American National Standard for

Respiratory Protection — Respirator Use

Physical Qualifications for Personnel

ANSI/AIHA Z88.6–2006

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American National Standard for Respiratory Protection — Respirator Use — Physical Qualifications for Personnel

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American National Standard

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FOREWORD

A series of related American National Standards were identified after the development of ANSI Z88.2–1980 “Respiratory Protection Programs” to address specialized technical elements of respiratory protection programs. ANSI Z88.6–1984 “Respirator Use — Physical Qualifications for Personnel” was the first of these standards to be developed. ANSI/AIHA Z88.10–2001 “Respirator Fit Testing Methods” has also been developed and is available to provide detailed respiratory protection program guidance in the area of respirator fit testing.

American National Standard Z88.6-1984 contained general, rather than specific requirements because it was the first standard to deal with this subject. It was intended that “more specific requirements” would be provided in future editions that would provide more detailed guidance to assist medical professionals in determining which individuals should and should not be medically qualified to wear respirators. Annex C of the 1984 standard concluded with suggested “Areas of Future Investigation.” This standard addresses these and other areas and presents a process that meets, and in many areas exceeds, the minimum requirements of the Occupational Safety and Health Administration’s (“OSHA”) Respiratory Protection Standard (the “federal standard”) 29 CFR 1910.134, and:

- Includes all the questions required by the OSHA respirator questionnaire as well as additional questions to assess the risk of cardiac disease,
- Recommends physician review of all cases that fall outside certain parameters, and
- Considers the physiologic demand of the type of work to be performed, and type of respirator for which approval is granted.

The Committee has made the following determinations regarding the revised Standard:

- Any medical professional authorized to evaluate respirator use should be required to know the physiologic demands associated with various types of respirators.
- The impact of safe and reliable work performance on fellow workers and the public should be considered.
- The impact of medical factors on job performance exclusive of respirator use should be considered.
- Conditional approval may be granted in appropriate cases.
- A periodic medical questionnaire prior to annual respirator fit testing should be administered.
- Clinical Exercise Stress Testing (EST) is a useful test for evaluating the functional capacity (work capacity) of users of industrial respirators as respiratory reserve is normally greater than circulatory system reserve and cardiac disease is more common as a disqualifier than pulmonary disease.
- The routine use of spirometry to determine the suitability of individuals to use respiratory protective devices is not required, although pulmonary function data (especially aggregate data) may be an important measure of response to worker exposure.
- Workers are less likely to have clinically significant Coronary Artery Disease “CAD” and to be heat intolerant if they achieve a negative EST to 10 METs.
- Specific blood pressure, body weight, and pulmonary function values will require physician consideration, and/or evaluation, and/or medical testing.
- The conservative definition of “heavy” work as suggested by “OSHA” should be adopted.
- A concise statement regarding facial hair should be included.
- Workers using contact lenses, and workers with perforated tympanic membranes should not be routinely excluded.
- A chest X-ray should not be used routinely to determine suitability to use respirators.
- Spirometry should be interpreted in accordance with the recommendations of the American Thoracic Society (ATS) and that ATS recommendations for performing spirometry tests should be considered as useful guidance by evaluators.

There are four annexes in this standard. These annexes are informative and are not considered part of the standard. Suggestions for the improvement of this standard will be welcome. They should be sent to the ANSI Z88 Secretariat, American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax VA. 22031.

Future revisions are anticipated to provide even more detailed guidance, especially as it applies to workers with known serious medical issues.

This standard was processed and approved for submittal to ANSI by the Z88 Accredited Standards Committee on Respiratory Protection. Committee approval of the Standard does not necessarily imply that all committee members voted for its approval. At the time it approved this Standard the Z88 Committee had the following members:

James S. Johnson, PhD, CIH, QEP, Chair
Stephen C. Graham, CIH, CSP, Vice Chair
Mili Mavely, Secretariat Representative

Organization Represented	*Name of Representative*
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U.S. Department of Labor	J. Steelnack
U.S. Department of the Army	S. Graham

Individual Members
C. Bien
D. Bevis
T. Nelson

At the time it approved this standard, the Z88 Committee had the following alternate members:

Organization Represented	*Name of Alternate Representative*
International Safety Equipment Association	J. Birkner
NIOSH	M. D'Alessandro
U.S. Department of Energy	D. Weitzman
U.S. Department of the Army	I. Richardson

The Z88.6 Subcommittee on Respirator Use – Physical Qualification for Personnel, which developed this Standard, had the following members:

Ronald J. Mack M.D., MPH, Chair
Ross L. Clay, MD, MPH
William Dyson, PhD, CIH
Richard Enkeboll
Connie R. Freiberg, CSP
Andrew Jackson
Charles P. Lisa, MD
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James P. Seward, PhD
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Patrick Westerkamp

American National Standard for Respiratory Protection — Respirator Use — Physical Qualifications for Personnel

1 Scope and Purpose

1.1 Scope. This standard provides information that is useful for the medical evaluation of respirator users. This standard does not deal with medical surveillance or biological exposure monitoring. It is understood that local circumstances vary, that no set of guidelines can cover all situations, and that specific programs and procedures should be modified for each individual workplace. Medical evaluation is only one element of a complete respiratory protection program. A complete respiratory protection program is defined in ANSI Z88.2–1992.

1.2 Purpose. This standard provides information and guidance to physicians or other licensed health care professionals (PLHCPs) to assist them in determining the medical suitability of personnel for respirator use. It identifies the responsibility of management to provide the PLHCP with supplemental information before the PLHCP makes a recommendation concerning an employee's ability to use a respirator (see Section 7.1 of this Standard). Evaluators shall use their clinical judgment in the application of these guidelines and require additional information or evaluation as necessary to permit certification or classification for respirator use.

1.3 "Shall" and "Should." The provisions of this standard are mandatory in nature where the word "shall" is used and advisory in nature where the word "should" is used.

1.4 Exceptions. Users of this standard should be aware that regulatory agencies may have requirements that are different from this standard.

2 Normative References. The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI Z88.2–1992, American National Standard for Respiratory Protection
ANSI Z88.6–1984, Respiratory Protection–Respirator Use — Physical Qualifications for Personnel
ANSI/AIHA Z88.10–2001- Respirator Fit Test Methods

3 Definitions

3.1 Body mass index (BMI): A measurement used to assess weight, relative to height. BMI is calculated by dividing body weight in kilograms by height in meters squared (kg/m^2).

3.2 Canister or cartridge: A container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

3.3 Emergency situation: Any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may, or does, result in an uncontrolled significant release of an airborne contaminant.

3.4 Employee exposure: An exposure to a concentration of an airborne contaminant

that would occur if the employee were not using respiratory protection.

3.5 End-of-service-life indicator: A system that warns the user of the approach that the end of adequate respiratory protection is imminent.

3.6 Escape-only respirator: A respirator intended only for use during emergency egress from a hazardous atmosphere.

3.7 Exercise stress test (EST): A standard graded exercise test used to assess an individual's ability to tolerate increasing intensities of exercise while electrocardiographic (EKG), hemodynamic, and symptomatic responses are monitored for manifestations of ischemia, electrical instability, or other exertion-related abnormalities.

3.8 Filter: A component used in respirators to remove solid or liquid aerosols from the inspired air.

3.9 Filtering facepiece: A negative-pressure respirator with an air-purifying element as an integral part of the facepiece or with the entire facepiece composed of the air-purifying medium.

3.10 Fit factor: A numeric estimate of how well a tight-fitting respirator facepiece fits an individual during a quantitative fit test. It is the ratio of the concentration outside the facepiece (C out) to the concentration inside the facepiece (C in). (Fit factor = C out/C in).

3.11 Fit test: The use of a challenge agent to evaluate an individual's ability to obtain an adequate seal with a specific respirator.

3.12 Helmet: A hood that offers head protection against impact and penetration.

3.13 Hood: A respiratory inlet covering that completely covers the head and neck and may cover portions of the shoulders.

3.14 Immediately dangerous to life and health (IDLH): Any atmosphere that poses an immediate hazard to life or poses immediate irreversible debilitating effects on health.

3.15 Interior structural firefighting: The physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient state (See 29 CFR 1910.155).

3.16 Loose-fitting facepiece: A respiratory inlet covering that is designed to form a partial seal with the face, does not cover the neck and shoulders, and may or may not offer head protection against impact and penetration.

3.17 Metabolic equivalents (METs): A unit of energy expended: one MET is 3.5 mL 0_2 /kg/min and represents the energy expended at rest. Standardized exercise protocols express energy expended in terms of multiples of resting metabolic energy or METs.

3.18 Negative pressure respirator: A respirator in which the air pressure inside the respiratory inlet covering is negative during inhalation with respect to the ambient air pressure.

3.19 Oxygen deficient atmosphere: An oxygen partial pressure of 96 to 122 mmHg shall be considered an oxygen-deficient atmosphere that is not immediately dangerous to life (IDLH). An oxygen partial pressure of 95 mmHg or less shall be considered IDLH. The oxygen deficiency may be caused by a reduction in the normal 20.9% oxygen content, by reduced total atmospheric pressure, or by any combination of reduced percentage of oxygen and reduced pressure.

3.20 Physician or other licensed health care professional (PLHCP): An individual whose legally permitted scope of practice (i.e., license, registration, or certification under state law) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of 29 CFR 1910.134.

3.21 Positive pressure respirator: A respirator in which the pressure inside the respiratory inlet covering is normally positive with respect to ambient air pressure.

3.22 Qualitative fit test (QLFT): A pass/fail test that relies on the subject's sensory response to detect the challenge agent.

3.23 Quantitative fit test (QNFT): A fit test that uses an instrument to measure the challenge agent inside and outside the respirator.

3.24 Respiratory inlet covering: The portion of a respirator that connects the wearer's respiratory tract to an air-purifying device or respirable gas source, or both. It may be a facepiece, helmet, hood, suit, or mouthpiece/nose clamp.

3.25 Self-contained breathing apparatus (SCBA): An atmosphere supplying respirator in which the respirable gas source is designed to be carried by the user.

3.26 Service life: The period of time that a respirator provides adequate protection to the wearer.

3.27 Tight-fitting facepiece: A respiratory inlet covering that is designed to form a complete seal with the face. A half-facepiece (includes quarter masks, filtering facepieces, and masks with elastomeric facepieces) covers the nose and mouth; a full facepiece covers the nose, mouth, and eyes.

3.28 User seal check: A procedure conducted by the wearer to determine if the respirator is properly sealed to the face.

4 Respirator Characteristics

4.1 Air-Purifying Respirators

4.1.1 General. Air-Purifying Respirators (APR) remove specific air contaminants by passing ambient air through an air-purifying filter, cartridge, or canister. APR are either non-powered or powered. APR are not approved for fire-fighting efforts.

4.1.2 Air-purifying (nonpowered) respirators: Inhalation through the filtering media and exhalation through the valve depend only on the breathing action of the lungs. Inhalation resistances are less than 35mm H_20 and exhalation resistances are less than 25 mm H_20.

4.1.3 Powered air-purifying respirators (PAPR): Powered units contain a blower to move the air through the filtering media. Inhalation and exhalation resistance is negligible, similar to a continuous-flow airline device. The weight of the blower varies from approximately 5 to 15 lb.

4.2 Atmosphere-Supplying Respirators

4.2.1 General. Atmosphere-supplying respirators are either self-contained or airline units. The self-contained breathing apparatus (SCBA) is completely portable. The airline apparatus requires the trailing of an air hose from the wearer to the source of breathing air.

Atmosphere-supplying respirators operate in continuous- flow, demand, or pressure-demand modes. Continuous-flow respirators blow air continuously into the mask. Demand-type apparatus require the wearer to inhale and reduce the mask pressure below atmospheric pressure, before the regulator will supply air. (This is similar to inhaling through an air-purifying device). In a pressure-demand (positive-pressure) device, a slight positive pressure is maintained in the facepiece at all times by the regulator. More air is admitted to the mask as the positive pressure decreases during inhalation. Exhalation resistances are greater than for demand devices.

4.2.2 Open-circuit SCBA. Open-circuit SCBA is available in demand or pressure-demand devices. In open-circuit devices, breathing air is supplied from a cylinder to the mask, and then dumped into the atmosphere on exhalation. The nitrogen in the breathing air is excess weight that does not contribute to the wearer's metabolism. The maximum allowed weight is 35 lb, although modern half-hour units may weigh 10 lb less. Significant reduction (up to 20%) in work capacity of the wearer can occur since the 35 lb load must be carried. Heavy work rates may be required during fire-fighting and rescue situations while wearing SCBA.

Regulators on current SCBA may not meet the high instantaneous demands of wearers at heavy work rates, and so may

impair work out-put further. The increased exhalation resistance of pressure-demand units may also degrade ability to perform heavy work.

4.2.3 Closed-circuit SCBA. Closed-circuit SCBA is available in demand or pressure-demand devices. In closed-circuit units (also known as rebreathers), oxygen is supplied from a compressed gas, liquid, or chemical source. Exhaled air is scrubbed of carbon dioxide and returned to the facepiece. Closed-circuit devices have a longer duration for their weight than does open-circuit equipment. Breathing is into and out of a bag rather than from a regulator. Oxygen concentrations may range from 21 to 90 percent.

4.2.4 Supplied-air respirators (SAR). Supplied-air or airline respirators are available as continuous-flow, demand, or pressure-demand devices. All supplied air respirators require a trailing air hose that limits movement about the workplace. Duration of use is limited only by the air source and the metabolic work rate. Exhalation resistance is equal to or lower than that of demand equipment, since the exhalation valve is held open by the continuous outward flow of air. Demand and pressure-demand versions of airline units have physiological effects similar to the SCBA, except for the additional weight burden of the SCBA.

5 Medical Evaluation Rationale

The effects of physical work effort, protective clothing, temperature, humidity, and the physiologic burden placed on a worker using a respirator must be considered during the medical evaluation for respirator use. PLHCPs shall provide reasonable assurance that a worker can endure these stressors without adverse medical consequences, and recommend any limitations on respirator use related to the medical condition of the employee or the work place conditions in which the respirator will be used.

6 Qualifications of Persons Who Conduct Medical Evaluations to Determine Suitability to Use Respiratory Protective Devices

6.1 Medical evaluation shall be performed by a physician or other licensed health care professional (LHCP) (e.g., nurse practitioner, physician assistant, occupational health nurse), provided that their license permits them to perform such evaluations. LHCPs are expected to consult with an appropriate physician when questions arise about an employee's physical condition and capability, such as those described in this standard.

7 Evaluation Requirements

7.1 The industrial hygienist, safety professional, or other employer representative shall provide the PLHCP with supplemental information before the PLHCP makes a recommendation concerning an employee's ability to use a respirator. The following supplemental information shall be provided (see Annex B2):

(a) The type and weight of the respirator to be used by the employee. This should include (i) effort of breathing, (ii) special features, such as size, shape, bulk, full face, hood, etc.

(b) The duration and frequency of respirator use (including use for rescue and escape);

(c) The expected physical work effort;

(d) Additional protective clothing and equipment to be worn;

(e) Temperature and humidity extremes that may be encountered;

(f) A copy of the written respiratory protection program; and,

(g) A copy of 29 CFR Part 1910.134 – Respiratory Protection; Final Rule.

7.1.1 Extent of usage should be defined as follows:

(1) On a daily basis (if so, state maximum hours a day of expected use).

(2) Occasionally, but probably more than once weekly (as in maintenance worker), if so state maximum hours per week of expected use.

(3) Rarely (if so state maximum hours per year of expected use).

(4) For emergency situations only.

7.1.2 Special responsibilities should be defined, such as, individuals who have responsibility for the safety of others and consequently may be expected to have special physical capabilities. This would include rescue workers, fire fighters, security personnel, and the like.

7.1.3 The estimated frequency for each type of "emergency situation" that may pose an IDLH risk, should be provided.

7.1.4 Other special environmental conditions (i.e., excessive heat, confined space usage, hyperbaric or hypobaric environments) should be identified. Additional requirements for protective clothing should also be listed.

7.1.5 The above supplemental information need not be provided for subsequent medical evaluations if the information remains the same and is transferred to the new evaluator.

7.1.6 The agents to which a worker will be exposed should be identified for regularly scheduled work and during emergencies when possible.

7.2 Based on this medical evaluation and the information provided, the PLHCP shall certify whether the individual is permitted to use a respirator under the circumstances described. The physical demands of the work shall be the limiting factor. The special characteristics of the respirator(s) to be used for this work, in so far as they significantly increase the work demands while in use, shall be considered.

7.2.1 In addition to the classification for respirator use, the report to the employer representative should include any other work limitations or restrictions found during evaluation even if they are not necessarily related specifically to respirator use.

7.2.2 The PLHCP shall classify the examinee in a category as follows (see Annex B2).

(1) *Class 1:* No restriction on respirator use.

(2) *Class 2:* Conditional respirator use permitted, subject to specific use restrictions, medical evaluations, or treatments. These work restrictions should be identified to permit a decision by the supervisor or safety representative to determine suitability for a specific task. Restrictions may include moderate/light work only, no SCBA use, PAPR only, annual medical evaluation or age–specific medical evaluation.

(3) *Class 3:* Permanent restriction from respirator use. No respirator use permitted (permanent) under any circumstances. The reason should not be identified on the report to the supervisor or to the safety department or other groups responsible for the respirator program.

(4) *Class 4:* Temporary restriction from respirator use. No respirator use permitted (temporary) — worker requires additional medical evaluation and/or treatment and physician evaluation.

(5) *Class 5:* Additional temporary or permanent non-respirator work restrictions (e.g., no heavy lifting, no climbing, no heat stress).

7.3 Written respirator program standard operating procedures shall include a written procedure describing the medical evaluation process for respirator users.

8 Medical History

8.1 A medical history (respirator questionnaire) should be utilized to identify the following (See Annex B3):

(1) Previously diagnosed disease, particularly known cardiovascular or respiratory diseases.

(2) Psychological problems or symptoms including claustrophobia.

(3) Problems associated with breathing during normal work activities.

(4) Past problems with respirator use.

(5) Past and current usage of medication.

(6) Any known physical deformities or abnormalities, including those which may interfere with respirator use.

(7) Known current pregnancy.

8.2 The PLHCP shall review the medical questionnaire.

Conditions that may possibly disqualify personnel for respirator use as identified by a positive response on the respirator questionnaire must be followed by an interview with a PLHCP.

If indicated, following an interview, the PLHCP shall refer or perform an evaluation of the individual (see Annex B1). The PLHCP will determine the scope of the evaluation and what testing, if any, shall be required to determine medical suitability to use a respirator.

In certain cases, following an evaluation, additional medical tests, consultation, or diagnostic procedures (such as, a cardiac exercise stress test (EST), spirometry, an audiogram, an ophthalmology consultation) may be necessary to make a final determination. Only the PLHCP's determination shall be communicated to the supervisor/manager (see Annex B2, Section B); no medical information shall be communicated.

9 Medical Evaluation

9.1 **Frequency.** An initial medical evaluation shall be performed using a medical history (respirator questionnaire) or interview and examination that obtain the same information as the medical questionnaire. Additional evaluations shall be required if: a) the employee reports medical signs or symptoms that are related to the ability to use a respirator; b) a PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated; c) information from the respiratory protection program including observations made during fit testing and program evaluation indicates a need for employee reevaluation, or, d) a change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

9.1.1 In addition, a follow-up questionnaire or interview should be used periodically to identify medical conditions that develop after the initial evaluation. This questionnaire could be administered prior to an annual fit test (see Annex B4). The frequency of this follow-up could be age-specific (e.g., every 5 years up to age 35), then every 2 years until age 45, and annually thereafter.

9.1.2 Annual evaluations for SCBA users of all ages shall be required.

9.1.3 Following review of the periodic questionnaire and/or interview, and/or limited medical testing, the PLHCP may determine that certain individuals require additional evaluation (such as, all or part of the physical examination and testing described in Annex B1) and/or medical testing, consultation, or diagnostic procedures.

9.2 **General Considerations.** The PLHCP's evaluation of suitability of the individual examinee for respirator use shall be based on the unique medical status of the individual (in light of the work load to be performed while wearing the respirator).

9.2.1 Following the initial or a subsequent evaluation the PLHCP may determine that periodic medical re-evaluation (examination, or testing, or consultation) is appropriate for a certain individual.

The PLHCP shall provide the worker-employee and the employer with a written recommendation regarding the worker's medical ability to use a respirator (see Annex B2, Section B). The PLHCP shall also notify the worker-employee of any medical conditions, actions recommended, and the frequency of necessary periodic-evaluations. (See Annex B5).

9.2.2 The following conditions shall be considered temporarily disqualifying for most respirator use. These conditions may require medical evaluation or treatment and may result in permanent restriction from respirator use. Additional communication with the treating physician and/or a consultant physician, and monitoring of health status may help to disposition workers with these conditions.

(1) Facial deformities and facial hair or other conditions that interfere with

proper sealing of the respirator (if the respirator has a face seal) shall disqualify the applicant. A fit test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface.

(2) Acute respiratory diseases which are anticipated to resolve (including acute pneumonia, acute bronchitis, and acute asthma) may prevent respirator use.

(3) "Moderate to severe" restrictive or obstructive pulmonary disease or perfusion disorders may require further evaluation. The worker's medical history, physical examination, and spirometry results may be used as a basis for temporary disqualification pending further medical evaluation (see Annex B 1-Temporary Disqualification Criteria). Spirometry may also be useful for medical surveillance purposes with certain workplace exposures.

(4) Symptomatic coronary artery disease (CAD), significant arrhythmias, (e.g., premature ventricular contractions (PVCs), tachycardia, or bradycardia), or a history of myocardial infarction may require further evaluation. If an EKG is performed it should be interpreted using informed clinical judgment with consideration of the workers overall health status.

(5) The determining physician, using clinical judgment, shall decide if individuals with treated or untreated hypertension, individuals using cardiovascular medications, and individuals with multiple risk factors or a single extreme risk factor require further medical evaluation.

(6) Workers with a systolic blood pressure (S.B.P.) greater than or equal to 180 or a diastolic blood pressure (D.B.P.) greater than or equal to 110 treated or untreated, shall be temporarily restricted from respirator use. Workers with a S.B.P. greater than or equal to 140 or a D.B.P. greater than or equal to 90 shall be referred for physician evaluation. The evaluating physician will disposition the worker after consideration of the medical information provided and the work effort anticipated.

(7) In cases where the evaluating physician has concerns about a worker's ability to use respiratory protective devices due to abnormal pulmonary function testing, (see Section 10.1 and Annex C), a history of Coronary Artery Disease, obesity [body mass Index (BMI) of greater than 30], or a combination of these or other medical problems, the worker may be medically cleared for respirator use at a known level of work (light, moderate, heavy) by use of an Exercise Stress Test (EST). The demonstration of greater than or equal to 10 Metabolic Equivalents (METs) functional capacity absent ischemia, arrhythmia, or abnormal BP response, on a physician supervised Exercise Stress Test (EST) — (See Section 10.1 and Annex A) is considered adequate for clearance to perform most heavy physical work and to work in heat stress environments. (See Annex B1.)

(8) Neurological Disability. Certain neurologic disorders that affect movement and/or consciousness may be aggravated by the work environment associated with respirator use (heat, humidity, protective clothing, strenuous work). Workers with such a disorder shall be temporarily disqualified pending physician evaluation.

(9) Medications. PLHCPs shall use clinical judgment to determine if an individual should be denied use of a respirator due to medication use (including prescription and non-prescription drugs) that may affect an employee's ability to perform his or her job. This decision may involve communication with a treating physician or consultant physician.

(10) Psychological Conditions. The PLHCP shall decide if an employee with a psychological condition that may impair judgment or reliability should be disqualified (e.g., claustrophobia, severe anxiety). The decision may involve communication with the treating physician, or a consultant physician. The PLHCP may recommend observed fit testing for the examinee.

(11) Hearing should be adequate to ensure response to instructions and alarm systems or hearing deficiencies should be otherwise accommodated. In certain work environments, olfaction may be an important sense to warn respirator users of poor face seal or other causes of respirator failure. Workers who report trouble smelling odors may require work restriction or additional medical evaluation (which may include olfactory testing) and these workers may be unsuitable for fit testing methods that rely on odor detection. Workers shall have adequate vision to perform their assigned job duties.

(12) If a worker has suffered a sudden loss of consciousness or response capability, a physician shall determine if the employee may use a respirator.

10 Special Testing

10.1 Spirometry or Exercise Stress Testing (EST) may be used if the PLHCP needs information in addition to a history and physical. Spirometry results do not in themselves indicate fitness or lack of fitness to use a respirator For accurate assessment, spirometry should be performed in accordance with the most recent recommendations of the American Thoracic Society (See Annex C).

Annex A: Exercise Stress Testing

Clinical exercise testing, or the exercise stress test (E.S.T.), is a useful test for evaluating the functional capacity (work capacity) of users of industrial respirators as respiratory reserve is normally greater than circulatory system reserve and cardiac disease is common in working populations.(1) Cardiac disease is a common cause of sudden incapacity, and decreased functional capacity. For normal humans, it appears there is no single exercise-limiting factor; the heart with contributions of muscle, rather than lungs and blood is largely responsible for exercise limitations, training effects, and differences in exercise capacity between people.(2)

The EST is a convenient means of determining exercise tolerance and precipitating symptoms and signs in a controlled environment. Standardized protocols, reduced equipment costs, and computerized interpretations have greatly enhanced the practicality and availability of this testing. Observations of heart rate are easily available data to compare performance on an EST with demands of job activities. At sub-maximal workloads, the relationship between heart rate and oxygen uptake (workload) is almost linear.(3)

Maximal testing with the aim of establishing safe levels of exercise or work performance can be performed on any person and aerobic capacity reported as METs (1 MET = metabolic equivalent = energy expended at rest = 3.5 mL 0_2 /Kg/min).(3)

It is prudent to selectively perform supervised EST in respirator users who are expected to engage in heavy work if the evaluating PLHCP suspects deconditioning or coronary disease on the basis of signs, symptoms, or risk factors. EST for cardiovascular fitness may be necessary, especially if the work requires strenuous exertion, heat stress will be present, or a clinical indication of a cardiovascular abnormality is present. The use of respirators in conjunction with water-impermeable protective clothing can impose significant thermal stress. Such situations occur in the hazardous waste, nuclear, and other industries. EST may also be advisable in the first two situations for workers older than 45 years of age regardless of clinical status. Resting ECGs are not predictive of risk from respirator use during exertion.(4)

EST requires the active cooperation and informed consent of the participant. Stress testing may not detect significant coronary disease, especially in asymptomatic workers.(5) Although this testing cannot reliably identify all persons at risk of an acute event it may increase the margin of safety. Workers should be evaluated on an individual basis and additional testing such as imaging studies may be recommended for those considered to be at higher risk.(3)

Supervision during EST should be provided by a physician with appropriate training and experience.(6)

Many protocols and types of equipment (treadmill, cycle ergo meter) are available to perform EST. The choice of equipment and protocol should be the decision of the testing physician.

Workers are less likely to have clinically significant CAD if they achieve a level of 10 METs functional capacity(7) with absence of arrhythmia, abnormal blood pressure response, or ischemia and are usually capable of performing heavy physical work and work in high heat stress situations.(8)

References

1) Evaluations of Impairment/Disability Secondary to Respiratory Disorders, Official Statement – American Thoracic Society, Adopted March, 1986
2) ATS/ACCP Statement on Cardiopulmonary Exercise Testing, Adopted by the American Thoracic Society (ATS) on March 1, 2002 and the American College of Chest Physicians (ACCP) on November, 1, 2002
3) **Temte, J.V.:** Cardiovascular Conditions and Worker Fitness and Risk. *Occ. Med. State of the Art Reviews 3(2)*:241–254 (1988).
4) **American Thoracic Society:** Respiratory Protection Guidelines, *Am. J. Respir. Crit. Care Med. 154*:1153–1165 (1996).
5) **Gibbons, R.J., G.J. Balady, J.W. Beasley, J.T. Bricker, W.F. Duvernoy, Froelicher V.F., et al:** ACC/AHA guidelines for exercise testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). *J. Am. Coll. Cardiol. 30*:260–311 (1997).
6) **Rodgers, G.P., J.Z. Ayurum, et al.:** American College of Cardiology/American Heart Association Clinical Competence Statement on Stress Testing: A Report of the American College of Cardiology/American Heart Association/American College of Physicians, American Society of Internal Medicine Task Force on Clinical Competence Circulation J02:1726–1738 (2000).
7) **Whaley, M.H., (ed.):** ACSM's Guidelines for Exercise Testing and Prescriptions, American College of Sports Medicine, 7th edition, Baltimore, Lippincott – Williams & Wilkins 2006
8) Criteria for a Recommended Standard Occupational Exposure to Hot Environments Revised Criteria, 1986 DHHS (NIOSH) Publication No. 86-113, 1986.

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Annex B1: Respirator Medical Examination Form/Temporary Disqualification Criteria

LAST NAME	FIRST NAME	M	DATE OF BIRTH	SEX (M/F)

SUPERVISOR	EXT.	DEPARTMENT	EMPLOYEE #

OCCUPATION	LOCATION	HOME TELEPHONE #

HOME ADDRESS

Do Not Write Below This Line – For PLHCP Use Only

Body Mass Index (BMI)
= Body weight in kilograms (Kg.)
Height in meters squared (m^2)

1 inch = .0254 meters
1 Kg. = 2.2 pounds (Lbs.)

BMI > 30 Probable Obesity

Height _____
Weight _____
BP _____
Pulse _____

Performed at PLHCP Request	Normal	Abnormal
Pulmonary Function Test	___	___
EKG	___	___
T.C.	___	___
HDL	___	___
Glucose	___	___
HEENT	___	___
Facial Config.	___	___
Heart Sounds	___	___
Lung Sounds	___	___
Musculoskeletal	___	___
Neurologic	___	___
Dermatologic	___	___
Visual Acuity	___	___
Audiogram	___	___
Other	___	___

Temporary Disqualification Criteria
Identified problem areas require physician review
And may necessitate further medical testing

BP	SBP ≥140 or ≥ DBP 90
Resting Pulse	< 40 or > 100
Pulmonary Function	FVC or FEV_1 <60% of predicted
BMI	> 30

History or findings suggestive of coronary artery disease without a current "negative" stress test and/or cardiology evaluation. For "Heavy Work" certification (Stress test must demonstrate ≥ 10 METs functional capacity with absence of arrhythmia, abnormal blood pressure response, or ischemia).

Any history or finding that prompts the examiner to be concerned about sudden incapacity or the ability to work safely, such as multiple risk factors or a single extreme risk factor for coronary artery disease or a musculoskeletal, neurological, psychological, endocrine disorder, dermatologic disorder, and/or significant obesity.

PLHCP Determination: Circle a Class

Class 1: **No restriction on respirator use.**
Class 2: Conditional Use: Some specific use restrictions or medical requirements (e.g., moderate/light work only, PAPR only, no SCBA use, annual medical evaluation, age-specific medical evaluation).
Class 3: No respirator use permitted (permanent).
Class 4: **No respirator use permitted (temporary) – you require additional medical evaluation and/or treatment and physician evaluation (see above).**
Class 5: Additional temporary/permanent (non-respirator) restrictions – (e.g., no heavy lifting, no climbing, no heat stress).

Restrictions/Additional Medical Requirements/Findings on Targeted Evaluation/Comments:_____

Date of Next Medical Re Evaluation	Evaluating PLHCP's Signature	Date

Title	Organization

Annex B2-A: Request for Medical Clearance for Respirator Use Questionnaire (The following areas should be considered in the medical evaluation and the medical/industrial hygiene interface documented appropriately)

Supervisor/Manager _____ **Department** _____

Employee _____ **Date of Birth** _____ **Employee #** _____

Circle Type or Types of Respirator to be used: (Indicate weight(s) of respirator(s)

	Weight		Weight
		Supplied air continuous-flow respirator	_____
Open-circuit SCBA	_____	Closed-circuit SCBA	_____
Pressure demand supplied	_____	Combination air-line and SCBA	_____
Air respirator	_____	Air-purifying (powered) (PAPR)	_____
Air-purifying (non powered)	_____		

Expected level of physical work effort (63CFR 1284) (Circle and describe all that apply):
Light: sitting while writing, typing, drafting, assembly work (< 3 mets)
Moderate: sitting while nailing or filing, driving a truck or bus in urban traffic, walking on a level surface @2mph (slowly) (<5 mets)
Heavy: lifting 50 lbs. from floor to waist or shoulder, loading dock, shoveling, climbing stairs with 50 lbs. (>5 mets)

Extent of Usage:

1. On a daily basis
2. Occasionally - but more than once a week
3. Rarely - or for emergency situations
4. Maximum Number of Hours of use Per Day (estimate): _____

Special Work Considerations (circle and describe all that apply)
Protective clothing
Vapor Barrier clothing
Temperature and humidity
Personal Protective Equipment
Responsibility for health and safety of others, of Public (Security, Rescue, HazMat, Fire Brigade, Nuclear)
Dangerous Work Environment (High Voltage, high places, machinery)
Hazardous material
Hazardous atmosphere (IDLH)
Confined Space
Communication essential
Normal vision essential
Description of usual job functions, title, tasks, work activities:

Annex B2-B: Supervisor/Manager's Copy of PLHCP's Written Recommendation

Detach or place on separate form or transmit electronically

PLHCP Determination: Circle a Class

Class 1: No restriction on respirator use.
Class 2: Conditional Use: Some specific use restrictions or medical requirements (e.g., moderate/light work only, PAPR only, no SCBA use, annual medical evaluation, age-specific medical evaluation).
Class 3: No respirator use permitted (permanent).
Class 4: No respirator use permitted (temporary) – you require additional medical evaluation and/or treatment and physician evaluation (see above).
Class 5: Additional temporary/permanent (non-respirator) restrictions – (e.g., no heavy lifting, no climbing, no heat stress).

Restrictions/Additional Medical Requirements: _____

Date of next medical re-evaluation _____ PLHCP Signature _____

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Annex B3: Medical Questionnaire for Respirator Users (Initial)

Instructions:

1. Ask the employee completing the form if they can read English. Can the employee read? ☐ 1. Yes ☐ 2. No
   If they cannot read, an impartial individual must read the questionnaire to the employee.
2. To maintain confidentiality, neither the employer nor supervisors may look at or review the questionnaire.
3. Provide instructions to the employee for forwarding the questionnaire to the appropriate health care professional.
4. Employees should print answers.

SECTION 1

1. Date: _____ 2. Name: _____ Employee # _____
3. Your age (to nearest year): _____ 4. Sex: ☐ Male ☐ Female 5. Your height _____ ft. _____ in.
6. Your weight: _____ lbs. 7. Your job title: _____
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include area code): _____ 9. The best time to phone you at this number: _____
10. Has your employer told you how to contact the health care professional who will review this questionnaire: ☐ Yes ☐ No
11. Check the type respirator you will use (you can check more than one category)
    - ☐ N, R, or P disposable respirator (filter-mask, noncartridge type only).
    - ☐ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).
12. Have you worn a respirator ☐ Yes ☐ No If yes, what type(s): _____
    Any Problems ? ☐ Yes ☐ No _____

SECTION 2

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: ☐ Yes ☐ No
2. Have you ever had any of the following conditions?
   a. Seizures (fits): ☐ Yes ☐ No
   b. Diabetes (sugar disease): ☐ Yes ☐ No
   c. Allergic reactions that interfere with your breathing: ☐ Yes ☐ No
   d. Claustrophobia (fear of closed-in places): ☐ Yes ☐ No
   e. Trouble smelling odors: ☐ Yes ☐ No
   f. Elevated Cholesterol ☐ Yes ☐ No
3. Have you ever had any of the following pulmonary or lung problems?
   a. Asbestosis: ☐ Yes ☐ No
   b. Asthma: ☐ Yes ☐ No
   c. Chronic bronchitis: ☐ Yes ☐ No
   d. Emphysema: ☐ Yes ☐ No
   e. Pneumonia: ☐ Yes ☐ No
   f. Tuberculosis: ☐ Yes ☐ No
   g. Silicosis: ☐ Yes ☐ No
   h. Pneumothorax (collapsed lung): ☐ Yes ☐ No
   i. Lung cancer: ☐ Yes ☐ No
   j. Broken ribs: ☐ Yes ☐ No
   k. Any chest injuries or surgeries: ☐ Yes ☐ No
   l. Any other lung problem that you've been told about: ☐ Yes ☐ No
4. Do you currently have any of the following symptoms of pulmonary or lung illness?
   a. Shortness of breath: ☐ Yes ☐ No
   b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: ☐ Yes ☐ No
   c. Shortness of breath when walking with other people at an ordinary pace on level ground: ☐ Yes ☐ No
   d. Have to stop for breath when walking at your own pace on level ground: ☐ Yes ☐ No
   e. Shortness of breath when washing or dressing yourself: ☐ Yes ☐ No
   f. Shortness of breath that interferes with your job: ☐ Yes ☐ No
   g. Coughing that produces phlegm (thick sputum): ☐ Yes ☐ No
   h. Coughing that wakes you early in the morning: ☐ Yes ☐ No
   i. Coughing that occurs mostly when you are lying down: ☐ Yes ☐ No
   j. Coughing up blood in the last month: ☐ Yes ☐ No
   k. Wheezing: ☐ Yes ☐ No
   l. Wheezing that interferes with your job: ☐ Yes ☐ No
   m. Chest pain when you breathe deeply: ☐ Yes ☐ No
   n. Any other symptoms that you think may be related to lung problems: ☐ Yes ☐ No
5. Have you ever had any of the following cardiovascular or heart problems?
   a. Swelling in your legs or feet (not caused by walking): ☐ Yes ☐ No
   b. Heart arrhythmia (heart beating irregularly): ☐ Yes ☐ No
   c. High blood pressure: ☐ Yes ☐ No
   d. Heart Failure; ☐ Yes ☐ No
   e. Heart attack: ☐ Yes ☐ No
   f. Stroke: ☐ Yes ☐ No
   g. Angina: ☐ Yes ☐ No
   h. Any other heart problems: ___ Yes ___ No
6. Have you ever had any of the following cardiovascular or heart symptoms?
   a. Frequent pain or tightness in your chest: ☐ Yes ☐ No

b. Pain or tightness in your chest during physical activity: ☐ Yes ☐ No
c. Pain or tightness in your chest that interferes with your job: ☐ Yes ☐ No

d. In the past two years, have you noticed your heart skipping or missing a beat: ☐ Yes ☐ No

e. Heartburn or indigestion that is not related to eating ☐ Yes ☐ No

f. Any other symptoms that you think may be related to heart or circulation problems : ☐ Yes ☐ No
g. A history of elevated cholesterol: (> 200 mg/dl) ☐ Yes ☐ No
h. A history of diabetes Yes No

7. Do you currently take medication for any of the following problems?
   a. Breathing or lung problems: ☐ Yes ☐ No
   b. Heart trouble: ☐ Yes ☐ No
   c. Blood pressure: ☐ Yes ☐ No
   d. Seizure (fits): ☐ Yes ☐ No

8. If you've used a respirator, have you ever had any of the following problems?
   (If you've never used a respirator, check the following block and go to question 9: ☐
   a. Eye irritation: ☐ Yes ☐ No
   b. Skin allergies or rashes: ☐ Yes ☐ No
   c. Anxiety: ☐ Yes ☐ No
   d. General weakness or fatigue: ☐ Yes ☐ No
   e. Any other problem that interferes with your use of a respirator: ☐ Yes ☐ No

9. Have you ever lost vision in either eye (temporarily or permanently): ☐ Yes ☐ No

10. Do you currently have any of the following vision problems?
    a. Wear contact lens: ☐ Yes ☐ No
    b. Wear glasses: ☐ Yes ☐ No
    c. Color blind: ☐ Yes ☐ No
    d. Any other eye of vision problem: ☐ Yes ☐ No

11. Have you ever had an injury to your ears, including a broken ear drum? ☐ Yes ☐ No

12. Do you currently have any of the following hearing problems?
    a. Difficulty hearing: ☐ Yes ☐ No
    b. Wear a hearing aid: ☐ Yes ☐ No
    c. Any other hearing or ear problem: ☐ Yes ☐ No
    d. Comments_____

13. Have you ever had a back injury? ☐ Yes ☐ No

14. Do you currently have any of the following musculoskeletal problems?

    a. Weakness in any of your arms, hands, legs or feet: ☐ Yes ☐ No
    b. Back pain: ☐ Yes ☐ No
    c. Difficulty fully moving your arms and legs: ☐ Yes ☐ No
    d. Pain or stiffness when you lean forward or backward at the waist ☐ Yes ☐ No
    e. Difficulty fully moving your head up or down: ☐ Yes ☐ No
    f. Difficulty fully moving your head side to side: ☐ Yes ☐ No
    g. Difficulty bending at your knees: ☐ Yes ☐ No
    h. Difficulty squatting to the ground: ☐ Yes ☐ No
    i. Difficulty climbing a flight of stairs or a ladder carrying more than 25 lbs.: ☐ Yes ☐ No
    j. Any other muscle or skeletal problem that interferes with using a respirator: ☐ Yes ☐ No

15. Do you have any facial hair that would interfere with a good face seal? Yes No
16. Are you allergic to latex? ☐ Yes ☐ No
17. Are you pregnant? ☐ Yes ☐ No
18. Would you like to talk to a health care professional who will review this questionnaire about your answers? ☐ Yes ☐ No

VERIFICATION/CONSENT STATEMENT

I verify that the above information is true and complete to the best of my knowledge. I hereby give permission for a physical examination (if needed) to determine my suitability for respirator use. I understand that this examination is designed to satisfy regulatory requirements and should not be considered to be a routine medical examination. *I agree to "self report" changes in my medical condition that may affect my ability to work safely to my supervisor.*

Full Name (Please Print) _____ Signature _____ Date _____

Additional Medical Evaluation Yes ___ No ____ Physician Evaluation Yes ____ No ____

Name (PLHCP) Print _____ Title (PLHCP) _____ Signature _____ Date _____

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Annex B4: Medical Questionnaire for Respirator Users (Periodic)

To be Administered and Reviewed Prior to Annual Fit Test (If no periodic physical examination is administered

B4-A:

NAME LABEL_____

1. Have you developed any medical problems or symptoms that may limit your ability to use a respirator?
   YES NO

2. Have you been treated for a heart or lung condition in the past year? (e.g., heart attack, pneumonia)
   YES NO If YES, please describe this condition.

3. Have you been under treatment by a physician for any other condition in the past year?
   YES NO If YES, please describe the condition.

4. Have you had any surgical operation or medical procedure in the past year?
   YES NO If YES, please describe procedure.

5. Have you been told by a health care professional, your supervisor, or the respirator program administrator or any one else that you should be medically reevaluated?
   YES NO

6. Has there been a change in workplace conditions, e.g., physical work effort, protective clothing, temperature, that has resulted in a substantial increase in the physical burden placed on you?
   YES NO

7. Have you had chest pain or pressure?
   YES NO If YES, please describe this condition.

8. Have you had to remove a respirator because of feeling "closed-in" (Claustrophobic) or short of breath?
   YES NO If YES, please describe this condition.

9. What medications are you currently taking? _____

It is <u>your</u> responsibility to report any change in health status that may effect your ability to use a respirator to your Supervisor

Signature ⟶ _____ Date _____

B4-B Medical Department Copy of PLHCP's Recommendation

<u>Detach or place on separate form or transmit electronically</u>

PLHCP Determination: Circle a Class

Class 1: No restriction on respirator use.

Class 2: Conditional Use: Some specific use restrictions or medical requirements (e.g., moderate/light work only, PAPR only, no SCBA use, annual medical evaluation, age-specific medical evaluation).

Class 3: No respirator use permitted (permanent).

Class 4: No respirator use permitted (temporary) – you require additional medical evaluation and/or treatment and physician evaluation (see above).

Class 5: Additional temporary/permanent (non-respirator) restrictions – (e.g., no heavy lifting, no climbing, no heat stress).

Restrictions/Additional Medical Requirements/Findings on Targeted Evaluation, Comments:

PLHCP Signature _____ Date _____

Confidential Medical Information

This Form is Given to the Worker ONLY and Retained by the Medical Evaluator.
This Information Cannot be Shared Without the Written Authorization of the Worker

Annex B5: Employee Copy of PLHCP's Written Recommendation ANSI Z88.6-2005

A.

❑ ***Medical evaluation has detected no medical conditions that would prevent you from using a respirator.***

B.

❑ **Please note that the following medical conditions (indicated by a check mark) have been identified during your medical evaluation. It is recommended that you discuss the below mentioned health problem(s) with your personal physician.**

❑ **Until these problems are evaluated further, you are temporarily disqualified from performing respirator/heat stress work.**

❑ Hearing impairment that requires further evaluation.

❑ Decreased visual acuity: In general 20/40 is desirable for distant vision in one eye with or without correction. Certain jobs have specific vision requirements.

❑ Electrocardiogram (EKG): This test was interpreted to be not within the range of normal. The examining physician will provide you with a copy of your EKG so that you can discuss it with your personal physician.

❑ Pulmonary Function Test (PFT – Breathing Test): This test was interpreted to be significantly below the lower limit of normal. **If you smoke, it is strongly recommended that you stop.**

❑ Blood Pressure Evaluation:
- o ≥180/≥110 Your blood pressure is _____
- o ≥ 140/≥90

❑ Body Mass Index (BMI) > 30. This measurement shows that you are overweight. This may have adverse health consequences.

❑ History of cardiac disease. Please provide your medical evaluator with a copy of your most recent stress test
It must demonstrate functional capacity in "METs" with the absence of clinically significant arrhythmia, abnormal blood pressure response, and ischemia.

❑ Other_____

C.

PLHCP Determination: Circle a Class

Class 1: **No restriction on respirator use.**
Class 2: Conditional Use: Some specific use restrictions or medical requirements (e.g., moderate/light work only, PAPR only, no SCBA use, annual medical evaluation, age-specific medical evaluation).
Class 3: No respirator use permitted (permanent).
Class 4: **No respirator use permitted (temporary) –you require additional medical evaluation and/or treatment and physician evaluation (see above).**
Class 5: Additional temporary/permanent (non-respirator) restrictions – (e.g., no heavy lifting, no climbing, no heat stress).

Restrictions/Additional Medical Requirements/Findings on Targeted Evaluation:

_____

Date of next medical evaluation _____

_____

PLHCP's Signature Date

Annex C: Spirometry

Introduction

Spirometry is the most frequently performed test of ventilatory function. However, since it is effort-dependent and requires attention to detail, failure to follow current American Thoracic Society (ATS) Guidelines often results in false positive test results.[1] The below-referenced ATS statements on equipment and test performance[2,3], interpretation of results[4], and screening for respirator use[5] are recommended as guidance. Since ATS Spirometry statements are periodically updated, e.g., the 2005 ATS update[2,4] is *In Press*, users should consult the most recent versions of the ATS Spirometry statements, available at http://www.thoracic.org. Similarly, the most current version of the American College of Occupational and Environmental Medicine (ACOEM) Guidelines can be found at http://www.acoem.org.

Specific Criteria

Spirometry is not routinely required for medical clearance of respirator users. The respiratory system's large reserve permits most healthy workers to tolerate the small respiratory impact of many respirators. However, moderate or severe reduction of ventilatory capacity may limit a subject's ability to use a respirator. "In the absence of other factors limiting the worker's overall ability to tolerate the demands of the job and the respiratory protective equipment, FEV1 (and FVC) of 60% or greater of the predicted value suggest that a trial of respirator use is allowable. For light duty work using low resistance respirators, even lower levels of function may not be disqualifying, but a more thorough clinical evaluation should be done."[5] Because of their variability, forced expiratory flow rates (FEF_{25-75} and instantaneous flows) should not be used in the evaluation of medical fitness for respirator use.

The (ATS) recommends spirometry testing for: 1) workers > 45-years-old who use SCBA with strenuous exertion; 2) younger workers using SCBA with strenuous exertion who report respiratory symptoms, or have abnormalities on the screening questionnaire; 3) all respirator users > age 55; and 4) workers reporting respiratory symptoms with the level of exertion required by their job.[5]

Unless recommended differently by the most current version of the ATS Spirometry Guidelines, spirometer performance should be documented by daily checks of the spirometer's calibration. When testing a subject, the technician should describe and *demonstrate* the maneuver, enthusiastically coach the subject, and try to record at least three "acceptable" curves (as defined by the ATS) with up to 8 attempts if necessary, achieving repeatability ("reproducibility") for both the FVC and the FEV_1. The largest FVC and FEV_1 are reported from the acceptable curves even if they are not from the same maneuver, and FVC and FEV_1 are corrected to body temperature (BTPS). Spirometry technicians should be highly motivated to conduct good tests and trained so that they can judge the subject's degree of effort and cooperation. ACOEM and the American Thoracic Society recommend that technicians initially complete a NIOSH-approved (or similar) spirometry training course and periodically attend spirometry refresher courses.[1,2]

In the screening setting, spirometry test results are interpreted by comparing the observed FVC and FEV_1, and their ratio, FEV_1/FVC% with predicted average values and Lower Limits of Normal (LLN) derived from reference populations of non-smokers. The goal is to determine whether the worker's results fall within the normal range, or below it, indicating possible respiratory impairment. Several prediction equations are referenced in the ACOEM Position Statement, and both ACOEM and ATS recommend use of the NHANES III prediction equation[1,4] if other prediction equations are not required by applicable regulations. A flow chart for interpreting results following ATS recommendations is included in the ACOEM Statement.[1]

Finally, it is becoming routine for individuals over 45 years of age engaged in strenuous activities to undergo an Exercise Stress Test in addition to Spirometry.

1. **American College of Occupational and Environmental Medicine:** ACOEM Position Statement: Spirometry in the Occupational Setting. *J. Occup. Env. Med. 42*:228–245 (2000).
2. **American Thoracic Society:** European Respiratory Society: General Considerations for Lung Function Testing. *Eur. Respir. J. 26(1)*:153–161 (2005).
3. **American Thoracic Society:** European Respiratory Society: Standardisation of Spirometry, *Eur. Respir. J. 26*:319–338 (2005).
4. **American Thoracic Society:** European Respiratory Society: Interpretative Strategies for Lung Function Tests, *Eur. Respir. J. 26(5)*:948–968 (2005).
5. **American Thoracic Society:** Respiratory Protection Guidelines. *Am. J. Respir. Crit. Care Med. 154*:1153–1165 (1996).

Annex D: Future Research Areas

Introduction

The final respiratory protection standard (29 CFR Parts 1910 and 1926 – Respiratory Protection) covers an estimated 5 million respirator wearers working in an estimated 1.3 million work places. There exists a wide variety of workers, work environments, physical stressors, and perceptions of risk. A recent well designed and executed retrospective analysis reported only 1.3 % of over 5000 workers evaluated received limitations on respirator use.

Spirometry has become strongly associated with respirator use as many users are in respiratory surveillance programs that involve periodic reevaluation to monitor the adverse effects of exposure. This secondary prevention/surveillance monitoring represents a major contribution of occupational medicine to society and has also resulted in the use of pulmonary function testing to determine job suitability. Careful studies of ventilation, resistance, hypoxia, tidal volume, expiratory time, inspiratory muscle fatigue, and pleural pressures have resulted. More recently the cardiopulmonary relationship has emerged with recognition that angina and arrhythmias may be aggravated by hypoxia or hypercarbia.

Rationale

This standard considers functional capacity a cardiopulmonary issue. The presence or absence of a “disease” may be almost incidental to work performance. An individual may be “disease free”, but unable to perform essential job functions or even climb a flight of stairs without interruption.

There is little “evidence based” science that applies directly to job suitability. There are, however, large bodies of literature that deal with Medical Screening, Pre Exercise Risk Stratification, Cardiac Rehabilitation, and Pulmonary Rehabilitation. The guidelines developed by these emerging disciplines seem applicable to job-suitability evaluation given the caveat that the predictive value of any medical testing has limits. We suggest that these disciplines can contribute much to the assessment of job suitability, and that this standard represents a humble beginning.

Any proposed process must also deal not only with science, but also with perceived risk to the worker, co-workers, and the public. Escalation of risk should not necessarily mean more medical tests but may lead to increased scrutiny of the work force and a more conservative interpretation of results. This standard did consider the recommendations of certain consensus standards (DOT, FAA, NFPA) and attempted to use them to “benchmark” risk. “Evidence” is being slowly assembled by these agencies and guidelines are periodically modified. The consensus recommendations in this standard must also be modified periodically as our ability to analyze and quantify risk evolves.

Research for Consideration:

Adoption of the OSHA questionnaire (or modifications of it) should be encouraged. An effectiveness survey program/process should then be developed that addresses the following:

- How are positive questionnaire responses dispositioned, and by who?
- How are employees with (common) established diseases (e.g., post myocardial infarction) evaluated?
- Could a “functional capacity” standard be developed and included in job descriptions similar to that developed for lifting as contained in the Dictionary of Occupational Titles?
- Could a smaller questionnaire consisting of “critical items” be developed?

American Industrial Hygiene Association
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031
(703) 849-8888
infonet@aiha.org
www.aiha.org
Stock Number: SRPA06-716