THE MINISTRY OF HEALTH -----	THE SOCIALIST REPUBLIC OF VIETNAM Independence - Freedom - Happiness --------
No. 3733/2002/QD-BYT	*Hanoi, October 10, 2002*

DECISION

PROMULGATING 21 LABOR HYGIENE STANDARDS, 05 PRINCIPLES AND 07 LABOR HYGIENE MEASUREMENTS

THE MINISTER OF HEALTH

Pursuant to the Law on People's health protection

Pursuant to the Government's Decree No. 68/CP of October 11, 1993 on defining the functions, tasks, powers and organizational structure of the Ministry of Health;

Upon obtaining the consent of the Ministry of Labor, War Invalids and Social Affairs in the Official Dispatch No. 941/LDTBXH-BHLD of April 02, 2002; Vietnam Chamber of Commerce and Industry in the Official Dispatch No. 0850/PTM-VPGC of April 17, 2002.

At the proposal of the Director of Defensive Medicine Department – the Ministry of Health

DECIDES:

Article 1. Promulgating together with this Decision:

1. Twenty one (21) Standards of labor hygiene applicable to facilities that employ workers.

2. Five (05) principles and seven (07) measurements of labor hygiene being fundamental guidance for establishing working systems and positions, working machinery and tools, labor classification.

Article 2. This Decision takes effect after 15 days as from its promulgation. The provisions on labor hygiene from section 1 to section 8 in the fourth part "Provisions on labor hygiene" in the Decision No. 505-BYT/QD on April 13, 1992 of The Minister of Health on promulgating a number of Temporary hygiene standards are abolished.

Article 3. The Director of Defensive Medicine Department is responsible to organize, direct and inspect the implementation of this Decision.

Article 4. the Chief officers, the Chief Inspector, the Director of Defensive Medicine Department – the Ministry of Health, Heads of units affiliated to the Ministry of Health, the Directors of the Services of Health of central-affiliated cities and provinces are responsible to implement this Decision.

FOR THE MINISTER OF HEALTH
DEPUTY MINISTER

Nguyen Van Thuong

TWENTY ONE (21) STANDARDS, FIVE (05) PRINCIPLES AND SEVEN (07) MEASUREMENTS OF LABOR HYGIENE

(Promulgated together with the Decision No. 3733/2002/QD-BYT of The Minister of Health on October 10. 2002)

Part 1: Twenty one (21) standards of labor hygiene

1. Standards of hygienic amenities

2. Standards of hygienic distance

3. Manual labor – Standards of task classification by energy consumption

4. Manual labor – Standards of task classification by heart rate

5. Carrying standard – Limited weight

6. Standards of lighting

7. Standards of microclimate

8. Standards of silicon dust

9. Standards of non-silicon dust

10. Standards of cotton dust

11. Standards of asbestos dust

12. Standards of noise

13. Standards of vibration

14. Standards of static magnetic field - Magnetic flux density

15. Standards of low-frequency magnetic field - Magnetic flux density

16. Standards of low-frequency electromagnetic field intensity and static electric field

17. Standards of intensity of electromagnetic field from 30kHz - 300GHz

18. Ultraviolet radiation – Acceptable limits

19. Standards of radioactivity

20. X-ray radiation – Acceptable limit

21. Chemicals – Acceptable limits in the working air.

Part 2: Five (05) principles and seven (07) measurements of labor hygiene

1. Principle 1 – Ergonomic design of labor systems

2. Principle 2 – Ergonomic design of labor positions

3. Principle 3 – Ergonomic design of machinery and tools

4. Principle 4 – Work area layout

5. Principle 5 – Work positions with computers

6. Measurement 1 – Work positions with computers

7. Measurement 2 – Height of work surfaces

8. Measurement 3 – Distance from eyes to things

9. Measurement 4 - View angle

10. Measurement 5 – Footrest

11. Measurement 6 – Lifting height

12. Measurement 7 – Physiological measurements of thermal strain - Limit values

Part 1

TWENTY ONE (21) STANDARDS OF LABOR HYGIENE

I. STANDARDS OF HYGIENIC AMENITIES

1. Scope of regulation: Specifying the number of hygienic amenities for workers.

2. Subjects of application: The facilities that employ workers (production facilities, business establishments, offices…)

3. Definition

The term is construed as follows:

- Hygienic amenities mean: The hygiene works and general amenities serving workers at facilities that employ workers.

4. Standards of hygienic amenities

Hygiene facilities	Standard	Scope of application
Latrine pit	By shift: 1- 10 people/pit 11- 20 people /pit 21 - 30 people /pit	Facilities with: 1- 100 people 101 - 500 people Over 500 people
Urinary pit	By shift: 1- 10 people /pit 11- 20 people /pit 21 - 30 people /pit	Facilities with: 1- 100 people 101 - 500 people Over 500 people
Bathroom	By shift: 1- 20 people /room 21- 30 people / room Over 30 people / room	Facilities with: 1- 300 people 301 - 600 people Over 600 people
Menstrual hygiene room	By shift: 1- 30 females/ room Over 30 females/ room	Facilities with: 1 - 300 people Over 300 people
Hand-washing faucet	By shift: 1 - 20 people / faucet 21 - 30 people / faucet Over 30 people / faucet	Facilities with: 1 - 100 people 101 - 500 people Over 500 people
Emergency clean water faucet	 1 - 200 people /faucet Over 200 people / faucet	Facilities with: 1 - 1,000 people Over 1,000 people
Clothes storing place	1 person/slot, hook, or small locker.	Facilities employing workers (production facilities, business establishments, offices…)
Potable water	1.5 liter/person/shift	Facilities hiring workers (production facilities, business establishments, offices…)

II. STANDARDS OF HYGIENIC DISTANCE

1. Scope of regulation: Minimum distance from the production facility to residential areas.

2. Subjects of application: These standards are applicable to facilities separately situated outside processing and exporting zones or industrial zones that emit toxic substances that harm the environment and human health.

3. Definition

The term is construed as follows:

- Standards of hygienic distance: is the minimum distance from the emission sources in the house, the producing facility or the technology line to residential areas.

4. Standards of hygienic distance:

4.1. Fuel

4.1.1. A distance of 1,000m for facilities:

a. Producing gas, lighting gas, vapor with production over 50,000 m^3/hour.

b. Producing inflammable gas with production over 5,000 ton/year.

c. Conducting petroleum refinery and petrochemistry with over 0.5% sulphur.

d. Filtering and treating coal

e. Processing fuel slabs.

f. Producing semi-finished products being naphthalene with production over 2,000 ton/year.

g. Producing hydrocarbons by chloridization and hydrochloridization.

4.1.2. A distance of 500m for facilities:

a. Producing inflammable gas from fossil coal or peat with production from 5,000 – 50,000 m^3/hour.

b. Processing fossil coal powder.

c. Conducting petroleum refinery and petrochemistry with production under 0.5% sulphur.

d. Producing acetylene from natural gas.

e. Producing inflammable gas with production from 1,000 to 5,000 m^3/hour.

f. Processing fluoric gas.

g. Producing acetylene from hydrocarbide

4.1.3. A distance of 100m for facilities:

a. Producing inflammable gas from fossil coal or peat with production under 5,000 m^3/hour.

b. Producing inflammable gas with production under 1,000 m^3/year.

c. Producing matches

d. Producing compressed oxygen and hydrogen

e. Being fuel depots.

g. Selling petrol.

h. Storing inflammable and explosive materials.

4.2. Chemicals, fertilizers and rubber

4.2.1. A distance of 1,000m for facilities:

a. Producing nitrogen and nitrogenous fertilizer.

b. Producing industrial finished products being dye from benzene and ether with production over 1,000 ton/year.

c. Producing NaOH by electrolysis

d. Producing oil (benzol, toluene, xylol naphthol, phenol cresol, anthracene, phenantrol, acridine, carbazole)

e. Producing chloride rubber “nairit” in facilities that produce chlorine.

f. Producing synthetic ethyl ether.

g. Producing methyl ether and ethyl solution.

h. Producing synthetic chemicals.

i. Producing organic and inorganic acid

- Sulfuric acid.

- Hydrochloric acid

- Nitric acid

- Picric acid.

- Flavic, criolit and fluoric salt.

- Aminolenan.

- Xinhin.

j. Producing

- Mercury.

- Arsenic and inorganic compounds with arsenic.

- Chorine.

- Phosphorus.

- Corundum.

- Beryllium.

4.2.2. A distance of 500m for facilities:

a. Producing ammonia

b. Producing

- Niobium.

- Tantalum.

- Rare metal using chloridization.

- Baryum chloride using hydrosulphur.

- Industrial grease (hydrogenated by non-electrolyzing methods).

c. Producing products from asbestos.

d. Producing industrial semi-finished products being aniline paint from benzene and ether with production over 1,000 ton/year.

e. Producing polyethylene and polypropylene from petroleum gas.

f. Producing synthetic fatty acid.

g. Producing synthetic rubber.

h. Recycling rubber.

i. Producing rubber, ebonite and rubber paper.

j. Vulcanizing rubber using hydrosulfur.

k. Producing nicotine.

l. Producing phenol formaldehyde and other artificial powder with production over 300 ton/year.

m. Producing artificial mineral paint.

n. Vulcanizing rubber using hydrosulfur.

o. Recycling rubber.

p. Producing spray paint.

q. Producing, processing, packing, preserving plant protection chemicals.

r. Producing phosphate and superphosphate.

s. Producing soap with production over 2,000 ton/year.

4.2.3. A distance of 100m for facilities:

a. Producing glycerine.

b. Producing natural rubber.

c. Producing shoe rubber without using dusty soluble organic substances.

d. Producing plastic being polyvinyl chloride, vinyl, polyurethane foam, spongy plastic, plastic glass, spyropo.

e. Producing perfume.

f. Vulcanizing rubber without using sulfurcarbon.

g. Producing artificial gems.

h. Producing plastic products or processed from semi-finished plastic materials.

i. Producing soap with production under 2,000 ton/year.

j. Producing products from synthetic powder, polymer and plastic using various methods.

4.3. Ferrous metallurgy

4.3.1. A distance of 1,000m for facilities:

a. Producing magnesium (Chloridizing method).

b. Refining cast iron that the total capacity of the blast furnaces is over 1,500 m^3.

c. Producing aluminum by electrolysis

d. Refining steel using open-hearth furnace method and transitional furnace with production over 1,000,000 ton/year.

e. Producing ferrous alloy.

4.3.2. A distance of 500m for facilities:

a. Producing magnesium (by non-chloridizing method).

b. Refining cast iron that the total capacity of the blast furnaces from 500 to 1,500 m^3.

b. Producing cast iron pipe with production over 10,000 ton/year.

d. Refining steel using open-hearth furnace method, electric furnace and transitional furnace with production under 1,000,000 ton/year.

e. Producing lead-sheathed cable insulated rubber-sheathed cable

4.3.3. A distance of 100m for facilities:

a. Producing bare cable.

b. Processing cast iron, steel with production under 10,000 ton/year.

c. Producing metal electrodes.

4.4. Non-ferrous metallurgy

4.4.1. A distance of 1,000m for facilities:

b. Re-processing non-ferrous metal with production over 3,000 ton/year.

b. Refining non-ferrous metal directly from ore and refined ore.

c. Burning non-ferrous metal ore and burned piryte.

4.4.2. A distance of 500m for facilities:

a. Producing non-ferrous metal with production over 2,000 ton/year.

b. Re-processing non-ferrous metal with production from 1,000 to 3,000 ton/year.

c. Producing zinc, copper, nickel, cobalt by electrolyzing solvent with water.

4.4.3. A distance of 100m for facilities:

a. Producing antimony by electrolysis.

b. Plating with zinc, chrome, nickel

4.5. Building material

4.5.1. A distance of 1,000m for facilities:

a. Producing porland cement, porland slag cements, puzolan cement with production over 150,000 ton/year.

b. Producing magnesite lime, dolomitic lime and samot lime using spinning furnace or other kinds of furnaces except for manual furnace.

4.5.2. A distance of 500m for facilities:

a. Producing porland cement, porland slag cements, puzolan cement with production under 150,000 ton/year.

b. Producing plaster.

c. Producing building materials (stones, sand, gravel).

d. Producing local cement with production under 5,000 ton/year.

e. Producing magnesite lime, dolomitic lime using manual furnaces.

f. Producing concrete, asphalt.

g. Producing glass wool and slag wool.

h. Producing asphalt paper.

4.5.3. A distance of 100m for facilities:

a. Producing fibro-cement and flagstones

b. Producing artificial stones and products from concrete.

c. Casting stones.

d. Producing products from ceramics and fireproof products.

e. Producing glass.

f. Producing building materials using scrap from thermo-electric power plants.

g. Producing products from porcelain.

h. Producing plaster products.

i. Producing products from clay.

j. Producing stones using non-explosive methods and processing natural stones.

4.6. Treating timber and forest products

4.6.1. A distance of 1,000m for facilities:

- a. Producing charcoal not using the pyrolytic method.

4.6.2. A distance of 500m for facilities:

a. Seasoning timber.

a. Producing charcoal by pyrolysis.

4.6.3. A distance of 100m for facilities:

a. Producing wood fiber.

b. Cutting wood; producing plywood and wooden furniture.

c. Building wooden ships and boats.

d. Producing materials from sedge, grass, straw, laminate.

e. Producing products from wood fiber (shavings laminate, wood fiber laminate, wood fiber cement laminate).

f. Producing sedge cloth.

g. Producing wooden furniture, coffins, floor timber.

h. Building wooden ships and boars.

4.7. Textile and garment

4.7.1. A distance of 500m for facilities:

Producing textile and thread using chemicals to treat, bleach and dye.

4.7.2. A distance of 100m for facilities:

- Producing textile and thread without dyeing, producing garment.

4.8. Cellulose and paper

4.8.1. A distance of 1,000m for facilities:

- Producing cellulose by sulphide acid, bisulphide acid and monosulphid acid methods that burn sulphur.

4.8.2. A distance of 500m for facilities:

- Producing fenylaldehyt cloth, paper coils and laminates with production over 100 ton/year.

4.8.3. A distance of 100m for facilities:

a. Producing fenylaldehyt cloth, paper coils and laminates with production under 100 ton/year.

b. Producing various kinds of paper and cardboard, products from wood, bamboo, cellulose without using liquified sulfur gas.

4.9. Tanning leather and products from leather and leatherette

4.9.1. A distance of 500m for facilities:

- Producing leatherette using dusty soluble organic substances.

4.9.2. A distance of 100m for facilities:

a. Producing leatherette using polyvinylchloride and other powders without using dusty soluble organic substances.

b. Tanning cattle

4.10. Food

4.10.1. A distance of 500m for facilities:

a. Being cattle farm with over 1,000 head.

b. Being slaughterhouse that process fish (fat, oil, fin).

c. Being facilities taking fat from sea animals.

d. Being facilities boiling and cleaning food.

e. Being station for rinsing and cleaning the carriages after carrying cattle.

f. Being sugar plants.

g. Being fishery facilities.

4.10.2. A distance of 100m for facilities:

a. Producing albumin.

b. Producing wine.

c. Grinding, producing cattle feed.

d. Producing meat and freezing meat.

e. Treating coffee.

f. Producing vegetable oil.

g. Producing vegetable butter.

h. Being fruit factories.

i. Producing dextrin, sugar, honey.

j. Boiling cheese.

k. Canning fish, processing fish with waste-recycling workshops, fish factory-chains.

l. Producing powder, alcohol and seasoning.

m. Producing cigarettes using yeast.

n. Producing acetone butyl.

o. Producing beer (together with malt and yeast).

p. Producing canned food.

q. Being fruit depots.

r. Producing sugar lumps.

s. Producing noodles.

t. Producing smoked fish.

u. Producing milk and butter (from animals).

v. Producing sausage with production over 3 ton/shift.

w. Producing sweet with production of 20,000 ton/year or above.

x. Producing bread.

y. Processing food.

z. Producing vinegar.

aa. Freezing food with capacity over 600 ton.

bb. Producing fruit wine.

cc. Producing fruit juice.

dd. Producing Cognac.

ee. Rolling cigarettes, hatched and dried tobacco.

4.11. Hygiene technical constructions and public amenities

4.11.1. A distance of 1,000m for:

a. Yards for storing and classifying rubbish (solids and liquids) and scrap.

b. Ash pile that stinks or discomposing waste pile.

4.11.2. A distance of 500m for:

a. Rubbish recycling and burning plants.

b. Hygienic waste burial yards.

c. Rubbish classification yards.

d. Industrial waste burial yards.

e. Parking yard of means of waste transport.

f. Reservoir for sewage from cities and town, sewage treatment zones.

g. Graveyards

h. Depots for recyclable materials.

4.11.3. A distance of 100m for:

- Temporary depots of untreated waste materials.

III. MANUAL LABOR – STANDARDS OF TASK CLASSIFICATION BY ENERGY CONSUMPTION

1. Scope of regulation: These standards are applicable to dynamic labor tasks (that release apparent energy) These standards do not apply to static labor tasks (that does not release apparent energy).

2. Subjects of application The workers at facilities that employ workers.

3. Definition

The terms in these standards are construed as follows:

- Energy consumption: is the amount of energy being used during the operation or the idle period. Usually represented in watt (W), kilocalorie per minute or per hour (Kcal/minute or Kcal/hour) or Kcal/kg of body weight/minute, or Kcal/minute/m^2 of body area.

- Energy consumption by netto: Is the energy consumption while working or resting excluding fundamental metabolism.

- Energy consumption by brutto: Is the energy consumption while working or resting including fundamental metabolism.

4. Standards of classification

Table 1. Classifying tasks by energy consumption

Class	Brutto energy consumption (Kcal/Kg/minute)	
	Male	Female
Light	< 0.062	< 0.050
Medium	0.062 – 0.080	0.050 – 0.065
Heavy	0.080 – 0.127	0.065 – 0.095
Very heavy	0.127 – 0.160	0.095 – 0.125
Extremely heavy	0.160 – 0.200	0.125 – 0.155
Maximum	> 0.20	> 0.155

IV. MANUAL LABOR – STANDARDS OF TASK CLASSIFICATION BY HEART RATE

1. Scope of regulation: These standards are applicable to the labor tasks (that release apparent energy) in environments of which the temperature does not exceed 32^0C. These standards do not apply to static labor tasks (that does not release apparent energy).

2. Subjects of application The workers at facilities that employ workers.

3. Definition

The term in these standards is construed as follows:

- Labor heart rate *is the heart rate being monitored while the subject has been working at least 3 minutes.*

4. Standards of classification

Class	Heart rate (beat/minute)
Light	< 90
Medium	90 - 100
Heavy	100 - 120
Very heavy	120 - 140
Extremely heavy	140 - 160
Maximum	>160

Note: The labor heart rate may be extrapolated from the heart rate of the first recovery minute multiplied with 1.14.

V. CARRYING STANDARDS – LIMITED WEIGHT

1. Scope of regulation: These standards specify the maximum carrying weight for each load of a person that have adapted to strenuous manual labor while doing regular or irregular carrying jobs.

2. Subjects of application: the workers at facilities employing workers.

3. Limit values:

Norm	Limit (kg)	
	Male	Female
Regular carrying jobs	40	30
Irregular carrying jobs	20	15

VI. LIGHTING STANDARDS

1. Scope of regulation: the requirements for lighting hygiene at workplaces in offices and workshops.

2. Subjects of application: the facilities that employ workers. These standards are not applicable to outdoor workplaces.

3. Cited standards

The values specified in these standards are recommendations in ISO 8995-1998 and equivalent to TCVN 3743 – 83.

4. Acceptable values

The minimum light intensity for the works is prescribed in Table 1. The maximum value must not exceed 5,000 lux for filament bulbs and 10,000 lux for fluorescent lamps.

Table 1: Light intensity

Kind of interior/work	**Class of work**	**Light intensity (lux)**	
		Fluorescent lamp	**Incandescent lamps** *
Indoor shared areas			
Ventilation area, corridor	D - E	50	30
Staircase, elevator	C - D	100	50
Locker room, restroom	C - D	100	50
Warehouse	D - E	100	50
Assembly workshops			
Manual tasks, heavy-duty machine assembly	C - D	200	100
Medium tasks, car assembly	B - C	300	150
Precision works, electronics assembly	A - B	500	250
Precision works, tool assembly	A - B	1,000	500
Chemicals			
Automated processes	D - E	50	30
Uncrowded production area	C - D	100	50
Shared interior	C - D	200	100
Laboratory	C - D	300	200
Medicine preparation	C - D	300	200
OTK	A - B	500	250
Colorimetry	A - B	750	400

Producing rubber pad	A - B	300	150
Garment industry			
Sewing	A - B	500	250
OTK	A - B	750	375
Ironing	A - B	300	150
Electricity industry			
Cable production	B - C	200	100
Telephone network installation	A - B	300	200
Line installation	A - B	500	250
Radio assembly	A - B	750	400
Extreme precision assembly of electronic components	A - B	1,000	500
Food industry			
Shared working area	C - D	200	100
Automated processes	D - E	150	75
Manual processing, OTK	A - B	300	200
Casting industry			
Casting workshop	D - E	150	75
Raw casting, core casting	C - D	200	100
Precision casting, core making, OTK	A - B	300	200
Glass and ceramics industry			
Furnace workshop	D - E	100	50
Casting, molding, mixing room	C - D	200	100
Finishing, glazing, polishing	B - C	300	150
Coloring, decorating	A - B	500	250
Grinding glass, precision works	A - B	750	400
Iron and steel industry			
Production area without manual work	D - E	50	30
Production area with occasional manual work	D - E	100	50
Fixed workplace in the factory	D - E	300	150
Supervision place and OTK	A - B	300	200
Leather industry			
Share working area	B - C	200	100
Molding, cutting, sewing, producing shoes	A - B	500	250
Quality testing, classifying, comparing	A - B	750	400
Machine and machine testing			
Unfixed works	D - E	150	75
Manual works, non-manual works, welding	C - D	200	100

Non-manual works with automated machines	B - C	300	150
Precision works, working with machines, precise machines, machine testing	A - B	500	250
Extremely precise works, measurement, OTK, complicated details	A - B	1,000	500
Painting and coloring			
Immersion painting, spraying raw paint	D - E	200	100
Usual painting, spraying and finishing	A - B	500	250
Correcting and comparing color	A - B	750	400
Paper industry			
Producing paper and cardboard	C - D	200	100
Automated production	D - E	150	75
OTK, classification	A - B	300	150
Printing and bookbinding			
Printer room	C - D	300	150
Editing and reading room	A - B	500	250
Precise testing, revising, acid carving	A - B	750	375
Color publishing and printing	A - B	1,000	500
Carving steel and copper	A - B	1500	750
Bookbinding	A - B	300	150
Typesetting, embossing	A - B	500	250
Textile industry			
Ornamenting	D - E	200	100
Spinning thread, coiling, winding, dyeing	C - D	300	150
Spinning small thread, weaving	A - B	500	250
Sewing, OTK	A - B	750	375
Carpentry workshop			
Sawing area	D - E	150	75
Sitting works, assembly	C - D	200	100
Comparing, selecting wood	B - C	300	150
Finishing, OTK	A -B	500	250
Office			
Shared rooms	A - B	300	150
Professional planning room	A - B	500	250
Graphic room	A - B	500	250
Conference room	A - B	300	150
Shops			
General lighting at shops			

Big shopping malls	B - C	500	250
Small shops	B - C	300	150
Supermarket	B - C	500	250
School			
General lighting	A - B	300	150
Office	A - B	300	150
Briefing room	A - B	300	150
Display room	A - B	500	250
Laboratory	A - B	300	150
Art display room	A - B	300	150
Hall	C - D	150	75
Hospital			
Areas			
General lighting	A - B	50	30
Diagnosis room	A - B	200	100
Reading room	A - B	150	100
Night shift	A - B	3	
Diagnosis room:			
General lighting	A - B	300	150
Localized diagnosis	A - B	750	375
Intensive treatment			
Bed-head	A - B	30	20
Observation place	A - B	200	100
Workplaces of nurses	A - B	200	100
Surgery room			
General lighting	A - B	500	250
Spot lighting	A - B	10,000	5,000
Automated examination room			
General lighting	A - B	500	250
Spot lighting	A - B	5,000	2.500
Pharmaceutical and test room			
General lighting	A - B	300	150
Spot lighting	A - B	500	250
Consultancy room			
General lighting	A - B	300	150
Spot lighting	A - B	500	250

Notes:

- A: Works that require extreme precision

- B: Works that require high precision

- C: Works that require precision

- D: Works that require mediocre precision

- E: Works that require little precision

** For places that use both fluorescent lamps and incandescent lamps, the incandescent lamp intensity shall prevail*

VII. MICROCLIMATE STANDARDS

1. Scope of regulation:

These standards specify the temperature, humidity, air speed, heat radiation intensity.

2. Subjects of application: all facilities that employ workers**.**

3. Cited standards

The value specified in these standards are equivalent to TCVN 5508 - 1991

4. Acceptable values

Table 1: Requirements of temperature, humidity, air speed, heat radiation intensity.

Time (season)	Work	Air temperature(^{0}C)		Air humidity (%)	Air speed (m/s)	Heat radiation intensity (W/m^2)
		Max	Min			
Cold season	Light Medium Heavy		20 18 16	80 or under	0.2 0.4 0.5	35 when more than 50% of the human body surface is exposed 70 when more than 25% of the human body surface is exposed
Hot season	Light Medium Heavy	34 32 30		80 or under	1.5	100 when less than 25% of the human body surface is exposed

For each measurement:

The temperature must not exceed 32^{0}C. The production area must not be hotter than 37^{0}C.

The temperature difference between the production area and outdoors is from 3^{0}C to 5^{0}C.

The relative humidity: 75 - 85%.

The wind speed must not exceed 2m/s.

The heat radiation intensity: 1 cal/cm^2/minute.

Table 2: Acceptable limits by Yaglou thermal index

Kind of work	Light	Medium	Heavy
Continuous work	30.0	26.7	25.0
50% working, 50% at rest	31.4	29.4	27.9
25% working, 75% at rest	33.2	31.4	30.0

VIII. STANDARDS OF SILICON DUST

1. Scope of regulation:

These standards specify the limited concentration of the dust that contains silicon dioxide (SiO_2).

2. Subjects of application: the facilities that employ workers**.**

3. Cited standards

The value specified in these standards are equivalent to TCVN 5509 - 1991

4. Limit values:

4.1. The maximum acceptable concentration of dust by particle

Table 1: The maximum acceptable concentration of dust by particle

Group of dust	Silicon content (%)	Overall dust concentration (particle/cm^3)		Respiratory dust concentration (particle/cm^3)	
		By shift	By time	By shift	By time
1	From over 50 to 100	200	600	100	300
2	From over 20 to 50	500	1,000	250	500
3	From over 5 to 20	1,000	2,000	500	1,000
4	From 5 and fewer	1,500	3,000	800	1,500

4.2. The maximum acceptable concentration of dust by weight

Table 2: The maximum acceptable concentration of dust by weight

Group of dust	Silicon content (%)	Overall dust concentration (mg/m^3)		Respiratory dust concentration (mg/m^3)	
		By shift	By time	By shift	By time
1	100	0.3	0.5	0.1	0.3
2	From over 50 to under 100	1,0	2.0	0.5	1.0
3	From over 20 to 50	2.0	4.0	1.0	2.0
4	From 20 and fewer	3.0	6.0	2.0	4.0

IX. STANDARDS OF NON-SILICON DUST

1. Scope of regulation:

These standards specify the limited concentration of the dust without silicon dioxide (SiO_2).

2. Subjects of application: the facilities that employ workers.

3. Limit values:

Table 1: The maximum acceptable concentration of non-silicon dust

Kind	Substance	Overall dust concentration (mg/m^3)	Overall dust concentration (mg/m^3)
1	Activated carbon, aluminum, bentonite, diatomite, graphite, kaolin, pyrite, talcum powder	2	1
2	Bakelite, coal, ferric oxide, zinc oxide, titanium dioxide, silicate, apatite, beryl, phosphatide, limestone, pearlite, marble, portland cement	4	2
3	Dust of herb, animal: tea, tobacco, wood dust, cereal dust	6	3

4	Organic and inorganic dust not belonging to kind 1, 2, 3	8	4

X. STANDARDS OF COTTON DUST

1. Scope of regulation:

These standards specify the limited concentration of dust of cotton and artificial cotton.

2. Subjects of application: the facilities that employ workers.

3. Limit values:

The maximum acceptable concentration of cotton dust (sampling for 8 hours): 1 mg/m^3

XI. STANDARDS OF ASBESTOS DUST

1. Scope of regulation:

These standards specify the acceptable values of vocational exposures to every kind of asbestos dust belonging to the Serpentine (Chrysotile) group in the air of the production area.

2. Subjects of application: the facilities that workers.

3. Limit values:

Table 1: The acceptable values of vocational exposures to asbestos dust

No.	Substance	In 8 hours (fiber/ml)	In 1 hour (fiber/ml)
1	Serpentine (Chrysotile)	0.1	0.5
2	Amphibole	0	0

XII. STANDARDS OF NOISE

1. Scope of regulation:

These standards specify the acceptable noise levels at workplaces in workshops, factories and agencies affected by the noise.

2. Subjects of application: Every facility that employs workers.

3. Cited standards

The acceptable values specified in these standards are equivalent to TCVN 3985 - 1999

4. Acceptable levels

4.1. The continuous noise level equivalent to **Leq dBA** at workplaces must not exceed **85 dBA in 8 hours**.

4.2. If the time of exposure to the noise **reduces by 50%,** the acceptable noise level may **increases 5 more dB.**

For **4 hours** of exposure, 5 dB increased, the acceptable level is **90 dBA**

2 hours ***95 dBA***

1 hour ***100 dBA***

30 minutes ***105 dBA***

15 minutes ***110 dBA***

< 15 minutes ***115 dBA***

The maximum loudness is 115 dBA.

Only exposure to noise under **80 dBA** is acceptable for the remaining time of the working day .

4.3. The acceptable noise pressure level for **noise under 5 dB** compared to the values specified in section 4.1, 4.2.

4.4. *In order to achieve the productivity at various working positions, the noise pressure level at such places must not exceed the values in the below table.*

Table 1: The noise pressure level at working positions

Work positions	Limit of noise level or the equivalent (dBA)	Limit of noise level (dB) of the corresponding octave (Hz)							
		63	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
1. Working areas of workers, places with workers in workshops and factories	85	99	92	86	83	80	78	76	74
2. Monitoring and remote control rooms without telephone, laboratories, computer rooms with noisy equipment.	80	94	87	82	78	75	73	71	70
3. Monitoring and remote control rooms with telephone, coordination room, precision assembly room, typing room..	70	87	79	72	68	65	63	61	59
4. Functional, administrative, accounting, planning, statistics rooms.	65	83	74	68	63	60	57	55	54
5. Mental working, designing, researching, statistics, programming, figure processing rooms and theoretic laboratory	55	75	66	59	54	50	47	45	43

XIII. STANDARDS OF VIBRATION

1. Scope of regulation:

These standards specify the acceptable vibration levels of chairs, working floors, control devices and tool handles that produces vibration affecting the workers during the production.

2. Subjects of application: Every facility that employ workers**.**

3. Cited standards

These standards are equivalent to TCVN 5127 - 90

4. Acceptable rate

The vibration levels at the working places must not exceed the values specified in Table 1, 2, 3.

Table 1: Vibration of working floors and chairs

Frequency band (Hz)	Acceptable vibration velocity (cm/s)	
	Vertical vibration	**Horizontal vibration**
1 (0.88 – 1.4)	12.6	5.0
2 (1.4 – 2.8)	7.1	3.5
4 (2.8 – 5.6)	2.5	3.2
8 (5.6 – 11.2)	1.3	3.2
16 (11.2 – 22.4)	1.1	3.2

31.5 (22.4 - 45)	1.1	3.2
63 (45 - 90)	1.1	3.2
125 (90 - 180)	1.1	3.2
250 (180 - 355)	1.1	3.2

Table 2: Vibration of control devices

Frequency band (Hz)	Acceptable vibration velocity (cm/s)	
	Vertical vibration	Horizontal vibration
16 (11.2 – 22.4)	4.0	4.0
31.5 (22.4 - 45)	2.8	2.8
63 (45 - 90)	2.0	2.0
125 (90 - 180)	1.4	1.4
250 (180 - 355)	1.0	1.0

Table 3: Vibration of the tool handles

Frequency band (Hz)	Acceptable vibration velocity (cm/s)	Correction coefficient k_0*
8 (5.6 – 11.2)	2.8	0.5
16 (11.2 – 22.4)	1.4	1
31.5 (22.4 - 45)	1.4	1
63 (45 - 90)	1.4	1
125 (90 - 180)	1.4	1
250 (180 - 355)	1.4	1
500 (355 - 700)	1.4	1
1,000 (700 - 1400)	1.4	1

* The correction coefficient k_0 is used for calculating the corrective vibration velocity V_{hD} (or total vibration velocity*)*

The acceptable corrective vibration velocity must not exceed *4 cm/s in 8 hours*

The acceptable V_{hD} by time:

8 hours – 4.0 cm/s 4 hours – 5.6 cm/s

7 hours – 4.2 cm/s 3 hours – 6.5 cm/s

6 hours – 4.6 cm/s 2 hours – 8.0 cm/s

5 hours – 5.0 cm/s 1 hours – 11.3 cm/s

< 0.5 hours under 16 cm/s

XIV. STANDARDS OF STATIC MAGNETIC FIELD - MAGNETIC FLUX DENSITY

1. Scope of regulation:

These standards specify the acceptable levels of magnetic flux density of static magnetic field in working environments affected by the static magnetic field.

2. Subjects of application: the facilities that employ workers**.**

3. Definition

The terms in these standards are construed as follows:

- Medical equipment: is the medical equipment aiding the physiological functions such as pacing systems.

4. Acceptable levels

Table 1: Acceptable levels of magnetic flux density of static magnetic field.

Subjects of application	8 hours of exposure	Maximum limit
Entire body	60 mT (600G)	2 T (2.10^4G)
Limbs	600 mT (6000G)	5 T (5.10^4G)
Attached medical equipment	-	0.5 mT (5G)

XV. STANDARDS OF LOW-FREQUENCY MAGNETIC FIELD - MAGNETIC FLUX DENSITY

1. Scope of regulation:

These standards specify the acceptable levels of magnetic flux density of low-frequency magnetic field at work areas.

2. Subjects of application: the facilities that employ workers.

3. Definition

The terms in these standards are construed as follows:

- Low frequency: are frequencies from 30 KHz and lower.

4. Acceptable levels

Table 1: The acceptable levels of vocational exposures to low-frequency magnetic field

	Frequency band
Acceptable level	Acceptable value □ 60/f
Maximum level	0.2 mT (2 G)

- f: the frequency of electric current (in Hz)

XVI. STANDARDS OF INTENSITY OF LOW-FREQUENCY ELECTRIC FIELD AND STATIC ELECTRIC FIELD

1. Scope of regulation:

These standards specify the acceptable levels of magnetic flux density of low frequency magnetic field at working areas.

2. Subjects of application: the facilities that employ workers.

3. Acceptable levels

Table 1: Acceptable levels of intensity of electric field below 30 KHz.

	Frequency band		
	0 Hz - 100Hz	**100Hz - 4kHz**	**4kHz - 30kHz**
Maximum value	25kV/m	$(2,5 \times 10^6)/f$	625V/m

- f: the frequency of electric current (in Hz)

XVII. STANDARDS OF INTENSITY OF ELECTRIC FIELD FROM 30KHz - 300GHz

1. Scope of regulation:

These standards specify the acceptable levels electromagnetic field intensity and the energy density of electromagnetic waves 30kHz-300GHz at working areas.

2. Subjects of application: the facilities that employ workers.

3. Acceptable levels

Table 1a: Acceptable levels of intensity of electromagnetic field from 30KHz-300MHz.

Frequency	*Electromagnetic field intensity* (E) (V/m)	Magnetic field intensity (H) (A/m)	Average value of E, H over a period (second)
30kHz – 1.5MHz	50	5	30
1.5MHz - 3MHz	50	5	30
3MHz - 30MHz	20	0.5	30
30MHz - 50MHz	10	0.3	30
50MHz - 300MHz	5	0.163	30

Table 1: Acceptable values of energy density of radiation from 300MHz - 300GHz.

Frequency	Energy density (W/cm^2)	Acceptable exposure duration in 1 day	Notes
300MHz - 300GHz	< 10	1 day	
	10 - 100	< 2 hours	The energy density must not exceed 10 W/cm^2 for the rest.
	100 - 1,000	< 20 minutes	

Table 2: Acceptable values of contacting current and inductive current.

Maximum current (mA)			
Frequency	**Through 2 feet**	**Through each foot**	**Contact**
30kHz - 100kHz	2000f	1,000f	1,000f
100kHz - 100MHz	200	100	100

- f: the frequency of high-frequency electric current (in Hz)

XVIII. ULTRAVIOLET RADIATION – ACCEPTABLE LEVELS

1. Scope of regulation: These standards specify the acceptable values of ultraviolet radiation within the spectrum from 180nm - 400nm (from arc, electric vapor discharge, fluorescence and intensive light sources, solar radiation). Ultraviolet laser is not regulated.

2. Subjects of application: the facilities that employ workers.

3. Definition

The terms in these standards are construed as follows:

- Near-ultraviolet spectrum: are light waves of which the wavelengths range from 315nm - 400nm.

4. Acceptable levels

- The acceptable values of exposure to ultraviolet radiation that damage skin or eyes where the radiation values are known and the exposure durations are controlled:

4.1. Unprotected bare eye exposures to near-ultraviolet spectrum:

a. For duration < 10^3 seconds, the radiation exposure must not exceed 1,0 J/cm^2.

b. For duration ≥10^3 seconds, the total radiation energy must not exceed 1.0 mW/cm^2.

4.2. The exposure of unprotected skin or eyes to ultraviolet radiation must not exceed the values specified in Table 1 in 8 hours

Table 1: Acceptable levels of ultraviolet radiation and spectral weighting function in 8 hours.

Wavelength (nm)	Acceptable levels (mJ/cm^2)	Spectrum intensity coefficient ($S_{\square}$)
180	250	0.012

190	160	0.019
200	100	0.030
205	59	0.051
210	40	0.075
215	32	0.095
220	25	0.120
225	20	0.150
230	16	0.190
235	13	0.240
240	10	0.300
245	8.3	0.360
250	7.0	0.430
254	6.0	0.500
255	5.8	0.520
260	4.6	0.650
265	3.7	0.810
270	3.0	0.1
275	3.1	0.960
280	3.4	0.880
285	3.9	0.770
290	4.7	0.640
295	5.6	0.540
297	6.5	0.460
300	10	0.300
303	25	0.120
305	50	0.060
308	120	0.026
310	200	0.015
313	500	0.006
315	1.0×10^3	0.003
316	1.3×10^3	0.0024
317	1.5×10^3	0.0020
318	1.9×10^3	0.0016
319	2.5×10^3	0.0012
320	2.9×10^3	0.0010
322	4.5×10^3	0.00067
323	5.6×10^3	0.00054

325	6.0×10^3	0.00050
328	6.8×10^3	0.00044
330	7.3×10^3	0.00041
333	8.1×10^3	0.00037
335	8.8×10^3	0.00034
340	1.1×10^4	0.00028
345	1.3×10^4	0.00024
350	1.5×10^4	0.00020
355	1.9×10^4	0.00016
360	2.3×10^4	0.00013
365	2.7×10^4	0.00011
370	3.2×10^4	0.000093
375	3.9×10^4	0.000077
380	4.7×10^4	0.000064
385	5.7×10^4	0.000053
390	6.8×10^4	0.000044
395	8.3×10^4	0.000036
400	1.0×10^5	0.000030

Table 2: Acceptable levels of ultraviolet radiation.

Exposure duration/day	**Effective radiation E_{eff} (□W/cm^2)**
8 hours	0.1
4 hours	0.2
2 hours	0.4
1 hour	0.8
30 minutes	1.7
15 minutes	3.3
10 minutes	3.3
5 minutes	10
1 minute	50
30 seconds	100
10 seconds	300
1 second	3,000
0.5 second	6,000
0.1 second	30,000

XIX. STANDARDS OF RADIOACTIVITY

1. Scope of regulation:

These standards specify the acceptable values of doses and levels of radioactive substances and radioactive rays at workplaces.

2. Subjects of application: These standards are applicable to people that directly or indirectly work with ionizing radiation. The general residents are not regulated.

3. Definition

The terms in these standards are construed as follows:

- Ionizing radiation, *as known as radioactivity, are all kinds of radiations (electromagnetic and particle radiation) that creates ions when interacting with the environment.*

- Radiation bases: are places that use radiation sources such as:

+ X-ray devices, □-ray emitters

+ Sources of closed radiation such as: Radium 226, cobalt, Strontium 90.

+ Sources of open radiation such as: I-131, P-32, U-238, Th-232.

- External radiation: *radiation from a source outside the body.*

- Internal radiation: radiation from a source inside the body.

- Equivalent dose: *is the equivalent dose for a period of time (Rem/hour).* Rem: Roentgent equivalent in man.

- Control zone: *is the contiguous zones around the radiation bases or the radioactive gas discharge pipe*

- Supervision zone: is the area outside the control zone that might be affected by the gaseous, liquid or solid radioactive substances.

4. Cited standards

- These standards are equivalent to TCVN 4397 - 87

5. Acceptable doses

The equivalent dose at working positions of the radiation bases must not exceed the values specified in Table 1.

Table 1: Acceptable equivalent dose

Radiated subjects	Workplace	P (mrem/h) with t □ 40h/week
Subject A	- Regular workplaces	1.2
	- Workplaces under 20h/week	2.4
Subject B	- In other working rooms within the control zone	0.12
	- In supervision zones	0.03

Notes: Subject A: Radiation worker

Subject B: Adjacent people

5.2. The limited doses in a year (for both internal and external radiation) of the radiated subjects and the vital organs are specified in Table 2:

Table 2: Limited dose in a year

Human subject	Limited dose for vital organs (rem/year)		
	Group I	Group II	Group III
A	5	15	30
B	0.5	1.5	3

Notes:

- Group I: whole-body, gonads, bone marrow.

- Group II: Organs outside Group I and III

- Group III: Skin, tissue, bones, hands, legs, feet, ankles

5.3. The limited density of radioactive substances in the air or workplaces are specified in Table 3. That of the radioactive compounds with unknown compositions are specified in Table 4.

5.4. The radioactive contamination levels of surfaces at workplaces and protective instruments are specified in Table 5.

5.5. The total accumulative doses of Subject A at any age over 18 are calculated by the formula:

D □ 5 (N - 18)

- D: Dose (in Rem).

- N: Age (in year).

If necessary, the accumulative dose may reach 12 rem/year, but then must be offset in 5 years so that the total dose would not exceed D.

Table 3: The limited air density of nuclides of which the compositions are totally or partly unknown (Ci/l)

The composition of radioactive nuclide mixtures that contaminate through the respiratory tract	Subject A	Subject B
Unknown composition	4×10^{-16}	1×10^{-17}
The composition does not contain Cm-248	8×10^{-16}	3×10^{-17}
The composition does not contain: PA-231, Pu 239, Pu-240. Pu 242, Cm-248, Cf-249, Cf-251	2×10^{-15}	5×10^{-17}
The composition does not contain: Ac-227, Th-230. Pa-231, Pu238, Pu-239, Pu-240. Pu-242, Pu-244, Cm-248, Cf-249, Cf-251	4×10^{-15}	1×10^{-16}
The composition does not contain any alpha radiation and Ac-227	2×10^{-14}	8×10^{-16}
The composition does not contain any alpha radiation and Pb-210. Ac-227, Ra-228, Pu-241	2×10^{-13}	8×10^{-15}
The composition does not contain any alpha radiation and Sr-90. I-192, Pb-210. Ac-227, Ra-228, Pa-230. Pu-241, Bk-249	$2 \times 10^{-16`}$	8×10^{-13}

Table 4: The limited density of radioactive substances in the working air

No.	Radioactive nuclide	Form in compounds	Limited density in the working air Ci/l		No.	Radioactive nuclide	Form in compounds	Limited density in the working air Ci/l	
			Subject A	Subject B				Subject A	Subject B
1	H-3(T)	Insoluble Soluble	2.0×10^{-6} 4.8×10^{-9}	6.6×10^{-8} 1.6×10^{-10}	31	Co-57	Soluble Insoluble	1.6×10^{-11}	5.5×10^{-12}
2	C-14	Soluble	3.5×10^{-9}	1.2×10^{-10}	32	Co-58	Soluble Insoluble	5.6×10^{-11}	1.9×10^{-12}
3	F-18	Soluble Insoluble	2.6×10^{-9}	8.7×10^{-11}	33	Co-60	Soluble Insoluble	8.8×10^{-12}	3.0×10^{-13}
4	Na-22	Soluble Insoluble	8.4×10^{-12}	2.9×10^{-13}	34	Ni-63	Soluble Insoluble	6.4×10^{-11}	2.2×10^{-12}

5	Na-24	Soluble Insoluble	$1.4x10^{-10}$	$4.9x10^{-12}$	35	Cu-64	Soluble Insoluble	$1.0x10^{-9}$	$3.6x10^{-11}$
6	P-32	Soluble Insoluble	$7.2x10^{-11}$	$2.4x10^{-12}$	36	Zn-65	Soluble Insoluble	$6.0x10^{-11}$	$2.6x10^{-12}$
7	S-35	Soluble Insoluble	$3.6x10^{-11}$	$1.2x10^{-12}$	37	As-74	Soluble Insoluble	$1.2x10^{-10}$	$4.2x10^{-12}$
8	Cl-36	Soluble Insoluble	$2.3x10^{-11}$	$7.8x10^{-13}$	38	Se-75	Soluble Insoluble	$1.2x10^{-10}$	$4.2x10^{-12}$
9	K-42	Soluble Insoluble	$1.1x10^{-10}$	$3.7x10^{-12}$	39	Br-82	Soluble Insoluble	$1.9x10^{-10}$	$6.4x10^{-12}$
10	Ca-43	Soluble	$3.2x10^{-11}$	$1.1x10^{-12}$	40	Rb-86	Soluble Insoluble	$6.8x10^{-11}$	$2.3x10^{-12}$
11	Ca-47	Insoluble	$1.7x10^{-10}$	$5.8x10^{-12}$	41	Sr-89	Soluble	$2.8x10^{-11}$	$9.4x10^{-13}$
12	Cr-51	Soluble Insoluble	$2.2x10^{-9}$	$7.7x10^{-11}$	42	Sr-90	Soluble	$1.2x10^{-12}$	$4.0x10^{-14}$
13	Mn-52	Soluble Insoluble	$1.4x10^{-10}$	$4.8x10^{-12}$	43	Y-90	Soluble Insoluble	$1.0x10^{-10}$	$3.5x10^{-12}$
14	Mn-54	Soluble Insoluble	$3.6x10^{-11}$	$1.2x10^{-12}$	44	Zr-93	Soluble Insoluble	$1.3x10^{-10}$	$4.4x10^{-12}$
15	Fe-55	Soluble Insoluble	$8.4x10^{-10}$	$2.9x10^{-11}$	45	Tc-99m	Soluble Insoluble	$1.4x10^{-9}$	$4.8x10^{-10}$
16	Fe-59	Soluble Insoluble	$5.2x10^{-11}$	$1.8x10^{-12}$	46	Tc-99	Soluble Insoluble	$6.0x10^{-11}$	$2.1x10^{-12}$
17	Mo-99	Soluble Insoluble	$2.0x10^{-10}$	$6.9x10^{-12}$	47	Au-198	Soluble Insoluble	$2.4x10^{-10}$	$8.0x10^{-12}$
18	In-113m	Soluble Insoluble	$6.8x10^{-9}$	$2.3x10^{-10}$	48	Hg-197	Soluble Insoluble	$1.2x10^{-9}$	$4.0x10^{-11}$
19	Sb-124	Soluble Insoluble	$1.9x10^{-11}$	$6.6x10^{-13}$	49	Hg-203	Soluble Insoluble	$7.2x10^{-11}$	$2.5x10^{-12}$
20	I-125	Soluble	$4.8x10^{-12}$	$1.6x10^{-13}$	50	Tl-201	Soluble Insoluble	$8.8x10^{-10}$	$3.0x10^{-11}$
21	I-126	Soluble	$3.6x10^{-12}$	$1.2x10^{-13}$	51	Pb-210	Soluble Insoluble	$6.0x10^{-14}$	$2.0x10^{-13}$
22	I-129	Soluble	$8.0x10^{-13}$	$2.7x10^{-14}$	52	Po-21	Soluble Insoluble	$9.3x10^{-14}$	$3.1x10^{-15}$
23	I-131	Soluble	$4.2x10^{-12}$	$1.5x10^{-13}$	53	Ra-226	Soluble Insoluble	$2.5x10^{-14}$	$8.5x10^{-18}$
24	Cs-131	Soluble Insoluble	$1.0x10^{-8}$	$3.6x10^{-10}$	54	Th-232	Soluble Insoluble	$1.0x10^{-15}$	$2.5x10^{-14}$
25	Cs-134m	Soluble	$6.0x10^{-9}$	$2.0x10^{-10}$	55	U-235	Soluble	$6.0x10^{-14}$	

		Insoluble				7.1x 10^{-8} năm	Insoluble		
26	Cs-134	Soluble Insoluble	$1.3x10^{-11}$	$4.4x10^{-14}$	56	U-238	Soluble Insoluble	$6.3x10^{-14}$	$2.2x10^{-15}$
27	Cs-137	Soluble Insoluble	$1.4x10^{-14}$	$4.9x10^{-13}$	57	Am-241	Soluble Insoluble	$3.0x10^{-15}$	$1.0x10^{-16}$
28	Ba-131	Soluble Insoluble	$3.5x10^{-10}$	$1.2x10^{-11}$	58	Cm-244	Soluble Insoluble	$46x10^{-15}$	$1.5x10^{-16}$
29	La-140	Soluble Insoluble	$1.2x10^{-10}$	$4x10^{-12}$	59	Cf-252	Soluble Insoluble	$3.2x10^{-15}$	$1.1x10^{-16}$
30	Ir-192	Soluble Insoluble	$2.6x10^{-11}$	$8.7x10^{-13}$					

Notes: Other specifications of the radioactive nuclides in this Table can be found in "Safety Norm of ionizing radiation" TCVN 4397-87

Table 5: Contamination levels of surfaces (particle/cm^2/minute)(1)

Contaminated subject	Nuclide emitting alpha particle		Nuclide emitting beta particle (4)
	Special nucleus(2)	Other nuclei	
Skin, towel, internal clothes, inner side of the front side of personal safety instruments.	1	1	100
Primary safety outfit, inner side of additional safety instruments	5	20	800
Surface of rooms with regular workers, outer side of additional safety instrument in these rooms.	5	20	2,000
Surface of machinery rooms without regular workers, outer side of additional safety instrument in these rooms.	50	200	8,000
Means of transport, outer side of containers and wrap of radioactive substances in the control zones(3).	10	10	100

Notes:

(1) For surfaces of working rooms, equipment, means of transport, containers, wrap, the contamination level is determined using dry cleaning method according to the non-sticky contamination amount (cleanable). For other cases, the contamination levels are determined by the total contamination level (non-sticky and sticky)

(2) Special nuclides are nuclides that emit alpha particles with acceptable density in the working air being 1.10^{-14} Curi/liter.

(3) The radioactive contamination on the outer side of the radioactive substance container and means of transport are not allowed outside the control zone.

(4) For Sr-90. Sr-90 + Y-90, the acceptable contamination level is 5 times lower. The tritium contamination is not regulated because it is controlled by the content in the air and in the body.

XX. X-RAY RADIATION – ACCEPTABLE LEVELS

1. Scope of regulation:

These standards specify the requirements for radiation safety of medical X-ray facilities.

2. Subjects of application: medical X-ray facilities**.**

3. Definition

The terms in these standards are construed as follows:

- Medical X-ray facilities are medical facilities using X-ray devices for medical examination and treatment.

4. Cited standards

These standards are equivalent to TCVN 6561-1999

5. Acceptable levels

5.1. Limited doses

Table 1: Acceptable doses in a year

Kind of dose and subjects of application	Radiation worker	Apprentice from 16-18 years old	Other people
Systemic effective dose	20mSv	6mSv	1mSv
Equivalent dose for crystalline lens	150mSv	50mSv	15mSv
Equivalent dose for limbs or skin	500mSv	150mSv	50mSv
Lounge and waiting room			1mSv

Notes: - The doses when working with X-ray do not include natural background radiation.

- Doses for special cases are specified in the Annex

Table 2: Acceptable instantaneous doses in X-ray rooms

Location	Dose (□Sv/h)
- Directly radiated workers	10.0
- Film development room	0.50
- Patient waiting room or lounge	0.50
- Working rooms and workplaces of employees	0.50
- The outer side X-ray machine	0.50

5.2. Limited doses in special cases

5.2.1. Effective doses for radiation worker: 20mSv, averagely sampled in 5 consecutive working years. The dose may reach 50mSv in a single year but the average dose in 5 years must not exceed 20mSv/year.

The effective dose for radiation workers is 20mSv/year being averagely sampled in 10 consecutive working years and the dose in any single year does not exceed 50mSv.

When the accumulative effective dose of a radiation worker reaches 100mSv, it must be reconsidered. If his/her health is still normal without manifestation of radioactive impacts, the blood formula is still unchanged etc., the work may continue.

5.2.2. Effective doses for other people: The dose may reach 5 mSv in a single year but the average dose in 5 consecutive years must not exceed 1 mSv/year The layout, sizes and radiation protection methods are specified in the Annex.

5.3. Location of a X-ray facility

The X-ray facility must be isolated from paediatrics, obstetrics, crowded areas etc, especially the tenements.

5.4. Layout of a X-ray facility

Each X-ray facility must contain at least the following rooms:

- The patient waiting room or lounge,

- The X-ray machine room,

- The film development room,

- The working room or place of radiation workers.

5.4.1. The Patient waiting room or lounge:

- The patient waiting room (or lounge) must be separated from the X-ray room. The limited dose in this room must not exceed 1mSv/year.

5.4.2. The X-ray machine room must satisfy the following requirements:

- Convinient for the installation and operation, safe for the patients to moves. The minimum area is 25 m^2, the minimum width is 4.5 m, the minimum height is 3m for an ordinary X-ray machine.

- The breast, teeth X-ray machines and CT scanners must comply with the standardized size in Table 3.

Table 3: The minimum size of working rooms for medical X-ray machines

Work	Room area	Minimum side length
- (CT scanner room)		
+ 2-dimension	28 m^2	4 m
+ 3-dimension	40 m^2	4 m
- X-ray room for teeth	12 m^2	3 m
- X-ray room for breast	18 m^2	4 m
- X-ray machine with contrast medium	30 m^2	4.5 m
- X-ray machine with signal contrast medium	36 m^2	5.5 m
- Automated dark room	7 m^2	2.5 m
- Non-automated dark room	8 m^2	2.5 m

- If the room design for new machines recommended by the producer is smaller than the above measurements, the consent of competent State agencies is compulsory.

- The thickness of the walls, the ceiling, the floor and the doors of the X-ray machine room must be calculated and designed in accordance with specifications of the equipment (voltage, current intensity), operation duration and the outer occupation coefficient of the X-ray room.

- The minimum height of the vents and windows of the X-ray room where people pass by is 2 m from the floor outside the X-ray room.

- The radiation signal light must be put at the eye level outside the door of the X-ray room. The signal light must glow throughout the radiation emission of the machine.

- The X-ray machine installation must ensure that the X-ray beam is not emitted toward the door or places with many people, and the eyes must be protected from the radiation sources. The shield height must be over 2m from the floor, the minimum width is 90cm and the corresponding thickness is 1.5mm of lead.

- For rooms with 2 X-ray machines, only 1 is allowed to operate at a time.

- The control panel is put inside or outside the X-ray room depending on the machine itself. There must be lead glass for observing the patient. The limited dose at the control panel must not exceed 20 mSv/year (excluding natural background radiation).

5.4.3. The film development room (the dark room):

- The dark room must be separated from the X-ray room.

- The dose in the dark room must not affect the film development. The undeveloped film must not be radiated over 1 mSv/year, excluding natural background radiation.

- The dark room door must not be directly radiated.

- The cassette pass box in the X-ray room must be covered with 2 mm lead.

5.4.4. The working room (or place) of radiation workers:

- The working room (or place) of radiation workers must be separated from the X-ray room. The doses in the room must not exceed 1 mSv/year, excluding natural background radiation.

XXI. CHEMICALS – ACCEPTABLE LIMITS IN THE WORKING AIR

1. Scope of regulation

These standards specify the maximum acceptable density of a number of chemicals in the working air.

2. Subjects of application

These standards are applicable to facilities that employ workers (production facilities, trading and service establishments…)

These standards are not applicable to the air in residential areas.

3. Limit values

Table 1: Limit values of chemicals in the air at working areas

No.	Chemical name	Chemical formula	Average value in 8 hours (mg/m^3) (TWA)	Maximum value at a time (mg/m^3) (STEL)
1	Acrolein	CH_2CHCHO	0.25	0.50
2	Acrylic amide	$CH_2CHCONH_2$	0.03	0.2
3	Acrylonitrile	CH_2CHCN	0.5	2,5
4	Allyl acetate	$C_5H_8O_3$	-	2
5	Ammonia	NH_3	17	25
6	Amyl acetate	$CH_3COOC_5H_{11}$	200	500
7	Phthalic anhydride	$C_8H_4O_3$	2	3
8	Aniline	$C_6H_5NH_2$	4	8
9	Antimony	Sb	0.2	0.5
10	ANTU	$C_{10}H_7NHC(NH_2)S$	0.3	1.5
11	Arsenic and compounds	As	0.03	-
12	Arsine	AsH_3	0.05	0.1
13	Asphalt		5	10
14	Acetone	$(CH_3)_2CO$	200	1,000
15	Acetone cyanohydrin	$CH_3C(OH)CNCH_3$	-	0.9
16	Acetonitrile	CH_3CN	50	100
17	Acetylene	C_2H_2	-	1,000

18	2, 4 - D (Dichloro - phenoxyacetic acid)	$Cl_2C_6H_3OCH_2COOH$	5	10
19	2, 4, 5 - T (Trichloro - phenoxyacetic acid)	$C_6H_2Cl_3OCH_2COOH$	5	10
20	Acetic acid	CH_3COOH	25	35
21	Boric acid and compounds	H_2BO_3	0.5	1
22	Hydrochloric acid	HCl	5	7,5
23	Formic acid	HCOOH	9	18
24	Methacrylic acid	$C_4H_6O_2$	50	80
25	Nitrous acid	HNO_2	45	90
26	Nitric acid	HNO_3	5	10
27	Oxalic acid	$(COOH)_2.2H_2O$	1	2
28	Phosphoric acid	H_3PO_4	1	3
29	Picric acid	$HOC_6H_2(NO_2)_3$	0.1	0.2
30	Sulfuric acid	H_2SO_4	1	2
31	Thioglycolic acid	$C_2H_4O_2S$	2	5
32	Trichloroacetic acid	$C_2HCl_3O_2$	2	5
33	Azinphos methyl	$C_{10}H_{12}O_3PS_2N_3$	0.02	0.06
34	Aziridine	H_2CNHCH_2	0.02	-
35	Silver	Ag	0.01	0.1
36	Silver compounds	như Ag	0.01	0.03
37	Barium oxide	BaO_2	0.6	6
38	Benomyl	$C_{14}H_{18}N_4O_3$	5	10
39	Benzene	C_6H_6	5	15
40	Benzidine	$NH_2C_6H_4C_6H_4NH_2$	0.008	-
41	Benzonitrile	C_7H_5N	-	1
42	Benzopyrene	$C_{20}H_{12}$	0,0001	0,0003
43	(o, p) Benzoquinone	$C_6H_4O_2$	0.4	1,0
44	Benzotrichloride	$C_7H_5Cl_3$	-	0.2
45	Benzoyl peroxide	$C_{14}H_{10}O_4$	-	5
46	Benzylchloride	$C_6H_5CH_2Cl$	-	0.5
47	Beryllium and compounds	Be	-	0.001
48	Polychlorinated biphenyls	$C_{12}H_{10-x}C_x$	0.01	0.02
49	Boron trifluoride	BF_3	0.8	1
50	Bromine	Br_2	0.5	1
51	Bromoethane	C_2H_5Br	500	800
52	Bromomethane	CH_3Br	20	40

53	Bromine pentafluoride	BrF_5	0.5	1
54	1,3-Butadiene	$CH_2CHCHCH_2$	20	40
55	Butyl acetate	$CH_3\,COO[CH_2]_3\,CH_3$	500	700
56	Butanols	$CH_3(CH_2)_3\,OH$	150	250
57	Octa decanoic acid, cadmium	$C_{36}H_{72}O_4Cd$	0.04	0.1
58	Cadmium and compounds	Cd	0.01	0.05
59	Carbondioxide	CO_2	900	1800
60	Carbon disulfide	CS_2	15	25
61	Carbonmonoxide	CO	20	40
62	Carbontetrachlorie	CCl_4	10	20
63	Carbofuran	$C_{17}H_{15}O_3N$	0.1	-
64	Carbonyl fluoride	COF_2	5	13
65	Calcium carbonate	$CaCO_3$	10	-
66	Calcium chromate	$CaCrO_4$	0.05	-
67	Calcium hydroxyde	$Ca(OH)_2$	5	-
67	Calcium oxide	CaO	2	4
69	Calcium silicate	$CaSiO_3$	10	-
70	Calcium sulfate dihydrate	$CaSO_4.2H_2O$	6	-
71	Calcium cyanamide	C_2CaN_2	0.5	1.0
72	Caprolactam (dust)	$C_6H_{11}NO$	1	3
73	Caprolactam (fume)	$C_6H_{11}NO$	20	-
74	Captan	$C_9H_8\,Cl_3NO_2S$	5	-
75	Carbaryl	$C_{10}H_7O\ O\ CNHCH_3$	1	10
76	Catechol	$C_{15}H_{14}O_6$	20	45
77	Lead tetraethyl	$Pb(C_2H_5)_4$	0.005	0.01
78	Lead and compounds	Pb	0.05	0.1
79	Chlorine	Cl_2	1.5	3
80	Chloroacetaldeh-yde	$ClCH_2CHO$	3	-
81	Chlorine dioxide	ClO_2	0.3	0.6
82	Chloroacetophe-none	$C_6H_5COCH_2Cl$	0.3	-
83	Chlorobenzene	C_6H_5Cl	100	200
84	1- Chloro - 2,4 -dinitro - benzene	$C_6H_3ClN_2O_4$	0.5	1
85	Chloronitrobenzene	$C_6H_4ClNO_2$	1	2
86	Chloroprene	$CH_2CClCHCH_2$	30	60
87	1- Chloro 2 - propanone	C_3H_5ClO	-	3

88	Chloroform	$CHCl_3$	10	20
89	Chloropicrin	CCl_3NO_2	0.7	1.4
90	3-Chloropropene	C_2H_5Cl	1	2
91	Chlorotrifluoroethy-lene	C_2ClF_3	-	5
92	Cobalt and compounds	Co	0.05	0.1
93	Cresol	C_7H_8O	5	10
94	Chromium trioxide	CrO_3	0.05	0.1
95	Chromium (III) compounds	Cr^{+3}	0.5	-
96	Chromium (VI) compounds	Cr^{+4}	0.05	-
97	Chrom (VI) compound (water soluble)	Cr^{+6}	0.01	-
98	Crotonaldehyde	$CH_3CHCHCHO$	5	10
99	Cumene	$C_6H_5CH(CCH_3)_2$	80	100
100	Mineral (mist)		5	10
101	Petroleum distillates (naphta)		1600	-
102	Turpentine	$C_{10}H_{16}$	300	600
103	Vegetable oil mist		10	-
104	Diamino 4, 4'-diphenyl methane	$NH_2C_6H_4C_6H_4NH_2$	-	0.8
105	Dimethyl - 1, 2 - dibromo - 2,2 - dichlorethyl phosphate (Naled)	$(CH_3O)_2POOCHBrCBrCl_2$	3	6
106	Rubber solvent		1570	-
107	Stoddard solvent (White spirit)		525	
108	Soapston	$3MgO.4SiO_2.H_2O$	3	-
109	Soapstone	$3MgO.4SiO_2.H_2O$	6	-
110	Decalin	$C_{10}H_{18}$	100	200
111	Demeton	$C_8H_{19}O_3PS_2$	0.1	0.3
112	Diazinon	$C_{12}H_{21}N_2O_3PS$	0.1	0.2
113	Diborane	B_2H_6	0.1	0.2
114	1,2 - Dibromo - 3 chloro - propane	$C_3H_5Br_2Cl$	0.01	-
115	Dibutyl phthalate	$C_6H_4(CO_2C_4H_9)_2$	2	4
116	Dichloroacetylene	ClCCCl	0.4	1.2
117	Dichlorobenzene	$C_6H_4Cl_2$	20	50
118	Dichloroethane	CH_3CHCl_2	4	8
119	1,1- Dichloroethylene	$C_2H_2Cl_2$	8	16

120	Dichloroethylene (1,2; Cis; Trans)	$C_2H_2Cl_2$	790	1,000
121	Dichloromethane	CH_2Cl_2	50	100
122	1,2- Dichloropropan	$C_3H_6Cl_2$	50	100
123	Dichloropropene	$C_3H_4Cl_2$	5	-
124	Dichlorostyrene	$C_8H_6Cl_2$	50	-
125	Dichlorvos	$(CH_3O)_2PO_2CHCCl_2$	1	3
126	Dicrotophos	$C_8H_{16}NO_5P$	0.25	-
127	Dimethylamine	C_2H_7N	1	2
128	Dimethyl formamide	$(CH_3)_2NCHO$	10	20
129	1,1 Dimethyl hydrazine	$(CH_3)_2 NNH_2$	0.2	0.5
130	Dimethyl phenol	$C_8H_{10}O$	-	2
131	Dimethyl sulfate	$(CH_3)_2SO_4$	0.05	0.1
132	Dimethyl sulfoxide	C_2H_6OS	20	50
133	Dinitrobenzene	$C_7H_6N_2O_4$	-	1
134	Dinitrotoluene (DNT)	$C_6 H_5CH_3(NO_2)_2$	1	2
135	Dioxathion	$C_{12} H_{26}O_6P_2S_4$	0.2	-
136	Diquat Dibromide	$C_{12} H_{12}N_2.2Br$	0.5	1
137	1,4-Dioxane	$OCH_2CH_2OCH_2CH_2$	10	-
138	Copper (dust)	Cu	0.5	1
139	Copper (fume)	Cu	0.1	0.2
140	Copper compounds	Cu	0.5	1
141	Endousulfan	$C_9H_6Cl_6O_3S$	0.1	0.3
142	2, 3 - Epoxy 1 - propanol	$C_3H_6O_2$	1	5
143	EPN (o - ethyl - o - paranitrophenyl - phosphonothioate)	$C_{18}H_{14}NO_4PS$	0.5	-
144	Ethanolamine	$NH_2C_2H_4OH$	8	15
145	Diglycidyl ether	$C_6H_{10}O_3$	0.5	-
146	Chloroethyl ether	$C_4H_8Cl_2O$	-	2
147	Chloromethyl ether	$(CH_2Cl)_2O$	0.003	0.005
148	Ethyl ether	$C_2H_5OC_2H_5$	1,000	1,500
149	Isopropyl glycidyl ether	$(CH_3)_2CHOCH(CH_3)_2$	200	300
150	Resorcinol monomethyl Ether	$C_7H_8O_2$	-	5
151	Ethylamine	$CH_3CH_2NH_2$	18	30
152	Ethylene	C_2H_4	1,150	-
153	Ethanethiol (Ethylmercaptan)	C_2H_5SH	1	3

154	Ethylene dibromide	$BrCH_2\,CH_2Br$	1	-
155	Ethylene glycol		10	20
156	Ethylene glycol	$C_2H_6O_2$	60	125
157	Ethylene glycol dinitrate	$C_2H_4(O_2NO)_2$	0.3	0.6
158	Ethylene oxide	C_2H_4O	1	2
159	Perchloroethylene	C_2Cl_4	70	170
160	Ethylidene norbornene	C_9H_{12}	-	20
161	Fensulfothion	$C_{11}H_{17}O_4PS_2$	0.1	-
162	Fenthiol	$C_{10}H_{15}O_3PS_2$	0.1	-
163	Fluorine	F_2	0.2	0.4
164	Fluorides		1	2
165	Formaldehyde	$HCHO$	0.5	1
166	Formamide	$HCONH_2$	15	30
167	Furfural	C_4H_3OCHO	10	20
168	Furfuryl alcohol	$C_5H_6O_2$	20	40
169	Coal Tar pitch volatiles		-	0.1
170	Halothane	$C_2HBrClF_3$	8	24
171	Mekuran (mixture of ethylmer cuirc chloride and lindane)		0.005	-
172	Heptachlor (iso)	$C_{10}H_5Cl_7$	0.5	1,5
173	Heptan	C_7H_{14}	800	1,250
174	Hexachlorobenzene	C_6Cl_6	0.5	0.9
175	Hexachloro 1,3-butadiene	C_4Cl_6	-	0.005
176	1, 2, 3, 4, 5, 6 - hexachloro-cyclohexane	$C_6H_6Cl_6$	0.5	-
177	Hexachlorocyclopen-tadiene	C_5Cl_6	0.01	0.1
178	Hexafluoroacetone	$(CF_3)_2CO$	0.5	0.7
179	Hexafluoropropene	C_6F_6	-	5
180	n - Hexane	C_6H_6	90	180
181	Hyrazine	H_4N_2	0.05	0.1
182	Hydrocarbons (1 - 10 C)		-	300
183	Hydrogen fluoride	HF	0.1	0.5
184	Hydrogen phosphide	H_3P	0.1	0.2
185	Hydrogen selenide	H_2Se	0.03	0.1
186	Hydrogene sulfide	H_2S	10	15
187	Hydrogen cyanide	HCN	0.3	0.6

188	Hydroxydes (alkaline) (Alkali hydroxide)		0.5	1
189	Hydroquinone (1,4 - Dihydroxybenzene)	$C_6H_6O_2$	0.5	1.5
190	Iodomethane	CH_3I	1	2
191	Iodoform	CHI_3	3	10
192	Iodine	I_2	1	2
193	Isopropyl glycidyl ether	$(CH_3)_2C_2H_2O(CH_3)_2$	240	360
194	Isopropyl nitrate	$C_3H_7NO_2$	20	40
195	Potassium cyanide	KCN	5	10
196	Welding fumes		5	-
197	Petroleum gas (liquefied)		1800	2250
198	Zinc chloride	$ZnCl_2$	1	2
199	Zinc Chromate	CrO_4Zn	0.01	0.03
200	Zinc fluoride	F_2Zn	0.2	1
201	Zinc oxide (dust, fume)	ZnO	5	10
202	Zinc phosphide	P_2Zn_3	-	0.1
203	Zinc stearate (inhalable dust)	$Zn(C_{18}H_{35}O_2)_2$	10	20
204	Zinc stearate (respirable dust)	$Zn(C_{18}H_{35}O_2)_2$	5	-
205	Zinc sulfide	ZnS	-	5
206	Camphor	$C_{10}H_{16}O$	2	6
207	Magnesium oxide	MgO	5	10
208	Malathion	$C_{10}H_{19}O_6PS_2$	5	-
209	Manganese and compounds	Mn	0.3	0.6
210	Methallyl chloride	C_4H_7Cl	-	0.3
211	Methane thiol	CH_4S	1	2
212	Methoxychlor	$Cl_3CCH(C_6H_4OCH_3)_2$	10	20
213	Methyl acrylate	$CH_2CHCOOCH_3$	20	40
214	Metyl acrylonitrile	$CH_2C(CH_3)CN$	3	9
215	2 - Methyl aziridine	$C_8H_{16}N_2O_7$	5	-
216	Methylamine	CH_5N	5	24
217	Methyl acetate	CH_3COOCH_3	100	250
218	Methyl ethyl keton	C_4H_8O	150	300
219	2 - Methyl furan	C_5H_6O	-	1
220	Methyl hydrazine	CH_3NHNH_2	0.08	0.35
221	Methyl mercaptan	CH_3SH	1	2

222	Methyl methacrylate	$CH_2C(CH_3)COOCH_3$	50	150
223	Methyl silicate	$C_4H_{12}O_4Si$	-	6
224	Mevinphos	$C_7H_{13}O_6Pi$	0.1	0.3
225	Monocrotophos	$C_7H_{14}NO_5P$	0.25	-
226	Ferric salt (as Fe)		1	2
227	Carbon black	C	3.5	7
228	Naled	$(CH_3O)_2P(O)$ $OCHBrCBrCl_2$	3	6
229	Naphthalene	$C_{10}H_8$	40	75
230	Chlorinated naphthalenes		0.2	0.6
231	Sodium bisulfite	$NaHSO_3$	5	-
232	Sodium borate	$Na_2B_4O_7$	1	-
233	Sodium cyanide	NaCN	5	10
234	Sodium fluoroacetate	FCH_2COONa	0.05	0.1
235	Sodium metabisulfite (Disodium pyrosulfite)	$Na_2S_2O_5$	5	-
236	Sodium azide	NaN_3	0.2	0.3
237	Neoprene	C_4H_5Cl	10	30
238	Aluminum and compounds	Al	2	4
239	Nicotine	$C_{10}H_{14}N_2$	0.5	1
240	Nickel and compounds (soluble)	Ni	0.05	0.25
241	Nickel monoxide	NiO, Ni_2O_3	0.1	-
242	Nickel carbonyl	C_4NiO_4	0.01	0.02
243	Nitrogen dioxide	NO_2 và N_2O_4	5	10
244	Nitrogen monoxide	NO	10	20
245	Nitrogene trifluoride	NF_3	30	45
246	Nitrobenzene	$C_6H_5NO_2$	3	6
247	1- Nitrobutane	$CH_3(CH_2)_3NO_2$	-	30
248	Nitro ethane	C_2H_5NO	30	-
249	Nitromethane	CH_3NO_2	30	-
250	1-Nitropropane	$CH_3(CH_2)_2NO_2$	30	60
251	Nitrotoluene	$CH_3C_6H_4NO_2$	11	22
252	Glycerol trinitrate (Nitroglycerine)	$CH_2NO_3CHNO_3CH_2NO_3$ $[C_3H_5(NO_3)_3]$	0.5	1
253	2-Nitropropane	$CH_3(CH_2)_2NO_2$	18	-
254	Octane	$C_{10}H_{22}$	900	1,400
255	Osmium tetroxide	OsO_4	0.002	0.003

256	Ozone	O_3	0.1	0.2
257	Paraquat	$(CH_3(C_5H_4N)_2CH_3).2Cl$	0.1	0.3
258	Parathion	$(C_2H_5O)_2PSOC_6H_4NO_2$	0.05	0.1
259	Pentaborane	B_5H_9	0.01	0.02
260	Pentachlorophenol	C_6Cl_5OH	0.2	0.4
261	Perchloryl fluoride	ClO_3F	14	25
262	Phenol	C_6H_5OH	4	8
263	Phenyl hydrazine	$C_6H_5 NHNH_2$	1	2
264	Phenyl isocxyanate	C_7H_5NO	0.02	0.05
265	Phenylene diamine	$C_6H_8N_2$	0.1	0.2
266	Phenyl phosphine	C_6H_7P	-	0.25
267	Phorate	$(C_2H_5O)_2P(S)SCH_2S\text{-}C_2H_5$	0.05	0.2
268	Phosgene	$COCl_2$	0.2	0.4
269	Phosphine	PH_3	0.1	0.2
270	Phosphorus(White, yellow)	P_4	0.03	0.1
271	Phosphoruos oxy chloride	$POCl_3$	0.6	1.2
272	Phosphorus trichloride	PCl_3	1	2
273	Phosphorous pentachloride	PCl_5	1	2
274	Picloram (iso)		10	20
275	Propoxur	$CH_3NHCOOC_6H_4OCH(CH_3)_2$	0.5	1.5
276	n-Propylacetat	$CH_3COOCH_2CH_2CH_3$	200	600
277	□-Propiolactone	$C_3H_4O_2$	1	2
278	Propylenimine	C_3H_7N	-	5
279	Pyrenthrin	$C_{21}H_{28}O_3$	5	10
280	Pyridine	C_5H_5N	5	10
281	Quinone	$C_6H_4O_2$	0.4	12
282	Resorcinol (1,3 - Dihydroxybenze)	$C_6H_6O_2$	45	90
283	Allyl alcohol	CH_2CHCH_2OH	3	6
284	Ethanol	$CH_3(CH_2)OH$	1,000	3,000
285	Furful alcohol	$C_5H_6O_2$	20	40
286	Methanol	CH_3OH	50	100
287	n - Amyl alcohol	$CH_3(CH_2)_4OH$	100	200
288	Propanol	$CH_3(CH_2)_2OH$	350	600
289	Propargyl alcohol	$HCCCH_2OH$	2	6
290	Rotenone (Derris)	$C_{23}H_{22}O_6$	5	10

291	Paraffin wax		1	6
292	Ferric oxide (dust, fume)	Fe_2O_3	5	10
293	Iron carbonyl	C_5FeO_5	0.08	0.1
294	Selenium and compounds	Se	0.1	1
295	Selenium dioxide	O_2Se	-	0.1
296	Stibine	SbH_3	0.2	0.4
297	Strychnine	$C_{21}H_{22}N_2O_2$	0.15	0.3
298	Selenium hexafluoride	SeF_6	0.2	-
299	Silane	H_2Si	0.7	1.5
300	Stearates		10	-
301	Styrene	$C_6H_5CH\ CH_2$	85	420
302	Sulfur chloride	S_2Cl_2	5	10
303	Sulfur dioxide	SO_2	5	10
304	Sunfuryl fluoride	F_2SO_2	20	40
305	Sulfur tetrafluoride	SF_4	0.4	1
306	Tellurium	Te	0.01	-
307	Tellurium hexafluoride	F_6Te	0.1	-
308	Tetrachloroethylene	C_2CL_4	60	-
309	1,1,7,7 Tetrachloroheptane	$C_7H_{12}Cl_4$	-	1
310	Tetraethyl pyrophosphate	$C_8H_{20}O_7P_2$	0.05	0.2
311	Tetralin	$C_{10}H_{12}$	100	300
312	Tetramethyl succinonitrile	$(CH_3)_2C_2(CN)_2(CH_3)_2$	3	6
313	Tetranitromethane	$CH_3(NO_2)_4$	8	24
314	Tin (organic)	Sn	0.1	0.2
315	Tin (inorganic)	Sn	1	2
316	Tin oxide	SnO_2	2	-
317	Thionyl Chloride	Cl_2OS	5	-
318	Benzenethiol	C_6H_6S	2	-
319	Mercury compounds (organic)	Hg	0.01	0.03
320	Titanium	Ti	10	-
321	Thiram	$(CH_3)_2\ (SCSN)_2\ (CH_3)_2$	5	10
322	Tobacco (dust)		2	5
323	Mercury and compounds (inorganic)	Hg	0.02	0.04
324	Titanium dioxide (respirable dust)	TiO_2	5	-

325	Titanium dioxide (inhalable dust)	TiO_2	6	10
326	Toluene	$C_6H_5CH_3$	100	300
327	Toluene diisocyanate	$C_9H_6N_2O_2$	0.04	0.07
328	(m-, o-, p-) Toluidine	$CH_3C_6H_4NH_2$	0.5	1
329	Tribromometan	$CHBr_3$	5	15
330	Tributyl phosphate	$C_{12}H_{27}O_4P$	2.5	5
331	Trichloroethane	$C_2H_3Cl_3$	10	20
332	Trichloroethylene	C_2HCl_3	20	40
333	Trinitrobenzene	$C_6H_3(NO_2)_3$	-	1.0
334	Trichloro nitrobenzene	$C_6H_2Cl_3NO_2$	-	1.0
335	2, 4, 6 - Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$	0.1	0.2
336	Tritolyl phosphate	$C_{21}H_{21}O_4P$	0.1	0.2
337	Uranium and compounds	U	0.2	-
338	Vanadium penta oxide	V_2O_5	0.05	0.1
339	Vanadium	V	0.5	1.5
340	Vinyl acetate	$CH_2CHOOCCH_3$	10	30
341	Vinyl bromide	CH_2CBr	20	40
342	Vinyl chloride	C_2H_3Cl	1	5
343	Vinyl cyclohexene dioxide (930)	$C_8H_{12}O_2$	60	120
344	Warfarine	$C_{19}H_{16}O_4$	0.1	0.2
345	Wofatox	$C_8H_{10}NO_5PS$	0.1	0.2
346	Petrol (Petrol distillates, gazonline)		300	-
347	Cellulose (inhalable dust)		10	20
348	Cellulose (respirable dust)		5	-
349	Cesium hydroxide	CsOH	2	-
350	Cyanogene	NCCN	4	20
351	Xyanogene chloride	ClCN	0.3	0.6
352	Cyanides	CN(K, Na)	0.3	0.6
353	Cyclohexane	C_6H_{12}	500	1,000
354	Cychlohexanol	$C_6H_{11}OH$	100	200
355	Xylene	$C_6H_4(CH_3)_2$	100	300
356	Xylidine	$(CH_3)_2C_6H_3NH_2$	5	10

Part 2:

FIVE (05) PRINCIPLES AND SEVEN (07) MEASUREMENTS OF LABOR HYGIENE

I. PRINCIPLE 1 – ERGONOMIC DESIGN OF LABOR SYSTEMS

1. Scope of regulation

The ergonomic principles for designing labor systems in order to create optimum work conditions, ensure the safety, comfort and human health, technical and economic efficiency.

2. Subjects of application: the labor systems in facilities that employ workers (production facilities, business establishments, offices…)

3. Definition:

The terms in these principles are construed as follows:

3.1. Working facilities: *are every production facilities, business establishments, offices…*

3.2. Labor system: *including humans and labor equipment, working together during the work process, performing the labor duties at working areas, in labor environment under the compulsory conditions of the labor duties.*

3.3. Labor duty: *is an expected result of the labor system.*

3.4. Labor equipment: *tools, machinery, vehicles and other machinery, devices or components used in the labor system.*

3.5. The labor process: *the continuation in time and space of the mutual impacts of humans, labor equipment, materials, energy and information within the labor system.*

3.6. Labor space: *the acceptable capacity for one or many people in the labor system to fulfill the labor duty.*

3.7. The labor environment: *the cultural, social, biological, chemical and physical factors around a person within his/her working space.*

3.8. Labor stress (or external burden): *every labor condition and external requirement for the labor system that negatively affect the human psychology and/or physiology.*

3.9. Labor anxiety (or internal reaction): *are impacts of labor stress on a person depending on his/her personal characteristics and abilities.*

3.10. Labor fatigue:

Are systemic or partial non-pathological manifestation of fatigue due to the labor anxiety that may totally be recovered after some rest.

4. General principles

4.1. Working space design and labor equipment

a. Designs related to the body sizes:

The designs of the working space and equipment must depend on the human body sizes and the labor process. The working space must be adapted to the workers.

b. Posture:

- The worker may alternate between standing and sitting postures. If the worker must choose one, the sitting posture is usually preferred. The standing posture may be required depending on the work process.

- The postures must not cause labor fatigue due to extensive static muscular tension. The postures are interchangeable.

c. Muscle endurance:

- The requirement of muscle strength must be compatible to the worker’s physical condition.

- The muscle groups must be strong enough to satisfy the physical requirements. If the physical requirements are overwhelming, the supportive energy sources must be supplemented during the labor process.

- The extensive static tension of a muscle group must be avoided

d. The body movements:

- The movements must be balanced. The movement is more preferred than extensive static positions.

- The movement that require high precision must not demand considerable muscle strain.

- The movement must be made and combined easily using compatible control equipment.

e. The signs, monitors and control panel.

- The signals and monitors must be selected, designed and set up appropriately for the human sensory features, in particular:

+ The features and quantity of the signals and monitors must be appropriate for the information characteristics.

+ For clear information reception in places with many monitors, the monitors must be placed in order to achieve clear, firm and quick orientation. They might be arranged by function or technical process or importance and use frequency of special information.

+ The features and designs of signals and monitors must ensure clear recognition. These are applicable to danger signals.

+ The extensive activities in which the observation and supervision prevail, the overloading or underloading impacts must be avoided by designing and arranging the signals and monitors.

f. Control panels:

- Kinds, designs and arrangement of the control panels corresponding to the control are carried out depending on the human characteristics including natural and conditioned reflexes.

- The movement or static position of the control panel must be chosen depending on the control, the anthropometry and biomechanics.

- The functions of control panels must be recognizable.

- If there are multiple control panels at the same place, they must be clearly set up in order to ensure safe and quick operation. This may be carried out similarly to that of the signals by grouping by functions of the process in which they are used etc.

- The emergency control panel must be safely covered in order to avoid accidental activation.

4.2. Labor environment designs

Depending on the labor system, the following measurement must be noticed:

- The workshop sizes (general layout, working space and traveling space) must be reasonable.

- The clean air must be regulated depending on the following factors:

+ The quantity of people in a room,

+ The demand for manual labor,

+ The workshop size (including the labor equipment)

+ The emission of pollutants in a room,

+ The thermal conditions

- The light must be sufficient

The lighting must ensure optimum visions for the required activities. The following measurements must be noticed:

+ The luminance.

+ The colors.

+ The light distribution.

+ The unwanted reflection and glare.

+ The contrast between the color and the reflection.

+ The worker age.

- The room and labor equipment colors must be selected depending on their impacts on the reflection distribution, the structure and quality of the field of view, the safety color perception.

- The negative or irritable impacts of noise, including the noise from external sources in auditory work areas must be prevented.

- The vibration and impacts on humans must not exceed the limit in order to avoid physical harm, physiological reaction, sickness or sensorimotor disorder.

- The exposure of the workers to dangerous material and hazardous radiation must be avoided.

- For outdoor works, the workers must be appropriately protected from negative impacts of the climate, e.g. cold, heat, wind, rain resistance etc.

4.3. Labor process designs

- The labor process must be designed in order to protect human health and safety, create comfort and ease the jobs, especially by avoid overload and underload. The overload and underload due to crossing the upper and lower limit of the mental and physical function scale. For example:

+ The physical burden and sensory burden that cause fatigue.

+ The underload burden or labor monotony may reduce vigilance.

- Apart from the above factor, the mental and physical stress also depend on the contents and the recurrence of the tasks and the control of humans throughout the work process.

- Taking measures for improving the work process quality. For example:

+ Only one worker performs a number of consecutive tasks of the same work instead of a few workers (work extension).

+ Only one worker performs a number of consecutive tasks of the different works instead of a few workers (work variety).

+ Changing works. For example: alternating the voluntary works among the workers on the same assembly line or in one autonomous team.

+ Organized or unorganized breaks.

- During the implementation of the above measures, it is required to pay attention to:

+ The change in the insomnia and the work ability in day and night.

+ The difference in work ability among the workers and the variance in ages.

+ The personal abilities.

II. PRINCIPLE 2 – ERGONOMIC DESIGN OF WORKING LOCATIONS

1. Scope of regulation

The ergonomic principles for designing working positions in every business line in order to create optimum work conditions, ensure the safety, comfort and human health, technical and economic efficiency.

2. Subjects of application: every working position

3. Definition:

The terms in these principles are construed as follows:

- Working position: is a space where the technical equipment is equipped for one person or a group of people to work on a job or a phase.

- The reaching zone of the motion range is part of the working position, limited by the arc created by a stretched arm’s movement around the shoulder joint.

- The easy reaching zone of the motion range is part of the working position, limited by the arc created by a stretch arm’s movement around the shoulder joint (where the control equipment is regularly used).

- *The optimum reaching zone of motion range is part of the working position, limited by the arc created by a stretch arm's movement around the elbow joint (where the control equipment is always used).*

4. General principles of ergonomics

- The working position must be adapted to each kind of work, to the ability, to the mental and physical characteristics of the worker.

- The working position must be designed on the basis of the analysis of the human work process with particular equipment, basing on the anthropometrical measurements, the mental and physical characteristics of the worker and the assessment of hygienic conditions of the work.

- The working area arrangement includes: calculating the sizes basing on the anthropometrical measurements, selecting the appropriate working zone, surface, comfortable working posture and reasonably designing, arranging the equipment.

- The machinery and equipment must be suitable for the mental and physical characteristics of the worker (especially the anthropometrical and biomechanical characteristics).

- Arranging labor in the production premises in an optimum way including safe and adequate passages.

- The light (artificial or natural) must be sufficient for both ordinary works and machinery maintenance.

- The noise and vibration from the working positions or other sources must not exceed the acceptable standards.

- The necessary measures for protecting workers from the impact of dangerous and toxic factors (physical, chemical, biological, psychological and physiological factors) during the production must be taken.

- The measures for preventing and reducing workers' fatigue, psychological stress and other negative impacts must be taken.

5. Principles for working position arrangement:

- The working location arrangement must ensure that the task is performed within the accessible zone of the motion range.

- There are 3 kinds of accessible zones of the motion range.

* Reaching zone

* Easy reaching zone

* Optimum reaching zone

- The space for legs and feet while sitting must be sufficient.

- The requirements for the vision from the working location must be satisfied.

- The information display zones must be optimized (display devices, signboards, signals…) for the worker to receive information efficiently.

- The height of working surfaces, the distance from eyes to the observed objects, the view angle, footrest space must be sufficient.

- The size and height of the chair must be convenient for changing the working posture. The chair must not be to deep. The distance from the chair surface to the table surface must not be lower than 270 - 300mm.

III. PRINCIPLE 3 – ERGONOMIC DESIGN OF MACHINERY AND TOOLS

1. Scope of application

The ergonomic principles for designing machinery and tools in every business line is to design optimum machinery and tools in order to ensure the safety, comfort and human health, technical and economic efficiency.

2. Subjects of application: every working machinery and tools.

3. The principles

- Depending on the variance in body size when systemically or partially move the body.

- Depending on the motion range of the joints. The comfortable angles of the body.

- Depending on the required forces on the control devices.

- The principle of movement limitation in order to ensure comfortable postures and optimum working zones.

- The requirements for hygiene and appearance (shape, paint color…) must be satisfied.

- The principle of using anthropometry figures: after using the tools, the subject shall select the anthropometry figures as the basis for calculating the sizes of machinery and tools, the percentage of people that concur with the tool and machinery design.

IV. MEASUREMENT 4 – HEIGHT OF WORK SURFACES

1. Scope of regulation: principles of work surface height design.

2. Subjects of application: every working position

3. The principles

	Work characteristics	Height of working zone
1	Works that demand precise observation	10 - 20 cm above the elbow
2	Works that need handwork	5 - 7cm above the elbow
3	Works that need free hand movement	Slightly under the elbow
4	Works with heavy material (for standing position only)	10 - 30cm under the elbow
5	Works with various demands	Determined by the work that demands the most

V. PRINCIPLE 5 – WORKING POSITIONS WITH COMPUTERS

1. Scope of application: the basic principles of designing working positions with computers.

2. Subjects of application: every working positions with desktop computer.

3. The principles

3.1. Working positions

- The working position must be designed suitably for the worker. Ideally the position should be adjusted to suit each worker. In case the position cannot be adjusted, the design must be based on the anthropometry (5% and 95%).

- The adjustable working surface height should range from 65 - 75cm. If the height is not adjustable: 70 cm

- The height of the monitor and keyboard must be independently adjustable.

- The minimum distance between two workers is 1m (from the center of the working position).

3.2. Working surface:

- The working surface must not be glaring and reflective, and must be spacious enough to place necessary stuff such as the keyboard, mouse and document for the worker’s comfort.

- The document holder (if any) must be firm and placed at positions that do not cause the user to make inconvenient head and eye movements.

- If the use of computers is primary, it must be placed in front of the operator. If the use of computers is secondary, it must be placed on the left, if the operator is right-handed and vice versa.

3.3. Chair and backrest:

- The chair height must be adjustable from 35-50 cm and rotatable.

- The chair must be firm. The chair must not be covered by synthetic waterproof material.

- The seat depth is 38- 43 cm, at least 45 cm in width, edgeless. The tilt being 0 - 10^0 that can handle the body weight on the buttock (not on the thigh).

- The performance on the keyboard must not be hindered when the arm is rested.

- For mobile chairs, the 5 castors must be fixed on the chair.

- The backrest must be adjustable that can handle the back (hip).

3.4. Footrest:

- There must be space for the operator's feet to be comfortable.

- The overly tall chairs must have footrests. The tilt angle of the footrest is approximately 30^0 with non-slip surface.

3.5. The operator's posture:

- The operator must sit comfortably with the back rested and feet on the floor or the footrest. The elbow angle is approximately 90^0, the angle between the body and the thigh is from 90-120^0.

- The operator should avoid rigid sitting posture for a long time but may change the position, stand, stretch or walk around if feel tired.

3.6. View angle and visions:

- The best view angle is between 10-30^0 below the horizontal line of sight of the operator. The upper side of the monitor must not be higher than the eye-level. The angle between the ray from the lower side of the monitor and the horizontal line of sight must not exceed 40^0.

- The appropriate vision is not shorter than 50 cm.

3.7. Glare prevention and lighting

- The general light intensity: 300 - 700 lux For places with special visual requirements, the intensity may reach 700 - 1,000 lux. Partial lighting might be used for document reading with lampshade for glare prevention.

- Diminishing the reflection and glare by properly placing the light sources, not using reflective surfaces and items...

- Paying attention to the light sources when arranging computers so that the monitor would not reflect the light. Arranging computer so that the window does not face the monitor or its back. The computers should be placed at intersections of the light sources overhead rather than right below them.

- The monitor must be covered with anti-glare coat. If the anti-glare coat is not available, the monitor must be equipped with anti-reflection equipment in order to prevent glare from reflection. Such equipment must not reduce the definition of graphics and text. Only use the anti-glare filter when other solutions are not available.

- The wall color must be elegant with low reflection level (non-glossy). The colors of surrounding equipment must also be non-glossy or dark in order to avoid reflection of light sources. Avoid using reflective, shimmering or glossy surfaces at workplaces.

3.8. Environment

- The working room temperature is from 23 - 25^0C, the maximum relative humidity is 75%.

- The minimum ventilation volume is 13 m^3/hour/person. The wind speed must not exceed 0.5 m/second.

- The noise must not exceed 55 dBA.

3.9. Breaks

- After every hour of continuous work with computer, a short break to rest or doing light works not related to the monitor is recommended It is best to leave the computer during this time.

- It is better to exercise the muscles or eyes during this time.

- This time is not included in the break time.

VI. V. MEASUREMENT 1 – WORKING POSITIONS WITH COMPUTERS

1. Scope of application

The basic measurements of designing working positions with computers basing on the basic principles stated above.

2. Subjects of application: the working positions with desktop computer.

3. Measurements

No.	Norm	Size
1	*Table, chair, posture*	
	Table height: - Adjustable (cm)	65 - 70
	- Non-adjustable (cm)	70
	- Chair height (adjustable) (cm)	35 - 50
	Seat depth (cm)	38 - 43
	Minimum seat width (cm)	45
	Seat slope toward the backrest (degree)	0 - 10
	Footrest space (cm)	19
	Footrest slop (degree)	30
	Elbow angle (degree)	85 - 95
	Body – thigh angle (degree)	90 - 120
	View angle (below the horizontal line of sight) (degree)	10 - 30
	Vision (cm)	>50
2	*Environment*	
	- General lighting (lux): - normal	300 -700
	- Special visual requirements	700- 1,000
	- Temperature (^{0}C)	23 - 25
	- Maximum humidity (%)	75
	- Minimum ventilation	13 m^3/hour/person
	- Wind speed(m/second)	Not exceeding 0.5
	- Noise (dBA)	Not exceeding 55
3	Continuous working time	1-2 hours

VII. MEASUREMENTS 2- – HEIGHT OF WORKING SURFACES

1. Scope of regulation

basic measurements of working surface height.

2. Subjects of application: working positions.

3. Measurements:

Posture	Kind of work	Height of working surface (cm)		
		Male	Female	Male and female
Standing	Light	88 - 102	85 - 97	86 - 99
	Medium	80 - 94	77 - 89	78 - 91
	Heavy	74 - 88	71 - 83	72 - 85
Sitting	High precision	73 - 86	70 - 83	70 - 83

	Precision	65 - 78	62 - 75	64 - 77
	Light works without high precision	60 - 73	57 - 70	59 - 72

VIII. MEASUREMENTS 3 – VIEW DISTANCE FROM EYES TO THINGS

1. Scope of regulation

The measurements of view distance from eyes to the working objects.

2. Subjects of application: working positions

3. Measurements

No.	Work characteristic	View distance (from eyes to things)
1	Works demanding extreme precisions (small part assembly…)	12 - 25cm
2	Works demanding high precision (drawing, sewing, seaming…)	25 - 35cm
3	Works demanding precision and medium precision (reading, lathe…)	35 - 50cm
4	Works demanding little precision	Over 50cm

IX. MEASUREMENTS 2 – VIEW ANGLE

1. Scope of regulation

The measurements of view angle in working position design in order to create comfort and productivity.

2. Subjects of application: working positions.

3. The measurement of view angle with the horizontal line of sight 0^0

No.	Working posture	View angle
1	Leaning backward (e.g. working in control rooms)	15^0
2	Leaning forward (e.g. – working at tables)	45^0

* One side of a view angle is the horizontal line of sight.

* The object of work under regular observation must be put at the front center field of view

X. SPECIFICATONS 5 – FOOTREST SPACE

1. Scope of regulation

The measurements of footrest space in working position design in order to create comfort and productivity.

2. Subjects of application: working positions.

3. Measurements:

No.	Working posture	Footrest space
1	*Sitting positions:*	
	Width	60 cm
	Depth at knee-level	□ 45
	Depth at floor-level	65
2	*Standing positions:*	

	Depth for feet	□ 15 cm
	Height for feet	□ 15 cm
3	*The free space behind the standing worker*	90 cm

XI. MEASUREMENTS 6 – LIFTING HEIGHT

1. Scope of regulation

The measurements of height from the floor to the person lifting in order to create comfort and avoid vocational risks.

2. Subjects of application: the workers that lift heavy things.

3. Definition`

The terms in these standards are construed as follows:

- Normal lifting height: within the range from the elbow joint to the shoulder joint.

- Low lifting height: under the elbow joint.

4. Measurements

Level	***Normal lifting height***				***Low lifting height***			
	Distance to the handle (cm)				**Distance to the handle (cm)**			
	< 30	30-50	50-70	>70	< 30	30-50	50-70	>70
	Lifting weight (kg)				**Lifting weight (kg)**			
1	Heavy things easily lifted by machines							
2	< 18	< 10	< 8	< 5	< 13	< 8	< 5	< 4
3	18-34	10-19	8-13	6-11	13-23	8-13	5-9	4-7
4	35-55	20-30	14-21	12-28	24-25	14-21	10-15	8-13
5	>55	>30	21	>18	>35	>21	>15	>8

XII. MEASUREMENTS 7: PHYSIOLOGICAL MEASUREMENTS OF THERMAL STRAIN – LIMIT VALUES

1. Scope of regulation: The limit values of physiological measurements of thermal strain including the risks to health of healthy workers, the adaptability to different technologies to detect such risks.

2. Subjects of application: workers at every facility working in hot or cold environment.

3. Reference standard: ISO 9886

4. Physiological specifications of thermal strain

4.1. Body core temperature

The body core temperature must not differ from the values in section 4.1.1 and 4.1.2.

4.1.1. Hot environment

The limit values depend on the core temperature increase and the used measurements.

The core temperature must not increase more than 1^0C (or not exceed 38^0C) in the following cases;

- The core temperature is taken many times, regardless of the techniques.

- When other physiological measurements are not taken.

In other conditions, especially when the esophagus temperature is continuously monitored concurrently with the heart rate, the limit may be raised such as increasing 1.4^0C or reaching 38.5^0C.

The increase of temperature over 38.5^0C might be tolerable when the following conditions are satisfied:

a. The subject has been given medical examination.

b. The subject has adapted to the heat by repeatedly exposing to such environment when performing special duties.

c. Under constant medical supervision and means of first-aid are ready.

d. The esophagus temperature is continuously monitored.

e. Other physiological measurements are concurrently monitored – especially the heart rate

f. The exposure might be immediately suspended when the intolerable symptoms appear such as fatigue, vertigo, nausea

g. The workers are entitled to leave the workplace when they want.

The core temperature must not exceed 39^0C.

4.1.2. Cold environment:

In cold environments, only the measurements of esophagus temperature (t_{es}), rectum temperaturer (t_{re}) and abdomen temperature are suitable. The lower limit for these temperatures is 36^0C. Conditions of application:

a. When these temperatures are monitored from time to time.

b. When the exposure is repeated in a day.

c. In some rare conditions, the lower temperature might be tolerable briefly.

d. The subject has been given medical examination

e. The skin temperature is concurrently monitored and the acceptable limit is noticed.

f. The workers are entitled to leave the workplace when they want.

4.2. The skin temperature limit values:

For the previously mentioned reasons, the below limits are only related to the pain threshold.

In hot environments, the maximum partial skin temperature is 40^0C. In cold environments: 20^0C for forehead skin, 10^0C for limb tip temperature (especially finger tips and toe tips).

4.3. Heart rate (HR):

The heart rate increase (ΔHR_T) by thermal strain is 33 beats for each degree increased of the core temperature. However, the heart reaction to heat varies from person to person. Therefore, in case the HR is the only physiological measurement monitored, the upper limit of HR_T around 30 beats/minute would be reasonable. In circumstances that the thermal strain might be high, it must be measured simultaneously with the core temperature. Moreover, there must be means to monitor the actual heart rate throughout the exposure.

The limited heart rate at workplaces must not exceed the maximum limit minus 20 beats/minute. Ideally, these values should be calculated by personal test. If such test cannot be carried out, the values could be approximated using the following formula:

$HR_L \approx 0.85$ A (A is the age in year).

According to the maximum limit of the core temperature being 39^0C, the maximum limit of the heart rate increase from the initial temperature may reach 60 beat/minute. This may be applicable to the similar situations, especially under medical supervision and constant monitoring.

4.4. Weight loss:

The limit value of weight loss is 800g for adapted workers and 1300g for unadapted ones, proportionally to the water loss being 3250g or 5200g in case the water intake is 75% of the water loss.

These values refer to subjects with 1.8 m^2 of skin and may be applicable to a particular subject by proportionally multiplied the skin area A_{Du} with the reference skin area being 1.8 m^2

Limit values	**Unadapted person**		**Adapted person**	
	Caution	**Danger**	**Caution**	**Danger**

Sweat level				
Idle: M<65W/m^2				
SW_{max} W/m^2	100	150	200	300
g/hour	250	390	520	780
Working: M>65W/m^2				
SW_{max} W/m^2	200	250	300	400
g/hour	520	650	780	1040
Maximum water loss				
D_{max}W.h/m^2	1 000	1 250	1 500	2 000
g	2 600	3 250	3 900	5 200
Notes: W □ watt-hour □ hour g □ gram				

Notes: * M □ energy metabolism level

* SW□ sweat weight

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