- The new hood in its pressurized mode gives a 6% decrease in acceptable fits when compared with configuration (2) without a hood.
- The rubber head strap of combat spectacles passing between the face and the sealing surface of the mask as tested in configuration (4) decreases the acceptable fits by 30% when compared with configuration (2) without glasses.
- The Valsalva procedure, which is included in the test maneuvers for all configurations, is a method of clearing the ears by pinching the nose shut, closing the mouth, and blowing. This procedure is so severe that the facepiece cannot maintain its seal. The data show a decrease of acceptable fits by 10 to 20%.

Evaluation of the Integrated Chemical Defense System (ICDS)

During late FY 1982, preliminary testing was conducted on the HGU-51/P ICDS (Fig. 2). The data from this testing was used to establish the test protocol and responsibilities in coordination with the Individual Protection Branch, Chemical Defense Division, Wright Patterson AFB, Ohio, and Gentex Corporation, Carbondale, Pennsylvania.

The ICDS helmet, visor, shroud assembly, oxygen hose, supply air hose, regulators, and connectors will each have quality assurance testing before protection level testing and at any time a unit may become suspect. This testing will be conducted by using a 16-m^3 test chamber, forward-light-scattering photometer, full-bodied mannequin, and equipment for measuring pressure and flow. When no penetration of aerosol is detected by the monitoring equipment, the unit will be considered to be aerosol tight and acceptable for human test subject quantitative fit test (QNFT).

All QNFTs will be conducted in a 16-m^3 test chamber that contains a polydispersed aerosol with a mass medium aerodynamic diameter (MMAD) of approximately 0.5 ± 0.1 µm and a particle concentration of 27.5 ± 1.3 mg/m^3. Total aerosol concentration in the chamber and sample air drawn from the eye cavity of the ICDS unit will be monitored with forward-light-scattering photometers. These samples will be taken at a sample rate of 1 L/min.

During the HGU-51/P tests, the single-particle-counter laser-aerosol spectrometer (LAS-X) will be operated simultaneously with a forward-light-scattering photometer to evaluate the correlation between the two measurement systems and will allow measurements beyond the operational capability of light-scattering equipment to be made.

All light-scattering photometers and the LAS-X have been set up and calibrated. A test panel has been confirmed and the quality assurance system constructed as outlined in the test procedures. Because of the delay of equipment delivery from the Gentex Corporation, the test schedule is now tentatively set for spring.

RESPIRATOR STUDIES FOR THE NUCLEAR REGULATORY COMMISSION (NRC)

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Funding Organization: NRC, Office of Research

This project provides the NRC with information of respiratory protective devices and programs for their licensee personnel. The following activities were performed during FY 1983:

Alternate Test Aerosols for Filter Quality Assurance (QA) Testing

The standard method for QA testing of high-efficiency particulate air (HEPA) respirator filters is to challenge the filter with a monodisperse, thermally generated aerosol of di-2-ethylhexyl

phthalate (DEHP). Because of the potential carcinogenicity of DEHP and the difficulty of generating monodisperse aerosols, several alternative QA methods are being evaluated for suitability as replacement aerosols and test procedures. In this study the following challenge aerosols were compared: (1) a thermally generated DEHP aerosol utilizing the existing Q–127 test system; (2) a thermally generated, di-2-ethylhexyl sebecate (DEHS) aerosol utilizing the Q–127 test system; (3) a polydisperse, air-jet-generated DEHS aerosol; and (4) a polydisperse NaCl aerosol.

Respirator cartridge test filters were chosen from three sources: (1) shelf stock or issue filters, (2) filters currently in everyday use, and (3) filters that failed previous QA testing. Test systems were constructed and calibrated for each of the aerosols.

There is a good correlation between the results obtained when using air-generated DEHS and thermally generated DEHP.[1] An accurate conclusion regarding the correlation between NaCl and the other aerosols could not be reached because of limited equipment sensitivity by using the NaCl system. The results suggest that commercially available DEHS quantitative fit test equipment may be used for QA testing of respirator HEPA filters. Further studies may be required to gain additional information before definite conclusions can be reached in regard to all aspects of concern.

Evaluation of MAG–1 Spectacles with Positive- and Negative-Pressure Respirators

The need for prescription eyewear while using respirators is a great problem for NRC licensees. A 1982 study using the Criss Optical Manufacturing Company's MAG–1 spectacles (Figs. 3 and 4) indicated that the MAG–1 spectacles could be worn safely with positive-pressure respirators without a loss of wearer protection or without an increase in self-contained breathing apparatus (SCBA) air use under laboratory test conditions. This limited data could *not* be used to indicate or predict protection for any type of negative-pressure respirators.

To eliminate the possibility that these results were biased by excessive assistance with the donning of the MAG–1 spectacles and/or respirator facepieces, QNFTs of an additional limited panel (11 subjects) were performed. All test subjects received general donning instructions, but there was no actual assistance with donning of the spectacles and/or the respirators. The data analysis and report will be completed in 1984.

A study was also performed by using the Criss Optical Manufacturing Company's MAG–1 spectacles to determine whether the temple strap interfered with the face-to-facepiece seal of three negative-pressure full-facepiece respirators. A 25-person anthropometrically selected panel

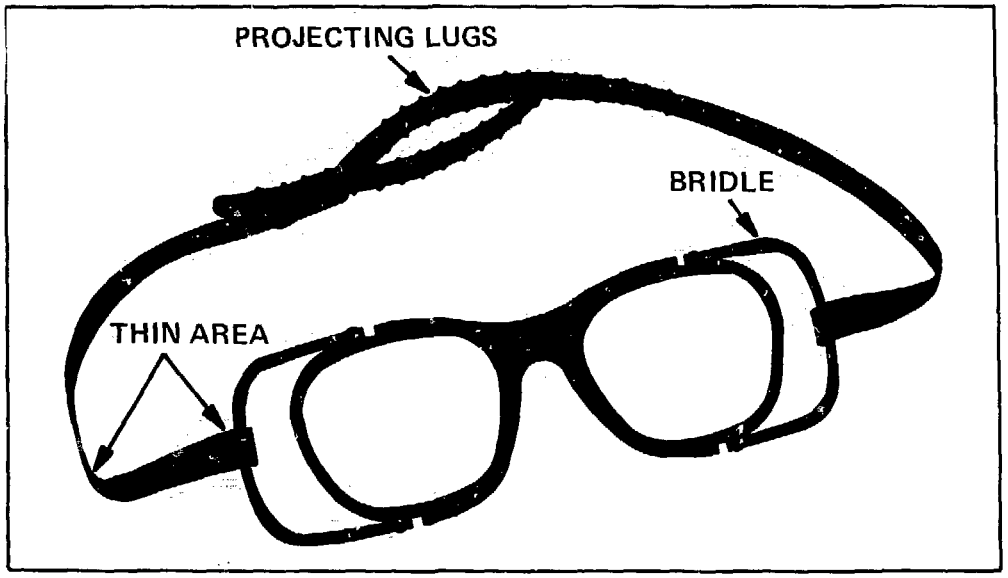

FIGURE 3.
Criss Optical MAG–1 spectacles.

was tested two times in each respirator, once wearing the spectacles and once without. Chamber testing was completed; data analysis and a report will be completed in 1984.

Acceptance Testing

The unique health and safety problems associated with NRC contract licensees' work frequently necessitates the utilization of special respiratory protective equipment. Sometimes this requires the use of equipment that is not, or cannot readily be, approved by the existing National Institute for Occupational Safety and Health approval system. A procedure was developed to permit review and approval of such devices. This will involve formation of a Respirator Advisory Committee to review data obtained by testing the equipment under the specific operating procedure required by the licensee. The list of potential members has been agreed upon and the committee formation is scheduled for FY 1984.

Manual of Respiratory Protection in Emergencies Involving Airborne Radioactive Materials

This manual was previously entitled "Respiratory Protection in Emergency Situations" but was renamed to reflect the NRC's major concern in nuclear facilities. A final draft of the manual was forwarded to NRC. It is based on information obtained from visits to NRC licensee facilities, a literature search of problems in radiological emergencies, and opinions solicited from respiratory protection consultants. The manual details the emergency use of respirators and emphasizes the need for proper selection, fitting, training, and maintenance beyond normal practice because of the increased probability of respiratory hazards. To aid workers assigned to rescue, firefighting,

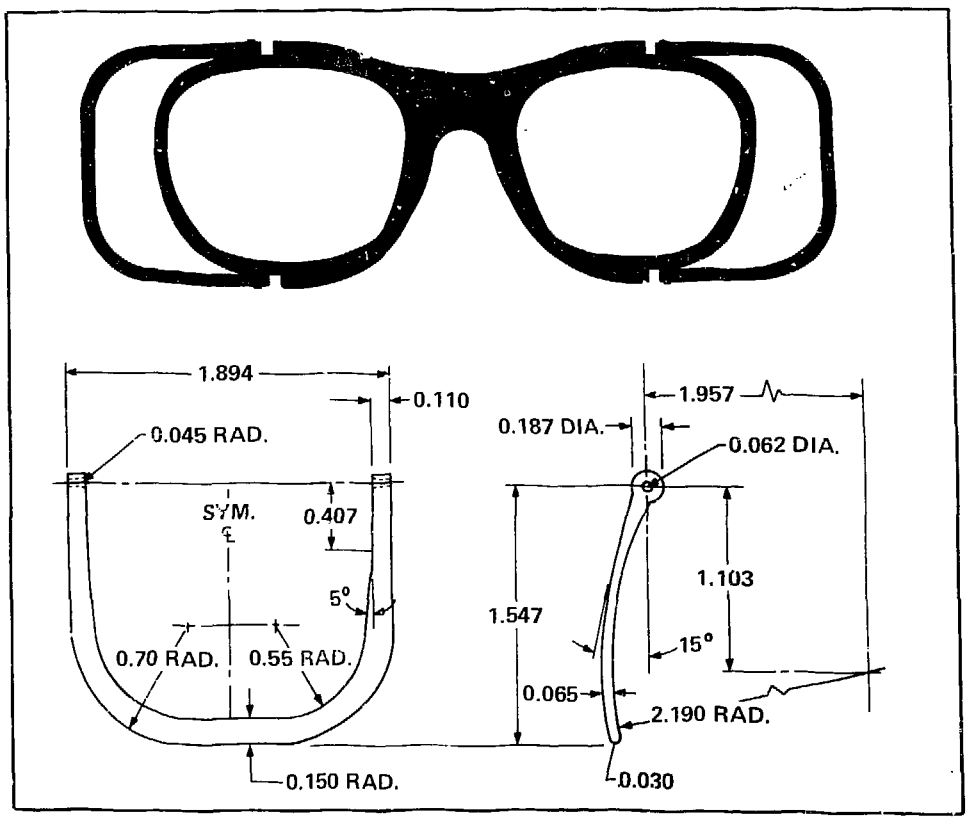

FIGURE 4.
MAG-1 spectacles with dimensions of the original-size bridles (unmodified) (Phase I tests).

damage control, and radiation survey teams, the uses and procedures for each type of emergency respiratory protection are described and illustrated by example. Support equipment and functions provided in emergencies, such as portable compressed-air systems and assistance by off-site agencies, are discussed. The manual will be published by NRC as a NUREG document to complement NUREG–0041.[2]

Technical Assistance

Guidance was provided NRC licensees regarding respirator applications involving respirator protection factors, quantitative versus qualitative fit testing, with specific questions relating to the test agents, supplied-air-system problems, respirator QA, and respirator maintenance.

References

1. Harrison F. Kerschner, III, H. J. Ettinger, J. D. DeField, and Richard Beckman, "A Comparative Study of HEPA Filter Efficiencies When Challenged with Thermal- and Air-Jet-Generated Di-2-Ethylhexyl Sebecate, Di-2-Ethylhexyl Phthalate, and Sodium Chloride," Los Alamos National Laboratory report LA–9985–MS (December 1984).
2. "Manual of Respiratory Protection Against Airborne Radioactive Materials," US Nuclear Regulatory Commission, Office of Standards Development report NUREG 0041 (1976).

TESTING AND EVALUATION OF THE M17A1 RESPIRATOR

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Funding Organization: US Army, Chemical Systems Laboratory

Evaluation of the M17A1 chemical protective mask was continued for the Chemical Systems Laboratory, now the Chemical Research and Development Center (CRDC). This involved a series of tests simulating field performance to determine what protection various masks could provide in the field without actual field experiments, to identify most probable leak points, and to assess mask performance.

Simulated Field Testing

This was a joint Los Alamos/CRDC effort. Los Alamos activities involved

- constructing the oil aerosol (di-ethylhexyl-sebecate) generation and detection equipment;
- mating this equipment to existing exposure chambers located at Edgewood Arsenal, Maryland;
- developing a data analysis method for oil aerosol respirator fit testing suitable for use by personnel from different agencies participating in this experiment;
- performing aerosol sizing and concentration measurements on the oil system and a companion salt aerosol system provided by CRDC; and
- performing a statistical data analysis independent of the effort by CRDC.

Mass concentrations and size distributions of the DEHS aerosol within the test chambers were measured repeatedly before testing and periodically during the several weeks of tests. Mass concentration was measured gravimetrically as well as with piezoelectric crystal mass monitors. The aerosol size distribution was measured primarily with a laser light-scattering aerosol spectrometer (LAS–X) and an automatic cascade impactor (CMCI).