MEDICAL CLEARANCE FOR RESPIRATOR USERS

I. Regulatory Statements

A. 29 CFR 1910.134 (a) 10 - "Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

B. ANSI Z88.2-1969, Section 3.7- Exactly as given for 1910.134. Actually, 1910.134 copied the wording from the ANSI document.

C. ANSI Z88.2-1978, Section 3.5 and Appendix A-4

(Still in draft form) Lists a number of physical conditions, says that people with those conditions should not were a respirator during work. Conditions included some reasonable ones, ie.,emphysema, and some questionable ones, ie., anemia. No mention of degree of impairment, or quidelines for interpretation of clinical tests.

D. NIOSH Criteria Documents - List recommended clinical tests for specific toxic materials. The recommended clinical tests are usually very standard tests which would normally be run anyway. No quidelines are given for interpretation of the test results.

E. Summary: Current regulations are vague, give little or no guidance. All started with ANSI Z88.2-1969; no MD's on, or consultant to, draft committee.

LASL has been doing work on the problems of medical clearance for respirator users and the physiological effects of respirator use for several years. From our research, and by soliciting comments from other researchers and from medical practitioners, we have drawn up a list of recommendations for the question of medical clearance. LASL does not consider those recommendations to be complete or a final result. However, the following recommendations represent everything we have been able to learn about the problem area, to date.

II. Medical History

A. The medical history questionnaire should include questions on 1) previously diagnosed pulmonary impairments, 2) problems with breathing during normal activities (ie, the

breathing difficulty section in the British MRC questionnaire), 3) any past problem with a respirator causing breathing difficulties, 4) any past history of claustrophobic-type reactions, 5) any current, prescribed, drug use (while this would be done anyway, I include it because the physician should consider how any given drug therapy would affect, or be affected by, respirator use, 6) any orthopedic problems (of concern for heavy devices), 7) the person's occupation or worksite.

A good medical history questionnaire, which includes the previous points should allow the majority of the working population to be cleared for respirator use.

III. Clinical Tests

At present the various regulatory agencies are recommending standard, clinical pulmonary function tests for workers who will wear respirators during work. We found Dr. Horvath's article on pulmonary testing, in the September-October issue of Health and Safety News, to be very applicable to the industrial environment. Depending on the specifics of the work situation other clinical tests have been recommended; for instance, an annual maximal stress EKG for fire fighters and rescue workers who often work at or near maximal capacity while wearing heavy SCBAs.

IV. Information for MD

The following information should be available to the occupational physician.

A. Task Information

The examining physician should know about the work that the examinee will be doing. The best means for the physician to get this information is personal observation of worksite operations. Since most physicians won't have time for such observations, I recommend that the plant industrial hygienist supply the physician with a quick-reference list of worksites, or worker types, giving examples of the routine and hardest work performed and the usual duration of that work. The examples should be simple descriptions of the work actions (ie, carrying, shoveling, climbing), not work units such as kg-m/min. The list should also include the type of respirator used, the frequency and duration of use, and the degree of hazard which necessitates the use of respirators in each worksite. The last point is provided so the physician will know whether the use of the respirator is mandatory (ie, for fire fighters) or protection against chronic exposures (ie, miners).

B. Environmental Information

The same as for section IV A, the best means for a physician to obtain worksite environmental information is by personal observation. Since time is usually not available for such worksite visits, I recommend that the industrial hygienist supply the physician with a list of the routine temperatures and humidities in each worksite.

C. Equipment Information

Certain information concerning the respirator equipment would be of value to the examining physician, specifically inhalation and exhalation resistances, dead space volumes, weights, and thermal load. Each of those areas of concern is dicussed below.

1. PROBLEM: people with pulmonary impairments will have difficulty breathing through any additional breathing resistance. The degree of their difficulty depends on the degree of their impairment and the type of respirator used.

PRO: The degree of pulmonary impairment would be shown by pulmonary function tests. The type of respirator used determines the breathing resistance. Inhalation and exhalation resistances, measured as a facepiece pressure at an airflow rate, can be found for types (classes) of respirators in the certification test schedules. Those values could be used by

the physician to decide whether a person can wear a type of respirator without discomfort.

CON: There are two problems with the values listed for certification. First, they only apply to properly operating, correctly maintained respirators. From our experience on visits and inspections, we don't expect to find such respirators too often. Second the certification test schedules list, for a type or class of respirator, a single data point of mask pressure vs flow rate. A multitude of curves can be drawn through one point. So, at present we do not believe there are any values that can be applied to actual use situations.

2. PROBLEM: The dead space volume added by a type of respirator could be a problem to those people who have pulmonary impairments due to increased CO_2 rebreathing.

PRO: A common method of measuring added dead space volume in medical/physiological research is to fill the breathing tubes with water, and measure the volume of water contained. Also, the literature has several reports on the effect of CO_2 rebreathing on healthy and impaired subjects. Research could be performed to determine the dead space and/or CO_2 build up for each type of respirator.

CON: The water volume method of determining dead space

volume could be used for unpowered air-purifying, half-and quarter-masks. However, full-facepieces are all designed so that inhaled air is directed up and along the visor before reaching the wearer. The question arises, should the directing passages be included in this measurement? And also, what about powered air-purifying and continuous-flow supplied-air devices? LASL's past work on respirator protection showed the necessity of using a panel of people selected on the basis of anthropometrical facial measurements. How will differing facial sizes affect the dead space added by a respirator? These questions will have to be answered experimentally, probably by defining an "effective dead space" which would take into account added dead space volume, differing facial sizes, and actual CO_2 build-up inside the device while it is being used. No data is now available on this problem. (Ralph James).

3. PROBLEM: The weight of the respirator is of concern for cardiovascular and orthopedic problems.

DISCUSSION: The maximum allowable weights for SCBAs are 35 pounds for open-circuit and 40 pounds for closed-circuit. Certain devices may weigh less, but we recommend that the physician use those maximum values unless he is sure of th weight. Other devices (air-purifying, etc.) can be considered as having negligable weight. Past work has shown that the weights listed above produce a 20% work capacity decrease in

healthy individuals.

4. PROBLEM: The thermal load caused by a respirator, exclusive of the environmental thermal load, would be of concern due to the added load on the cardiovascular system. It depends on the type of device used.

DISCUSSION: Probably, an air-purifying full-facepiece respirator would cause the largest thermal build-up, because of body heat build up in a small, intermittantly ventilated volume, while a continuous-flow hood would cause the smallest, because of the cooling effect of the continuous flow of air over the head and trunk. Data on heat build up is not available for all types of respirators; there is some data available on specific types (such as British work on mine rescue "rebreathers." Also, the users condition is very much affected by other protective clothing used, ie., plastic coveralls and gloves.

V. Worker Classification

The worker classification scheme which we have been recommending is, basically, the scheme put forth by C. Cooper, MD, in his 1974 paper, modified by recent research results.

A. Classification Scheme

1. No restrictions on respirator use

2. Some specific use restrictions (ie., for pulmonary problems, no unpowered air purifying devices; for cardiovascular problems, no heavy (SCBA) devices).

3. No respirator use under any circumstances.

B. Discussion

The question that comes to mind when classifications are discussed is, "Exactly how should a physician separate people into the classes?" After checking the literature, and talking to researchers and practitioners in both the medical and industrial hygiene fields, we know of no specific quidelines to recommend. From the discussions we have had in the past year there are several general recommendations we will present here as quidelines for classifying workers according to the preceeding scheme.

The first class is for the normal, healthy people, and the third class is for the extremely impaired or diseased people; the second class is the gray area. The best suggestion for the second-class comes from Commander Horvath, MD, who suggested "When in doubt, try it out". That has received wide acceptance, though each physician interprets it in a slightly different manner. Generally, as I understood it from Dr. Horvath, if a question exists in the examining physician's

mind, after clinical tests (such as standard pulmonary function tests) have been performed, have the person wear the respirator he would wear during work in the clinic for about 30-min. If he has no serious discomfort, have him perform moderate exercise, while wearing the respirator, for about 10-min. If he still has no serious discomfort, let him try using the respirator while working. Dr. C. Cooper suggests that at this point the physician should involve the person in the decision. Explain the problem to him, and, after he's tried wearing it during actual work, let him decide if he is able to wear the respirator during his work. The example Dr. Cooper used was an insulation worker who needs a respirator infrequently and then for short durations. Such a worker might decide that he can put up with the discomfort during those periods when he must wear a respirator.

If he does have serious discomfort from the respirator, either in the clinic or at work, it may be possible to substitute another type of respirator for the standard issue type. For instance, if he is experiencing difficulty breathing with an unpowered, air-purifying respirator, then either a powered air-purifying or supplied-air hood or helmet should greatly reduce both the breathing resistance and the effective dead space. Such special attention should also improve employer-employee relations.

A special circumstance where merely trying out the device in the clinic would not be enough would be for a fire fighter or rescue worker required to use an SCBA, with a history of cardiovascular problems. Commander MacIntyre, MD, suggested that for such a person a maximal stress test while wearing the device should be required to show that the person could perform his work while using the device. Others have objected that such a test would only be good for a short time (1-2 months) following the test, since conditioning is so important in maximal stress tests. Also, such testing is expensive in terms of equipment, trained personnel, and time.

VI. Special Problems

A. Psychological Problems

The psychological problems associated with respirator use can be divided into claustrophobic reactions, and irrational actions under stress. An example of claustrophobic reactions would be a person who cannot stand to wear a face covering of any kind, even after training. The qualifier about training is included because most people exhibit a claustrophobic reaction to the initial use of a respirator; this usually subsides with training and experience.

An example of a person performing irrational actions under

stress is a fire fighter who exhibits no claustrophobic reactions during SCBA training, understands the equipment, understands the need for it, but who will remove the facepiece and attempt to push through a wall when in a hot, smokey, lightless situation (for instances, a training "smokehouse" maze).

A psychological profile questionnaire could be developed that would identify people with either of those psychological conditions. We know of no specific questionnaire which would be immediately applicable.

Recommendations that can be made at present are to check on a previous history of claustrophobic responses, and/or previous difficulty wearing a respirator, as was listed in the section on a medical history questionnaire. Positive responses to these questions indicates the need for further checking and/or special training for that individual, depending on the organization. In a large company having a respirator fitting program, the physician should be able to indicate that special training and/or fitting is needed, and leave that to those who routinely perform the fitting. If there is no fitting and training program, the physician should consider discussing the problem with the person, and letting him try on a respirator in the clinic. After that the physician can follow the same procedure used for people with pulmonary problems; the worker

will either decide to put up with some discomfort, or decide that he can't wear the respirator. If the latter is the case a different type of device may cure the problem.

B. Diabetes and Epilepsy

There is no data showing that diabetes or epilepsy is affected by respirator use. But, in a case where epileptic seizures can be brought on by claustrophobic tension, then respirator use may trigger seizures.

Diabetes and epilepsy are listed as special problems because diabetics and epileptics are subject to insulin shock and seizures, respectively. Since in a large number of cases respirator use indicates a hazardous situation, diabetics and epileptics in such a situation could endanger those around them. (This same type of reasoning is used by DOT to bar diabetics and epileptics as interstate truck drivers.)

The decision as to whether or not diabetes or epilepsy is a problem depends on the specifics of the work situation. The physician should consider both the medical aspects (history of stabilization, etc) and the worksite conditions (degree of hazard, criticality of the individuals task, etc.).

C. Physical Features Interfereing With Respirator Use.

Physical features which could interfere with respirator use are; scars are wrinkles in the sealing area, necessary use of eyeglasses or contacts, facial hair (beards, sideburns) in the sealing area, hollow temples (for full facepieces), dentures, etc. In a large organization this problem could be left up to those responsible for routine respirator fitting. In small organizations, or when a routine fitting program does not exist, the examining physician should be aware that physical features like those previously listed will hinder getting a good face to facepiece seal, thus lowering the protection afforded by the respirator.

VII. Information Now Available

The preceding sections listed general recommendations. This section will present what specific information is now available.

A. Literature

1. "The Physiological Consequences of Wearing Industrial Respirators: A. Review" by P. B. Raven, submitted to AIHA Journal.

2. "The Thermal Stress Caused by Wearing a PVC Supplied-Air Suit" by P. B. Raven, submitted to AIHA Journal.

3. LASL FY 1976 R port, LA-6733-PR

4. Dr. Horvath's article in Occupational Health and Safety, September-October, 1977.

B. Positive Pressure and/or Dry Air Systems

Military aviators use positive pressure breathing systems which use dry air or dry oxygen. The Navy and The Air Force have done several studies investigating possible adverse effects of these systems. To date, no long term or short term adverse effects have been found which could be attributed to either the positive pressure or the extreme dryness of the air or oxygen used.

A large compressor manufacturer has stated that any complaints they ever received about dry air was eventually traced to irritation due to contaminants, not primarily to the dryness of air. The experience of the military aviators is in agreement with that statement.

However, all the above information is taken from healthy subjects. No information is available at present on the effect of dry air or positive pressure systems on pulmonary impaired people.

Military aviation instructors do hear the same complaints about positive pressure systems that we do, and have seen the same training effect. After an initial exposure to the positive pressure system, any exercise or performance of a task requiring concentration removes the complaint. Dr. MacIntyre, at the Naval Aerospace Medicine Institute suggested that the complaints stem from signals from the lung stretch receptors, which the subject is not used to and which he interprets as "something wrong."

C. Ongoing Work

1. Joint LASL-AF work

2. Continuing AF work

3. Dr. Boehlecke's work at NIOSH on the effect of resistance on subject's with pulmonary impairments.