QUALITATIVE VS. QUANTITATIVE

RESPIRATOR FIT TESTING

***

ASSE REGION III

PROFESSIONAL DEVELOPMENT CONFERENCE

TEXAS A&M UNIVERSITY

FEBRUARY 6, 1984 --- FEBRUARY 8, 1984

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THIS AFTERNOON I WILL BE PRESENTING AN OVERVIEW OF RESPIRATOR RESEARCH CONDUCTED BY DUPONT OVER THE PAST FEW YEARS. SOME OF THE MAIN INVESTIGATORS FOR THIS PERIOD WERE STEVE DIXON, TOM NELSON, ORRIN SKRETVEDT AND OTHERS. THE INFORMATION I WILL PRESENT HAS BEEN PREVIOUSLY PUBLISHED AT AMERICAN INDUSTRIAL HYGIENE ASSOCIATION MEETINGS AND AT LOCAL AND TRADE ASSOCIATION SEMINARS.

ONE OF THE FIRST ITEMS WAS TO ESTABLISH A PROTOCOL THAT COULD BE QUANTIFIED AND WOULD MEASURE THE PROTECTION REQUIRED TO PROTECT ANY EMPLOYEE FROM TOXIC AGENTS.

THE NEXT ELEMENT OF THE PROTOCOL WAS THE SELECTION OF THE RESPIRIATOR. (SLIDE 1). SEVERAL MANUFACTURERS' MASK IN VARIOUS SIZES WERE MADE AVAILABLE AND THE EMPLOYEE WAS ALLOWED TO CHOOSE THE RESPIRATOR THAT FIT OR WAS MOST COMFORTABLE TO WEAR (SLIDE 2). IT IS IMPORTANT RECOGNIZE THAT AN EMPLOYEE NEEDS TO FEEL COMFORTABLE AND CONFIDENT IN USING ALL PERSONAL PROTECTIVE EQUIPMENT.

ANOTHER WAY OF SAYING THIS; IF THE EMPLOYEE IS INVOLVED AND PART OF A PROCESS, HE IS MORE LIKELY TO USE THE EQUIPMENT PROPERLY.

AFTER THIS SELECTION, THE FIT TEST METHOD WHICH I WILL DISCUSS LATER WAS PRESENTED ON AN EIGHT MINUTE SOUND/SLIDE ORIENTATION PROGRAM (SLIDE 3).

THIS PROGRAM WOULD ENSURE AN UNDERSTANDING OF THE NEED FOR COOPERATION, A DATA COLLECTION FORM FOR RECORD PURPOSES, THE ISOAMYL ACETATE SENSITIVITY CHECK, FACEPIECE SELECTION (STANDARD PROCEDURES FOR ASSEMBLING A FIT TEST CHAMBER), STANDARD TEST EXERCISES AND STANDARD PRACTICES FOR CONDUCTING POSITIVE AND/OR NEGATIVE PRESSURE FIT TESTS. IT SHOULD BE UNDERSTOOD THAT WHETHER THE EMPLOYEE SELECTS A RESPIRATOR FIRST OR SEES THE SLIDE/SOUND PRESENTATION IS VERY DEPENDENT ON THEIR FAMILIARITY WITH RESPIRATOR USE.

I WILL NOW DISCUSS THE MERITS AND DETAILS OF THE ISOAMYL ACETATE RESPIRATOR FIT TEST. BESIDES PROVIDING AN EMPLOYEE ADEQUATE RESPIRATORY PROTECTION, ANOTHER GOAL OF THE PROJECT WAS TO SELECT A TEST WHICH WAS SAFE, RELIABLE, SIMPLE, AND COST EFFECTIVE.

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(SLIDE 4) RESPIRATOR FIT TESTING IS ACCOMPLISHED BY EXPOSING A RESPIRATOR WEARER TO A TEST ATMOSPHERE AND DETERMINING THE EXTENT OF FACEPIECE LEAKAGE EITHER QUANTITIVELY OR QUALITATIVELY (SLIDE 5). THE RATIO OF THE INSIDE FACEPIECE CONCENTRATION TO THE OUTSIDE TEST ATMOSPHERE CONCENTRATION DETERMINES THE PROTECTION FACTOR OF FIT FACTOR.

(SLIDE 6) QUALITATIVE FIT TEST AGENTS WHICH HAVE BEEN USED ARE ISOAMYL ACETATE, SACCHARIN, AND IRRITANT SMOKE; EXCESSIVE LEAKAGE HAS BEEN DETECTED BY ODOR, TASTE OR IRRITATION. CHIEF DRAWBACKS OF THESE METHODS PRIOR TO RECENT DEVELOPMENT WERE THE TEST ATMOSPHERE WAS UNCONTROLLED AND SENSITIVITY WAS UNVALIDATED.

(SLIDE 7) TO BETTER QUANTIFY THE ISOAMYL ACETATE TEST, THE ATMOSPHERE SHOULD BE REPRODUCIBLE (APPROXIMATELY 150 PPM) AND AN ODOR SENSITIVITY CHECK--VERIFICATION THAT THE SUBJECT CAN SMELL/DETECT 1 PPM OR LESS OF ISOAMYL ACETATE. (SLIDE 8) THEREFORE, THE TEST PERFORMANCE WOULD PROVIDE A PROTECTION FACTOR OF 150.

(SLIDE 9) THE ISOAMYL ACETATE SENSITIVITY TEST IS DONE BY MIXING ISOAMYL ACETATE AND ODORLESS WATER IN CANNING JARS. [1.0 ML OF ISOAMYL ACETATE INTO 800 ML OF ODORLESS WATER, AND THEN MIXING 0.5 ML OF THIS STOCK SOLUTION INTO 500 ML OF WATER.] (SLIDE 10) THE SUBJECT REMOVES THE TOP AND SNIFFS THE HEAD SPACE TO DETERMINE WHETHER HE CAN SMELL 1 PPM OF ISOAMYL ACETATE. TO MAKE THE TEST BLIND, A SIMILARLY LABELLED JAR OF ODORLESS WATER IS PREPARED AND THE TEST SUBJECT MUST CORRECTLY IDENTIFY THE JAR CONTAINING ISOAMYL ACETATE.(SLIDE 11) DATA ON THE REPRODUCIBILITY OF THE ODOR SENSITIVITY SOLUTION PREPARATION ARE SHOWN HERE. THESE DATA WERE PROVIDED BY MEASURING THE CONCENTRATIONS FROM REPLICATE SENSITIVITY SOLUTIONS BY GAS CHROMATOGRAPHY. AS YOU CAN SEE, THE PROCEDURE GIVES AN APPROXIMATE 1 PPM CONCENTRATION WITH ADEQUATE REPRODUCIBILITY. (SLIDE 12) WE CONDUCTED TESTS ON THE EFFECT OF WATER TEMPERATURE ON ODOR TEST CONCENTRATIONS AND FOUND NO SIGNIFICANT VARIATION OVER A WIDE RANGE OF WATER TEMPERATURES.

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RECALL AS I MENTIONED EARLIER, THE SELECTION FOR COMFORT PROCEDURE ALLOWS THE WEARER TO SELECT A PREFERRED, COMFORTABLE RESPIRATOR FROM AN ASSORTMENT OF TYPES AND SIZES. THIS STEP IS VERY IMPORTANT TO ENSURE THAT A RESPIRATOR WHICH IS COMFORTABLE THEREFORE, WILL BE WORN PROPERLY, IS ASSIGNED FOR FIT TESTING.

(SLIDE 13) DIMENSIONS AND PROCEDURES FOR ASSEMBLING A STANDARD FIT TEST CHAMBER IS A 24" DIAMETER PLYWOOD DISK, A POLYETHYLENE BAG (CLEAR GARBAGE BAG FOR A 55-GALLON DRUM), 24" X 60" WITH A BOLT THROUGH THE MIDDLE FOR HANGING THE UNIT FROM THE CEILING AND HOLDING THE ISOAMYL ACETATE PAPER STRIP PROVIDED TO ENSURE A UNIFORM AND REPRODUCIBLE TEST ATMOSPHERE, AND ADEQUATE ROOM FOR FIT TEST EXERCISES. (SLIDE 14) A CONTROLLED TEST ATMOSPHERE IS PRODUCED IN THE FIT TEST CHAMBER BY PLACING 0.5 ML OF ISOAMYL ACETATE ONTO A 4 X 5 INCH PAPER TOWEL (SLIDE 15), SUSPENDING IT FROM A HOOK IN THE FIT TEST CHAMBER, AND WAITING 2 MINUTES FOR A CONSTANT TEST ATMOSPHERE TO BE PRODUCED. (SLIDE 16) DATA ON THE REPRODUCIBILITY OF THE TEST ATMOSPHERE GENERATION PROCEDURE ARE SHOWN HERE. GAS CHROMATOGRAPHY WAS USED TO MEASURE TEST ATMOSPHERE CONCENTRATIONS FOR ADEQUATE REPRODUCIBILITY. (SLIDE 17) WE ALSO DID STUDIES ON THE EFFECT OF ROOM TEMPERATURE ON CHAMBER CONCENTRATION OF ISOAMYL ACETATE, AND FOUND NO SIGNIFICANT VARIATION.

(SLIDE 18) STANDARD TEST EXERCISES ARE DONE TO EVALUATE THE POTENTIAL FOR LEAKS DURING VARIOUS HEAD, NECK AND MOUTH MOVEMENTS. WE FOUND IN OTHER STUDIES THAT THERE ARE SIGNIFICANT DIFFERENCES IN QUANTITATIVE FIT FACTORS FOR THE DIFFERENT TEST EXERCISES AND, THEREFORE, THAT THE RANGE OF EXERCISES ARE NEEDED. (SLIDE 19) FOR THE OVERALL FIT TEST PROCEDURE THE TEST SUBJECT:

1. VIEWS THE ORIENTATION PROGRAM,
2. TAKES THE SENSITIVITY TEST,
3. SELECTS A RESPIRATOR FOR COMFORT, AND
4. TAKES THE FIT TEST.

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- IF HE PASSES, HE IS ASSIGNED THAT SIZE AND TYPE OF RESPIRATOR.
- IF HE FAILS, HE REPEATS THE SENSITIVITY TEST AND THE REST OF THE PROCEDURE UNTIL HE IS ASSIGNED A RESPIRATOR.

(SLIDE 20) TO QUANTITATIVELY EVALUATE THE PERFORMANCE OF THE ISOAMYL ACETATE PROCEDURE WE INCLUDED A STUDY IN WHICH A QUANTITATIVE FIT TEST WAS DONE FOR A NUMBER OF TEST SUBJECTS AFTER THEY HAD BEEN ASSIGNED A RESPIRATOR. THE RESPIRATOR WAS NOT REMOVED OR DISTURBED BETWEEN THE ISOAMYL ACETATE FIT TEST AND THE QUANTITATIVE FIT TEST. COMBINATION ORGANIC VAPOR/HIGH EFFICIENCY PARTICULATE FILTERS WERE USED. A DYNATECH-FRONTIER FE250A SYSTEM AS USED FOR ALL QUANTITATIVE FIT TESTS FOR THIS STUDY, AND FOR THE WORKPLACE PROTECTION FACTOR STUDY WHICH I WILL DISCUSS LATER. (SLIDE 21) WE FOUND THAT ONLY 3 OF 187 SUBJECTS WHO PASSED THE ISOAMYL ACETATE FIT TEST FACTORS BELOW 150, THE THREE WERE A 96, A 105, AND A 146. (SLIDE 22) THIS EQUATES TO 98% OF THE TEST SUBJECTS WITH FIT FACTORS ABOVE 150. (SLIDE 23) USING NONPARAMETRIC STATISTICS WE FOUND THAT 96% OF THE TEST SUBJECTS WILL HAVE FIT FACTORS ABOVE 150 AT THE 95% CONFIDENCE LEVEL.

NON-PARAMETRIC STATISTICS MEANS THAT THE DATA DOES NOT FIT ANY OF THE USUAL DISTRIBUTIONS--GAUSSIAN, LOG-NORMAL, POISSON. EACH DATA POINT IS COUNTED AS AN INDIVIDUAL VALUE.

WE HAVE ALSO DONE TWO SUPPLEMENTAL TESTS TO EVALUATE THE PERFORMANCE OF THE FIT TEST FOR SUBJECTS WHO HAVE RELATIVELY POOR QUANTITATIVE FIT FACTORS. (SLIDE 24) OF 67 BEARDED SUBJECTS, 61 OF WHOM HAD FIT FACTORS BELOW 100, NONE PASSED THE ISOAMYL ACETATE FIT TEST. TEST WERE DONE FOR HALF-MASK AND FULL-FACE RESPIRATORS. (SLIDE 25) OF 66 OTHER SUBJECTS, 29 OF WHOM HAD HALF-MASK FIT FACTORS BELOW 100, ONLY 15 PASSED THE ISOAMYL ACETATE FIT TEST. FOR THE 15 SUBJECTS PASSING, THE LOWEST FIT FACTOR WAS 692. IN OUR EVALAUTION OF THE ISOAMYL ACETATE FIT TEST WE USED QUANTITATIVE FIT FACTORS AS THE YARDSTICK FOR

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COMPARISON, JUST AS THEY HAVE BEEN USED TO DETERMINE ASSIGNED PROTECTION FACTORS FOR CLASSES OF RESPIRATORS. HOWEVER, THERE WAS AN OBVIOUS NEED TO ALSO EVALUATE THE ISOAMYL ACETATE FIT TEST AGAINST REAL-WORLD WORKPLACE PROTECTION FACTORS, SINCE THE RELATIONSHIP BETWEEN QUANTITATIVE FIT FACTORS AND WORKPLACE PERFORMANCE OF RESPIRATORS WAS NOT KNOWN.

(SLIDE 26) NOW THAT THE ISOAMYL ACETATE FIT TEST HAS BEEN VALIDATED, I WILL TO DISCUSS THE WORKPLACE PERFORMANCE OF RESPIRATORS.

(SLIDE 27) I WILL BE USING TERMINOLOGY RECOMMENDED BY NIOSH WHERE:

- FIT FACTOR (FF) IS THE RESPIRATOR TO FACE SEAL MEASURED BY A FIT TEST.
- ASSIGNED PROTECTION FACTOR (APF) IS THE FACTOR ASSIGNED TO TYPE OR CLASS OF RESPIRATORS WHICH REPRESENTS PROTECTION PROVIDED TO MOST PEOPLE.
- WORKPLACE PROTECTION FACTOR (WPF) IS THE MEASURED PROTECTION ACTUALLY PROVIDED WHEN A PROPERLY FUNCTIONING RESPIRATOR CORRECTLY WORN IN THE WORKPLACE.
- EFFECTIVE PROTECTION FACTOR (EPF) IS THE OVERALL PROTECTION THAT IS PROVIDED OVER THE WHOLE WORK SHIFT WHEN A PROPERLY FUNCTIONING RESPIRATOR IS CORRECTLY WORN FOR ONLY PART OF THE WORK SHIFT. IT INCLUDES THE PERCENTAGE OF TIME THAT THE RESPIRATOR IS NOT WORN.

PROGRAM PROTECTION FACTOR IS THE PROTECTION PROVIDED AS RESPIRATORS ARE ACTUALLY WORN IN THE WORKPLACE. IT IS A FUNCTION OF THE TOTAL RESPIRATOR PROGRAM INCLUDING FACTORS SUCH AS MOTIVATION, MAINTENANCE, STORAGE SUPEVISION AND EMPLOYEE WORK HABITS.

(SLIDE 28) THE PRIMARY OBJECTIVE OF THIS STUDY WAS TO DETERMINE THE WORKPLACE PROTECTION FACTOR DISTRIBUTION FOR SUBJECTS WHO HAVE PASSED THE

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--ISOAMYL ACETATE FIT TEST. A SECONDARY OBJECTIVE WAS TO DETERMINE WHETHER WORKPLACE PROTECTION FACTORS CAN BE QUANTITATIVELY PREDICTED BY QUANTITATIVE FIT FACTORS.

(SLIDE 29) KEY ELEMENTS FOR WORKPLACE PROTECTION FACTOR STUDIES, WHICH WERE INTERGRATED INTO OUR STUDY, ARE:

- RECORDING AGE, RACE, SEX AND FACIAL SIZE DATA FOR FUTURE REFERENCE AND
- TRAINING AND FIT TESTING TO ENSURE AN ADEQUATELY FITTING RESPIRATOR AND GOOD KNOWLEDGE OF PROPER RESPIRATOR USE.

FOR TRAINING AND FIT TESTING WE USED THE NATIONAL PAINT AND COATINGS ASSOCIATIONS "A GUIDE TO RESPIRATOR FIT TESTING" WHICH WAS DEVELOPED FROM OUR ISOAMYL ACETATE FIT TEST DESCRIBED PREVIOUSLY.

OTHER KEY ELEMENTS WERE:

- CLOSE OBSERVATION AND NOTES ON ANY ACTIONS WHICH MIGHT EFFECT RESPIRATOR FIT AND
- FILED TECHNIQUES TO AVOID SAMPLE CONTAMINATION.

I WILL PRESENT DATA ON ACTUAL TESTING IN AN AREA WHERE RESPIRATOR PROTECTION AGAINST A LEAD CONTAINING DUST WAS REQUIRED. ELEVEN MALES PARTICIPATED IN THIS STUDY USING A SURVIVAIR® 2000 RESPIRATOR EQUIPPED WITH HIGH EFFICIENCY PARTICULATE FILTERS. THIS IS NOT AN ENDORSEMENT FOR SURVIVAIR® BUT REPRESENTS TEST INFORMATION. IT SHOULD BE NOTED THAT THE USE OF ORGANIC VAPOR CARTRIDGES IN THE ISOAMYL ACETATE TEST AND HIGH EFFICIENCY PARTICULATE FILTERS IN THE WORKPLACE DO NOT BIAS THE STUDY SINCE THE SAME FACEPIECE IS USED.

OUR SAMPLES WERE TAKEN AT 2 LITERS PER MINUTE ONTO 0.8 UM POLYCARBONATE FILTERS MOUNTED IN 25 MM CASSETTES. AN ULTRASENSITIVE ANALYTICAL METHOD WAS USED TO ANALYZE THE SAMPLES, PROTON INDUCED X-RAY EMISSION ANALYSIS. THE METHOD'S LIMIT OF RELIABLE DETECTION WAS 2 NG OF LEAD/SAMPLE. (SLIDE 30) PRECISION WAS VERY GOOD, WITH A 3% COEFFICIENT OF VARIATION AT 70 NG/M^3 WHICH WAS

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VERY GOOD, WITH A 3% COEFFICIENT OF VARIATION AT 70 NG/M^3 WHICH WAS THE GEOMETRIC MEAN LEAD CONCENTRATION INSIDE OF THE RESPIRATORS , AND A 2% COEFFICIENT OF VARIATION AT 225,000 NG/M^3 WHICH WAS THE GEOMETRIC MEAN LEAD CONCENTRATION OUTSIDE OF THE RESPIRATORS.

(SLIDE 31) THE WORKPLACE PROTECTION FACTOR WAS CALCULATED AS THE RATIO OF THE CORRECTED MASS OF LEAD ON THE OUTSIDE FILTER DIVIDED BY THE AIR SAMPLE VOLUME, AND THE CORRECTED MASS OF LEAD ON INSIDE FILTER DIVIDED BY THE INSIDE AIR SAMPLE VOLUME.

(SLIDE 32) FOR 37 WORKPLACE PROTECTION FACTORS, WE FOUND A GEOMETRIC MEAN OF 3,400, A GEOMETRIC STANDARD DEVIATION OF 3.8 AND A RANGE OF 94 TO GREATER THAN 27,000. (SLIDE 33) SHOWS THE PROBABILITY DISTRIBUTION PLOT OF THE DATA.

(SLIDE 34) FOR 42 WORKPLACE PROTECTION FACTORS, WHICH INCLUDES 5 FOR WHICH THE FACEPIECE WAS DISTRIBUTED TO TALK, WE FOUND A GEOMETRIC MEAN OF 2,400 A GEOMETRIC STANDARD DEVISION OF 5.1 AND A RANGE OF 40 TO GREATER THAN 27,000. (SLIDE 35) SHOWS THE PROBABILITY DISTRIBUTION PLOT OF THE DATA.

WE FOUND THE DISTRIBUTION OF WORKPLACE PROTECTION FACTORS TO BE APPROXIMATELY LOG-NORMAL. (SLIDE 36) THE BEST ESTIMATE OF THE FIFTH PERCENTILE WAS 390 FOR THE 37 WORKPLACE PROTECTION FACTORS AND 160 WHEN INCLUDING THE DISTURBED FACEPIECE DATA. THESE PARAMETERS REPRESENT THE PROTECTION FACTORS THAT 95% OF THE TEST SUBJECTS ARE EXPECTED TO ATTAIN OR EXCEED.

(SLIDE 37) TO ESTIMATE THE PROGRAM PROTECTION FACTORS TAHT RESPIRATOR WEARERS AT THIS SITE ATTAINED OVER THE PREVIOUS YEAR, WE DID A STATISTICAL ANALYSIS OF BLOOD LEAD AND AIR LEAD VALUES FOR SEVEN DISCRETE JOB CLASSIFICATIONS AND A CONTROL GROUP WHO DID NOT WEAR RESPIRATORS. (SLIDE 38) WE FOUND THAT, BASED ON ONE WAY ANALYSIS OF VARIANCE, THAT THE BLOOD LEAD VALUES FOR JOB ASSIGNMENTS A THROUGH F, FOR WHICH RESPIRATORS WERE WORN, DID NOT DIFFER

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FROM THE CONTROL GROUPS. THEREFORE, THE PROGRAM PROTECTION FACTORS CAN BE ESTIMATED AS THE RATIO OF THE AIRBORNE EXPOSURES OF JOB ASSIGNMENT F AND THE CONTROL GROUP (SLIDE 39) THAT IS 236 UG/M^3 ÷ 6.6 UG/M^3 OR 36.

(SLIDE 40) ANOTHER PART OF THE STUDY WAS TO DETERMINE WHETHER A QUANTITATIVE RELATIONSHIP EXISTS BETWEEN THE WORKPLACE PROTECTION FACTOR AND THE QUANTITATIVE FIT FACTOR. PAIRED T TESTS ON WORKPLACE PROTECTION FACTORS AND QUANTITATIVE FIT FACTORS FOUND SHOWED THEM TO BE SIGNIFICANTLY DIFFERENT. REGRESSION ANALYSIS OF WORKPLACE PROTECTION FACTORS AND QUANTITATIVE FIT TESTS DONE AT THE BEGINNING OF THE STUDY AND QUANTITATIVE FIT TESTS DONE IMMEDIATELY BEFORE AND AFTER WORKPLACE PROTECTION FACTORS SHOWED NO SIGNIFICANT CORRELATION EXISTS AT A 5% PROBABILITY LEVEL.

THE CONCLUSIONS OF THIS STUDY (SLIDE 41) WERE:

1. WORKPLACE PROTECTION FACTORS EXCEEDED 10 AND WILL LIKELY EXCEED 100 FOR PERSONS WHO WERE FITTED WITH A RESPIRATOR USING THE ISOAMYL ACETATE PROCEDURE,
2. PROGRAM PROTECTION FACTORS ALSO EXCEEDED 10,
3. THE WORKPLACE PROTECTION FACTOR DISTRIBUTIONS WERE FOUND TO BE APPROXIMATELY LOG NORMAL, AND
4. QUANTITATIVE FIT FACTORS DO NOT QUANTITATIVELY PREDICT WORKPLACE PROTECTION FACTORS.

THANK YOU FOR THIS OPPORTUNITY TO PRESENT THESE STUDIES ON QUANTITATIVE FIT TESTING OF RESPIRATORS. AGAIN I WISH TO MENTION THOSE ACTUALLY CONDUCTING THE STUDIES--S. DIXON, T. NELSON, AND O. SKRETVEDT AND MANY OTHERS. I WILL BE GLAD TO TRY TO ANSWER ANY QUESTIONS IN THE REMAINING TIME.

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cc: RESPIRATORY PROTECTION FILE
DR. J.K. MOON #18
5-4-83

TO: R.L. McCLURE #42
I.M. SINGER #16
K.C. WEIS #20

FROM: L.T. FREELAND

OPTIONAL RESPIRATORY PROTECTION EQUIPMENT USE WITH NUISANCE DUSTS/PARTICULATES ONLY

This memo will serve to record the discussion of the above during the past two weeks. Engg. Division personnel have requested the use of respiratory protection on an employee optional basis. It was agreed that the Sabroviden® half-facepiece mask with cartridges for dusts, fumes and mists would be appropriate. Cartridges would be dated as to expiration if used for short tasks after one week use. If used for a short task (cutting the installation & other easily identified tasks) cartridges would be discarded after each use. This use will not be confused with use of respiratory equipment for toxic dusts only nuisance dusts.

Training would be conducted and recorded by the Safety Division. The isoamyl acetate test should be satisfactory for this respiratory protection equipment use (Mr. Bell protocol attached KCW). Monitoring for particulates/dusts would not be

conducted because the qualitative fit test is more than adequate.

Engg. Division will issue an EDS to cover the use of the equipment. Safety Plan will be modified to reflect the use of the equipment and test protocol.

No other half facepiece or protective equipment will be permitted in lieu of the Survivair Opti-Fit. Stores has a supply of the cartridges and should be advised if the minimum is adequate to satisfy this new application.

Please send me a copy of the EDS for review. I would estimate it will take 3-4 months to fully implement the program. If any employee is unable to use this type of respiratory equipment and has been medically cleared because of medical review an additional review may allow the use of this equipment (contact Dr. Moon).

If you have any additional questions let's discuss it at your convenience.

BEAUMONT

PETROCHEMICALS DEPARTMENT

RESPIRATOR PROGRAM

BEAUMONT INTERMEDIATES OPERATIONS
BEAUMONT WORKS

cc: L. A. Putzier - #1

February 22, 1978

TO: R. L. McCLURE - #42
D. E. SPEIER - #20
G. M. RICHARDSON - #80

FROM: R. H. HAAR - #1

BEAUMONT PD RESPIRATOR PROGRAM

Attached for your information is a copy of the PD Respirator Program. This documentation includes the general requirements for all types of respirators and the specifics concerning the ACRN air-line respirator.

RHH/me
Attachment

DUP 0501973

DU 001636

Copy no. 5

BEAUMONT PD

RESPIRATOR PROGRAM

Program Description

The Beaumont Works, Petrochemicals Department (PD), Respirator Program has been developed to:

(1) Protect employees from airborne contaminants through the use of respirators where engineering controls are not feasible or during non-routine activities or under emergency conditions.

(2) Comply with the Federal regulations pertaining to respirators, Title 29 CFR 1910.134 and ANSI Z88.2-1969.

Beaumont Works site respirator procedures are listed in Sections G-5 and G-7 of Safety How and in the Beaumont Works Respiratory Protection Program.

This document describes the essential elements of the Beaumont PD Respirator Program which includes program administration and surveillance, respirator selection, use, training, fit testing, inspection, cleaning and maintenance, and storage; medical surveillance and specific Standard Operating Procedures for each type of respirator used.

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RESPIRATOR PROGRAM

Program Administration

The PD Environmental Control Coordinator has departmental responsibility for the Respirator Program. The Safety Supervisor is responsible for all site respirator programs. The Safety Division is responsible for providing "approved" breathing air, centralized cleaning and maintenance facilities, and permanent fit testing facilities.

Surveillance of Work Area

Surveillance of work area is primarily a line responsibility as are other safety tasks. There shall be a continuing surveillance of the work area which will include personnel monitoring and area measurements to determine the exposure level and also an annual audit of the entire Respirator Program.

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RESPIRATOR PROGRAM

Selection of Respirators

An evaluation of the area work requirements and working conditions shall be made initially and on an ongoing basis by area supervision. The evaluation must consider the following factors:

- Nature of the hazard.
  (chemical and physical properties, toxicity and concentration of hazardous material)
- Extent or severity of the hazard.
- Type of hazard.
  (gaseous vapor or particulate or combination of both)
- Concentration of hazardous material in air.
- Length of time protection is required.
- Use required in oxygen deficient atmosphere.
- Use required in atmosphere immediately dangerous to life and health (IDLH).
- Work time.
  (Length of time worker would be required to wear respirator protection)
- Worker activity.
- Vision and communications.
- Temperature.
  (extremes in temperature may cause undue stress or facepiece fogging)
- Eye Protection.
- Physical features and capability of the wearer.
- Operating characteristics and limitations of available respirators.
- Interference with other protective equipment, i.e. hard hat, goggles, etc.

Respirators approved by the Bureau of Mines and/or National Institute of Occupational Safety and Health per Title 30 CFR Part 11 shall be used if available. Selection will be made among the "approved" respirators by Technical and Operations personnel with consent from other affected site groups and the Safety Division.

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RESPIRATOR PROGRAM

Use of Respirators

Respirators shall be used whenever the permissible exposure limit (PEL) of a hazardous compound is exceeded or whenever Supervision determines it to be necessary.

Use of respiratory protection is normally considered a "temporary" measure until engineering changes or work practices can be instituted to reduce the airborne concentration of a hazardous material to less than the PEL.

Respiratory protection can be classified as a "permanent" measure for non-routine jobs and under emegency conditions for jobs where exposure control solely by engineering changes and work practices is not feasible.

Individual respirators will be assigned as required. The date of issuance is recorded on Form G-7-A. Spare respirators will be available for those who have occasional use for them.

Individuals must be properly trained in the use, care and maintenance of respirators.

The facepiece fit shall be checked by the wearer each time he wears the respirator. The manufacturer's facepiece fitting instructions for a "field fit test" should be used.

Each area shall provide written procedures covering the safe use of respirators in normal operations and in emergency situations.

Respirators shall be inspected before and after each use. (See Inspection Procedure, page 7).

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RESPIRATOR PROGRAM

Respirator Training

Respirator training shall include the following:

- Instructions in the nature of the hazard being protected against; whether chronic or acute, or both; irritant, toxic or carcinogen; etc.
- Permissible exposure limits (PEL).
- Discussion of programs completed, in progress, and/or planned to reduce exposure levels.
- Discussion of why this is the proper type of respirator for the particular purpose.
- Discussion of respirator parts and its capabilities and limitations.
- Instructions and training on use of respirator, including use under emergency situations.
- Discussion of various other aspects of respirator program:
  - inspection
  - cleaning and maintenance
  - storage
  - fit test
- Fit test procedure will include opportunity for wearer to handle respirator, wear it in normal air and wear it in a test atmosphere.

Respirator training sessions will be presented initially and reviewed annually. Training records are kept on form G-7-A. Respirator training programs recorded on video tape to date are:

- ACRN Respirator Program (Air-line Respirator) 11/77

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RESPIRATOR PROGRAM

Fit Test

A test of the face-to-facepiece seal is required for all respirators to insure they provide adequate protection. Technical personnel are responsible for installing and equipping "temporary" fit testing facilities (complete 11/77) and "permanent" facilities. Qualified Operations and Technical personnel will fit test their respective individuals. Record of fit testing is kept on form G-7-A.

Qualitative and/or Quantitative fit testing will be performed as necessary. Qualitative testing involves the wearer detecting leakage via his senses - by using a chemical smoke spray (cough) or iso-amyl acetate (sweet smell). Written Standard Operating Procedures for both of these fit tests are attached.

Quantitative fit testing involves measuring the atmosphere within the wearer's mask and comparing it to the known test atmosphere. Such facilities are being installed by the site in their respirator room.

Conditions which are known to prevent a good face seal are excess facial hair, i.e. beard, moustache and/or sideburns, temple pieces of eyeglasses and the absence of one or both dentures.

Per DuPont Safety Engineering Standard S2H and the Beaumont Works Respiratory Protection Program, "persons required to wear the respirators for protection against other than nuisance atmospheric contamination must be clean shaven in the area of the respirator unless a positive pressure respirator is used." The new ACRN air-line respirators are an example of a positive pressure respirator.

Special glasses, ones without temple pieces, will be supplied to those wearers of full facepiece respirators that require prescription eyeglasses.

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RESPIRATOR PROGRAM

Respirator Inspection

All respirators shall be inspected before and after each use. The routine inspection shall include the various part of the respirator (as noted in the Inspection SOP's) with special attention to the exhalation and inhalation valves and the condition of the facepiece sealing surface. If any defects are found, the respirator should be returned to the site respirator room for repairs and a replacement respirator will be issued.

Respirators not routinely used but kept for emergency use shall be inspected before and after each use and at least monthly to assure that they are in satisfactory working condition.

Self contained breathing apparatuses shall be inspected monthly, including a check of the regulator and warning devices.

A thorough inspection of all respirators will be made each time the respirator is disassembled for cleaning and maintenance.

A record shall be maintained for inspections of emergency use respirators.

Frequent random inspections shall be made by qualified persons to assure that respirators are properly selected, used, cleaned and maintained.

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RESPIRATOR PROGRAM

Cleaning and Maintenance

Respirators may be cleaned as often as needed with the spray disinfectant found at Stores.

Personnel assigned individual respirators should turn them in for a thorough cleaning and maintenance after one week's use. A more definite schedule will be established for each type of respirator depending on its actual use.

Spare respirators must be turned in for cleaning and maintenance after each individual's use.

The site is providing centralized facilities where the respirators will be disassembled, inspected and repaired if necessary, cleaned, disinfected and reassembled.

Recommended cleaning procedure is listed in ANSI Standard Z88.2-1969.

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RESPIRATOR PROGRAM

Respirator Storage

Respirators should be stored in a plastic bag and at a location where they are protected from dust, sunlight, extremes in temperature, excessive moisture or damaging chemicals.

Respirators should be stored so that the facepiece and exhalation valve will rest in a normal position. The object here is not to deform the respirator or impair its function by careless storage.

Respirators should not be stored in contaminated areas during break periods.

Storage areas will be provided for storage of personal respirators.

Storage of spare respirators must also comply with the requirements as listed above.

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BEAUMONT PD

RESPIRATOR PROGRAM

Medical Surveillance

Medical approval will be requested for each individual and each respirator type which must be used.

The plant physician shall determine what health and physical conditions are pertinent.

The respirator user's medical status shall be reviewed annually in conjunction with the routine physical.

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APPENDIX A

STANDARD OPERATING PROCEDURES

AIR-LINE RESPIRATOR

2/17/78

DOCUMENTATION OF SELECTION
ACRN AREA
AIR-LINE RESPIRATOR

The positive pressure-demand, air-line respirator, Scott #801548, has been selected for employee protection from hazardous concentrations of acrylonitrile (ACRN) in the atmosphere.

The factors are listed in the "Selection of Respirators" section of this document were considered during the selection of this respirator. The positive pressure-demand, air-line respirator was considered to be the optimum choice.

These air-line respirators provide adequate protection in ACRN atmospheres up to 2,000 times the PEL. With the SKA PAK, the air-line respirators are permitted in atmospheres up to 10,000 times the PEL. The air-line respirators are not to be used for emergency re-entry into a known hazardous atmosphere such as for fire fighting. A self-contained breathing apparatus (Scott Air Pak) must be used for emergency re-entry.

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BEAUMONT PD
ACRN AREA
AIR-LINE RESPIRATOR ROUTINE INSPECTION

The positive pressure-demand, air-line respirator is being used for protection against hazardous concentrations of ACRN in the atmospheres. The following is a list of the parts of the respirator to be inspected and what to look for:

- facepiece
  - condition of sealing surface
- plastic lens
  - scratched, loose
- five adjustable headbands
  - any missing
  - pliable, any sign of deterioration
  - defective clips
- regulator (base of mask)
  - screwed on finger tight
  - can only be operated in pressure-demand mode
- exhalation valve (base of mask)
  - tight connection
  - maintains slight positive pressure in mask
- inhalation valve (above regulator)
  - distributes air on lens to reduce fogging
- glass clips
  - attach if needed
- hoses
  - 6" red "tee" section (SKA PAK)
  - 6' red "lead" hose
  - proper connections
  - deterioration of rubber

If any defects are found, turn in the respirator at the designated location and you will receive a replacement.

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BEAUMONT PD
ACRN AREA
USE OF AIR-LINE RESPIRATOR

Normal Operations

1. Instructions in the use of respirators in general are discussed in the Beaumont PD Respirator Program. Other essential elements of a compliance program are also listed in this reference.

2. Air-line respirators are to be used:

   a) Whenever the permissible exposure limit (PEL) of ACRN and/or other hazardous compound is exceeded or

   b) whenever Supervision determines it to be necessary.

3. Air-line respirators are to be used with the 3 minute SKA PAK.

   a) Whenever there is a possibility that the atmosphere might be immediately dangerous to life and health (IDLH) and there consequently would be a need for an emergency exit from the area or

   b) whenever Supervision determines it to be necessary.

4. Only approved and tested breathing air cylinders are to be used. Do not use instrument air or oxygen.

5. Respirator parts are to be inspected before and after each use. See SOP I/AL for list of parts to inspect.

6. Air-line respirators being used are positive pressure-demand type. A slight positive pressure inside the mask is maintained at all times. Air is supplied to the wearer according to his breathing rate since it is a demand respirator.

7. The following steps are to be taken when using an air-line respirator:

   a) Inspect respirator parts per SOP I/AL.

   b) Connect hose to breathing air supply (always keep 6" "tee" section in line in case SKA PAK is required).

   c) Put on respirator and tighten head straps (should be tight but not uncomfortable).

   d) Check fit by temporarily cutting off air supply (by bending hose).

   e) Connect SKA PAK as required.

Emergency Situations

1. Air-line respirators are not to be used for emergency re-entry into a hazardous area. Only self-contained breathing apparatus (Scott Air Pak) is to be used for this purpose.

2. As noted above, SKA PAK is to be worn with air-line respirator whenever there might be a need for an emergency exit from an area.

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BEAUMONT WORKS - ACRN
AIR-LINE RESPIRATOR FIT TEST PROCEDURE
IRRITANT SMOKE AROUND SEAL

General Note: The smoke used in this method of determining respirator leakage is a minor irritant to the eyes so precautions should be taken during the test procedure to minimize eye contact with the smoke.

1. The test should be performed in an area where there is a means of removing the smoke, i.e., a chemical fume hood or exhaust fan.

2. Eye glasses are not to be worn during the test.

3. The respirator will be tested in positive pressure-demand mode.

4. The test subject will don the full facepiece respirator in a normal fashion, taking care not to tighten the head straps uncomfortably tight.

5. A visual inspection of the facepiece-to-face seal will be made by the tester.

6. An obvious leak in the facepiece-to-face seal shall be reaon to abandon the test and record that mask as unsatisfactory.

7. The test subject should wear the respirator for a minute or two and perform normal head movements before proceeding. Further adjustments to the head bands should be made at this time if needed.

8. The tester will instruct the test subject to close his eyes until he is told to open them. The test subject should also breathe shallowly during the initial test.

9. The tester will lightly spray the smoke from a smoke tube over the respirator from a distance of about 2 feet.

10. If the test subject detects no leakage then the tester will increase the smoke density and move the smoke tube closer to the sealing surfaces of the respirator. If no leakage is detected then the subject may open his eyes and resume normal breathing.

11. The test subject will finally be tested while performing normal head and face movements (i.e., talking, moving head side to side and up and down).

12. If leakage is detected by the test subject at any time during the test, the respirator should be readjusted and the test resumed. If readjustment of the respirator does not prevent leakage then the test must be abandoned.

13. If there is any doubt about the condition of the respirator, then another like respirator shall be tested to assure the leakage was due to a poor facepiece-to-face seal.

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