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AN ACCEPTABLE RESPIRATORY PROTECTION PROGRAM AND LASL RESPIRATOR RESEARCH*

BY

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ABSTRACT

A short history is presented on the LASL Respiratory Protection Training Programs. Then a discussion is given on the major points of an acceptable respiratory protection program utilizing the points required by the OSHA Regulation 29 CFR 1910.134. Finally, the LASL Respirator R. and D. Section's contributions to respirator research are reviewed.

*Work supported by the U.S. Department of Energy and the Nuclear Regulatory Commission and performed at the Los Alamos Scientific Laboratory.

Ladies and Gentlemen:

I wish to thank Mat Kotowski for inviting me to make this presentation to your group this morning.

The title of my presentation is:

AN ACCEPTABLE RESPIRATORY PROTECTION PROGRAM

AND LASL RESPIRATOR RESEARCH

First I would like to answer the question asked by many people, "How did LASL become involved with Respiratory Protection Training?"

LASL RESPIRATORY PROTECTION TRAINING PROGRAMS

Our section at the University of California's Los Alamos Scientific Laboratory, Industrial Hygiene Group, is involved with a very specialized portion of worker safety, that of respiratory protection. Approximately 23 years ago research

was initiated to learn how to best protect employees working in radioactive environments, as well as those environments found in other industrial work situations where toxic materials are used. The available respiratory equipment was evaluated and protection programs were developed.

Other members of the Atomic Energy Commission community who were having similar problems came to LASL for informal and individual training between the years of 1958 and 1972. LASL received many other requests in the 1960's to train industry and other government personnel in basic respiratory protection because these people also had requirements to protect their workers.

In 1970 the Williams-Steiger Occupational Safety and Health Act was passed making respiratory protection necessary for some work situations, and establishing minimum requirements for a total respirator program. The requests for our services increased.

In 1973 the AEC funded LASL to conduct formal respiratory protection training courses for the other AEC contractors. When the AEC became the Energy Research and Development Administration on Jan. 1, 1975 they continued these courses.

For industry personnel, the laboratory organized a separate course to be taken to the user. This traveling course with which I have been associated, was begun four years ago in October 1975 at Denver, Colo. During these four years we have had 1154 students attend our classes. As of September 30, 1979, LASL has discontinued this training since other groups and small business can provide this service. We will now direct all of our efforts toward full time respirator research.

In any case a person could say that LASL has an extensive background in respiratory protection training.

Now let's discuss

AN ACCEPTABLE RESPIRATORY PROTECTION PROGRAM.

The major problem facing the safety specialist and/or industrial hygienist is HOW TO DEVELOP and OPERATE AN ACCEPTABLE PROGRAM. Acceptable not only to OSHA, but to the workers; because the best program in the world is not going to be effective, unless the workers can be convinced that they must wear these potentially hot, uncomfortable devices called Respirators.

Whether you develop a new program or have been put in charge of an existing program, you MUST comply with the OSHA Respiratory Protection Regulation, Title 29 Code of the Federal Regulations, part 1910.134.

This regulation first states that the control of occupational diseases caused by breathing contaminated air should be accomplished by accepted engineering control measures: such as confinement of the operation, general and local ventilation, or substitution of less toxic materials.

When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used in accordance with the requirements of OSHA 1910.134.

The first requirement for an acceptable program is a written plan of action, usually called a Standard Operating Procedure or S.O.P. This SOP should incorporate the following components to be in compliance with the OSHA respirator regulation and assure adequate worker protection:

Please read these points with me.

A. PROGRAM ADMINISTRATION

B. RESPIRATOR SELECTION

C. RESPIRATOR USE:

D. FITTING and TRAINING

E. RESPIRATOR MAINTENANCE

F. MEDICAL CLEARANCE and SURVEILLANCE

G. SPECIAL PROBLEMS

H. PROGRAM EVALUATION

I. DOCUMENTATION (records)

Obviously, if a person is initiating a new respiratory protection program, he can not write a COMPLETE SOP at this time. He would only use these points as a basic outline.

In the case of a person taking over an existing program, the SOP would be used to investigate the existence, acceptability, and compliance of the program.

PROGRAM ADMINISTRATION

The responsibility for the respiratory protection program should be vested in ONE and ONLY one person. This person may have a background in health physics, industrial hygiene, or

safety engineering, but must have at least one year field experience in the use of respirators. This person must have the ability, training, and experience to properly direct and supervise the program.

SELECTION OF RESPIRATORS

Selection of appropriate, NIOSH/MESA or NIOSH/MSHA approved respirators is the third point of the program. However, you must first identify the hazards and their physical, chemical, and warning properties. Then the concentrations must be estimated or measured for each area. Any other data which helps to form a total picture of the work environment, such as temperature & humidity, work duties, emergency duties, etc, must be collected.

The appropriate respirators are then chosen utilizing all of the hazard data. 1910.134 requires that proper selection shall be made according to the guidance of the American National Standard Practices for Respiratory Protection, Z88.2-1969.

This document can be used to learn the classification, description, and limitations of the respirators in the field and is presently being re-written to include new technologies. The NIOSH/OSHA Respirator Decision Logic is another document that can be used to select respirators.

RESPIRATOR USE:

Routine Operations: are those planned activities that are generally repetitive. These areas should have engineering controls, and respirators should be used only when these controls are not practical (i.e. during some maintenance operations) or while they are being instituted or evaluated.

Each hazard should be listed along with the appropriate respirator and its use defined.

Non-routine Operations: are those activities that are either non-repetitive or occur so infrequently that adequate limitation of exposures by engineering controls is impractical. Again the hazards are to be listed and the appropriate respirators and their use defined.

EMERGENCIES

Emergencies: are unplanned and unexpected events characterized by risks sufficient to require immediate action to avoid an abrupt or rapidly deteriorating situation. Although emergencies are unplanned; preparations must be made for coping with all potential events. Such preparations include a program for providing necessary and sufficient respiratory protection for any possible hazards. All emergency equipment and its proper use should be described.

There are two major categories of emergencies, ESCAPE and ENTRY:

a. ESCAPE devices are : those respirators located near or on the worker that facilitate his departure from a hazardous, Immediately Dangerous to Life or Health (IDLH) situation without exposure. Examples are:

a mouthpiece respirator,

airline respirators in combination with 3, 5, or 10 minute escape bottles, or

a SCBA (Self Contained Breathing Apparatus) with a 3, 5, or 10 minute bottle.

An important consideration when choosing an escape device is the time required to don the device.

b. Entry devices are for ENTRY-Into IDLH situations where the best possible protection is required because of unknown hazards. Only those devices which have a Protection Factor of 10,000 or higher and suitable for oxygen deficient atmospheres should be used. This limits the choice to Pressure-Demand SCBA or Pressure-Demand airline respirators equiped with escape bottles.

Other Related Areas :

Oxygen Deficient or confined areas: which should be defined and have special regulations concerning the use of atmosphere supplying respirators. Any safety procedures required to be executed should be clearly defined.

Breathing Air Specifications: should be defined when airline or SCBAs are required in any of the above situations. The breathing air source (whether air bottles, a compressor, or a synthetic system) should be specified as well as the surveillance and maintenance requirements for providing at least Grade D quality air as specified in the OSHA regulations and the Compressed Gas Association Commodity Specification G7.1-1966.

The ISSUE OF RESPIRATORS: should be defined, and only persons trained to insure that proper respirators are issued, shall be permitted to give respirators to persons needing them.

FITTING and TRAINING:

An acceptable respirator FITTING program is a very important part of this program because if the respirator that is issued to the worker does not fit, exposures will continue, and your program will not be effective.

In the past, the worker was issued a new respirator in its box with the written instructions for donning, and THAT was his fitting and training program. This is not an adequate program.

The manufacturers direct the wearer to perform the POSITIVE or NEGATIVE PRESSURE TEST as the fitting test. We agree that this is better than no fitting tests at all. However, we have learned that these tests are better performed as field or workplace donning procedures to insure correct implacement of a previously fitted respirator and are inadequate as fitting tests.

Qualitative Tests such as the ISOAMYL ACETATE (some times called the banana oil) TEST or the IRRITANT SMOKE TEST are much better fitting tests, and can be performed without a great deal of time or equipment cost. These tests, however, are very subjective requiring a determination of leakage to be made by the test subject, some of whom have olfactory deficiencies.

For more accurate, and certainly much more thorough fitting, a program of Quantitative testing is the best. A test aerosol is used such as Sodium Chloride or DOP (Dioctyl Phthalate). The leakage penetration into the mask is measured and compared with the challange atmosphere. By this method a PROTECTION FACTOR can be calculated for that specific mask on a particular face. In other words, the face-to-facepiece fit is tested. This type of testing is not subjective because it relies on an instrument to measure concentrations rather than a subject's report of odors.

TRAINING

Training: is the area that I feel is probably one of the most important in the entire program. You must teach the respirator user how to properly put on his device, and convince him that it is imperative that he wear the it for his own protection and safety. We have had many people come to us and say that they worked with their users teaching them the correct methods and the benefits of wearing their respirators. Then several weeks later on a walk-through plant inspection, they would see someone with his respirator on improperly. When the employee suspected an inspection, he grabbed the respirator and hastily put it on incorrectly. The problem is that the worker was not convinced that he needed the respirator, and I agree this is probably the hardest part of training.

RESPIRATOR MAINTENANCE:

It is of the utmost importance that this protective equipment retain its original effectiveness, and this requires proper Cleaning, Inspection, Repair, and Storage.

Cleaning: in small facilities might be done by each worker with a scru ·brush, sink of water, detergent, and a disinfectant. However, in a plant with a large work-force, a centralized facility is required. Respirators can be washed and disinfected in commercial dishwashers; and dried in special cabinets or commercial dryers, if the temperatures are reduced to no more than 140°F. but not less than 120°.

Inspection: All equipment should be INSPECTED by trained personnel after the cleaning procudures to see if there are any worn, distorted, or missing parts. When a deficiency or deterioration is discovered, it should be corrected by replacing .he parts. If the respirator can not be repaired, then it should be destroyed.

STORAGE

Proper STORAGE is very important, because a misshappen facepiece seal, many times will not revert to its proper shape and will leak. Proper packaging is required to keep dust,

dirt, moisture, or other contaminents from soiling the respirator or ruining the cartridges. In high humidity areas, the cartridges should be kept sealed in the manufacturer's packaging until the time they are used.

Another factor of storage is proper location, near or on the worker if for emergency escape, and out of the contaminated area if for routine or emergency re-entry situations.

MEDICAL CLEARANCE and SURVEILLANCE:

Physicals performed prior to respirator issue are important so that baseline medical information can be established. LASL has surveyed many Occupational Health Physicians to see what information the plant respirator specialist can given them to aid in making the decision of whether or not a person is physically capable of wearing these protective devices. Information on work duties, the workplace environment, the respirator types required, and necessary duration of wear should be given for each worksite, thus providing parameters for better health decisions.

Most of these physicians state that a well-written questionaire that includes questions on respiratory difficulties, heart problems, and orthopedic impairments; followed by routine tests and a thorough physical examination, would help certify the majority of the workers for respirator use areas.

The problem facing most physicians is choosing the best clinical tests to indicate pulmonary impairments. LASL is supporting research of physiologically impaired subjects wearing respirators by Dr. Peter B. Raven of the Texas College of Osteopathic Medicine at Ft. Worth, TX. During this research, Dr. Raven has investigated negative-pressure air purifying respirators modified by LASL with pre-set inhalation and exhalation resistances.

The clinical tests that are suggested by this research as being the most valid for indicating respiratory impairments are lung function tests that indicate dynamic function such as Maximum Breathing Capacities or Isoflow Volume tests. One isoflow volume test uses heliox (a helium-oxygen mixture) to test the maximum expiratory volume. This test is very sensitive since it measures the effort independent regions of the lungs.

Dynamic tests such as the FORCED EXPIRATORY VOLUME at one second (FEV_1) measures a combination of the effort-dependent and effort-independent areas of the lungs, and are not as sens.tive.

The frequency of re-examination and testing depends upon the workstress, hazards, the worker's age, and health. Annual physicals and tests are usually prescribed by most physicians. For the stressful occupations such as firefighting and rescue, these workers should have more frequent testing such as an examination every 6 months.

SPECIAL PROBLEMS:

Problems such as facial hair, eyeglasses, contact lenses, and communications should be addressed in this section outlining the company policies in each area. In this way, the worker knows what is required. We recommend:

1. No facial hair because of the interference with the face-to-facepiece seal, as stated in the OSHA regulations.

2. Approved prescription glasses should be fitted into the respirator for the person requiring glasses.

3. Contact lenses not be permitted because of the possibility of contamination getting under or permeating through the lens and the worker removing the mask in a toxic environment.

4. For communications- use approved equipment or devices such as in the slide that requires no mask modification.

If there are any unusual circumstances in any work situations that require special treatment, these areas should be identified and all instructions provided explicitly.

PROGRAM EVALUATION

Program Evaluation is necessary for the continuance of an effective respiratory protection program. Inspection of all phases of the program, and assessment of any workplace or procedure changes that would require program modifications must be constantly scrutinized. Biomedical assay and continuous hazards evaluation are other methods that insure continued program effectiveness.

DOCUMENTATION (Record Keeping)

Documentation (record keeping) of all phases of the program is the most efficient method of statistical comparison of data relating to the program and its evaluation. It also affords the proof that certain procedures or tests were carried out and when. Meticulously kept records are a must in an acceptable program.

We have now covered all of the points of an acceptable respiratory protection program,

Lets review these points again :

There must be a WRITTEN SOP that covers all of the following sections:

The PROGRAM ADMINISTRATION should be by ONE and ONLY ONE person.

RESPIRATOR SELECTION is complete hazards evaluation and the selection of proper approved respirators to fit each situation.

RESPIRATOR USE for routine, non-routine, and emergency situations must be evaluated and the proper respirators assigned.

FITTING and TRAINING must be good, so the workers not only have good protection, but wear it.

RESPIRATOR MAINTENANCE is cleaning, inspection, repair, and storage of respirators to retain maximum efficiency.

MEDICAL CLEARANCE and SURVEILLANCE requires physicals prior to respirator issuance, and continued medical attention for the workers protection and program effectiveness.

SPECIAL PROBLEMS such as facial hair, eye glasses, and other specific problems should be clearly defined.

PROGRAM EVALUATION is surveillance for continued program efficiency.

and DOCUMENTATION is meticulously kept records of all phases of the total program.

Let me now describe some of:

LASL's RESPIRATOR RESEARCH

LASL has invested a great deal of effort in developing Protection Factors for all classes of Respiratory Protection Equipment. Each respirator available in the class was evaluated and a protection factor designated for the entire class to protect the worker.

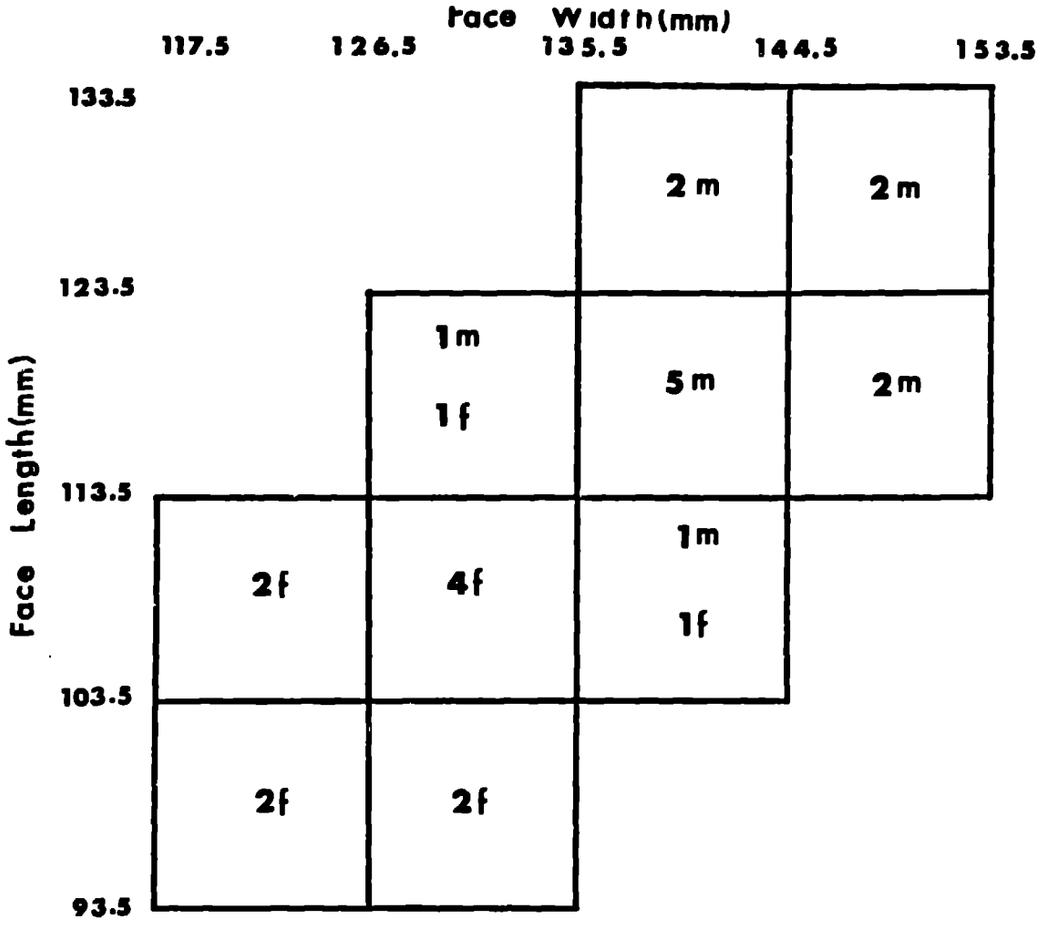
Face Width (mm)
117.5
126.5
135.5
144.5
153.5
Face Length (mm)
133.5
123.5
113.5
103.5
93.5
2 m
2 m
1 m
1 f
5 m
2 m
2 f
4 f
1 m
1 f
2 f
2 f

FIG. 1

LASL and anthropometric consultants developed an Anthropometric Test Panel System to simulate the faces of 95% of the working population. In fig. 1, the number in each box gives the number of test subjects with the indicated size characteristics.

LASL has developed modern non-destructive respirator test methods for certification of DOE contractors, NRC licensees, and the general industry.

We developed a very sensitive D-O-P (dioctyl phthalate) fit test system. This system can be used in two configurerations: a small test chamber with a hood that encloses the upper torso, and a large ($16m^3$) chamber that gives space for work simulating exercises such as deep knee bends, touching the toes, etc. All LASL employees are tested in a large DOP chamber to receive respirator use clearance. Each person who is certified receives a picture card to carry on his person which gives the mask that fits him, his Protection Factor, and the conditions for wear.

A Sodium Chloride respirator fit test apparatus was developed to test particulate filters and respirators, especially those with resin impregnation since oil mist aerosols such as DOP cause deterioration of the filter effectiveness. This system is not as sensitive as the DOP test system, and we hope to be allowed to perfect it utilizing recent technological advancements.

Since there are no prescribed NIOSH/MSHA procedures for testing and approving supplied-air suits required in many areas of radioactive work, LASL has developed testing procedures to fill this void for DOE.

Our CONTINUING RESEARCH includes:

Support of the Physiological stress testing of impaired subjects wearing respirators by Dr. Peter B. Raven, of the Texas College of Osteopathic Medicine, Ft. Worth, TX. This year he will investigate the effects of Positive-pressure apparatus.

Dr. William Morgan of the University of Wisconsin has completed a literature review of information on the PSYCHOLOGICAL CONSEQUENCIES OF RESPIRATOR USE. It is apparent from this review that very little research has been done in this area and that actual tests could be developed to indicate when and if a person would have severe psychological problems wearing respirators.

Mr. Alan Hack of our LASL Respirator R and D Section is presently investigating the Operational characteristics of Closed-Circuit Breathing Apparatus and developing Protection Factors for these devices. We will also EVALUATE TEST EXERCISES, both under STRESS and SEDENTARY conditions to ascertain their effectiveness in simulating real work situations.

LASL has always investigated better worker protection and will continue to be in the for-front in this area.

Thank you.