



National Institute for Occupational Safety and Health
National Personal Protective Technology Laboratory
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Procedure No. RCT-APR-STP-0066	Revision: 1.1	Date: 12 September 2005
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DETERMINATION OF END OF SERVICE LIFE INDICATOR (ESLI) TEST,
AIR-PURIFYING RESPIRATORS
STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedure for ensuring that the level of protection provided by the end of service life indicator (ESLI) requirements on air-purifying respirators submitted for Approval, Extension of Approval, or examined during Certified Product Audits meet the minimum certification standards set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d); Volume 60, Number 110, June 8, 1995, and in the Federal Register Notice Volume 49, Number 140, dated July 19, 1984.

2. GENERAL

This STP describes the Determination of End of Service Life Indicator (ESLI) Test, Air-Purifying Respirators test in sufficient detail that a person knowledgeable in the appropriate technical field can select equipment with the necessary resolution, conduct the test, and determine whether or not the product passes the test.

3. EQUIPMENT/MATERIAL

3.1. The list of necessary test equipment and materials follows:

3.1.1. A complete system test set up for any gas or vapor described in STP's 33-48, 50, and 62 in which the cartridge or canister employs an End of Service Life Indicator (ESLI).

3.1.2. Stop watch or timer

4. TESTING REQUIREMENTS AND CONDITIONS

4.1. Prior to beginning any testing, all measuring equipment to be used must have been calibrated in accordance with the manufacturer's calibration procedure and schedule. At a minimum, all measuring equipment utilized for this testing must have been calibrated within the preceding 12 months using a method traceable to the National Institute of Standards and Technology (NIST).

Approvals:	1 st Level	2 nd Level	3 rd Level
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Procedure No. RCT-APR-STP-0066	Revision: 1.1	Date: 12 September 2005	Page 2 of 6
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- 4.2. Normal laboratory safety practices must be observed. This includes safety precautions described in the current ALOSH Facility Laboratory Safety Manual.
 - 4.2.1. Safety glasses, lab coats, and hard-toe shoes must be worn at all times.
 - 4.2.2. Work benches must be maintained free of clutter and non-essential test equipment.
 - 4.2.3. When handling any glass laboratory equipment, lab technicians and personnel must wear special gloves which protect against lacerations or punctures.

CRITERIA FOR CERTIFICATION OF END-OF SERVICE-LIFE INDICATORS*

* Federal Register Notice Volume 49, Number 140, dated July 19, 1984.

- 4.3. An applicant for certification of ESLI of use against substances with poor warning properties must provide NIOSH with the following information:
 - 4.3.1. Data demonstrating that the ESLI is a reliable indicator of sorbent depletion (less than or equal to 90% of service life.) The data shall include the results of a flow-temperature study at low and high temperatures, humidities, and contaminant concentrations which are reasonably representative of actual workplace conditions where it is anticipated that a given respirator will be used. A minimum of two contaminant levels must be utilized for each study, including the limit level (permissible exposure limit, threshold limit value, etc.) and the limit level times the assigned protection factor for the respirator type.
 - 4.3.2. Data on desorption of any impregnating agents used in the indicator. The data shall include the results of a flow-temperature study at low and high temperatures and humidities which are reasonably representative of actual workplace conditions where it is anticipated that a given respirator will be used. Data shall be sufficient to demonstrate safe levels of desorbed agents.
 - 4.3.3. Data on the effects of industrial interferences which are commonly found in workplaces where it is anticipated that a given respirator will be used. Data should be sufficient to show which interferences could impair the effectiveness of the indicator and the degree of impairment, and to show which substances will not affect the indicator.
 - 4.3.4. Data on any reaction products produced in the reaction between the sorbent and the contaminant gases and vapors against which it is designed to protect, including the concentrations and toxicities of such products.
 - 4.3.5. Data which predicts the storage life of the indicator. Simulated aging tests will be acceptable.
- 4.4. In addition to the foregoing, all passive ESLI shall meet the following criteria:
 - 4.4.1. A passive ESLI shall be situated on the respirator so that it is readily visible to

the wearer.

- 4.4.2. If the passive indicator utilizes color change, the change shall be detectable to people with physical impairments such as color blindness.
- 4.4.3. If the passive indicator utilizes color change, reference colors for the initial color of the indicator and the final (end point) color of the indicator shall be placed adjacent to the indicator.
- 4.5. All ESLI shall meet the following criteria:
 - 4.5.1. The ESLI shall not interfere with the effectiveness of the face seal.
 - 4.5.2. The ESLI shall not change the weight distribution of the respirator to the detriment of the facepiece fit.
 - 4.5.3. The ESLI shall not interfere with required lines of sight.
 - 4.5.4. Any ESLI that is permanently installed in the respirator facepiece shall withstand cleaning and a drop from a 6-foot height. Replaceable ESLI must be able to be easily removed and to withstand a drop from a 6-foot height.
 - 4.5.5. A respirator with an ESLI shall still meet all other applicable requirements set forth in 30 CFR Part 11. (*Referred to as 42 CFR Part 84 as of June 8, 1995.*)
 - 4.5.6. Any electrical components utilized in an ESLI shall conform to the provisions of the National Electrical Code and be “intrinsically safe.” Where permissibility is required, the respirator shall meet the requirements for permissibility and intrinsic safety set forth in 30 CFR Part 18, Subpart D, 18.82, “Permit to use experimental electrical face equipment in a gassy mine or tunnel.” Also, the electrical system shall include an automatic warning mechanism that indicates a loss of power.
 - 4.5.7. Effects of industrial interferences for substances which are commonly found in workplaces where it is anticipated that a given respirator will be used must be determined, and those substances which hinder ESLI performance shall be identified. Substances which are commonly found where the respirator will be used must be investigated. Data sufficient to indicate whether the performance is affected must be submitted to NIOSH. Manufacturers of respirators equipped with ESLI shall label the respirator to make the user aware of the use conditions that could cause false positive and negative ESLI responses.
 - 4.5.8. The ESLI shall not create any hazard to the wearer’s health or safety.
 - 4.5.9. Consideration shall be given to the potential impact of common human physical impairments on the effectiveness of the ESLI.

5. PROCEDURE

Note: Reference Section 3 for equipment, model numbers and manufacturers. For calibration purposes use those described in the manufacturer's operation and maintenance manuals.

- 5.1. Follow individual NIOSH Standard Test Procedures (STP's 33-48, 50, and 62) for set up and testing requirements and conditions.
- 5.2. Read the special use instructions in the manufacturers user instructions in regard to the ESLI information.
- 5.3. Once the gas or vapor concentration has been established, testing may begin on the respirator.
- 5.4. Start the timer.
- 5.5. In addition to monitoring the breakthrough penetration of the specific gas or vapor, the ESLI is observed for change. Any change in appearance of the ESLI is recorded along with the time the appearance is noted. The ESLI is monitored in percentage increments. Once the minimum service life is surpassed or breakthrough occurs, testing is stopped.
- 5.6. Determine if the ESLI is a reliable indicator of sorbent depletion from the data collected.
 - 5.6.1. For example: A mercury vapor respirator equipped with an ESLI has been performance tested and testing stopped at 620 minutes with no breakthrough. The minimum service life for a mercury vapor cartridge is 480 minutes. The ESLI must indicate sorbent depletion at less than or equal to 90% of the service life. If the ESLI has indicated sorbent depletion at 432 minutes or less, the ESLI has met the requirements for sorbent depletion.
- 5.7. The ESLI is monitored for each test and the noted data, along with any other additional comments is recorded in the comment section on the second page of the Gas and Vapor Test Data Sheet.

6. PASS/FAIL CRITERIA

- 6.1. The criterion for passing this test is set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d); Volume 60, Number 110, June 8, 1995, and in the Federal Register Notice Volume 49, Number 140, dated July 19, 1984.
- 6.2. This test establishes the standard procedure for ensuring that:
 - 84.63 Test requirements; general.
 - (a) Each respirator and respirator component shall when tested by the applicant and by the Institute, meet the applicable requirements set forth in subparts H through L of this part.

(c) In addition to the minimum requirements set forth in subparts H through L of this part, the Institute reserves the right to require, as a further condition of approval, any additional requirements deemed necessary to establish the quality, effectiveness, and safety of any respirator used as protection against hazardous atmospheres.

(d) Where it is determined after receipt of an application that additional requirements will be required for approval, the Institute will notify the applicant in writing of these additional requirements, and necessary examinations, inspections, or tests, stating generally the reasons for such requirements, examinations, inspections, or tests.

7. RECORDS/TEST SHEETS

- 7.1. All test data will be recorded on the END OF SERVICE LIFE INDICATOR (ESLI) test data sheet.
- 7.2. All videotapes and photographs of the actual test being performed, or of the tested equipment shall be maintained in the task file as part of the permanent record.
- 7.3. All equipment failing any portion of this test will be handled as follows:
 - 7.3.1. If the failure occurs on a new certification application, or extension of approval application, send a test report to the RCT Leader and prepare the hardware for return to the manufacturer.
 - 7.3.2. If the failure occurs on hardware examined under an Off-the-Shelf Audit the hardware will be examined by a technician and the RCT Leader for cause. All equipment failing any portion of this test may be sent to the manufacturer for examination and then returned to NIOSH. However, the hardware tested shall be held at the testing laboratory until authorized for release by the RCT Leader, or his designee, following the standard operating procedures outlined in Procedure for Scheduling, and Processing Post-Certification Product Audits, RB-SOP-0005-00.

Revision History

Revision	Date	Reason for Revision
1.0	11 July 2001	Historic document
1.1	12 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method