GROUP H

VENTILATION, AIR-CONDITIONING AND HEATING – DESIGN STANDARD

1. GENERAL PROVISIONS

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

3. Ventilation, air-conditioning and heating

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.

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	$29 + \frac{4}{B}$	≥ 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 φ^{tt} %
Cold	I II III	$\frac{t^{T}_{\min} \; t^{TB}_{\min .TLN}}{2}$ $t^{TB}_{\min}$	
Hot	I	t^{T}	

	II III	§ $t_{\max}^{T\,\S}$ $t_{13\ 15\ .TNN}^{TB}$ 2 $t_{13\ 15\ .TNN}^{TB}$	

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
- φ^{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}, φ^{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 φ^{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	0,00005	Metyl hexylxeton	0,001
Diclofiniltricloxilan	0,01	Ete metylic của axt aoxylic Metyl	0,005
Dicloêtan	0,02	propilxeton Metylsytôc	0,001
1,1 - dicloêtilen	0,05	Metyletylketon Monôbutilamin	
Diêtilamin	0,001	Monômetylamin Monôclostyrôn Rượu	

Izôprôpilnitrat	0,01	butilic Rượu metylic Rượu propylic Rượu	0,01
Iot	0,05	etylic Xtyrôn	0,01
Camphor	0,03	Tetralin Tetrauytrometan Tetracloheptan	0,0001
Caprolactam	0,005	Tetraclopentan Tetraclopropan	0,01
Kerosence	0,001	Bụi có nguồn gốc thực vật và	0,2
Xilidin	0,003	động vật có chứa dưới l0% SiO2	0,02
Xilen (dimetil benzen)	0,01	Bụi bột ép và chất dẻo amin	0,2
Ligzôin	0,3	Các loại bụi khác Clorua mêtilen	0,0001
Hêxamêtilen diamin	0,093	Clomêtyltricloxinlan Clorôpen	0,2
Hycrazin, hidrathydrazin	0,05	Carbon tetrachlorous CCl4	0,01
và sản phẩm cùng nhóm	0,3	Extralin Epiclohydrin Etilaxetat	0,005
Dêcalin	0,001	Ete êtilic	0,05
Divinyl, giả butilen	0,0001	Hêcxacloxiclôhexan (hỗn hợp các	0,2
Dimêtilamin		đồng phân)	0,005
Dimêtilformemid		Hêxacloxiclôhenxan (đồng phân)	0,2
Danil	0,1	Hêcxaclobênzôn	1,0
Dinitrobenzôn	0,1	Heptaclo Dinitrorodanbenzôn Octametil	0,05
Dinitrotolu	0,001	Pôliclopinen Pentaclonitrôbenzôn	0,1
Hydroasen	0,01	Dinitroxotocrizôn Tiofốt	0,0003
Tereametyl chì	0,01	Clorindan	0,001
Touluudin	0,001	Clotan	0,001
Toluylendizoxianat	0,001	Etilphốtphat thủy ngân	0,001
Toluene	0,0003	Etil clorid thủy ngân	
Trinytrotoluen	0,000005	Dôn khí kim loại, A và hợp	
Tricmhenzôn	0,003	chấtcủa chúng	4,0
Tricloentylen		Aluminium, aluminium oxide, aluminium	
Spilit trắng		alloy	
Nhóm hydro cachua quy ra C	0,0005	Beryllium and compounds	6,0
Axit axetic	0,05	Vanadium and compounds: vanadium	10,0
Fênylmẹtyldicloxilan	0,001	oxide	0,05
Phenol	0,1	vanadium oxide dust	0,001
Focmandehid	0,05	Ferôvanadi	0,002
Fosghen	0,3	Wolfram, calbid wolfram	0,02
Sulfur carbon	0,3	Oxit sắt	0,003
Sylvan	0,005	Cadmium oxide	0,001
Turpentine oil	0,001	Cobalt (cobalt oxide) Macgan	0,2
Dầu salven	0,005	Molipden	0,3
Rượu amylic	0,001		0,1
Fuafurol	0,0005	Asen và anhydrid As	
Clo	0,01	Nickel, nickel oxide	
Clobenzôn	0,001	Lead, inorganic compounds of lead	0,05
Difenyl clo hóa	0,3	Selenium	
Oxit difenyl clo hóa	0,1	Anhydrid xelua	
Băng phiến clo hóa (băng phiến	0,01	Chloroe mercury HgCl2	0,9
hệ cao)	0,01	Oxit tantali	0,01
Vinyl chloroe	0,001	Telua	2,0
Hydro clorua và axit clohydric tính	0,05	Oxit tatan	0,02
chuyển sang hydroclorua Pirydin	0,001	Tori	0,2
Propil axêtat	0,0005	Triclophenoliat đồng	0,5
Mercury	0,001	Uranium (dissolved mixture)	3,0

Hydro xianua và các muối xianmhidric quy về HCN Xiclohecxanon		Uranium (undissolved mixture) Anhydrid	0,05
Xiclohecxaronocxin	0,03	Crôm, crômet, bicrômat quy ra Cr2O3	0,01 0,2
Bụi và dôn khí		Zinc oxide	0,005
Mineral dust and organic dust		Ziniconi	0,005
Dust containing over 70% SiO2		Dôn bari quy ra NaOH	mg/m3
Dust containing from l0% to 70% SiO2	0,01		
Asbestos dust and mixed dust containing over 10% asbestos			2,0
Hydro phosphorus	0,005		
Anhydrid phosphorus	0,2		0,001
Yellow phosphorus	0,00001		0,1
Muối axit florua quy ra HF	0,0003		
Hydro fiorua			
Glass fibre and mineral fibre dust			0,5
Silicate dust (dissolved powder, olivine, etc.) containing less than 10% free SiO2	0,01		1,0 6,0 4,0
Boric, apatite, phosphorid cement dust containing less thanl0% SiO2	0,01 mg/m3		0,1 0,5
Man-made grindstone dust (corund, carborund)			0,3 4,0
Cement, clay, mineral stone and their mixture not containing SiO2			0,3 0,5
Coal dust and coal-soil dust containing more than l0% SiO2	1,0 2,0		0,01 2,0
Coal dust containing less than l0% SiO2			0,1 0,1
Tobacco dust and tea dust	2,0		10,0
Vegetation-origin dust (cotton, jute, grain, wood, wool, fur dust, etc.) containing more than l0%SiO2	0,0001 0,001 0,00003 0,001		0,01 10,0 0,05 0,1
	0,0005		0,015 0,075
	30		
	4,0		0,1
	5,0		
	5,0		5,0
	6,0		5,0 0,5
	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*