Safety Equipment

WEDNESDAY AFTERNOON SESSION

October 16, 1935

The session was called to order by Chairman, Irwin W. Millard, president, Industrial Gloves Corporation, Danville, Ill. Chairman Millard mentioned some of the problems of providing adequate safety equipment for industry.

Respiratory Protective Devices

(An interpretation of the U. S. Bureau of Mines, Schedule 21)

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The respiratory protective devices of industrial hygienic importance are those designed to protect against the inhalation of harmful solid, gaseous, or liquid atmospheric contaminants, or the inhalation of air deficient in oxygen.

The devices in common use are the mechanical filter respirator (commonly referred to as respirator) for protection against the inhalation of dusts, smokes, fumes, and mists or what may be referred to collectively as atmospheric particulate matter; gas masks for protection against the inhalation of gases and vapors; oxygen breathing apparatus, hose masks, and air-line respirators for protection against the inhalation of any atmosphere provided it does not contain harmful constituent which can be absorbed readily through the skin; and the abrasive blasting helmet or hood for protection against the inhalation of and the impact and abrasion from the atmospheric particulate matter generated in sand blasting or abrasive blasting with steel shot.

These devices are designed to furnish protection either by making the wearer's inspired air safe to breathe or by supplying the wearer with safe air from a supply which he carries or from outside the contaminated zone.

The wearer of the first or air-purifying type, on inspiration draws air from his immediate surroundings through the device which either removes the contaminant, usually by chemical or mechanical filtration, or converts it into a harmless substance. This type, of course, offers no protection against atmospheres deficient in oxygen as it does not add oxygen to the air.

There are two types of respiratory protective devices of the second type designed to supply the wearer with safe air. In one, the wearer receives his air supply from a cylinder of compressed oxygen, liquid oxygen, liquid air, or from a chemical which yields oxygen upon decomposition. This air supply is part of the self-contained unit, all of which is carried by the wearer. In the other type a hose, attached to a facepiece, is connected to a compressor or blower whose intake is located in safe air. Air is forced through the hose to the wearer.

There is some confusion in the use of the term "respirator," to designate devices for protection against the inhalation of atmospheric particulate matter. Such devices were the first and for a long time were the only respiratory protective devices. They were logically called respirators, and as long as they were the only devices of this kind there was no confusion. The development of other devices of industrial hygienic importance and the development of devices for maintaining artificial respiration over long periods and for enabling men trapped in submerged submarines to reach the surface safely, all called respirators, was responsible for the confusion. The Bureau of Mines suggests that the term "respirator" be retained for all of these devices, but that respiratory protective devices of industrial hygienic importance be called industrial respirators and that the different kinds of industrial respirators be assigned a name which will indicate their operating principle or field of use or both. Satisfactory names in common use should be retained. On this basis, the Bureau of Mines suggests the following classification for respiratory protective devices of industrial hygienic importance:

Industrial Respirators

1. Supplied-Air Respirators
   - a. Self-contained type
     - (1) Oxygen breathing apparatus[a]
   - b. Hose type
     - (1) Hose mask
     - (2) Air-line respirator[b]
     - (3) Abrasive blasting respirator[c]
2. Air-Purifying Respirators
   - a. Chemical filter respirator[d]
     - (1) Acid gas or type A[e] chemical filter respirator
     - (2) Organic vapor or type B[e] chemical filter respirator
     - (3) Ammonia or type C[e] chemical filter respirator
     - (4) Carbon monoxide or type D[e] chemical filter respirator
   - b. Mechanical filter respirator[f]
     - (1) Dust or type A[g] mechanical filter respirator
     - (2) Fume or type B[g] mechanical filter respirator
     - (3) Mist or type C[g] mechanical filter respirator
   - c. Chemical and mechanical filter respirator[h]

Testing and Approving of Industrial Respirators by the U. S. Bureau of Mines

Since its organization the U. S. Bureau of Mines has been interested in industrial respirators as a means of protecting workers in the mineral industry against harmful atmospheric contaminants. To this end the Bureau has developed an approval system, the purposes of which are: (1) To encourage and aid manufacturers in the development and marketing of safe and suitable equipment; and (2) to encourage the consumer to use such equipment, to aid him in obtaining it and to instruct him in its use. These purposes are accomplished by establishing a schedule of the material and performance requirements that a safe and suitable device should meet; by making approval tests for conformance to such a schedule; and by informing the public of the

[a] Sometimes called mine rescue breathing apparatus.
[b] Sometimes called paint spray respirator or positive pressure respirator.
[c] Sometimes called sand-blast helmet or hood.
[d] Commonly called gas mask.
[e] Letters assigned to canisters of chemical filter respirators. See U. S. Bureau of Mines Approval Sched. 14D, Procedure for Testing Gas Masks for Permissibility, 17 pp., 1935.
[f] Commonly called respirator. Sometimes referred to as dust respirator or mechanical filter-type respirator.
[g] Letters assigned to mechanical filter respirator filters. See U. S. Bureau of Mines Approval Sched. 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility, 14 pp., 1934.
[h] The devices now referred to as Type N or All Service Gas Mask and the chemical cartridge respirator fall under this heading.

advantages in the use of devices bearing Bureau of Mines approval. If the device is found by examination and test to meet the requirements of the schedule the Bureau of Mines gives the manufacturer a certificate of approval which he may display as evidence of the quality of his product. The approved devices are marked in a manner which clearly distinguishes them and indicates the purpose for which they are approved and the limitations under which they may be used. As an aid to the consumer, the Bureau of Mines periodically issues a list of the devices which have met the requirements.

The submission of equipment is entirely voluntary on the part of the manufacturer. On making application for tests, the manufacturer deposits a fee which is turned into the miscellaneous receipts of the treasury of the United States; none of the money accrues to the Bureau of Mines. The approval system is motivated entirely by the desire of the manufacturers to produce and market good equipment, the interest of the Bureau of Mines in having safe equipment available commercially, and the demand of the consumer for such equipment.

Approval schedules have been issued for oxygen breathing apparatus,[1] chemical filter respirators or gas masks,[2] hose masks[3] and mechanical filter respirators.[4] The schedule covering hose masks is being revised to include the other kinds of supplied-air respirators, namely, air-line and abrasive-blasting respirators. When this revision is completed, the Bureau of Mines will have approval schedules for all types of respirators now in common use. The approval system undoubtedly is largely responsible for the development of fundamentally safe and suitable devices, and the elimination of confusion in their selection and use.

The general plan of the various schedules is similar. The requirements may be divided into 3 parts:

(1) Pre-test requirements, or those with which the manufacturer must comply before examination and test of a device will be undertaken. For example, the respirator must be in a fully developed form ready for market and available for purchase if approval is granted. Also, the manufacturer must be prepared to test and maintain control of the essential characteristics of his device by a method which meets the approval of this Bureau.

(2) Material, construction, and performance requirements which the equipment must meet by examination and test.

(3) Post-test requirements, or those with which the manufacturer must comply after the device is approved. From the viewpoint of the consumer the most important of these concern labeling and marking, provision of adequate instructions for proper use of the device, and maintenance of design and quality of the product marketed under the approval. As a check on the latter, the Bureau of Mines obtains samples of the device on the open market and subjects them to the various inspections and tests of the appropriate schedule. The Bureau reserves the right to withdraw its approval of any device for cause.

Interpretation of U. S. Bureau of Mines Approval Schedule 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility

Among the reasons for the development of Schedule 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility, was the realization by the Bureau of Mines and others that there was a definite need for mechanical filter respirators to protect workers against harmful atmospheric particulate matter in situations where better methods of control of dust production and removal were either not available or practical, the inefficiency of existing mechanical filter respirators, and

[1] Bureau of Mines, Procedure for Establishing a List of Permissible Self-Contained Oxygen Breathing Apparatus; Tests, Character of Tests, and Condition Under which Mine Rescue Breathing Apparatus will be Tested; Sched. 10A, January 21, 1930, 12 pp.
[2] Bureau of Mines, Procedure for Testing Gas Masks for Permissibility; Sched. 14D, May 9, 1935, 17 pp.
[3] Bureau of Mines, Procedure for Testing Hose Masks for Permissibility; Sched. 19, April 28, 1927, 8 pp.
[4] Bureau of Mines, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility; Sched. 21, August 20, 1934, 14 pp.

sts from manufacturers and consumers that this bureau test and approve such s.

Schedule 21 follows the general plan of the other bureau approval schedules for ial respirators; the pre-test and post-test requirements are quite similar, and neral principles of the test requirements are the same. The primary purpose of aper is to explain the reasons for the various test requirements.

Pre-Test Requirements

The pre-test requirements of Schedule 21 require that the manufacturer submit nation, drawings, and samples of the device to be tested. The device must be pletely developed and ready for release to the public, and the device when tested he manufacturer or his agent must have passed tests of the nature described chedule 21. The reasons for the third requirement are: (1) To assure the on that the manufacturer is prepared to control the filtering characteristics of respirator; (2) to eliminate any question of competition with private consulting ies in developing respirators; (3) to furnish evidence that the respirator really dy for release to public market; and (4) to save the manufacturer's and the au's time. After the manufacturer has complied with all the above pre-test rements he must submit a fee for the examination and test of his device. fee is turned into the miscellaneous funds of the U. S. treasury and none of money reverts to the Bureau of Mines.

Test Requirements

In developing the tests for mechanical filter respirators consideration was given to the general requirements for a safe and suitable device. These requirements similar for all types of industrial respirators. The respirator must (1) give quate protection, (2) be reasonably comfortable and physically convenient to r, and (3) provide an acceptable service life.

Adequate protection implies that the mechanical filter respirator when properly ntained and worn must prevent the wearer from breathing enough particulate ter to cause a harmful physiological response under the conditions of occupational osure for which it is designed to be used.

Comfort and physical convenience factors are equal in importance to adequate tection. Even though aware of the ultimate serious effect which will be produced r prolonged daily exposure, workmen are inclined to be diffident and unwilling ffer much daily inconvenience and discomfort from the respirator.

Encumbrance and discomfort also increase fatigue, cause distraction, and in eral handicap the wearer's ability to take care of himself, thus increasing the sibility of accident. Important specific items include the weight of the respirator, carriage on the face or head, effect on vision, heating of the area of the skin r the facepiece, inability to expectorate, difficulty in talking, and resistance to athing. The importance of comfort and physical convenience cannot be over rated.

The service life involves elements of practicability in the wearing and maintenance the device, and indirectly the safety. This type of respirator is primarily not an rgency device, but a part of the workman's equipment for doing his regular job ly. If the service life is short, the bother of changing of filter elements will reflected in the workman's attitude toward good maintenance and use.

All mechanical filter respirators are subjected to certain inspections and tests they must fulfill certain requirements. The general design and construction, ecially as to facial fit, freedom from irritating facial contacts, weight, effect vision and the wearing of goggles, and ease of changing filter elements, and ained. The materials are examined to determine if they are obviously suited the purpose for which they are designed. Rubber parts which come in contact h the skin must not contain any skin-irritating constituent.

Resistance to Air Flow Requirements

The requirements for resistance to air flow are the same for all approved me- sical filter respirators. At no time during or after the filter efficacy testing period st the resistance to air being drawn through the device at the rate of 85 liters

(3 cubic feet) per minute exceed 50 millimeters (1.97 inches) of water column height or the resistance to air being blown through the device at the same rate of flow exceed 25 millimeters of water column height. An air flow of 85 liter per minute is approximately equivalent to the respiratory rate of a man doing heavy work. The amount of particulate matter pulled to the device during the filter efficacy tests is roughly equivalent to the amount that would be pulled to the filter by a worker wearing the mechanical filter respirator in a moderately concentrated suspension of the particulate matter during an 8-hour period. Thus resistance to air flow of an approved mechanical filter respirator should not become excessive when worn for an 8-hour period in most suspensions of atmospheric particulate matter encountered in industry. The manufacturer is required to give instructions on cleaning or changing the filter elements when the resistance to air flow noticeably increases.

Direct Leakage and Man Test

All mechanical filter respirators are subjected to a direct leakage and man test to determine facial fit, whether there is any direct leakage of unfiltered air, and to obtain information on the comfort of the device. Three of the mechanical filter respirators are worn for 30 minutes by 3 men with different facial features in an atmosphere containing a heavy suspension of bituminous-coal dust. At the end of the period the respirators are removed and that part of the face covered by the facepiece is examined for evidence of any leak under the edge of the facepiece. Sticks a millimeter thick were wedged under the edges of the facepieces worn by subjects A and C to cause the leaks. The location and approximate magnitude of the leaks are shown by the black streaks on that part of the face covered by the edges of the facepieces. The nasal passages and sputum of the subjects are also examined before and after the tests.

Filtering-Efficacy Tests

In the development of the filtering-efficacy tests, particular attention was given to the physical properties, especially particle size, of the significant kinds of atmospheric particulate matter encountered in industry. Previous studies of filtering materials had shown that, in general, filtering efficacy decreases with a decrease in particle size.

It was decided that most of the significant industrially generated atmospheric particulate matter could be classified into the following three groups in accordance with method of generation, physical state, and particle size:

1. *Mechanically generated dusts* resulting from the disintegration of a solid, such as the dust clouds produced in the various processes of mining, quarrying and tunneling and the grinding, crushing, and general processing of solid materials. This type of atmospheric particulate matter is referred to as Type A atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type A mechanical filter respirators.

2. *Fumes* of various metals (usually their chemical compounds, as oxides or carbonates) such as lead, mercury (except mercury vapor) manganese, magnesium, aluminum, antimony, arsenic, copper, chromium, iron, cadmium, and zinc resulting from sublimation or the condensation of their vapor, or from the chemical reactions between their vapor and gases. This type of atmospheric particulate matter is referred to as Type B atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type B mechanical filter respirators.

3. *Mists* as produced by spray-coating with paint and vitreous enamels, chromic acid mist as produced in chromium plating, and other mists of materials whose liquid vehicle does not produce harmful gases or vapors. This type of atmospheric particulate matter is referred to as Type C atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type C mechanical filter respirators.

The mechanically generated dusts and fumes consist of solid particles while the mists consist of liquid or liquid-coated solid particles. The particle size of mechanically generated dusts extends over a wide range, in some cases, from particles visible to the naked eye probably down to molecular dimensions. The range in particle size of fumes is much smaller. The upper limit is in the lower microscopic

...nge (about 0.5 micron), while the lower limit probably approaches molecular ...mensions. The particles of some fumes, particularly zinc and magnesium, readily ...n and form large flocklike clusters. The effect is least pronounced in the case ...lead. Mist particles are spherical and probably more uniform in particle size than ...se of dusts and fumes.

Suspensions of each of the types of industrially-generated atmospheric particle ...atter were selected for use in the filtering-efficacy tests. These suspensions were ...osen on the basis of their industrial hygienic significance and their physical ...roperties, such as particle-size distribution and tendency to aggregate, which have ...appreciable effect on filtration. It was desired to test the mechanical filter ...pirators against the most common or widespread harmful suspensions of each ...pe: the test suspensions to have physical properties, such as particle size and ...gregation tendency, which would render them as difficult to remove by filtration ...any other suspension of the same type. The test suspensions selected are:

(a) For testing Type A mechanical filter respirators or those designed to ...rnish protection against mechanically generated dusts a suspension generated from ...ry fine (99+ per cent through 325 standard mesh sieve) silica dust consisting of ...+ per cent free silica (SiO_2) is used. The suspension is generated in such a way ...at all particles larger than about 3 microns are removed before the suspension ...ters the test chamber. The particle-size distribution of the test suspension must ...t exceed a geometric mean of 0.6 micron and a standard geometric deviation of ...0. The particle-size determination is made by collecting samples of the suspension ...the Owens jet dust counter and determining the particle size distribution by a ...icroprojection method developed by the Bureau of Mines.[8]

(b) For testing Type B mechanical filter respirators or those designed to ...rnish protection against fumes, a lead oxide fume generated by the combustion of ...atural gas containing lead tetraethyl vapor is used. The particles of this fume are ...xtremely small and have about the least tendency to aggregate of any fume, hence ...ey are very difficult to remove from the air by mechanical filtration. A suspension ...magnesium oxide is also used to determine the effect of a fume, whose particles ...adily aggregate in large clusters, on the resistance to air flow of the filter of the ...vice.

(c) For testing Type C mechanical filter respirators or those designed to ...rnish protection against mists, three different suspensions are used. Chromic ...id mist generated by electrolyzing an aqueous solution of chromic acid, as is done ...industrial chromium plating; lead paint mist generated by spray-coating with lead ...int; and a water mist carrying silica dust generated by spraying a 2 per cent ...ueous suspension of silica dust are used. The water-mist carrying silica dust is ...ed to simulate the mists generated in spray-coating with vitreous enamels.[9]

The concentration of the particulate matter in the test suspensions was chosen ...represent more or less the higher concentrations found in industry. Since the ...ncentration of mechanically generated dust found in industry varies over such ...de limits it was decided to test Type A mechanical filter respirators against two ...ncentrations; one to represent the more or less average dusty industrial condi...ns, and the other to represent very dusty conditions.

The complete mechanical filter respirator is tested on a mechanical testing ...paratus. The test suspension is pulled through the device at the rate of 32 liters ...13 cubic feet) per minute, continuous flow. The volume of air pulled through ...e mechanical filter respirator is 10 cubic meters in all cases except in some ...ts against particular kinds of suspensions as mechanically generated lead dusts ...d in the high-silica dust-concentration test and the magnesium oxide test whose ...imary object is to determine the increase in resistance to air flow of the filter ...th the amount of particulate matter retained. Ten cubic meters is approximately ...uivalent to the volume of air breathed by a worker in 8 hours. The samples of ...rticulate matter for concentration determinations are precipitated electrically ...m the air of the test suspension both before and after it has passed through ...e mechanical filter respirator. The samples are collected in containers which ...n be weighed readily on an analytical balance. For reasons of convenience, speed,

[8] Brown, C. E. and Yant, W. P. The Microprojector for Determining Particle Size Distribution and Number Concentration of Atmospheric Dusts. U. S. Bureau of Mines Report Investigations 3289, 1935.

and accuracy the samples of silica dust are quantitated by weight rather than by count. Samples of the other particulate matter are quantitated chemically.

The requirements as to the amount of particulate matter that the mechanical filter respirators must remove from the air pulled through them is based on the best available information on the concentration of the particulate matter that is safe to breathe. These requirements are subject to change with the accumulation of knowledge on the physiological effects of industrially generated atmospheric particulate matter. In other words, the filtering-efficacy requirement is that the air inhaled by the wearer of such a device must be safe to breathe, and not that the device have any particular percentage filtering efficiency.

Mechanical filter respirators are not approved for any substance more harmful than the particulate matter in the test suspension against which they are tested. Thus Type A respirators are not approved for any substance more harmful than free silica (SiO_2) dust. However, Schedule 21 provides for testing and approving mechanical filter respirators against any kind of industrially generated atmospheric particulate matter. For example, Type A mechanical filter respirators are not approved for protection against poisoning by breathing dusts whose main harmful constituents are metals or their compounds. However, two mechanical filter respirators have been submitted and approved for protection against the inhalation of mechanical generated lead dusts.

Table I summarizes the details of the filtering-efficacy tests and lists the mechanical filter respirators which have been approved to date. (Pages 140-141.)

Post-Test Requirements

The manufacturer of an approved mechanical filter respirator is required to mark his device with the name of his company, the name letter, or number by which the type is designated for trade purposes, and the approval number assigned to the device by the Bureau of Mines; and the filter unit must be marked with the approval number and with the type or kind of atmospheric particulate matter for which it is approved.

The mechanical filter respirator and replacement filter units must be provided with substantial and durable containers. Copies of the approval labels issued to the manufacturer by the Bureau of Mines must be attached to these containers. The approval label gives the approval number, shows to whom the approval is issued, states what the device is and is not approved for, and cautions the wearer to follow the manufacturer's instructions for the use and care of the device.

The following is a sample of the required instructions furnished by the manufacturer. These instructions are similar for all of the approved mechanical filter respirators.

Instructions for Use of Mechanical Filter Respirator

1. Respirators will not protect unless placed on the face properly each time they are worn. Carelessness in face-fit means dangerous leakage. In general, a better fit is obtained if the mask is worn not too high on the nose.

2. To fit the respirator to the face hold the respirator, exhaust valve pointing downward, by the metal screw connection with either hand, and hold the headstrap with the other hand. Place the facepiece against the face and hold it in place while pulling the headstrap over the head and below the ears. Then adjust the facepiece until a firm snug fit is obtained. The head-strap may be adjusted while the respirator is in place by holding the metal slide between the thumb and forefinger of one hand and pulling on the proper strap with the other hand.

3. To instruct the wearer in the proper adjustment of the head-straps and position of the respirator on the face a cardboard disc is enclosed. To use this disc unscrew the filter bag, place the disc against the felt washer in the metal connection on the felt bag, assemble the respirator, and put it on. The wearer should not be able to breathe through the respirator or feel any inward leakage of air under the edges of the facepiece.

The presence or absence of dust streaks on the face inside the line of fit of the facepiece after wearing the respirator in a dusty atmosphere can also be used to tell whether a proper fit was obtained.

4. The recommended procedure for cleaning the filter bag is to insert loosely the nozzle of a high-pressure air hose into the bag opening and to blow several

TABLE 1. DETAILS OF FILTERING EFFICACY TESTS AND LIST OF APPROVED MECHANICAL FILTER-TYPE RESPIRATORS

Kind of mechanical filter-type respirator	Industrially generated atmospheric particulate matter against which the device is designed to furnish protection	Test suspensions used	Concentration of test suspension, milligrams[a] per cubic meter[b] of air	Volume of test suspension pulled through the device, cubic meters[c]	Maximum amount of particulate matter permitted to pass through the device: Milligrams	Maximum amount of particulate matter permitted to pass through the device: Milligrams per cubic meter of air	Name and manufacturer of mechanical filter-type respirators approved to date, September 25, 19[d]
Type A	Mechanically generated dusts resulting principally from the disintegration of a solid, such as the dust clouds produced in mining, quarrying and tunneling, and the industrial operations of grinding, crushing, and processing of minerals	Air-suspended ground flint, which consists of 99+ percent free silica (SiO_2). Over 99 percent of the dust passes through 325-mesh standard sieve	(a) 50 ± 10[d]	2.83	4 mg. for any 1 of 3 devices, or an average of 3 mg. for each of the 3 devices	1.0[d]	M.S.A. Comfo Respirator, Approval No. 2101, issued to Mine Safety Appliances Co. Willson Bag Respirator No. 1 Approval No. 2102, issued to Willson Products, Inc.
			(b) 5 ± 2[d]	9.90	12 mg. for any 1 of 3 devices, or an average of 10 mg. for each of the 3	1.0[d]	Willson Bag Respirator No. 1 Approval No. 2103, issued to Willson Products, Inc.* Pulmosan M-15 Pouch-Type Respirator. Approval 2 [illegible] 20[illegible] issued to Pulmosan Safety Equipment Corp. Biever Respirator. Approval 2105, issued to Standard Safety Equipment Co.*
Type B	Fumes of various metals (usually their chemical compounds, as oxides or carbonates) such as lead, mercury (except mercury vapor), manganese, copper, chromium, iron, cadmium, zinc, magnesium, aluminum, antimony, and arsenic resulting from sublimation or condensation of their vapor, or from chemical reactions between their vapor and gases	(a) Lead oxide fume produced by the decomposition and combustion of lead tetraethyl	15 ± 5 of lead	9.90	1.5	0.15	Willson Bag Respirator No. 1 Approval No. 2104, issued to Willson Products, Inc.*
Type C	Mists as produced by spray-coating with paint and vitreous enamels, chromic acid mist as produced in chromium plating, and other mists of materials whose liquid vehicle does not produce harmful gases or vapors	(b) Magnesium oxide fume, freshly produced by burning magnesium ribbon	100 ± 25	2	—	—	
		(a) Chromic acid mist produced by electrolyzing an aqueous solution (300-500 grams of chromic acid per liter) of chromic acid	15 ± 5 of chromic acid	9.90	1	0.1	M.S.A. Comfo Respirator, Approval No. 2101, issued to Mine Safety Appliances Co.*
		(b) Lead paint mist produced by spraying a paint having the following composition: white lead (paste having approximately 50 percent white lead and 9 percent linseed oil by weight), 100 grams; linseed oil, 50 cubic centimeters; and steam-distilled turpentine, 25 cubic centimeters	200-400 of lead	9.90	1.5	0.15	M.S.A. Comfo Respirator not passed for lead containing mist
		(c) Mist produced by spraying a 2 percent aqueous suspension of ground flint, air-floated (99+ percent through 325 standard mesh sieve). The ground flint consists of 99+ percent free silica (SiO_2).	10 ± 5[e] of silica dust	9.90	5	0.5[e]	M.S.A. Comfo Respirator, Approval No. 2101, issued to Mine Safety Appliances Co.*
Chemically treated lead	Mechanically generated dusts whose main harmful constituent is lead, such as lead dusts generated in manufacturing storage batteries; enameling; pottery making; rubber compounding; sandpapering and chipping painted surfaces; paintmaking; preparing litho-transfers; and mixing, milling and processing lead ores	Mixture used in making negative plates of lead storage batteries. Contains 72 percent litharge, PbO; 25 percent red lead, Pb_3O_4; and 3 percent lampblack	15 ± 5 of lead	2.83	0.15	0.15	M.S.A. Comfo Respirator with special filters for lead dust, Approval No. 2107, issued to Mine Safety Appliances Co.* Willson Bag Respirator No. 1 Approval No. 2108, issued to Willson Products, Inc.*

[a] One milligram = 0.0154 grain.
[b] One cubic meter = 35.315 cubic feet.
[c] Rate of sampling = 32 liters (1.13 cubic feet) per minute.
[d] One milligram of this silica dust contains approximately 300 million particles as determined by the impinger method as described by the U. S. Public Health Service. Hence, 1 milligram per cubic meter of this dust is approximately equivalent to 85 millions of particles per cubic foot.
[e] See previous listing of company for complete address.

short blasts of air into the bag. This procedure removes from the bag dust and grit which clogs the pores of the filter and makes breathing difficult. The proper time for cleaning the bag is when the wearer experiences discomfort in breathing. When compressed air is not available some dust may be removed by tapping the bag lightly and brushing the outside of the bag.

5. To prevent irritation of the skin and for general sanitary purposes the respirator should be cleaned after each day's use. The rubber and metal parts may be cleaned with soap and water, and for general sterilization they may be dipped in a 3 per cent solution of carbolic acid, a 2 per cent solution of lysol, or a 70 per cent solution of denatured alcohol, then rinsed with water, assembled, and hung up by the loop in the felt bag to dry. The filter bag and headstrap always must be removed before the respirator is washed or sterilized.

6. While not in use the respirator should be kept in a dust-free place, preferably in the original container.

The manufacturer is required to maintain the quality of his product and to see that each mechanical filter respirator in all its parts is constructed according to the drawings or records that have been accepted by the Bureau for this device and that are in the Bureau's files. Mechanical filter respirators that exhibit changes in design or include any parts that have not been approved are not permissible respirators and must not bear the Bureau's approval label. Schedule 21 provides for the manufacturer to apply for an extension of approval on any change in the mechanical filter respirator which does not affect the filtering characteristics of the filter. Changes in the filter require the application for a new approval.

The Bureau obtains information on the maintenance of design and quality of approved mechanical filter respirators by testing samples of the devices obtained on the open market. The Bureau reserves the right to rescind for cause any approval issued.

A Safety Style Show

By E. J. SMITH

Safety and Health Director, Western Electric Company Hawthorne Works, Chicago

For the purpose of assisting our foremen in the selection of the proper safety equipment we have standard specifications and every foreman has a copy. In it he will find the protective equipment required for any class of work.

Molders, cupola tenders, furnace tenders and helpers in foundry and forge are equipped with heavy duty metal or composition cup goggles with hardened lenses. The lenses in the furnace tender's goggles are of a forge and furnace shade. Electric furnace tenders, however, wear a welder's goggle, described later. When a goggle is equipped with clear lenses, it is used for such operations as breaking defective castings, cleaning castings with compressed air, grinding castings to remove gates or fins, pounding on castings to remove sand cores, pouring molten metal into molds with hand or bull ladles, removing gates or fins from castings with air chisels, or hand chisels and hammers, and working in vicinity of chipping hammers.

Leggings are of the non-lacing, non-buckling and snap buttoning type held in place by hidden steel springs similar to the old bicycle pants guard. They will come off instantly from a tug at any point. There are no gadgets to confuse you or those who are trying to help you in an emergency. Just one simple thing to remember—grab anywhere and pull.

Men wear safety hats when chipping slag out of cupolas. Our construction crews of masons, carpenters, millwrights, and so on, wear them whenever they are engaged in work where there is the slightest chance of objects falling from overhead.

Our employees wear "Congress" safety shoes for their protection in addition to the leggings.

We use a leather steel faced glove when charging a cupola or handling pig iron.

Full leather palm gloves with hand top are used in chipping casting fins, loading and unloading tumbling barrels, and removing castings from sand.

For the protection of health, workers in the brass foundry are provided with overalls and undershirts with full length sleeves. This is in accordance with Illinois