc B, hoặc C, hoặc F. 5. Cũng gian sản xuất thuộc một nhóm như điểm 4 sang có cửa thông nhau. 6. Lỗ cửa. 7. Ống dẫn gió chuyển tiếp. 8. Ống góp. 9. Hệ thống hút cục bộ môi trường khí dễ nổ trong hỗn hợp với không khí. 10. Phòng máy thông gió. 11. Sàn. 12. Mái. 13. Vách hoặc tường với độ chịu lửa 0,75h có cửa chống cháy với độ chịu lửa 0,6h (giữa các gian sản xuất nhóm A hoặc B, hoặc C) ; còn giữa các gian sản xuất nhóm F – vách không thấm khí và không lọt bụi. 14. Các vách khác. 15. Đoạn ống áp lực (theo điều 3.10.27). 16. Quạt gió dự phòng (theo điều 3.5.6 và 3.5.8).*

Trong nhà sản xuất kiểu hành lang giữa trong đó có những gian sản xuất thuộc cùng một nhóm kể trên thì được phép bố trí ống gió trong hành lang của từng tầng riêng rẽ với điều kiện lắp van một chiều tự đóng trên đường ống chung cho mỗi nhóm phòng có tổng diện tích không quá 300m$^2$ (hình 8)

***Chú thích :***

*1. Các gian sản xuất thuộc nhóm A, B và C được ngăn cách bởi tường có giới hạn chịu lửa 0,75h, hoặc có lỗ thông ở sàn ngăn che giữa các tầng, thì coi như một gian.*

*2. Các gian sản xuất nhóm F có tường, sàn ngăn chia thông nhau hoặc tường sàn thấm khí thì coi như một gian.*



***Hình 8** : Sơ đồ đường ống dẫn gió trong nhà sản xuất hành lang giữa.*
*1. Đường ống cấp gió cho các gian sản xuất tổng diện tích không quá 300m$^2$.*
*2. Đường ống thải gió cho các gian sản xuất tổng diện tích không quá 300m$^2$.*
*3. Các gian sản xuất thuộc cùng một nhóm A, hoặc B, hoặc C, hoặc F.*
*4. Van một chiều tự đông.*
*5. Hành lang.*

*Figure 7: Layout of air ducts for the production rooms under group A, or B, or C, or F.*

*Common air inspiration and exhaust system. 2. Air supply and air condition system. 3. Auto check valve. 4. Production rooms under group A or B, or C, or F. 5. Also production rooms under group A, or B, or C, or F but with intercommunicating door. 6. Door opening. 7. Transition air ducts. 8. Collecting duct. 9. Local exhaust system of explosive air in the air mix. 10. Ventilator room. 11. Floor. 1.2 Roof. 13. Fire resistance*

*partitions or walls in 0.75 hour with fire resistant doors in 0.6 hour (between production rooms under group A, or B, or C); but between production rooms under group F – air and dust unabsorbing walls. 14. Other partitions. 15. Pressured duct (according to Article 3.10.27). 16. Standby fan (according to Article 3.5.6 and 3.5.8).*

In the production building designed with middle corridors in which some of the production rooms are under the same group as mentioned above, air ducts can be positioned in the corridor of each floor in condition of being equipped with auto-check valve on the same duct for each room group total area of which does not exceed 300m2 (Figure 8).

*Note:*

1. *Production rooms under group A, B and C separated by fire walls rated in 0.75 hour or have openings on the floor floor (ceiling) between floors can be considered one room.*
2. *Production rooms under group F separated by intercommunicating partition walls, floors or by air absorbing floors can be considered one room.*

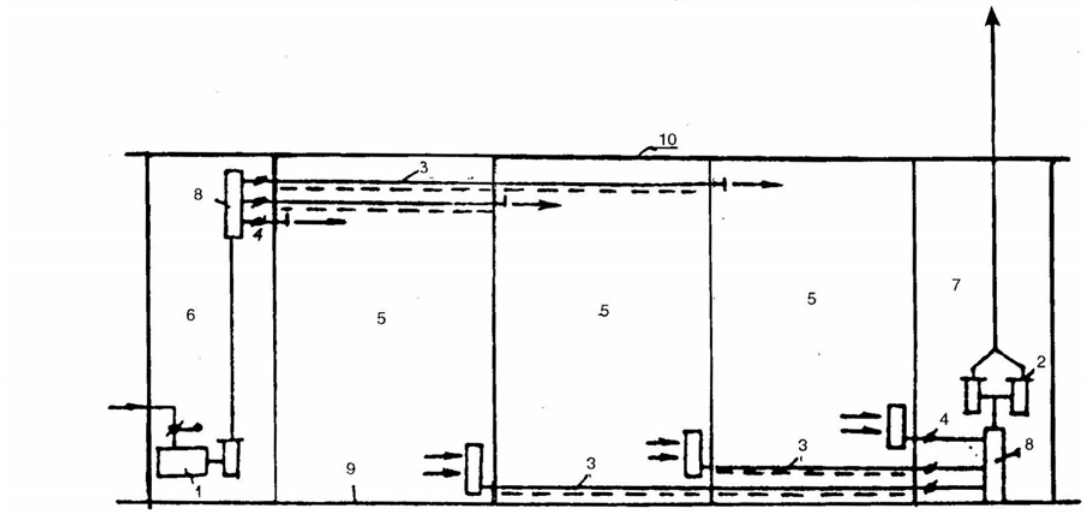
*Figurre 8: Layout of air ducts in the production building with middle corridors.*

1. *Air supply ducts for the production rooms with total area not over 300m2.*
2. *Air exhaust ducts for the production rooms with total area not over 300m2.*
3. *Production rooms under a group A, or B, or C, or F.*
4. *Auto check valve.*
5. *Corridor.*

*3.* On air duct branches where substances can burn and spread from the lower to the upper floors in case of fire, auto check valves shall be installed.

3.10.20. Air ducts for independent rooms and storage of the production rooms under group A, B and F in any complex with total area not over 1100m$^2$ (Article 3.2.10) in the one storey building and with exit doors opened to the outside shall be designed separately and shall be connected to other rooms like reducing ducts with fire resistant partitions rated in 0.5 h.

Air ducts shall be connected via collecting ducts positioned in the ventilator room (Figure 9), and shall be provided with auto check valve on all branches.




*Hình 9. Sơ đồ đường ống dẫn gió trong kho hay gian sản xuất nhóm A, B., C và F trong nhà một tầng có cửa thoát ra ngoài.*

*1. Hệ thống cấp gió hoặc hệ thống Đ.T.K.K. 2. Hệ thống hút thải có quạt dự phòng kèm động cơ. 3. Ống dẫn gió chuyển tiếp. 4. Van một chiều tự đóng. 5. Gian sản xuất nhóm A, B, C và F. 6. Gian máy thông gió cấp. 7. Gian máy thông gió thải. 8. Ống góp. 9. Sàn. 10. Mái*

*Figure 9. Layout of air ducts in storages or production rooms under group A, B, C and F in the one storey building with exit doors opened to the outside.*

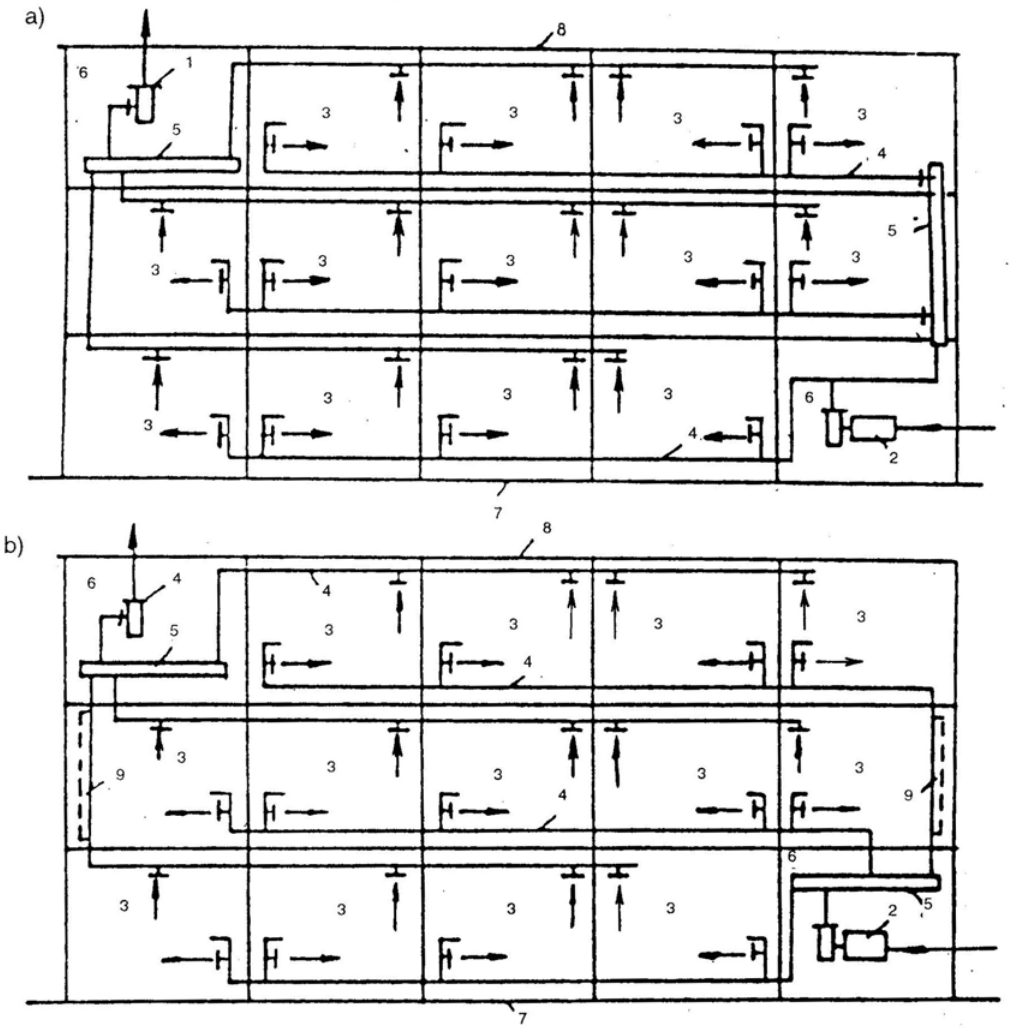
*1. Air supply system or air condition system. 2. Inspiration and exhaust system equipped with standby fans and motors. 3. Air reducing duct. 4. Auto check valve. 5. Production rooms under group A, B, C and F. 6. Supply ventilator room. 7. Exhaust ventilator room. 8. Collecting duct. 9. Floor. 10. Roof*

3.10.21. Vent ducts for the production rooms under group D and E (Article 3.2.15) can be provided to all rooms at the same floor and to be connected to the collecting duct if neccesary. In buildings with fire resistance grade I and II, the collecting duct can be positioned at any floor (but it should be positioned on the ground floor or on the top floor) as well as can be positioned vertically through all floors of the building or outside the building (Figure 10-a).

In buildings with fire resistance grade III and IV, the collecting duct shall be positioned in only one floor or outside the building (Figure 10-b).

3.10.22. If the collecting duct is highly positioned for the vertical air duct (Figure 11) in public buildings or subsidiary buildings of more than 10 stories, by-pass duct around fan shall be designed in case of fire to convert the system to the natural force of gravity when fan stops operating and the duct's temperature reaches 50oC.

3.10.23. Air ducts for the production rooms under group A, B, C and F as well as the local extraction duct of explosive substances are not normally led to the production rooms of any fire – explosion hazard.
If enough basis, air transition ducts crossing over brick, concrete walls or floor slabs with fire resistance grade from 0.75 hour above can be positioned between the two fire walls. For the production rooms under group A, B and F and the local exhaust rooms of explosive substances, air transition ductsshall be designed in compliance with Article 3.10.24.




*Hình 10 : Sơ đồ đường ống dẫn gió trong các gian sản xuất nhóm D và E*
*a) Đối với nhà cấp chịu lửa I và II ; b) Đối với nhà cấp chịu lửa III – V.*
*1. Hệ thống hút thải. 2. Hệ thống cấp gió hay điều tiết không khí. 3. Gian sản xuất nhóm D và E.*
*4. Ống dẫn gió. 5. Ống góp. 6. Gian máy thông gió. 7. Sàn. 8. Mái. 9. Ống dẫn gió chuyển tiếp.*

*Figure 10: Layout of air ducts in the production rooms under group D and E*

*a) For building with fire resistant grade I and II; b) For building with fire resistant grade III – V.*
*1. Inspiration and exhaust system 2. Air supply or air condition system. 3. Production rooms under group D and E. 4. Air duct. 5. Collecting duct. 6. Ventilator room. 7. Floor. 8. Roof. 9. Air reducing duct*

For the production rooms under group C, fire resistant valves shall be positioned at the crossing position over walls or floors or air transition ductsshall be installed to ensure the fire resistance as required in Article 3.10.24.

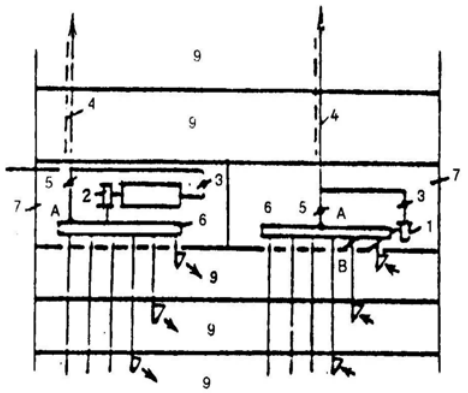
3.10.24. Air transition ducts for the production rooms under group A, B and F as well as for the local extraction and discharge of explosive substances shall be closed made and without dismentlement and installation mechanism. If it is neccesary to dismantle air ducts for cleaning or anti-rust painting, air flanged reducing duct with incombustible washer (made of amiang or incombustible materials) can be provided, but:

- Air ducts shall be made of incombustible materials with fire resistance from 0.25 hour above for one storey buildings or at one floor of the multi-storey buildings.

- In multi-storey buildings: the air reducing duct positioned beyond the floor range and crossing over the floor shall be made of incombustible material with fire resistance not less than 0.5 hour.

  Fire resistance rate of the air reducing duct wall going through the production room under group F is normally undefined if it is used for the production rooms under the same group also.

The collecting ducts in the production rooms under group A, B and F used to connect extraction ducts from different floors shall be made of incombustible materials with fire resistance rate as stipulated in this standard.




*Hình 11 : Sơ đồ ống góp trong gian máy thông gió nhà ở nhà công cộng, nhà phụ trợ cao trên 10 tầng.*
*1. Hệ thống hút thải. 2. Hệ thống cấp gió hay điều tiết không khí. 3. Van khống chế. 4. Ống dẫn gió (theo yêu cầu điều 3.10.7). 5. Van tự động, mở khi quạt dừng và nhiệt độ ở điểm A đạt 50°C. 6. Ống góp. 7. Gian máy thông gió. 8. Van một chiều tự đóng. 9 Tầng nhà*

3.10.25. Air ducts are not allowed to go through fire walls, unless otherwise stated in Article 3.12.

3.10.26. Air transition ducts shall not be led through shelter-pits or staircase frames where are used for evacuation in case of emergency (except for air supply ducts that prodcude positive pressure in the stair frame), in general, air shall not be transisted to the storage of flammable materials or flammable unpackaged materials.

3.10.27. Surplus pressure pushing duct of the local exhaust system of explosive steam and air or toxic gas grade 1, 2 shall not be installed through other rooms, unless otherwise specified in the approved standards.

Surplus pressure pushing duct of the local exhaust system of toxic gas grade 3, 4, heat and humidity is normally installed through other rooms. If installed, measures for protection against toxic and harmful hazards coming into the room.

3.10.28. For dwelling houses, public and subsidiary houses of the 3 or above storey enterprise, the air horizontal duct of the ventilation, air condition and heating system shall be installed. The layout of air exhaust shall not be applied for hospitals - treatment rooms. The collecting ducts connecting air ducts for each floor or for each group shall not exceed 10 storeys if using mechanical propulsive force and not exceed 25 storeys if using natural propulsive force.

Duct branch in each floor shall be connected to the collecting duct positioned adjacent to the upper floor or the lower floor from the duct floor (Figure 12a).

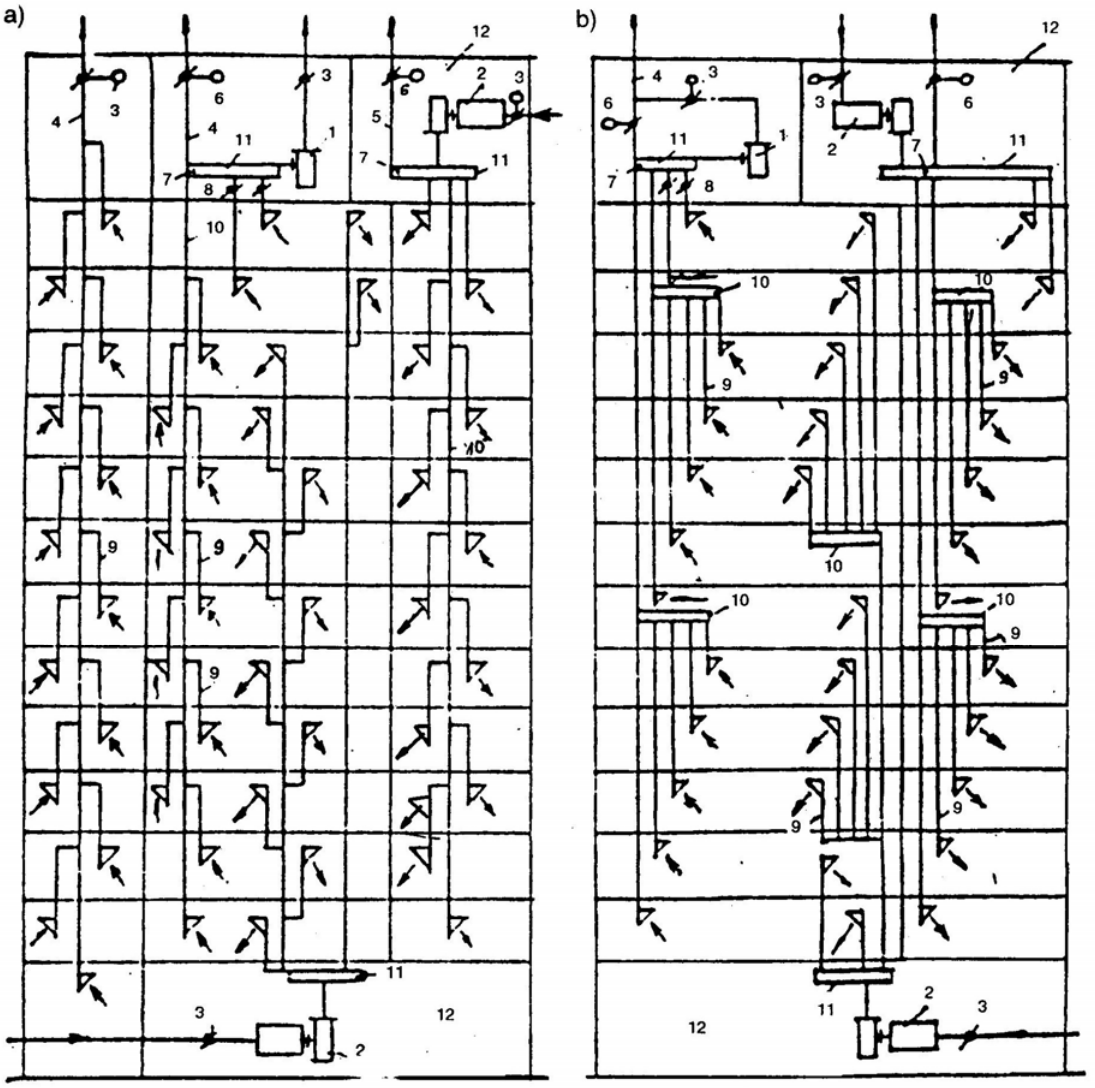
For 2 - 5 storey buildings as well as for every 5 floor of the multi - storey buildings, duct branches are allowed to be connected to one horizontal collecting duct (Figure 12h).

The collecting duct of all vertical ducts from different floors shall not be positioned in the corridor, staircase frame or exits.

In the 10 or above storey buildings, auto check valves shall be installed on the air exhaust ducts of the two top floors at the inlet of the horizontal ducts.

3.10.29. Distance between air duct walls with surface temperature over 80oC and air duct walls containing explosive dust and air shall not be less than 0.3m (for air ducts and insulated ducts,

the distance will be calculated from the outside surface of the insulation). In case of overlaping ducts, the higher temperature one shall be placed on the other.




***Hình 12 : Sơ đồ đường ống dẫn gió trong nhà ở, nhà công cộng nhà phụ trợ nhiều tầng. a) Sơ đồ với ống góp đứng ; b) Sơ đồ với ống góp ngang ; 1. Hệ thống hút thải. 2. Hệ thống cấp gió hay điều tiết không khí. 3. Van. 4, 5. Giếng thải gió. 6. Van mở tự động khi quạt dừng và nhiệt độ ở điểm 7 tăng đến 50°C. 7. Vị trí đặt bộ cảm nhiệt. 8. Van một chiều tự động. 9. Nhánh ống cho một hay nhiều phòng trên cùng tầng. 10. Ống góp. 11. Ống góp trong gian máy thông gió. 12. Gian máy thông gió.***

*Figure 12: Layout of air ducts in the multi-storey dwelling houses, public and subsidiary buildings*

*a) Layout for vertical collecting duct; b) Layout for horizontal collecting duct; 1. Inspiration and exhaust system. 2. Air supply or air condition system. 3. Valve. 4,5. Air exhaustwell. 6. Auto open valve when fan stops operating and the temperature at point 7 reaches 50oC. 7. Position of heat sensor. 8. Auto check valve. 9. Duct branch for one or many rooms on the same floor. 10. Collecting duct . 11. Collecting duct in the ventilator room. 12. Ventilator room*

3.10.30. Gas ducts or combustible liquid ducts shall not be put through air ducts or hang on the air duct wall and positioned in the ventilator room.

3.10.31. Heat ducts shall not be crossed over vent ducts containing flammable and explosive dust and air if their temperature is more than 80% fire temperature (oC) of the environment inside the vent duct. Heat ducts in this case shall not be hung on the ventilation duct wall.

3.10.32. Air exhaust ducts of the production rooms under group A, B and F shall not be underground positioned.

For air ducts containing flammable substances, service openings shall be made for cyclic cleaning .

3.10.33. Air ducts in the production rooms under group A, B and F as well as the local air exhaust duct of flammable and explosive substances shall not be positioned in the basement, underground ditch, unless otherwise stated in the approved professional standard.

3.10.34. Air ducts shall be hung in such a way that their load shall not be carried by fans as well as on other ventilators.

Air ducts connected with fans shall normally operate via flexible ducts (anti-vibration duct).

3.10.35. In order to calculate the ventilated air, holes shall be made on the air duct wall, on ventilators and air conditioners.

*3.11 Heat duct*

3.11.1. Heat ducts for ventilation, air condition and heating system by air (including steam and condensed water duct) shall not be connected with heat ducts for the heat exchange system of the hot water supply network for domestic or production.purposes.

Separate ducts shall be provided for:

a) Air dryer

b) Cyclic heat consuming system, if the regular heat consumption of households is included in its operation.

3.11.2. Heat ducts positioned through the fire wall shall be sealant, tight and ensure the expansion toward the both side of the fire wall.

3.11.3. Heat ducts shall be selected according to annex N05 (if steel ducts produced in Soviet Union are used).

If other products are used, it shall follow the equivalent specification to that product.

3.11.4. Heat ducts (hot water, condensed water, steam) shall not be positioned in one ditch or cross over the ditch where the liquid duct has the burning temperature under 120oC or the gas duct or the corrosive air duct.

3.11.5. Heat ducts shall be insulated in order to:

a) Stable thermal parameters and avoid heating the air environment in rooms where the ducts go through.

b) Avoid fire incident in the production and working rooms where fire is caused by the high temperature of the duct surface.

3.11.6. Insulation thickness shall abide by the approved standards or shall be calculated to ensure economic-technical requirements.

3.11.7. The surface insulation including the duct cover and heat radiation equipment in the production rooms under group A, B, C, F as well as on the roof top, or in the basement shall be made of incombustible material, except for the painting.

In other circumstances when ducts and equipment are positioned in the technical floor, the insultation can be composed of retardant material and combustible coating.

3.11.8. Hydraulic calculation of heat ducts shall be based on the thickness of the following pipe group:

- Water and steam pipes 0,2mm

- Condensed water pipes l,0mm

*3.12 Ventilator room*

3.12.1. The design of construction - structure of the ventilator room shall meet the requirements under related codes and regulations to: industrial houses, public facilities, dwelling houses… as well as codes and regulations on fire protection, hygienic safety and other related codes.

3.12.2. Ventilation room (local ventilation, emergency ventilation and common ventilation) shall meet the requirements on fire and explostion protection for production rooms, production stages and the system will serve depending on the production grade and group or in equivalent to dwelling houses, public and subsidiary buildings of the enterprise.

*Note: The requirements on fire and explosion protection of the most hazardous production group shall be ensured for ventilator rooms serving for the production rooms at different fire and explosion protection grade*.

3.12.3. Ventilator room for air supply systems shall meet the requirements on fire protection as for the production rooms according to the following grade:

a) Grade C: if oil-dust filter positioned in the ventilator room can contain more than 60kg oil in a filter.

b) Grade E: if no air circulator or oil dust filter is used in the ventilation systems or if the oil volume in one filter is less than 60kg.

c) Same grade with the production rooms served by the ventilation system in case of using air circulator, except in case of point a). Rooms for air supply systems in dwelling houses, public and subsidiary buildings shall meet the requirements on fire protection of rooms served by the air supply system.

Ventilator room for air supply systems serving for the production rooms positioned in the dwelling houses, public and subsidiary buildings shall be designed as required in Article 3.12.3.

3.12.4. Ventilator room for the production rooms under group A, B and F as well as the local exhaust fan room of explosive substances shall not be used for other purposes or a space in the room shall be occupied for repairs or oil regereration.

In the ventilator room for the air supply system serving for the production rooms under group A, B and F can be oil intakes for the heat supply network, heating and pumping rooms.

3.12.5. For production and public buildings in which more than 5 ventilators are positioned, a space used for equipment repairs and oil regeneration shall be forseen, if the building has no repair workshop or centre oil generating equipment.

3.12.6. Ventilator room serving for the production rooms under all hazardous group shall be located in the other side of the fire wall in only buildings with fire resitance grade I and II and on the following conditions (Figure 13):

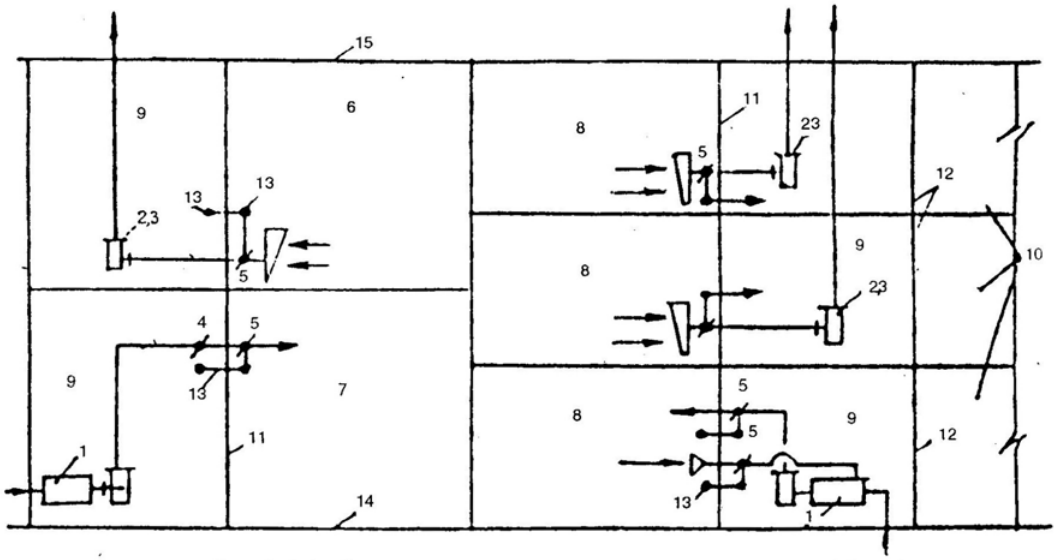
a) Ventilator room shall be positioned adjacent to the fire wall;

b) Walls and floors of the ventilator room seperated with other rooms in the other side of the fire wall shall has a fire rating in 1.5 hour; and doors shall have a fire rating in 1 hour.

Fire resistant valve shall be provided in the crossing position of the air duct over the fire wall.

Fire valve shall be provided at the crossing position of the air duct over the fire wall.

Ventilator rooms serving for rooms in the other side of the fire wall shall not contain ventilators for rooms in this side of the fire wall.




***Hình 13** : Sơ đồ bố trí phòng máy thông gió bên ngoài tường chắn lửa.*
*1. Hệ thống cấp gió hay điều tiết không khí. 2. Hệ thống hút cục bộ. 3. Hệ thống hút thải chung. 4. Van một chiều tự động. 5. Van chắn lửa (đặt ở vị trí ống xuyên qua tường). 6. Gian sản xuất nhóm A, hoặc B, hoặc F, hoặc nơi có hệ thống hút cục bộ chất dễ nổ. 7. Gian sản xuất nhóm A, hoặc B, hoặc F. 8. Gian sản xuất nhóm C, hoặc D, hoặc E. 9. Phòng máy thông gió. 10. Gian sản xuất bất kì nhóm nào. 11. Tường chắn lửa của công trình. 12. Tường có giới hạn chịu lửa 1,5h. 13. Cần điều khiển van chắn lửa (nằm ở cả 2 phía tường). 14. Sàn. 15. Mái.*

*Figure 13: Layout of ventilator rooms outside the fire wall.*

*1. Air supply or air condition system. 2. Local exhaust system. 3.Common inspiration and exhaust system. 4. Auto check valve. 5. Fire valve (at the …). 6. Production room under group A, or B, or F, or where the local exhaust system of explosive substances is installed. 7. Production room under group A, or B, or F. 8. Production room under group C, or D, or E. 9. Ventilator room. 10. Production room at any group. 11. Fire wall. 12. Fire wall rating at 1.5 hour. 13. Fire valve controlling rod (at both side of fire wall). 14. Floor. 15. Roof*

3.12.7. Dry dust filter rooms to filt flammable substances must not be located beneath permanently or temporarily crowded rooms (such as relaxing room, dining room, medical station, meeting room, conference hall or auditorium, etc…)

3.12.8. Height of the ventilator room shall be at least 0.8m from the ventilator and not be less than 1.9m from the floor to the lowest part of ceiling structure at the access for service men.

Access width for service men calculated between the projections of equipment or between equipment and column or wall shall not be less than 0.7m.

*Note:*

1. *Access width for observing and repairing equipment periodically can be reduced by 0.6m (calculated between equipment or between equipment and building structure).*
2. *The above regulation does include the equipment installation and dismentlement space for periodical maintenance and repair*.

3.12.9. Ventilator rooms serving for the production rooms producing toxic and harmful substances grade 1, 2 or the production rooms under group A, B and F shall be ventilated in such a way that the exhaust air volume shall be at least 1 time exchange volume more than the supplied air volume, or provided with an exhaust system with the airflow under 1 time exchange volume.

Natural or mechanical ventilation system which can be positioned in the ventilator room can be applied for the above purposes.

3.12.10. In the ventilator room where air supply system serving for the production rooms generating toxic and harmful substances grade 1,2 or the production rooms under group A, B and F is installed, the normal airflow of the air supply system shall be at least as 2 times as volume of the ventilator room .

Air can be supplied from:

a. The air supply or air condition system serving for the production rooms under any group which is positioned in this room. Air extraction duct for this purpose shall be positioned in front of the auto close check valve.
b. The dedicated air supply system which is positioned in the ventilator room.

3.12.11. In case of neccesity, water inlets shall be provided to the ventilator room for cleaning equipment and floor.

## 4. Cooling supply

### *4.1 General instructions*

4.1.1. Technical requirements in this chapter are applied only to cooling stations which provide ventilation and air-conditioning.

4.1.2. In cool areas and mountainous regions, it is recommended to make use of natural water taken from rivers, springs and deep wells; or combine natural sources with refrigerations to save energy.

4.1.3. the use of ice as a cooling source shall be based on economic and technical considerations.

4.1.4. In order to protect the environment, including the ozone layer, it is important to select cooling agents which do no harm or little harm to the environment.

4.1.5. Selecting air-conditioners for air cooling shall be based on specific conditions of the local energy source (electricity, water, steam, redundant heat, etc.) and on economic and technical considerations.

4.1.6. Cooling station using piston compressors and screw-axis compressors with total power less than 1.5 million kcal/h (calculated in operating conditions) should use a combination of two or three machines of the same capacity in tandem; it is possible to use a single machine if there is a power-adjusting mechanism.

4.1.7. Cooling station using turbine compressors should be designed to use one or more machines of the same capacity of about 1 million kcal/h or more. In addition, it is possible to put one or two less powerful machines (include piston compressor or screw-axis compressor) in order to serve the demands of variable cooling additional charge and to increase the number of non-stop operating hours of turbine compressors.

4.1.8. When there are many users in an industrial zone or residential sub-area, it is recommended to create a central cooling station.

4.1.9. Provision shall be made for the availability of stand-by refrigerations in case technological demands arise.

4.1.10. To rationalize the operation of refrigeration equipment, it is necessary to use cool-storage tank. The capacity of cool storage (container, tank, etc.) of the cooling system shall not be less than the 15-minute-of-operation capacity of the smallest machines in the cooling station.

When calculating cool-storage tank (include cooling storage capacity of the cooling system) for turbine compressors, it is needed to calculate the continuous operation capacity of the

compressors not less than 7 hours with the ability of power adjustment (limit of power adjustment is provided by the manufacturer).

4.1.11. Form the circulation circuit of heat conductors (water, salt solution, etc.) through closed evaporator to operate independently with cooling network to consumer - households. Where necessary conditions are met, it is permitted to design the cooling system to serve users directly from supply pumps with the heat conductors put into the evaporator.

4.1.12. Insulating layer of cooling equipment and sound-proof structures used in cooling station shall be made from fire-proof materials.

4.1.13. It is important to use refrigeration equipment according to heat-pumping cycle on adequate and suitable FS.

4.1.14. When designing water supply to cool the condenser and absorber (for absorbent refrigeration), water temperature must be kept below the following limits:

300C - for steam-water pump refrigeration with condenser below atmospheric pressure.

320C - for compressor using R - 12

300C - for compressor using R - 22 and Br - Li absorbent refrigeration

280C - for steam-water pump refrigeration with closed condenser

250C - for NH3 absorbent refrigeration

*Note: When increasing the temperature of condensed water, it is important to make economic-technical calculations to ensure economy and technical safety.*

4.1.15. Instructions on water supply treatment shall be followed when treating water cooling in the condenser and absorber of refrigeration equipment to remove dregs, parasites and mud.

4.1.16. Boiling temperature of cooling agents in the closed evaporator shall not be 6$^{o}$C less than the average temperature of the cooling environment but shall not be less than 2$^{o}$C; the temperature of water going out of the evaporator shall not be less than 6$^{o}$C

To reduce the water temperature to a lower level, use evaporator structures which do not break pipes when freezing, such as an evaporator placed in open tank.

4.1.17. When determining additional charge for cooling station, the following cool losses should be considered:

a) Cool losses inside the finished machine with each combination (flow losses);

*Note: For synchronic combinations (Freon refrigeratiors, Br - Li absorbent refrigeration), useful power of machine in the catalogue has been included losses inside the machine.*

b) Cool losses inside the cool-consuming system, include the temperature increase of cool-consuming substance in circulating pump, but shall not exceed 12% of useful power of refrigeration

4.1.18. Cooling station used for the purpose of air-conditioning shall also meet the safety requirements of TCVN 4206: 1986 "safe cooling system".

### *4.2 Freon refrigeratiors*

4.2.1. Freon cooling station can be installed in manufacturing factories, public construction works, residential houses and subordinate houses of factories, unless exceeding the limits in 4.1.14.

4.2.2. Freon cooling station and any single refrigeration of the same capacity cannot be placed directly in living-rooms, in stair structures (space under stair, landing) or in the balcony, hall, exit of houses and other construction works).

*Note: The above limit is not applied for refrigeration in local air-conditioner (except in relation with stairs).*

4.2.3. Freon cooling station and single refrigeration with power of over 300,000 kcal/h cannot be placed in the basement of houses and other construction works.

It is permitted to place freon cooling station and single refrigeration with power not exceeding 600,000 kcal/h in the basement (except basement in dwelling house) if the floors above basement are not permanent or temporary crowded places.

It is permitted to place cooling station with power over 600,000 kcal/h in the machine-space next to the construction work using the machine, in manufacturing houses, in separate semi-underground space or in basement placed out of the surrounding wall of the construction work

4.2.4. Freon refrigeration with power under 150,000 kcal/h, which has power-adjusting structure, can be directly connected with air-cooling trellis according to the following requirements:

a) Each machine shall be connected with a group of air-cooling trellises by independent pipe not connected with other machines;

b) The distance between compressor-condensed trellis combination and air-cooling trellis shall not exceed 10 meters;

c) The amount of freon contained in refrigerations and cooling equipment, which is calculated for 1m3 of room volume, shall not exceed 0.5kg (for R - 12) or 0.35kg (for R - 22).

4.2.5. In case of using combined air-conditioner with directly evaporating cooling trellis, installation shall be conducted in compliance with manufacturer's regulations, and:

a) Check safety requirements according to 4.2.4 c)

b) Give priority to machines with safety exhaust valve

c) Lead the safe exhaust duct into the air in case of not ensuring 4.2.4 c)

4.25.1. Freon refrigeratiors using piston or screw-axis with power under 600,000 kcal/h are used only when cooling demand is under 1.5 million kcal/h.

4.25.2. Do not connect freon ducts between refrigerations, except connections between refrigerations with common freon container.

4.25.3. Comply with instructions of installing electrical equipment when selecting engines for cooling compressors.

*4.3 NH3 refrigeration*

4.3.1. Piston NH3 refrigeration is deployed to meet coolings demands of air-conditioning systems in manufacturing worshops or industrial users.

Turbine NH3 refrigeration is applied to supply cool for air-conditioning systems in manufacturing worshops where total cooling demand doesn’t exceed 9 million kcal/h. Absolutely do not use NH3 refrigeration for dwelling houses, public construction works and accessory houses of factories.

4.3.2. NH3 refrigeration shall be placed in a separate room or separate building. Cooling equipment shall be placed outdoor.

4.3.3. Cool supply source for air-conditioning system provided by NH3 refrigerations shall be used through a closed water-using thermal exchanger.

It is permissible to apply open thermal exchanging method (spray booth style) with the condition of placing an intermediary thermal exchanger (water-water type or water-salt solution type).

4.3.4. Pulling engine of NH3 refrigeration and technological equipment of NH3 cooling station shall be placed and selected in compliance with the requirements for installing electrical equipment.

*4.4 Refrigeration using heat source*

4.4.1. Br - Li refrigeration is applied when there is a steam source with pressure above 0.3kg/$m^2$, a hot water source with temperature above 80oC, a gas source and the cooling demand is not less than 250,000 kcal/h.

*Note: Using hot water source with temperature under 80oC is permitted when there are adequate and suitable FS.*

4.4.2. NH3 absorbing refrigeration can be applied to cool manufacturing house when there is a need for cool-consuming substance under 2$^oC$ and requirement in 4.3.3 is ensured.

4.4.3. Cooling station and NH3 absorbing refrigeration are not allowed to be cooling source for dwelling houses, public construction works or subordinate houses of factories; or not allowed to be placed in those houses.

4.4.4. It is permitted to place refrigeration absorbing Br - Li and NH3 and flush-pump refrigeration in vacant grounds outdoor, but electric board and control board must be placed indoor.

*4.4.5.* It is permitted to place refrigeration absorbing Br - Li and steam flusing pump in manufacturing houses, dwelling houses and public construction works or subordinate houses in factories.

*4.5. Machine room and equipment space of cooling stations*

4.5.1. Cooling stations should be considered as one of fire and explosion prone areas according to Appendix N012.

Structural and construction solutions for cooling stations and refrigerations corresponding to safety level of fire and explosion prevention shall meet the building requirements of similar groups of construction works.

4.5.2. The height of machine room for both cooling station and refrigeration shall ensure the minimum requirement as follows:

4,8m - for NH3 refrigeration
3,6m - for freon refrigeration

Alleys between control board and the salient part of equipment shall not be less than 1.5m; alleys between machine and equipment components and walls shall not be less than 0.8m; between machine components and columns - not less than 0.7m.

4.5.3. It is necessary to build floors and stairs system to serve and operate big equipment groups of refrigerations.

4.5.4. All cooling machines and equipments which contain under-pressure cooling agents shall be equipped with safety valves in their structures.

Pressures shall not be allowed to exceed permissible levels even when valves are operating fully open.

*Note: To exhause NH3, there needs to be an exhaust pipe lifted up to the height of 5m from the roof top of the highest building within the radius of 50m.*

4.5.5. For complete imported set of air-conditioners including refrigerations, see Article 4.2. for more details.

Service and oerpating space can be in compliance with Article 4.5.2 and installing instructions of manufacturer; special attention should be paid to the requirements of manufacturer, especially spare space for maintenance, disassembly-assembly and operation (condensing trellis, evaporating trellis, dust filter, safety valve, etc.).

4.5.6. It is necessary to anticipate two outlet doors in NH3 refrigeration room; the distance between them should be as long as possible. One of them must lead to outdoor and the door must open to the outside.

There must not be potholes in NH3 refrigeration rooms.

4.5.7. In case of placing NH3 equipment in open space, the clear distance between the outside wall which has the door hole of cooling station and the surface of equipment which has technological relation with cooling station shall be over 2m. In this case, the exit from house to cooling station shall be placed in the opposite direction. In other cases, for NH3 equipment or freon equipment, this distance need not be stipulated.

4.5.8. On the flat roof surface of machine room and equipment room of cooling station, it is allowed to place:

- Condensing trellis to cool by wind
- Evaporating trellis to cool the cooling agent
- Solution divider
- Water-flushing tower

The area occupied by subordinate equipment on the roof of NH3 refrigeration room should not exceed 25% of the roof area.

4.5.9. In NH3 and freon cooling room, it is necessary to place an electric crane or manual one operated from floor; requirements for installing electrical equipment in this kind of work must be met.

4.5.10. Pipes, technology of conducting cooling agent and cooling oil containing cooling agent should be designed in strict compliance with the requirements of approved technological design standards.

4.5.11. Paint color of technological pipes in cooling station, except cool agent pipes, shall be in compliance with instructions of interior color decoration in manufacturing houses.

Paint color of cool agent pipes within cooling station is applied according to TCVN 4206:1986.

4.5.12. There must be lighting system in the open space area where cooling station equipment is placed.

## 5. Heating

5.1 Heating is applied as a limted measures to ensure comfortable condition in certain hours through the year for some regions where it is not capable of air-conditioning.

5.2 Unless otherwise required, give priority of heating design to those types of construction works such as medical treatment, newborn care centers, maternity hospitals, kindergartens, etc.

5.3 Outdoor temperature calculation is determined according to Parameter level II for cold season.

5.4 Economic and technical considerations should be made when designing heating system in order to:

a) Select heat source: supplied by fuels (coal, oil, wood, etc.) and by electricity.

b) Select heating-by-air option to make use of this system for ventilation purpose in hot season, or local heating option using electric heater.

Central heating system (water, steam, etc.) should not be applied because of limited use in a year, high metal costs and big thermal inertia.

5.5 In case of using air-conditioning system for the purpose of heating in cold season, it is possible to use refrigeration in heat pump mode as a heat source when adequate and suitable FS are available according to Article 4.1.13.

## 6. Check and control

### *6.1 General instructions*

6.1.1. Checking and control system (checking and control of technical parameters, equipment protection, information, etc.) of ventilation, heating and air-conditioning systems is designed in order to:

a) Ensure environmental parameters, increase reliability of the system, close and open the system according to operation requirements or in case of problem.

b) Simplify operation stage, reduce service staff, save energy, optimalize controlling process.

6.1.2. The modernness and complexity of control system depend on the grade of house and construction work, the nature of the system and economic effectiveness.

6.1.3. The check and control system shall be implemented based on the simplest diagrams and solutions, minimizing the use of controlling, measuring and information equipment.

6.1.4. Controlling and measuring equipment should be unified and of the same grade and type, meeting technical requirements for the measuring environment and the assembling position: internal rooms or outside house; anti-corrosion, antifire, anti-explosion or normal.

*6.2 Checking*

6.2.1. Parameters to be checked:

a) In the air-heating system:
- Room temperature
- Temperature of the air supplied.

b) Air-conditioning system :
- Temperature and relative humidity inside the room
- Temperature and relative humidity behind the treating equipment
- Temperature and relative humidity of the environment outside the house

c) Local absorbing system in fire and explosion prone environment
- Concentration of fires and explosives.

6.2.2. Systems helping dangerous production phases: manufacturing room of Group A, B and F; absorbing system discharging toxic substances of grade 1, 2, dysfunctional ventilating systems, technical ventilating system beyond regular checking range, etc. must have alarm equipment informing the operation stop signal.

*Note: Requirement of this Article is not applied to ventilating systems of subordinate houses (WC, smoking rooms, storehouses, etc.)*

6.2.3. Technical safety parameters which may cause technical problems when not ensured, require the installation of checking and warning devices.

## Appendix 1

### Appropriate- optimum microclimate parameter for working states

| Labour states | Winter | | | Summer | | |
|---|---|---|---|---|---|---|
| | t° C | φ % | | t° C | φ % | |
| Resting | 22-24 | 60-75 | Resting | 22-24 | 60-75 | Resting |
| Light | 22-24 | 61-75 | Light | 22-24 | 61-75 | Light |
| Medium | 20-22 | 60-75 | Medium | 20-22 | 60-75 | Medium |
| Heavy | 18-20 | 60-75 | Heavy | 18-20 | 60-75 | Heavy |

## Appendix 2

### In- door microclimatic limits

| Type | Summer | | | | Winter | | |
|---|---|---|---|---|---|---|---|
| | Air temperature t° C | Humidity % | | Air temperature t° C | Humidity % | | Air temperature t° C |
| - Natural MC | ≤ 29,5 | ≤ 80 | ≥ 0,5 | 29 + 4/B | ≥ 21,5 | ≤ 80 | ≤ 0,1 |
| - Artificial MC | 25,5 | 60-70 | 0,3 | - | 24,5 | 60-70 | 0,05 |

Note: B- radiation angle between structures & heads

$$B=1 - 0,8\frac{x}{1}$$

x- Distance between heads & structures

*1 =; F – area of shielded enclosure*

## Appendix 3

### Outdoor calculating parameter

| Seasons | Level | Calculation temperature | Relative humidity $\varphi^{tt}$ % |
|---|---|---|---|
| Cold | I<br>II<br>III | $\frac{t^{T§}_{\min} \quad t^{TB}_{\min.TLN}}{2}$<br>$t^{TB}_{\min}$ | |
| Hot | I<br>II<br>III | $t^{T§}$<br>$\frac{t^{T§}_{\max} \quad t^{TB}_{13\ 15\ .TNN}}{2}$<br>$t^{TB}_{13\ 15\ .TNN}$ | |

Note:

- Out-door temperature ( ° C) &relative humidity
- Out-door minimum & maximum absolute temperature
- Average temperature between 13-15 PM of the coldest and hottest month
- Average humidity between 13-15 PM of the coldest and hottest month

TCVN 4088 : 1985 4th (13-15) data a not available so the 4th (13-15) humidity may apply the following methods :

- Identify $t^{min}$ of the month bases on the diagram No 3 of TCVN 4088-1985
- $\varphi^{o}$ follows A1 type of TCVN 4088 -1985
- $t^{max}$ : bases on table No 2 of TCVN 4088-1985
- Based on the parameter ( $t^{min}$ , $\varphi^{o}$ ) of the diagram J-d following d line – const to the value :

$$T = \frac{t^{max}tb + t^{min}tb}{2}$$ To find out $\varphi^{tt}$13-15

## Appendix 4

### Permissible concentration levels (NGCP) of toxic gases and in production rooms (According to CH - 245 - 71)

| Name of substance | NGCP | Name of substance | NGCP |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| Gases and airs (Mg/l) | mg/l | M-31 (0,0 dmetyl β- | 0,0001 |
| Acrolein | 0,0007 | etylmelapatanditionfotphat | |
| Amilacetat | 0,1 | Naphthalene | 0,02 |
| Amoniac | 0,02 | Rượu không no thuộc chuỗi béo | 0,002 |
| Anilin | 0,003 | (alilic, crotorylic...) | |
| Acetaldehit | 0,005 | Nitryl của axit acylic | 0,0005 |
| Acetone | 0,2 | Compounds of nitrobenzone | 0,001 |
| Petrol solven | 0,3 | Nitrobutan Nitrometan Nitropropa | 0,03 |
| Fuel petrol | 0,1 | Nitroetan Nitrobenzone Ozone | 0,03 |
| Benzene | 0,02 | Oxid Nitơ tính sang N2O5 | 0,03 |
| Butyl acetate | 0,2 | Oxit cacbon Oxit etylen Picalin | 0,03 |
| Vinyl acetate | 0,01 | Sulfuric acid, anhydrid sulfur | 0,003 |
| Hexaghen (group | 0,001 | Anhydrid sulfurous | 0,0001 |
| cyclotriacetylene) | | Hydro suynfua Metafos | 0,005 |
| Hexamêtilen diizoxiznat | | Methyl acetate | 0,02 |
| Điôxin Diclobenzôn Diclostirôn | | Metyl hexylxeton | 0,001 |
| Diclofiniltricloxilan | 0,00005 | Ete metylic của axt aoxylic Metyl | 0,005 |
| Dicloêtan | 0,01 | propilxeton Metylsytôc | 0,001 |
| 1,1 - dicloêtilen | 0,02 | Metyletylketon Monôbutilamin | |
| Diêtilamin | 0,05 | Monômetylamin Monôclostyrôn Rượu | |
| Izôprôpilnitrat | 0,001 | butilic Rượu metylic Rượu propylic Rượu | 0,01 |
| Iot | 0,01 | etylic Xtyrôn | 0,01 |
| Camphor | 0,05 | Tetralin Tetrauytrometan Tetracloheptan | 0,0001 |
| Caprolactam | 0,03 | Tetraclopentan Tetraclopropan | 0,01 |
| Kerosence | 0,005 | Bụi có nguồn gốc thực vật và | 0,2 |
| Xilidin | 0,001 | động vật có chứa dưới l0% SiO2 | 0,02 |
| Xilen (dimetil benzen) | 0,003 | Bụi bột ép và chất dẻo amin | 0,2 |
| Ligzôin | 0,01 | Các loại bụi khác Clorua mêtilen | 0,0001 |
| Hêxamêtilen diamin | 0,3 | Clomêtyltricloxinlan Clorôpen | 0,2 |
| Hycrazin, hidrathydrazin | 0,093 | Carbon tetrachlorous CCl4 | 0,01 |
| và sản phẩm cùng nhóm | 0,05 | | |
| Dêcalin | | | |

| | | | |
|---|---|---|---|
| Divinyl, giả butilen | 0,3 | Extralin Epiclohydrin Etilaxetat | 0,005 |
| Dimêtilamin | 0,001 | Ete êtilic | 0,05 |
| Dimêtilformemid | 0,0001 | Hêcxacloxiclôhexan (hỗn hợp các | 0,2 |
| Danil | | đồng phân) | 0,005 |
| Dinitrobenzôn | | Hêxacloxiclôhenxan (đồng phân ) | 0,2 |
| Dinitrotolu | 0,1 | Hêcxaclobênzôn | 1,0 |
| Hydroasen | 0,1 | Heptaclo Dinitrorodanbenzôn Octametil | 0,05 |
| Tereametyl chì | 0,001 | Pôliclopinen Pentaclonitrôbenzôn | 0,1 |
| Touluudin | 0,01 | Dinitroxotocrizôn Tiofốt | 0,0003 |
| Toluylendizoxianat | 0,01 | Clorindan | 0,001 |
| Toluene | 0,001 | Clotan | 0,001 |
| Trinytrotoluen | 0,001 | Etilphốtphat thủy ngân | 0,001 |
| Tricmhenzôn | 0,0003 | Etil clorid thủy ngân | |
| Tricloentylen | 0,000005 | Dôn khí kim loại, A và hợp | |
| Spilit trắng | 0,003 | chấtcủa chúng | 4,0 |
| Nhóm hydro cachua quy ra C | | Aluminium, aluminium oxide, aluminium | |
| Axit axetic | | alloy | |
| Fênylmẹtyldicloxilan | | Beryllium and compounds | 6,0 |
| Phenol | 0,0005 | Vanadium and compounds: vanadium | 10,0 |
| Focmandehid | 0,05 | oxide | 0,05 |
| Fosghen | 0,001 | vanadium oxide dust | 0,001 |
| Sulfur carbon | 0,1 | Ferôvanadi | 0,002 |
| Sylvan | 0,05 | Wolfram, calbid wolfram | 0,02 |
| Turpentine oil | 0,3 | Oxit sắt | 0,003 |
| Dầu salven | 0,3 | Cadmium oxide | 0,001 |
| Rượu amylic | 0,005 | Cobalt (cobalt oxide) Macgan | 0,2 |
| Fuafurol | 0,001 | Molipden | 0,3 |
| Clo | 0,005 | | 0,1 |
| Clobenzôn | 0,001 | Asen và anhydrid As | |
| Difenyl clo hóa | 0,0005 | Nickel, nickel oxide | |
| Oxit difenyl clo hóa | 0,01 | Lead, inorganic compounds of lead | 0,05 |
| Băng phiến clo hóa (băng phiến | 0,001 | Selenium | |
| hệ cao) | 0,3 | Anhydrid xelua | |
| Vinyl chloroe | 0,1 | Chloroe mercury HgCl2 | 0,9 |
| Hydro clorua và axit clohydric tính | 0,01 | Oxit tantali | 0,01 |
| chuyển sang hydroclorua Pirydin | 0,01 | Telua | 2,0 |
| Propil axêtat | 0,001 | Oxit tatan | 0,02 |
| Mercury | 0,05 | Tori | 0,2 |
| Hydro xianua và các muối xianmhidric | 0,001 | Triclophenoliat đồng | 0,5 |
| quy về HCN Xiclohecxanon | 0,0005 | Uranium (dissolved mixture) | 3,0 |
| Xiclohecxaronocxin | 0,001 | Uranium (undissolved mixture) Anhydrid | 0,05 |
| ***Bụi và dôn khí*** | | Crôm, crômet, bicrômat | 0,01 |
| Mineral dust and organic dust | | quy ra Cr2O3 | 0,2 |
| Dust containing over 70% SiO2 | 0,03 | Zinc oxide | 0,005 |
| Dust containing from l0% to 70% | | Ziniconi | 0,005 |
| SiO2 | | Dôn bari quy ra NaOH | mg/m3 |
| Asbestos dust and mixed dust | | | |
| containing over 10% asbestos | | | |
| Hydro phosphorus | 0,01 | | |
| Anhydrid phosphorus | | | 2,0 |
| Yellow phosphorus | | | |

| | | | |
|---|---|---|---|
| Muối axit florua quy ra HF | 0,005 | | |
| Hydro fiorua | 0,2 | | 0,001 |
| Glass fibre and mineral fibre dust | 0,00001 | | 0,1 |
| Silicate dust (dissolved powder, olivine, etc.) containing less than 10% free SiO2 | 0,0003 | | 0,5 |
| Boric, apatite, phosphorid cement dust containing less thanl0% SiO2 | | | 1,0 |
| Man-made grindstone dust (corund, carborund) | 0,01 | | 6,0 |
| Cement, clay, mineral stone and their mixture not containing SiO2 | 0,01 mg/m3 | | 4,0 0,1 0,5 |
| Coal dust and coal-soil dust containing more than l0% SiO2 | | | 0,3 4,0 |
| Coal dust containing less than l0% SiO2 | 1,0 | | 0,3 0,5 0,01 |
| Tobacco dust and tea dust | 2,0 | | 2,0 |
| Vegetation-origin dust (cotton, jute, grain, wood, wool, fur dust, etc.) containing more than l0%SiO2 | 2,0 | | 0,1 0,1 10,0 |
| | 0,0001 | | 0,01 |
| | 0,001 | | 10,0 |
| | 0,00003 | | 0,05 |
| | 0,001 | | 0,1 0,015 0,075 |
| | 0,0005 | | |
| | 30 | | 0,1 |
| | 4,0 | | 5,0 5,0 0,5 |
| | 5,0 | | |
| | 5,0 | | |
| | 6,0 | | |
| | 2,0 | | |

## Appendix 5
## Metal pipes used for ventilating heat supply

| Heat carring substance | Pipe type (defined diameter) | |
|---|---|---|
| | Under 50 | Over 50 |
| Hot water | Black steel pipe, light, conducting water and gas TOCT 3262:1962. | Hot water |
| Steam and condensed steam | Black steel pipe, normal, conducting water and gas TOCT 3262: 1962 | Steam and condensed steam |

*Notes:*

1. *Hot water pipes installed inside the work structure must increase one grade: use normal pipe.*
2. *When lack of light pipes, it is allowed to use normal pipes instead (increase grade of pipe).*
3. *When using pipes of other systems, requirements of this Standard should be ensured*
4. *Steel pipes with diameter over 100mm must be in compliance with TCVN 2979- 79 - TCVN3007 – 7*

## Appendix 6 (applied for Article 3.2.42)
## Coefficient K, used to determine permissible dust concentration in the air exhausted into the environment

| Limit concentration (N§CP) of dust in working area ($mg/m^3$) | Coefficient K | Limit concentration (N§CP) of dust in working area ($mg/m^3$) | Coefficient K |
|---|---|---|---|
| 2 and less than 2<br>From 2 to 4 | 0,3<br>0,6 | From 4 to 6<br>Over 6 | 0,8<br>1,0 |

## Appendix 7
## Minimum outdoor air supply volume via ventilating and air conditioning system

| Project types | Volume/ person | Out-door wind / person ($m^3/h$) | | Note |
|---|---|---|---|---|
| | | Natural ventilating availability | Natural ventilating un-availability | |
| Production buildings | <10 $m^3$<br>>20 $m^3$<br>any | 30<br>20<br>- | -<br>-<br>60, but not less than 1V (once passing through) | Production buildings |
| | | | 60, but not less than 20% volume passing through 75, but not less than 17.5% volume passing through 90, but not less than 15% volume passing through 105, but not less than 12.5% volume passing through 120, but not less than 10% volume passing through. | |
| Public and others | | Follow the similar regulations applied to other works. | 60 | Public and others |

## Appendix 8
## Resistance force coefficient of closed valve to determine air losses

| | Resistance force coefficient corresponds with valve area when it is open (m3 | | | |
|---|---|---|---|---|
| | < 0,5 | 0,5-1 | 1-2 | >2 |
| η | 2000 | 1000 | 600 | 400 |

## Appendix 9
## Engine power storage coefficient K

| Power on engine axis (KW) | Coefficient K corresponds with fan type | |
|---|---|---|
| | Centrifugal fan | Hanging fan |
| Under 0,5 | 1,5 | 1,2 |
| From 0,5 to 1 | 1,3 | 1,15 |
| From 1 to 2 | 1,2 | 1,1 |
| From 2 to 5 | 1,15 | 1,05 |
| Above 5 | 1,1 | 1,05 |

## Appendix 10
## Materials for air duct

| Particularity of transport environment in air duct | Materials to make pipes |
|---|---|
| - Air having t<800C and φ < 60% | - Concrete pipes and blocks, reinforced concrete; asbestos cement pipes; lime-plaster plates; plaster plates, etc. together with metal plates; steel plates; paper and board. ; |
| - Like above, but humidity φ > 60% | - Concrete pipes and blocks, reinforced concrete; asbestos cement pipes; plastic pipes and blocks; aluminium plates; plates of moisture-proof construction materials; glazed pipes; zinc-coated steel; soaked paper and |
| - Mixed environment of air and corrosion and dust | - Glazed pipes; plastic-soaked pipes; chemical-proof construction materials; steel plates; paper and board soaked or painted for protection in conformity with transport environment; acid-proof concrete; specialized concrete for corrosible environment |
| - Mixed environment of air and dust and neutral air. | - Glazed pipes; paper and board soaked in conformity with the gas environment; asbestos cement pipes (for gas environment); plastic pipes and plates (for gases); reinforced concrete pipes and plates (for gas environment); lime-plaster plates; slag-plaster (for gas environment); steel plates (for gas and dust environment); aluminium plates (for gases); plastic concrete blocks (for gas environment). |

*Notes:*

1. *When atmospheric moisture is above 60%, steel plates should be covered with moisture-proof and rust-proof paint.*
2. *For residential and public buildings and subordinate houses, air ducts made from non-metal materials are encouraged to use.*

## Appendix 11
## Dimensions of standard pipes

| Diameter of round pipe | Size of rectangular pipe | | |
|---|---|---|---|
| 80 | 80 x 80 | 200 x 200 | 500 x 500 |
| 100 | 80 x 100 | 200 x 250 | 500 x 630 |
| 125 | 80 x 125 | 200 x 315 | 500 x 800 |
| 160 | 80 x 160 | 200 x 400 | 500 x 1000 |
| 200 | 80 x 200 | 200 x 500 | 500 x 1250 |
| 250 | 80 x 250 | 200 x 630 | 630 x 630 |
| 315 | 100 x 100 | 250 x 250 | 630 x 800 |
| 400 | 100 x 125 | 250 x 315 | 630 x 1000 |
| 500 | 100 x 160 | 250 x 400 | 630 x 1250 |
| 630 | 100 x 200 | 250 x 500 | 800 x 800 |
| 800 | 100 x 250 | 250 x 630 | 800 x 1000 |
| 1000 | 100 x 315 | 315 x 315 | 800 x 1250 |
| 1250 | 125 x 125 | 315 x 400 | 800 x 1600 |
| 1400 | 125 x 160 | 315 x 500 | 1000 x 1000 |
| 1600 | 125 x 200 | 315 x 630 | 1000 x 1250 |
| 1800 | 125 x 250 | 315 x 800 | 1000 x 1600 |
| 2000 | 125 x 315 | 316 x 1000 | 1000 x 2000 |
| | 125 x 400 | 400 x 400 | 1250 x 1250 |
| | 160 x 160 | 400 x 500 | 1250 x 1600 |
| | 160 x 200 | 400 x 630 | 1250 x 2000 |
| | 160 x 250 | 400 x 800 | 1600 x 1600 |
| | 160 x 315 | 400 x 1000 | 1600 x 2000 |
| | 160 x 400 | 400 x 1250 | |
| | 160 x 500 | | |

## Appendix 12
## Grades of fire prevention and fire-explosion prevention for cooling stations

| Cooling agent | Place of machine room and room for cooling equipment | Grade of fire prevention and fire-explosion prevention |
|---|---|---|
| - Freon 12 and 22 | Indoor | E(*) B |
| - Amoniac | Indoor and outdoor | E |
| - Water in Br - Li refrigeration and steam flushing pump | Indoor and outdoor | |

*(*) Machine oil is not allowed to be kept in machine room*

## Appendix 13
## Air flow needed to supply for room to ensure required hygiene conditions

Air flow to be supplied should be equal to the maximum value according to the following formulas but cannot be less than those values according to Article 3.3.2; 3.3.6; 3.3.10 and Appendix N07 :

a) To dispose of redundant heat in the form of nhiet bien :

***Formula***

b) To dispose of redundant moisture (steam):

*Formula*

c) To dispose of total heat volume:

*Formula*

d) To dispose of toxic substances or dust

*Notes* : In the above formulas:

LV1 - LV4 - Air flow to be blown in (m3/h) Lc,b - Air flow to be absorbed locally (m3/h)

Qh , Q0 - Redundant heat in the form of existing heat and total heat (Kcal/h)

1,2 - Air volume weight (kg/m3)

tc.b , tr , tv - Respectively: air temperature in local absorbing hole, discharged air temperature and supplied air temperature

W - Redundant moisture amount in the room (g/h)

dc.b , dr , dv - Respectively: air temperature in local absorbing hole, dung am of discharged air and supplied air

Ic.b , Ir , Iv - Respectively: thermal capacity of air in local absorbing hole, thermal capacity of discharged air and supplied air .

G - Amount of toxic substances (or dust) discharged inside the room (mg/h)

Zc.b , Zr , Zv - Respectively: Concentration of toxic substances (or dust) in local absorbing hole, concentration of toxic substances (or dust) in discharged air and supplied air (mg/m3)

## Appendix 14
## Table of explosive safety grading

| Production line | Particularity of production | Dangerousness and explosiveness of industrial process | Name of production line (example) |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| A | Dangerous with regard to fire and explosion | In the production process, use gases with lower explosion limit equal to or less than 10% of air volume in room, or use liquids with burning temperature in gas form equal to or less than 280oC; or in case the above gases or liquids can make dangerous mixtures with regard to explosion which exceed 5% room volume; or inflammable and explosive substances act with water, with oxygen in the air or interact. | Workshops preparing and using natrium and kalium; workshops of factories producing man-made fibres and man-made rubber; Hydrogen producing stations; chemical workshops of man-made silk factories; workshops producing man-made liquid fuels, recovering and distilling organic dissolving liquid with burning temperature in gas form equal to or under 280oC; depots containing gas tanks; petrol depots; rooms containing alkaline batteries and acids of power plants; liquid pumping stations with burning temperature in gas form equal to or under 280oC |

| | | | |
|---|---|---|---|
| B | Dangerous with regard to fire and explosion | In the production process, use inflammable gases with lower explosion limit over 10% of air volume in room, or use liquids with burning temperature in gas form from 280oC to 610oC; or use inflammable liquids which are burnt up to or over burning temperature in the production process; gases or dusts and liquids with certain amount that can make an explosive mixture exceeding 5% of air volume in room. In the production process, inflammable dust or fibre is discharged with lower explosive limit equal to or less than 65g/m3 of room air. | Workshops producing and transporting coal dust or sawdust; stations cleansing liquid tanks with burning temperature in gas form from 280oC to 610oC; workshops crushing and grinding solids; workshops processing man-made rubber; workshops producing sugar; peat-crushing equipment; depots containing mazut of power plants; liquid pumping stations with burning temperature in gas form from 280$^{o}$C to 610$^{o}$C |
| C | Dangerous with regard to fire | In the production process, use liquids with burning temperature in gas form over 610oC; use inflammable solids and materials, inflammable dust or fibre discharged in the production process with lower explosive limit content over 65g/m3 of room air. | Workshops spliting wood; workshops making wooden fine handicrafts; workshops making mock-ups; workshops making wooden furniture; textile and garment factories; workshops of textile and paper-making industry with dry production process; enterprises preliminarily processing fibre and cotton; factories preliminarily processing fibre, jute and other kinds of fibre; screening and winnowing units of grinding factories and grain storehouses; , workshops recycling lubricant; workshops reboiling lubricant and distilling bitumen; depots containing inflammable materials and lubricant; open-cast oil depot and lubricant-containing equipment of power plants; electricity-distributing equipment with interrupter and electric equipment over 60 kg for an equipment unit; overpasses and balconies used to transport coal and peat; closed depots containing coal; storehouses containing mixed goods; liquid pumping stations with burning temperature in gas form over 610oC |
| D | Dangerous with regard to fire | In the production process, use uninflammable substances and materials in the burning-to-fire, burning or melting status, in which there is heat emission or spark or flame emission in the processing; or solids, liquids or gases to burn or use as fuels | Cast and metallury workshops; kiln parts of gas fuel producing stations; forge workshops; welding workshops; stations repairing railway engine run by steam and explosive engine; metal laminating workshops; explosive engine testing stations; house space where placing internal combustion engines; workshops processing metal by heat; main workshops of power plants, i.e. kiln room, turbine room, etc., electricity-distributing equipment with lubricant amount over 60 kg for an equipment unit; high voltage electricity laboratories; boiler stations, etc. |

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| E | Dangerous with regard to fire | In the production process, use uninflammable substances and materials in cool status. | Mechanical workshops processing cool metal (except magnesium alloy), grounds containing thermal materials (optics) .<br>Alkali producing workshops (except kiln part); wind fan stations; stations compressing air and other uninflammable substances; workshops recycling acids; stations repairing tram and tram engine; workshops producing technical devices; workshops coolly laminating metal; businesses coolly exploiting and processing minerals, asbestos, salt and other uninflammable materials; workshops of textile and paper industry with wet production process; workshops processing foodstuff, meat and fish; workshops repairing electric control board; water-cleaning works (filering, cleansing, etc.), pumping and absorbing stations of power plants; units containing cacbonic acid and chlorine; cleaning towers; uninflammable liquid pumping stations, etc. |
| F | Dangerous with regard to explosion | In the prodution process, use inflammable gases skipping liquefying stage where danger-in-explosion dust may make explosive mixture over 5% air volume in room when technology process happening in room can only explode (not burn afterwards), or can explode (not burn afterwards) when acting with water, oxygen in the air or interacting. | |