

1 OCTOBER 1999

Certified Current 3 June 2010

Civil Engineering



**NUCLEAR, BIOLOGICAL, AND CHEMICAL
(NBC) MASK FIT AND LIQUID HAZARD
SIMULANT TRAINING**

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RELEASABILITY: There are no releasability restrictions on this publication.

OPR: HQ AFCESA/CEXR

Certified by: HQ AFCESA/CEX
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Supersedes AFMAN 32-4006, 14 October 1994

Pages: 30

This manual implements AFPD 32-40, *Disaster Preparedness* and AFI 32-4001, *Disaster Preparedness Planning and Operations*. It provides protocol and gives procedural guidance on NBC mask quantitative fit, mask confidence, and liquid hazard simulant training. **Records Disposition.** Ensure that all records created by this manual are maintained and disposed of in accordance with AFMAN 37-139, *Records Disposition Schedule*.

SUMMARY OF CHANGES

This publication has been completely revised to include procedural guidance for administering quantitative fit training (QNFT) using the M41 Protection Assessment Test System (PATS). Qualitative fit training protocols have also been revised, including authorizing use of stannic chloride as a challenge agent. The reporting requirement in this manual is exempt from licensing in accordance with paragraph 2.11.4 or 2.11.10 of AFI 37-124, *The Information Collections and Reports Management Program: Controlling Internal, Public, and Interagency Air Force Information Collections*.

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Chapter 1

INTRODUCTION

1.1. Purpose. This manual contains procedural guidance for the Air Force NBC mask quantitative fit training (QNFT) program, mask confidence training (MCT), and liquid hazard simulant (LHS) training.

1.1.1. Air Force NBC Mask QNFT Program. The purpose of the Air Force NBC mask QNFT program is to enhance NBC defense survivability by helping personnel maximize their NBC mask protection and instill mask confidence.

1.1.2. Mask Confidence Training. The purpose of MCT is to check the fit and operation of the mask and instill mask confidence.

1.1.2.1. MCT is a pass/fail test that relies on the ability of the wearer to sense a test agent.

1.1.2.2. The Air Force Surgeon General's Office approved the use of o-chlorobenzylidene malononitrile (CS) and chloroacetophenone (CN), isoamyl acetate (banana oil), stannic chloride, or camphor crystals for MCT. CS is the preferred agent; use CN when CS is not available. **Note:** The Office of the Surgeon General strongly rejects any MCT procedures involving the use of CS or CN "which require personnel to enter a tear agent training facility unprotected, remain so until instructed to mask, and then stay in place until the student clears the mask of agent."

1.1.2.3. Conduct MCT using CS or CN for initial NBC defense training. If using CS or CN is not feasible, use the other agents listed in paragraph 1.1.2.2. for initial training. Stannic chloride, isoamyl acetate, or camphor are the preferred protocols for refresher training.

1.1.3. Liquid Hazard Simulant (LHS) Training. The purpose of LHS training is to check the student's ability to process through a contamination control area (CCA) without transferring contamination to the skin.

1.2. Responsibilities. Organizations that conduct QNFT, MCT, and LHS training will develop training procedures which comply with this manual. Specific responsibilities are included in following chapters.

1.3. Equipment Listing. Attachment 2 contains nomenclature, national stock number, and unit of issue for equipment items.

1.4. Reaction to Agents. Direct anyone suffering adverse reactions, other than temporary coughing or minor burning or tearing of the eyes, to the installation medical treatment facility for evaluation and treatment. If immediate action is needed, the instructor or assistant must notify medical personnel. The installation Aerospace Medicine Squadron (AMDS) (or equivalent) will evaluate these adverse reactions as occupational illnesses and identify each incident to their major command (MAJCOM) SGP/CEX. MAJCOMs will identify adverse trends to AFMOA/SGO and HQ AFCEA/CEX.

Chapter 2

AIR FORCE QUANTITATIVE MASK FIT PROGRAM

2.1. Introduction. The NBC mask QNFT program applies to negative pressure masks designed specifically for use in an NBC environment. QNFT uses the M41 PATS and the commercial variant (Porta-Count,) to measure face seal leakage of a test aerosol and, therefore, does not rely on a wearer's sensitivity to a test agent. This program includes the groundcrew and firefighter NBC masks. It does not include the aircrew mask.

2.1.1. QNFT will:

2.1.1.1. Increase protection by training personnel to properly don masks to attain adequate protection, while ensuring the mask can be worn comfortably for extended periods.

2.1.1.2. Ensure personnel know how the mask feels when an adequate fit is attained (for example, head harness tension).

2.1.1.3. Instill mask confidence in NBC environments.

2.1.2. The Air Force target Fit Factor (FF) is 2000. Air Force personnel require training to know how to don, fit, and adjust their NBC masks to meet or exceed the target FF. This FF was derived by increasing the threat-based FF of 1667 to 2000 to account for error associated with the fit test method.

2.1.3. QNFT will be accomplished in accordance with T.O. 14P4-15-11, *Operator and Unit Maintenance Manual for Protective Assessment Test System, M41*. Where guidance within other publications or training videos conflicts, follow the T.O.

2.1.4. Careful performance of Preventive Maintenance checks and Services (PMCS) eliminates most problems, which may compromise NBC mask protection. PMCS must be stressed to QNFT subjects.

2.1.5. QNFT is a training aid, not a certification tool.

2.2. HQ USAF Responsibilities:

2.2.1. Air Force Medical Operations Agency (AFMOA/SGOE):

2.2.1.1. Serves as the Air Force QNFT Program Office of Primary Responsibility (OPR).

2.2.1.2. In coordination with The Civil Engineer (AF/ILE), provides policy and guidance to ensure effective QNFT implementation.

2.2.1.3. Reviews program data for trends and indicators of potential health impact.

2.2.2. AF/ILEXR:

2.2.2.1. Serves as the QNFT Program Office of Collateral Responsibility (OCR).

2.2.2.2. Maintains primary responsibility for Air Force NBC mask programs.

2.2.2.3. In coordination with AFMOA/SGOE, provides policy and guidance to ensure effective QNFT implementation.

2.2.2.4. Reviews QNFT program data for trends and indicators for new or revised NBC mask program needs.

2.3. MAJCOM Responsibilities:

2.3.1. MAJCOM Bioenvironmental Engineering (BEE):

- 2.3.1.1. Serves as the QNFT Program OPR.
- 2.3.1.2. Advocates for BE-related funding of the QNFT program through the MAJCOM CEX.
- 2.3.1.3. Resolves or elevates problems identified in the QNFT process or procedures.
- 2.3.1.4. Provides a consolidated MAJCOM QNFT report to AFMOA/SGOE and HQ USAF/ILEX, according to paragraph [2.7.2.2](#).
- 2.3.1.5. Ensures that all performance work statements, statements of work and statement of objectives clearly include the specific requirements when contracted services are utilized.

2.3.2. MAJCOM CEX:

- 2.3.2.1. Advocates for CE Readiness Flight-related funding of the QNFT Program using the appropriate program element (PE), in accordance with AFI 32-4001.
- 2.3.2.2. Resolves or elevates problems identified in the QNFT process or procedures.

2.3.3. MAJCOM LGC: Ensures contracting officers are involved early in the acquisition process to support and assist the customer in ensuring all contract performance work statements comply with the requirements of this manual.

2.4. Installation Responsibilities:

2.4.1. The BE and CE Readiness flights will administer the QNFT program jointly. The BE Flight has experience selecting and quantitatively fitting industrial respirators; the CE Readiness Flight has expertise and overall responsibility for NBC mask programs.

- 2.4.1.1. Work share will be locally determined, based upon flight manpower and total base requirements.
- 2.4.1.2. BE and CE Readiness Flights will establish a schedule for QNFT.
- 2.4.1.3. CE Readiness Flight will provide testing equipment, which may be augmented by BE Flight equipment to meet the local fit testing workload.
- 2.4.1.4. Wings will develop procedures to ensure personnel will deploy carrying the same mask worn for their QNFT.

2.4.2. The BE Flight:

- 2.4.2.1. Serves as the installation QNFT Program OPR.
- 2.4.2.2. Develops an installation QNFT implementation plan with assistance from the CE Readiness Flight.
- 2.4.2.3. Fit tests personnel on a workshare basis with the CE Readiness Flight and contracted sources, if necessary. Ensures personnel are trained to operate both the M41 PATS and the PortaCount, (if/as necessary), and troubleshoot NBC mask problems.
- 2.4.2.4. Plans, programs, and budgets for PortaCount, consumables, calibration, and maintenance.

2.4.2.5. Prepares and provides to MAJCOM/SGPB/CEX a consolidated QNFT report, in accordance with paragraph 2.7.2.1.

2.4.2.6. Ensures that all performance work statements, statements of work and statement of objectives clearly include specific QNFT requirements when contracted services are used.

2.4.3. The CE Readiness Flight:

2.4.3.1. Serves as the installation QNFT Program OCR.

2.4.3.2. Fit tests personnel on a workshare basis with the BE Flight and contracted sources, if necessary. Ensures test administrators are trained to operate both M41 PATS and the PortaCount,, and troubleshoot NBC mask problems.

2.4.3.3. **Plans, programs, and budgets for M41 consumables, calibration, and maintenance. See the M41 T.O. for parts listings.**

2.4.4. The LGS/CC:

2.4.4.1. Issues serviceable NBC masks based on caliper measurement according to Technical Order (TO) 14P4-15-1, *MCU-2A/P*. Caliper measurement will be completed before issuing the mask.

2.4.4.2. Establishes procedures to ensure each individual deploying to NBC high- and medium-threat areas has the same mask used during QNFT. This may be accomplished by issuing a mask to an individual for the duration of the home station assignment.

2.4.4.3. Establishes a bench stock of spare parts in the CE Readiness Flight to support the QNFT program. Programming, budgeting, and reimbursement procedures will be determined locally. See [Table A2.2.](#) and A2.3 for a listing of consumables and mask replacement items.

2.4.5. The AMDS (or equivalent) commander:

2.4.5.1. Establishes procedures to conduct medical evaluations. (See paragraph 2.8.2.)

2.4.5.2. Makes medical recommendations to unit commanders as necessary in support of the QNFT program.

2.4.5.3. Employs pre-deployment medical screening mechanisms to ensure personnel receive QNFT according to requirements.

2.4.6. The CONS/CC: Ensures contracting officers are involved early in the acquisition process to support and assist the customer in ensuring all contract performance work statements comply with the requirements of this manual.

2.4.7. Unit commanders will ensure personnel obtain QNFT according to frequencies identified in paragraph 2.6.

2.4.8. Personnel issued NBC masks:

2.4.8.1. Deploy to NBC medium- and high-threat areas with the same mask used for QNFT.

2.4.8.2. Ensure masks are adequately stored and maintained according to T.O. 14P4-9-31, *Mask Protective Field M17A2 and Accessories*, and T.O. 14P4-15-1. AFH 32-4014V4, *USAF Ability to Survive and Operate Procedures in a Nuclear, Biological, and Chemical (NBC) Environment*, may be used in addition to the technical orders as a quick reference source when inspecting.

2.5. Training Facilities. Location of QNFT will be determined locally by the BE and CE Readiness Flights.

2.5.1. QNFT facilities must provide a fairly uniform concentration of airborne particles for an accurate mask fit assessment. Combustion engines and highly variable particle generators create atmospheres unsuitable for QNFT.

2.5.2. Candles or particle generators (available from the M41/PortaCount[™] manufacturer) may be used to generate and achieve a fairly uniform particle concentration. Contact the installation fire prevention program manager to ensure safety procedures are established for using candles.

2.6. Timetable. **Table 2.1.** lists the NBC threat area requirements. QNFT will be accomplished when:

2.6.1. A new mask is issued.

2.6.2. The wearer gains/loses 10% or more pounds of body weight based upon their weight at QNFT.

2.6.3. The wearer experiences extensive dental work, facial surgery, scarring, or disfigurement.

Table 2.1. QNFT Timetable.

NBC Low Threat Area (LTA)	Within 90 days of assignment to a mobility position, or prior to deploying to a medium threat area (MTA) or high threat area (HTA), whichever comes first.
NBC MTA	Within 60 days of permanent change of station (PCS) arrival in MTA, or prior to deploying to MTA or HTA, whichever comes first.
NBC HTA	Within 30 days of PCS arrival in HTA, or prior to deploying to MTA or HTA, whichever comes first.

2.7. Documentation. The BE Flight will maintain the database of all NBC mask QNFT. This includes two sets of data: (1) individual QNFT results, and (2) program overview tracking.

2.7.1. Individual QNFT Results:

2.7.1.1. As a minimum, the information listed below will be maintained in the BE Flight. The CE Readiness Flight (and contractors, if applicable) conducting fit testing will submit the information to the BE Flight in a format and at a frequency determined locally. The information is sensitive in nature and must include the Privacy Act Statement according to AFI 37-132, *Air Force Privacy Act Program*.

Personal Data

Name:

Rank:

SSN:

Gender:

Unit:

AFSC:

Weight:

Mask Data

Mask size:

Mask type:

Mask lot number:

Spectacle inserts: Yes/No

Testing Information

Test date:

Test reason (routine, after medical evaluation):

Test instrument type and serial number:

Instrument calibration date:

Test Results

How many tests were required to pass:

Mask problems:

Test time (in minutes):

Normal breathing FF:

Deep breathing FF:

Side-to-side FF:

Up-down FF:

Rotate chin FF:

Final FF

Include special mask donning procedures needed to attain the target FF (for example, sequence of head harness tightening). Also include the mask fit certifier's full name, grade, and signature.

2.7.1.2. Document QNFT (to include, at a minimum, name, SSN, mask size and type, overall FF and specific instructions), providing two copies — one for the individual's personal use and one for their mobility folder.

2.7.1.3. It is suggested that the individual's personal copy be placed in the mask carrier. It is the responsibility of the individual to place the second copy in his/her mobility folder.

2.7.2. Program Overview Tracking. The BE Flight will prepare a consolidated report, to include the information listed below. The report will also include lessons learned, likely causes for low FFs, mask and test equipment problems, scheduling problems, and other issues identified locally.

Test period:

Installation:

How many people were tested:

How many people passed:

How many people required multiple attempts to attain minimum target FF:

Note: This includes individuals who fail to obtain a count below 3.0 particles per cubic centimeter at the beginning of testing protocol.

How many people achieved an FF of (annotate # of individuals tested with spectacle inserts)

0-999:

1000-1999:

2000-4999:

5000-19,999:

20,000 or higher:

Remarks (include observations on corrective actions taken, problems with failures, and status of equipment):

2.7.2.1. BE Flights will submit consolidated reports to MAJCOM/SGPB/CEX quarterly: 15 January (report as of 30 December), 15 April (report as of 30 March), 15 July (report as of 30 June), and 15 October (report as of 30 September). Provide the CE Readiness Flight with an informational copy.

2.7.2.2. MAJCOMs will submit a consolidated report to AFMOA/SGOE and AF/ILEX, summarizing all base reports, and arriving no later than 15 November of each year.

2.8. Testing Protocol. Use the following protocol to test each subject (refer to the flowchart in [Attachment 3](#)).

2.8.1. Test Subjects:

2.8.1.1. Will use the NBC protective mask issued. To avoid an inaccurate reading, test subjects must not smoke, wear lotions, perfumes, or colognes; use mouthwash, eat or drink anything for at least 30 minutes before the test. Test subjects will not chew gum during the test. The mask must be clean prior to QNFT. Recommend that QNFT schedulers inform test subjects of these requirements prior to attending QNFT.

2.8.1.2. (Women) will remove hair fasteners (hair clips, pins) and let hair hang freely before donning the mask.

2.8.1.3. Who wear corrective lenses required for their occupation will don spectacle inserts before donning the mask.

2.8.2. Referrals for Medical Evaluation:

2.8.2.1. If a test subject reporting for QNFT has an obvious medical condition that might interfere with a valid evaluation (for example: swelling due to dental surgery; a skin condition; a shaving waiver), do not proceed with QNFT. The BE Flight will refer that individual to the medical facility for an evaluation to determine a new QNFT date (or other medical recommendation). When

training is conducted by the CE Readiness Flight, all obvious or questionable cases will be referred to the BE Flight.

2.8.2.2. The AMDS (or equivalent) commander will determine local procedures for medical evaluations and referrals. It is suggested that the commander designate one health care provider for all QNFT referrals.

2.8.3. Test Administrator:

2.8.3.1. Ensures sufficient replacement parts are available. See [Table A2.1.](#) and [Table A2.2.](#) for QNFT consumables.

2.8.3.2. Configures the M41 for a five-step test protocol. Sets up the M41 to display individual and final test results according to the M41 T.O.

2.8.3.3. Configures the PortaCount, for the five-step test protocol at 20 seconds of mask sampling per protocol.

2.8.3.4. Sets the M41/PortaCount, to a passing FF of 2000.

2.8.3.5. Before each QNFT session, ensures the M41/PortaCount, shows a particle count of at least 3000, and has test subjects remove their hoods before beginning the test.

2.8.3.6. For the MCU-2A/P and M17A2, trims the sample tube extender to a length of approximately $\frac{3}{4}$ -inch and insert it in the drink tube. The purpose of the extender is to position the drink tube sampling port away from the mouth. (**Note:** Do not extend the tube into the eye region.) The sample tube extension cannot be used for the NBC fire fighter mask; in this case, turn the drink tube away from the test subject's mouth.

NOTE: The DOS-based software available with the PortaCount, may be used to run the M41. Windows-based software is also available for the M41 and the PortaCount,. Consult the M41 T.O. for ordering information. The DOS and Windows version software can be used to change the settings to comply with paragraphs [2.8.3.2.](#) through [2.8.3.4.](#) It can also be used to save fit-test results and some of the individual QNFT information listed in paragraph [2.7.1.1.](#)

2.8.3.7. Do not instruct test subjects in donning the mask during the initial QNFT iteration (exception: if the test subject has not had initial NBC defense training, the trainer will assist by providing instructions). The purpose of this procedure is to evaluate the test subject's donning procedures. Observe the donning procedures, and provide feedback to the test subject if target FF is not attained during the first or subsequent iterations.

2.8.3.8. Makes adjustments or repairs and retest when a test subject does not attain target FF. Recommended adjustments and retesting procedures are listed in the M41 T.O.

2.8.4. Interpretation of Test Results. The test administrator will interpret test results, using the following guidelines:

2.8.4.1. QNFT is complete if the test subject attains at least the target FF of 2000.

2.8.4.2. If a test subject cannot achieve a passing FF during the “Normal Breathing” or “Deep Breathing” steps, an overall failure is probable.

2.8.4.3. If a test subject fails the “Side-to-Side” step, the mask is probably leaking on the sides.

2.8.4.4. If a test subject fails the “Up-and-Down” step, the mask is probably leaking at the jaw and/or forehead.

2.8.4.5. If a test subject fails the “Jaw Rotation” step, the mask is probably leaking in the jaw region.

2.9. Personnel Who Cannot Attain the Minimum Target FF:

2.9.1. Exhaust all feasible options to attain the highest FF possible for personnel assigned to or who may deploy to medium or high threat areas.

2.9.2. The BE Flight will notify the unit commander in writing. An example letter is at [Attachment 4](#). An example QNFT fact sheet, which can be provided with the letter to the individual and unit commander, is at [Attachment 5](#). The letter and fact sheet may be modified locally.

2.10. Training Videos. Videos may be used to enhance training for the system operators. Follow ordering instructions in AFI-32-4001.

2.10.1. M41 Protection Assessment Test System (PATS) - Short Version, 0:9:30

Production Identification Number (PIN) - 710441

Internal Control Number (ICN) - TVT 3-97

This program provides an overview of the M41 protection assessment test system (PATS) and how it is used to evaluate the fit and serviceability of the protective mask.

2.10.2. M41 Protective Mask Fit Validation Instrument (PMFVI): New Equipment Training

PIN - 710502

ICN - TVT 3-90

This video demonstrates setup procedures, mask fit tests on M-40 and M-17 series masks, and operator maintenance procedures. It provides operation and maintenance instructions for the M41 protective mask fit validation instrument.

Chapter 3

MASK CONFIDENCE TRAINING PROCEDURES

3.1. Basic Requirements. The following applies to all MCT.

3.1.1. Challenge Agents. Use CS or CN, stannic chloride, isoamyl acetate (banana oil), or camphor crystals.

3.1.2. Facilities. For CS or CN operations, the facility must be at least 100 meters from any occupied structure. If a tent is used, earth should be banked around the tent's base to help prevent escape of CS or CN. During training, all challenge agent vapors and aerosols should be contained within the facility to the greatest extent possible.

3.1.2.1. The facility should have adequate lighting. Separate entry and exit doorways are preferred.

3.1.2.2. An eyewash station satisfying Air Force Occupational Safety and Health (AFOSH) Standard 91-32, *Emergency Shower and Eyewash Units*, must be readily available.

3.1.2.3. Conduct a safety inspection of the facility before training exercises. Ensure a fire extinguisher is available and note its location.

3.1.3. Training Exercises. Students will perform exercises listed in [Table 3.1.](#) within the training environment.

Table 3.1. MCT Training Exercises.

1. Normal Breathing - In a normal standing position, without talking, the subject breathes normally.
2. Deep Breathing - In a normal standing position, the subject breathes slowly and deeply, taking care not to hyperventilate.
3. Turning head side-to-side - Standing in place, the subject slowly turns his/her head from side to side between extreme positions on each side. The subject holds his/her head at each extreme momentarily to allow the subject to inhale at each side. See Figure 3.1.
4. Moving head up and down - Standing in place, the subject slowly moves his/her head up and down. Instruct the subject to inhale in the up position (i.e., when looking toward the ceiling). See Figure 3.2.
5. Rotating chin - Standing in place, the subject moves his/her jaw in a circular pattern, holding the mouth slightly open to simulate speaking.

Figure 3.1. Side-to-Side Head Movements.



Figure 3.1. Continued.



Figure 3.2. Up-and-Down Head Movements.



Figure 3.2. Continued.



3.2. CS, CN, and Camphor Procedures:

3.2.1. Safety Precautions:

3.2.1.1. One instructor per six students is suggested. Instructors should be certified in cardiopulmonary resuscitation and basic first aid. You must have, as minimum, two instructors per MCT facility. The instructors must be clearly identifiable by wearing clothing such as coveralls, TyvekÆ suits, or brightly colored vests. One primary instructor will be located inside the facility and one secondary instructor, acting as a safety backup, will be located outside the facility.

3.2.1.2. CS, CN, and camphor require a heat-generating device (e.g., Sterno, candle, or hot plate). Wear gloves when handling.

3.2.1.3. To avoid exposure to the challenge agents, students will don the mask and ground crew ensemble (GCE) before entering the MCT facility.

3.2.1.4. Before donning the mask, women will remove hair fasteners (hair clips, pins) and let hair hang freely, tucked within the GCE jacket.

3.2.1.5. Pregnant women or women who may be pregnant, and those with appropriate medical waivers, will not participate in MCT. After medical approval, the unit will reschedule these subjects for MCT.

3.2.1.6. Should a student become ill inside the MCT facility, immediately remove him/her into fresh air and contact medical services as necessary.

3.2.2. Pre-MCT Actions:

3.2.2.1. CS and CN. Prepare an aerosol concentration in the facility according to the installation BE recommendations. The CS or CN vapor level should not exceed 10 milligrams per cubic meter (mg/m³). Don't use more than one capsule in facilities 200 cubic meters (7062 cubic feet) or smaller. For larger facilities, estimate the number of capsules using the following formula: *Room Volume in Cubic Meters x 0.0107 = Estimated Number of Capsules Needed.*

3.2.2.2. Camphor. Vaporize the camphor. Normally, use 1 to 2 ounces of camphor crystals placed on a heat generator. The camphor does not need to be completely vaporized for an initial concentration. Remove or extinguish the heat source after initial vapor concentration is established, then reheat as necessary to maintain the concentration.

3.2.3. Instructor Actions. See [Table 3.2](#).

Table 3.2. CS, CN, and Camphor MCT Instructor Actions.

1. Brief students on the purpose of the training, type of agent being used, MCT actions, and safety requirements.
2. Preposition students waiting to enter the facility upwind to avoid potential exposure to the challenge agent before masking.
3. Have students don masks and check for problems. Assist students with mask or GCE problems before entering the MCT.
4. Have students enter the MCT facility individually or in small groups. Six students per instructor is recommended.
5. Perform training exercises according to Table 3.1 .
6. If the training agent is detected during the MCT, have the student immediately leave the facility. The secondary instructor will identify and correct the problem.

7. Once the problem has been corrected, have the student reenter the facility.
8. When the instructor has determined that the masks are operating properly, have one student at a time face the instructor, remove his/her mask, and immediately leave the MCT facility. Continue until all students have left.
9. Before leaving the MCT, extinguish the heat-generating device.
10. Face students into the wind until their eyes have cleared.
11. Ensure water and paper towels are available for students to wash their faces and any exposed skin.
12. Brief students on problem areas.
13. As part of the training, ensure students clean and properly store masks.

3.3. Isoamyl Acetate (Banana Oil) Procedures:

3.3.1. Safety Precautions. Conduct an isoamyl acetate vapor test outdoors (calm winds) or in a well-ventilated indoor location. **Caution: Isoamyl acetate is flammable; prohibit smoking or open flames near the MCT area.** Conduct the MCT wearing rubber gloves to prevent the isoamyl acetate from contacting the fingers. After MCT, wash hands with soap and water. Dispose of used ampoules or swabs in outdoor trash containers.

3.3.2. Instructor Actions. See [Table 3.3](#).

Table 3.3. Isoamyl Acetate MCT Instructor Actions.

1. When using agent from the bottle, dip a cotton swab and squeeze out excess liquid. Use ampoules according to manufacturer's instructions. Normally, use one swab or ampoule for at least 10 students.
2. Present the agent about two inches from the student's mask. Move around the facepiece (don't touch the mask or wearer), outlet valve/voicemitter assembly, eyelenses, and air intakes.
3. Training Exercises. Have students perform training exercises according to Table 3.1 .
4. If the agent is detected during the MCT, help the student correct the problem (e.g., adjust straps) and resume the test.

3.3.3. Post-MCT Actions. Each student passing the banana oil test will be given a sensitivity screening check to confirm he/she can detect the smell of banana oil. If the agent in the air has already dissipated, hold the swab about two inches from the student's head. If the student detects the smell, the test was valid. Failure to detect the smell voids the fit test. Redo the test using a different qualitative mask confidence protocol (normally, stannic chloride).

3.4. Stannic Chloride Procedures:

3.4.1. Safety Precautions. This qualitative fit test uses a subject's response to the irritating chemicals released in the "smoke" produced by a stannic chloride smoke tube to detect leakage into the respirator.

3.4.1.1. The smoke can be irritating to the eyes, lungs, and nasal passages. The test administrator must take precautions to minimize the test subject's exposure to irritant smoke.

3.4.1.2. Training will be conducted in an area with adequate ventilation to prevent exposure of the person conducting the fit test or buildup of irritant smoke in the atmosphere.

3.4.2. MCT Instructor Actions. See [Table 3.4](#).

Table 3.4. Stannic Chloride MCT Instructor Actions.

1. Using a squeeze bulb, direct the stream of irritant smoke from the smoke tube toward the faceseal area of the student.
2. Begin at least 12 inches from the facepiece and move the smoke stream around the entire perimeter of the mask.
3. Gradually make two more passes around the perimeter of the mask, moving to within six inches of the mask.
4. Training Exercises. Have students perform training exercises according to Table 3.1 .
5. If the agent is detected during the MCT, the instructor helps the student correct the problem (e.g., adjust straps) and resumes the test.

3.4.3. Post-MCT Actions. Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) will be given a sensitivity screening check with the smoke from the same smoke tube used during the fit test once the mask has been removed to determine whether he/she reacts to the smoke. Failure to evoke a response voids the test. Repeat the test using a different qualitative mask confidence protocol.

Chapter 4

LIQUID HAZARD SIMULANT TRAINING PROCEDURES

4.1. Simulant Description. The simulant used for LHS training is a solution of water, Tinopal CBS-X, and polyethylene glycol-200 (PEG-200). This mixture's physical characteristics do not mimic any actual chemical warfare agents; however, transfer characteristics make it suitable as a training simulant. It has a consistency between actual thickened and non-thickened agents. Additionally, LHS will cause an indication of "G" nerve agent on M8 paper.

4.1.1. PEG-200 is a clear liquid of low toxicity used in various consumer (cosmetics, pharmaceuticals) and industrial products.

4.1.2. Tinopal CBS-X is a fluorescent-whitening agent found in commercial laundry detergents. Its presence can be detected through an ultraviolet (UV) light scan.

4.1.3. When storing or using Tinopal and PEG-200, be sure to follow all applicable safety information on the Material Safety Data Sheets (MSDS).

4.2. Facilities. Depending on the sprayer, spray area, detection method, and detection booth used, procedures for liquid hazard transfer training will differ. Shield the LHS spray area from the wind and rain to ensure a uniform mist on each student. Develop local procedures to ensure training consistency.

4.3. Safety Precautions:

4.3.1. These agents pose no health hazard to personnel when used as directed by this manual. Always follow environmental guidelines and MSDSs that may accompany the chemicals. Clear the procedures with BE, also ensuring that use of the UV lamp will not pose an eye hazard to the students or instructors. **Caution: Ensure personnel do not look directly at the UV lamp.**

4.3.2. An eyewash station that meets the requirements of AFOSH STD 91-32 must be readily available.

4.3.3. Do not inhale or ingest the simulant or components; do not allow skin or eye contact.

4.3.4. The BE Flight will evaluate the simulant preparation and spray application procedures to determine personal protective equipment (PPE), or other control requirements for the instructors.

4.3.5. To avoid exposure to the simulant, students will don the GCE before entering the LHS training facility. See AFI 32-4001 for a listing of GCE items.

4.3.6. Before donning the mask, women will remove hair fasteners (hair clips, pins) and let hair hang freely, tucked within the GCE jacket.

4.3.7. Unprotected personnel will not remain in the area during and immediately after spray application of the simulant.

4.3.8. If exposure occurs:

4.3.8.1. Eyes. Flush with water for at least 15 minutes; get medical attention.

4.3.8.2. Skin. Remove contaminated clothing and flush skin with large amounts of water. If irritation persists, contact a physician.

4.3.8.3. Inhalation. Remove to fresh air. Seek medical attention as necessary.

4.3.8.4. Ingestion. Seek medical attention.

4.3.8.5. Contaminated Clothing. Launder normally.

4.3.9. Pregnant women or women who may be pregnant, and those with appropriate medical waivers, will not participate in LHS training. After medical approval, the unit will reschedule these subjects for the training.

4.3.10. If an individual becomes ill inside the LHS facility, immediately remove him/her into fresh air and contact medical services as necessary.

4.4. Preparation of the LHS:

4.4.1. Pour 1 US gallon (about 4 liters) of PEG-200 into a container.

4.4.2. Add about 1 $\frac{3}{4}$ teaspoons (5 grams) of Tinopal CBS-X.

4.4.3. Mix until large particles are dissolved.

4.4.4. Wait 24 hours. Ensure the Tinopal CBS-X has dissolved. Mix again as necessary until all particles are dissolved.

4.5. LHS Training Procedures:

4.5.1. Set the spray apparatus nozzle to a fine mist. If the spray apparatus is unable to efficiently deliver simulant in a fine mist, further dilute the LHS with water to a maximum dilution level of 50/50.

4.5.2. Spray each student as he/she turns around 360 degrees.

4.5.3. Have students process through a CCA according to AFMAN 32-4005, *Personnel Protection and Attack Actions*.

4.6. Evaluation Criteria. Any LHS transferred to skin or clothing surfaces can be seen under the UV light. Each student should stand in the UV light and turn slowly in place as an instructor looks for LHS transfer. Using the information in [Attachment 6](#), develop a contamination profile sheet and mark any contamination found on each student. The instructor may use this to show areas requiring further decontamination.

JOHN W. HANDY, Lt General, USAF
DCS/Installation & Logistics

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFPD 32-40, *Disaster Preparedness*

AFI 32-4001, *Disaster Preparedness Planning and Operations*

AFI 37-124, *The Information Collections and Reports Management Program: Controlling Internal, Public, and Interagency Air Force Information Collections*

AFI 37-132, *Air Force Privacy Act Program*

AFMAN 37-139, *Records Disposition Schedule*

AFMAN 32-4005, *Personnel Protection and Attack Actions*

AFH 32-4014V4, *USAF Ability to Survive and Operate Procedures in a Nuclear, Biological, and Chemical (NBC) Environment*

AFOSH STD 91-32, *Emergency Shower and Eyewash Units*

TO 14P4-9-31, *Mask Protective Field M17A2 and Accessories*

TO 14P4-15-1, *MCU-2A/P*

T.O. 14P4-15-11, *Operator and Unit Maintenance Manual for Protective Assessment Test System, M41*

Additional References

AFOSH STD 48-137, *Respiratory Protection Program*

Abbreviations and Acronyms

AFSC—Air Force Specialty Code

AFTO—Air Force Technical Order

BE—Bioenvironmental Engineering

BEE—Bioenvironmental Engineer

CCA—Contamination Control Area

CS—O-Chlorobenzylidene Malononitrile

CN—Chloroacetophenone

FF—Fit Factors

GCE—Ground Crew Ensemble

HTA—High Threat Area

LHS—Liquid Hazard Simulant

LTA—Low Threat Area

MCT—Mask Confidence Training

MFP—Mask Fit Program

MSDS—Material Safety Data Sheets

MTA—Medium Threat Area

NBC—Nuclear, Biological and Chemical

OCR—Office of Collateral Responsibility

OPR—Office of Primary Responsibility

PATS—Protection Assessment Test System

PCS—Permanent Change of Station

PEG—Polyethylene Glycol

PIN—Product Identification Number

PMCS—Preventive Maintenance Checks and Services

QLFT—Qualitative Fit Test

PPE—Personnel Protective Equipment

QNFT—Quantitative Fit Training

SSN—Social Security Number

T.O.—Technical Order

UV—Ultraviolet

Terms

Chemical Agent—A chemical substance which is intended for use in military operations to kill, seriously injure, or incapacitate personnel through its physiological effects. The term excludes riot control agents, herbicides, smoke, and flame.

Chemical-Biological Threat Areas—Geographical areas considered as high, medium, and low for readiness and deliberate planning purposes. Unit and MAJCOM programmers must equip, train, and exercise personnel consistent with the need to survive and operate in areas where Air Force personnel may encounter chemical-biological agents.

Chemical-Biological High Threat Area—Geographical areas where Air Force personnel, through training, equipping, and deliberate planning, must maintain a high level of readiness.

Chemical-Biological Medium Threat Areas—Geographical areas where Air Force personnel, through training, equipping, and deliberate planning, must maintain an increased level of readiness. Units must be prepared to assume a higher state of readiness or support deployments to a high CB threat area.

Chemical-Biological Low Threat Areas—Geographical areas where Air Force personnel, through training, equipping, and deliberate planning, must maintain a normal level of readiness. Units must be prepared to assume a higher state of readiness or support deployments to a medium/high CB threat area.

Contamination—(1) The deposit, absorption, or adsorption of radioactive material, or of biological or chemical agents on or by structures, areas, personnel, or objects. (2) Food and/or water made unfit for consumption by humans or animals because of the presence of environmental chemicals, radioactive

elements, bacteria or organisms, the byproduct of the growth of bacteria or organisms, the decomposing material (to include the food substance itself), or waste in the food or water.

Contamination Control—Procedures to avoid, reduce, remove, or render harmless, temporarily or permanently, nuclear, biological, and chemical contamination for the purpose of maintaining or enhancing the efficient conduct of military operations.

Contamination Control Area—An area in which chemically contaminated individual protective equipment (IPE) is removed; people, equipment, and supplies are decontaminated to allow processing between a toxic environment and a toxic free area; and people exiting a toxic free area may safely don IPE.

Fit Factor—The fit factor is a measure of the quality of the faceseal. It is calculated using the ambient concentration of an airborne substance outside the respirator and the concentration of the substance inside the respirator cavity.

Individual Protective Equipment (IPE)—In nuclear, biological, and chemical warfare, the personal clothing and equipment required to protect an individual from biological and chemical hazards and some nuclear effects.

Protection Factor—A protection factor indicates the degree to which an adequately fitted mask will reduce the concentration of a contaminant. Example: An adequately fitted mask with a protection factor of 10,000 will reduce the wearer's exposure to 1/10,000th of the contaminant level outside the mask.

Qualitative Fit Test—Test that relies on the ability of the wearer to sense a test agent.

Quantitative Fit Test—Test that uses an instrument to measure face seal leakage of a test aerosol. During the test, the concentration of the aerosol is measured both inside and outside the mask.

Simulant—The test agent used in the qualitative mask confidence training.

Attachment 2

SUPPORT EQUIPMENT

A2.1. MCT and LHS Equipment List. Use [Table A2.1.](#) to order supplies and equipment for the Air Force qualitative fit test (QLFT) and LHS training.

Table A2.1. MCT and LHS Equipment List.

<i>Nomenclature</i>	<i>National Stock Number</i>	<i>Unit of Issue</i>
Chloroacetophenone (CN)	1365-00-383-3909	50 pellets
O-Chlorobenzylindene Malononitrile (CS)	1365-00-690-8656	Each
Fuel, compressed	9110-00-263-9865	Box
Hot plate, electric	7310-00-634-2831	Each
Candles	Local purchase	
Camphor crystal	6810-00-763-4397	Pound can
Isoamyl acetate (liquid) bottle	6810-00-123-7047	Pint
Isoamyl acetate (ampoules)	6810-01-115-7792	Box (100 ea)
PEG-200	6810-01-257-1864	5-gallon can
Tinopal CBS-X	6810-01-306-2469	1-US pound bag
Fluorescent bulbs	6240-00-295-2643	Pack of 6 each
Spray apparatus (spray bottle, hand pressurized sprayer, or pressurized air sprayer)	Local purchase	
Bulb, aspirator, kit (squeeze bulb)	6665-00-978-5516	1 Each
Tube, smoke (stannic chloride)	6665-00-928-5731	1 Box, 12 each

A2.2. Equipment and Material Required to Support the QNFT Program. The M41 T.O. lists consumable items by national stock number and part number associated with the M41 PATS. [Table A2.2.](#) lists replacement parts for the MCU-2A/P and M17A2 series mask. Units must anticipate replacement of certain worn or defective mask parts which support the QNFT program, and budget accordingly.

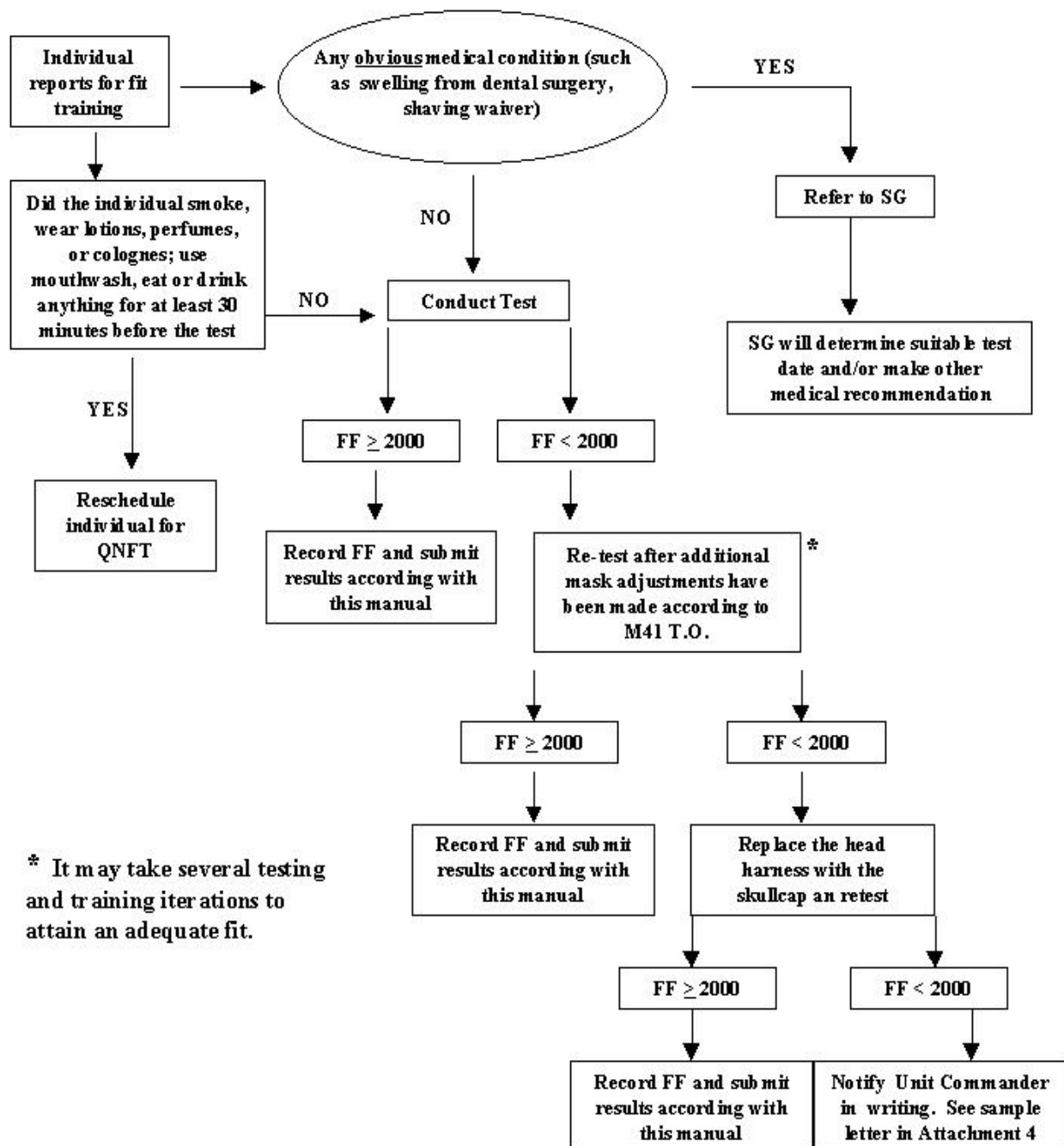
Table A2.2. MCU-2A/P and M17A2 Replacement Parts Listing.

<i>MCU-2A/P Nomenclature</i>	<i>National Stock Number</i>	<i>M17A2 Nomenclature</i>	<i>National Stock Number</i>
Harness, head	4240-01-223-7313	Harness, head	4240-00-690-8765
Harness, skull cap	4240-01-390-3057	Clip and buckle	4240-00-602-2207
Outlet valve	4240-01-334-6824	Outlet valve	4820-00-712-6090
Inlet valve	4820-01-224-6336	Inlet/nose cup valve	4240-01-104-0965
Nose cup valve disc	4240-01-246-1996		
Skull cap head harness	4240-01-390-3057		
Side voicemitter gasket	5630-01-260-8702		

Attachment 3

QNFT FLOWCHART

A3.1. QNFT Flowchart. BEE and CE Readiness Flights should use the flowchart to guide them through the QNFT process.



Attachment 4**SAMPLE MEMORANDUM TO UNIT COMMANDER**

MEMORANDUM FOR (UNIT COMMANDER)

FROM: XXX/SGPB

SUBJECT: Report of NBC Mask Quantitative Fit Training (QNFT), MSgt Ron S. Smith

QNFT was conducted on MSgt Smith on (date) according to AFMAN 32-4006, *Nuclear, Biological and Chemical (NBC) Mask Fit and Liquid Hazard Simulant Training*. MSgt Smith attained a fit factor (FF) of XXXX, which does not meet the Air Force minimum target FF of 2000. This could indicate inadequate protection against NBC agents. We used all available options to achieve the best possible fit. The highest FF attained during the test was XXXX.

A fact sheet that explains the QNFT program is attached for your information. If you have any questions, please call me at XXX-XXXX.

JACK BLACK, Maj, USAF

Bioenvironmental Engineering Flight Commander

Attachment:

Fact sheet

cc: XXX/CEX

Attn: MSgt Smith

Attachment 5**FACT SHEET FOR AIR FORCE NBC MASK QUANTITATIVE FIT
TRAINING (QNFT) PROGRAM**

Q: What is the QNFT program?

A: The Air Force has implemented a program to perform “quantitative” fit training for NBC protective masks. This is a joint program conducted by the Bioenvironmental Engineering and Civil Engineer Readiness Flights.

The quantitative method determines how well the mask fits the wearer. In the past the Air Force used subjective qualitative (go/no go) methods to determine if the gas masks fit. QNFT does not rely on an individual’s smell and taste sensitivity to a test agent. AFMAN 32-4006, *Nuclear, Biological And Chemical (NBC) Mask Fit And Liquid Hazard Simulant Training*, outlines the program. QNFT involves measuring the dust concentration in the atmosphere and inside the mask cavity, and calculating a fit factor (FF). The higher the FF, the better the fit.

Q: Why do QNFT?

A: The purpose of the NBC mask QNFT program is to enhance NBC defense training, help Air Force personnel maximize their NBC mask protection, and instill mask confidence. The NBC mask QNFT program applies to negative pressure masks designed specifically for use in an NBC environment. This program is intended to be a training aide rather than a certification tool to ensure personnel meet or exceed the minimum target FF.

QNFT increases protection through training personnel to attain an adequate FF by:

- (1) Confirming individuals’ mask sizes are correct.
- (2) Teaching individuals what their mask feels like when an adequate fit is attained (for example, head harness tension).
- (3) Teaching individuals how to properly don their masks to attain an adequate fit (for example, sequence of head harness adjustment).

Q: What is the “minimum target” fit factor?

A: The Air Force selected a FF of 2000 as a division between “adequate” and “poor” fitting gas masks. Based on a test program conducted in PACAF in 1998, almost 95% of the population eventually achieve this fit.

The FF indicates how well the mask fits; it is not a protection factor (PF). A PF indicates the degree to which an adequately fitted mask will reduce the concentration of a contaminant. For a given contaminant,

an adequately fitted mask with a protection factor of 10,000 will reduce the wearer's exposure to 1/10,000th of the contaminant level outside the mask. The QNFT does not measure the protection factor.

Some of the reasons people do not attain the minimum target FF include use of corrective lens inserts (straps may interfere with the seal), and the normal shape and size of the individual's head. It is also important to realize that the Air Force masks were not designed to fit 100 percent of the Air Force population; there will be persons who, due to the size and shape of their heads, will fall outside the design percentiles for the mask. Currently there is no capability to make custom masks.

Q: What could preclude a valid QNFT?

A1: It could be medical condition or a mask problem.

A2: If an individual reporting for QNFT has an obvious medical condition that might interfere with a valid evaluation (for example: swelling due to dental surgery; a skin condition; or a shaving waiver), QNFT will be delayed pending a medical evaluation. The evaluation may result in rescheduling QNFT to a later date or some other medical followup.

A3: There could be something physically wrong with the mask (e.g., dirt in exhalation valve).

Q: What can be done to improve fit?

A: The person conducting the fit test will determine if something can be changed to improve the fit of the mask. This may include modifying donning procedures, using a skull cap, or selecting a smaller or larger mask. All of this is done at the time of the fit test. Most people who do not reach the minimum fit factor will be able to achieve it through these simple actions.

Q: What if a person in your unit cannot achieve the minimum target FF?

A: The person will NOT be separated from the Air Force. All feasible options will be exhausted to attain the highest FF possible for personnel assigned to or who may deploy to medium or high threat areas.

Q: When will QNFT be repeated?

A:

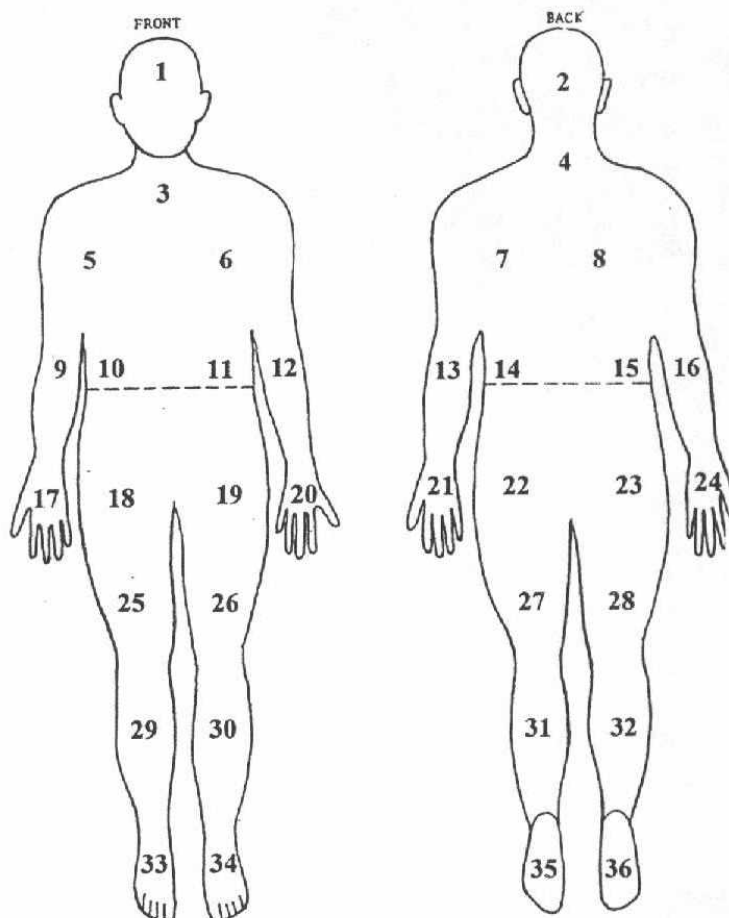
- (1) Every time a new mask is issued.
- (2) When an individual has difficulty with negative pressure self-checks.
- (3) When an individual gains or loses 10% or more pounds of body weight based upon their weight at QNFT.
- (4) When an individual has extensive dental work, facial surgery, scarring, or disfigurement.

If a person has questions regarding the need for another QNFT, the person should contact the BE or CE Readiness Flights.

Attachment 6

SAMPLE LHS CONTAMINATION PROFILE SHEET

Figure A6.1. LHS Contamination Profile Sheet.



FRONT HEAD 1
 BACK HEAD 2
 FRONT OF NECK 3
 BACK OF NECK 4
 RIGHT UPPER CHEST 5
 LEFT UPPER CHEST 6
 LEFT UPPER BACK 7
 RIGHT UPPER BACK 8
 FRONT RIGHT UPPER ARM 9

RIGHT ABDOMEN 10
 LEFT ABDOMEN 11
 FRONT LEFT UPPER ARM 12
 BACK LEFT UPPER ARM 13
 LOWER LEFT BACK 14
 RIGHT LOWER BACK 15
 BACK RIGHT UPPER ARM 16
 FRONT RIGHT LOWER ARM 17
 RIGHT THIGH 18

LEFT THIGH 19
 FRONT LEFT LOWER ARM 20
 BACK LEFT LOWER ARM 21
 BACK LEFT UPPER LEG 22
 BACK RIGHT UPPER LEG 23
 BACK RIGHT LOWER ARM 24
 RIGHT KNEE 25
 LEFT KNEE 26
 BACK RIGHT MID LEG 27

BACK LEFT MID LEG 28
 RIGHT SHIN 29
 LEFT SHIN 30
 LEFT CALF 31
 RIGHT CALF 32
 TOP FOOT RIGHT 33
 TOP FOOT LEFT 34
 LEFT BOTTOM FOOT 35
 RIGHT BOTTOM FOOT 36