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ROCKY FLATS RESPIRATOR-FITTING PROGRAM

by

S. E. Hammond
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RELEASED FOR ANNOUNCEMENT
IN NUCLEAR SCIENCE ABSTRACTS

THE DOW CHEMICAL COMPANY
ROCKY FLATS DIVISION
P. O. BOX 888
GOLDEN, COLORADO 80401
U.S. ATOMIC ENERGY COMMISSION
CONTRACT AT(29-1)-1106

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ABSTRACT

The experience is reviewed of fitting, in the field, over 2000 workers with several different types of half-mask respirators. Procedures, numbers receiving a satisfactory fit, and areas of possible respirator improvement are discussed.

INTRODUCTION

program of fitting individuals with half-mask respirators has been under way at Rocky Flats for about 3 years. Originally three types of half-masks were available; the American Optical R-6000, the Mine Safety Appliances Comfo, and the Willson 809. Since the start of the program, the Willson 809 has been replaced by the newer 1009. Two new types, the Welsh 7580 and the Acme Duo-Seal, have been added on a limited basis. This gives a total of five different brands of respirators, as illustrated in Figure 1, available to the employees.

Rocky Flats uses half-mask respirators for protection from toxic particulates. Each employee who enters an area where airborne contamination is a possibility must carry a respirator. The half-mask is preferred because of convenience. However, full face, self-contained, or airline-supplied equipment is available for special applications such as protection from vapors and gases, where additional eye protection, or protection from higher concentrations of particulates is required. The type used is determined by an experienced health physicist. With the exception of paint spray respirators, all respiratory protective equipment must be capable of protecting against toxic particulates.

The point at which respiratory protection is most likely to fail is at the seal between the face piece and the wearer's face,⁽¹⁾ or from leakage around valves and filters. Our fitting program is not intended as an evaluation of respirator performance, but is intended solely to determine the best-fitting respirator or respirators for the individual on the basis of a leak-proof face seal. This fitting is done in the field with the subject at rest, thus respirator fit during active work or under adverse conditions is not necessarily determined by the test. The fitting program was originally scheduled through line supervision. Fitting was accomplished at the rate of about 12 employees per hour. New employees are now fitted at the time they receive a health physics indoctrination.

PROCEDURES

Following the practice of the National Reactor Testing Station⁽²⁾ employees are not instructed on how to wear a

(1) *Respiratory Protective Devices Manual*, American Industrial Hygiene Association and American Conference of Industrial Hygienists, 1963.

(2) Held, B. J., and Hueter, L. J., *Respiratory Protection Program for the National Reactor Testing Station*, May 3, 1962, USAEC Report IDO-12020.

Figure 1. RESPIRATOR TYPES

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respirator. Each is asked to read a sheet of instructions which state the reasons for the test, to put on a respirator as he would normally wear one, to close his eyes to prevent possible irritation, and to inhale in short breaths in case the respirator does not fit properly. Unless it is apparent the employee needs help, no other instruction is given. In this manner the employee becomes aware of his ability to use the respirator correctly.

Smoke, from a Mine Safety Appliance Company's ventilation smoke tube, is introduced around the edges of the mask as in Figure 2. This smoke, which is actually hydrogen chloride absorbed on a fume formed when air is blown through a tube of stannous chloride - impregnated pumice, has a 0.5- to 3-micron diameter particle⁽³⁾ which is effectively filtered out by the particulate filter. A short length of pliable plastic tubing on the end of the tube keeps the end of the smoke tube at sufficient distance from the mask to allow the fume to form and also prevents cuts if the test subject should move during the test. High concentrations of fume with rapid deep inhalation can cause some penetration of the filter.

11544-6

Figure 2. INTRODUCTION OF SMOKE AROUND RESPIRATOR

Visual inspection gives some indication of whether a mask is going to fit. If there is a possibility of leak, very little smoke is released, and this in the suspect area. If this indicates no leak, the edges of the mask are well smoked.

The use of the smoke tube leaves little room for doubt (Figure 3). If the mask leaks it is noticed immediately. A small blower or low pressure air hose is used to dissipate smoke from around the test subject before he removes the mask.

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Figure 3. RESPIRATOR TESTING

All types of masks are tried. The employee is then advised to wear any of those types which fit him satisfactorily. If it is apparent some instruction in proper wearing of the device is needed, it is given at this time. Instructions on caring for the respirator are also given. This includes inspection before use, proper fit, cleaning if needed, and replacement when necessary. The Russians recommend using eau de cologne or vodka as a sterilizing and cleansing agent.⁽¹⁾ We assume the auditor would question an order for any quantity of either, so we recommend ethyl alcohol to clean and freshen the face piece.

RESULTS

To date, 2100 employees have been tested with the original three types of half-mask, about 100 with the Acme mask, and about 50 with the Welsh. Figure 4 indicates the percentage of those tried who could obtain a satisfactory fit with each type respirator. Six percent could get a satisfactory fit from only the AO, 10 percent from the MSA Comfo, and 5 percent with the Willson only. We found 15 of the original 2100 could not wear any of the three with any confidence. Eight of these 15 were available for testing with the two new types. All can obtain a good fit with the Acme or Welsh.

Several female employees were tested. Generally their faces were so small as to prevent a good fit. They are not included in the numbers in Figure 4. The number of tests made with the Acme and Welsh is relatively low. They are not included in the discussion.

As can be noted in Figure 4, a greater percentage can wear the MSA Comfo. This mask has been available for several

(3) Hyatt, E. C., "Air Purifying Respirators for Protection Against Airborne Radioactive Contaminants," *Health Physics*, 9, 4 (1963).

(1) *Loc. cit.*, p 1.

MANUFACTURER	PERCENT OBTAINING SATISFACTORY FIT		
	PLANTWIDE	PLUTONIUM AREAS	URANIUM AREAS
AMERICAN OPTICAL	57	65	48
MSA	80	81	77
WILLSON	69	74	62
ACME	90	90	--
WELSH	64	64	--
ALL THREE TYPES (AO, MSA, WILLSON)	29	35	22
NONE OF THE ABOVE	0.7	0.7	0.8

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Figure 4. RESPIRATOR FITTINGS

years, in fact, it was the only one available immediately previous to the testing program. This could indicate that familiarity with the mask enables more employees to obtain a satisfactory fit. This is also borne out if areas are considered. In plutonium areas, respirators must be carried on the person at all times and their use is quite common. Uranium areas require the use of protection only occasionally. Hence, the greater percentage received a satisfactory fit in plutonium areas.

Employees are instructed to keep a respirator several days, depending on its use. Dirty or contaminated respirators are returned to the laundry. Here they are disassembled. The face pieces and O-rings are washed in a modified commercial dishwasher shown in Figure 5 in a 140°F water-detergent solution, rinsed, sterilized with a germicide solution, and air dried. Cartridges are sterilized in a commercial surgical sterilizer (Figure 6) utilizing ethylene oxide. These cartridges are then reused up to 10 times, unless they are obviously defective or contaminated.

11544-3

Figure 5. RESPIRATOR WASHER-DRYER

11544-10

Figure 6. COMMERCIAL SURGICAL STERILIZER

The respirators are then reassembled as in Figure 7, inspected and stored in transparent plastic bags. The laundry runs from 350 to 700 respirators a day through this cycle, depending on work loads.

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Figure 7. REASSEMBLY OF RESPIRATORS

Respirators are made available in the work areas in bins as shown in Figure 8. Clean respirators occupy the top, used are deposited in the bottom section.

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Figure 8. RESPIRATOR BINS

During the first year of using all three types, about five MSA filters were used to each filter of the others, giving an indication of the worker's preference. This can be attributed to two factors, mainly, the familiarity with the Comfo unit, and the fact that the small filters make this one fit in a pocket more comfortably. If all types can be worn, the more compact unit will probably be carried. If it is known that much time will be spent wearing respirators, probably another model with less breathing resistance will be the choice.

An attempt was made to correlate a poor fit of the Comfo with positive bio-assay results. Those who had been in areas where exposures could be due to poor-fitting masks were also the ones who had been most exposed to other modes of entry into the body, such as cuts and punctures, so no correlation is apparent.

SUGGESTED IMPROVEMENTS

The latest type half-masks are a definite improvement over earlier models, however, something is left to be desired. The expert on respirators, the man who wears one a good part of the working day, is the best source of desired improvements, and as with experts, generally, they don't necessarily agree.

Probably foremost is comfort, which includes respirator weight, balance, softness of the face piece, filter resistance, and even filter size. Softness of the area contacting the face is important, commensurate with proper fit. Lower resistance across the filters is desirable, yet the physical size of these should be kept as small as possible. Small filters permit the respirator to be easily carried. Those working in a dry box often have their face close to the windows. Large cartridges, even on the side of the face piece, interfere with head movement and can, in some cases, interfere with vision.

We still find it difficult in most cases to wear glasses comfortably with a respirator. Safety glasses are required in all production areas at Rocky Flats, and will always be worn with a respirator.

Spot checking confirms that double straps are preferable. We have found that elastic straps are more satisfactory than rubber in that they stay adjusted better. Most employees definitely prefer metal adjustments, hooks, eyes, buckles, and face piece attachments. Many plastic castings have sharp ridges and are not as durable as metal. These also tend to slip more on the elastic straps than do their metal counterparts.

The color of O-rings, if used, should contrast with the filter holder to facilitate inspection.

DISCUSSION AND CONCLUSIONS

The ventilation smoke tube is well suited to a field respirator-fitting program. The subject is advised to close his eyes during the test to prevent possible eye irritation. Many opened their eyes in the presence of the fume without obvious ill effects. One man returned a few minutes after testing complaining of eye irritation. Water was used to cleanse the eyes and no more trouble was reported. One man reported to the Medical department the following day with a rash on his face which possibly could be attributed to the fume. This cleared up rapidly. Two or three reported nausea following the test, probably due to coughing from fume entering the mask.

Our primary aim is to get a good seal for each man with at least one type of respirator. We have done some refitting with some changes in fit, but not in significant numbers.

This program has been well received throughout the plant. This testing and subsequent addition of new types of respirators has informed the employee that advances in respiratory protection are being watched. It has given us a chance for personal contact with a large portion of the plant population. It has also given employees and supervision a point of reference for any questions they may have on respiratory protection.