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ТЕМА:
«Hygienic evaluation of chemical and microbial pollution of air environment of living, educational, and medical locations (part 1,2,3)»

Methodical recommendations to the lesson
for students in the specialty 31.05.01 "General Medicine"

г. Волгоград, 2020 г.

The motivational description of the theme

Most people spend more than 70% of time indoors (in their houses, educational, therapeutic establishments, etc.). Therefore, their setting conditions should be up to the physical needs of the body as well as be conducive to both efficient labour and good rest. Comfortable indoor conditions depend on the layout of the building, type of construction materials, quality of the air in the room, illumination, noise, indicators of microclimate, etc. At this practical class we shall speak in detail about the air environment, about the factors contributing to its formation and measures which should be taken to optimize the quality of the air in the room.

The problem of the quality of the indoor environment has become especially pressing nowadays. It has been aggravated by the use of modern construction and decoration materials which may be responsible for the accumulation of chemical toxic and radioactive substances in the room. One aspect of this problem, i.e. “sick building syndrome” is of great significance to us. The term “sick building syndrome” refers to a number of complaints and symptoms developed by a person and caused by the chemical and physical factors of the indoor environment. The clinical manifestations of the syndrome are as follows: drowsiness, difficulty in swallowing, headache, irritation and dryness of mucous membranes, suppressed non-specific immunity. As a result, the general disease incidence, in particular of catarrhal diseases, has increased considerably over the past years.

Thus, providing optimum hygienic conditions in the room is considered as one of the basic ways of primary prevention of diseases.

The objective: to give an idea of the air environment as a factor which has a favorable effect on the health and work capacity and productivity of people; to consider the indoor environment as a factor which has an unfavorable effect on the human health causing non-specific symptoms and pre-pathologic conditions in the human body and developing certain diseases.

Students’ independent classroom activities

1. Estimating the system of ventilation and its efficiency in the room.
2. Case problems. Two case problems must be solved.
3. Presentation and discussion of individual students’ reports.

Self-study task

1. Indoor air environment (chemical composition of the air, factors contributing to its formation).
2. Microbial contamination of the indoor environment.
3. Criteria to estimate indoor air quality.
4. The notion of ventilation. Natural, artificial ventilation, air-conditioning; rules of their installation.
5. Hygienic estimation of polymeric and synthetic construction materials. Their effects on the human health.

Plan of students’ independent activities.

1. Case problems (type 1, type2). The solution of case problems should be reported in writing.

2. Practical work.

Estimation of the ventilation system in the room (see the appendix).

2.1 Calculation and estimation of the aeration coefficient in a classroom.

2.2 Calculation of ventilation capacity and air change rate in a classroom.

2.3 Calculation of the time required to air the classroom.

2.4 Making a conclusion and recommendations for optimizing the quality of the air environment in a classroom.

Reference information.

Term descriptions

ANTHROPOTOXINS are toxic, gaseous and waste materials.

NATURAL VENTILATION is infiltration of the outdoor air through different cracks in windows or doors as well as through air cavities in building materials. The term also refers to the ventilation of rooms through open windows, vents and fanlights for better natural air exchange.

AIR-CONDITIONING is a system of ventilation which makes it possible to maintain automatically the optimum temperature of the air, air humidity, air velocity and air purity for a certain period of time.

AERATION COEFFICIENT is the ratio of the window area to the floor area.

VENTILATION CAPACITY is the volume of the incoming air per hour.

AIR CHANGE RATE is the number of times the indoor air is replaced with outdoor air per hour.

“SICK BUILDING SYNDROME” includes a number of complaints and symptoms developed by a person staying indoors for a long time.

Social Hygiene of Human Dwellings.

Hygienically, residential premises should be spacious, dry and light. They should be aired regularly. The air in the room should be clean and it should not contain any hazardous substances or pathogenic microorganisms. The microclimate in the room should be favorable. Esthetically, the interior should be pleasing. The person should feel comfortable to have a rest or to work in the room.

1. *Orientation of residential premises.*

To provide sufficient lighting and heating of the room, one should be aware of the orientation of residential premises. The room should be accessible to sunlight. From 22nd March till 22nd September the exposure to direct solar irradiation (**insolation)** in the territory of Russia should be no less than 2.5 hours per day long. In this case buildings facing south or south-east are most beneficial. In the torrid zone, sun rays fall upright. Therefore, the room is hardly accessible to sunlight. In the frigid zone, however, sun rays are more oblique. Therefore, sun rays penetrate deeper into the room. In the torrid zone, residential buildings should not face west, because sun rays penetrate into the room in the afternoon when the air in the room and the walls of the residential buildings are warm enough. It can result in overheating. In the temperate zone, meridian orientation of residential buildings should have an angle of deviation of 19 – 22º from the meridian. In this case buildings usually face east or west.

2. *Construction materials.*

The main hygienic requirement imposed on construction materials is that they should have poor heat conductivity. This will protect buildings from over-cooling or overheating. For example, the wood has a heat conductivity factor of 0.15- 0.25; the brick – 0.5- 0.75; the concrete – 0. 9- 1.25.

Low sound-conductivity of building materials used in supporting structures is also of great importance.

Beside natural construction materials, such as wood, brick and stone, some polymeric construction materials are commonly used nowadays. They are cheaper, lighter, more solid and waterproof. It is much easier to clean them. However, they can be rather dangerous for human health.

A wide use of polymeric and synthetic construction materials threatens the health of a person due to *toxic monomers* released from the materials in the course of their wear and tear. Most monomers contain functionally active chemical groups and biologically, they are much more aggressive than polymeric construction materials, which are obtained from them. The toxicity level of polymeric materials depends on the constituents added to make the construction materials more commercial. These constituents include softeners, stabilizers, colouring agents, etc. They have an unfavorable effect on the environment too. The number of hazardous substances and the terms of their emission from polymeric materials depend upon their physical and chemical properties (volatility, steam tension, etc.), operating conditions (microclimate, sun rays, etc.), rate of their wear and tear (polymer destruction).

On the basis of general hygienic evaluation, which involves sanitary, chemical, physical, physiological, hygienic, toxicological and microbiological research (the scope of research is determined by the conditions in which the materials are used) the Centre for Sanitary & Epidemiological Control regulates the use of polymeric and synthetic construction materials. According to the results of a comprehensive study, the Centre for Sanitary & Epidemiological Control gives permission to use polymeric materials (current inspection is carried out every three years). Hygienic research is carried out according to the rules of Sanitary Law (Item № 2.1.2. 729-99 “Polymeric and polymer-impregnated construction materials, goods and constructions. Hygienic requirements imposed on safe construction materials”).

However, in some cases production technologies and the use of these materials are inadequate which results in mass diseases. The doctor who establishes the diagnosis of allergic, acute respiratory and other diseases should consider that the disease can be associated with the contact of people with polymeric and synthetic materials at home or at work. Unless the effect of the construction materials is eliminated, the treatment will not be successful.

Thus, the use of rubber linoleum in the wards of a hospital promoted the development of the symptoms of drug allergy. The withdrawal of the drugs did not improve the patients' condition. The patients were discharged from the hospital and they recovered shortly after the discharge. After changing the floor in the wards of the hospital, the patients did not develop the same symptoms any more.

Beside allergic reactions, substances which are emitted as a result of polymer destruction (such as phenol, formaldehyde, styrene, phtalates, xylyl, benzol, etc.), can have a general toxic effect.

Polymeric construction materials are good dielectrics. They keep electricity from escaping the body and thus, they have an unfavorable effect on metabolic and trophic processes which take place in the human body. Moreover, polymeric construction materials are able to produce static electric fields (dc fields) on their surface. When the fields are discharged, instantaneous electrolyte rearrangement occurs in the human body which results in changes of the central nervous system. Static electric fields at a level of 500 V/cm2 can have a mutagenic and **embryotropic** effect.

The specific nature of physical and chemical properties of polymeric construction materials can be the cause of the deterioration of the microclimate in human dwellings, of considerable vertical temperature fluctuations and air humidity changes. All these can cause influenza and some other catarrhal diseases as well as peripheral central nervous system diseases, for example radiculitis.

To prevent diseases caused by polymeric and synthetic construction materials, doctors should take the following measures:

1) When taking the history of the patient presenting with the symptoms of allergy, the doctor should find out what polymeric and synthetic building materials are used at home and at work, notably: flooring, interior, decoration, furniture, carpets, etc. The doctor should also find out whether avoiding the contact with polymeric materials improves the patient's condition.

2) When establishing the polymeric material which provoked the disease in one or several patients, the doctor should inform the Centre for Sanitary and Epidemiological Control about the cases. He should do it in writing within 3 days from the day the cause of the disease has been revealed. The report should be signed by the Principal Doctor of the hospital.

3) The doctor should carry out sanitary and educational work among the population. The doctor should promote the use of natural construction materials for decorating their flats. At the same time they should convince people to reduce the amounts of polymeric and synthetic materials used in construction or to use these materials according to hygienic standards.

4) The doctor should control the use of polymeric and synthetic materials in constructing, reconstructing or redecorating patient care institutions.

Polymer materials which are permitted to be used for building and redecorating various settings are listed in *Polymer and polymer-containing materials and structures permitted for use in construction industry.*

Possible ways of using polymeric materials

According to maintenance conditions, duration of people’s stay in the building, their physiological state and climatic region, some types of buildings are singled out:

Type A. Houses/dwellings. Pre-school educational establishments. Children´s homes. Patient care institutions. Nursing and residential homes. Sanatoria. Rest homes. Educational establishments. Sports facilities. Personnel facilities.

Type B. Enterprises of food industry. Public catering services. Hotels. Durable goods shops. Communication agencies. Consumer service venues. Entertainment and performance venues. Governmental offices.

Type C. Industrial venues, auxiliaries. Warehouses.

Note: 1. It is not allowed to use polymeric construction materials for covering the floor, decorating the interior of educational establishments for pre-school children and children´s homes.

2. Polymeric construction materials, which are not included in the list, can be used according to the documentation approved by the Russian Federation Public Health Ministry.

Table 1

№	Name	Type of building
	Flooring materials	
1.	Multilayer and single-layer PVC linoleum without sub-base	A-C
2.	PVC cloth supported linoleum	A-C
3.	PVC floor tile	A-C
4.	PVC expanded cloth supported linoleum	A-C
5.	Special PVC floor covering	B-C
6.	Pressed PVC tile	B-C
7.	Alkyd linoleum mats	A-C
8.	Roll chemical floor covering	B-C
	Heat- & sound-insulating materials	
9.	Insulating plastic foam board based on one-step and phenol- formaldehyde resins	A-C
10.	Phenolic plastic	B-C
11.	Wood wool building slabs	B
12.	Mineral wool synthetic binder boards & mats	A-C
13.	Urea-fomaldehyde foam	A-C
	Wall & ceiling finishing materials	
14.	PVC decorative film	A-C
15.	Paper-base PVC film, isoplan	B-C

16.	PVC finishing agent	B-C
17.	Polystyrene tile	B-C
18.	Polystyrene decorative tile	B-C
19.	Lining plastic panels	A-C
	Adhesive, reinforcement, paintwork materials	
20.	Busitilat adhesive	A-C
21.	Isotal floor covering adhesive	A-C
22.	Mastic	C
23.	Nitrocellulose putty	B-C
	Paints	
24.	Water-based paint	A-C
25.	Outdoor isoprene paint	A-B
26.	Pentaphthalic paint	B-C
	Vanishes	
27.	Polyester varnish	A-C
28.	Pentaphthalic enamel	B-C
29.	Nitrocellulose lacquer	B-C

NOTE**:** When making the diagnosis of an allergic, acute respiratory or some other diseases, the doctor should consider that the disease can develop due to the exposure to polymeric and synthetic materials at home or at work. This gave rise to the development of *Guidelines on prevention of diseases due to the exposure to polymeric materials*.

2. Layout and size of rooms

The layout of a flat is well-planned when its rooms are cross-ventilated. It means that windows should be at the opposite sides. It is important both for keeping the air clean and choosing the most appropriate room for work and rest away from street noise and other nuisances. Thus, the method of cross ventilation of rooms is reasonable in all climatic regions, except the frigid zone.

The depth of the living area should not exceed 6 m. The minimum size of the living area per person in Russia is 9 m², which is going to be increased up to 12 m². The height of the room is determined according to the peculiarities of the climate, required air space per one person and the system of ventilation. There are the following standard heights for rooms: in a frigid zone – 2, 7 m, in a temperate zone – 3 m and in a torrid zone - 3, 2 m. In hostels, which are intended for sleeping in and resting, the minimum living space per one person is 6 m².

Table 2

Area of the rooms in medical settings

Hospital settings	Area (m ²)
Area per one bed in wards of different profiles and capacities	
1. Hospital wards for one bed:	
Wards of Intensive care	18
Wards for children up to 7, with twenty-four-hour	12

presence of mothers	
Wards for adults and for children over 7 years	14
2. Hospital wards for two or more beds:	
Intensive care units	13
Isolation ward for infectious diseases including tuberculosis for adults	8
Isolation ward for infectious diseases including tuberculosis for children up to 7 years	8
For adults	7
For children up to 7 years	6
3. Venues for consulting, treating and diagnosing patients:	
Doctor's office for seeing adult patients	12
Dressing room	18
Medical treatment room	12
Massage room, manual therapy room	8 for 1 place
Functional diagnostics unit	16

Table 3

The area of the room in basic educational settings per person (m²)

1	School classroom area	2,5
2	School classroom area for group work	3,5
3	Assembly hall area	0,65
4	Library area	0,6
5	University laboratory area	4
6	University classroom area	2,2
7	Lecture-hall area	1,1

3. Ventilation of rooms

Rooms in different types of buildings are ventilated to timely eliminate excess heat, moisture and hazardous gaseous substances found in the air. The air in poorly ventilated buildings can have a negative effect on human health, as well as aggravate pulmonary, cardiac, renal diseases due to the changes in its chemical and bacterial composition, physical and other properties. The volume of the air to be exchanged depends on the number of people in a room, its cubic volume, type of work done in it.

The volume of the incoming and outcoming air is determined on the basis of different indices, one of them being carbon dioxide content. The permissible concentration of carbon dioxide in the air should not be exceeded. It should not exceed 1 ‰ (0, 1%). Air purity in a room is ensured by the required volume of air per person, i.e. by the so-called air or ventilation space per person as well as regular air exchange. Thus, in living quarters the standard air space should be 25 – 27 m^3 per person and ventilation rate – 37, 7 m^3. Therefore, to replace the vitiated air with fresh air, it is necessary to ensure approximately 1.5-fold exchange of the room air for the outdoor one per hour. Thus, air change rate is considered as one of the main criteria of the intensity of ventilation.

3.1. Types of ventilation

3.1.1. *Natural ventilation.*

Air exchange by means of infiltration ensures ½, ¾-fold air exchange per hour. Epidemiologically, it is not sufficient. Therefore, special vents and fanlights are used for airing the room. The size of a vent should be no less than 1/50 of the area of the floor (i.e. *aeration coefficient*). Cross ventilation should be created as it will ensure rapid air exchange without cooling walls and other surfaces thus preventing the so-called radiation cooling of the body. Sometimes, it is necessary to install fanlights which are open at an angle of 45º. In this case cold air first goes up to the ceiling, it partly warms up there and goes down without creating a cold airflow and causing overcooling. In many buildings, however, exhaust channels are used. In the upper part of the exhaust channel there are special intake openings. The channels usually pass into an exhaust shaft in the attic where the air goes out. This system of natural ventilation is based on natural air draft.

3.1.2. *Artificial ventilation.*

Artificial ventilation is usually used in public facilities intended to hold a great number of people at the same time, as well as industrial enterprises. There may be local (canopy, exhaust hoods, etc.), and central (general) ventilation. When air supply and air removal are considered, ventilation systems are divided into plenum systems, exhaust systems, plenum and exhaust systems, and recirculation systems.

3.2. Sanitary indices of the efficiency of air ventilation.

Sanitary indices of the efficiency of air ventilation in living and public settings are as follows: smell (or absence of smell), concentration of carbon dioxide in the air, temperature of the air, air humidity, air velocity, bacterial content in the air. If the air is polluted with chemical contaminants, the degree of air pollution should be determined.

The significance of carbon dioxide in the indoor environment.

Carbon dioxide plays a significant role in our life. Life on the Earth would not exist without carbon dioxide. Besides, it is a physiological stimulus of the respiratory centre when its concentration in the air is 0, 03 – 0, 04%.

Inhaling highly concentrated carbon dioxide can result in impaired oxidation and reduction processes. When the concentration of carbon dioxide in the air increases to 4%, one can develop headaches, tinnitus, palpitation, agitation. When the concentration of carbon dioxide in the air is 8%, it could be fatal.

Air purity of in a room is evaluated considering the concentration of carbon dioxide in the air. High concentration of carbon dioxide in the air usually suggests inadequate sanitary conditions (overcrowding, poor ventilation, etc.).

The higher the concentration of carbon dioxide in the air, the worse some other physical properties of the air. For example, when the temperature of the air and air humidity increase, the number of microorganisms in the air increase as well and anthrapotoxins begin to appear in the air.

Anthropotoxins include the following substances: dimethylamine, benzol, methylethylkethon, hexane, methylbenzene, mercaptan, indole, ammonia, nitrogen oxides, etc. The content of these substances in the air depends on the number of people in the room, duration of their stay indoors, type of work done, etc.

Concentration of anthropotoxins in the air is inversely proportional to the air supply. If the air supply is 120 m^3/h, the index of reduction of anthropotoxin accumulation in the air should be 80 – 85%. In these conditions the air can be cleaned up easily.

As the concentration of carbon dioxide in the air increases and microclimatic conditions worsen, ionization of the air changes as well (i.e. the number of heavy ions increases and the number of light ions decreases). It can be due to light ion retention during respiration and contact to skin as well heavy ion delivery with the exhaled air.

When estimating the quality of the air in the indoor environment, the concentration of carbon dioxide in the air should be considered. The maximum permissible concentration of carbon dioxide in the air is 0, 07% (for patient care settings) and 0, 1% (for residential and public venues). The latter is accepted as the calculation value when estimating the efficiency of ventilation in living and public facilities.

4. *Microflora of the indoor air.*

Microbial contamination of the air is of great epidemiological importance as air is the most common medium through which airborne and droplet infections, including dust borne infections, are transmitted to a person. In case of airborne and droplet infections, such as influenza, acute respiratory diseases, tonsillitis, diphtheria, etc., bacterial contamination occurs as small particles of saliva and sputum get into the air when a person coughs, sneezes or speaks. Dustborne infections are transmitted when inhaling airborne dust which forms as infected droplets released from human respiratory passages get dry. Airborne dust which is found in the air remain infective for 2 – 3 hours, however, some viruses, such as influenza virus, diphtheria rod, etc., have been proved to survive for 3 – 4 months. Dust and bacterial contamination of the air is interdependent: great amounts of dust in the air can rapidly increase bacterial contamination of the air. Thus, if the air has been cleaned up, the bacterial contamination of the air decreases.

The degree of bacterial contamination of the indoor air depends on air exchange, sanitary conditions of the room, number of people in the room, observation of the rules of personal hygiene, etc. These factors should be well considered in patient care institutions when admitting inpatients. No more than 750 microorganisms per 1 m^3 should be in the air in summer and 150 – in winter. The indoor pure air should contain no more than 1500 microbes per 1 m^3 in summer, however, in winter these amounts should be no more than 4500 per 1 m^3.

Table 4

Permissible levels of bacterial contamination of the air in medical settings

Room	Total number of microorganisms in 1 m^3	Content of *Staphylococcus aureus* in 1 м^3 of air	Content of Gram-negative bacteria in 1 м^3 of air
Operating rooms having 10-20 or more air changes (prepared to be used)	No more than 100	None	None
Resuscitation wards	No more than 1000	No more than 4	None
Isolation wards/cubicles (before patients have been accommodated in them)	No more than 50	None	None
Isolation wards/cubicles (after patients have been accommodated in them)	No more than 250	No more than 1-2	No more than 1-2
Medical treatment room (before use)	No more than 50	None	None
Medical treatment room (after used)	No more than 2000	No more than 1-2	No more than 1

Bacterial contamination of the air, especially if it is increasing is considered to be a sign of poor sanitary conditions.

5. Electric properties of the indoor air (ionization of the air).

The term “ionization of the air” is usually referred to the breakdown of the air into molecules and atoms when exposed to such external factors as nuclear radiation, ultraviolet radiation, luminous radiation, cosmic radiation, water atomization. Light aero ions, whose velocity is 1 – 2 cm/s, can exist for 1 – 2 min. and then, they recombine rapidly. Light aero ions can attract airborne dust particles and microbe bodies thus turning into neutral, heavy and super heavy ions. Ions are not only produced in the atmosphere but also destroyed as oppositely charged ions bind together. These processes constantly occur in the atmosphere accounting for ionization equilibrium. The number of light ions varies greatly depending on geographical and geological factors, weather, air contamination.

Ionization mode is determined as the ratio of the number of heavy ions to that of light ions. The greater the degree of the air contamination, the higher this ratio is. For example, in the area of public resorts the content of light ions should be 2000 – 3000 per cm^3, in industrial areas it should be 200 – 300 per cm^3 and even less. Decreased number of light ions in the air is a sign of poor sanitary condition of the air. Observation of the changes in the ionization of the indoor air also testifies to it (e.g. in the residential area, at school, at the cinema, etc.). It is noteworthy that the number of light ions in the air decreases when the microclimatic conditions of the air worsen and the concentration of carbon dioxide in the air increases. Light ions are easily absorbed by the skin, clothes and linen. When one breathes, great amounts of heavy ions are released into the air. It should be mentioned that aero ions have a multifaceted effect on the human body. Electron exchange in the pulmonary tissue as well as neuro-reflector responses to the stimulation of skin and mucous receptors of the respiratory tract by aero ions underlie the physiological mechanism of the action of the ionized air. High concentrations of light ions have a favorable effect on gaseous exchange and mineral metabolism, accelerate healing of wounds. At present, artificial negative air ionization is used in treating essential hypertension, bronchial asthma and allergies. Positive ions, however, have a depressant effect and they can cause drowsiness, depression, reduced work capacity and productivity of people.

Appendix

Calculation of ventilation capacity and air change rate in the indoor environment

Ventilation capacity is the volume of the incoming air per hour. It is calculated either per person or per room.

Air change rate is the number showing how many times the indoor air has to be replaced with the outdoor one.

Air change rate in the indoor environment is calculated in the following way: the volume of the incoming and outcoming air within a certain period of time (Y) should be determined and its value should be divided by the cubic volume of the room (K):

$$\textbf{Air change rate} = \mathbf{Y / K}$$

The volume of the incoming or outcoming air is calculated as follows: the area of a vent should be multiplied by the air velocity. The air velocity is usually measured with the help of an anemometer which is placed in the centre of the vent. The air velocity is measured for 5 minutes. Then, the average air velocity (mps) should be calculated.

Case problem 1: The room with an area of 0, 4 m² was aired for 5 minutes. The total volume of the incoming air should be calculated using the following equation:

$2 \text{ m/sec.} \cdot 0,4 \text{ m}^2 \cdot 300 \text{ sec.} = 240 \text{ m}^3$

The cubic volume of the classroom is 165 m³. Hence, the air change rate can be calculated using the following equation: 240 : 165 = 1, 4. The given air change rate should be compared with the required one using the following formula:

$$\mathbf{S} = \frac{\mathbf{22,6 \cdot N}}{\mathbf{(P - 0,4) \cdot K}}$$

where,

S – unknown value (ventilation rate);

22, 6 – carbonic acid (liters) inhaled by an adult per hour;

N – number of people in the room;

P – permissible concentration of carbon dioxide in the room, ‰;

0, 4 – average value of carbon dioxide in the air, ‰;

K – cubic volume of the room, m^3.

The idea of the required air change rate enables us to calculate the time necessary for airing the room. The number of people in the room should be considered as well.

Case problem 2: The time necessary for airing the classroom having an area of 165 m^3 and a vent having an area of 0, 4 m^2 should be calculated. There are 10 people in the room. One can calculate the required air change rate using the following formula:

$$\frac{22,6 \cdot 10}{(1-0,4) \cdot 165} = 2,3$$

Thus, the air should be changed 2.3 times in the classroom per hour. In other words, 379 m^3 of air enters the room through an open vent (i.e. 165 $m^3 \cdot 2,3$). The time necessary for airing the classroom can be calculated using the equation:

$$\frac{379\ m^3}{0,4\ m^2 \cdot 2\ m/sec} = 473\ \text{sec. or } 8\ \text{min.}$$

<u>Conclusion:</u> The time necessary for airing the room and providing a 2.3-fold air change rate is 8 minutes.

Air velocity measurement technique

As a rule, air velocity is measured with the help of either an anemometer or a catathermometer. It depends on the air velocity. The work of the dynamic anemometer is based on the rotation of the vanes attached to the central axis of the anemometer. For measuring high air velocity (more than 1 m/sec.) a cup (wheel-type) anemometer should be used. If the air velocity is within 0.3 to 1 m/sec., however, a vane anemometer should be used.

Before measuring the air velocity, it is necessary to record the initial readings of the anemometer. The readings of the system of thousands and hundreds on the small scale of the anemometer should be recorded first and then the readings of the decimal system and the system of the whole numbers on the large scale of the anemometer. Thus, if the hand of the anemometer is between “3” and “4” on the scale of the thousands, it will correspond to “7” and “8” on the scale of hundreds. If it reads “75” on the large scale, the initial readings of the anemometer should be recorded as follows: “3775”.

The anemometer is placed so that the impeller should be in the current of the air, above or below the centre of the vent. As soon as the vanes of the anemometer begin to rotate, the readings of the anemometer should be recorded thoroughly for 3 minutes. The required air velocity should be calculated by subtracting the given readings of the anemometer from the initial ones.