The Ministry of Health Care and Social Development
The Volgograd State Medical University
The Chair of hygiene and ecology

# Lecture

# Occupational hygiene. The factors of working environment, their effect on the human health. diseases. Preventive measures against occupational diseases

- **Occupational hygiene** is a branch of hygiene which studies the effects of the production process and the conditions of working on the human body. Its aim is to work out preventive measures against occupational diseases, to support health and optimum functioning

# Occupation Hygiene develops:

· Hygienic demands to the rational use of equipment ,

Hygienic norms and regulations in working conditions,

· Building and upkeep of industrial enterprises;

· Measures of personal hygiene;

· Suggestions for the rational working conditions organization and rest and creation of the healthy and safe conditions of working;

decrease and elimination of occupational diseases

**Maximum Allowable Concentrations (MACs)**

Are those concentrations that in case of daily exposure at work for 8 hrs throughout the entire working life will not cause any disease or deviation from a normal state of health

# The harmful factors of working environment

- include the basic factors of production process and working environment which under certain conditions can cause occupational diseases, temporary or permanent decrease of capacity and work productivity of people, increase in the occurrence of somatic and infectious diseases, and may lead to health problems of posterity.

# The dangerous factors of working environment

- include the factors of production process and those of working environment which under certain conditions can cause an acute disease or a progressive deterioration of health. In some cases it may be even fatal

# Occupational diseases

- are the diseases which are most frequently caused by the effects of the unfavorable factors of production process and those of the working environment. Thus, if a person breathes in the dust containing silicon dioxide, he develops silicone. If a person is constantly under the influence of vibration, he may develop a vibration disease.

# Occupational Diseases

- Occupational diseases have a long latent period.
- Most occupational diseases cannot be treated.
- All occupational diseases can be prevented.

# Classification

*I. Diseases due to physical agents*:

**Cold**: Trench foot, frostbite

**Light**: Occupational cataract, miner's nystagmus

**Noise:** Occupational deafness

**Radiation:** Cancer, leukaemia, aplastic anaemia, pancytopenia

**Dust:** Pneumoconiosis

*II. Diseases due to chemical agents:*

**Gases**: Gas poisoning

**Metals and their compounds:** Chemicals & Solvents

***III. Diseases due to biological agents:***

Leptospirosis, anthrax, actinomycosis, tetanus

***IV. Occupational cancer:***

Cancer of skin, lungs, bladder

***V. Occupational dermatosis:***

Dermatitis, eczema

- An **acute occupational disease** is an unpredicted impairment of health which may be lethal. It usually occurs as a result of a single contact of a person (during the work shift) with the relatively high concentrations of chemical substances which are found in the air of the working area.

- **Chronic occupational diseases** are

  diseases which usually arise as a result of a long term influence of the harmful factors of production process and those of the working environment on the human health.

# PREVENTION OF OCCUPATIONAL DISEASES

# ENGINEERING MEASURES (technical – sanitary-technical)

*** Design of Building**

The type of floor, walls, height, ceiling, roof, doors and windows, cubic space etc. should receive attention at design stage

# * Mechanization / Automation

- The plant should be mechanized to the fullest possible extent to reduce the hazard of contact with harmful substances
- Hand-mixing is replaced by mechanical devices
- Harmful substances like acids etc. can be conveyed from one place to another through pipes

# *Substitution

Replacement of a harmful material by a harmless one, or one of lesser toxicity

- Use of zinc or iron paints in place of harmful lead paints

# *Enclosure

Enclosing the harmful materials and processes to prevent the escape of dust and fumes into the factory atmosphere e.g. grinding machinery

Working area fully **enclosed** in a cabinet with interior lighting

# *Isolation

- To isolate the offensive process in a separate building so that workers not directly connected with the operation are not exposed to the hazard
- Certain operations can be done at night in the absence of the usual staff

# *Control at Source

- Dusts can be controlled at the point of origin by water sprays e.g. wet drilling of rocks
- Inclusion of a little moisture in the materials will make the processes of grinding, sieving and mixing comparatively dust-free
- Wetting of floors and work benches in lead industry

# *General Ventilation

- Proper ventilation is needed for the control of noxious vapors, fumes and dusts and prevention of fatigue and industrial accidents

# *Good Housekeeping

- Walls, ceilings and passages should be white- washed at least once a year or painted with water washable paint once in 3 years and washed at least once in 6 months
- Dust which settles down on the floor, ledges, beams, machinery and other stationery objects should be promptly removed by vacuum cleaners or by wetting agents
- Masks, gloves, aprons and other protective equipment should be kept clean and in a state of good repair

# Personal Protective Measures

- Masks, Aprons, Gloves
- Helmets, Safety shoes, Gum boots, Goggles, Screens
- Ear plugs, Ear muffs
- Barrier Creams

# LEGISLATIVE MEASURES

## *The Factories Act

- The factories act covers the matters relating to *Health, Safety & Welfare of the workers*
- Lighting, Ventilation & Temperature Standards
- Hours of work day *(not more than 48 hours per week & 9 hours per day)*
- Employment of young persons *(< 18yrs)*
- Treatment of Waste & Effluent to render them safe

# *Social Security Act

- Benefits to the employees
  - Medical
  - Sickness
  - Disablement
  - Maternity
  - Dependents Benefit

# Periodical Medical Examination

**To detect early, reversible health affects**

# Health Protection Measures

- Nutritional Program/ Supplements
- Mental Health
- Measures for women & children
- Recreation Facilities

# CLASSIFICATION OF HARMFUL & DANGEROUS FACTORS OF PRODUCTION PROCESS & WORKING ENVIRONMENT

# 1. The factors of **physical nature** include:

- the temperature, humidity, velocity of the air; thermal radiation;
- non-ionizing electromagnetic fields and radiation: electrostatic fields, electrical and magnetic fields, electromagnetic radiation of radio-frequency region, electromagnetic radiation of optical band (including laser and ultra-violet radiation);
- ionizing radiation;
- industrial noise, ultrasound, infrasound (i.e. infrasonic sound);
- vibration;
- aerosols (occupational dust) of mainly fibrogenic action;
- lighting - natural (absence or insufficient lighting), artificial (insufficient lighting);
- electric charged particles of the air – these are aeroions.

# 2. The **chemical factors**

include both the chemical substances and some substances of biological origin which are synthesized chemically:

- antibiotics;
- vitamins;
- hormones;
- ferments (enzymes);
- protein preparations.

3.The factors of the working environment of **biological nature** include:

- pathogenic microorganisms;
- Microorganisms - producers;
- living cells and spores contained in some preparations.

4.The factors of production process which characterize **the strain of labour**:

- physical dynamic load;
- pure mass of  the lifted and moved goods;
- stereotype work movements;
- static load;
- work position;
- angles of slope of the human body;
- space movements (horizontally and vertically).

5. The factors of production process which characterize the **intensity of labour**:

- intellectual, sensor, emotional loads;
- monotony of loads;
- regime of work.

# Classification of working conditions based on hygienic criteria

- According to the hygienic criteria, working conditions are divided into 4 types:
- 1st type – optimum working conditions,
- 2nd type – maximum permissible working conditions,
- 3rd type – harmful,
- 4th type – dangerous working conditions.

The 1st and the 2nd types of working conditions fall under the category of safe working conditions.

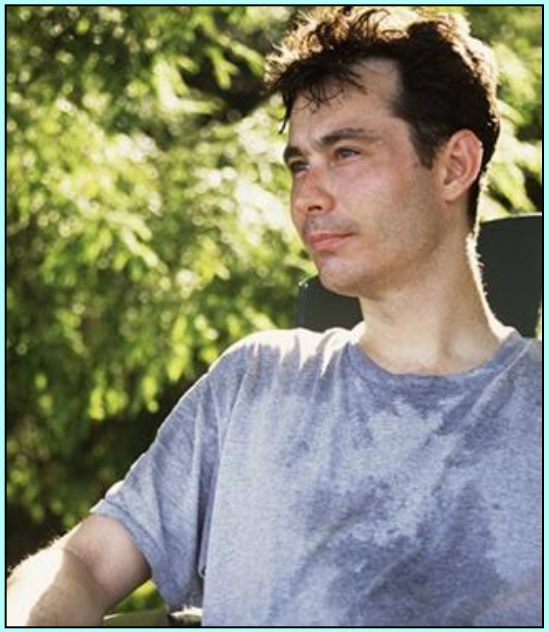
**Harmful factors of the working environment of physical nature.**

**Prophylaxis of occupational diseases.**

# Working in Hot Conditions

# Natural cooling system

- When blood temperature exceeds - your heart rate increases and blood circulates closer to the surface of the skin.
- This allows heat to transfer out of the blood and into the cooler environment outside the body.
- If your body can’t lose enough heat by transferring heat out of the bloodstream, your brain will signal the sweat glands to start sending fluids to the surface of the skin.
- The body’s heat will leave with the evaporated sweat.



- But when **humidity is high**, the body's cooling system isn't very effective. High heat prevents cooling through heat transfer out of the bloodstream, and high humidity prevents sweat from evaporating. The result can be **heat-related illness.**

# Additional Heat Stress Factors

- Radiant heat
- Contact with hot objects
- Limited air movement (no breeze, wind or ventilation, Air velocity)

# Personal Sensitivity To Heat

- Acclimatization (getting used to heat)
- Age
- Physical condition and overall health
- Metabolism
- Use of alcohol

# Fainting (Heat Syncope)

- Worker not used to hot environment
- Worker stands still in heat
- Blood pools in the legs, so less blood goes to the brain
- Quick recovery after lying down in cool place
- Prevent by moving around a little rather than standing still all the time

# Heat Cramps

- Cramping of either active muscles (arms, legs) or involuntary (usually abdominal) muscles (or both).
- Caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating
- It is important to understand that cramps can be caused by both too much and too little salt

# Heat Cramps

- Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments
- **First Aid:** Replenish electrolytes through drinking of fluids. Rest in a cool environment.

# Heat Exhaustion

- Loss of fluids and salt
- Feeling weak, dizzy, or nauseous
- Skin is clammy and complexion is pale or flushed
- Treatment:
  - Rest in cool place
  - Drink electrolyte solution
- Severe cases: victims vomit or lose consciousness

# Heatstroke

- Victim stops sweating
- Symptoms include hot, dry skin
- Confusion, convulsions, or loss of consciousness may follow
- Keep victim cool and provide fluids if conscious

# Heat Can Cause Accidents

- Decreased strength, increased fatigue
- Reduced comprehension and ability to retain information
- Safety procedures not followed
- Other risks

# Prevention
# Engineering Controls (technical)

- Air conditioning (such as air-conditioned crane or construction equipment cabs, air conditioning in break rooms).
- Increased general ventilation.
- Spot cooling
- Cooling fans.
- Local exhaust ventilation at points of high heat production or moisture (such as exhaust hoods in laundry rooms).
- Insulation of hot surfaces (such as furnace walls).
- Elimination of steam leaks.

# Engineering Controls

- Reflective shields to redirect radiant heat. (workers and workstations might be located inside an air-conditioned control room).

- Heat-resistant shields might be installed around ovens or melting pots

# Engineering Controls

- Outdoor workers might be provided with tent-like devices that shade them from the radiant heat of the sun.
- Substituting machinery for manual labor
- Automation and distant control of technological processes - in hot work environments employees might control machine operations from inside a cool control booth

# Administrative Controls

- Schedule heavy work for a cooler time of year or in the evening and early morning
- Allow more frequent breaks or longer rest periods
- Allow time for workers to become conditioned to heat
- Employers should take steps that help workers become acclimatized

# Administrative Controls

- Reduce physical demand on workers
- Use relief workers
- Limit hours on hot work environments
- Pace the work

# Personal Protective Equipment

- Shade-providing hats
- Portable water products
- Reflective clothing
- Systems that circulate air around the body

# Medical Surveillance

- Periodic medical evaluation
- People should be examined thoroughly by the doctor
- Determining risk of heat-related illness
- Removing high-risk employees from hot working environments

# Water, Water, Water

- Drink plenty of water all day
- Drink electrolyte-balanced fluids if you sweat a lot
- Drink at least one cup of fluid every 15-20 minutes when working in hot conditions
- Avoid caffeine and alcohol

# Dust

According to the **degree of dispersion**, the dust may be:

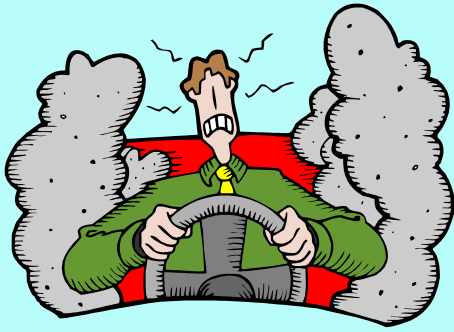
- **visible** (the size of the particles is more than 10 micro millimeters),
- **microscopic** (the size of the particles is from 0, 25 to 10 micro millimeters),
- **ultramicroscopic** (the size of the particles is less than 0, 25 micro millimeters).

The dust with the size of the particles less than 5 micro millimeters is **the most dangerous** as it can penetrate into deeper layers of the lungs up to the alveoli and can be stored there.

- **Occupational dust** may lead to **non-specific diseases** of diseases:
- of the skin and mucosa
- of eyes (conjunctivitis)
- the respiratory organs (for example, rhinitis, pharyngitis, dust bronchitis, pneumonia)
- allergic diseases (for example, allergic dermatitis, bronchial asthma)
- cancer
- and **specific diseases -** pneumoconiosis.

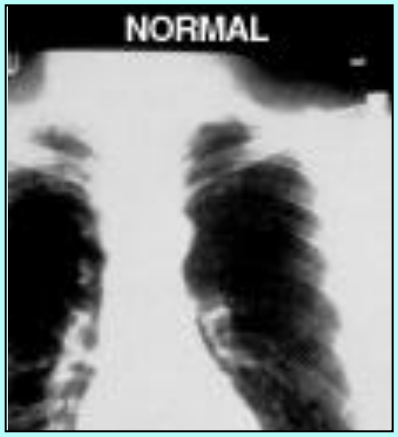
# Lung Diseases Caused by Dust

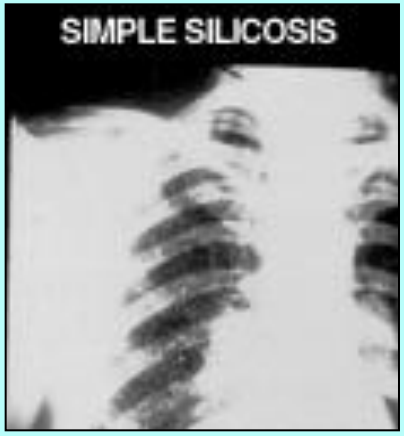
- Depends on chemical composition, particulate size, concentration, shape, specific gravity & body's reaction
- **Pneumoconiosis**
  - Asbestosis
  - Silicosis
  - Coal workers pneumoconiosis
- Lung diseases caused by dust of organic origin
  - Byssinois (exposure to cotton dust)
  - Mushroom workers lung
  - Suberrosis (Cork dust)
  - Bird breeders lung (chickens, parrots, pigeons)
- Occupational asthma
  - Flour insects and pollens: linseed, soya beans, teak wood, hair, fur, etc: isocyanates, poly urethane, amines, metals



# What Is Silicosis?

- Silicosis is a lung disease
- Caused by breathing dust containing **silica**
- Lungs become scarred and stiffened
- Breathing becomes difficult
- Risk of heart disease and tuberculosis increases



# How Dust Can Be Hazardous

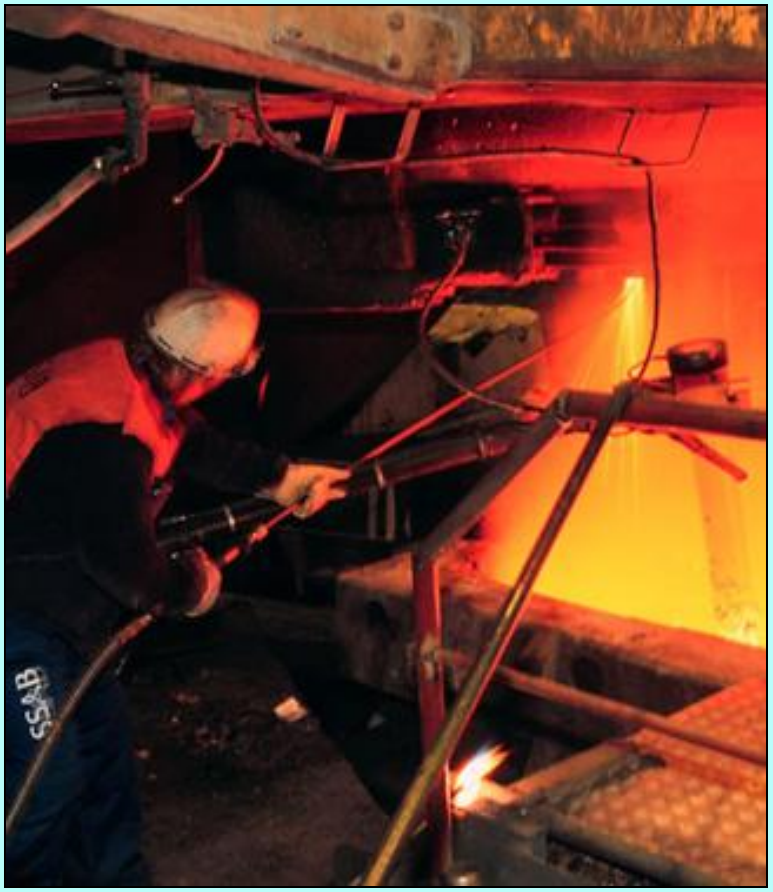
- Particles are generated by work processes
- Any airborne dust can be a hazard
- Invisible particles go deep into the lungs
- Large particles are removed by mucus
- Silica-containing dust is particularly hazardous

# At-Risk Industries and Jobs

- Mining
- Construction
- Stone cutting

# At-Risk Industries and Jobs

- Foundry work
- Cement production
- Glass manufacturing

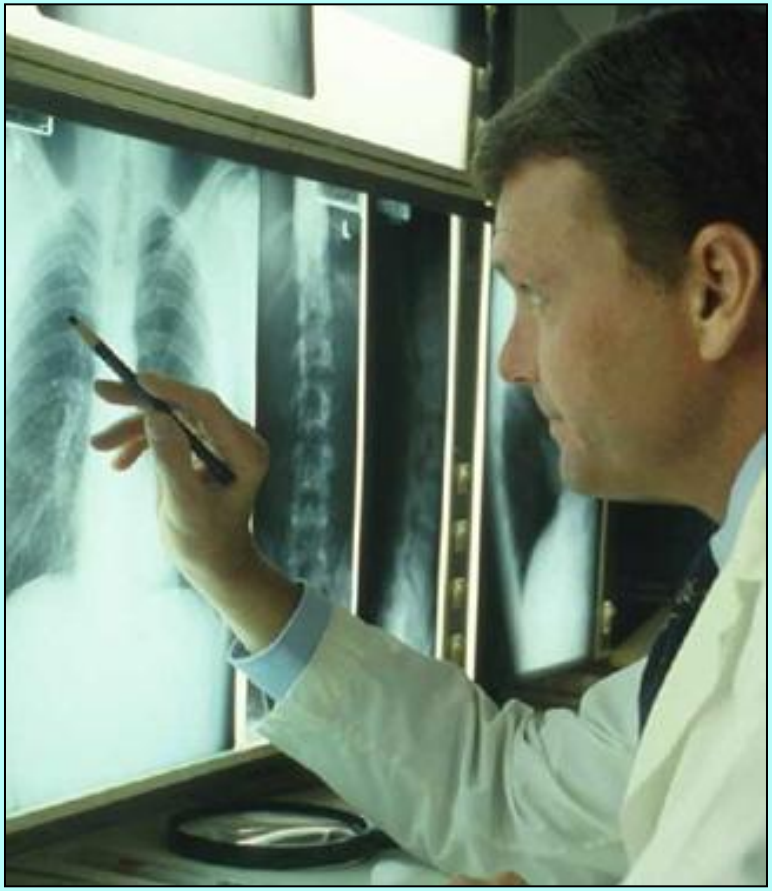


# At-Risk Industries and Jobs

- Ceramics, clay, and pottery manufacturing
- Abrasive cleaning or sand blasting
- Paint, plastic, soap, and abrasives manufacturing
- Electronics production
- Filtration of food and beverages

# Chronic Silicosis

- Develops slowly over many years
- Exposure to dust with 10 percent silica
- No symptoms for 15-20 years
- Symptoms get progressively worse
- May lead to life-threatening complications



# Acute Silicosis

- Develops after 1-3 years of exposure
- Overwhelming concentrations of silica
- Symptoms appear after only 7 months
- Cough, weight loss, and fatigue
- Liquid in lungs
- Fatal within 2 years

# Preventive measures against dust

- Engineering controls
- Limit the amount of dust inhaled
- Inspect work area
- Monitor exposure levels
- Substitute other materials

# Engineering Controls

- Use ventilation and dust collection systems
- Isolate silica dust work processes
- Suppress dust with moisture

# Engineering Controls

- General ventilation systems
- Local exhaust ventilation
- Inspection every 3 months
- Inspection when processes change
- Industrial hygiene surveys
- Use a vacuum for dust removal

# Personal Hygiene

- Change into disposable or washable work clothes
- Vacuum work clothes
- Take a shower
- Put on clean street clothes
- Wash hands before eating, drinking, or smoking
- Don’t bring personal items into hazardous work areas

# Use respiratory protection

- Use air-purifying, air-supplying respirator
- Make sure respirators fit well and are worn properly

# Medical Surveillance

- Physical exam including:
  - Medical history
  - Chest X ray
  - Evaluation for tuberculosis
- Frequency of exams determined by doctor
- Early diagnosis of silicosis can help control disease

# OCCUPATIONAL NOISE

- Noise is a term describing an undesirable sound or a combination of sounds which has a negative effect on the human body and interferes with work and rest.
- “stress factor”

# Sources of Noise Pollution

- Road Traffic noise
- Air Craft
- Noise from railroads
- Construction Noise
- Noise in Industry
- Noise in building
- Noise from Consumer products
- Loud Speakers
- Firecrackers

# Problems of Noise Pollution

- It has **a specific effect** on the organs of hearing : Hearing Impairment (Temporary or permanent Deafness)

- Noise may have **a non-specific effect** :
- CNS: Fatigue, Lack of concentration, Aggressive Behavior
- Sleep interference
- Mental Illness (anxiety, stress, nervousness, nausea, headache, emotional instability, argumentativeness, changes in mood, increase in social conflicts, neurosis, panic attacks)
- CVS (Increase in the rate of heart-beat, increased cholesterol level and Constriction of blood vessels)
- Stress related illness
- Digestive problems

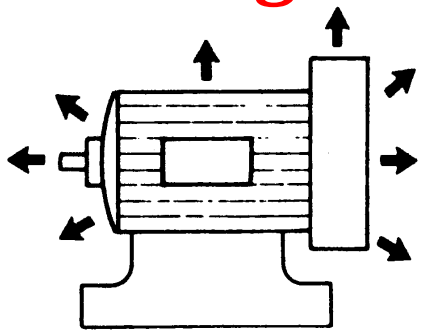
# A non-specific effect

Noise can trigger both endocrine and autonomic nervous system responses that affect the **cardiovascular system** and thus may be a risk factor for CVS.

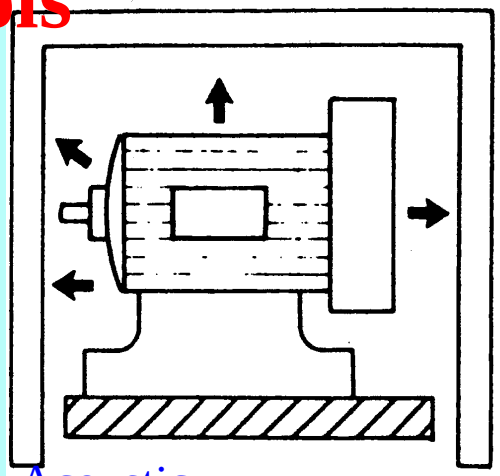
High levels of stress hormones such as cortisol, adrenaline, and noradrenalin can lead to hypertension, stroke, heart failure, and immune problems.

# PREVENTION

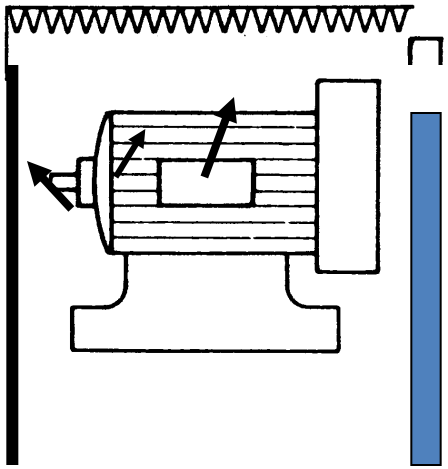
## Engineering Controls



Re-design or maintain

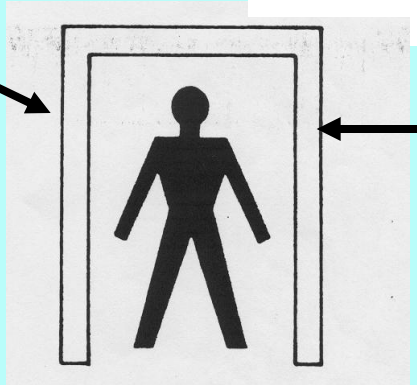


Acoustic Guard



Absorb or Shield

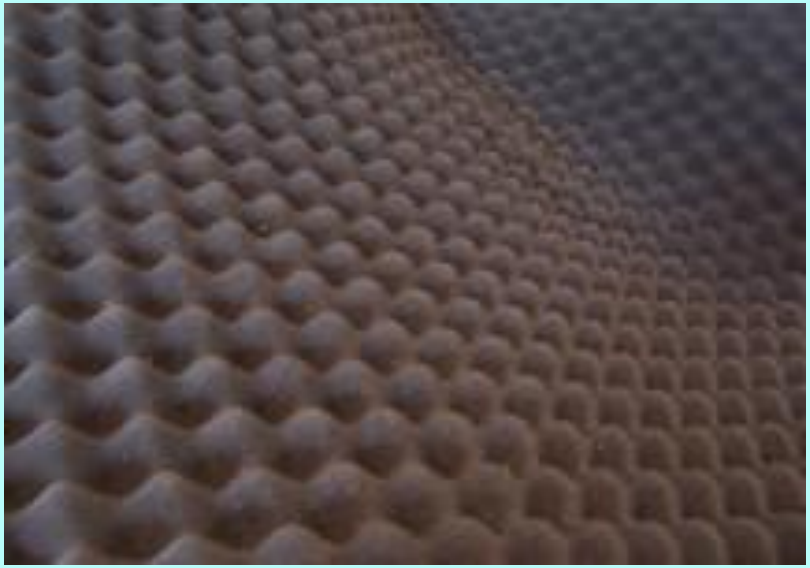
Shadow

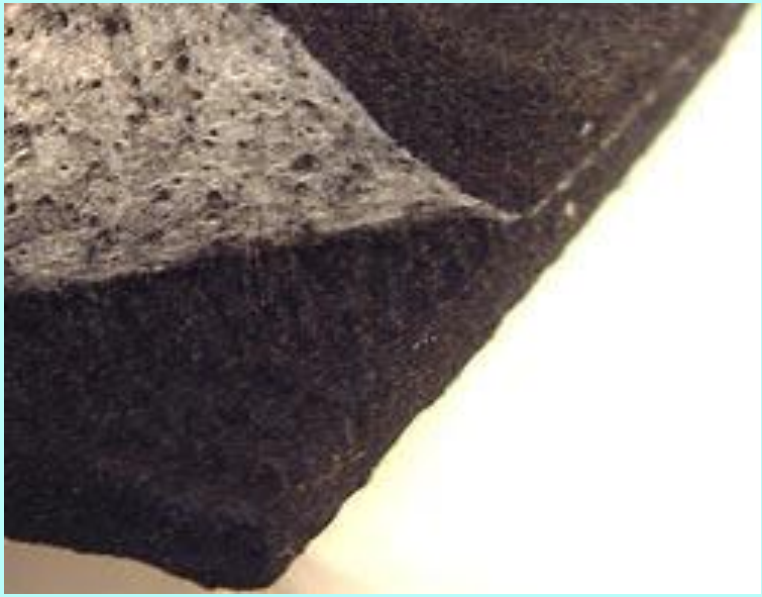


Enclose the person

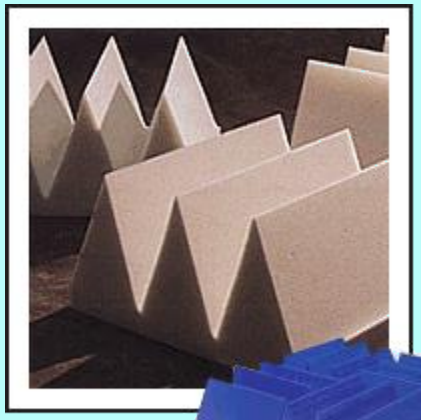
Noise

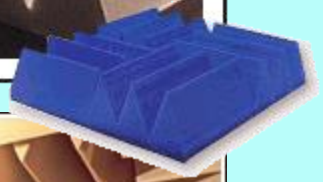
# *Absorbing materials

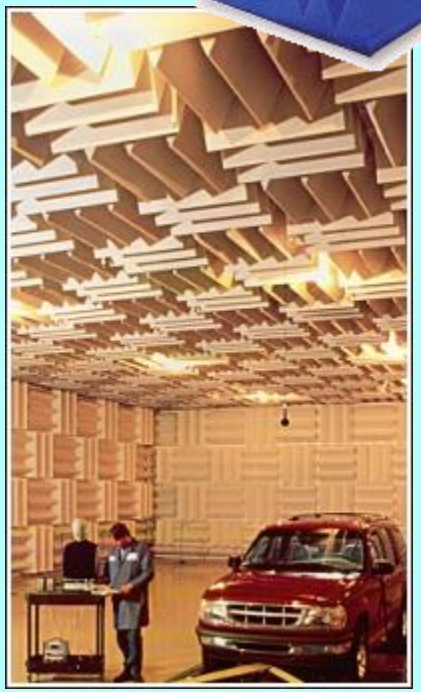




# Absorbing materials

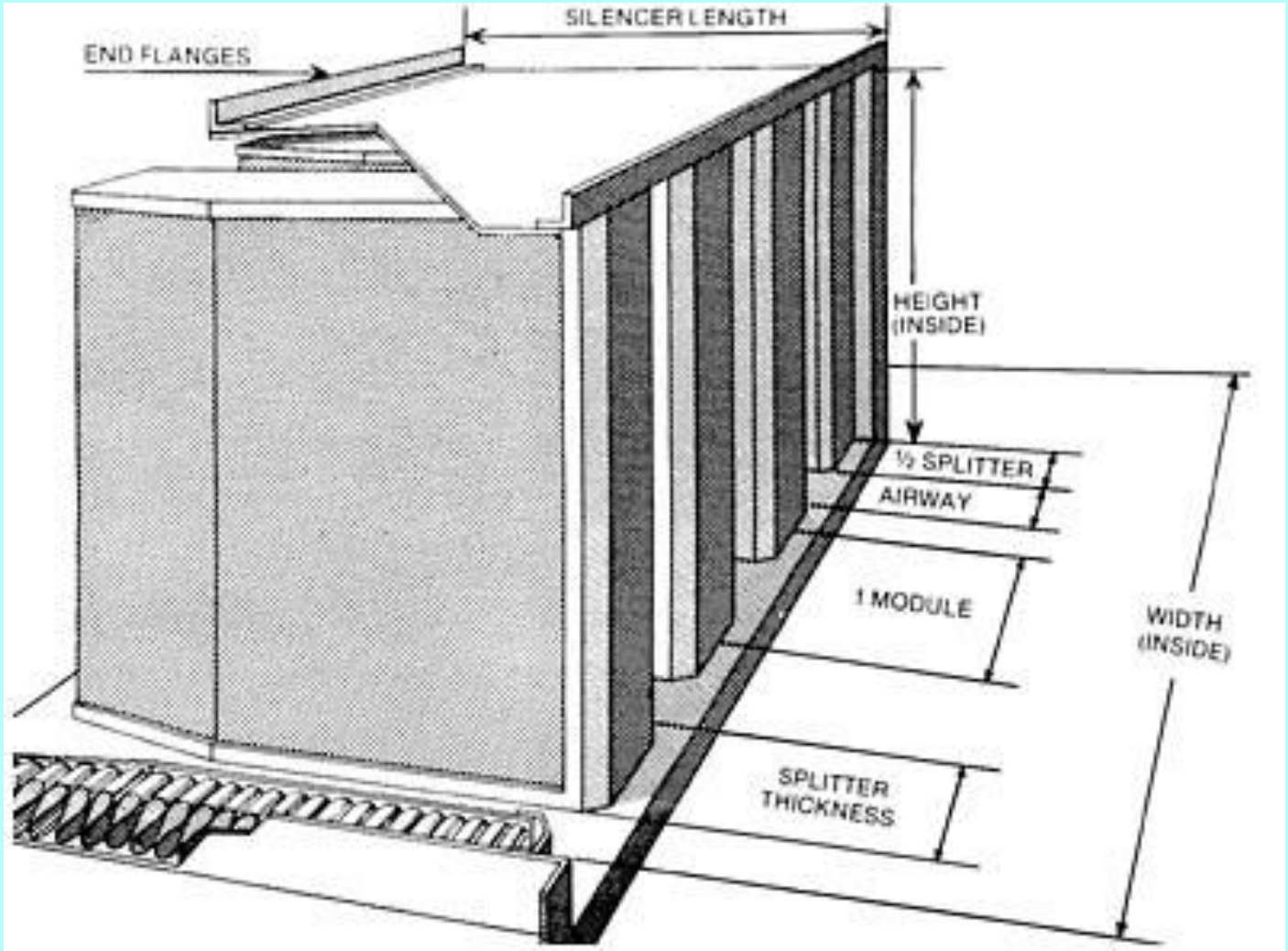




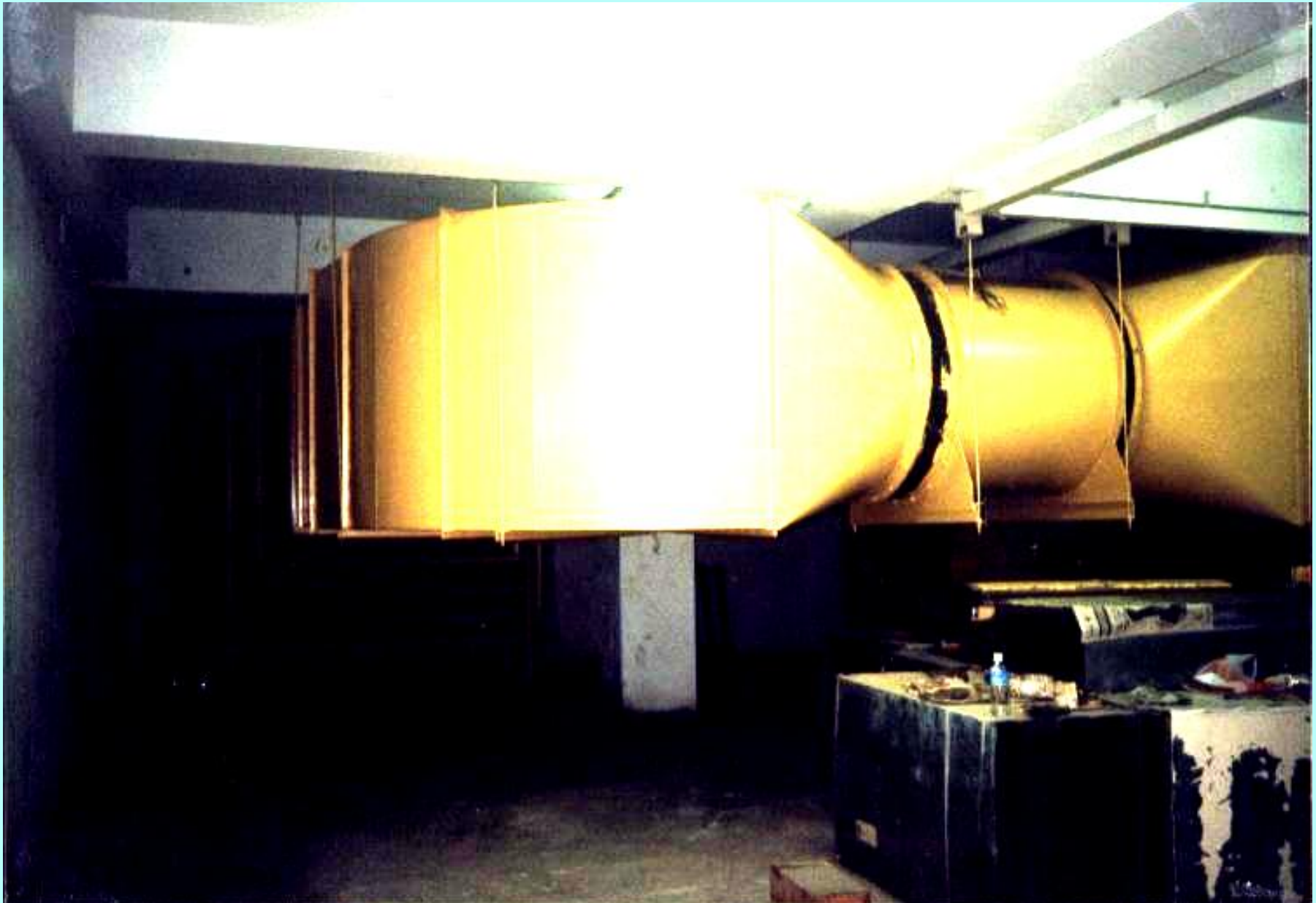


# *Acoustic panels installed in conference room (right) and theatre (left)

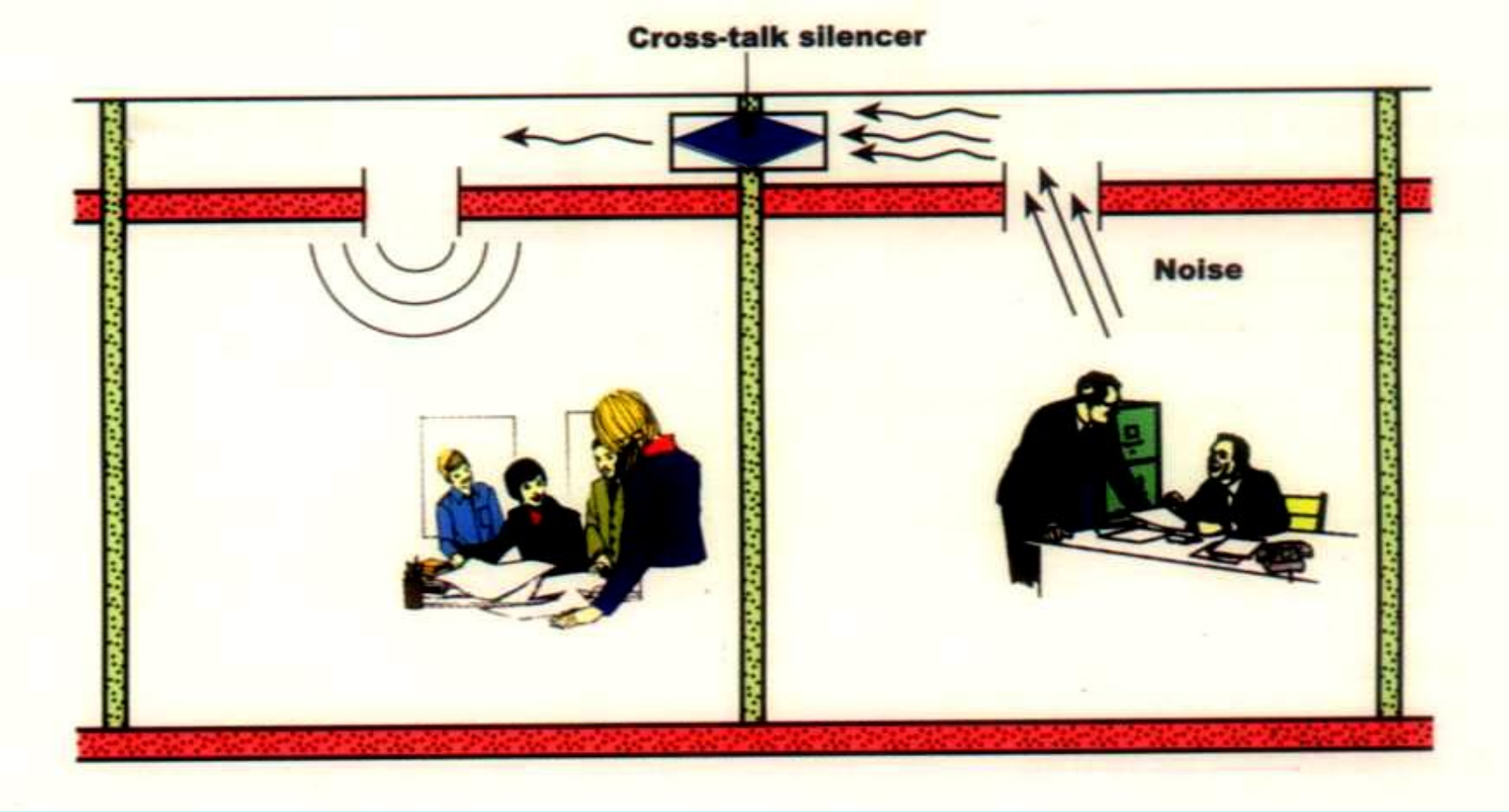
# *Silencer


SILENCER LENGTH
END FLANGES
HEIGHT (INSIDE)
½ SPLITTER
AIRWAY
1 MODULE
WIDTH (INSIDE)
SPLITTER THICKNESS

# Fans - Silencers



# Cross-talk silencer

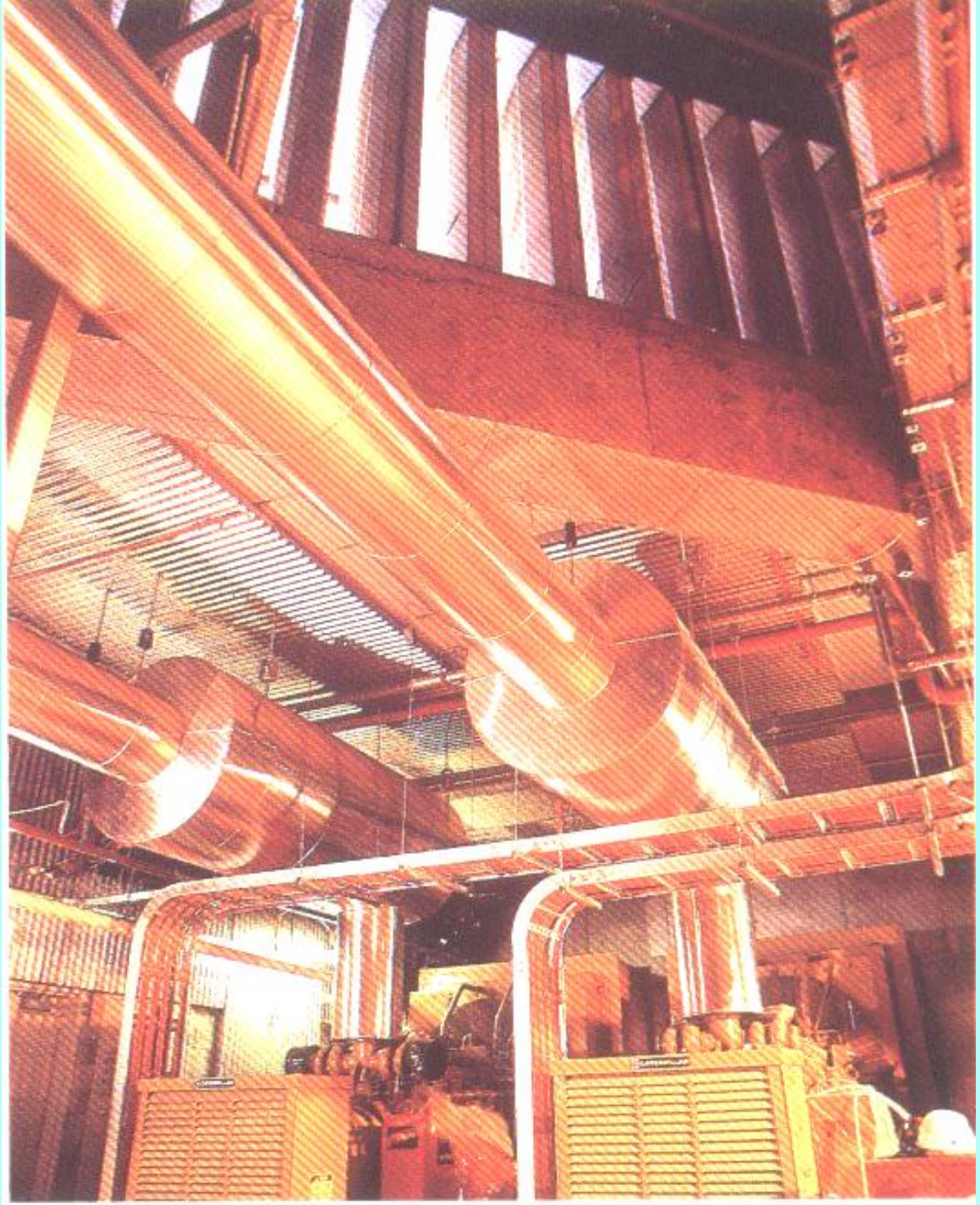


# Acoustic Enclosures

# Acoustic Enclosure

# Generator Set Room

**(Mufflers, Ventilation Silencers, Acoustic Linings & Vibration Isolators)**



# Vibration Mounting

Vibration isolation hangers for water pipes

Vibration Isolation mountings for water pipes

# Administrative Controls

- It is necessary to control the level of noise on workplace.
- Planting bushes and trees in and around sound generating sources is an effective solution for noise pollution.
- Factories and industries should be located far from the residential areas

# Personal Protective Equipment

- Wear adequate hearing protection, such as foam ear plugs or ear muffs, when you must be in a noisy environment or when using loud equipment

# Periodical Medical Examination

- Social awareness programs should be taken up to educate the public about the causes and effects of noise pollution

# Vibration disease

is a professional disease, the main etiological factor of which is industrial vibration. The favourable background for the development of the disease there are the following concomitant occupational factors of risk: noise, super cooling, significant muscle tension of shoulder, forced position of body.

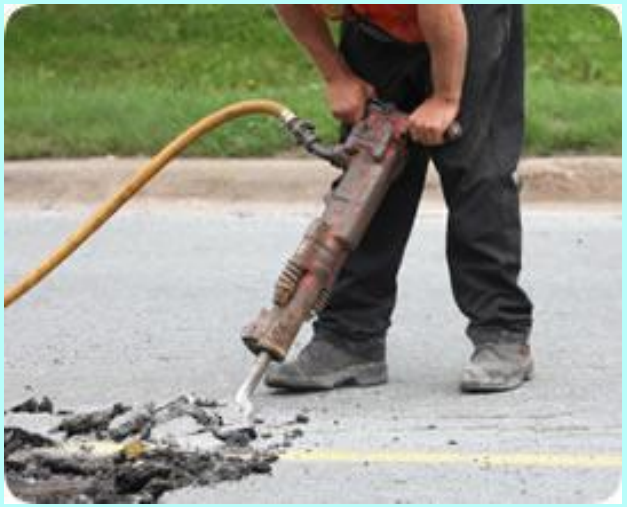
- Usually vibration disease is met among the workers of machine building, metallurgical, aircraft, shipbuilding, mineral resource industries, and also in transport and agriculture. Mainly among those workers, whose character of work is related with the long influence of vibration during the use of hand mechanic tools of percussion action.

# According to the character of influence on the organism there is

- - local
- - general

# Local vibration

- During the local vibration the transmission of mechanic oscillations to the body is realized through the arms. Most often this etiologic factor we can be among the face-workers, drillers, tunnellers, polishers, grinders, wood-cutters.



## The sources of the general vibration are

- the vibroplatform, the table vibrator, the forming and concrete-laying machines, the floor of weaving-mills, agricultural machines (tractors, combines), excavators, vehicles (airplanes, helicopters, sea and river ships).

# Pathogenesis of vibration disease

- Complexity of vibration disease's pathogenesis is explained by the polymorphy of clinic manifestations of the affection of cardiovascular and nervous systems, articular and motor apparatus and also metabolic process, in the foundation of development of which lay the complicated mechanisms of neurocirculatory, neurohumoral, reflex and regulatory disorders.

# Hand Arm Vibration - Causes & Effects

- HAV Symptoms
  - Tingling and loss of sensation in the fingers
  - Attacks of whitening (blanching) of one or more fingers when exposed to cold/wet
  - Loss of light touch
  - Pain and cold sensations between periodic white finger attacks
  - Loss of grip strength
  - Bone cysts in fingers and wrists

## Main syndromes of vibration disease:

- **1. Angiodistonic** - it is observed at influence of high-frequency vibration in initial one and moderately marked stages. Basic complaints on **pains in hands at night, paresthesias**. Objectively there are insignificant vegetative vascular disorders (chilling and cyanosis of hands, hyperesthesia on separate phalanxes).

# Main syndromes of vibration disease:

- **2. Angiospastic syndrome** - meets at I, II and III stage of vibration disease at influence of high-frequency and medium-frequency vibration. For this syndrome the marked **paresthesias** and moderate arm aches are typical, attacks of angiospasm of the type of **"white fingers".** Objectively we find the reduction of skin temperature on hands, the increase of the threshold of vibration sensibility, disturbance of all types of sensitiveness of the type of "gloves", spasm of capillaries.

## Main syndromes of vibration disease:

- **3. The syndrome of vegetative-sensory polyneuritis** arises up at influence of vibration of different frequencies, meets at moderate and marked VD. The syndrome is characterized by the intensive pains and paresthesias in extremities, disturbance of superficial sensitiveness after a polyneurotic type, reduction of skin temperature, more expressed vegetative disorders (chilling, hyperhidrosis, cyanosis of hands)

## Main syndromes of vibration disease:

- **4. Syndrome of somatic nerves' lesion (neuritis, plexitis, radiculitis).** Neuritis and plexitis in pure form at influence of vibration meet rarely; it is possible to speak about its combination with other symptoms, typical for VD, vegetative-sensory polyneuritis, vegetative myofascitis.

## Main syndromes of vibration disease:

- **7. Vestibular syndrome** - develops at influence of general vibration. It is characterized by dizziness, nystagmus, ataxia, vestibular crises.

# Diagnostics of vibration disease

- The diagnosis of vibration disease is proposed on the basis of the collected complaints, anamnesis of disease and life, study of professional route, sanitary and hygienic description work conditions.

# The typical additional sign of vascular disorders

- **1.** **Symptom of "white spot".** You ask a patient to clench firmly the fist of hand and through 5 sec quickly unclench it. In a norm the white spots which appeared have to vanish in 5 sec. If spots do not disappear quickly – the test is positive.

# Preventive measures against vibration

- Look for alternative ways of working which eliminate the vibrating equipment altogether
- Make sure your employees use the most appropriate equipment for each job

- Minimize the time individuals use the equipment

- Break up periods of continuous equipment use by individuals
- Design the job so that poor posture is avoided.

# Mechanization removes the risk

Machine-mounted pick replaces hand-operated breakers

# Demolition without vibration
# Use hydraulic crushers instead of demolition hammers

# Preventive measures against vibration

- Ways to minimize risk, including:
  - Changes to working practices to reduce vibration exposure;
  - Correct selection, use and maintenance of equipment;
  - Maintenance of good blood circulation at work, eg by keeping warm, exercising fingers and not smoking.

# Medical examination

is to be performed periodically and before accepting for the job,

-thermal procedures for the hands (water procedures),

-massage of the hands and of the shoulder girdle,

-industrial gymnastics,

-ultraviolet irradiation,

-vitamin intake (especially vitamin C, B1 and rutin) are also advisable.

# MEDICAL MEASURES

- Pre-employment medical check up
- Periodic medical examination
- Health promotion
- Health education
- Specific protection
- Assessment of risk by supervision of working environment